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Design of Single, Dual and Tri Band Notched Ultra-wideband Antenna Using Metallic Strips

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Abstract: This paper presents design of single, dual and tri band notched ultra wideband antenna using metallic strips. This is a compact, low power ultra wide band (UWB) antenna which mitigates the saturation of spectrum. Its low power characteristic make it invisible for the radio systems sharing the same spectrum hence minimizes interference due to other licensed bands. This proposed band notched UWB antenna is used for several frequency bands such as Wi-Max(3.3 GHz to 3.6 GHz), WLAN (5.15 GHz to 5.35 GHz and 5.725 GHz to 5.825 GHz) and HIPERLAN/ 2(5.15 to 5.35 GHz and 5.47GHz to 5.725 GHz).

Keywords: Ultra-wideband antenna, VSWR, Partial ground plane, rectangular metallic strip, U-slot rectangular patch antenna.

I. INTRODUCTION

Since the U.S. Federal Communication Commission (FCC) authorized the unlicensed use of the Ultra Wide Band (UWB) in (3.1-10.6 GHz) in February 2002, significant research activities and interests have been increased in academic and industrial fields recently to explore various UWB antennas [1].

There are various design challenges in design of UWB antenna some of them are radiation stability, compact size, low manufacturing cost & electromagnetic interference. The frequency range for UWB systems approved by the FCC between 3.1 to 10.6 GHz will cause interference to the existing wireless communication systems, such as the IEEE 802.16 Wi-MAX system at 3.5 GHz (3.3-3.7 GHz) and the IEEE 802.11a wireless local area network (WLAN) system at 5.2/5.8 GHz (5.15-5.825 GHz) [2]. Various techniques are used to create a single antenna which works for all frequency bands. The designed antenna should have high speed, low power and high data rate.

Antenna technology and radio system uses the same spectrum which causes electromagnetic interference due to licensed bands such as Wi-Max, WLAN, etc. So to reduce this electromagnetic interference, band notch antennas are used.

II. LITERATURE SURVEY

Following are some of the inventions.

1. Nine types of planar monopole antennas are presented for generation of dual band notched characteristics.

The band rejection operation is achieved by taking the length of embedded slot approximately equal to one half wavelength of the desired notch frequency. Excited surface currents experience destructive interference which causes the antenna to be non responsive to a particular frequency [2].

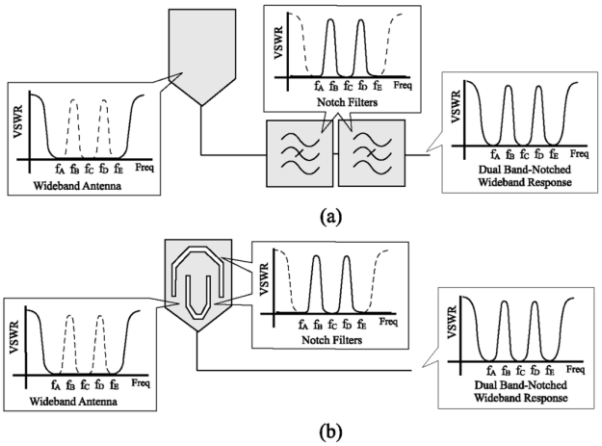

Fig.1. (a) RF front end with wideband antenna and two notch filters. (b) Proposed dual band-notched antenna.

2. Another compact planar wideband antenna is achieved by etching the nested C-shape slots in the patch. It provides two band notched characteristics for Wi-Max (3.4GHz) and WLAN (5.5GHz) bands [3]. This antenna has stable radiation patterns, constant gain and broadband matched impedance.

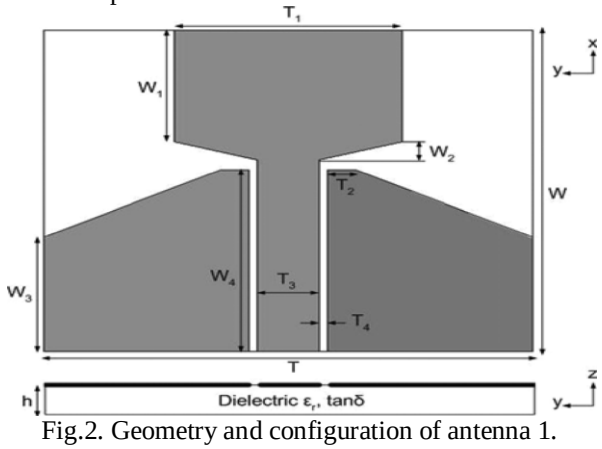

Fig.2. Geometry and configuration of antenna 1.

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3. To increase the notched bandwidth complementary split ring resonators are developed. This antenna has notched frequency range 4GHz - 7.2 GHz [4]. This antenna is advancement over conventional Complementary Split Ring Resonators (CSRR) having stop band from 4.1-5 GHz. CSRR has negative dielectric constant (€). CSRR units has strong coupling relative to other micro strip lines. The stop bandwidth of CSRR units can be increased by combining different orientations of CSRR unit.

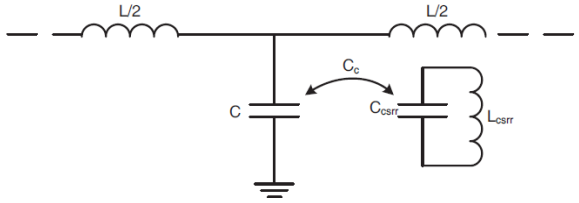

Fig. 3. Circuit model of basic CSRR-loaded microstrip line.

4. Multiple notch antenna is implemented using L-type band stop filter, inserting a Split Ring Resonator (SRR). Four stop bands are at 2.4 GHz, 3.5 GHz, 5.5 GHz and 7.6 GHz. In this antenna various L- branches are connected on the radiation disc and it is fabricated by a standard Printed Circuit Board (PCB)[5].

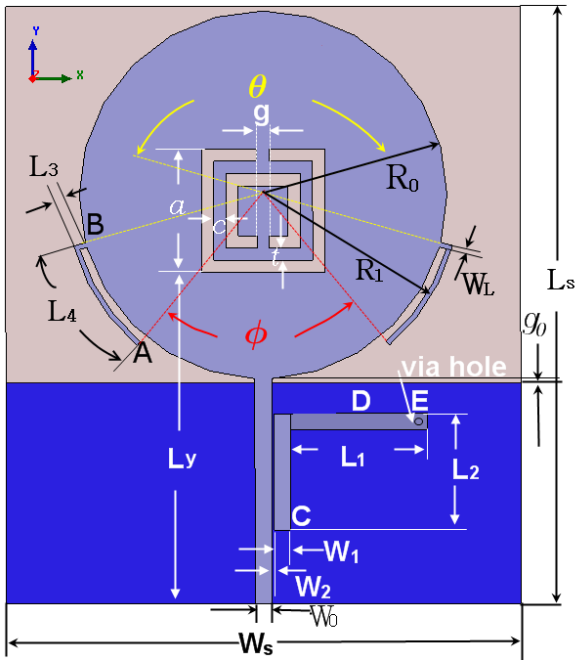

Fig.4. Schematic diagram of the multiple notch antenna.

III. ANTENNA DESIGN

We propose a compact planar UWB antenna having 3 band notched characteristics. It is developed using metallic strips. The 3 band notched frequencies are 3.5 GHz, 4.9 GHz and 9.3 GHz. This antenna is non-responsive to Wi-Max, lower WLAN and upper WLAN.

The antenna is notched using metallic strips which has simple design and compact size. The notch frequency can be varied by adjusting the width and position of metallic strips in the slot of antenna. It has a curved patch with a partial ground plane. A 50 ohms microstrip line is fed at the partial ground plane.

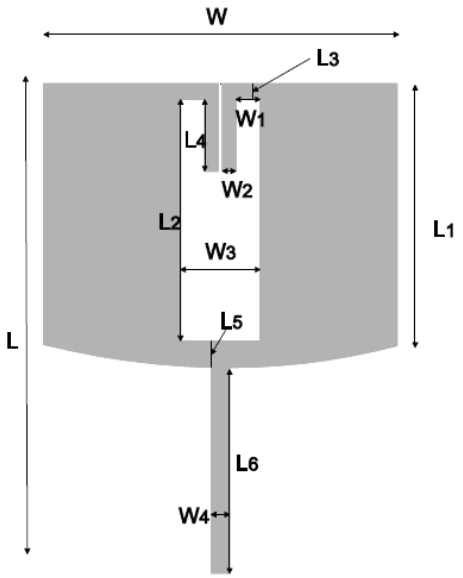

Fig. 5 (a) Antenna front view

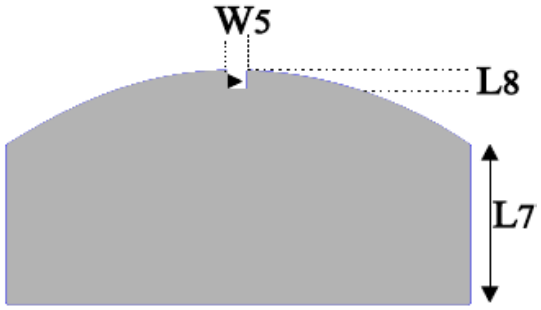

Fig. 5 (b) Ground plane of antenna.

The notch frequencies are achieved by introducing metallic strips one for each notch frequency. Hence desired notch band is obtained without changing geometry of original antenna. One can obtain the exact notch band frequency by adjusting the length of strip line. Frequency response and radiation patterns can be observed using simulation software like High Frequency Structure Simulator (HFSS) or Computer Simulation Technology (CST). HFSS is able to display results in various formats such as Smith chart, current E-field, H- field, S,Y,Z parameter matrices, radiation patterns.

IV. CONCLUSION

In this paper review of existing UWB antennas and a new method of designing a UWB antenna is proposed. Proposed antenna has operating frequency range of 3.1 GHz to 10.6 GHz. Structure is compact and designed for three band notch frequencies such as Wi-MAX, Lower WLAN and Upper WLAN. Metallic strips are used for selecting notch frequency. Length of metallic strip is the main parameter for deciding the exact notch band frequency. Variation in the length of metallic strip line will result in variation of notch frequency. HFSS and CST simulation softwares can be used.

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