

M E D I C A L

Ultrasonic Technology for
Medical Applications

Medical In-Line Sensors



Occlusion Sensors

CeramTec designs and manufactures accurate pressure sensors using piezo-resistive technology. They can detect both negative pressure caused by upstream blockages and positive pressure caused by downstream blockages in the tubing. Tube contact sensors offer non-invasive detection of pressure changes in a flexible tube without the requirement of a disposable cassette. They are suitable for use with a soft thin walled tubing and are ideal where blocked tube detection is required.

Medical In-Line Sensors

CeramTec specialises in the design and manufacture of In-Line sensors for a variety of medical equipment such as infusion pumps, enteral feeding pumps, dialysis equipment and other fluid management applications.

Our range of medical In-Line sensors offers non-invasive detection of gas bubbles, pressure changes and fluid levels in soft flexible tubing as well as soft or hard body disposable sets and containers. In tubing leading into and out of the body it is vital that variables such as air content, pressure and levels are monitored, therefore our safety critical sensors are an important part of critical medical care.

Our scope of supply ranges from tuned piezo ceramic discs and plates, to a fully functional packaged sensor. The sensors can either be selected from our standard range, or more frequently customised to suit specific OEM needs. Our dedicated design team is able to develop custom solutions for a wide range of applications that fully meet the customer's requirements, and these designs can be manufactured in our ISO13485 certified factory based in Southampton, England.



This image is an example of a custom sensor combining bubble and occlusion sensors. Additional sensing technologies can also be added, such as blood leakage detectors, thermistors and micro switches, to detect correct tube insertion and fluid temperature.

09186 Occlusion Sensor

This occlusion sensor combines MEMS Silicon machined technology and a precision machined lid and catch to provide accurate relative pressure measurements on tube contact.

Combination Sensors

Often both occlusion sensors and bubble detectors are required simultaneously, CeramTec can provide both these sensors in one housing with a single connection. Combining the two sensors reduces the number of suppliers and the footprint needed.

General sensor performance characteristics*

Tube outside diameter	4.0 - 5.0 mm
Typical Output	> 3 mV/V/bar
Span	130 mV ± 10 mV
Recoverable over force	10 N
Destructive force	45 N (applied directly to the sensor element)
Environmental	IPX4

* Based on 5V DC drive voltage and 4.0 mm OD x 0.75 wall thickness PVC tube (Tygon B-44-4X)



Air-In-Line Sensors / Bubble Sensors

CeramTec has a range of air bubble sensors to suit a variety of applications. These sensors are designed to detect the presence of air bubbles in flexible tubing, for example in infusion lines. All the sensors can be mounted in any orientation and are designed to be dry coupled to flexible tubing such as PVC and silicone. Our sensor portfolio covers a large range of tube sizes and are IP67 rated, RoHS and REACH compliant.

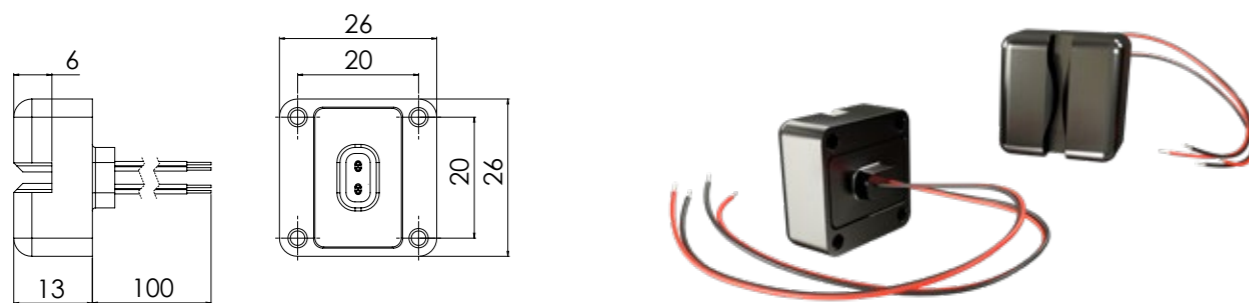
Our Air-in-Line sensors (AIL sensors) are designed to operate in conjunction with the ultrasonic signal generator/ analyser in your machines with two major advantages:

1. Sensors can be very small in size when there is no requirement for on-board electronics.
2. High cost efficiency. Necessary driver hardware can be integrated into your system architecture.

These sensors are compatible with common medical cleaning agents and are designed to work with a variety of liquids commonly used in the medical industry.

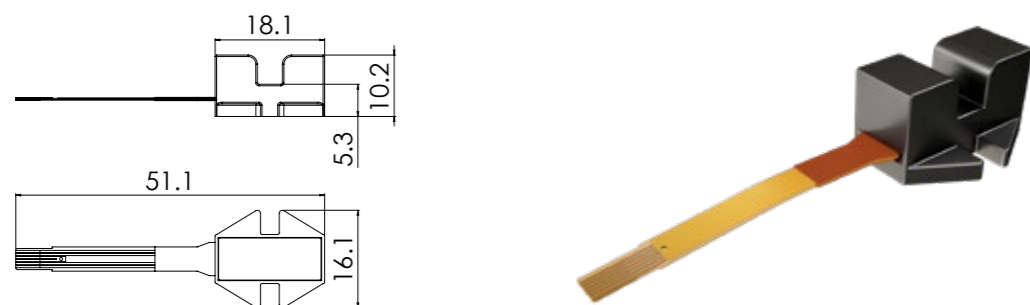
Model 09254

This sensor is designed for small diameter tubing around 3/32" (2.4 mm) outside diameter where low flow rates and volumes are required, such as accurate liquid dispensing and insulin pumps.



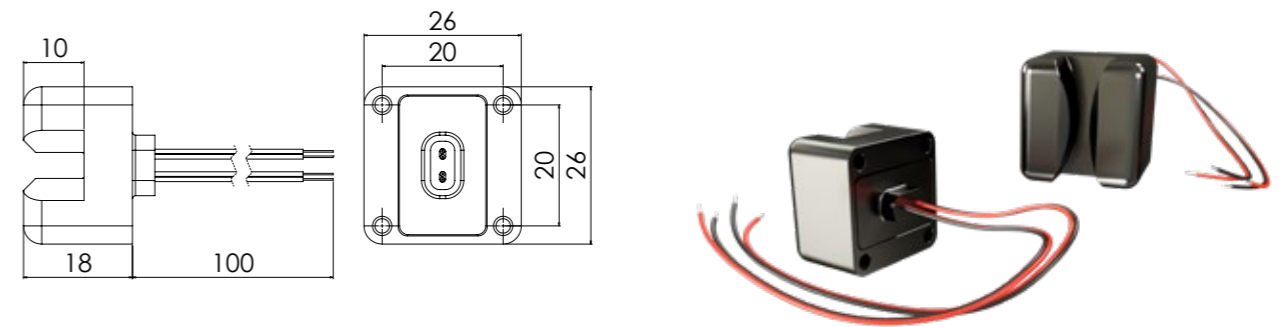
Model 09168

This sensor is designed for tubes around 3/16" (4.7mm) outside diameter and is used extensively in liquid handling applications and, due to its small size, especially suitable for infusion pumps where space is at a premium.



Model 09267

This sensor is designed for tubes around 1/4" (6.3mm) outside diameter where larger flow rates are required. Typical applications include: haemodialysis, blood apheresis, cardio-pulmonary bypass and blood heating.



Model Specifications			
Model Number	09254	09168	09267
Tubing outside diameter	2.2 mm – 3.5 mm	4 mm – 4.6 mm	5.5 mm – 7 mm
Operating frequency	4 MHz	1.45 MHz	2 MHz
Casing material	PC/ABS blend	PC/ABS blend	PC/ABS blend
Mounting	4 x No 4 self-tapping screw	To accept a 3mm OD screw	4 x No 4 self-tapping screw
IP rating	IP67	IP67	IP67
Operating temperature	10°C – 40°C	10°C – 40°C	10°C – 40°C
Storage temperature	-20°C – 70°C	-20°C – 70°C	-20°C – 70°C
Drive electronics	No	No	No
Signal to noise ratio	>10:1	>10:1	>10:1
Cable length	100 mm	Flexible Circuit or 100 mm	100 mm

Drive Conditions:

- Can be driven in continuous wave or burst mode
- Can be driven with square wave or sine wave
- Can be driven up to 24Vpp under any configuration (Receive signals are roughly proportional to input voltage)

CeramTec can develop drive electronics for applications where it is not possible or impractical to incorporate them onto the system mother board. CeramTec has considerable knowledge of the requirements of bubble sensors and using our ISO9001 certified partner, electronics packages can be developed to match with your requirements.

Ultrasonic Level Sensors for non-invasive Level Measurement

Utilising CeramTec's extensive range of piezo materials and expert design team, we have developed custom solutions for global medical device manufacturers based on the technology behind our level sensors to detect the level of a variety of liquids in disposable sets. Solutions have been found for a variety of common complex problems, with some of the benefits being:

- Dry couple to rigid or flexible, disposable or reusable chambers
- Multiple levels can be detected on chambers of any size with the minimum and maximum levels as close as 4 mm apart
- Pulse echo or through-beam (transmit and receive) technology, depending on the complexity of the chamber
- Multiple levels can be monitored using a single sensor block
- Detects foam as air, unlike capacitive sensors which detect foam as liquid
- Not affected by liquid or chamber colour
- Highly temperature stable

Applications

- Liquid dispensing
- Industrial
- Dialysis
- Liquid drug handling
- Contrast injection
- Bottle filling

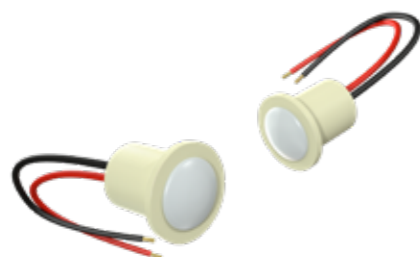
Key features

- Removable and reusable
- Dry-coupled
- Compact size
- Range 10-300 mm



Model 09288

Our screw mounted through-hole level sensor offers the flexibility to dry couple to rigid or semi-rigid walled containers. Designed for mounting on chamber bases for the sensor to receive its own reflected signal back from the surface of the fluid, allowing for the calculation of fluid depth.



Model 09304

These sensors are designed to be compact probes for integration into a range of existing or new level sensing applications. They offer the same dry coupling benefits of our other sensors and can operate in a pair or individually.



Model 09303

CeramTec's self-clamping dry couple level sensor can measure the level of common medical containers such as drip chambers for dialysate mixing.

Mechanical Specification

- Screw mounting and bonded mounting options available
- Operate individually as a pulse/echo measurement device, reflecting from the surface of fluid or housing back walls
- Operate together as a pair in a through-beam measurement device
- Housing made from tough, chemical resistant polymer
- Innovative compliant coupling layer
- Level measurement accuracy ~2 mm

CeramTec can develop drive electronics for applications where it is not possible or impractical to incorporate them onto the system mother board. CeramTec has considerable knowledge of the requirements of level sensors and using our ISO9001 certified partner, electronics packages can be developed to match with your requirements.

Customer Sensors

The majority of our customers specify unique features and requirements for their sensors. Our design team can help to optimise housing geometry, materials and performance to suit the specific application. Tubing used in each application might also influence clamping method used, dimensions needed for tube diameter and coupling required for tubing material, all of which we can design for. Customer specific terminations can be catered for, such as flexible circuit, cables and custom connectors.

We can also design sensors with a combination of functions such as Air-In-Line, occlusion, optical sensing, temperature measurement and flow rate.

Our sensors are typically used in the following applications:

- Infusion Pumps
- Haemodialysis
- Transfusions
- Liquid Dispensing
- Enteral Feeding Pumps
- Blood Processing Equipment
- Contrast Injectors
- Cardiopulmonary bypass

Why choose CeramTec safety critical products:

- Designed and manufactured to ISO13485 quality standard in the UK
- Comprehensive range to cover most fluid handling applications
- Compact and robust design
- Customisation including multiple sensor solutions in one module reduces overall cost and installation times
- Contract sub-assembly option utilizing CeramTec in-house piezo ceramic from our catalogue of industry leading materials

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