ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 7, July 2017

Design of Compact Wideband Key-slotted Circular Microstrip Patch Antenna with partial Ground Plane

Yeeshu Relhan, Yogita,

Asst. Professor, Department of Electronics and Comm, PIET, PANIPAT, Haryana, India

M.Tech Student, Department of Electronics and Comm, PIET, PANIPAT, Haryana, India

ABSTRACT: Paper reports the design and performance of a modified circular microstrip patch antenna with modified ground plane. Proposed antenna with overall dimensions length 50 mm , breadth 50, height 1.6mm is simulated by applying CST Microwave Studio simulator and fed through a quarter wave line. This antenna has an impedance bandwidth of 3.16 GHz (3.4GHz – 6.5GHz) with flat gain (close to 3dBi) in the desired frequency range. The E plane radiation patterns simulated at frequency 4.5GHz are almost omni directional while H-plane patterns resembles with that of a dipole antenna. Both patterns are directed normal to patch geometry. This antenna may be proved useful in modern wireless communication systems.

KEYWORDS: Partial ground structure, wireless communication, wideband, CST, Radiation patterns

I. INTRODUCTION

Antennas with improved performance for modern wireless communication systems have resulted into extensive research of compact antennas. Antennas for these systems must be light weight, low cost and compact in size so that they may be put inside the handset without protruding out [1-2]. Antennas with infinite ground planes have limitations in their performance including their capability to radiate only in the upper hemisphere. The bandwidth of these antennas may be improved only up to certain limit but for antennas applicable for wideband and ultra wide band applications, infinite ground plane is not an effective solution. Looking limitations of microstrip antennas with infinite ground plane, antennas with finite [3-4] and defected ground planes [5-6] and coplanar antennas having radiating and ground planes on same side of substrate [7-8] came into existence. In the proposed work, performance of a circular patch antenna having modified ground plane is reported. The overall performance of proposed antenna is improved considerably than a circular patch antenna with infinite ground plane. The design and performance of this antenna are reported in the next section.

II. ANTENNA DESIGN AND ANALYSIS

Initially a circular patch microstrip antenna with patch radius 9 mm is designed on Glass epoxy FR-4 substrate of size 50 mm x 50 mm having relative permittivity ε_r = 4.4, substrate height h = 1.6 mm and loss tangent = 0.025. A quarter wave line of length 7.2mm and width 3mm is attached with this patch to feed this antenna and connected with a 50 ohm cable through SMA connector. The front and rear view of considered antenna are shown in Figs. 1(a) & 1(b) respectively. The simulation analysis of antenna is carried out by applying CST Microwave Studio simulation software [9]. The simulation results indicate that antenna resonates at effectively at frequency 4GHz and 5.56GHz as shown in fig. 2. The bandwidth presented at this frequency is narrow (~3%) therefore this antenna may not be applied in modern communication systems. This antenna is modified in steps by modifying the considered ground plane.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 7, July 2017

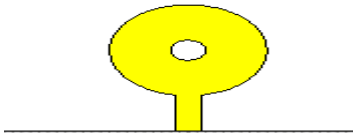


Fig 1(a) . Front view of designed antenna

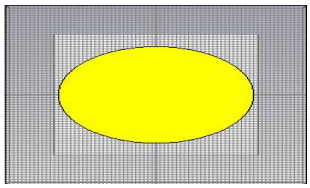


Fig 1(b). Back view of designed antenna

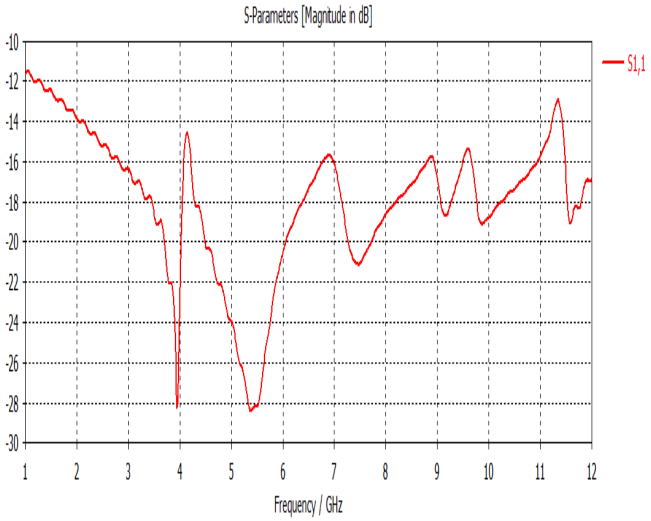


Fig 2 Simulated reflection coefficient with frequency for CCMP

The size of ground plane is further optimized and finally by making the partial ground plane 50mm x 50 mm, antenna is re-simulated. No other change in patch geometry is introduced. Under this condition, it is realized that performance of antenna is improved considerably. Much larger impedance bandwidth is achieved in this condition. Hence in the next step, the patch antenna is further modified by introducing a key shaped slot in the patch geometry as shown in figure 3. The applied ground plane is dim in shade while patch is bright. The radius of circular slot in the patch is 1.5mm while width of rectangular slot attached with circular slot to form key shaped slot is 1mm. These parameters are obtained after extensive optimizations.

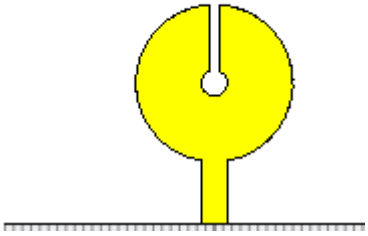


Fig 3. Antenna with key slot

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 7, July 2017

The variation of simulated reflection coefficient with frequency for this modified circular patch antenna is shown in figure 4. The proposed antenna now resonates at frequencies 4GHz and 5.5 GHz and presents an impedance bandwidth close to 3..16 GHz or 81% with respect to central frequency 3.9GHz. .

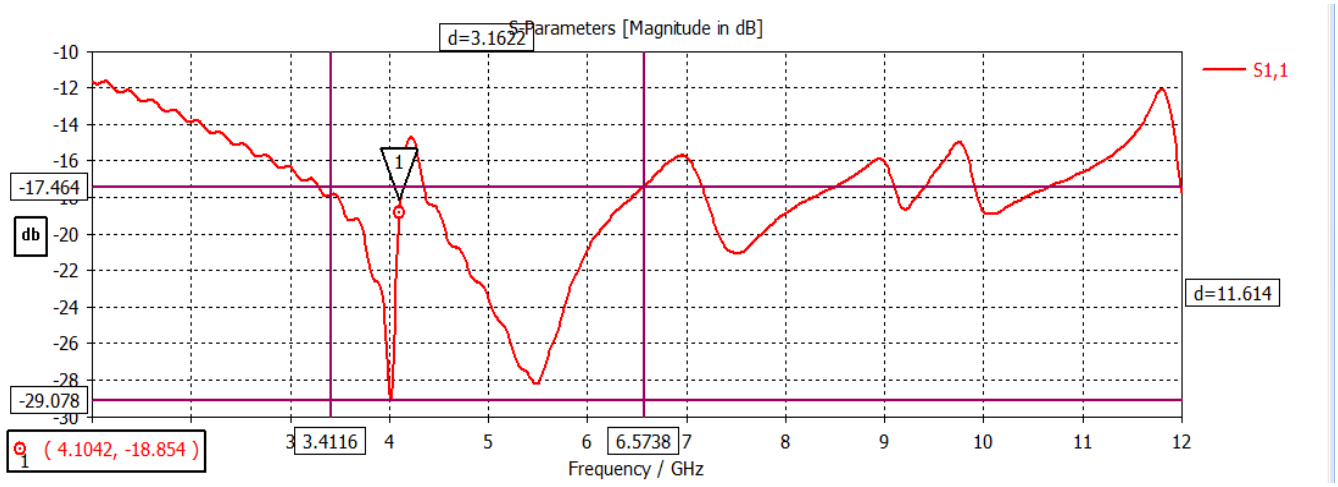
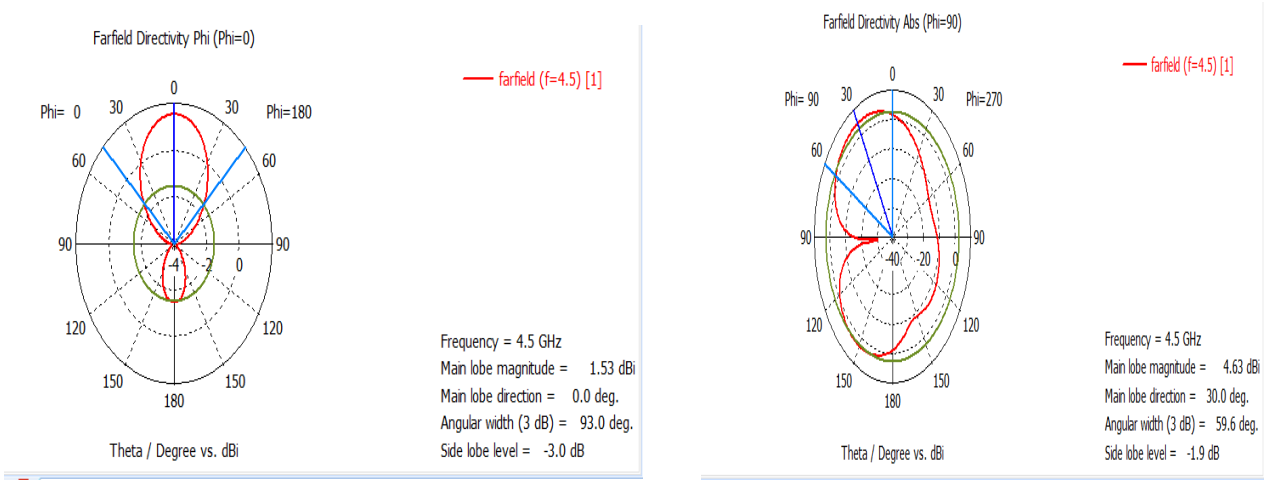


Fig 4. Simulated reflection coefficient for modified circular patch structure

III. FAR FIELD RADIATION PATTERN

The E and H plane simulated far-field radiation patterns obtained at 4.5GHz are shown in figure 5. The E-plane indicates that antenna is radiating large amount of power in the forward direction ($\theta = 0^o$) and in back direction ($\theta = 180^o$) radiation intensity is nearly 1.47dB lower than that in ($\theta = 0^o$). In this way, this pattern may be considered nearly. The H plane pattern has 4.63dB beamwidth~ 60^o and the direction of maximum radiation is normal to patch geometry ($\theta = 0^o$).



E plane H plane

Fig 5. E and H plane simulated radiation patterns at 4.5 GHz

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 7, July 2017

IV. CONCLUSION & FUTURE WORK

This paper presents the design and performance of a compact key slotted circular patch antenna with partial ground plane. The combined effect of modifications in patch geometry provided significantly improved impedance bandwidth (81%) along with gain enhancement (~ 3.16dBi) in comparison to a conventional circular patch antenna. Measurements of radiation patterns are currently underway. This antenna is designed looking Indian wireless communication system requirement. Different shapes of slot and different shapes to partially ground the ground plane can be used to enhance the performance of antenna.

REFERENCES

[1] R. Garg, P. Bhartia, I. Behl, A. Ittipiboon, Microstrip Antenna Design Handbook, Artech House Inc, 2001.
[2] Debatosh Guha , Yahia M.M. Antar, Microstrip and Printed Antennas New Trends, Techniques and Applications, Wiley Int. Sc., U.K., 2011.
[3] Y. X. Guo, K. M. Luk, K. F. Lee, L-Probe Fed Thick-Substrate Patch Antenna Mounted on a Finite Ground Plane, IEEE Transactions on Antennas and Propagation, Vol. 51, No. 8, August 2003.
[4] H. C. Lien, Y. C. Lee, W. F. Lee and H. C. Tsai, Microstrip Slot Antenna with a Finite Ground Plane for 3.1{10.6GHz Ultra Wideband Communication, PIERS Proceedings, Beijing, China, March 23 - 27, 2009.
[5] H. Liu, Z. Li, X. Sun, Compact defected ground structure in microstrip technology, Electronics Letters 41 (3) pp. 132-134, 2005.
[6] J.X. Liu, W.Y. Yin, S.L. He, A new Defected Ground Structure and its application for miniaturized switchable antenna, Progress in Electromagnetics Research vol. PIER 107 pp. 115-128, 2010.
[7] C. Y. Pan, J. H. Duan, J. Y. Jan, Coplaner Printed Monopole Antenna using Coaxial Feedline for DTV Application, Progress In Electromagnetics Research Letters, Vol. 34, 21 - 29, 2012.
[8] M. Majidzadeh and C. Ghobadi, Wide Band CPW-fed Circular Patch Antenna with Tapered Ground Plane, International Journal of Natural and Engineering Sciences, ISSN: 1307-1149, E-ISSN: 2146-0086, 6 (3) : 105-108, 2012.
[9] www.cst.com