*International Journal on Recent and Innovation Trends in Computing and Communication*
*ISSN: 2321-8169 Volume: 11 Issue: 9*
***Article Received:*** *25 July 2023* ***Revised:*** *12 September 2023* ***Accepted:*** *30 September 2023*

# Compact-size and Broadband Microstrip Patch U slot Antennas for C band Application and Stable Radiation Pattern overall band

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**Abstract**—A wide band antenna using U slot and truncated ground plane antenna is presented, The antenna used four U slot at the reflecting patch and via hole is shorted in between radiating and reflecting patch of an antenna, the antenna is all four corner truncated and four U shape is printed on ground plane. The proposed antenna is suitable for C band applications and stable radiation pattern to overall band. The antenna is resonance at a band of 7.1 to 14 GHz. The VSWR bandwidth of the proposed antenna is 65.40% and achieved a directivity of 6 dBi and gain 3.9 dBi. The size of the of the antenna is 18.18x15.541x1.5 mm3. The antenna is suitable for Wimax, WLAN and other C band applications.

**Keywords**- Microstrip, U-slot, Compact size, Radiation Pattern.

## I. INTRODUCTION

As the use of wireless communication systems grows, there is a growing interest in working to improve the performance of antennas. Since we already know that microstrip antennas have advantages over traditional microwave antennas, they are employed in a variety of applications, including radar, telemedicine, mobile and satellite communication, and GPS [1-3].

Microstrip patch antennas have various benefits over traditional microwave antennas, including ease of fabrication, light weight, thin profile, dual frequency, and dual polarisation. However, antennas have intrinsic drawbacks such as low gain (due to limited separation between the ground plane and radiating patch, the RF power of the antenna drops making it inappropriate for high power applications), low gain (due to narrow impedance bandwidth which is less than 5%), and efficiency. Utilising a dielectric substrate with a low dielectric constant and greater height can enhance an antenna's performance in terms of efficiency, bandwidth, and radiation pattern.

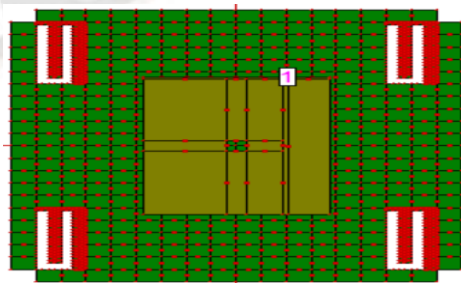
However with lower dielectric constant, as the height of dielectric substrate increases cause to increase in antenna size. Thus for compact Microstrip patch antenna, dielectric substrate with higher dielectric constant is required which is less efficient and provides narrow bandwidth. Therefore antenna performance can be improved on the cost antenna dimensions.[4-7]

Much seriously inquire about has been drained later a long time to create transmission capacity upgrade as well as to progress other parameters with compactness. A few of the procedures like shorted pins, melded spaces, post-gap, or parasitic components can be utilized to decrease the estimate of radio rays as well as to upgrade impedance transmission capacity but all these methods has its claim side impact that's a tall cross polarization (XP) .

In this way another method, microstrip fix radio wire with the concept of deformity ground structure has been considered for stifling the cross polarization as well as to moving forward the impedance transfer speed [3-5].

## II. ANTENNA DESIGN

Novel antenna with U shape at ground plane antenna is designed to have stable radiation as well as phase shifts of the x axis and y axis components of the electric magnetic field, Ex,Ey and Hx,Hy, respectively, at around 7.1GHz to 14 GHz have elliptical polarization to CP with respect to 3-dB AR.



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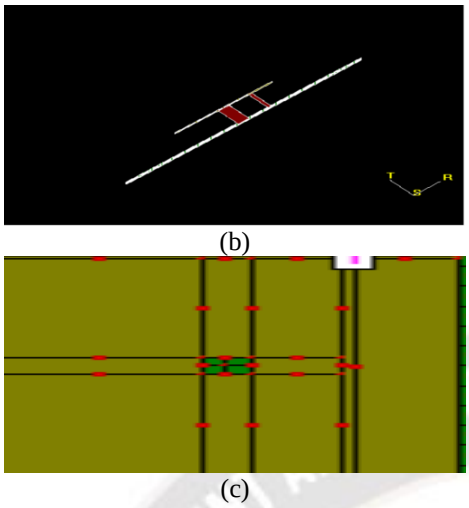


(b)

(c)

Figure 1: (a) and (b) Top and side views of proposed antenna with four U shape slot and all corner truncated. (c) Structures used for radiating Patch with a via hole (open structure) configure a and b

The geometry of the antenna structure with four U shape and reflector is shown in Fig. 1(a)(b), where the patch dimension is reduced from the ground plane by running the U shape and inductive load to reflector. Due to this the area reduction of the ground plane for manages to stable Circular Polarization characteristics. The proposed antenna consists of two copper layer separated by Fr4 substrates, namely an upper substrate with a radiating patch.

## III. SIMULATION RESULTS

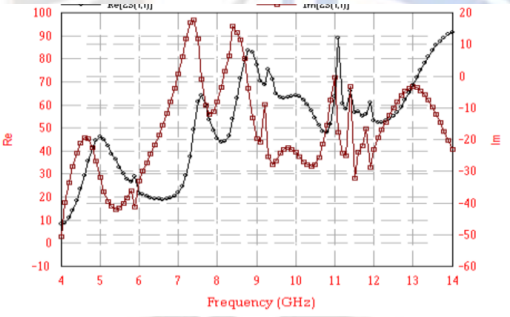



Figure 2: Reflection phases and phase difference of a proposed antenna

Fig 2 it is clear that the middle substrate Fr4, and a lower grounded substrate with four U slot and the probe feeding is used to reduce cross-polarization. The dimension of the proposed antenna of 18.18 mm × 15.54 mm for obtaining stable antenna gain characteristics. The radiating patch has a rectangular shape with dimensions of 9.18 mm × 6.541 mm and four truncated corners with dimensions of 1 mm for stable radiating. The antenna is fed by a simple probe feed line. Four U shape with corner truncated of the ground plane and radiated patch is separated by a dielectric substrate and open via line(0.5mm) is connected to each other at the center to remove the losses (cross polarization ) and enhance the effective radiation into the load . The diameter of the vias is 1mm.The feeding point of the radiating patch is 1mm from the center of the truncated patch along the x axis for sufficient impedance matching and AR over a broad bandwidth. The optimized dimensions of the proposed antenna are shown in Fig. 1. The dimension is 18.18 mm × 15.54 mm on the substrate, and the patch of the U Shape slot is 4.20 mm × 1.5 mm. A 1.5-mm-thick Fr4 substrate is used for all the substrates in the proposed antenna. Fig. 2 shows the phase shift characteristics of the rectangular Microstrip patch antenna shown in Fig. 1(c), the boundary conditions are applied to each unit cell by Method of Moment (IE3d).EFFECT OF DAGS.

The performance of proposed antenna with four U shape and corner truncated antenna (18.18 mm × 15.541 mm) is compared with that of other antenna shown in Figs. 1(a) and 1(b), respectively. The proposed antenna structure was simulated and verified the results in IE3d software. Its characteristics and radiation pattern were verified. All geometry metallic surface by the Fr4 dielectric substrate material using etching technique to be fabricated (for Future) . Fig. 1 shows a picture of the geometry of an antenna. Fig. 3 shows a return loss of −10-dB S11 bandwidth of 65.4% (from 7.1 to 14 GHz) for the antenna in the simulation.

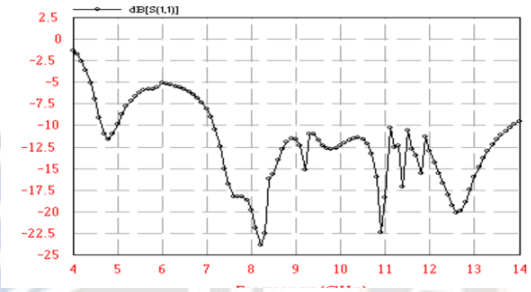
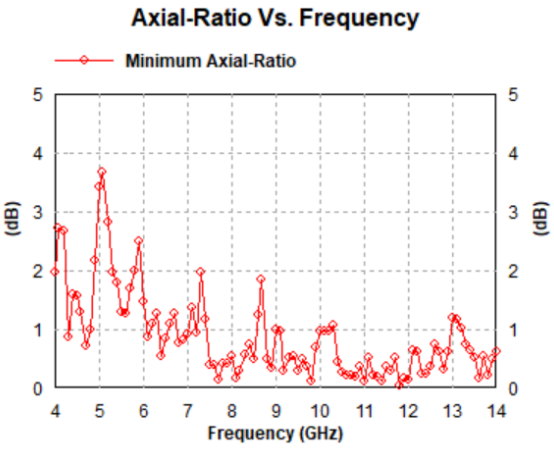



Figure 3: Simulated reflection coefficients for structures with AGS and LDAGS, respectively, compared to simulated and measured S11 for proposed antenna with SDAGS

As shown in Fig. 3, the simulated result and impedance wide bandwidths for the proposed antenna with a four U shape slot and corner truncated ground plane (|S11|≤−10 dB) is 65.41% in the frequency ranges of 7.15–14 GHz, respectively, with good agreement. The radiation in a far-field by radiation boundary in open region boundary conditions by using IE3d software simulation is shown in fig.




(a)

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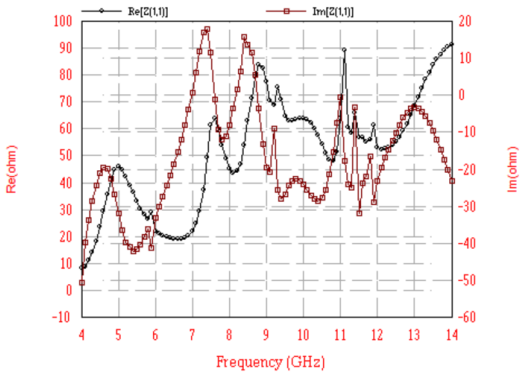



(b)

Figure 4: Simulated (a) AR characteristics (along with measurement results) in +z direction of structures, (b) amplitude characteristics of |Ex |/|Ey

Fig. 4(a) and (b) shows the axial ration characteristics in the propagation direction for an antenna with a conventional ground plane with truncated ground plane and the simulated AR characteristics of the proposed antenna with H slot. Simulated 3-dB AR bandwidths of 65.4.7% (from 7.1 to 14 GHz) are obtained with good agreement. as shown in Fig. 4(a).

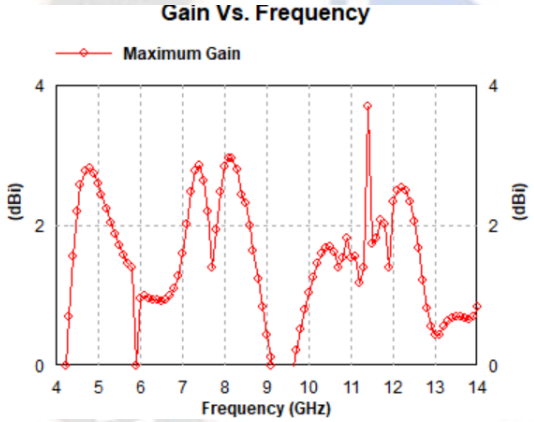
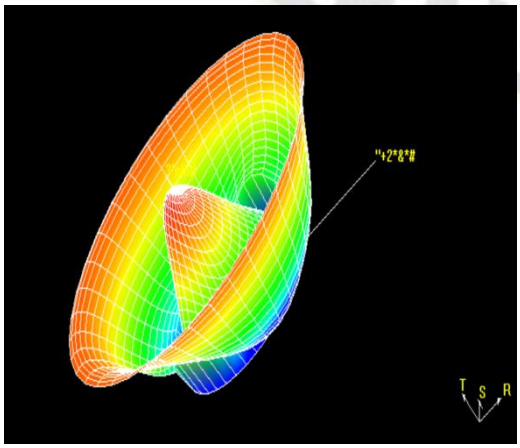
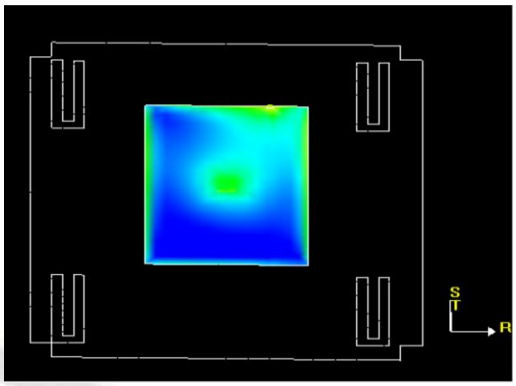



Figure 5: Simulated gain characteristics in +z direction for structures with four U slot , truncated and Via hole.

The gain of the proposed antenna is constant over the 3-dB Axial ratio, especially at high frequency (7.1 to 14 GHz). In the figure, the simulated results show good agreement in the 3-dB AR band, with maximum gains of 3.9 dBi, respectively.





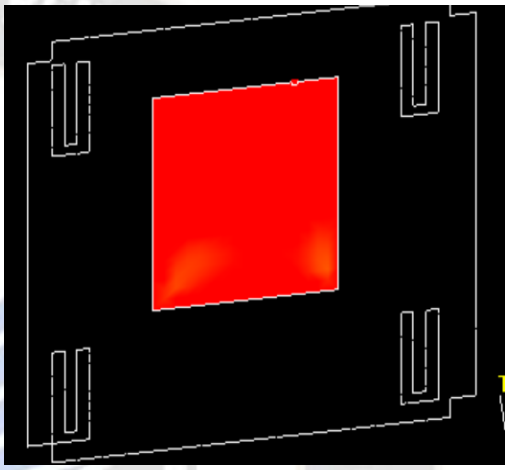
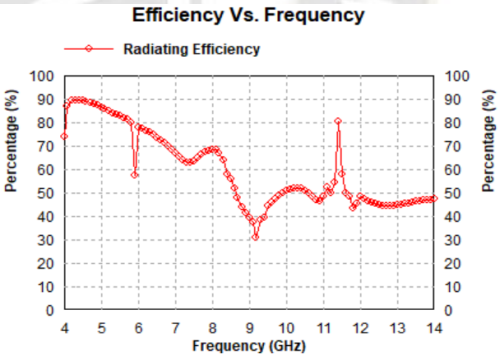


Figure 6: Simulated and measured radiation characteristics of proposed microstrip patch antenna.



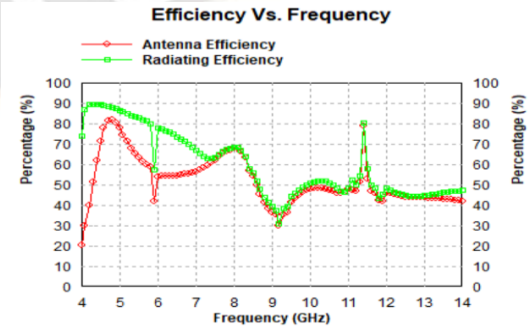




Figure 7: Simulated and measured co- and cross-polarization radiation patterns in x- z and y-z planes for proposed antenna at frequency from 4Ghz to 14 Ghz

As per figure it is shown that the antenna gain is stable and its characteristics of the antenna with the proposed antenna along with four U slot and corner truncated. It was also observed that cross polarization of the proposed antenna was satisfactory suppressed. Fig. 7 shows that the simulated radiation patterns of the antenna have good agreement in the x-y-z plane. In this geometry, the radiation pattern is a composite result from the patch elements and the U slot. The broad band widths of |S11|≤−10 dB (65.4%) and 3-dB gain variation (65.4%). The proposed antenna also achieves comparable results in terms of the bandwidth of axial ratio ≤ 3 dB (65.4%) and a gain of (3.9 dBi) while having a lower profile and more compact dimensions. In addition, the 3-dB AR band is included in the bandwidths of the 3-dB gain and −10-dB |S11|.

## IV. CONCLUSION

Broadband Circularly Polarized Microstrip Patch Antenna with H shape and corner truncated Ground Structure is proposed. The antenna with four U shape, truncated and vial hole position prevents strong resonances of surface waves on the ground plane. The proposed structure, have a compact size and achieve a stable 3dB axial ratio up to 65.41% and stable radiation pattern. Furthermore, the antenna is suitable for uniform magnetic field for all operating band (7.1 to 14 GHz) the resonance frequency is to be adjust by adjusting the position of the slot as well as via hole. These effects shown as stable gain characteristics, specifically at high frequencies.

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