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Design and Fabrication of a Microstrip Antenna with Multiple Notch Functions

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Abstract: **A compact microstrip antenna with multiple band-notch characteristics is proposed. The proposed antenna has an operating frequency of 2 to 11 GHz. The notches created WiMAX (3.3–3.6 GHz), WLAN (5.15–5.35, 5.725–5.825 GHz), and ITU 8. A return loss of -10 dB has been achieved in the operating frequency range of 2 to 9 GHz, other than the notches. The antenna size L X W = 24 X 17mm. The proposed structure consists of a UWB semi-elliptical planar monopole, attached to an approximate trapezoidal spiral for 2.45-GHz Bluetooth application.**

Keywords- FR4, Multiple band-notches, reflection coefficient, ultrawideband (UWB), VSWR.

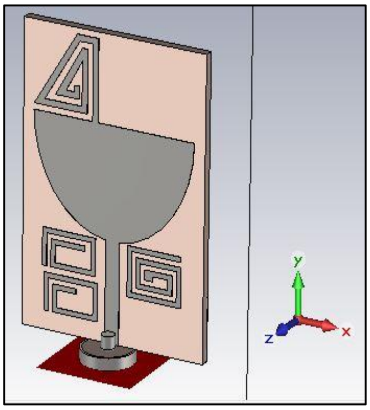
I. INTRODUCTION

RECENTLY, with an increase in the number of wireless communication devices, the electromagnetic interference has also increased. In 2002, the Federal Communications Commission (FCC) released a new spectrum from 3.1 GHz to 10.6 GHz with a spectral mask of -41.3 dBm/MHz [8]. This led to rapidly growing research efforts targeting Ultrawideband (UWB) applications like high data rate communication, precise localization and through-wall imaging [1]. UWB technology has become the preferred choice for short-range and high-speed (Mb/s) indoor data communications. Bandwidth defined between 3.1–10.6 GHz requires UWB antennas, among which includes planar monopole antennas (PMAs) that offer the following attractive features: 1) large impedance bandwidth (IBW); 2) ease of fabrication using conventional microwave integrated circuit (MIC) technology and 3) appropriate radiation properties.

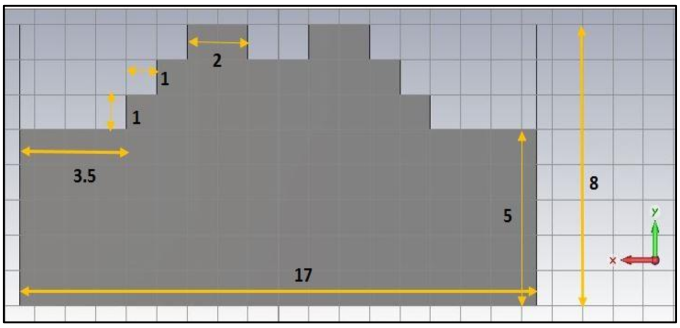
Unfortunately, within the UWB frequency band coexist other wireless narrowband standards such as WLAN (5.15–5.35and 5.725–5.825 GHz). To reduce interference from these frequency bands, bandpass filters can be utilized, but this will increase the cost and overall system size. Thus, a compact UWB antenna with multiband .rejection characteristics is desirable. Slot techniques are very effective in producing band notches. However, they can produce single- or dual band-notches only. For multiple band-notch characteristics, multiple slots can be used but multiple slots affect the antenna's gain and efficiency [3].

II. DESIGN CONSIDERATIONS

The basic design is intended to be constructed using printed circuit board (PCB) technology. It presumes an FR4 substrate with the dielectric constant, εr = 4.3 and loss tangent, tanδ = 0.025. Its overall size is L x W x H =24mm x 17mm x 0.787mm. A simple configuration is presented in Fig.1. A rectangular stepped shaped slot is centred on the top side of an FR4 board.



(a)



(b)

Fig. 1. Configuration of designed antenna. (a) Top view. (b) Bottom view.

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The patch is fed by a 50ohms microstrip line [7]. The gap between the patch and the ground plane is 0.6 mm. The radiating element coupled strongly with the conducting partial ground plane and the designed antenna is a capable of supporting multiple resonances leading to the wide operating band of 2 to more than 9 GHz as depicted in Fig.2.With a compact profile of 24x17mm^2, the antenna's operating band is sufficient to cover the UWB frequency band of 3.1–10.6 GHz [4].

III. SIMULATION AND DISCUSSION

The reflection coefficients for different values are compared in Fig. 2. In the design, the step dimensions are kept symmetric along the width and the length of the antenna to ensure circularity of the radiation patterns. Further, to have less cross polarization, the microstrip feed is made to cross the slot orthogonally and at the center. The feed line extends beyond the slot to form a tuning stub. The stub reduces the high impedance offered by the slot. Alternately, to improve the impedance matching, the feed can be placed offset from the center or can be made inclined. However, with offset feeding, the far-field patterns get distorted while with inclined feed, polarization purity gets affected [3].

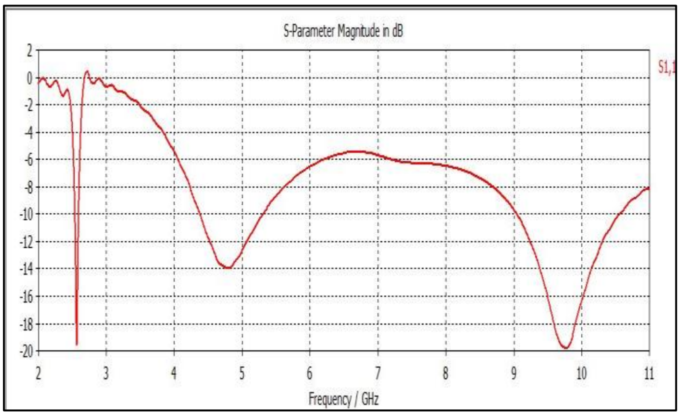


Fig. 2. Simulated Reflection coefficient of designed antenna.

The resonant frequencies and impedance matching of the stepped-slot configuration depends not only upon the individual slot lengths, but also on the ratio of their characteristic impedances (dependent on the widths). The effect of varying the widths of different sections of the slot namely S1W, S2W and S3W.Section 1(S1) is excited by the microstrip line and hence the width of this section is crucial for tuning and matching the impedance of the structure to the microstrip line. In Fig.2.the variable b defines the length of section2 (S2).

Also, the feed dimensions are slightly changed to retain the ultra-wide impedance bandwidth. The simulated and measured VSWRs for the designed antenna is shown in Fig.3. It depicts the VSWR comparison of the antenna for different values with notch. When compared with the simulated VSWR, the measured VSWR of the band-notch design shows a slight shift to the lower side which may be attributed to fabrication errors.

At the band-notch frequency, the strips act as short-circuit to the input microwave energy. As a result, there is a high current density on them and the currents reaching the slot end are reduced which minimizes the radiation.

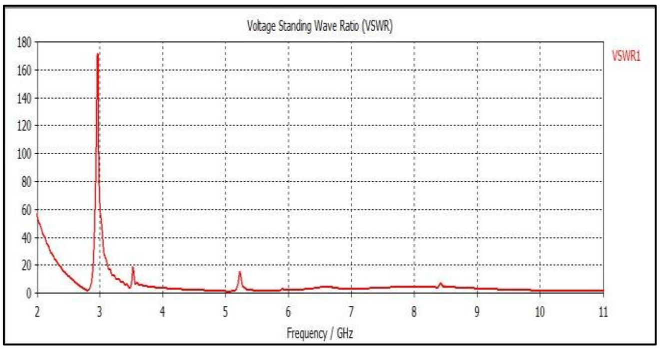


Fig. 3. Simulated VSWR of designed antenna.

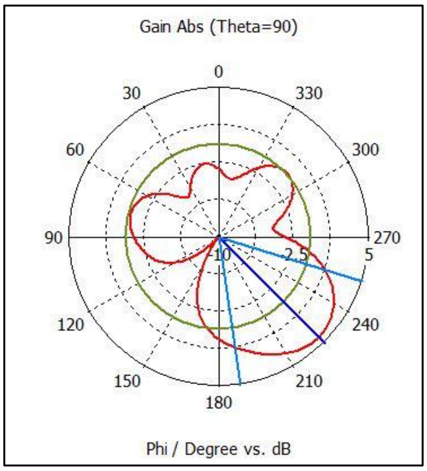
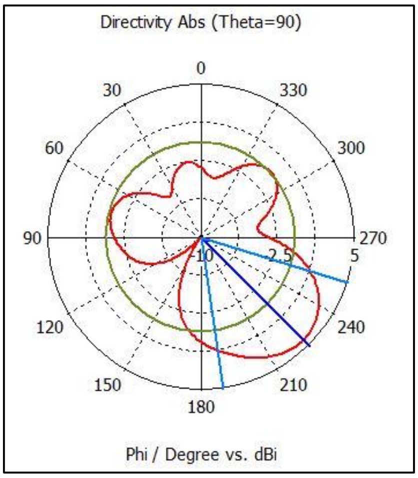


Fig. 4a



(b)

Fig. 4. Simulated radiation patterns of designed antenna.
(a) Gain at 6.5GHz. (b) Directivity at 6.5GHz.

IV FABRICATION AND MEASUREMENT

The designed antenna was fabricated using the optimized antenna parameters that were described in Figures 2.1, 2.2 and Table1. Fig.5 shows the photographs of the fabricated antenna with its top view and back view respectively. The antenna operates over 3.2–9 GHz. An SMA adapter was connected at one end of the microstrip line for measurement, which was directed by Agilent N9925A ENA RF network analyzer with the highest frequency at 20GHz. The correctness of the simulation results can thus be verified.

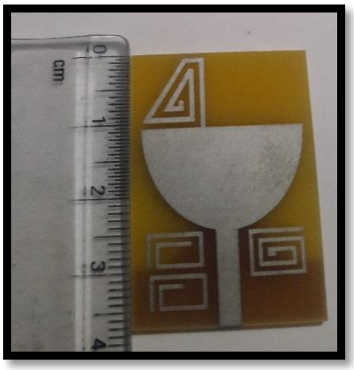


Figure 4.1 Front view of the fabricated antenna

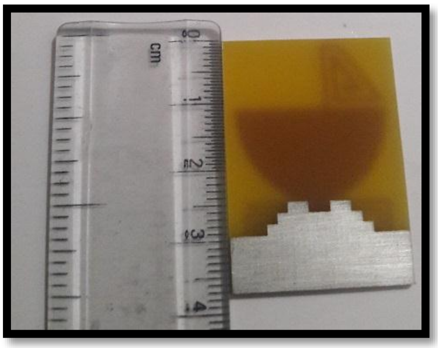


Figure 4.2 Back view of the fabricated antenna

V. CONCLUSION

The microstrip patch rectangular stepped slot antenna with multiple band-notch characteristics was designed for UWB applications. The performance of the antenna was studied in terms the antenna parameters and the -10 dB return loss has been achieved in the operating frequency range of 2 to 11GHz with bandwidth of 9GHz.The slot shape and dimensions are chosen such that stable and symmetric radiation patterns are achieved with maximum gain in the broadside direction. The peak gain of the proposed antenna is around 5.5 dBi.

REFERENCES

[1] G.Shrikanth Reddy, Anil Kamma, Sanjeev K. Mishra and Jayanta Mukherjee, “Compact Bluetooth/UWB Dual-Band Planar Antenna with Quadruple Band-Notch Characteristics,” IEEE Antennas and Wireless Propagation Letters, vol. 13, pp.872-875, May2014.

[2] Majid Shokri, Hamed Shirzad, Sima Movagharnia, Bal Virdee, Zhale Amiri, and Somayeh Asiaban, “Planar Monopole Antenna With Dual Interference Suppression Functionality,” IEEE Antennas and Wireless Propagation Letters, vol. 12, pp.1554-1524,Dec.2013.

[3] Raj Kumar, Rajas K. Khokle and R. V. S. Ram Krishna, “A Horizontally Polarized Rectangular Stepped Slot Antenna for Ultra Wide Bandwidth with Boresight Radiation Patterns,” IEEE Antennas and Wireless Propagation Letters, vol. 62, pp.3501-3510, Jul.2014.

[4] Rezaul Azim, Mohammad Tariqul Islam and Ahmed Toaha Mobashsher, “Dual Band-Notch UWB Antenna with Single Tri-Arm Resonator,” IEEE Antennas and Wireless Propagation Letters, vol. 13, pp.670-673, Mar.2014.

[5] Gyeong-Ho Kim and Tae-Yeoul Yun, “Compact Ultra Wideband Monopole Antenna with an Inverted-L-Shaped Coupled Strip,” IEEE Antennas and Wireless Propagation Letters, vol. 12, pp.1291-1294, Sep.2013.

[6] Anil Kr Gautam, Swati Yadav and Binod Kr Kanaujia, “A CPW-Fed Compact UWB Microstrip Antenna,” IEEE Antennas and Wireless Propagation Letters, vol. 12, pp.151-154, Mar.2013.

[7] C. A. Balanis, Antenna Theory Analysis & Design, 3nd edition, New York, NY, USA: Wiley, 2005.

[8] Federal Communications Commission, Washington, DC, USA, “Federal Communications Commission revision of Part 15 of the commission’s rules regarding ultra-wideband transmission system from 3.1 to 10.6 GHz,” 2002.

[9] Debdeep Sarkar, Kumar Vaibhav Srivastava and Kushmanda Saurav, “A Compact Microstrip-Fed Triple Band-Notched UWB Monopole Antenna,” IEEE Antennas and Wireless Propagation Letters, vol. 13, pp.396-399, Mar.2014.

[10] Ming-Chun Tang, Richard W. Ziolkowski and Shaoqiu Xiao, “Compact Hyper-Band Printed Slot Antenna with Stable Radiation Properties,” IEEE Transactions on Antennas and Propagation, vol. 62, no. 6, pp.2962-2969, June 2014.

[11] Zheng Guo, Huiping Tian, Xudong Wang, Qun Luo and Yuefeng Ji, “Bandwidth Enhancement of Monopole UWB Antenna with New Slots and EBG Structures,” IEEE Antennas and Wireless Propagation Letters, vol. 12, pp.1550-1553, Dec.2013.

[12] You-Zhi Cai, Hong-Chun Yang and Ling-Yun Cai, “Wideband Monopole Antenna With Three Band-Notched Characteristics,” IEEE Antennas and Wireless Propagation Letters, vol. 13, pp.607-610, April 2014.