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UWB Antenna with Dual Band Noteches

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Abstract

To prevent interference problems due to existing nearby communication systems within an ultrawideband (UWB) operating frequency, the importance of an efficient band-notched design is increased. Here the antenna consists of a square radiating patch with a pair of L-shaped slits, and an E-shaped slot and a ground plane with two I-shaped notches in both sides of the microstrip feed line ant a T shaped slot. L-shaped slits in the radiating patch generate single band-notch characteristics. Dual band-notch function is achieved by adding an E-shaped slot in the center of the radiating patch.

Introduction

ULTRAWIDEBAND (UWB) communication systems have become an attractive wireless topic since the Federal Communication Commission (FCC) first approved in 2002 the rules for the utilization of the 3.1–10.6 GHz unlicensed band for commercial UWB communication. The high demands on such communication systems have stimulated research into many UWB antenna designs. Nonetheless, antenna designs for UWB applications face many challenges including their impedance matching, radiation stability, compact size, low manufacturing cost and electromagnetic interference (EMI) problems. The EMI problems are quite serious for UWB systems since there are several other existing narrowband services which occupy frequency bands within the designated UWB bandwidth. These include world interoperability for microwave access (WiMAX) service from 3.3 to 3.6 GHz; wireless local area network (WLAN) services such as IEEE 802.11a in the USA (5.15 to 5.35 GHz, 5.725 to 5.825 GHz) and HIPERLAN/2 in Europe (5.15 to 5.35 GHz, 5.47 to 5.725 GHz). To mitigate any interference with these coexisting systems, it is necessary to introduce a UWB antenna that has intrinsic filtering properties at their service frequencies. To minimize the footprint of the antenna system, the signal processing requirements, and the cost, it is highly desirable for those filters to be intrinsically handled rather than through any additional external band-stop filter device.

ANTENNA DESIGN

The proposed antenna is shown in Fig. 1, which is printed on an FR4 substrate of thickness 1.6 mm and permittivity 4.4. The width of the microstrip feed line is 2 mm. The basic antenna structure consists of a square radiating patch, a feed line, and a ground plane. The patch is connected to a feed line, as shown in Fig. 1. On the other side of the substrate, a conducting ground plane is placed.

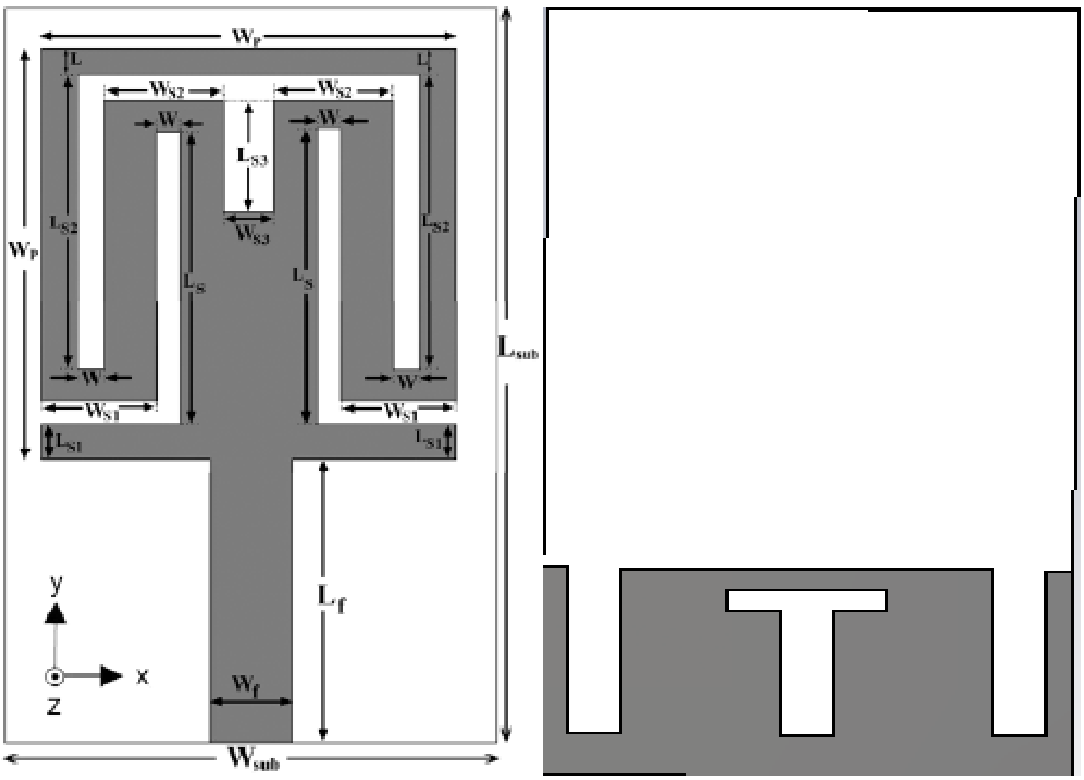

Fig.1. Configuration and parameters of the proposed antenna (unit: millimeters).

TABLE I DIMENSIONS OF THE DESIGNED ANTENNA

W_{sub}	l_{sub}	l_f	l_s	w_f	ws_1	l_{s1}	L_{s2}	w_p	w	W_{s2}	W_{s3}	L_{s3}	l
10	16	6	7	2	2	0.5	7	9	0.5	3	1	2.5	0.5

RESULT AND DISCUSSION

To fully understand the behavior of the antenna's structure and to determine the optimum parameters, the antenna was analyzed using CST Microwav Studio 2011. The optimized values of each physical dimension of the proposed antenna are shown in Fig. 1.

Fig.3. shows the simulated return loss characteristics of the Antenna. Fig.2.shows VSWR characteristics for an ordinary square patch antenna with two I slots and one T slot on the ground plane and with a pair of L-shaped slits and an E-shaped slot.

In order to generate single band-notch characteristics (5.2/5.8-GHz WLAN), we use two L-shaped slits in the corners of the radiating patch. And an E-shaped slot in the center of the radiating patch, a dual band-notch function is achieved that covers all the 5.2/5.8-GHz WLAN, 3.5/5.5-GHz WiMAX, and 4-GHz C-bands. The simulated current distribution on the radiating patch for the proposed antenna at the notch frequencies of 4 and 5.5 GHz is presented in Fig.4.

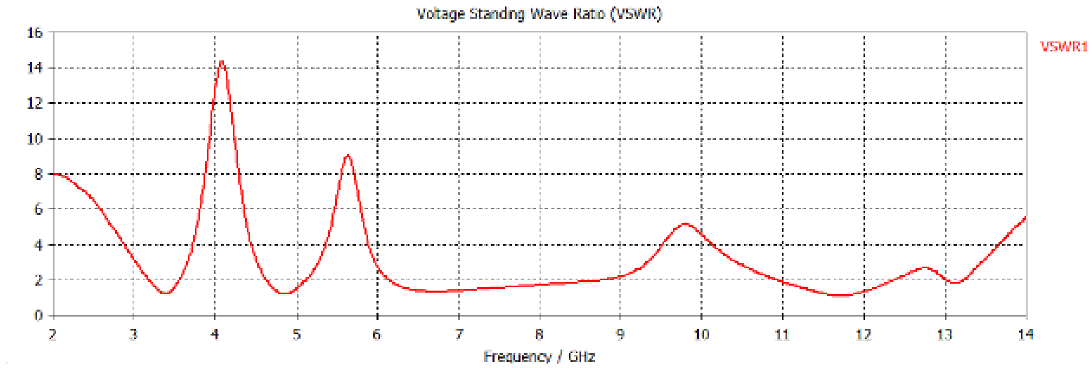

Fig.2. simulated VSWR characteristics for the proposed antenna.

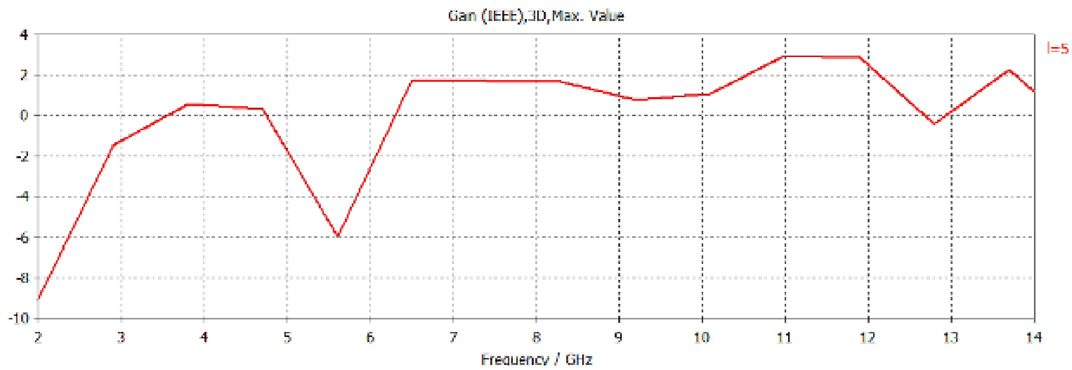

Fig.3. Measured Gain of the structure

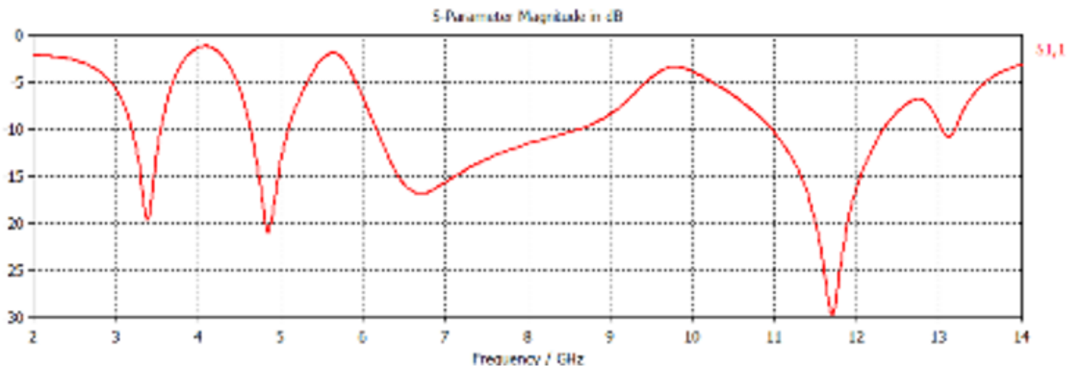

Fig.4. Measured Return loss curve of the designed antenna

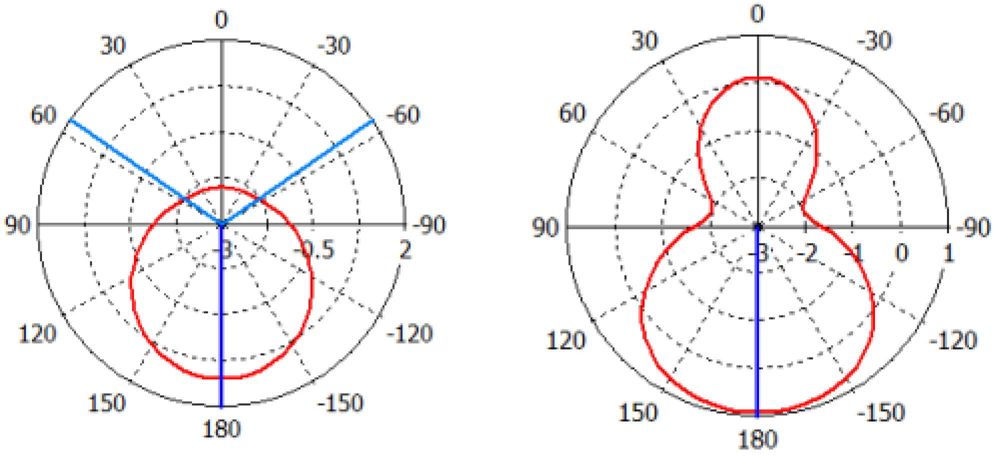

Fig.5. Radiation pattern of Designed Antenna

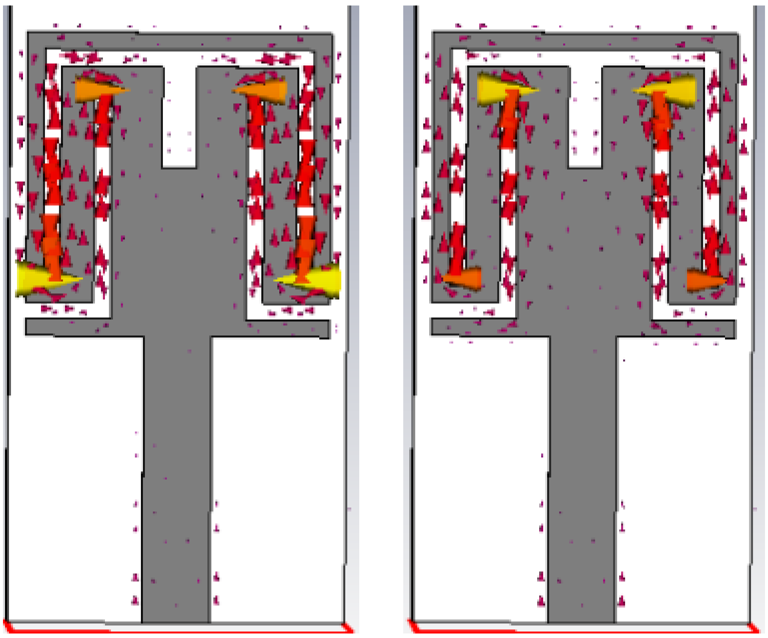

Fig.6 Simulated surface current distributions on the radiating patch for theproposed antenna shown in Fig. 1 at (a) 4 GHz (first notch frequency) and (b) 5.5 GHz (second notch frequency).

CONCLUSION

A compact printed monopole antenna with dual band notched characteristics used for UWB applications has been presented and investigated. In this design, the proposed antenna can operate from 2.89 to 17.83 GHz with two rejection bands around 3.47–4.33 and 5.11–5.94 GHz. By cutting two L-shaped slits and an E-shaped slot with variable dimensions on the radiating patch dual band-notch characteristics generated.

The designed antenna has a small size. Good return loss and radiation pattern characteristics are obtained in the frequency band of interest.

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