iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 Issue: VI Month of publication: June 2017

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Circular Microstrip Patch Antenna for RFID Application

Swapnali D. Hingmire[1], Mandar P. Joshi[2], D. D. Ahire[3]

[1,2,3] E&TC Department, [1]R. H. Sapat COE, Nashik, [2,3]Matoshri COE, Nashik, Savitri Bai Phule Pune University

Abstract: ***In this paper, circular microstrip patch antenna (CMPA), with coaxial probe feeding, have been proposed. The proposed antenna operates in the frequency range of (2.4-2.48) GHz RFID band. The antenna is fabricated on FR4 substrate with size of 50mm × 50mm × 1.6mm. The antenna is simulated using the method of moment's CAD FEKO antenna simulator. The measured and simulated results are found to be in good agreement.***

Keywords— microstrip, circular, RFID, polarization, frequency

I. INTRODUCTION

Radio frequency identification (RFID) systems in UHF band have attracted many researcher's attention for their popular applications in manufacturing companies and service industries. Radio frequency identification (RFID) technology allow users to uniquely identify tagged people or objects [13]. RFID employs electromagnetic (EM) waves to exchange information between readers and tags for the purpose of identification and tracking [11]. Microstrip antennas are used in many application because of its low profile, ease of fabrication and low cost. Circular patch or disk is the one of the popular configuration to design a Microstrip patch antenna [12].

S.J. Pawar *et.al.* proposed coaxial feed dual band circular microstrip patch antenna (CMPA) for ISM (2.4-2.5GHz) and WLAN (5.150-5.350GHz) application. Dual frequency bands has been achieved by inserting a circular slot in the circular radiator as well as bandwidth enhancement is achieved by modifying the ground plane[1]. D.D. Ahire *et.al.* proposed dual band rectangular microstrip patch antenna using T-slot and capacitive loading. The 'T' shaped slot is used on radiator and ground plane to enhance the bandwidth [2]. Xiong Ying Liu *et.al.* proposed a broadband circularly polarized stacked coin-shaped patch antenna for a universal UHF-RFID reader. For achieving circular polarization, the main patch is fed by four probes, connected to the feeding strip with an interval of a quarter-wavelength at 900 MHz [3]. Yu-Shao *et.al.*proposed a printed slot antenna that utilizes a ring slot and a cross slot. Ring slot and cross slot controls the lower band and upper band respectively [4]. Lee Chang *et.al*, proposed a single-feed active RFID tag antenna that operates in the microwave frequency. The reported antenna functions as a dipole when used in free space and it functions as a patch when applied on a metallic surface. The antenna structure contains no ground plane [5].

In this paper, circular microstrip patch antenna with coaxial feeding technique is presented for RFID application. This paper has been organized as in four main sections. Section I includes introduction, Section II depicts design of antenna for RFID application. Section III and IV shows analysis and results respectively.

II. ANTNNA DESIGN

The antenna geometry consists of circular patch with square cut inside the patch area to achieve circular polarization. The coaxial probe feed is applied having location x = 4 and y = - 4 to the circular patch radiator. The circular patch radius (α) and ground plane area of the antenna are 14.5 mm and 50mm × 50mm, respectively. The proposed antenna is designed on a FR4 substrate with thickness, h = 1.6mm, dielectric constant, $\varepsilon_r = 4.4$. The diagonal corner of circular patch has been cut with dimensions of 6 mm × 8mm. The antenna resonates at 2.46 GHz for RFID (2.4-2.48) GHz band.

The geometry of circular microstrip patch antenna is depicted in fig.1.

The circular patch radius (α) is given in the following equation,

$$\alpha = \frac{F}{1+\frac{2h}{\pi\varepsilon_r F[\ln(\frac{\pi F}{2h})]^{1/2}}} \qquad (1)$$

Where,

$$F = \frac{8.791 \times 10^9}{f_r\sqrt{\varepsilon_r}} \qquad (2)$$

©IJRASET: All Rights are Reserved

α = Radius of circular patch
h = Height of substrate
ε_r = Relative permittivity of dielectric substrate

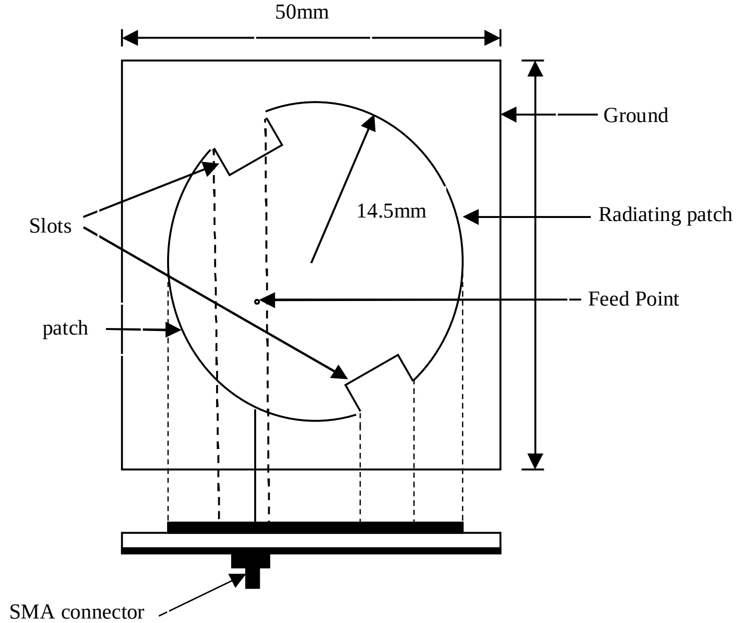


Fig.1: Geometry of proposed CMPA

III. PARAMETRIC ANALYSIS

Performance of circular microstrip patch antenna is dependent on different parameters such as radius of patch, size and location of rectangular slots, shape and size of ground plane. For designing a circular microstrip patch antenna for (2.4 - 2.48) GHz, it is required to maintain the position of rectangular slots.They are rotated in 30˚ from vertical axis. Size of rectangular slots is selected as 6mm × 8mm. For rectangular slot of size 5 mm × 7 mm the resonant frequency shifts towards lower band while for slot size of 7 mm × 9 mm resonant frequency shifts towards upper frequency band. Hence optimized slot dimension in order to satisfy the (2.4 - 2.48) GHz band is 6mm × 8mm.

The feed location is optimized and hence location selected is in between center and edge of the circular patch. The selected location of feeding for proposed antenna is, at x = 4 mm and y = - 4 mm, as depicted in the fig.1.

IV. RESULTS

The modeling and simulation of the proposed CMPA is performed using CADFEKO simulation software. The antenna is fabricated with printed circuit board technology as shown in fig.2. A 50-Ω type-subminiature-A (SMA) connector is soldered at the feed point.

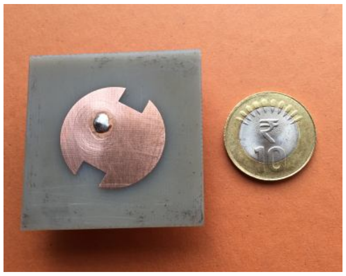


Fig.2: Fabricated CMPA

A. Simulated Results

From simulation, reflection coefficient for proposed circular microstrip patch antenna is depicted in fig.3. Simulated results presented above shows that proposed antenna resonates at 2.46 GHz with reflection coefficient of -18.27 dB with bandwidth of 60 MHz. Axial ratio for proposed circular microstrip patch antenna is depicted in fig.4. The figure shows that axial ratio for propsed

©IJRASET: All Rights Reserved

www.ijraset.com
IC Value: 45.98
Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

CMPA is below 3 dB, which results in circularly polarized antenna.

Maximum current is observed at 2.46 GHz on the circular radiating patch. Current distribution is depicted in fig.5.

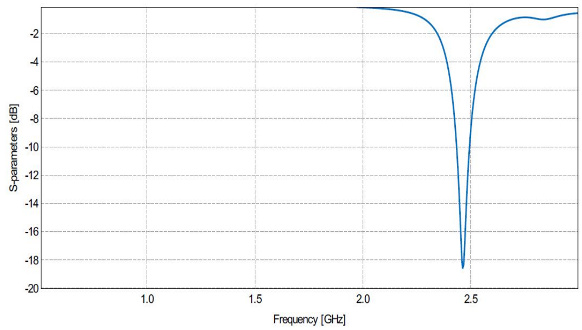


Fig.3: Reflection coefficient for proposed CMPA

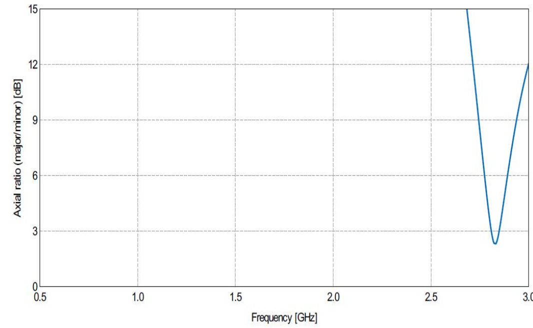
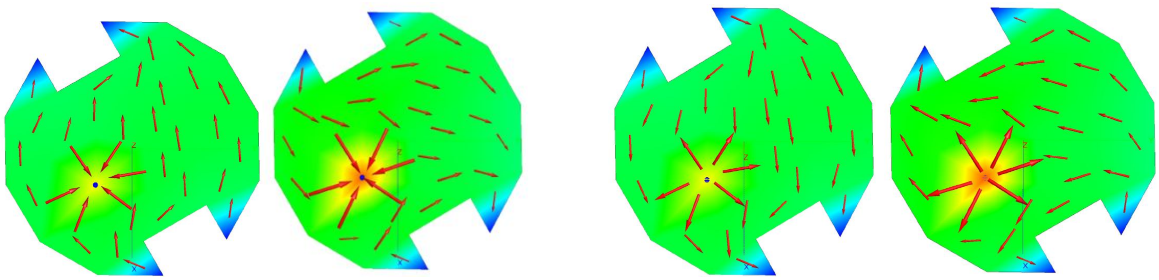


Fig.4: Axial ratio for proposed CMPA



(a) surface current at θ=0˚ and θ=90˚ respectively (b) surface current at θ=180˚ and θ=270˚ respectively

Fig.5(a)&(b) : Current Distribution at 2.46 GHz

Figures 5(a) and (b) presents that, arrow heads of current rotates clockwise. Hence right hand circular polarization (RHCP) has been acquired.

Radiation pattern for 2.46 GHz resonating frequency is depicted in fig.6. From simulated radiation pattern, maximum gain is 1.61 dBi at 2.46 GHz.

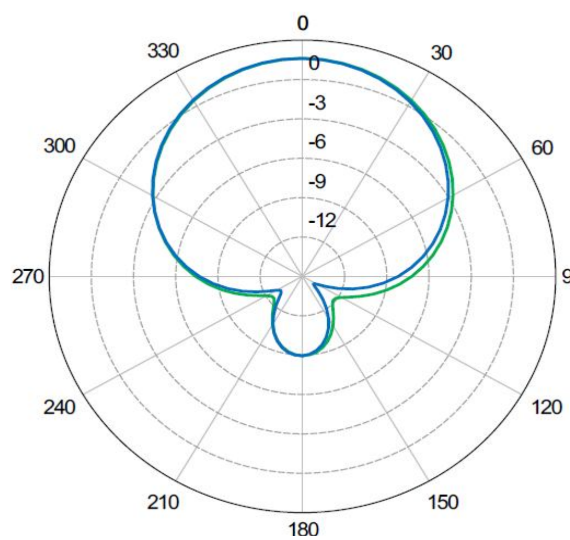


Fig.6: Radiation pattern at 2.46 GHz

B. Measured Results

The return loss (RL) performance of the fabricated circular microstrip patch antenna are measured on Agilent Technologies N9916A Vector Network Analyzer. Measured reflection coefficient for proposed circular microstrip patch antenna is depicted in fig.7.Measured results above shows that proposed circular microstrip patch antenna resonates at resonating frequency of 2.419 GHz

©IJRASET: All Rights are Reserved

with return loss of -22.55dB. This shows that a good impedance matching is achieved by proposed CMPA.

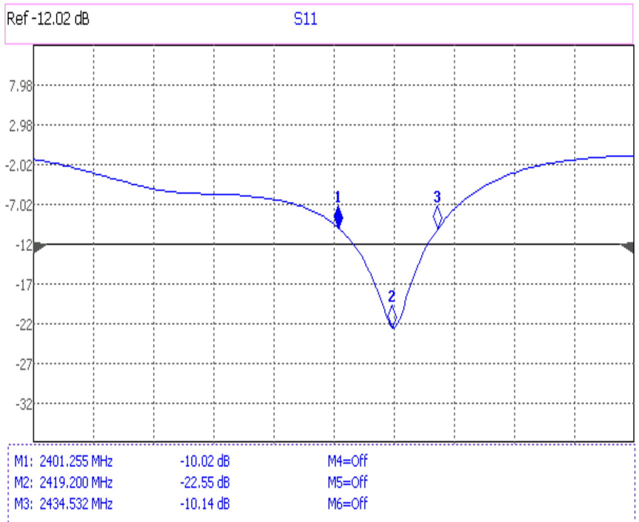


Fig.7: Measured Return Loss of CMPA

TABLE I: Simulated ans measured values for CMPA

Parameter	Simulated value	Measured Value
Resonant Frequency	2.46 GHz	2.41 GHz
Reflection coefficient	-18.27 dB	-22.55 dB

V. CONCLUSIONS

The design and simulation of the proposed CMPA is carried out in this work. The measured and simulated results show that the proposed CMPA is a good candidate for, (2.4-2.48 GHz) RFID applications.

VI. ACKNOWLEDGMENT

Authors would like to thank Principal and H.O.D. E&TC of AVCOE, Sangamner, for providing measurement facilities.

REFERENCES

[1] Sayali J. Pawar and Mandar P. Joshi, “Design Of Dual Band Circular Microstrip Patch Antenna for ISM and WLAN,” 2016 International Conference on Automatic Control and Dynamic Optimization Techniques (ICACDOT), Pune, pp. (608-611), 2016.

[2] D.D. Ahire and G.K. Kharate, “Dual Band Microstrip Patch Antenna for Wireless Applications,” International Journal of Computer Technology and Applications (IJCTA), 9(10), pp. (1-11), 2016.

[3] Xiong Ying Liu, Yi Liu and M. M. Tentzeris, “A Novel Circularly Polarized Antenna with Coin-Shaped Patches And Ring-Shaped Strip For Worldwide UHF RFID Applications,” IEEE Antennas and Wireless Propagation Letters, Vol.14, pp.(707-710), 2015.

[4] Yu Shao and Zhangyou Chen, “A design of Dual-Frequency Dual-sence Circularly polarized Slot Antenna,” IEEE Transaction on ANtennas and propagation, Vol. 60, No.11, pp. (4992-4997), Nov. 2012.

[5] Le Chang, H. Wang, Z. Zhanh, Yue Li and Z. Feng, “Compact Single-Fed Dual-mode Antenna for Active RFID Tag Application,” IEEE Transactions on Antennas and Propagation, Vol.60, No.11, pp.(4992-4997), Nov. 2012.

[6] AkankshaFarswan, A. K. Gautam, B. K. Kanaujia and K. Rambabu, “Design of Koch Fractal Circularly Polarized Antenna for Handheld UHFReader Applications,” IEEE Transactions on Antennas and Propagation, Vol.64, No.2, pp.(771-775), Feb 2016.

[7] Chow-Yen-Desmond Sim, Yi-Wen Hsu and Gunali Yang, “Slits Loaded Circularly Polarized Universal UHF-RFID Reader Antenna,”IEEE Antennas and Propagation Letters, Vol.14, pp.(827-830), 2015.

[8] Rong Cao and Shun C. Yu, “Wideband Compact CPW-Fed Circularly Polarized Antenna for universal UHF-RFID Reader,” IEEE Transactions on Antennas and Propagation, Vol.63, No.9, pp.(4148-4151), Sept. 2015.

[9] Jui-Han Lu and Sang-Fei Wang, “Planar Broadband Circularly Polarized Antenna with Square Slot for UHF-RFID reader,” IEEE Transactions on Antennas and Propagation, Vol.61, No.1, pp.(45-53), Jan 2013.

[10] Yi-Fang Lin, C. Lee, S. C. Pan and H. M. Chen,“Proximity-Fed Circularly Polarized Slotted Patch Antenna for RFID Handheld Reader,”IEEE Transactions on

©IJRASET: All Rights Reserved

Volume 5 Issue VI, June 2017
ISSN: 2321-9653

Antennas and Propagation, Vol.61, N0.10, pp.(5283-5286), Oct 2013.

[11] Yi-Fang Lin, C. Lee, S. C. Pan and H. M. Chen,"Proximity-Fed Circularly Polarized Slotted Patch Antenna for RFID Handheld Reader,"IEEE Transactions on Antennas and Propagation, Vol.61, N0.10, pp.(5283-5286), Oct 2013.

[12] Zhi-Ning Chen, X. Qing and H. L. Chung, "A Universal UHF RFID Reader Antenna," IEEE Transactions on Antennas and Propagation, Vol.57, No.5, pp.(1275-1282), May 2009.

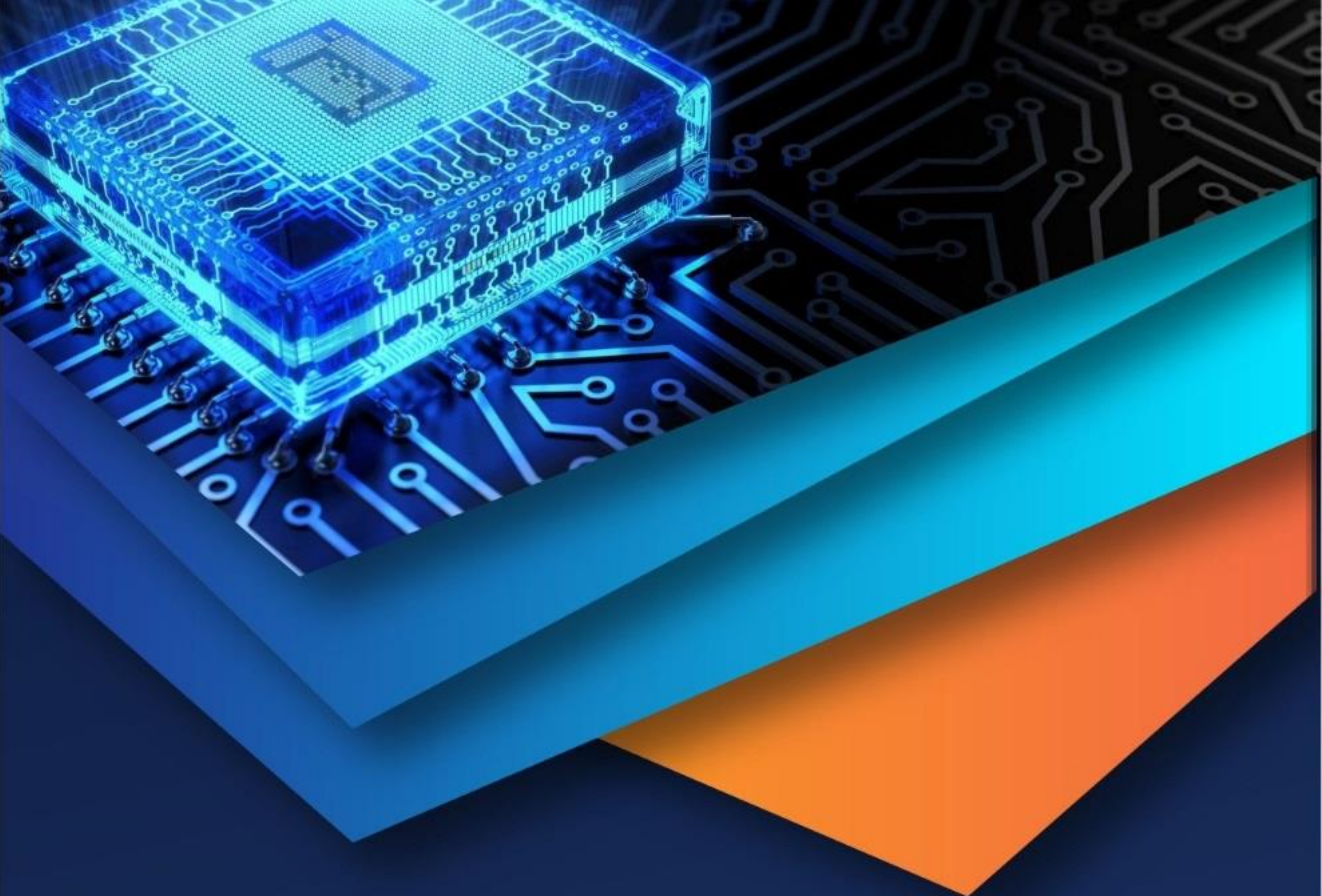
[13] R. Want, "An introduction to RFID technology," IEEE Pervasive Comput., vol. 5, no. 1, pp. 25−33, Jan. 2006.

[14] C. A. Balanis, Antenna Theory: Analysis and Design, 3rd ed. New York, NY, USA: Wiley, 2005.

[15] V. Hunt, A. Puglia, M. Puglia, RFID: A Guide to Radio Frequency Identification, New York, NY, USA: Wiley, 2007.

[16] Sayali J. Pawar and Mandar P. Joshi, "Design of Dual Band Circular Microstrip Patch Antenna with Defected Ground Structure for ISM and WLAN Band Applications," International Journal o Emerging Technology and Advanced Engineering, Vol. 6, pp. (132-136), July 2016.

©IJRASET: All Rights are Reserved



10.22214/IJRASET

INDEX COPERNICUS
45.98

ISRA JIF
IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)