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Dual Band Notched Square Monopole Antenna with wide bandwidth for UWB Applications

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Abstract*—A compact ultra wideband (UWB) monopole antenna with dual band-notched characteristics is presented. The antenna consists a square radiating patch with L shaped slots on the radiation patchand a U shaped slot as the feedline. By cutting two C-shaped slots in the ground plane, additional resonance is excited and hence much wider impedance bandwidth can produced, especially at the higher band, which results in a wide usable fractional bandwidth of more than 127% (3.1-13.2 GHz). With a pair of L-shaped structure and U slot in microstripfeedline frequency band stop performance is generated. The proposed antenna has a size small of 18x20 mm^2. The simulated results show that antenna covers5.1/5.8 WLAN and 4 GHz C- band with dual band notched function.

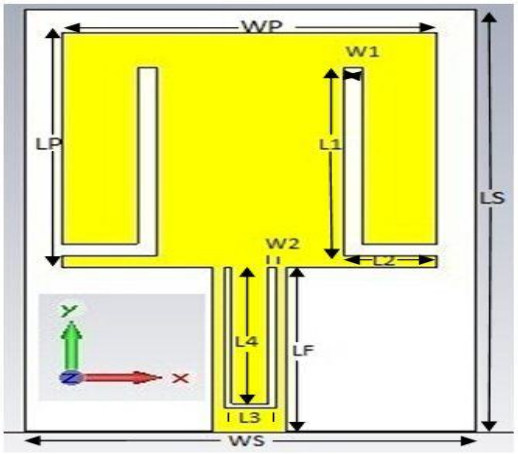
***Keywords*—C band,dual band notched,U slot, ultrawideband (UWB), L slot.**

I. INTRODUCTION

Since the commercial application of the UWB technologywas authorized to work at 3.1-10.6GHz band by the FederalCommunication Commission (FCC) of USA [1], many kindsof ultra-wideband (UWB) antennas have been designed andstudied for the wireless communication. The UWB system hasdrawn a great attention, because of its high data rate, smallemission power, low cost, and strong anti-interference capacity[2]. Although the UWB is authorized to work at 3.1 -10.6 GHz,it is still essential to remove the band of the already exitingwireless communication systems to avoid the interference withthem [3].In previous times, numerous researchers have designed diverse antenna geometries, method of design and structureto achieve band-notched characteristic. Someexamples of thistechnique are by inserting slot in the ground plane [4], orCutting slots with different shapes in the radiating patch [5],or utilizing capacitive loaded loops [6], or inserting a thin strip inthe slot [7], or using micro strip open loop resonator [8].Nevertheless, most of the methodsproposed have onlymanaged to create a single notched bandand unable to providesufficient rejection bandwidth in the targeted narrowbandoperating frequency range. In contrast,Xue-jie Liao et a proposed an UWB with dual band-notched [9]. In this paper, a new band-notch monopole antenna is presented.The notched band is provided by using two L shaped slots in the radiation patch and U slot in the feedline. Also, by cutting a pair of C shaped slots in the ground planeadditional impedance bandwidth especially at the higher band canbe produced.

II. ANTENNA DESIGN

Fig.1 depicts the configuration of the proposed antenna. The antenna is printed on the 18x20x1.6mm^3 FR4 substratewith relative permittivity ϵ_r=4.4and tangent loss factor 0.025. As shown in Fig. 1, the designedantenna consists of a simple square radiating patch with aL-shaped slot, microstripfeedline with U-shaped slot and a rectangular groundplane with two C-shaped slots. The ordinary antenna structure have a squarepatch, a feed-line and a partially ground plane. The width of square patch has a Wp. The patch is connected to a feed-line with the width of W_f and the length of L_f, as shown in Fig. 1. Onthe back side of the substrate, a partially ground plane of length Lg and width Ws is placed. The feed line is fixed at 2mm in width to achieve 50-Ωimpedance match.50-Ω SMA connector is connected to the proposed antenna for signal transmission. The length of L1 and L4 plays a critical role in deciding the centre-rejected frequencies in notched bands. Optimum design parameters suitable to achieve the desired band rejected frequencies are listed below. On practically implementing the antenna its stop band frequencies shifts on account of various factors. To overcome this effect the stop band characteristics of the antenna can be controlled by flexibly tuning the length of the slots.The optimal values of main parameters of the designed antenna are as follows: Ws=18 mm, Ls=20 mm, Wp= 10 mm, L1=7.5 mm, Lp= 10 mm,W1=0.5 mm, L3=1.4 mm,L2=2.5mm, L4=5 mm, W2=0.2 mm, L=2.5 mm, W=3 mm, W3=0.5 mm, and Lg=3.5mm. The electromagnetic solver, computer simulation technology (CST) which works on methods of moment is used to simulate the proposed antenna structure.



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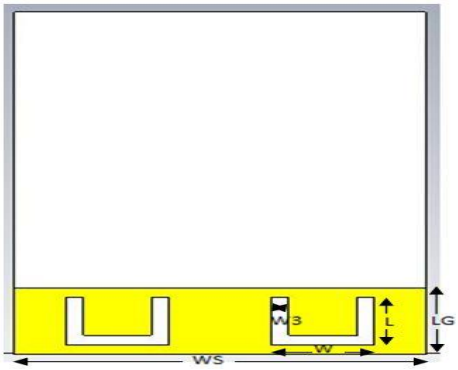

Fig.1. Structure of designed antenna front and back view

III. RESULTS AND DISCUSSIONS

For the micro strip antenna, its radiation is mainly determined by the size and the shape of the radiation patch and the ground plane. To design a novel antenna, and also in order to increase the upper frequency bandwidth, modified C-shaped slots are inserted in the partial ground plane of the proposed antenna as shown in Fig. 1. Fig.2. shows the simulated VSWR characteristic for the proposed antenna. To obtain the single band notch characteristics we use pair of L-shaped slots in the corners of the radiating patch. By adding a U-shaped slot in the microstripfeedline, a dual notch function is achieved.

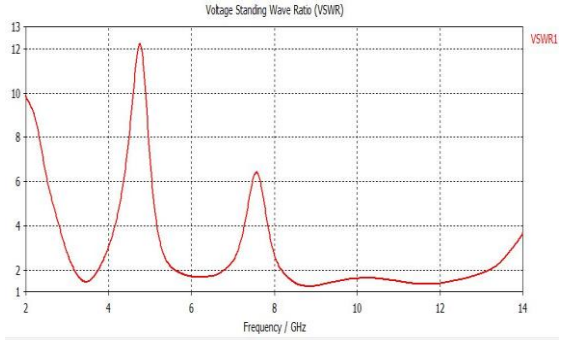

Fig.2. Simulated VSWR characteristics for the proposed antenna

To know about the dual band-notchperformance, distribution of the surface current on theradiation patch for the proposed antenna at the notch frequencies of 4.7 and 7.6 GHz is presented in Fig. 4(a) and(b), respectively. It can be observed in Fig. 4(a) and (b) thatthe most of the current are on the interior andexterior edges of the two L-shaped slot at 4.7 GHz and on theedges of the interior and exterior of the U-shaped slot at 7.6 GHz.

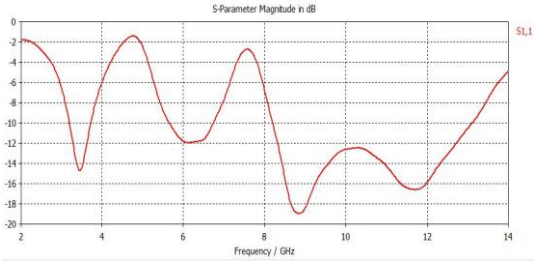

Fig.3. Simulated S11 parameter result for the proposed antenna.

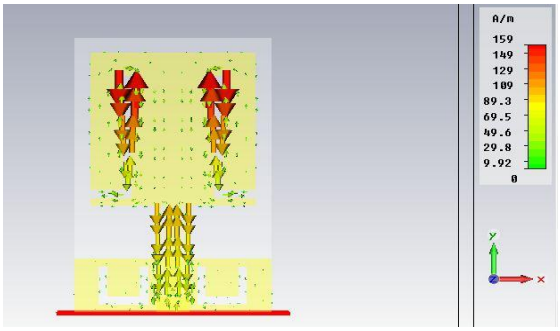

Fig.4. distribution of surface current on the radiation patch at (a) 4.7GHz

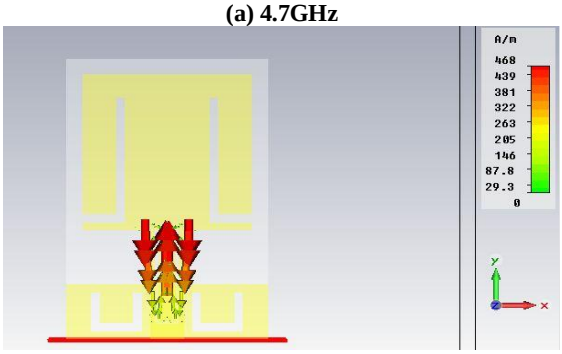

Fig.4. distribution of surface current on the radiating patchat (b) 8.8GHz

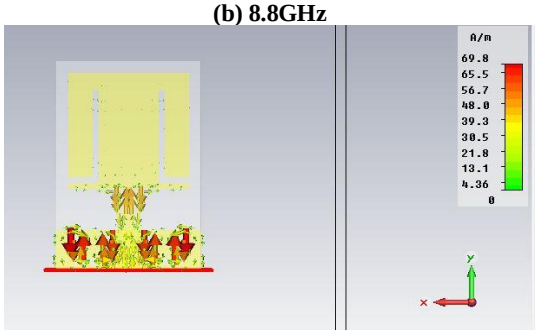

Fig.4. distribution of surface current on the ground plane for the proposed antenna shown in Fig. 1 at (c) 11.6GHz

Fig. 5 shows the effects of the L-shaped slots and U-shapedslot on the maximum gain. As shown in Fig. 5, gain of the antenna is below 2.2db and gain of the antenna increases with frequency. It can be seen from Fig.5 the gain of the proposed antenna is decreased with the use of the L-shaped slots and the U-shaped slot in the radiation patch ofthe antenna. It can be observed in Fig. 5 that by using a square radiatingpatch with a pair of L-shaped slots and an U-shaped slot,two sharpdecreases ofmaximum gainat the

Fig.5. Simulated peak gain of the proposed antenna.

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Notched frequencies band at 4.7 and 7.6 GHz are shown. For other frequenciesoutside the notched frequencies band, the antenna gain with thefilter is similar to those without it. Fig.6. shows far field pattern of presented antenna at 4.7, 8.8 and 11.6 GHz frequency.

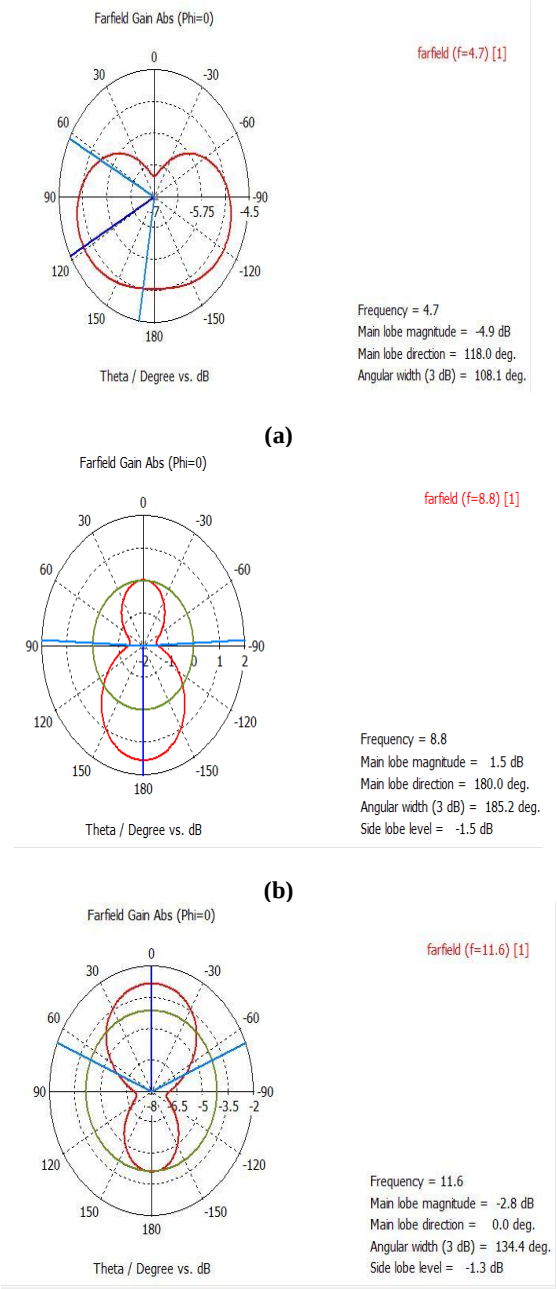

Fig.6. Farfield pattern for the presented antenna (a) at first notch 4.7 GHz (b) at second notch 8.8 GHz (c) at 11.6 GHz

IV. CONCLUSION

In this paper, a UWB antenna with dual band notched isproposed and investigated. The volume of the antenna is 12×18×1.6 mm^3. The simulated results illustrate that theproposed antenna can obtain a bandwidth 3.1-13.2 GHz andachieve dual notched bands around3.72–5.60 GHz and 6.81–8.15 GHzby inserting a L-shaped slot on the radiating patchand a U-shaped slot on micro strip feed line. By cutting two C-shaped slots in the ground plane, much wider impedance bandwidth canbe produced especially at the higher band because of additional resonances areexcited. The antenna gives good radiation pattern, return loss and VSWR. Also antenna is of small size. In future presented antenna can be fabricated and measured result can be compared to simulate result.

V. ACKNOWLEDGMENT

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