

# Dual-Band Printed L-Slot Antenna for 2.4/5 GHz WLAN Operation in the Laptop Computer

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**Abstract**— This paper presents a dual-band L-shaped slot antenna for laptop computer operated in WLAN system of 2.4/5.2/5.8 GHz. The proposed antenna is formed by L-shaped slot and fed by strip line structure. The antenna size is relatively compact with the dimension of 15 mm × 60 mm × 0.8 mm. The antenna is compatible to embed at the top of the display panel for laptop computer. The antenna can be operated from 2.3 GHz to 2.6 GHz and from 5.0 GHz to 6.0 GHz that can cover WLAN system of 2.4 GHz, 5.2 GHz and 5.8 GHz.

## I. INTRODUCTION

Presently, the wireless local area network (WLAN) technology is very important for laptop computer because WLAN system is very easy to connect for internet access. The internal laptop antenna is essential part of wireless communication system to connect with other devices and internet [1-2]. The internal laptop antenna is required to possess compact size and nearly omnidirectional pattern. The printed slot antenna is the good candidate for internal laptop antenna because the antenna has thin structure and low profile suitable for the design and the fabrication. The antenna is embedded at the top edge of the display panel of laptop computer.

In this paper, the dual-band printed L-shaped slot antenna is proposed. The antenna is formed by L-shaped slot with strip line [3-4]. The size of antenna is relatively compact with width of 15 mm, length of 60 mm and thickness of 0.8 mm for dual-band WLAN 2.4/5 GHz operated in laptop computer. The antenna is printed on both sides of the FR-4 substrates. The ground plane of laptop antenna is integrated with the antenna for simulation. The antenna structure is described, and the simulated and measured results of the antenna are presented and discussed in the next section.

## II. ANTENNA STRUCTURE

The geometry of dual band printed L-shaped slot antenna is shown in Figure 1. The antenna is printed on both sides of FR-4 substrate with relative permittivity of 4.3.

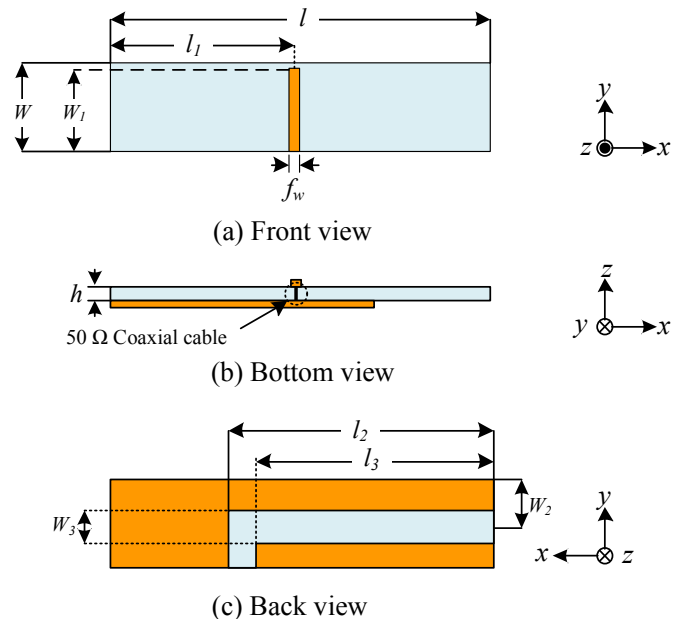


Figure 1. Geometry of the proposed antenna.

The parametric description and physical size of the proposed antenna is shown in Table I. The antenna size is small with 15 mm × 60 mm × 0.8 mm.

TABLE I  
The associated dimension of the proposed antenna.

Parameter	Physical Size (mm)
$f_w$	1.65
$h$	0.80
$l$	60.00
$l_1$	30.80
$l_2$	47.00
$l_3$	44.00
$w$	15.00
$w_1$	13.75
$w_2$	7.50
$w_3$	8.60

The antenna structure consists of L-shaped slot fed by strip line via 50  $\Omega$  coaxial cable. In this study, the antenna is to be mounted at the center of the top edge of the ground plane with the length of 26 mm and width of 20 mm. The ground plane is modeled using 0.2 mm-thick copper plate and treated as the system ground plane or supporting metal frame for display panel.

III. SIMULATED RESULTS

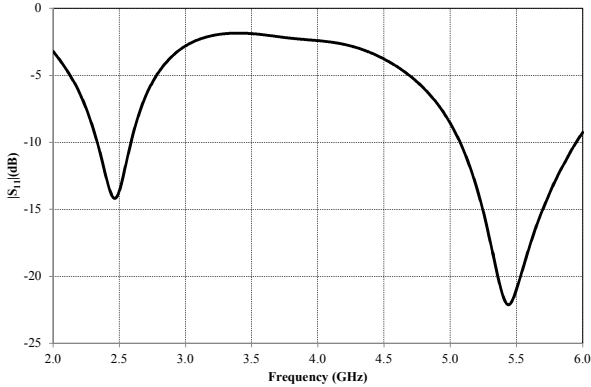
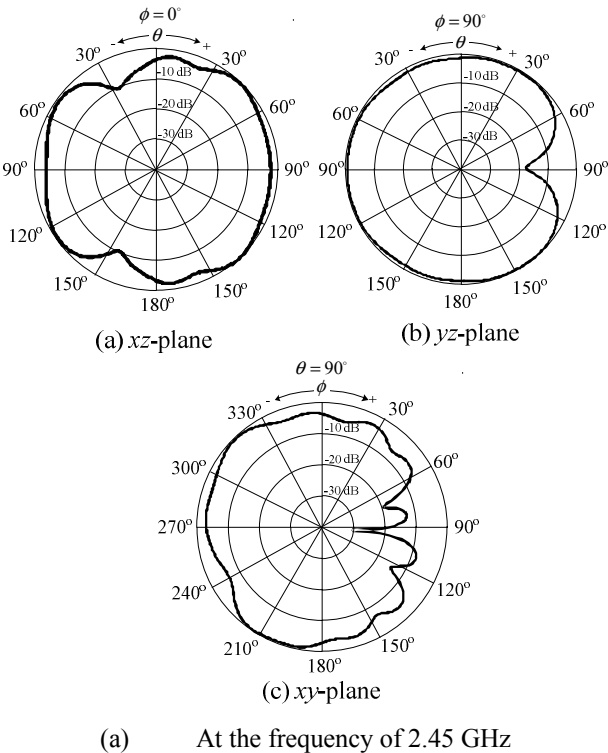
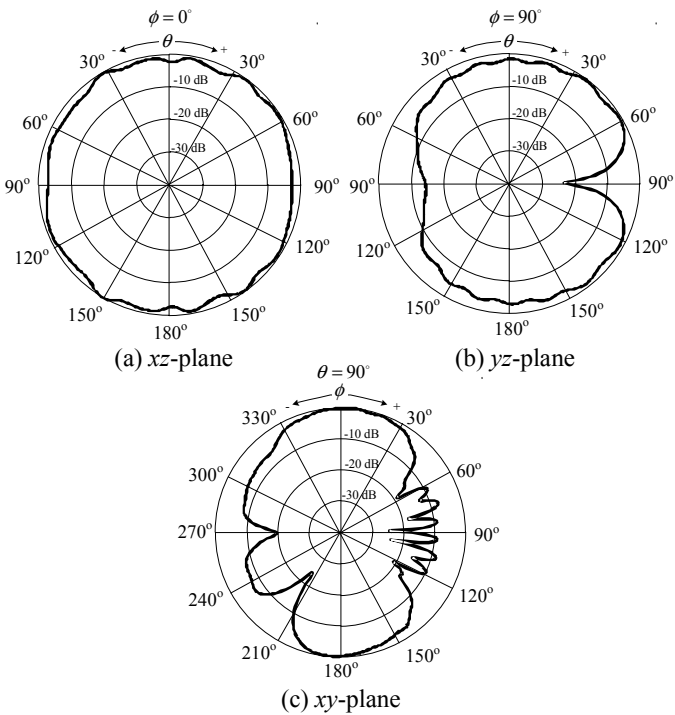


Figure 2. The simulated  $|S_{11}|$  versus frequency of the proposed antenna.

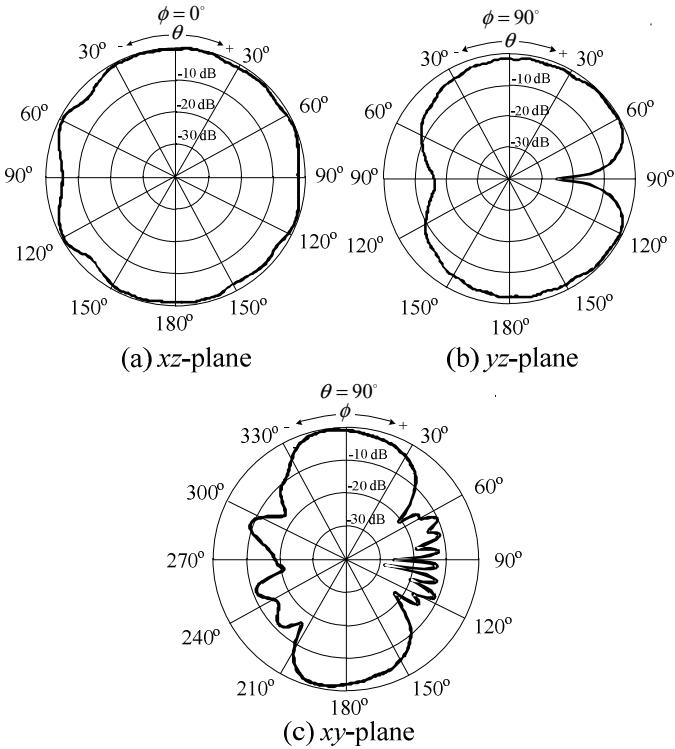
Figure 2 shows the simulated  $|S_{11}|$  of the antenna. The  $|S_{11}|$  of the antenna is lower than -10 dB at the dual-band frequencies from 2.33GHz to 2.55 GHz and from 5.1 GHz to higher than 6 GHz. From the  $|S_{11}|$  result, the antenna can be operated to cover WLAN system of 2.4 GHz, 5.2 GHz and 5.8 GHz.



(a) At the frequency of 2.45 GHz



(b) At the frequency of 5.2 GHz



(c) At the frequency of 5.8 GHz

Figure 3. The simulated radiation pattern of proposed antenna.

Figure 3 shows the simulated radiation pattern of the antenna. The radiation pattern of the proposed antenna is almost omnidirectional beam.

TABLE II

The simulated gain of the proposed antenna.

Frequency(GHz)	Gain (dBi)
2.45	3.23
5.20	4.05
5.80	4.41

Table II shows the simulated gain of the antenna. The simulated maximum gain at 5.8 GHz is 4.41 dBi.

#### IV. RESULTS AND DISCUSSION

The photograph of the prototype antenna is depicted in Figure 4. The comparison between simulation and measurement results are shown. The simulated results show the  $|S_{11}|$  of the proposed antenna with the structure given in Figure 1. The simulated and measured results of  $|S_{11}|$  are shown in Figure.5, where the acceptable reflection is considered at  $|S_{11}| < -10$  dB. The covered bandwidth is ranging from 2.31 GHz to 2.54 GHz and from 5.12 GHz to 5.94 GHz.



Figure 4 The photograph of the prototype antenna.

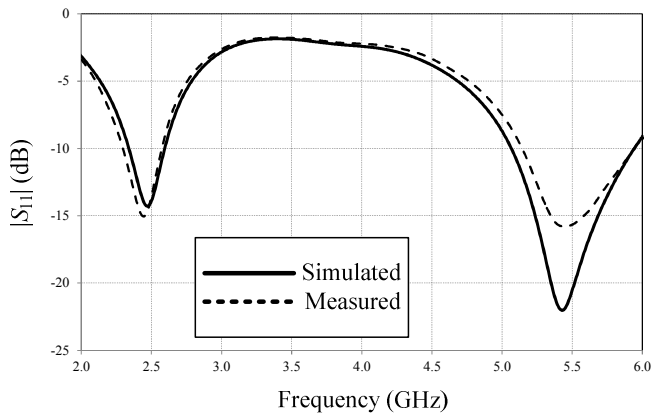
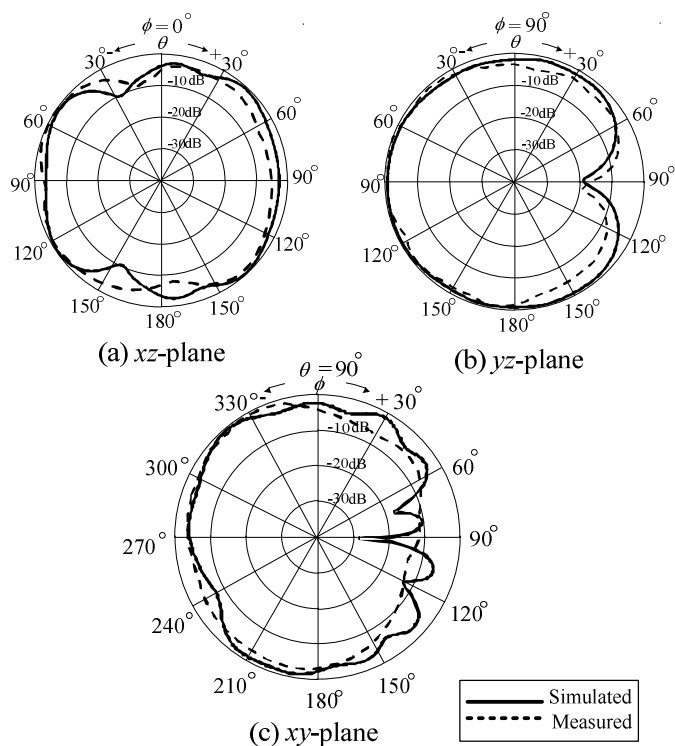
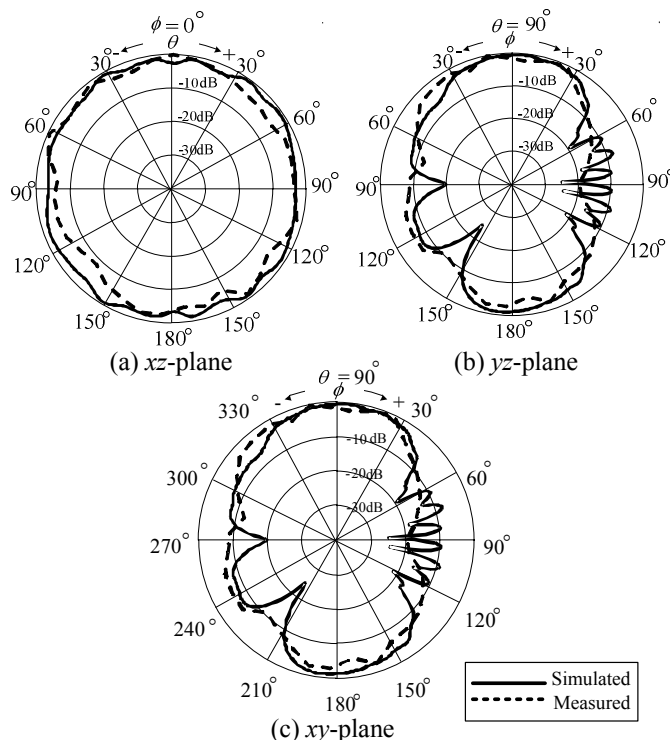


Figure 5 The compared  $|S_{11}|$  from the simulation and measurement.

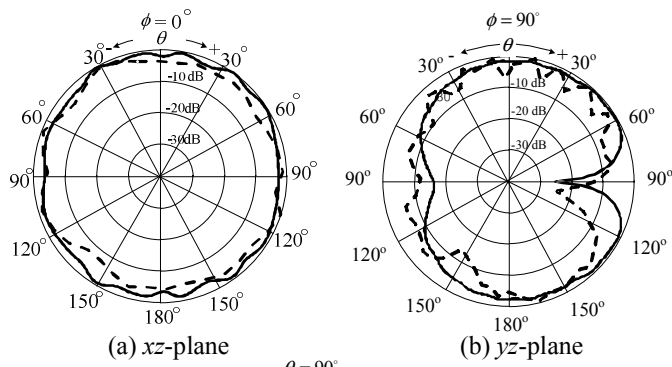
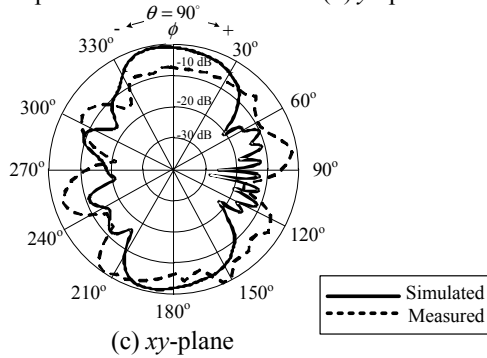
Figure. 6 shows the radiation pattern at 2.45 GHz, 5.2 GHz, 5.5GHz and 5.8 GHz which are frequencies of WLAN system. The radiation pattern from the simulation and measurement is almost omnidirectional pattern.



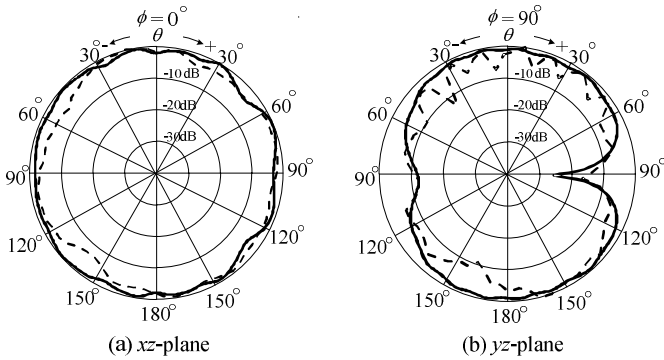
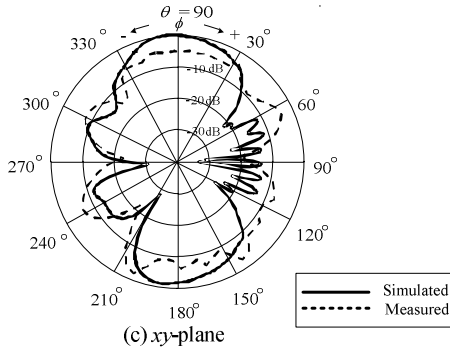
(a) At the frequency of 2.45 GHz



(b) At the frequency of 5.2 GHz

(a)  $xz$ -plane(b)  $yz$ -plane(c)  $xy$ -plane

(c) At the frequency of 5.5 GHz

(a)  $xz$ -plane(b)  $yz$ -plane(c)  $xy$ -plane

(d) At the frequency of 5.8 GHz

TABLE III

The measured gain of the proposed antenna.

Frequency (GHz)	Gain (dBi)
2.45	2.13
5.20	1.67
5.50	1.73
5.80	1.24

Table III shows the measured gain of the antenna. The measured gain at 2.45 GHz, 5.2 GHz and 5.8 GHz are 2.13 dBi, 1.67 dBi and 1.24 dBi, respectively.

## V. CONCLUSION

A dual-band printed L-shaped slot antenna for laptop computer has been proposed. The proposed antenna is formed by an L-shaped slot and fed by strip line. The antenna is printed on both sides of FR-4 substrate. The proposed antenna is mounted on the ground plane of laptop computer for simulation. The measured  $|S_{11}|$  is lower than -10 dB. The covered bandwidth is ranging from 2.31 GHz to 2.54 GHz and from 5.12 GHz to 5.94 GHz. The radiation patterns are almost omni-directional beam in  $E$ -plane. The measured maximum gain at 2.45 GHz is 2.13 dBi. Therefore, the proposed antenna can be operated for dual-band to cover WLAN 2.4/5.2/5.8 GHz. Accordingly, the antenna is suitable to mount on the ground plane of laptop computer.

## REFERENCES

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Figure 6 The radiation pattern from the comparison between the simulation and the measurement.