

A novel design of the internal eight-band mobile phone antenna with a tuning element

#Cheng-Wei Chang², Wen-Hsiu Hsu¹, Shan-Cheng Pan¹, Hua-Ming Chen²

¹Department of Computer and Communication, Shu-Te University

No. 59, Hengshan Rd., Yanchao Dist., Kaohsiung, 82445 Taiwan

hsuwhr40@stu.edu.tw

pansc123@stu.edu.tw

²Institute of Photonics & Communications,

National Kaohsiung University of Applied Sciences, 807 Kaohsiung, Taiwan.

s98637118@stu.edu.tw

hmchen@cc.kuas.edu.tw

Abstract

A planar monopole with a tuning element is presented. The operation bandwidth of this design can cover the LTE(700/2300/2500)/GSM(850/900)/DCS1800/PCS1900 and UMTS bands of the mobile phone. By using the coupling feed and the tuning element, the propose antenna can achieved wide band operations. Under the voltage standing wave ratio (VSWR) of 3 : 1, the impedance bandwidth is wide. Due to the compact size, the antenna area is only occupied $60 \times 14 \text{ mm}^2$, the proposed antenna design is fitting to be applied in the smart phone.

Key Words: coupling feed mobile phone tuning element multiband.

1. Introduction

With the rapid growth of the personal portable communications, the demand for antennas with small size, light weight, high performance, low cost and ease manufacture have been considerably increased; hence the compact antenna designs have been received much attention. Several promising on-board printed antennas with a small printed area on the system circuit board for WWAN (wireless wide area network) operation covering the GSM850/900 bands and GSM1800/1900/ UMTS bands in the mobile phone have been reported very recently[1-3]. In the near future, it is expected that the LTE (Long Term Evolution) service which can provide better mobile broadband and multimedia services than the existing GSM and UMTS mobile networks will become very attractive for the mobile users [4-7]. The LTE can also support hand-over to the existing mobile networks. For this application, how to use simply pattern and easy way to design broadband antennas, which included the LTE700, GSM850/GSM900/GSM1800/GSM1900/UMTS/LTE2300 and LTE2500 bands is become very important. In this article, we present a promising simply pattern with coupled-feed and tuning element to cover the eight-band LTE/GSM/UMTS operations. The proposed antenna is suitable to be directly printed on the system circuit board of the mobile phone, making it easy to fabricate at low cost and attractive for slim mobile phone applications. The antenna requires a small footprint of about 840 mm^2 .

2. Antenna Description

Fig.1 (a) shows the configuration of the proposed antenna applied to a mobile phone. The size of the system PCB plane is selected to be $60 \times 114 \text{ mm}^2$. The PCB ground is $60 \times 100 \text{ mm}^2$ and is printed on a FR4 substrate with thickness of 0.8 mm, this system dimension is reasonable for practical PDA phone. Main antenna is feeding through 50Ω microstrip lines and SMA coaxial cable. The detail placement of the main antenna is shown in Fig. 1(b).

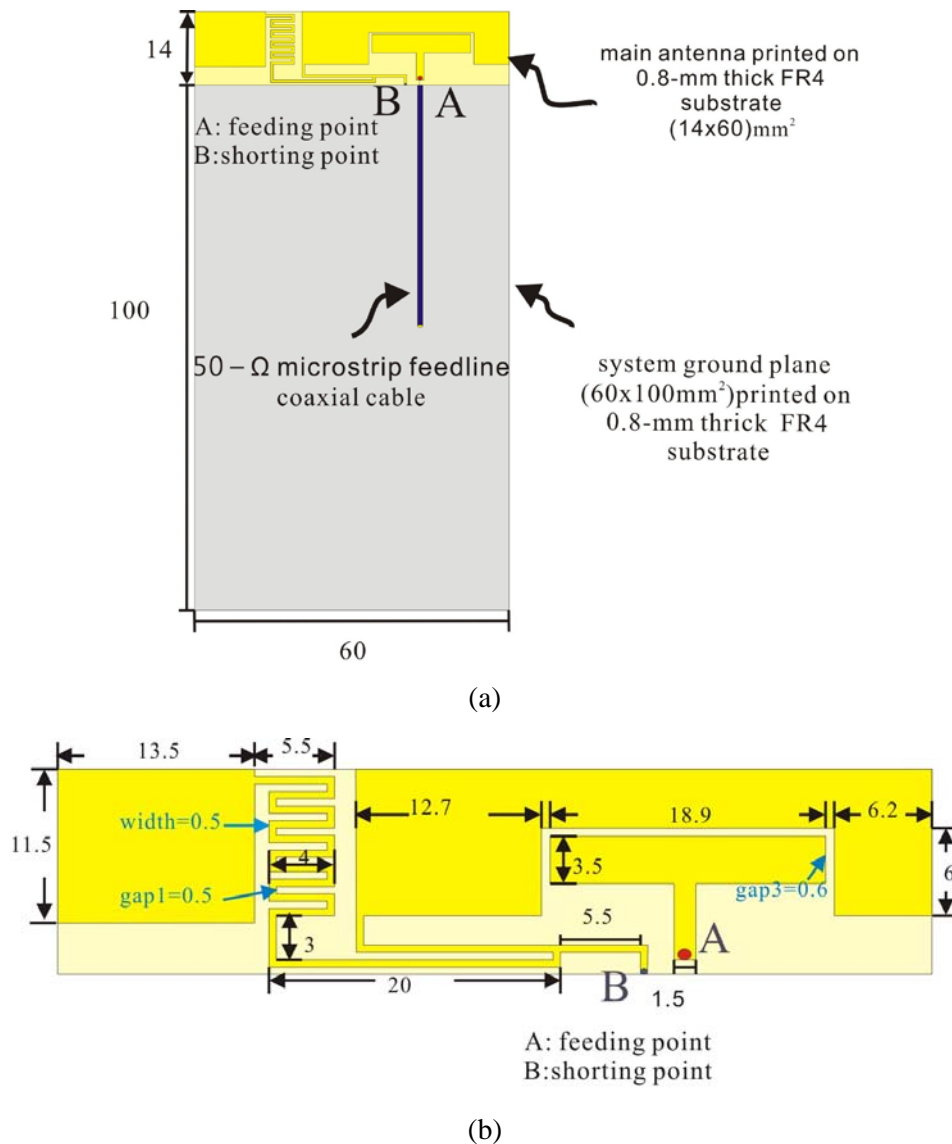


Fig.1 (a)Geometry of the multiband antenna for eight-band operations in the PDA phone.

(b) Detail placement of the propose antenna.

Fig1(b) demonstration antenna dimensional, the pattern include a T-shape feed and a couple sheet-metal and tuning element infoport . It has 0.5 mm spacing between the feed and couple-patch, the tuning element is made with a meandered strip and a rectangle, finally the tuning element links with the main couple patch and connects to system ground.

3. Results and Discussion

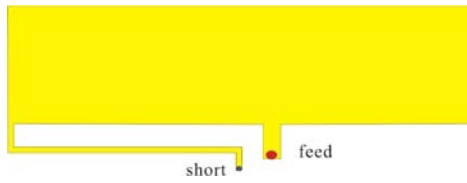


Fig.2(a) with a direct feed

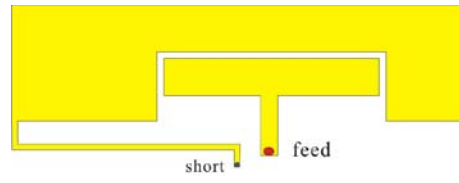
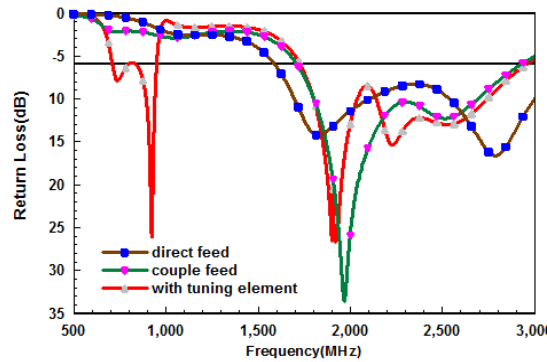


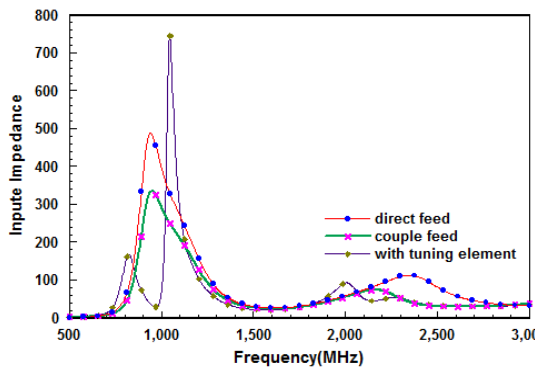
Fig.2(b) with a couple feed



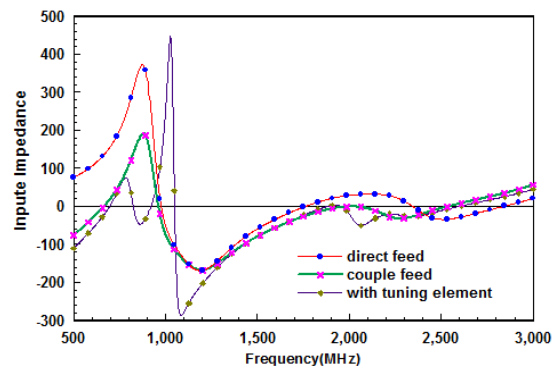
Fig.2(c) with a couple feed and tuning element



(a)



(b)



(c)

Fig (3) Simulated return loss and impedance by HFSS.

Simulated figure (2) the different case, first case with the direct feed, second case with the couple feed, final case couple feed and add the tuning element .And figure (3) is show the input impedance of the propose antenna. By the pictures, we can get some verdicts, direct feed to made high impedance and get one mode in the low band, so we have to used couple feed can effectively to abate the impedance and made two mode in the low band. We can get better impedance matching by tuning element.

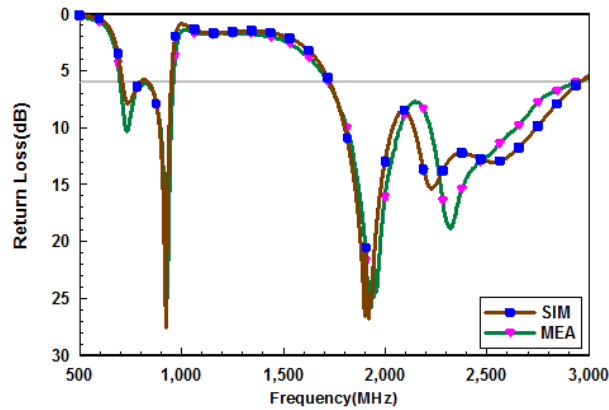


Fig.4 Measured and simulated return loss of propose antenna.

4. CONCLUSION

A novel design for LTE/GSM/UMTS bands antenna design has been proposed and studied. By using the tuning element, we can get simply design to cover the desired frequency ranges of (690 - 960) and (1710-2690) MHz. The obtained results indicate that the proposed antenna is suitable to be applied in the modern slim mobile phone for the eight-band LTE/GSM/UMTS operations.

REFERENCES

- [1] W. Y. Li and K. L. Wong, "Internal penta-band printed loop-type mobile phone antenna," *2007 IEEE Region 10 Conference*, pp. 1-4, 2007.
- [2] C. I. Lin and K. L. Wong, "Internal meandered loop antenna for multiband mobile phone with the user's hand," *2007 IEEE Antennas and Propagation Society International Symposium*, pp. 3572 – 3575, 2007.
- [3] B. Jung, H. Rhyu, Y. J. Lee, F. J. Harackiewicz, M. J. Park, and B. Lee, "Internal folded loop antenna with tuning notches for GSM/GPS/DCS/PCS mobile handset applications," *Microw. Opt. Technol. Lett.*, 48, pp. 1501–1504, Aug. 2006.
- [4] S. J. Eom, J. H. Lee, A. Kim, and S. O. Park, "Broadband internal antenna for 700MHz LTE application with distributed feeder," *2009 Asia Pacific Microwave Conference*, pp. 1845 – 1848, 2009.
- [5] W. Y. Li and K. L. Wong, "Internal printed loop-type mobile phone antenna for penta-band operation," *Microw. Opt. Technol. Lett.*, vol. 49, pp. 2595–2599, Oct. 10, 2007.
- [6] K. L. Wong and W. Y. Chen, "Small-size printed Loop-Type antenna integrated with two stracked couple-fed shorted strip monopoles for eight-band LTE/GSM/UMTS operations in the mobile phone," *Microw Opt Technol. Lett.*, vol. 52, pp.1471-1476, July 2010.
- [7] S. C. Chen and K. L. Wong, "Bandwidth enhancement of coupled-fed on-board printed PIFA using bypass radiating strip for eight-band LTE/WWAN slim mobile phone" *Microw Opt Technol. Lett.*, vol.52,pp.2059-2065, September 2010.