

# Compact and Wideband Fylfot-Shaped Planar Monopole Antenna

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**Abstract**—In this paper, a novel compact and wideband fylfot-shaped planar monopole antenna is proposed. The fylfot-shaped is suggested to reduce the volume of a general crossed planar monopole antenna. The volume of the proposed antenna is about 1/4 of a general crossed planar monopole antenna under the conditions where the wideband characteristics are maintained. This technique is suitable for the design of wideband planar monopole antenna which needed a small volume.

**Index Terms**—Crossed Planar Monopole Antenna, Fylfot-Shaped, Wideband Antenna, Small Volume Antenna

## I. INTRODUCTION

Depending on the needs of a variety of wireless communication services, various types of antenna technologies are being developed[1].

The planar monopole has been investigated as an antenna for UWB(Ultra Wideband) communications [2],[3]. The band-notched characteristic, and the dual/triple resonance characteristics of a crossed planar monopole antenna were also studied[4],[5],[6],[7],[8].

In this paper, we proposed the technique to reduce the volume of a general crossed planar monopole antenna under the conditions where the wideband characteristics are maintained. The tri-plate monopole antenna with three folded rectangular plates spaced by  $120^\circ$  was developed in [9].

The center frequency of the designed antenna is 2.5GHz which operates bluetooth, ETCS(Electronic Toll Collecting System), ITS(intelligent transportation systems), and WLAN. The simulation results were

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obtained from the typical antenna design tool, CST MICROWAVE Studio 4.2[10].

## II. THE PROPOSED ANTENNA

Fig. 1 shows the geometry of a general crossed planar monopole antenna. The antenna height 'ho' is fixed at  $\lambda_0/4$  from an interesting frequency. The thickness of an antenna is 0.2mm. The width of a crossed planar monopole antenna, '2 wo', must be selected to supply for wideband characteristics.

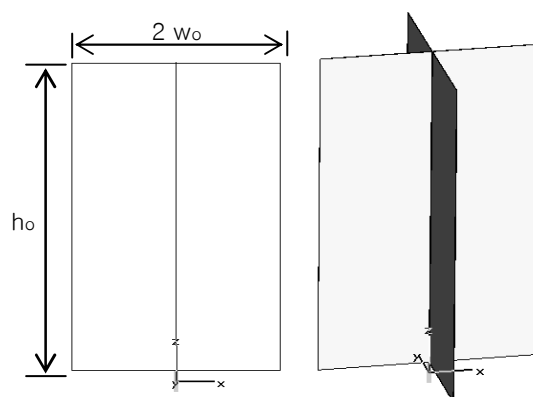


Fig. 1 Geometry of a General Crossed Planar Monopole Antenna (Ground plane is set to a perfect electric conductor.)

Fig. 2 shows the simulation results of reflection coefficients(S11) depending on the width '2 wo'. From Fig. 2, the most wideband characteristics will be obtained from '2 wo'=18mm. However, the size or volume of the antenna is very bulky. So, the fylfot-shaped is suggested to reduce the size or volume of a general crossed planar monopole antenna under the conditions where the wideband characteristics are maintained.

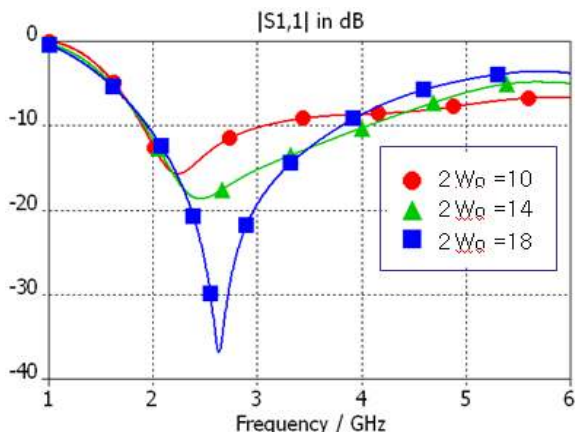


Fig. 2 Reflection Coefficients( $S_{11}$ ) of a General Crossed Planar Monopole Antenna

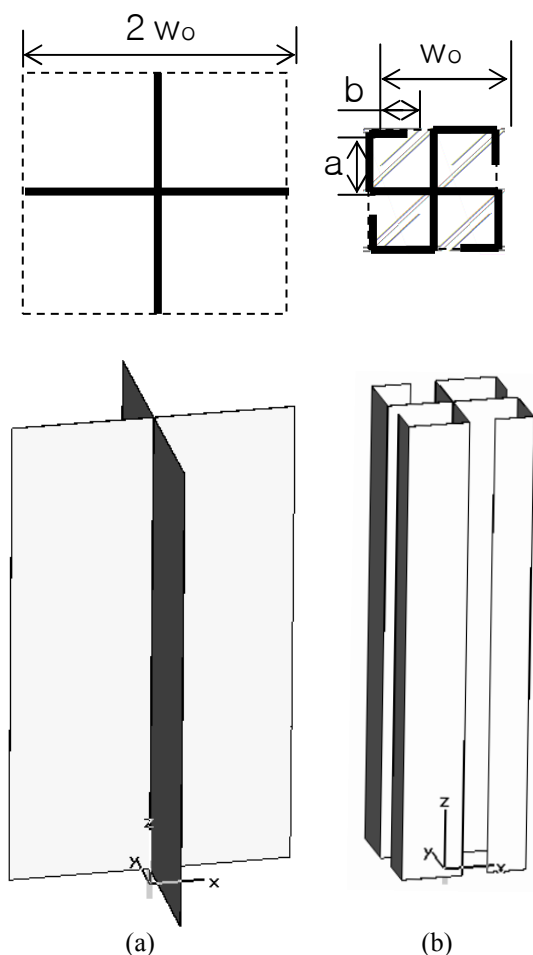


Fig. 3 Geometry of the Proposed Antenna (a) General Crossed Planar Monopole Antenna, (b) Proposed Fylfot-Shaped Planar Monopole Antenna. (Ground plane is set to a perfect electric conductor.)

Fig. 3 shows the geometry of a proposed fylfot-shaped planar monopole antenna. As shown in Fig. 3(b), the extended length ‘a’ and ‘b’ are proposed to maintain the wideband characteristics. In this paper, the extended length ‘a’ and ‘b’ are selected as 4.77mm and 3mm, respectively, from an optimization function of CST MICROWAVE Studio 4.2[10].

The width of the proposed antenna, ‘w<sub>0</sub>’, is fixed as 10mm which is about half of the general crossed planar monopole antenna shown in Fig. 3(a). Therefore, the volume of the proposed antenna is about 1/4 of a general crossed planar monopole antenna.

- ▷ Volume\_Crossed Antenna =  $2w_0 \times 2w_0 \times h_0$
- ▷ Volume\_Proposed Antenna =  $w_0 \times w_0 \times h_0$

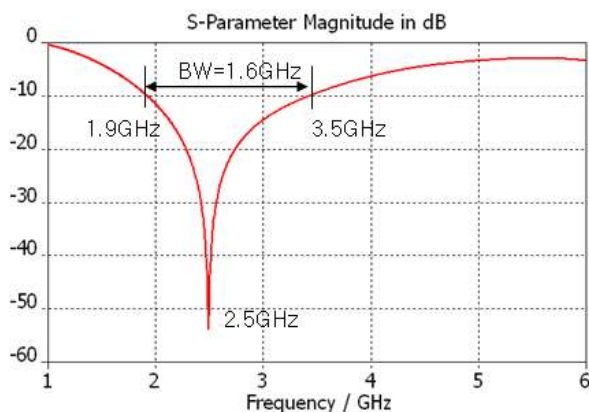


Fig. 4 Reflection Coefficients( $S_{11}$ ) of the Proposed Fylfot-Shaped Planar Monopole Antenna ( $w_0=10\text{mm}$ ,  $h_0=30\text{mm}$ ,  $a=4.77\text{mm}$ ,  $b=3\text{mm}$ )

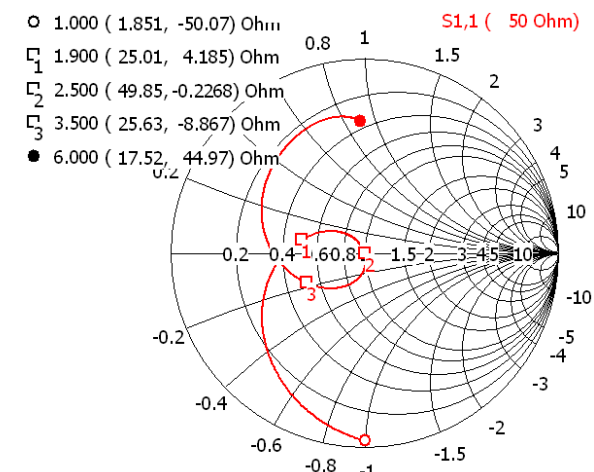


Fig. 5 Antenna Input Impedance of the Proposed Fylfot-Shaped Planar Monopole Antenna ( $w_0=10\text{mm}$ ,  $h_0=30\text{mm}$ ,  $a=4.77\text{mm}$ ,  $b=3\text{mm}$ )

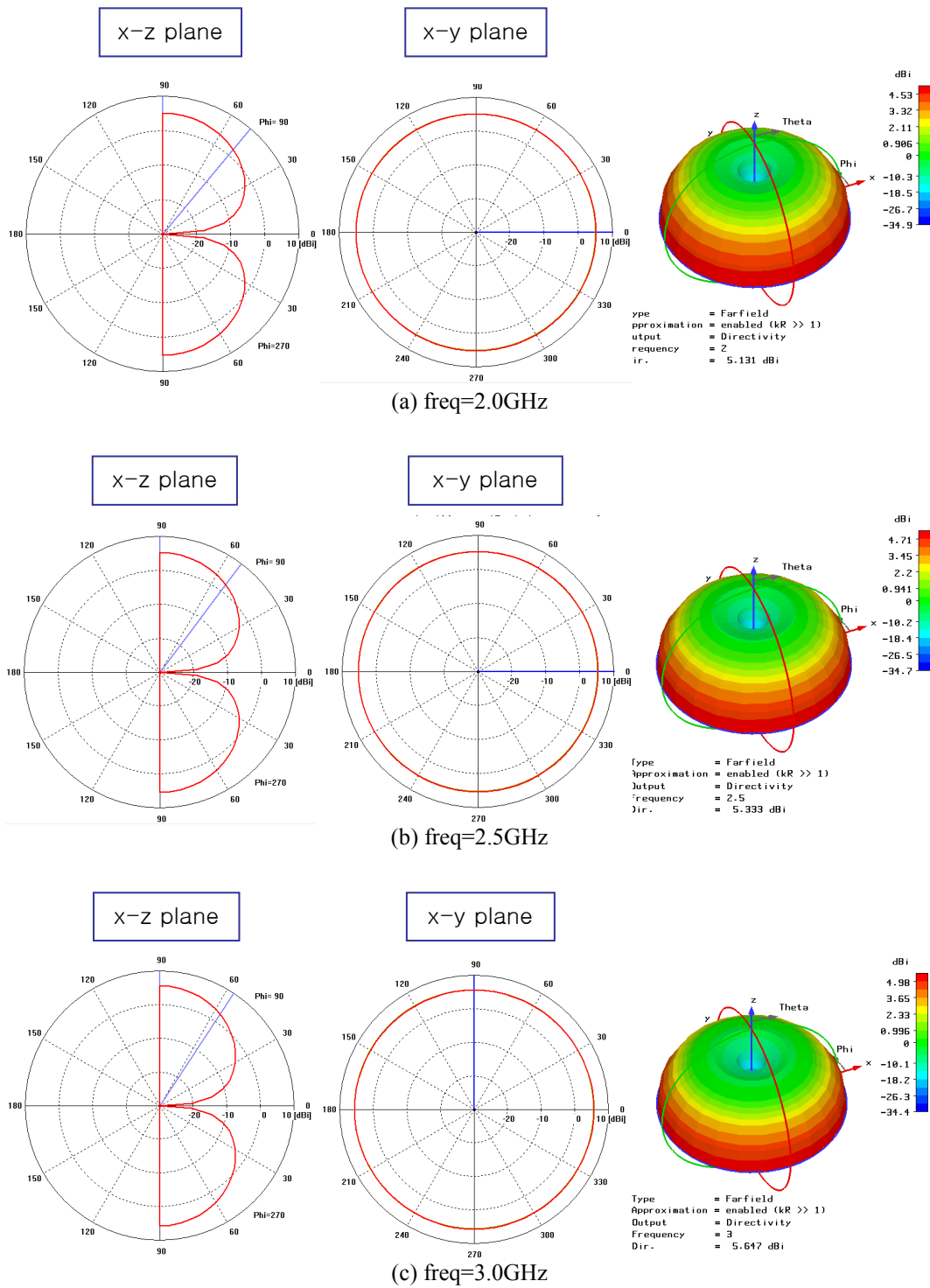


Fig. 6 Radiation Pattern of the Proposed Fylfot-Shaped Planar Monopole Antenna  
 (a) freq=2.0GHz, (b) freq=2.5GHz, (c) freq=3.0GHz  
 ( $w_0=10\text{mm}$ ,  $h_0=30\text{mm}$ ,  $a=4.77\text{mm}$ ,  $b=3\text{mm}$ )

### III. THE SIMULATION RESULTS

Fig. 4 shows the reflection coefficients( $S_{11}$ ) of the proposed fylfot-shaped planar monopole antenna. As shown in Fig. 4, the resonance frequency is 2.5GHz and the bandwidth which the reflection coefficients ( $S_{11}$ ) below -10dB is 1.6GHz. From these results, the wideband characteristics of the proposed antenna are maintained.

Fig. 5 shows the input impedance of the proposed fylfot-shaped planar monopole antenna.

Fig. 6 shows the radiation pattern of the proposed antenna at  $f=2.0$ GHz,  $f=2.5$ GHz, and  $f=3.0$ GHz. The antenna gain is 5.3dBi at 2.5GHz. As shown in Fig 6, the proposed fylfot-shaped planar monopole antenna has an omni-directional radiation patterns(x-y plane). Actually, all the radiation patterns, x-z plane and x-y plane, are very similar to those of a typical linear monopole antenna. This type antenna is suitable for a mobile communications.

### IV. CONCLUSIONS

In this paper, a novel compact and wideband fylfot-shaped planar monopole antenna is proposed. The fylfot-shaped is suggested to reduce the size or volume of a general crossed planar monopole antenna.

Specifically, the extended length 'a' and 'b' are proposed to maintain the wideband characteristics as shown in Fig. 3(b). From these techniques, the proposed antenna is achieved about 75% volume reduction from a general crossed planar monopole antenna under the conditions where the wideband characteristics are maintained. All the radiation patterns, x-z plane and x-y plane, are very similar to those of a typical linear monopole antenna. This technique is suitable for the design of wideband planar monopole antenna which needed a small volume.

### ACKNOWLEDGEMENT

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