A Ring Loading Approach to Patch Antenna for Dual frequency Applications

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***Abstract*—This paper presents the design a dual frequency (2.4 GHz and 4.4 GHz) microstrip patch antenna. The dual frequency nature is achieved using two parallel slots and the rectangle ring in the patch antenna. The dimensions of rectangle ring are designed so that antenna resonates at lower frequency and the dimensions of slots are designed so that antenna resonates at upper frequency. The radiation patterns are obtained using HFSS.**

I. INTRODUCTION

Microstrip patch antenna is used to reduce the size of the transceiver systems used in modern wireless communication. Microstrip antennas are low profile, simple and robust when mounted in rigid surface and inexpensive to manufacture using modern printed circuit technology. Despite increased popularity, efficient design and fabrication of planar array antennas with lowside-lobe levels and wide impedance bandwidth still remains a challenging task.

Microstrip antennas are used for the multi frequency operation for the different systems like Wi-Max or Wi-Fi or Bluetooth. This paper presents the one of the methods for the multi frequency operation of Microstrip patch antenna. The desired goal is achieved using the rectangular patch antenna having the two parallel slots in it and surrounded by rectangular ring.

II. ANTENNA DESIGN

In this section, we design dual band patch antenna for the two frequencies (2.4 GHz and 3.4 GHz). Figure 1 shows the shape of the patch antenna. The height of patch is h=1.6 mm. The first resonance (higher frequency) will be obtained due to the current flow between the two edges in the middle part of the antenna with path length, as the single band conventional patch antenna. In order to achieve a resonance in the lower frequency band, two slots are introduced in the patch as shown in figure 1. The slots are used to allow another path for the current flow. The current from the edge of the patch would flow around the slots through a path, which is longer than the length of the first path. This path should cause additional resonance at a lower frequency.

In order to get deeper return loss plot at the desired frequencies, the parasitic element is added in the patch design. The parasitic element is the rectangular ring which provides the electromagnetic coupling between the patch with slots and a ring. These help us to have deeper return loss and improvement in VSWR.

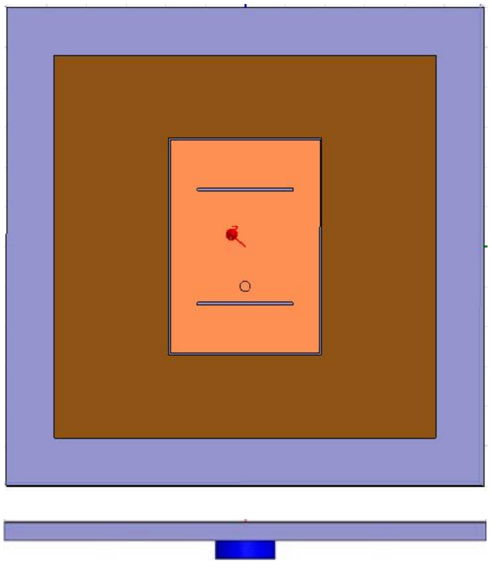
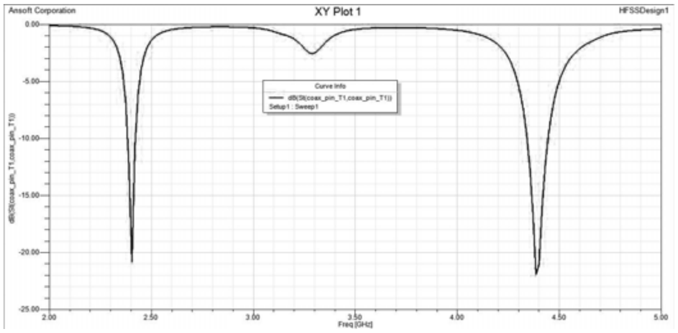


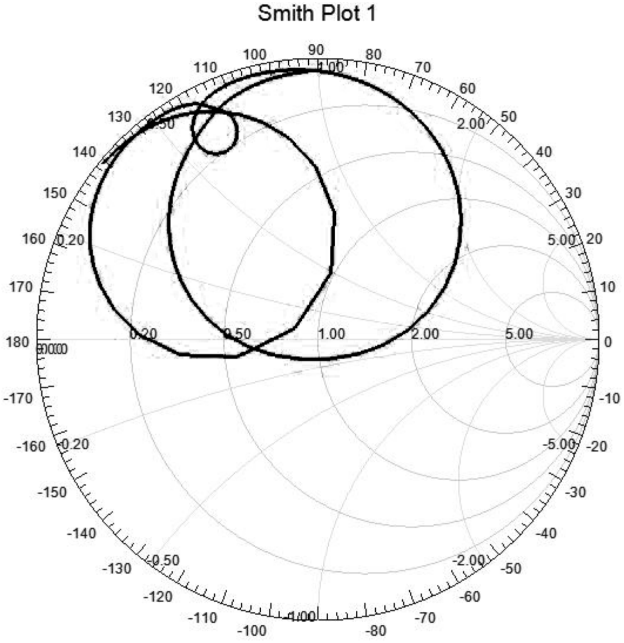
Fig. 1. Microstrip Patch Antenna

The width and the height of the middle patch is 18.32 mm and 26.68 mm respectively. The substrate used is FR4 (E_r = 4.4 and thickness = 1.6 mm). The width and height of the outer ring is 25 mm and 25 mm respectively. The gap between the patch and ring is of 1 mm. The width and height of two slots are 8 mm and 0.4 mm respectively. The separation between two slots is 10 mm. The coaxial feed mechanism is used. The coaxial probe has 50 ohms impedance. The feed point is (0, 2.5 mm) from the center of the patch. The patch antenna having these dimensions is simulated in HFSS and the simulated return loss, smith chart and VSWR graphs are shown in figure 2.

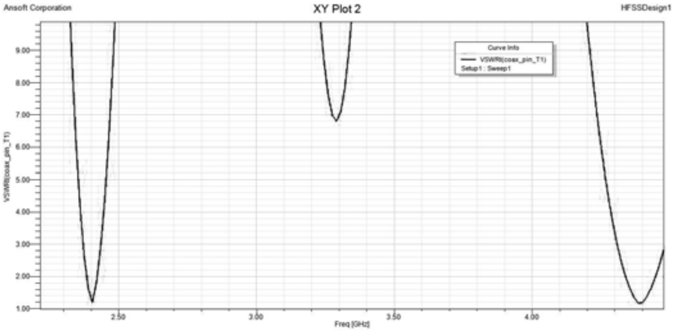
III. RESULTS



(a) Return Loss



(b) Smith Chart



(c) VSWR

Fig. 2. (a) Return Loss (b) Smith Chart and (c) VSWR

The graph of return loss shows that the antenna has two resonance frequencies which are 2.4 GHz and 4.4 GHz having the deep of -22 dB and -24 dB respectively. The bandwidth at From the return loss graph, we can say that this design does not contain the ripples. Hence, it can be considered as stable design. Their corresponding VSWR values are 1.19 and 1.18 respectively. The radiation pattern at 2.4 GHz is shown in figure 3 and that is, for 3.4 GHz is shown in figure 4.

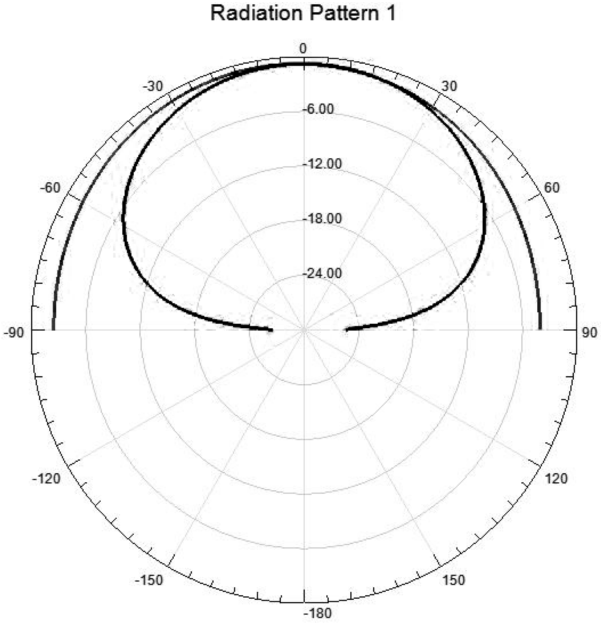


Fig. 3. 2.4 GHz Radiation Pattern

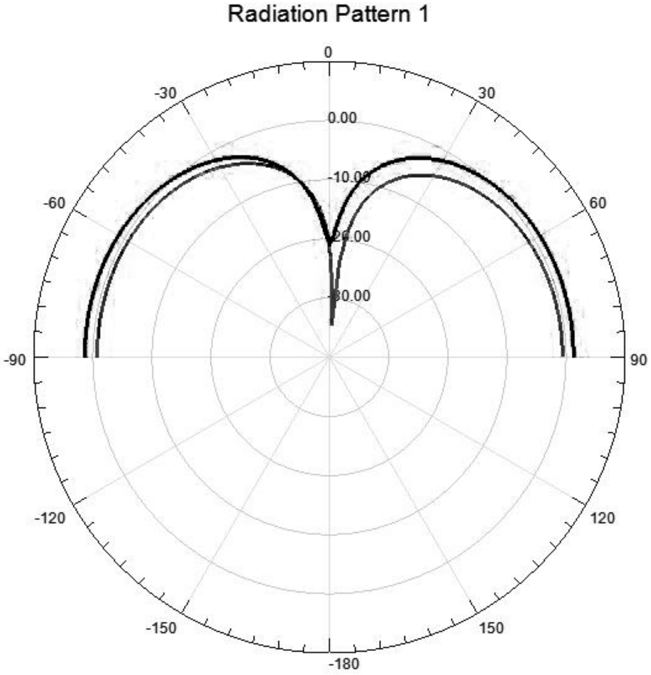


Fig. 4. 3.4 GHz Radiation Pattern

As shown in figure 3, the gain at 2.4 GHz is 5.305 dB and beamwidth is 92.4 deg. From figure 4, the gain at 3.4 GHz is 5.010 dB and beamwidth is 180 deg.

IV. CONCLUSION

A dual frequency microstrip patch antenna has been designed. The designed frequencies are 2.4 GHZ and 4.4 GHz. The proposed structure is then simulated with HFSS and results are also presented. By properly adjusting the position of slots and the dimensions of rectangular ring the lower and upper resonance frequencies can be changed. Compared to tradition one, this antenna has improved VSWR. The peak gain antenna for both the frequencies is above 5 dB.

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