A MIMO LTE Antenna System with Decoupling Elements for Smart Phone Application

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***Abstract* – A MIMO LTE antenna system with decoupling elements for smart phone application is presented in this paper. The MIMO LTE antenna system consists of two coupling-fed antennas and two decoupling elements that all assembly on a smart phone PCB board. The proposed main and diversity LTE antennas are respectively located on the top and bottom of PCB board with the same size. Both main and diversity antennas radiation efficiency all can reach 40% above and can cover 700/850/900/1800/1900/2100/2300/2500 bands requirement. Two decoupling elements are respectively located along the two vertical sides of PCB board. By suitable arrangement and design, the isolation can keep under -10 dB and the envelope correction coefficient (ECC) performance less than 0.5 between main and diversity LTE antennas. All simulation data had been simulated by SEMCAD software tool [1], the measured results are shown to illustrate the decoupling elements can effective achieve higher isolation capabilities of the proposed antenna structure.**

***Index Terms* — MIMO, LTE, ECC, Isolation, Decoupling.**

I. INTRODUCTION

In recent years, LTE (Long Team Evolution) and MIMO (Multiple Input and Multiple Output) technology are vigorous development and been extensively discuss. LTE and MIMO technology can bring high speed data rate and capacity under the background of limited frequency resources. MIMO technology is one of the LTE major technologies used to improve performance. To achieve the good performance of an MIMO system, integrating multiple antennas with good radiation efficiency and high isolation is necessary. In addition, the internal LTE antenna design for smart phone usually have compact size and multiband operating to compromise with limited antenna space. However, the design of multi antennas with good performance and uncorrelated in personal wireless device is still an open issue, it became a big challenge for engineers. There are more research on MIMO antenna system in wireless device been proposed on [2]-[4], those proposed paper aroused us to design a high isolation, low ECC and high efficiency antenna structure for smart phone application.

II. LTE ANTENNA DESIGN AND PERFORMANCE

A MIMO LTE antenna with decoupling elements is presented in this paper. Fig. 1 (a) shows the geometry of the dual LTE antennas with a FR4 PCB as the smart phone circuit board (140 × 60 × 1 mm^3) where the keep-out area for antenna is 10 × 60 mm^2. The Fig. 1 (b) and (c) shows the geometry of main and diversity LTE antenna, respectively. Both size of main and diversity LTE antennas with its carrier are 10 × 60 × 5 mm^3. The MIMO LTE antenna system consists of two coupled-fed structures and separate within 129 mm distance between two antenna elements that placed on the top and bottom side of PCB board.

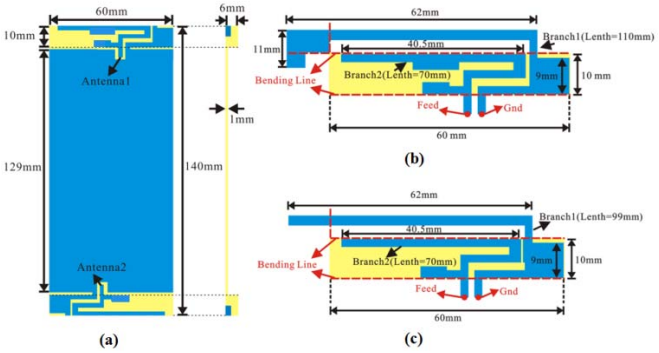

Fig. 1. The geometry of (a) proposed LTE MIMO antenna system, (b) main LTE antenna, (c) diversity LTE antenna.

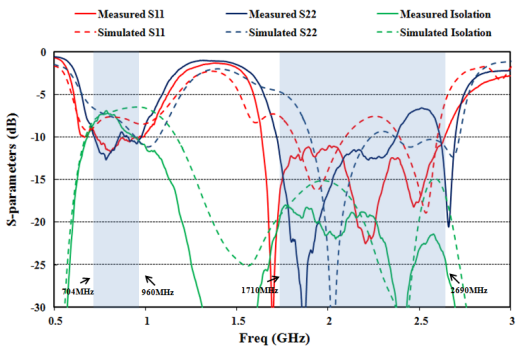

Fig. 2. The return loss and isolation of proposed MIMO LTE antenna system without decoupling elements.

The measured/simulated return loss and isolation of proposed MIMO LTE antenna system without decoupling elements are shown in Fig. 2. Both main and diversity LTE antenna can cover 700/850/900/1800/1900/2100/2300/2500 bands, determined -10 dB return loss. The isolation is about -7.5 dB ~ -10 dB at lower bands of 704 MHz ~960 MHz and under -16 dB at upper bands of 1710 MHz ~ 2690 MHz. The antenna efficiency of both main and diversity without

decoupling elements is 50% above in all bands. ECC of proposed LTE antenna can be calculated by using measured far filed radiation patterns, the ECC value is about 0.4 ~ 0.7 in lower bands and about 0.02 in upper bands. All the efficiency and ECC comparison of with and without decoupling elements are shown in Fig. 5 and Fig. 6, respectively.

III. DECOUPLING ELEMENTS DESIGN AND PERFORMANCE

We add two decoupling elements are respectively located along the two vertical sides of PCB board as shown in Fig. 3. Each decoupling elements had one shorting pin connected to the ground of PCB board. Dimension of two decoupling elements are 10 × 50 × 5 mm^3 and 10 × 42 × 5 mm^3, respectively.

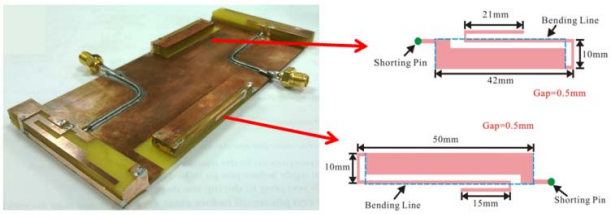

Fig. 3. The geometry of proposed LTE MIMO antenna system with decoupling element.

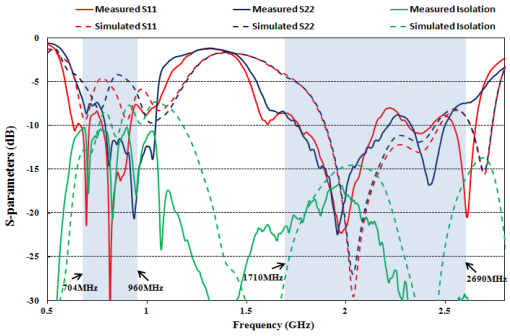

Fig. 4. The return loss and isolation of proposed MIMO LTE antenna system with decoupling elements.

The Fig. 4 Shows the measured return loss can keep under -7.5 dB in all bands. Compared with the MIMO LTE antenna without decoupling elements, we can find the isolation effectively improved to under -10 dB in lower bands of 704 MHz ~ 960MHz by adding the decoupling elements. The Fig. 5 shows the efficiency comparison of MIMO LTE antenna system with and without decoupling elements, the antenna with decoupling elements efficiency is above 40% in lower bands and above 50% in upper bands. The Fig. 6 shows the ECC value comparison, we can find the ECC value can effectively reduced to 0.3 ~ 0.4 in lower bands by adding decoupling elements. The ECC value is less than 0.5 in lower bands and less than 0.02 in upper bands.

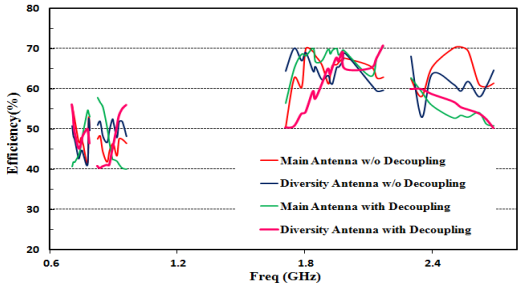

Fig. 5. The efficiency of proposed MIMO LTE antenna system with and without decoupling elements.

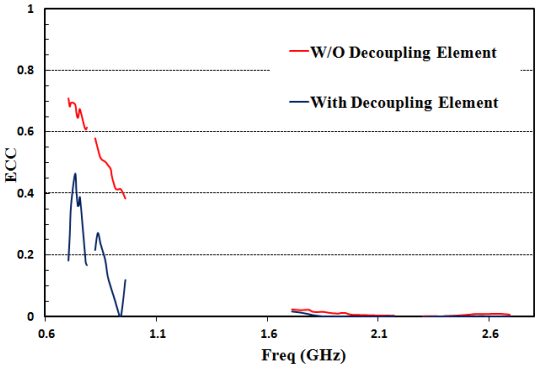

Fig. 6. The ECC comparison of proposed MIMO LTE antenna system with and without decoupling elements.

IV. CONCLUSION

A MIMO LTE antenna system with decoupling elements for smart phone application is proposed in this paper. The MIMO LTE antenna system consist of two coupled-fed structures and add two decoupling elements respectively located along the two vertical sides of PCB board. The MIMO LTE antenna can operate with efficiency above 40% in 704 MHz ~ 960 MHz and above 50% in 1710 MHz ~ 2690 MHz. The isolation and ECC in lower band can effectively been reduced by using the decoupling elements, the isolation is less than -10 dB in all bands and ECC is under 0.5 in all bands. More detail results and design will be described in the presentation.

REFERENCES

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