ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 4, April 2015

Realization of Printed Monopole Antenna for Dual Band Application

Gaurav Kulkarni[1], Rahul Pandey[2], Mrunali Kothavale[3],Meghna Nair[4]

Student, Electronics & Telecommunication, LokmanyaTilak College of Engineering, Navi Mumbai, India [1,2,3,4]

Abstract: This paper describes the design of a small dual band planer antenna to operate in the ISM (2.4-2.48 GHz) and WLAN (5-6 GHz) band. Dual band operation is achieved by choosing proper microstrip antenna shape and reduced ground plane which becomes a monopole antenna. Simulation of the antenna is carried out using IE3D software. The simulated results in terms of return loss and radiation patterns are studied. It exhibits broadband impedance matching, consistent omnidirectional radiation patterns and appropriate gain characteristics (>2.5 dBi) in the RFID and WLAN frequency regions. The designed antenna can be suitable for the ISM band (2.4-2.48 GHz) and WLAN (5-6 GHz) band.

Keywords:ISM Band, WLAN band, Microstrip patch antenna, Printed monopole, Return Loss.

I. INTRODUCTION

Wireless communications have gained a wider and wider popularity in the later years. Presently, the trend is that of providing a wireless link to every kind of electronic device. In this framework, Personal Digital Assistants (PDAs), notebooks, cellular phones are becoming constitutive elements of new generation networks. In particular, there is a specific need for greater capacities and transmission speeds, which, together with a growing demand from users for more complicated services, imply the design of higher performance systems. The first cellular telephones were big, heavy, and clumsy but worked well using large, coax-fed, half wavelength antennas. As cellular-phone handsets became smaller, so did the antennas. As the continuing cellular- infrastructure build up eases demand on the communications-link margin more cell towers mean a better signal service providers are willing to surrender 2 or 3 dB of communications-link margin to offer distinctively designed, highly compact phones that rely solely on internal antennas. Multi-band operation is a necessary feature for nearly every cellular phone. The design of an effective single-band internal antenna is not trivial, and designing a multi-band internal antenna is even more demanding. Many of the fundamental design issues conflict with each other. The planar antennas are very easy to manufacture, low-cost, and can be easily integrated within the printed circuit boards (PCBs) of notebook computers, mobile terminals, and other wireless networking equipment. The planar monopole antenna has attracted the most attention since it can be integrated with other devices in the system. The ground-plane effects on planar monopole antennas are an important issue and have beeninvestigated by some researchers in the past. It was shown that the ground plane has significant effects on antenna properties, such as impedance bandwidth, radiation pattern etc. This is due to the fact that the ground plane may introduce extra resonant modes and change the current distribution on the antenna structure, hence to distort its performance. In this design a method of cutting slots on the ground plane is introduced to reduce ground-plane effects on antennas. Here a big rectangular slot is cut from the top edge of the ground plane to confine the current distribution on the ground around the radiator so as to reduce the effects from other part of the ground plane. This method has advantages of being general and easy to implement.

The three essential parameters for the design of a C shaped printed monopole antenna are as follow:

Frequency of operation (fo): The resonant frequency of the antenna must be selected appropriately. The ISM Band frequency ranges from 2.4 - 2.4835 GHz and 5-6 GHz for WLAN Band. Hence the antenna designed must be able to operate in this frequency range. The resonant frequency selected for my design is 2.45 GHz.

Dielectric constant of the substrate (Ɛr): The dielectric material selected for my design is glass epoxy FR4 substrate which has a dielectric constant of 4.3. A substrate with a high dielectric constant has been selected since it reduces the dimensions of the antenna.

Height of dielectric substrate (h): For the microstrip patch antenna to be used in ISM Band Application, it is essential that the antenna is not bulky. Hence, the height of the dielectric substrate is selected as 1.59 mm.

II. METHODOLOGY

1. **Estimate patch dimension:** Patch dimension of monopole antenna is calculated by using equation of lower edge frequency according to the resonant frequency and required bandwidth and gain.
2. **Design of Antenna:** According to the dimensions and parameters calculated in above step monopole antenna is designed by using IE3D software.
3. **Simulation:** Simulate the above designed antenna by using the IE3D simulator and obtain parameters such

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

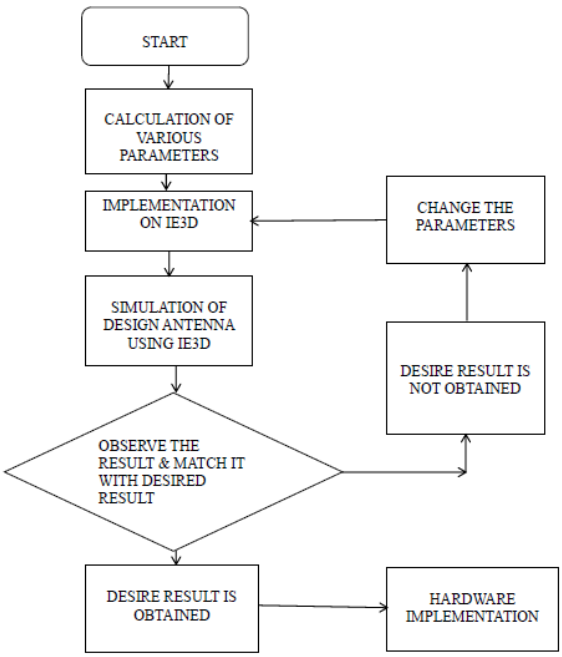
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 4, April 2015

as current distribution, radiation pattern, gain v\s frequency plot, VSWR etc.

4. **Hardware Implementation:** If the desired parameters and results are satisfied then implement the structure on hardware, design monopole printed antenna using double sided copper clad.

5. **Observation of hardware result:** After implementing the structure on hardware analyze the result and observe whether the desired parameters are achieved as in software design.

III. FLOW CHART



IV. DESIGNED STRUCTURE

Fig.1 shows the structure of monopole antenna investigated in this letter. This antenna is built using a standard FR4 substrate (dielectric constant=4.3) with a thickness of 1.6 mm. The antenna consists of a C shaped radiator connected to a 50ohm microstrip feed line of width 3 mm. The antenna has a size of 40 mm x 20 mm and a portion of ground material is removed which makes it monopole antenna with a ground plane of a size 20 mm x 15 mm. The antenna can resonates at dual band with a reflection coefficient below -10 db. For the radiator microstrip line of width 3 mm is used.

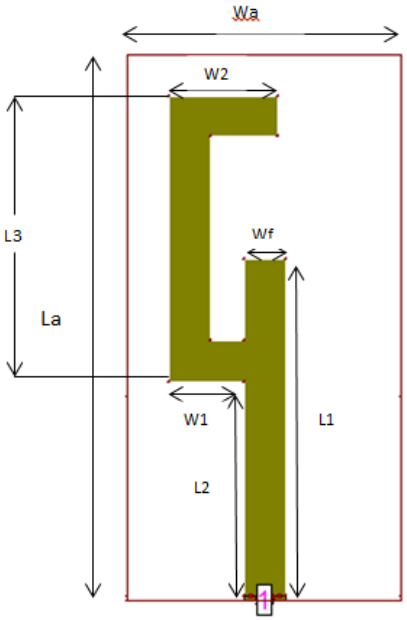


Fig.1 Design Structure

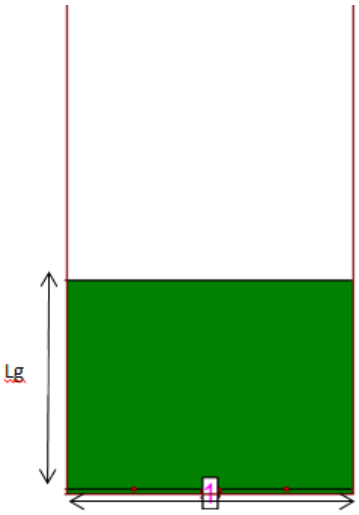


Fig.2 Ground Plane

Table 1 Dimensions of Designed Structure

Wa	20mm
Wg	20mm
La	40mm
Lg	15mm
L1	25mm
L2	16mm
L3	21mm
W1	5.5mm
W2	8mm
Wf	3mm

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 4, April 2015

In design of Fig. 3 C shape monopole antenna having ground dimension of 20x8 mm, p=2 mm and substrate of dimension 40x20 mm was designed. After designing and simulating the antenna frequency range of 3.5-3.65 GHz for ISMand 4.6-6.3 GHz for WLAN is achieved.

In design of Fig. 4 C shape monopole antenna ground dimension of 20x10 mm, p=2 mm and substrate of dimension 40x20 mm was designed. After designing and simulating the antenna frequency range of 2.3-2.6 GHz for ISM and 5.1GHz-6.1GHz for WLAN is achieved.

In design of Fig. 5Cshape monopole antenna ground dimension of 20x15 mm, p=1 mm and substrate of dimension 40x20 mm was designed. After designing and simulating the antenna frequency range of 2.4-2.7 GHz for ISM and 5-8.2GHz for WLANis achieved.

V. RETURN LOSS

The antenna is simulated with reducing the ground plane and varying the radiator length. Position of slot on ground plane and radiator dimension adjusted accordingly in order to achieve proper impedance bandwidth with dual band characteristics. Here the ground plane effect in terms of return loss plot is studied. The ground plane is reduced from 15 mm to 8mm and simulated. Finally the dual band is achieved.

The simulated results in terms of return loss plots for the structures shown with varying ground plane are shown in

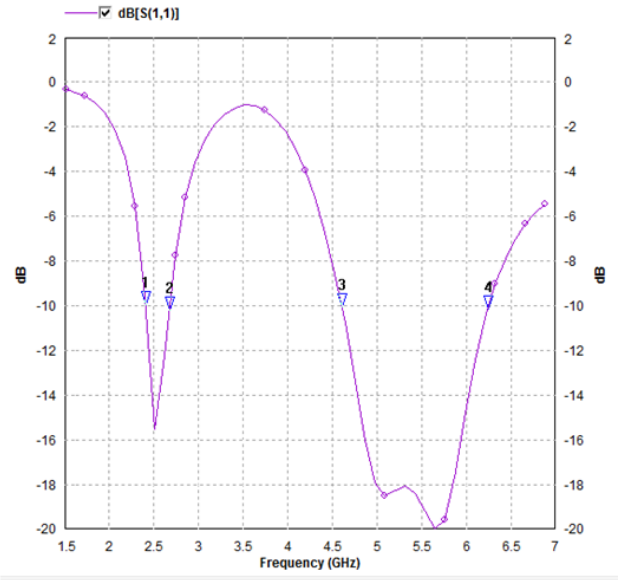


Fig.3Return loss geometry of G=15mm

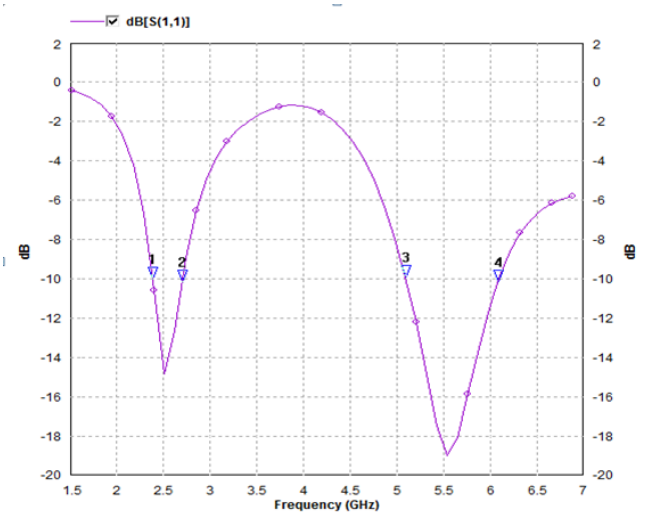


Fig.4 Return loss geometry of G=10mm

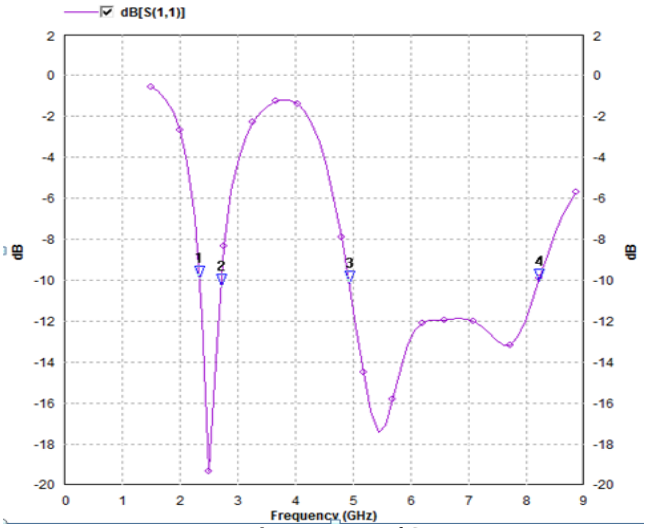


Fig.5 Return loss geometry of G=15mm

Table 2 Comparison of Ground Planes

Ground(Lg in mm)	ISM(Range in GHz)	WLAN(Range in GHz)
10	2.3-2.6	5.1-6.1
8	2.3-2.65	4.6-6.3
15	2-2.7	5-8.2

DOI 10.17148/IJARCCE.2015.4479

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 4, April 2015

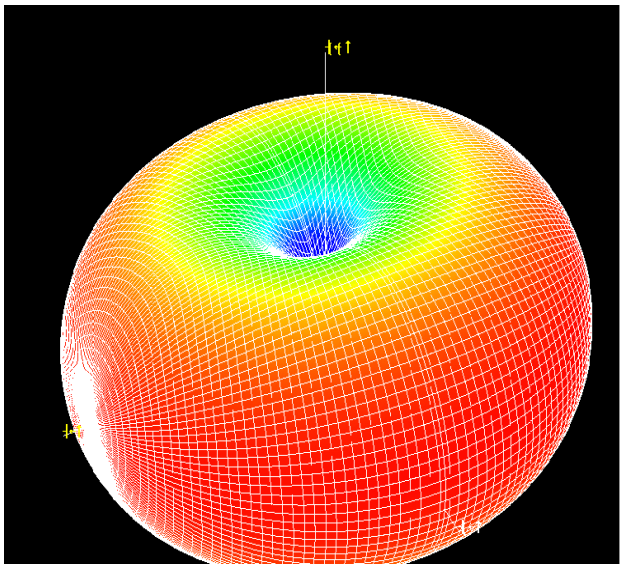


Fig.6 Radiation Pattern of 15mm

VI. CONCLUSION

The C-shaped radiator shape and ground plane reducing effects are investigated to achieve dual band operation. The antenna resonates at 2.4 GHz and 5 GHz with good impedance bandwidth. The designed antenna is compact in structure and can be suitable for the dual band application in the ISM band (2.4-2.48 GHz) and WLAN band (5-6 GHz).Comparison between software and hardware results are done and also studied the output as it can be seen that we obtained approximately 30% difference.

ACKNOWLEDGEMENT

The authors wish to express their appreciation to **Asst Prof. Vandana Khobragade** & **AsstProf. Mohd Farhan** for their support and guidance towards the research reported here.

REFERENCES

[1] J. R. Panda and R. S. Kshetrimayum, ".A printed 2.4GHz/5.8GHz dual band monopole antenna with a protuding stub in the ground plane for WLAN and RFID applications "Progress In Electromagnetics Research, Vol. 117, 425-434, 2011.
[2] "Design and Implementation of Printed Monopole Antenna for ISM Band" Mr. Mohd Farhan1, Mr. Sandip G. Dhende2, Dr.Balaji G. Hogade3. Department of Electronics and Telecommunication, India
[3] Girish Kumar, K. P. Ray "Broadband Microstrip Antennas" pp 205-376.
[4] Balanis, C.A. (2005) Antenna Theory, Analysis and Design, 3rd edition, John Wiley & Sons.
[5] C. Vishnu Vardhana Reddy, Rahul Rana "Design of linearly polarized rectangular microstrip patch antenna using IE3D/PSO"
[6] Rahul Gupta, Dr. D. K. Raghuvanshi, "Design of E-Shape Patch Antenna Using IE3D Simulator"