# Design of Smart Phone Multi-Band Monopole Antenna using Defected Ground Structure

Mrs. R. Brinda,
Assistant professor
Department of Electronics and Communication
MepcoSchlenk Engineering College
Virudhunagar, INDIA

T. Dineshpandian,
Department of Electronics and Communication
Mepco Schlenk Engineering College
Virudhunagar ,INDIA

R. Rajaselvan
Department of Electronics and Communication
Mepco Schlenk Engineering College
Virudhunagar, INDIA

***Abstract* – This paper presents a size reduction technique for a smart phone multi-band monopole antenna using the concept of defected ground structure (DGS) which can operate inUMTS(1920 ~ 2170 MHz), WiBro (2300 ~ 2390 MHz), Bluetooth (2.42 ~2.48 GHz), S-DMB (2.630 ~ 2.655 GHz), and WLAN (5.1 ~ 5.37,5.75 ~ 5.9 GHz) frequency bands.The ground is defected so that the antenna layer and the battery layer are merged together. The ground plane of the antenna after applying DGS has a volume of 30.13cm$^3$ which is 35% less than the original ground plane. Radiation performances and return loss characteristics of theproposed antenna are compared with the same antenna without DGS. The proposed antenna provides the same performance with reduced volume.**

***Index terms–monopole antenna, Defected Ground Structure, coaxial feed.***



## I. INTRODUCTION

Monopole antennas are used because of their special attractive features such as omnidirectional, light weight, easy fabrication. It requires half power given to the dipole to produce same current [1]. The development of communication engineering with integration technology demands size reduction of low frequency antennas as an important design perspective. Present day applications require antennas with smaller sizes capable of operating in wider bandwidths [2]. Another emerging trend in the recent years is that the modern mobile phones require small antenna in terms of height. Antenna commonly used for mobile handsets is a combination of monopole and Planar Inverted-F antenna(PIFA) [1].

Defected Ground Structure (DGS) is a technique in which the ground of the antenna is intentionally modified to enhance the performance [2] and to reduce the area of the ground. The defect that has been placed acts as an infinite perfectly conducting current sink.

## II. ANTENNA DESIGN AND SIMULATION

DGS technique is applied to the microstip monopole antenna for the multiband. The dimensions of the antenna are given as follows:[1] a1 = 20, a2 = 14, a3 = 19, a4 = 7.4, a5 = 9.5, a6 = 5.5, a7 = 1, a8 = 1.5, a9 = 3.0, b1= 20, b2 = 5, b3 = 3.5, b4 = 7.5, b5 = 11, b6 = 9, b7 = 7.5, b8 = 1.5, b9 = 10, h = 1.5

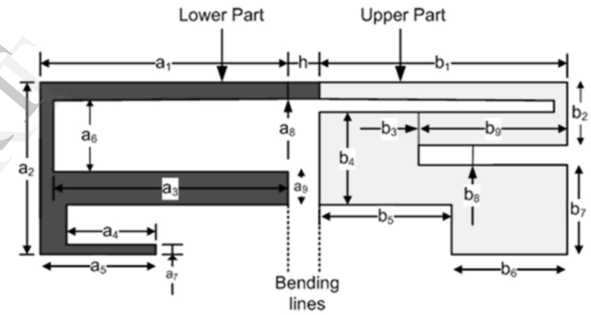



Fig 1- Monopole Multi-Band Antenna [1]

The ground plane, placed below the substrate, is a finite ground plane. On the surface of the substrate a patch is placed. This patch is connected to the resonator which is connected to the top by means of a support material which holds the conductors [1].

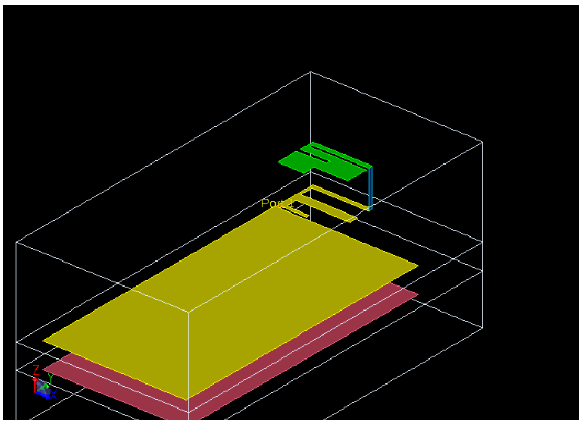


Fig 2 Structure Showing The Mobile Antenna Without Dgs

The radiator and the ground plane are placed on the opposite sidesof the substrate and isfed using a coaxial cable.This ground plane is reduced by applying DGS. The difference Boolean logic is applied over the area where the defect has to be introduced. The ground plane of the antenna is first reduced to a small extent as shown in fig 3. The return loss of this is calculated which was in accordance with that of the original antenna. When the ground was further reduced along with the side arm,the return loss is decreased.

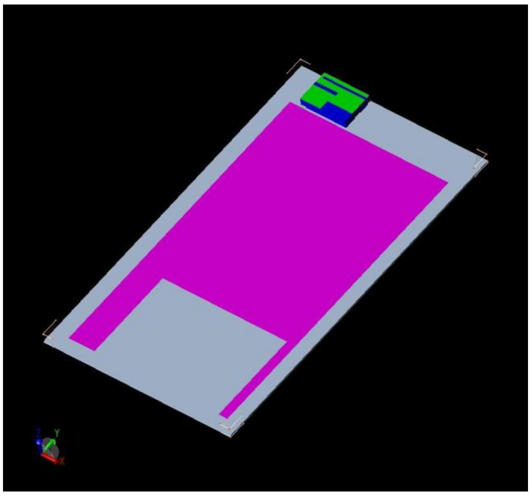


Fig3- Reduced Ground Plane Using Dgs.

The side arm is reduced because of the reason that when the ground plane is reduced beyond certain limit, the return loss is increased. To counter balance the return loss, the side arm is reduced. The performance of the same is evaluated which shows the same return loss as expected. A false arm is introduced at the end of the side arm in order to enhance the gain.The ground with minimum return loss was taken. The antenna with the false arm is shown in the FIG 4.

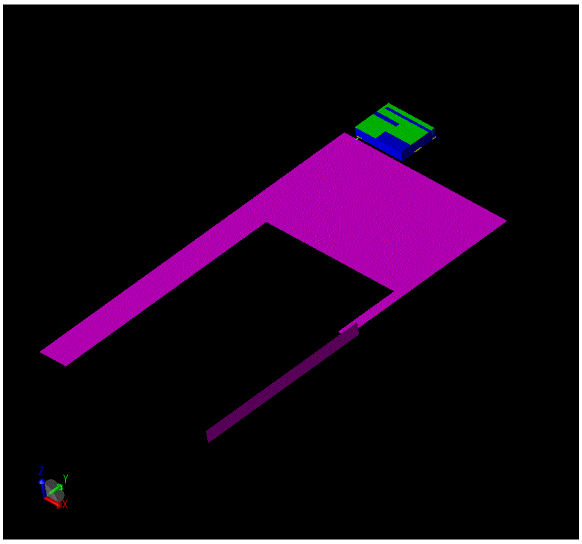


Fig4-Antenna Structure With Dgs And False Arm

The battery layer is then merged with the antenna layer. The battery is fitted into this region.
The depth of the ground plane where the defect exists is50mm.

III RESULTS AND DISCUSSION

The antenna performance has been verified by the return loss and the radiation pattern. The return loss graph for various defected ground plane is shown in the figure5.

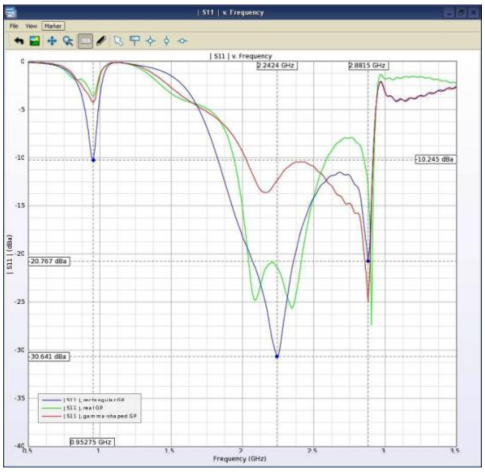
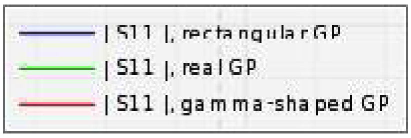



Fig 5- Return Loss For Different Ground Planes




The return loss for 0.9GHz is -10.245 dB and that of 2.25GHz band is -30dB for rectangular ground plane. The plot with the battery connected is shown in Fig 6

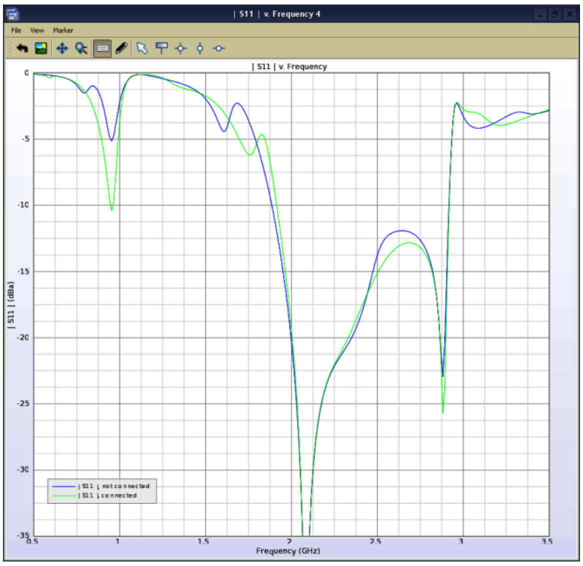



Fig 6- Return Loss Of The Antenna With Battery Layer

It can be seen that the return loss of the antenna with the battery connected is good. The 3-D radiation pattern of the antenna at 937MHz is shown in figure 7.

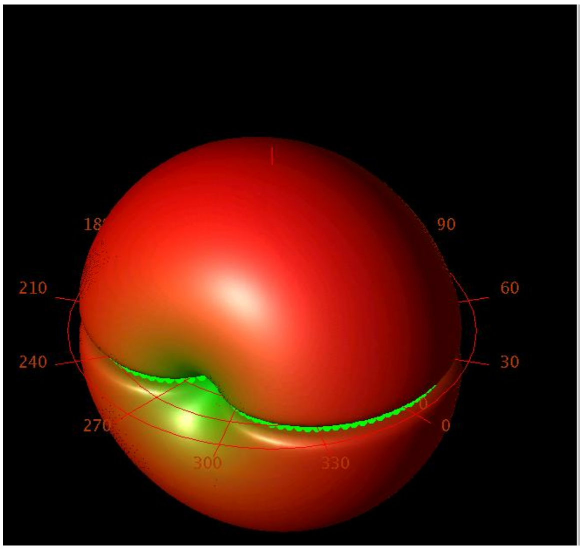



Fig 7- Radiation Pattern

The figure represents that the antenna is Omni-directional in nature i.e. the radiation can be absorbed from any direction. The gain and the radiated power are shown in figure 7.

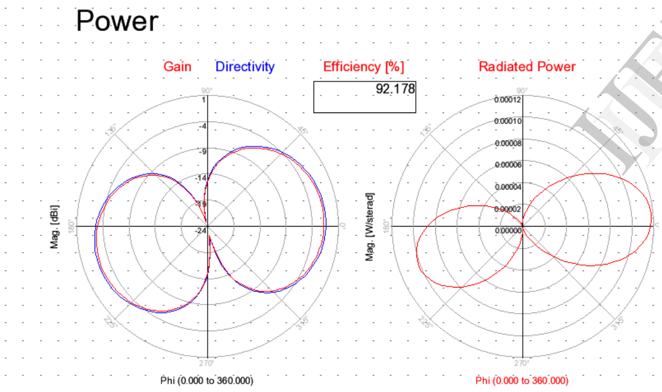



Fig 7- Gain And Radiated Power

The efficiency of this antenna is found to be 92.17%. Thus with the defected ground structure technique the ground plane of the antenna has been reduced by 35% compared to the original structure without degrading the performance.

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