A NEW ULTRA-WIDEBAND ANTENNA FOR UWB APPLICATIONS

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ABSTRACT: *In this paper, we propose a new ultra-wideband (UWB) antenna for UWB applications. The proposed antenna is designed to operate from 3.2 to 12 GHz. It consists of a rectangular patch with two steps, a single slot on the patch, and a partial ground plane. Details of the proposed antenna design and measured results are presented and discussed.* Microwave Opt Technol Lett 40: 399–401, 2004; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mop.11392

Key words: *ultra-wideband antenna; partial ground plane; group delay*

1. INTRODUCTION

For many years, ultra-wide band (UWB) antennas have had many applications in communication systems with broadband and spread-spectrum features in radar systems [1]. The UWB performances of antennas result from excitation by impulse or nonsinusoidal signals with rapidly time-varying performances. Guillanton et al. [2] proposed a new balanced antipodal Vivaldi antenna for UWB applications with ultrawide bandwidth (1.3–20 GHz) with respect to 10-dB impedance. Recently, a new version of ultrawideband monocone antenna has been designed for UWB channel measurement [3], and the transient responses of a logarithmic periodic dipole and a Vivaldi antenna are presented for the characterization of a UWB antenna [4].

In this paper, we propose a new ultrawide band antenna for UWB applications. The proposed antenna consists of a rectangular patch with two steps, a single slot on the patch, and a partial ground plane. Investigations based on experiments and simulations are conducted. The simulation is performed using the commercially available simulation software CST Microwave Studio. The proposed antenna is successfully implemented and the simulated results show reasonable agreement with the measured results. In this design, a 3.2–12-GHz frequency range for VSWR < −10 dB is obtained. Radiation patterns and gains are also examined.

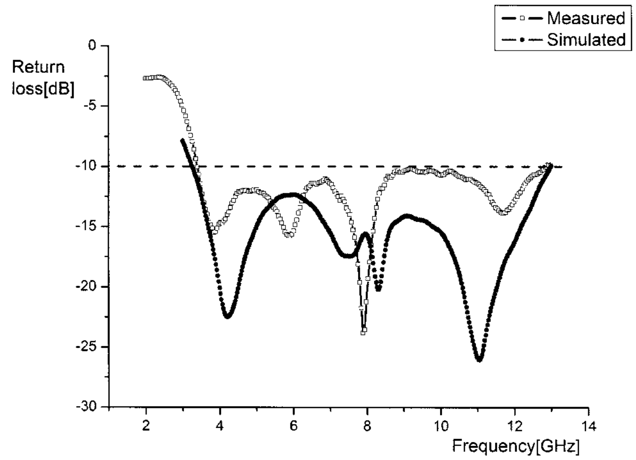


Figure 2 Measured and simulated return loss for the proposed antenna

2. ANTENNA DESIGN AND MEASURED RESULTS

Figure 1 shows the configuration of the proposed UWB antenna, which consists of a rectangular patch with two steps, a single slot on the patch, and a partial ground plane. The antenna, which has compact dimensions of 15 × 14.5 mm^2, is printed in the front of substrate FR4 of thickness 1.6 mm and relative permittivity 4.4. The dimension of the slot is 11 × 0.5 mm^2 and the dimension of the ground plane is chosen to be 30 × 11.5 mm^2 in this study. The excitation is a 50Ω microstrip line printed on the partial grounded substrate. The antenna has the following parameters: L_{sub} = 35 mm, W_{sub} = 30 mm, L_p = 14.5 mm, W_p = 15 mm, and L_g = 11.5 mm. The dimensions of step 1 and step 2 are 1 × 9 mm^2 and 1.5 × 12 mm^2, respectively. Note that the design dimensions of the proposed antenna are obtained using CST Microwave Studio. To design the UWB antenna, we have applied three techniques to the proposed antenna: the use of (i) two steps, (ii) a partial ground plane, and (iii) a single slot on the patch, which can lead to a good impedance matching. By selecting these parameters, the proposed

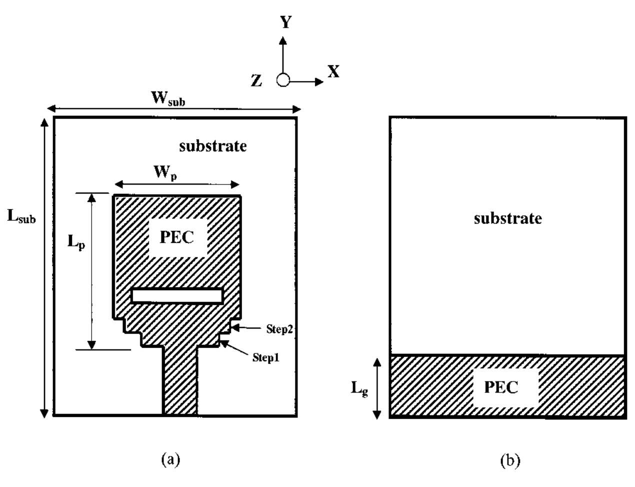


Figure 1 Geometry of the proposed UWB antenna: (a) front view (b) back view

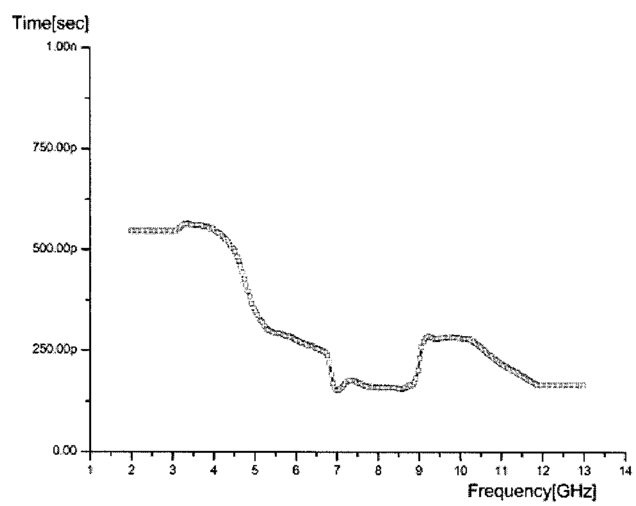


Figure 3 Measured group delay

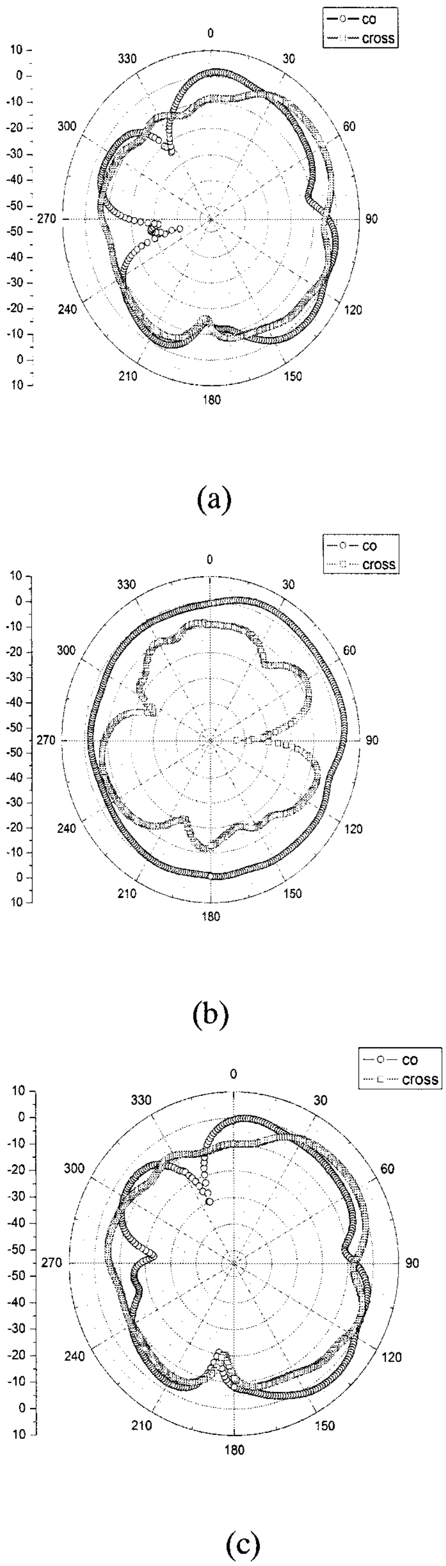


Figure 4 Measured radiation patterns at 3 GHz: (a) *XY* plane; (b) *XZ* plane; (c) *YZ* plane

antenna can be tuned to operate in the 3.2–12-GHz frequency range.

The proposed antenna was constructed and studied. Using an Anritsu Vector Network Analyzer (37397C), the measured return loss of the proposed antenna is obtained at 2–12 GHz, as depicted in Figure 2. Figure 2 also shows the simulated results from Microwave Studio for comparison. The measured return loss S_{11} reasonably agrees with the simulated results. A 3.2–12-GHz frequency range below −10 dB of VSWR is obtained. Group delay is an important parameter in UWB antenna design, which represents the degree of distortion of pulse signal. Figure 3 shows the

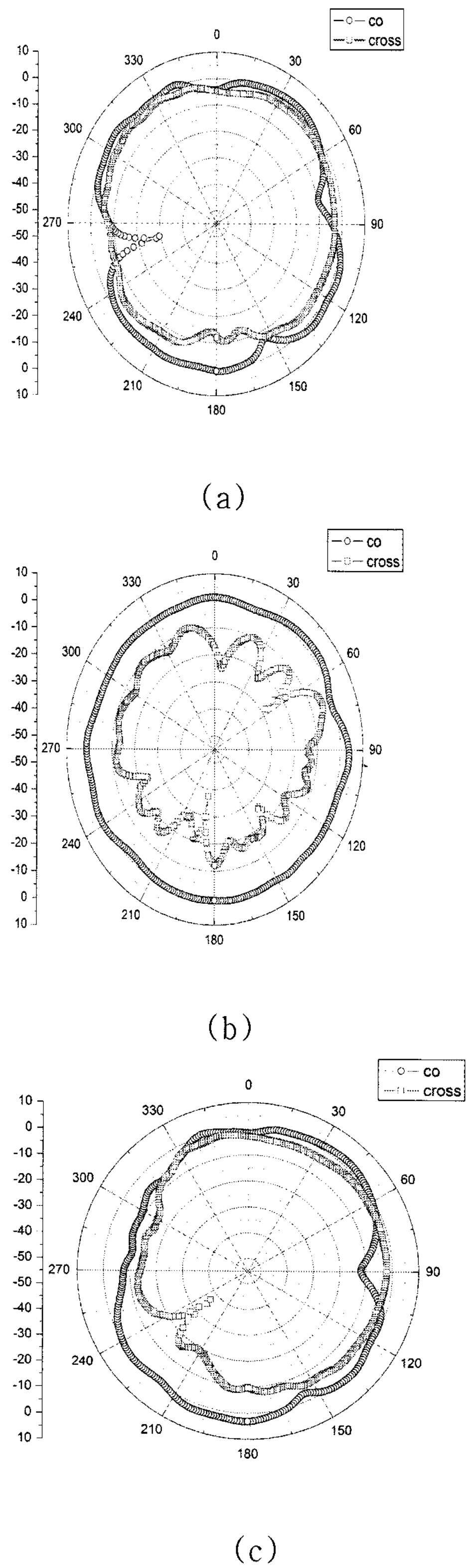
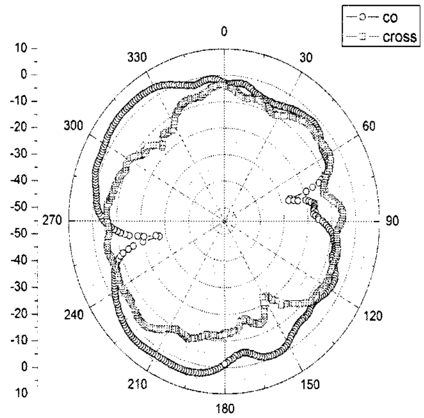


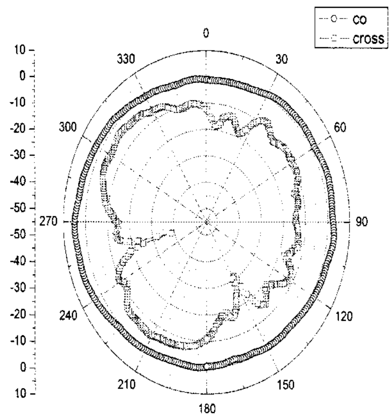
Figure 5 Measured radiation patterns at 5 GHz: (a) *XY* plane; (b) *XZ* plane; (c) *YZ* plane

measured group delay. From the figure, it can be seen that the group delay variation is less than 0.5 ns.

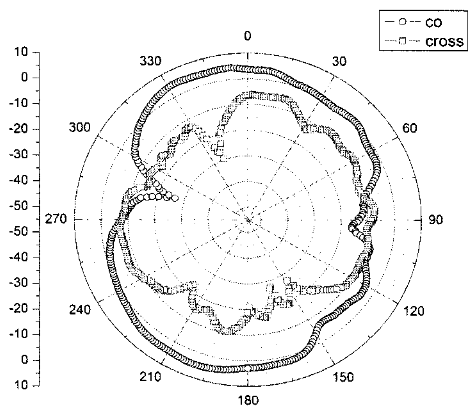
Figures 4–6 plot the measured radiation patterns at 3, 5, and 7 GHz for the proposed antenna. The measured radiation patterns are



(a)



(b)



(c)

Figure 6 Measured radiation patterns at 7 GHz: (a) *XY* plane; (b) *XZ* plane; (c) *YZ* plane

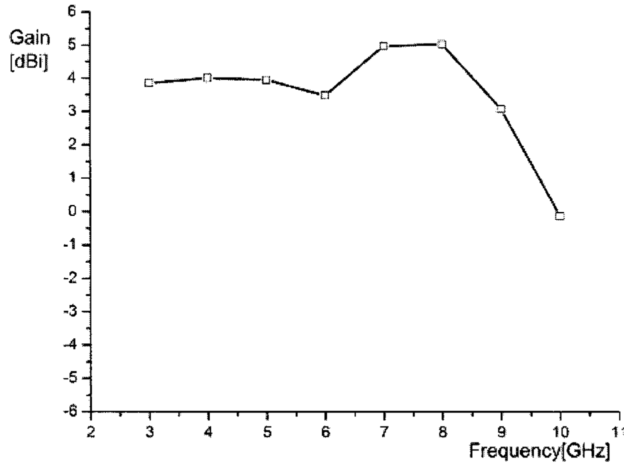


Figure 7 Measured antenna gain in the 3–10-GHz frequency range

similar and the radiation patterns are stable across the operating frequency. Figure 7 shows the measured antenna gain in a frequency range (3–10 GHz) and the gain variations are less than about 5 dBi.

3. CONCLUSION

A new ultra-wideband antenna has been proposed for UWB applications. The simulated results conducted by the CST Microwave Studio Simulator show reasonable agreement with the measured results. The frequency range obtained for VSWR < -10 dB is 3.2–12 GHz. The group delay was measured and its variation is less than 0.5 ns. The measured radiation patterns at 3, 5, and 7 GHz and antenna gain in the 3–10-GHz frequency range were also presented.

ACKNOWLEDGMENT

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Return to Homepage