ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, January 2016

Study and Design of a Circular Shaped CPW fed Broadband Fractal Antenna for UWB Application

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ABSTRACT: A coplanar waveguide (CPW) fed ultra wide band (UWB) fractal antenna has been designed in this paper. This antenna consists of Triangular fractal shape for the UWB antenna good omnidirectional radiation pattern and a peak gain of 5.8dBi has been observed. The group delay of the proposed antenna is within 1ns .

KEYWORDS: Ultrawide band, Coplanar Waveguide, Fractal geometry, Impedance Bandwidth.

I. INTRODUCTION

Now days there is an increased in the demand for smaller size antenna which consists of broadband features and this demand has increased due to the ultra wide band frequency range and that is between 3.1GHZ and 10.6 GHZ which is assigned by the FCC(Federal Communication Commission)[1].Despite of this there are many challenges in the design and integration of ultra wide band products due to the 2.8GHz to 14GHz impedance bandwidth and the requirement of low cost for designing antenna[2-5]. Various antenna designs has been suggested for ultra wide band antenna such as sub wavelength structures and electromagnetic band gap structures. In last few years printed monopole antennas design have been developed for ultra wide band range. Matching techniques,bevelling of ground planes feed gap etc. are being used to increase the bandwidth and hence to obtain ultra wide band[6-8]. Recently, fractal geometries are being used to obtain smaller and cheaper ultra wide band antenna. So in order to obtain a multiband miniaturized antenna was to include fractal geometry[9-13].

II.DESIGN AND PARAMETRIC STUDY Of THE ANTENNA

The Design of the proposed antenna is shown in the below figures. The proposed antenna has been designed on an FR4 substrate with relative permittivity 4.4 with a dimension of 30 x 33 mm^2 (W_{sub} x L_{sub}).

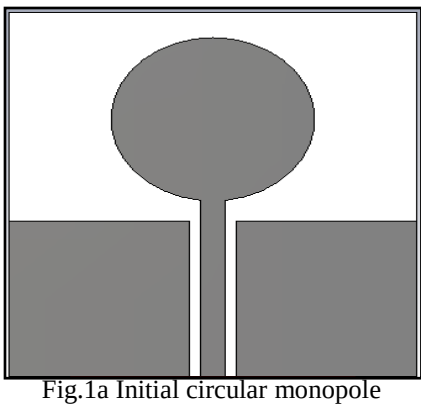

Fig.1a Initial circular monopole

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The initial height of the two ground plane d_g is taken to be 10mm Fig.1a whereas Fig.1b shows the height of the two ground plane after beveling. The proposed antenna is shown in the Fig.2.Initially the planar antenna was designed to cover the entire ultra wide band range.

Effect of parameter of the radiating patch gap between ground planes has been studied. Fig.2 shows the complete layout of the CPW fed fractal antenna where L_{sub} and W_{sub} denotes the length and width of the substrate i.e 33mm x 30mm respectively. Gap between the ground plane and feed (g) is 0.80mm and the field width is 3.9mm.

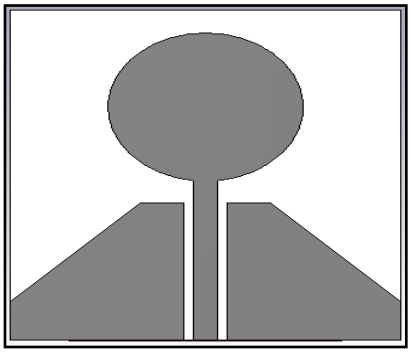

Fig. 1b Construction of bevelled ground

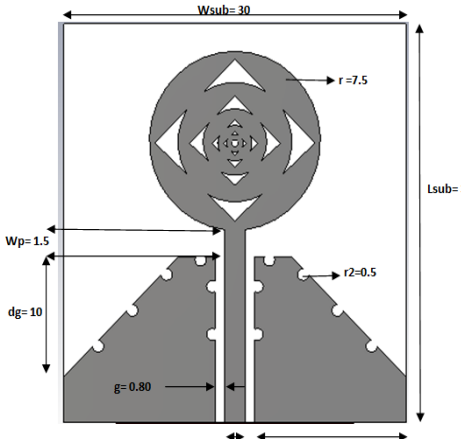

Fig. 2 Circular fractal antenna

The width of the ground plane (W_g) and the gap between the patch and the ground plane (W_p)are 12.5mm and 1.5mm respectively, where W_p is the most important parameter for impedance matching as shown in Fig. 3.

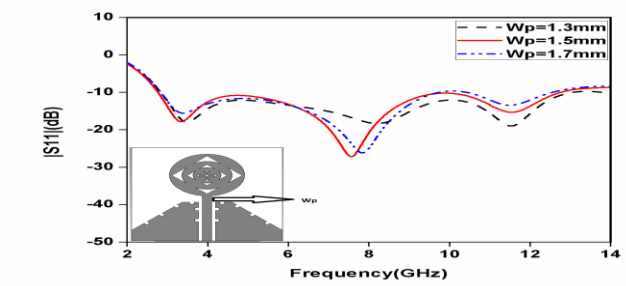

Fig. 3 Simulated result of proposed antenna gap variation between patch and ground.

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III.RESULT AND DISCUSSION

A. CURRENT DISTRIBUTION

Basically antenna is a radiating slot formed between the ground plane and radiating patch. In Fig. 4 simulated current distributions of the proposed antenna have been shown at four frequencies, i.e. 3.5,5.5,7.5 and 10.2 GHz.

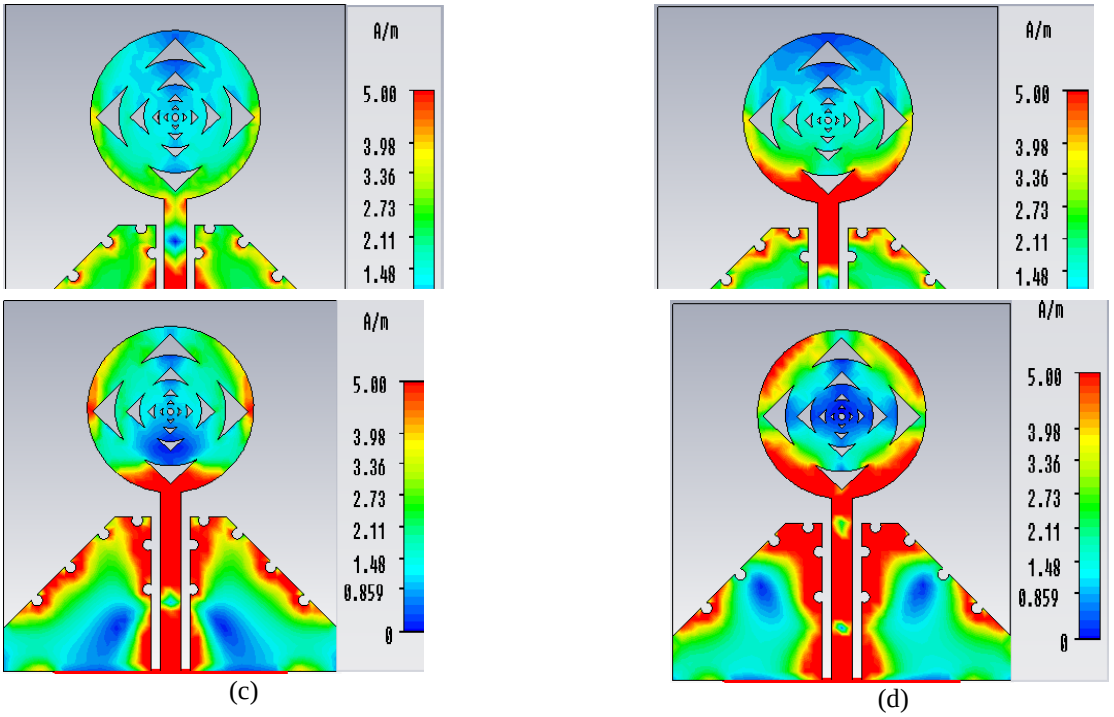

Fig. 4 Simulated current distribution of the proposed antenna at (a) 3.5GHz, (b)5.5GHz, (c)7.5GHz and (d)10.2GHz.

B. RETURN LOSS

The proposed antenna has a compact size of 30x33mm^2.The comparison between S_{11} parameter of the antenna is shown in Fig. 5 and it is noticeable that the impedance bandwidth of the antenna ranges from 2.8GHz to14 GHz.

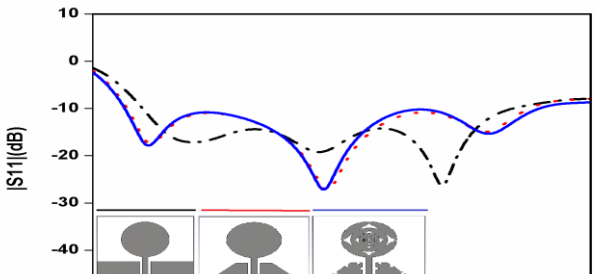

Fig. 5 Comparison of the S_{11} parameter with and without bevelling and with fractal slots.

C. RADIATION PATTERN

The simulated radiation pattern in E-Plane and H-Plane of the proposed antenna at 3.5,5.5,7.5 and 10.2 GHz is shown in Fig.6(a) and Fig. 6(b), the E and H plane radiation pattern.

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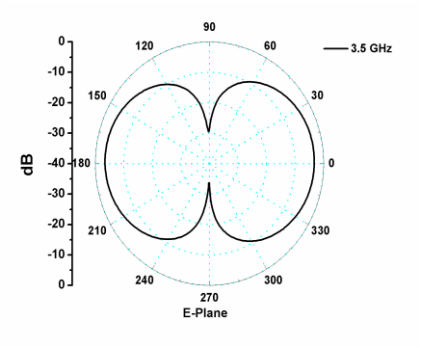
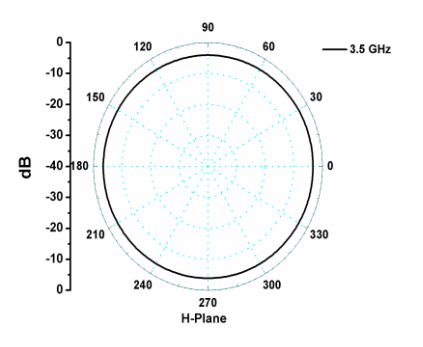
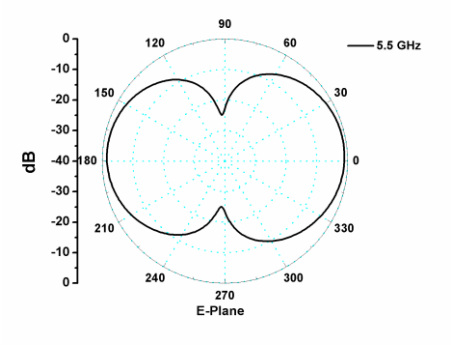


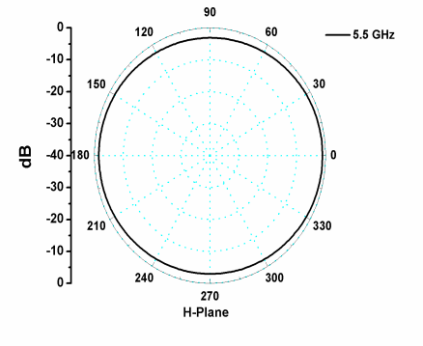
(a)E-Plane



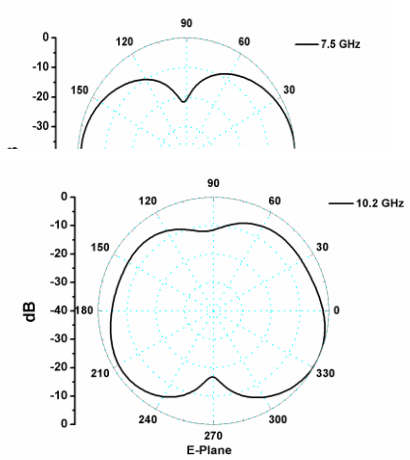
(a)H-Plane



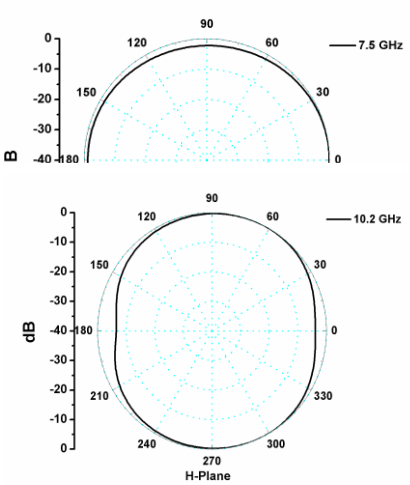
(b)E-Plane



(b)H-Plane



(d)E-Plane



(d)H-Plane

Fig. 6(b) Simulated Radiation pattern in E-plane and H-Plane at a (a)3.5GHz(b)5.5GHz(c)7.5GHz and (d)10.2GHz

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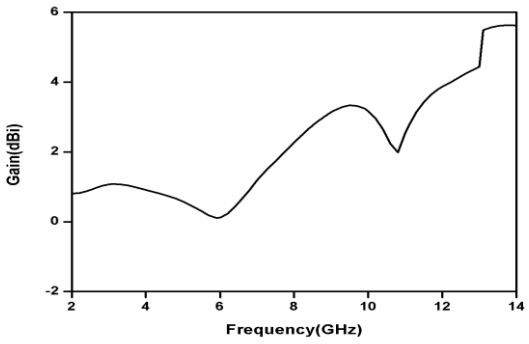
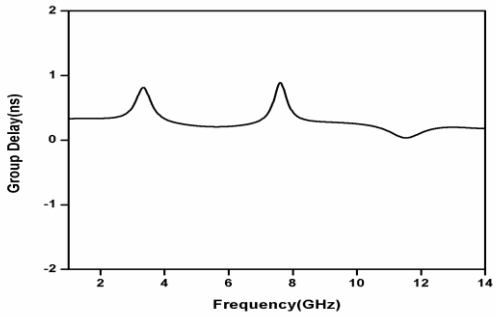
D. PEAK GAIN AND GROUP DELAY

As frequency increases peak gain increases. The simulated peak gain of the proposed antenna is 5.8dBi, which is shown in Fig.7. After a certain higher frequency, the peak gain is almost constant. The group delay of the proposed antenna is shown in Fig.8, which is within 1ns this shows that the antenna non dispersive.





A coplanar waveguide fed circular broadband antenna is proposed. The stimulated radiation pattern of the antenna shows that the proposed antenna is very close to omnidirectional in H-Plane and bidirectional in E-Plane. The gain and group delay of antenna is within 5.8dBi and 1ns respsectively.The dimension of the proposed antenna is 30 x 33mm^2,which is very compact size. The impedance bandwidth of the proposed antenna is from 2.8GHz to 14GHz.

ACKNOWLEDGEMENTS

My sincere thanks to Vikas Sahu and Deepti Singh ,co-author,for their guidance.I also want to thank all the researchers whose works has been used as references in preparing this paper.

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