A Compact Multi-Bands Antenna for 4G Mobile Terminals

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2021 IEEE International Conference on Consumer Electronics-Taiwan (ICCE-TW) | 978-1-6654-3328-0/21/$31.00 ©2021 IEEE | DOI: 10.1109/ICCE-TW52618.2021.9602926

***Abstract*-- A compact multi-bands antenna for the 4G mobile terminal applications is presented. The proposed antenna consists of a T shape feeding structure and an inverted F shape radiation structure. Among them, the T shape feeding structure covers the WLAN2.4-GHz and LTE2600 bands; the inverted F-shape antenna covers the GSM850/900, LTE1800. A prototype was fabricated and measured on a FR4 substrate with an overall size of 135 mm × 55 mm × 0.8 mm and the size of antenna only has 55 mm × 8 mm × 0.8 mm. The measured efficiencies are above 40% at all work bands.**

I. INTRODUCTION

With the rapid development of the wireless communication technologies, wireless communication network environment has become an indispensable part of people. The antenna is an important part of the wireless communication device. The design of the antenna directly affects the quality of the communication service. Today's consumer electronic products are designed to be compact, thick and easy to carry. In the limited space, the antenna has become miniaturization and compact with supporting multi-bands.

Several techniques have been reported with different design methods. Many antennas with multiband for 4G mobile terminals [1] - [3] have been studied. The antenna in [1] is planar printed monopole antenna with coupling feeding design. The basic resonance of the monopole combines with the resonance formed by the coupling strip. The advantage of planar printed type is easy to manufacture, but the antenna size is large. The antenna in [2] is also the planar printed type. A parasitic structure near to the driven monopole and excites another resonate mode. The driven monopole and the parasitic shorted-strip both contribute their fundamental and higher-order resonant modes to form the wide operating band, respectively. It has simple structure and ease to manufacture, but also has the size issue. The antenna in [3] is a multi-slot printed antenna and excited with a microstrip line. All three slots, which generate multiple modes, are excited by a transmission line. It has wideband but only cover the LTE band and WLAN band but GSM bands. This article proposes the antenna with size 55 mm × 8 mm covered GSM850 (824-960MHz)/900 (880-960MHz), LTE1800 (1710-1880MHz)/2600 (2500-2690MHz), and WLAN2.4-GHz (2402MHz-2494MHz).

II. DESIGN OF THE ANTENNA ELEMENT AND PARAMETRIC STUDY

Figure 1 shows the overall view of the proposed antenna. The antenna is printed on both sides of a 135 mm × 55 mm× 0.8 mm FR4 substrate. The size of the radiating element is 55 mm × 8 mm × 0.8 mm as shown in Fig. 2. The more detail parameters of the proposed antenna are also shown in Fig. 2. The antenna consists of a T-shaped feeding structure on the front side and an inverted-F shape strip on the back side. The proposed antenna is fed by a 50-ohm coaxial cable. The feeding structure and the strip from point C to ground G of the inverted-F shape structure at the back side excite the GSM850/900 and LTE1800 bands. The WLAN-2.4GHz and LTE2600 bands are excited by the strip from point A to point B and the inverted-F shape strip from point D to point G at the back side. Fig. 2(a) and (b) show the front and back sides and the detail parameters of the proposed antenna.

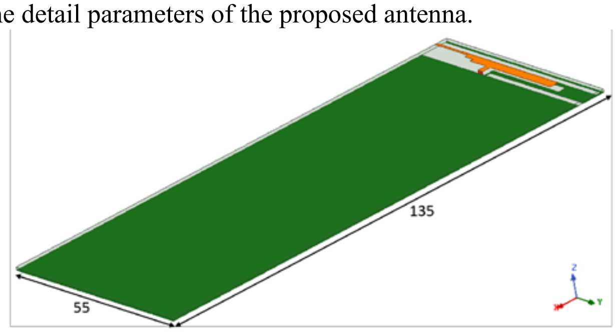
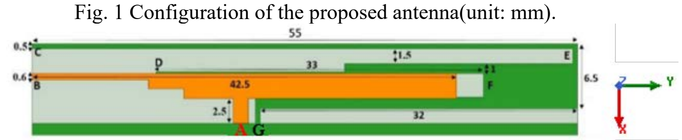
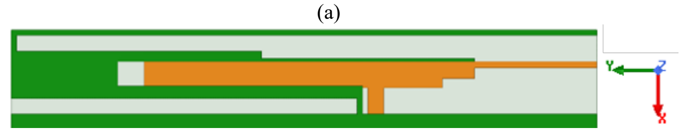


Fig. 1 Configuration of the proposed antenna(unit: mm).



(a)



(b)

Fig. 2 (a) the front side (b) the back side of the proposed antenna with detail parameters (unit: mm).

Figure 3 shows the reflection coefficient (S11) of adjusting the parameter L1 of the proposed antenna. When L1 decreases, the low-frequency and middle-frequency bands will move toward to high frequency, but the high-frequency band will not be affected. Fig.4 shows the S11 of adjusting the parameter W5 of the antenna. When W5 increase, the bandwidth of the low-frequency band becomes narrow, and the middle-frequency band will move to the low-frequency, but the high-frequency band will not be affected.

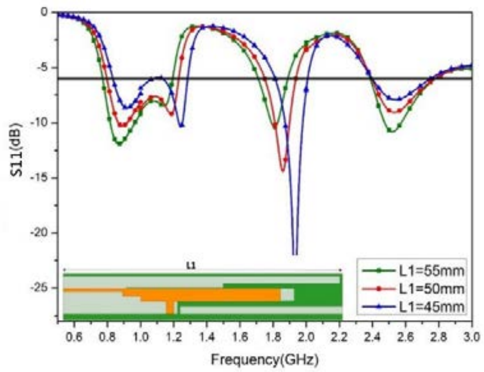


Fig. 3 Simulated S11 with different lengths of L1 as a function of frequency.

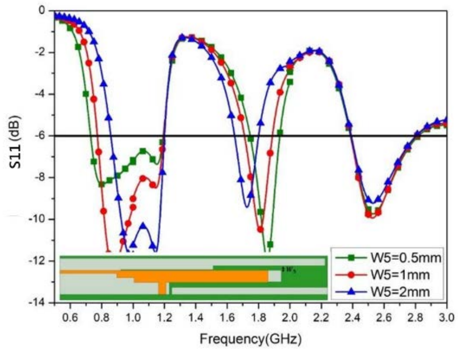


Fig. 4 Simulated S11 with different lengths of W5 as a function of frequency.

III. Results and Discussion

Figures 5(a) and (b) show the front and back sides of the fabricated 4G mobile terminal antenna respectively. Fig.6 shows the simulated and measured S11 of the proposed antenna. The measured 10-dB impedance bandwidth covers the GSM850/900, LTE 1800/2600, WLAN-2.4GHz bands. Fig. 7 shows the measured radiation efficiency of the proposed antenna. The measured efficiency is 67% － 97% in GSM850/900 bands, 65%－97% in LTE1800 band, and 43% －68% in WLAN-2.4GHz and LTE2600 bands. Fig. 8 shows the measured peak gain of the antenna. The measured peak gain is 2.35－3.44 dBi in GSM850/900 bands, 3.6－4.89 dBi in LTE1800 band, and 2.34 － 4.98 dBi in WLAN-2.4GHz and LTE2600 bands. Fig. 9 shows the measured 3-D radiation patterns in the 870 MHz, 930 MHz, 1850 MHz, 2490 MHz, and 2610 MHz

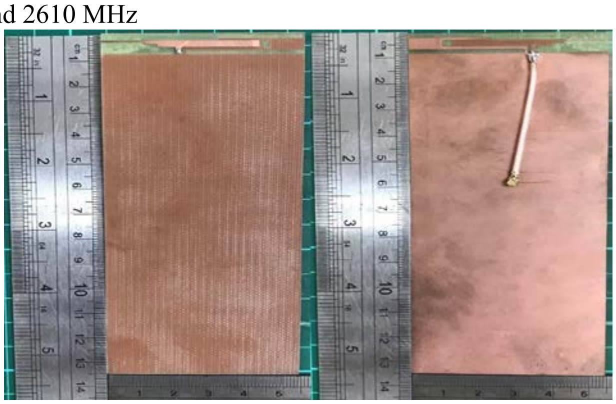


Fig. 5 Photographs of the (a)front and (b)back sides of the fabricated proposed antenna.

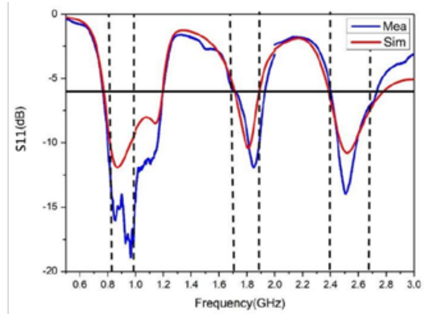


Fig. 6 Simulated and measured S11 of the proposed antenna as a function of frequency.

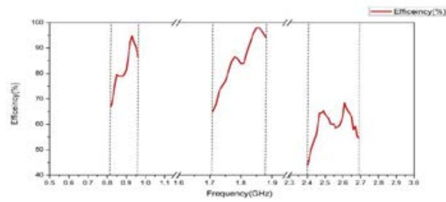


Fig. 7 Measured efficiency of the proposed antenna as a function of frequency.

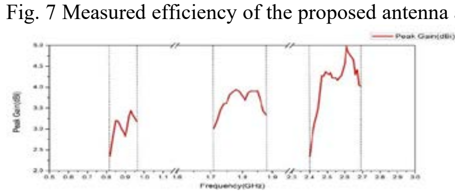


Fig. 8 Measured peak gain of the proposed antenna as a function of frequency.

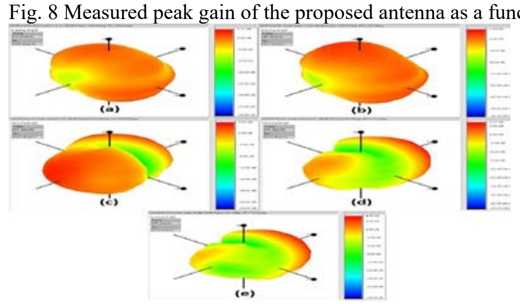


Fig. 9 Measured antenna 3-D radiation patterns in (a)870MHz, (b)930MHz, (c)1850MHz, (d)2490MHz, and (e)2610MHz.

IV. Conclusion

A compact multi-band antenna for 4G mobile terminal has been investigated in this paper. Its size is 55 mm × 8 mm × 0.8 mm. This antenna covers the GSM850/900, LTE1800/2600, and WLAN-2.4GHz bands. The efficiency of the antenna is between 43%－97% and the peak gain is between 2.35 and 4.98 dBi. This antenna is suitable for a mobile terminal device such as the mobile phones, tablets, and laptops.

Reference

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