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Enhanced Dipole Antenna for RFID by Using Metamaterials

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ABSTRACT

The paper at hand discusses a novel method of miniaturization of antenna design using metamaterials. We suggest a novel method to improve frequency characteristics while reducing antenna size. This method is based on the connection of this element resonant two split rings resonator. The resonant frequency, return loss, bandwidth, radiation pattern, gain, directivity, electromagnetic field, and current supplied by the proposed antenna are the parameters addressed in this study. CST software generates all simulation results.

1. INTRODUCTION

Metamaterials are artificial material which have unique natural features [1-4]. Metamaterials Their electromagnetic characteristics theoretically proposed by Veselago in 1968 [1] typically attract considerable attention in the scientific community.

In 1999, Pendry empirically confirmed these characteristics [2]. One year later, Shelby et al. [3] were approving the existence of a material by left hand to demonstrate experimentally the existence of two periodic, homogeneous split-ring resonators which can produce a negative efficient permeability and metal files, which produce negative effective permittivity and therefore achieve refractive efficiency. Some years later, Sanada et al. [4] suggested a technique to use a transmission line based on a microstrip technology to create metamaterials left hand. Some researchers have quickly developed miniature methods and improved performance antennas that usually react to RFID technology [5]. The methods of fractal pattern and folding dipole are among the most common. Another method to use [6-11] to increase metamaterial characteristics. In this backdrop, we suggest a novel approach to the development of this essential RFID tag technology working in the UHF band in this article.

The first component is to depict our metamaterial antenna construction suggested by the combination of two traditional divided ring resonators with a dipole antenna on the microstrip. In the second phase, an examination of the findings determines the advantage gained from this structure.

The rest of the paper is as follows: Section 2 briefly describes RFID technology; Section 3 gives an overview of antenna structure; Section 4 presents the results and comparison; and finally conclusions are given in section 5.

2. RFID TECHNOLOGY

Radio Frequency Identification is a wireless technique designed to increase traceability and is currently carried out via the barcode. The RFID system consists of a base station to read the information in the product's chip. The chip and antenna are referred to as RFID tag. In order that RFID tags, be successful in that market, they must always have the best frequency and compact size qualities to be placed in all goods. For the use of various technologies many frequency bands were assigned. The UHF antennas of 2.45 GHz are at the focus of this paper.

3. METHODS

The antenna structure of the suggested metamaterials is of the circular dipole form provided by a discrete port with a horizontal excitation and a resistance R equal to 50 ohms. The antenna is positioned between two divided hexagonal split ring resonators, as the Figure 1 below illustrates.

These 3 units have a dielectric substrate with a ROGERS RO4232 type informed by the permittivity of a relative Er=3.2 permeability and a loss of tangent tan =0.0018 (conts.fit). The substrate consists of a cubic geometric form with a height of h=1.6 mm and a side of 100mm.

The first split ring resonator (exterior part) is hexagonal split with outer ring radius its 39 mm « R1» and its opening gap «D» equivalent to 4mm and its «W» track wide of 1.5mm outside the structure.

The second split-ring resonator (inner part) is a hexagonal construction with an inner ring radius «R2» of 29 mm from the ring and a gap "D" of 4mm with a gauge of "W" of 1.5mm.

There is a circular dipole antenna between these two resonators with a horizontal shape.

The dipole antenna being examined is defined by its diameter, equivalent to « $R_{antenna}$» 34 mm, partly below half the wavelength λ. It also has a track of 1.5 mm width "W.", as the following picture shows, the goal is to ensure the continuity of the distribution current inside the structure.

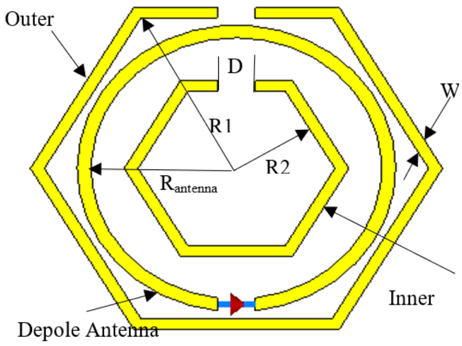


Figure 1. Metamaterials geometric parameters of antennas

4. RESULTS AND DISCUSSION

The findings indicate that this structural antenna has extremely low resonance peak of about 2.45 GHz, as seen in the curve of the retour loss in Figure 2. The findings seem to be somewhat conflicting when metamaterials are included. This combination enables us to enhance the antenna and make it more flexible to an approximate 2.4 GHz resonance frequency with a return loss S11 equivalent -22.7dB with a 'Bf' frequency range equal to 180 MHz the decrease of the frequency of resonance by 50 MHz is the result of metamaterial presence. The Figure 3 show that.

Therefore, we get a second Resonance peak according to this structure, which is lower than the primary antenna resonant frequency. With this new frequency of operation, a considerable decrease in the size of the antenna.

The metamaterial and its above geometry exhibit a gain of 2.46dB and a directivity equal to 2.52dBi the Figures 4 and 5 show that.

If we get a " η " efficiency of 97% from Eq. (1) for the efficiency antenna in accordance with the gain and radiation pattern.

$$\eta = \frac{Gain}{Direcivity} \times 100 \qquad (1)$$

By utilizing metamaterials, this novel approach for attending improvement allows us to enhance the antenna's electromagnetic surfaces.

The antenna in presence of the metamaterials has thus been established, shown in Figures 6, 7, with a maximum electro-panel of 24717 V/m and a maximum magnetic surface area of 74.9 A/m. The antenna is shown in Figures 6, 7. In the absence of any metamaterials, the rate of progression is 16008 V/m and 44.1A/m as opposed to the dipole antenna.

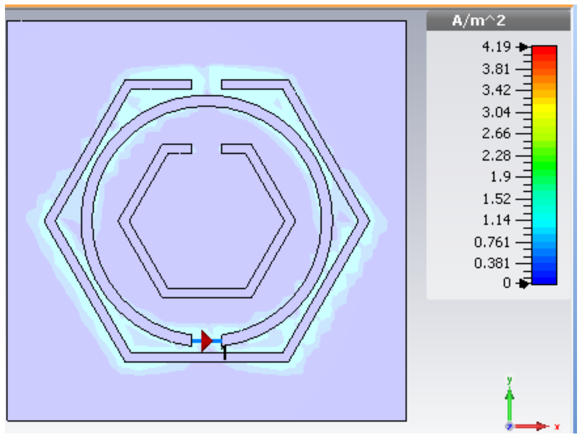


Figure 2. Current circulation of the antenna metamaterials

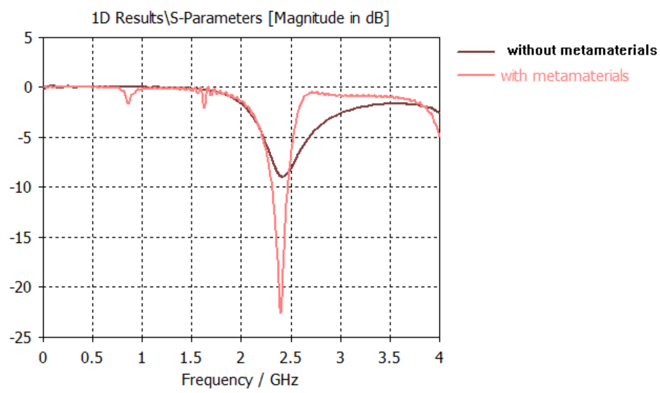


Figure 3. Measure the antenna-typical return loss

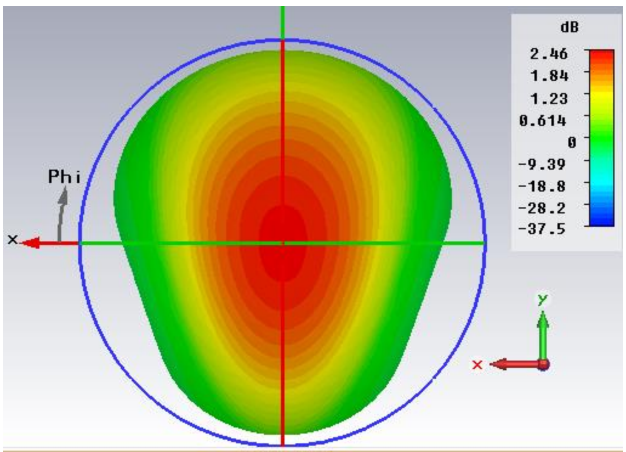


Figure 4. The Metamaterials antenna radiation pattern for the gain calculation

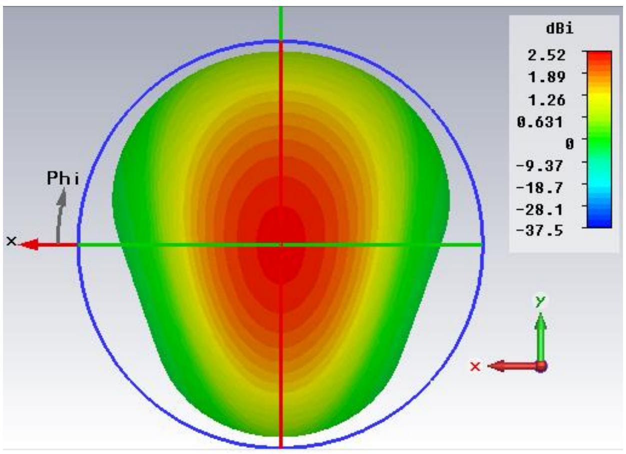
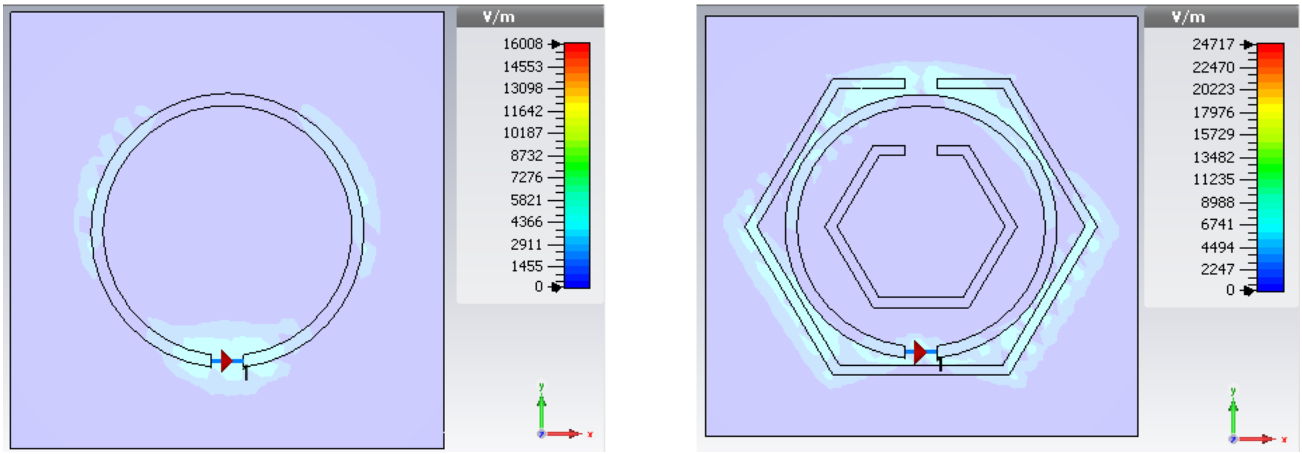


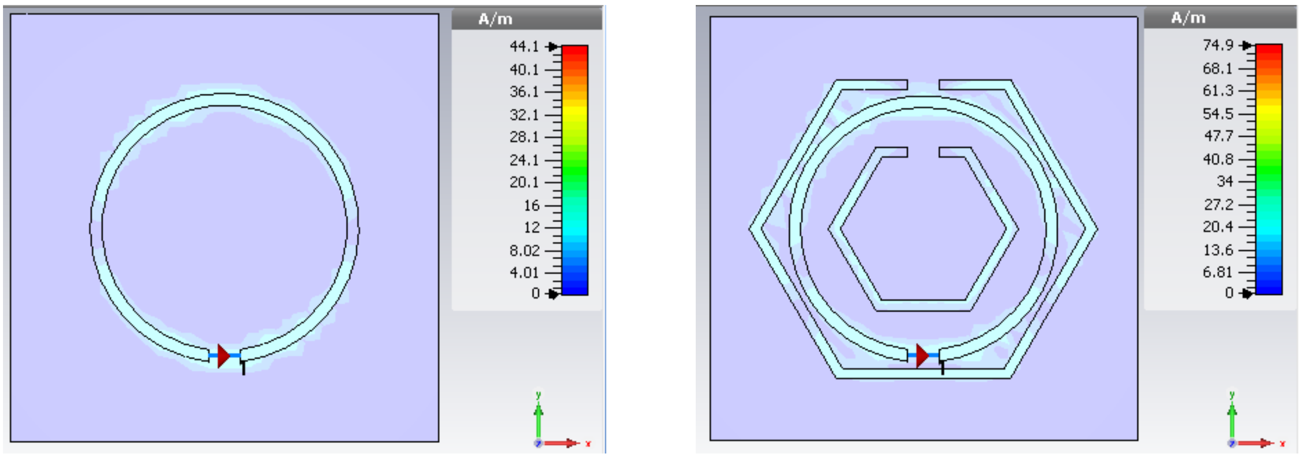
Figure 5. Metamaterials antenna radiation pattern for the calculation of guidance



(a) Antenna with metamaterials without metamaterials

(b) Metamaterial antenna

Figure 6. Electric field distribution



(a) Metamaterial antenna without metamaterial

(b) Metamaterial antenna

Figure 7. Magnetic field distribution

5. CONCLUSION

A novel contribution has been made to enhance and miniaturise the UHF-functioning RFID antenna utilizing the hexagonal split ring resonator. We can demonstrate the effectiveness of our method from the best simulation results. Accordingly, we can obtain a very high frequency antenna with very little size, utilizing this technique.

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