Size Reduction And Bandwidth Enhancement Of Rectangular Printed Antenna Using Tripple Narrow Slits For Wireless Communication System And Micro Wave X-Band Applications

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ABSTRACT

A reduced size printed antenna with enhanced band width is proposed in this paper. Resonant frequency has been reduced by cutting unequal narrow slits at the edges of the patch and broad band-width is achieved from 8.44-9.69 GHz. With the introduction of slits at the edges of the patch the antenna size has been reduced by 43.38% and bandwidth is enhanced upto 13.78% So, we can also use this proposed antenna as a broad band antenna. The antenna efficiency,radiationefficiency,Gain and radiation pattern of the proposed antenna is also studied.The design and Simulation of proposed antenna is performed using method of moment based EM Simulator IE3D.

KEYWORDS - Compact , slit , broadband ,wireless communication

I.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 multifrequency 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 SudhirBhasker and Sachinkumargupta et al[10] proposed H-Shaped patch for Bandwidth improvement microstrip antenna where the feeding is done by Microstripline.Our work achieves better result with coaxial feeding and compared to [11] Bandwidth is also increasedwithout defecting the ground plane.

II. 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 $\Delta L/h$= Normalised extension of patch, L_{eff}= effective length of the patch
The length and width of Conventional Rectangular microstrip patch antenna are 12mm and 16mm respectivelyWith substrate thickness h= 1.6 mm and dielectric constantε_r = 4.4.

III. RESULT AND DISCUSSION

Simulated (using IE3D[13]) results of return loss of conventional and slit loaded rectangular,Microstrip antenna are shown in figure.1 and figure.2 .

A significant improvement of frequency reduction is achieved in slit loaded rectangular microstrip antenna with respect to the conventional antenna structure. In the conventional rectangular microstrip antenna return loss of about -27.88 dB and -16.88 dB at 5.45 GHZ and 9.09 GHZ are obtained. Due to the presence of slits in antenna the first resonant frequency is obtained at4.32 GHZ with return loss of about -10.77 dB, the second resonant frequency obtained at 4.59 GHZ at -14.19 dB, third and fourth resonant frequency at 6.09 GHZ, 7.54 GHZ are -16.22 dB and-10.93 dB respectively. Main thing is that broad bandwidth is obtained from 8.44 GHZ-9.69 GHZ. In percentage the band width of the antenna is 13.78%. The antenna efficiency and radiation efficiency of the proposed compact slit loaded antenna for 4.32 GHZ, 4.59 GHz, 6.09 GHZ, 7.54 GHZ, 8.44 GHZ 9.69 GHZ are 68.8%, 44.8%, 5.6%, 13.12%, 31.52%, 8% and 79.04%, 69.76%, 17.76%, 23.04%, 37.28%, 8.74% respectively. The VSWR for proposed compact antenna for 4.32 GHZ, 4.59 GHZ, 6.09 GHZ,7.54 GHZ, 8.44 GHZ, 9.69 GHZ are 1.80, 2.64, 5.23, 1.98, 1.89 and 1.91 respectively. The absolute gain of proposed antenna is 4.84 dBi for 4.32 GHz.

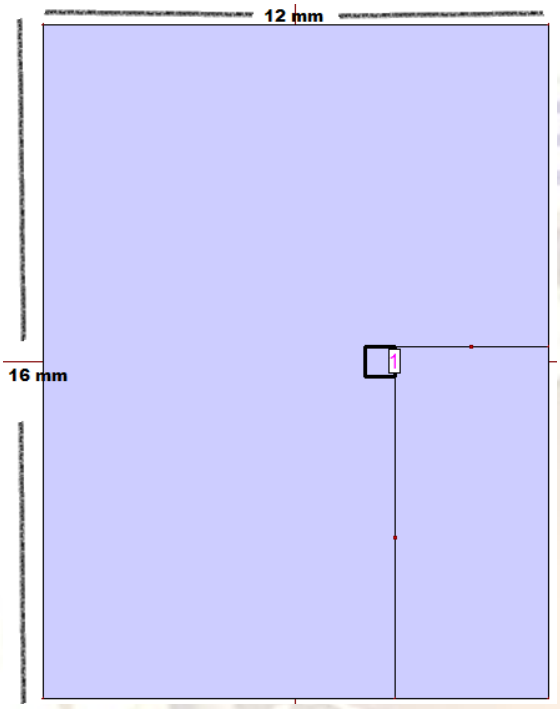

Fig.1 Structure of Conventional Rectangular Microstrip patch Antenna

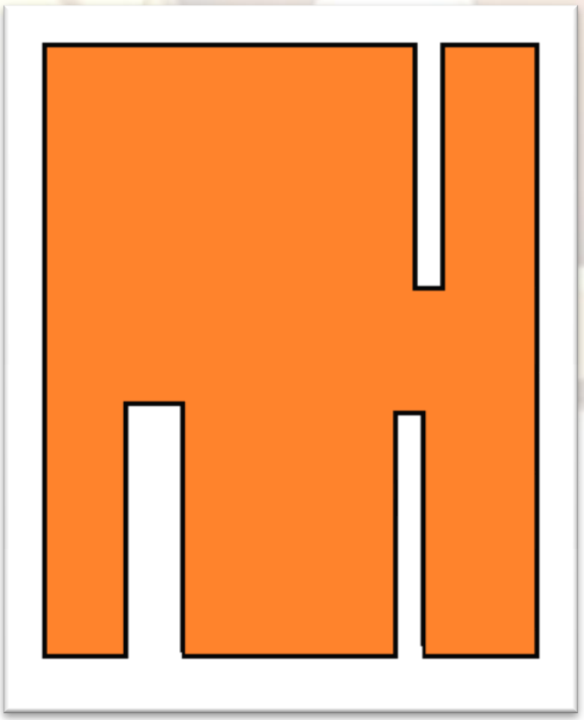

Fig.2 Structure of rectangularMicrostrip patch Antenna with tripple slits

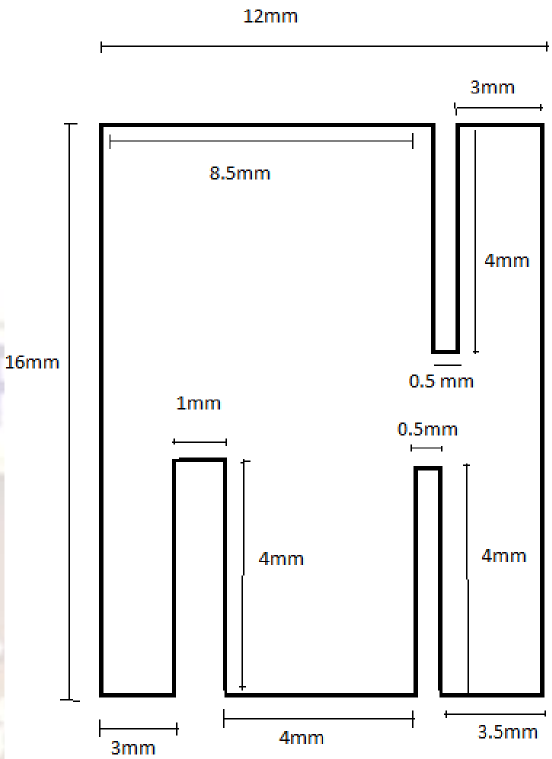

Fig.3 Structure of rectangularmicrostrip patch Antenna using tripple narrow slits with Dimensions

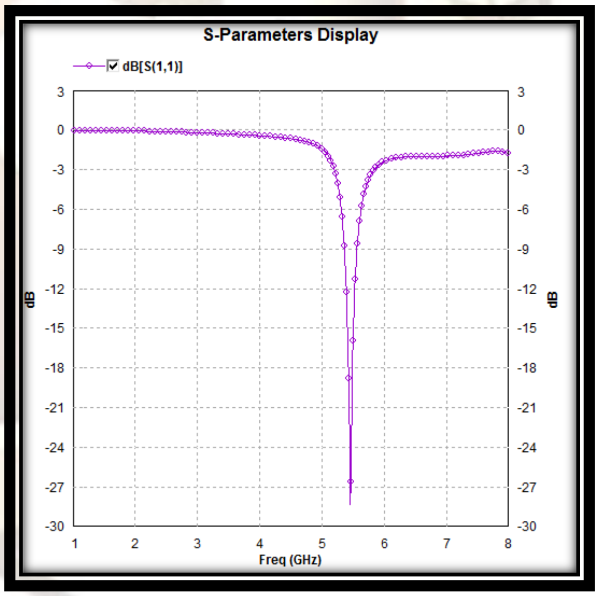

Fig.4 Return loss of Conventional Rectangular Microstrip patch Antenna(without slit)

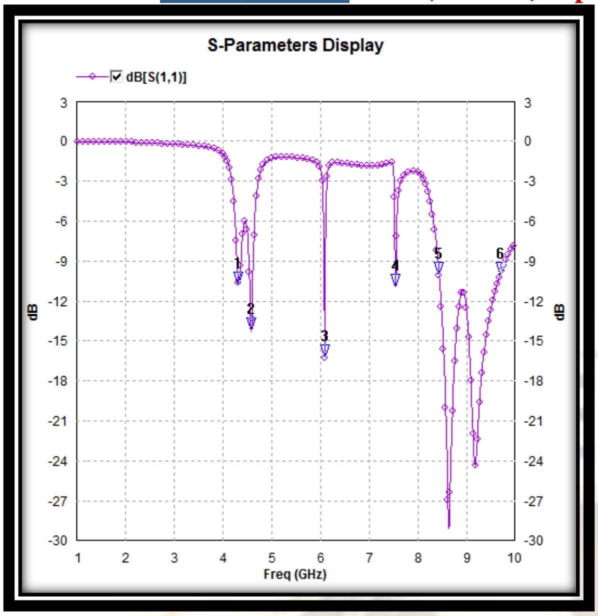

Fig.5 Return loss of Rectangular Microstrip patch Antenna using narrow slits(modified)

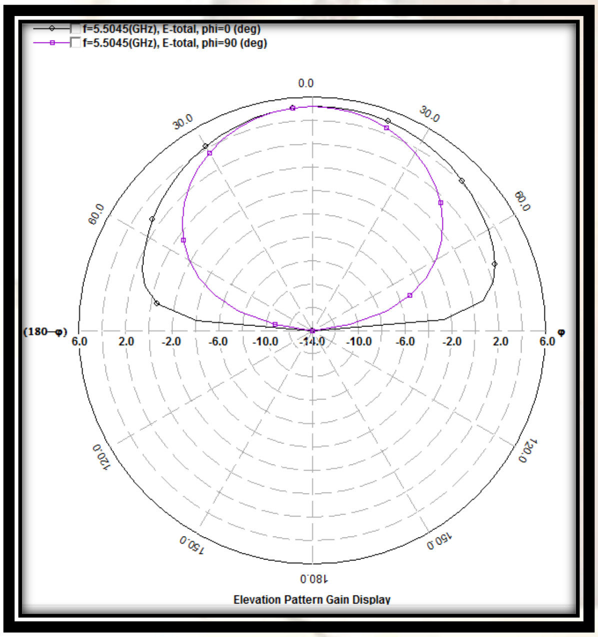

Fig.6 Radiation pattern of conventional Microstrip patch Antenna(5.45 GHZ)

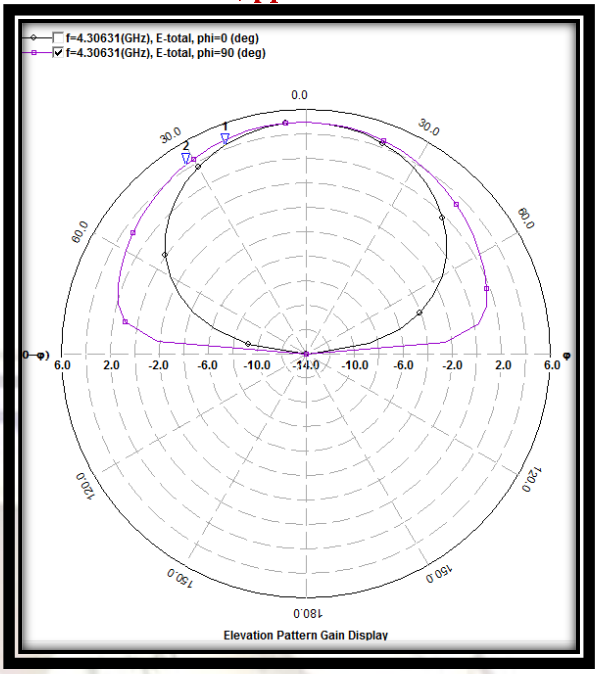

Fig.7 Radiation pattern of Modified rectangularMicrostrip Antenna (4.32 GHZ)

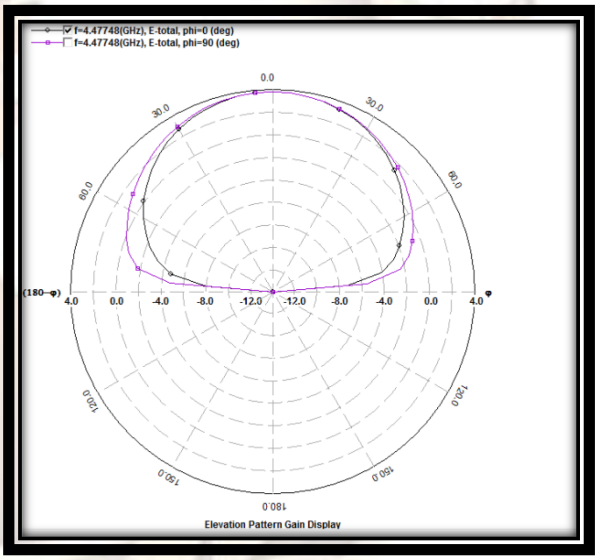

Fig.8 Radiation pattern of Modified Rectangular Microstrip patch Antenna(4.59 GHZ)

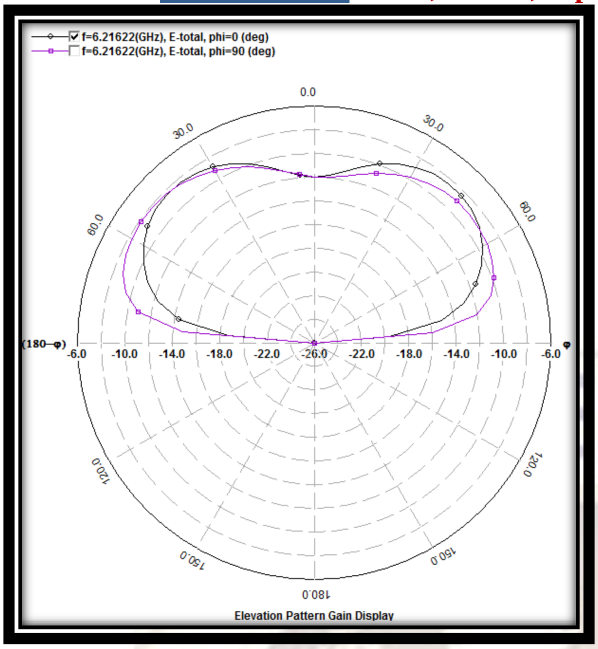

Fig.9 Radiation pattern of Modified rectangularMicrostrip patch Antenna(6.09 GHZ)

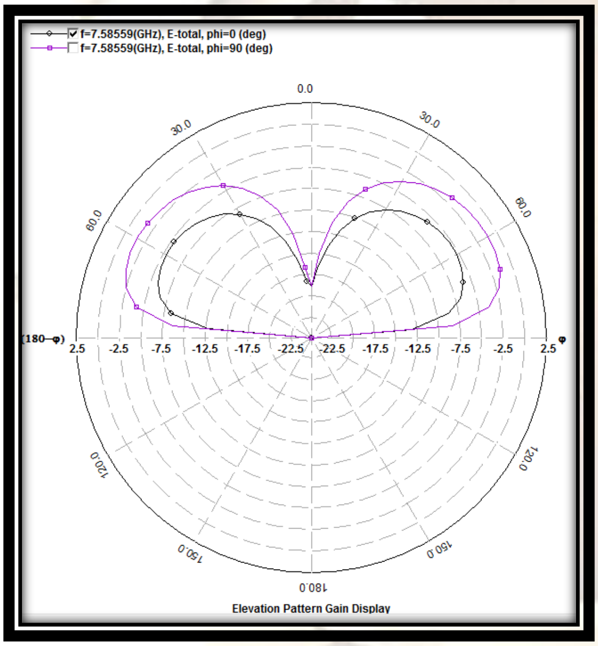

Fig.10 Radiation pattern of Modified rectangularMicrostrip patch Antenna(7.54 GHZ)

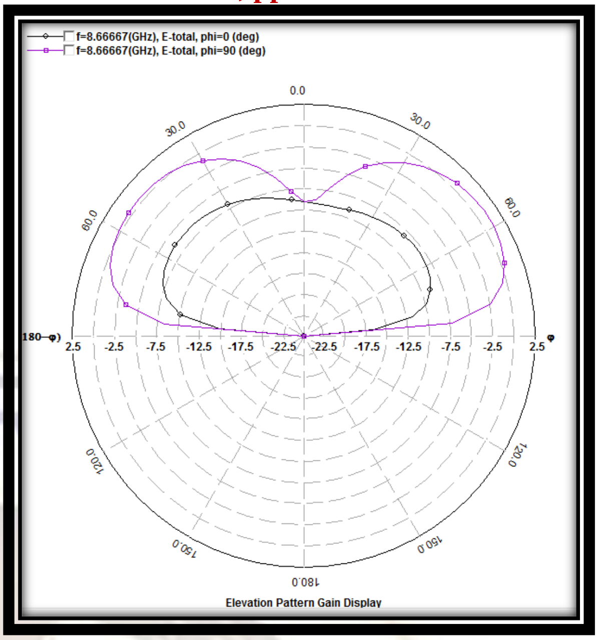

Fig.11 Radiation pattern of Modified RectangularMicrostrip patch Antenna(8.44 GHZ)

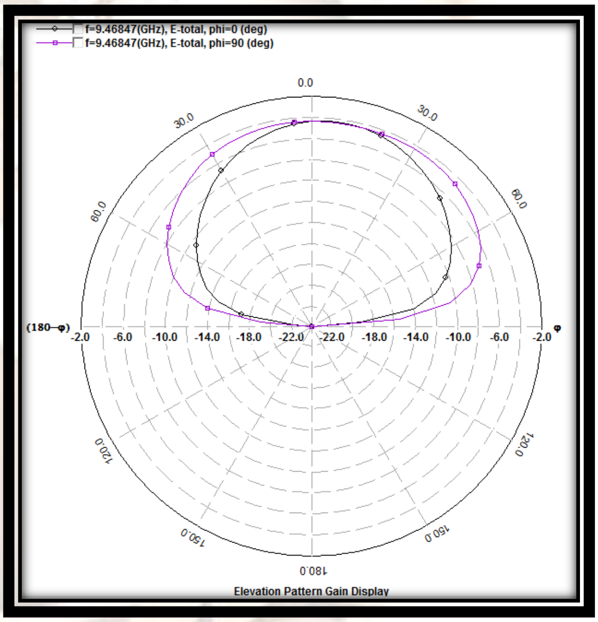

Fig.12 Radiation pattern of Modified rectangularMicrostrip Patch Antenna (9.69 GHZ)

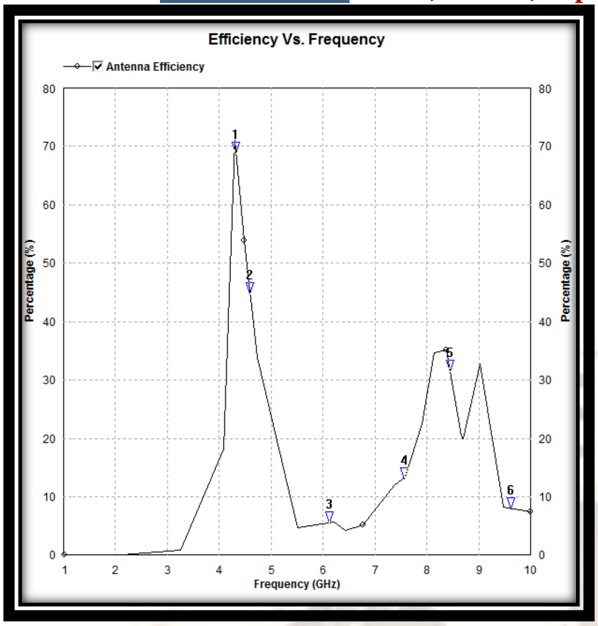

Fig.13 Antenna efficiency of compact RectangularMicrostrip Antenna

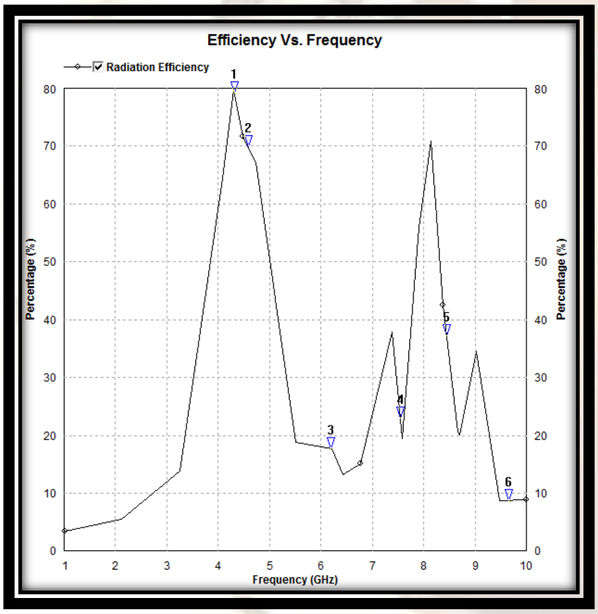

Fig.14 Radiation efficiency of modified compact RectangularMicrostrip Antenna

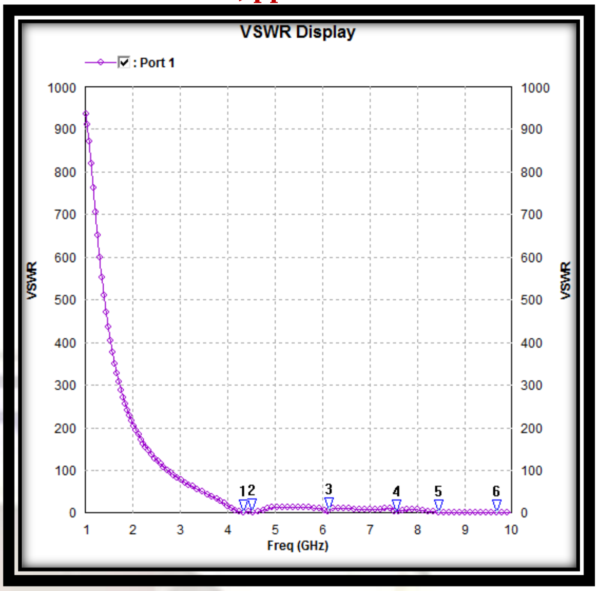

Fig.15 VSWR plot of proposed compact Rectangular Microstrip patch Antenna

TABLE.1 Simulated Results for Antenna 1, 2

Antenna Structure	Resonant Frequency (GHZ)	Return loss(dB)	10 dB Bandwidth (MHZ)
1	5.57	-22.99	205
2	4.32	-10.77	46
	4.59	-14.19	74
	6.09	-16.22	24
	7.54	-10.03	10
	8.94(centre)	-11.29	1250

TABLE.2 Simulated Results for Antenna 1, 2

Antenna Structure	Frequency (GHZ)	Gain (dBi)	Directivity (dBi)
1	5.57	3.29	6.50
2	4.32	4.84	6.44
	4.59	2.84	6.50
	6.09	-5.16	7.39
	7.54	-1.64	7.25
	8.94(centre)	0.98	6.16

IV. CONCLUSION

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 44% and also bandwidth improvement of 13.78% has been achieved. The location of the feed point of this modified antenna structures presented in this paper is (2,-2). 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 10 dB 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 X-band application.

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