Planar Compact Tablet Monopole Antenna for LTE/WWAN System

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Abstract - This work describes a compact tablet monopole antenna with eight-band LTE/WWAN operation by introducing a G-shaped driven monopole strip. The obtained impedance bandwidths across dual operating bands approach 264 / 1046 MHz at the LTE and WWAN bands, respectively. Given that the overall antenna size is only 35 × 10 × 0.8 mm3, the proposed planar monopole antenna provides more than 40% reduction in antenna size over that of the conventional ones. Additionally, the measured peak gains and antenna efficiencies are approximately 3.6 / 5.2 dBi and 67 / 70 % for the LTE/WWAN bands, respectively.

Index Terms — Monopole antenna, long-term evolution (LTE), wireless wide area network (WWAN).

I. INTRODUCTION

Due to the tremendous development of modern mobile communication, the long term evolution (LTE) system with three operating bands in the LTE700 (698 ~ 787 MHz), LTE2300 (2300 ~ 2400 MHz) and LTE2500 (2500 ~ 2690 MHz) [1] has received great interest for use in 4G wireless wide area network (WWAN) systems. Moreover, to fulfill the bandwidth specifications of the 4G system and be embedded into a limited space, a compact multi-band antenna is the most promising means of providing commercial broadband coverage in the 698–960 / 1710–2690 MHz bands in LTE/WWAN environments. The applications of several planar monopole antennas (MAs) developed for LTE/WWAN operations include tablet computers [2-9]. However, those antenna designs are limited by a larger antenna size for the above MAs with a greater planar dimension [2-6] or insufficient operating bandwidth [7-9] for LTE/WWAN operations in tablet computers. Several designs have been presented by using the lumped LC matching circuit [9] to enhance the operating bandwidth or adding a chip component [6, 8] to make the antenna dimensions more compact. However, the lumped element in the external matching circuit also incurs additional losses, possibly decreasing the total efficiency of the antenna [6, 8-9]. To overcome this limitation, this article proposes a G-shaped driven monopole strip to excite dual resonant modes in the upper (1710–2690 MHz) band of the desired antenna. An inverted L-shaped parasitic strip shorted at point E. A 50-Ω mini coaxial line is connected to the feeding point (point A) of the G-shaped driven monopole and the display grounding point (point B) to excite this monopole antenna. Several designs have been presented by using the lumped LC matching circuit [9] to enhance the operating bandwidth or adding a chip component [6, 8] to make the antenna dimensions more compact. However, the lumped element in the external matching circuit also incurs additional losses, possibly decreasing the total efficiency of the antenna [6, 8-9]. To overcome this limitation, this article proposes a G-shaped driven monopole strip to excite dual resonant modes in the upper (1710–2690 MHz) band of the desired antenna. An inverted L-shaped shorting strip is then introduced as the parasitic element to generate dual 0.25-wavelength resonant modes at approximately 750/940 MHz bands in order to cover the LTE700/GSM900 MHz operating bandwidth. Additionally, as for the overall antenna volume, the proposed antenna with a small size of 35 × 10 × 0.8 mm3 (280 mm3) has an antenna size at least 40 % less than that of the smallest LTE/WWAN internal antenna with a dimension of 40 × 15 × 0.8 mm3 [2] for a tablet computer.

II. ANTENNA DESIGN AND EXPERIMENTAL RESULTS

Fig. 1 shows the geometry of the proposed compact uniplanar printed antenna with the G-shaped driven monopole strip for tablet computer application.

Fig. 1. Geometry of the proposed compact uniplanar printed antenna with the G-shaped driven monopole strip for tablet computer application.
excited as the first and second operating modes of the upper band. Additionally, based on the above guidelines, the proposed MA is optimized by using Ansoft HFSS, a commercially available software package based on the finite element method [10].

Fig. 2. Simulated and measured results against frequency for the proposed compact MA with a mockup or not.

![Simulated and measured results against frequency for the proposed compact MA with a mockup or not.](image)

III. CONCLUSIONS

The proposed uniplanar monopole antenna reduces the antenna size by more than 40% since the overall antenna size is only $35 \times 10 \times 0.8$ mm$^3$. The proposed small-size monopole antenna provides eight-band LTE/WWAN operations for tablet computers by using the inverted L-shaped parasitic shorted strip and a novel G-shaped driven monopole. The impedance bandwidth across the operating bands can reach approximately 264 / 1046 MHz at the LTE / WWAN bands, respectively. The measured peak gains and antenna efficiencies are approximately 3.5 / 5.2 dBi and 67 / 70 % for the LTE and WWAN bands, respectively.

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REFERENCES