Compact Size of CPW Dual-Band Meander-Line Transparent Antenna for WLAN Applications

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***Abstract* — An incredible working concept for a transparent communication technology has provided a glimpse into the future of consumer technology which is rapidly advent in communication systems. Widespread use of this technology, leads engineers to design cheaper and simpler communication equipments. A major hurdle in adapting the technology to smaller screens stems from physical constraints is realized through the implementation of resonant meander line into the radiating patch. In this paper, the proposed co-planar waveguide (CPW) antenna is printed-type antenna based on a AgHT-4 film with dimensions 30mm × 30 mm, demonstrate to achieve dual operating WLAN frequencies at 2.45GHz and 5.8GHz is presented.**

Index Terms — CPW, Miniature, meander line, dual band, WLAN.

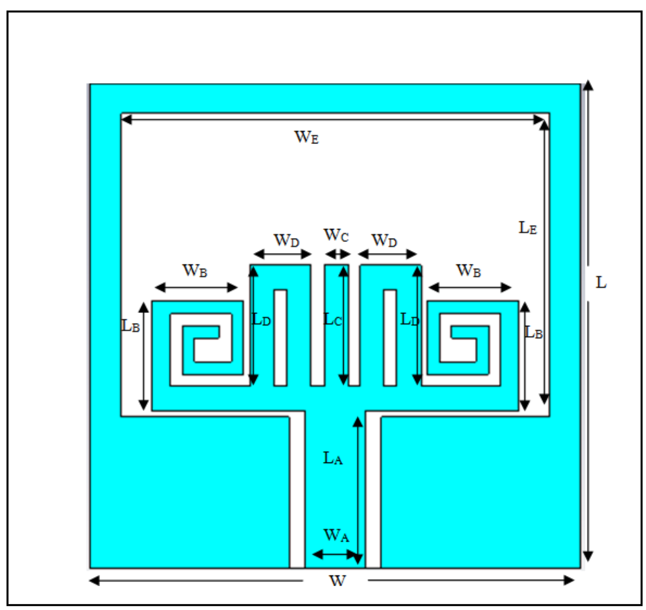
I. Introduction

As wireless communication systems progressed drastically, mobile components are explored to become compact, transparent and miniature in size for the purpose of easily installation in mobile devices. Antennas made from transparent conductors have been popular for these recent years because it carries a lot of advantageous to the communication developments especially it allows the transmission of electric currents while retaining the optically transparency and have the invisible properties [1-4].

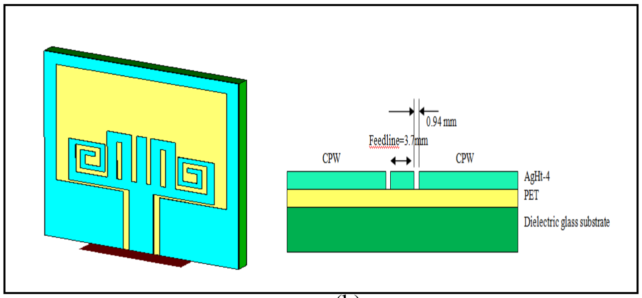
The advantage of CPW fed slot antenna is that active devices can be mounted on top of the circuit, like on microstrip wideband antenna in which many research introduce the several shape of slot antenna for use in WLAN applications [5]. Meander-line antenna is a truly transformation of monopole antenna, which has significant advantages; it is electrically small, low profile antenna and has simple structure [6-7]. As an alternative, the proposed antenna structure is designed by combining meander-shaped resonant radiator and inverted U-shaped slots CPW ground plane. By properly selecting shapes and dimensions of these embedded slots, the dual-resonance situations at 2.4GHz and 5.8GHz are obtained.

II. Antenna Structure And Design

Fig. 1(a) shows the dimensions of CPW transparent dual band antenna. The radiating element is designed using AgHT-4 film which is 0.175mm thickness and has conductivity of $\sigma = 2.2 \times 10^5$ S/m) [7], fed by a 50Ω microstrip feed line with a width of 3.7 mm and a length of 9.7 mm. The transparent antenna is mounted on 2mm thick glass substrate which has dielectric permittivity of 7. The CPW ground plane is located on the upper side of the dielectric substrate, shown in Fig. 1(b), where an inverted U-shaped slot is illustrated.



(a)



(b)

Fig. 1. Geometry of CPW dual-band transparent antenna. (a) Front view (b) Perspective view.

To achieve the dual-band operation for WLAN applications, meander-shaped line was modified from original monopole radiator and a inverted U-slot was added to the extended ground. The antenna is fed by a 50Ω CPW with a signal strip width of 3.7 mm and a gap distance of 0.94 mm between the feed strip and the coplanar ground plane. The parameter of proposed antenna is tabulated in Table 1.

TABLE I
THE ANTENNA DIMENSIONS (IN MM).

Length Parameter	Size (mm)	Width Parameter	Size (mm)
L	30.0	W	30.0
L_A	9.7	W_A	3.7
L_B	6.7	W_B	5.6
L_C	7.5	W_C	1.5
L_D	7.5	W_D	3.7

III. RESULTS AND DISCUSSION

The proposed transparent CPW dual band antenna is designed and optimized using the CST Microwave Studio, simulation tool. As shown in Figure 2, the 'ANTENNA' word with font 27 can be seen which indicates that the antenna is transparent and compact in size. The promising results of these designs are highly contributed by the usage of AgHT-4 which has a higher conductivity and lesser surface resistance of 4Ω.sq.

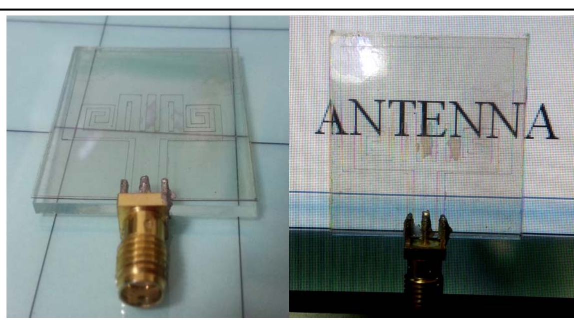


Fig.2. Prototype of the fabricated antenna.

As shown in Fig. 2, the 'ANTENNA' word with the font of 27 can be seen through the antenna which indicates the antenna is transparent and compact in size.

A. S-Parameter

As shown in Fig. 3, the simulation and measurement performance shows that the BLC gives return loss response at resonance of 2.45GHz and 5.8GHz. Referring to return loss, good transmission output signal indicated by the value of S_{11} which has a compromising value (less than -10dB) across the frequencies. The measured -10 dB bandwidth ranged from 2.37GHz to 2.5GHz while at the 5.8GHz resonance the bandwidth covers from 5.52GHz to 5.9GHz, yield a high percentage of bandwidth which provide potentials for the use in other broad bandwidth applications. A perfect match transmission line will minimize the reflected signal thus will produce a stabilized energy.

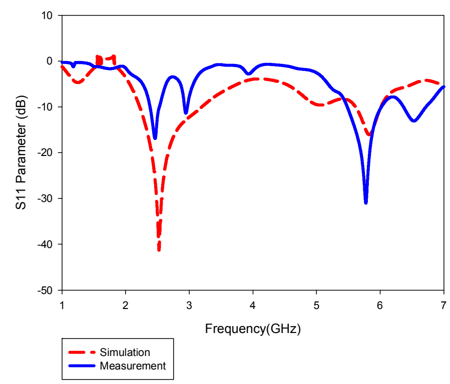


Fig. 3. Simulation and Measurement Results of S_{11}-Parameter Magnitude in dB

B. Radiation Patterns

Fig. 4 shows the surface current distribution at frequency 2.4 GHz. As seen from the figure, the surface currents concentrated more along the resonant meandered line of the antenna. This shows that the resonant meandered line acts as a resonator to generate the resonance the dual frequencies. Fig. 5 illustrates the radiation pattern of the proposed antenna which yields 2.42dB and 2.85dB at the dual frequencies respectively. The transparent antenna has dipole like radiation pattern and can easily mounted against glass in order to have a signal on both sides.

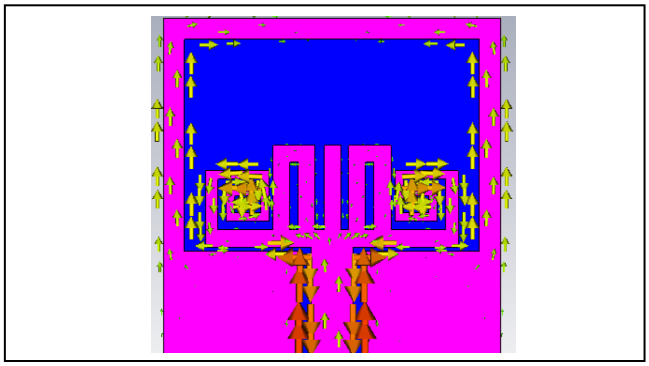
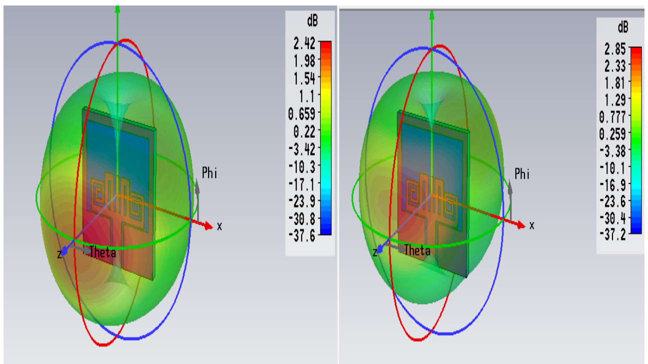


Fig. 4. Current distributions.



(a) (b)

Fig.5. Radiation pattern at respective frequency (a) 2.45Ghz (b) 5.8GHz.

Fig. 6 exhibits the measured normalized farfield radiation patterns in E-plane. The measured radiation patterns in the *xz* - plane at 2.45 GHz have been generated by exciting feed port 1 where the 3 dB beamwidth are 44±5° and 58± 5° for the 2.45GHz and 5.8GHz frequencies, respectively. These radiation characteristics reveal that the proposed antenna is competent for the WLAN applications.

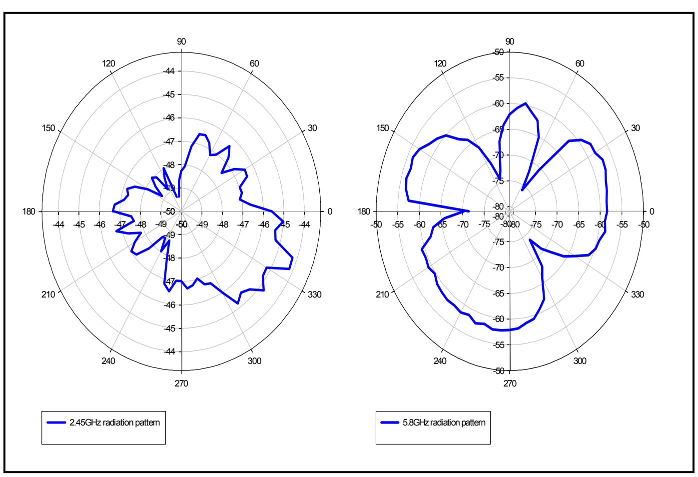


Fig.6. Measured radiation patterns at 2.45 GHz & 5.8GHz of the proposed antenna.

IV. Conclusion

A new CPW-fed dual-band antenna has been proposed. By employing two different types of resonant meandered structure and embedding a monopole radiator, the antenna can obtain good dual-band operation performance which can cover the 2.4/5GHz bands for WLAN applications. The antenna prototype is then designed, fabricated, and measured. The measured results show reasonable agreement with the simulated ones. Additionally, due to the good radiation pattern performance and stable gains in the required bands, the proposed antenna is able to find extensive use for wireless communication application.

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