Journal of Basic and Applied Engineering Research
p-ISSN: 2350-0077; e-ISSN: 2350-0255; Volume 5, Issue 2; January-March, 2018, pp. 50-52

http://www.krishisanskriti.org/Publication.html

A Planar Ultra Wide Band Antenna Design with Band Notch Characteristics using Two Identical Rectangular Slots

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Abstract—*A proposed planar wideband antenna with two identical rectangular slots is inserted on the right top side of the patch having two beveled corners on the lower side. The UWB antenna is designed and simulated using Computer Simulated Technology Microwave Studio (CST-MWS) .The proposed antenna operates at a frequency of 4 GHz and find it applications in 3.5 GHz/5.8GHz (WLAN), 5.5 GHz (WIMAX).*

Keywords*: UWB, Band Notch, Rectangular slots, Micro strip feed line, partial ground plane.*

1. INTRODUCTION

In past 20 years UWB is used for radar, sensing and military communication, but after the approval and allocation of the frequency band by FCC between 3.1–10.6 GHz the ultra wideband (UWB) technology could be used for data communication as well as for radar applications. This band range will cause the interference between wireless communication system such as WLAN operate in 5.15-5.35 and 5.725-5.825 GHz band and for WIMAX 3.3-3.6 GHz and X-band satellite communication service 7.25-8.39 GHz downlink (7.25-7.745Ghz) and uplink (7.9-8.39 GHz) . A FCC developed a report after going through the merits of UWB to allow UWB as a communication and imaging technology. A UWB definition was designed whose fractional bandwidth will be less than 0.2.The fractional bandwidth is defined as [1]

$$2*(f_H- f_L)/(f_H+f_l)$$

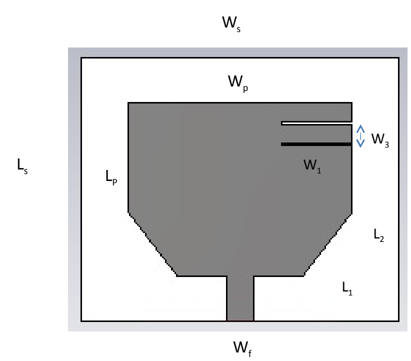
Where f_H= High frequency at -10db below the peak value

f_L= Low frequency at -10db below peak value

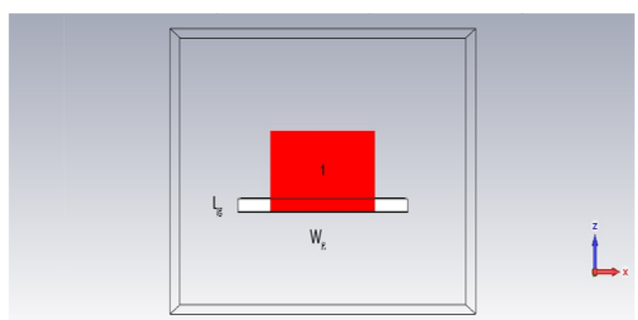
UWB is a huge leap forward because it has compact size, low cost, and good omni-directional radiation pattern. Main advantage of UWB is that it has enormous bandwidth which means that UWB offers data rates of the orders of Gbps[2]. Ultra wideband (UWB) can be protected from being overloaded by strong signals and sensitive components by using the front end receiver**.** UWB signals are emitted at a level that restraint its spectral power density to -40dBm/MHz between frequency range 3.1 GHz to 10.6 GHz [3]. The geometry of proposed UWB antenna is shown in Fig.1.

2. ANTENNA DESIGN

The geometry of proposed UWB antenna is shown in Fig.1.



Top View



Side View

Fig. 1: Geometry of proposed antenna

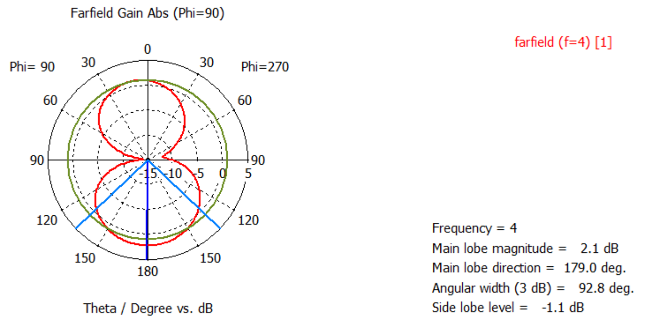
The proposed antenna is constructed on FR-4 substrate of 1.6 mm thickness and overall dimension of antenna is 32.42(L)

×27(W) ×1.6(H) mm^3.The rectangular patch whose dimension is $W_P \times L_p$ consists of two beveled corners whose length is L_1 and L_2 respectively. Dielectric constant is 4.3 and loss of tangent is 0.025.The optimal dimension of the proposed antenna are as follows:

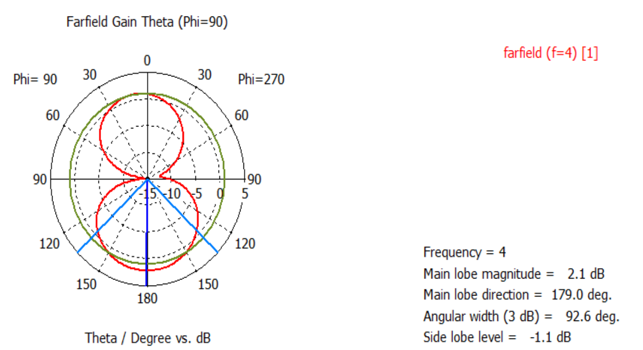
W_s=32.42mm, Ls=27mm,W_P=22.8mm,L_P=17.8mm, W_f=2.75mm,L_1=5mm,L2=6.5mm,W_1=7.2mm,W_2=0.2mm,W_3 =32.42mm,L_g=3.55mm,W_g=32.42mm.

3. RESULTS & DISCUSSIONS

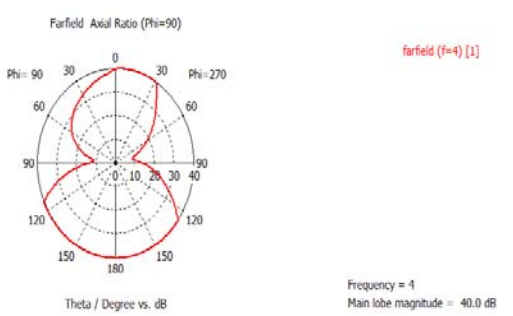
The Fig. 2 shows the radiation pattern at 4 GHz. It can be easily observed that it is a bidirectional radiation pattern and this design can be utilized for the application related to bidirectional radiation pattern. It has a gain of about 2.1 dB at main lobe. One can also observe that the axial ratio shows main lobe magnitude to be equals to 40 dB at 4 GHz.



(a)



(b)



(c)

Fig. 2: Radiation pattern of proposed antenna at 4 GHz

The Fig. 3 and 4 shows the return loss and VSWR curve of the proposed antenna. The proposed structure operates from 3.1 GHz to 11.3 GHz while rejecting one entire band between 5 GHz to 6 GHz. It can be seen from the above diagram that it covers the entire UWB (3.1 GHz to 10.6 GHz) while rejecting some portion (between 5 GHz to 6 GHz approximately). The maximum peak is achieved at 9 GHz of frequency nearly of about -29.6 dB. The curve has two peaks; another peak is obtained at 4.2 GHz of frequency of about -28 dB. The curve also shows that it is clearly rejecting the band lying between the 5 GHz and 6 GHz used for Wi-Fi and WiMax.

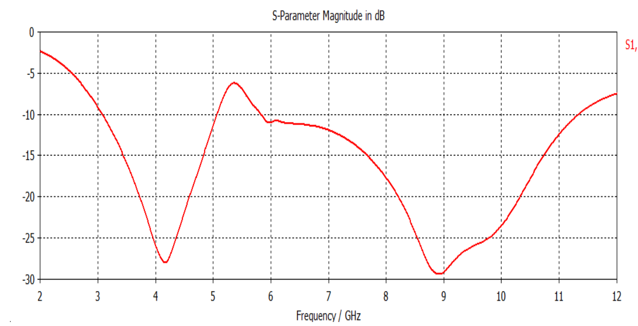


Fig.3. Return loss curve (S_{11}) of the proposed antenna

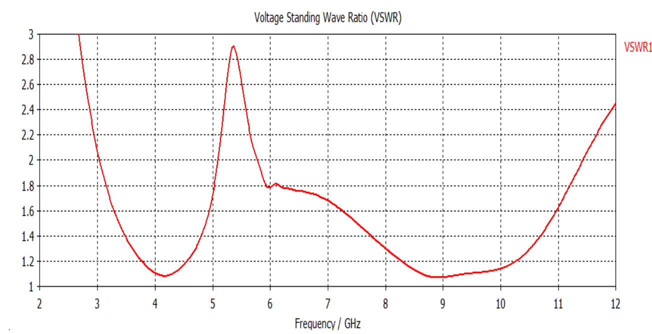


Fig.4.VSWR curve of the proposed antenna

4. FABRICATED ANTENNA

Fig. 5 Fabricated Front View

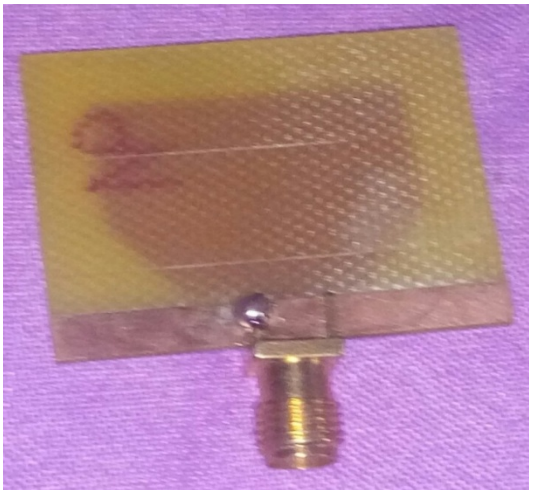


Fig. 6: Fabricated bottom View

5. MEASURED RESULT AND COMPARISON WITH SIMULATED RESULT

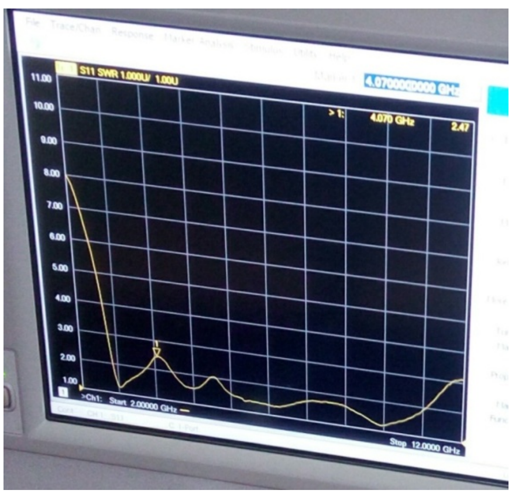


Fig. 7: Measured VSWR

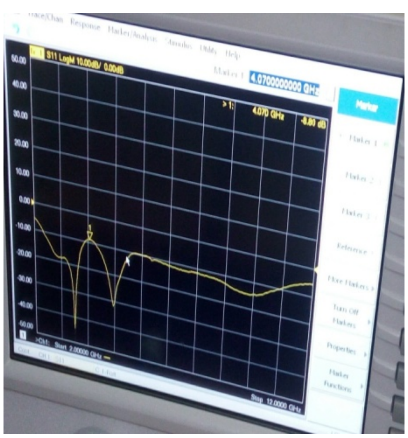


Fig. 8. Measured Return Loss (S11)

As one can easily compare the simulated and measured results for return loss and VSWR. The trajectory of the measured result is nearly same as was in the case of simulated result in case of return loss and VSWR. The maximum return loss in case of measured result is coming on nearly 3.5 GHz as -45 dB (approx.) where as it is -28 dB at 4.1 GHz. VSWR in case of band rejection is shifted to lower frequency (about 1 GHz) in comparison with the simulated VSWR.

6. CONCLUSION

In this paper a planar ultra wideband antenna is proposed. The antenna has been designed with band notch characteristics having two rectangular slots as well as beveled corners. Dimensions of the proposed antenna are taken such that the return loss and VSWR can be achieved which is suited for ultra wide band operations.

7. ACKNOWLEDGEMENTS

I would like to thank my supervisor Dr. Uma Shankar Modani for valuable suggestions whenever required. Special thanks to my colleagues Mr. Mayank Sharma and Mr. Ravi Goyal for supporting me in the designing of the proposed antenna.

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