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A Simple Uhf Rfid Circularly-Polarized Reader Antenna Design

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ABSTRACT
In this paper, the simple antenna is proposed for ultra high- frequency (UHF) radio frequency identification (RFID) application. It is designed to achieve circular polarization with unidirectional beam. The antenna is composed of the truncated radiation patch and ground plane. The simulation results show that the antenna achieves the return loss of -31.92 dB, gain of 8 dBic, axial ratio (AR) of 1.8 dB and 3 dB AR beamwidth of 60 degree over the band width of 915-928 MHz.
Keywords— RFID, UHF, Circular polarize, Unidirectional

I. INTRODUCTION

In an ultra-high-frequency (UHF) RFID system, the reader emits signals through reader antennas. When an RFID tag comprising an antenna and an application specific integrated circuit (ASIC) is located in the reading zone of the reader antenna, the tag is activated and interrogated for its content information by the reader. The querying signal from the reader must have enough power to activate the tag ASIC to perform data processing, and transmit back a modulated string over a required reading distance.

Since the RFID tags are always arbitrarily oriented in practical usage and the tag antennas are normally linearly polarized, circularly polarized (CP) reader antennas have been used in UHF RFID systems for ensuring the reliability of communications between readers and tags [2], [3].

The RFID in ultra-high frequency (UHF) band is desired for long range applications, which the operating frequency depends on the use of different country.

Globally, each country has its own frequency allocation for UHF RFID applications, e.g., 840.5–844.5 and 920.5–924.5 MHz in China, 915–928 MHz in Brazil, 866–869 MHz in Europe, 902–928-MHz band in North and South of America, 866–869 and 920–925 MHz in Singapore, and 952–955 MHz in Japan, and so on, so that the UHF RFID frequency ranges from 840.5 to 955 MHz (a fractional bandwidth of 12.75%) [4].

In the RFID system, the antenna readers have an important role in communication between the reader and the tag that can communicate with various tags orientations are desirable. Therefore, the antenna radiate circular polarization is needed in dealing with this problem [1]-[5]. In these papers, the antenna needs to reduce cost, size and complexity.

This paper proposes a simple structure of patch antenna with single feed to radiate unidirectional beam and circular polarization in the operating frequency of 920-925 MHz. This antenna is consists of the rectangular truncated radiation patch and ground plane.

The remainder of this paper is organized as follows. Section II describes the geometry of the proposed antenna. The simulated results, analysis, and discussion are presented in Section III.The validation of the proposed antenna in RFID system applications is exhibited in Section V. Finally, a conclusion is drawn in Section VI.

II. ANTENNA CONFIGURATION

A singly – fed circular polarization may be regarded as one of the simplest radiators for exciting circular polarization and is very helpful in situations where the space do not allow to accommodate dual-orthogonal feeds with a power divider network. This technique generally radiates linear polarization; but in our study case we want to achieve a circular polarization, so we are going to talk of some techniques used to achieve this goal.

Single feed circularly polarized antennas are currently receiving much attention. Circular polarization is beneficial because current and future commercial and military applications require the additional design freedom of not requiring alignment of the electric field vector at the receiving and transmitting locations. A single feed allows a reduction in the complexity, weight and RF loss of any array feed and is desirable in situations where it is difficult to accommodate dual orthogonal feeds with a power divider network. Circularly polarized micro strip antennas have the additional advantage of small size, weight, suitability in confirm mounting and compatibility with microwave and millimeter

wave integrated circuits, and monolithic microwave integrated circuits (MMICS).

Fig. 1 shows the configuration of the proposed antenna. The antenna comprises two layers of conductor, which include two main radiating patch, and a finite-size ground plane.

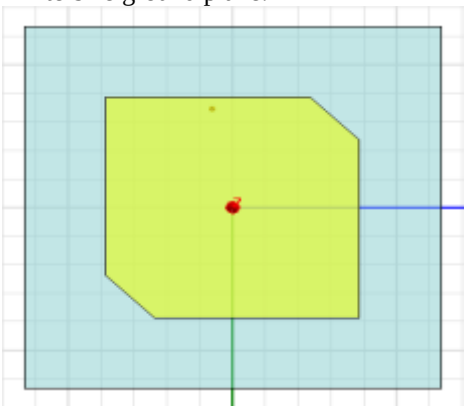


Fig. 1 shows the configuration of the proposed antenna

The main radiating patch of ($156mm \times 156mm$) and with a truncation ΔL_1 of 30 mm at two diagonal corners is placed above the finite-size ground plane of $h_1 = 15mm$.

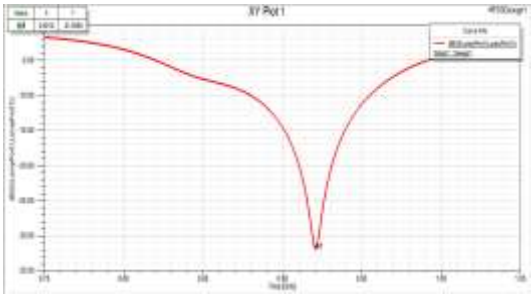
The truncated patch and ground plane are all made of copper and fixed using plastic spacers. A coaxial cable is directly connected to the microstrip feed line to simplify the assembly of the antenna.

III. RESULTS AND DISCUSSION

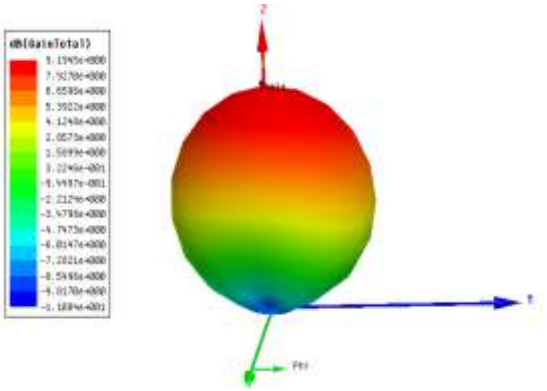
With aid of simulation by the Ansoft HFSS 8 3-D EM simulator, which is based on the finite-element method (FEM), the antenna is optimized.

To better understand the influence of the parameters on the performance of the antenna, only one parameter at a time will be varied, while others are kept unchanged unless especially indicated.

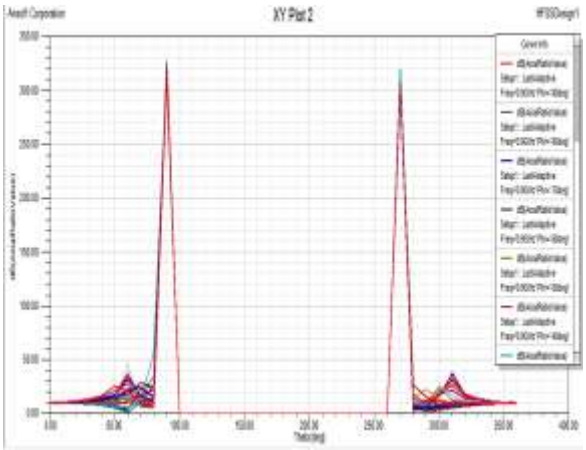
Fig. 2(a) shows the simulated return loss of the antenna. The simulated return loss is 31.9280 dB at 921 MHz. Fig. 2(b) exhibits the simulated AR. The simulated gain is illustrated in Fig. 2(c). The antenna exhibits the simulated gain with a peak gain of 9.3 dBic at 921 MHz.



(a)



(b)



(c)

Fig. 2. Simulated and measured results of the proposed antenna. (a) Return loss. (b) AR. (c) Gain.

IV. CONCLUSIONS

The flat patch antenna for UHF RFID reader has been proposed for simple structure, circular polarized and unidirectional beam by using truncate radiation patch antenna. The single feed is used for this antenna and An air-substrate truncated patch antenna is used to achieve the circularly polarized characteristic..

From the simulation, it is obvious that the antenna radiates unidirectional beam with the beamwidth 63 degree. The axial ratio is 1.8 dB and the gain is 8.36 dBic over the frequency band 918-928 MHz respectively. This antenna can be efficient used as the reader antenna of the UHF-RFID system.

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