

Analysis of E-Shape geometry Microstrip Antenna

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ABSTRACT: We have proposed the design and analysis of E- shaped microstrip patch antenna in this paper. Input is offered throughout the rectangular microstrip line feed. The functioning frequency of the antenna is 5 GHz. The antenna design includes a single layer of thickness of 3.2 mm along with dielectric invariable of 2.94 fabricated on a substance of plasma ion. The simulation effects of the recommended E-shape antenna are prepared with the aid of IE3D Zealand Software. The design and analysis of the antenna is achieved by utilizing transmission line model and cavity model. The consequences of various antenna parameters like S(1, 1), VSWR, 3D directivity and 2-D Polar plot are also analyzed.

KEYWORDS: Microstrip patch antenna, Dielectric material, IE3D.

I. INTRODUCTION

Microstrip patch antennas are planer resonant cavities that escape from their edges and also emit radiations. We can employ printed circuit systems to engrave the antennas on soft substrate to generate low-cost and repeatable antennas in a low profile. The antennas fabricated on compliant substrate endure great shock and vibration situations. Procedures for mobile communication base stations frequently make these antennas straightly in sheet metal and accumulate them on dielectric posts or foam in different techniques to remove the cost of substrates and engraving [7]. This also abolishes the difficulty of emission from surface waves excited in a thick dielectric substrate utilized enlarge bandwidth. So as to make simpler the analysis and functioning prediction, the patch is usually square, rectangular, circular, triangular, elliptical or in some other ordinary shapes. In case of a rectangular patch, the length L of the patch is generally $0.3333\lambda < L < 0.5\lambda_0$, in which λ_0 is the free space wavelength. The patch is chosen to be extremely thin so that $t \ll \lambda_0$ (in which t is the patch thickness). The height h of the dielectric substrate is generally $0.03\lambda_0 \leq h \leq 0.05\lambda_0$. The dielectric constant of the substrate (ϵ_r) is normally within the range of $2.2 \leq \epsilon_r \leq 12$.

II. DESIGN PROCEDURE

A design process is outlined which is founded on transmission line model and cavity model formulation that guides us to realistic designs of microstrip antennas. The procedure is finished with the help of particular information like dielectric constant of the substrate (ϵ_r), the resonant frequency (f_r) and the height of the substrate h. The procedure is as described as follows [1]:-Specify ϵ_r , f_r (in Hz), and h (in cm) and determine the actual dimension length (l) and width (w) of the patch.

Length (l) is found out by the equation, $l = \frac{\lambda}{2} - 2\Delta l$

The extended length (Δl) is given by $\Delta l = 0.412 \frac{(\epsilon_{reff}+0.3)(\frac{w}{h}+0.264)}{(\epsilon_{reff}-0.258)(\frac{w}{h}+0.8)}$

The effective dielectric constant (ϵ_{reff}) is given by $\epsilon_{reff} = \frac{\epsilon_r+1}{2} + \frac{\epsilon_r-1}{2} [1 + 12 \frac{h}{w}]^{-1/2}$

Furthermore the effective length (L_{eff}) is found out by $L_{eff} = L + 2\Delta l$

Width (w) is found out by, $w = \frac{v_0}{2f_r} \sqrt{\frac{2}{\epsilon_{r+1}}}$

where, λ = free space wavelength, ϵ_{reff} = effective dielectric constant, ϵ_r = dielectric constant, h = height of the substrate, w = width of the substrate, v_0 = free space velocity of light, f_r = resonant frequency and ϵ_r = dielectric constant.

III. ANTENNA CONFIGURATION

The geometry of the suggested antenna is illustrated in figure 1. It is made up of a distinct radiating E- shaped patch excited with the aid of a rectangular line feed microstrip feed line. The excitation frequency has been chosen as 5 GHz. The antenna is devised on a Rogers RT/Duroid 6202 laminate substrate along with dielectric constant of 2.94 and loss tangent of 0.001. The substrate height has been chosen as 3.2 mm. The length of the patch is 16.06 mm while the width of the patch is 15.22 mm. The simulation is completed utilizing the software IE3D.

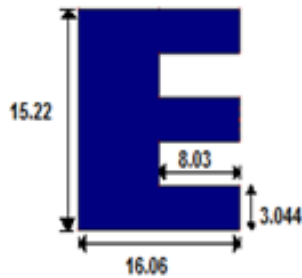


Fig. 1 Antenna Geometry

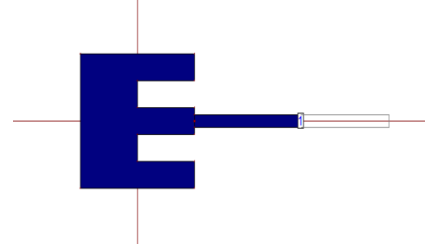


Fig. 2 Patch

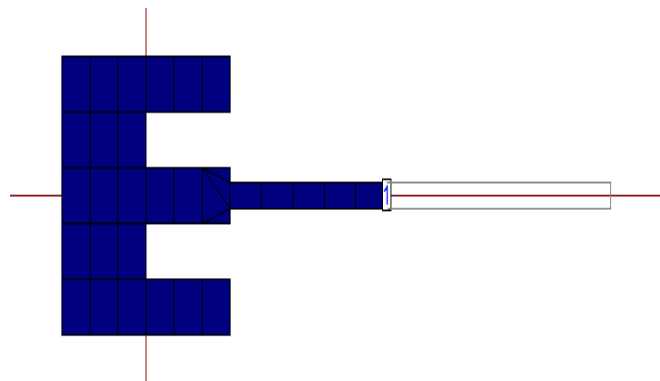


Fig.3 Mesh Pattern

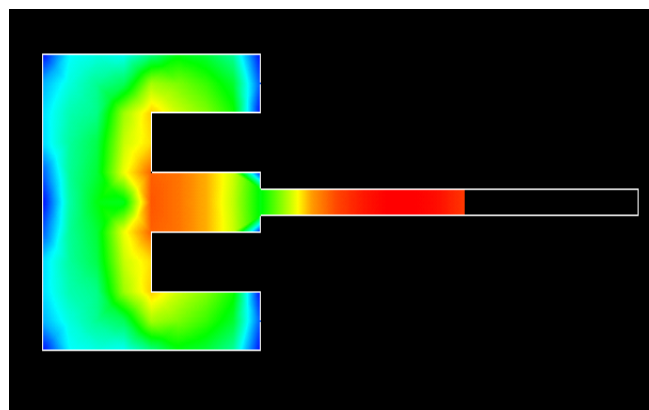


Fig. 4 Current Distribution Density

In figure 5 the $S(1, 1)$ obtained at 4.53 GHz is about -1.01 dB and bandwidth obtained is about 4.1MHz. In figure 6 the VSWR is obtained at 4.53 GHz is about 1.302.

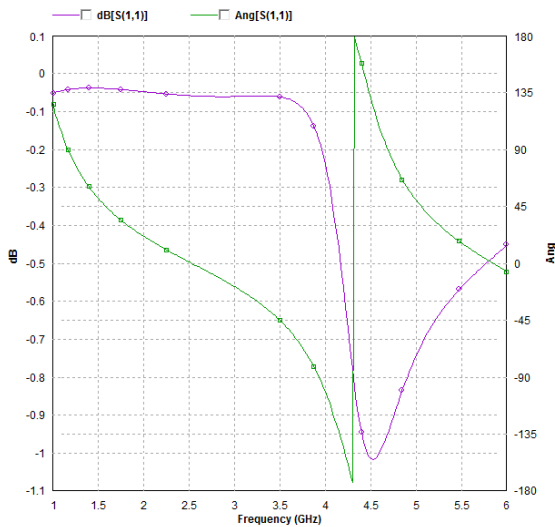


Fig. 5 S(1, 1)

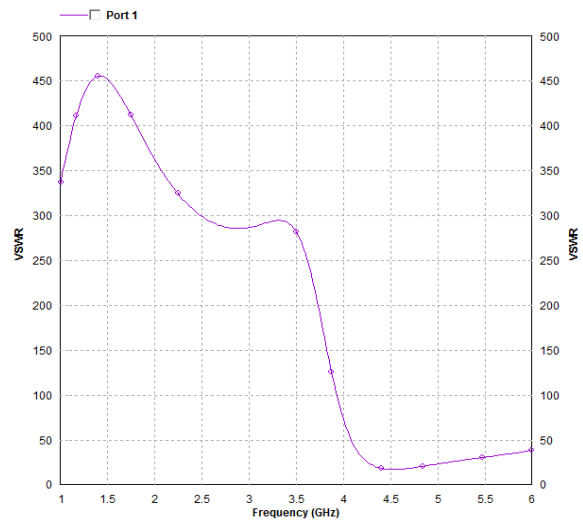


Fig. 6 VSWR

In the figure 7, 3-D pattern of Directivity is obtained with resonant frequency 5 GHz. In figure 8, 2-D polar plot of directivity is obtained of E- θ and E- ϕ at $\phi=0^\circ$ and $\phi=90^\circ$, exciting at 5GHz.

IV. SIMULATED RESULTS

In figure 2 the patch and its microstrip feed line is seen. In figure 3 meshed pattern view can be seen at 5GHz frequency and 20 cells per wavelength. In figure 4 current distribution of whole patch at 5GHz excitation. Sides of the patch show higher current density.

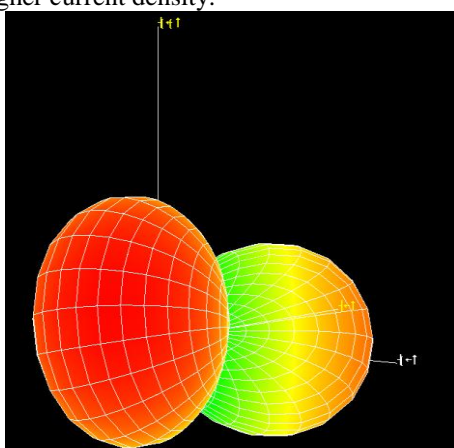


Fig. 7 Directivity Pattern

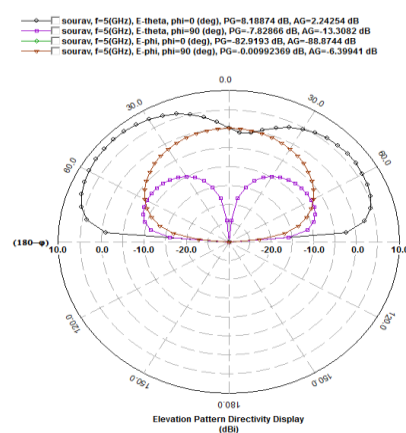


Fig. 8 2-D Directivity Polar Plot

V. CONCLUSION

This paper represents the designing and analysis of E-shaped Antenna with the help of IE3D software and analysis is done utilizing transmission line model and cavity model. The antenna is excited with the aid of a rectangular microstrip feed line at 5 GHz. A plasma ion ground plane is utilized so as to increase the bandwidth and gain of the antenna. The

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principal parameters like S (1, 1), VSWR, directivity, 2-D Polar plot and current density of the antenna is illustrated. In simulation and measurement the return loss possesses a negative which states that the losses are smallest during the transmission. The VSWR for the recommended antenna has a superior value of 1.302 which specifies that the level of mismatch is not very high. From the consequences of simulation we can state that the E- shaped microstrip antenna provides better results at operating frequency 5GHz.

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