Australian Journal of Basic and Applied Sciences, 10(1) January 2016, Pages: 433-438

AUSTRALIAN JOURNAL OF BASIC AND APPLIED SCIENCES

ISSN:1991-8178 EISSN: 2309-8414
Journal home page: www.ajbasweb.com

Compact F-shaped Mobile Antenna for Multiple Wireless Applications

[1]A.E.Ramanujan, [2]Dr.H.Umma Habiba, [3]S.Revathy, [3]R.Rukmangathan

[1-3]Student, M.E, Communication Systems Sri Venkateswara College of Engineering Chennai, India.
[2]Professor, Department of Electronics and Communication Sri Venkateswara College of Engineering Chennai, India.

Address For Correspondence:
R.Rukmangathan, Student, M.E, Communication Systems Sri Venkateswara College of Engineering Chennai, India
E-mail: rampgmcs@gmail.com

ARTICLE INFO

Article history:
Received 10 December 2015
Accepted 28 January 2016
Available online 10 February 2016

Keywords:
slot; stacking; multi frequency; line resonator.

ABSTRACT

Wireless and mobile networks are being used in diverse areas such as travel, education, stock trading, military, package delivery, disaster recovery, and medical emergency care. In this paper the proposed Compact F-Shaped Mobile Antenna works for Multiple Wireless Applications which operates at 1.575 GHz (Global Positioning System), 2.1 GHz (3G), 2.3 GHz (Universal Mobile Telecommunications System) and 2.9 GHz (Digital Multimedia Broadcasting). The antenna consists of a F-shape defected microstrip patch and line resonators embedded to semi-infinite Ground plane for achieving multi band resonance. The F-shape patch and defected microstrip patch is incorporated for generating four resonating frequencies. Ground plane is optimized to achieve proper Quad band operation of the antenna. The model of the antenna is built and simulated using ADS software. The designed antenna having the good return loss of > -13 dB for all frequencies and the size of 39 mm x 26 mm is achieved.

INTRODUCTION

Mobile and wireless systems cover two areas such as mobility and computing. Mobile computing means continuous accessibility to the user while wireless implies communicating without wires. As indicated in (Agrawal, D.P. 1999), mobile and wireless technology has improved substantially, making wireless devices remarkably convenient and affordable. Wireless networking is specifically appropriate for situations wherein installation of physical media is not feasible and which require on-the-spot access to information. Wireless networking makes it possible to have access to multimedia applications Multi-frequencies and multimode devices such as cellular phones, mobile phone jammer, wireless local area networks (WLAN) and wireless personal area network place several demands on the antennas. Primarily, the antennas need to have high gain, small physical size, and multi bandwidths.

Recently there are many demands to design antennas that cover global positioning system (GPS) mobile phone systems, Universal Mobile Telecommunications System (UMTS) bands (2300–2400 MHz) systems, Wideband Code-Division Multiple Access (WCDMA) bands (2100–2170 MHz) and Digital Multimedia Broadcasting (DMB) systems with 2600-2900 MHz band.

The first handheld mobile phone was demonstrated by John F. Mitchell (http://www.brophy.net; http://www.brophy.net) and Martin Cooper of Motorola in 1973, using a handset weighing 2 kg (Heeks, Richard, 2008). In 1983, the DynaTAC 8000x was the first commercially available handheld mobile phone. From 1983 to 2014 considerable research has been made where as in 2009 a compact film type antenna capable of generating two wide resonant modes for covering the AMPS/GSM bands and the DCS/PCS/UMTS bands for mobile phones was proposed (Ning GUAN, Koichi ITO, 2009). A multiband planar monopole slot antenna which operates in GSM 850, GSM900, GSM1800, and GSM1900 was developed in 2012 with higher return loss (Anis Suliman Ali, *et al*., 2012). In the same year a mobile phone antenna which covers almost 60 GSM and 3G

To Cite This Article: A.E.Ramanujan, Dr.H.Umma Habiba, S.Revathy,.Rukmangathan, Compact F-shaped Mobile Antenna for Multiple Wireless Applications. ***Aust. J. Basic & Appl. Sci.,*** *10(1): 433-438, 2016*

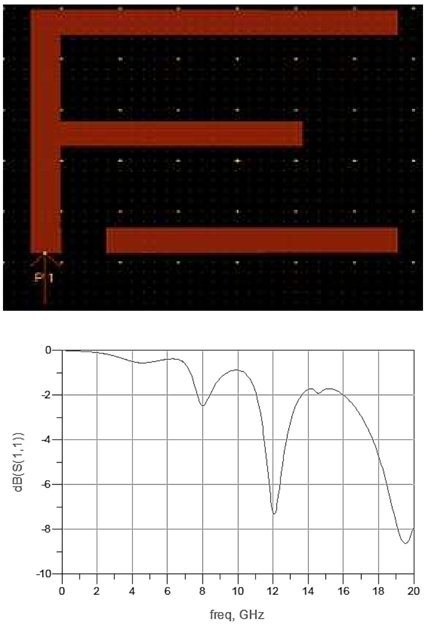
handsets, ranging from the first GSM handset with an internal antenna to the current Nokia, Sony-Ericsson, Motorola, and Apple handsets was developed (Corbett Rowell and Edmund Y. Lam, 2012). In 2014 a multiband four-antenna system with high isolation for the mobile phone applications was designed. The four antennas consisting of a main antenna and three auxiliary antennas are located on a $135 \times 65 \times 0.8mm^3$ FR4 epoxy board. The main antenna is an improved monopole antenna which can cover LTE, GSM, UMTS and 2.4-GHz WLAN bands (Jingli Guo1, *et al*., 2014). The design of compact planar multiband antennas intended for existing wireless services including GSM 850, GSM 900, DCS 1800, PCS 1900, WLAN and Wi -MAX for 3:1 VSWR was designed in the same year (Ayman Nasih Salman Younis, 2014). In 2015 a wideband PIFA antenna for GSM (1800MHz & 1900MHz), UMTS (2100MHz), Bluetooth & Wi-Fi (2.4GHz) and LTE system (2.3GHz, 2.5GHz, and 2.6GHz) was designed (Nazem Alsmadi and Khalid Saif, 2015).

In this paper the F-shaped mobile antenna is designed for 1.575 GHz, 2.1 GHz, 2.3 GHz and 2.9 GHz frequencies having very good return loss of > -13 dB with real value of 4.6 and loss tangent of 0.01 using ADS software which brings in compactness compared to other earlier designs.

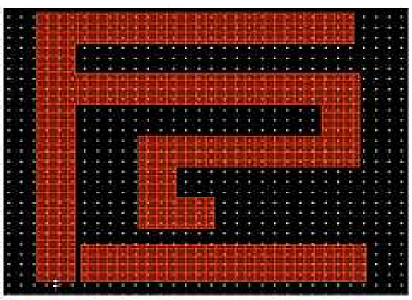
I. Design Of Quad Band Antenna:

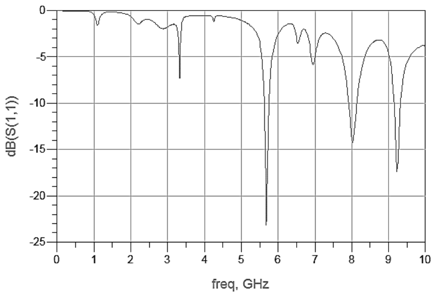
A. Evolution of Quad Band Antenna:

The evolution of the proposed antenna is depicted in Fig. 1. At first, an F-shaped radiator of 6 mm width as shown in Fig. 1(a) is designed to operate at the lowest resonant frequency. This prototype has a ground plane of dimension 28 x 26 mm. To this fundamental antenna, another meandered radiator as in Fig. 1(b) is added to excite the frequency bands at 5.7, 8.0 and 9.2 GHz respectively. Thus, a triband radiator is achieved using the folded strip line configuration. The designed antenna needs optimization. On this notion, the width of the primary F-shaped radiator and the side arm of secondary radiator are reduced to 1 mm to achieve resonance centered at 4.2, 4.5 and 15.8 GHz as in Fig. 1(c). Further, short discontinuities are added to the primary and secondary radiating arms as shown in Fig. 1(d) to improve the impedance characteristics at lower frequencies of 1.2, 3.6 and 5.9 GHz. The length of the ground plane is reduced to improve the performance of the radiator at 4.9, 8.0 and 11GHz in Fig. 1(e). The optimized geometry of the triband antenna is shown with extended ground stub added in Fig. 1(f) which operates at 1.575, 2.1, 2.3 and 2.9 GHz.

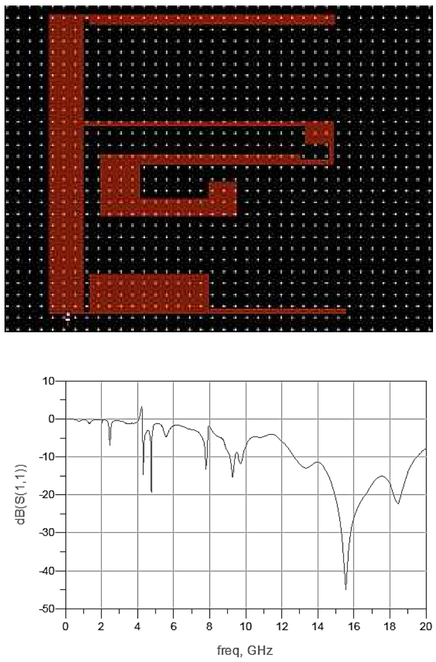


(a)

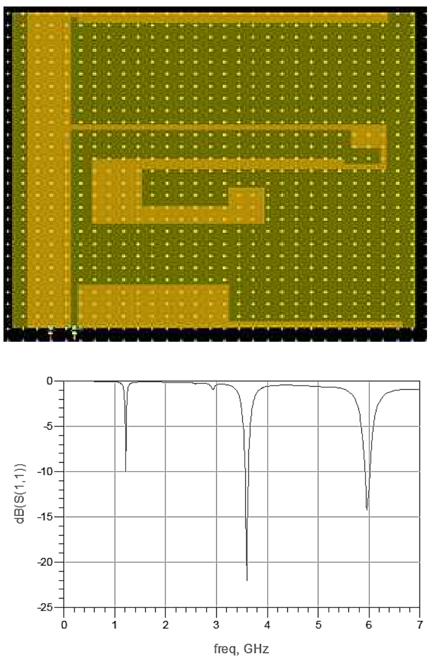




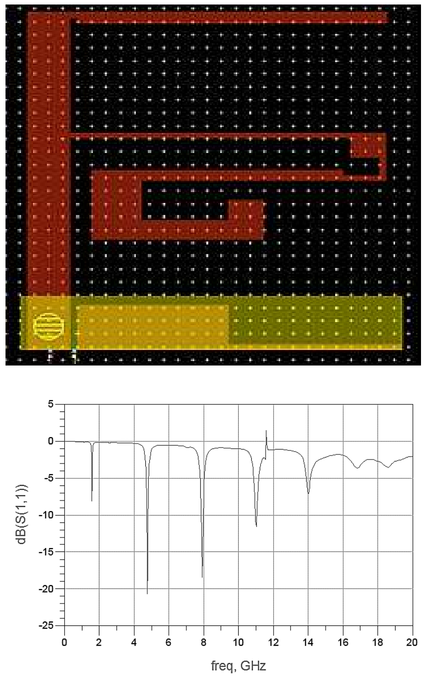
(b)



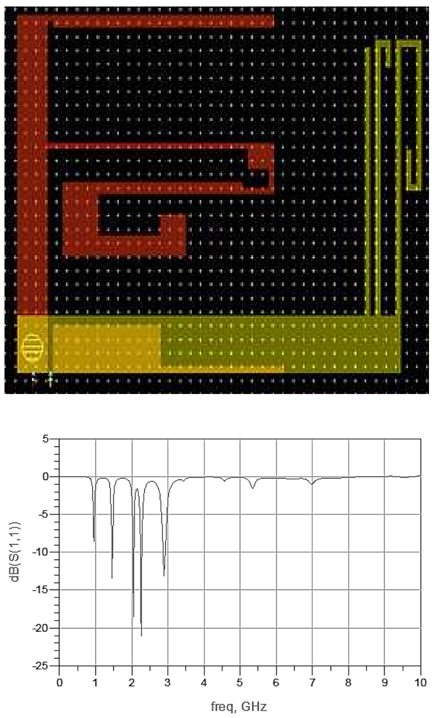
(c)



(d)



(e)



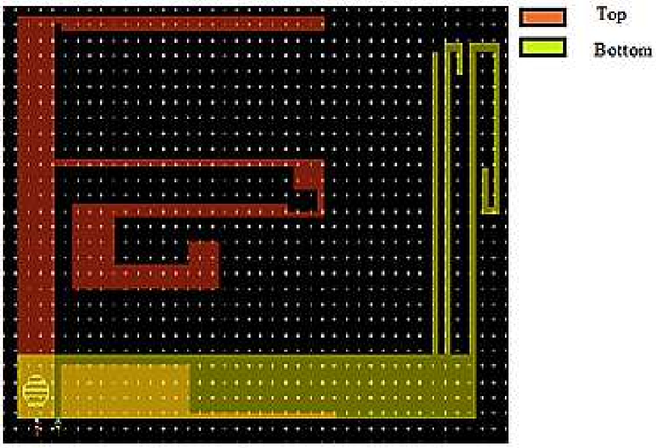
(f)

Fig. 1: Evolution of the multifrequency antenna. (a) Primary radiator. (b) Secondary triband radiator. (c)Antenna with discontinuities in primary and secondary radiator (d) Antenna with finite ground plane. (e) Antenna with semi-infinite ground plane. (f) Proposed quadband antenna with line resonator.

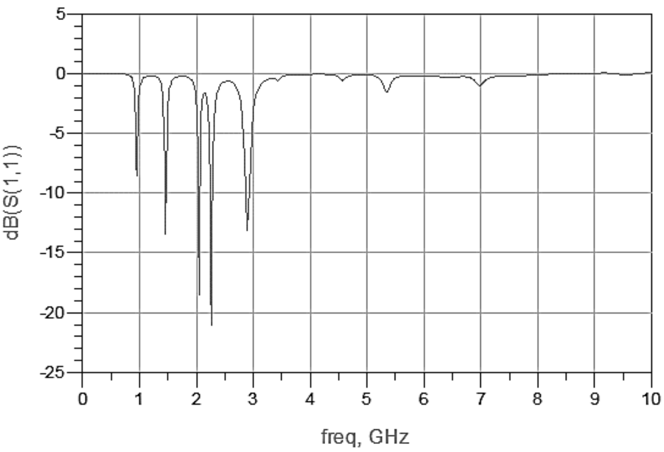
B. Design of Quad Band Antenna:

Fig. 2. Shows the geometry of the proposed quad band antenna which occupies a volume of 39 x 26 mm. The evolution of the proposed antenna is depicted in Fig. 1 At first, an F-shaped radiator of 6 mm width as shown in Fig. 1(a) is designed to operate at the lowest resonant frequency. This prototype has a ground plane of dimension 28 x 26 mm. To this fundamental antenna, another meandered radiator as in Fig. 1(b) is added to excite the frequency bands at 5.7, 8.0 and 9.2 GHz respectively. Thus, a triband radiator is achieved using the folded strip line configuration. The designed antenna needs optimization. On this notion, the width of the

primary F-shaped radiator and the side arm of secondary radiator are reduced to 1 mm to achieve resonance centered at 4.2, 4.5 and 15.8 GHz as in Fig. 1(c).



(a)



(b)

Fig. 2: Layout of the proposed quad band antenna (a) and Simulated S11 result (b).

Further, short discontinuities are added to the primary and secondary radiating arms as shown in Fig. 1(d) to improve the impedance characteristics at lower frequencies of 1.2, 3.6 and 5.9 GHz. The length of the ground plane is reduced to improve the performance of the radiator at 4.9, 8.0 and 11 GHz in Fig. 1(e). The optimized geometry of the triband antenna is shown with extended ground stub added in Fig. 1(f) which operates at 1.575, 2.1, 2.3 and 2.9 GHz.

RESULTS AND DISCUSSION

The Primary radiator antenna-a operates in only one frequency. The Secondary triband radiator operates in three frequencies. The Combination of primary and secondary radiators of antenna-c operates at lower and higher frequencies. Antenna with discontinuities in primary and secondary radiator works also at three different frequencies which constitute triband. Antenna with semi-infinite ground plane also works also at three different frequencies which constitute triband. Proposed quad band antenna with line resonator operates at four different frequency relating four applications like GPS, cellular phone, UMTS and DMB.

APPLICATIONS	SIMULATED RESULTS (IN GHz)
GPS	1.575
Cellular phone	2.1
UMTS	2.3
DMB	2.9

Fig. 3: Simulated frequencies and its related application.

Conclusion:

The designed antenna satisfies quad band operation. Also the antenna is compact in size which can be suitable for integration with the packaging device. In this paper, the multiband configuration of the antenna is achieved by controlling the slots on the patch. The antenna resonates at 1.575 GHz (GPS), 2.1 GHz (3G), 2.3 GHz (UMTS) and 2.9 GHz (DMB) with good return loss which can be suitable for cellular communication applications.

REFERENCES

Agrawal, D.P. 1999. Future directions in mobile computing and networking systems. Workshop sponsored by the NSF, University of Cincinnati.

http://www.brophy.net/PivotX/?p=john-francis-mitchell biography.

http://www.brophy.net/PivotX/?p=john-francis-mitchell-biography#CELLPHONEINVENTOR.

Heeks, Richard, "Meet Marty Cooper – the inventor of the mobile phone", 2008.

Ning GUAN, Koichi ITO, 2009. “A Compact Wideband Two-Arm-Antenna for Mobile Phones”, RADIOENGINEERING, 18: 4.

Anis Suliman Ali, Sholeh Hadi Pramono, M. Sarosa, 2012. “Handset Antenna Design For Mobile Communication System”, IOSR Journal of Electronics and Communication Engineering (IOSRJECE), ISSN: 2278-2834 2: 4.

Corbett Rowell and Edmund Y. Lam, 2012. “Mobile-Phone Antenna Design”, IEEE Antennas and Propagation Magazine, 54(4): 14-34.

Jingli Guo1, Bin Chen, Youhuo Huang and Hongwei Yuan, 2014. “A Multiband Four - Antenna System for the Mobile Phones Applications, Progress In Electromagnetics Research Letters, 50: 55-60.

Ayman Nasih Salman Younis, 2014. “Compact Loop Antenna for Multi-Bands Mobile Handset Applications”, Electrical and Electronic Engineering, 4(3): 58-61.

Nazem Alsmadi and Khalid Saif, 2015. “Mobile Phone Antenna Design”, Electrical engineering with emphasis on telecommunication.