

**INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH
TECHNOLOGY****COMPACT ULTRA WIDE BAND ANTENNA WITH BAND NOTCHED
CHARACTERISTICS.****Raksha Sherke^{*}, Ms. Prachi C. Kamble, Dr. Lakshmappa K Ragh**^{*} M.E Student, Electronics Engineering Department, Terna Engineering College, Navi Mumbai ,India.

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ABSTRACT

A compact ultra wide band antenna with band notched characteristics is presented in this paper. Single band notch is created in 5.4 GHz to 6.4 GHz frequency region with the help of two C shaped slots in order to reduce the interference in WiMax and X-band systems. A good return loss (S11) values have been noted in WiMax (5.1 GHz to 5.8 GHz) and X-band (7.1 GHz to 7.7 GHz) frequency range. The designed antenna covers the ultra wide band range of 3.1 GHz to 10.6 GHz which has VSWR less than 2 and the return loss is less than -10db and has an omni-directional radiation pattern. The designing and simulation results are done by using ANSOFT High Frequency Structure Simulator. A prototype was fabricated on FR4 substrate and measurements were done using Agilent N9916A Fieldfox handheld vector network analyzer.

KEYWORDS: Ultra-wide band, slot antenna, band notched, patch antenna.**INTRODUCTION**

Ultra Wide Band (UWB) is a wireless technology used for transmitting large amount of data over wide spectrum of frequency bands. Ultra wideband transmits data with very low power over a short distance. Bandwidth of the UWB technique is very huge.

Features of Ultra wideband technique are as follows:

- High performance at a low cost.
- Robust against fading.
- High Speed Transmission
- High Precision Ranging
- Low Power Consumption
- Simple Hardware configuration
- Compact size
- Low Complexity

Ultra wideband systems occupies very large bandwidth, so they have to share the spectrum with the existing communication systems and because of which interference occurs. So there is a need to reduce these interferences in UWB systems. Ultra wide band (UWB) communication systems attracts lot of attention due to all the above features, since the U.S Federal Communication Commission has released the 3.1GHz to 10.6GHz bandwidth [1]. Micro-strip antennas has very attractive merits such as, compact size, ease of fabrication, low cost, and good omni-directional radiation characteristics. These characteristics are favorable for UWB antennas[2].

In practice, interference between existing communication systems and ultra wide band communication systems is a serious issue for UWB application systems. Even though UWB has approval of FCC to operate in 3.1GHZ to 10.6GHZ band, notching bands in order to avoid interference to nearby communication systems like IEEE 802.11,HIPERLAN/2, etc may become necessary. Band notching may become necessary as UWB transmitters should not cause any interference in existing communication systems such as WLAN networks and vice versa. Therefore , notching characteristics are required in ultra wide band antennas.

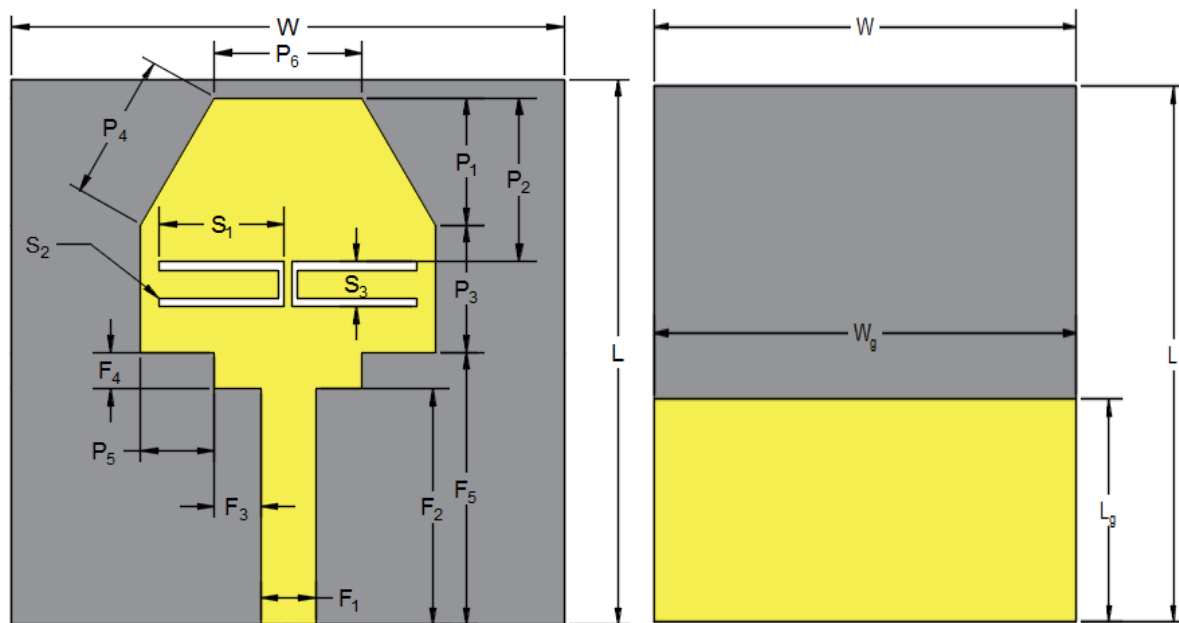
Different techniques are presented in literature to reduce the interference in UWB systems like using studs[3][4], different shaped slots[5][6], meander slot, parasitic elements[3] and various types of resonators. There exists various band-reject UWB antenna designs. Recently, in [3] band notched has been realized for 3.22 GHz–4.06 GHz (WiMAX) band by embedding a stub in hollow center of a U-shaped feed line and second notch for 4.84–5.96 GHz (WLAN) band is realized by etching an inverted T-shaped parasitic strip. The T-shaped parasitic strip is etched on back plane surrounded by a dielectric resonator and the width of second notch is controlled by cutting the slot at proper position in ground plane.

Uniplanar Ultra-Wide Band (UWB) antenna design that can achieve the rejection of two extremely narrow WLAN 5.25 GHz and 5.775 GHz bands and closely-spaced frequencies is presented in [4] and the rejection is achieved using double open-circuited stubs, which are chosen based on their narrowband performance. In [5], a uniplanar ultra-wide band (UWB) polarization diversity differential antenna having band-notched characteristics is presented. The antenna has two pairs of differentially fed monopoles which are orthogonal to each other for polarization diversity performance over the band and arc shaped slots are inserted in the monopoles to notch 5.5GHz WLAN band. Koch fractal geometry are used in the antenna design in [7] due to its self-similar and space filling properties and by etching a C-shaped slot from the monopole of antenna, band rejection is achieved in wireless local area network band. Ultra wide band antenna with upper WLAN band notched is presented in [8], the band notched is realized using meander shaped slots in the radiation patch.

MATERIALS AND METHODS

Antenna Design And Configuration

All the optimization and simulation of the proposed antenna has been done using the Ansoft HFSS 13 software. The geometry of the proposed compact band-notched UWB antenna is illustrated in Figure 1.



(a) (b)
Figure 1: (a) Front view of designed antenna, (b) Back view of designed antenna.

Table 1. Optimized Dimensions Of Antenna

Variables	W	L	W _g	L _g	F ₁	F ₂	F ₃	F ₄	F ₅
Size (mm)	30	30	30	12.5	3	13	2.5	2	15
	P ₁	P ₂	P ₃	P ₄	P ₅	P ₆	S ₁	S ₂	S ₃
	7	9	7	8.06	4	8	6.8	0.5	2.5

The UWB antenna consists of a rectangular shaped radiating patch and two C-shaped slots etched on it. The rectangular patch is printed on the front side of the FR4 substrate with dimensions 26*30*1.6 mm, relative permittivity $\epsilon_r=4.4$, loss tangent of 0.02 and thickness of 1.6 mm.. Designed antenna has used CPW feed line of width $F_1 = 3$ mm and Length $F_2= 13$ mm to achieve 50 Ohm characteristic impedance.

In this work two C shaped slots are used to achieve reduction in interference in UWB systems. Two C-Shaped slot has been cut on radiating patch to create notch in WLAN band shown in Figure 1. C-slot length is roughly $\lambda_g/2$ long. The width of the slot is S_2 . The ground plane with size of $W_g * L_g$ mm is applied on the back side of the dielectric substrate. The structure is composed of a rectangle shape radiator fed through 50 Ohm microstrip line. For the purpose of bandwidth improvement, the rectangular patch has a cut at two upper corners of the patch. The simulated results are achieved using the simulation software Ansoft HFSS.

RESULTS AND DISCUSSION

A prototype was fabricated on thin, lightweight FR4 substrate and was measured to validate the reliability of the simulated results. The measured results for the return loss (S11) and VSWR are presented in Figure 2 and Figure 3 respectively. The measured result is the best reported of its kind (narrow-band rejection).

From Figure 3 we can see that C-slot provides a single band notching feature in UWB band for 5.4 GHz–6.4 GHz band application. The two C-shaped slots has been introduced in the radiating patch. The length of each C-shaped slot is nearly half the guided wavelength as shown in Equation 1.

$$L_{C-slot} = \lambda_g/2 \quad (1)$$

The measurement of the presented antenna was performed with Agilent N9916A Fieldfox handheld vector network analyzer for return loss and VSWR. Measured results show good covenant with the simulated results. The discrepancy in simulated results and measured results is resulting due to the simulation error, cable & connector losses not considered during measurements and tolerance in fabrication.

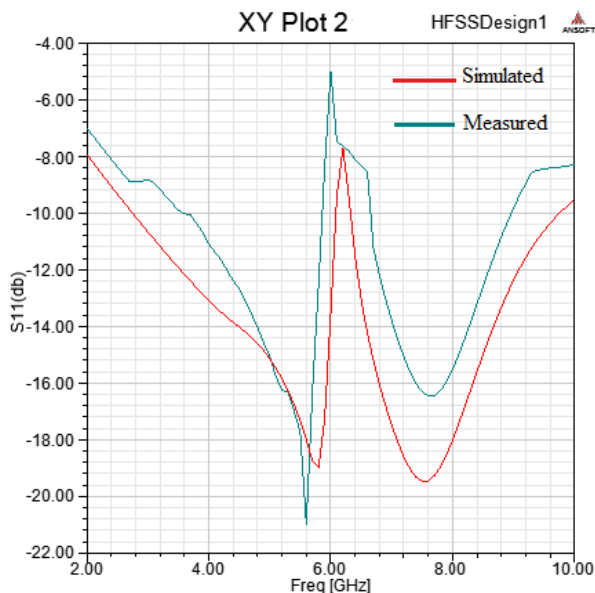


Figure 2: Simulated and measured s11 of the proposed antenna.

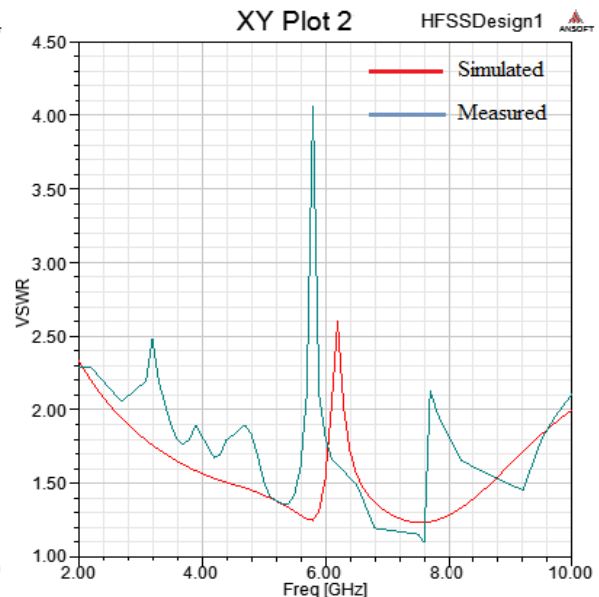


Figure 3: Simulated and measured VSWR of proposed antenna.

A return loss and VSWR of suggested antenna has been displayed in Figure 2 and Figure 3 respectively that shows the notched band creation is in good agreement of simulated and measured results. With regards to

antenna design, any reflections between the antenna and the load will reduce the effectiveness of the antenna, so a VSWR that is as low as possible is desired. The suggested antenna successfully exhibits good S11 values at WiMax and X-band systems, maintaining broadband performance for VSWR less than 2. Smith chart is used to find the input impedance of the proposed antenna. The Figure 4 and Figure 5 shows the smith chart and impedance curve for the proposed antenna.

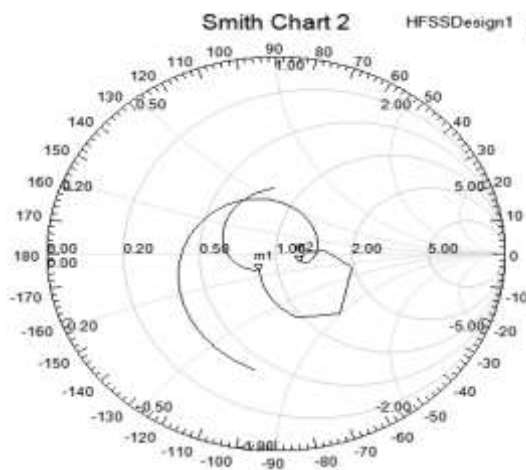


Figure 4: Smith chart for impedance measurement.

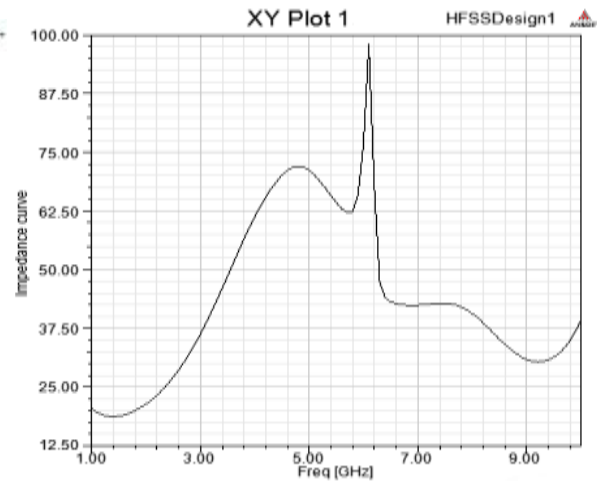


Figure 5: Impedance curve.

The smith chart shows a good impedance match of 62.3 Ohm at 5.7 GHz and 43.3 Ohm at 7.6 GHz which is close to characteristics impedance 50 ohm and can be verified by the impedance curve in Figure 5. From the radiation pattern we can say that the antenna has Omni-directional radiation pattern at the frequency 7.6 GHz with gain of 1.06 db as shown in Figure 6. Fabricated prototype antenna and simulated antenna has been shown in Figure 7 and Figure 8 respectively.

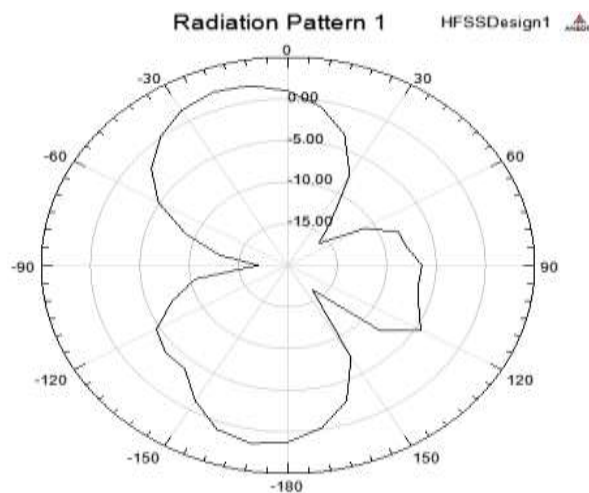


Figure 6: Radiation Pattern.



Figure 7: Fabricated antenna.

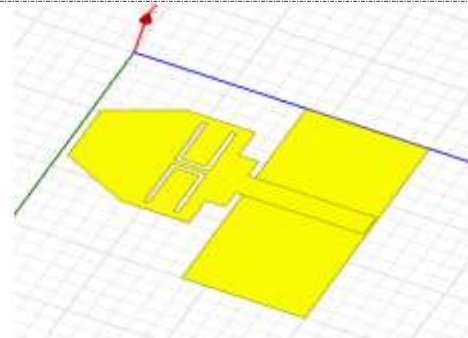


Figure 8: Simulated antenna.

CONCLUSION

The presented antenna supports UWB application and also rejects the frequency band 5.4 GHz-6.4GHz in order to avoid potential interference with existing communication system using the C-shaped slots in the proposed antenna structure. The proposed antenna shows good return loss values at WiMax and X-band frequency range, which indicates its usefulness for communication in these areas. A UWB antenna with compact size is successfully designed and measured. Antenna is simple in structural design, has an omni-directional radiation pattern and overall size of 26x30x1.6 mm³, which is easy to be integrated in miniature devices. Results & analysis of presented antenna indicate that it is applicable in miniature devices and has a simple design & compact size as an added advantage of the antenna.

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