International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.01, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Design of a Single Band Notched Monopole Antenna with Bandwidth Enhancement for UWB Applications

KM Jyoti Singh

Department of Electronics and Communication Engineering

Madan Mohan Malaviya University of Technology, Gorakhpur - 273010 (U.P.) (India)

ABSTRACT

A design of a single band notched monopole antenna with intereference rejection and bandwidth enhancement property is designed in this paper for ultra wideband applications. The range of this type of antenna is from 2.7899 to 13.7251 GHz. This microstrip patch antenna is thoughtful for various applications in upper S band from 2 to 4 GHz, C band from 4 to 8 GHz, U-NII (Unlicensed National Information Infrastructure) band from 5.15 to 5.825 GHz, WLAN band from 5.2 to 5.8 GHz, X band from 8 to 12 GHz and ITU uplink satellite communication band from 8.1 to 8.4 GHz, while rejecting WiMAX band from 3.4 to 3.69 GHz. A single band rejection notch from 3.4095 to 4.075 GHz frequency range is created for reduction of intereference. The antenna efficiency is 94% at 10.5 GHz. The VSWR of the proposed antenna is less than 2 for whole performing frequency extent except for the single band rejection frequency range.

Keywords —monopole antenna; microstrip patch antenna; single band rejection; Ultra wide band

I.INTRODUCTION

Due to its high data transmission rates, constant antenna gain, low VSWR, constant antenna group delay over the complete frequency band spectrum, an appreciable measure of research has been concerned to the evolution of ultra wide band (UWB) antenna [1]. For the applications in wireless transmission systems, UWB antennas have excessive consideration in both academic and industrial fields. Federal Communication Commission (FCC) approves the UWB in March 2002 for unauthorized operation in the 3.1 to 10.6 GHz range for the use of indoor and hand-held systems [2]. Ultra wide band signals have a large complete bandwidth. High absolute bandwidth is responsible for various advantages of ultra wide band antenna including accurate ranging, good obstruction penetration, convert action, protection to jamming, meat to propagation dying, rejection of interference and concurrence with narrow bandwidth transmission system [3].To preserve a return loss in excess of 10dB with gratifyingy radiation properties, circular UWB antenna has been used mostly [3][4][5][6]. Gratifying antenna radiation properties and modest antenna efficiency are also required over the complete frequency band spectrum range at the same

time. Radiation pattern of UWB antenna should be omnidirectional because flexibility is attained in transmitter and receiver position of antenna due to it [6]. UWB antenna has another demand of an magnificent time domain attainment i.e., an magnificent desired feedback with minimal distortion [7]. Antenna bandwidth can be increased by using various techniques like use of partial and modified ground plane structure , use of inset feedline, use of open stubs and use of ground surface with modified patch [8][9][10]. Monopole antennas are of different size and shapes such as circular, square, pentagonal, rectangular, hexagonal and elliptical. These broadband antenna designs contain high complete bandwidths, small sizes, simple structures, fabrication ease and pleasant antenna radiation properties. Still, over the working Ultra wide band, there are presence of some narrowband transmission systems, such as WIMAX, WLAN, HYPERLAN, which may create potential interference with ultra wide band transmission systems. Thus many compelling band-notched approaches have been recommended in UWB antennas to reduce this interference. Many band notched techniques including etching U slot [11], V slot [12], C slot [13], S slot [14], applying a defected ground plane [15] or establishing folded CLL (capacitively loaded loop) resonators beside the feed line [16][17]. In this paper, a design of microstrip patch antenna with intereference rejection property is presented.

II.ANTENNA DESIGN

Proposed dual band rejection antenna is imprinted by containing FR4 (Flame Retardant material) Epoxy dielectric substrate. FR4 Epoxy dielectric substrate has tan ξ 0.025, permittivity of 4.3 and height of 1.6 mm. The substrate dimensions of this microstrip patch antenna are 16.5 mm × 18 mm × 1.6 mm. A single band rejection notch antenna can be created by inserting one E shaped slot into the radiation patch. By correctly adjusting the every guideline of the various slots, a single band rejection notch from 3.4095 to 4.075 GHz frequency range is created for reduction of interference.

Table 1. Dimensions of the proposed antenna

Parameter	Value(mm)
L	32
W	28
Lfeed	12
Wfeed	3
Lgnd	11
A	17.5
B	19.5
C	6
D	4
E	7
F	14
a	0.5

Figure 1& 2 shows the design of the scheduled monopole antenna.

 IJARSE
ISSN: 2319-8354

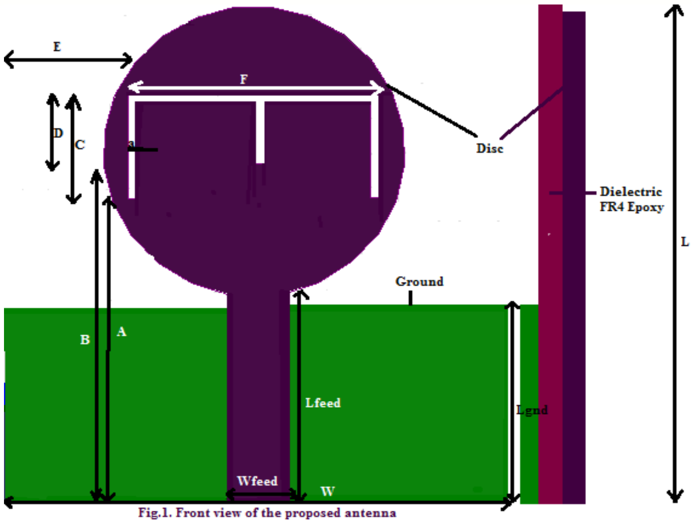

Fig.1. Front view of the proposed antenna

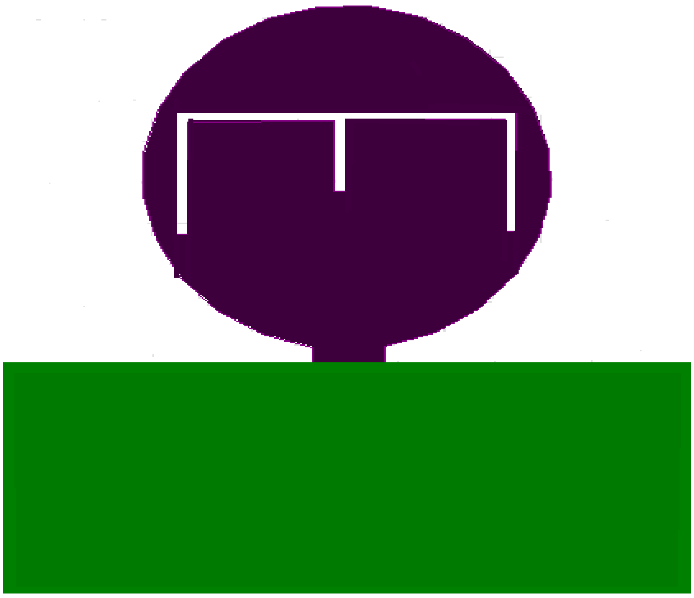
Fig.2. Back view of the proposed antenna

III.RESULTS & DISCUSSION

A design of microstrip patch antenna with intereference rejection property is designed in this paper by selecting convenient standards of various criterions. A software tool High Frequency Structural simulator (HFSS) is used to model this type of antenna structure. A single band rejection notch can be created by using an E shaped slot into the radiation patch for reducing the interference introduced by the WIMAX band. The different parameters of E shaped slot may be selected for better rejection of desired WiMAX. As shown in figure 3 the return loss curve of this single band rejection antenna achieved its peak value for return loss -29 dB at 4.7 GHz.

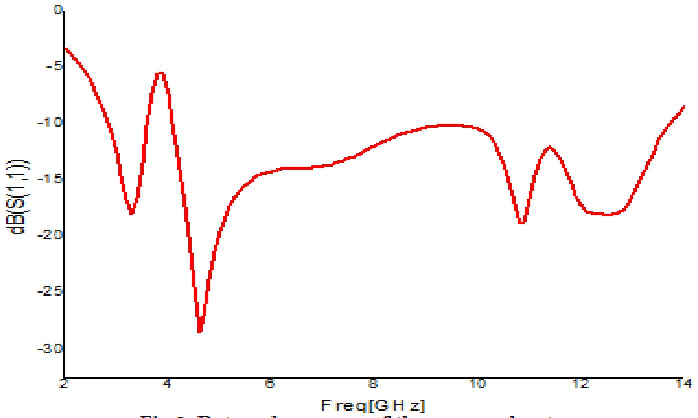

Fig.3. Return loss curve of the proposed antenna

The VSWR is less than 2 for full operating bandwidth scale except for desired rejection bands.

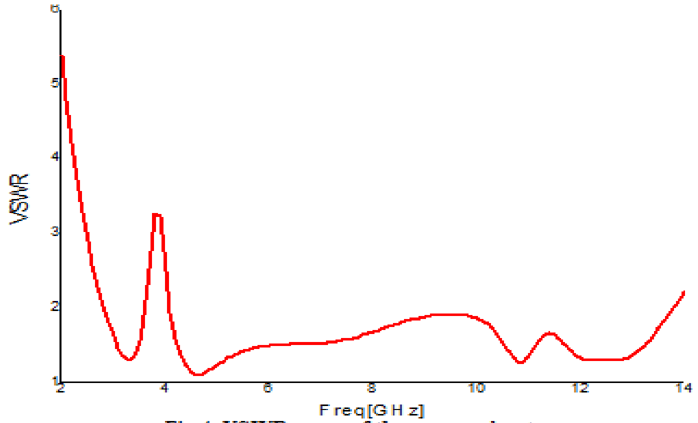

Fig.4. VSWR curve of the proposed antenna

Radiation efficiency of the scheduled antenna is 95% at 4.5 GHz and upto 97% at 12 GHz.

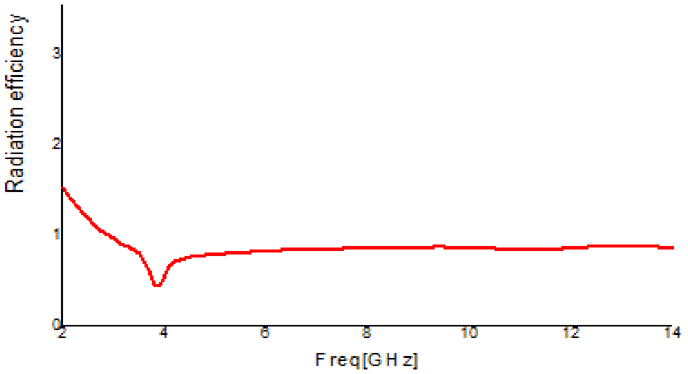

Fig.5. Radiation efficiency of the proposed antenna

3-D polar plot of the proposed antenna is shown in fig.6.

IJARSE
ISSN: 2319-8354

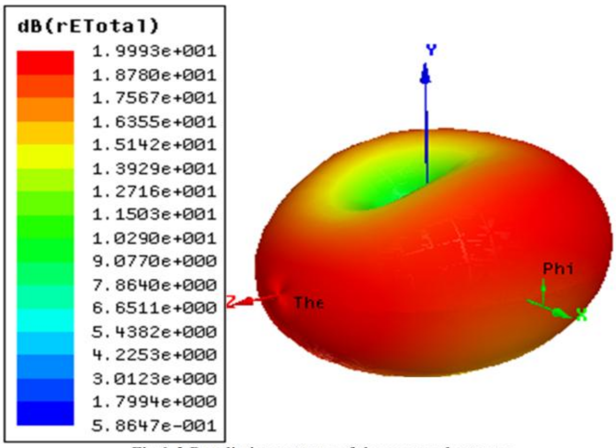

Fig.6. 3-D radiation patterns of the proposed antenna

Radiation patterns (Gain) at 3.5 GHz, 4.5 GHz and 11 GHz of the proposed antenna is shown in Fig.7.

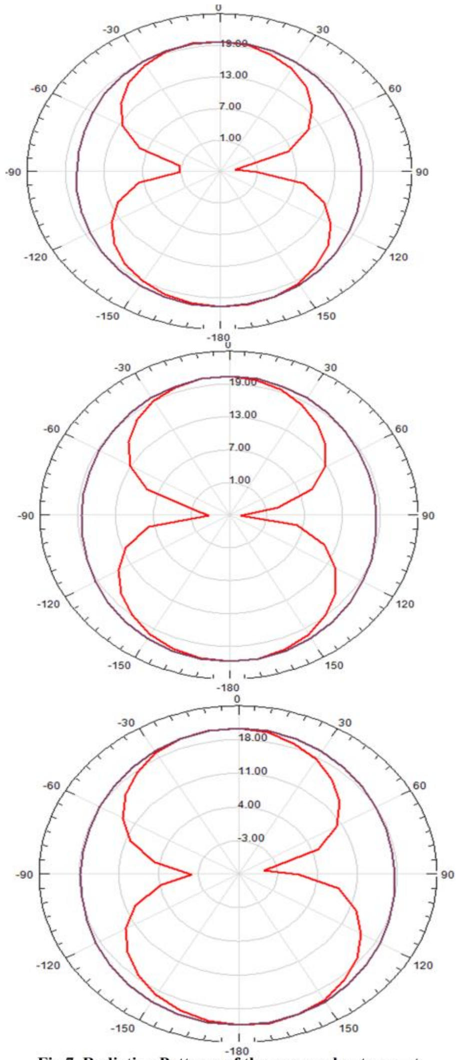

Fig.7. Radiation Patterns of the proposed antenna at (a) 3.5 GHz (b) 4.5 GHz (c) 11 GHz

IJARSE
ISSN: 2319-8354

IV. CONCLUSIONS

A design of microstrip patch antenna with intereference rejection property is designed in this paper for ultra wideband applications. The range of this type of antenna is from 2.7899 to 13.7251 GHz. This microstrip patch antenna is thoughtful for various applications in upper S band from 2 to 4 GHz, C band from 4 to 8 GHz, U-NII (Unlicensed National Information Infrastructure) band from 5.15 to 5.825 GHz, WLAN band from 5.2 to 5.8 GHz, X band from 8 to 12 GHz and ITU uplink satellite communication band from 8.1 to 8.4 GHz, while rejecting WiMAX band from 3.4 to 3.69 GHz. A single band rejection notch can be created by using an E-shaped slot into the radiation patch for reducing the interference introduced by the WIMAX band. The substrate dimensions of this microstrip patch antenna are 16.5 mm × 18

mm × 1.6 mm, which is sufficient proportion for distinct devices. Thus, this type of band rejection microstrip patch antenna is benign candidate for convenient UWB operations.

REFERENCES

[1]. Mewara, H. S., Mayank Sharma, M. M. Sharma, and Ajay Dadhich. "A novel ultra-wide band antenna design using notches and stairs", 2014 International Conference on Signal Propagation and Computer Technology (ICSPCT 2014), 2014.

[2]. Rajan Mishra and Vijay Shanker Tripathi, "A Compact Circular Disc Monopole Antenna For UWB applications International Journal of Applied Engineering Research, Vol. 12,2017; pp.3049-3053.

[3]. FCC Report and Order for Part 15 Acceptance of Ultra Wideband (UWB) Systems from 3.1 –10.6 GHz, FCC, Washington, DC, 2002.

[4]. T.Q. S. Quek, M. Z. Win, and D. Dardari, B Unified analysis of UWB transmitted reference schemes in the presence of narrowband interference, IEEE J. Sel. Areas Commun., vol. 6, no. 6, pp. 2126Y2139, 2007.

[5]. User's Manual, vol. 4, CST-Microwave Studio, 2002.

[6]. Jung, J., W. Choi, and J. Choi, "A small wideband microstrip fed monopole antenna, "IEEE Microwave Letters, Vol. 15, No. 10, 703–705, October 2005.

[7]. Lawas, Prameet, and Ashok Kajla. "An ultra-wide band antenna design with two inverted L slots for U-NII band rejection", 2015 International Conference on Signal Processing and Communication (ICSC), 2015.

[8]. K.S. Lim, M. Nagalingam, and C.P. Tan, "Design and construction of microstrip UWB antenna with time domain analysis," Progress in Electromagnetics Research M, Vol. 3, 153–164, 2008.

[9]. Printed circular disc monopole antenna for ultra wideband applications, Electron. Lett., vol. 40, no. 20, Sep. 2004 R. Zaker, Ch. Ghobadi, and J. Nourinia., "A Modified Microstrip-Fed Two-Step Tapered Monopole Antenna For UWB And WLAN Applications," Progress In Electromagnetics Research, PIER 77, 137–148, 2007.

[10]. Y. L. Chao and R. A. Scholtz, B Ultra-wideband transmitted reference systems,[IEEE Trans. Veh. Technol., vol. 54, no. 5, pp. 1556Y1569, 2005.

[11]. P. Gao, L. Xiong, J. Dai, Shuang He and Yi Zheng, "Compact Printed Wide-Slot UWB Antenna With 3.5/5.5-GHz Dual Band-Notched Characteristics" IEEE Antennas And Wireless Prpagation Letters, Vol. 12, 2013.

[12]. H. G. Schantz, "Ultra wideband technology gains a boost from new antennas," Antenna Syst. Technol., vol. 4, no. 1, Jan./Feb. 2001.

[13]. M. Ojaroudi, S. Yazdanifard, N. Ojaroudi, and R. A. Sadeghzadeh, "Band-Notched Small Square-Ring Antenna With a Pair of T-Shaped Strips Protruded Inside the Square Ring for UWB Applications" IEEE Antennas And Wireless Propagation Letters, Vol. 10, 2011.

[14]. N. Ojaroudi and M. Ojaroudi, "Novel Design of Dual Band-Notched Monopole Antenna With Bandwidth Enhancement for UWB Applications" IEEE Antannas And Wireless Propagation Letters, Vol. 12, 2013.

[15]. Z. Chen, X. Wu, H. Li, N. Yang, and M. Y. W. Chia, ―Considerations for source pulses and antennas in UWB radio systems, IEEE Trans.Antennas Propag., vol. 52, no. 7, pp. 1739–1748, Jul. 2004.

[16]. Rakhi and Sonam Thakur, "Performance Analysis of Different Shapes Patch Antennas at 2.45 GHz", International Journal of Engineering Research and Technology, Vol.3, Issue 9, 2014.

[17]. Sharma Aanchal, Sharma M.M., "An UWB antenna design with dual band notch characteristic using U - shaped slots" Signal Processing and Communication (ICSC), 2016 International Conference on ; pp. 470 – 473, Dec. 2016.