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CPW-fed Triband Patch Antenna with Enhanced Bandwidth

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Abstract

We presented triple band line fed microstrip patch antenna for wireless communication application. In proposed design, it has been found that the ground dimension and feed position of patch have clear impact on bandwidth of antenna. We introduced one rectangular slot and one L-shape slot on ground plane of antenna, to enhance the bandwidth of mictrostrip antenna. Adjusting the dimension of ground plane and patch, its enhanced bandwidth at primary and secondary resonance mode can increased sufficiently to achieve desired bandwidth of proposed antenna. We demonstrated many antenna structures to study of these parameters on the resulting tri band response. In this paper, we designed triple-band microstrip rectangle antenna with slot antenna using line-feed technique, it support the three wireless communication bands that is (1.2-3.1 GHz), (4.9-6.8 GHz) and (9.6-10.6GHz)

Keywords:— *Triple band 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 WORK

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(a). Actual patch shape is shown in figure 1(b), it consists of two triangular notch on both side of patch and two opposite rectangular slot symmetrical to each other at the center of patch. Each end and placed within the patch [7]. The resulting antenna structure has the following parameters; the patch shape length Wp = 9 mm, and its width Lp =10 mm. The size of the ground plane has been found to be of Lg1 = 25mm and Wg_1 = 25mm. The height of substrate is h= 0.8 mm and dielectric constant εr = 4.4. A line feed is attached to the microstrip and has a length 8.37 and width 1.5mm. The length and width of four rectangle-slot that is S is 15mm and 1.5mm respectively. The two sides of the square patch are replaced with triangular notch, opposite notch are of same angle that is X1= 45° [11].

Initially, we will conduct a simulation study on the structure of figure 1(a) by adjusting the dimension of slot S that is position of feed line to patch. The resulting dimension of slot after simulation antenna structure is S= 14.35. 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 -25dB. The ground substrate length on backside of patch is reduced and simulated for different dimension; it is observed that we get two band (1.1-3.1 GHz), and (4.9-6.8 GHz) with sufficient return loss, the resulting return loss responses obtained by reducing ground plane, we obtain optimized return loss as presented in figure 2. Further we simulated to get third band, we introduced two rectangular slot on patch, we simulated for different dimension of rectangular slot on patch to get third band, dimension of rectangular slot for third band is 6mm × 1mm, in this case it observed that we get first, second and third band with sufficient return loss, the resulting return loss presented in figure 3.

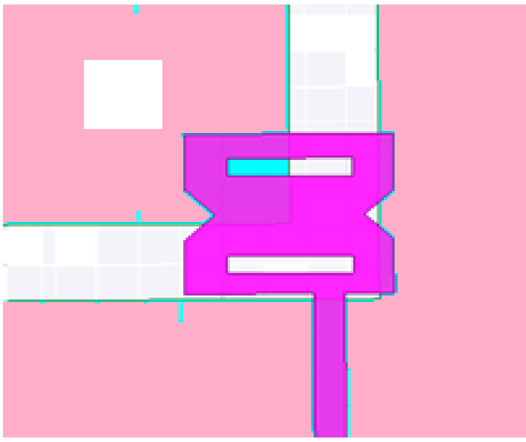

Figure 1(a). Proposed antenna simulation setup

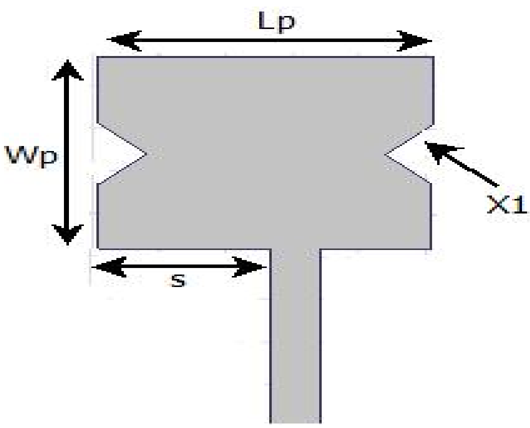

Figure 1(b). Proposed antenna design(Patch)

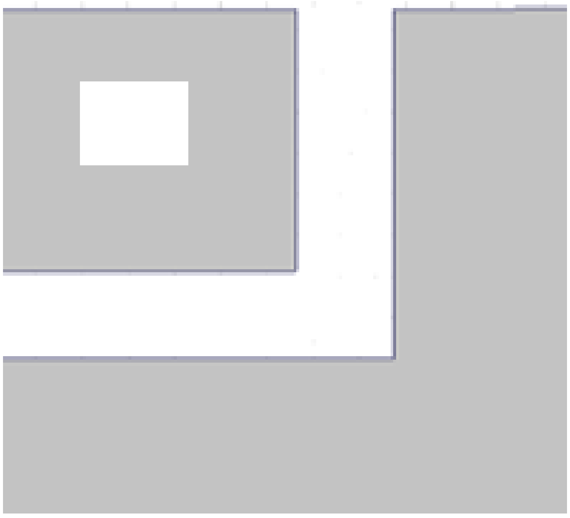

Figure 1(c). Proposed antenna design(Ground)

From figure 2 and figure 3, it is observed that, we get minimum return loss that is -20dB, -20dB, and -27dB at 2.1GHz, 3.9GHz, and 9.9GHz respectively.

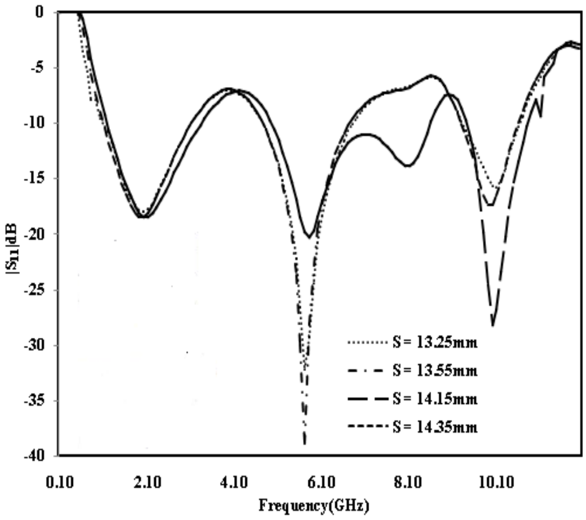

Figure 2: Return loss of antenna for variation in slot

Results of the variation of the size of the ground plane, as figure 2 implies that the triple band response increases for ground plane reduction by introducing slot into it.

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 2, and figure 3.

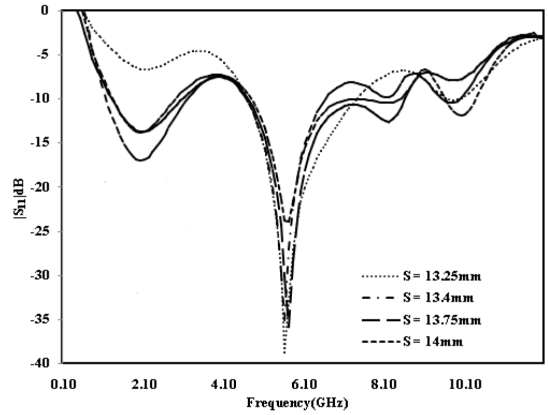

Figure 3: Return loss of antenna for variation in ground plane

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

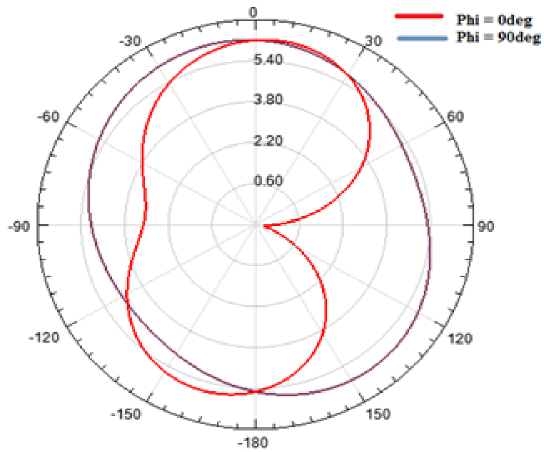

Figure 4: Radiation pattern at 2.1GHz

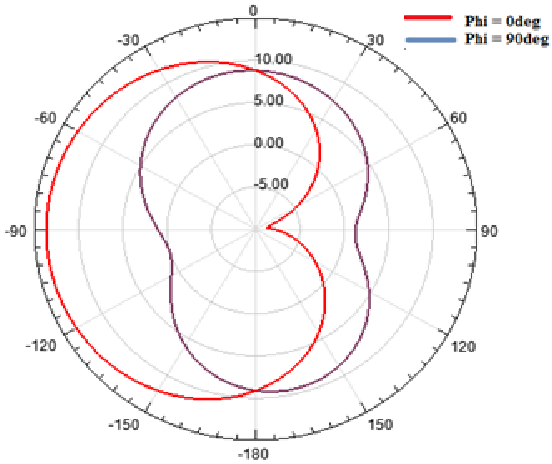

Figure 5: Radiation Pattern at 3.9GHz

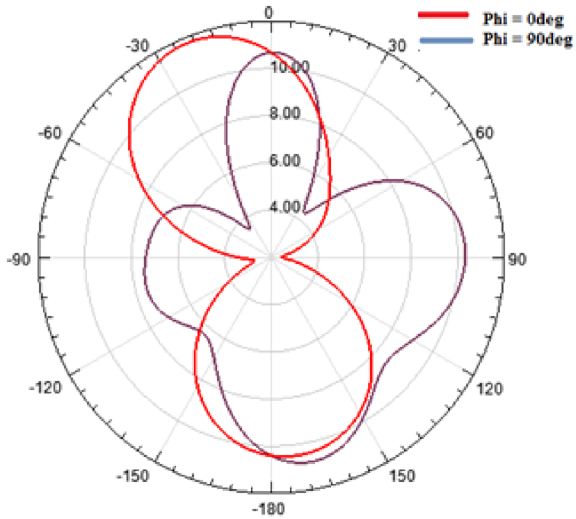

Figure 6: Radiation pattern at 9.9GHz

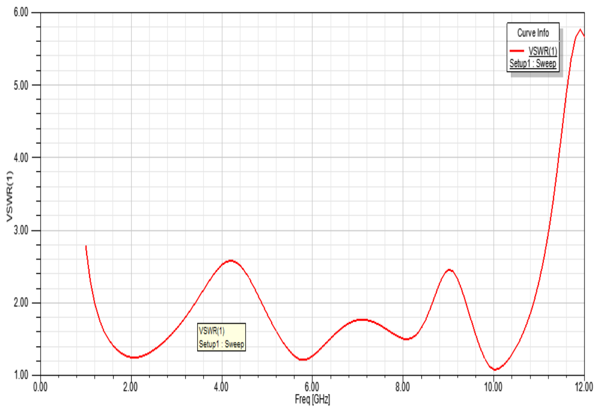

Figure 7: VSWR

Figure 4 to figure 6 depicts the radiation pattern for tri band that is at 2.1GHz, 3.9GHz, and 9.9GHz frequency since return loss at this frequency is -20dB, -20dB and -27dB respectively.

Figure 7 represents VSWR for all band, VSWR is less than 2 for all band that is good matching between feed line patch.

III. 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 bandwidth this design is obtained method, as a candidate for use tri band that is (1.2-3.1 GHz), (4.9-6.8 GHz) and (9.6-10.6GHz)

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 enhanced bandwidth triple band applications. The simulated results of HFSS at 2.1 GHz is Return loss = -20dB, at 3.9GHz Return loss = -20 dB, and at 9.9 GHz Return loss = -27dB. VSWR at 2.41 GHz is 1.5, Gain = 1.3dBi at 2.1 GHz Efficiency= 88%.

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