Integration of a Passive UHF RFID into a Metallic Package

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The demand for RFID's in the industrial environment is growing, especially for real-time tracking applications, in harsh conditions, with the aim of improved reading speed. RFID tag's operating in such harsh environments (e.g., metallic surface or even metallic box) require smart antenna design and integration. The integration of a passive UHF RFID into a metallic package is described in the report.

RFID is an identification technology with many potential applications in the domain of contactless object monitoring and tracking. The most common COTS RFID tags, like many barcodes, are self-adhesive labels. Unlike the barcode, where the information is stored in a graphic form, the data on a RFID label is recorded in a circuit, which is read by reader using magnetic or electromagnetic (EM) waves.

For data transmission, passive RFID tags use the energy of the reader EM field. The principle of an RFID communication system is presented in the following block diagram in Figure 1.

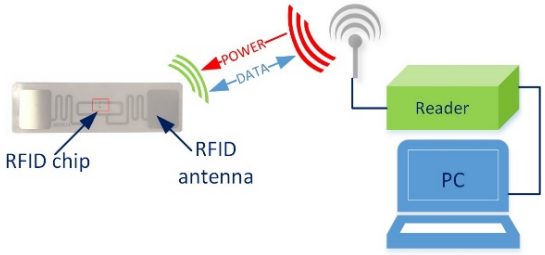

Figure 1: Basic RFID communication system blocks.

An RFID reader does not require direct visibility of the tag in order to read its data. In case of circular polarized reader antenna, the tag orientation also does not matter. Tags may be read through the packaging, which makes hidden placement possible. By comparison, a barcode reader requires direct visibility of the barcode for reading.

RFID systems can be distinguished by their operating frequency ranges (*e.g.*, LF, HF, UHF and microwave). Our focus is on an UHF RFID solution operating at 868 MHz (Europe) and 915 MHz (USA). Passive RFID tags can be detected at a distance up to 10 meters, depending on the radiated power of the RFID reader and the architecture of the tag.

Real-time tracking of goods may be performed in the warehouse or upon delivery. This allows the reception and shipment processes to be accelerated, reliability and transparency of operations are increased, and the influence of the human factor is reduced. Beyond tracking of goods, RFID solutions can provide protection against theft of products or even implement counterfeiting solutions. They may be used as a smart device with sensor functionality, *e.g.*, analog to digital conversion and timer. Some RFID tags even have a built-in microcontroller enabling a wide range of applications.

Today though, a very small number of available RFID tags can operate in harsh environments (*e.g.*, metallic surfaces, metallic construction). These tags are bulky and have a predefined size. This makes it difficult or even impossible to use them in a confined space. One of the reasons for the predefined size is the antenna. The antenna is very important part of the RFID system. A non-optimized or detuned antenna can drastically degrade the system performance (*i.e.*, tag reading range).

The aims of this work are: 1) to integrate an UHF RFID tag into a metallic case without mechanical or structural modification of the case, and 2) to verify the conditions and limitations of the approach, as well as, the other exploitable properties with respect to the targeted applications.

A cylindrical metallic container or box (50 mm in diameter x 60 mm height) is used for the demo. The top cover of the container is detachable. The EM Microelectronic EM 4325 FID chip is located inside the top cover of the metallic box as presented in Figure 2. Two wire antennas with optimized lengths are connected to the tag and to the top cover of the metallic box as presented in Figure 2.

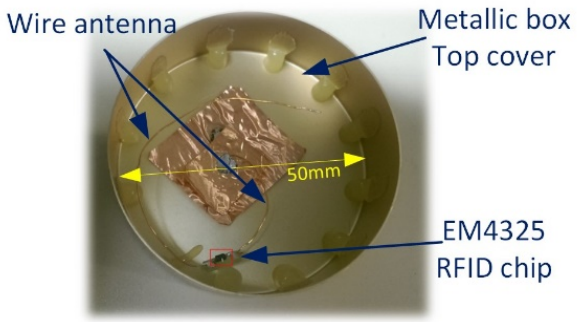

Figure 2: RFID tag and wire antennas location in the metallic box (top cover).

The proposed configuration allows the metallic box to be leveraged as part of the antenna. As a result, the reader with 200 mW output power can easily read the tag at a distance of about 60 cm (see Figure 3).

An additional metallic strip line, as presented on the photo (Figure 3) can further improve the communication range and add a security feature. The RFID tag will not work if the metallic strip is broken due to the box opening.

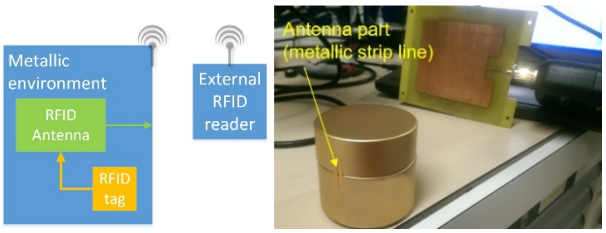

Figure 3: Block diagram of the RFID in the metallic box solution and implemented solution under laboratory test.

A passive UHF RFID was successfully integrated into a metallic package. The approach can be easily translated to much smaller metallic volumes, *e.g.*, 2 to 5 times the current tested volume.