In the Cloud with RFID Sensor Technology
RFID Technology

Radio Frequency Identification (RFID) provides the contact-less electronic identification of objects and goods as well as living beings. RFID makes it possible to implement purely passive (battery-free) identification systems in which both the data transfer as well as the transponder (tag) power supply are wireless. The energy required to operate the transponder is taken from the magnetic or electromagnetic field of the reader. By adding an active power source with the help of batteries, the transponders can be strengthened to increase distance ranges. Compact and dirt resistant, RFID is not dependent on lighting situations and is able to simultaneously detect many tags. Applicable systems data can be electronically placed directly in the labeling elements, making RFID an excellent tool for documenting the origin and movement of goods.

Sensor Transponder

RFID technology is mainly applied in the area of logistics, traditionally used to identify objects, good or commodities. Modern industrial applications also often require the wireless measurement of physical parameters such as temperature, humidity, light and pressure with the help of sensor technology. This is especially the case when the use of cable connections is not possible due to inaccessible locations and moving or rotating parts. In such situations, passive RFID sensor transponders provide a viable solution by combining extremely energy-efficient sensor technology with standards-based RFID protocols. The energy needed to measure sensor values is completely delivered via commercially available RFID readers.

Because of their high energy needs, active wireless systems usually rely on replaceable or rechargeable batteries for additional energy storage. In this context, there is always the question of maintenance costs incurred with either replacing or recharging energy stores. Taking energy directly from the field of the reader, passive RFID sensor transponders are, in contrast, completely maintenance-free and, with a virtually unlimited service lifetime, can be incorporated into inaccessible places.

For years, Fraunhofer IPMS has been working on its own RFID transponder circuits for different frequencies. These ASICs are characterized by a flexible interface concept for external sensor technology, making it possible to integrate almost any analog or digital sensor. Fraunhofer IPMS develops customer-specific RFID sensor transponders based on both its own and commercial RFID circuits. Sensor technology, the electronic circuitry and the antenna geometry are adapted to the special needs, deployment scenarios and environmental parameters of customers and research partners. Due to years of experience and broad expertise, Fraunhofer IPMS is able to provide specialized solutions such as complex designs or transponders on metallic substrates in different quantities.
RFID sensor tags for detecting moisture, light, temperature and pressure.

**Fraunhofer IPMS RFID Sensor Technology Development Examples**

**Measuring contact temperature in the control cabinet**
Taking temperatures of connecting screws on power rails in control cabinets can provide information on their condition and allow long-time monitoring to be conducted. Wireless temperature recording can be carried out in cabinet areas that must otherwise be measured in a turned-off state. This system can identify malfunctions early and reduce downtimes for maintenance work.

**Measuring moisture in construction**
Introduced directly into building materials, sensor transponders developed by Fraunhofer IPMS can be used for punctual, wireless measurement of moisture in walls, roofs and streets. These systems assist in the documentation of drying processes and water damage. Integrated transponders are used to identify components, store additional information and can be read as passive sensors for many years.

**Counting hours of operation**
Controlling and monitoring the length of time a device is in operation provides important information on utilization. Actual operating time is also key for calculating and adhering to service intervals. The Fraunhofer IPMS operating hours counter with RFID interface allows for the control to monitor the operating voltage of a device. Information about actual operating hours is read via the RFID interface, without the device having to be switched on.

**RFID pressure sensor**
RFID pressure measurement systems based on the Fraunhofer IPMS sensor transponder provide, for example, the wireless detection of pressure conditions in machinery and equipment. The advantage of such a system lies in the ability to access measurement values at several positions without problematic cabling. Maintenance free operation is thereby ensured for many years. Data is used to optimize both plant and process control, increase the service reliability and support a tailored maintenance strategy.
**IPMS ROAD Server**

The integration of new RFID components into existing or to-be-established process environments is usually associated with considerable installation time and costs. Readers as well as identification and sensor transponders differ substantially according to manufacturer, frequency band used, protocol, interface and sensor so that they cannot be readily combined with one another.

The OPC UA (Open Platform Communication Unified Architecture) AutoID Companion Specification was created as an industry standard to simplify the integration of AutoID devices in professional process environments. The Fraunhofer IPMS RFID OPC UA AutoID server (ROAD server) middleware offers a new software solution. This follows the OPC UA AutoID Companion Specification for RFID components to enable a vendor-neutral, standards-based communication within automation technology. The ROAD server offers the advantage of using standard readers as well as identification and sensor transponders from different manufacturers in various frequencies (LF, HF, UHF, and NFC). ROAD server recognizes the reader and transponder types and autonomously implements suitable control to allow the user to access the transponder and to read the ID, memory and measured values via a standard interface. The user must therefore no longer be concerned about readers, transponders and sensors on either an electronic or protocol level.

Building upon this single fundamental framework, Fraunhofer IPMS supports the design and implementation of customized software solutions. This includes intuitive solutions for simple data acquisition, customized applications for mobile operating systems, integration of data acquisition and control in industrial environments as well as professional cloud applications. Fraunhofer IPMS has the expertise needed to appropriately analyze large amounts of data obtained over long-term measurements and to convert this data into information on process conditions.

**Features**
- Simple integration of AutoID devices in OPC UA environments
- Unified interface for any RFID reader, hardware, identification or sensor transponder
- Supports LF, HF, NFC and UHF
- Access to measurement readings, events and historical data of sensor transponders

**Included in package**
- ROAD server
- Driver libraries of supported readers
- Sample application (client) with source code
Fraunhofer IPMS offers complete customer-specific solutions and services encompassing RFID ASICs, RFID sensor technology and middleware for RFID manufacturers, suppliers and system integrators. Fraunhofer IPMS covers the complete value chain from circuit design to software integration in complex industrial applications, all from a single source.

Fraunhofer IPMS services include:

- Problem analysis and concept development
- Development of application-specific RFID circuits
- Calculation and simulation of custom antenna geometries
- Adaptation to specific applications such as small geometries, exotic substrates, metallic surfaces and 3D integration
- Development of energy-optimized firmware to sensor-close signal processing
- Development of customer-specific sensor transponders
- Construction and testing of sensor systems
- Extension of conventional sensors by IoT interfaces
- Extension of AutoID devices by OPC UA interfaces
- Integration of RFID components into existing software environments
- Development of individual software solutions in the RFID environment, including analysis and evaluation of sensor data
- Development of applications for mobile operating systems and cloud solutions
Short Profile

Based in Dresden, Fraunhofer IPMS is your research and service partner in the fields of optical sensors and actuators, integrated circuits, micro-systems (MEMS/MOEMS) and nanoelectronics. As one of the currently 67 independent institutes making up the Fraunhofer Society for the Promotion of Applied Research, the leading European organization for near-industrial research, our approximately 280 scientists work together with both private industrial and service companies as well as the public sector in projects to directly benefit business and society. To meet the high standards of our customers, Fraunhofer IPMS is certified by DEKRA in accordance with DIN EN 9001:2008 for the research, development and manufacturing of microsystems, respective semiconductor and microsystems processes as well as integrated actuators/sensors.

Fraunhofer IPMS supports companies in realizing their innovative ideas in the area of wireless data acquisition using RFID sensors with consulting, concept development, specification and implementation. Fraunhofer IPMS has extensive experience in application-oriented research and development, especially in the areas of analog and digital circuit design, antenna design and sensor integration as well as system integration in modern industrial architecture. We further provide ultra-modern metrology for the characterization of transponder circuits. Fraunhofer IPMS is therefore able to offer complete and comprehensive assistance from idea to prototype production and pilot series.