**A DUAL BAND-NOTCHED ANTENNA USING T-STUB AND C-STUBS FOR UWB COMMUNICATION**

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**Abstract**— In the respective paper, a dual notched UWB antenna is proposed. To obtain notching characteristics of dual band antenna, T-shaped stubs are embedded into circular patch and a pair of C-shaped strips is used beside the feed line. Notching of Wi-MAX and WLAN band from UWB spectrum (3.1-10.6 GHz) is obtained. The advantage of using circular ring patch antenna with modified ground and FR4 substrate is the reduction in the patch size and the economical design.

**Keywords**— WLAN, Wi-MAX, Band notching, UWB antenna.

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**I. INTRODUCTION**

The UWB technology is a revolutionary wireless technology which makes use of narrow pulse (Impulse) and time-domain signal processing. The digital data is transmitted over a wide spectrum of frequency with very low power (Ptx<50mw) for high transmission rate and short distance applications (WLAN), for low transmission rate telemetry applications etc. The UWB spectrum spans 3.1 to 10.6 GHz with lower band (3.1 -5.1 GHz) and upper band (5.85-10.6GHz) as assigned by the FCC [2,3]. The Ultra-wide band antennas tend to have potential to handle high data rate with low power requirement and it produces Omni-directional radiation pattern, low cost. Applications of UWB systems are Geo-location system, Radar, position locator, tracking, ranging, Indoor wireless communication (short range) with low transmit power, unlicensed operation and resistance to multipath interference. The problems faced are that the ultra-wideband systems are much sensitive to electromagnetic interferences with narrowband wireless communication systems, X-band satellite communication system so it is necessary to design UWB antennas with multiband filtering characteristics to avoid interferences with the other bands due to which the system complexity increases. The designing of a UWB antenna is difficult because of the larger size which is not easy to integrate with the modern wireless devices [2,3]. The various types of UWB antennas are designed for different applications: UWB antenna with CPW fed or Micro strip fed, Band notched UWB antennas, Reconfigurable UWB antennas for Cognitive Radio and Multiband applications, MIMO, UWB antennas. Adding or removing of the resonating structure is termed as ‘Band-notching’. The band notching performs the band stop operation using different methods like different shaped slots (U, V, C or S), which are introduced either on the radiating patch or on ground plane. The notching is possible by making use of split-ring resonators (SRR), meandering, folded strips, resonated cells on CPW, tuning stubs (L, C, T, rectangular, semi-circular etc), EBG etched on patch/ground, addition of a quasi-complementary split ring resonator (CSRR)[7] in feed line or compact folded stepped impedance resonators (SIRs) or capacitively loaded loop (CCL) resonators or quarter-wavelength tuning stub in a large slot on the patch in fed [2].

**II. BAND NOTCHED UWB ANTENNA**

As discussed in [1], to curtail the interferences due to other services in the UWB spectrum, a square patch of (13x14) mm2 antenna with stubs is introduced and at the corner of the patch (2x2) mm notches are made. The substrate of thickness 0.8mm and material Rogers4003 is used. The use of Roger4003 makes the design costly and due to square planar configuration the area occupied is more. To solve this problem a circular patch is designed using FR4 as substrate. The ground plane is bevelled with a triangle for smooth transitions from one to other resonant frequencies as shown in Figure 2. The simulations indicate band rejection with central frequencies of 3.6 and Thickness 0.7 mm 1 mm 5.5GHz. Figure 1 Front view of the circular patch antenna To make it operate in UWB spectrum circular patch antenna is made as circular ring UWB antenna with outer radius of 7mm, ring size of 1.5 mm and feed line length and width of 13.5mm and 2mm respectively as shown in Figure 3. The T-shaped stub in added to the circular ring radiating patch and two C-strips beside the feed-line are designed. The T-stub in the patch notches Wi-MAX (3.3-3.7 GHz) and the two C-strips notches WLAN frequency band (5.15-5.825 GHz). We get comparatively low cost and reduced size antenna as shown in Figure 4.

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**Figure 1. Antenna using circular patch**
By varying the length and width of both T-stub and C-stubs, different bands notching of operating frequency band is achieved. In the following, the length of T-stub is varied and the effect of the same is discussed. Here "L" is length of the T stubs, for L=6 mm the notching is achieved at frequency 3.64-4.35 GHz and 5.5-5.77 GHz, for L=6.5 mm notched bands obtained at 3.65-4.02 GHz and 5.03-5.76 GHz, for L=7 mm notched bands 3.34-3.92 GHz and 5.01-5.77 GHz, for L=7.5 mm notched bands obtained at 3.13-3.73 GHz and 4.9-5.83 GHz. As it can be observed the best result obtained is at length 7.5 mm. The T-stub length is now fixed at 7.5 mm. The T-stub length is now fixed at 7.5 mm. Then the T-stub length is varied. Here it can be observed from the VSWR and S11 graph that the antenna doesn’t operate in following range which is 3.13-3.73 GHz and 4.9-5.83 GHz. So here the interference from the nearby frequency has notched bands obtained at 3.19-3.72 GHz and 5-5.78 GHz. With T=0.6 mm notched bands obtained at 3.19-3.75 GHz and 5-5.78 GHz. With T=0.7 mm notched bands obtained at 3.23-3.8 GHz and 5.01-5.78 GHz. With T=0.8 mm bands notched at 3-3.63 GHz and 5-5.8 GHz. The best result is achieved at T=0.7 mm. Here the same procedure of optimisation can be done with respect to C stubs. For the length of C stub, Lc= 6 mm the band notch is obtained at 3.16-3.49 GHz and 5.10-5.89 GHz, for Lc=6.5 mm it is from 3.09-3.67 GHz and 5.92 GHz, for Lc=6.6 mm it ranges from 3.23-3.8 GHz and 5.01-5.78 GHz, for Lc=6.7 mm it is from 3.13-3.70 GHz and 5.02-5.92 GHz, for Lc=7 mm band notched obtained at 3.15-3.73 GHz and 4.86-5.7 GHz. The best result achieved at Lc=6.6 mm. Same procedure carried out for length of the c stub (Lw), at Lw= 5 mm it give the most promising result with notched band at 3.13-3.73 GHz and 4.9-5.83 GHz. The table below shows the optimised dimension of the T and C stubs.

<table>
<thead>
<tr>
<th></th>
<th>T stub</th>
<th>C stub</th>
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<tbody>
<tr>
<td>Length</td>
<td>7.5 mm</td>
<td>6.0 mm</td>
</tr>
<tr>
<td>Width</td>
<td>6.5 mm</td>
<td>5.0 mm</td>
</tr>
<tr>
<td>Thickness</td>
<td>0.7 mm</td>
<td>1.0 mm</td>
</tr>
</tbody>
</table>

For the same optimised dimensions the results are shown and discussed below.
been eliminated and the antenna can operate without and interference in the operating band.

**CONCLUSION**

The characteristics of band notched UWB antenna have been studied and effect of it is found on the UWB spectrum. The antenna operates in UWB band from 3.8–4.9 GHz by notching the Wi-Max and WLAN frequency. The results are analyzed for circular patch antenna. Using FR4 a cheaper circular ring antenna is designed. The results for different T-stub and C-stub length and width are analyzed. The best result is obtained using T-stub (L: 7.5mm W: 6.5mm T: 0.7mm) and with C-stub (L: 6.6mm W: 5mm T: 1 mm). The notching of WLAN and Wi-MAX band is achieved.

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