National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Sensors

Capacitive Pressure Sensor System and Packaging

Proven system provides in-situ data acquisition in extreme conditions

Innovators at NASA's Glenn Research Center have developed a state-of-the-art packaged capacitive pressure sensor system that provides in-situ dynamic data acquisition in harsh operating environments. Designed to monitor jet turbofan engine health, this pressure sensor can be placed directly on the engine for highly accurate, real-time data analysis. Another unique feature of this simply designed system is that it can be fitted with an antenna to transmit data wirelessly. This smart sensing technology has undergone extensive testing in extreme environments and is expected to play a key role in the development of a suite of next-generation maintenance and monitoring systems. This important sensor system and packaging can provide more accurate data, improve performance, and extend the service lifetime of commercial and military aircraft, automotive engines, power plants, and more.

BENEFITS

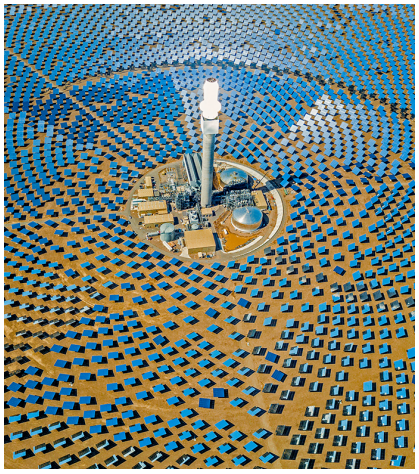
- Compact: The first of its kind to achieve high-temperature capability and maintain miniaturization
- Efficient: Maintains a strong signal (97 to 117 MHz) that can be transmitted wirelessly
- Robust: Can withstand a pressure range from 0 to 350 psi and a temperature range from 25°C to 500°C
- Durable: Extends the operational lifetime of key components by enabling closed-loop control
- Proven: Passed acceptance temperature, pressure, and vibration testing at 515°C, 295 psi, and 5.3 G, respectively, in an on-wing operating engine

THE TECHNOLOGY

Pressure sensors play an important role in engine maintenance and monitoring systems by diagnosing problems before they happen. To capture the most accurate data, however, these sensors must be placed directly on an engine. In order to withstand extreme temperature and vibration, traditional pressure sensor technologies are bulky and complex, lacking the on-board control of microsystem technologies. Glenn's new capacitive pressure sensor system and packaging is the first of its kind to achieve high-temperature capability while maintaining miniaturization.

This novel system consists of a Clapp-type oscillator that is fabricated on a high temperature alumina substrate. It comprises a silicon carbide (SiC) nitride pressure sensor, a metal-semiconductor field-effect transistor, and one or more chip resistors, wire-wound inductors, and SiC metal-insulator-metal (MIM) capacitors. The pressure sensor is located in the tank circuit of the oscillator so that a variation in pressure causes a change in capacitance, thus altering the resonant frequency of the sensing system. The chip resistors, inductors, and MIM capacitors have been characterized at temperature and operational frequency, and exhibit less than 5% variance in electrical performance. The system, which can be installed with a borescope plug adaptor in an on-wing operating engine, has been extensively tested and proven to operate reliably under extreme conditions. Its compact size, wireless capability, and ability to provide real-time in-situ data acquisition make this technology a game-changer in next-generation maintenance and monitoring systems.

This pressure sensor system could be used for automotive engines and exhaust monitoring



This sensor's high-temperature capability makes it a prime candidate for energy generation monitoring systems

APPLICATIONS

The technology has several potential applications:

- System monitoring
- Aerospace
- Power
- Oil and gas
- Automotive
- Environmental monitoring
- Industrial processes
- Military
- Sensors

PUBLICATIONS

Patent No: 10,378,986

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NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

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