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Study on Triple-Band Fork Shaped Microstrip Antenna

P. Gowtham Kumar, Chinnarappa Gari Raghava Reddy, P. Chandrasekhar

Abstract: - In this paper, new Fork shaped microstrip patch antenna is designed to be operated in X-band and is used in applications like radar and in satellite communications. The dimensions of the ground plane, substrate and patch are (40 x 40) mm, (40 x 40) mm and (20 x 20) mm respectively. Copper annealed is used as the ground plane and also as the patch, the substrate is FR4 (lossy) material. The proposed antenna has the return loss of -34.064083dB, -27.912185dB and -24.539951dB at the operating frequencies of 11.352GHz, 10.04GHZ and 8.4682GHzrespectively. The directivities of the proposed antenna are 9.227dBi, 8.802dBi and 7.010dBi at respective frequencies of 11.352GHz, 10.04GHz and 8.4682GHZ. The results are simulated in CST Studio Suite software.

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

I. INTRODUCTION

An antenna is a transducer which is used to convert electrical energy into electromagnetic energy and vice versa. Normal antennas are very large in size and cannot be used in applications where size of antenna is very less. So, in the applications where size of antenna should be less, we use microstrip antennas. Microstrip antennas are the widely used antennas in present because of the following advantages like small size, low weight and they can be easily designed and fabricated. In this paper, fork shaped microstrip antenna has been proposed. This antenna can be used for many applications. This antenna functions in X band whose frequency range is 8-12 GHz. The proposed antenna is designed to be tuned at three frequency bands whose operating frequencies are 8.4682GHz, 10.04GHz, and 11.352 GHz respectively.

II. PROPOSED ANTENNA DESIGN

There are many stages in designing a fork shaped microstrip antenna. For a square shaped microstrip patch antenna if we incorporate three parallel slots in the patch, fork shaped microstrip patch antenna will be obtained. The fork shaped microstrip patch antenna is shown in Fig.1. Copper (annealed) is used as ground plane and also as the patch. The thickness of ground plane and the patch are 0.1mm and 0.1mm respectively. The dimensions of ground plane are 40 x 40 x 0.1 mm and the dimensions of patch are 20 x 20 x 0.1 mm. To reduce the size of the antenna, substrate having high dielectric constant should be chosen. So, FR4 (lossy) having high dielectric constant of 4.3 is used as a substrate.

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The thickness of the dielectric substrate in this antenna is 3.2mm. Feed is given to the antenna at 'h'.

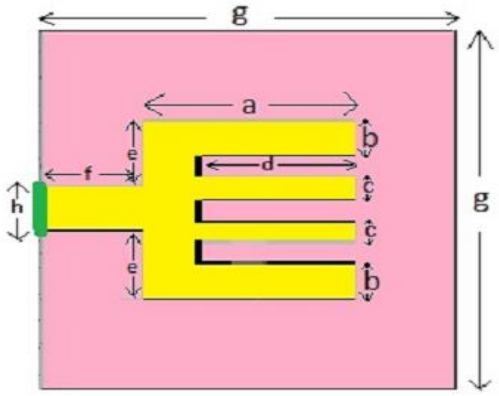

Fig.1: Fork shaped microstrip antenna

The dimensions of the antenna are presented in table.1

Table 1: Details of proposed antenna

A	20mm
B	4mm
C	2.25mm
D	15mm
E	7.125mm
F	10mm
G	40mm
H	6.75mm

III. RETURN LOSS

Return Loss - Return loss of any antenna should be very less if the antenna is efficient. The S-Parameter results are shown in Fig.2, Fig.3, Fig.4 for frequencies 8.4682, 10.04 and 11.352 GHz respectively.

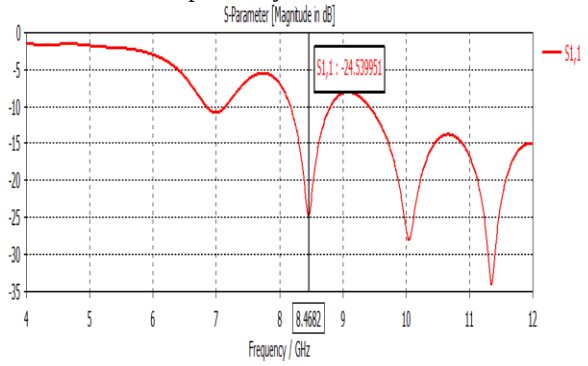

Figure.2: Return loss of proposed antenna at frequency f=8.4682GHz

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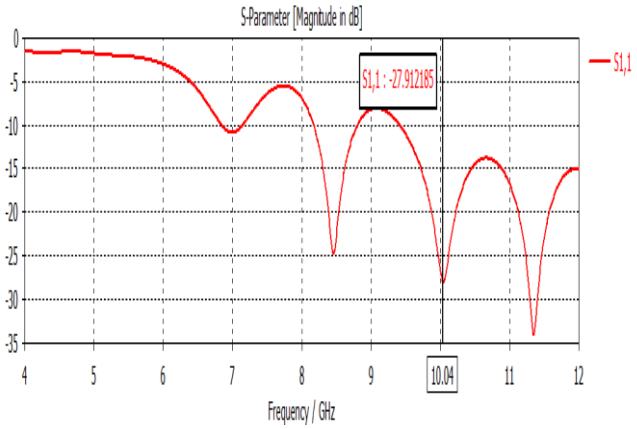

Figure.3: Return loss of proposed antenna at frequency f=10.04 GHz

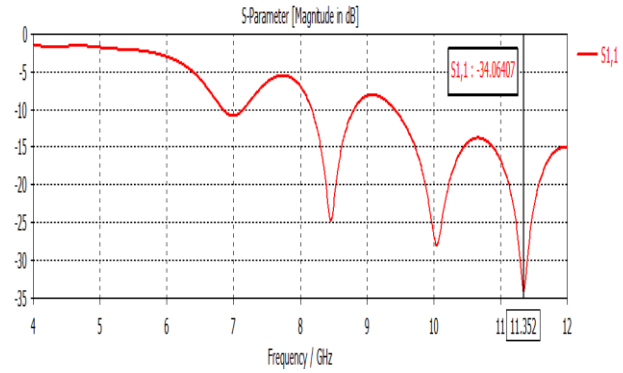

Figure.4: Return loss of proposed antenna at frequency f=11.352 GHz

IV. VSWR

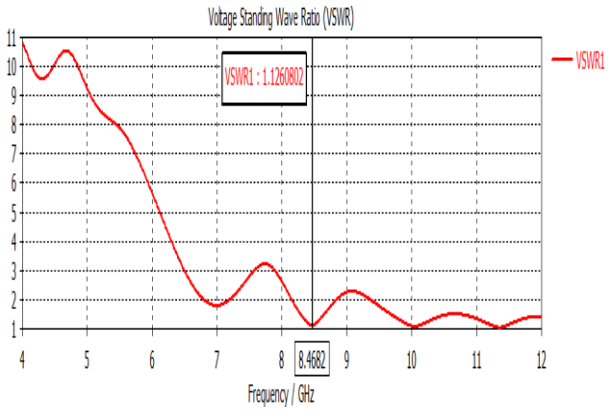

Figure.5: VSWR of proposed antenna at frequency f=8.8462GHz

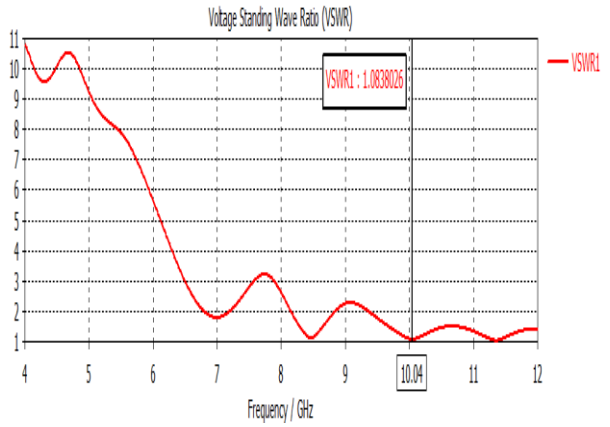

Figure.6: VSWR of proposed antenna at frequency f=10.04GHz

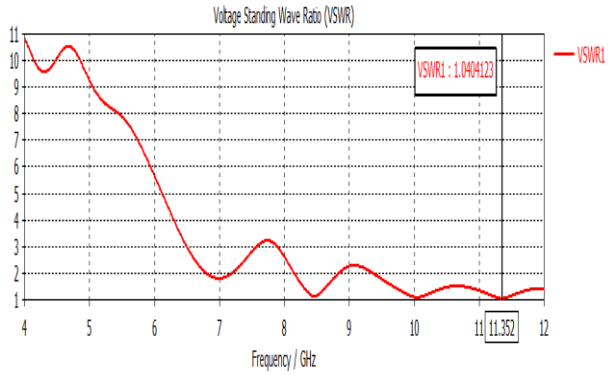

Figure.7: VSWR of proposed antenna at frequency f=11.352GHz

V. FAR FIELD PATTERN

The simulated results of far field patterns of the proposed antenna are shown in Figures 8 to 13.

3D plots:

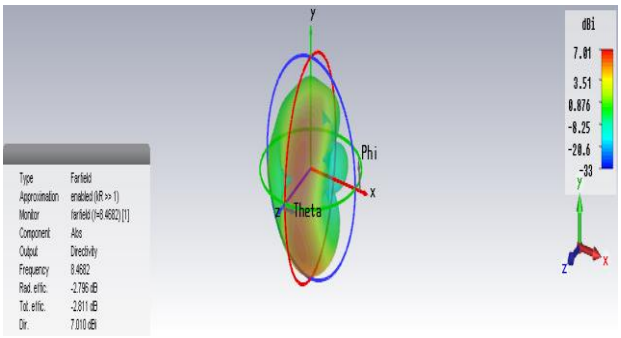

Figure.8: 3-D plot of far field pattern of proposed antenna at frequency f=8.4682GHz

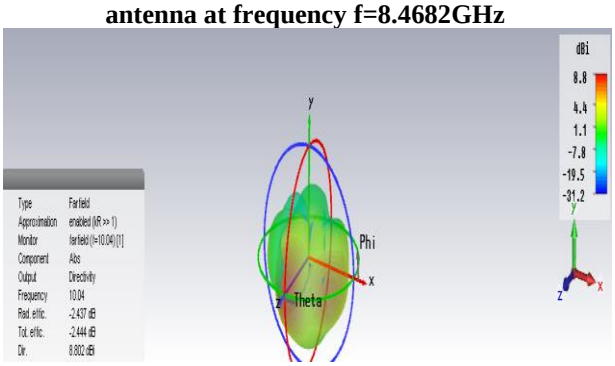

Figure.9: 3-D plot of far field pattern of proposed antenna at frequency f=10.04GHz

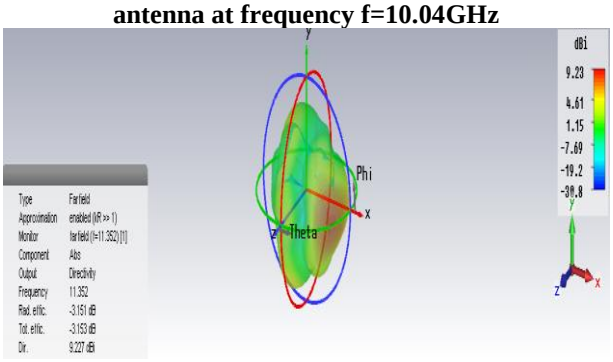

Figure.10: 3D plot of far field pattern of proposed antenna at frequency f=11.352GHz

Polar Plots:

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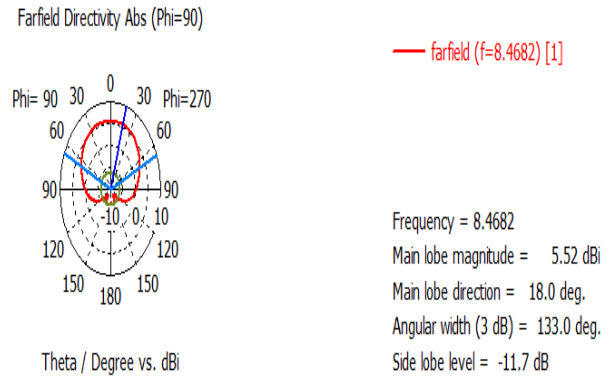

Figure.11: Polar plot of far field pattern of proposed antenna at frequency f=8.4682GHz

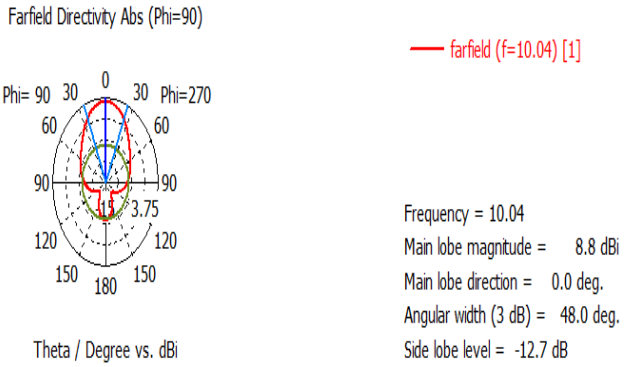

Figure.12: Polar plot of far field pattern of proposed antenna at frequency f=10.04GHz

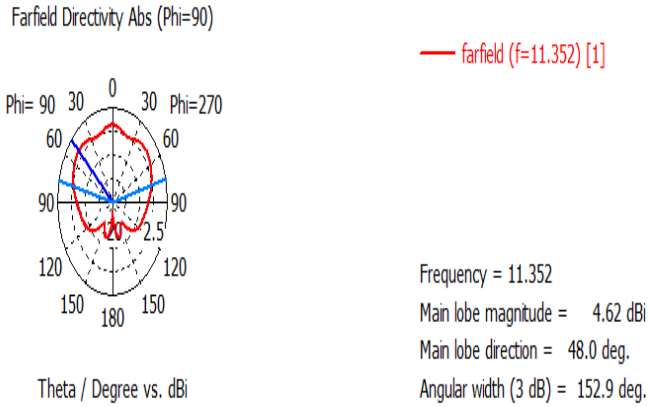

Figure.13: Polar plot of far field pattern of proposed antenna at frequency f=11.352GHz

VI. CONCLUSION

In this paper, the Fork shaped microstrip antenna operating at three different frequencies in X-band is presented. The simulated results from the software show that the antenna operates at three different ultra wide bands and also the return loss, VSWR and directivity are good compared with other antenna shapes.

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