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Crab shaped Antenna for RFID Tag at UHF Band

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Abstract

A crab shaped tag antenna which has a better performance than conventional label type of tag antenna is proposed for UHF band RFID systems. The proposed antenna is a dipole with T-matching network, and parasitic loop is inserted to the T-matching network. The antenna is analyzed by simulator, Ansoft HFSS software, and the measured results based on backscattering method are presented.

Introduction

The UHF band (860 ~ 960MHz) RFID system becomes more attractive for many industrial services since it is able to provide the high reading speed, capable multiple accesses, anti-collision, long read range and low manufacturing costs compared to LF(125 KHz) or HF(13.56MHz) band RFID system [1]. For UHF band tags, the label type of a dipole antenna has been used in many applications. Generally, the label type tag antenna is printed on the very thin PET substrate and connected to the microchip using the anisotropic conductive adhesive paste (ACP). However, this results in a small change in the tag performances (impedance, frequency, efficiency) due to the effect permittivity of the PET substrate and the conductive particle characteristics of the ACP. Therefore, to maximize the performance of a tag, this performance change should be considered when a tag antenna is designed. The conventional tag antenna is used the T-matching method for a conjugate impedance match between the microchip and the antenna [2]. However, according to the variation of the feed loop size and the connected point with the radiator, the impedance and the resonant frequency is extremely changed. Therefore, the tag antenna which can easily control its impedance is needed. In this paper, the tag antenna in which the complex impedance is easily controlled to match the impedance by inserting a parasitic half-loop at the feed loop is proposed. The impedance characteristic of the

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proposed antenna is analyzed by HFSS simulation tool [3]. The measurement for the radiation pattern and the reading distance is performed by using the commercial microchip based on back-scattering method [4].

Antenna Structure and Result

The structure of the proposed antenna is shown in Fig. 1. The tag antenna consists of the feed loop, the crab shaped radiator, and the T-matching network with the parasitic half-loop. Overall size of the antenna is $90\times16mm^2$. The radiator is electrically connected to the feed loop by a parasitic half-loop. The impedance of the microchip, which is connected to the microchip pad of the feed loop, is 33-j97.6Ω at 915MHz in this work [5]. The T-matching network itself and T-matching network with a parasitic-half loop are shown Fig. 2. Fig 3 shows the simulated input impedance of the antenna with varying *a* when other dimensions are fixed as shown in Fig. 2(a). Fig. 4 shows the simulated input impedance of the proposed antenna with varying the diameter of parasitic loop *d* as shown in Fig. 2(b). It should notice that adjusting complex impedance by using T-matching network with parasitic half-loop is easier compare to only T-matching network. The transmission coefficient and the radiation efficiency presented in Fig. 5 are more than 87% in the frequency band from 860 to 960MHz. The measured radiation pattern and the complex impedance are shown as Fig. 6. The radiation pattern of the proposed antenna is omni-directional, and the peaks have been normalized to 0 dB.

Conclusion

A crab shaped RFID tag antenna, which has a better performance due to better impedance match with a easy impedance adjusting, is proposed and measured. The proposed antenna has a T-matching network with parasitic half-loop. Therefore, it gives an easy and better impedance match compare to T-matching network itself. The maximum reading distance is 7.4 m. The proposed antenna can be used for a tag in UHF band RFID systems.

References

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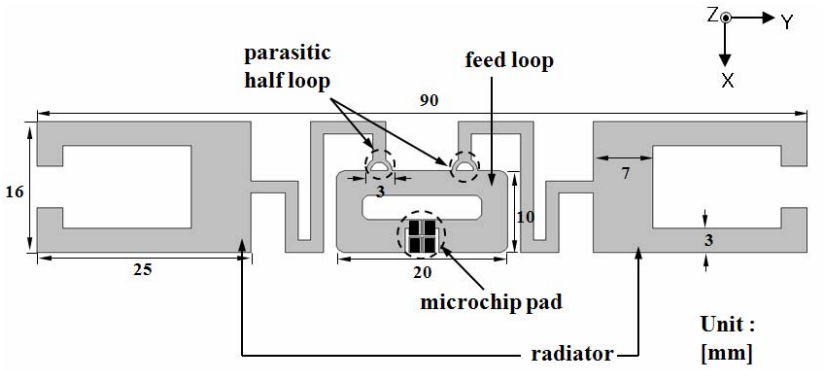
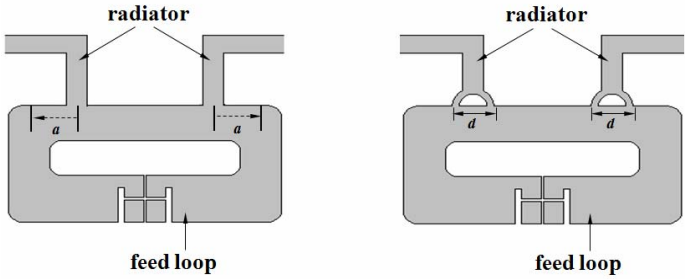
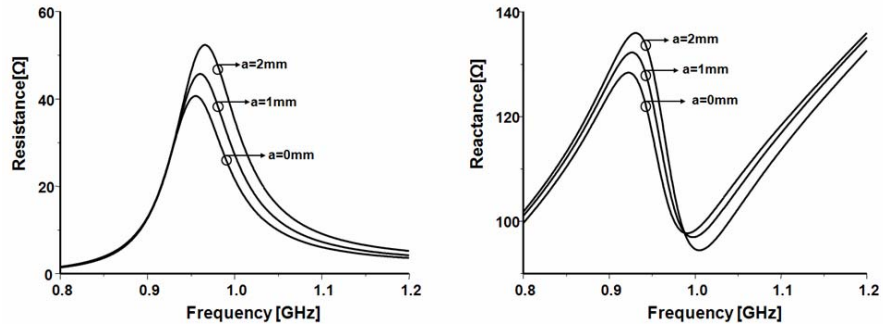


Fig. 1 Configuration of proposed antenna



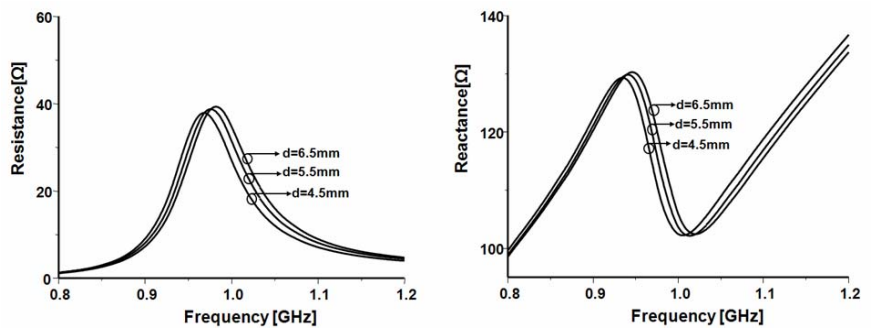
(a) (b)

Fig. 2 T-matching network: (a) T-match only, (b) T-match with a parasitic half-loop



(a) (b)

Fig. 3 Variation of impedance: (a) Resistance versus frequency with varying *a*, (b) Reactance versus frequency with varying *a*



(a) (b)

Fig. 4 Variation of impedance: (a) Resistance versus frequency with varying *d*, (b)Reactance versus frequency with varying *d*

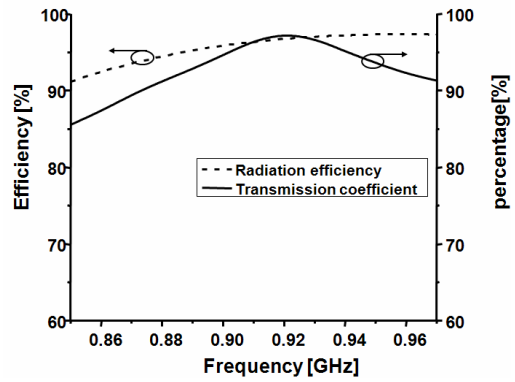
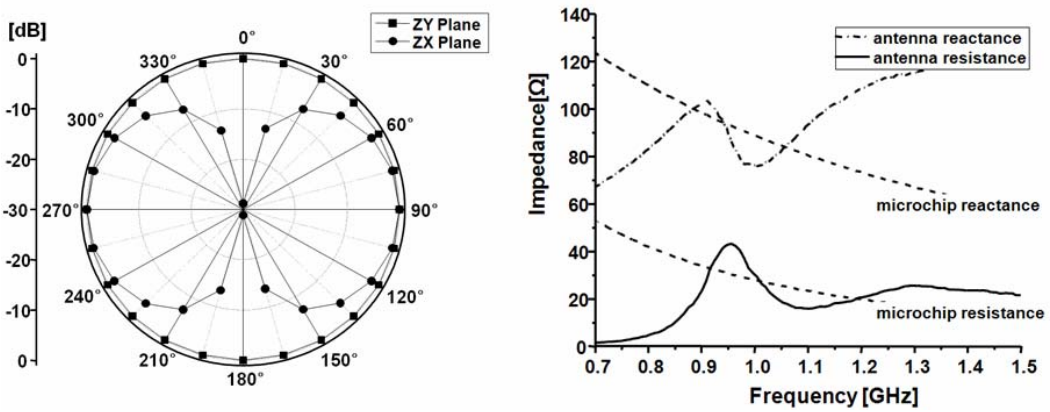


Fig. 5 Radiation efficiency and transmission coefficient of proposed antenna



(a) (b)

Fig. 6 Measured result of proposed antenna: (a) Radiation patterns at 915MHz, (b) Impedance characteristics of microchip and antenna