Compact Wide Band Microstrip Line Feed Microstrip Patch Antenna for Wireless Application

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***Abstract*: This paper presents the increase in bandwidth of a Microstrip Antenna using a simple slotted structure fed by Microstrip line. The main aim of proposed work is to obtain a large bandwidth antenna with reduced size. The proposed microstrip antenna has a wide bandwidth covering the range from 1.806-2.978 GHz. By using simple Microstrip Line feed wide bandwidth of 48.99% has been achieved. The proposed patch antenna is designed and simulated on the Zeeland IE3D software.**

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Keywords: Line feed, Wideband, and patch antenna.

I. 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 increasing in popularity for use in wireless applications due to their low-profile structure. Therefore they are extremely compatible for embedded antennas in wireless devices such as cellular phones, pagers etc. The telemetry and communication antennas on missiles need to be thin substrate.

In this paper we have presented directional wide band microstrip antenna with compact size. The microstrip patch antennas are widely used due to their inherent advantages of low profile, low weight, low cost. In early implementation antennas suffered from narrow bandwidth Therefore, various approaches have been proposed in the literature to increase the bandwidth. These include parasitic patches and cutting slots in the metallic patch in addition to the common techniques which are increasing patch height and decreasing substrate permittivity. The proposed antenna has been designed on glass epoxy substrate to give a wide bandwidth of **48.99%** and maximum radiating efficiency of about **99%.**

II. ANTENNA DESIGN

The length and width of rectangular patch antenna are calculated from the equations (1) – (5) Where c is the velocity of light, ε_r is the dielectric constant of Substrate. The transmission line model is used to infinite ground plane. However, for practical considerations, it is essential to have a finite ground plane. It is observed that similar results for finite and infinite ground plane can be obtained if the size of the ground plane is greater than the patch dimensions by approximately six times the substrate thickness. Hence, for this design, the ground plane dimensions would be given as:

$$W_g = W + 6(h) = 31 + 6(2) = 43 \text{ mm} \qquad (1)$$

$$L_g = L + 6(h) = 23.8 + 6(2) = 35.8 \text{ mm}$$

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

$$\varepsilon_{eff} = \frac{(\varepsilon_r + 1)}{2} + \frac{(\varepsilon_r - 1)}{2}\left[1 + 10\frac{h}{W}\right]^{-\frac{1}{2}} \tag{3}$$

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

$$L = \frac{c}{2f\sqrt{\varepsilon_{eff}}} - 2\Delta l \tag{5}$$

The three essential parameters for the design of a rectangular Microstrip Patch Antenna are:

Frequency of operation (fo): The resonant frequency of the antenna must be selected appropriately. The Mobile Communication Systems uses the frequency range from 2100-5600 MHz Hence the antenna designed must be able to operate in this frequency range. The resonant frequency selected for my design is **3 GHz.**

Dielectric constant of the substrate (εr): The dielectric material selected for our design is glass epoxy which has a dielectric constant of **4.2.** A substrate with a high dielectric constant has been selected since it reduces the dimensions of the antenna.

Height of dielectric substrate (h): For the microstrip patch antenna is to be used in cellular phones, it is essential that the antenna is not bulky. Hence, the height of the dielectric substrate is selected as **2mm**.

Hence, the essential parameters for the design are:

Table 1.Proposed antenna design parameters.

Parameters	Value (mm)
ε_r	4.2
H	2.0
W_g	43
L_g	35.8
L_1	13
W_1	31
L_2	10.8
W_2	11
W_3	13.5

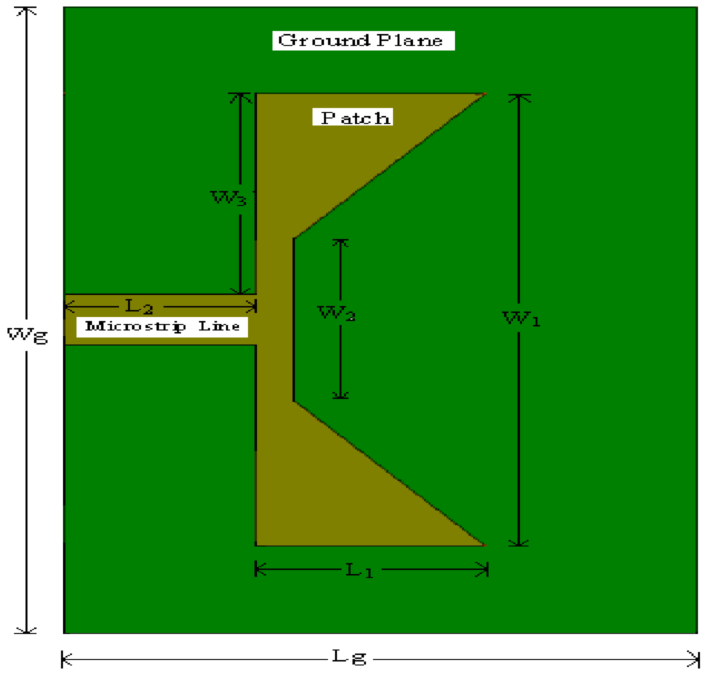

Figure 1 Geometry of proposed microstrip antenna.

III. RESULT AND DISCUSSION

Figure 2 shows the return loss plot of proposed microstrip antenna. The proposed antenna resonates at 2.528GHz frequency giving a wide band width of **48.99%.** 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.The proposed microstrip antenna have better gain and good radiation efficiency of about **99%**. Fig 5 & fig 6 shows elevation pattern & efficiency plot which is unidirectional. The component E theta at phi = 0 is shown giving a power gain of 2.1380dB and Average gain of 0.83639Db.

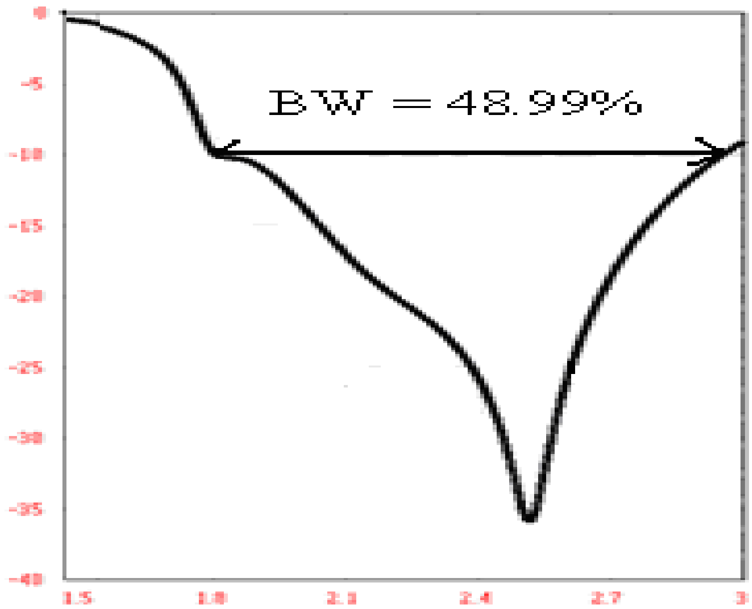

Figure2 Return loss vs frequency of proposed microstrip antenna

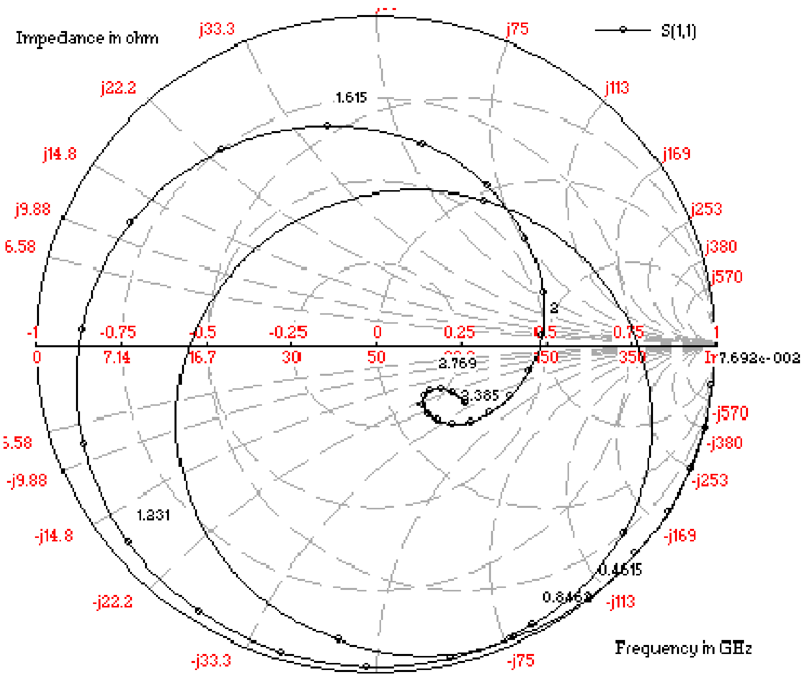

Figure3 Smith chart plot of proposed microstrip antenna.

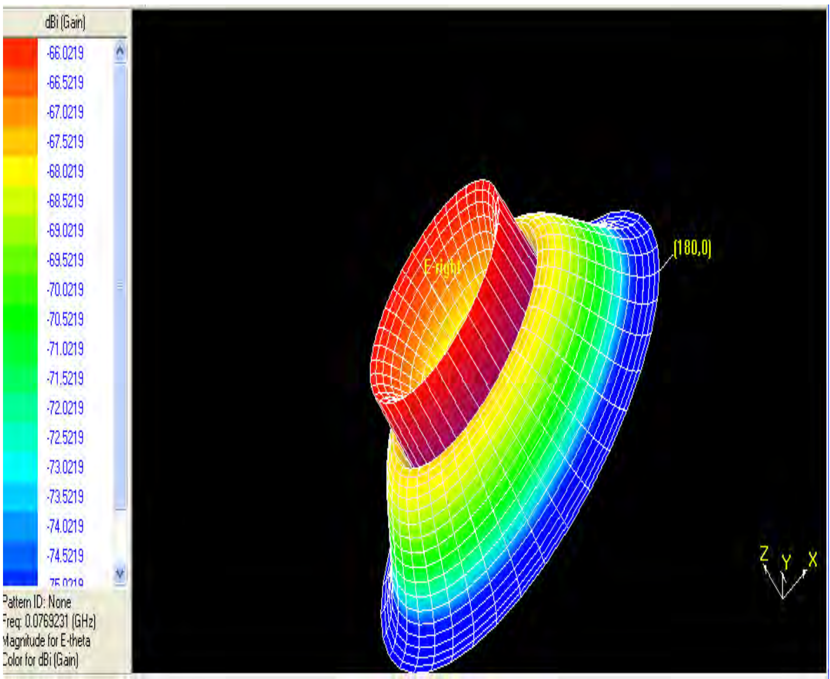

Figure 4 3D radiation pattern of proposed microstrip antenna

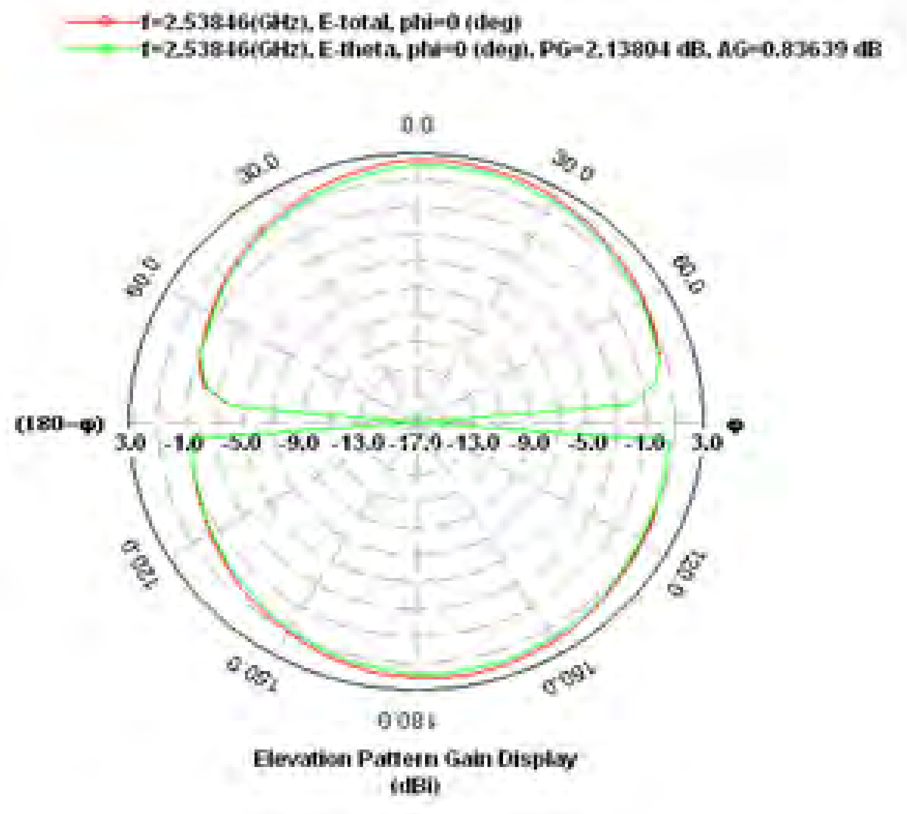

Figure 5 Elevation pattern of proposed microstrip antenna.

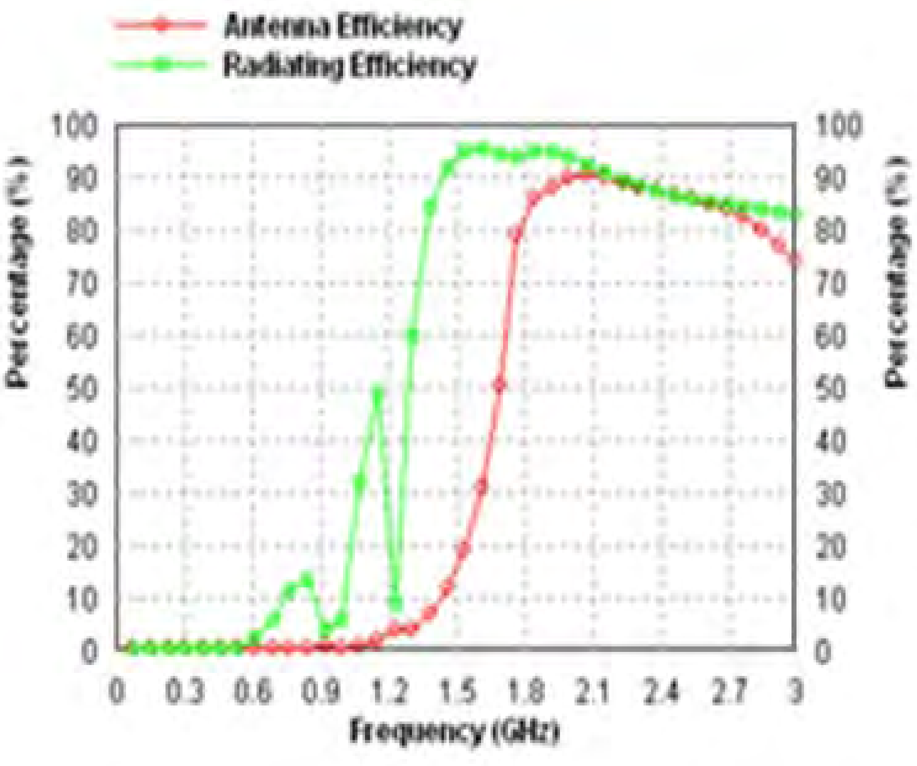

Figure 6 Efficiency Vs frequency of proposed microstrip antenna.

IV-CONCLUSION

A wide band line feed microstrip antenna has simulated & designed on substrate of dielectric constant 4.2and operating on the frequency below 3 GHz.. The proposed antenna has been designed on glass epoxy substrate to give a wide bandwidth of **48.99%** and maximum radiating efficiency of about 99%.The investigation has been limited mostly to the patch of the microstrip antenna. The characteristics of small patch antenna are simulated and studied in this paper and the antenna is designed to operate in the frequency range of 1.806-2.978 GHz.

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