Dual-Band CPW-fed Planar F-Shape Antenna for WLAN Applications

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Abstract

This paper presents a CPW-fed dual-band planar F-shape antenna for 2.4/5GHz WLAN applications. The antenna comprises a main F-shape radiated element and a shorting strip to obtain dual-band operation and reducing antenna size. The measured results show good dual-band operation, with -10-dB impedance bandwidths of 13.3% and 18.6% at the resonant frequencies of 2.48GHz and 5.535GHz, respectively. This is suitable for applications to the 2.4/5.2/5.8 GHz WLAN communication systems.

Introduction

Wireless local area network (WLAN) communication systems have evolved at an astonishing rate during the last decade, so the dual-band antennas have received more and more attention. Usually, the design of these antenna demands small size, light weight, low profile and low cost. To fulfill these requirements, planar antennas are considered an obvious choice. Planar Inverted-F antenna (PIFA) has good results for dual-band operation [1-3]. And, the coplanar waveguide (CPW)-fed antenna has become very popular owing to its easy realization with a simple structure, wide bandwidth, dual- or multiband operation.

This paper presents an F-shape antenna with CPW-fed for the WLAN applications. This antenna fits the IEEE 802.11 a/b/g WLAN standards in the 2.4GHz (2400-2484 MHz), 5.2GHz (5150-5350 MHz) and 5.8GHz (5725-5825MHz) bands. The antenna is fabricated on the FR4 and the return loss under -10dB and radiation patterns are also measured. The operating bandwidth of the low-band is around 13.3% from 2.28GHz to 2.67GHz and of the high-band is 18.6% from 5.01GHz to 6.06GHz.

Antenna design and experimental result

Fig. 1 shows the geometry of the proposed CPW-fed F-shape antenna for dual-band operation. This antenna is fabricated on one side of the FR4 dielectric substrate (relative permittivity 4.4) with 40mm x 70mm x 0.8mm. The antenna is fed by a 50-Ω CPW transmission line which comprises a strip line with wide of W4 and a gap distance of Wg between the strip line and the coplanar ground plane. Two radiated elements strip B and C of the F-shape antenna are adjusted for low- and high-operating frequency respectively. We tuned the wide of these two strips to obtain the require bandwidth. Shorting strip D connects the F-shape body and ground to reduce the antenna size. The structure parameters of the F-shape antenna are follows: L1=17mm, L2=7.3mm, L3=7.5mm, W1=2mm, W2=2.5mm, W3=1mm, W4=3mm, W5=18.2mm, Wg=0.3mm, d1=8mm, d2=3mm, d3=5mm.

Both numerical and experimental return-loss results of the F-shape antenna are shown in Fig. 2. From the Fig. 2, they are in good agreement. The return loss of the F-shape antenna was measured with Agilent E5071A network analyzer. The results show that the antenna has a return loss of 27.2dB at 2.49GHz, a bandwidth of 13.3% for return loss < 10dB and a return loss of 37.1dB at 5.78GHz for return loss < 10dB. The radiation pattern was also measured. The radiation patterns of 2.45GHz, 5.3GHz and 5.75GHz are shown in Fig. 3-5. They are omnidirectional patterns in the xz-plane.

Conclusion

This paper presents that analysis and design of an F-shape with CPW-fed antenna on a FR4 substrate for the 2.4-GHz and the entire 5-GHz bands. Numerical analysis has been validated by experimental results. As the data shown, this antenna indeed satisfies the demand of wide-band and dual-frequency operations and the radiation pattern is omnidirection in xz-pane. The F-shape antenna has some good properties, such as low profile, low cost, easy fabrication and wide bandwidth. It is very suitable for using in WLAN applications.

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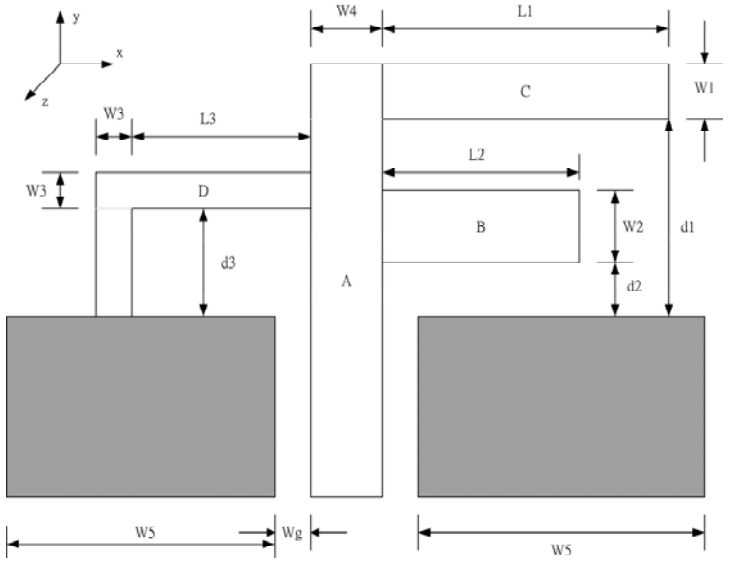

Fig. 1 Geometry of the proposed dual-band CPW-fed PIFA

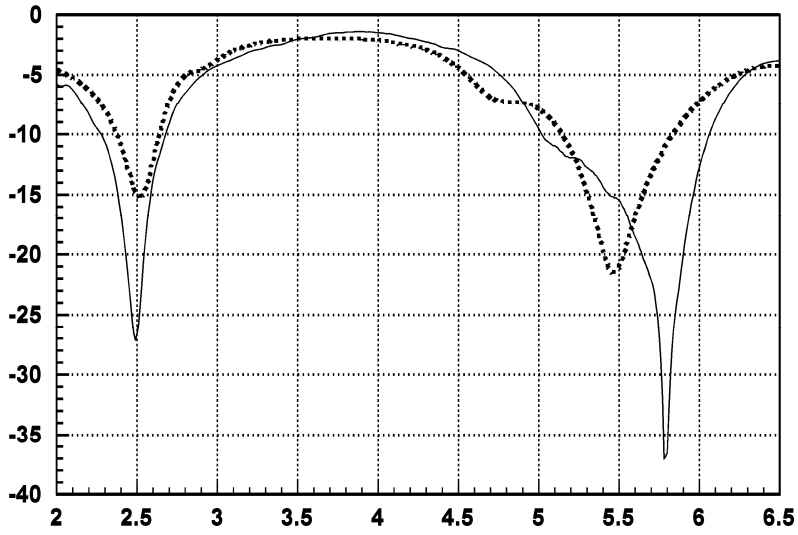

Fig. 2 Simulated and measured return losses, solid-line is measured result and dotted-line is simulated result

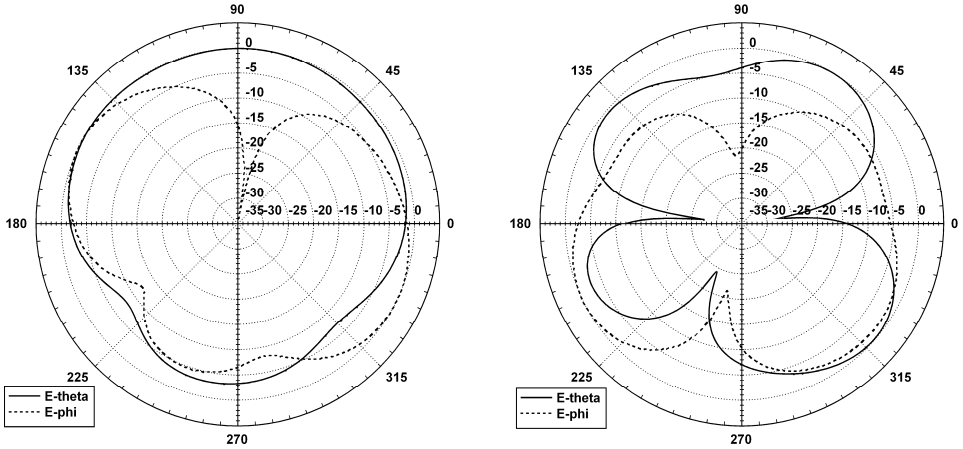

Fig. 3 Radiation pattern measured at 2.45GHz (a) xz-plane (b) yz-plane

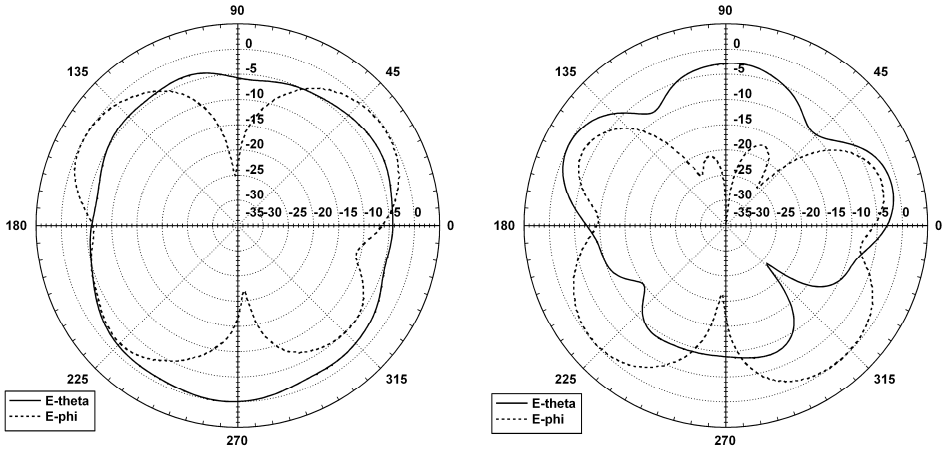

Fig. 4 Radiation pattern measured at 5.3GHz (a) xz-plane (b) yz-plane

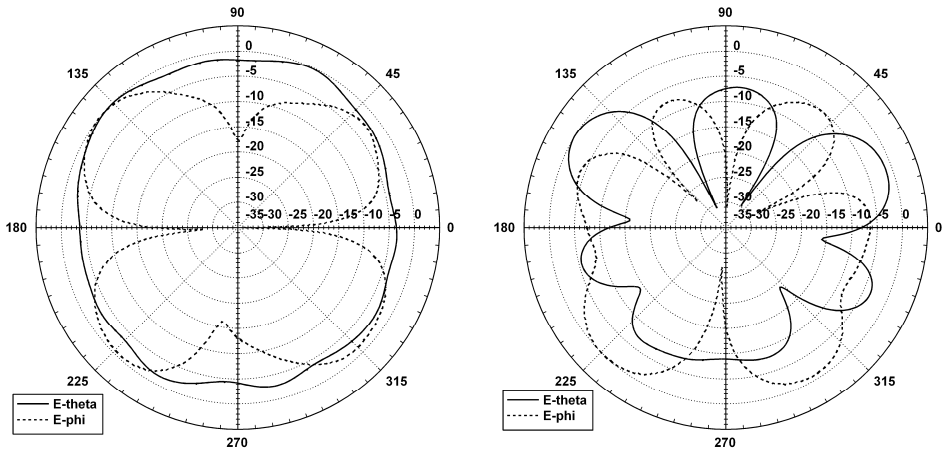

Fig. 5 Radiation pattern measured at 5.75GHz (a) xz-plane (b) yz-plane