



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 9, September 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

A Compact Dual Band Microwave RFID Tag Antenna Based on SRR

Koduri Sreelakshmi¹

¹Department of ECE, Anil Neerukonda Institute of Technology and Sciences (A), Vishakhapatnam, India,

ABSTRACT: In this article a passive dual band microwave RFID tag antenna is presented. The circular split ring resonator (SRR) is employed to design a compact size antenna. The investigated tag antenna is designed on Rogers RT/duriod 5880 (tm) substrate with thickness of 1.6 mm. The investigated tag antenna has compact size of 38 mm × 38 mm. This antenna operates at 2.4 GHz and 5.8 GHz bands with a S_{11} of -17.9 dB and -35.2 dB respectively. Numerical simulations are presented for the investigated tag antenna by using Ansys HFSS Software. The investigated antenna exhibits nearly symmetrical radiation patterns and acceptable reflection coefficient across all application bands, thus making the antenna suitable for RFID applications.

I. INTRODUCTION

RFID is an acronym for radio frequency identification, which is an automated data collection technology that uses radio waves to locate, track, and identify animals, objects, or people. In recent decades, RFID technology has advanced dramatically, and many service businesses, manufacturing firms, distribution logistics, and commodities flow systems have incorporated it [1]. A radio frequency identification (RFID) system consists of a tag that is attached to an item and communicates with a reader via an antenna. In general, the reader radiates a signal at a specific frequency. Whenever an RFID tag moves well within reading zone of the reader antenna, it is identified and interrogated by the reader for its content information [2-3]. RFID applications have been using a wide range of frequency bands, including low-frequency band LF (125 KHz-134 KHz), high-frequency band HF (13.56MHz), ultra-high frequency band UHF (860MHz-960MHz), and microwave band MW (2.45GHz or 5.8GHz) [4]. RFID tags are classified into two types: passive RFID and active RFID. Passive RFID does not require batteries or an internal power source, and it is commonly used for file tracking, race timing, supply chain, and smart labelling. Since the microwave band RFID system is a passive system, the reader antenna transmits a radio signal into the air to activate the tag, then listens for backscatter from the tag by first powering it, and reads the tag [5]. Various tag antennas were designed for RFID applications in the microwave band 2.45 GHz; they include a novel metamaterial printed antenna using U slot in the radiating element for RFID applications [6], a novel dual-band metamaterial monopole antenna for RFID applications in microwave band [7], a new topology for RFID antenna matched on the microwave RFID's band [8], a new microstrip slot antenna using two inverted L-shaped slots embedded on the radiating patch, suitable for RFID applications at 2.45 GHz [9], and a miniature microstrip antenna at 2.45 GHz by using the slots technique [10].

In this article the design of the passive microwave tag antenna using SRR is presented. The antenna structure presented is optimized using HFSS EM simulation software. This paper is split into three sections, section II describes the antenna design, section III presents the simulated results, and section IV concludes the paper.

II. ANTENNA DESIGN

The structure of the investigated RFID tag antenna is shown in Fig. 1. The investigated antenna consists of circular SRR as the radiating element. The investigated antenna is developed on Rogers RT/duriod 5880 (tm) substrate with relative permittivity of 2.2, loss tangent 0.0009 and thickness 1.6 mm and fed by a 50 Ω coaxial feedline. The overall dimensions of investigated antenna are 28 mm × 28 mm. Table 1 summarizes the investigated antenna functional parameter values.

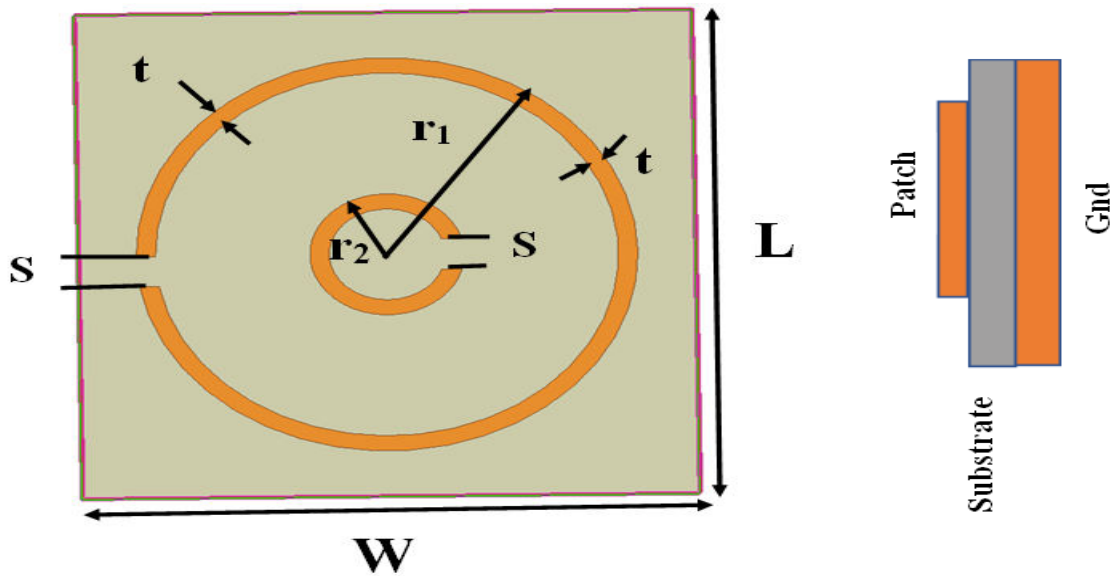


Figure 1: Stru (a) investigated antenna (a) Top view (b) Side view (b)

Table 1. Investigated antenna dimensions

Parameter	Value
L	28 mm
W	28 mm
r ₁	13 mm
r ₂	4 mm
S	2 mm
t	1 mm

The investigated antenna operates at dual bands at 2.48 GHz and 5.74 GHz thus facilitating coverage for microwave RFID tags. The effective radius (r₁) of outer circular SRR is calculated by using the formulae

$$L_1 = \frac{c}{2\pi\sqrt{\epsilon_{reff}}f_1}$$

$$r_1 = \frac{L_1 + S}{2\pi}$$

$$\epsilon_{reff} = \frac{\epsilon_r + 1}{2}$$

where C is the speed of light, ϵ_{reff} is the effective relative permittivity of the substrate and $f_1 = 2.48$ GHz

The effective radius (r₂) of inner circular SRR is calculated by using the formulae

$$L_2 = \frac{c}{2\pi\sqrt{\epsilon_{reff}}f_2}$$

$$r_2 = \frac{L_2 + S}{2\pi}$$

$$\epsilon_{reff} = \frac{\epsilon_r + 1}{2}$$

where C is the speed of light, ϵ_{reff} is the effective relative permittivity of the substrate and $f_2 = 5.74$ GHz

III. RESULTS AND DISCUSSION

The investigated antenna simulations were performed with Ansys HFSS software. Fig. 2 demonstrates the simulated S_{11} characteristics of the investigated tag antenna. Dual-frequency bands are noted at 2.48 GHz and 5.74 GHz, with maximum S_{11} values of -17.9 dB and -35.2 dB, respectively. The bandwidth of the first band is 4%, and this band is used for microwave RFID tag at 2.4 GHz; the bandwidth of the second band is 3.3%, and this band is used for microwave RFID tag at 5.8 GHz.

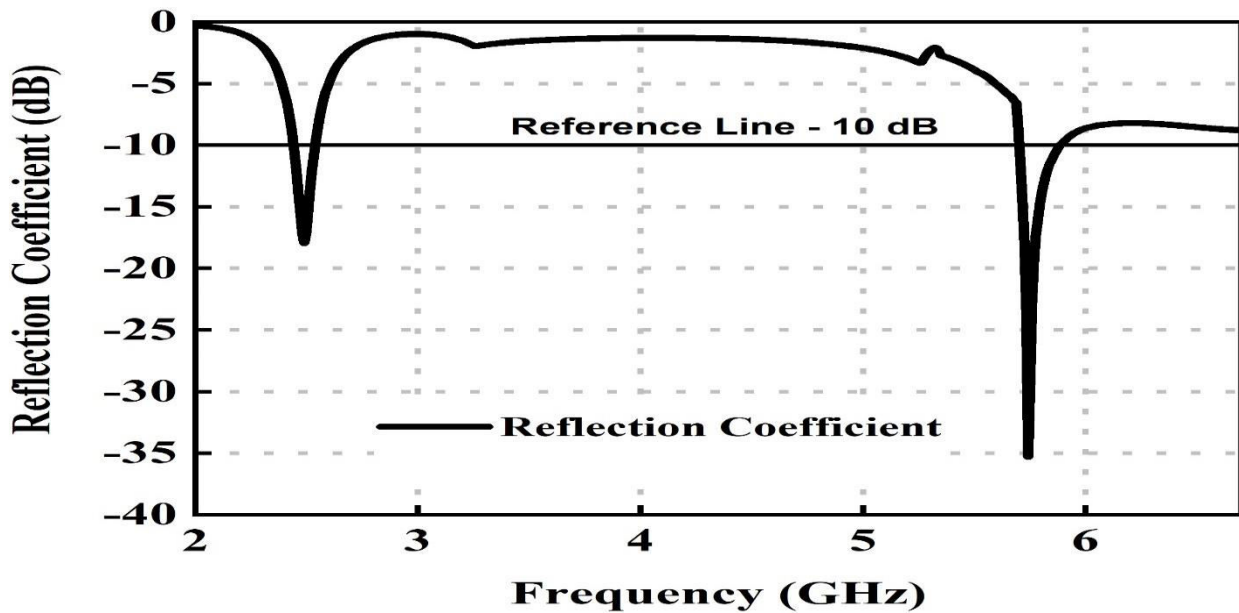
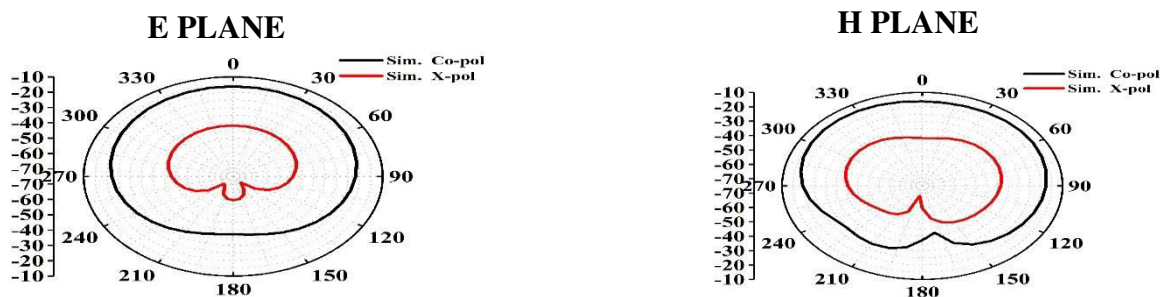


FIGURE 2. Simulated S_{11} values of investigated antenna

Fig. 3 illustrates the simulated 2D radiation characteristics of the investigated antenna at 2.48 and 5.74 GHz. The investigated antenna has a unidirectional radiation pattern in the E- and H-planes



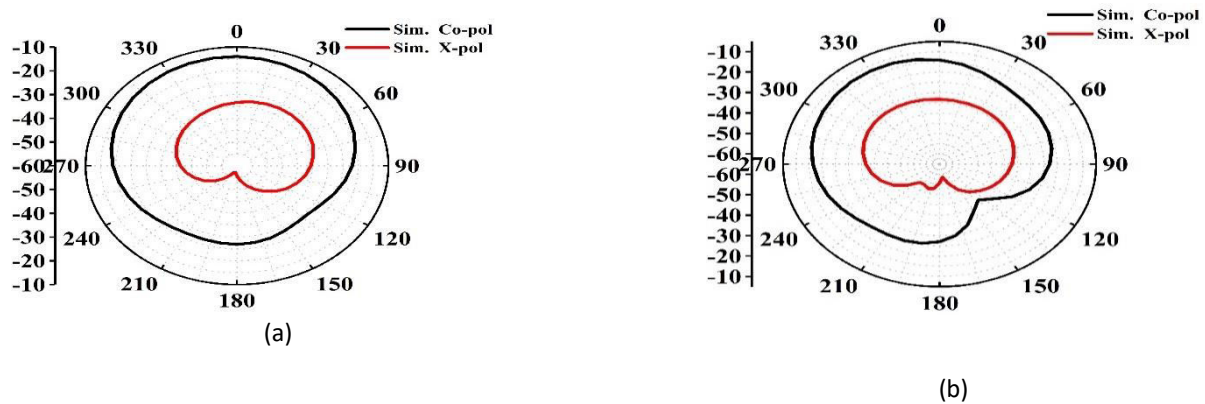


FIGURE 3. Simulated 2D radiation patterns of investigated antenna at a) 2.48 GHz and b) 5.74 GHz

The investigated antenna has radiation efficiencies of 78% and 90% at 2.48 and 5.74 GHz, respectively. The investigated antenna has simulated gains of 3.32 and 3.92 dBi at 2.48 and 5.74 GHz and measured gains of 2.26, 3.14, and 3.73 dBi.

IV. CONCLUSION

A miniaturized a passive dual band microwave tag antenna for RFID applications is presented. The investigated antenna is designed, simulated and optimized by using Ansys HFSS software. The usage of circular split rings resonators allows the antenna to operate in dual bands and enhances investigated antenna performance. The simulated results demonstrate that the investigated tag antenna configuration is confirmed in two frequency bands 2.44-2.54 GHz and 5.7-5.89 GHz, which accommodate the RFID operating Frequency at microwave band, respectively. The radiation patterns of the investigated tag antenna are unidirectional in both H-plane and E-plane.

REFERENCES

1. Finkenzeller, K., RFID Handbook, 2nd ed. New York: John Wiley and Sons, 2003
2. Konstantinos Domdouzis, Bimal Kumar, Chimay Anumba, "RadioFrequency Identification (RFID) applications: A brief introduction", 2006 Elsevier Ltd. *Advanced Engineering Informatics* 21 (2007) 350–355.
3. N. Chen and X. Qing, "Antennas for RFID applications," *2010 International Workshop on Antenna Technology (iWAT)*, 2010, pp. 1-4, doi: 10.1109/IWAT.2010.5464865.
4. K. V. S. Rao, P. V. Nikitin and S. F. Lam, "Antenna design for UHF RFID tags: a review and a practical application," *IEEE Transactions on Antennas and Propagation*, vol. 53, no. 12, pp. 3870-3876, Dec. 2005, doi: 10.1109/TAP.2005.859919.
5. Banks, J., Pachano, et al., RFID applied. New Jersey: John Wiley & Sons, Inc, 2007
6. Ennajih A, Zbitou J, Latrach M, Errkik A, El Abdellaoui L, Tajmouati A. Dual Band Metamaterial Printed Antenna Based on CSRR For RFID Applications. *Int. J. of Microwave and Opt. Tech.* 2017; 12(2): 106-113
7. Abdelhadi Ennajih, Jamal Zbitou, Mohamed Latrach, Ahmed Errkik, Larbi EL Abdellaoui, Abdelali Tajmouati. New Miniature Microstrip Antenna Based on Metamaterial for RFID Applications. *TELKOMNIKA*. 2018; 16(1): 174-181
8. T. Deleruyelle, P. Pannier, E. Bergeret and S. Bourdel, "Dual band UHF and microwave RFID antenna," *2008 European Conference on Wireless Technology*, 2008, pp. 342-345, doi: 10.1109/EUMC.2008.4751818.
9. A. E. Hamraoui, E. H. Abdelmounim, J. Zbitou, H. Bennis and M. Latrach, "Compact dual-band microstrip slot antenna for UHF and microwave RFID applications," *2016 11th International Conference on Intelligent Systems: Theories and Applications (SITA)*, 2016, pp. 1-4, doi: 10.1109/SITA.2016.7772280
10. M. Ihamji, E. Abdelmounim, J. Zbitou, H. Bennis, and M. Latrach, (2018) "A miniature L-slot microstrip printed antenna for RFID" *TELKOMNIKA (Telecommunication Computing Electronics and Control)* 16(5): 1923–1930. DOI: 10.12928/telkomnika.v16i5.9378



Impact Factor: 8.423



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details