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Reliability and Failure Analysis of UHF-RFID Tags for Harsh Environments Applications

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Abstract- Nowadays, the RFID technologies are used in many domains such as aeronautics, automotives, pharmaceuticals and smart cards [1-2]. UHF passive RFID tags are especially suitable for these purposes because they are inexpensive, compact, mechanically robust, and their read range is several meters [3].

Due to their numerous different applications, RFID tags may be exposed to various environmental conditions during their lifetime. Different stresses from the environment may affect the reliability of a tag. The environmental stresses may, for example, include high temperature or humidity levels, and mechanical vibration [4]. Accelerated environmental tests can be used to study the effects of environmental stresses on reliability of passive tags [5-7].

In this work we have chosen to study the high temperature effect on the performance of passive UHF-RFID system. Therefore, a measurement bench was developed, and a thermal storage testing at various extreme temperatures (140 ° C, 160 ° C and 180 ° C) were made.

The results for the thermal storage test at a temperature of 160 °C are shown in Figure 1.

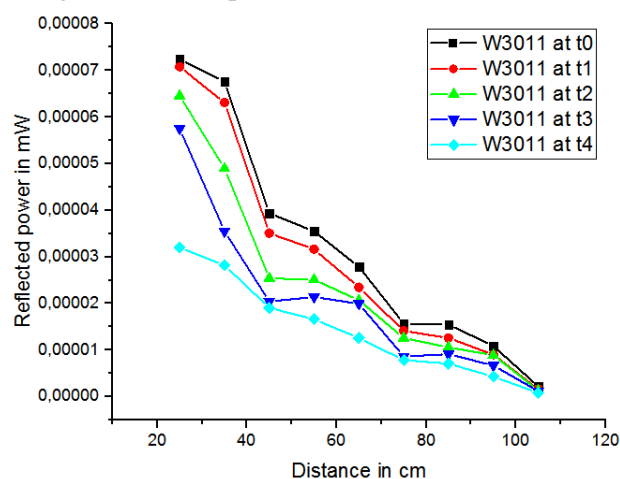


Fig.1. Reflected powers by the tag “W3011” versus distances for different aging times

The performance parameters of the tag are significantly changed during the tests, the reflected power decreases after each test which strongly influences the range of the tag.

Clear differences in the time to failure (TTF) depending on the selected temperature were observed. Statistical analyzes using the predicted reliability calculation tools are implemented to estimate the lifetime of this type of tag for nominal operating temperatures. Also a physical analysis of the aged tags, using the optical microscopy and SEM (Scanning Electron Microscopy), are implemented to reveal the failure mechanisms.

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