IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 16, Issue 2, Ser. II (Mar - Apr 2021), PP 19-23
www.iosrjournals.org

Co-axial fed Rectangular Tri-slot Enhanced Microstrip Antenna

Rajeshri Gore [1]
VDF School of Engineering & Technology Latur, India, 413 531

Abstract : *We simulated and presented tri-band co-axial fed microstrip patch antenna for wireless communication application. In proposed microstrip antenna, it has been found that the rectangular slot dimension of patch and feed position of patch have clear impact on good performance of antenna. . We introduced three rectangular slot on patch to achieve desired narrow band of proposed antenna. We demonstrated many antenna structures to study of these parameters on the resulting dual-band response. In this paper, we designed tri-band microstrip rectangle antenna with slot antenna using co-axial-fed technique, it support the three wireless communication bands that is (2.28-2.35 GHz), (4.05-4.11 GHz) and (5.8-5.9) GHz.*

Keywords - *Tripleband Microstrip Antenna, bandwidth enhancement, and co-axial feed technique.*

Date of Submission: 10-04-2021 Date of Acceptance: 26-04-2021

I. Introduction

Rapid development of wireless communication and microstrip antenna it has been found that, analysis of Microstrip antenna with co-axial and line-feed technique, microstrip patch Antenna experimentally optimize antenna parameters and decreases the Return Loss up to -35dB for the frequency range to operate for Bluetooth antenna in frequency range 2.4 GHz to 2.5GHz and VSWR is less than 1.5 by using RT DUROID 5880[1]. In further study of optimization of dual band microstrip antenna [2] it has been found that the return loss for dual band Frequency at 2.4GHz is -43dB and at 3GHz is -27dB and acceptable VSWR. To get compact size and maintain performance of antenna for multiple band that is dual band, triple band antenna etc., various shapes of antenna was integrated [3]. It was presented in [4], introducing slot into patch that is L-Shape, experimentally increase bandwidth up to 13%. To enhance bandwidth further various shapes like L-shape, U-shape etc., slot was introduced and bandwidth up to 42% was increased [5,6]. In [7] and [8] the author's proposed bandwidth enhancement techniques that is by using photonic band gap structure and wideband stacked microstrip antennas respectively. By introducing stacked microstrip antenna band width and gain was enhanced. While Designing of symmetrical microstrip antenna, it has been found that microstrip antenna has narrow Bandwidth [9], Asymmetrical position of patch antenna on ground affect the performance of antenna that is to enhance bandwidth it was also found that asymmetrical position of slot on patch affects performance of antenna [10] that is asymmetrical L-shape, U- shape position of slot on patch affects the performance. In [10] designed asymmetrical slot of L-shaped on patch antenna for UWB application with acceptable return loss that is -10dB and peak gain 2.2 to 6.1 dBi for operating bandwidth 3.01-11.30 GHz frequencies. In this paper we simulated and presented our design by using HFSS.13 simulator. In this paper a line feed patch with three rectangle slot microstrip antenna with two ant symmetrical notch (Figure 1) is designed and simulated for the frequency range of 1-6 GHz.

II. Proposed Design

In proposed tri band microstrip patch antenna verified in HFSS Simulator with optimization. Initially, microstrip antenna was designed for dual \ band further it is designed and optimized for tri band; simulation setup is shown in Figure 1. Actual patch shape of size 24mm X 24mm is shown in figure 2, it consists of two rectangular notch of size 0.2mmx12.5mm, using this two slot on patch side of antenna .we designed single band antenna with acceptable performance parameter. We further introduced central rectangular notch of size 13.4x1.0 mm to optimize and operate antenna for dual band. [7]. The resulting antenna structure has the following parameters; the patch shape length Wp = 12 mm, and its width Lp =12 mm. The size of the ground plane has been found to be of Lg1 = 12 mm and Wg_1 = 12 mm. The height of substrate is h= 0.8 mm and dielectric constant ε_r = 4.4. A co-axial fed at 10x10mm distance from corner of patch. The length and width of center slot is 1.0mm x 13.4mm.

Initially, we will conduct a simulation study on the structure of Figure 1 by adjusting the dimension of slot that is position of fed line to patch. Initially we put ground position for entire patch. As we reduce ground material, it is found that return loss is getting reduced from -10dB to -18dB. The ground substrate length on backside of patch is reduced and simulated for different dimension; it is observed that we get two band (2.28-2.35 GHz) and (4.05-4.11 GHz) with sufficient return loss, the resulting return loss responses obtained by reducing ground plane, we obtain optimized return loss as presented in figure 3.

Table 1: Optimization parameter

Parameter	Actual dimension (in mm)	Optimized dimension	Optimized return loss
Wp	12.5	12.0	29
Lp	12.5	12.0	27
Lg1	12.5	12.0	27
Wg1	12.5	12.0	25

Further we simulated to get third band, we introduced two rectangular slot (Ls as shown in figure 3) on patch, we simulated for different dimension of rectangular slot on patch to get optimum result, dimension of rectangular changes from 0.8x12mm to 1.2x12mm and return loss is presented in figure 3. Further we changed the dimension of central slot from 0.1x13.4 mm to 0.8x13.4 mm (Ls in figure 4), return loss is presented in figure 4. Table 1 presents actual and optimized parameter.

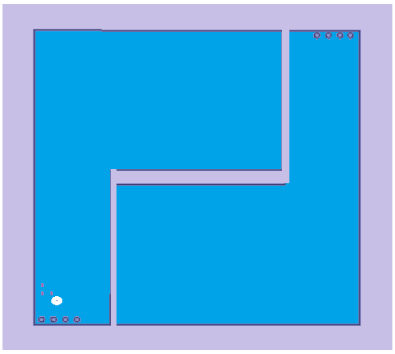

Figure 1. Proposed antenna simulation setup

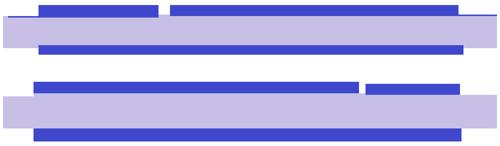

Figure 2: Proposed antenna design (Ground)

III. Result Analysis

In this section parametric study is conducted to optimize the proposed antenna. The key design parameters used for the optimization are number of slot on patch, dimension of ground plane (length and width) and fed position. The detailed analysis of these parameters is investigated in the following paragraphs of this section. From figure 3 and figure 4, it is observed that, we get minimum return loss that is -25dB, and -22 dB at 2.3GHz and 4.07 GHz respectively.

We enhanced this designed dual microstrip antenna for multiband application that is we analyzed for third band, by adjusting position of fed line, feed line position by 0.1 mm from 9.5x10.5 to 10x10.5mm performance is presented in figure 5.It is observed that antenna is good candidate to operate for tri band frequency response.

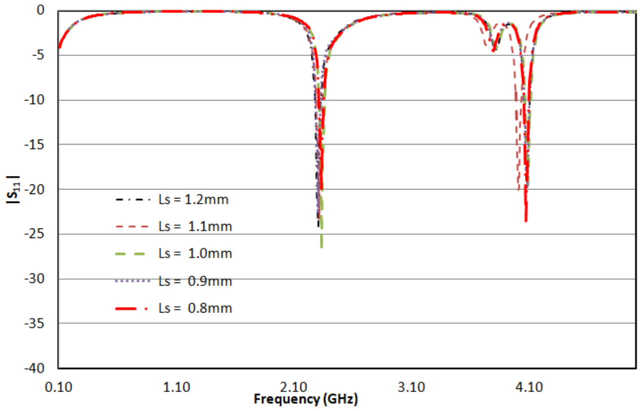

Figure 3: Return loss of antenna for variation in slot

Results of the variation of the size of the ground plane, as Figure 3 implies that the dual band response increases for slot dimension reduction by introducing slot into it. However, dual-band responses are obtained with increased or decreased higher resonating bands. The effect of the width of ground has been demonstrated in Figure 3, and Figure 4. Also figure 5 implies that there is clear impact of feed line position on multiband response of antenna

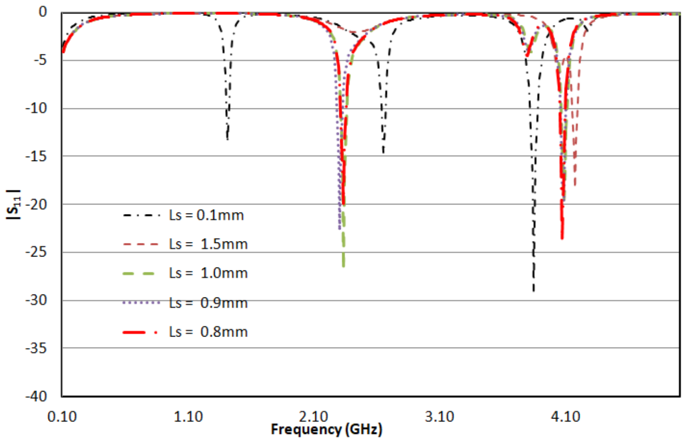

Figure 4: Return loss of antenna for variation in ground plane

For larger values of the width of ground, the antenna offers a one-band resonant behavior, and the dual-band resonance occurs as the width is made smaller and approaches that of the reference antenna.

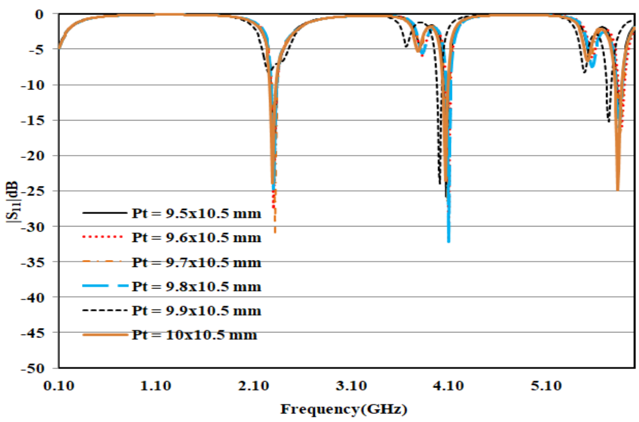

Figure 5: Return loss of antenna for variation fed position

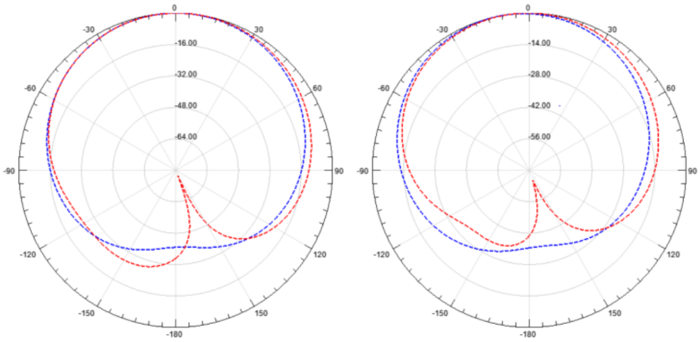

Figure 6: E-Field and H-Field Radiation pattern at 2.3GHz (Red: θ=0°, Blue: Φ=90°)

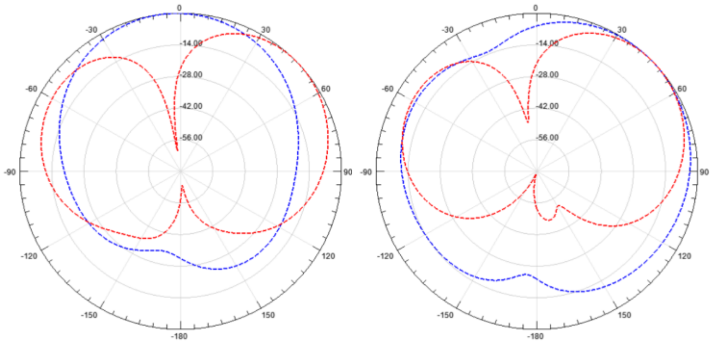

Figure 7: E-Field and H-Field Radiation pattern at 4.05GHz (Red: θ=0°, Blue: Φ=90°)

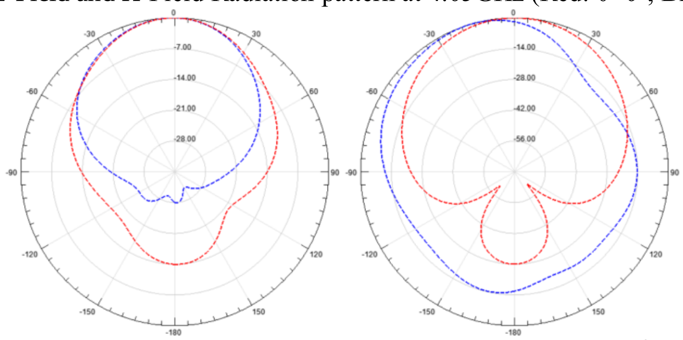

Figure 8: E-Field and H-Field Radiation pattern at 5.85 GHz (Red: θ=0°, Blue: Φ=90°)

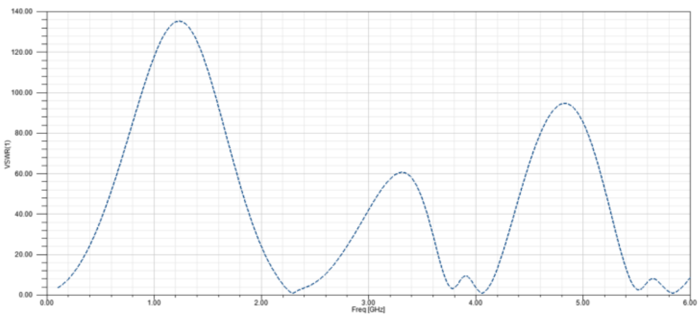

Figure 9: VSWR

Figure (6)-(8) depicts the radiation pattern for tri band that is at 2.3GHz, 4.07GHz and 5.85GHz frequency since return loss at this frequency is -25dB, -24dB and -27dB respectively. Figure (9) represents VSWR for all band, VSWR is less than 2 for all band that is good matching between feed line patch. Table 1 presents optimized result of microstrip antenna.

Table 1. Simulation Result

Frequency	Return loss	VSWR	Efficiency
2.35-2.4 GHz	-27	1.2	97%
4.1-4.21 GHz	-26	1.2	95%
5.85-5.95GHz	-28	1.3	95%

IV. Conclusion

The design optimization of a two slot patch antenna has been presented and discussed. It has been shown that, with correct selection of slot dimensions on patch and shape of ground plane, a tri band frequency response can be achieved. With this antenna, we get much improved performance this design is obtained method, as a candidate for use tri band that is (2.35-2.4 GHz) , (4.1-4.21 GHz) and (5.85-5.95) GHz. The antenna has been modeled and its performance has been analyzed using a HFSS simulator. The proposed antenna has been found to possess a miniaturized size and a width making it suitable for compact size narrow bandwidth tri band applications

References

[1]. Ahmed H. Reja "Study of Micro Strip Feed Line PatchAntenna", Antennas and Propagation International Symposium, vol. 27, pp. 340-342 December 2008..

[2]. Sahntanu Kumar Behera and Y. Choukiker, "Design andOptimization of Dual Band Micro Strip Antenna Using Practicle Swarm Optimization Technique," Springer Science Business Media, LLC, pp. 1346-1354, 2010

[3]. M. A. S. Alkanhal, "Compact composite triple band antenna", Progress In Electromagnetics Research, PIER 93, 221-236, 2009

[4]. A. A. Deshmukh and G. Kumar, "Compact broadband gapcoupled shorted L-shaped microstrip antennas," IEEE Antennas and Propagation International Symposium, vol 1, (Baltimore, Maryland), pp. 106–109, IEEE, July 2001.

[5]. Z. M.Chen and Y. W. M. Chial, "Broadband probe-fed Lshaped plate antenna," Microwave and Optical Technology Letters, vol. 26, pp. 204–206, 1985.

[6]. K. F. Lee, K. M. Luk, K. F. Tong, Y. L. Yung, and T.Huynh, "Experimental study of the rectangular patch with a U-shaped slot," IEEE Antennas and Propagation International Symposium, vol.1, (Baltimore, Maryland), pp. 10–13, IEEE, July 1996.

[7]. S. C. Gao, L. W. Li, M. S. Leong, and T. S. Yeo, "Designand analysis of a novel wideband microstrip antenna," IEEE Antennas and Propagation International Symposium,vol.1, (Boston, Massachusetts), pp. 90–93, IEEE, July 2001.

[8]. M. Khodier and C. Christodoulou, "A technique to furtherincrease the bandwidth Of stacked microstrip antennas," IEEE Antennas and Propagation International Symposium, vol. 3, pp. 1394–1397, IEEE, July 2000.

[9]. Neenansha Jain, Anubhuti Khare, Rajesh Nema, "E-ShapeMicro strip Patch Antenna on Different Thickness for pervasive Wireless Communication", International Journal of Advanced Computer Science and Applications, Vol. 2, No. 4, 2011

[10]. K. Song, Y.-Z. Yin, S.-T. Fan, and B. Chen," compact open ended L-shaped slot antenna with asymmetrical rectangle patch for UWB application", Progress In Electromagnetics Research C, Vol. 19, 235-243, 2011

[11]. V.V.Reddy, N. V. S. N. Sarma, "Triband Circularly Polarized Koch Fractal Boundary Microstrip Antenna", IEEE antennas and wireless propagation letters, vol. 13, 2014

[12]. T.-H. Chang and J.-F. Kiang, "Compact multi-band H-shaped slot antenna,"IEEE Trans. Antennas Propag., vol. 61, no. 8, pp. 4345–4349,

[13]. K. Song, Y.-Z. Yin, S.-T. Fan, and B. Chen, "compact open-ended l-shaped slot antenna with asymmetrical rectangular patch for UWB applications", Progress In Electromagnetics Research C, Vol. 19, 235-243, 2011

[14]. Zijian Shao, Yue Ping Zhang, "Miniaturization of Differentially-Driven Microstrip Planar Inverted F Antenna", IEEE Transactions On Antennas And Propagation, 0018-926X (c) 2018.

Rajeshri Gore . "Co-axial fed Rectangular Tri-slot Enhanced Microstrip Antenna ." *IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)* 16(2), (2021): 19-23.