A New and Improved Design for a Dual Notch UWB-Patch Antenna

Vasudha R, M. Neelaveni Ammal
Dept. of Electronics and Communication Engineering
SRM University, Kattankulathur
Chennai, India
e-mail: vasudha.rallapalli@gmail.com
e-mail: neelaveni.m@ktr.srmuniv.ac.in

Abstract— In this paper, we have investigated a planar antenna with rectangular patch for UWB applications. The proposed antenna is supposed to cover the entire UWB range (i.e., 3.1GHz to 10.6GHz) except the frequency bands of 4.5-4.8GHz (Super extended C-band) and 8GHz of ITU (International Telecommunication Union). This antenna proposed to antenna consists of a rectangular patch and a partial ground plane. The operational bandwidth of the designed antenna is from 3.1GHz to 10.6 GHz covering the entire UWB range. The details of the proposed antenna design and simulated results are presented and discussed.

Keywords- *Dual notch,UWB antenna,Resonator*

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I. INTRODUCTION

UWB systems are the next best thing in the field of communication. It uses a bandwidth of 3.1GHz to 10.6GHz. This huge bandwidth allows it to be used in various communication aspects and has intrigued many researchers. Unlike all other communication systems it uses Gaussian Pulses for modulation purposes making it inherently immune to interference. Due to the high speed data rate, low power consumption and high capacity in recent years UWB communication has become an essential in military domain and high speed short range wireless communication. Though it's own immunity other high frequency or mid-frequency systems are not immune to the interference from the UWB systems. So it has become crucial to design antennas for specific user purposes, which can neglect frequencies used by the neighboring systems. The antennas need to be designed application specific, i.e. according to the environment they are going to be placed in. So some antennas might require removing a WLAN range while at some other system it might not be an issue rather it needs to neglect some other range of frequencies. In this paper we have tried to design an antenna which removes the frequency bands of Super Extended C-band (4.5-4.8 GHz) and International Telecommunication Union Frequency Range around 8GHz. We've designed a rectangular patch with a tri slot resonator. The resonator essentially has a H-shape.

Section 2 of this article discusses on the shape and design of the antenna in detail. Section 3 presents the results and discussion of the simulated antenna. Section 4 concludes the article with the research findings.

II. ANTENNA DESIGN

The design used in this article for the antenna is being derived from the square shaped patch concept and the resonator is derived from a H shaped resonator.

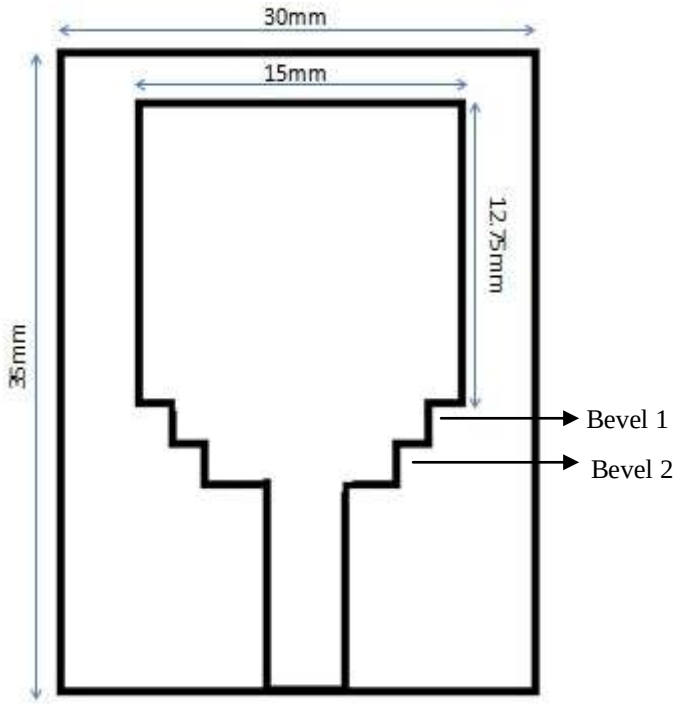

Figure 1: Front side of the antenna

Fig.1 shows the designed antenna is a rectangular patch of dimensions 15mm x 15.25mm x 0.2mm on an FR-4 epoxy substrate of 30mm x 35mm as shown in Figure 1. The antenna has a substrate thickness of 1.6mm and a dielectric constant of Er =4.4 was considered. The partial ground has a width of W_g = 9mm from the base of the substrate. The patch has two bevels on both sides of the patch. Bevel 1 is of dimensions 1.5mm x 1.5mm x 0.2mm and Bevel 2 is of dimensions 1mm x 3mm x 0.2mm. The excitation to the antenna is provided by a 50Ω micro-strip feed line of 3mm x 9.875mm x 0.2mm. The bevels in the patch of the antenna provide accurate working of antenna in the UWB frequency range.

 ISSN: 2321-8169
1232 - 1234

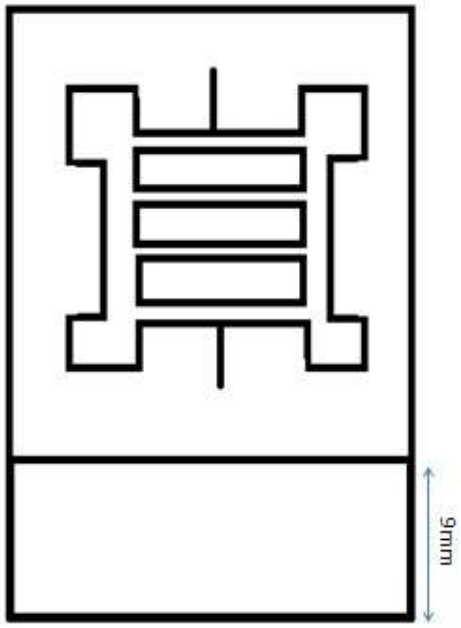

Figure 2: Back side of the antenna

Figure 2 gives structure of the resonator etched at the back of the antenna above the partial ground plane. The dimensions of the rectangular radiator etched in copper on the backside of the antenna measures 18.296mm x 13.59mm x 0.2mm. Seven slots were made on the resonator; 3 slots in the centre and 4 on each side of the rectangular resonator. The three slots in the centre of the resonator measure 8mm x 1.17mm x 0.2mm with a spacing of 2.04mm. The rectangular slots removed from the sides of the rectangular patch are of the dimensions 1.5mm x 6mm x 0.2mm. The spacing between the side slot and the centre slots vertically measure exactly 1.5mm. And additional connecting thin strips of 3mm each were placed at the centre of the vertical upper and lower side of the resonator. These values were obtained by rigorous simulation work to provide an optimum result.

III. EXPERIMENTAL RESULTS AND DISCUSSION

The prototype of the discussed antenna was designed and simulated using HFSS 13.0 (High Frequency Structure Simulator). The following are the results of the above mentioned design.

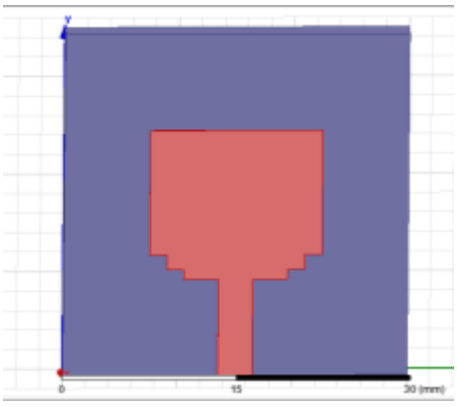

Figure 3: Antenna modeling in HFSS (front-side)

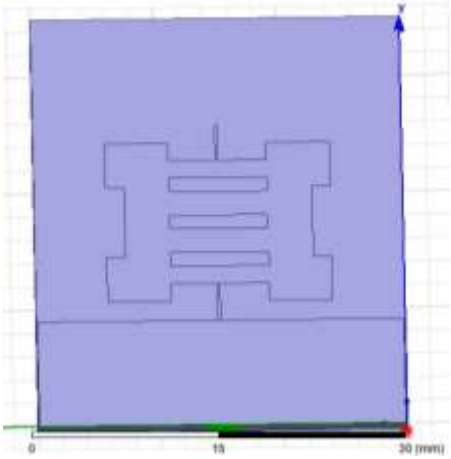

Figure 4: Antenna modeling in HFSS (Back side)

Figure 3 and Figure 4 shows the modeling of the antenna in HFSS 13.0. The model consists of a rectangular shaped patch antenna of dimension (15mm X 15.25mm) over a substrate of dimension (30mm X 35mm) of FR-4 epoxy resin. The center frequency is taken to be as 6.85 GHz. The antenna radiates and receives the frequencies from 3.1 GHZ to 10.6 GHZ having a bandwidth of 7.5GHz.

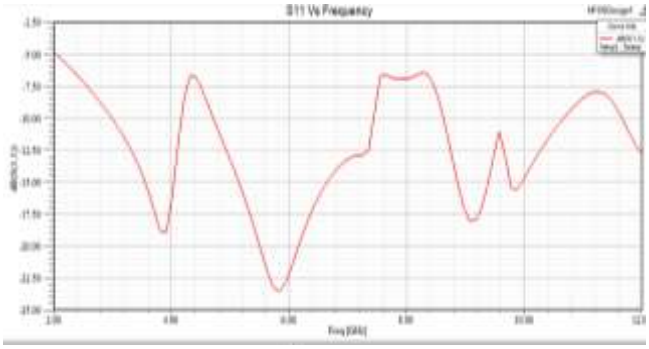

Figure 5: Return loss Vs Frequency

Figure 5 shows that the antenna covering the complete UWB range from 3.1GHz to 10.6GHz excepting the frequency ranges of 4.2GHz – 4.7GHz and 7.4 GHz to 8.5GHz, successfully notching (rejecting) Super extended C-band and 8GHz of ITU.

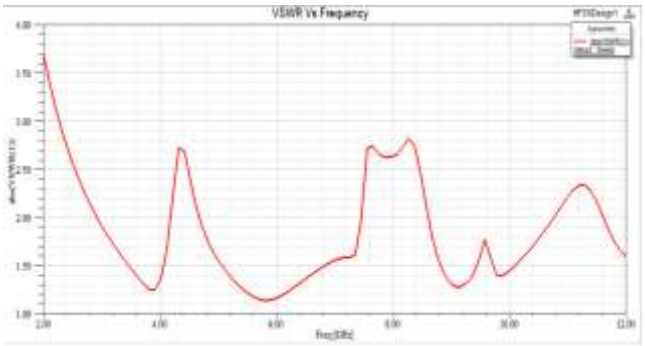

Figure 6: VSWR Vs Frequency

Figure 6 shows that excepting for frequencies that are notched, all the other frequencies are being accepted by the antenna and are well within the acceptable range of VSWR<2

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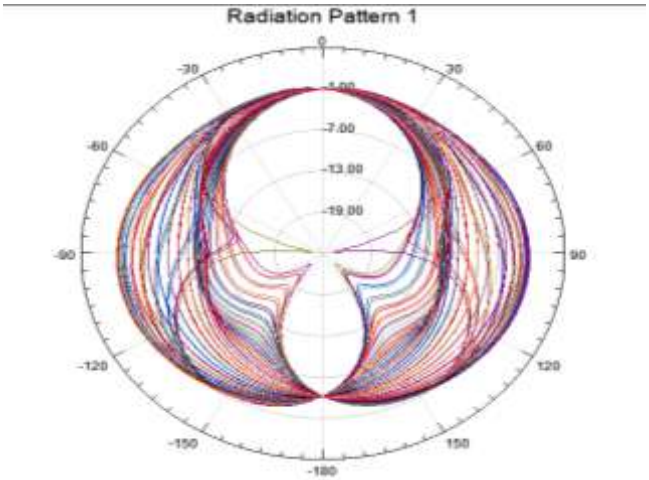

Figure 7: Radiation Pattern

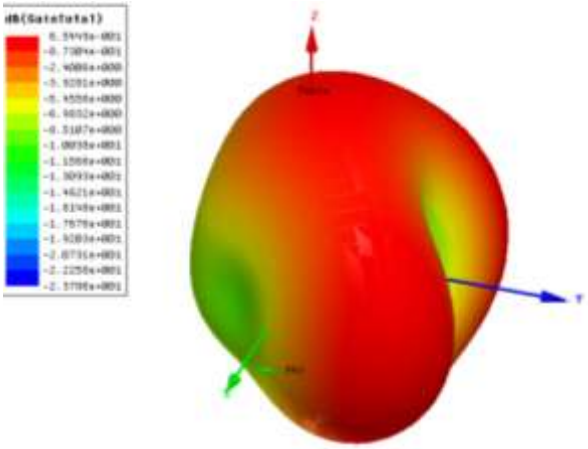

Figure 8: 3-D polar plot of the antenna

IV. CONCLUSION

In this paper, a planar antenna working in UWB range with two notches has been obtained. The resonator design used provides good performance. The band notches were created to cause no or less interference in the super extended C band and 8GHz ITU band and this purpose was successfully achieved.

Figure 7 and Figure 8 show radiation pattern and 3-D polar plot of the antenna respectively.

ACKNOWLEDGMENT

I would like to express my deepest appreciation to my guide, Mrs. M. Neelaveni Ammal, Assistant Professor (Sr.G.), who has the attitude and the substance of a genius. She continually and convincingly conveyed a spirit of adventure in regard to research and an excitement in regard to project. Without her guidance and persistent help, the project would not have been possible.

REFERENCES

[1] Compact Bluetooth/UWB dual band planar antenna with quadruple band notch characteristics

[2] G.Shrikanth Reddy, Student Member IEEE, Anil Kamma,Sanjeev K Mishra,member,IEEE and Jayanta Mukherjee,Senior member IEEE, IEEE antennas and wireless propagation letters Vol.13,2014 Page no: 872-875

[3] CPW-fed monopole antenna with Quadruple band notch for UWB applications

[4] Yuchang Yang, Fa chun, Yunqing Sun, Hongchun Yang Institute of physical electronics of University of electronic science and technology of China IEEE antennas and wireless propagation letters 2011 Page no: 404-406

[5] Novel UWB monopole antenna with triple band notch characteristics: Wen Tao Li, Xiao Weishi, Senior member IEEE, and Yong Qiang Slei, IEEE Antennas and wireless propagation letters, Vol.8 2009

[6] A compact CPW feed UWB antennas with GSM,GPS and blue tooth with dual notch band applications: Yonglun Luo, Liang Xu, Zhengyu Xin and Shuang He, Progress in Electromagnetic Research Centre, Vol.35,205-219,2013

[7] Compact asymmetric inverted cone ring monopole antenna for UWB applications: Su.S.Thwin, Progress in EM research letters, Vol.36,57-65,2013

[8] Triple band notched band UWB planar monopole antenna using a modified H-shape resonator: Yo-sung, IEEE transactions on antennas and propagation Vol.61, No.2 , February 2013

[9] Design of planar monople antenna for use with UWB having a band notch characteristics: Aaron Kerkhoff,Hao King,Applied Research Laboratories, University of Texas

[10] Compact UWB Antenna With Multiple Band-Notches for WiMAX and WLAN Ming-Chun Tang, Shaoqiu Xiao, Tianwei Deng, Duo Wang, Jian Guan, Bingzhong Wang, and Guang-Ding Ge, IEEE IEEE transactions on antennas and propagation, Vol. 59, No. 4, April 2011.