Study on Dual Band Double Layered Substrate Microstrip Fork Antenna

P. Gowtham Kumar, P. Chandrasekhar, K. V. R. S. Santhosh

Abstract: - The design of dual band double layered substrate fork shaped microstrip antenna has been proposed. The proposed antenna operates in Ku Band and can be used in satellite communications particularly for editing and broadcasting satellite television. The dimensions of this antenna are 40 x 40 x (h+h1) mm, where h=0.8mm is the thickness of substrate1 and h1=2mm is the thickness of substrate2 and h+h1 is the total thickness of the substrate. FR4 (lossy) material is used as substrate1 and RogersRT6006 (lossy) material is used as substrate2. Copper (annealed) metal is used as both ground plane and the patch. The proposed antenna operates at two frequencies and the frequencies are 14.33 and 13.823GHz. The return losses are -46.319426dB and -40.421846dB at frequencies 14.33 and 13.823GHz. The directivities of the proposed antenna are 8.001 and 7.962dBi at frequencies 14.33 and 13.823GHz.

Keywords: - Antenna, fork antenna, Dual Band, Double Substrate, Return Loss, VSWR, Directivity.

I. INTRODUCTION

The demand for high efficiency antennas is increasing day by day. Although, many advances are made in this research, a number of drawbacks are needed to be rectified so that they can be made to function efficiently in mobile communications. In this category of mobile communications, microstrip antenna plays a prominent role among the other type of antennas, due to chiefly three important features. They are a) Micro strip antenna can be easily printed on the circuit board b) Micro strip antenna is of small size c) Micro strip antenna is of low weight d) Micro strip antenna is of low cost and can be easily fabricated. A Microstrip antenna consists of mainly three parts. They are ground plane, substrate and patch. Ground plane of a microstrip antenna acts as a base of the antenna. The efficiency of the antenna depends on the material of consideration and the thickness of the ground plane. For the return loss of the antenna varies with the thickness of the ground plane. The second component of the microstrip antenna is substrate. The thickness and design of the substrate plays a prominent role in analyzing the patch antenna parameters like return loss and VSWR (voltage standing wave ratio). The final component of the microstrip antenna is the patch. The geometry of the patch plays an important role in designing the required antenna. This patch can take any shape like rectangular, square, circular, elliptical etc.

In this paper, a fork shaped patch antenna performance is compared with that of another fork shaped patch antenna along with the parasitic patch. This patch plays a prominent role in analyzing the antenna.

In this paper, a dual band double layered substrate microstrip fork antenna is presented. It operates at two different frequencies and it has 2 different layers of substrate.

II. PROPOSED ANTENNA DESIGN

There are numerous steps to design a microstrip antenna. The proposed antenna has a ground plane, a substrate which has two layers and a patch. The dimensions of the ground plane are 40 x 40 x 0.1mm. Copper (annealed) material is used as ground plane. Rogers RT6006 (lossy) material whose dielectric constant value is 6.15 is the top layer of the substrate with thickness 2mm and FR4 (lossy) material whose dielectric constant value is 4.3 is the bottom layer of the substrate with thickness 2.8mm. Thus copper (annealed) material and FR4 (lossy) material together constitute substrate and the thickness of substrate is 2.8mm. The dimensions of the substrate are 40 x 40 x 2.8mm. Copper (annealed) material is used as patch and the thickness of patch is 0.1mm. The proposed antenna is presented in Figure.1.

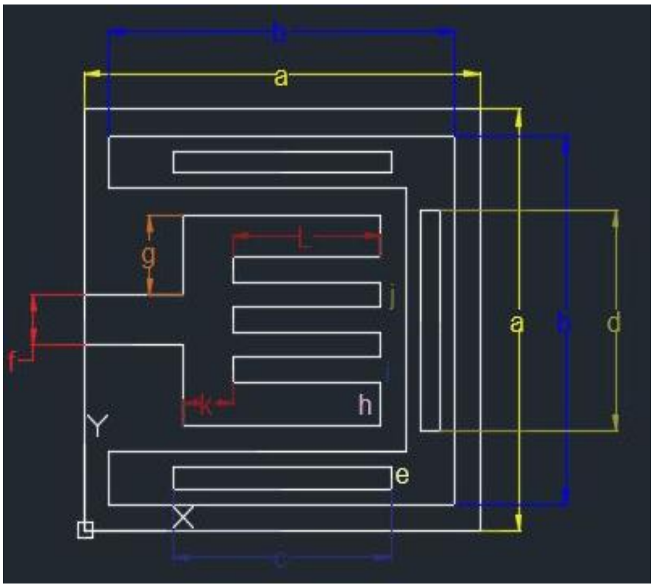

Figure. 1: Dual Band Double Layered Substrate Microstrip Antenna

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The dimensions of the antenna are presented in table.1

Letter Designation	Dimensions in mm
a	40
b	35
c	20
d	21
e	2
f	4.75
g	7.125
h	4
i	2.5
j	2.25
k	5
L	15

Table 1: Details of proposed antenna

III. RETURN LOSS

Return loss is the measure of how well the antenna is matched with the transmission line. For an efficient antenna, return loss is very less. The simulated return loss output for proposed antenna is shown in figure.2 and figure.3.

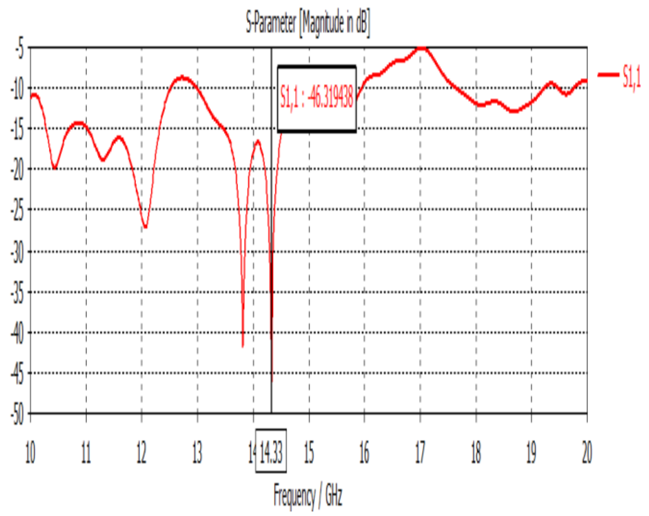

Figure. 2: Return loss of proposed fork antenna frequency 14.33GHz

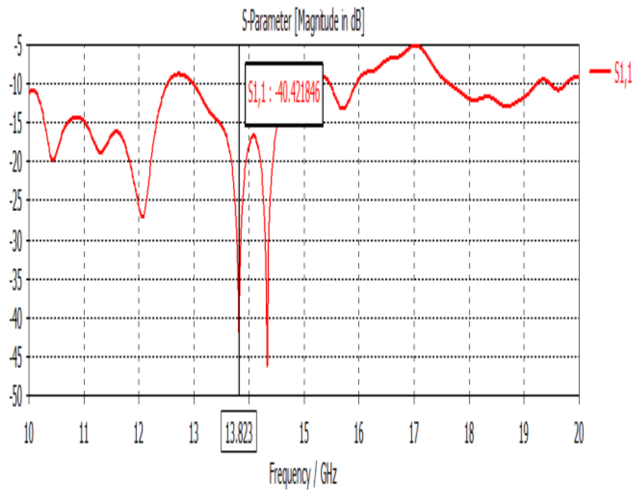

Figure. 3: Return loss of proposed fork antenna frequency 13.823GHz

IV. VSWR

Voltage Standing wave ratio of an antenna should be less if an antenna is efficient. The simulated VSWR output for the proposed antenna is shown in Figure.4 and Figure.5

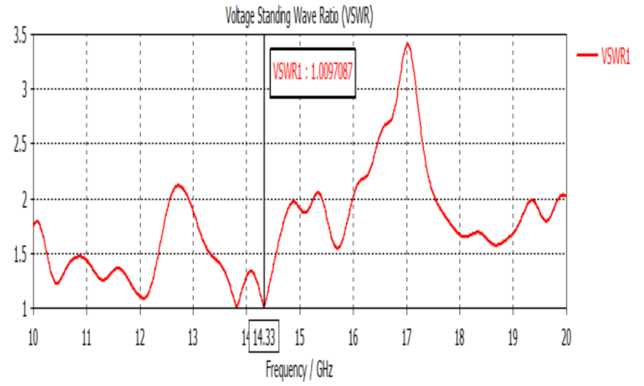

Figure. 4: VSWR of proposed fork antenna frequency 14.33GHz

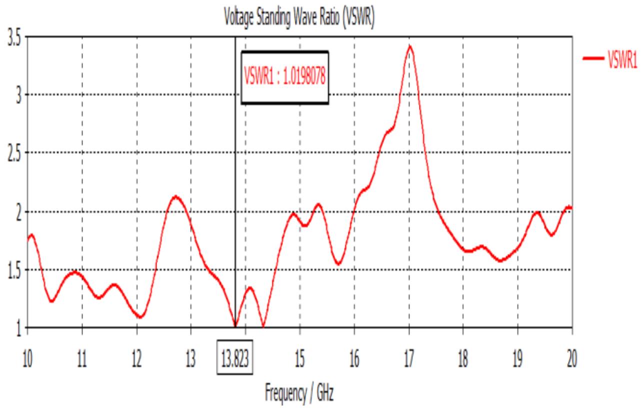

Figure. 5: VSWR of proposed fork antenna frequency 13.823GHz

V. FAR FIELD PATTERN

The simulated results of far field patterns of the proposed antenna are presented in Figure.6, Figure.7, Figure.8 and Figure.9.

3D plots:

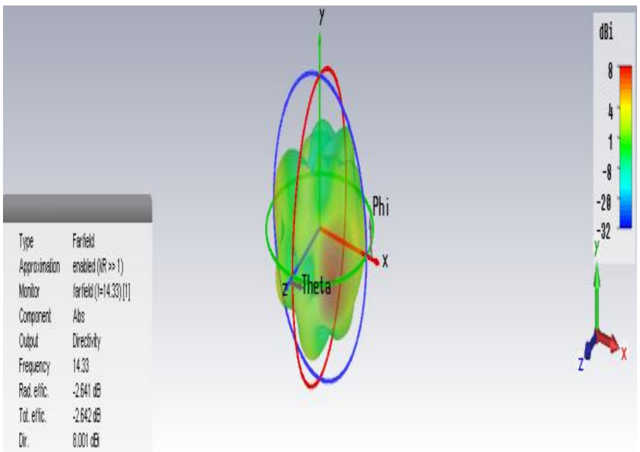

Figure. 6: 3D plot of far field pattern of proposed antenna at frequency 14.33GHz

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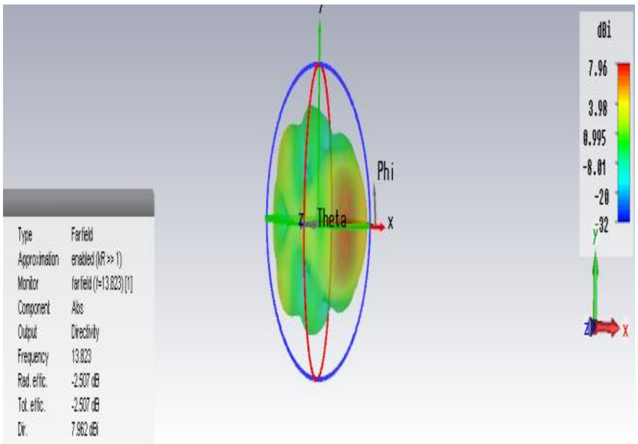

Figure. 7: 3D plot of far field pattern of proposed antenna at frequency 13.823GHz

Polar Plots:

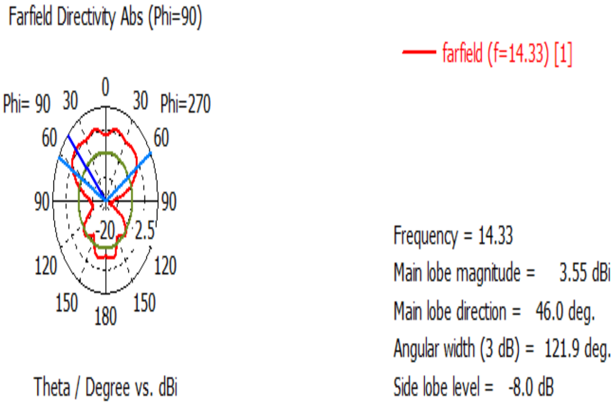

Figure. 8: Polar plot of far field pattern of proposed antenna at frequency 14.33GHz

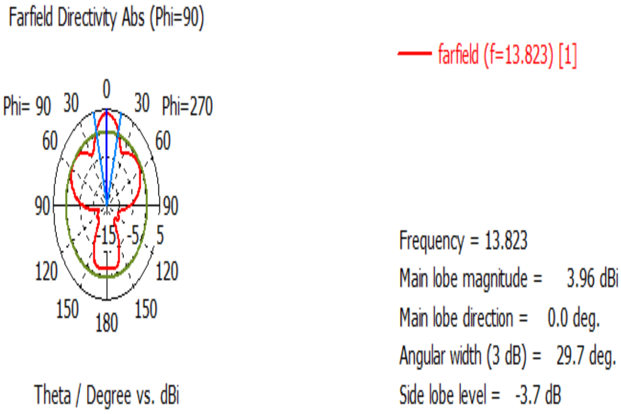

Figure. 9: Polar plot of far field pattern of proposed antenna at frequency 13.823GHz

VI. CONCLUSION

The proposed antenna has the return loss of 46.31942dB and -40.421846dB at frequencies 14.33 and 13.823 GHz. The proposed antenna has directivity of 8.001dBi and 7.962dBi at frequencies 14.33 and 13.823 GHz. Thus, the proposed antenna operates at two different frequencies in Ku band and the simulated results of this antenna are good when compared with other antenna shapes.

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