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A Harsh Environment Wireless Pressure Sensing Solution Utilizing High Temperature Electronics

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Introduction

A pressure dimension beneathneath harsh environment, specifically at excessive temperatures, is of wonderful hobby to many industries. The applicability of modern stress sensing technology in severe environments is confined with the aid of using the embedded electronics which cannot live to tell the tale past 300 °C ambient temperature as of today. In this paper, a stress sign processing and wi-fi transmission module primarily based totally at the modern-day Silicon Carbide (SiC) gadgets is designed and developed, for a business piezoresistive MEMS stress sensor from Kulite Semiconductor Products, Inc. Equipped with this superior excessive-temperature SiC electronics, now no longer best the sensor head, however the whole stress sensor suite is able to working at 450°C. The addition of wi-fi capability additionally makes the stress sensor greater bendy in harsh environments with the aid of using doing away with the high-priced and fragile cable connections. The proposed method becomes confirmed via prototype fabrication and excessive temperature bench trying out from room temperature as much as 450°C. This novel excessive-temperature stress sensing era may be implemented in real-time fitness tracking of many structures regarding harsh environments, which includes army and business turbine engines.

Pressure dimension has been one of the number one measurements of hobby to engineers and scientists for centuries, seeing that Evangelista Torricelli used a tube of mercury to degree the stress of air in 1643. Originally, the stress becomes measured with the aid of using mechanical methods, which become steadily changed with the aid of using electric powered dimension approaches. Due to the non-stop development of micromachining era in ultimate decades, Micro-Electromechanical System (MEMS) sensors commenced gambling a first-rate position in stress dimension. Nowadays there are numerous forms of stress sensing technology for specific applications, which includes capacitive stress sensors that make use of a diaphragm and a stress hollow space to create a variable capacitance; piezoelectric stress sensors that make use of the piezoelectric impact in a few substances to degree the stress because of stress; Surface Acoustic Wave (SAW) stress sensors that make use of the segment speed variant of floor acoustic wave on piezoelectric substrate whilst stress is implemented; optical stress sensors wherein the traits of optical sign which includes intensity, polarization, segment or spectrum are modulated with the aid of using the stress stimulus; and the maximum usually used piezoresistive stress sensors, for which the resistance of the piezoresistive cloth may be altered with the aid of using the stress implemented on it.

In commercial applications, many structures that perform at excessive stress additionally are afflicted by different harsh situations, which include excessive temperature, excessive radiation, chemical corrosion, etc. Among them, the nearest dating is fashioned among excessive temperature and excessive stress, because the stress of fueloline is immediately proportional to the temperature. The necessities of measuring stress at severe environments, which can be usually visible in inner combustion engines, fueloline turbines, oil wells, etc., spark off the improvement of superior harsh surroundings stress sensing technology with new substances. Silicon Carbide (SiC) primarily based totally piezoresistive and capacitive stress sensors for excessive-stress (1,000 psi) dimension at temperatures as much as 600°C had been studied, at the same time as polycrystalline diamond will also be used for excessive-temperature stress sensor fabrication. However, those forms of sensors usually have low sign outputs and require considerable embedded sign conditioning electronics. The temperature predicament of silicon electronics is best 150°C (after unique excessive-temperature treatment), therefore the applicability of those sensors in harsh environments is significantly confined. Major stress sensor manufacturers, which includes Honeywell International, Inc., (Morristown, NJ, USA) and Kulite Semiconductor products, Inc. (Leonia, NJ, USA) begin enforcing and incorporating begin-of-artwork excessive-temperature silicon-on-insulator (HTSOI) era into their excessive-temperature stress sensors, which elevates the temperature restrict of the incorporated electronics as much as 300 °C.

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