

# Circularly Polarized Fractal Patch Antenna With Probe Feed Technique For Wi-Max Applications

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## ABSTRACT

Circularly polarized Fractal patch antennas at two frequency ranges are to be resonated in this paper. This fractal antenna is performed better by using probe feeding technique. Existing method is resonate at 3.4GHz and proposed method resonating at 2.5 and 3.4GHz frequency ranges. Ground dimensions are 40mm x40mm and substrate dimensions are 26mm x 26mm, and substrate material is RT/Duriod5880. The proposed method involves unit cell structure with a size of 10mm x 10mm. This Paper enhances the frequency ranges and improves the gain and better return loss. These range of frequency ranges mostly useful for Wi-max applications. All Parameters are simulated by using HFSS software.

**Keywords:** Fractal patch antenna, Unit cell Structure, Circular Polarization.

## Introduction

Miniaturization is one of the promising technologies to reduce the size and improve the performance etc. Fractal patches are also used to reduce the size by arranging the unit cells in same pattern which is reduced to 18% to 20% reduction in size. Reduction of size means it can decrease the mutual coupling[1]Slots have been used to improve the gain performance. Triple slots can be placed on the ground plane can be used for further reduction of mutual coupling. One of the reduction mechanisms is electromagnetic band gap with uniplanar structure.[2]Frequency selective surface covers maximum size. In order to reduce the size by introducing Antenna-filter-Antenna based frequency selective surface. This AFA FSS also covers broader range of frequencies (K Band).[3]Fractal patch antenna array mainly used for the reduction of size and performance of reflect array antenna[4].Square fractal patch antenna covers Ultra wide band frequency responses, it maintains approximately 3 to 10GHz. This fractal patch antenna not only covers UWB range but also maintains the constant gain and wider bandwidth. Mainly it is suitable for radar applications[[5]Nowadays modern systems suitable for different applications resonate at various frequency bands. Therefore one of the multiband antennas is circularly polarized triple band antenna[6]For better size reduction and return loss. This paper introduces a multilayer fractal patch

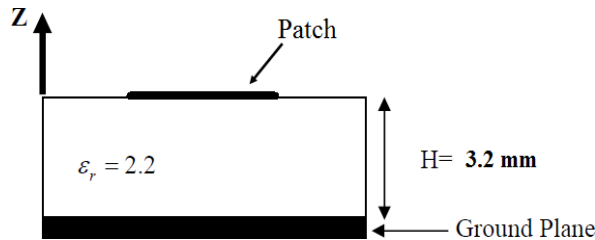
antenna array[7]Wearable antenna is most promising technology for different applications like RADARS, military etc. Single pole fractal antenna is combined with electromagnetic band gap structure. Therefore it reduces the radiations entered into the human body[8]One type of geometry of fractal is Giuseppe peano is used for miniaturization. Enhanced miniaturization has done by inserting slots on the structure[9]one author proposed ultra-wide band hexagonal shape fractal patch antenna. Faithful reproduction of the signal can be done by using monopole antenna with fractal elements. It supports ultra-wide range of frequencies i.e. 3.1 to 10.6GHz [10].Two radiating patches or elements are placed at the sides fractal isolator. It resonates at a frequency range of X band to Ka band of frequency ranges. This fractal isolator is a metamaterial based electromagnetic band gap[11]Fractal curve is elevated for achieving good circular polarization at center resonant frequency. We can also minimize the size by introducing fractal curves [12] Miniaturization is integrated with wideband and multiband and UWB is mostly preferable more number of applications. Triangle shaped slots were formed by using hexagonal shape fractal cure [13]AFA-FSS contains upper and lower patches, above patches are in inductive nature and below patches are acts as a capacitive nature. This Inductor and capacitor shows a transmission line approach. It is used to measure the transmission and reflection coefficients. If

Number of layers is arranged one by one, then it is called as a multilayer FSS layer[14].

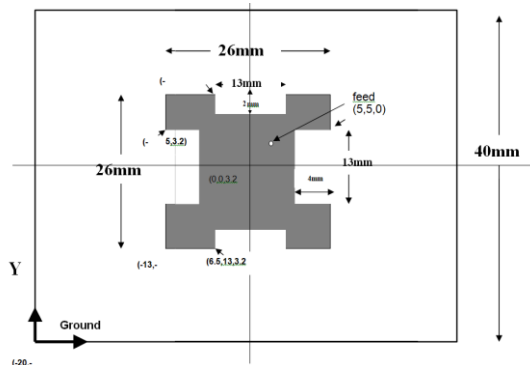
**Fractal Patch Antenna Design**

Circularly polarized fractal patch antenna is resonating at dual frequency ranges. Here we are using Probe feeding technique. In the existing system and proposed system, both are having same

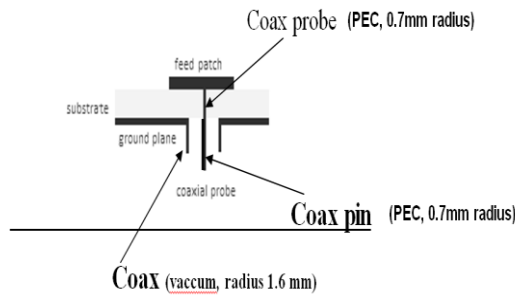
dimensions but only difference in the proposed system is unit cell structure with a size of 10mm x 10mm is added. Ground plane size 40 mm x 40 mm, Square patch size is 26 mm x 26 mm for Wi-MAX – 3.4 GHz band; fractal indentation depth is 2 mm along y - axis curves and 4 mm along x - axis. Substrate used is Rogers RT/ duroid 5880; dielectric constant is 2.2. Substrate thickness is 3.2 mm.



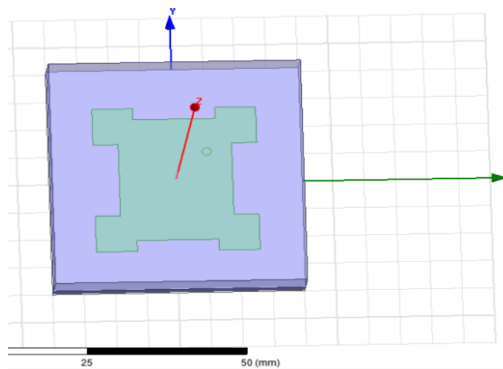
**Fig 1: Cross View of the Patch antenna**



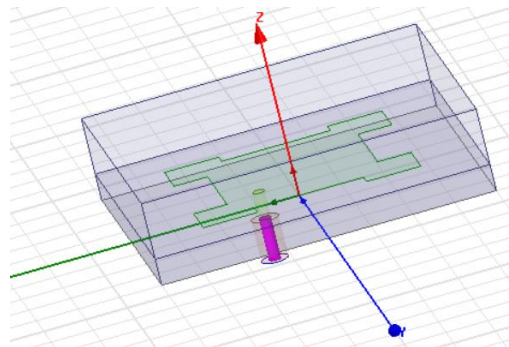
**Fig 2: Top View of the Existing Fractal patch antenna**



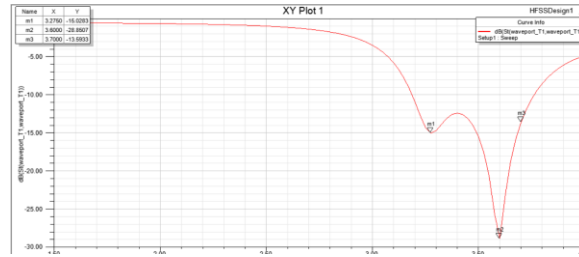
**Fig 3: Probe Feed Fractal patch antenna**



**Fig 4: Top view simulation design of existing fractal patch antenna**



**Fig 5: Cross view simulation design of existing Fractal patch antenna**



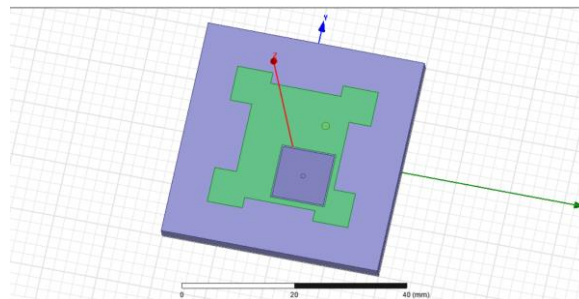
**Fig 6: Returns loss of Existing method**

### Geometry Of Fractal Patch Antenna

Fractal patch antennas are divided into small sections, these small sections are repeated in same manner in complete structure, and thus we can form the fractals. This fractal antenna design is mostly used for miniaturization purpose. Circularly polarized fractal patch antennas are used for many applications such as Wi-max, satellite and RADAR applications. Generally the circular polarization with monopole feed by square patch with truncated corners, approximately square patch with inserted slots and cutting slots are proposed in several papers. The circular polarization is produced by varying the electrical length in bi directions, therefore if the antenna is fed diagonal elements, it is operated in two orthogonal modes, these all are excited and 90 degree out of phase. One of the advantage is in

Fractal patch antenna is operated in different bands of frequencies. In the proposed techniques, one unit cell is added together with fractal boundary structure, this unit cell shape is also a square type and this size is 10mm x 10mm. when a fractal design is used as surrounding structure for the square patch and different shapes of patches, it is mainly used for miniaturization in size and area. This is important feature when it is compulsory to reduce the losses. This miniaturization will help maximum quality factor and maximum gain.

The proposed Fractal patch antenna involves unit cell structure, this structure as shown in figure 6. This proposed method extended to another frequency rather than existing method, i.e. existing method operated at one frequency and this proposed method resonating at two frequency ranges



**Fig 6: Proposed method involves unit cell structure**

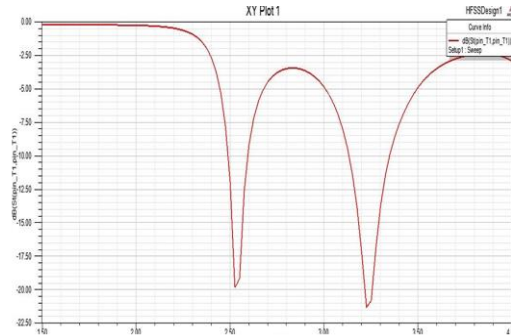
### Results

Fractal patch antenna with unit cell structure results were obtained by using simulation tool like HFSS. In this results, Return loss, radiation pattern, Gain and Gain Vs Frequency, E field Distribution and H field

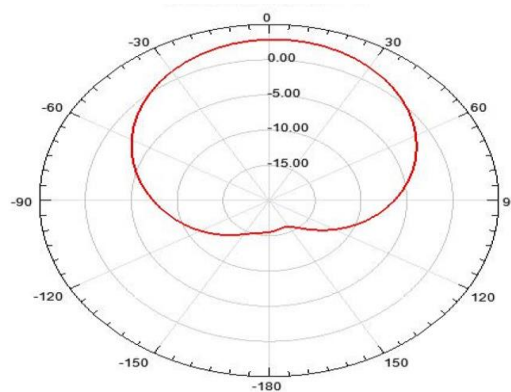
distribution are obtained. Return loss simulated at two frequency ranges compared to existing method. Table 1 shows the comparison between existing and proposed method.

**Table 1: Comparison between Existing and Proposed method**

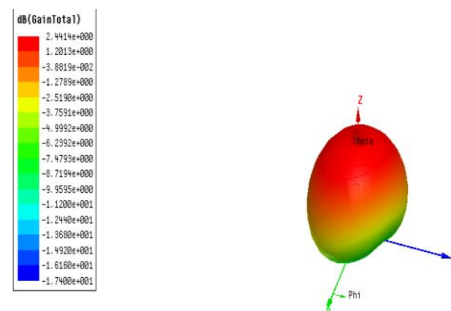
| S.No | Parameter | Existing | Proposed   |
|------|-----------|----------|------------|
| 1    | Frequency | 3.4GHz   | 2.4&3.4GHz |
| 2.   | Gain      | 1.04dB   | 2.44dB     |
| 3.   | Unit cell | No       | Yes        |



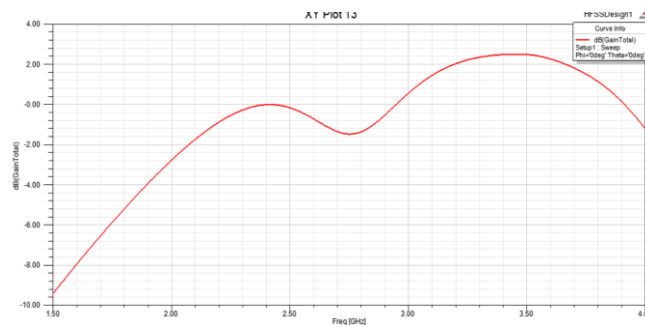
**Fig 7: Return loss of fractal antenna with Unit cell structure**



**Fig 8: Radiation Pattern of Fractal antenna with Unit cell structure**



**Fig 9: Gain of Circularly polarized Fractal antenna**



**Fig 10: Gain Vs Frequency of fractal antenna with unit cell structure**

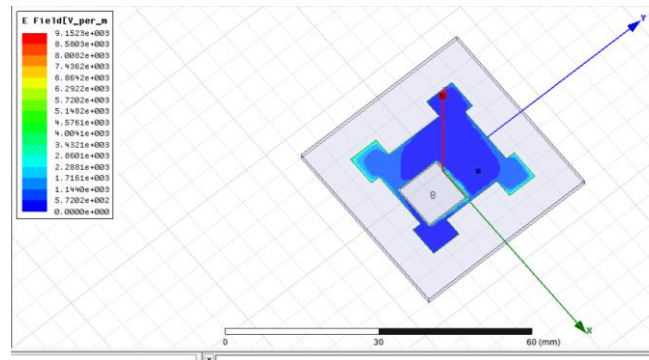


Fig 11: E field Distribution of unit cell fractal antenna

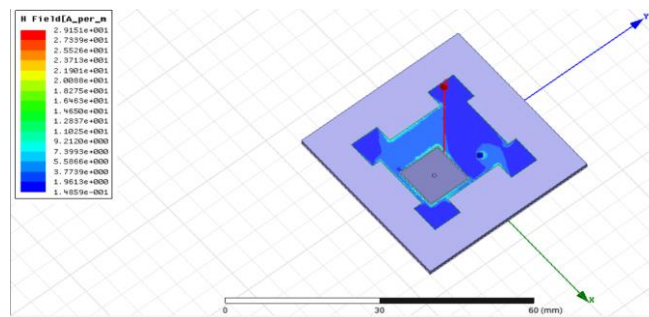


Fig 12: H field Distribution of unit cell fractal antenna

### Conclusion

A Fractal patch antenna is excited by Probe feed technique, therefore it performs circular polarization. By selecting correct dimensions in two directions of the antenna, then it is very easy to operate in circular polarization. Fractal patch antenna with unit cell structure resonate at dual frequency ranges one is 2.5GHz and another one is 3.4GHz, one is used for Microwave applications and other frequency is used for Wi-Max applications.

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