International Journal of Information & Computation Technology.
ISSN 0974-2239 Volume 4, Number 6 (2014), pp. 565-570

http://www. irphouse.com

Design and Simulation of Inverted T-Shaped Antenna for X-band Applications

Ankita Goel[1], M R Tripathy[2] and Sohaib Abbas Zaidi[3]

[123]Department of ECE, Amity School of Engineering & Technology, Amity University, Noida, India
[1]ankita_goel199t@yahoo.co.in, [2]mrtripathy@amity.edu, [3]sohaib.abbas87@gmail.com

ABSTRACT

In this paper, inverted T shaped microstrip patch antenna is being proposed. Inverted T shaped microstrip patch antenna is being designed using FR4-epoxy substrate. The proposed antenna is operating in triple band with return loss of -27.63 dB, -23.29 dB and -14.29 at the 9.4 GHz, 8.4 GHz & 5.1 GHz respectively. The gain of the proposed antenna is 6.63 dB, 6.024 dB & 4.42 dB at 9.4 GHz, 8.4 GHz & 5.1GHz respectively. The return loss & gain of the proposed antenna show that it has promising characteristics for various X band (8-12 GHz) applications. The design is being simulated using HFSS (High Frequency Structure Simulator) software.

Keywords- HFSS, microstrip patch antenna, microstrip feed.

1. INTRODUCTION

In recent years, the evolution and optimization of antenna design has got much attention for investigation. Due to many reasons, mainly due to the large onboard application requirements of antenna in communication system, its size and weight are of prime concern. The primary goal of antenna designers is to design an antenna which is compact in size, light weight, with minimum cost and ease of fabrication. The proposed antenna operates in X band frequency range. The X band ranges from 8 GHz -12 GHz as defined by an IEEE standard for radio waves. The most common application of antenna operating in X band is radar communication [1]. Radar and satellite communication uses X band based antennas for short range tracking, missile guidance, marine, and airborne intercept.

In this paper, the inverted T shaped microstrip patch antenna [2-3] is proposed for X band application [4-9]. The inverted T shaped antenna is formed by combining two

inverted T shaped structures. The proposed antenna is operating in triple band configuration. The proposed antenna is providing a return loss of -27.6363 dB & gain of 6.63 dB at 9.4GHz. At operating frequency of 8.4 GHz the obtained return loss is -23.2989 dB while the obtained gain is around 6 dB. The gain of 4.42 dB & return loss of -14.29 dB is observed at 5.1 GHz. The operating characteristics of antenna shows that it can be used for various X band applications.

2. ANTENNA GEOMETRY

The geometry of the proposed inverted T shaped antenna is shown in figure 1. The two inverted T shaped structures are united to constitute the structure of the patch. The dimensions of the middle rectangle R3 is 4.8mm X 24mm. The rectangles R1 & R2 has the dimensions of 10mm X 5mm. The substrate used is FR4_epoxy having dielectric constant value 4.4. The thickness of the substrate is 1.5mm. The proposed antenna is fed using microstrip line feed having the dimensions of 7.2mm X 4.8mm. The slotted ground is used for the proposed antenna. The ground is having the dimensions of 42mm X 58 mm. The provided slot has the dimensions of 32mm X 48mm.

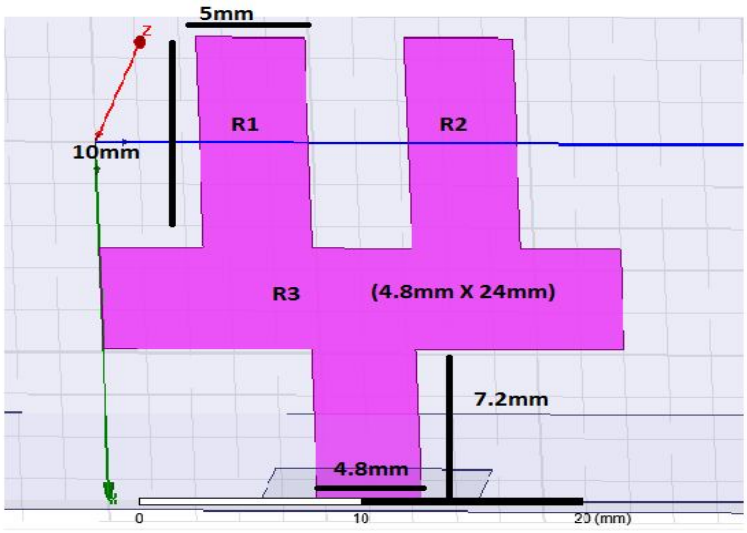

FIGURE 1

3. RESULTS & DISCUSSION

The simulation of the design is being done using HFSS software. Results of the simulation concerning the return loss of antenna are shown in figure 2. It is observed that impedance is matched properly in three bands as the return loss obtained is below from the limit of -10 dB. The proposed antenna is working in triple band. The first operating band is from 5.0417 GHz to 5.2262 GHz. In this band the obtained return loss is -14.29 dB at 5.1 GHz. The obtained gain at 5.1 GHz is 4.42 dB. This is shown by the figure 3. The second operating band is from 8.0625 GHz to 8.629 GHz. The

return loss obtained here is -23.2989 dB with a gain of 6.024 db at 8.4 GHz. This is shown by the figure 4. The third band of operation is from 9.2321 GHz to 9.6071 GHz. At 9.4 GHz the obtained return loss is -27.6363 dB. The gain of 6.6373 dB is observed in figure 5 at 9.4GHz. From the radiation pattern of the three bands it is clearly visible that antenna is working as the monopole. It is radiating in a specific direction. It can also be observed from the radiation pattern of three bands that no back lobes are present. The range of the obtained gain is from 4 dB to 6 dB approximately validates the 3 dB margin. Simulation results show that second & third operating bands lie in X band with sufficient gain so that it can be used in various X band applications. Figures below show the return loss & gain characteristics of the proposed antenna.

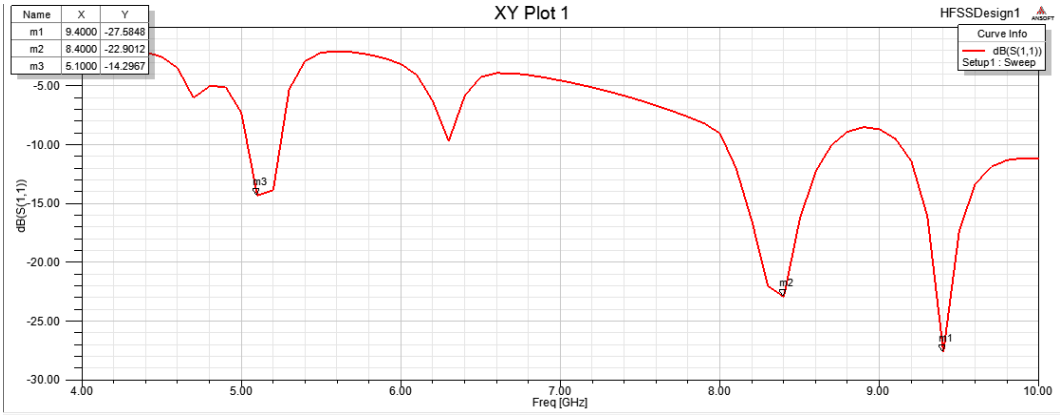

FIGURE 2 SIMULATED RETURN LOSS

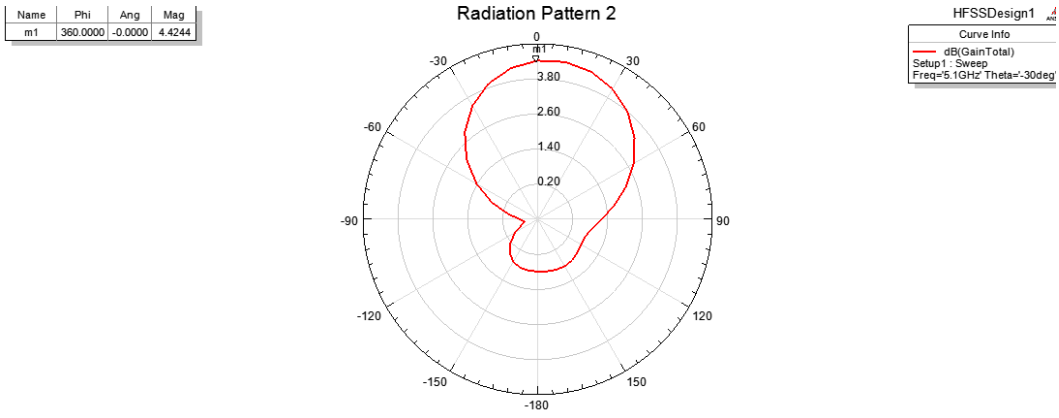

FIGURE 3 RADIATION PATTERN at 5.1 GHz

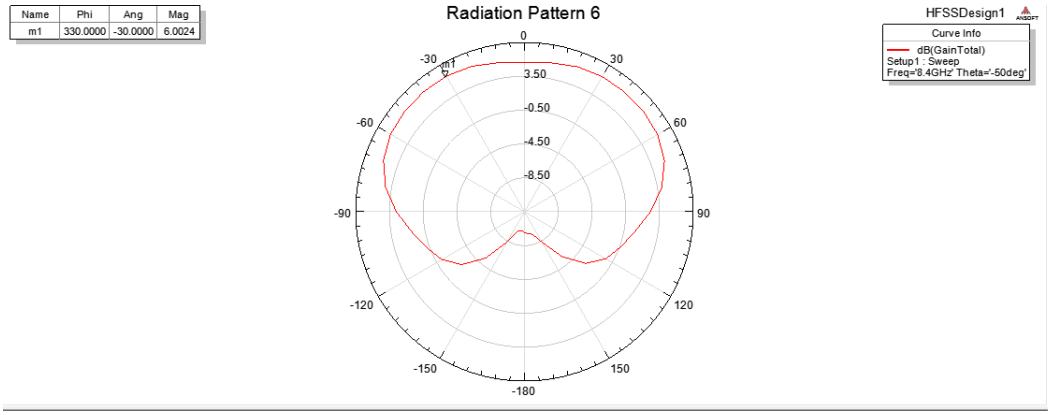

FIGURE 4 RADIATION PATTERN at 8.4 GHz

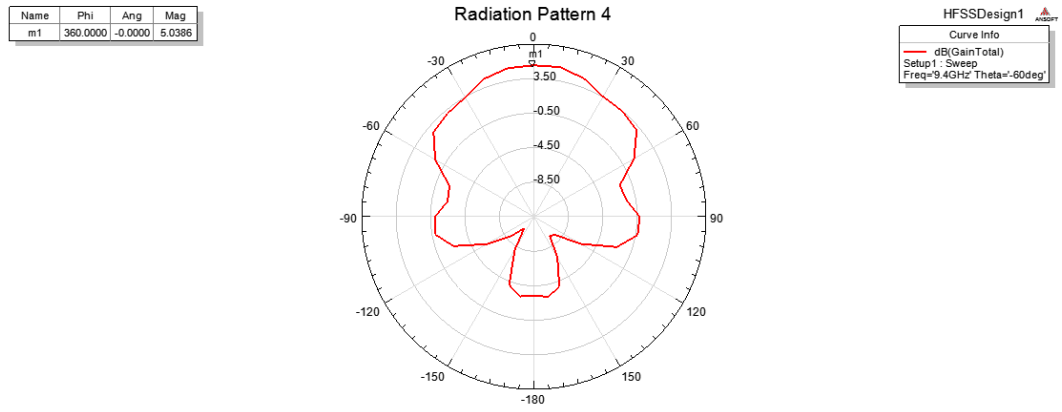

FIGURE 5 RADIATION PATTERN at 9.4 GHz

4. CONCLUSION

In this paper an inverted T shaped antenna is being proposed. The proposed antenna is working in triple band configuration. The operating bands are covering the frequency from 5 GHz to 10 GHz. The return loss of the simulated result shows that there is proper impedance matching as return loss is quite below from the set limit of -10 dB. The gain obtained also ranges from 4dB to 6 dB approximately showing the good radiating characteristics of the antenna. Out of three bands, two bands lie in the X band i.e. 8 GHz to 12 GHz. The simulation results of return loss and gain show that this antenna can be used for various civil, military & government institutions applications of X band.

5. REFERENCES

[1] J. M. Fernández González, P. Padilla, G. Expósito-Domínguez and M. Sierra-Castañer, “Lightweight Portable Planar Slot Array Antenna for Satellite

Communications in X-Band", IEEE Antennas and Wireless Propagation Letters, vol. 10, pp.1409-1412, 2011.

[2] Garg R, Bhartia P, Bahl I & Ittipiboon A, Microstrip Antenna design handbook, Artech House London, pp. 1-16, 2001.

[3] Balanis C.A, Antenn Theory & Analysis, John Wiley & Sons, pp. 811-843, 2007.

[4] Ghatak R, Chaterjee S & Poddar D.R, "Wideband fractal shaped slot antenna for X band application", Electronics Letters, vol. 48, No. 4, pp. 198-199, 2012.

[5] Soliman E A, Brebels S, Vandenbosch G & Beyne E, "X-band brick wall antenna fed by CPW", Electronics Letters, vol. 34, No. 9, pp. 836-838, 1998.

[6] Abdelnasser A. Eldek, Atef Z. Elsherbeni & Charles E. Smith, "Wide-Band Modified Printed Bow-Tie Antenna with Single and Dual Polarization for C– and X-Band Applications", IEEE Transactions on Antennas and Propagation, vol. 53, No. 9, pp. 3067- 3072, 2005.

[7] Locker C. & Thomas F. Eibert, "Unidirectional Radiation Efficient Stacked Aperture Antenna for X-Band Application", IEEE Antennas and Wireless Propagation Letters, vol. 7, pp. 264-266, 2008.

[8] Harrabi A, Razban T, Mahe Y, Osman L & Gharsallah A, "Wideband Patch antenna for X-band applications", Progress In Electromagnetics Research Symposium Proceedings, pp. 1043- 1046, 2013.

[9] Claudius Locker, Thomas Vaupel, & Thomas F. Eibert, "Radiation Efficient Unidirectional Low-Profile Slot Antenna Elements for X-Band Application", IEEE Transactions on Antennas and Propagation, vol. 53, No. 8, pp. 2765-2768, 2005.