Design of a Printed Antenna for Mobile Terminals

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Abstract— A printed mobile terminals antenna with multi operating bands for the 2G/3G/4G LTE (long term evolution) is presented. The antenna has three operating bands covering low band of 900 MHz, middle band 1900 MHz and high band 2600 MHz for GSM 900 MHz, UMTS 1900 MHz and LTE 2600 MHz. The antenna occupies a ground clearance of 54 mm $*$ 19 mm and has a thin of 1 mm. The antenna comprises radiating branches to generate multi operating bands. Dimensions and working principle of the antenna are discussed.

1. INTRODUCTION

With rapid development of modern wireless mobile communication technologies, multiband antenna covering the bands of 2G/3G/4G LTE (long term evolution) systems are in urgent need. Especially, the design of multiband and broadband antenna with limited space for mobile terminal devices is a tough problem. In order to achieve different bands for a multiband system, various antennas were reported in recent publications [1–6]. In this letter, a multiband antenna for the 2G/3G/4G LTE (long term evolution) mobile terminals is proposed. The measured -5 dB low bandwidth is 900 MHz (870–960 MHz), middle bandwidth from 1.7 to 2.22 GHz and high band from 2.49 to 2.72 GHz. It can cover the bandwidth of GSM 900 MHz, UMTS1900 MHz and LTE 2600 MHz for 2G/3G/4G LTE systems.

2. ANTENNA DESIGN

The antenna is printed on an FR-4 substrate with a thickness of 1 mm. The relative permittivity of the substrate is 4.4 and loss tangent is 0.025. Figure 1 shows the geometry of multiband mobile terminal antenna.

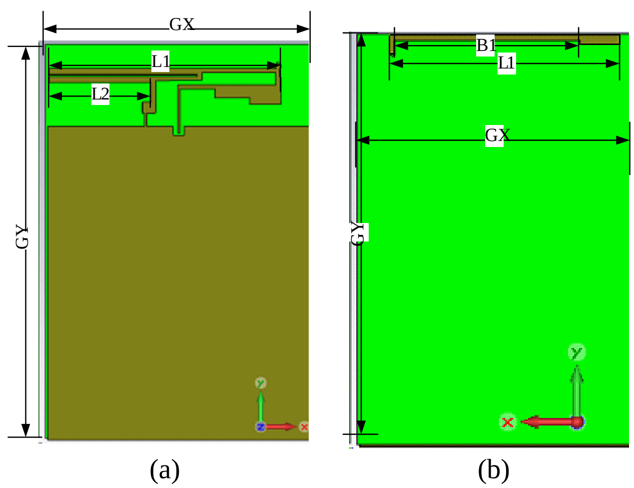

Figure 1: Geometry of the printed antenna. (a) Top view. (b) Bottom view.

Table 1: mm.

D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9	D_{10}	D_{11}	H_0	H_1
0.6	8	8	7	17	1	1	9	1	3	0.6	2.5	2	8.5
H_2	H_3	H_4	H_5	H_6	H_7	H_8	H_9	H_{10}	H_{11}	H_{12}	H_{13}	H_{14}	H_{15}
6.5	5	9.5	12.2	10.5	10	11.3	11.8	13.2	16.2	18.2	3	5.5	12.2

The structure of the multiband antenna can be shown clearly from Figure 2, and Table 1.

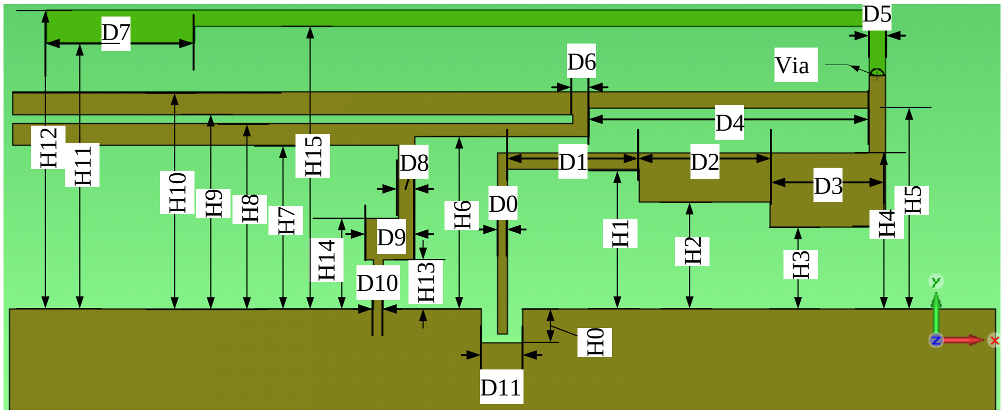

Figure 2: Proposed antenna configuration.

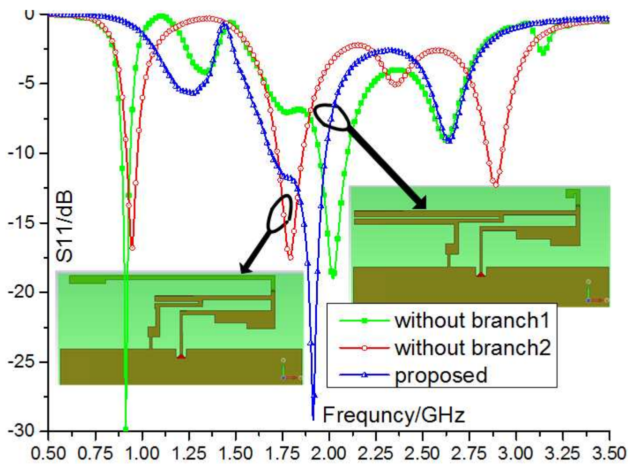

Figure 3: S_{11}.

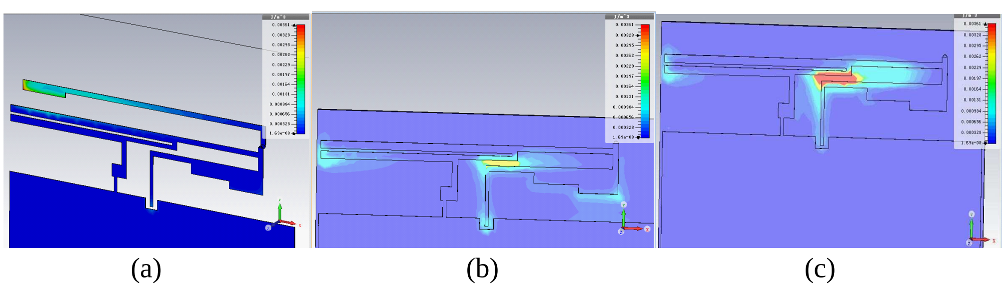

Figure 4: The simulated E-energy-Density. (a) At low band of 900 MHz. (b) At middle band of 1.9 GHz. (c) At high band of 2.6 GHz.

3. ANTENNA RESULTS

The CST simulator of version 2014 was used to obtain simulated results. The S_{11} parameters with different structure are shown in Figure 3. As can be seen in Figure 3, the low band can get with branch1 and the middle band will have a better performance with branch2.

To understand the effect of S_{11} parameters with and without branche1 or branch2, the e-energy-Density simulated by CST at three typical frequencies are shown in Figure 4. As clearly shown in Figure 4(a), the low resonance is related to branch1 which have a great of surface E-energy-Density distributions at low band. The middle resonance is not only related to brunch2 but also related to other couples. The high resonance is mainly related to the couple in the center of the multiband antenna. The impedance of high resonance can be improved by changing the length of D_4.

The 2D and 3D radiation patterns are shown in Figure 5. For the low band of 0.9 GHz in Figures 5(a) and (b) of the 2D and 3D radiation patterns, the gain is 2.038 dBi, it looks like a

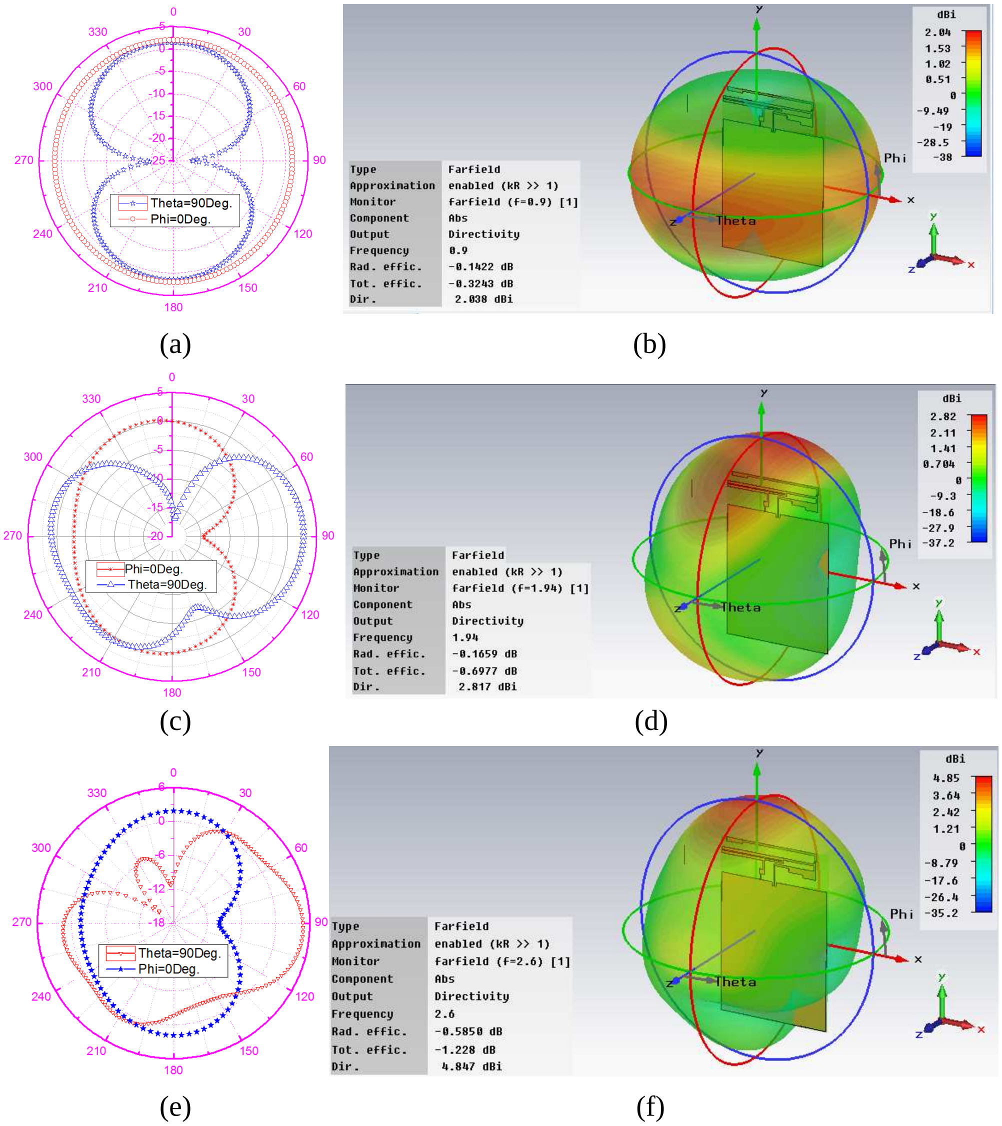

Figure 5: 2D and 3D radiation patterns.

dipole radiation.

For the middle band in Figures 5(a) and (b), the antenna gain is 2.817 dBi and the gain is 4.847 dBi at the high band in Figures 5(c) and (d). The 2D and 3D patterns like a pattern of directional radiation antenna. The ground works as a reflector at the middle and high band, so the radiation pattern will be influenced by the ground directly.

4. CONCLUSIONS

A multiband antenna with a size of 90 mm $*$ 60 mm FR4 sub and a thin thickness of 1 mm for 2G/3G/4G mobile terminal devices has been proposed. The S_{11}, energy density and radiation patterns have been discussed. The triple bands are achieved by radiation branches and coupled structures. The low band is designed for GSM 900 MHz, middle band is designed for 3G and high band is designed for LTE 2.6 GHz.

ACKNOWLEDGMENT

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