A major problem associated with piezoresistive pressure sensors is their cross-sensitivity to temperature. Moreover, in batch fabrication, minor process variations change the temperature characteristics for individual units. An important economic implication for the success of smart sensors is the use of batch fabrication techniques to bring down the cost of individual units. This research fulfills this need by developing a new temperature compensation technique suitable for batch fabricated sensors for a temperature range of -40°C to 130°C over a pressure range of 0 to 45 psi. Hardware for the implementation of the technique and digitization of sensor output is also developed.

The sensor model is developed from the viewpoint of simulating the sensor I/O characteristics as a function of pressure, temperature, and processing variations. The model includes the effects of temperature, resistor mismatch, and appropriate structural details. The simulation results provide the worst case error band for sensors coming from the same wafer or different wafers. All sensor parameters are functions of temperature and the tracking errors.

The temperature compensation technique is implemented in two parts, using a compensation bridge and a temperature half bridge. The zero pressure offset is reduced below the measurement precision limit for the entire pressure and temperature range. For the sensor output, the technique is very effective for the pressure values below 35psi and provides reasonable results for higher pressures. The possible use of a software approach to implement part of the compensation technique is also discussed.

The hardware for the amplification, temperature compensation, and the digitization of the sensor output has been designed and verified. A dual slope A/D conversion has been identified as a simple and precise conversion technique, suitable and compatible for on-chip integration with the sensor. The bipolar dual slope ADC with a word length of 10-bits and the clock frequency of 50 KHz has been designed and verified.

The temperature compensation technique is suitable for batch fabrication. More over, it does not require compensation of individual units under sensor operating conditions. The resulting interface circuit is simple, requiring modest chip area. It can be implemented using standard IC fabrication techniques.

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