

Fundamentals of Ultrasonic Detection

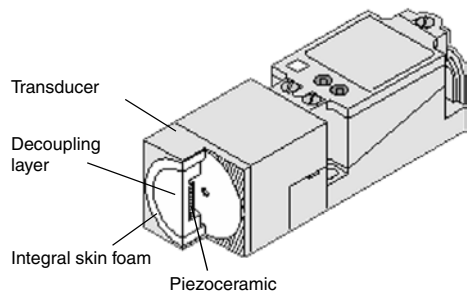
Operating principles and technology of ultrasonic sensors

Sound with a frequency over 16kHz is inaudible to the human ear. This is referred to as ultrasound. Ultrasonics travel at 344 m/s through the air - the same as audible sound. By evaluating the speed of sound and its runtime, the distance of an object can be measured precisely.

Ultrasonic sensors are ideal for consistent object detection, even in harsh and problematic conditions. Objects made from different materials and with different shapes, colors, or consistencies are reliably detected.

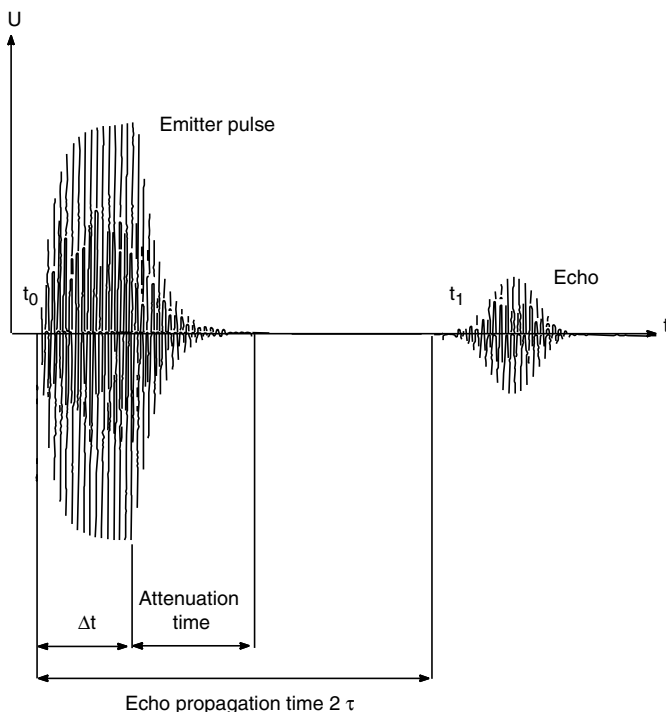
Pepperl+Fuchs ultrasonic sensors operate with a piezoelectric transducer as the sound transmitter and receiver. A patented process is used to decouple the ultrasonics to the air - an acoustically thin medium.

Ultrasonic sensors are available with switching and/or analog outputs. Depending on the model, different output functions are available.



Deadband/unuseable area

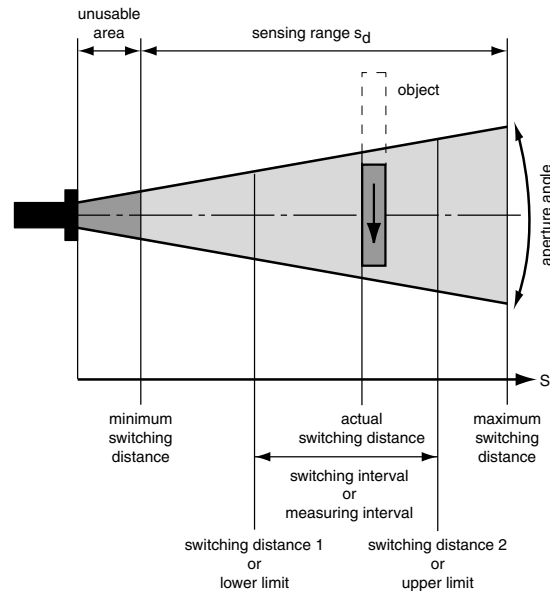
The deadband is the unusable area that defines the minimum distance for target detection. The transducer transmits a series of sonic pulses and converts the echo pulse into a voltage. The integrated controller computes the distance from the echo time and the velocity of sound. The transmitted pulse duration Δt and the decay time of the sonic transducer result in an unusable area where the ultrasonic sensor cannot detect an object.



Sensing range

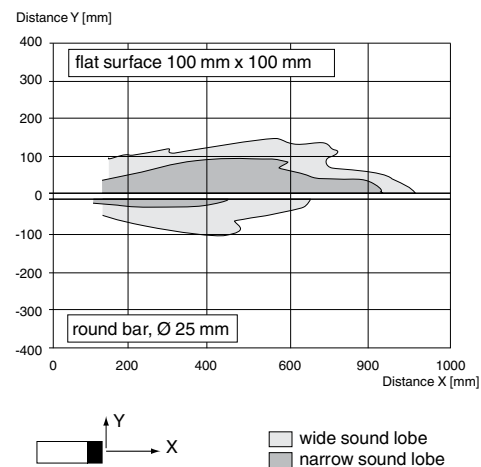
The active area of the ultrasonic sensor is known as the sensing range, s_d , and is limited by the shortest and longest operating distance. The longest operating distance is included in the model number.

The ultrasonic sensor detects objects within its sensing range, regardless of whether these objects approach the sensor axially or move through the beam angle laterally.



Response curves

The following figure shows the detection areas for two typical objects. The specified object is detected within this area.



The upper part of the diagram illustrates the response characteristic on a standard flat plate measuring 100 mm x 100 mm, the lower part using a rod with a diameter of 25 mm as the object. Many sensors include a feature for setting the sound beam width. Both sound beam shapes are shown in the diagram.

The information in the type designation relates to a normal flat plate measuring 100 mm x 100 mm. This plate must be perpendicular to the propagation direction of the ultrasonic signal. The sound is reflected away from upright objects and the echo does not reach the sensor.