A Novel Design of H-shape slot Ultra Wideband Antenna having Tri- band notched Function

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***Abstract*-This paper presents a design, simulation and optimization study of a triple band notch. The antenna consists of a circular patch fed by a 50Ω micro strip line. An altered H-shaped slot is etched on the proposed radiator to introduce the tri-band notched function. An embedding resonance circuit (ERC) is introduced to increase the depth and width of stop band. Therefore the antenna attains a better band-notched characteristic than other tri-band notched antennas at the same frequency bands. The fabricated antenna has a compact size of 34mm*26mm*1.6mm. The simulated results [1]Masters Degree, Communication Engineering and Signal Processing, Acharya Nagarjuna University College of Engineering and Technology, Andhra Pradesh matching over the band width of 2.8 to 10.7GHz Omni directional radiation pattern and with a stable gain, except three stop bands of 2.6-3.7GHz, 5.3-6.1GHz, and 6.5-7.6GHz for filtering the WiMAX, WLAN, and C-band satellite communication system.**

***Index Terms:* - Tri-band notched, ultra wide band, embedding resonance circuit.**

I. INTRODUCTION

Ultra wide band(UWB) radio technology have attracted much attention since the U.S. Federal Communications Commission (FCC) allocated a frequency range with a bandwidth of 7.5GHz (3.1-10.6GHz) for unlicensed radio applications [1-2]. Federal Communications Commission (FCC) has allocated a frequency spectrum from 3.1-10.6 GHz for commercial applications [3]. UWB become the center of attraction.UWB antennas are to be operated with wide band characteristics, Omni directional radiation pattern and constant group delay. Since then UWB technology provides high data rates for a variety of applications, such as short-range, high band width communications, precision locating and tracking applications [4], radar sensing, and body-area networking [5]. It is a well-known fact that planar monopole antennas present attractive features, such as tiny size, low cost, simple structure, stable radiation patterns, and constant gain over the entire operating band. Owing to these characteristics, planar monopoles are attractive for the use in emerging UWB applications, and research activity is increasingly focused on them.

Over the above frequency band, there exist wireless systems such as WiMAX (2.6-3.7GHz), IEEE802.11a WLAN (5.3-6.1GHz), and C-band (6.5-7.6GHz), which may cause electromagnetic interference with the frequency bands in UWB systems thus affecting the UWB transmitter performance. So UWB antenna with band notched characteristics is a main requirement [6-11]. Therefore, several methods are introduced to decrease the interference between different communication systems. One of the most common methods is to use filters. But this method can increase the complexity of the system and the cost of production. In fact, UWB antennas with band-notched characteristic to filter the potential interference are the most desire. Among the most popular methods is to embed complementary resonance elements into either the radiating plane, ground plane or the feed line of the antenna.

In [12] a novel ultra wideband antenna was proposed with simple structure and band-notched function. This paper firstly realizes the tri-band-notched functions at WiMAX, WLAN and C-band satellite communication by etching H-shape slot on the radiator. However, the depth and bandwidth of stop band at WLAN band can not satisfy the demand. Therefore, then the ERC is introduced to solve this problem [13].

II. ANTENNA CONFIGURATION AND DESIGN

The front view of the radiating element of the proposed antenna shown in figure1 (b).This antenna consists of a circular patch adopted H-shape slot and adding an embedded resonance circuit is placed on the micro strip line. The patch is fed by a 50Ω micro strip line.

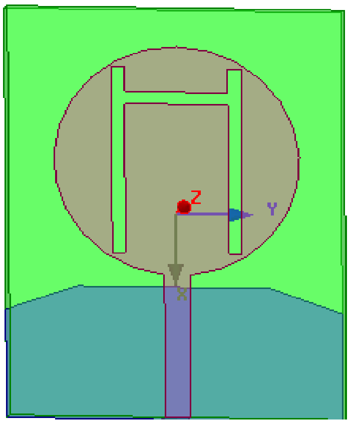


Figure1 (a) with out ERC of the proposed antenna1

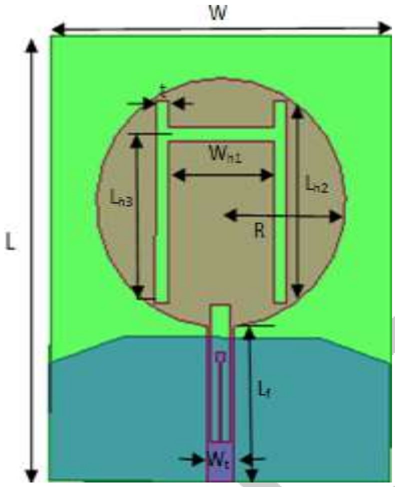


Figure1 (b) with ERC of the proposed antenna2

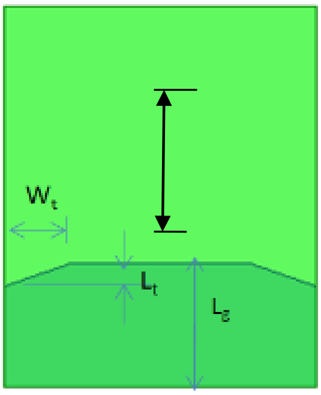


Figure1 (c) Back view of the proposed antenna

In this paper the proposed antenna is fabricated on a standard FR4 substrate with a thickness of 1.6mm, a loss tangent of 0.025 and a dielectric substance of 4.4. In order to get good impedance matching and increase the bandwidth, the ground plane is tapered at its end.

Figure1 (a) shows that with out ERC of the proposed antenna1. Figure1 (b) shows that with ERC of the proposed antenna2. ERC can be used to increase the depth and width of the rejection bands.

Figure 1 (c) shows the back side of the antenna. In our proposed antenna is based on Defective ground Structure (DGS), by cutting a slot on ground.

The simple way to achieve band- notched function is by embedding slots either on the feeding line, radiating plane or ground plane. This way will change the distributions of surface current. According to equation (1), the length of the added slot is approximately half-wavelength [14].

$$L = \frac{c}{2f\sqrt{(\varepsilon_r+1)/2}} \qquad (1)$$

Equation (1) shows that L is the length of the slot. ε_r is a dielectric substance. C is the speed of light. In this paper, the H-shaped slot is etched on the radiator to achieve tri-band notched function at WiMAX, WLAN and C -band satellite communication system. The simulation model as well as the optimization of the designed antenna parameter values is carried out using Ansoft HFSS 13.0. The final optimized parameter values are shown in table 1.

Table1.The dimensions of the proposed antenna

NOTATION	DIMENSION(mm)
T	1
W	26
L	34
R	9.5
W_{h1}	8
W_f	2
W_t	5.5
L_{h2}	15.4
L_{h3}	13.5
L_f	12.5
L_t	2
L_g	11

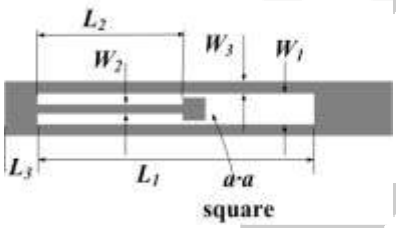


Figure 2 Geometry of the ERC

The geometry of the embedded resonance circuit and its dimensions are shown in figure2. ERC is equivalent to resonant cavity in transmission line model. The band-notched function depends on the length of L_2, a, and width of W_1. With L_2 increasing, the central frequency of stop band will decrease .The parameter values of ERC dimensions as shown in the table2.

$$L_2 = \frac{c}{4f_0\sqrt{\varepsilon_r}} \qquad (2)$$

Table2. The parameter values of ERC

NOTATION	DIMENSION(mm)
a	0.7
L_1	10.5
L_2	6.2
L_3	3
W_1	1.4
W_2	0.2

III.RESULTS AND DISSCUSSIONS

In this paper, we use Ansoft HFSS 13.0 to design, model and simulate. Figure6 shows the simulated VSWR of the proposed antenna2 with tri-band notch. The three notch bands can be obtained in the range from 2.6-3.7GHz, 5.3-6.1GHz, and 6.5-7.6GHz. The central frequencies of notched bands are 2.7GHz, 5.7GHz and 7.2GHz for implementing the rejection of the desired signal of WiMAX, WLAN, and C-band satellite communication system.

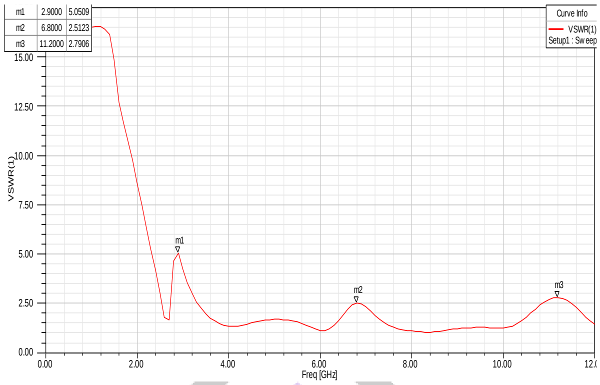


Figure3 simulated VSWR of the proposed antenna1

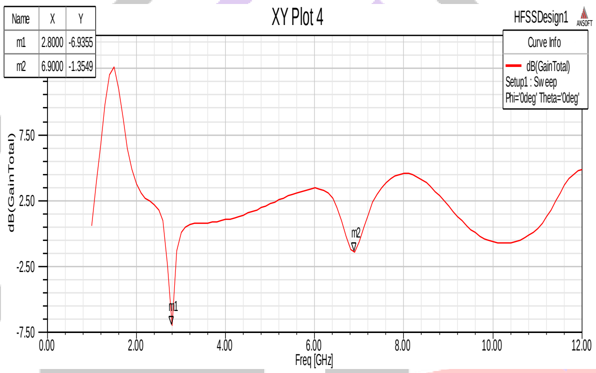


Figure4 simulated gain of the proposed antenna1

The simulated VSWR of the proposed antenna1 shows in figure3. It indicates the max peak values. Figure4 indicates the simulated gain of the proposed antenna1. It can be clearly noted that the proposed antenna1 exhibits only two notch bands.

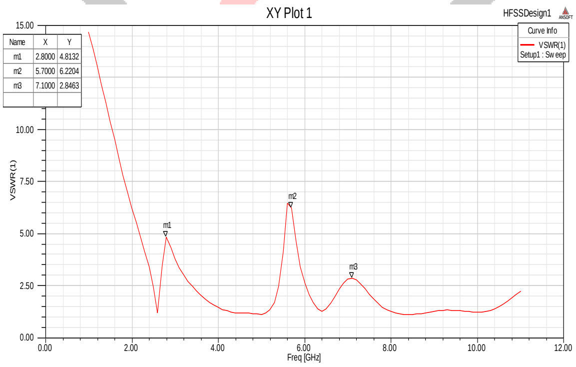


Figure5 simulated VSWR of proposed antenna2

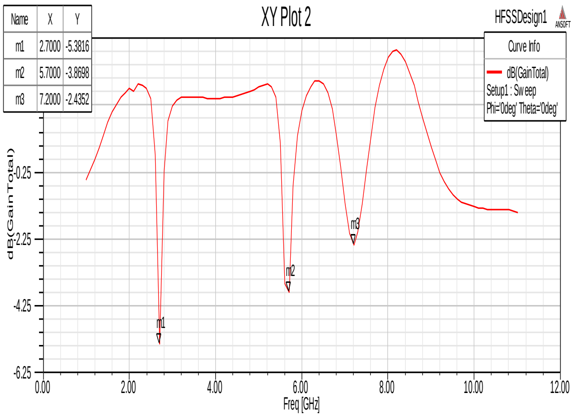
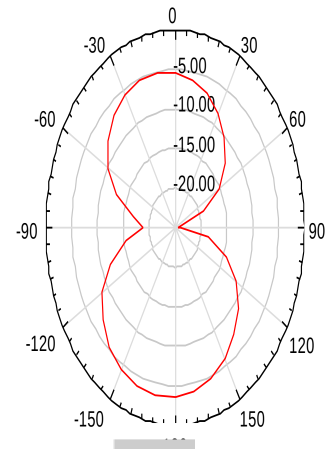
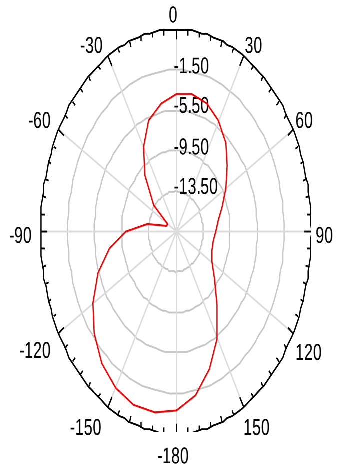


Figure6 Simulated gain of proposed antenna2

Further we developed with ERC of the proposed antenna2.

The simulated VSWR of the notching elements along with the tri-band notched UWB antenna is shown in figure5. It can be indicated the three notch bands have a VSWR>2, whereas a wideband performance with VSWR<2 is observed for the entire UWB band.





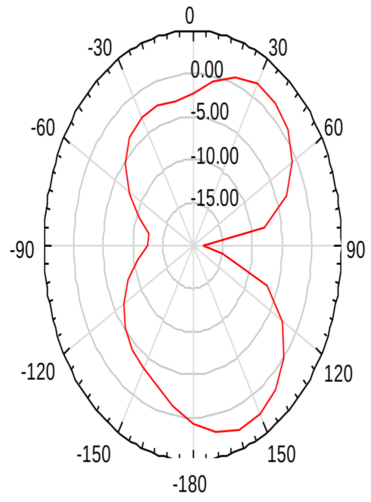


Figure7 simulated radiation pattern (a) 2.7GHz (b) 5.7GHz (c) 7.2GHz.

Figure7 clearly indicates the low receiving power at notched frequencies 2.7GHz, 5.7GHz and 7.2GHz. We can note that the radiation pattern is Omni directional.

IV. CONCLUSION

In this paper a novel H shape slot tri-band notch ultra wide band antenna has been proposed. By adopting H- shaped slot on the circular radiating patch with the resonating frequency at 4.5GHz, and ERC is placed on the micro strip feed line, band rejecting around WiMAX (2.6-3.7GHz) and WLAN (5.3-6.1GHz) and C-band satellite communication system (6.5-7.6GHz) is realized. The designed antenna has a good impedance matching and keeps stable gain.

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