



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. The global player has a strong presence with 61 sales branches and representative offices as well as nine production sites on all continents. The corporate headquarters in Neuhausen a.d.F. is located near Stuttgart.

Balluff products represent the entire technological spectrum with varied operating principles, including high-quality sensors and systems for position and 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 accessories.

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.

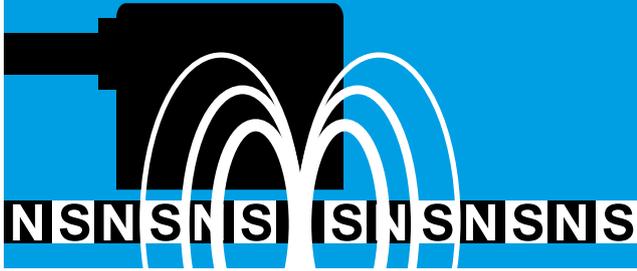
Balluff stands for application-specific customer solutions, comprehensive services, individual consultation and prompt service. Our staff of more than 3000 employees is committed to providing outstanding service worldwide.

Benefit from comprehensive sensor expertise from a single source. Get exactly the solutions you need.



Magnetically Coded Position and Angle Measurement System BML	4
Micropulse Transducers BTL	12
Inductive Positioning System BIP	26
Photoelectric Distance Sensors BOD	30
Inductive Distance Sensors BAW	36
Inclination Sensors BSI	44
Alphanumeric Index	50





Magnetically Coded Position and Angle Measurement System



Magnetically Coded Position and Angle Measurement System Contents

Series S1H, absolute

6

Series S2C, incremental

8

Motor Feedback Evaluation Kit

10



A large range of position and angle measurement tasks or the dynamic, accurate detection of speed 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. Moreover, the contactless technology enables extremely high measurement speeds.

S1H Series, Absolute

SSI interface, BiSS-C interface

Absolute, direct-measuring system

Inaccuracy and tolerances in the drive train negatively affect the production quality. Direct measuring systems solve this problem. They determine the current position directly on the slide or the load support. The magnetically encoded position and angle measurement system BML-S1H measures highly dynamic applications exactly and absolutely. It works contactlessly and wear-free. External factors such as dirt and temperature do not affect it. This ensures a long service life and high availability. This reduces the costs of machines and systems as a whole.

Benefits

- Absolute measuring system for short strokes up to 1024 mm
- BiSS-C or SSI interface
- High system accuracy and resolution
- Mounted parallel or perpendicular to tape
- Tiny design in a robust metal housing



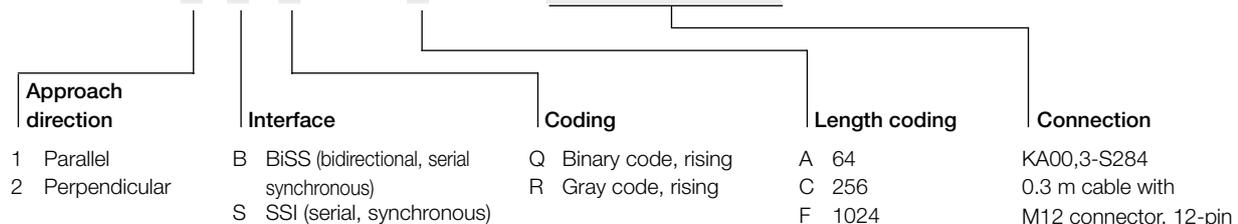
Series
Output signal
Data format
Resolution
Repeat accuracy
Overall system accuracy
Supply voltage
Current consumption at 5 V supply voltage
Max. read distance sensor/tape
Max. measuring length
Pole pitch, analog track
Max. travel speed
Sampling rate
Operating temperature
Storage temperature
Housing material
Degree of protection

All specifications in conjunction with tape BML-M02-A33...

More versions of the BML-S1H product family can be found in the full-line catalog for Linear Position Sensing and Measurement, page 25

Ordering example: sensor head

BML-S1H - 6 C-M3 A-D0-KA00.3-S284



S1H Series, Absolute SSI interface, BiSS-C interface

Magnetically Coded Position and Angle Measurement System
Series SH1
 Series S2C
 Motor Feedback Evaluation Kit



BML-S1H...

Absolute: SSI or BiSS C, additional analog signal sin/cos 1 V_{SSW}

20-bit

< 1 μm (= 1000/1024 μm per LSB)

BML-S1H_-6_C-M3_A-DO-KA00,3-S284

±1 increment

±7 μm

5 V ±5%

< 50 mA + Controller current consumption, at 120 Ω load resistance

0.35 mm (without cover strip)

1024 mm

1 mm

5 m/s (absolute)

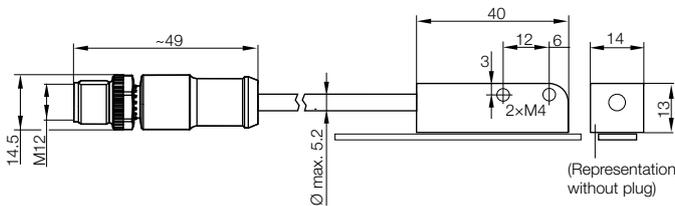
f_{STANDARD} = 50 kHz (SSI), 10 MHz (BiSS C)

-20...+80 °C

-30...+85 °C

Aluminum

IP67



Series	Magnetic Tape
Output signal	for BML-S1H with 1024 mm measuring length
	BML04YM
Length	1024 mm
Measuring length	997 mm
Magnetic tape material	Rubber ferrite, stainless steel substrate
Cover strip material	Stainless steel

More versions of the magnetic tape material can be found in the full-line catalog for Linear Position Sensing and Measurement, page 27

More accessories can be found in the full-line catalog Linear Position Sensing and Measurement or online at www.balluff.com

Digital display,	
CAM controller	page 29
Sensor guide	page 67
Mounting Accessories	page 67
Connection Cables	page 28

S2C Series, Incremental Basic and Premium

For large tolerances

The long read distance of the new incremental measurement system BML S2C makes it ideal for installation situations where large tolerances can occur.

Application

- Applications with long measurement sections, such as determining speed and position in warehouse and conveyor technology
- Determining angles of rotation

Benefits

- Contactless, wear-free measuring principle
- Compensation for height tolerances in the measurement section up to 5 mm
- Rugged plastic housing with compact design
- Status LED and error function
- Easy installation and maintenance resulting in lower costs
- High system availability
- Long service life



Series

Output signal incremental

Resolution

Repeat accuracy

Output voltage (A/B/Z)

Overall system accuracy

Supply voltage

Current consumption

Max. read distance sensor/tape

Max. travel speed

Operating temperature

Housing material

Degree of protection

Ordering example for sensor head:

B M L - S 2 C 0 - Q 5 3 G - M 6 2 4 - K 0 - K A 0 5

Interface/supply voltage/output signal

Q51 digital square-wave signals, 10...30 V DC, differential voltage signal (RS422)
 Q53 digital square-wave signals, 10...30 V DC, level same as operating voltage HTL
 Q61 digital square-wave signals, 5 V DC, differential voltage signal (RS422)

Resolution (edge separation A/B)

G 10 μm K 50 μm L 100 μm
 N 500 μm T 2500 μm

Pole width

6 10 mm

Reference signal

0 no signal
 2 pole-periodic signal

Error signal

0 no error signal
 4 Error signal (not for BML-...-KF..)

Min. edge separation /max. travel speed

K 10 μm L 8 μm M 10 μm
 N 16 μm P 24 μm R 100 μm
 S 1 ms T 2 ms

Connection

KA05 5 m cable, PUR, 12-conductor, cable lengths 2, 5, 10, 15, 20 m
 KF05 5 m cable, PUR, 8-conductor, cable lengths 2, 5, 10, 15, 20 m
 KA00,3-S284 0.3 m cable with M12 connector, 12-pin

S2C Series, Incremental Basic and Premium

Magnetically Coded Position and Angle Measurement System
Series SH1
Series S2C
Motor Feedback Evaluation Kit



BML-S2C Basic

Digital RS422 or HTL
10 μm, 50 μm, 100 μm, 500 μm, 2500 μm
±1 increment

BML-S2C0-Q _ _ -M600- _ 0- _ _ _

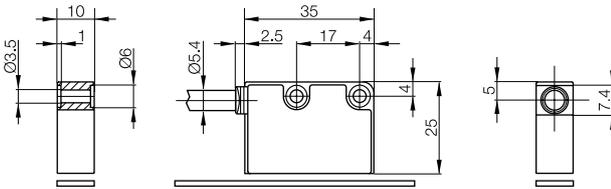
RS422 as per DIN 66259 or as supply voltage 10...30 V
±400 μm
10...30 V or 5 V ±5%
< 100 mA (operating voltage 5 V)
< 80 mA (operating voltage 10...30 V)
1...5 mm (without cover strip)
10 m/s
-20...+80 °C
PBT
IP67

BML-S2C Premium with LED and error function

Digital RS422 or HTL
10 μm, 50 μm, 100 μm, 500 μm, 2500 μm
±1 increment

BML-S2C0-Q _ _ -M624- _ 0- _ _ _

RS422 as per DIN 66259 or as supply voltage 10...30 V
±400 μm
10...30 V or 5 V ±5%
< 100 mA (operating voltage 5 V)
< 80 mA (operating voltage 10...30 V)
1...5 mm (without cover strip)
10 m/s
-20...+80 °C
PBT
IP67



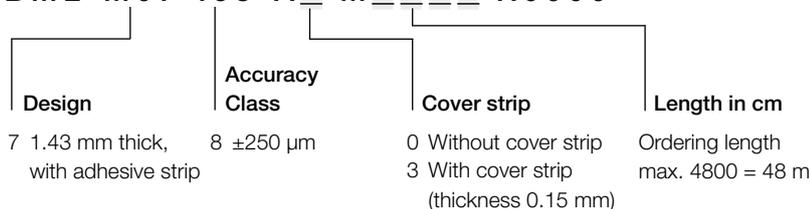
Series	Magnetic Tape
Output signal	For BML-S2C
	BML-M07-I68-A _ -M _ _ _ _ _
Length	max. 48 m
Magnetic tape material	Rubber - ferrite
Cover strip and tape carrier material	Stainless steel

More accessories can be found in the full-line catalog **Linear Position Sensing and Measurement** or online at www.balluff.com

Digital display,	page 29
CAM controller	page 29
Sensor guide	page 67
Mounting Accessories	page 67
Connection Cables	page 28

Ordering example: magnetic tape

BML - M07 - I68 - A _ - M _ _ _ - R0000



Motor Feedback Evaluation Kit

BiSS-C/SSI-USB-Adapter

Absolute and innovative – the retrofittable, non-contact magnetic feedback system for small motors and drives

This system offers:

- High system accuracy
- Energy savings through high signal quality and minimal motor loss
- Absolute position sensing for single-turn applications
- For use in high-dynamic applications (high resolution and rotational speed)
- Integrates perfectly

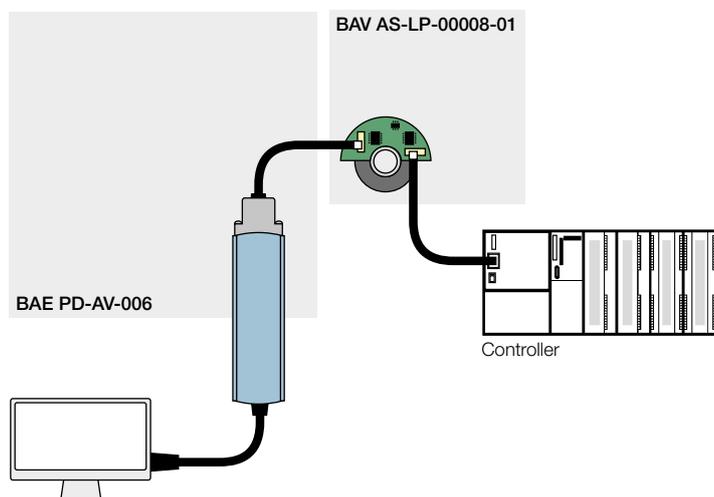
Properties

- Magnetically coded absolute disk (nonius)
- Absolute SSI or BiSS interface
- Incremental sin/cos or ABZ interface
- Resolution up to 17-bit
- Rotational speed 12,000 rpm
- System accuracy < 0.2°

The Evaluation Kit is an all-in-one product offering various interface choices for test environments. Electronics and geometry composed of PCBA can be modified for series production.

The following interfaces are available:

- BiSS-C
- SSI
- Sin/cos
- ABZ

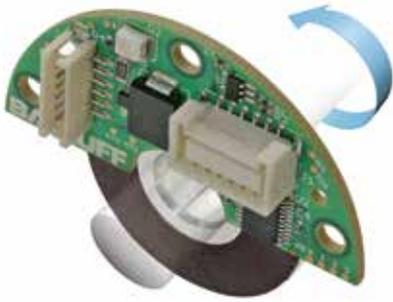


Series

Output signal absolute
Output signal incremental
Data format
Max. measuring length
Resolution
Repeat accuracy
Overall system accuracy
Supply voltage
Current consumption
Read distance
Rotational speed max.
Operating temperature
Storage temperature
Scope of delivery

Motor Feedback Evaluation Kit

BiSS-C/SSI-USB-Adapter



Magnetically Coded Position and Angle Measurement System
Series SH1
Series S2C
Motor Feedback Evaluation Kit

Motor feedback system

BAV000M

SSI or BiSS-C

Analog sin/cos 1 V_{pp}, digital RS422

19 bits

1 rotation (single-turn)

17-bit (approx. 0.003°)

±1 increment

< ±0.2° absolute

5 V ±5%

90 mA

0.1...0.5 mm

12000 rpm

-40...+80 °C

-40...+85 °C

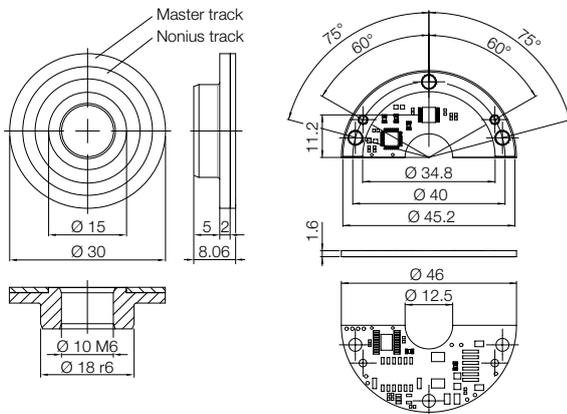
- Absolute disk
- Electronic processor unit
- Cable set for electronics and controller

BiSS-C/SSI-USB-Adapter

BAE00MW

- PC adapter
- Cable set for adapter and PC

The associated software for the BiSS-C/SSI-USB adapter can be downloaded from the Internet at www.balluff.com/downloads-bml



Configuration software

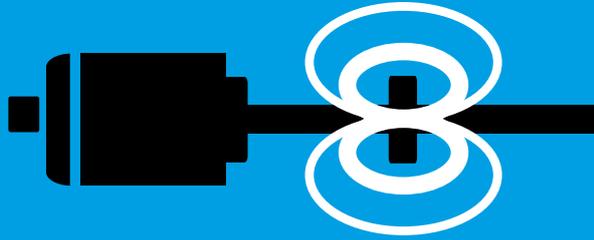


Accessories:

The magnetically coded disc can be ordered separately.

BML04HN





Micropulse Transducers



Micropulse Transducers

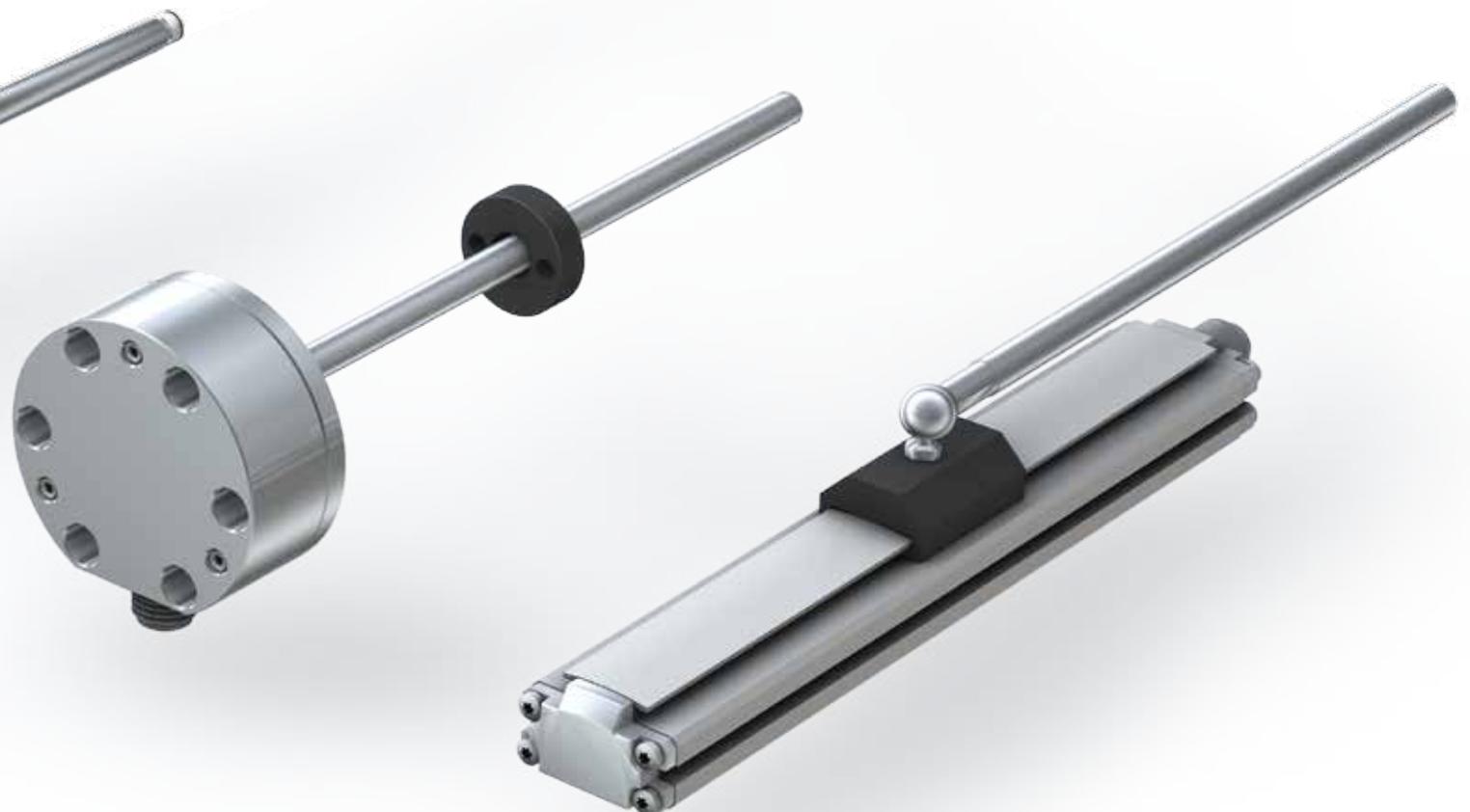
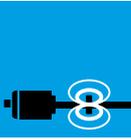
Contents

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. Magnetostrictive linear displacement transducers achieve IP67 to IP69K protection without cumbersome, expensive and fault-prone sealing concepts. Their high resistance to shock and vibration makes them ideal for challenging industrial applications in heavy machinery and systems building. 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.

Profile P	14
Rod B and Z	18
Rod NEX	20
Rod DEX	22
Rod J-DEXC	24



Profile P

DPI/IP and SSI

Reliable signal transmission with DPI/IP pulse interface

Transducers in the profile-style housing are non-contact, absolute measurement systems for precise detection of one or more stroke paths. The digital DPI/IP pulse interface is compatible with controllers from most manufacturers and ensures reliable signal transmission.

These transducers feature rugged construction with a high protection rating, simple installation and a wear-free, highly precise measuring principle. The current axis positions are marked by the position encoder magnets through the wall of the aluminum profile. They tolerate a vertical and lateral offset of up to 15 mm.

In presses and stamping machines the position measurement system simultaneously and reliably measures the axis position of load and molding stroke movement.

Can be used in closed loops with SSI interface

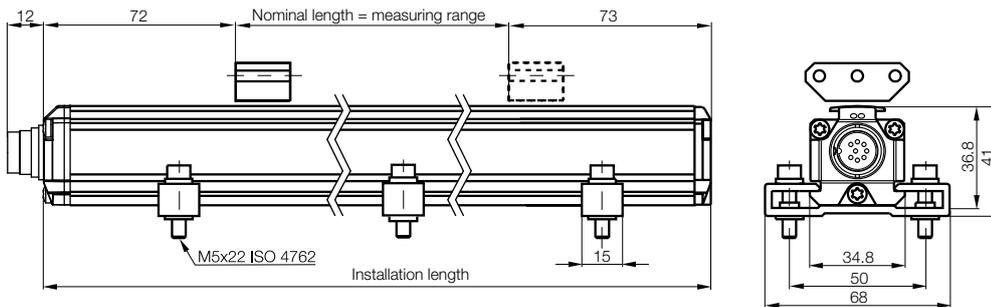
The synchronized SSI interface and precise position measurement make the transducer system ideal for use in demanding applications.

Data acquisition in the transducer is synchronized with the external clock of the controller. This allows the controller to perform optimal speed calculations.

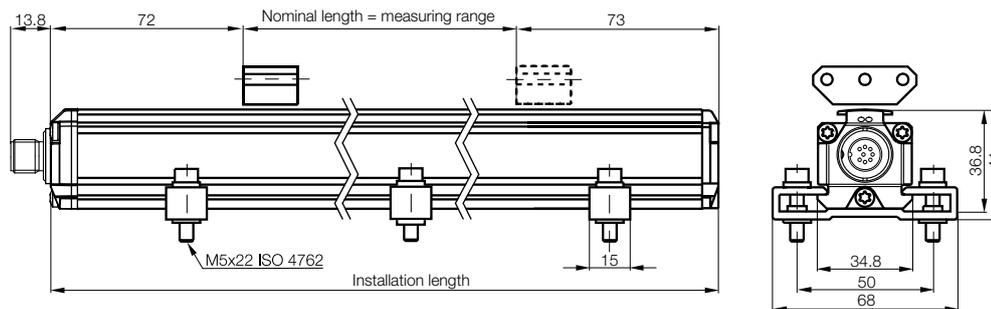
Benefits

- Highly accurate machine positioning with synchronous data transmission and 1 μm resolution
- Fast and dynamic value acquisition with up to 4 kHz update frequency
- Stroke lengths up to 7620 mm
- Insensitive to contamination
- Time-saving installation and startup

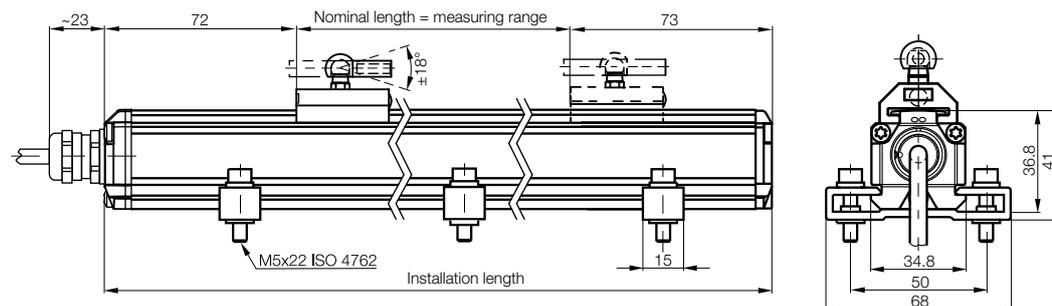
Transducer with floating position encoder and S32 connection



Transducer with floating position encoder and S115 connection



Transducer with captive encoder and KA cable outlet



Profile P DPI/IP and SSI



Micropulse transducers
Profile P
DPI/IP and SSI
Profinet and EtherCAT
Rod B and Z
Rod NEX
Rod DEX
Rod J-DEXC

Series	Profile P BTL7	Profile P BTL7
Interface	DPI/IP	SSI
	BTL7-P511-M - -P- -	BTL7-S5 -M -P- -
Standard nominal lengths	50...7620 mm	50...7620 mm
Resolution	1 µm	1 µm
Repeat accuracy	≤ ±5 µm, (typ. ±2.5 µm)	≤ ±5 µm
Linearity deviation	Nominal length ≤ 500 mm = ±50 µm Nominal length > 500 to ≤ 5500 mm = ±0.01 % FS Nominal length > 5500 mm = ±0.02 % FS	≤ ±30 µm ≤ 10 µm resolution Nominal length 50...5500 mm, ≤ ±2 LSB > 10 µm resolution Nominal length 50...5500 mm, ±0.02 % Nominal length 5501...7620 mm
Max. sampling frequency	4 kHz	4 kHz
Temperature coefficient	≤ 15 ppm/K	≤ 15 ppm/K
Max. number of position encoders	16	2
Supply voltage	10...30 V DC	10...30 V DC
Polarity reversal protected/	Yes/Yes	Yes/Yes
Overvoltage protection		
Ambient temperature	-40...+85 °C	-40...+85 °C
Degree of protection	IP67	IP67
Shock load	150 g	150 g
Vibration	20 g	20 g
Housing material	Aluminum	Aluminum
Approvals	CE, UL-listed	CE, UL-listed
Connection	Connector/cable	Connector/cable

Ordering example: DPI/IP

BTL7-P511-M - -P- -

Standard
Nominal length (mm)

0050...7620 mm
in 1 mm increments

Connection

S32 M16 connector, 8-pin

S115 M12 connector, 8-pin

S135 M16 connector, 6-pin

KA05 PUR cable 5 m

Ordering example: SSI

BTL7-S5 -M -P- -

Data format

24 bits	25 bits	26 bits
0 Binary, in-cremting	6 Binary, in-cremting	A Binary, in-cremting
1 Gray incre-menting	7 Gray incre-menting	B Gray incre-menting
2 Binary, de-cremting	8 Binary, de-cremting	C Binary, de-cremting
3 Gray, de-cremting	9 Gray, de-cremting	D Gray, de-cremting

Resolution

1	1 µm
2	5 µm
3	10 µm
4	20 µm
5	40 µm
6	100 µm
7	2 µm
8	50 µm
9	0.5 µm

Synchronous or asyn-chronous operation

B	Synchronous operation
without B	Asynchronous operation

Standard
Nominal length (mm)

0050...7620 mm
in 1 mm increments

Connection

S32 M16 connector, 8-pin

S115 M12 connector, 8-pin

S147 M16 connector, 7-pin

KA05 PUR cable 5 m

Profile P

Profinet and EtherCAT

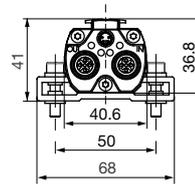
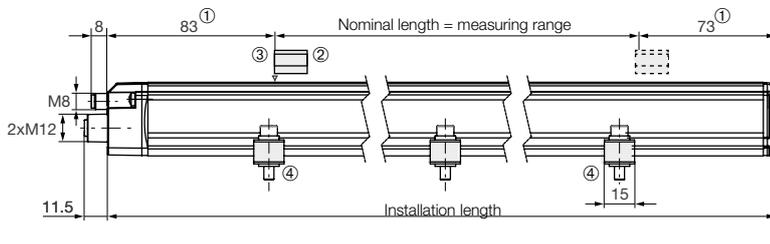
Data transmission in real-time

Micropulse transducers are now available with your choice of Profinet or EtherCAT Ethernet interfaces. This provides multiple advantages in machine building. For example, the integration into the controller and the replacement of parameters through the defined protocols is easy and time-saving. Measurement data are transmitted in the process synchronously in real time. This allows the system to be controlled faster and more accurately, increasing machine output and manufacturing quality. The simple plug-and-play design makes it quick and easy to replace a system.

Benefits

- Fast, accurate and absolute position and speed measurement
- Non-contact and wear-free
- Insensitive to contamination
- Shock and vibration-resistant
- Fast and easy commissioning and communication
- Synchronous position measurement

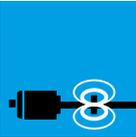
Transducer with plug connection C003 (Profinet, EtherCAT)



- ① Non-usable area
- ② Not included in the scope of delivery
- ③ The notch on the top of the profile indicates the beginning of the measuring area
- ④ Mounting clamp with insulating bushings and cheese-head screws ISO 4762 M5 x 22, max. tightening torque 2 Nm

Profile P

Profinet and EtherCAT



Micropulse transducers
Profile P
DPI/IP and SSI
Profinet and EtherCAT
Rod B and Z
Rod NEX
Rod DEX
Rod J-DEXC

Series	Profile P BTL7	Profile P BTL7
Interface	Profinet IRT	EtherCAT
Special properties	Synchronous mode IRT, flexible Magnet-Mode, configurable	Synchronous mode DC, flexible Magnet-Mode, configurable
	BTL7-V50T-M____-P-C003	BTL7-V50E-M____-P-C003
Standard nominal lengths	50...7620 mm	50...7620 mm
Resolution	1 µm	1 µm
Repeat accuracy	≤ ±5 µm	≤ ±5 µm
Linearity deviation	Nominal length ≤ 5500 mm ±30 µm Nominal length > 5500 mm ±0.02 % FS	Nominal length ≤ 5500 mm ±30 µm Nominal length > 5500 mm ±0.02 % FS
Max. sampling frequency	780 Hz	1.1 kHz
Temperature coefficient	≤ 18 ppm/K	≤ 18 ppm/K
Max. number of position encoders	16	16
Supply voltage	10...30 V DC	10...30 V DC
Polarity reversal protected/	Yes/Yes	Yes/Yes
Overvoltage protection		
Ambient temperature	-40...+85 °C	-40...+85 °C
Degree of protection	IP67	IP67
Shock load	150 g	150 g
Vibration	20 g	20 g
Housing material	Aluminum	Aluminum
Approvals	CE, UL-listed	CE, UL-listed
Connection	3 × connector	3 × connector

Ordering example: Profinet IRT and EtherCAT

BTL7-V50__-M____-P-C003

Interface

T Profinet IRT
E EtherCAT

**Standard
Nominal length [mm]**

0050...7620 mm
in 1 mm increments

Rod B and Z

Profinet and EtherCAT

For hydraulic drives

The rod-style Micropulse transducers are used primarily in hydraulic drives. When installed in the pressure section of the hydraulic cylinder, the displacement sensor requires the same pressure rating as the actual hydraulic cylinder. In practice, the sensor must be able to withstand pressures up to 1000 bar.

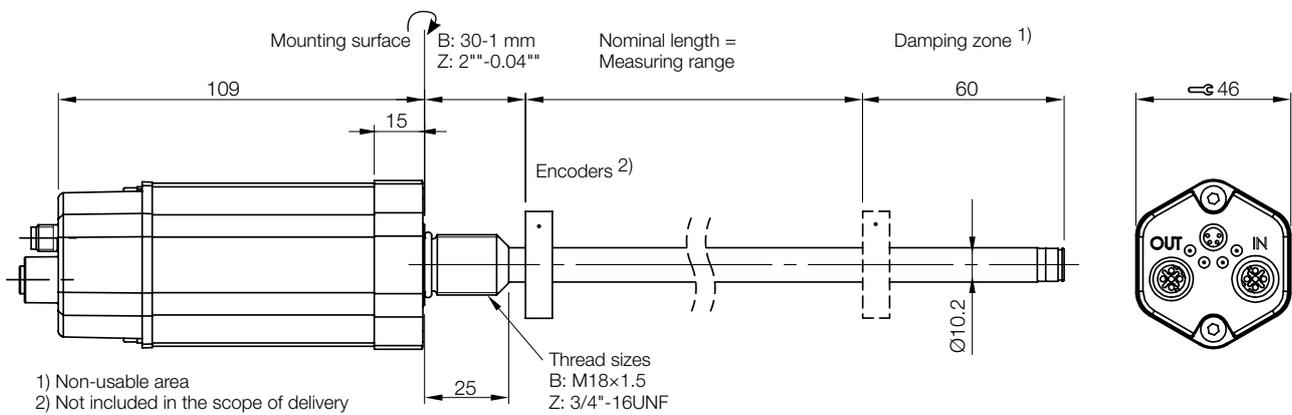
The electronics are integrated in an aluminum or stainless steel housing and the waveguide in a pressure-resistant tube made from nonmagnetic stainless steel that is sealed off at the front end with a welded plug. An O-ring seal in the flange at the opposite end seals off the high-pressure section. An encoder ring with magnets slides over the tube or rod with internal waveguide to mark the position prior to detection.

Features

- The universal standard series
- Measuring lengths up to 7620 mm
- Multiple paths – one system which measures position in many paths
- Programmable output signals – measuring range, inverting, configuring, documenting
- Synchronous position and speed measurement

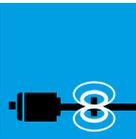
Benefits

- Flexible installation with various thread types
- Long service life thanks to wear-free and non-contacting measuring method
- Expanded measuring possibilities with multi-magnet technology



Rod B and Z

Profinet and EtherCAT

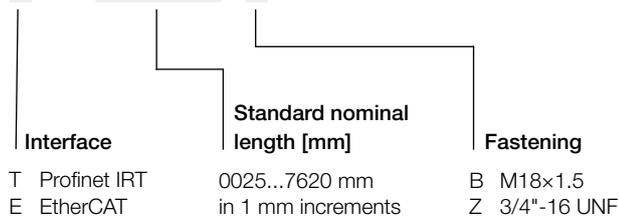


Micropulse transducers
Profile P
Rod B and Z
Rod NEX
Rod DEX
Rod J-DEXC

Series	Rod B and Z BTL7	Rod B and Z BTL7
Interface	Profinet IRT	EtherCAT
Special properties	Synchronous mode IRT, flexible Magnet-Mode, configurable	Synchronous mode DC, flexible Magnet-Mode, configurable
	BTL7-V50T-M_ _ _ _ -C003	BTL7-V50E-M_ _ _ _ -C003
Standard nominal lengths	25...7620 mm	25...7620 mm
Resolution	1 µm	1 µm
Repeat accuracy	≤ ±5 µm	≤ ±5 µm
Linearity deviation	Nominal length ≤ 5500 mm ±30 µm Nominal length > 5500 mm ±0.02 % FS	Nominal length ≤ 5500 mm ±30 µm Nominal length > 5500 mm ±0.02 % FS
Max. sampling frequency	780 Hz	1.1 kHz
Temperature coefficient	≤ 18 ppm/K	≤ 18 ppm/K
Max. number of position encoders	16	16
Supply voltage	10...30 V DC	10...30 V DC
Reverse polarity/overvoltage protection	Yes/Yes	Yes/Yes
Ambient temperature	-40...+85 °C	-40...+85 °C
Degree of protection	IP67	IP67
Shock load	150 g	150 g
Vibration	20 g	20 g
Housing material	Aluminum, stainless steel	Aluminum, stainless steel
Approvals	CE, UL-listed	CE, UL-listed
Connection	3 × connector	3 × connector

Ordering example:

BTL7-V50 - M - - - - - C003



Rod NEX

SSI and analog

For ATEX applications

The transducer marked II 3 G Ex nA IIC T4 X and II 2 D Ex tb IIC T135 °C X IP6x meets the requirements for electrical equipment in explosion hazard areas per the following standards:

- EN 60079-0: General requirements
- EN 60079-15: Ignition class "n"
- EN 60079-31: Ignition class "t"

In addition to the ATEX requirements the transducer was certified under IECEx EPS 13.0004 X.

Ignition class "na" and "tb"

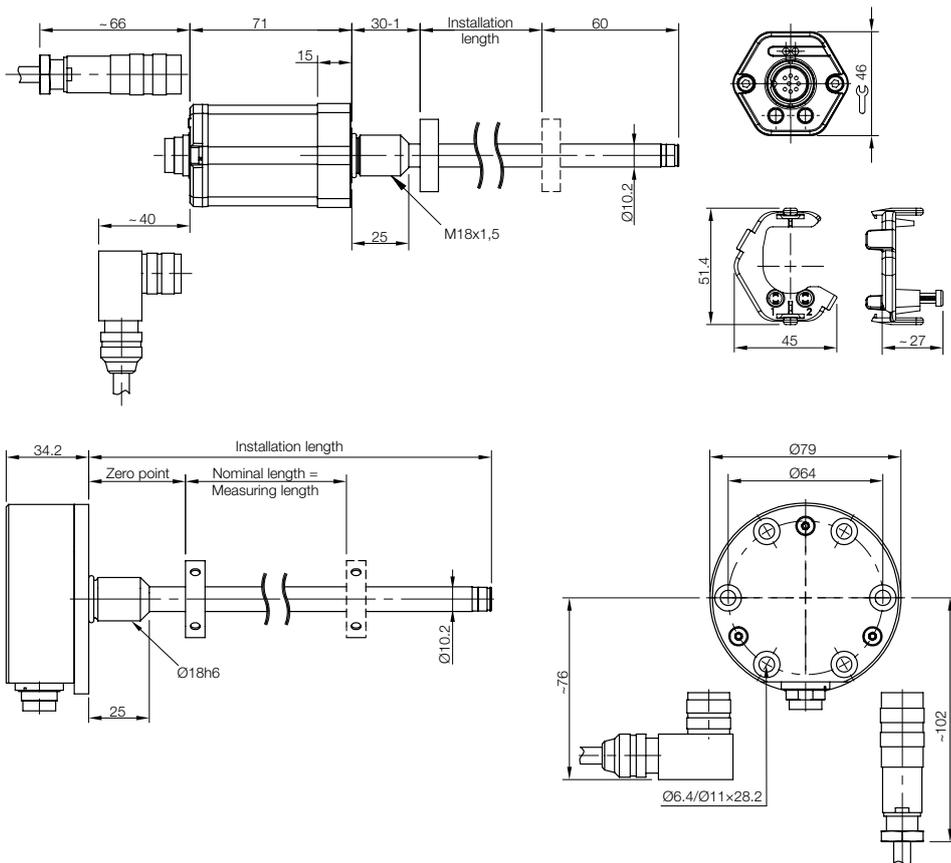
Devices in this category are intended for use in areas where an explosive atmosphere is not expected. The probability is extremely small. Even if an explosive atmosphere were to occur, it would be only for a short time. A manufacturer's declaration confirms that the indicated product meets the requirements for electrical equipment in potentially explosive areas.

Features

- Like transducer in Zone 2
- Absolute output signal
- Max. resolution of 1 µm (depending on the electronic processor unit)
- Pressure-resistant to 600 bar

Benefits

- Short housing saves valuable installation space
- Characteristic curve can be remotely set for fast startup
- CSA approval for the North American market



Version	D1	G	A	M	N	O
...-B-...	10.2 mm	M4 x4/6	0.5 mm	M18 x1,5	30 - 1 mm	15.4 x 2.1
...-Z-...			Ø 25 mm	3/4"-16 UNF	2" - 0.04"	15.3 x 2.4
...-A-...			0	M18 x1,5	30 - 1 mm	15.4 x 2.1
...-Y-...			3/4"-16 UNF	2" - 0.04"	15.3 x 2.4	
...-B8-...	8 mm		0.5 mm	M18 x1,5	30 - 1 mm	15.4 x 2.1
...-Z8-...			Ø 25 mm	3/4"-16 UNF	2" - 0.04"	15.3 x 2.4
...-A8-...			0	M18 x1,5	30 - 1 mm	15.4 x 2.1
...-Y8-...			3/4"-16 UNF	2" - 0.04"	15.3 x 2.4	
...-CD-...	12.7 mm	M4 x4/6	0.5 mm, Ø 25 mm	M22 x1.5	30 - 1 mm	19.3 x 2.2

Rod NEX

SSI and analog

Style B/Z/CD



Style K



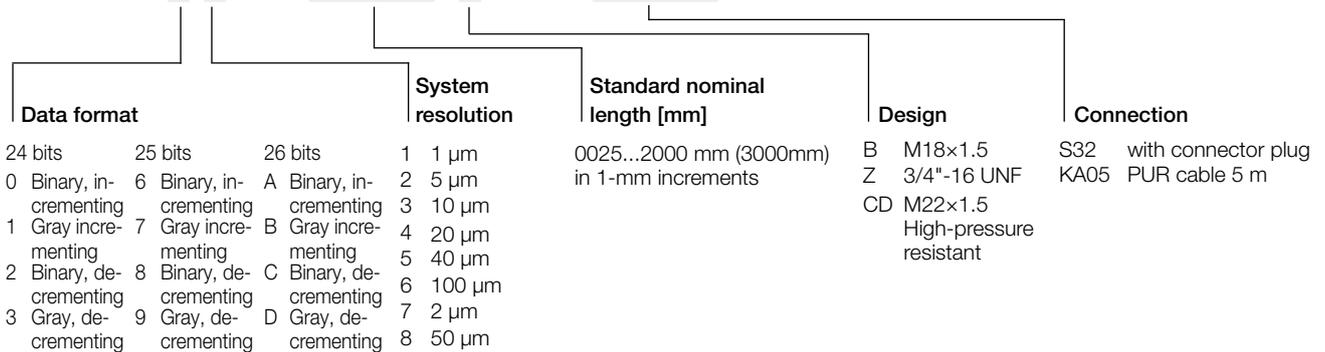
Micropulse transducers
Profile P
Rod B and Z
Rod NEX
Rod DEX
Rod J-DEXC

Series	Rod NEX BTL7		Rod NEX BTL7	Rod NEX BTL7
Interface	SSI		Analog voltage 0...10 V -10...10 V	Analog current 4...20 mA 0...20 mA
Special properties	Teach-in		Teach-in	Teach-in
	BTL7-S5_ -M_ - -NEX-_____		BTL7-_-M_ - -NEX-_____	BTL7-_-M_ - -NEX-_____
	BTL7-S5_ B-M_ - -NEX-_____			
Standard nominal lengths	Style B/Z/K Style CD	25...3000 mm 25...2000 mm	25...3000 mm 25...2000 mm	25...3000 mm 25...2000 mm
Resolution		1 µm	≥ 5 µm	≥ 5 µm
Repeat accuracy		±2.5 µm	±10 µm	±5 µm
Linearity deviation		±30 µm	Nominal length ≤ 500 mm ±50 µm Nominal length > 500 mm ±0.01 % FS	Nominal length ≤ 500 mm ±50 µm Nominal length > 500 mm ±0.01 % FS
Max. sampling frequency		4 kHz	4 kHz	4 kHz
Temperature coefficient		≤ 30 ppm/K	≤ 30 ppm/K	≤ 30 ppm/K
Max. number of position encoders		1	1	1
Supply voltage		10...30 V DC	10...30 V DC	10...30 V DC
Reverse polarity/overvoltage protection		Yes/Yes	Yes/Yes	Yes/Yes
Ambient temperature		-20...+60 °C	-20...+60 °C	-20...+60 °C
Degree of protection		IP67	IP67	IP67
Shock load		150 g	150 g	150 g
Vibration		20 g	20 g	20 g
Housing material	Style B/Z/CD Style K	Aluminum, stainless steel Stainless steel	Aluminum, stainless steel Stainless steel	Aluminum, stainless steel Stainless steel
Approvals		CE, CSA, IECEx	CE, CSA, IECEx	CE, CSA, IECEx
Connection		Connector, cable	Connector, cable	Connector, cable

Ordering example: SSI

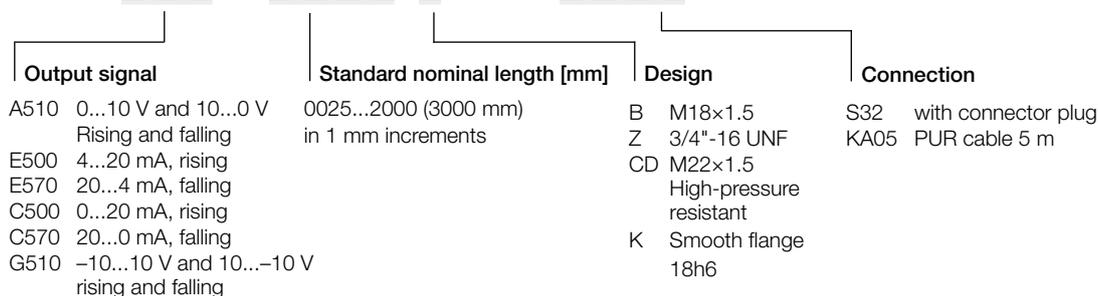
BTL7-S5 _ _ _ - **M** _ _ _ _ - - **NEX** - _ _ _ _ for asynchronous operation

BTL7-S5 _ _ _ **B-M** _ _ _ _ - - **NEX** - _ _ _ _ for synchronous operation



Ordering example: Analog voltage and analog current

BTL7 - _ _ _ - **M** _ _ _ _ - - **NEX** - _ _ _ _



Rod DEX

Analog voltage and analog current

For explosion hazard areas and flammable dust

Transducers designated Ex d IIC T5/ T6 Ga/Gb meet the requirements for electrical equipment in potentially explosive areas. In addition they meet the requirements for areas with flammable dust Category II 2D designated Ex tb IIIC T85 °C/T100 °C Db IP67.

When in use you must follow applicable safety regulations:

- Explosion protection guidelines (EX-RL)
- Constructing electrical equipment in potentially explosive atmospheres (EN 60079-14)
- Ignition protection type "d", flameproof encapsulation (EN 60079-1)

Features

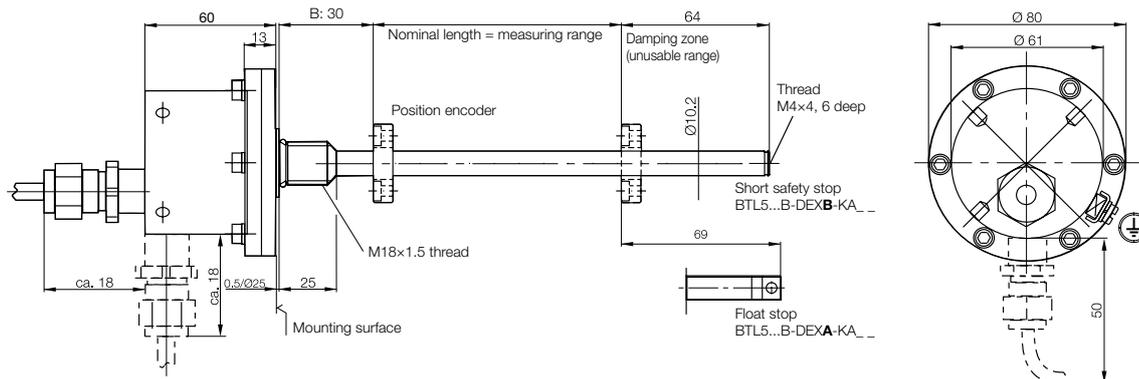
- Ex protection type "d" – flameproof encapsulation
- Filling Level Sensor in Zone 0/1
- Transducer in Zone 1
- For measuring ranges between 25 and 7620 mm
- Non-contact detection of the measuring position
- Insensitive to shock and vibration
- Insensitive to contamination
- Absolute output signal
- Max. resolution of 5 µm (depending on the electronic processor unit)
- Pressure-resistant to 350 bar

Benefits

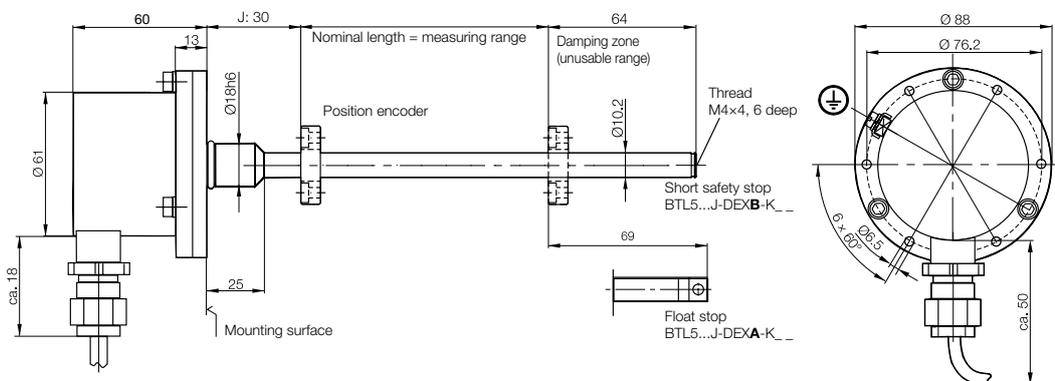
- Short housing saves valuable installation space
- Characteristic curve can be remotely set for fast startup
- IECEx, ATEX, EAC and many additional international approvals



Housing B, metric mounting thread Cable outlet axial, radial



Model J, flange Ø 18 mm, pitch circle Ø 76.2 mm, Cable outlet radial



Rod DEX

Analog voltage and analog current



Micropulse
transducers
Profile P
Rod B and Z
Rod NEX
Rod DEX
Rod J-DEXC

Series	Rod DEX BTL7	Rod DEX BTL7
Interface	Analog voltage 0...10 V -10...10 V	Analog current 4...20 mA 0...20 mA
Special properties	Teach-in BTL7- -M- - -DEX- -	Teach-in BTL7- -M- - -DEX- -
Standard nominal lengths	25...7620 mm	25...7620 mm
Resolution	≥ 5 μm	≥ 5 μm
Repeat accuracy	±10 μm	±10 μm
Linearity deviation	Nominal length ≤ 500 mm ±50 μm Nominal length > 5500 mm ±0.01 % FS Nominal length > 5500 mm ±0.02 % FS	Nominal length ≤ 500 mm ±50 μm Nominal length > 5500 mm ±0.01 % FS Nominal length > 5500 mm ±0.02 % FS
Max. sampling frequency	4 kHz	4 kHz
Temperature coefficient	≤ 30 ppm/K	≤ 30 ppm/K
Max. number of position encoders	1	1
Supply voltage	10...30 V DC	10...30 V DC
Reverse polarity/overvoltage protection	Yes/Yes	Yes/Yes
Ambient temperature	-40...+80 °C	-40...+80 °C
Degree of protection	IP67	IP67
Shock load	150 g	150 g
Vibration	20 g	20 g
Housing material	Stainless steel	Stainless steel
Approvals	CE, ATEX, IECEx	CE, ATEX, IECEx
Connection	Cable	Cable

Ordering example:

BTL7 - -M- - -DEX- -

	Output signal	Standard nominal length [mm]	Design	Rod end	Connection
A510	0...10 V and 10...0 V Rising and falling	0025...7620 mm in 1 mm increments	B M18×1.5 J Ø18h6 Z 3/4"-16 UNF	A Float stop B Short safety stop	Axial cable outlet only for model B, Z KA02 PUR cable 2 m KA05 PUR cable 5 m KA10 PUR cable 10 m KA15 PUR cable 15 m
E500	4...20 mA, rising				
E570	20...4 mA, falling				
C500	0...20 mA, rising				
C570	20...0 mA, falling				
G510	-10...10 V and 10...-10 V rising and falling				Radial output K02 PUR cable 2 m K05 PUR cable 5 m K10 PUR cable 10 m K15 PUR cable 15 m

Rod J-DEXC

SSI and analog

Pressure encapsulated housing and quick-change electronics module

The 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 replaceable for servicing.

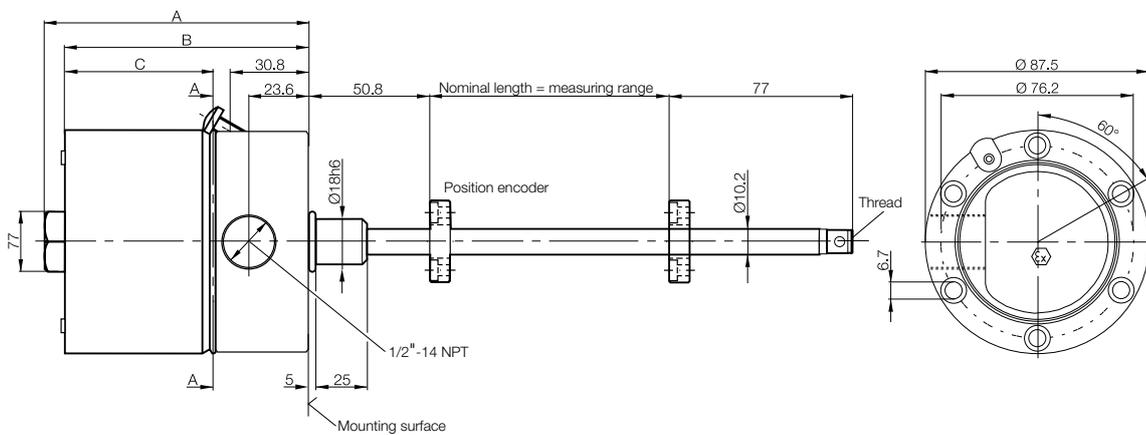
Features

- Ex protection type "d" – flameproof encapsulation
- Filling Level Sensor in Zone 0/1
- Transducer in Zone 1
- Corrosion-resistant housing available as an option
- Absolute output signal
- Max. resolution of 5 μm (depending on the electronic processor unit)
- Pressure-resistant to 600 bar

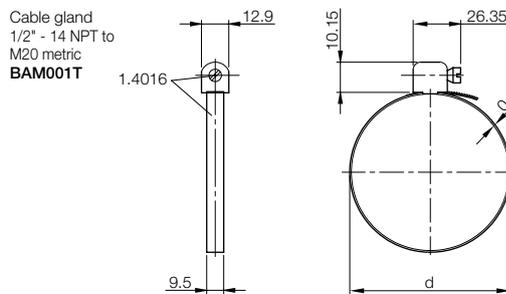
Benefits

- Replaceable electronics modules for simple field replacement
- Characteristic curve setting for rapid startup
- CSA approval for the North American market

Model J-DEXC, flange $\varnothing 18$ mm, pitch circle $\varnothing 76.2$ mm



Interface	A (mm)	B (mm)	C (mm)
Analog A, E, C	104,12	96,12	59,5
Digital SSI			



Ordering example: SSI

BTL7-S5 - **M** - **J-M01-TA** (replacement electronics module without pressure housing)

BTL7-S5 - **M** - **J-DEXC-TA12** for asynchronous operation (complete position sensor)

BTL7-S5 **B-M** - **J-DEXC-TA12** for synchronous operation

Data format			System resolution	Standard nominal length [mm]	Connection
24 bits	25 bits	26 bits	1 1 μm	0025...7620 mm	TA12 Internal thread 1/2"-14 NPT
0 Binary, incrementing	6 Binary, incrementing	A Binary, incrementing	2 5 μm		
1 Gray incrementing	7 Gray incrementing	B Gray incrementing	3 10 μm		
			4 20 μm		
			5 40 μm		
			7 2 μm		
			8 50 μm		

Rod J-DEXC

SSI and analog



Micropulse transducers
Profile P
Rod B and Z
Rod NEX
Rod DEX
Rod J-DEXC

Series	Rod J-DEXC BTL7	Rod J-DEXC BTL7	Rod J-DEXC BTL7
Interface	SSI	Analog voltage 0...10 V -10...10 V	Analog current 4...20 mA 0...20 mA
Special properties	Teach-in BTL7-S5_ _-M_ _ _-J-M01-TA BTL7-S5_ _-M_ _ _-J-DEXC-TA12 BTL7-S5_ _B-M_ _ _-J-DEXC-TA12	Teach-in BTL7- _ _0-M_ _-J-M01-TA BTL7- _ _0-M_ _-J-DEXC-TA12	Teach-in BTL7- _ _0-M_ _-J-M01-TA BTL7- _ _0-M_ _-J-DEXC-TA12
Standard nominal lengths	25...7620 mm	25...7620 mm	25...7620 mm
Resolution	1 µm	±5 µm	±5 µm
Repeat accuracy	≤ ±5 µm	±10 µm	±5 µm
Linearity deviation	≤ ±30 µm at resolution ≤ 10 µm Nominal length 25...5500 mm, ≤ ±2 LSB at resolution > 10 µm Nominal length 25...5500 mm, Nominal length 5501...7620 mm ±0.02 % FS	Nominal length ≤ 500 mm ±50 µm Nominal length > 5500 mm ±0.01 % FS Nominal length > 5500 mm ±0.02 % FS	Nominal length ≤ 500 mm ±50 µm Nominal length > 5500 mm ±0.01 % FS Nominal length > 5500 mm ±0.02 % FS
Max. sampling frequency	4 kHz	4 kHz	4 kHz
Temperature coefficient	≤ 30 ppm/K	≤ 30 ppm/K	≤ 30 ppm/K
Max. number of position encoders	1	1	1
Supply voltage	10...30 V DC	10...30 V DC	10...30 V DC
Reverse polarity/overvoltage protection	Yes/Yes	Yes/Yes	Yes/Yes
Ambient temperature	-40...+80 °C	-40...+80 °C	-40...+80 °C
Degree of protection	IP68	IP68	IP68
Shock load	100 g	100 g	100 g
Vibration	12 g	12 g	12 g
Housing material	Stainless steel	Stainless steel	Stainless steel
Approvals	CE, CSA, IECEx	CE, CSA, IECEx	CE, CSA, IECEx
Connection	Screw terminals	Screw terminals	Screw terminals



Class I, Division 1, Groups A, B, C, and D
Class II, Division 1, Groups E, F, and G; Class III
T6 Ta=65°C, T5 Ta=80°C Type 4X/6P; IP 68
Class I, Zone 1 AEx d IIC T6 Ta=65°C, T5 Ta=80°C
Class I, Zone 1 Ex d IIC T6 Ta=65°C, T5 Ta=80°C

SIRA 11ATEX1104X
IECEx SIR 11.0048X



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

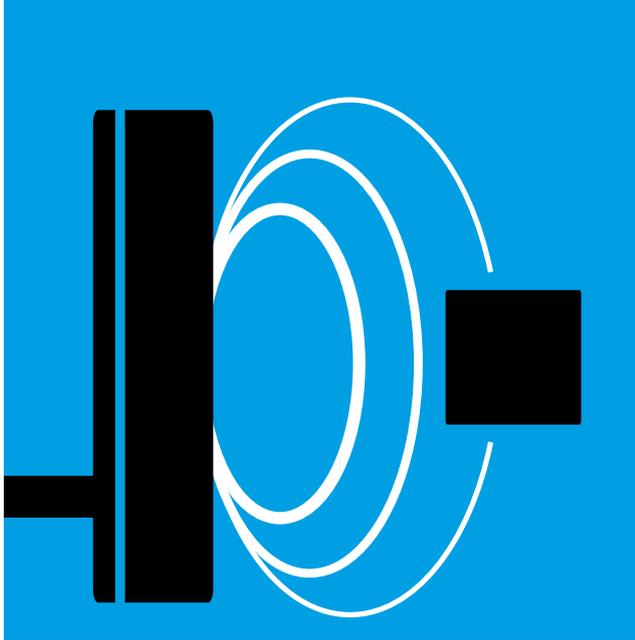
CE 0518 ⊕

Ordering example: Analog voltage and analog current

BTL7- _ _ _ _ 0-M_ _-J-M01-TA (replacement electronics module without pressure housing)

BTL7- _ _ _ _ 0-M_ _-J-DEXC-TA12 (complete position sensor)

Output signal	Operating voltage	Signal characteristics	Standard Nominal length [mm]	Connection
A 0...10 V and 10...0 V G -10...10 V and 10...-10 V E 4...20 mA and 20...4 mA C 0...20 mA and 20...0 mA	5 10...30 V	1 Rising and falling (output types A and G only) 0 Rising and falling Minimal output at connection end (output types C and E only) 7 Falling output only Minimal output at connection end (output types C and E only)	0025...7620 mm in 1 mm increments	TA12 Internal thread 1/2"-14 NPT



Inductive Positioning Systems

Inductive positioning systems are typically used in automation equipment and toolmaking wherever adjustment values and positions have to be monitored in very tight spaces.

These positioning systems 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 an IP degree of protection and makes these sensors resistant to stresses related to shocks and vibrations.

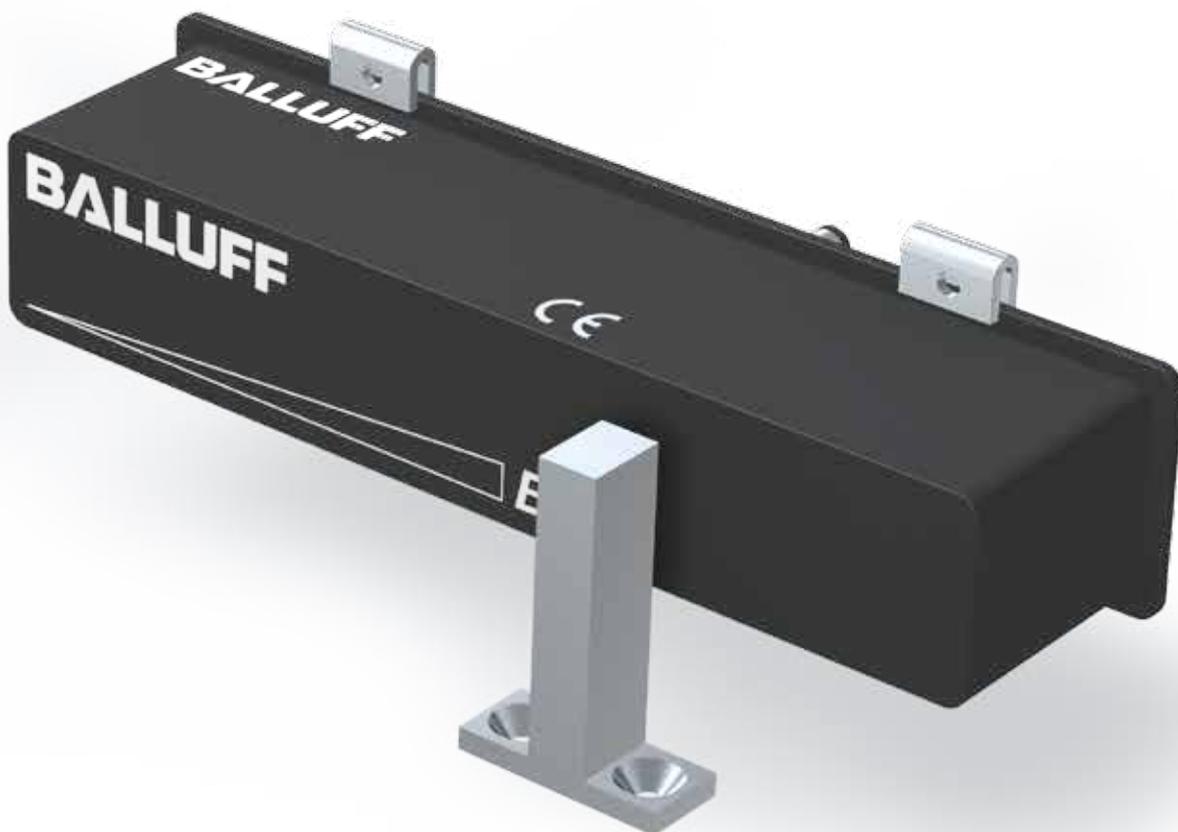


BIP02

28

BIP03

28



Inductive Positioning System BIP

BIP02 and BIP03

The precision measuring system for position detection of metallic objects

The BIP inductive positioning system outputs the target position as a distance-proportional analog or digital signal.

Inductive positioning systems are typically used in automation equipment and toolmaking wherever adjustment values and positions have to be monitored in very tight spaces.

Features

- Measuring ranges from 0...133 mm, teachable
- Compact, fully encapsulated design
- Non-contact and wear-free
- High repeat accuracy and precise positioning
- Shock and vibration-resistant

Benefits

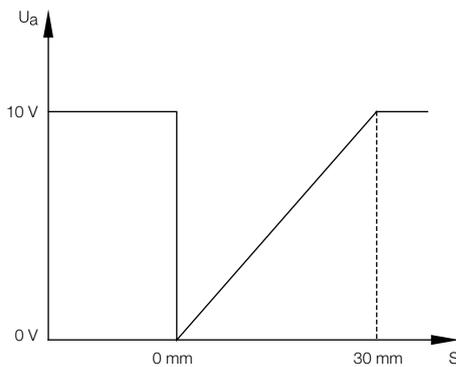
- Flexible measuring length concept makes it easy to adapt to any application
- Can be integrated even in extremely limited mounting spaces
- Non-contact induction principle – proven over decades in continuous industrial use
- The position encoder can be designed as an integral part of an application.

Series
Output signal
Length of measuring range is teachable
Detection range
Target width (EC80)
Target distance
Repeat accuracy
Linearity deviation
Ambient temperature
Supply voltage
Housing material
LED function indicator
Connection

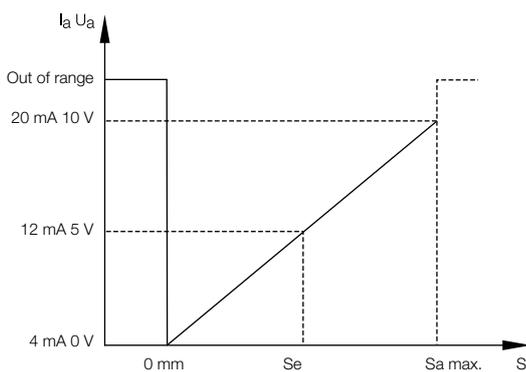
More versions of the BML-product family can be found in the full-line catalog for Linear Position Sensing and Measurement, page 301.

Other connection options on request.

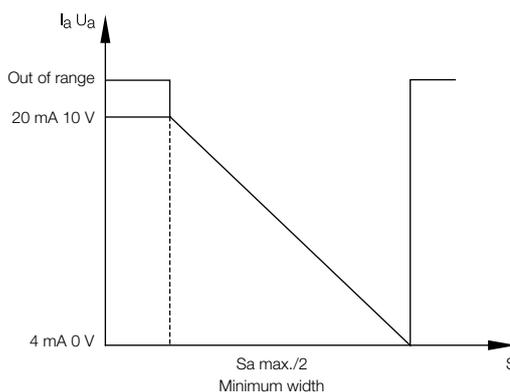
Output signal BIP000L



Output signal Standard output curve BIP000M and BIP000R



Output signal reduced measuring range BIP000M and BIP000R



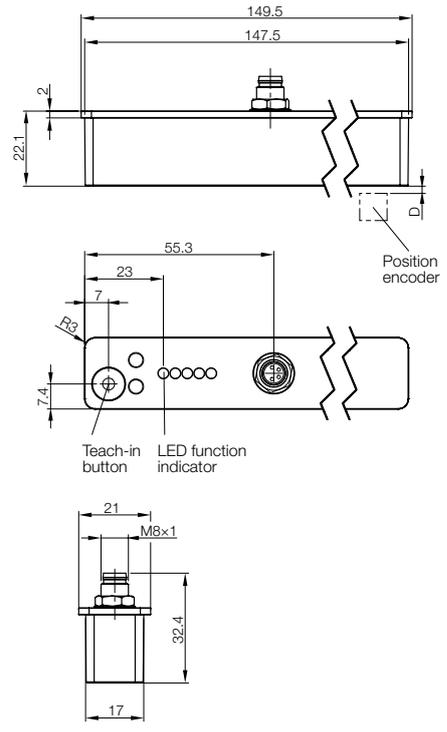
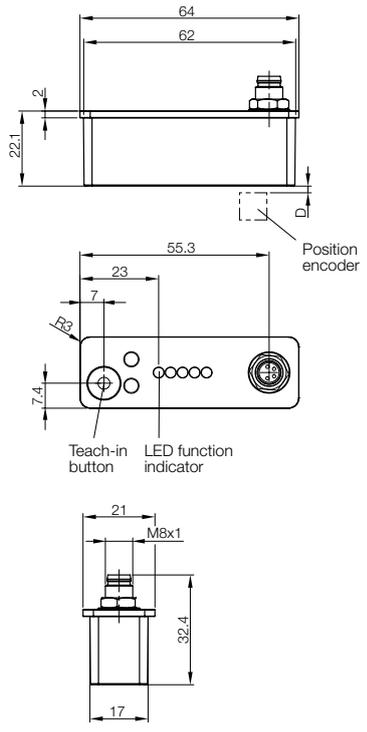
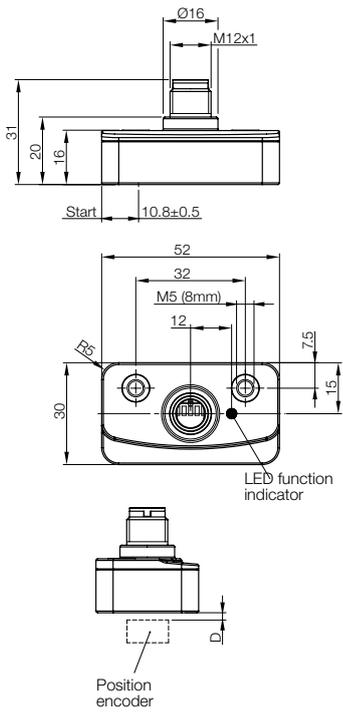
Inductive Positioning System BIP

BIP02 and BIP03

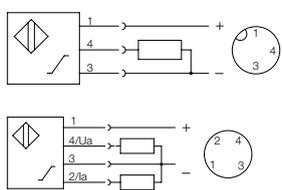


Inductive displacement sensors
BIP

BIP02	BIP03	BIP03
BIP000L	BIP000M	BIP000R
0...10 V	0 to 10 V and 4 to 20 mA	0 to 10 V and 4 to 20 mA
Not teachable	24...48 mm	66.5...133 mm
0...30 mm	0...48 mm	0...133 mm
9,5 mm	8 mm	8 mm
1...3 mm	0.5...3 mm	0.5...3 mm
±100 µm	±80 µm	±80 µm
±500 µm	±400 µm	±400 µm
-25...+85 °C	-25...+85 °C	-25...+85 °C
15...30 V	16...30 V	16...30 V
PA	PBT	PBT
Yes	Yes	Yes
M12 connector	M8 connector	M8 connector

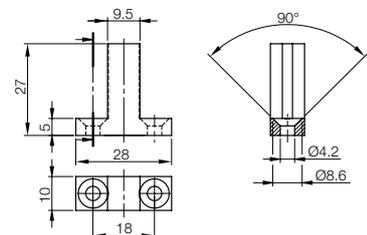


Pin configurations:

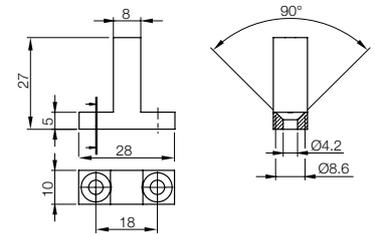


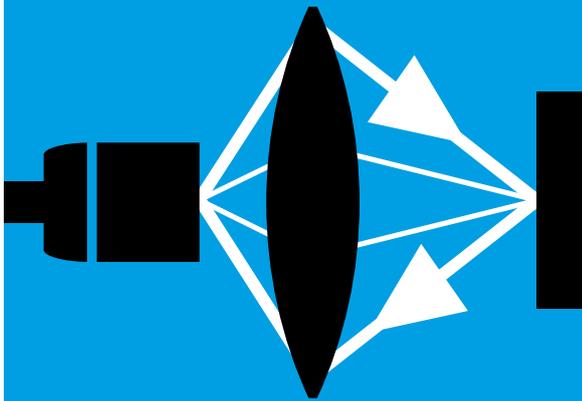
Please order metal target separately:

BAM0289
for sensor BIP000L



BAM01CP
for sensors BIP000M and BIP000R





Photoelectric Distance Sensors

Photoelectric distance sensors are used when distances to objects need to be measured or monitored or their precise position needs to be determined. They support positioning tasks, material flow controls and level detections in the most diverse of applications – also across large distances.

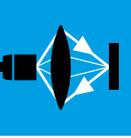
Users can choose from a wide range of output signals. For example, users can choose from analog current and voltage outputs or digital, serial interfaces. However, variants with IO-Link are available for a simple and efficient connection to higher-level controllers.



Photoelectric Distance Sensors

Contents

BOD 6K	32
BOD 23K	34



Photoelectric Distance Sensors

BOD 6K

Individually adjustable

Users now have greater flexibility in accurately positioning small parts. The Photoelectric Distance Sensors BOD 6K have an adjustable measuring range that can be optimally matched to a variety of applications.

They have an invertible output curve. And the switching outputs can be assigned individually as normally open or normally closed. The adaptation via teach-in is fast and easy. BOD 6K offer a high degree of protection and give you high-resolution precision at a low price.

Application

- Positioning parts in production and assembly lines, e.g. in the automobile industry
- Positioning linear drives, e.g. in automatic crimpers

Benefits

- Adjustable measuring range between 30 and 200 mm
- Analog output 1...10 V with an additional switching output
- Resolution 0.68 mm
- Switching outputs NO/NC, dark/light switching adjustable using buttons
- Teach-in: measuring range and switching output can be adjusted independently
- Invertible output curve
- IP67/IP69K protection
- Ecolab certified
- Very good price/performance ratio
- Compact design for applications with tight installation tolerances



Series
Working range
PNP, NO/NC contact
Supply voltage U_s
Analog output
No-load supply current I_0 max.
Polarity reversal protected/short-circuit protected
Emitter, light type
Wavelength
Light spot diameter
Resolution
Linearity
Temperature drift
Power-on indicator
Output function indicator
Switching frequency f max.
Degree of protection as per IEC 60529
Ambient temperature T_a
Permissible ambient light
Material
Housing
Optical surface
Connection

Measurement values referenced to 100x100 mm, 90% reflective Kodak gray card.

More versions of the BOD 6K product family can be found in the full-line catalog for Linear Position Sensing and Measurement, page 313



Recommended accessories:
(please order separately)



Description

Mounting bracket **BAM00UH**

You can find additional mechanical accessories in our **Accessories** catalog.



Suitable connectors:
(please order separately)



Size	Design	Cable material	Color	Length	
M8, 4-pin	straight	PUR	Black	5 m	BCC02N3
M8, 4-pin	right-angle	PUR	Black	5 m	BCC02NE

You can find additional electrical accessories in our catalog **Industrial Networking and Connectivity**.

Photoelectric Distance Sensors

BOD 6K



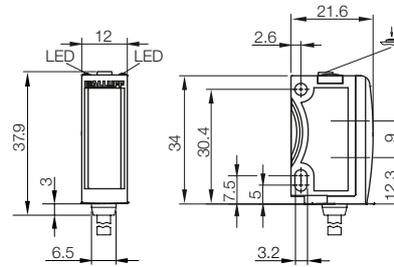
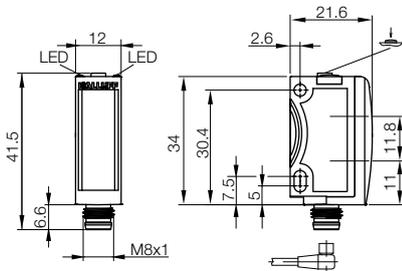
BOD 6K
30...200 mm
BOD001R
13...30 V DC
1...10 V
30 mA
Yes/Yes
LED, red light
632 Nm
Ø 9.5 mm at 100 mm
0.68 mm
±2 mm
0.2 mm/°K
Green LED
Yellow LED
1 kHz
IP67/IP69K
-20...+60 °C
5000 Lux
ABS
PMMA
M8 connector, 4-pin



BOD 6K
30...200 mm
BOD001T
13...30 V DC
1...10 V
30 mA
Yes/Yes
LED, red light
632 Nm
Ø 9.5 mm at 100 mm
0.68 mm
±2 mm
0.2 mm/°K
Green LED
Yellow LED
1 kHz
IP67/IP69K
-20...+60 °C
5000 Lux
ABS
PMMA
2 m PVC cable, 4 × 0.14 mm ²



Photoelectric
distance
sensors
BOD 6K
BOD 23K



Photoelectric Distance Sensors

BOD 23K

Measuring range: 5 m

For reliable, stable measurement independent of the characteristics of the surface, we have developed the ideal solution in the photoelectric distance sensors BOD 23K. The Time-of-Flight (TOF) technology and high repeat accuracy in the mm range are convincing reasons.

Safe use is guaranteed by laser class 1, the high degree of protection and the Ecolab certification of the sensors.

Application

- Stack height measurement of metal and plastic parts
- Positioning of robots in the automotive industry
- Checking the diameter of coils in auto body construction

Benefits

- Stable measurement independent of the surface properties thanks to TOF technology
- Analog output with 2 teach points
- High range up to 5 m
- Maximum protection through Laser Class 1
- High repeat accuracy in the mm range
- High IP67 and IP69K protection rating
- Ecolab certified
- Laser class 1: variety of possible applications in the automotive industry
- Easy and intuitive operation of the sensor
- Compact design and convenient installation on the system
- Cost-effective solution for positioning tasks in 5 m measuring range



Series
Working range
PNP, NO/NC contact
Supply voltage U_S
Analog output
No-load supply current I_0 max.
Polarity reversal protected/short-circuit protected
Emitter, light type
Wavelength
Laser class per IEC 60825-1
Light spot diameter
Resolution
Linearity
Temperature drift
Power-on indicator
Output function indicator
Switching frequency f max.
Degree of protection as per IEC 60529
Ambient temperature T_a
Permissible ambient light
Material
Housing
Optical surface
Connection

Measurement values referenced to 100x100 mm, 90% reflective Kodak gray card.

**Wh: Working range high – max. working range = 5000 mm



Recommended accessories:
(please order separately)



Image similar

Description

Mounting bracket **BAM027E**

You can find additional mechanical accessories in our **Accessories** catalog.



Suitable connectors:
(please order separately)



Size	Design	Cable material	Color	Length	
M12, 5-pin	straight	PUR	Black	5 m	BCC098C

You can find additional electrical accessories in our catalog **Industrial Networking and Connectivity**.

Photoelectric Distance Sensors

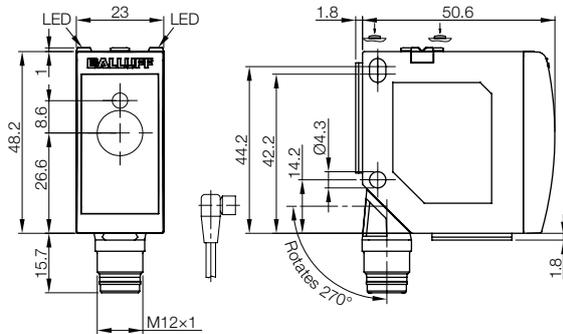
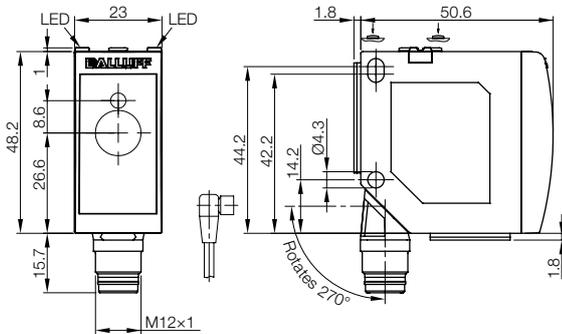
BOD 23K

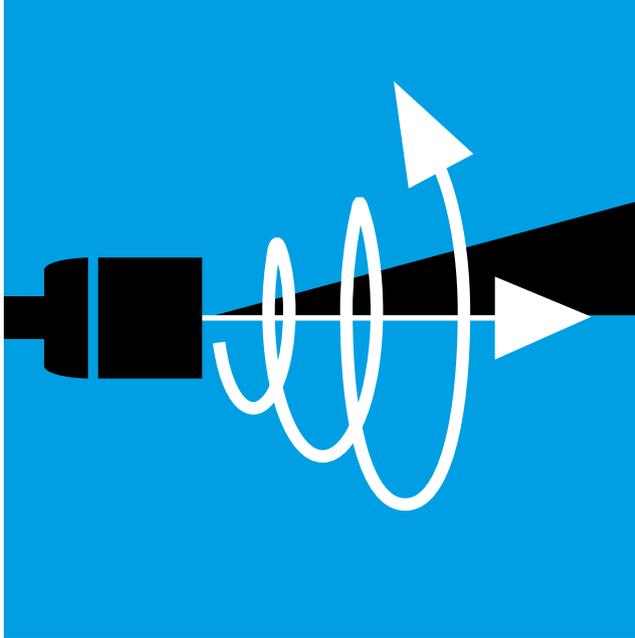


BOD 23K	BOD 23K
100...5000 mm	100...5000 mm
BOD001N	BOD001P
18...30 V DC	18...30 V DC
0...10 V	4...20 mA
60 mA	60 mA
Yes/Yes	Yes/Yes
Laser, red light	Laser, red light
655 Nm	655 Nm
1	1
5.5 × 7 mm at 5000 mm	5.5 × 7 mm at 5000 mm
5 mm	5 mm
±0.6 % of Wh*	±0.6 % of Wh*
0.1 mm/°K	0.1 mm/°K
Green LED	Green LED
Yellow LED	Yellow LED
250 Hz	250 Hz
IP67/IP69K	IP67/IP69K
-40...+60 °C	-40...+60 °C
5000 Lux	5000 Lux
ABS	ABS
PMMA	PMMA
M12 connector, 5-pin	M12 connector, 5-pin



Photoelectric
distance
sensors
BOD 6K
BOD 23K





Inductive Distance Sensors

Inductive distance sensors BAW provide an absolute voltage or current signal that changes proportionally to the distance of a metallic target. Distance sensors with IO-Link are also available. 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

Tubular styles, M12 × 1

For high function reliability

Reliable and wear-free distance measurement is ensured by contact-free sensor technology. The analog and IO-Link BAW sensors take you to the next level: They no longer check only the presence of metallic objects. Rather they are able to reliably and accurately determine distances of workpieces having various shapes and sizes.

Their analog and linear characteristics allow the new BAW to be used for clamping force measurement, measuring imbalances or implementing a soft-stop in the cylinder.

The new sensor family features long service life. The convenient teach function ensures quick commissioning during initial installation and low downtimes during sensor replacement due to the adjustable linear range.

Benefits

- Highly linear
- Wide measuring range
- Low temperature drift
- Adjustable linearity range
- Analog (voltage and current) and IO-Link versions



Series
Installation type
Output signal
Linear range s_l
Supply voltage U_S
Effective distance s_e
Load resistance $R_{L \min}$
Load resistance $R_{L \max}$
Polarity reversal protected/transposition protected/short-circuit protected
Settings (Teach-in)
Adjustment display (LED)
Ambient temperature T_a
Repeat accuracy R_{BWN}
Non-linearity max.
Limit frequency (–3 dB)
Response time
Degree of protection as per IEC 60529
Approvals
Material
Housing
Sensing surface
Connection

For more versions of the M12 product family × 1 see the full-line catalog Linear Position Sensing and Measurement starting on page 374

 **Recommended accessories:**
(please order separately)

Description	
Teach adapter	BAE00MN
Teach adapter	BAE00MP
Mounting bracket	BAM00C0
Mounting cuff	BAM0218



You can find additional mechanical accessories in our **Accessories** catalog.

 **Suitable connectors:**
(please order separately)

Size	Design	Cable material	Color	Length	
M12, 3-pin	straight	PUR, shielded	Black	5 m	BCC030U
M12, 3-pin	straight	PUR, unshielded	Black	5 m	BCC030L
M12, 3-pin	straight	PUR, shielded	Black	5 m	BCC030Z
M12, 3-pin	right-angle	PUR, shielded	Black	5 m	BCC031H

You can find additional electrical accessories in our catalog **Industrial Networking and Connectivity**.

Inductive Distance Sensors

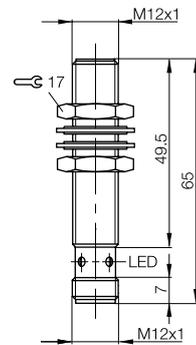
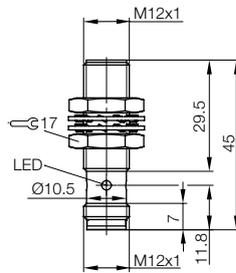
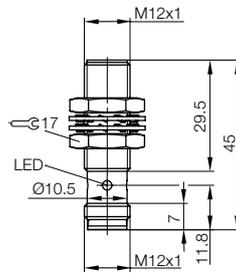
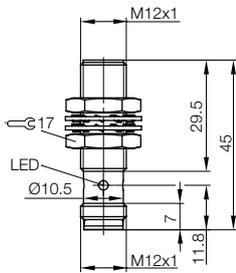
Tubular styles, M12 × 1



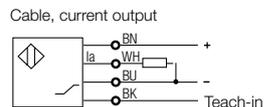
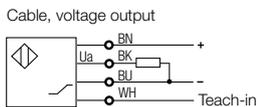
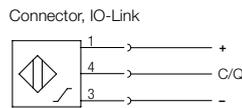
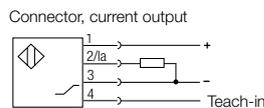
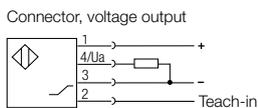
M12 × 1	M12 × 1	M12 × 1	M12 × 1
Flush	Flush	Flush	Flush
Voltage 0...10 V	Current 4...20 mA	Current 0...20 mA	Voltage 0...10 V
0.2...3.5 mm	0.2...3.5 mm	0.2...3.5 mm	0.2...3.5 mm
BAW004K	BAW0055	BAW0054	BAW004C
15...30 V DC	16...30 V DC	16...30 V DC	15...30 V DC
1.85 mm	1.85 mm	1.85 mm	1.85 mm
2 kΩ			2 kΩ
	500 Ω	500 Ω	
Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes
Measuring range	Measuring range	Measuring range	Measuring ranges
Yes	Yes	Yes	Yes
-40...+80 °C	-40...+80 °C	-40...+80 °C	-40...+80 °C
±7 μm	±7 μm	±7 μm	±7 μm
±35 μm	±35 μm	±35 μm	±35 μm
1 kHz	1 kHz	1 kHz	1 kHz
0.2 ms	0.2 ms	0.2 ms	0.2 ms
IP67	IP67	IP67	IP67
CE, cULus, EAC	CE, cULus, EAC	CE, cULus, EAC	CE, cULus, EAC
Brass-coated	Brass-coated	Brass-coated	Brass-coated
LCP	LCP	LCP	LCP
M12 connector, 4-pin	M12 connector, 4-pin	M12 connector, 4-pin	M12 connector, 4-pin



Inductive distance sensors
Tubular styles
M12 × 1



Wiring diagrams



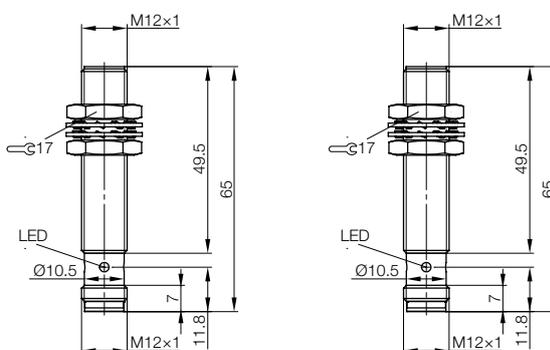
Inductive Distance Sensors

Tubular styles, M12 × 1



Series	M12 ×1	M12 ×1
Installation type	Flush	Flush
Output signal	Current 0...20 mA	Current 4...20 mA
Linear range	0.2...3.5 mm	0.2...3.5 mm
	BAW004P	BAW004U
Supply voltage U_S	16...30 V DC	16...30 V DC
Effective distance s_e	1.85 mm	1.85 mm
Load resistance $R_{L\ max.}$	500 Ω	500 Ω
Polarity reversal protected/transposition protected/short-circuit protected	Yes/Yes/Yes	Yes/Yes/Yes
Settings (Teach-in)	Measuring range	Measuring range
Adjustment display (LED)	Yes	Yes
Ambient temperature T_a	-40...+80 °C	-40...+80 °C
Repeat accuracy R_{BWN}	$\pm 7\ \mu\text{m}$	$\pm 7\ \mu\text{m}$
Non-linearity max.	$\pm 35\ \mu\text{m}$	$\pm 35\ \mu\text{m}$
Limit frequency (-3 dB)	1 kHz	1 kHz
Response time	0.2 ms	0.2 ms
Degree of protection as per IEC 60529	IP67	IP67
Approvals	CE, cULus, EAC	CE, cULus, EAC
Material	Housing: Brass-coated Sensing surface: LCP	Brass-coated LCP
Connection	M12 connector, 4-pin	M12 connector, 4-pin

For more versions of the M12 × 1 product family see the full-line catalog Linear Position Sensing and Measurement starting on page 374



Recommended accessories:
(please order separately)

Description	
Teach adapter	BAE00MN
Teach adapter	BAE00MP
Mounting bracket	BAM00C0
Mounting cuff	BAM0218



You can find additional mechanical accessories in our **Accessories** catalog.

Suitable connectors:
(please order separately)

Size	Design	Cable material	Color	Length	
M12, 3-pin	straight	PUR, shielded	Black	5 m	BCC030U
M12, 3-pin	straight	PUR, unshielded	Black	5 m	BCC030L
M12, 3-pin	straight	PUR, shielded	Black	5 m	BCC030Z
M12, 3-pin	right-angle	PUR, shielded	Black	5 m	BCC031H



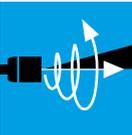
You can find additional electrical accessories in our catalog **Industrial Networking and Connectivity**.

Inductive Distance Sensors

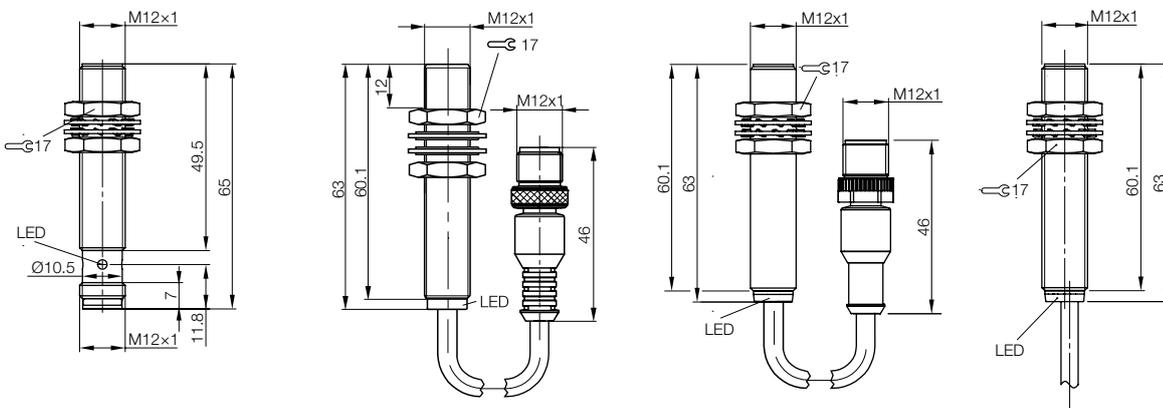
Tubular styles, M12 x 1



M12 x1	M12 x1	M12 x1	M12 x1
Flush	Flush	Flush	Flush
IO-Link	Current 4...20 mA	Current 0...20 mA	Current 4...20 mA
0.2...3.5 mm	0.2...3.5 mm	0.2...3.5 mm	0.2...3.5 mm
BAW004M	BAW004R	BAW004F	BAW0051
18...30 V DC	16...30 V DC	16...30 V DC	16...30 V DC
1.85 mm	1.85 mm	1.85 mm	1.85 mm
	500 Ω	500 Ω	500 Ω
Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes
Measuring range	Measuring range	Measuring range	Measuring range
Yes	Yes	Yes	Yes
-40...+80 °C	-40...+80 °C	-40...+80 °C	-40...+80 °C
±7 μm	±7 μm	±7 μm	±7 μm
±35 μm	±35 μm	±35 μm	±35 μm
1 kHz	1 kHz	1 kHz	1 kHz
2.0 ms	0.2 ms	0.2 ms	0.2 ms
IP67	IP68	IP68	IP68
CE, cULus, EAC	CE, cULus, EAC	CE, cULus, EAC	CE, cULus, EAC
Brass-coated	Brass-coated	Brass-coated	Brass-coated
LCP	LCP	LCP	LCP
M12 connector, 4-pin	0.2 m PUR cable with M12 connector, 4-pin	0.2 m PUR cable with M12 connector, 4-pin	2 m PUR cable, 4 x 0.25 mm ²

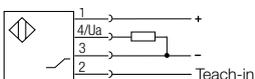


Inductive distance sensors
Tubular styles
M12 x 1

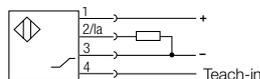


Wiring diagrams

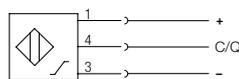
Connector, voltage output



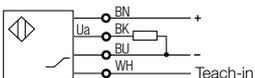
Connector, current output



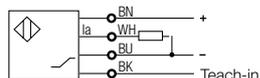
Connector, IO-Link



Cable, voltage output



Cable, current output



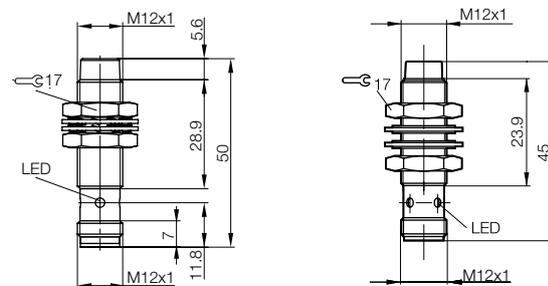
Inductive Distance Sensors

Tubular styles, M12 × 1



Series	M12 ×1	M12 ×1
Installation type	non-flush	non-flush
Output signal	Voltage 0...10 V	Voltage 0...10 V
Linear range	0.2...7 mm	0.2...7 mm
	BAW004H	BAW004J
Supply voltage U_S	15...30 V DC	15...30 V DC
Effective distance s_e	3.6 mm	3.6 mm
Load resistance $R_{L \min.}$	2 k Ω	2 k Ω
Load resistance $R_{L \max.}$		
Polarity reversal protected/transposition protected/short-circuit protected	Yes/Yes/Yes	Yes/Yes/Yes
Settings (Teach-in)	Measuring range	Measuring range
Adjustment display (LED)	Yes	Yes
Ambient temperature T_a	-25...+70 °C	-25...+70 °C
Repeat accuracy R_{BWN}	$\pm 7 \mu\text{m}$	$\pm 7 \mu\text{m}$
Non-linearity max.	$\pm 70 \mu\text{m}$	$\pm 70 \mu\text{m}$
Limit frequency (-3 dB)	1 kHz	1 kHz
Response time	0.2 ms	0.2 ms
Degree of protection as per IEC 60529	IP67	IP67
Approvals	CE, cULus, EAC	CE, cULus, EAC
Material	Housing Brass-coated	Brass-coated
	Sensing surface LCP	LCP
Connection	M12 connector, 4-pin	M12 connector, 4-pin

For more versions of the M12 × 1 product family see the full-line catalog Linear Position Sensing and Measurement starting on page 374



 **Recommended accessories:**
(please order separately)

Description	
Teach adapter	BAE00MN
Teach adapter	BAE00MP
Mounting bracket	BAM00C0
Mounting cuff	BAM0218



You can find additional mechanical accessories in our **Accessories** catalog.

 **Suitable connectors:**
(please order separately)

Size	Design	Cable material	Color	Length	
M12, 3-pin	straight	PUR, shielded	Black	5 m	BCC030U
M12, 3-pin	straight	PUR, unshielded	Black	5 m	BCC030L
M12, 3-pin	straight	PUR, shielded	Black	5 m	BCC030Z
M12, 3-pin	right-angle	PUR, shielded	Black	5 m	BCC031H



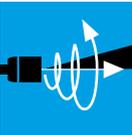
You can find additional electrical accessories in our catalog **Industrial Networking and Connectivity**.

Inductive Distance Sensors

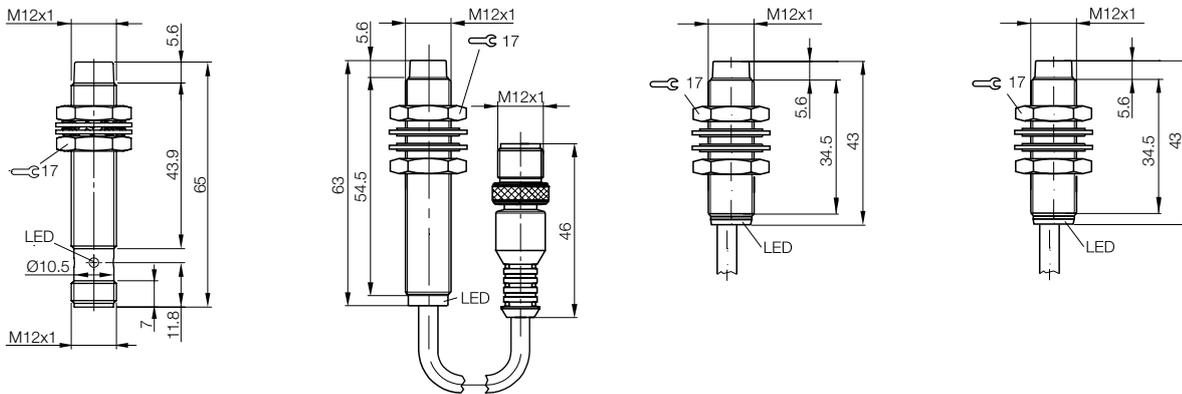
Tubular styles, M12 × 1



M12 × 1	M12 × 1	M12 × 1	M12 × 1
non-flush	non-flush	non-flush	non-flush
IO-Link	Voltage 0...10 V	Current 0...20 mA	Current 4...20 mA
0.2...7 mm	0.2...7 mm	0.2...7 mm	0.2...7 mm
BAW0056	BAW004E	BAW004L	BAW004T
18...30 V DC	15...30 V DC	16...30 V DC	16...30 V DC
3.6 mm	3.6 mm	3.6 mm	3.6 mm
	2 kΩ		
Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes
Measuring range	Measuring range	Measuring range	Measuring range
Yes	Yes	Yes	Yes
-25...+70 °C	-25...+70 °C	-25...+70 °C	-25...+70 °C
±7 μm	±7 μm	±7 μm	±7 μm
±70 μm	±70 μm	±70 μm	±70 μm
1 kHz	1 kHz	1 kHz	1 kHz
2.0 ms	0.2 ms	0.2 ms	0.2 ms
IP67	IP68	IP68	IP68
CE, cULus, EAC	CE, cULus, EAC	CE, cULus, EAC	CE, cULus, EAC
Brass-coated	Brass-coated	Brass-coated	Brass-coated
LCP	LCP	LCP	LCP
M12 connector, 4-pin	0.2 m PUR cable with M12 connector, 4-pin	2 m PUR cable, 4 × 0.25 mm ²	2 m PUR cable, 4 × 0.25 mm ²

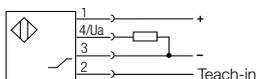


Inductive distance sensors
Tubular styles
M12 × 1

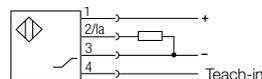


Wiring diagrams

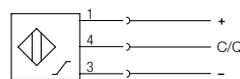
Connector, voltage output



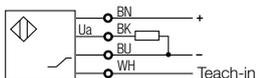
Connector, current output



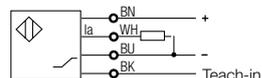
Connector, IO-Link

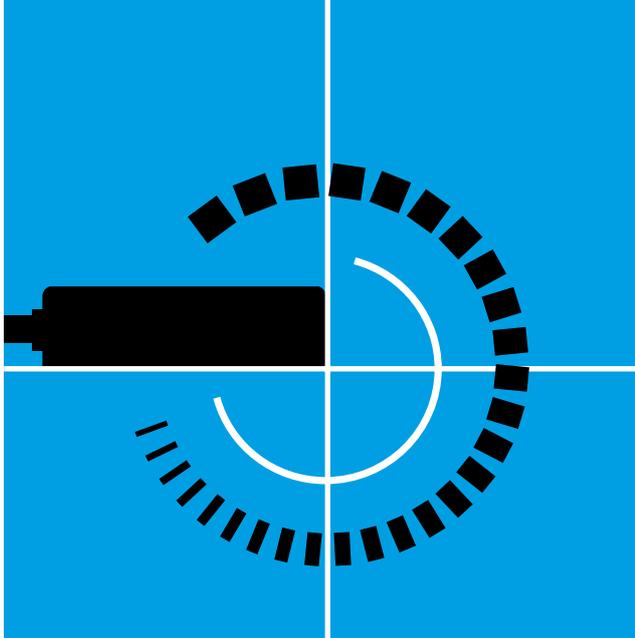


Cable, voltage output



Cable, current output





Inclination Sensors

Angle measurement made easy – MEMS-based inclination sensors BSI

Inclination sensors provide precise position control and continuous tracking of rotating movements. This is possible using MEMS (Micro-Electro-Mechanical-Systems)-based inclination sensors. Their compact chips with micro-mechanical structures move in relation to the inclination from the affect of gravity. The deformation of these structures is evaluated using a capacitive measuring principle.

Features

- Two versions for different requirements
- Compact design
- Maintenance-free operation

Benefits

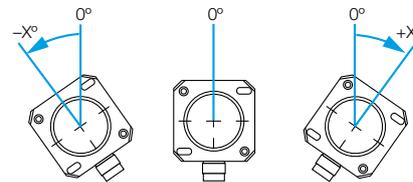
- Measure two axes with just one sensor
- Large selection of various measuring ranges
- Centering function (calibration)

1- and 2-axis: factory calibrated - can be individually centered

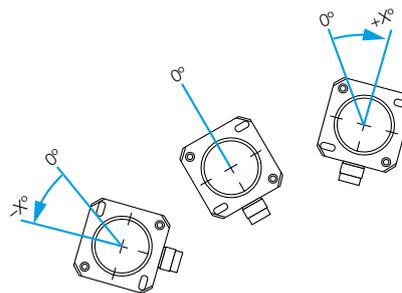
1- and 2-axis versions are available which are factory calibrated to perfectly vertical or perfectly horizontal. The maximum deviation for each is 0.2° . If the current installation position deviates from these perfect vertical and horizontal alignments, the sensor can be centered.

The single-axis version can be centered in a vertical position over 360° (see illustrations), whereas the dual axis version can only be set in a range of $\pm 5^\circ$ from the horizontal.

Starting position – working range ($\pm x^\circ$) as factory set



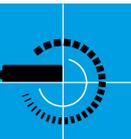
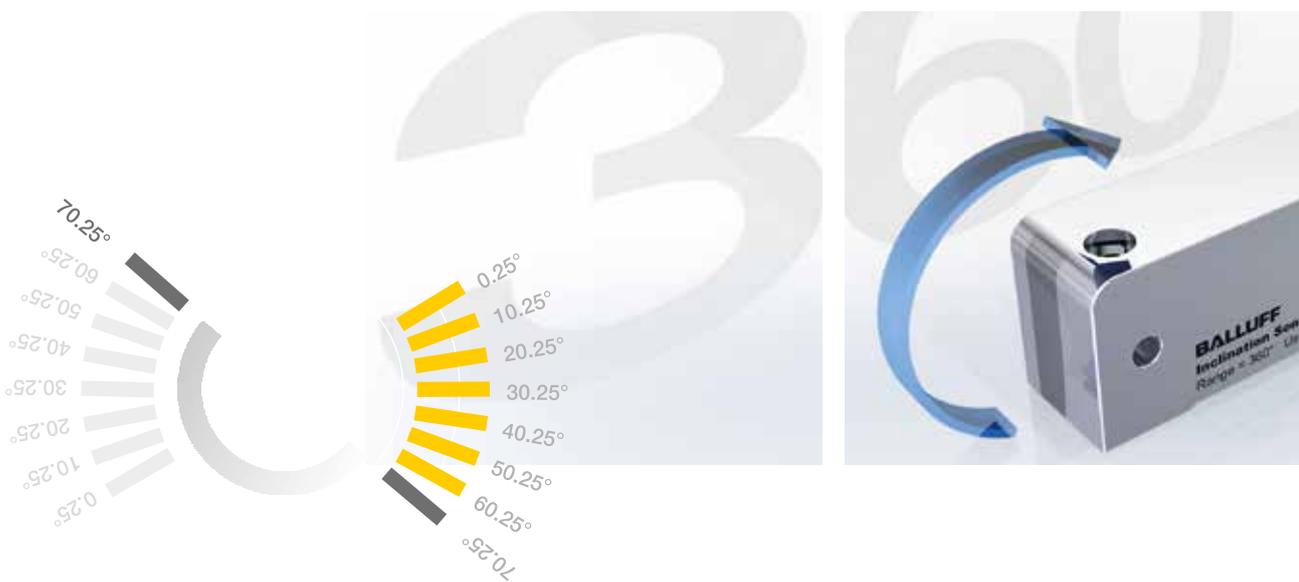
New position – working range ($\pm x^\circ$) after centering



Inclination Sensors BSI

Contents

BSI Q41	46
BSI R65	48



Inclination Sensors BSI

BSI Q41

Direct position detection

Inclination sensors BSI Q41 provide an easy means of directly detecting positions without making contact. Integrating them into systems is easy, because they operate without elaborate mechanisms or other targets.

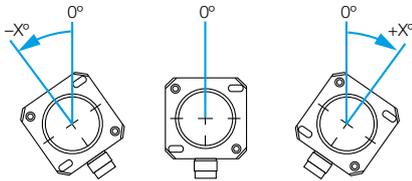
Application

- Packaging machines
- Mobile implements
- Solar power systems

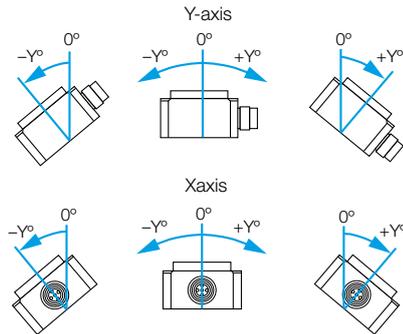
Benefits

- Compact
- Cost-effective
- Choice of one or two measurement axes

Inclination axis – 1-axis (vertical installation)



Inclination axis – 2-axis (horizontal installation)



Series	
Measuring principle	
Version	
Output signal	
Measuring range	±15° ±30° ±45° ±90° ±180°
Supply voltage	
Current consumption	
Resolution	
Accuracy	
Temperature drift	
Sampling rate	
Ready delay	
Polarity reversal protected/short-circuit protected	
Operating temperature	
Degree of protection as per IEC 60529	
Approx. weight	
Housing material	
Connection	



Suitable connectors:
(please order separately)



Size	Design	Cable	Length	
M12, 5-pin	straight	PUR, black	2 m	BCC08KN
M12, 5-pin	straight	PUR, black	5 m	BCC08KP
M12, 5-pin	straight	PUR, black	10 m	BCC08KR
M12, 5-pin	right-angle	PUR, black	2 m	BCC0AT1
M12, 5-pin	right-angle	PUR, black	5 m	BCC0AT2

You can find additional electrical accessories in our catalog
Industrial Networking and Connectivity.

Inclination Sensors BSI

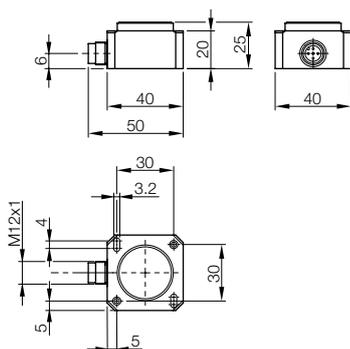
BSI Q41



BSI Q41																		
MEMS-based (Micro-Electro-Mechanical Systems)																		
1-axis										2-axis								
4...20 mA					0...10 V					4...20 mA				0...10 V				
BSI000J	BSI000K	BSI000P	BSI000R	BSI000H	BSI000M	BSI000N	BSI000T	BSI000U	BSI000L	BSI000W	BSI000Y	BSI0011	BSI0012		BSI000Z	BSI0010	BSI0013	BSI0014
■					■					■					■			
	■					■					■					■		
		■					■					■					■	
			■					■					■					■
				■					■									
10...30 V DC					12...30 V DC					10...30 V DC				12...30 V DC				
< 15 mA					< 15 mA					< 15 mA				< 15 mA				
0.09°					0.09°					0.09°				0.09°				
0.6°	0.6°	0.8°	0.8°	1.0°	0.6°	0.6°	0.8°	0.8°	1.0°	0.6°	0.6°	0.8°	0.8°		0.6°	0.6°	0.8°	0.8°
±0.8°/10 K					±0.8°/10 K					±0.8°/10 K				±0.8°/10 K				
< 20 ms					< 20 ms					< 20 ms				< 20 ms				
< 1 s					< 1 s					< 1 s				< 1 s				
Yes/Yes					Yes/Yes					Yes/Yes				Yes/Yes				
-25...+85 °C					-25...+85 °C					-25...+85 °C				-25...+85 °C				
IP67					IP67					IP67				IP67				
45 g					45 g					45 g				45 g				
PBTP					PBTP					PBTP				PBTP				
M12 connector, 5-pin					M12 connector, 5-pin					M12 connector, 5-pin				M12 connector, 5-pin				



BSI inclination sensors
BSI Q41
BSI R65



Inclination Sensors BSI

BSI R65

For rotating movements

Inclination sensors BSI R65 enable continuous detection of rotational movements along one axis. Furthermore, they are ideally suited for monitoring the precise position of machine components in two axes.

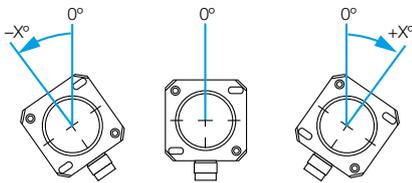
Application

- Medical technology
- Metal processing
- Oil and gas extraction

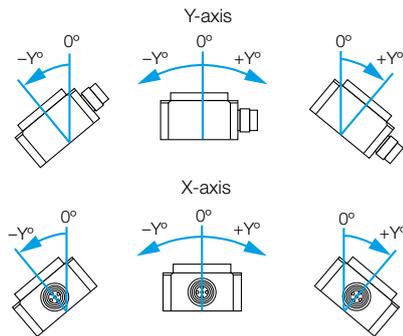
Benefits

- High precision
- Large temperature range
- Contact-free measuring principle

Inclination axis – 1-axis (vertical installation)



Inclination axis – 2-axis (horizontal installation)



Suitable connectors:
(please order separately)



Size	Design	Cable	Length	
M12, 8-pin	straight	PUR, black	2 m	BCC0HCC
M12, 8-pin	straight	PUR, black	5 m	BCC0HCE
M12, 8-pin	straight	PUR, black	10 m	BCC0HCF

You can find additional electrical accessories in our catalog **Industrial Networking and Connectivity**.



Series	
Measuring principle	
Version	
Output signal	
Measuring range	±15° ±30° ±45° ±90° ±180°
Supply voltage	
Current consumption	
Resolution	
Accuracy	
Temperature drift	
Sampling rate	
Ready delay	
Polarity reversal protected/short-circuit protected	
Operating temperature	
Degree of protection as per IEC 60529	
Approx. weight	
Housing material	
Connection	

Inclination Sensors BSI

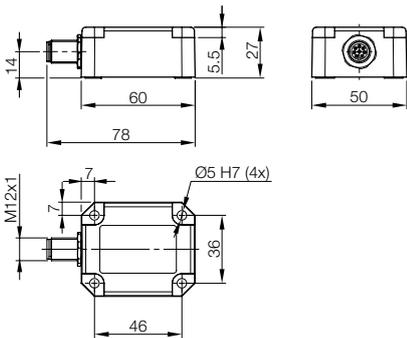
BSI R65



BSI R65																			
MEMS-based (Micro-Electro-Mechanical Systems)																			
1-axis										2-axis									
4...20 mA					0...10 V					4...20 mA					0...10 V				
BSI001E	BSI0018	BSI0019	BSI001A	BSI0015	BSI001C	BSI0017	BSI001F	BSI0005	BSI0016	BSI0006	BSI0007	BSI0008	BSI0009	BSI000A	BSI000C	BSI000E	BSI000F		
■					■					■				■					
	■					■					■				■				
		■					■					■				■			
			■					■					■				■		
				■					■									■	
10...30 V DC					12...30 V DC					10...30 V DC					12...30 V DC				
< 25 mA					< 25 mA					< 25 mA					< 25 mA				
0.01°					0.01°					0.01°					0.01°				
0.2°	0.2°	0.2°	0.2°	0.25°	0.2°	0.2°	0.2°	0.2°	0.25°	0.08°	0.2°	0.2°	0.2°	0.08°	0.2°	0.2°	0.2°	0.2°	0.2°
±0.1°/10 K					±0.1°/10 K					±0.1°/10 K					±0.1°/10 K				
< 20 ms					< 20 ms					< 20 ms					< 20 ms				
< 1 s					< 1 s					< 1 s					< 1 s				
Yes/Yes					Yes/Yes					Yes/Yes					Yes/Yes				
-40...+85 °C					-40...+85 °C					-40...+85 °C					-40...+85 °C				
IP67					IP67					IP67					IP67				
110 g					110 g					110 g					110 g				
PBTP					PBTP					PBTP					PBTP				
M12 connector, 8-pin					M12 connector, 8-pin					M12 connector, 8-pin					M12 connector, 8-pin				



BSI inclination sensors
BSI Q41
BSI R65

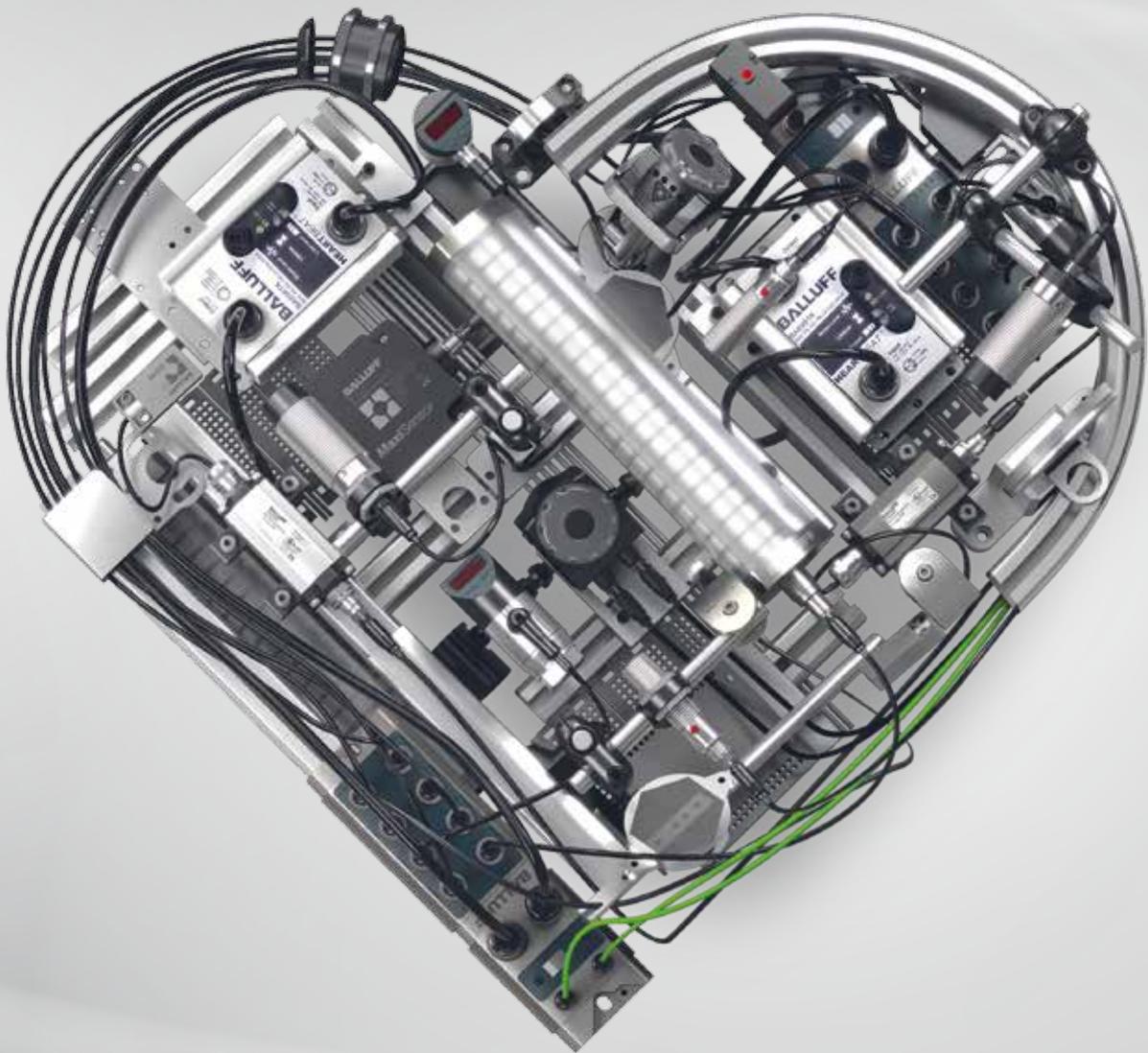


Alphanumeric Index

Order code	Page	Order code	Page
BAE		BSI000K 46	
BAE00MN	42	BSI000L	46
BAE00MP	42	BSI000M	46
BAE00MW	10	BSI000N	46
BAM00CO	42	BSI000P	46
BAM		BSI000R	46
BAM00UH	32	BSI000T	46
BAM01CP	29	BSI000U	46
BAM0218	42	BSI000W	46
BAM027E	34	BSI000Y	46
BAM0289	29	BSI000Z	46
BAV		BSI0010	46
BAV000M	10	BSI0011	46
BAW		BSI0012	46
BAW004C	38	BSI0013	46
BAW004E	42	BSI0014	46
BAW004F	40	BSI0015	48
BAW004H	42	BSI0016	48
BAW004J	42	BSI0017	48
BAW004K	38	BSI0018	48
BAW004L	42	BSI0019	48
BAW004M	40	BSI001A	48
BAW004P	40	BSI001C	48
BAW004R	40	BSI001E	48
BAW004T	42	BSI001F	48
BAW004U	40	BTL	
BAW0051	40	BTL7-P511-M_-P_-	14
BAW0054	38	BTL7_-M_-_-NEX_-	20
BAW0055	38	BTL7-0-M_-J-DEXC-TA12	24
BAW0056	42	BTL7-0-M_-J-M01-TA	24
BCC		BTL7_-M_-_-DEX_-	22
BCC02N3	32	BTL7-S5_-M_-_-NEX_-	20
BCC02NE	32	BTL7-S5_-B-M_-_-NEX_-	20
BCC030L	42	BTL7-S5_-M_-_-J-DEXC-TA12	24
BCC030U	42	BTL7-S5_-M_-_-J-M01-TA	24
BCC030Z	42	BTL7-S5_B-M_-_-J-DEXC-TA12	24
BCC031H	42	BTL7-S5_-M_-P_-	14
BCC098C	34	BTL7-V50E-M_-_-C003	18
BIP		BTL7-V50E-M_-P-C003	16
BIPO00L	28	BTL7-V50T-M_-_-C003	18
BIP000M	28	BTL7-V50T-M_-P-C003	16
BIPO00R	28	BML	
BML		BML04HN	11
BML04YM	7	BML04YM	7
BML-M07-I68-A-M_-_-_-_-_-	9	BML-M07-I68-A-M_-_-_-_-_-	9
BML-S1H_-6_C-M3_A-DO-KA00,3-S284	6	BML-S1H_-6_C-M3_A-DO-KA00,3-S284	6
BML-S2C0-Q_-_-M624-0_-	8	BML-S2C0-Q_-_-M624-0_-	8
BML-S2C0-Q_-M600-0_-	8	BML-S2C0-Q_-M600-0_-	8
BOD		BOD	
BOD001N	34	BOD001N	34
BOD001P	34	BOD001P	34
BOD001R	32	BOD001R	32
BOD001T	32	BOD001T	32
BSI		BSI	
BSI0005	48	BSI0005	48
BSI0006	48	BSI0006	48
BSI0007	48	BSI0007	48
BSI0008	48	BSI0008	48
BSI0009	48	BSI0009	48
BSI000A	48	BSI000A	48
BSI000C	48	BSI000C	48
BSI000E	48	BSI000E	48
BSI000F	48	BSI000F	48
BSI000H	46	BSI000H	46
BSI000J	46	BSI000J	46

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