

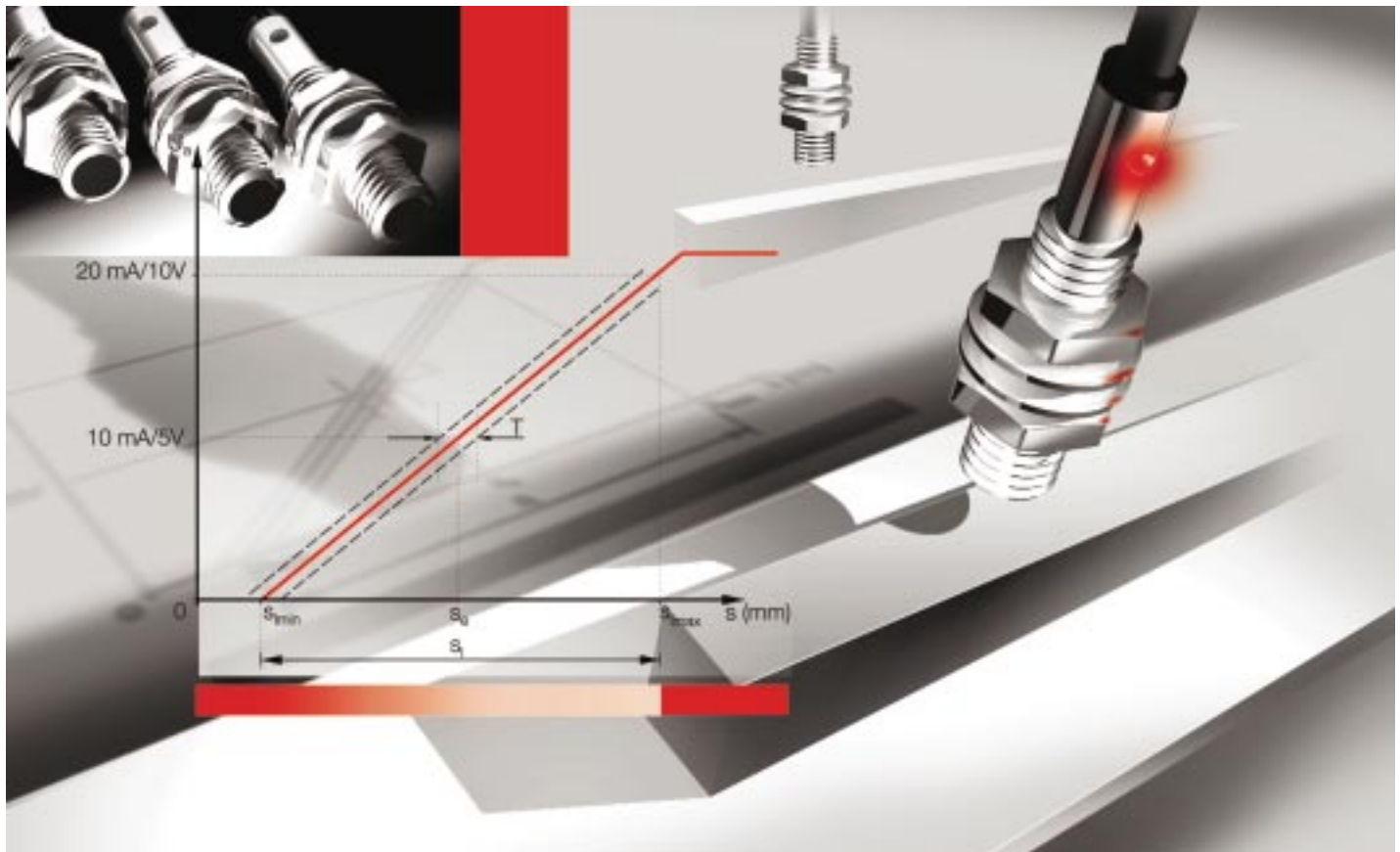


# BALLUFF

## ULTRALINEAR

Inductive Analog Sensors

Precision  
Measurements in  
Hostile Environments



# Inductive Sensors

## ULTRALINEAR™ Analog Sensors M8, M12, M18, M30 PG 36, 80×80×40

### Technical Description

Inductive sensing technology is widely recognized for its ruggedness and stability under extreme industrial conditions. Balluff ULTRALINEAR™ analog sensors take advantage of inductive technology's strengths to bring you precision non-contact position measurement in an affordable family of compact housings. For applications involving relatively short travel of metal targets, there is no better solution.

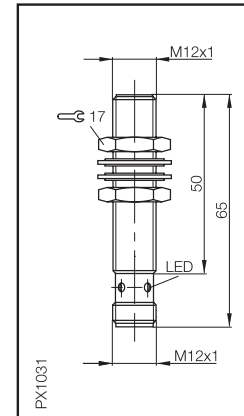
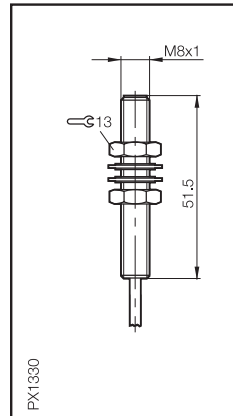
ULTRALINEAR™ analog sensors are simple three-wire devices that operate on 24 V DC. They provide an electrical signal that varies in proportion to the position of a metal target within the working range. The linear analog signal is available in either voltage or current.

The ULTRALINEAR™ family: precision measurements in hostile environments.

### Features

- Linear analog output provides exact position measurement
- 0...10 VDC or 0...20 mA analog outputs available
- Reliable measurements in the harshest environments (just like our rugged inductive sensors)
- No setup required, apply power and it's ready
- Totally self-contained units, no separate amplifier
- Full range of housing sizes provide a fit for any application
- Status LED warns if target is outside the measurement zone
- Fully protected against short circuit, overload and polarity reversal.

Housing size	<b>M8×1</b>	<b>M12×1</b>
Mounting	flush	flush
Output signal	<b>0...10 V</b>	<b>0...10 V</b>
Linear range $s_L$	0.5...1.5 mm	0.5...2 mm



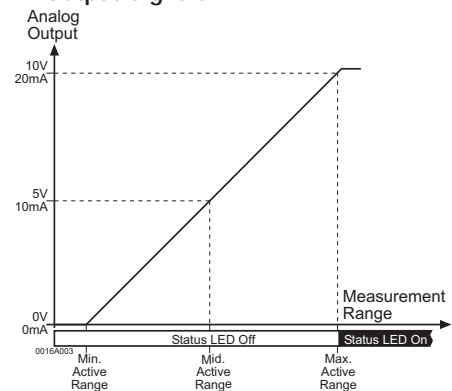
### Ordering code

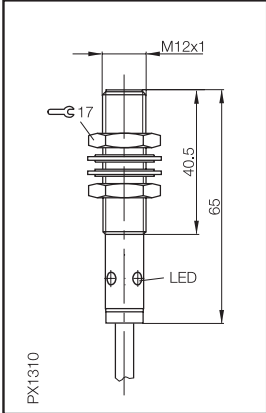
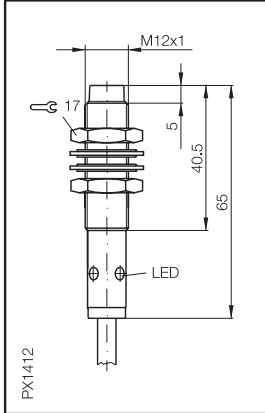
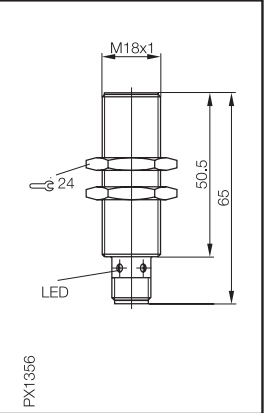
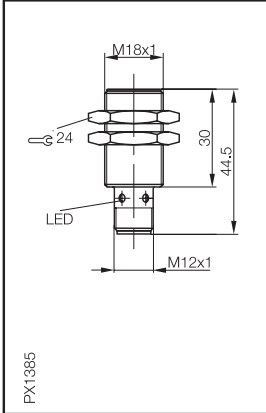
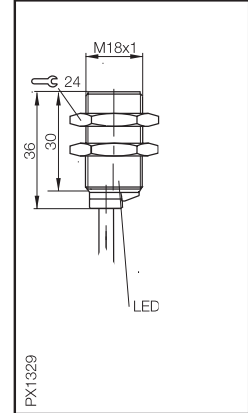
Voltage output, 0 - 10V	BAW M08EI-UAD15B-BP05	BAW M12MI-UAC20B-S04G
Current output, 0 - 20mA		
Current output, 4 - 20mA		
Rated operational voltage $U_e$	24 V DC	24 V DC
Supply voltage $U_B$	15...30 V DC	15...30 V DC
Supply voltage ripple, max. 15% of $U_e$	≤3.60 V DC @ 24 V DC	≤ 3.60 V DC @ 24 V DC
No-load supply current $I_o$ @ $U_e$	≤8.0 mA	≤10.0 mA
Linear span $s_L$ <sup>1</sup>	1.00 mm	1.50 mm
Midpoint of linear range $s_e$ <sup>2</sup>	1.00 ± 0.1 mm	1.25 ± 0.125 mm
Resolution <sup>3</sup> , voltage output	0.01 V per 0.001 mm	0.01 V per 0.0015 mm
Resolution <sup>3</sup> , current output	0.02 mA per 0.001 mm	-
Non-linearity <sup>4</sup>	± 0.03 mm	± 0.045 mm
Repeatability <sup>5</sup>	± 0.03 mm	± 0.045 mm
Temperature drift <sup>6</sup> (+15...55 °C)	0.00025 mm/°K	0.000375 mm/°K
Ambient temperature range $T_a$	-10...+70 °C	-10...+70 °C
Cutoff frequency (-3 dB output amplitude)	1000 Hz	500 Hz
Time delay before availability $t_v$	≤1.0 ms	≤1.0 ms
Load resistance $R_L$	≥2 kΩ	≥2 kΩ
Rated insulation voltage $U_i$	250 V AC	250 V AC
Degree of protection per IEC 529	IP 67	IP 67
Housing material	stainless steel	nickel plated brass
Sensing face material	PBTP	PA 12
Conductors (cable versions)	5 m unshielded PUR cable (3 x 26 AWG)	
Connector (connector versions)	M12 DC Micro <sup>7</sup>	M12 DC Micro
Linear range display (LED ON when out of range)	yes	yes
Short circuit/overload protected	yes	yes
Protected against polarity reversal	yes	yes

### Notes:

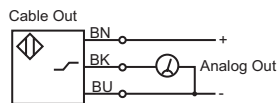
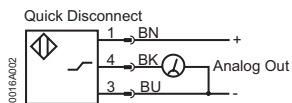
1. Size of the linear sensing window
2. Midpoint with tolerance, sensor to sensor
3. Change in output per change in target movement
4. Deviation over the linear span, 3% of full scale
5. Ability to repeat output level for a given target distance, 3% of full scale
6. Deviation relative to 25 °C ambient temperature  
As a percent of full scale:  
+15...55 °C = 1%  
+10...60 °C = 2.5%  
-10...+70 °C = 5%
7. For pigtail connector, replace -BP05 with -BP0.2-GS04

### Output Signals



M12×1 flush 0...10 V, 0-20 mA 0.5...2 mm	M12×1 non flush 0...10 V 1...4 mm	M18×1 flush 0...10 V, 0-20 mA, 4-20 mA 1...5 mm	M18×1 flush 0...10 V 1...5 mm	M18×1 flush 0...10 V 1...5 mm
				
BAW M12MG2-UAC20B-BP05 BAW M12MG2-IAC20B-BP05	BAW M12MF2-UAC40F-BP05	BAW M18MI-UAC50B-S04G BAW M18MI-IAC50B-S04G BAW M18MI-ICC50B-S04G	BAW M18ME-UAC50B-S04G	BAW M18ME-UAC50B-BP05
24 V DC 15...30 V DC ≤3.60 V DC @ 24 V DC ≤10.0 mA 1.50 mm 1.25 ± 0.125 mm 0.01 V per 0.0015 mm 0.02 mA per 0.0015 mm ± 0.045 mm ± 0.045 mm 0.000375 mm/°K -10...+70 °C 500 Hz ≤1.0 ms ≥2 kΩ 250 V AC IP 67 nickel plated brass PA 12 5 m unshielded PUR cable (3 x 22 AWG) M12 DC Micro <sup>7</sup> yes yes yes	24 V DC 15...30 V DC ≤3.60 V DC @ 24 V DC ≤10.0 mA 3.00 mm 1.25 ± 0.125 mm 0.01 V per 0.003 mm - ± 0.09 mm ± 0.09 mm 0.00075 mm/°K -10...+70 °C 500 Hz ≤1.0 ms ≥2 kΩ 250 V AC IP 67 nickel plated brass PBTP 5 m unshielded PUR cable (3 x 22 AWG) M12 DC Micro <sup>7</sup> yes yes yes	24 V DC 15...30 V DC ≤3.60 V DC @ 24 V DC ≤10.0 mA 4.00 mm 3.00 ± 0.3 mm 0.01 V per 0.004 mm 0.02 (0.016) mA per 0.004 mm ± 0.12 mm ± 0.12 mm 0.001 mm/°K -10...+70 °C 500 Hz ≤1.0 ms ≥2 kΩ 75 V DC IP 67 nickel plated brass PBTP M12 DC Micro yes yes yes	24 V DC 15...30 V DC ≤3.60 V DC @ 24 V DC ≤10.0 mA 4.00 mm 3.00 ± 0.3 mm 0.01 V per 0.004 mm - ± 0.12 mm ± 0.12 mm 0.001 mm/°K -10...+70 °C 500 Hz ≤1.0 ms ≥2 kΩ 75 V DC IP 67 nickel plated brass PBTP M12 DC Micro yes yes yes	24 V DC 15...30 V DC ≤3.60 V DC @ 24 V DC ≤10.0 mA 4.00 mm 3.00 ± 0.3 mm 0.01 V per 0.004 mm - ± 0.12 mm ± 0.12 mm 0.001 mm/°K -10...+70 °C 500 Hz ≤1.0 ms ≥2 kΩ 75 V DC IP 67 nickel plated brass PBTP 5 m unshielded PUR cable (3 x 22 AWG) M12 DC Micro <sup>7</sup> yes yes yes

### Wiring Diagram



# ANALOG Inductive Sensors

ULTRALINEAR™  
Analog Sensors  
M8, M12, M18, M30  
PG 36, 80×80×40

M18x1	M30x1.5	PG 36	80×80×40
non flush	flush	flush	non flush
0...10 V	0...10 V	0...10 V	0...10 V
2...8 mm	2...10 mm	0...20 mm (adj.)	0...50 mm (adj.)
BAW M18MG-UAC80F-S04G	BAW M30ME-UAC10B-S04G	BAW MKZ-471_19-S4	BAW MKK-050_19-S4
24 V DC	24 V DC	24 V DC	24 V DC
15...30 V DC	15...30 V DC	19...29 V DC	19...29 V DC
≤3.60 V DC @ 24 V DC	≤3.60 V DC @ 24 V DC	≤3.60 V DC @ 24 V DC	≤3.60 V DC @ 24 V DC
≤10.0 mA	≤10.0 mA	≤12.0 mA	≤12.0 mA
6.00 mm	8.00 mm	20.0 mm	50.0 mm
5.00 ± 0.5 mm	6.00 ± 0.6 mm	10.0 ± 0.1 mm	25.0 ± 1.0 mm
0.01 V per 0.006 mm	0.01 V per 0.008 mm	0.01 V per 0.02 mm	0.01 V per 0.05 mm
-	-	-	-
± 0.18 mm	± 0.24 mm	± 0.2 mm	± 1.0 mm
± 0.18 mm	± 0.24 mm	± 0.2 mm	± 1.0 mm
0.0015 mm/°K	0.002 mm/°K	0.005 mm/°K	0.0125 mm/°K
-10...+70 °C	-10...+70 °C	-10...+70 °C	-10...+70 °C
500 Hz	500 Hz	75 Hz	75 Hz
≤1.0 ms	≤1.0 ms	≤1.0 s	≤1.0 s
≥ 2 kΩ	≥ 2 kΩ	≥ 10 kΩ	≥ 10 kΩ
75 V DC	75 V DC	250 V AC	250 V AC
IP 67	IP 67	IP 67	IP 67
nickel plated brass	nickel plated brass	nickel plated brass	polymeric PBT
PBTP	PBTP	polymeric PBT	polymeric PBT
M12 DC Micro	M12 DC Micro	M12 DC Micro	M12 DC Micro
yes	yes	no	no
yes	yes	yes	yes
yes	yes	yes	yes

## Approvals

IEC 60947-5-2

UL 508

CSA C22.2 No. 14-M91

NEMA ICS 5-1996



Analog Sensors

# Inductive Sensors

## ULTRALINEAR™ Analog Sensors Set Point Output

### Technical Description

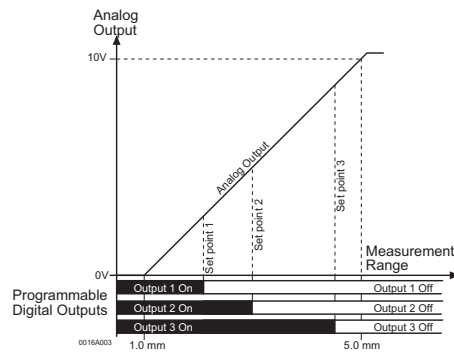
For the ultimate in flexibility, Balluff offers an ULTRALINEAR™ analog sensor with three independently programmable, discrete setpoint outputs, along with an analog voltage output for reference. By holding a metal target in position and momentarily connecting the control line to the supply, the output is preset to change states whenever it reaches the programmed analog signal level. Setpoint programming can be accomplished using your PLC or with an available hand-held programmer (order separately BES-516-4).

### Features

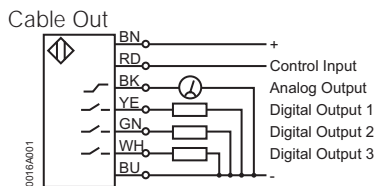
All the exceptional features from our standard ULTRALINEAR™ family plus...

- Remotely programmable setpoints
- Process can be reconfigured on the fly by altering controller's programmed response
- No need to physically adjust sensor position for a particular setpoint
- Status LED for each setpoint output

### Output Signals

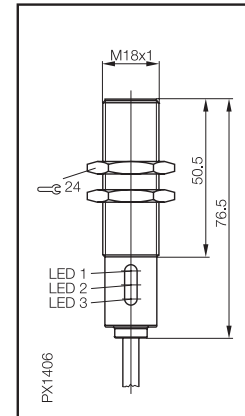


### Wiring Diagram



Housing size
Mounting
Output signal
Linear range $s_L$

<b>M18x1</b>
flush
<b>0...10 V</b>
1...5 mm



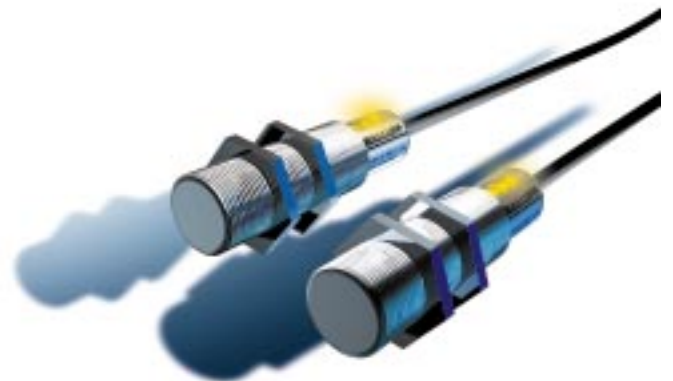
### Ordering code

Voltage 0...10 V
Rated operational voltage $U_e$
Supply voltage $U_B$
Ripple
Linear span $s_L$ <sup>1</sup>
Midpoint of linear range $s_e$ <sup>2</sup>
Resolution <sup>3</sup>
Repeatability <sup>5</sup>
Non-linearity, max. <sup>4</sup>
Temperature drift, max. <sup>6</sup> (+15...55 °C)
Ambient temperature range $T_a$
Cutoff frequency (-3 dB analog output amplitude)
Maximum switching frequency, discrete outputs
Load resistance $R_L$
No-load supply current $I_o$ @ $U_e$
Ambient temperature range $T_a$
Current rating $I_e$ per setpoint output
Switchpoint hysteresis
Switchpoint repeatability
Rated insulation voltage $U_i$
Degree of protection per IEC 529
Housing material
Sensing face material
Connection
LED display for each setpoint output - active ON
Short circuit/overload protected
Protected against polarity reversal

<b>BAW M18M12-UAC50B-BP05-002</b>
24 V DC
15...30 V DC
≤ 3.6V DC
4.00 mm
3.00 mm ± 0.3 mm
0.01 V per 0.004 mm
± 0.12 mm
± 0.12 mm
0.001 mm/°K
-10...+70 °C
500 Hz
1000 Hz
≥ 2 kΩ
≤ 20.0 mA
-10...+70 °C
20.0 mA
≤ 0.3 mm
≤ 0.1 mm
75 V DC
IP 67
nickel plated brass
PBTP
5 m unshielded PUR cable (7 x 24 AWG)
yes
yes
yes

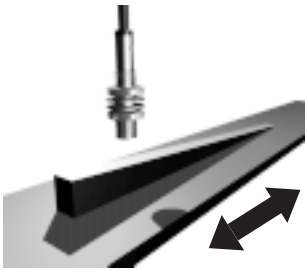


Optional BES-516-4 hand-held programming unit

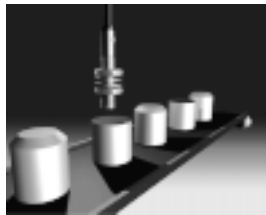


## Applications

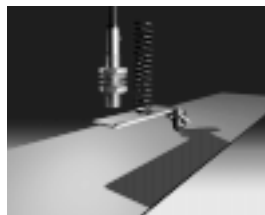
- distance measurement
- thickness measurement using opposed sensors
- thickness measurement using leverage
- concentricity measurement
- circularity measurement
- wobble measurement
- deflection measurement
- wear measurement
- metal homogeneity measurement
- sorting metal objects by size, shape, material
- metal object orientation sensing
- absolute linear position feedback using direct metal target approach
- absolute linear travel feedback using angled metal surface to increase effective range
- absolute rotary position feedback using eccentric metal cam



Position feedback using ramped target.



Sorting metal objects.



Paper thickness measurement using leverage. This arrangement can be used to distinguish between 1 or 2 sheets. Applications include document readers, mass printers, etc. Resolution varies with leverage.



Eccentricity sensing or absolute angle positioning.



Nuts are checked for correct orientation (automated assembly).



Measuring the deflection of a spring steel band to maintain pressure on sheet material.



Measuring deflection of a saw blade. The saw blade position is detected by the sensor and the blade guide mechanism accordingly adjusted.



Detecting large linear motion on machines using economical analog sensors. Detecting a defined center position of a sliding, rotating machine part. A controller processes both sensor signals.

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