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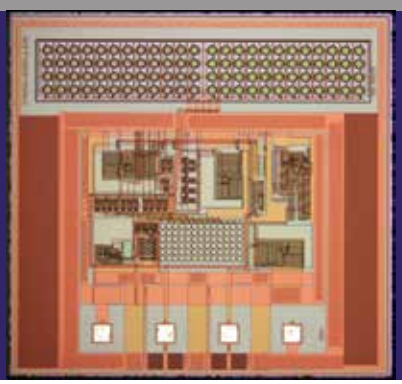

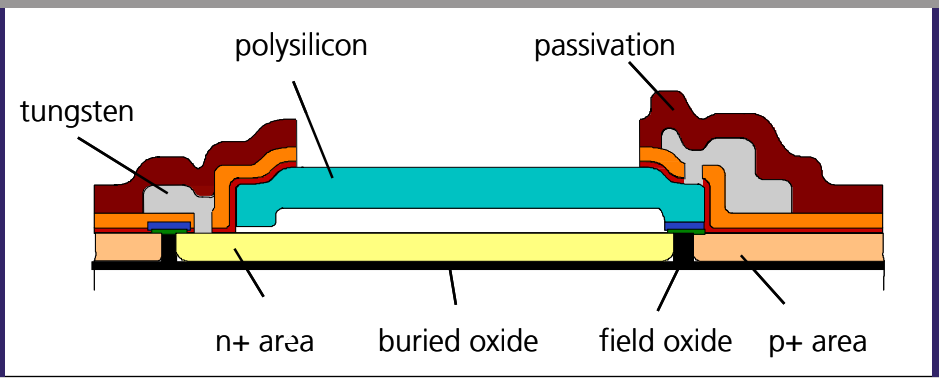


1 *Integrated SOI CMOS pressure sensor*
2 *SOI implementation of sensing element*

# HIGH TEMPERATURE CAPACITIVE PRESSURE SENSOR

- **OPERATING TEMPERATURE +250°C**
- **ON-CHIP SIGNAL CONDITIONING**
- **SOI CMOS**

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The IMS developed an absolute pressure sensor with full scale pressures from ambient pressure to 70 bar.

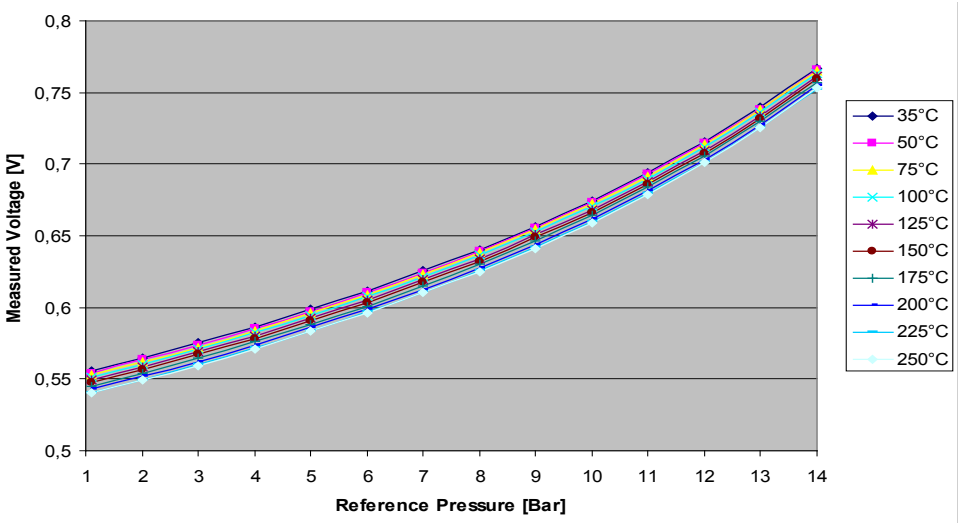
- Precise pressure measurements at temperatures up to 250 °C
- Compact size and low mass
- High overload pressure
- Internal amplification
- Low power consumption

## SOI CMOS pressure sensor

A MEMS pressure sensor option has been integrated into the Fraunhofer IMS 1µm High-Temperature SOI CMOS process. The pressure sensing element consists of a polysilicon diaphragm over a conducting active area forming a capacitor whose capacitance depends on the deflection of the diaphragm which is proportional to the applied input pressure. The monolithic integration of the sensor with signal conditioning circuits on a single chip reduces the influence of external noise sources on the sensor output signal and allows a variety of output options.

## Applications

The small size, the low power consumption and the high temperature capability allows for high quality pressure measurements in locations where other sensors will not work. The sensor can be used for uninterrupted, long lasting pressure monitoring in high temperature applications like geothermal wells, offshore drilling, automotive, aerospace and nuclear power applications with temperatures up to 250 °C.




## Sensor characteristics

Figure 4 shows the temperature and pressure dependence of the high temperature pressure sensor. The table below summarizes the specifications of the sensor system. The characteristics listed here are derived from a basic MEMS pressure sensor chip with no onboard linearization or temperature compensation. In this case linearization has been done by software with a 4th order polynomial for the pressure and 2nd order for the temperature dependence. The advanced MEMS pressure sensor chip provides a calibration table for programmable linearization and temperature compensation.

## High temperature packaging

When dealing with high temperature electronics packaging is another issue as standard polymer-based techniques fail. IMS has developed a novel reliable and cost effective technique allowing die bonding and glob topping without the need for expensive vacuum packages.

## IMS services

The competences of Fraunhofer IMS in the field of high temperature sensor systems are the development and series-production of MEMS including the implementation of further on-chip functionalities like programmable linearization, temperature compensation, combined with EEPROM for the on-chip storage of calibration data by the monolithic integration of electronic circuit components in addition to the pressure sensor cells on one single chip. A modern 8'' fab working at four shifts ensures the production of the microchips.

| | | |
|---|---|---|
| Pressure Sensor Type | | Capacitive |
| Measuring ranges | Bar | Design controlled, full scale from ambient pressure to 70 Bar (higher pressure ranges on request) |
| Overload | Bar | 3x of maximum of measuring range (higher overload on request) |
| Supply Voltage | VDC | 4,5…5,5 |
| Power Consumption | mW | <1,5 |
| Output Signal | V | Analog or digital, adaptable to nearly any standard output range by design |
| Min. / Max. Temperature | °C | -40 / 250 (tested 35-250 °C) |
| Hysteresis (35-250 °C) | %FSO | <0,7 |
| Thermal zero shift (35-250 °C) | %FSO | <0,5 |
| 1 σ- Noise (35-250 °C) | %FSO | <0,5 |
| Measurement Error (35-250 °C) | %FSO | <0,6 |
| Response Time | | <300 µs |
| Weight | g | 0,01 |

3 *High temperature application*

4 *Sample of sensor output*

5 *Table of sensor characteristics*