STUDY ON MULTI-BAND ALCHEMY FERMENT FRACTAL PATCH ANTENNA

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Abstract

A Multi-Band Alchemy Ferment Fractal Patch Antenna is presented in this paper. It operates in both X-band and Ku-band of frequencies. The proposed antenna is used in applications like in radar and in satellite communications. The dimensions of the proposed antenna are 40 x 40 x 3.8mm. Copper (annealed) metal is used as both ground plane and patch. FR4 (lossy) material is used as substrate. The proposed antenna has return losses of -34.78865dB, -35.963662dBat operating frequencies of 8.133GHz, , 14.724GHz respectively. The directivities of proposed antenna are 7.563dBi, , 9.465dBi at operating frequencies of 8.133GHz, 14.724GHz, respectively. The proposed antenna is simulated in CST Studio Suite Software.

Keywords: - *Antenna, Alchemy Ferment patch, Multiband, Return Loss, VSWR and Directivity.*

I. INTRODUCTION

An antenna is a transducer. In applications where size of an antenna should be very small, we go for microstrip antennas. Microstrip antennas have many advantages compared to normal antennas like small size, light weight, low cost and they can be easily fabricated. A microstrip antenna has a ground plane, patch and a substrate. Return loss, directivity and some other parameters of antenna changes as we vary the thickness and material of substrate, ground plane and patch.

In the recent years several fractal geometries have been proposed for designing wide band, dual frequency and multi-frequency antennas. In this paper, an alchemy ferment fractal patch antenna is proposed which operates at 6 different frequencies in X-band and Ku-Band.The “X” band frequency range is from 8GHz to 12.4GHz and “KU” band frequency range is from 12.4GHz to 18GHz.

II. PROPOSED ANTENNA DESIGN

Several steps are needed to be followed while designing a fractal microstrip antenna. The dimensions of the ground plane are 40 x 40 x 0.1mm. Copper (annealed) metal is used as both ground plane. The thickness of ground plane is 0.1mm. The dimensions of the substrate are 40 x 40 x 3.6mm. FR4 (lossy) material is used as substrate. The thickness of the substrate is 3.8mm. The dimensions of the patch are 20 x 20 x 0.1mm. Copper (annealed) metal is used as patch. The thickness of patch is 0.1mm. The proposed antenna is presented in Figure.1.

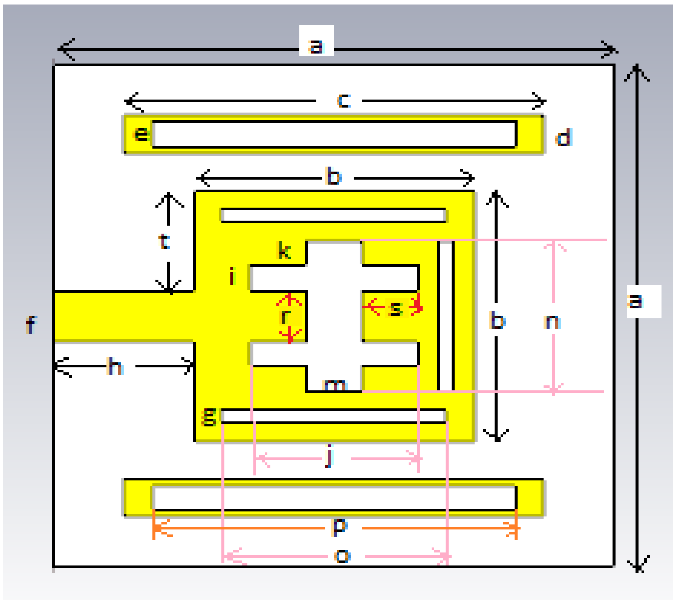

Figure.1: Alchemy Ferment Fractal Patch Antenna

The dimensions of the antenna are presented in table.1

Letter Designations	Dimensions in mm
a	40
b	20
c	30
d	1
e	0.8
f	2
g	0.5
h	10
i	1
j	12
k	4
m	4
n	12
o	16
p	26
r	4
s	4
t	9

Table 1: Details of proposed antenna

Design of Alchemy Ferment Fractal Patch Antenna

III. DESIGN PROCEDURE OF ALCHEMY FERMENT FRACTAL PATCH ANTENNA

Height (h)=3.8mm; width(w)=40mm; length(l)=40mm; relative permeability(εr)=4.5

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\left(\frac{h}{w}\right)\right]^{\frac{-1}{2}}$$

By substituting the values of h, w, l of the Alchemy Ferment Fractal Patch Antenna

$$\varepsilon_{reff} = 3.9823$$

L_{eff} =L+2ΔL=40+2(1.71)=43.42

$$\Delta L = 0.412 * h \frac{(\varepsilon_{reff} + 0.3)}{(\varepsilon_{reff} - 0.258)} \frac{\left[\frac{w}{h} + 0.264\right]}{\left[\frac{w}{h} + 0.8\right]} = 1.71$$

$$f_r = \frac{1}{2L_{eff}\sqrt{\varepsilon_{eff}}\sqrt{\mu_o \varepsilon_o}}$$

$$f_r = 2.4GHZ$$

After implementation of Alchemy Ferment fractal dimensions to the above procedure it's resonant frequency varies between X band and KU band of frequencies.

IV. RETURN LOSS

Return loss of an antenna is the measure of performance of an antenna. If an antenna is efficient, then the return loss of that antenna should be very less. The simulated results of return losses are shown in Figures 2 to 7.

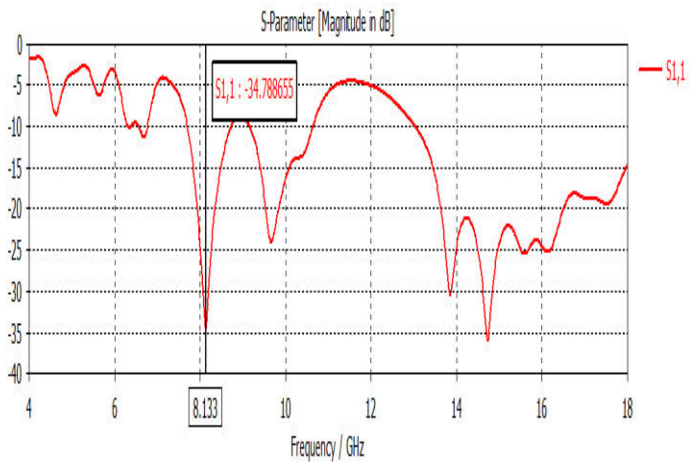

Figure.2: Return loss of proposed antenna at frequency 8.133 GHz

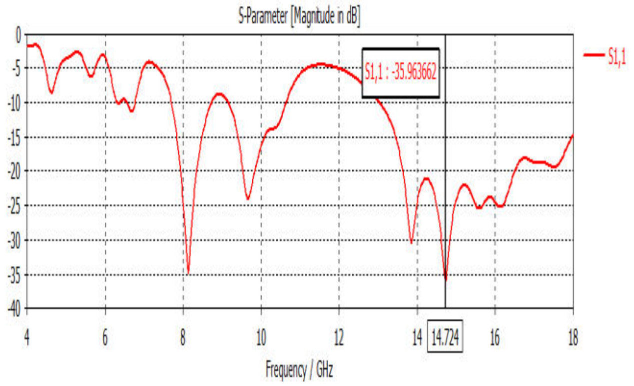

Figure.3: Return loss of proposed antenna at frequency 14.724 GHz

V. VSWR

VSWR (voltage standing wave ratio) of an antenna should be very close to '1' if an antenna is efficient. The simulated results of VSWR are shown

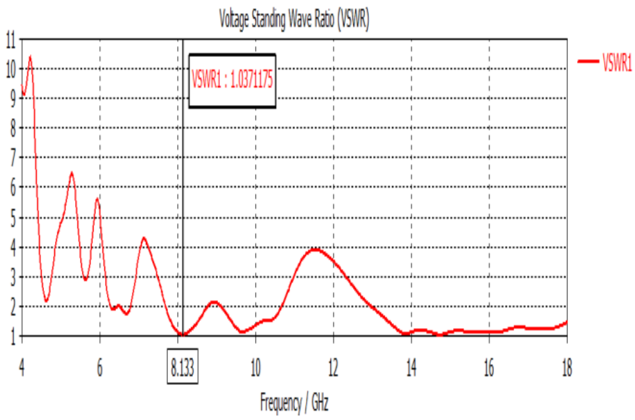

Figure.4: VSWR of proposed antenna at frequency 8.133 GHz

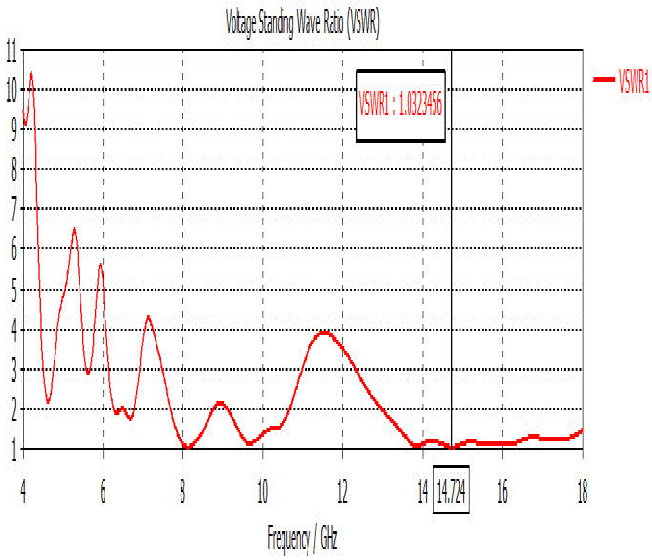

Figure.5: VSWR of proposed antenna at frequency 14.724GHz

S.NO.	Frequency(GHz)	Return loss(db)	Directivity (dbi)	VSWR
1	8.133	-34.632	7.563	1.037
2	14.72	-35.829	9.465	1.032

Table 2: Return Loss, Directivity and VSWR of proposed antenna at frequency 14.724GHz, 8.133GHz.

VI. FAR FIELD PATTERN

The simulated results of far field patterns of the proposed antenna are shown in Figures 6 to7

3D plots:

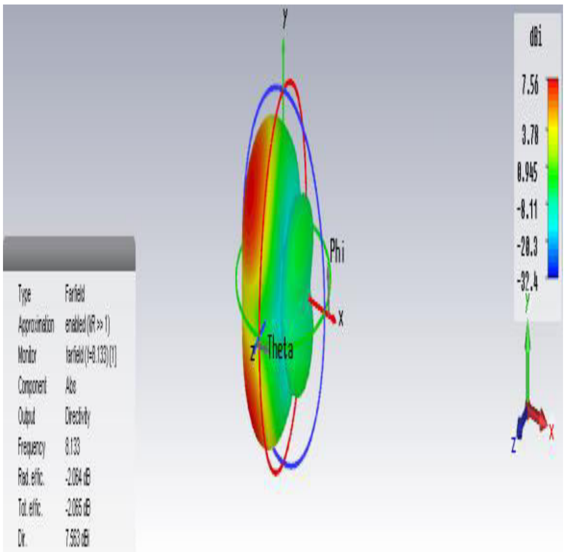

Figure.6: Dimensional plot of far field pattern at frequency 8.133GHz

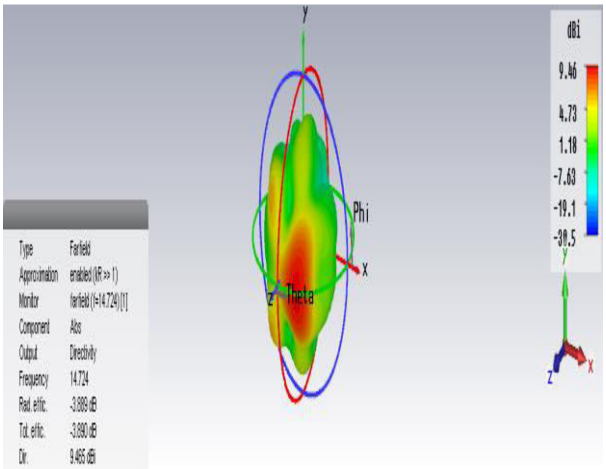

Figure.7: 3D plot of far field pattern of proposed antenna at frequency 14.724GHz

VII. POLAR PLOTS

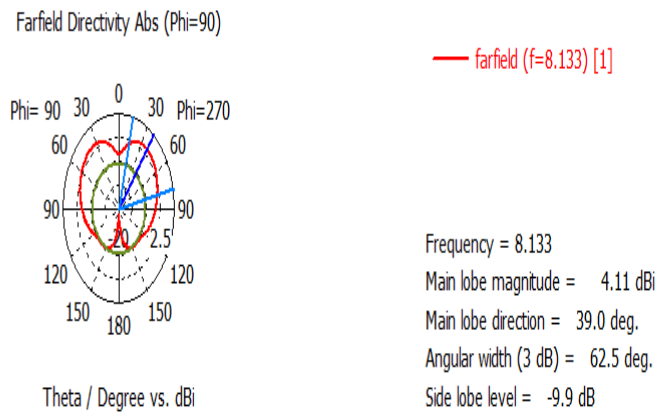

Figure.8: 3D plot of far field pattern of proposed antenna at frequency 14.724GHz

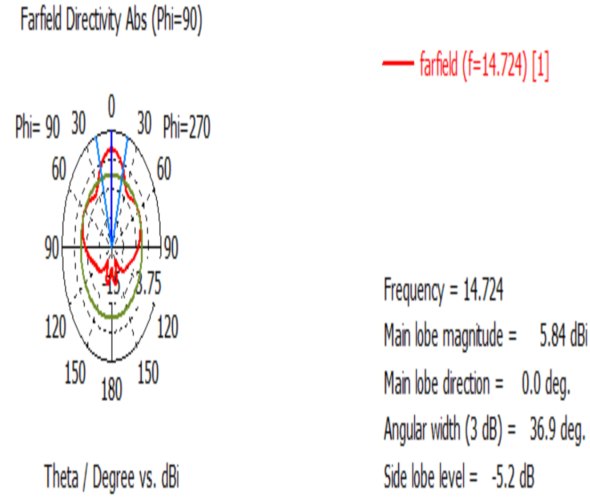

Figure.9: Polar plot of far field pattern of proposed antenna at frequency 14.724GHz

VIII. CONCLUSION

In this report we proposed a Multiband Alchemy Ferment Fractal Patch Antenna which operates in X-band and Ku-band of frequencies. The proposed antenna has return losses of -34.78865dB,-35.963662dB at operating frequencies of 8.133GHz, 14.724GHz respectively. The directivities of proposed antenna are 7.563dBi,9.465dBi at operating frequencies of 8.133GHz,14.724GHz respectively. The return loss of the Alchemy Ferment Fractal Patch Antenna is reduced to the maximum possible level, so that the signal can travel more efficiently without any loss in the system can be reduced to maximum extent.

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