Fundamental Characteristics of Compact Folded Dipole Antenna with a Space-saving

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1. Introduction

Recently the services (IMT-2000, Bluetooh, W-LAN, WiMAX, Digital TV Reception) for the cellular phone are increasing. So wider bandwidth antennas for handsets are required. In addition, built-in antennas become popular.

In our previous paper [1] [2], in order to make a small size and lower profile of antenna for handsets, the built-in folded dipole antenna (BFDA) and built-in bent folded dipole antenna (BBFDA) have been introduced and analyzed. Those antennas can be built in a small volume and placed very close to the rectangular ground plane (GP), which represents a shielding plate used in the handset units, because they have a folded structure and high radiation resistance. In addition, a fold dipole antenna has the self-balanced effect, which means no balun is needed even if BFDA and BBFDA are fed by a coaxial cable [3]. In a result, the relative bandwidths of BFDA and BBFDA for VSWR≤2 are approximately 39.3% and 35.6%, respectively. And the relative bandwidths of the balanced mode are approximately 23.0% and 20.1%

In this paper, more compact folded dipole antenna (CFDA) based on BFDA is proposed and its characteristics are analyzed in both theoretically and experimentally.

2. Antenna structure

Fig.1 shows the structure of CFDA. The main difference between CFDA and our previous antenna is geometrical arrangement and CFDA has more space on the ground plane. The width of antenna element is w. The spacing between antenna elements is S_a .The spacing between the antenna and GP is S_g . The spacing between the feed and short strips is g. The antenna element is placed beside the rectangular GP, which represents a shielding plate used in the handset unit, and the size of GP is 45 mm × 120 mm. The antenna element and GP are made of copper plates with thickness of 0.2mm and 0.5mm, respectively. CFDA has a folded dipole element bended into U-shape and placed along the upper end of GP. The inside antenna element has a gap of 1.0mm at the center. The fundamental parameters are l_1 = 49 mm, l_2 = 14 mm and S_a = S_g = 1.0 mm. The antenna element is fed by a coaxial cable at the feed strip and connected to GP at the short strip. In the experiment, a semi-rigid coaxial cable with a diameter of 2mm is used.

3. Results

The simulator IE3D, which is based on the MoM, is used in the calculation.

Fig.2 shows the calculated input impedance of CFDA. Fig.2 (a) shows the impedance characteristics against the w and (b) shows the reflection coefficient S_{11} parameter against g, respectively. From the results, w = 7.0mm and g = 10mm are selected in the next calculation.

Fig.3 shows the VSWR characteristics in the calculation and measurement when w = 7.0 mm and g = 10 mm. As can be seen in the figure, the wideband characteristics of both calculated and measured results agree well each other and CFDA has three-resonance modes. The calculated and measured bandwidths (VSWR≤2) are approximately 630MHz (27.2%) at the center frequency of 2,315MHz and 810MHz (36.7%) at the center frequency of 2,205MHz, respectively.

Fig.4 shows the calculated current distributions on the GP for the balanced feed model and the three resonant frequencies. The balanced feed model has a gap feed without connecting with the GP. The current distributions of 1st resonant frequency are very different from those of the other cases. The current distributions at 2nd and 3rd resonant frequencies are similar to those of the balanced feed model. From these results, it can be seen that self-balance effect is still maintained at the 2nd and 3rd resonant frequencies.

Fig.5 shows the calculated radiation patterns in the yz plane of the balanced feed model and the three resonant frequencies. The radiation patterns are shown by the power gain (dBi). The radiation patterns at the 2nd and 3rd resonant frequencies are similar to those of the balanced feed model. It can be also confirmed that the self-balanced effect is maintained at the 2nd and 3rd resonant frequencies.

4.Conclusion

In this paper, a new compact folded dipole antenna for handsets is proposed and its characteristics are analyzed. It is found that this antenna have almost the same characteristics of BFDA. In addition, as can be seen in the figure of this antenna from the top view, CFDA has more space compare with BFDA. More detailed analyses are next subject to be studied.

References

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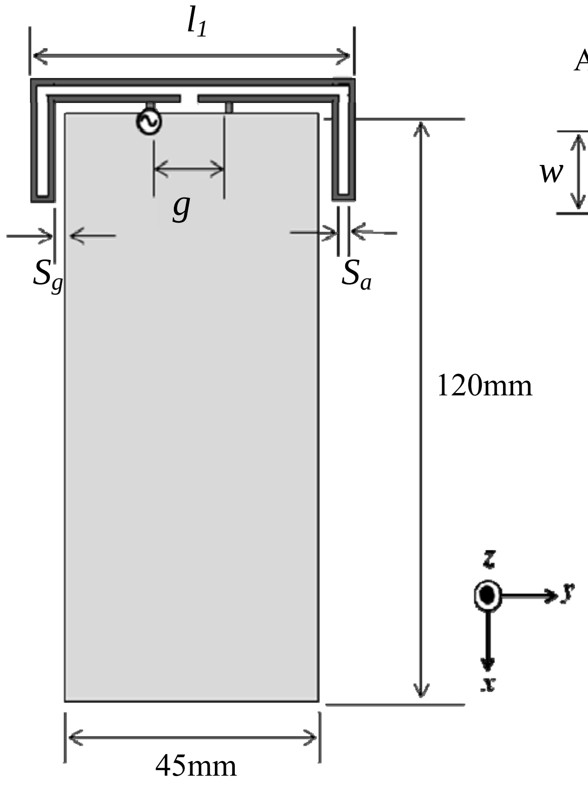
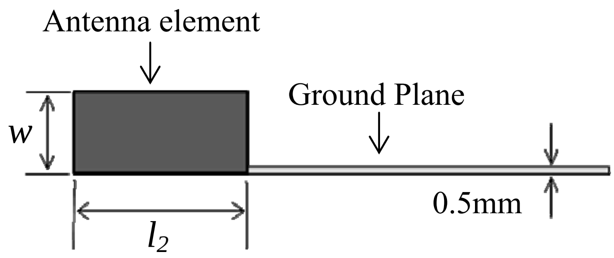
[2] A. Kajitani, Y. Kim, H. Morishita, Y. Koyanagi, "Characteristics of Built-in Bent Folded Dipole Antenna for Handsets ", TENCON Proc.,ThAP-O4.3, Sep. 2007.

[3] S. Hayashida, H. Morishita and K. Fujimoto, "Self-Balanced Wideband Fold Loop Antenna'', IEE Proc. - Microw. Antennas Propag., Vol.1,pp.7-12, Feb. 2006.

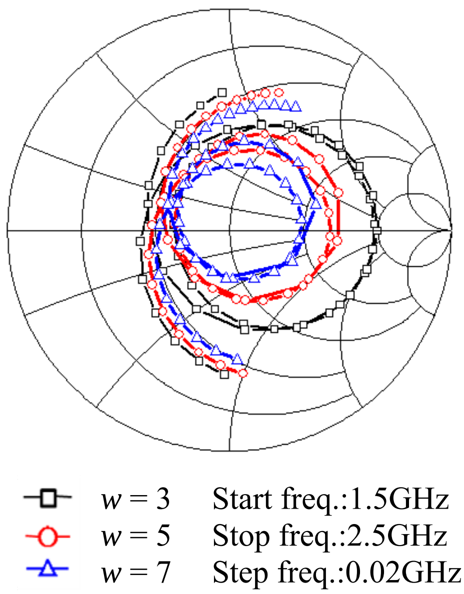


(a) Top view

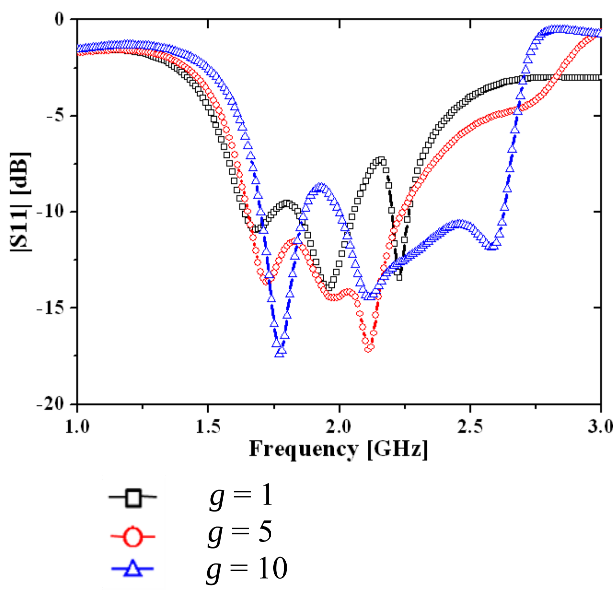


(b) Side view

Fig.1 Antenna structure



(a) On a Smith chart



(b) Reflection coefficient S_{11} parameter

Fig.2 Input impedance characteristics

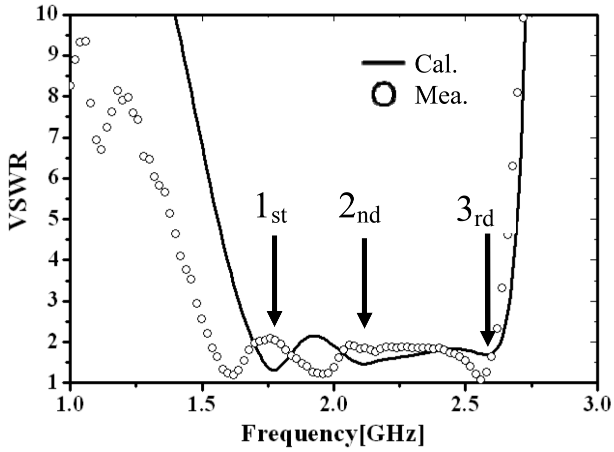


Fig.3 VSWR characteristics

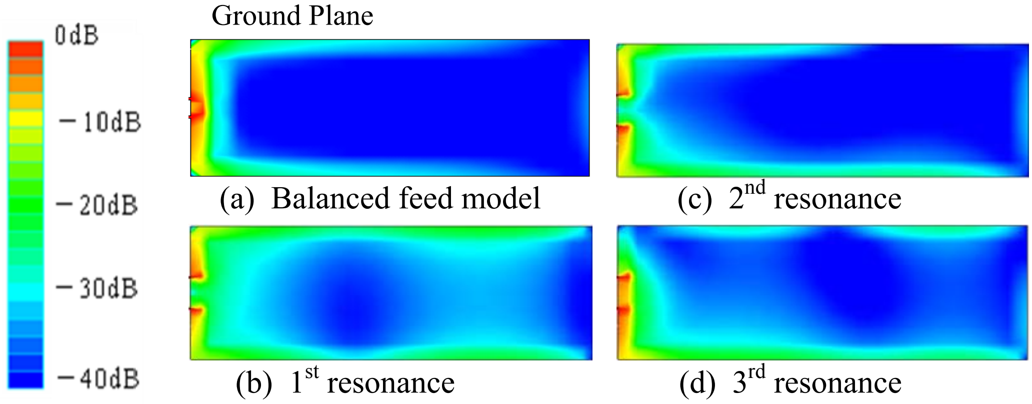


Fig.4 Current Distribution

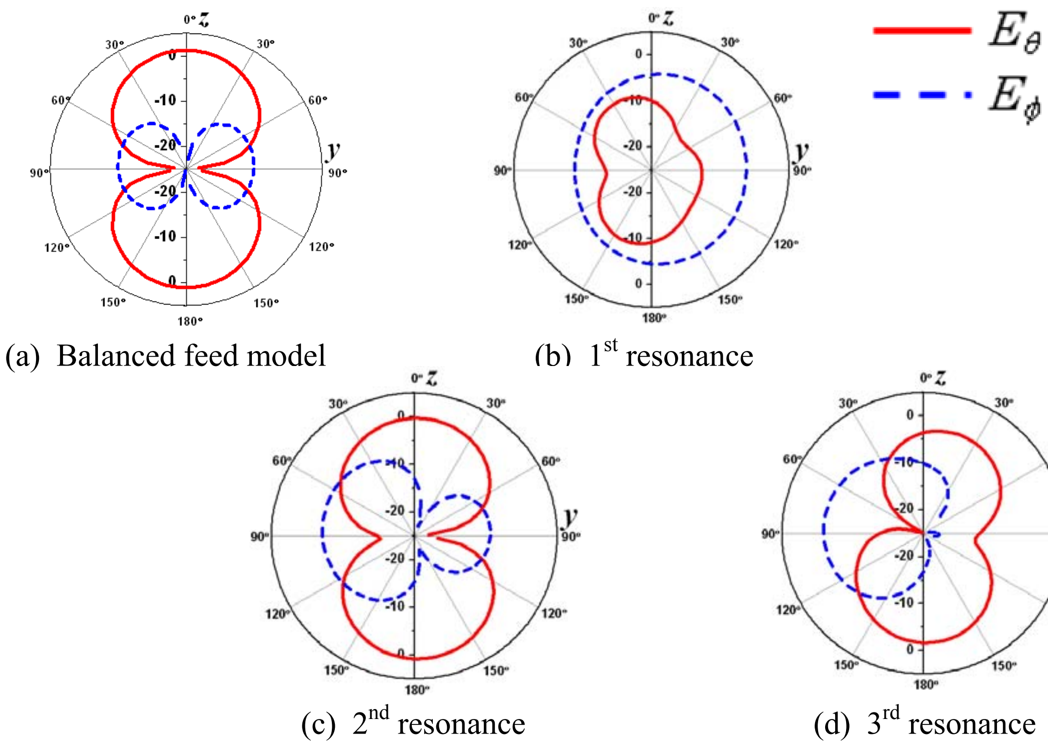


Fig.5 Radiation patterns