The Correction of Temperature Error of Pressure Piezoelectric Sensors for Space Technology Products

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Abstract. The article presents the questions of correction of temperature error of piezoelectric pressure sensors in conditions of transient temperature and thermal shock. It is noted that when the piezoelectric pressure sensor is operating in thermal shock conditions, it is important to measure the main parameter by means of the piezoelectric sensor: the pressure and piezoelectric element temperature at a single point of space and at the same time to eliminate the influence of the temperature gradient. That makes difficult to use additional sensors to measure the temperature of operating environment. It is proposed to use the impedance parameters of working and vibrocompensation piezoelectric elements as information source about the temperature of piezoelectric elements. The scheme of secondary transmitter of output signals of working and vibrocompensation piezoelectric elements is presented; its description and algorithm for obtaining the correction signals are described. The results showed that the change of the conversion efficiency of the pressure piezoelectric sensor of the piezoelectric elements form the PZT-83G piezoelectric material in the range of -180 to $+200\,°C$ is approximately $35\,\%$. Moreover, time dependence of output signals from the working and vibrocompensation piezoelectric elements of the pressure piezoelectric sensor when exposed by thermal shock of liquid nitrogen is presented. It is shown that using the proposed correction method of measurement errors from the transient temperature of operating environment can reduce measurement error of dynamic pressure from the thermal shock.

Key words: pressure sensors, piezoelectric element, temperature error, membrane, equivalent circuit, impedance, conversion efficiency