International Journal of Advanced Smart Convergence Vol.4 No.2 29-33 (2015)
http://dx.doi.org/10.7236/IJASC.2015.4.2.29

IJASC 15-2-5

Design and Manufacture of LTE3G / WLAN/ LTE4G Tri-band Antenna System for Mobile Communication Applications

Bayarmaa.O, Yong Pyo Hong, Kab Ki Kim[†]

[*,†]*Dept. of Information and Communication Eng, Mokpo National Maritime University, Haeyangdaehak-ro 91, Jeollanam-do, Mokpo 530-729, Korea*
E-mail: bayarmaa@mmu.ac.kr

Abstract

In this paper, we propose the method to improve the performance of the antenna system that contains three bands, such as Lte3G, WLAN and Lte4G. This antenna has an advantage that can cover the three different frequency bands 2.1㎓, 2.4㎓ and 2.6㎓ through one antenna design. The design and simulations are done using CST Microwave Studio 2014 program. The antenna is designed by using the FR-4 (lossy) substrate with the dielectric constant of er=4.3 and dielectric loss tangent 0.025. The substrate dimensions are the following; Thickness[h] is 1.6㎜, Length is 90㎜, and Width is 40㎜. The ground is designed by using the PEC material with h=0.035㎜. The patch is designed by using the copper with h=0.035㎜. In the near future, we will fabricate the antenna, which we have designed, and then apply this antenna to the mobile communication system. And we will test this mobile communication system for the diverse environments.

Keywords: *LTE3G, WLAN, LTE4G, Monopole antenna, Mobile Communication*

1. Introduction

Communication is one of the integral parts of science that has always been a focus point for exchanging information among parties at locations physically apart. After its discovery, telephones have replaced the telegrams and letters. Similarly, the term ‘mobile’ has completely revolutionized the communication by opening up innovative applications that are limited to one’s imagination. Today, mobile communication has become the backbone of the society. All the mobile system technologies have improved the way of living. Its main plus point is that it has privileged a common mass of society.[1]

This paper is proposed to design mobile handset antenna for make mobile handset more compact and thin. This antenna has an advantage of performing different frequency bands by one antenna design. Design and simulations are done using CST Microwave Studio program. The structure and geometry of the proposed antenna, whole conductor is FR-4 (lossy) substrate with the dielectric constant of er=4.3 and dielectric loss tangent 0.025. The substrate thickness of h=1.6[mm], length=L_sub, width=W_sub. The ground is designed

Manuscript Received: Sept. 7, 2015 / Revised: Sept. 30, 2015 / Accepted: Oct. 15, 2015
Corresponding Author: bayarmaa@mmu.ac.kr
Tel: +82-61-240-7250, Fax: +82-61-240-7253
Dept. of Information and Communication Eng, Mokpo National Maritime University

by using the PEC material with h-0.035[mm] and length=3/L_sub. The patch designed by using the copper with h=0.035[mm], length=1/L_sub. In a result, return loss was below (S|11|<-13dB at 2.1GHz, S|11|<-24dB at 2.4GHz and S|11|<-13dB at 2.6GHz band.[2]

Also LTE3G 2.1㎓, designed for the 2.4 GHz WLAN and H-Shaped for tri-band band-pass filter suitable for use in the 2.6㎓ LTEG4G band. Filter the substrate is FR-4 (lossy), epsilon is 2.2, mue is 1, el.tand. Is 0.0009 (Const.fit), Therm.cond is 0.3 [W / Km] The patch Copper (annealed) lossy metal, mue is 1, el.cond is 5.96e + 007 [S / m], Rho is 8930 [kg / m ^ 3], Therm.cond is 401 [W / Km], Young's Mod is 120 [kN / mm ^ 2], Poiss.Ratio 0.33, the Thermal Exp is 17 [1e-6 / K].

2. Tri-band monopole antenna system simulation and result

The proposed novel antenna is designed by using the FR-4 (lossy) substrate with the dielectric constant of er=4.3 and dielectric loss tangent 0.025. The substrate thickness of h=1.6[mm], length=L_sub, width=W_sub. The ground is designed by using the PEC material with h-0.035[mm] and length=3/L_sub. The patch designed by using the copper with h=0.035[mm], length=1/L_sub. The design parameters of the proposed antenna are shown in Figure 1.

As a result, this paper presents the performance of the new tri-band antenna operating at 2.1GHz, 2.4GHz and 2.6GHz.

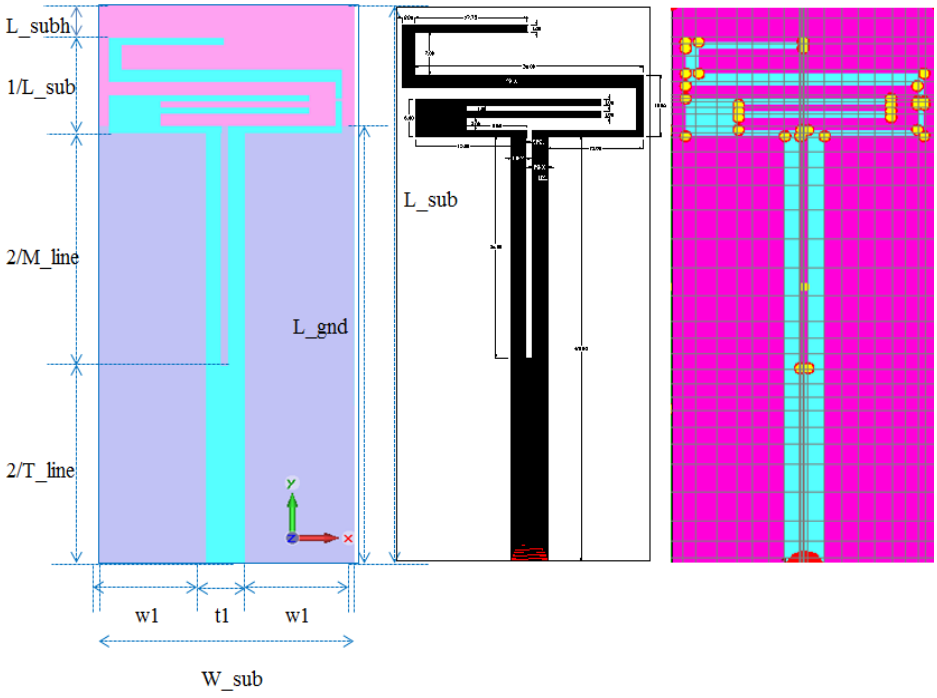
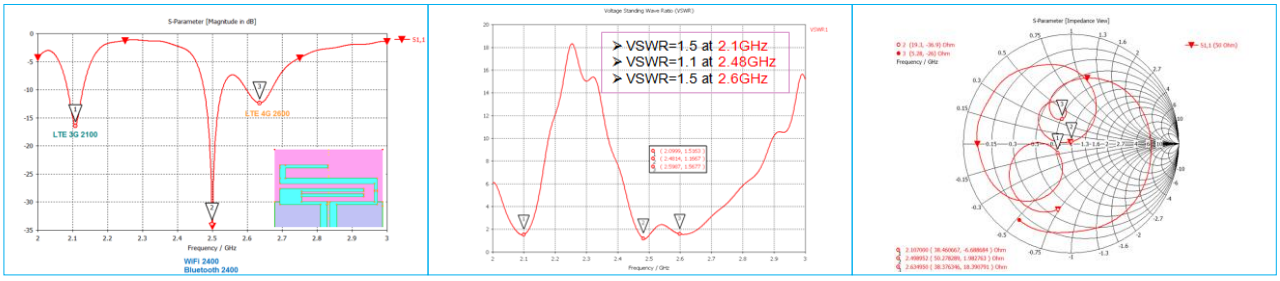


Figure 1. Layout of Tri-band antenna

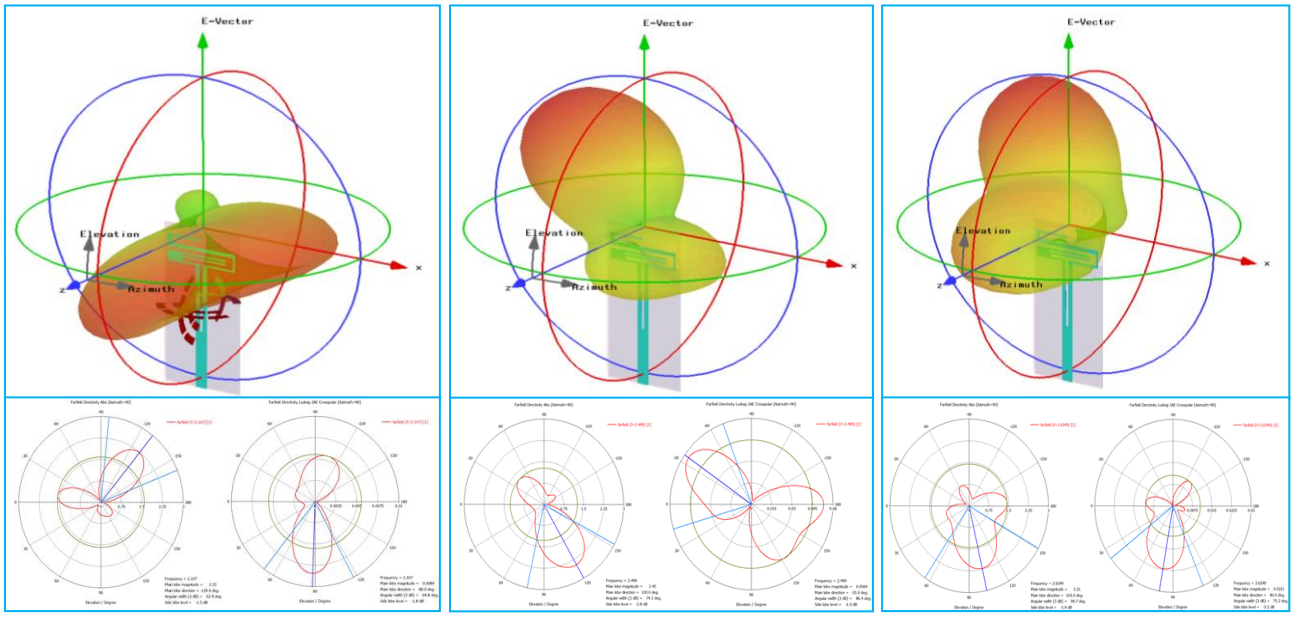
Fig.3-5 shows the simulated return loss of the proposed antenna. The simulation result was obtained from CST Microwave Studio program. From the obtained results, it is clearly seen the return losses of the proposed antenna can cover the required bandwidth of the (S|11|<-13dB at 2.1GHz, S|11|<-24dB at 2.4GHz and S|11|<-13dB at 2.6GHz band.



(a) (b) (c)

Figure 2. (a). Return Loss S11, (b). Voltage Standing Wave Ratio , (c). Smith chart at 2.1GHz, 2.4GHz and 2.6GHz

Voltage Standing Wave Ratio(VSWR) is definition the ratio of maximum (Vmax) and minimum (Vmin) voltages if the standing wave function. VSWR=1.5 at 2.1GHz, VSWR=1.1 at 2.48GHz and VSWR=1.5 at 2.6GHz.



(a) (b) (c)

Figure 3. (a). E-field & H-field at 2.1GHz , (b). E-field & H-field at 2.4GHz, (c). E-field & H-field at 2.6GHz

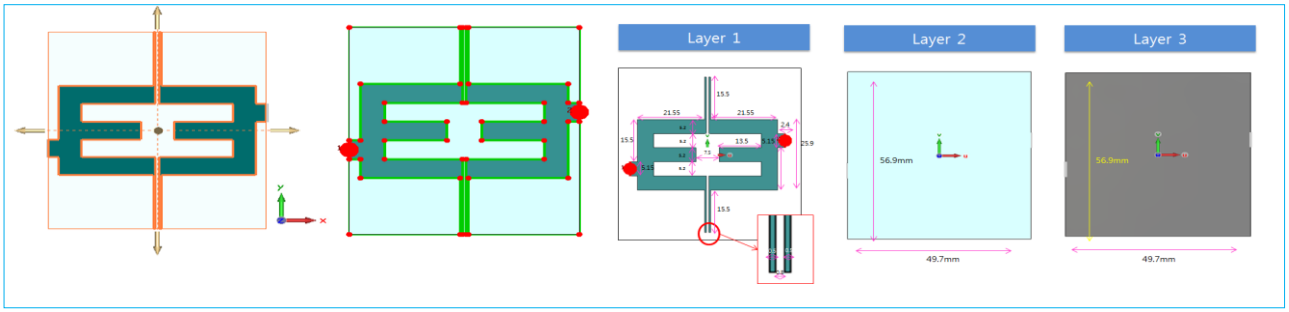
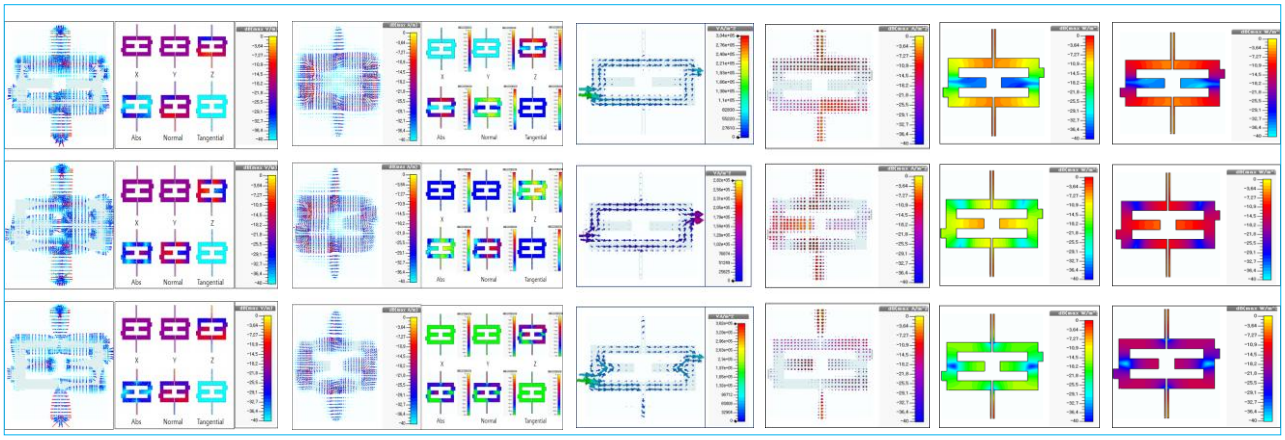


Figure 4. Layout of Tri-band pass filter



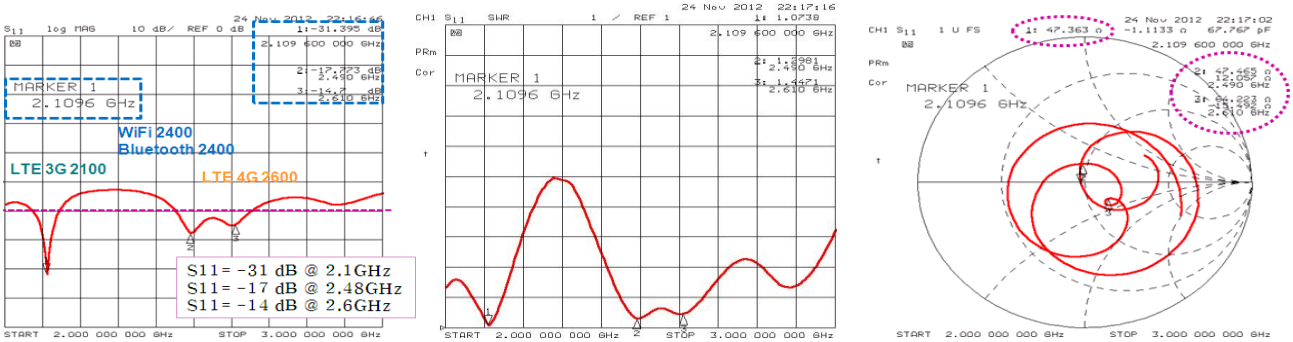
(a) (b) (c) (d) (e) (f)

Figure 5. (a). E-field, (b). H-field, (c). Power flow, (d). Current density, (e). Current loss dens, (f). Power loss dens.

3. Tri-band monopole antenna system manufacture and result

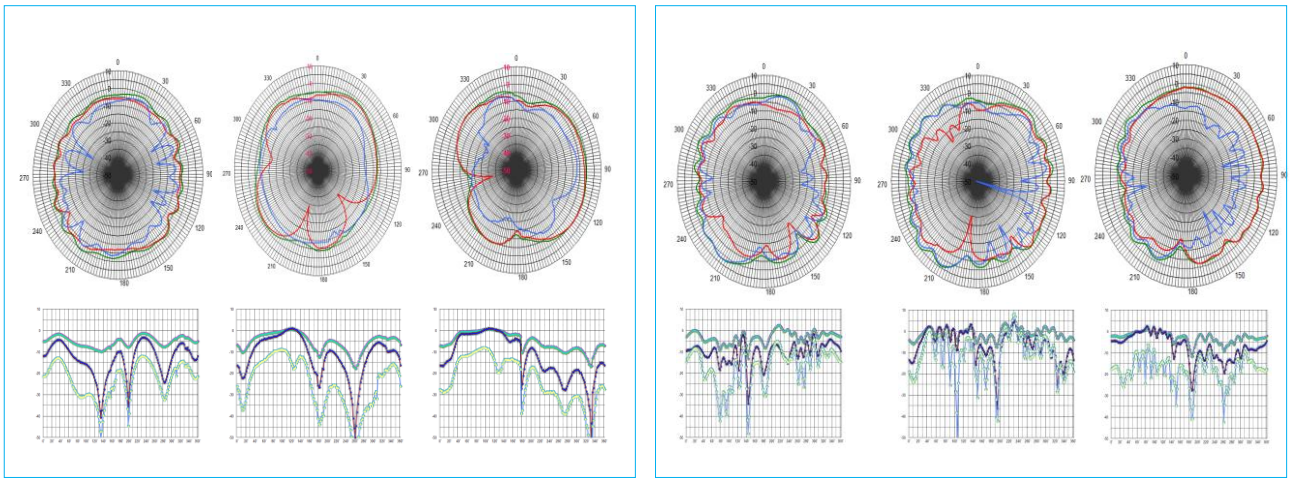
Manufacture return loss of the proposed antenna. The simulation result was obtained from CST Microwave Studio program. From the obtained results, it is clearly seen the return losses of the proposed antenna can cover the required bandwidth of the (S|11|<-31dB at 2.1GHz, S|11|<-17dB at 2.4GHz and S|11|<-14dB at 2.6GHz band.

Figure 6. Fabricated tri-band antenna system



(a) (b) (c)

Figure 7. (a). Fabricated Return Loss S11, (b). Fabricated Voltage Standing Wave Ratio , (c). Fabricated Smith chart at 2.1㎓, 2.4㎓ and 2.6㎓



(a) (b)

Figure 8. (a). E-Field result of fabricated antenna, (b). H-Field result of fabricated antenna

4. Summary

First, design an antenna which can perform multiple frequencies are LTE 3G 2100 MHz, WiFi and Bluetooth 2400 MHz and LTE 4G 2600GHz. Second, reduced a size of the antenna: Now, we using phone sizes are I phone (115mm x 58.6mm), Samsung (132mm x 71mm). The designed reconfigurable antenna size is more compact (90mm x 40mm) than phones. Design and simulations are done using CST Microwave Studio program. An Antenna is designed by using the FR-4 (lossy) substrate with the dielectric constant of er=4.3 and dielectric loss tangent 0.025. The substrate thickness of h=1.6[mm], length=L_sub, width=W_sub. The ground is designed by using the PEC material with h-0.035[mm] and length=3/L_sub. The patch designed by using the copper with h=0.035[mm], length=1/L_sub. In a result, return loss was below -13dB at 2.1GHz, -24dB at 2.4GHz and -13dB at 2.6GHz band. VSWR=1.5 at 2.1GHz, VSWR=1.1 at 2.48GHz and VSWR=1.5 at 2.6GHz. In the future, this antenna design will be fabricated and used in a mobile handset systems.

REFERENCES

[1] Dr. Abhijit Mitra, "Lecture Notes on Mobile Communication," A Curriculum Development Cell Project Under QIP, IIT Guwahati, Department of Electronics and Communication Engineering Indian Institute of Technology Guwahati Guwahati – 781039, India November 2009.

[2] Bayarmaa.O, Yong-Pyo Hong, Kab Ki Kim, "Design of lte3g/wlan/ lte4g tri-band monopole antenna system for mobile communication applications," *Korean Navigation Institute*, pp. 148-151, 2015.