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Dual Band Dielectric Resonator Antenna with a Ring Slot

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Abstract

A dualband dielectric resonator antenna that has a ring slot is investigated in this paper. The simulated 10-dB impedance bandwidths for the lower and upper bands are 9.37%(4.58-5.03GHz) and 9.02%(5.61-6.14GHz), respectively. The reflection coefficient, radiation pattern, and antenna realized gain of the dualband dielectric resonator antenna were simulated using Ansoft HFSS.

Keywords

Dualband, dielectric resonator antenna, ring slot.

1. Introduction

The dielectric resonator antenna has received extensive attention due to a number of advantages such as its small size, lowloss, light weight, high radiation efficiency, and ease of excitation [1, 2]. Many efforts have been devoted to developing multiband or wideband dielectric resonator antennas [3, 4]. In [5], a dualband dual-slot circular polarization antenna with a dielectric cover is investigated. It consists of a zonal slot antenna and an annular slot antenna, which are located on the sidewall and top face of the cavity, respectively. A dualband operation can also be obtained by simultaneously exciting the first (fundamental) and second resonant modes of the slot [6]. However, in this method, the higher resonance frequency cannot be determined at will because it is about twice the fundamental resonance frequency. In [7], a composite aperture has been conceived to excite cylindrical dielectric

resonator antenna simultaneously with two different modes, resulting in broadside radiations at two adjacent bands. However, the models of the above papers are a bit more complicated. In this paper, a dual-band dielectric resonator antenna is presented, which has a simple structure.

2. Antenna Configuration

Figure 1 shows the configuration of the proposed dualband dielectric resonator antenna. The DRA of the top layer of the proposed antenna has a diameter of d_3 = 40 mm and a height of h_2 = 12 mm. The ring slot has a height of h_3 = 8 mm and a gap distance of d_2 = 4.5 mm. The small central DRA has dimensions of d_1 = 7 mm and h_3 = 8 mm. All DRAs have a dielectric constant of ε_r = 3.2. The square copper ground plane has a dimension of g=52mm, with a thickness of 0.3mm. The s_x = 22 mm and s_y = 2 mm dimensions of the coupling slot in the ground plane. The substrate below the ground plane, fabricated from FR4 with a dielectric constant of ε_r = 4.4, has a dimension of g = 52 mm. The bottom feed line is made of copper with the dimensions f_x = 2.5 mm, f_y = 36mm and a thickness of 0.5 mm.

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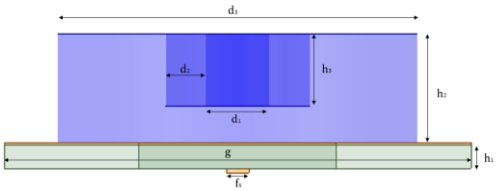
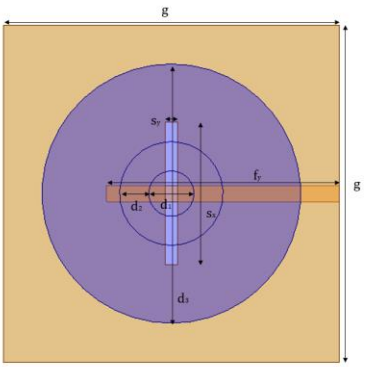


(a)



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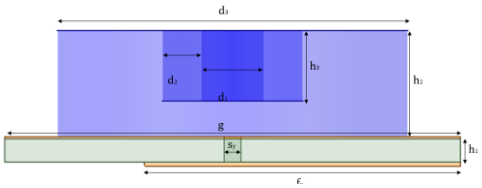
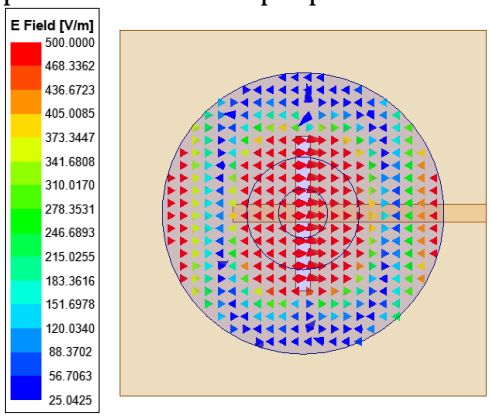


(c)

Figure 1: Configuration of the proposed antenna. (a) Front view. (b) Top view. (c) Side view.

3. Simulated Results

The simulated result using HFSS is shown in Figure 2, Figure 3, Figure 4 and Figure5. In Figure 2, it is shown that the excitation mode of the HEM_{111}. Figure 3 shows two resonant frequencies of 4.8 GHz and 6.05 GHz for the given configuration dimensions. The simulated 10 dB impedance bandwidths for the lower and upper bands are 9.37%(4.58-5.03GHz) and 9.02%(5.61-6.14GHz), respectively. In the bandwidth from 4.58 to 5.03 GHz, the maximum realized gain is 5.36 dBi, and in the bandwidth from 5.61 to 6.14 GHz, the maximum realized gain is 5.6 dBi, as shown in Figure 4. As shown in Figure 5, the radiation patterns of x-z plane and y-z plane at 5.5 GHz. The cross-polarization in z-axis direction is even less than -20 dB, which shows the good cross-polarization of the proposed antenna.



(a)

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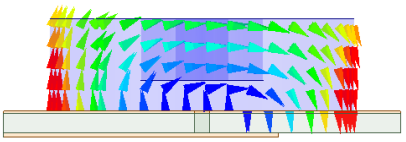


(b)

Figure 2: The internal electric field distribution of the proposed DRA structure. (a) X-y plane. (b) Y-z plane.

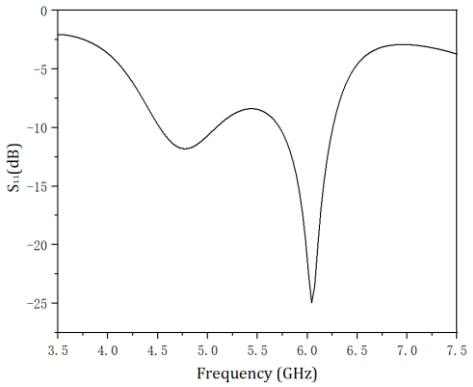


Figure 3: Simulated S-parameters of the presented DRA.

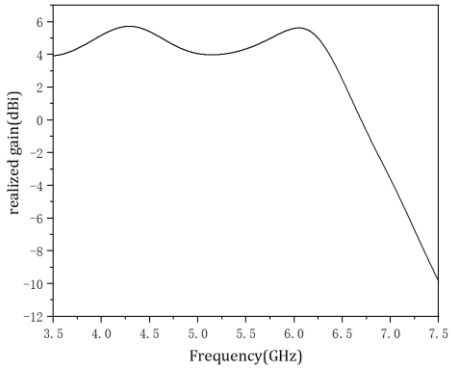
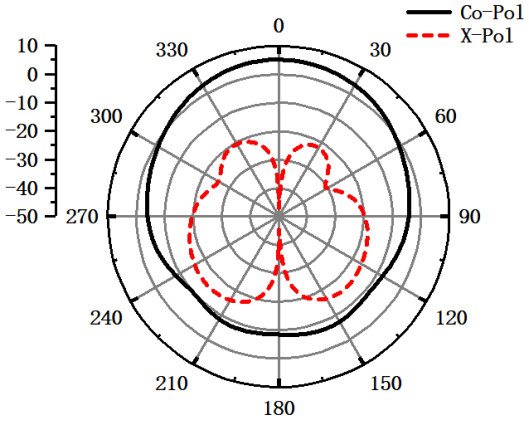


Figure 4: Simulated realized gain of the presented DRA.



(a)

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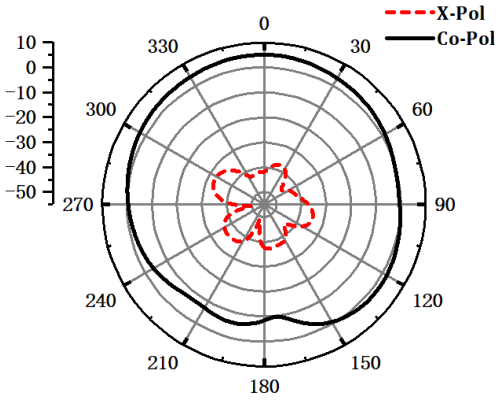

(b)

Figure 5: Simulated and measured radiation patterns at 5.5 GHz (a) X-z plane. (b) Y-z plane.

4. Conclusion

In this paper, a dual-band ring-slot dielectric resonator antenna has been investigated. The reflection coefficient, radiation pattern and realized gain of the proposed configuration were simulated using Ansoft HFSS. The simulated antenna has impedance bandwidths of 9.37%(4.58-5.03GHz) and 9.02%(5.61-6.14GHz) in the lower and upper bands, respectively.

Acknowledgements

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