# Ultrawideband Antenna with Triple Band-Notched Characteristics

**Monika Kunwal, Gaurav Bharadwaj, Kiran Aseri and Sunita**

**Abstract** Nowadays, world has been moving toward augmented data rate and performance of antenna. UWB has been adapted due to its higher data rate over the large bandwidth. A compact ultrawideband antenna with triband rejection characteristics has been proposed. The three types of notches can be obtained by inserting two slots in the ground structure and one slot in the radiating patch, respectively. The proposed antenna not only shows better radiation pattern but also provides constant gain over the ultrawideband with the exception of notched frequency band. CST Microwave Studio software is used for optimizing the parameters of UWB antenna with band-notch features.

**Keywords** Band reject antenna · UWB antenna

## 1 Introduction

Owing to the progress in the field of wireless communication, UWB antenna has procuring more attention because of augmented data rate, little power emission, compact in size, low profile, omnidirectional radiation pattern, inexpensive, little power consumption, high radiation efficiency, low group delay, high security, and low cost. In 2002, the Federal Communication Commission permitted the unlicensed band that starts from 3.1 to 10.6 GHz for ultrawideband application [1]. In this frequency range, various other systems share the same bandwidth and thus they

Monika Kunwal (✉) · Gaurav Bharadwaj · Kiran Aseri · Sunita
Government Women Engineering College, Ajmer, India
e-mail: monikakunwal@gmail.com

Gaurav Bharadwaj
e-mail: gwecaexam@gmail.com

Kiran Aseri
e-mail: kiranrids18@gmail.com

Sunita
e-mail: olasunita30@gmail.com



S.C. Satapathy et al. (eds.), *Proceedings of the International Congress on Information and Communication Technology*, Advances in Intelligent Systems and Computing 438, DOI 10.1007/978-981-10-0767-5_6

create interference, so regulation is made on the UWB systems. The main center of attraction of UWB antenna is that it is not only easily fabricated on the PCB but also incorporated in the portable devices.

Several UWB antennas have been reported in the literature such as triangular, square, rectangular, circular, annular, elliptical, and hexagonal, in shape [2, 3]. Several single and multiband-notched antennas have been reported in the literature [1–6]. Various methods are available to get band-notched antenna which is used to etch the slot not only on the patch but also on the ground or on the feed [3–6].

In this paper, three band-rejecting antennas have been presented for UWB applications. C-shaped type slot is embedded in ground plane for eliminating band from 5.09 to 6.02 GHz; and for eliminating band from 2.352 to 2.67 GHz and from 3.118 to 3.76 GHz, E-shaped type slot and inverted U-shaped type slot are introduced in the radiating patch. The required band-notched frequency can be realized by altering the horizontal and vertical lengths of the desired band-notched structure.

## 2 Antenna Structure Design

Figure 1 shows the configuration of UWB antenna with band-notch feature. The radiating patch is put on the FR-4 substrate with 1.6 mm thickness, 4.4 dielectric constant, and 0.02 loss tangent. 50 Ω microstrip line is used for feeding the antenna. The gap is introduced between the ground and the radiating patch for improving the VSWR. The dimensions of antenna structure are optimized using the software called CST in order to achieve better impedance bandwidth and to get stable gain and radiation characteristics (Table 1).

## 3 Result and Discussions

The simulated VSWR is shown in Fig. 2. The simulated impedance bandwidth of the UWB antenna is 2.25–10.3 GHz, for $S_{11} \leq -10$ dB. There are three stop bands in the frequency ranges from 2.363–2.792, 3.254–3.76, and 5.047–5.99 GHz, for VSWR > 2. Therefore, these stop bands are used to avoid interference with 2.5/3.5 GHz Wi-MAX and 5.5 GHz WLAN band.

For understanding the band-notched characteristics, the distribution of surface current or H field of UWB antenna at the center of the band-notched frequency has been investigated. The simulated surface current is mainly distributed around the E-shaped slot at the 2.51 GHz. At 3.51 and 5.509 GHz, surface current is mainly concentrated at edges of inverted U-shaped type slot and C-shaped type slot (Fig. 3).

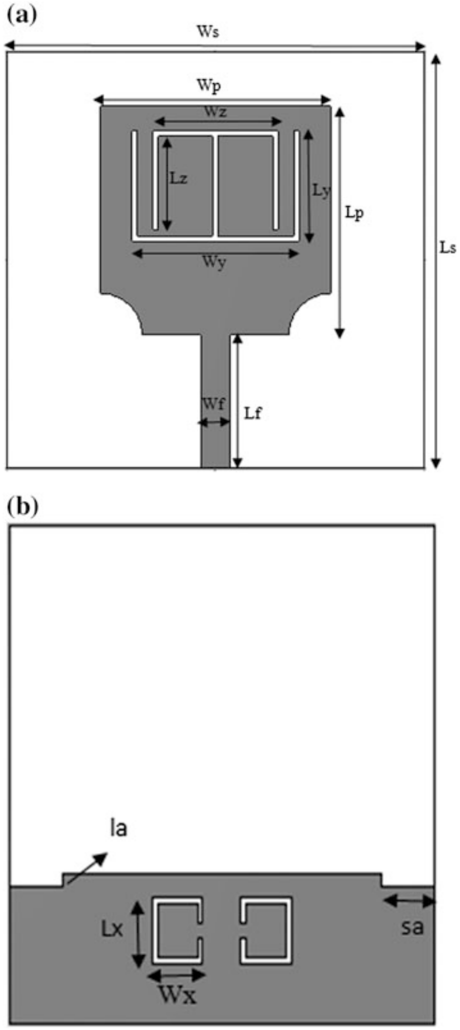


**Fig. 1** Configuration of the proposed antenna. **a** Top view. **b** Bottom view

The simulated gain and radiation efficiency of UWB antenna with triple band-notch features are shown in Figs. 4 and 5. Stable gain is obtained throughout the UWB band except at the rejection band. Almost 80 % radiation efficiency is obtained throughout UWB band except the rejected bands.

Figure 6 illustrates the *E*- and *H*-plane patterns of UWB antenna with triple band notch at 3, 5.5, and 10 GHz. At lower frequency (i.e., 3 GHz), the radiation pattern is like a dipole and at higher frequency (i.e., 10 GHz), the radiation pattern has many lobes in the *E*-plane.

**Table 1** Dimension of the antenna structure

| Parameters | Values (mm) |
|---|---|
| Ws | 40 |
| Ls | 40 |
| Wp | 22 |
| Lp | 22 |
| Wf | 2.8 |
| Lf | 12.8 |
| Wy | 16 |
| Ly | 10.6 |
| Wg | 40 |
| Lg | 12 |
| Wz | 12 |
| Lz | 9.5 |
| Wx | 4.7 |
| Lx | 5.42 |
| Hh | 5 |
| Sa | 3 |
| La | 0.5 |

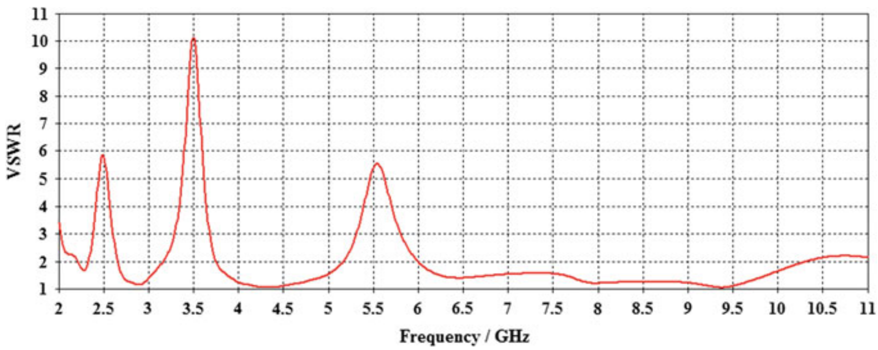


**Fig. 2** The VSWR of the proposed antenna

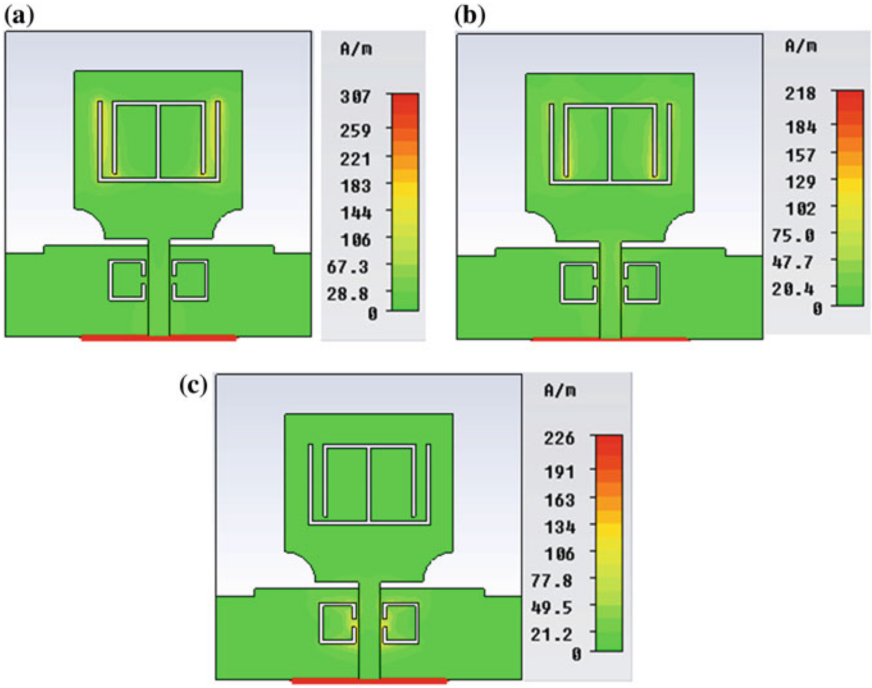


**Fig. 3** The distribution of surface current of the proposed antenna at different frequencies

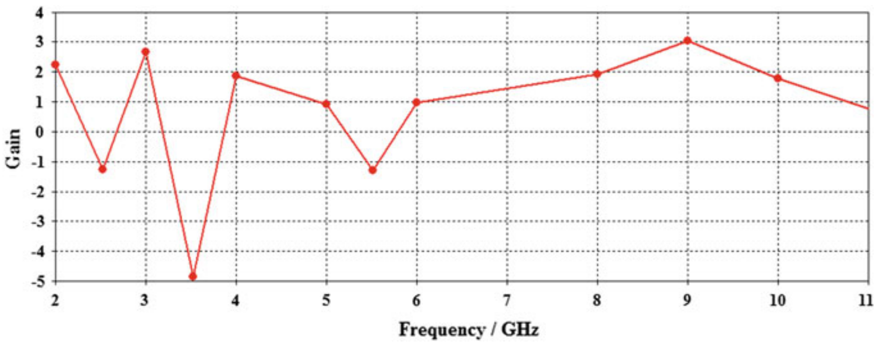


**Fig. 4** The simulated gain of the proposed antenna

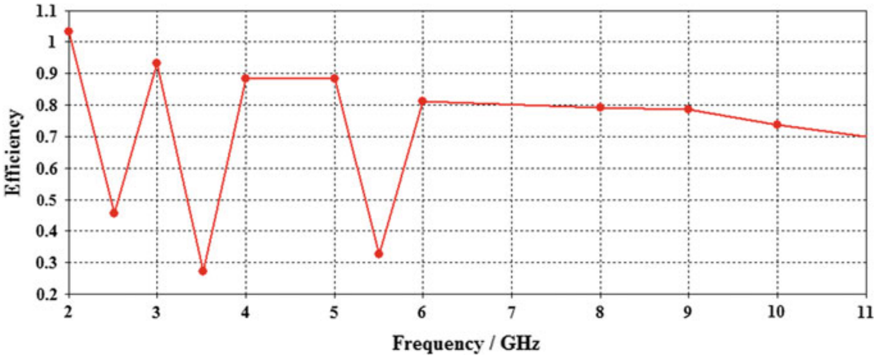


**Fig. 5** The simulated radiation efficiency of the proposed antenna

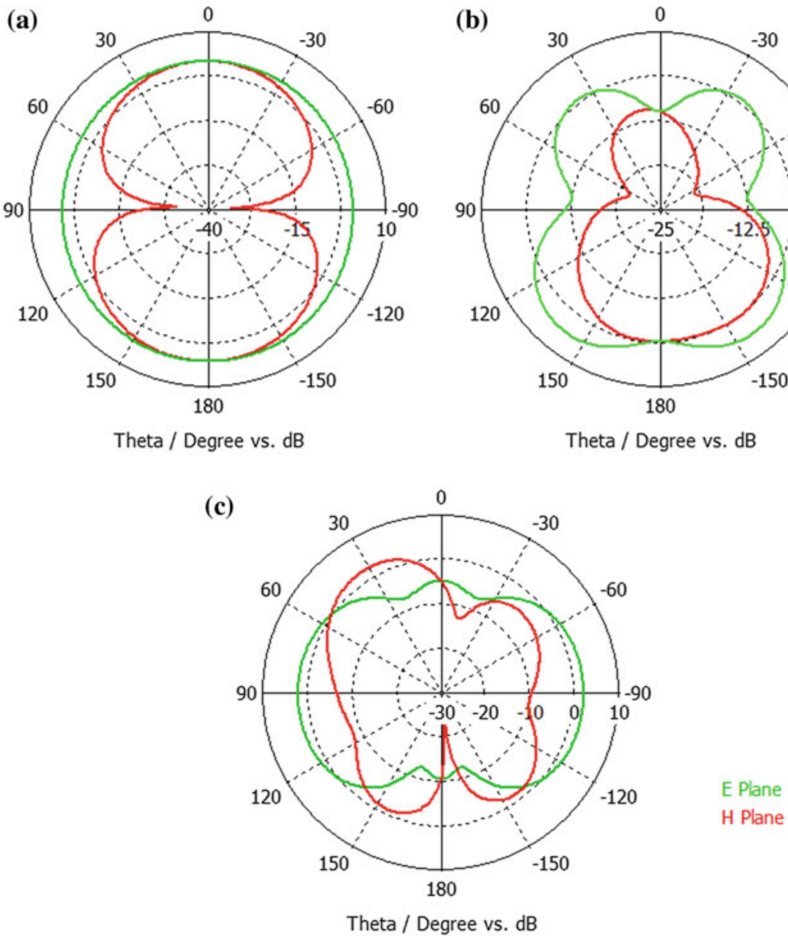


**Fig. 6** The simulated radiation pattern of proposed antenna at different frequencies

# 4 Conclusion

Benefits of this antenna are easy to assemble, low cost, and simple structure. The fundamental frameworks of the antenna such as return loss, radiation patterns, and bandwidth are acquired. All frameworks satisfy the acceptable antenna standard and the satisfactory results are observed. The three stop bands are attained by introducing the E-shaped slot and the inverted U-shaped type slot and C-shaped type slot. The UWB antenna with triple band notch is expected to be good option to incorporate with UWB systems.

# References

1. Tapan Mandal and Santanu Das: Ultrawideband-printed hexagonal monopole antennas with WLAN band rejection, Microwave and Optical Technology Letters Volume 54, Issue 6, pages 1520–1525 (2012).
2. Sanjeev K. Mishra. "Low-cost, compact printed circular monopole UWB antenna with 3.5/5.5-GHz dual band notched characteristics", Microwave and Optical Technology Letters (2012).
3. J.M. Xi and C.H. Liang: CPW-fed trapezoidal antenna with dual band-notched characteristic for UWB application, Microwave Opt Technol Lett 52, pp. 898–900 (2010).
4. K. Yin and J.P. Xu: Compact ultra-wideband antenna with dual band stop characteristic, Electron Lett 44, pp. 453–454 (2008).
5. S. Natarajamani, Santanu Kumar Behera and Sarat Kumar Patra: A triple band-notched planar monopole antenna for ultrawide band applications, Microwave and Optical Technology Letters Volume 54, Issue 2, pages 539–543 (2012).
6. J.R. Panda, and R.S. Kshetrimayum: A compact CPW-fed monopole antenna with an U-shaped slot for 5 GHz/6 GHz band-notched ultrawideband applications, Indian Antenna Week, pp. 1–4 (2010).