UWB Microstrip Antenna with Dual notch Band Behavior

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Abstract - In this paper a compact planar ultrawideband (UWB) antenna with dual band-notched behavior is proposed. Two U shaped slots are etched in it for getting the dual notch behavior. The presented antenna is successfully designed, simulated and measured. The designed antenna is showing band notch property at 5.7GHz and 7.9GHz as both these bands interfere with the UWB frequency band. This antenna is designed on Fr-4 substrate with dielectric constant 4.3 and thickness of 1.6 mm. The size of antenna is compact, patch dimension 34 X 27 mm². The antenna parameters such as return loss, VSWR, gain and directivity are simulated and optimized using commercial computer simulation technology microwave studio (CST MWS). The main advantage of this antenna is that the designed structure is very simple compared to other proposed WLAN antennas and the cost for making this antenna is also low.

Keywords: - C-shaped slots, U-shaped slots, dual band-notched characteristics, equivalent circuits, ultrawideband (UWB) antennas microstrip antenna, monolithic microwave integrated circuits (MMIC), wireless local area network (WLAN).

I. INTRODUCTION

In 2002 when FCC approved the commercial use of UltraWideBand (UWB) [1], (UWB) radio system has become a competitive topic in telecommunication industry. Antenna is the basic components of UWB systems and drawn attention of researchers in recent years. A UWB antenna includes broad bandwidth from 3.1 to 10.6 GHz, stable radiation pattern and gain, with compact size and economic. UWB face interference from the IEEE 802.11a wireless local area network (WLAN) band which is of frequency band from 5.1-5.9 GHz. So now it is extremely desired to design UWB antennas with frequency notched band characteristics. Basically there are two bands which interfere with UWB first the WLAN band second is the satellite communication band in7-8 GHz frequency range. UWB antenna designed should provide dual notch behavior which is proposed in this paper. Various designs were implemented for the notch-band behavior of planar UWB antennas like cutting slots of different shapes on the patch or on the ground [3]-[7].

There is lot of applications, UWB antenna also uses filters for suppressing unwanted bands, but filters increase the complexity of the UWB systems which ultimately result in system’s cost. Due to this reason several design methods and structures have been reported by researchers. These UWB antennas have property to filter out the 5–6 GHz band and these have been proposed not only to remove the interferences but it has also removes the requirement of an extra bandstop filter in the system [4], [5] so that system size is reduced. A UWB antenna with single notch band is explained in [8] based on that research this paper proposes a new UWB antenna with dual notch behavior.

This paper proposes a Microstrip patch antenna for UWB applications. Designed antenna operates in whole UWB band and rejects two bands, first one at 5.7 GHz used for WLAN applications and other at 7.9 GHz which is used for satellite communication. Simple design of this fabricated structure reduces cost and time of manufacturing. As UWB antenna have wide range of applications so the reduced cost can promote its applications in small budget areas too. The substrate used for designing this antenna is FR-4 which is cheaper and easily available material.

This paper is organized in four sections. First is Introduction, second section describes designed structure of proposed antenna. Third section includes the simulated results of designed antenna of following parameters the return loss, VSWR, gain, directivity and current distribution of proposed antenna and final section is conclusion.
II. ANTENNA DESIGN

Fr-4 substrate with the dimension $34 \times 27 \text{ mm}^2$ and the thickness of 1.6 mm is used for designing this antenna. The dielectric constant of this substrate is 4.3, this antenna is extended from the antenna explained in [8]. Microstrip feeding technique is used for feeding this antenna with dimension $L_4 = 8.5 \text{ mm}$ and $W_4 = 3 \text{ mm}$, designed antenna is shown in Fig.1.

In this structure there are two slots the first slot is mentioned in [8] due to which first notch band is achieved and using the second U-slot second notch band is achieved. Current distribution at both notch bands satisfies this as maximum current flow through first U-slot for the first notch band as shown in fig. 2(a) and through second U-slot for second notch maximum current flow as shown in fig. 2(b). Dimensions of designed antenna are mentioned in TABLE I and the geometry of the designed antenna is shown in Fig.1.

![Proposed Antenna](image)

TABLE I

<table>
<thead>
<tr>
<th>Antenna parameter</th>
<th>Value</th>
<th>Antenna parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L$</td>
<td>34 mm</td>
<td>$W$</td>
<td>27 mm</td>
</tr>
<tr>
<td>$L_1$</td>
<td>4 mm</td>
<td>$W_1$</td>
<td>6.6 mm</td>
</tr>
<tr>
<td>$L_2$</td>
<td>11 mm</td>
<td>$W_2$</td>
<td>3 mm</td>
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<td>6 mm</td>
<td>$W_3$</td>
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</tr>
<tr>
<td>$L_4$</td>
<td>8.5 mm</td>
<td>$W_4$</td>
<td>3 mm</td>
</tr>
<tr>
<td>$L_5$</td>
<td>2.2 mm</td>
<td>$W_5$</td>
<td>8.8 mm</td>
</tr>
<tr>
<td>$L_6$</td>
<td>6.8 mm</td>
<td>$W_6$</td>
<td>1 mm</td>
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<tr>
<td>$L_7$</td>
<td>5 mm</td>
<td>$W_7$</td>
<td>0.3 mm</td>
</tr>
<tr>
<td>$L_8$</td>
<td>2 mm</td>
<td>$W_8$</td>
<td>1.3 mm</td>
</tr>
<tr>
<td>$L_9$</td>
<td>5.3 mm</td>
<td>$W_9$</td>
<td>8.2 mm</td>
</tr>
</tbody>
</table>
Fig. 3 (a) shows the simulated return loss of the antenna in this result it is clear that the antenna is working for whole UWB band with two notch bands one at 5.7GHz and other at 7.9 GHz as the first one is used in WLAN applications and second one is used for satellite communications. These both bands one at 5.7GHz and other at 7.9 GHz interfere with UWB and this antenna is providing notch at these bands. The return loss for whole band is less than -15dB. For microstrip antenna acceptable value of VSWR for resonant frequency should be less than or equal to 2 and Fig. 3 (b) shows the VSWR of designed antenna from graph it is clear that for the whole UWB band VSWR is less than 2 except at the two notch bands one at 5.7GHz and other at 7.9 GHz in UWB band. Thus the VSWR condition is satisfied.
Fig. 3. Simulated results for (a) Return loss (b) VSWR of proposed antenna

Fig. 4 (a-b) shows the radiation pattern of this rectangular patch antenna at center frequency 7.65 GHz. The different parameters we get from radiation pattern are as follows:

- Angular width (3dB) = 84.5 Degree
- Gain (dB) = 5.6 dB
- Directivity = 5.4 dBi
A low cost and compact sized planar antenna for UWB applications with dual notch behavior is proposed. This antenna is designed on FR-4 material having dielectric constant 4.3 and the thickness is 1.6 mm. The designed antenna is working for the frequency band 2.7 to 12.8 GHz with two notched bands first at 5.7 GHz and second at 7.9 GHz. At center frequency the VSWR = 1.6, directivity =5.4dBi and gain = 11.5 dB. The simulated results of designed are good and its simple planar structure makes it perfect for microwave integrated circuits. In future this antenna can be converted to a reconfigurable antenna using PIN diode or RF MEMS switches.

REFERENCES

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