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CO-PLANAR WAVEGUIDE FED FRACTALS WITH DEFECTED GROUND STRUCTURE

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***Abstract*— A CPW-fed octagonal fractal antenna is presented. It consists of fractal elements, co-planar waveguide feed line and modified ground plane with a pair of rectangular notches with defected ground structure. Parametric analysis is performed and different shapes are added to the antenna as the fractal element. The desired antenna has the advantages of wider bandwidth and impedance matching. To validate the simulation results, the prototypes of the antenna are fabricated and tested.**

***Index Terms*—Co-planar waveguide, fractal element** *(key words)*

I. INTRODUCTION

In modern communication systems, the demand for antenna with wide bandwidth and the miniatured dimensions has significantly increased. Compare to typical microstrip antenna [I], CPW structures have several useful properties. To cover both short and long range communications at least 10:1 and more at 10 dB return loss. To achieve wide band performance multiple antenna elements with dimensions according to different frequencies are required. Application of fractal geometry [II] to an antenna is an excellent solution to design compact, multiband, wideband antennas. It provides the impedance matching, miniaturization and consistence performance over huge frequency range. The change in the antenna physical structure, the frequency of the antenna also changes its functionality in nature; these antennas find their applications in space communication, cognitive radio and Multiple-Input Multiple-Output (MIMO) systems. The proposed antenna was designed and validates the results using simulation. The Ansys High Frequency Structure Simulator (HFSS) version 15.0 is used for modeling and analysis of the proposed antenna.

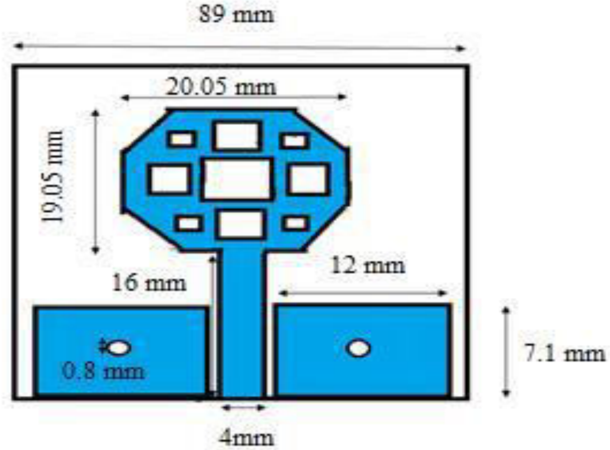
II. DESIGN OF ANTENNA

The proposed antenna has been designed using FR4 substrate with a Loss tangent =0.002 and a relative permittivity

= 4.4, h=1.617mm and size of the substrate L=36.05 mm and W=29mm. The octagonal patch was designed with a dimension of L=16mm and W= 4mm. The fractal concept was introduced in the structure. It was followed by three iterative square slots which are shown in the fig (2), fig (3), fig (4). It helps in providing better impedance matching and reduces the size of the antenna. The co-planar waveguide feeding technique is utilized owing to several advantages such as ease of fabrication and low radiation loss. The structure having two ground plane with L= 7.1mm and W= 12mm. The defected ground structure was introduced in the ground with a radius of 0.8mm as shown in the Fig (1). The main purpose of the defected ground structure is to avoid the extra frequency and to obtain the desired frequency range. The performance of the antenna is analyzed by using High Frequency Structure Simulator (HFSS) software.

III.STRUCTURE OF ANTENNA

BASIC ANTENNA DESIGN:



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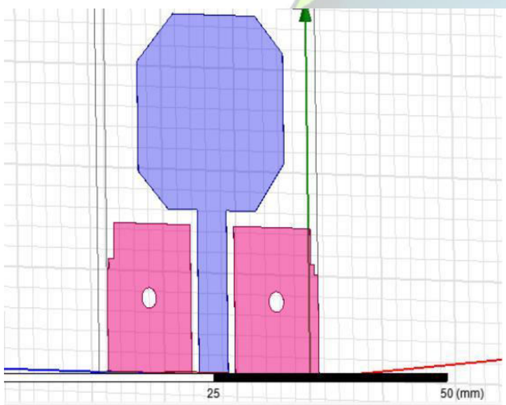
TABULATION:

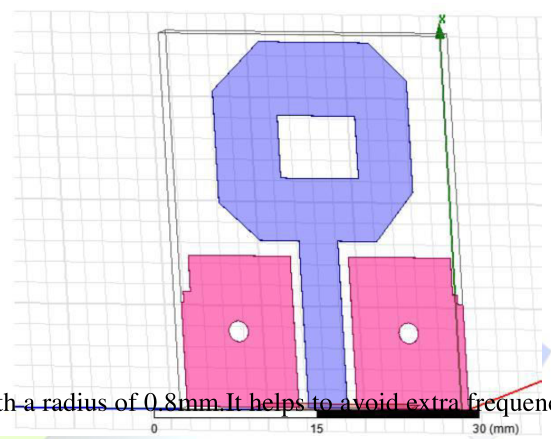
S.NO	PARAMETRS	LENGTH(mm)
1.	Ground length	7.1
2.	Ground width	2
3.	Substrate width	89
4.	Substrate Length	44
5.	Feed Length	16
6.	Feed width	4
7.	Radius	0.8

Fig (1) INTRODUCTION OF DGS



DESIGNING OF FRACTAL STRUCTURE

Fig (2) 1st Iteration



The defected ground structure was introduced in the ground plane with a radius of 0.8mm.It helps to avoid extra frequency and to obtain the desired frequency range.

RETURN LOSS

When the load is mismatched with the load, the whole power will not delivered to the load and that this is called loss and the loss returned is called return loss. Return loss is a measure of how well devices or lines are matched. A match is good if the return loss is high. A high return loss is desirable and results in a lower insertion loss. It is usually expressed as a ratio in decibels (dB). By introducing DGS for frequencies 6.4 GHz the return loss obtained is -14.4883 dB and for 2.0 GHz the return loss obtained is -9.2559 dB.

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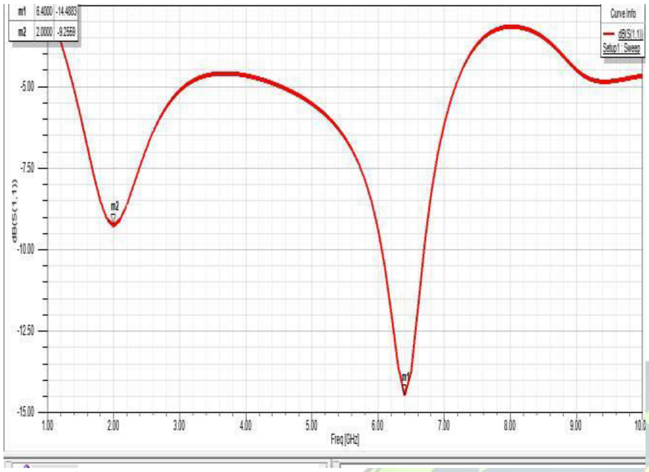
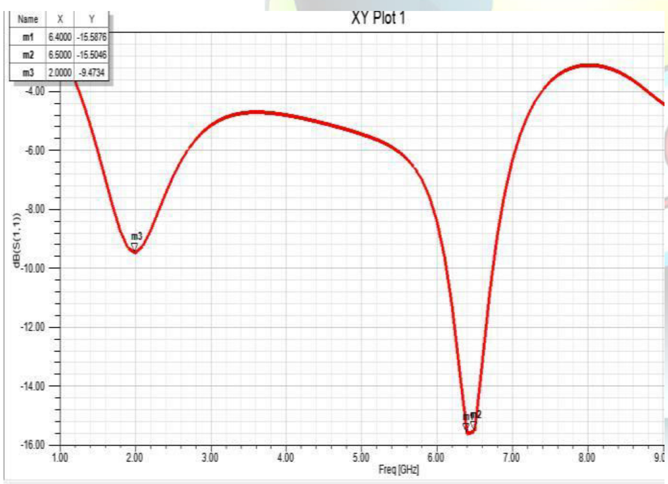
RETURN LOSS:



FREQUENCY (GHz)	RETUEN LOSS (dB)
6.4	-14.4883
2.0	-9.2559

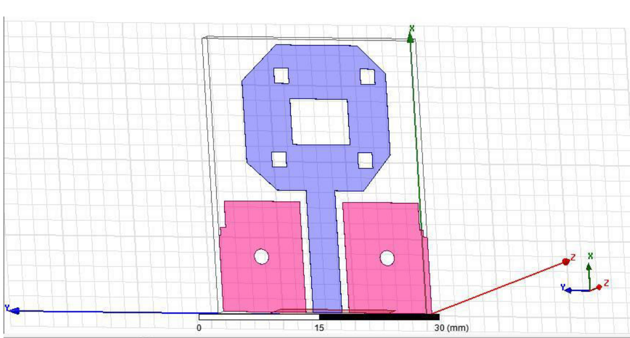
During the first iteration, single square fractal was introduced. The return loss for this fractal antenna is -15.26 dB for the frequency range is 6.4GHz.

RETURN LOSS RESULT



FREQUENCY (GHz)	RETURNLOSS (dB)
6.4	-15.2603

Fig (3) 2nd Iteration



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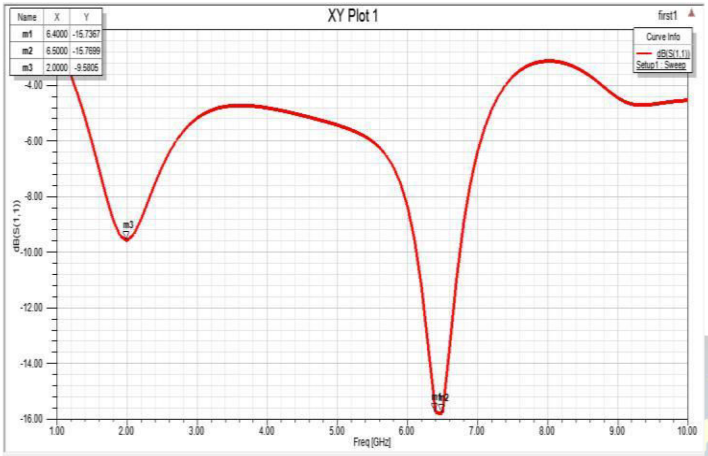
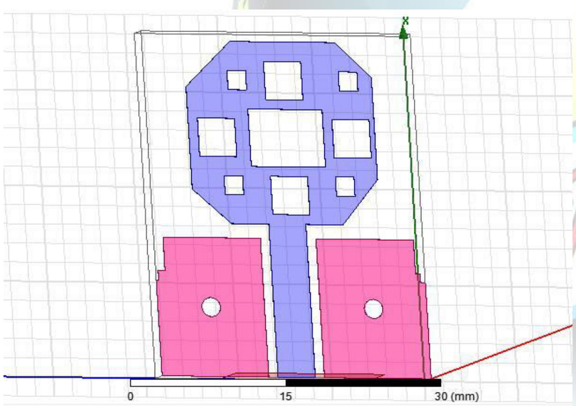
During second iteration, four square fractals are introduced at the corner of size 2mm .The return loss for the frequency range of 6.4GHz is -17.07dB.

RETURN LOSS RESULT



FREQUENCY (GHz)	RETURNLOSS (dB)
6.4	-17.0700

Fig (4) 3rd Iteration



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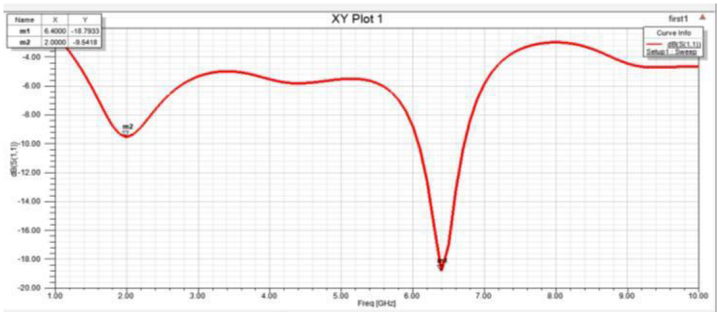
RETURN LOSS RESULT

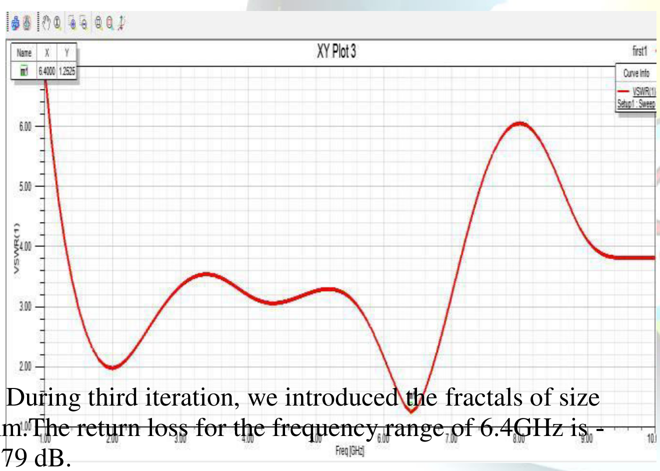


FREQUENCY (GHz)	RETURN LOSS (DB)
6.4	-18.79

VOLTAGE SIGNAL WAVE RATIO (VSWR):

A VSWR is an indication of the quality of the impedance matching. It is the numerical measure of how well the antenna is impedance matched with the transmission line. In general, it is a measure of how efficiently radio-frequency power is transmitted from a power source, through a transmission line, to an antenna. VSWR measures the voltage variances. It is the ratio of the highest voltage anywhere along the transmission line to the lowest. VSWR value should be less than 2. The VSWR result is shown in the fig (5).

Fig (5) VSWR RESULT



During third iteration, we introduced the fractals of size 4mm. The return loss for the frequency range of 6.4GHz is -18.79 dB.

FREQUENCY (GHz)	VSWR VALUE
6.4	1.28

RADIATION PATTERN:

Radiation pattern describes the relative strength of the radiated field in the various directions from the antenna at a constant

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distance. Radiation patterns are diagrammatical representation of the distribution of radiated energy into space, as a function of direction. It is the function of angular position and radial distribution from the antenna. The radiation patterns can be field patterns or power patterns. The radiation pattern result is shown in the fig (6).

Fig (6) RADIATION PATTERN

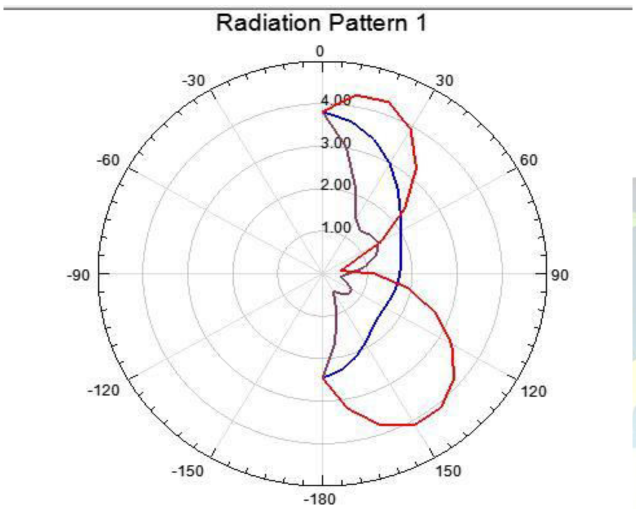
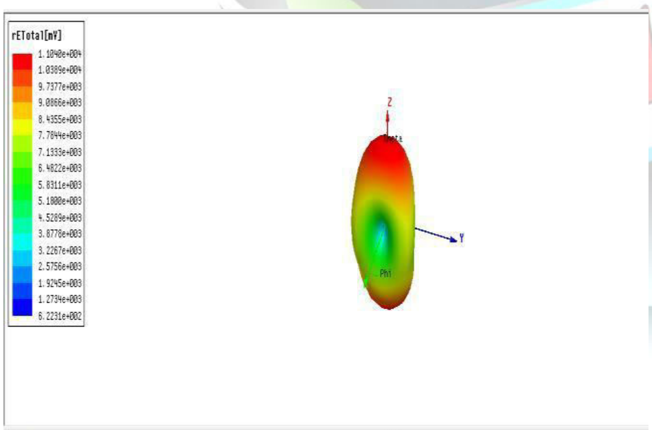


Fig (7) 3D POLAR RADIATION:



CONCLUSION:

The proposed antenna is manufactured on a FR4 substrate and parameters such as return loss , Voltage Signal Wave Ratio (VSWR), Radiation Pattern and 3D Radiation pattern is measured. The Fractal concept is one of the best solutions to design simple low profile and miniatured size antenna. The efficiency of the antenna depends on the materials and size and shape of the antenna. Thus the results arecompared by designing the antenna with the materials in HFSS software.

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