ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 2, February 2015

Parallel Slot Loaded Proximity Coupled Equilateral Triangular Microstrip Antenna for Dual Band Operation

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ABSTRACT: In this paper a compact wideband dual-frequency microstrip antenna is proposed. By arranging two parallel slot on proximity coupled equilateral triangular microstrip antenna(PSPCETMSA) operating at dual frequency at 3.07 and 6.22 GHz with the impedance band width of 10.49% (311MHz) and 5.37% (333MHz) respectively is presented, which is suitable for Mobile Wimax (Worldwide Interoperability for Microwave Access) IEEE 802.16 and Fixed Wimax IEEE 802.16 applications. The antenna gives broadside radiation characteristics at each resonating frequency. This antenna is simulated by using Ansoft HFSS electromagnetic simulation software. A design concept of the antenna is given and simulated results are presented and discussed.

KEYWORDS: Equilateral triangular microstrip antenna, Proximity coupled, Parallel slot, bandwidth, radiation pattern.

I. INTRODUCTION

Microstrip patch antennas are widely implemented in many applications in wireless communication due to their attractive features. Therefore they are extremely compatible for embedded antennas in handheld wireless devices. Some of their principal advantages are light weight, low volume, low fabrication cost, easy to mount, low profile, conformal, linear and circular polarization possible, easy to implement by position of feed, dual frequency use possible, solid state devices easily integrated [1]. The patch using a simple proximity coupled feed is advantages due to ease of matching and fabrication [2]. However in equilateral triangular proximity coupled microstrip antenna using a microstrip line feed may often be more appropriate [3] [4] [5]. In general, the impedance bandwidth of the traditional microstrip antenna is only a few percent (2% - 5%) [6]. Therefore, it becomes very important to develop broadband technique to increase the bandwidth of the microstrip antenna for dual band operation [7] [8]. So we designed a parallel slot loaded equilateral triangular proximity coupled Microstrip antenna for dual frequency with enhancing the band width of the proposed antenna.

II. ANTENNA DESIGN AND CONSIDERATION

In this paper the proposed antenna has been designed for the frequency of 3 GHz. By loading properly arranged slots in an equilateral-triangular microstrip patch. A low cost glass epoxy substrate material with substrate S1 and S2 having thickness of 0.32 cm with dielectric constant $\varepsilon r = 4.2$ is used to simulate the antenna.The Fig. 1 shows the design of parallel slot loaded proximity coupled equilateral triangular microstrip antenna (PSPCETMSA) and Ansoft HFSS antenna module of PSPCETMSA as shown in Fig. 2.

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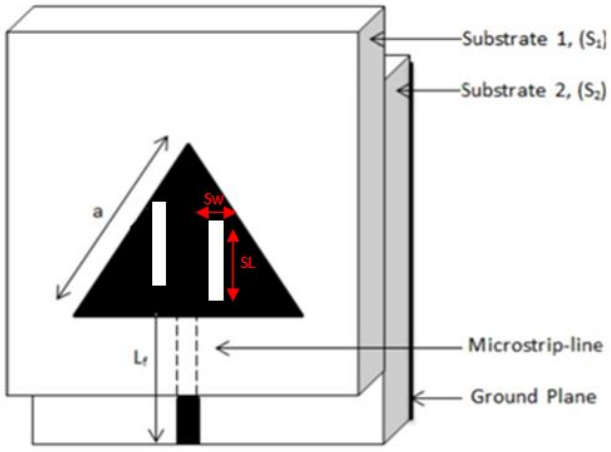

Fig .1 Top view geometry of PSPCETMSA

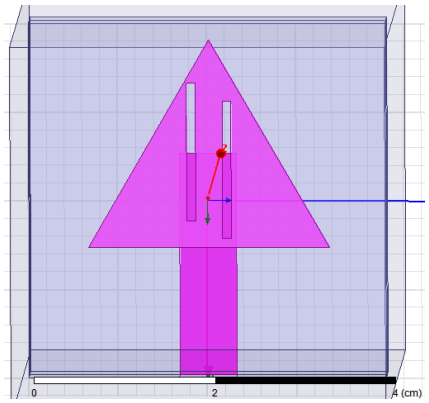

Fig .2 Simulation antenna module of PSPCETMSA

The proposed design is achieved by loading parallel slot on the triangular patch by varying the position with same dimensions. The equilateral triangular radiating patch with parallel slot etched on top surface of substrate S_1, where S_L and $S_W$are the dimensions of the slot respectively. The microstripline feed of L_f and W_f is etched on the top surface of substrate S_2. The glass epoxy substrate material S_2 is placed below substrate S_1 such that the tip of the feed line and the center of the radiating patch consider one over the other. Here the bottom surface of the substrate S_2 acts as the ground plane.All the specifications of the proposed antenna are given in Table. 1

Table .1 Designed parameters of the proposed antennas

Antenna Parameters	Dimensions in cm
Side length of equilateral triangle (a)	2.70
Length of the slot S_L	1.55
Width of the slot S_W	1.0
Length of the feedline L_f	2.5
Width of the feedline W_f	0.633
Length and width of the ground plane (Lg and Wg)	4.6
Thickness of substrate S_1 and S_2 (h1+h2)	0.64

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III. SIMULATION RESULTS AND DISCUSSION

The characteristics of proposed antennas have been experimentally designed and measured by using Ansoft HFSS simulation software. The variation of return loss versus frequency characteristics of PSPCETMSA antenna as shown in Fig.3,from this figure it is seen that, the antenna resonates very close to its designed frequency of 3GHz. The impedance bandwidth over return loss less than -10dB it has been calculated by using the equation (1). We also plot the graph for VSWR of the antenna which is shown in Fig. 4.

$$BW = \left[\frac{f_2 - f_1}{f_c}\right] \times 100\% \qquad (1)$$

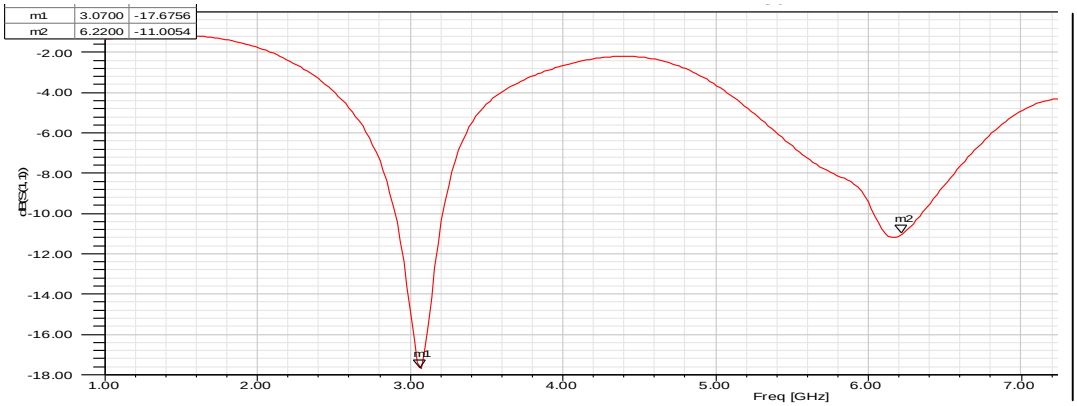

Fig.3. Simulation return loss versus frequency of PSPCETMSA

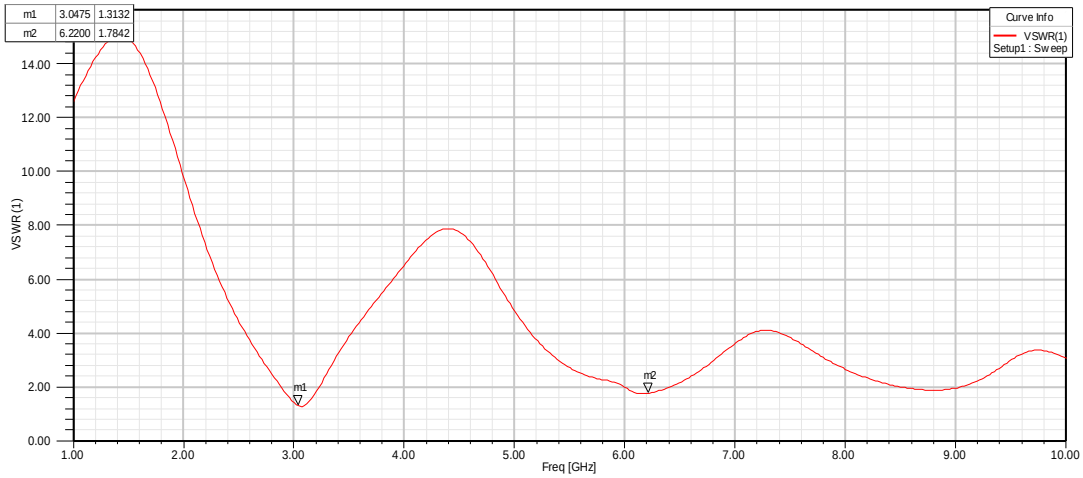

Fig.4. Simulation VSWR of PSPCETMSA

From the Fig. 3, it is clear that, the antenna operate between the frequencies 3.07 to 6.22 GHz with impedance bandwidth of 10.49% (2.89GHz-3.21GHz) and 5.37% (6.02GHz-6.35GHz) and the minimum return loss is found to be -17.67dB and -11.00dB, which covers WiMax and Wi-Fi frequency ranges. The measured VSWR of the proposed antenna is 1.31 and 1.78 respectively.

The radiation patterns of the simulated antenna at their resonating frequencies are studied and plotted. The E and H plane radiation patterns of the proposed antenna for θ at 0^0 and 90^0 and φ at 0^0 and 90^0 is as shown in Fig. 5(a) and Fig. 5(b).From these figures it is clear that the obtained radiation patterns are broadside in nature and linearly polarized.

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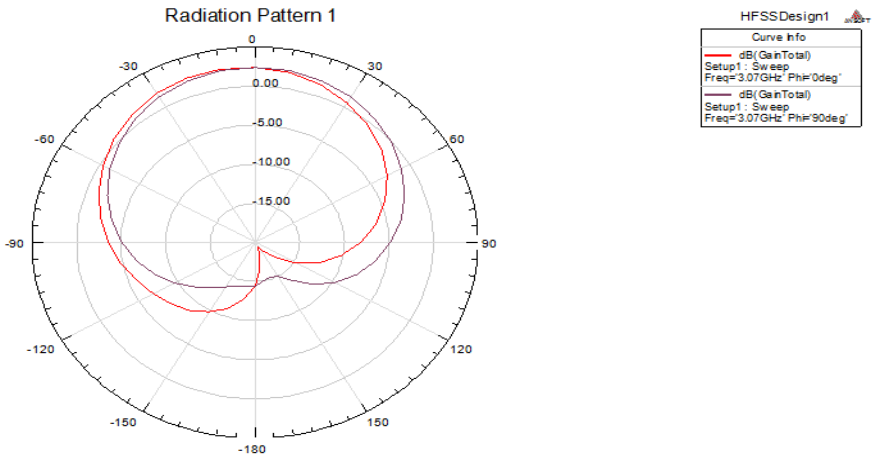
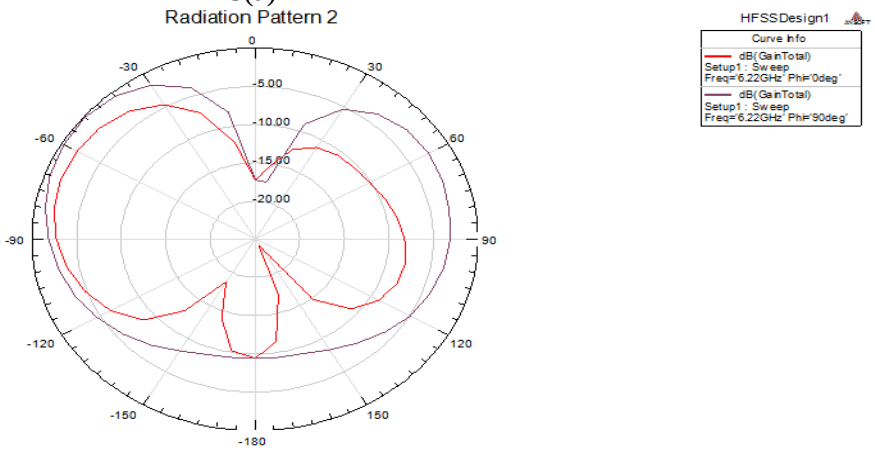


5(a)



5(b)

Fig. 5.The simulated radiation patterns of PSPCETMSA measured at 5(a) 3.07 GHz and 5(b) 6.22GHz

IV. CONCLUSIONS

From the study it is observed that the proposed antenna is simple in their design, compact and they use low cost substrate material. The PSPCETMSA antenna resonates at two different frequency points, also there is enhancement in bandwidth with better broadside radiation characteristics at each resonating frequencies. This antenna can be used for wireless applications such as Mobile Wimax IEEE 802.16 and Fixed Wimax IEEE 802.16.

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