A novel PIFA for 2.4 and 5 GHz WLAN application

Y. S. Shin and S. O. Park
School of Engineering
Information and Communications University, 119, Munjiro, Yusong-gu,
Daejon, Korea 305-714

Introduction

With the development of wireless communications, demands for small size, low profile, and multi-band of antennas are continuously increasing. At this point of time, Planar Inverted-F antennas (PIFA) are very attractive because of several advantages such as their simple structure, low profile, and easy fabrication in order to satisfy these requirements. But there are some important disadvantages such as narrow bandwidth and large volume at low frequency. Accordingly, many technical solutions for broad bandwidth and small size have been investigated [1]-[6].

In this paper, a novel PIFA for 2.4/5 GHz Bluetooth and WLAN bands is presented. The size of the proposed antenna is 24.3 × 7.5 × 5 mm^3 and the bandwidth is about 190 MHz and 1850 MHz at 2.4/5 GHz Bluetooth and WLAN bands, respectively. Also, the measured maximum gain is 4.47 dBi at 5.25 GHz. Details of the proposed design are described and the measured results are presented.

Antenna design

The geometry of the proposed planar inverted-F antenna is shown in Fig. 1. The antenna is mounted on a FR-4 substrate which size is 40 × 80 × 1 mm^3 considered to be the circuit board of a practical handset. Also, the metal of the bottom side of the substrate is removed. The proposed antenna is fed by using a 50-Ω coaxial line and the inner conductor is directly connected to the feed part. As seen in Fig 1(b), the antenna size is 24.3 × 7.5 × 5 mm^3 which comprise the shorting and feed plates with 1mm in width, and reversed C-shape metal strip with 2mm and 2.5mm in width, respectively. For small volume, the end part of the radiated element is bent and for broad bandwidth, there is the step shape near folded position. The main tuning parameters are d, w_1, and w_2. By adjusting the distance d between shorting and feeding plate, better impedance matching is obtained and the desired Bluetooth and WLAN band are obtained according to change tuning parameters w_1 and w_2. In order to find the optimized antenna characteristics, Microwave Studio (MWS) is used to tuning the each associated parameters of antenna structure. The proposed antenna is fabricated and measured. The experimental results are presented in the following section.

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Results and discussion

The proposed PIFA has manufactured and measured with an Anritsu 37377C network analyzer to confirm its performance. Fig. 2 shows the measured and simulated scattering parameters of the fabricated prototype. Fig. 2 shows the PIFA with $d = 9$, $w_1 = 16.8$, and $w_2 = 2$. The experimental results have a good agreement with the simulated results. As seen in Fig. 2, the antenna resonates at 2.37 and 5.725 GHz with the bandwidth 8 % and 32.3 % at $S_{11} < -10$ dB covering 2.4 GHz (2.4-2.484 GHz) and 5 GHz (5.15-5.35/5.725-5.875 GHz) bands for WLAN operations. Fig. 3 and 4 show the measured radiation patterns at 2.4 GHz and 5.725 GHz. The measured maximum gain of the proposed antenna is about 4.47dBi at 5.25 GHz.

Conclusion

A novel planar inverted-F antenna with a simple structure for 2.4/5 GHz Bluetooth and WLAN bands has been proposed and experimentally studied. The proposed antenna is a compact dimension of $24.3 \times 7.5 \times 5$ mm^3 and the distance between feed point and shorting pin and lengths of the antenna were adjusted in order to cover dual bands. It has relatively broader impedance bandwidths covering the 2.4 GHz (2.3-2.49 GHz) and 5 GHz (5.15-7 GHz) bands at $S_{11} < -10$ dB and the measured maximum gain is 4.47 dBi at 5.25 GHz.

Acknowledgments

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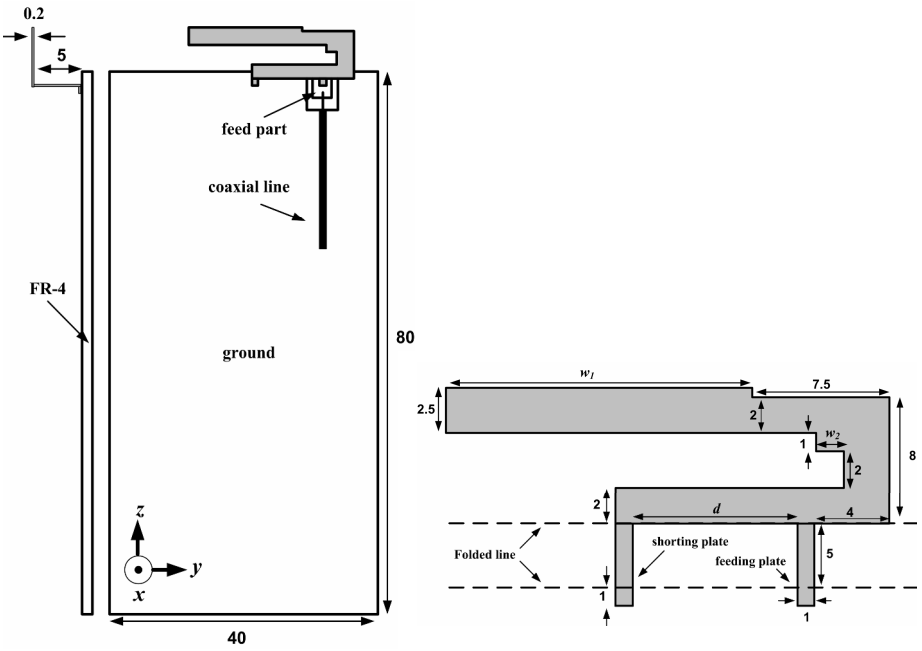
References:

[1] Fu-Ren Hsiao, Wen-Shyang Chen, and Kin-Lu Wong, "Dual-Frequency PIFA with a Rolled Radiating Arm for GSM/DCS Operation", IEEE AP-s, Vol. 3, p. 103-106, 2003.

[2] S. Villeger, P. Le Thuc, R. Staraj, and G. Kossiavas, "Dual-band Planar Inverted-F Antenna", Microwave and Optical Technology Letters, Vol. 38, no. 1, p. 40-42, 2003.

[3] F. Wang, Z. Du, Q. Wang, and K. Gong, "Enhanced-bandwidth PIFA with T-shaped ground plane", IEE Electronics Letters, Vol. 40, no. 23, p. 1504-1505, 2004.

[4] Evangelos S. Angelopoulos, Antonis I. Kostaridis, and Dimitra I. Kaklamani, "A Novel Dual-band F-inverted antenna printed on a PCMCIA card", Microwave and Optical Technology Letters, Vol. 42, no. 2, p. 153-156, 2004.



(a) The side and top view (b) Detail dimensions of the antenna

Fig. 1. Geometry of the proposed PIFA (unit : mm)

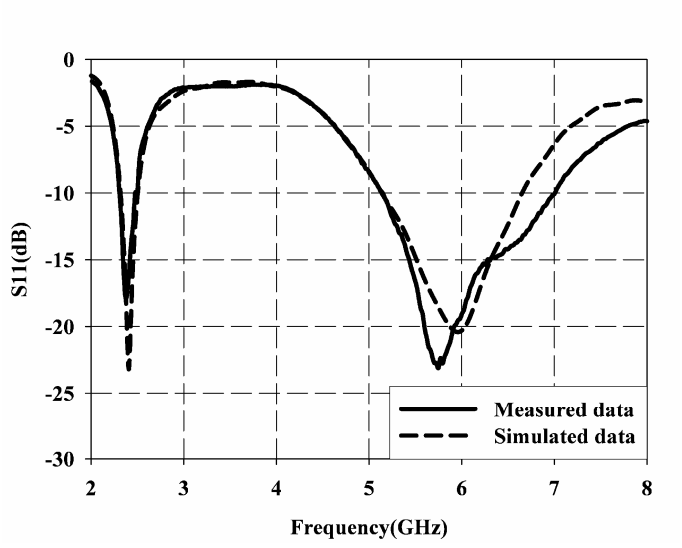


Fig. 2. The measured and simulated return losses of the proposed antenna

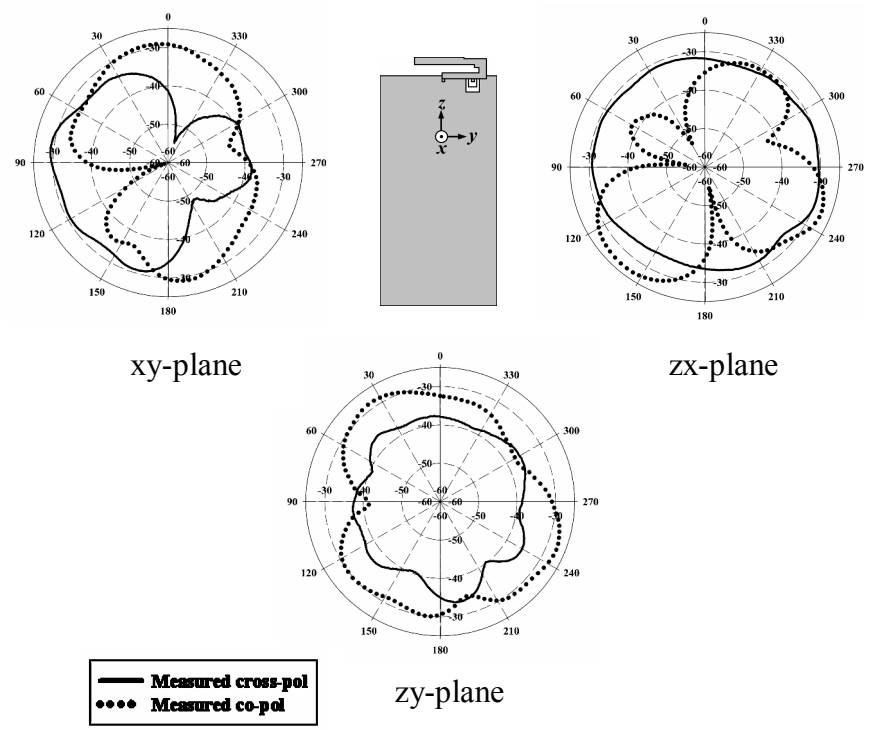


Fig. 3. Measured radiation patterns at 2.4 GHz

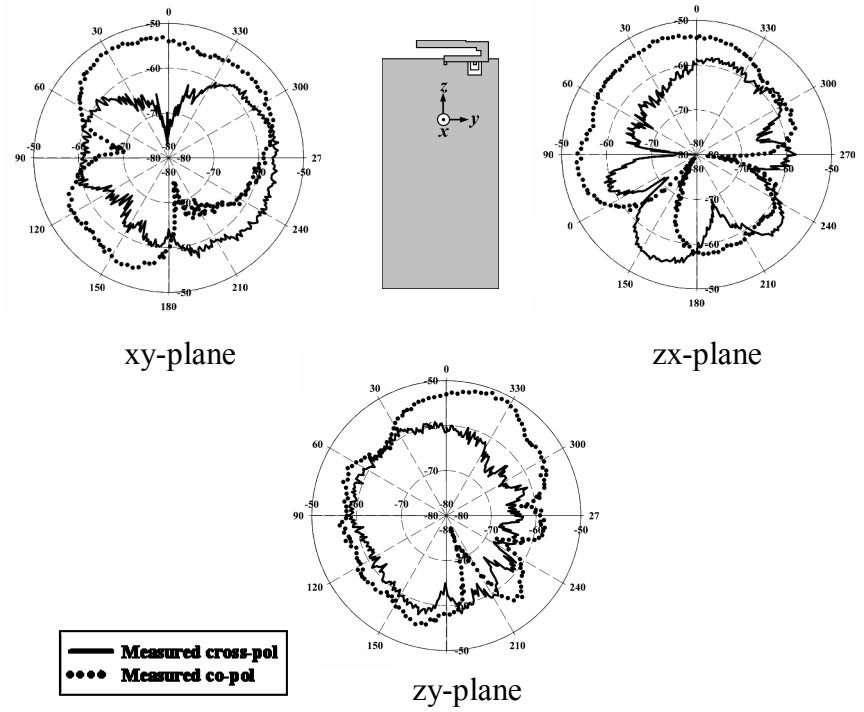


Fig. 4. Measured radiation patterns at 5.725 GHz