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European Journal of Advances in Engineering and Technology, 2015, 2(6): 10-13

Research Article ISSN: 2394 - 658X

Compact Microstrip Patch Antenna Using Parasitic Technique for C-Band Line of Sight Communication

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ABSTRACT

In this paper, design of compact Microstrip patch antenna using parasitic technique for line of sight communication is proposed, having hexagonal shape ground plane. The proposed antenna has slots in the patch to achieve wideband. The antenna model is simulated using Finite element method at the frequency 4.65 GHz to 5.25 GHz. The antenna design demonstrates desirable features for wireless communication.

Key words: Microstrip patch antenna, parasitic technique, C-Band, Line of Sight Communication

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INTRODUCTION

Microstrip antennas have always been an attractive choice for the researchers, especially in the field where light weight and easy to fabricate structures are desired such as in line of sight communication or Mobile communication. Microstrip Patch antenna is known to be a low profile antenna, which can be mounted on a flat surface. It is basically designed with radiating patch on one side of a dielectric substrate and on the other side of this dielectric substrate, a ground plane is fixed. The patch is usually made up of various conducting materials such as copper or gold and can be produced in any possible shape. Electric fringing fields between the edges of the conductor element and the ground plane behind it are the primary source of the antenna's radiation. The antenna's radiation depends upon various properties of antenna such as dielectric constant, height of the substrate, the patch dimensions and the frequency. The radiating patch is made up of a perfect electric conductor material on one side of its substrate is made up of material Rogers RT/Duroid 5880 and the ground plane on the other side of the substrate[1-2]. These antennas are designed mainly for single mode operation, but as the number of users and number of desired applications in a single device are increasing day by day, demand of wideband antennas is also growing in order to fulfil such needs.

PROPOSED ANTENNA MODEL AND DESIGN

In this paper a compact Microstrip patch antenna is presented using parasitic technique for line of sight communication. It consists of slots in the patch to enhance the bandwidth of the designed model [3-8]. By optimization of the length and width of these slots, wideband is obtained. Fig. 1 shows the geometry of the proposed antenna, which is a coaxial-fed slotted patch for line of sight operation in the wireless communication. The antenna formed by the strip which is directly printed on the patch portion. In this antenna model, the patch has size of 20 mm X 24 mm and substrate is made from a 1.6 mm thick RT/Duroid 5880 substrate of relative permittivity 2.2 and loss tangent is 0.0009. The ground plane used here is of hexagonal shape to improve the radiation pattern of the antenna.

Microstrip antenna design equations as mentioned in equations (1-4) have been used to calculate width, length and effective dielectric constant for proposed antenna.

$$W = \frac{c}{2 f_r}\left(\frac{\varepsilon_r + 1}{2}\right)^{-\frac{1}{2}} \quad (1)$$

$$L = \frac{c}{2 f_r \sqrt{\varepsilon_e}} - 2\Delta l \quad (2)$$

$$\varepsilon_e = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left(1 + \frac{12h}{W}\right)^{-\frac{1}{2}} \quad (3)$$

$$\frac{\Delta l}{h} = 0.412 \frac{\left(\varepsilon_e + 0.3\right)\left(\frac{W}{h} + 0.264\right)}{\left(\varepsilon_e - 0.258\right)\left(\frac{W}{h} + 0.8\right)} \quad (4)$$

where the following parameters are used, f_r is the resonant frequency, w is the width of the patch, L is the length of the Patch, h is the thickness of substrate, ε_r is the relative permittivity of the dielectric substrate, ε_e is effective dielectric constant and c is speed of light

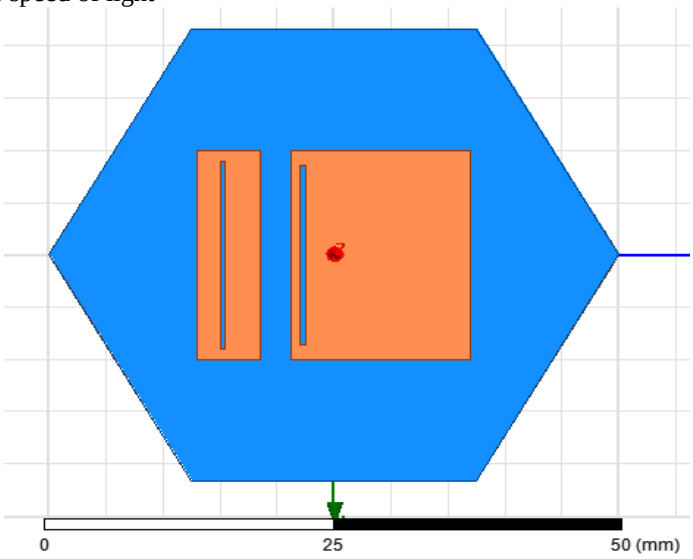

Fig. 1 Proposed antenna model

SIMULATED RESULTS

After proper modeling of the proposed antenna it has been simulated and optimized using HFSS software. Simulated results of the antenna is shown in Fig. II (a, b, c and d). Fig. 2 shows that simulated VSWR of the antenna is less than 2 throughout the band i.e. 4.66 GHz to 5.25 GHz and Fig. 3-5 shows the radiation pattern. Fig. 6 and 7 shows the gain versus frequency and directivity versus frequency respectively. From the Fig. it is very clear that at the desired frequency band of operation the gain is greater than 6 dBi, in between there is a slight change which is due the parasitic technique but this does not make any affect in the performance of the antenna.

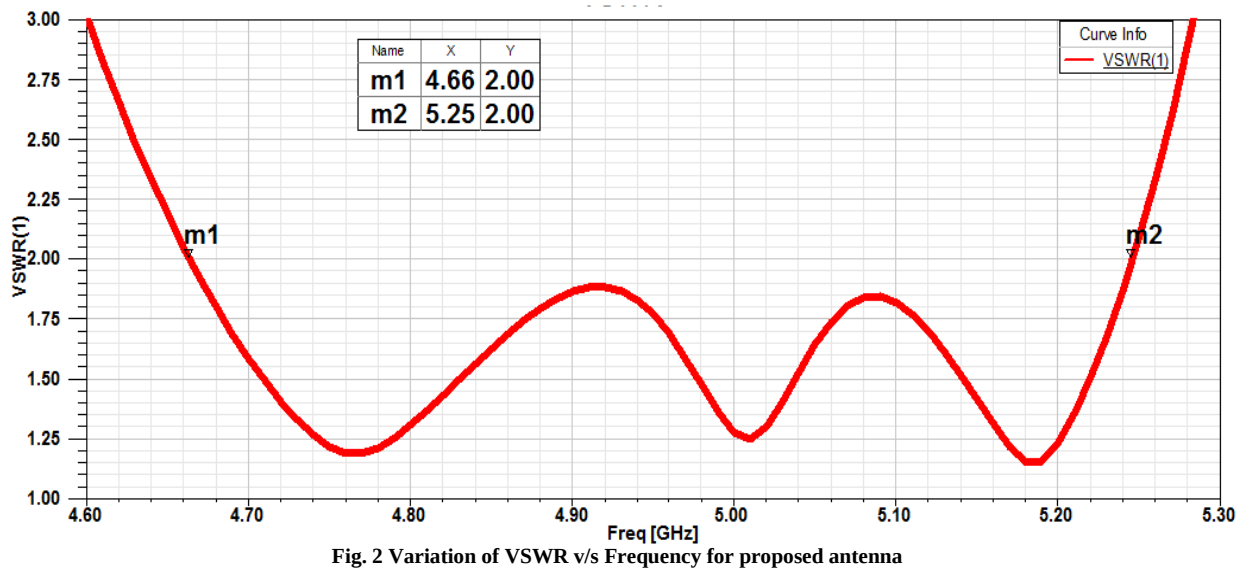

Fig. 2 Variation of VSWR v/s Frequency for proposed antenna

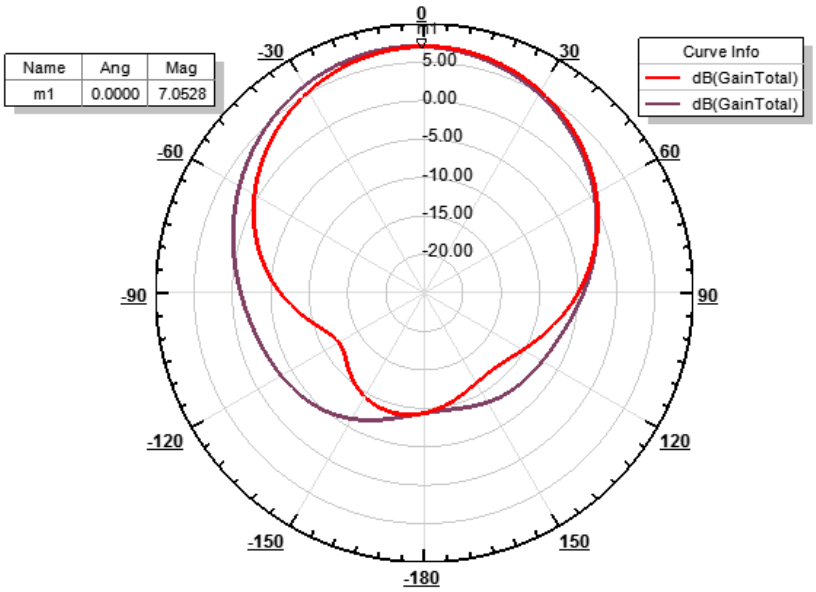

Fig. 3 Radiation pattern of proposed antenna at 4.7 GHz

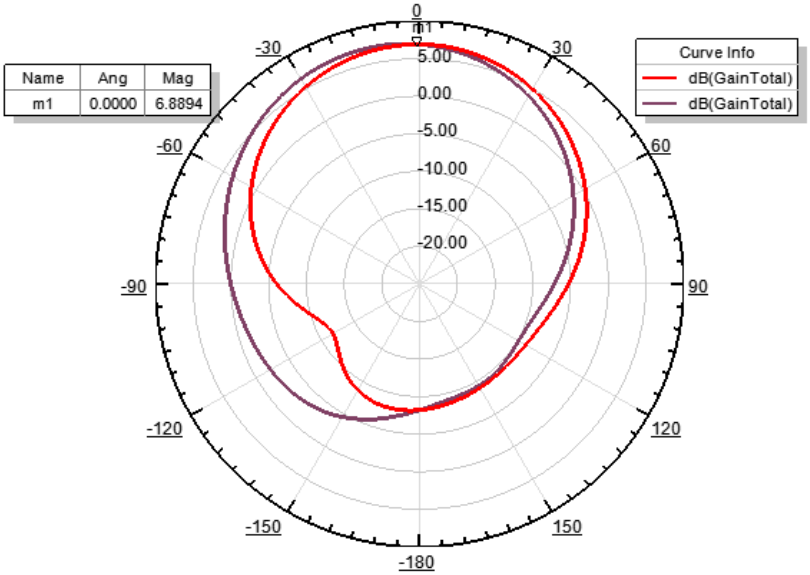

Fig. 4 Radiation pattern of proposed antenna at 4.8 GHz

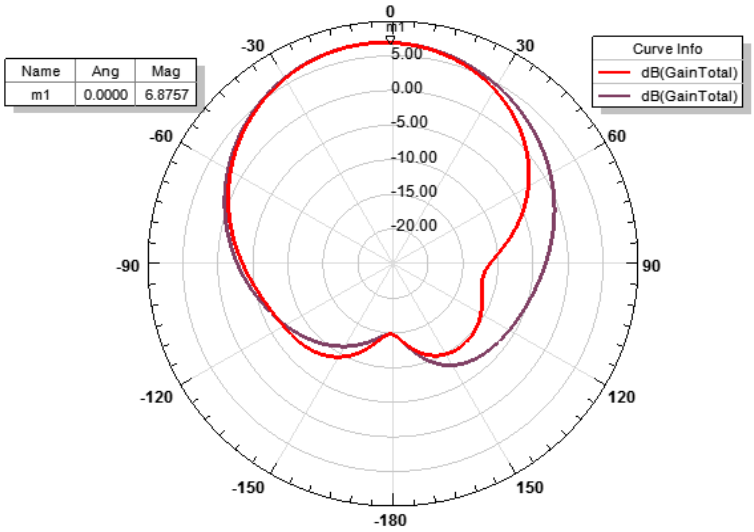

Fig. 5 Radiation pattern of proposed antenna at 5.2 GHz

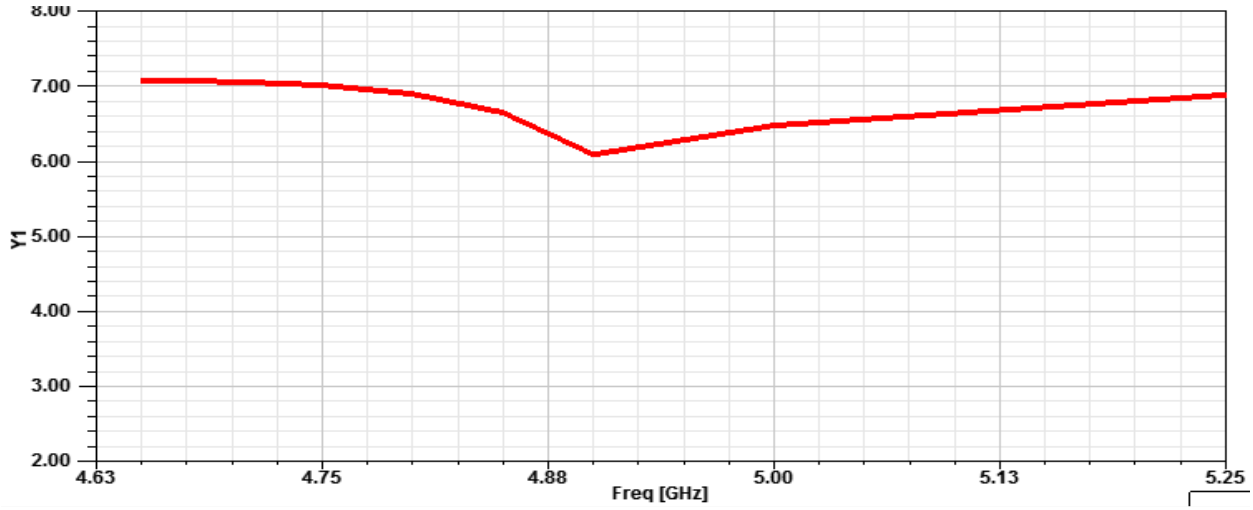

Fig. 6 Variation of gain v/s frequency for proposed antenna

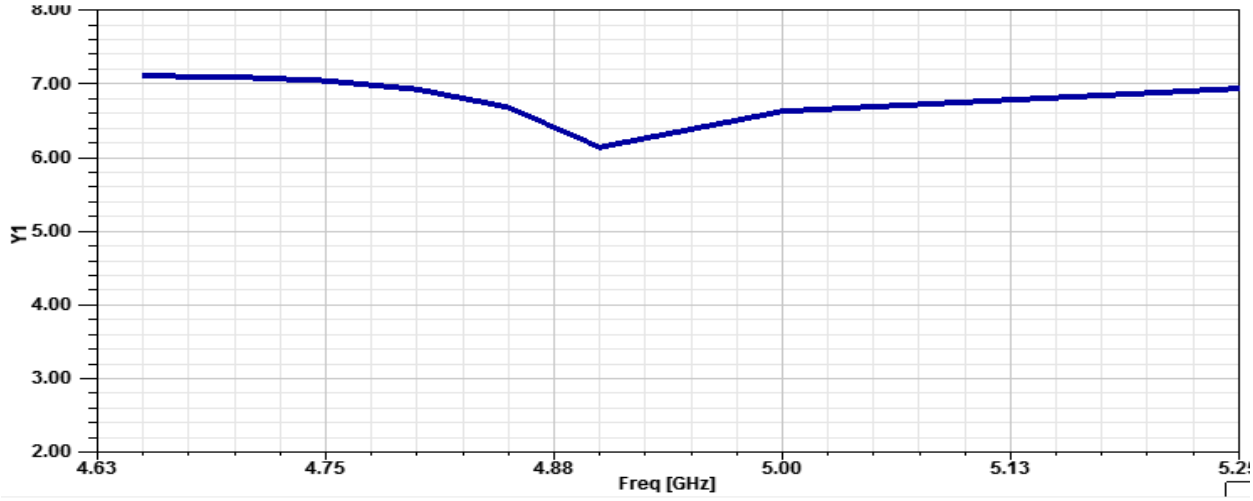

Fig. 7 Variation of directivity v/s frequency for proposed antenna

CONCLUSION

A low profile innovative compact Microstrip patch antenna using parasitic technique has been designed and simulated using HFSS software. Impedance bandwidth of the order of 12.89 % has been achieved in single layer Microstrip configuration. Simulated gain of the designed antenna is more than 6 dBi over the band of operation. The designed antenna can be used in line of sight communication system at C-Band.

REFERENCES

[1] Constantine A Balanis, *Antenna Theory Analysis and Design*, Wiley student edition, 2008.
[2] I.J Bahl and P Bhartia, *Microstrip Antennas Design Handbook*, Dedham, MA: Artech House, 1981.
[3] R.S Kushwaha, D.K Srivastava, S. Dhupkariya, J.P saini and K. Prasad, Slot loaded Electromagnetically Coupled Microstrip Line Fed Microstrip Patch Antenna for Wideband Applications *IEEE Conference on Communications and Signal Processing (ICCSP)*, 2013, 1082-1086.
[4] Vijay Sharma, A Novel Design of Parasitically Gap Coupled Patches Forming an Elliptical Patch Antenna for Broadband Performance, *Chinese Journal of Engineering*, **2014**, Article ID 365048, 6 pages, doi:10.1155/2014/365048, 2314-8063 (Online).
[5] R Caso, AA Serra, M Pino, P Nepa and G Manara, A Wideband Slot-Coupled Stacked-Patch Array for Wireless Communications, *IEEE Antennas Wireless Propagation Letters*, **2010,** 9, 986–989.
[6] Mohammad Tariqul Islam, Mohammed Nazbus, Shakib, Norbahiah Misran, Baharudin Yatim, Analysis of Broadband Microstrip Patch Antenna, *IEEE Proceedings on ICCIT* **2008** , 758-761.
[7] V Sharma, BR Sharma, KB Sharma and D Bhatnagar, Truncated Elliptical Patch Antenna for Broadband Performance, *Proceeding of SPIE (International Society for Optics and Photonics)*, **2013**, 8760, 87601 Q1 –Q8.
[8] KL Wong and WH Hsu, A Broadband Rectangular Patch Antenna With a Pair of Wide Slits, *IEEE Transactions on Antennas and Propagation*, **2001**, 49, 1345-1347.