DUAL-BAND RECTANGULAR SLOT ANTENNA FOR 2.4/5 GHz WIRELESS COMMUNICATION

Hai-Ming Hsiao [1] and Jui-Han Lu [2]

[1] Department of Marine Engineering
[2] Department of Electronic Communication Engineering
National Kaohsiung Marine University, NKMU
Kaohsiung, Taiwan 811, R.O.C.
Email: jhlu@mail.nkmu.edu.tw

Introduction

Compared with the patch antenna, the slot antenna fed by microstrip line has the better characteristics including wider bandwidth, less conductor loss, and better isolation between the radiating element and feeding network [1]. For wireless local area network (WLAN) application, dual- or triple-band slot antenna designs have been presented by using slot ring antenna with a narrow rectangular slot [2], parasitic element [3] or stair-shaped slot antenna [4]. However, the broadband dual-frequency design for rectangular slot antenna is very scant in the literature. Therefore, in this article, we propose a novel rectangular slot antenna embedded with a U-shaped strip for dual-broadband operation. Owing to the embedded U-shaped strip around the side boundary of the rectangular slot antenna, the new resonant mode can be excited and operated close to the second harmonic mode of the regular rectangular slot antenna to make the bandwidth of the high band wider. It is found that by adjusting the spacing between the horizontal arms of the U-shaped strip to be 15.5 mm, the obtained bandwidth for two resonant frequencies adjusted close to 2.4 and 5.2 GHz are 200 and 400 MHz, respectively, which is enough for wireless communication. Details of the proposed slot antenna designs are described, and experimental results for the obtained dual-band performance are presented and discussed.

Antenna Design and Results

As shown in Fig. 1, a U-shaped narrow strip is embedded in the rectangular slot antenna with the length of L and width of W. The U-shaped strip has the width of b and the horizontal and vertical arms' length of T and S, respectively. The rectangular slot antenna is etched on a substrate of thickness h and relative permittivity ε_r. Due to the

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presence of the embedded U-shaped strips, a new resonant mode can be excited and operated close to the second resonant mode of the rectangular slot antenna to have broadband operation. For the low band, the fundamental resonant mode is slightly perturbed to make the operating frequency less shifted. Fig. 2 shows the simulated and experimental results of the return loss for the rectangular slot antenna design of Fig. 1. Results show the satisfactory agreement for the proposed slot antenna design operating at the 2.4 and 5.2 GHz bands. By properly adjusting the vertical arm's length, *S*, of the U-shaped strip, the frequency ratio of two resonant modes can be in the range of 1.8 ~ 2.4. The measured bandwidth can reach about 12.4% (300 MHz) for 2.4 GHz band and 18.1% (900 MHz) for 5 GHz band for the condition of *S* = 17 mm. The proposed slot antenna has much greater operating bandwidth for two operating bands to meet the 802.11a+b specifications. Measured operating frequencies and frequency ratios against the vertical arm's length of the embedded U-shaped strip are shown in Fig. 3. The radiation patterns at the two resonant modes of the proposed slot antenna are measured and plotted in Fig. 4. These two resonant modes are seen to be of same polarization planes and similar radiation characteristics.

Conclusions

The novel rectangular slot antenna with dual-broadbandband operation for wireless communication has been proposed and experimentally studied. With the use of U-shaped strip, the operating bandwidths for two resonant bands can reach about 12.4% for 2.4 GHz band and 18.1% for 5 GHz band, which is enough for the 802.11a+b specifications.

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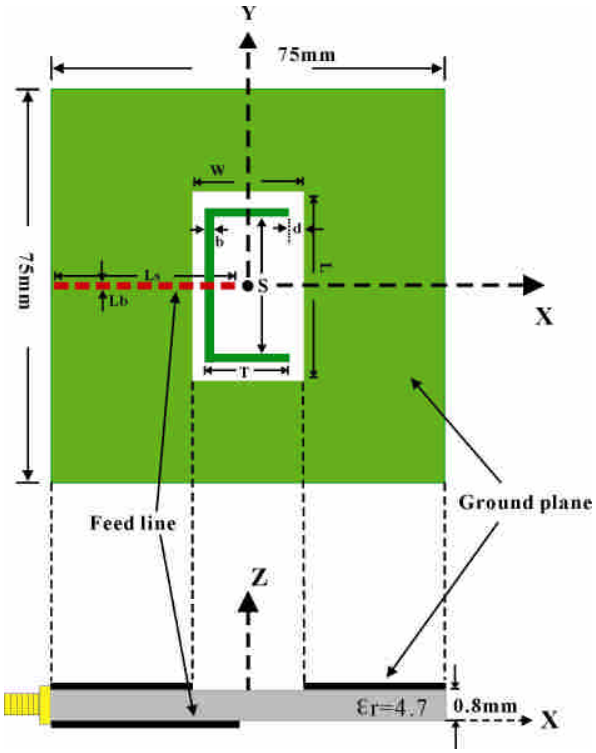


Fig. 1 The geometry of the proposed rectangular slot antenna for dual-broadband operation.

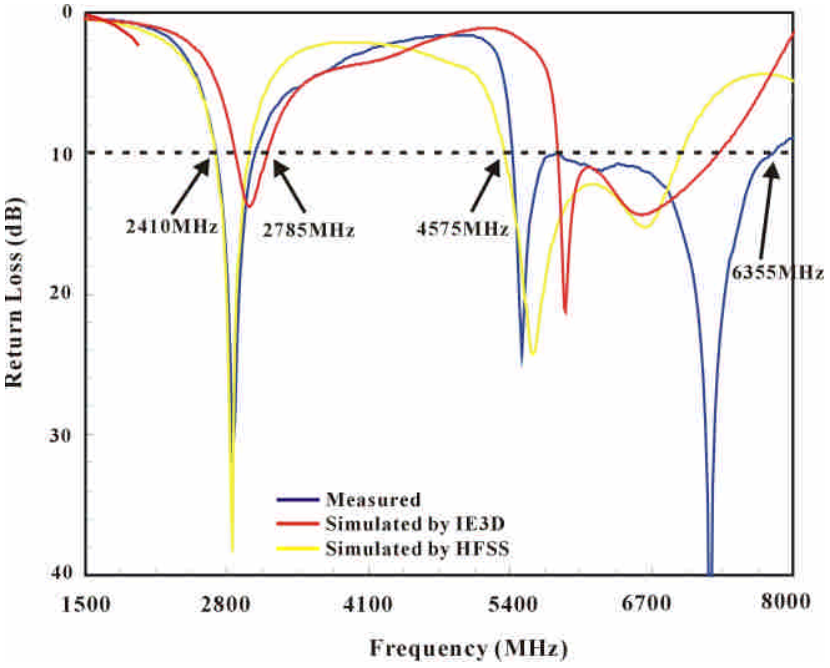


Fig. 2 Simulated and measured return loss for the dual-broadband rectangular slot antenna; ε_r = 4.7, h = 0.8 mm, L = 30 mm, W = 17.7 mm, ground plane size = 75 ×75 mm^2, Ls = 37.5 mm, Lb = 1.41 mm, b = 1.5 mm, T = 15.7 mm, d = 1 mm, S = 20 mm.

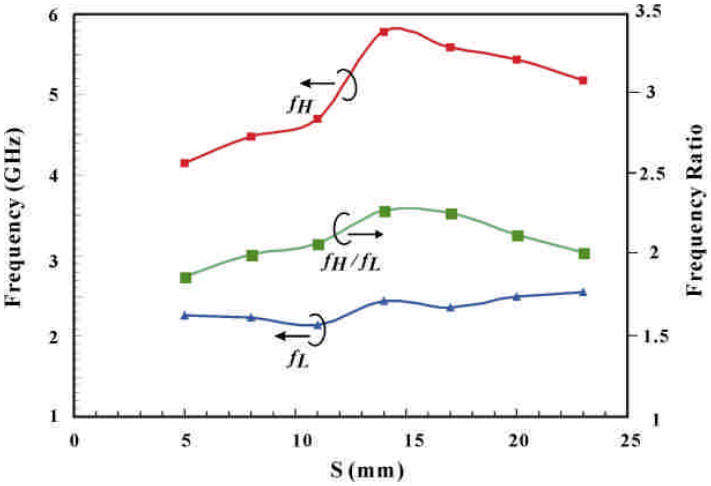
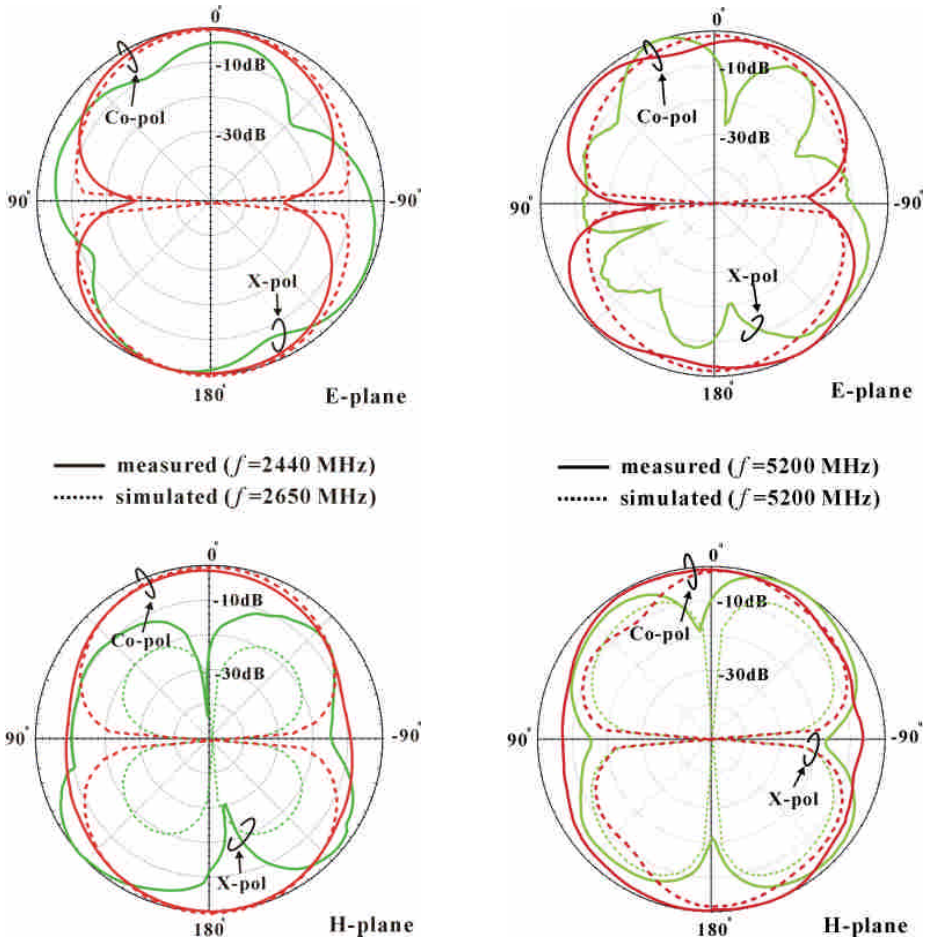


Fig. 3 Measured operating frequencies and frequency ratios against the vertical arm's length of the embedded U-shaped strip.



(a) f = 2450 MHz (b) f = 5200 MHz

Fig. 4 E-plane (x-z plane) and H-plane (y-z plane) radiation patterns given in Fig. 2. (a) f = 2450 MHz. (b) f = 5200 MHz.