Compact Two-Branch Monopole Tablet Computer Antenna with Integrated Wideband Matching Network for LTE Dual-Wideband Operation

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***Abstract* - A simple two-branch monopole antenna with an integrated wideband matching network to achieve the LTE dual-wideband operation (698~960/1710~2690 MHz) with a small occupied volume (10 × 30 × 3 mm^3) in the tablet computer is presented. The two-branch monopole contributes to one resonant mode in the LTE low band and one resonant mode in the LTE high band. With the aid of the wideband matching network, the bandwidths of the two resonant modes can both be widened to cover the LTE dual-wideband operation. In addition, the matching network requires no additional board space on the system circuit board of the tablet computer and is disposed inside the ground clearance region occupied by the antenna. Experimental results are presented and discussed.**

***Index Terms* — Mobile antennas, tablet computer antennas, LTE antennas, wideband matching network, small-size antennas.**

I. Introduction

There have been many tablet computer antennas reported to cover the LTE dual-wideband operation [1]-[4], and very few of the reported antennas can occupy a small ground clearance of about 10 × 30 mm^2 only [4], if no active switching network is applied [3]. The recently reported LTE antenna in [4] uses two hybrid feeds and requires a small ground clearance of 10 × 30 mm^2. To cover the LTE dual-wideband operation, two wideband matching networks are connected to the two hybrid feeds to greatly widen the antenna bandwidths. In such an antenna design, the wideband matching networks are crucial in achieving two wide operating bands for the LTE operation [4]. Hence, if the wideband matching network design can be simplified, it is expected that such an antenna design can be more attractive for practical applications. In this paper, a promising two-branch monopole antenna with an integrated wideband matching circuit, which is simpler than the design reported in [4], to achieve the LTE dual-wideband operation with a small occupied volume (10 × 30 × 3 mm^3) in the tablet computer is presented.

II. Proposed Antenna

Fig. 1 shows the proposed antenna. The fabricated antenna is shown in Fig. 2. The antenna is mounted along the long edge of the device ground plane of a tablet computer and flushed to one corner thereof. The dimensions of the device ground plane are selected to be 200 × 150 mm^2 to fit for a 9.7-inch tablet computer.

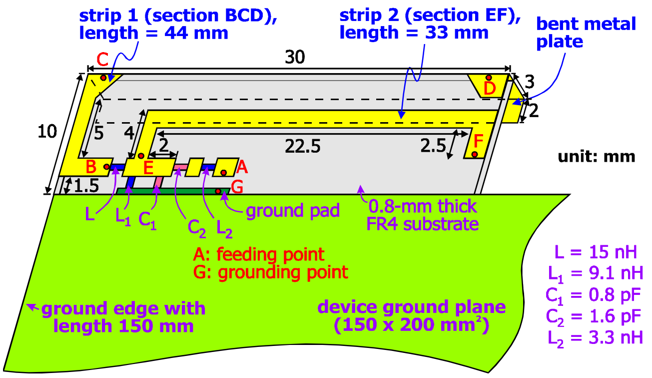

Fig. 1. Geometry of the proposed antenna.

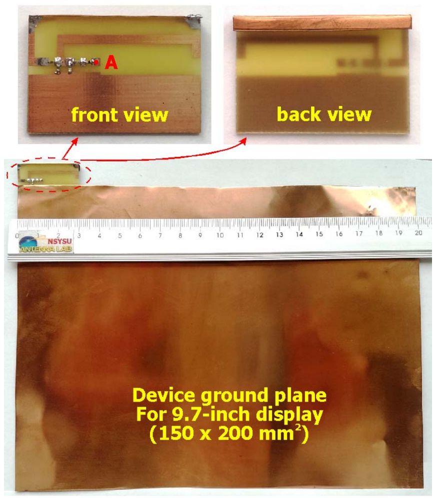

Fig. 2. Photos of the fabricated antenna.

The two-branch monopole includes strip 1 (section BCD, length 42 mm) and strip 2 (section EF, length 33 mm), with strip 2 printed on the 0.8-mm FR4 substrate and strip 1 connected to strip 2 through a chip inductor L of 15 nH. This leads to a small size for the antenna operated in the LTE low band. Also note that the major portion of strip 1 is mainly formed by a bent metal plate of 2 × 3 × 30 mm^3 connected to point C and D on the FR4 substrate. Strip 2 is printed on the

FR4 substrate and has a length of 33 mm, which is close to about 0.25 wavelength at about 2.2 GHz.

A simplified model of the antenna with the wideband matching network is shown in Fig. 3. The wideband matching network includes a shunt chip inductor L_1 (9.1 nH), a shunt chip capacitor C_1 (0.8 pF), a series chip capacitor C_2 (1.6 pF) and a series chip inductor L_2 (3.3 nH). The inductor L_1 and capacitor C_2 can lead to significant bandwidth enhancement of the antenna's low band, with small effects on the high-band performance. On the other hand, the capacitor C_1 and inductor L_2 can effectively adjust the impedance matching of the antenna's high band to achieve a much wider operating band, with small effects on the low-band performance.

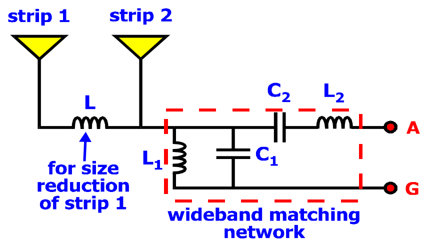

Fig. 3. Simplified circuit model of the wideband feed structure.

The proposed antenna can be decomposed into a low-band antenna (the case without strip 2) and a high-band antenna (the case without strip 1). Their corresponding geometries are shown in Fig. 4. Note that strip 1 and strip 2 respectively contribute a resonant mode to the antenna's low band and high band, while the wideband matching network leads to bandwidth enhancement of the two operating bands at the same time.

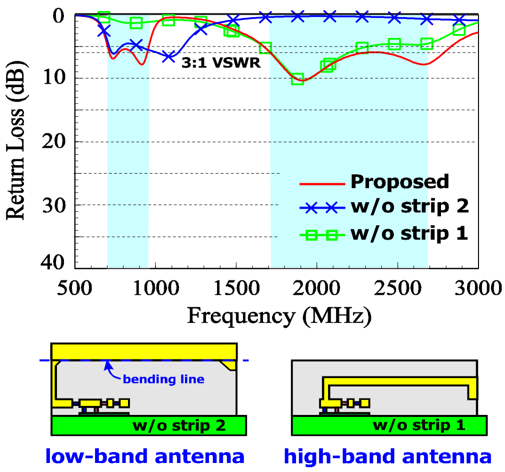

Fig. 4. Simulated return loss for the proposed antenna, the case without strip 2 (low-band antenna), and the case without strip 1 (high-band antenna).

III. Experimental Studies And Discussion

The measured and simulated return losses for the fabricated antenna are presented in Fig. 5(a). The fabricated antenna can cover the LTE dual-wideband operation in the 698~960 and 1710~2690 MHz bands. The measured and simulated antenna efficiencies which include the mismatching losses are shown in Fig. 5(b). The measured antenna efficiency reaches about 50~62% over the low band and are about 58~82% over the high band. The obtained antenna efficiencies are acceptable for practical mobile communication applications. More results will be provided in the presentation.

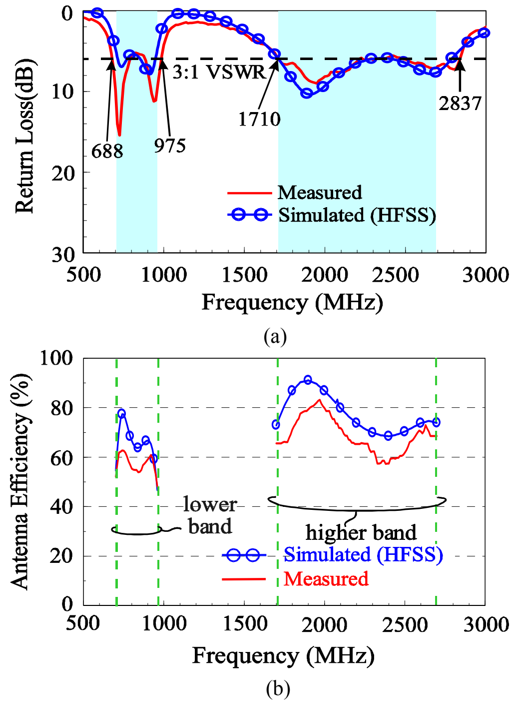

Fig. 5. Measured and simulated (a) return loss and (b) antenna efficiency.

IV. Conclusion

A simple tablet computer antenna design with the aid of an integrated wideband matching network to achieve the LTE dual-wideband operation in the 698~960 and 1710~2690 MHz bands has been proposed and experimental studied. The antenna is not only simple in structure, but also small in size. The occupied ground clearance is 10×30 mm^2 only, and the antenna has a thin thickness of 3 mm. Experimental results of the fabricated antenna have also been presented, and good radiation characteristics have been obtained.

References

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