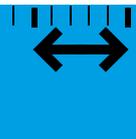


BALLUFF

sensors worldwide

Ultrasonic Sensors BUS

Precise all-rounder with remarkable operating range



ANALOG MEASURING SENSORS

CHECK DISTANCES AND SAGS

QUICKLY AND PRECISELY!

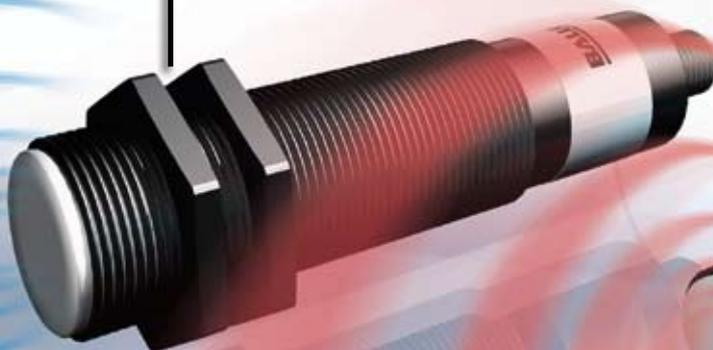


SWITCHING SENSORS

DETECT, COUNT

AND MONITOR OBJECTS

SIMPLE AND RELIABLE!



more added value

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.



Ultrasonic Sensors



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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

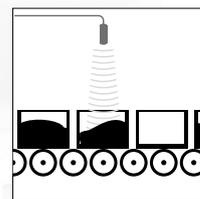
Ultrasonic Sensors

Performance spectrum

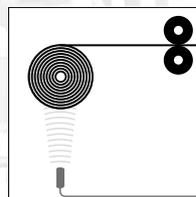
Whether position detection, distance measurement or the detection of solid, powder or liquid media: BUS ultrasonic sensors are precise all-rounders. And always high-performance – independent of color, transparency and surface properties. Even poor lighting conditions and dark or opaque or transparent 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.

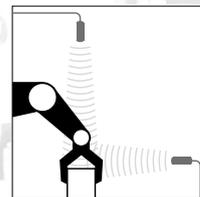
Ultrasonic sensors can also replace conventional sensors or supply additional distance information. You simply decide what you want to use.



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

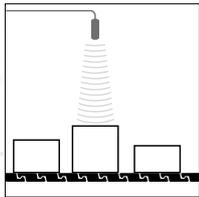


Ultrasonic Sensors

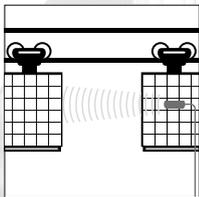
Performance spectrum

BUS ultrasonic sensors at a glance

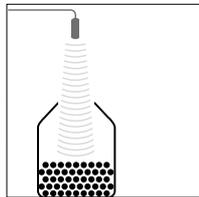
- with impressive operating range and high resolution
- extremely precise, independent of the object:
fast detection of small bodies as well
- reliable in difficult applications: even with sound-dampening materials such as foam or Styrofoam
- reliable under critical conditions, such as dirt, dust or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



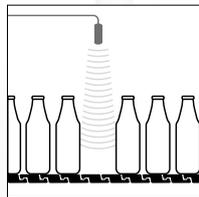
Sort containers and parts of differing heights. Count objects.



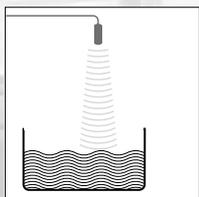
Collision monitoring for overhead conveyors.



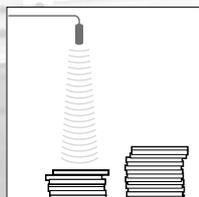
Monitor filling levels in silos, bunkers and containers for all bulk materials (e.g. sand, gravel, coal, grain).



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.

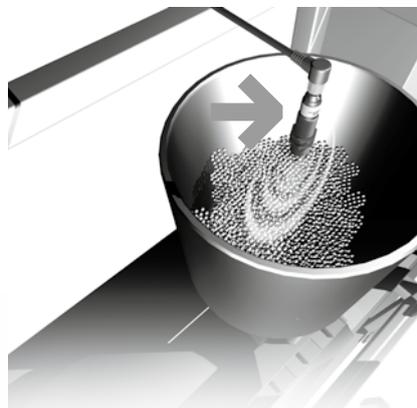
You can also profit from the possibility of having one sensor take on the function of a second sensor. And save money at the same time. Because you have the option of using either one or two switch points, of opting for strictly analog operation, or of combining analog functionality with two switch points.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



Optimally monitor foil sag

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

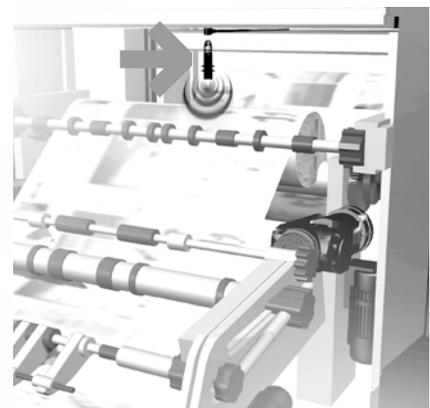
To efficiently fill blisters, the foil needs to be fed into the packaging machine quickly. To accomplish this, the foil sag must be set optimally. BUS sensors monitor this absolutely reliably and thereby ensure high process reliability. Independent of foil color and surface. The BUS sensors are also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

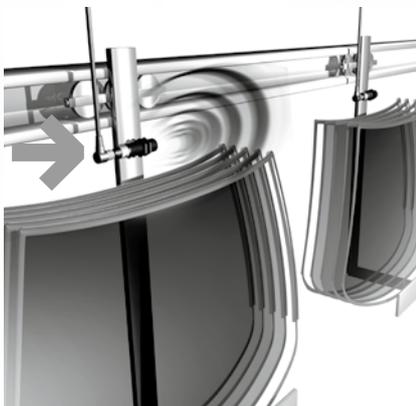
- The benefits to you
- **Just one BUS instead of several sensors**
 - **Prompt roll changes**
 - **Reduced downtimes**
 - **Increased productivity**

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.

Ultrasonic Sensors

Applications

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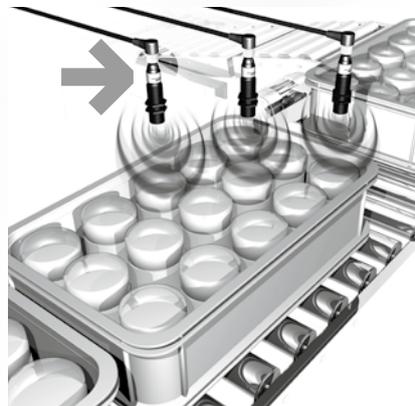


Reliably monitor distance

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 from 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.



Ultrasonic Sensors Products



	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		■	■		



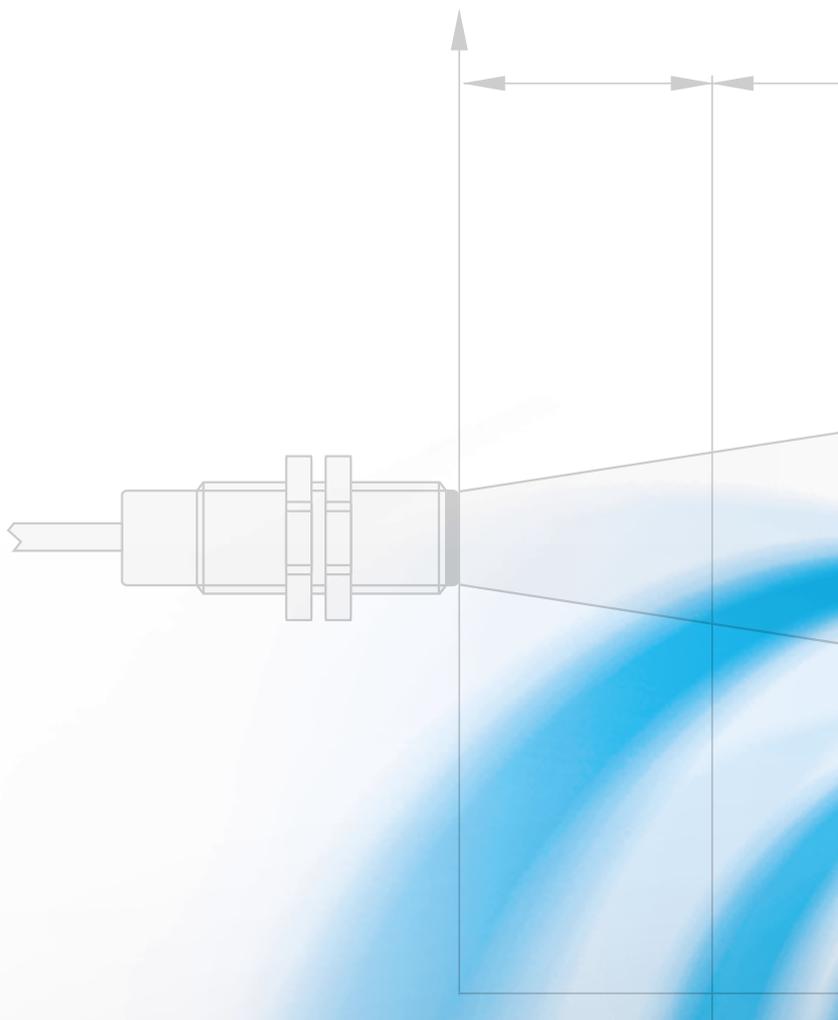
Object Detection (switching output)

Output function	M12	M18	M30	R05	Maxisensor
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	M12	M18	M30	R05	Maxisensor
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

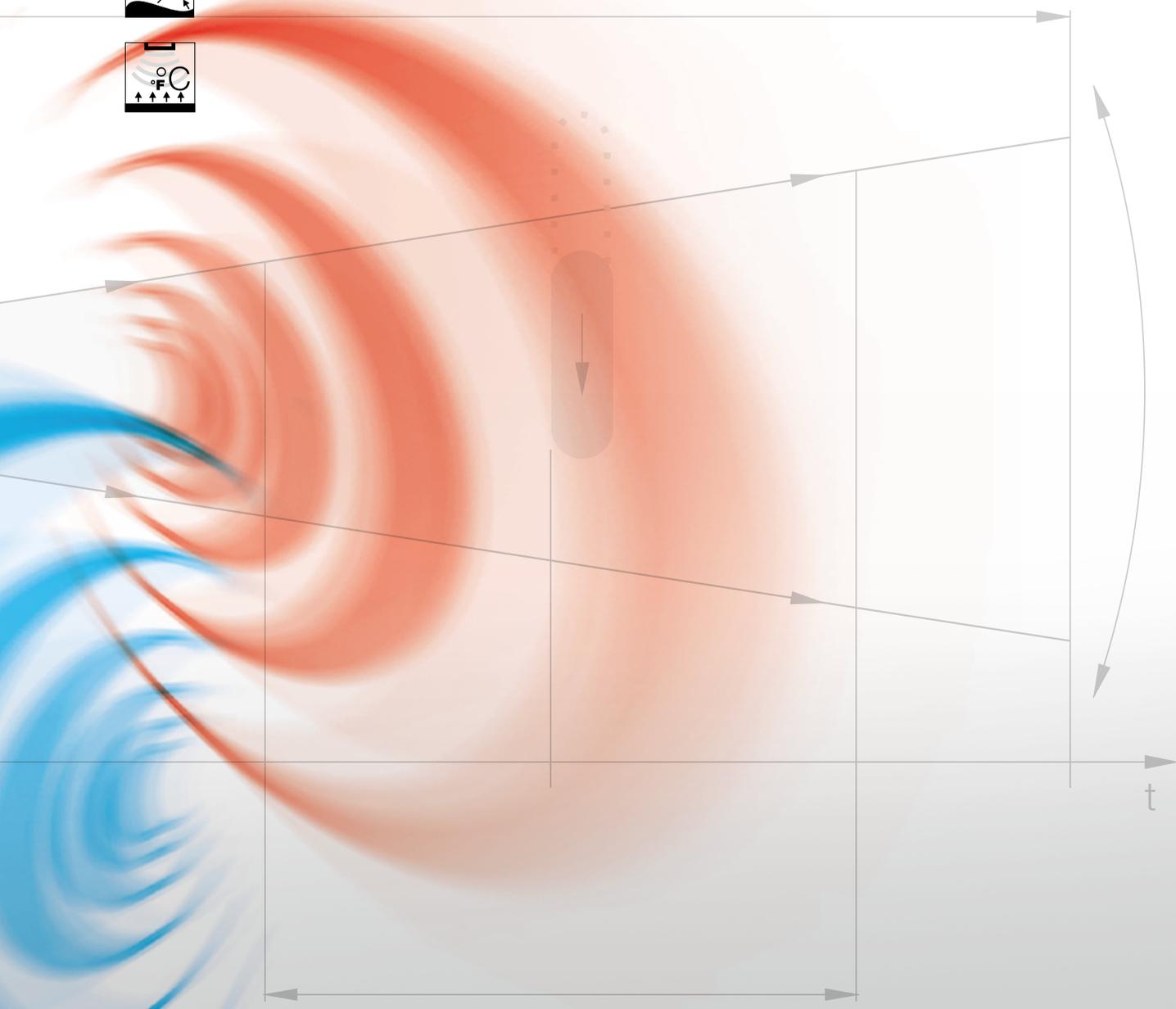
Contents



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.



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Fundamentals and Definitions

Functional principle

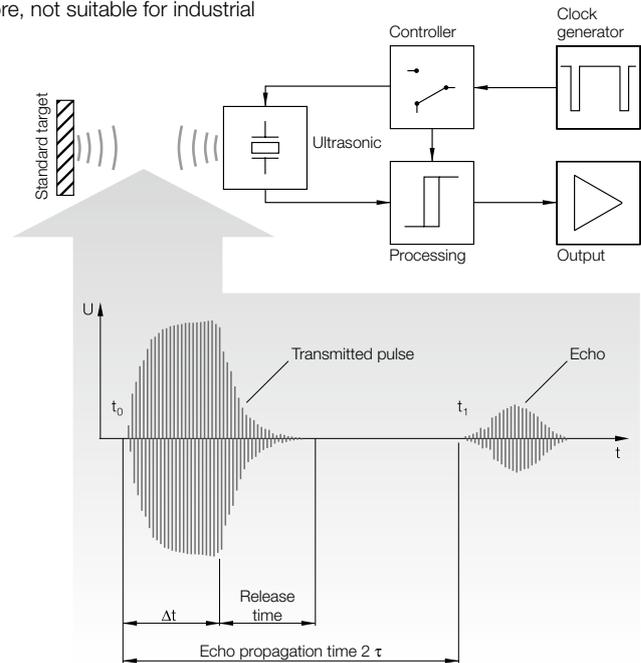
Functional principle

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.

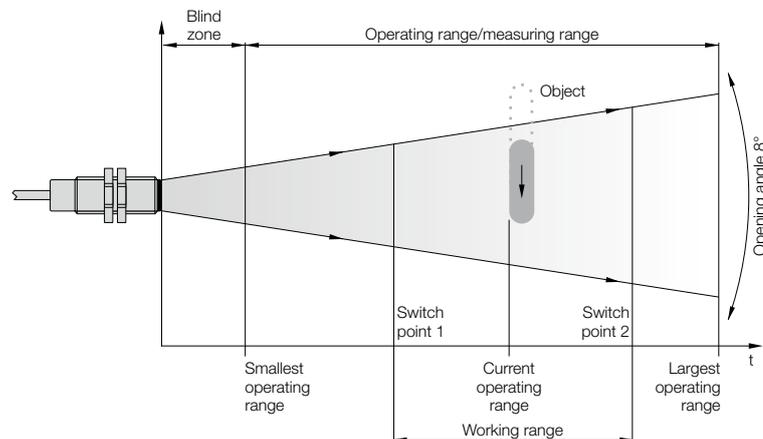
Industrial applications operate with high-frequency ultrasound in excess of approx. 80 kHz. At these high frequencies, bundled sound cones are created. Depending on the surface properties, shape and direction, these sound cones are reflected to varying degrees. Lower-frequency ultrasound, on the other 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.

Fundamentals and Definitions

Installation notes

Mounting

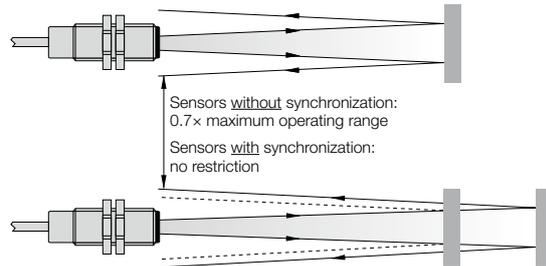
The ultrasonic sensors may be installed in any position, provided no deposits are permitted to collect on the acoustically active surface. The ultrasonic cone can be deflected through the use of sound deflection brackets, though at the expense of the maximum operating range.

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.

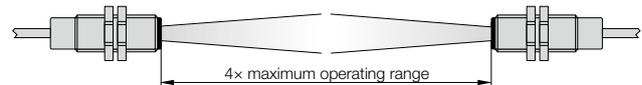
Row mounting

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



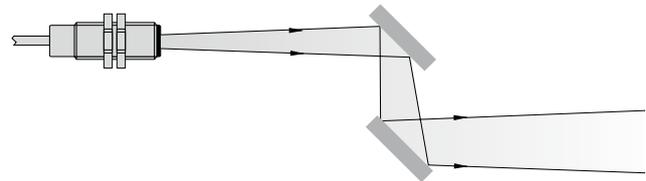
Opposite mounting

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



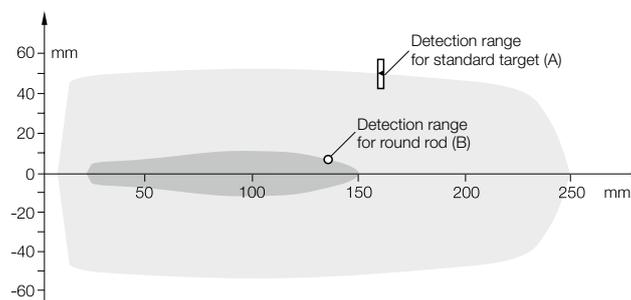
Deflection

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) 100x100 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 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.



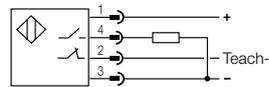
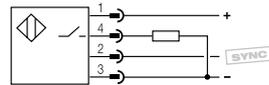
Switching sensors for object detection

DC 4-wire

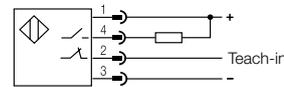
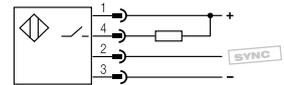
N.O. contact: The switching output is implemented as an N.O. contact.

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

PNP (+) sourcing



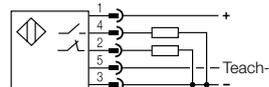
NPN (-) sinking



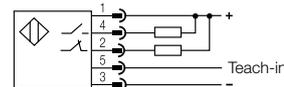
DC 5-wire

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

PNP (+) sourcing



NPN (-) sinking

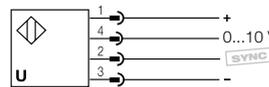


Analog-measuring sensors for distance measurement

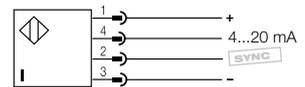
DC 4-wire

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

Voltage output 0...10 V DC



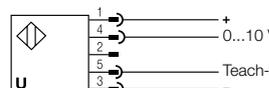
Current output 4...20 mA



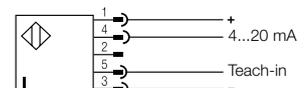
DC 5-wire

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

Voltage output 0...10 V DC

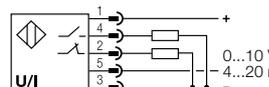


Current output 4...20 mA

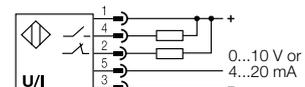


One voltage or current output (0...10 V DC or 4...20 mA) with variable slope and two programmable and evaluable switch points (N.O./N.C.).

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



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



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

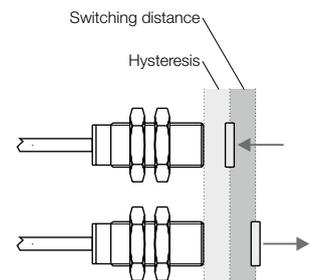
The hysteresis is the difference in distance between the switch-on point (for an object that is approaching) and the switch-off point (for an object that is receding).

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 $\Delta T = 10$ °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 $\Delta T = 20$ °C, the change in distance is $\Delta s = 3.4$ 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 Polybutylenterephthalat	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 Eléctricos 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.



Fundamentals and Definitions

Adjustment

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.

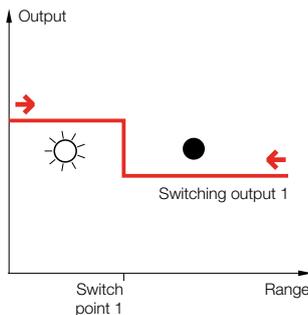


Object detection

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

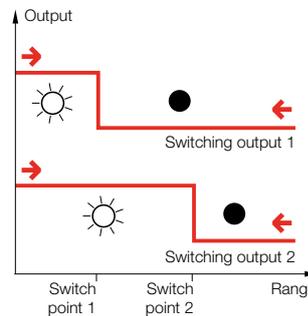
One switch point (1 SP)

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.

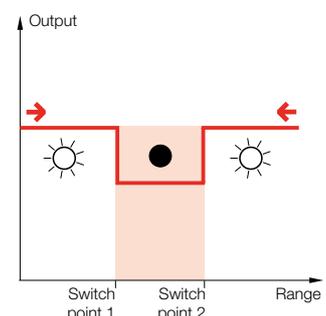
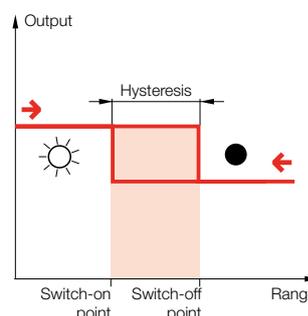


Hysteresis function – same switching characteristic

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.

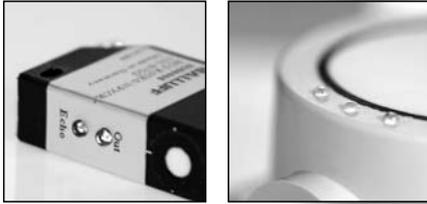
Window function – opposite switching characteristic

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

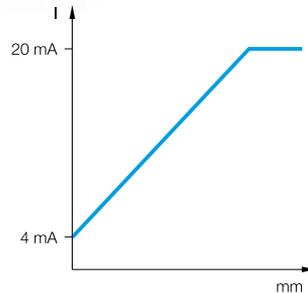
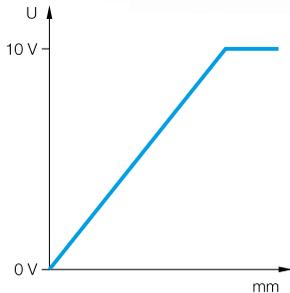


Analog distance measurement

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.

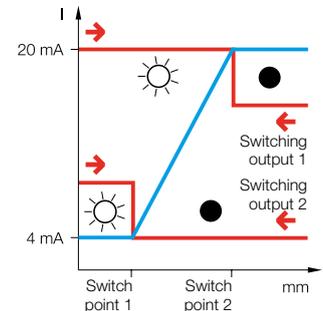
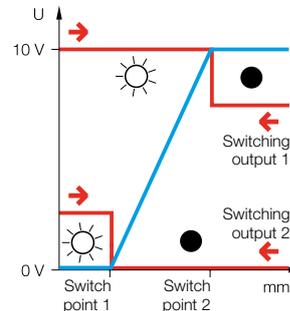
Fixed slope

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).



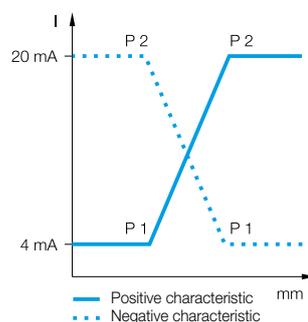
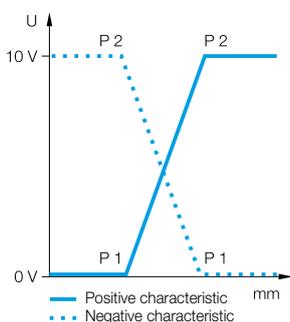
Variable slope

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	M12	24
	M18	24
	M30	25
Block-style housings	41×26×12 mm (R05)	26
	80×80×50 mm (Maxisensor)	27



Tubular housings
Block-style housings



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



Object Detection

Tubular housings · M12, M18



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 N.O./N.C.	Ordering code	BUS0005
		Part number	BUS M12E0-PPXCR-020-S04G
PNP	2× programmable N.O./N.C.	Ordering code	
		Part number	
NPN	N.O.	Ordering code	BUS000Y
		Part number	BUS M18K0-NSXEP-030-EP00,3-GS92
NPN	programmable N.O./N.C.	Ordering code	BUS0006
		Part number	BUS M12E0-NPXCR-020-S04G
NPN	2× programmable N.O./N.C.	Ordering code	
		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 mm ² with M12-connector, 5-pin, A-coded

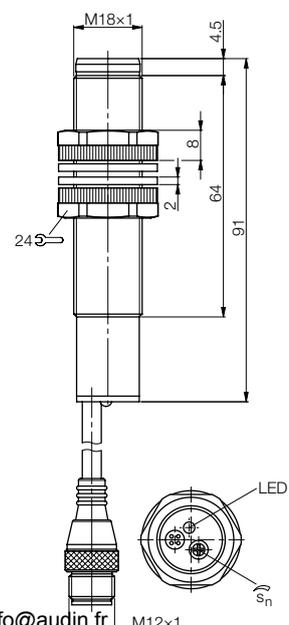
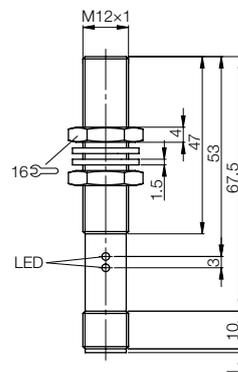


Hysteresis and window function are possible. For explanations, see chapter Fundamentals and Definitions, page 20.



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.



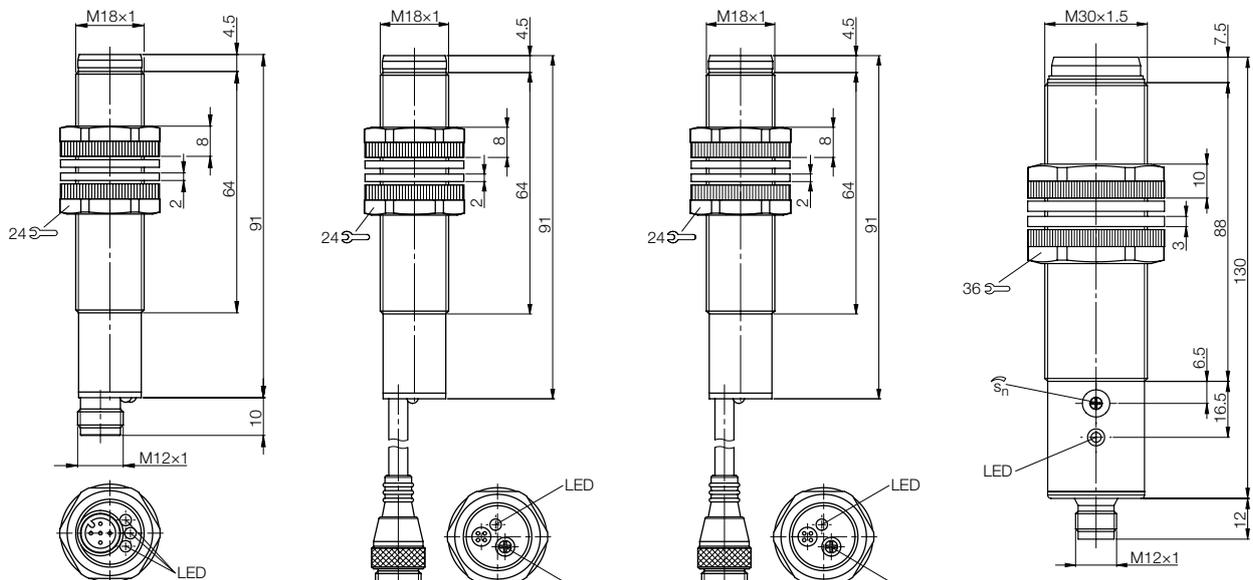
Object Detection

Tubular housings · M18, M30



Tubular housings
Block-style housings

M18x1 30...400 mm	M18x1 100...600 mm	M18x1 200...1500 mm	M30x1.5 300...2500 mm
	BUS000R BUS M18K0-PSXEP-060-EP00,3-GS92	BUS000P BUS M18K0-PSXEP-150-EP00,3-GS92	BUS000Z BUS M30K0-PSXER-250-S04K
BUS0001 BUS M18K0-PWXER-040-S92K			
	BUS000W BUS M18K0-NSXEP-060-EP00,3-GS92	BUS000U BUS M18K0-NSXEP-150-EP00,3-GS92	BUS0010 BUS M30K0-NSXER-250-S04K
BUS0002 BUS M18K0-NWXER-040-S92K			
24 V DC ±25 % 500 mA ≤ 80 mA yes/yes -15...+70 °C 15 Hz 2x LED yellow LED green IP 67 yes 360 kHz 8° 0.2 mm Teach-in (remote) PBT Epoxy-resin hollow-glass-spheres PBT CE M12 connector, 5-pin, A-coded	24 V DC ±25 % 500 mA ≤ 35 mA yes/yes -15...+70 °C 25 Hz LED yellow IP 67 yes 300 kHz 8° 0.2 mm Potentiometer PBT Epoxy-resin hollow-glass-spheres PBT CE, cULus 0.3 m cable PUR, 5x0.34 mm ² with M12-connector, 5-pin, A-coded	24 V DC ±25 % 500 mA ≤ 35 mA yes/yes -15...+70 °C 8 Hz LED yellow IP 67 yes 180 kHz 8° 0.2 mm Potentiometer PBT Epoxy-resin hollow-glass-spheres PBT CE, cULus 0.3 m cable PUR, 5x0.34 mm ² with M12-connector, 5-pin, A-coded	24 V DC ±25 % 500 mA ≤ 35 mA yes/yes -15...+70 °C 5 Hz LED yellow IP 67 yes 130 kHz 8° 0.2 mm Potentiometer PBT Epoxy-resin hollow-glass-spheres PBT CE, cULus M12 connector, 4-pin, A-coded



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



Object Detection

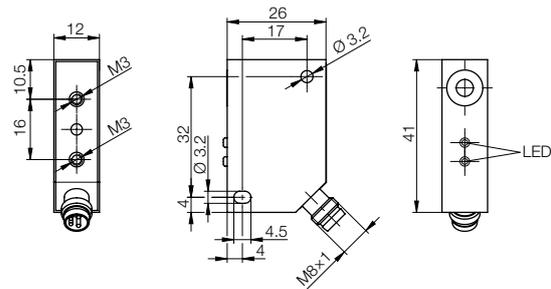
Block-style housings · 41×26×12 mm
R05



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 $\pm 25\%$		
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



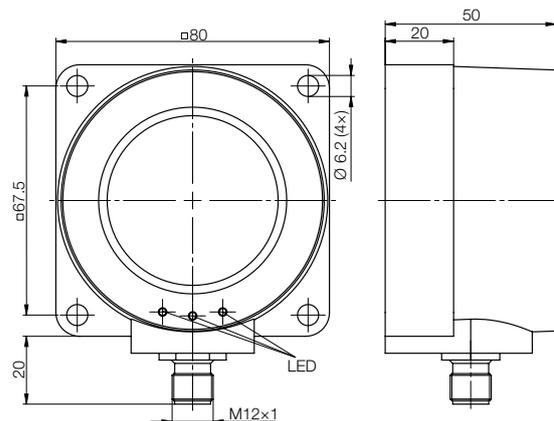
Tubular housings

Block-style housings

Housing size	80×80×50 mm (Maxisensor)		
Operating range	600...6000 mm		
PNP	2× programmable	Ordering code	BUS000A
	N.O./N.C.	Part number	BUS Q80K0-PWXER-600-S92K
NPN	2× programmable	Ordering code	BUS000C
	N.O./N.C.	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

Tubular housings	M18	30
	M30	33
Block-style housings	41×26×12 mm (R05)	34
	80×80×50 mm (Maxisensor)	35

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



Analog Distance Measurement

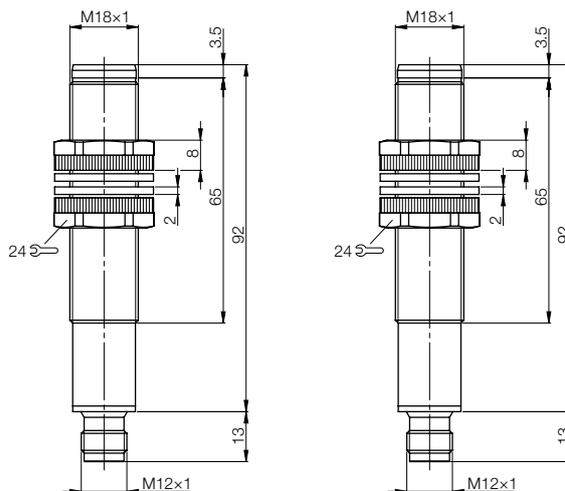
Tubular housings · M18



Housing size		M18x1	M18x1
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 $\pm 25\%$	24 V DC $\pm 25\%$
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		$\leq 0.3\%$	$\leq 0.3\%$
Characteristic slope		42 mV/mm	67 μ A/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



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.

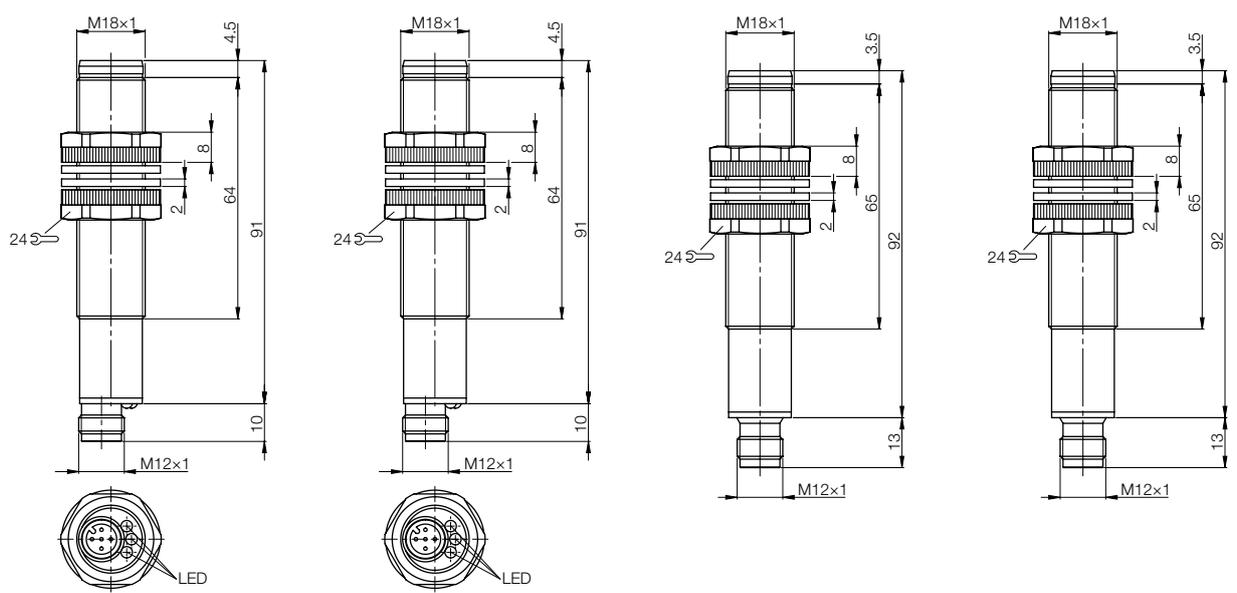


Analog Distance Measurement

Tubular housings · M18



M18x1 30...400 mm	M18x1 30...400 mm	M18x1 100...600 mm	M18x1 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 % ≤ 40 mA yes/yes -15...+70 °C 2x LED yellow LED green IP 67 yes 360 kHz 8° 0.2 mm ≤ 0.5 % adjustable Teach-in (remote) 100 ms PBT Epoxy-resin hollow-glass-spheres PBT CE M12 connector, 5-pin, A-coded	24 V DC ±25 % ≤ 40 mA yes/yes -15...+70 °C 2x LED yellow LED green IP 67 yes 360 kHz 8° 0.2 mm ≤ 0.5 % adjustable Teach-in (remote) 100 ms PBT Epoxy-resin hollow-glass-spheres PBT CE M12 connector, 5-pin, A-coded	24 V DC ±25 % ≤ 35 mA yes/yes -15...+70 °C IP 67 yes 300 kHz 8° 0.2 mm ≤ 0.3 % 20 mV/mm 50 ms PBT Epoxy-resin hollow-glass-spheres PBT CE, cULus M12 connector, 4-pin, A-coded	24 V DC ±25 % ≤ 35 mA yes/yes -15...+70 °C IP 67 yes 300 kHz 8° 0.2 mm ≤ 0.3 % 32 µA/mm 50 ms PBT Epoxy-resin hollow-glass-spheres PBT CE, cULus M12 connector, 4-pin, A-coded



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



Analog Distance Measurement

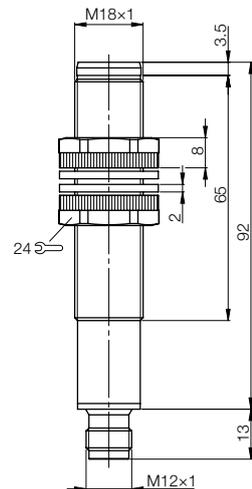
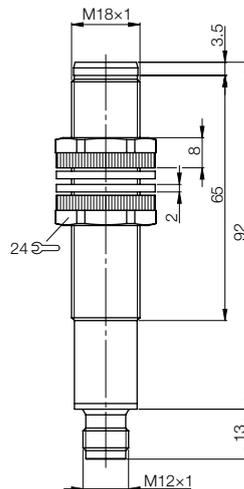
Tubular housings · M18



Housing size		M18x1	M18x1
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 $\pm 25\%$	24 V DC $\pm 25\%$
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		$\leq 0.3\%$	$\leq 0.3\%$
Characteristic slope		5.5 mV/mm	8.8 μ A/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



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.



Analog Distance Measurement

Tubular housings · M30



Tubular housings
Block-style housings

Housing size		M30x1.5	M30x1.5
Measuring range		80...1600 mm	350...3500 mm
0...10 V DC or 4...20 mA and 2x 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 2x 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 $\pm 25\%$	24 V DC $\pm 25\%$
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		2x LED yellow	2x 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



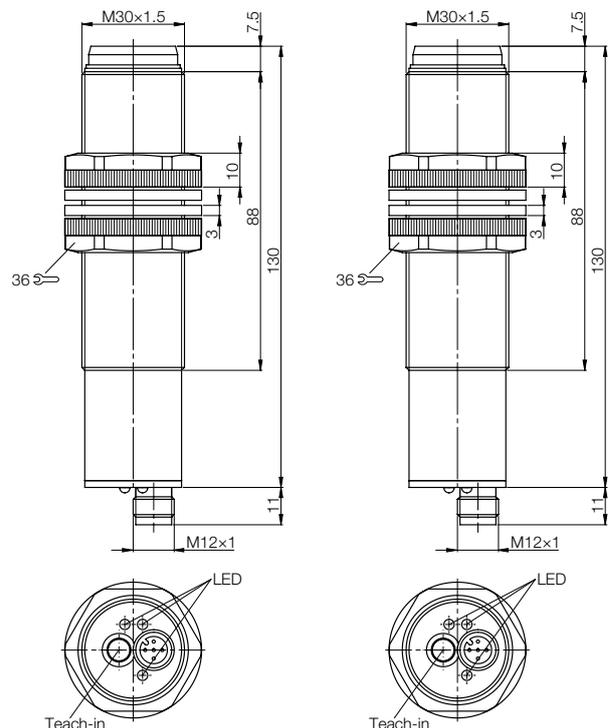
Hysteresis and window function are possible. For explanations, see chapter Fundamentals and Definitions, page 20.



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.

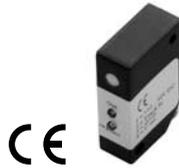


Electrical devices, connectors and holders, see Accessories section, starting on **page 37**

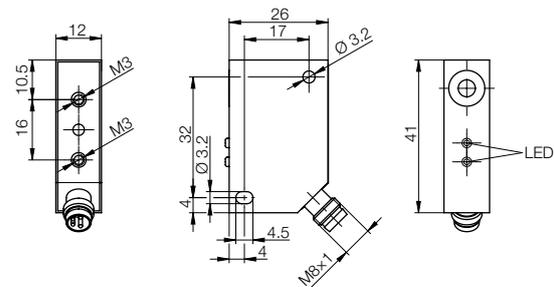


Analog Distance Measurement

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 $\pm 25\%$	
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	$\leq 0.3\%$	
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	



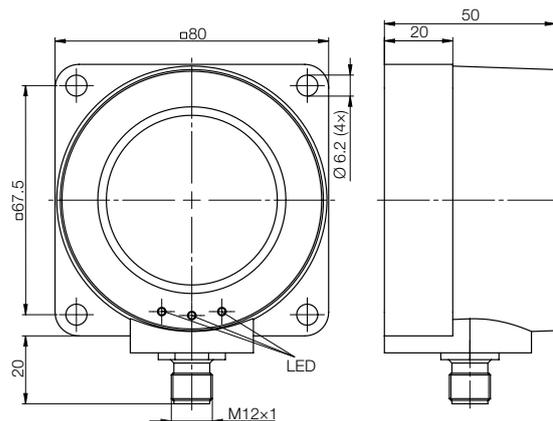
Analog Distance Measurement

Block-style housings · 80×80×50 mm
Maxisensor



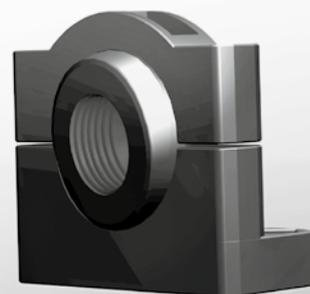
Tubular housings
Block-style housings

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 $\pm 25\%$	
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	$\leq 0.5\%$	
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**





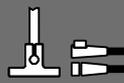
Accessories

Contents

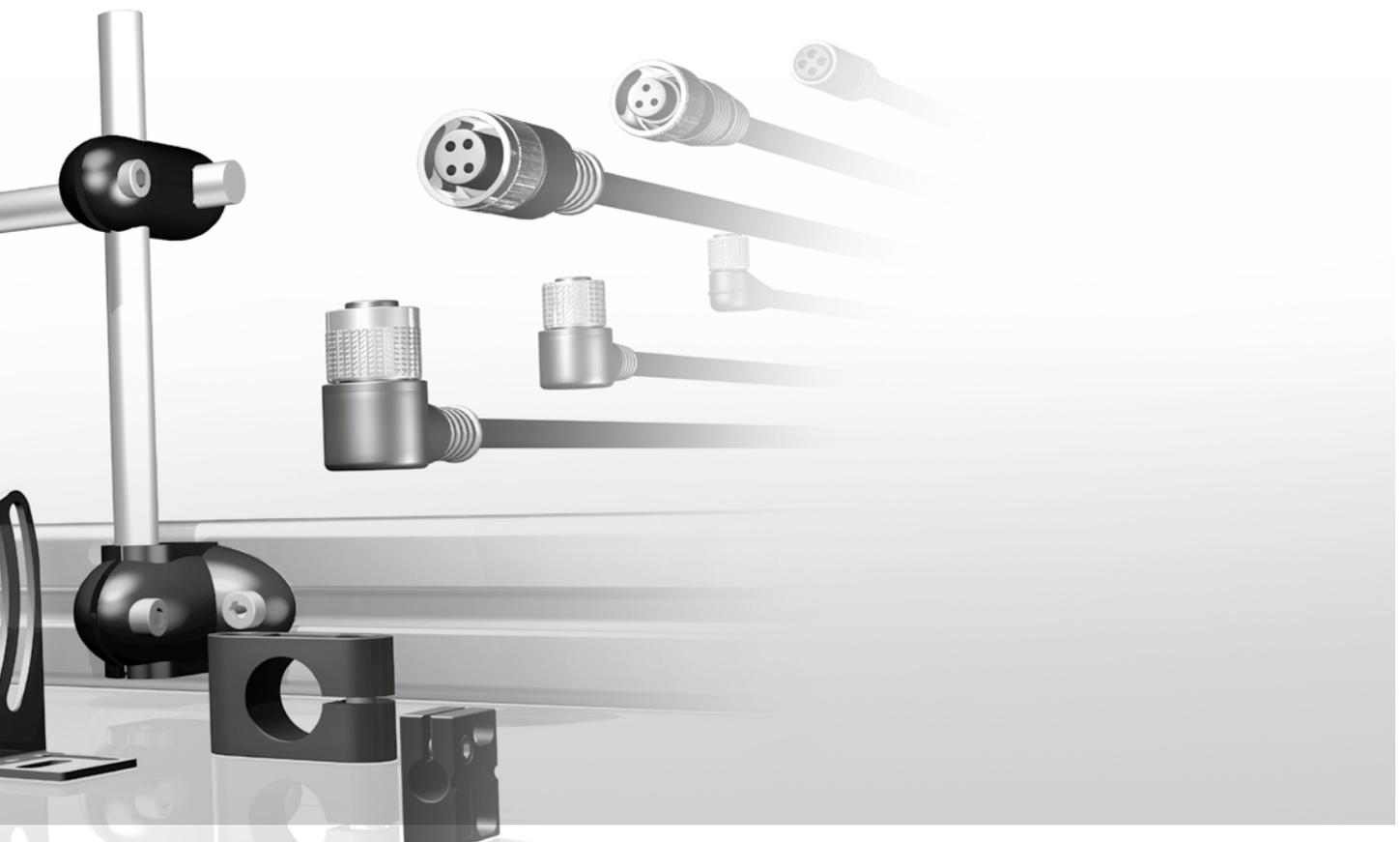
BUS models for individual solutions are optimized through appropriate accessories. For example, power supplies ensure great flexibility for various voltages. They ensure continuity even under high loads. And precisely fitting mounting elements guarantee exact positioning right from the start.

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

Electrical devices	Power supplies	38
	Digital display	39
	Signal adapters	40
Connectors	M8	42
	M12	43
Mounting components	Holders and fasteners	44
	Mounting system	45
BUS-specific accessories	Sound deflection brackets	46
	Focussing attachments	46



Electrical devices
Connectors
Mounting components
BUS-specific accessories

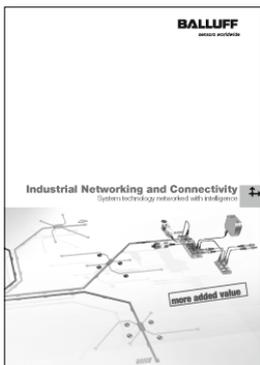


Accessories

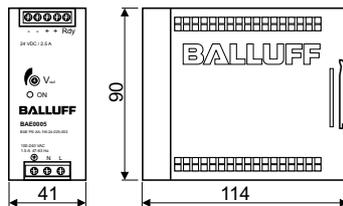
Power supplies · Single-phase input voltage
2.5 A



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	<table border="1"> <tr> <td>L, N</td> <td>Input terminals</td> </tr> <tr> <td>PE</td> <td>PE connection</td> </tr> <tr> <td>Vo -</td> <td>Output terminal -</td> </tr> <tr> <td>Vo +</td> <td>Output terminal +</td> </tr> <tr> <td>Rdy</td> <td>Ready output</td> </tr> </table>	L, N	Input terminals	PE	PE connection	Vo -	Output terminal -	Vo +	Output terminal +	Rdy	Ready output
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".



Accessories

Digital display

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

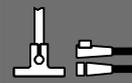
- 4 function keys on the front panel

Standard software with the following functions

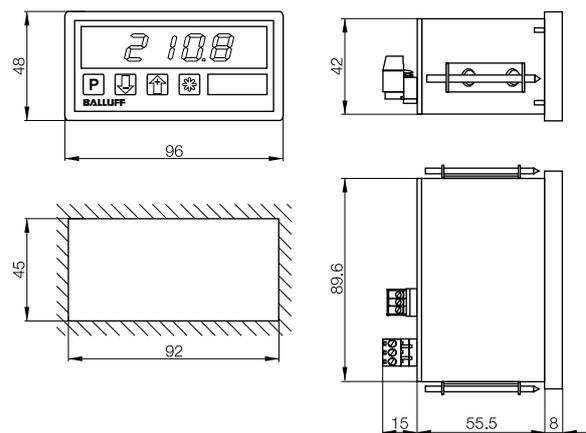
- Scaling
- Tare
- Decimal point
- Display test



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, $\pm 0.05\%$, ± 1 digit
Input impedance	$\geq 50\text{ k}\Omega$
Current	0/4...20 mA, $\pm 0.05\%$, ± 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, $\pm 20\%$ DC (isolated)
Current draw	max. 65 mA
Housing	
Dimensions	96x48x63.5 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	$\leq 80\%$, non-condensing
Contamination class	2
Insulation class	□
Weight	approx. 200 g



Electrical devices
Connectors
Mounting components
BUS-specific accessories



Accessories

Signal adapters

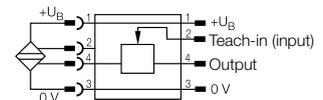
With the signal adapters, various additional functions on the sensors can be adjusted quickly. For example, these can be used to change the output signals or counting and time functions without any additional installation. The signal adapter is simply plugged in between the standardized M12 connection 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.



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_B	
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)

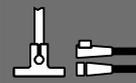


Accessories

Signal adapters

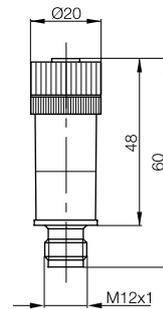
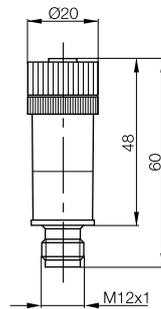
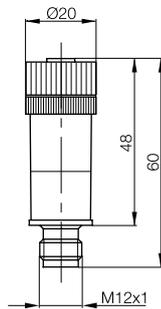
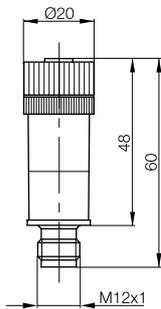


Programmable pulse or pause counter, switching inverter	Programmable timer for on- and off-delay	NPN/PNP converter, configurable N.O./N.C. toggle	Programmable frequency monitoring
BAE002E	BAE002M	BAE002H	BAE002K
BOS S-C01	BOS S-T01	BOS S-F01	BOS S-M01
BAE002F	BAE002N	BAE002J	BAE002K
BOS S-C02	BOS S-T02	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	PNP	PNP	PNP
NPN	NPN	NPN	NPN
PNP	PNP	PNP	PNP
NPN	NPN	NPN	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



Electrical devices

Connectors
Mounting components
BUS-specific accessories



Accessories

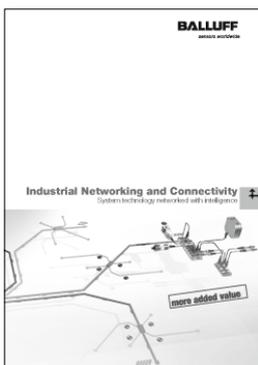
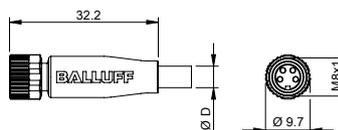
M8-female straight,
4-pin, no LED



Connector diagram and wiring	<p>PIN 1: brown PIN 2: white PIN 3: blue PIN 4: black</p> <p>1 _____ 2 _____ 3 _____ 4 _____</p>		
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 mm ²		
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
PUR	black	2 m	Part number 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



PIN 1: brown
PIN 2: white
PIN 3: blue
PIN 4: black



250 V AC

250 V DC

molded

4×0.34mm²

IP 68

-25...+80 °C

complementary (N.O./N.C.) \curvearrowright / \curvearrowleft

Ordering code

Part number

BCC032F

BCC M415-0000-1A-003-PX0434-020

BCC032H

BCC M415-0000-1A-003-PX0434-050

BCC032J

BCC M415-0000-1A-003-PX0434-100



PIN 1: brown
PIN 2: white
PIN 3: blue
PIN 4: black
PIN 5: gray



60 V AC

60 V DC

molded

5×0.34mm²

IP 67

-25...+80 °C

Ordering code

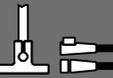
Part number

BCC0096

BKS-S137-17-PU-05

BCC0097

BKS-S137-17-PU-10



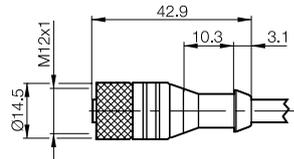
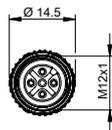
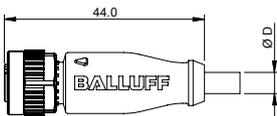
Electrical
devices

Connectors

Mounting
components

BUS-specific

accessories

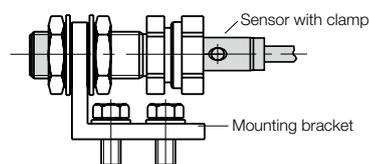
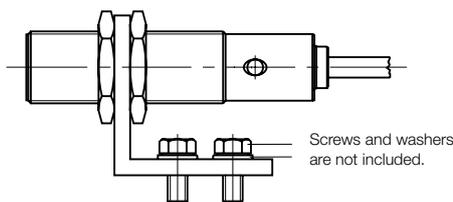
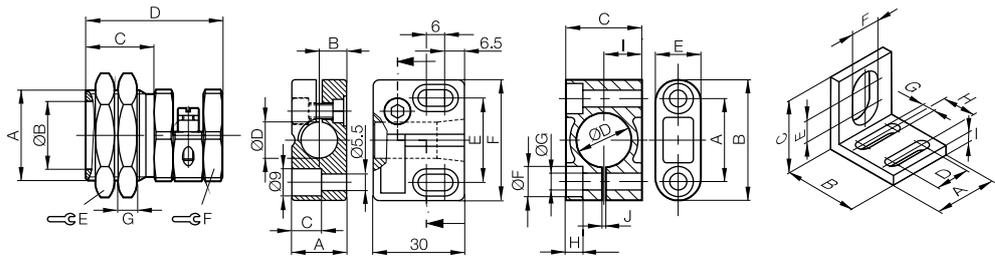


Accessories

Holders and fasteners



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					BAM00HN			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.

Accessories

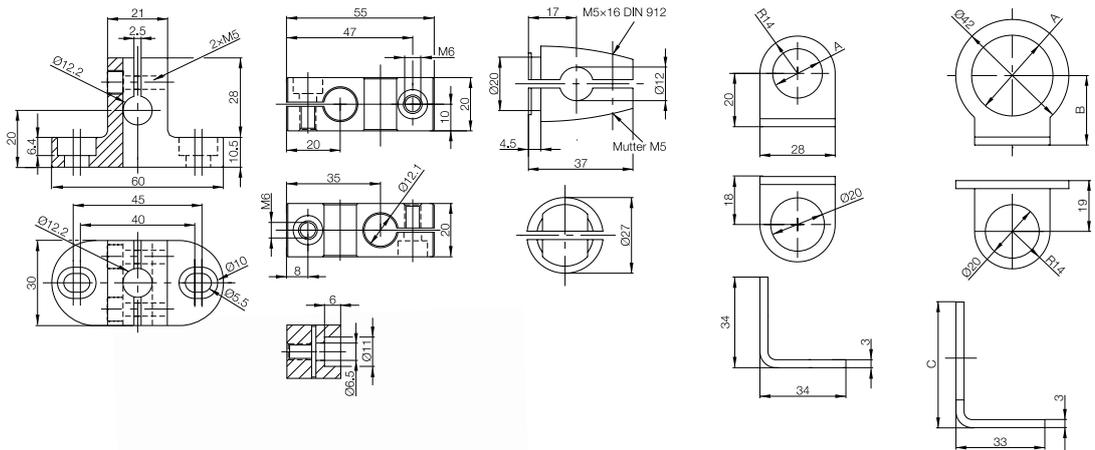
Mounting system



Description	Base holder	Cross-connector	Clamping cylinder	Sensor holder	Sensor holder
Version	For 1 rod \varnothing 12 mm (vertical or horizontal)	For 2 rods \varnothing 12 mm		For clamping cylinder	For clamping cylinder
Use	For mounting on base plates or extrusions	Connecting element for 2 rods \varnothing 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		
\varnothing 12 mm	Ordering code			BAM0037	
Part number				BMS CS-M-D12-ID12-01	
\varnothing 18 mm	Ordering code			BAM0032	
Part number				BMS CS-M-D12-ID18-01	
\varnothing 30 mm	Ordering code				BAM0033
Part number					BMS CS-M-D12-ID30-01
Material	Al anodized	Al anodized	GD-Zn	Stainless steel	Stainless steel



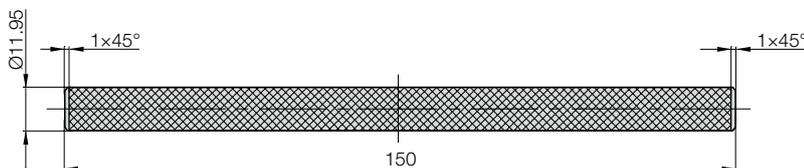
Electrical devices
Connectors
Mounting components
BUS-specific accessories



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

Mounting rods \varnothing 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.

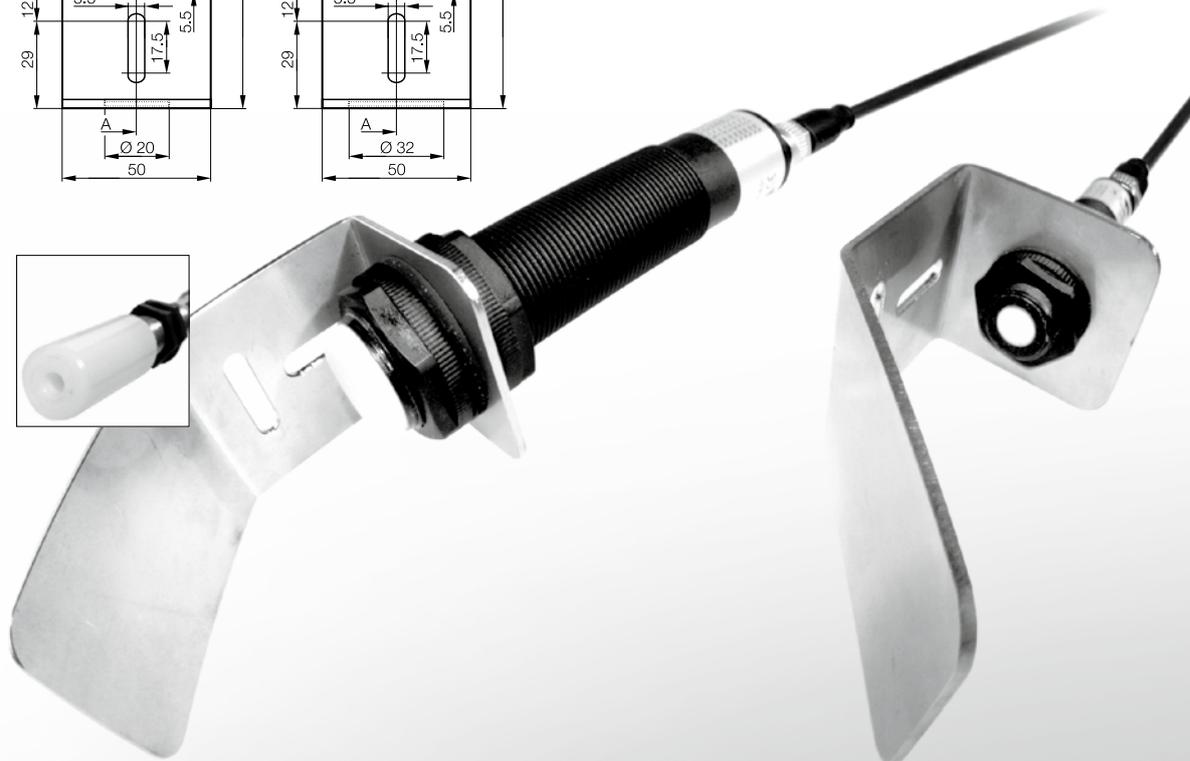
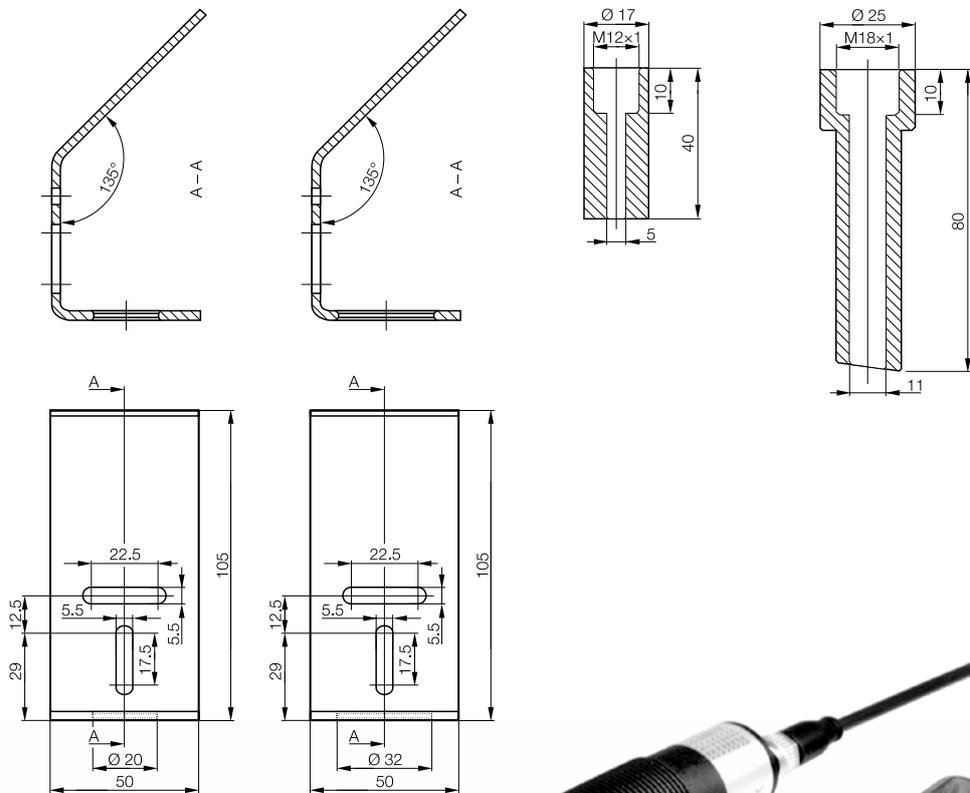


Accessories

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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Alphanumeric index



Sorted by part number



Sorted by ordering code

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BUS000K	BUS M18K0-XAFX-030-S04K	30
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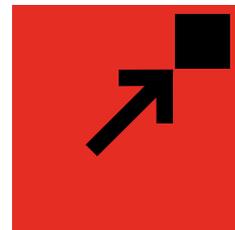
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Linear Position Sensing

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Industrial Identification

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Industrial RFID Systems BIS L
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Industrial RFID Systems BIS S
Vision Sensor BVS

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Industrial Networking and Connectivity

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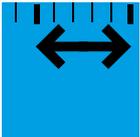
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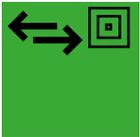
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Object Detection



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