iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 3 **Issue:** IV **Month of publication:** April 2015

DOI:

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Dual Resonant Frequency Antenna for Mobile Communications

V.B.Muthuraman[1], V.Jayaprasanna[2], S.Aswinbabu[3], G.Valarmathy[4], S.Rengaraj[5]
Department of Electronics and Communication Engineering, GKM College of Engineering and Technology, Chennai-600063, TamilNadu
Chennai Institute of Technology, Chennai

Abstract*—The dual resonant frequency antenna module is proposed for the purpose of mobile communications. The microstrip patch antenna incorporated with a slot design that makes the antenna to perform both higher and lower frequency operations. Various iterations for the patch design are compared, and an optimized design is chosen. The proposed antenna is a low profile antenna and it operates in the frequency band 750MHz to 3GHz. This antenna provides the sophisticated support for the enhanced mobile applications like GPS, Wi-Fi which are common in smart phones nowadays and also it extend its support for 4G (LTE) with the back compatibility. Several properties of the antenna such as radiation patterns, radiation efficiency and gain have been demonstrated.
***Keywords*—resonant; microstrip; slot; sophisticated; low profile; back compatibility.**

I. INTRODUCTION

The wireless communication systems experienced a drastic changes over decades, mobile handsets made a great technological leap and have been transformed into smart devices with enhanced multiple functionality and called as smart phones. Nowadays smart phones support global positioning services (GPS), video conferencing, surfing, Bluetooth file transfer, Wi-Fi hotspots and so on. Thus, the design complexity of mobile handsets is increasing [1]. Moreover, the frequency bands that are supported by internal mobile handset antenna are still constantly increasing. The mobile handsets with multiple functionalities require individual antennas for each application. This influences in the complex design of mobile handsets. In order to reduce the complexity the proposed antenna will provide the sophisticated support for enhanced mobile applications like GPS, Wi-Fi and also it extend its support for 4G (LTE) with its back compatibility. The antenna will be capable of providing high directivity. The provided slot shape deals with the directivity as it has many edges. In this paper we propose a dual resonant frequency antenna with a slot structure which performs both lower and higher band operations. The proposed antenna supports the existing and 4th generation services and also sophisticated mobile applications such as GPS (global positioning systems), Wi-Fi hotspots, Bluetooth applications.

II. MICROSTRIP PATCH ANTENNA

A microstrip patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side. The patch is generally made of conducting material such as copper or gold and can take any possible shape. The radiating patch and the feed lines are usually photo etched on the dielectric substrate. For a rectangular patch, the length L of the patch is usually $0.3333\lambda_o < L < 0.5\lambda_o$, where λ_o is the free-space wavelength. The patch is selected to be very thin such that $t \ll \lambda_o$ (where t is the patch thickness).
The height h of the dielectric substrate is usually $0.003\lambda_o \leq h \leq 0.05\lambda_o$. The dielectric constant of the substrate (ε_r) is typically in the range $2.2 \leq \varepsilon_r \leq 12$.Microstrip patch antennas radiate primarily because of the fringing fields between the patch edge and the ground plane. For good antenna performance, a thick dielectric substrate having a low dielectric constant is desirable since this provides better efficiency, larger bandwidth and better radiation. However, such a configuration leads to a larger antenna size. In order to design a compact Microstrip patch antenna, substrates with higher dielectric constants must be used which are less efficient and result in narrower bandwidth. Hence a trade-off must be realized between the antenna dimensions and antenna performance.[6]
The dimensions of the antenna will be determined by the following footprint equations.[6]

$$W = \frac{c_0}{2fr}\sqrt{\frac{2}{\varepsilon_r + 1}} \quad c_0 = \text{speed of the light}$$

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

$$\varepsilon_{reff} = (\varepsilon_r + 1)/2 + (\varepsilon_r - 1)/2\left[1 + 12\left(\frac{h}{w}\right)\right]^{-\frac{1}{2}}$$

$$\frac{\Delta L}{h} = 0.412 \frac{(\varepsilon_{reff} + 0.3)(\frac{W}{h} + 0.264)}{(\varepsilon_{reff} - 0.258)(\frac{W}{h} - 0.8)}$$

$$L = \frac{c_o}{2 f_r \sqrt{\varepsilon_{reff}}} - 2\Delta L$$

III. ANTENNA CONFIGURATION

The configuration of the dual resonant frequency antenna module is given in the Figure 1.

The slot has been designed with number of edges in order to have improved directivity and also it makes the antenna to perform both lower band and higher band operations. The dimension of the antenna is 39.5mm × 50.7mm × 1.1mm. The dielectric substrate thickness is 1mm.Since the proposed antenna is desired to perform both lower and frequencies the resonant frequency (f_r) is chosen to be 1.8GHz. Figure 2 depicts the antenna module after fabrication.

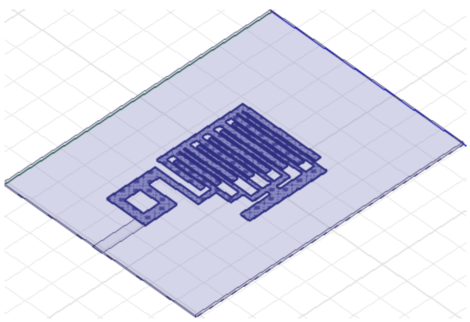


Figure 1: Configuration of Antenna

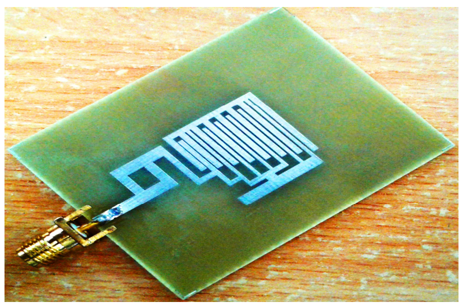


Figure 2: Antenna Module

The antenna module with its slot makes it as an efficient competitor for multiband antennas. The antenna operates in the range of 750MHz to 3GHz. This antenna supports GPS, Wi-Fi, LTE, UMTS, and WCDMA respectively.

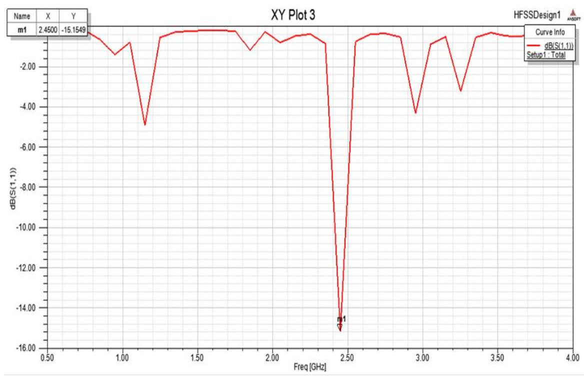
IV. ANTENNA PERFORMANCE

The performance of dual resonant frequency antenna is examined by the parameters such as return loss, radiation, gain, polarization, rectangular plot respectively. From the performance it is clearly stated that this proposed antenna will be capable of performing lower and higher frequency operations and exhibits high directivity.

Volume 3 Issue IV, April 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

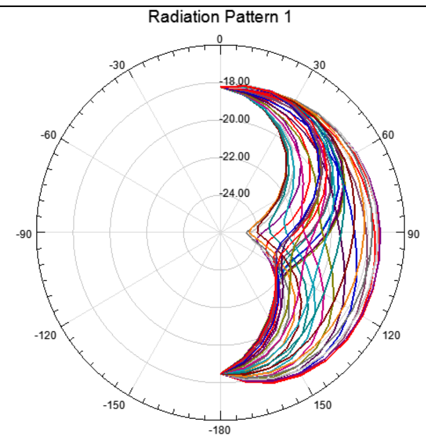
A. Return Loss

The simulated graph shows the achieved return loss of -5 dB and -15 dB and radiating at 1.2 GHz and 2.45GHz.



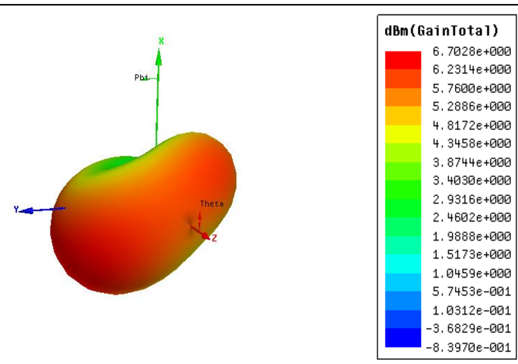
B. Radiation

The radiation pattern shown above is obtained as a result of fixing frequency at 1.8 GHz and varying the Phi from 0 degree to 180 degree. The maximum radiation is obtained.



C. Gain

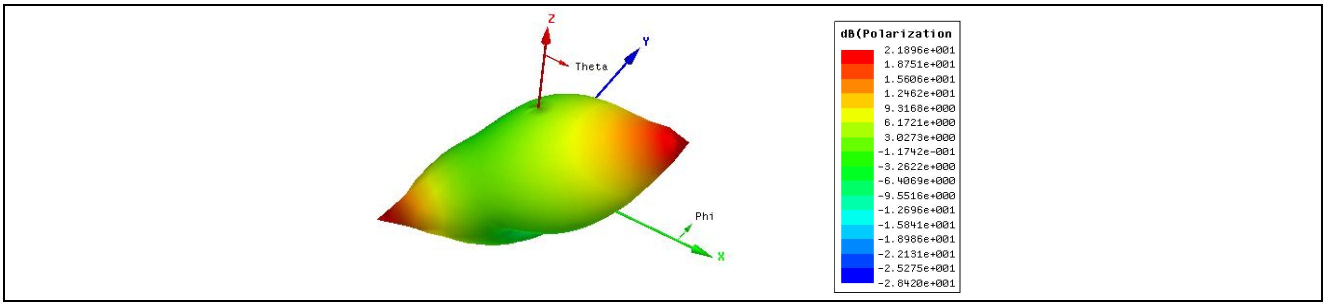
The gain of the antenna at various levels are examined and at maximum power level the gain is known to be 6.7020e^{+000}



International Journal for Research in Applied Science & Engineering Technology (IJRASET)

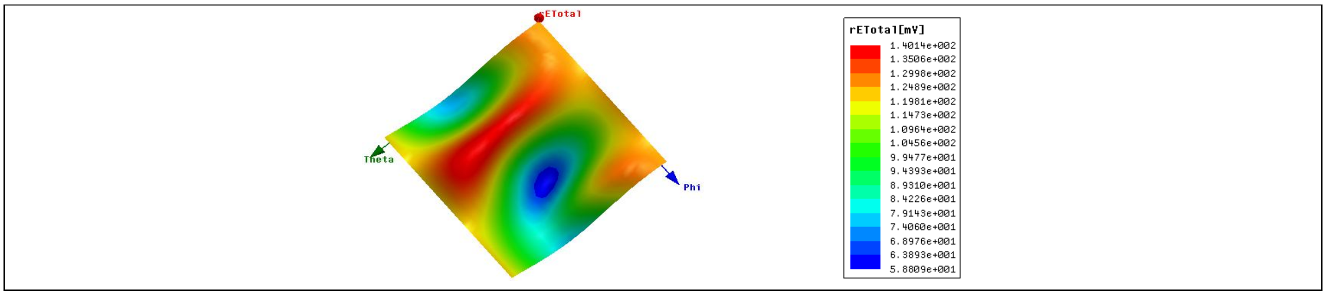
D. Polarization

The polarization of the proposed antenna for far field is 2.1896e +001 dB and for near field it is -2.8420e +001 dB to for various directions.



E. 3D Rectangular Plot

The rectangular plot is a three dimensional plot between theta, phi and rE total. The polar plot can also be plotted using the rectangular co-ordinates. The maximum electric field distribution obtained is 1.40 × 10-2 mV



V. CONCLUSION

In this paper, the Dual Resonant Frequency Antenna for Mobile Communications is designed. The proposed structure is simulated using Ansoft HFSS. This type of antenna is suitable for supporting enhanced mobile applications and also LTE with back compatibility. This makes the antenna to be a good competitor for recently developing antennas. The design method is discussed, the return loss can be reduced and the performance of patch antenna has been increased. Antenna will be examined for different individual frequencies and its parameter response for each frequency will be studied as a future work of this paper.

REFERENCES

[1] Jaesuk Lee, Yang Liu, and Hyeongdong Kim "Mobile Antenna Using Multi-Resonance Feed Structure for Wideband Operation" IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL.62, NO.11,NOVEMBER2014.

[2] J. Anguera, A. Andújar, and C. Garc´ıa, "Multiband and small coplanar antenna system for wireless handheld devices," IEEE Trans. Antennas Propag., vol. 61, no. 7, pp. 3782–3789, Jul. 2013.

[3] Fang-Hsien Chu and Kin-Lu Wong "Planar printed strip monopole with a closely-coupled parasitic shorted strip for eight-band LTE/GSM/UMTS mobile phone," IEEE Trans. Antennas Propag.,

vol. 58, no. 10, pp. 3426–3431, Oct. 2010.

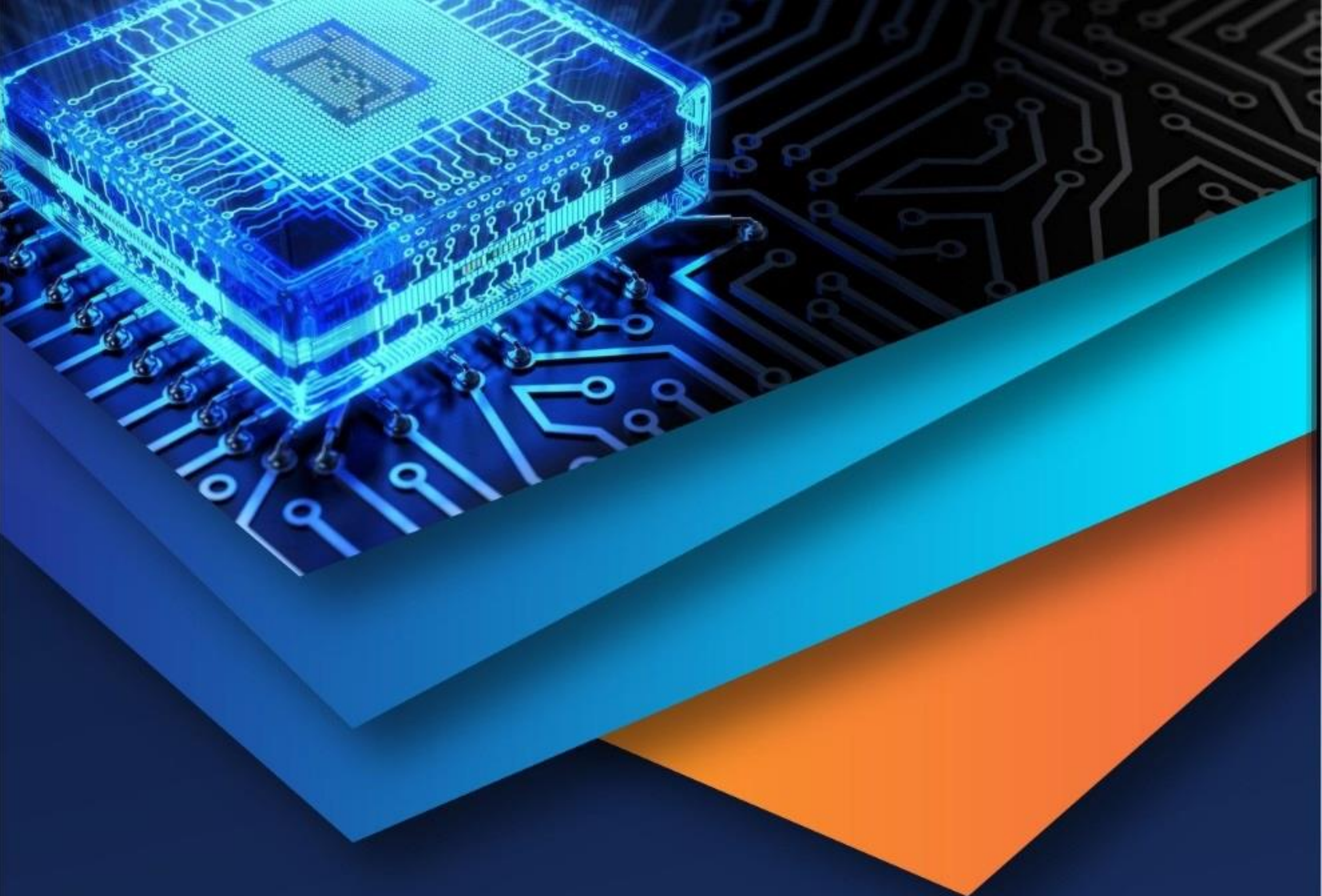
[4] Cheng-Tse Lee and Kin-Lu Wong, "Planar monopole with a coupling feedand an inductive shorting strip for LTE/GSM/UMTS operation in the mobile phone," IEEE Trans. Antennas Propag., vol. 58, no. 7, pp.

2479–2483, Jul. 2010.

[5] Ting-Wei Kang, Kin-Lu Wong, Liang-Che Chou, andMing-Ren Hsu, "Coupled-fed shorted monopole with a radiating feed structure for eight-band LTE/WWAN operation in the laptop computer," IEEE Trans. Antennas Propag., vol. 59, no. 2, pp. 674–679, Feb. 2011.

[6] Constantine A. Balanis Antenna Theory Analysis and Design

[7] Victor Bernard 1, John Paul Izuchukwu Iloh2" Microstrip Antenna Design Using Transmission Line Model " International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume3,Issue11,November2013)



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY