

Press Release

Ceramic Pressure Sensors Ready to Use

Korb, Germany, April 2, 2008

Ceramic pressure sensors are increasingly part of open and closed loop control systems. They are chemically resistant to aggressive media and are used in pressure switches and analog measuring systems for their accuracy and reliability. Users also appreciate their good price-performance ratio – cost pressures are still increasing after all, while any diminution of reliability and quality is unacceptable.

Metallux AG in Korb, Germany has expanded its product range for ceramic thick-film pressure sensors, adding yet another innovative sensor which, compared with previous sensors, has a ratiometrically balanced output signal of 0.5...4.5V. The amplifier is integrated directly on the measuring cell in this ready-to-use ceramic pressure sensor with its standardized output signal.

The Pressure Sensor Principle – State of the Art

The ceramic pressure sensor from Metallux AG has a monolithic aluminum-oxide body. Gold conductive lines, the connecting pads and the actual sensor circuit in the form of a Wheatstone bridge are printed on the side facing away from the media using screen printing technology. Resistors to compensate the sensor offset and PTC resistors for temperature compensation are added. The individual layers are burned in using suitable temperature profiles, typically at 850° C. The required sensor accuracy is achieved by laser trimming. In a first calibration step, the sensor offset is calibrated. In a second calibration step, the temperature error of the sensor is determined in the temperature range between -25° C and 85° C in order to adjust the sensor to requirements by laser trimming the PTC resistors. Laser trimming is also used in this procedure for fully automated precision calibration of the offset signal. In this way, an offset of ± 0.1 mV per 1V of excitation voltage and a temperature coefficient of $\pm 0.01\%$ FS/K is achieved at the sensor in accordance with system requirements.

In order to achieve good long-term stability of the sensor signal, the sensor is protected by a glass cover and a temperature- and moisture-resistance layer. A ribbon cable, for example, typically connects the sensor to the signal conditioning unit. The contact pads on the sensor are potted after soldering of the ribbon cable, which increases stability and reduces the potential effect of errors. One special feature in the manufacturing process for the sensor is the fully automated soldering, testing and potting unit. Following the soldering process for the ribbon cable, the sensors undergo a 100% final inspection. In addition to the parameters already mentioned, the sensitivity of the output signal, linearity, hysteresis and reproducibility are measured and documented.

The sensor is usually installed in a metal or plastic housing. The sensor is sealed radially as it is pressed against a media-resistant O-ring made of e.g. PTFE, Viton or NBR using a hold-down pressure pad. The specified clamping force required to seal the system is

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generated by the close tolerances established for the housing parts (a few hundredths of a millimeter).

These ceramic pressure sensors are purely passive. Since the sensitivity of the ceramic measuring cells is comparatively low – typically 2...5mV/V – the pressure signal from the measuring cell must be amplified and adjusted to the requirements of the overriding system with respect to electrical output values. For this reason, the cells are usually connected to an electronic signal conditioning unit following installation in the housing. The span and offset are adjusted on a pressure calibration unit with the help of the signal conditioning circuit to a standardized output signal, e.g. 4...20 mA, 0...1-V or 0.5...4.5V.

CPS 3500 – The Logical Development

The sensors for the CPS 3500 series represent a ready-to-use module with an output signal of 0.5...4.5V and they allow the user to build up media-resistant pressure transmitters or pressure switches without additional calibration steps. Compared with sensors with integral signal processing already available on the market, the CPS 3500 intentionally does away with an additional PCB to accommodate the circuit. The IC for evaluating the sensor signal and components to protect the circuit from the effects of EMC are assembled directly on the ceramic measuring body without affecting the measurement properties of the pressure sensor. Consequently, the sensors are characterized by extremely high resistance to mechanical influences such as shock and vibration.



Metallux CPS 3500

The manufacturing processes for the thick-film circuit were also optimized. The pressure sensor dispenses with additional calibration and compensation resistors. All the compensation and calibration processes are carried out digitally in the evaluation IC. Dispensing with the associated laser trimming results in significantly greater long-term stability

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for the sensors. The evaluation IC used allows offset and span to be calibrated. Temperature errors between -25°C ... 125°C are compensated.

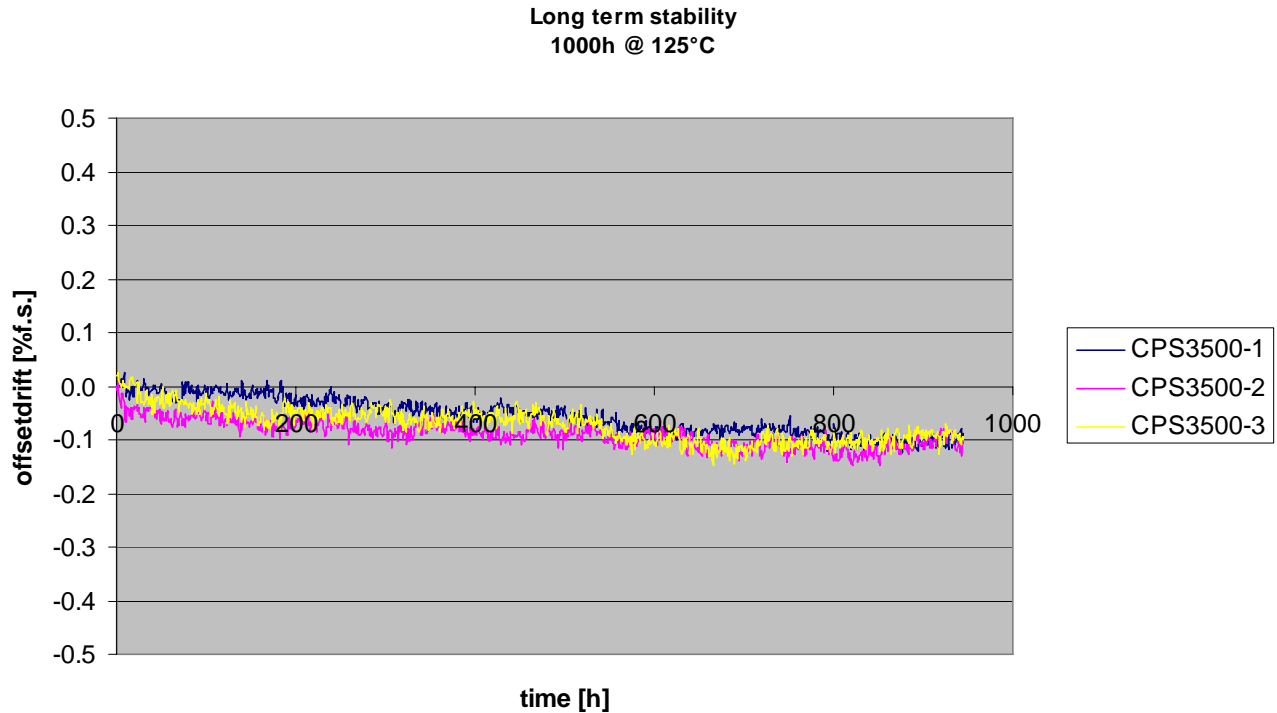
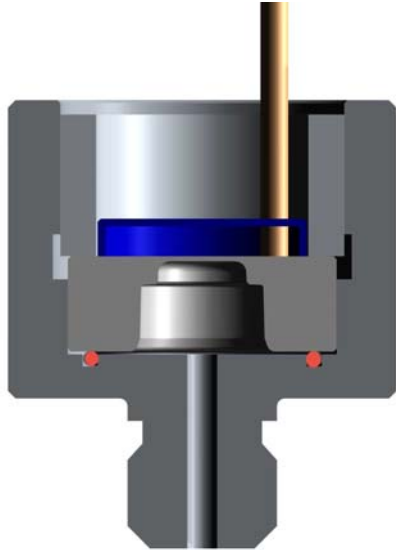


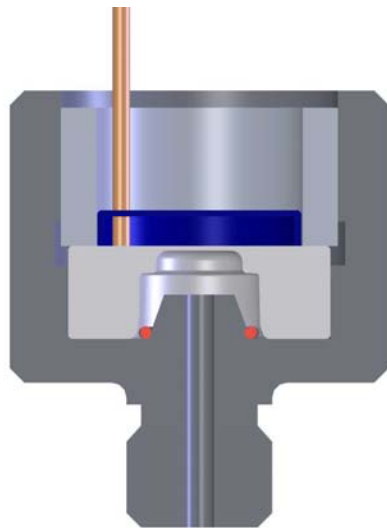
Figure: Sensor off-set stability at 125° C over 1000 hours

With its 18-mm diameter, which is familiar and in general use, the CPS 3500 can be integrated into already existing transmitter housings without major changes being necessary. The modified measuring body geometry is a further innovation. It allows the user to select radial sealing for the pressure sensor in addition to the usual axial sealing.

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Installation example for Metallux CPS 3500 with axial sealing



Installation example for Metallux CPS 3500 with radial sealing

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The benefits of the CPS 3500 can be summarized as follows:

- Integral signal conditioning with ratiometric output signal 0.5 ... 4.5V
- No calibration by the user required
- Exceptionally good EMC properties by amplification on the measuring cell
- Quick and easy installation
- Minimal effects of temperature changes on accuracy
- Both axial and radial sealing possible for the sensor

Applications

Pressure Switch

The ceramic pressure sensor (CPS) is characterized by its high resistance to corrosive and aggressive media, e.g. brake fluid or coolant, sea water and many lyes and acids. In addition, it is used as a sensor in analog measuring systems and in pressure switch applications on account of its good mechanical properties, its temperature- and long-term stability and not least its comparatively good price-performance ratio. These benefits are greatly appreciated by users in industry and the automotive sector.

The primary requirements for sensors used in pressure switches are high stability and outstanding reproducibility relative to the required switching point. For example, to ensure optimal fuel conditions for diesel engines, the pressure of the medium is monitored and if the temperature of the medium drops, resulting in higher viscosity, a heating process is initiated. In this instance, reproducibility of the switching point (0.1% of the final value) is of crucial importance. Good temperature stability of the offset and of the output signal are mandatory. The basic values are defined as 0.01% full scale per ° C for the zero point and 0.01% of the measured value per ° C. The ceramic sensor body is resistant to a wide variety of media, such as fuels, transmission or industrial fluids and refrigerants which contain aggressive additives. Its compact construction helps to reduce space requirements and weight. One of its attractive features is its price-performance ratio, the result of a sophisticated automated manufacturing process making it possible to position this analog sensor in the pressure switch field in the automotive industry.

Analog Measuring Systems

The monolithic ceramic pressure sensor has proved its worth in analog measuring systems and consolidated its position. In addition to the properties described above such as temperature stability, reproducibility and extremely good media compatibility, the values for linearity and hysteresis are crucial for applications in measuring systems. In general, values of $< \pm 0.5\%$ overall for linearity, hysteresis and reproducibility are required in the installed state. The 0.5...4.5V sensor signal can easily be processed further.

To summarize, the monolithic ceramic pressure sensor is an affordable, robust, accurate and reliable sensor which has a great future in a multiplicity of applications.

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Author:

Metallux AG
Andreas Karaus
Executive Board for Technology
Tel. 07151/939 35-0
andreas.karaus@metallux.de

About Metallux:

Metallux AG is a high-capacity manufacturer of electronic thick-film components. Metallux provides a broad spectrum of services and in addition to the standard program of pressure, position, angle and foil sensors, high-tension and power resistors also offers complete customer-specific solutions including customization of potentiometers and joysticks. Proven customer orientation providing suitable ideas and solutions ensures satisfied customers.

Innovative products and many years of experience – numerous well-known customers from the automobile industry, electrostatics, medical and industrial electronics and sensor systems have relied on the company headquartered in the vicinity of Stuttgart for more than 22 years.

For more information:

www.metallux.de

PR contact:

Metallux AG
Anja Puttkammer
Manager Marketing & PR
Tel. 07151/93935 -14
Fax. 07151/93935-3
anja.puttkammer@metallux.de