A Novel CB ACS-Fed Dual Band Antenna with Truncated Ground Plane for 2.4/5GHz WLAN Application

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Abstract—A novel conductor backed asymmetric coplanar strip (CBACS) fed Dual band antenna which is suitable for wireless local area network is presented in this paper. The proposed antenna composed of inverted L shaped exciting strip, a lateral ground plane and a modified truncated ground plane on the back side with overall dimension of about 25x17.5x1.6mm³. The parametric studies indicate that operating frequencies and wider bandwidth is determined by the dimension of the ground plane at the top and bottom. The proposed antenna covers IEEE 802.11a/b WLAN/HYPERLAN-2/RFID band with good radiation characteristics. The measurement of proposed antenna printed on an FR4 substrate with dielectric constant 4.4 yield good conformity between simulated results. The proposed structure is simulated using the method of moment based electromagnetic solver IE3D version 15.10

Keywords — Asymmetric coplanar strips, Coplanar Waveguide, Conductor Backing, Dual band antenna, Radiation Pattern, Gain

I. INTRODUCTION

The growth of high date rate communication devices tremendously increases the demand of wireless antennas should be equipped with limited equipment space. So researchers are mainly concentrating on the design and development of highly miniaturized and low profile antenna for different user requirements. The coplanar wave guide is a promising candidate in this category because of its numerous advantages of light weight, ease of impedance matching, low profile, ease of integration with monolithic integrated circuits and its broad bandwidth. A lot of investigations have been done to exploit the advantage of conventional CPW like miniaturization of CPW fed slot antenna with reactive terminations and truncated bi-lateral ground plane [1]. A compact dual band CPW fed planar monopole antenna for WLAN application [2]. Dual band CPW fed monopole antenna with the asymmetrical ground plane for bandwidth enhancement [3]. A compact monopole antenna with double meander line is proposed for WLAN application [4]. These designs [1-10], however have complex in structures and occupy little bit more area so difficult to integrate with WLAN systems. This article primarily focuses on the development of miniaturized antenna with good gain. Here we present an asymmetric coplanar strip fed conductor backed configuration which is obtained by removing the ground plane at the left of coplanar waveguide fed antenna, the conductor backing acts as a ground plane for resulting CB ACS fed proposed antenna. Many researches are having reports on various ACS fed uniplanar configurations [12-20] like compact asymmetric coplanar strip fed monopole antenna for multiband applications proposed [11]. ACS fed printed F-shaped uniplanar antenna for dual band WLAN applications by [12]. A compact asymmetric coplanar strip fed dual Band Antenna for DCS/WLAN application [13]. However these geometries are larger in dimension than our current proposal.

II. ANTENNA DESIGN AND STRUCTURE

Fig.1(a). shows the geometry of the Asymmetric coplanar strip fed proposed antenna having total length Ls and width Ws and Fig.1(b) shows the back side truncated ground plane with tuning stub of length L1 and width w.. The feed of proposed antenna is designed using standard design equations of asymmetric coplanar strip [18-20]. The antenna is designed and printed on an FR4 epoxy substrate having dielectric constant 4.4 and thickness 1.6mm. It has to be noted that the overall antenna dimension in terms of area is greatly reduced in the case of the proposed antenna using the ACS feed since it uses only a single lateral ground plane. The size reduction achieved about half of the similar coplanar waveguide fed configuration

(a)                                     (b)
Fig. 1 Geometry of the proposed antenna (a) front view (b) backside ground plane

![Prototype of the proposed antenna](image)

### TABLE 1

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Ls</th>
<th>Ws</th>
<th>Lg</th>
<th>Wg</th>
<th>L1</th>
<th>L2</th>
<th>w</th>
<th>g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values(mm)</td>
<td>25</td>
<td>17.5</td>
<td>15</td>
<td>7.1</td>
<td>10</td>
<td>9</td>
<td>2.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

### III. RESULTS AND DISCUSSION

A prototype used for measurement of the proposed dual band antenna is fabricated on an FR4 substrate with dielectric constant ($\varepsilon_r$) 4.4, thickness (h) 1.6mm, and its photograph is shown in Fig. 2. The return loss of the proposed dual band antenna is measured by Agilent E8363B vector network analyser (VNA). The measured and simulated return loss characteristics of the proposed antenna are shown in Fig. 3. It can be seen that good agreement between simulated and measured results and obtained bands are wide enough to cover ISM 2.4/5.2/5.8 WLAN bands. The lower band at 2.45GHz (2.30-2.55GHz) and upper band at 5 GHz (4.06GHz - 6.65GHz).

![Return Loss characteristics of the proposed Antenna](image)

The simulated current distribution through the backside conductor of the proposed antenna for the resonant frequencies shown in Fig. 4, which shows the current perturbed more through tuning stubs in the lower band of resonance. The upper band of resonance the current is distributed across the ground plane surface and edges. The parametric study of the proposed antenna by with and without conductor backing (CB) is carried and given in Fig. 5, here it is found that with the application of additional ground plane the upper band of resonance widens and it is tuned to the desired frequency by a wide band tuning stub in the truncated ground plane. The dimensions of the wide band tuning stub greatly influences the bandwidth of the upper band of resonance in such a way that by varying the dimension $L_2$ by keeping $L_1$ and w ($L_1$=10mm and w=2.5mm) constant shown in figure 6, from this analysis we can observe that $L_2=9mm$ better response achieved.

![Current distribution via conductor backing proposed antenna](image)
The radiation patterns of E-plane and H-plane for 2.4GHz, 5GHz, 6.2GHz are given in Fig. 9. The results show good and omnidirectional radiation pattern at H plane and bidirectional patterns at E-plane. The small asymmetry in the patterns because of asymmetry in the proposed antenna feeding configuration.

The figure 12 shows the simulated gain of proposed antenna for the dual band of operation. The proposed antenna exhibit average gain of 1.8dBi in lower band and 4dBi in upper band. The conductor backing greatly influences the bandwidth and gain of 5GHz WLAN band. The peak gain of the antenna increases to 4.5dBi which is superior with respect to its CPW counterpart given in Ref [2].
A compact dual band ACS fed antenna for WLAN application is presented and examined experimentally in this paper. The proposed structure shows good conformity with simulated results and it has total dimension of 25x17.5x1.6mm. The structure exhibit sufficient impedance bandwidth, good radiation characteristics and moderate gain for both 2.4GHz and 5GHz band WLAN applications.

IV. CONCLUSIONS

A compact Asymmetric coplanar strip fed antenna for WLAN application is presented and examined experimentally in this paper. The proposed structure shows good conformity with simulated results and it has total dimension of 25x17.5x1.6mm. The structure exhibit sufficient impedance bandwidth, good radiation characteristics and moderate gain for both 2.4GHz and 5GHz band WLAN applications.

ACKNOWLEDGMENT

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Figure 12. Gain of the proposed antenna.

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