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# Designing of Truncated Square Micro Strip Patch Antenna for Circular Polarization

**Swathi Lakshmi Boppana, K.Keerthana., K.Yuva Naga Vardhan**

***Abstract—In this article design of an antenna which is wearable with Circular Polarization(CP) is presented. This antenna works at 2.45GHz frequency band for WLAN applications. A square patch antenna with corners truncated will degenerate $TM_{10}$ mode into two orthogonal modes. The realization of circular polarization is presented in this paper. This paper will clearly explain the working of patch cut circularly polarized micro strip patch antenna for wireless communication purposes and also as wearable antenna.***

***Keywords — Square micro strip antenna, Circular polarization, circular slot***

## I. INTRODUCTION

The broadband micro strip patch antennas can be realized using different shapes, various types of feeding techniques may be used for the CP micro strip patch antenna. Various kinds of feed procedures might be utilized for the CP micro strip fix receiving wire. The objective of this paper is to design an antenna with circular polarization using the microstrip technologies at 2.45 GHz with the intent that it will be part of the RFID system that is a wireless technology used for tracking a tag attached to an object and uniquely identifying it. This type of antenna is very popular now, because it's economic, easy production, low weight and reduced dimensions. The circular polarization is important in the design because regardless of receiver orientation, it will always receive a component of the signal. To obtain circular polarization there are two principal options, the first option is feed the patch with two perpendicular feeds. The second option is truncate the structure of the patch, so that the complete system can be smaller than the first option. To be part of an RFID system the antenna must have a gain around 10dBi, good reflection coefficient ($S_{11}$) and of course circular polarization. To design the antenna, High Frequency Structure Simulator (HFSS) is used. It is an electromagnetic simulation software tool for the electromagnetic field analysis of 3D structures. Through this HFSS different parameters like radiation pattern, reflection coefficient, axial ratio, and electrical field can be obtained which are used for the analysis of antenna.

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* Correspondence Author
**Swathi Lakshmi Boppana*,** working as Assistant Professor in ECE Department, Prasad V Potluri Siddhartha Institute of Technology, Kanuru, Vijayawada, India. Email: boppanaswathi@gmail.com.
**K.Keerthana,** is pursuing B.Tech in ECE Department, Prasad V Potluri Siddhartha Institute of Technology, Kanuru, Vijayawada, India. Email: keerthanakaturi@gmail.com
**K.Y.N.Vardhan,** is pursuing B.Tech in ECE Department, Prasad V Potluri Siddhartha Institute of Technology, Kanuru, Vijayawada, India. Email: kannayuvanagavardhan54@gmail.com



## II. LITERATURE SURVEY

The idea of microstrip antenna with patch on a ground plane alienated by dielectric substrate turned into failure till the revolution in digital circuit miniaturization and large-scale integration in 1970's. After that many researchers have explained the radiation from ground plane by the dielectric substrate for one of a variety of configurations. Various mathematical evaluation models were developed in favor of this micro strip antenna and its applications were extended to many different fields. Now these antennas are best for designer's choice. It can be located that the peak gain may be better than 3dBi at 3.5 GHz. A microstrip patch antenna [1] for twin band WLAN utility is proposed here and it achieves a rate of recurrence range from 5.0GHz to 6.0GHz with maximum gain of 8.4dBand 7.1dB in decrease and better frequency bands correspondingly. A microstip slot antenna [2] fed via a microstrip line has been presented in this article. Here bandwidth of an antenna has been enhanced. A Broadband patch antenna [3] for WiMAX and WLAN is proposed and it exhibits wideband traits that rely on numerous parameters including U-slot dimensions, circular probe –fed patch. The paper [4] has been proposed for describing numerous feeding techniques. In this paper a circularly polarized patch antenna in "I" shape on Glass epoxy for BLUETOOTH programs has been identified. It explains a very good impedance matching situation between the ground plane and the patch without any additional matching elements. This antenna indicates 36.2% impedance bandwidth with greater than 90% antenna efficiency and is suitable for 2.3/2.5GHz WiMAX and 2.4 GHz WLAN bands. In this paper [5] a dual band antenna was proposed for WLAN/WiMAX utility. A compact square patch antenna [6] has been provided for Wi-MAX and WLAN utility. A double L-slot microstrip patch antenna [7] array with Co Planar Waveguide (CPW) feed generation has been proposed for microwave get entry to and wireless local area community programs. This paper results in compact antenna with right omnidirectional radiation traits for proposed running frequencies. This antenna has compact, feed effective, easy shape and appropriate for all frequency bands of WiMAX and WLAN applications. Later many researchers have defined the radiation from the ground plane by way of a dielectric substrate for extraordinary configurations.

Papers near the beginning and findings of Munson on micro strip antennas makes those antennas used as a low profile flush set up antennas on rockets and missiles confirmed that this become a useful concept to be used in many antenna system problems.

## III. DESIGNING EQUATIONS

The primary plan is to design a single feed circularly polarized antenna. This radio wire transmits in direct polarization. To acknowledge direct polarization at recurrence 2.4 GHz, it is nourished on a level plane and further enhancement is finished by changing the length of the feed line to accomplish return loss less than - 10 dB at 2.4 GHz. The opening radio wire is encouraged utilizing a micro strip feed line with 50 ohm characteristic impedance and the radius of coaxial probe feed line R. The elements of the width, W and length, L is at 2.45GHz frequency are determined and λ is also determined.

$$f = \frac{c}{2\ \text{eff}\sqrt{\varepsilon\text{reff}}} = \frac{c}{2(L+\Delta l)\sqrt{\varepsilon\text{reff}}}$$

Where Δl is

$$\Delta l = 0.412h\frac{(\varepsilon\text{reff}+0.3)\left(\frac{w}{h}+0.264\right)}{(\varepsilon\text{reff}-0.258)\left(\frac{w}{h}+0.8\right)}$$

Length of patch

$$L = \frac{c}{2\sqrt{\varepsilon\text{reff}}\, f_r} - 2\Delta_l$$

Width of patch

$$W = \frac{1}{2\sqrt{\varepsilon 0 \mu 0}\, f_r}\frac{\sqrt{2}}{\varepsilon r+1}$$

where

$$\varepsilon\text{reff} = \frac{\varepsilon r + 1}{2} + \frac{\varepsilon r - 1}{2}\left(1 + h\frac{12}{w}\right)^{-0,5}$$

$$\lambda = c/f$$

where $c=3*10^8$ m/s;

f=2.45GHz

## IV. ANTENNA DESIGN

The designed antenna is implemented using HFSS version 2013. Analysis is done for λ/6 .

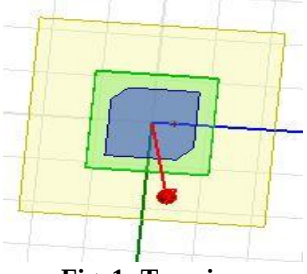

**Fig. 1: Top view**

The top view of design is presented in fig1. Rogers 5880 dielectric material is used and all other parts are made up of PEC material.

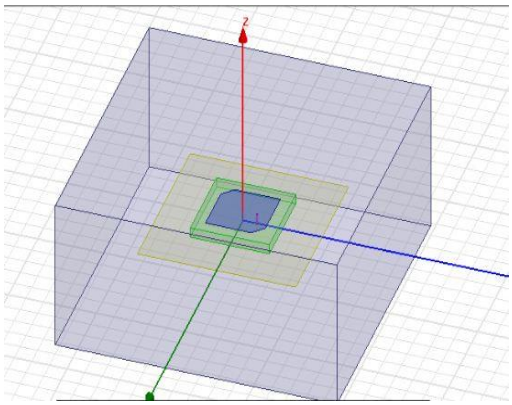

**Fig. 2: Antenna design**

The entire model is presented in fig 2 and in fig3 the bottom view of antenna is presented

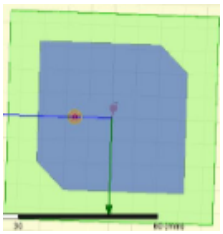

**Fig. 3: Bottom view**

The following table shows the dimensions of antenna. The dimensions specified in below table are in mm.

**Table-I: Dimensions of Antenna**

| | | | |
|---|---|---|---|
| Length of patch | 40mm | Length of patch cut | 6mm |
| Width of Patch | 40mm | Radius of feed | 1.5mm |
| Radius of port | 0.5mm | Dielectric thickness | 1.6mm |

## V. RESULTS AND DISCUSSION

The results were obtained by using High Frequency Structure Simulator (HFSS). The 50 ohms feed line is used for the simulation purpose.

1. **S-parameters**:

Fig.4 shows the simulated Return Loss curve for the projected micro strip patch antenna. The antenna is having return loss below -10dB. This band covers the applications for WLAN applications at 2.45 GHz.

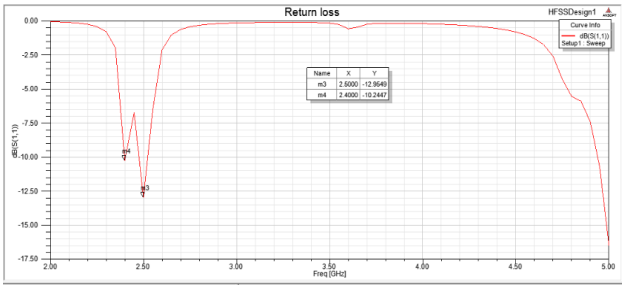


**Fig. 4: Return Loss of proposed Antenna**

## 2. VSWR:

Fig. 5 shows the simulated VSWR curve for projected antenna. From the VSWR plot the operating bands are below the acceptable range i.e. VSWR of 1.5 at 2.45GHz.

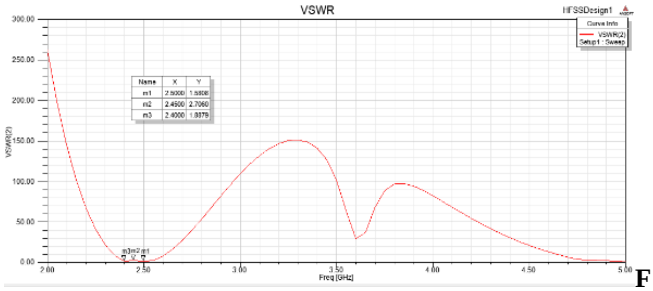


**Fig. 5: VSWR of proposed antenna**

## 3. Radiation Pattern:

The 3D polar plot of designed antenna is projected in Fig. 6. The H plane and E plane patterns of projected micro strip antenna at a particular frequency is shown in Fig. 7(a), 7(b)

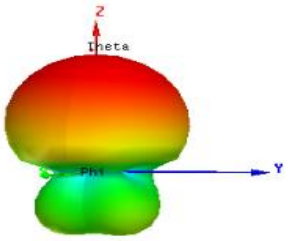


**Fig. 6: 3D-PolarPlot**

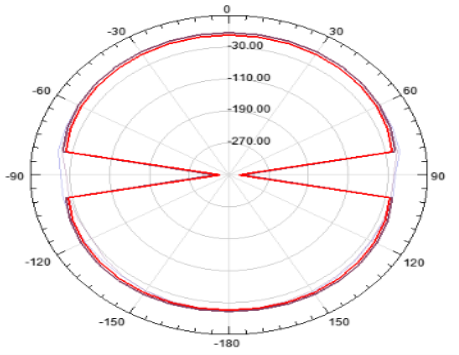


**Fig. 7 (a): H-plane Pattern**

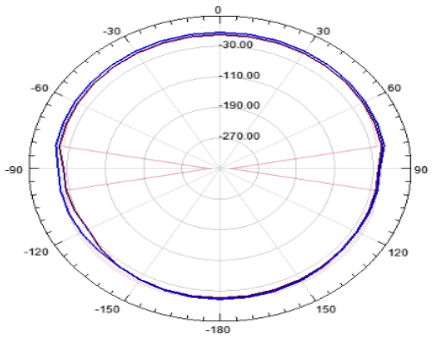


**Fig. 7 (b): E-plane Pattern**

## 4. Surface Current Distribution:

The Fig. 8 shows simulated surface current distribution on proposed antenna at 2.5GHz.

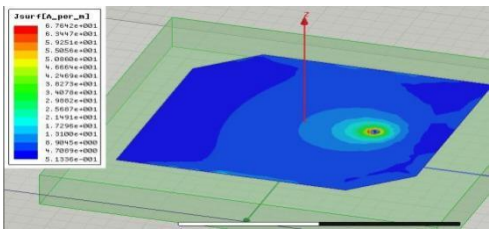

**Fig. 8: Current Distribution**

## 5. Axial Ratio:

The proposed antenna has constant peak gain around 0.88 at 2.4GHz operating frequency. The simulated peak gain of proposed antenna are shown in Table -II.

**Table-II: Realized axial ratio of proposed antenna**

| mag(Axial Ratio) Phi=0deg | mag(Axial Ratio) Phi=90deg | tan(Axial Ratio) Phi=0deg | tan(Axial Ratio) Phi=90deg | sin(Axial Ratio) Phi=0deg |
|---|---|---|---|---|
| 2.087500 | 2.087503 | 0.883822 | 0.883814 | 0.869452 |

## 6. Farfield Gain:

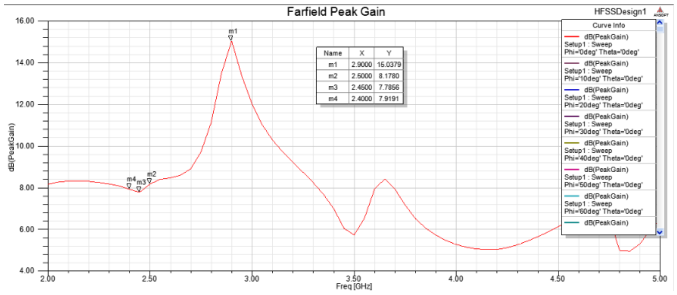


**Fig. 10: Gain of proposed antenna**

## VI. CONCLUSION

A micro strip patch antenna has been designed at WLAN frequency with circular polarization. An antenna with coaxial probe feed input, with gain greater than 7.5dB , VSWR of 1.5, Axial ratio of 0.88, and Radiation efficiency of 96% is designed and simulated

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## AUTHORS PROFILE


**Swathi Lakshmi Boppana** working as Assistant Professor in ECE Department, Prasad V. Potluri Siddhartha Institute of Technology, Kanuru, Vijayawada. She has 14 years of teaching experience. She is working in the area of antennas. She is a member of ISTE.

**K.Keerthana** is pursuing B.Tech in ECE Department, Prasad V Potluri Siddhartha Institute of Technology, Kanuru, Vijayawada. She is a member of IETE student forum.

**K.Y.N.Vardhan** is pursuing B.Tech in ECE Department, Prasad V Potluri Siddhartha Institute of Technology, Kanuru, Vijayawada. He is a member of IETE student forum.