A CPW-Fed Slot Antenna with Dual Band and Dual Circular Polarization

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Abstract - **A novel inverted-annular shaped antenna with a dual band and dual circular polarization is investigated in this letter. The inverted-annular structure is designed to achieve dual-band CP characteristic. The simulated results show that circular polarization are obtained at 2.10GHz with LHCP and 2.90GHz with RHCP, in which the axial radio bandwidths are 100MHz (2.05GHz-2.15GHz) and 200MHz (2.82GHz-3.02GHz). Furthermore, the proposed antenna also possesses the advantages of low profile, small volume and easy feed structure.**

Index Terms **—Slot Antenna, CPW-Fed, Dual-band, Dual-CP.**

1. Introduction

Wireless communication has been developing by leaps and bounds. With the advantages of enhancing the channel capacity and frequency reuse, antennas with dual polarization have already been a researching hotspot, especially in the multiple-input-multiple-output systems application [1-2]. CP antennas have become very promising in deploying a transmitter and a receiver without causing a polarization mismatch between them [3-6]. Based on the above options, the study of dual band and dual CP antennas has a very high value of theory and practical.

In this letter, a CPW-fed slot antenna with dual band and dual circular polarization is proposed. The dual band and dual CP characteristic are achieved owing to the two inverted-annular branches. They excite two orthogonal modes for the dual-band CP characteristic. In [3-4], antennas of similar structure have been designed. These antennas exhibit good CP with dual-band, but they are difficult to design due to the complicated feeding structure. The antenna in this letter is fed by CPW. No extra network is needed. The characteristics of the proposed antenna have been simulated by HFSS. The bandwidth, axial radio, radiation patterns influenced by the inverted-annular structure have been analyzed below in detail.

2. Design considerations:

Fig.1 shows the geometry of the proposed antenna. The antenna is fabricated on a FR4 substrate of thichness 1.0mm, permittivity 4.4 and loss tangent 0.002. The upper surface of the substrate consists of CPW-fed structure, rectangle slot and inverted-annular radiating structure. The dimensions of the proposed antenna are listed below.

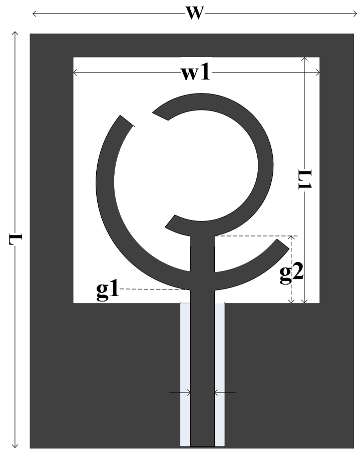

Fig.1 Geometry of the proposed antenna

TABLE I
Optimal dimensions of the proposed antenna

parameter	mm	parameter	mm	parameter	mm
L	45	W	36	g_1	0.3
L_1	24	W_1	29	g_2	5.0

The antenna basic parameters such as slot length, slot width and feed line width have much influence on impedance matching and resonating frequency. After ascertaining these basic parameters in our design, the width and radian of the inverted-annular structure are analyzed which can be used to tune the axial ratio of the antenna. By changing the length and the width of the arms of the asymmetrical inverted-annular structure, same magnitude and 90º phase differences of the two modes can be achieved at the given frequency. Finally, 2mm wide arc with 160 degree on the left and 280 degree on the right is determined. The bandwidth has also slight changes with variations of the inverted-annular structure. But they have no much influence on resonating frequency. The results and analysis are shown below.

3. Results and analysis

The simulated S-parameter of the proposed antenna is shown in Fig.2. The -10 dB impendence bandwidths are 1.1GHz (2.0GHz-3.1GHz). The results show that the impendence band is very wide. Fig.3. shows the simulated axial radio value of the proposed antenna at 2.10GHz and 2.90GHz. The axial radio bandwidth is 100MHz in the lower band and 190MHz in the upper band. The simulated E-plane and H-plane patterns in both bands are shown in Fig.4 and Fig.5. As it is shown, at 2.1GHz, LHCP is obtained in the upper space. The cross polarization is about 20dB below the co polarization in E-plane and 18dB in H-plane. At 2.9GHz, RHCP is obtained in the upper space. The cross polarization is about 19dB below the co polarization in E-plane and 18dB in H-plane. If the inverted-annular structure is designed in the opposite direction, reverse polarization characteristics can be achieved as respected.

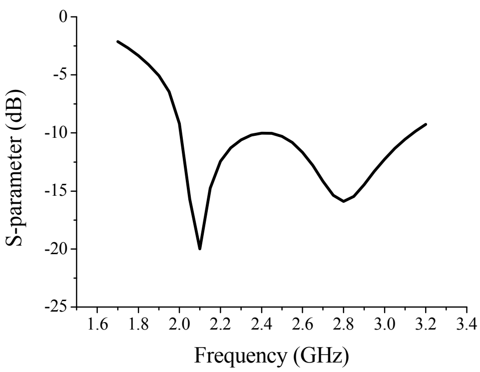

Fig. 2. Reflection coefficients of the proposed antenna

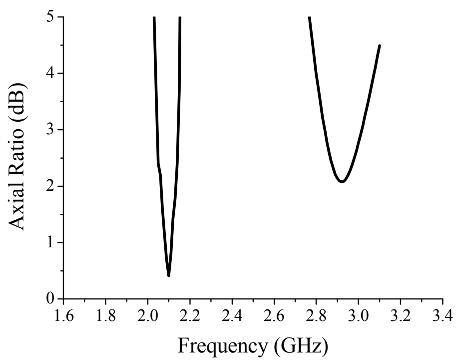

Fig. 3. Axial radio value of the proposed antenna

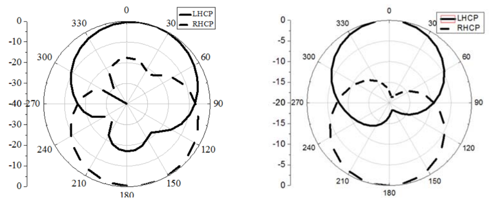

Fig. 4. Radiation patterns of the proposed antenna at 2.1GHZ: (a) E-plane; (b) H-plane

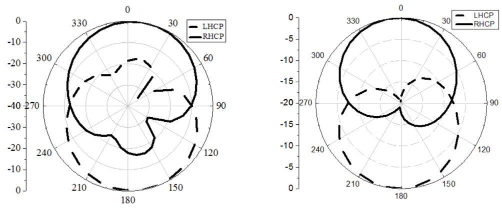

Fig. 5. Radiation patterns of the proposed antenna at 2.9GHZ: (a) E-plane; (b) H-plane

4. Conclusion

In this letter, a novel inverted-annular monopole antenna with dual band and dual circular polarization is proposed. The inverted-annular structure is designed to obtain dual band CP characteristic. CPW is used to feed the antenna without any extra feed network so that the antenna can be used as a basic element to construct a complicated antenna array. Therefore, the proposed antenna can be beneficial for various communication systems that require dual band and polarization diversity characteristic.

References

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