IJETIR

ISSN (Online) 2583-0554

International Journal of Emerging Technologies and Innovative Research (IJETIR)

Volume 5, Issue 12, December 2025

Impact Factor: 5.731

Design and Analysis of Frequency Reconfigurable Microstrip Antenna for Dual Band Operation

Chandrappa D. N[1] and Rajendra Soloni[2]

Associate Professor, Dept. of ECE,

East Point College of Engineering and Technology, Bengaluru, Karnataka, India[1]

Assistant Professor, Dept. of ECE, JIT, Davangere, Karnataka, India[2]

chandrappa@eastpoint.ac.in and rajendrasoloni@gmail.com

Abstract: *A simple dual band frequency reconfigurable microstrip antenna is presented. The proposed antenna can be used for S-band and C-band applications. CST Microwave Studio Suite 2014 is used to implement and simulate the proposed antenna. The effect of slot with two PIN diodes is evaluated and simulation results were analyzed. The antenna is resonating at 2.84 GHz, 2.88 GHZ, 3.19 GHZ, 3.41 GHZ and 4.02 GHz frequencies..*

Keywords: Frequency reconfigurable antenna, PIN Diode, CST MWS.

I. INTRODUCTION

Reconfigurable antennas are must to meet the growing demand for wireless communications and increased bandwidth. Size, cost and required hardware can be reduced by using reconfigurable antenna because conventional antenna only resonate at a single frequency whereas the reconfigurable antenna resonate at different frequencies. Reconfigurable antennas can adapt to one or more of its radiation characteristics in real time, such as the resonant frequency, the bandwidth, the radiation pattern, or even the polarization. There are different ways to achieve these changes, and different techniques have been presented, but all those techniques are based on suitable modifications of the size or shape of the antenna in order to obtain specific radiation performances [1]. PIN diodes or MEMS switches can be used to reconfigure the antenna [2]. Reconfigurability has become an important and desired feature of modern, radio-frequency (RF) systems for wireless and satellite communications [3]. In [4] Slotted reconfigurable antennas for multi-standard personal communication systems, using varactor diodes as switches for 1.71-1.745 GHz and 2.38-2.43 GHz presented, but the designed antenna has very narrow bandwidth.

II. ANTENNA GEOMETRY

CST microwave studio 2014 is used to implement the proposed antenna as shown in figure1. FR-4 (lossy) is used as the substrate material with dielectric constant of 4.3. Patch has the dimension of 36.85X44.29 mm2 and quarter wave transformer method is used to feed the antenna. On the patch a slot is implemented as shown in fig1. By incorporating two PIN diodes (BAP50_02) in the slot frequency reconfigurability is achieved.

IJETIR
ISSN (Online) 2583-0554
International Journal of Emerging Technologies and Innovative Research (IJETIR)
Volume 5, Issue 12, December 2025
Impact Factor: 5.731

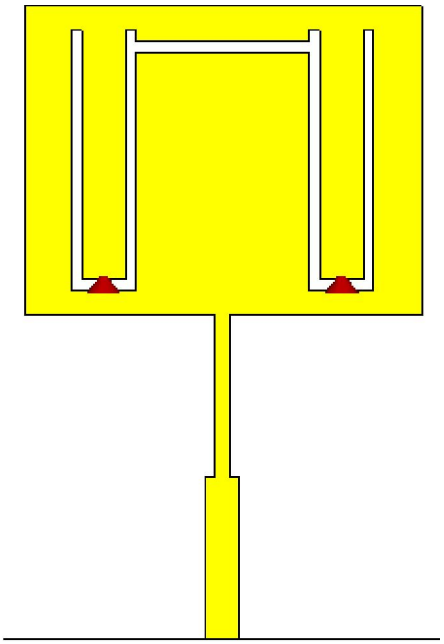

Fig1. The proposed antenna geometry in CST MWS tool

To design the reference antenna following formulae were used [5]:

To find the width of the patch

$$W = \frac{\frac{c}{2f_r}\sqrt{\frac{2}{\varepsilon_r+1}}}{} \quad \text{---------- (1)}$$

Where c = 3 x 10^8 m/s, fr=Resonating frequency and εr= dielectric constant. To find the length of the patch is used to feed the antenna. On the patch a slot is implemented as shown in fig1. By

$$L = Leff - 2\Delta L \quad \text{- (2)}$$

Where

$$\Delta L = 0.412h \frac{\left[\left(\varepsilon_{reff}+0.3\right)\left(\frac{W}{h}+0.264\right)\right]}{\left[\left(\varepsilon_{reff}-0.258\right)\left(\frac{W}{h}+0.8\right)\right]} \quad \text{-----(3)}$$

$$\varepsilon_{reff} = \frac{(\varepsilon_r+1)}{2} + \frac{(\varepsilon_r-1)}{2}\left[1+12\frac{h}{W}\right]^{-0.5} \quad \text{------(4)}$$

$$L_{eff} = \frac{c}{2f_r}\sqrt{\frac{2}{\varepsilon_{reff}}} \quad \text{----------(5)}$$

IJETIR
ISSN (Online) 2583-0554
International Journal of Emerging Technologies and Innovative Research (IJETIR)
Volume 5, Issue 12, December 2025
Impact Factor: 5.731

Table1. Different parameters values for proposed antenna

Parameters	Width (mm)	Length (mm)
Ground/Substrate (Wg, Lg)	73.70	88.58
Patch (W, L)	36.85	28.56
Feeding Line (Wf, Lf)	3.1144	14.9985
Quarter wave Transformer Line (Wt, Lt)	1.2925	15.0144

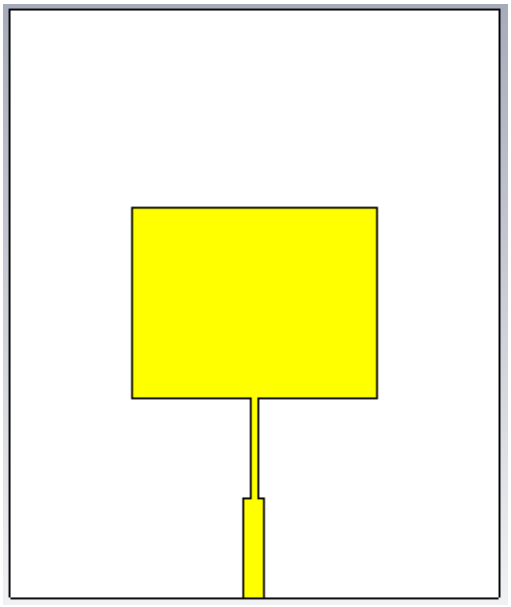

Fig2: The reference antenna

III. RESULTS AND DISCUSSIONS

A. Effect of Spiral Slotted antenna

Patch is modified in the form of square spiral and its performance is evaluated in the CST Microwave studio tool. The figure2 shows its return loss graph.

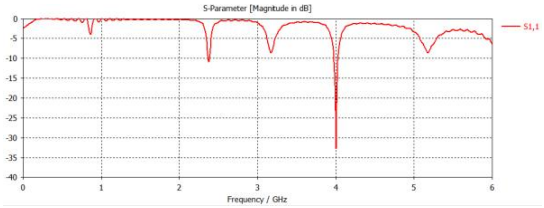

Fig3. Return loss for slotted antenna The slotted antenna is resonating at frequency 4GHz. Return loss is -32 dB, VSWR is 1.05 and bandwidth is 0.056GHZ. Radiation pattern is shown in figure 3.

IJETIR
ISSN (Online) 2583-0554
International Journal of Emerging Technologies and Innovative Research (IJETIR)
Volume 5, Issue 12, December 2025
Impact Factor: 5.731

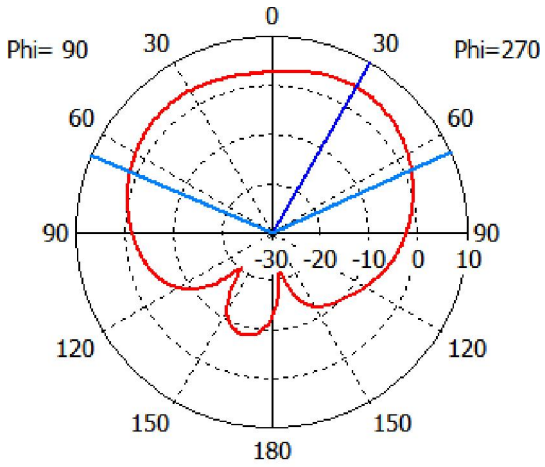

Fig4. Radiation Pattern at f=4 GHz

A. Effect of PIN Diode

PIN Diodes are used as switches as shown in the figure 1. The proposed antenna is configured for five different frequencies. Radiation patterns remain same even though frequency of operation changes. Table1 shows the performance of the simulated slotted antenna with PIN diodes. The figure 5s shows return loss for proposed antenna.

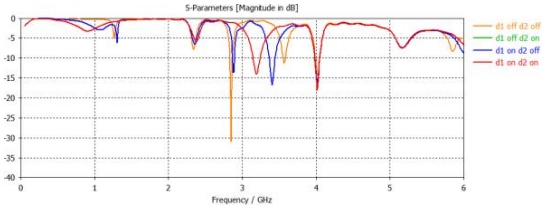

Fig 5: Return Loss for proposed antenna.

Table 1 (a): For D1 OFF D2 OFF configuration

Parameters	D1 OFF D2 OFF	
	For 2.84 GHz	For 4.02GHz
Return Loss (dB)	-24.54	-14.15
Bandwidth (GHz)	0.03	0.05
VSWR	1.9	1.39

Table 1 (b): For D1 ON D2 OFF configuration

Parameters	D1 ON D2 OFF and D1 OFF D2 ON		
	For 2.88 GHz	For 3.41 GHz	For 4.02 GHz
Return Loss (dB)	-13.66	-16.04	-16.03
Bandwidth (GHz)	0.02	0.08	0.06
VSWR	1.88	1.99	1.45

IJETIR
ISSN (Online) 2583-0554
International Journal of Emerging Technologies and Innovative Research (IJETIR)
Volume 5, Issue 12, December 2025
Impact Factor: 5.731

Table 1 (c): For D1 OFF D2 ON configuration

Parameters	D1 ON D2 ON	
	For 3.19 GHz	For 4.02GHz
Return Loss (dB)	-14	-17.9
Bandwidth (GHz)	0.09	0.08
VSWR	1.9	1.39

III. CONCLUSION

The proposed antenna is frequency reconfigurable by using two PIN diodes. The antenna is resonating between 2.84 GHz and 4.02 GHz. The performance of the antenna is evaluated for different parameters like return loss, bandwidth and VSWR. The proposed antenna shows that return loss is <-10 dB with better bandwidth.

ACKNOWLEDGMENT

I express my sincere gratitude to my guide, Dr. Chandrappa. D. N, Professor, Dept. of Electronics and Communication Engineering, G M Institute of Technology, Davanagere, Karnataka for the consistent support in successful completion of this paper.

REFERENCES

[1] Ricardo Gonçalves, Pedro Pinho, and Nuno B. Carvalho, “Compact, Frequency Reconfigurable, Printed Monopole Antenna,” International Journal of Antennas and Propagation, vol. 2012, Article ID 602780, 6 pages, 2012. doi:10.1155/2012/602780

[12] M. F. Ismail, M. K. A. Rahim and H. A. Majid, "The Investigation of PIN diode switch on reconfigurable antenna," RF and Microwave Conference (RFM), 2011 IEEE International, Seremban, Negeri Sembilan, 2011, pp. 234-237.

[3] Christodoulou, C.G.; Tawk, Y.; Lane, S.A.; Erwin, S.R., "Reconfigurable Antennas for Wireless and Space Applications," Proceedings of the IEEE, vol.100, no.7, pp.2250, 2261, July 2012

[4] Chandrappa D.N., Mrs.Vani R.M. and P.V. Hunagund “Design and Implementation of Slotted Reconfigurable Microstrip Antenna for Wireless Application”, International Journal of Electronics and Communication Engineering. ISSN 0974-2166 Volume 6, Number 3 (2013), pp. 233-239

[5] C.A. Balanis, Antenna Theory Analysis and Design, Third Edition, New Jersey: J. Wiley & Sons, 2005