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A MICROSTRIP PATCH ANTENNA FOR QUAD BAND APPLICATIONS IN MOBILE COMMUNICATION

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***Abstract*— A single feed compact rectangular microstrip antenna for quad band applications has been designed and developed. This antenna is incorporated by two L-shaped slot structure along the length on the patch. Four resonating frequencies are obtained at 1.86 GHz with return loss -22.09 dB, 2.6 GHz with return loss -18.69 dB, 3.3 GHz with return loss -22.56 dB and 4.83 GHz with return loss -22.11 dB. The size of the antenna has been reduced by 80.2% when compared to a conventional microstrip patch without slot. The characteristics of the designed structure are investigated by using MoM based electromagnetic solver, IE3D.The simple configuration and low profile nature of the proposed antenna leads to easy fabrication and multi frequency operation makes it suitable for the applications in Wireless Communication system.**

***Keywords*— Patch antenna, Quad band, compact, slot.**

I. INTRODUCTION

Microstrip antennas are very attractive because of their low profile, low weight, conformal to the surface of objects and easy production. A large number of microstrip patches to be used in wireless applications have been developed [1–3]. The work to be presented in this paper is a compact microstrip antenna design obtained by the insertion of two L-shaped slot on the right hand side of the patch(Figure: 2).The work to be presented in this paper is directed towards the reduction of the size of the antenna as well as to operate the antenna in multi-frequencies. The proposed antenna (substrate with $\varepsilon r=4.4$) has four resonant frequencies and presents a size reduction of about 80.2% when compared to a conventional rectangular microstrip patch The simulation has been carried out by IE3D software which uses the MoM method [10]. Due to the Small size, low cost, low weight and multiband characteristics this antenna is a good candidate for application in Mobile communication system, mobile phones, digital cameras & laptops.

II. ANTENNA CONFIGURATION

The configuration of the Conventional antenna is shown in Figure 1. The antenna is a 15mm x 12 mm rectangular patch. The dielectric material selected for this design with €r=4.4 and substrate height =1.5875 mm..

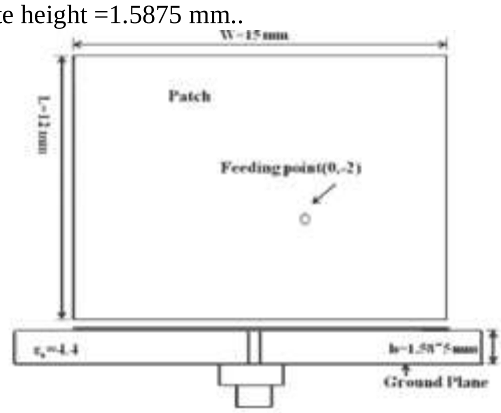

Figure 1: Antenna 1 Configuration

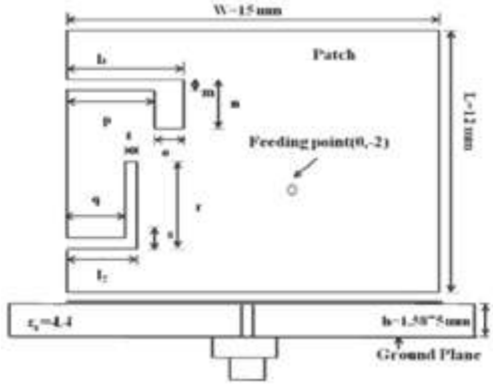

Figure 2: Antenna 2 Configuration

Figure 2. Shows the configuration of antenna 2 designed with similar substrate. Two unequal L slots (l_1, l_2) each are created and the location of coaxial probe- feed (radius=0.5 mm) are shown in this figure.

The optimal parameter values of the L slots are listed in Table 1 & 2:

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Table 1:

Parameters	m	n	o	p	l_1
Values(mm)	.3	4	1.3	4.35	5.65

.3	3.15

Table 2:

Parameters	q	r	s	t	l_2
Values(mm)	2.85	2.5	.3	.3	3.15

.3	3.15

III. SIMULATED RESULTS & ANALYSIS

In this section, simulated return loss (of antenna 1 and 2) and normalized E-field and H-field radiation patterns (of antenna2) are shown. 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 only one resonant frequency is obtained below -10 dB which is 3.7 GHz and the return loss was found to be about -28.89 dB with 68(3.693-3.761) MHz bandwidth. For the proposed antenna resonant frequencies are 1.86GHz,2.6 GHz,3.3 GHz, 4.83 GHz and their corresponding return losses are -22.09 dB,- 18.69 dB,-22.56 dB and --22.11 dB respectively. Simulated 10 dB bandwidths are 16 (1.837-1.853) MHz, 16 (2.584-2.600) MHz, 40 (3.268-3.308) MHz and 49 (4.803-4.852) MHz respectively.

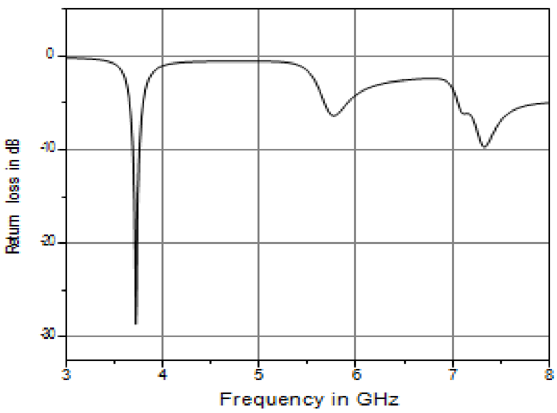


Figure 3: Simulated return loss of the antenna1

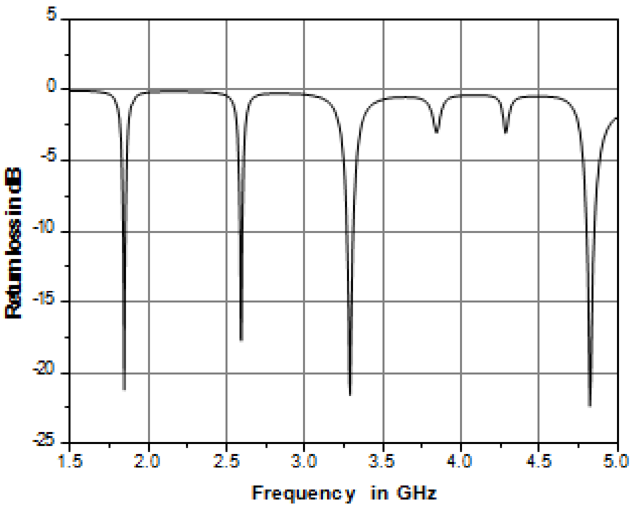
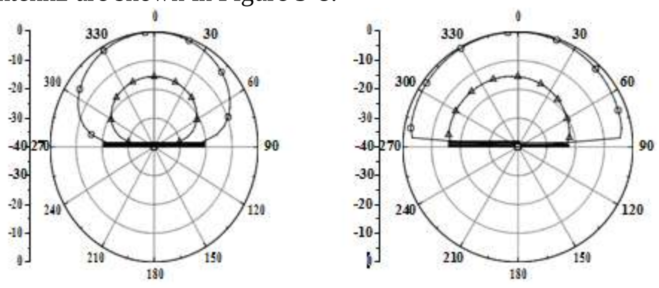


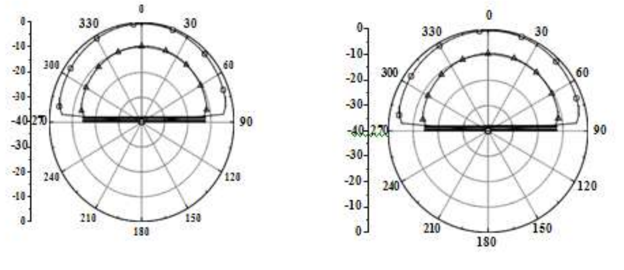
Figure 4: Simulated return loss of the antenna2

The simulated E plane and H plane radiation patterns for antenn2 are shown in Figure 5-8.



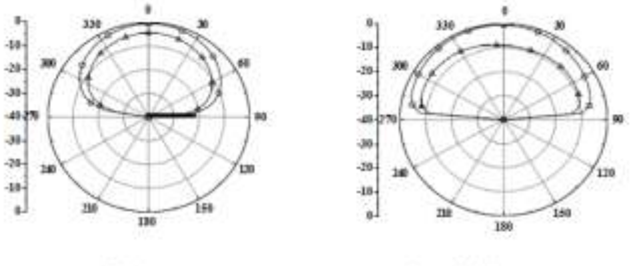
(a) E-field pattern (b) H-field pattern

Figure5: Simulated normalize radiation pattern at 1.86 GHz



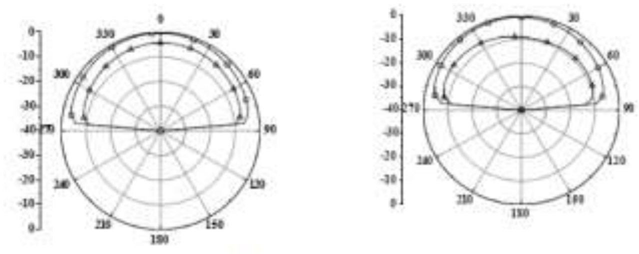
(a) E-field pattern (b) H -field pattern

Figure6: Simulated normalize radiation pattern at 2.6 GHz



E-field pattern (b) H-field pattern

Figure7: Simulated normalize radiation pattern at 3.3 GHz



(a) E-field pattern (b) H-field pattern

Figure8: Simulated normalize radiation pattern at 4.83 GHz

Experiment Result:

The prototype of the antenna 1 (conventional) and antenna 2 (proposed antenna) was fabricated and tested, which measurements are carried out using Vector Network Analyzer (VNA) Agilent N5 230A.

The measured return losses of the antennas are illustrated in Fig. 9-10.

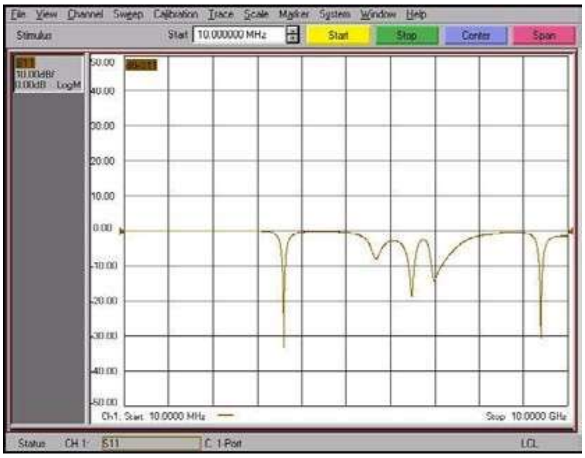


Figure 9 : Measured return loss of antenna 1

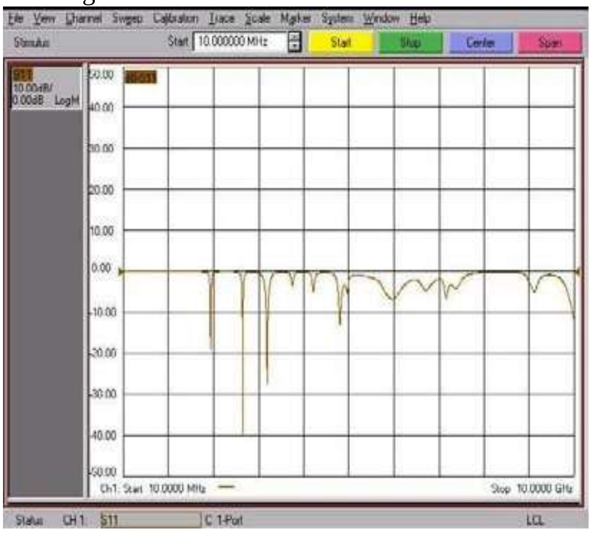


Figure 10 : Measured return loss of antenna 2

Comparisons between the measured return loss with the simulated ones are shown in Figure.11 and 12. The discrepancy between the measured and simulated results is due to the effect of improper soldering of SMA connector or fabrication tolerance.

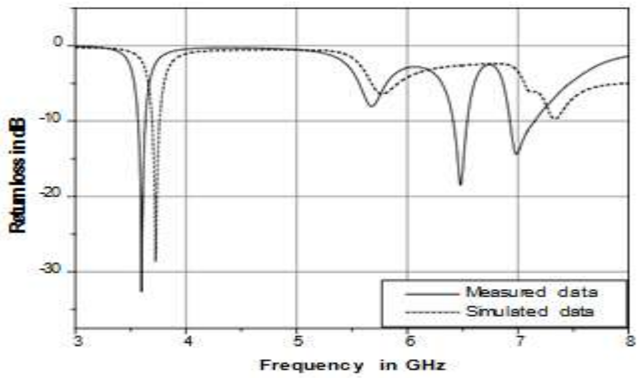


Figure 11: Comparison between measured and simulated return losses for antenna1

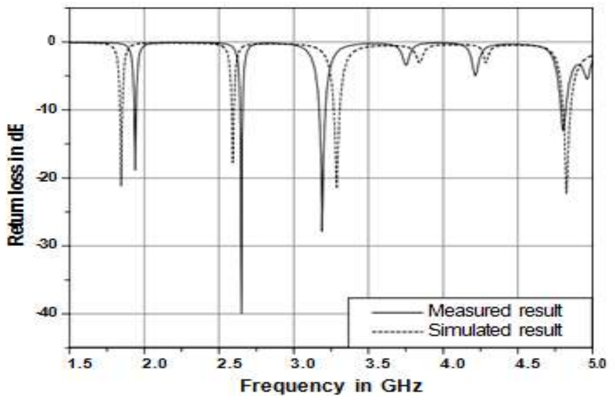


Figure 12: Comparison between measured and simulated return losses for antenna2.

IV. CONCLUSION

A single feed rectangular microstrip antenna with L-shaped slot insertion has been proposed in this paper. It is shown that the proposed antenna can operate in four frequency bands in the frequency ranges of GSM (1800 MHz), WiMAX (2.5-2.69 GHz and 3.2-3.8GHz) and Hyperlan (4.8-5.8 GHz). The polarization type of the antenna is linear and due to the perturbation of the time varying current, effective patch area of the proposed antenna is reduced by 80.2 % when compared to a conventional patch (without slot). Maximum gain of the proposed antenna is found to be about 5 dBi at 3.3 GHz. The location and length of the L-slots are optimized in such a way that the antenna can operate in four suitable band. The experimental result shows that this design is ideally practical for quad band applications.

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