# Design and Performance Analysis of a Novel Ultra Wideband Antenna with Three Rejection Bands in 3.1GHz – 10.6GHz Frequency Range

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***Abstract***— **In the long run ultra wideband (UWB) systems should be viewed differently than the narrowband systems. UWB systems are enabler for services that requires immunity to multipath and jamming. Such a novel UWB antenna printed with defected ground plane and slotted patch is proposed and discussed in this paper. By employing such structures, three rejection bands of 3.3-3.6 GHz (WiMAX), 5.1-5.8 GHz (WLAN) and 8.1-8.34 GHz (Satellite Communication) are achieved. The proposed antenna has been designed and simulated using HFSS.**

***Keywords—*** *Defected ground structure, band-notch characteristics, Ultra wideband, wireless LAN.*

## I. INTRODUCTION

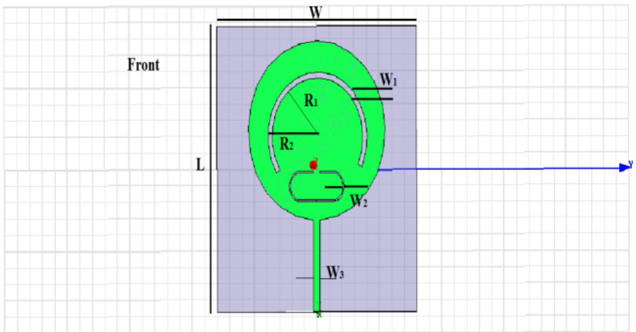
Aiming to provide a low complexity, multipath and jamming immune system, academic and industry communities endeavor to design feasible ultra wideband (UWB) systems [1]. Unlike the conventional narrowband communication systems dealing with UWB systems follow different perspective for rendering good performance because optimized synthesis vary significantly in the entire UWB band causing a distraction in the transmission and reception of pulses. The Federal Communication Commission (FCC) announced 3.1-10.6 GHz as the commercial operation range for UWB systems with the purpose of serving wireless communication, networking, radar processing, imaging and positioning systems. As is known, there are various narrowband and satellite communication systems within this frequency range such as WLAN (5.15-5.35 GHz and 5.725-5.825 GHz), Wi-MAX (3.3-3.6 GHz) and satellite communication systems (8-8.4 GHz) which can cause severe interference and would have serious implication on performance of UWB systems. Adding a number of stop bands would mitigate the problem. Currently, slots and square ring resonator loaded in the antenna tuning stub gives multi-band notched characteristics [4] that includes U-shaped slot [5], V-shaped slot [6], and complementary split ring resonator (SRR) [7]. Though all these design demonstrates two and some three notched bands there is still a risk of interference from other narrowband.

And so, in order to address the issue of interference from other narrowband, in this paper a novel planar UWB antenna is proposed and discussed in detail. Section II provides the design of UWB antenna and Section III gives the simulation results.

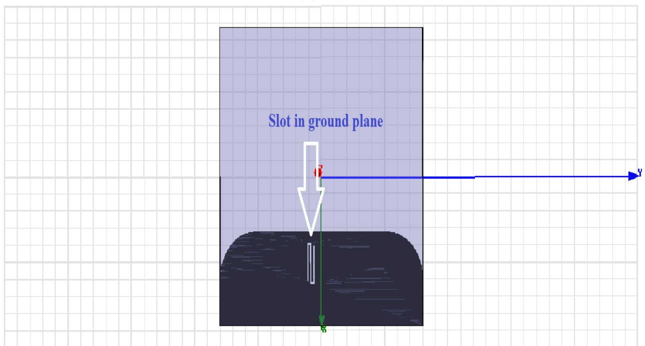
## II. ANTENNA DESIGN

### *A. Microstrip Array Design*

The geometry of UWB antenna with rejection properties in the WLAN, Wi-MAX, and Satellite frequency range is shown in Fig. 1




(a)




(b)

Fig.1. The geometry of the UWB antenna simulated using HFSS (a) front (b) back

The antenna consists of a circular metallic patch printed on a R04350B substrate with relative permittivity, $\varepsilon_r$ = 3.4 and a partial ground plane. A 50 Ω microstrip line of width 1.04 mm is used as feeding technique. On the front side of the substrate, two arc shaped slots are implanted on the circular patch that assures band notched characteristics in 3.3 – 3.6 GHz and 5.1 – 5.8 GHz frequency range. On the other side of the substrate, a curve shaped defected ground structure on the partial ground plane gives rejection band of 8.1 – 8.34 GHz.

## III. SIMULATION RESULTS AND DISCUSSION

The antenna synthesis and analysis are carried out using the design tool Ansoft HFSS.

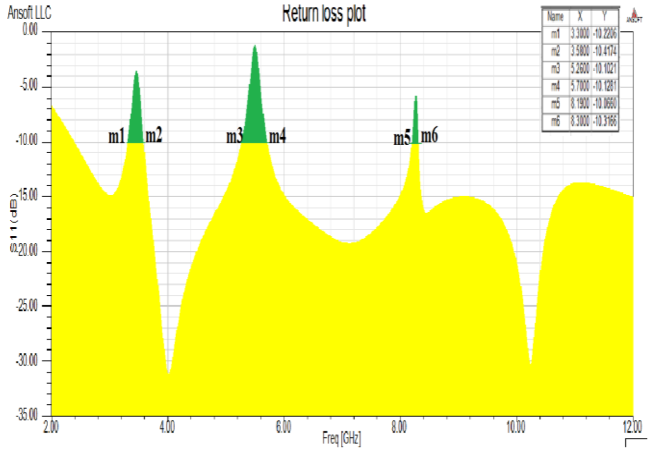



Fig.2. Simulated return loss plot for UWB antenna with triple band notched characteristics

As seen from Fig. 2, the designed UWB antenna gives three rejection bands with central frequency of 3.45 GHz, 5.45 GHz and 8.2 GHz.

Further with the encouraging simulation results the influences of various parameters on the notch band were studied. At first, the length of the arc, T was considered and its effects on stop bands is shown in Fig. 3

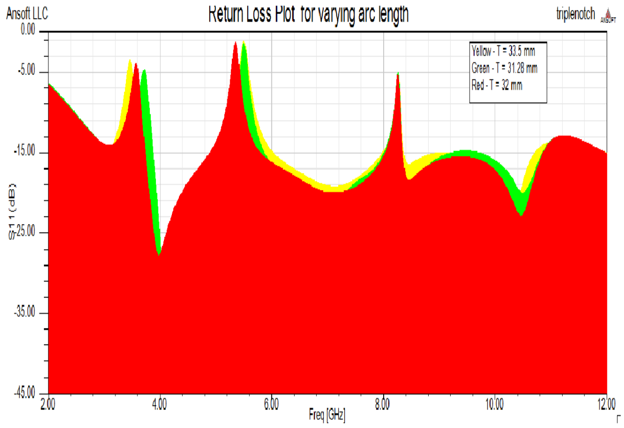



Fig.3. Simulated return loss plot for varying arc length

From Fig. 3 it can be seen that as T is varied there is a shift in 3.45 GHz and 5.45 GHz stop bands while the 8.2GHz stop band is unaffected.

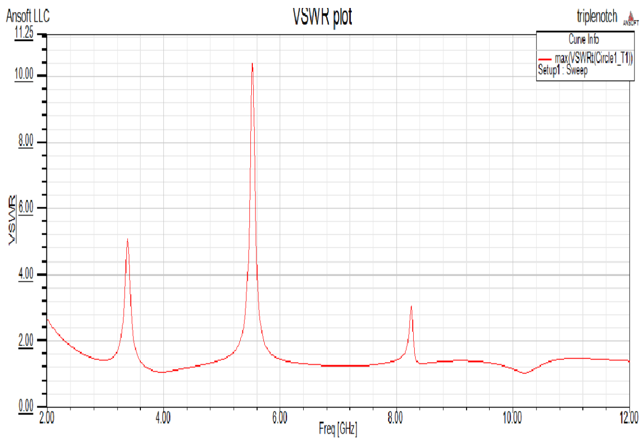



Fig.4. Simulated VSWR for UWB antenna with three notch band characteristics

From Fig. 4 it can be seen that the simulated VSWR is less than two in the pass band of entire UWB spectrum while VSWR>2 in the three rejection bands of 3.3 – 3.6 GHz, 5.1 – 5.8 GHz and 8.1 – 8.34 GHz.

The simulated radiation pattern for the UWB antenna with three band-notched characteristics is shown in Fig. 5

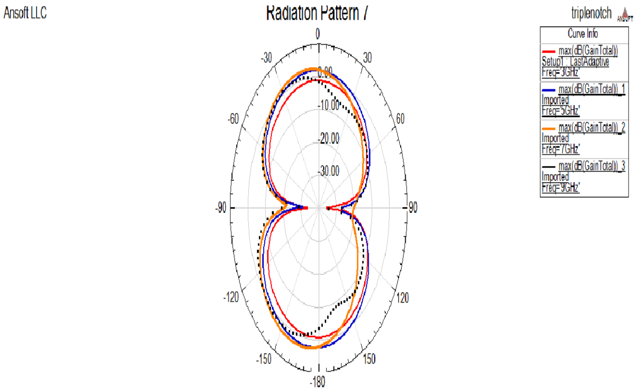



Fig.5. Simulated far field radiation pattern of the UWB antenna with triple band notch characteristics

As seen in Fig. 5, the antenna gives omni-directional radiation pattern. The frequency band selected lies in the pass band of the UWB spectrum. The average gain is nearly 2dB for all considered frequency.

## IV. CONCLUSION

In this paper, a novel UWB antenna with three rejection properties in the Wi-MAX, WLAN and SATCOM frequency range is presented. The method for the synthesis of band notched UWB antennas include a defected ground plane and slotted radiating patch. Frequency domain parameters such as return loss, VSWR, gain are simulated using HFSS and analyzed. Further the bulkiness of the antenna can be treated for miniaturization using suitable techniques.

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