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# A CPW Fed Inverted L-Shape Fractal Antenna for Dual Band Applications

T Naga Poornima [1], Ch Raghavendra [2]
[1, 2] *Department of Electronics and Communication Engineering, VRSEC, JNTUK, India*

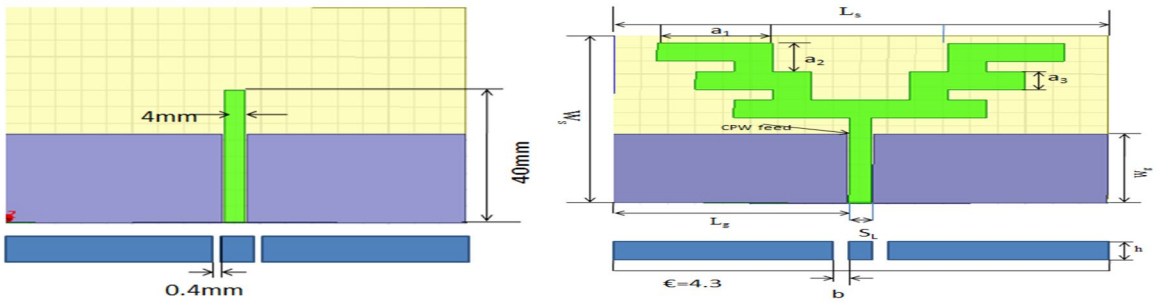
***Abstract:*** ***This paper demonstrates the operation of a dual band fractal antenna. The geometry of the inverted fractal antenna are 90mm × 65mm which is imprinted on FR4 substrate material whose dielectric constant is 4.4 with a thickness of 1.6mm. The proposed antenna operates at dual band i.e., from 0.9GHz to 1.4GHz and 2.4GHz to 2.7GHz which is capable of operating as a reader antenna, GPS and also WiMAX applications. The proposed antenna is simulated and analyzed using HFSS software. The antenna has an acceptable gain with desired radiation pattern across these operating bands.***
***Keywords*****: *Co-planar waveguide feed, HFSS, WiMAX, RFID, Fractal***

## I. INTRODUCTION

The wireless communication between any two points is possible only by using antenna. Now a days, the ability to integrate more than one device into a single system is difficult due to their compact size and limited space. So, the modern antenna design requires dual or multiband operation, simple structure and easy integration. Microstrip patch antennas are suitable only for low impedance bandwidth applications. These are not suitable for present wireless communications. To defeat this issue we have to design a multiband antenna by utilizing the fractal geometry i.e. self-similar structure. The antenna with small size, light weight, low profile are required in mobile, wireless communications, global positioning system etc. The broadband remote known as WiMAX (Worldwide Interoperability for Microwave Access) which is dispersed an information transmission of 2.5GHz 2.69GHz / 3.4GHz-3.6GHz / 5.2GHz-5.8GHz. GPS uses two frequency bands i.e., 1.57GHz known as L1 band and 1.22GHz band known as L2 band.
The term fractal implies broken or sporadic section that has a self-likeness in their geometrical structure [2]. These are the iterative structures which provides several resonating frequencies in a single element. So, fractal geometry is implemented design small and multiband antennas. Fractals are capable of operating with good performance at many different frequencies simultaneously. CPW feed is more suitable for compact wireless communication [3-4]. The main advantage of CPW feeding technique is that patch and ground are placed on same plane which reduces the fabrication cost. Here in this paper a dual band inverted L-shaped fractal antenna is designed for GPS, WLAN, WiMAX applications and also as a RFID reader antenna.

## II. DESIGN OF PROPOSED ANTENNA

The proposed antenna is analyzed using software HFSS. This proposed geometry is imprinted on FR4 substrate with relative permittivity of 4.4 and loss tangent 0.02. The overall dimensions of the antenna are 90mm×65mm of thickness 1.6mm. The antenna is fed with a 50Ω CPW transmission line with a strip width of 4mm. the inverted L-shapes are designed for dual band operations. The designed antenna is operated in dual bands i.e., first band from 0.9GHz-1.47GHz which covers the RFID frequency and GPS operating band with an impedance bandwidth of 56MHz, second band from 2.45GHz- 2.74GHz which covers the WiMAX with a impedance bandwidth of 28MHz. The two achieve the dual band resonant frequencies at 1.2GHz and 2.6GHz. Fig. 1(b) shows the geometry CPW fed inverted L-shape fractal antenna.




(a) (b)

Fig.1: (a) CPW fed monopole antenna (b) CPW fed inverted L-shape fractal antenna.

The parameters to design the antenna are listed in the following table.

Table I: Parameters Of The Designed Antenna

| Parameters | Value in mm |
|---|---|
| $L_s$ | 90 |
| $W_s$ | 65 |
| $L_g$ | 42.6 |
| $W_g$ | 26.7 |
| $a_1$ | 21 |
| $a_2$ | 11 |
| $a_3$ | 7 |
| $S_L$ | 4 |
| B | 0.4 |
| H | 1.6 |

The length of the ground plane is varied till good return loss is achieved at desired frequencies. The size of the ground plane affects the resonant frequency and bandwidth.

## III. SIMULATION RESULTS

The designed antenna is tested using HFSS which is based on FEM (Finite Element Method). Table II indicates the comparison of existing and proposed antenna in terms of antenna dimensions, bandwidth and frequency of operation. The existing inverted L-shape fractal antenna is operated at 0.9GHz which is suitable for RFID reader antenna and also the size of the antenna is large

TABLE II: Comparison of Proposed and Existing Designs

| Parameters | Existing Design | Proposed Design |
|---|---|---|
| Antenna dimensions (mm) | 90 × 105 × 1.6 | 90 × 65 × 1.6 |
| Substrate | FR4 | FR4 |
| Operating Bands | Single band | Dual band |
| Frequency Ranges | 902 – 928 MHz | 0.9 -1.47 GHz<br>2.45 - 2.74 GHz |
| Application | RFID reader antenna | RFID Reader, GPS, WiMAX |

By reducing the size of the antenna and placing the two arms of the structure symmetrically, proposed antenna is operated at dual band which is capable for reader antenna, GPS, WiMAX.

Fig.2 represents the return loss characteristics obtained by varying the ground plane size. Both the resonant frequencies and the bandwidth of the antenna are affected by varying the ground plane size. The below plot shows the return loss for 3 different ground plane sizes. By considering the ground plane size as 24cm, the simulated results shows that it is operated only at a single frequency band with an impedance bandwidth of 489MHz, which is suitable for GPS and RFID applications.

If we increase the ground plane size to 25mm it is operated at dual band with an impedance bandwidth of 528MHz and 187MHz respectively. But it has a better radiation pattern only in a single band.

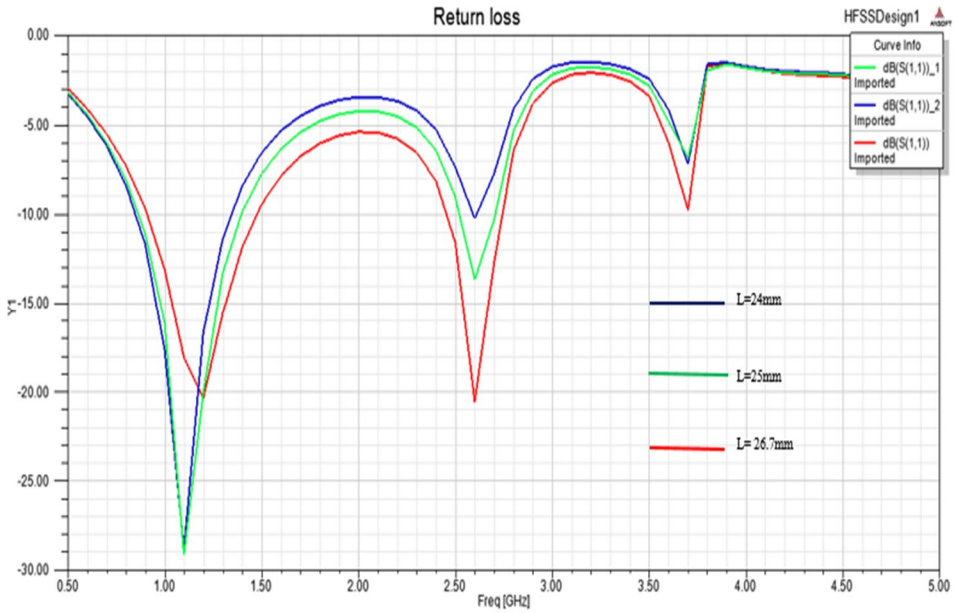



Fig.2: Return Loss for Various Ground Sizes

By performing various iterations we get a better return loss characteristics and radiation patterns at a ground plane size of 26.7mm. The simulated results of the proposed antenna gives a better impedance matching at resonant frequencies 1.2GHz and 2.6GHz with a return loss of -20.0 and -19.9 dB respectively. Fig 3 shows the return loss vs. frequency plot of the designed antenna.

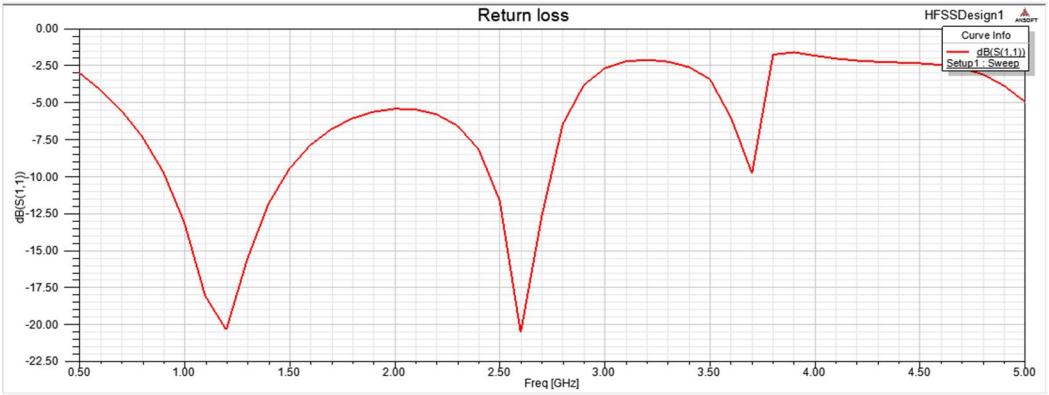



Fig.3: Return Loss of Designed Antenna

Fig.4 shows the VSWR vs. frequency plot. VSWR value below 2 is desirable for any antenna. The VSWR values at resonant frequencies are <2 i.e., 1.21 at 1.2GHz, 1.82 at 0.92GHz and 1.23 at 2.6GHz.

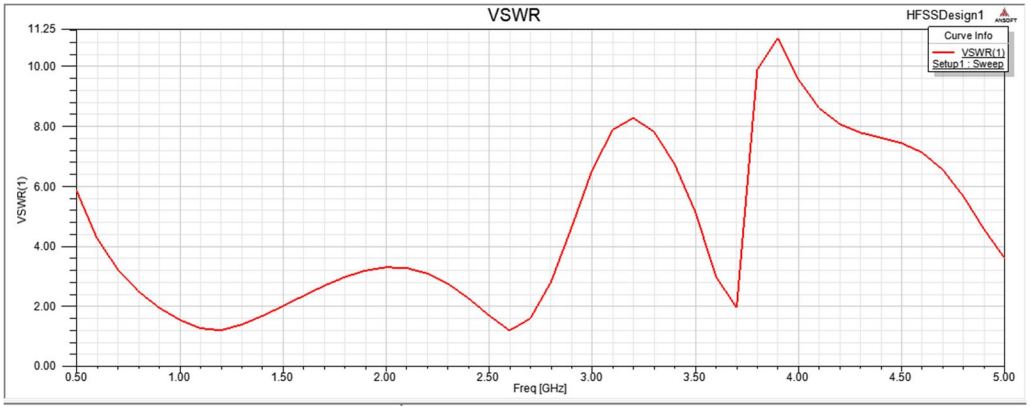
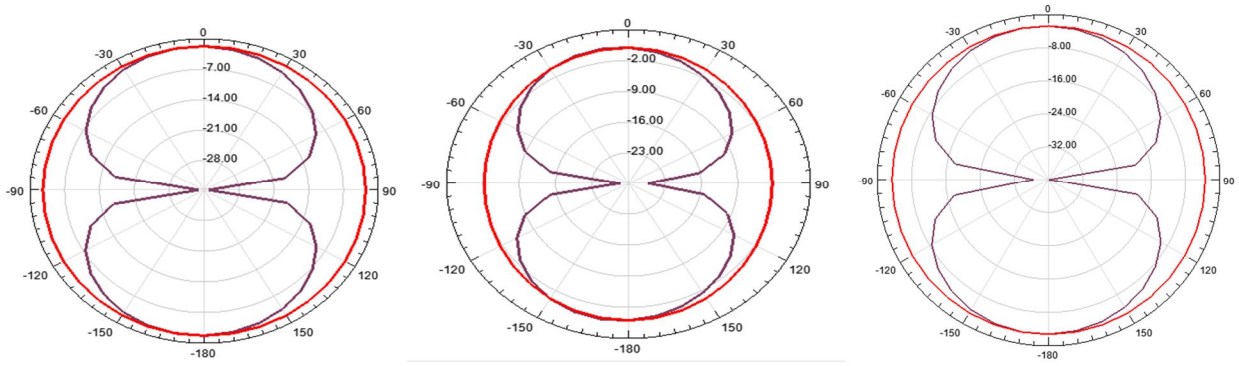



Fig.4: VSWR of Designed Antenna

The simulated radiation patterns in E-plane and H-plane for the frequencies 1.2GHz, 2.45GHz and 2.6GHz are shown below. The antenna has an omni directional radiation pattern which is suitable for GPS and WiMAX applications.




(a) (b) (c)

Fig.6: E-plane and H-plane radiation patterns at (a) 1.2GHz (b) 2.45GHz, (c) 2.6GHz, and (d) 0.92GHz

## IV. CONCLUSION

A CPW fed inverted L-shape fractal antenna is analyzed using High Frequency Structure Simulator (HFSS) software. The simulated results for various ground plane size are observed. The return loss characteristics show that the designed antenna with a ground plane size of 26.7mm gives good results. The simulated antenna resonates at dual bands which finds its applications in GPS, RFID reader antenna and WiMAX. It has san omni-directional radiation patterns. The antenna has small size with good impedance matching.

## V. ACKNOWLEDGMENT

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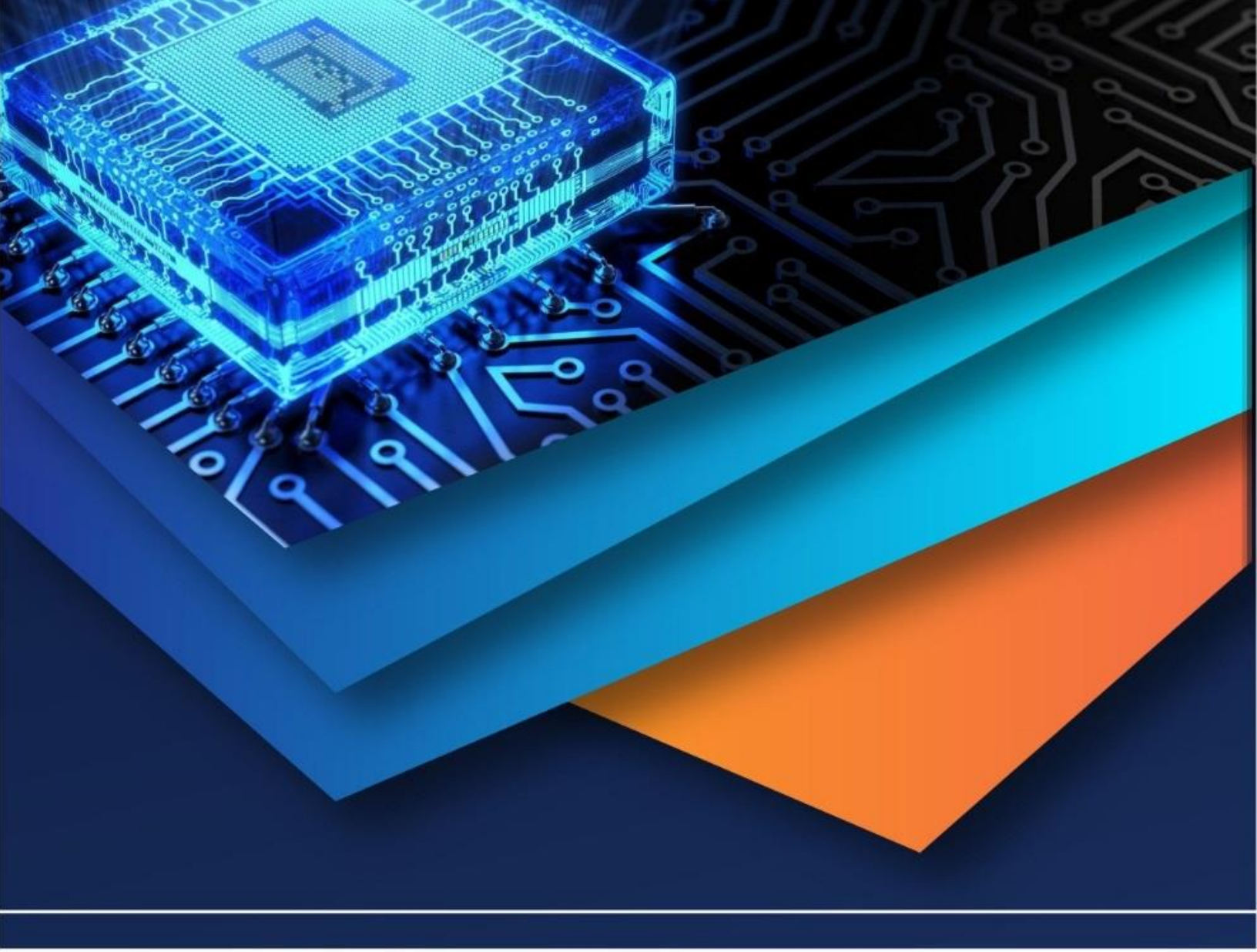

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