A Compact Microstrip antenna for X band Application

Barun Mazumdar

Abstract*— In the recent years the development in communication systems requires the development of low cost, minimal weight, low profile antennas that are capable of maintaining high performance over a wide spectrum of frequencies. This technological trend has focused much effort on the design of a Microstrip patch antenna. A single feed compact Circular microstrip antenna is presented in this paper. L slits are introduced at the right edge of the patch to reduce the resonant frequency. For the proposed antenna resonant frequency obtained at 11.4 GHz with -38.2 dB return loss &. 21GHz Bandwidth which is suitable for X band application.

***Index Terms*— Compact, Conventional, patch, slit.**

I. INTRODUCTION

The extensive, rapid and explosive growth in wireless communication technology and communication systems is prompting the extensive use of low profile, low cost, less weight and easy to manufacture antennas. Development of microstrip antennas [6-9] was initiated in 1981, where a space-borne, light-weight, and low-profile planar array was needed for a satellite communication system. There are varieties of patch structures available but the rectangular, circular and triangular shapes [3] are most frequently used. In this paper we use circular patch antenna [1-5]. For the proposed antenna resonant frequency obtained at 11.4 GHz with -38.2 dB return loss & .21GHz bandwidth. It has a gain of 4.82 dBi at 11.4 GHz. The simulation has been carried out by IE3D [10] software which uses the MOM method.

II. ANTENNA DESIGN

The configuration of the Conventional antenna is shown in Figure 1. The Circular patch antenna has a radius of 3 mm.

The dielectric material selected for this design with ε_r=2.4 and substrate height =1.6 mm.

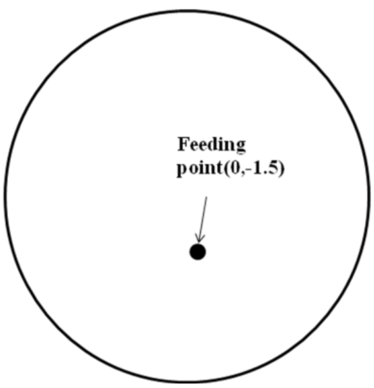

Fig 1: Antenna 1 configuration.

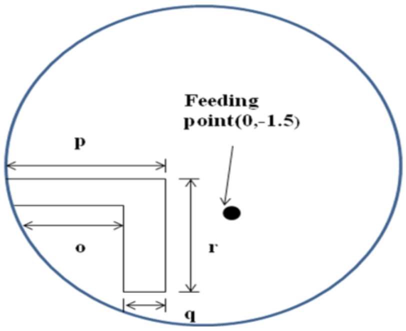

Fig 2: Antenna2 configuration.

Figure 2 shows the configuration of antenna 2 designed with similar substrate. L slit created and the location of coaxial probe- feed (radius=0.2 mm) are shown in the fig 2.

The optimal parameter values of the L slit is listed in Table.

Table:

Parameters	o	p	q	r
Values (mm)	1.1	1.6	.5	2.6

III. SIMULATED RESULTS & DISCUSSION

Simulated (using IE3D [10]) results of return loss of the Conventional & proposed antenna are shown in Figure 3 & 4. A significant improvement of frequency reduction is achieved in with respect to a conventional microstrip antenna. In Conventional antenna frequency is obtained below -10 dB which is 17.60 GHz & return loss is found about -14.5 dB with 3.23 GHz bandwidth. For the proposed antenna resonant frequency is 11.4 GHz and their corresponding return loss is -38.2 dB, Simulated 10 dB bandwidth is .21 GHz.

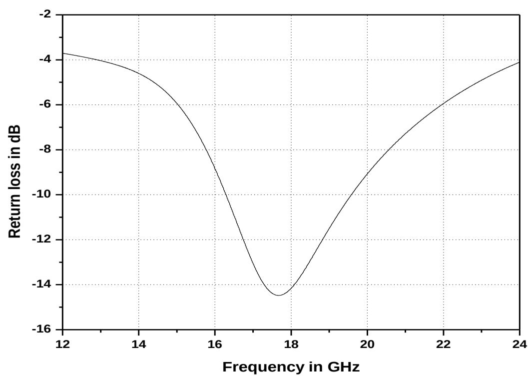

Fig 3: Return loss of the Conventional antenna.

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Prof. Barun Mazumdar, ECE Department, AIEMD, West Bengal, India.

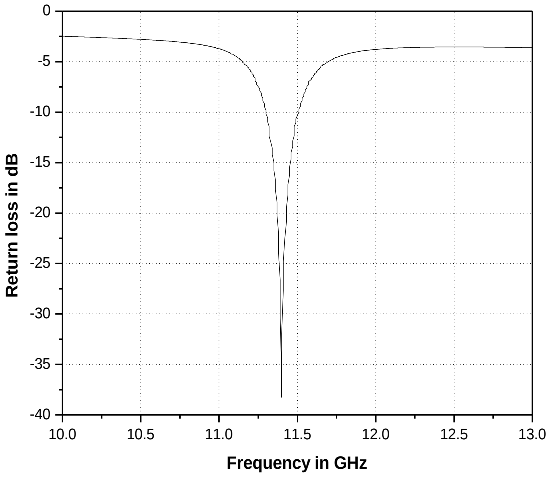

Fig 4: Return loss of the proposed antenna.

Simulated radiation pattern

The simulated E –H plane radiation patterns for antenna 2 are shown in Figure 5-6.

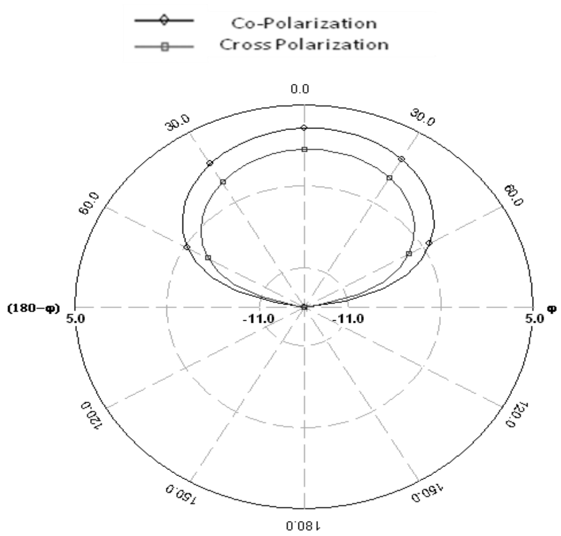

Fig 5: E plane Radiation Pattern of the antenna 2 for 11.4 GHz

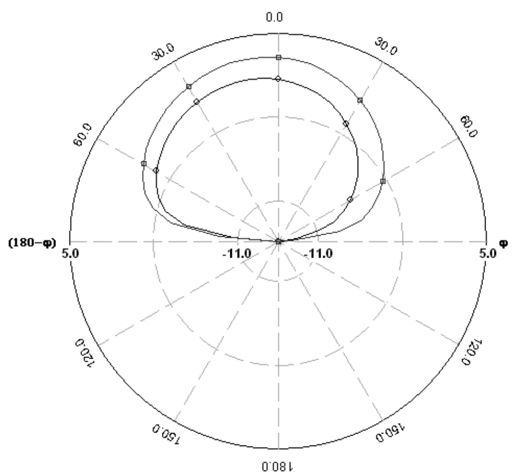

Fig 6: H plane Radiation Pattern of the antenna 2 for 11.4 GHz

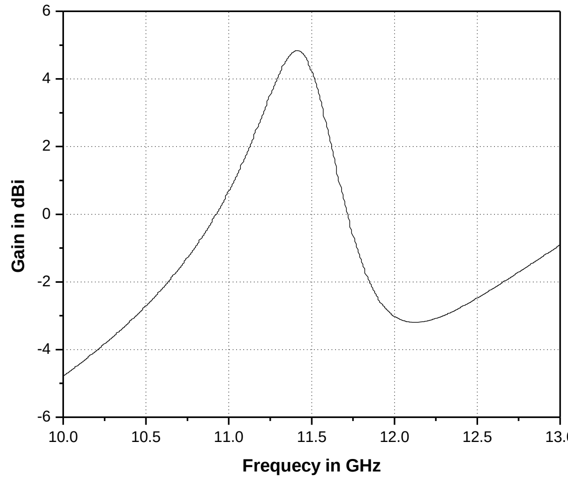

Fig 7: Gain versus frequency plot for the antenna 2.

Figure 7 shows the Gain versus frequency plot for the antenna 2.It is observed that gain is about 4.82 dBi for 11.4 GHz.

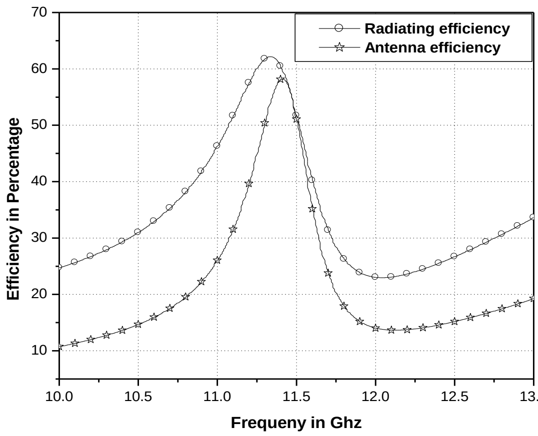

Fig 8: Antenna efficiency versus frequency plot for the antenna 2.

Efficiency of the antenna 2 with the variation of frequency is shown in figure 8. It is found that antenna efficiency is about 58.16 % for 11.4 GHz.

IV. EXPERIMENTAL RESULTS & DISCUSSION

Comparisons between the measured return losses 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.

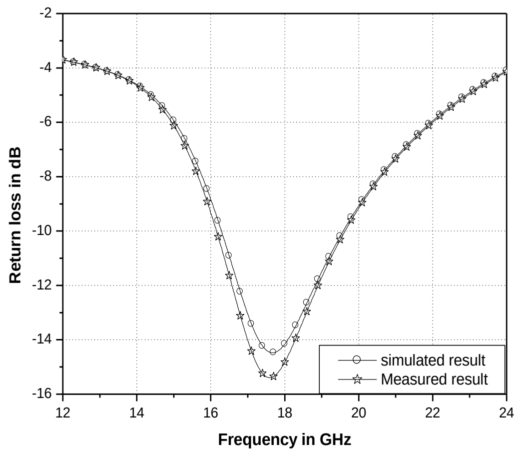

Fig.9. Comparison between measured and simulated return losses for antenna1

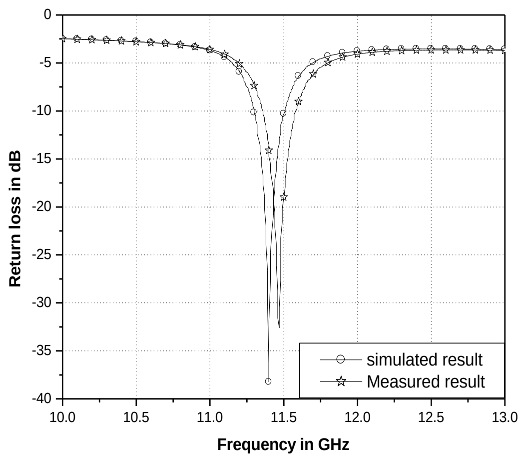

Fig.10. Comparison between measured and simulated return losses for antenna2

V. CONCLUSION

A single feed single layer L slit microstrip antenna has been proposed in this paper. The slot increases the bandwidth up to .21 GHz with a return loss of -38.2 dB, absolute gain about 4.82 dBi. Efficiency of antenna has been achieved 58 .16%. An optimization between size reduction and bandwidth enhancement is maintained in this work.

REFERENCES

1. Jui-Han Lu "Broadband Dual-Frequency Operation of Circular Patch Antennas and Arrays with a Pair of L shaped Slots," IEEE Transactions on Antenna and propagation, Vol.51, pp 1018-1023 No.5, May 2003.
2. Jui - Han Lu "Bandwidth Enhancement Design of Single layer Slotted Circular Microstrip Antennas," IEEE Transactions on Antenna and propagation, Vol.51, pp 1126-1129 No.5, May 2003.
3. Y. J. Sung and Y.S Kim "Circular Polarized Microstrip Patch Antenna for Broadband and Dual Band Operation "Electronics letters 29th April 2004, Vol.40 no.9
4. Ho, M.-H. Hsu, C.-I.G.Dept. of Electron. Eng., Nat. Changhua Univ. of Educ., Changhua City, Taiwan, Circular-waveguide-fed microstrip patch antennas, IEEE transaction Issue Date : 27 Oct. 2005 Volume : 41 , Issue:22
5. Boyon Kim "Novel Single-Feed Circular Microstrip Antenna with Reconfigurable Polarization Capability," IEEE Transaction on Antenna and Propagation, Vol. 56, No.3 March 2008
6. Kin-Lu Wong, Compact and Broadband Microstrip Antennas, Jon Wiley & Sons, Inc.,2002
7. S. Bhunia, M.-K. Pain, S. Biswas, D. Sarkar, P. P. Sarkar, and B. Gupta, "Investigations on Microstrip Patch Antennas with Different slots and Feeding Points" , *Microwave and Optical Technology Letters*, VOL 50, NO. 11, November 2008 pp 2754-2758.
8. J.-S. Kuo and K.-L. Wong, "A compact microstrip antenna with meandering slots in the ground plane," Microwave and Optical Technology Letters, vol. 29, no. 2, pp. 95–97, 2001.
9. C.A.Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons., New York, 1989.
10. Zeland Software Inc. IE3D: MoM-Based EM Simulator.
11. Web: http://www.zeland.com

AUTHOR PROFILE

Barun Mazumdar was born in India, W.B, in 1985. He received the B.Tech, M.Tech degrees from West Bengal University, India in 2008 and 2011 respectively. His research interests include antennas, microwave and wireless communications. From 2009-2011 he worked as lecturer and from 2011 to till date he is working as Asst. professor in Electronics Engineering. He has published 10 papers in International journals & 8 papers in national & International conference.