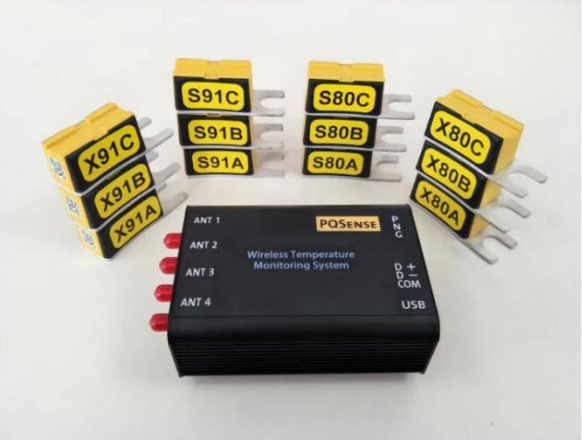
Surface Acoustic Wave (SAW) vs RFID Temperature Monitoring System for Switchgear

Continuous Temperature Monitoring is Important for Switchgear Safety

Monitoring temperature in switchgear equipment is a reliable method for predicting and preventing failures. To safely and continuously monitor temperature of switchgear equipment, it is important for the monitoring solution to be wireless and battery-free.

Going with RFID Solution is the Smart Thing to Do

In this article, we describe how RFID Solution meets all these requirements and more, significantly outperforming traditional solutions designed around SAW sensors.



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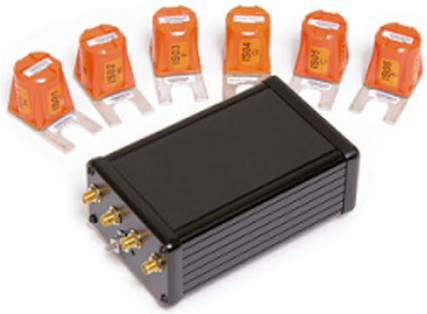

SAW Sensor System

RFID Solution comprises of a reader hooked up to antennas that wirelessly communicate with our wide assortment of sensors, all of which are battery-free.

How is RFID Solution Better?

1. ### Wider Range in the Sensor Form Factor

   RFID temperature sensors come in a variety of shapes and attachment mechanisms to allow them to be lug-mounted or adhesive-attached to busbars, cable heads and contactor assemblies. This customization of form-factor allows RFID sensors to make better contact with the switchgear equipment thus allowing for accurate temperature monitoring.

The sensors in a SAW-based temperature monitoring system tend to have a single form-factor, which is bulkier and not as low-profile as RFID sensors. This makes SAW sensors unsuited for critical locations like cable heads and contactor assemblies. This greatly limits coverage within the switchgear assembly and reduces the efficacy of the solution.

2. ### Higher Number of Uniquely Addressable Sensors

   Switchgear cabinets typically require 20 to 30 sensors to provide sufficient coverage of all critical locations in the equipment where temperature is likely to rise. RFID temperature sensors can be uniquely identified using a 128-bit electronic product code (EPC) that can be programmed onto the

sensor post-production. This allows for a sufficient number of sensors that can be uniquely addressed, without having to manufacture each sensor differently.

Each SAW sensor needs a unique backscatter pattern to distinguish it from other SAW sensors. Based on the sensor material and design characteristics, each sensor must be manufactured with a different backscatter pattern, allowing only a finite number of tags to be uniquely identified. This greatly limits the number of sensors that can be used in a switchgear solution. Most leading SAW-based solutions provide up to 12 sensors for each reader antenna. Increasing the number of SAW sensors requires increasing the number of antennas and/or readers thus bringing up the total cost of the installation.

3. Robust and Efficient Communication Protocol between the Reader and Sensors

The communication link between RFID sensors and the reader is digital and is based on a digital protocol. There are error checking mechanisms in place which prevent transmission errors caused due to electrical transients or interference from other sensors within the same cabinet or outside. The protocol also allows communication mechanisms where only a select group of sensors can respond to a reader command. This reduces the number of read commands and improves throughput.

SAW sensors communicate with the reader by frequency modulating the RF signal. This analog communication is subject to false positives from events that may produce high-frequency transients (like arcing in a switchgear cabinet, or simply turning switches on or off). Due to the limited number of backscatter patterns available with SAW sensors, interference between sensors placed in different cabinets is common. This further complicates the installation procedure and limits the efficacy of the solution.

4. Smart Features on the Reader

In addition to the temperature reading, RFID temperature sensors also report back a Received Signal Strength Indicator (RSSI). The reader can use this to qualify the temperature reading (by rejecting the reading from those sensors that have an out-of-bounds RSSI). Further, the reader can probe an RFMicron sensor multiple times in a short span of time (on the same frequency band or several) and average these readings to reduce numerical noise and improve precision.

These features are notably absent in SAW-based solutions.

5. Diversity of Applications beyond Switchgear

Besides the switchgear industry, medical and cold-chain applications require temperature monitoring as well. These applications may require monitoring the temperature of a water bath, a box of fruit or a vaccine vial.

By separating the sensing element and the antenna, RFID sensors can monitor temperature while being immersed in a liquid. Our reel-to-reel manufacturing process and extremely small die size allows a sensor to be fabricated on a thin film substrate (like PET). This technique produces a flexible and low-profile sensor inlay that can be inserted in labels, wrapped around bottles or taped to boxes. This allows us to meet the temperature monitoring needs of many industrial, medical and automotive applications besides switchgear.

SAW devices are not suited for applications requiring temperature monitoring in liquid environments because the SAW is completely damped out due to energy loss in the liquid. Also, since SAW sensors require a rigid piezoelectric substrate, they cannot be wrapped around a test-tube or taped to a bag.