OEM-TRANSMITTERS: ALL-INCLUSIVE

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Miniaturization in Pressure Measurement Technology

Keller's OEM transmitters are systems that can be described as „embedded" in the best sense of the word – and in two different ways. First, the sensor and the downstream electronics are embedded in the same housing and second, the transmitter capsules themselves are ideally suited for embedding in application-specific systems. Depending on requirements, the output signal is standardized and temperature-compensated (ratiometric or digital).

Thanks to the Chip-in-Oil (CiO) technology developed at Keller, the trend toward sensor miniaturization is now a reality. This development can offer impressive advantages: an extremely compact structural design, high resistance to electrical noise fields and high vibration resistance thanks to low mass and short conduction paths.

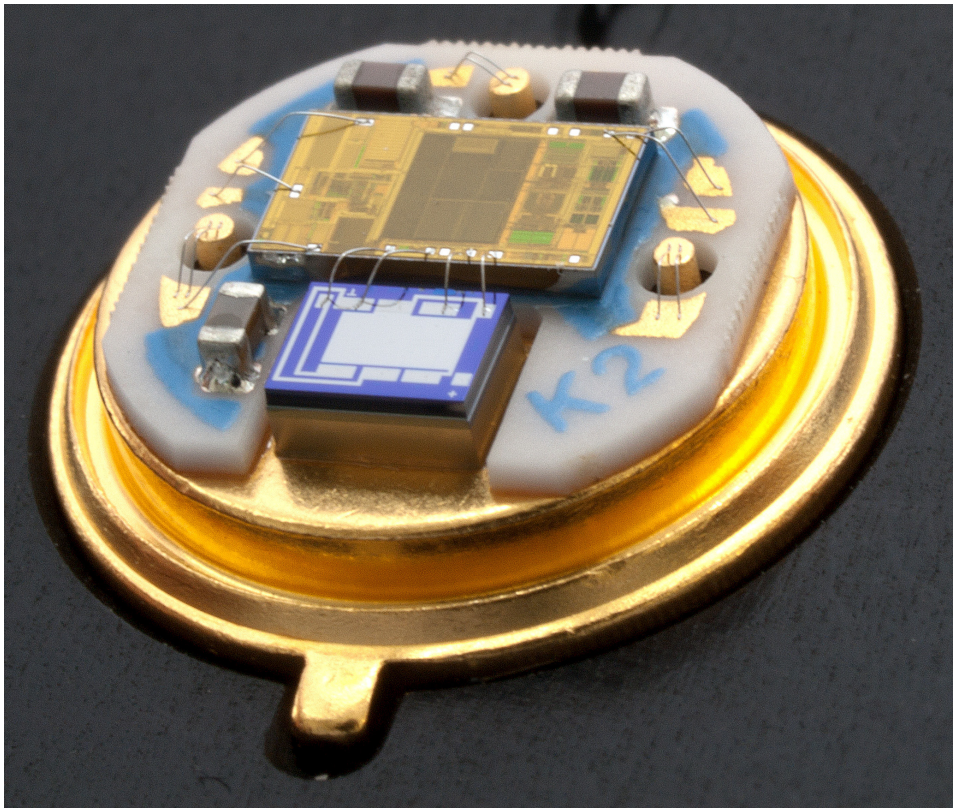
To put it clearly, CiO technology means that an ASIC is fitted directly next to the pressure sensor - in the same housing - to provide users with a whole range of beneficial functions. However, this does not make the pressure measurement capsule any larger: its external dimensions remain the same. This transmitter concept is available in housings 4L ... 9L, starting from a diameter of 11 mm.

Sintered-in pressure-resistant glass leadthroughs feed the transmitter signals outwards. The internal wiring uses short, lightweight bonding wires - with the total exclusion of air in oil. First, this approach eliminates the need to connect filigree signal processing boards with multiwire cabling in the rest of the installation process for the pressure transducer. And second, there is no need to protect the downstream electronics against moisture and condensation.

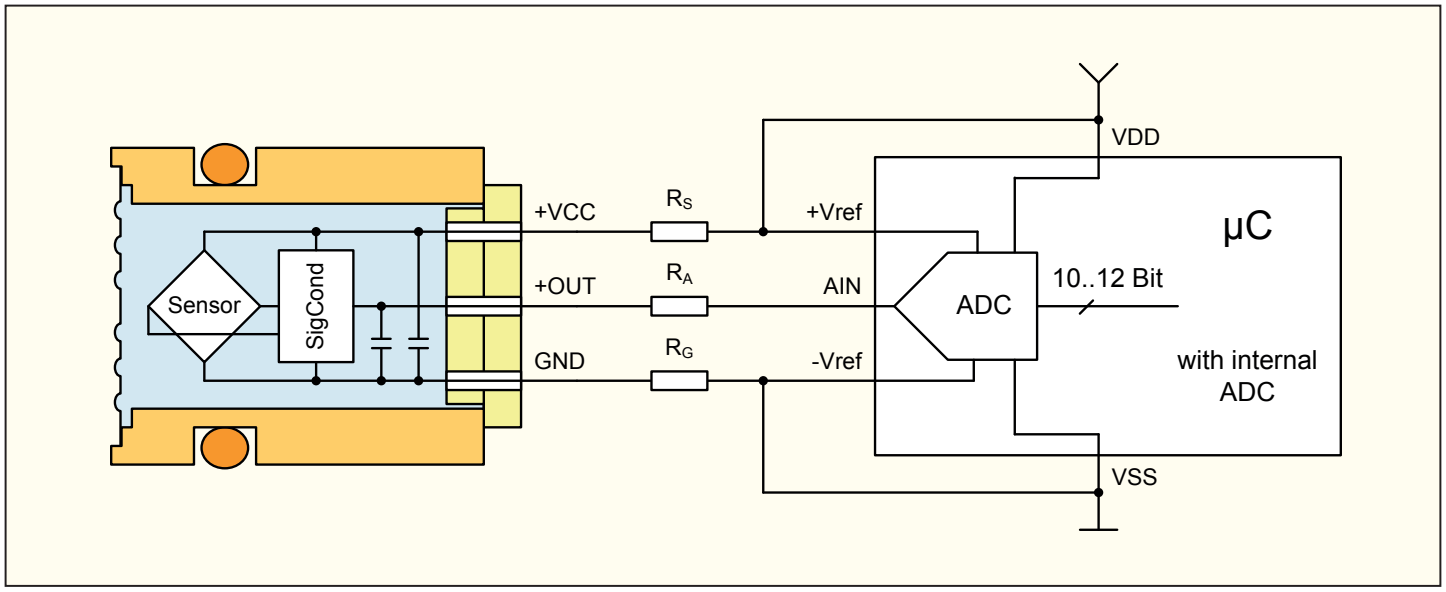
Together with the high-grade steel housing, the glass leadthroughs act as feedthrough capacitors, forming a Faraday cage. This makes the CiO technology extremely resilient to electrical fields. Even field strengths of 250 V/m at frequencies of up to 4 GHz are unable to influence the measurement signal.

The ASIC is designed as a microcontroller with the corresponding peripherals, so the sensor signals can be registered with high resolution and dynamism (sampling rate: 2 kHz). In addition to the process pressure as such, the temperature of the pressure sensor is measured and is used for mathematical temperature compensation when the signal is processed.

OEM transmitters supply two output signals: a ratiometric analog voltage output and a digital inter-integrated circuit interface (I2C).



The sensitive sensor signals are connected to the signal conditioning IC via ultrashort wire-bonding wires, and are fed outwards as low-resistance processed signals via the glass feedthrough pins. Even EMC and ESD protection are integrated.



Schematic structure of a C-line OEM transmitter, directly connected to a microcontroller with integrated analog/digital converter. If care is taken to keep the line resistances low, no calibration is needed because the ADC and „SigCond“ are referenced to one another.

Ratiometric output signal

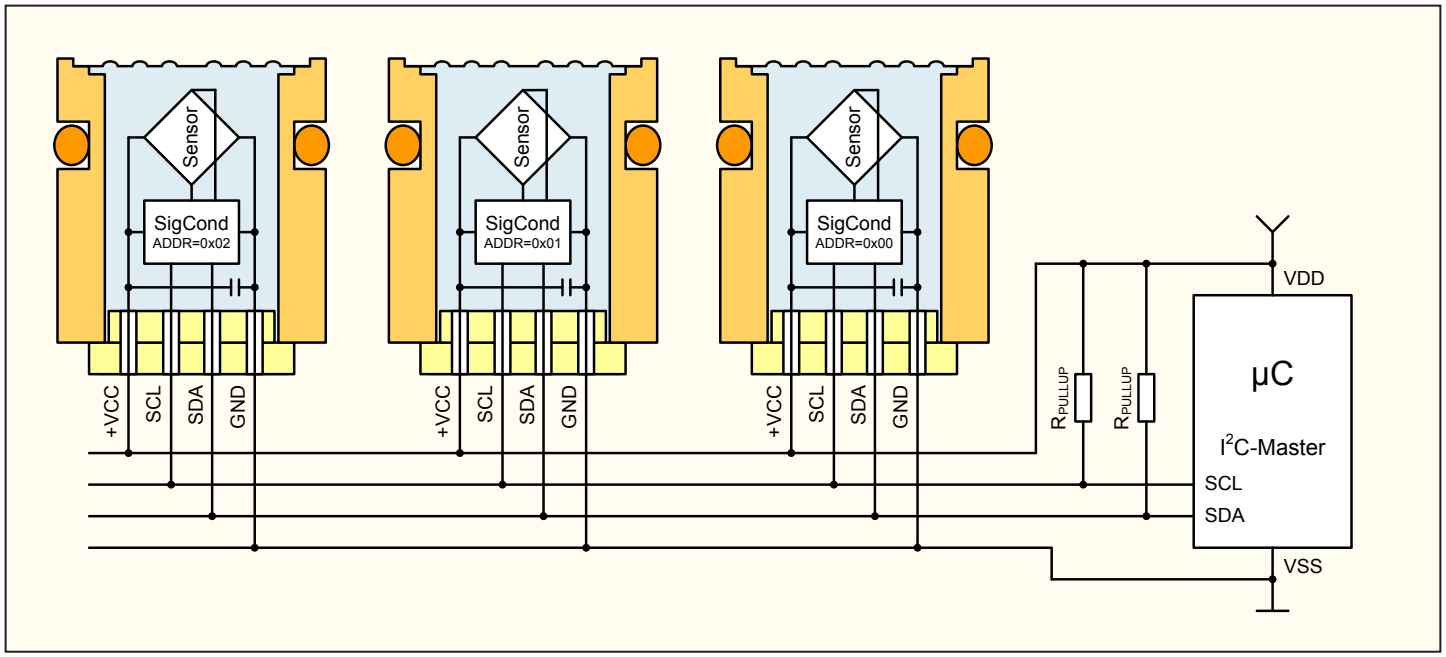
The secret of the ratiometric format of the output signal is that it actually has no format at all, because it depends on the voltage supplied. This is an inestimable advantage for applications in integrated systems. If the analog-to-digital converter downstream of the transmitter is operated with the same supply voltage, the digital measured value will always be correct. This is because the height of the digitization steps depends on the voltage supply, but the number of steps does not – and their number is the critical factor. Using ratiometric signals substantially reduces the outlay on passing signals from the pressure transmitter to the A/D converter in the downstream electronics, and calibration steps are unnecessary; in the specific case of connection to a microcontroller with an integrated A/D converter, this outlay equals zero. Nevertheless, an interval is specified for the output signal, i.e. 0.5 ... 4.5 V for a supply voltage of 5.0 V. With a stable and precise supply voltage, this interval can also be used directly as the „standard signal“. Moreover, the embedded electronics in CiO technology provide constant protection against overvoltage and polarity reversal on all lines up to ±33 VDC.

Embedded Interface I2C

OEM transmitters that are the same size as pressure measurement capsules are never connected directly to field bus systems. Instead, the respective coupling modules have corresponding input interfaces, e.g. for the inter-integrated circuit or I2C interface. For years, this has been the serial standard to cope with short distances in embedded systems. The I2C master needs two lines for the serial data and the pulse (clock) for synchronous sampling. Consequently, no timing requirements are specified for the master - which, in fact, determines the timing. Each OEM transmitter has its own address, which is addressed by the I2C master. In the existing configuration, one master can manage 128 different addresses. The current pressure and temperature values are available on the transmitters (slaves) and are clocked from the transmitter on request from the master, according to a specified protocol.

Series 4 LC
……the smallest with a diameter of 11 mm

Series 6 LC
…the high-pressure version



Schematic structure of a mini-network of C-line OEM transmitters, I2C version. Two free digital tri-state I/O lines are the only requirement for the microcontroller, which freely determines the timing in its capacity as master.

Mobile Application

Unlike the CiO version with a ratiometric output, CiO versions with a I2C output can also operate with a voltage supply of only 3 VDC ±10%, so they are excellently prepared for mobile battery-powered applications. This also includes the start-up behavior: the current measured values for pressure and temperature are available a mere 5 ms after switching on the power supply. In formal terms, this calls for applications with on/off operation, because the average power consumption of the OEM transmitter is then reduced to the magnitude of µA.

OEM Transmitters for Everyone

Typical key data vary according to the format of the output signal – ratiometric or digital. With an analog output, the transmitter can be used at temperatures of between -40 °C and +150 °C, whereas the I2C output is subject to an upper limit of 80°C. The pressure range for the analog version extends from 2 bar to 1,000 bar; for the digital version, the range is from 2 bar to 200 bar. Both versions offer a very good dynamic range with an internal sampling rate of 2 kHz. Power consumption during continuous operation is another interesting aspect. In this respect, the digital version requires less than 2 mA, whereas consumption by the analog version is about four times as much.

Summary

Keller's C-series OEM transmitters herald a new chapter in the history of high-integration pressure measurement technology. The Chip-in-Oil concept moves signal processing directly into the protective oil-filled pressure measurement capsule housing, made of stainless steel. Linearization, temperature compensation and parameterization are handled here. For integration into higher-level systems or battery-powered devices, versions are available with a ratiometric voltage output or with a serial-digital I2C interface. Various structural designs can be supplied depending on the specific application.

Series 9 FLC
……with flange for welding or sealing

Series 9 LC
…the low-pressure version