A Wideband U Shape Slotted Microstrip Patch Antenna for C Band Application

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Abstract- A wide band U shape slotted micro strip patch antenna using FR4 substrate is implemented. The proposed antenna consist of U shape slot with a shorting pin at centre and power is delivered through probe feed. The resonating frequency used is 10GHz. For this antenna we achieved bandwidth of 66%(from6.6 Ghz-13.2 GHz)with a minimum return loss at -32dBi and maximum directivity of 4.94dBi.The bandwidth of proposed antenna can be used for microwave applications like SART, satellite communication, radar communication, etc.

Keywords—Broadband, IE3D SIMULATOR, Shorting technique, probe feed, U shape slot .

I. INTRODUCTION

Now a day's micro strip patch antenna is gaining importance due to their size minimization, low profile, simple to design and less weight. They can be easily used in handheld devices like laptops, mobiles, wireless applications, etc. But their major disadvantage is narrow bandwidth and low gain. Hence lot of researches have been constantly done in this field using different techniques such as slotting different shapes, shorting techniques, stacking and many more. But still narrow bandwidth is the major issue of these antennas [6].

The major propose of this designed antenna is bandwidth enhancement and reduction in size for different microwave application. The proposed antenna is suitable for 6.6GHz to 13.2GHz. Use of shorting pin is effective to adjust the resistance and reactance of the antenna and thus bandwidth of 32.20% can be enhanced as compared to normal MSA [1]. Similarly by varying the length and position of each ended slot the antenna can be made to operate on two bands [6]. By stacking technique the researchers have proved that bandwidth can be improved by 52.8% [5].

The designed antenna covers a wide range and can be used for microwave applications like satellite , transponders used in marine radar communication

II. MATHEMATICAL ANALYSIS

Antenna Configuration:

In order to design antenna transmission line model method is used to calculate the length and width of the patch and substrate of microstrip patch antenna. Following formulas are used for designing :

$$W = \frac{c}{2f_0\sqrt{\frac{\varepsilon_r+1}{2}}}$$

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{w}\right]^{\frac{-1}{2}}$$

$$\Delta L = \frac{0.412h(\varepsilon_{reff} + 0.3)(\frac{w}{h} + 0.264)}{(\varepsilon_{reff} - 0.258)(\frac{w}{h} + 0.8)}$$

$$L_{eff} = \frac{c}{2f_0\sqrt{\varepsilon_{reff}}}$$

$$Lg = L + 2*6h$$

$$Ws = W + 2*6h$$

Where f= operating frequency, = permittivity of the dielectric, εeff = effective permittivity of the dielectric,W= patch's width, L = patch's length, h = thickness of the dielectric, L_g =length of ground plate, and W_g = width of ground plate.

The designed U shape slotted antenna with shorting pin is shown in figure1.The rectangular patch is easy to fabricate and current distribution across it can be easy predicted. Thus rectangular with probe feed is used in the proposed antenna. Coaxial probe feed can be positioned at any favorite location and simple to fabricate.

The resonant frequency used to design antenna is selected on basis of application. The resonant frequency is 10 GHz. The dielectric material chosen for antenna design is FR-4 whose dielectric constant is 4.4 and tangent loss is tan δ = 0.019. The dielectric material chosen for antenna design is FR-4 whose dielectric constant is 4.4 and tangent loss is tan δ = 0.019.

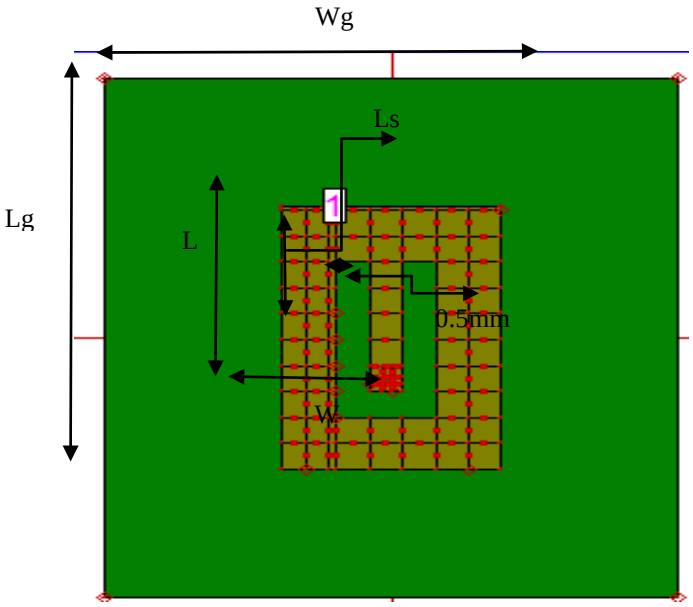

Fig.1 Geometry of Proposed antenna

For this proposed antenna width(Ws) and length(Ls) of patch is 9.21mm and 5.5mm respectively. The shorting pin is shifted to get desired results (x_f =0.15mm and y_f = 1.67mm).

III ANTENNA DESIGN AND RESULT ANLYSIS

A. Antenna Design by Using IE3D Software.

In this work analyzed geometry, observed improvement in return loss and enhanced bandwidth. Slotted Patch and defects on the ground plane generate broadband frequency all are redefine near to each other so that obtained a broad bandwidth slot for improving antenna and radiating efficiency and directivity of antenna. Whole geometry is designed for the application in radar and satellite communication. Shorting technique is used to enhance antenna parameters.

Simulated results show that the antenna features a wide operating bandwidth of 60% ranging from 6.6GHz to 13.2GHz

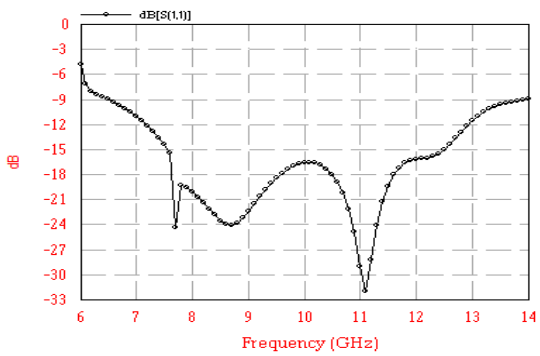

Fig.2Return loss Vs frequency

The simulated design approximately achieved the return loss of -32 dB at 11 GHz. And return loss below -10dB is from 6.6 GHz to 13.2 GHz.

The simulated design achieved the frequency from 6.6 GHz to 13.2 GHz and bandwidth is 66 %.

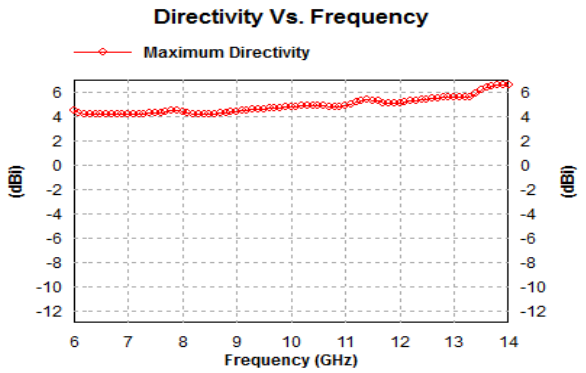

Fig .3 Directivity vs. Frequency

Directivity of the radiations in the designed antenna varies from 4 dBi to 6dBi.Thus antenna implemented has very good directivity. At operating frequency it is 4.94 dBi.

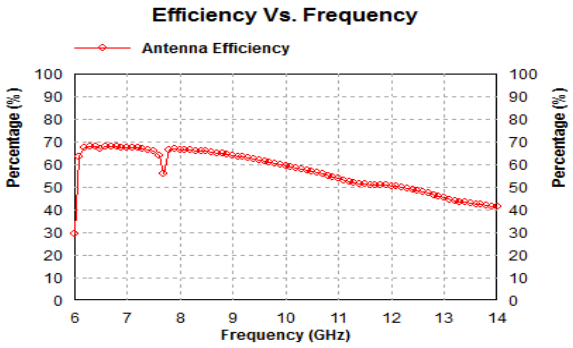

Fig .4.Antenna Efficiency vs. Frequency

The antenna efficiency of the simulated antenna varies from 50 % to 70%.

IV. CONCLUSION

The small, U shape slotted microstrip patch antenna with rectangular patch and shorting pin used to enhance the bandwidth. To deliver power to the antenna, probe feed is used. Simulated results show that the antenna features a wide operating bandwidth of 60% ranging from 6.6GHz to 13.2GHz and a minimum return loss of -32dB has been obtained at resonant frequency 11GHz. The efficiency of proposed antenna is ranging from 50% to 70% in the desired band. The antenna gain and directivity at resonant frequency of 11 GHz are 2 dBi and 4.94 dBi respectively. As the designed antenna covers operational bandwidth between 6.6 GHz to 13.2 GHz, it is suitable for microwave applications such as radar communication (8.29-11.4GHz) and Search And Research Transponders (SART) (9.2- 9.5 GHz) used in

marine radar communication and satellite communication.

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