

# The Novel Compact Ultra Wide Band Monopole Antenna With Notch Filter

<sup>#1</sup>Sagar V. Chapke, <sup>#2</sup>Prof. S. P. Bhosale

<sup>1</sup>sagarchapke19@gmail.com  
<sup>2</sup>spbhosale23@rediffmail.com

<sup>#1</sup>Pune University, A.I.S.S.M.S. COE, Kennedy Road, Pune, India

<sup>#2</sup>Assistant Professor, Department of electronics, A.I.S.S.M.S COE, Pune, India



## ABSTRACT

This paper presents a microstrip-fed monopole antenna for ultra wideband (UWB) applications with notch filter. This antenna is based on the planar rectangle monopole antenna. The notch filter is added at 5.2 GHz. The characteristic of the antenna is improved by altering the figure of the radiation patch and the ground. HFSS is used to conduct simulation calculation so as to get various performance parameter of the antenna, to make sure that its frequency band range is 3.1GHz~10.6GHz, and to meet the design requirement of the ultra-wideband antenna.

**Keywords**— Monopole antenna, Ultra-wide band, Notch filter, Micro-strip line feed, HFSS

## ARTICLE INFO

### Article History

Received 25th March 2016

Received in revised form :

27th March 2016

Accepted : 29th March 2016

**Published online :**

**2nd April 2016**

## I. INTRODUCTION

Since the Federal Communication Commission (FCC) allowed 3.1-10.6GHz unlicensed band for ultra-wide band (UWB) communication in 2002, UWB communication systems attract great attentions in the wireless world [1]. UWB communication systems have many advantages, including high speed data rate, extremely low spectral power density, high precision ranging, and low cost. So the study of ultra-wideband antenna is always a hot spot [2]. Antenna is an important part of UWB communication systems, and it is a challenge to design then antenna suitable for such a wide frequency band applications. Printed monopole antenna, due to the simple structure, wide bandwidth & nearly omni-directional radiation patterns, has been widely used in UWB antenna design. Many planar monopole antenna designs have been widely used in the UWB system [3]. Recently, the ultra-wide band (UWB) communication systems have gained much attention because of their many advantages including low power spectral density radiated power and potential for accommodating higher data rate. To avoid interference between the UWB systems and the wireless local area network system (WLAN) with 5.15-5.825 GHz frequency band, a notch filter in the UWB system is necessary [4].

In this paper, a compact UWB monopole antenna with a band notched characteristics has been proposed. The

proposed antenna's radiating patch fed by 50 ohm micro-strip line and a rectangular shaped ground plane. To achieve the band notched characteristics, a pair of L-shaped slots forming U-Shape and symmetrical step slot is etched on the ground plane to obtain the centre frequency of 5.2 GHz band notched characteristics. The proposed antenna is simulated by HFSS 13 Software which is electromagnetic solver.

## II. DESIGN OF THE ANTENNA

The geometry of proposed antenna is shown in Fig.1 and Fig.2. It is fed by 50 ohm micro-strip line. The size of micro-strip feed line is chosen  $3 \times 35$  as milli-meter to achieve the characteristics impedance of 50 ohm. Radiating patch is designed on 1.6mm thick FR4 substrate with the relative permittivity and loss tangent of substrate is 4.4 and 0.02, respectively.

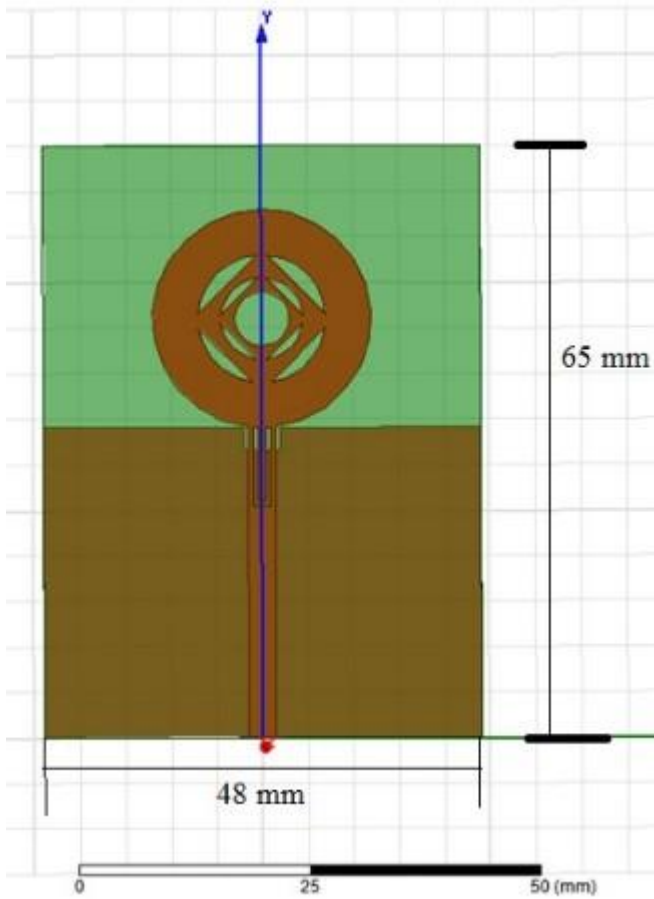


Fig.1. Front view of proposed antenna

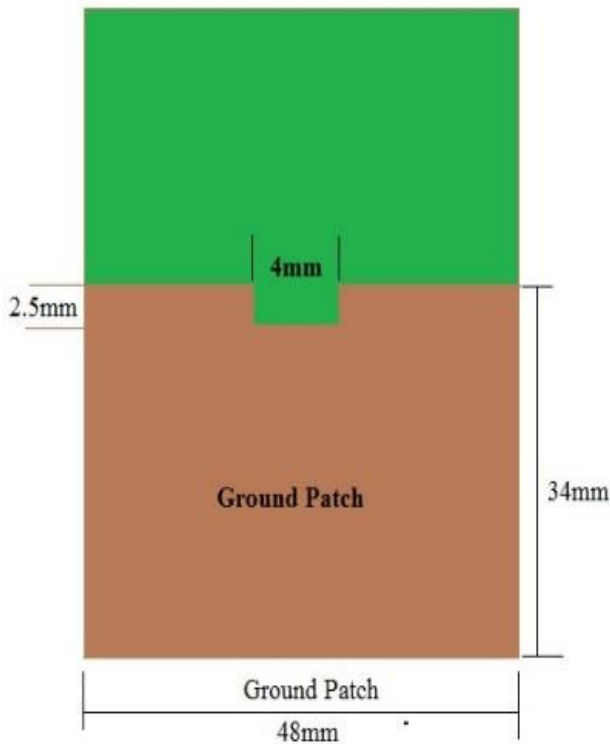


Fig.2. Back view of the antenna

In antenna design, we analyze and simulate this antenna by using Ansoft HFSS 13 software. For better matching of input impedance the radiating patch is placed in the position with respect to ground plane of the antenna. The Radiating patch of the antenna is designed by following steps as 1) First created outer circle of radius 12 mm. 2) Then circle 2 of radius 7 is deleted from it. 3) Inside that now inserted rectangle 1 of 11 x 11. 4) From this rect. Delete circle 3 of radius 4.5. 5) Now insert rectangle of 7x7 in between. 6) Delete circle 4 of radius 3 from it.

The shape of the ground plane as rectangle with dimension 48 mm x 34 mm. It Exhibits a better results. Dimensions of rectangular ground plane have been optimized to exhibits best gain and bandwidth. These optimized dimensions are obtained after a good number of simulations.

### III. THE SIMULATION AND ANALYSIS OF THE ANTENNA

In this paper, we use Ansoft HFSS 13 to simulate the UWB monopole antenna. The return loss S11 of the simulation result is shown in Fig. 3. It is easy to find that When the bandwidth is in 5.5- 15 GHz, the value of S11 is less than - 10 dB. Maximum radiation is 30dbi.

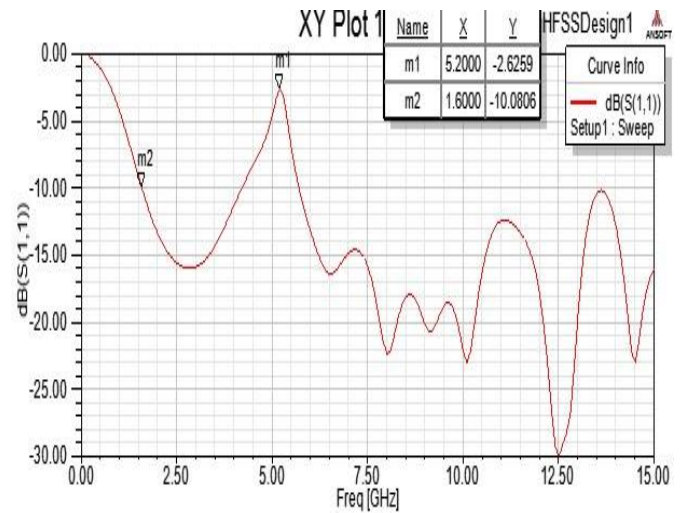


Fig.3. The simulated return loss S11 of the antenna

The voltage standing-wave ratio (VSWR) is shown in Fig. 4. It can be seen that when the bandwidth is in 5.5-15GHz, the VSWR value is less than or equal to 2. So the bandwidth is larger than the FCC's requirement. VSWR is 6.64 at 5.2 GHz indicates strong rejection. Its very close to 1 in pass band.

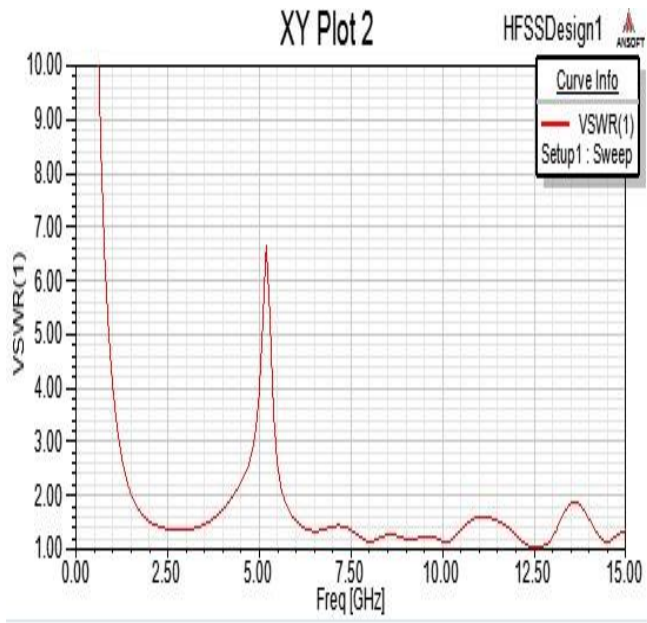


Fig.4. The simulated voltage standing-wave ratio (VSWR) of the antenna

The proposed UWB Monopole antenna will radiates from 1.5 GHz to 15 GHz. Fig.5 and Fig.6. shows the 2D and 3D radiation pattern of antenna. We have added notch filter at 5.2 GHz. thus antenna will not radiate from 4.2 GHz to 5.6 GHz with center frequency of 5.2 GHz which is WLAN frequency. The radiation characteristics of the antenna in the whole bandwidth are suitable for UWB communication system requirements.

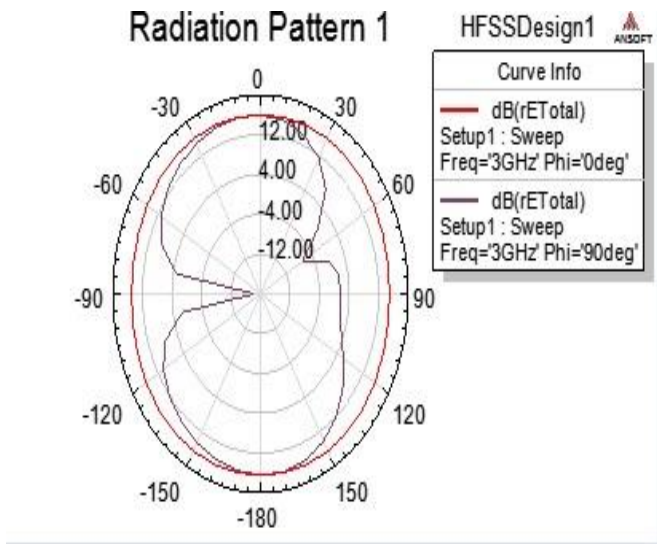


Fig.5. The simulated radiation pattern of antenna

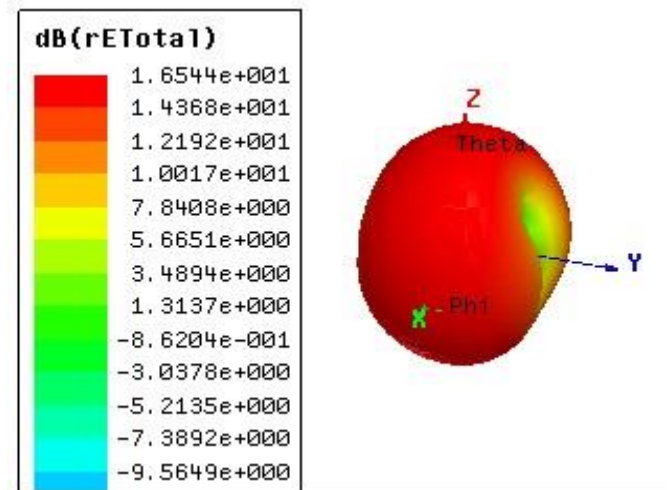


Fig.6. The simulated 3D radiation pattern of the antenna

Gain achieved for proposed antenna is almost constant for all pass band frequencies. The Fig.7 shows the gain of the antenna. Maximum value 4.84 dB and it also decreased at 5.2 GHz.

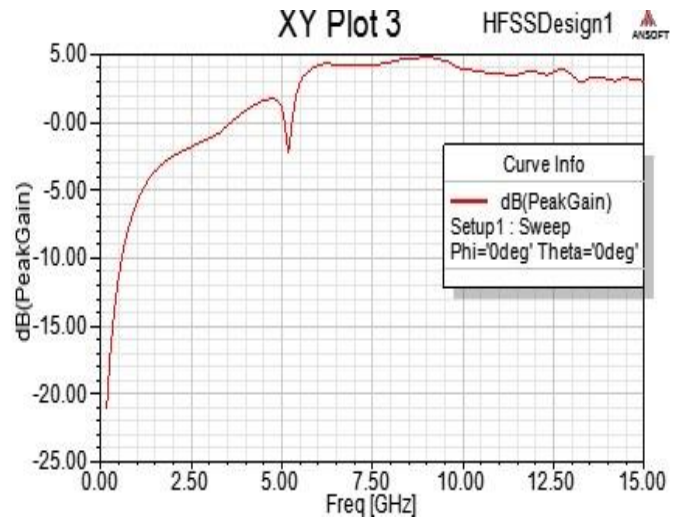


Fig.7. Gain of the proposed antenna

**IV. CONCLUSION**

The monopole antenna is a hot one for the research of the UWB antennas. In this paper, radiating patch and ground plane are designed to increase the bandwidth of the monopole antenna. The bandwidth is extended to 1.5 GHz to 15 GHz. Moreover, the radiation characteristic is good in working bandwidth. The size is small and the structure is simple, so the proposed antenna meets the design standards of the UWB antennas with WLAN band notched characteristics.

**REFERENCES**

[1] Yang L, Giannakis G B., Ultra-wideband communication: an idea whose time has come [J]. IEEE Signal Processing Magazine, 2004(21): 26-54.

- [2] FCC. First report and order, FCC 02-48, Feb. 14; 2002.
- [3] Monika Kunwal, Gaurav Bharadwaj, M.M Sharma, "Compact U-shaped monopole antenna for UWB applications with WLAN band notched", 2015 Fifth International Conference on Communication Systems and Network Technologies.
- [4] S. K. Mishra , R. Gupta, A. Vaidya, and J. Mukherjee, "Printed fork shaped dual band monopole antenna for bluetooth and uwb applications with 5.5ghz wlan band notched characteristics" Progress In Electromagnetics Research C, Vol. 22, 195{210, 2011.
- [5] S. De, P.P. Sarkar, "A high gain ultra-wideband monopole antenna", 1434-8411/2015 Elsevier GmbH.
- [6] Monika Kunwal, Gaurav Bharadwaj, "Compact U-shaped monopole antenna for UWB applications with WLAN band notched", 2015 Fifth International Conference on Communication Systems and Network Technologies.
- [7] Agrawal PN, Kumar G, "Wideband planar monopole antennas", IEEE TransAntennas Propagate 1998;46(Feb):294–5.
- [8] Ammann MJ, "Square planar monopole antennas", In: IEE publication no. 461.York, UK: Inst. Elect. Eng. NCAP; 1999. p. 37–40.
- [9] Zhi Ning Chen and Y. W. M. Chia, "Broadband monopole antenna with parasitic planer element", Microwave and optical technology letters / Vol. 27, No. 3, November 5 2000.