

# The Comparative Study of Microstrip Patch Antenna Using Slotted Defects



Engineering

KEYWORDS :

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## ABSTRACT

The microstrip patch antennas are widely used for the wireless applications in the present scenario. In this paper the microstrip patch antenna is being presented where a comparative study has been done on the frequency of 2 GHz using defects on the ground and on the upper part of the design. The structure has been simulated using CST microwave studio software, the results shows the potential of the antenna design. The effects of the defects enhance the return loss and the gain of the antenna. The simulation result shows the effectiveness of the design return loss with or without defects is decreased up to 50db, and the bandwidth is also found about 34 MHz.

## I. INTRODUCTION

The rapid development of wireless applications ranging from Bluetooth, WLANs, GSM, LTE, Satellite and military application requires more efficient, low profile and flexible antennas. Microstrip patch antennas are generally used in communication systems for their benefit of ease of fabrication, low profile, light in weight and low cost. However, there is limitation in terms of patch antenna bandwidth. The design of antenna using microstrip patch has been designed and the results are verified [1]. However design using L-probe feeding technique contributes the enhancement in the gain, it also describes the importance of the parasitic element to improve characteristics [2]. [3] Shows the single and dual band implementation of the microstrip patch antenna which describes the integration technique between antenna and pure filter. The size reduction technique is a major concern these days and a schematic cross-shaped slot is embedded along one of the diagonal axes for cp reduction and the antenna size reduction [4]. H-slot antenna technique combined with basic rectangular patch antenna design to investigate the resonate frequency, return loss, gain and radiation pattern [5]. Recently, several designs related to reconfigurable pattern antenna element have been proposed and studied. These design use defect methods to reconfigure antenna such as switching connection by pin diodes and switching feeding network [6]. [7] Shows design of microstrip patch antennas with or without slots is described. The Size reduction is the very important aspect of the antenna design, considering this aspect here the approach of antenna design is being proposed using rectangular defects on the upper and the ground plane of the antenna which improves the capacitive effects. The proposed structure has been simulated using flame retardant-4 (FR4) material with dielectric constant of 4.4 is used as the substrate of the microstrip patch antenna with thickness of 1.6 mm at frequency of 2 GHz using CST microwave studio 2010. The fig.1 shows the basic patch antenna diagram where L is the length of the antenna and W is the width of the antenna.

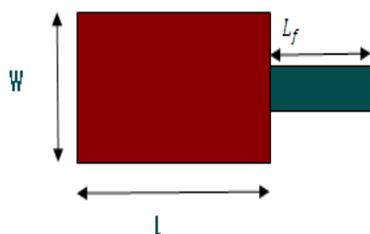


Fig.1 Basic antenna design

## II. ANTENNA DESIGN

To design the antenna for the wireless applications, antenna

parameters calculation is done [8]-[9]. Formulas are being shown below,

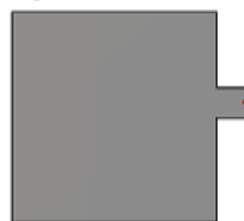
$$W = \frac{c}{2f} \sqrt{\frac{2}{\epsilon+1}} \tag{1}$$

$$L = \frac{1}{2f\sqrt{\epsilon\mu\epsilon}} \tag{2}$$

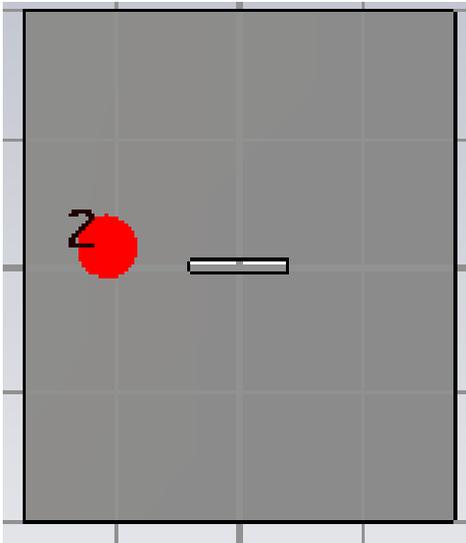
Where f is centre frequency and is the efficient permeability. ΔL is extended incremental length of patch can be calculated using equation below.

$$\frac{\Delta L}{h} = .412 \frac{(\epsilon + 0.3) \left(\frac{W}{h} + 0.264\right)}{(\epsilon - 0.258) \left(\frac{W}{h} + 0.8\right)}$$

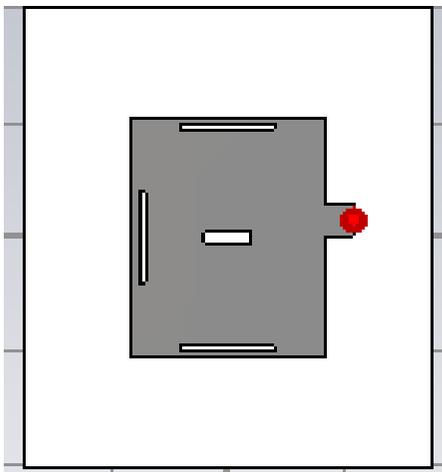
The design is created using flame retardant-4 (FR4) substrate of dielectric constant 4.4 and height 1.6 mm. The microstrip patch of length is 35.44 mm and the width is 45.64 mm has been calculated for 2 GHz frequency using (1)-(2). To improve the characteristics of the antenna the dimension of length and width of the antenna are adjusted. It has been found that by reducing the size antenna gives better response on the same frequency. So the design with reduced dimensions 33\*42 is being shown in the figure below. To enhance the return loss and to improve the antenna radiations two approaches have been used i.e. antenna using defects and without defects. Now three designs have been simulated to verify our approach, where first shows the rectangular patch antenna without any defects on the reduced size fig.2 (a). The next design is achieved by incorporating a line shape slot of optimum geometry at suitable location on ground plane, the return loss is enhanced from 31 dB to 42dB and compactness is achieved over conventional antennas shown in fig.2 (b). The DGS shape defect etched in the ground plane of the microstrip give rise to increase in effective capacitance [10]. In the third design slots have been given in the patch. The patch is a combination of R, L, C components arranged in series or parallel. The current distribution of the microstrip patch changes due to slots in the microstrip patch shown in fig.2(c). These slots act as a cut along the resistance and capacitance of layout, this result in an extra capacitance and extra resistance in the circuit.



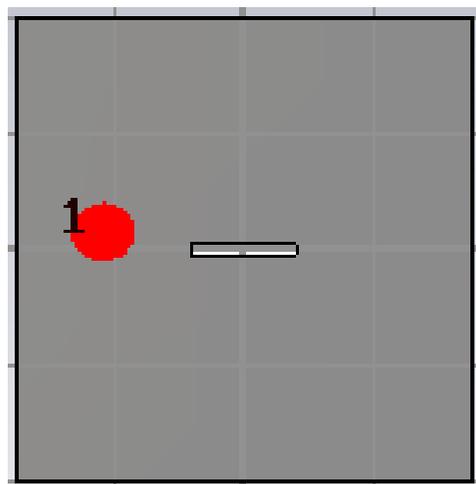
(a)



(b)



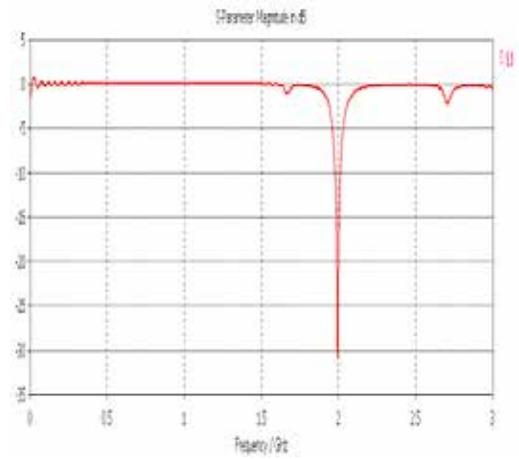
(c)



(d)

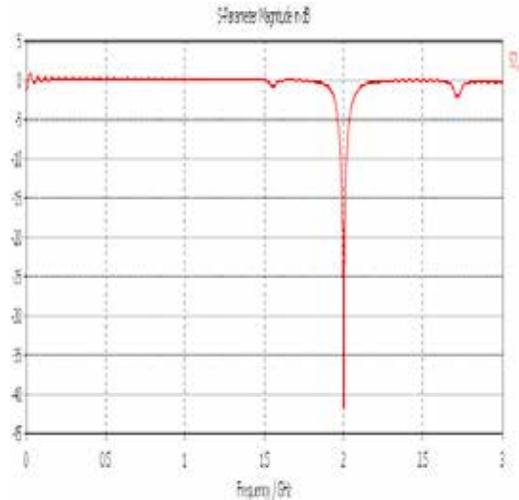
Fig.2 shows the simulated design of the antenna (a) front view of the first design and second design (b) back view of the second design (c) front view of the third design (d) back view of the third design.

RESULTS



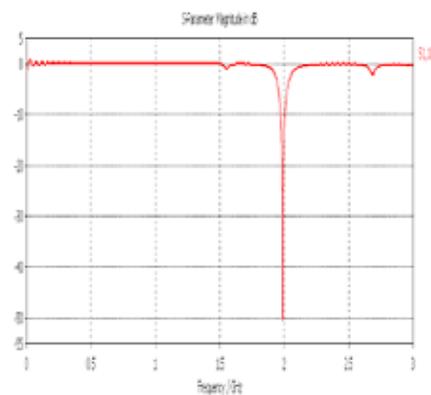
(a)

Fig.3 (a) shows the return loss of microstrip patch antenna without any defect of first design (simulation results in CST microwave studio) at frequency 2GHz. Here the return loss is obtained 31 dB.



(b)

Fig.3 (b) shows the return loss of the second design obtained giving a line slot of optimum geometry at center position of the base, the return loss obtained 42dB (simulation results in CST microwave studio)



(c)

Fig.3 (b) shows the return loss of the third design obtained giving a line slots of optimum geometry at center position of the base as well as slots are given on the surface of radiating patch. One slot is given in the center and three slots are given along the edges of the microstrip radiating patch. The return loss obtained 52dB (simulation results in CST microwave studio).

## CONCLUSION

The design of single feed microstrip patch antenna by using CST simulation software is presented. Three different antennas based on either no defects or defects given on base and ground surface have been compared. The work shows return loss improvement due to defects given at various antennas. The antenna length and width is reduced from 35.44mm to 33mm and 45.64mm to 42mm respectively. The bandwidth of design is 34 MHz which can be further improved by increasing dielectric height locations in ground and surface of microstrip patch antenna. The size reduction is achieved by reducing the length and width of antenna from 35.44mm to 33mm and 45.64mm to 42mm..

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