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Design and Analysis of Notched Square slot loaded Microstrip Patch Antenna.

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Abstract— This paper presents simulation of notched square-slot-loaded microstrip patch antenna fed by coaxial probe. A coaxial feed, notched* rectangular-*slot loaded, microstrip antenna is proposed for linear polarization. The compactness of the antenna is easily obtained by inserting a square-slot. The square-slot-loaded microstrip antenna is simulated using IE3D software.

***Index Terms*—Bandwidth,IE3D,Notched,smith chart .**

I. INTRODUCTION

Microstrip antennas are popular for their attractive features such as low profile, low weight, low cost, ease of fabrication and integration with RF devices, allow multi-frequency operation to be achieved [1] Linearly polarized microstrip antennas (LPMAs) are widely used in many wireless communication applications. The classification of the LPMAs is based upon the single-feed or dual-feed types. Single-feed wideband LPMAs are currently receiving much attention. The single fed antenna is useful, because it can excite polarization (LP) without using an external polarization. In the resent years, radar and communication system, such as global positioning system (GPS), synthetic aperture radar (SAR) Often require dual frequency patch antennas to avoid the use of two different antennas. Dual frequency is obtained by introducing the slots parallel to radiating edges of the patch co-axial [2-3]. The patch radiator was fabricated from the copper sheet and mounted on a duroid substrate. However, the patch radiator on the duroid substrate is mechanically unstable. Moreover, the coaxial feed in this antenna makes it unsuitable for a low-cost antenna array design. The slot loading allows one to strong interaction between the main patch and the slot resonant frequency. The slot loading is also a good solution to minimize and enhance the impedance mismatch and bandwidth almost similar radiation pattern for the rectangular and slot loaded patch antennas confirm that the current distributions are not much affected by the slot cut in the patch. In this paper, we propose a new compact, coaxial feed, linearly polarized,notched square-slot-loaded microstrip antenna. The antenna consists of a notched-slot-loaded patch radiator and a coaxial feeding structure. The results are compared with the results obtained by EM simulator software, IE3D.

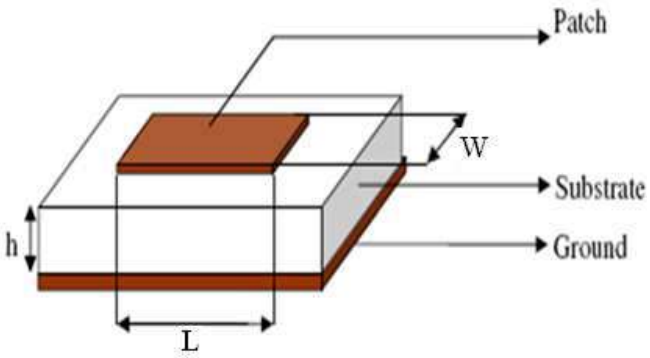

Figure 1. Rectangular Microstrip Patch Antenna

II. PROPOSED ANTENNA GEOMETRY AND DESIGN

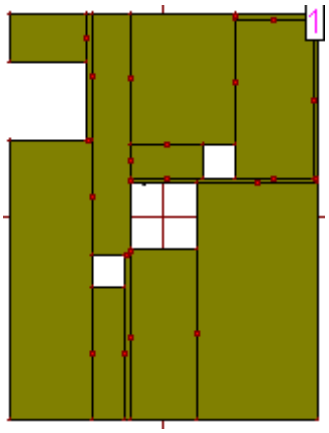

Figure 2. Geometry of notched square slot loaded microstrip antenna

The proposed antenna geometry is shown in Fig. 2. The antenna is first analyzed using the method of transmission line model. The width and length of the patch are given by [4]

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

$$L = \frac{c}{2f\sqrt{\varepsilon_{eff}}} - 2\Delta l \quad (2)$$

Where ,w is the width of patch
L is the length of patch
c is the velocity of light,
ε_r is the dielectric constant of substrate,
f_o is the antenna working frequency,
and the effective dielectric constant ε_{eff} is given as,

$$\epsilon_{eff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2}(1 + \quad (3)$$

$$\frac{\Delta l}{h} = 0.412\frac{\left(\varepsilon_{eff} + 0.300\right)\left(\frac{W}{h} + 0.262\right)}{\left(\varepsilon_{eff} - 0.258\right)\left(\frac{W}{h} + 0.813\right)} \quad (4)$$

And theoretically bandwidth can be calculated as

$$Bw(\%) = (3.77(\frac{\epsilon_r -}{\epsilon_r^2} \quad (5)$$

Δl is effective length of patch, h is height of substrate

III. DESIGNED PARAMETERS

For designing the notched square-slot-loaded microstrip patch antenna, following parameters were used

Design frequency	= 2.47 GHZ
Free space wavelength	= 125mm
Dielectric constant	= 4.4
Loss tangent (tan δ)	= 0.02
The thickness of the substrate	= 1.6 mm
Length of the patch	=28 mm
Width of the patch	= 37 mm
Length of slot	= 6 mm
Width of slot	= 6mm
Length of notched shape	= 14mm
Width of notched shape	= 6 mm

IV. ANTENNA FABRICATION AND RESULTS

The Notched square-slot-loaded microstrip patch antenna designed on EM simulator software IE3D and it's radiation pattern, current distribution, return losses, Smith chart parameters impedence and admittance curve is shown in figure . It is mounted on a RT duroid substrate 4.4. The resulting data are presented in Figures.4, 5, 6 & 7 for return losses, Smith chart, admittance and impedance curve respectively and figures 8& 9 for 3D radiation pattern and VSWR curve.

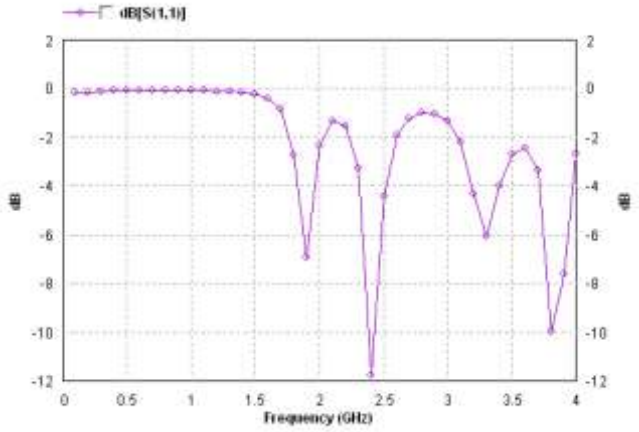

Figure 4. . Return loss(S11) Vs frequency plot of RMA on IE3D

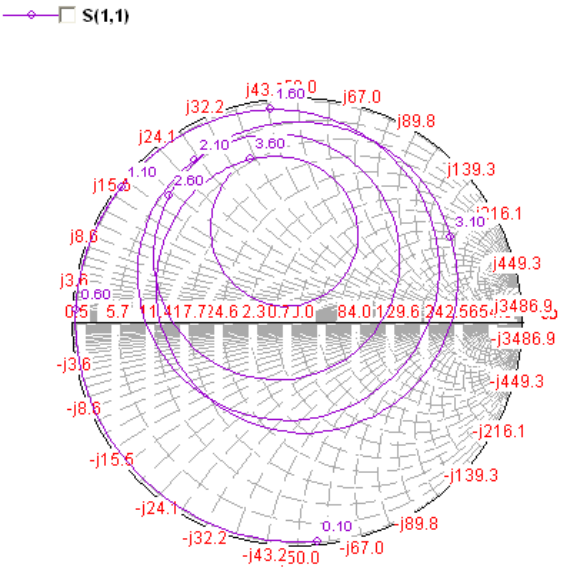

Figure 5. Smith chart of RMA on IE3D.

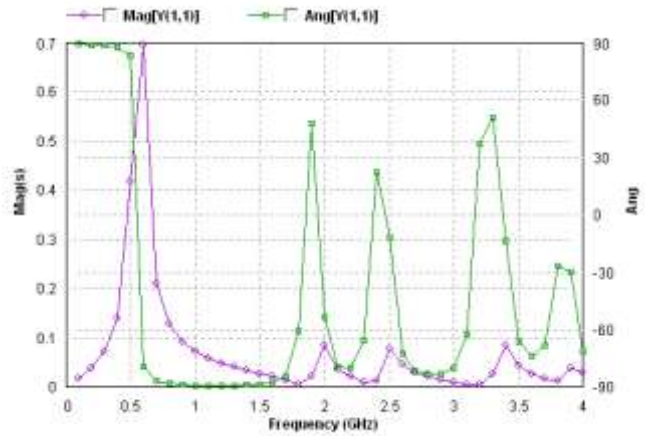

Figure 6. Y parameters (Y11) Vs frequency plot of RMA on IE3D

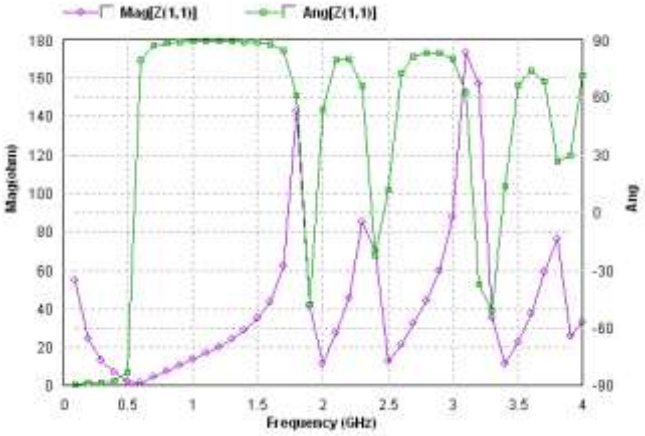

Figure 7. Z parameters (Z11) Vs frequency plot of RMA on IE3D

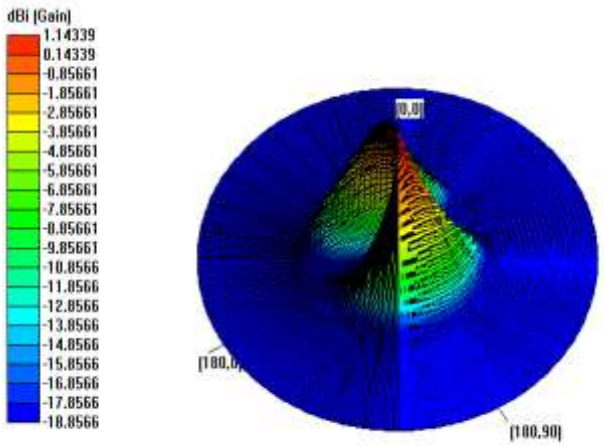

Figure 8.Radiation pattern of Notched square slot loaded RMA.

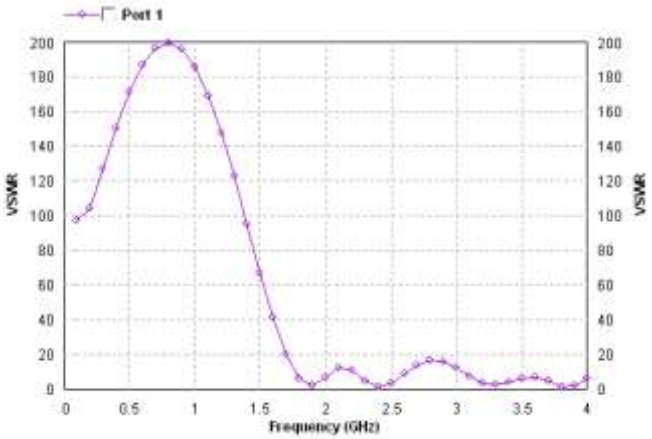

Figure 9 . VSWR parameters Vs frequency plot of RMA on IE3D

. V CONCLUSIONS

It is concluded that a coaxial feed, linearly polarized, Notched square-slot-loaded microstrip antenna has been designed, and simulated. After comparison the proposed antenna gives better results as compared to normal rectangular microstrip antenna. The proposed Notched square-slot-loaded microstrip antenna is suitable for implementing compact arrays, thus achieving even higher gain and good impedance matching.

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