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Isolation-improved LTE MIMO antenna for laptop-computer applications

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***Abstract* – A simple technique for achieving enhanced isolation between two long-term evolution (LTE) antennas operating at the LTE700/2300/2500 band for the multiple-input multiple-output (MIMO) operation in the laptop computer is presented. The two antennas are mounted along the top edge of the supporting metal plate, which is generally disposed on the inner surface of the upper cover of the laptop computer. Improved isolation (simulated S_{21} better than –17 dB in the LTE700 band and –30 dB in the LTE2300/2500 bands) between the two antennas is easily achieved. By arranging a pair of the isolation elements at two separate null current locations of the excited surface current distribution of the LTE700-band modes of the two antennas can improve isolation in the LTE700 band. It can effectively cause weaker surface currents flowing along the top edge of the supporting metal plate. Over the lower and upper bands, the antenna efficiencies are about 46-58% and 50-68%, respectively.**

***Index Terms* —LTE antennas, antenna isolation, MIMO antennas, laptop computer antennas.**

I. Introduction

For the LTE MIMO operation, it is important to achieve good isolation between the LTE antennas embedded in mobile communication devices including mobile phones and laptop computers. Some techniques especially suitable for applications in mobile handsets to achieve enhanced isolation between LTE antennas in the LTE700 band have been reported [1]. However, very few isolation techniques have been reported for achieving high-isolation LTE antennas in the laptop computer. In this article, we propose a simple isolation technique for two LTE MIMO antennas on laptop computers, especially in the LTE700 band. The two LTE antennas capable of covering the LTE700/2300/2500 bands are arranged to be mounted separately at the left and right corners of the top edge of the supporting metal plate to achieve a large distance between the antennas so that the isolation in the LTE2300/2500 bands can be enhanced. However, it is usually observed that the surface currents excited in the supporting metal plate are strong along the top edge, which leads to increased coupling between the antennas, especially in the LTE700 band. To overcome this problem, a pair of isolation elements arranged at two separate null current locations of the excited surface current distribution of the LTE700-band modes of the two antennas is proposed. The isolation elements can act as resonators designed in the LTE700 band, and hence the exited surface currents flowing in the supporting metal plate can be effectively trapped in the LTE700 band. Hence, decreased coupling between the antennas can be obtained. Details of the proposed isolation technique of the proposed LTE MIMO antennas will be described.

II. Proposed Isolation Technique

Figure 1(a) shows the geometry of the proposed LTE MIMO antenna with isolation-improvement performances for laptop-computer application. The two LTE antennas (noted as Ant1 and Ant2) mounted along the top edge of the supporting metal plate, which is generally disposed on the inner surface of the upper cover of the laptop computer as a system ground plane. Note that the size of the inner surface of the upper cover of the laptop computer is selected to be about 200 × 260 mm^2. As shown in the figure, the two LTE antennas with the respective size of only 10 × 40 mm^2 have the same configuration and are mounted separately at the left and right corners of the top edge of the metal plate with an in-between distance of 180 mm. The antennas have a planar structure and can be fabricated at low cost by printing on a 0.4-mm-thick FR4 substrate of relative permittivity 4.4 and loss tangent 0.024. The antenna is composed of a driven strip and a shorting strip to form a coupled-fed loop antenna which can cover the LTE700/2300/2500 bands.

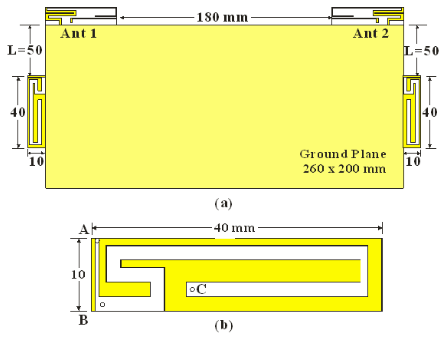

Fig. 1. (a) Geometry of proposed isolation-improved LTE MIMO antenna for laptop-computer application and (b) geometry of the meander open slot acting as an isolation element.

To enhance the isolation between the two antennas, two isolation elements are separately placed at the position with a 50-mm distance away from the top edge of the system ground plane along the two vertical side edges. The isolation element is comprised of a meander open slot, as shown in Fig. 1 (b). With the meander open slot of length about 100 mm, about a quarter-wavelength around 750 MHz, enhanced isolation between the source antennas in the LTE700 band can be achieved. The isolation element is chosen to be placed at a null current location of the excited surface current distribution of the LTE700-band modes of the two antennas to act as a resonator [2] designed in this band, which can effectively trap the exited surface current flowing in the ground plane for the frequencies in the LTE700 band. This behavior leads to enhanced isolation between the source antennas.

III. Results And Discussion

The simulated results of S_{11}, S_{22}, and S_{21} obtained using the three-dimensional full-wave electromagnetic field simulator HFSS version 15 [3] are presented in Figure 2. Based on the bandwidth definition of 6-dB return loss, the operating bandwidths of Ant1 and Ant2 are designed to cover the LTE700/2300/2500 bands. The simulated isolation is better than –17 dB over the LTE700 band and –30 dB over the LTE2300/2500 bands, which is acceptable for practical laptop computer applications.

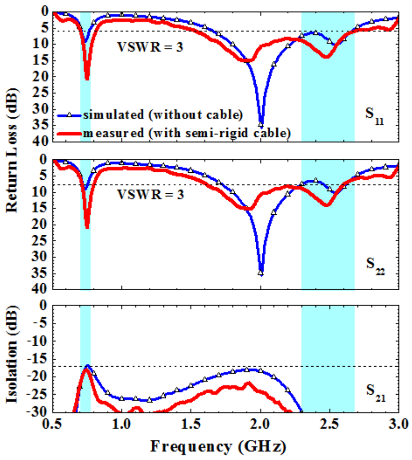

Fig. 2. Simulated and measured S parameters for proposed isolation-improved LTE MIMO antenna.

Figure 3 shows the comparison of the simulated S parameters for the proposed antenna and Reference antenna (the antenna the same as the proposed one but without the isolation elements). Results show that without the isolation elements, the S_{21} values are only about –12, and –25 dB in the LTE700 and LTE2300/2500 bands, respectively. With the presence of the isolation elements, the S_{21} in the LTE700 band is better than –17 dB. These results imply that the isolation elements can indeed decrease the mutual coupling between Ant1 and Ant2. Also notice that for the above two cases, good impedance matching with S_{11} and S_{22} less than –10 dB can be obtained over the LTE700/2300/2500 bands.

Figure 4 shows the measured radiation efficiencies for Ant1 and Ant2 of the proposed design. Over the LTE700 band, the radiation efficiencies are about 46–58%, and the results over the LTE 2300/2500 bands are about 50–68%.

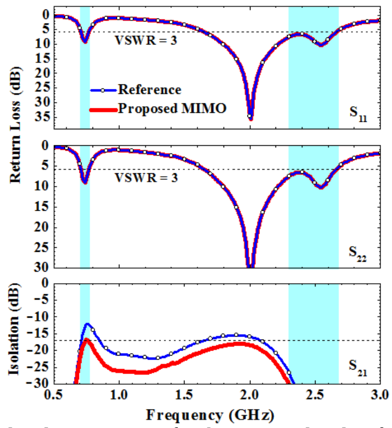

Fig. 3. Simulated S parameters for the proposed and Reference antennas.

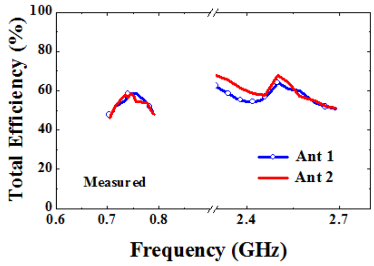

Fig. 4. Measured radiation efficiency for Ant1 and Ant2 of the proposed antenna

IV. Conclusion

An isolation-improved LTE MIMO antenna for laptop-computer applications has been proposed. By arranging a pair of the isolation elements at two separate null current locations of the excited surface current distribution of the LTE700-band modes of the two antennas can improve isolation in the LTE700 band. Improved isolation (simulated S_{21} better than –17 dB in the LTE700 band and –30 dB in the LTE2300/2500 bands) between the two antennas has been achieved. Furthermore, good antenna efficiencies of larger than about 46% and 50%, respectively, in the LTE700 and LTE2300/2500 bands have been obtained for the two antennas.

References

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