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COMPACT MICROSTRIP-FED ANTENNA FOR ULTRA-WIDEBAND APPLICATIONS

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Abstract—A novel printed monopole antenna for ultra-wideband (UWB) applications is presented, which is composed of wide slot and Y-shaped microstrip feed line with a pair of inverted-L-shaped notches. The prototype with an overall size of 26 mm × 30 mm × 2 mm achieves good impedance matching, constant gain, stable radiation patterns, and a relative impedance bandwidth of 110.6% is achieved, which covers 3.09–10.74 GHz.

1. INTRODUCTION

In the past few years ultrawideband (UWB) technology has received increasing attention in the wireless world [1–15]. United States Federal Communication Commission approved the commercial use of UWB in February 2002 and the defined frequency band from 3.1 to 10.6 GHz, including, return loss less than −10 dB, omnidirectional radiation patterns, minimum distortions in the received waveforms, etc. One attractive kind of UWB antenna is the planar wide slot antenna [16, 17], and many works concerning this kind of antenna can be found. In [18], the impedance bandwidth of the antenna is enhanced by changing the corner of the wide rectangular slot from right angle to round. Reference [19] introduced a CPW-fed tapered-ring slot antenna which can achieve a relative bandwidth more than 120%. However, most existing antennas require large ground planes, e.g., the size of the antennas in [18, 19] are 110 × 110, 66.1 × 44 mm, respectively. A novel miniaturised printed antenna for ultra-wideband applications is introduced in this Letter. The dimensions of the antenna can be minimised to 26 × 30 mm. Measurement results show that the proposed

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antenna can achieve a broad impedance bandwidth of 3.09–10.74 GHz, which covers the released frequency band for UWB.

2. ANTENNA STRUCTURE

The configuration of the proposed UWB antenna is shown in Fig. 1, where a Duroid substrate with relative permittivity of 2.2 and thickness of 2 mm is used. It is composed of wide slot and Y-shaped microstrip feed line with a pair of inverted-L-shaped notches. The slot is surrounded by narrow ground strips, which makes the antenna compact. Two tapers are added at the corners of the upper folded ground strips to bevel the slot for enhancing impedance matching, especially at lower frequencies. Notches on the bottom of the feed line also provide the mechanism to enhance the impedance bandwidth of the proposed antenna. The antenna is fed by a 50-Ω microstrip line with a Y-shaped feeding structure which is printed on the bottom side of the substrate. The specified impedance matching and radiation characteristics can be achieved by selecting the dimensions of the slot, the ground plane, and the feeding line properly.

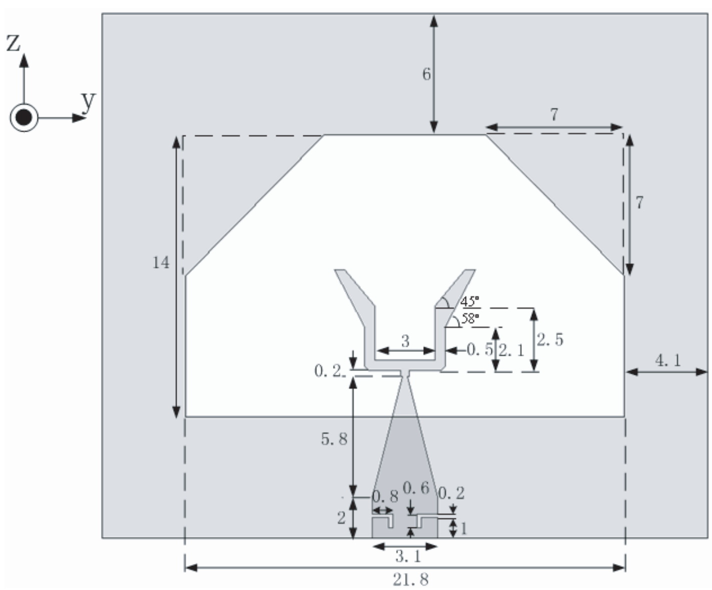


Figure 1. The configuration of the proposed antenna with dimensions in mm.

Figure 2. Photograph of fabricated antenna prototype.

3. EXPERIMENTAL RESULTS

A prototype of the proposed UWB monopole antenna with the optimal geometrical parameters was fabricated as shown in Fig. 2. The simulated and measured VSWR obtained using HFSS11 and WILTRON37269A vector network analyzer are presented in Fig. 3. The measured bandwidth defined by VSWR $<$ 2 of the proposed antenna is from 3.09 to 10.74 GHz, which covers the entire UWB band. The far-field radiation patterns for the proposed antenna were also carried out at three frequencies. Figs. 4(a) and (b) show the radiation pattern at 3.1, 7 and 9 GHz, respectively. As can be seen

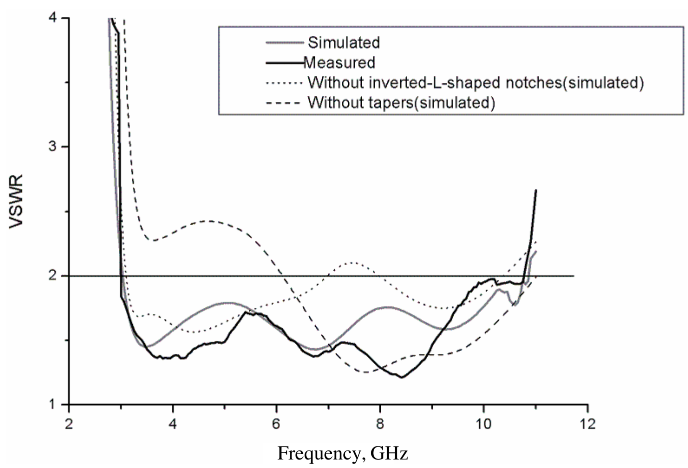
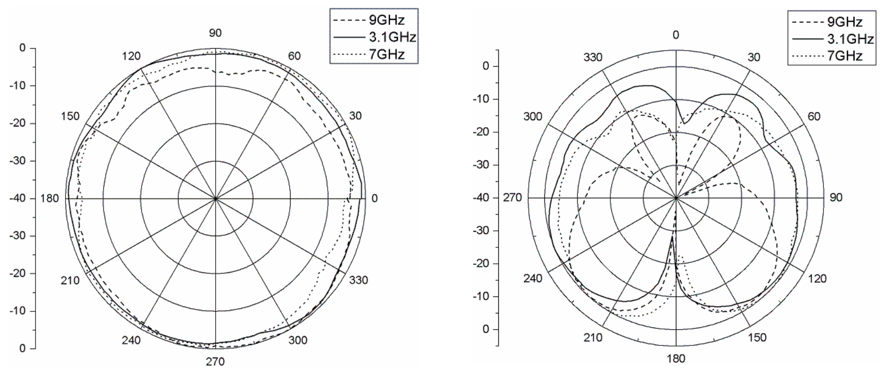


Figure 3. Measured and simulated VSWR of the proposed antenna.



(a) E_φ in x-y plane (b) E_θ in y-z plane

Figure 4. Measured radiation pattern at 3.1, 7 and 9 GHz.

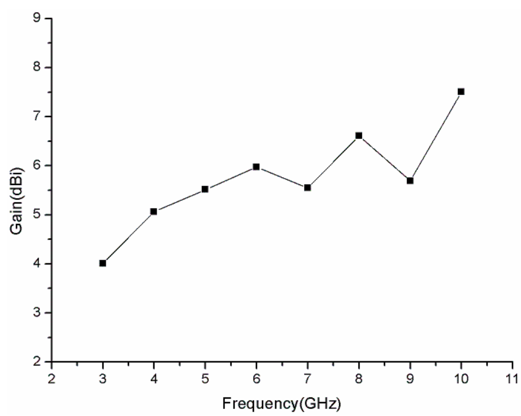


Figure 5. Simulated peak antenna gain against frequency for the proposed antenna.

from the figures, omnidirectional patterns can be observed for the H-plane. These patterns are comparable to those reported for a conventional dipole antenna. It is important to note that at the higher frequency there is an obvious deviation from the omnidirectional shape in the H-plane radiation patterns, this may be caused by the different effect of the feeding connector on the current distribution at different frequencies.

Owing to the restriction of equipment, the highest frequency of our radiation pattern measurement system is limited to 9 GHz. The simulated gain of the antenna at different frequencies is given in Fig. 5.

4. CONCLUSION

A novel small-size configuration of CPW-fed antenna that gives larger bandwidth has been investigated. The measured bandwidth of the proposed antenna is from 3.09 to 10.74 GHz (110.6%) for VSWR < 2, which covers the commercial UWB band approved by the FCC. This antenna has relative good matching, also an omnidirectional radiation pattern in the H-plane. All these good performances make it a good candidate for UWB applications.

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