3.5 GHz Rectangular Dielectric Resonator Antenna

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***Abstract* -** In this paper, dielectric resonator antenna operated at 3.5 GHz was design and simulated using CST Microwave Studio and subsequently fabricated. Direct microstrip line of 50 Ω was used as the feeder. In this design, rectangular shape was used as the dielectric resonator as it offers more option to control the resonant frequency. The position of rectangular DR was varied to determine the best coupling and the distance was found to be 6 mm. The simulated results of the return loss, resonant frequency together with radiation pattern were compared with the measured results. It was found that rectangular DRA has potential to be used in wireless system.

Keywords: Antenna, Dielectric resonator antenna

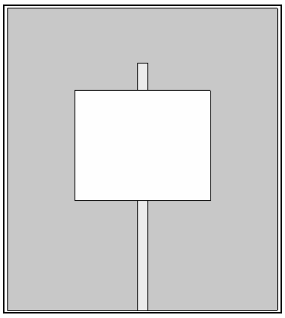
1. Introduction

In wireless communication, antenna plays crucial part in transmitting and receiving the signal. However, in order to fulfill the requirement for the latest wireless communication technologies, flexibility of a particular antenna playing an important role to adapt with any existing technologies. Instead of using many antenna designs with different structure, a single antenna can be fabricated with adjusting some of its parameter to achieve any design goal. Dielectric resonator antenna (DRA) can realize this problem as it has many appealing features which make it as one of the alternative antenna technology in wireless communications [1-2]. Its offer very wide design flexibility including wide range of permittivity from about 8 to 100, and can be excited with different feeder as well as can be formed into different shape of dielectric resonator (DR) [3-4]. Previous work focusing on cylindrical-shape DRA [5]. As compared to the other shape of DR, rectangular shape is easy to fabricate and has two aspect ratios (width/length and height/length) of the resonators which provide extra control of DRA properties in design process [6-7].

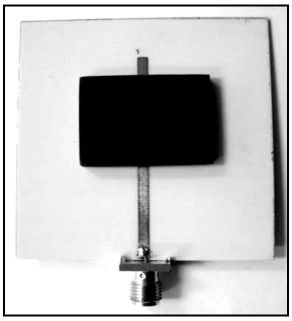
In this paper, the rectangular-shape DRA of permittivity, ε_r = 55 was fabricated to operate at 3.5 GHz. In the simulation part, CST Microwave Studio was used. The measured return loss was done by using Hewlett Packard 8753E Network Analyzer.

2. Antenna Design

The structure of the antenna is shown in Figure 1. The DRA was fed with direct 50 Ω microstrip line which wide and length were 1.9mm and 45mm, respectively. This microstrip line was photo-etched on substrate of permittivity, 3.38. The height of the substrate was 0.813 mm while the width and length were 50 mm and 55 mm, respectively. The dimension of the rectangular DR was 25mm (length) and 20mm (width) with high was 3mm. In this design, the distance between rectangular DRA and open end of the microstrip line was 6mm as the position where the finest coupling was obtained.



(a)



(b)

Figure 1: Rectangular DRA; (a) Simulated structure, (b) Fabricated structure.

3. Result and Discussions

Simulated and measured return loss is given in the Figure 2. Simulated return loss is -35.16 dB at frequency of 3.553 GHz while measured return loss is -33.21 dB at frequency of 3.54 GHz. The lowest the return loss, the minimum is the loss and the DRA can accept maximum power from the source. Both of the return loss values are lower than -30 dB which indicate good matching. Besides, it also can be noted that the curves which represent measured and simulated return loss result are in good agreement.

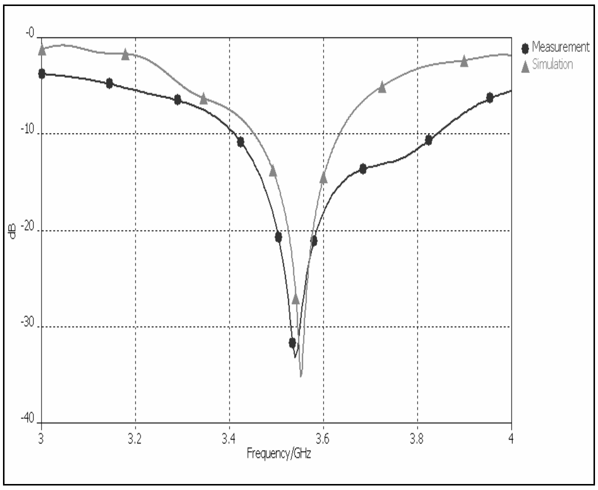


Figure 2: Measured and simulated Return loss (S_{11}).

Figure 3 and Figure 4 represent radiation pattern for both the E-plane and H-plane, respectively. The former one indicates that simulated pattern has high back lobe level with dip at 90˚ and 270˚. Even though measured pattern is not exactly coincidence with the simulated pattern, it also has high back lobe level. The dissimilarity was due to the position of DRA which was not aligned with the transmitting antenna. Hence, measured E-plane has pattern which is slightly move to the left of the plane.

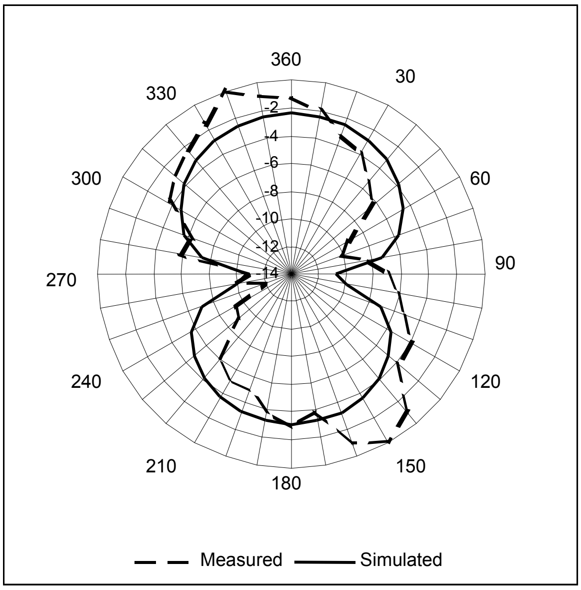


Figure 3: Measured and simulated radiation pattern at 3.5 GHz for E-plane (x-y plane).

Simulated and measured H-plane is given in the Figure 4. The upper part of the H-plane pattern gives indication that radiation happen in broadside direction. Besides, it can be clearly observed that there is no radiation below the ground plane for the simulated pattern. On the contrary, radiation occurs beneath the ground plane for the measured H-plane. This is probably due to the reflection signal from the surrounding objects.

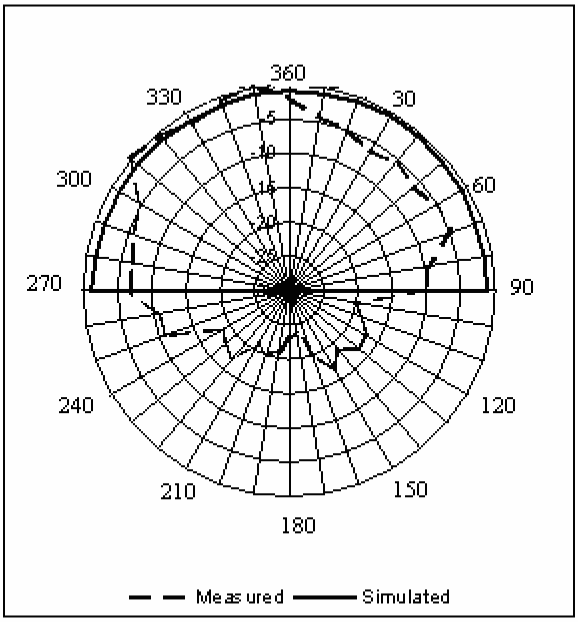


Figure 4: Measured and simulated radiation pattern at 3.5 GHz for H-plane (y-z plane).

4. Conclusion

This paper present rectangular DRA operating at 3.5 GHz. Rectangular shape DRA was used as it offers more flexibility in controlling the resonant frequency due to its two aspect ratios. Hence, it provides high degree of freedom in controlling antenna performance. Apart from that, E-plane and H-plane of the radiation pattern indicates that this antenna is suitable to be used in the wireless system especially at S-band.

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