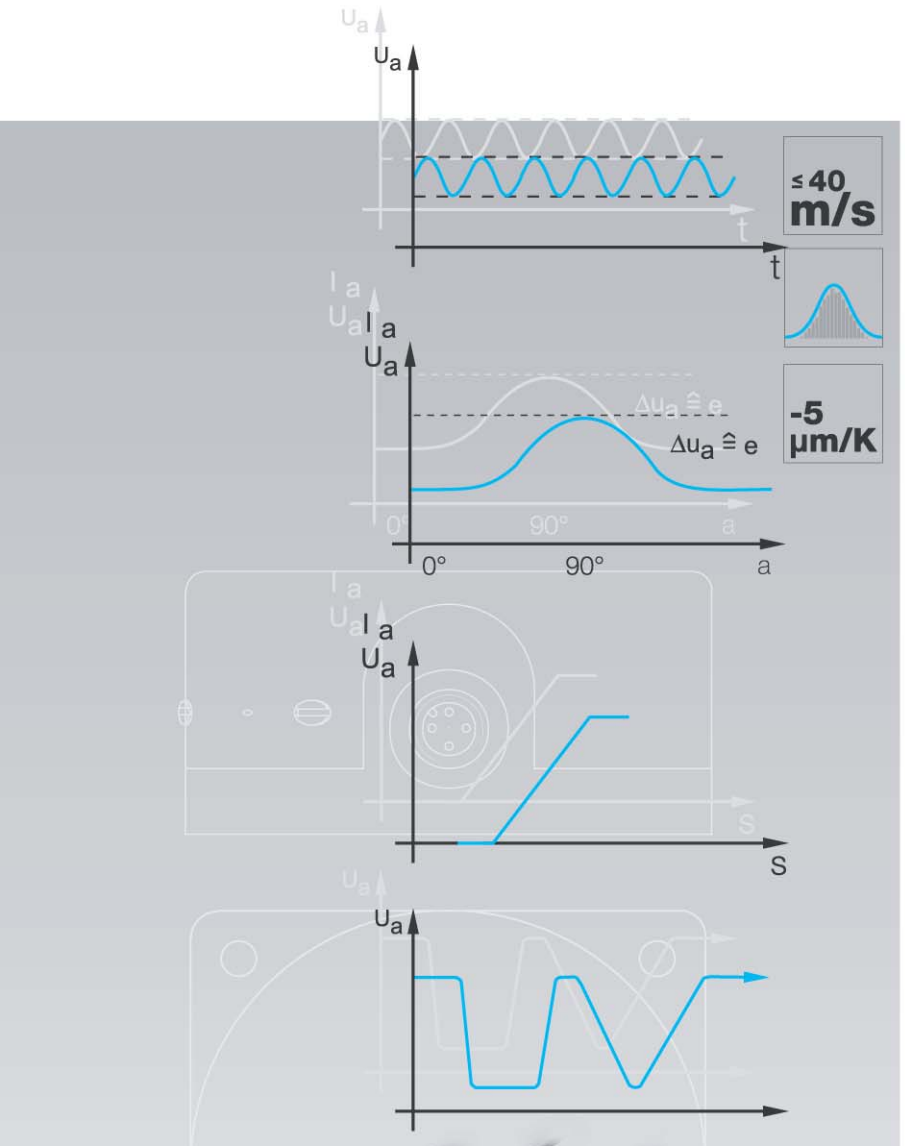
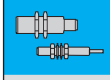


Inductive Distance Sensors

BAW inductive distance sensors provide a linear voltage or current output signal which changes in proportion to the distance between the damping element and the sensing face.



Connectors, holders ... starting page 81

Distance sensors with analog output

... are sensors which generate a continually varying output signal depending on the distance between their sensing face and the damping element.

Effective distance s_e

... is the point in the center of the linear range s_l used as a reference point for other specifications.

Linear range s_l

... corresponds to the working range in which the distance sensor is characterized by a defined linearity.

Non-linearity

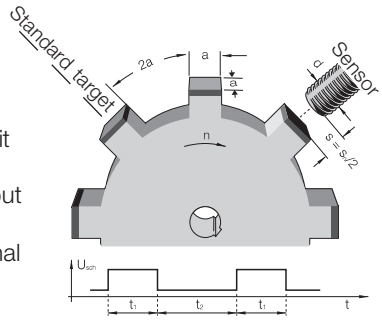
… indicates the maximum deviation of the output curve from a reference straight line. This value applies to the linear range.

Limit frequency (–3 dB)

.. refers to the maximum number of switching operations per second.

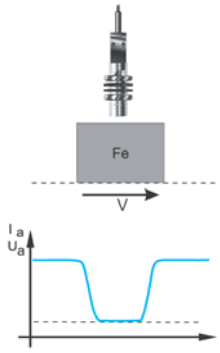
Damping is per EN 60947-5-2 with standard targets on a rotating, non-conducting disk. The surface area ratio of iron to non-conductor must be 1 : 2.

The rated value of the limit frequency (–3 dB limit) is reached when the output signal has dropped to approx. 70% of the original signal level.



Measuring speed

… indicates the ability to reliably detect the distance of a linear moving object. The direction of movement of the object is assumed to be parallel to the sensing face of the sensor.



Response time

… is the time which a sensor requires in order to reliably and steadily change the output signal. The specified time, which was determined at maximum measuring speed, includes both the electrical response time of the sensor and the time for the mechanical change in the damping state.

Slope

… is a measure of the sensitivity of the sensor with respect to a distance change. This physical relationship can be calculated for distance sensors as follows:

$$\text{Slope S [V/mm]} = \frac{U_a\,\text{max} - U_a\,\text{min}}{s_l\,\text{max} - s_l\,\text{min}}$$

resp.

$$\text{Slope S [mA/mm]} = \frac{I_a\,\text{max} - I_a\,\text{min}}{s_l\,\text{max} - s_l\,\text{min}}$$

Temperature drift

... is the shift which a point experiences on the actual output curve at various temperatures. The temperature drift is described by the temperature coefficient.

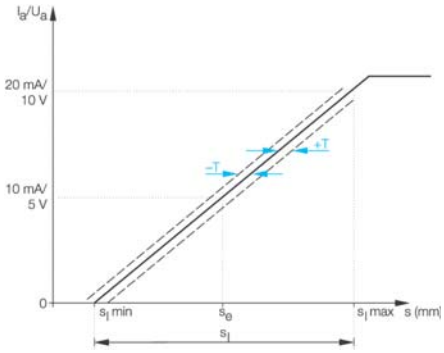
Temperature coefficient TK

… describes the deviation in the sensor output signal under the effect of a temperature change.

Tolerance T

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

Housing size	„T“ for flush mountable sensors	„T“ for non-flush mountable sensors
Ø 6.5 mm	± 0.125 mm	
M8	± 0.1 mm	± 0.15 mm
M12	± 0.125 mm	± 0.25 mm
M18	± 0.3 mm	± 0.5 mm
M30	± 0.6 mm	± 0.8 mm
PG 36	± 0.1 mm	
20×30×8 mm	± 0.125 mm	
80×80×40 mm	± 1.0 mm	



Repeat accuracy R

... is the value of the output signal changes under specified conditions, expressed 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). Distance sensors with analog output achieve the value R defined in the standard of ≤ 5 %.

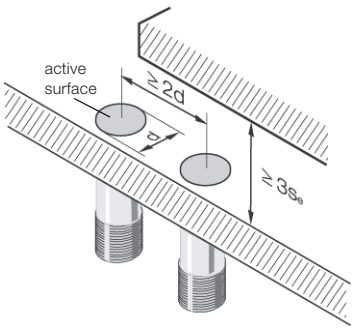
Repeat accuracy R_{BWN}

… describes the precision which an analog sensor achieves when approaching the same point multiple times. The value specified on the basis of the Balluff Factory Standard (BWN Pr. 44) describes the maximum deviation from this measuring point.

Installation in metal – Sensors with analog output

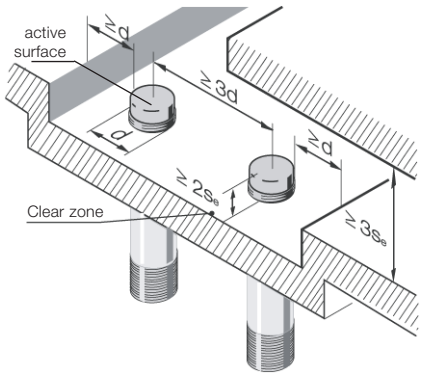
Flush mountable proximity switches

... can be installed with their sensing faces flush to the metal. The distance from opposing metal surfaces must be ≥ $3s_e$ and the distance between two proximity switches (side-by-side) ≥ 2d.



Non-flush mountable proximity switches

... can be identified by their “caps”, since they have no metal housing surrounding the area of the sensing face. The sensing face must extend ≥ $2s_e$ from the metallic installation medium. The distance from opposing metal surfaces must be ≥ $3s_e$ and the distance between two adjacent proximity switches ≥ 3d.



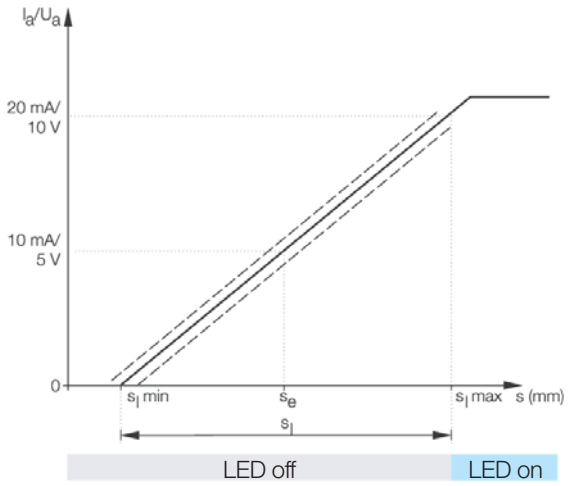
BAW
Connectors, holders ... starting page 81

Balluff **inductive distance sensors BAW** provide an absolute voltage or current signal which changes in proportion to the distance of a metal target. Workpieces of varying shapes and sizes made of ferrous or non-ferrous material damp the sensor to varying degrees. This provides a simple way of detecting positions, distances and material differences.

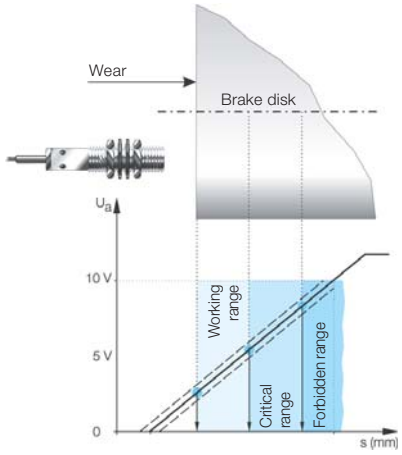
Features

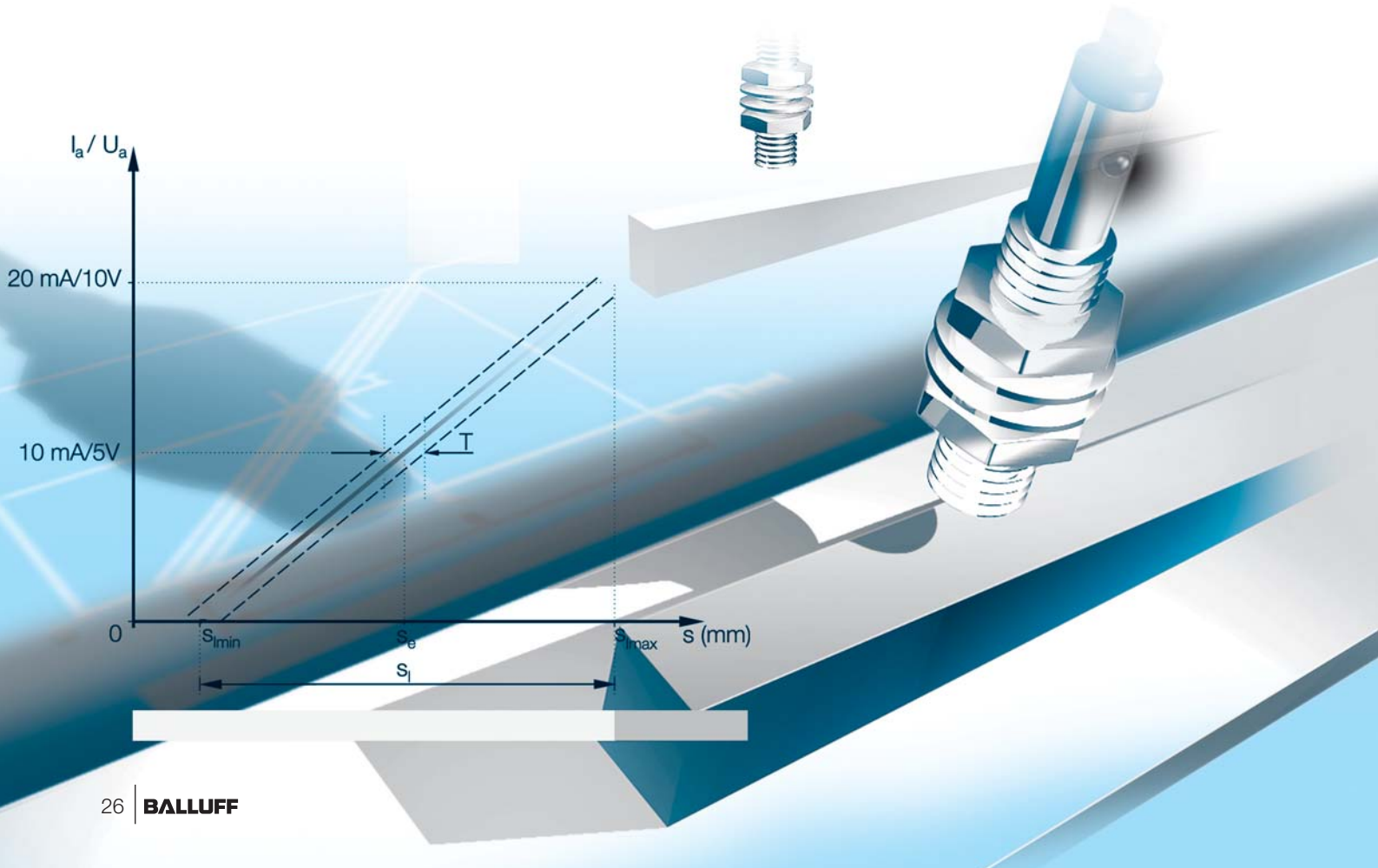
- Distance-proportional analog output signal
- Non-contact, absolute measuring principle
- Variety of form factors:
  - tubular
  - block style
- Measuring ranges from 0.5 to 50 mm
- High repeat accuracy
- Optimal linearity
- Low temperature drift
- Measuring speed up to 40 m/s
- LED for restricting the working range
- Insensitive to contamination

Output curve



Evaluating programmed switching points (brake disk example)



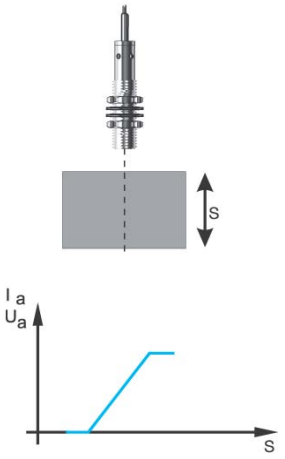


Applications

A few examples of the many industrial application possibilities:

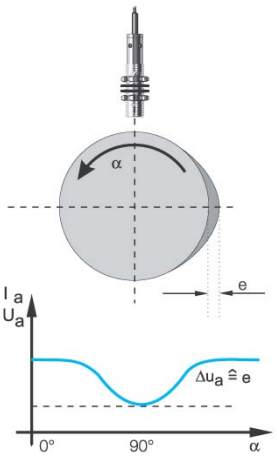
- Distance sensing (even at high speeds)
- Thickness measurement of films, sheets
- Band center measurement
- Measuring the width of metal bands
- Detecting waviness
- Counting
- Positioning
- Position monitoring
- Clamping distance monitoring
- Selection of various sizes and materials

Axial approach



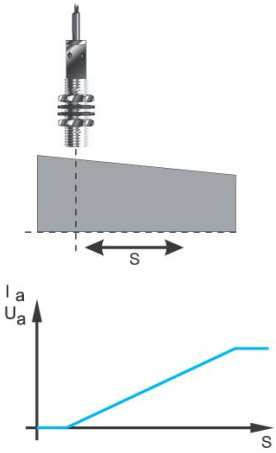
Distance changes in the sensor axis result in distance-proportional output signals.

Scanning a rotating object



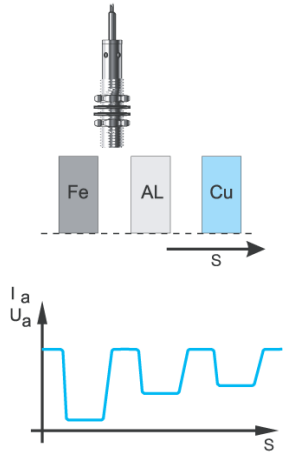
Eccentrics, cams or unbalanced motion result in a periodic change in the output signal.

Lateral approach



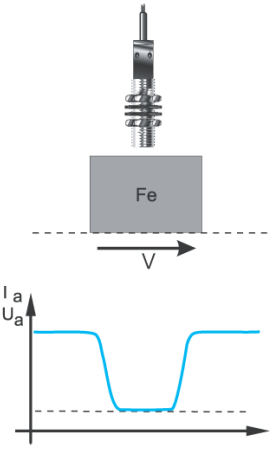
Detecting longer distances by sensing an inclined plane.

Detecting various materials



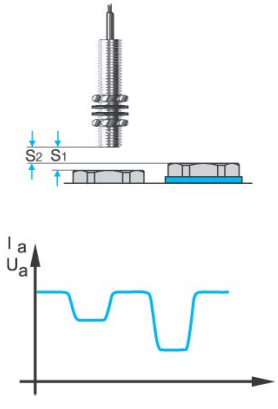
When the distance is kept constant, the output signal changes only when the object material is different.

Distance measurements at high object traverse speeds



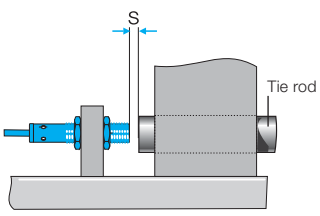
Even at high traverse speeds distances can be precisely measured.

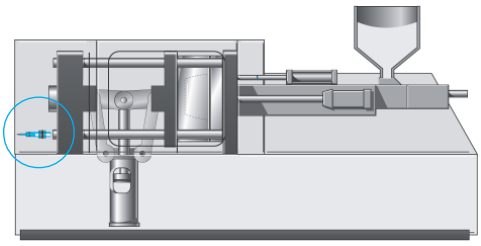
Detecting installed seal rings



The seal ring effectively reduces the distance between the nut/screw and the sensor, thereby changing the output signal.

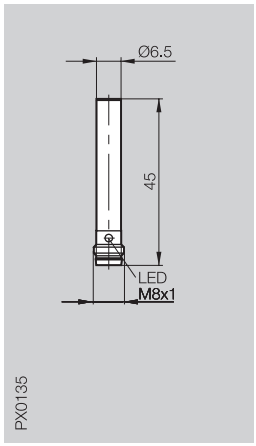
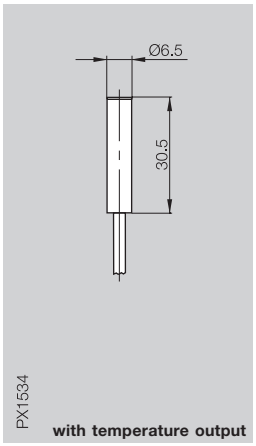
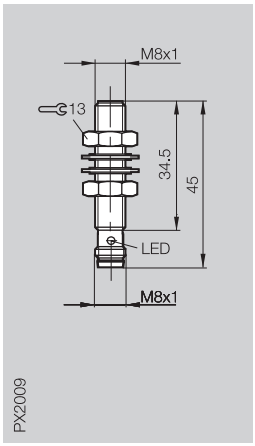
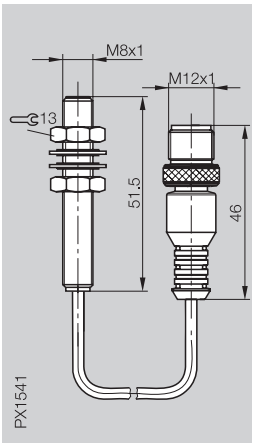
Tie rod length change on an injection molding machine





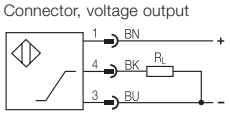
In injection molding machines, the clamping force of the tool is built up through a toggle joint and a hydraulic cylinder. The extension of the machine tie rods is thereby directly proportional to the clamping force, and can be easily determined using an inductive distance sensor.

BAW
Connectors, holders ... starting page 81

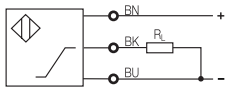
Housing size	**Ø 6.5 mm**	**Ø 6.5 mm**	**M8×1**	**M8×1**
Mounting	flush	flush	flush	flush
Output signal	**Voltage 0...10 V**	**Voltage 0...10 V**	**Voltage 0...10 V**	**Voltage 0...10 V**
Linear range s_l	0.5...2 mm	0.5...2 mm	0.5...1.5 mm	0.5...1.5 mm
				
Ordering code	BAW G06EF-UAC20B-S49G	BAW G06EE-UAF20B-EP03-K	BAW M08EF-UAC15B-S49G	BAW M08EI-UAD15B-BP00.2-GS04
Supply voltage U_B	15...30 V DC	21.6...26.4 V DC	15...30 V DC	15...30 V DC
Ripple	≤ 15 % of U_e	≤ 10 % of U_e	≤ 15 % of U_e	≤ 15 % of U_e
Rated insulation voltage U_i	75 V AC	75 V DC	250 V AC	250 V AC
Effective distance s_e	1.25 mm	1.25 mm	1 mm	1 mm
Load resistance R_L (R_T)	≥ 2 kΩ	≥ 5 kΩ (≥ 5 kΩ)	≥ 2 kΩ	≥ 2 kΩ
No-load current I_0 at U_e	≤ 10 mA	≤ 15 mA	≤ 10 mA	≤ 8 mA
Polarity reversal protected	yes	no	yes	yes
Short circuit protected	yes	no	yes	yes
Adjustment indicator (end of linear range)	yes	no	yes	no
Ambient temperature range T_a	+10...+60 °C*	+10...+60 °C*	–10...+70 °C	–10...+70 °C
Repeat accuracy R_{BWN}	±10 µm	±10 µm	± 8 µm	± 8 µm
Non-linearity	≤ ±45 µm	≤ ±45 µm	≤ ±30 µm	≤ ±30 µm
Limit frequency (–3 dB)	1000 Hz	1000 Hz	1000 Hz	1000 Hz
Measuring speed	≤ 10 m/s	≤ 10 m/s	≤ 20 m/s	≤ 20 m/s
Response time	0.5 ms	1 ms	0.5 ms	0.5 ms
Temperature coefficient TK typical	–1 µm/K	–1 µm/K	–1 µm/K	–1 µm/K
in the optimal range min.	+1 µm/K	+1 µm/K	–0.5 µm/K	–0.5 µm/K
from +10...+50 °C max.	–3 µm/K	–3 µm/K	–2 µm/K	–2 µm/K
Degree of protection per IEC 60529	IP 67	IP 67	IP 67	IP 67
Insulation class			⧈	⧈
Housing material	Stainless steel	Stainless steel	Stainless steel	Stainless steel
Material of sensing face	PBT	PBT	PBT	PBT
Connection	Connectors	3 m cable PUR	Connectors	0.2 m cable (PUR) with connector
No. of wires × cross-section		4×0.14 mm²		
Approval	cULus	cULus	cULus	cULus
Recommended connector	BKS-_ 48/BKS-_ 49		BKS-_ 48/BKS-_ 49	BKS-_ 19

Wiring diagrams

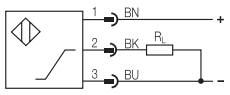
Connector, voltage output



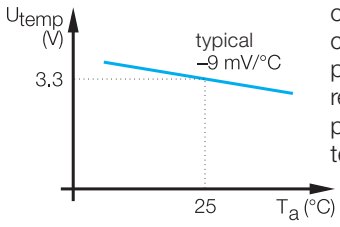
Cable, voltage output



Connector, current output

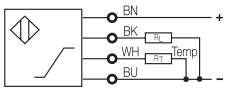


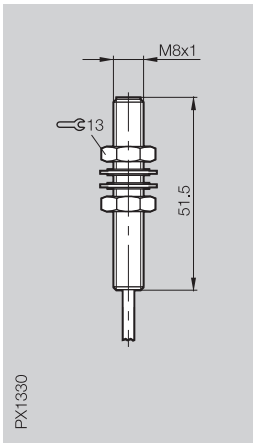
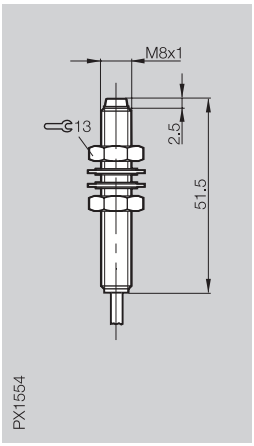
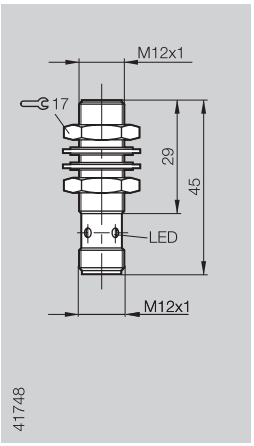
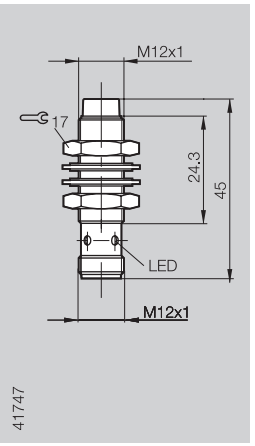
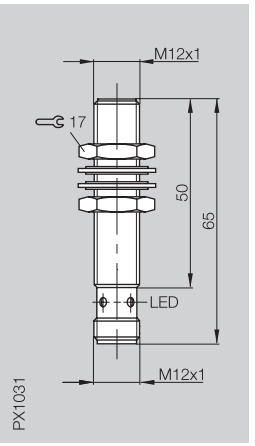
Temperature output



The temperature output (not short circuit protected) provides a signal representing a precisely measured temperature change.

Cable, voltage output, additional temperature output

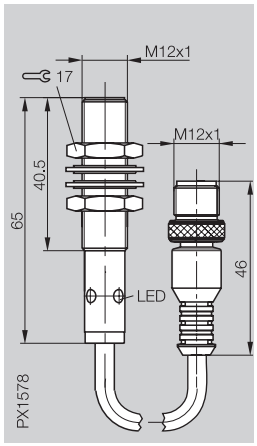
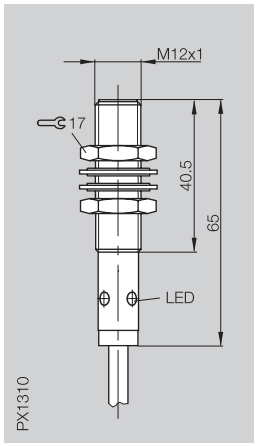
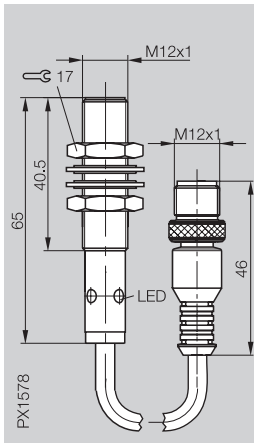
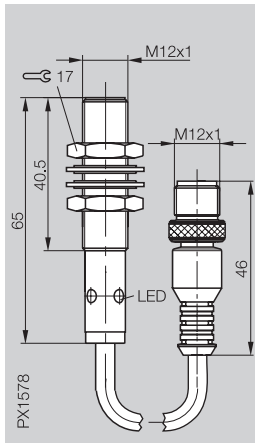


	M8×1	M8×1	M12×1	M12×1	M12×1
	flush	non-flush	flush	non-flush	flush
	Voltage 0...10 V	**Voltage 0...10 V**	**Voltage 0...10 V**	**Voltage 0...10 V**	**Voltage 0...10 V**
	0.5...1.5 mm	0.5...2.5 mm	0.5...2 mm	1...4 mm	0.5...2 mm
					
	BAW M08EI-UAD15B-BP03	BAW M08EI-UAD25F-BP03	BAW M12ME-UAC20B-S04G	BAW M12MD-UAC40F-S04G	BAW M12MI-UAC20B-S04G
	15...30 V DC	15...30 V DC	15...30 V DC	15...30 V DC	15...30 V DC
	≤ 15 % of U_e	≤ 15 % of U_e	≤ 15 % of U_e	≤ 15 % of U_e	≤ 15 % of U_e
	250 V AC	250 V AC	250 V AC	250 V AC	250 V AC
	1 mm	1.5 mm	1.25 mm	2.5 mm	1.25 mm
	≥ 2 kΩ	≥ 2 kΩ	≥ 2 kΩ	≥ 2 kΩ	≥ 2 kΩ
	≤ 8 mA	≤ 8 mA	≤ 10 mA	≤ 10 mA	≤ 10 mA
	yes	yes	yes	yes	yes
	yes	yes	yes	yes	yes
	no	no	yes	yes	yes
	–10...+70 °C	+10...+60 °C*	–10...+70 °C	–10...+70 °C	–10...+70 °C
	± 8 µm	±10 µm	± 8 µm	±10 µm	± 8 µm
	≤ ±30 µm	≤ ±60 µm	≤ ±45 µm	≤ ±90 µm	≤ ±45 µm
	1000 Hz	1000 Hz	500 Hz	500 Hz	500 Hz
	≤ 20 m/s	≤ 10 m/s	≤ 40 m/s	≤ 20 m/s	≤ 40 m/s
	0.5 ms	1 ms	0.5 ms	1 ms	0.5 ms
	–1 µm/K	–1.5 µm/K	–0.5 µm/K	0 µm/K	–0.5 µm/K
	–0.5 µm/K	0 µm/K	1.5 µm/K	–2 µm/K	+1.5 µm/K
	–2 µm/K	–8 µm/K	–2.5 µm/K	4 µm/K	–2.5 µm/K
	IP 67	IP 67	IP 67	IP 67	IP 67
	⧈	⧈	⧈	⧈	⧈
	Stainless steel	Stainless steel	Nickel plated brass	Nickel plated brass	Nickel plated brass
	PBT	PBT	PA 12	PBT	PA 12
	3 m cable PUR	3 m cable PUR	Connectors	Connectors	Connectors
	3×0.14 mm²	3×0.14 mm²			
	cULus	cULus	cULus	cULus	cULus
			BKS-_ 19/BKS-_ 20	BKS-_ 19/BKS-_ 20	BKS-_ 19/BKS-_ 20

Other cable lengths on request.

*The function is assured over a range of –10...+70 °C.

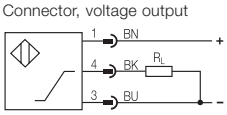
BAW
Connectors, holders ... starting page 81

Housing size	**M12×1**	**M12×1**	**M12×1**	**M12×1**
Mounting	flush	flush	flush	flush
Output signal	**Voltage 0...10 V**	**Voltage 0...10 V**	**Current 0...20 mA**	**Current 4...20 mA**
Linear range s_l	0.5...2 mm	0.5...2 mm	0.5...2 mm	0.5...2 mm
				
Ordering code	BAW M12MG2-UAC20B-BP00.2-GS04	BAW M12MG2-UAC20B-BP03	BAW M12MG2-IAC20B-BP00.2-GS04	BAW M12MG2-ICC20B-BP00.2-GS04
Supply voltage U_B	15...30 V DC	15...30 V DC	10...30 V DC	10...30 V DC
Ripple	≤ 15 % of U_e	≤ 15 % of U_e	≤ 15 % of U_e	≤ 15 % of U_e
Rated insulation voltage U_i	250 V AC	250 V AC	250 V AC	250 V AC
Effective distance s_e	1.25 mm	1.25 mm	1.25 mm	1.25 mm
Load resistance R_L	≥ 2 kΩ	≥ 2 kΩ	≤ 0.5 kΩ	≤ 0.5 kΩ
No-load current I_0 at U_e	≤ 10 mA	≤ 10 mA	≤ 10 mA	≤ 10 mA
Polarity reversal protected	yes	yes	yes	yes
Short circuit protected	yes	yes	yes	yes
Adjustment indicator (end of linear range)	yes	yes	yes	yes
Ambient temperature range T_a	–10...+70 °C	–10...+70 °C	–10...+75 °C	–10...+70 °C
Repeat accuracy R_{BWN}	± 8 µm	± 8 µm	± 5 µm	± 6 µm
Non-linearity	≤ ±45 µm	≤ ±45 µm	≤ ±45 µm	≤ ±40 µm
Limit frequency (–3 dB)	500 Hz	500 Hz	500 Hz	500 Hz
Measuring speed	≤ 40 m/s	≤ 40 m/s	≤ 40 m/s	≤ 40 m/s
Response time	0.5 ms	0.5 ms	0.5 ms	0.5 ms
Temperature coefficient TK typical	–1 µm/K	–1 µm/K	–1 µm/K	–0.5 µm/K
in the optimal range min.	–0.5 µm/K	–0.5 µm/K	0 µm/K	–3.5 µm/K
from +10...+50 °C max.	–2 µm/K	–2 µm/K	–3 µm/K	+4.5 µm/K
Degree of protection per IEC 60529	IP 67	IP 67	IP 67	IP 67
Insulation class	⧈	⧈	⧈	⧈
Housing material	Nickel plated brass	Nickel plated brass	Nickel plated brass	Nickel plated brass
Material of sensing face	PA 12	PA 12	PA 12	PA 12
Connection	0.2 m cable PUR with connector	3 m cable PUR	0.2 m cable PUR with connector	0.2 m cable (PUR) with connector
No. of wires × cross-section		3×0.34 mm²		
Approval	cULus	cULus	cULus	cULus
Recommended connector	BKS-_ 19		BKS-_ 19	BKS-_ 19

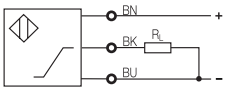
Wiring diagrams

Other cable lengths on request.

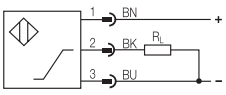
Connector, voltage output

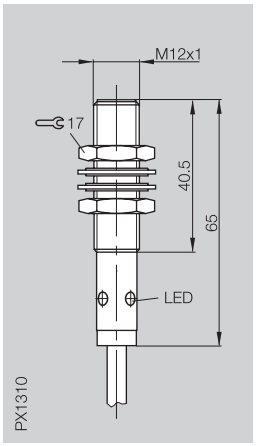
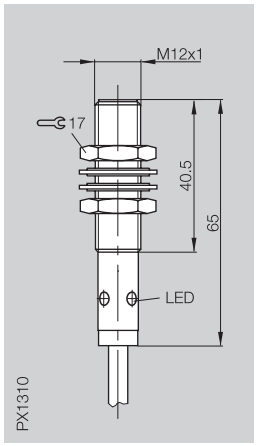
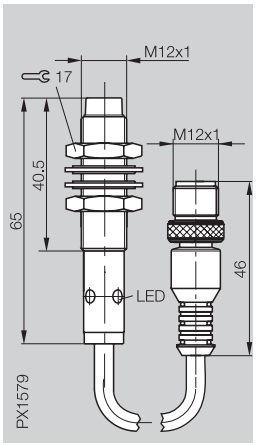
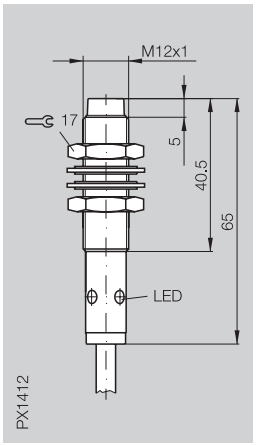


Cable, voltage output



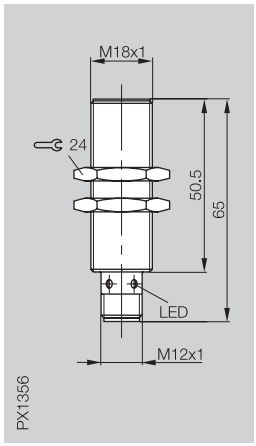
Connector, current output

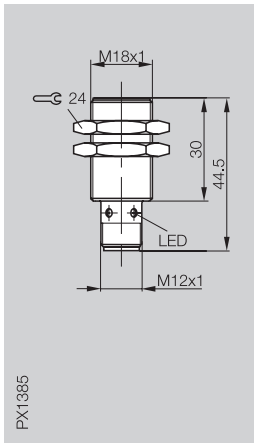


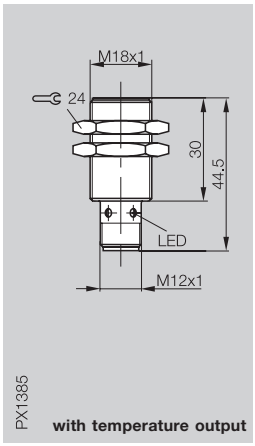
	M12×1 flush **Current 0...20 mA** 0.5...2 mm	**M12×1** flush **Current 4...20 mA** 0.5...2 mm	**M12×1** non-flush **Voltage 0...10 V** 1...4 mm	**M12×1** non-flush **Voltage 0...10 V** 1...4 mm
				
	BAW M12MG2-IAC20B-BP03	BAW M12MG2-ICC20B-BP03	BAW M12MF2-UAC40F-BP00.2-GS04	BAW M12MF2-UAC40F-BP03
	10...30 V DC	10...30 V DC	15...30 V DC	15...30 V DC
	≤ 15 % of U_e	≤ 15 % of U_e	≤ 15 % of U_e	≤ 15 % of U_e
	250 V AC	250 V AC	250 V AC	250 V AC
	1.25 mm	1.25 mm	2.5 mm	2.5 mm
	≤ 0.5 kΩ	≤ 0.5 kΩ	≥ 2 kΩ	≥ 2 kΩ
	≤ 10 mA	≤ 10 mA	≤ 10 mA	≤ 10 mA
	yes	yes	yes	yes
	yes	yes	yes	yes
	yes	yes	yes	yes
	–10...+70 °C	–10...+70 °C	–10...+70 °C	–10...+70 °C
	± 5 µm	± 6 µm	±10 µm	±10 µm
	≤ ±45 µm	≤ ±40 µm	≤ ±90 µm	≤ ±90 µm
	500 Hz	500 Hz	500 Hz	500 Hz
	≤ 40 m/s	≤ 40 m/s	≤ 20 m/s	≤ 20 m/s
	0.5 ms	0.5 ms	1 ms	1 ms
	–1 µm/K	–0.5 µm/K	0 µm/K	0 µm/K
	0 µm/K	–3.5 µm/K	–2 µm/K	–2 µm/K
	–3 µm/K	+4.5 µm/K	+4 µm/K	+4 µm/K
	IP 67	IP 67	IP 67	IP 67
	⧈	⧈	⧈	⧈
	Nickel plated brass	Nickel plated brass	Nickel plated brass	Nickel plated brass
	PA 12	PA 12	PBT	PBT
	3 m cable PUR	3 m cable PUR	0.2 m cable (PUR) with connector	3 m cable PUR
	3×0.34 mm²	3×0.34 mm²		3×0.34 mm²
	cULus	cULus	cULus	cULus
			BKS-_ 19	

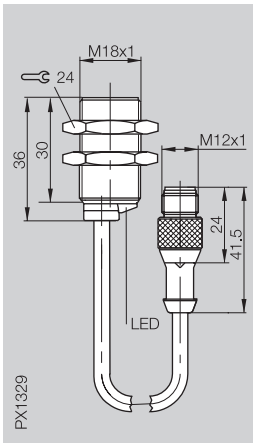
BAW
Connectors, holders ... starting page 81

Housing size	**M18×1**	**M18×1**	**M18×1**	**M18×1**
Mounting	flush	flush	flush	flush
Output signal	**Voltage 0...10 V**	**Voltage 0...10 V**	**Voltage 0...10 V**	**Voltage 0...10 V**
Linear range s_l	1...5 mm	1...5 mm	1...5 mm	1...5 mm





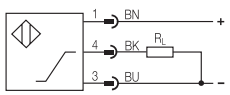




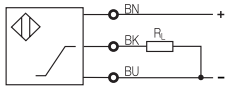
Ordering code	BAW M18MI-UAC50B-S04G	BAW M18ME-UAC50B-S04G	BAW M18ME-UAE50B-S04G-K	BAW M18ME-UAC50B-BP00.2-GS04
Supply voltage U_B	15...30 V DC	15...30 V DC	21.6...26.4 V DC	15...30 V DC
Ripple	≤ 15 % of U_e	≤ 15 % of U_e	≤ 10 % of U_e	≤ 15 % of U_e
Rated insulation voltage U_i	250 V AC	75 V DC	75 V DC	75 V DC
Effective distance s_e	3 mm	3 mm	3 mm	3 mm
Load resistance R_L (R_T)	≥ 2 kΩ	≥ 2 kΩ	≥ 2 kΩ (≥ 2 kΩ)	≥ 2 kΩ
No-load current I_0 at U_e	≤ 10 mA	≤ 10 mA	≤ 10 mA	≤ 10 mA
Polarity reversal protected	yes	yes	yes	yes
Short circuit protected	yes	yes	yes	yes
Adjustment indicator (end of linear range)	yes	yes	yes	yes
Ambient temperature range T_a	–10...+70 °C	–10...+70 °C	–10...+70 °C	–10...+70 °C
Repeat accuracy R_{BWN}	± 8 µm	± 8 µm	± 8 µm	± 8 µm
Non-linearity	≤ ±120 µm	≤ ±120 µm	≤ ±120 µm	≤ ±120 µm
Limit frequency (–3 dB)	500 Hz	500 Hz	500 Hz	500 Hz
Measuring speed	≤ 40 m/s	≤ 40 m/s	≤ 40 m/s	≤ 40 m/s
Response time	1 ms	1 ms	1 ms	1 ms
Temperature coefficient TK typical	–2 µm/K	–2 µm/K	–1 µm/K	–1 µm/K
in the optimal range min.	+1 µm/K	–1 µm/K	0 µm/K	0 µm/K
from +10...+50 °C max.	–8 µm/K	–5 µm/K	+4 µm/K	–4 µm/K
Degree of protection per IEC 60529	IP 67	IP 67	IP 67	IP 67
Insulation class	⧈			
Housing material	Nickel plated brass	Nickel plated brass	Nickel plated brass	Nickel plated brass
Material of sensing face	PBT	PBT	PBT	PBT
Connection	Connectors	Connectors	Connectors	0.2 m cable (PUR) with connector
No. of wires × cross-section				
Approval	cULus	cULus	cULus	cULus
Recommended connector	BKS-_ 19/BKS-_ 20	BKS-_ 19/BKS-_ 20	BKS-_ 19/BKS-_ 20	BKS-_ 19

Wiring diagrams

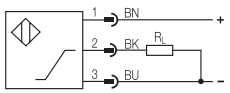
Connector, voltage output



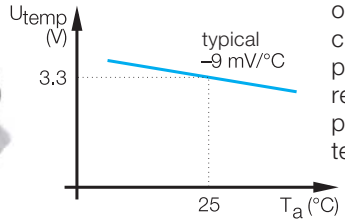
Cable, voltage output



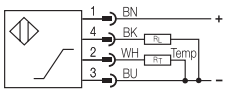
Connector, current output



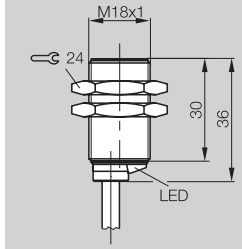
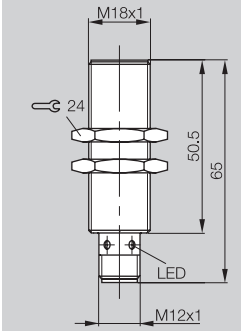
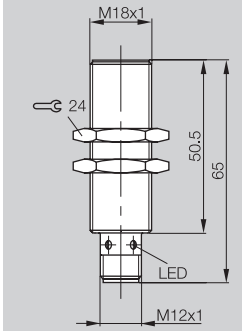
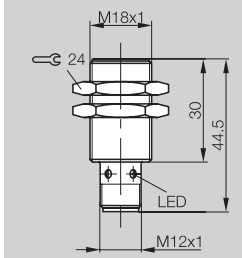
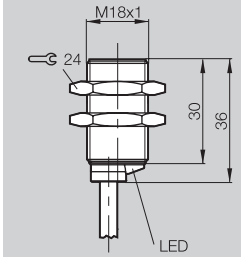
Temperature output



Connector, voltage output
additional temperature output



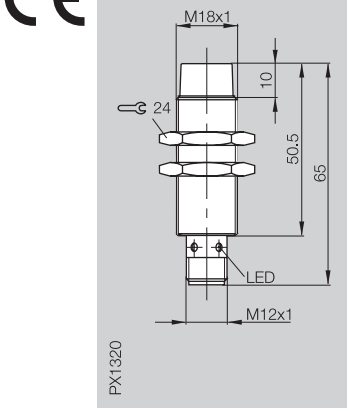
The temperature output (not short circuit protected) provides a signal representing a precisely measured temperature change.

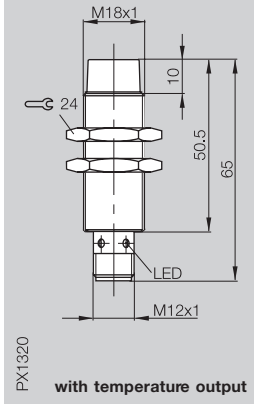
	M18×1 flush **Voltage 0...10 V** 1...5 mm	M18×1 flush **Current 0...20 mA** 1...5 mm	M18×1 flush **Current 4...20 mA** 1...5 mm	M18×1 flush **Current 4...20 mA** 1...5 mm	M18×1 flush **Current 4...20 mA** 1...5 mm
	 PX1384	 PX1356	 PX1356	 PX1385	 PX0143
	BAW M18ME-UAC50B-BP03	BAW M18MI-IAC50B-S04G	BAW M18MI-ICC50B-S04G	BAW M18ME-ICC50B-S04G	BAW M18ME-ICC50B-BP03
	15...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC	15...30 V DC
	≤ 15 % of U_e	≤ 15 % of U_e	≤ 15 % of U_e	≤ 15 % of U_e	≤ 15 % of U_e
	75 V DC	250 V AC	250 V AC	75 V DC	75 V DC
	3 mm	3 mm	3 mm	3 mm	3 mm
	≥ 2 kΩ	≤ 0.5 kΩ	≤ 0.5 kΩ	≤ 0.5 kΩ	≤ 0.5 kΩ
	≤ 10 mA	≤ 10 mA	≤ 10 mA	≤ 10 mA	≤ 10 mA
	yes	yes	yes	yes	yes
	yes	yes	yes	yes	yes
	yes	yes	yes	yes	yes
	–10...+70 °C	–10...+70 °C	–10...+70 °C	–10...+70 °C	–10...+70 °C
	± 8 µm	± 8 µm	± 8 µm	± 8 µm	± 8 µm
	≤ ±120 µm	≤ ±120 µm	≤ ±120 µm	≤ ±120 µm	≤ ±120 µm
	500 Hz	500 Hz	500 Hz	500 Hz	500 Hz
	≤ 40 m/s	≤ 40 m/s	≤ 40 m/s	≤ 40 m/s	≤ 40 m/s
	1 ms	1 ms	1 ms	1 ms	1 ms
	–1 µm/K	–1 µm/K	–5 µm/K	–3 µm/K	–3 µm/K
	0 µm/K	+1 µm/K	–1 µm/K	–1.5 µm/K	–1.5 µm/K
	–4 µm/K	–5 µm/K	–14 µm/K	–5.5 µm/K	–5.5 µm/K
	IP 67	IP 67	IP 67	IP 67	IP 67
		⧈	⧈		
	Nickel plated brass	Nickel plated brass	Nickel plated brass	Nickel plated brass	Nickel plated brass
	PBT	PBT	PBT	PBT	PBT
	3 m cable PUR	Connectors	Connectors	Connectors	3 m cable PUR
	3×0.34 mm²				3×0.34 mm²
	cULus	cULus	cULus	cULus	cULus
		BKS-_ 19/BKS-_ 20	BKS-_ 19/BKS-_ 20	BKS-_ 19/BKS-_ 20	

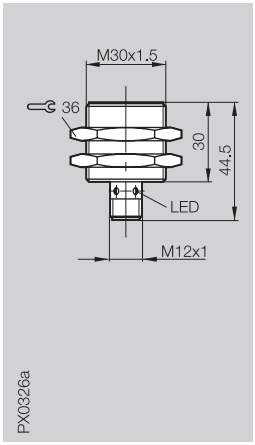
These sensors are also available as IO-Link types.
Please request our separate IO-Link brochure!

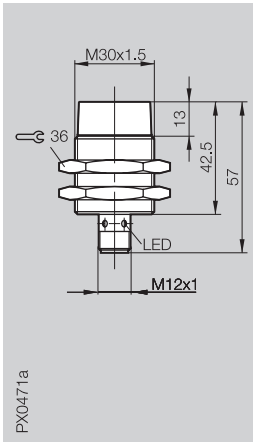
BAW
Connectors, holders ... starting page 81

Housing size	**M18×1**	**M18×1**	**M30×1.5**	**M30×1.5**
Mounting	non-flush	non-flush	flush	non-flush
Output signal	**Voltage 0...10 V**	**Voltage 0...10 V**	**Voltage 0...10 V**	**Voltage 0...10 V**
Linear range s_l	2...8 mm	4...16 mm	2...10 mm	3...15 mm





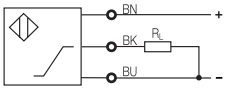




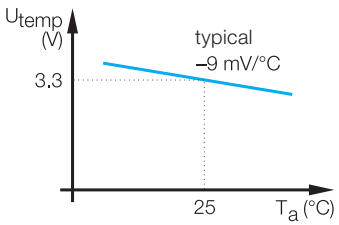
Ordering code	BAW M18MG-UAC80F-S04G	BAW M18MG-UAC16F-S04G-K	BAW M30ME-UAC10B-S04G	BAW M30ME-UAC15F-S04G
Supply voltage U_B	15...30 V DC	15...30 V DC	15...30 V DC	15...30 V DC
Ripple	≤ 15 % of U_e	≤ 15 % of U_e	≤ 15 % of U_e	≤ 15 % of U_e
Rated insulation voltage U_i	250 V AC	250 V AC	250 V AC	250 V AC
Effective distance s_e	5 mm	10 mm	6 mm	9 mm
Load resistance R_L (R_T)	≥ 2 kΩ	≥ 2 kΩ (≥ 2 kΩ)	≥ 2 kΩ	≥ 2 kΩ
No-load current I_0 at U_e	≤ 10 mA	≤ 10 mA	≤ 10 mA	≤ 10 mA
Polarity reversal protected	yes	yes	yes	yes
Short circuit protected	yes	yes	yes	yes
Adjustment indicator (end of linear range)	yes	yes	yes	yes
Ambient temperature range T_a	–10...+70 °C	+10...+60 °C*	–10...+70 °C	–10...+70 °C
Repeat accuracy R_{BWN}	± 12 µm	± 200 µm	±10 µm	± 12 µm
Non-linearity	≤ ±180 µm	≤ ±360 µm	≤ ±240 µm	≤ ±360 µm
Limit frequency (–3 dB)	500 Hz	500 Hz	500 Hz	350 Hz
Measuring speed	≤ 20 m/s	≤ 5 m/s	≤ 20 m/s	≤ 10 m/s
Response time	1.5 ms	3 ms	1.5 ms	3 ms
Temperature coefficient TK typical	–3 µm/K	+8 µm/K	+1.5 µm/K	+1.5 µm/K
in the optimal range min.	+2 µm/K	+1 µm/K	–1 µm/K	–3 µm/K
from +10...+50 °C max.	–13 µm/K	+30 µm/K	+5 µm/K	+13 µm/K
Degree of protection per IEC 60529	IP 67	IP 67	IP 67	IP 67
Insulation class	⧈	⧈	⧈	⧈
Housing material	Nickel plated brass	Nickel plated brass	Nickel plated brass	Nickel plated brass
Material of sensing face	PBT	PBT	PBT	PBT
Connection	Connectors	Connectors	Connectors	Connectors
No. of wires × cross-section				
Approval	cULus	cULus	cULus	cULus
Recommended connector	BKS-_ 19/BKS-_ 20	BKS-_ 19/BKS-_ 20	BKS-_ 19/BKS-_ 20	BKS-_ 19/BKS-_ 20

Wiring diagrams

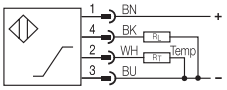
Connector, voltage output



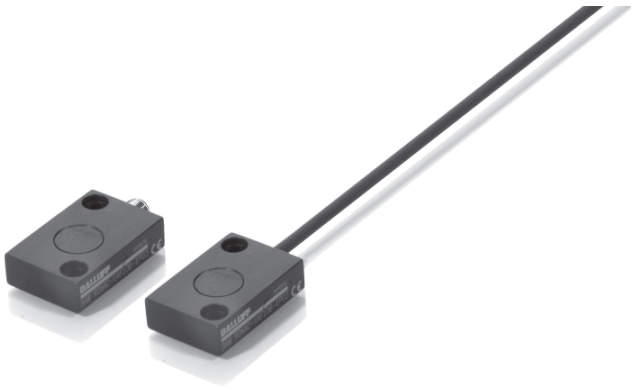
Temperature output

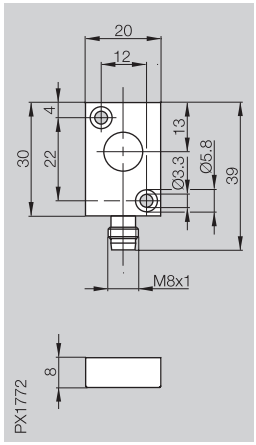


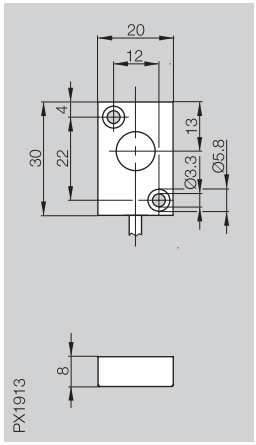
Connector, voltage output
additional temperature output



The temperature output (not short circuit protected) provides a signal representing a precisely measured temperature change.







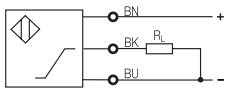
Housing size		**20×30×8 mm**	**20×30×8 mm**
Mounting		flush	flush
Output signal		**Voltage 0...10 V**	**Voltage 0...10 V**
Linear range s_l		0.5...2 mm	0.5...2 mm
Ordering code		BAW R06AC-UAF20B-S49G	BAW R06AC-UAF20B-EP03
Supply voltage U_B		21.6...26.4 V DC	21.6...26.4 V DC
Ripple		≤ 10 % of U_e	≤ 10 % of U_e
Rated insulation voltage U_i		75 V DC	75 V DC
Effective distance s_e		1.25 mm	1.25 mm
Load resistance R_L		≥ 5 kΩ	≥ 5 kΩ
No-load current I_0 at U_e		≤ 15 mA	≤ 15 mA
Polarity reversal protected		no	no
Short circuit protected		no	no
Adjustment indicator (end of linear range)		no	no
Ambient temperature range T_a		+10...+60 °C*	+10...+60 °C*
Repeat accuracy R_{BWN}		± 12 µm	± 12 µm
Non-linearity		≤ ±45 µm	≤ ±45 µm
Limit frequency (–3 dB)		1000 Hz	1000 Hz
Measuring speed		≤ 10 m/s	≤ 10 m/s
Response time		0.5 ms	0.5 ms
Temperature coefficient TK	typical	+0.5 µm/K	+0.5 µm/K
in the optimal range	min.	–1 µm/K	–1 µm/K
from +10...+60 °C	max.	+2 µm/K	+2 µm/K
Degree of protection per IEC 60529		IP 67	IP 67
Housing material		Anodized Al	Anodized Al
Material of sensing face		PBT	PBT
Connection		Connectors	3 m cable PUR
No. of wires × cross-section			3×0.14 mm²
Recommended connector		BKS-_ 48/BKS-_ 49	

Other cable lengths on request.

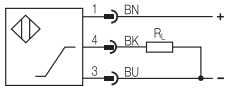
* The function is assured over a range of –10...+70 °C.

Wiring diagrams

Cable



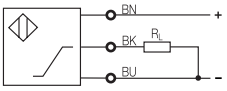
Connector, voltage output



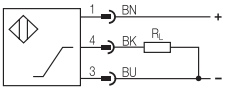
BAW
Connectors, holders ... starting page 81

Housing size	**10×30×6 mm**	**10×30×6 mm**	**10×30×6 mm**	**14×38.5×17 mm**
Mounting	flush	flush	flush	flush
Output signal	**Voltage 0...10 V**	**Voltage 0...10 V**	**Voltage 0...10 V**	**Voltage 0...10 V**
Linear range s_l	1...4 mm	1...4 mm	1...4 mm	1...5 mm

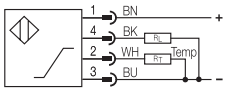
Cable

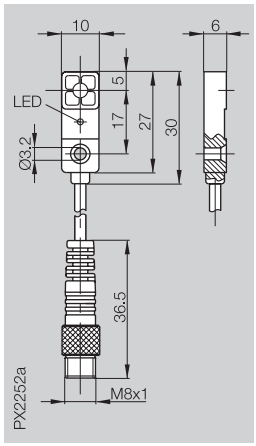


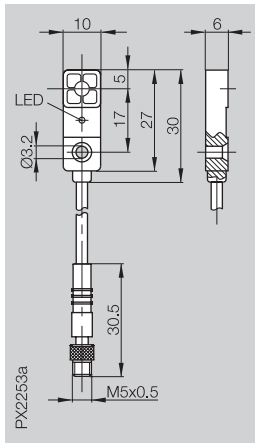
Connector, voltage output

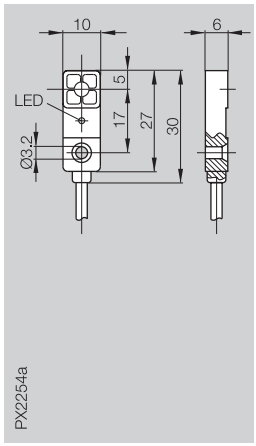


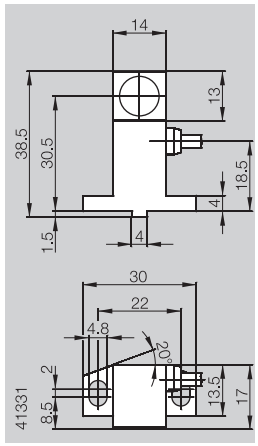
Connector, voltage output additional temperature output









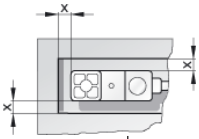


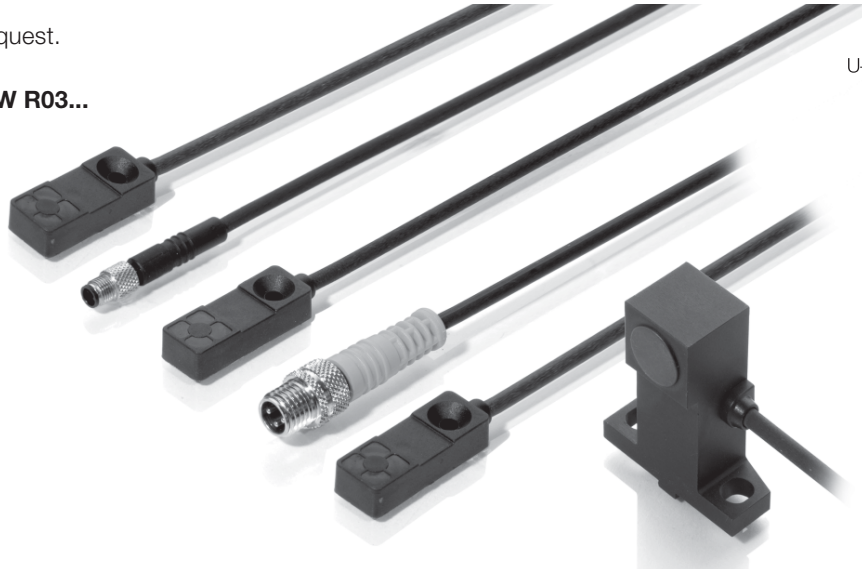
Ordering code	BAW R03KC-UAE40B-BP00.3-GS49	BAW R03KC-UAE40B-BP00.3-GS26	BAW R03KC-UAE40B-BP03	BAW Z01AC-UAD50B-DP03-K
Supply voltage U_B	21.6...26.4 V DC	21.6...26.4 V DC	21.6...26.4 V DC	15...30 V DC
Ripple	≤ 10 % of U_e	≤ 10 % of U_e	≤ 10 % of U_e	≤ 15 % of U_e
Rated insulation voltage U_i	75 V DC	75 V DC	75 V DC	75 V DC
Effective distance s_e	2.5 mm	2.5 mm	2.5 mm	3 mm
Load resistance R_L	≥ 5 kΩ	≥ 5 kΩ	≥ 5 kΩ	≥ 2 kΩ
No-load current I_0 at U_e	≤ 15 mA	≤ 15 mA	≤ 15 mA	≤ 12 mA
Polarity reversal protected	no	no	no	yes
Short circuit protected	no	no	no	yes
Adjustment indicator (end of linear range)	yes	yes	yes	no
Ambient temperature range T_a	0...+70 °C	0...+70 °C	0...+70 °C	+10...+60 °C
Repeat accuracy R_{BWN}	± 35 µm	± 35 µm	± 35 µm	±10 µm
Non-linearity	≤ ±150 µm	≤ ±150 µm	≤ ±150 µm	≤ ±120 µm
Limit frequency (–3 dB)	1000 Hz	1000 Hz	1000 Hz	1000 Hz
Measuring speed	≤ 20 m/s	≤ 20 m/s	≤ 20 m/s	≤ 5 m/s
Response time	0.5 ms	0.5 ms	0.5 ms	1 ms
Temperature coefficient TK typical	+4.7 µm/K	+4.7 µm/K	+4.7 µm/K	-3 µm/K
in the optimal range min.	+1 µm/K	+1 µm/K	+1 µm/K	+7 µm/K
from +10...+60 °C max.	+7 µm/K	+7 µm/K	+7 µm/K	-20 µm/K
Degree of protection per IEC 60529	IP 67	IP 67	IP 67	IP 67
Housing material	PA 6	PA 6	PA 6	Aluminum
Material of sensing face	PA 6	PA 6	PA 6	PA 12
Connection	0.3 m cable (PUR) with connector	0.3 m cable (PUR) with connector	3 m cable PUR	3 m cable PUR
No. of wires × cross-section			3×0.14 mm²	4×0.14 mm²
Approval	cULus	cULus	cULus	cULus
Recommended connector	BKS-_ 48/BKS-_ 49	BKS-_ 25		

Other cable lengths on request.

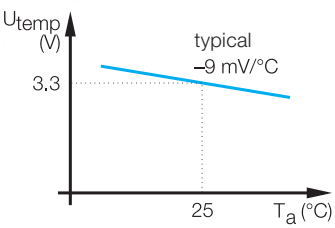
Installation note for BAW R03...

Material	Installation dimension „x“
Steel	0 mm
Brass	5 mm
Aluminum	5 mm
Stainless steel	5 mm



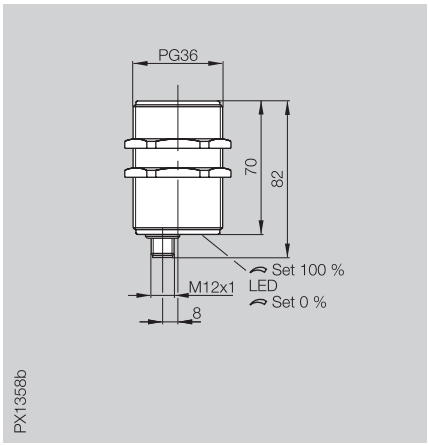


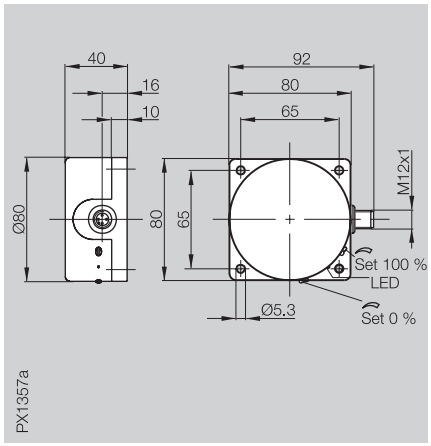
Temperature output



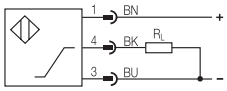
The temperature output (not short circuit protected) provides a signal representing a precisely measured temperature change.

Housing size	**PG 36**	**80×80×40 mm**
Mounting	flush	non-flush
Output signal	**Voltage 0...10 V**	**Voltage 0...10 V**
Linear range s_l	0...20 mm	0...50 mm





Connector, voltage output

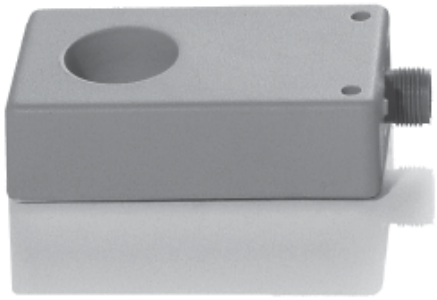


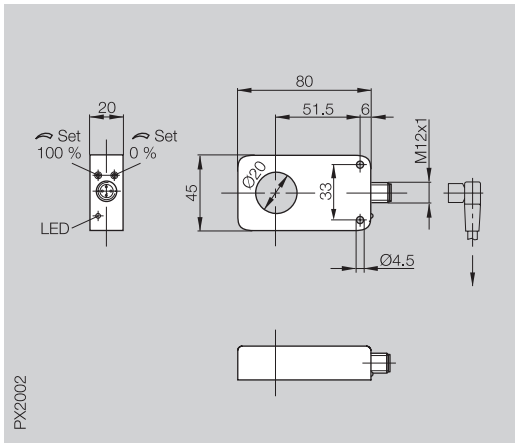
Ordering code	BAW MKZ-471.19-S4	BAW MKK-050.19-S4
Supply voltage U_B	19.2...28.8 V DC	19.2...28.8 V DC
Ripple	≤ 15 % of U_e	≤ 15 % of U_e
Rated insulation voltage U_i	75 V DC	75 V DC
Effective distance s_e	10 mm	25 mm
Load resistance R_L	≥ 10 kΩ	≥ 10 kΩ
No-load current I_0 at U_e	≤ 12 mA	≤ 12 mA
Polarity reversal protected	yes	yes
Short circuit protected	yes	yes
Function indicator	yes	yes
Ambient temperature range T_a	–10...+70 °C	–10...+70 °C
Repeat accuracy R_{BWN}	5 µm	12 µm
Non-linearity	≤ 600 µm	≤ 1500 µm
Limit frequency (–3 dB)	20 Hz	15 Hz
Degree of protection per IEC 60529	IP 67	IP 67
Housing material	Nickel plated brass	PBT
Material of sensing face	PBT	PBT
Connection	Connectors	Connectors
Recommended connector	BKS-_ 19/BKS-_ 20	BKS-_ 19/BKS-_ 20

Standard version of BAW MKZ/MKK with rising output curve! These sensors are also available with falling output curve.
Please specify separately when ordering!

Connectors, holders ... starting page 81

Housing size	**80×45×20 mm**
Inside diameter d_w	**∅ 20 mm**
Output signal	**Voltage 0...10 V**





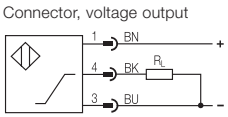
Compact analog ring sensor with 20 mm opening. Various metallic objects or insertion depths result in measured value changes.

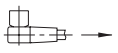
Applications include thickness measurement of various screws, rods or wires, distance measurement on machines by inserting conical objects into the sensor.

Ordering code	BAW MKV-020.19-S4
Supply voltage U_B	15...30 V DC
Ripple	≤ 10 % of U_e
Rated insulation voltage U_i	75 V DC
Effective distance s_e	30 mm
Load resistance R_L	≥ 2 kΩ
No-load current I_0 at U_e	≤ 20 mA
Polarity reversal protected	yes (exception Pin 2 and 5)
Short circuit protected	yes
Function indicator	yes
Ambient temperature range T_a	–10...+70 °C
Repeat accuracy R_{BWN}	400 µm
On-delay	1 s
Measuring repetition frequency	50 Hz
Temperature error	≤ 5 %
Temperature error at 50% of measuring range	≤ 2.5 %
Degree of protection per IEC 60529	IP 67
Housing material	PBT
Material of sensing face	PBT
Connection	Connectors
Recommended connector	BKS-_ 19/BKS-_ 20

Wiring diagram

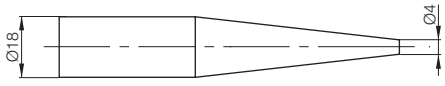
Connector, voltage output



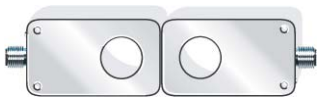


Connector orientation

Cone for determining the insertion depth (measuring range and linearizing)

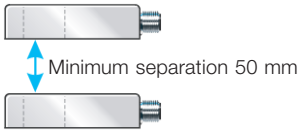


Installation conditions

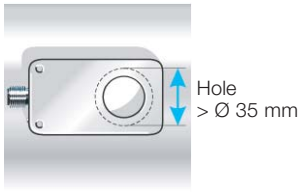


No mutual interference for front-mounting of two sensors.

No mutual interference for parallel mounting of two sensors.



When stacking multiple sensors, the separation must be at least 50 mm.



For flat mounting on metal the opening should be at least Ø 35 mm.

Inductive distance sensors provide an output signal proportional to the distance from the damping target surface.

In many applications the idea is to also generate a switching signal at particular points along the output curve. These switching signals indicate when a particular position, e.g. the distance to a machine member, is reached.

This used to require an additional analog switching amplifier.
Now you can eliminate this extra component.
Balluff has developed an analog distance sensor with three integrated switching thresholds. These switching thresholds are programmable and are provided on separate outputs as a switching signal.

Two in one – Sensor and analog switching amplifier

Instead of installing two devices, now all you need is a single sensor. By programming the switching outputs using a control line you can set them when the sensor is installed in a difficult to access location.

Programming of the 3 switching outputs is accomplished using a teach-in procedure.
The sensor is simply brought to the desired switching distance from the object.
By connecting the control line to the (+) side of the supply voltage, this position is taught to the sensor.

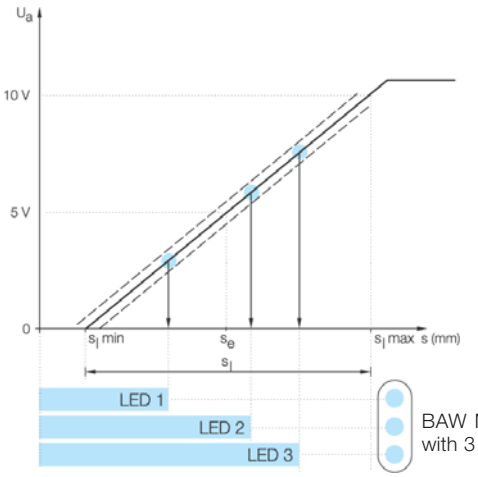
An LED is provided for each switching output as a status indicator.
In addition, you can access the 0...10 V signal on the cable.

If LED's are not required, you can also use the BAW M18MM-UAZ50B... with its shorter housing.

BAW

Connectors, holders ... starting page 81

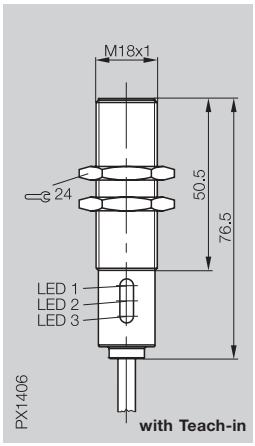
Approach curve

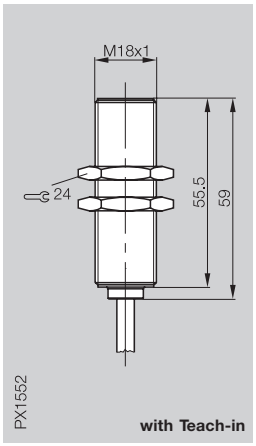


BAW M18MI2-UAC50... with 3 LED's

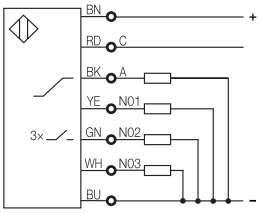
For sensors with teach-in function the switching distance can be freely programmed in the working range. This can be done either using the BES 516-4 tester and programmer or directly by using the control line on the sensor.

Housing size	**M18×1**	**M18×1**
Mounting	flush	flush
Output signal	**Voltage 0...10 V**	**Voltage 0...10 V**
Linear range s_l	1...5 mm	1...5 mm





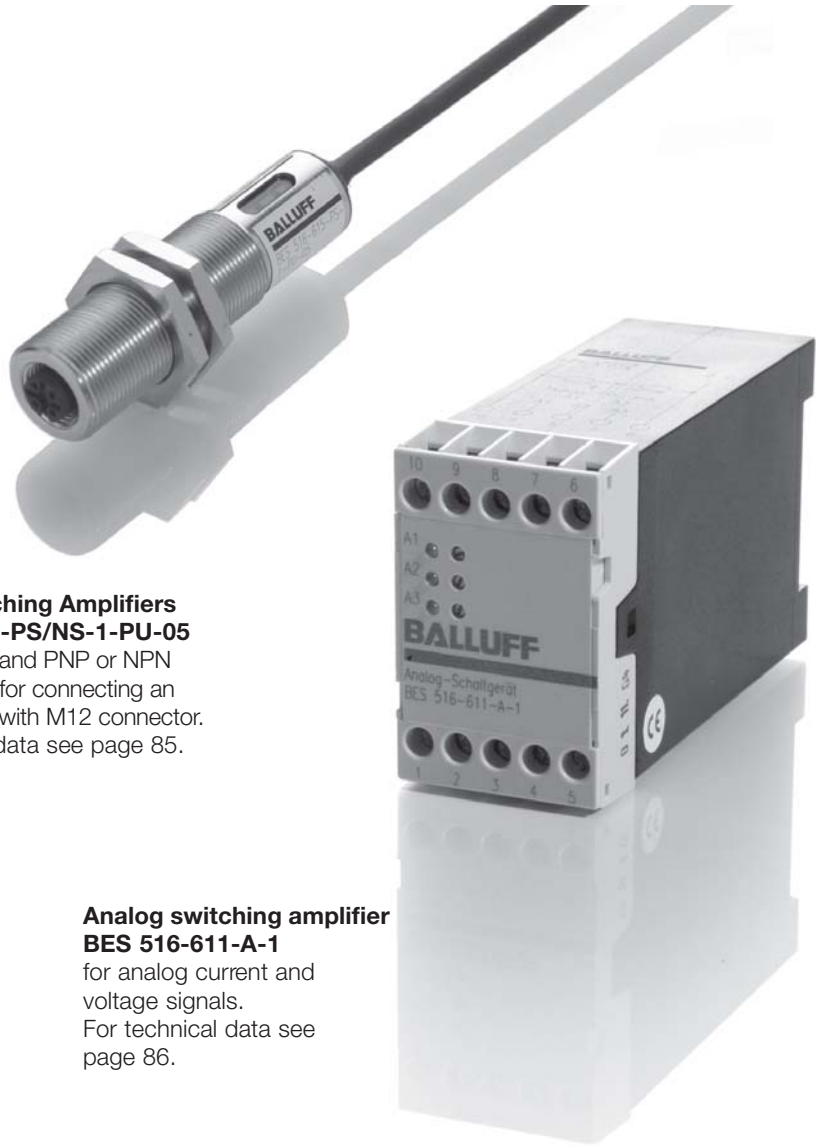
Wiring diagram



Ordering code	BAW M18MI2-UAC50B-BP05-002	BAW M18MM-UAZ50B-BP05-505
Supply voltage U_B	15...30 V DC	21.6...26.4 V DC
Ripple	≤ 15 % of U_e	≤ 10 % of U_e
Rated insulation voltage U_i	250 V AC	250 V AC
Effective distance s_e	3 mm	3 mm
Load resistance R_L for analog output	≥ 2 kΩ	≥ 2 kΩ
No-load current I_0 at U_e	≤ 20 mA	≤ 20 mA
Polarity reversal protected	yes	yes
Short circuit protected	yes	yes
Adjustment indicator	1 LED/output	no
Ambient temperature range T_a	–10...+70 °C	+10...+60 °C*
Repeat accuracy R_{BWN}	± 8 µm	± 8 µm
Non-linearity	≤ ±120 µm	≤ ±120 µm
Limit frequency (–3 dB)	500 Hz	500 Hz
Measuring speed	≤ 40 m/s	≤ 40 m/s
Response time	1 ms	1 ms
Temperature coefficient TK typical	–1.5 µm/K	0 µm/K
in the optimal range min.	0 µm/K	–1 µm/K
from +10...+50 °C max.	–3 µm/K	+1.5 µm/K
Degree of protection per IEC 60529	IP 67	IP 67
Insulation class	⧈	⧈
Housing material	Nickel plated brass	Nickel plated brass
Material of sensing face	PBT	PBT
Connection	5 m Cable PUR	5 m Cable PUR
No. of wires × cross-section	7×0.25 mm²	7×0.25 mm²
Approval	cULus	
Function indicator for each output	yes	no
Teach-in function	yes	yes
Hysteresis of switching outputs	≤ 0.3 mm	≤ 0.3 mm
Effective operating current I_e for one switching output	20 mA	20 mA
Voltage drop U_d at I_e	≤ 1.5 V	≤ 1.5 V

*The function is assured over a range of –10...+70 °C.

Analog Switching Amplifiers
are available in tubular housing form for direct installation near the sensor, or for installation in a control cabinet.



Analog Switching Amplifiers
BES 516-615-PS/NS-1-PU-05
Analog output and PNP or NPN normally open for connecting an analog sensor with M12 connector.
For technical data see page 85.

Analog switching amplifier
BES 516-611-A-1
for analog current and voltage signals.
For technical data see page 86.

Tester/Programmer
BES 516-4
see page 89

Connectors, holders ... starting page 81