Circuit-Defined Dual-Wideband Antenna for LTE Tablet Device

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***Abstract* - A circuit-defined dual-wideband antenna for the LTE operation in the tablet computer is presented. The antenna occupies a small ground clearance of 10 × 30 mm^2 and is easy to implement by feeding a simple radiating portion through an inductive branch (inductor-loaded branch) and a capacitive branch (capacitor-loaded branch). By further aided using a simple matching network, both the antenna's lower and higher bands can have enhanced bandwidths. In this study, the obtained bandwidths can cover two wide bands of 698~960 and 1710~2690 MHz for the LTE operation.**

***Index Terms* —Mobile antennas, LTE antennas, tablet computer antennas, dual-wideband antennas.**

I. INTRODUCTION

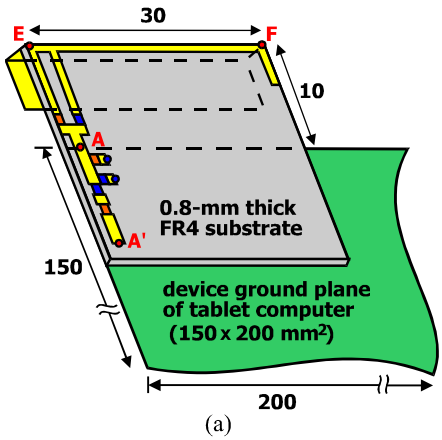
It has been shown that dual-band or dual-wideband operation of the mobile device antenna can be obtained based on applying the matching circuit design or the passive switching circuit design [1]-[4]. Since the dual-wideband operation is obtained by the passive switching circuit design, these antennas are referred here as circuit-defined antennas.

The dual-wideband technique of using the passive switching circuit design is different from the traditional design mainly based on configuring the antenna's radiating portion [5], which generally leads to a complicated antenna configuration and a larger antenna volume as well. On the other hand, although the recently reported LTE tablet computer antenna based on the passive switching circuit design occupies a small ground clearance of 10 × 30 mm^2 only [3], the circuit design thereof required in achieving the LTE dual-wideband operation is still relatively complicated.

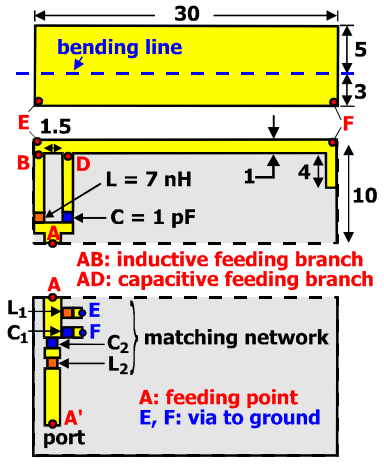
In this paper, we present the design of a new circuit-defined antenna with two hybrid feeding branches and a simple matching network to achieve the LTE dual-wideband operation for the tablet device application.

II. PROPOSED ANTENNA

Fig. 1(a) shows the geometry of the proposed antenna, and Fig. 1(b) shows the exploded view of the antenna. The antenna can provide two wide operating bands and occupies a clearance region of 10 × 30 mm^2 along the top edge of the ground plane of size 150 × 200 mm^2. The selected size of the device ground plane is for applications in a popular 9.7-inch tablet computer. The antenna comprises a printed metal pattern on a 0.8-mm thick FR4 substrate (relative permittivity 4.4 and loss tangent 0.024) and a metal plate bent into an L shape of size 3 × 5 × 30 mm^3 and connected to the printed metal pattern. The printed metal pattern is an inverted-F shape. It includes a 1-mm wide metal strip of length 34 mm, an inductive feeding branch (strip AB) loaded by a chip inductor of 7 nH (L), and a capacitive feeding branch (strip AD) loaded by a chip capacitor of 1 pF (C). The inductive feeding branch mainly controls the antenna to generate a resonant mode in the desired lower band, while the capacitive feeding branch leads to the generation of a resonant mode in the desired higher band.



(a)



(b)

Fig. 1. (a) Geometry of the simple monopole antenna with inductive and capacitive feeding branches. (b) Exploded view of the antenna.

A simple matching network consisting of a shunt inductor (L_1, 8.7 nH), a shunt capacitor (C_1, 0.3 pF), a series capacitor (C_2, 2 pF), and a series inductor (L_2, 5.6 nH) is disposed on the device ground plane. The matching network causes dual-resonance excitation of the excited resonant modes in the antenna's lower and higher bands to respectively cover the desired 698~960 and 1710~2690 MHz bands. The dual-resonance excitation in the lower band is mainly owing to the inductor L_1 and the capacitors C_1, C_2, while the dual-resonance excitation in the higher band is mainly owing to the inductor L_2.

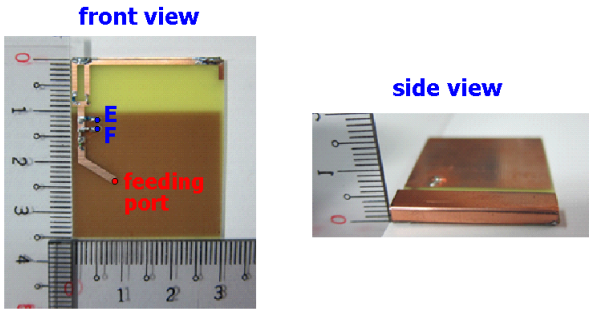


Fig. 2. the photo of the fabricated antenna in its front and side views.

III. Experimental Results And Discussions

Fig. 2 shows the photo of the fabricated antenna in its front and side views. Fig. 3 shows the measured and simulated return loss of the fabricated antenna with the device ground plane. The measured return loss in general agrees with the simulated results. Over the 698~960 and 1710~2690 MHz bands, the measured return loss is better than about 3:1 VSWR (6 dB).

Fig. 4 shows the measured and simulated antenna efficiency of the fabricated antenna. The antenna efficiency includes the mismatching loss and is measured in a far-field anechoic chamber. In the lower and higher bands, the measured antenna efficiency is respectively about 45~62% and 61~95%, which is acceptable for practical applications in mobile devices.

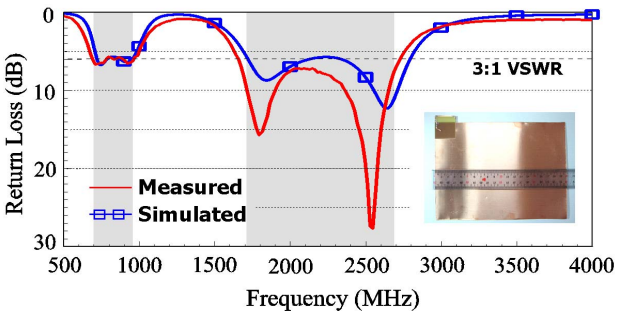


Fig. 3. Measured and simulated return loss of the fabricated antenna with the device ground plane.

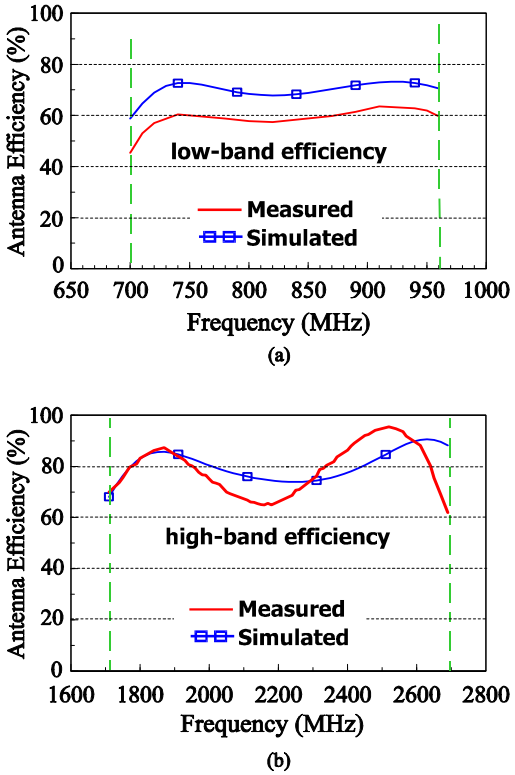


Fig. 4. Measured and simulated antenna efficiency of the fabricated antenna. (a) Low band. (b) High band.

IV. Conclusion

A new circuit-defined dual-wideband antenna has been presented. The antenna can provide two operating bands, with the lower one owing to the inductive feeding branch and the higher one owing to the capacitive feeding branch. The two operating bands are easy to control and the bandwidths thereof can be enhanced to cover the desired 698~960 and 1710~2690 MHz using a simple matching network. Good radiation characteristics have also been obtained for the antenna.

References

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