

A Slot Antenna with Multiple Steps for Mobile Phone Applications

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Abstract—A novel slot antenna is proposed for mobile phone applications. The antenna has two slots named Slot1 and Slot2, respectively. Slot1 has a hybrid shape of the combination of a circle and a rectangle with four steps located at the lower edge of the rectangle. Slot2 is of rectangular shape. The two slots are opened at opposite edges of the system board. The antenna is fed with a folded shaped 50 Ω microstrip connected to a circular patch and a rectangular patch. There are four steps located at the lower edge of the rectangular patch. The measured -6 dB bandwidths of the antenna are 0.67-1.03, 1.58-2.13, 2.30-2.78, 3.48-6.8 GHz.

Index Terms—Mobile antennas, multiband antennas, slot antennas.

1. Introduction

The antenna for a smart mobile phone is required with multiband and low profile. The popular used frequency bands for mobile phone include LTE700 (698-787MHz), GSM850 (824-894MHz), GSM900 (880-960 MHz), GSM1800 (1710-1880MHz), GSM1900 (1850-1990MHz), UMTS (1920-2170), LTE2300 (2305-2400MHz), and LTE2500 (2500-2690MHz). With the size limitation, it is not easy to cover the lower band of 698-960 MHz for a miniaturized antenna. The purpose of this paper is to design an antenna to cover 698-960 MHz at lower band. Printed slot antenna is popular in handset antenna design [1]-[6].

We proposed a slot antenna with circular shape in [7] covering 1.73-11 GHz. Further modification is made in [8] with inverted-L shaped slot and feeding to cover lower band. The bandwidth is enhanced to 0.69-0.97 and 2.3-3.32 GHz. In this paper, a slot antenna with multiple steps is proposed. This antenna has smaller size and wider bandwidth than the one in [8]. The

2. Antenna Configuration

The configuration of the proposed antenna is shown in Fig. 1. The antenna is printed on a 0.8 mm FR4 board with relative permittivity of 4.4 and dielectric loss tangent of 0.02. The system board has a size of 65 mm x115 mm. The antenna has two slots named Slot1 and Slot2, respectively.

Slot1 has a hybrid shape of the combination of a circle and a rectangle with four steps located at the lower edge of the rectangle. Slot2 is of rectangular shape. The two slots are opened at opposite edges of the system board. The antenna is fed of a folded shaped 50 Ω microstrip connected to a circular patch and a rectangular patch. There are four steps located at the lower edge of the rectangular patch.

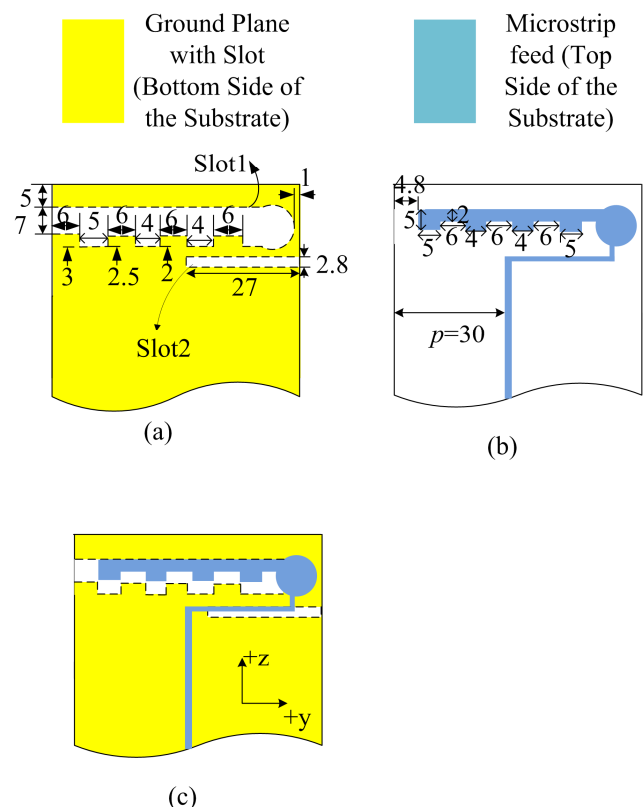


Fig. 1. Configuration of the proposed antenna. (a) Bottom layer. (b) Top layer. (c) Bottom and top layer.

3. Antenna Measurement and Analysis

The antenna was fabricated and measured. Fig. 2 shows the photographs of the fabricated antenna. The measured and simulated $|S_{11}|$ is shown in Fig. 3. The measurement agrees well with simulation at frequencies below 5 GHz. And the measured $|S_{11}|$ is higher than simulation at frequencies above 5 GHz. This may be caused by the fabrication and measurement environment. The measured -6 dB bandwidths of the antenna are 0.67-1.03, 1.58-2.13, 2.30-2.78, 3.48-6.8 GHz, covering mobile communication bands of LTE700/GSM850/GSM900/DCS/PCS/LTE2300/LT2500.

Fig. 4 shows simulated current distributions at the first two resonant frequencies of 0.8 and 1.95 GHz. At the two frequencies, currents flow around the two slots with the guide of the folded shaped feeding. The insert of steps in slot and feeding patch enlarge the length of current path resulting in frequency band shifting to the left.



Fig. 2. Photographs of the fabricated antenna. (a) Bottom layer. (b) Top layer.

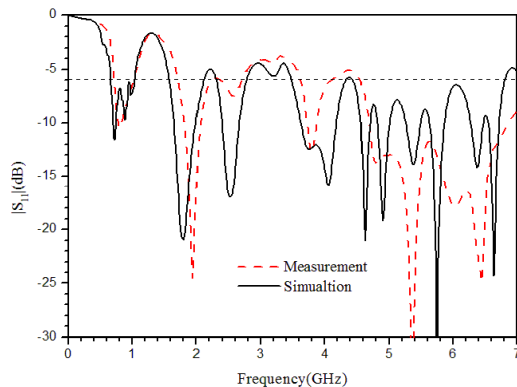


Fig. 3. Simulated and measured $|S_{11}|$ of the proposed antenna.

4. Conclusion

A slot antenna with multiple steps in slot and feeding structure is proposed. The antenna has wide bandwidth at lower band of 0.67-1.03 GHz. The bandwidths at higher band cover 1.58-2.13, 2.30-2.78, and 3.48-6.8 GHz.

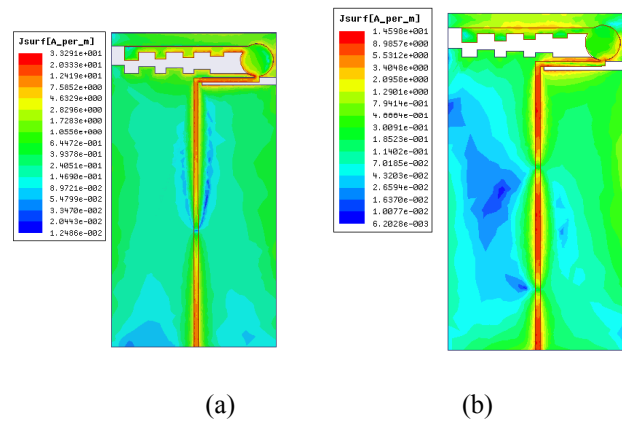


Fig. 4 Simulated current distribution of the proposed antenna. (a) 0.8 GHz. (b) 1.95 GHz.

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