Dual-Band Dipole Antenna for RFID Tag Applications

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Abstract— New design of a dipole antenna with rectangular fractal shape radiator element with two operating bands for Radio Frequency Identification (RFID) is presented. By using fractal shape slot and metal meander patch, the proposed antenna has the wide and dual measured return loss bandwidth. Besides, the omnidirectional radiation pattern of the design antenna cover the entire frequency range including Ultra High Frequency (UHF, 860MHz~960MHz) band and microwave (2.45GHz) band has been obtained. Several properties of the proposed antenna for dual-band operation such as impedance bandwidth, radiation pattern and measured gain have been investigated numerically and experimentally in detail.

I. INTRODUCTION

The recently year, wireless communication and personal area network technology grew up fast and wide markets have been raised and developed, Radio Frequency Identification (RFID) especially. The RFID technology consists of a variety of technologies including integrated circuit technique, computer technique, identification technique and communication technique. This working band of RFID technology has cover 100~500KHz in the low band range, 13.56MHz in the high band and microwave band range including 860~960MHz and 2.45GHz [1]. The electronic label demand most strong field the electronic coupons of the transportation system, secondly it is entrance guard correlated with saving form damage safely card, and use RFID label retailing the thorough fare or the consuming products to rank with saving form damage safely card, and use RFID label retailing the thorough fare or the consuming products to rank the third for RFID applications. The read range of low band and high band is smaller than 0.1m in the RFID system. The advantages have long read range, read speed fast, low profile and cost down in the microwave operating band. Such as Ultra High Frequency (UHF), EPCglobal standard has been worked and planned UHF band for global countries used. Because of it has 5m read range and 1500 tag/sec read speed.

A RFID tag is an antenna combined with a microchip in a compact package. To select designed tag antenna has good characteristics for the UHF and Microwave RFID system is very important project. Dipole-type and patch-type designed antennas made RFID tag antenna main used and modified pliable shape for person customization [2]-[5]. The dipole antenna for RFID tag is good candidate owing to their omnidirectional radiation pattern, simple structure, low cost and ease of construction. Conventionally, design shape of the dipole antenna by printed microstrip lines, such as folded shape, meander shape and slot-coupled shape have attracted increasing attention due to their low profile, reduced size and resonance frequency for operating band [2]-[5]. However, a fractal shape of technology has been used to create wide-band or multi-band antenna. Several fractal geometries have been introduced for antenna application with varying degrees of success in improving antenna characteristics. Some of these geometries have been particularly useful in reducing the size of the antenna. These are low profile antennas with moderate gain and can be operative at multiple frequency bands. The proposed antenna of this letter is presented and experimented by way of arranging in four stages with the rectangular fractal self-similar rule of shape and metal meander patch, we could be applied to the dipole antenna, and a wide dual-band characteristic with the fractal improves the narrow band of the printed dipole antenna for RFID dual-band application.

II. ANTENNA DESIGN

Fig. 1 shows the geometry of the proposed antenna for RFID dual-band application. It is printed on the FR4 substrate of relative permittivity 4.4 and has a dimension of 107.4 x 33.2mm² in this study. The fractal shape dipole antenna has a rectangular fractal shape (maximum length edge, 10.8mm; minimum length edge, 0.4mm) and a pair meander patch with metal length of 24.7mm and width of 1mm, and end gap distance of 0.5mm between the meander patch end and the feed microstrip line. The length of proposed antenna for RFID tag is about one third of the fractal size and their total length is less than the half-wavelength measured at the dual frequency operation. The optimal dimensions of proposed antenna are W₁=33.2mm, L₁=107.4mm, W₂=1mm, L₂=9.4mm, L₃=31.6mm, L₄=12mm, L₅=24.7mm. The dimensions of the antenna were firstly studied by Ansoft HFSS simulation electromagnetic software, and then verified by experiment. Details of the proposed antenna and results of the prototypes are discussed easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

III. SIMULATED AND MEASURED RESULTS

Fig. 2 shows the simulated and measured return loss of the proposed dipole tag antenna with fractal shape radiator. Evidently, the results in between experiment and simulation are in fairly good agreement. It shows the significant effects on the bandwidth. The measured return loss of rectangular fractal shape operation portion within 850MHz~1050MHz (-10dB return loss) at first resonance mode. Nevertheless, the
The measured gain of the proposed antenna is given in Fig. 4. The gain changed ranges are varied from -1.8dBi to -5.6dBi within UHF band and from 3.3dBi to 5.7dBi within microwave operation frequency band. According to fractal relevant dissertations, high level stages could to achieve ideal wideband. Therefore, this experiment is by way of arranging in four stages with the rectangular fractal shapes, and hopes to obtain the wider dual-band phenomenon. Through proposed antenna measured result to display, not only have dual-band effect but also reach tag antenna of RFID system standard (from 850MHz to 1050MHz and from 2.02GHz to 2.69GHz, respectively).

IV. CONCLUSION

A fractal shaped dipole antenna has been developed and could achieve wide dual-band bandwidth and stable radiation pattern across the whole operating bands. From the investigation of RFID tag antennas, it is found that the feed structure and the fractal make a strong effect on the antenna’s operating bandwidth and radiation pattern. Experimental results show that by choosing fractal shape and metal meander patch and tuning their dimensions, operating bandwidth, measured gain and stable radiation patterns can be obtained.
Fig. 3 Measured radiation patterns of the proposed antenna at 910MHz

Fig. 4 Measured radiation patterns of the proposed antenna at 2.45GHz

Fig. 5 The measured gain of the proposed antenna
(a) UHF band (b) Microwave band

REFERENCES


