Co-axial fed Dual-band patch antenna with narrow Bandwidth

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Abstract : We simulated and presented two band co-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 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 two-band microstrip rectangle antenna with slot antenna using co-axial-fed technique, it support the two wireless communication bands that is (2.28-2.35 GHz) and (4.05-4.11 GHz).

IndexTerms– Dual-band Microstrip antenna, narrow band antenna, co-axial fed antenna.

I. INTRODUCTION

With 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 two rectangle slot microstrip antenna with two antisymmetrical notch (Figure 1) is designed and simulated for the frequency range of 1-5 GHz. This antenna presents an extension to Miniaturization of Differentially-Driven Microstrip Planar Inverted F Antenna [11]. The proposed antenna has a gain of 1.8 dBi.

II. PROPOSED DESIGN

The results of proposed dual band microstrip patch antenna verified in HFSS Simulator with optimization. Initially, microstrip antenna was designed for single band further it is designed and optimized for dual band, simulation setup is shown in Figure 1. Actual patch shape of size 25mm X 25mm 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 13.4x1.0mm to optimize and operate antenna for dual band. [7]. The resulting antenna structure has the following parameters; the patch shape length Wp = 12.5 mm, and its width Lp =12.5 mm. The size of the ground plane has been found to be of Lg1 = 12.5 mm and Wg_1 = 12.5mm. 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. 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 0.8x12.5mm to 1.2x12.5mm 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.

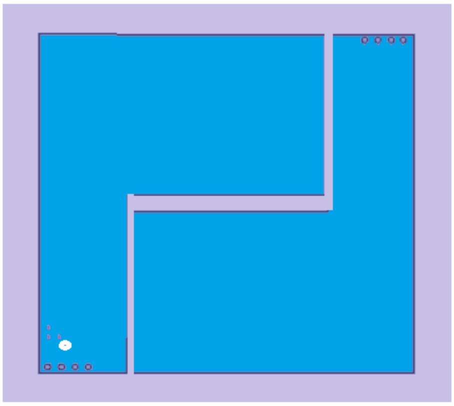

Figure 1. Proposed antenna simulation setup

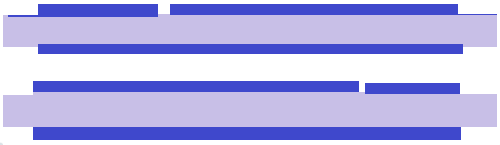

Figure 2: Proposed antenna design (Ground)

III. RESULT ANALYSIS

From figure 3 and figure 4, it is observed that, we get minimum return loss that is -18dB, and -31dB at 2.3GHz and 4.07GHz respectively.

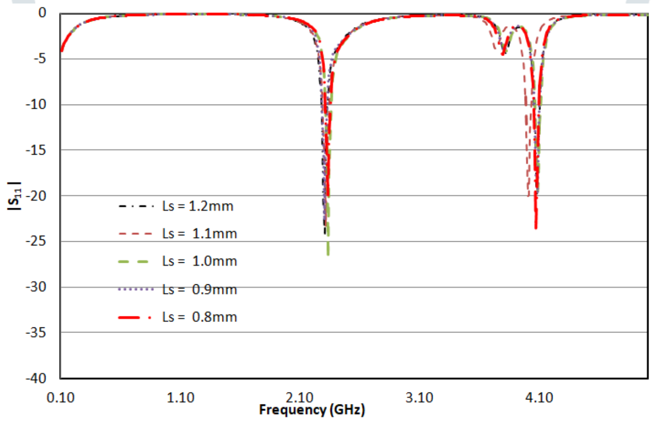

Fig 3: Return loss of antenna for variation in slot

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.

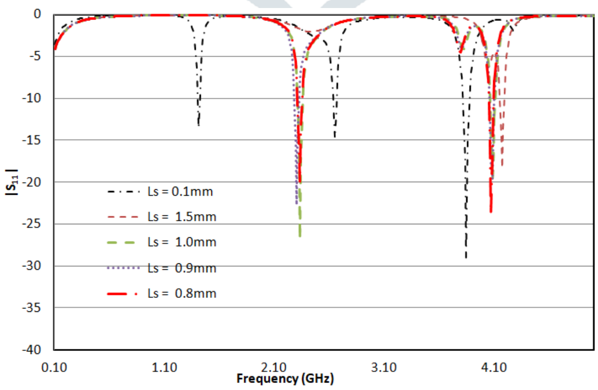

Fig 4: Return loss of antenna for variation in ground plane

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.

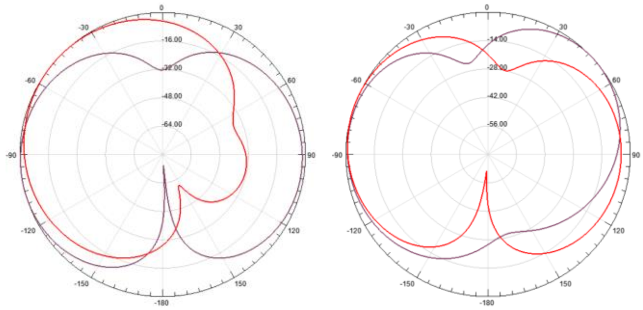

Fig. 5 Radiation pattern at 2.3GHz

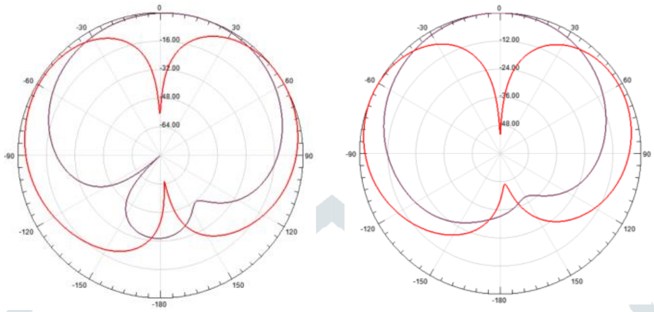

Fig. 6 Radiation pattern at 4.07GHz

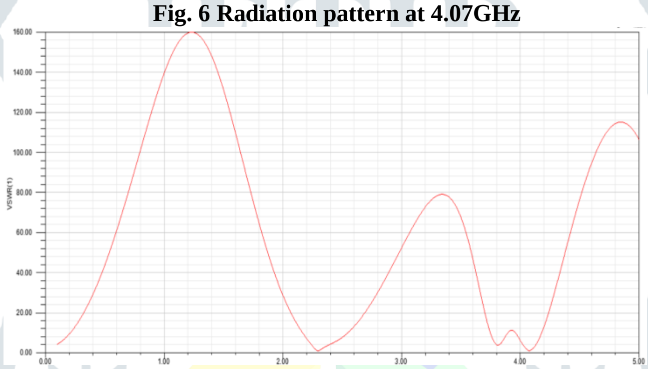

Fig. 7 VSWR

Figure (5)-(6) depicts the radiation pattern for tri band that is at 2.3GHz and 4.07GHz frequency since return loss at this frequency is -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. Table 1 presents optimized result of microstrip antnna.

Frequency	Return loss	VSWR	Efficiency
2.28-2.35 GHz	-27	0.9	95%
4.05-4.11 GHz	-24	1.1	94%

Table 1. Simulation Result

IV. 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 dual band frequency response can be achieved. With this antenna, we get much improved performance this design is obtained method, as a candidate for use dual band that is (2.28-2.35 GHz) and (4.05-4.11 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 dual band applications. The simulated results of HFSS at 2.30 GHz is Return loss = -21dB, at 4.07 GHz Return loss = -18 dB, and at 11.64 GHz Return loss = -31dB. VSWR at 2.31 GHz is 1.2, Gain = 1.4dBi at 2.3 GHz Efficiency= 91%.

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