Bandwidth Improvement of Microstrip Patch Antenna for WLAN Application

Janabeg Loni, Vinod Kumar Singh, Shahanaz Ayub

***Abstract*— A wide band coaxial probe feed triangle slotted microstrip patch antenna has been simulated on IE3D software to give a wide bandwidth of 30.37% and antenna efficiency of about 98%.The performance characteristics of proposed microstrip antenna such as efficiency, gain and directivity has been presented. The proposed antenna is designed to operate in the frequency range of 2.148-2.917GHz which is applicable in WLAN (2.40-2.484 GHz).**

***Index Terms*— Coaxial probe, Slotted patch, WLAN, Wideband MSA.**

I. INTRODUCTION

Microstrip Antenna consists of a radiating patch on one side of a dielectric Substrate and a ground plane on the other side. The conducting patch and the ground plane are separated by a low loss dielectric material called a substrate. Radiation from MSA can occur from the fringing fields between the periphery of the patch and the ground plane. Microstrip patch antenna is a type of microwave antenna and attracted due to their small size, light weight and low profile. They are simple to manufacture and are easily integrated with circuits [1-3]. The shape of the patch can be arbitrary. It may be square, rectangular, dipole, circular, elliptical, triangular, disc sector, circular ring; ring sector. The most popular shapes however, are the rectangle and circle. [4-10]. The dimensions such as size, shape, as well as the thickness and dielectric constant (ε_r) of the substrate used to separate the patch and the ground plane of the patch, is determined on the basis of operating frequency of the patch antenna. If the operating frequency is lowered then the area of the patch is increased (whenever the substrate is not changed). The design of Microstrip antenna is vital study for today's Wireless communication system to achieve higher radiation pattern, highly directional beam and larger bandwidth. [11-18].

In this article, the design and bandwidth enhancement of slotted microstrip patch antenna is introduced. It is designed on glass epoxy substrate which is best suitable for WLAN applications.

II. ANTENNA DESIGN

In this paper the proposed design is shown in Fig.1 having the dimension 27.16 mm x 35.2 mm and ground plane length and width is 36.76 mm x 44.8 mm.The dual triangle slotted microstrip patch antenna is designed to operate in the frequency range of 2.148-2.917 GHz. The characteristics of proposed antenna such as return loss (RL), VSWR, and bandwidth (BW) of the proposed antenna have been investigated. The simulation has been done by using Zeland IE3D electromagnetic simulator.

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TABLE 1
ANTENNA DESIGN PARAMETERS

Parameter	Value
h	1.6mm
ε_r	4.4
Wg	44.8mm
Lg	36.76mm
W	35.2mm
L	27.16mm

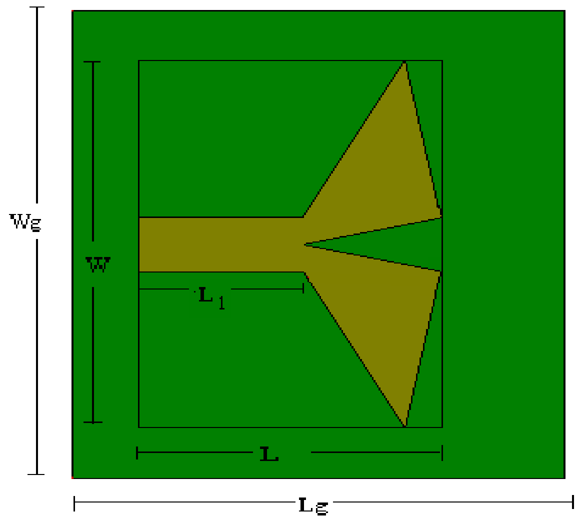

Fig.1. Geometry of proposed microstrip antenna

The calculations are based on transmission line model. The width and length of the microstrip patch have been calculated by using following equations (1)-(4).

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

The effective length (L_{eff}) of the patch can be calculated with the help of equations (3) and (4).

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

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

By using above equations we can find the value of actual length of the patch as,

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

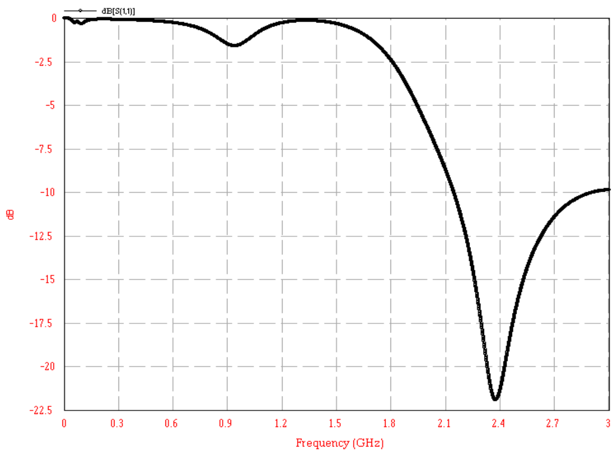

Fig2. Return loss Vs frequency of proposed microstrip antenna

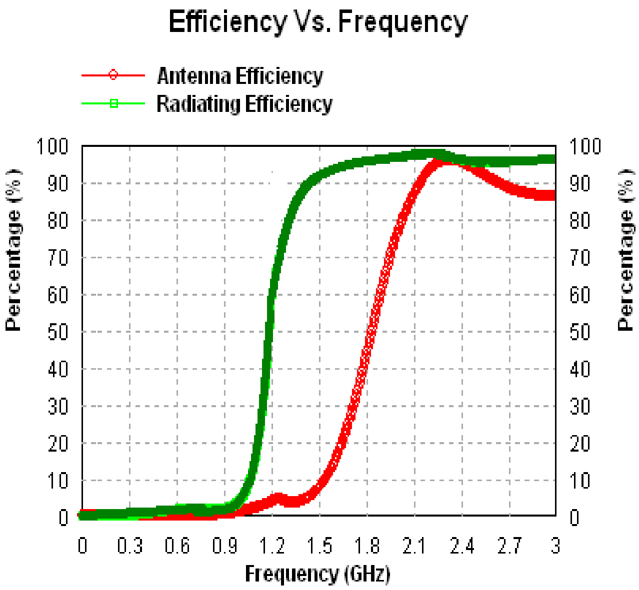

Fig.3. Efficiency Vs Frequency of proposed microstrip antenna

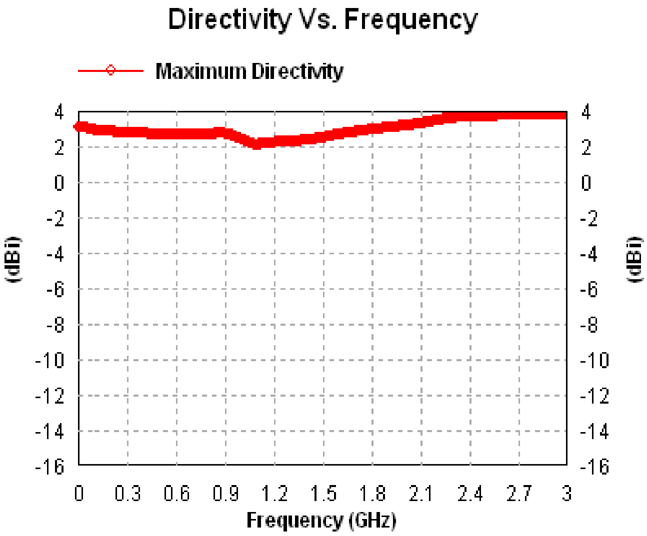

Fig.4. Directivity Vs Frequency of proposed microstrip antenna

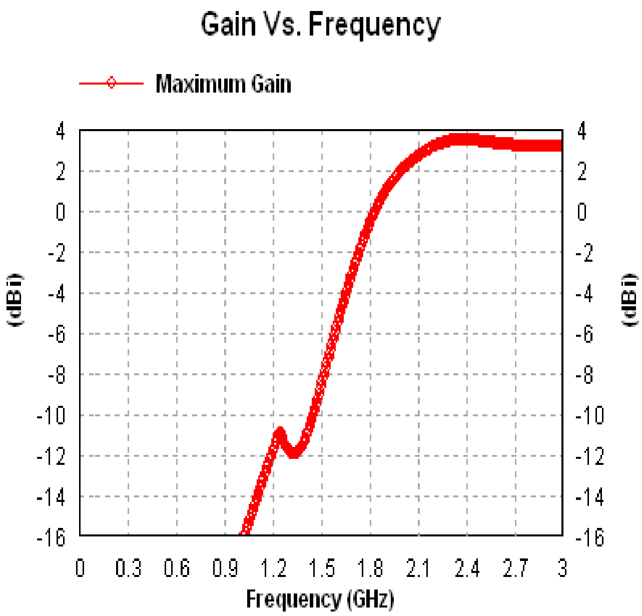

Fig.5. Gain Vs frequency of proposed microstrip antenna

III. RESULT AND DISCUSSION

The proposed reduced size antenna has been simulated by IE3D software and the simulated results are presented. As shown in the figure 2, the maximum achievable bandwidth is 30.37% which is better compare to design reported in [4]. Figure 3 shows the simulated total efficiency of the patch antenna. The figure indicates high antenna efficiency over the operational frequency and it is around an average of 98%, which is best suitable for WLAN (2.40 - 2.484 GHz) application. Figure4 and Figure5 shows Directivity & Gain Vs Frequency plot of proposed microstrip antenna.

IV. CONCLUSION

A wide band coaxial probe feed microstrip antenna has simulated and designed on substrate of glass epoxy (dielectric constant 4.4) to give a optimum wide bandwidth 30.37% and maximum antenna efficiency of about 98% and the antenna is design to operate in the frequency range of 2.148-2.917GHz GHz Which is best suitable for WLAN application.

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