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BANDWIDTH ENHANCEMENT OF RECTANGULAR MICROSTRIP PATCH ANTENNA USING L-SHAPED SLITS FOR WIRELESS COMMUNICATION SYSTEM AND MICRO WAVE C-BAND APPLICATIONS

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ABSTRACT

A single feed compact rectangular microstrip antenna for different band application is presented in this paper. One L-shaped slits are introduced at the edges of the patch to reduce the resonant frequency. For the proposed antenna two resonant frequencies are obtained at 4.65GHz and 8.90GHz(centre) respectively. With the introduction of slit at the edges of the patch the antenna size has been reduced by 17.60% and bandwidth is enhanced up to 718 MHz. So, we can also use this proposed antenna as a broad band antenna. The design and simulation of the proposed antenna is carried out using MoM based electromagnetic solver IE3D. The VSWR, input impedance, and S11 performance are used for the analysis of the different configurations. Resonant frequency has been reduced by cutting L-shaped slits at the edges of the patch and broad band-width is achieved from 8.220-9.55 GHz. The simple configuration of the proposed antenna makes it suitable for the applications in wireless communication system.

KEYWORDS— Broad Band, Compact, Slits, C-Band, IE3D

INTRODUCTION

The microstrip patch antenna is one of the most preferred antenna structures for their low cost and compact design for wireless system and RF applications. In Satellite and wireless communication applications. Microstrip antennas have attracted much interest due to their small size, light weight, and low cost on mass production, low profile and easy integration with other components [1-2]. With the recent advancements in mobile and wireless communication systems particularly for data communication systems, the demand for broad band multi-frequency patch antenna was realized. These requirements forced workers for modification in patch antenna geometries. The most important disadvantage of microstrip patch antenna is their narrow bandwidth (1-3 %) [3]. To overcome this problem without disturbing their principle advantages (such as simple printed circuit structure, planer profile, light weight and cheapness), a number of methods and here recently been investigated [4-9]. Recently Sudhir Bhasker and Sachin kumar Gupta et al [10] proposed H-Shaped patch for Bandwidth improvement microstrip antenna where the feeding is done by Microstrip line. Our work achieves better result with coaxial feeding and compared to [11]. Bandwidth is also increased without defecting the ground plane.

Antenna Design

The width(W) and length(L) of antenna are calculated from conventional equations [12].

$$f_r = \frac{c}{2W}\sqrt{\frac{2}{1+\varepsilon_r}} \quad (1)$$

$$L = L_{eff} - 2\Delta L \quad (2)$$

$$\frac{\Delta L}{h} = 0.412 \times \frac{(\varepsilon_{reff}+0.3)(\frac{w}{h}+0.264)}{(\varepsilon_{reff}-0.258)(\frac{w}{h}+0.8)} \quad (3)$$

$$\varepsilon_{reff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left[1 + 12\frac{h}{w}\right]^{-1/2} \quad (4)$$

$$L_{eff} = \frac{c}{2f_r\sqrt{\varepsilon_{reff}}} \quad (5)$$

Where ΔL/h= Normalised extension of patch, Leff = effective length of the patch The length and width of Conventional Rectangular microstrip patch antenna are 12mm and 16mm respectively. With substrate thickness h= 1.6 mm and dielectric constant εr= 4.4.

ANALYSIS AND RESULT

Simulated (using IE3D) results of return loss of conventional and slot loaded rectangular Microstrip patch antenna are shown in figure. 1 and figure. 2. A significant improvement of frequency reduction is achieved in slot loaded rectangular microstrip antenna with respect to the conventional antenna structure. In the conventional rectangular microstrip antenna return loss of about -10.02dB at 5.47GHz is obtained. Due to the presence of slots in antenna the first resonant frequency is obtained at 4.65GHz with return loss of about -15.45dB. Main thing is that broad bandwidth is obtained from 8.220GHz to 9.55GHz. In comparison to the conventional antenna a size reduction of above 17.60% is obtained with respect to the first resonant frequency at 4.65GHz. The antenna efficiency and radiation efficiency of the proposed compact slot loaded antenna for 4.65Hz is 67.46% and 69.80% respectively, the broad band central frequency at 8.90GHz is 25.56% and 25.77% respectively. The proposed antenna gain is obtaining at first resonant frequency 4.65GHz is 4.78dB and at broad band central frequency 8.90GHz is 0.55dB. So, the proposed antenna used for wireless communication such as broad band application and microwave C-band application.

TABLE I

FOR CONVENTIONAL ANTENNA PARAMETER (ANTENNA 1)

Substrate Thickness(mm) H	**Dielectric Constant εr**	**Resonant Frequency fr**	**Width of Conventional antenna (mm)**	**Lenth of Conventional antenna (mm)**
1.6	4.4	5.47	16	12

Antenna 1

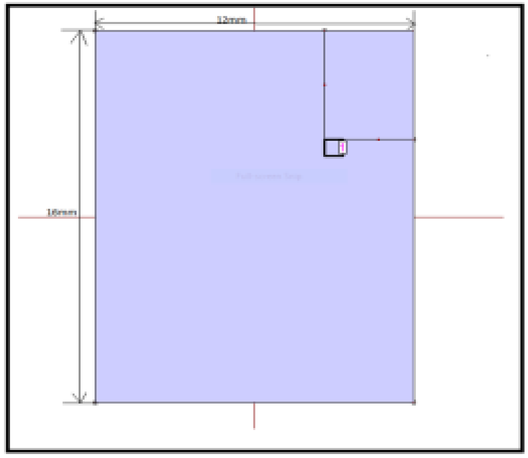

Fig. 1 Structure of Conventional Rectangular Microstrip patch Antenna
Antenna 2

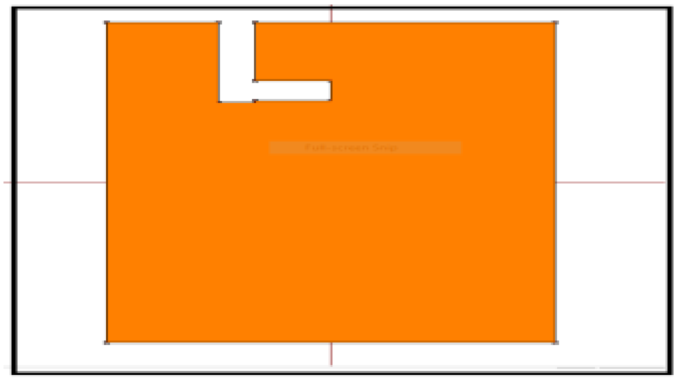

Fig. 2 Structure of Rectangular Microstrip patch Antenna with L-shaped slots

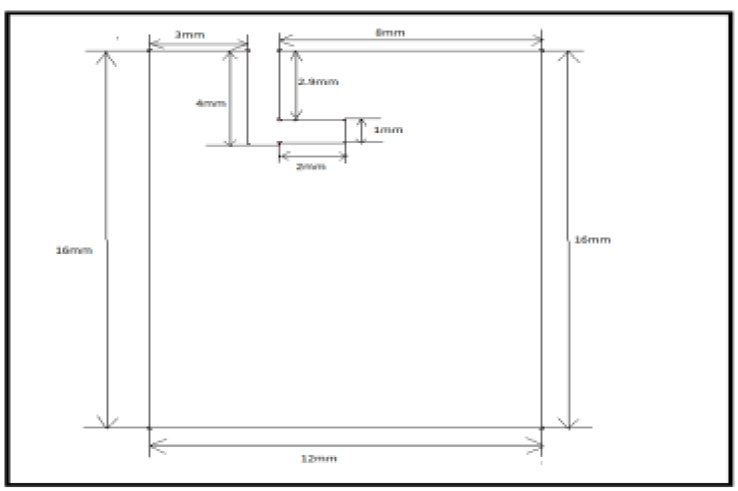

Fig. 3 Structure of Rectangular Microstrip patch Antenna using L-shape slots with Dimensions (Modified)

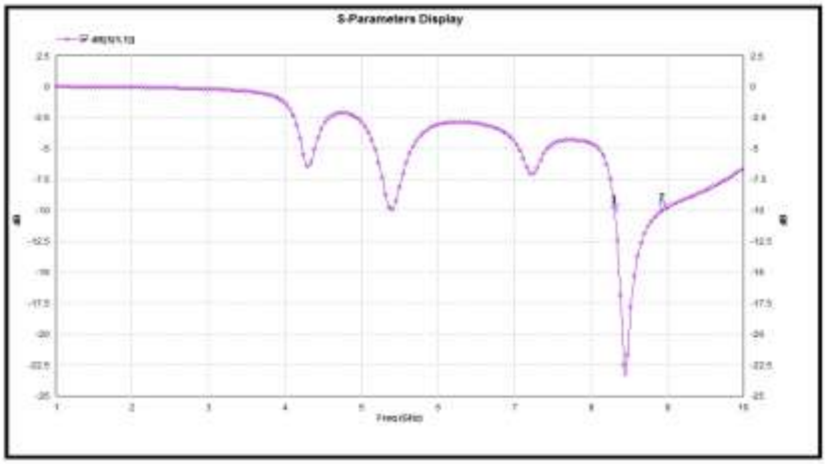

Fig. 4 Return loss of Conventional Rectangular Microstrip Patch Antenna

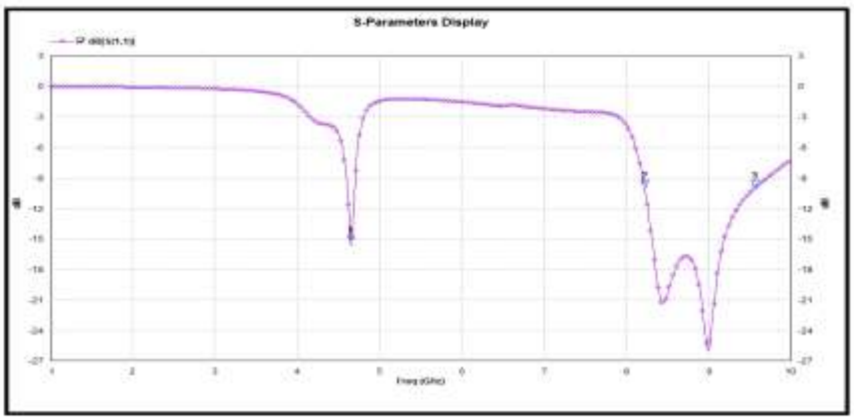

Fig. 5 Return loss of Rectangular Microstrip patch using L-shape slots (Modified)

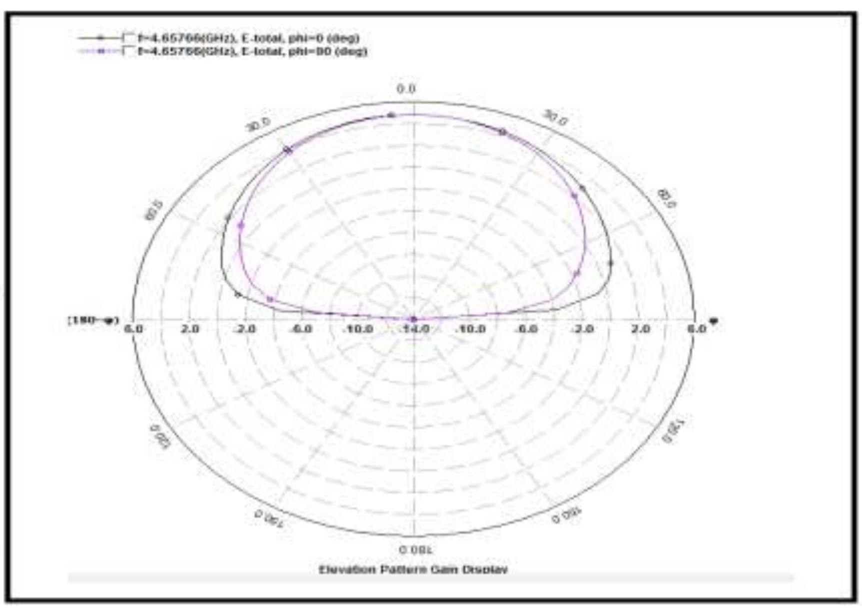

Fig. 6 Radiation Pattern of Modified Microstrip patch Antenna (4.65 GHz)

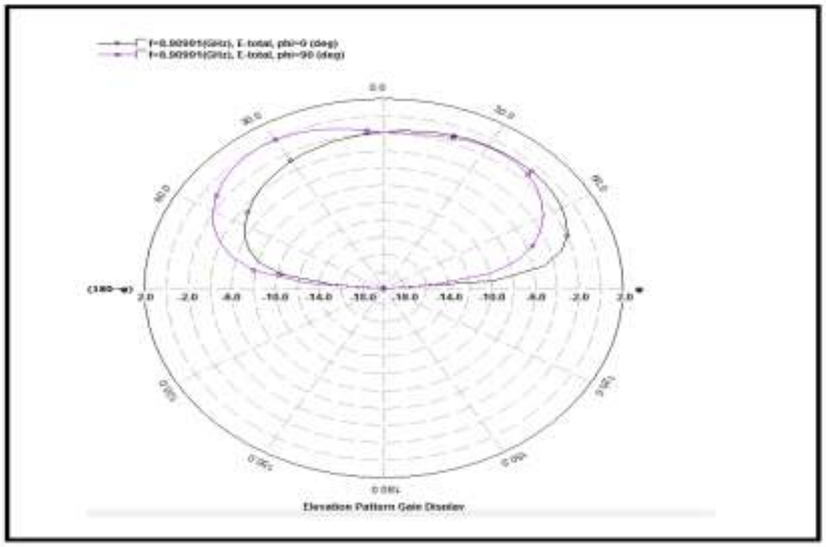

Fig. 7 Radiation Pattern of Modified Microstrip patch Antenna (8.90 GHz)

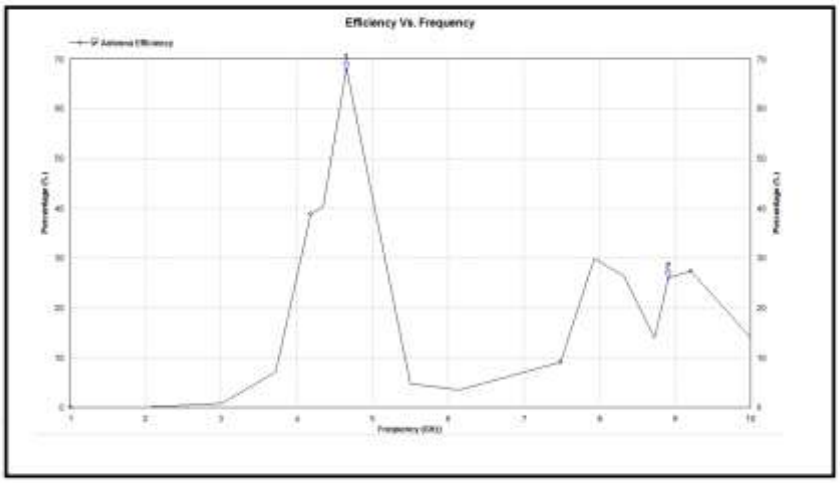

Fig. 8 Antenna efficiency of compact Microstrip Antenna with L-shape Slots (Modified)

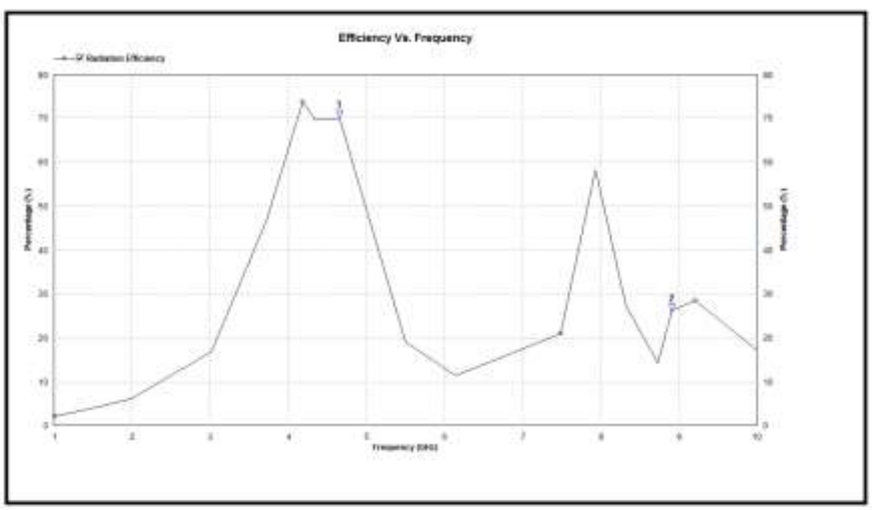

Fig. 9 Radiation efficiency of modified compact Microstrip patch Antenna

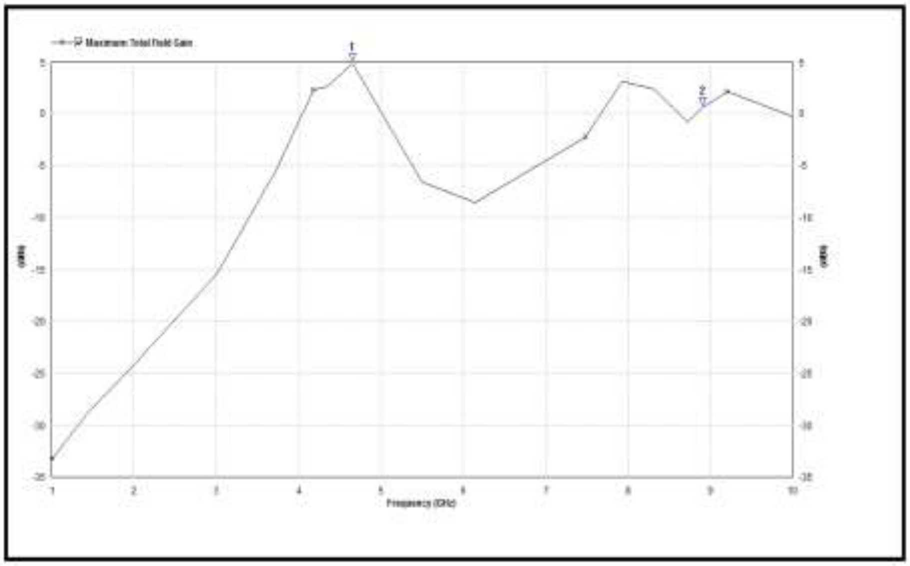

Fig. 10 Gain vs. Frequency plot of proposed compact Rectangular Microstrip patch Antenna

The value of the characteristic parameters of the proposed antenna such as return loss, bandwidth, gain and directivity are shown in two different tables.

TABLE III
SIMULATED RESULTS FOR ANTENNA 1, 2

Antenna Structure	Resonant Frequency (GHZ)	Return loss(dB)	Gain (dBi)	10dB Bandwidth (MHZ)
1	8.62(centre)	-22.99	3.29	617
2	4.65	-15.45	4.78	205
	8.90(centre)	-22.22	0.55	1335

CONCLUSIONS

Theoretical investigations of a single layer single feed Microstrip patch Antennas have been carried out using Method of Moment based software IE3D. With the Introduction of slits at the edges of Rectangular patch a size reduction of about 17.60% and also bandwidth enhanced up to 718MHz has been achieved. The location of the feed point of this modified antenna structures presented in this paper is (2,0). Alternation of the location of the feed point results in narrower 10 dB bandwidth and less sharp resonance. Hence it may be concluded that the parametric study of the location of feed point on the sharpness of resonance and the 10dB bandwidth may give the optimum location of the feed point for this particular antenna. The proposed antenna in this paper finds application in wireless communication and Microwave C-band application.

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