A compact printed antenna with a parasitic plate for Wireless LAN systems

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1. Introduction

The printed antennas are good candidates for wireless systems, because of its advantage of low cost, low profile and easy to integrate to MMIC. Recently, researchers have attracted the dual-band and the multi-band antennas for wireless applications. Wireless local area network (WLAN) technology is a wireless communication standard, which covering the lower band from 2.4 to 2.484 GHz (IEEE 802.11b/g) and the higher band from 5.15 to 5.825 GHz (IEEE 802.11a). In order to apply to the WLAN systems, many printed monopole antennas have been proposed in the literature [1-8]. Such as CPW-fed tapered bent folded monopole antenna [1]. In [2-3], the microstrip-fed printed monopole antenna. In [4], Dual-band Hybrid Antenna is proposed for WLAN application. In dual-band antenna is proposed using a parasitic plate for WLAN applications [5-8]. In this paper, we propose an antenna design with a low-complexity and a small size for Wireless LAN systems. Compared to [5-8], the proposed antenna has advantage of small antenna size, broad impedance bandwidth and simple structure. In the further, the dual-band characteristic of the monopole antenna is forming by using a parasitic plate under a rectangular patch. Details of the proposed antenna configuration and experimental results are discussed.

2. Antenna Design

In Figure 1 shows the configuration of the proposed printed antenna with a parasitic plate for WLAN applications. In this design, the 50-Ω microstrip feed-line and radiation patch of $W_1 x L_1$ is designed on the upside of FR4 substrate with dielectric constant (ε_r = 4.4) and thickness (H = 0.8 mm), while the ground plane of $W_{sub} x L_g$ and the parasitic plate of $W_1 x L_1$ were set under the rectangular patch, respectively. The overall dimension of the substrate is 26x40x0.8 mm^3. A 50-Ω microstrip feed-line is with a fixed width at 1.53 mm (W_f), and the distance between rectangular patch and ground plane (G_1) is 3.2 mm. The rectangular patch has chosen a dimension of 11x14 mm^2, which can excite a resonant mode at 3 GHz. The parasitic plate of 16x16 ($W_1 x L_1$) mm^2 is to produce coupling effect between the rectangular patch and the parasitic plate, which can meliorate the impedance matching at higher frequency. In addition, this configuration will cause the first resonant frequency of the proposed antenna without parasitic plate decreases, which leads the proposed has a compact effect. While the value of G_2 between the ground plane and the parasitic plate is set at 8 mm, the frequency band at 3 GHz can be shifted to cover the lower band from 2.4 to 2.484 GHz (IEEE 802.11b/g) and good impedance matching is obtained around the higher band from 5.15 to 5.825 GHz (IEEE 802.11a). Thus, the distance of G_2 is an important parameter to achieve the desired dual-band operation for the proposed design.

3. Experimental Results and Discussion

The measured impedance bandwidth determined from return loss of 10dB and using a Network analyzer. The antenna performance was simulated by using HFSS software. In Figure 2 shows the measured return losses of the proposed antennas for WLAN Applications. The obtained bandwidth of the proposed antenna has a lower band of 2.39 to 2.91 GHz and a higher band of 4.06

to 6.73 GHz, which covering the band of 2.4 to 2.484 GHz and the band of 5.15 to 5.825 GHz of Wireless LAN systems. Note that the proposed antenna with a parasitic plate has a lower 1st resonant frequency at 2.45GHz comparing to that of the antenna without a parasitic plate at 3GHz. It causes that the proposed antenna with a parasitic plate has a compact performance. The far-field radiation patterns were measured and calibrated in our anechoic chamber. The antenna gains of the proposed antenna are also measured. The antenna peak gain is 1.26 dBi of the proposed antenna at the band from 2.35 to 2.5 GHz; the gain is 4.81 dBi at the band from 5.15 to 5.85 GHz. And the gain variations are less then 1 dB at the dual bands. Figure 3 shows the measured radiation patterns of the proposed antenna at 2.45, 5.25 and 5.85 GHz in both X-Y plane and Z-X plane, respectively. As these results, the proposed antenna has good characteristics for WLAN Applications.

4. Conclusion

The novel design of printed antenna with a parasitic plate for WLAN applications has been proposed and studied. To achieve the dual band operation, the parasitic plate on the bottom side of substrate has been designed by using the parameter analysis. By adding a parasitic plate on the proposed antenna, the antenna's impedance matching can be improved and the 1st frequency band can be shifted to lower frequency. The dual-band operation of the monopole antenna is from 2.39 to 2.91 GHz at lower-band and 4.06 to 6.73GHz at higher-band. The proposed antenna with a compact size and simple structure will be attracted for WLAN applications.

Acknowledgments

This work was supported by the IC Design and Application Development Center at Southern Taiwan University, Tainan County 710, Taiwan.

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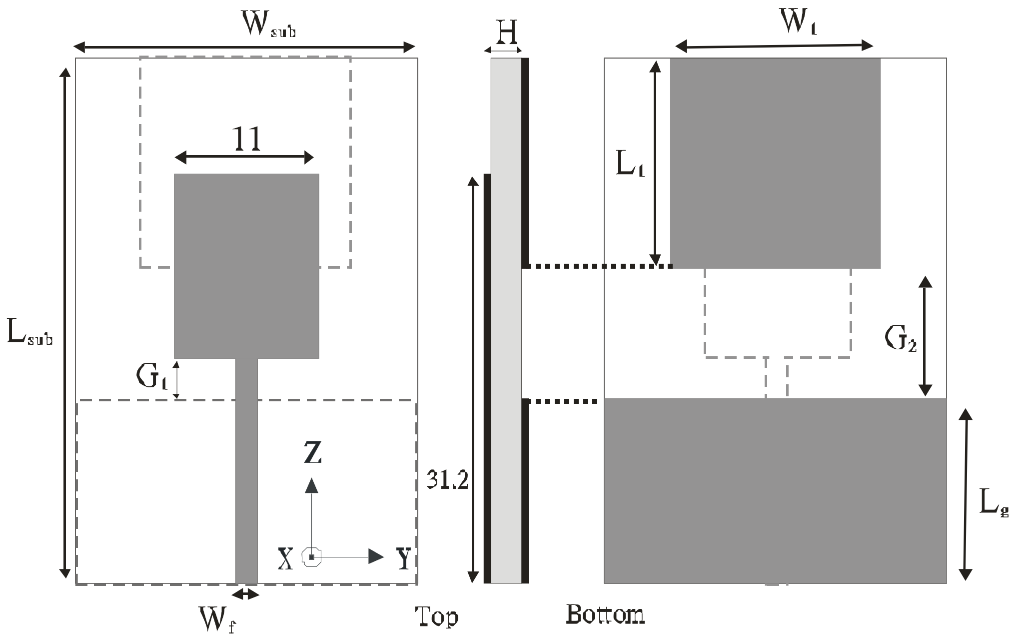

Figure 1: The geometry of the proposed antenna.

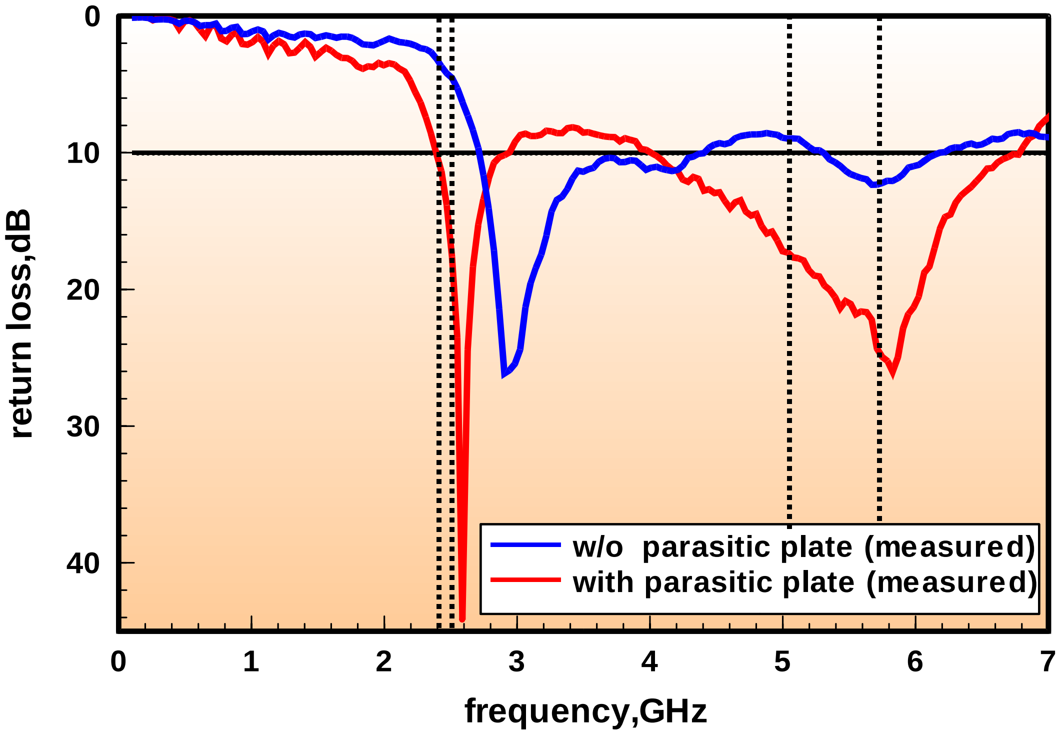

Figure 2: Return losses of the proposed antenna

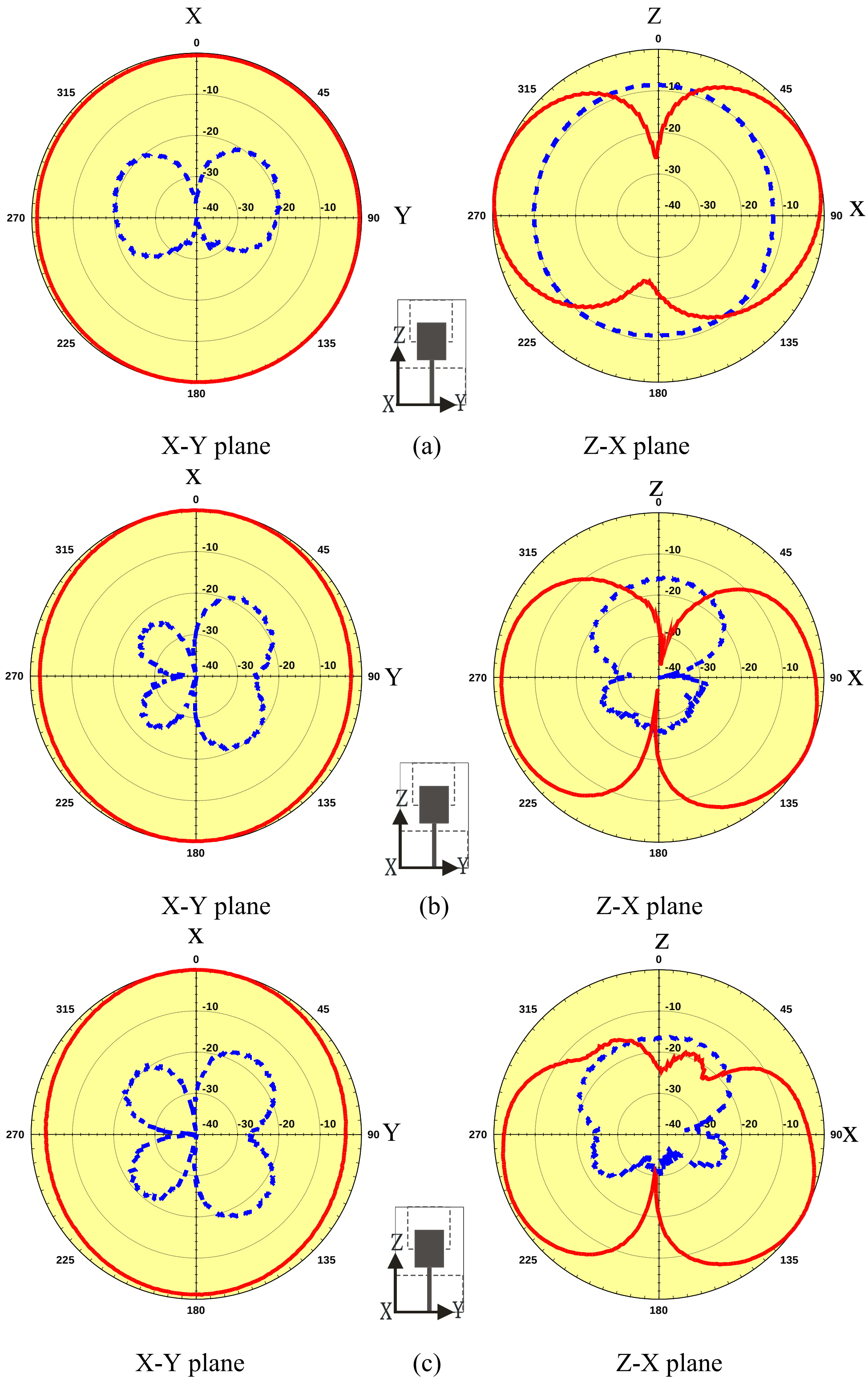

Figure 3: Measured far-field radiation patterns of Antenna in the X-Y plane and Z-X plane at (a) f = 2.45 GHz, (b) f = 5.25 GHz and (c) f = 5.85 GHz, (Where co-pol presented by solid line, and cross-pol presented by dash line).