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Design and Analysis of I-Slotted Rectangular Microstrip Patch Antenna for Wireless Application

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ABSTRACT

This paper presents a novel design of a I- slotted patch antenna with compact nature and the study of various antenna parameters. The antenna is fed by inset feeding technique. The proposed patch antenna is designed and simulated on IE3D simulation software. The main aim of proposed work is to obtain a large bandwidth antenna with compact size. The proposed microstrip antenna has a wide bandwidth covering the range from 1.444-2.393 GHz. By using simple Inset feed technique & by introducing I-slotted wide bandwidth of 49.46%, High Gain 5dBi & good radiation efficiency of about 99% has been achieved.

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1. INTRODUCTION

Modern wireless systems are placing greater emphasis on antenna designs for future development in Communication technology because of antenna being the key element in the whole communication system. Communication between human was first by sound through voice. These optical communication devices, of course, utilized the light portion of the electromagnetic spectrum. It has been only very recent in human history that the electromagnetic spectrum, outside the visible region, has been employed for communication, through the use of radio. One of humankind's greatest natural resources is the electromagnetic spectrum and the antenna has been instrumental in harnessing this resource.

Microstrip patch antennas are widely used in wireless application due to great advantages such as low-profile, high transmission efficiency, light weight, low profile, conformal and planar structure, compactness, low cost and ease of integration with microwave circuit [1]. Now a days Compact microstrip antennas are getting much more attention due to the increase in demands of small size antennas used in personal and commercial purposes. In order to design a compact microstrip antenna at a fixed operating frequency higher dielectric constant of substrate must be used [2-4].

The proposed antenna has been designed on glass epoxy substrate to give a wide bandwidth of **49.46%** and maximum radiating efficiency of about **99%.**

2. ANTENNA DESIGN AND LAYOUT

For a rectangular patch antenna, the length and the width are calculate as below

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

Where **c** is the velocity of light, ε_r is the dielectric constant of substrate, ***f*** *is* the antenna working frequency, **W** is the patch width, the effective dielectric constant and the length extension are given as,

$$\varepsilon_{eff} = \frac{(\varepsilon_r + 1)}{2} + \frac{(\varepsilon_r - 1)}{2}\left[1 + 10\frac{h}{W}\right]^{-\frac{1}{2}} \quad (2)$$

$$\frac{\Delta l}{h} = 0.412\frac{\left(\varepsilon_{eff} + 0.300\right)\left(\frac{W}{h} + 0.262\right)}{\left(\varepsilon_{eff} - 0.258\right)\left(\frac{W}{h} + 0.813\right)} \quad (3)$$

$$L = \frac{c}{2 f \sqrt{\varepsilon_{eff}}} - 2\Delta l \quad (4)$$

In this paper, a compact slotted patch antenna having dimensions L×W has been designed on glass epoxy substrate having dielectric constant equal to 4.4. Figure1 shows the layout of a Inset feed I-slotted patch antenna.

Table 1. Proposed antenna design parameters.

Parameters	Value (mm)
ε_r	4.4
H	1.6
W_g	100
L_g	100
L	35.44
W	45.64
L_1	27.72
W_1	6
L2	30
W_2	40

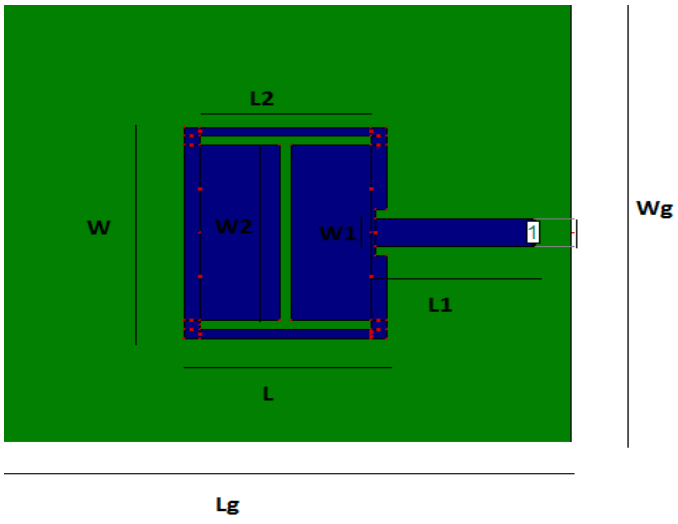

Figure 1. Geometry of proposed microstrip antenna

3. RESULTS AND DISCUSSION

Figure 2 shows the return loss plot of proposed microstrip antenna. The proposed antenna give a wide band width of **49.46%.** It is suitable for wide band operation. Figure 3 shows the smith chart & Figure 4 shows the 3D radiation pattern which is obtained from IE3D. Figure 5 shows Gain Vs frequency of proposed microstrip antenna which is 5dBi. Figure 6 & figure 7 shows Efficiency Vs frequency graph & Directivity Vs frequency of proposed microstrip antenna. The proposed microstrip antenna have better gain and good radiation efficiency of about **99%**.

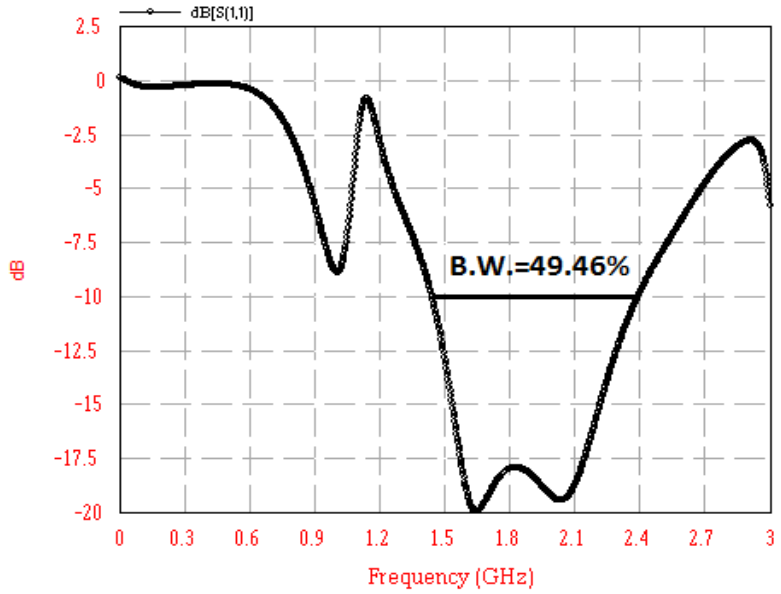

Figure 2. Return loss Vs frequency of proposed microstrip antenna

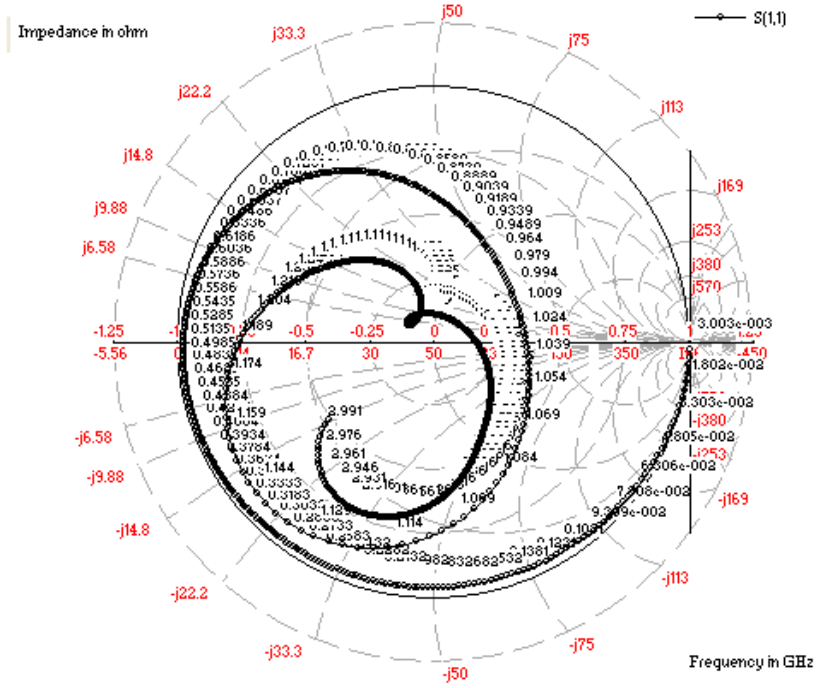

Figure 3. Smith chart plot of proposed microstrip antenna

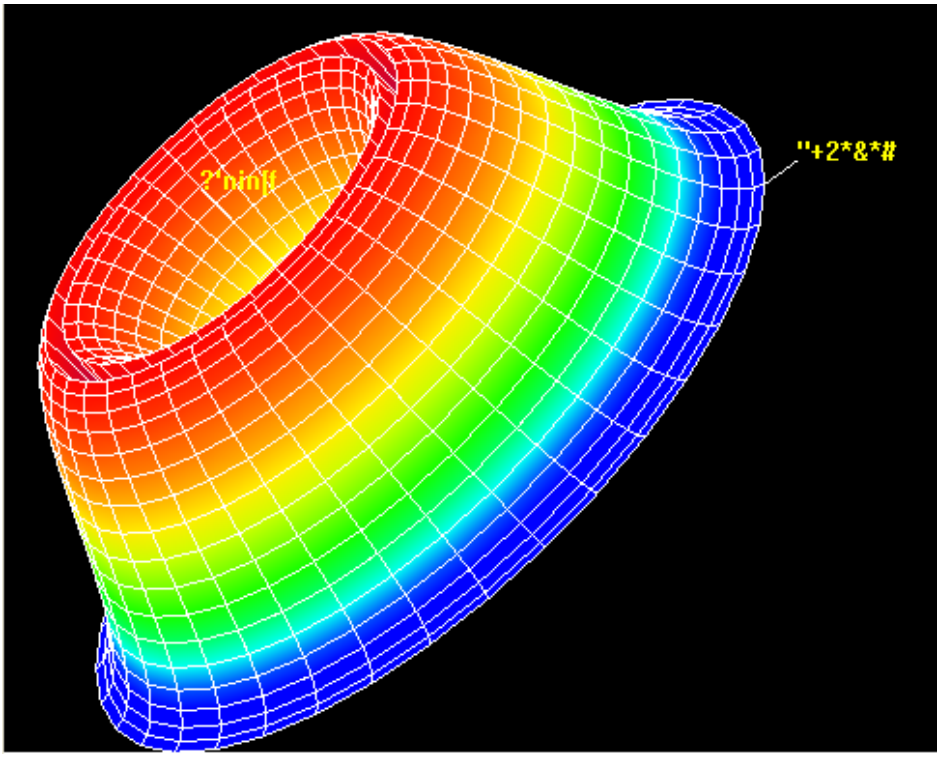

Figure 4. 3D radiation pattern of proposed microstrip antenna

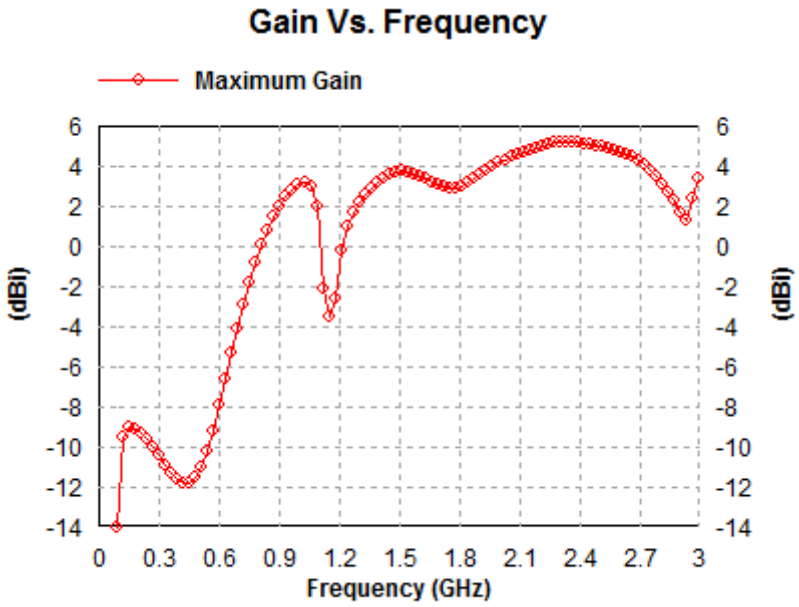

Figure 5. Gain Vs frequency of proposed microstrip antenna

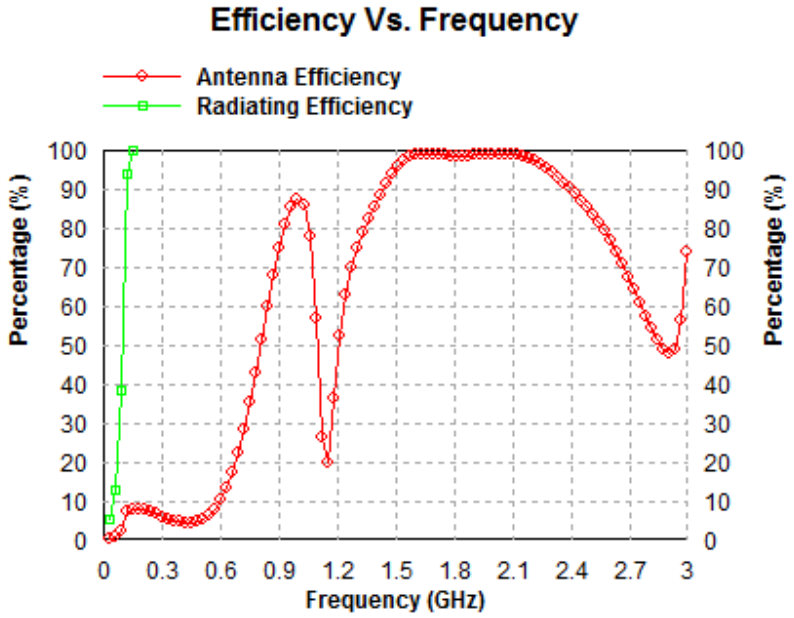

Figure 6. Efficiency Vs frequency of proposed microstrip antenna

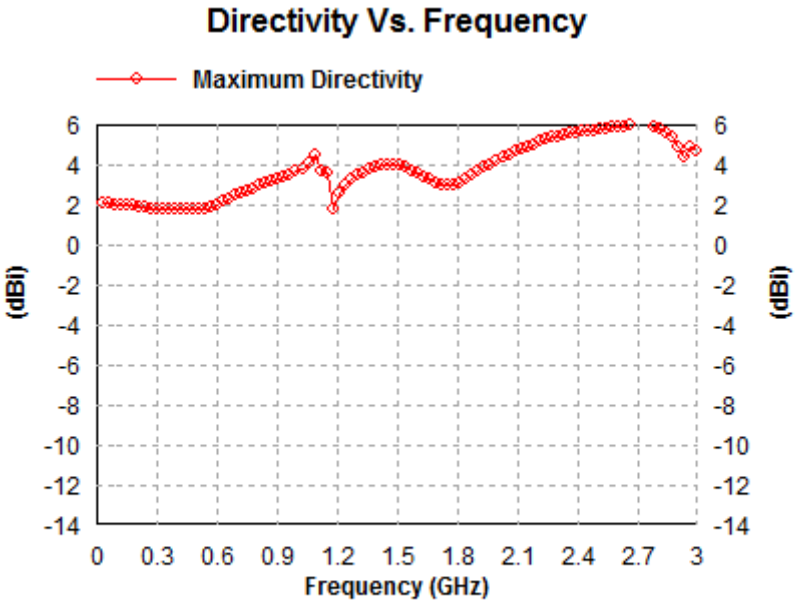

Figure 7. Directivity Vs frequency of proposed microstrip antenna

4. CONCLUSION

In this paper a wide band Inset line feed microstrip antenna with I-slotted has simulated. It is designed on glass epoxy substrate of dielectric constant 4.4 and operating on the frequency below 2 GHz to give a wide bandwidth of **49.46%** .The characteristics of compact patch antenna are studied and the antenna has been designed for WLAN application to operate in the frequency range of **1.444-2.393** GHz. The proposed microstrip antenna has high gain up to 5 dBi and good radiation efficiency of about 99%.

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