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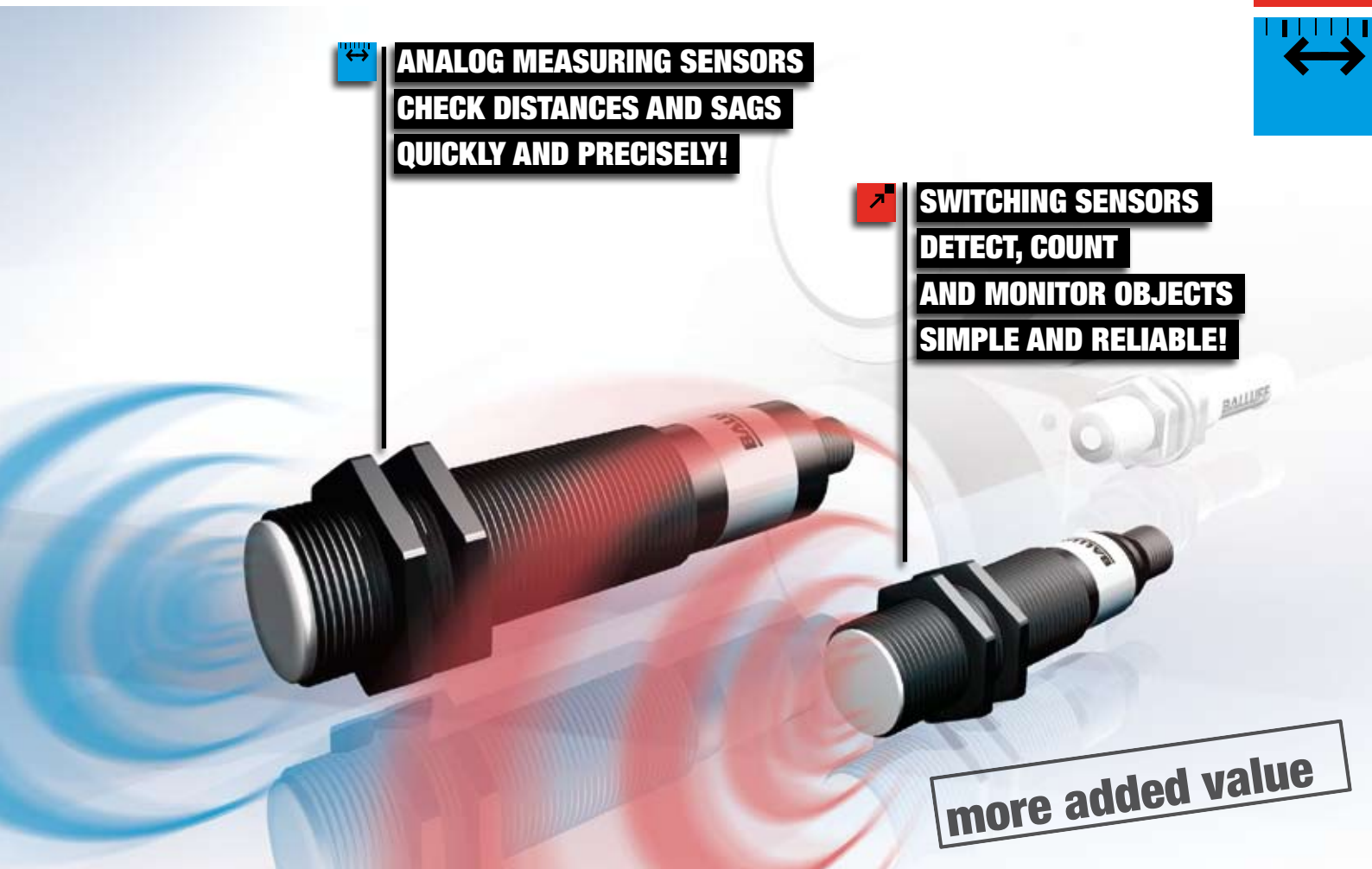
BALLUFF
sensors worldwide

Ultrasonic Sensors BUS

Precise all-rounder with remarkable operating range



Ultrasonic Sensors

Precise all-rounder with remarkable operating range

With over 50 years of sensors experience, Balluff is a globally leading sensor specialist with its own line of connectivity products for every area of factory automation. Balluff is well represented on all continents; the German headquarters as well as 54 representatives and subsidiaries are tightly networked internationally.

Balluff stands for comprehensive systems from a single source, continuous innovation, the most modern technology, highest quality and greatest reliability. And even more: for distinctive customer orientation, custom-tailored solutions, fast worldwide service and outstanding application assistance. In short: for reliable, expert partnership.

Whether electronic and mechanical sensors, rotary and linear transducers, identification systems or optimized connectivity products for high-performance automation. Balluff not only masters the entire technological variety with all of the operating principles, but also offers innovative technology and the most modern electronics – verified down to the last detail in our own accredited testing laboratory. Balluff quality management is certified in accordance with DIN EN ISO 9001:2008. Balluff technology can be used anywhere in the world, since it meets even regional quality standards. And Balluff technology is available internationally. So there is always a Balluff expert near you.

Balluff products increase throughput, quality and productivity day in and day out. They satisfy prerequisites for meeting the demands of the global market when it comes to greater performance and cost reduction. Including in the most demanding areas. No matter how stringent your requirements may be, Balluff provides state-of-the-art solutions.

Benefit from the broad performance spectrum of the Balluff BUS ultrasonic sensors. And profit from maximum precision, even in difficult areas.

LISTED

ALPHA

Ultrasonic Sensors

more added value

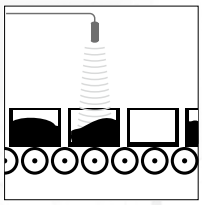
- Simple solutions to challenging applications
  e.g. sound-dampening materials such as foam, Styrofoam etc.
- Safely handle critical environmental conditions
  e.g. soiling, dust or mist
- Extremely precise detection independent of the object

Ultrasonic Sensors
Performance spectrum

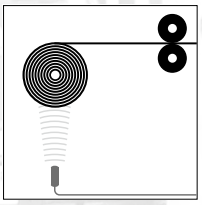
Whether position detection, distance measurement or the detection of solid, powder or liquid media: BUS ultrasonic sensors are precise all-rounders. And always high-performance – independent of color, transparency and surface properties. Even poor lighting conditions and dark or opaque or transparent and reflective objects pose no problem.

Ultrasonic sensors show their true strength when long operating ranges and high accuracy are needed. In dusty, humid and hazy environments, they are sometimes the only alternative. And even in the case of heavy soiling, BUS sensors have proven themselves.

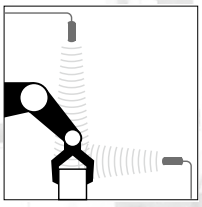
Ultrasonic sensors can also replace conventional sensors or supply additional distance information. You simply decide want you want to use.



Scan the contents of transport containers. Detect filled or empty pallets.



Diameter inspection for unwinding controls.



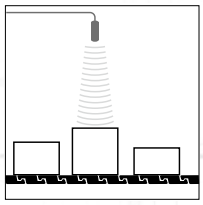
Guide automated handling equipment.

BUS ultrasonic sensors –
particularly well suited for the following industries

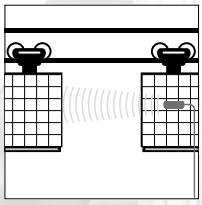
- Handling and automation
- Specialty machinery building
- Automobile industry
- Bottling and packaging
- Pharmaceutical industry
- Plastics and rubber industry
- Timber and furniture industries
- Paper and printing industries

BUS ultrasonic sensors at a glance

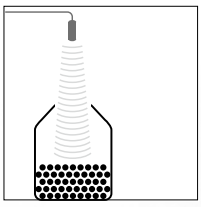
- with impressive operating range and high resolution
- extremely precise, independent of the object: fast detection of small bodies as well
- reliable in difficult applications: even with sound-dampening materials such as foam or Styrofoam
- reliable under critical conditions, such as dirt, dust or mist
- contactless and wear-free



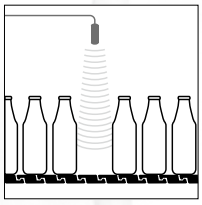
Sort containers and parts of differing heights. Count objects.



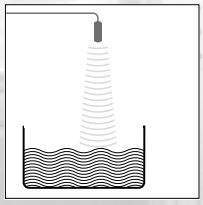
Collision monitoring for overhead conveyors.



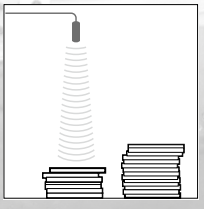
Monitor filling levels in silos, bunkers and containers for all bulk materials (e.g. sand, gravel, coal, grain).



Report incorrect loading on conveyor belts and transport equipment.



Determine fluid levels in containers.

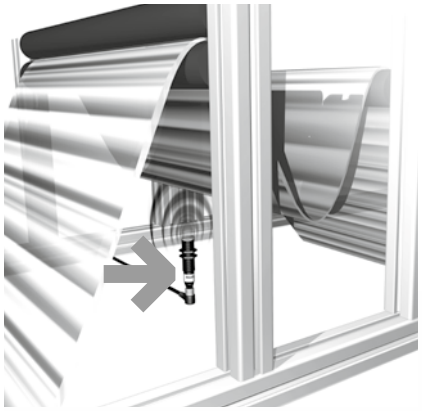


Automated monitoring of inventory levels (paper, sheet metal, wood, rock) at loading equipment.

Ultrasonic Sensors
Applications

In the broad spectrum of industrial automation, Balluff BUS ultrasonic sensors are strongly positioned. They offer maximum precision for the dependable detection of even small objects and reliable distance measurement independent of the object.
Thus, the M12 cylinder is predestined not only for detecting small parts, but is also perfectly suited for installation in tight spaces.
And in the robust stainless steel housing, Balluff ultrasonic sensors also meet the challenges posed by harsh conditions. Its big brother, on the other hand, captivates with impressive operating ranges.

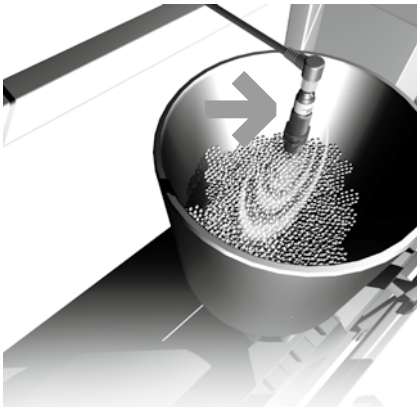
You can also profit from the possibility of having one sensor take on the function of a second sensor. And save money at the same time. Because you have the option of using either one or two switch points, of opting for strictly analog operation, or of combining analog functionality with two switch points. Powerfully flexible.
For more efficiency.



Optimally monitor foil sag

The benefits to you
- **Reliable loading**
- **Less scrap**
- **Faster process**
- **More efficient**

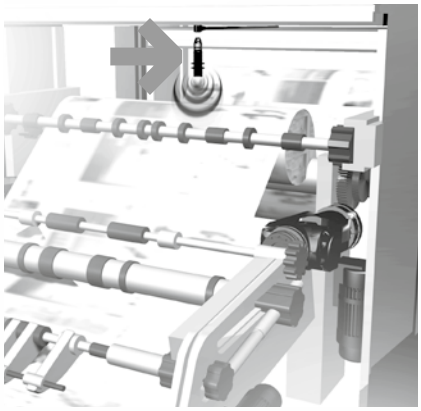
To efficiently fill blisters, the foil needs to be fed into the packaging machine quickly. To accomplish this, the foil sag must be set optimally. BUS sensors monitor this absolutely reliably and thereby ensure high process reliability. Independent of foil color and surface. The BUS sensors are also able to simply mask out dust and dirt.



Efficiently monitor filling level

The benefits to you
- **Broad application spectrum**
- **Independent of environment and material**
- **Lower costs**

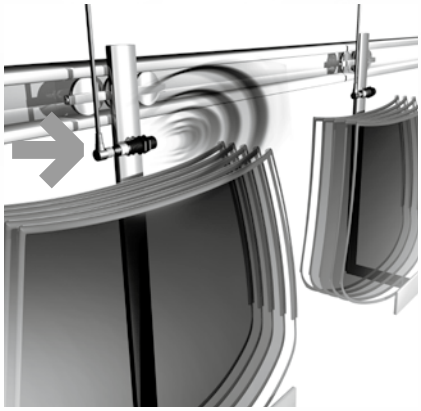
BUS sensors are not influenced by media properties. They are able to contactlessly and reliably detect nearly all powder, paste and liquid materials. Fill levels are even detected over long distances. And, at the same time, they can correctly query minimum and maximum values. Thus, a BUS sensor is able to help lower costs.



Precise measurement of roll diameters

The benefits to you
- **Just one BUS instead of several sensors**
- **Prompt roll changes**
- **Reduced downtimes**
- **Increased productivity**

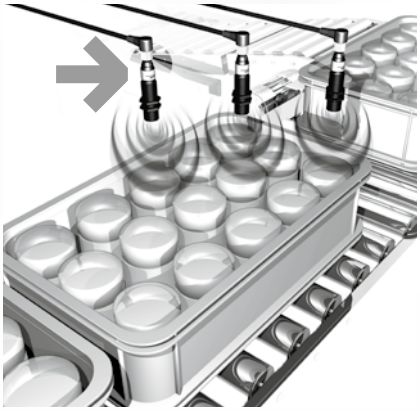
Just one BUS is all you need in order to precisely measure roll thicknesses on printing and paper machines and, at the same time, reliably display the minimum diameter. This is made possible by an analog and an additional switching output that detect both functions at once. Downtimes are thereby reduced to a minimum and prompt roll changes guaranteed.



Reliably monitor distance

The benefits to you
- **Reliable results, even from a long ways away**
- **Independent of color and surface**
- **High process reliability**

Balluff ultrasonic sensors perform strongly even over long distances. At distances as great as 6 m, they completely reliably detect distances and positions. Users in the automotive industry are, for example, able to avoid collisions of mobile robots or suspended conveyors. And thereby ensure high process reliability.



Reliably detect and count objects

The benefits to you
- **Fewer blind zones means greater design freedom**
- **Reliable monitoring, even in areas with limited space**

Packing well means using available space efficiently. Thus, things can get pretty tight in boxes. Nevertheless, the contents can be reliably inspected in order to exactly check and precisely count bottles or cartons. With Balluff BUS ultrasonic sensors, whose narrow sound cone gets top marks in tight spaces.

Correctly measure stack heights

The benefits to you
- **High application reliability, even with dust and dirt**
- **Broad application spectrum**
- **Exceptionally efficient**

In the printing, furniture and glass industries, paper, wood and glass must be measured with precision. BUS ultrasonic sensors do this with absolute reliability. Analog or switching. If both outputs are combined with one another, one sensor can be used to ascertain both the minimum as well as the maximum level, providing exceptional efficiency.

Ultrasonic Sensors
For high technical demands

Extreme precision in critical environments
Wear-free Balluff BUS ultrasonic sensors with enclosure rating IP 67 are designed for a wide range of applications and are compatible with one another. Their detection range extends from 25 mm to 6 m, meaning that even longer object distances can be handled without problem. Their high resolution and small blind zones ensure extreme precision. As a result, they are able to detect nearly all materials, even at close range. And this in critical environments. Mist, steam, dust and dirt are not an issue for BUS sensors.

Diverse applications:
object detection and distance measurement
BUS ultrasonic sensors differ form one another in their output signal. By means of a switching version and an analog version, they are able to both reliably detect and count objects as well as determine distances with extreme precision. This guarantees use in diverse applications. But not only that: various output functions give you freedom of choice, even during operation. You simply decide whether you want to use the BUS as an N.C. or N.O. contact.

Great design freedom
Tubular and block-style housings stand for greater design freedom. And for reliable detection, Balluff ultrasonic sensors do not even need to be mounted on the container, meaning that it is not necessary to remove them when cleaning the container or during format changes. This simplifies work considerably, saving time and money.

Another plus: greater dependability and lower costs
Some analog BUS ultrasonic sensors feature two switching outputs. Thus, one sensor achieves what otherwise only two sensors can accomplish. Not only do you reduce the number of required devices, but, more importantly, you increase the dependability of your application.

Use the table at the right for a quick overview.





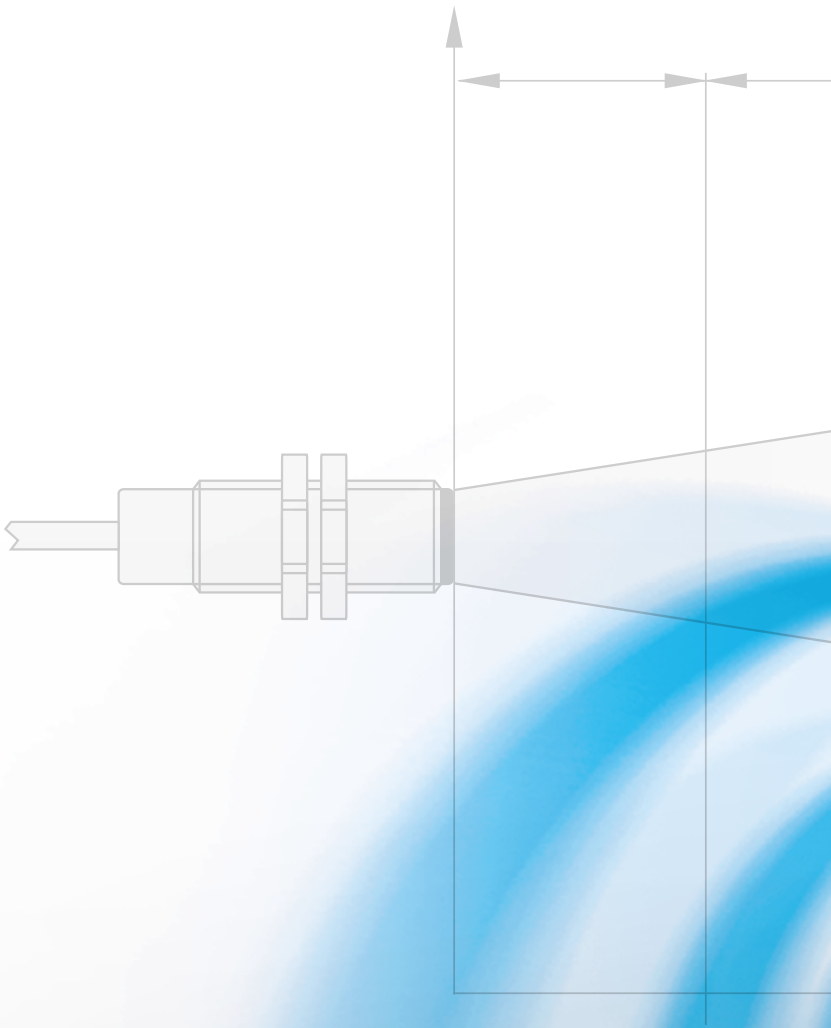
	M12	M18	M30	R05 41×26×12 mm	Maxisensor 80×80×50 mm
Housing materials					
V2A	■				
Plastic		■	■	■	■
Wiring					
Connector	■	■	■	■	■
Cable with connector		■			
Special features					
Adjustable slope		■	■	■	■
Window function possible	■	■	■	■	■
Adjustable hysteresis	■	■	■	■	■
Synchronizable		■	■		

Object Detection (switching output)

Output function					
N.O.		p. 24...25	p. 25		
Programmable N.O./N.C.	p. 24			p. 26	
2× Programmable N.O./N.C.		p. 25			p. 27
Ranges					
25...200 mm	p. 24				
25...250 mm				p. 26	
60...300 mm		p. 24			
30...400 mm		p. 25			
100...600 mm		p. 25			
200...1500 mm		p. 25			
300...2500 mm			p. 25		
600...6000 mm					p. 27
Settings (teach-in)					
Remote	p. 24	p. 25			p. 27
Potentiometer		p. 24...25	p. 25		
Magnet				p. 26	

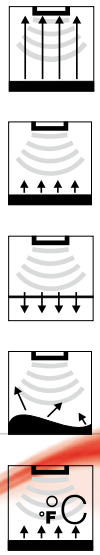
Analog Distance Measurement

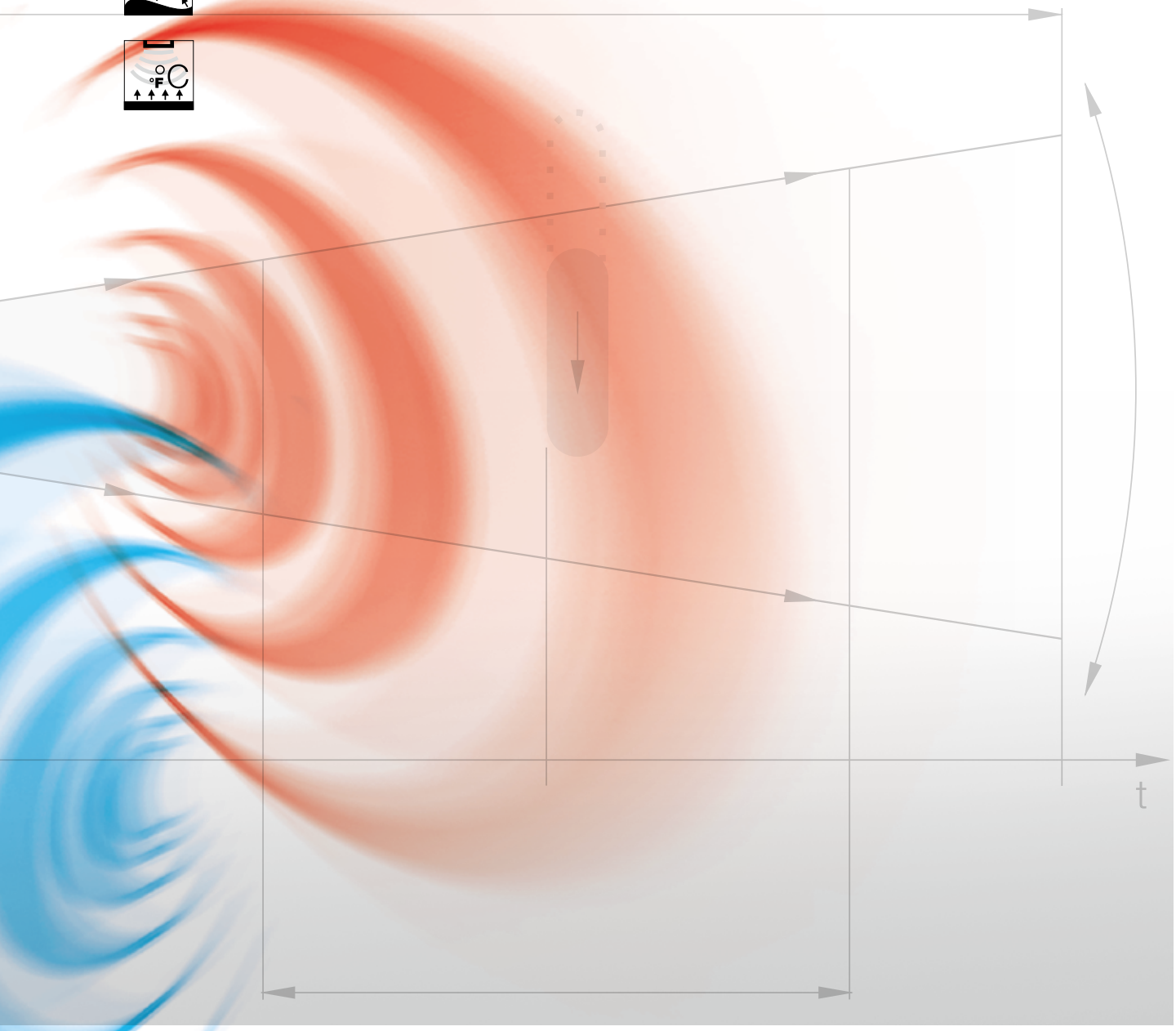
Output function					
0...10 V DC		p. 30...32		p. 34	p. 35
4...20 mA		p. 30...32			p. 35
0...10 V DC or 4...20 mA and 2× N.O./N.C.			p. 33		
Ranges					
25...250 mm				p. 34	
60...300 mm		p. 30			
30...400 mm		p. 31			
80...1600 mm			p. 33		
100...600 mm		p. 31			
200...1500 mm		p. 32			
350...3500 mm			p. 33		
600...6000 mm					p. 35
Settings (teach-in)					
Remote		p. 31		p. 34	p. 35
Button			p. 33		
Magnet				p. 34	



Fundamentals and Definitions
Contents

Balluff BUS ultrasonic sensors can be used for reliable object detection or contactless distance measurement. To do this, they evaluate the echo, which is reflected by the object or the filling level that is to be measured, detected by the ultrasonic transducer and amplified in a downstream amplifier into a signal that can be evaluated. Thus, ultrasonic sensors can also detect smaller objects or contactlessly detect fill levels of bulk materials or paste-like or liquid media.

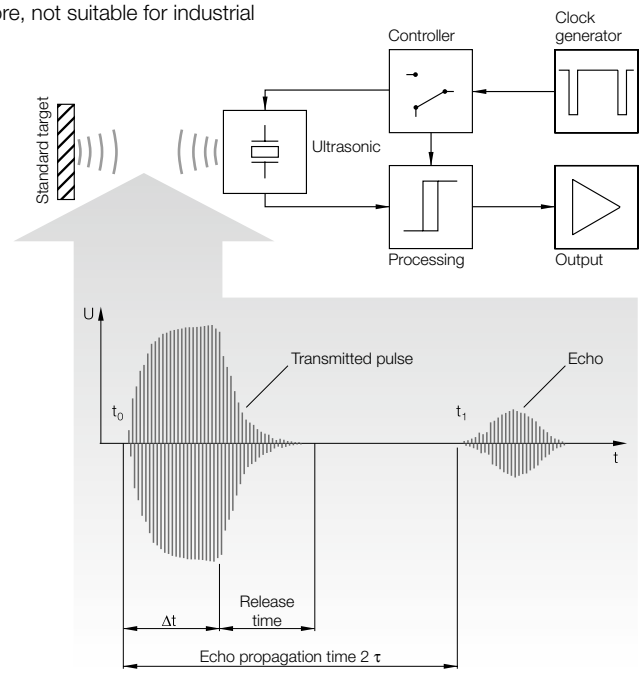




Functional principle

Ultrasound consists of acoustic waves greater than 20 kHz which, unlike electromagnetic waves, can only propagate in matter. If incident against a solid body, the sound is reflected. The sensors make use of this principle. The sensor receives the reflected sound waves as an echo, determines the distance and then converts this value into an output signal.

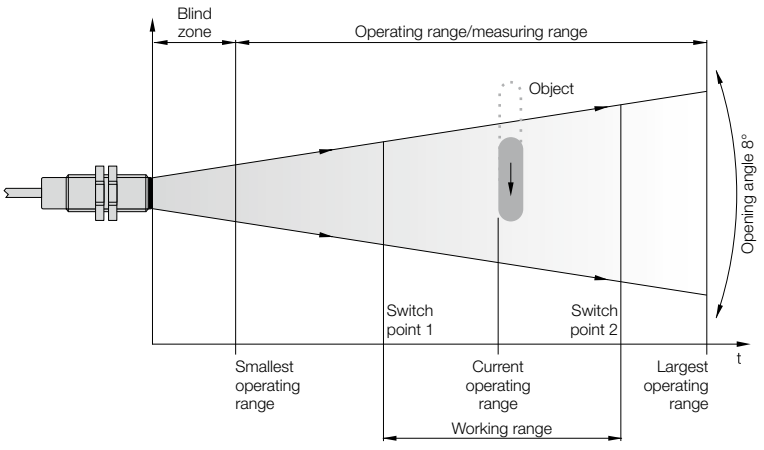
Industrial applications operate with high-frequency ultrasound in excess of approx. 80 kHz. At these high frequencies, bundled sound cones are created. Depending on the surface properties, shape and direction, these sound cones are reflected to varying degrees. Lower-frequency ultrasound, on the other hand, propagates spherically in all directions and is, therefore, not suitable for industrial applications.



Echo propagation time measurement

An ultrasonic transducer emits a short wavetrain that propagates at the speed of sound of the surrounding medium. If incident against an object, part of the wave is reflected back to the sensor. This echo is detected and amplified by an amplifier into a signal that can be evaluated. From the echo propagation time and the speed of sound, the integrated controller calculates the difference.

The range in which the sensor can detect objects is limited by the smallest and largest operating range. This, as well as the size of the blind zone, is determined by the size of the transducer. In the blind zone, the ultrasonic sensor cannot detect any objects. The zone is the result of the duration of the transmitted pulse and the release time of the ultrasonic transducer.



Object influences

Nearly all objects (solid bodies, liquids, bulk materials) reflect sound and can, thus, be detected. Even sound-dampening materials, such as foam, can be detected at reduced operating ranges. In general, solid, liquid or powder media/objects can be detected.

With **convex (cylindrical and spherical) surfaces**, each surface element has a different angle to the beam axis. As a result, the reflected beam diverges and the portion that is reflected to the receiver is reduced accordingly. The maximum range decreases with decreasing cylinder (sphere) size.

The roughness and surface structures of the object that is to be detected also play a role in determining the scanning properties of ultrasonic sensors. Surface structures that are larger than the ultrasonic wavelengths, as well as large-grain bulk materials, reflect ultrasonic waves diffusely and, under some circumstances, are not optimally detected by ultrasonic sensors.

In ultrasonic applications, hard material reflects nearly all of the pulse energy, making it ideal for detection with ultrasound.

Soft material, on the other hand, absorbs nearly all of the pulse energy. Thus, it is not as well detected by ultrasound. These materials include, e.g. felt, cotton, coarse fabrics, foams …

Thin-walled foils behave like soft materials. To use ultrasound, the foil should therefore be at least 0.01 mm thick.

Liquids can be detected with ultrasound. The beam axis must not deviate by more than 3° from vertical relative to the liquid surface, however.

Hot target objects with high temperatures cause thermal convection of the surrounding air. Under certain circumstances, the axis of the sound cone may be deflected so strongly in the vertical direction that the echo can be received only poorly or even not at all.

Environmental influences

Ultrasonic sensors are designed for use in atmospheric air. Environmental influences, such as dust and smoke, do not affect their measurement accuracy. Operation in other gases, e.g. carbon monoxide, may result in measurement errors, however, because the specific speed of sound is different and the ultrasound is dampened. Fluids that evaporate solvents may also affect the sensor function.

Strong air movements and turbulence result in instabilities in the measurement, but, under normal conditions, can be neglected. This is because flow velocities of up to several m/s can be handled without problem, leaving the door open for outdoor applications.

Precipitation, such as rain or snow of normal density, does not affect the function of the ultrasonic sensor and its output signal. The transducer surface should not become wet, however.

Mounting

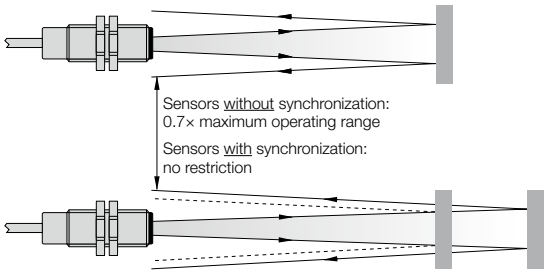
The ultrasonic sensors may be installed in any position, provided no deposits are permitted to collect on the acoustically active surface. The ultrasonic cone can be deflected through the use of sound deflection brackets, though at the expense of the maximum operating range.

Minimum distance

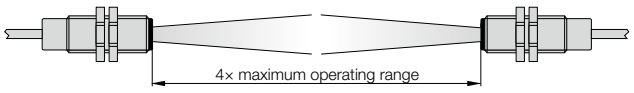
If not installed properly, ultrasonic sensors may influence one another and cause faulty switching. To prevent this, minimum distances must be maintained. For some of the BUS sensors, this mutual interference can be prevented through synchronization.

Row mounting
Row mounting ensures that proper sensor spacing is maintained. This can also be achieved by means of synchronization, however.

SYNC

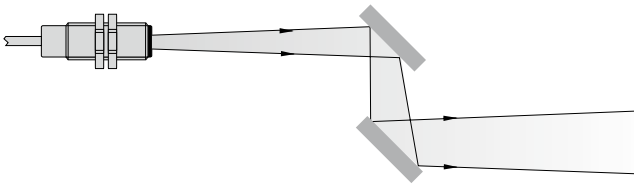


Opposite mounting
To prevent faulty switching from occurring, a minimum distance must be maintained.



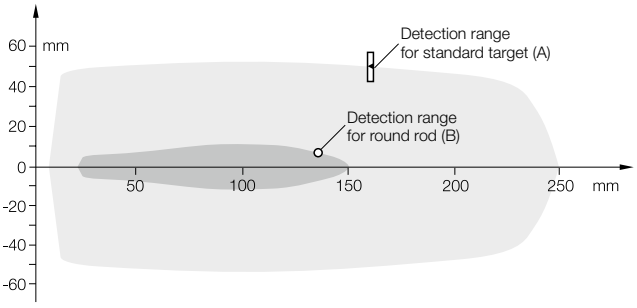
Deflection

Deflection of the sensor is generally possible with hard, flat surfaces. BUS sensors should not be deflected more than twice, since deflection can result in a decrease in operating range.



Detection range

The opening angle of the sound cone is approx. 8°. It corresponds to the maximum detection range at approximately the 3-dB limit. Objects of appropriate size, shape and surface properties can still be detected outside of this angle, however. The following figure shows the detection range of a flat, standard target (A) 100×100 mm oriented vertically relative to the direction of propagation of the ultrasound as well as the detection range of a round rod (B) with a diameter of 25 mm. Detection of the specified objects is ensured within these ranges.



Detection range – using the M12 ultrasonic sensor (BUS M12E0...) as an example.
Within range (A), the BUS sensor detects the standard target. Within range (B), the BUS sensor detects the standard target and the round rod.

Output functions

Switching output: N.O. contact

The switching output of the sensor is not switched through in its deactivated state.

Switching output: N.C. contact

The switching output of the sensor is switched through in its deactivated state.

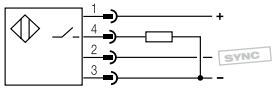
Switching sensors for object detection

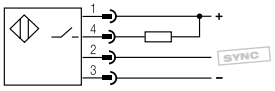
DC 4-wire

PNP (+) sourcing

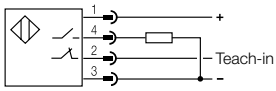
NPN (–) sinking

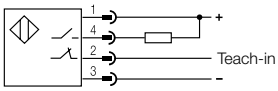
N.O. contact: The switching output is implemented as an N.O. contact.





Programmable N.O./N.C. contact: The switching output of the sensor can be implemented as either an N.C. or N.C. contact.



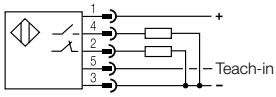


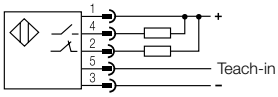
DC 5-wire

PNP (+) sourcing

NPN (–) sinking

2× programmable N.O./N.C. contacts: 2 switching outputs enable variants: N.C./N.O., N.O./N.O. or N.C./N.C.





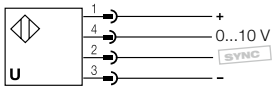
Analog-measuring sensors for distance measurement

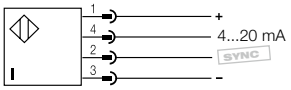
DC 4-wire

Voltage output 0...10 V DC

Current output 4...20 mA

One voltage or current output (0...10 V DC or 4...20 mA) with fixed slope.



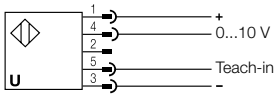


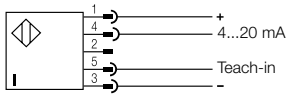
DC 5-wire

Voltage output 0...10 V DC

Current output 4...20 mA

One voltage or current output (0...10 V or 4...20 mA) with variable slope.

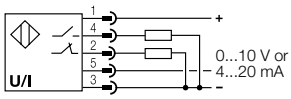


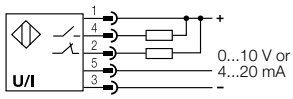


One voltage or current output (0...10 V DC or 4...20 mA) with variable slope and two programmable and evaluable switch points (N.O./N.C.).

Voltage output 0...10 V DC and PNP (+) sourcing

Current output 4...20 mA and NPN (–) sinking





SYNC

Synchronization

Some Balluff ultrasonic sensors can be synchronized. This has the advantage that adjacent sensors do not interfere with one another. Sensors are synchronized by connecting their sync lines together. Synchronized sensors start their transmit pulse at the same time. The slowest sensor determines the cycle time.

Working range

The area between two individual switch points is the working range of the sensor.

Detection range

The entire three-dimensional space in which objects can be detected or distances measured is the detection range.

Operating range/ measuring range

With minimum and maximum values, the operating range/measuring range specifies the range in which objects can be reliably detected or distances measured.
Used as a reference here is the 100×100 mm standard target. The maximum operating range/maximum measuring range of the object that is to be detected is dependent on its reflective properties. These are determined by its size, material characteristics and surface structure. To ensure the maximum operating range/maximum measuring range, the object must be oriented at a right angle to the beam axis. The operating range/measuring range may be reduced if very small objects are to be detected.

Blind zone

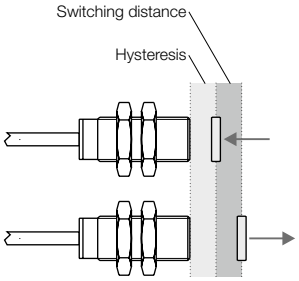
Ultrasonic sensors use a transducer to transmit and receive the ultrasonic pulse. Because the transducer cannot, of course, simultaneously transmit and receive, there is a zone in front of the sensor in which the object position cannot be determined.

Sound cone opening

The sound cone opening is approx. 8°. This determines the 3-dB limit. Near the sound cone, objects can also be detected outside of these limits. The diameter of the ultrasound cone increases with increasing distance from the sensor. The energy density also drops off in proportion to distance. This applies equally to the reflected cone as it returns from the scanned object to the receiver.

Resolution

Resolution is the smallest change in distance that causes a modification in the output value.



Hysteresis H

The hysteresis is the difference in distance between the switch-on point (for an object that is approaching) and the switch-off point (for an object that is receding).

Sensing face

The active surface of the ultrasonic sensor (transducer) consists of an epoxy-resin hollow-glass-sphere mixture. It is the zone through which the ultrasound enters the air.

Standard target

The standard target (100×100 mm) is used to ascertain the rated values that are specified in the technical data.

Response time

For dynamic object scanning (e.g. for numbers of objects), the response time is not negligible due to the relatively low speed of sound (340 m/s). Depending on sensor type and evaluation method, it lies in the range of 40...700 ms. For correct detection, the object must remain in the sound cone for a minimum period of time.
The response time is delayed both during the entry phase as well as during the exit phase of the object.

Switching frequency f

Due to the response times, switching frequencies vary in the Hz range. The switching frequency is inversely proportional to the distance of the target object.

Ambient temperature range T_a

The ambient temperature determines the temperature range in which the sensor may be operated. This generally lies between –15...+70 °C. All BUS sensors are equipped with temperature compensation.

Temperature drift

Specifies the amount by which the switching distance can change as a function of the temperature. The temperature coefficient has a value of 0.17 %/K. Thus, a change in temperature of ΔT = 10 °C results in a change in the speed of sound of approx. 1.7 % and a distortion of the switching threshold of approx. –1.7 %.
For example, at a range of s = 1 m and a temperature change of ΔT = 20 °C, the change in distance is Δs = 3.4 cm.

Supply voltage U_B

The voltage range in which proper function of the sensor is ensured. It includes all voltage tolerances and ripple.

Output current max.

The maximum current with which the sensor may be loaded at its output in continuous operation.

No-load supply current I_0 max.

The intrinsic current consumption of the sensor at maximum supply voltage U_B with no switched load.

Short-circuit protection and overload protection

All DC sensors feature this protection device. In the event of overload or short-circuit at the output, the output transistor is automatically switched off. As soon as the malfunction has been corrected, the output stage is reset to normal functioning.

Polarity reversal protection

The sensor electronics are protected against possible polarity reversal or interchanging of the connection wires.

Function indicators

Echo and output function are displayed via LEDs. The output function returns the state of the sensor. The yellow LED illuminates when the sensor switches (for N.O. contacts). The green LED illuminates as soon as an object is detected and the reflected echo is received.

Mounting torques

To ensure that the sensors are not mechanically destroyed during installation, make sure that you comply with the following torque values.

Size	Material	Tightening torque
M12×1	V2A	40 Nm
M18×1	PBT	1 Nm
M30×1.5	PBT	3 Nm

Housing materials

Material	Use and characteristics
Plastics	
Epoxy-resin hollow-glass-spheres	Hollow-glass-spheres can be treated with epoxy-resins. They are used to manufacture transducers with low density and high pressure resistance
PA Polyamide	High impact resistance, good chemical resistance
PBT Polybutylenterephtalat	High mechanical strength and temperature resistance. Good chemical resistance. Good oil resistance.
POM Polyoxymethylene	High impact resistance, good mechanical strength. Good chemical resistance
PUR Polyurethane	Elastic, abrasion-resistant, impact-resistant. Good resistance to oils, greases, solvents (used for gaskets and cable jackets)
Metal	
V2A Stainless steel	Excellent corrosion resistance and strength. Quality, 1.4301: Standard material for the foods industry.

Insulation class

II ⧈ EN 60947-5-2/IEC 60947-5-2

Degree of protection (enclosure rating)

The enclosure ratings IP 20, IP 40, IP 54, IP 64 up to IP 68 are in accordance with IEC 60529.
Code letters IP (International Protection) designate protection against shock hazard, ingress of solid foreign bodies, and water, for electrical equipment.

First digit:
2 Protection against penetration of solid bodies larger than 12 mm, shielding from fingers and objects
4 Protection against penetration of solid bodies larger than 1 mm, shielding from tools and wires
5 Protection against harmful dust deposits, complete shock-hazard protection
6 Protection against penetration of dust, complete shock-hazard protection

Second digit:
0 No special protection
4 Protection against water spraying from all directions against the piece of equipment concerned
5 Protection against a water jet from a nozzle, directed from all directions against the piece of equipment concerned
7 Protection against water, when the piece of equipment concerned (housing) is immersed in water under specified pressure and time conditions

Quality management system in accordance with DIN EN ISO 9001:2008

Balluff companies	
Balluff GmbH	Germany
Balluff SIE Sensorik GmbH	Germany
Balluff Elektronika Kft.	Hungary
Balluff Ltd.	Great Britain
Balluff Automation s.r.l.	Italy
Balluff Inc.	USA
Balluff GmbH	Austria
Balluff CZ, s.r.o	Czech Republic
Balluff Hy-Tech AG	Switzerland
Balluff Sensortechnik AG	Switzerland
Balluff Controles Elétricos Ltda.	Brazil
Balluff de México S.A. de C.V.	Mexico

Environmental management system in accordance with DIN EN ISO 14001:2005

Balluff companies	
Balluff GmbH	Germany
Balluff Elektronika Kft.	Hungary

Testing laboratory

The Balluff testing laboratory works in accordance with ISO/IEC 17025 and is accredited by DATech for testing electromagnetic compatibility (EMC).

Balluff products meet the EU directives

Products requiring labeling are subjected to a conformity evaluation process according to the EU directive and the product is labeled with the CE marking. Balluff products fall under the following EU directives:

2004/108/EC	EMC directive

Approvals

Approvals are granted by national and international institutions. Their symbols affirm that our products meet the specifications of these institutions. "US Safety System" and "Canadian Standards Association" under the auspices of Underwriters Laboratories Inc. (cUL).

Balluff is a member of ALPHA

ALPHA, an association for testing and certification of low-voltage devices, promotes the individual responsibility of the manufacturer of such devices by means of uniform test procedures according to current standards and thereby supports the attainment of such high product quality. Under certain prerequisites, ALPHA also grants nationally recognized product certificates. Through ALPHA's membership in LOVAG (Low Voltage Agreement Group), its certificates are also recognized in other European countries.

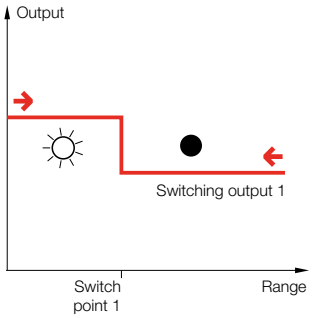
Adjustment of Balluff BUS ultrasonic sensors
BUS sensors can be adjusted in a variety of ways:
– with a potentiometer
– via a remote cable
– at the touch of a button or
– by means of a magnet
Custom and fast adjustment is comfortably supported by means of LEDs. The yellow LED, for example, displays the switching state. And the green LED on some sensors is used to aid in positioning, as it shows the received echo.



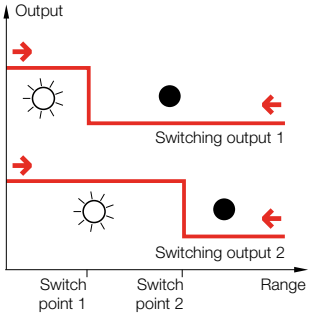
Object detection

Balluff BUS ultrasonic sensors for object detection are available with one or two switch points.

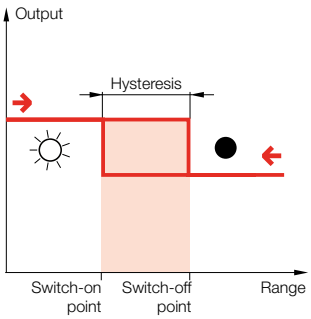
One switch point (1 SP)
The yellow LED is necessary for teaching-in a single switch point. To teach in the switch point, the teach-in input must be connected to GND until the yellow LED begins to flash rapidly (alternative: button or magnet). After approx. 8 sec., disconnect: the yellow LED begins to flash slowly; the sensor is now in teach mode. The switch point must be taught-in within 35 sec. For this purpose, move the object to the desired position. If the LED begins to flash, briefly reconnect the teach-in input to GND. The output is individually configured as an N.O. contact. If the sensor is to be configured as an N.C. contact, the teach-in input is then connected to GND at a moment when the LED is not flashing.



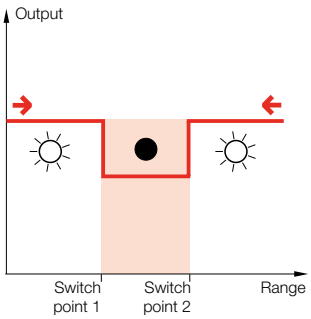
Two switch points (2 SP)
If two switch points are to be programmed, the first switch point is taught as described under 1 SP. The procedure for adjusting the second switch point corresponds to that used to adjust the first. The difference is that the teach-in input must first be connected to GND for approx. 16 sec.



Hysteresis function – same switching characteristic
The switching characteristic of SP 1 determines SP 2. For example, if SP 1 is programmed as an N.C. contact, SP 2 can likewise only be taught as an N.C. contact. And vice versa.



Window function – opposite switching characteristic
If SP 1 is programmed as an N.C. contact, SP 2 must be taught as an N.O. contact. And vice versa. Thus, the switching output between both points is either active or inactive.

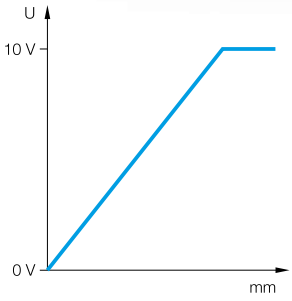


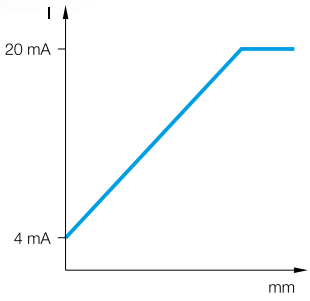
Legend
☼ = yellow LED on
● = yellow LED off

Analog distance measurement

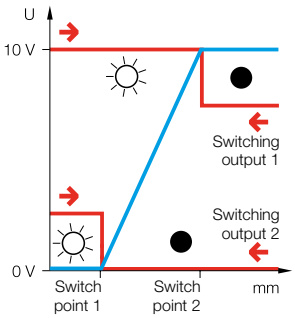
Balluff BUS ultrasonic sensors for analog distance measurement are available with fixed slope, variable slope or variable slope with two evaluable switch points. In addition to the yellow LED, some sensors are also equipped with green LEDs, which serve as positioning aids.

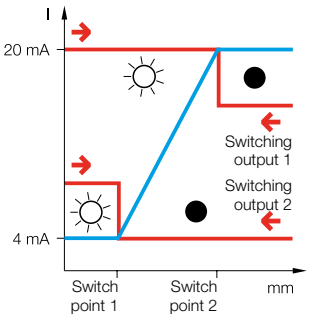
Fixed slope
The maximum range of the sensor has a fixed slope that cannot be changed.





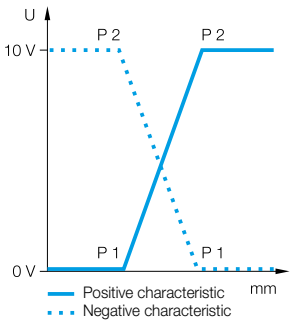
Variable slope with two evaluable switch points
Here, P 1 and P 2 also define the position of both switch points. The adjustment of P 1 corresponds to that of SP 1. Accordingly, the adjustment of P 2 corresponds to that of SP 2 (see object detection SP 2).

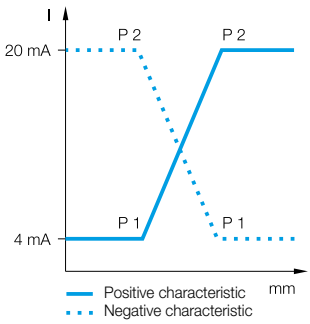




Variable slope
The working range of the analog characteristic is defined with P 1 and P 2. P 1 determines the position at which the characteristic takes the value 0 V DC or 4 mA, P 2 determines the position of 10 V DC or 20 mA.
Positive characteristic: P 1 < P 2 (see graphic)
Negative characteristic: P 1 > P 2 (see graphic)

The adjustment of P 1 corresponds to that of SP 1. Accordingly, the adjustment of P 2 corresponds to that of SP 2 (see object detection SP 2).





Object Detection
Contents

Balluff BUS ultrasonic sensors with ranges of up to 6 m ensure reliable detection. And are ideally suited for a wide range of applications in industrial automation. Whether in tubular or block design, the BUS sensors satisfy all standards. And more. The M12 housing, for example, is perfectly suited for the detection of small objects. And saves space, even in extremely tight areas.

For window and hysteresis operation, BUS sensors for object detection are available with two switch points. Some types also include an option for synchronization, which can be used to prevent adjacent sensors from interfering with one another.

Tubular housings

Block-style housings

Electrical devices, connectors and holders, see Accessories section, starting on **page 37**

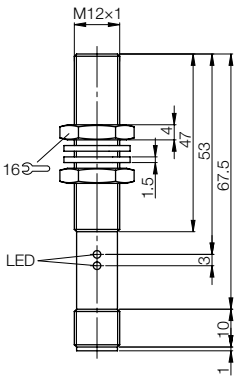
Housing size			**M12×1**	**M18×1**	
Operating range			**25...200 mm**	**60...300 mm**	
PNP	N.O.	**Ordering code**		**BUS000T**	
		Part number		BUS M18K0-PSXEP-030-EP00,3-GS92	
PNP	programmable	**Ordering code**	**BUS0005**		
	N.O./N.C.	Part number	BUS M12E0-PPXCR-020-S04G		
PNP	2× programmable	**Ordering code**			
	N.O./N.C.	Part number			
NPN	N.O.	**Ordering code**		**BUS000Y**	
		Part number		BUS M18K0-NSXEP-030-EP00,3-GS92	
NPN	programmable	**Ordering code**	**BUS0006**		
	N.O./N.C.	Part number	BUS M12E0-NPXCR-020-S04G		
NPN	2× programmable	**Ordering code**			
	N.O./N.C.	Part number			
Supply voltage U_B			24 V DC ±25 %	24 V DC ± 25 %	
Output current max.			100 mA	500 mA	
No-load supply current I_0 max.			≤ 35 mA	≤ 35 mA	
Reverse polarity/short circuit protected			yes/yes	yes/yes	
Ambient temperature range T_a			–20...+70 °C	–15...+70 °C	
Switching frequency f			30 Hz	25 Hz	
Output function indicator			LED yellow	LED yellow	
Echo function indicator			LED green		
Degree of protection per IEC 60529			IP 65	IP 67	
Temperature compensation			yes	yes	
Ultrasonic frequency			400 kHz	330 kHz	
Sound cone opening			8°	8°	
Resolution			0.2 mm	0.2 mm	
Settings			Teach-in (remote)	Potentiometer	
Material		Housing	V2A	PBT	
		Sensing face	Epoxy-resin hollow-glass-spheres/PUR	Epoxy-resin hollow-glass-spheres	
		Cover		PBT	
Approvals			CE	CE, cULus	
Connection			M12 connector, 4-pin, A-coded	0.3 m cable PUR, 5×0.34 mm² with M12-connector, 5-pin, A-coded	

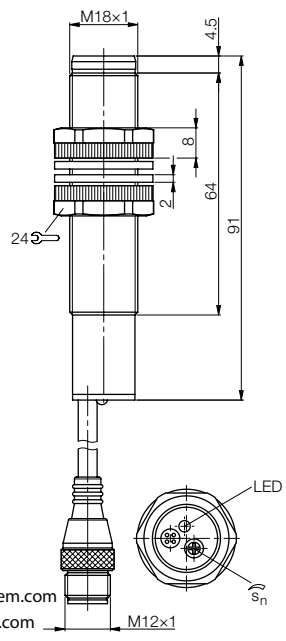
h w

Hysteresis and window function are possible. For explanations, see chapter Fundamentals and Definitions, page 20.

SYNC

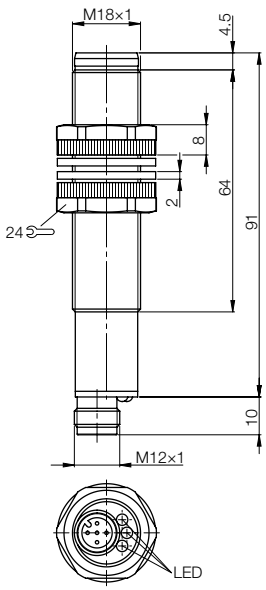
Synchronization prevents sensors that are positioned adjacent to one another from interfering with each other. Sensors are synchronized by connecting their sync lines together. Synchronized sensors start their transmit pulse at the same time. The slowest sensor determines the cycle time.

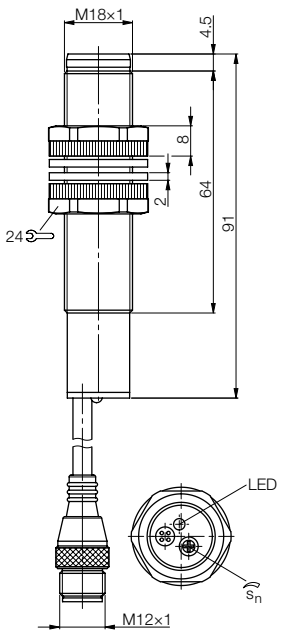


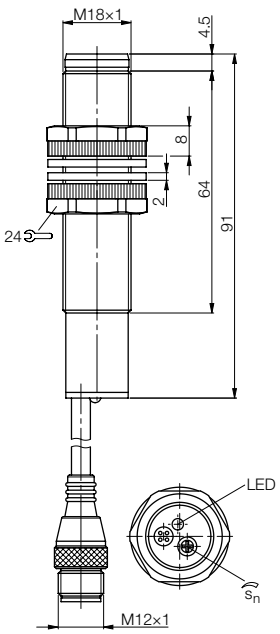


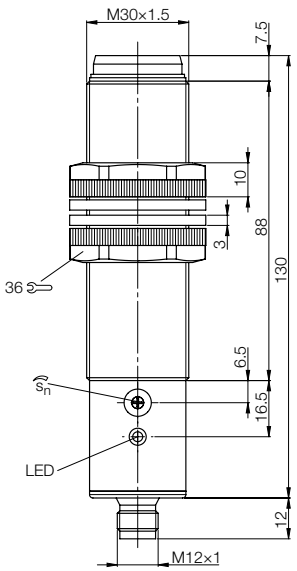
Sound deflection brackets and focussing attachments can be found on page 46.

	M18×1	**M18×1**	**M18×1**	**M30×1.5**
	30...400 mm	**100...600 mm**	**200...1500 mm**	**300...2500 mm**
		BUS000R	**BUS000P**	**BUS000Z**
		BUS M18K0-PSXEP-060-EP00,3-GS92	BUS M18K0-PSXEP-150-EP00,3-GS92	BUS M30K0-PSXER-250-S04K
	BUS0001			
	BUS M18K0-PWXER-040-S92K			
		BUS000W	**BUS000U**	**BUS0010**
		BUS M18K0-NSXEP-060-EP00,3-GS92	BUS M18K0-NSXEP-150-EP00,3-GS92	BUS M30K0-NSXER-250-S04K
	BUS0002			
	BUS M18K0-NWXER-040-S92K			
	24 V DC ±25 %	24 V DC ±25 %	24 V DC ±25 %	24 V DC ±25 %
	500 mA	500 mA	500 mA	500 mA
	≤ 80 mA	≤ 35 mA	≤ 35 mA	≤ 35 mA
	yes/yes	yes/yes	yes/yes	yes/yes
	–15...+70 °C	–15...+70 °C	–15...+70 °C	–15...+70 °C
	15 Hz	25 Hz	8 Hz	5 Hz
	2× LED yellow LED green	LED yellow	LED yellow	LED yellow
	IP 67	IP 67	IP 67	IP 67
	yes	yes	yes	yes
	360 kHz	300 kHz	180 kHz	130 kHz
	8°	8°	8°	8°
	0.2 mm	0.2 mm	0.2 mm	0.2 mm
	Teach-in (remote)	Potentiometer	Potentiometer	Potentiometer
	PBT	PBT	PBT	PBT
	Epoxy-resin hollow-glass-spheres	Epoxy-resin hollow-glass-spheres	Epoxy-resin hollow-glass-spheres	Epoxy-resin hollow-glass-spheres
	PBT	PBT	PBT	PBT
	CE	CE, cULus	CE, cULus	CE, cULus
	M12 connector, 5-pin, A-coded	0.3 m cable PUR, 5×0.34 mm² with M12-connector, 5-pin, A-coded	0.3 m cable PUR, 5×0.34 mm² with M12-connector, 5-pin, A-coded	M12 connector, 4-pin, A-coded









Tubular housings
Block-style housings

Electrical devices, connectors and holders, see Accessories section, starting on **page 37**

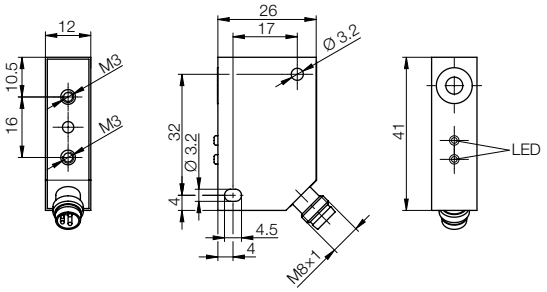
Object Detection

Block-style housings · 41×26×12 mm

R05

Housing size			**41×26×12 mm** (R05)
Operating range			**25...250 mm**
PNP	programmable	**Ordering code**	**BUS0007**
	N.O./N.C.	Part number	BUS R05K0-PPXCR-025-S75G
NPN	programmable	**Ordering code**	**BUS0008**
	N.O./N.C.	Part number	BUS R05K0-NPXCR-025-S75G
Supply voltage U_B			24 V DC ±25 %
Output current max.			100 mA
No-load supply current I_0 max.			≤ 100 mA
Reverse polarity/short circuit protected			yes/yes
Ambient temperature range T_a			–10...+70 °C
Switching frequency f			25 Hz
Output function indicator			LED yellow
Echo function indicator			LED green
Degree of protection per IEC 60529			IP 67
Temperature compensation			yes
Ultrasonic frequency			400 kHz
Sound cone opening			8°
Resolution			0.2 mm
Settings			Teach-in (remote, magnet)
Material		Housing	PA
		Sensing face	Epoxy-resin hollow-glass-spheres/PUR
		Cover	PA
Approvals			CE
Connection			M8 connector, 4-pin

Hysteresis and window function are possible. For explanations, see chapter Fundamentals and Definitions, page 20.



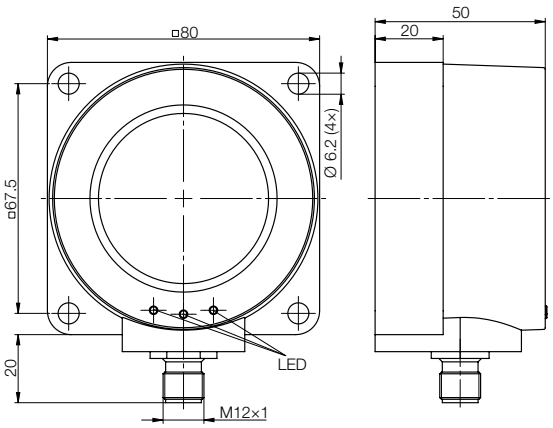
Object Detection

Block-style housings · 80×80×50 mm

Maxisensor

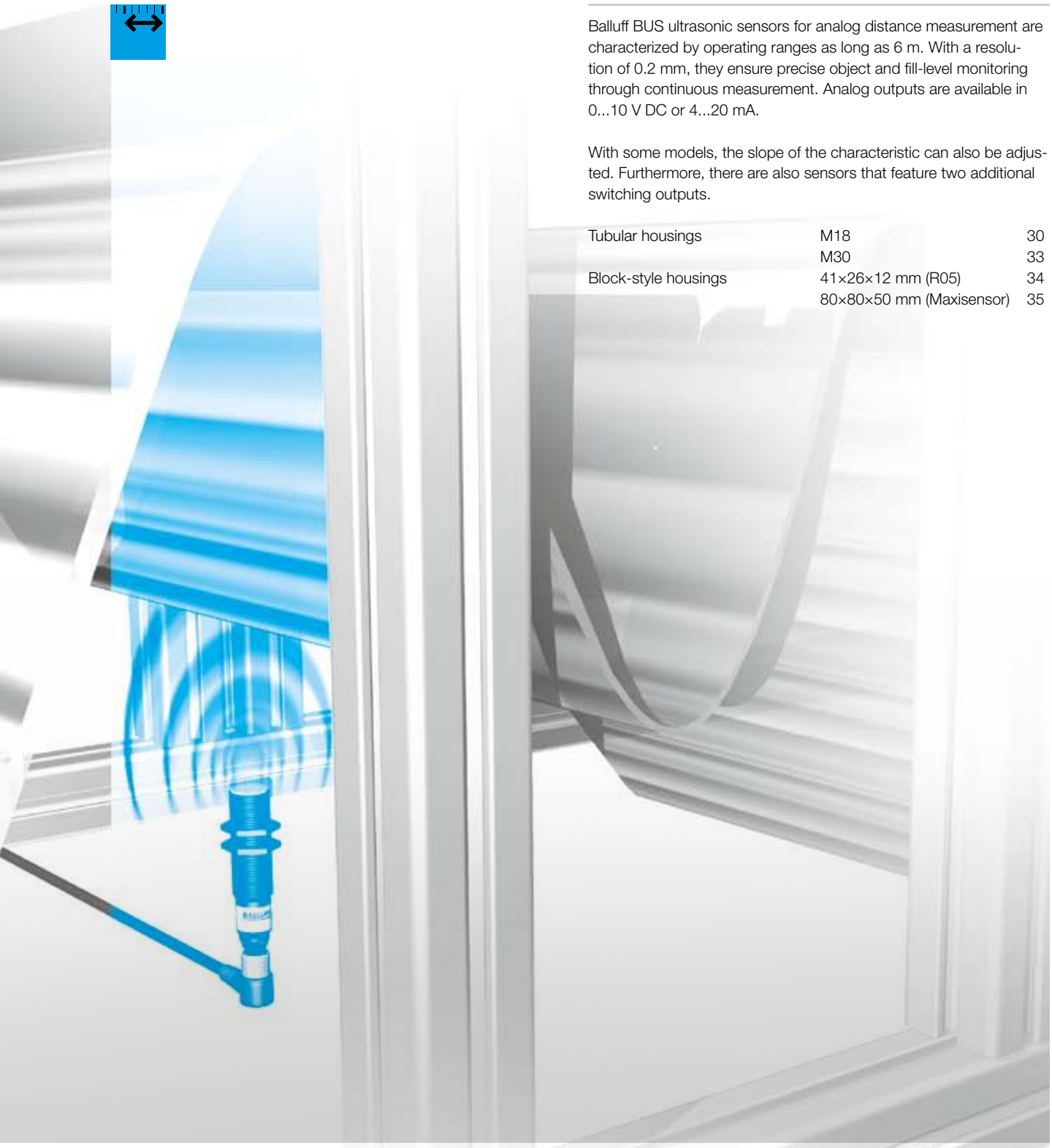
Housing size			**80×80×50 mm** (Maxisensor)
Operating range			**600...6000 mm**
PNP	2× programmable N.O./N.C.	**Ordering code**	**BUS000A**
		Part number	BUS Q80K0-PWXER-600-S92K
NPN	2× programmable N.O./N.C.	**Ordering code**	**BUS000C**
		Part number	BUS Q80K0-NWXER-600-S92K
Supply voltage U_B			24 V DC ±25 %
Output current max.			500 mA
No-load supply current I_0 max.			≤ 60 mA
Reverse polarity/short circuit protected			yes/yes
Ambient temperature range T_a			–15...+70 °C
Switching frequency f			0,5 Hz
Output function indicator			2× LED yellow
Echo function indicator			LED green
Degree of protection per IEC 60529			IP 65
Temperature compensation			yes
Ultrasonic frequency			80 kHz
Sound cone opening			8°
Resolution			1 mm
Settings			Teach-in (remote)
Material		Housing	PBT
		Sensing face	Epoxy-resin hollow-glass-spheres/PUR
		Cover	PBT
Approvals			CE
Connection			M12 connector, 5-pin, A-coded

Hysteresis and window function are possible. For explanations, see chapter Fundamentals and Definitions, page 20.



Electrical devices, connectors and holders, see Accessories section, starting on **page 37**

Analog Distance Measurement
Contents



Balluff BUS ultrasonic sensors for analog distance measurement are characterized by operating ranges as long as 6 m. With a resolution of 0.2 mm, they ensure precise object and fill-level monitoring through continuous measurement. Analog outputs are available in 0...10 V DC or 4...20 mA.

With some models, the slope of the characteristic can also be adjusted. Furthermore, there are also sensors that feature two additional switching outputs.

Tubular housings

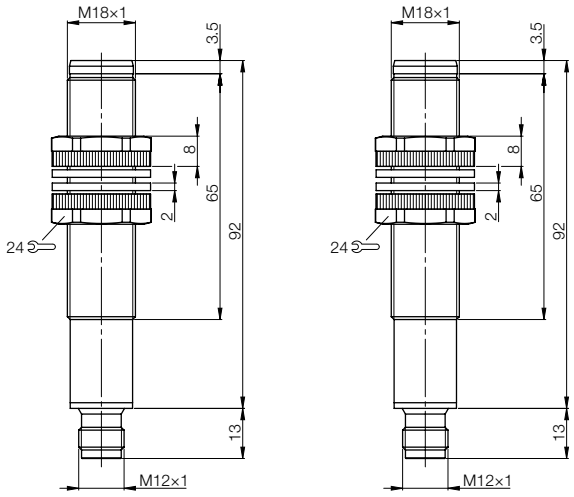
Block-style housings

Electrical devices, connectors and holders, see Accessories section, starting on **page 37**

Housing size		**M18×1**	**M18×1**
Measuring range		**60...300 mm**	**60...300 mm**
0...10 V DC	**Ordering code**	**BUS000K**	
	Part number	BUS M18K0-XAFX-030-S04K	
4...20 mA	**Ordering code**		**BUS000N**
	Part number		BUS M18K0-XBFX-030-S04K
Supply voltage U_B		24 V DC ±25 %	24 V DC ±25 %
No-load supply current I_0 max.		≤ 35 mA	≤ 35 mA
Reverse polarity/short circuit protected		yes/yes	yes/yes
Ambient temperature range T_a		–15...+70 °C	–15...+70 °C
Output function indicator			
Echo function indicator			
Degree of protection per IEC 60529		IP 67	IP 67
Temperature compensation			
Ultrasonic frequency		330 kHz	330 kHz
Sound cone opening		8°	8°
Resolution		0.2 mm	0.2 mm
Max. characteristic deviation		≤ 0.3 %	≤ 0.3 %
Characteristic slope		42 mV/mm	67 µA/mm
Settings			
Response time		50 ms	50 ms
Material	Housing	PBT	PBT
	Sensing face	Epoxy-resin hollow-glass-spheres	Epoxy-resin hollow-glass-spheres
	Cover	PBT	PBT
Approvals		CE, cULus	CE, cULus
Connection		M12 connector, 4-pin, A-coded	M12 connector, 4-pin, A-coded

SYNC

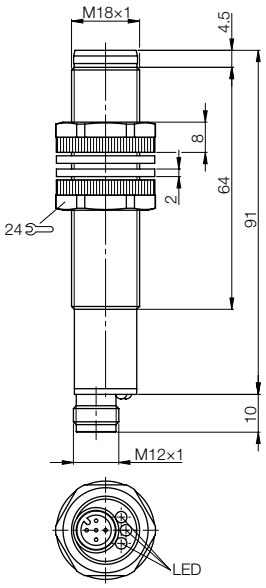
Synchronization prevents sensors that are positioned adjacent to one another from interfering with each other. Sensors are synchronized by connecting their sync lines together. Synchronized sensors start their transmit pulse at the same time. The slowest sensor determines the cycle time.

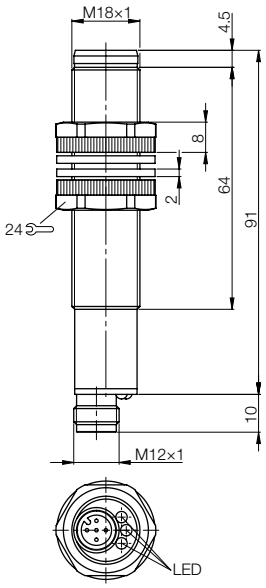


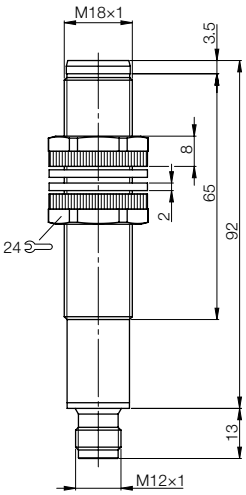
Sound deflection brackets and focussing attachments can be found on page 46.

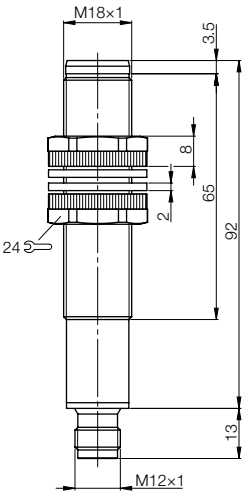


	M18×1 30...400 mm	M18×1 30...400 mm	M18×1 100...600 mm	M18×1 100...600 mm
	BUS0003		**BUS000J**	
	BUS M18K0-XAER-040-S92K		BUS M18K0-XAFX-060-S04K	
		BUS0004		**BUS000M**
		BUS M18K0-XBER-040-S92K		BUS M18K0-XBFX-060-S04K
	24 V DC ±25 %	24 V DC ±25 %	24 V DC ±25 %	24 V DC ±25 %
	≤ 40 mA	≤ 40 mA	≤ 35 mA	≤ 35 mA
	yes/yes	yes/yes	yes/yes	yes/yes
	–15...+70 °C	–15...+70 °C	–15...+70 °C	–15...+70 °C
	2× LED yellow	2× LED yellow		
	LED green	LED green		
	IP 67	IP 67	IP 67	IP 67
	yes	yes	yes	yes
	360 kHz	360 kHz	300 kHz	300 kHz
	8°	8°	8°	8°
	0.2 mm	0.2 mm	0.2 mm	0.2 mm
	≤ 0.5 %	≤ 0.5 %	≤ 0.3 %	≤ 0.3 %
	adjustable	adjustable	20 mV/mm	32 µA/mm
	Teach-in (remote)	Teach-in (remote)		
	100 ms	100 ms	50 ms	50 ms
	PBT	PBT	PBT	PBT
	Epoxy-resin hollow-glass-spheres	Epoxy-resin hollow-glass-spheres	Epoxy-resin hollow-glass-spheres	Epoxy-resin hollow-glass-spheres
	PBT	PBT	PBT	PBT
	CE	CE	CE, cULus	CE, cULus
	M12 connector, 5-pin, A-coded	M12 connector, 5-pin, A-coded	M12 connector, 4-pin, A-coded	M12 connector, 4-pin, A-coded









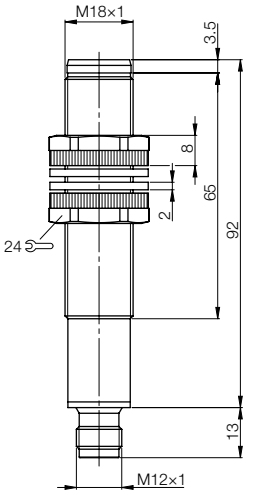
Tubular housings
Block-style housings

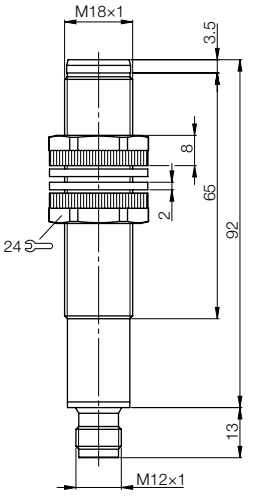
Electrical devices, connectors and holders, see Accessories section, starting on **page 37**

Housing size		**M18×1**	**M18×1**
Measuring range		**200...1500 mm**	**200...1500 mm**
0...10 V DC	**Ordering code**	**BUS000H**	
	Part number	BUS M18K0-XAFX-150-S04K	
4...20 mA	**Ordering code**		**BUS000L**
	Part number		BUS M18K0-XBFX-150-S04K
Supply voltage U_B		24 V DC ±25 %	24 V DC ±25 %
No-load supply current I_0 max.		≤ 35 mA	≤ 35 mA
Reverse polarity/short circuit protected		yes/yes	yes/yes
Ambient temperature range T_a		–15...+70 °C	–15...+70 °C
Degree of protection per IEC 60529		IP 67	IP 67
Ultrasonic frequency		180 kHz	180 kHz
Sound cone opening		8°	8°
Resolution		0.2 mm	0.2 mm
Max. characteristic deviation		≤ 0.3 %	≤ 0.3 %
Characteristic slope		5.5 mV/mm	8.8 µA/mm
Response time		150 ms	150 ms
Material	Housing	PBT	PBT
	Sensing face	Epoxy-resin hollow-glass-spheres	Epoxy-resin hollow-glass-spheres
	Cover	PBT	PBT
Approvals		CE, cULus	CE, cULus
Connection		M12 connector, 4-pin, A-coded	M12 connector, 4-pin, A-coded

SYNC

Synchronization prevents sensors that are positioned adjacent to one another from interfering with each other. Sensors are synchronized by connecting their sync lines together. Synchronized sensors start their transmit pulse at the same time. The slowest sensor determines the cycle time.





Sound deflection brackets and focussing attachments can be found on page 46.

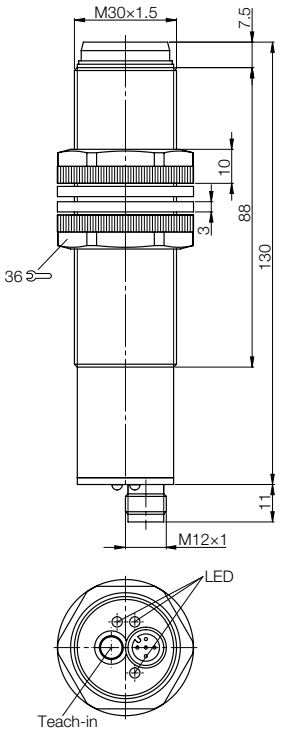
Housing size		**M30×1.5**	**M30×1.5**
Measuring range		**80...1600 mm**	**350...3500 mm**
0...10 V DC or 4...20 mA and 2× PNP N.O./N.C.	**Ordering code**	**BUS0016**	**BUS0015**
	Part number	BUS M30K0-PWCET-150-S92K	BUS M30K0-PWCET-350-S92K
0...10 V DC or 4...20 mA and 2× NPN N.O./N.C.	**Ordering code**	**BUS0018**	**BUS0017**
	Part number	BUS M30K0-NWCET-150-S92K	BUS M30K0-NWCET-350-S92K
Supply voltage U_B		24 V DC ±25 %	24 V DC ±25 %
Output current max.		100 mA	100 mA
No-load supply current I_0 max.		≤ 60 mA	≤ 60 mA
Reverse polarity/short circuit protected		yes/yes	yes/yes
Ambient temperature range T_a		–15...+70 °C	–15...+70 °C
Switching frequency f		1 Hz	1 Hz
Output function indicator		2× LED yellow	2× LED yellow
Echo function indicator		LED green	LED green
Degree of protection per IEC 60529		IP 67	IP 67
Temperature compensation		yes	yes
Ultrasonic frequency		220 kHz	130 kHz
Sound cone opening		8°	8°
Resolution		1 mm	1 mm
Max. characteristic deviation		0.5 %	0.5 %
Characteristic slope		adjustable	adjustable
Settings		Teach-in (button)	Teach-in (button)
Response time		300 ms	500 ms
Material	Housing	PBT	PBT
	Sensing face	Epoxy-resin hollow-glass-spheres	Epoxy-resin hollow-glass-spheres
	Cover	PBT	PBT
Approvals		CE	CE
Connection		M12 connector, 5-pin, A-coded	M12 connector, 5-pin, A-coded

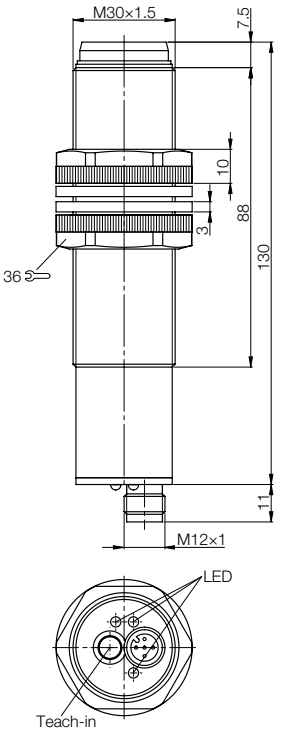
Tubular housings
Block-style housings

Hysteresis and window function are possible. For explanations, see chapter Fundamentals and Definitions, page 20.

BAE006Y (BES 516-611-A-1)

Analog switching device for control cabinet installation
The analog switching device is operated with 24 V and supplies the voltage for analog sensors. The device is controlled directly via the current or voltage signals. From this signal, separate push-pull final stages (PNP/NPN) are used to create three switch points (A1...A3) which can be set independently using the potentiometer (on the front side). The respective switching state is indicated by LEDs.





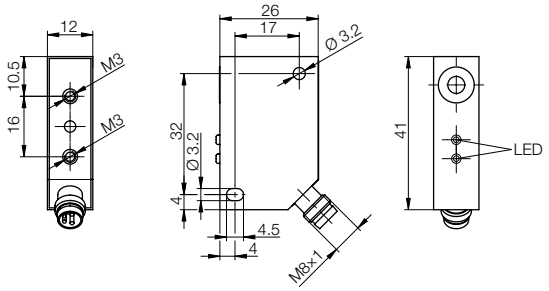
Electrical devices, connectors and holders, see Accessories section, starting on **page 37**

Analog Distance Measurement

Block-style housings · 41×26×12 mm

R05

Housing size		**41×26×12 mm** (R05)
Measuring range		**25...250 mm**
0...10 V DC	**Ordering code**	**BUS0009**
	Part number	BUS R05K0-XACR-025-S75G
Supply voltage U_B		24 V DC ±25 %
No-load supply current I_0 max.		≤ 100 mA
Reverse polarity/short circuit protected		yes/yes
Ambient temperature range T_a		–10...+70 °C
Output function indicator		LED yellow
Echo function indicator		LED green
Degree of protection per IEC 60529		IP 67
Temperature compensation		yes
Ultrasonic frequency		400 kHz
Sound cone opening		8°
Resolution		0.2 mm
Max. characteristic deviation		≤ 0.3 %
Characteristic slope		adjustable
Settings		Teach-in (remote, magnet)
Response time		40 ms
Material	Housing	PA
	Sensing face	Epoxy-resin hollow-glass-spheres/PUR
	Cover	PA
Approvals		CE
Connection		M8 connector, 4-pin

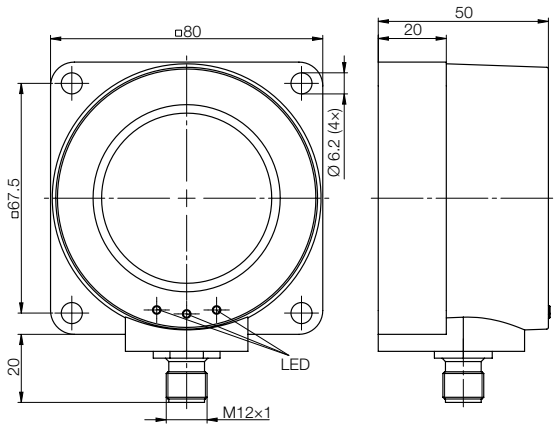


Analog Distance Measurement

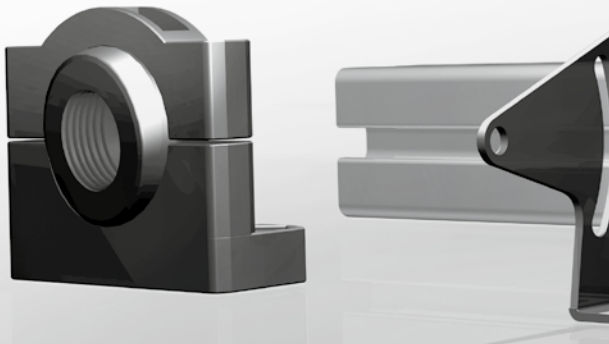
Block-style housings · 80×80×50 mm

Maxisensor

Housing size		**80×80×50 mm** (Maxisensor)
Measuring range		**600...6000 mm**
0...10 V DC	**Ordering code**	**BUS000E**
	Part number	BUS Q80K0-XAER-600-S92K
4...20 mA	**Ordering code**	**BUS000F**
	Part number	BUS Q80K0-XBER-600-S92K
Supply voltage U_B		24 V DC ±25 %
No-load supply current I_0 max.		≤ 35 mA
Reverse polarity/short circuit protected		yes/yes
Ambient temperature range T_a		–20...+70 °C
Output function indicator		2× LED yellow
Echo function indicator		LED green
Degree of protection per IEC 60529		IP 65
Temperature compensation		yes
Ultrasonic frequency		80 kHz
Sound cone opening		8°
Resolution		1 mm
Max. characteristic deviation		≤ 0.5 %
Characteristic slope		adjustable
Settings		Teach-in (remote)
Response time		700 ms
Material	Housing	PBT
	Sensing face	Epoxy-resin hollow-glass-spheres/PUR
	Cover	PBT
Approvals		CE
Connection		M12 connector, 5-pin, A-coded



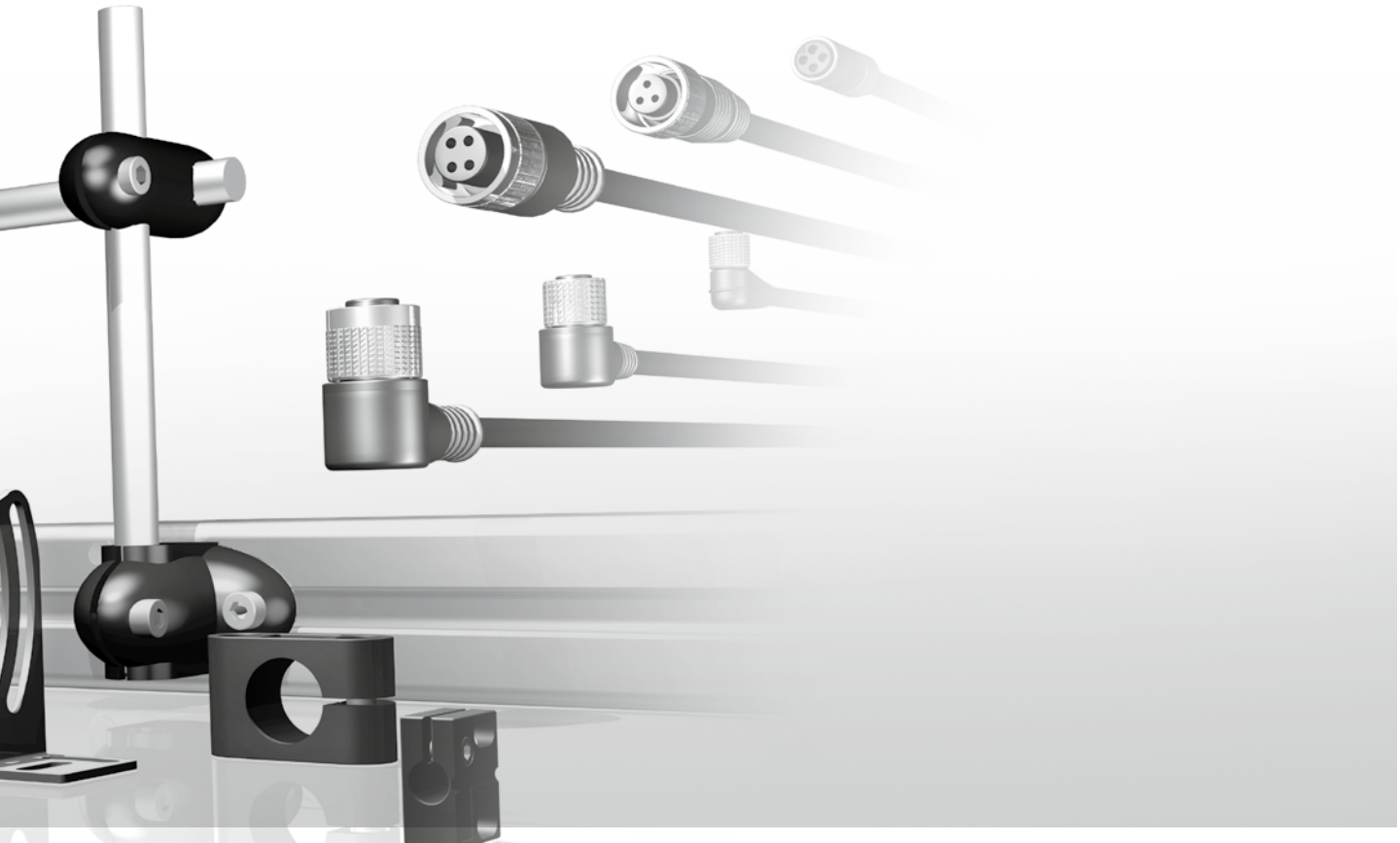
Electrical devices, connectors and holders, see Accessories section, starting on **page 37**



Accessories
Contents

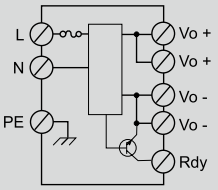
BUS models for individual solutions are optimized through appropriate accessories. For example, power supplies ensure great flexibility for various voltages. They ensure continuity even under high loads. And precisely fitting mounting elements guarantee exact positioning right from the start.

The extensive line of connector ensure the best connection and safeguards the use of Balluff BUS ultrasonic sensors in all areas of automation.

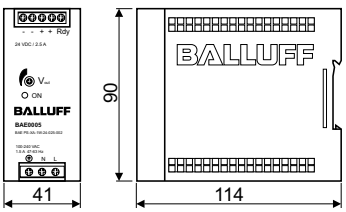


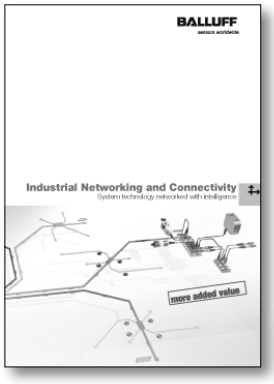
Accessories

Power supplies · Single-phase input voltage
2.5 A

Output current	2.5 A
Output power	60 W
Output voltage	24 V DC
Input voltage	100...240 V AC
Ordering code	**BAE0005**
Part number	BAE PS-XA-1W-24-025-002
Input voltage range	85...264 V AC/90...375 V DC
Inrush current	115 V AC < 30 A/230 V AC < 60 A
Frequency range	47...63 Hz
Input fuse	T2 A/250 V AC internal
Voltage adjustment range	24...28 V DC
Temperature coefficient	±0.02 %/°C
Ripple & noise	50 mV
Holdup time	115 V AC > 20 ms/230 V AC > 30 ms
Status indicator DC ON	LED green
Efficiency	89 %
Response	Hiccup mode
Switching frequency f	> 100 kHz
Isolation voltage	3000 V AC
Isolation resistance	100 MΩ
Turn-on delay	< 1 s
Ambient temperature range T_a	–25...+71 °C
Derating	–2.5 %/°C above +61 °C
Parallel mode	yes (with external diodes)
Degree of protection per IEC 60529	IP 20
Ready output	DC OK output
Cooling	Air convection
Housing material	Plastic
Weight	0.36 kg
Approvals	CE, TÜV, UL/cUL
Wiring diagram	

L, N	Input terminals
PE	PE connection
Vo –	Output terminal –
Vo +	Output terminal +
Rdy	Ready output





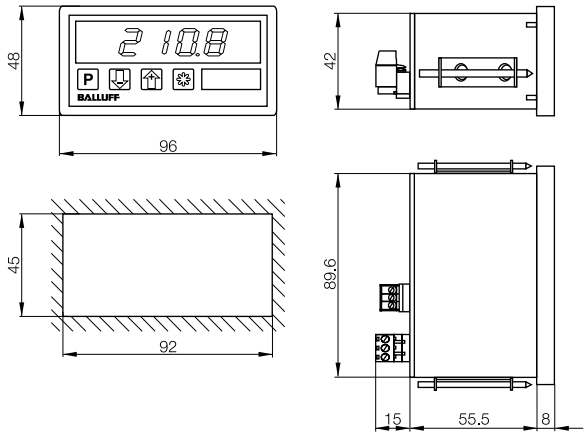
Other power supplies can be found in our catalog "Industrial Networking and Connectivity".

Digital display for analog input signals
The model BDD-UM 3023 measurement value display is a universal device for acquiring the following analog measurement values.
– Voltage 0...10 V DC
– Current 0...20 mA/4...20 mA

Standard hardware
– 4 function keys on the front panel

Standard software with the following functions
– Scaling
– Tare
– Decimal point
– Display test

Description	Digital display
Use	For analog sensors
Ordering code	**BAE006K**
Part number	BDD-UM 3023
A/D converter resolution	12 bits
Measuring ranges	
Voltage	0...10 V, ±0.05 %, ±1 digit
Input impedance	≥ 50 kΩ
Current	0/4...20 mA, ±0.05 %, ±1 digit
Input impedance	10 Ω
Sampling rate	5 measurements/s
Indicator	4-digit, 14 mm, red, programmable decimal point, leading zero suppression, minus symbol for negative values
Operation, keypad	Front keypad with short-stroke keys
Rated supply voltage	24 V, ±20 % DC (isolated)
Current draw	max. 65 mA
Housing	
Dimensions	96×48×63.5 mm
Installation depth	≤ 72 mm (incl. screw terminals)
Housing front enclosure rating	IP 54
Terminals enclosure rating	IP 20
Ambient temperature range T_a	0...+60 °C
Storage temperature range	–20...+70 °C
Relative humidity	≤ 80 %, non-condensing
Contamination class	2
Insulation class	⧈
Weight	approx. 200 g



Accessories
Signal adapters

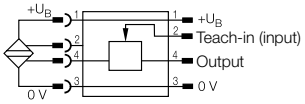
With the signal adapters, various additional functions on the sensors can be adjusted quickly. For example, these can be used to change the output signals or counting and time functions without any additional installation. The signal adapter is simply plugged in between the standardized M12 connection of the sensor and connection cable and adjusted via a control cable. Signal adapters can also be used as switching amplifiers and can be combined with each other.

CE

Version	Functionality	Device	Setting
N.C./N.O.-inverter	**Pulse or pause counter:** The BOS S-C counts a sensor's output pulses or pauses and sends an output pulse when a predefined number is reached. The count range is from 1...65535 and can be freely set. It also includes an output inverter function (N.C./N.O.).	BOS S-C...	Pause counter
Flip-Flop			Pause counter
Divider (1 pulse per rotation)			Pulse counter n
Count parts (Count down)			Pulse counter n
Switching amplifier up to 400 mA			Pulse counter 1
Release delay	**Timer for switch-on delay and release delay:** With the BOS S-T, a switch-on delay or release delay of 1 ms to 65 s can be implemented. A release delay of 100 ms is set in the factory.	BOS S-T...	Release delay n
Switch-on delay			Switch-on delay n
PNP/NPN conversion	**PNP/NPN converter:** The BOS S-F converts a connected PNP signal to a NPN signal. In addition, the N.C./N.O. output function can be toggled.	BOS S-F...	Factory settings
PNP/NPN conversion and N.C./N.O. toggle			Teach N.C./N.O.
Standstill monitoring	**Frequency monitoring:** The BOS S-M is a freely adjustable module for frequency monitoring. It is "active" when the frequency value is 5% below the set frequency.	BOS S-M...	
Speed monitoring			
Backlog detection			

Function	
PNP	**Ordering code**
	Part number
NPN	**Ordering code**
	Part number
Supply voltage U_B	
Rated operating current I_e	
No-load supply current I_0 max.	
Polarity reversal protected	
Short circuit protected	
Input impedance	
On/off delay	
Max. input frequency	
Input	
Output	
Smallest preset number	
Largest preset number	
Shortest settable time	
Longest settable time	
Monitoring frequency range	
Function indicator	
Ambient temperature range T_a	
Degree of protection per IEC 60529	
Insulation class	
Housing material	
Connection type – input	
Connection type – output	
Weight	

Wiring diagram

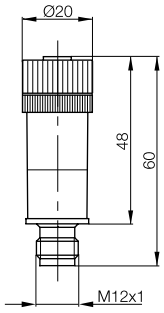


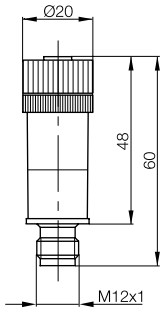
Use
All of the listed signal adapters can be used with sensors with switching output and M12 plug connection. The sensors can be connected independent of functional principle (ultrasonic, inductive, photoelectric or capacitive). Depending on which sensor is used, either a signal adapter with PNP or with NPN input is used.

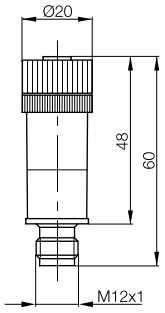
Signal adapter selection aid
BOS S-...01: PNP input (for sensors with PNP output)
BOS S-...02: NPN input (for sensors with NPN output)

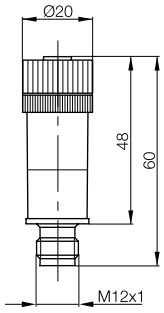



	Programmable pulse or pause counter, switching inverter		Programmable timer for on- and off-delay		NPN/PNP converter, configurable N.O./N.C. toggle		Programmable frequency monitoring	
	BAE002E		**BAE002M**		**BAE002H**		**BAE002K**	
	BOS S-C01		BOS S-T01		BOS S-F01		BOS S-M01	
	BAE002F		**BAE002N**		**BAE002J**		**BAE002K**	
	BOS S-C02		BOS S-T02		BOS S-F02		BOS S-M02	
	10...30 V DC		10...30 V DC		10...30 V DC		10...30 V DC	
	< 400 mA		< 400 mA		< 400 mA		< 400 mA	
	≤ 10 mA		≤ 10 mA		≤ 10 mA		≤ 10 mA	
	yes		yes		yes		yes	
	yes		yes		yes		yes	
	> 10 kΩ		> 10 kΩ		> 10 kΩ		> 10 kΩ	
	0.1 ms		0.1 ms		0.1 ms		0.1 ms	
	10 kHz		10 kHz		10 kHz		10 kHz	
	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN
	PNP	NPN	PNP	NPN	NPN	PNP	PNP	NPN
	1							
	65535							
			1 ms					
			65535 ms					
							0.015 Hz...1 kHz	
	LED red		LED red		LED red		LED red	
	0...+60 °C		0...+60 °C		0...+60 °C		0...+60 °C	
	IP 67		IP 67		IP 67		IP 67	
	⧈		⧈		⧈		⧈	
	PBT/PA 6.6		PBT/PA 6.6		PBT/PA 6.6		PBT/PA 6.6	
	M12 female 4-pin		M12 female 4-pin		M12 female 4-pin		M12 female 4-pin	
	M12 connector, 4-pin		M12 connector, 4-pin		M12 connector, 4-pin		M12 connector, 4-pin	
	15 g		15 g		15 g		15 g	

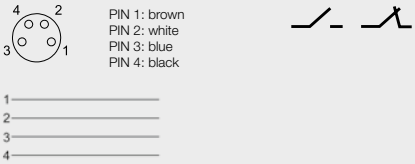






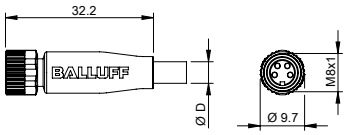


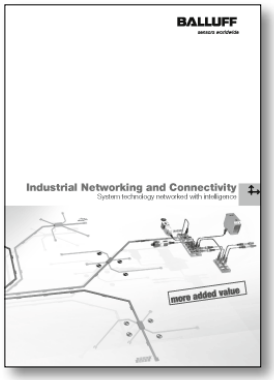
Accessories
M8-female straight, 4-pin, no LED

Connector diagram and wiring	
Supply voltage max. AC U_B	30 V AC
Supply voltage max. DC U_B	30 V DC
Cable	molded
No. of wires × cross-section	4×0.34 mm²
Degree of protection per IEC 60529	IP 67
Ambient temperature range T_a	–25...+80 °C
Use	complementary (N.O./N.C.)

Cable material	Color	Length	Ordering code
			Part number
PUR	black	2 m	**BCC02N2**
			BCC M314-0000-10-003-PX0434-020
PUR	black	5 m	**BCC02N3**
			BCC M314-0000-10-003-PX0434-050
PUR	black	10 m	**BCC02N4**
			BCC M314-0000-10-003-PX0434-100

Other cable materials, colors and lengths on request.
Connectors without LED are suitable for PNP and NPN switching functions.

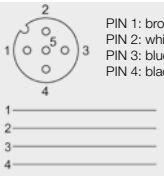


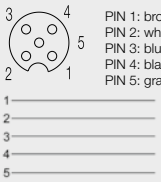


Other connectors and connectivity products can be found in our catalog "Industrial Networking and Connectivity".

Accessories

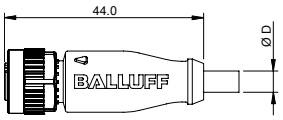
M12 female connector, straight
4-pin and 5-pin, no LED

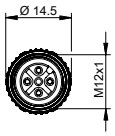


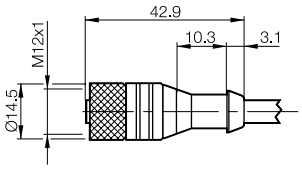


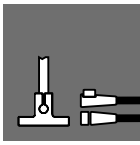
250 V AC	60 V AC
250 V DC	60 V DC
molded	molded
4×0.34mm²	5×0.34mm²
IP 68	IP 67
–25...+80 °C	–25...+80 °C
complementary (N.O./N.C.) ⌐ / ⌐	

Ordering code	Ordering code
Part number	Part number
BCC032F	
BCC M415-0000-1A-003-PX0434-020	
BCC032H	**BCC0096**
BCC M415-0000-1A-003-PX0434-050	BKS-S137-17-PU-05
BCC032J	**BCC0097**
BCC M415-0000-1A-003-PX0434-100	BKS-S137-17-PU-10



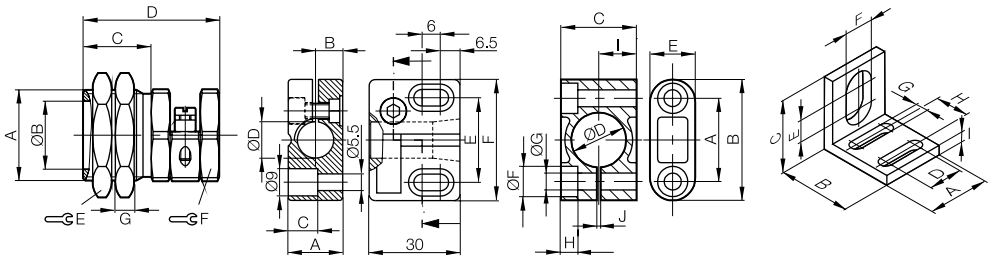


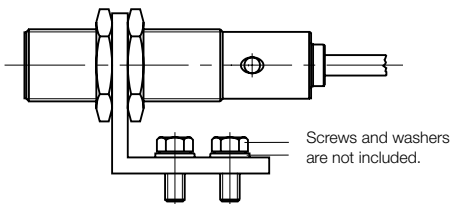


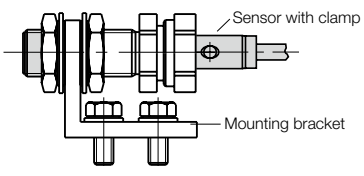





Description		Clamp without positive stop			Mounting clamp without positive stop			Mounting cuff			Mounting bracket		
Ø 12 mm	**Ordering code**	**BAM00E4**			**BAM00C9**			**BAM00C4**			**BAM00C0**		
	Part number	BES 12,0-KH-4			BES 12,0-KB-3			BES 12,0-BS-1			BES 12-HW-1		
Ø 18 mm	**Ordering code**	**BAM00FZ**			**BAM00F7**			**BAM00F2**			**BAM00EY**		
	Part number	BES 18,0-KH-4			BES 18,0-KB-3			BES 18,0-BS-1			BES 18-HW-1		
Ø 30 mm	**Ordering code**	**BAM00J8**						**BAM0HN**			**BAM00HH**		
	Part number	BES 30,0-KH-4						BES 30,0-BS-1			BES 30-HW-1		
Style		for Ø 12 mm	for Ø 18 mm	for Ø 30 mm	for Ø 12 mm	for Ø 18 mm		for Ø 12 mm	for Ø 18 mm	for Ø 30 mm	for Ø 12 mm	for Ø 18 mm	for Ø 30 mm
Dimension A		M16x1	M24x1.5	M36x1.5	18	24		22	26	42	25	30	40
Dimension B		12	18	30	9	12		32	36	55	30	40	40
Dimension C		16	18	18	9.7	13.5		20	26	38	30	40	60
Dimension D		30.5	36	40	Ø 12	Ø 18		Ø 11.9	Ø 17.9	Ø 30	14	18	30
Dimension E		flat-to-flat 22	flat-to-flat 30	flat-to-flat 41	28	28		12	12	18	9	11	19
Dimension F		flat-to-flat 17	flat-to-flat 24	flat-to-flat 41	40	40		Ø 8	Ø 8	Ø 10	12.1	18.1	30.1
Dimension G		3.9	5.0	5.9				Ø 4.5	Ø 4.5	Ø 5.5	5.2	5.2	5.2
Dimension H		2.1	3.2	3.2				4.5	4.5	5.5	14	14	14
Dimension I								10	13	19	4	5	5
Dimension J								1	1	1.5			
Material		CuZn coated			PA 6			PA 6			Al		







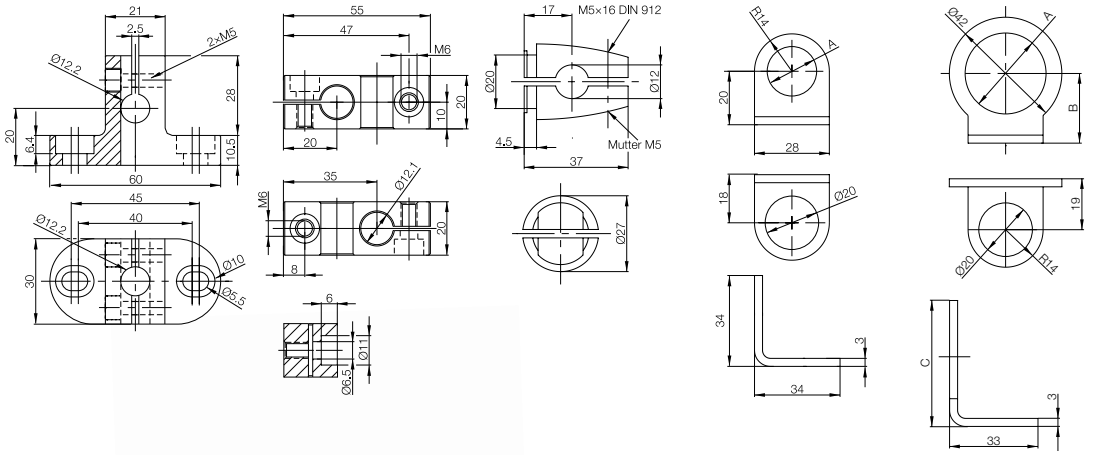
These aluminum mounting brackets provide a way of easily and quickly attaching sensors to the machine.
When using tubular sensors, it is recommended that additional clamps be used.

Use
For all sensors with appropriate diameter.





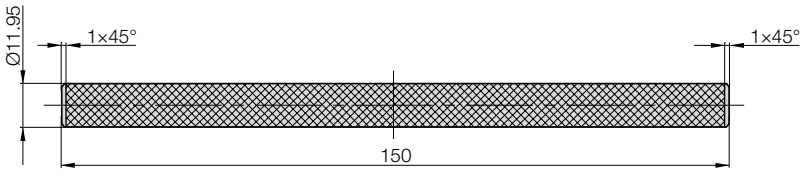
Description		Base holder	Cross-connector	Clamping cylinder	Sensor holder	Sensor holder
Version		For 1 rod Ø 12 mm (vertical or horizontal)	For 2 rods Ø 12 mm		For clamping cylinder	For clamping cylinder
Use		For mounting on base plates or extrusions	Connecting element for 2 rods Ø 12 mm	Accommodates all holders, sensors and reflectors	For tubular sensors and clamps M12, M18	For tubular sensors M30
	Ordering code	**BAM002W**	**BAM002Z**	**BAM0031**		
	Part number	BMS CU-M-D12-A040-00	BMS CC-M-D12-B-00	BMS CS-M-D12-IZ		
Ø 12	**Ordering code**				**BAM0037**	
mm	Part number				BMS CS-M-D12-ID12-01	
Ø 18	**Ordering code**				**BAM0032**	
mm	Part number				BMS CS-M-D12-ID18-01	
Ø 30	**Ordering code**					**BAM0033**
mm	Part number					BMS CS-M-D12-ID30-01
Material		Al anodized	Al anodized	GD-Zn	Stainless steel	Stainless steel



	A		A	B	C
BMS CS-...12	Ø 12	BMS CS-...30	Ø 30.2	26	47
BMS CS-...18	Ø 18				

Mounting rods Ø 12 mm, Al anodized

Ordering code	Part number	Length
BAM002R	BMS RS-M-D12-0150-00	150 mm
BAM002T	BMS RS-M-D12-0250-00	250 mm
BAM002U	BMS RS-M-D12-1000-00	1000 mm (for user assembly)

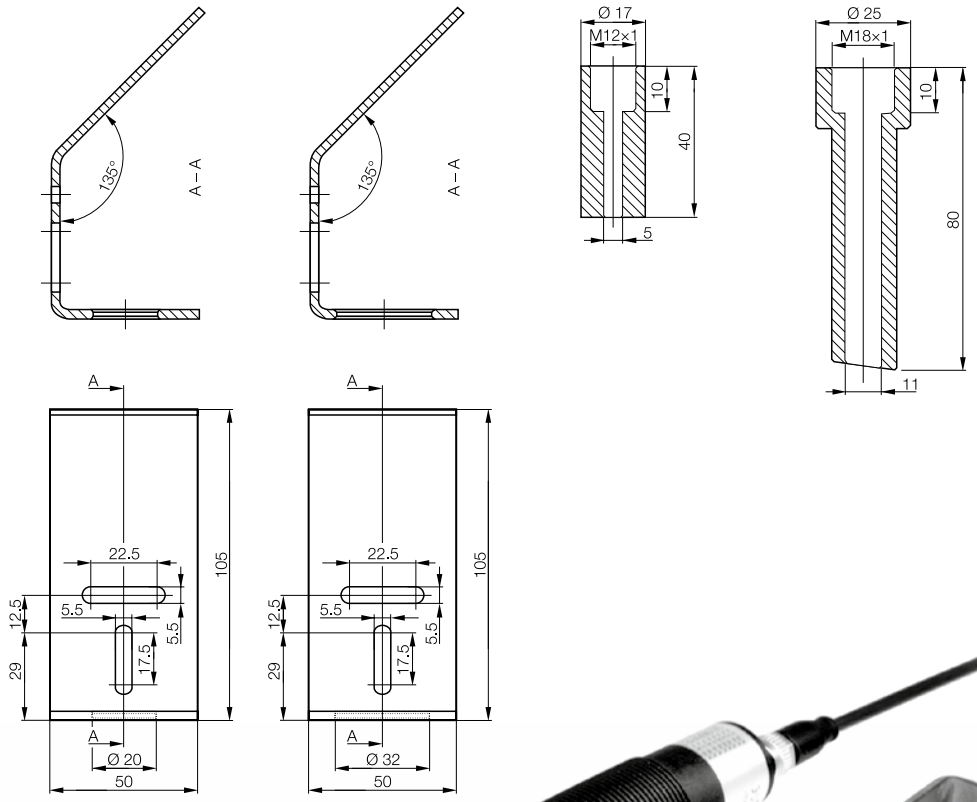


The mounting rods are knurled full-length.
This prevents any position change.

Accessories

Sound deflection brackets and focussing attachments

Description	Sound deflection bracket for BUS M18	Sound deflection bracket for BUS M30	Focussing attachments M12 → 5 mm	Focussing attachments M18 → 11 mm
Ordering code	**BAM01EP**	**BAM01ER**	**BAM01ET**	**BAM01EU**
Part number	BAM BD-US-001-D20-4	BAM BD-US-001-D32-4	BAM AP-US-001-M12-0	BAM AP-US-002-M18-0
Material	V2A	V2A	POM	POM



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SMART*LEVEL* **sensors set new standards**
Simply describing **SMART***LEVEL* as a level sensor for reliable sensing of liquid, conductive media does not do it justice. Because **SMART***LEVEL* sensors can do far more – precisely when all other types have long since taken in their sails: in applications that were previously either tricky or simply impossible to solve. **SMART***LEVEL* sensors go the extra mile.

SMART*LEVEL*
– Compensate for moisture, foam and build-up
– Penetrate glass or plastic walls even over 10 mm thick
– Detect aqueous to highly conductive media
– Feature chemically resistant housings made of PTFE

SMART*LEVEL* sensors reduce cost
– Adjustment-free installation and
– Freedom from cleaning in most applications
– Reduced use of materials and
– Less construction outlay (e.g. no bypass tubes)

SMART*LEVEL* sensors optimize production processes and increase application reliability.

SMART*LEVEL* **takes off in the Airbus A380**
Airbus is equipping the rest rooms in their 4-engine large-body A380 with a mixer tap. The heart of this exclusive system in the elegant Airbus design are compact **SMART***LEVEL* capacitive sensors from Balluff. These enable passengers to conveniently select the desired water temperature with the assistance of an LED indicator. The show-stopper: sensing errors are impossible, since **SMART***LEVEL* sensors ignore clinging dirt, liquid films and soap foam. Only hand-touching the faucet results in a switching operating, even if a wet paper towel covers it.

Find out more about our product range in our brochures or online!

■ www.balluff.com

Object Detection

Sensor Line
Inductive Sensors BES DC 3-/4-wire
Inductive Sensors BES DC 2-wire
Inductive Sensors BES AC/DC
Inductive Sensors BES with special properties
Sensors for Pneumatic Cylinders BMF
Magnetic Field Sensors BMF
Capacitive Sensors BCS
Ultrasonic Sensors BUS
Pressure Sensors BSP

Photoelectric Line
Diffuse energetic BOS with fore- and background suppression
Retro-reflective Sensors BOS
Through-beam Sensors BOS (emitter/receiver)
Fiber Optic Amplifier BFB
Slot Sensors BGL
Optical Window Sensors BOWA
Light Grids BLG
Contrast Sensors BKT
Luminescence Sensors BLT
Color Sensors BFS
Photoelectric Distance Sensors BOD

Mechanical Line
Mechanical Multiple and Single Position Switches
Mechanical Multiple and Single Position Switches per DIN EN 60204-1/VDE 0113
Mechanical Multiple and Single Position Switches with forced opening
Mechanical Multiple and Single Position Switches with quick plunger block
Inductive Multiple and Single Position Switches
Inductive Multiple and Single Position Switches with extended switching distance
Mechanical Wireless Position Switches
Mixed assembly Multiple Position Switches

Linear Position Sensing

Linear Position Sensing
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Micropulse® Transducers BTL AT series
Micropulse® Transducers BTL rod series
Micropulse® Transducers BTL compact rod series
Micropulse® Processors, BUS modules
Magnetic Linear Encoder Systems BML
Incremental and Absolute Encoders BDG/BRG
Inductive Linear Position Sensor BIW
Inductive Distance Sensors BAW
Magneto-inductive Position Sensors BIL
Photoelectric Distance Sensors BOD
Ultrasonic Sensors BUS

Industrial Identification

Industrial Identification
Industrial RFID Systems BIS C
Industrial RFID Systems BIS L
Industrial RFID Systems BIS M
Industrial RFID Systems BIS S
Vision Sensor BVS

Industrial Networking and Connectivity

Industrial Networking and Connectivity
Connectors and Cables BCC
Passive Splitter Boxes BPI
Expansion Modules BNI
IO-Link
Inductive Transmission Systems Remote
Inductive Couplers BIC
BUS Systems
Wireless
Electrical Devices

Mechanical Accessories

Mechanical Accessories
Holders and Fasteners
Mounting System BMS

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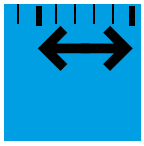
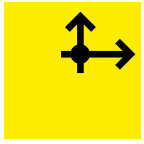
Object Detection



Linear Position Sensing

Industrial Identification



Industrial Networking and Connectivity

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