Design of Printed Antenna for USB Dongle for IEEE 802.11 a/b/g Application

Wen-Shan Chen [1], Guang-Yuan Cai[1], and Tzu-Chi Lu[1]
[1] Department of Electronic Engineering, Southern Taiwan University of Science and Technology
chenws@stust.edu.tw, ma333101@stust.edu.tw, ma430105@stust.edu.tw

A design of printed antenna with compact size for IEEE 802.11 a/b/g application is proposed. The antenna is printed on an FR4 substrate of thickness 1.6 mm and dielectric constant of 4.4. The size of the design is with the overall dimensions of 40 x 5 mm^2 and that of an antenna area is 14 x 5 mm^2. The antenna consists of a T-shaped metal strip fed by 50-ohm mini-coaxial cable on the front side of the substrate, a long slot with inverted U-shaped, a U-shaped slot and a small slot printed on the back side of the substrate. The opened slot of inverted U-shape and the T-shaped metal strip are used to produce the bandwidth of the low band and high band. A very small slot very close to the feed point is to adjust impedance. The design with the small size of 40 x 5 mm^2 and good performances can be applied in USB dongle devices.

Index Terms **— Printed antenna, inverted U-shaped slot, T-shaped metal strip, Dongle antenna.**

1. INTRODUCTION

Printed antenna with low profile, low cost, and easy manufacturing is widely adopted in wireless applications. Miniaturized printed antenna can meet the needs of the applications on USB devices. In addition, the antenna operates the bands for the IEEE 802.11a / b / g. Several designs [1-6] have been published for WLAN USB dongles. The sizes of overall size and antenna portion of these designs are still too large, and it would be limited to applications. In the paper, a dongle antenna with an overall size of 40mm × 5mm × 1.6mm and a radiation area occupied by 14mm × 5mm × 1.6mm will be proposed and investigated. The design with a T-shaped metal strip on the front side, an inverted U-shaped slot and a U-shaped slot and a very small slot on the FR4 substrate achieve the design goal. Detailed parameters and structure will be discussed in the following sections.

2. ANTENNA DESIGN

The geometry of the proposed antenna is shown in Fig. 1. The design is fabricated on an FR4 substrate with a thickness 1.6 mm, a relative permittivity of 4.4, and a loss tangent of 0.024. A 50-ohm mini-coaxial line is used for RF signal input. The design is composed of a ground plane and an antenna portion. The antenna consists of a T-shaped metal strip on the front side of the substrate, an inverted U-shape slot and a U-shaped slot and a very small slot close to the feeding point. The inverted U-shaped slot is excited by the T-shaped metal strip resonates at 2.4 GHz frequency band. The high modes of the inverted U-shaped slot and the mode of the T-shaped metal strip form the bands at 5 GHz. Combing the bandwidths stated as above is to form the WLAN bands of 2.4/5.2/5.8 GHz for IEEE 802.11a/b/g.

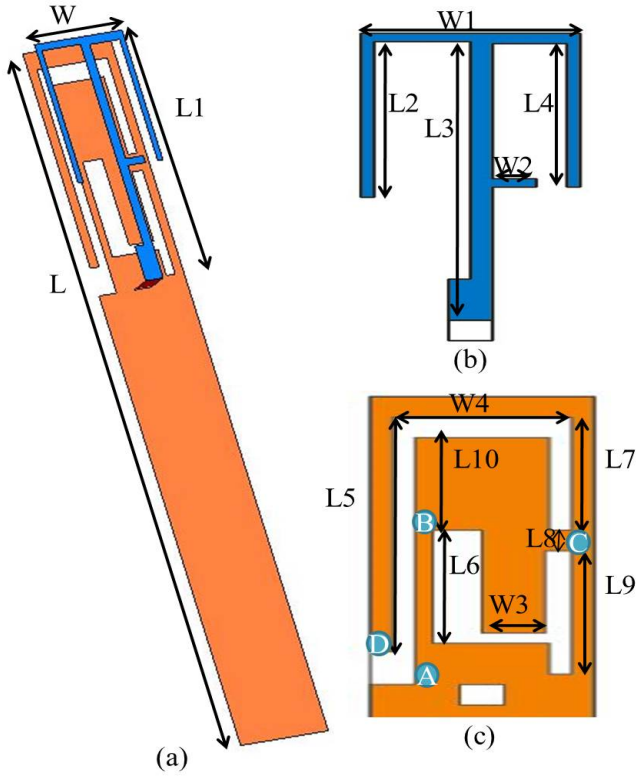

Fig. 1 (a) antenna geometry (b) monopole antenna (c) slot strip

TABLE I
DETAIL DIMENSIONS OF THE PROPOSED ANTENNA

W=5	W1=5	W2=1	W3=1.4
W4=4	L=40	L1=14	L2=7.6
L3=13.6	L4=7.5	L5=11.4	L6=5.5
L7=5.5	L8=1	L9=6	L10=4.5
			Unit:mm

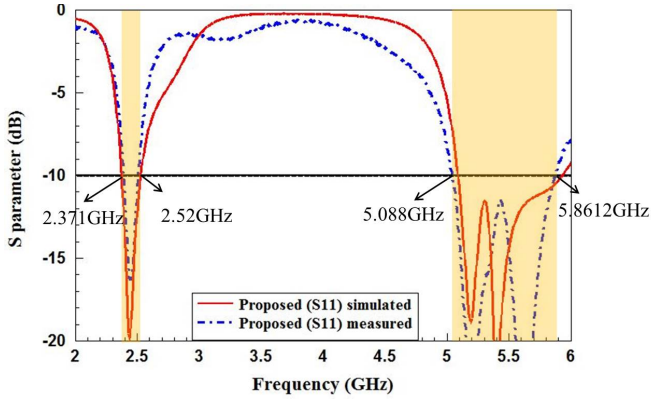

Fig. 2 Measured and simulated S11 of the proposed antenna

3. RESULTS AND DISCUSSIONS

Fig. 2 shows the measured and simulated S11 of the proposed design. The measured bandwidth of 2.37 to 2.52 GHz and 5.09 to 5.86 GHz covers the WLAN bands of 2.4/5.2/5.8 GHz. The simulated and measured results are in good agreement to verify the design. Fig. 3 shows the simulated S11 of the proposed antenna (a) with and without L9, and (b) with and without L6. The length of L9 strongly affects the impedance at 5.2/5.8 GHz bands. The length of L6 can affect the impedance match at 2.4 and 5.2/5.8 GHz bands. The U-shaped slot affects the impedance of the design.

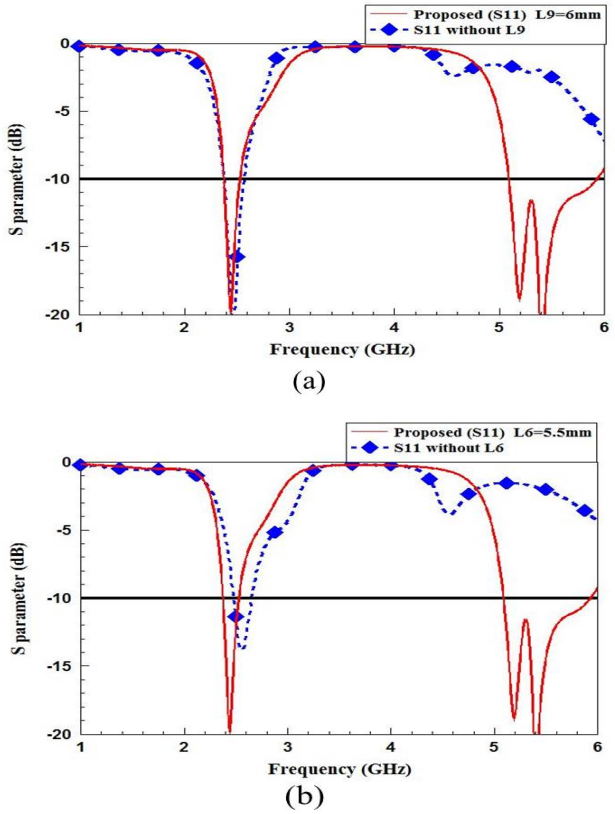

Fig. 3 Simulated S11 of the proposed antenna (a) with and without L9, (b) with and without L6

Fig. 4 shows the simulated S11 of the design with/without L8. The band at 2.4 GHz is strong moved to lower frequency. The design without L8 excites a mode at lower frequency. It can be verified that the 2.4 GHz band is produced by inverted U-shaped slot.

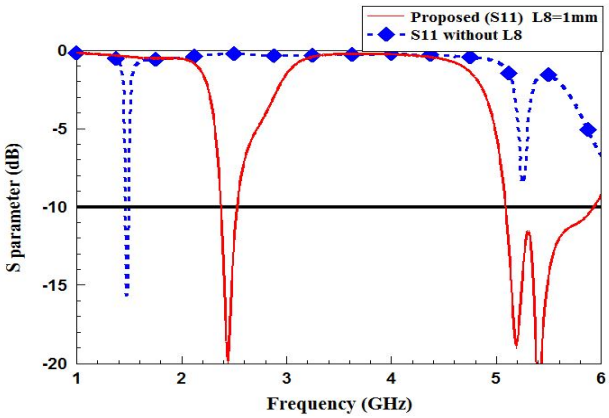

Fig. 4 Simulated S11 of the proposed antenna with and without L8

4. CONCLUSION

A printed antenna with 2.4/5.2/5.8 GHz band for IEEE 802.11 a/b/g has been proposed. The antenna is composed of an inverted U-shaped opened slot, a U-shaped slot, a very small slot, and a T-shaped metal strip. From the results, the design can cover the bands of 2.37 to 2.52 GHz and 5.09 to 5.86 GHz to meet the required demands of WLAN bands. The antenna with a small size of 14 x 5 mm^2 and good characteristic is a good candidate of antenna for WLAN USB applications.

REFERENCES

[1] X.L. Sun, S.W. Cheung and T.I. Yuk, "A Dual-band Antenna for Wireless USB Dongle Applications," *2013 international Workshop on Antenna Technology (iWAT2013)*, pp. 307-310, Mar. 2013.

[2] S. H. Lee, Y. J. Sung, "A Triple Band Antenna for a Wireless USB Dongle," *2011 IEEE AP-S Topical conference on Antennas and Propagation in Wireless Communications (APWC2011),* pp. 552-555, Sept. 2011.

[3] Y. Yu and J. Choi, "Compact internal inverted-F antenna for USB dongle applications," *Electronics Leters*, pp. 92-93, Jan. 2009.

[4] Y. Yu, Y. Lee, S. Lee and J. Choi, "A Compact Internal Antenna for Wireless USB Dongle Application," *IEEE*, pp. 1084-1086, Feb. 2009.

[5] S.J. Jeong and K.C. Hwang, "Compact loop-coupled spiral antenna for multiband wireless USB dongles," *Electronics Letters,* vol. 46, pp. 388-390, Mar. 2010.

[6] J.-G. Gong, Y.-C. Jiao, Q. Li, Y. Song, and J. Wang, "Compact Internal Wideband Antenna for Wireless USB Dongle Application," *IEEE Antennas and Wireless Propagation Letters*, pp. 879-882, Sept. 2010.