Evaluation of stand-alone RFID miniature antennas using the MST principle

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Evolution towards miniaturization of communication devices, leads to a significant reduction of the antenna electrical and physical sizes. Electrical reduction has a negative impact in bandwidth and radiation efficiency. Physical reduction implies significant measurement difficulties using the conventional antenna measurement equipment. RFID miniature antennas are comparable in electrical size to common test equipment, which perturb the normal behaviour of the antenna. Despite current methods can be considered non-invasive, there are still some limitations that hinder an accurate characterization of small antennas. The wheeler cup method requires the use of a metallic plane, being suitable for characterizing antennas with a ground plane (patch antennas). The transmission power budget method entails the use of a VCO connected to the antenna port, what perturbs the measurement when dealing with extremely small antennas.

The way to overcome the current limitations entails measuring the antenna under conditions that faithfully reproduce its actual working environment. Real RFID tag antennas operate on a receive/transmit regime. Such regime can be reproduced by measuring the scattered field created by the antenna when it is illuminated by an incident field. In order to relate this backscattered field to the transmit/receive parameters of the small antenna, it is necessary to differentiate it from the unwanted scattering of the background. Illuminating the small antenna with a calibrated antenna with transmitted power P_T and gain G_T, and using the Modulated Scattering Technique (MST), the signal scattered by the small antenna is modulated (with a modulation index α_m) by a photodiode, and a coherent detection in the receiver extracts the desired signal (modulated reflected scattering), P_R, from the noisy background (unmodulated reflected scattering). The antenna gain, G_{AUT}, can then be extracted from the measured parameters as:

$$\frac{P_R}{P_T} = G_T^2 \left(\frac{\lambda}{4\pi R} \right)^4 \alpha_m G_{AUT}^2 \qquad (1)$$

This paper details the novel non-invasive gain-efficiency measurement method based on the MST. Measurement results will be discussed and compared to those of wheeler cup and transmission power budget methods.

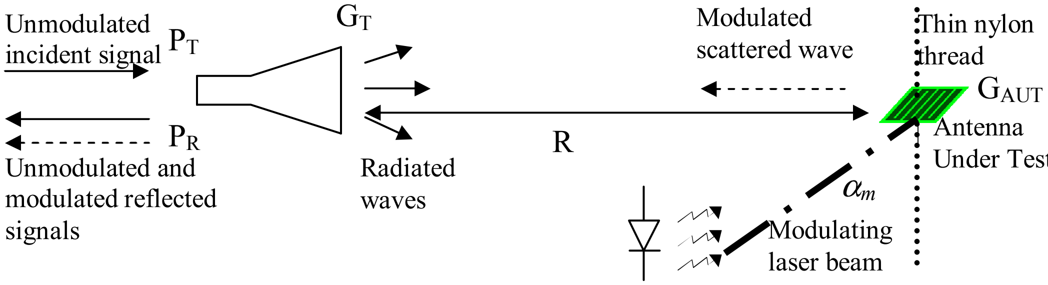

Figure 1: Measurement set-up for efficiency measurement using MST