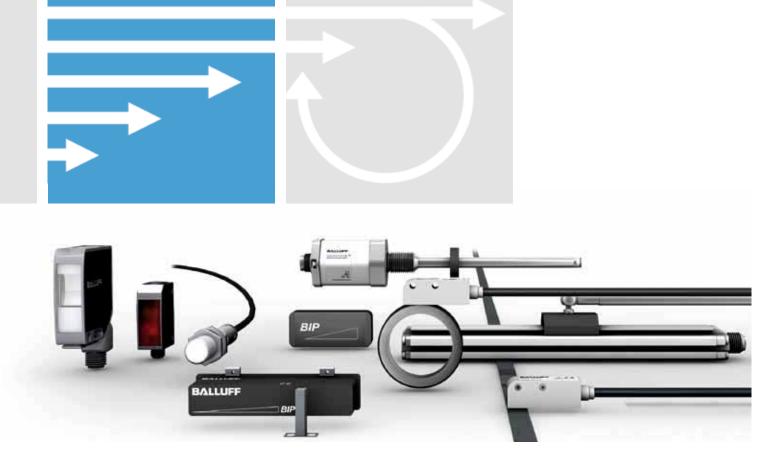


Linear Position Sensing and Measurement



With the appropriate measuring principle to achieve the optimal solution





As the leading sensor specialist and system provider with more than 90 years of company tradition, Balluff GmbH has been a recognized partner in factory automation for decades. With 56 locations, Balluff has a strong presence on every continent. The corporate headquarters in Neuhausen a.d.F. is located near Stuttgart.

Balluff masters the entire technological variety with various operating principles, including high-quality sensors and systems for position measurement and identification, as well as sensors for detecting objects and measuring fluids. The full-range assortment includes optimal network and connection technology and a comprehensive line of accessory products.

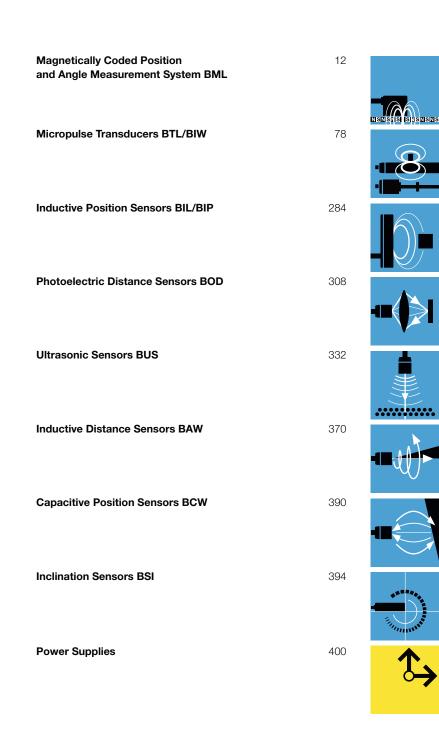
We offer innovative, first-class products tested in our own accredited laboratory, and maintain certified quality management in accordance with DIN EN 9001:2008. Our technology speaks for itself in international applications since it also meets regional standards.

Balluff stands for application-specific customer solutions, comprehensive services, individual consultation and prompt service. Our staff of more than 2450 employees is committed to providing outstanding service worldwide. Benefit from the high quality and superior position measurement technology of Balluff products.









Alphanumerical Directory	406
Worldwide Sales	410

Linear Position Sensing and Measurement **Position or distance sensors**

Balluff position measurement - the right solution for you

Balluff position measurement technology provides efficient customized solutions ranging from position detection to distance measurement.

With very diverse operating principles for distances from 1 to 48,000 mm and resolutions from 1 to 100 $\mu m.$

Choose what is ideal for you and we will customize exactly to your requirements, taking into account both technical and economical aspects. Optimum solutions fulfill your specific measurement tasks, function reliably, and are flexible and cost-effective at the same time.

Robust industrial Balluff position measurement technology is accurate, reliable, non-contact, and wear-free. Its quality is well-engineered, as shown by its longtime success.

Requirements that designers and developers must fulfill for future machine generations

- More flexibility
- Product changeovers using a keyboard
- Longer cycle times
- Increased availability
- Short set-up times
- Less downtime
- Greater degree of automation

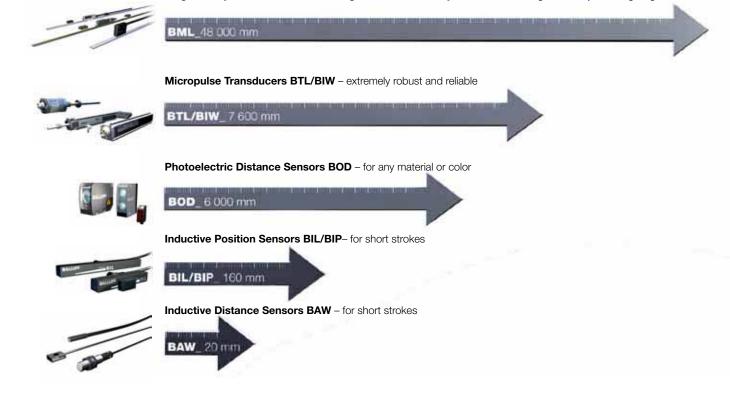
Balluff position measurement – Equipped for the future!

Broad range of applications with full-range assortment
 Greater efficiency with optimized solutions
 Superior position measurement technology for increased productivity

Expert application consultation:

Phone: +49 7158 173-370 or +49 7158 173-777 tsm@balluff.de or service@balluff.de

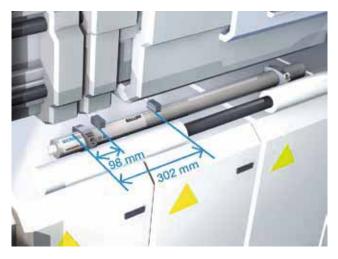
Magnetically Coded Position and Angle Measurement System BML - for high accuracy and long lengths





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 encoder that is part of the system.



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 magnetostrictive Micropulse position measurement systems, the position-giving element is the position encoder, which has permanent magnets integrated into it, and which is attached to the part that is moved.

Position measurement

See page 6

Example:

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

Distance measurement

See page 8



Position measurement

Find the right position measurement system in just 4 steps

1

Length How long is the path to be measured? Select the series that are in question.

Accuracy What accuracy is required? Select the appropriate accuracy.

Resolution range

Accuracy class*

3

Interface Select the interface appropriate for the controller or electronic processor 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 conditions
- Mechanical features
- Approvals
- Ordering code
- Accessories
- You can find this information in the chapter devoted
- to the selected series.



A		5-3	- 21 7 - F		
0(2048,000) mm	0(257600) mm	0(257600) mm	0(75750) mm	0(10160) mm	
12000 µm	1100 µm	1100 µm	5 μm	0.1 mm	
2– 1, 3 – 4	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, woodworking machines, drive tech- nology	Plastic injection molding machines, concrete block making machines, presses	Feedback system in hydraulic axes, valve actuators, level measurement, Ex area	Non-contact replace- ment for potentiom- eters, plastic injection molding machines	Gripper, spindle clamp- ing distance monitor, format adjustment, roll gap measurement	and the second s
BML	BTL profile	BTL rod	BIW	BIL/ BIP	\$,
See page 12	See page 90	See page 150	See page 144	See page 284	

SNS

Distance measurement

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.

Accuracy What accuracy is required? Select the appropriate accuracy.

Resolution range

Accuracy class*

3

Interface Select the interface appropriate for the controller or electronic processor unit.

4

Measuring principle

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

* 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 conditions
Mechanical features
Approvals
Ordering code
Accessories
You can find this information in the chapter devoted to the selected series.

Linear Position Sensing and Measurement Configuring the distance measurement system

			a line	Aller	
0(20)6000) mm	0(256000) mm	0(0.550) mm	08 mm	
0.02	.1 mm	0.021 mm	0.20.5 mm	0.05 mm	
6 –4		5 –6	4 -3	4 –7	
Analog	g, digital	Analog, digital	Analog	Analog	
Absolu	ıte	Absolute	Absolute	Absolute	
	electric, light time or triangula-	Ultrasound, echo-travel time measurement	Inductive	Capacitive	
position of object	urement and on determination acts in the mate- w of production ment	Level measurement for liquids and granu- lar material, distance control for overhead conveyors, measure- ment of roll diameters	Clamping distance monitoring on spindles and grippers, sheet thickness measurement, roll gap monitoring, ec- centricity measurement for shafts, shape moni- toring for metal parts	Layer thickness monitoring and shape monitoring for non-metallic materials and objects, level monitoring	
E	BOD	BUS	BAW	BCW	
See pa	age 308	See page 332	See page 370	See page 390	

Application consultation by our Technical Support Team

Discuss your technical requirements. And take advantage of our expertise.

Clarification for which products can meet your expectations is always essential whenever new tasks have to be solved or existing applications need to be optimized. Our experienced engineers know our products inside and out and can provide you with the professional consultation you need.

An assigned expert is at your side throughout the process, ensuring that your needs are met. By telephone or in person, you can discuss your concerns with our expert, specify your requirements, and explain your application so we can present the best recommendations to you.

The benefits to you

- Competent support from A to Z—from accessories to system inspection and beyond
- In-depth documentation of all solution suggestions with product overview:
 - Which solutions are ideal? Are there alternatives?
 - How do you install the solution?

Order with **BSS CSL**

- What must be paid attention to in the surroundings?
- A personal contact person for the duration of the project

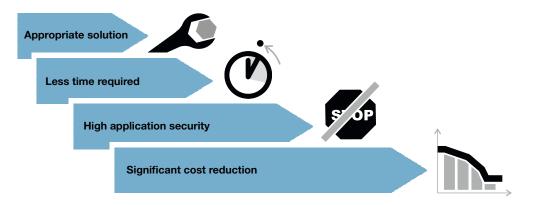
With over 20,000 products available, you can choose the right product for your application.

Real-world test in advance

A real-world test can be carried out in advance on request. Application scenarios are tested on site according to your specifications. This offers the best functionality and secures high quality.

Examples

- Selection of the right position measurement system
- IO-Link concept as a cost-effective alternative to conventional wiring
- System consulting for radio frequency identification (RFID): identification of large steel pipes in adverse environments
- Commissioning the position measurement system in the application



Custom sets

Put your components in a set as needed. And order with just one number.

For items you need regularly, you can create custom sets with us with the different components that are an exact match for your application. They are logically combined types of sensors, complete systems - both with and without accessories, and separate for each type of machine. We create a customized package with its own order number for quick ordering and fast installation.

The benefits to you

The benefits to you

Increase productivity

Reduce downtimes and lower costs

Express hotline: +49 7158 173-777

- Time savings—one ordering code enables quick and efficient ordering
- Error prevention without additional testing, all parts are complete
 Delivery according to your needs

Examples

- Equipping a series cylinder with a Micropulse position measurement system, position encoders and cable sets
- Position measurement systems and suitable accessories
 Assembling a complete magnetic tape
- measurement system BML with tape, guide rail and counter display











Express Production of Micropulse Transducers Work at our speed and you can get our Micropulse transducers in almost no time.

The express production* of a micropulse transducer BTL means a maximum production time of 24 hours from receipt of order. If ordered by 10 a.m., the position measurement system will be produced that very workday and transferred to shipping by 5 p.m.

ensure high system availability.

Orders received after 10 a.m. will be shipped on the next workday.

Express shipping is available on request. Rely on prompt service and

* Please consult with us before placing an order. Not all types can be manufactured using express production.

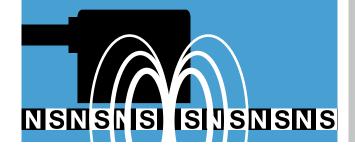








Magnetically Coded Position and Angle Measurement System



BALLUF



Magnetically Coded		
Position and Angle Measurement System		
Applications	14	
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Function Principle	20	NSNSIS
S1H Series (1 μm Absolute)	22	
S1G Series (1 µm Absolute)	30	
S1F Series (1 µm Incremental)	38	
S2B/S2E/S1C Series (5 µm Incremental)	46	
S2B/S2E/S1C Accessories	62	
Basic Information and Definitions	68	

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 measurement systems make the position information available within microseconds and therefore are optimum feedback systems in electric drive shafts.

By means of its extremely small dimensions and contactless measurement technology, BML allows for integration even in tight spaces or extreme ambient conditions. Expensive downtimes and service work are prevented from the outset by means of the wear-free operating principle; service-intensive encapsulation becomes unnecessary. Moreover, the contactless technology enables extremely high measurement speeds. INSNS

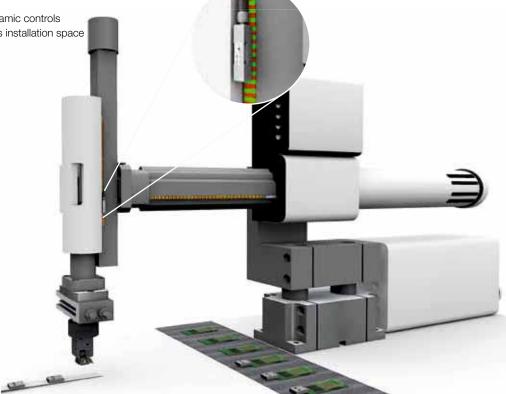


Magnetically Coded Position and Angle Measurement System Applications

Feedback system for pick and place

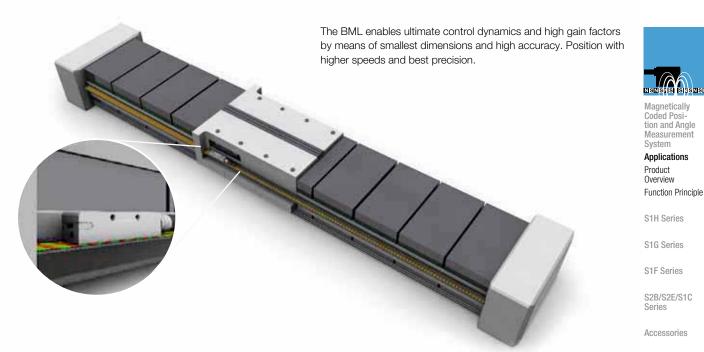
With the smallest design of an absolute magnetic position measurement sensor and the option of measuring perpendicular to the tape, the magnetically coded position and angle measurement system BML provides position feedback in highly dynamic applications even in extremely tight spaces.

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



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

Magnetically Coded Position and Angle Measurement System Applications



Basic Information and Definitions

Successfully used for years 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.

A 14 1

Magnetically Coded Position and Angle Measurement System Applications

Ultrasonic welding

Exact position feedback for perfect results. By means of direct absolute measurement on the load, inaccuracies and tolerance shifts are reliably eliminated.

- Exact results by means of position detection right
- on the load support
- Compact design
- Ideal for short strokes
- Long-term reliability
- Wear-free due to non-contact measuring



Quickly holds the welding tool on point and with millimeter precision.





In universal milling machines, magnetically coded position and angle measurement systems BML are used for accurate positioning of the x, y, and z axes.

The BML measurement system with sensor head and toroidal tape for highly accurate speed monitoring including detection of direction in the drive train.



Magnetically Coded Position and Angle Measurement System

Applications Product Overview Function Principle

S1H Series

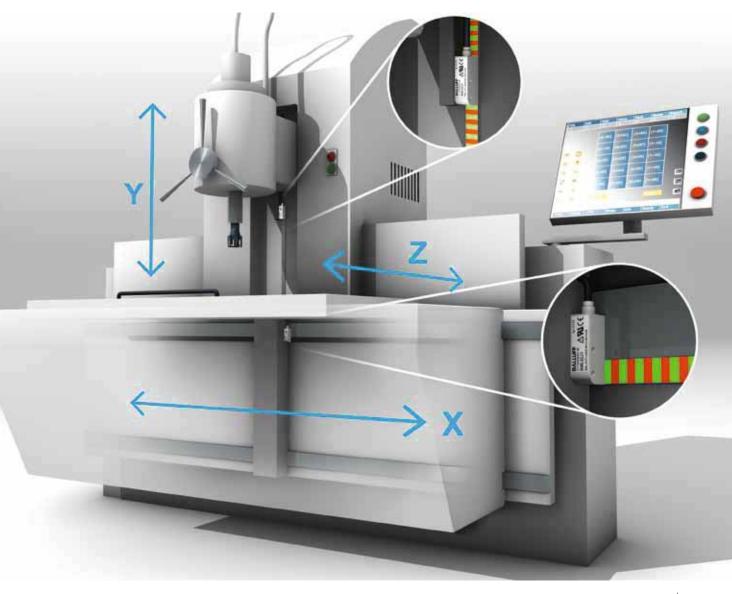
S1G Series

S1F Series

S2B/S2E/S1C Series

Accessories

Basic Information and Definitions



Magnetically Coded Position and Angle Measurement System Product overview

High precision and extended lengths



Series	BML-S1HM3AA	BML-S1HM3CA	BML-S1G0	
Resolution	< 1 µm	< 1 µm	110 µm	
System accuracy	±7 μm	±7 μm	±20 μm	
Distance to tape	0.10.35 mm	0.10.35 mm	0.10.8 mm	
Linear tape	064 mm	0256 mm	048 m	
Rotary tape (magnet ring) Ø 30300 mm				
Angle measurement with magnetic tape < 360°	10 A 10			
Interfaces				
Absolute SSI	1.1	10 A 10	10 A 10	
Absolute BiSS C	1.1	10 A 10	10 A 10	
Incremental digital RS422 (TTL)				
Incremental digital HTL (as supply voltage 1030 V)				
Incremental analog sin/cos (1 V_{pp})	10 A 10			
Magnetia tana				

Magnetic tape	BML-M02-AM0009-A	BML-M02-AM0028-C	BML-M02-AE	
Pole pitch (fine interpolation track)	1 mm	1 mm	2 mm	
From page	22	22	30	



AndAndAndAndImage: And AndImage: AndImage: And AndImage: AndImage: AndImage: And <tr< th=""><th>BML-S1FQ 110 μm ±10 μm 0.10.35 mm 048 m</th><th>BML-S1FA up to 0.25 μm* ±10 μm 0.10.35 mm 048 m</th><th>BML-S2B0-Q 550 μm ±50 μm 0.12 mm 048 m</th><th>المعادي المعادي المع المعادي المعادي المعمدي المعادي ال</th><th>BML-S1C0-Q 1002000 μm ±100 μm 0.12 mm 048 m</th><th>Applications Product Overview Function Principle S1H Series S1G Series S2B/S2E/S1C Series Accessories Basic Information and Definitions</th></tr<>	BML-S1FQ 110 μm ±10 μm 0.10.35 mm 048 m	BML-S1FA up to 0.25 μm* ±10 μm 0.10.35 mm 048 m	BML-S2B0-Q 550 μm ±50 μm 0.12 mm 048 m	المعادي المع المعادي المعادي المعمدي المعادي ال	BML-S1C0-Q 1002000 μm ±100 μm 0.12 mm 048 m	Applications Product Overview Function Principle S1H Series S1G Series S2B/S2E/S1C Series Accessories Basic Information and Definitions
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BML-M02-I3 BML-M02-I4 BML-M02-I4 BML-M02-I4 1 mm 1 mm 5 mm 5 mm 5 mm						
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1 mm 1 mm 5 mm 5 mm						
1 mm 1 mm 5 mm 5 mm						
	BML-M02-I3	BML-M02-I3	BML-M02-I4	BML-M02-I4	BML-M02-I4	
38 38 46 46 46	1 mm	1 mm	5 mm	5 mm	5 mm	
	38	38	46	46	46	

* Depending on the customer's electronics

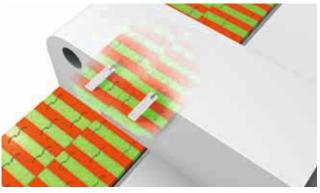
Magnetically Coded Position and Angle Measurement System Function principle

	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 processor unit. With the absolute systems, the absolute position is processed as an SSI or BiSS signal at the standard interface of the electronic processor 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 measurement system. Resolution is down to 1 μ m. Accuracy degrees of \pm 7 μ m can be achieved. The BML has no trouble with absolute measurement of travel speeds up to 10 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 ro- bust, 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 measurement system operates magnetically, unlike optical systems it is highly tolerant of 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.
Custom fastures	

System features of absolute systems

- Non-contact operating principle
- Resolution down to 1 µm
- System accuracy to ±7 µm
- Absolute signal SSI and BiSS C
- Additional real-time signal
- Gap between sensor and tape up to 0.8 mm

Operating principle of absolutely coded position and angle measurement system BML



Perpendicular magnetic tape



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_{pp}
- Gap between sensor and tape up to 2 mm
- Reference and limit switch function

Operating principle of incremental position and angle

measurement system BML

North pole South pole Field lines Cosine sensor

Customizing

Do you have a very specific application?

Simply contact us! We offer you not just the standard product line, but also customized solutions. Some examples:

- Higher resolutions
- Other interpolation factors

Perpendicular magnetic tape

- Higher travel speeds
- Larger read distances
- Special cables/plugs
- Special tape encodings
- Special designs/hubs



Magnetically Coded Position and Angle Measurement System

Applications Product Overview Function Principle

S1H Series

S1G Series

S1F Series

S2B/S2E/S1C Series

Accessories

Basic Information and Definitions



S1H Series, 1 µm Absolute

With the S1H sensor series, the magnetically coded position and angle measurement system BML provides high-resolution systems in robust metal housings.

By means of the absolute position detection, the position is immediately output even if the supply voltage fails and the system is switched on again, without a reference run. The particularly compact design and parallel or perpendicular use to the tape enables integration even under very tight installation conditions.

Magnetically Coded Position and Angle Measurement System



S1H, 1 µm Absolute

General Data SSI Interface, BiSS-C Interface Magnetic Tape Connection Cables Digital Display, CAM Controller







1 µm absolute



Features

- Absolute measurement system
- Additional sin/cos analog signal for fast control applications
- ±7 µm system accuracy
- 1 µm resolution
- Smallest design
- Rugged metal housing
- Mounted parallel or perpendicular to tape
- Signal period 1 mm

Caution!

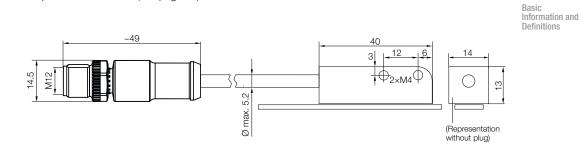
Before design, installation and startup please familiarize yourself with the user's guide to be found at www.balluff.com.



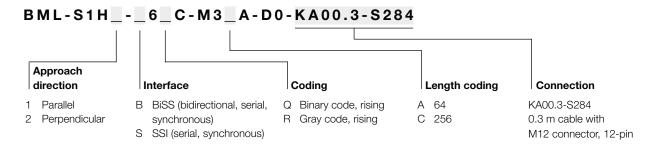


		Coded Position and Angle Measurement
Series	BML-S1H	System
Output signal	Absolute: SSI or BiSS C, additional analog signal sin/cos 1 Vpp	
Data format	16-bit (BML-S1HM3AA) or 18-bit (BML-S1HM3CA)	S1H Series
Resolution	< 1 µm (= 1000/1024 µm per LSB)	General
Part number	BML-S1H6_C-M3_A-DO-KA00.3-S284	Data CCI Interface
Repeat accuracy	±1 increment	 SSI Interface, BiSS-C
Overall system accuracy	±7 μm	Interface
Supply voltage	5 V ±5%	Magnetic Tape
Current consumption at 5 V supply voltage	< 50 mA + Controller current consumption, at 120 Ω load resistance	Connection Cables
Max. read distance sensor/tape	0.35 mm (without cover strip)	Digital Display,
Max. measuring length	64 mm (M3AA) or 256 mm (M3CA)	CAM Controller
Pole pitch, analog track	1 mm	
Max. travel speed	5 m/s (absolute)	S1G Series
Measurement rate	f _{STANDARD} = 50 kHz (SSI), 10 MHz (BiSS C)	S1F Series
Operating temperature	–20+80 °C	STF Selles
Storage temperature	–30+85 °C	S2B/S2E/S1C
Housing material	Aluminum	Series
Degree of protection	IP 67	

All data applies in conjunction with tape BML-M02-A33... (see page 27)



Ordering example: sensor head



Preferred models

www.balluff.com

BML-S1H1-S6QC-M3CA-D0-KA00.3-S284 (BML0393)

Approach direction parallel to the tape, SSI interface, rising binary code, 256 series length coding, pigtail 0.3 m with M12 connector

BML-S1H2-S6QC-M3CA-D0-KA00.3-S284 (BML0394)

Approach direction perpendicular to the tape, SSI interface, rising binary code, 256 series length coding, pigtail 0.3 m with M12 connector

Magnetically

Accessories

S1H Series, Absolute SSI interface, BiSS-C interface

1 µm absolute

SSI interface

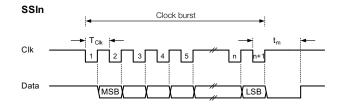
The SSI interface provides synchronous serial data transmission and is suitable for controllers from different manufacturers.

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:

BML-S1H_-S6_C-M3A...: 16-bit

- BML-S1H_-S6_C-M3C...: 18-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,

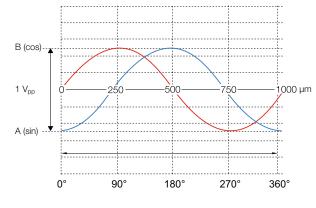
settings can be (continuously) configured on the sensor head without interrupting the sensor data.

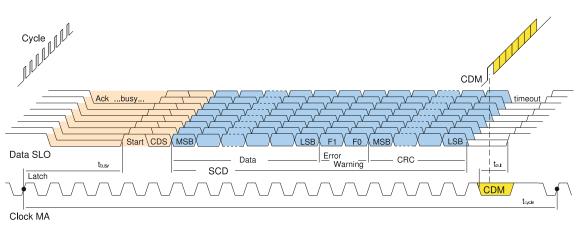
BiSS C supports CRC, warnings and error messages.

ERFA

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

Additional analog real-time signal sin/cos 1 V_{pp}

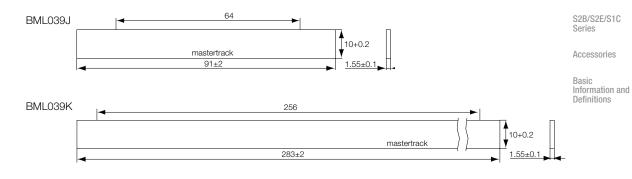








Series	Magnetic tape	Magnetic tape	BISS-C Interface
Output signal	for BML-S1H with 64 mm measuring length	for BML-S1H with 256 mm measuring length	Magnetic Tape
Ordering code	BML039J	BML039K	Connection Cables
Part number	BML-M02-A33-A3-M0009-A	BML-M02-A33-A3-M0028-C	
Length	91 mm	283 mm	 Digital Display, CAM Controller
Measuring length	64 mm	256 mm	
Magnetic tape material	Rubber ferrite, stainless steel carrier	Rubber ferrite, stainless steel carrier	S1G Series
Cover strip material	Stainless steel	Stainless steel	
			S1F Series



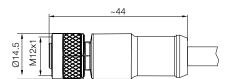




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Acces

Accessories		M12 connection cable	
		12-pin, female straight	
Series		BML-S1HS284	
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 plug, molded, black	
Description/additional data		Cable: Ø 4.9 mm, 12×0.08 mm ²	
		Bending radius:	
		15×D (dynamic), 7.5×D (static)	
		■ Temperature range: -25 °C+70 °C	

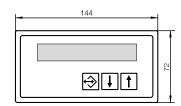








Series	BDD-AM 10-1-SSD	BDD-CC 08-1-SSD
	Digital display	CAM controller
	SSI Interface	SSI Interface
Ordering code	BAE0069	BAE006F
Part number	BDD-AM 10-1-SSD	BDD-CC 08-1-SSD
Features	7 1/2-digit display with leading sign	8 programmable outputs
	LED display, 14 mm-high red	8 directional switching points possible
	7-segment digits	LED display, six 14-mm high red
	Scalable measured values	7-segment digits
	Variable decimal place setting	Switching points can be monitored using
	Adjustable zero point	LEDs on the front panel
	Supply voltage 1032 V	300 switching points can be distributed
	2 programmable relay outputs, each as	over up to 15 programs
	limit switch/comparator	Adjustable top dead center/zero point
	Cam	shift
	2-point controller	Dynamic dead-time compensation for
	1 configurable input	each individual switching point
	External zeroing	Multiple BDD-CC 08 units can be wired
	Retention of the display value	in parallel
	Integrated transducer supply voltage	Integrated transducer supply voltage
	300 mA, 5 V or 24 V	300 mA, 5 V or 24 V
	Insulated DIN housing for mounting in	Insulated DIN housing for mounting in
	front panel (clamp included in the scope	front panel (clamp included in the scope
	of delivery)	of delivery)



Housing depth 110 mm

144 789 123000000 123000000 123 10 →±0C

Housing depth 110 mm

Magnetically Coded Position and Angle Measurement System

S1H Series General Data SSI Interface, BISS-C Interface Magnetic Tape Connection Cables Digital Display, CAM Controller

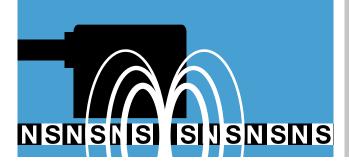
S1G Series

S2B/S2E/S1C Series

Accessories

Basic Information and Definitions

S1F Series



Magnetically Coded Position and Angle Measurement System

AICE

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, 1 µm Absolute

General Data SSI Interface, BiSS-C Interface Magnetic Tape Connection Cables Digital Display, CAM Controller





1 µm absolute

Connection cables

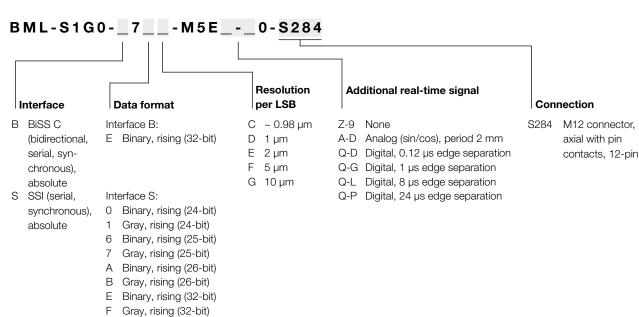
Page 36



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
- Signal period 2 mm
- Large length up to 48 m

Ordering example: sensor head



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

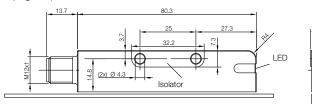
For large lengths

S1G Series, Absolute SSI Interface, BiSS-C interface



		and A
Series	BML-S1G	Meas Syste
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	S1H
Resolution	~0.98, 1, 2, 5 or 10 µm	
Part number	BML-S1G0-B/S7M5E0-S284	S1G
Repeat accuracy	±1 increment	Gene Data
Overall system accuracy	±20 μm	SSI Ir
Supply voltage	5 V ±5 % and 1028 V DC	BiSS
Current consumption	70 mA at 24 V DC supply voltage	Inter
Max. read distance sensor/tape	0.8 mm (without cover strip)	Magn Conn
Max. measuring length	48 m	Cable
Pole pitch, fine interpolation track	2 mm	Digita
Max. travel speed	10 m/s	CAM
Measurement rate	f _{STANDARD} = 50 kHz (SSI), f _{STANDARD} = 10 MHz (BiSS C)	S1F S
Operating temperature	–20+70 °C	316.0
Storage temperature	−25+85 °C	S2B/
Housing material	Zinc, surface coated	Serie
Degree of protection	IP 67	

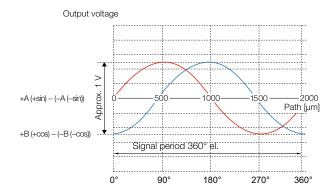
All data applies in conjunction with tape BML-M02-A33... (see page 35)



Additional analog, incremental real-time signal

(BML-S1G0-___-M5EA-_0-...)

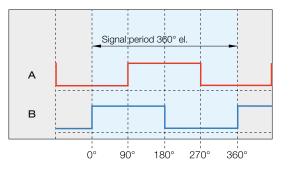
In addition to the SSI or BiSS signal, an analog real-time signal sin/cos 1 $V_{\rm pp}$ is output for highly dynamic control applications.



Additional digital, incremental real-time signal

(BML-S1G0-___-M5EQ-_0-...)

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





Magnetically Coded Position and Angle Measurement System

S1H Series

S1G Series General Data SSI Interface, BiSS-C Interface Magnetic Tape Connection Cables Digital Display, CAM Controller

S1F Series

2B/S2E/S1C eries

Accessories

Basic Information and Definitions

S1G Series, Absolute SSI Interface, BiSS-C interface



SSI Interface

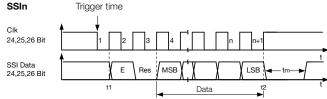
The SSI interface provides synchronous serial data transmission and **SSIn** is suitable for controllers from different manufacturers.

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

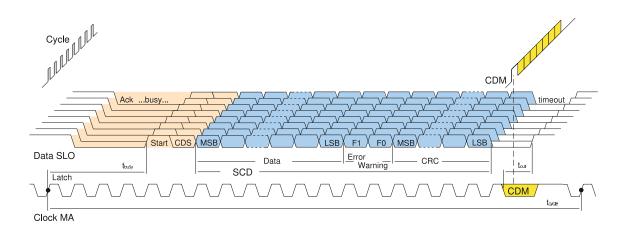


BiSS-C interface

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.

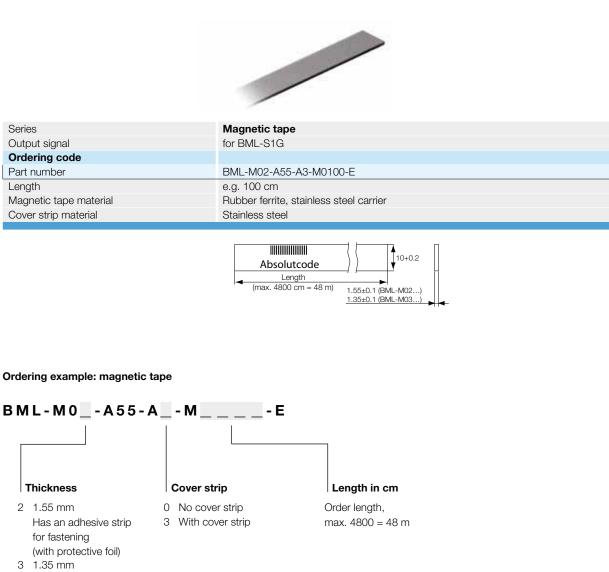




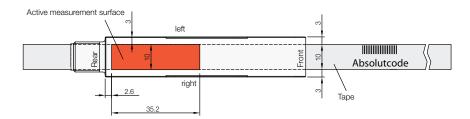
Caution!

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





Positioning



Without adhesive strip

Magnetically Coded Position and Angle Measurement System

S1H Series

S1G Series

SSI Interface, BiSS-C Interface

Magnetic Tape Connection Cables

Digital Display, CAM Controller

S1F Series S2B/S2E/S1C Series

Accessories

Definitions

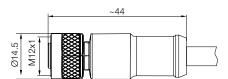
Basic Information and

General Data





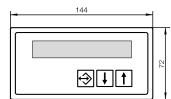
Accessories		M12 connection cable
		12-pin, female straight
Series		BML-S1HS284
Length 2 m	Ordering code	BCC09MW
	Part number	BCC M41C-0000-1A-169-PS0C08-020-C009
Length 5 m	Ordering code	BCC09MY
	Part number	BCC M41C-0000-1A-169-PS0C08-050-C009
Length 10 m	Ordering code	BCC09MZ
	Part number	BCC M41C-0000-1A-169-PS0C08-100-C009
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 plug, molded, black
Description/additional data		Cable: Ø 4.9 mm, 12×0.08 mm ²
		Bending radius:
		15×D (dynamic), 7.5×D (static)
		■ Temperature range: -25 °C+70 °C







		Data
		SSI Interface,
0 1 3		BiSS-C Interface
		Magnetic Tape
		Connection
		Cables
		Digital Display, CAM Controller
	01 1	CAW CONTOINED
0 0	LED display, six 14-mm high red	S1F Series
Scalable measured values	7-segment digits	511 561165
Variable decimal place setting	Switching points can be monitored using	S2B/S2E/S1C
Adjustable zero point	LEDs on the front panel	Series
Supply voltage 1032 V	300 switching points can be distributed	
2 programmable relay outputs, each as	over up to 15 programs	Accessories
limit switch/comparator	Adjustable top dead center/zero point	
Cam	shift	Basic Information and
2-point controller	Dvnamic dead-time compensation for	Definitions
0	01	
0		
'	'	
0 0	5 0	
or delivery)	or delivery)	
	 Adjustable zero point Supply voltage 1032 V 2 programmable relay outputs, each as limit switch/comparator 	Digital displayCAM controllerSSI InterfaceSSI Interface BAE0069BAE006F BDD-AM 10-1-SSDBDD-CC 08-1-SSD7 1/2-digit display with leading sign8 programmable outputsLED display, 14 mm-high red8 directional switching points possible7-segment digitsLED display, six 14-mm high red7-segment digitsScalable measured valuesVariable decimal place settingSwitching points can be monitored usingAdjustable zero pointLEDs on the front panelSupply voltage 1032 V300 switching points can be distributed over up to 15 programs2 programmable relay outputs, each as limit switch/comparatorAdjustable top dead center/zero pointCamDynamic dead-time compensation for each individual switching point2-point controllerDynamic dead-time compensation for each individual switching pointExternal zeroingMultiple BDD-CC 08 units can be wired in parallelIntegrated transducer supply voltage 300 mA, 5 V or 24 VInsulated DIN housing for mounting in front panel (clamp included in the scope



Housing depth 110 mm

144 789 456 123 00000000000012345678 72 10

Housing depth 110 mm



S1G Series General Data ce, Tape on



Magnetically Coded Position and Angle Measurement System

S1F Series, Incremental

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, Incremental, 1 mm Pole Pitch General Data Technical Selection Guide Magnetic Tape Magnet Rings







Features

■ 1 µm resolution (digital)

- ±10 µm system accuracy permits high gain factors
- High repeat accuracy ±1 increment
- Reference signal
- Smallest design
- Rugged metal housing
- Mounted parallel or perpendicular to tape
- Pole pitch 1 mm

Ordering example: sensor head, pole width 1 mm

		Z - M 3 _ 0 - 90 M 3 _ 0 0 _		og output signal sin/cos) al square-wave signal RS422)
Approach direction	Resolution	Reference signal	Min. Edge separation*	Connection
1 Parallel I	D 1µm	0 None	D 0.12 µs	KA02 PUR cable 2 m
2 Perpendicular	E 2µm	1 Individually or	E 0.29 μs	KA05 PUR cable 5 m
I	F5µm	fixed-periodic	F 0.48 µs	KA10 PUR cable 10 m
(G 10 µm	2 Pole-periodic,	G 1 µs	KA15 PUR cable 15 m
		only with digital	H 2µs	KA20 PUR cable 20 m
		design	K 4 µs	
		Q61	L 8µs	
			N 16 µs	
			P 24 µs	

Sensor connectors (e.g. SUB-D) are available on request. Better resolution and accuracy available on request. * For selection guide, see page 42: Resolution – speed – edge separation

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 μ m, edge separation 0.48 μ s, max. travel speed 1 m/s

Compact S1F Series, Incremental **General data** and high-resolution



BML-S1F_-Q... Digital square-wave signals RS422 A, /A, B, /B, Z, /Z 1 µm, 2 µm, 5 µm or 10 µm 1 mm BML-S1F_-Q61_-M3_ 0-_0-RS422 to DIN 66259 ±10 µm 5 V ±5% Current consumption at 5 V supply voltage < 50 mA + current consumption of the controller (depending on internal resistance) 0.35 mm 20 m/s -20...+80 °C Aluminum IP 67



BML-S1F_-A... Sinusoidal analog signals sin/cos A, /A, B, /B, Z, /Z Depends on evaluation, up to 0.25 µm 1 mm BML-S1F_-A62Z-M3_ 0-90- $1 V_{pp}$ ±10 µm 5 V ±5% < 50 mA + current consumption of the controller (depending on internal resistance) 0.35 mm 20 m/s -20...+80 °C Aluminum IP 67

Magnetically Coded Position and Angle Measurement System

S1H Series

S1G Series

S1F Series

Technical Selection Guide

Magnetic Tape

Magnet Rings

S2B/S2E/S1C

Accessories

Definitions

Basic Information and

Series

General Data

All specifications in conjunction with tape BML-...-I34... (see page 44).

Series

Output signal

Pole pitch signal periods

Output voltage (A/B/Z)

Overall system accuracy

Max. read distance sensor/tape

Resolution

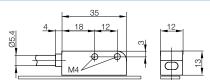
Part number

Supply voltage

Max. travel speed

Operating temperature Housing material

Degree of protection



Digital square-wave signals RS422

- RS422 square-wave signals in acc. with DIN 66259
- Direction information = 90° phase-shifted
- Resolution = edge separation A/B
- Differential signals
- Reference pulse (optional)
- Terminating resistor ≥ 120 ohms (usually integrated in the processor unit)
- Forward movement: A before B

Sinusoidal analog signals 1 V_{pp}

- Sinusoidal voltage signals
- Direction information = 90° phase-shifted

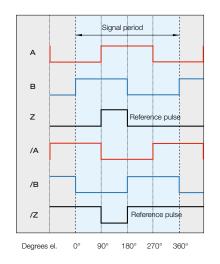
35

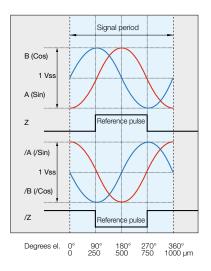
.12

12

18

- Signal period = 1000 µm
- Differential signals
- Reference pulse (optional)
- Terminating resistor ≥ 120 ohms
- (usually integrated in the processor unit)
- Forward movement: A before B





Caution!

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

S1F Series, Incremental **Technical selection guide**

The position measurement system BML must be exactly matched to the respective application. Use the technical selection guide. For additional examples, see Basic Information and Definitions on page 68

Compatibility of the counting frequency of the controller and BML

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.

Maximum travel speed, resolution and edge separation

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

			V _{max} in accordance Mechanical resolut	with edge separation	on and resolution	
		periods)	D 1 µm	E 2 µm	F 5 µm	G 10 µm
D	0.12 µs	2083.33 kHz	5 m/s	10 m/s	20 m/s	20 m/s
Е	0.29 µs	862.07 kHz	2 m/s	4 m/s	10 m/s	10 m/s
F	0.48 µs	520.83 kHz	1 m/s	2 m/s	5.41 m/s	5.41 m/s
G	1 µs	250.00 kHz	0.65 m/s	1.3 m/s	2.95 m/s	2.95 m/s
н	2 µs	125.00 kHz	0.3 m/s	0.6 m/s	1.54 m/s	1.54 m/s
κ	4 µs	62.50 kHz	0.15 m/s	0.3 m/s	0.79 m/s	0.79 m/s
L	8 µs	31.25 kHz	0.075 m/s	0.15 m/s	0.34 m/s	0.34 m/s
Ν	16 µs	15.63 kHz	0.039 m/s	0.079 m/s	0.19 m/s	0.19 m/s
Ρ	24 µs	10.42 kHz	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



Pulses/revolution with 4-fold evaluation

Ø of magnet ring, outside

Rotary applications

Sensor head resolution

The position measurement system BML enables the detection of rotary movements. The rotary tapes can be matched to the respective application. Use the technical selection guide for rotary systems.

72 mm

228000

114000

45600

22800

BML002K

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.

122 mm

384000

192000

76800

38400

BML01EW



Magnetically Coded Position and Angle Measurement System

S1H Series

S1G Series

S1F Series General

Data **Technical Selection Guide** Magnetic Tape

Magnet Rings

S2B/S2E/S1C Series

Accessories

Basic Information and Definitions

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

Maximum speed

Ordering code

 $\mathbf{D} = 1 \ \mu m$

E = 2 µm

 $\mathbf{F} = 5 \, \mu m$

G = 10 µm

The speed and the diameter of the magnet 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:

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:

75 mm

238000

119000

47600

23800

BML01KM

You are using a BML-S1F sensor with a resolution of 5 μ m (F) and a minimum edge separation of 1 μ s (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. The maximum speed of 705 rpm should not be exceeded.

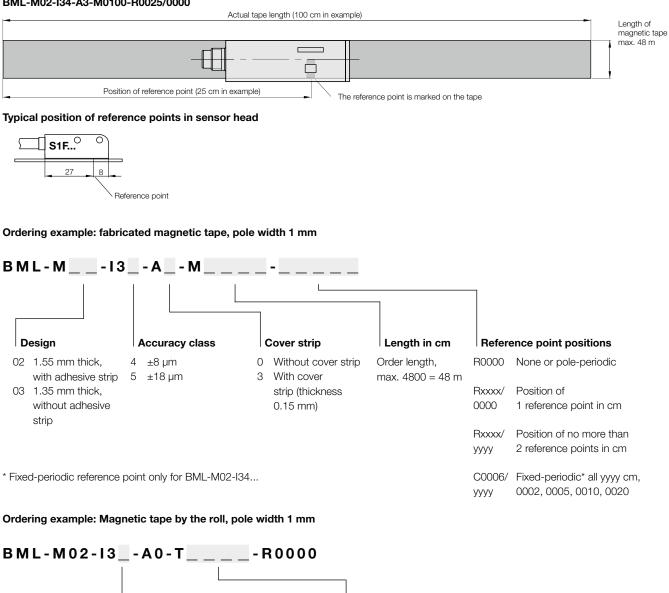
Look-up table for max. RPM, see Table 2, page 77.



Accessories can be found on page 62.

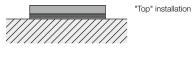
Position of single reference point using example of

BML-M02-I34-A3-M0100-R0025/0000



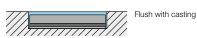
Accuracy class			Leng	yth
4 ±8 µm		0	500	5 m
5 ±18 µm		1(000	10 m
(Better accuracy classes	available on	24	400	24 m
request.)		48	300	48 m

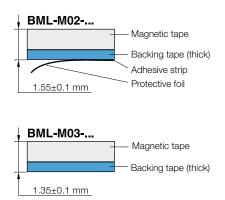
Magnetic tape mounting options







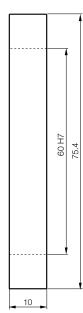








54 72 72



90H7 122

10

Accessories

Basic Information and Definitions And Ang Measure NSNSNSNSNSNSNS System

Magnetically Coded Position and Angle Measurement System

S2B/S2E/S1C Series, Incremental

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, Incremental, 5 mm Pole Pitch

General Data	48	
Technical Selection Guide	51	
Magnetic Tape	52	
Magnet Rings	53	

S1C/BMF 12M, Incremental, 5 mm Pole Pitch

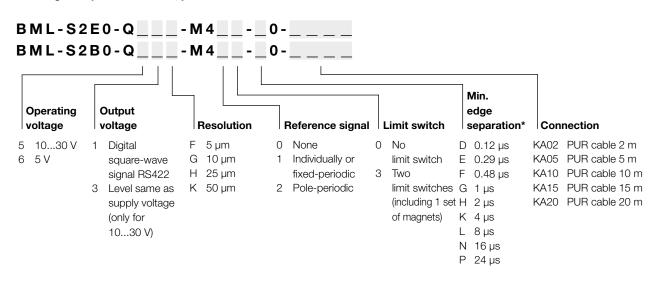
General Data	56
Technical Selection Guide	58
Magnetic Tape	59
Magnet Rings	61
	60





- 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...30 V
- Two freely positionable limit switches
- Reference signal
- LED display for reference signal
- Pole width 5 mm

Ordering example: sensor head, pole width 5 mm



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

* Selection guide, page 50: Resolution – speed – edge separation

Preferred models

BML-S2B0-Q53F-M410-D0-KA05 (BML0211)

Digital signal, 10...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...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

universal

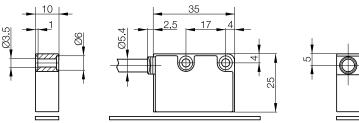
S2B/S2E Series, Incremental **General data**





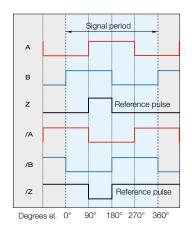
Series	BML-S2B0	BML-S2E0
Output signal	Digital square-wave signals	Digital square-wave signals
	A, /A, B, /B, Z, /Z (RS422) or A, B, Z (HTL)	A, /A, B, /B, Z, /Z (RS422) or A, B, Z (HTL)
Resolution	5 μm, 10 μm, 25 μm or 50 μm	5 μm, 10 μm, 25 μm or 50 μm
Pole pitch, signal periods	5 mm	5 mm
Part number	BML-S2B0-QM40	BML-S2E0-QM40
Output voltage (A/B/Z)	RS422 as per DIN 66259	RS422 as per DIN 66259
	or as supply voltage 1030 V	or as supply voltage 1030 V
Overall system accuracy	±50 μm	±100 μm
Supply voltage	1030 V or 5 V ±5%	1030 V or 5 V ±5%
Current consumption at	< 50 mA + current consumption of the con-	< 50 mA + current consumption of the con-
5 V supply voltage	troller (depending on internal resistance)	troller (depending on internal resistance)
Current consumption at	< 40 mA + current consumption of the con-	< 40 mA + current consumption of the con-
1030 V supply voltage	troller (depending on internal resistance)	troller (depending on internal resistance)
Max. read distance sensor/tape	2 mm	2 mm
Max. travel 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 52).



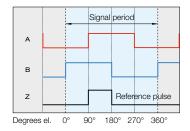
Digital square-wave signals RS422

- RS422 square-wave signals in acc. with DIN 66259
- Direction information =
- 90° phase-shifted Resolution = edge separation A/B
- Differential signals
- Reference pulse (optional)
- Terminating resistor ≥ 120 ohms
- (usually integrated in the processor unit)
- Forward movement: A before B



Digital square-wave signals HTL

- Square-wave signals HTL =
- Level same as supply voltage Direction information =
- 90° phase-shifted
- Resolution = edge separation A/B
- Reference pulse (optional)
- Terminating resistor > 5 kOhms
- (usually integrated in the processor unit) Forward movement: A before B



Caution!

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

Magnetically Coded Position and Angle Measurement System

S1H Series

S1G Series

S1F Series

S2B/S2E Series General Data Technical Selection Guide

Magnetic Tape Magnet Rings

S1C Series General Data Technical Selection Guide Magnetic Tape Magnet Rings

Accessories

Basic Information and Definitions

S2B/S2E Series, Incremental **Technical selection guide**

The position measurement system BML must be exactly matched to the respective application. Use the technical selection guide. For additional examples, see Basic Information and Definitions on page 68.

Compatibility of the counting frequency of the controller and BML

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.

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 quency (signal			V _{max} in accordance with edge separation and resolution Mechanical resolution			
		periods)	F 5 µm	G 10 µm	H 25 µm	K 50 µm
D	0.12 µs	2083.33 kHz	20 m/s	20 m/s	20 m/s	20 m/s
Е	0.29 µs	862.07 kHz	10 m/s	20 m/s	20 m/s	20 m/s
F	0.48 µs	520.83 kHz	5 m/s	10 m/s	20 m/s	20 m/s
G	1 µs	250.00 kHz	3.25 m/s	6.5 m/s	14.75 m/s	14.75 m/s
н	2 µs	125.00 kHz	1.5 m/s	3 m/s	7.7 m/s	7.7 m/s
κ	4 µs	62.50 kHz	0.75 m/s	1.5 m/s	3.95 m/s	3.95 m/s
L	8 µs	31.25 kHz	0.375 m/s	0.75 m/s	1.7 m/s	1.7 m/s
Ν	16 µs	15.63 kHz	0.195 m/s	0.395 m/s	0.95 m/s	0.95 m/s
Ρ	24 µs	10.42 kHz	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 position measurement system BML enables the detection of rotary movements. The rotary tapes can be matched to the respective application. Use the technical selection guide for rotary systems.

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 Puls	Pulses/revolution with 4-fold evaluation			
Ø of	magnet ring, outside			and Angle Measurement
31 m	าm	49 mm	72 mm	System
Ordering code BML	_002T	BML002R	BML002P	S1H Series
BML	_002L	BML002M	BML002N	5111 561165
F = 5 μm 2000	00	32000	46000	S1G Series
G = 10 μm 1000	00	16000	23000	
H = 25 μm 4000)	6400	9200	S1F Series
K = 50 μm 2000)	3200	4600	

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

Maximum speed

The speed and the diameter of the magnet 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:

60 × max. travel speed (m/s) Max. speed (rpm) = - $\pi \times$ magnet ring diameter (m)

Look-up table for max. RPM, see Table 2, page 77.

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 1 μs (G). For this sensor, Table 1 gives a maximum travel speed of 3.25 m/s.

If the magnet ring diameter is 48 mm = 0.048 m, a speed of 1293 rpm can be achieved using the formula. The maximum speed of 1164 rpm should not be exceeded.



S2B/S2E Series General Data

Technical Selection Guide Magnetic Tape Magnet Rings

S1C Series

General Data Technical Selection Guide Magnetic Tape Magnet Rings

Accessories

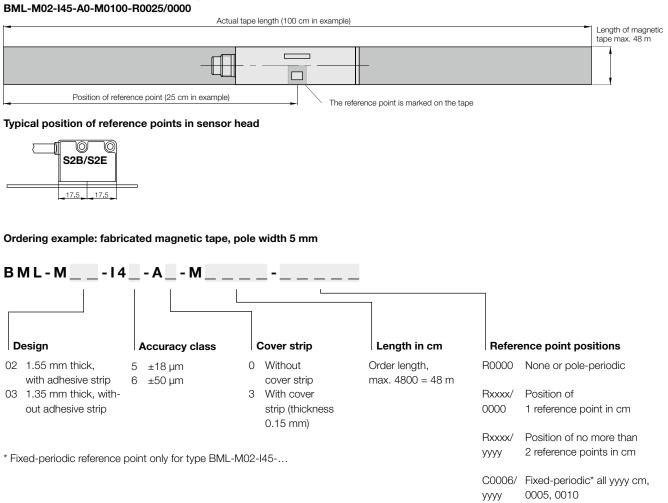
Basic Information and Definitions



Accessories can be found on page 62.



Position of single reference point using example of

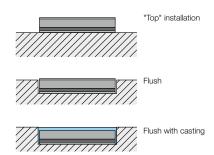


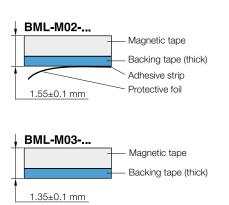
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Ordering example: Magnetic tape by the roll, pole width 5 mm

BML-M02-I4A0-T_		- R 0 0 0
Accuracy class	Leng	gth
5 ±18 µm	0500	5 m
6 ±50 μm	1000	10 m
(Better accuracy classes available	2400	24 m
on request)	4800	48 m

Magnetic tape mounting options



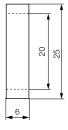


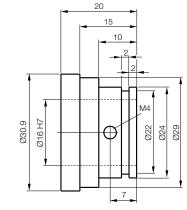






Series	Sensor family B/E	Sensor family B/E	
Ordering code	BML04E2	BML002T	S1
Part number	BML-M33-I40-A0-M025/020-R0	BML-M22-I40-A0-M031/016-R0	
Number of poles	16	20	S
Pole width	5 mm	5 mm	
With reference mark	no	no	S2 Ge
Material	Plastic	Hard ferrite/aluminum	Da
			Te





Magnetically Coded Position and Angle

Coded Position and Angle Measurement System

S1H Series

S1G Series

S1F Series

S2B/S2E Series

General Data Technical Selection Guide Magnetic Tape Magnet Rings

S1C Series General Data Technical Selection Guide

Magnetic Tape

Magnet Rings

Basic Information and Definitions

Special solutions for a range of applications

Magnet rings are suitable for all types of application where the monitoring of rotary movements is required. Due to the high resolution, synchronous run monitoring is just as easy to implement as precision angle positioning.

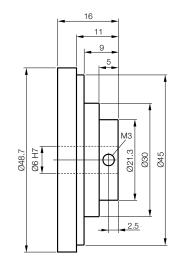
Balluff offers a range of standard rotary tapes that are suitable for most types of application. Due to the wide variety of different machine applications, special dimensions and magnetic configurations are available on request. Even linear tapes can be used successfully in rotary applications. For example, the magnetic tape can simply be stuck to the shaft of a solar panel unit to monitor whether the panel is optimally aligned. Balluff also offers prefabricated magnetic tapes with holes for convenient, simplified installation.







Series	Sensor family B/E	Sensor family B/E
Ordering code	BML002R	BML002P
Part number	BML-M21-I40-A0-M048/006-R0	BML-M20-I40-A0-M072/054-R1
Number of poles	32	46
Pole width	5 mm	5 mm
With reference mark	No	Yes
Material	Hard ferrite/aluminum	Hard ferrite



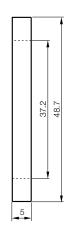












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General Data Technical Selection Guide Magnetic Tape

Magnet Rings Accessories

Basic Information and Definitions



7

S1C Series, Incremental **General data**

cost-effective



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...30 V (HTL)
- Cable connection
- 10...30 V DC supply voltage
- Pole width 5 mm

Ordering example: sensor head, pole width 5 mm

BML-S1C0-Q53_	- M 4 0 0 -	0	
	Resolution	Max. edge separation*	Connection
1	nesolution	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
Ν	500 µm		KA10 PUR cable 10 m
Р	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.

* For selection guide, see page 58: Resolution – speed – edge separation

Preferred type

BML-S1C0-Q53L-M400-M0-KA05 (BML003U)

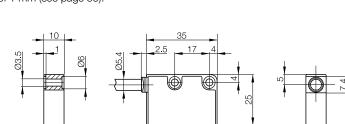
Digital signal, 10...30 V, 5 m cable, resolution 0.1 mm, edge separation 10 µs, max. travel speed up to 8 m/s

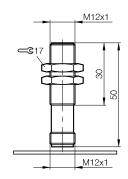




Series	BML-S1C0	BMF 12M	S1G Series
Output signal	Digital square-wave signals	PNP/NPN normally open	010 00103
		1 switching operation per pole	S1F Series
Resolution	0.1 mm, 0.2 mm, 0.5 mm, 1 mm, 2 mm		
Pole pitch, signal periods	5 mm	5 mm	S2B/S2E Serie
Ordering code		BMF0022	General
Part number	BML-S1C0-Q53M4000-KA	BMF 12M-PS-D-2-S4 (PNP normally open)	Data
Ordering code		BMF0021	 Technical Selection Guide
Part number		BMF 12M-NS-D-2-S4 (NPN normally open)	Magnetic Tape
Output voltage (A/B)	Same as supply voltage 1030 V	Supply voltage –U _d	Magnet Rings
Overall system accuracy	±100 μm	> ±5 mm	
Supply voltage	1030 V	1030 V DC	S1C Series
Voltage drop U _d		≤ 3.15 V	General Data
Current consumption at	< 40 mA + current consumption of the con-	200 mA	Technical
1030 V supply voltage	troller (depending on internal resistance)		Selection Guide
Max. read distance sensor/tape	2 mm	2 mm	Magnetic Tape
Max. travel speed	10 m/s	7 kHz	Magnet Rings
Operating temperature	−20+80 °C	–25+85 °C	
Housing material	PBT	Brass-coated	Accessories
Degree of protection	IP 67	IP 67	Basic
			Dasio

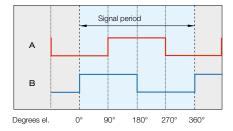
All data applies in conjunction with tape BML-...-I46-... at a read distance of 1 mm (see page 59).





Digital square-wave signals HTL

- Square-wave signals HTL = Level same as supply voltage
- Direction information = 90° phase-shifted
- Resolution = edge separation A/B
- Terminating resistor ≥ 120 ohms (integrated in the processor unit)





Magnetically Coded Position and Angle Measurement System

S1H Series

ries ide

Information and Definitions

S1C Series, Incremental **Technical selection guide**

The position measurement system BML must be exactly matched to the respective application. Use the technical selection guide. For additional examples, see Basic Information and Definitions on page 68.

Compatibility of the counting frequency of the controller and BML

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.

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 and quency (signal quency (signal decomposition quency (signal quency qu				ration and resoluti	resolution		
ration		periods)	L 100 µm	M 200 µm	N 500 µm	P 1000 µm	R 2000 µm
Μ	10 µs	25.00 kHz	8 m/s	10 m/s	10 m/s	10 m/s	10 m/s
R	100 µs	2.50 kHz	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 position measurement system BML enables the detection of rotary movements. The rotary tapes can be matched to the respective application. Use the technical selection guide for rotary systems.

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	BML002T	BML002R	BML002N		
code	BML002L	BML002M			
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 magnet rings from the S1C series

Maximum speed

The speed and the diameter of the magnet 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:

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.

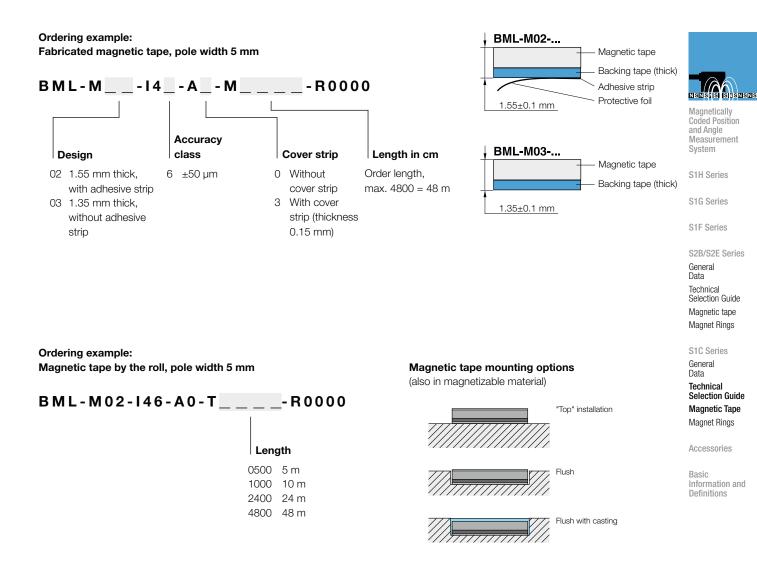
Look-up table for max. RPM, see Table 2, page 77.

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. The maximum speed of 2865 rpm should not be exceeded.





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 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. It 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.





Accessories can be found on page 62.

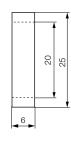


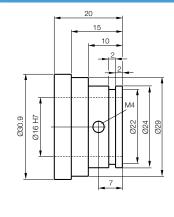


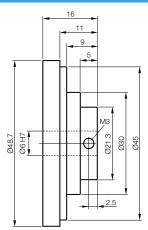




Series	Sensor family C	Sensor family C	Sensor family C	
Ordering code	BML04E2	BML002T	BML002R	
Part number	BML-M33-I40-A0-M025/020-R0	BML-M22-I40-A0-M031/016-R0	BML-M21-I40-A0-M048/006-R0	
Number of poles	16	20	32	
Pole width	5 mm	5 mm	5 mm	
With reference mark	No	No	No	
Material	Plastic	Hard ferrite/aluminum	Hard ferrite/aluminum	

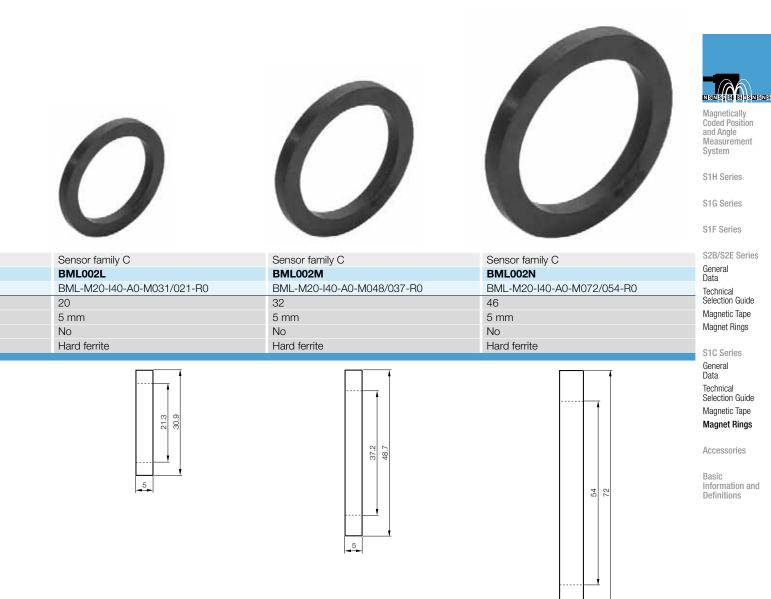












Special solutions for a range of applications

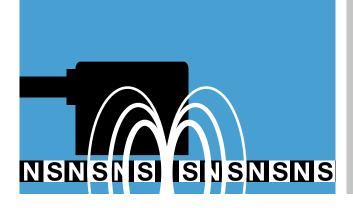
Magnet rings are suitable for all types of application where the monitoring of rotary movements is required. Due to the high resolution, synchronous run monitoring is just as easy to implement as precision angle positioning.

Balluff offers a range of standard rotary tapes that are suitable for most types of application. Due to the wide variety of different machine applications, special dimensions and magnetic configurations are available on request. Even linear tapes can be used successfully in rotary applications. For example, the magnetic tape can simply be stuck to the shaft of a solar panel unit to monitor whether the panel is optimally aligned. Balluff also offers prefabricated magnetic tapes with holes for convenient, simplified installation.

7

We offer custom solutions. Contact us.





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, highprecision measurement systems even where there is no optimum guide.

BALLUFF



S1F, S2B, S2E, S1C Accessories, Incremental Counter Display Sensor Guide









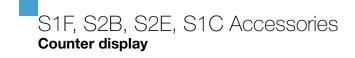
Magnetically Coded Position and Angle Measurement System: Measuring and displaying speeds

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.



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

 Power adapter for connecting to 115 V/230 V, for example, BAE0001 or BAE00EN, on page 403.





		Coded Position and Angle Measurement System
BDD 610	BDD 611/BDD 622/BDD 632	
Single-axis counter	Single-axis, two-axis, three-axis counter	S1H Series
for BML-S2B, BML-S1C	for BML-S1F, BML-S2B, BML-S2E, BML-S1C	
and BML-S2E		S1G Series
BAE004J	BAE004K	
BDD 610-R3Q3-0-53-N-00 (2 dig. outputs)	BDD 611-R3Q4-0-52-N-00 (1 axis)	S1F Series
BAE004H	BAE004M	S2B/S2E Series
BDD 610-R3Q3-0-51-N-00 (2 dig. inputs)	BDD 622-R3Q4-0-52-N-00 (2 axes)	OZD/OZE OCITCS
	BAE004P	S1C Series
	BDD 632-R3Q4-0-52-N-00 (3 axes)	
Set value	Set value	Accessories
Actual value memory	Actual value memory	Counter Display
Factor calculation	Factor calculation	Sensor Guide
Count direction reversal	Edge evaluation	
Up to 3 decimal places	Count direction reversal	Basic Information and
Assignable key functions	Up to 3 decimal places	Definitions
Reset and set logic	Assignable key functions	
Logic for inputs and outputs	Reset and set logic	
Security code	Absolute and incremental measurement	
	Offset logic	
	Sawtooth correction	
	Logic for inputs and outputs	
	Security code	
	Reference pulse	
Power supply 24 V DC*	Power supply 24 V DC*	
1×6-decade LED display	■ 1×6/2×6/3×6-decade LED display	
Digit height 14 mm	Incremental measurement system with tracks A, /A, B, /B, Z, /Z or A, B, Z	
Incremental measurement system with	Digit height 14 mm	
tracks A, B	4 digital inputs	
max. 25 kHz	2 digital outputs	
2 digital inputs (-51-)	■ Min. edge separation with 4-fold evaluation: 250 µs	
2 digital outputs (-53-)	BDD 611: max. input frequency: Signal A or B: 1 MHz	
for BML-S2B0, BML-S2E0	For BML with supply voltage 5 V/1030 V, output voltage RS422/HTL,	
and BML-S1C0Q53	min. edge separation Code E, F, G, H, K, L, M, N, P, R	
min. edge separation Code M, N, P, R		
		+
BDD 610	BDD 611 BDD 622 BDD 632	7
96		

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F 🔸 🔺 E

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96

Magnetically

S1F, S2B, S2E, S1C Accessories **Sensor guide**

Protection and guide

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 joint rod 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

You may cover the magnetic tape with a stainless steel cover strip to protect it from damage caused by swarf 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 44, 52, or 59).
- The cover strip is available in 4 different lengths.



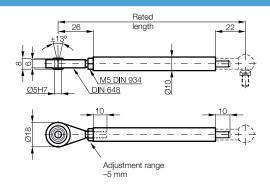
Accessories	Joint rod	
	for BML-C01, BML-C02	
Ordering code	e.g. BAM000P (100 mm)	
Part number	BTL2-GS10A	
Use	For connecting the sliding carriage to the	
	machine	

Sensor guide

Part number

Features

Ordering code







for sliding carriage BML-C01, BML-C02

BML-R01-M_ _ _ (order length in cm)

Lateral groove for alternate mounting

* Use the same length tape and rail and

mechanically affix the tape at the ends.

Guide rail

e.g. BAM01N4 (3 m)

Anodized aluminum

Mounting holes

using brackets

Lubricant-free

Mountable side by sideMaintenance-free dry operation

Suitable for all linear tapes*



Sliding carriage

BAM01MF

Aluminum

Lubricant-free

BML-C01

for sensors BML-S2B, BML-S2E, BML-S1C

Fully mounted with runners

Connection for drag chains

Maintenance-free dry operation

Connection for joint rod



Sliding carriage

BAM01MH

Aluminum

BML-C02

for sensors BML-S1F

Fully mounted with runners

Connection for drag chains

Connection for joint rod

	5
/lagnetically	

Coded Position and Angle Measurement System

S1H Series

S1G Series

510 56165

S1F Series

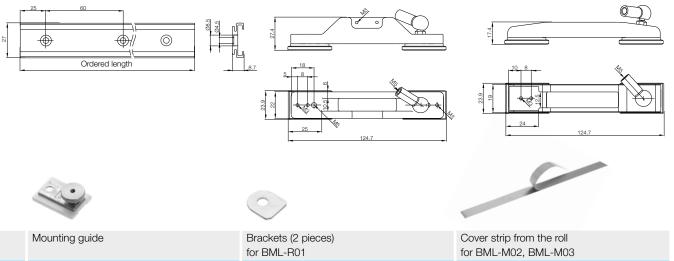
S2B/S2E Series

S1C Series

- Maintenance-free dry operation
- Lubricant-free

Accessories Counter Display Sensor Guide

Basic Information and Definitions



00					
	for BML-R01	for BML-N	102, BML-N	03	
AM01L9	BAM01JL	e.g. BMLC	001K (10 m)		
ML-Z0010	BML-Z0008	BML-A013	3-T		
stalling the magnetic tape on BML-R01	For lateral mounting of the rail and at transi-	0500	1000	2400	4800
	tion points	5 m	10 m	24 m	48 m
١	AM01L9 //L-Z0010	for BML-R01 AM01L9 BAM01JL ML-Z0010 BML-Z0008 stalling the magnetic tape on BML-R01 For lateral mounting of the rail and at transi-	for BML-R01for BML-MAM01L9BAM01JLe.g. BMLML-Z0010BML-Z0008BML-A013stalling the magnetic tape on BML-R01For lateral mounting of the rail and at transi-0500	for BML-R01for BML-M02, BML-M0AM01L9BAM01JLe.g. BML001K (10 m)ML-Z0010BML-Z0008BML-A013-Tstalling the magnetic tape on BML-R01For lateral mounting of the rail and at transi-0500 1000	for BML-R01 for BML-M02, BML-M03 AM01L9 BAM01JL e.g. BML001K (10 m) ML-Z0010 BML-Z0008 BML-A013-T stalling the magnetic tape on BML-R01 For lateral mounting of the rail and at transi- 0500 1000 2400





Adhesive strip



Magnetically Coded Position and Angle Measurement System



BALLUF



Basic Information and Definitions Definitions Examples and Help for Selecting the System



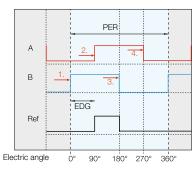




Basic Information and Definitions **Definitions**

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.	Accuracy of the tape BML-M02-I34
	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).	±8 µm
4x evaluation	With 4-fold evaluation, the controller counts every 4 edge changes within a signal period. A signal period = $4x$ selected resolution.	Accuracy of the sensor head BML-S1F
	Example: Sensor head 1 µm resolution, magnet ring with 384 poles (1 mm). 4 edges (each 1 µm) per signal period	S. P.
	= 4 μ m period length = 250 periods per pin = 96,000 periods per 360° (384,000 pulses per 360°)	±2 μm
	During installation, make sure the sensor is correctly aligned over the	· · ·

±10 µm

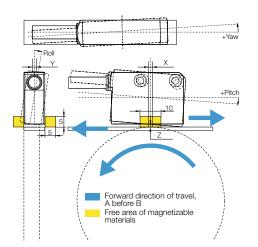


PER = a signal period EDG = Edge separation

Installation tolerance

tape. To ensure the correct function and linearity class of the system, the distances and tolerances must be adhered to. We recommend an air gap of 0.1 mm (about paper thickness)

For detailed **installation instructions**, refer to our operating manual at www.balluff.de





Basic Information and Definitions **Definitions**

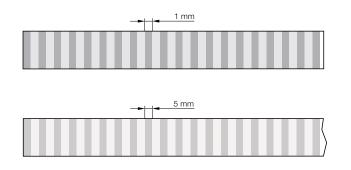
Edge separation	With 4-fold evaluation, the following applies (each edge is counted):	
	Period length = Counting frequency 4	
	Counting frequency $\geq \frac{1}{\text{Min. edge separation}}$	Magnetically Coded Posi- tion and Angle Measurement
	Example: Edge separation = 1 µs Counting frequency = 1 MHz	System
	Period length = 250 kHz	S1G Series
	Important! The controller/display must be able to count the minimum time- based edge separations shown in the tables (note the counting	S1F Series S2B/S2E/S1C
	frequency of your controller).	Series
	The minimum edge separation may occur even when the system is at rest due to the internal interpolation procedure.	Accessories
	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.	Basic Informa- tion and Defini- tions Definitions Examples and
Repeat accuracy	Repeat accuracy is the value resulting when moving to the same po- sition from the same direction under unchanging ambient conditions.	Help for Selecting the System
Incremental	After the system is switched on, the measured value currently avail- able 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 incre- ments 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.	
Measurement rate	The measurement rate is the frequency at which the output posi- tion information is updated. It can be the same as the number of measurements per second. A high measurement rate for rapidly changing positions is important if a process is time-critical.	

Basic Information and Definitions Examples and help for selecting the system

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 tapes exist in 1 mm (BML-M...-I3_-...) and 5 mm (BML-M...-I4_-...) pole width.

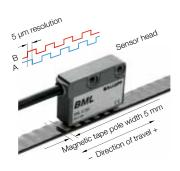


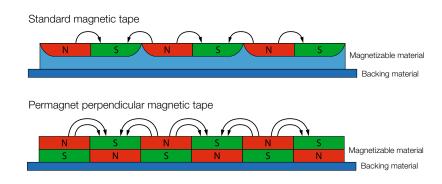


 	5 mr	<u>n</u>							
			R						

The magnetic tapes are available in various versions. Make sure the magnetic tape and sensor head fit together.

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





+ larger field strength

+ better accuracy

Interpolation

magnetic tape

Permagnet perpendicular

Examples and help for selecting the system
Basic Information and Definitions

Reference point function	For each incremental position measurement system, the reference position is essential as a starting point for the counting. How the reference position 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	Sensor head design for controller with 4-fold evaluation:
separation (examples)	Example 1: Resolution needed: F = 5 µm
	In table 1 on page 51: Select column 1.
	Max. travel speed = 7 m/s
	Select line 2 = 10 m/s.
	→ Edge separation E = 0.29 μ s
	Example 2: Resolution needed: $G = 10 \ \mu m$
	In table 1 on page 51: Select column 2.
	Max. counting frequency of the controller = 0.5 m/s edge separation H = 2 μs
	Select line 5.
	\rightarrow Maximum possible travel speed: 3 m/s
	Example 3: Max. travel speed = 2 m/s
	Controller detects min adapted approximation M 10 up

Controller detects min. edge separation M = 10 μs

- In table 1 on page 58: Select line 1.
- Select column 1.
 - \rightarrow 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⁾	Counting frequency (Signal period)
D	0.12	8,333	2,083.33
E	0.29	3.448	862.07
F	0.48	2.083	520.83
G	1	1.000	250.00
н	2	500	125.00
К	4	250	62.50
L	8	125	31.25
М	10	100	25.00
Ν	16	63	15.63
Р	24	42	10.42
R	100	10	2.50

Table 1: Relationship of edge separation – counting frequency $^{1)}$ Signal period = 1/4 \times counting frequency



Magnetically Coded Position and Angle Measurement System

S1H Series

S1G Series

S1F Series

S2B/S2E/S1C Series

Accessories

Basic Information and Definitions

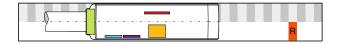
Definitions Examples and Help for Selecting the System



Basic Information and Definitions Examples and help for selecting the system

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

40 cm	Visually marked reference point position				
	100 cm				
Total length					

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.

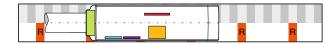
Ordering example for the tape shown below: BML-M02-I46-A0-M0200-R0050/0120

	R	R <mark>.</mark>
50 cm	Reference point 1	Reference point 2
	120 cm	_
-	200 cm	
	Total length	



Fixed-periodic reference signals

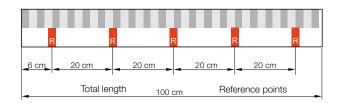
System consisting of: BML-S_B/E...-M41_-... or BML-S1F...-M31... Tape BML-M...-I__-...-C0006/____



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 fixedperiodic reference points, type BML-M...-C0006/____ For magnetic tape 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





Magnetically Coded Position and Angle Measurement System

S1H Series

S1G Series

S1F Series

S2B/S2E/S1C Series

Accessories

Basic Information and Definitions

Definitions Examples and Help for Selecting the System



Basic Information and Definitions Examples and Help for Selecting the System

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



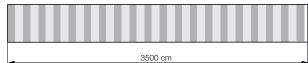
In the simplest position measurement system, the sensor head scans the magnetic periods with the incremental sensors. On the tape, there is a track with magnetic north and south poles. The position is determined by the controller by adding up the counted increments.

For the pole-periodic reference point signal, a reference point signal is output with each magnetic pole. 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 sensor 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



Total length



Maximum speed

The measurement system BML enables the detection of rotary movements. The speed and the diameter of the magnet 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:

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

Magnetically Coded Position and Angle Measurement System

S1H Series

S1G Series

S1F Series

S2B/S2E/S1C Series

Accessories

Basic Information and Definitions

Definitions Examples and Help for Selecting the System

For the maximum travel speed and minimum edge separation, see table 1 on page 51. Recommendation: max. speed 10 % less than determined speed value.

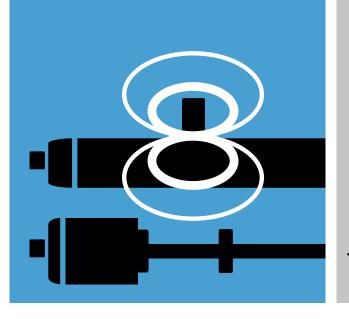
Max. travel	RPM					
speed	Outer diameter					
	31 mm	49 mm	70 mm	75.4 mm	122 mm	
	31 mm	49 ጠጠ	7211111	73.4 ጠጠ	122 11111	
20 m/s	12322	7795	5305	5066	3131	
14.75 m/s	9087	5749	3913	3736	2309	
10 m/s	6161	3898	2653	2533	1565	
8.8 m/s	5422	3430	2334	2229	1378	
8 m/s	4929	3118	2122	2026	1252	
7.7 m/s	4744	3001	2042	1950	1205	
6.5 m/s	4005	2533	1724	1646	1018	
5 m/s	3080	1949	1326	1266	783	
4.2 m/s	2588	1637	1114	1064	657	
3.95 m/s	2434	1540	1048	1001	618	
3.25 m/s	2002	1267 ¹⁾	862	823	509	
3 m/s	1848	1169	796	760	470	
1.8 m/s	1109	702	477	456	282	
1.7 m/s	1047	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 (magnet ring)

Example

Sensor head BML-S2B... with a resolution of 5 μ m (F) and a min. edge separation of 1 μ s (G). From table 1 on page 51, for this sensor head, there is a max. travel speed of 3.25 m/s. With a magnet 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





Magnetostrictive position measurement 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 measurement systems to be used universally.

Non-contact, precise and absolute measuring are the critical features that have brought linear magnetostrictive encoders 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 it to be installed in hermetically sealed housings. The current position information is transferred via magnetic fields contactlessly through the housing wall to the internal sensor element. In principle, the simultaneous measurement of multiple positions with one measurement system is possible. Without inconvenient, high-effort and error-prone seal designs, magnetostrictive position measurement systems achieve a degree of protection of IP 67 to IP 69K. The high resistance with regard to shocks 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 Transducers Applications 80 **Function Principle** 84 Designs 85 Product Overview 88 Profile P 90 Profile PF 118 Profile AT 130 Profile BIW 144 Rod 150 **Rod Compact and Rod AR** 182 220 Rod EX, T Redundant and CD Filling Level Sensor SF 242 Accessories 250 **Basic Information and Definitions** 274

MICROPULSE[®]



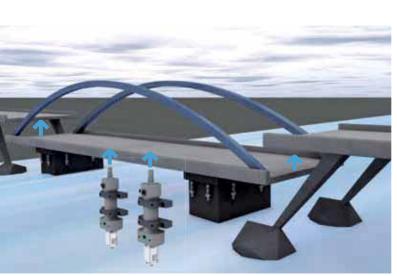


Areas of use in which high reliability and precision are in demand are typical application areas for Micropulse Transducers.

As integrated or compact versions with measuring lengths of 25 to 7,500 mm, Micropulse position measurement systems can 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 is used as an absolute signal for the controller in a wide range of different interfaces.

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



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

Areas of application

Pitch adjustment on wind generators

Positioning reflection channels of thermosolar power plants

- Large, hydraulically powered valves
- Casting and rolling mills
- Lift controls
- Flight simulators
- Foundries
- Logging machines
- Automation engineering
- Hydroelectric power plants
- Locks and floodgates
- Construction machinery
- Combine harvesters

Structural design and calculations

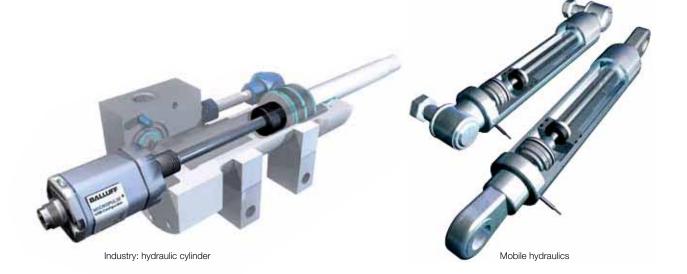
- Active support of walls
- Bridge positioning and lifting technology
- Leveling structures
- Off-shore sector
- Tunnel construction

Industrial applications

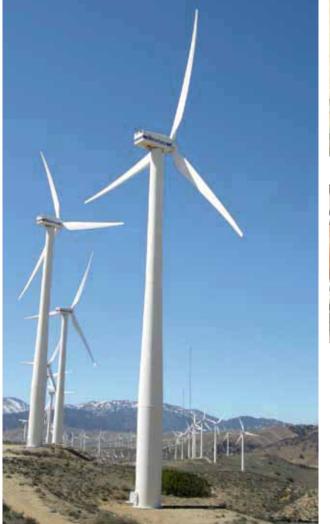
- Pumps and compressors
- Elevator and lifting technology
- Forging presses
- High-pressure hydraulics



Large valve with controlled actuating drive





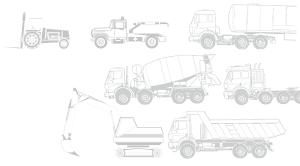




Sawmill machinery



Hydraulic riveting system





Micropulse Transducers Applications Function Principle Designs Product Overview

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

Basic Information and Definitions

Wind power plant



Solar-thermal parabolic trough power plant



Solar-thermal parabolic trough power plant

Micropulse Transducers **Applications**

Precision, freedom from wear, ease of installation, a high degree of protection and a low price are of high priority for automating a wide variety of machine types.

Micropulse transducers in a profile housing entirely fulfill automation technology requirements.

Areas of application

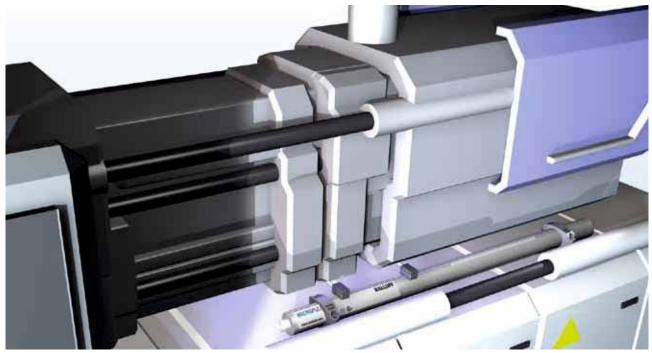
- Injection molding
- Pressing
- Handling systems
- Portal robots
- Woodworking machinery
- Packaging machinery
- Conveyor technology
- Straightening machinery
- Surgical tables
- Concrete block making machinery





Film slitting machinery

Injection molding machinery



Injection molding machinery





Multiple-stage press



Micropulse Transducers Applications Function Principle Designs Product Overview

Profile P

Profile PF

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Rod

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions



Automation engineering



Laundry press

Micropulse⁺ position measurement systems guarantee high costeffectiveness and quality in the manufacture of concrete blocks. In a concrete block machine, the Micropulse⁺ position measurement 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



Function 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 waveguide, 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 and are integrated in the waveguide.

In the area of the waveguide, 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 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.

NICROPULSE



Rod housings

Rod system components

Rod housings are mainly used in hydraulic drive 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 pressureresistant 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 encoder ring with magnets slides over the tube or rod with internal waveguide to mark the position prior to detection.

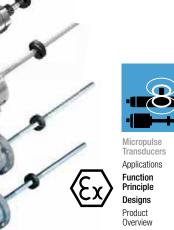
A position measurement system consists of the actual transducer, the position encoder and wiring for the electronic processor unit.

Position measurement systems

pressure-resistant encapsulated

with electronic head and

measurement section



Position encoder rings

.....

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

Basic Information and Definitions

A prerequisite for flawless function is the use of original Balluff position encoders.

Micropulse Transducers Designs

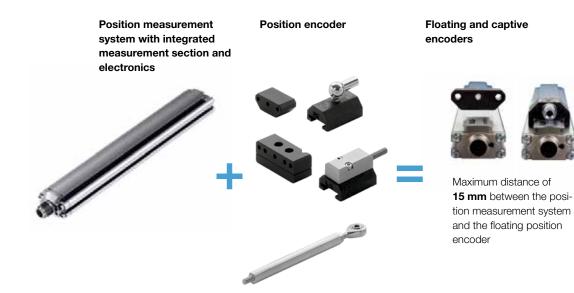
Profile housings

The electronics and the measurement section are housed in an aluminum profile. The aluminum housing is hermetically sealed according to degree of protection IP 67. The magnets on the encoder act on the waveguide through the wall of the aluminum profile. The position encoder exists as a captive and a floating variant. Floating position encoders are secured directly on the moving machine part and move with the part above and along the profile at a certain 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 even these generous tolerances cannot be adhered to, captive encoders are ideal. With captive encoders, the profile housing of the displacement sensor acts as a sliding rail along which the position encoder travels. In this case, a joint rod with spherical heads compensates for even highly unparallel movements.



Profile system components

A position measurement system consists of the actual transducer, the position encoder and wiring for the electronic processor unit.





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. They often have a double- or triple-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 measurement sections offset by 120°C and housed in a collective protective tube along which a position encoder moves, in much the same way as standard designs. The magnets on the encoder act on all three measurement sections simultaneously. The evaluation of the 3 positions is done by 3 independent and completely disconnected electronics, which, however, may be stored in the same housing. Application examples include ship propulsion drives, power stations and train inclination technology.





Micropulse Transducers Applications Function Principle Designs Product Overview

Profile P

Profile PF

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Rod

Rod Compact and Rod AR

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Basic Information and Definitions



extremely rugged and reliable

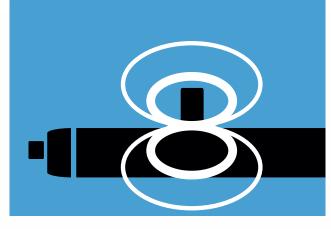
				0	0	00	/
	OT-	1		ALT.	5-5	S	
Series	Profile style	Profile style	Profile AT	Profile BIW	Rod	Rod Compact	
Design	Р	PF	A1	P1	B, A, Z, Y	H, K, W	
Installation version e.g. in hydraulic cylinders External fitting version e.g. on machine frames					1	1	
Filling level sensor e.g. device filling systems							
Special approvals							
Position encoder	Floating/ captive	Floating/ captive	Floating	Captive push rod	Free or floating	Free or floating	
Multi-position encoder	•		- -		- -		
Interfaces							
Analog voltage 010 V, 100 V, -10 V+10 V		1.1	1.0				
Analog current 420 mA, 020 mA	- - -			- -	- -	- -	
SSI	1 A 1				10 A.	10 A 10	
SSI-SYNC	1.1						
CANopen							
DeviceNet	1.1						
Profibus DP							
Start/stop pulse interface			10 A.				
VARAN			1.1				
EtherCAT							
IO-Link		1.1					
From page	90	118	130	144	150	182	

Micropulse Transducers Product overview



Rod Pro Compact	Rod AR	Rod DEX	Rod J-DEXC TA12	Rod NEX	Rod PEX	Rod Redundant	Filling Level Sensor	Micropulse Transducers
HB/WB	E2/E28	B/J	С	K, B, Z	B, Z	т	SF	Applications Function Principle
				1 A 1				Designs
								Product Overview
	Vehicle approval	Potentially explosive operation	Potentially explosive operation	Potentially explosive operation	Potentially explosive operation		Certified for foodstuffs	Profile P Profile PF
	KBA, e1	Flameproof "d" zone 0, zone 1, ATEX, KOSHA, GOST, IECEX	Flameproof "d", zone 0, Zone 1, ATEX, CENELEC, FM, CSA, IECEX	lgnition pro- tection type "n" zone 2	Dust protec- tion zone 22	Increased safety 2 or 3 times redundant	Conforms with FDA, 3A, ECOLAB, EHEDG	Profile AT Profile BIW Rod
Free or floating	Free or floating	Free or floating	Free or floating	Free or floating	Free or floating	Free or floating	Floating	Rod Compact and Rod AR
								Rod EX, T Redundant and CD
1.1	1.1	1.1	1.1	1.1		1.1	1.1	Filling Level Sensor SF
1.1	1.1						1.1	Accessories
1.1								Basic Information and Definitions
- -			10 A.					
	1.1							
182	182	220	220	220	220	220	242	

MICROPULSE®



Micropulse Transducers

Profile P

- The universal standard series
- Measuring lengths up to 7,620 mm
- Multiple paths one system, which measures position in many paths
- Programmable output signals measuring range, inverting, configuring, documenting
- Floating and captive encoders
- Up to 15 mm distance between position encoder and system truly contactless!
- Measures position and speed
- Differential and synchronized measurement
- Available with analog signals, digital interfaces and fieldbuses





P BTL7 MICROPULSE +

General Data	92
Analog Interface	94
Programming	96
EtherCAT	98
P BTL5	
Canaral Data	100

General Data	100
Analog Interface	102
Digital Pulse Interface	104
SSI Interface	106
CANopen Interface	108
DeviceNet Interface	110
Profibus DP Interface	112
Floating Position Encoders	114

Floating Position Encoders Captive Position Encoders, Joint Rod

MICROPULSE®

116

Profile P BTL7 Micropulse+ General data

One system – two paths

Series	Profile P BTL7
Shock load	150 g/6 ms as per EN 60068-2-27
Continuous shock	150 g/2 ms as per IEC 60068-2-29
Vibration	20 g, 102000 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 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
Electrical fast transient bursts (BURST)	EN 61000-4-4 Severity level 3
Surge voltage	EN 61000-4-5 Severity level 2
Conducted interference induced	EN 61000-4-6 Severity level 3
by high-frequency fields	
Magnetic fields	EN 61000-4-8 Severity level 4
Standard nominal strokes [mm]	00507620 mm in 5-mm increments

Non-contact detection of the measuring position

IP 67, insensitive to contamination

Wear-free

Insensitive to shock and vibration

Absolute output signal

- Measurement length up to 7,620 mm
- Two measurement paths per system
- Error and status LED

Caution!

Before design, installation and startup please familiarize yourself with the user's guide to be found at www.balluff.com. Please order separately: USB communication box, page 96 Position encoders, see page 114 Plug connectors, page 252

Transducer (select your interface from page 94)

Mounting clamps with insulating sleeves and screws

Scope of delivery

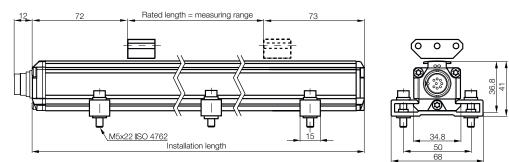
Quick start instructions



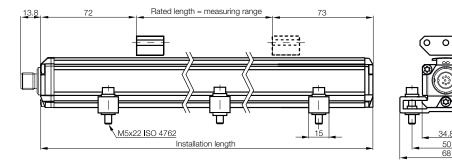




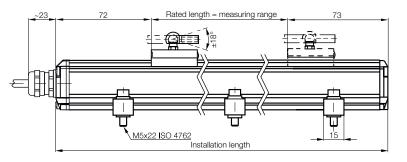
Transducer with floating position encoder and S32 connection

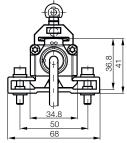


Transducer with floating position encoder and S115 connection



Transducer with captive encoder and KA cable outlet



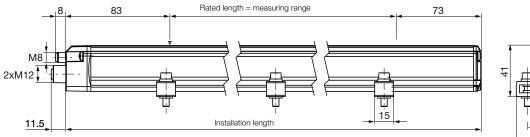


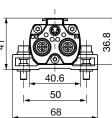
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Transducer with EtherCAT connection C003







Micropulse Transducers

Profile P BTL7 General Data Analog Interface Programming

Programming EtherCAT

Profile P BTL5 General Data Analog Interface Digital Pulse Interface CANopen Interface DeviceNet Interface Profibus DP Interface

Floating Position Encoders Captive Position Encoders

Profile PF

Profile AT

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions

Profile P BTL7 Micropulse+ Analog interface

"Long" up to 7620 mm

Micropulse⁺ USB-Configurable BTL7-A/E501

- Simple configuration and adjustment of the start and end point via the USB interface, quick startup
- Configurable dual output functions, position and speed
- Increased operating reliability with status LEDs for indicating the operating status and for diagnostics

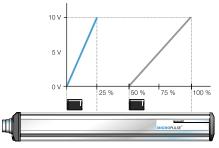
Position and velocity

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	
Measurement rate, length-dependent	
Max. linearity deviation	
Temperature coefficient	
Supply voltage	
Polarity reversal protected	
Overvoltage protection	
Dielectric strength	
Operating temperature	

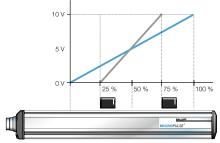


Operating mode: Double position encoder



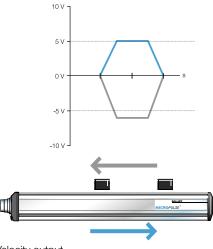
2 encoders, 2 movements, 2 output signals

Operating mode: Differential



Differential signal between 2 encoders, position and difference possible.

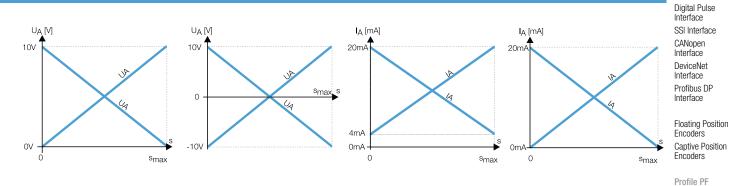
Operating mode: Speed



Velocity output

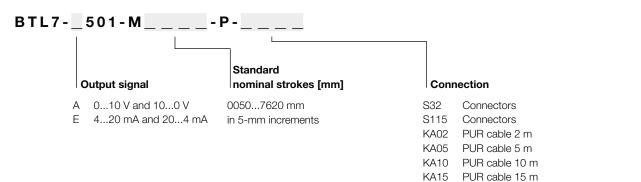


Profile P BTL7	Profile P BTL7	
Analog	Analog	
Α	E	
Analog	Analog	
BTL7- A501 -MP	BTL7- E501 -MP	
010 V and 100 V	420 mA and 204 mA	
-1010 V and 1010 V	020 mA and 200 mA	
Max. 5 mA		
	≤ 500 Ω	
≤ 0.33 mV	≤ 0.66 µA	
≤ 150 mA	≤ 180 mA	Micropulse
≤ 10 µm	≤ 5 µm	Transducers
System resolution/min. 2 µm	System resolution/min. 2 µm	Profile P BTL7
Max. 4 kHz	Max. 4 kHz	General
$\pm 50 \ \mu m$ to $\leq 500 \ mm$ rated length	$\pm 50 \ \mu m$ to $\leq 500 \ mm$ rated length	Data
$\pm 0.01\%$ FS > 500 \leq 5500 mm rated length	$\pm 0.01\%$ FS > 500 \leq 5500 mm rated length	Analog
$\pm 0.02\%$ FS > 5500 mm rated length	$\pm 0.02\%$ FS > 5500 mm rated length	Interface Programming
≤ 30 ppm/K	≤ 30 ppm/K	EtherCAT
1030 V DC	1030 V DC	LUICIOAI
to 36 V	to 36 V	Profile P BTL5
to 36 V	to 36 V	General
500 V AC (GND to housing)	500 V AC (GND to housing)	Data
−40+85 °C	−40+85 °C	Analog Interface



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

Ordering example:



Rod Rod Compact and Rod AR Rod EX, T Redundant

Profile AT

Profile BIW

and CD Filling Level Sensor SF

Accessories

Basic Information and Definitions



USB Configurable

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 are:
- Online display of the current position of the encoder
- 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

USB communication box

BTL7-A-CB01-USB-S32

BTL7-A-CB01-USB-KA

Scope of delivery

Cable set

BTL7-A-CB01-USB-S115

USB communication box

Quick start instructions

Part number

Demo mode without having a transducer connected

Connecting the USB communication box

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

with cable sets

S32 connector

S115 connector

Cable connection



with S32 or S115 connector





Communication box connected via cable in the control cabinet

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

Caution!

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

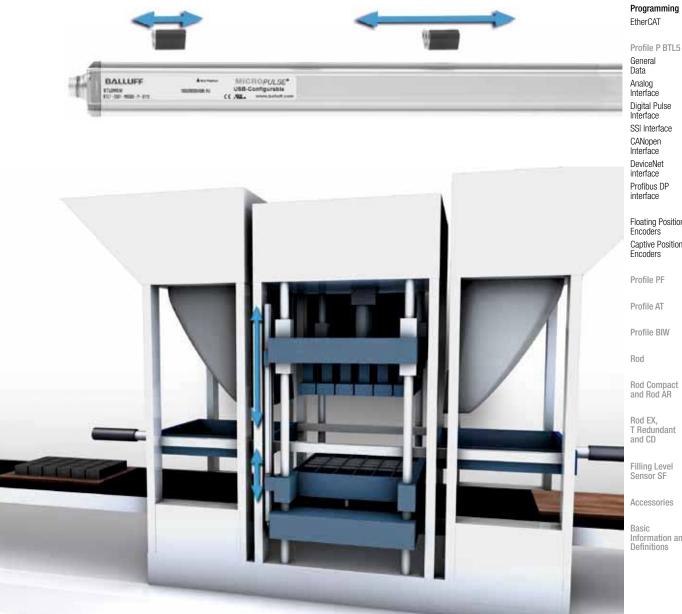


Micropulse⁺ position measurement systems in a profile housing are non-contact, absolute measurement systems for accurately measuring one or more measurement paths. They feature a robust design including the high IP 67 degree of protection, ease of installation, and a wear-free measuring principle with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

Features

- Non-contact detection 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 measurement systems guarantee high costeffectiveness and quality in the manufacture of concrete blocks. In a concrete block machine, the Micropulse+ position measurement system simultaneously and reliably measures the axis position of load and molding stroke movement.





Micropulse Transducers

Profile P BTL7 General Data Analog Interface Programming EtherCAT

Analog Interface Digital Pulse Interface SSI Interface CANopen Interface DeviceNet interface Profibus DP interface

Floating Position Encoders Captive Position Encoders

Profile PF

Profile AT

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions

Profile P BTL7 Micropulse+ EtherCAT interface

synchronous and dynamic

EtherCAT

EtherCAT is an Ethernet-based fieldbus initiated by Beckhoff. 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 ($\leq 100 \ \mu$ s), low jitter for exact synchronization ($\leq 1 \ \mu$ s) 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

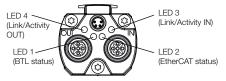
The BTL7-V50E-... can also be used as a cam switch. For this purpose there are four cams (Cam) available per position encoder (Magnet).

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

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

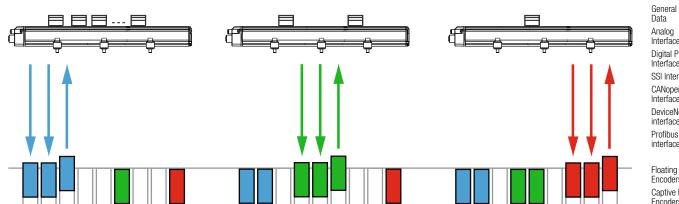
Series				
Output signal				
Transducer interface				
Position signal interface, customer device				
Part number				
EtherCAT interface				
Repeat accuracy				
System resolution, configurable Position				
Velocity				
Hysteresis				
Measurement rate				
Max. linearity deviation				
Temperature coefficient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







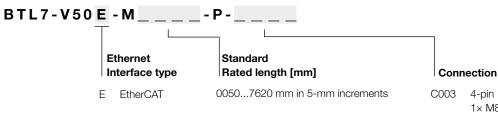
Profile P BTL7	
EtherCAT	
V50E	
EtherCAT	
BTL7- V50E -MP-C003	
Floating	
\leq 5 µm, (typically ±2.5 µm)	
1 µm	
0.1 mm/s increments configurable	
≤ ±10 µm	
f _{STANDARD} = 1 kHz	Micropulse
≤ 5500 ±30 µm, > 5500 ±0.002 % FS	Transducers
≤ 18 ppm/K (at 500 mm)	Profile P BTL7
1030 V DC	General
≤ 120 mA	Data
–40+85 °C	Analog
–40+100 °C	Interface
www.balluff.com	Programming EtherCAT
< 100 m	LUICIOAI



Function principle of the EtherCAT data transmission

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

Ordering example:



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

Profile P BTL5

Analog Interface Digital Pulse Interface SSI Interface CANopen Interface DeviceNet interface Profibus DP interface

Floating Position Encoders Captive Position Encoders

Profile PF

Profile AT

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions



go beyond the limit

The structural design, high degree of protection and easy installation of Balluff Micropulse transducers housed in a profile make them an excellent alternative to linear transducers, such as potentiometers, glass rulers and LVDTs. The measurement section is protected inside an extruded aluminum profile.

A passive encoder with no power supply 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 measuring 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 processor unit)
- Direct signal evaluation or in conjunction with processor units for all control and closed-loop systems

Series	Profile P BTL5
Shock load	100 g/6 ms as per EN 60068-2-27
Vibration	12 g, 102000 Hz as per EN 60068-2-6
Polarity reversal protected	yes
Overvoltage protection	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
Electrical fast transient bursts (BURST)	IEC 61000-4-4 Severity level 4
Conducted interference induced	EN 61000-4-6 Severity level 3
by high-frequency fields	
Standard nominal strokes [mm]	00505500 mm in 5-mm increments, depending on the interface

Scope of delivery

Transducer (select your interface from page 102)Quick start instructions

Mounting clamps with insulating sleeves and screws

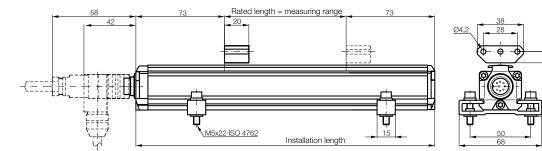
Caution!

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





Transducers with floating position encoder and connection S32 with connector BKS-S 32M/BKS-S 32M-C/BKS-S 33M for transducers with analog interface, digital pulse interface and SSI interface, page 252





Micropulse Transducers

Profile P BTL7 General Data Analog Interface Programming EtherCAT

EtherCAT Profile P BTL5 General Data Analog Interface

Digital Pulse Interface SSI Interface CANopen Interface DeviceNet Interface Profibus DP

Interface

Floating Position Encoders Captive Position Encoders

Profile PF

Profile AT

Profile BIW

Rod

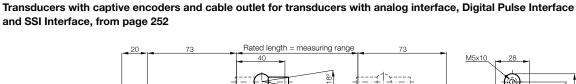
Rod Compact and Rod AR

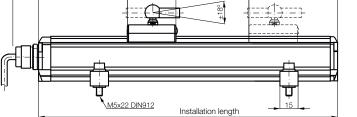
Rod EX, T Redundant and CD

Filling Level Sensor SF

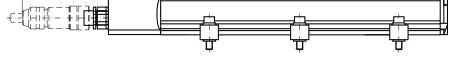
Accessories

Basic Information and Definitions





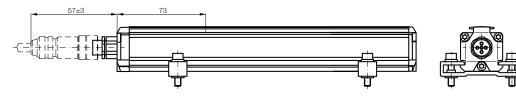
CANopen connection S94 with connector BKS-S94-00 and BKS-S92-00 for transducers





CANopen connection S92 with connector BKS-S92-00 for transducers with CANopen interface, page 254

with CANopen interface, page 254



DeviceNet connection S93 with connector BKS-S92-00, BKS-S93-00 and BKS-S 48-15-CP-__, page 254 Profibus DP connection S103 with plug connector BCC0715 and BCC0714, page 257 and BKS-S48-15-CP-__ page 254

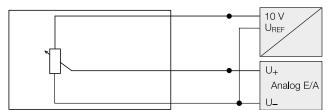




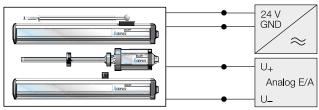
The analog outputs of the profile series are floating with respect to the input voltage. The isolation is galvanic using DC/DC converters. BTL transducers with analog outputs are available in the variants 0...10 V, 4...20 mA, 0...20 mA and -10...10 V, with a rising and falling characteristic.

Series	
Output signal	
Transducer interface	
Customer device interface	
Part number	
Output	
Output voltage	
Output current	
Load current	
Max. residual ripple	
Load resistance	
System resolution	
Hysteresis	
Repeat accuracy	
Measurement rate	
Max. linearity deviation	
To see the second second second	
Temperature coefficient	Voltage output
Current unaltana	Current output
Supply voltage	
Current consumption	
Polarity reversal protected	
Overvoltage protection	
Dielectric strength	
Operating 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 rated length in the part number.

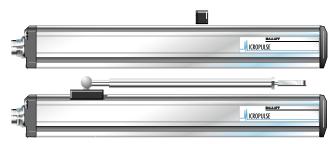
Scope of delivery

Storage temperature

Transducer

- Mounting clamps with insulating sleeves and screws
- Quick start instructions

Please order separately: Position encoders, see page 114 Plug connectors, see page 252





Profile P BTL5	Profile P BTL5	Profile P BTL5	Profile P BTL5	
Analog	Analog	Analog	Analog	
Α	E	С	G	
Analog	Analog	Analog	Analog	
BTL5- A 11-MP	BTL5- E 1MP	BTL5- C 1MP	BTL5-G11-MP	
Floating	Floating	Floating	Floating	
010 V and 100 V			-1010 V and 1010 V	
	420 mA or 204 mA	020 mA or 200 mA		
Max. 5 mA			Max. 5 mA	
≤ 5 mV			≤ 5 mV	
	≤ 500 Ω	≤ 500 Ω		Micropulse
≤ 0.1 mV	≤ 0.2 µA	≤ 0.2 µA	≤ 0.1 mV	Transducers
≤ 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	Profile P BTL7
$f_{\text{STANDARD}} = 1 \text{ kHz}$	$f_{\text{STANDARD}} = 1 \text{ kHz}$	$f_{\text{STANDARD}} = 1 \text{ kHz}$	$f_{\text{STANDARD}} = 1 \text{ kHz}$	General Data
±100 µm up to 500 mm rated length	±100 µm up to 500 mm rated length	±100 µm up to 500 mm rated length	±100 µm up to 500 mm rated length	Analog
±0.02% 500 max. rated length	±0.02% 500 max. rated length	±0.02% 500 max. rated length	±0.02% 500 max. rated length	Interface
$[150 \ \mu\text{V/}^{\circ}\text{C} + (5 \ \text{ppm/}^{\circ}\text{C} \times \text{P} \times \text{U/L})] \times \Delta\text{T}$	Ŭ	, i i i i i i i i i i i i i i i i i i i	$[150 \ \mu V/^{\circ}C + (5 \ ppm/^{\circ}C \times P \times U/L)] \times \Delta T$	Programming
	$[0.6 \ \mu\text{A/°C} + (10 \ \text{ppm/°C} \times \text{P} \times \text{I/L})] \times \Delta\text{T}$	$[0.6 \ \mu\text{A/°C} + (10 \ \text{ppm/°C} \times \text{P} \times \text{I/L})] \times \Delta\text{T}$		EtherCAT
2028 V DC	2028 V DC	2028 V DC	2028 V DC	Profile P BTL5
≤ 150 mA	≤ 150 mA	≤ 150 mA	≤ 150 mA	General
yes	Ves	Ves	yes	Data
TransZorb protection diodes	TransZorb protection diodes	TransZorb protection diodes	TransZorb protection diodes	Analog
500 V DC (GND to housing)	500 V DC (GND to housing)	500 V DC (GND to housing)	500 V DC (GND to housing)	Interface
-40+85 °C	-40+85 °C	-40+85 °C	-40+85 °C	Digital Pulse Interface
-40+100 °C	-40+100 °C	-40+100 °C	-40+100 °C	SSI Interface
				CANopen
UAM	IA [mA]	I _A [mA]	U _A [V]	Interface
10V	20mA	20mA	10V	DeviceNet Interface
	1.5-E10	ABLOCIO.		Profibus DP
	VA BI	I I I I I I I I I I I I I I I I I I I	UA UA	Interface
			0 Smax s	Floating Position
	A BTIC			Encoders
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	4 BILS.EIT.	4 Bills CIP.		Captive Position
	4mA			Encoders
ov +	0mA	OmA	-10V	Profile PF
0 ^s max	0 s _{max}	0 s _{max}		
				Profile AT
				Profile BIW

#### Ordering example:

BTL5-		- P -			Rod Compact and Rod AR
			- -		Rod EX, T Redundant and CD
	Output signal	Characteristic	Standard Rated length [mm]	Connection	Filling Level Sensor SF
А	010 V and 100 V	<ol> <li>rising and falling (with A and G)</li> <li>rising</li> </ol>	00504500 mm in 5-mm incre- ments	S32 Connectors KA02 PUR cable 2 m KA05 PUR cable 5 m	Accessories Basic
E	420 mA or 204 mA	(at C and E) 7 falling (for C and E)		KA10 PUR cable 10 m KA15 PUR cable 15 m	Information and Definitions
С	020 mA or 200 mA	, , , , , , , , , , , , , , , , , , ,			
G	–1010 V and				

10...-10 V

Rod



# low-cost and synchronous

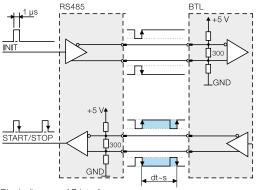
#### P Interface

The P interface is compatible with BTA/BTM processor units as well as with controllers and modules from various manufacturers, including Siemens, B & R, Phoenix Contact, Mitsubishi, Sigmatek, Esitron, WAGO and others.

Reliable signal transmission, even over cable lengths up to 500 m, between processor unit BTA and transducer BTL is guaranteed by the particularly interference-free RS485 differential drivers and receivers. Interference signals are effectively suppressed.

#### **M** Interface

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



Block diagram of P interface



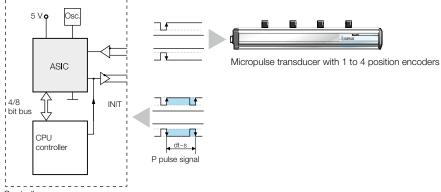
Digitizing chip 44QFP

#### Highly precise digitizing of the P pulse signal

Companies developing their own electronic control and electronic processor unit can create a highly accurate P pulse interface costeffectively 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.

#### 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 position encoders can be processed simultaneously
- 4/8-bit processor interface



Controller or electronic processor unit

ASIC INFO: +49 7158 173-370



Series	Profile P BTL5	Profile P BTL5	
Transducer interface	Pulse P	Pulse M	
Customer device interface	Pulse P	Pulse M	
Part number	BTL5- <b>P</b> 1-MP	BTL5- <b>M</b> 1-MP	
System resolution	processing-dependent	processing-dependent	
Repeat accuracy	2 μm or ±1 digit	2 μm or ±1 digit	
	depending on electronic processor unit	depending on electronic processor unit	
Resolution	≤ 2 µm	≤ 2 µm	G
Hysteresis	≤ 4 µm	≤ 4 µm	
Measurement rate	3 kHz to 500 Hz depending on rated length	3 kHz to 500 Hz depending on rated length	
Max. linearity deviation	±100 µm up to 500 mm rated length	$\pm 100 \ \mu m$ up to 500 mm rated length	Micropulse
	±0.02% 5005000 mm rated length	±0.02% 5005000 mm rated length	Transducer
Temperature coefficient of overall system	(6 µm + 5 ppm × L)/°C	(6 µm + 5 ppm × L)/°C	D. CL. D.D.
Supply voltage	2028 V DC	2028 V DC	Profile P B General
Current consumption	≤ 90 mA	≤ 90 mA	Data
Operating temperature	–40+85 °C	-40+85 °C	Analog
Storage temperature	-40+100 °C	-40+100 °C	Interface
			Programmir

INIT



Analog Interface

CANopen Interface DeviceNet Interface Profibus DP Interface

Digital Pulse Interface SSI Interface

Floating Position Encoders Captive Position Encoders

Profile PF Profile AT Profile BIW

Rod

Rod Compact and Rod AR

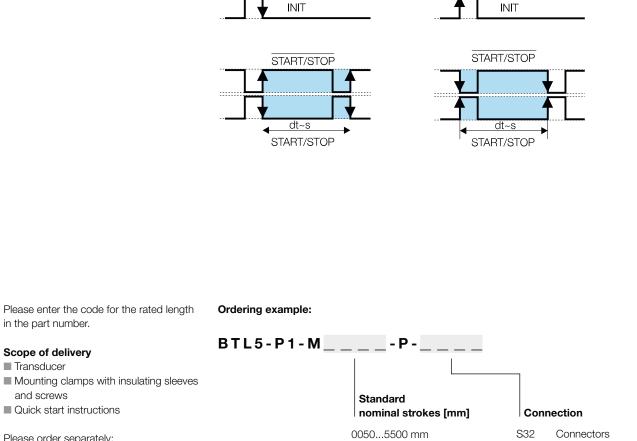
Rod EX, T Redundant

Filling Level

Accessories

Sensor SF

and CD



Please order separately: Position encoders, see page 114 Plug connectors, see page 252

Transducer

in 5-mm increments

KA02 PUR cable 2 m KA05 PUR cable 5 m KA10 PUR cable 10 m KA15 PUR cable 15 m

INIT

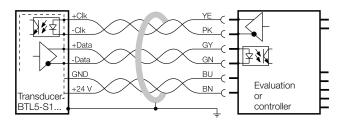
Basic Information and Definitions



# 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/control units. Reliable signal transmission, even with cable lengths of up to 400 m between controller and BTL transducer, is assured by interferencefree RS485/422 differential drivers and receivers. Any interference signals are effectively suppressed.



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

#### Synchronized SSI interface BTL5-S1__B-M____-P-__

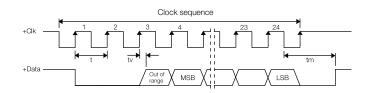
Micropulse Transducers with synchronized SSI interface are well suited for dynamic control applications. Data acquisition in the transducer is synchronized using the external clock of the controller, allowing an optimum speed calculation to be performed in the regulator/controller. Prerequisite for this 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 to the right:



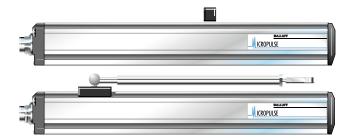
Rated length range			Scan rate
< Rated length	≤	100 mm :	1500 Hz
100 mm < Rated length	≤	1000 mm :	1000 Hz
1000 mm < Rated length	≤	1400 mm :	666 Hz
1400 mm < Rated length	≤	2600 mm :	500 Hz
2600 mm < Rated length	≤	4000 mm :	333 Hz

#### 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



#### Super-fast 2.5 kHz sampling rate





Series	Profile P BTL5	
Output signal	Synchronous-serial	
Transducer interface	S	
Customer device interface	synchronous serial (SSI)	
Part number	BTL5- <b>S</b> 1MP	
Part number synchronization	BTL5- <b>S</b> 1B-MP	
System resolution depending on model (LSB)	1, 2, 5, 10, 20, 40 or 100 μm	
Repeat accuracy	±5 μm	
Hysteresis	$\leq 4 \ \mu m \text{ or } \leq 1 \text{ digit}$	
Measurement rate	$f_{STANDARD} = 2 \text{ kHz}$	
Max. linearity deviation	$\pm$ 30 µm at $\leq$ 10 µm resolution or $\leq$ $\pm$ 2 LSB at > 10 µm resolution	Micropulse
Temperature coefficient of overall system	(6 μm + 5 ppm × L)/°C	Transducers
Supply voltage	2028 V DC	Duefile D DTI 7
Current consumption	≤ 80 mA	Profile P BTL7 General
Operating temperature	-40+85 °C	Data
Storage temperature	-40+100 °C	Analog
		Interface

Please enter code for coding, system resolution and rated length in the part number.

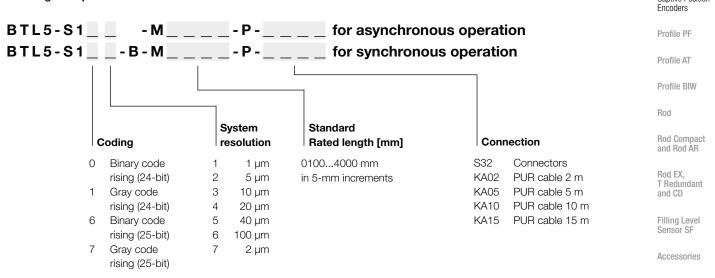
#### Scope of delivery

Transducer

Mounting clamps with insulating sleeves and screwsQuick start instructions

Please order separately: Position encoders, see page 114 Plug connectors, see page 252

Ordering example:



Basic Information and Definitions

Programming EtherCAT

Profile P BTL5

General Data

Analog Interface

Digital Pulse Interface

SSI Interface CANopen Interface DeviceNet Interface Profibus DP Interface

Floating Position Encoders

Captive Position





#### **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 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 position information 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:

- Current encoder position with resolution in 5 µm increments
- Current speed of the position encoder, with resolution selectable in 0.1mm/s increments
- the current status of four freely programmable cams per position encoder

#### 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 in accordance with 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 for positions 3 and 4.

#### **Emergency Object**

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

#### Service Data Object (SDO)

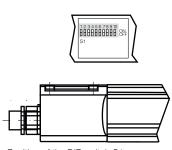
Service Data Objects transmit the configuration parameters to the transducer. The transducer may be configured on the bus by the controller or offline with a bus analyzer/CANopen tool. The configuration is stored in the transducer's non-volatile memory.



CiA 199911-301v30/11-009

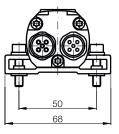
#### Use of multiple position encoders

The minimum distance between the position encoders must be 65 mm.



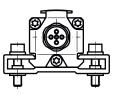
Position of the DIP switch S1, only on BTL-H1____P-S94

BTL5-H1__-M___-P-S94



Node ID can be set by DIP switch.

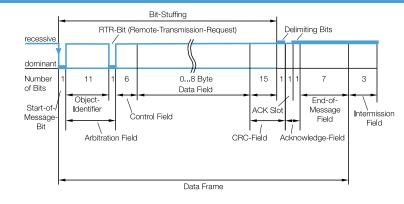
BTL5-H1__-M___-P-S92





Series		Profile	P BTL5						
Output signal		CANope	CANopen						
Transducer interface		н							
Customer device inte	erface	CANope	en						
Part number		BTL5-H	1M	P-S92					
Part number		BTL5-H	1M	P-S94					
CANopen version		DS301,	DS406						
Repeat accuracy		±1 digit							
System resolution	Position	Configu	rable in incr	ements of 5	μm				
Configurable	Velocity	0.1 mm	/s incremen	ts configurat	ole				
Hysteresis		≤ 1 digit							
Sampling rate	<b>f</b> STANDAR	$f_{\text{STANDARD}} = 1 \text{ kHz}$							
Max. linearity deviation	on	±30 µm	$\pm$ 30 $\mu$ m at 5 $\mu$ m resolution						
Temperature coefficie	nt of overall system	(6 µm +	(6 μm + 5 ppm × L)/°C						
Position encoder tra	vel speed	any	any						
Supply voltage			2028 V DC						
Current consumption		≤ 100 m	≤ 100 mA						
Operating temperature		-40+8	35 °C						
Storage temperature		-40+1	00 °C						
Cable length [m] per	CiA DS301	< 25	< 50	< 100	< 250	< 500	< 1000	< 1250	< 2500
Baud rate [kbaud] pe	er CiA DS301	1000	800	500	250	125	100	50	20/10

Using the CANopen interface and cable lengths up to 2500 m, 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 rated length in the part number.

# Scope of delivery

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

Please order separately:

Position encoders, see page 114 Plug connectors, see page 252

# Ordering example:

BTL5-H1M BTL5-H1M			S92 S94	
Software configuration	В	aud ra	ate	Standard Rated length
1 1 × Position and	0	1	Mbaud	00504000
1 × Velocity	1	800	kbaud	in 5-mm increme
2 2 × Position and	2	500	kbaud	
2 × Velocity	3	250	kbaud	
	4	125	kbaud	
	5	100	kbaud	
	6	50	kbaud	
	7	20	kbaud	
	8	10	kbaud	

ropulse 1sducers

file P BTL7 eral log rface gramming erCAT

file P BTL5 eral Data Analog Interface Digital Pulse Interface SSI Interface CANopen Interface DeviceNet Interface Profibus DP Interface

Floating Position Encoders Captive Position Encoders

Profile PF

Profile AT

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level

Accessories

Sensor SF

# [mm]

ents



# 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. Using a standard data sheet in the form of an EDS file, it is easy to link the Micropulse transducers to any DeviceNet system.

## **DeviceNet features**

- Linear topology
- Low-cost wiring with two-wire cable
- Fast response times
- High data integrity due to CRC checking
- Hamming distance of 6
- Floating 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</p>
- 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 encoder position with resolution in 5 µm increments
- Current encoder speed in increments of 0.1 mm/s
- Current status of the four freely programmable cams

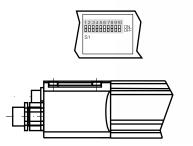
## Synchronization

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.







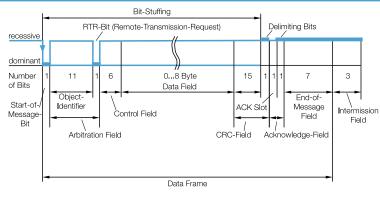
# Device address can be set by DIP switch

**Use of multiple position encoders** The minimum distance between the position encoders must be 65 mm.

Position of the DIP switch S1



Series		Profile P BTL5				
Output signal		DeviceNet	DeviceNet			
Transducer interface		D	D			
Customer device interface	Э	DeviceNet				
Part number plug version	S103	BTL5- <b>D</b> 1M	P-S93			
Profibus version		Encoder profile				
Profibus interface		Floating				
Repeat accuracy		±1 digit				
System resolution Po	osition	Configurable in increme	ents of 5 µm			
Configurable Ve	locity	0.1 mm/s increments c	configurable			
Hysteresis		≤ 1 digit				Micropulse
Sampling rate		$f_{STANDARD} = 1 \text{ kHz}$				Transducers
Max. linearity deviation		±30 µm at 5 µm resolut	tion			Profile P BTL7
Temperature coefficient of o	overall system	$(6 \ \mu m + 5 \ ppm \times L)/^{\circ}C$				General
Position encoder travel sp	beed	any				Data
Supply voltage		2028 V DC				Analog
Current consumption		≤ 100 mA				Interface
Operating temperature		-40+85 °C				Programming EtherCAT
Storage temperature		-40+100 °C				EIIIEIGAI
Address assignment		Mechanical switches or	r DeviceNet			Profile P BTL5
Cable length [m]		100	250	ł	500	General
Baud rate [Kbps]		500	250		100	Data
						Analog



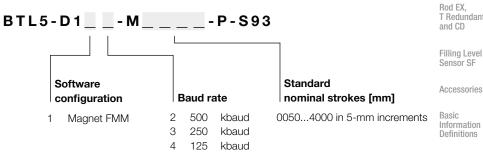
Please enter code for software configuration, baud rate and rated length in the part number.

# Scope of delivery

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

Please order separately: Position encoders, see page 114 Plug connectors, see page 252

# Ordering example:



Floating Position Encoders Captive Position Encoders

Profile PF

Profile AT

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX, T Redundant

and CD

Accessories

Basic Information and





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 position measurement system 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 to 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 node has the same priority. Prioritizing 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. These can be selected freely by the users so that they can configure their system according to the function they want. The BTL5-T is a modular device with the possibility 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.

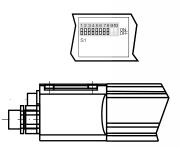
# DP/V1 and DP/V2 isochronous mode

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  $\mu$ s.

### 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.





Position of the DIP switch S1

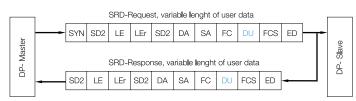


# Device address can be set by DIP switch

**Use of multiple position encoders** The minimum distance between the position encoders must be 65 mm.



Series	Profile P BTL5						
Output signal	Profibus DP						
Transducer interface	т	r					
Customer device interface	Profibus DP						
Part number plug version S103	BTL5- <b>T</b> 1_0-MP-S10	03					
Profibus version	DPV1/DPV2 EN 50170, enc	oder profile					
Profibus interface	Floating						
Repeat accuracy	±1 digit						
System resolution Position	Configurable in increments of	of 5 µm					
Configurable Velocity	0.1 mm/s increments config	urable					
Hysteresis	≤ 1 digit				Micropulse Transducers		
Sampling rate	$f_{\text{STANDARD}} = 1 \text{ kHz}$						
Max. linearity deviation	±30 µm at 5 µm resolution						
Temperature coefficient of overall system	(6 μm + 5 ppm × L)/°C						
Position encoder travel speed	any						
Supply voltage	2028 V DC						
Current consumption	≤ 120 mA				Interface		
Operating temperature	–40+85 °C				Programming EtherCAT		
Storage temperature	-40+100 °C						
GSD file	BTL504B2.GSD						
Address assignment	Mechanical switches or Class 2 master						
Cable length [m]	< 100 < 200	< 400 <	1000	< 1200	General Data		
Baud rate [Kbps]	12000 1500	900 18	87.5	93.7/19.2/9.6	Analog Interface		



alog erface Digital Pulse Interface SSI Interface CANopen Interface DeviceNet Interface Profibus DP Interface

Floating Position Encoders Captive Position Encoders

Profile PF

Profile AT

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions

Please enter code for software configuration and rated length in the part number.

# Scope of delivery

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

Please order separately: Position encoders, see page 114 Plug connectors, see page 252

Ordering example:

# BTL5-T1 0-M -P-S103

# Software configuration

1 × Magnet 1 1 × Position 1 × Velocity

- 2 2 × Position
- 2 × Velocity

Standard nominal strokes [mm]

0050...4000 in 5-mm increments



# Non-contact! Distance up to 15 mm

Balluff encoders are available in captive or floating designs. Maximum resolution and reproducibility are achieved using transducers with captive encoders.

The position encoder BTL5-P-4500-1 is an electromagnet and requires an operating voltage of 24V, which can be turned on and off for selective activation. This allows multiplex operation with multiple encoders on a single transducer, since only one encoder is active at a time.

Description	
for Series	
Version	
Ordering code	
Part number	
Housing material	
Weight	
Position encoder travel speed	
Supply voltage	
Current consumption	
Operating temperature/Storage temperature range	
Scope of delivery	
Accessories	

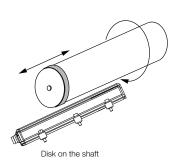
(please order separately)

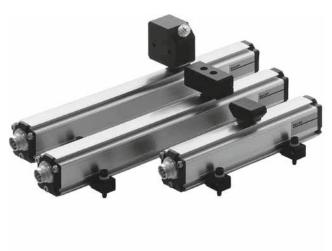
# Magnetic tape position encoder for detecting the position of a rotating shaft

For rotating machine parts adjusted in the direction of travel, a rotating position encoder can be set up with the magnetic tape. Example: Installation in a groove of a nonmagnetic ring or a round disk for querying the position of a rotating shaft with Micropulse transducers.



Installing the strip





## Caution!

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

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

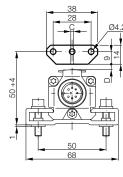
Mounting clamps with insulating sleeves and screws included in the scope of delivery of the transducer.

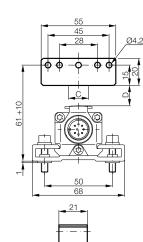
1 pair of replacement mounting clamps and screws. No.: 110404





Position encoder	Position encoder	Position encoder	Magnetic tape position encoder	
Profile P BTL	Profile P BTL	Profile P BTL	Profile P BTL	
Floating	Floating	Floating	Floating	
BAM014M	BAM014T	BAM014P	BAM013E	
BTL5-P-3800-2	BTL5-P-5500-2	BTL5-P-4500-1	BTL-A-TM01-M1000	
Plastic	Plastic	Plastic	Plastic	
approx. 12 g	approx. 40 g	approx. 90 g	approx. 50 g	
any	any	any	any	$\overline{\mathbf{G}}$
		24 V DC		
		100 mA		
−40+85 °C	–40+85 °C	-40+60 °C	−40+85 °C	Micropulse
Position encoder	Position encoder	Position encoder	Magnetic tape	Transducers
2 fastening screws DIN 84				Due file D DTI
M4×35-A2 with washers and				Profile P BTI
nuts				General Data
		Connector, straight*	Cover strip (optional)	Analog
		BCC M415-0000-1A-014-PS0434	BML-A013-T0200	Interface
		Connector, angle*		Programming
		BCC M425-0000-1A-014-PS0434		EtherCAT

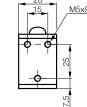






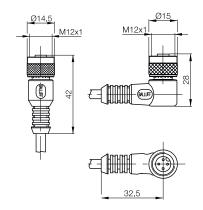
Lateral offset:  $C = \pm 15 \text{ mm}$ Distance of position encoder: D = 5...15 mm

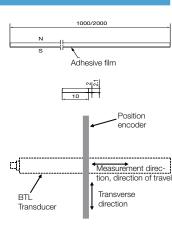
45



Lateral offset:  $C = \pm 2 \text{ mm}$ Distance of position encoder: D = 0.1...2 mm

* Please include the cable length code in the part number. 020 = 2 m, 050 = 5 m, 100 = 10 m





Offset in transverse direction: C = Magnetic tape lengthDistance of magnetic tape: D = 0...4 mm

Rod

Profile BIW

Profile P BTL5

General Data

Analog Interface

Digital Pulse Interface

SSI Interface

CANopen

Interface

DeviceNet

Interface Profibus DP

Interface

Floating Position Encoders

Captive Position Encoders

Profile PF

Profile AT

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories





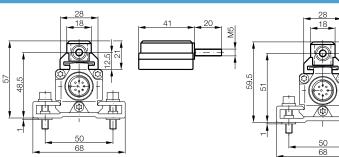


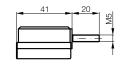




# Guidance system included

Description		Position encoder	Position encoder	
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	
Position encoder travel speed		any	any	
Operating temperature/Storage temperature range		–40+85 °C	–40+85 °C	





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# Caution!

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

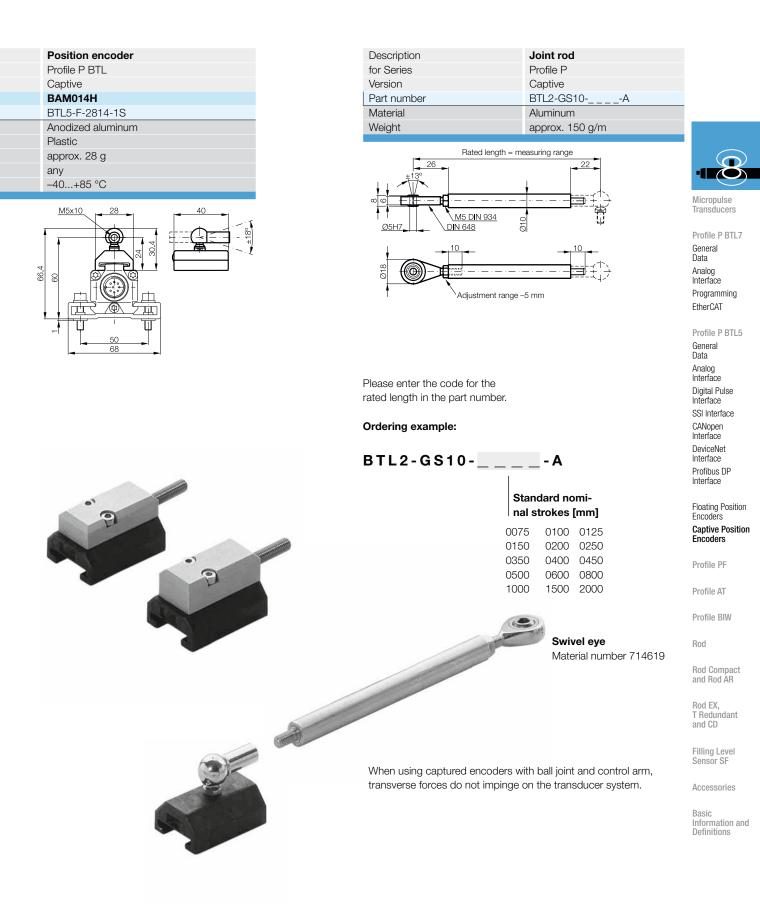
Length			Number of mounting clamp pairs
	to	250 mm	1
251	to	750 mm	2
751	to	1250 mm	3
1251	to	1750 mm	4
1751	to	2250 mm	5
2251	to	2750 mm	6
2751	to	3250 mm	7
	more than	3251 mm	8

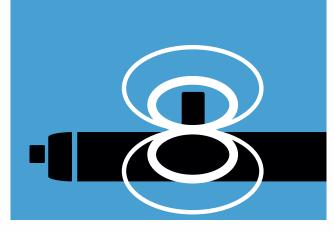
Mounting clamps with insulating sleeves and screws included in the scope of delivery of the transducer.

1 pair of replacement mounting clamps and screws. No.: 229157 Part number: BAM MC-TL-025-P-1



Profile P BTL Captive position encoders





# Micropulse Transducers

# Profile PF

- Flat design, fits in every niche
- Easy to install
- Characteristic curve setting with LED support for quick commissioning
- High degree of protection, IP 67 standard
- Up to 15 mm distance between position encoder and system truly contactless!
- Floating and captive ball joint arm position encoders
- Available with the entire series of analog signals





# PF

General Data
Analog Interface
IO Link V1.1
Floating Position Encoders
Captive Position Encoders

120 122 124

126 128

- (







The structural design, high degree of protection and simple installation of Balluff Micropulse transducers in a profiled housing makes them an excellent alternative to linear transducers, e.g. potentiometers, glass rulers and LVDTs. The measurement section is protected inside an extruded aluminum profile.

A passive encoder with no power supply marks the measuring point on the measuring path without making contact. Measuring ranges between 50 and 4572 mm are possible.

- Non-contact detection of the measuring position
- IP 67, insensitive to contamination
- Wear-free

Profile PF General data

- Insensitive to shock and vibration
- Absolute output signal
- Max. resolution of 0.005 mm (depending on the electronic processor unit)
- Direct signal evaluation or in conjunction with processor units for all control and closed-loop systems



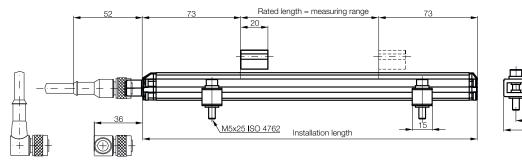
## Caution!

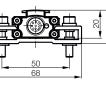
Before design, installation and startup please familiarize yourself with the user's guide to be found at www.balluff.com.



Series	Profile PF BTL6
Shock load	50 g/6 ms as per IEC 60068-2-27
Vibration	12 g, 102000 Hz as per EN 60068-2-6
Polarity reversal protected	Yes (up to 36 V)
Overvoltage protection	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	Connectors
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 (BURST)	EN 61000-4-4 Severity level 3
Surge voltage	EN 61000-4-5 Severity level 2
Conducted interference induced	EN 61000-4-6 Severity level 3
by high-frequency fields	
Magnetic fields	EN 61000-4-8 Severity level 4
Standard nominal strokes [mm]	00504572 in 5-mm increments

# Transducers with floating position encoder and connection S115 with BKS-S115/BKS-S116 connector





Profile AT Profile BIW

Captive Position Encoders

Micropulse Transducers

Profile PF General Data Analog Interface IO-Link V1.1 Floating Position Encoders

Rod Compact and Rod AR

Rod

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions

# Scope of delivery

www.balluff.com

Transducer (select your interface from page 122)

Quick start instructions

Mounting clamps with insulating sleeves and screws

Please order separately: Position encoders, see page 126 Plug connectors, see page 260





24.8



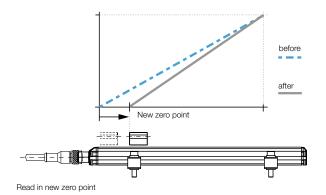
# Adjustable with diagnostics

## 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 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 BTL-C/E)

The characteristic 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.

## Reset

Restoring the transducer to its factory default settings.

# Calibration box with cable set

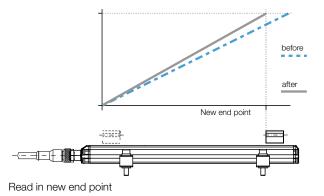
Part number	Cable set
BTL7-A-CB02	Cable connection
BTL7-A-CB02-S115	Plug connector S115
BTL7-A-CB02-S32	Connector S32

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



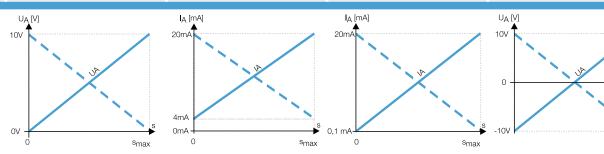
Set the output characteristic with the calibration box. Zero and end point, measuring range, rising or falling characteristic.

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





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- <b>A</b> 500-MPF-S115	BTL6- <b>E</b> 500-MPF-S115	BTL6- <b>C</b> 500-MPF-S115	BTL6- <b>G</b> 500-MPF-S115	
010 V			 _1010 V	
	420 mA	0.120 mA		
Max. 5 mA			Max. 5 mA	
≤ 5 mV			≤ 5 mV	
	≤ 500 Ω (500 Ω)	≤ 500 Ω (500 Ω)		
≤ 0.35 mV	≤ 0.7 µA	≤ 0.7 µA	≤ 0.35 mV	Micropulse
f _{max} = 2 kHz	f _{max} = 2 kHz	f _{max} = 2 kHz	f _{max} = 2 kHz	Transducers
±200 µm up to 500 mm rated length	±200 µm up to 500 mm rated length	$\pm 200\mu\text{m}$ up to 500 mm rated length	±200 µm up to 500 mm rated length	Drofilo D
±0.04% 500 max. rated length	±0.04% 500 max. rated length	±0.04% 500 max. rated length	±0.04% 500 max. rated length	Profile P
30 ppm at 500 mm	30 ppm at 500 mm	30 ppm at 500 mm	30 ppm at 500 mm	Profile PF
1030 V DC	1030 V DC	1030 V DC	1030 V DC	General
≤ 150 mA	≤ 150 mA	≤ 150 mA	≤ 150 mA	Data
–25+70 °C	–25+70 °C	–25+70 °C	–25+70 °C	Analog
–40+100 °C	–40+100 °C	–40+100 °C	–40+100 °C	Interface



Output signal can be inverted via programming inputs



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

# Scope of delivery

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

Please order separately: Position encoders, see page 126 Plug connectors, see page 252

Ordering example:

BTL6	_50	0 - M		PF-S115
	Outp signa	ut al		Standard nominal strokes [mm]
E	C 0.	010 V 420 mA 120 mA –1010 V	(	00504572 in 5-mm increments

IO-Link V1.1 Floating Position Encoders Captive Position

Profile AT

Encoders

s_{max}

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

# Profile PF IO-Link V1.1

# Contactless position measurement technology with IO-Link

Micropulse PF IO-Link is an absolute and non-contact position measurement system that continuously provides measured values in  $\mu$ m on a 1 ms cycle. These measured values are directly transferred digitally via IO-Link.

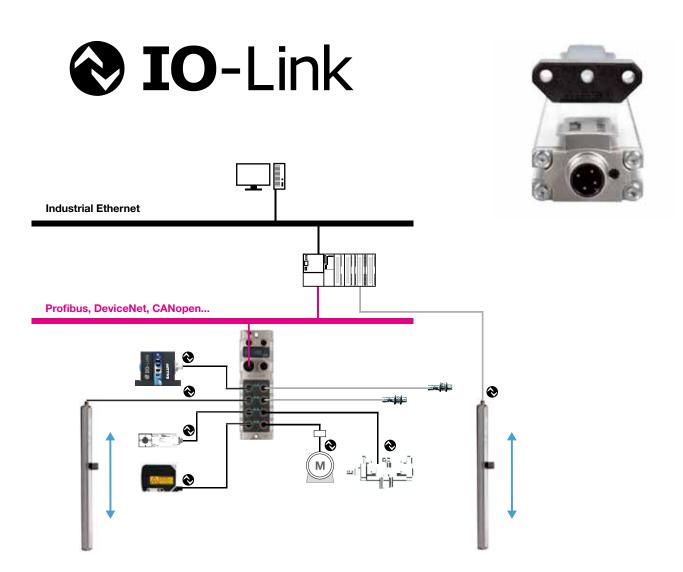
# IO-Link is a point-to-point connection within any number of networks. An IO-Link system consists of an IO-Link device such as a sensor or actuator, an IO-Link master and wiring. The IO-Link master is either an integrated/modular IP20 module for central operation in the control cabinet or as a remote I/O module in IP 65/67 degree 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 (230 kBaud), 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 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 M12 cable plug 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

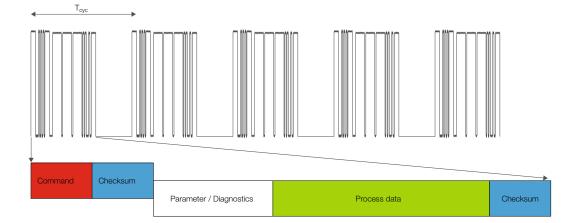
About IO-Link: www.io-link.com

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-MPF-S4	
System resolution	5 µm	
Repeat accuracy	≤ 30 µm	
Measurement rate	f _{STANDARD} = 1 kHz (< 1300 mm)	
Linearity deviation	$\leq \pm 200 \mu\text{m}$ up to 500 mm rated length	
	±0.04 %	
Supply voltage	1830 V DC	
Current consumption	≤ 150 mA	Micropulse
Polarity reversal protected	yes	Transducers
Operating temperature	–25+70 °C	D. Cl. D
Storage temperature	-40+100 °C	Profile P
Mode	COM 3	Profile PF
Transmission rate	230.4 kbaud	General
Process data cycle	1 ms	Data
Process data	Position value in µm	Analog
Parameters	Measuring range, zero point	Interface IO-Link V1.1
Diagnostics	Position encoder in the measuring range, below, above, no magnet	Floating Posit



Profile PF IO-Link V1.1

Please enter the code for the rated length in the part number.

# Scope of delivery

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

Please order separately: Position encoders, see page 126 See separate catalog for plug connectors: Industrial networking and connectivity Ordering example:



Standard nominal strokes [mm]

0050...4572 mm in 5-mm increments

.1 sition Encoders Captive Position

Encoders Profile AT

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories



# non-contact Distance up to 15 mm

Balluff encoders are available in captive or floating designs. Maximum resolution and reproducibility are achieved using transducers with captive encoders.

The position encoder BTL5-P-4500-1 is an electromagnet and requires an operating voltage of 24V, which can be turned on and off for selective activation. This allows multiplex operation with multiple encoders on a single transducer, since only one encoder is active at a time.

Description	
for Series	
Version	
Ordering code	
Part number	
Housing material	
Weight	
Position encoder travel speed	
Supply voltage	
Current consumption	
Operating temperature/Storage temperature range	
Scope of delivery	

Accessories (please order separately)



LED for diagnostics and programming



#### Caution!

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

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.

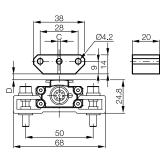
Replacement: BTL6-A-MF07-A-PF/M5 1 pair of brackets and screws, ordering code: BAM01N3



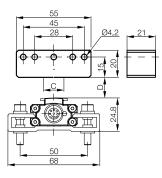


Position encoder	Position encoder	Position encoder	
Profile PF BTL	Profile PF BTL	Profile PF BTL	
Floating	Floating	Floating	
BAM014M	BAM014T	BAM014P	
BTL5-P-3800-2	BTL5-P-5500-2	BTL5-P-4500-1	
Plastic	Plastic	Plastic	
approx. 12 g	approx. 40 g	Approx. 90 g	
any	any	any	
		24 V DC	
		100 mA	
−40+85 °C	−40+85 °C	−40+60 °C	Micropulse
Position encoder	Position encoder	Position encoder	Transducers
2 fastening screws DIN 84 M4×35-A2 with			Profile P
washers and nuts			
			Profile PF
			General Data
	Profile PF BTL Floating <b>BAM014M</b> BTL5-P-3800-2 Plastic approx. 12 g any -40+85 °C Position encoder	Profile PF BTLProfile PF BTLFloatingFloatingBAM014MBAM014TBTL5-P-3800-2BTL5-P-5500-2PlasticPlasticapprox. 12 gapprox. 40 ganyany-40+85 °C-40+85 °CPosition encoderPosition encoder2 fastening screws DIN 84 M4×35-A2 withProfile PF BTL	Profile PF BTLProfile PF BTLProfile PF BTLFloatingFloatingFloatingBAM014MBAM014TBAM014PBTL5-P-3800-2BTL5-P-4500-1BTL5-P-4500-1PlasticPlasticPlasticapprox. 12 gapprox. 40 gApprox. 90 ganyanyany-40+85 °C-40+85 °C-40+85 °CPosition encoderPosition encoderPosition encoder2 fastening screws DIN 84 M4x35-A2 with-40+85 °CPosition encoder

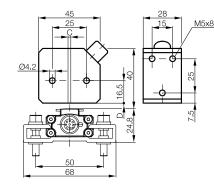
Connector, angle* BCC M425-0000-1A-014-PS0434-..



Lateral offset:  $C = \pm 2 \text{ mm}$ Distance of position encoder: D = 0.1...4 mm



Lateral offset:  $C = \pm 15 \text{ mm}$ Distance of position encoder: D = 5...15 mm



Lateral offset:  $C = \pm 2 \text{ mm}$ Distance of position encoder: D = 0.1...2 mm

* Please include the cable length code in the part number. 020 = 2 m, 050 = 5 m, 100 = 10 m



Data Analog Interface 10-Link V1.1 Floating Position Encoders

Captive Position Encoders Profile AT

Profile BIW

Rod

Rod Compact and Rod AR

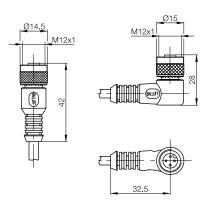
Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories



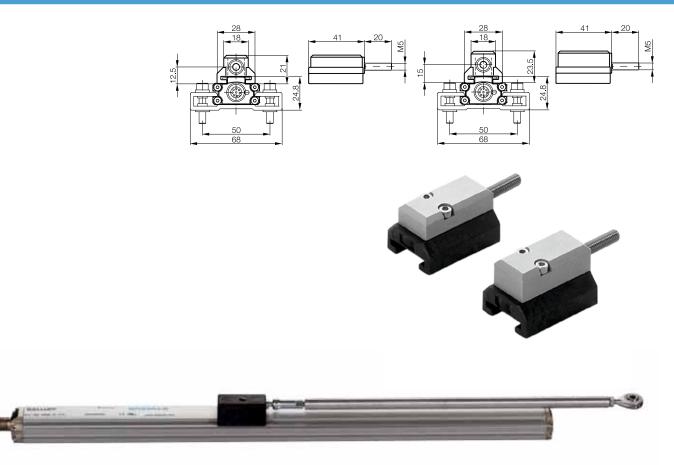






# **Guidance system included**

Description		Position encoder	Position encoder	
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	
Position encoder travel speed		any	any	
Operating temperature/Storage temp	erature range	−40+85 °C	−40+85 °C	



## Caution!

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

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

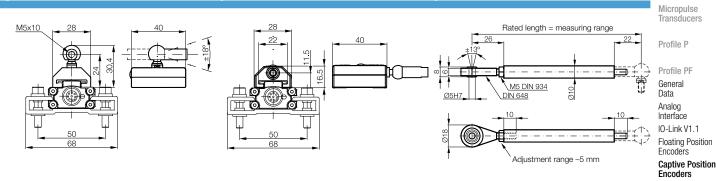
Mounting clamps with insulating sleeves and screws included in the scope of delivery of the transducer.

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





Po	osition encoder	Position encoder	Joint rod
Pr	ofile PF BTL	Profile PF BTL	Profile PF BTL
Ca	aptive	Captive	Captive
BA	AM014H	BAM01FC	
BT	TL5-F-2814-1S	BTL5-T-2814-1S	BTL2-GS10A
Ar	nodized aluminum	Anodized aluminum	Aluminum
Pla	astic	Plastic	
ap	pprox. 28 g	approx. 28 g	approx. 150 g/mg
an	Ŋ	any	
-4	0+85 °C	–40+85 °C	



Please enter the code for the rated length in the part number.

# Ordering example:



0075

0150

0350

0500

1000

Standard nominal strokes [mm]

0200

0400

0600

1500

0100 0125

0250

0450

0800

2000

Rod EX, T Redundant and CD

Rod Compact and Rod AR

Profile AT

Profile BIW

Rod

Filling Level Sensor SF

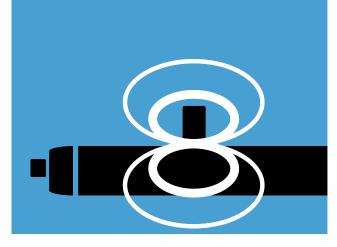
Accessories

Basic Information and Definitions

Swivel eye Material number 714619



When using captured encoders with ball joint and control arm, transverse forces do not impinge on the transducer system.



# Micropulse Transducers

# Profile AT

- In a robust 30-mm pipe housing for universal fastening
- The cost-effective, contactless position measuring solution
- Multiple paths one system, which measures position in many paths
- With analog output signal and Real-Time Ethernet





# AT

General Data Analog Interface Operating Modes Digital Pulse Interface Ethernet interface Accessories



132

134

136

# MICROPULSE®





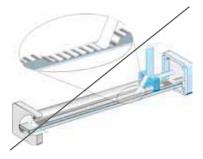
# flexible and simple

# Micropulse transducers – a contactless alternative to contacting transducers

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

A passive encoder with no power supply marks the measuring point on the measuring path without making contact. Measuring ranges between 50 and 1,500 mm are possible.

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



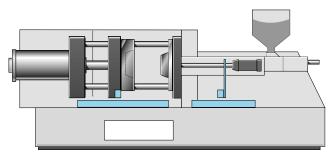


### From optional to standard

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.

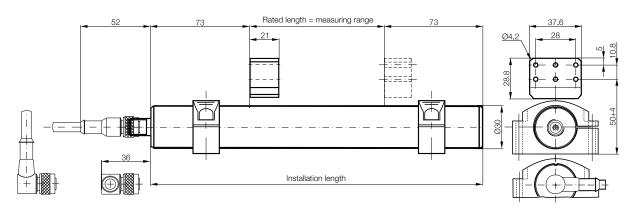
With the Micropulse AT position feedback system, now even standard machines can feature the benefit of minimum downtime provided by non-contact transducer systems.





Series	Profile A1 BTL6
Part number	BTL6MA1-S115
Part number	BTL6- <b>A</b> 301-MA1-S115
Shock load	50 g/6 ms as per IEC 60068-2-27
Vibration	12 g, 102000 Hz as per EN 60068-2-6
Polarity reversal protected	yes
Overvoltage protection	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 (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 (BURST)	EN 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 position encoder and connection S115 with plug connector BKS-S115/BKS-S116 for transducer with analog interface, Digital Pulse Interface and VARAN Bus interface on page 134



Caution!

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

#### Scope of delivery

Transducer (select your interface from page 134)
 Quick start instructions

Please order separately: Position encoders, see page 143 Mounting clamps/cuff, see page 142 Plug connectors, see page 252



Micropulse Transducers

manauucera

Profile P

Profile PF

Profile AT

#### General Data Analog Interface Operating Modes Digital Pulse

Digital Pulse Interface Ethernet Interface Accessories

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX, T Redundant and CD

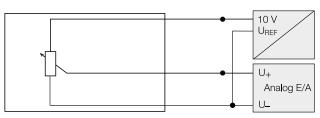
Filling Level Sensor SF

Accessories

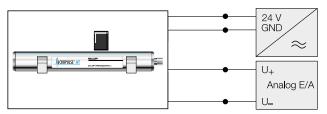


The analog outputs of the standard series BTL6-A110 are non-floating.

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.



Connection scheme potentiometer, block diagram



Micropulse Transducer connections, block diagram

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

### Preferred models

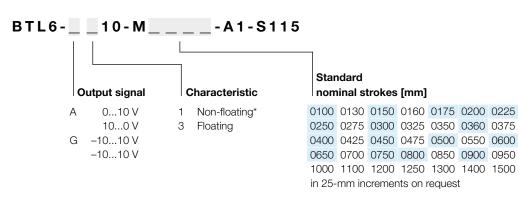
BTL6-A110-M____A1-S115 are available from stock in the rated lengths highlighted in blue.

# Scope of delivery

TransducerQuick start instructions

Please order separately: Position encoders, see page 143 Mounting clamps/cuff, see page 142 Plug connectors, see page 252

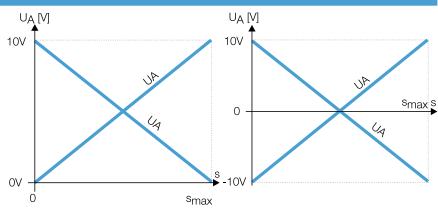
## Ordering example:



*only for BTL6-A110-M____A1-S115



Series	Profile A1 BTL6	Profile A1 BTL6	
Output signal	Analog	Analog	
Transducer interface	Α	G	
Customer device interface	Analog	Analog	
Part number	BTL6-A110-MA1-S115	BTL6-G310-MA1-S115	
Output voltage	010 V and 100 V	-1010 V and 1010 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	Micropulse
Measurement rate	$f_{STANDARD} = 1 \text{ kHz}$	f _{STANDARD} = 1 kHz	Transducers
Linearity deviation	$\leq \pm 200 \ \mu m$ up to 500 mm rated length	$\leq$ ±200 µm up to 500 mm rated length	Drofilo D
	typ. ±0.02%, max. ±0.04%	typ. ±0.02%, max. ±0.04%	Profile P
	5001500 mm rated length	5001500 mm rated length	Profile PF
Supply voltage	2028 V DC	2028 V DC	Tronic TT
Current consumption	≤ 70 mA	≤ 70 mA	Profile AT
Polarity reversal protected	yes	yes	General
Operating temperature	0+70 °C	0+70 °C	Data
Storage temperature	–40+100 °C	–40+100 °C	Analog Interface





Operating Modes Digital Pulse Interface Ethernet Interface

Accessories

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories





# One system – two paths

### 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 sensor 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 encoders. If one encoder leaves the measuring range or if only one is present, the position is indicated on Output 1. Output 2 then indicates an error value.

### Inputs 6 inactive 0/0 0+0 Ð Inputs active 0 Magnet Magnet a 2 Zerc End Zero Fnd nioa point point

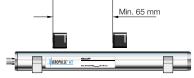
Teach-in

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

Example: Programming steps for setting the measuring range

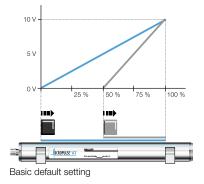
# Mode selection

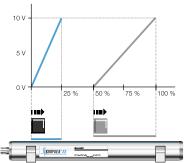
The standard function is the separate measurement of two positions. The programming inputs are used to switch the mode.



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

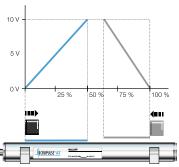
# Mode 1: Single measurement of 2 positions (single measurement default setting 100%/50%)





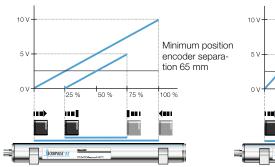
Programming example: Output 1: 25% rated length, signal rising Output 2: 50% rated length, signal rising

Output 2: 50% rated length, signal rising



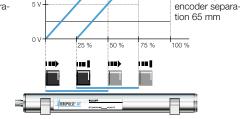
Programming example: Output 1: 50% rated length, signal rising Output 2: 37.5% rated length, signal falling

# Mode 2: Differential measurement between 2 position encoders



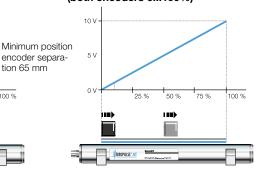
Default setting: Differential measurement Output 1: Standard displacement signal (not shown) Output 2: Differential signal 100% rated length = 10 V Programming example:

Differential displacement 50% rated length = 5 V differential signal



Programming example: Differential displacement 50% rated length = 10 V differential signal

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





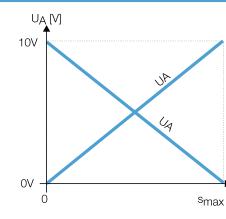
# Features of Micropulse BTL6-A

- 100% setting range of the analog signals
- Error signal value, no position encoder 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 analog outputs 0...10 V

Series	Profile A1 BTL6	
Output signal	Analog	
Transducer interface	Α	
Customer device interface	Analog	
Part number	BTL6- <b>A</b> 301-MA1-S115	
Output	Floating	
Output voltage	010 V programmable	
Load current	Max. 5 mA	
Max. residual ripple	≤ 5 mV	-1
System resolution	≤ 10 µm	
Repeat accuracy	≤ 10 μm	Mici
Reproducibility	≤ 20 μm	Tran
Measurement rate	f _{STANDARD} = 1 kHz (< 850 mm)	Prof
Linearity deviation	$\leq$ ±200 µm up to 500 mm rated length	PIOI
	typ. ±0.02%, max. ±0.04%	Prof
	5001500 mm rated length	1101
Supply voltage	1830 V DC	Prof
Current consumption	≤ 100 mA	Gene
Polarity reversal protected	yes	Data
Operating temperature	0+70 °C	Anal Inter
Storage temperature	-40+100 °C	Ope
		Mod



8

Micropulse Transducers

Profile P

. . . . . .

Profile PF

Profile AT General

Data Analog Interface

Operating Modes Digital Pulse Interface

Ethernet Interface Accessories

Profile BIW

Rod

Pod Compa

Rod Compact and Rod AR

Rod EX, T Redundant and CD

s

Filling Level Sensor SF

Accessories

Basic Information and Definitions

Please enter the code for the rated length in the part number.

# Preferred models interface A301

BTL6-A301-M_ _ _ _-A1-S115 are available from stock in the rated lengths highlighted in blue.

## Scope of delivery

Transducer

Quick start instructions

Please order separately: Position encoders, see page 143 Mounting clamps/cuff, see page 142

#### Ordering example:

# BTL6-A301 - M _ _ _ - A1-S115

### Characteristic

Electrically separated 2 analog outputs Individual or differential measurement, rising, falling, zero and end point programmable

# Standard Rated length [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
 in 25-mm increments on request

Standard rated length (mm): 0050, 0100, 0130, 0150 for single magnet only



# Self-configuring

# P110 interface

The P110 interface works with Balluff BTA processor 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 processor 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 interface 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 processor units 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.

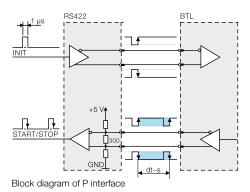
# P111 interface – Cost savings using DPI/IP for start-up and installation

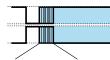
DPI/IP is a protocol for direct data exchange between a controller and transducer. The signal lines are used to send additional information such as manufacturer, measuring length and waveguide gradient. This allows start-up or replacement of a transducer without having to make manual changes to the controller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

# Features

Bi-directional communication

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

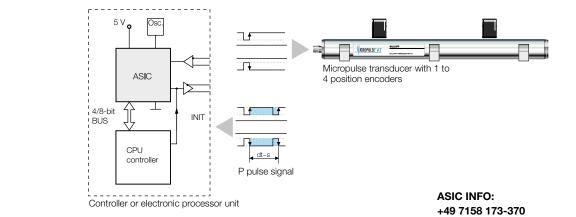




111000010111

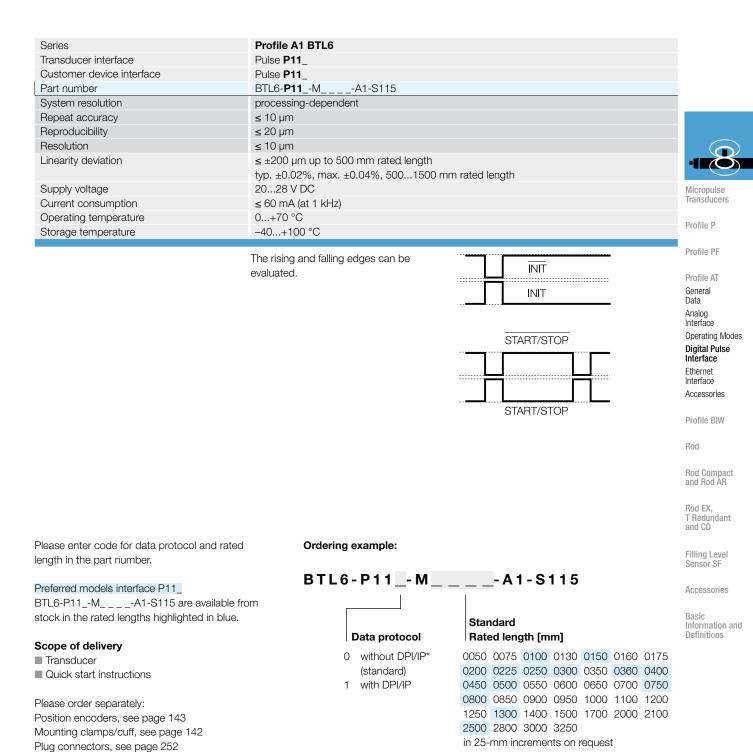
# Benefits

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









*The version without DPI/IP is only available up to a rated length of 1,500.



# Real-time Ethernet cost-effective

# Micropulse position measurement system BTL6-V11_ Profile AT with real-time Industrial Ethernet

# Precision measurement of the travel path of primary and secondary axes!

Micropulse position measurement systems in a profile housing are non-contact, absolute measurement 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 threeplug models.

# Up to four axes with one position measurement system

Up to four passive position encoders with no power supply "mark" the measuring positions on the measuring path without making contact, with measuring ranges from 50 to 4000 mm. The particular attraction of this is that as a result of the system, up to four different paths can be measured simultaneously with one transducer. The position measurement systems tolerate a lateral offset as well as a vertical offset of up to 15 mm.

# Features

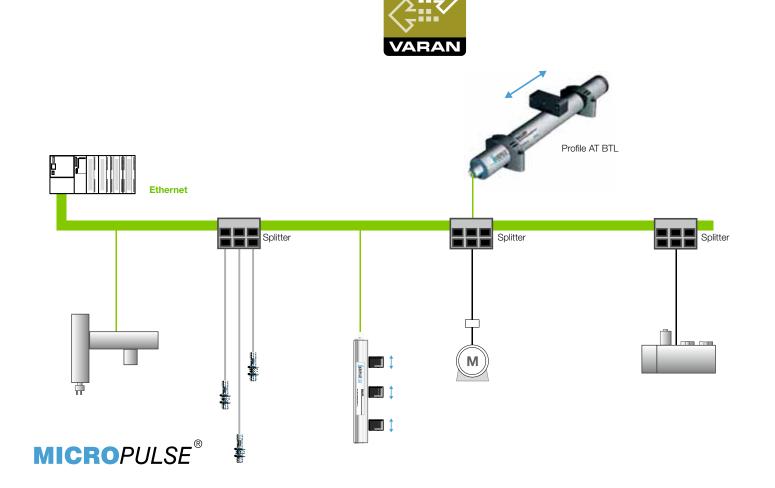
Non-contact detection of the measuring position

- IP 67, insensitive to contamination
- Insensitive to shock and vibration
- Absolute output signal
- Measuring lengths up to 4012 mm
- Up to 4 measurement paths per system
- Fast, simple mounting
- Single-plug solution lower system costs.
- Secure data transmission

## Additional information

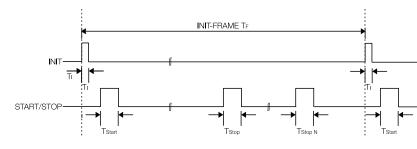
For VARAN, see www.varan-bus.net or for EtherCAT, see www.ethercat.org







Series	Profile A1 BTL6	Profile A1 BTL6
Output signal	VARAN	EtherCAT
Transducer interface	V11V	V11E
Customer device interface	VARAN	EtherCAT
Part number	BTL6- <b>V</b> 11V-MA1-S115	BTL6- <b>V</b> 11E-MA1-S115
System resolution	≤ 15 µm	≤ 15 µm
Repeat accuracy	≤ 20 µm	≤ 30 µm
Reproducibility	≤ 30 µm	≤ 30 µm
Measurement rate	f _{STANDARD} = 1 kHz (< 850 mm)	f _{STANDARD} = 1 kHz (< 850 mm)
Linearity deviation	$\leq$ ±200 µm up to 500 mm rated length	$\leq$ ±200 µm up to 500 mm rated length
	±0.04% 5001500 mm rated length	±0.04% 5001500 mm rated length
Supply voltage	2028 V DC	2028 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 rated length in the part number.

# Scope of delivery

Transducer

Quick start instructions

Please order separately: Position encoders, see page 143 Mounting clamps/cuff, see page 142 Plug connectors, see page 252 Ordering example:

BTL6-V11MA1-S115							
Interfa		ndard ninal s [.]	trokes	; [mm]			
V VAR	AN 0160	0175	0200	0225	0250	0275	0300
E Ethe	erCAT 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		4012	

in 25-mm increments on request

Mierrenzies

Micropulse Transducers

Profile P

Profile PF

Profile AT General Data Analog Interface Operating Modes Digital Pulse Interface Ethernet Interface Accessories

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

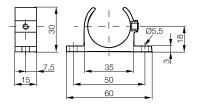


The position encoder BTL6-A-3800-2 can be operated at a distance of 4...8 mm from the profile surface.

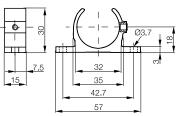
In conjunction with mounting clamp BTL6-A-MF01-A-50 and mounting cuff BTL6-A-MF03-K-50, the mechanical installation is compatible with series BTL5-...-P-S32 with encoder BTL5-P-3800-2 or BTL5-P-5500-2.

As a result, large measurement lengths or transducers with a bus connection, for example, can be implemented optionally without requiring mechanical modifications.

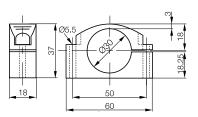
# Mounting clamps/cuff



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



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



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

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

#### Caution!

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

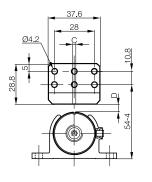
Application-specific mounting options

For connector accessories, see page 252





Description	Position encoder	Position encoder
for Series	Profile A1 BTL	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
Position encoder travel speed	any	any
Operating temperature/Storage temperature range	–40+85 °C	−40+85 °C
Scope of delivery	Position encoder	Position encoder



Lateral offset:  $C = \pm 5 \text{ mm}$ Distance of position encoder: D = 4...8 mm

37.6

Lateral offset:  $C = \pm 5 \text{ mm}$ Distance of position encoder: D = 4...8 mm



Micropulse Transducers

Profile P

Profile PF

2<u>1</u>

Profile AT General Data Analog Interface Operating Modes Digital Pulse Interface

Accessories Profile BIW

Ethernet

Interface

Rod

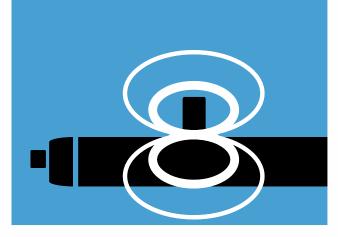
Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories





# Micropulse Transducers

# Profile BIW

- The contactless potentiometer in the compact push rod design
- With high measurement rate for quick movements
- The characteristic of the analog output can be inverted via a programming input





**BIW** General Data Analog Interface

146 148









### Sampling rate 32 kHz

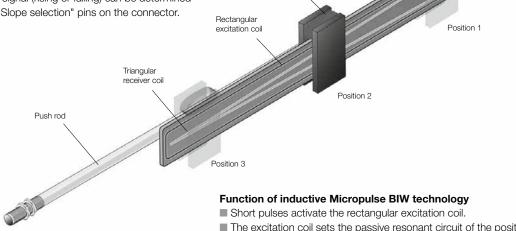
#### The inductive transducer BIW is based on a new, patented operating principle which detects the actual position without making contact.

The transducer BIW 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.

The resonant circuit is momentarily triggered via the emitter sensor element with a measurement rate of 32 kHz and a signal is coupled into the receiver sensor element at the current position. The position is immediately available on the output and is absolute.

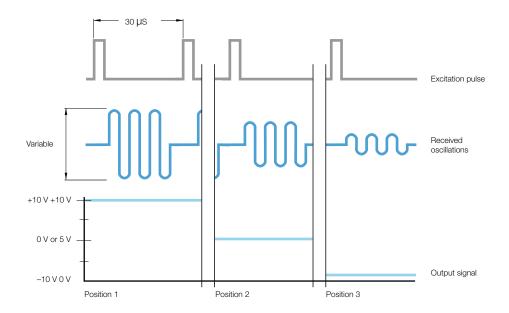
The slope of the output signal (rising or falling) can be determined through the use of the "Slope selection" pins on the connector.



Passive resonant

circuit

- The excitation coil sets the passive resonant circuit of the position encoder in motion.
- The resonant circuit on the position encoder transmits the frequency inductively to the triangular receiver coil without making contact.
- The amplitude level varies according to the position of the position encoder resonant circuit. Comparable to the amplitude level, the electronics integrated in the Micropulse BIW issue a standard analog voltage or current signal.





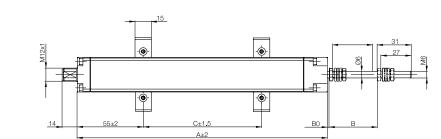
Series	Profile P1 BIW
Shock load	100 g/2 ms
Vibration	12 g, 102000 Hz
Dielectric strength	500 V (GND to housing)
Degree of protection as per IEC 60529	IP 54
Housing material	Anodized aluminum
Fastener	Mounting clamps
Connection	Connector M12, 8-pin standard
Standard nominal strokes [mm]	0075, 0100, 0130, 0150, 0175, 0225, 0260, 0300,
	0360, 0375, 0400, 0450, 0500, 0600, 0650, 0750

Micropulse Transducers

Profile P

Profile PF





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₩



Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions

Housing length	A = rated length + 100 mm
Mechanical zero point	B0 = 0 + 2 mm
Electrical zero point	B0 + 5 mm
Electrical stroke = mechanical stroke	B = rated length + 10 mm
Recommend clamp distance	
Rated length ≤ 300 mm	C = rated length - 20 mm
Rated length 300 mm to $\leq$ 600 mm	C = rated length – 15 mm
Rated length > 600 mm	C = rated length – 10 mm

Þ

#### **Calculation example**

BIW1-...-M0100-P1-S115 Rated length 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: Plug connectors, see page 260

#### Caution!

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





Profile AT

Rod

BALLUFF 147



### Sampling rate 32 kHz

#### Properties of the transducer BIW

- High resolution and reproducibility
- Resistant to shock, vibration and noise fields
- Absolute rising or falling analog output signal
- Captive sensor element
- Sampling rate 32 kHz
- Floating
- Non-contact measuring principle

Genes
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
Measurement 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
Fastener
Connection
Housing length A

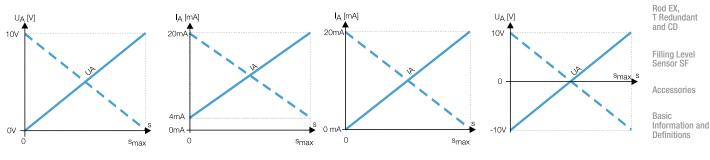
Housing length A Mechanical stroke B

Series





Profile P1 BIW	Profile P1 BIW	Profile P1 BIW	Profile P1 BIW	
Analog	Analog	Analog	Analog	
Α	E	С	G	
Analog	Analog	Analog	Analog	
BIW1-A310-MP1-S115	BIW1- <b>E</b> 310-MP1-S115	BIW1- <b>C</b> 310-MP1-S115	BIW1-G310-MP1-S115	
010 V			-1010 V	
	420 mA	020 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	N
<b>≤</b> 0.02%	≤ 0.02%	≤ 0.02%	≤ 0.02%	Т
1830 V DC	1830 V DC	1830 V DC	1830 V DC	Р
≤ 80 mA	≤ 80 mA	≤ 80 mA	≤ 80 mA	^r
−20+85 °C	–20+85 °C	−20+85 °C	–20+85 °C	Р
-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	P
12 g, 102000 Hz	12 g, 102000 Hz	12 g, 102000 Hz	12 g, 102000 Hz	
500 V (GND to housing)	500 V (GND to housing)	500 V (GND to housing)	500 V (GND to housing)	P
IP 54	IP 54	IP 54	IP 54	G
Anodized aluminum	Anodized aluminum	Anodized aluminum	Anodized aluminum	D
Mounting clamps	Mounting clamps	Mounting clamps	Mounting clamps	Î
Connector M12,	Connector M12,	Connector M12,	Connector M12,	
8-pin standard	8-pin standard	8-pin standard	8-pin standard	R
Rated length + 100 mm	Rated length + 100 mm	Rated length + 100 mm	Rated length + 100 mm	
Rated length + 10 mm	Rated length + 10 mm	Rated length + 10 mm	Rated length + 10 mm	R



- Output signal can be inverted via programming inputs

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

#### Scope of delivery

- Transducer
- Quick start instructions

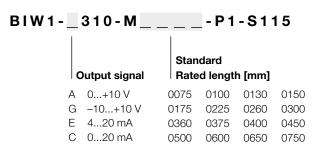
www.balluff.com

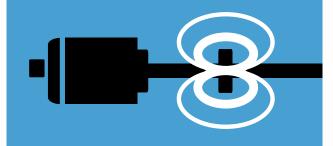
2 mounting clamps BIW-A-MF02-M

Please order separately: Plug connectors, see page 252



Ordering example:





## Micropulse Transducers

### Rod

Rod housings are mainly used in hydraulic drive 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 pressureresistant tube made from nonmagnetic stainless steel that is sealed off at the front end with a welded plug. An O-ring in the flange at the opposite end seals off the high-pressure section. An encoder ring with magnets slides over the tube or rod with internal waveguide to mark the position prior to detection.





#### BTL7 MICROPULSE +

General Data	152
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Programming	158
SSI Interface	162
Programming	164
Digital Pulse Interface	166
BTL5/BTL6	-
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CANopen Interface	170
Profibus DP Interface	174
Ethernet Interface	176
4 Programmable Switching Points	178
Installation Notices	180
	100

## MICROPULSE®





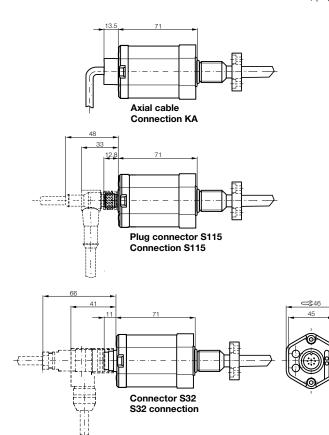
# "**Long**" up to 7620 mm

#### Pressure-resistant to 600 bar, high reproducibility, contactless, robust

The Micropulse Transducer BTL 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 highpressure 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.

Rod BTL7
150 g/6 ms as per EN 60068-2-27
20 g, 102000 Hz per EN 60068-2-6
yes
TransZorb protection diodes
500 V AC (GND to housing)
IP 68 with cable outlet, IP 67 with screwed-on plug connector BKS-S
Anodized aluminum/1.4571 stainless steel protective tube, 1.3952 stainless steel cast flange
Style B thread M18×1.5, style Z 3/4"-16 UNF
600 bar with installation in hydraulic cylinder
250 bar installed in hydraulic cylinder
Plug connector or cable connection
EN 55016-2-3 (industrial and residential area)
EN 61000-4-2 Severity level 3
EN 61000-4-3 Severity level 3
IEC 61000-4-4 Severity level 3
EN 61000-4-5 Severity level 2
EN 61000-4-6 Severity level 3
EN 61000-4-8 Severity level 4
00257620 mm in 1-mm increments

Please order separately: USB communication box, page 164

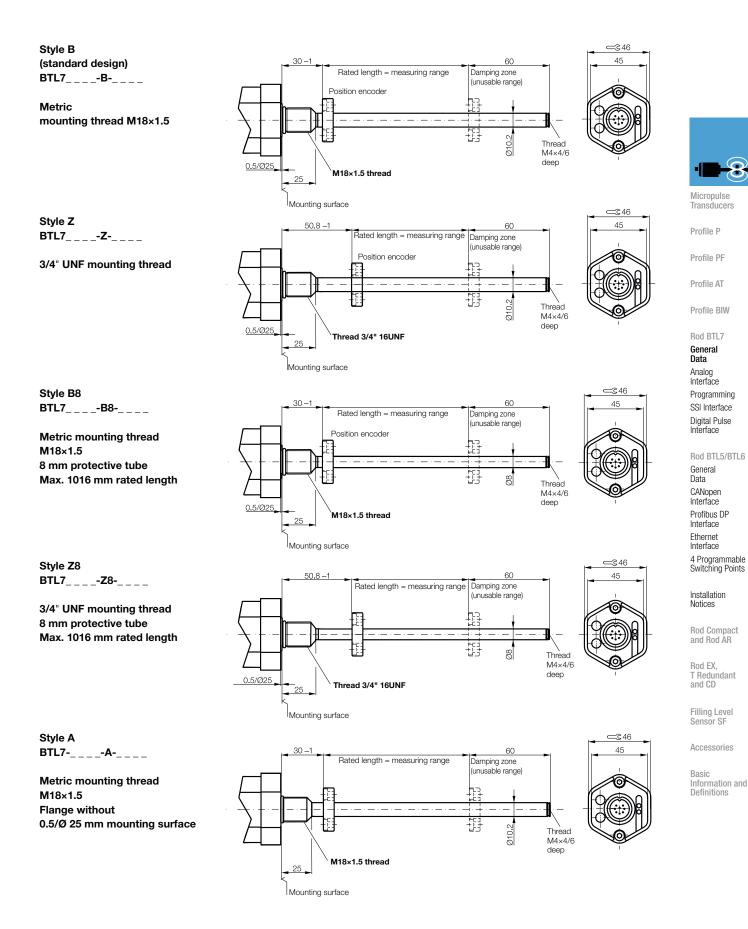




#### Caution!

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







### 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)

- Electronics head can be replaced in the event of service
- Compact housing, saves space
- Error signal, no position encoder 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 158.

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, length-dependent	
Max. linearity deviation	
Temperature coefficient	
Supply voltage	
Current consumption at 24 V DC	

Supply voltage Current consumption at 24 V DC Polarity reversal protected Overvoltage protection Dielectric strength Operating temperature



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

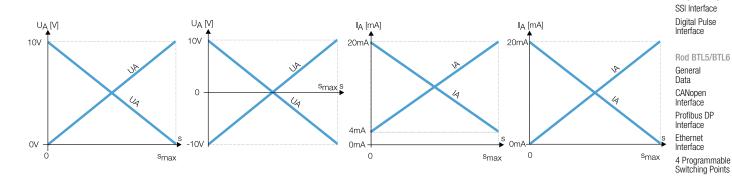
#### Scope of delivery

TransducerCalibration deviceQuick start instructions

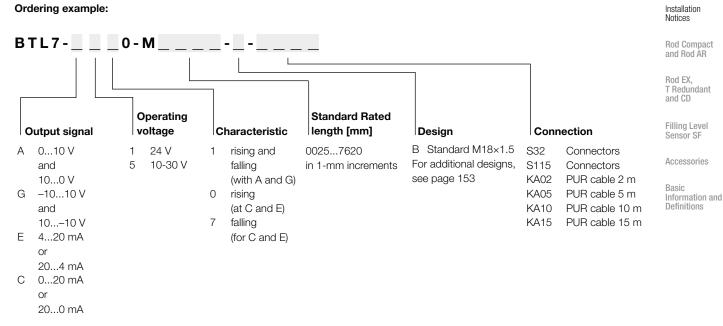
Please order separately: Calibration box, see page 164 Position encoders, see page 218 Floats, see page 216 Fastening nut, see page 219 Plug connectors, see page 252



Rod BTL7	Rod BTL7	Rod BTL7	Rod BTL7	
Analog	Analog	Analog	Analog	
Α	G	E	С	
Analog	Analog	Analog	Analog	
BTL7- <b>A</b> 110-M	BTL7- <b>G</b> 110-M	BTL7- <b>E</b> 1_0-M	BTL7- <b>C</b> 1_0-M	
010 V and 100 V	-1010 V and 1010 V			
		420 mA or 204 mA	020 mA or 200 mA	
Max. 5 mA	Max. 5 mA			
≤ 5 mV _{pp}	≤ 5 mV _{pp}			
		≤ 500 Ω	≤ 500 Ω	
≤ 0.33 mV	≤ 0.33 mV	≤ 0.66 µA	≤ 0.66 µA	N
≤ 5 µm	≤ 5 µm	≤ 5 µm	≤ 5 µm	Ti
System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm	Р
Max. 4 kHz	Max. 4 kHz	Max. 4 kHz	Max. 4 kHz	
$\pm 50 \ \mu m$ to $\leq 500 \ mm$ rated length	$\pm 50 \ \mu m$ to $\leq 500 \ mm$ rated length	$\pm 50 \ \mu m$ to $\leq 500 \ mm$ rated length	$\pm 50 \ \mu m$ to $\leq 500 \ mm$ rated length	Р
±0.01% 5015500 mm rated length	±0.01% 5015500 mm rated length	±0.01% 5015500 mm rated length	±0.01% 5015500 mm rated length	
$\pm 0.02\%$ FS > 5500 mm rated length	$\pm 0.02\%$ FS > 5500 mm rated length	$\pm 0.02\%\mbox{ FS} > 5500\mbox{ mm}$ rated length	$\pm 0.02\%$ FS > 5500 mm rated length	Р
≤ 30 ppm/K	≤ 30 ppm/K	≤ 30 ppm/K	≤ 30 ppm/K	
2028 V DC	2028 V DC	2028 V DC	2028 V DC	P
≤ 150 mA	≤ 150 mA	≤ 150 mA	≤ 150 mA	
yes	yes	yes	yes	R
yes	yes	yes	yes	G
500 V AC (GND to housing)	500 V AC (GND to housing)	500 V AC (GND to housing)	500 V AC (GND to housing)	A
–40+85 °C	–40+85 °C	−40+85 °C	−40+85 °C	In
				Ρ



Ordering example:





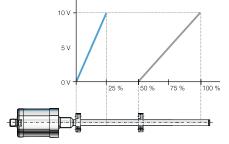
### **USB** configurable

#### Position and velocity

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

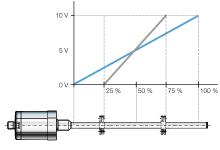
#### Mode examples:

#### Double position encoder



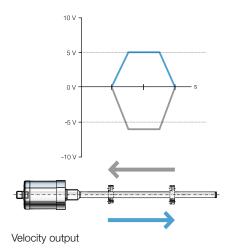
2 encoders, 2 movements, 2 output signals

#### Differential



Differential signal between 2 position encoders, position and difference possible

#### Velocity



SeriesOutput signalTransducer interfacePosition signal interface, customer devicePart numberOutput signal factory settingOutput signal can be adjusted via configurable USBLoad currentMax. residual rippleLoad resistanceSystem resolutionCurrent consumption at 24 V DCHysteresisRepeat accuracyMeasurement rate, length-dependentMax. linearity deviation
Transducer interfacePosition signal interface, customer devicePart numberOutput signal factory settingOutput signal can be adjusted via configurable USBLoad currentMax. residual rippleLoad resistanceSystem resolutionCurrent consumption at 24 V DCHysteresisRepeat accuracyMeasurement rate, length-dependent
Position signal interface, customer devicePart numberOutput signal factory settingOutput signal can be adjusted via configurable USBLoad currentMax. residual rippleLoad resistanceSystem resolutionCurrent consumption at 24 V DCHysteresisRepeat accuracyMeasurement rate, length-dependent
Part number       Image: Constraint of the second sec
Output signal factory 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         Measurement rate, length-dependent
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         Measurement rate, length-dependent
Load current Max. residual ripple Load resistance System resolution Current consumption at 24 V DC Hysteresis Repeat accuracy Measurement rate, length-dependent
Max. residual ripple         Load resistance         System resolution         Current consumption at 24 V DC         Hysteresis         Repeat accuracy         Measurement rate, length-dependent
Load resistance System resolution Current consumption at 24 V DC Hysteresis Repeat accuracy Measurement rate, length-dependent
System resolution Current consumption at 24 V DC Hysteresis Repeat accuracy Measurement rate, length-dependent
Current consumption at 24 V DC Hysteresis Repeat accuracy Measurement rate, length-dependent
Hysteresis Repeat accuracy Measurement rate, length-dependent
Repeat accuracy Measurement rate, length-dependent
Measurement rate, length-dependent
Max. linearity deviation
Temperature coefficient
Supply voltage
Polarity reversal protected
Overvoltage protection
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)
- The electronics head can be replaced in the event of service
- Compact housing
- Error signals, no position encoder within measuring range

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

#### Scope of delivery

- Transducer
- Calibration device
- Quick start instructions

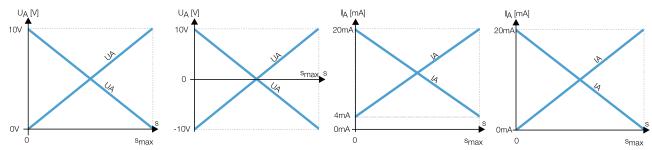
Please order separately: USB communication box, see page 159 Position encoders, see page 218 Floats, see page 216 Fastening nut, see page 219 Plug connectors, see page 252



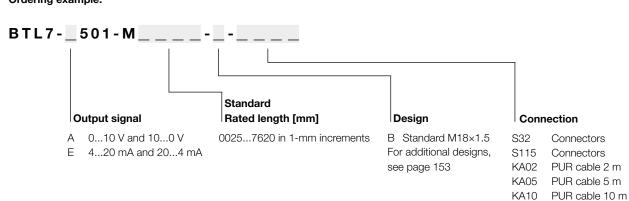
Rod BTL7 Rod BTL7	
Analog Analog	
A E	
Analog Analog	
BTL7- <b>A501</b> -MBTL7- <b>E501</b> -M	
010 V and 100 V 420 mA and 204 mA	
-1010 V and 1010 V 020 mA and 200 mA	
Max. 5 mA	
$\leq 5 \text{ mV}_{pp}$	· <b></b>
≤ 500 Ω	
≤ 0.33 mV ≤ 0.66 µA	Micropulse
≤ 150 mA ≤ 180 mA	Transducers
≤ 5 µm ≤ 5 µm	Profile P
System resolution/min. 2 µm System resolution/min. 2 µm	TIONICT
Max. 4 kHz Max. 4 kHz	Profile PF
$\pm 50 \ \mu m$ to $\leq 500 \ mm$ rated length $\pm 50 \ \mu m$ to $\leq 500 \ mm$ rated length	
±0.01% FS > 500≤ 5500 mm rated length ±0.01% FS > 500≤ 5500 mm rated length	Profile AT
$\pm 0.02\%$ FS > 5500 mm rated length $\pm 0.02\%$ FS > 5500 mm rated length	
$\leq$ 30 ppm/K $\leq$ 30 ppm/K	Profile BIW
1030 V DC 1030 V DC	
yes yes	Rod BTL7
yes yes	General Data
500 V AC (GND to housing) 500 V AC (GND to housing)	Analog
-40+85 °C -40+85 °C	Interface

Rod BTL7

**Analog interface** 







Programming SSI Interface Digital Pulse Interface Rod BTL5/BTL6 General Data CANopen Interface Profibus DP Interface Ethernet Interface

Installation Notices

4 Programmable Switching Points

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions

KA15

PUR cable 15 m



# Quick commissioning

#### Setting options for the start and end point

	BTL7 Standard	BTL7-A/E501 Micropulse ⁺ USB configurable
1. Calibration device		1 C C C C C C C C C C C C C C C C C C C
Teach-in		
Adjusting		
Online setting		
Easy Setup		
2. Remote setup, calibration box	• • • • • • • • • • • • • • • • • • •	
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, selectable by pressing a button combination. Two-color LED indicators assist the procedure.

#### Easy Setup

For BTL7-A/E501 Micropulse*only. Simple programming mode for adjusting the start and end point of the transducer to the current application in just a few steps. The position encoder 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 encoder. 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 encoder to the start and/or end point. Move the encoder 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**

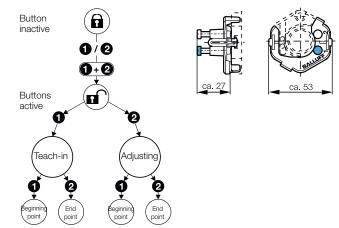
This programming function allows you to set the start and end point while in run mode, such as in a closed loop configuration. No error value is output during the setup procedure. The calibration range is limited to  $\pm 25\%$ .

#### 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 position encoder 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.

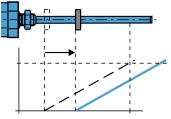


Selecting the calibration procedure BTL7 Standard

#### Procedure for teach-in, rising signal

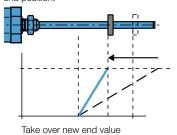


1. Move the position encoder into the new zero position.

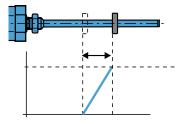


Take over new zero value

2. Move the position encoder into the new end position



3. Newly set measurement path





L_b, pin 8

La, pin 4

Button 1

24 \

Button 2

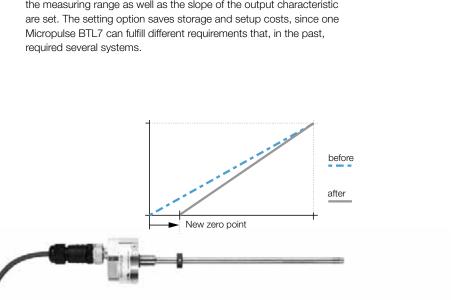
#### 2. Remote setup

#### Setting 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  $L_a$  and button 2, gray, to input  $L_b$ .

### Remote setting of the start and end points using calibration box

With the Calibration Box BTL-A-CB02, the characteristic 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 downloads, the measuring range as well as the slope of the output characteristic are set. The setting option saves storage and setup costs, since one Micropulse BTL7 can fulfill different requirements that, in the past, required several systems.



Electronic processor unit supply voltage

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

Calibration box with cable set			
Part number	Cable set		
BTL7-A-CB02	Cable connection		
BTL7-A-CB02-S115	Plug connector S115		
BTL7-A-CB02-S32	Connector S32		

8

Micropulse Transducers

Profile P

Profile PF

Profile AT

Profile BIW

Rod BTL7 General Data Analog Interface

Programming SSI Interface Digital Pulse Interface

Rod BTL5/BTL6

General Data CANopen Interface Profibus DP Interface Ethernet Interface 4 Programmable Switching Points

Installation Notices

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions



#### 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 encoder
- 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

#### 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

#### Part number BTL7-A-CB01-USB-S32 BTL7-A-CB01-USB-S115 BTL7-A-CB01-USB-KA

with cable sets Connector S32 Plug connector S115 Cable connection

#### Scope of delivery

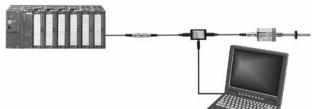
- USB communication box
- Cable set
- Quick start instructions

#### 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 communication box with S32 or S115 connector

Communication box connected via cable

in the control cabinet





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

Caution!

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



Micropulse Transducers

Profile P

Profile PF

Profile AT

Profile BIW

Rod BTL7 General Data

Analog Interface **Programming** SSI Interface Digital Pulse Interface

Rod BTL5/BTL6

General Data CANopen Interface Profibus DP Interface Ethernet Interface 4 Programmable Switching Points

Installation Notices

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions



## outstanding linear and synchronous performance

### SSI interface Micropulse standard for asynchronous operation BTL7-S5__-M____B-___

The synchronous serial data transmission is 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 interference-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 measuring 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 scan rate**  $f_A$ , with which a new, current value is available on each sampling, can be approximated from the table to the right. An exact diagram can be found in the current user's guide.

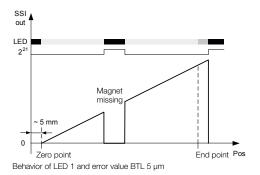
### SSI interface Micropulse Plus for synchronous operation BTL7-S510B-M____B-__-B-___

Via an integrated USB interface, functions,

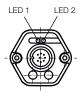
Functions, interface parameters and measuring range can be set via an integrated USB interface.

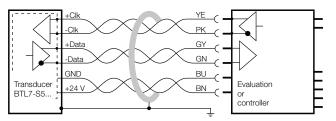
#### The clock frequency depends on the cable length.

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



#### LED indicator









Rated lengt	h ra	nge				Scan rate
25 mm	<	Rated length	≤	150 mm	:	4050 Hz
150 mm	<	Rated length	≤	300 mm	:	3250 Hz
300 mm	<	Rated length	≤	500 mm	:	2200 Hz
500 mm	<	Rated length	≤	1000 mm	:	1200 Hz
1000 mm	<	Rated length	≤	2000 mm	:	650 Hz
2000 mm	<	Rated length	≤	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	<b>Normal function</b> The position encoder is within the limits
Red	<b>Error</b> No position encoder, or position encoder 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
Flashing	Programming mode
green	Only with BTL7-S510(B)





+Data

Series	Rod BTL7	
Output signal	Synchronous-serial	
Transducer interface	S	
Customer device interface	Synchronous-serial	
Part number - Standard asynchronous	BTL7-S5M	
Part number - Plus asynchronous	BTL7-S510-M	
Part number - Standard synchronous	BTL7-S5 <b>B</b> -M	
Part number - Plus synchronous	BTL7-S510 <b>B</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	Micropulse
Max. linearity deviation	$\pm$ 30 µm with 5 and 10 µm resolution or $\leq$ $\pm$ 2 LSB	Transducers
Temperature coefficient, typical	≤ 15 ppm/K	Duefile D
Supply voltage, stabilized	1030 V DC	Profile P
Current consumption	≤ 120 mA	Profile PF
Operating temperature	–40+85 °C	TIONICTI
Storage temperature	-40+100 °C	Profile AT

Clock sequence

MSB

LSB

Out

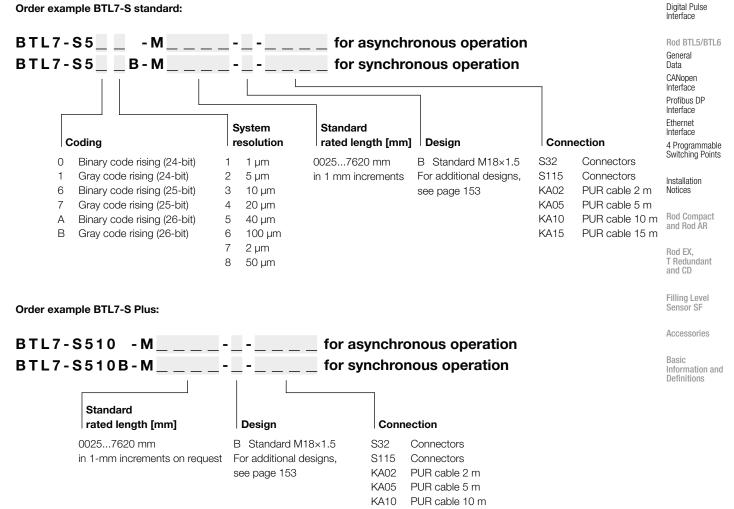
#### Scope of delivery

Transducer

Quick start instructions

Please enter code for coding, system resolution, rated length, design and connection in the part number.

Order example BTL7-S standard:



KA15

PUR cable 15 m

www.balluff.com

Profile BIW

Rod BTL7

General Data

Analog Interface

Programming SSI Interface



### 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 encoder
- Graphical support for setting the functions and characteristics
- Display of information via the connected transducer (model, serial number, firmware version, nominal length, SSI output signal)
- Selectable number formats and units for display
- Reset to factory settings possible
- Demo mode without having a transducer connected

### Configuration options of the position measuring system BTL7-S510_-...

- Number of position encoder 1 or 2
- Position
- Velocity
- Differential position
- Speed difference

#### 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

#### 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** 

Micropulse Configuration Tool					
BALLUFF sensors worldwide			al		2
	Positionsueber []	lusgang	www.balluff.com	Datei   Wegaufnehr	ner   Einstellungen   Hilf
	Funktion Position Geschwindigkeit Caschwindigkeit (kein Verzeichen)	Datenformat Bitancahi 24 Coderung Gray	0 000 mm	1.0 ⁺⁺ / ₊₊ µm/1r 0 ⁺ / ₊ 150.000 ⁺ / ₊ 150.000 ⁺ / ₊	Position einlesen
	O desthore: O desthore: O desthore: O desthore:	Obergrenze 15 Untergrenze		CONTRACTOR STRUCT	latenbits 1 kompatibel (Bit 25)
MICROPULSE	Number of Street		Position		
	Ausgangskenglinie		Revenue Sie d	a Pupits auf day hore	e, ure die zu verändeler.
nformation Wegaufnehmer TL7-65108-M0150-8-632 exennummer: 09070300050610 08 imvere: 0.01.011 ennlängei 350 mm	Ausgangskennlinie 150.000 131.072		Bavegen bie d Reigungzänderung die Tur		e, um die zu verlandem, niet 2 verdie al bevoegen.
Information Wegaufinehmer ITU-/51064-N0250-4-592 Iernennummer en 099703000050610 DE Iernennumner insvesse 0.0.0.011 Ierneniese 2100 mm Visigangstype 881 Visi Stease Visi Stea	150.000	7.44			nist 2 vertical becegar.
Information Wegaufinehmer ITU-51064-10250-4-522 Itereanwenner: 09970300050610 DE Itereanwenner: 150 000 Itereanwenner: 150 0000 Itereanwenner: 150 0000 Itereanwenner: 150 000 Itereanw	130.000	20. 49.			ndi 2 vertikal tevesor.



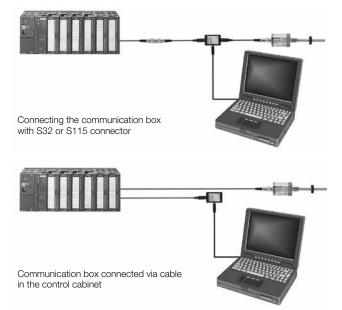
#### Connecting the USB communication box

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 with cable set				
Part number	Cable set			
BTL7-A-CB01-USB-S32	Connector S32			
BTL7-A-CB01-USB-S115	Plug connector S115			
BTL7-A-CB01-USB-KA	Cable connection			

#### Scope of delivery

- USB communication box
- Cable set
- Quick start instructions



#### Caution!

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



Micropulse Transducers

Profile P

Profile PF

Profile AT

Profile BIW

Rod BTL7 General Data Analog Interface

Programming SSI Interface Digital Pulse Interface

Rod BTL5/BTL6

General Data CANopen Interface Profibus DP Interface Ethernet Interface 4 Programmable Switching Points

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Filling Level Sensor SF

Accessories

Basic Information and Definitions

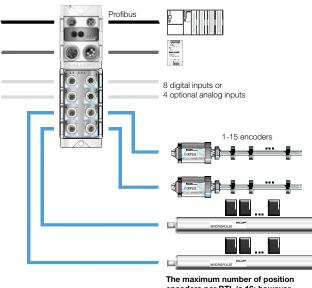


## cost-effective and synchronous performance

### 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 encoders can be used per BTL port. The maximum rated length 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 268



encoders per BTL is 16; however altogether, it is 60 per module.

#### Highly accurate digitalizations of the P511 pulse signal

Companies developing their own electronic control and processor units 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

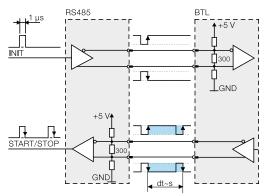
### P511 interface – Cost savings using DPI/IP for start-up and installation

DPI/IP is a protocol for direct data exchange 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

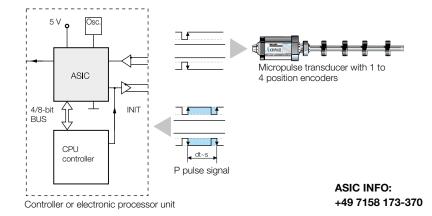
- Position measurement system controller using Init and start/stop signals
- Integrated diagnostic functions
- Plug and Play
- Automatic configuration shorter downtimes
- Transmission of sensor type, measuring length, specific parameters
- Measurement length up to 7,620 mm



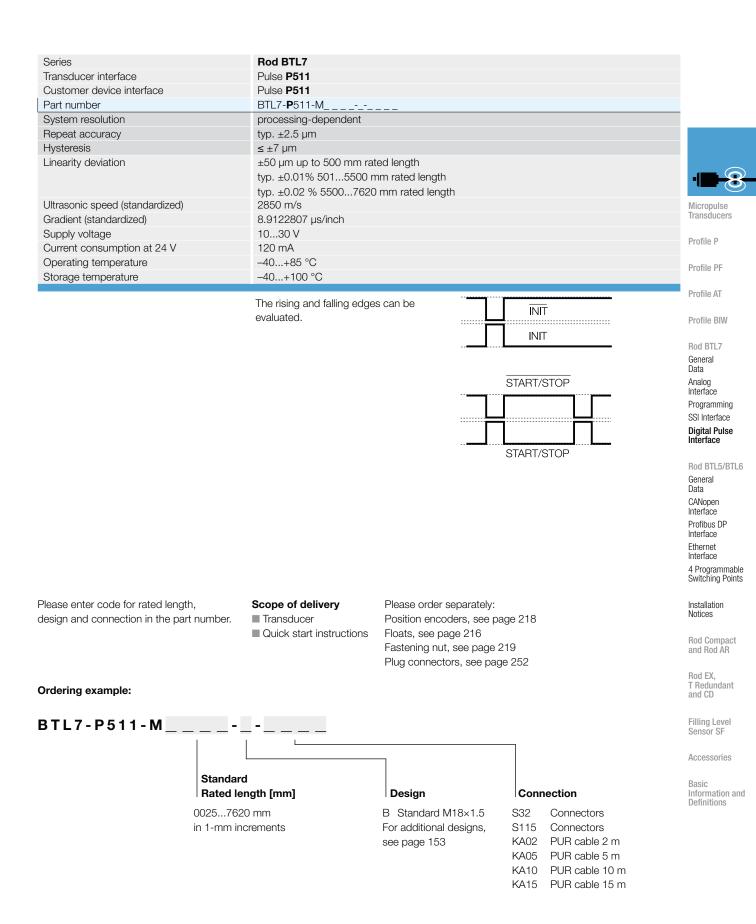
Block diagram of P interface

#### Benefits

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







### **Multitalent**

#### Pressure-resistant to 600 bar, high reproducibility, contactless, robust

Rod BTL5 **General data** 

The Micropulse Transducer BTL 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 highpressure 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 EN 60068-2-27
Vibration	12 g, 102000 Hz as 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 67 (with IP-67 connector BKS-S attached)
Housing material	Anodized aluminum/1.4571 stainless steel protective tube, 1.3952 stainless steel cast flange
Housing attachment	Style B thread M18×1.5, style Z 3/4"-16 UNF
Pressure rating	
with 10.2 mm protective tube	600 bar with installation in hydraulic cylinder
with 8 mm protective tube	250 bar 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
Electrical fast transient bursts (BURST)	EN 61000-4-4 Severity level 3
Conducted interference induced by	EN 61000-4-6 Severity level 3
high-frequency fields Standard nominal strokes [mm]	00255500 mm in 1-mm increments,
	,
with an 8 mm protective tube, the	depending on the interface
max. rated length is 1016 mm	
Scope of delivery	Please order separately:

- Transducer (select your interface Position encoders, see page 218 from page 170)
- Quick start instructions

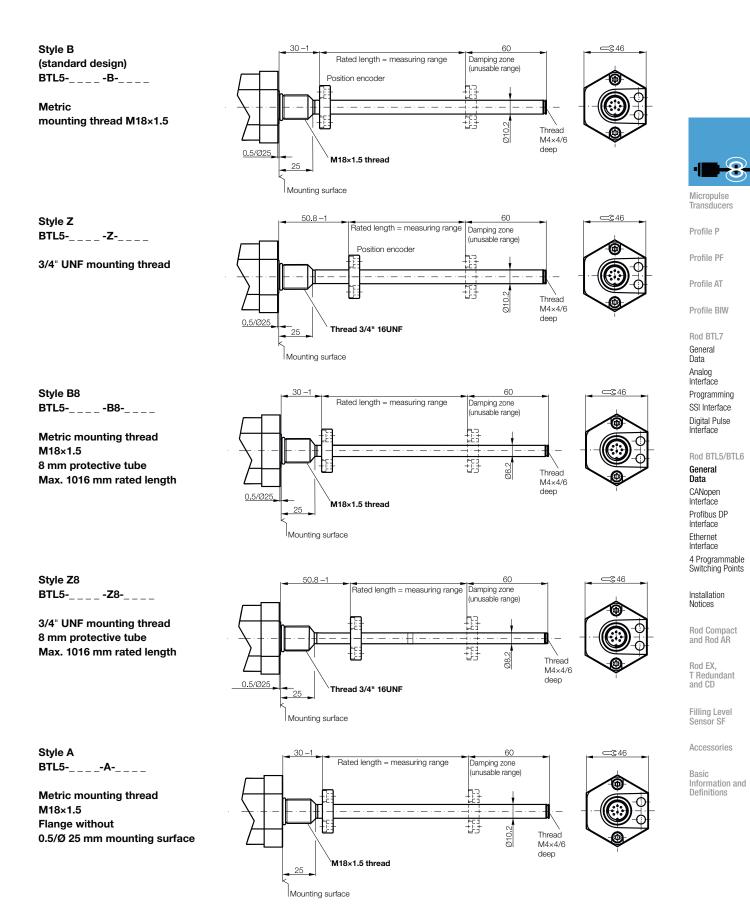
Floats, see page 216 Fastening nut, see page 219 Plug connectors, see page 252



Caution!

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







### Position and Velocity

#### **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 position information 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:

- Current encoder position with resolution in 5 µm increments
- Current speed of the position encoder, with resolution selectable in 0.1mm/s increments
- the current status of four freely programmable cams per position encoder

#### 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 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 in accordance with 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 for positions 3 and 4.

#### **Emergency Object**

This object is sent with the highest priority. This is used, for example, for error messages when 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 transducer's non-volatile memory.



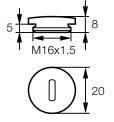
CiA 199911-301v30/11-009

#### Use of multiple position encoders

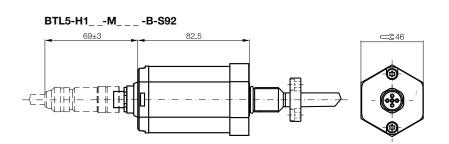
The minimum distance between the position encoders must be 65 mm.

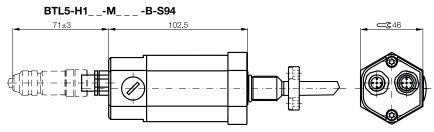
#### Inside temperature monitoring

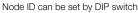
A built-in temperature sensor enables monitoring of the inside temperature in the electronic head. The temperature can be queried via the bus protocol.



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

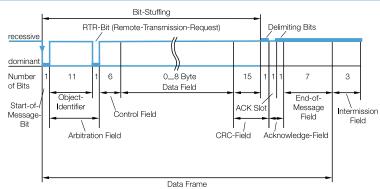








Series		BTL5 ro	BTL5 rod							
Output signal		CANope	n							
Transducer interface		н								
Customer device inte	erface	CANope	CANopen							
Part number		BTL5-H	3TL5- <b>H</b> 1MS92							
Part number		BTL5-H	BTL5- <b>H</b> 1MS94							
Repeat accuracy		±1 digit	±1 digit							
System resolution	Position	5 µm inc	rements							
Configurable	Velocity	0.1 mm/	's incremen	its						
Hysteresis		≤ 1 digit								
Measurement rate		<b>f</b> STANDARE	) = 1 kHz							Micropulse
Max. linearity deviation	on	±30 µm	at 5 µm res	solution						Transducers
Temperature coefficie	nt of overall system	(6 µm +	5 ppm × L)	/°C						Drofilo D
Supply voltage		2028 \	/ DC							Profile P
Current consumption	ı	≤ 100 m	A							Profile PF
Operating temperatu	re	-40+8	–40+85 °C							110mc 11
Storage temperature		-40+100 °C						Profile AT		
Cable length [m] per	CiA DS301	< 25	< 50	< 100	< 250	< 500	< 1000	< 1250	< 2500	
Baud rate [kbaud] pe	er CiA DS301	1000	800	500	250	125	100	50	20/10	Profile BIW



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

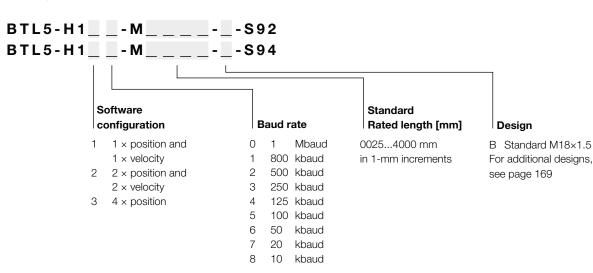
#### Scope of delivery

Transducer

Quick start instructions

Please order separately: Position encoders, see page 218 Floats, see page 216 Fastening nut, see page 219 Plug connectors, see page 252

#### Ordering example:



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 implemented in the data protocol. Analog Interface Programming SSI Interface Digital Pulse Interface Rod BTL5/BTL6 General Data CANopen Interface

Rod BTL7

General Data

CANopen Interface Profibus DP Interface Ethernet Interface 4 Programmable Switching Points

Installation Notices

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions



### CANopen and 2 analog inputs

#### **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 ( $\mu$ C).

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 -

#### Use of one to four position encoders

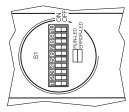
The number of encoders can be preset to 1-4 via CANopen. The transducer is preset to operate with an encoder on delivery. The minimum distance between the position encoders must be 65 mm.

#### Setting the node ID

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

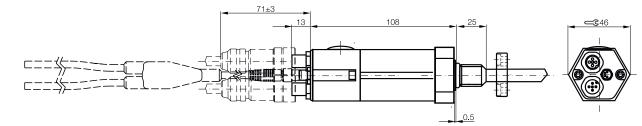


CiA 199911-301v30/11-009

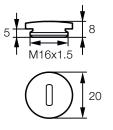


#### BTL5-H1__-M____-C001





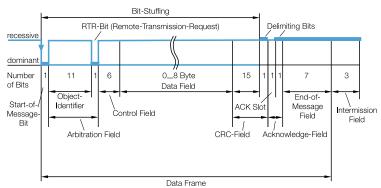
Node ID can be set by DIP switch



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



Series		Rod BT	Rod BTL5							
Output signal		CANope	en							
Transducer interface		Н								
Customer device inte	erface	CANope	CANopen							
Part number		BTL5-H	BTL5- <b>H</b> 1M							
CANopen version		Floating	Floating							
Repeat accuracy		±1 digit								
System resolution	Position	5 µm inc	crements							
Configurable	Velocity	0.1 mm/	/s incremen	ts						
Hysteresis		≤ 1 digit								
Measurement rate		f _{STANDARI}	_D = 1 kHz							Micropulse
Max. linearity deviation	on	±30 µm	at 5 µm res	solution						Transducers
Temperature coefficie	ent of overall system	(6 µm +	5 ppm × L)	/°C						Drofilo D
Supply voltage		2028	V DC							Profile P
Current consumption	า	≤ 100 m	ıΑ							Profile PF
Operating temperatu	ire	-40+8	-40+85 °C							1 TOILE T
Storage temperature	)	-40+100 °C					Profile AT			
Cable length [m] per	CiA DS301	< 25	< 50	< 100	< 250	< 500	< 1000	< 1250	< 2500	
Baud rate [kbaud] pe	er CiA DS301	1000	800	500	250	125	100	50	20/10	Profile BIW



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

#### Scope of delivery

Transducer

Quick start instructions

Please order separately: Position encoders, see page 218 Floats, see page 216 Fastening nut, see page 219 Plug connectors, see page 252

#### Ordering example:

#### BTL5-H1 - C 0 0 1 - M -L Standard Input configuration Baud rate Rated length [mm] Design A 3-wire voltage, 0 1 Mbaud 0025...4000 mm B Standard M18×1.5 0...+10 V, 12-bit, 1 800 kbaud in 1-mm increments For additional designs, 2 500 kbaud see page 169 Max. 2 inputs С 3-wire current, З 250 kbaud 0...20 mA, 12-bit, 4 125 kbaud 5 100 kbaud Max. 2 inputs Е 6 50 kbaud 2 wire current, 4...20 mA, 12-bit, 7 20 kbaud 8 10 kbaud Max. 2 inputs

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 implemented

in the data protocol.

www.balluff.com

Rod BTL7

General Data

Analog Interface

Programming

SSI Interface

Digital Pulse Interface

General Data

CANopen Interface

Profibus DP Interface

4 Programmable Switching Points

Installation Notices

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions

Ethernet Interface

Rod BTL5/BTL6



### Position and velocity

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

Master Class 1

Slave 1

Slave 2

Slave 3

Slave 4

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 to 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 node 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  $\mu$ s 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  $\mu$ s.

#### FMM

Class 2 master

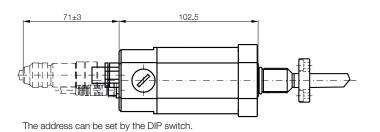
Slave x

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.

#### Inside temperature monitoring

A built-in temperature sensor enables monitoring of the inside temperature in the electronic head. The temperature can be queried via the bus protocol.

#### Device address can be set by DIP switch

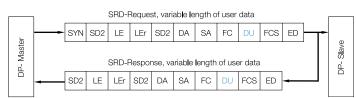


5 M16x1.5

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



Series	Rod BTL5					
Output signal	Profibus DP					
Transducer interface	т					
Customer device interface	Profibus DP					
Part number plug version S103	BTL5- <b>T</b> 1_0-	MS103				
Profibus version	EN 50170, e	ncoder profile				
Profibus interface	Floating					
Repeat accuracy	±1 digit					
System resolution Position	Configurable	in increments of 5 µm	1			
Configurable Velocity	0.1 mm/s inc	rements configurable				
Hysteresis	≤ 1 digit					Micropulse
Measurement rate	$f_{STANDARD} = 1$	kHz				Transducers
Max. linearity deviation	±30 µm at 5	µm resolution				Profile P
Temperature coefficient of overall system	(6 µm + 5 pp	m × L)/°C				Prome P
Position encoder travel speed	any					Profile PF
Supply voltage	2028 V DC					110ml011
Current consumption	≤ 120 mA					Profile AT
Operating temperature	-40+85 °C					
Storage temperature	-40+100 °	C				Profile BIW
GSD file	BTL504B2.G	iSD				
Address assignment	Mechanical s	witches and Class 2 r	naster			Rod BTL7
Cable length [m]	< 100	< 200	< 400	<1000	< 1200	General Data
Baud rate [Kbps]	12000	1500	900	187.5	93.7/19.2/9.6	Analog
						Interface



Please enter code for software configuration, rated length and design in the part number.

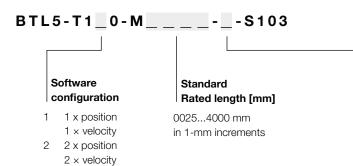
#### Scope of delivery

Transducer

Quick start instructions

Please order separately: Position encoders, see page 218 Floats, see page 216 Fastening nut, see page 219 Plug connectors, see page 252

#### Ordering example:



#### Design

B Standard M18×1.5 For additional designs, see page 169 Programming SSI Interface Digital Pulse Interface

#### Rod BTL5/BTL6

General Data CANopen Interface Profibus DP Interface Ethernet Interface 4 Programmable Switching Points

Installation Notices

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions



### Real-time Ethernet cost-effective

#### Feedback system for hydraulically controlled axes

Micropulse position measurement systems with a rod design integrated in the pressure section of the hydraulic cylinder measure the current piston position directly. Optimal control quality of the hydraulic axis is achieved through dynamic, reproducible high-precision measurements. The extremely quick and secure real-time data transmission of the industrial Ethernet and the precise dynamic measurement of the piston position of the Micropulse BTL makes the system ideal for use in advanced applications with regulated axes.

#### **Reduction in material and installation costs**

The Micropulse position measurement system's single-plug solution lowers total system costs enormously. And every plug connection spared also means that a significant source of errors is eliminated.

#### Features

Non-contact detection of the measuring position

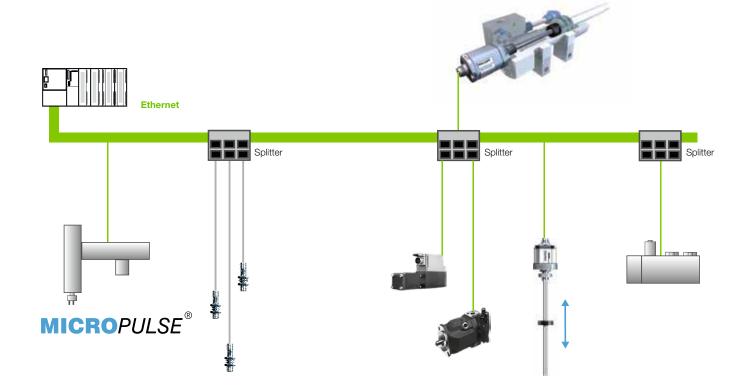
- Pressure-resistant up to 600 bar (1000 bar) for direct integration in the pressure area
- IP 67, insensitive to contamination
- Insensitive to shock and vibration
- Absolute output signal
- Measurement length up to 4012 mm
- Fast, simple mounting
- Single-plug solution lower system costs

#### Additional information

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

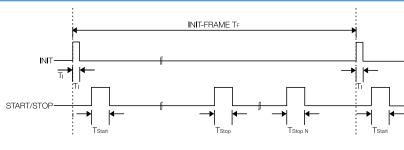








Series	Rod BTL6	Rod BTL6	
Output signal	VARAN	EtherCAT	
Transducer interface	V11V	V11E	
Customer device interface	VARAN	EtherCAT	
Part number	BTL6-V11 <b>V</b> -MB-S115	BTL- <b>V</b> 11E-MB-S115	
System resolution	≤ 15 µm	≤ 10 µm	
Repeat accuracy	≤ 20 µm	≤ 30 µm	
Measurement rate	f _{STANDARD} = 1 kHz (< 850 mm)	f _{STANDARD} = 1 kHz (< 850 mm)	
Linearity deviation	$\leq$ ±200 µm up to 500 mm rated length	$\leq \pm 200 \mu$ m up to 500 mm rated length	-1
	±0.04 %	±0.04 %	
	5001500 mm rated length	5001500 mm rated length	Micropulse
Supply voltage	2028 V DC	2028 V DC	Transducers
Current consumption	≤ 75 mA	≤ 100 mA	Du Che D
Polarity reversal protected	yes	yes	Profile P
Operating temperature	0+70 °C	0+70 °C	Profile PF
Storage temperature	-40+100 °C	-40+100 °C	I TOILE FI
			Profile AT



Please enter the code for the rated length in the part number.

#### Scope of delivery

TransducerQuick start instructions

Please order separately: Position encoders, see page 218 Floats, see page 216 Fastening nut, see page 219 Plug connectors, see page 252

#### Ordering example:



B Standard M18×1.5 For additional designs, see page 169 Rod BTL5/BTL6 General Data

Profile BIW Rod BTL7

General Data

Analog Interface

Programming SSI Interface Digital Pulse Interface

CANopen Interface Profibus DP Interface

Ethernet Interface 4 Programmable Switching Points

Installation Notices

Rod Compact and Rod AR

> Rod EX, T Redundant and CD

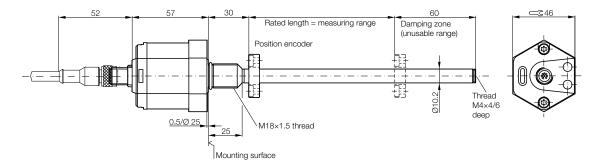
Filling Level Sensor SF

Accessories

Basic Information and Definitions



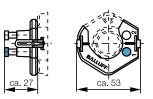
### simple switching

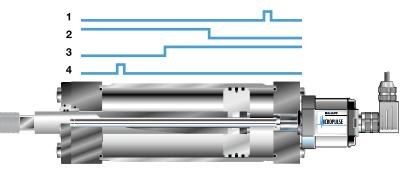


### Single position measurement between the piston limits on a standard cylinder series

#### 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





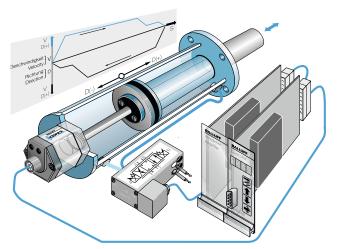
Series	Rod BTL5	
Transducer interface	F	
Customer device interface	digital	
Part number	BTL5- <b>F</b> 1_0-MS115	
Output signals	4 switching outputs	
Max. current load per output	100 mA	
Max. current load for 4 outputs	200 mA	
Repeat accuracy	±0.1 mm	
Measurement rate	$f_{STANDARD} = 1 \text{ kHz} = \le 1400 \text{ mm}$	
Supply voltage	24 V DC ±20%	
Current consumption without load	≤ 100 mA	Micropulse
Operating temperature	−40+85 °C	Transducers
Storage temperature	-40+100 °C	Profile P
Shock load	100 g/6 ms as per EN 60068-2-27	TIONET
Vibration	12 g, 102000 Hz as per EN 60068-2-6	Profile PF
Dielectric strength	500 V DC (GND to housing)	
Degree of protection as per IEC 60529		Profile AT
Housing material	Anodized aluminum/1.4571 stainless steel protective tube, 1.3952 stainless steel cast flange	
Fastener	Thread M18×1.5, 3/4"-16 UNF on request	Profile BIW
Pressure rating	600 bar with installation in hydraulic cylinder	
Connection	Connectors	Rod BTL7 General
		Data
	Ausgang 1	Analog
	Ausgang 2	SSI Interface
		Digital Pulse
	Ausgang 3	Interface
	Ausgang <b>4</b> O	NUU DILJ/DILU
		) General Data
		CANopen
		Interface
Please enter code for output signal, rate	d	Profibus DP Interface
length and design in the part number.	ProSet	Ethernet
	DraCat	Interface
Scope of delivery		4 Programmable Switching Points
Transducer		<b>j</b>
Quick start instructions		Installation
Calibration device		Notices
		Rod Compact
Please order separately:		and Rod AR
Position encoders, see page 218		
Floats, see page 216		Rod EX,
Fastening nut, see page 219		T Redundant and CD
Plug connectors, see page 252		
		Filling Level
Ordering example:		Sensor SF
		Accessories
BTL5-F1_0-M	S115	ACCESSOILES
		Basic
		Information and
Sta	ndard	Definitions
	ed length [mm] Design	
·		
	4000 mm in 1-mm increments B Standard M18×1.5	
NPN switching	For additional designs, see page 169	
1 Output DND owitching		
PNP switching		



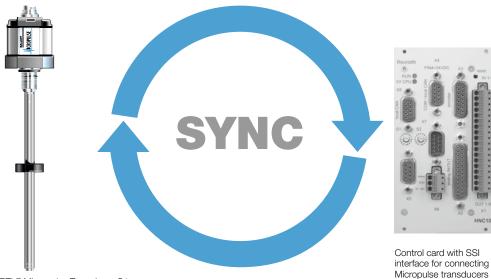
#### SSI-SYNC - better control behavior and higher dynamics

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 loop gain and with it, better control behavior and higher dynamics.

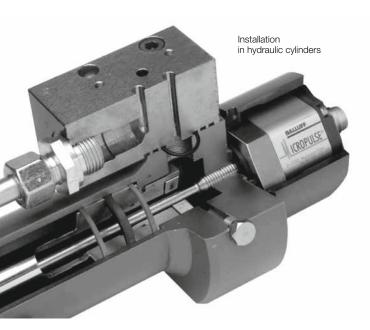


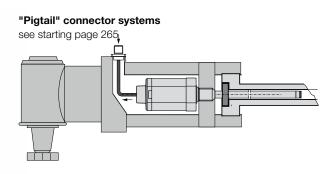
Application with hydraulic cylinder in a control loop



Control card with SSI

BTL7 Micropulse Transducer S1_ _





#### Caution!

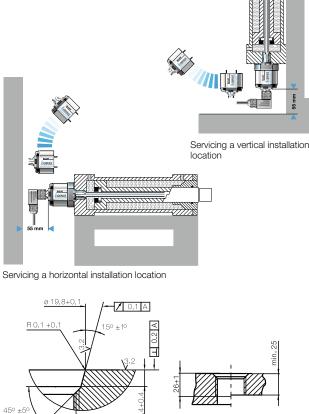
Before design, installation and startup please familiarize yourself with the user's guide to be found at www.balluff.com.



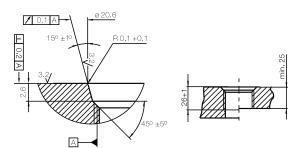
#### Service without great assembly effort

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 waveguide is often a difficult and expensive proposition.

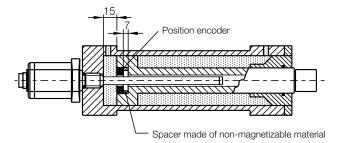
Should a problem occur in the electronics of the Micropulse Transducer, the electronics head can be easily and quickly exchanged for a new one. The fluid circuit is also not closed in the event of service, as no drainage is necessary.

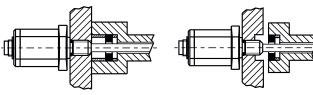


A Tapped hole M18×1.5, as per ISO 6149, O-ring 15.4×2.1



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



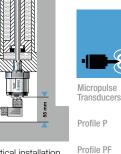


Installation

The Micropulse transducer BTL has a mounting thread M18×1.5. 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, for example, in the B design, with a M18×1.5 thread with an included 15.4×2.1 O-ring.

#### **Tapped hole**

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



Profile AT

Profile BIW

Rod BTL7 General Data Analog Interface Programming SSI Interface Digital Pulse Interface

Rod BTL5/BTL6 General Data CANopen Interface Profibus DP Interface Ethernet Interface

4 Programmable Switching Points

#### Installation Notices

Rod Compact and Rod AR

Rod EX, T Redundant and CD

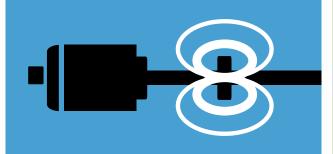
Filling Level Sensor SF

Accessories

Basic Information and Definitions



www.balluff.com



# Micropulse Transducers

# Rod Compact and Rod AR

- Compact housing with only 34 mm in length saves valuable space in and around the cylinder.
- Stainless steel housing with connecting flange and robust 6-screw fastening (K) no additional protective housing is needed
- Simple characteristic settings
- shock and vibration-resistant with IP 67/68 degree of protection
- Pressure-resistant housing, for extreme applications like offshore or under water
- Available with analog signals, digital interfaces and fieldbuses
- for complete integration in hydraulic cylinders (AR)

Rod Compact and Rod AR Contents

#### **Rod Compact**

nou compute	
K BTL7, General Data	184
H/W BTL7, General Data	186
BTL7, General Data	188
K BTL5, General Data	192
H/W BTL5, General Data	194
HB/WB BTL5, General Data	196
Analog Interface	198
Digital Pulse Interface	200
SSI Interface	202
CANopen Interface	204
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Rod AR BTL6	
General Data	208
Analog Interface	210
Digital Pulse Interface	212
Installation Notices	214

Floats	216
Position Encoders	218



## becomes flat

#### Pressure-resistant to 600 bar, high reproducibility, contactless, robust

General data

Rod Compact K BTL7

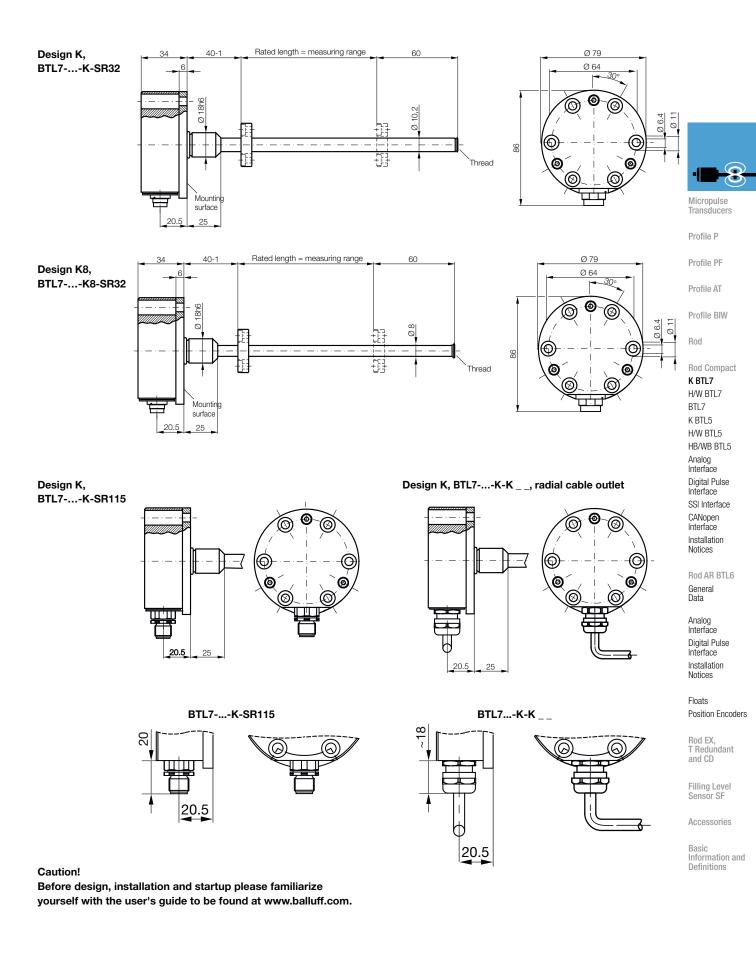
The Micropulse Transducer BTL is a robust position measuring system for measuring ranges between 25 and 7620 mm under extreme ambient conditions. The actual measurement section is protected inside a highpressure resistant stainless steel tube. The system is ideal for use in hydraulic cylinders for position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

Series	Rod Compact K BTL7
Shock load	150 g/6 ms as per EN 60068-2-27
Vibration	20 g, 102000 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	IP 68 with cable outlet, IP 67 with screwed-on plug connector
60529	BKS-S
Housing material	Anodized aluminum/1.4571 stainless steel protective tube, 1.3952
	stainless steel cast flange
Fastener	Design K, 18h6 with 6 cylinder head screws
Pressure rating	
with 10.2 mm protective tube	600 bar with installation in hydraulic cylinder
with 8 mm protective tube	250 bar installed in hydraulic cylinder
Connection	Plug 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
Electrical fast transient bursts	EN 61000-4-4 Severity level 3
(BURST)	
Surge voltage	EN 61000-4-5 Severity level 2
Conducted interference	EN 61000-4-6 Severity level 3
induced by high-frequency	
fields	
Magnetic fields	EN 61000-4-8 Severity level 4
Standard nominal strokes [mm]	00257620 mm in 1-mm increments
with an 8 mm protective tube, the	
max. rated length is 1016 mm	

**Stainless steel** 

Stai





### Rod Compact BTL7 H/W General data

#### Pressure-resistant to 600 bar, high reproducibility, contactless, robust

The Micropulse Transducer BTL 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 highpressure 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.

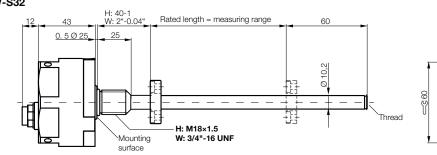
Series	Rod Compact BTL7 H/W
Shock load	150 g/6 ms as per EN 60068-2-27
Vibration	20 g, 102000 Hz per EN 60068-2-6
Polarity reversal protected	to 36 V
Overvoltage protection	to 36 V
Dielectric strength	500 V AC (GND to housing)
Degree of protection as per IEC	IP 68 with cable outlet, IP 67 with screwed-on plug connector
60529	BKS-S
Housing material	Anodized aluminum/1.4571 stainless steel protective tube, 1.3952 stainless steel cast flange
Fastener	Design H M18×1.5 thread
	Design W 3/4"-16 UNF
Pressure rating	
with 10.2 mm protective tube	600 bar with installation in hydraulic cylinder
with 8 mm protective tube	250 bar installed in hydraulic cylinder
Connection	Plug 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
Electrical fast transient bursts (BURST)	EN 61000-4-4 Severity level 3
Surge voltage	EN 61000-4-5 Severity level 2
Conducted interference	EN 61000-4-6 Severity level 3
induced by high-frequency	
fields	
Magnetic fields	EN 61000-4-8 Severity level 4
Standard nominal strokes [mm]	00257620 mm in 1-mm increments
with an 8 mm protective tube, the	
max. rated length is 1016 mm	

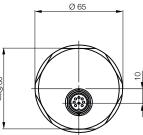


Caution! Before design, installation and startup please familiarize yourself with the user's guide to be found at www.balluff.com.

## "Long" Rod Compact BTL7 H/W General data

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







Micropulse Transducers

Profile P

Profile PF

- -

Profile AT

Profile BIW

Rod

Rod Compact K BTL7

K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface CANopen Interface Installation Notices

Rod AR BTL6 General Data Analog Interface Digital Pulse Interface Installation Notices

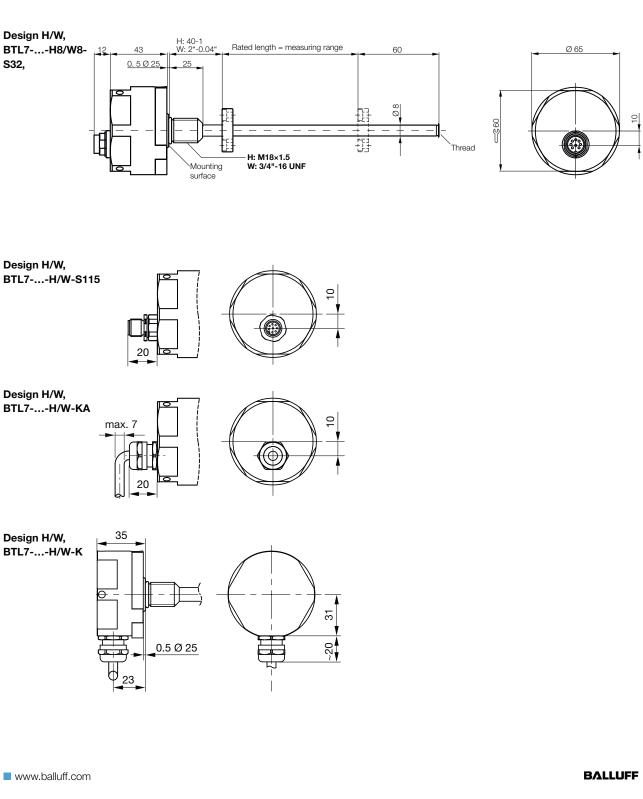
Floats Position Encoders

Rod EX, T Redundant and CD

> Filling Level Sensor SF

Accessories

187





### 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-mm increments
- Flexibly adjustable measuring range through button programming
- High measurement rate up to 4 kHz
- Temperature range –40...+85°C

### Micropulse transducer BTL7 Compact with calibration box BTL-A-CB02

With the Calibration Box BTL-A-CB02, the characteristic 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 downloads, the measuring range as well as the slope of the output characteristic are set. The setting option saves storage and setup costs, since one Micropulse BTL7 Compact can fulfill different requirements that, in the past, required several systems.

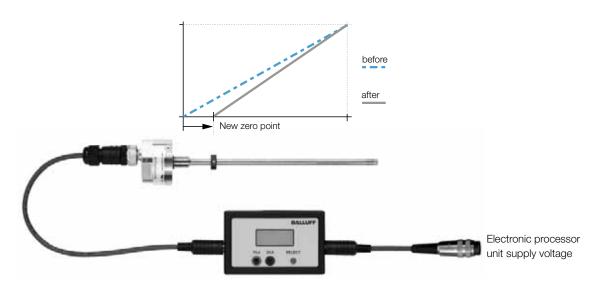
Series	
Output signal	
Transducer interface	
Customer device interface	
Part number	
Output voltage	
Output current	
Load current	
Load resistance	
System resolution	
Repeat accuracy	
Measurement rate, length-dependent	
Max. linearity deviation	
Temperature coefficient	
Supply voltage	
Current consumption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

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

#### Scope of delivery

- Transducer
- Quick start instructions
- Stainless steel fastening screws "600 bar"

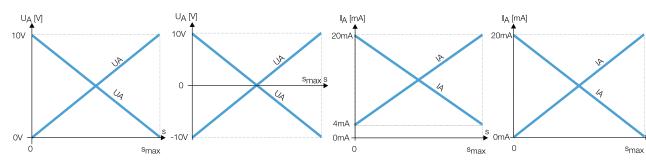
Please order separately: Calibration box, see page 190 Position encoders, see page 216



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
Α	G	E	С
Analog	Analog	Analog	Analog
BTL7- <b>A</b> 510-M	BTL7- <b>G</b> 510-M	BTL7- <b>E</b> 5_0-M	BTL7- <b>C</b> 5_0-M
010 V and 100 V	-1010 V and 1010 V		
		420 mA or 204 mA	020 mA or 200 mA
Max. 5 mA	Max. 5 mA		
		≤ 500 Ω	≤ 500 Ω
≤ 0.33 mV	≤ 0.33 mV	≤ 0.66 µA	≤ 0.66 µA
System resolution/min. 2 µm			
Max. 4 kHz	Max. 4 kHz	Max. 4 kHz	Max. 4 kHz
$\pm 50 \ \mu m$ to $\leq 500 \ mm$ rated length	$\pm 50 \ \mu m$ to $\leq 500 \ mm$ rated length	$\pm 50 \ \mu m$ to $\leq 500 \ mm$ rated length	$\pm 50 \ \mu m$ to $\leq 500 \ mm$ rated length
±0.01% FS < 5500 mm rated length			
±0.02% FS > 5500 mm rated length	$\pm 0.02\%$ FS > 5500 mm rated length	$\pm 0.02\%$ FS > 5500 mm rated length	$\pm 0.02\%$ FS > 5500 mm rated length
≤ 30 ppm/K	≤ 30 ppm/K	≤ 30 ppm/K	≤ 30 ppm/K
1030 V DC	1030 V DC	1030 V DC	1030 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 (GND to housing)			
−40+85 °C	–40+85 °C	–40+85 °C	-40+85 °C



Ordering example:

	7 5 _	_0-M		-				Rod AR BTL6 General Data Analog Interface Digital Pulse Interface Installation
Output signal	τ	Characteristic	nominal strokes [mm]		esign	Con	nection	Notices
A 01	0 V 1	rising and falling	00257620 in 1-mm increments	K K	10.2 mm protective tube 8 mm protective tube		al design PUR cable 2 m	Float Position Encoders
10	.0 V 10 V C	(at A and G)		H H8 W	10.2 mm protective tube 8 mm protective tube 10.2 mm protective tube	K05 K10 K15	PUR cable 5 m PUR cable 10 m PUR cable 15 m	Rod EX, T Redundant and CD
10	.–10 V 7 20 mA	· · · · · ·		W8	8 mm protective tube	SR32	Connectors 5 Connectors	Filling Level Sensor SF
	.4 mA					H/W r K02	adial design PUR cable 2 m	Accessories
or	20 mA .0 mA					K05 K10 K15	PUR cable 5 m PUR cable 10 m PUR cable 15 m	Basic Information and Definitions
							lesign, axial PUR cable 2 m PUR cable 5 m PUR cable 10 m PUR cable 15 m Connectors Connectors	

H/W BTL7

BTL7

K BTL5

H/W BTL5

Analog Interface

HB/WB BTL5

Digital Pulse Interface

SSI Interface

CANopen

Interface Installation Notices



Calibration box with cable set		
Part number	Cable set	
BTL7-A-CB02	Cable connection	
BTL7-A-CB02-S115	Plug 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 characteristic 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.

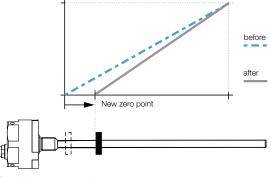
#### Adjusting

Setting and adjusting the characteristic with stopped position encoder. 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.

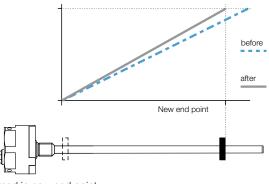
Adjustment is possible from serial number 120615000xxxxx xx.

#### Reset

Restoring the transducer to its factory default settings.





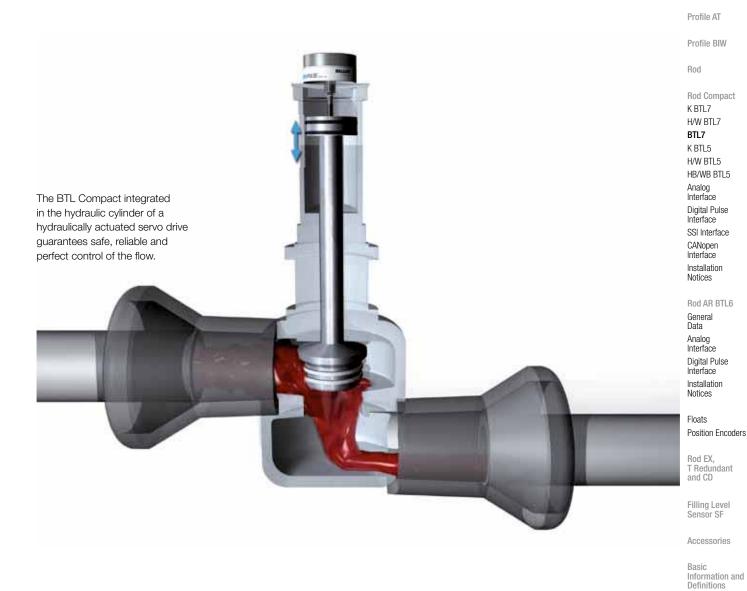


Read in new end point



### BTL Compact – the standard in power plant and process engineering

Balluff, as the first manufacturer of magnetostrictive position measurement 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 measurement 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.



BALLUFF | 191

Micropulse Transducers

Profile P

Profile PF

### Rod Compact K BTL5 General data

## **Stainless steel**

#### Pressure-resistant to 600 bar, high reproducibility, contactless, robust

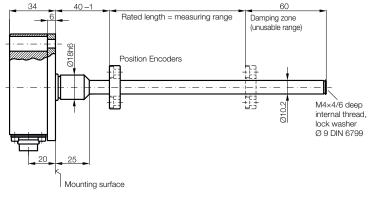
The Micropulse Transducer BTL is a robust position measurement system for measuring ranges between 25 and 5500 mm as well as for use under extreme ambient conditions. The actual measurement section is protected inside a high-pressure resistant stainless steel tube. The system is ideal for use in hydraulic cylinders for position feedback or as a level monitor with aggressive media in the food and chemical industries.

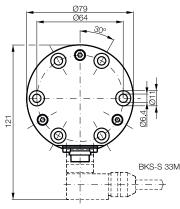
Series	Rod Compact K BTL5
Shock load	100 g/6 ms in accordance with EN 60068-2-27 and 100 g/2 ms in
	accordance with EN 60068-2-29
Vibration	12 g, 102000 Hz as per EN 60068-2-6
Polarity reversal protected	yes
Overvoltage protection	TransZorb protection diodes
Dielectric strength	500 V DC (GND to housing)
Degree of protection as per IEC	IP 67 (with IP-67 connector BKS-S attached);
60529	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	Plug connector or cable connection
Plug connector suggestion	BKS-S 32M/BKS-S 32M-C/BKS-S 33M
see page 188/212	
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
(BURST)	
Conducted interference	EN 61000-4-6 Severity level 3
induced by high-frequency	
fields	
Standard nominal strokes [mm]	00255500 mm in 1-mm increments, depending on the interface



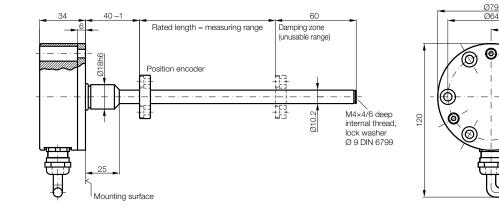


#### Design K, BTL5-...-M_ _ _ _-K-SR32





Design K, BTL5-...-M____-K-K__



Rod Compact K BTL7 H/W BTL7 BTL7 K BTL5 HB/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface CANopen Interface Installation Notices

Micropulse Transducers

Profile P

Profile PF

Profile AT Profile BIW

Rod AR BTL6 General Data Analog Interface Digital Pulse Interface Installation Notices

Floats Position Encoders

Rod EX, T Redundant and CD

> Filling Level Sensor SF

Accessories

Basic Information and Definitions

#### Caution!

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

### Rod Compact H/W BTL5 General data

# **Stainless steel**

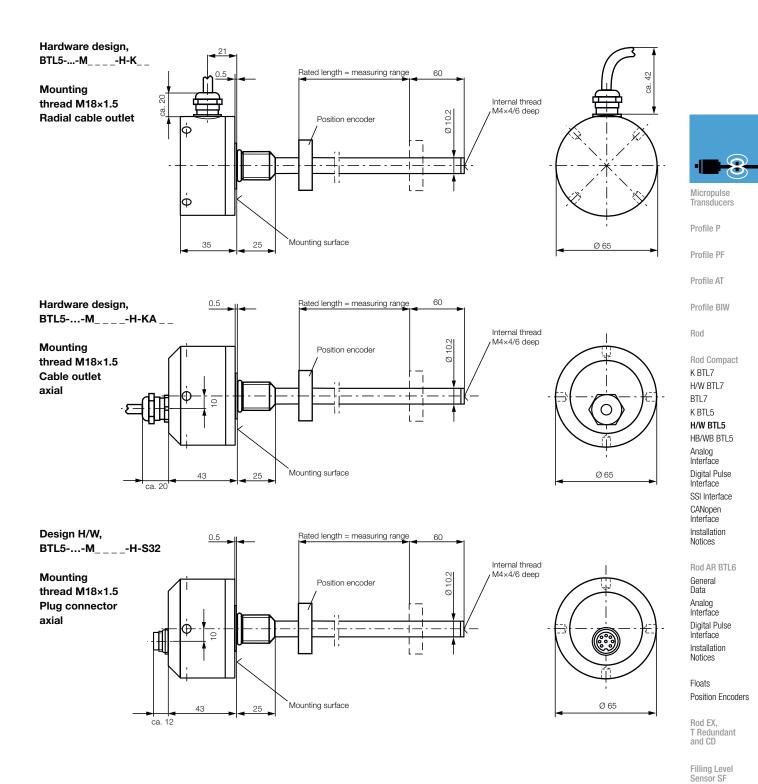
#### Pressure-resistant to 600 bar, high reproducibility, contactless, robust

The Micropulse Transducer BTL is a robust position measurement 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.

Shock load100 g/6 ms in accordance with EN 60068-2-27 and 100 g/2 ms in accordance with EN 60068-2-29Vibration12 g, 102000 Hz as per EN 60068-2-6Polarity reversal protectedyesOvervoltage protectionTransZorb protection diodesDielectric strength500 V DC (GND to housing)Degree of protection as per IECIP 67 (with IP-67 connector BKS-S attached);60529IP 68 (5 bar with cable)
Vibration12 g, 102000 Hz as per EN 60068-2-6Polarity reversal protectedyesOvervoltage protectionTransZorb protection diodesDielectric strength500 V DC (GND to housing)Degree of protection as per IECIP 67 (with IP-67 connector BKS-S attached);
Polarity reversal protectedyesOvervoltage protectionTransZorb protection diodesDielectric strength500 V DC (GND to housing)Degree of protection as per IECIP 67 (with IP-67 connector BKS-S attached);
Overvoltage protectionTransZorb protection diodesDielectric strength500 V DC (GND to housing)Degree of protection as per IECIP 67 (with IP-67 connector BKS-S attached);
Dielectric strength500 V DC (GND to housing)Degree of protection as per IECIP 67 (with IP-67 connector BKS-S attached);
Degree of protection as per IEC IP 67 (with IP-67 connector BKS-S attached);
60520 IP 68 (5 bar with cable)
60529 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 H thread M18×1.5, design W 3/4"-16 UNF
Connection Plug connector or cable connection
Plug connector suggestion BKS-S 32M/BKS-S 32M-C/BKS-S 33M
see page 188/212
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
(BURST)
Conducted interference EN 61000-4-6 Severity level 3
induced by high-frequency
fields
Standard nominal strokes [mm] 00255500 mm in 1-mm increments







#### Caution!

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

Accessories

### Rod ProCompact HB/WB BTL5 General data

# 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 used as an absolute signal for the controller in a wide range of different interfaces.

#### Areas of application

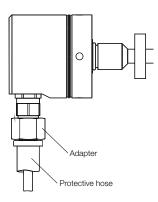
- Locks and floodgates
- Water power plants
- Large, hydraulically powered valves
- Positioning the reflection channels
- for thermosolar power plants

  Dredger
- Railway track
- Logging machines
- Hydroelectric power plants
- Construction machinery
- Combine harvesters



#### Accessories for the cable protection system

. . .

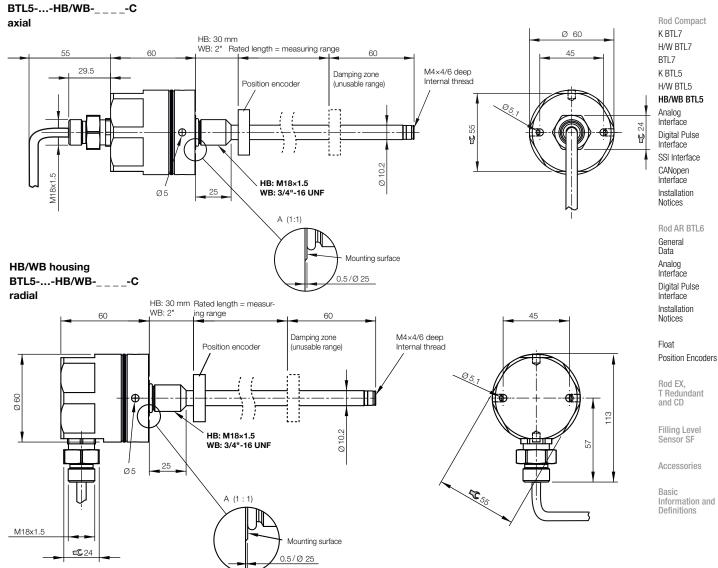


Series	Adapter
Ordering code	BAM01JW
Part number	BAM AD-XA-007-M18×1.5/D12-2
Housing material	Brass (not saltwater-resistant)
Ordering code	BAM01JY
Part number	BAM AD-XA-007-M18×1.5/D12-4
Housing material	Stainless steel V2A (conditionally saltwater-resistant)
Series	Protective hose
Part number	BAM PT-XA-001-095-0
Tube length	02, 05, 10, 15, 20, 30, 50 and 100 m
Degree of protection	IP 68 (40 bar)
	IP 69K (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



- · ·		
Series	Rod ProCompact HB/WB BTL5	
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, 102000 Hz as 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	Micropulse
EMC testing		Transducers
Radio interference emission	EN 55016-2-3 (industrial and residential area)	Duefile D
Static electricity (ESD)	EN 61000-4-2 Severity level 3	Profile P
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3	Profile PF
Electrical fast transient bursts (BURST)	EN 61000-4-4 Severity level 3	I TOILE I I
Conducted interference induced	EN 61000-4-6 Severity level 3	Profile AT
by high-frequency fields		
Standard nominal strokes [mm]	00255500 mm in 1-mm increments	Profile BIW

#### HB/WB housing



#### Caution!

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

Rod



## 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 used as an absolute signal for the controller in a wide range of different interfaces.

#### Areas of application

- 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 plants
- 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, rated length, design and connection in the part number.

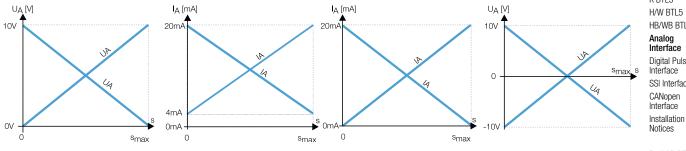
#### Scope of delivery

TransducerQuick start instructions

Please order separately: Position encoders, see page 218 Floats, see page 216 Fastening nut, see page 219 Plug connectors, see page 252



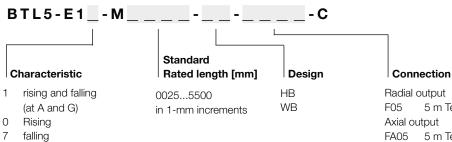
Rod Compact BTL5	Rod Compact BTL5	Rod Compact BTL5	Rod Compact BTL5
Analog	Analog	Analog	Analog
Α	E	С	G
Analog	Analog	Analog	Analog
BTL5- <b>A11</b> -MHB/WB	BTL5- <b>E1</b> -MHB/WB	BTL5- <b>C1</b> -MHB/WB	BTL5- <b>G11</b> -MHB/WB
010 V and 100 V			-1010 V and 1010 V
	420 mA or 204 mA	020 mA or 200 mA	
Max. 5 mA			Max. 5 mA
≤ 5 mV			≤ 5 mV
	≤ 500 Ω	≤ 500 Ω	
≤ 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
$f_{STANDARD} = 1 \text{ kHz}$	$f_{STANDARD} = 1 \text{ kHz}$	$f_{STANDARD} = 1 \text{ kHz}$	$f_{STANDARD} = 1 \text{ kHz}$
±100 up to 500 mm rated length	±100 up to 500 mm rated length	±100 up to 500 mm rated length	±100 up to 500 mm rated length
±0.02% 500 max. rated length	±0.02% 500 max. rated length	±0.02% 500 max. rated length	±0.02% 500 max. rated length
$[150 \ \mu\text{V/}^{\circ}\text{C} + (5 \ \text{ppm/}^{\circ}\text{C} \times \text{P} \times \text{U/L})] \times \Delta\text{T}$			$[150 \ \mu\text{V/°C} + (5 \ \text{ppm/°C} \times \text{P} \times \text{U/L})] \times \Delta\text{T}$
	$[0.6 \ \mu\text{A/°C} + (10 \ \text{ppm/°C} \times \text{P} \times \text{I/L})] \times \Delta\text{T}$	$[0.6 \ \mu\text{A/°C} + (10 \ \text{ppm/°C} \times \text{P} \times \text{I/L})] \times \Delta\text{T}$	
2028 V DC	2028 V DC	2028 V DC	2028 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 (GND to housing)	500 V DC (GND to housing)	500 V DC (GND to housing)	500 V DC (GND 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



5 m Teflon cable

5 m Teflon cable

Ordering example:



7 falling (for C and E) Rod Rod Compace K BTL7 H/W BTL7 BTL7 K BTL5 HB/WB BTL5 HB/WB BTL5 HB/WB BTL5 HB/WB BTL5 HB/WB BTL5 Interface SSI Interface CANopen Interface

> Rod AR BTL6 General Data Analog Interface Digital Pulse Interface Installation Notices

Floats Position Encoders

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories



# Compact and cost-effective

#### P Interface

The P interface is compatible with BTA processor units as well as with controllers and modules from various manufacturers including Siemens, B & R, Phoenix Contact, Mitsubishi, Sigmatek, Parker, Esitron, WAGO and others.

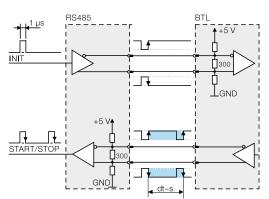
Reliable signal transmission, even with cable lengths of up to 500 m between the BTA processor unit and the BTL transducer. This is guaranteed by the especially interference-free RS485 differential drivers and receivers. Interference signals are effectively suppressed.

#### Highly precise digitizing of the P pulse signal

Companies developing their own electronic control and processor 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.

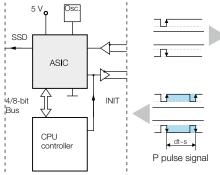
#### Benefits

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



Block diagram of P interface







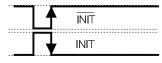
Micropulse transducer with 1 to 4 position encoders

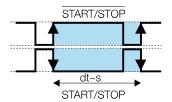
Controller or electronic processor unit

ASIC INFO: +49 7158 173-370



Series	Rod Compact BTL5	
Transducer interface	Pulse P	
Customer device interface	Pulse P	
Part number	BTL5- <b>P</b> 1-M	
System resolution	processing-dependent	
Repeat accuracy	2 µm or ±1 digit depending on electronic processor unit	
Resolution	≤ 2 µm	
Hysteresis	≤ 4 µm	
Measurement rate	$f_{STANDARD} = 1 \text{ kHz} = \le 1400 \text{ mm}$	
Max. linearity deviation	±100 µm up to 500 mm rated length	
	±0.02% 5005500 mm rated length	Micropulse
Temperature coefficient of overall system	(6 μm + 5 ppm × L)/°C	Transducers
Supply voltage	2028 V DC	D. Cla D
Current consumption	≤ 100 mA	Profile P
Operating temperature	−40+85 °C	Profile PF
Storage temperature	-40+100 °C	TUNCT
		Profile AT





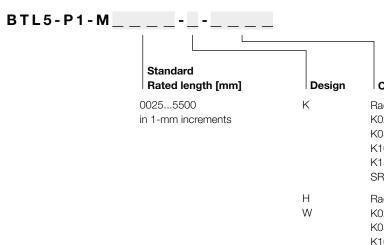
Please enter code for rated length, design and connection in the part number.

#### Scope of delivery

TransducerQuick start instructions

Please order separately: Position encoders, see page 218 Floats, see page 216 Fastening nut, see page 219 (for Stab Compact H) Plug connectors, see page 252

#### Ordering example:



Conne	ction
Radial ou	utput
K02	PUR cable 2 m
K05	PUR cable 5 m
K10	PUR cable 10 m
K15	PUR cable 15 m
SR32	Connectors
Radial ou	utput
K02	PUR cable 2 m
K05	PUR cable 5 m
K10	PUR cable 10 m
K15	PUR cable 15 m
Axial out	put
KA02	PUR cable 2 m
KA05	PUR cable 5 m
KA10	PUR cable 10 m
KA15	PUR cable 15 m
S32	Connectors

Profile BIW Rod Rod Compact K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface CANopen Interface Installation Notices

> Rod AR BTL6 General Data Analog Interface Digital Pulse Interface Installation Notices

Floats Position Encoders

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Rod Compact SSI interface

#### Standard SSI interface

The synchronous serial data transmission is used by 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.

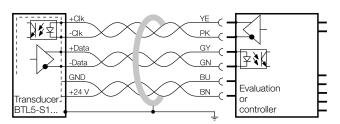
Reliable signal transmission, even with cable lengths of up to 400 m between controller and BTL transducer. This is guaranteed by the especially interference-free RS485/422 differential drivers and receivers. Any interference signals are effectively suppressed.

#### 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 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 scan rate**  $f_{\text{A}}$ , at which a new current value is generated for each scan, can be derived from the table:



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

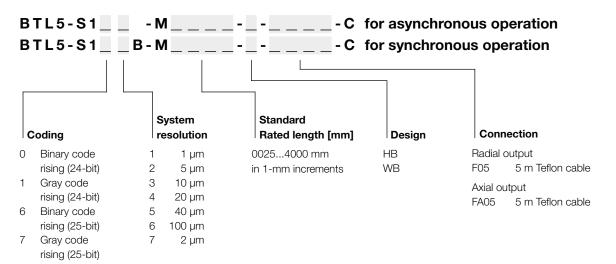


Rated length range			Scan rate
< Rated length	≤	100 mm	1500 Hz
100 mm < Rated length	≤	1000 mm	1000 Hz
1000 mm < Rated length	≤	1400 mm	666 Hz
1400 mm < Rated length	≤	2600 mm	500 Hz
2600 mm < Rated length	≤	4000 mm	333 Hz

#### The clock frequency depends on the cable length.

Cab	le 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:



# 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-S1M	
Part number synchronization	BTL5-S1B-M	
System resolution depending on model (LSB	3) 1, 2, 5, 10, 20, 40 or 100 μm	
Repeat accuracy	±1 digit	
Hysteresis	≤ 1 digit	
Measurement rate	$f_{STANDARD} = 1 \text{ kHz}$	
Max. linearity deviation.	$\pm 30 \ \mu m$ at $\leq 10 \ \mu m$ resolution or $\leq \pm 2 \ LSB$	Micropulse
Temperature coefficient of overall system	(6 μm +5 ppm × L)/°C	Transducers
Supply voltage	2028 V DC	Profile P
Current consumption	≤ 80 mA	FIUIILE F
Operating temperature	−40+85 °C	Profile PF
Storage temperature	-40+100 °C	FIUNGTI
	+Data	Rod Rod Compac
lease enter code for coding, system reso- tion, rated length, design and connection the part number.		Rod Compac K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog
tion, rated length, design and connection the part number.	*Data     Out of range     MSB     LSB     LSB     Scope of delivery     Please order separately:     Transducer     Position encoders, see page 218     Quick start     Floats, see page 216     instructions     Fastening nut, see page 219     Plug connectors, see page 252	Rod Compac K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface
tion, rated length, design and connection the part number.		Rod Compac K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse
tion, rated length, design and connection the part number.	*Data     Out of range     MSB     LSB     LSB     Scope of delivery     Please order separately:     Transducer     Position encoders, see page 218     Quick start     Floats, see page 216     instructions     Fastening nut, see page 219     Plug connectors, see page 252	Rod Compac K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interfacc CANopen
tion, rated length, design and connection the part number.		Rod Compac K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface <b>SSI Interfac</b> CANopen Interface Installation Notices
tion, rated length, design and connection the part number.		Rod Compac K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface CANopen Interface Installation Notices Rod AR BTL0 General
tion, rated length, design and connection the part number.		Rod Compac K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface CANopen Interface Installation Notices Rod AR BTL0 General Data
tion, rated length, design and connection the part number.		Rod Compac K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface CANopen Interface Installation Notices Rod AR BTL0 General
tion, rated length, design and connection the part number.		Rod Compa K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface Installation Notices Rod AR BTL General Data Analog Interface Digital Pulse
tion, rated length, design and connection the part number.	<ul> <li>+Data</li></ul>	Rod Compa K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface SSI Interface Installation Notices Rod AR BTL General Data Analog Interface Digital Pulse Interface Digital Pulse Interface
tion, rated length, design and connection the part number. TL5-S1M TL5-S1B-M Coding	<ul> <li>LB</li> <li>LB</li> <li>Scope of delivery Please order separately:</li> <li>Transducer Position encoders, see page 218</li> <li>Quick start Floats, see page 216 instructions Fastening nut, see page 219 Plug connectors, see page 252</li> <li>Image of the second se</li></ul>	Rod Compa K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface <b>SSI Interfac</b> CANopen Interface Installation Notices <b>Rod AR BTL</b> General Data Analog Interface Digital Pulse Interface Installation
tion, rated length, design and connection the part number. TL5-S1M TL5-S1B-M Coding re 0 Binary code 1	<ul> <li>*Data</li> <li>*Place</li> <li>*</li></ul>	Rod Compa K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface SSI Interface Installation Notices Rod AR BTL General Data Analog Interface Digital Pulse Interface Digital Pulse Interface
tion, rated length, design and connection the part number.	Scope of delivery Please order separately:          • Transducer       Position encoders, see page 218         • Quick start       Floats, see page 219         • Quick start       Floats, see page 219         • Plug connectors, see page 252	Rod Compa K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface CANopen Interface Installation Notices Not AR BTL General Data Analog Interface Digital Pulse Interface Installation Notices
tion, rated length, design and connection the part number.	<ul> <li>*Data</li> <li>*Place</li> <li>*</li></ul>	Rod Compa K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface <b>SSI Interfac</b> CANopen Interface Installation Notices <b>Rod AR BTL</b> General Data Analog Interface Digital Pulse Interface Installation

www.balluff.com

6 Binary code

7 Gray code,

rising (25-bit)

rising (25-bit)

5 40 µm

6 100 µm

7 2 µm

Rod EX,

T Redundant and CD

Filling Level Sensor SF

Accessories

Information and Definitions

Basic

PUR cable 15 m

PUR cable 2 m

PUR cable 5 m

PUR cable 10 m

PUR cable 15 m

PUR cable 2 m

PUR cable 5 m

PUR cable 10 m PUR cable 15 m

Connectors

Connectors

K15

K02

K05

K10

K15

KA02

KA05

KA10

KA15 S32

Н

W

SR32

Radial output

Axial output



#### **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 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 position information 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:

Current encoder position with resolution in 5 µm increments

- Current speed of the position encoder, with resolution selectable in 0.1mm/s increments
- the current status of four freely programmable cams per position encoder

#### 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.

#### 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. This is used, for example, for error messages when 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/CANopen tool. The configuration is stored in the transducer's non-volatile memory.

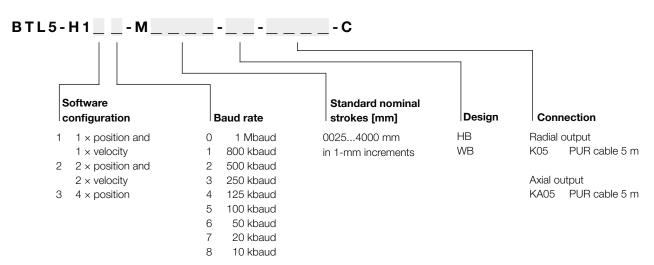


CiA 199911-301v30/11-009

#### Use of multiple position encoders

The minimum distance between the position encoders must be 65 mm.

#### Ordering example:





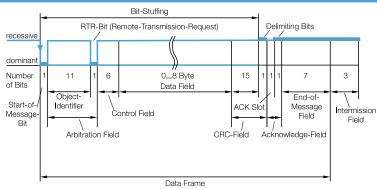
Series		Rod Co	mpact BT	L5						
Output signal		CANope	n							
Transducer interface		Н								
Customer device inte	erface	CANope	n							
Part number		BTL5-H	1M							
CANopen Version		Floating								
Repeat accuracy		±1 digit								
System resolution,	Position	5 µm inc	rements							
configurable	Velocity	0.1 mm/	's incremen	ts						
Hysteresis		≤ 1 digit								
Measurement rate		<b>f</b> STANDARE	) = 1 kHz							Micropulse
Max. linearity deviation	on	±30 µm	at 5 µm res	solution						Transducers
Temperature coefficie	nt of overall system	(6 µm +	5 ppm × L)	/°C						Drofilo D
Supply voltage		2028 \	/ DC							Profile P
Current consumption	1	≤ 100 m	A							Profile PF
Operating temperatu	re	-40+8	5 °C							TIONETT
Storage temperature		-40+1	00 °C							Profile AT
Cable length [m] per	CiA DS301	< 25	< 50	< 100	< 250	< 500	< 1000	< 1250	< 2500	
Baud rate [kbaud] pe	er CiA DS301	1000	800	500	250	125	100	50	20/10	Profile BIW

Please enter code for software configuration, baud rate, rated length and design in the part number. Cable on request.

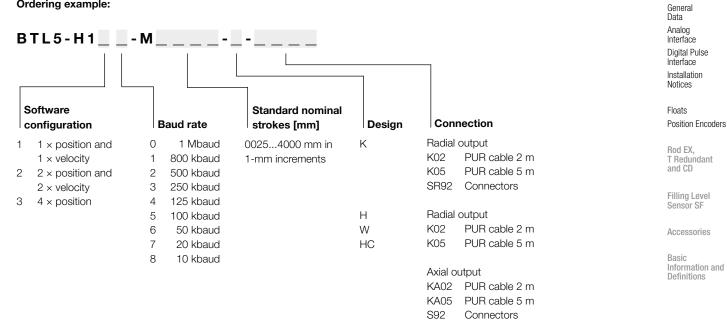
#### Scope of delivery

Transducer Quick start instructions

Please order separately: Position encoders, see page 218 Floats, see page 216 Fastening nut, see page 219 Plug connectors, see page 252



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 implemented in the data protocol.



#### Ordering example:

Rod

K BTL7

BTL7

K BTL5

H/W BTL5

Analog Interface

HB/WB BTL5

Digital Pulse Interface

SSI Interface

CANopen

Interface Installation

Notices

Rod AR BTL6

H/W BTL7

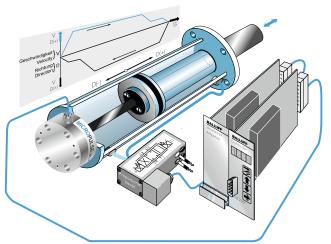
Rod Compact

### Rod Compact H/K/W BTL5/7 Installation notices

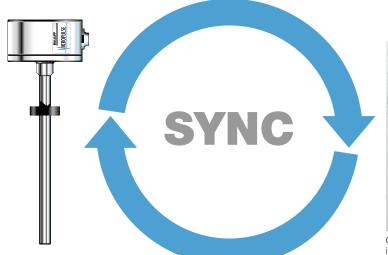
#### SSI-SYNC - better control behavior and higher dynamics

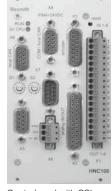
The absolute position information from the Micropulse transducer is transmitted synchronously to the axis control card. This synchronous data acquisition permits a precise calculation of the speed and acceleration.

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 loop gain and with it, better control behavior and higher dynamics.



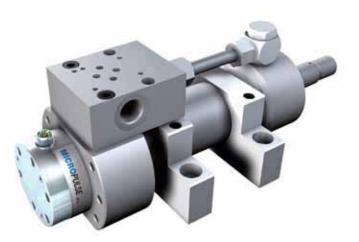
Application with hydraulic cylinder in a control loop





Control card with SSI interface for connecting Micropulse Transducers

Micropulse Transducer BTL5 S1__



Caution!

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



Z 0.1 A

#### Installation of BTL Rod Compact H

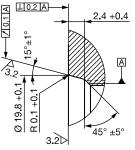
The Micropulse Transducer BTL has an M18×1.5 mounting thread. We recommend that the mounting is made of non-magnetizable material.

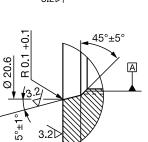
If magnetizable materials are used, then the measures shown below have to be taken. Sealing is at the flange mounting surface using the supplied 15.4×2.1 O-ring with M18×1.5 thread.

#### Installation of BTL Rod Compact W

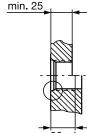
The Micropulse transducer BTL has a mounting thread M18×1.5. We recommend that the mounting is made of non-magnetizable material.

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.





2.6



26 + 1



10.2 A Countersink for O-ring



min. 25

Rod Rod Compact K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface CANopen

Interface Installation Notices

Rod AR BTL6

General

Interface

Interface Installation

Notices

Digital Pulse

Data Analog

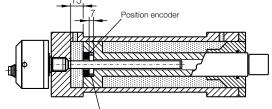
Micropulse Transducers

Profile P

Profile PF

Profile AT

Profile BIW

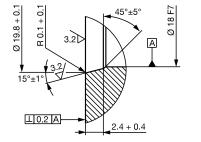


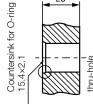
Spacer made of non-magnetizable material

#### Installation BTL Rod Compact K

The Micropulse Transducer BTL 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.



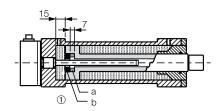


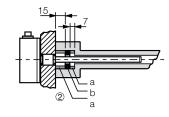


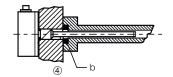
Rod EX. T Redundant and CD

Filling Level Sensor SF

Accessories







- with magnetizable material 1-2 with non-magnetizable material
- 4 А Spacer made of non-magnetizable
- material В Position encoder



## **Mobile hydraulics**

### Position detection in mobile hydraulics

Sensors are being used increasingly to extend the useful life and improve safety in mobile equipment.

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 eve end cylinders or large bore cylinders. The electronic processor 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.

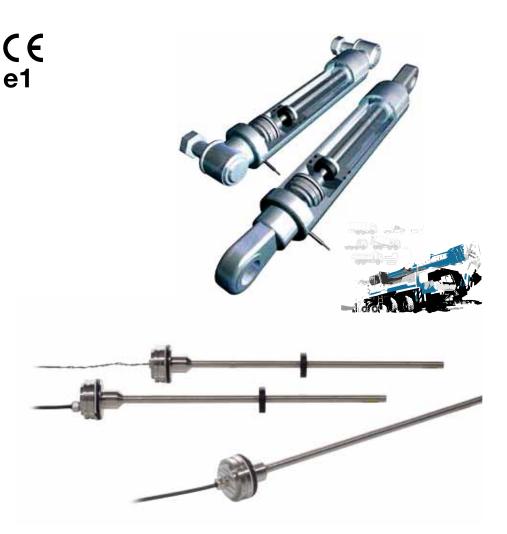
### Compatibility testing according to EMC Directives

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

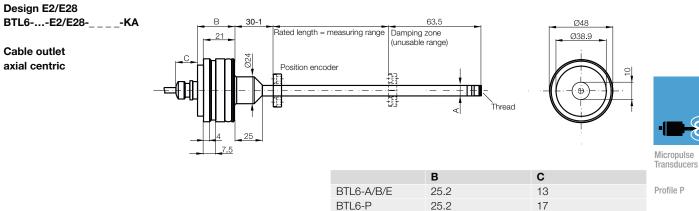
#### e1 type approval

The e1 type approval is granted by the German Federal Motor Transport Authority (Kraftfahrt-Bundesamt, or KBA). It confirms that special motor vehicle standards have been maintained. The devices may be mounted on vehicles which travel on public roads. The standards describe EMC conditions under which the devices must operate interference-free. e1 approved Micropulse Transducers are indicated by "-SA265-" in the part number.

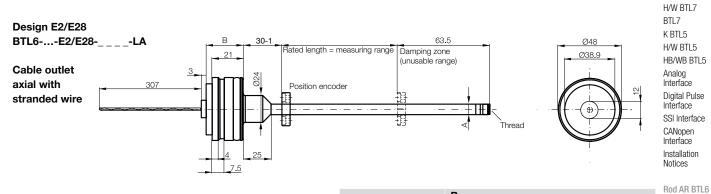
Series	Rod AR BTL6
Shock load	100 g/6 ms as per EN 60068-2-27
Continuous shock	50 g/2 ms
Vibration	12 g, 102000 Hz as per EN 60068-2-6
Polarity reversal protected	yes
Dielectric strength	500 V DC (GND to housing)
Degree of protection as per IEC 60529	IP 67
Housing material	Stainless steel protective tube 1.4571, stainless steel flange 1.4404
Pressure rating	
with 10.2 mm protective tube E2	350 bar installed in hydraulic cylinder
with 8 mm protective tube E28	250 bar 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
Electrical fast transient bursts	EN 61000-4-4 Severity level 3
(BURST)	
Surge voltage	EN 61000-4-5 Severity level 2
Conducted interference	EN 61000-4-6 Severity level 3
Magnetic fields	EN 61000-4-8 Severity level 4
Standard nominal strokes [mm]	00502000 mm in 1-mm increments
with 8 mm outer tube (style E28),	
the max. rated length is 1016 mm	







BTL6-P	25.2	17
	Α	G
E2	10.2	Thread M4×4/6 deep
E28	8	without thread



	В	
BTL6-A/B/E	25.7	
BTL6-P	25.7	
	Α	G
E2	10.2	Thread M4×4/6 deep
E28	8	without thread

### Notices Float

General Data Analog Interface Digital Pulse Interface Installation

Profile PF

Profile AT

Profile BIW

Rod Compact K BTL7

Rod

#### Position Encoders

Rod EX, T Redundant and CD

> Filling Level Sensor SF

Accessories

Basic Information and Definitions

#### Caution!

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

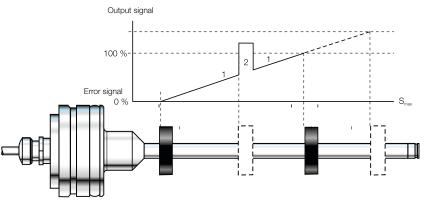


The position encoder's position is determined from the runtime of an ultrasonic wave, triggered by magnetostriction.

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

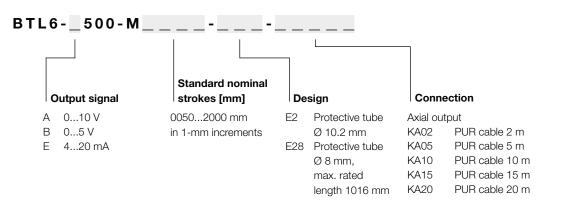
- Within the measuring range (1)
- Position encoder not available (2)



#### 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 Voltage output Temperature coef-Current output ficient Supply voltage Current consumption Polarity reversal protected Overvoltage protection Dielectric strength Operating temperature Storage temperature

Output signal with rising characteristic

#### Ordering example:

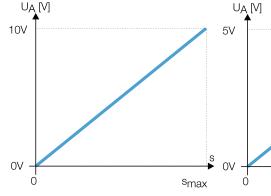


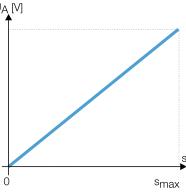
Axial output LA00,3 PUR stranded wire, 0.3 m

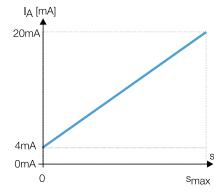
"Pigtail" connector systems "ZA" See page 265.



Rod AR BTL6	Rod AR BTL6	Rod AR BTL6	
Analog	Analog	Analog	
Α	В	E	
Analog	Analog	Analog	
BTL6- <b>A</b> 500-M	BTL6- <b>B</b> 500-M	BTL6- <b>E</b> 500-M	
010 V	05 V		
		420 mA	
Max. 2 mA	Max. 2 mA		
≤ 5 mV	≤ 2 mV		- (
		≤ 500 Ω	
±1.5 mV	±1.5 mV	±7 μA	Micropuls
≤ 5 µm	≤ 4 µm		Transduc
System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm	Duefile D
f _{STANDARD} = 1 kHz	f _{STANDARD} = 1 kHz	f _{STANDARD} = 1 kHz	Profile P
±200 µm to 500 mm rated length	±200 µm to 500 mm rated length	±200 µm to 500 mm rated length	Profile PF
typ. $\pm 0.02\% \ge 500$ rated length	typ. $\pm 0.02\% \ge 500$ rated length	typ. $\pm 0.02\% \ge 500$ rated length	TTOHICTT
$[150 \ \mu\text{V/}^{\circ}\text{C} + (5 \ \text{ppm/}^{\circ}\text{C} \times \text{P} \times \text{U/L})] \times \Delta\text{T}$	$[150 \ \mu V/^{\circ}C + (5 \ ppm/^{\circ}C \times P \times U/L)] \times \Delta T$	$[150 \mu\text{V/°C} + (5 \text{ppm/°C} \times \text{P} \times \text{U/L})] \times \Delta\text{T}$	Profile AT
$[0.6 \ \mu\text{A/°C} + (10 \ \text{ppm/°C} \times \text{P} \times \text{I/L})] \times \Delta\text{T}$	$[0.6 \ \mu\text{A/°C} + (10 \ \text{ppm/°C} \times \text{P} \times \text{I/L})] \times \Delta\text{T}$	$[0.6 \ \mu\text{A/°C} + (10 \ \text{ppm/°C} \times \text{P} \times \text{I/L})] \times \Delta\text{T}$	
1030 V DC	1030 V DC	1030 V DC	Profile BI
typ. ≤ 60 mA	typ. ≤ 60 mA	typ. ≤ 60 mA	
yes	yes	yes	Rod
yes	yes	yes	
500 V DC (GND to housing)	500 V DC (GND to housing)	500 V DC (GND to housing)	Rod Comp
−40+85 °C	−40+85 °C	–40+85 °C	K BTL7 H/W BTL7
-40+100 °C	–40+100 °C	-40+100 °C	H/W BIL/ BTL7







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

#### Scope of delivery

Transducer Quick start instructions

Please order separately: Position encoders, see page 218 Floats, see page 216

Floats Position Encoders

Rod AR BTL6

General Data

Analog Interface Digital Pulse

Interface Installation

Notices

s •

H/W BTL5

Analog Interface Digital Pulse Interface SSI Interface CANopen Interface Installation Notices

HB/WB BTL5

Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories



#### P510 interface

The 510 interface is compatible with BTA processor 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 processor unit and the transducer. This is guaranteed by the especially interference-free RS485/differential drivers and receivers. Interference signals are effectively suppressed.

#### 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.

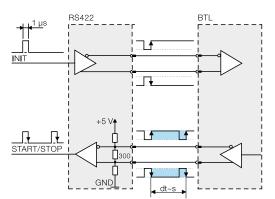
The difference lies in how the edges are processed. The falling edges are processed in the P interface and the rising edges in the M interface. To reduce the number of different models to a minimum, the P510 interface was created as a universal pulse interface which combines both functions. The reference 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 processor 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.

#### **Benefits**

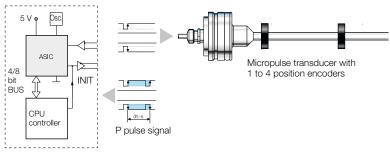
- High position resolution: the actual 1 µm resolution of the BTL position measurement system is supported completely by the
- 133 ps resolution of the chip (at low clock frequency 2 or 20 MHz).Position data from 4 position encoders can be processed simultaneously
- 4/8-bit processor interface



Block diagram of P interface



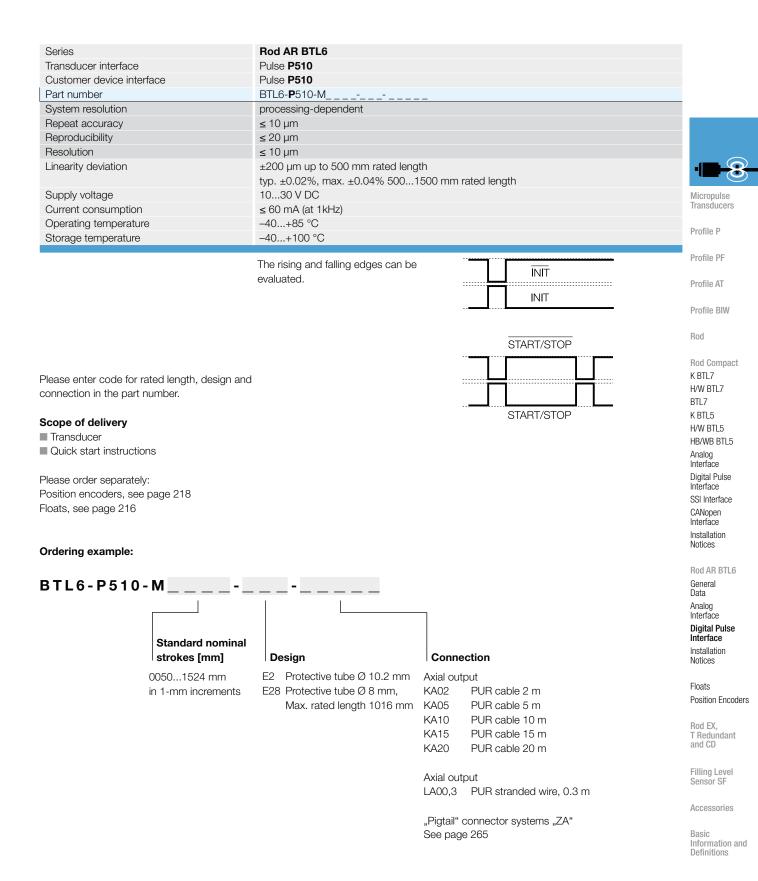
Digitizing chip 44QFP



Controller or electronic processor unit

ASIC INFO: +49 7158 173-370

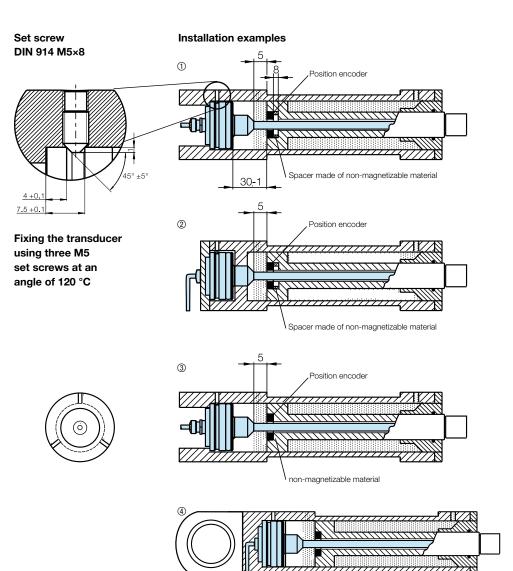






Series AR Micropulse Transducers BTL are designed for integration in hydraulic cylinders. The transducer is supported mechanically on the housing. Three M5 set screws at an angle of 120 °C hold the transducer, which fits into a Ø 48 H8 fitting bore.

Sealing is accomplished using the supplied O-ring and support ring. The position encoder integrated in the piston marks the actual position of the piston without making contact. The metal surrounding of the cylinder eliminates the need for a cable shield with the BTL AR...**LA**, cable outlet stranded wire version is installed in the cylinder. The stranded wire version cannot be used without additional EMC protection (shield).



#### Caution!

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

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





Micropulse Transducers

Profile P

Profile PF

Profile AT

Profile BIW

Rod

Rod Compact K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface CANopen Interface Installation Notices

Rod AR BTL6 General Data Analog Interface Digital Pulse Interface Installation Notices

Floats Position Encoders

Rod EX, T Redundant and CD

> Filling Level Sensor SF

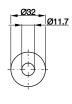
> Accessories



Description	Float	Float
for Series	Rod BTL (8 mm)	Rod BTL
Ordering code	BAM01ZE	BAM024J
Part number	BTL-S-2510-2Z	BTL2-S-3212-4Z
Material	Stainless steel 1.4404	Stainless steel 1.4404
Weight	approx. 9 g	Approx. 20 g
Operating temperature/Storage temperature range	–20+130 °C	–20+120 °C
Immersion depth in water	approx. 30 mm	approx. 35 mm
Pressure rating (static)	60 bar	24 bar





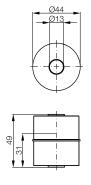






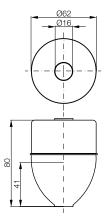


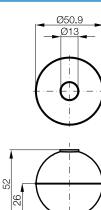
Float	Float	Float
Rod BTL	Rod BTL	Rod BTL
BAM0146	BAM014C	BAM0149
BTL2-S-4414-4Z	BTL2-S-6216-8P	BTL2-S-5113-4K
Stainless steel 1.4404	Stainless steel 1.4404	Stainless steel 1.4404
Approx. 34 g	Approx. 69 g	Approx. 35 g
–20+120 °C	–20+120 °C	–20+120 °C
approx. 31 mm	approx. 41 mm	approx. 26 mm
20 bar	15 bar	40 bar



Before design, installation and startup please familiarize your-

self with the user's guide to be found at www.balluff.com.





8

Micropulse Transducers

Profile P

Profile PF

Profile AT

Profile BIW

Rod

Rod Compact K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface CANopen Interface Installation Notices

Rod AR BTL6 General Data Analog Interface Digital Pulse Interface Installation Notices

Floats Position Encoders

Rod FX

Rod EX, T Redundant and CD

Filling Level Sensor SF

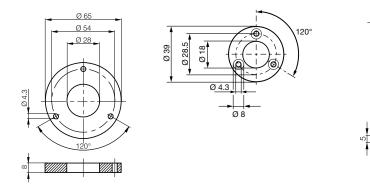
Accessories

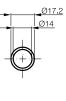
Basic Information and Definitions

Caution!



Description	Position encoder	Position encoder	Position encoder	
for Series	Rod BTL	Rod BTL	Rod BTL	
Ordering code	BAM01CE	BAM013Y	BAM013H	
Part number	BTL-P-1018-3R	BTL-P-1028-15R	BTL-P-0814-GR-PAF	
Material	AI	Al	Ferrite bound in PA	
Weight		approx. 68 g	approx. 1.5 g	
Position encoder travel speed	any	any	any	
Operating temperature/ Storage temperature	−40+100 °C	−40+100 °C	-40+100 °C	
Ordering code				
Part number PA 60				
fiberglass reinforced				
Material				
Weight				
Position encoder travel speed				
Operating temperature/Storage temperature				

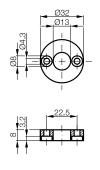


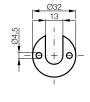


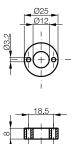


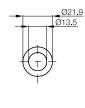


Position encoder	Position encoder	Position encoder	Position encoder	
Rod BTL	Rod BTL	Rod BTL	Rod BTL	
BAM013L	BAM013P	BAM013J	BAM013R	
BTL-P-1013-4R	BTL-P-1013-4S	BTL-P-1012-4R	BTL-P-1014-2R	
Aluminum	Aluminum	Aluminum	Aluminum	
approx. 12 g	approx. 12 g	approx. 12 g	approx. 10 g	
any	any	any	any	
-40+100 °C	−40+100 °C	−40+100 °C	–40+100 °C	· <b>B</b> -8
BAM013M		BAM013K		Micropulse
				Transducers
BTL-P-1013-4R-PA		BTL-P-1012-4R-PA		Dur Cha D
PA 60 fiberglass reinforced		PA 60 fiberglass reinforced		Profile P
approx. 10 g		approx. 10 g		Profile PF
any		any		TIONICTT
				Profile AT
-40+100 °C		-40+100 °C		
				Profile BIW









Rod Rod Compact K BTL7 H/W BTL7 BTL7 K BTL5 H/W BTL5 HB/WB BTL5 Analog Interface Digital Pulse Interface SSI Interface CANopen Interface Installation Notices

Rod AR BTL6 General Data Analog Interface Digital Pulse Interface Installation Notices

Floats Position Encoders

Rod EX, T Redundant and CD

> Filling Level Sensor SF

Accessories

Basic Information and Definitions

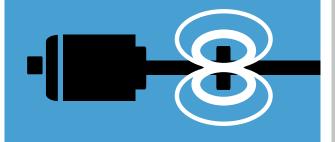
0

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

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

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

www.balluff.com



## Rod EX

- For use in a potentially explosive environment
- With IECEx, ATEX, FM, and many other international approvals
- Different solutions in accordance with the requirements
- With a slim, 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 M18×1.5 or UNF 3/4" thread or via adapter with connecting flange and 6 cheese head screws

# Micropulse Transducers

# Rod CD

- Pressure-resistant up to 1000 bar the sensor for high-pressure hydraulic units
- Mounting thread M22×1.5 with 12.7 mm pressure pipe
- Measuring lengths up to 2000 mm in millimeter increments
- Shock- and vibration-resistant with high degree of protection, for robust use
- Available with analog signals, digital interfaces, fieldbuses, and Real-Time Ethernet





Rod EX		
Filling Level Sensor in Zone 0/1	222	
Transducer in Zone 1	223	
Rod DEX, General Data	224	
Rod J-DEXC, General Data	227	
Rod PEX, General Data	230	
Rod NEX, General Data	231	
Floats and Encoders	232	
Rod T Redundant		•
General Data	234	
Programming	238	
Position Encoders	239	

Rod CD General Data

240



COPULY

BTLS-ATLIAISID-LOEX.

ALU



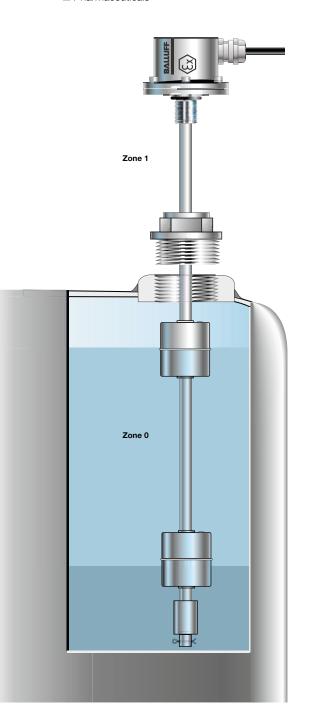
## **Compact housing**

#### 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. Floats, see page 232.

#### Applications

- Filling stations
- Tank systems
- Refineries
- Chemical industry
- Pharmaceuticals



Installation examples





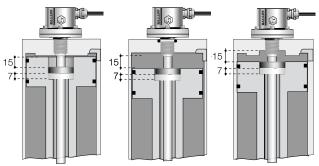


#### BTL5-_1-M...-B-DEXB-__

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





Micropulse Transducers

Profile P Profile PF Profile AT

Profile BIW

Rod

Rod EX Filling Level

Rod Compact and Rod AR

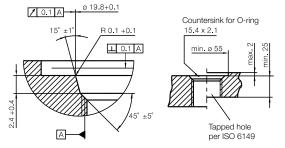


General linear position detection in zone 1

#### Installation The Micropuls

The Micropulse transducer BTL has a M18 $\times$ 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.



Sensor in Zone 0/1 Transducer in Zone 1 Rod DEX Rod J-DEXC Rod PEX Rod NEX Floats and Encoders

> Rod T Redundant General Data Programming Position Encoders

Rod CD General Data

Filling Level Sensor SF

Accessories

Basic Information and Definitions

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www.balluff.com



### Flameproof IECEx

### Pressure-resistant up to 600 bar, high reproducibility, contactless, robust

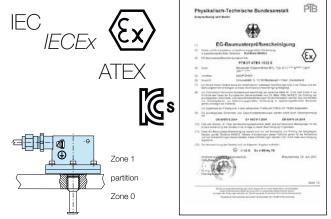
The Micropulse transducer BTL is a robust position feedback system for measuring ranges between 25 and 4000 mm as well as use under extreme ambient conditions.

#### 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)
- Ignition 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.



Series	Rod DEX BTL5
Part number	BTL5MDEX
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, 102000 Hz in accordance with 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	EN 61000-4-6 Severity level 3
by high-frequency fields	

Please enter code for output signal, interface, coding, rated length, model, rod end, and connection in the part number.

#### Scope of delivery

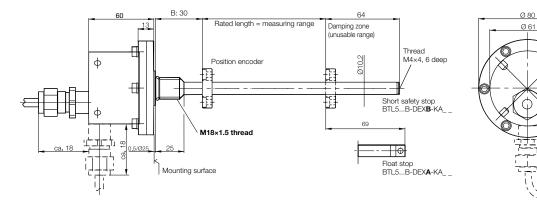
Transducer

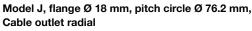
User's Guide

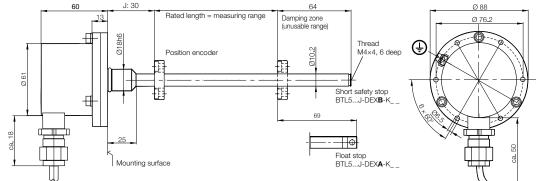
Please order separately: Position encoders, see page 232 Floats, see page 232



Housing B, metric mounting thread Cable outlet axial, radial









Micropulse Transducers

(<del>Į</del>)

C

Profile P

Profile PF

. . . . . . . .

Profile AT

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX Filling Level Sensor in Zone 0/1 Transducer in Zone 1 Rod DEX Rod J-DEXC Rod PEX Rod NEX Floats and Encoders

Rod T Redundant General Data Programming Position Encoders

Rod CD General Data

Filling Level Sensor SF

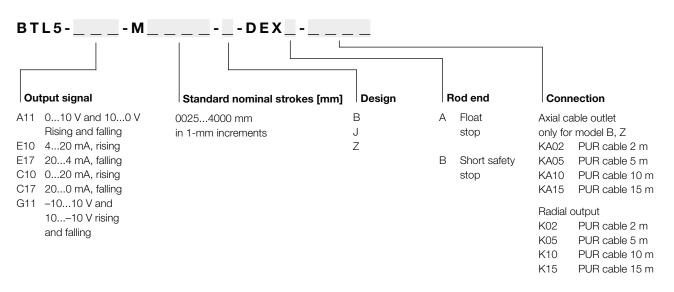
Accessories

Basic Information and Definitions

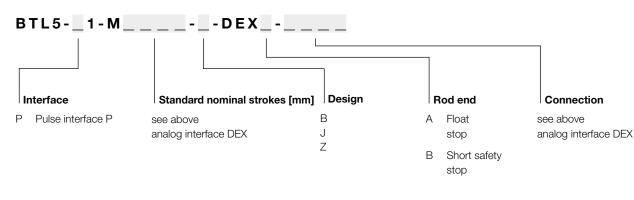
#### Caution!



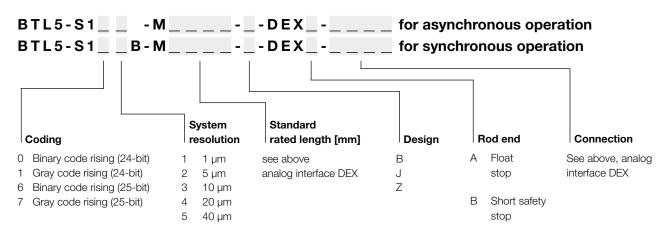
Analog interface no zero- or end-point setting possible; see technical data on page 198 Ordering example:



Digital pulse interface, see technical data on page 200 Ordering example:



**SSI interface**, see technical data on page 202 **Ordering example:** 







The Micropulse transducer J-DEXC has been specially developed for use in potentially explosive atmospheres. The important demands of the oil and gas industry for high reliability and ease of servicing are combined in the J-DEXC system.

J-DEXC comprises a robust flameproof Ex housing and an electronics module that is easily accessible and exchanged for servicing. Spare electronics modules can be ordered from Balluff Service department.

#### **Fields of application**

- Hydraulically or pneumatically actuated valves
- Clutch travel monitoring for compressors
- Level monitoring
- Level control
- Actual value sensing in hydraulic cylinders in Ex areas

Series	Rod J-DEXC-TA12	Micropulse
Part number	BTL5MJ-DEXC-TA12	Transducers
Shock load	100 g/6 ms in accordance with EN 60068-2-27	D (1) D
Vibration	12 g, 102000 Hz as per EN 60068-2-6	Profile P
Operating temperature	–20+80°C for T5	Profile PF
Storage temperature	-40+100 °C outside of Ex zone	FIUIIIE FF
Degree of protection	IP 68	Profile AT
Housing material	Stainless steel AISI 304, optional: AISI 316L, Nitronics 60	
Protective tube	Stainless steel 1.4571	Profile BIW
Pressure rating	600 bar max.	
Connection	Screw terminals	Rod
Cable entry	Ex cable gland BTL-A-AD09-M-00EX or Ex installation pipe system	
EMC testing		Rod Compact and Rod AR
Radio interference emission	EN 55016-2-3 (industrial and residential area)	and nou An
Static electricity (ESD)	EN 61000-4-2 Severity level 3	Rod EX
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3	Filling Level
Electrical fast transient bursts (BURST)	EN 61000-4-4 Severity level 3	Sensor in Zone 0/1
Conducted interference induced	EN 61000-4-6 Severity level 3	Transducer
by high-frequency fields		in Zone 1

Please enter the code for the output signal, interface, coding, system solution, software configuration, baud rate, rated length, and connection in the part number.

#### Scope of delivery

- TransducerUser's Guide

Please order separately: Position encoders, see page 232

Floats, see page 232

Filling Level Sensor SF

Rod DEX Rod J-DEXC Rod PEX

Rod NEX

Rod T Redundant

General Data Programming Position Encoders

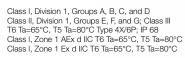
Rod CD General Data

Floats

and Encoders

Accessories

Basic Information and Definitions



SIRA 11ATEX1104X IECEx SIR 11.0048X



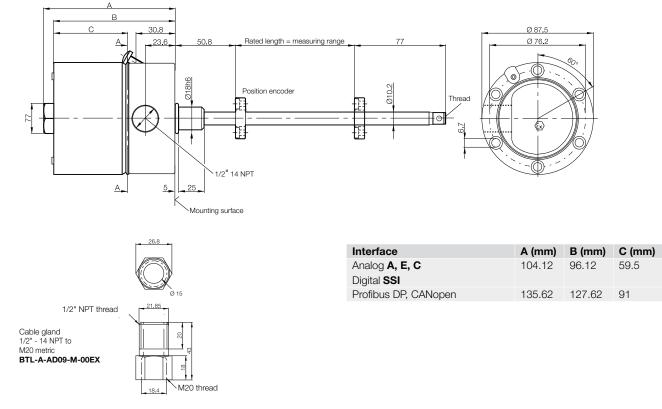
i IS

II 1/2GD
 Ex d IIC T6/T5 Ga/Gb Ta +65°C (T6) +80°C (T5)
 Ex t IIIC T85/T100°C Da IP 68 Ta +65°C (T85) +80°C (T100)

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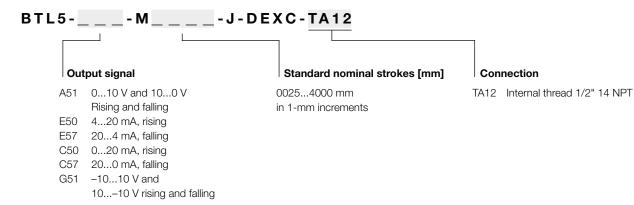
www.balluff.com





#### Model J-DEXC, flange Ø 18 mm, pitch circle Ø 76.2 mm

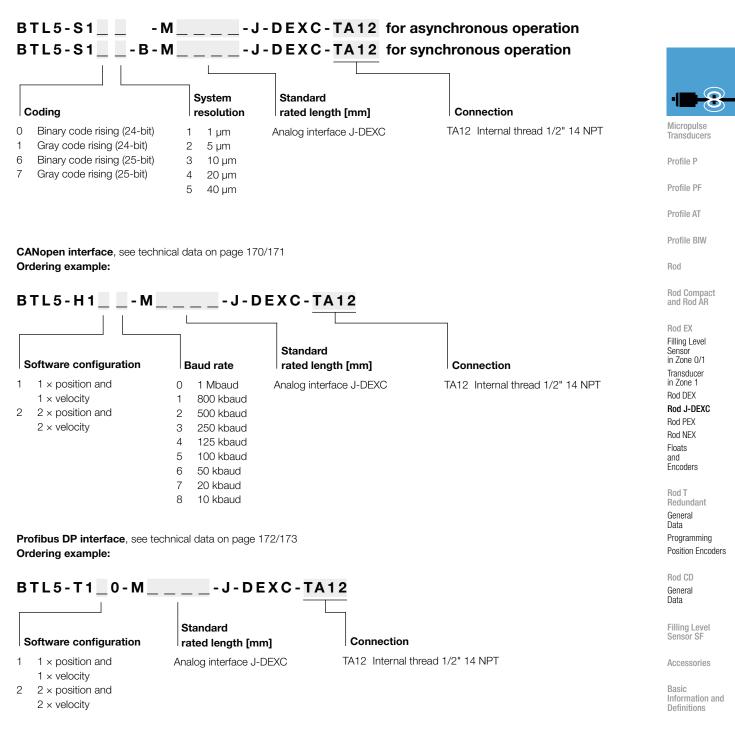
Analog interface, see technical data on page 154/155 Ordering example:



Programming tool for zero point and end point BTL5-A-EH03



**SSI interface**, see technical data on page 162/163 **Ordering example:** 



#### Caution!



### Dust protection zone 22 II 3 D T 90°C X

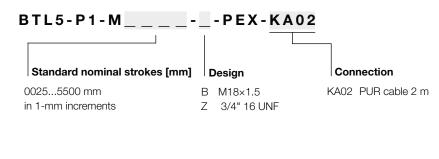
#### **Dust protection zone 22**

Devices in these categories are intended for use in areas where swirling dust is not expected to create an explosive atmosphere. The probability is extremely small. Even if it were to occur, it would be only for a short time.

A manufacturer's declaration confirms that transducers designated **II 3 D T 90°C X** meet the requirements for electrical equipment for use in areas with combustible dust.

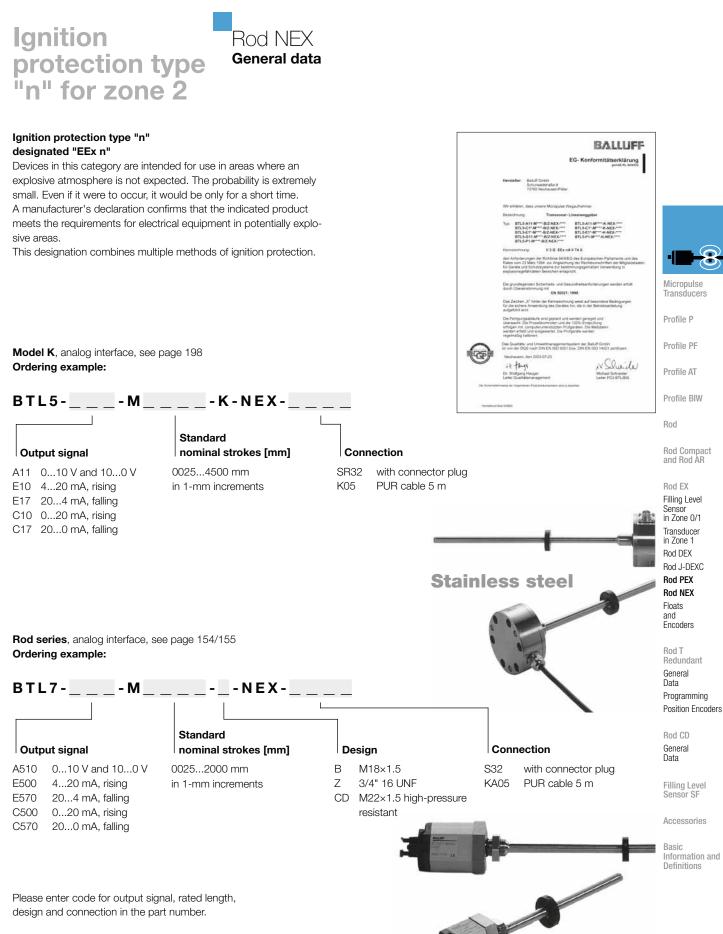


Digital pulse interface, for technical data refer to the user's guide Ordering example:





Caution!



Please order separately: Position encoders, see page 233 Floats, see page 232 Plug connectors, see page 252



Floats (Zone 0)

#### BTL2-S-4414-4Z-Ex Ordering code: BAM0147

Cylindrical float, zone 0 permitted up to density  $\rho \ge 0.7$  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

Ø10

49±0.5

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.



#### Caution!



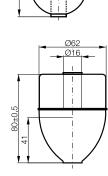
#### BTL2-S-5113-4K-Ex

Ordering code: **BAM014A** Ball float, zone 0 permitted up to density  $\rho \ge 0.7$  g/cm³

Orientation: Raised dimple on upper side of float

#### BTL2-S-6216-8P-Ex

Ordering code: **BAM014E** Parabolic float, permitted up to  $\rho \ge 0.6$  g/cm³



Ø50.9

Ø13

÷.

22

Float type	Immersion depths given $\rho = 1$ g/cm ³ (	H ₂ O) Immersion depths given $\rho = 0.7$ g/cm ³	Profile
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	Rod
BTL2-S-4414-4Z-Ex	s _s ~ 30 mm	s _s ~ 39 mm	Ded Ca
BTL2-S-4414-4Z01-Ex	s _s ~ 45 mm	submerges	Rod Co and Ro

For technical data, see standard series on page 216.

Position encoder (zone 1) for installation in hydraulic cylinder See page 218

Processor units, digital displays

See page 266



Profile PF Profile AT Profile BIW

Micropulse Transducers

Profile P

Rod Compact and Rod AR

Rod EX Filling Level Sensor in Zone 0/1 Transducer in Zone 1 Rod DEX Rod J-DEXC Rod PEX Rod NEX Floats and Encoders

Rod T Redundant General Data Programming Position Encoders

Rod CD General Data

Filling Level Sensor SF

Accessories

Basic Information and Definitions



Series	Rod Redundant BTL7
Shock load	100 g/6 ms in accordance with EN 60068-2-27
Vibration	12 g, 102000 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
Fastener	Model TB thread M18×1.5, Model TZ thread 3/4" 16 UNF
	Model TK, 18h6 with 6 cheese head screws,
	Model TT thread M30×1.5
Pressure rating with 10.2 mm protective	600 bars if installed in a hydraulic cylinder up to 2000 mm in rated length
tube	300 bar for rated length > 2000 mm
Pressure rating with 21 mm protective tube	250 bars if installed in hydraulic cylinder up to 2000 mm rated length
Connection	Plug 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
Electrical fast transient bursts (BURST)	EN 61000-4-4 Severity level 3
Surge voltage	EN 61000-4-5 Severity level 2
Conducted interference induced by high-	EN 61000-4-6 Severity level 3
frequency fields	
Magnetic fields	EN 61000-4-8 Severity level 4
Standard nominal strokes [mm]	257620 mm in 1-mm increments

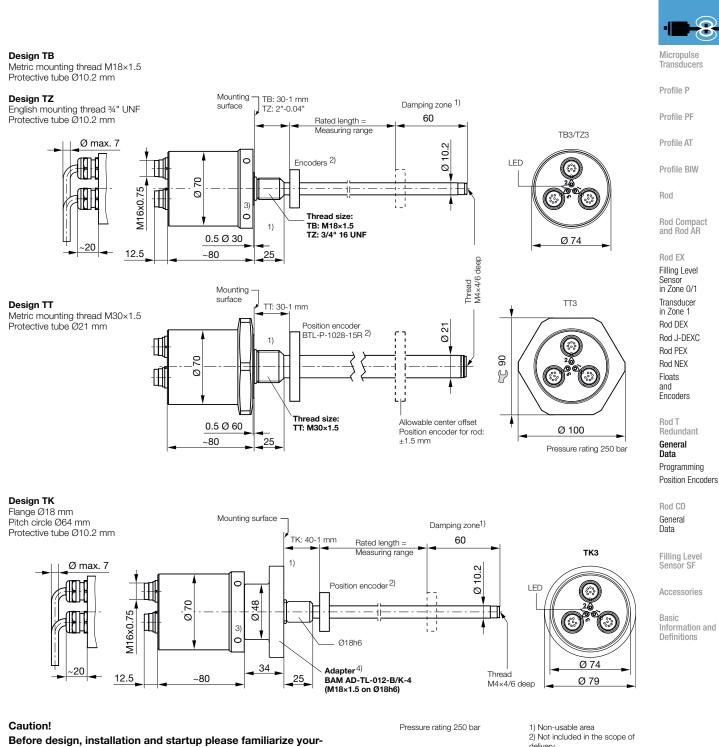


# "Long" Rod Redundant up to 7620 mm ^{General data}

### Pressure-resistant up to 600 bar, high reproducibility, redundant, contactless

Redundant Micropulse Transducers BTL7: the robust position measurement system for use in safety-related valves and hydraulic cylinders for measuring ranges between 25 and 7620 mm.

Up to three independent position measurement systems in the same housing enable failsafe linear measurement of, for example, safety valves or the combined monitoring of position and adjustment speed.



self with the user's guide to be found at www.balluff.com.

delivery 3) Ø 6.1 for hook wrench Ø 74

a) Ø 6.1 for nook wrench Ø 74
4) Included in the scope of delivery

) 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...+85°C

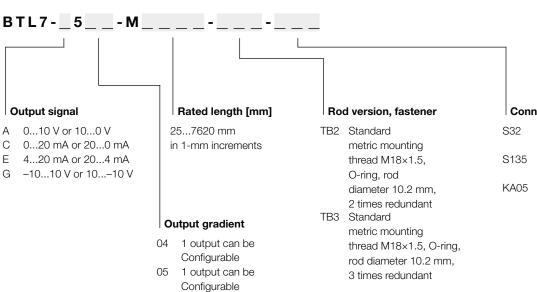
#### Flexible measuring range

The start and end point of the measuring range can be adapted to the application. The output signal for the position indicator or the travel speed can be set just as conveniently.

Once configured, settings can easily be copied redundantly to the remaining measuring channels of the BTL 7.

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 (per unit)	
Polarity reversal protected	
Overvoltage protection	
Dielectric strength	
Operating temperature	

#### Ordering example:



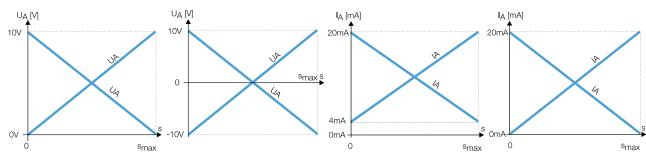
For additional designs, see page 235

Connection

8-pin, M16 plug according to IEC 130-9 6-pin, M16 plug according to IEC 130-9 5 m cable, PUR



Rod Redundant BTL7	Rod Redundant BTL7	Rod Redundant BTL7	Rod Redundant BTL7
Analog	Analog	Analog	Analog
Α	G	E	С
Analog	Analog	Analog	Analog
BTL7- <b>A</b> 5M	BTL7- <b>G</b> 5M	BTL5- <b>E</b> 5M	BTL7- <b>C</b> 5M
010 V	–1010 V		
		420 mA	020 mA
Max. 5 mA	Max. 5 mA		
		≤ 500 Ω	≤ 500 Ω
≤ 0.33 mV	≤ 0.33 mV	≤ 0.66 µA	≤ 0.66 µA
System resolution/min. 2 µm			
Max. 500 Hz	Max. 500 Hz	Max. 500 Hz	Max. 500 Hz
$\pm 200 \ \mu m$ to $\leq 500 \ mm$ rated length	$\pm 200 \ \mu m$ to $\leq 500 \ mm$ rated length	$\pm 200 \ \mu m$ to $\leq 500 \ mm$ rated length	$\pm 200 \ \mu m$ to $\leq 500 \ mm$ rated length
±0.04% FS > 500 mm rated length	$\pm 0.04\%$ FS > 500 mm rated length	±0.04% FS > 500 mm rated length	$\pm 0.04\%$ FS > 500 mm rated length
≤ 40 ppm/K	≤ 40 ppm/K	≤ 20 ppm/K	≤ 20 ppm/K
1030 V DC	1030 V DC	1030 V DC	1030 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 (GND to housing)			
–40+85 °C	–40+85 °C	–40+85 °C	–40+85 °C



Please enter code for output signal, rated length, 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, see page 190 Position encoders, see page 239 Micropulse Transducers

Profile P Profile PF Profile AT

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX Filling Level Sensor in Zone 0/1 Transducer in Zone 1 Rod DEX Rod J-DEXC Rod J-DEXC Rod PEX Rod NEX Floats and Encoders

LIIOOdol

Rod T Redundant General Data

Programming Position Encoders

Rod CD General Data

Filling Level Sensor SF

Accessories

Basic Information and Definitions

www.balluff.com

Programming

Rod Redundant

#### 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 software called Micropulse Configuration Tool 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 encoder
- 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 with cable set

Part number	Cable set
BTL7-A-CB01-USB-S32	Connector S32
BTL7-A-CB01-USB-KA	Cable connection

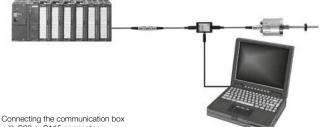
#### Scope of delivery

USB communication box

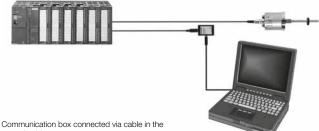
Cable set

Quick start instructions

Description	
for Series	
Ordering code	
Part number	
Material	
Weight	
Position encoder travel speed	
Operating temperature/Storage temperature range	
Ordering code PA 60 fiberglass reinforced	
Part number PA 60 fiberglass reinforced	
Material	
Weight	
Position encoder travel speed	
Operating temperature/Storage temperature range	



with S32 or S115 connector



control cabinet

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

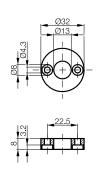


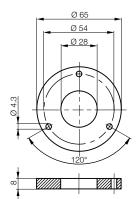


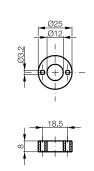


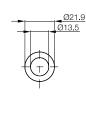


Position encoder	Position encoder	Position encoder	Position encoder		
Rod BTL	Rod BTL	Rod BTL	Rod BTL		
BAM013L	BAM013Y	BAM013J	BAM013R	Micropulse	
BTL-P-1013-4R	BTL-P-1028-15R	BTL-P-1012-4R	BTL-P-1014-2R	Transducers	
Aluminum	Aluminum	Aluminum	Aluminum	Duefile D	
approx. 12 g	approx. 68 g	approx. 12 g	approx. 10 g	Profile P	
any	any	any	any	Profile PF	
–40+100 °C	-40+100 °C	-40+100 °C	-40+100 °C	TIONETT	
BAM013M		BAM013K		Profile AT	
BTL-P-1013-4R-PA	BTL-P-1012-4R-PA				
PA 60 fiberglass reinforced		PA 60 fiberglass reinforced		Profile BIW	
approx. 10 g		approx. 10 g			
any		any		Rod	
–40+100 °C		-40+100 °C			
				Rod Compact and Rod AR	
				unu nou An	











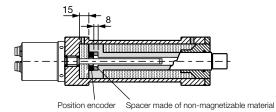
Rod T Redundant General Data Programming Position Encoders

Rod CD General Data

Filling Level Sensor SF

Accessories

Basic Information and Definitions



#### Caution!



### 1000 bar High-pressure resistant

Micropulse CD transducers ensure that extreme loads are moved steadily and with precision. They are based on the established 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
   Ex area zone 2; non-incendive "nA"
- Plug or cable variants
- Multi-magnet technology

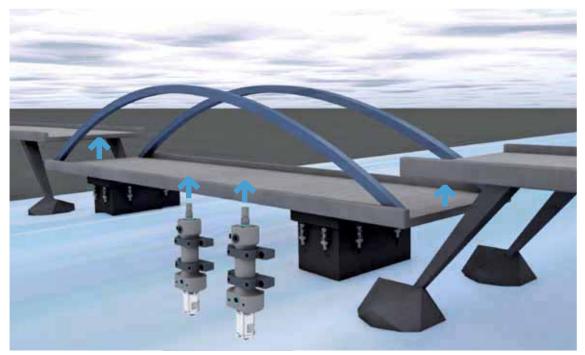


#### Structural design and calculations

- Active support of walls
- Bridge positioning and lifting technology
- Leveling structures
- Off-shore sector
- Tunnel construction

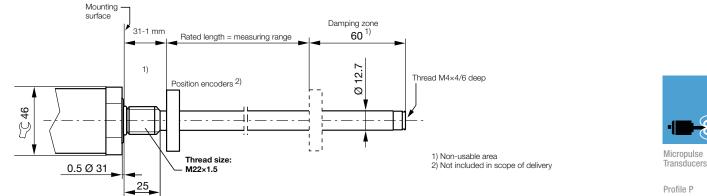
#### Industrial applications

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



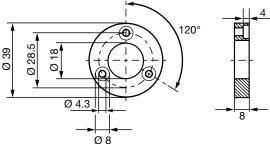
Heavy-duty cylinders raise the bridge to the planned road level after they are "floated" into position.



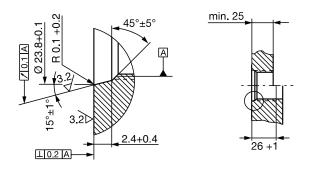


#### BTL-P-1018-3R

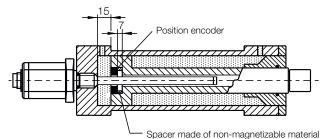
Weight: Approx. 19 g Housing: Anodized aluminum



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.



Programming Position Encoders

General Data

Profile PF

Profile AT

Profile BIW

Rod Compact and Rod AR

Rod EX

Filling Level

Sensor in Zone 0/1

Transducer in Zone 1

Rod DEX Rod J-DEXC

Rod PEX

Rod NEX

Encoders

Rod T Redundant

Floats

and

Rod

Rod CD General Data

Information and Definitions

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

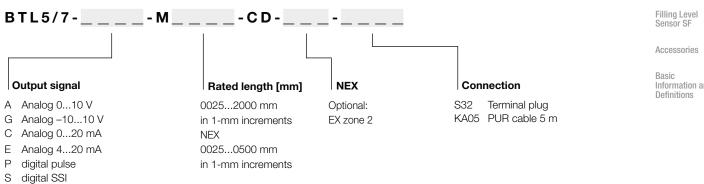
#### Scope of delivery

Transducer

Quick start instructions

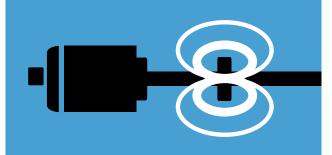
Please order separately: Calibration box, see page 190 Position encoders, see page 239

#### Ordering example:



Analog interface, see page 154; SSI interface, see page 162; Digital Pulse Interface, see page 166; NEX, see page 231

S



# Micropulse Transducers

# Filling Level Sensor SF

- Highly accurate filling level sensor
- Compensation for inaccuracies due to 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	
General Data	
Analog Interface	
Floats and Accessories	





244 246 248





## 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. Take advantage of the best quality directly from the manufacturer.

#### Other benefits

- Neutral for all liquids
- Compensates for 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 for flexible installation
- Internationally certified quality for 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.













Scope of delivery

Quick start instructions

Please order separately: Tri-Clamp, see page 248

Weld nipple, see page 248

Floats, see page 248

Seal, see page 248

Transducer



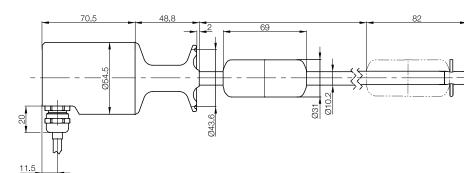
#### Series Polarity reversal protected Overvoltage protection Dielectric strength Degree of protection as per IEC 60529 Housing material Flange and tube material Connection Fastener Pressure rating EMC testing Radio interference emission Static electricity (ESD) Electromagnetic fields (RFI) Electrical fast transient bursts Conducted interference induced by high-frequency fields Surge voltage Magnetic fields Standard rated length (mm)

#### Rod SF BTL5

yes 36 V 500 V DC (GND to housing) IP 67/IP 69K (flange and tube) Stainless steel 1.4404 1.4404 Cable connection 1.5" Tri-Clamp as per SSI 3A standard 74-06 300 bar (depending on float)

EN 55016-2-3 (industrial and residential area) EN 61000-4-2/EN 61000-4-2 Severity level 3 EN 61000-4-3/EN 61000-4-3 Severity level 3 EN 61000-4-4/EN 61000-4-4 Severity level 3 EN 61000-4-6/EN 61000-4-6 Severity level 3

IEC 61000-4-5/EN 61000-4-5 Severity level 2 IEC 61000-4-8/EN 61000-4-8 Severity level 4 50...2500 in 1-mm increments



Profile P Profile PF

Micropulse Transducers

Profile AT

Profile BIW

Rod

Rod Compact and Rod AR

Rod EX, T Redundant and CD

Filling Level Sensor SF

#### **General Data** Analog Interface

Floats and Accessories

Accessories

Basic Information and Definitions

#### Caution!

### 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.

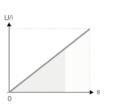
#### Features

- Economically priced system solution
- Can be used from each controller
- Cable break monitoring using 4...20 mA signal
- Current signal, interference-free signal transmission
- High resolution and reproducibility
- 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	
Measurement 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

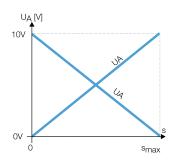
Transducer Quick start instructions

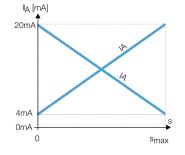
Please order separately: Tri-Clamp, see page 248 Floats, see page 248 Seal, see page 248 Weld nipple, see page 248

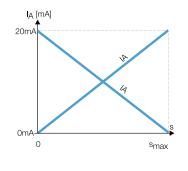
Teflon cable - LIF5Y-FC-5Y (7×0.25 mm²): Temperature-resistant up to 200°C Good resistance to chemicals and oil



AnalogAnalogAnalogAECAnalogAnalogBTL5-A11-MSFBTL5-E1MSF010 V and 100 V420 mA or 204 mAMax. 5 mA- $\leq 5 mV$ $\leq 500 \Omega (500 \Omega)$ $\leq 0.1 mV$ $\leq 0.2 \mu A$ $\leq 4 \mu m$ $\leq 4 \mu m$ System resolution/min. 2 $\mu m$ fstaNDARD = 500 HzfstaNDARD = 500 Hz $\pm 100 \mu m \mu to 500 mm rated length\pm 0.02\% 500 max. rated length\pm 0.02\% 500 mA\pm 150 mA\leq 150 mA\leq 150 mA\leq 150 mA\leq 0.00 V DC (GND to housing)500 V DC (GND to housing)$	Rod SF BTL5	Rod SF BTL5	Rod SF BTL5	
AnalogAnalogAnalogAnalogBTL5-A11-MSFBTL5-E1MSFBTL5-C1MSF010 V and 100 V420 mA or 204 mA020 mA or 200 mAMax. 5 mA $\leq$ 5mV $\leq$ 500 $\Omega$ (500 $\Omega$ ) $\leq$ 500 $\Omega$ (500 $\Omega$ ) $\leq$ 0.1 mV $\leq$ 0.2 $\mu$ A $\leq$ 0.2 $\mu$ A $\leq$ 0.2 $\mu$ A $\leq$ 4 $\mu$ m $\leq$ 4 $\mu$ m $\leq$ 4 $\mu$ mSystem resolution/min. 2 $\mu$ mSystem resolution/min. 2 $\mu$ mSystem resolution/min. 2 $\mu$ mForanDaRD = 500 Hz $\pm$ 100 $\mu$ m up to 500 mm rated length $\pm$ 100 $\mu$ m up to 500 mm rated length $\pm$ 100 $\mu$ m up to 500 mm rated length $\pm$ 0.02% 500 max. rated length $\pm$ 0.02% 500 600 Mm, float $\pm$ 0.02% 500 max. rated length $\pm$ 0.02% 500 max. rated length $\pm$ 0.02% 500 600 Mm, float $\pm$ 0.02% 500 max. rated length $\pm$ 0.02% 500 max. rated length $\pm$ 0.02% 500 600 Mm, float $\pm$ 0.02% 500 float $\pm$ 0.02% 500 float $\leq$	Analog	Analog	Analog	
BTL5-A11-MSFBTL5-E1MSFBTL5-C1MSF $010 V$ and $100 V$ $420 mA \text{ or } 204 mA$ $020 mA \text{ or } 200 mA$ Max. 5 mA $\leq 500 \Omega$ (500 $\Omega$ ) $\leq 500 \Omega$ (500 $\Omega$ ) $\leq 0.1 mV$ $\leq 500 \Omega$ (500 $\Omega$ ) $\leq 500 \Omega$ (500 $\Omega$ ) $\leq 0.1 mV$ $\leq 0.2 \mu A$ $\leq 0.2 \mu A$ $\leq 4 \mu m$ $\leq 4 \mu m$ $\leq 4 \mu m$ System resolution/min. 2 µmSystem resolution/min. 2 µmSystem resolution/min. 2 µmfstanDaRD = 500 Hz $\pm 100 \mu m up to 500 mm rated length\pm 100 \mu m up to 500 mm rated length\pm 0.02\% 500 max. rated length\pm$	Α	E	С	
$ \begin{array}{ c c c c } \hline 010 V and 100 V \\ \hline 020 mA or 204 mA \\ \hline 020 mA or 200 mA \\ \hline 020 ma value and blength \\ \hline 0.02v 500 mm rated length \\ \pm 0.02v 500 mm rated length $	Analog	Analog	Analog	
Max. 5 mA $420 \text{ mA or } 204 \text{ mA}$ $020 \text{ mA or } 200 \text{ mA}$ $\leq 5 \text{ mV}$ $\leq 500 \Omega (500 \Omega)$ $\leq 500 \Omega (500 \Omega)$ $\leq 0.2 \mu A$ $\leq 0.2 \mu A$ $\leq 0.2 \mu A$ $\leq 4 \mu m$ $\leq 0.2 \mu A$ $\leq 0.2 \mu A$ $\leq 0.2 \mu A$ $\leq 0.2 \mu A$ $Micropulse$ $\leq 4 \mu m$ $\leq 4 \mu m$ $\leq 4 \mu m$ $\leq 4 \mu m$ $Profile P$ System resolution/min. 2 µmfstanDARD = 500 HzfstanDARD = 500 Hz $fstanDARD = 500 Hz$ $from up to 500 mm rated length\pm 100 \mu m up to 500 mm rated length\pm 100 \mu m up to 500 mm rated length\pm 0.02\% 500 max. rated length\pm 0.02\% 500 max. rated length\pm 0.02\% 500 max. rated length\pm 40 ppm/K for rated length 500 mm, floatat center of measuring range\pm 40 ppm/K for rated length 500 mm, float\pm 100 \mu m up to 500 mm rated length\pm 0.02\% 500 max. rated length\leq 40 ppm/K for rated length 500 mm, floatat center of measuring range\pm 100 \mu m up to 500 mm, float\pm 0.02\% 500 max. rated length 500 mm, float2028 V DC2028 V DC2028 V DC2028 V DC2028 V DC2150 mA\leq 150 mA\leq 150 mA\leq 150 mA\leq 160 mAyesyesyesyesNed Compact36 V500 V DC (GND to housing)500 V DC (GND to housing)500 V DC (GND to housing)-40+85 ^{\circ}C-40+85 ^{\circ}C-40+85 ^{\circ}C-40+85 ^{\circ}C-20+130 ^{\circ}C-20+130 ^{\circ}C-20+130 ^{\circ}C-20+130 ^{\circ}C$	BTL5-A11-MSF	BTL5- <b>E</b> 1MSF	BTL5- <b>C</b> 1MSF	
Max. 5 mAImage: Solution floatImage: Solution floatImage: Solution floatImage: Solution float $\leq 5 \text{ mV}$ $\leq 500 \Omega (500 \Omega)$ $\leq 0.2 \mu A$ $\leq 0.2 \mu A$ $\leq 0.2 \mu A$ $\leq 0.2 \mu A$ Micropulse $\leq 4 \mu m$ $\leq 4 \mu m$ $\leq 4 \mu m$ System resolution/min. $2 \mu m$ System resolution/min. $2 \mu m$ Profile PSystem resolution/min. $2 \mu m$ $f_{\text{5TANDARD}} = 500 \text{ Hz}$ $\pm 100 \mu m up to 500 mm rated length\pm 100 \mu m up to 500 mm rated length\pm 100 \mu m up to 500 mm rated length\pm 100 \mu m up to 500 mm rated length\pm 0.02\% 500 max. rated length\pm 0.02\% 500 ma$	010 V and 100 V			
$ \begin{array}{ c c c c c c } \hline & \leq 5 \mbox{ mV} & \leq 500 \ \Omega (500 \ \Omega) & \leq 500 \ \Omega (500 \ \Omega) & \leq 500 \ \Omega (500 \ \Omega) & \leq 0.2 \ \mu A & = 0.2 \$		420 mA or 204 mA	020 mA or 200 mA	
	Max. 5 mA			
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	≤ 5 mV			
$\leq 4 \ \mu\text{m}$ $\leq 4 \ \mu\text{m}$ $\leq 4 \ \mu\text{m}$ TransducersSystem resolution/min. 2 \ \mumSystem resolution/min. 2 \ \mumSystem resolution/min. 2 \ \mumProfile P $f_{STANDARD} = 500 \ Hz$ $f_{STANDARD} = 500$		$\leq 500 \ \Omega \ (500 \ \Omega)$	$\leq 500 \ \Omega \ (500 \ \Omega)$	
S 4 µmS 4 µmS 4 µmS 4 µmS 4 µmS 4 µmSystem resolution/min. 2 µmSystem resolution/min. 2 µmSystem resolution/min. 2 µmProfile P $f_{STANDARD} = 500 Hzf_{STANDARD} = 500 Hzf_{STANDARD} = 500 HzProfile P\pm 100 µm up to 500 mm rated length\pm 100 µm up to 500 mm rated length\pm 100 µm up to 500 mm rated lengthProfile PF\pm 0.02\% 500 max. rated length\pm 0.02\% 500 max. rated length\pm 0.02\% 500 max. rated length\pm 0.02\% 500 mm, floatS 40 ppm/K for rated lengthProfile PF\pm 0.02\% 500 max. rated length\pm 0.02\% 500 mm, floatS 40 ppm/K for rated length 500 mm, floatS 40 ppm/K for rated length 500 mm, floatS 40 ppm/K for rated length 500 mm, floatProfile PF\pm 0.02\% 500 28 V DC2028 V DC2028 V DC2028 V DCProfile BIW\leq 150 mA\leq 150 mA\leq 150 mA\leq 150 mA\leq 150 mAS 6 VgesgesgesgesgesRod36 V500 V DC (GND to housing)500 V DC (GND to housing)Rod Compactand Rod AR-40+85 °C-40+85 °C-40+85 °C-40+85 °C-40+130 °CRod EX,T Redundant$	≤ 0.1 mV	≤ 0.2 µA	≤ 0.2 µA	
$f_{STANDARD} = 500 Hz$ $f_{STANDARD}$	≤ 4 µm	≤ 4 µm	≤ 4 µm	Transducers
$f_{STANDARD} = 500 Hz$ $f_{STANDARD}$	System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm	Drofilo D
±0.02% 500 max. rated length±0.02% 500 max. rated length±0.02% 500 max. rated length±0.02% 500 max. rated length≤ 40 ppm/K for rated length 500 mm, float at center of measuring range≤ 40 ppm/K for rated length 500 mm, float at center of measuring range≤ 40 ppm/K for rated length 500 mm, float at center of measuring rangeProfile AT2028 V DC2028 V DC2028 V DCProfile BW≤ 150 mA≤ 150 mA≤ 150 mA≤ 150 mAyesyesyesNes36 V36 V36 V36 V500 V DC (GND to housing)500 V DC (GND to housing)500 V DC (GND to housing)-40+85 °C-40+85 °C-40+85 °C-20+130 °C-20+130 °CRod EX, T Redundant	f _{STANDARD} = 500 Hz	f _{STANDARD} = 500 Hz	f _{STANDARD} = 500 Hz	Prome P
±0.02% 500 max. rated length±0.02% 500 max. rated length±0.02% 500 max. rated length≤ 40 ppm/K for rated length 500 mm, float at center of measuring range≤ 40 ppm/K for rated length 500 mm, float at center of measuring range≤ 40 ppm/K for rated length 500 mm, float at center of measuring rangeProfile AT2028 V DC2028 V DC2028 V DCProfile BW≤ 150 mA≤ 150 mA≤ 150 mA≤ 150 mAyesyesyesRod36 V36 V36 V36 V500 V DC (GND to housing)500 V DC (GND to housing)500 V DC (GND to housing)-40+85 °C-40+85 °C-40+85 °C-20+130 °C-20+130 °CRod EX, T Redundant	$\pm 100 \ \mu m$ up to 500 mm rated length	±100 µm up to 500 mm rated length	±100 µm up to 500 mm rated length	Profile PF
at center of measuring range         2028 V DC       2028 V DC       2028 V DC       2028 V DC       Profile BIW         ≤ 150 mA       ≤ 150 mA       ≤ 150 mA       ≤ 150 mA       Sol V       Rod         yes       yes       yes       36 V       36 V       36 V       Sol V DC (GND to housing)       Foot V DC (GND to housing)       Rod Compact and Rod AR         -40+85 °C       -40+85 °C       -40+85 °C       -40+85 °C       -20+130 °C       Rod EX, T Redundant	±0.02% 500 max. rated length	±0.02% 500 max. rated length	±0.02% 500 max. rated length	110mc 11
2028 V DC       2028 V DC       2028 V DC       Profile BIW         ≤ 150 mA       ≤ 150 mA       ≤ 150 mA       ≤ 150 mA         yes       yes       yes       Rod         36 V       36 V       36 V       36 V         500 V DC (GND to housing)       500 V DC (GND to housing)       500 V DC (GND to housing)       Rod Compact and Rod AR         -40+85 °C       -40+85 °C       -40+85 °C       -40+85 °C       Rod EX, T Redundant	$\leq$ 40 ppm/K for rated length 500 mm, float	$\leq$ 40 ppm/K for rated length 500 mm, float	$\leq$ 40 ppm/K for rated length 500 mm, float	Profile AT
≤ 150 mA         yes       yes       yes       yes       Rod         36 V       36 V       36 V       36 V       Compact and Rod AR         500 V DC (GND to housing)       500 V DC (GND to housing)       500 V DC (GND to housing)       Rod Compact and Rod AR         -40+85 °C       -40+85 °C       -40+85 °C       -40+85 °C       Rod CMR         -20+130 °C       -20+130 °C       -20+130 °C       Rod EX, T Redundant	at center of measuring range	at center of measuring range	at center of measuring range	
yes         yes         yes         Rod           36 V         36 V         36 V         36 V         36 Compact and Rod AR           500 V DC (GND to housing)         500 V DC (GND to housing)         500 V DC (GND to housing)         Rod Compact and Rod AR           -40+85 °C         -40+85 °C         -40+85 °C         -40+85 °C         Rod Compact and Rod AR           -20+130 °C         -20+130 °C         -20+130 °C         Rod EX, T Redundant	2028 V DC	2028 V DC	2028 V DC	Profile BIW
yes         yes         yes         yes           36 V         36 V         36 V         36 V           500 V DC (GND to housing)         500 V DC (GND to housing)         500 V DC (GND to housing)         Rod Compact and Rod AR           -40+85 °C         -40+85 °C         -40+85 °C         -40+85 °C         Rod Compact and Rod AR           -20+130 °C         -20+130 °C         -20+130 °C         Rod EX, TRedundant	≤ 150 mA	≤ 150 mA	≤ 150 mA	
500 V DC (GND to housing)         500 V DC (GND to housing)         500 V DC (GND to housing)         Rod Compact and Rod AR           -40+85 °C         -40+85 °C         -40+85 °C         -40+85 °C         -40+85 °C           -20+130 °C         -20+130 °C         -20+130 °C         Rod EX, T Redundant	yes	yes	yes	Rod
500 V DC (GND to housing)         500 V DC (GND to housing)         500 V DC (GND to housing)         and Rod ÅR           -40+85 °C         -40+85 °C         -40+85 °C         -40+85 °C         Rod ÅR           -20+130 °C         -20+130 °C         Rod ÅR         Rod ÅR	36 V	36 V	36 V	
-40+85 °C       -40+85 °C         -20+130 °C       -20+130 °C         Rod EX, T Redundant	500 V DC (GND to housing)	500 V DC (GND to housing)	500 V DC (GND to housing)	
T Redundant	–40+85 °C	−40+85 °C	–40+85 °C	Sand How Fill
T Redundant	–20+130 °C	–20+130 °C	–20+130 °C	Rod EX,
				T Redundant







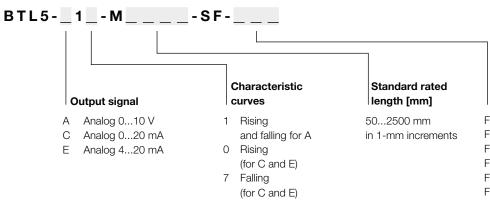
Filling Level Sensor SF General Data

Analog Interface Floats and Accessories

Accessories

Basic Information and Definitions

#### Ordering example:



#### Radial connection

F-radial design F02 2 m Teflon cable F05 5 m Teflon cable F10 10 m Teflon cable F15 15 m Teflon cable F20 20 m Teflon cable

### Filling Level Sensor SF Floats and accessories









			198		
Designation	Float	Float	Tri-Clamp (DIN 32676)	O-ring	
for Series	Rod SF BTL	Rod SF BTL	Rod SF BTL	Rod SF BTL	
Ordering code	BAM01KA	BAM01A2	BAM01A5	BAM01A4	
Part number	BTL-S-3112-4Z-SA10	BTL-S-3112-4Z	BAM MC-XA-006-D38,1-5	BAM SE-XA-002-D38,1-S	
Material	Stainless steel 1.4404	Stainless steel 1.4404	USA ASTM 316 (1.4401)	Platinum catalyzed silicone	
Weight Operating temperature/ Storage temperature range	Approx. 30 g -20+130 °C	Approx. 30 g -20+130 °C			
Immersion depth in water	approx. 54 mm	approx. 31 mm			
Pressure rating (static)	25 bar	4 bar			
	3 3				
I20 °С - 130 °С	Process temperature: maximum permissible tem the rod under the flange (r contact). Certain production process sterilization at 120130°C for 0.51 ho instance.	with media sses require our, for Included in Float Instruction Cotter pir st. Caution! Approvals Before des	a scope of delivery for float ns (spring pin 2×30) (spring pin 2×3	f these components. p please familiarize your-	



- Continuously precise measurement in  $\mu$  area 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
- Compensates for foam to deliver 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

Rod EX, T Redundant and CD

Rod Compact and Rod AR

Filling Level Sensor SF General Data Analog Interface

Floats and Accessories

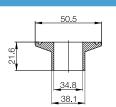
Accessories

Basic Information and Definitions

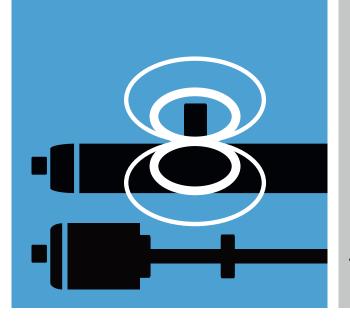


#### Weld nipple Rod SF BTL

BAM01A3 BAM-AD-XA-003-D38,1-5 Part no. W. 1.4435 BN2 (Fe ≤ 0.5%) as per EB 10088







# Micropulse Transducers





#### Accessories

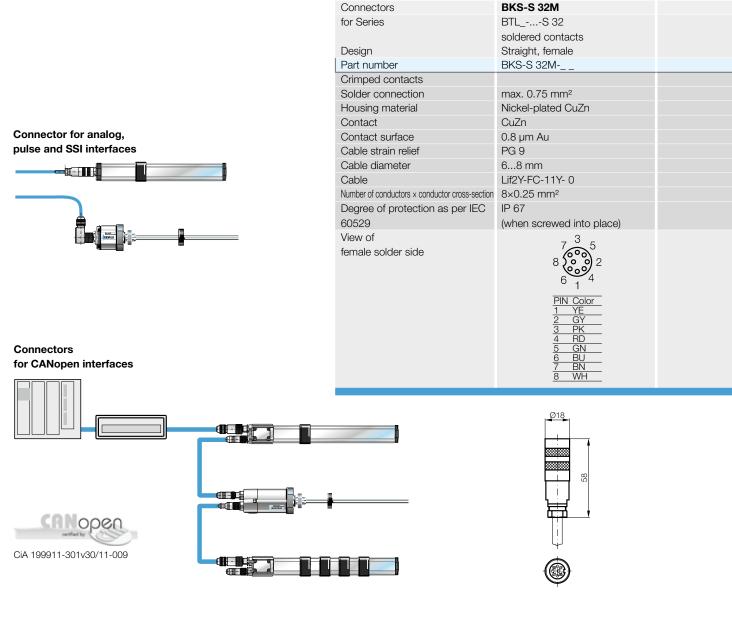
Connectors "Pigtail" Connector System Processor Units Profibus Modules P111 BUS Interface Modules Digital Display, CAM Controller



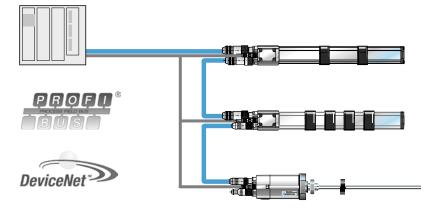




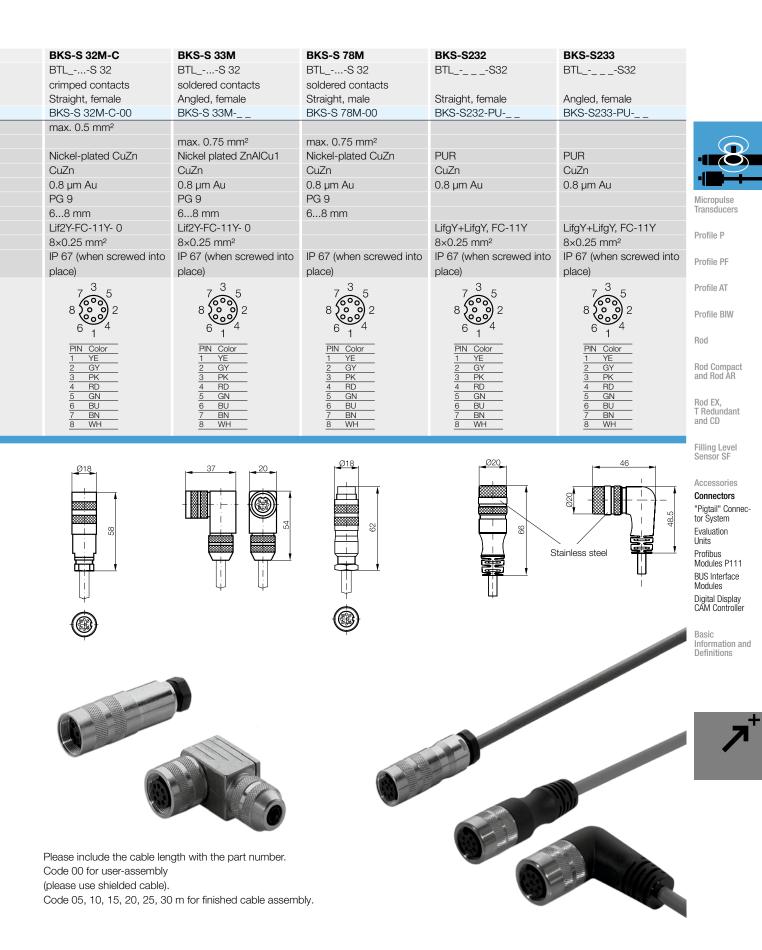




#### Connectors for Profibus DP and DeviceNet interfaces



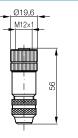


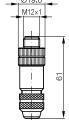


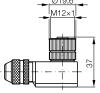
# Accessories Connectors for CANopen and DeviceNet interfaces

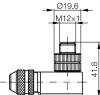
Connectors	BKS-S92-00	BKS-S94-00	BKS-S93-00	BKS-S95-00
for Series	BTLHS92/S93/S94	BTLHS92/S93/S94	BTLHS92/S93/S94	BTLHS92/S93/S94
	Screw terminals	Screw terminals	Screw terminals	Screw terminals
Design	5-pin, female	5-pin, male	5-pin, female	5-pin, male
Part number	BKS-S92-00	BKS-S94-00	BKS-S93-00	BKS-S95-00
Screw terminal	max. 0.75 mm ²			
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	68 mm	68 mm	68 mm	68 mm
Number of conductors × conductor cross-section				
Degree of protection as per IEC 60529	IP 67 (when screwed into place)			
Knurled nut				
Finish				
O-ring				
Resistor				
Coding	А	А	А	A
Slot on transducer	1	2	1	2
View of	5	5	5	5
female coupling side				
	2 3	2 3	2 3	
	PIN         Signal           1         CAN_GND           2         +24 V           3         GND (0 V)           4         CAN HIGH	PIN         Signal           1         CAN_GND           2         +24 V           3         GND (0 V)           4         CAN HIGH	PIN         Signal           1         CAN_GND           2         +24 V           3         GND (0 V)           4         CAN HIGH	PIN         Signal           1         CAN_GND           2         +24 V           3         GND (0 V)           4         CAN HIGH
CANopen	5 CAN_LOW	5 CAN_LOW	<u>5 CAN_LOW</u>	5 CAN_LOW

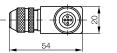




















Slot 3 Power supply for DeviceNet: BKS-S48-15-CP-... page 259



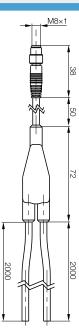
2



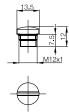
	BKS-S92-TA1	BKS-S137-19-PC	BKS-S151-19-PC	BKS-S94-R01	BKS-S92-16/GS92	
	BTLHS92	BTLHS92/S93/S94	BTLHS92/S93/S94	BTLHS92/S93/S94	BTLHS92/S93/S94	
	T-splitter, 2 × female, 1 × male	5-pin, female	5-pin, male	Terminating resistor, male	Male/female extension	
	BKS-S92-TA1	BKS-S137-19-PC	BKS-S151-19-PC	BKS-S94-R01	BKS-S92-16/GS92	
	PA	PUR	PUR	TPU	PUR	$\bigcirc$
	CuZn	CuZn	CuZn	CuZn	CuZn	
	NI	0.8 µm Au	0.8 µm Au	0.8 µm Au	0.8 µm Au	
						Micropulse
	15.07	5×0.25 mm ²	5×0.25 mm ²	10.00	5×0.34 mm ²	Transducers
	IP 67 CuZn	IP 67 CuZn	IP 67 CuZn	IP 68 CuZn	IP 67 CuZn	Profile P
	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	Profile PF
				121 Ω		Profile AT
	A 1*	A 1	A	A 2	A 1/2	Drefile DIW
	^		2	2	1/2	Profile BIW
						Rod
						Rod Compact
				2 3		and Rod ÅR
				PIN Signal		Rod EX,
				$\frac{2}{3}$ –		T Redundant and CD
				4 <u>5</u> 121 Ω		Filling Level
	*Only for	Please include the	Please include the		Please include the	Sensor SF
	BTL5-H1M-P/B-S92	cable length with the part	cable length with the part		cable length with the part	Accessories
		number!	number!		number.	Connectors
		02 = Length of  2  m	02 = Length of  2  m		02 = Length of  2  m	"Pigtail" Connec- tor System
		05 = Length of 5 m 10 = Length of 10 m	05 = Length of 5 m 10 = Length of 10 m		05 = Length of 5 m 10 = Length of 10 m	Evaluation Units
	50.5					Profibus
	56.5	→Ø14.5 M12×1	→Ø14.5 M12×1	Ø14.5 M12×1	→ <u>Ø14.5</u> M12×1 M12×1	Modules P111 BUS Interface
	Ø4.5 6					Modules
		A CONTRACTOR OF A CONTRACTOR OF A CONTRACTOR OF A CONTRACTOR A CONTRAC				Digital Display CAM Controller
			ن 💻			Decia
			46.5			Basic Information and Definitions
				₩.		Definitions
	→ <u>M12×1</u> Ø14.5			I		
		Ψ				
10						+
.0	- 2					7
1		/				-
6		1		I		
					~ ///	
				-7-	and and a second second	
	/ /			Please order the	0610	
4		/		clear view cover separately.	6161	
10000	5			Order designation:	Car	
2	A REAL PROPERTY AND A REAL			order designation.		
	20 5			BTL5-A-CP01-K		
				BTL5-A-CP01-K		
	BAR BI	Star at		BTL5-A-CP01-K		



		8	\$
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	for connector type M12×1
		ports	
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	1030 V DC		
Number of conductors ×	4×0.34 mm ²		
conductor cross-section			
Connection	Molded-in		
Degree of protection as per IEC 60529	IP 67		
Ambient temperature Ta	–25+85 °C	–20+80 °C	
Housing material	PUR	Plastic	Brass
View of female/male side	3 4 PIN 1: brown PIN 2: white PIN 3: blue PIN 4: black		







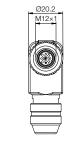
# Accessories **Connectors for Profibus DP**





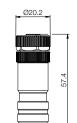
Connectors	M12	M12	M12	M12	
Design	B-coded	B-coded	B-coded	B-coded	
	5-pin	5-pin	5-pin	5-pin	
Use	Male	Male	Female	Female	
Ordering code	BCC0714	BCC0716	BCC0715	BCC0717	Micropulse Transducers
Part number	BCC M475-0000-2B-000-01X575-000	BCC M485-0000-2B-000-01X575-000	BCC M475-0000-1B-000-01X575-000	BCC M485-0000-1B-000-01X575-000	nansuucers
Supply voltage U _S	1030 V DC	1030 V DC	1030 V DC	1030 V DC	Profile P
Number of conductors ×	5x max. 0.75 mm ²	5x max. 0.75 mm ²	5x max. 0.75 mm ²	5x max. 0.75 mm ²	
conductor cross-section					Profile PF
Cable diameter	68 mm	68 mm	68 mm	68 mm	
Connection	Screw terminal	Screw terminal	Screw terminal	Screw terminal	Profile AT
Degree of protection as	IP 67	IP 67	IP 67	IP 67	
per IEC 60529	(when screwed into place)	(when screwed into place)	(when screwed into place)	(when screwed into place)	Profile BIW
Ambient temperature T _a	–25+85 °C	–25+85 °C	–25+85 °C	–25+85 °C	Ded
Housing material	CuZn	CuZn	CuZn	CuZn	Rod
Shielded design	yes*	yes*	yes*	yes*	Rod Compact
Coding	В	В	В	В	and Rod AR
Slot on transducer	2	2	1	1	
View of	2	2	2	2	Rod EX, T Redundant
female/male side	3(● ● ⁵ ●)1	$3 \left( \bullet \bullet^5 \bullet \right) 1$	$1(0, 0^5 0)_3$	$1(0, 0^5 0)_3$	and CD
	4	4			
					Filling Level
*Knurled ring used	Previously BKS-S 105-00	Previously BKS-S 106-00	Previously BKS-S 103-00	Previously BKS-S 104-00	Sensor SF
Knurled nut	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	Accessories
	02 = Length of 2 m	02 = Length of 2 m	02 = Length of 2 m	02 = Length of 2 m	Connectors
	05 = Length of 5 m	05 = Length of 5 m	05 = Length of 5 m	05 = Length of 5 m	"Pigtail" Connec-
	10 = Length of 10 m	10 = Length of 10 m	10 = Length of 10 m	10 = Length of 10 m	tor System

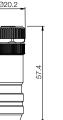
Ø20.2 18 5 63.7

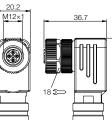


41.8 54.9 1

18 D







Modules Digital Display CAM Controller 56.0 Basic Information and Definitions

Evaluation Units Profibus Modules P111

BUS Interface







## Accessories Connector for M12. 5-pin, B-coded for Profibus DP

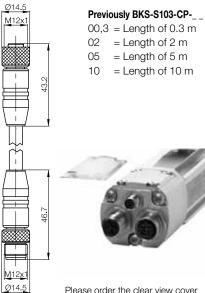
Connector diagram	and wiring	$5 \overset{3}{\underset{2}{\bigcirc} \overset{\circ}{\overset{\circ}{\bigcirc} 0}} \overset{4}{\underset{1}{\bigcirc} 1} \overset{4}{\underset{1}{\longleftarrow} 0} \overset{3}{\underset{2}{\underbrace{5}}} \overset{3}{\underset{2}{\bigcirc} 5}$	1     NC       2     Line A green       3     NC       4     Line B red       5     NC	$5 \frac{3}{2} \frac{0}{0} \frac{0}{1} \frac{4}{1}$	1         NC           2         Line A green           3         NC           4         Line B red           5         NC	
Configuration						
Design						
Use		Female/male		Female		
Supply voltage $U_S$		300 V		300 V		
Cable material	Cable material			PUR		
Color	Color			Violet		
Number of conductor	Number of conductors × conductor cross-section			2×0.38 mm	n ²	
Degree of protection	n as per IEC 60529	IP 67		IP 67		
Ambient temperatur	re T _a	−25+80 °C		-25+80 °	°C	
Housing material		PUR		PUR		
Knurled nut		Nickel-plated CuZn		Nickel-plate	ed CuZn	
Coding		В		В		
Slot on transducer		1/2		1		
	Ordering code					
	Part number					
Cable length	Ordering code	BCC0A12				

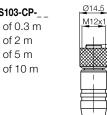
Cable length	ordering code	BOOGATE		
0.6 m	Part number	BCC M415-M412-3B-329-PS72N1-006		
Cable length	Ordering code	BCC0A13		
1 m	Part number	BCC M415-M412-3B-329-PS72N1-010		
Cable length	Ordering code	BCC0A14	BCC070Y	
2 m	Part number	BCC M415-M412-3B-329-PS72N1-020	BCC M415-0000-1B-031-PS72N1-020	
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	



Previo	ously 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





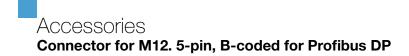


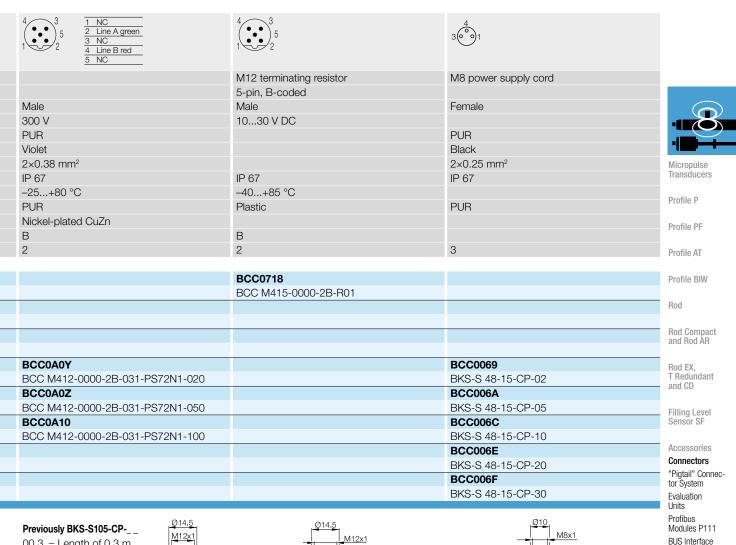


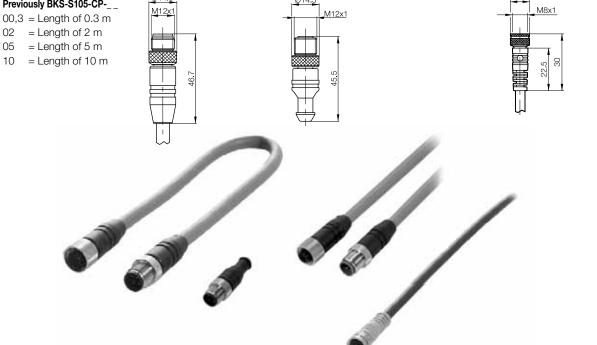
Please order the clear view cover separately! Order designation: BTL5-A-CP01-K

# CE

43.2







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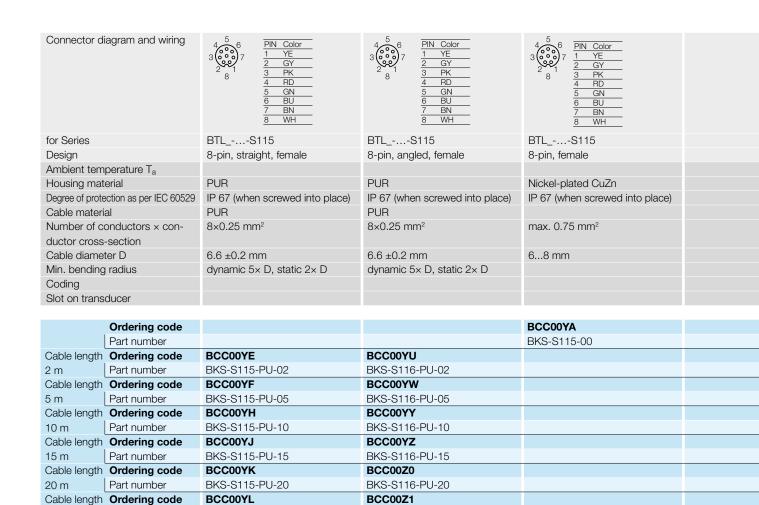
Modules

Digital Display CAM Controller

Basic Information and

Definitions

Accessories M12 female straight and right-angle connectors, 8-pin, customized assembly





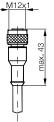
25 m

50 m

Part number

Part number

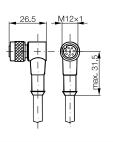
Cable length Ordering code



BKS-S115-PU-25

BKS-S115-PU-50

BCC00YM

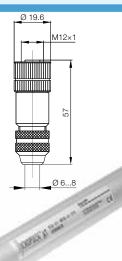


F

BKS-S116-PU-25

BKS-S116-PU-50

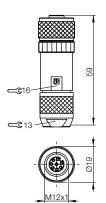
BCC00Z2

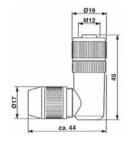


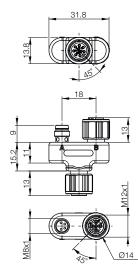
Adapter BKS-S115 to BKS-S 32 Ordering code: BKS-S115/GS32-PU-00,2



$ \begin{array}{c}  & & & & \\  & & & & \\  & & & & \\  & & & &$	$1 \underbrace{\begin{pmatrix} 2 & 0 & 0 \\ 0 & 0 & 0 \\ 7 & 0 & 0 \\ 7 & 6 & 5 \\ \end{array}}_{7} \underbrace{\begin{pmatrix} 2 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 5 & 5 \\ \end{array}}_{1}$	$1 \underbrace{\begin{pmatrix} 2 \\ 0 \\ 0 \\ 0 \\ 4 \end{pmatrix}}_{4}^{2} 3 1 \underbrace{\begin{pmatrix} 2 \\ 0 \\ 0 \\ 0 \\ 3 \end{bmatrix}}_{3}^{2} \underbrace{\begin{pmatrix} 4 \\ 0 \\ 0 \\ 0 \\ 7 \\ 0 \\ 0 \\ 6 \end{bmatrix}}_{6}^{3} \underbrace{\begin{pmatrix} 2 \\ 0 \\ 0 \\ 0 \\ 5 \\ 0 \\ 5 \end{bmatrix}}_{4}^{3} $	Micropulse Transducers Profile P
M12 female, straight, 8-pin -25+85 °C CuZn IP 67 (when screwed into place) 8×0.140.25 mm ² 48 mm	M12 female, angled, 8-pin -25+85 °C CuZn IP 67 (when screwed into place) 8×0.140.25 mm ² 48 mm	M12/M18 Y-plug splitter -25+85 °C TPU IP 67 (when screwed into place)	Profile PF Profile AT Profile BIW Rod Rod Compact and Rod AR
		I = A, III = D C	Rod EX, T Redundant and CD
BCC04MC BCC M478-0000-1A-000-43X834-000	BCC050F BCC M488-0000-1A-000-43X834-000	BCCOCK4 BCC_M418-M314-M415-V0038-000	Filling Level Sensor SF Accessories Connectors "Pigtail" Connec- tor System Evaluation Units Profibus Modules P111 BUS Interface Modules Digital Display CAM Controller Basic Information and Definitions











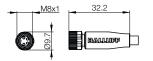


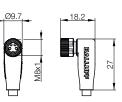


Connector diagram and wiring

Configuration	M8 connector, straight, molded,	M8 connector, angled, molded,
	fabricated	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 mm ²	4×0.34 mm ²
Degree of protection as per IEC 60529	IP 67	IP 67
Ambient temperature T _a	–25+80 °C	–25+80 °C
Ordering code		

	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			





## Accessories M12 connector, M12 connection cable 4-pin, for EtherCAT



M12 connector, straight

4-pin, D-coded

Male



M12 connector, angled

4-pin, D-coded

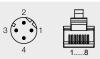
Male



M12 connection cable, straight/straight

4-pin, D-coded

Male/male



4-pin, D-coded Male/male

	18
M12 conn	ection cable,



Micropulse Transducers straight/RJ45 straight 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 BUS Interface Modules Digital Display CAM Controller

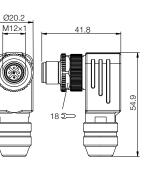
Basic Information and Definitions

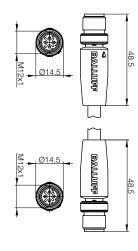


60 V AC/DC	60 V AC/DC	60 V AG/DC	60 V AC/DC
		PUR	PUR
		Green	Green
4×0.75 mm ²	4×0.75 mm ²	4×22 AWG	4×22 AWG
IP 67	IP 67	IP 68	IP 68/IP 20
–25+85 °C	–25+85 °C	–20+60 °C	–20+60 °C
BCC03WZ	BCC03Y0		
BCC M474-0000-2D-000-51X475-000	BCC M484-0000-2D-000-51X475-000		
		BCC04K1	BCC04K7
		BCC M414-M414-6D-331-PS54T2-020	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
			BCC04ZJ
			BCC M414-E834-8G-668-PS54T2-150
		BCC04K4	BCC04KA

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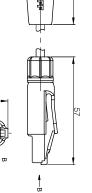




BCC M414-M414-6D-331-PS54T2-200

M12x1 Ø14.5

BCC M414-E834-8G-668-PS54T2-200



15.9

13.7

48.5

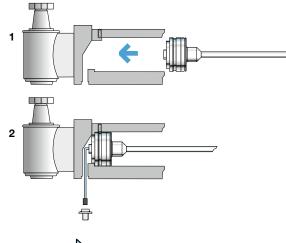
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# **Plug & Play**

### Accessories "Pigtail" connector system, 4-pin ZAON and ZAOB 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.



#### Carrie

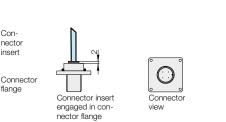
Series		
<b>KA</b> 00,20- <b>ZA0_</b>	PUR cable 0.2 m	Connector system for trans-
<b>KA</b> 00,30- <b>ZA0_</b>	PUR cable 0.3 m	ducers with cable outlet
<b>LA</b> 00,07- <b>ZA0_</b>	Stranded wire 0.07 m	Connector system for
<b>LA</b> 00,15- <b>ZA0_</b>	Stranded wire 0.15 m	transducers with strand-
<b>LA</b> 00,20- <b>ZA0_</b>	Stranded wire 0.20 m	ed wire output
<b>LA</b> 00,30- <b>ZA0_</b>	Stranded wire 0.30 m	

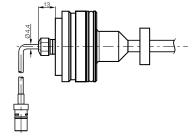
Pin	-ZAON	-ZAOR
1	10.	30 V
2	not assigned 1)	Output signal
3	GI	ND ²⁾
4	Output signal	not assigned 1)
		Pin assignment (top view of the plug), 4-pin round plug M12

¹⁾ Unassigned wires can be connected with GND by the controller, but not with the shielding.

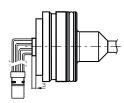
²⁾ Reference potential for supply voltage and EMC GND.

#### Connector system with cable outlet -KA-





Connector system with stranded wire output -LA-



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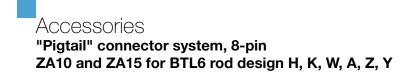
Connector

insert

flange

J

O-ring for perfect sealing

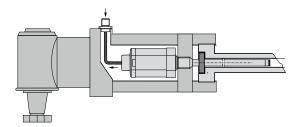


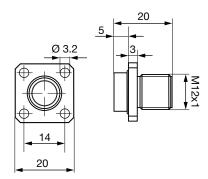
#### Series ZA10

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 260



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 BUS Interface Modules Digital Display CAM Controller

Basic Information and Definitions

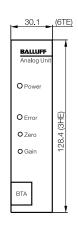




#### Features

- The processor 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 processor 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 position encoder.

Series	BTA-A
Output signal Displacement signal	Analog
Velocity	Analog
Input interface (transducer)	Ρ
Part number	BTA-A1
Features	Resolution 0.1 mV/0.2 µA,
	LED function indicator,
	Zero point adjustment 15%,
	Span adjust 15%,
	Velocity output,
	Error output (relay)
Transducer rated length	505500 mm
Design	Edge connector, 32-pin,
	DIN 41612 F, 19" plug-in card
Supply voltage	2028 V DC
Current consumption	130 mA at 24 V DC
Operating temperature	00° C
Update time for standard	1 kHz
Interface	Analog
	voltage
Output Displacement signals	010 V and 100 V
signals Velocity	±10 V at ±2.5 m/s
Accessories (please order separately)	Card holder
	48-pin
	Form F/627164



#### Micropulse analog processor unit

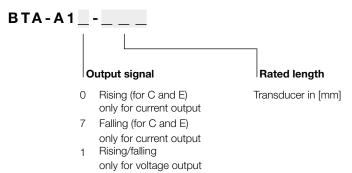
Please enter code for output signal and rated length in the part number.

Micropulse digital processor unit

rated length in the part number.

Please enter code for output signal and

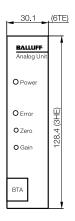
# Ordering example:



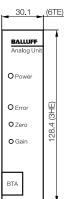
266 BALLUFF



BTA-C	BTA-E	BTA-G	
Analog	Analog	Analog	
Analog	Analog	Analog	
Р	Ρ	Р	
BTA-C1	BTA-E1	BTA-G1	
Resolution 0.1 mV/0.2 µA,	Resolution 0.1 mV/0.2 µA,	Resolution 0.1 mV/0.2 µA,	
LED function indicator,	LED function indicator,	LED function indicator,	
Zero point adjustment 15%,	Zero point adjustment 15%,	Zero point adjustment 15%,	
Span adjust 15%,	Span adjust 15%,	Span adjustment 15%,	
Velocity output,	Velocity output,	Velocity output,	
Error output (relay)	Error output (relay)	Error output (relay)	Micropulse
505500 mm	505500 mm	505500 mm	Transducers
Edge connector, 32-pin,	Edge connector, 32-pin,	Edge connector, 32-pin,	Profile P
DIN 41612 F, 19" plug-in card	DIN 41612 F, 19" plug-in card	DIN 41612 F, 19" plug-in card	TIONET
2028 V DC	2028 V DC	2028 V DC	Profile PF
130 mA at 24 V DC	130 mA at 24 V DC	130 mA at 24 V DC	
060 °C	060 °C	060 °C	Profile AT
1 kHz	1 kHz	1 kHz	
Analog	Analog	Analog	Profile BIW
voltage, current	voltage, current	voltage	
010 V and 100 V, 020 mA	010 V and 100 V, 420 mA	-10+10 V and +1010 V	Rod
±10 V at ±2.5 m/s	±10 V at ±2.5 m/s	±10 V at ±2.5 m/s	
Card holder	Card holder	Card holder	Rod Compact and Rod AR
48-pin	48-pin	48-pin	
Form F/627164	Form F/627164	Form F/627164	Rod EX,
			T Redundant and CD









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Filling Level Sensor SF

# Accessories Analog and digital processor units

Series		BTM-H1	BTM1
Output signal	Displacement signal	digital	Analog
	Velocity		Analog
Input interface (1	transducer)	Ρ	Р
Part number		BTM-H1	BTM1
Features		Resolution of 0.01 mm, 0.025 mm, 0.1 mm,	16-bit resolution
		1 mm, BCD, binary, Gray code, zero point	Up to 4 encoders on a single transducer
		adjustment, direction signal, DATA READY,	can be processed individually. Analog
		min./max. programming, ENABLE, DATA	velocity output. 100% programmable
		HOLD, bus-compatible, Error output.	measuring range, error output
		Replaces processor units:	
		BTA-D, BTA-H, BTA-P	
Transducer rate	d length	505500 mm	254000 mm
Design		Plastic housing for mounting on standard	Plastic housing for mounting on standard
		top-hat rail EN 50022-35	top-hat rail EN 50022-35
Supply voltage		2028 V DC	2028 V DC
Current consum	nption	Max. 500 mA	Max. 300 mA
Operating temp		060 °C	070 °C
Update time for	standard	2 kHz	2 kHz
Interface		Digital 22-bit parallel BCD, binary, Gray code,	Analog, voltage or current
		24-bit synchronous serial (SSI) Gray code	see ordering code
Output signals	Displacement signals	Digital TTL 5 V DC (BTM-H1-340)	Analog, voltage or current
		PNP source driver, 24 V DC (BTM-H1-240)	see ordering code
	Velocity		Analog ±10 V programmed to 1000 mm/s,
			adjustable over a range of 50 mm/s10 m/s
Accessories (ple	ease order separately)		

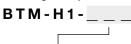
#### Micropulse digital processor unit

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

#### Micropulse analog module

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

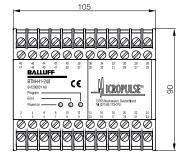
#### **Ordering examples:**

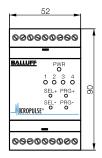


#### Output driver

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)





#### Output signal

BTM-_1-_

- A 0...10 V, 10...0 V -10...10 V, 10...-10 V 4...20 mA, 20...4 mA Е 0...20 mA, 20...0 mA
- Versions

101 1 analog output, 1 position encoder

- 102 2 analog outputs, 2 position encoders
- 103 3 analog outputs, 3 position encoders
- 104 4 analog outputs, 4 position encoders

#### BTM-_1-102-VM1000

#### Output signal

- A 0...10 V, 10...0 V
- –10...10 V, 10...–10 V 4...20 mA, 20...4 mA
- Е 0...20 mA, 20...0 mA

- Velocity
- 1 Analog output 2 Position encoder with speed

Versions

±10 V at a speed of 1000 mm/s

# Accessories **Profibus modules P111 for BTL**



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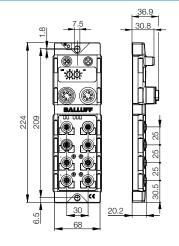


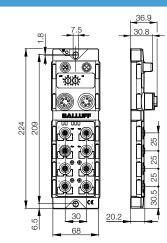
Fieldbus	Profibus	Profibus	Micropulse
Design	4× P111 or M1	4× P111 or M1	Transducers
Ordering code	BNI001A	BNI002H	Profile P
Part number	BNI-PBS-551-000-Z001	BNI-PBS-552-000-Z001	FIUIIIE F
Supply voltage U _S	1830 V DC	1830 V DC	Profile PF
Function indicator	BUS RUN	BUS RUN	110110111
Fault function indicator	Red LED		Profile AT
Power-on indicator	V _A , V _S , undervoltage	V _A , V _S , undervoltage	
Connection: Fieldbus	M12, B-coded	M12, B-coded	Profile BIW
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	Rod
Connection: P111 port	M12, A-coded, 8-pin, female	M12, A-coded, 8-pin, female	
No. of I/O ports	8	8	Rod Compact and Rod AR
No. of digital inputs	8		
No. of analog inputs		4	Rod EX,
Outputs	0	0	T Redundant and CD
No. of P111 inputs	4	4	allu ob
Max. load current for sensors/channel	1 A	1 A	Filling Level
Port status indicator (signal status)	Yellow LED	Yellow LED	Sensor SF
Port diagnostic indicator (overload)	Red LED	Red LED	
Total current U _{Sensor}	9 A	9 A	Accessories
Degree of protection as per IEC 60529	IP 67 (when screwed into place)	IP 67 (when screwed into place)	Connectors
Operating temperature T _a	0+55 °C	0+55 °C	"Pigtail" Conne tor System
Weight	Approx. 735 g	Approx. 735 g	Evaluation
Fastener	2 mounting holes	2 mounting holes	Units
Dimensions (L×W×H)	224×68×36.9	224×68×36.9	Profibus Modules P111
Housing material	Nickel-plated GD-Zn, matt finish	Nickel-plated GD-Zn, matt finish	BUS Interface

Profibus modules P111 are an elegant, costeffective 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 module is fitted with four independent ports for Micropulse transducers BTL with a P111 or M1 pulse interface. A maximum of 16 encoders can be used per BTL port. The maximum rated length is 7500 mm. Four additional ports can be configured with digital or analog sensors, depending on the version.

You can achieve maximum functionality and cost efficiency for fieldbus integration by combining Micropulse transducers BTL with Profibus modules P111.





Compact Rod AR EX, dundant CD g Level or SF ssories ectors il" Connec-

stem uation ous iles P111 BUS Interface Modules Digital Display CAM Controller

Basic Information and Definitions

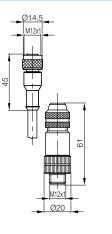


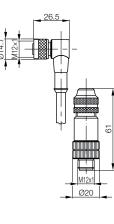
All modules include four screw plugs and a label set.

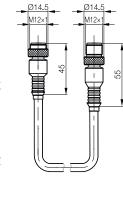
## Accessories Profibus modules P111 for BTL

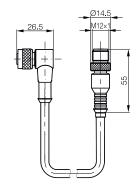
Design	8-pin, female	8-pin, female	8-pin, pin, female	8-pin, pin, female
Use	8-pin, pin	8-pin, pin	for Profibus modules	for Profibus modules
	for Profibus modules	for Profibus modules	BNI-PBS 0-3 BTL	BNI-PBS 0-3 BTL
	BNI-PBS 0-3 BTL	BNI-PBS 0-3 BTL		
Part number	BIS Z-501-PU1/E	BIS Z-502-PU1/E	BIS Z-501-PU1/M	BIS Z-502-PU1/M
Male	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 ×	8×0.25 mm ²	8×0.25 mm ²	8×0.25 mm ²	8×0.25 mm ²
conductor cross-section				
Ambient temperature	−40+85 °C	−40+85 °C	−40+85 °C	−40+85 °C
Plug in	BKS-S117-00	BKS-S117-00		
M12 pin scope of delivery				
Cable	One end molded-in, other	One end molded-in, other	Both ends molded-on	Both ends molded-on
	end pigtailed	end pigtailed		

*When plugged in









Please include the cable length with the part number:

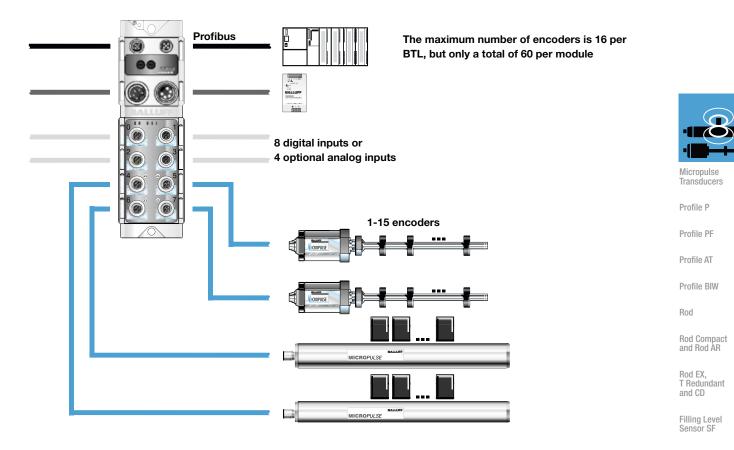
05	=	Length	5 m
10	=	Length	10 m
20	=	Length	20 m
25	=	Length	25 m
50	=	Length	50 m

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





Accessories Connectors "Pigtail" Connector System Evaluation Units

Profibus Modules P111 BUS Interface Modules Digital Display CAM Controller

Basic Information and Definitions



#### WAGO Digital Pulse Interface 750-635 for BTL5-P1-__ or BTL6-P1__-

The digital pulse interface was developed for connecting Micropulse transducers (BTL5-P1-...). The RS422 interface ensures quick and interference-free signal transmission with a resolution down to 1  $\mu$ m. The absolute position of the Micropulse transducer is sent to the higher-level controller as a 24-bit value.

The controller can perform a zero point shift and configure the number of encoders.

The bus terminal with a digital pulse interface can be operated by all bus drivers of the WAGO-I/O-SYSTEM 750, except the Economy variants.

#### Interfaces

- Inter-Bus
- Profibus DP
- CANopen
- DeviceNet
- Ethernet TCP/IPModulbus
- CC-Link
- GC-LINK

Resolution: 1 µm Number of magnets configurable (1...4)

Further technical details and orders from:

#### WAGO

Kontakttechnik GmbH Hansastrasse 27 32423 Minden, Germany Phone +49 571 887-0 Fax +49 571 887 169 E-mail: info@wago.com www.wago.com

#### Phoenix Contact IMPULSE-IN terminal for BTL5-P1-__ or BTL6-P1__-

The IB IL IMPULSE-IN is a terminal from the Inline product family by Phoenix Contact and is used for evaluating Micropulse transducers with a pulse interface.

The IMPULSE-IN terminal enables particularly cost-effective solutions because it senses the positions using a low-cost pulse interface. In addition, the pulse interface has the advantage of real time capability, making it especially suitable for applications with position or bearing control.

#### Interfaces

- Inter-Bus
- Profibus DP
- CANopenDeviceNet
- Ethernet

Further technical details and orders from:

Phoenix Contact GmbH & Co. KG Flachsmarktstrasse 8 32823 Blomberg, Germany Phone +49 5235 300 Fax +49 5235 341200 E-mail: info@phoenixcontact.com www.phoenixcontact.com





Series	BDD-UM 3023	BDD-AM 10-1-P B	BDD-AM 10-1-SSD	BDD-CC 08-1-P	BDD-CC 08-1-SSD
	Digital display	Digital display	Digital display	CAM controller	CAM controller
	for analog input signals	for BTL5-P with for	or BTL5-S with	for BTL5-P with	for BTL5-S with
	Current / voltage	P Interface S	SSD interface	P Interface	SSD interface
Part number	BDD-UM 3023	BDD-AM 10-1-P E	BDD-AM 10-1-SSD	BDD-CC 08-1-P	BDD-CC 08-1-SSD
Features	4-digit display with	7 1/2-digit displ	lay with	8 programmable	outputs
	leading sign	leading sign		8 directional swi	tching points
	LED display, 14 mm-high,	LED display, 14	l mm-high,	possible	
	red 7-segment digits	red 7-segment	digits	LED display, six	14-mm high red
	Programmable decimal point	Scalable measu	ured values	7-segment digit	S
	12-bit AC/DC converter	Variable decima	al point setting	Switching points	s can be moni-
	Measurement range selection	Adjustable zero	point	tored using LED	s on the front
	Voltage input of 010 V	Supply voltage	1032 V	panel	
	Current input of 0/420 mA	2 programmabl	e relay out-	300 switching p	oints can be dis-
	Scalable display range	puts, each as lir	mit switch/	tributed over up	to 15 programs
		comparator		Adjustable top d	lead center/zero
		Cam		point shift	
		2-point controlle	er	Dynamic dead ti	me compensa-
		1 configurable ii	nput	tion for each ind	lividual switching
		External zeroing	2	point	
		Retention of the	e display value	Multiple BDD-CO	C 08 units can
		Insulated DIN h	ousing for	be wired in para	llel
		mounting in fror	nt panel	Integrated trans	ducer supply
		(clamp included	d in the scope	voltage 300 mA	, 24 V
		of delivery)		Insulated DIN ho	ousing for
				mounting in fror	it panel (clamp
				included in the s	scope of delivery)

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- Housing depth 110 mm

Housing depth 110 mm

Basic Information and Definitions

Accessories Connectors

Evaluation

Profibus Module P111

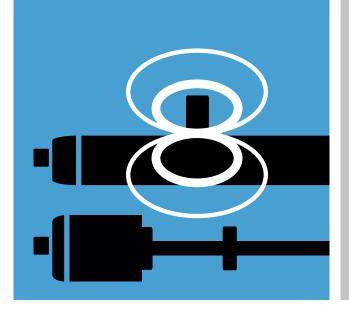
**BUS Interface** Modules Digital Display CAM Controller

Units

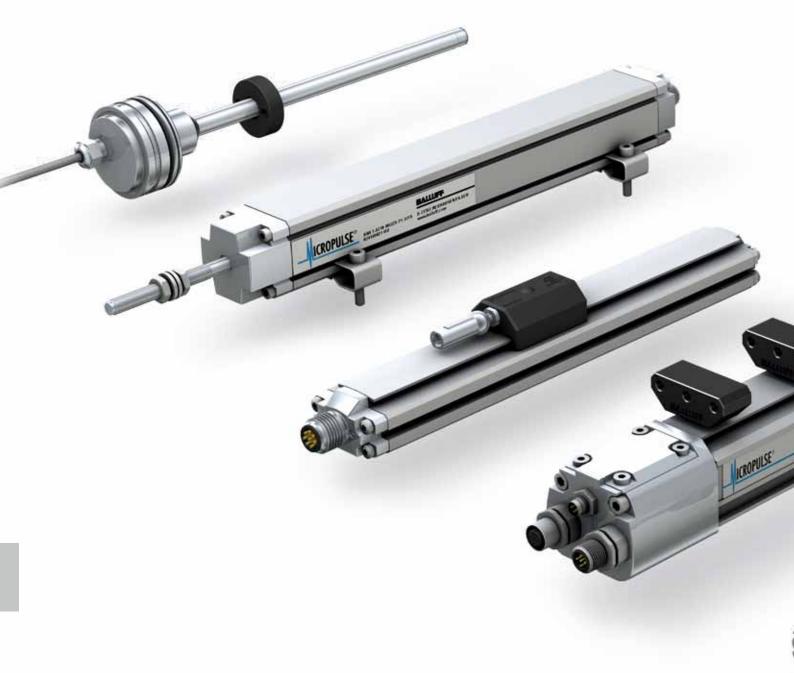
"Pigtail" Connec-tor System



www.balluff.com



# Micropulse Transducers





#### **Basic Information and Definitions**

Definitions		
Designs		
Interfaces		



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Basic Information and Definitions **Definitions** 

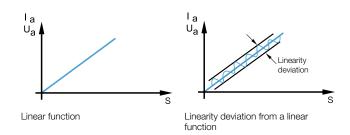
Output signal, characteristic curve, resolution, sensitivity

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 encoder 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.

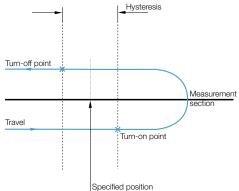


Linearity deviation

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.



# Basic Information and Definitions **Definitions**

SYNC mode	The absolute positioning information of the position measurement system is determined and transmitted synchronously to the read cycle of the electronic processor unit, e.g. an axis controller or a regulating controller.	
Incremental	After the system is switched on, the measured value currently avail- able 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 incre- ments from the reference point.	Micropulse Transducers
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.	Profile P Profile PF Profile AT
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 $\alpha$ with linear relationship y = y0 (1 + $\alpha \times \Delta$ T).	Profile BIW Rod Rod Compact and Rod AR Rod EX, T Redundant
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.	and CD Filling Level Sensor SF Accessories
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.	Basic Information and Definitions Definitions Designs Interfaces
Measurement rate	The measurement rate is the frequency at which the output posi- tion information is updated. It can be the same as the number of measurements per second. A high measurement 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 er-	
	roneous output signal or an error signal will be output if the encoder is allowed to travel into this zone, which must not be considered valid information.	

# Basic Information and Definitions 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	(Ex)
Flameproof encapsulation "d" Coding "Ex d"	<ul> <li>Parts that could ignite a potentially explosive atmosphere must be housed in an enclosure:</li> <li>that can withstand the pressure resulting from the explosion of an explosive mixture inside the housing, and</li> <li>that prevents the internal explosion from igniting the potentially explosive atmosphere surrounding the housing.</li> </ul>	
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 declaration confirms that the product satisfies re- quirements 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 number.	e1
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.	FD/2





#### 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 processor 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.













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

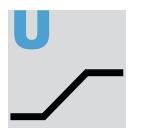
Accessories

Basic Information and Definitions Definitions Designs

Interfaces

# ROPULSE ®

# Basic Information and Definitions Interfaces



#### Analog voltage output

The output voltage is directly proportional to the position of the encoder along the measurement section.

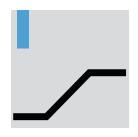
The most important parameter for analog outputs is the refresh rate and residual ripple of the output signal.

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 a fundamentally improved circuit design. This means fast output signals with low levels of ripple and noise in the output voltage.

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).



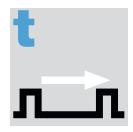
#### Analog current output

The output current is directly proportional to the position of the encoder along the measurement section.

Analog current interfaces 0...20 mA and 4...20 mA are standard in numerous applications and in many industries. Current interfaces are significantly less sensitive to induced noise voltage than analog voltage interfaces. A 500  $\Omega$  resistor can be used to easily convert the 0...20 mA signal into a 0...10 V voltage.

The 4...20 mA interface 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 characteristic.



#### **Pulse interface**

The time between a query and reply signal is directly proportional to the position of the encoder along the measurement section. These pulses are transmitted using RS485/422 differential drivers, guaranteeing interference-free signal transmission over cable lengths of up to 500 m. The great advantage of these interfaces is the noise-immune signal transmission with 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 encoder 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  $\pm 30 \,\mu\text{m}$  maximum linearity deviation of the SSI Micropulse transducer over the entire length, the max. 5 kHz update frequency and a resolution of 1  $\mu\text{m}$  make SSI Micropulse transducers an ideal feedback sensor – even in the most demanding positioning and control applications.



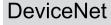
#### CANopen

The position of the encoder along the measurement 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 by your Micropulse sensor. Cyclically or on-demand.

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 highpriority 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 configured using the electronic device data sheet (EDS file).





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

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F

# Basic Information and Definitions Interfaces

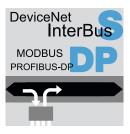


#### **Profibus DP**

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  $\mu$ m increments and the velocity resolution at 0.1 mm/s increments.

A zero point and working ranges can be configured individually for each encoder.



#### 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 driver to the higher-level 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 driver. 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 measurement 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.



Basic Information and Definitions Interfaces



#### 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 IP20 module for central operation in the control cabinet or as a remote I/O module in IP 65/67 degree 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 consistently saved, so that a configuration is possible and reproducible at any time. More information about IO-Link:

#### EtherCAT

Micropulse position measurement 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.



Micropulse Transducers

Profile P

Profile PF

Profile AT

Profile BIW

Rod

Rod Compact and Rod AR

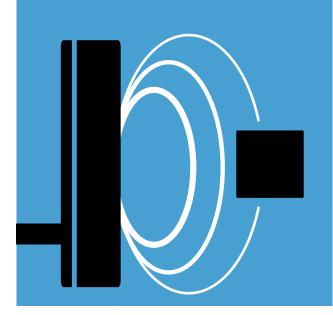
Rod EX, T Redundant and CD

Filling Level Sensor SF

Accessories

Basic Information and Definitions Definitions Designs Interfaces

www.io-link.com.

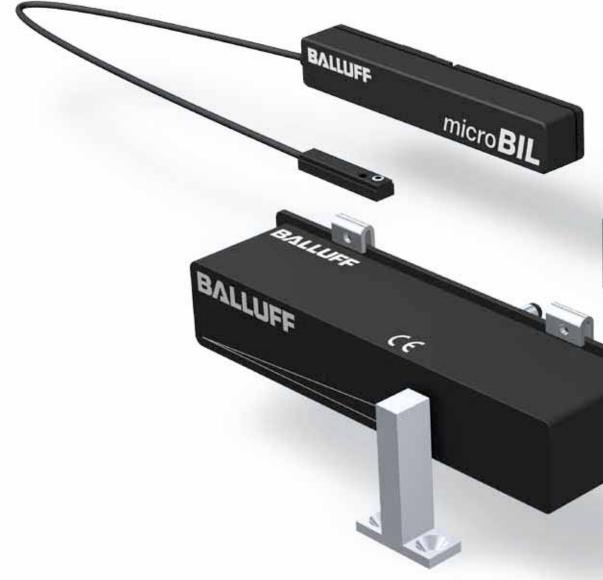


# Inductive Position Sensors

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 shocks and vibrations.





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Inductive Position Sensors BIP	298
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## Inductive Position Sensors Applications

#### BIL

Balluff magneto-inductive position sensors detect positions up to 160 mm away. Analog displacement sensors BIL measure **without contact and absolutely using a passive position encoder**. The compact design means these sensors can be easily integrated into the application even when installation space is extremely tight.



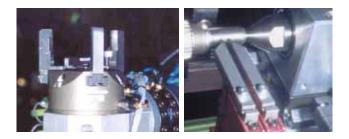
#### Micro-BIL

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

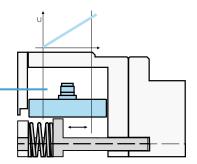
The inductive positioning system BIP is an accurate measurement system for detecting the position of metallic objects.

#### 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 clamping distance monitoring

Position sensor BIP in use at a drive spindle for tools





Inductive Position Sensors Applications Summary

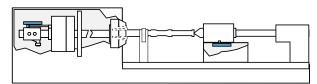
Magnetoinductive Position Sensors BIL

Inductive Position Sensors BIP

Basic Information and Definitions

#### Applications

The positioning systems BIP are ideal for integrated production monitoring because their unmatched working length ratio makes installation possible in even the most confined applications. The position detection of a simple metal target, without the need for a magnet, makes this sensor extremely flexible for use in mechanical engineering.





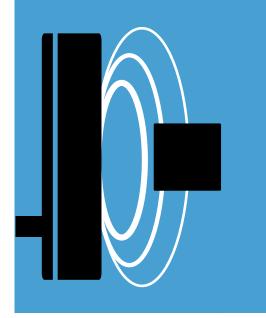
Inductive Position Sensors Summary

# **Compact and absolute**

Series		SMARTSENS Micro-BIL	SMARTSENS	SMARTSENS		
Measuring range		010 mm	060 mm	0160 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	010 V			100 B		
	420 mA			100 B		
IO-Link						
Target/position encoder						
Magnet				100 B		
Metal						
From page		292	294	295		



(		Reference of the second			
	BIP 14	BIP 40	BIP 70	BIP 103	
	014 mm	040 mm	070 mm	0103 mm	
	100 B 100 B	100 B	100 B	100 B	Inductive Position Sensors
	14 µm	40 µm	80 µm	80 µm	Applications Summary
	±250 μm	±400 μm	±300 µm	±400 μm	
	±80 μm	±100 μm	±80 μm	±80 µm	Magneto- inductive Position Sensors BIL
					Inductive
	100 A	100 A		100 A	Position Sensors BIP
	100 A. 100 A.	100 A 100 A	100 A.	100 A.	Basic Information and Definitions
	100 A 100 A	100 A 100 A			Deminuons
	1.1.1	1.1.1	100 A	100 A	
	301	301	302	302	



# Inductive Position Sensors

# Magneto-inductive Position Sensors BIL

Magneto-inductive position sensors BIL are compact displacement sensors for position detection up to 160 mm away. The magneto-inductive analog displacement sensor measures without contact and absolutely, using a wireless position encoder.





#### Magneto-inductive Position Sensors BIL

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Micro-BIL, General Data	293
BIL, General Data	294
Accessories	296







# 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







Original mounting brackets and screws are recommended for attaching the Micro-BIL. Please order accessories separately. See page 296



# becomes narrow

Magneto-inductive Position Sensors Micro BIL General data



Code what in our distribution, typical (typical axial field strength – parallel to sensing surface)Magneto- inductiveResidual ripple $\leq 10\%$ of UeMagneto- inductiveRated insulation voltage Ui $75 \lor DC$ Position SenEffective distance se $5 mm$ SummaryLoad resistance RLAt voltage output Uout: $R_L = \geq 2 k\Omega$ , At current output $I_{out}: R_L = \leq 500 \Omega$ Micro-BILNo-load supply current Io at Ue $\leq 30 mA$ AccessoriesPolarity reversal protectedyesInductive Position SenShort-circuit protectedyesInductive Position SenAmbient temperature Ta $-10+70 \ ^{\circ}C$ Position Sen BilRepeat accuracy R _{BWN} $\leq \pm 30 \mu m$ Basic	Output signal U _{out}		Voltage 010 V or	
Linear range si010 mmOrdering codeBIL 0002Part numberBIL ED0-8010P-02/30-S75Supply voltage UsAt voltage output Uous: Us = 15 to 30 V DC, At current output Ious: Us = 1030 V DCField strength, axial H,10 kA/m typical2 dB width of the axial field distribution, typical typical axial field strength - parallel to sensing surface $10 kA/m$ typicalResidual ripple $\leq 10\%$ of U_uRated insulation voltage U, Effective distance sa5 mmLoad resistance RLAt voltage output Uour: RL = $\geq 2 k\Omega$ , At current output Iour: RL = $\leq 500 \Omega$ Summary Micro-BiL BiL BiL Current Output Iour: RL = $\leq 500 \Omega$ No-load supply current I_0 at U_a $\leq 30 mA$ AccessoriesPolarity reversal protectedyesShort-circuit protectedyesNon-inearity $= 0.3 mm$ Temperature coefficient TCTypical TypicalIn the optimum rangeMin. $+ 2 \mum/K$ In the optimum rangeMin. $+ 2 \mum/K$ Power-on indicatoryesProgramming indicatoryesP	Output signal lout		Current 420 mA	
Ordering codeBil 0002Part numberBiL ED0-B010P-02/30-S75Supply voltage UsAt voltage output Uou: Us = 15 to 30 V DC, At current output Iou: Us = 1030 V DCField strength, axial Hn10 kA/m typical-3 dB width of the axial field distribution, typical (typical axial field strength - parallel to sensing surface)2.5 mmResidual ripple $\leq 10\%$ of UpRated insulation voltage U, Effective distance sp.75 V DCRated insulation voltage U, Load resistance RLAt voltage output Uout: RL = $\geq 2$ kQ, At voltage output Uout: RL = $\leq 500 \ \Omega$ No-load supply current Io at Up Polarity reversal protectedyesNon-linearity $\pm 30 \ mA$ Non-linearity $\pm 0.3 \ mm$ Temperature coefficient TC From +10+50 °CTypicalHa optimum range Porgramming indicatoryesPorger of protection as per IEC 60529IP 67Porger of protectionyesPorgramming indicatoryesPorgramming indicatoryesPower-on Indicator	Working range s _w		010 mm	
Part numberBIL ED0-B010P-02/30-S75Image: Constant of the second	Linear range s _l		010 mm	
Supply voltage UsAt voltage output Uout: Us = 15 to 30 V DC, At current output Iout: Us = 10 :30 V DCInductiveField strength, axial Hn10 kA/m typical2.5 mmInductive-3 dB width of the axial field distribution, typical2.5 mmMagneto- inductiveMagneto- inductiveResidual ripple $\leq$ 10% of Ue75 V DCMagneto- inductiveMagneto- inductiveRated insulation voltage Ui75 V DCSmmSummaryLoad resistance Se5 mmSummarySummary Micro-BILSummary Micro-BILLoad resistance RLAt voltage output Uout: RL = $\leq$ 500 $\Omega$ BillSummary Micro-BILNo-load supply current Io at Ue $\leq$ 30 mA $\leq$ 30 mAAccessoriesPolarity reversal protectedyes $=$ 10+70 °CPosition Sen BIPNon-linearity $\pm$ 0.3 mn $=$ 10+70 °CPosition Sen BIPTemperature coefficient TCTypical $+4$ µm/KInductive Position Sen BIPIn the optimum rangeMin. $+2$ µm/KInductive Position Sen BIPPower-on indicatoryesMin. $+2$ µm/KPower-on indicatoryesPosition Sen BIPPower-on indicatoryesPosition Sen BIPPower-on indicatoryesPosition Sen BIPProgramming indicatoryesPosition Sen BIPPower-on indicatoryesPosition Sen BIPPower-on indicatoryesPosition Sen BIPDegree of protection as per IEC 60529IP 67 Housi	Ordering code		BIL0002	
At current output $l_{out}$ : $U_S = 1030 \vee DC$ Field strength, axial $H_h$ 10 kA/m typical-3 dB width of the axial field distribution, typical2.5 mmResidual ripple $\leq 10\%$ of $U_e$ Rated insulation voltage $U_i$ 75 V DCBated insulation voltage $U_i$ $T5 \vee DC$ Bated insulation voltage $U_i$ $S mm$ Load resistance $R_L$ At voltage output $U_{out}$ : $R_L = \geq 2 k\Omega,At current output I_{out}: R_L = \leq 500 \OmegaNo-load supply current I_0 at U_e\leq 30 \text{ mA}Polarity reversal protectedyesShort-circuit protectedyesShort-circuit protectedyesNon-linearity\pm 0.3 \text{ mm}Non-linearity\pm 0.3 \text{ mm}Temperature C_m+10 \mu m/KPower-on indicatoryesPower-on indicatoryesProgramming indicatoryesPogene of protection as per IEC 60529IP 67PonectionConnectors$	Part number		BIL ED0-B010P-02/30-S75	
Field strength, axial $H_n$ 10 kA/m typicalInductive-3 dB width of the axial field distribution, typical (typical axial field strength – parallel to sensing surface)2.5 mmPosition SenResidual ripple $\leq 10\%$ of $U_e$ Position SenPosition SenRated insulation voltage $U_i$ 75 V DCPosition SenEffective distance $s_e$ 5 mmSummaryLoad resistance $R_L$ At voltage output $U_{out}$ : $R_L = \geq 2 k\Omega,At current output I_{out}: R_L = \leq 500 \OmegaBil.No-load supply current I_0 at U_e\leq 30 \text{ mA}AccessoriesShort-circuit protectedyesBil.Short-circuit protectedyesInductivePosition SenNon-linearity\leq 1.3\% on mBasicH m/KTemperature coefficient TCTypicalTypical\pm 20 \mu m/KProgramming indicatoryesBasicPosition SenProgramming indicatoryesBasicPosition SenProgramming indicatoryesPosition SenPortection as per IEC 60529IP 67Housing materialPA fiberglass reinforcedConnectionConnectors$	Supply voltage U _S		At voltage output $U_{out}$ : $U_S = 15$ to 30 V DC,	
$-3 dB$ width of the axial field distribution, typical (typical axial field strength – parallel to sensing surface)2.5 mmPosition Sen Magneto- Inductive Position Sen BitResidual ripple $\leq 10\%$ of UeMagneto- Position Sen BitMagneto- Position Sen BitEffective distance s_e5 mmSummary Micro-Bit At current output Uout: $R_L = \geq 2 k\Omega$ , At current output $U_{out}: R_L = \leq 500 \Omega$ BitNo-load supply current $I_0$ at Ue $\leq 30 \text{ mA}$ AccessoriesPolarity reversal protectedyesInductive Position Sen BIPShort-circuit protectedyesInductive Position Sen BIPRepeat accuracy R _{BWN} $\leq \pm 30 \text{ µm}$ $= \pm 30 \text{ µm}$ Non-linearity $\pm 0.3 \text{ mm}$ $= 4.4 \text{ µm/K}$ In the optimum rangeMin. $+ 2 \text{ µm/K}$ In the optimum rangeMin. $+ 2 \text{ µm/K}$ Programming indicatoryesProgramming indicatoryesProgramming indicatoryesProgramming indicatoryesProgramming indicatoryesProgramming indicatoryesProgramming indicatoryesPorgramming indicatoryesPorgramming indicatorYesPorgramming indicatorPA fiberglass reinforcedConnectionConnectors			At current output $I_{out}$ : U _S = 1030 V DC	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	0		10 kA/m typical	
Residual ripple $\leq 10\%$ of UeMagneto- InductiveRated insulation voltage Ui75 V DCPosition SenEffective distance se5 mmSummaryLoad resistance RLAt voltage output Uout: RL = $\geq 2 k\Omega$ , At current output Iout: RL = $\leq 500 \Omega$ Summary Micro-BILNo-load supply current Io at Ue $\leq 30 mA$ AccessoriesPolarity reversal protectedyesInductive Position SenShort-circuit protectedyesInductive YesAmbient temperature Ta $-10+70 °C$ Repeat accuracy Rewn $\leq \pm 30 \mu m$ Non-linearity $\pm 0.3 mm$ Temperature coefficient TCTypical TypicalIn the optimum rangeMin. H 2 $\mu m/K$ Power-on indicatoryesPower-on indicatoryesPorgramming indicatoryesDegree of protection as per IEC 60529IP 67Housing materialPA fiberglass reinforcedConnectionConnectors	-3 dB width of the axial field dist	ribution, typical	2.5 mm	Position Sensors
Restore inductive Rated insulation voltage $U_i$ 75 V DCProstion Sen BitEffective distance $s_e$ 5 mmSummary Micro-Bit At current output $U_{out}$ : $R_L = \ge 2 k\Omega$ , At current output $I_{out}$ : $R_L = \ge 2 k\Omega$ , At current output $I_{out}$ : $R_L = \ge 2 k\Omega$ , At current output $I_{out}$ : $R_L = \ge 2 k\Omega$ , At current output $I_{out}$ : $R_L = \ge 2 k\Omega$ , At current output $I_{out}$ : $R_L = \ge 2 k\Omega$ , At current output $I_{out}$ : $R_L = \ge 2 k\Omega$ , At current output $I_{out}$ : $R_L = \ge 2 k\Omega$ , AccessoriesSummary Micro-Bit Bit Bit AccessoriesPolarity reversal protectedyesInductive yesInductive yesShort-circuit protectedyesInductive yesAmbient temperature $T_a$ $-10+70 \ ^{\circ}C$ Position Sen BipRepeat accuracy $R_{BWN}$ $\le \pm 30 \ \mu m$ $= 4.30 \ \mu m$ Non-linearity $\pm 0.3 \ mm$ $\pm 0.3 \ mm$ Temperature coefficient TCTypical $+4 \ \mu m/K$ In the optimum rangeMin. $+2 \ \mu m/K$ Power-on indicatoryesProgramming indicatoryesDegree of protection as per IEC 60529IP 67Housing materialPA fiberglass reinforcedConnectionConnectors	(typical axial field strength - parallel to	o sensing surface)		Manuala
Effective distance $s_e$ 5 mmBILLoad resistance $R_L$ At voltage output $U_{out}$ : $R_L = \ge 2 k\Omega$ , At current output $I_{out}$ : $R_L = \le 500 \Omega$ Summary Micro-BIL Bill AccessoriesNo-load supply current $I_0$ at $U_e$ $\le 30 \text{ mA}$ AccessoriesPolarity reversal protectedyesInductive yesShort-circuit protectedyesInductive Polarity reversal protectedAmbient temperature $T_a$ $-10+70 \ ^\circ C$ Repeat accuracy $R_{BWN}$ $\le \pm 30 \ \mum$ Non-linearity $\pm 0.3 \ mm$ Temperature coefficient TCTypicalTypical $+4 \ \mum/K$ In the optimum rangeMin. $10 \ \mum/K$ $20 \ max$ Power-on indicatoryesProgramming indicatoryesPogree of protection as per IEC 60529IP 67Housing materialPA fiberglass reinforcedConnectionConnectors				
Effective distance $s_e$ 5 mmSummaryLoad resistance $R_L$ At voltage output $U_{out}$ ; $R_L = 2 k \Omega$ , At current output $I_{out}$ ; $R_L = 500 \Omega$ Micro-BL BlL AccessoriesNo-load supply current $I_0$ at $U_e$ $\leq 30 \text{ mA}$ BlL AccessoriesPolarity reversal protectedyesInductive Position Sen BIPAmbient temperature $T_a$ $-10+70 \ ^{\circ}C$ Inductive $\pm 30 \ \mu$ mRepeat accuracy $R_{BWN}$ $\leq \pm 30 \ \mu$ mBasic $BIPNon-linearity\pm 0.3 \ mmBasic\pm 0.3 \ mmTemperature coefficient TCTypicalTypical+4 \ \mu m/KIn the optimum rangeMin.\pm 10 \ \mu m/KPower-on indicatoryesPogramming indicatoryesProgramming indicatoryesDegree of protection as per IEC 60529IP 67Housing materialPA fiberglass reinforcedConnectionConnectors$				Position Sensors
Load resistance $H_L$ At voltage output $U_{out}$ ; $H_L = \leq 2$ k2, At current output $I_{out}$ ; $H_L = \leq 2$ k2, At current output $I_{out}$ ; $H_L = \leq 200 \Omega$ Micro-BiL BiL AccessoriesNo-load supply current $I_0$ at $U_e$ $\leq 30$ mAAccessoriesPolarity reversal protectedyesInductive YesAmbient temperature $T_a$ $-10+70$ °CInductive $\pm 30 \ \mu$ mRepeat accuracy $R_{BWN}$ $\leq \pm 30 \ \mu$ mBil PolarityNon-linearity $\leq \pm 30 \ \mu$ mBil PolarityTemperature coefficient TCTypical $+4 \ \mu$ m/KIn the optimum rangeMin. $+2 \ \mu$ m/KPower-on indicatoryesPogramming indicatoryesPogramming indicatoryesPogramming indicatoryesPerformation a per IEC 60529IP 67Housing materialPA fiberglass reinforcedConnectionConnectors	Ŭ			
At current output $I_{out}$ : $R_L = \le 500 \Omega$ BILNo-load supply current $I_0$ at $U_e$ $\le 30 \text{ mA}$ AccessoriesPolarity reversal protectedyesInductiveShort-circuit protectedyesInductiveAmbient temperature $T_a$ $-10+70 \ ^{\circ}C$ Position SenRepeat accuracy $R_{BWN}$ $\le \pm 30 \ \mu m$ $\pm 0.3 \ m m$ Non-linearity $\pm 0.3 \ m m$ BasicTemperature coefficient TCTypical $+4 \ \mu m/K$ In the optimum rangeMin. $+2 \ \mu m/K$ From $+10+50 \ ^{\circ}C$ max $+10 \ \mu m/K$ Power-on indicatoryesProgramming indicatoryesDegree of protection as per IEC 60529IP 67Housing materialPA fiberglass reinforcedConnectionConnectors	Load resistance $R_L$			•
Polarity reversal protected       yes       Accessities       Accessities         Short-circuit protected       yes       Inductive         Ambient temperature Ta       -10+70 °C       Position Sen         Repeat accuracy RewN       ≤ ±30 µm       BIP         Non-linearity       ±0.3 mm       Basic         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       yes         Programming indicator       yes       yes         Perogramming indicator       yes       yes         Perogramming indicator       Yes       PA fiberglass reinforced         Connection       Connectors       Connectors				
Short-circuit protected       yes       Inductive       Inductive       Inductive       Position Sen       Inductive         Ambient temperature Ta       -10+70 °C       Short-circuit protected       Inductive       Position Sen       Inductive       <		e	≤ 30 mA	Accessories
Ambient temperature $T_a$ $-10+70 \ ^{\circ}C$ Position Sen BIPRepeat accuracy $R_{BWN}$ $\leq \pm 30 \ \mu$ m $BIP$ Non-linearity $\pm 0.3 \ m$ m $Basic$ Temperature coefficient TCTypical $+4 \ \mu$ m/KIn the optimum rangeMin. $+2 \ \mu$ m/KFrom $+10+50 \ ^{\circ}C$ max $+10 \ \mu$ m/KPower-on indicatoryesProgramming indicatoryesDegree of protection as per IEC $\leftarrow 0529$ IP 67Housing materialPA fiberglass reinforcedConnectionConnectors			yes	
Anderit temperature $\Gamma_a$ -10+70 °CBIPRepeat accuracy $R_{BWN}$ $\leq \pm 30 \ \mu m$ $\pm 0.3 \ m m$ $BiP$ Non-linearity $\pm 0.3 \ m m$ $\pm 0.3 \ m m$ $Bir$ Temperature coefficient TCTypical $+4 \ \mu m/K$ $Hin.$ $+2 \ \mu m/K$ In the optimum rangeMin. $+2 \ \mu m/K$ $Hin.$ $Hin.$ From $\pm 10 \ \mu m/K$ $Hin.$ $\pm 0.3 \ m m$ $Hin.$ $Hin.$ Power-on indicatoryes $Hin.$ $Hin.$ $Hin.$ Programming indicatoryes $Hin.$ $Hin.$ $Hin.$ Degree of protection as per IEC 60529IP 67IP 67Housing materialPA fiberglass reinforcedConnectorsConnectionConnectorsConnectors	· · · · ·			
Non-linearity       ±0.3 mm       Basic         Temperature coefficient TC       Typical       +4 µm/K       Information 2         In the optimum range       Min.       +2 µm/K       Definition 3         From +10+50 °C       max       +10 µm/K       Power-on indicator       yes         Power-on indicator       yes       yes       Pogree of protection as per IEC 60529       IP 67         Housing material       PA fiberglass reinforced       Connectors       Connectors       Connectors				
Temperature coefficient TC     Typical     +4 μm/K     Information a       In the optimum range     Min.     +2 μm/K     Information a       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     Connectors				
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     Connectors	,			
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       Connectors				Information and Definitions
Power-on indicatoryesProgramming indicatoryesDegree of protection as per IEC 60529IP 67Housing materialPA fiberglass reinforcedConnectionConnectors	1 0	Min.		Dominiono
Programming indicatoryesDegree of protection as per IEC 60529IP 67Housing materialPA fiberglass reinforcedConnectionConnectors		max	+10 μm/K	
Degree of protection as per IEC 60529IP 67Housing materialPA fiberglass reinforcedConnectionConnectors			•	
Housing material     PA fiberglass reinforced       Connection     Connectors	5 5			
Connection Connectors	<b>o</b>			
	0			
Approval CULus				
Recommended connector BKS-S 74/BKS-S 75	Recommended connector		BKS-S 74/BKS-S 75	

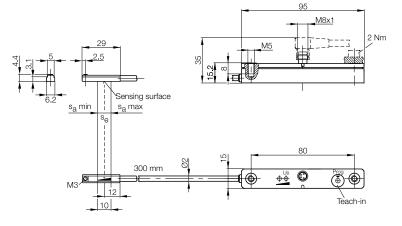
Adjustment to different magnetic field strengths is possible at the touch of a button. The technical data refer to reference measurements. Different grippers/cylinders with differing magnetic fields may affect the technical data.

#### Connection wiring diagram

	1.	BN	
	4	BK	
	3	BU	
	2	WHERLIA	-

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Connect either the voltage or current output.



# Magneto-inductive Position Sensors BIL General data



Output signal Uout		Voltage 010 V, out-of-range 11 V	
Output signal lout			
Working range s _w		060 mm	
Linear range s _l		555 mm	
Ordering code		BIL0001	
Part number		BIL AMD0-T060A-01-S75	
Supply voltage U _S		1530 V DC	
Residual ripple		$\leq$ 10% of U _e	
Rated insulation voltage U _i		75 V DC	
Effective distance se		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	
Measurement 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		Connectors	
Approval		cULus	
Recommended connector		BKS-S 74/BKS-S 75	

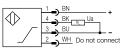
#### **Out-of-range function**

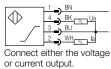
Position encoder within working range:

- Output voltage 0...10 V or output current 4...20 mA
- LED not on
- Position encoder outside the working range:
- Output voltage approx. 11 V or output current approx. 22 mA
   LED lights up

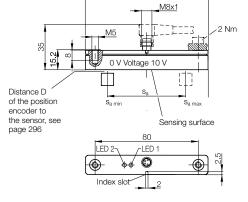


BIL EMD0.../BIL ED0...





Original mounting brackets and screws are recommended for attaching the BIL.



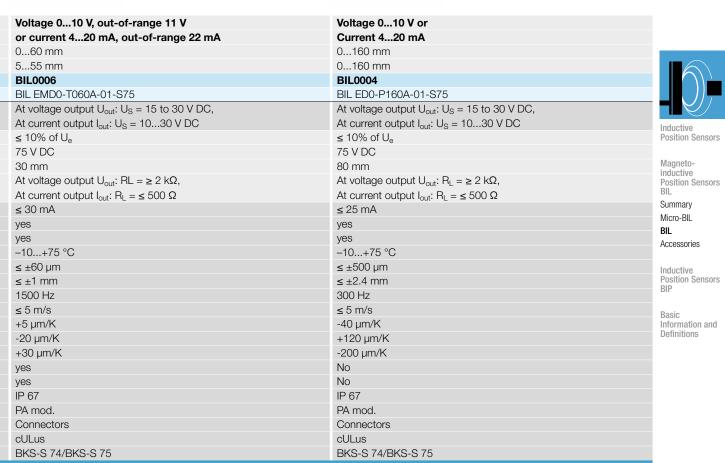
95

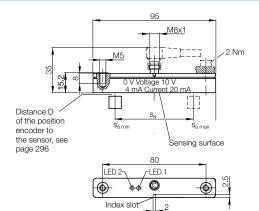
Please order accessories separately. See page 296

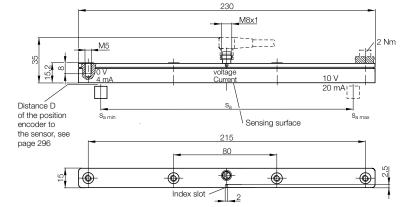


## Magneto-inductive Position Sensors BIL General data







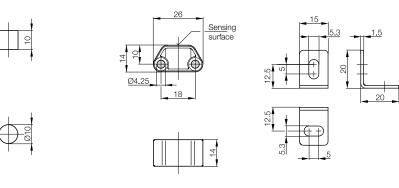


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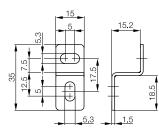


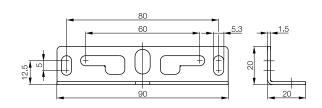


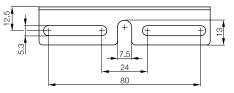
Designation	Position encoder	Position encoder	Mounting bracket
Size	Ø 10×10 mm	26×14×14 mm	
Ordering code	BAM0176	BAM0177	BAM00K4
Part number	BIL 000-MH-A	BIL 001-MH-A	BIL 01-HW-1
Material	Hard ferrite	PA fiberglass reinforced	Stainless steel
Distance D	2 mm	1 mm	



Designation	Mounting bracket	Mounting bracket	
Ordering code	BAM00K5	BAM00K6	
Part number	BIL 01-HW-2	BIL 01-HW-3	
Material	Stainless steel	Stainless steel	



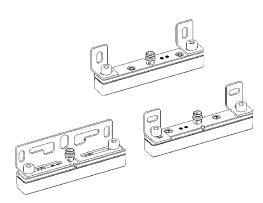


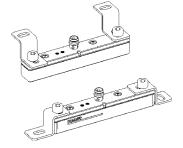


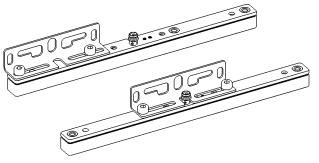




#### Mounting examples









Inductive Position Sensors

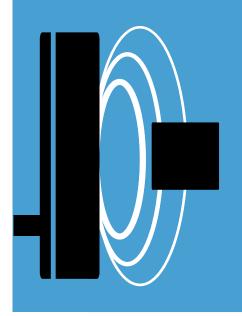
Magnetoinductive Position Sensors BIL Summary Micro-BIL

BIL Accessories

Inductive Position Sensors BIP

Basic Information and Definitions





# Inductive Position Sensors

# Inductive Position Sensors BIP

Balluff magneto-Inductive Position Sensors detect positions up to 103 mm away. Displacement sensors BIP measure without contact and absolutely using a passive non-magnetic position encoder. The compact design means these sensors can be easily integrated into the application even when installation space is extremely tight. Even the position encoder can be designed as an integral part of an application. Analog and digital interfaces ensure easy usability.

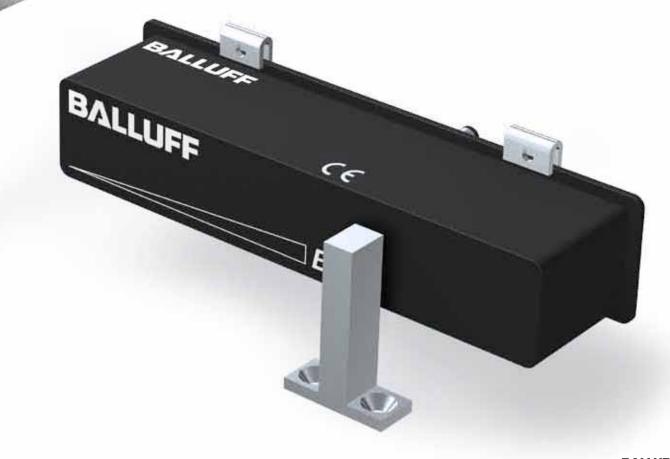




Inductive Position Sensors BIP General Data

300





# Inductive Position Sensors BIP General data

# Able to be integrated perfectly



- 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

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	







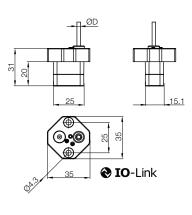


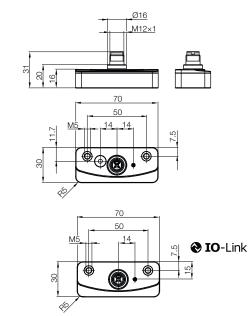






	20001	BIP0007	BIP0008	BIP0002	BIP0004	BIP0005
BIP	AD0-B014-01-EP02	BIP LD2-T014-01-EP02	BIP CD2-B014-01-EP02	BIP AD2-B040-02-S4	BIP LD2-T040-02-S4	BIP CD2-B040-02-S4
0	10 V	IO-Link	420 mA	010 V	IO-Link	420 mA
7	14 mm			2040 mm		
0	14 mm			040 mm		
8 m	nm			14 mm		
0.5	2 mm			13 mm		
14	μm			40 µm		
±8(	) μm			±100 μm		
±25	50 µm			±400 μm		
-25	5+70 °C			–25+85 °C		
2 m	n cable			M12 connector		
15.	1530 V (IO-Link 1830 V)			1530 V (IO-Link 18	.30 V)	
PA				PA		
yes	3			yes		







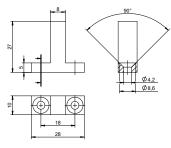
Magnetoinductive Position Sensors BIL

Inductive Position Sensors BIP

General Data

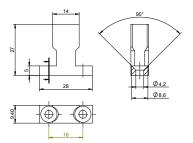
Basic Information and Definitions

#### 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.



# Inductive Position Sensors BIP **General data**

# Optimized working length





121

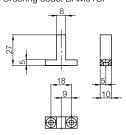
21

Ordering code	BIP000C	BIP000E
Part number	BIP ED2-B070-03-S75	BIP ED2-B103-03-S75
Output signal	010 V and 420 mA	010 V and 420 mA
Length of measuring range is teachable	3570 mm	51.5103 mm
Detection range	076.5 mm	0105 mm
Target width (EC80)	8 mm	8 mm
Target distance	13 mm	13 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	1630 V	1630 V
Housing material	PBT	PBT
LED function indicator	yes	yes

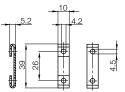
92.5

90.5

Please order Metal Target separately. Part number: BAM TG-XE-001 Ordering code: BAM01CP



Two fastening clips incl. screws are included in the delivery.



M8×1 119 55.3 55.3 串 đ 32.5 S 23 23 . O 0 ٥

21

M8×1

- 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

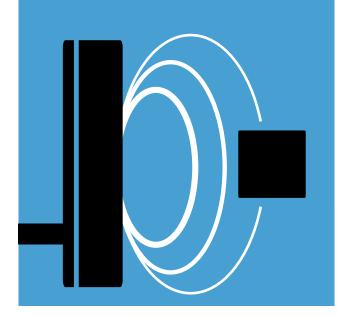


Inductive position sensors detect linear motion and provide a position-dependent output signal. The compact design makes them easy to integrate and monitor assembly and joining processes.

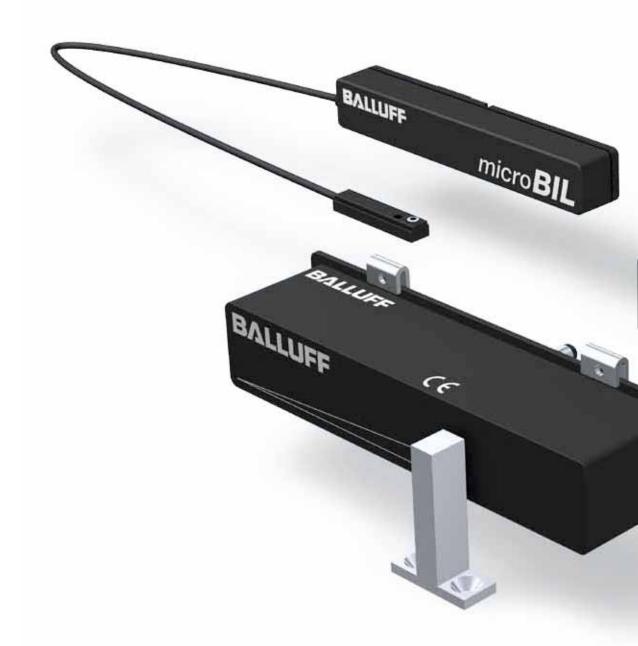
- Compact and easy to integrate
- Wear-free
- Absolute measuring principle
- High power density Optimal measurement path ratio
- to the housing geometry
- Analog output signal or IO-Link







# Inductive Position Sensors





**Basic Information and Definitions** Definitions

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# Basic Information and Definitions **Definitions**

Displacement sensors with analog output	The displacement sensors with analog output are sensors which generate a continuously varying output signal that depends on the distance. For the inductive position sensor, this depends on the posi- tion of the position encoder. For the inductive distance sensor, it depends on the distance of the sensing surface to the position encoder.		
Working range s _w	Working range $\ensuremath{s}_{\ensuremath{w}}$ is the travel path usable for position detection.		
Effective distance s _e	Effective distance $s_{\rm e}$ is the point in the middle of the linear range $s_{\rm l}$ and is used as the reference point for other specifications.		
Linear range s _i	Linear range $s_{\rm l}$ 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.		
Measurement 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 surface.		
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 measurement 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 displacement sensors as follows:		
	$\begin{aligned} \text{Slope S [V/mm]} &= & \frac{U_{out} \max - U_{out} \min}{s_w \max - s_w \min} \\ \text{or} \\ \text{Slope S [mA/mm]} &= & \frac{I_{out} \max - I_{out} \min}{s_w \max - s_w \min} \end{aligned}$		
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). Displacement sensors with analog output achieve the value R of  $\leq 5\%$ 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. Inductive **Output curves** BIL AMD0 ... BIL EMD0 ... / BIP ED2 ... BIL ED0.../ BIP AD.../ BIP CD... la la U_a Magneto-inductive .113 22 mA 11 V Ь U. 10 \ 20 mA 10 20 mA 10 V Inductive 5\ 12 mA 5 \ 12 mA 5 \ Basic 4 m/ 4 m.

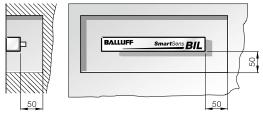
#### Installation notices

It is recommended that the BIL and position encoder 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 position encoder.

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 position encoders neighboring BIL sensors.

#### Recommended minimum distances from magnetizable materials or other BIL sensors

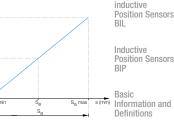


Values in mm

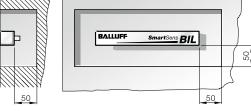
An area free of metals should be maintained all the way around the BIP's sensing surface in order to minimize the effects on the measuring signal caused by the installation material (see notes in the user's guide).

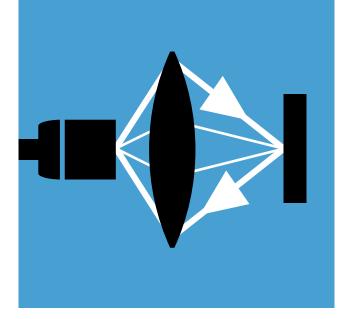
Invalid measurement signals may result if the sensor detects another metal part aside from the position encoder.











# Photoelectric Distance Sensors

Photoelectric distance sensors are used when distances to objects need to be measured or monitored or their precise position is to be determined. They support positioning tasks, material flow controls and level detections in the most diverse of applications – also across large distances.

Users can choose from a wide range of output signals. For example, users can choose from analog current and voltage outputs or digital, serial interfaces. However, variants with IO-Link are available for a simple and efficient connection to higher-level controllers.





#### Photoelectric Distance Sensors

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Distance Sensors BOD 66M-L Laser	330





# Photoelectric Distance Sensors Applications

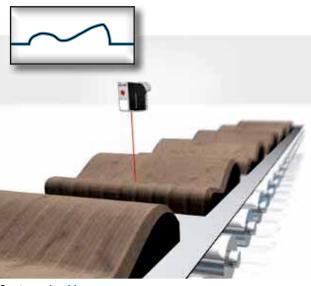
Optical distance sensors are used when distances of objects need to be measured or monitored with precise position determination. Distance measurement is based on the triangulation principle, where light travel time is measured.

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

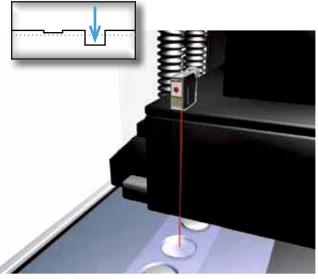
Control tasksSensing

- Object positioning
- Level detection



#### **Contour checking**

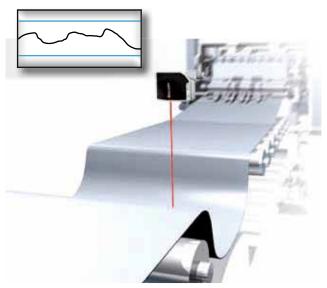
Optical distance sensors continuously detect dimensions or contours on tongue and groove boards. Analog sensing detects individual defects and gradual deviations directly for continuous monitoring of the production process.



#### Blister packaging

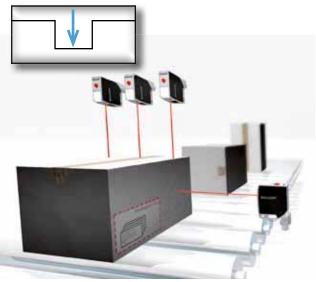
Optical distance sensors monitor the packaging process, optimize product filling and increase system productivity.

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.

# Photoelectric Distance Sensors Product overview

Туре		Working range	Resolution	esolution Light Analog Output U _S Connection			Page															
<b>Ordering</b> Part numb				Red light	Laser light	010 V	110 V	420 mA	RS485 interface	PNP transistor	IO-Link	2× PNP transistor	Alarm output	Push-pull PNP/NPN	1530 V DC	1830 V DC	M8 connector, 4-pin	M12 connector, 4-pin	M12 connector, 5-pin	M12 connector, 8-pin	Cable	
	tance sensor																					
B0D001L	BOD 6K-RA02-S75	2080 mm	20 µm																			313
BOD001M	BOD 6K-RA02-02	2080 mm	20 µm																			313
BOD000L	BOD 21M-LA01-S92	2545 mm	30 µm																			314
BOD000P	BOD 21M-LB01-S92	2545 mm	30 µm																			314
BOD000M	BOD 21M-LA02-S92		100200 µm																			315
BOD000R	BOD 21M-LB02-S92		100200 µm																			315
BODOOON	BOD 21M-LA04-S92		100500 µm																			315
BOD000T	BOD 21M-LB04-S92	20500 mm	100500 µm																			315
B0D0002	BOD 26K-LA01-S4-C	4585 mm	80 µm		-																	317
B0D0004	BOD 26K-LA02-S4-C	4585 mm	20 µm																			317
B0D0001	BOD 26K-LA01-C-06	4585 mm	80 µm																	_		317
BOD0003	BOD 26K-LA02-C-06	4585 mm	20 µm																			317
																						-
B0D0005	BOD 26K-LB04-S115-C	30100 mm	0.1% of Wh																			319
BOD000C	BOD 26K-LBR04-S115-C	30100 mm	0.1% of Wh																			319
B0D0006	BOD 26K-LB05-S115-C	80300 mm	0.1% of Wh																			321
BOD000E	BOD 26K-LBR05-S115-C	80300 mm	0.1% of Wh																			321
B0D0007	BOD 26K-LB06-S92-C	20 100 mm	0.1 % of Wh-WI		-			_		_						_						000
	BOD 26K-LB06-S92-C BOD 26K-LB07-S92-C		0.1 % of Wh-WI		-			-		-						-			-			323
B0D0008	DOD 2011-D01-992-0	00300 11111	U.1 /0 UI WII-WI																			323
B0D0012	BOD 63M-LI06-S4	2006000 mm	1 mm																			325
BODOOU	BOD 63M-LA02-S115	2002000 mm	1 mm		-													-				325
B0D0000	BOD 63M-LB02-S115	2002000 mm	1 mm												1							325
2020010		200112000 11111	1 11/11										-									520
BOD000W	BOD 63M-LA04-S115	2006000 mm	1 mm																			327
B0D0011	BOD 63M-LB04-S115	2006000 mm	1 mm																			327
DODOOTU		100 000	100 500	_			_							_		_			_			0.00
BOD001H	BOD 66M-RA11-S92		100500 µm	-										-		-			-			329
BOD001C	BOD 66M-RB11-S92	100600 mm	100500 µm										_	-					-			329
B0D001J	BOD 66M-RA12-S92	100800 mm	100800 µm																			331
BOD001K	BOD 66M-LB12-S92	100800 mm																				331
B0D001E	BOD 66M-LA14-S92	1502000 mm	13 mm																			331
B0D001F	BOD 66M-LB14-S92	1502000 mm	13 mm																			331

Photoelectric 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-R

NPN on request

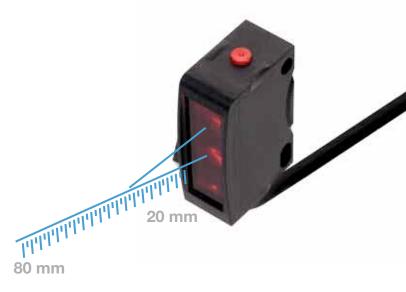
### Photoelectric Distance Sensors **Distance Sensors BOD 6K**

# The new generation!

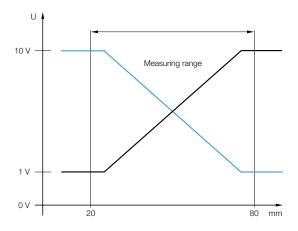
The new generation of BOD 6K sensors with a resolution of  $20\,\mu\text{m}$  is a real alternative for short-range measuring tasks! The new BOD 6K provides a distance-proportional analog output signal with falling voltage over an adjustable measuring range of 20 to 80 mm. With a switching output adjustable using teach-in, the sensor can also be used as a sensing device with background suppression.

#### Features

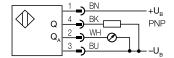
- Adjustable measuring range between 20...80 mm
- Analog output 1...10 V
- Adjustable background suppression
- Switching output PNP, NO/NC selection
- Teach-in (measuring range and switching output can be adjusted independently of each other)
- Button disable
- Connector- or cable version
- 20 µm resolution
- Invertable analog characteristic
- IP 69K/IP 67



#### Analog output BOD 6K-RA0...



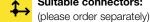
#### Connection wiring diagram





You can find special accessories for photoelectric sensors, such as reflectors, apertures, lenses, filters and deflection heads,, in our 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 Accessories catalog.



Suitable connectors:



Size	Design	Cable material	Color	Length	Ordering code
M8, 4-pin	Straight	PUR	Black	5 m	BCC02N3
M8, 4-pin	Angled	PUR	Black	5 m	BCC02NE

Connectors without LED are suitable for PNP and NPN sensors.

You can find more electrical accessories including a large selection of plug connectors and connecting cables in a wide variety materials, colors and lengths in our Industrial Networking and Connectivity catalog.

# Photoelectric Distance Sensors **Distance Sensors BOD 6K**





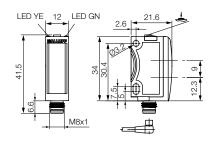


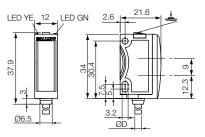
Series		BOD 6K	BOD 6K
Working range		2080 mm	2080 mm
Measuring range		60 mm	60 mm
PNP NO/NC	Ordering code	BOD001L	BOD001M
	Part number	BOD 6K-RA02-S75	BOD 6K-RA02-02
Supply voltage U _S		1330 V DC	1330 V DC
Analog output		110 V (max. 3 mA)	110 V (max. 3 mA)
No-load supply current Io	) max.	≤ 30 mA at 24 V DC	≤ 30 mA at 24 V DC
Output current		≤ 100 mA	≤ 100 mA
Switching type		Light/dark (selectable)	Light/dark (selectable)
Polarity reversal protected/s	short-circuit protected	yes/yes	yes/yes
Settings		Teach-in	Teach-in
Emitter, light type		LED, red light	LED, red light
Wavelength		632 nm	632 nm
Light spot diameter		5×5 mm at 50 mm	5×5 mm at 50 mm
Resolution		20 µm	20 µm
Linearity		±0.4 mm	±0.4 mm
Repeat accuracy		< 0.4 mm	< 0.4 mm
Temperature drift		0.1 mm/°K	0.1 mm/°K
Power-on indicator		Green LED	Green LED
Output function indicator		Yellow LED	Yellow LED
Switching frequency f		≤ 1000 Hz	≤ 1000 Hz
Degree of protection as p	per IEC 60529	IP 67/IP 69K	IP 67/IP 69K
Ambient temperature Ta		–20+60 °C	–20+60 °C
Permissible ambient light		5 klx	5 klx
Material	Housing	ABS	ABS
	Optical surface	PMMA	PMMA
Connection		M8 connector, 4-pin	2 m PVC cable, 4×0.14 mm ²

Measurement values referenced to 100×100 mm, 90% reflective Kodak gray card.



Connector orientation





Photoelectric

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

### Photoelectric Distance Sensors Laser distance sensors BOD 21M

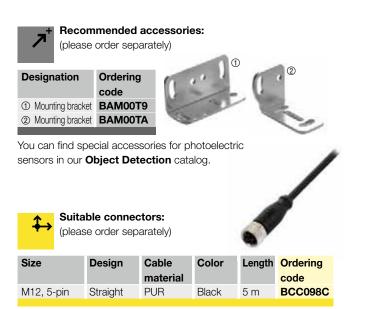
The BOD 21M is connected using a 5-pin M12 connector. The connector orientation on the sensor can be set over a range of 270°, allowing the BOD 21M to be attached in any position.

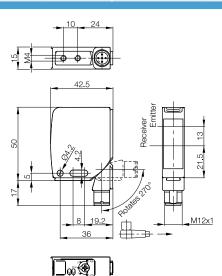




Series			BOD 21M	BOD 21M
Working ra	nge		2545 mm	2545 mm
Measuring	easuring range		20 mm	20 mm
2× PNP	Normally open/	Ordering code	BOD000L	BOD000P
	normally closed	Part number	BOD 21M-LA01-S92	BOD 21M-LB01-S92
Supply vol	tage U _S		1830 V DC	1830 V DC
Analog out	put		110 V (max. 3 mA)	420 mA
Settings			Teach-in (rotary switch)	Teach-in (rotary switch)
Switching	type		Light/dark switching	Light/dark switching
Emitter, lig	nt type		Laser, pulsed red light	Laser, pulsed red light
Wavelengt	h		630 nm	630 nm
Laser class	3		2	2
Light spot	diameter		Ø 1 mm at 45 mm	Ø 1 mm at 45 mm
Temperatu	re drift		≤ 0.2%/°K	≤ 0.2%/°K
Resolution			30 µm	30 µm
Linearity	Linearity		±0.5 %	±0.5 %
Stand-by o	delay		≤ 300 ms	≤ 300 ms
On/off dela	ıy		≤ 7 ms	≤ 7 ms
Switching	frequency f		≤ 70 Hz	≤ 70 Hz
Power-on	ndicator		Green LED	Green LED
Output fun	ction indicator		Yellow LED	Yellow LED
Degree of	protection as per IEC 6052	29	IP 67	IP 67
Polarity rev	ersal protected/short-circu	uit protected	yes	yes
Permissible	e ambient light		5 klx	5 klx
Ambient te	mperature T _a		–10+50 °C	−10+50 °C
Material		Housing	GD-Zn	GD-Zn
		Optical surface	Glass	Glass
Connection	า		M12 connector, 5-pin	M12 connector, 5-pin

Measured values referenced to Kodak gray card 90% reflective.  $\textcircled{} \rightarrow$  - Connector orientation





Green LED Yellow LED

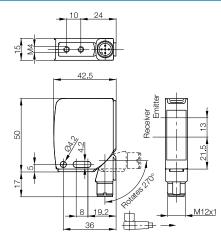
Connectors without LED are suitable for PNP and NPN sensors.



# Photoelectric Distance Sensors Laser distance sensors BOD 21M



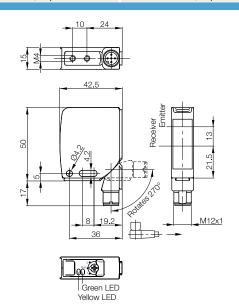






#### **Connection wiring diagrams**

BOS 21M-LA	BOS 21M-LB
1 +U ₀ PNP-L/NPN-D 5 0V 0V	1 +U ₀ PNP-L/NPN-D 5 A 3 OV





Photoelectric 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

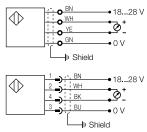
#### Features

■ Fixed measuring range between 45 to 85 mm

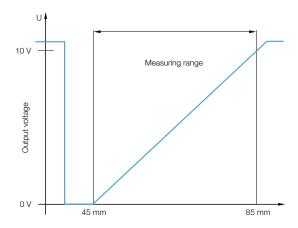
- Analog output 0...10 V
- 20 µm or 80 µm resolution
- Connector- or cable version



#### **Connection wiring diagrams**



#### Analog output BOD 26K-LA0...





You can find special accessories for photoelectric sensors, such as **reflectors, apertures, lenses, filters and deflection heads,**, in our **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 **Accessories** catalog.

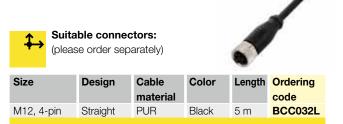


Series				
Working range				
Measuring range	Measuring range			
Ordering code				
Part number				
Supply voltage U _S				
Analog output				
No-load supply current I ₀ max.				
Output current				
Polarity reversal protected/short-circuit protected				
Settings				
Emitter, light type				
Wavelength				
Laser class				
Light spot diameter				
Temperature drift				
Resolution				
Linearity				
Power-on indicator				
Contamination indicator				
Limit 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				

50111661011

Measured values referenced to Kodak gray card 90% reflective.

Connector orientation



Connectors without LED are suitable for PNP and NPN sensors.

You can find more electrical accessories including a large selection of plug connectors and connecting cables in a wide variety materials, colors and lengths in our Industrial Networking and Connectivity catalog.



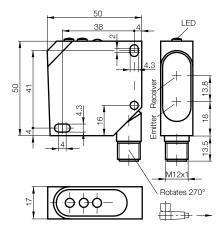


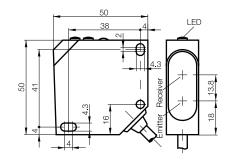


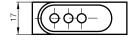




BOD 26K	BOD 26K	BOD 26K	BOD 26K	
4585 mm	4585 mm	4585 mm	4585 mm	
40 mm	40 mm	40 mm 40 mm		
BOD0002	BOD0004	BOD0001	BOD0003	
BOD 26K-LA01-S4-C	BOD 26K-LA02-S4-C	BOD 26K-LA01-C-06	BOD 26K-LA02-C-06	
1828 V DC	1828 V DC	1828 V DC	1828 V DC	
010 V (max. 3 mA)	010 V (max. 3 mA)	010 V (max. 3 mA)	010 V (max. 3 mA)	
35 mA	35 mA	35 mA	35 mA	
100 mA	100 mA	100 mA	100 mA	
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	
Ø 0.8 mm at 65 mm	Ø 0.8 mm at 65 mm	Ø 0.8 mm	Ø 0.8 mm	
18 µm/K	18 µm/K	18 µm/K	18 µm/K	
80 µm	20 µm	80 µm	20 µm	
≤ 1 % of Wh	≤ 1 % of Wh	≤ 1 % of Wh	≤ 1 % of Wh	
Green LED	Green LED	Green LED	Green LED	
Red LED	Red LED	Red LED	Red LED	
400 Hz	40 Hz	400 Hz	40 Hz	
3 ms	30 ms	3 ms	30 ms	
2 ms	20 ms	2 ms	20 ms	
IP 67	IP 67	IP 67	IP 67	
0+45 °C	0+45 °C	0+45 °C	0+45 °C	
3000 Lux	3000 Lux	3000 Lux	3000 Lux	
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,	6 m PVC cable,	
		4×0.25 mm ²	4×0.25 mm ²	

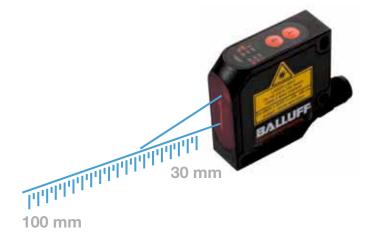




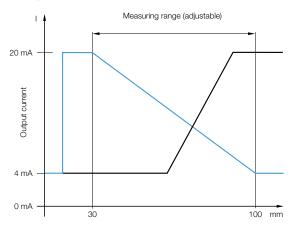


#### Features

- 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



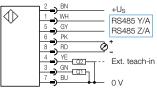
#### Analog output BOD 26K-LB(R)04...



#### Connector diagram



#### **Connection wiring diagram**

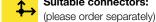


only type BOD 26K-LBR ....



You can find special accessories for photoelectric sensors, such as reflectors, apertures, lenses, filters and deflection heads,, in our 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 Accessories catalog.



Suitable connectors:



Size	Design	Cable material	Color	Length	Ordering code
M12, 8-pin	Straight	PVC	Gray	5 m	BCC0995
M12, 8-pin	Angled	PVC	Gray	5 m	BCC0998

Connectors without LED are suitable for PNP and NPN sensors.

You can find more electrical accessories including a large selection of plug connectors and connecting cables in a wide variety materials, colors and lengths in our Industrial Networking and Connectivity catalog.





Series		BOD 26K			
Working range		30100 mm			
Measuring range		adjustable max. 70 n			
2× PNP Normally open/	Ordering code	BOD0005			
normally closed	Part number	BOD 26K-LB04-S115-			
Supply voltage $U_S$		1830 V DC			
Analog output		420 mA			
No-load supply current	l ₀ max.	≤ 40 mA			
Output current max.		100 mA			
Switching type		Light/dark switching			
Interface					
Polarity reversal protected	l/short-circuit protected	yes/yes			
Settings		Teach-in			
Additional function					
Emitter, light type		Laser, red light			
Wavelength		650 nm			
Laser class		2			
Light spot diameter		1.5 mm × 3.25 mm a			
Resolution		< 0.1 % of Wh			
Linearity		< 0.25 % of Wh			
Power-on indicator		Green LED			
Output function indicate	or	Yellow LED			
Switching frequency		1 kHz			
Time function		50 ms pulse stretching			
Degree of protection as	s per IEC 60529	IP 67			
Ambient temperature T	a	−10+60 °C			
Permissible ambient lig	ht	5000 Lux			
Material	Housing	Impact-resistant ABS			
	Optical surface	PMMA			
Connection		M12 connector, 8-pin			

BOD 26K 30...100 mm adjustable max. 70 mm BOD0005 BOD 26K-LB04-S115-C 18...30 V DC 4...20 mA ≤ 40 mA 100 mA Light/dark switching yes/yes Teach-in Laser, red light 650 nm 2 1.5 mm × 3.25 mm at 100 mm < 0.1 % of Wh < 0.25 % of Wh Green LED Yellow LED 1 kHz 50 ms pulse stretching IP 67 –10...+60 °C 5000 Lux Impact-resistant ABS PMMA



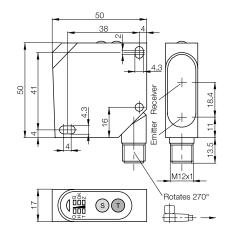
BOD 26K
30100 mm
adjustable max. 70 mm
BOD000C
BOD 26K-LBR04-S115-C
1830 V DC
420 mA
≤ 40 mA
100 mA
Light/dark switching
RS485
yes/yes
Teach-in
Master-slave mode
Laser, red light
650 nm
2
1.5 mm × 3.25 mm at 100 mm
< 0.1 % of Wh
< 0.25 % of Wh
Green LED
Yellow LED
1 kHz
50 ms pulse stretching
IP 67
-10+60 °C
5000 Lux
Impact-resistant ABS
PMMA
M12 connector, 8-pin

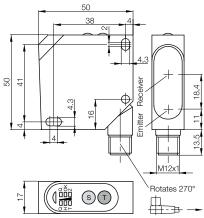


Photoelectric distance sensors Applications Product overview BOD 6K BOD 21M Laser BOD 26K-LA Laser BOD 26K-LB Laser BOD 63M Laser BOD 66M-R BOD 66M-L Laser

Measured values referenced to Kodak gray card 90% reflective.

日 - Connector orientation





#### Features

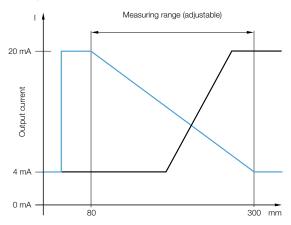
- Adjustable measuring range between 80 to 300 mm
- Analog output 4...20 mA
  - Adjustable: Rising or falling
- Optional with RS485-interface (for master-slave-mode) and for visualization using a computer (additional software required)

- 2 switching outputs with adjustable switching points
- Teach-in
- Adjustable averaging
- Numerous additional functions



300 mm

#### Analog output BOD 26K-LB(R)05...

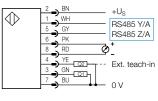


#### **Connector diagram**

80 mm



#### **Connection wiring diagram**



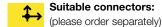
only type BOD 26K-LBR ...

BALLUF



You can find special accessories for photoelectric sensors, such as reflectors, apertures, lenses, filters and deflection heads,, in our 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 Accessories catalog.



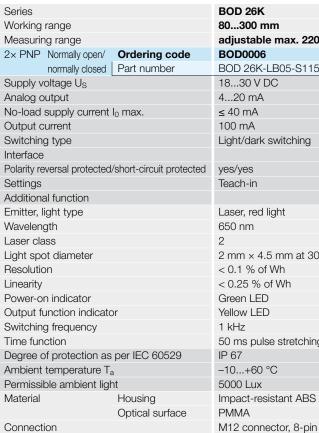
Size	Design	Cable	Color	Length	Ordering
		material			code
M12, 8-pin	Straight	PVC	Gray	5 m	BCC0995
M12, 8-pin	Angled	PVC	Gray	5 m	BCC0998

Connectors without LED are suitable for PNP and NPN sensors.

You can find more electrical accessories including a large selection of plug connectors and connecting cables in a wide variety materials, colors and lengths in our Industrial Networking and Connectivity catalog.







BOD 26K
80300 mm
adjustable max. 220 mm
BOD0006
BOD 26K-LB05-S115-C
1830 V DC
420 mA
≤ 40 mA
100 mA
Light/dark switching
yes/yes
Teach-in
Laser, red light
650 nm
2
2 mm × 4.5 mm at 300 mm
< 0.1 % of Wh
< 0.25 % of Wh
Green LED
Yellow LED
1 kHz
50 ms pulse stretching
IP 67
−10+60 °C
5000 Lux
Impact-resistant ABS
PMMA



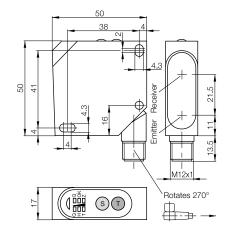
BOD 26K
80300 mm
adjustable max. 220 mm
BOD000E
BOD 26K-LBR05-S115-C
1830 V DC
420 mA
≤ 40 mA
100 mA
Light/dark switching
RS485
yes/yes
Teach-in
Master-slave mode
Laser, red light
650 nm
2
2 mm × 4.5 mm at 300 mm
< 0.1 % of Wh
< 0.25 % of Wh
Green LED
Yellow LED
1 kHz
50 ms pulse stretching
IP 67
–10+60 °C
5000 Lux
Impact-resistant ABS
PMMA
M12 connector, 8-pin

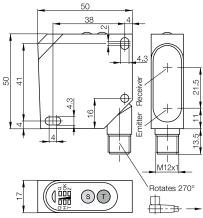


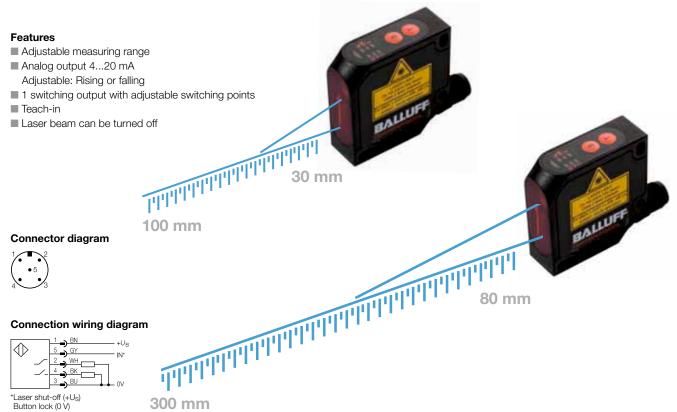
Photoelectric distance sensors Applications Product overview BOD 6K BOD 21M Laser BOD 26K-LA Laser BOD 26K-LB Laser BOD 63M Laser BOD 66M-R BOD 66M-L Laser

Measured values referenced to Kodak gray card 90% reflective.

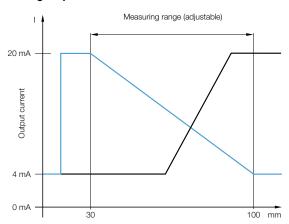
Д - Connector orientation







#### Analog output BOD 26K-LB06...



**Recommended accessories:** 

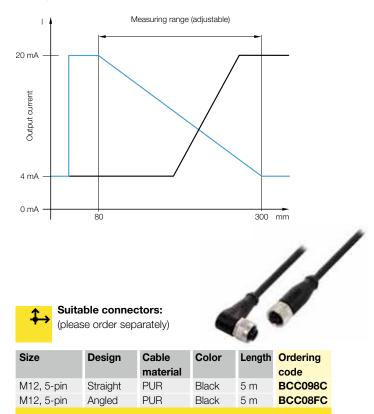
(please order separately)

Ordering

code

Mounting bracket **BAM00TK** 

Analog output BOD 26K-LB07...



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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 Accessories catalog.

Connectors without LED are suitable for PNP and NPN sensors.

You can find more electrical accessories including a large selection of plug connectors and connecting cables in a wide variety materials, colors and lengths in our Industrial Networking and Connectivity catalog.

Designation







Series						
Workin	Working range					
Measuring range a						
PNP	NO/NC	Ordering code	В			
		Part number	В			
Supply voltage U _S						
Analog output						
No-load supply current I ₀ max.						
Output	Output current					
Switching type						
Polarity reversal protected/short-circuit protected						
Settings T						
Emitter, light type						
Wavelength						
Laser class						
Light spot diameter						
Resolution						
Linearity						
Power-	Power-on indicator					
Output	Output function indicator					
	Switching frequency					
Time fu	unction		5			
Degree	of protection a	as per IEC 60529	IF			
Ambient temperature T _a						
Permissible ambient light						
Materia	al	Housing	In			
		Optical surface	Ρ			
Conne	ction		N			

BOD 26K			
30100 mm			
adjustable max. 70 mm			
BOD0007			
BOD 26K-LB06-S92-C			
1830 V DC			
420 mA			
≤ 40 mA			
100 mA			
Light/dark switching			
yes/yes			
Teach-in			
Laser, red light			
650 nm			
2			
1.5 mm × 3.25 mm at 100 mm			
< 0.1 % of (Wh-WI)			
< 0.25 % of (Wh-WI)			
Green LED			
Yellow LED			
1 kHz			
50 ms pulse stretching			
IP 67			
–10+60 °C			
5000 Lux			
Impact-resistant ABS			
PMMA			
M12 connector, 5-pin			

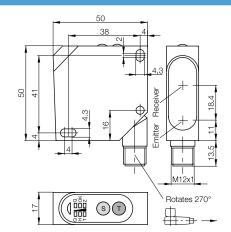


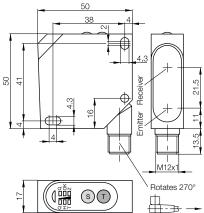


Photoelectric distance sensors Applications Product overview BOD 21M Laser BOD 26K-LA Laser BOD 26K-LB Laser BOD 66M-R BOD 66M-R BOD 66M-L Laser

Measured values referenced to Kodak gray card 90% reflective.

Connector orientation





Sorios

#### 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.

The **BOD 63M** in a robust metal housing has a working range of 200 to 2000/6000 mm. It has adjustable background suppression and an analog output with 0...10 V or 4...20 mA. Speed of light measurement principle 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



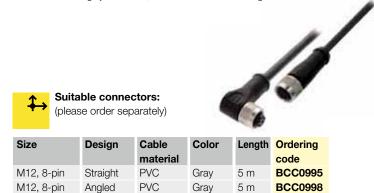
Recommended accessories:

(please order separately)

Designation Ordering code Mounting bracket BAM00P6



**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 **Accessories** catalog.



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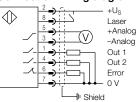
Series						
Working range						
Measuring range						
2× PNP Normally	Ordering code					
open	Part number					
Supply voltage $U_S$						
Analog output						
No-load supply curre	ent I ₀ max.					
Switching type						
Switching points	Switching points					
Polarity reversal protect	ted/short-circuit protected					
Settings						
Emitter, light type						
Wavelength						
Laser class						
Light spot diameter						
Resolution						
Gray value shift						
Repeat accuracy per	BWN					
Temperature drift						
Output curve deviation						
Switching hysteresis						
On/off delay						
Stand-by delay						
Switching frequency						
Power-on indicator						
Switching output						
Stability indicator						
Response time						
Degree of protection	as per IEC 60529					
Ambient temperature						
Permissible ambient light						
Material	Housing					
	Optical surface					
Connection						
IO-Link						
Mode						
Transmission rate						
Value range analog						

Measured values referenced to Kodak gray card 90% reflective.



#### Connection wiring diagram

Diagnostics Parameters





### Photoelectric Distance Sensors Distance sensors BOD 63M Laser



BOD 63M 200...6000 mm 5800 mm BOD0012 BOD 63M-LI06-S4 18...30 V DC 90 mA Light switching 2 yes/yes Teach-in Laser, red light 660 nm 2 per EN 60825 5 mm at 3 m, 10 mm at 6 m 1 mm ≤ 1.5% ≤ ±4 mm ≤ 1.5 mm/K  $\leq \pm 1$  % of Wh ≤ 15 mm ≤ 3.3 ms ≤ 20 ms 150 Hz Green LED Yellow LED Red LED IP 67 -10...+60 °C  $\leq 10 \text{ klx}$ Anodized aluminum Glass



BOD 63M 200...2000 mm 1800 mm BOD000U BOD 63M-LA02-S115 15...30 V DC 0...10 V ≤ 75 mA Light switching

yes/yes Potentiometer, 4 revolutions Laser, red light 660 nm 2 per EN 60825 9 mm at 2000 mm ≤ 1 mm ≤2% ≤ ±3 mm  $\leq 0.6 \text{ mm/K}$  $\leq \pm 2$  % of Wh ≤ 10 mm ≤ 20 ms 250 Hz Green LED 2× yellow LED Red LED ≤ 2 ms IP 67 -10...+60 °C  $\leq 10 \text{ klx}$ Anodized aluminum Glass M12 connector, 8-pin



BOD 63M 200...2000 mm

### BOD0010

BOD 63M-LB02-S115 15...30 V DC

**4...20 mA** ≤ 75 mA Light switching

yes/yes Potentiometer, 4 revolutions Laser, red light 660 nm 2 per EN 60825 9 mm at 2000 mm ≤ 1 mm ≤ 2% ≤ ±3 mm ≤ 0.6 mm/K ≤ ±2 % of Wh ≤ 10 mm

≤ 20 ms 250 Hz Green LED 2× yellow LED Red LED ≤ 2 ms IP 67 -10...+60 °C ≤ 10 klx Anodized aluminum Glass M12 connector, 8-pin

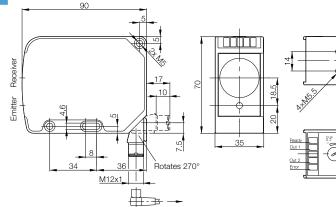


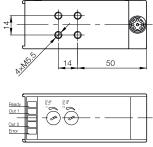
Photoelectric distance sensors Applications Product overview BOD 6K BOD 21M Laser BOD 26K-LA Laser BOD 26K-LB Laser BOD 66M-R BOD 66M-R BOD 66M-L Laser

COM 2 38.4 kbaud 00C8 H...1770 H for W_L...W_h

M12 connector, 4-pin

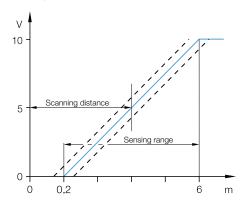
Stability indicator Switching points, laser on/off, button disable

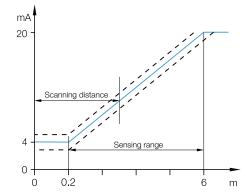




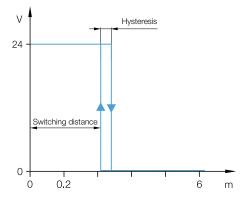
### Photoelectric Distance Sensors Distance sensors BOD 63M Laser

Analog output

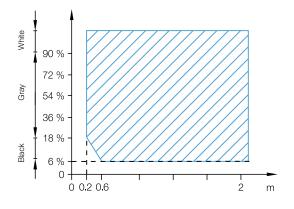




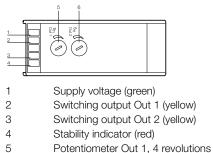
#### Switching output



Measuring range BOD 63M-LA/LB02... depending on object reflection

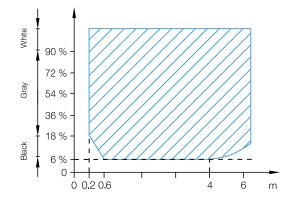


Indicators and operating elements



6 Potentiometer Out 2, 4 revolutions

Measuring range BOD 63M-LA/LB04... depending on object reflection



#### **Connector diagram**

	Pin-assignment	Cable color	
3(• •8 •)7	1	White	Out 1
4 6	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



### Photoelectric Distance Sensors Distance sensors BOD 63M Laser





Series		BOD 63M
Working range		2006000
Measuring range		5800 mm
2× PNP Normally	Ordering code	BOD000W
open	Part number	BOD 63M-I
Supply voltage $U_S$		1530 V D
Analog output		010 V
No-load supply curr	ent l ₀ max.	≤ 75 mA
Output current	Switching output	200 mA
	Error output	200 mA
Switching type		Light switch
Polarity reversal protect	cted/short-circuit protected	yes/yes
Settings		Potentiome
Emitter, light type		Laser, red li
Wavelength		660 nm
Laser class		2 per EN 60
Light spot diameter		10 mm at 6
Resolution		1 mm
Gray value shift		≤ 1.5%
Repeat accuracy pe	er BWN	≤ ±4 mm
Temperature drift		≤ 1.5 mm/k
Output curve deviat	ion	$\leq \pm 1$ % of V
Switching hysteresis	3	≤ 15 mm
Power-on indicator		Green LED
Switching output		2× yellow L
Stability indicator		Red LED
Stand-by delay		≤ 20 ms
Response time	≤ 2 ms	
Switching frequency	250 Hz	
Degree of protection	n as per IEC 60529	IP 67
Ambient temperatur	e T _a	-10+60 °
Permissible ambient	t light	$\leq$ 10 klx
Material	Housing	Anodized a
	Optical surface	Glass
Connection		M10 conno

BOD 63M
2006000 mm
5800 mm
BOD000W
BOD 63M-LA04-S115
1530 V DC
010 V
≤ 75 mA
200 mA
200 mA
Light switching
yes/yes
Potentiometer, 4 revolutions
Laser, red light
660 nm
2 per EN 60825
10 mm at 6000 mm
1 mm
≤ 1.5%
≤ ±4 mm
≤ 1.5 mm/K
$\leq \pm 1$ % of Wh
≤ 15 mm
Green LED
2× yellow LED
Red LED
≤ 20 ms
≤ 2 ms
250 Hz
IP 67
–10+60 °C
$\leq$ 10 klx
Anodized aluminum
Glass
M12 connector, 8-pin

BOD 63M 200...6000 mm 5800 mm BOD0011 BOD 63M-LB04-S115 15...30 V DC 4...20 mA  $\leq 75 \,\mathrm{mA}$ 200 mA 200 mA Light switching yes/yes Potentiometer, 4 revolutions Laser, red light 660 nm 2 per EN 60825 10 mm at 6000 mm 1 mm  $\leq 1.5\%$  $\leq \pm 4 \text{ mm}$  $\leq 1.5$  mm/K  $\leq \pm 1$  % of Wh ≤ 15 mm Green LED 2× yellow LED Red LED ≤ 20 ms ≤2 ms 250 Hz IP 67 -10...+60 °C  $\leq 10 \text{ klx}$ Anodized aluminum Glass M12 connector, 8-pin



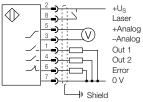
Photoelectric distance sensors Applications Product overview BOD 21M Laser BOD 26K-LA Laser BOD 26K-LB Laser BOD 63M Laser BOD 66M-R BOD 66M-R

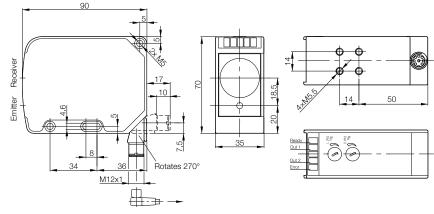
Connection

Measured values referenced to Kodak gray card 90% reflective.









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 sensor with background suppression for object detection.

The BOD 66M-R_01 uses red light over a measuring range of 100 to 600 mm at a resolution of 0.5 mm.

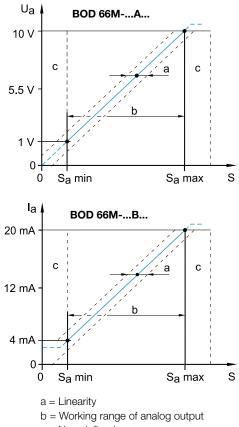
#### Features

- Extremely color- and ambient light insensitive
- Working range 100 to 600 mm
- Resolution 0.1...0.5 mm
- Analog output with voltage (1 to 10 V) or current (4...20 mA)
- Robust metal housing with display and keyboard
- Scratch-resistant glass optics
- Inverted characteristic
- Extensive configuration using OLED display and membrane keyboard

#### Applications

- Fill-level monitoring
- Positioning tasks
- Winding diameter detection
- Profile measurement
- Sag control

#### Analog output BOD 66M-R...

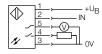


c = Non-defined range

#### **Connector diagram**



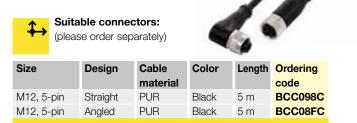
#### **Connection wiring diagram**





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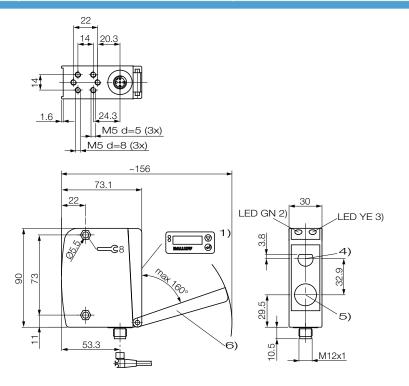
## Photoelectric Distance Sensors BOD 66M-R distance sensors





Series		BOD 66M	BOD 66M	
Working range		100600 mm	100600 mm	
Measuring range		500 mm, adjustable	500 mm, adjustable	
PNP/NPN	Ordering code	BOD001H	BOD001C	
NO/NC	Part number	BOD 66M-RA11-S92	BOD 66M-RB11-S92	
Supply voltage U _S	;	1830 V DC	1830 V DC	
Analog output		110 V	420 mA	•
No-load supply cu	urrent l ₀ max.	150 mA	150 mA	
Switching type		NO/NC	NO/NC	
Polarity reversal prot	tected/short-circuit protected	yes/yes	yes/yes	
Settings		Display/keyboard	Display/keyboard	
Emitter, light type		LED, red light	LED, red light	Photoelectric distance sensors
Wavelength		655 nm	655 nm	Applications
Laser class		2	2	Product
Light spot diameter	ər	Ø 15 mm at 600 nm	Ø 15 mm at 600 nm	overview
Resolution		100500 μm	100500 µm	BOD 6K
Reproducibility ma	ax.	±0.5% of Wh	±0.5% of Wh	BOD 21M Laser
Output curve devi	ation	±1.5 % of W	±1.5 % of W	BOD 26K-LA Laser BOD 26K-LB Laser
Temperature drift		0.04 %/°K (% of W)	0.04 %/°K (% of W)	BOD 20K-LB Laser BOD 63M Laser
Power-on indicato	or	LED	LED	BOD 66M-B
Output function in	dicator	LED	LED	BOD 66M-L Laser
Response time ma	ax.	15 ms	15 ms	
Switching frequen	су	2001000 Hz	2001000 Hz	
Degree of protecti	ion as per IEC 60529	IP 65	IP 65	
Ambient temperat	ure T _a	–20+50 °C	–20+50 °C	
Permissible ambie	ent light	5000 Lux	5000 Lux	
Material	Housing	GD-Zn	GD-Zn	
	Optical surface	Glass	Glass	
Connection		Connector, M12×1-S92	Connector, M12×1-S92	

Connector orientation



The **BOD 66M-L_04** features an analog output along with an additional switching output.

It measures the object position across a range from 150...2000 mm. In addition, it allows the switching output (background suppression) to be configured in the same range using teach-in. Forward-looking laser- and CCD-technology ensure accuracy and reliability.

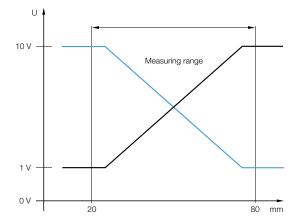
#### Features

- Expansion of the measuring ranges:
- 150...800 mm and 150...2000 mm
- Small light spot over the entire range
- Extremely color- and ambient light insensitive
- Teachable analog and switching outputs
- Optimized resolution
- Configuration using display and membrane keyboard
- Rugged metal housing
- Optimized switching frequency distance, suitable for highly dynamic applications

#### Applications

- Background suppression up to 2 m
- Analog measuring at up to 2 m target distance
- Positioning tasks

#### Analog output BOD 66M-L...



#### Laser class

Connector diagram

– +U_B – Teach-in

The emitter corresponds to a class 2 laser according to EN 60825-1:2001-11. Thus no additional protective measures are required for operation.

Series

Install the device so that the laser warning label is easily visible.



Selles					
Working range					
Measuring range					
PNP/NPN	Ordering code				
NO/NC	Part number				
Supply voltage	U _S				
Analog output					
No-load suppl	y current l ₀ max.				
Switching type	,				
Polarity reversal prote	cted/short-circuit protected				
Settings					
Emitter, light ty	/pe				
Wavelength					
Laser class					
Light spot diar	neter				
Resolution					
Reproducibility	/ max.				
Characteristic	deviation max.				
Temperature d	lrift				
Absolute meas	suring accuracy				
Power-on india	cator				
Output functio	n indicator				
Response time					
Switching frequency					
Degree of protection as per IEC 60529					
Ambient temperature Ta					
Permissible ambient light					
Material	Housing				
	Optical surface				

Connection



You can find special accessories for photoelectric sensors, such as **reflectors, apertures, lenses, filters and deflection heads,**, in our **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 **Accessories** catalog.





Size	Design	Cable Color		Length	Ordering
		material			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.

You can find more electrical accessories including a large selection of plug connectors and connecting cables in a wide variety materials, colors and lengths in our Industrial Networking and Connectivity catalog.



### Photoelectric Distance Sensors Distance sensors BOD 66M-L Laser





1

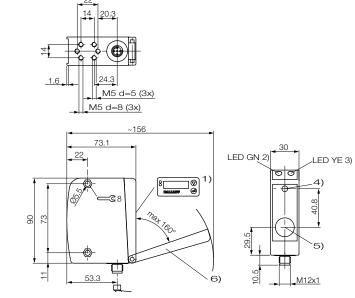


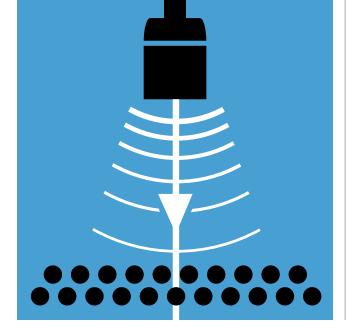


1↓

BOD 66M	BOD 66M	BOD 66M	BOD 66M	
150800 mm	150800 mm	1502000 mm	1502000 mm	
650 mm, adjustable	650 mm, adjustable	1850 mm, adjustable	1850 mm, adjustable	
BOD001J	BOD001K	BOD001E	BOD001F	
BOD 66M-LA12-S92	BOD 66M-LB12-S92	BOD 66M-LA14-S92	BOD 66M-LB14-S92	
1830 V DC	1830 V DC	1830 V DC	1830 V DC	I
110 V	420 mA	110 V	420 mA	
150 mA	150 mA	150 mA	150 mA	
NO/NC	NO/NC	NO/NC	NO/NC	
yes/yes	yes/yes	yes/yes	yes/yes	
Display/keyboard	Display/keyboard	Display/keyboard	Display/keyboard	
Laser, red light	Laser, red light	Laser, red light	Laser, red light	Photoelectric distance sen
655 nm	655 nm	655 nm	655 nm	Applications
2	2	2	2	Product
Ø 1 mm at 800 mm	Ø 1 mm at 800 mm	2 mm × 6 mm at 2000 mm	2 mm × 6 mm at 2000 mm	overview
100800 µm	100800 µm	13 mm	13 mm	BOD 6K
±0.5 % of Wh	±0.5 % of Wh	±0.5 % of Wh	±0.5 % of Wh	BOD 21M Las
±1.5 % of W	±1.5 % of W	±1.5 % of W	±1.5 % of W	BOD 26K-LA BOD 26K-LB
0.04 %/K (% of W)	0.04 %/K (% of W)	0.04 %/K (% of W)	0.04 %/K (% of W)	BOD 20K-LB BOD 63M Las
±2% (at the measuring distance)	$\pm 2\%$ (at the measuring distance)	$\pm 2\%$ (at the measuring distance)	±2% (at the measuring distance)	BOD 66M-R
LED	LED	LED	LED	BOD 66M-L
LED	LED	LED	LED	
15 ms	15 ms	15 ms	15 ms	
2001000 Hz	2001000 Hz	2001000 Hz	2001000 Hz	
IP 65	IP 65	IP 65	IP 65	
–20+50 °C	–20+50 °C	–20+50 °C	–20+50 °C	
5000 Lux	5000 Lux	5000 Lux	5000 Lux	
GD-Zn	GD-Zn	GD-Zn	GD-Zn	
Glass	Glass	Glass	Glass	
Connector, M12×1-S92	Connector, M12×1-S92	Connector, M12×1-S92	Connector, M12×1-S92	

Connector orientation





# Ultrasonic Sensors

# Ultrasonic sensors for object detection

#### Independent of material and surface properties

BUS ultrasonic sensors are perfect for distance measurement or position detection of granular materials, liquids 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 properties, and are not affected by transparent objects that generate strong reflections.

Ultrasonic sensors are precision all-rounders designed for critical situations. They function reliably even with dust, dirt and steam.

#### Broad detection range - high precision

Their detection range extends from 20 mm to 8 m, meaning that even longer object distances can be handled without problem. Their high resolution and small blind zones ensure extreme precision. Integrated synchronization means that the sensors do not interfere with one another.

#### Switching and analog variants

Our BUS ultrasonic sensors differ form one another in their output signal. Each series is available as a switching or analog version, whereby all analog versions are available with voltage or current output (0–10 V or 4–20 mA).

The BUS M30 series 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.





Media Industries, Application Areas Application Areas, Sensor Selection Operating Modes	334 335 336 337
Sound Cones	338
Installation Notices, Definitions	340
<b>Cylinder designs</b> BUS M30 BUS M18 BUS M12	342 350 366
Block designs BUS R06 BUS Q80	360 368







### The all-rounders, even for difficult environments

Because the distance to the object is determined via a sound transit time, ultrasonic sensors have excellent background suppression. With their travel time measurement, ultrasonic sensors can record the measured value with resolution that is precise to the millimeter. 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 films, transparent materials and different colors are not a problem. 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.



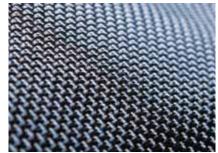
#### Contrasts

Black objects against a black background or white on white — even with weak contrasts, our BUS sensors measure without ifs and buts.



Liquids

Clear water, cloudy liquids, oils or black coffee — ultrasonic sensors can be used with nearly any liquid. The liquid surface should have no foam.



Material surfaces Whether velvet, wool or leather — nearly all clothing materials can be simply detected

with our BUS ultrasonic sensors.



# BUS ultrasonic sensors are particularly well suited 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
- Conveyor technology

- Commercial vehicles
- Scales
- Agricultural machinery
- Food processing machinery
- Office and information technology
- Construction and building material ma
  - chinery
- Textile machinery



Handling and automation



Bottling and packaging



Automotive industry

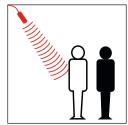


Ultrasonic Sensors

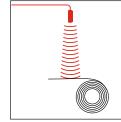
Media, Industries, Application Areas, Sensor Selection, Operating Modes, Sound Cones, Installation Notices, Definitions

Cylinder Designs Block Designs

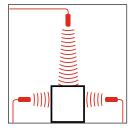
### Ultrasonic sensors can be used in many application areas



Detection of people If people need to be detected, a sensor should be used that has an operating scanning range that is considerably greater than the required measurement distance. The greater the operating scanning range, the lower the ultrasonic frequency. And the better absorbent pieces of clothing, such as wool, can be detected.



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-shaped housing.



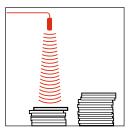
#### Positioning

When scanning glass plates or other smooth and flat surfaces, make certain that the ultrasound strikes the surface at a right angle.

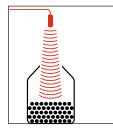


#### Wire-breakage monitoring When winding and

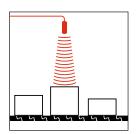
unwinding a wire rope, ultrasonic sensors with analog output detect its position on the layer.



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 BUS 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 sensing distance and the associated, three-dimensional detection range.

#### Definitions

#### Blind zone

The blind zone defines the smallest reliable sensing distance of the sensor. There must be no objects or interfering reflections within the blind zone, as measurement errors may otherwise occur.

#### Operating scanning range

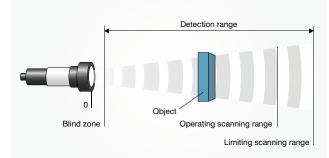
The operating scanning range is the typical working range of a sensor.

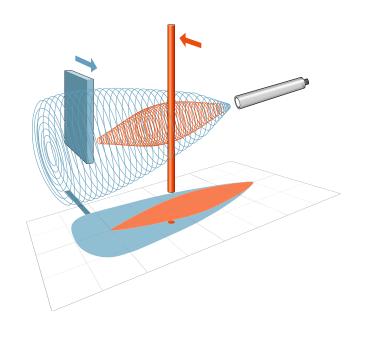
#### Limiting scanning range

For objects with good reflective properties, the sensor can also be used up to its limiting scanning range.

#### Detection range

The detection range is measured using various standard reflectors.





#### **Detection ranges**

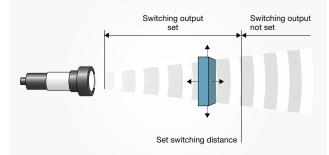
The red areas are measured with a thin round rod ( $\emptyset$  10 mm or 27 mm, depending on sensor type) and show the typical working range of a sensor.

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.



The classic operating mode of the **ultrasonic sensor is as a reflective light scanner**. Compared to the other sensor principles, it has superior background suppression. During operation, the switching output is set as soon as the object is located within the set switching distance. The switching point has a hysteresis. The operating mode is suitable for, e.g., counting objects on a conveyor belt or for performing presence verification.

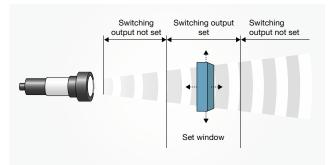


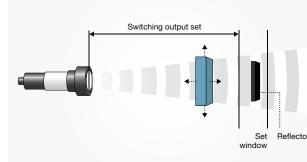
The ultrasonic sensor in window mode is an extended function of the ultrasonic reflective light scanner. In this case, the switching output can only be set if the object is located within a window that is defined by two window limits. This can be used to monitor, e.g., the correct bottle size in a bottle crate. Bottles that are too tall or too short are sorted out. Window mode and the diffuse reflection ultrasonic sensor can be set on all ultrasonic sensors that are equipped with teach-in.

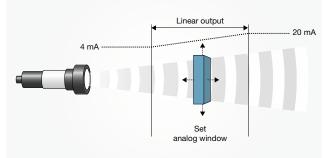
The function of the **diffuse reflection ultrasonic sensor** is similar to that of a photoelectric sensor. Any reflector, such as a metal sheet, is sufficient. In window mode, the ultrasonic sensor is set so that the permanently mounted reflector lies within the window. The ultrasonic sensor returns a signal as soon as an object fully covers the reflector. It plays no role here whether the object completely absorbs or reflects away the sound. This operating mode is therefore used for materials than can be only poorly reflected, such as foam, or for scanning objects with irregular surfaces.

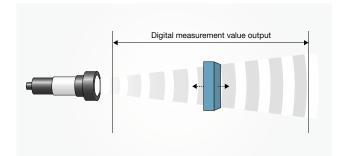
**Ultrasonic sensors with analog output** output the measured distance value as a voltage that is distance-proportional (0...10 V) or as current that is distance-proportional (4...20 mA). For the ultrasonic sensors with analog output, the sensor-near and sensor-distant window limits of the analog characteristic as well as a rising or falling characteristic can be set. Depending on the sensor type 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.











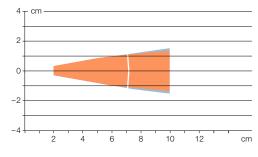
Ultrasonic Sensors

Media, Industries, Application Areas, Sensor Selection, Operating Modes, Sound Cones, Installation Notices, Definitions

Cylinder Designs Block Designs

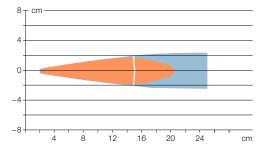
### Ultrasonic Sensors Sound cones

Sound cone No. 1, 0.07 m



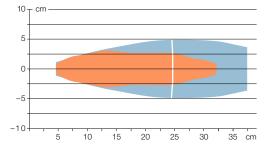


#### Sound cone No. 2, 0.15 m



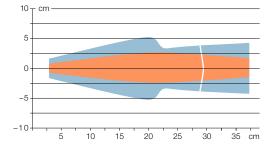
# Blind zone20 mmScanning range150 mmLimiting scanning range250 mmUltrasonic frequency380 kHz

#### Sound cone No. 3, 0.24 m



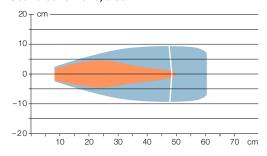
Blind zone 50 mm Scanning range 240 mm Limiting scanning range 350 mm Ultrasonic frequency 500 kHz

#### Sound cone No. 4, 0.25 m



Blind zone30 mmScanning range250 mmLimiting scanning range350 mmUltrasonic frequency320 kHz

#### Sound cone No. 5, 0.35 m

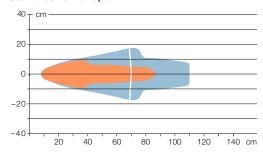


Blind zone65 mmScanning range350 mmLimiting scanning range600 mmUltrasonic frequency400 kHz

Round rod 10 mm/27 mm
 Plate 500×500 mm
 Scanning range

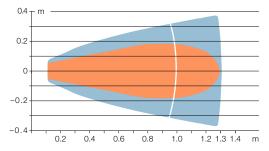


Sound cone No. 6, 0.7 m



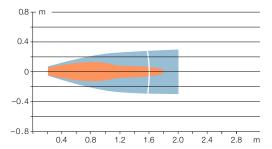


#### Sound cone No. 7, 1.0 m



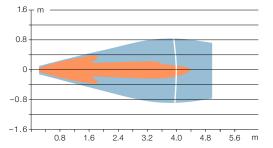
Blind zone120 mmScanning range1.0 mLimiting scanning range1.3 mUltrasonic frequency200 kHz

#### Sound cone No. 8, 1.3 m



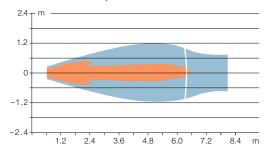
Blind zone	200 mm	
Scanning range	1.3 m	
Limiting scanning rang	ge	2.0 m
Ultrasonic frequency	200 kHz	

#### Sound cone No. 9, 3.4 m



Blind zone350 mmScanning range3.4 mLimiting scanning range5.0 mUltrasonic frequency120 kHz

#### Sound cone No. 10, 6.0 m



Blind zone600 mmScanning range6 mLimiting scanning range8 mUltrasonic frequency80 kHz

Round rod 10 mm/27 mm
 Plate 500×500 mm
 Scanning range



Ultrasonic Sensors

Media, Industries, Application Areas, Sensor Selection, Operating Modes, Sound Cones, Installation Notices, Definitions

Cylinder Designs Block Designs



#### Installation and operation

Sensors can be installed in any position. Avoid installation position that lead to heavy dirt deposits on the sensor surface.

Water drops and heavy layers of crust on the converter surface can impair function.

Light layers of dust and paint spray have no effect on function.

For objects to be scanned that have flat and smooth surfaces, the sensors have to be installed at an angle of  $90^{\circ} \pm 3^{\circ}$  to the surface. Rough surfaces, on the other hand, permit significantly greater angular deviations. A surface is considered rough for ultrasound purposes if its surface roughness is in the same or larger order of magnitude of the wavelength of ultrasonic frequency.

The sound is then reflected diffusely, which can reduce the scanning range. For rough surfaces, the maximum permitted angular deviation and the maximum possible sensing distance must be found by trial and error.

#### Installation distances and synchronization

If two or more sensors are installed too close to each other, they can influence each other. To prevent this, either select sufficiently large installation distances or synchronize the sensors with each other.

#### Sound deflection

The sound beam can be deflected by a smooth and reverberant reflective surface without major loss. For this purpose, 90° deflection surfaces are available as accessories.



#### Accuracy

The (absolute) accuracy is the deviation between the true distance of the sensor and object and the distance measured by the sensor. The accuracy that can be attained depends on the reflective properties of the object and the physical effects on the sound velocity in air. Objects with poor reflective properties or a surface roughness greater than the wavelength of the ultrasonic frequency impede the accuracy that can be attained.

It is almost impossible to specify an exact value for this; as a rule of thumb, we can assume an uncertainty of several wavelengths of the ultrasonic frequency used.

#### Air temperature

The greatest influence on the sound velocity and thus on the accuracy is air temperature, with 0.17 %/K.

Therefore, most Balluff ultrasonic sensors feature internal temperature compensation.

An even better way to measure the effect of the temperature is using a comparison measurement with a known segment.

Temperature-compensated sensors enable an accuracy of  $\leq \pm 1~\%$  to be achieved.

#### Air pressure/relative humidity

The sound velocity is largely independent of the air pressure. The effect of humidity on accuracy is negligible compared to the effect of air temperature.

#### **Repeat accuracy**

The repeat accuracy or reproducibility describes the deviation of the measured distance values from each other, which are measured under conditions that remain the same over a defined period. The repeat accuracy of Balluff ultrasonic sensors is better than  $\pm 0.15$  %.

#### Standards

All sensors fulfill the requirements of national standards (DIN) and European standards (EN) DIN EN 60947-5-2 (Proximity switches standard) DIN EN 61000-4-2 (Electrostatic discharge) DIN EN 61000-4-3 (Resistance to effects of high frequency) DIN EN 61000-4-4 (Fast transients) EN 55011 (Interference emission) IEC 60068-2-6 (Vibration resistance) IEC 60068-2-27 (Shock resistance) EN 60529 (Degree of protection)

#### Attenuation of sound in air

Depending on the air temperature, relative humidity and air pressure, the sound is attenuated in air. The physical relationships are complex and have different features for the individual ultrasonic frequencies. Put very simply, when the temperature and humidity increase, the attenuation in air also increases. This necessitates a reduction of the detection ranges.

When the temperature and the relative humidity decrease, the attenuation in the air decreases, and the detection ranges increase accordingly.

The reduction of the detection ranges is largely compensated for by the function reserve. For temperatures below 0 °C, a few sensors can measure twice as far as specified here.

With increasing air pressure, the attenuation in air decreases significantly. This must be taken into account for positive pressure applications. Sound cannot dissipate in a vacuum.

The scanning ranges listed in the sound cone diagrams (see page 338) specify the maximum distance to which the ultrasonic sensor can measure on conventional reflectors with sufficient function reserve. For good reflectors, the sensor can also be used up to its limiting scanning range. The limiting scanning range is always greater than the scanning range. The diagrams apply for 20 °C, a relative humidity of 50 % and normal pressure.



Ultrasonic Sensors

Media, Industries, Application Areas, Sensor Selection, Operating Modes, Sound Cones, Installation Notices, Definitions

Cylinder Designs Block Designs

### Ultrasonic Sensors

#### Cylinder design, BUS M30M switching output, with display

#### Features

- 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 sensing distances with a measuring range from 30 mm to 8 m
- 1 or 2 switching outputs in PNP or NPN design
   4...20 mA and 0...10 V analog output
- Automatic switchover between current and voltage output **Analog output plus switching output**
- For distance-proportional measurement with an additional limit value
- Teach-in via 2 buttons

for simple, menu-guided commissioning

Ultrasonic sensors are accurate all-rounders. They measure fill levels, heights and sag without making contact as well as count and monitor the presence of objects. And particularly suited for critical situations. They function reliably even with dust, dirt and steam.

Thanks to their display, the ultrasonic sensors of the BUS M30M series with a metal housing are particularly easy to operate. A complete numeric presetting of the sensor is possible. You can choose to have all measured values displayed in mm/cm or % during operation.

The sensor family includes five versions and, with a measuring range from 30 cm to 8 m, covers a wide range of applications.

All versions are available with the option of one or two switching outputs, a current and voltage analog output, or as a combination with switching output and analog output, so that nearly every application can be solved.

The sensors can be used in multiplex operation as well as automatically synchronized to prevent them from interfering with one another.





#### TouchControl

With TouchControl, all settings are made on the sensors. The threedigit 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 completeness

Performance shows up on conveyor belts. Multiple ultrasonic sensors simultaneously monitor transport containers for completeness. Reflective, transparent or different-colored surfaces are reliably detected. In multiplex operation, mutual interference of the sensors is prevented.

# M30



Туре		Sensing dis- tance	Hous mate	-	Outp	ut				Us	Conne tion	ec-	Special fea- tures	Page
Ordering code			SS	Stainless steel	PNP, NO/NC contact	VPN, NO/NC contact	2× PNP, NO/NC	2× NPN, NO/NC	010 V/420 mA	930 V DC	M12 connector, 5-pin		Display	
			Brass	Stai	PNF	NPN	2×	2×	0	9	5-p		Disp	
BUS M30M														
Switching out	tput													
BUS0022	BUS M30M1-PPX-03/025-S92K	30250 mm												344
BUS002J	BUS M30M1-NPX-03/025-S92K	30250 mm												344
BUS002R	BUS M30M1-PWX-03/025-S92K	30250 mm												344
BUS002H	BUS M30M1-NWX-03/025-S92K	30250 mm												344
BUS005F	BUS M30M1-PPX-07/035-S92K	65350 mm												344
BUS005P	BUS M30M1-NPX-07/035-S92K	65350 mm												344
BUS005H	BUS M30M1-PWX-07/035-S92K	65350 mm												344
BUS005R	BUS M30M1-NWX-07/035-S92K	65350 mm												344
BUS0039	BUS M30M1-PPX-20/130-S92K	2001300 mm												345
BUS0036	BUS M30M1-NPX-20/130-S92K	2001300 mm												345
BUS003C	BUS M30M1-PWX-20/130-S92K	2001300 mm												345
BUS0035	BUS M30M1-NWX-20/130-S92K	2001300 mm												345
BUS003P	BUS M30M1-PPX-35/340-S92K	3503400 mm												345
BUS003J	BUS M30M1-NPX-35/340-S92K	3503400 mm												345
BUS003W	BUS M30M1-PWX-35/340-S92K	3503400 mm												345
BUS0046	BUS M30M1-NWX-35/340-S92K	3503400 mm												345
BUS0045	BUS M30M1-PPX-60/600-S92K	6006000 mm												345
BUS0054	BUS M30M1-NPX-60/600-S92K	6006000 mm												345
BUS003Z	BUS M30M1-PWX-60/600-S92K	6006000 mm												345
BUS0055	BUS M30M1-NWX-60/600-S92K	6006000 mm												345
BUS M30M														
Analog outpu	t													
BUS002N	BUS M30M1-XC-03/025-S92K	30250 mm												346
BUS005K	BUS M30M1-XC-07/035-S92K	65350 mm												346
BUS003F	BUS M30M1-XC-20/130-S92K	2001300 mm												347
BUS003T	BUS M30M1-XC-35/340-S92K	3503400 mm												347
BUS0041	BUS M30M1-XC-60/600-S92K	6006000 mm												347
BUS M30M														
Switching and	d analog output													
BUS002L	BUS M30M1-PPC-03/025-S92K	30250 mm												348
BUS005M	BUS M30M1-PPC-07/035-S92K	65350 mm												348
BUS0038	BUS M30M1-PPC-20/130-S92K	2001300 mm												349
BUS003N	BUS M30M1-PWC-20/130-S92K	2001300 mm												349
BUS003L	BUS M30M1-PPC-35/340-S92K	3503400 mm												349
BUS0044	BUS M30M1-PWC-35/340-S92K	3503400 mm												349
BUS0043	BUS M30M1-PPC-60/600-S92K	6006000 mm												349

Ultrasonic Sensors Media,

Media, Industries, Application Areas, Sensor Selection, Operating Modes, Sound Cones, Installation Notices, Definitions

**Cylinder Designs** Block Designs



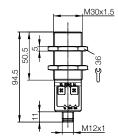
# M30 Switching output

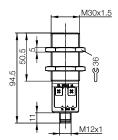


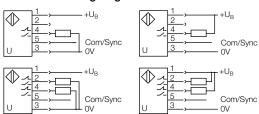


Size		M30×1	M30×1			
Туре		Switching output	Switching output			
Operating scanning range		30250 mm	65350 mm			
PNP,	Ordering code	BUS0022	BUS005F			
NO/NC contact	Part number	BUS M30M1-PPX-03/025-S92K	BUS M30M1-PPX-07/035-S92K			
NPN,	Ordering code	BUS002J	BUS005P			
NO/NC contact	Part number	BUS M30M1-NPX-03/025-S92K	BUS M30M1-NPX-07/035-S92K			
2x PNP,	Ordering code	BUS002R	BUS005H			
NO/NC contact	Part number	BUS M30M1-PWX-03/025-S92K	BUS M30M1-PWX-07/035-S92K			
2x NPN,	Ordering code	BUS002H	BUS005R			
NO/NC contact	Part number	BUS M30M1-NWX-03/025-S92K	BUS M30M1-NWX-07/035-S92K			
Blind zone		030 mm	065 mm			
Limiting scanning ra	ange	350 mm	600 mm			
Resolution		0.025 mm	0.025 mm			
Sound cone		See page 338, No. 4	See page 338, No. 5			
Repeat accuracy		±0.15 %	±0.15 %			
Accuracy		±1 % (temperature drift internally compensated)	±1 % (temperature drift internally compensated)			
Switching hysteresis		3 mm	5 mm			
Supply voltage U _S		930 V DC	930 V DC			
Output current		200 mA	200 mA			
No-load supply curr	rent l ₀ max.	≤ 80 mA	≤ 80 mA			
Polarity reversal prote	cted/short-circuit protected	yes/yes	yes/yes			
Settings		Teach-in	Teach-in			
Response delay		32 ms	64 ms			
Switching frequency	y f	25 Hz	12 Hz			
Degree of protection	n as per IEC 60529	IP 67	IP 67			
Operating temperature		–25…+70 °C	–25…+70 °C			
Material Housing		Nickel-plated CuZn	Nickel-plated CuZn			
Plastic parts		PBT, TPU	PBT, TPU			
	Sensing surface Polyurethane foam,		Polyurethane foam,			
		epoxy resin containing glass	epoxy resin containing glass			
Connection		M12 connector, 5-pin	M12 connector, 5-pin			

Sensors are also available as stainless steel variants.









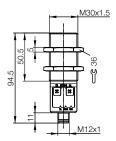


M30×1
Switching output
2001300 mm
BUS0039
BUS M30M1-PPX-20/130-S92K
BUS0036
BUS M30M1-NPX-20/130-S92K
BUS003C
BUS M30M1-PWX-20/130-S92K
BUS0035
BUS M30M1-NWX-20/130-S92K
0200 mm
2000 mm
0.18 mm
See page 339, No. 8
±0.15 %
±1 % (temperature drift internally compensated
20 mm
930 V DC
200 mA
≤ 80 mA
yes/yes
Teach-in
92 ms
8 Hz
IP 67
−25+70 °C
Nickel-plated CuZn
PBT, TPU
Polyurethane foam,
epoxy resin containing glass
M12 connector, 5-pin





	M30×1	M30×1	
	Switching output	Switching output	
	3503400 mm	6006000 mm	
	BUS003P	BUS0045	
D-S92K	BUS M30M1-PPX-35/340-S92K	BUS M30M1-PPX-60/600-S92K	
	BUS003J	BUS0054	
D-S92K	BUS M30M1-NPX-35/340-S92K	BUS M30M1-NPX-60/600-S92K	
	BUS003W	BUS003Z	
0-S92K	BUS M30M1-PWX-35/340-S92K	BUS M30M1-PWX-60/600-S92K	
	BUS0046	BUS0055	
0-S92K	BUS M30M1-NWX-35/340-S92K	BUS M30M1-NWX-60/600-S92K	
	0 350 mm	0600 mm	
	5000 mm	8000 mm	
	0.18 mm	0.18 mm	
	See page 339, No. 9	See page 339, No. 10	
	±0.15 %	±0.15 %	•••••
rnally compensated)	±1 % (temperature drift internally compensated)	±1 % (temperature drift internally compensated)	Ultrasonic Sensors
	50 mm	100 mm	00113013
	930 V DC	930 V DC	Media,
	200 mA	200 mA	Industries, Ap-
	≤ 80 mA	≤ 80 mA	plication Areas Sensor Selec-
	yes/yes	yes/yes	tion, Operating
	Teach-in	Teach-in	Modes,
	172 ms	240 ms	Sound Cones, Installation
	4 Hz	3 Hz	Notices,
	IP 67	IP 67	Definitions
	–25…+70 °C	-25+70 °C	Cylinder
	Nickel-plated CuZn	Nickel-plated CuZn	Designs
	PBT, TPU	PBT, TPU	Block Designs
	Polyurethane foam,	Polyurethane foam,	มชอเฐเาอ
ISS	epoxy resin containing glass	epoxy resin containing glass	
	M12 connector, 5-pin	M12 connector, 5-pin	

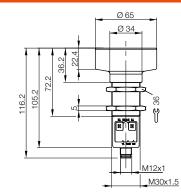


# Ø 34 69.2 102.2 113.2 <u> 112x1</u> M30x1.5

**Ordering code** BCC098C

BCC08FC

Ø 47.5



### **Recommended accessories**

Designation	Ordering code					
Mounting cuff	BAM00HN					
Mounting clamp	BAM00TN					
Mounting bracket	BAM00HH					
Sound deflection angle	BAM01ER					

You can find additional electrical accessories in our catalog Industrial Networking and Connectivity.

5 m/PUR 5 m/PUR

Length/cable material

You can find additional mechanical accessories in our catalog Accessories.

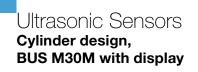
as,

Suitable connectors

M12, 5-pin/straight

M12, 5-pin/angled

Size/design



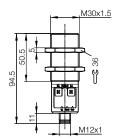
# M30 Analog output

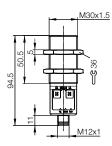


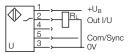


Size		M30×1	M30×1				
Туре		Analog output	Analog output				
Operating scanning ra	ange	30250 mm	65350 mm				
010 V/420 mA	Ordering code	BUS002N	BUS005K				
	Part number	BUS M30M1-XC-03/025-S92K	BUS M30M1-XC-07/035-S92K				
Blind zone		030 mm	065 mm				
Limiting scanning rang	ge	350 mm	600 mm				
Resolution		0.0250.10 mm	0.0250.17 mm				
(depends on analog w	vindow used)						
Sound cone		See page 338, No. 4	See page 338, No. 5				
Repeat accuracy		±0.15 %	±0.15 %				
Accuracy		±1 % (temperature drift internally compensated)	$\pm 1$ % (temperature drift internally compensated)				
Supply voltage U _S		930 V DC	930 V DC				
Output current		200 mA	200 mA				
No-load supply currer	nt l _o max.	≤ 80 mA	≤ 80 mA				
Polarity reversal protected	ed/short-circuit protected	yes/yes	yes/yes				
Settings		Teach-in	Teach-in				
Response delay		32 ms	64 ms				
Degree of protection a	as per IEC 60529	IP 67	IP 67				
Operating temperature		–25…+70 °C	−25+70 °C				
Material	Housing	Nickel-plated CuZn	Nickel-plated CuZn				
Plastic parts Sensing surface		PBT, TPU	PBT, TPU				
		Polyurethane foam,	Polyurethane foam,				
		epoxy resin containing glass	epoxy resin containing glass				
Connection		M12 connector, 5-pin	M12 connector, 5-pin				

Sensors are also available in stainless steel variants.









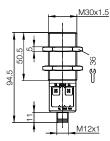


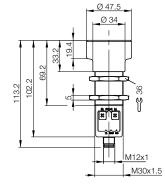
M30×1
Analog output
2001300 mm
BUS003F
BUS M30M1-XC-20/130-S92K
0200 mm
2000 mm
0.180.57 mm
See page 339, No. 8
±0.15 %
±1 % (temperature drift internally compensated)
930 V DC
200 mA
≤ 80 mA
yes/yes
Teach-in
92 ms
IP 67
-25+70 °C
Nickel-plated CuZn
PBT, TPU
Polyurethane foam,
epoxy resin containing glass
M12 connector, 5-pin

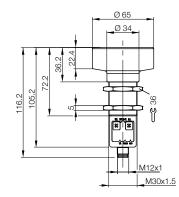




M30×1	M30×1					
Analog output	Analog output					
3503400 mm	6006000 mm					
BUS003T	BUS0041					
BUS M30M1-XC-35/340-S92K	BUS M30M1-XC-60/600-S92K					
0350 mm	0600 mm					
5000 mm	8000 mm					
0.181.5 mm	0.182.4 mm					
See page 339, No. 9	See page 339, No. 10					
±0.15 %	±0.15 %					
±1 % (temperature drift internally compensated)	±1 % (temperature drift internally compensated)					
930 V DC	930 V DC					
200 mA	200 mA					
≤ 80 mA	≤ 80 mA					
yes/yes	yes/yes					
Teach-in	Teach-in					
172 ms	240 ms					
IP 67	IP 67					
–25…+70 °C	–25+70 °C					
Nickel-plated CuZn	Nickel-plated CuZn					
PBT, TPU	PBT, TPU					
Polyurethane foam,	Polyurethane foam,					
epoxy resin containing glass	epoxy resin containing glass					
M12 connector, 5-pin	M12 connector, 5-pin					







Ultrasonic Sensors

Media, Industries, Ap-plication Areas, Sensor Selec-Sensor Selec-tion, Operating Modes, Sound Cones, Installation Notices, Definitions

Cylinder Designs Block Designs

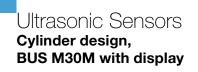


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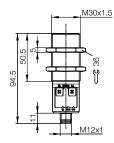
# M30 Switching and Analog Output

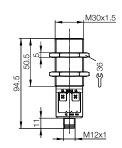




Size		M30×1	M30×1				
Туре		Switching and analog output	Switching and analog output				
Operating scanning rang	0	30250 mm	65350 mm				
010 V/420 mA	Ordering code	BUS002L	BUS005M				
PNP, NO/NC contact	Part number	BUS M30M1-PPC-03/025-S92K	BUS M30M1-PPC-07/035-S92K				
010 V/420 mA	Ordering code						
2x PNP, NO/NC contact	Part number						
Blind zone		030 mm	065 mm				
Limiting scanning range		350 mm	600 mm				
Resolution		0.0250.10 mm	0.0250.17 mm				
(depends on analog win	ndow used)						
Sound cone		See page 338, No. 4	See page 338, No. 5				
Repeat accuracy		±0.15 %	±0.15 %				
Accuracy		±1 % (temperature drift internally compensated)	±1 % (temperature drift internally compensated)				
Switching hysteresis		3 mm	5 mm				
Supply voltage U _S		930 V DC	930 V DC				
Output current		200 mA	200 mA				
No-load supply current	I ₀ max.	≤ 80 mA	≤ 80 mA				
Polarity reversal protected	/short-circuit protected	yes/yes	yes/yes				
Settings		Teach-in	Teach-in				
Response delay		32 ms	64 ms				
Switching frequency f		25 Hz	12 Hz				
Degree of protection as	per IEC 60529	IP 67	IP 67				
Operating temperature		–25…+70 °C	−25…+70 °C				
Material	Housing	Nickel-plated CuZn	Nickel-plated CuZn				
Plastic parts		PBT, TPU	PBT, TPU				
Sensing surface		ng surface Polyurethane foam, Polyurethane foam,					
	-	epoxy resin containing glass	epoxy resin containing glass				
Connection		M12 connector, 5-pin	M12 connector, 5-pin				

Sensors are also available in stainless steel variants.











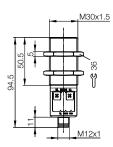
M30-1

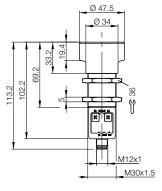
M30×1	M30×1
Switching and analog output	Switching and analog of
2001300 mm	3503400 mm
BUS0038	BUS003L
BUS M30M1-PPC-20/130-S92K	BUS M30M1-PPC-35/3
BUS003N	BUS0044
BUS M30M1-PWC-20/130-S92K	BUS M30M1-PWC-35/
0200 mm	0350 mm
2000 mm	5000 mm
0.180.57 mm	0.181.5 mm
See page 339, No. 8	See page 339, No. 9
±0.15 %	±0.15 %
±1 % (temperature drift internally compensated)	±1 % (temperature drift in
20 mm	50 mm
930 V DC	930 V DC
200 mA	200 mA
≤ 80 mA	≤ 80 mA
yes/yes	yes/yes
Teach-in	Teach-in
92 ms	172 ms
8 Hz	4 Hz
IP 67	IP 67
−25+70 °C	–25…+70 °C
Nickel-plated CuZn	Nickel-plated CuZn
PBT, TPU	PBT, TPU
Polyurethane foam,	Polyurethane foam,
epoxy resin containing glass	epoxy resin containing
M12 connector, 5-pin	M12 connector, 5-pin

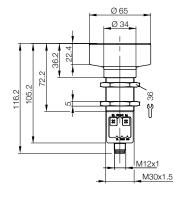




	M30×1	M30×1	
	Switching and analog output	Switching and analog output	
	3503400 mm	6006000 mm	
	BUS003L	BUS0043	
	BUS M30M1-PPC-35/340-S92K	BUS M30M1-PPC-60/600-S92K	
	BUS0044		
	BUS M30M1-PWC-35/340-S92K		
	0350 mm	0600 mm	
	5000 mm	8000 mm	
	0.181.5 mm	0.182.4 mm	
	See page 339, No. 9	See page 339, No. 10	
	±0.15 %	±0.15 %	
ted)	±1 % (temperature drift internally compensated)	±1 % (temperature drift internally compensated)	
	50 mm	100 mm	
	930 V DC	930 V DC	
	200 mA	200 mA	US
	≤ 80 mA	≤ 80 mA	0
	yes/yes	yes/yes	Ν
	Teach-in	Teach-in	Ir
	172 ms	240 ms	p S
	4 Hz	3 Hz	
	IP 67	IP 67	ti O N
	–25+70 °C	–25+70 °C	S
	Nickel-plated CuZn	Nickel-plated CuZn	Ν
	PBT, TPU	PBT, TPU	D
	Polyurethane foam,	Polyurethane foam,	С
	epoxy resin containing glass	epoxy resin containing glass	Ď







M12 connector, 5-pin

Suitable connectors		Recommended accessories					
Size/design	Length/cable material	Ordering code	Designation	Ordering code			
M12, 5-pin/straight	5 m/PUR	BCC098C	Mounting cuff	BAM00HN			
M12, 5-pin/angled	5 m/PUR	BCC08FC	Mounting clamp	BAM00TN			
			Mounting bracket	BAM00HH			
			Sound deflection angle	BAM01ER			

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Ultrasonic Sensors

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**Cylinder Designs** Block Designs Ultrasonic Sensors Cylinder design, BUS 18M

Features

- Variant with 90° angle head 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 sensing distances with a measuring range from 20 mm to 1.3 m
- 1 push/pull switching output PNP- or NPN-switching
   Analog output 4...20 mA or 0...10 V
- for analog distance measurement
- Teach-in via control line (pin 5)

With a housing length of only 41 mm, the new ultrasonic sensors BUS 18M are extremely compact. With their narrow sound cone and a blind zone of only 20 mm, they provide flexible application options. Two housing variants—straight and with a 90° angle head—are available, each with four sensing distances up to 1.3 m. The sensor family covers a broad range of applications through three different output stages: a push-pull switching output or an analog output, available with 4...20 mA or 0...10 V.

The highlight is complete support of the IO-Link interface. By means of the switching output, the sensors can communicate with an IO-Link-capable controller or an IO-Link master.

The sensors can be synchronized with one another, so that they do not influence one another.





#### IO-Link — the new standard

The IO-Link interface allows you to meet all of the prerequisites 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 increased.

#### Advantages of IO-Link

- In IO-Link mode, the measured distance values are transmitted to the master in cyclical form. This makes the IO-Link mode a costeffective replacement for an analog output.
- After a sensor failure, the controller can automatically load all settings to the new sensor.



## 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 roller driver or a brake readjusted. Another sensor with analog output readjusts the material infeed at the dancer roller as a function of the cable loop.



Туре		Sensing dis- tance/ Range	Desig	n	Outpu	Output				Us		U _S Connec- tion		- Special features		Page
<b>Ordering co</b> Part number	ıde		Straight	Angled	PNP, NO/NC contact	NPN, NO/NC contact	010 V	420 mA	1030 V DC	M12 connector, 5-pin		IO-Link SIO mode	Focusing attachment possible			
BUS M18M																
Switching BUS0020	BUS M18M1-GPXI-02/015-S92G	20150 mm	-		-	-			-				_	250		
BUS0020 BUS0029	BUS M18M1-GPXI-02/015-S92G BUS M18M1-GPXI-03/025-S92G	30250 mm	-		-	-			-	-		-	-	352 352		
BUS0029	BUS M18M1-GPXI-03/023-392G	65350 mm	-			-			-			-	-	353		
BUS0042	BUS M18M1-GPXI-12/100-S92G	1201000 mm				-								353		
BUS0023	BUS W18M1-GPXI-02/015-S92G	20150 mm	-		-	-				-				354		
BUS002A	BUS W18M1-GPXI-03/025-S92G	30250 mm		-	-	-			-	-				354		
BUS004Y	BUS W18M1-GPXI-07/035-S92G	65350 mm		-		-								355		
BUS004N	BUS W18M1-GPXI-12/100-S92G	1201000 mm		-		-								355		
BUS M18M					_				_							
Analog out	put															
BUS0026	BUS M18M1-XA-02/015-S92G	20150 mm												356		
BUS0025	BUS M18M1-XB-02/015-S92G	20150 mm												356		
BUS0024	BUS M18M1-XA-03/025-S92G	30250 mm												356		
BUS002C	BUS M18M1-XB-03/025-S92G	30250 mm												356		
BUS004T	BUS M18M1-XA-07/035-S92G	65350 mm												357		
BUS004W	BUS M18M1-XB-07/035-S92G	65350 mm												357		
BUS0052	BUS M18M1-XA-12/100-S92G	1201000 mm												357		
BUS004M	BUS M18M1-XB-12/100-S92G	1201000 mm												357		
BUS0028	BUS W18M1-XA-02/015-S92G	20150 mm												358		
BUS0027	BUS W18M1-XB-02/015-S92G	20150 mm												358		
BUS0050	BUS W18M1-XA-03/025-S92G	30250 mm												358		
BUS002E	BUS W18M1-XB-03/025-S92G	30250 mm												358		
BUS004R	BUS W18M1-XA-07/035-S92G	65350 mm												359		
BUS004U	BUS W18M1-XB-07/035-S92G	65350 mm												359		
BUS0051	BUS W18M1-XA-12/100-S92G	1201000 mm												359		
BUS0053	BUS W18M1-XB-12/100-S92G	1201000 mm												359		

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Cylinder Designs

Block Designs



# M18M Switching output IO-Link



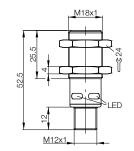


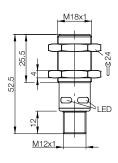
Size	
Туре	
Operating scanning rar	nge
Push/Pull, IO-Link,	Ordering code
NO/NC	Part number
Blind zone	
Limiting scanning range	Э
Resolution	
Sound cone	
Repeat accuracy	
Accuracy	
Switching hysteresis	
Supply voltage $U_S$	
Output current	
No-load supply current	l ₀ max.
Polarity reversal protected	d/short-circuit protected
Settings	
Response delay	
Switching frequency f	
Degree of protection as	s per IEC 60529
Operating temperature	
Material	Housing
	Plastic parts
	Sensing surface

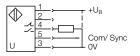
M18×1
Switching output, straight
20150 mm
BUS0020
BUS M18M1-GPXI-02/015-S92G
020 mm
250 mm
0.069 mm
See page 338, No. 2
±0.15 %
±1 % (temperature drift internally compensated)
2 mm
1030 V DC
100 mA
≤ 40 mA
yes/yes
Teach-in (via Pin 5)/IO-Link
32 ms
25 Hz
IP 67
–25…+70 °C
Nickel-plated brass tube
PBT
Polyurethane foam,
epoxy resin containing glass
M12 connector, 5-pin

M18×1
Switching output, straight
30250 mm
BUS0029
BUS M18M1-GPXI-03/025-S92G
030 mm
350 mm
0.069 mm
See page 338, No. 4
±0.15 %
±1 % (temperature drift internally compensated)
3 mm
1030 V DC
100 mA
≤ 40 mA
yes/yes
Teach-in (via Pin 5)/IO-Link
32 ms
25 Hz
IP 67
–25+70 °C
Nickel-plated brass tube
PBT
Polyurethane foam,
epoxy resin containing glass
M12 connector, 5-pin

Connection











M18×1
Switching output, straight
65350 mm
BUS004Z
BUS M18M1-GPXI-07/035-S92G
065 mm
600 mm
0.069 mm
See page 338, No. 5
±0.15 %
±1 % (temperature drift internally compensated)
5 mm
1030 V DC
100 mA
≤ 40 mA
yes/yes
Teach-in (via Pin 5)/IO-Link
64 ms
12 Hz
IP 67
–25…+70 °C
Nickel-plated brass tube
PBT
Polyurethane foam,
epoxy resin containing glass
M12 connector, 5-pin



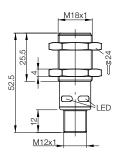
M18×1			
Switching output, straight			
1201000 mm			
BUS004P			
BUS M18M1-GPXI-12/100-S92G			
0120 mm			
1300 mm			
0.069 mm			
See page 339, No. 7			
±0.15 %			
±1 % (temperature drift internally compensated)			
20 mm			
1030 V DC			
100 mA			
≤ 40 mA			
yes/yes			
Teach-in (via Pin 5)/IO-Link			
80 ms			
10 Hz			
IP 67			
–25…+70 °C			
Nickel-plated brass tube			
PBT			
Polyurethane foam,			
epoxy resin containing glass			
M12 connector, 5-pin			

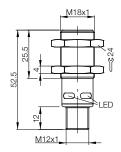


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Cylinder Designs Block Designs





Suitable connectors		Recommended accessories		
Size/design	Length/cable material	Ordering code	Designation	Ordering code
M12, 5-pin/straight	5 m/PUR	BCC098C	Mounting cuff	BAM00F2
M12, 5-pin/angled	5 m/PUR	BCC08FC	Mounting clamp	BAM00T3
			Mounting bracket	BAM00EY
			Focusing attachment*	BAM01HJ
			Sound deflection angle	BAM01EP
			Weld protection	BAM01LS

You can find additional electrical accessories in our catalog Industrial Networking and Connectivity.

Designation	Ordering code
Mounting cuff	BAM00F2
Mounting clamp	BAM00T3
Mounting bracket	BAM00EY
Focusing attachment*	BAM01HJ
Sound deflection angle	BAM01EP
Weld protection	BAM01LS

* Only for BUS0020 and BUS0029

You can find additional mechanical accessories in our catalog Accessories.



# W18M Switching output IO-Link



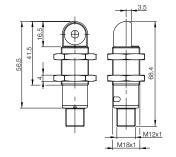


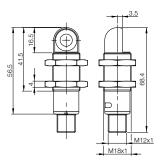
Size				
Туре				
Operating scanning ra	nge			
Push/Pull, IO-Link,	Ordering code			
NO/NC	Part number			
Blind zone				
Limiting scanning rang	je			
Resolution				
Sound cone				
Repeat accuracy				
Accuracy				
Switching hysteresis				
Supply voltage $U_S$				
Output current				
No-load supply curren	t l _o max.			
Polarity reversal protected/short-circuit protected				
Settings				
Response delay				
Switching frequency f				
Degree of protection as per IEC 60529				
Operating temperature				
Material	Housing			
	Plastic parts			
	Sensing surface			

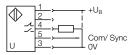
M18×1	I
Switching output, angled	3
20150 mm	;
BUS0023	I
BUS W18M1-GPXI-02/015-S92G	ł
020 mm	(
250 mm	(
0.069 mm	(
See page 338, No. 2	0
±0.15 %	-
±1 % (temperature drift internally compensated)	:
2 mm	(
1030 V DC	
100 mA	
≤ 40 mA	:
yes/yes	2
Teach-in (via Pin 5)/IO-Link	-
32 ms	;
25 Hz	1
IP 67	I
–25+70 °C	-
Nickel-plated brass tube	
PBT	ł
Polyurethane foam,	ł
epoxy resin containing glass	e
M12 connector, 5-pin	I

M18×1 Switching output, angled 30...250 mm BUS002A BUS W18M1-GPXI-03/025-S92G 0...30 mm 350 mm 0.069 mm See page 338, No. 4 ±0.15 % ±1 % (temperature drift internally compensated) 3 mm 10...30 V DC 100 mA  $\leq 40 \text{ mA}$ yes/yes Teach-in (via Pin 5)/IO-Link 32 ms 25 Hz IP 67 –25…+70 °C Nickel-plated brass tube PBT Polyurethane foam, epoxy resin containing glass M12 connector, 5-pin

Connection











M18×1
Switching output, angled
65350 mm
BUS004Y
BUS W18M1-GPXI-07/035-S92G
065 mm
600 mm
0.069 mm
See page 338, No. 5
±0.15 %
±1 % (temperature drift internally compensated)
5 mm
1030 V DC
100 mA
≤ 40 mA
yes/yes
Teach-in (via Pin 5)/IO-Link
64 ms
12 Hz
IP 67
–25+70 °C
Nickel-plated brass tube
PBT
Polyurethane foam,
epoxy resin containing glass
M12 connector, 5-pin



# M18×1

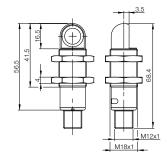
Switching output, angled				
1201000 mm				
BUS004N				
BUS W18M1-GPXI-12/100-S92G				
0120 mm				
1300 mm				
0.069 mm				
See page 339, No. 7				
±0.15 %				
$\pm 1$ % (temperature drift internally compensated)				
20 mm				
1030 V DC				
100 mA				
≤ 40 mA				
yes/yes				
Teach-in (via Pin 5)/IO-Link				
80 ms				
10 Hz				
IP 67				
–25…+70 °C				
Nickel-plated brass tube				
PBT				
Polyurethane foam,				
epoxy resin containing glass				
M12 connector, 5-pin				



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5.6.5 M12x1 M18x1



Cylinder Designs Block Designs

Suitable connectors		Recommended accessories		
Size/design	Length/cable material	Ordering code	Designation	Ordering code
M12, 5-pin/straight	5 m/PUR	BCC098C	Mounting cuff	BAM00F2
M12, 5-pin/angled	5 m/PUR	BCC08FC	Mounting clamp	BAM00T3
			Mounting bracket	BAM00EY

You can find additional electrical accessories in our catalog Industrial Networking and Connectivity.

You can find additional mechanical accessories in our catalog Accessories.



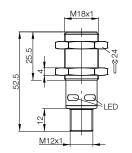
# M18M Analog output

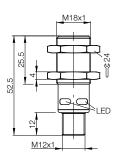


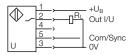


Size		M18×1
Туре		Analog output, straig
Operating scanning range		20150 mm
010 V	Ordering code	BUS0026
Rising/falling	Part number	BUS M18M1-XA-02/01
420 mA	Ordering code	BUS0025
Rising/falling	Part number	BUS M18M1-XB-02/01
Blind zone		020 mm
Limiting scanning rang	je	250 mm
Resolution		0.069 mm
(depends on analog w	vindow used)	
Sound cone	See page 338, No. 2	
Repeat accuracy	±0.15 %	
Accuracy	±1 % (temperature drift in	
Supply voltage $U_S$	1030 V DC	
Output current	100 mA	
No-load supply curren	≤ 40 mA	
Polarity reversal protecte	yes/yes	
Settings	Teach-in (via pin 5)	
Response delay	32 ms	
Degree of protection a	IP 67	
Operating temperature	–25…+70 °C	
Material	Housing	Nickel-plated brass tub
	Plastic parts	PBT
	Sensing surface	Polyurethane foam,
		epoxy resin containing
Connection	M12 connector, 5-pin	

×1	M18×1	
log output, straight	Analog output, straight	
.150 mm	30250 mm	
0026	BUS0024	
M18M1-XA-02/015-S92G	BUS M18M1-XA-03/025-S92G	
0025	BUS002C	
M18M1-XB-02/015-S92G	BUS M18M1-XB-03/025-S92G	
20 mm	030 mm	
mm	350 mm	
9 mm	0.0690.10 mm	
page 338, No. 2	See page 338, No. 4	
5 %	±0.15 %	
(temperature drift internally compensated)	±1 % (temperature drift internally compensated)	
.30 V DC	1030 V DC	
mA	100 mA	
mA	≤ 40 mA	
yes	yes/yes	
h-in (via pin 5)	Teach-in (via pin 5)	
าร	32 ms	
7	IP 67	
+70 °C	−25+70 °C	
el-plated brass tube	Nickel-plated brass tube	
	PBT	
urethane foam,	Polyurethane foam,	
ky resin containing glass	epoxy resin containing glass	
connector, 5-pin	M12 connector, 5-pin	











M18×1	N
Analog output, straight	A
65350 mm	1
BUS004T	В
BUS M18M1-XA-07/035-S92G	В
BUS004W	B
BUS M18M1-XB-07/035-S92G	В
065 mm	0
600 mm	1
0.0690.17 mm	0
See page 338, No. 5	S
±0.15 %	±
±1 % (temperature drift internally compensated)	±
1030 V DC	1
100 mA	1
≤ 40 mA	≤
yes/yes	У
Teach-in (via pin 5)	Т
64 ms	8
IP 67	IF
−25+70 °C	-
Nickel-plated brass tube	Ν
PBT	Ρ
Polyurethane foam,	Ρ
epoxy resin containing glass	е
M12 connector, 5-pin	Ν



M18×1	
Analog output, straight	
1201000 mm	
BUS0052	
BUS M18M1-XA-12/100-S92G	
BUS004M	
BUS M18M1-XB-12/100-S92G	
0120 mm	
1300 mm	
0.0690.38 mm	
See page 339, No. 7	
±0.15 %	
$\pm 1$ % (temperature drift internally compensated)	
1030 V DC	
100 mA	
≤ 40 mA	
yes/yes	
Teach-in (via pin 5)	
80 ms	
IP 67	
–25…+70 °C	
Nickel-plated brass tube	
PBT	
Polyurethane foam,	
epoxy resin containing glass	
M12 connector, 5-pin	

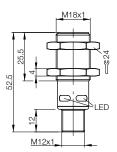


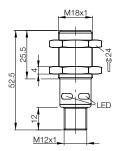
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Cylinder Designs

Block Designs





Suitable connectors			Recommended accessories	
Size/design	Length/cable material	Ordering code	Designation	Ordering code
M12, 5-pin/straight	5 m/PUR	BCC098C	Mounting cuff	BAM00F2
M12, 5-pin/angled	5 m/PUR	BCC08FC	Mounting clamp	BAM00T3
			Mounting bracket	BAM00EY
			Focusing attachment*	BAM01HJ
			Sound deflection angle	BAM01EP
			Weld protection	BAM01LS

You can find additional electrical accessories in our catalog Industrial Networking and Connectivity.

Mounting cuff	BAM00F2
Mounting clamp	BAM00T3
Mounting bracket	BAM00EY
Focusing attachment*	BAM01HJ
Sound deflection angle	BAM01EP
Weld protection	BAM01LS

* Only for BUS0026, BUS0025, BUS0024 and BUS002C

You can find additional mechanical accessories in our catalog Accessories.

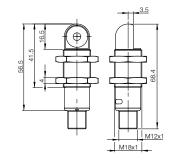


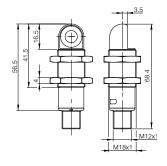
# **W18M Analog output**

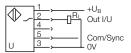




Size		M18×1	M18×1	
Туре		Analog output, angled	Analog output, angled	
Operating scanning range		20150 mm	30250 mm	
010 V	Ordering code	BUS0028	BUS0050	
Rising/falling	Part number	BUS W18M1-XA-02/015-S92G	BUS W18M1-XA-03/025-S92G	
420 mA	Ordering code	BUS0027	BUS002E	
Rising/falling	Part number	BUS W18M1-XB-02/015-S92G	BUS W18M1-XB-03/025-S92G	
Blind zone		020 mm	030 mm	
Limiting scanning rang	ge	250 mm	350 mm	
Resolution		0.069 mm	0.0690.10 mm	
(depends on analog v	vindow used)			
Sound cone		See page 338, No. 2	See page 338, No. 4	
Repeat accuracy		±0.15 %	±0.15 %	
Accuracy		±1 % (temperature drift internally compensated)	±1 % (temperature drift internally compensated)	
Supply voltage U _S		1030 V DC	1030 V DC	
Output current		100 mA	100 mA	
No-load supply current $I_0$ max.		≤ 40 mA	≤ 40 mA	
Polarity reversal protected	ed/short-circuit protected	yes/yes	yes/yes	
Settings		Teach-in (via pin 5)	Teach-in (via pin 5)	
Response delay		32 ms	32 ms	
Degree of protection as per IEC 60529		IP 67	IP 67	
Operating temperature		–25…+70 °C	−25+70 °C	
Material	Housing	Nickel-plated brass tube	Nickel-plated brass tube	
	Plastic parts	PBT	PBT	
	Sensing surface	Polyurethane foam,	Polyurethane foam,	
		epoxy resin containing glass	epoxy resin containing glass	
Connection		M12 connector, 5-pin	M12 connector, 5-pin	











1	10
100	20
	2
1000	1
A 201	

M18×1	
Analog output, angled	,
65350 mm	•
BUS004R	I
BUS W18M1-XA-07/035-S92G	I
BUS004U	I
BUS W18M1-XB-07/035-S92G	l
065 mm	(
600 mm	
0.0690.17 mm	(
See page 338, No. 5	;
±0.15 %	1
±1 % (temperature drift internally compensated)	:
1030 V DC	ľ
100 mA	1
≤ 40 mA	:
yes/yes	2
Teach-in (via pin 5)	-
64 ms	ł
IP 67	I
−25+70 °C	•
Nickel-plated brass tube	I
PBT	I
Polyurethane foam,	I
epoxy resin containing glass	(
M12 connector, 5-pin	I

•	
M18×1	
Analog output, angled	
1201000 mm	
BUS0051	
BUS W18M1-XA-12/100-S92G	
BUS0053	
BUS W18M1-XB-12/100-S92G	
0120 mm	
1300 mm	
0.0690.38 mm	
See page 339, No. 7	
±0.15 %	
±1 % (temperature drift internally compensated)	
1030 V DC	
100 mA	
≤ 40 mA	
yes/yes	
Teach-in (via pin 5)	
80 ms	
IP 67	
–25…+70 °C	
Nickel-plated brass tube	
PBT	
Polyurethane foam,	
epoxy resin containing glass	
M12 connector, 5-pin	

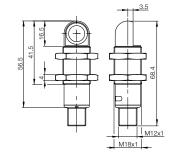


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Cylinder Designs

Block Designs



Suitable connectors			Recommended accessories	
Size/design	Length/cable material	Ordering code	Designation	Ordering code
M12, 5-pin/straight	5 m/PUR	BCC098C	Mounting cuff	BAM00F2
M12, 5-pin/angled	5 m/PUR	BCC08FC	Mounting clamp	BAM00T3
			Mounting bracket	BAM00EY

You can find additional electrical accessories in our catalog **Industrial Networking and Connectivity**.

You can find additional mechanical accessories in our catalog **Accessories**.

#### www.balluff.com

Ultrasonic Sensors Block design, BUS R06K

#### Features

- Small ultrasonic sensor in block-shaped housing makes completely new solutions possible
- Same construction as many optical sensors a true alternative in critical applications
- Option for focusing attachment for challenging measurement tasks
- 5 sensing distances with a measuring range from 20 mm to 1 m
- 1 switching output in PNP or NPN design
- Analog output 4...20 mA or 0...10 V
- Teach-in via button

The small ultrasonic sensors in a block-shaped housing operate with high resolution, so that they leave nothing to be desired in terms of accuracy.

For challenging measurement tasks, BUS R06K1..02/007 and BUS R06K1..02/015 can be upgraded with a sound transmission attachment. This allows measurements to be performed in bore holes and openings with diameters > 5 mm.

Due to its short response delay and the high switching frequency of 250 Hz, the BUS R06K1..02/015 is particularly suitable for detecting fast processes.

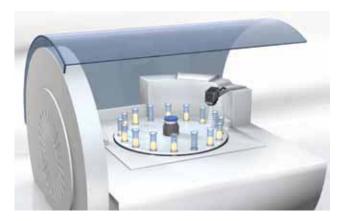
The series has a synchronization input for simultaneous operation of up to ten sensors where space is at a minimum. The diversity of their versions with switching output or current or voltage analog output with five scanning ranges offer nearly endless fields of application.





#### Focusing attachment

For fill-level measurement through tiny openings with diameters to 5 mm, the sensor with focusing attachment is positioned directly over the measurement location. The tightly bundled sound field is incident 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.



#### Fill-level measurement in narrow containers

On a rotary indexing table, narrow containers are filled with liquid or solid media. The ultrasonic sensor then checks the exact filling level.

# R06K



Туре		Sensing distance/ Range	Desig	In	Outpu	ıt			Us	Connec- tion	Spec featu			Pag
<b>Ordering cod</b> Part number	e		Front sound outlet	Side sound outlet	PNP, NO/NC contact	NPN, NO/NC contact	010 V	420 mA	2030 V DC	M8 connector, 4-pin	Increased switching frequency	High switching frequency	Focusing attachment possible	
BUS R06K														
Switching											_			
BUS0021	BUS R06K1-PPX-02/007-S75G	2070 mm												36
BUS004E	BUS R06K1-NPX-02/007-S75G	2070 mm	_							-			_	36
BUS004C	BUS R06K1-PPX-02/015-S75G	20150 mm	-		•	_			-	-			_	36
BUS004A	BUS R06K1-NPX-02/015-S75G	20150 mm	_		_	-			_	_	_		_	36
BUS0049	BUS R06K1-PPX-02/015-S75G-F01	20150 mm	-		_	_			-	-			_	36
BUS004H	BUS R06K1-NPX-02/015-S75G-F01	20150 mm	_		_	-			_	_	-		-	36
BUS004L	BUS R06K1-PPX-05/024-S75G	55240 mm	-		-	_			-	-				36
BUS0048	BUS R06K1-NPX-05/024-S75G BUS R06K1-PPX-03/025-S75G	55240 mm 30250 mm		_	_	-			_	_	_			36 36
BUS0057 BUS0058	BUS R06K1-PPX-03/025-S75G BUS R06K1-NPX-03/025-S75G	30250 mm		-	-	-			-	-				36
BUS0058	BUS R06K1-NPX-03/025-S75G BUS R06K1-PPX-12/070-S75G	120700 mm		-	-	-				-				30
BUS0059 BUS005A	BUS R06K1-PPX-12/070-S75G	120700 mm		-	-	-			-	-				30
BUS R06K		12070011111				-								50
Analog out														
BUS004K	BUS R06K1-XA-02/015-S75G	20150 mm												36
BUS004J	BUS R06K1-XB-02/015-S75G	20150 mm												36
BUS0056	BUS R06K1-XA-05/024-S75G	55240 mm												36
BUS004F	BUS R06K1-XB-05/024-S75G	55240 mm												36
BUS005E	BUS R06K1-XA-12/070-S75G	120700 mm												36
BUS005C	BUS R06K1-XB-12/070-S75G	120700 mm												36

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Cylinder Designs Block Designs



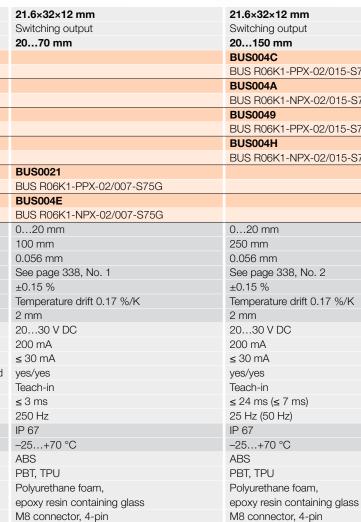
Size

Туре

Operating scanning range

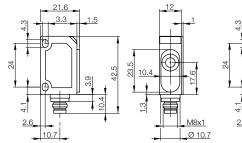
## **R06K Switching output**

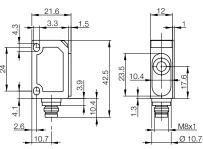




BUS R06K1-PPX-02/015-S75G BUS R06K1-NPX-02/015-S75G BUS R06K1-PPX-02/015-S75G-F01 BUS R06K1-NPX-02/015-S75G-F01

PNP	Normally open/	Ordering code			
	normally closed	Part number			
NPN	Normally open/	Ordering code			
	normally closed	Part number			
PNP	Normally open/	Ordering code			
50 Hz	normally closed	Part number			
NPN	Normally open/	Ordering code			
50 Hz	normally closed	Part number			
PNP	Normally open/	Ordering code	В		
250 Hz	normally closed	Part number	В		
NPN	Normally open/	Ordering code	В		
250 Hz	normally closed	Part number	В		
Blind zon	e		0.		
Limiting s	scanning rang	le	1(		
Resolutio	n		0.		
Sound co	one		S		
Repeat a	ccuracy		±		
Accuracy	/		Te		
Switching	g hysteresis		2		
Supply vo	oltage U _S		20		
Output c	urrent		20		
No-load s	supply curren	t l _o max.	≤		
Polarity rev	versal protecte	d/short-circuit protected	ye		
Settings			Te		
Response	e time		≤		
Switching	g frequency f		2		
Degree of protection as per IEC 60529					
Operating	g temperature	9	-2		
Material		Housing	A		
		Plastic parts	Ρ		
		Sensing surface	Ρ		
			e		





#### **Connection wiring diagram**

		1+
KID 2		2
	^{/nc}	Z Sync
		F
	/ U	0V

+U_B

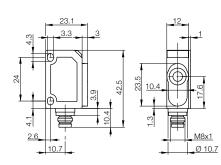


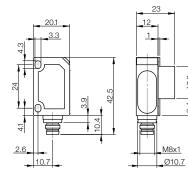






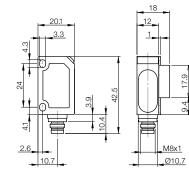
23×32×12 mm	20×32×23 mm	20×32×18 mm	
Switching output	Switching output	Switching output	
55240 mm	30250 mm	120700 mm	
BUS004L	BUS0057	BUS0059	
BUS R06K1-PPX-05/024-S75G	BUS R06K1-PPX-03/025-S75G	BUS R06K1-PPX-12/070-S75G	
BUS0048	BUS0058	BUS005A	
BUS R06K1-NPX-05/024-S75G	BUS R06K1-NPX-03/025-S75G	BUS R06K1-NPX-12/070-S75G	
055 mm	030 mm	0120 mm	
350 mm	350 mm	1000 mm	
0.037 mm	0.069 mm	0.037 mm	
See page 338, No. 3	See page 338, No. 4	See page 339, No. 6	
±0.15 %	±0.15 %	±0.15 %	
Temperature drift 0.17 %/K	Temperature drift 0.17 %/K	Temperature drift 0.17 %/K	
2 mm	2 mm	2 mm	
2030 V DC	2030 V DC	2030 V DC	
200 mA	200 mA	200 mA	
≤ 35 mA	≤ 35 mA	≤ 35 mA	
yes/yes	yes/yes	yes/yes	
Teach-in	Teach-in	Teach-in	
24 ms	20 ms	36 ms	
25 Hz	31 Hz	11 Hz	
IP 67	IP 67	IP 67	
–25…+70 °C	–25…+70 °C	–25…+70 °C	
ABS	ABS	ABS	
PBT, TPU	PBT, TPU	PBT, TPU	
Polyurethane foam,	Polyurethane foam,	Polyurethane foam,	
epoxy resin containing glass	epoxy resin containing glass	epoxy resin containing glass	
M8 connector, 4-pin	M8 connector, 4-pin	M8 connector, 4-pin	





17.9

M8x1



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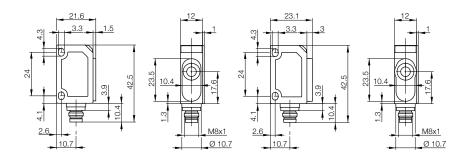
### Ultrasonic Sensors Block design, BUS R06K

## R06K Analog output





0.		00.00.40	
Size	21.6×32×12 mm	23×32×12 mm	
Туре	Analog output	Analog output	
Operating scanning range	20150 mm	55240 mm	
010 V Ordering of		BUS0056	
Rising/falling Part number			
420 mA Ordering of		BUS004F	
rising/falling Part number			
Blind zone	020 mm	055 mm	
Limiting scanning range	250 mm	350 mm	
Resolution (dependent on set wind	low) 0.056 mm	0.0370.072 mm	
Sound cone	See page 338, No. 2	See page 338, No. 3	
Repeat accuracy	±0.15 %	±0.15 %	
Accuracy	Temperature drift 0.17 %/	/K Temperature drift 0.17 %/K	
Supply voltage U _S	2030 V DC	2030 V DC	
Output current	200 mA	200 mA	
No-load supply current I ₀ max.	≤ 25 mA	≤ 25 mA	
Polarity reversal protected/short-circuit	protected yes/yes	yes/yes	
Settings	Teach-in	Teach-in	
Response time	24 ms	24 ms	
Degree of protection as per IEC 60	529 IP 67	IP 67	
Operating temperature	–25…+70 °C	–25…+70 °C	
Material Housing	ABS	ABS	
Plastic part	s PBT, TPU	PBT, TPU	
Sensing su	rface Polyurethane foam,	Polyurethane foam,	
	epoxy resin containing gla	epoxy resin containing glass	
Connection	M8 connector, 4-pin	M8 connector, 4-pin	



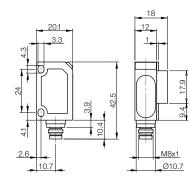
#### Connection wiring diagram

$\bigcirc$	1 2 ,	- +U _B Sync
U ~		Out I/U - 0V





20×32×18 mm		
Analog output		
120700 mm		
BUS005E		
BUS R06K1-XA-12/070-S75G		
BUS005C		
BUS R06K1-XB-12/070-S75G		
0120 mm		
1000 mm		
0.0370.215 mm		
See page 339, No. 6		▙
±0.15 %		5
Temperature drift 0.17 %/K		
2030 V DC		
200 mA		•••••
≤ 25 mA		Ultrasonic Sensors
yes/yes		36113013
Teach-in		Media,
36 ms		Industries, A
IP 67		plication Are Sensor Seleo
–25+70 °C		tion,
ABS		Operating Modes,
PBT, TPU		Sound Cone Installation
Polyurethane foam,		Notices,
epoxy resin containing glass		Definitions
M8 connector, 4-pin		Cylinder



#### Suitable connectors

Size/design	Length/cable material	Ordering code
M8, 4-pin/straight	2 m/PUR	BCC02N2
M8, 4-pin/straight	2 m/PVC	BCC02PL
M8, 4-pin/angled	2 m/PUR	BCC02NC
M8, 4-pin/angled	2 m/PVC	BCC02PZ

You can find additional electrical accessories in our catalog Industrial Networking and Connectivity.

#### **Recommended accessories**

	100	
Designation	Ordering code	
Mounting tab	Included	
Focusing attachment*	BAM01YU*	
Mounting bracket	BAM00UH	

* Only for BUS0021, BUS004E, BUS004C, BUS004A, BUS0049, BUS004H, BUS004K and BUS004J

You can find additional mechanical accessories in our catalog Accessories.

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Cylinder Designs Block Designs



## M12 stainless steel Switching output

Stainless steel housing

- Measuring range from 25 mm to 200 mm
- 1 switching output in PNP or NPN design
- Teach-in via line (PIN 2)



#### Monitoring of packages

High hygienic requirements in the food industry place special demands on sensor technology. The ultrasonic sensor reliably monitors the proper sealing of packages and thereby ensures uniform quality.





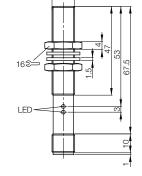
Size		M12×1			
Туре		Switching output			
Operating scanning range		25200 mm			
PNP	Ordering code	BUS0005			
NO/NC	Part number	BUS M12E0-PPXCR-020-S04G			
NPN	Ordering code	BUS0006			
NO/NC	Part number	BUS M12E0-NPXCR-020-S04G			
Blind zone		025 mm			
Resolution		0.2 mm			
Sound cone opening		approx. 8°			
Repeat accuracy		≤ 0.3 mm			
Switching hysteresis		1 %			
Supply voltage U _S		1830 V DC			
Output current		100 mA			
No-load supply current I ₀ n	nax.	≤ 35 mA			
Polarity reversal protected/	short-circuit protected	yes/yes			
Settings		Teach-in (pin 2)			
Switching frequency		30 Hz			
Degree of protection as pe	r IEC 60529	IP 65			
Operating temperature		–20+70 °C			
Material Housing		V2A			
Plastic parts		PA			
	Sensing surface	Epoxy resin - hollow-glass sphere /PUR			
Connection		M12 connector, 4-pin			



Ultrasonic Sensors

Media, Industries, Ap-plication Areas, Sensor Selec-tion, Operating Modes, Sound Cones, Installation Notices Notices, Definitions

Cylinder Designs Block Designs



M12×1

#### Connection wiring diagram

BN BK WH BU	+24 V Out Teach-in 0 V
BN BK WH BU	+24 V Out Teach-in 0 V

Suitable connectors		Recommended access	Recommended accessories	
Size/design	Length/cable material	Ordering code	Designation	Ordering code
M12, 4-pin/straight	2 m/PUR	BCC032F	Mounting cuff	BAM00C4
M12, 4-pin/straight	5 m/PUR	BCC032H	Mounting clamp	BAM01KM
M12, 4-pin/angled	2 m/PUR	BCC032Y	Mounting bracket	BAM00C0
M12, 4-pin/angled	5 m/PUR	BCC032Z	Focusing attachment	BAM01ET

You can find additional electrical accessories in our catalog Industrial Networking and Connectivity.

Designation	Ordering code
Mounting cuff	BAM00C4
Mounting clamp	BAM01KM
Mounting bracket	BAM00C0
Focusing attachment	BAM01ET

You can find additional mechanical accessories in our catalog Accessories.



## Q80 Switching output Analog output

- Measuring range from 600 mm to 6000 mm
- 2 switching output in PNP or NPN design
- Analog output 4...20 mA or 0...10 V
- Teach-in via line (PIN 5)





## 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 optionally be output by an analog signal or with two switching signals as min./max. value.



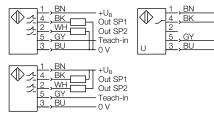


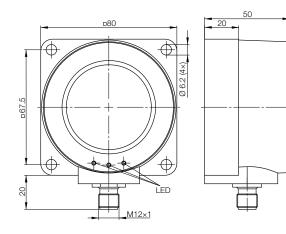


Size		Q80	Q80	
Operating scanning range	,e	6006000 mm	6006000 mm	
Switching output				
2× PNP	Ordering code	BUS000A		
NO/NC	Part number	BUS Q80K0-PWXER-600-S92K		
2x NPN	Ordering code	BUS000C		
NO/NC	Part number	BUS Q80K0-NWXER-600-S92K		
Analog output				
010 V	Ordering code		BUS000E	
Rising/falling	Part number		BUS Q80K0-XAER-600-S92K	
420 mA	Ordering code		BUS000F	
Rising/falling	Part number		BUS Q80K0-XBER-600-S92K	
Blind zone		0600 mm	0600 mm	H H
Resolution		1 mm	1 mm	
Sound cone opening		approx. 8°	approx. 8°	
Repeat accuracy			≤ 0.2%	•••••
Switching hysteresis		1 %	1 %	Ultrasonic Sensors
Supply voltage $U_S$		1830 V DC	1830 V DC	36113013
Output current		500 mA		Media,
No-load supply current $I_0$	max.	≤ 60 mA	≤ 35 mA	Industries, A
Polarity reversal protected	d/short-circuit protected	yes/yes	yes/yes	plication Are Sensor Sele
Settings		Teach-in (pin 5)	Teach-in (pin 5)	tion, Operating
Response time			≤ 700 ms	Modes,
Switching frequency		0.5 Hz		Sound Cone Installation
Degree of protection as p	ber IEC 60529	IP 65	IP 65	Notices,
Operating temperature		–15+70 °C	−20+70 °C	Definitions
Material	Housing	PBT	PBT	Cylinder
	Sensing surface	Epoxy resin - hollow-glass sphere /PUR	Epoxy resin - hollow-glass sphere /PUR	Designs
Connection		M12 connector, 5-pin	M12 connector, 5-pin	Block Designs

Cylinder Designs Block Designs

#### **Connection wiring diagram**





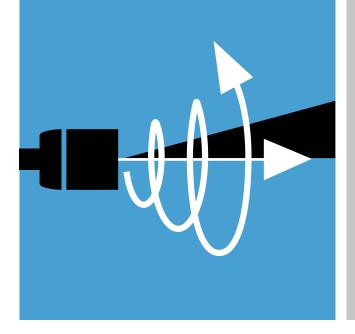
#### Suitable connectors

Size/design	Length/cable material	Ordering code
M12, 5-pin/straight	5 m/PUR	BCC098C
M12, 5-pin/angled	5 m/PUR	BCC08FC

- +U_B - Out U/I

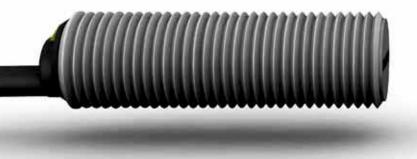
- Teach-in - 0 V

You can find additional electrical accessories in our catalog Industrial Networking and Connectivity.



# Inductive Distance Sensors

Inductive distance sensors BAW provide an absolute voltage- or current signal that changes proportionally to the distance of a metallic target. Workpieces of varying shape and size made of ferrous or nonferrous materials damp the sensor to different degrees. This provides a simple way of detecting positions, distances and material differences.





#### Inductive Distance Sensors

Features, Output Curve,	
Evaluating Programmed Switching Points	372
Applications	373
Cylinder designs	374
Block designs	385

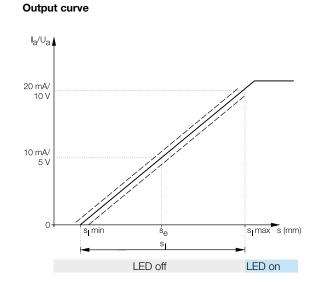




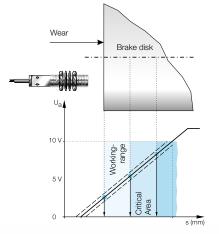
## Inductive Distance Sensors Features, output curve, evaluating programmed switching points

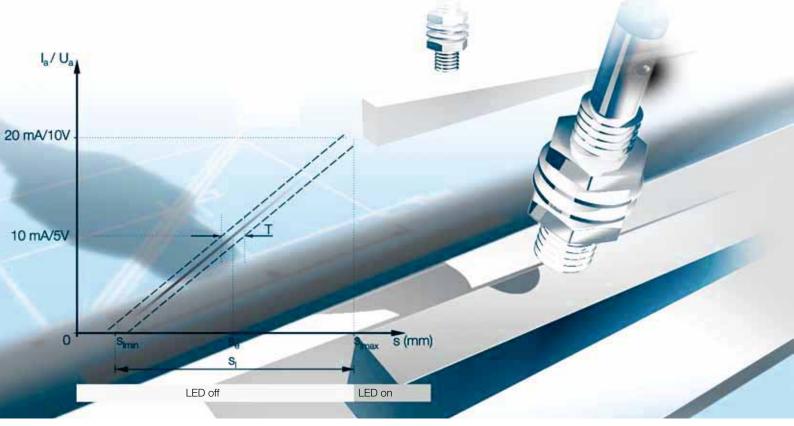
#### Features

- Distance-proportional analog output signal
- Contactless, absolute measuring principle
- Wide variety of designs: cylindrical and cubical
- Measuring ranges from 0.5 to 50 mm
- High repeat accuracy
- Optimal linearity
- Low temperature drift
- Measurement speed up to 40 m/s
- LED for restricting the working range
- Insensitive to contamination



## Evaluating programmed switching points (brake disk example)



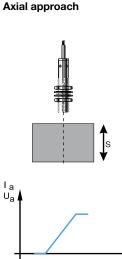


## Inductive Distance Sensors **Applications**

#### Applications

Examples of the various

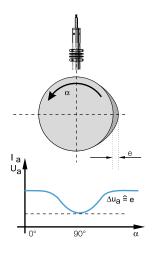
- industrial applications include: Distance sensing (even at high travel speeds)
- Measurement of film and sheet thicknesses
- Belt center measurement
- Measurement of metal strip widths
- Detection of surface waves
- Counting tasks
- Positioning
- Position checking
- Clamping distance monitoring
- Selection of different sizes and materials



Distance changes in the sensor axis result in output signals proportional to distance.

S

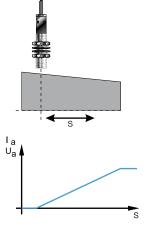
Identifying different materials



Sensing a rotating object

Eccentrics, cams or unbalanced motion result in a periodic change in the output signal.

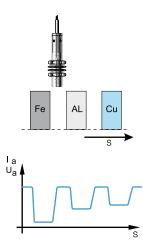
Distance measurements at high object travel speeds

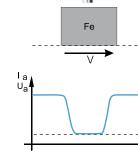


Lateral approach

Detecting longer distances by sensing an inclined plane.

#### **Detecting installed seal rings**





If the distance is kept constant, the even at high travel speeds.

П U,





Inductive

Designs Block Designs

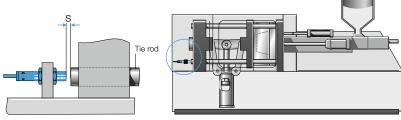
output signal only changes if the object material is different.



Distances can be precisely measured

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 Distance Sensors Cylinder designs, Ø 6.5 mm, M8×1





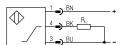


			Temperature output	
Series		Ø 6.5 mm	Ø 6.5 mm	M8×1
Installation type (observe instructions in Basic Information chapter)		Flush	Flush	Flush
Output signal		Voltage, 0 to 10 V	Voltage, 0 to 10 V	Voltage, 0 to 10 V
Linear range s _l		0.52 mm	0.52 mm	0.51.5 mm
Ordering code		BAW000L	BAW000J	BAW000N
Part number		BAW G06EF-UAC20B-S49G	BAW G06EE-UAF20B-EP03-K	BAW M08EI-UAD15B-BP00.2-GS04
Supply voltage U _S		1530 V DC	21.626.4 V DC	1530 V DC
Rated insulation voltage	U _i (protection class)	75 V DC	75 V DC	250 V AC (🗉)
Effective distance se		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/transp	osition 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, ty	yp. in range from +10 to +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,	M12 connector,
			4×0.14 mm ²	3-pin with

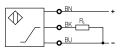
 *  The function is assured over a range of –10 to +70  $^{\circ}\text{C}$ 

#### **Connection wiring diagrams**

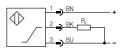
Connector, voltage output



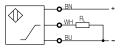
Cable, voltage output

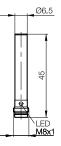


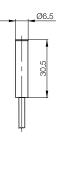
Connector, current output

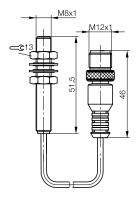


Cable, current output



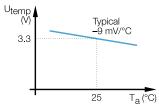






0.2 m PUR cable

#### Temperature output



The temperature output (not shortcircuit protected) provides a signal representing a precisely measured temperature change.

## Inductive Distance Sensors Cylinder designs, M8×1, M12×1







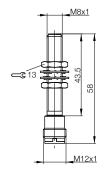


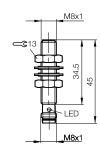


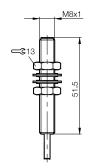
M8×1	M8×1	M8×1	M8×1
Flush	Flush	Flush	Non-flush
Voltage, 0 to 10 V	Voltage, 0 to 10 V	Voltage, 0 to 10 V	Voltage, 0 to 10 V
0.51.5 mm	0.51.5 mm	0.51.5 mm	0.52.5 mm
BAW003R	BAW000M	BAW000T	BAW000W
BAW M08EH-UAD15B-S04G	BAW M08EF-UAC15B-S49G	BAW M08EI-UAD15B-BP03	BAW M08EI-UAD25F-BP03
1530 V DC	1530 V DC	1530 V DC	1530 V DC
250 V AC	250 V AC (💷)	250 V AC (💷)	250 V AC (🗉)
1 mm	1 mm	1 mm	1.5 mm
2 kΩ	2 kΩ	2 kΩ	2 kΩ
yes/yes/yes	yes/yes/yes	yes/yes/yes	yes/yes/yes
No	yes	No	No
-10+70 °C	−10+70 °C	–10+70 °C	-10+60 °C*
±40.0 μm	±40.0 μm	±8.0 μm	±10.0 μm
±30 μm	±30 μm	±30 μm	±60 μm
1 kHz	1 kHz	1 kHz	1 kHz
0.5 ms	0.5 ms	0.5 ms	1 ms
0 µm/K	0 µm/K	–1 μm/K	–1.5 µm/K
IP 67	IP 67	IP 67	IP 67
CE, cULus	CE, cULus	CE, cULus	CE, cULus
Stainless steel	Stainless steel	Stainless steel	Stainless steel
PBT	PBT	PBT	PBT
M12 connector, 3-pin	M8 connector, 3-pin	3 m PUR cable,	3 m PUR cable,
		3×0.14 mm ²	3×0.14 mm ²

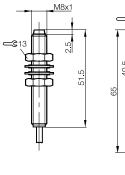


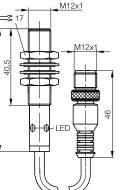
3-pin with 0.2 m PUR cable











Inductive Distance Sensors Features, Output Curve, Evaluating Programmed Switching Points Applications Cylinder Designs Block Designs

## Inductive Distance Sensors Cylinder designs, M12×1







Series		M1
Installation type (observe instrue	ctions in Basic Information chapter)	Flus
Output signal		Cur
Linear range s _l		0.5.
Ordering code		BA
Part number		BAW
Supply voltage U _S		10
Rated insulation voltage L	J _i (protection class)	250
Effective distance se		1.28
Load resistance R _L min.		
Load resistance R _L max.		500
Polarity reversal protected/transport	sition protected/short-circuit protected	yes
Adjustment display (LED)		yes
Ambient temperature T _a		-10
Repeat accuracy R _{BWN}		±6.0
Non-linearity max.		±45
Limit frequency (–3 dB)		500
Response time		0.5
Temperature coefficient, typ	o. in range from +10 to +50 °C	-0.5
Degree of protection as p	er IEC 60529	IP 6
Approvals		CE,
Material	Housing	Bra
	Sensing surface	PBT
Connection		3 m
		3×0

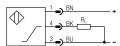
	100
12×1	M12×1
ush	Flush
urrent, 4 to 20 mA	Voltag
52 mm	0.52
AW001H	BAW0
AW M12MG2-ICC20B-BP03	BAW M12
)30 V DC	1530
50 V AC (🗉)	250 V /
25 mm	1.25 m
	2 kΩ
Ω 00	
es/yes/yes	yes/yes
es	yes
10+70 °C	-10+
6.0 µm	±8.0 μι
45 µm	±45 μr
DO Hz	500 Hz
5 ms	0.5 ms
).5 µm/K	-1 µm/
67	IP 67
E, cULus	CE, cU
rass, coated	Brass,
BT	PBT
m PUR cable,	M12 co
×0.34 mm²	3-pin v
	0.2 m l

2×1	
sh	
tage, 0 to 10 V	1
2 mm	(
W001J	
M12MG2-UAC20B-BP00.2-GS04	
30 V DC	
) V AC (🗆)	
5 mm	
Ω	1
/yes/yes	1
	1
)+70 °C	
0 µm	
δμm	
) Hz	;
ms	(
µm/K	
67	
cULus	,
ss, coated	
Г	
2 connector,	I
in with	
m PUR cable	

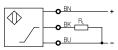
M12×1
Flush
Voltage, 0 to 10 V
0.52 mm
BAW001P
BAW M12MI-UAC20B-S04G
1530 V DC
250 V AC (🗉)
1.3 mm
2 kΩ
yes/yes/yes
yes
−10+70 °C
±8.0 μm
±45 μm
500 Hz
0.5 ms
–0.5 µm/K
IP 67
CE, cULus
Brass, coated
PBT
M12 connector, 3-pin

#### **Connection wiring diagrams**

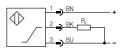
Connector, voltage output



Cable, voltage output

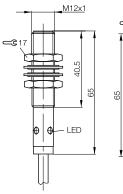


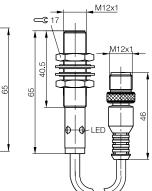
Connector, current output

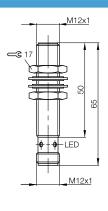


Cable, current output



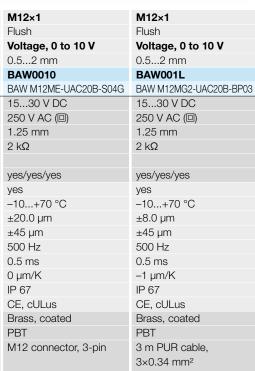






## Inductive Distance Sensors Cylinder designs, M12×1









Current, 0 to 20 mA

BAW M12MG2-IAC20B-BP00.2-GS04

M12×1

0.5...2 mm

BAW0019

10...30 V DC

250 V AC (D)

1.25 mm

yes/yes/yes

-10...+70 °C

±5.0 μm

±45 µm

500 Hz

0.5 ms

IP 67

PBT

-1 µm/K

CE, cULus

3-pin with

Brass, coated

M12 connector,

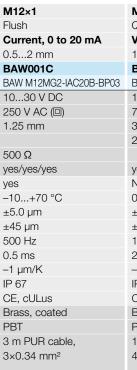
0.2 m PUR cable

500 Ω

yes

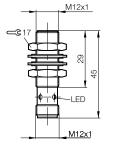
Flush

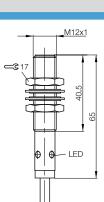


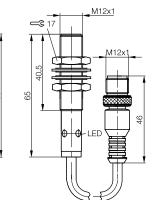


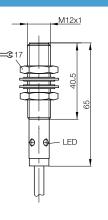


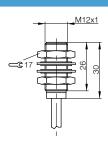
Quasi-flush Voltage, 0 to 10 V 1...5 mm BAW0011 BAW M12ME-UAD50B-BP01 15...30 V DC 75 V DC 3 mm 2 kΩ yes/yes/yes No 0...+60 °C ±10.0 µm ±160 µm 1 kHz 2 ms –1.5 µm/K IP 67 CE, cULus Brass, coated PA 12 1 m PUR cable, 4×0.25 mm²



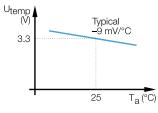








Temperature output



The temperature output (not shortcircuit protected) provides a signal representing a precisely measured temperature change.



Pistance Sensors Features, Output Curve, Evaluating Programmed Switching Points Applications Cylinder Designs Block Designs

## Inductive Distance Sensors Cylinder designs, M12×1





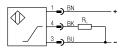


Series		M12×1
Installation type (observe i	nstructions in Basic Information chapter)	Non-flu
Output signal		Voltage
Linear range s _l		14 m
Ordering code		BAW00
Part number		BAW M12N
Supply voltage $U_S$		1530
Rated insulation volta	age U _i (protection class)	250 V A
Effective distance se		2.5 mm
Load resistance R _L n	nin.	2 kΩ
Load resistance R _L n	nax.	
Polarity reversal protected/tra	ansposition protected/short-circuit protected	yes/yes
Adjustment display (L	_ED)	yes
Ambient temperature	e T _a	-10+
Repeat accuracy R _{BV}	WN	±10.0 µ
Non-linearity max.		±90 µm
Limit frequency (-3 d	B)	500 Hz
Response time		1 ms
Temperature coefficien	t, typ. in range from +10 to +50 °C	0 µm/K
Degree of protection	as per IEC 60529	IP 67
Approvals		CE, cUI
Material	Housing	Brass, o
	Sensing surface	PBT
Connection		M12 cc
		3-pin w

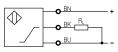
			Sec
	M12×1	M12×1	M12×1
apter)	Non-flush	Non-flush	Non-flush
	Voltage, 0 to 10 V	Voltage, 0 to 10 V	Voltage, 0 to 10 V
	14 mm	14 mm	14 mm
	BAW0014	BAW000Z	BAW0017
	BAW M12MF2-UAC40F-BP00.2-GS04	BAW M12MD-UAC40F-S04G	BAW M12MF2-UAC40F-BP03
	1530 V DC	1530 V DC	1530 V DC
	250 V AC (🗉)	250 V AC (🗉)	250 V AC (🗆)
	2.5 mm		2.5 mm
	2 kΩ	2 kΩ	2 kΩ
ected	yes/yes/yes	yes/yes/yes	yes/yes/yes
	yes	yes	yes
	–10+70 °C	–10+70 °C	–10+70 °C
	±10.0 μm	±10.0 μm	±10.0 μm
	±90 μm	±90 μm	±90 μm
	500 Hz	500 Hz	500 Hz
	1 ms	1 ms	1 ms
O°C	0 µm/K	–2 μm/K	0 µm/K
	IP 67	IP 67	IP 67
	CE, cULus	CE, cULus	CE, cULus
	Brass, coated	Brass, coated	Brass, coated
	PBT	PBT	PBT
	M12 connector,	M12 connector, 3-pin	3 m PUR cable,
	3-pin with		3×0.34 mm ²
	0.2 m PUR cable		

#### **Connection wiring diagrams**

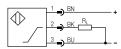
Connector, voltage output



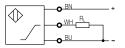
Cable, voltage output

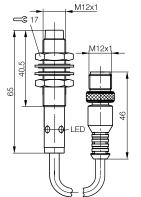


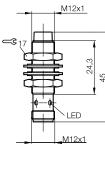
Connector, current output

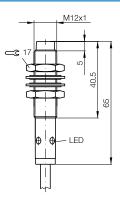


Cable, current output









## Inductive Distance Sensors Cylinder designs, M12×1, M18×1





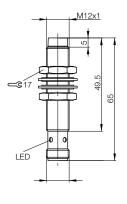


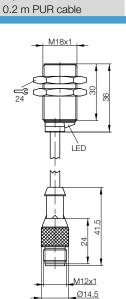


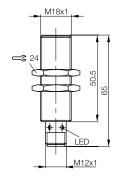
Temperature output

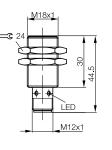


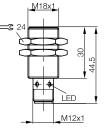
M12×1	M18×1	M18×1	M18×1	M18×1
Non-flush	Flush	Flush	Flush	Flush
Current, 4 to 20 mA	Voltage, 0 to 10 V	Voltage, 0 to 10 V	Voltage, 0 to 10 V	Voltage, 0 to 10 V
14 mm	15 mm	15 mm	15 mm	15 mm
BAW003N	BAW001Z	BAW002K	BAW0026	BAW0025
BAW M12MH1-ICC40F-S04G	BAW M18ME-UAC50B-BP00.2-GS04	BAW M18MI-UAC50B-S04G	BAW M18ME-UAE50B-S04G-K	BAW M18ME-UAC50B-S04G
1030 V DC	1530 V DC	1530 V DC	21.626.4 V DC	1530 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 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
	±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	M12 connector, 3-pin with	M12 connector, 3-pin	M12 connector, 4-pin	M12 connector, 3-pin



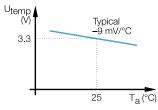








#### Temperature output



The temperature output (not shortcircuit protected) provides a signal representing a precisely measured temperature change.





Inductive Distance Sensors Features, Output Curve, Evaluating Programmed Switching Points Applications **Cylinder Designs** Block Designs

## Inductive Distance Sensors Cylinder designs, M18×1



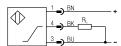




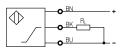
		3 switching points	With Teach-in	
Series		M18×1	M18×1	M18×1
Installation type (observe instru	ctions in Basic Information chapter)	Flush	Flush	Flush
Output signal		Voltage, 0 to 10 V	Voltage, 0 to 10 V	Voltage, 0 to 10 V
Linear range s _l		15 mm	15 mm	15 mm
Ordering code		BAW002M	BAW002U	BAW0022
Part number		BAW M18MI2-UAC50B-BP05-002	BAW M18MM-UAZ50B-BP05-505	BAW M18ME-UAC50B-BP03
Supply voltage $U_S$		1530 V DC	21.626.4 V DC	1530 V DC
Rated insulation voltage	J _i (protection class)	250 V AC (🗉)	250 V AC (🗉)	75 V DC
Effective distance se		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/transpo	sition protected/short-circuit protected	yes/no/yes	yes/no/yes	yes/yes/yes
Adjustment display (LED)		yes	No	yes
Ambient temperature Ta		-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, typ	o. in range from +10 to +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,	5 m PUR cable,	3 m PUR cable,
		7×0.25 mm ²	7×0.25 mm ²	3×0.34 mm ²

#### **Connection wiring diagrams**

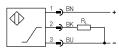
Connector, voltage output



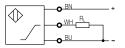
Cable, voltage output

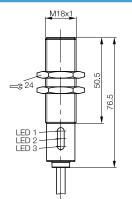


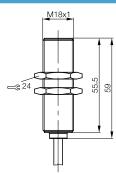
Connector, current output

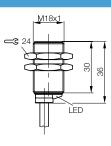


Cable, current output









## Inductive Distance Sensors Cylinder designs, M18×1





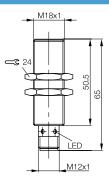


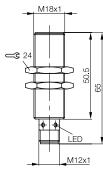


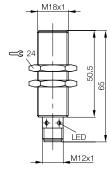


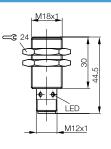


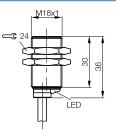
M18×1	M18×1	M18×1	M18×1	M18×1
Flush	Flush	Flush	Flush	Flush
IO-Link, falling with increasing proximity	Current, 0 to 20 mA	Current, 4 to 20 mA	Current, 4 to 20 mA	Current, 4 to 20 mA
15 mm	15 mm	15 mm	15 mm	15 mm
BAW002F	BAW002H	BAW002J	BAW001U	BAW001T
BAW M18MI-BLC50B-S04G	BAW M18MI-IAC50B-S04G	BAW M18MI-ICC50B-S04G	BAW M18ME-ICC50B-S04G	BAW M18ME-ICC50B-BP03
1830 V DC	1030 V DC	1030 V DC	1030 V DC	1530 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,
				3×0.34 mm ²











Inductive Distance Sensors Features, Output Curve, Evaluating Programmed Switching Points Applications **Cvlinder** 

Applications Cylinder Designs Block Designs

## Inductive Distance Sensors Cylinder designs, M18×1, M30×1.5





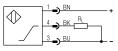


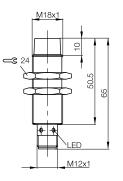
		-		
			Temperature output	
Series		M18×1	M18×1	M30×1.5
Installation type (observe instru	uctions in Basic Information chapter)	Non-flush	Non-flush	Flush
Output signal		Voltage, 0 to 10 V	Voltage, 0 to 10 V	Voltage, 0 to 10 V
Linear range s _l		28 mm	416 mm	210 mm
Ordering code		BAW002C	BAW0029	BAW002W
Part number		BAW M18MG-UAC80F-S04G	BAW M18MG-UAC16F-S04G-K	BAW M30ME-UAC10B-S04G
Supply voltage U _S		1530 V DC	1530 V DC	1530 V DC
Rated insulation voltage	U _i (protection class)	250 V AC (💷)	250 V AC (🗆)	250 V AC (💷)
Effective distance se		5 mm	10 mm	6 mm
Load resistance $R_L$ min.		2 kΩ	2 kΩ	2 kΩ
Polarity reversal protected/transp	osition protected/short-circuit protected	yes/yes/yes	yes/yes/yes	yes/yes
Adjustment display (LED)		yes	yes	yes
Ambient temperature Ta		−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, typ. in range from +10 to +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

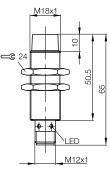
 *  The function is assured over a range of –10 to +70  $^{\circ}\text{C}$ 

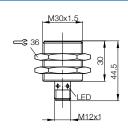
#### **Connection wiring diagram**

Connector, voltage output

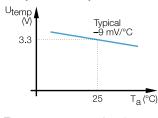








#### Temperature output



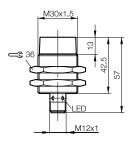
The temperature output (not shortcircuit protected) provides a signal representing a precisely measured temperature change.

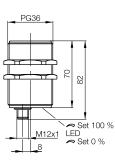






M30×1.5	PG36
Non-flush	Flush
Voltage, 0 to 10 V	Voltage, 0 to 10 V
315 mm	020 mm
BAW002Y	BAW003M
BAW M30ME-UAC15F-S04G	BAW MKZ-471.19-S4
1530 V DC	2030 V DC
250 V AC (🗆)	75 V DC
9 mm	10 mm
2 kΩ	10 kΩ
yes/yes/yes	yes/yes/yes
yes	yes
–10+70 °C	-10+70 °C
±12.0 μm	±5.0 μm
±360 μm	±600 μm
350 Hz	20 Hz
3 ms	
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





Inductive Distance Sensors Features, Output Curve, Evaluating Programmed Switching Points Applications **Cylinder Designs** Block Designs

## Inductive Distance Sensors Cylinder design, 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 technol-
- ogy





Series	M12×1	
Installation type (observe ins	Flush	
Output signal		Voltage, 0 to 10 V
Linear range s _l		0.52 mm
Ordering code		BAW0040
Part number		BAW Z08EO-UAD20B-S04G-H11
Supply voltage U _S		1530 V DC
Rated insulation voltage	U _i (protection class)	75 V DC
Effective distance se		1.25 mm
Load resistance $R_L$ min.		2 kΩ
Polarity reversal protected/tran	sposition protected/short-circuit protected	yes/yes/yes
Adjustment display (LED	)	No
Ambient temperature Ta	–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,	typ. in range from +10 to +50 °C	–1 μm/K
Degree of protection as	IP 68	
Approvals		CE, cULus
Material	Housing	Stainless steel
	Sensing surface	Ceramic
Connection		M12 connector,
	3-nin	







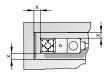


Cariaa		<b>10206</b> D02	10206 mm D02
Series		10×30×6 mm R03	10×30×6 mm R03
, , ,	ve instructions in Basic Information chapter)	Flush	Flush
Output signal		Voltage, 0 to 10 V	Voltage, 0 to 10 V
Linear range s _l		14 mm	14 mm
Ordering code		BAW0030	BAW0031
Part number		BAW R03KC-UAE40B-BP00.3-GS26	BAW R03KC-UAE40B-BP00.3-GS49
Supply voltage U _S		21.626.4 V DC	21.626.4 V DC
Rated insulation voltage	e U _i (protection class)	75 V DC	75 V DC
Effective distance se		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 Ta		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	t, typ. in range from +10 to +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	PA6-FG30	PA6-FG30
	Sensing surface	PA6-FG30	PA6-FG30
Connection		M5 connector, 3-pin with	M8 connector, 3-pin with
		0.3 m PUR cable	0.3 m PUR cable

#### Installation notice for BAW R03...

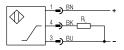
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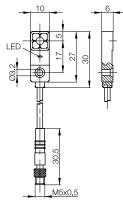
Material	Installation dimensions
Steel	0 mm
Brass	5 mm
Aluminum	5 mm
Stainless steel	5 mm

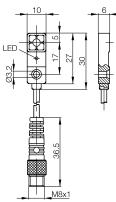


#### Connection wiring diagram

Connector, voltage output







Inductive Distance Sensors Features, Output Curve, Evaluating Programmed Switching Points Applications Cylinder Designs Block Designs



## Inductive Distance Sensors Block designs, 10×30×6 mm, 20×30×8 mm



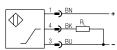


Series		<b>10×30×6 mm</b> B03	<b>20×30×8 mm</b> R06	
· · ·	e instructions in Basic Information chapter)	Flush	Flush	
Output signal		Voltage, 0 to 10 V	Voltage, 0 to 10 V	
Linear range s _l		14 mm	0.52 mm	
Ordering code		BAW0032	BAW0034	
Part number		BAW R03KC-UAE40B-BP03	BAW R06AC-UAF20B-S49G	
Supply voltage U _S		21.626.4 V DC	21.626.4 V DC	
Rated insulation voltage	e U _i (protection class)	75 V DC	75 V DC	
Effective distance se		2.5 mm	1.3 mm	
Load resistance R _L min.		5 kΩ	5 kΩ	
Polarity reversal protected	I/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	, typ. in range from +10 to +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,	M8 connector, 3-pin	
		3×0.14 mm ²		

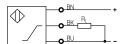
 *  The function is assured over a range of –10 to +70  $^{\circ}\text{C}$ 

#### **Connection wiring diagrams**

Connector, voltage output

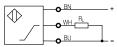


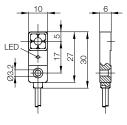
Cable, voltage output

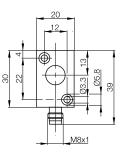


Connector, current output

Cable, current output













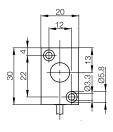


Temperature output

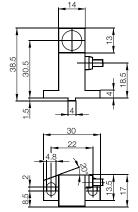


Temperature output 38.5×17 mm Z01

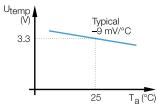
20×30×8 mm R06	14×38.5×17 mm Z01	14×38.5×17 mm Z01	14×38.5×17 mm Z05
Flush			
Voltage, 0 to 10 V	Voltage, 0 to 10 V	IO-Link, falling with increasing proximity	IO-Link, falling with increasing proximity
0.52 mm	15 mm	15 mm	15 mm
BAW0033	BAW003E	BAW003A	BAW003W
BAW R06AC-UAF20B-EP03	BAW Z01AC-UAD50B-DP03-K	BAW Z01AC-BLD50B-DP03	BAW Z05AC-BLD50B-BP00,75-GS04
21.626.4 V DC	1530 V DC	1830 V DC	1830 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 m PUR cable,	3 m PUR cable,	M12 connector, 3-pin
3×0.14 mm ²	4×0.14 mm ²	4×0.14 mm ²	with 0.75 m PUR cable



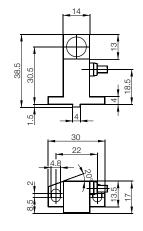




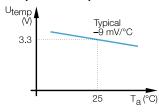
Temperature output



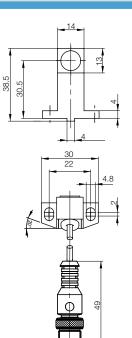
The temperature output (not shortcircuit protected) provides a signal representing a precisely measured temperature change.



Temperature output



The temperature output (not shortcircuit protected) provides a signal representing a precisely measured temperature change.





IO-Link

Inductive Distance Sensors Features, Output Curve, Evaluating Programmed Switching Points Applications Cylinder Designs Block Designs

M12x1

## Inductive Distance Sensors Block designs, 80×80×40 mm

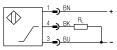


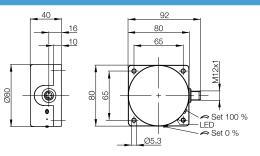


Series	80×80×40 mm Maxisensor	
Installation type (observe instructions in Basic Information chapter)	Non-flush	
Output signal	Voltage, 0 to 10 V	
Linear range s _l	050 mm	
Ordering code	BAW003K	
Part number	BAW MKK-050.19-S4	
Supply voltage U _S	2030 V DC	
Rated insulation voltage U _i (protection class)	75 V DC	
Effective distance se	25 mm	
Load resistance R _L min.	10 kΩ	
Polarity reversal protected/transposition protected/short-circuit protected	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, typ. in range from +10 to +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	

#### Connection wiring diagram

Connector, voltage output





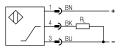


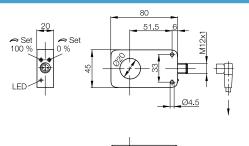


Series		80×45×20 mm analog ring sensor
Installation type	(observe instructions in Basic Information chapter)	
Output signal		Voltage, 0 to 10 V
Linear range s _l		060 mm
Ordering code		BAW003L
Part number		BAW MKV-020.19-S4
Supply voltage U _S		1530 V DC
Rated insulation voltage U _i (protection class)		75 V DC
Effective distance se		30 mm
Load resistance R _{L min.}		2 kΩ
Polarity reversal protected/transposition protected/short-circuit protected		yes/no/yes
Adjustment display (LED)		yes
Ambient temperature T _a		–10+70 °C
Repeat accuracy R _{BWN}		±200 μm
Non-linearity max.		±1500 μm
Response time		1 ms
Temperature coefficient, typ. in range from +10 to +50 °C		100 µm/K
Degree of protection as per IEC 60529		IP 67
Approvals		CE
Material	Housing	PBT
	Sensing surface	PBT
Connection		M12 connector, 3-pin

#### **Connection wiring diagram**

Connector, voltage output







Inductive Distance Sensors Features, Output Curve, Evaluating Programmed Switching Points Applications Cylinder Designs Block Designs

Compact analog- ring sensor with 20 mm opening. Various metallic objects or insertion depths result in measured value changes. Applications include thickness measurement of various screws, rods or wires, position measurement on machines by inserting conical objects into the sensor.

#### Installation conditions

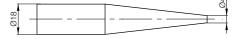


No mutual interference for frontmounting of two sensors.



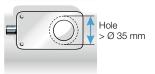
No mutual interference for parallel mounting of two sensors.

#### Testing cone for determining insertion depth (measuring range and linearization)



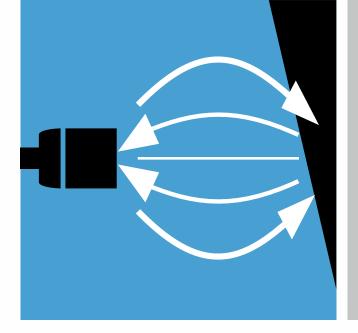


There should be at least 50 mm of spacing when stacking multiple sensors.



h

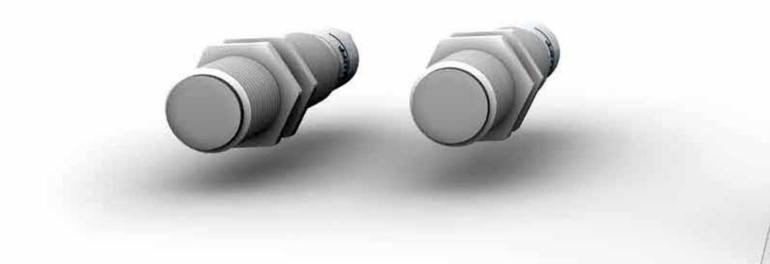
The opening should be at least at least Ø 35 mm for flat installation on metal surfaces.



Capacitive Sensor for Analog Distance Measurement

## Capacitive Sensor for Analog Distance Measurement

Capacitive sensors for analog distance measurement have a measuring range of 0 to 8 mm. Their current output signal is 4 to 20 mA. They are installed flush and are available in an M18 housing.





**Standard sensor** Cylinder Design

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HULLE

## Capacitive Sensor for Analog Distance Measurement

The capacitive analog sensor detects objects without contact, so that the detected object is not worn down mechanically. Object color and surface properties do not influence its measurement results.

#### **Technical details**

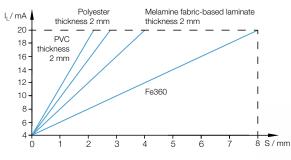
Adjustable measuring range of 0...8 mmFlush installation

- Output signal, current 4...20 mA
- Housing M8

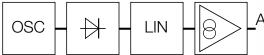
#### Function

The capacitive distance sensor measures objects that are in its response range without contact. As soon as the object enters it, the electrical field changes its sensing surface and, with it, the output current. In this way, material composition, size and distance of the object to the sensing surface can be determined.

The output signal (4...20 mA) can be adapted to the material using the potentiometer (LED lights green). It is evaluated directly on the analog output of the controller.



Added plus: A blinking LED signals to the user a high-impedance load.

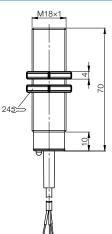








0.			
Size		M18×1	
Installation type		Flush	
Measuring range		08 mm	
Output current		420 mA	
PNP/NPN and	Ordering code	BCW0001	
NO/NC codable	Part number	BCW M18B4M1-ICM80C-DV02	
Supply voltage U _S		1235 V DC	
Rated insulation voltage U _i		75 V DC	
No-load supply current I ₀ max.		< 17 mA	
Polarity reversal protected/transposition protected/short-circuit protected		Yes/Yes, with load monitoring	
Ambient temperature T _a		–10…+55 °C	
Switching frequency f		100 Hz (3 dB limit frequency)	
Supply voltage/output function indicator		Green LED/Red LED	
Degree of protection as per IEC 60529		IP 67	
Material	Housing	Stainless steel	
	Sensing surface	PBT	
Connection		2 m PVC cable, 3×0.25 mm ²	

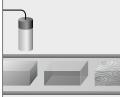




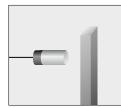
Capacitive Sensor for Analog Distance Mea-surement Cylinder Design

#### Applications

The capacitive analog sensor makes linear evaluation of a position possible for the first time; as soon as an object is located within the sensor's measuring range, a precise output current is produced. The uses shown represent only a fraction of the multifaceted application options provided by the capacitive analog sensor.

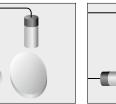


Material selection

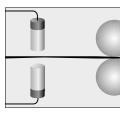


Static/dynamic movement

Measuring nonmetallic coating thicknesses



Registering radial runout



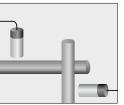
Product thickness monitoring



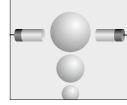
Concentricity and eccentricity



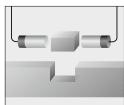
Height measurement



Axial and radial concentricity deviation

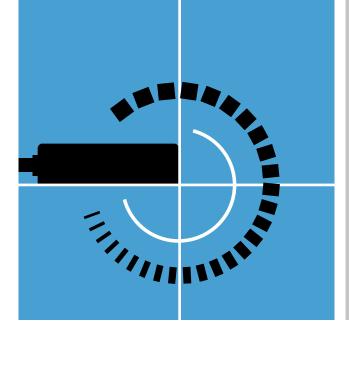


Determining diameters



Monitoring fit





# Inclination Sensors

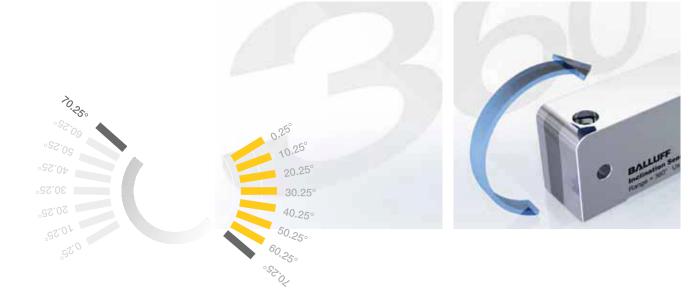




Inclination Sensors BSI Applications Inclination Sensors

396 398





# High precision over 360° – so that nothing gets out of place

- Contactless and absolute measuring principle
- High repeat accuracy and precision
- Extremely low temperature drift

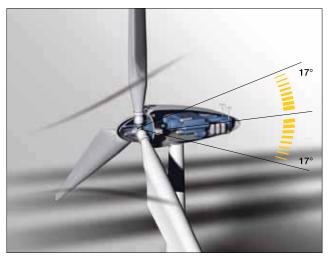
Precise position monitoring and continuous tracking of rotational movement are of great importance in many applications. Balluff inclination sensors BSI measure the deviation on an axis from the horizontal by up to 360°. They can be used down to -40 °C, require little space and have a very robust metal housing.



## Wind energy systems



## Solar-thermal power plants



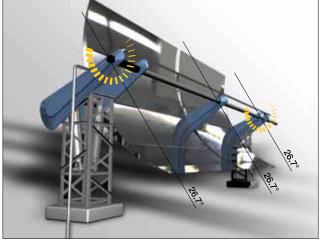
#### Monitoring tower tilt

Constantly changing wind conditions cause abrupt load changes in wind turbines. Particularly during strong gusts of wind, storms or a wind energy system's start-up phase, towers can tilt so much that the overall system lifetime is affected. An inclination sensor can reduce this load on the system. It reliably measures the absolute angle of inclination and ensures that limit values are not exceeded.

Easy to install

■ Temperature range of -40 to +85 °C

Rugged metal housing



#### Positioning parabolic troughs

Parabolic trough systems can provide power continuously for 24 hours a day. During the hot midday period, electricity is produced and a salt storage tank is heated, which sustains the water-steam circuit during the night. The highest possible temperatures have to be present in the solar field for this. These temperatures have to be achieved by optimally aligning the parabolic troughs to the position of the sun. BSI absolute tilt sensors ensure this precise positioning and thus increase the efficiency of the solar energy system.

- Compact, robust metal housing eases installation
- Analog output signal for continuously detecting the position of parabolic troughs, even after power failure
- Precise measurement for accurate positioning: accuracy over a full 360°



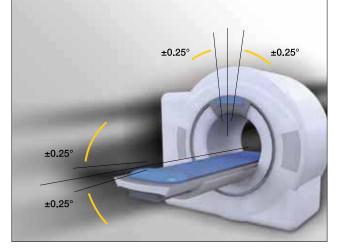
#### The benefits to you

- Compact, robust metal housing in IP 67, which can be easily installed and integrated into a system
- High accuracy of 0.1° for precisely controlling processes
- Extended temperature range of -40 to +85 °C is suitable for outdoor applications



### Medical technology





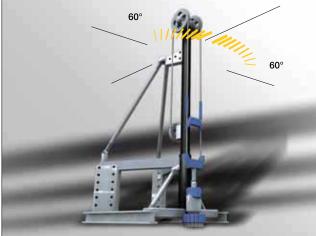
#### Positioning radiation treatment tables

Treatment tables have to be

positioned precisely to make radiation therapy as safe as possible. Capacitive inclination sensors are exceptionally outstanding here. Because their impressive accuracy and their excellent resolution accomplishes this with no ifs, ands or buts. Capacitive inclination sensors thus create the best conditions for best positioning a patient.

- High precision
- Excellent resolution
- Compact, for easy installation even
- in places where space is limited

### Oil and gas extraction



## THE REAL PROPERTY OF

BSI inclination sensors Applications Inclination Sensors

#### Setting up oil pumps over a borehole

Oil pumps have to be placed precisely over the borehole. This is easy to achieve with Balluff BSI inclination sensors, because they are made for rough outdoor environments. Thanks to their analog angle values, they position pumps so precisely that they minimize loads and wear.

- High protection class IP 67 suitable
- for use in rough conditions
- Precise, absolute angle measurement
- Compact housing



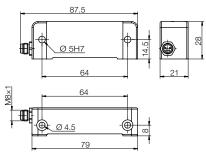


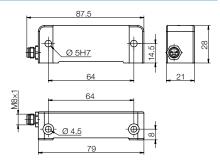




Size			
Interface			
Measuring range	Ordering code		
0360°	Part number		
Measuring range	Ordering code		
±45°	Part number		
Supply voltage $U_{\rm S}$			
Current consumpti	on		
Resolution max.			
Characteristic devia	ation max.		
Temperature drift			
Sampling rate			
Settling time			
Polarity reversal protected/short-circuit protected			
,	•		
Degree of protection as per IEC 60529 Ambient temperature Ta			
Weight			
Housing material			
Calibration, measurement protocol			
Connection			
CONNECTION			

79×28×20 mm	79×28×20 mm
420 mA	Modbus RTU RS-485
BSI0004	BSI0003
BSI R11A0-XB-CXP360-S75G	BSI R11A0-XXR-CXP360-S75G
BSI0002	
BSI R11A0-XB-CXS045-S75G	
1030 V DC	1030 V DC
< 31 mA	< 20 mA
±0.01°	±0.01°
±0.1% (min. 0.1°)	±0.1° at 1040 °C,
	±0.15° in any other temperature range
±0.01 %/10 K	
< 150 ms	< 150 ms
< 1 s	< 1 s
yes/yes	yes/yes
IP 67	IP 67
-40+85 °C	–40+85 °C
Approx. 80 g	Approx. 80 g
Aluminum	Aluminum
Optional	Optional
M8 connector, 4-pin	M8 connector, 4-pin







Suitable connectors:
 (please order separately)

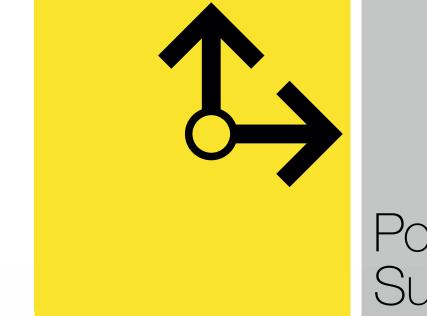
Size	Design	Cable	Length	Ordering code
M8, 4-pin	Straight	PUR, black	5 m	BCC02N6
M8, 4-pin	Angled	PUR, black	5 m	BCC02NJ

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 catalog Industrial Networking and Connectivity.

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BSI inclination sensors Applications Inclination Sensors



# Power Supplies





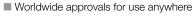
**Power Supplies** 

Standard Units	402
Intelligent Power Supply Units	404

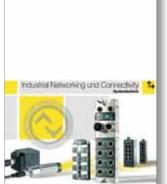
Industrial automation is becoming ever more demanding and the complexity of its tasks is constantly increasing. Efficient operation of equipment and machines demands reliable power sources more than ever. Balluff power supplies are the powerful solution for faultfree system operation.

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







BALLUFF

Learn more about our connectors and cables and our wide range of Industrial Networking and Connectivity products in our brochures or online! Order your catalog online, via telephone or by e-mail.

www.balluff.com



### 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 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.

- Ultra-reliable power supplies for protecting sensitive control electronics
- Protection against unforeseen events integrated overload and overvoltage protection
- Wide selection of models

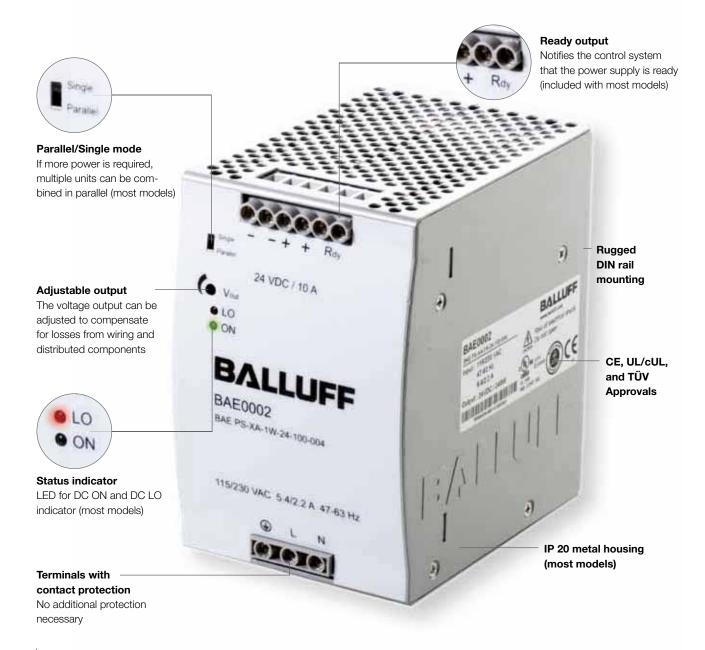
whether stand-alone or an individual combination of various models, these solutions are perfect for your requirements

Clean, precise power supply for especially demanding systems

Load regulation at  $\pm1\%$  for all models, ripple and 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







1 = 100...240 V AC

2 = 115/230 V AC (Auto-Select)

³ = 340...575 V AC

#### Power for controllers and networks

Specially developed for controller units, Balluff power supplies can be perfectly integrated into your control package.

The PS series of ultra-reliable power supply units is available in a wide range of 12, 24, and 48 V DC models with single or 3-phase input. With a bandwidth of 18 W to 960 W, they truly leave nothing to be desired. For even greater power, multiple power supplies are interconnected (parallel switching mode). Do you need a different voltage? Please contact us.





Power Supplies Standard Units Intelligent Power Supply Units



#### Trouble-free installation

Reliable power has never been so simple to install. Starting with the convenient mounting of DIN rails using the integrated Balluff high-performance mounting system. The screw terminals are aligned to enable the integration of an AC input from below and a DC output from above. Connections with contact protection render additional safety equipment superfluous.

### Power Supplies Intelligent devices for demanding industrial automation applications

#### Intelligent power supply units from Balluff

The installation of power supply units with IP 67 protection locally without switching cabinets is becoming more and more popular in industrial automation. Although local power supply units are available, they are generally difficult to access once installed. And to further complicate matters, monitoring the operating status is practically impossible. As a result, operators rely on preventive maintenance concepts to guarantee maximum possible availability. This procedure is reliable, but also expensive, because devices are frequently replaced during the maintenance cycle well before the end of their service life, as there is no alternative system available.

For the first time, intelligent, energy-saving power supply units from Balluff promise to remedy this situation. Their condition is represented using visible indicators.

This novel concept allows detection of the condition of the device at a glance. The device follows dynamic loads and can therefore be operated at a high level of capacity utilization. This makes typical reserves of 30 to 50% superfluous.

The intelligence supports continuous high utilization of the devices. Their operational status is displayed visually via:

- Load level
- Stress level
- Lifetime

Visualization should make the status apparent to the operator in the simplest way possible.

One special feature is that the three-phase intermediate transformer that is usually installed in wind turbines can be omitted. That saves money. A large input voltage range of 380 to 690 V allows the primary switching power supply to be connected directly to the generator voltage on the wind turbine and then operated normally.



### General key information about the IP 20 and IP 67 power supply units

- High 92% efficiency
- Minimal heat loss and generation
- Increased system efficiency
- 3-stage status indication
- Power boost (150% for 4 sec.)
- Extremely compact
- More efficient utilization of the power supply units
- Planned reserves are not wasted
- Prevention of failures caused by continuous overload
- Scheduled maintenance and repairs no longer necessary
- Higher productivity
- PSU only replaced at the end of its service life
- Lifetime of 15 years (at 80% load and 40°C), MTBF > 800,000 h
- Enclosed housing guarantees high degree of resistance to vibration and shock loads
- With IP 20, also with floating alarm contacts

Ideal areas of application for these intelligent power supply units include local installations in the automobile industry, machine construction, wind turbines, etc.









#### Utilization level:



Load level ■ Reversible in short term

Load level indicates the current load on the device. The display indicates the load without any delay.

#### Heartbeat:



Stress level Reversible in medium term

Stress level indicates the physical and thermal loads. Changing the load has an effect on device wear.

#### Wear indicator:



Lifetime ■ Irreversible in long term

Lifetime shows the remaining service life of the device, based on the total of all loads.

All indicators are multicolored—green, yellow, or red—and show the status of the device.





Degree of prote	ction 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			100240 V AC	100240 V AC
			Single phase	Single phase
5 A/120 W	Isolated output	Ordering code	BAEOOEK	<b>.</b>
Single phase	(4-pin), SELV	Part number	BAE PS-XA-1W-24-050-013	
10 A/240 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
Single phase	(4-pin), SELV	Part number		BAE PS-XA-1W-24-038-607
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	7/8", 4-pin (female)
			Floating alarm contacts	Suitable for Ethernet/IP,
			for DC alarm and lifetime	DeviceNet
				7/8", 5-pin (socket)
				Suitable for CC-Link,
				Profinet, Profibus
Ambient temperature			-25+70 °C	-25+70 °C
Storage temper	ature		-40+80 °C	-40+80 °C
Fastener			DIN rail mounting	Panel, wall and
				field mounting
Housing materia	al		Metal, semi-potted	Metal, fully potted
Service life (at 8	0% load and 40 °C)		15 years	15 years
Warranty			2 years	2 years



Power Supplies Standard units Intelligent power supply units

SELV = Safety Extra Low Voltage

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3AE PS-XA-1W-24-038-003	BAE003J	403	BAW MKK-050.19-S4	BAW003K	388
3AE PS-XA-1W-24-038-601	BAE00EN	405	BAW MKV-020.19-S4	BAW003L	389
3AE PS-XA-1W-24-038-602	BAE00EP	405	BAW MKZ-471.19-S4	BAW003M	383
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3AE PS-XA-1W-24-038-607	BAE00FW	405	BAW R03KC-UAE40B-BP00.3-GS49	BAW0031	385
3AE PS-XA-1W-24-050-003	BAE0006	403	BAW R03KC-UAE40B-BP03	BAW0032	386
3AE PS-XA-1W-24-050-013	BAE00EK	405	BAW R06AC-UAF20B-EP03	BAW0033	387
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BAE PS-XA-1W-24-200-005	BAE0003	403	BCC M314-0000-10-014-PS0434-020	BCC02N5	262
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BAE PS-XA-3Y-24-100-006	BAE0008	403	BCC M314-0000-10-014-PS0434-100	BCC02N7	262
3AE PS-XA-3Y-24-200-007	BAE0009	403	BCC M324-0000-10-014-PS0434-020	BCC02NH	262
3AE PS-XA-3Y-24-400-010	BAE003R	403	BCC M324-0000-10-014-PS0434-050	BCC02NJ	262
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BAW M12MF2-UAC40F-BP03	BAW0017	378	BCC M415-M412-3B-329-PS72N1-100	BCC0A16	258
3AW M12MG2-IAC20B-BP00.2-GS04	BAW0019	377	BCC M415-M412-3B-329-PS72N1-150	BCC0A17	258
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BAW M18ME-UAC50B-BP03	BAW0022	380	BCC M478-0000-1A-000-43X834-000	BCC04MC	261
BAW M18ME-UAC50B-S04G	BAW0025	379	BCC M484-0000-2D-000-51X475-000	BCC03Y0	263
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<b>Commissioning</b> Order expert knowledge. And benefit from a quick start of production.	<ul> <li>Real-world examples:</li> <li>Setting up an optical checkpoint with the vision sensor BVS</li> <li>Consulting and support during the programming of RFID systems BIS</li> <li>Installation and commissioning of a color detection application with the BFS color sensor</li> </ul>
Fully customized products Specific versions according to your requirements: from preas- sembly to engineering services	<ul> <li>Real-world examples:</li> <li>Extending the housing of a BHS high-pressure resistant inductive sensor</li> <li>Extra threads for the housing cover of a BTL micropulse transducer</li> <li>Customer-specific holder for an RFID data carrier</li> <li>Adaptation of the characteristics for BAW analog sensors</li> </ul>
<b>Training</b> Make use of well-founded manufacturer knowledge. And benefit from application security.	<ul> <li>Professional sensor use: Select operating principles, install sensors professionally and ensure the reliable operation of your application.</li> <li>Position and distance measurement: This is how you make precise and wear-free measurements.</li> <li>RFID: The right data at the right time at the right place.</li> <li>Vision sensor: Using an image processing sensor, ensure manufacturing quality in three steps.</li> <li>Vision sensor identification: Reliably identify data matrix codes with an image-processing sensor.</li> <li>Industrial networking with IO-Link: Manage signals intelligently and cost-effectively.</li> </ul>
The right solutions	
High application	security S OP
Signific	ant cost reduction



## SENSOR SOLUTIONS AND SYSTEMS

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Industrial Identification



Object Detection



Linear Position Sensing and Measurement



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Condition Monitoring and Fluid Sensors

Accessories

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