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Design of a Multiband Antenna with Defected Micro Strip and Defected Ground Structures

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Abstract: ***A microstrip-fed multi-band antenna is proposed for wireless communication applications. So far the multiband characteristics are achieved by using Defected Ground Structures(DGS), in the proposed antenna the multi-band characteristics are implemented by using Defected Microstrip Structure(DMS) along with Defected Ground Structure. In the process of DMS, the defected structures are formed by cutting 'U' shape structures of different dimensions in the microstrip feed line. The proposed antenna can be operated at three different bands of frequencies at 2.4GHZ, 6.7GHZ and 9.34GHZ, which are very suitable for S-band, C-band and X-band communication systems. The proposed antenna is designed and simulated by using HFSS software.***

Keywords: ***Microstrip patch antenna, Defected ground structure, Defected microstrip structure and HFSS.***

I. INTRODUCTION

In modern wireless communication systems, microstrip antenna[3] is one of the most preferred antenna structures for wireless communication devices and handheld communication devices due to its small size, light weight, low profile and easy integration with other components. One of the physical characteristics of these handheld and wireless communication devices are their small size. Recent advancements in communications reported the use of multiband antenna with compact size. A number of techniques have been reported for multiband operation with reduced size. In this paper the proposed multiband antenna with compact size is designed by using defected microstrip structure[2] and defected ground structures. In defected microstrip structures the 'U' shape structures were removed from the microstrip feed line and in defected ground structure some part of the ground material is removed. DMS increases the electric length of the microstrip line and makes the effective capacitance and inductance increase. The proposed antenna exhibits multiband characteristics at frequencies 2.4GHZ, 6.7GHZ and 9.34GHZ in three different bands namely S-band, C-band and X-band respectively. The antenna not only operated at these S-band, C-band and X-band but also without these U shape structures the simple antenna can be used for ultra wide band applications. The proposed multiband antenna has its practical applications in Wi-Fi, small communication satellites, radar and space applications.

II. DESIGN OF THE ANTENNA

The dimensions of the designed patch antenna are shown in Fig.1. Considering that Arlon AD260A (tm) is low-loss and stable, the antenna is built on the Arlon AD260A (tm) substrate with dielectric constant (ε_r) 2.6 and loss tangent 0.0017. Out of many available substrate materials, Arlon AD260A (tm) is chosen because it has excellent low loss electrical properties. The electrical properties of AD260A are highly desired in applications where higher frequency and expectations for increased fidelity with broadband signals are beyond the performance capabilities offered by high temperature or low temperature ceramics and thermosets. The antenna is composed of a patch with microstrip feed line. The antenna is designed with patch dimensions $48\text{mm} \times 32\text{mm} \times 1\text{mm}$ by tapering the edges of the patch at top and cutting rectangular slots in the patch. The designed antenna is fed with microstrip feeding technique. The slots in the microstrip feed line structure results in multiband behavior and tapering of patch causes improved bandwidth[5].

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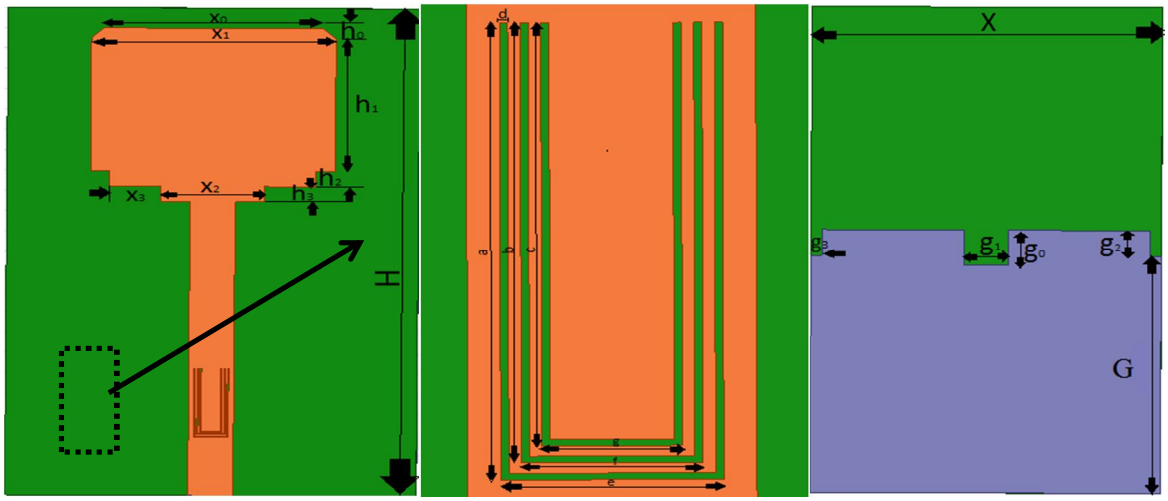
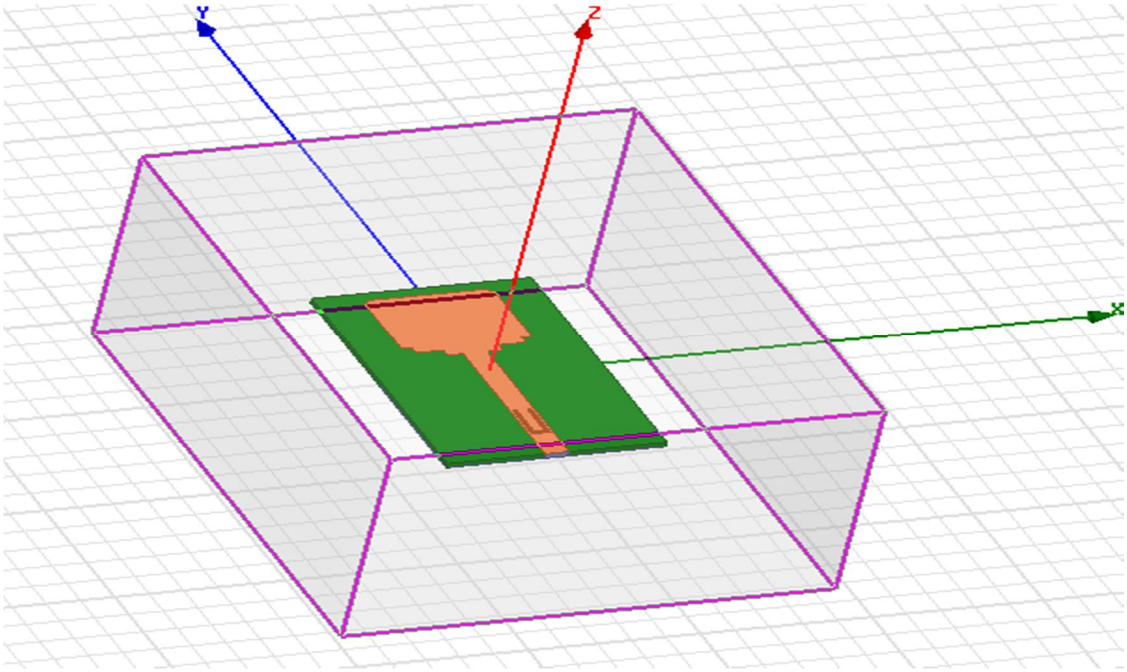


(a)Top view (b) 'U'shape cuts (c)back view



(d)3D view

Fig.1.Dimensions of the antenna; (a)Top view, (b) 'U'shape cuts, (c)back view and (d)3D view

(X=32mm, x0=18mm, x1=19mm, x2=8mm, x3=4mm, H=48mm, h0=1mm, h1=13mm, h2=1.5mm, h3=1.5mm, G=23.4mm, g0=3.5mm, g1=4mm, g2=2.6mm, g3=1mm, a=6.75mm, b=6.50mm, c=6.25mm, d=0.1mm, e=2.5mm, f=2mm, g=1.5mm).

III. SIMULATION AND RESULTS

The antenna design and simulation is done by using HFSS software. HFSS is a commercial electromagnetic simulator produced by Ansys company. The output graphs like return loss, VSWR, Radiation patterns and gain patterns were plotted using this software.

A. Return Loss

Return loss (S11) is a parameter which represent how much power is reflected from the antenna. Return loss is a measure of how well devices or lines are matched. The results for the three operating bands S-band, C-band and X-bands were shown in figure 2. Return loss for S-band (2.4 GHz) is -18.9287dB, for C-band (6.7GHz) is -21.5897dB, for X- band (9.34 GHz) is -19.9567dB. The return loss is less than -10dB for all the three bands. The Return loss plot for proposed antenna is shown in fig 2.

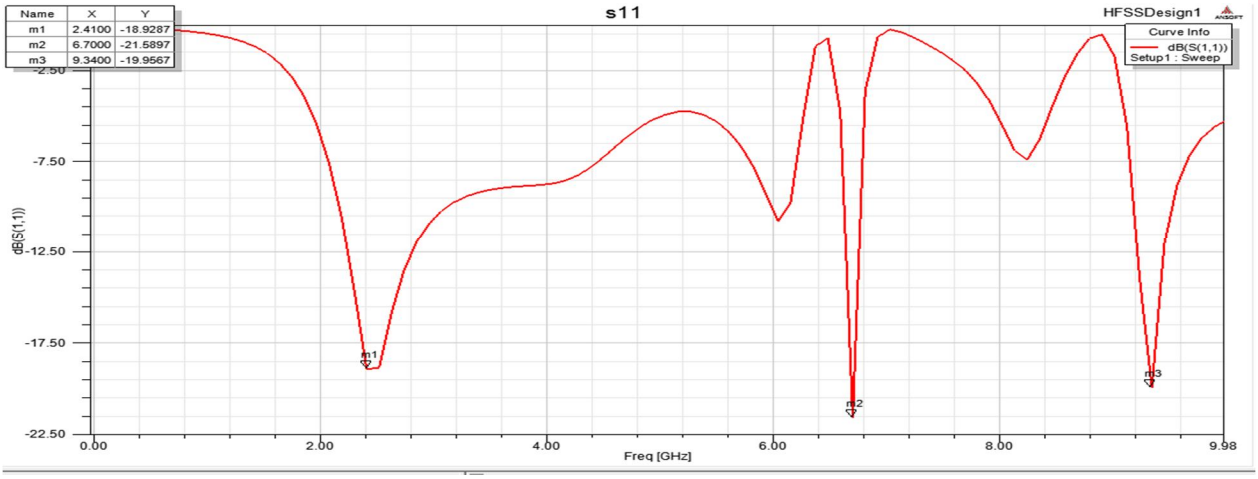


Fig 2: Return loss Vs. frequency plot

B. Voltage Standing Wave Ratio (VSWR)

VSWR is a measure that numerically describes how the antenna impedance is matched with transmission line impedance. The VSWR values for S-band (2.4 GHz) is 1.2551, for C-band (6.7GHz) is 1.1817, for X- band (9.34 GHz) is 1.2235. The VSWR plot for proposed antenna is shown in fig 3.

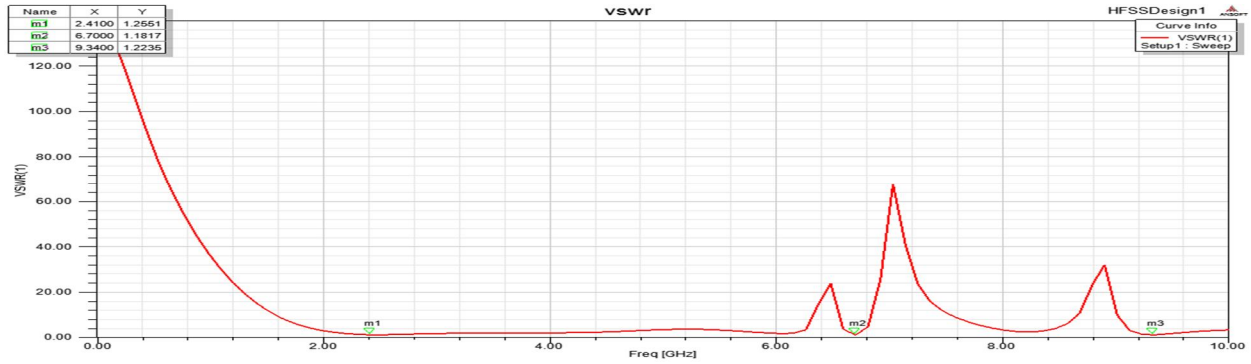
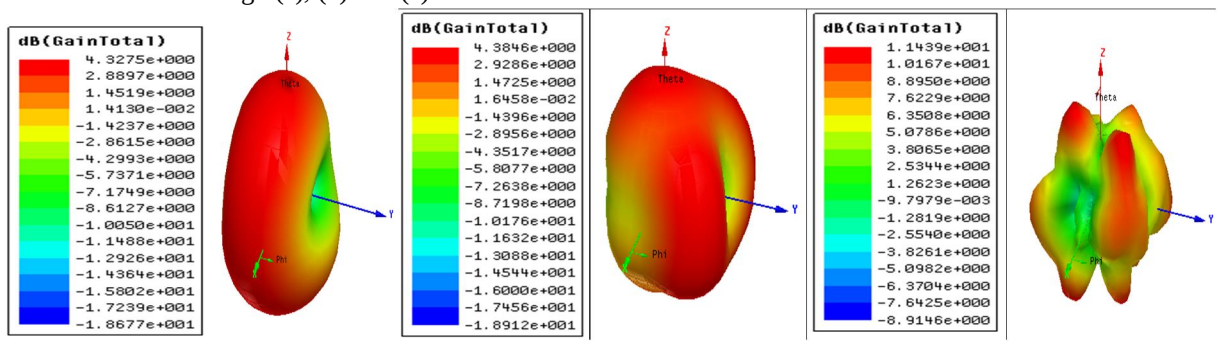


Fig 3.VSWR Vs. frequency plot

C. Gain

Antenna gain describes how much power is transmitted in the direction of peak radiation to that of an isotropic source. The gain values for S-band (2.4 GHz) is 4.32dB, for C-band (6.7GHz) is 4.38dB, for X- band (9.34 GHz) is 11.43dB. The Gain plot for proposed antenna is shown in fig 4(a), (b) and (c).



(a)3-D polar plot at 2.4GHz (b) 3-D polar plot at 6.7GHz (c) 3-D polar plot at 9.34GHz

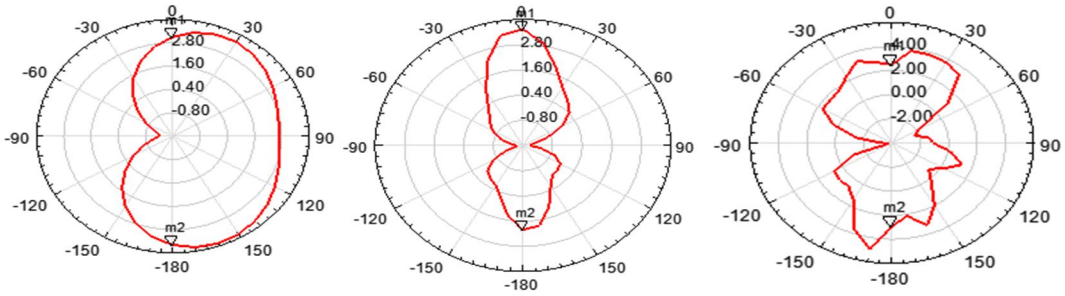
D. Radiation Pattern

Radiation pattern is a graphical representation of the radiation properties of antenna as a function of space coordinates. The radiation patterns for S-band (2.4 GHz), C-band (6.7GHz) and X-band(9.34GHz) is shown in figure 5(a), (b) and (c).

Name	Theta	Ang	Mag
m1	0.0000	0.0000	3.1060
m2	-180.0000	-180.0000	3.5966

Name	Theta	Ang	Mag
m1	0.0000	0.0000	3.5409
m2	180.0000	180.0000	2.0079

Name	Theta	Ang	Mag
m1	0.0000	0.0000	2.5045
m2	-180.0000	-180.0000	2.9430



(a) Radiation pattern at 2.4GHz (b) Radiation pattern at 6.7GHz (c) Radiation pattern at 9.34GHz

IV. CONCLUSION

In this paper a microstrip fed multiband antenna using DMS and DGS is simulated using HFSS software and the obtained results shows that the antenna is capable of operating in three different bands which are S-band, C-band and X-band which have a tremendous applications in these bands like Wi-Fi, satellite, radar and space communications. Also the proposed antenna has a good multiband characteristics.

V. BIOGRAPHIES

N Atchyuth Kumar is currently pursuing M. Tech degree in Communication Engineering and Signal Processing (CESP) from University College of Engineering and Technology, Acharya Nagarjuna University, Guntur, India. He obtained B. Tech degree in Electronics and Communication Engineering from QIS College of Engineering and Technology, Ongole in 2015. His areas of interest are Antenna designing and Wireless communication systems.

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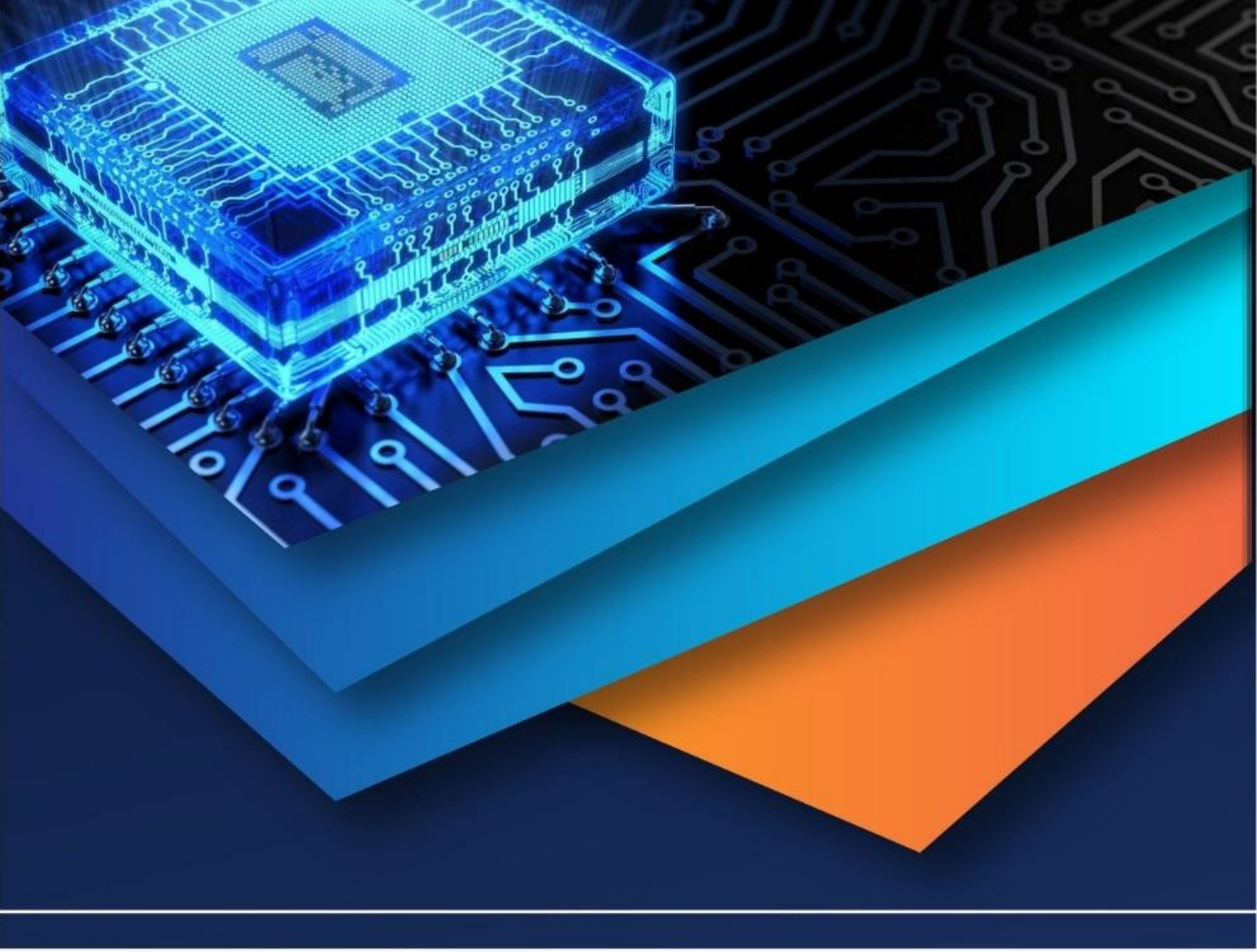

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