Development of a Dual Band Antenna from Finite Ground Coplanar Wave Guide

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1. Introduction

The tremendous growth in wireless networking demands design of low cost, compact, single layer antennas for efficient communication. Wireless router plays a major role in wireless local area networks (WLAN) to facilitate interconnection between PCs, laptops, smart phones and other wireless modules. The major challenges in the design of antennas for these applications include miniaturization, low cost and single layer design while maintaining impressive radiation characteristics. The IEEE standard specification for 2.4GHz WLAN is from 2400MHz - 2485MHz and 5.2 hyperlan spectrum includes frequency from 5150MHz – 5350MHz. At present many other systems such as cordless phones, microwave oven and Bluetooth accessories also utilizes the 2.4GHz spectrum which resulted most of the WLAN systems utilize 5.2GHz band for efficient, distortion less communication. In this scenario a single, compact antenna supporting both these WLAN bands is of important significance and this has attracted many researchers around the world [1,2,3,4]

In this paper, the authors present a compact dual band, low cost, single layer antenna suitable for 2.4/5.2GHz WLAN applications. The CST Microwave Studio™ [5] is utilized for the optimization and analysis of the antenna. A prototype of the optimized design which meets the design goals as per the IEEE 802.11 specification is fabricated and experimentally characterized. Details of the proposed antenna design, along with the simulated and measured results are presented and discussed.

2. Antenna Configuration

The geometry of the proposed dual band antenna for 2.4/5.2 WLAN applications is depicted in figure 1. The initial design of the antenna includes a 50Ω single sided coplanar wave guide in which the center conducted is extended to form a strip monopole with dimension L1. This strip monopole is top loaded with a horizontal strip with dimension L2 and L3. The dual band performance of the proposed antenna is obtained by loading the 'T' shaped, CPW fed, strip monopole with an additional strip (with design dimension L5) which is away from the ground plane by a distance L4. The design parameters are optimized for dual band WLAN applications and fabricated on FR4 substrate of thickness 1.6mm and dielectric constant 4.4. In this geometry L1+L2+Wf is pertaining to the lower resonance frequency and L1+2*L5+L3+Wf is related to the upper resonance frequency. The parameter L4 is optimized through simulation in order to obtain specified impedance bandwidth. The optimum values for the present design are L1 = 16.4, L2 = 4, L3 = 4, L4=5, L5 = 5.6, wf = 2.766 and g = 0.3(all units in mm). The photograph of the fabricated prototype is shown in figure.1(c).

3. Results and Discussions

The simulated and measured results of reflection coefficient, surface current distribution, radiation patterns and gain of the proposed antenna are investigated in this section. The proposed antenna is simulated, optimized and validated experimentally using Agilent N5230A Performance Network Analyzer. The measured and simulated reflection coefficient of the proposed antenna is in good agreement and is shown in figure 2. The measurement results shows first resonance from 2.09GHz – 2.52GHz (18%) and the second resonance from 5.14GHz – 5.78GHz (12%) which meets the 2.4GHz and 5.2GHz WLAN specifications. The simulated surface current distribution over the proposed antenna geometry at 2.4GHz and 5.2GHz are presented in figure 3. It can be seen that the length corresponds to L1+L2+wf behaves like a ½ λg monopole at first resonance while the current distribution along L1+2*L5+L3+wf corresponds to a ¾ λg monopole where λg is the effective wavelength [4]. Therefore, independent tuning of first and second resonant band can be performed by sweeping the dimensions L2 and L5 respectively and it is illustrated in figure 4.

The radiation patterns in the orthogonal planes are measured at 2.4GHz and 5.2GHz in the anechoic chamber and are plotted in figure 5.The average of measured peak gain of the antenna is found to be 2.1dBi and 3.5dBi in first and second resonant band respectively. It is evident from the radiation characteristics of the antenna that moderate gain with nearly omni directional radiation patterns makes the proposed antenna a good candidate for low cost wireless router applications.

4. Conclusion

A coplanar waveguide fed uniplanar, dual band antenna fabricated on a low cost dielectric substrate, suitable for 2.4/5.2 GHz WLAN applications is presented. The Antenna provides 2:1 vswr bandwidth from 2.09GHz – 2.52GHz (18%) and 5.14GHz – 5.78GHz (12%) in the first and second resonant bands respectively. The design facilitates independent control for both the resonances by modifying corresponding geometrical parameters. It is evident from the measured radiation characteristics that, the antenna provides moderate gain in both the resonant bands while providing nearly omnidirectional radiation pattern.

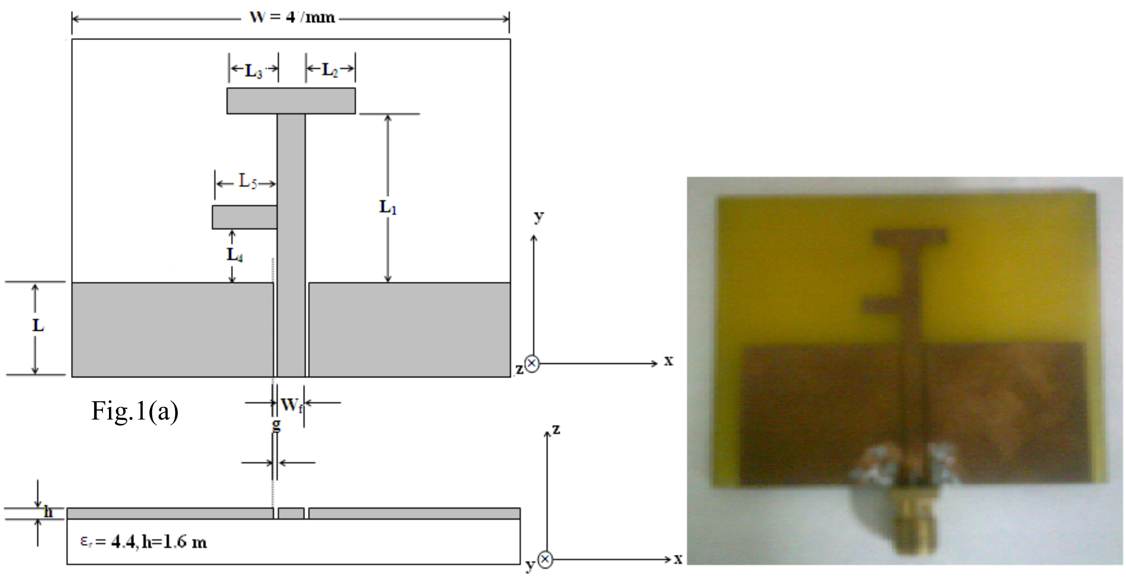


Fig.1(a)

Fig.1(b)

Fig.1(c)

Figure 1: Antenna Geometry
(a) Top View (b) Side View (c) Photograph of the Fabricated Prototype

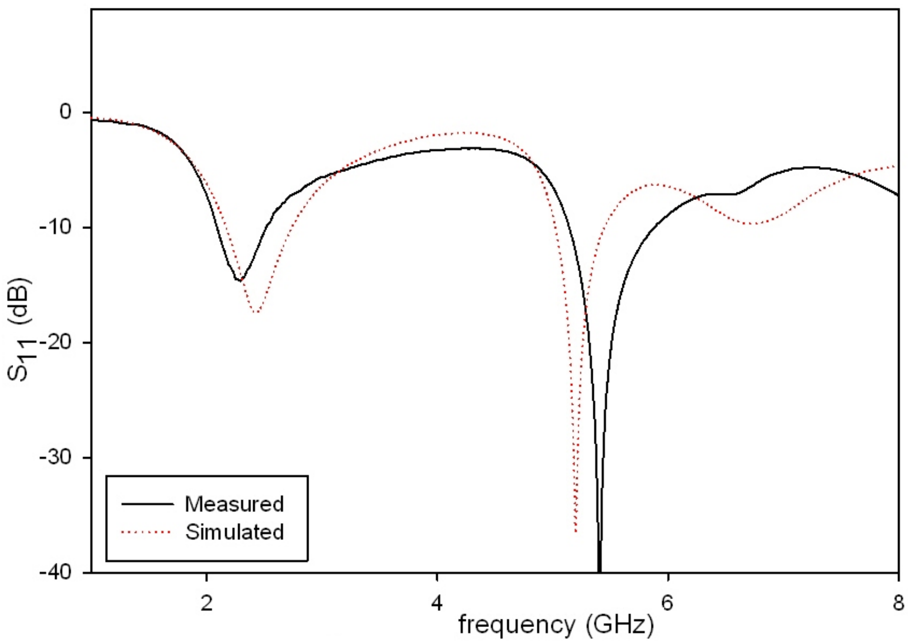


Figure 2: Measured and Simulated reflection coefficient.

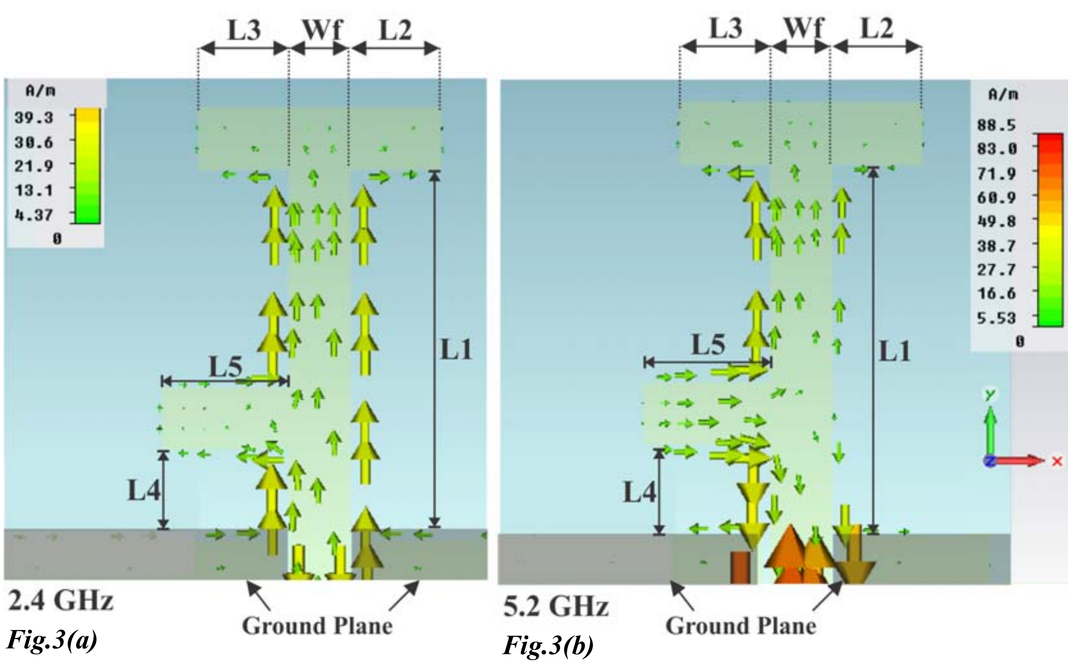
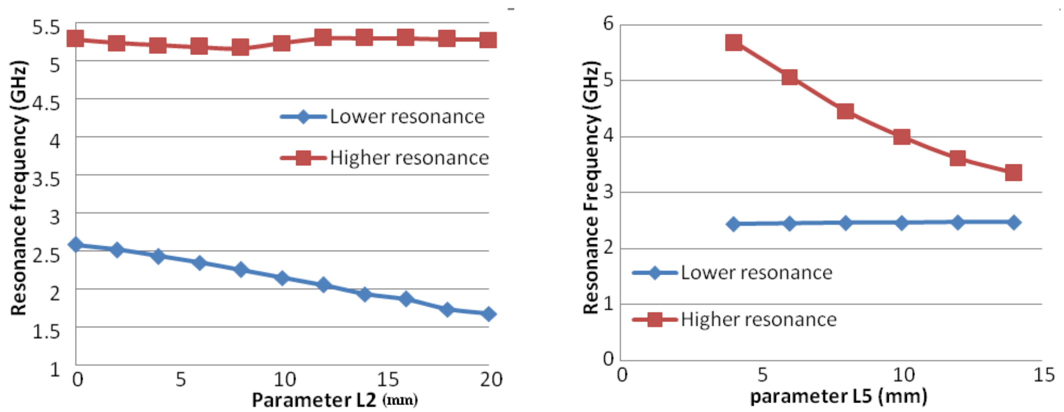


Figure 3: Surface current density plots at (a) 2.4GHz (b) 5.2GHz



(a) (b)

Figure 4: Frequency Tuning of (a) first resonance by L2 (b) second resonance by L5

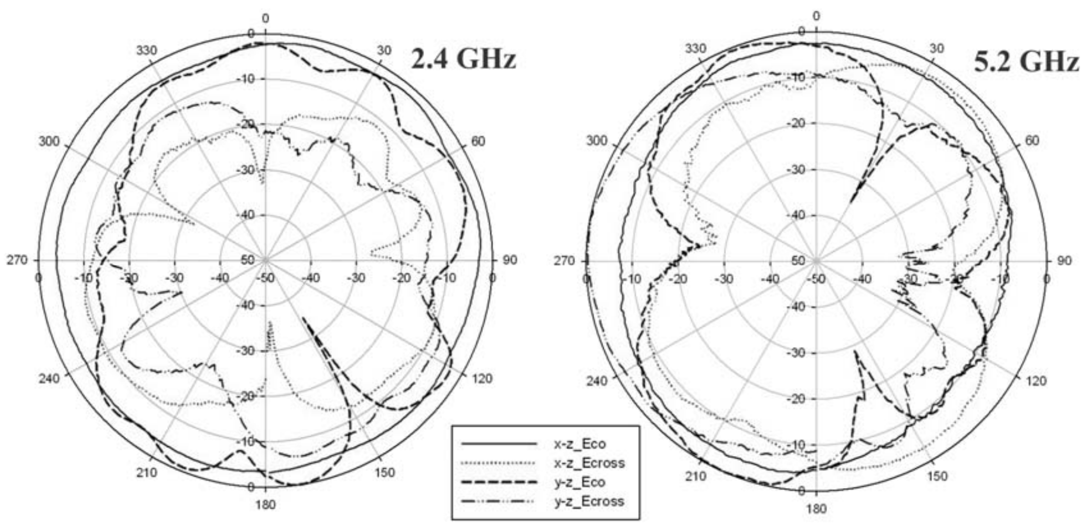


Figure 5: Measured Radiation Pattern at (a) 2.4GHz (b) 5.2GHz

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