ELLIPTICALLY SHAPED ULTRA-WIDEBAND PATCH ANTENNA WITH BAND-NOTCH FEATURES

Tao Yuan,1 Cheng-Wei Qiu,1 Le-Wei Li,1 Mook Seng Leong,1 and Qun Zhang2
1 Department of Electrical Engineering, National University of Singapore, Singapore, 117576; Corresponding author: chengweiqiu@nus.edu.sg
2 Institute of Telecommunication, AFEU, China, 710077

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ABSTRACT: A series of ultra-wideband antenna using an elliptically curved patch is investigated. The band-notch feature is realized by cutting off a bended slot, which can be tuned. S11 is controllable by the length of the tunable slot. The antenna exhibits good omnidirectional performance across the operation bandwidth. © 2008 Wiley Periodicals, Inc. Microwave Opt Technol Lett 50: 736–738, 2008; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mop.23191

Key words: band notch; ultra-wideband antenna; modulation

1. INTRODUCTION

Recently, planar monopole antennas, which feature broad bandwidth and small size, have received intensive attention in ultra-wideband (UWB) application [1, 2] due to the merits of wide impedance bandwidth and omnidirectional radiation pattern. The broad operating frequency range of 3.1–10.6 GHz differentiates UWB systems from conventional systems [3]. However, due to the overlap of the currently allocated UWB frequency band with the existing wireless local area network (WLAN), special characteristics such as band notch is much desired for UWB antennas to reduce the interference between those two communication systems. In view of this, different shapes of antennas have been proposed, such as adding a U-shape or V-shape [4, 5] slot into the planar monopoles. As such, a notched band can be realized.

In contrast to previous studies, we first present, in this article, a hybrid shape is adopted for the planar monopole antenna, which has UWB operating bandwidth and band-notch feature. Unlike the triangular patch [6], the patch is rounded by elliptical curvatures with an E-shape notch. The rounded sides make the variation of the intrinsic impedance not less drastic, leading to wider impedance matching bandwidth [7]. At the center notch frequency, the

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<th>Table 1 Dimensions of antenna</th>
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Figure 1 Geometry of the proposed band-notched monopole antenna

Figure 2 Photograph of the proposed UWB antenna. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com]

Figure 3 Measured and simulated return loss of the antenna. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com]
disturbance of surface current distribution in this hybrid patch will be smaller compared with the conventional rectangular or square patch, thus causing a smaller mismatch of the antenna’s input impedance. Hence, the performance of the UWB antenna is improved. Details of the proposed antenna are described and the results of the prototype are presented.

2. ANTENNA DESIGN

The configuration of the proposed planar ultra-wideband (UWB) monopole antenna with a band-notch feature is shown in Figure 1. The antenna was fabricated on a Rogers substrate having 20 mil thickness and relative dielectric constant of 3.46. The area occupied by the antenna aperture is only \(35 \text{ mm} \times 35 \text{ mm}\). Antenna part is formed by two ellipses with a rectangle to smooth out the discontinuity of the overlap parts. On the backside of the substrate, the finite ground plane of length \(L_2\) = 12 mm is printed to cover only the microstrip feed line. By inserting a rotated E-shape slot into the planar monopoles, a notched band can be achieved. The notched frequency can be adjusted by tuning the length of E-shape slot and the notched depth can be slightly adjusted by optimizing the length of middle slot. The detail dimensions (mm) of the antenna are obtained in Table 1.

3. EXPERIMENTAL AND SIMULATED RESULTS

The antenna prototype is shown in Figure 2. The proposed monopole antenna is simulated and optimized using the commercial simulation software CST Microwave Studio simulator. Figure 3 shows return loss of the proposed antenna which a notched frequency band centered at 5.55 GHz is observed.

The measured antenna radiation patterns at 4 and 7 GHz are plotted in Figure 4. At the low frequency, E-plane radiation pattern is similar to that of the traditional monopole antenna. For the H-plane radiation patterns, it is still remain nearly omnidirectional across the operation bandwidth. Also the comparison of the measured gain in the boresight is shown in Figure 5, which is over the entire UWB frequency band. A sharp antenna-gain drop in the notched frequency band is presented.

Figure 6 shows measured signal of the antenna impulse response. From the Figure 6(b), a well-behaved pulse is demonstrated. Figure 7 shows a measured spectrum of the antenna emitted pulse sequence. It can be seen that the pulse has been shaped such that its major spectrum energy occupies the FCC UWB band (3.1–10.6 GHz). Also at the frequency band with the

![Figure 4](image-url)  
**Figure 4** Measured radiation patterns of the antenna: (a) E-plane at 4 GHz; (b) H-plane at 4 GHz; (c) E-plane at 7 GHz; (d) H-plane at 7 GHz. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com]

![Figure 5](image-url)  
**Figure 5** Measured antenna gain in boresight vs. frequency

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existing wireless local area network (WLAN), the proposed UWB antenna with band-notch characteristic is behaved.

4. CONCLUSION

In this article, a hybrid shape is adopted for the planar monopole antenna, which has UWB operating bandwidth and band-notch feature. The measured S-parameter and radiation patterns show that the antenna can be used effectively for UWB communication. By inserting a rotated E-shape slot into the planar monopoles, a notched band can be achieved. Measured waveforms and spectrum of the receive signal demonstrate that the proposed antenna is suitable for UWB applications.

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REFERENCES


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