ISSN2394-3777 (Print)
ISSN2394-3785 (Online)
Available online atwww.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 9, March 2018

# COMPACT TRIANGULAR MICROSTRIP PATCH ANTENNA FOR UWB APPLICATION

V.SENDIL KUMAR,
M.E. Student,
Dr.Paul's Engg.College,

Mr. M.ARULAALAN,
Associate Professor,
Alpha college of Engineering and Technology

Mr.R. MOHANA MURALI,
Associate Professor,
Dr.Paul's Engg.College

***Abstract*—A novel compact triangular shaped Microstrip antenna is designed and simulated for UWB application. The antenna arrangement consists of triangular radiating patch with Microstrip line feed and modified ground plane. It has a wide bandwidth from 3.4 to 10.7 GHz for voltage standing wave ratio (VSWR) < 2 and an average gain of 0.8 dB with a peak of 3 dB Structures. Good agreement between designed and simulated results convincing that the antenna can operate over a wide bandwidth for UWB application.**

***Index Terms*— UWB, Microstrip Antenna, Microstrip Feed**

## I. INTRODUCTION

Wireless communication is experiencing an increased demand for enhanced transmission quality and high data rate. In the field of short-distance wireless communication, a new opportunity has been introduced by the Federal Communications Commission (FCC) with the announcement of the 3.1–10.6 GHz frequency band for unlicensed radio communication[1] The demand of higher data transfer rate and higher bandwidths supplemented existing operating frequencies. The UWB band is an area of interest due to the fact that it can accommodate higher data transfer rate on a large bandwidth and the release by the Federal Communications Commission (FCC) of a bandwidth of 7.5GHz (from 3.1GHz to 10.6GHz) for ultra-wideband (UWB) wireless communication made UWB to grow rapidly advancing as a high data rate wireless communication technology.

UWB is rapidly advancing as a high data rate wireless communication technology. As is the case in conventional wireless communication systems, an antenna also plays a very crucial role in UWB systems. There is more challenges in designing a UWB antenna than a conventional one. A suitable UWB antenna should be capable of operating over an ultra wide bandwidth as allocated by the FCC. At the same time, satisfactory radiation properties over the entire frequency range are also necessary. Many antennas are proposed for UWB application [1]-[7]. The antenna configurations such as inverted F antenna (IFA) [8], planar IFA [9], co-planar waveguide-fed antenna [10] and defected ground antenna [11] have increasingly found usage in the portable devices since they provide high performance and compact designs.

In this paper a novel compact triangular shaped Microstrip antenna is designed and simulated for UWB application. The antenna arrangement consists of triangular radiating patch with Microstrip line feed and modified ground plane for UWB applications. The antenna is designed on an inexpensive dielectric substrate FR-4 with relative permittivity (εr) of 4.4 with thickness of 1.6 mm. The proposed antenna system should operate over a wide frequency range from 3.4 GHz to 10.7 GHz .The antenna is designed and tested using Advanced Design System software. It has been demonstrated that these antenna is suitable for UWB applications.

## II. ANTENNA GEOMETRY AND DESIGN

The triangular patch antenna finds a good replacement for a rectangular and circular patch antenna due to similar radiation characteristics and it has the advantage of occupying less metalized area on substrate than the other existing shapes like rectangular and circular. The radiating element is a triangular patch with Microstrip line feed, printed on an FR4 substrate with the thickness of $t$ = 1.6mm and relative permittivity of $\varepsilon_r$ =4.4. The FR4 substrate was chosen for its low cost, zero water absorption and good mechanical strength. The equilateral triangular patch antenna shown in Fig. 1 was designed with a side length of a = 16 mm. For an equilateral triangular microstrip antenna, the side length 'a' is calculated by using the formula [12] - [13]

$$f_r = \frac{2c}{3a\sqrt{\varepsilon_r}} \quad (1)$$

ISSN2394-3777 (Print)
ISSN2394-3785 (Online)
Available online atwww.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 9, March 2018

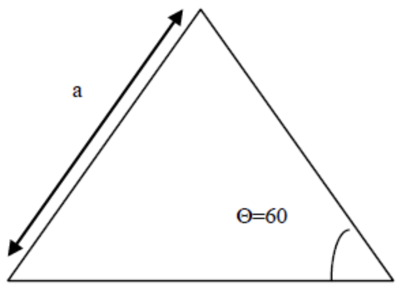



Figure 1. Equilateral triangular Microstrip patch antenna

The micro strip line feed width and length is calculated in ADS line calculator or any micro strip line Calculator .The impedance matching is good for inset fed micro strip patch antenna

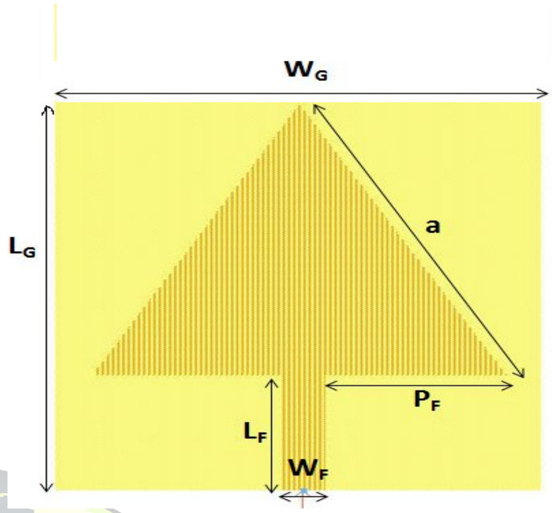



**Fig 3 Design dimensions**

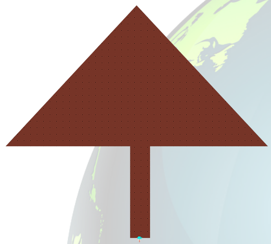


**Figure 2 Layout of Line fed ETMSA**

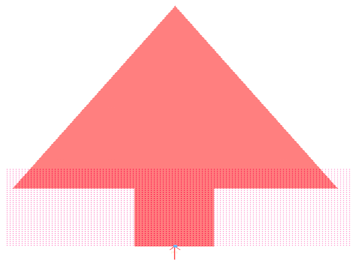


**Fig 4 Layout in Schematic window**

As shown in Figure 2, the ETMSA structure is connected with a conducting strip at the base of the triangle that acts as a feeding for excitation, and the technique or scheme is Microstrip line feeding technique [14-15]. The breadth or width of the conducting feed line strip is smaller in dimension as that of the base of the patch i.e. ETMSA. This technique has an advantage of the triangular patch and the feed line lying in the same plane above the substrate and can be etched easily during fabrication.

## III. PRIMITIVE DESIGN

Figure 3 and Figure 4 displays the design layout for TMSA UWB antenna. FCC (Federal Communication Commission) approved and authorized the 3.1 GHz to 10.6 GHz band as the UWB (Ultra-wide Band). The simulation of the antenna is carried by using Advanced Design System (ADS) which is an electronic design automation software system produced by Key sight EEs of EDA, a division of Key sight Technologies. Table 1 displays the dimensions of the UWB antenna

| S.No | Parameter | Dimensions (mm) |
|---|---|---|
| 1 | A | 16 |
| 2 | $L_F$ | 4.4 |
| 3 | $W_F$ | 3.9 |
| 4 | $L_G$ | 18.25 |
| 5 | $W_G$ | 17 |

**Table 1 Dimensions of the TMSA UWB Antenna**

## IV. PROPOSED ANTENNA SIMULATION RESULTS

The proposed antenna is tested for Return loss, VSWR, Radiation pattern and Surface current density. The The return loss shows that the antenna can operate from 3.53 GHz to 10.7 GHz. Fig 5 displays the return loss obtained by the UWB antenna. The return loss shows that the antenna can operate from 3.53 GHz to 10.7 GHz.

ISSN2394-3777 (Print)
ISSN2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 9, March 2018

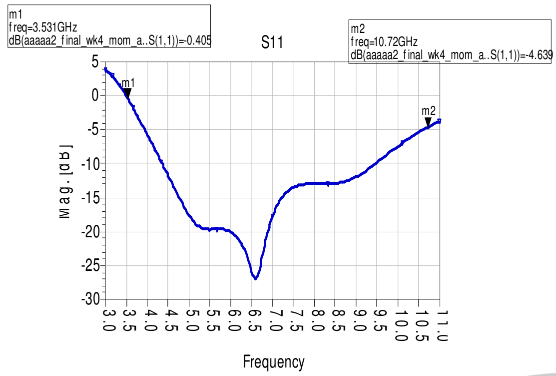



Fig 5 Return loss for the proposed UWB antenna

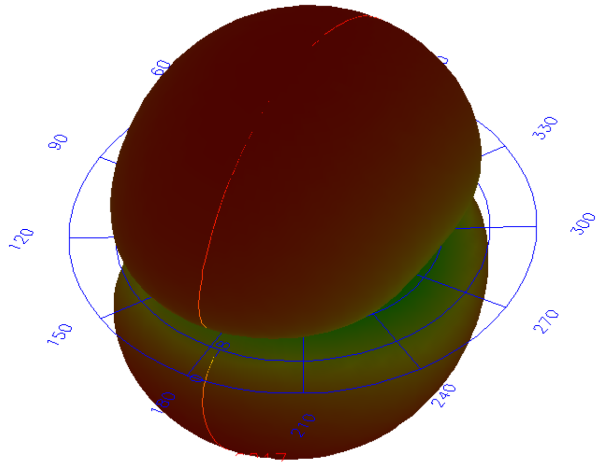


Fig 7 Simulated 3D radiation pattern at 4.33 GHz

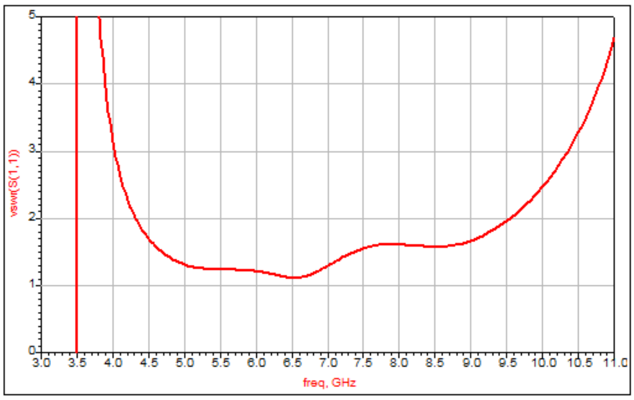
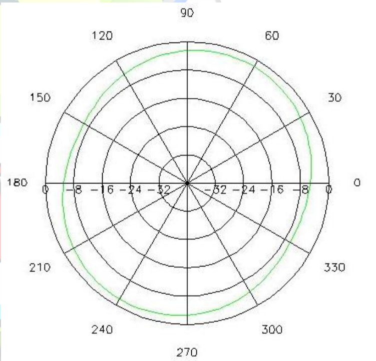
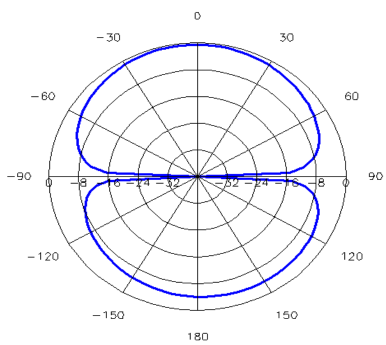



Fig 6 VSWR for the proposed UWB antenna

Fig 6 displays the VSWR obtained by the designed UWB antenna. The Figure 6 shows that the UWB antenna has VSWR value less than 2 for the operating frequency range.



(a) E-plane



(b) H-plane

**Fig 8 Simulated 2D radiation pattern at 4.33 GHz**

The designed antenna provided omnidirectional pattern in H-plane and bidirectional pattern in E-plane for 4.33GHz as shown in Figure 8. Figure 7 depicts the 3D radiation pattern of the UWB antenna.

ISSN2394-3777 (Print)
ISSN2394-3785 (Online)
Available online atwww.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 9, March 2018

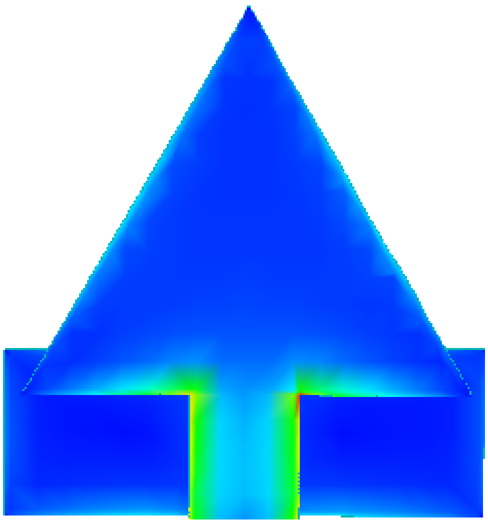


Fig 9 Distribution of surface current density

Fig 9 displays the current 4.33 GHz .It is noted that the current density is confined to the patch of the antenna. The current pass through the feed and it is then transferred to the patch of the antenna.

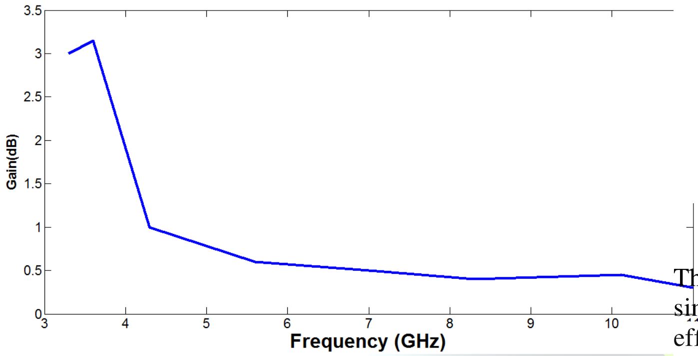



Fig 10 UWB antenna Gain at various frequencies

The gain of the UWB antenna at various frequencies is plotted in Figure 10 .The antenna has a gain of more than 0.3 dB at all operating frequencies.

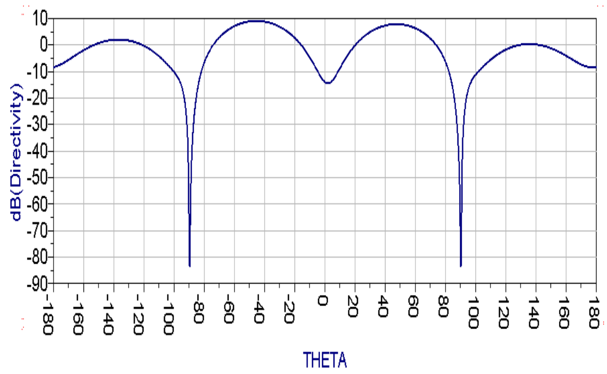



Fig. 11 Directivity of the UWB antenna

Fig. 11 shows the directivity of the UWB antenna simulated in ADS Momentum. The directivity of the system, is approximately 10 dB for various angles. As it is a single patch antenna, it does not possess great directivity since it has omnidirectional pattern.

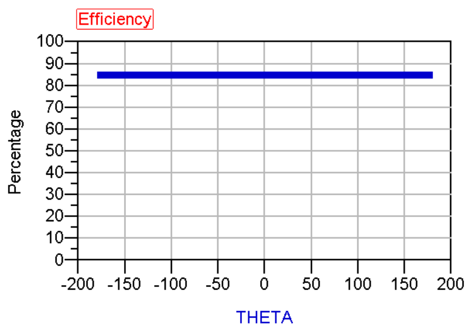



**Fig. 12 Efficiency of the UWB antenna**

The figure 12 shows the efficiency of the UWB antenna simulated by ADS. The antenna efficiency (or radiation efficiency) can be written as the ratio of the radiated power to the input power of the antenna. The efficiency of the antenna is 85%

## V. Conclusion

The UWB technology will be the key solution for the future WPAN systems. This is due to its ability to achieve very high data rate which results from the large frequency spectrum occupied. Besides, extremely low power emission level will prevent UWB systems from causing severe interference with other wireless systems. As the only nondigital part of a UWB system, antenna remains as a particular challenging topic because there are more stringent requirements for a suitable UWB antenna compared with a narrowband antenna. Therefore, the antenna design and analysis for UWB systems were carried out in this project. The proposed antenna demonstrated a wide impedance bandwidth,

ISSN2394-3777 (Print)
ISSN2394-3785 (Online)
Available online atwww.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 9, March 2018

suitable radiation characteristics, and satisfactory gain for UWB applications. The details pertaining to the antenna design and its low-profile characteristics render this antenna suitable to be deployed for practical wireless communication applications, especially in an indoor environment.

## References

[1] Federal Communications Commission: 'First report and order'. Revision of part 15 of the Commission's rules regarding ultra-wideband transmission systems, February 2002

[2] Gautam, A.K., Yadav, S., and Kanaujia, B.K.: 'A CPW-fed compact UWB microstrip antenna', IEEE Antennas Wirel. Propag. Lett., 2013, 12, pp. 151–154

[3] Guo, Z., Tian, H.P., Wang, X.D., et al.: 'Bandwidth enhancement of monopole UWB antenna with new slots and EBG structures', IEEE Antennas Wirel. Propag. Lett., 2013, 12, pp. 1550–1553

[4] Aboufoul, T., Parini, C., Chen, X.D.A., et al.: 'Pattern-reconfigurable planar circular ultra-wideband monopole antenna', IEEE Trans. Antennas Propag., 2013, 61, (10), pp. 4973–4980

[5] Gao, G.P., Hu, B., and Zhang, J.S.: 'Design of a miniaturization printed circular-slot UWB antenna by the half-cutting method', IEEE Antennas Wirel. Propag. Lett., 2013, 12, pp. 567–570

[6] Gopikrishna, M., Krishna, D.D., Aanandan, C.K., et al.: 'Compact linear tapered slot antenna for UWB applications', Electron. Lett.,2008, 44, (20), pp. 1174–1175

[7] Zhu, F.G., Gao, S., Ho, A.T.S., et al.: 'Ultra-wideband dual-polarized patch antenna with four capacitively coupled feeds', IEEE Trans. Antennas Propag., 2014, 62, (5), pp. 2440–2449

[8]. Karaboikis, M., Soras, C., Tsachtsiris, G., Makios, V.: 'Compact dual-printed inverted-F antenna diversity systems for portable wireless devices', IEEE Antennas Wirel. Propag. Lett., 2004, 3, (1), pp. 9–14

[9] Pazin, L., Telzhensky, N., Leviatan, Y.: 'Wideband flat-plate inverted-F laptop antenna for Wi-Fi/WiMAX operation', IET Microw. Antennas Propag, 2008, 2, (6), pp. 568–573

[10] Chattha, H.T., Huang, Y., Ishfaq, M.K., Boyes, S.J.: 'Bandwidth enhancement techniques for planar inverted-F antenna', IET Microw. Antennas Propag, 2011, 5, (15), pp. 1872–1879

[11] Li, W.–T., Shi, X.–W., Hei, Y.Q.: 'Novel planar UWB monopole antenna with triple band-notched characteristics', IEEE Antennas Wirel. Propag. Lett., 2009,8, pp. 1094–1098

[12] Jaswant.S. Dahele, Kai Fong Lee, on the resonant frequencies of the triangular patch antenna, *IEEE Transactions on Antennas and Propagation, vol-35, pp.100-101,Jan 1987.*

[13] Lee K.F, Luk. K.M and Dahele, Characteristics of the equilateral riangular patch antenna, *IEEE Trans., vol.36, pp. 1510- 1518, Nov 1988.*

[14]. Li. L, Cheung.S.W and Yuk.T.I, "Dual band antenna with compact radiator for 2.4/5.2/5.8 GHz WLAN applications", IEEE Transactions on Antennas and Propagation, vol. 60, no.12, pp. 5924–5931, 2012.

[15.] CHIH-YU HUANG AND EN-ZO YU, "A SLOT-MONOPOLE ANTENNA FOR DUAL-BAND WLAN APPLICATIONS", IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL.10, PP.500-502, 2011.