

## Applications & Cases



Media-resistant pressure transmitters

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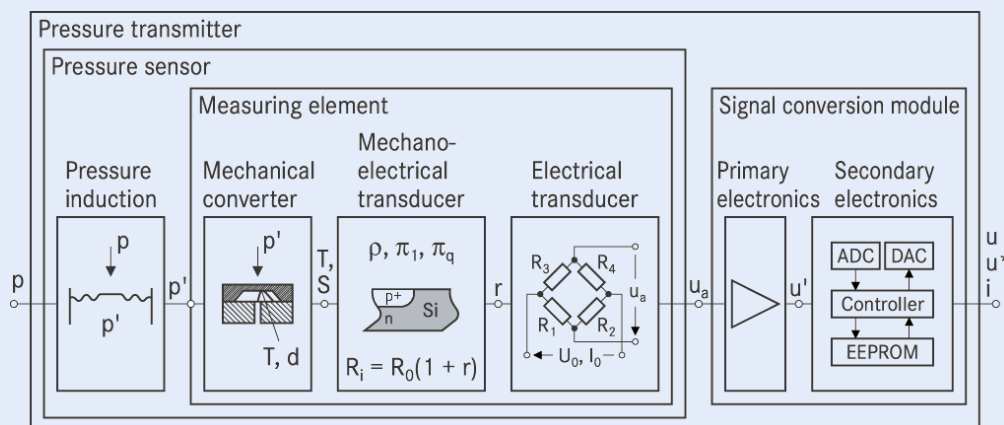
## Compact, rugged and highly sensitive

Pressure sensors are subject to ever-tougher requirements. This calls for a combination of compact and rugged designs, extended temperature ranges and high measurement precision. Aktiv Sensor, a company within the EPCOS group, has developed highly rugged pressure sensors with a new package concept. These operate in the range from 100 mbar to 25 bar and can also be used in the extended temperature range between -40 and

+140 °C with an accuracy of better than one percent (FS). Fig. 1 shows the circuit diagram including the evaluation electronics.



**FIGURE 1: SCHEMATIC STRUCTURE OF A PRESSURE TRANSMITTER**



Signal processing chain and system limits of the media-separated pressure transmitter.

### Structure of the sensors

The measured pressure is converted to an electrical signal in a piezoresistive sensor element by detuning a Wheatstone bridge comprising doped piezoresistive resistors. As a microsystem component made of monocrystalline silicon, the piezoresistive pressure sensor has high long-term stability – an important criterion for industrial applications.

To ensure mechanical decoupling, the silicon sensor element is mounted onto a specially shaped silica substrate that is mechanically isolated from the sensor package by an adhesive elastic seal.

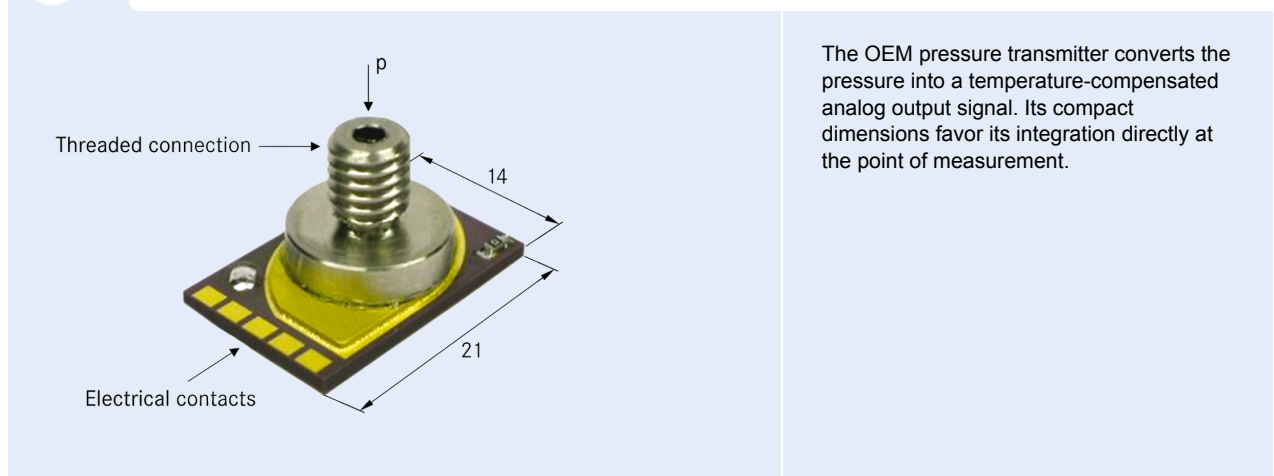
A drawback of conventional piezoresistive silicon measuring elements is their poor resistance to various media. To improve this significantly, the pressure to be measured is not transmitted directly to the element but via a coupling medium. Inert, highly insulating liquids such as silicon oil or purified natural oils are suitable media for applications in the food industry. They ensure long-term protection of the sensor element. The measuring and coupling media are separated by a metallic membrane. This balances out any volume fluctuations due to changing temperatures of the filling medium in the package and permits the pressure to be introduced and transferred.

## Applications & Cases

The innovative sensor package is manufactured from a multilayer ceramic (LTCC or HTCC). This allows electrical interconnections for the entire signal-processing circuitry to be incorporated in the ceramic layers. The measurement signal is amplified by a signal transducer that compensates static sensor faults by means of individual programming. The output signal of the pressure transmitter is matched to standardized interfaces and varies between 0.5 and 4.5 V. This ensures sufficient interference immunity for the transfer to the signal processing units. Additional circuit boards for signal processing are not necessary. Fig. 2 shows an OEM sensor element with all the components required for pressure measurement and signal processing.



**FIGURE 2: UNPACKAGED PRESSURE TRANSMITTER**



The OEM pressure transmitter converts the pressure into a temperature-compensated analog output signal. Its compact dimensions favor its integration directly at the point of measurement.

The advantage of this design is its low volume of less than 3 cm<sup>3</sup>. In particular, this solution enables miniaturized and media-separated differential pressure measurement based on a single-chip transmitter element. The pressure transmitters can be used wherever they can be integrated into higher-level systems that protect the transmitter sufficiently from external influences. The parts carrying the media to the pressure input line are made of stainless steel and ensure high resistance to aggressive media. The process connection may be implemented as an O-ring, tube fitting or thread, depending on the pressure range and incorporation site. Its applications include measuring the pressure of polluted water in a multi-sensor system.

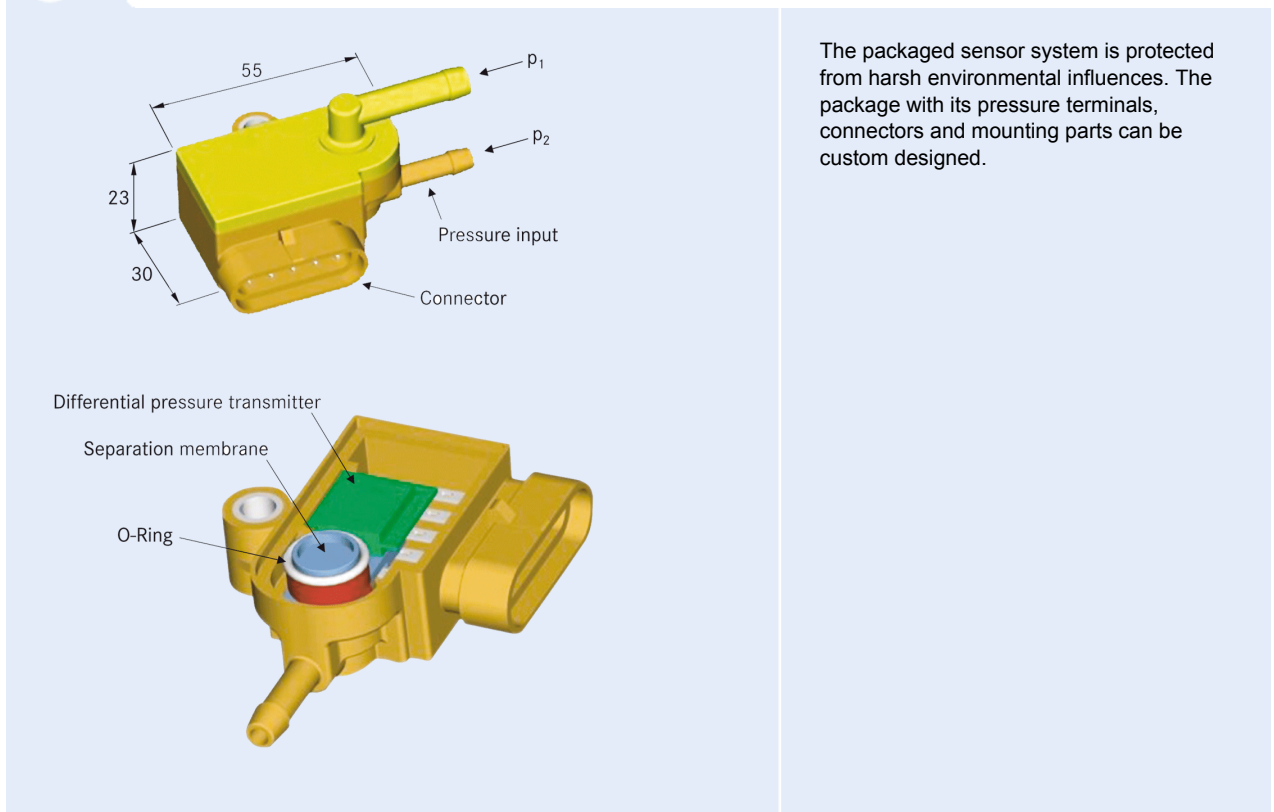
### **Packaged pressure transmitter as an autonomous measuring system**

If the pressure transmitter is used as an autonomous measuring system, it must be protected from external influences such as dust and water mist at their point of incorporation. This is done with a plastic package that offers good media resistance and sufficient temperature stability in most applications. The package, with its pressure terminals, connectors and mounting parts is matched to suit the customer-specific purpose (Fig. 3). For particularly high demands, a stainless-steel version of this package is also available. Applications include measurement of differential pressures, monitoring filters in aggressive gases and measuring the pressure of a coolant.

## Applications & Cases



**FIGURE 3: COMPLETE SENSOR SYSTEM FOR DIFFERENTIAL PRESSURE MEASUREMENT**



**Author:**

Dr. Christian Wohlgemuth, Product Development Pressure Sensors, Aktiv Sensor, a company of the EPCOS Group