A dual-band internal antenna of PIFA type for Bluetooth/WLAN in mobile handsets

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Introduction

Recently, mobile handsets are increasingly being equipped with wireless local area networks (WLAN) for IEEE 802.11a/b. The market trends for devices capable to operate in WLAN bands have been putting on reducing the handset size. Accordingly, internal antennas have to be minimized enough to be placed in mobile handsets while retaining good performance with respect to bandwidth, radiation patterns and gains. Internal planar inverted-F antennas are the most attractive candidate because of their reduced dimension, low profile and good performance.

In this paper, a novel internal antenna of the planar inverted-F antenna type for mobile handsets is presented[1]-[3]. The proposed antenna operates at Bluetooth (2400-2483.5MHz) bands and WLAN (2400-2483.5 MHz, 5150-5875 MHz) bands. The bandwidth of the proposed antenna (VSWR < 2) shows 170 MHz in lower band and 1650 MHz in upper band. The proposed antenna can be applicable to practical mobile handsets because of its small size and low profile[4]. The experimental result of the proposed antenna is compared with the simulation result to evaluate our proposed antenna design.

Antenna design

The proposed internal antenna for Bluetooth/WLAN applications is shown in Fig. 1. The proposed antenna comprises a T-shape patch, a shorting pin and a bent feed line which are made of copper with thickness 0.2 mm. The T-shape patch is composed of two subpatches, p1 and p2. The dimension of a radiating element is 23 mm 10 mm 5 mm. It is mounted above the ground plane which is consist of the FR4 substrate (ε_r = 4.6) with thickness 1 mm and the copper plate with thickness 0.03 mm. The ground plane has a dimension of 45 mm 85 mm. Detailed dimension for the antenna design is listed in Fig. 1. Two sides of the radiating element are separately drawn for the convenience of easier showing the proposed antenna. In this paper, the CST Micro Wave Studio (MWS) is used to finding the optimized antenna characteristics, such as a S-parameter and radiation patterns. The simulated and measured results are compared to each other.

Results and discussion

T The proposed antenna has measured with an Agilent 8510C network analyzer to validate its performance. Fig. 2 shows the computed and measured return losses of the proposed antenna. The calculated and measured results show a good agreement between them. The measured VSWR < 2 bandwidth is about 7.1% from 2320 to 2490 MHz at lower frequency band and about 31.9% from 4770 to 6420 MHz at upper frequency band which are sufficient to cover the required operating bandwidths of Bluetooth (2400-2483.5 MHz) and WLAN (2400-2483.5 MHz, 5150-5875 MHz).
The measured radiation patterns at the resonant frequency of 2.4 and 5.18 GHz are plotted in Fig. 3 and 4, individually. The maximum radiation gains of about 1.98 dBi and 3.82 dBi are measured at 2.4 and 5.18 GHz, respectively.

Conclusion

A novel internal planar inverted-F antenna for mobile handsets has been presented in this paper. It can serve as a dual-band internal antenna for Bluetooth/WLAN mobile handset applications. Also, the total volume of the proposed antenna, 23 mm 10 mm 5 mm, makes it suitable for a internal mobile handset antenna. Simulated and Experimental results showed good agreement for the dual-band behavior of the studied antenna.

Acknowledgments

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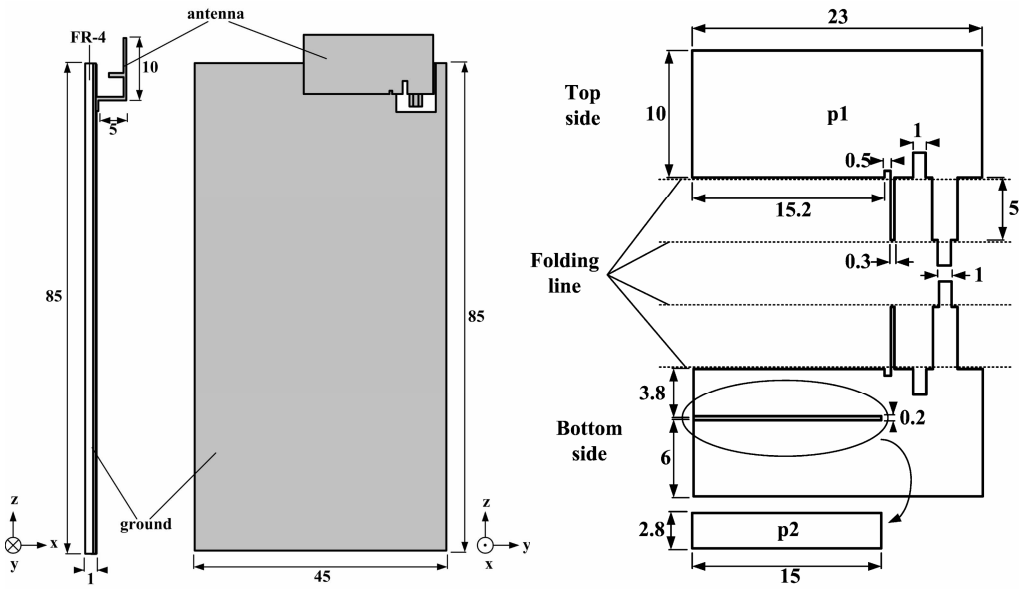

(a) The side and top view (b) Dimensions of the radiating element

Fig. 1. Configuration of the proposed antenna for Bluetooth/WLAN applications.

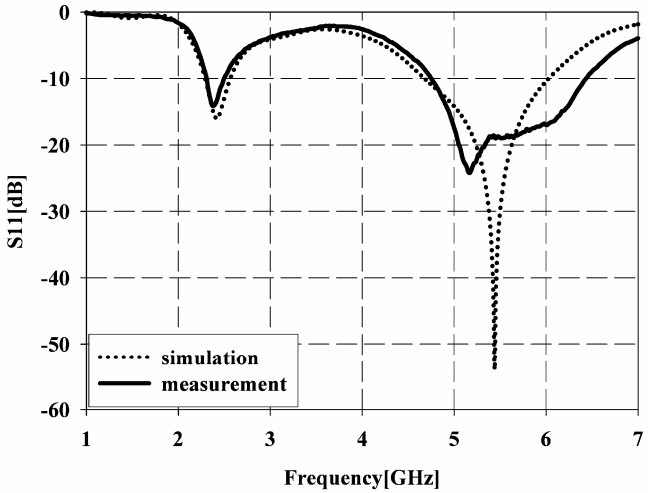

Fig. 2. Simulated and measured return loss for proposed antenna.

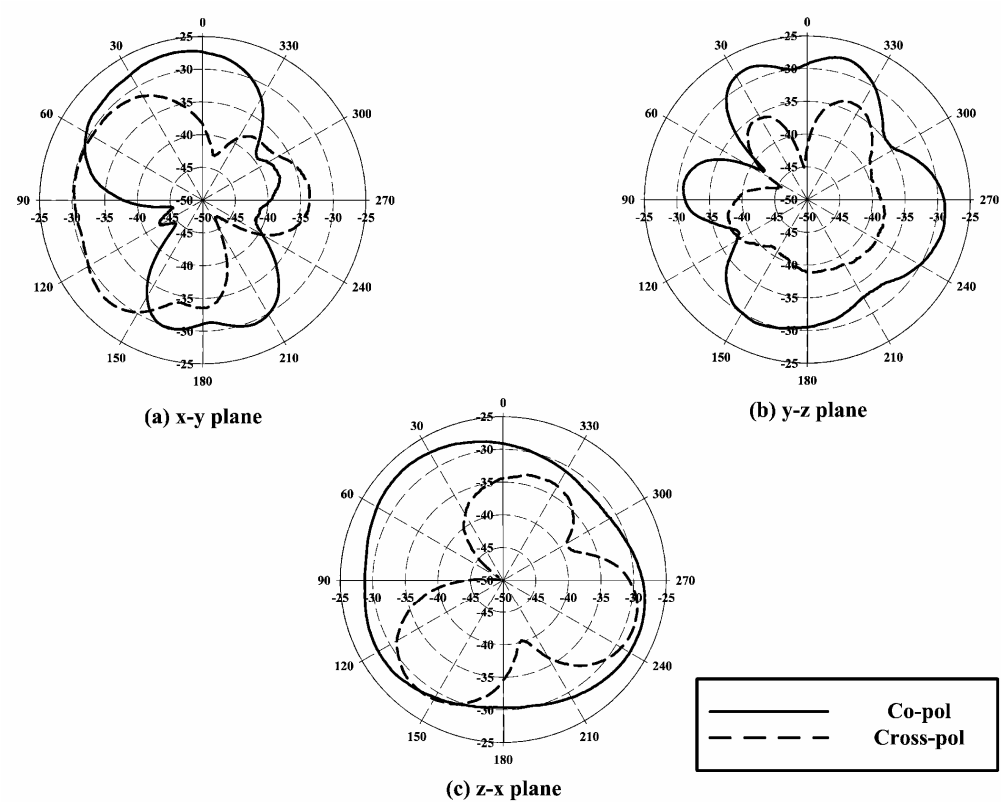

Fig. 3. Measured radiation patterns for the proposed antenna at 2.4GHz.

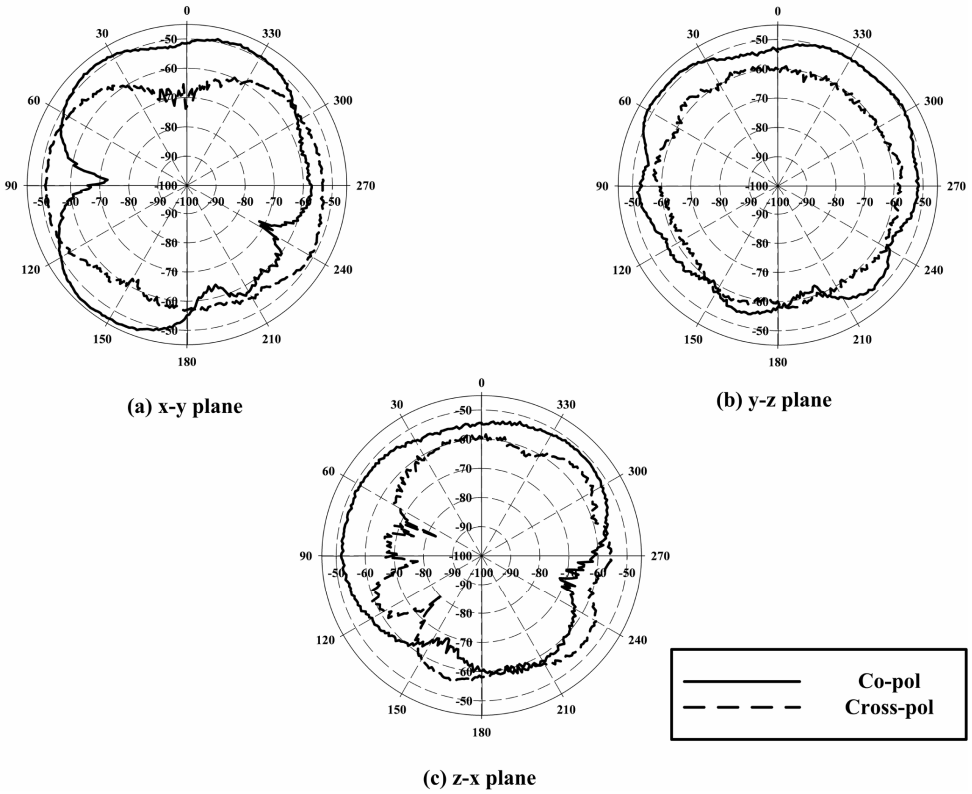

Fig. 4. Measured radiation patterns for the proposed antenna at 5.18GHz.