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Ultrasonic sensors
Osisonic®, Optimum and Universal

Applications Detection of any object without physical contact, irrespective of: - material (metal, plastic, wood, cardboard, etc.), - nature (solid, liquid, powder, etc.), - colour, - degree of transparency.	Cylindrical sensors - Solid-state digital output					
Dimensions (mm)	**Ø 12**		**Ø 18**		**Ø 30**	
						
Sensing distance Sn	**5 cm**	**10 cm**	**15 cm**	**50 cm (adjustable)**	**1 m (adjustable)**	**8 m (adjustable)**
Assured sensing distance (mm)	6.4...51, fixed	6.4...102, fixed	25...152, fixed	Adjustable using teach mode		
Type of output	PNP/NPN	NPN or PNP	PNP/NPN	NPN or PNP	PNP/NPN or NPN or PNP	NPN or PNP
Degree of protection	IP 67	IP 67	IP 67	IP 67	IP 65	IP 65
Function	NO	NO	NO	NO	NO or NO + NC	NO + NC
Connector	●	●	●	●	●	●
Power supply	⎓ 12...24 V with protection against reverse polarity					
Sensor type	**XX5 12A●**		**XX5 18A●**		**XX6 30A●**	
Pages	4/10 to 4/13					

Cylindrical sensors - Analogue output				Flat form sensors - Solid-state digital output		
Ø 30				7.6 x 19 x 33	16 x 30 x 74	18 x 33 x 60 + Ø 18
						
1 m (adjustable)	**8 m (adjustable)**	**1 m (adjustable)**	**8 m (adjustable)**	**10 cm**	**25 cm**	**50 cm (adjustable)**
Adjustable using teach mode				6.4...102, fixed	51...254, fixed	Adjustable using teach mode
4-20 mA		0-10 V		NPN or PNP	NPN or PNP	NPN or PNP
IP 65				IP 67		
–				NO		
●		●		Connector on flying lead	●	●
⎓ 15...24 V with protection against reverse polarity				⎓ 12...24 V with protection against reverse polarity		
XX9 30A●				**XX7 F1A2**	**XX7 K1A2**	**XX7 V1A1**
4/14 to 4/17				4/18 to 4/21		

Ultrasonic sensors
Osisonic®

Quality, standards and certifications

Quality control

The Osisonic ultrasonic sensors are subjected to special precautions in order to guarantee their reliability in the most arduous industrial environments.

■ **Qualification**
A **qualification procedure** on the characteristics of Osisonic ultrasonic sensors is carried out in our laboratories.

■ **Production**
- The electrical characteristics, sensing distances at the ambient temperature and operating temperatures are 100% verified.
- Sensors are randomly selected during the course of production and subjected to **monitoring tests** on all qualified characteristics.

■ **Customer returns**
Defective ultrasonic sensors are subjected to systematic analysis and corrective actions are implemented to eliminate recurrence of the fault.

Conformity to standards

The Osisonic ultrasonic sensors conform to the standards IEC 60947-5-2.
Standards and characteristics: refer to page 4/11.

Resistance to chemicals in the environment

To ensure lasting efficient operation, it is essential that any chemicals coming into contact with the ultrasonic sensors will not affect their casing and, in doing so, prevent their reliable operation.

Due to the materials used, Osisonic ultrasonic sensors are very resistant to:

■ chemical agents:
- salts, aliphatic and aromatic oils,
- petroleum, diluted bases and acids.

Depending on their nature and concentration, tests should be carried out beforehand for the following chemical agents:
- alcohols, ketones and phenols.

■ food and beverage industry products:
- vegetable oils, animal fats,
- fruit juices,
- milk proteins, etc.

Resistance to the environment

■ **IP 65**: protection against water jets.
Test according to IEC 60529: the device is subjected to water sprayed from a Ø 6,3 mm nozzle, at a flow rate of 12,5 litres/min for 3 min at a distance of 3 m.
No deterioration in either operating or insulation characteristics is permitted.

■ **IP 67**: protection against the effects of immersion.
Tested in accordance with IEC 60529: sensor immersed for 30 minutes in 1 m of water.
No deterioration in either operating or insulation characteristics is permitted.

Ultrasonic sensors
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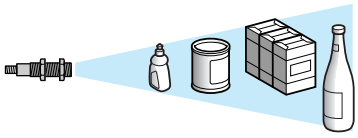
Recommendations

The ultrasonic sensors are designed for use in standard industrial applications involving presence detection.
Since these sensors do not incorporate a redundant electrical circuit, they are not suitable for use in safety applications.
For safety applications, please refer to our "Safety solutions using Preventa" catalogue.

Principle of ultrasonic detection



Presentation

Ultrasonic sensors enable detection, without contact, of any object irrespective of its:
- material (metal, plastic, wood, cardboard, etc.),
- nature (solid, liquid, powder, etc.),
- colour,
- degree of transparency.

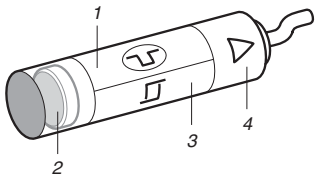
They are used in industrial applications for detecting, for example:
- the position of machine parts,
- the presence of the windscreen during automobile assembly,
- the flow of objects on a conveyor system: glass bottles, cardboard packages, cakes, etc.,
- the level

- of different colour paints in pots,
- of plastic pellets in injection moulding machine feeders.

The ultrasonic sensors are simple to install due to their integral connector and availability of cabling and fixing accessories.

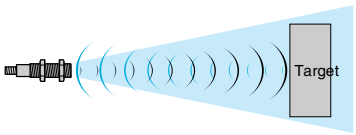
Operating principle

The principle of ultrasonic detection is based on measuring the time taken between transmission of an ultrasonic wave (pressure wave) and reception of its echo (return of transmitted wave).



Osisonic ultrasonic sensors are of the cylindrical type. They comprise:
1 *high voltage generator*
2 *piezoelectric transducer (transmitter and receiver)*
3 *signal processing stage*
4 *output stage*

Excited by the high voltage generator ***1***, the transducer (transmitter-receiver) ***2*** generates a pulsed ultrasonic wave (200 to 500 kHz depending on the product) which travels through the ambient air at the speed of sound. When the wave strikes an object, it reflects (echo) and travels back towards the transducer. A micro controller ***3*** analyses the signal received and measures the time interval between the transmitted signal and the echo. By comparison with the preset or learnt times, it determines and controls the output states ***4***.
The output stage ***4*** controls a solid-state switch (PNP or NPN transistor) corresponding to a NO or NC contact (detection of object).

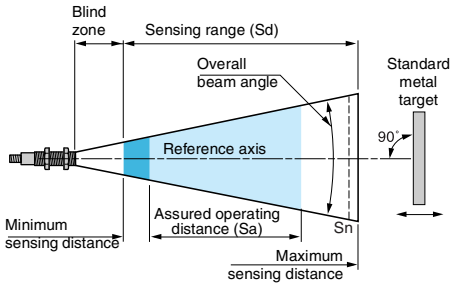


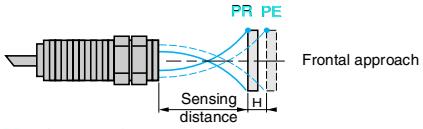
Advantages of ultrasonic detection

- No physical contact with the object to be detected, therefore, no wear and detection possible of fragile or freshly painted objects, etc.
- Detection of any material, irrespective of colour, at the same distance, without adjustment or correction factor.
- Teach mode function, by simply pressing a button, for defining the effective sensing range. Teach of the minimum and maximum sensing distances (very precise foreground and background suppression, ± 6 mm).
- Very good resistance to industrial environments (robust products entirely encapsulated in resin).
- Solid-state units: no moving parts in the sensor, therefore, service life independent of the number of operating cycles.

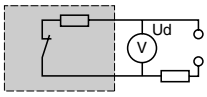
Ultrasonic sensors
Osisonic®

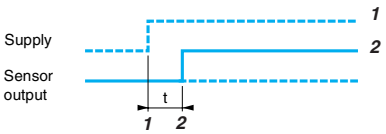
Terminology

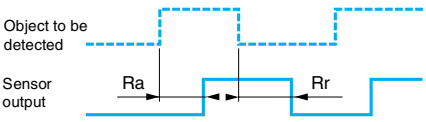




PR = drop-out point
PE = pick-up point







Definitions

The terms listed below are defined by the standard IEC 60947-5-2:

■ Nominal sensing distance (Sn)
Conventional value for indicating the sensing distance. It does not take into account manufacturing tolerances nor variations caused by external conditions such as voltage and temperature.

■ Sensing range (Sd)
Zone in which the sensor is sensitive to objects.

■ Minimum sensing distance
Lower limit of the specified sensing range.

■ Maximum sensing distance
Upper limit of the specified sensing range.

■ Assured operating distance (Sa)
This corresponds to the operating zone of the sensor (activation of outputs), and is included in the sensing range.
Its limits are fixed:
- at the factory for fixed sensing distance sensors,
- when setting-up within the application for sensors with teach mode.

■ Blind zone
Zone between the sensing face of the sensor and the minimum sensing distance in which no object can be reliably detected.
Avoid any passing of objects in this blind zone during operation of the sensor. This could lead to instability of the output states.

■ Differential travel
The differential travel (H) or hysteresis is the distance between the pick-up point as the standard metal target moves towards the sensor and the drop-out point as it moves away from the sensor.

■ Repeat accuracy
The repeat accuracy (R) is the precision of reproduction between two successive measurements of the sensing distance, made in identical conditions.

■ Overall beam angle
Solid angle around the reference axis of an ultrasonic proximity sensor.

■ Standard target
The standard IEC 60947-5-2 defines the standard target as a square metal plate, 1 mm thick with rolled finish, placed perpendicularly to the reference axis.
Its side dimension depends on the sensing range:

Sensing range (mm)	Size of target (mm)
< 300	10 x 10
300 < d < 800	20 x 20
> 800	100 x 100

■ Voltage drop (Ud)
The voltage drop (Ud) corresponds to the voltage at the terminals of the sensor when in the closed state (value measured at the nominal current of the sensor).

■ First-up delay
Time required to ensure operation of the sensor's output signal following power-up.
1 *Power-up*
2 *Output signal state (0 or 1)*

■ Response time
□ Response time (Ra): time taken between the instant the object to be detected enters the active zone and the changing of the output signal state. This time limits the passing speed of the target in relation to its dimensions.
□ Recovery time (Rr): time taken between the object being detected leaving the active zone and the changing of the output signal state. This time limits the interval between 2 objects.

Ultrasonic sensors
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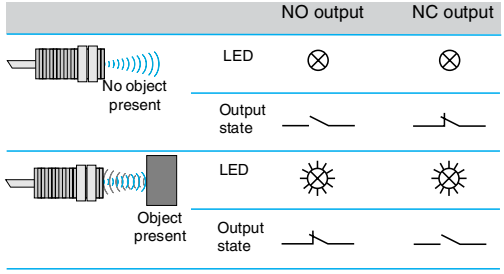
Digital outputs



LED indicators

The majority of Osisonic ultrasonic sensors incorporate light-emitting diode output state indicators.

■ Ø 12 sensor, sensitivity 50 mm
□ Green LED (power on)
□ Yellow LED (object present).

■ Ø 12 sensor, sensitivity 100 mm
□ Green LED (power on)
□ Yellow LED (object present).

■ Ø 18 sensor, sensitivity 500 mm
□ Yellow (object present) and green (power on) LED + user assistance when adjusting the detection zone.

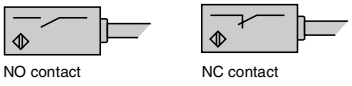
■ Ø 30 sensor, sensitivity 1 to 8 m
□ Multicolour LED for assisting the user when adjusting the detection zone
□ Yellow LED (object present).

■ Ø 30 sensor, sensitivity 1 to 8 m with analogue output
□ Multicolour LED for assisting the user when adjusting the detection distance
□ Yellow LED (object present, with luminosity increasing as output signal increases).

■ Parallelepiped format sensor
□ XX7 F: Dual colour yellow (object present) and green (power on) LED
□ XX7 V: Dual colour yellow (object present) and green (power on) LED + user assistance when adjusting the detection zone
□ XX7 K: Yellow (object present) and green (power on) LED.

Sensors with digital switching

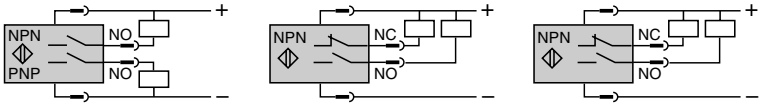
Contact logic output



■ Normally open (NO)
Corresponds to a sensor whose output changes to the closed state when an object is present in the operating zone.
■ Normally closed (NC)
Corresponds to a sensor whose output changes to the closed state when an object is present in the operating zone.

4-wire technique ⎓

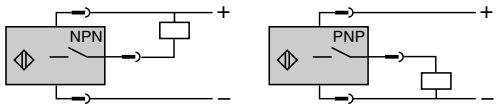
NO output/ PNP and NPN	NO + NC output/ NPN	NO + NC output/ PNP



These sensors comprise 2 wires for the supply and 1 wire for each output signal.

3-wire technique ⎓

NO output / NPN	NO output / PNP



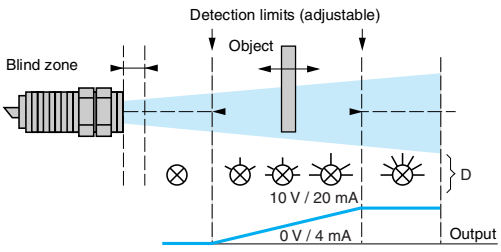
These sensors comprise 2 wires for the supply and 1 wire for the output signal.

PNP type: switching the positive side to the load
NPN type: switching the negative side to the load

Sensors with analogue output

Operation

The characteristic feature of these sensors is the output which delivers a signal (either current or voltage) that is proportional to the distance of the object being detected. Within the detection limits, which are adjustable using teach mode, the value of the output signal increases as the object moves away.
When an object is detected, an LED indicator (D) illuminates and its luminosity increases in relation to the value of the output signal.



Advantages

■ Visual information available relating to the sensor / object distance.
■ Protection against reverse polarity.
■ Protection against overloads and short-circuits.
■ No residual current, low voltage drop.

Ultrasonic sensors
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Power supply

d.c. source
Check that the voltage limits of the sensor and the acceptable level of ripple, are compatible with the supply used.

a.c. source (comprising transformer, rectifier, smoothing capacitor)
The supply voltage must be within the operating limits specified for the sensor.

Where the voltage is derived from a single phase a.c. supply, the voltage must be rectified and smoothed to ensure that:
- the peak voltage of the d.c. supply is lower than the maximum voltage rating of the sensor. Peak voltage = nominal voltage x √2
- the minimum voltage of the d.c. supply is greater than the minimum voltage rating of the sensor, given that:
  ΔV = (I x t) / C
  ΔV = maximum ripple: 10 % (V),
  I = anticipated load current (mA),
  t = period of 1 cycle (10 ms full-wave rectified for a 50 Hz supply frequency),
  C = capacitance (µF).
  As a general rule, use a transformer with a lower secondary voltage (Ue) than the required d.c. voltage (U).

Example:
~ 18 V to obtain ⎓ 24 V.

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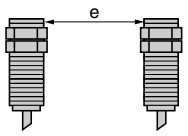
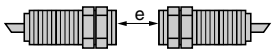
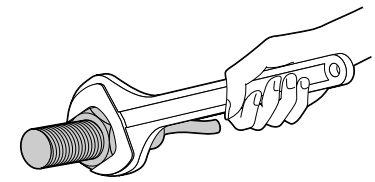
Setting-up precautions

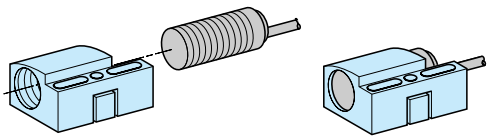


Mounting side by side
e ≥ Sn



Mounting face to face
e ≥ 4 Sn max.





Mounting

Mounting distance between ultrasonic sensors
If 2 standard sensors are mounted too close to each other, the wave transmitted by one sensor is likely to interfere with the other and result in erratic operation.
In order to avoid this, it is necessary to adhere to the minimum distances between sensors.

Maximum tightening torque

Cylindrical sensor	Diameter mm	Tightening torque
XX5 12●	Ø 12	0,7 N.m
XX5 18●	Ø 18	1 N.m
XX6 30●	Ø 30	1,35 N.m

Flat form sensors	Screw	Tightening torque
XX7 F●	M3	0,7 N.m
XX7 K●	M4	1 N.m
XX7 V●	M3	0,7 N.m
	Ø 18	1 N.m

Interchangeability
Using the indexed **fixing clamp**, the assembly is similar to a block type sensor.

Cabling

Electrical connection
- **Connect the sensor before switching on the supply**

- **Length of cable**
  - No limitation up to 200 m or up to a line capacitance of < 0.1 µF (characteristics of sensor remain unaffected).
  - It is, however, advisable to take into account the voltage drop on the line.

- **Separation of control and power cables**
  - The sensors are immune to electrical interference encountered in normal industrial conditions.
  - Where extreme conditions of electrical "noise" could occur (large motors, spot welders, etc.), it is advisable to protect against transients in the normal way:
- suppress interference at source,
- separate power and control wiring from each other,
- smooth the supply,
- limit the length of cable.