Dual band DGS Antenna for WLAN Applications

Rajeshwar Goud Jangampally[1], Bandi Manjula[2], Begari Akhila[3], Begari Sai Prudhvi[4], Adabala Kalyan Naidu[5]

[1]*Associate. Prof., ECE Dept., Hyderabad institute of technology and management,*Medchal, T.S., India

[2,3,4,5]*Student, Electronics and communication engineering, Hyderabad Institute of Technology and management,* Hyderabad, India

***Abstract—* A novel and compact dual band Antenna for 2.4/5.1-GHz wireless local area network (WLAN) applications is proposed. The proposed antenna is defected in ground and it is fed. The antenna is printed on FR4 substrate and with dielectric constant 4.4. The antenna operates on two bands at 2.4GHz and 5.1 GHz which is for WLAN respectively and the simulation is done in HFSS software. The planar design, simple feeding technique and compactness make it easy for the integration of the antenna into circuit boards. DGS has been integrated on the ground plane with planar transmission line, that is, microstrip line, coplanar waveguide, and conductor backed coplanar wave guide. The defects on the ground plane disturb the current distribution of the ground plane. Simulation tool, based on the method of moments has been used to analyze and optimize the antenna. Various features such as miniature size, simple con-figuration and low fabrication cost make the antenna suitable for wireless networks**

Keywords - Dual-band, HFSS, in set fed, DGS, WLAN.

I. INTRODUCTION

In recent times, Microstrip patch antennas are extremely prevalent because of its benefits, for example, low profile, inexpensive to manufacture, light weight and easy to fabricate.Inspite of these benefits, there are faults like narrow bandwidth, poor power handling capacity in microstripantennas [1-2]. Generally, microstrip antennas operate in different frequency bands, individual antennas are required to cover each band which prompts space-restricting problem. Oneway to fulfill this requirement is using multiple antennas, but itwill increase the size and complexity of the system. To conquerthis problem, dual-band slot antennas are required where a single antenna provides two resonate frequencies. Henceforth it decreases the system size and complexity [3]. In dual-band microstrip antennas it is conceivable that numerous measures, for example, WLAN principles can be coordinated into a single wireless device. To accomplish the wide bandwidth, slot need to be adjusted with appropriatelength and width. With suitable development of antenna, to accomplish a wide bandwidth different shapes of slot antennaswere proposed, which included rectangular, triangular, circular[4], elliptical [5], triangles [6]. Slot antenna with edge fed is used to obtain dual-band antenna [7].

Over the previous years, a few procedures have been accounted for dual-band antenna design, one of the generally acknowledged strategy to outline is loading the radiating patch with a slot [12]. DGS has been integrated on the ground plane with planar transmission line, that is, microstrip line, coplanar waveguide, and conductor backed coplanar wave guide. The defects on the ground plane disturb the current distribution of the ground plane; this disturbance changes the characteristics of a transmission line (or any structure) by including some parameters (slot resistance, slot capacitance, and slot inductance) to the line parameters (line resistance, line capacitance, and line inductance). In other words, any defect etched in the ground plane under the microstrip line changes the effective capacitance and inductance of microstrip line by adding slot resistance, capacitance, and inductance.[3]

II. ANTENNA CONSTRUCTION AND DESIGN

The structure of Dual band DGS antenna is shown in fig. 1

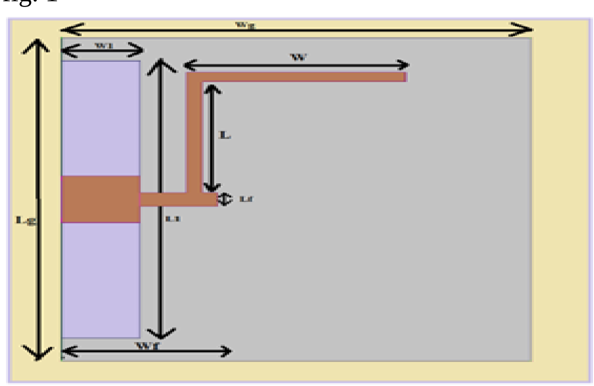

Fig. 1. Dual band DGS antenna

The dual-band DGS antenna is designed with its patch length(L) and width(W), using FR4 epoxy substrate having dielectric constant of 4.4.

TABLE I. DESIGN DIMENTIONS

NAME	DIMENSIONS (mm)
W_g	60
L_g	70
W	14
L	13.25
L_f	1.5
W_f	6
W_1	5
L_1	30

In our study, electrical size of the antenna is decreased, good impedance matching is obtained and antenna becomes compact by cutting all the corners of a patch. Second resonantmode is excited by first resonant mode as they are very nearer to each other to achieve dual-band operation. This antenna will provide the good return loss, VSWR and radiation pattern.

III. RESULTS AND DISCUSSION

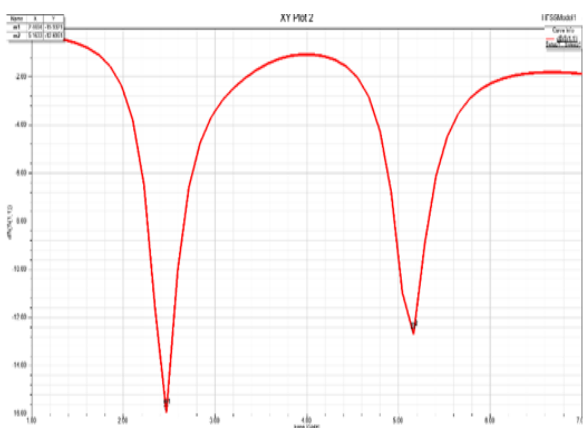

Fig.2. simulated return loss at 2.4 GHz -5.1 GHz

Fig.3. simulated VSWR of Dual band antenna

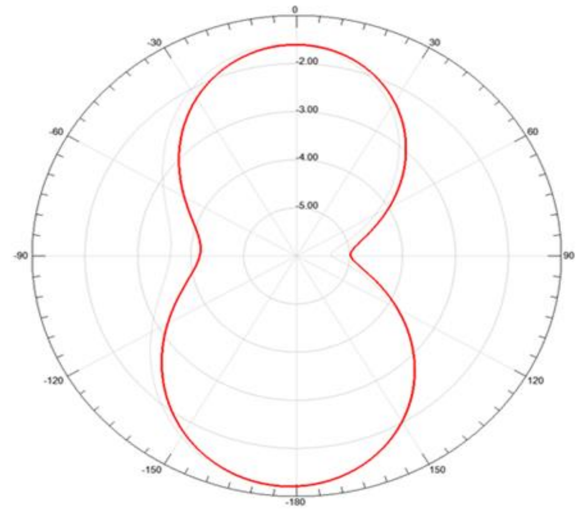

Fig.4.simulated radiation pattern $(0=90^0)$

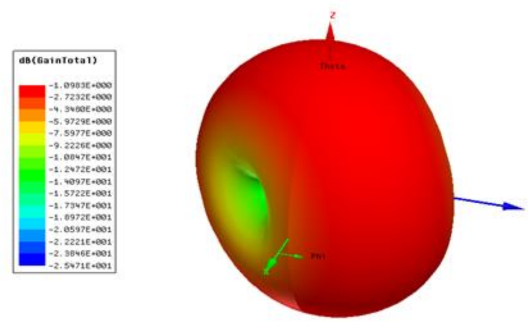

Fig.5. simulated 3D polar plot for 2.4 GHz

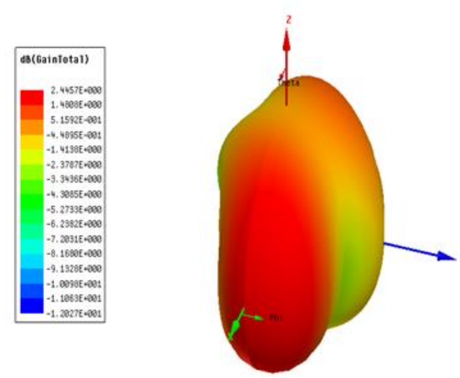

Fig.5. simulated 3D polar plot for 5.1 GHz

The VSWR and return loss were measured using vector network analyzer. The measured value of inset-fed antenna return loss is -16dB at 2.4 GHz and -15dB at 5.1 GHz as shown in fig. 3. These antenna parameters meet the requirements for WLAN [3].

IV. CONCLUSION

The simulation studies are carried for the antenna at designated frequency bands. A good agreement is noticed among the simulation and experimental results of inset-fed antenna in the frequency band 2.4 GHz to 5.1 GHz. we designed Dual band DGS antenna for different materials at different thickness (mm) using substrate material (having dielectric constant r = 4.4) and feed position by using High Frequency Structure Simulator (HFSS) software. The overall working of antennas wasunderstood. The major parameter such as Return Loss of the design at 2.4 and 5.1GHz and applications were studied and achieved successfully. For changing substrate thickness all materials have their best bandwidth (%) at a certain thickness. For slot, we used FR-4 Epoxy™ (dielectric constant, er is 4.4) as substrate material. For a thickness of 1.6 mm the maximum percentage bandwidth is 35.5%[3]. The measured and simulated result shows that the antenna bandwidth has enhanced.

REFERENCES

[1] Surendra K. Gupta, Ashish Sharma, Binod K. Kanaujia, Shekar Rudra, Ritu Raj Mishra and G.P. pandey, "Orthogonal slit cut stacked circular patch Microstrip antenna for Multiband operation". Microwave Optical Technology letters/ Volume 55, No. 4, April 2013.

[2] S.-W. Qu, J.-L. Li, J.-X. Chen, and Q. Xue, "Ultrawideband strip- loaded circular slot antenna with improved radiation patterns," *IEEE Trans. Antennas Propag.*, vol. 55, no. 11, pp. 3348–3353, Nov. 2007.

[3] Rajeshwar Goud Jangampally, "corner cut inset-fed Dual-Band slot antenna for PCS and Bluetooth/WLAN Applications" *IEEE Trans.*, 978-1-5386-7070-6/18,2018.

[4] S.-W. Qu, J.-L. Li, J.-X. Chen, and Q. Xue, "Ultrawideband strip- loaded circular slot antenna with improved radiation patterns," *IEEE Trans. Antennas Propag.*, vol. 55, no. 11, pp. 3348–3353, Nov. 2007.

[5] P. Li, J. Liang, and X. Chen, "Study of printed elliptical/circular slot antennas for ultrawideband applications," *IEEE Trans. Antennas Propag.*, vol. 54, no. 6, pp. 1670–1675, Jun. 2006.

[6] W.-S. Chen and F.-M. Hsieh, "Broadband design of the printed trian- gular slot antenna," in *Proc. IEEE APS Int. Symp.*, Jul. 2004, vol. 4, pp. 3733–3736.

[7] Y. F. Liu, K. L. Lau, Q. Xue, and C. H. Chan, "Experimental studies of printed wide-slot antenna for wide-band applications," *IEEE Antennas Wireless Propag. Lett.*, vol. 3, pp. 273–275, 2004.

[8] D.N. Elsheakh, H.A. Elsadek, E.A. Abdallah, M.F. Iskander, and H. Elhenawi, "Reconfigurable single and multiband inset feed microstrip patch antenna for wireless communication devices," Progress in Electromagnetics Research C, vol.12, pp.191–201, 2010.

[9] S. Verma, J. A. Ansari, and M. K. Verma, "A novel compact multi-band microstrip antenna with multiple narrow slits," Microwave and Optical Technology Letters, vol.55, no.6, pp. 1196–1198, 2013.

[10] L. Xu, Z. Y. Xin, and J. He, "A compact triple-band for k shaped antenna for WLAN/WiMAX applications," Progress in Electromagnetics Research Letters, vol.40, pp.61–69,2013.

[11] L. Dang, Z.-Y. Lei, Y.-J. Xie, G.-L. Ning, and J. Fan, "A compact microstrip slot triple-band antenna for WLAN/WiMAX applications," *IEEE Antennas Wireless Propag. Lett.*, vol. 9, pp. 1178–1181, 2010.

[12] D.D. Krishna, M. Gopalkrishna, C.K. Anandan, P. Mohanan, and Vasudevan, Compact dual band slot loaded circular microstrip antenna with a superstrate, ProgrElectromagn Res 83 (2008), 245–255.

[13] J. P. Thakur, J.-S. Park, B.-J. Jang, and H.-G. Cho, "Smallsize quad band microstrip antenna," Microwave and Optical Technology Letters, vol.s49, no.5,pp.997–1001,2007.

[14] J. Pei, A.-G. Wang, S. Gao, and W. Leng, "Miniaturized triple-band antenna with a defected ground plane for WLAN/WiMAX applications," IEEE Antennas and Wireless Propagation Letters, vol. 10, pp. 298–301, 2011.