Dual Band-Notch UWB Antenna With Single Tri-Arm Resonator

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***Abstract*—A microstrip line-fed planar antenna with dual notched bands is designed and prototyped for ultrawideband (UWB) communication applications. The dual band-notch characteristic is achieved by etching a single tri-arm resonator below the patch. The simulated and experimental results show that the designed antenna has achieved a wide bandwidth (return loss ≤ -10 dB) ranging from 2.98 to 10.76 GHz with two notched bands operating at 3.5 and 5.5 GHz. The proposed antenna uses only one simple filter element to create and control dual notched bands, which give it advantages over the recently proposed band-notch antennas. In addition, the designed antenna achieved a good gain and exhibits omnidirectional radiation patterns except at notched bands, which make it a suitable candidate for UWB applications.**

***Index Terms*—Notched band, tri-arm resonator, ultrawideband (UWB), WiMAX, wireless local area network (WLAN).**

I. Introduction

An ULTRAWIDEBAND (UWB) system is a type of high-data-rate system that operates in the frequency range of 3.1–10.6 GHz. However, there are several other narrowband services that already occupy frequencies in the UWB band, such as Worldwide Interoperability for Microwave Access (WiMAX) in the 3.3–3.7-GHz band and Wireless Local Area Network (WLAN) in the 5.15–5.825-GHz band. These existing narrowband services may cause interference with the UWB systems. An approach to suppress the interfering signals is to use antennas that are capable of filtering the frequency bands that are used by these narrow bands from the UWB frequency spectrum [1].

Usually, a single parasitic element or slot can generate only one notched band and fails to meet the requirements of mitigating the multiple interferences. In order to realize a dual band-notched UWB antenna, multiple elements/slots/strips are commonly used [1]–[7]. For example, in [3], a coplanar waveguide (CPW)-fed dual band-notch antenna was proposed. To realize two dispensed bands at 3.5 and 5.5 GHz, a pair of bended dual L-shaped branches was added to the circular slotted ground plane. It was found that with an overall dimension of 40×30 mm^2, the designed antenna exhibits UWB characteristics with dual notch bands of 3.3–3.7 and 5.15–5.825 GHz. By etching two slots in the ground plane and a pair of arc-shaped parasitic strips around the radiating patch, the antenna proposed in [4] achieved two notched bands for WiMAX and WLAN frequency bands. Though the designed antenna attains an ultra-wide operating band, it possesses a large size of 39×35 mm^2. In [5], a printed UWB antenna was prototyped on a 32×28-mm^2 FR4 dielectric substrate. The dual notched bands centered at 3.5 and 5.5 GHz were achieved by putting two C-shaped slots and a U-shaped slot into the patch. In [6], to realize a notched band at 3.5 GHz, a T-shaped stub was inserted into the slot of the patch while two U-shaped parasitic strips were etched out near the microstrip feedline to create another notched band centered at 5.5 GHz. A compact UWB antenna with 3.5/5.5-GHz dual band-notched characteristic was presented in [7]. By etching two nested C-shaped slots in the radiating patch, the designed antenna achieved band-dispensed properties in the WiMAX and WLAN frequency bands. Though these antennas can exhibit high performances, they still possess some inherent drawbacks such as use of multiple filter elements, occupation of too big a space on the antenna, as well as the strong coupling between the filtering elements.

In this letter, a very simple UWB antenna with dual notched bands is designed and fabricated. To realize dual notched band, only one tri-arm filter element has been inserted below the radiating patch. It is found that by adjusting the size and position of the filter element, the realized antenna achieved UWB characteristics with dual notched band centered at 3.5 and 5.5 GHz. When compared to the antennas reported in [1] and [3]–[7], the designed antenna is smaller in size and uses only one simple filter element to realize dual notched band.

II. Design and Optimization

The configuration of the proposed antenna is displayed in Fig. 1. In the proposed design, a rectangular patch of 14.5×14.75 mm^2 is etched on one side of a double-sided FR4 printed circuit board (PCB) substrate material, while a ground plane with side length L_G is etched out on the other side. The dielectric constant and loss tangent of 1.6-mm-thick substrate material are 4.6 and 0.02, respectively. The patch is fed by a 50-Ω microstrip line, and the gap between the patch and the ground plane is 0.5 mm. The radiating element coupled strongly with the conducting partial ground plane and the designed antenna is

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