

A Triple band Microstrip Antenna with Enhanced Bandwidth for Radar Applications

E. Kusuma Kumari, M. Vinod Kumar

Abstract—Here in this paper a triple band microstrip antenna is proposed. The designed antenna is of compact structure with dimensions 96mm x 27mm x 1.6mm including ground plane which is fabricated using Fr-4 substrate with dielectric constant of 4.6. This antenna has three resonant frequencies which are working at 6.6GHz with bandwidth of 1.1 GHz second band working at 8.3 GHz with bandwidth of 200MHz. and third operating frequency is 9.4GHz with bandwidth of 750MHz. All the band obtained here are providing large bandwidth which have wide range of applications. The other antenna parameters like return loss, directivity, gain, VSWR and current distribution are mentioned in this paper. The main purpose of this antenna was to provide a single antenna for multiple applications and with improved bandwidth for transferring large amount of data. The designed antenna is suitable for industrial applications also as because of its compact structure and its wide range of applications like radar, communication satellites, radiolocation, navigation air traffic control etc.

Keywords—multiband antenna, Triple-band antenna, Defective Ground Structure.

I. INTRODUCTION

The term microwave is employed to explain magnetic attraction waves with wavelengths starting from 1cm to 1m. The corresponding frequency vary is three hundred MHz to 300 gigahertz. This spectrum is restricted and needs to be shared, thus the demand for top performance RF/Microwave circuits is increasing that have high property and constant information measure is bit by bit increasing[1]. In recent years, the shrinking of antennas has become additional and additional necessary thanks to the increasing demand for little antennas because the fast development in wireless communications[2]. The advantages of microstrip antennas build them well-liked in several wireless communication applications like satellite communication measuring instrument, medical applications, aircraft, spacecraft, and missile applications at identical time disadvantages of Microstrip antenna is slender information measure, poor potency [3].

Thus, to improve the performance of microstrip antenna various techniques are used now a days one of which is DGS, in this we introduce some defects in ground plane and depending on the shape and dimensions of the defect, the shielded current distribution in the ground plane is disturbed, resulting a controlled excitation and propagation of the electromagnetic waves through the substrate layer [4].

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Various feeding techniques square measure used for transmission the magnetic attraction energy to a microstrip patch antenna. the task of feeding is incredibly necessary just in case of economical operation of antenna to enhance the antenna input electrical resistance matching [5]. the varied forms of feeding techniques square measure microstrip printing operation, co-axial feed, aperture coupled feed, proximity feed. The feeding used here during this antenna structure is microstrip printing operation during which a conducting strip is connected on to the sting of diverging patch. though many French telephone multiband antenna styles were projected [6],[7] they're either fed by microstrip lines [6],[7] or mini-coaxial cable [8].

This paper works for 3 bands with wide information measure applications below C band and X band. The antenna consists of 2 rectangular ring style of structures, and there a 2 stubs hooked up in it. The resonant frequencies we tend to have gotten ar as a result of these stubs as by variable their length there'll be variation in operative frequencies. we've additionally introduced the defect in ground plane as victimization this DGS technique the opposite antenna parameters were improved. The bandwidths measured here all follow the -5dB come back loss. The designed antenna is often used for radar, mobile applications, satellite applications, measuring instrument, military, traffic management etc.

This paper is in organized in four sections which are as follow. As the section I here give a grief introduction of proposed antenna. Section II, basic design of antenna is described, and fabricated structure is also included in it. In Section III, the simulated and measured results of designed antenna are presented and finally, the paper is concluded in Section IV.

II. ANTENNA DESIGN

In this section the basic design of proposed antenna is included. It includes both simulated as well as fabricated structure is explained. Figure 1 shows the structure of microstrip antenna both fabricated and simulated. Table I includes the dimensional parameters of antenna. For input two-dimensional conductor variety of feeding is employed. within the structure for every aspect of feeding one rectangular ring is hooked up with that one stub is hooked up within. The antenna structure is intended exploitation Fr-4 substrate that have stuff constant ($\epsilon_r=4.6$). The variation in in operation frequency and in antenna parameters is discovered

by varied the length and breadth of stub. The come loss parameters is improved by dynamical the breadth of rectangular ring. the opposite antenna parameters square measure improved by introducing the defects in ground structure. By varied the bottom structure, we have a tendency to square measure varied the present distributing that helps in up the antenna parameters. the opposite dimensions of projected antenna square measure given in Table one.

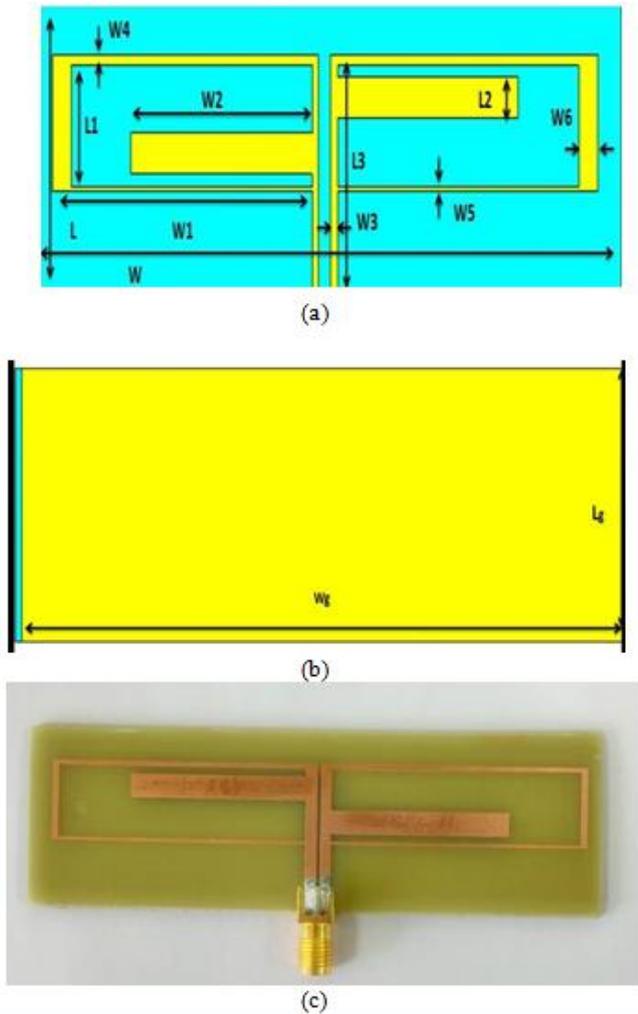


Fig.1 Proposed antenna structure (a)simulated structure front view. (b)simulated structure back view. (c) Fabricated structure

**TABLE 1
KEY DIMENSIONS OF ANTENNA DESIGN**

Name	Dimensions	Name	dimensions
L	27 mm	W	96 mm
L1	11.2 mm	W1	39.8 mm
L2	3.8 mm	W2	29.85mm
L3	22 mm	W3	1 mm
W4	1 mm	W5	0.3 mm
W6	3.15 mm	L _g	27 mm
W _g	94.85 mm		

III.SIMULATION RESULTS AND ANALYSIS

For simulation and optimization of proposed antenna electromagnetic simulation software CST is used. Various antenna parameters like return loss, radiation pattern and current distribution were observed and included in this section.

A. Return Loss and VSWR

The return loss graph is shown in fig.2 from the figure antenna is working for three bands first band is from 6Ghz to 7.1 GHz with the bandwidth of 1.1GHz, return loss is -35dB, second band is from 8.2GHz to 8.4GHz with a bandwidth of 200MHz return loss is -20dB, and the third band is from 9GHz to 9.745GHz with a band width of 745MHz return loss is -30dB as shown in Fig.2(a) Fig2(b) shows the measured results. From the graphs both the simulated and measured results are showing good similarity in their results.

Fig3. shows the graph for VSWR of antenna. For the operating frequency the VSWR should be less than 2. From the graph for three bands (first band is from 6Ghz to 7.1 GHz with the bandwidth of 1.1GHz, second band is from 8.2GHz to 8.4GHz with a bandwidth of 200MHz and the third band is from 9GHz to 9.745GHz with a band width of 745MHz.) VSWR is less than 2.

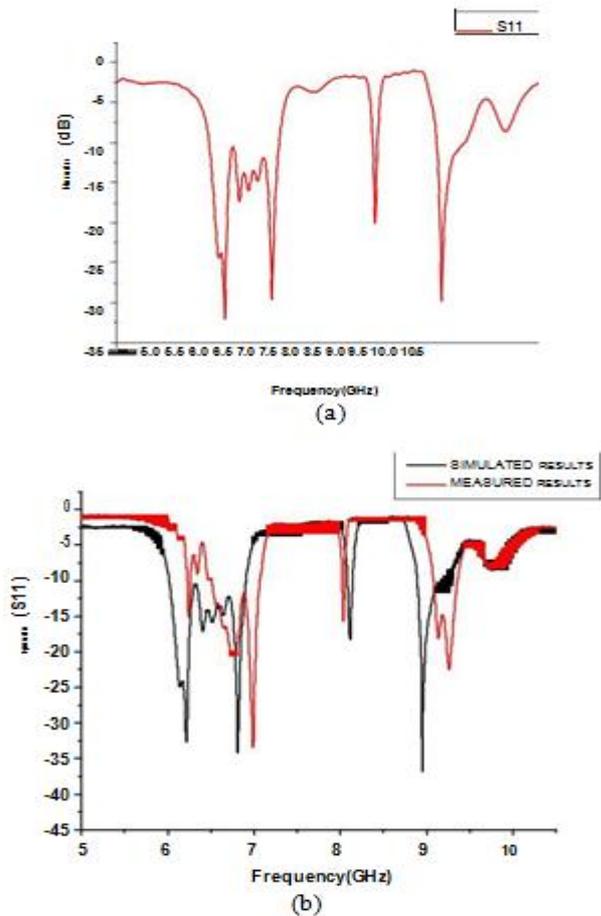


Fig.2 Return loss (a) simulated (b) comparative result of simulated andmeasured

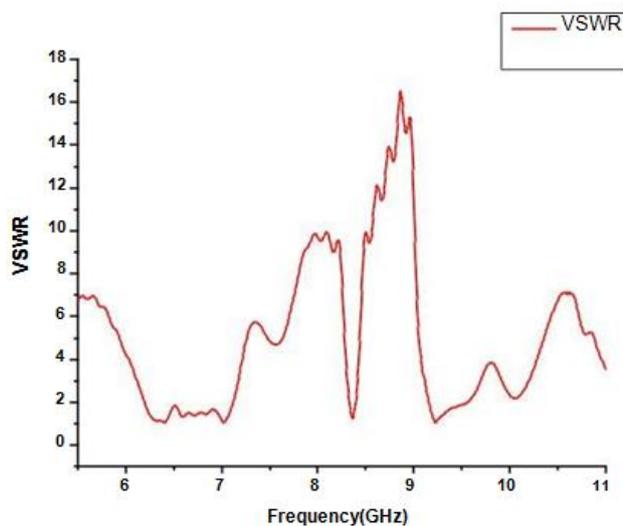
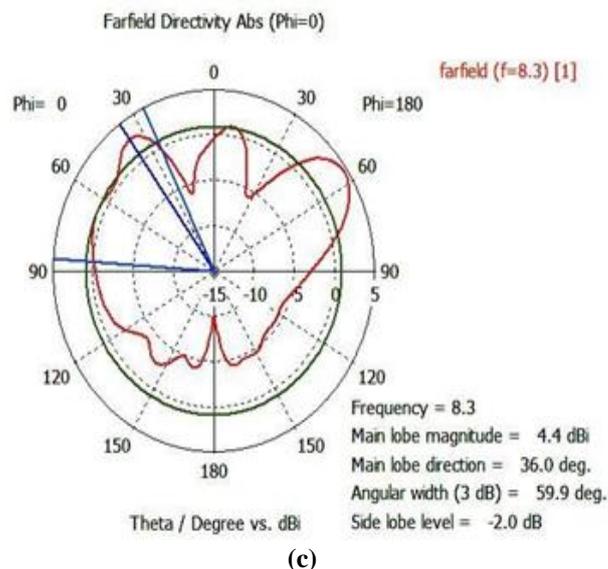
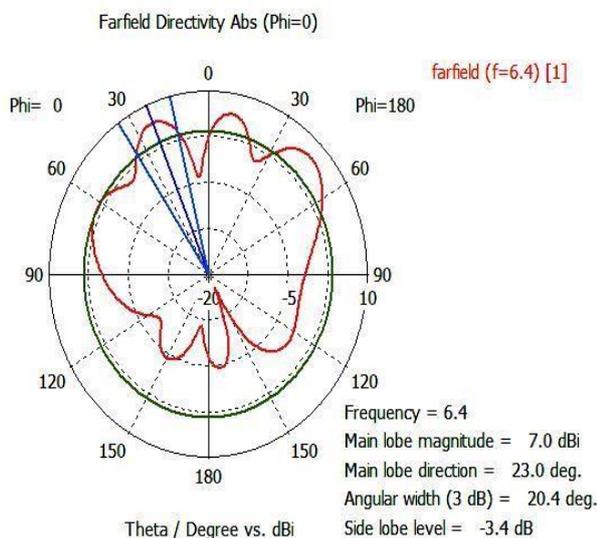


Fig.3. Simulated VSWR

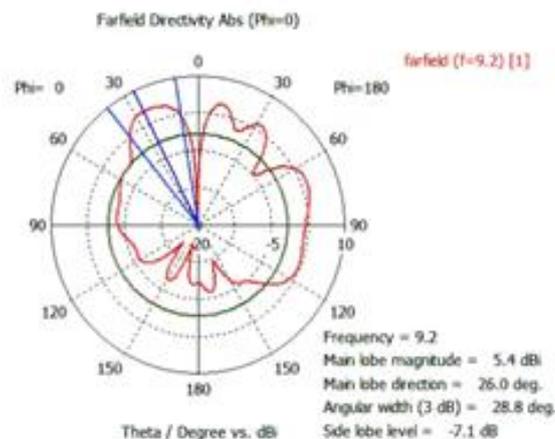


(c)

B. Radiation pattern

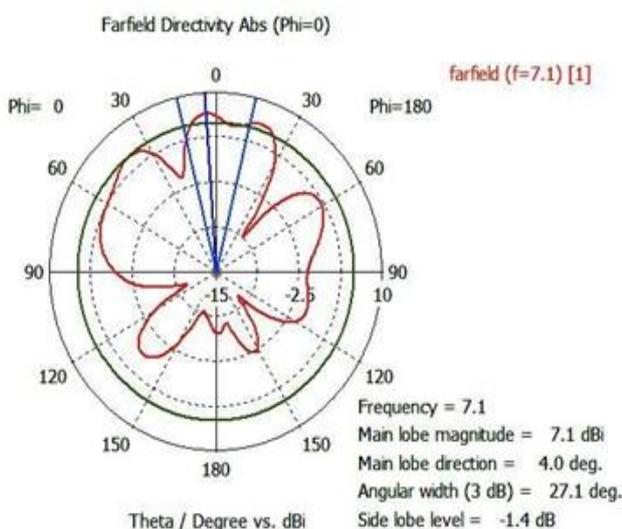


(a)



(d)

Fig.4 Directivity at (a)6.4GHz (b)7.1GHz (c)8.3GHz (d) 9.2 GHz



(b)

C. Surface Current Distribution

Surface current in an antenna shows the flow of current in the antenna. It shows the current density as where the current is maximum, and it is shown by dark areas and where the current density is low it is shown by light shaded area. Fig.5 shows the surface current distribution at all the resonant frequencies. From the entire figure it can be concluded that near the of comb like antenna structure maximum current is flown.

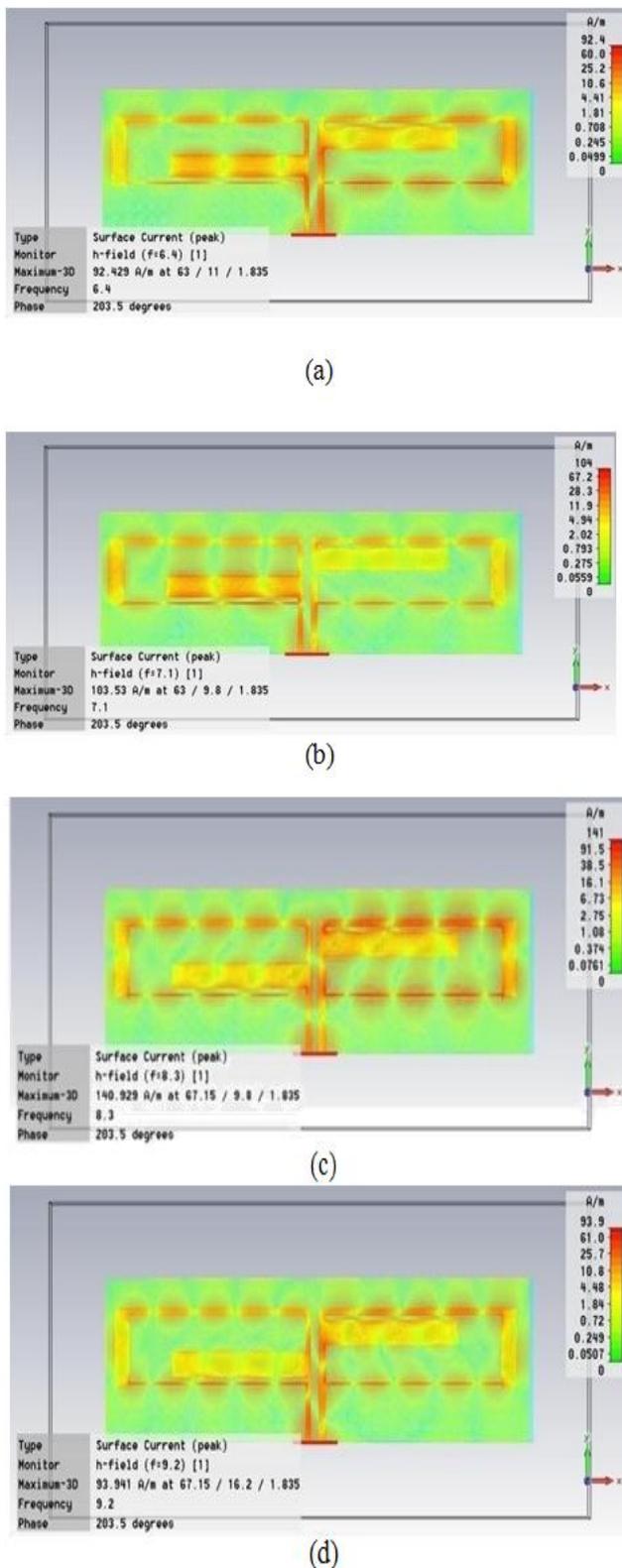


Fig.5 Surface current distribution at different resonant frequencies

IV. CONCLUSION

A triple band micro strip antenna is proposed in this paper. The antenna is improved from its last structure [1] as in that it was working for six different bands while their bandwidth was not good, so this new structure shows three bands working for various applications as the bands have wide

bandwidth. The structure has two rectangular hollow patches and one stub in each rectangular patch. The three bands achieved have wide bandwidth the first band is from 6GHz to 7.1 GHz with the bandwidth of 1.1GHz, second band is from 8.2GHz to 8.4GHz with a bandwidth of 200MHz and the third band is from 9GHz to 9.745GHz with a band width of 745MHz. The bandwidths measured here all follow the -5dB return loss. The designed antenna can be used for weather radar, mobile applications, satellite applications, radiolocation, military, air traffic control etc.

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