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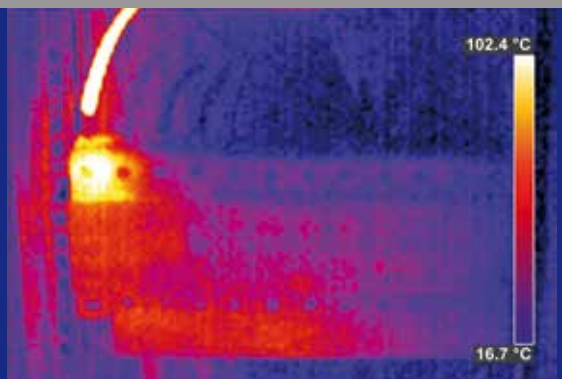

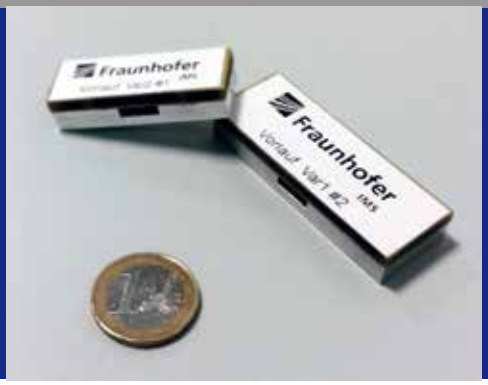

1 *Unwanted heating caused by faulty electrical contact*
2 *RFID-Transponder with temperature sensor*

WIRELESS TEMPERATURE MONITORING SYSTEM

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Remote monitoring is crucial for distributed production and infrastructure components because it is a prerequisite for a productive, high quality and faultless overall operation. Among various monitoring parameters such as strain, pressure, vibration, etc., temperature is one of the most critical factors to evaluate the reliability and safety status of indispensable components.

Wireless temperature monitoring systems imply easy and cost saving installation on moving and static elements. Battery-free sensors ensure reduced maintenance requirements while enabling a low-cost and low-weight mechanical construction.

Electrical cabinets represent a typical example of critical infrastructure components. Most of the fire events in electrical cabinets are caused by faulty electrical contacts. A fire causes a long-term breakdown of the system. However, in industrial environments a reliable electrical energy supply is indispensable. The thermography picture (Figure 1) exemplifies the unwanted heating of a faulty connection in a cabinet. Due to electro-chemical reactions or mechanical influence – for example vibrations - the contact resistance may increase over time with a significant temperature rise. If the critical temperature for structural integrity of used plastic components is exceeded, a fire will be the consequence. The reason for faulty contacts is very often an improper installation mainly due to incorrectly pressed lugs or screws with incorrectly tightened torque, for example. Unfortunately, this effect cannot be observed visually. Thermography pictures do represent snapshots at best and do require on-site deployment of personnel. Hence a fault of a cabinet cannot easily be foreseen and prevented. Continuous temperature monitoring of cabinets prevents these fire events and hence increase safety and reliability of electrical energy supply.

The solution developed by Fraunhofer IMS is an RFID temperature monitoring system (Figure 2). RFID transponders are enhanced by

temperature sensors and placed at electrical contacts. The RFID transponders operate battery-less by harvesting energy from the RF field of the reader. Therefore, these sensor transponders can be made inexpensively and maintenance free, providing the basis for a reliable wireless temperature sensing of electrical contacts. A reader system installed in the cabinet enables the automatic acquisition of sensor data. Multiple RFID transponders can be tracked simultaneously. A smart reader antenna placement prevents communication holes and ensures the readout of all RFID transponders distributed within an electrical cabinet.

Figure 3 shows the system topology. It is composed of the RFID transponders with integrated temperature sensor, reader antennas connected to a reader unit via a multiplexer and a single board computer connected to the internet. A customized web service application implemented on the single board computer is provided with temperature and identification data by an abstraction layer using IP communication. Various options for remote visualization and data processing are feasible.

Key features

- Increase of reliability and safety of electrical cabinets
- Continuous monitoring of critical electrical connections
- Remote readout via internet or cloud based services
- Early prevention possible by alert function in case of temperature increase
- No on-site maintenance necessary anymore
- Easy to upgrade an existing cabinet

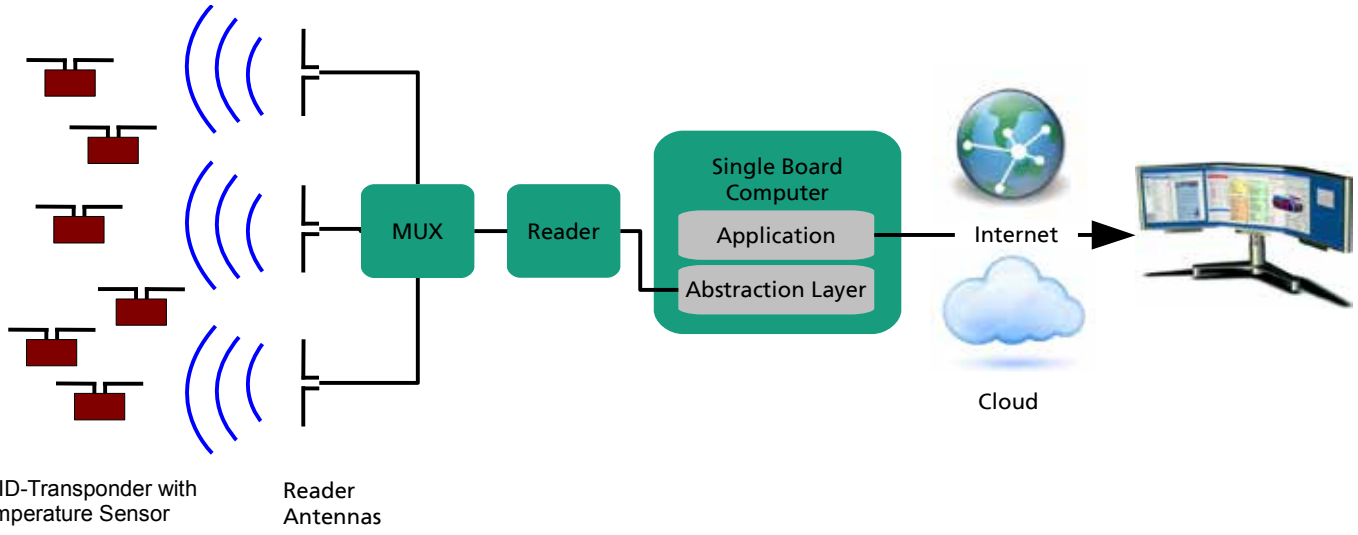
Specifications

Depending on the environment the typical system specifications are:

- 60 transponders or more
- -20 °C up to +85 °C
- readout range app. 50 cm
- size of the tags: a few cm
- measurement rate depending on number of transponders, e.g. 50 tags/sec

Additional applications

Of course the use of RFID temperature transponders is not limited to the electrical cabinet application. They can also be applied to critical components of industrial facilities, for example bearings, pumps, gears, which may overheat by defect or wearing. Thus fire can be prevented and the requirement for maintenance can be indicated. Especially in cases of rotating and moving parts RFID based solutions are predestined.



3 *Remote cabinet monitoring system*