Compact Dual Broadband Planar Slot Antenna For Wireless LAN Application

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Abstract

A new compact dual broadband planar slot antenna that covers two frequency bands of 2.4GHz and 5.2GHz for modern mobile broadband wireless network applications is presented. The antenna structure includes folded self-resonance meander slots as the main radiators, and using the CPW-fed combined with a coupling mechanism at its feeding input to match the large input impedance exhibits at the input of the slot antenna. The use of meander slot together with the coupling CPW-fed feeding network enables us to reduce the antenna size, the manufacturing complexity as well as the operating bandwidth. The antenna is manufactured using the FR4 print circuit board and the results show the wanted characteristics and performance.

Index terms- Slot Antenna, Coplanar Waveguide (CPW), Broad Band Wireless Local Area Network (WLAN)

I. Introduction

With the popularity in the applications of the mobile wireless communications, the increasingly demand on antennas that is low profile, small in size, light in weight, low cost, ease of fabrication. More than that, they are readily compatible to other radio frequency microwave integrated circuit in manufacturing and low coupling effect in installation. Recently, the design techniques of dual radio frequency bands planar antennas for modern wireless local area network can be founded in literatures [1-4]. Among them, the proposed antenna structure in [1] comprises a planar patch element with an L-shaped slit to become a double inverted-L monopole and is capable of generating two separate resonant modes with good impedance matching condition. In [2], by inserting two pairs of symmetrical strips in the middle strip of the trident-shaped antenna, dual frequency operating bands with 10 dB return-loss bandwidths of 33.7%, ranging from 1.80 to 2.53 GHz, and of about 1100 MHz centered at 5.5 GHz have been achieved. The other structure found in [3] is a meandered patch antenna with CPW-fed and adding two equal L-shaped on ground plane symmetrically situated along each side of the CPW line. Another structure of a CPW-fed rectangular meander monopole proposed for dual-band GSM/DCS operation is shown in [4]. Commonly, the slot antennas have their characteristics in less coupling effect due to its grounding plane arrangement [5,6] and further the coplanar waveguide (CPW) exhibits several advantages on wider operating bandwidth, better isolation and easier tuning and manufacturing [7,8]

As a result, a new uniplanar dual-bands meander slot antenna fed by a CPW line is proposed in this paper (see Fig. 1). The antenna structure includes folded self-resonance meander slots as the main radiators, and using the CPW-fed combined with a slot coupling to match the high impedance exhibits at the input of the slot radiator. It is founded that the meander slot structure together with CPW and coupling feeding mechanism enables us not only to reduce the antenna size, the fabrication complexity but also to enlarge the operating band bandwidth.

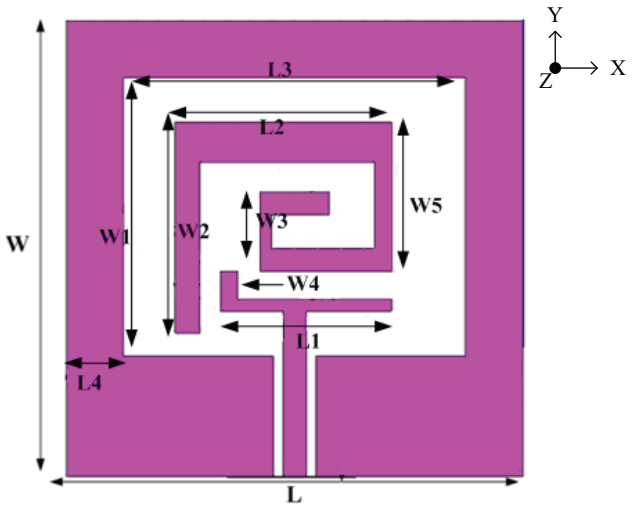

Fig 1 . Dual-Broadband Planar Slot Antenna Configuration

II. Antenna Structure Description

The proposed dual-broadband CPW-fed planar slot antenna is shown in Fig. 1. The antenna was printed on a FR4 print circuit board (PCB) with dimension of 50mm x 40mm. The PCB has characteristics of 4.4 dielectric constant, 0.0245 loss tangent, and 1.6 mm thickness. The associating antenna design parameters (lengths and widths) are listed in Table 1. A 50- Ω CPW transmission line and the main antenna radiators are incorporated into the single layer of the print circuit board.

Table 1

Index	Length
W	40mm
W1	24.5mm
W2	18.5mm
W3	5mm
W4	1.5mm
W5	13mm
L	40mm
L1	15mm
L2	19mm
L3	30mm
L4	5mm

III. Antenna Design Simulation and Measurement

This proposed CPW-fed Dual-Broadband slot antenna for the wireless Local Area Network (WLAN) is simulated by using High-Frequency System Simulation software package. The dominant design parameter for lower band of 2.4GHz found is the length L4 in Fig. 1, simulation result is given in Fig. 2.

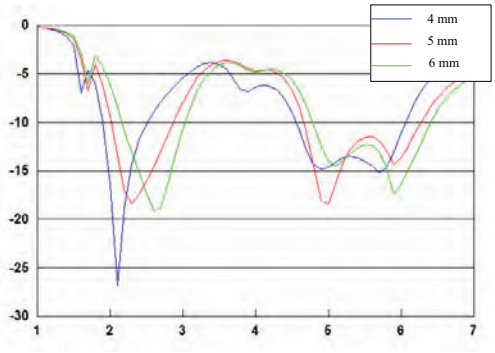

Fig. 2. The tuning of L4 for 2.4GHz (Simulation)

After applying the antenna design parameters listed in Table 1, the antenna return loss corresponding to operating frequency is shown in Fig. 3. The current distributions of the proposed antenna at both two operating frequency bands of 2.4GHz and 5.2GHz are shown in Fig. 4, 5 respectively. Observing from the simulation results, it is seen that the bandwidth at 2.4GHz is about 750MHz or fractional bandwidth of 31%, and that at 5.2GHz is 2.6GHz or fractional bandwidth of 50%.

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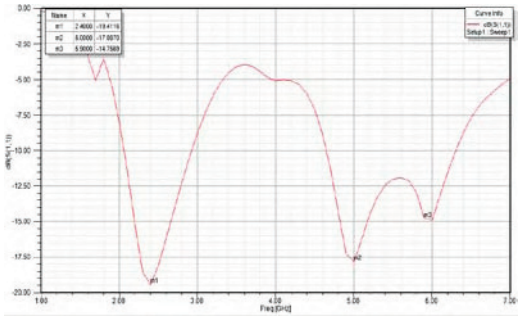

Fig 3. Antenna return loss (simulation)

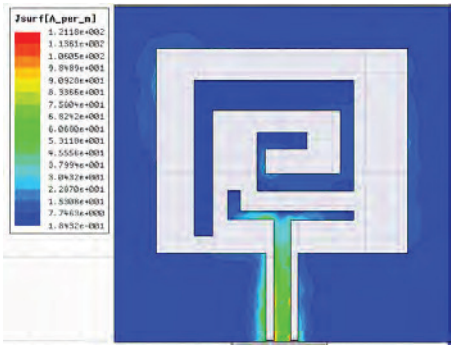

Fig 4 Antenna current distribution in 2.4GHz (Simulation)

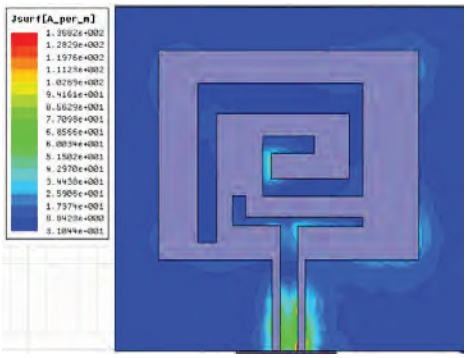

Fig 5 Antenna current distribution in 5.2GHz (Simulation)

The proposed CPW-fed meander slot antenna is implemented on the very common FR4 PCB as shown in Fig. 6. The corresponding return loss is measured and shown in Fig. 7.

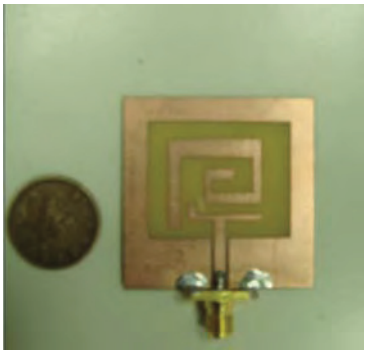

Fig. 6 The implemented CPW-fed Meander Slot Antenna

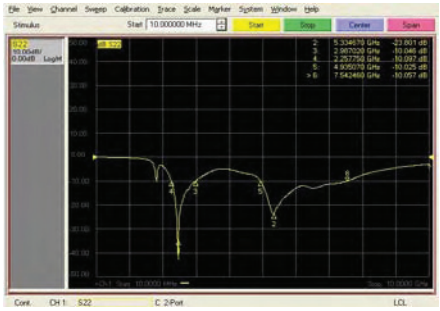

Fig. 7 Antenna return loss (Measurement)

The antenna radiation patterns in both XZ and YZ planes for dual frequency bands are shown in Fig. 8 to 11 respectively.

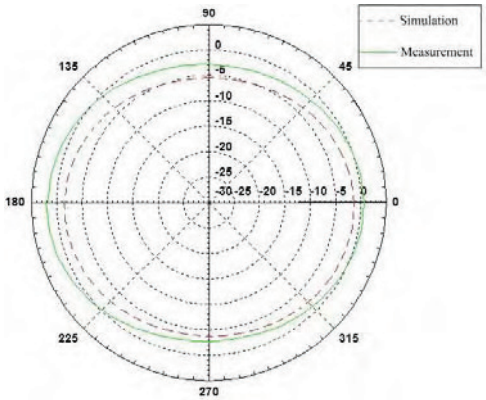

Fig. 8 2.4GHz XZ plane radiation pattern

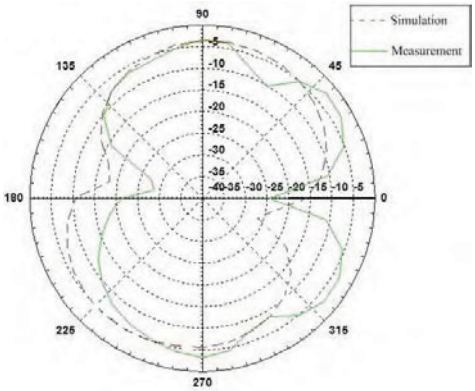

Fig. 9 2.4GHz YZ plane radiation pattern

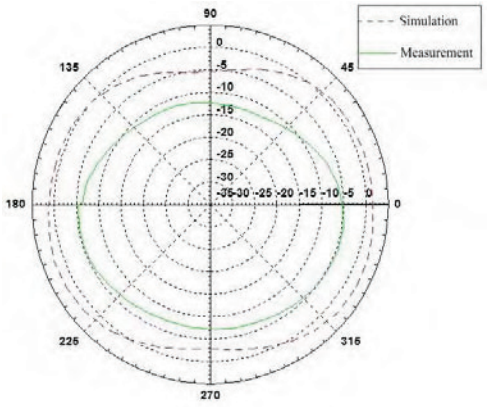

Fig. 10. 5.2GHz XZ plane radiation pattern

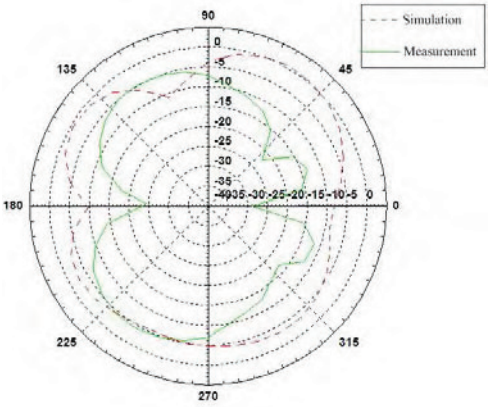

Fig 11. 5.2GHz YZ plane radiation pattern

IV. Conclusion

A new dual-broadband CPW-fed meander slot planar antenna is presented in this paper. The design methodologies combine the advantages of self-resonance slot structure and CPW-fed coupling feeding network enables us to reduce dramatically in antenna dimension and fabrication complexity, further to broaden the antenna operating bandwidth. It is found that the proposed antennas are suitable for mobile wireless WLAN applications, and the measurement results show the desirable characteristics and performance issued in the mobile wireless broadband local area network systems

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