Impedance characterization of RFID Tag Used in Near Field Communication

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1 Introduction

Radio frequency identification (RFID) is one of the most promising technologies for wireless identification system and sensor work system[1]. The power transmission coefficient of RFID tag is very important[2]. However, the influence of environment on tag antenna effects the input impedance of the antenna. In this study, RFID tags are placed on a two-dimensional communication sheet as a RFID reader antenna used in Smart-Shelf system to investigate the effect of the environment on tags.

2 Impedance Matching

A RFID tag consists of an antenna and a chip can be consider as an generator-load circuit with two complex impedance as shown in Fig. 1. The power transmission coefficient of the circuit τ is define as

$$\tau = 1 - |\Gamma|^2 = 1 - \left| \frac{Z_l - Z_s^*}{Z_l + Z_s} \right|^2 \tag{1}$$

where Z_l is the load impedance and Z_s is the source impedance. Therefore, the maximum power transfer to the chip when Z_l is conjugated with Z_s.

3 RFID Tag Analysis

A commercial RFID tag (SMARTRAC DogBone) is used in this study. The chip impedance is experimentally measured by using impedance analyzer and the input impedance of the tag antenna is numerically analyzed by using Method of Moment. The power transmission coefficient of the tag is shown in Fig. 2. It illustrates that the input impedance of the antenna conjugated with the chip impedance can achieve larger power transmission coefficient.

A RFID system can be considered as a two port network. The power gain of the system is shown in Fig. 3. It illustrates that the tag antenna should be designed with the reader antenna to reduce the influence of the environment on antenna input impedance.

4 Conclusions

In this study, the effect of the environment on the RFID tag antenna was clarified. The impedance of the tag chip was experimentally measured and the input impedance of the RFID tag antenna was numerically analyzed. It was shown that the RFID tag antenna design shown be consider the affect of the environment to achieve the maximum power transmission coefficient.

Reference

[1] C. R. Medeiros, et al., IEEE Antennas Propag. Mag., vol. 53, no. 2, pp. 39-50, Apr. 2011.

[2] C. R. Medeiros, et al., IEEE Antennas Wireless Propag. Lett., vol. 7, pp. 773-776, 2008.

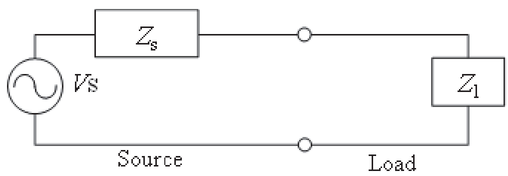

Fig. 1 Generator-load circuit with two complex impedance

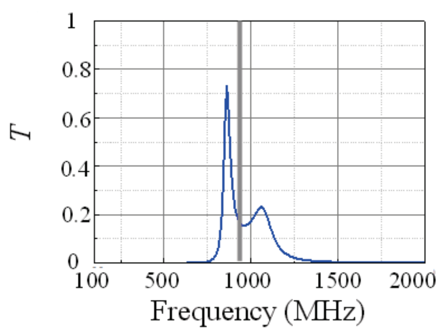

Fig. 2 Power transmission coefficient of tag.

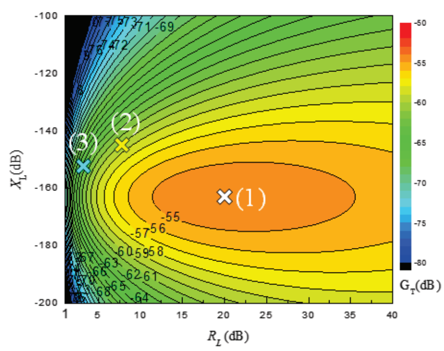

Fig. 3 Power gain of RFID system. (1)Tag on sheet, (2)measured chip impedance, and (3)conjugated tag impedance.