Printed Monopole Antenna for Wireless USB Dongle Applications

Wen-Shan Chen [1], Min-Hsuan Liu[1], and Ching-Yu Huang[1]
[1]Department of Electronic Engineering, Southern Taiwan University of Science and Technology, Tainan 710, Taiwan

Abstract*—The monopole antenna using a simple architecture for WLAN 2.4 GHz and using a 50-ohm mini coaxial cable is proposed and investigated. Using an extended strip on a longest path of the antenna is to resonate a 2.4GHz mode and a mode about 5.8GHz. By an introduction of a pair of L-shaped strips on the antenna to help the impedance match. The antenna is designed with a simple structure, and a compact size of 35 × 12 mm^2. Obtained bandwidth of the antenna meets the bands of WLAN (2.4 - 2.484 GHz, 5.15 - 5.35 GHz and 5.725 - 5.825 GHz) and WiMAX (3.4 - 3.7 GHz and 5.25 - 5.85 GHz). The simulated radiation patterns are omni-directional, which is suitable for USB device applications.

Index Terms —WLAN, Dongle, WiMAX

I. INTRODUCTION

In recent years, wireless networks are widely used in variety ways. Short-range wireless communication technology becomes focus of attention. Wireless communication system are developed for public, such as: Bluetooth (Blue Tooth), 802.11 (Wi-Fi), ultra-wideband communications (UWB), wireless local area network (WLAN), short-range wireless communications (NFC) and WiMAX. In wireless communication systems, USB Dongle for WLAN and Wi-Fi system with small size and easy to carry is deployed in more modern products [1-2]. In order to maintain compact size and achieve the required frequency band, the designs used double-sided approach[3-4] are published. The design used bent structure [5] on the top of the antenna to shrink the antenna size was proposed. A design using fractal monopole [6] to achieve the USB application was presented. Antenna using a simple single-sided design to achieve simplification performance is desirable for applications. And, the width of the USB antenna should be narrow to meet the requirements of portable devices [5-6]. In the paper, a printed monopole with a size of 12 × 10 mm^2 produces good bandwidth and radiation performances is proposed and investigated. The bandwidth of the design meet the bands of 2.4 - 2.484 GHz, 5.15 - 5.35 GHz and 5.725 - 5.825 GHz and WiMAX 3.4 - 3.7 GHz and 5.25 - 5.85 GHz bands.

II. ANTENNA DESIGN AND APPLICATION BANDS

The proposed antenna is shown in Fig. 1, and the antenna is fabricated on FR4 substrate with a thickness of 1.6 mm, a dielectric constant 4.4 and a loss tangent of 0.0245. The overall size of the antenna is 35 × 12 mm^2 (L1 × W1), and the size of the ground plane is 25 × 12 mm^2 (L2 × W1). The detail antenna parameters are listed in Table 1. The longest path of the antenna resonates a mode near 2.4GHz and 5.8 GHz, and the introduction of the strip of W6×L8 is to reduce frequency of the resonant mode to 2.4GHz and help to produce a mode about 3.7 GHz. Two L-shaped strips distributed between L11 and L13 are used to help impedance match. The antenna is implemented and investigated in the paper. The Fig. 2 shows the simulated and measured S parameters of the proposed antenna. The simulated and measured ones are in good agreement. The measured frequency bands of the design covers the bands of 2.4 - 2.5GHz and 3.36 - 5.98GHz, which meet the regulations of WLAN IEEE 802.11 a/b/g bands, WiMAX 3.5 GHz, and WiMAX 5 GHz.

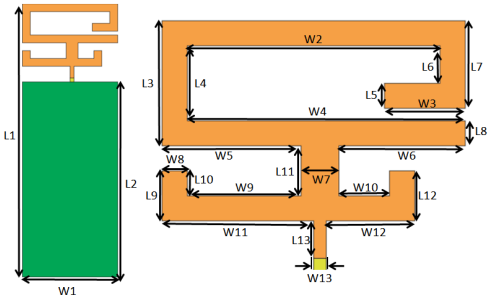


Fig. 1 The geometry of the proposed antenna.

TABLE I Detailed dimensions of the proposed antenna.

Parameter	L1	L2	L3	L4	L5	L6	L7	L8	L9
(mm)	35	25	5	3	1	1.5	3.5	1	2
Parameter	L10	L11	L12	L13	W1	W2	W3	W4	W5
(mm)	1	2	2	1.5	12	10	3.2	11	5.5
Parameter	W6	W7	W8	W9	W10	W11	W12	W13	
(mm)	5	1.5	1	4.5	2	6	3.5	0.5	

III. RESULTS AND DISCUSSIONS

Some parametric studies on the proposed design are also investigated by simulation. Fig. 3 shows the simulated S parameters of the proposed antenna with different length of L7. The length of L7 affects the resonant mode near 2.4GHz and impedance match of the band from 3.5 to 5.98GHz.

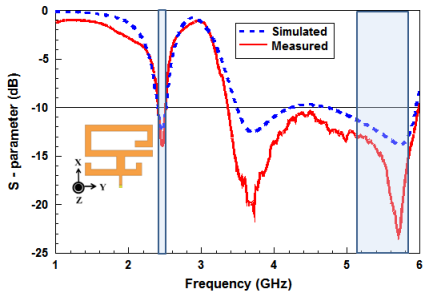


Fig. 2 Simulated and measured S parameters of the proposed antenna.

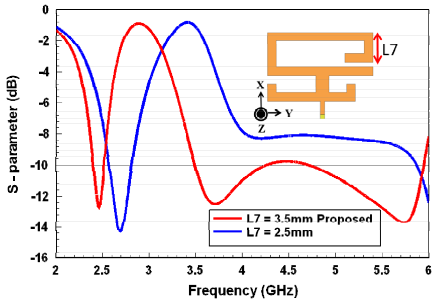


Fig. 3 Simulated S parameters of the proposed antenna in different lengths of L7

Fig. 3 shows the simulated S parameters of the proposed antenna with different length of L6. The length of L6 will affect slightly the mode at 2.4GHz. It also affects the impedance match of the band from 3.5 to 5.98GHz. Fig. 5 shows the simulated radiation patterns of the proposed antenna in XY, XZ and YZ planes. The patterns in YZ plane show an omni-directional characteristic.

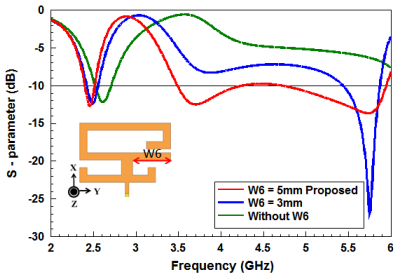
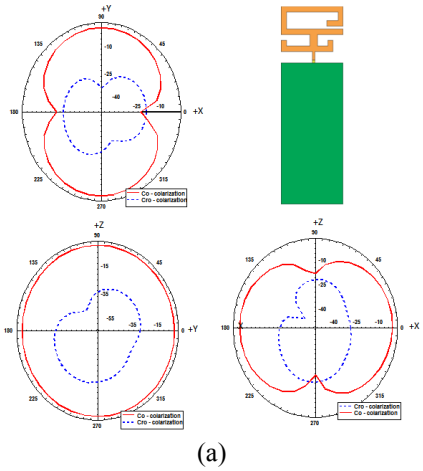


Fig. 4 Simulated S parameters of the proposed antenna in different length of W6

IV. Conclusion

The antenna with simple structure and good bandwidth and radiation performance has been proposed. The monopole antenna with broadband effect from 3.36 - 5.98GHz is also achieved in the design. The obtained bandwidth convers the band of WLAN bands (IEEE 802.11 a/b/g), WiMAX 3.5 GHz, and WiMAX 5 GHz. Simulated radiation pattern in Y-Z plane is omnidirectional. The all performances shown above are suitable for practical application in the USB Dongle.



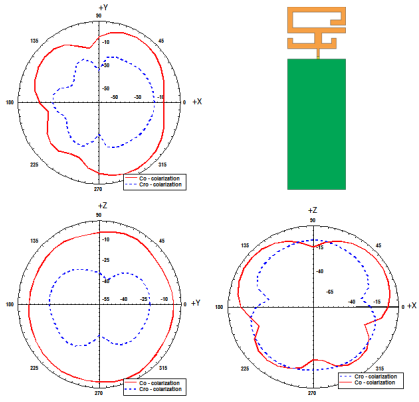


Fig. 5 Simulated radiation patterns for the proposed design (a) at 2.45 GHz (b) at 5.74 GHz

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