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Flexible Rectangular Microstrip Patch Antenna with circular and rectangular slots

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ABSTRACT

This article presents a design of rectangular microstrip patch antenna with optimized circular and rectangular slot in order to obtain better performance. The aim of the paper is to obtain multiband resonance in a flexible antenna for WLAN application. The proposed design resonates at 2.4 GHz and 4.38 Ghz. The size of antenna is 100mm×90 mm. Full wave simulation software was used to design and analyze the antenna proposed. The result obtained of gain, SWR and return loss are depicted in this paper.

KEYWORDS: Slot antenna, WLAN antenna, Multiband.

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INTRODUCTION

There are many advantages of microstrip antennas such as conformal planar shape. There are extensive quantity of papers within the literature which deals with microstrip antennas. Despite the fact that individual microstrip patch antenna has numerous benefits, it additionally has a few drawbacks, for instance, less gain, narrow bandwidth with low efficiency. These impediments can be overwhelmed by developing an array configuration. The ground plane with slot to reduce the size of microstrip antenna was proposed in [1]. To obtain the multiband operation planar inverted-L antenna was proposed in [2].The methods to obtain the circularly polarized multiband microstrip antenna was proposed in [3.] The advantage of circularly polarized antenna over the linear polarized one is that the orientation of the device on which the antenna is installed does not affect the received power. Antenna array for multiple input and multiple output application was discussed in [4]. The advantages, disadvantages and applications of microstrip antennas were discussed in [5].

Numerous techniques for making multiband Microstrip patch antenna with metamaterial had been proposed in [6].Negative refractive index material load patch antenna for extremely wideband application was proposed in [7].Tunable dual band metamaterial antenna based split ring resonator (SRR) had been proposed in [8].

Antenna array is the combination of similar antenna elements which work together as a one antenna. All the elements presents are fed using the microstripline feeding such that all the individual elements gets excited to radiate.

Antenna array has an advantage that it concentrates the power of all the antenna elements in a desired direction and reduce the power radiated in the undesired direction. These results in a higher gain and less interference as compared to an individual antenna element. Antenna array can be classified into two types depending on the direction in which it radiates. If it radiated in a direction perpendicular to its axis such antenna array is named as broadside array. If it radiates in a direction along its axis such an array is called as endfire array. [9]

PROPOSED MODEL AND DESIGN

This paper examines the rectangular microstrip patch antenna array consisting of eight four circles of radius 5mm which are symmetrically placed at the proper optimized position using the iterations in High Frequency simulation software (HFSS). The design also includes a two rectangular slot of 8×5 mm for getting the dual band.The coaxial feed line is used to feed the patch. Firstly the traditional rectangle antenna was designed using the design equation then small circular slots and rectangular slots were subtracted from the patch in order to achieve the multiband operation. Extensive parametric analysis was done using Full wave simulation software in order to reach at the optimum size of patch and slots.

For the design purpose jeans material having thickness of 3.2 mm was taken which is having a relative permeability of 1.7. The design of the proposed rectangular microstrip patch antenna with four circular slots and two rectangular slots is shown in figure 1. HFSS 15 was used to design and analyze the proposed design. The coaxial feeding technique was used to feed the patch.The point where the structure has the 50 ohm impedance was chosen using parametric analysis in full wave simulation software, The feed was given at that point as the cable also has a 50 ohm impedance, hence the maximum power can get transferred to the antenna from the feeding cable and there should be minimal loss at the cable and antenna juncture.

Table 1 delineates the material chose for patch and substrate. The material utilized for patch and ground is copper while for the substrate Jeans having relative permeability of 1.7 and loss tangent of 0.019 was used. The Thickness chosen while simulating the design of patch and ground was 3.2 mm.

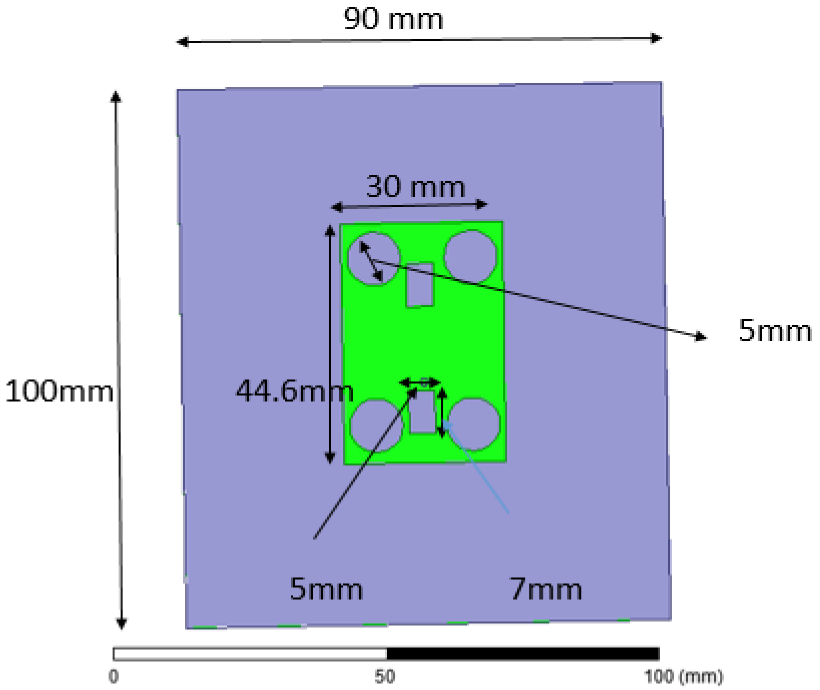

Fig. 1. Top View of proposed rectangular microstrip patch antenna with circular and rectangular slots

SIMULATION RESULTS

This section depicts the results obtained after simulating the proposed design using High frequency simulation software (HFSS 15). Figure 2 depicts the return loss versus the frequency plot of the proposed antenna. It can be observed from the figure 2 that the proposed design resonates at multiple frequencies such as 2.4 GHz and 4.38 GHz. The return loss values obtained at this different frequency has been summarized in table 2.

Figure 3 depicts the VSWR obtained at different frequencies. The VSWR values obtained at different frequency has been depicted in Table 3.

Figure 4 depicts the 3D Radiation pattern in HFSS of the proposed antenna. It can be observed from the figure 4 that the gain is 6.42 dB.it can be clearly observed that the antenna radiates in broadside direction. Figure 5 depicts the radiation pattern of the proposed antenna in both E and H plane.

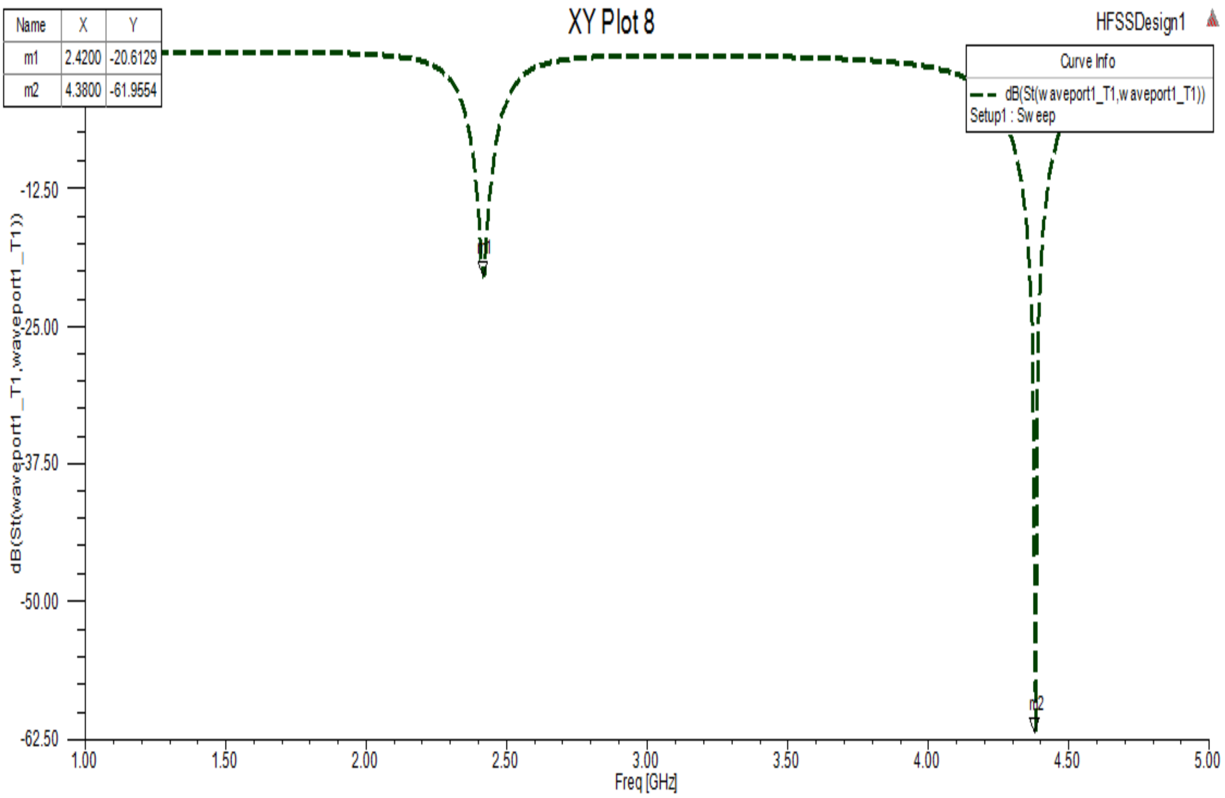

Fig. 2. Return loss of proposed design

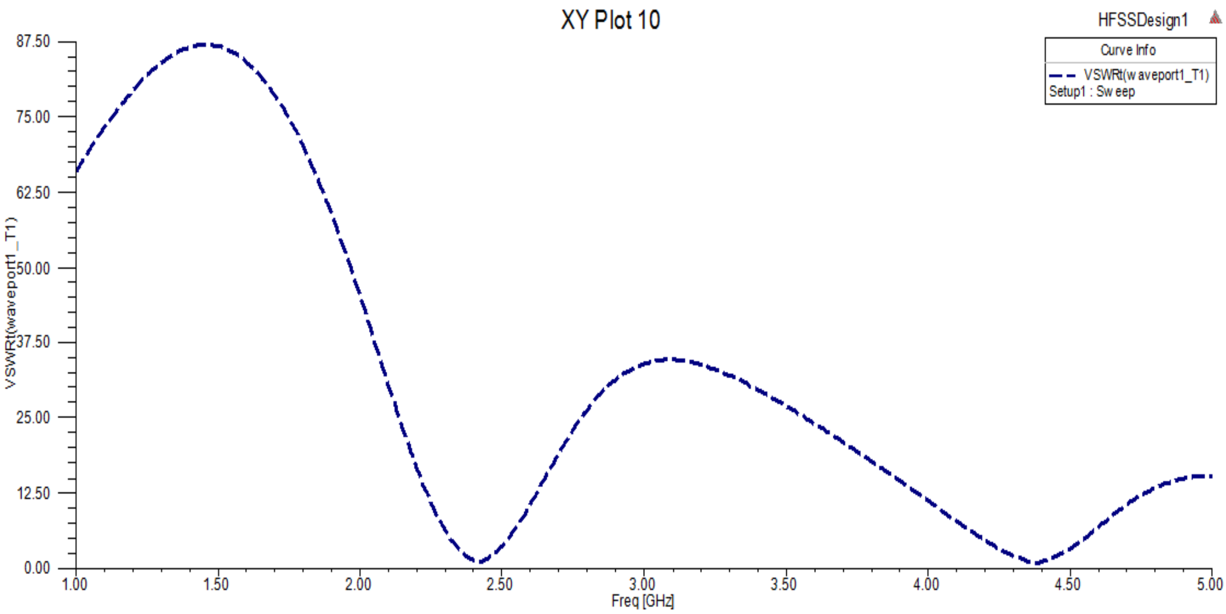

Fig. 3. VSWR results for proposed design

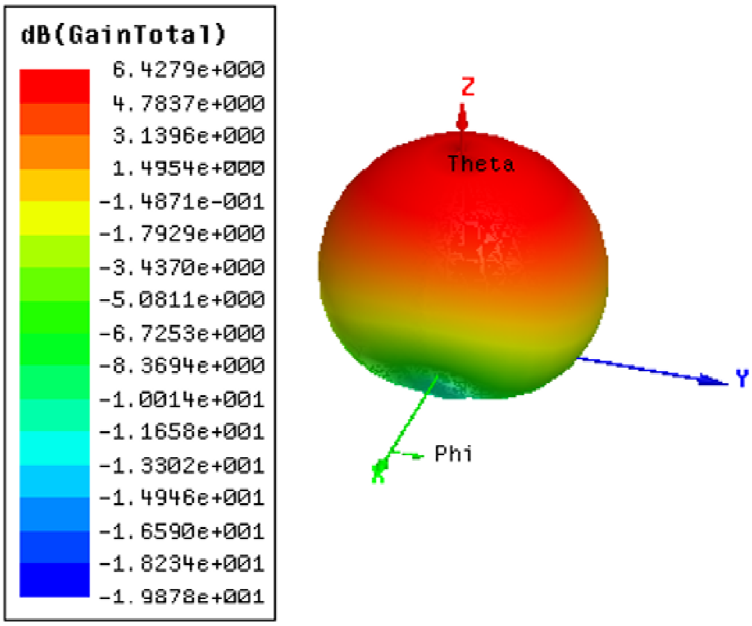

Fig. 4. 3D Radiation pattern of the proposed design

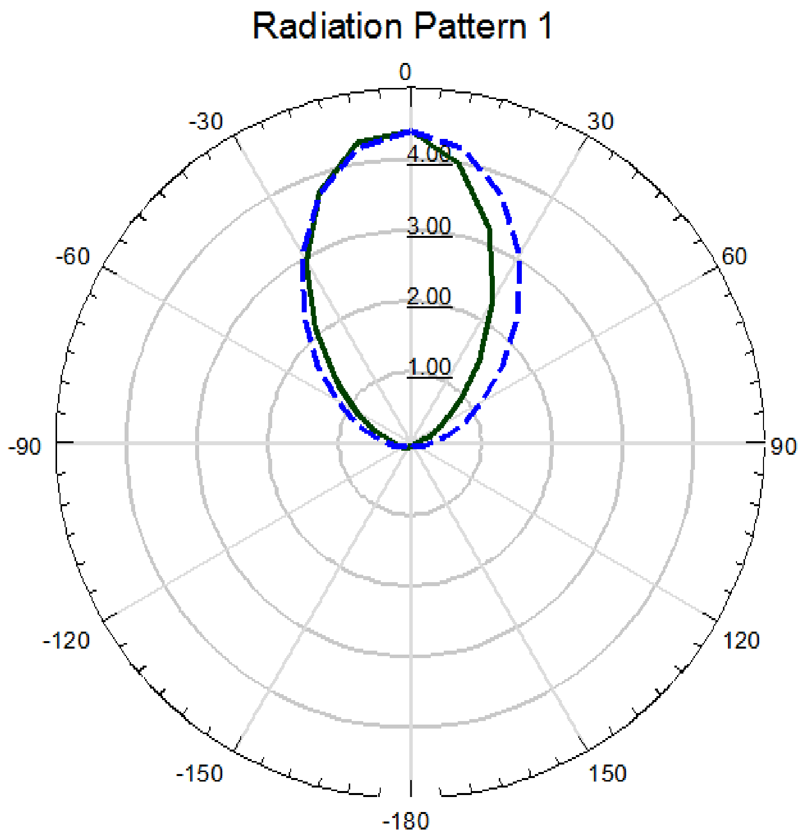

Fig. 5. E plane and H plane radiation pattern of the proposed design

TABLE 1 Materials chosen for the design

	Material chosen	Thickness
Patch	Copper	0.035 mm
Substrate	Jeans	3.2 mm
Ground	Copper	0.035 mm

TABLE 2 Return loss obtained at different frequencies

Centre Frequency (GHz)	Return loss (dB)
2.4	-20.6
4.38	-61.9

TABLE 3 VSWR values obtained at different frequencies

Centre frequency (GHz)	VSWR
2.4	1.20
4.38	1.11

CONCLUSION

A novel design of rectangular microstrip patch having small circular and rectangular slots have been introduced. The proposed antenna has been intended to be utilized as a part of WLAN framework applications. The proposed antenna is resonating at multiple frequencies of 2.4 GHz and 4.38 GHz.The simulation was carried using HFSS 15 and the chosen centre frequency was 2.4 GH.

The return loss, VSWR and radiation pattern results obtained was presented. The gain obtained was 6.42 dB.

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