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1 *UHF transponder reader mounted at the truck chassis.*

2 *UHF tire pressure sensor transponder mounted at the truck rim.*

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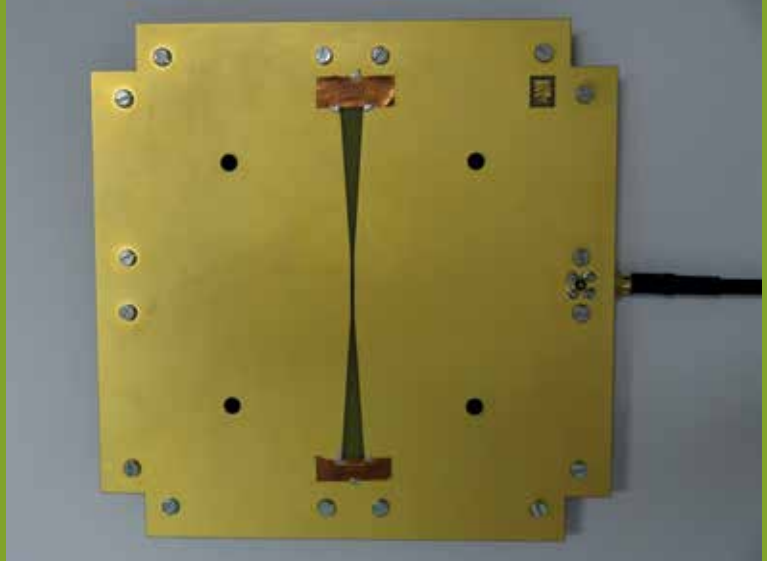
UHF PASSIVE PRESSURE & TEMPERATURE MONITORING – SELF-SUFFICIENT RFID SENSOR TRANSPONDERS

Introduction

Scientists at the Fraunhofer Institute for Microelectronic Circuits and Systems in Duisburg are combining RFID technology with smart sensors to create new applications for modern transponder technology. Similar to traditional identification tags, the new transponders contain a microchip and an antenna or a coil. One or more CMOS (Complementary Metal Oxide Semiconductor) sensors can be integrated on the same chip to measure environmental conditions such as pressure or temperature. Measurement data are sent to a base station or reader for further processing (fig. 1). Passive Transponders do not require batteries or solar cells. The tags are smaller, cheaper and have a longer life span than active, battery-powered solutions. A number of passive systems have been successfully developed at Fraunhofer IMS. Applications include medical implants for the measurement of pressure or temperature. Solutions have also been developed for automotive applications, like the measurement and monitoring of tire pressure. These systems operate in ISM (Industrial Scientific Medical) bands at low and intermediate frequencies (133 kHz, 13.56 MHz). Data and energy transfer takes place in the magnetical near field of the reader.

Advantages

The operating range can be significantly improved to several meters by using electromagnetical waves at UHF (Ultra High



Frequency) frequencies for the energy- and data transfer. Another important advantage of using UHF frequencies is the higher data rate. A large number of tags can be addressed within a short timeframe. All components are integrated on a single CMOS chip (except for the antenna), so the transponders are very small and light. The monolithic integration of all components also reduces the cost of the tags high-volume production. The extended range enables an easier implementation in applications.

Applications

Monitoring of cold chains in the field of medical transports or food logistics are two examples of a successful combination of RFID technology and sensors for the logistics sector. A small number of readers are installed in containers, trucks and warehouses. Because of the improved range and data rate, a large number of tags can be addressed. The temperature at the exact location of each sensitive product is monitored. When a critical temperature is detected in one of the products, this temperature and a timestamp are saved in the reader. An alarm signal can be triggered on demand.

Another example is the measurement and monitoring of pressure and temperature data in truck tires with UHF sensor-transponders.

Truck tire pressure monitoring system

To increase the safety in road traffic, the automatic monitoring of tire pressure makes a significant contribution. In the upscale segment of cars such systems are already state of the art. Trucks with a significantly lower driving speed have a much higher tire load due to their payload. This potentially high risk makes it necessary to measure and monitor the pressure and temperature of truck tires. As an open system, it should be standard compatible, for UHF transponders this is the ISO 18000-6C standard. For the system realization a special energy budget and also a link budget, which include for example the influence from the metal tissue integrated in the truck tire and the wheel spin must be prepared for energy harvesting and communication. The system must be able to harvest and store the energy over some time from the RF field to ensure the energy demand from pressure sensor and transponder. The real challenge for such a system has been the readability of a truck's twin tires. Figure 2 shows such a transponder which has been developed for the monitoring of truck tires. This transponder is adaptable to other applications where pressure and temperature must be wirelessly and self-sufficiently monitored.

Temperature monitoring in cabinets

Furthermore, such technology can solve the problem of extensive cabling for temperature monitoring in cabinets.

The bolted joints of bus bars, can deteriorate over time, which manifests itself in an increasing contact resistance. A direct consequence are rising temperatures on the transition resistors. In the worst case, this can cause a fire in the control cabinet. Small UHF transponders with integrated temperature measuring, which are placed near such hot spots, detect the rising in temperature long before the risk of a burning cabinet exists. For such a system, simply an additional ISO 18000-6C standard compatible UHF reader device with antenna has to be mounted. Figure 4 shows the small form factor UHF transponder for hot spot monitoring in cabinets.

3 *UHF reader antenna for high power radiation.*

4 *UHF sensor transponder for cabinet monitoring.*