Design & Analysis of Microstrip Patch Antenna for BW Enhancement using Symmetrical Cuts

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Abstract*— *The narrow BW of microstrip antenna is one of the important features that restrict its wide usages. This paper present omnidirectional microstrip patch antenna with wide bandwidth has been designed with centre frequency of 2GHz. In order to achieve BW enhancement a rectangular cut structure have been introduced in the simple rectangular patch antenna with ground optimization. It has been analyzed that Broad BW of 2.46 GHz at 2 GHz is achieved & omnidirectional pattern obtained, the results were obtained using the simulation software HFSS.

Index Terms*— *BW, rectangular microstrip patch antenna, ground variation, symmetrical cuts, return loss, radiation efficiency.

I. INTRODUCTION

Microstrip antennas are used in a wide range of applications because of their advantageous features in terms of low profile, low cost, light weight and easy fabrication. However two major disadvantages is narrow bandwidth when high dielectric constant material is used for fabrication of the microstrip antenna. Several approaches have been used to enhance the by perturbing the higher order mode by interpolating surface modification into patch geometry. BW enhancement achieved by cutting symmetrical slot on rectangular patch used in simulation at 2GHz which is the key frequency in modern wireless communication era.

II. ANALYSIS OF SIMPLE PLAN RECTANGULAR PATCH ANTENNA

Figure 1, shows the simple rectangular plan patch antenna with ground variation. The rectangular microstrip patch antenna designed on one side of the glass/epoxy structure with ε_r= 4.4 with tangent loss 0.02. & height from the ground plane= 1.6mm. The width of the patch element (W) is given by:

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

The effective dielectric constant is:

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left\{1 + 12\frac{h}{w}\right\}^{1/2}$$

The effective length is given by:

$$L_{eff} = \frac{c}{2 f_r \sqrt{\epsilon_{reff}}}$$

The length extension (ΔL) is given by:

$$\Delta L = h\left[0.412\frac{(\varepsilon_{reff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{W}{h} + 0.8\right)}\right]$$

The actual length (L) of patch is obtained by
L = Leff - 2ΔL

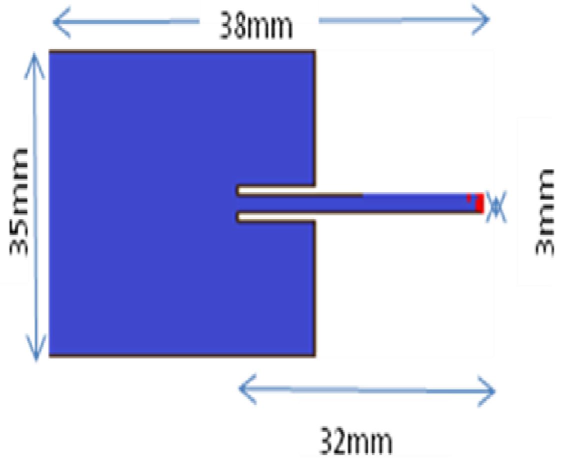

Fig.1.Simple Rectangular microstrip plan patch antenna

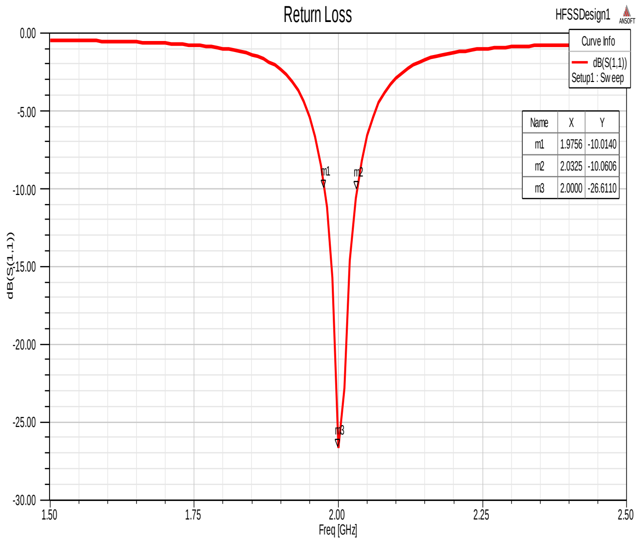

Fig.1a. Return loss for simple microstrip plan patch antenna

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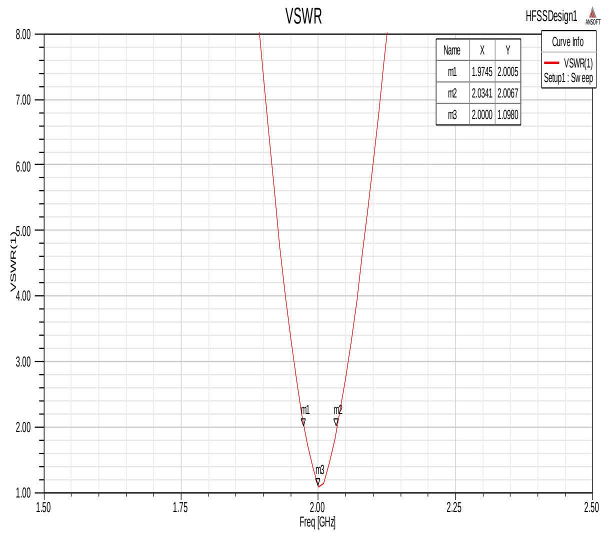

Fig.1b. VSWR for simple microstrip plan patch antenna

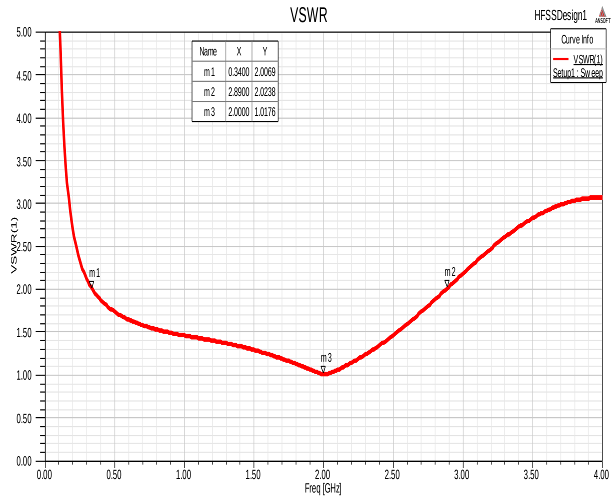

Fig.2b.VSWR for microstrip patch antenna with ground variation

III. ANALYSIS OF SIMPLE RECTANGULAR PATCH ANTENNA WITH GROUND VARIATION

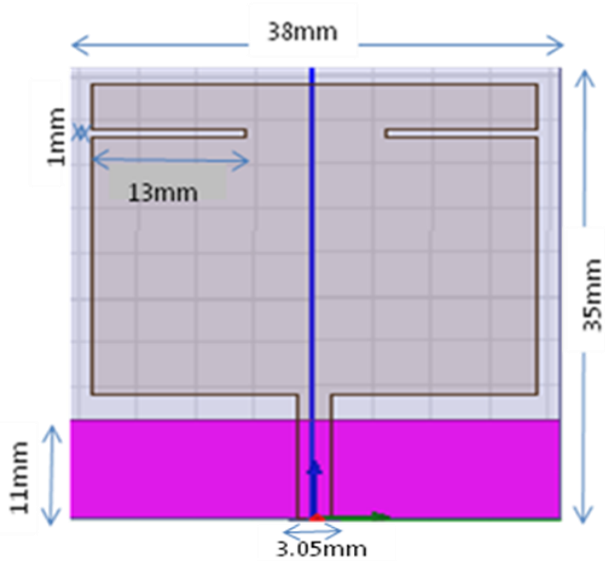

Fig.2.Rectangular microstrip patch antenna with ground variation & symmetric slots.

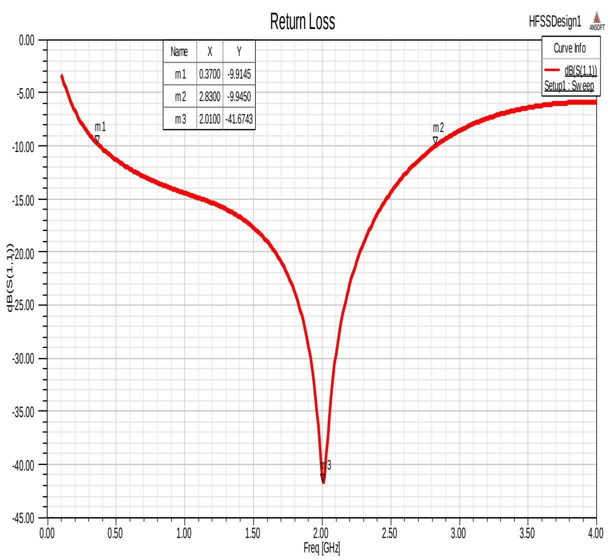

Fig.2a. Return loss for rectangular microstrip patch antenna with ground variation.

IV. MICROSTRIP PATCH ANTENNA WITH GROUND VARIATION & SYMMETRIC SLOTS

The microstrip patch antenna with symmetrical rectangular cuts on the same rectangular patch with optimized ground shown in fig 2. Cut length = 13mm and cut width= 1mm.

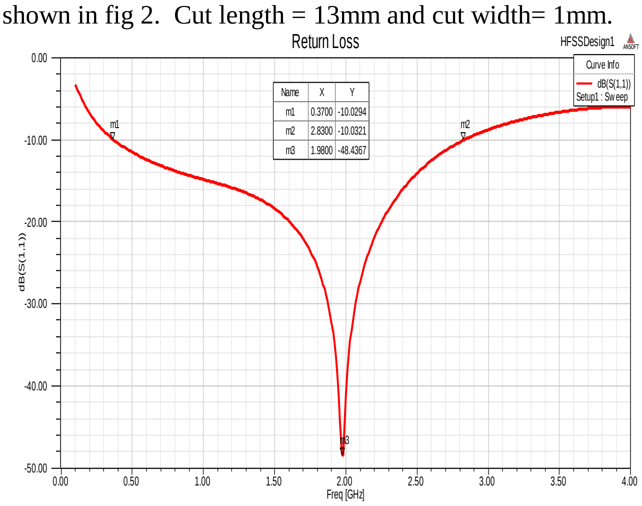

Fig.2c. Return loss for microstrip patch antenna with symmetric slot.

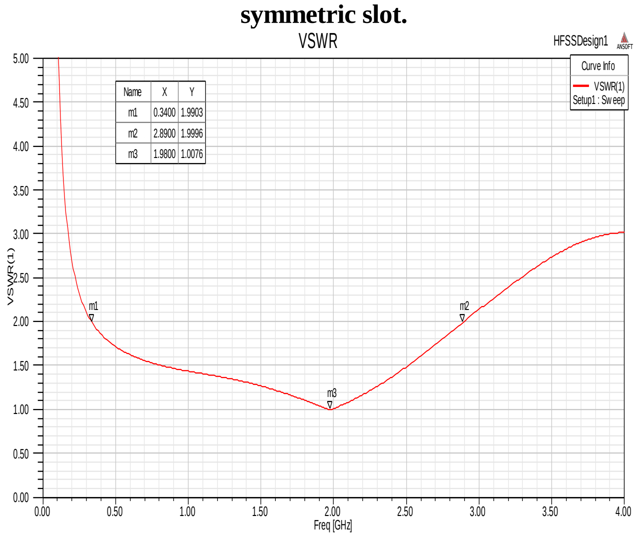

Fig.2d. VSWR for microstrip patch antenna with symmetric slot

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V. RESULTS

Antenna parameter	Plan patch	Ground variation	Symmetric slot
Resonant Freq.	2GHz	2GHz	2GHz
Return loss	-26dB	-42dB	-48dB
VSWR	1.09	1.017	1.007
BW	56.9MHz	2.46 GHz	2.46 GHz
Radiation Efficiency	47%	95%	96%

VI. CONCLUSION

A simple microstrip patch antenna designed by simply optimizing the ground for broad band operation has been simulated. The comparison between the simple rectangular patch antenna with ground variation and microstrip patch antenna with symmetrical rectangular cuts on patch is shown in the table, which shows the increase in the return loss from (-26)db to (-48)dB ,increase in BW from 56.9MHz to 2.46GHz & increase in radiation efficiency from 47% to 96%.

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