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Design of Circular patch antenna using L-slit for WIMAX, WLAN & X-band applications

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ABSTRACT: A single feed compact Circular microstrip antenna for dual band applications is presented in this paper. L slit is introduced at the right edge of the patch to reduce the resonant frequency. For the proposed antenna two resonant frequencies are obtained at 5.769 GHz and 9.74 GHz with bandwidth of 18.57 MHz, return loss –15.35 dB and bandwidth of .74 GHz, return loss -25.47 dB respectively. The antenna size has been reduced by 75.3 % when compared to a conventional microstrip patch. Mainly it is developed to operate in the WiMAX, WLAN & X-band application.

Keywords**:** Compact, Conventional, Dual band, Patch, slit.

I. INTRODUCTION

Compact printed antenna is a topic of intensive research in recent years because of increasing demand for small antennas used in various types of communications including mobile communication. There are varieties of patch structures available but the rectangular, circular and triangular shapes [1-3] are most frequently used. Design of WLAN antennas also got popularity with the advancement of microstrip antennas [4-7]. Wireless local area network (WLAN) requires three bands of frequencies: 2.4GHz (2400-2484MHz), 5.2GHz (5150-5350MHz) and 5.8GHz (5725-5825MHz). WiMax (Worldwide Interoperability for Microwave access) has three allocated frequency bands. The low band (2.5-2.69 GHz), the middle band (3.2-3.8 GHz) and the upper band (5.2-5.8 GHz).The size of the antenna is effectively reduced by cutting slit in proper position on the microstrip patch. It has a gain of 2.84 dBi at 5.769 GHz, 6.04 dBi at 9.74 GHz presents a size reduction of about 75.3% when compared to a conventional microstrip patch. The simulation has been carried out by IE3D software which uses the MOM method. Due to the Small size, low cost and low weight this antenna is a good candidate for the application of wireless communication systems, mobile phones, digital cameras & laptops.

II. ANTENNA CONFIGURATION

The configuration of the antenna is shown in Figure 1. The Circular patch antenna has a radius of 5mm. The dielectric material selected for this design with ε_r=2.4 and substrate height =1.6 mm.

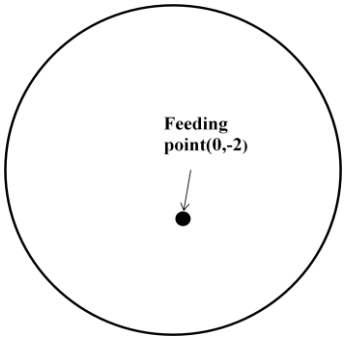

Fig. 1 (a) Antenna 1 configuration.

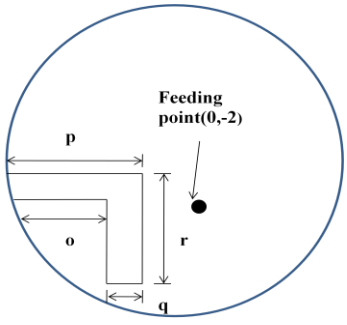

Fig.1 (b) Antenna 2 configuration.

The configuration of antenna 2 designed with similar substrate, L slit is created whose dimensions and the location of coaxial probe- feed (radius=0.2 mm) are shown in the fig (b).

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

TABLE I:

Parameters	o	p	q	r
Values (mm)	2.74	5.64	1.4	4.1

III. SIMULATED RESULTS AND DISCUSSION

Simulated (using IE3D [8]) results of return loss of the Conventional & proposed antenna are shown in Figure 2 . A significant improvement of frequency reduction is achieved in with respect to a conventional microstrip antenna. In Conventional antenna only one frequency is obtained below -10 dB which is 10.36 GHz & return loss is found about -14.51dB with 1.15 GHz bandwidth. For the proposed antenna resonant frequencies are 5.769 GHz & 9.74 GHz and their corresponding return losses are -15.35 dB & -25.47 dB respectively. Simulated 10 dB bandwidths are 18.57 MHz & .74 GHz respectively.

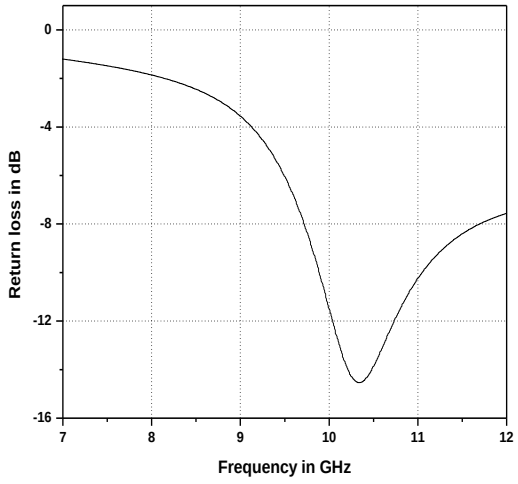

Fig . 2 (a) Return loss of the Conventional antenna

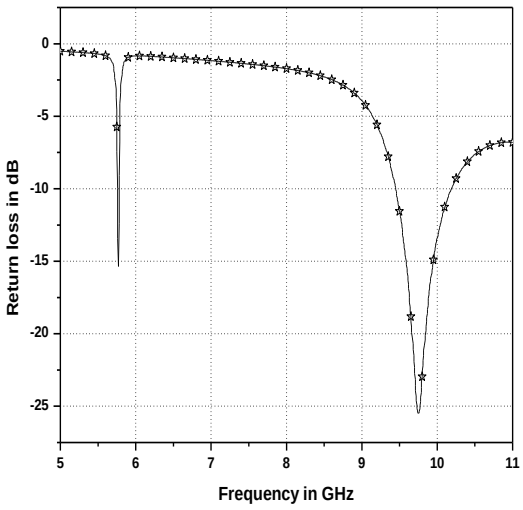

Fig .2 (b) Return loss of the proposed antenna

Simulated radiation pattern

The simulated E –H plane radiation patterns for antenna 2 are shown in Figure 3-4.

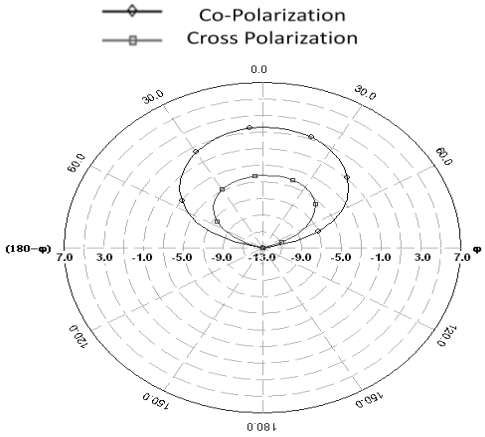

Fig. 3 (a) E plane Radiation Pattern of the antenna 2 for 5.769 GHz

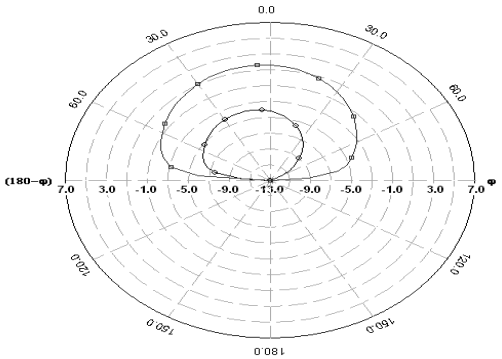

Fig. 3 (b) H plane Radiation Pattern of the antenna 2 for 5.769 GHz

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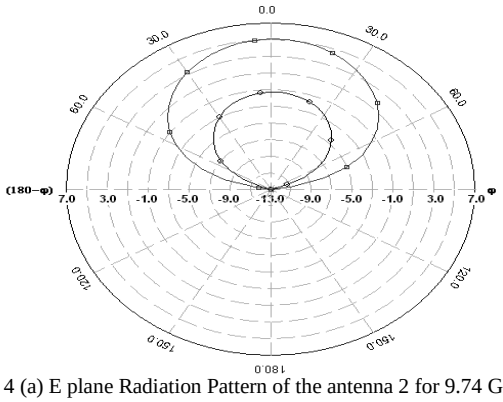

Fig . 4 (a) E plane Radiation Pattern of the antenna 2 for 9.74 GHz

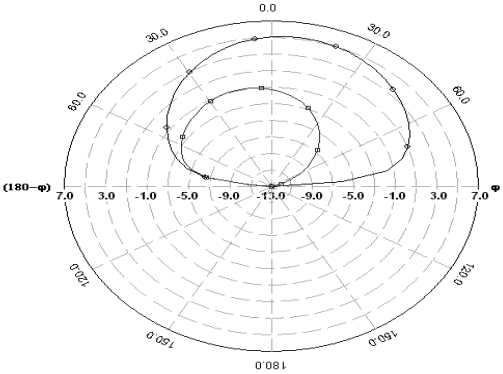

Fig . 4 (b) H plane Radiation Pattern of the antenna 2 for 9.74 GHz

Figure 5 shows the Gain versus frequency plot for the antenna 2.It is observed that gain is about 2.84 dBi for 5.769 GHz & 6.04 dBi for 9.74 GHz.

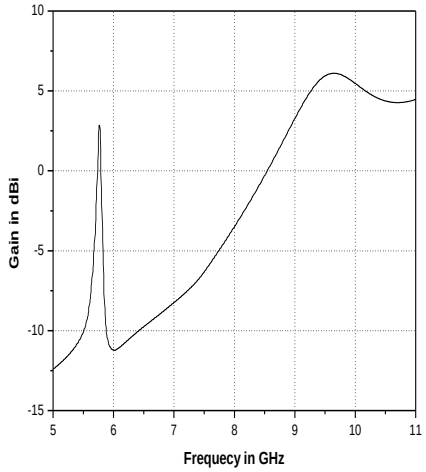

Fig .5 Gain versus frequency plot for the antenna 2.

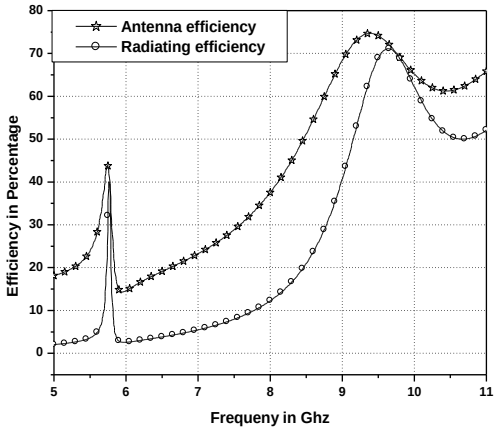

Fig. 6 Antenna efficiency versus frequency plot for the antenna 2.

Efficiency of the antenna 2 with the variation of frequency is shown in figure 6. It is found that antenna efficiency is about 40% for 5.769 GHz & 70% for 9.74 GHz.

IV. EXPERIMENTAL RESULTS

Comparisons between the measured return losses with the simulated ones are shown in Figure 7 and 8. 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.

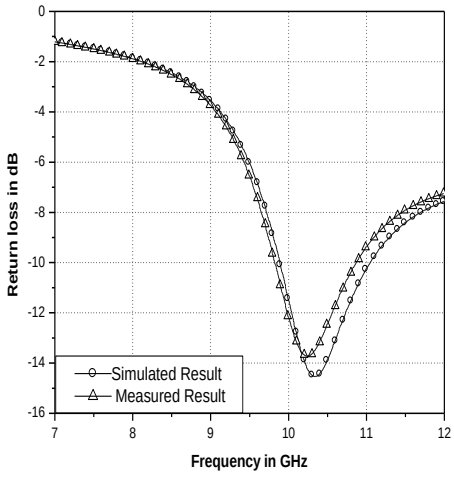

Fig . 7 Comparison between measured and simulated return losses for antenna1

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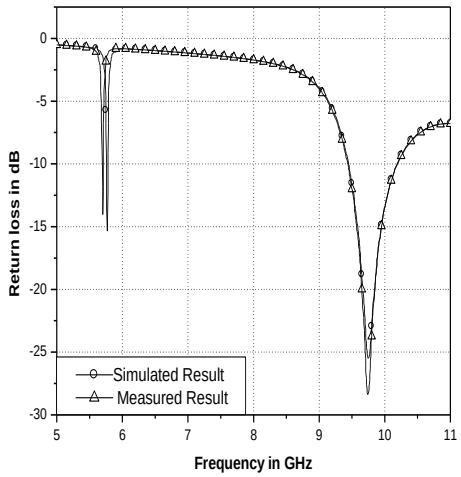

Fig . 8 Comparison between measured and simulated return losses for antenna 2

V. CONCLUSION

A single feed single layer L slit microstrip antenna has been proposed in this paper. It is shown that the proposed antenna can operate in two frequency bands. The slits reduced the size of the antenna by 75.3 % and increase the bandwidth up to .74 GHz with a return loss of -25.47 dB, absolute gain about 6.04 dBi. Efficiency of antenna has been achieved 40 % for the lower band and 70 % for the higher band of operation. An optimization between size reduction and bandwidth enhancement is maintained in this work.

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Biography

Barun Mazumdar was born in India, W.B, in 1985. He received the B.Tech, M.Tech degrees from West Bengal University of Technology, 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 17 papers in International journals & 7 papers in International & national conference.