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Research Paper

A Compact Antenna with WiMAX and WLAN bands notched for UWB applications

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Abstract

A Compact antenna with WiMAX and WLAN bands notched for ultra wide band (UWB) applications is proposed. The proposed antenna is designed for the planar ultra wide band (UWB) antenna and ultra wide band (UWB) antenna having two band rejections. The proposed antenna overall size is 30mm x 40mm x 1.6mm. The antenna consists of a rectangular patch on the top of FR4 substrate with 50ohm feed with defected ground structure. This patch consists of one round cut at each corner having radius 1.575mm. The simulated band width with return loss (RL) >=10db is 3.1 to 11.2 GHz with VSWR<2. It works for the applications of WiMAX system at 3.5GHz (3.3 – 3.7 GHz), C-band satellite communication (3.7 - 4.2 GHz), wireless local area network (WLAN) system at 5GHz (5.15 – 5.825 GHz), X-band satellite communication system (7.25 - 7.75 GHz). The ultra wide band frequency range for these wireless systems causes interference. To diminish obstruction, the band rejection is made. WiMAX and WLAN groups are dismissed by designing slots on the patch. This antenna has an incredible pick up in the Gain while a sharp drop in the rejected groups.

Keywords: *Compact, Dual Notch, Rectangular patch antenna, Ultra-wide band (UWB), VSWR.*

1. Introduction

There has been an awesome interest for the antennas that involve a little volume in remote correspondence applications to decrease expenses and increment portability. What's more, in light of the fact is that a solitary antenna is wanted to deal with the more extensive operational data transmission of the antenna likewise ends up noticeably imperative.
A little size antenna is required with a wide working data transmission, however without relinquishing the effectiveness or the pick-up of the radiation characteristics, gain, VSWR, Directivity. In this way, it is important to comprehend as far as possible to acquire an ideal outline. Likewise, if there is a gap between the hypothetical and reasonable points of confinement, it is additionally vital to see how to change the antenna to decrease the gap.
Because of the speedy development in technology throughout the world, ultra-wideband (UWB) reception apparatuses got extraordinary consideration in light of the fact that they have gigantic focal points, for example, high speed, straightforward assembling, little size, low power utilization [1][2][9] , less complexity, security, less obstruction, minimal effort and low profile [7] [13].It is utilized as a major aspect of different applications, for instance, radar, images in the correspondence of medications and military. Links that get UWB must be non-dispersive or dispersive in a controlled way and satisfactory for compensation. Ultra-wideband (UWB) development is as of now spreading in a few zones, for example, compass radars, radiometers, radio star perceptions, repeat bounces, scattering reach and OFDM remote mapping outlines, check outlines and direct essentialness [12]. The UWB settle beneficiary links could be arranged with different geometries; that is rectangular, triangular, circle, square and so on [8]. The desired antenna for a specific agenda relies upon the kind of use, recurrence, pick up, and so on. In many applications, the antennas are micro-strip antennas, planar antennas, monopole antennas, dielectric resonators etc. [3], due to its position of safety. These antennas have a wide application in versatile frameworks, WLAN with 5GHz band, WiMAX with 3.5 GHz band, ultra-wide band (UWB) with band 3.1 - 10.6GHz [14-23].
Today, these antennas wound up noticeably well known, so the specialists concentrated for the most part on them [10]. Among all the antennas, they lean toward the UWB since it can wipe out similar frequencies if there should arise an occurrence of impedance [2]. This end should be possible by making openings in various positions, for example like patch, feed and ground plane [11]. To build the data transfer capacity and proficiency of the UWB antenna [5], corner cuts, two openings in the patch and feed are made. Here in this proposition, two band dismissals are made at frequencies of 3.3-3.7 GHz and 5.15-5.825 GHz.

2. UWB Antenna Design

The proposed compact dual band notched antenna, shown in the Fig.1(a) & 1(b), this antenna is built on the FR4 substrate where ε_r =4.4 and tan δ=0.02 for this material. The antenna contains all dimensions in mm only. The substrate has width W_{sub} =30, length L_{sub}=40 and height h=1.6, the rectangular patch has width W_p=15 and length L_p=12 the feed line has width W_{feed}=2.4 and length L_{feed}=18 the ground plane has width W_g=30 and length L_g =17.
To enhance the BW gathering mechanical assembly and facilitate it, round advances are added to the lower and upper corners of the patch, notwithstanding including the floor opening [8]. Cutting steps at the base of the radiator assembles the partition between the obsession and the ground plane [4], which tunes the capacitive coupling between them by cutting steps at the upper corners of the

installation, refines the inductive piece of the getting device that slaughters the capacitive coupling between the ground and the obsession to acquire impedance of unadulterated resistive data, while the opening of the floor disposes of the capacitive limit through the inductive thought of the answer for get an impedance of relatively unadulterated resistive data [1]. The reproduced RL has a superior impedance coordination and BW more broad while including a lower round progress instead of two, a little change in the impedance coordination to incorporate a prevalent round progress contrasted and the one without higher venture amid all repeat, while including ground openings enhance the coordination of impedance in the repeat band higher than the lower band [6]. To enhance the BW of the antenna, round advances are added to the lower and upper corners of the patch. The range of every round is r = 1.575mm.

The simulated RL which is equal to –S11 (scattering parameter), shown in fig.2, for the proposed antenna shown in fig. 1(a) & (b), shows that with RL>10 dB the antenna has BW 3.39–11.9GHz with minimum RL of 27dB. The best dimensions of proposed antenna are R1= R2= R3= R4= 1.575, W_p=15, L_p=12, W_{feed}=2.4 and L_{feed}=18. The designed antenna has a ground plane having the length of 17mm and width is 30mm. The VSWR of the antenna is presented in the fig.3.

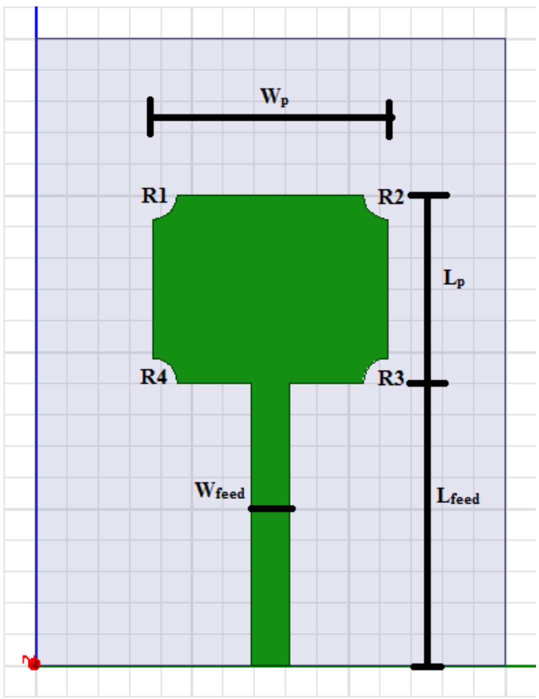

Figure 1(a): UWB Antenna top view

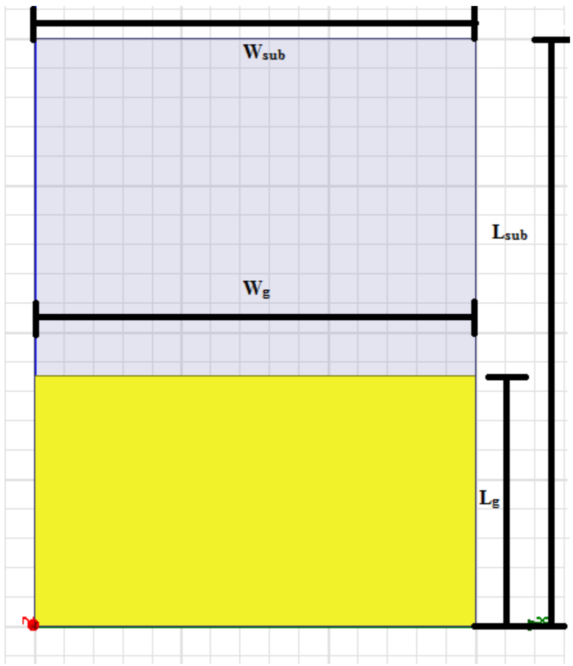

Figure 1(b): UWB Antenna bottom view

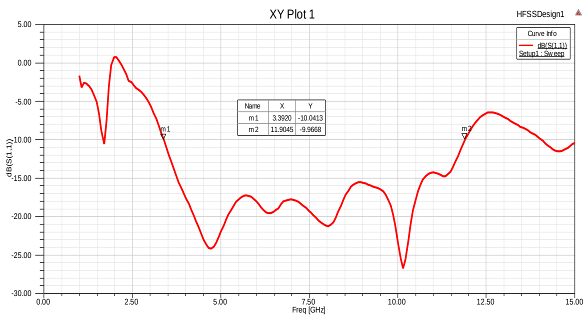

Figure 2: Return Loss

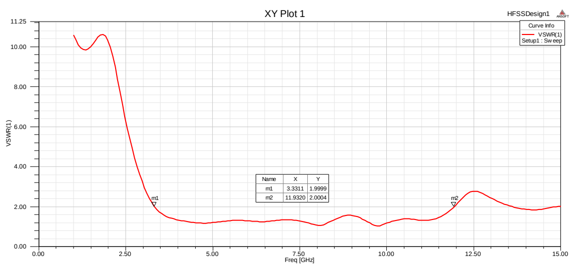

Figure 3: VSWR

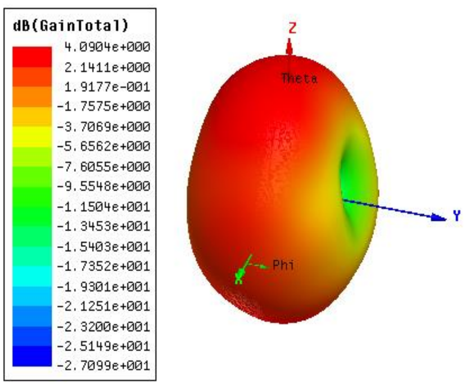

Figure 4: 3D Gain

3. Study of Band Rejection Slots

The achieved band rejections are for WLAN and WiMAX. Two slot shapes are implemented in this approach.
In this design, there are two sorts of openings, one for the planar Ultra-Wide band antenna and another for band dismissal. To acquire the transmission capacity of (3.1-10.6 GHz), the round spaces are made in the four corners of the rectangular fix reception apparatus with a range of 1.575. To tune the inductive part, the capacitive coupling between the patch and the ground and to accomplish the resistive information impedance, the upper corners of the antenna are cut. The band dismissals are accomplished for WLAN and WiMAX. Two notch shapes (inverted U, tuning fork).

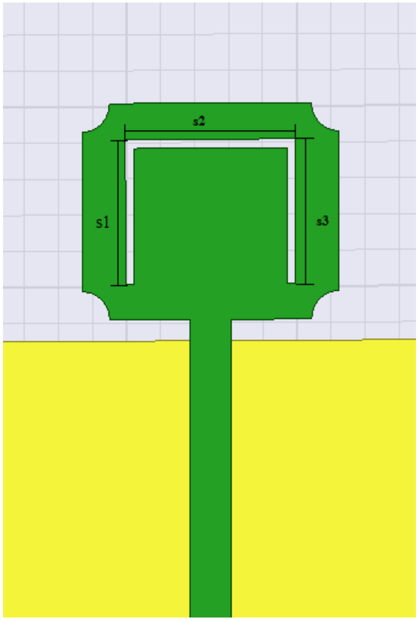

Figure 5 (a): Inverse U-slot on the patch for Wi-MAX rejection

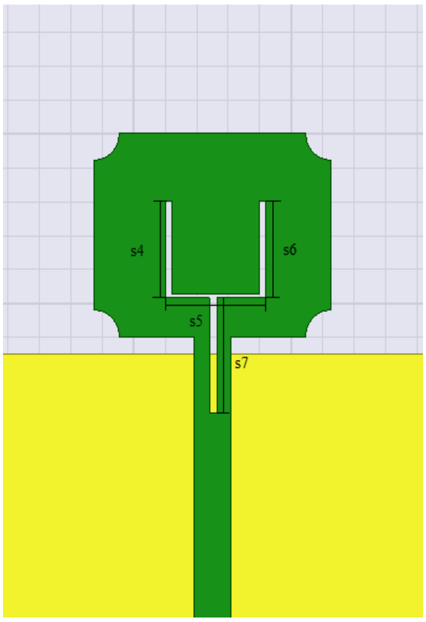

Figure 5 (b): Tuning fork shape slot on the patch for WLAN band rejection

3.1 Rejection of Wi-MAX band

The inverted U shape in the patch is used to reject the Wi-MAX (3.3-3.7 GHz) band. The length of the S1 is 8 and width is 0.5, S2 length is 10 and width is 0.5 and S3 length is 8 and width is 0.5. The low values of S2 cause a narrow rejection band, where high values of S1 and S2 decrease in the center frequency of the rejecter band with lower RL values. All the values are in mm.

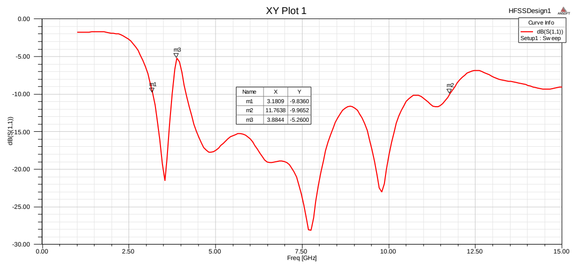

Figure 6(a): Return Loss for figure 5(a) rejecting Wi-MAX band

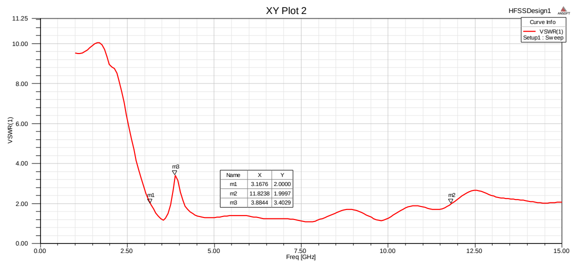

Figure 6(b): VSWR for figure 5(a) rejecting Wi-MAX band

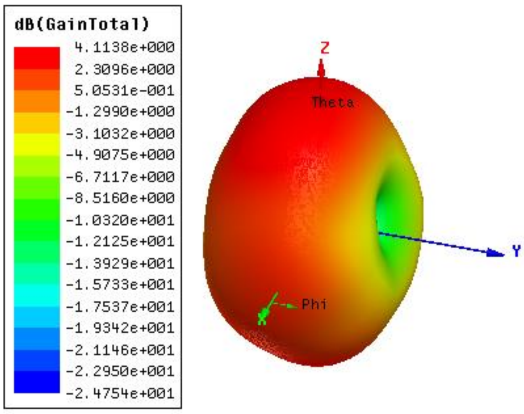

Figure 6(c): 3D Gain for figure 5(a)

3.2 Rejection of WLAN band

The tuning fork shape in the patch and feed is used to reject WLAN (5.15-5.825 GHz) band. Here S4, S5, S6, S7 slots are used the S4 having the length of 5.7 and width is 0.4. The S5 having length of 5.5 and width is 0.2. The S6 having length of 5.7 and width is 0.4 finally the S7 having the length of 7 and the width is 0.5. The slot S7 is laying on the feed. It was found that varying them will affect mainly the location of the central frequency of the rejected band. All the values are in mm.

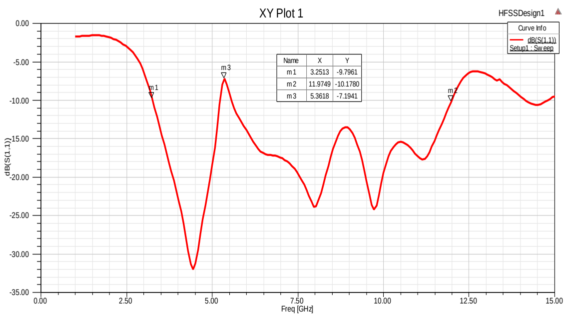

Figure 7(a): Return Loss for figure 5(b) rejecting WLAN band

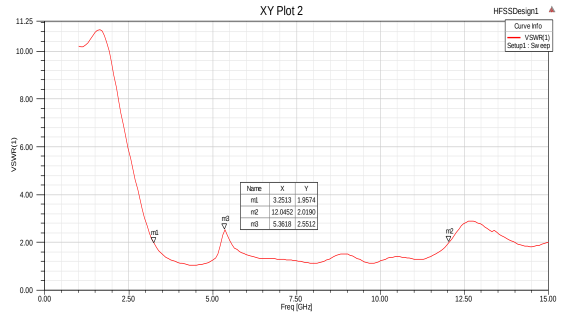

Figure 7(b): VSWR for figure 5(b) rejecting WLAN band

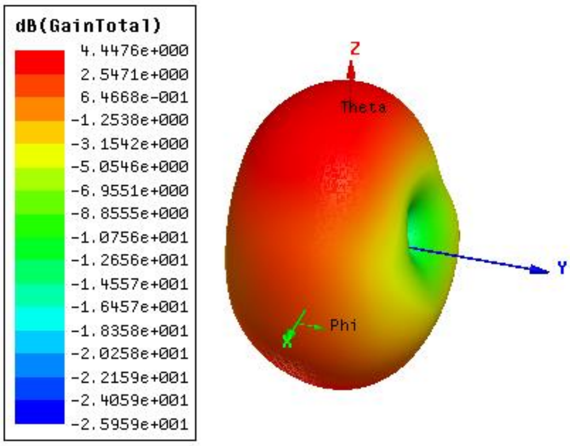

Figure 7(c): 3D Gain for figure 5(b)

3.3 Rejection of both WLAN & Wi-MAX bands

After investigating various slot shapes, in the patch and the feed line, by observing their performance with regard to the UWB antenna requirements, we combine the two slot types in the proposed antenna to form an antenna which rejects two bands as shown in Fig. 8. The simulated RL results for the multi-slots antenna show that the rejection bands are narrow enough to reject the desired interferences from the WLAN and the WiMAX frequency range. The curves for the proposed antenna with inverted U-slot & tuning fork-slot are shown in Fig. 9(a) & (b).

The simulated peak gain for the multi-slot antenna is shown. A significant reduction in gain occurred at the two central frequencies of the rejected bands.

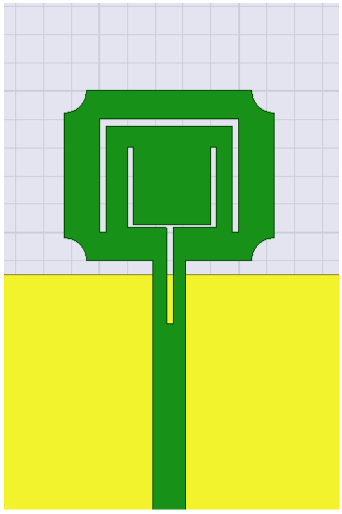

Figure 8: Dual Slot UWB Antenna.

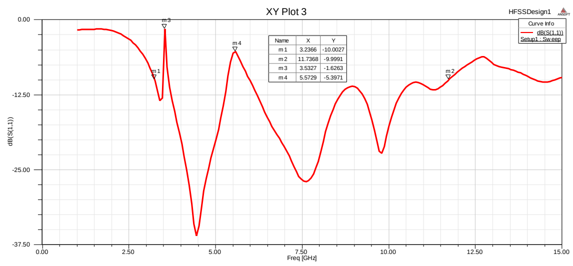

Figure 9(a): Return loss for dual slot

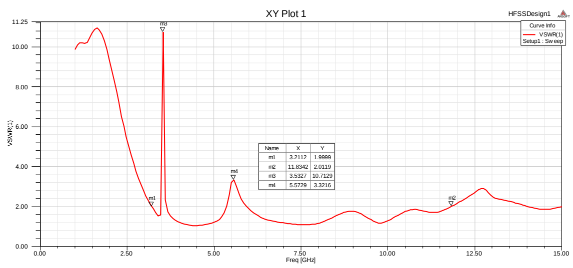

Figure 9(b): VSWR for dual slot

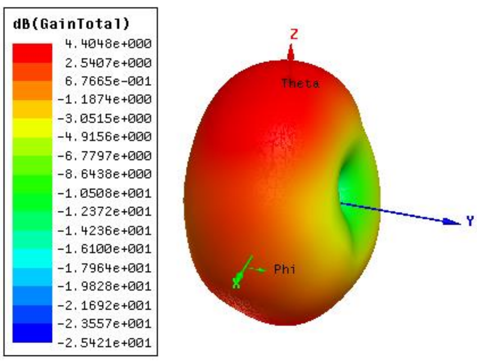

Figure 9(c): 3D Gain for dual rejected band.

4. Conclusion

The results that gained from the above analysis show that a reasonable characteristic has obtained for the entire range of UWB band. Also notched two frequencies one for WLAN & other for WiMAX. VSWR is maintained between 1< VSWR < 2 for the entire band. So this band can be used for UWB wireless applications with well-maintained gain of 4.4 db.

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