ISSN: 2278-0181
Vol. 2 Issue 6, June - 2013

Design And Simulation Of Circular Monopole Inverted T-Shaped Patch Antenna For Multiband Wireless Applications Using HFSS-11

Mrs. Geetika Mathur[1]
[1]*Asso. Professor, Dept. of ECE, Jodhpur Institute of Engg. & Technology - Jodhpur, Rajasthan, INDIA,*

Mr. Deepak Sharma[2]
[2]*Asst. Professor, Dept. of ECE, Sri Balaji College of Engg. & Technology Jaipur, Rajasthan, INDIA,*

Mr. Ashish Mathur[3]
[3]*Asso. Professor, Dept. of ECE, JIET School of Engg. and Technology for girls Jodhpur, Rajasthan, INDIA,*

***Abstract*— In this paper, the radiation performance of a monopole inverted T shape patch antenna designed on glass epoxy FR4 substrate. The proposed design is capable of providing enhanced bandwidth to cover Wi MAX, Wi Fi and Bluetooth operations at Absolute Bandwidth (GHz) Below -10 dB is 2.4GHz to 3.8 GHz = 1.4 GHz Second 5.2 GHz to 6 GHz = 0.8 GHz and Third 7 GHz to 8.6 GHz =1.6 GHz allotted by IEEE 802.16 working group for Wi MAX applications. The performance of proposed antenna is optimized considering at different conditions to obtain an antenna with dual band and high bandwidth performance. The Simulated results for various parameters like radiation patterns, total field gain, return loss, VSWR, input impedance and radiation efficiency of proposed antennas are also calculated with high frequency structure simulator HFSS-11.**

Keywords-* *Ultra-wide band, Multiband Band, Patch antenna

1. INTRODUCTION

FCC (Federal communications commission) allocated a block of radio spectrum from 3.1GHz to 10.6 GHz for UWB operations [1].UWB systems can support more than 500 Mbps data transmission within 10m [1]. Compact size, low-cost printed antennas with Wideband and Ultra wideband characteristic are desired in modern communications. The Ultra wide band antennas can be classified as directional and omni-directional antennas [3]. A directional antenna have the high gain and relatively large in size. It has narrow field of view. Whereas the omni-directional antenna have low gain and relatively small in size. It has wide field of view as they radiates in all the directions [3].

The UWB antennas have broad band. There are many challenges in UWB antenna design. One of the challenges is to achieve wide impedance bandwidth. UWB antennas are typically required to attain a bandwidth, which reaches greater than 100% of the center frequency to ensure a sufficient impedance match is attained throughout the band such that a power loss less than 10% due to reflections occurs at the antenna terminals. Various planar shapes, such as square, circular, triangular, and elliptical shapes are analyzed and reported. Compared with monopole based planar antennas, the design of ultra wide band circular ring type antennas is difficult because of effect of the ground Plane.

The bandwidth of the micro strip antenna can be enhanced by modifying the ground plane [6]. Many designers have tried various ways to improve the structure of the traditional circular antennas, and many valuable results have been obtained.

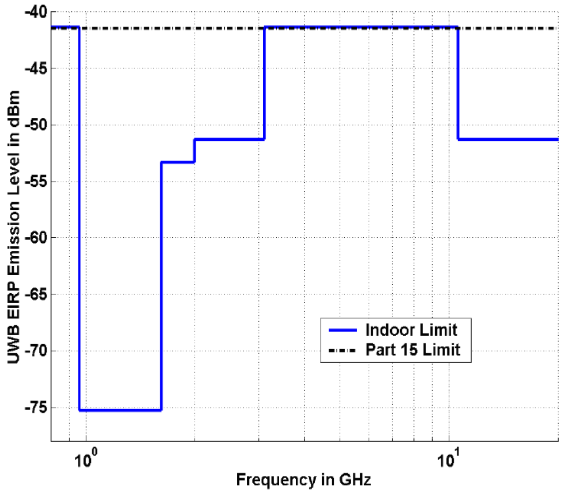

Figure 1 UWB Spectral Mask per FCC (Modified) Part 15 Rules [1]

1.1 Important properties of UWB

The following properties are required for the UWB antennas:

Wsub	Lsub	Wp	Lp	Wf	Lf	Wg	Lg	R	r
50	50	25	25	3	22	50	20	12.5	10

1) *Linear phase and constant group delay in directivity*: If the group delay is not constant, the pulse waveform is spread out in the time domain.

2) *Low return loss over ultra wide bandwidth:* If there are mismatches both at the antenna end and the circuitry end, the overall dispersion characteristic is much degraded due to the multipath within the feeding cable.

3) *Constant directivity over ultra wide bandwidth:* The variation of the directivity according to the frequency results in the ripples of the frequency transfer function in some citation direction. The dispersion characteristic is then degraded.

1.2 Fundamental principles to achieve UWB

There are two fundamental principles to achieve the broadband or UWB property of the antennas [2].

4) *Self similarity antenna:* A self similarity antenna is with the constant electric shape over the wide frequency bandwidth. Here, the electric shape means the shape described in the dimension of the wavelength. A biconical antenna, a bow-tie antenna, a discone antenna, an equi-angular spiral antenna are the examples of this class.

5) *Self complementary antenna:* A self complementary antenna is usually composed of planar conductor(s), and its complementary structure is identical to the original structure. Here, complementary structure is obtained by replacing the conductor and the non-conductor parts in the plane. Among the self complementary antennas, the log-periodic antenna is well known.

2. Antenna Configuration and Design

For patch antenna the length and width of patch antenna are used as calculated from the equations. The first step is of dimension 2.5 x 1 mm^2 and second step is 4 mm on Y-axis and 1 mm on X-axis. The ground plane is of 50 x 50 mm^2. The slot present at patch is 4 x 8 mm^2. The ground plane is modified to enhance the bandwidth of the antenna. The whole structure of patch antenna is shown in Fig. 2 and the dimensions of proposed antenna are shown in Table 1.1 and Table 1.2.

Table 1.1 Dimensions (in mm) of a CPM antenna

Table 1.2 Dimensions (in mm) of Inverted T slot

Ws1	Ls1	Ws2	Ls2
4	8	15	4

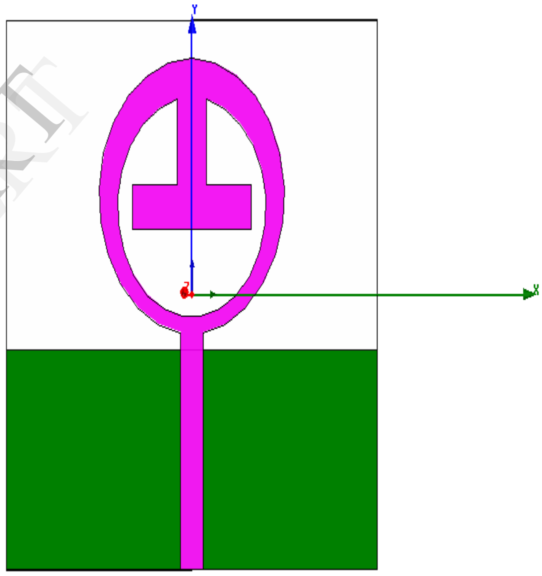

Figure 2 Whole structure of circular patch for Wireless communication

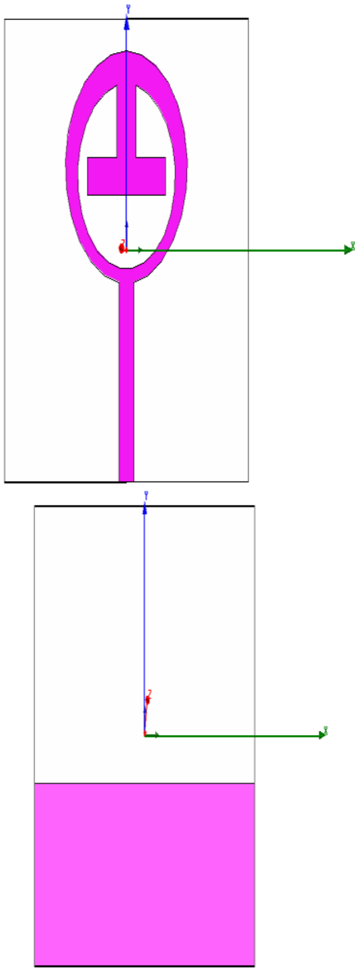

Figure 3 (a) Top View Figure 3 (b) Bottem View

Top view and bottom view of design geometry of patch antenna is indicated in Fig.3 (a) and Fig. 3(b). The proposed antenna designed on a Rogers RT/duroid 5880TM substrate with dielectric constant ε_r = 4.4 and height of the substrate is h = 1.6 mm. The substrate has length L= 50 mm and width W = 50 mm.The substrate is mounted on ground of 20 mm length and 50 mm width.

3. SIMULATION RESULTS

Fig.4 and 5 Shows that S_{11} and VSWR of Multiband band patch antenna. This antenna is suitable for operating frequency 2.4GHz to 3.8 GHz = 1.4 GHz second 5.2 GHz to 6 GHz = 0.8 GHz and Third 7 GHz to 8.6 GHz =1.6 GHz allotted by IEEE 802.16 working group for Wi MAX applications. The VSWR obtained is less than 1.1 the patch antenna is found to have the compact size and 45%, 14%, 20% Maximum Fractional Bandwidth. The return loss value of first band is -24 at 2.8GHz and for second band are -23.0 at 7.9GHz

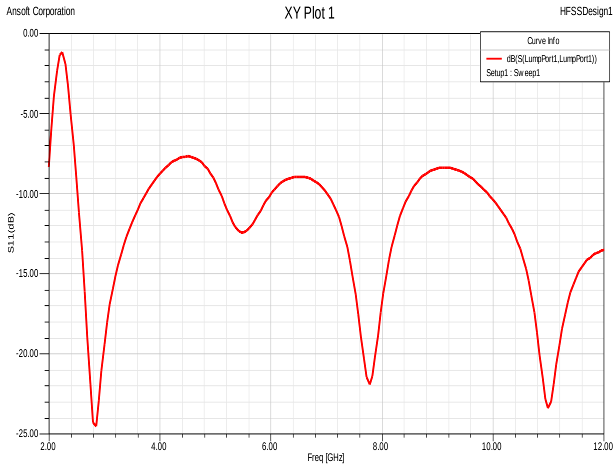

Figure 4 S_{11} of dual band patch antenna

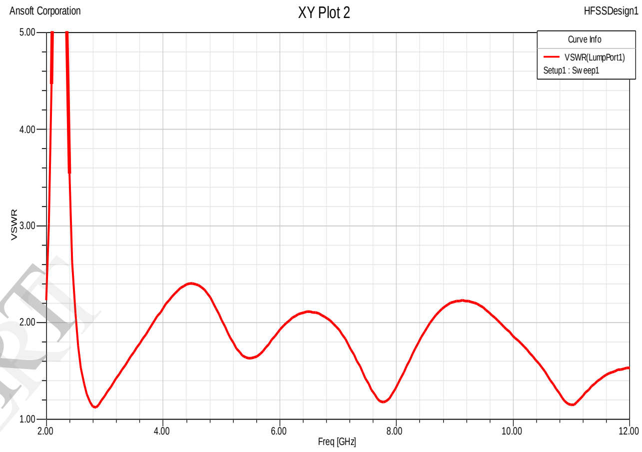

Figure 5 VSWR of dual band patch antenna

Fig. 6 Shows the relationship between frequency and impedance for the real and imaginary part of proposed design and gives the value of input impedance (Z_{in}) which will be ≤ 50 Ω for the perfect matching with transmission line.

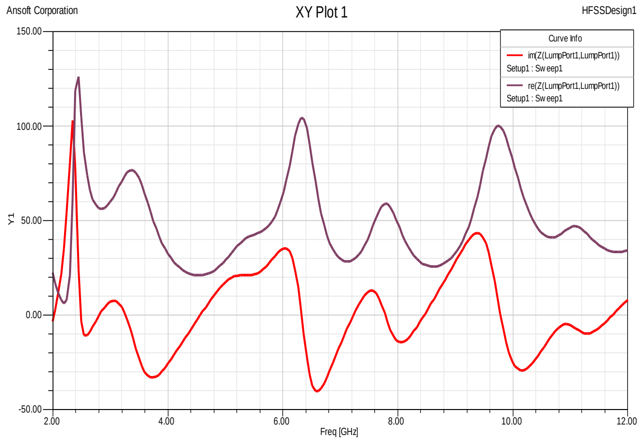

Figure 6 Z- Parameter of dual band patch antenna

The plot curve for Gain, E – H Plane, Directivity and Polar Plot are shown in Fig. 7, Fig. 8, Fig. 9 and Fig. 10 respectively at 5 GHz.

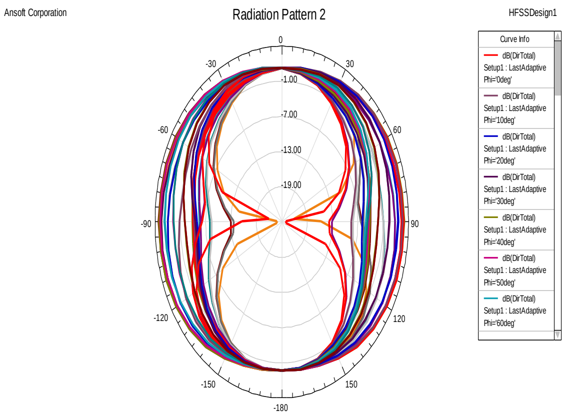

Figure 7 Gain in db at 5GHz

From Fig.7, we see that the gain of antenna is low (~3dBi) and maximum radiations are normal to the patch antenna geometry.

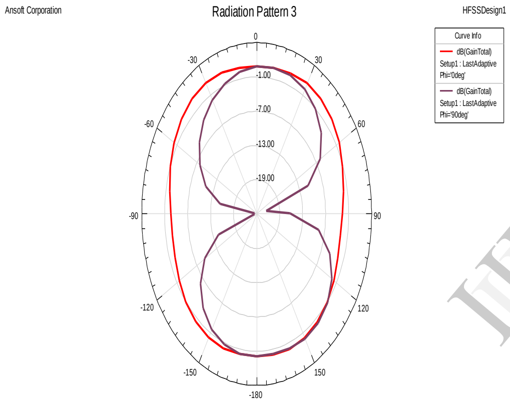

Figure 8 E-H Planes at 5GHz

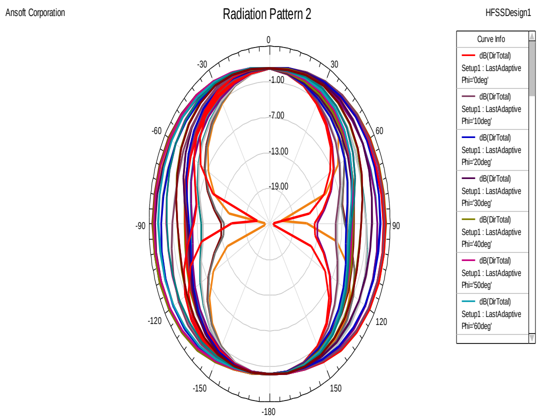

Figure 9 Directivity at 5GHz

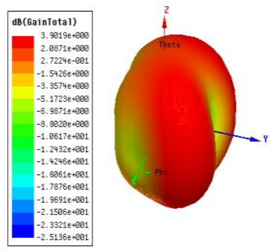

Figure 10 Gain in 3D Polar at 5GHz

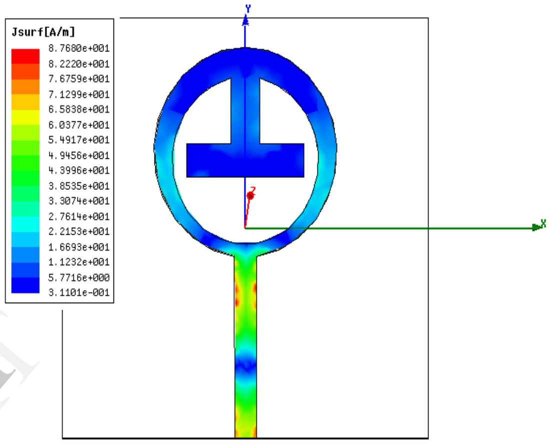

Figure 11 Surface current distribution at 5GHz

4. CONCLUSION

In this paper, Monopole circular Patch Inverted T shaped micro strip antenna suitable for wireless communication systems is simulated using HFSS-11. The fabricated antenna has advantages of small size, easy fabrication and simple construction. Antenna is circularly polarized and operates at three centre frequency first is 2.4GHz -3.8 GHz with Absolute Bandwidth 1.4 GHz ,second is 5.2 GHz -6 GHz with Absolute Bandwidth 0.8 GHz and third 7 GHz -8.6 GHz with Absolute Bandwidth 1.6 GHz. This antenna is under testing stage and further better results with low loss substrate are expected.

Radiation performance of inverted T-Shape circular patch antenna is also presented in this thesis. The simulated results indicate that an ultra wide band antenna with Maximum Fractional Bandwidth 45%, 14%, 20% can be designed by cutting an inverted T-Shape in a complete circular patch. The radiation efficiency 82% and antenna efficiency 79% may be achieved and we conclude that proposed geometry is applicable for three different pass bands in the range of ISM (2.4GHz-2.4835GHz) Bluetooth (2.4GHz-2.484GHz) and Wi max IEEE 802.16 (3.3GHz-3.7GHz).

5. ACKNOWLEDGMENT

The authors thank Prof. P.S.Ashtankar Department of Electronics & Communication Engineering, Kits, Ramtek (M.S.),India-44110 for providing antenna design, fabrication and characterization facilities.

REFERENCES

[1] Ashish Mathur ,Deepak Sharma,Geetika Mathur "Design and Simulation of Dual Band Patch Antenna for Ultra Wide Band (UWB) Applications Using HFSS, ICMARS2012- Jodhpur, Volume 1, Issue 1 pp.771-774, December 11-15, 2012.

[2] Ashish Mathur ,Deepak Sharma,Geetika Mathur "Design and Simulation of Rectangular and Half Ring Patch Antenna for Ultra Wide Band (UWB) Applications Using HFSS, ICMARS2012- Jodhpur, Volume 1, Issue 1 pp.296-300, December 11-15, 2012.

[3] Ashish Mathur ,Deepak Sharma,Geetika Mathur "Design and Simulation of Dual Band Patch Antenna for ISM, WI-MAX and C-Band Rejection Using HFSS" in International Conference in Advancement on Information Technology (ICAIT), Souvenir March 22-23, 2013.

[4] Prof. P.S.Ashtankar and Dr.C.G.Dethe "Design and Modification of Circular Monopole UWB Antenna for WPAN Application Computer Engineering and Intelligent Systems ISSN 2222-1719 (Paper) ISSN 2222-2863 (Online) Vol 3, No.5, 2012.

[5] C. Balanis, Antenna Theory: Analysis and Design, New York, John Wiley & Sons, Inc., 1997.

[6] Shelly Chawla, Jagtar Singh, Paras Chawla "Single to Multiband Frequency Technique for Wireless and Telecomm Microstrip Antenna Design" International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-2, Issue-5, November 2012.

[7 Radouane Karli and Hassan Ammor "Design of Microstrip Patch Antenna for 3.6 GHz WIMAX Applications " European Journal of Scientific Research ISSN 1450-216X Vol. 88 No 4, pp.556-564, October, 2012.

[8] Priya Upadhyay, Richa Sharma "Design and Implementation of Series Micro Strip Patch Antenna Array For Wireless Communication" Int.J.Computer Technology & Applications, Vol 3 (5), 1769-1774 ISSN: 2229-6093 Sept-Oct 2012.

[9] K.Naga Mallik, Ch. Radhika, D.Ujwala, H.M.Ramesh, A. Gowtham Kumar, P.Karthik "A Compact Microstrip Patch Antenna with Triangular Snipped Slot for Wireless Applications" International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-1, Issue-4, April 2012.

[10] Swapnil Thorat Raj Kumar "Design of Rectangular-Cut Circular Disc UWB Antenna with Band-Notched Characteristics" International Journal of Engineering Science and Technology (IJEST) ISSN: 0975-5462 Vol. 4 No.04 April 2012.

[11] J.V.Suresh, N.Anand Ratnesh, Siva Rama Krishna.K, L.Yogesh, B.Anil Babu, K.V.V.Kumar "Design of Far-Field Focusing Circular Patch Antenna at 5.8GHZ for RFID Applications " International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 2, Issue 2, pp.640-644, Mar-Apr 2012.