



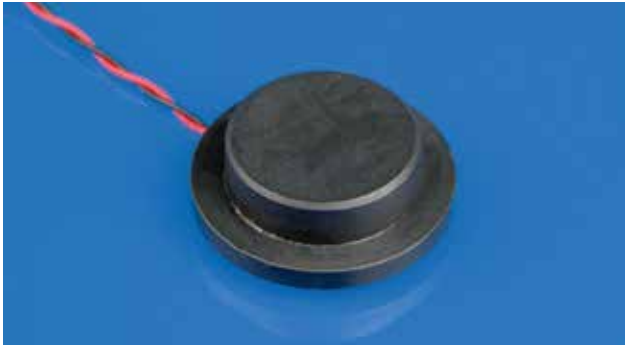
Water Coupled Transducers for Ultrasonic Flow Metering

Piezoceramics in Ultrasonic Applications

Water Coupled Transducers for Ultrasonic Flow Metering

CeramTec presents its Ultrasonic Flow Sensors, ideal for applications including smart metering for heat meters and water meters. These transducers are intended to transmit and receive ultrasonic waves across a liquid channel for Time of Flight or Doppler shift flow measurement of liquids.

Combined with temperature monitoring the transducer can be used in a system for heat metering. Typical meters using this technology will use 1, 2 or 4 of these transducers.



can adjust the architecture, manufacture process and material of the sensor for a particular application in low, medium or high volumes. Upon request we can provide a quotation for development and manufacture of electronics to integrate with the customer's system.

Part Number	09204/00X	09265/00X
Nominal resonant frequency	1 MHz	2MHz
Bandwidth for a pair (-6dB)	> 15%	> 20%
Receive signal at 100mm separation for two transducers (reference operating voltage)	> -13dB	> -7dB
Beam angle (-3dB)	11°	
Insulation resistance at 250V	> 1GΩ	> 1GΩ
Operating temperature	1°C to 120°C	1°C to 120°C
Storage temperature	-2°C to 130°C	-10°C to 130°C
Maximum burst pressure	100 Bar	50 Bar
Housing material	Stainless steel*	Thermoplastic

* Advanced ceramic materials available for extreme pressure requirements, alternative geometries available upon request

Membrane Assemblies

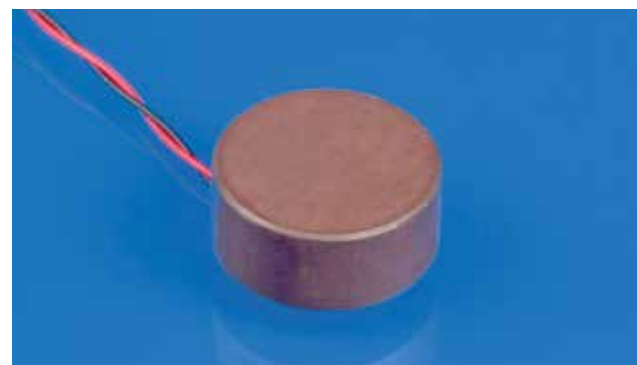
We can offer bonded assemblies to the temperature and pressure specification defined above. Flat or wrap around electrodes (bull's eye or moon configurations) can be offered, with gold, nickel or silver plating. The high density, high consistency materials offer exceptional frequency tolerance on piezoceramic shapes and assemblies (+/-1%). Nickel or gold plating provides a good connection for sprung loaded contacts to reduce the overall cost of assembly.



Custom Sensor and Transducer Design and Manufacture

Our transducer research and development team are dedicated to working with customers to find solutions for their products. Using top of the range tools, such as 3D Finite Element Analysis, they can virtual prototype transducers to cut down development time.

Additionally, we design and manufacture air-coupled sensors for Smart Metering of natural gas. Our design engineers



Flow Meter Set-Up for Time of Flight Flow Metering

Measuring the flow of clean liquid can be achieved by mounting transducers at an angle, by reflective blocks, or by channelling the flow stream between the sensors.

If the distance between the two transducers (L) is known, then by driving transducer 1 and monitoring the time it takes for transducer 2 to respond (t_1), then driving transducer 2 and monitoring the time for transducer 1 to respond (t_2), it is possible to calculate the flow rate (v) of the fluid within which the transducers are located according to the following equation:

$$v = \frac{L t_1 - t_2}{2 t_1 t_2}$$

If required, the speed of sound (c) in the transmission material in question can be found from the same two measurements:

$$c = \frac{L t_1 + t_2}{2 t_1 t_2}$$

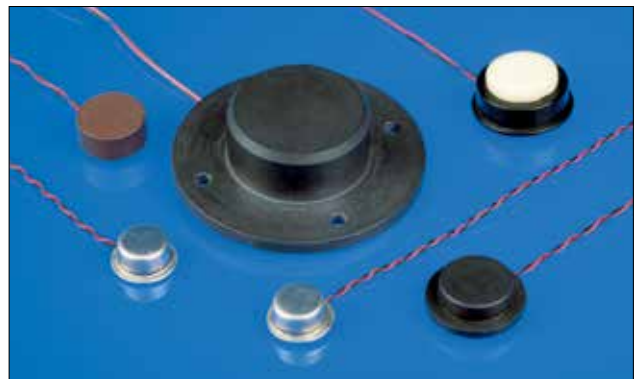
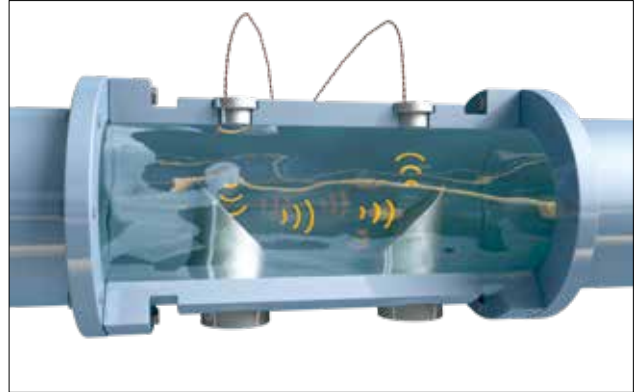
Doppler flow measurement

Alternatively it is possible to measure flow rate with a single transducer placed at an angle clamped onto the pipe. Entrained air bubbles in the stream of fluid reflect the transmitted wave back to transducer.

The Doppler shift of the frequency is used to measure the speed of the flow. This technique is useful for measuring the flow rate of non-clean liquids, liquids with bubbles or turbulent liquids. This method requires 100 parts per per million (ppm) of 100 μ m suspended bubbles.

With the transmitting frequency (f_t), receiving frequency (f_r), speed of sound in the liquid (c) and angle of incidence to the flow (θ), the flow rate (v) can be calculated from:

$$v = \frac{c f_r - f_t}{\cos^{\theta} 2 f_t}$$



CeramTec is a global materials engineering company which designs and manufactures a wide range of high specification products with extraordinary properties, across multiple sectors and geographies.

From an extensive range of advanced materials we produce components, assemblies and systems that deliver significantly enhanced performance for our customers' products and processes. Our engineered solutions are produced to high tolerances and many are designed for use in extreme environments.

We design and manufacture products for demanding applications in a variety of markets using a comprehensive range of advanced ceramic, glass, precious metal, piezoelectric and dielectric materials. We utilise core competences of applications engineering and superior materials technology, together with state of the art fully integrated manufacturing processes to offer precision ceramic components, ceramic-to-metal assemblies and special coatings for use in a variety of applications.



The measured values mentioned before were determined for test samples and are applicable as standard values. The values were determined on the basis of DIN-/DIN-VDE standards and if these were not available, on the basis of CeramTec standards. The values indicated must not be transferred to arbitrary formats, components or parts featuring different surface qualities. They do not constitute a guarantee for certain properties. We expressly reserve the right to make technical changes.

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