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Wide Band U Shape Slot Microstrip Patch Antenna For C Band Application

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Abstract: ***A wide band U shape micro strop patch antenna with via hole on a FR4 substrate is presented. The proposed structure consists of U-shape slot at the top of antenna and for widen the bandwidth of the antenna adding a a shorting pin between excited patch and ground plane. The proposed antenna is designed for 10GHz.For this geometry we achieved Bandwidth 82 % for VSWR<2, minimum return loss= - 19 dB, and maximum directivity 5dBi.The Bandwidth of proposed antenna for C and X investigated.***

Keywords: Broadband, IE3D SIMULATOR, Shortening technique, probe feeding U shape.

I. INTRODUCTION

The Microstrip patch antenna is used by many researchers because of their unique advantage such as low profile, low weight, simple design and planner surface. For earlier many researchers are work on bandwidth enhancement and several have been proposed to improve bandwidth [1]. The latest achieved a resulted antenna with excellent bandwidth by using stacked and different slot technique antennas [1]-[5]. The antenna has been widely used in various wireless systems, mostly military, earth and spacecraft. Now they can be used for long-range point-to-point applications, like WLAN, WISP and satellite links. Although the backfire antenna is suffer by narrow bandwidth [1]-[4]

The major approach for proposed antenna is bandwidth enhancement and reduction in size for and X band application. The proposed antenna is suitable for 5GHz to 12GHZ. The antenna by using V shape slot for car to car and WLAN communication has a wider impedance bandwidth by using shorting pin. Use of shorting pin is effective to adjust the resistance and reactance of the antenna and achieved a bandwidth of 32.20% [1] similarly by varying the length and position of each ended slot the researcher operated in two band [6]. By stacking technique the research approach a bandwidth of 52.8% [5]

II. MATHEMATICAL ANALYSIS

ANTENNA CONFIGURATION

In order to demonstrate the design of proposed antenna with a frequency range of $10GH_Z$, flame Retardant 4 (FR4) substrate with relative permittivity ε_r=4.4, tangent loss = .019 and thickness(h)=1.5milimetre . Using mathematical analysis we calculate width and length of the patch, ground plane, and reflectors.

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

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

$$\Delta L = 0.412h\frac{(\varepsilon_{reff} + 0.3)\,((W/h) + 0.264)}{(\varepsilon_{reff} + 0.258)\,((W/h) + 0.8)}$$

$$L = \frac{c}{2f\sqrt{\varepsilon_{reff}}} - 2\Delta L$$

$$L_o = L + 6h$$
$$W_o = W + 6h$$

Where f= operating frequency, = permittivity of the dielectric,$_{eff}$ = effective permittivity of the dielectric,W= patch's width, L = patch's length, h = thickness of the

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dielectric, L_o =length of ground plate, and W_o = width of ground plate.

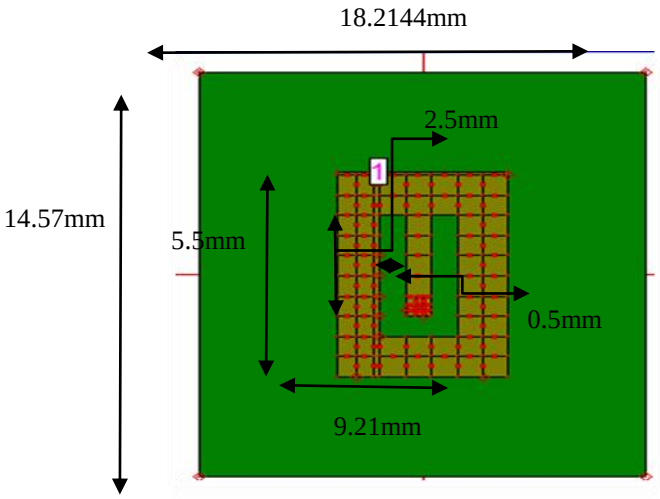

Figure 1: Geometry of Proposed antenna with shorting pin.

The proposed antenna with loaded U shape slot and shorting pin is as shown in figure. It is known the triangular patch antenna which provides a bandwidth enhancement as compares to other antenna [1]. For further increase the bandwidth we connect a shorting pin between the ground and excited patch

S. N.	Parameters	Values for proposed antenna
1	Design frequency(f_o)	10GHz
2	Dielectric constant(ε_r)	4.4
3	Height of substrate($_h$)	1.5 mm
4	Loss tangent for FR4	0.019
5	Width of rectangular patch(W)	9.21442mm
6	Length of rectangular patch(L)	5.5745 mm
7	Width of ground plane(W_g)	18.2144 mm
8	Length of ground plane(L_g)	14.5774mm
9	Shorting pin radius xf, yf	0.15mm, 1.67mm
10	Feed location: X_f along length),Y_f(along width)	1.50662 mm, 4.6072mm

Table 1: Mathematical calculation for the proposed antenna

III. ANTENNA DESIGN AND RESULT ANLYSIS

A. ANTENNA DESIGN BY USING IE3D SOFTWARE

The proposed antenna is designed in Flame Retardant 4 (FR4) such that the return loss, directivity, and the radiation pattern can be obtained by using the EM Simulator IE3D (version 9.0) software. Based on the simulations and mathematical calculation we find the length and width of rectangular microstrip patch of short backfire antenna.

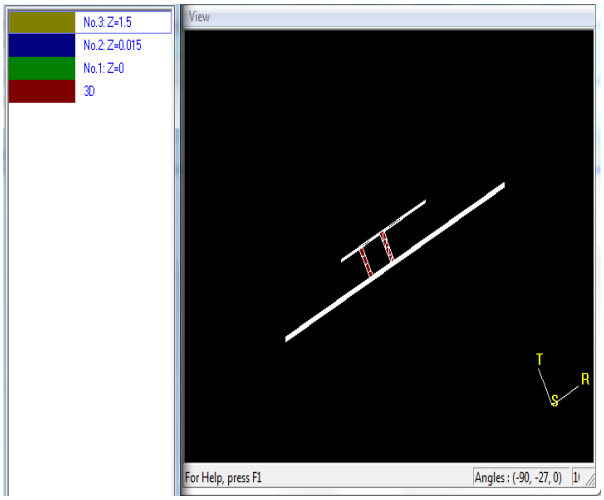

Figure 2: Dview proposed antenna

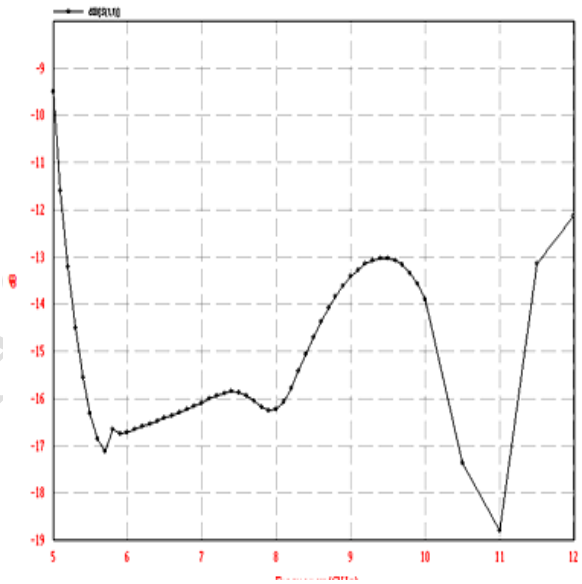

Figure 3: Return loss curve for antenna with U slot shorting pin

For proposed design the antenna have single band form 5GHz to 12GHz, The Return Loss for notch is effective between 5.1GHz to 12GHz.

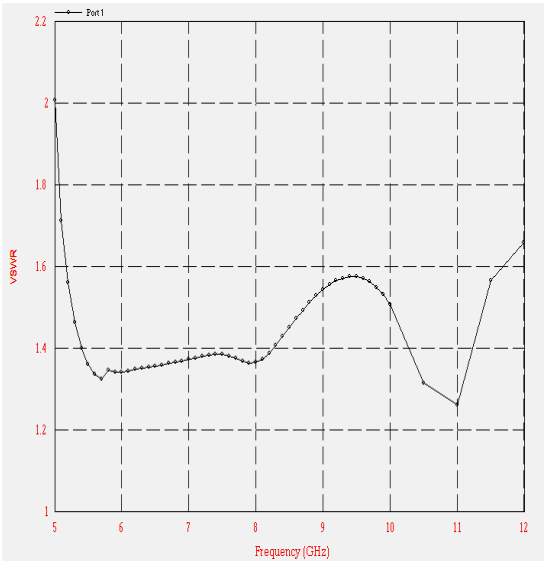

Figure 5: VSWR curve for antenna with reflector (R1)

The VSWR is effectively less than 2 in between 5 to 12GHz respectively, for this value Return Loss is minimum about.

IV. CONCLUSION

The proposed antenna presented the design of the microstrip patch with slot shorting pin antenna, for bandwidth enhancement. All the antenna parameters are calculated for10 GHz frequency spectrum. The proposed antenna produces a bandwidth of approximately 82%, with a stable radiation pattern within the frequency range. On FR4 substrate this antenna can be easily fabricated because of its small size and thickness. Here we use simple coaxial feeding technique for the design of this antenna.

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