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NOTCHBAND MICROSTRIP ANTENNA USING PGP

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Abstract— In this paper, a novel rectangular planar ultra-wide band antenna (UWB) with band-notched characteristics is presented. The proposed design has circular slot in the middle of the patch and two level stepped corners (lower) at the radiating patch along with two inverted L shaped slots on the two non-radiating edges of the microstrip patch antenna. The proposed antenna is designed and simulated using Computer Simulation Technology Microwave Studio (CST-MWS). This antenna operates in a frequency band ranging from 2.87 to 11.14 GHz with a band rejection from 3.75 to 6.12 GHz. The dimension of the proposed design is 27.00 mm (L), 32.42 mm (W) and 1.6 mm (H). The VSWR is less than 2 for entire operating frequency range. The impedance bandwidth of the proposed design is nearly 7.18 GHz with band rejection. This antenna can be used in various applications in 3.5 GHz WiMAX, 4 GHz C band and lower frequencies of X. The effect of the partial ground plane and the dimensions of stepped corners with two inverted L slots are optimized for better return loss.

Keywords— Rectangular planar ultra-wide band antenna, stepped corners with microstrip feed, partial ground plane(PGP), two inverted L slots.

Plane is the major concern for planar UWB antenna designs. For designing an UWB antenna, various methods like slotted patch, slotted ground, partial ground, modified feed, truncated corner patch, etc. have been used [2-6].

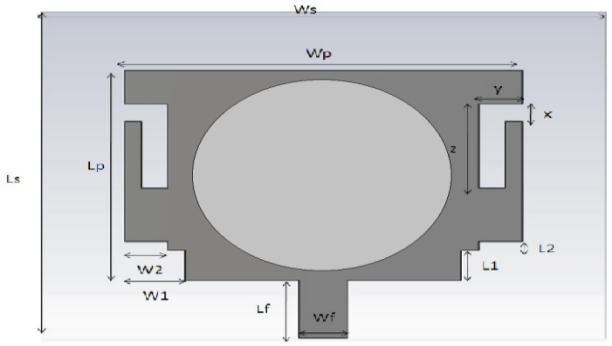

Fig. 1 Top view of the proposed antenna with parameters

I. INTRODUCTION

With the increase in demand for large bandwidth in wireless communication there has been a drastic advancement in ultra-wide band applications. Due to this increasing demand for multiple band antennas for wireless communications, the ultra-wide band technology (3.1 GHz to 10.6 GHz) has grabbed much attention of large number of researchers. The researchers were attracted more towards UWB antennas as on 14 February, 2002 U.S. Federal Communication Commission (FCC) has approved license free low power communication for short distance [1]. The key features of UWB patch antenna are compact size, large bandwidth, low cost, higher data rates for short range communications, light weight, simple geometry, good impedance properties and high gain radiations in desired directions [2-4]. An UWB antenna must operate over entire frequency band allocated by FCC with low power characteristics and VSWR ≤ 2 for entire band but most of UWB antennas do not operate over entire specified UWB band.

The last decade witnessed various literatures on UWB antenna designs showing planar monopole UWB with large bandwidth, low cost and simple geometry [5-6]. The shape and geometry of the radiating patch and ground

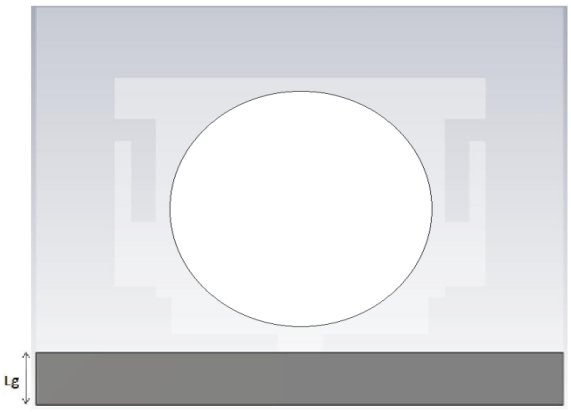

Fig.2. Bottom view of the proposed antenna with parameters

Top and bottom view of the proposed antenna is shown in Fig. 1 and 2. In this design, a novel rectangular planar UWB antenna is proposed with band notched characteristics. Partial ground plane and two level stepped corners are used to increase the bandwidth of the proposed antenna suited for UWB applications. Stepped corner at the radiating patch increases the Electromagnetic current path which directly affects the bandwidth of the antenna. It was also verified that on removing the ground plane beneath the radiating patch the bandwidth of the antenna increases extensively [7-9].

II. ANTENNA DESIGN

The configuration and geometry of proposed antenna is shown in Fig. 1 and 2. The proposed antenna is simulated on FR-4 substrate of 1.6 mm thickness with dielectric constant of 4.3 And loss tangent (tan δ) of 0.025. The rectangular patch with $W_p \times L_p$ dimension consist of two level stepped corners at the feeding edge. $W_{1\ and}$ $W_{2\ are}$ the width of first and second step whereas L_1 and $L_{2\ are}$ the lengths respectively. The radiating patch has two inverted L slots of z length, y width and x thickness. The optimal designed parameters of the proposed antenna are as follows: W_s = 32.42 mm, L_s = 27 mm, W_p = 22.82 mm, L_p = 17.4 mm, W_1 =3.5 mm, L_1 = 2.5 mm, W_2 = 2.5 mm, L_2 = 0.75 mm, x = 1.5 mm, y = 2.5 mm, z = 5.5 mm, L_g = 3.55 mm, W_f = 2.75 mm, L_f = 4.8 mm and h = 1.6 mm.

III. RESULTS AND DISCUSSIONS

The proposed UWB antenna with band notch characteristics is designed by selecting the optimal values of the various above said parameters. In the parametric study the optimal value of each parameter was chosen and remaining parameters were optimized by fixing it. The Computer Simulation Technology Microwave Studio (CST-MWS 11) is used for this parametric study and simulation results were obtained.

Firstly, the length L_g of the partial ground plane is reduced to achieve ultra-wide bandwidth. But even after optimizing the length of ground plane the proposed design do not achieved a bandwidth greater than 7.5 GHz, therefore stepped corners are utilized for additional bandwidth.

The return loss and VSWR curve for the proposed antenna is shown in Fig. 5 and 6.For entire operating bandwidth the VSWR is less than 2 except from 3.75 to 6.12 GHz.

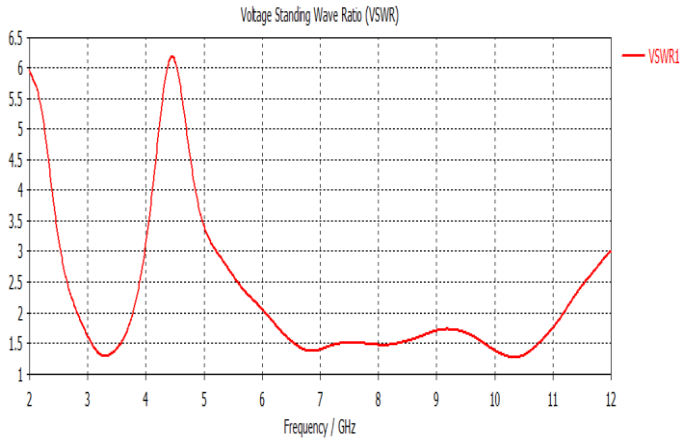

Fig. 6. VSWR curve of the proposed antenna.

The smith chart of the proposed design is shown in Fig.7 which clearly indicates the fairly good matching of impedance.

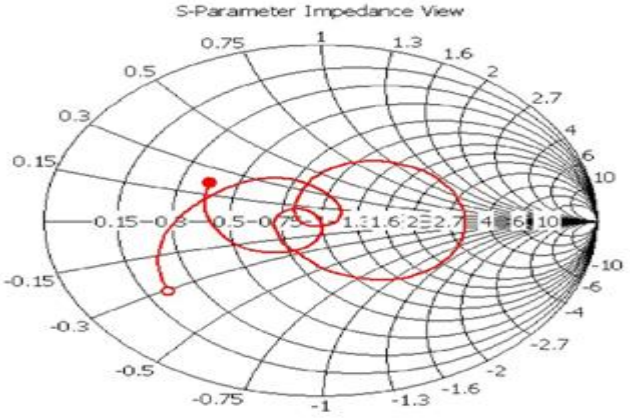

Fig.7.Smith Chart of the proposed antenna.

The Gain radiation patterns of the proposed antenna is shown in Fig. 8 given below.

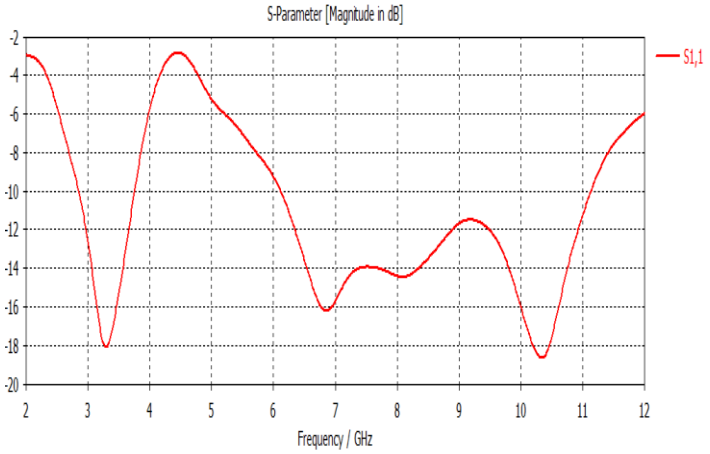

Fig. 5. Return loss (S_{11}) curve of the proposed antenna

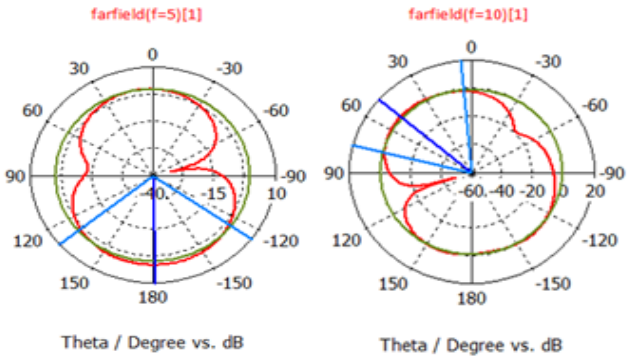

Fig. 8. The Gain radiation patterns of the proposed Design

The gain of the proposed design varies from 1 to 5 dB for the entire ultra-wide band. The gain-frequency curve of the proposed antenna is shown in Fig. 9

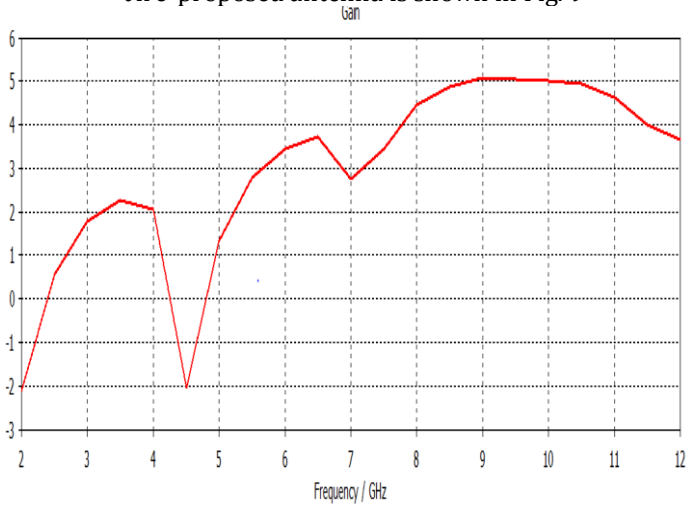

Fig.9.Gain-frequency curve of the proposed antenna

IV.CONCLUSIONS

In this paper, a planar rectangular ultra-wide band antenna with band notch characteristics is proposed to reject lower, middle and upper U-NII band for various indoor and outdoor applications. In this proposed design two level stepped corners with two inverted shaped slots were used with partial ground plane. The dimension of each parameter used for designing the proposed antenna was optimized for improved return loss curve and ultra-wide band operations with band rejections.

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