



GLOBAL JOURNAL OF RESEARCHES IN ENGINEERING
ELECTRICAL AND ELECTRONICS ENGINEERING
Volume 12 Issue 5 Version 1.0 April 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4596 & Print ISSN: 0975-5861

A Compact Microstrip Patch Antenna for Wireless Communication

By B.Mazumdar, U.Chakraborty, A.Bhowmik, S.K.Chowdhury
& A.K.Bhattacharjee

JIS College of Engineering

Abstract - A single feed compact square microstrip antenna is proposed in this paper. Two L slits are introduced on the right edge of the patch to study the effect of the slit on radiation behavior with respect to a conventional microstrip patch. An extensive analysis of the return loss, radiation pattern and efficiency of the proposed antenna is shown in this paper. For the optimize value of the slit parameters antenna resonant frequencies are obtained at 2.16, 2.68, 3.22 & 4.37 GHz with corresponding bandwidth 11.02 MHz, 13.07 MHz, 35.86 MHz, 48.56 MHz and return loss of about -23.4, -15.2, -30.6 & -20.3 dB respectively. For the lowest resonant frequency (2.16 GHz) the size of the antenna has been reduced by 71.14 % when compared to a conventional rectangular microstrip patch. The characteristics of the designed structure are investigated by using MoM based electromagnetic solver, IE3D. The simple configuration, low profile nature, reduced size and quad band characteristics of the proposed antenna makes it suitable to operate in the frequency ranges of 2.165-2.176, 2.673-2.686, 3.208-3.244 and 4.343-4.392 GHz.

Keywords : Compact, patch antenna, slit, Quad band.

GJRE- F Classification : FOR Code: 0906



Strictly as per the compliance and regulations of:



© 2012. B.Mazumdar, U.Chakraborty, A.Bhowmik, S.K.Chowdhury & A.K.Bhattacharjee. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-NonCommercial 3.0 Unported License (<http://creativecommons.org/licenses/by-nc/3.0/>), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

A Compact Microstrip Patch Antenna for Wireless Communication

B.Mazumdar ^α, U.Chakraborty ^σ, A.Bhowmik ^ρ, S.K.Chowdhury ^ω & A.K.Bhattacharjee [¥]

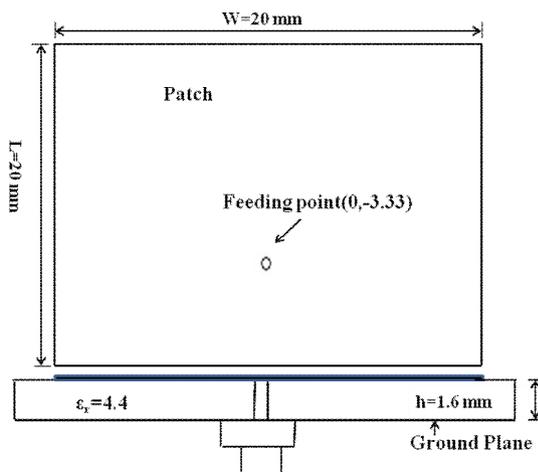
Abstract- A single feed compact square microstrip antenna is proposed in this paper. Two L slits are introduced on the right edge of the patch to study the effect of the slit on radiation behavior with respect to a conventional microstrip patch. An extensive analysis of the return loss, radiation pattern and efficiency of the proposed antenna is shown in this paper. For the optimize value of the slit parameters antenna resonant frequencies are obtained at 2.16, 2.68, 3.22 & 4.37 GHz with corresponding bandwidth 11.02 MHz, 13.07 MHz, 35.86 MHz, 48.56 MHz and return loss of about -23.4, -15.2, -30.6 & -20.3 dB respectively. For the lowest resonant frequency (2.16 GHz) the size of the antenna has been reduced by 71.14 % when compared to a conventional rectangular microstrip patch. The characteristics of the designed structure are investigated by using MoM based electromagnetic solver, IE3D. The simple configuration, low profile nature, reduced size and quad band characteristics of the proposed antenna makes it suitable to operate in the frequency ranges of 2.165-2.176, 2.673-2.686, 3.208-3.244 and 4.343-4.392 GHz.

Keywords : Compact, patch antenna, slit, Quad band.

I. INTRODUCTION

In recent years compact antenna with multiband characteristics is topic of interest for research work for application in wireless Communication system. One of the techniques to design a compact microstrip antenna [MSA] is cutting slots or slits on the radiating patch to increase the length of the patch of the surface

Fig. 1: Antenna 1 Configuration



Author ^α : ECE Dept, Aryabhatta Institute for Engineering and Management, Durgapur, West Bengal, India.

E-mail: barun_bm@rediffmail.com

Author ^σ : ECE Dept, Natinal Institute of Technology, Durgapur, West Bengal, India. E-mail: ujjal_dgp@yahoo.co.in

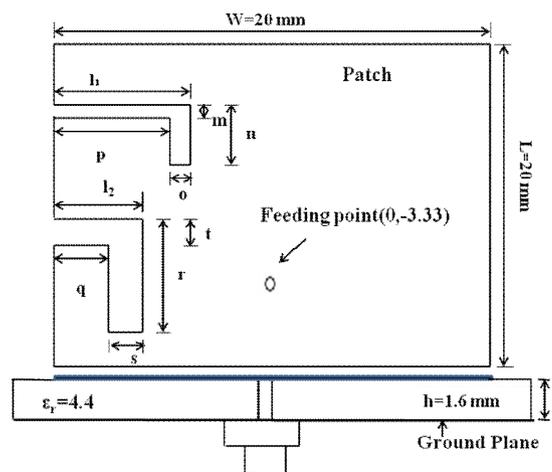
Author ^ρ : ECE Dept, B.C.Roy Engineering College, Durgapur, West Bengal, India. E-mail: aritra_bhowmik@rediffmail.com

current. Some articles on the design of compact MSA were studied by the author [1-4]. MSAs are used in a broad range of applications from communication systems to biomedical systems, primarily due to several attractive properties such as light weight, low profile, low production cost, conformability, reproducibility, reliability, and ease in fabrication and integration with solid statedevices. The work to be presented in this paper is also a compact microstrip antenna by cutting two L slits on the right side of the patch [5-7]. Our aim is to reduce the size of the antenna as well as increase the operating bandwidth. The proposed antenna (substrate with $\epsilon_r=4.4$) presents a size reduction of 71.14% when compared to a conventional square microstrip patch with a maximum bandwidth of 48.56 MHz. The simulation has been carried out by IE3D software which uses the MOM method [8]. Due to the Small size, low cost and low weight this antenna is a good candidate for the application of EMPS and WiMax technology.

II. ANTENNA STRUCTURE

The geometry of the square patch is shown in Figure1 which is a 20 mm x 20 mm. The antenna is fabricated on a substrate of FR4 epoxy with dielectric constant (ϵ_r) =4.4 and substrate height (h) =1.6 mm. Co-axial probe feed of radius 0.5 mm.

Fig. 2 : Antenna 2 Configuration



Author ^ω : ECE Dept, JIS College of Engineering, Phase-III, Block-A5, Kalyani, Nadia, West Bengal, India.

E-mail: santoshkumarchowdhury@gmail.com

Author [¥] : ECE Dept, Natinal Institute of Technology, Durgapur, West Bengal, India. E-mail : akbece12@yahoo.co.in

FIGURE 2 SHOWS the configuration of antenna 2 which is designed with a similar substrate. The antenna is also a 20mm x 20 mm square patch. The location of coaxial probe-feed (radius=0.5 mm) is shown in figure 2.

III. SIMULATED RESULTS

In this section, various parametric analysis of the proposed antenna are carried out and presented. Several slit parameters have been investigated to improve bandwidth, gain and return loss performance of the antenna. Optimal parameter values of the two L slits are listed in Table 1 and 2.

Table 1:

Parameters	p	m	n	o	l ₁
Values(mm)	8.95	.5	5.2	1.1	10.05

Table 2:

Parameters	q	r	s	t	l ₂
Values(mm)	5.75	6.9	2	1	7.75

The simulated return loss of the conventional antenna (antenna 1) and the proposed antenna (antenna 2) are shown in Fig. 3 and fig 4 respectively. In conventional antenna return loss found of about -17.77 dB at 3.42 GHz and corresponding bandwidth is 50.54 MHz. Due to the presence of slot at the edge of the patch of antenna 2 multi frequency operation is obtained with large values of frequency ratio. For antenna 2 return losses -23.4 dB is obtained at 2.16 GHz, -15.2 dB at 2.68 GHz, -30.6 dB at 3.22GHz and -20.3 dB at 4.37 GHz and corresponding 10 dB bandwidth is 11.02 MHz, 13.07 MHz, 35.86 MHz and 48.56 MHz respectively.

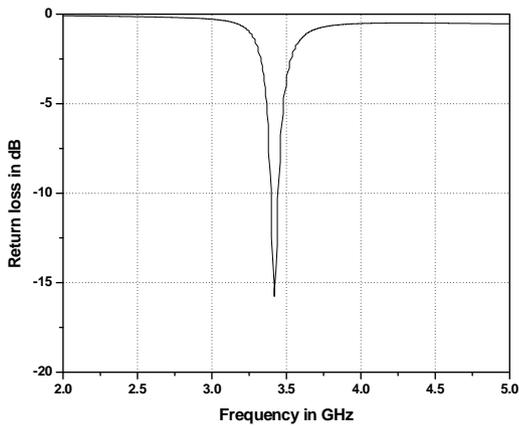


Fig. 3: Simulated return loss of the antenna1

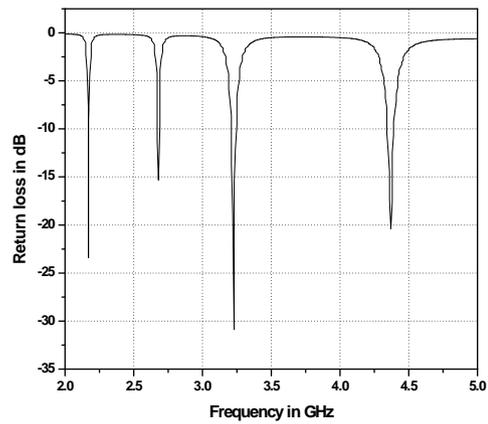
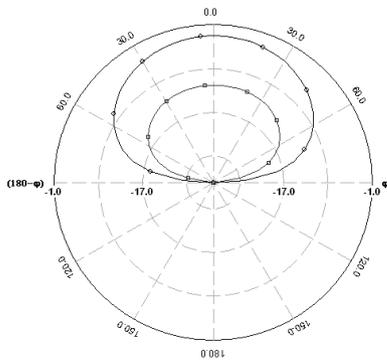


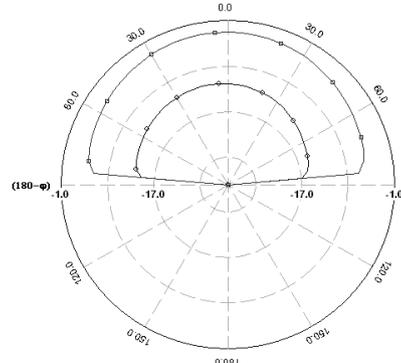
Fig. 4: Simulated return loss of the antenna2

The simulated E plane and H plane radiation patterns for antenna 2 are shown in Figure 5-8.

—◆— Co-Polarization
 —■— Cross Polarization



(a) E-field pattern



(b) H-field pattern

Fig. 5: Simulated normalize radiation pattern at 2.16 GHz

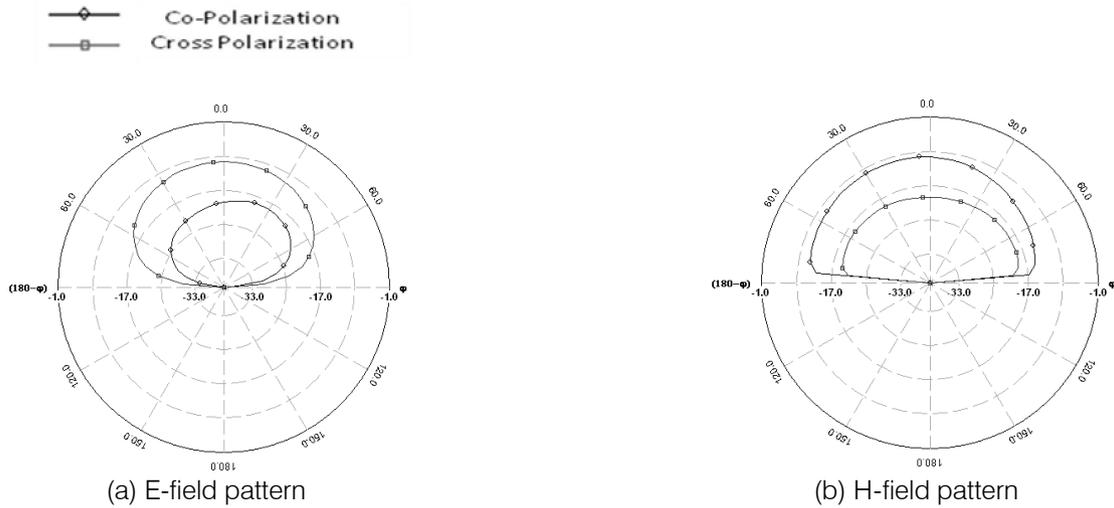


Fig. 6: Simulated radiation pattern at 2.68 GHz

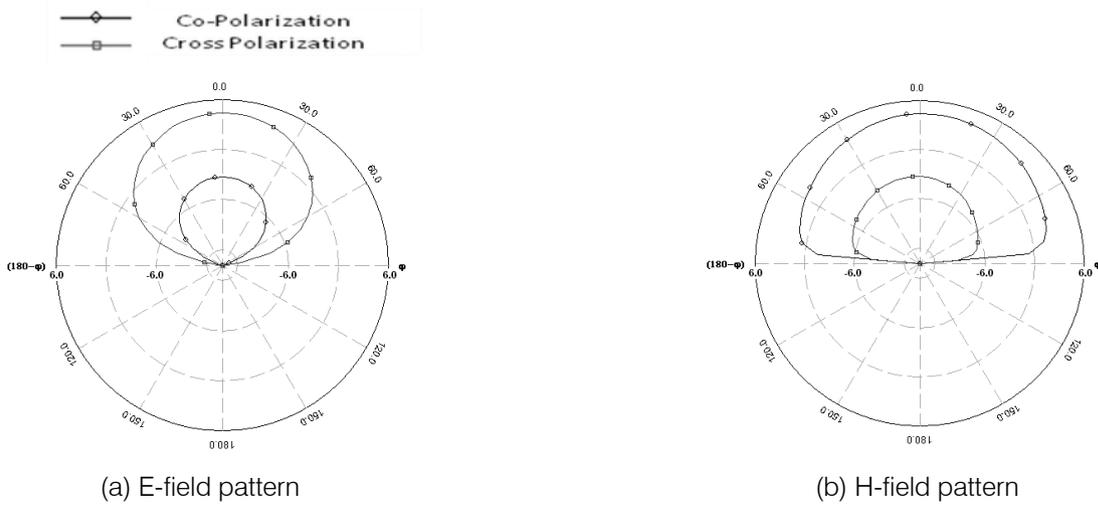


Fig. 7: Simulated normalize radiation pattern at 3.22 GHz

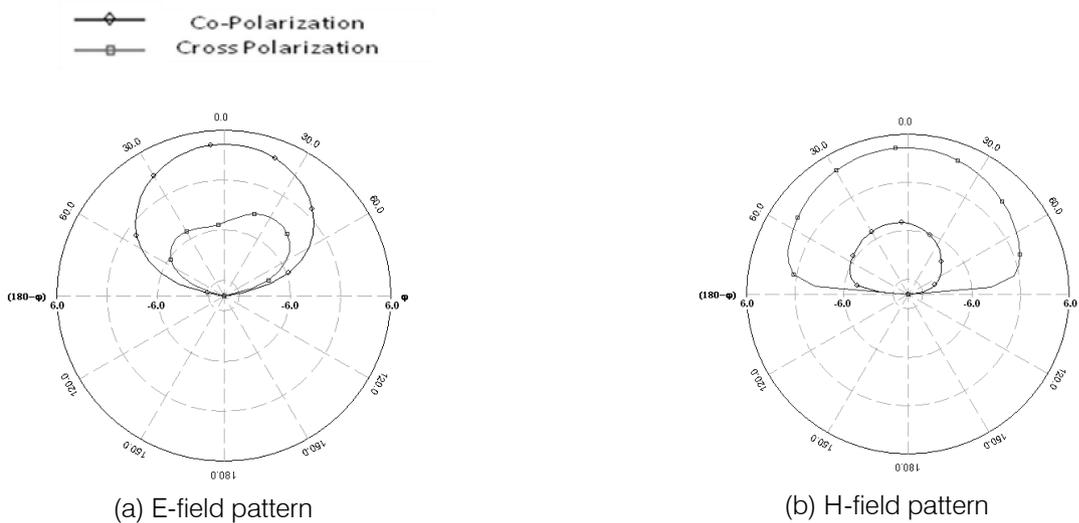


Fig. 8: Simulated normalize radiation pattern at 4.37 GHz



IV. EXPERIMENTAL RESULTS

Comparisons between the measured return loss with the simulated ones are shown in Fig.9 and 10. All the measurements are carried out using Vector Network Analyzer (VNA) Agilent N5 230A. The agreement between the simulated and measured data is reasonably good. The discrepancy between the measured and simulated results is due to the effect of improper soldering of SMA connector or fabrication tolerance.

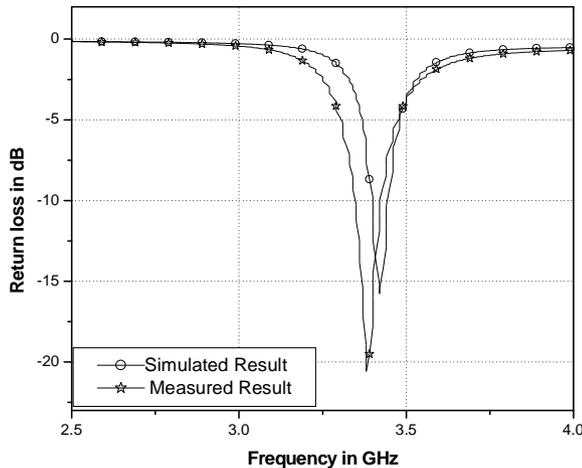


Fig. 9 : Comparison between measured and simulated return losses for antenna1

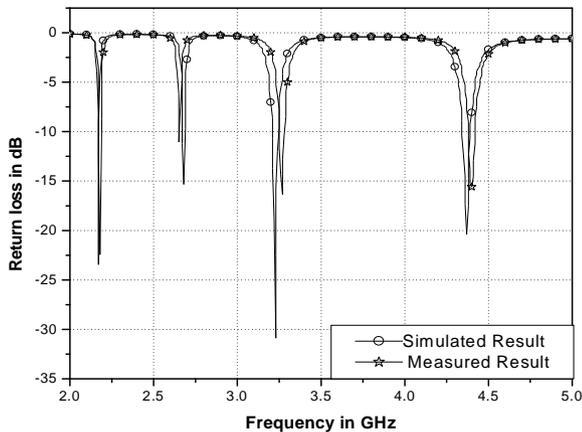


Fig.10: Comparison between measured and simulated return losses for antenna 2

V. CONCLUSION

A single feed single layer two L slits microstrip antenna has been proposed in this paper. It is shown that the proposed antenna can operate in four frequency bands. The slits reduced the size of the antenna by 71.14 % for the resonant frequency 2.16GHz and increase the bandwidth up to 48.56 MHz with a return loss of -30.6 dB and 3 dB beamwidth of 166.82 deg. An optimization between size reduction with multiband operation is maintained in this work.

REFERENCES RÉFÉRENCES REFERENCIAS

1. J.Y. Jan and L.C. Tseng, " Small planar monopole Antenna with a shorted parasitic inverted-L wire for Wireless communications in the 2.4, 5.2 and 5.8 GHz bands" , IEEE Trans. Antennas and Propag., VOL. 52, NO. 7, July 2004, pp -1903-1905.
2. U.Chakraborty, B.Mazumdar,S. K. Chowdhury, and A. K. Bhattacharjee, "A Compact L-slot Microstrip Antenna for Quad band Applications in Wireless Communication," Global Journal Of Researches in Engineering (F) Volume XII Issue II Version I Feb,2012.
3. Gu, J.-H., S. S. Zhong, L. L. Xue, and Z. Sun, "Dual-band monopole antenna with L-shaped strips for 2.4/5 GHz WLAN applications," Microwave Opt. Technol. Lett., Vol. 50, 2830- 2833, 2008.
4. Q. Zhao, S. X. Gong, W. Jiang, B. Yang, and J. Xie "Compact wideslot tri band antenna for WLAN/WIMAX applications," Progress In Electromagnetics Research Letters, Vol. 18, 9-18, 2010.
5. G. Ramesh, P. Bhartia, I. Bahl and A. Ittipiboon, Microstrip Antenna Design Handbook, Artech House Inc., Norwood, MA, 2001.
6. E. O. Hammerstad, " Equations for Microstrip Circuit De-sign", Proc. Fifth European Microwave Conf. Pp 268-272, September 1975.
7. C. A. Balanis, "Advanced Engineering Electromagnetic", John Wiley & Sons., New York, 1989.
8. Zeland Software Inc. IE3D: MOM-Based EM Simulator. Web: <http://www.zeland.com>.