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A Compact L-slit Microstrip antenna for GSM, Bluetooth, WiMAX & WLAN Applications

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ABSTRACT

A single feed compact microstrip antenna is proposed in this paper. L slit is 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. The resonant frequencies are obtained at 1.85, 2.4, 3.44 &4.31 GHz with corresponding bandwidth 10 MHz, 15.13 MHz, 35.19 MHz, 56.13 MHz and return loss of about -29.58, -14.57, -15.89&-29.25 dB respectively. The antenna has been reduced by 63 % when compared to a conventional rectangular microstrip patch. The characteristics of the designed structure are investigated by using MoM based electromagnetic solver, IE3D.

Keywords **– Compact, Conventional, patch, slit**

I. INTRODUCTION

Wireless communications is rapidly progress due the development of lightweight, low profile, flush-mounted and single-feed antennas. Also, it is highly desirable to integrate several RF modules for different frequencies into one piece of equipment. Hence, multi-band antennas that can be used simultaneously in different standards have been in the focus points of many research projects [1-3]. To reduce the size of the antenna one of the effective technique is cutting slit in proper position on the microstrip patch. The work to be presented in this paper is also a compact microstrip antenna design obtained by cutting an L slit on the right edge of the patch. Our aim is to reduce the size of the antenna as well as increase the operating bandwidth. The proposed antenna (substrate with ε_r=2.4) has maximum gain of 6.53 dBi and presents a size reduction of 63% when compared to a conventional microstrip [4-7] patch with a maximum bandwidth of 56.13 MHz. 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 mobile communication.

II. ANTENNA DESIGN

The configuration of the proposed antenna is shown in Figure 1. The antenna is a 38.34 mm x 31.53 mm rectangular patch. The dielectric material selected for this design is a Neltec NX 9240 epoxy with dielectric constant (ε_r) =2.4 and substrate height (h) =1.5875 mm.

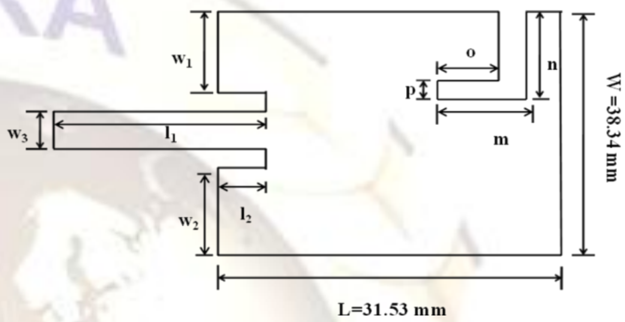

Fig 1. Antenna 2 Configuration

The optimal parameter values of the antenna are listed in Table1& 2.

Table 1:

Parameters	m	n	o	p	l_1
Values (mm)	11.3	11.54	9.65	2.7	12.5

Table 2:

Parameters	w_1	w_2	w_3	l_2
Values (mm)	15.67	14.67	2	4.5

III. SIMULATED RESULTS AND DISCUSSION

The simulated return loss (using IE3D [8]) of the conventional & proposed antennas is shown in Fig. 2 & 3.

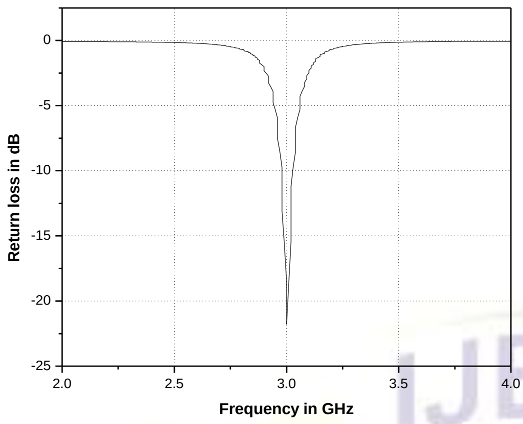

Fig 2 . Simulated return loss of the conventional antenna.

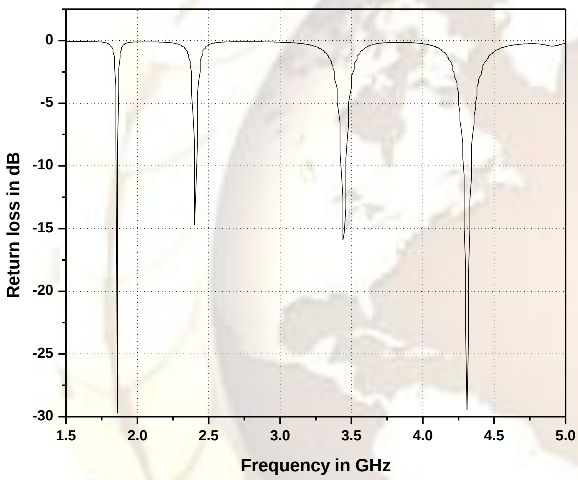

Fig 3 . Simulated return loss of the proposed antenna.

In conventional antenna return loss found of about -21.68 dB at 3 GHz & corresponding bandwidth is 53.13 MHz. For antenna 2 return losses -29.58 dB is obtained at 1.85 GHz, -14.57 dB at 2.4 GHz, -15.89 dB at 3.44 GHZ and -29.25 dB at 4.31 GHz and corresponding 10 dB bandwidth is 10 MHz, 15.13 MHz, 35.19 MHz and 56.13 MHz respectively.

Simulated radiation pattern

The simulated E plane and H plane radiation patterns for antenna 2 are shown in Figure 4-10.

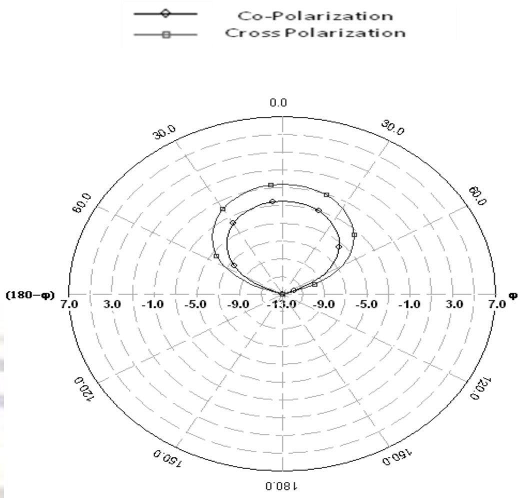

Fig 4 . E plane Radiation Pattern of the antenna 2 for 1.85 GHz

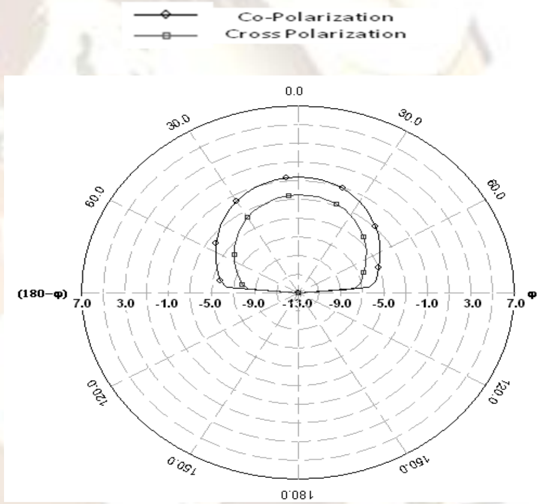

Fig 5 . H plane Radiation Pattern of the antenna 2 for 1.85 GHz

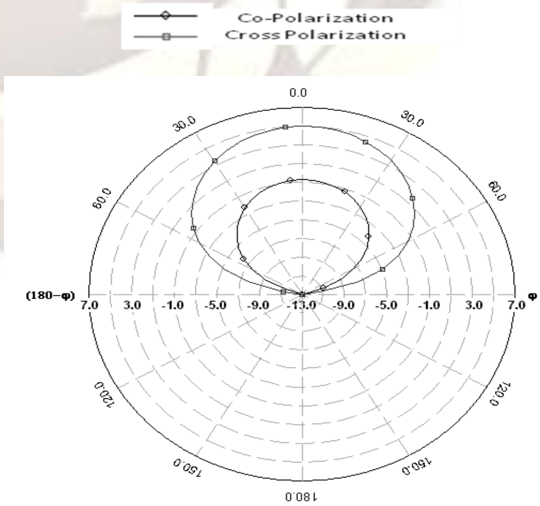

Fig 6 . E plane Radiation Pattern of the antenna 2 for 2.4 GHz

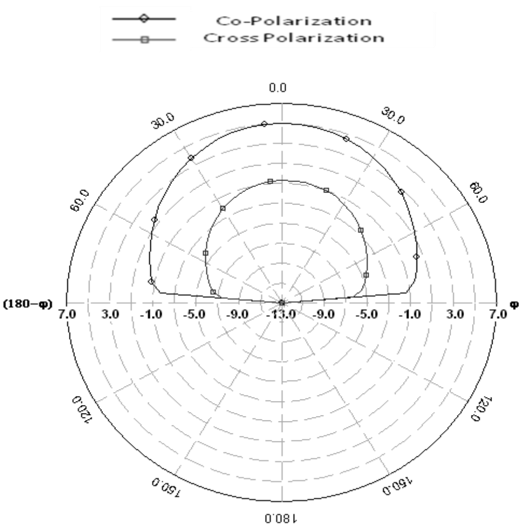

Fig 7 . H plane Radiation Pattern of the antenna 2 for 2.4 GHz

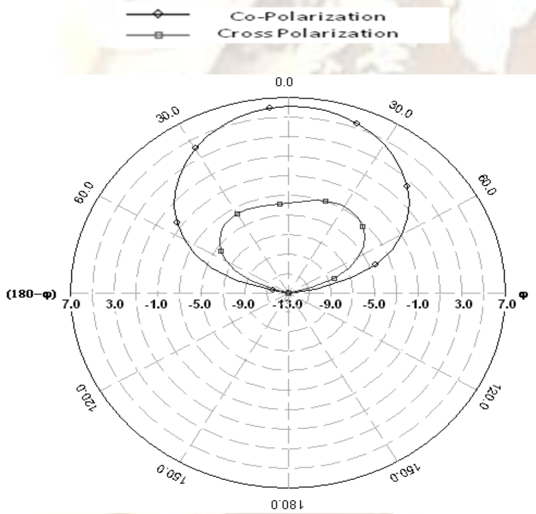

Fig 7 . E plane Radiation Pattern of the antenna 2 for 3.44 GHz

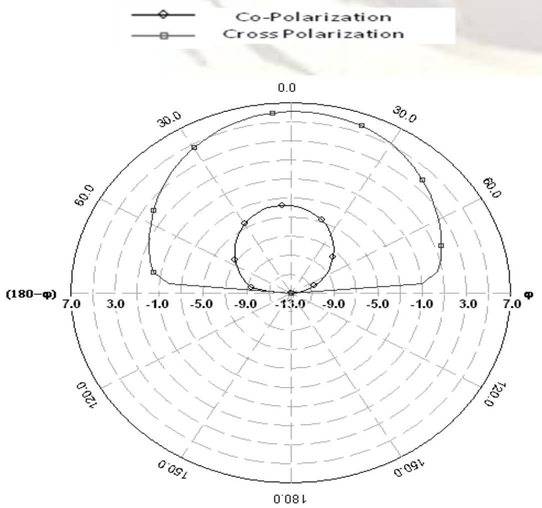

Fig 8. H plane Radiation Pattern of the antenna 2 for 3.44 GHz

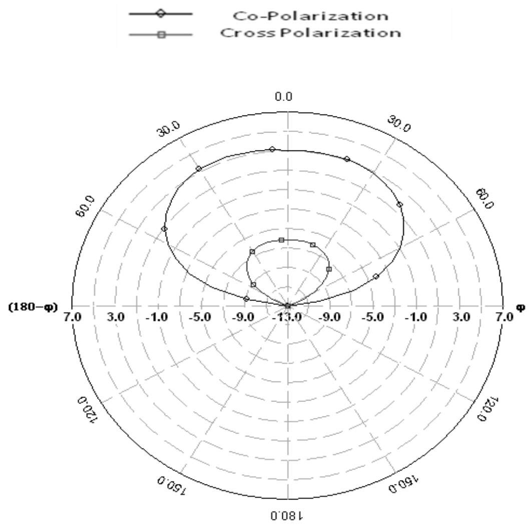

Fig 9 . E plane Radiation Pattern of the antenna 2 for 4.31 GHz

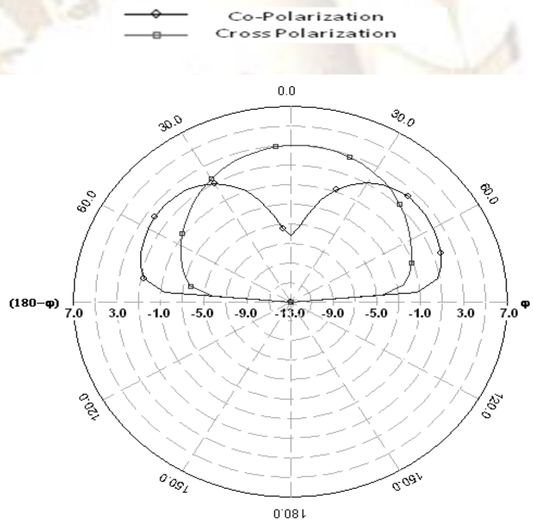

Fig 10 . H plane Radiation Pattern of the antenna 2 for 4.31 GHz

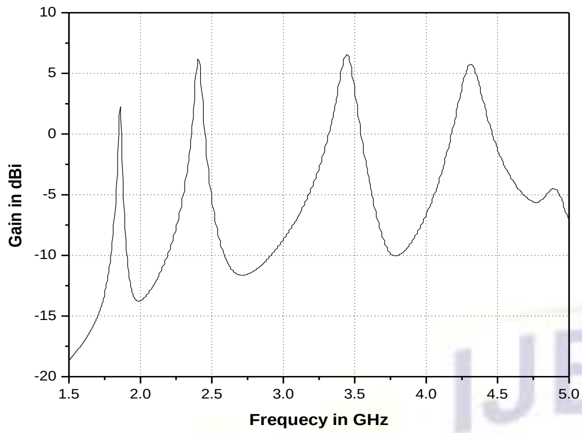

Fig 11: Gain versus frequency plot for the antenna 2.

Figure 11 shows the Gain versus frequency plot for the antenna 2.It is observed that gain is about 1.55 dBi for 1.85 GHz, 6.06 dBi for 2.4 GHz , 6.53 dBi for 3.44 GHz & 5.72 dBi for 4.31 GHz.

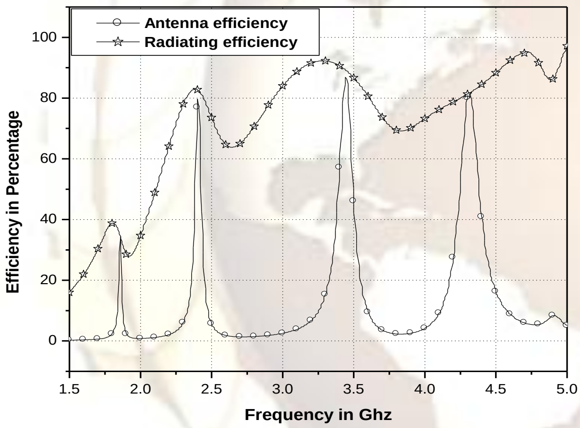

Fig 12: Antenna efficiency versus frequency plot for the antenna 2.

Efficiency of the antenna 2 with the variation of frequency is shown in figure 12. It is found that antenna efficiency is about 78 % for 2.4 GHz, 87 % for 3.44 GHz & 82% for 4.31 GHz.

IV. EXPERIMENTAL RESULTS

Comparisons between the measured return losses with the simulated ones are shown in Fig.13 and 14. 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.

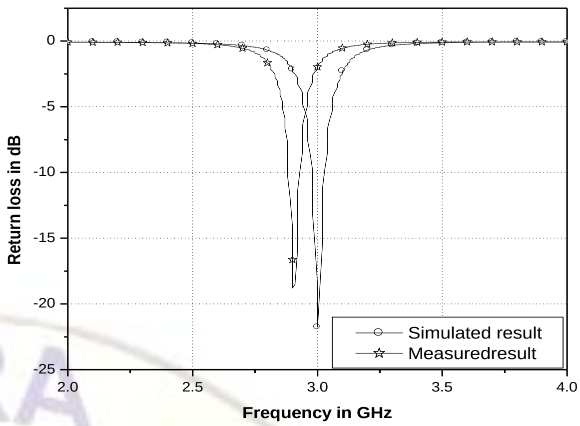

Fig 13. Comparison between measured and simulated return losses for conventional antenna.

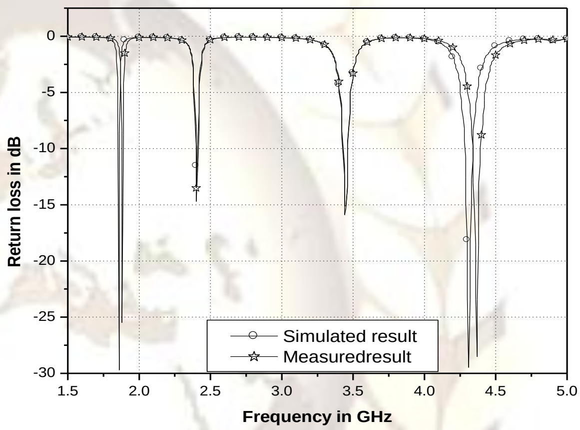

Fig 14. Comparison between measured and simulated return losses for proposed antenna

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 four frequency bands. The slit reduced the size of the antenna by 63 % and increase the bandwidth up to 53.13 MHz with a return loss of -29.25 dB, absolute gain about 6.53 dBi .Efficiency of antenna has been achieved 82 % for the higher band of operation. An optimization between size reduction and bandwidth enhancement is maintained in this work.

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