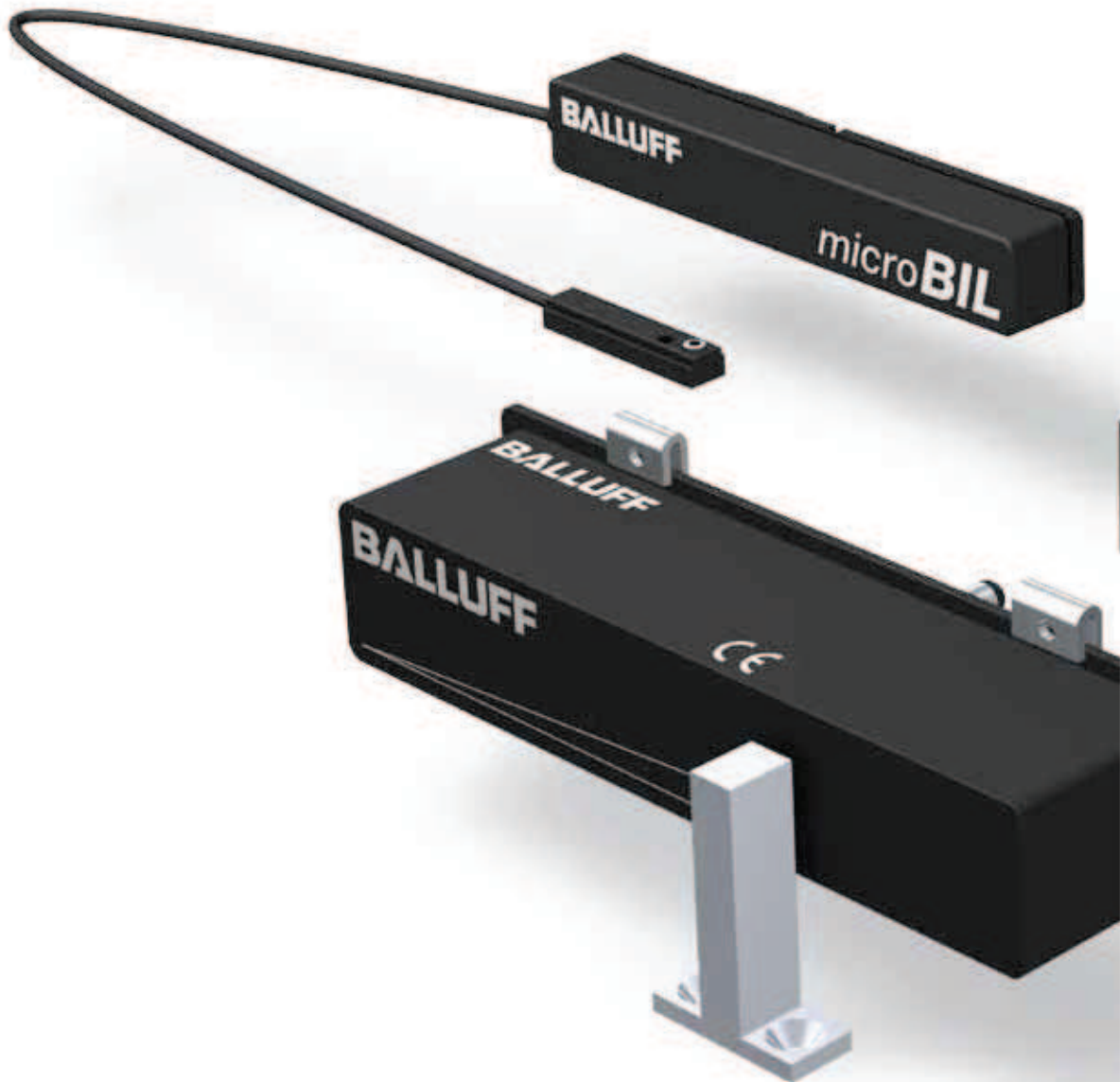


Inductive Position Sensors

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.



Inductive Position Sensors	
Applications	286
Summary	288
Magneto-inductive Position Sensors BIL	290
Inductive Position Sensors BIP	298
Basic Information and Definitions	304

SMARTSENS



Basic information and definitions can be found on page 304

Inductive Position Sensors

Applications

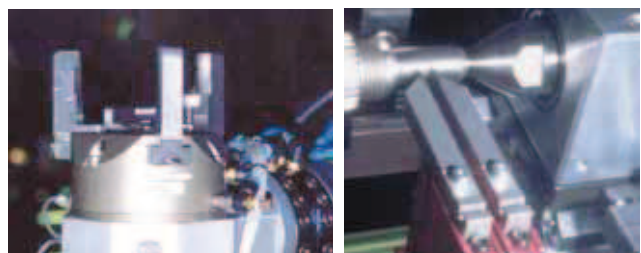
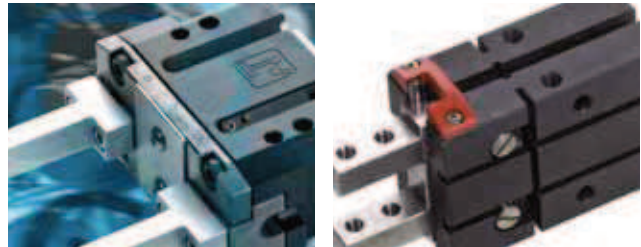
BIL

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.



Inductive Position Sensors

Applications

BIP

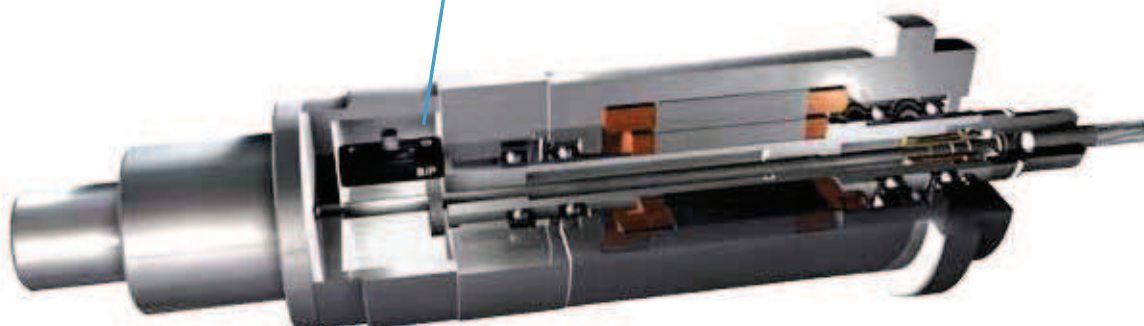
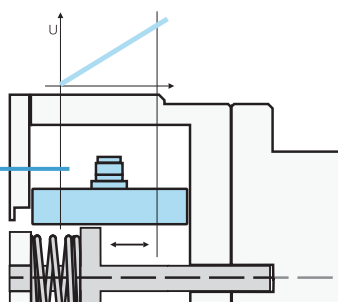
The inductive positioning system BIP is an accurate measurement system for detecting the position of metallic objects.

Applications

The main application area of the BIP is linear position monitoring of drive spindles and clamping devices for tools and workpieces.

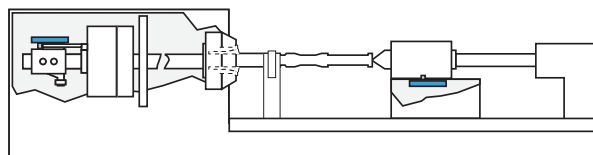
The optimal sensor for clamping distance monitoring

Position sensor BIP in use at a drive spindle for tools



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

Applications
Summary

Magneto-inductive Position Sensors BIL

Inductive Position Sensors BIP

Basic Information and Definitions



SMARTSENS



SMARTSENS



SMARTSENS

Series		Micro-BIL	BIL 60	BIL 160	
Measuring range		0...10 mm	0...60 mm	0...160 mm	
Teachable analog output					
Resolution		±25 µm	±0.15 mm	±0.4 mm	
Linearity		±0.3 mm	±1 mm	±2.4 mm	
Repeat accuracy		±30 µm	±60 µm	±0.5 mm	
Interfaces					
Output	0...10 V	■	■	■	
	4...20 mA	■	■	■	
IO-Link					
Target/position encoder					
Magnet		■	■	■	
Metal					
From page		292	294	295	

Inductive Position Sensors Summary



	BIP 14	BIP 40	BIP 70	BIP 103
	0...14 mm	0...40 mm	0...70 mm	0...103 mm
	■	■	■	■
	14 μm	40 μm	80 μm	80 μm
	±250 μm	±400 μm	±300 μm	±400 μm
	±80 μm	±100 μm	±80 μm	±80 μm
	■	■	■	■
	■	■	■	■
	■	■	■	■
	■	■	■	■
	■	■	■	■
	301	301	302	302



Inductive
Position Sensors
Applications
Summary

Magneto-
inductive
Position Sensors
BIL

Inductive
Position Sensors
BIP

Basic
Information and
Definitions



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.



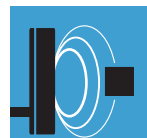


Magneto-inductive Position Sensors BIL Contents

Magneto-inductive Position Sensors BIL

Summary	292
Micro-BIL, General Data	293
BIL, General Data	294
Accessories	296

SMARTSENS



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

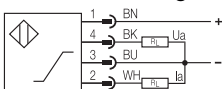


Output signal U_{out}	Voltage 0...10 V or
Output signal I_{out}	Current 4...20 mA
Working range s_w	0...10 mm
Linear range s_l	0...10 mm
Ordering code	BIL0002
Part number	BIL ED0-B010P-02/30-S75
Supply voltage U_S	At voltage output U_{out} : $U_S = 15$ to 30 V DC, At current output I_{out} : $U_S = 10...30$ V DC
Field strength, axial H_n	10 kA/m typical
-3 dB width of the axial field distribution, typical (typical axial field strength – parallel to sensing surface)	2.5 mm
Residual ripple	$\leq 10\%$ of U_e
Rated insulation voltage U_i	75 V DC
Effective distance s_e	5 mm
Load resistance R_L	At voltage output U_{out} : $R_L \geq 2$ k Ω , At current output I_{out} : $R_L \leq 500$ Ω
No-load supply current I_0 at U_e	≤ 30 mA
Polarity reversal protected	yes
Short-circuit protected	yes
Ambient temperature T_a	-10...+70 °C
Repeat accuracy R_{BWN}	$\leq \pm 30$ μ m
Non-linearity	± 0.3 mm
Temperature coefficient TC	Typical +4 μ m/K
In the optimum range	Min. +2 μ m/K
From +10...+50 °C	max +10 μ m/K
Power-on indicator	yes
Programming indicator	yes
Degree of protection as per IEC 60529	IP 67
Housing material	PA fiberglass reinforced
Connection	Connectors
Approval	cULus
Recommended connector	BKS-S 74/BKS-S 75

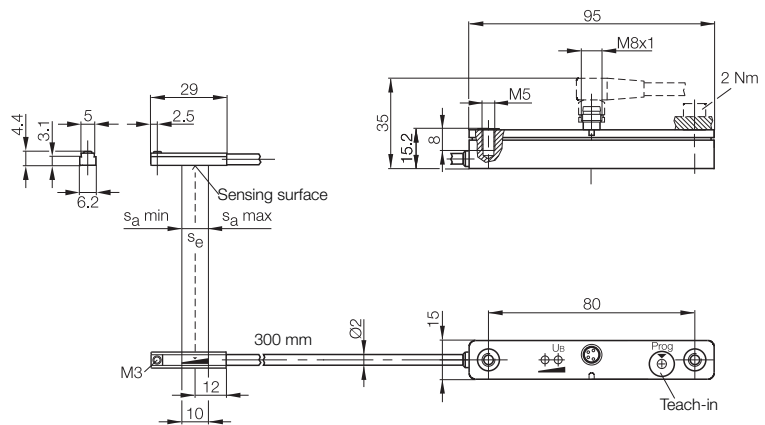
Inductive Position Sensors
Magneto-inductive Position Sensors BIL
Summary
Micro-BIL
BIL
Accessories
Inductive Position Sensors BIP
Basic Information and Definitions

Adjustment to different magnetic field strengths is possible at the touch of a button. The technical data refer to reference measurements. Different grippers/cylinders with differing magnetic fields may affect the technical data.

Connection wiring diagram



Connect either the voltage or current output.



Magneto-inductive Position Sensors BIL

General data



Output signal U_{out}	Voltage 0...10 V, out-of-range 11 V	
Output signal I_{out}		
Working range s_w	0...60 mm	
Linear range s_l	5...55 mm	
Ordering code	BIL0001	
Part number	BIL AMD0-T060A-01-S75	
Supply voltage U_s	15...30 V DC	
Residual ripple	$\leq 10\%$ of U_e	
Rated insulation voltage U_i	75 V DC	
Effective distance s_e	30 mm	
Load resistance R_L	$\geq 2 \text{ k}\Omega$	
No-load supply current I_0 at U_e	$\leq 30 \text{ mA}$	
Polarity reversal protected	yes	
Short-circuit protected	yes	
Ambient temperature T_a	$-10...+75 \text{ }^\circ\text{C}$	
Repeat accuracy R_{BWN}	$\leq \pm 60 \mu\text{m}$	
Linearity	$\leq \pm 1 \text{ mm}$	
Limit frequency (-3 dB)	1500 Hz	
Measurement speed	$\leq 5 \text{ m/s}$	
Temperature coefficient TC	Typical	$+5 \mu\text{m/K}$
In the optimum range	Min.	$-20 \mu\text{m/K}$
From $+10...+50 \text{ }^\circ\text{C}$	max	$+30 \mu\text{m/K}$
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

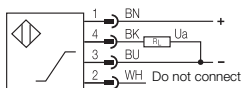
Position encoder within working range:

- Output voltage 0...10 V or output current 4...20 mA
- LED not on

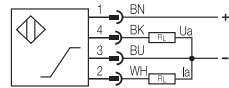
Position encoder outside the working range:

- Output voltage approx. 11 V or output current approx. 22 mA
- LED lights up

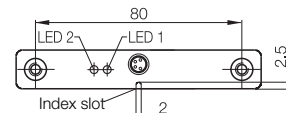
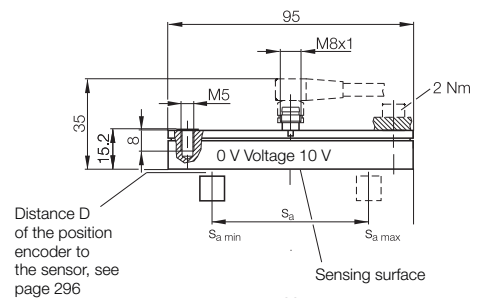
BIL AMD0...



BIL EMD0.../BIL ED0...



Connect either the voltage or current output.



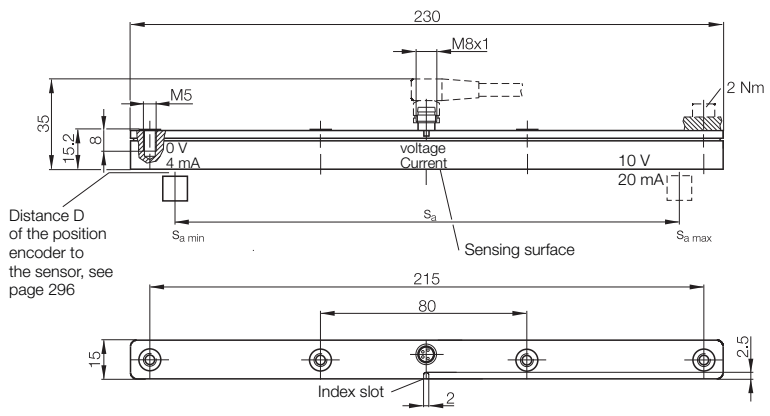
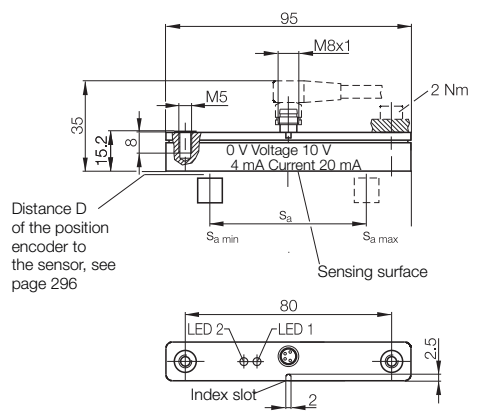
Original mounting brackets and screws are recommended for attaching the BIL.

Please order accessories separately. See page 296



Voltage 0...10 V, out-of-range 11 V or current 4...20 mA, out-of-range 22 mA	Voltage 0...10 V or Current 4...20 mA
0...60 mm	0...160 mm
5...55 mm	0...160 mm
BIL0006	BIL0004
BIL EMD0-T060A-01-S75	BIL ED0-P160A-01-S75
At voltage output U_{out} : $U_S = 15$ to 30 V DC, At current output I_{out} : $U_S = 10...30$ V DC $\leq 10\%$ of U_e	At voltage output U_{out} : $U_S = 15$ to 30 V DC, At current output I_{out} : $U_S = 10...30$ V DC $\leq 10\%$ of U_e
75 V DC	75 V DC
30 mm	80 mm
At voltage output U_{out} : $R_L = \geq 2$ k Ω , At current output I_{out} : $R_L = \leq 500$ Ω	At voltage output U_{out} : $R_L = \geq 2$ k Ω , At current output I_{out} : $R_L = \leq 500$ Ω
≤ 30 mA	≤ 25 mA
yes	yes
yes	yes
$-10...+75$ °C	$-10...+75$ °C
$\leq \pm 60$ μ m	$\leq \pm 500$ μ m
$\leq \pm 1$ mm	$\leq \pm 2.4$ mm
1500 Hz	300 Hz
≤ 5 m/s	≤ 5 m/s
+5 μ m/K	-40 μ m/K
-20 μ m/K	+120 μ m/K
+30 μ m/K	-200 μ m/K
yes	No
yes	No
IP 67	IP 67
PA mod.	PA mod.
Connectors	Connectors
cULus	cULus
BKS-S 74/BKS-S 75	BKS-S 74/BKS-S 75

- Inductive Position Sensors
- Magneto-inductive Position Sensors BIL
- Summary
- Micro-BIL
- BIL**
- Accessories
- Inductive Position Sensors BIP
- Basic Information and Definitions

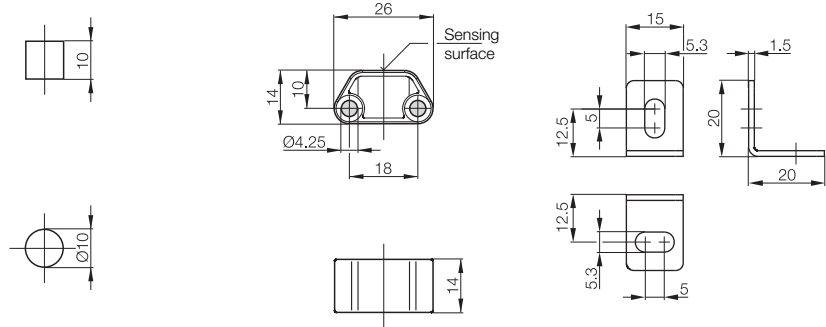


Magneto-inductive Position Sensors BIL

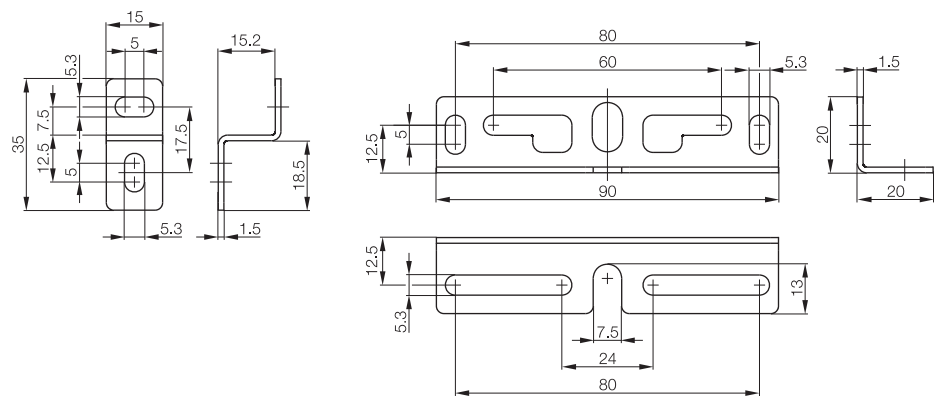
Accessories



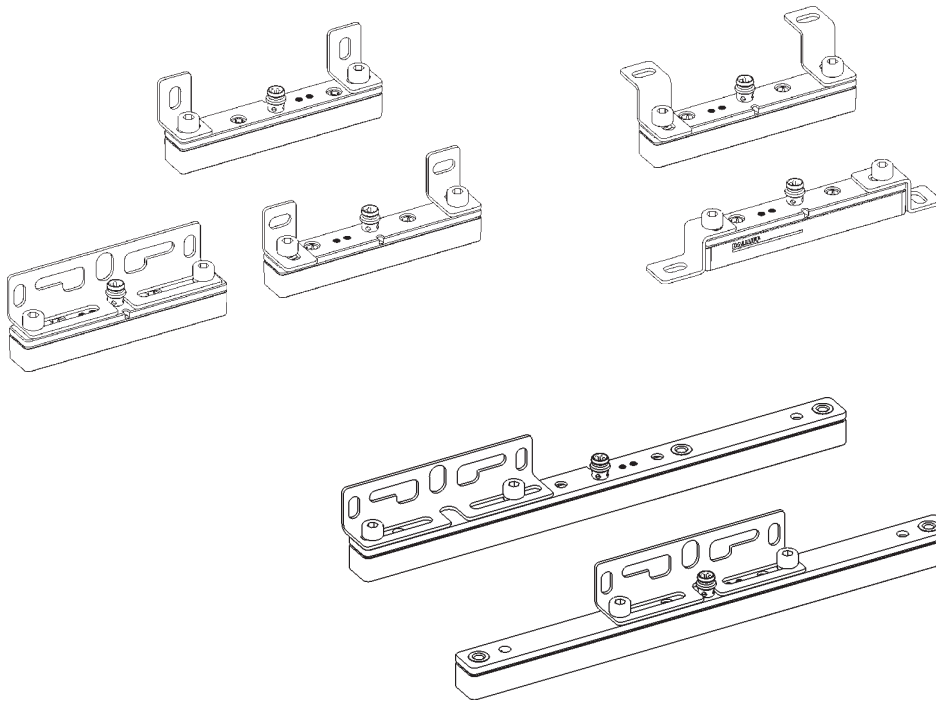
Designation	Position encoder	Position encoder	Mounting bracket
Size	Ø 10×10 mm	26×14×14 mm	
Ordering code	BAM0176	BAM0177	BAM00K4
Part number	BIL 000-MH-A	BIL 001-MH-A	BIL 01-HW-1
Material	Hard ferrite	PA fiberglass reinforced	Stainless steel
Distance D	2 mm	1 mm	



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

Magneto-
inductive
Position Sensors
BIL
Summary
Micro-BIL
BIL
Accessories

Inductive
Position Sensors
BIP

Basic
Information and
Definitions

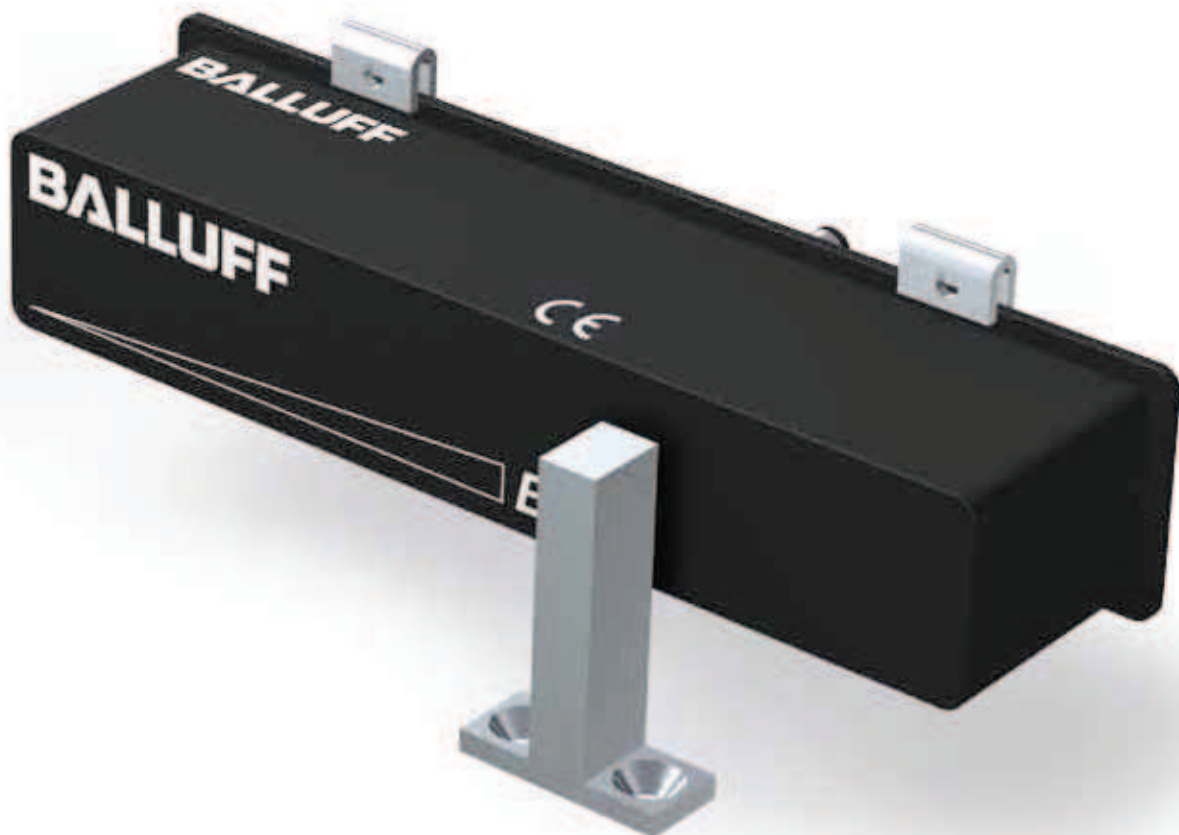


Inductive Position Sensors

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

- 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

Able to be integrated perfectly



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	

Inductive Position Sensors BIP

General data



BIP0001	BIP0007	BIP0008	BIP0002	BIP0004	BIP0005
BIP AD0-B014-01-EP02	BIP LD2-T014-01-EP02	BIP CD2-B014-01-EP02	BIP AD2-B040-02-S4	BIP LD2-T040-02-S4	BIP CD2-B040-02-S4
0...10 V	IO-Link	4...20 mA	0...10 V	IO-Link	4...20 mA
7...14 mm			20...40 mm		
0...14 mm			0...40 mm		
8 mm			14 mm		
0.5...2 mm			1...3 mm		
14 µm			40 µm		
±80 µm			±100 µm		
±250 µm			±400 µm		
-25...+70 °C			-25...+85 °C		
2 m cable			M12 connector		
15...30 V (IO-Link 18...30 V)			15...30 V (IO-Link 18...30 V)		
PA			PA		
yes			yes		



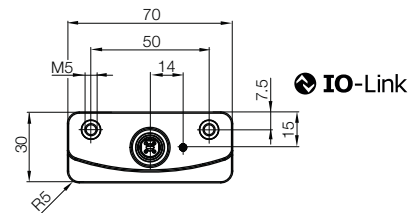
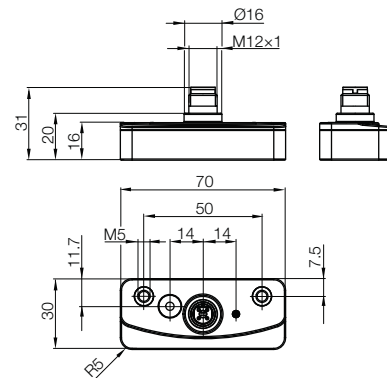
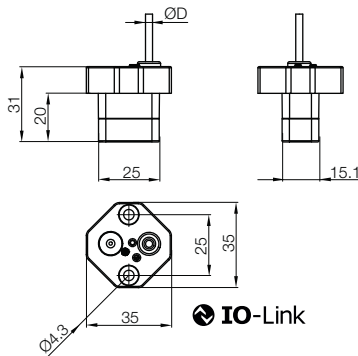
Inductive Position Sensors

Magneto-inductive Position Sensors BIL

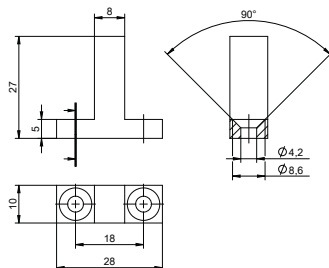
Inductive Position Sensors BIP

General Data

Basic Information and Definitions

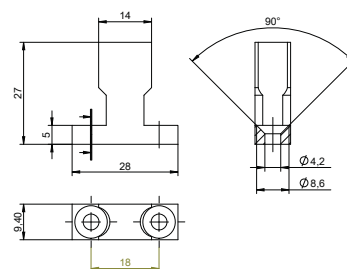


BAM TG-XE-001



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.





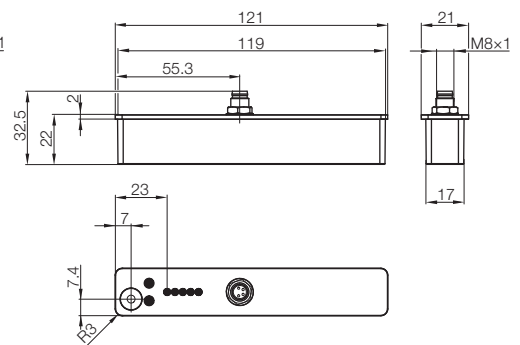
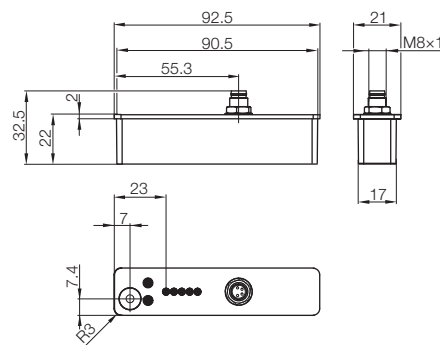
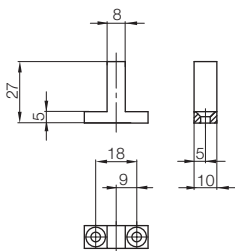
teachable



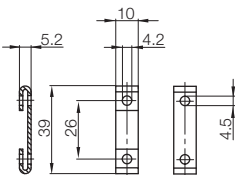
teachable

Ordering code	BIP000C	BIP000E
Part number	BIP ED2-B070-03-S75	BIP ED2-B103-03-S75
Output signal	0...10 V and 4...20 mA	0...10 V and 4...20 mA
Length of measuring range is teachable	35...70 mm	51.5...103 mm
Detection range	0...76.5 mm	0...105 mm
Target width (EC80)	8 mm	8 mm
Target distance	1...3 mm	1...3 mm
Resolution	80 µm	80 µm
Repeat accuracy	±80 µm	±80 µm
Linearity deviation	±300 µm	±400 µm
Ambient temperature	-25...+85 °C	-25...+85 °C
Connection	M8 connector	M8 connector
Supply voltage	16...30 V	16...30 V
Housing material	PBT	PBT
LED function indicator	yes	yes

Please order **Metal Target** separately.
Part number: BAM TG-XE-001
Ordering code: BAM01CP



Two fastening clips incl. screws are included in the delivery.



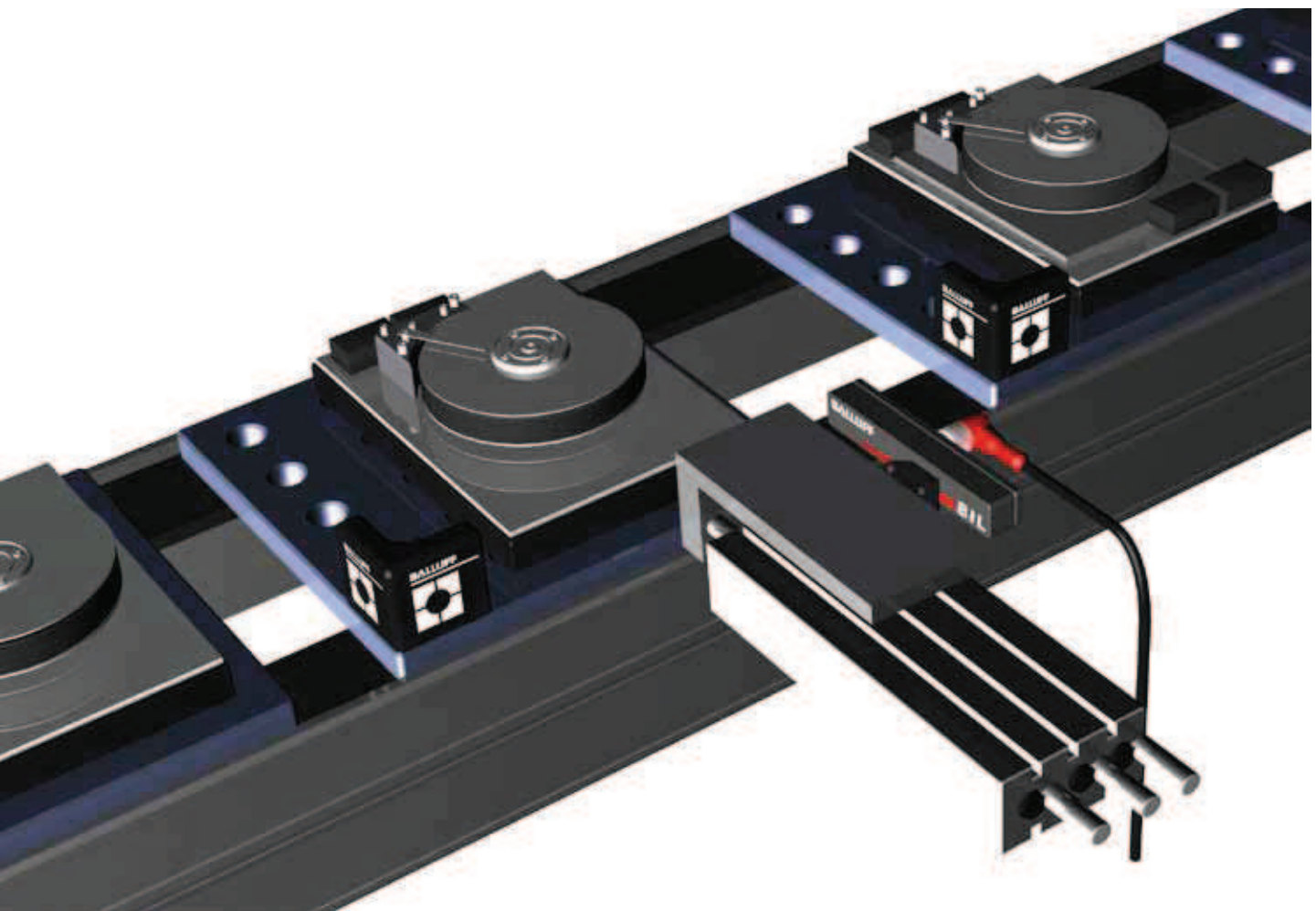
- Absolute measuring principle, several measuring ranges, teachable
- High repeat accuracy and precision
- Wide working temperature range and low temperature drift
- Optimized housing design, IP 67 degree of protection
- Standard output 0...10 V, 4...20 mA

Inductive Position Sensors BIP

Application

Inductive position sensors detect linear motion and provide a position-dependent output signal. The compact design makes them easy to integrate and monitor assembly and joining processes.

- Compact and easy to integrate
- Wear-free
- Absolute measuring principle
- High power density – Optimal measurement path ratio to the housing geometry
- Analog output signal or IO-Link



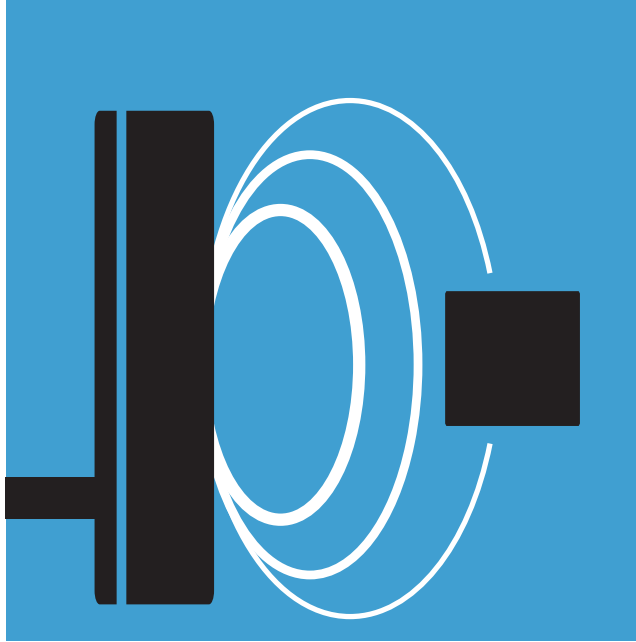
Inductive Position Sensors

Magneto-inductive Position Sensors BIL

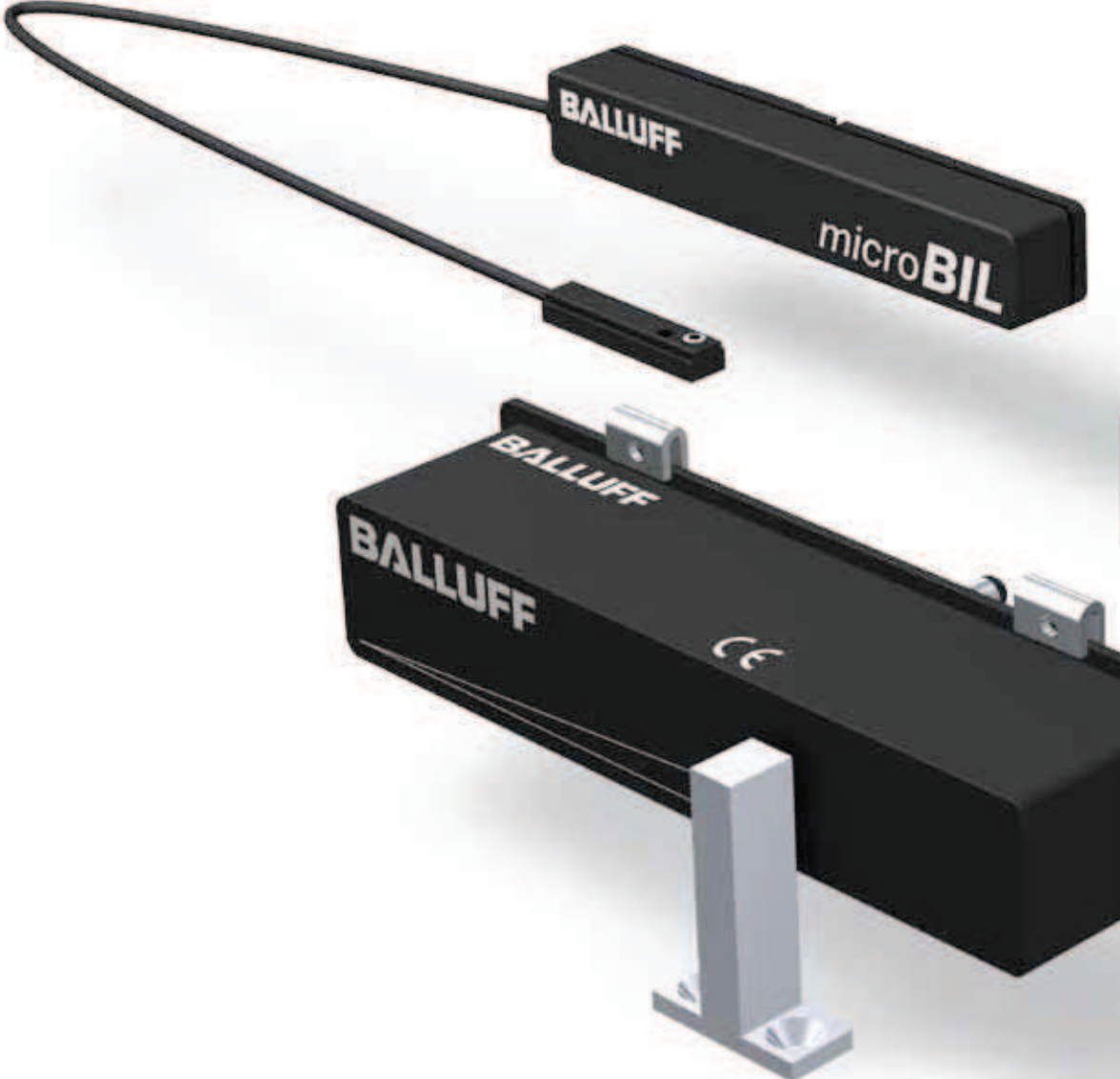
Inductive Position Sensors BIP

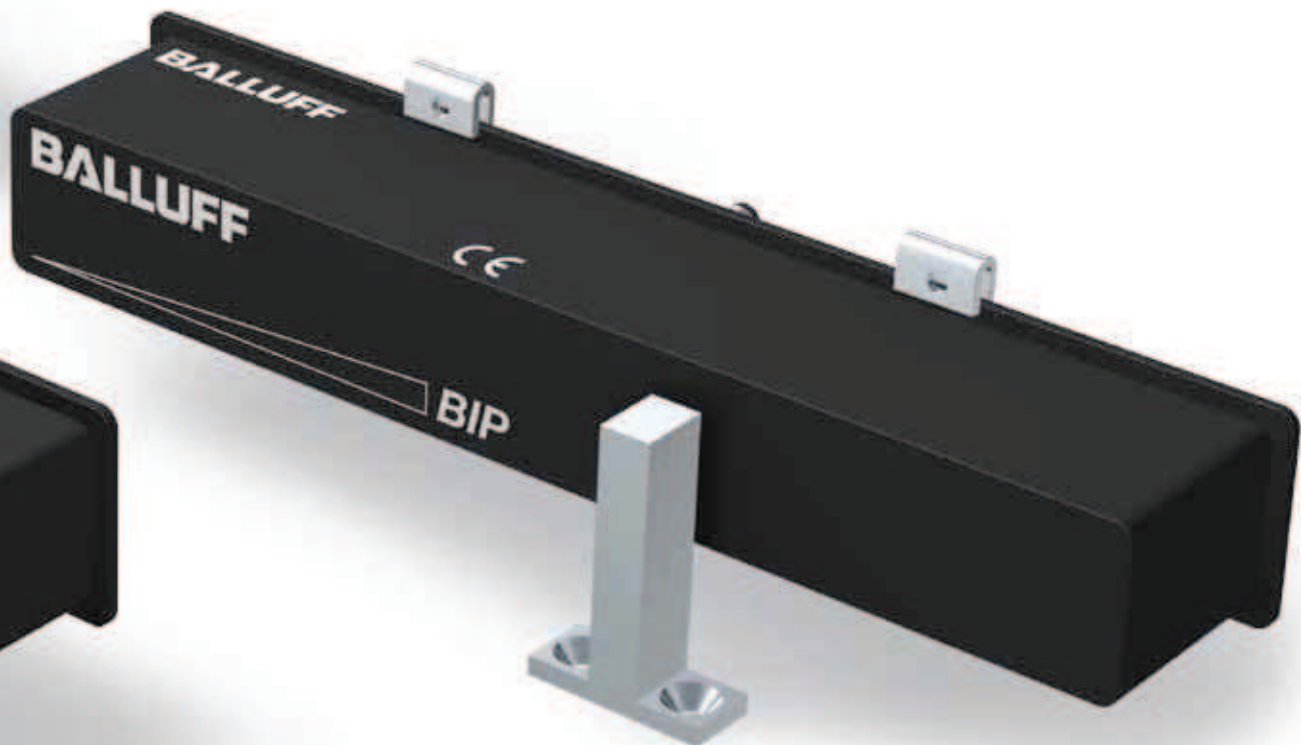
General Data

Basic Information and Definitions



Inductive Position Sensors





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 position 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 s_w is the travel path usable for position detection.

Effective distance s_e

Effective distance s_e is the point in the middle of the linear range s_l and is used as the reference point for other specifications.

Linear range s_l

Linear range s_l corresponds to the working range where the displacement sensor exhibits a defined linearity.

Non-linearity

Non-linearity specifies the maximum deviation of the characteristic from a straight reference line. This value applies to the linear range.

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:

$$\text{Slope } S \text{ [V/mm]} = \frac{U_{\text{out max}} - U_{\text{out min}}}{s_w \text{ max} - s_w \text{ min}}$$

or

$$\text{Slope } S \text{ [mA/mm]} = \frac{I_{\text{out max}} - I_{\text{out min}}}{s_w \text{ max} - s_w \text{ min}}$$

Temperature drift

Temperature drift is the shift a point experiences on the actual output curve at different temperatures. Temperature drift is described by the temperature coefficient.

Temperature coefficient TC

Temperature coefficient TC describes the deviation of the sensor output signal under the effect of a temperature change, and thus represents a quality criterion for the sensor as well.

Tolerance T

Tolerance T is a variable that defines the manufacturing tolerance band of the output curve, thereby determining the maximum sample deviation.

Basic Information and Definitions

Definitions

Repeat accuracy R

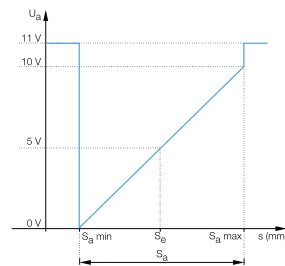
Repeat accuracy R is the value of output signal changes under defined conditions, expressed as a percentage of the upper distance. The measurement must be taken in the lower, upper and center area of the linear range. It corresponds to the repeat accuracy R of proximity switches and is determined under 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}

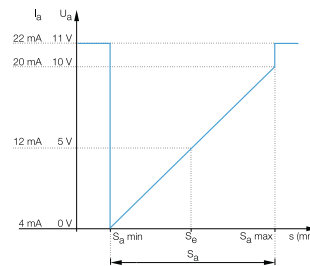
Repeat accuracy R_{BWN} describes the precision an analog sensor achieves when moving to a measuring point multiple times. This value, specified based on Balluff Factory Standard (BWN Pr. 44), describes the maximum deviation from this measuring point.

Output curves

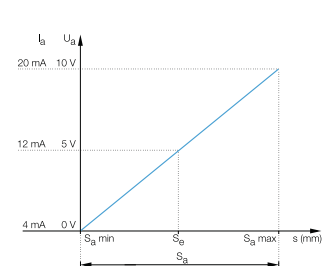
BIL AMD0...



BIL EMD0... / BIP ED2...



BIL ED0... / BIP AD... / BIP CD...



Inductive Position Sensors

Magneto-inductive Position Sensors BIL

Inductive Position Sensors BIP

Basic Information and Definitions

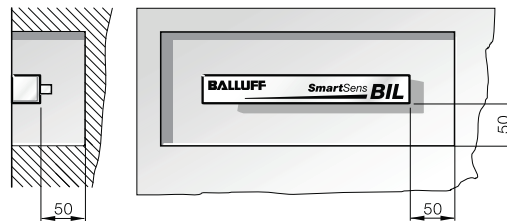
Installation notices

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.

