

Line-fed Triband Patch Antenna with Octagonal slot

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Abstract : We presented triple band line-axial fed microstrip patch antenna for wireless communication application. In proposed design, it has been found that the slot dimension of patch and feed position of patch have clear impact on good performance of antenna. We introduced octagonal slot on patch and rectangular slot on ground plane of antenna, to achieve desired band of proposed antenna. We demonstrated many antenna structures to study of these parameters on the resulting tri band response. In this paper, we designed tripple-band microstrip rectangle antenna with slot antenna using line-fed technique, it support the three wireless communication bands that is (5.31-5.62 GHz), (6.41-6.72 GHz) and (7.21-7.55GHz).

IndexTerms– Tripleband Microstrip antenna, bandwidth enhancement, line feed technique

I. INTRODUCTION

With rapid development of micro strip antenna it has been found that, Study of Micro Strip antenna with symmetrical Feed Line technique, Patch Antenna experimentally increase the Return Loss up to -33dB at frequency range 2.4 GHz to 2.5GHz and VSWR is less than 1.5 by using RT DUROID 5880[1]. With further study and 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 two rectangle slot microstrip antenna with two symmetrical triangular notch (Figure 1) is designed and simulated for the frequency range of 1-12 GHz. This antenna presents an extension to Triband Circularly Polarized Microstrip Antenna [11]. The proposed antenna has a gain of 1.8 dBi.

II. PROPOSED DESIGN

The results of proposed triple band microstrip patch antenna verified in HFSS Simulator with optimization. The initial antenna simulation setup is shown in Figure 1. Actual patch shape is shown in figure 2, it consists octagonal notch on patches side and rectangular plane opposite side as a ground plane as shown in figure 3. The resulting antenna structure has the following parameters; the patch shape length $W_p = 26.6$ mm, and its width $L_p = 19.67$ mm. The size of the ground plane has been found to be of $L_{g1} = 38$ mm and $W_{g1} = 31$ mm. The height of substrate is $h = 1.6$ mm and dielectric constant $\epsilon_r = 4.4$. A line fed at center of with width of 2.6mm.

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 three band (5.31-5.62 GHz), (6.41-6.72 GHz) and (7.21-7.55GHz) with sufficient return loss, the resulting return loss responses obtained by reducing ground plane, we obtain optimized return loss as presented in figure 4. Further we simulated to get enhancement in return loss, we simulated for different length of ground plane as presented in figure 4. From figure 4 it is observed that tri band results are optimum at 38mm length of ground plane. It is observed return loss for triband is -19dB, -15dB and -27dB at (5.31-5.62 GHz), (6.41-6.72 GHz) and (7.21-7.55GHz) respectively.

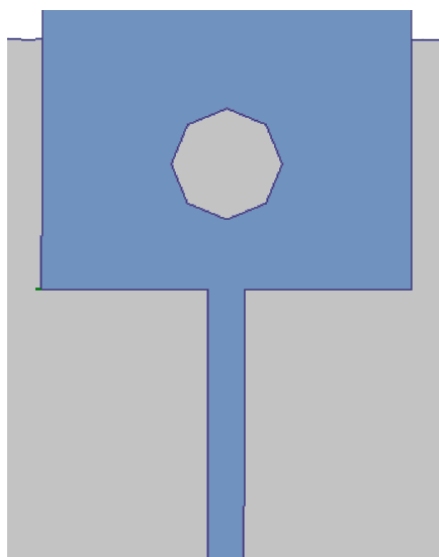


Figure 1. Proposed antenna simulation setup

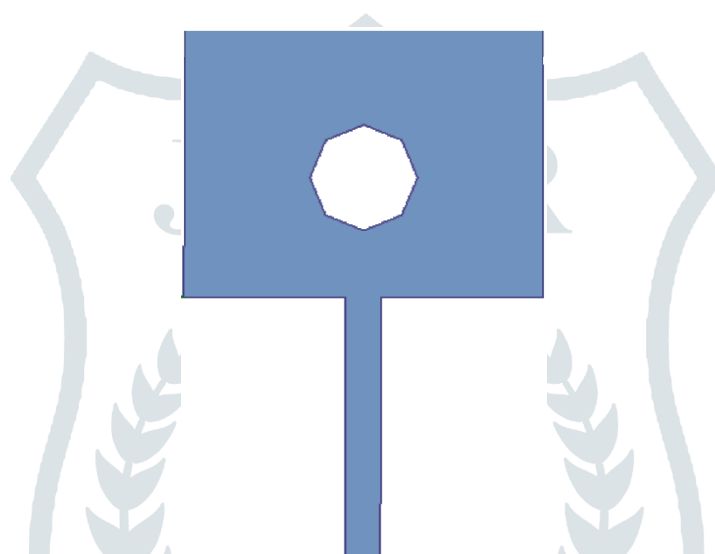


Figure 2. Proposed antenna design (Patch)

Further we simulated for enhancement of by changing width of ground plane form 27mm to 35mm, return loss is presented in figure 5, it observed that at 31mm width antenna operates with enhanced result. In this study we get minimum return loss -35dB, -20dB, and -37dB for respective tri band.

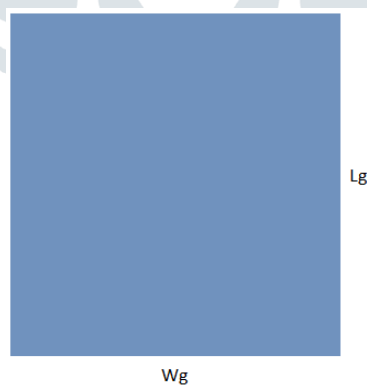


Figure 3. Proposed antenna design (Ground)

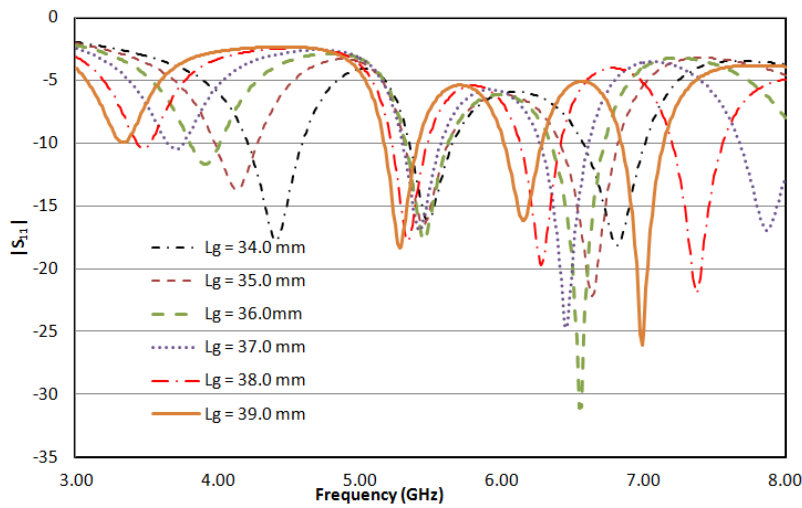


Fig 4: Return loss of antenna for variation in length of ground

Results of the variation of the size of the ground plane, as Figure 4 implies that the triple band response increases with reduction in ground plane.

However, tri-band responses are obtained with increased or decreased higher resonating bands. The effect of the width of ground has been demonstrated in Figure 4, and Figure 5.

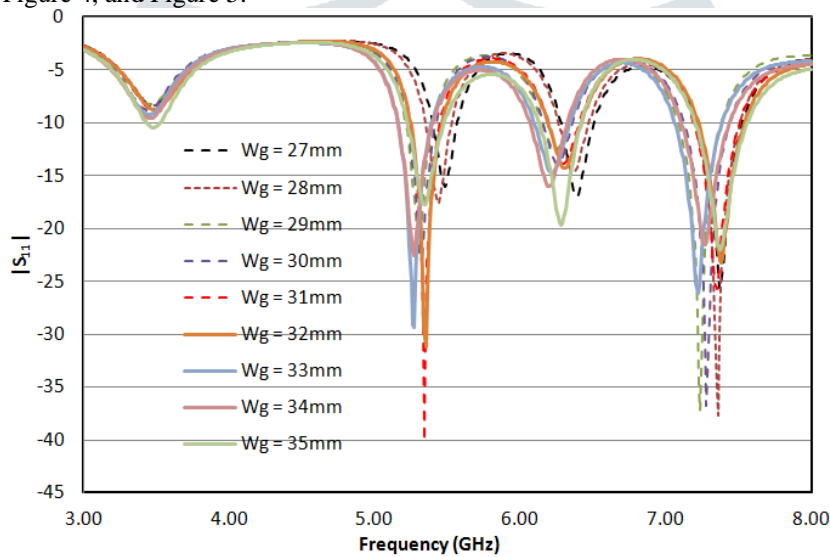


Fig 5: Return loss of antenna for variation in width of ground

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

We further simulated for patch dimension that is length of patch varied from 24mm to 29mm, we observed optimum result at 26.6mm, which is at this dimension we observed minimum return loss.

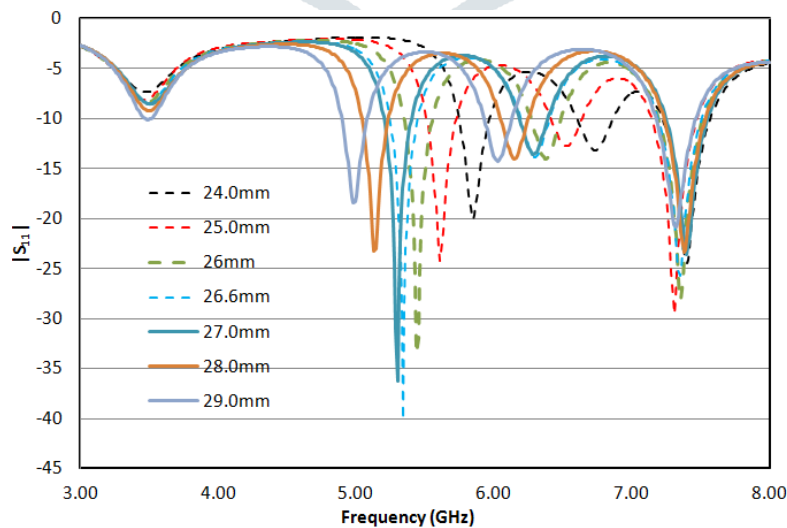


Fig 6: Return loss of antenna for variation in patch dimension

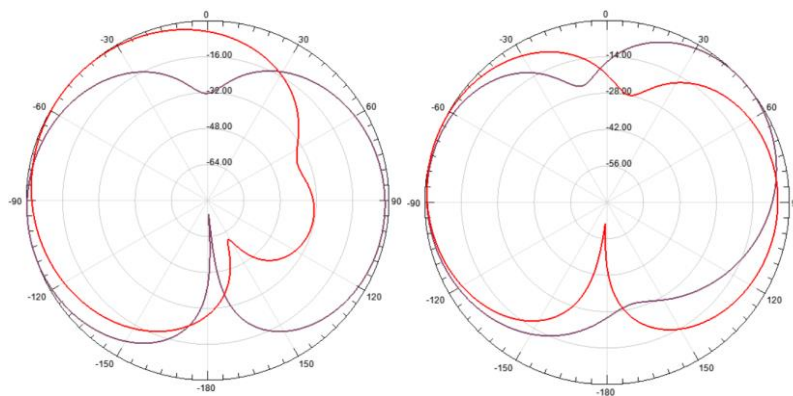


Fig. 7 Radiation pattern at 5.41 GHz

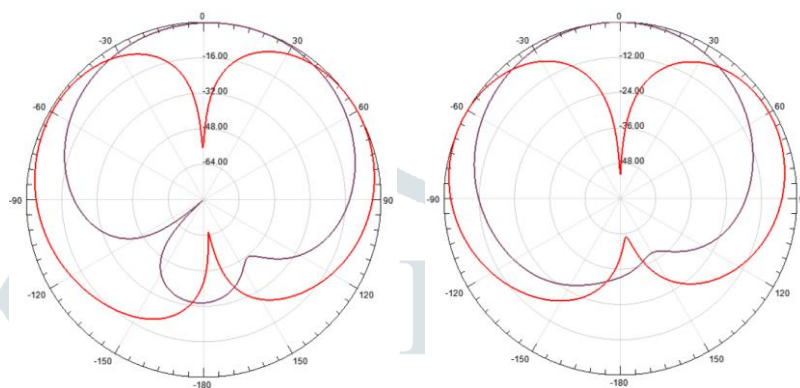


Fig. 8 Radiation pattern at 6.55 GHz

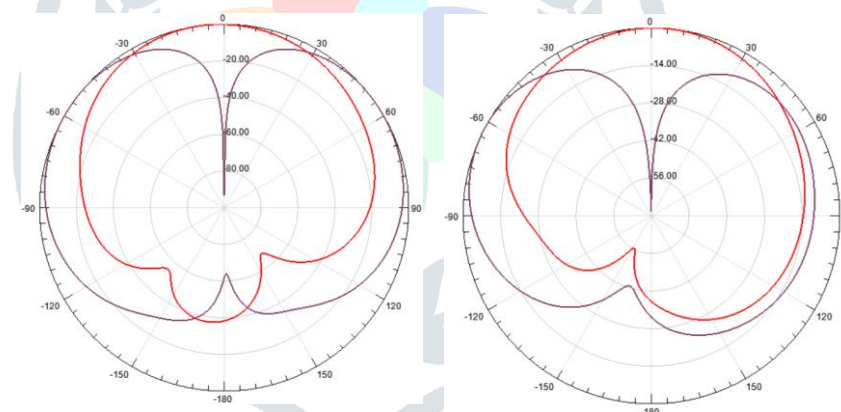


Fig. 9 Radiation pattern at 7.31GHz

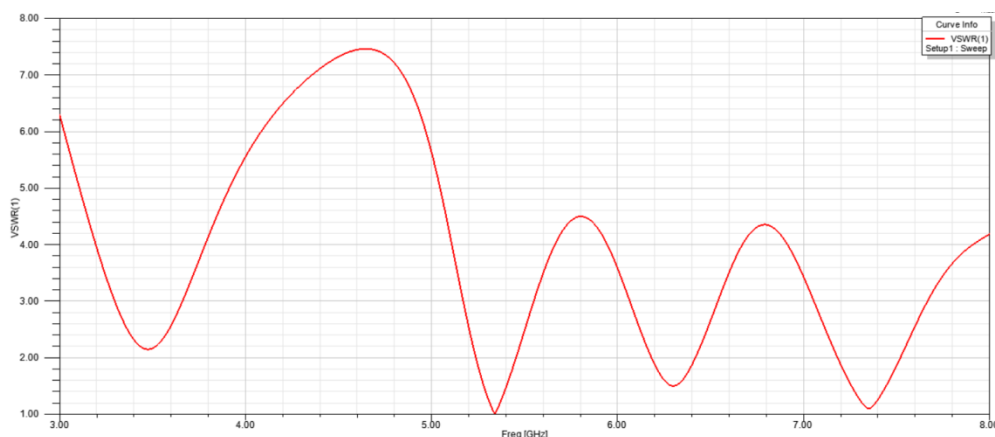


Fig. 10 VSWR

Figure (7)-(9) depicts the radiation pattern for tri band that is at 5.41 GHz, 6.55 GHz, and 7.31GHz frequency since return loss at this frequency is -20dB, -20dB and -27dB respectively.

Figure(10) represents VSWR for all band, VSWR is less than 2 for all band that is good matching between feed line patch.

III. COCLUSION

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 (5.31-5.62 GHz), (6.41-6.72GHz) and (7.21-7.55GHz).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 tripple band applications. The simulated results of HFSS at 5.51 GHz is Return loss = -15dB, at 6.51 GHz Return loss = -18 dB, and at 7.41 GHz Return loss = -31dB. VSWR at 5.51 GHz is 1.8, Gain = 1.3dBi at 2.1 Hz Efficiency= 91%..

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