A Novel Dual-Band Microstrip Antenna for WLAN Application

R.J. Lin, M. Ye

School of Communication and Information Engineering , Shanghai University , Shanghai 200072, China

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Abstract

A novel dual-band microstrip patch antenna for Wireless Local Area Network (WLAN) application is proposed. Dual band characteristic for the 2.4 GHz band and the 5 GHz band is produced by using U-slot and T-slot. The rectangular window for ground plate is used to increase the impedance bandwidth. This design can completely cover the 2.4/5 GHz band for IEEE 802.11b/g and 802.11a standards.

1 Introduction

With the rapid development of wireless communications, wireless local area network (WLAN) applications nowadays have become more popular. WLAN provides wireless communication between the client devices with an access point in a local network. According to the standard of IEEE for WLAN, the network works at 2.4 GHz band (2.4-2.483 GHz for IEEE 802.11 b/g) and 5 GHz band (5.15-5.35 GHz and 5.725-5.825 GHz for IEEE 802.11a).

Antenna is an important device in WLAN communication system because its performance will directly impact on the quality of wireless communications. Moreover, one antenna that can operate at all these frequencies is more efficient than several antennas for each frequency band. Therefore dual-band antenna which can work at IEEE standards for WLAN is needed. In recent years, some dual-band antennas for WLAN application have proposed such as [1- 4]. However, these researches can not cover all of the WLAN frequencies.

In this paper, we proposed a dual-band antenna which can completely cover the all of the WLAN frequencies. The proposed antenna is composed of U-slot and T-slot on the patch and a rectangular window for ground plate.

2 Antenna design and analysis

The geometry of the proposed dual-band antenna is showed in Fig. 1. The substrate considered for this study is FR4_expoy (ε_r =4.4) and the thickness of the substrate is h=4mm. The proposed antenna occupies a size of W × L. U-slot and T-slot are on the horizontal axis of symmetry. The parameters of U-slot are: D_1, L_3, W_2, W_4, and W_5. The parameters of T-slot are: D, L_2, W_1 and W_3. The distance from T-slot to left margin of the patch is L_1. A rectangular window of $D_2 \times L_6$ for ground plate is on the horizontal axis of symmetry. The distance from the bottom of the rectangular window to right margin of the patch is L_7. The feed point of the antenna is at the horizontal axis and the distance from the feed point to right margin of the patch is L_5. The antenna parameters are determined by using the commercial simulation software Ansoft HFSS 10.0.

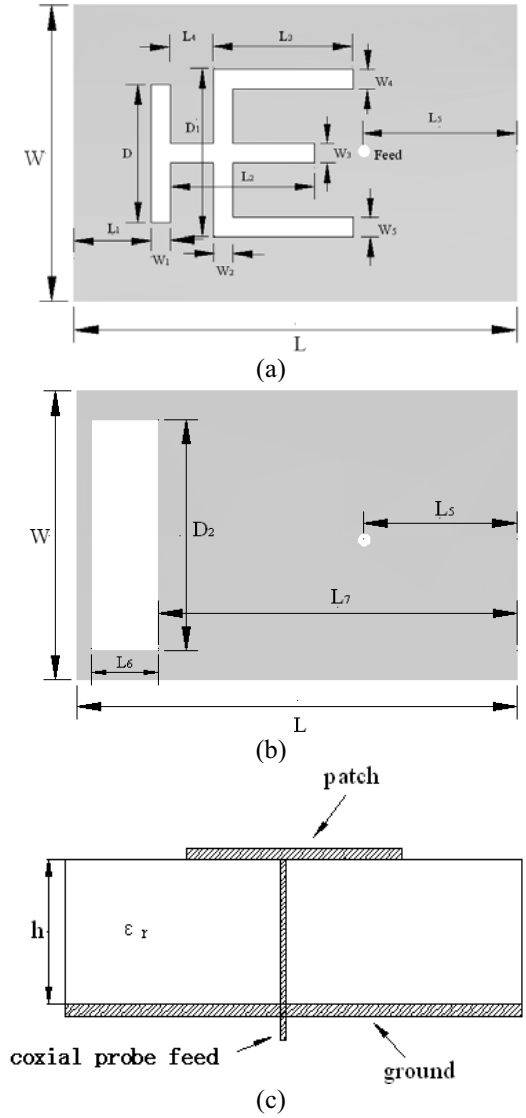

Fig.1 Configuration of the proposed antenna (a) top view, (b) bottom view and (c) side view

The proposed antenna is composed of U-slot and T-slot on the patch and a rectangular window for ground plate. Dual band characteristic for the 2.4GHz band and the 5 GHz is produced by using U-slot and T-slot. The rectangular window for ground plate is used to increase the impedance bandwidth. Fig. 2 shows the simulated return loss for the proposed antenna

with various L_3. It is found that with the increase of L_3, the lower resonant frequency is decreased and the upper resonant frequency is increased. Fig. 3 shows the simulated return loss for the proposed antenna with various D. It is found that with the increase of D, the lower resonant frequency is slightly affected and the upper resonant frequency is increased. In Fig. 2, other parameters used for this study are: W = 30 mm, L = 46 mm, L_1 = 4.5 mm, D = 14 mm, W_1 = 2 mm, L_4 = 4.5 mm, D_1 = 17 mm, W_2 = 2 mm, L_2 = 15 mm, W_3 = 2 mm, W_4 = 2 mm, W_5 = 2 mm, L_5 = 16 mm, L_6 = 7 mm, D_2 = 24 mm, L_7 = 37.5 mm. In Fig. 3, other parameters are: W = 30 mm, L = 46 mm, L_1 = 4.5 mm, W_1 = 2 mm, L_4 = 4.5 mm, D_1 = 17 mm, W_2 = 2 mm, L_2 = 15 mm, L_3 = 14.5 mm, W_3 = 2 mm, W_4 = 2 mm, W_5 = 2 mm, L_5 = 16 mm, L_6 = 7 mm, D_2 = 24 mm, L_7 = 37.5 mm.

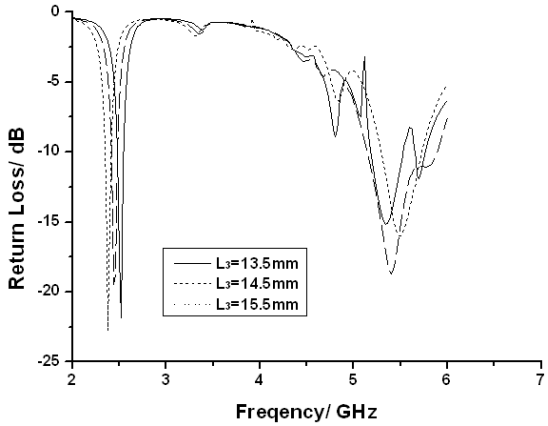

Fig.2 Return loss against frequency for various L_3

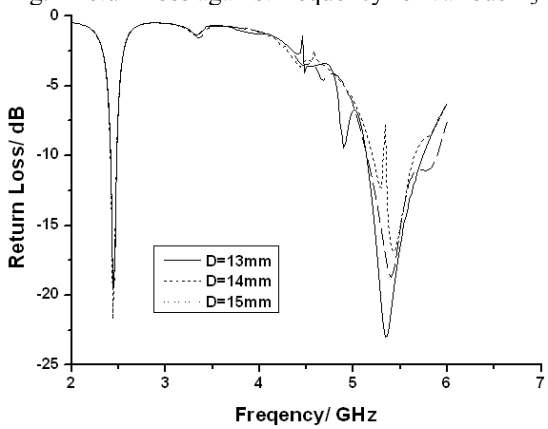

Fig.3 Return loss against frequency for various D

3 Simulated results

After an abundant parametric study, the proposed antenna parameters are set as follows: W=30mm, L=46mm, L_1=4.5mm, D=14mm, W_1=2mm, L_4=4.5mm, D_1=17mm, W_2=2mm, L_2=15mm, L_3=14.5mm, W_3=2mm, W_4=2mm, W_5=2mm, L_5=16mm, L_6=7mm, D_2=24mm, L_7=37.5mm. Fig. 4 shows the simulated return loss of this proposed antenna. The simulated impedance bandwidth for -10dB return loss is from 2.40 GHz to 2.49 GHz and 5.15 GHz to 5.89 GHz, covering the two standard WLAN bands at IEEE 802.11b/g (2.4-2.4835 GHz) and IEEE 802.11a (5.15-5.35 GHz and 5.725-5.825 GHz). Figs. 5, 6 and 7 show the simulated normalized radiation patterns at 2.45 GHz, 5.2 GHz and 5.8 GHz. It is observed that the lower and higher bands have similar radiation characteristics. The simulated peak gain of the proposed antenna is 4.48dBi, 5.1dBi and 6.5dBi at 2.45 GHz, 5.2 GHz and 5.8 GHz respectively.

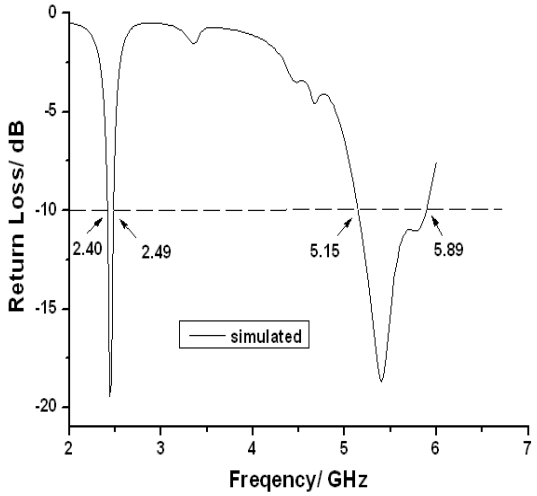

Fig.4 Simulated return loss for the proposed antenna

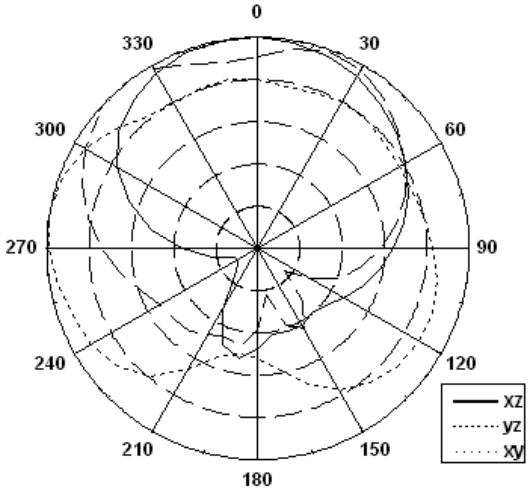

Fig.5 Normalized radiation patterns at 2.45 GHz

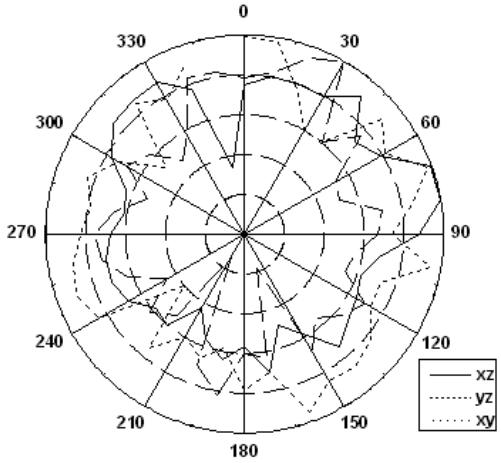

Fig.6 Normalized radiation patterns at 5.2 GHz

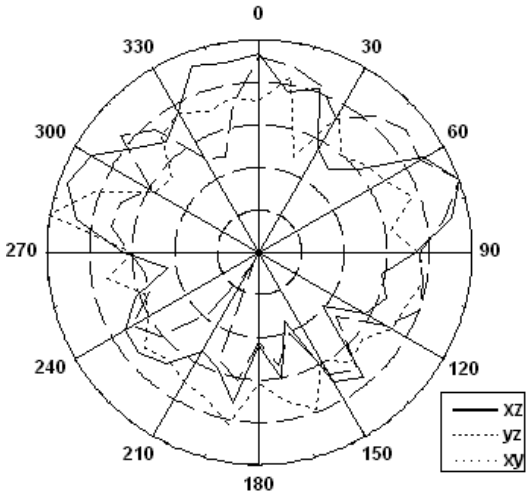

Fig.7 Normalized radiation patterns at 5.8 GHz

4 Conclusion

A dual-band microstrip antenna for WLAN application has been proposed in this paper. The simulated impedance bandwidth for -10dB return loss is from 2.40 GHz to 2.49 GHz and 5.15 GHz to 5.89 GHz, covering 2.4 GHz (2.4–2.4835 GHz) and 5 GHz (5.15-5.35 GHz and 5.725-5.825 GHz) WLAN bands. It is shown that the proposed antenna is suitable for WLAN application.

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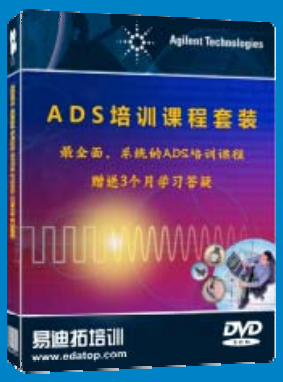

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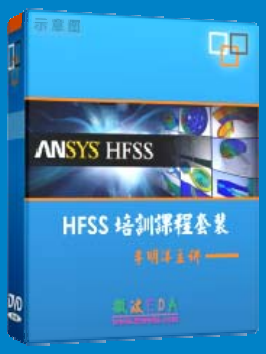

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