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A NOVEL COMPACT UWB NOTCH-FILTER ANTENNA WITH A DUAL-Y-SHAPED SLOT

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Abstract—A novel compact planar antenna with a frequency band-filter characteristic for UWB applications is proposed and investigated. Having a dual-Y-shaped slot on the patch, a frequency-notched characteristic at 5.2 GHz is obtained. The band-notched mechanism of the designed antenna is implemented and experimentally studied. The designed antenna satisfies the voltage standing wave ratio (VSWR) requirement of less than 2.0 in the frequency band between 2.8 and 18.6 GHz while showing the band rejection performance in the frequency band from 5.0 to 5.6 GHz. This technique is suitable for creating ultra-wideband (UWB) antenna with narrow frequencynotched characteristics.

1. INTRODUCTION

Wireless communications have evolved at an astonishing rate recently. The future development of the personal communication device will lay emphasis on the production of image, speech and data communications at any time, and anywhere around the world. Ultra-wideband (UWB) technology owing to its attractive performances, such as low complexity, low cost, and extremely high data rates, has been largely used in communication systems. In 2002, the Federal Communication Commission (FCC) put out an unlicensed 3.1–10.6 GHz frequency band with an effective isotropic radiated power level of less than 241.3 dBm/MHz for UWB applications, where UWB is defined as the occupied fraction bandwidth $> 20\%$ or larger than 500 MHz of the absolute bandwidth. Recently, many planar broadband antennas have been studied for UWB applications [1–3]. UWB antennas

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are also necessary for the rejection of an interference with existing wireless networking technologies. This is due to the fact that UWB transmitters should not cause any electromagnetic interference on nearby communication system such as wireless local area network (WLAN) applications. Therefore, several UWB antennas with band-notched performance in WLAN frequency band are studied and designed [4–14].

In this paper, a novel compact UWB planar monopole antenna with notch-filter characteristic is studied. The structure of the antenna is simple and the notch-filter characteristic at the frequency 5.2 GHz is controlled by the dual-Y-shaped slot introduced on the radiation patch. The prototype of the proposed antenna has been constructed and tested, and details of both the predicted and measured antenna performance, such as input return loss, radiation patterns, and gains, are presented and discussed.

2. ANTENNA DESIGN

Figure 1 shows the proposed antenna with a dual-Y-shaped-slotted patch having a frequency band-notched function. The total size of the antenna including the ground plane is only $28 \times 32\,\text{mm}^2$, which is printed on a substrate with a thickness of 1 mm and relative permittivity of 2.65. The radiation element is an eliptical patch with a major radius of 13.5 mm and a subsidiary radius of 9 mm. A 50-Ω microstrip line is used in this antenna design, which serves as the feeder

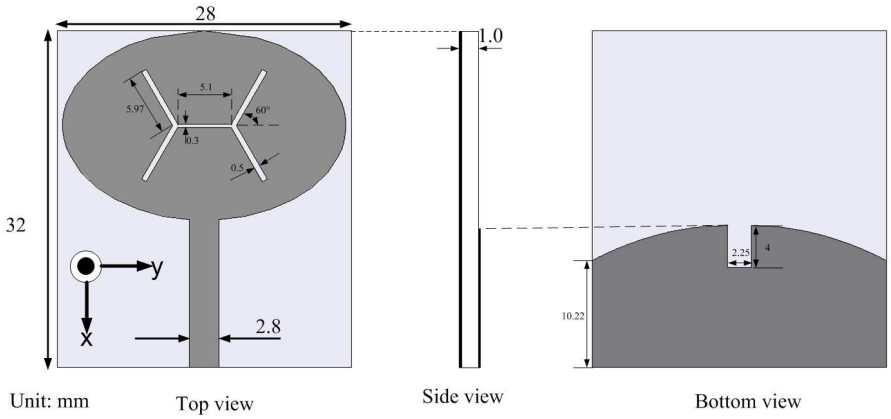
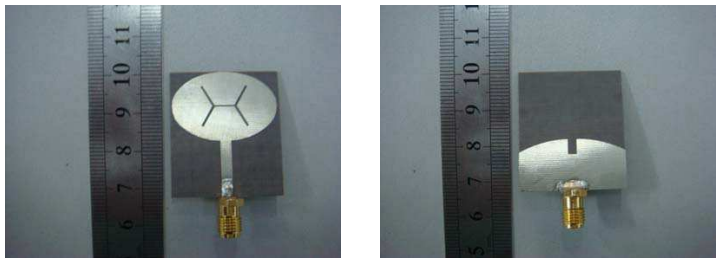


Figure 1. Geometry of the proposed UWB antenna with a dual-Y-shaped-slotted patch.



(a) (b)

Figure 2. Photograph of the proposed UWB antenna with a dual-Y-shaped-slotted patch. (a) Top view, (b) bottom view.

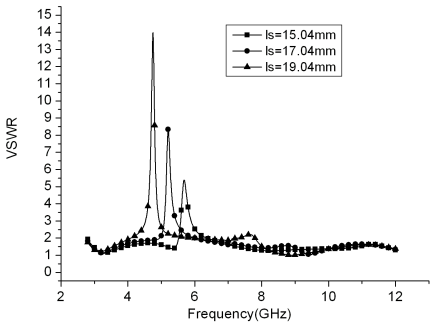


Figure 3. Simulated VSWR characteristics of the proposed antenna for various folded stripline slot lengths on the radiation patch.

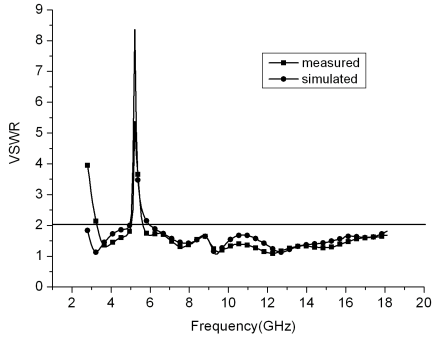


Figure 4. Simulated and measured VSWR of the proposed UWB antenna with a dual-Y-shaped-slotted patch.

with a width of 2.8 mm. A square notch with a size of 4 mm by 2.25 mm on the top of the ground provides the mechanism to enhance the impedance bandwidth of the proposed antenna. A frequency-notched response can be achieved by introducing a dual-Y-shaped slot having a length of 17.04 mm on the center of the radiation element. The length of the slots is about 0.3λ at the desired notched frequency of 5.2 GHz. Fig. 3 gives the simulated VSWR of the proposed antenna with varying the length of the folded stripline slot on the radiation patch, from the figure it can be seen that when $l_s = 17.04$ mm (l_s is the total length of the dual-Y-shaped slot), the center of the frequency notched band is at 5.2 GHz, desirably. The photograph of manufactured antenna is shown in Fig. 2.

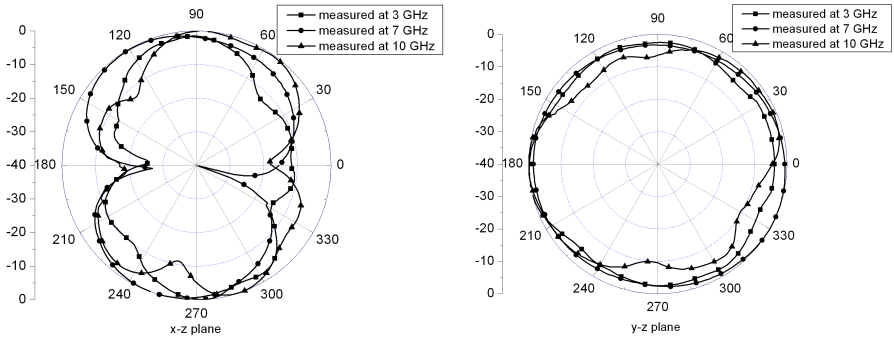


Figure 5. Radiation patterns of the proposed UWB antenna with a dual-Y-shaped-slotted patch.

3. RESULTS AND DISCUSSION

The simulated and measured VSWR obtained using HFSS v11 and WILTRON37269A vector network analyzer are presented in Fig. 4, respectively. It can be seen that the measured VSWR reasonably agrees well with the simulated results. Fig. 5 shows the measured radiation patterns of the prototype antenna at sampling frequencies of 3, 7 and 10 GHz, respectively. Nearly omnidirectional radiation patterns in the y-z plane and dipole-like radiation patterns in the x-z plane are obtained at these frequencies. Fig. 6 presents the measured peak gains of the proposed UWB monopole antenna with and without the dual-Y-shaped slot on the patch within its working frequency band. As shown in Fig. 6, gain decreases drastically at the notched frequency band of 5.2 GHz.

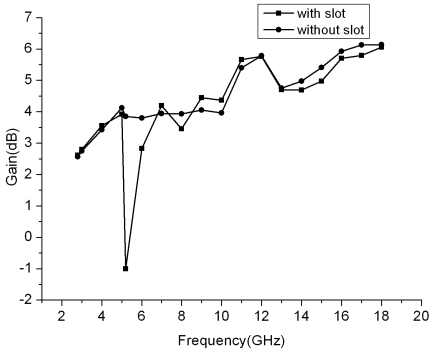


Figure 6. Measured gain of the proposed UWB antenna with and without a dual-Y-shaped-slotted patch.

4. CONCLUSION

In this paper, a novel compact UWB notch-filter antenna with a modified radiation patch has been designed and manufactured. A notch-filter characteristic at 5.2 GHz is achieved by incorporating a dual-Y-shaped slot on the patch. The proposed antenna has the frequency band from 2.8 GHz to over 18 GHz for VSWR less than 2.0 with a rejection band between 5.0 GHz and 5.6 GHz. The proposed antenna having a frequency band-notched function, and the results show good performances for the notch-filter antenna in the frequency range for UWB applications.

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