

Sensor for Air Bubble Detection at Liquid Filled Tubes



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1 General Information

1.1 Application

The air bubble detector is used for the detection of air bubbles in liquid filled tubes made of synthetic materials. It is also suitable for wet/dry indication at tubes.

The sensor is used especially in the fields of medical and food technology, since it has no contact with the liquid. The sensor is also suitable for industrial applications such as the bubble detection at tubes filled with glue or paint.

The type and dimensions of the sensor depend on the diameter and the flexibility of the tube as well as on the kind of liquid.

Without using any coupling medium the tube is easily put into the sensor and enables a smooth and uncomplicated change.

The sensor is constructed as a component to be integrated into machines and apparatus. The mechanical installation and electrical integration into the control system can be carried out easily.

Besides standardized applications the sensors can also be adapted to customized applications.

1.2 Measuring Principle

An ultrasonic principle with short high-frequency pulses is used for measuring. If there is liquid in the tube a part of the ultrasonic sound is transmitted from the emitter through the tube to the receiver. If the tube is empty or a bubble is placed in the measuring point, the part of sound is much smaller. The amplitude of the received ultrasonic pulses is analyzed.

The sensor adapts to dynamically changing acoustic conditions. Hence, a high reading stability against varying environmental conditions can be ensured.

2 Technical Specifications

2.1 Sensitivity of Bubbles / Direction of Mounting

The bubble sensitivity depends on the diameter of tube and on the mounting position. For optimal bubble detection the tube must be placed vertically or horizontally with lateral insertion. This way bubbles with a diameter greater than 30 % ... 50 % related to the inner diameter of tube will be detected.

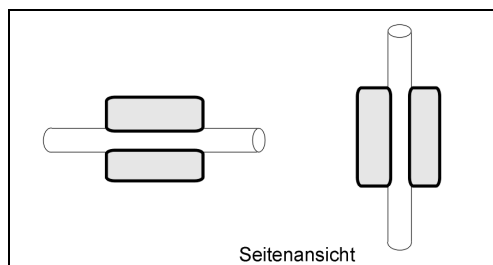


Figure 1: Recommended mounting position of the sensor

Example:
 Outer diameter of tube = 6.5 mm
 Inner diameter of tube = 4.9 mm
 → Bubbles bigger than 5 µl are detected at a flow rate of 1 ... 1000 ml/min.

If the opening of the channel points upwards, the threshold at which bubbles can be detected reliably is the highest.

2.2 Liquid Standards

In general all low-viscosity liquids which contain no or only little filler are suitable.



For industrial applications with high-viscosity liquids (e.g. fats / special paints), screening tests must be made.

The intensity of ultrasound which is transmitted into the liquid is so small, that no biological damage occurs. The sensor is tested e.g. for applications with human blood.

2.3 Tube Standards

According to the tube diameter there are various models with a different channel width. The type of sensor depends on the outer diameter, the flexibility as well as the wall thickness of the tube.



In order to make sure to select the most appropriate type, consult our service team. If available a short piece of the tube should be sent to our company.

Outer diameter	3 ... 17 mm
Wall thickness	Optimal 10 ... 20 % of outer diameter
Material	Plastics, e.g. PVC, PE, silicon, PUR
Features	Other materials only on request or after test
Elasticity	Tube must be plane on the outside, no textile tube

Table 1: Requirements to the tube



The tube is put into the measuring cell without coupling gel.

ATTENTION: There must be no liquid in the channel. An acoustic short circuit may be caused due to the liquid. The function of the sensor is strongly disturbed.

Normally, after being put in, the tube is fixed firmly by the hinged cover. Especially when using very small tubes or tubes with a very low wall thickness (less than 10 % of the outer diameter) it is necessary, that the cover presses the tube and keeps it firmly on the right position.



The elasticity of the tube may be changing by an increased operating temperature.

2.4 Connection of the Sensor

For normal operating the sensor is connected via a M12 sensor connector (3 poles).

A suitable cable can be delivered optionally (length: 2 m / 5 m / 10 m). A shielding cable is not necessary for short distances. We recommend a shielding for greater lengths (> 30 m) or in rough industrial environments.

For the service a special cable (5 poles) is required. Using the additional lines it is possible to configure the sensor and to adapt it to customized specifications. Do not connect unused lines!



Use the service lines only in combination with the ABD Monitor for the SONOCHECK (delivered on request). Otherwise the sensor could be damaged.

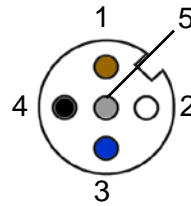
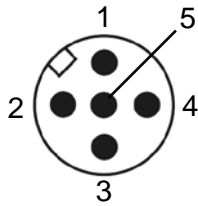


Figure 2: View on connector of the sensor

Figure 3: View on connector of the cable (female)

Pin	Color	Connection
1	Brown	Power supply voltage +12 ... 30 VDC
2	White	For service only: serial control input (5 V / TTL)
3	Blue	Ground
4	Black	Switching output, PNP, max. 150 mA
5	Grey	For service only: serial control output (5 V / TTL)
	Shield	If available: should be grounded on the side of controlling unit

Table 2: Pin configuration of M12 sensor connector

2.5 Settings / ABD Monitor:

For settings or for diagnostics a computer is required.

By setting the parameters the sensor could be customized:

- Response time / hold time for output / state of output
- Adaption to the right kind of tube



For detailed information do not hesitate to contact our service team.

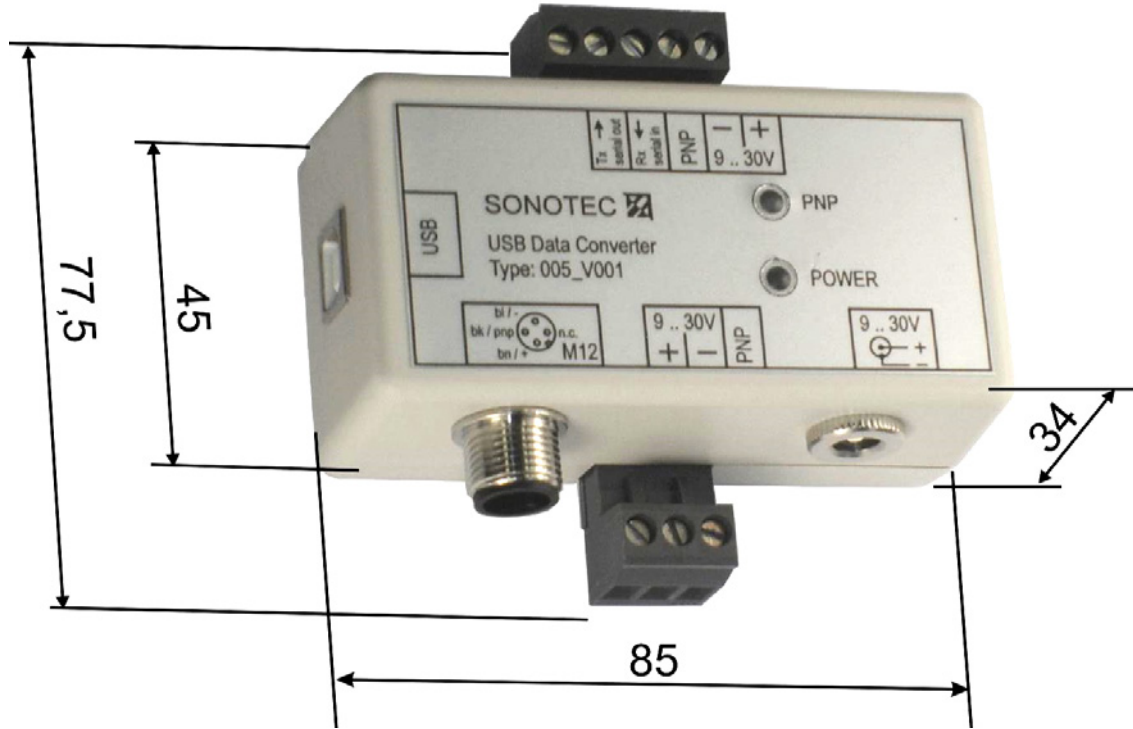
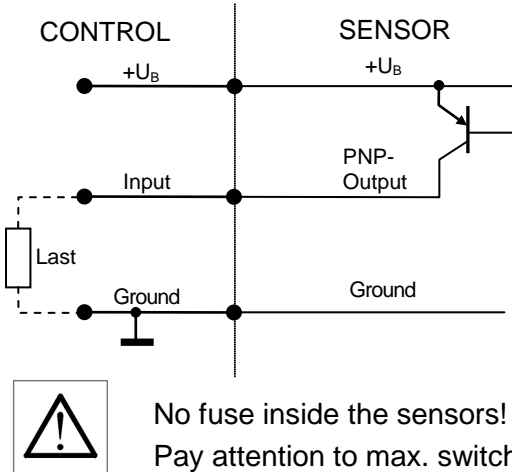


Figure 4: USB Data Converter for connecting the sensor to the USB port of the computer

3 Technical Data

SONOCHECK, Type ABD06.xx Sensor for air bubble detection at liquid filled tubes		
Measuring Principle	Ultrasonic principle Tube is put dry in sensor, no coupling gel is required.	
Type of Models	Model	Outer Diameter of Tube
	S	3.0 ... ca. 8.5 mm
	L	8.0 ... ca. 17.0 mm
	Dimensions of sensor and hinged cover depending on diameter, wall thickness and flexibility of tube. If possible, provide a short piece of tube for an optimal selection!	
Materials	<ul style="list-style-type: none"> ▪ Housing: plastics / POM / black ▪ Hinged cover: plastics / POM / black, mounting claw made of steel ▪ Measuring cell: plastics / PMMA / black ▪ Potting: PUR <i>Note: Other materials are available on request.</i>	
Mounting	2 x holes M4 on the rear side of the sensor	
Operating Temperature	+5 °C ... +60 °C	
Storage Temperature	-20 °C ... +70 °C	
Degree of Protection	IP67 (potted)	
Operating Voltage	+12 ... 30 VDC, ripple max. 10 %, protection against reverse polarity	
Power Requirement	Max. 50 mA (without switching current)	
Switching Output	PNP, max. switching current 150 mA  <p>No fuse inside the sensors! Pay attention to max. switching current!</p>	
Output Specification (Default)	State	Level of PNP-Output
	Air / Bubble	+24 V
	Liquid	Ground
	Internal error (self-test)	+24 V
	<i>The state of output can be configured according to the application by means of the ABD Monitor.</i>	

Measuring Cycle	200 μ s
Response Time Hold Time	Minimal < 0,5 ms <i>The Response Time can be adjusted in a wide range. Furthermore, the Hold Time can be set in order to increase the duration of the output signal.</i>
CE Compliance	<p>Compliance with DIN EN 61326-1: 2006</p> <p>EN 61000-4-3 EMC, Radiated radio-frequency - Electromagnetic field immunity, Test Result A, Test with 10 V/m (0.15 ... 1000 MHz)</p> <p>EN 61000-4-4 EMC, Electrical fast transient/burst immunity test, Test Result A (see restrictions below)</p> <p>EN 61000-4-6 EMC, Immunity to conducted disturbances, induced by radio-frequency fields, Test Result A, Test with 10 V/m</p> <p>EN 55011 Electromagnetic disturbance characteristics, Limit 30 dBμV/m</p> <p><i>For testing typical settings for bubble detection have been applied. The interference immunity depends on a reasonable configuration. Operating with very high bubble sensitivity combined with a very short response time can cause disturbances of the system, induced by electromagnetic disturbing, pressure changing, mechanical vibration, etc.</i></p>
Scope of Delivery	<p>Bubble detector type ABD06, model and dimensions adjusted to tube of customer</p> <p>Hinged cover with mounting claw: dimensions adjusted to sensor and tube.</p> <p>Technical data sheet</p>
Accessories/Options	<p>M12 sensor cable, 3 poles, length 2 m / 5 m / 10 m</p> <p>ABD Monitor, consisting of :</p> <ul style="list-style-type: none"> ▪ USB data converter ▪ M12 sensor cable, 5 poles, length 2 m ▪ USB cable type A-B, length 1.5 m ▪ CD with software ABD Monitor

Table 3: Technical data sensor SONOCHECK – type ABD06.xx

4 Drawings

4.1 Model S: Outer diameter 3.0 ... ca. 8.5 mm

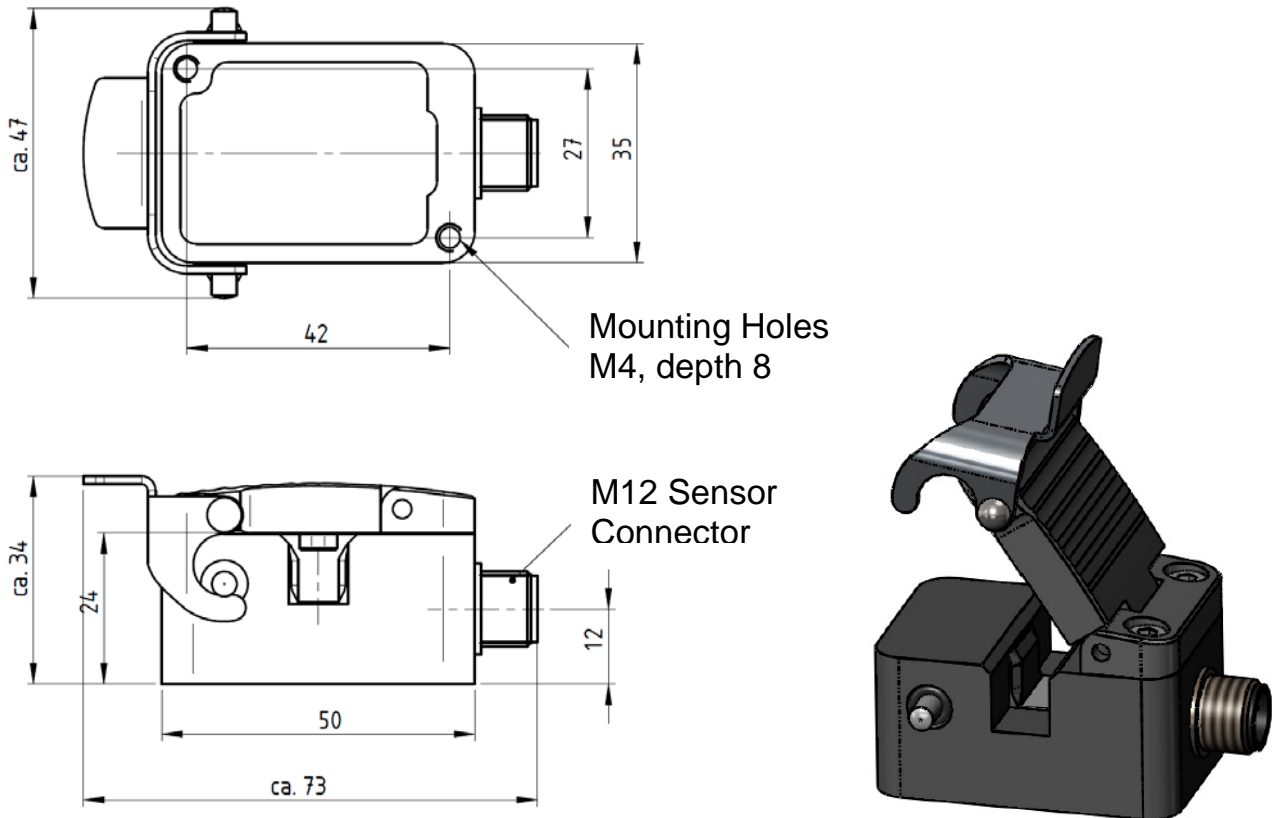


Figure 5: Drawing of sensor model S.
Note: The drawings do not conform to real dimensions.

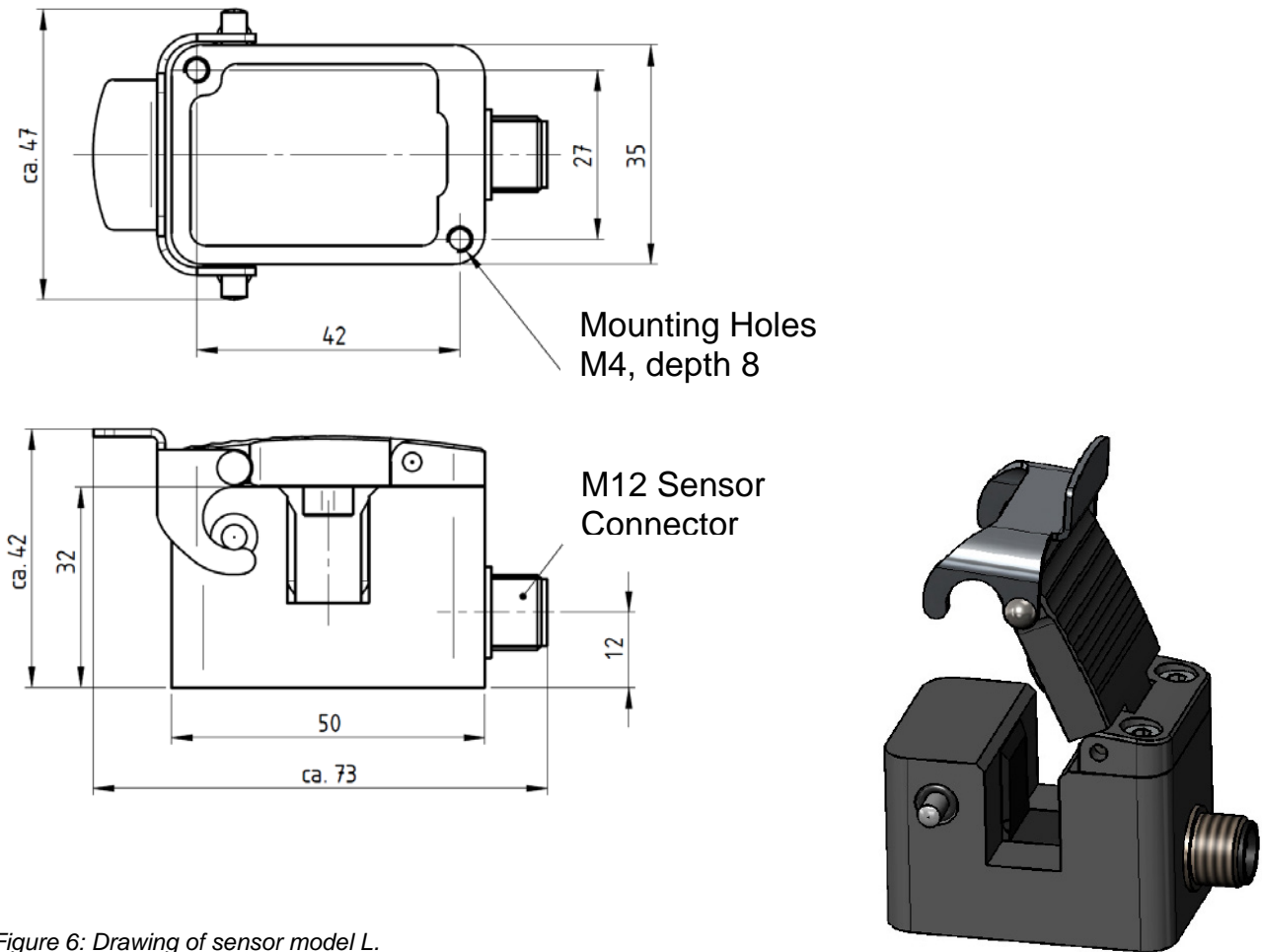
4.2 Model L: Outer diameter ca. 8.0 ... 17.0 mm

Figure 6: Drawing of sensor model L.
Note: The drawings do not conform to real dimensions.