An equilateral triangular coaxial-fed patch antenna with Rectangular – Shaped notches

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***Abstract*—A coaxial-fed equilateral triangular patch antenna that has improved gain and a centre frequency of 3.5 GHz has been developed. Rectangular notches have been added in the sides of an equilateral triangular patch antenna that would enhance gain.**

I. Introduction

Microstrip or patch antennas are becoming more popular [1] since they can be printed directly onto a circuit board. Microstrip antennas are becoming increasingly popular in the mobile phone industry. Patch antennas are inexpensive, have a low profile, and are simple to manufacture. Contrary to conventional antennas, micro-strip patch antennas have a number of disadvantages, including restricted bandwidth, low efficiency, and low gain. Patch geometry surface alterations have been employed in a number of ways to disrupt the higher order mode and increase gain [2], [3].One of the way to achive gain enhancement is by cutting notches [9]. It has recently been proved that you may achieve enhancement by cutting two T-notches on opposing sides of a rectangular patch antenna to excite the TM_{21} mode [4], [5]. The patch is supported over the ground plane by plastic supports, and air is employed as a dielectric. Placing a plastic post between the radiator and the ground can change the dielectric medium's ϵ_{eff}, which can be challenging to compute. Another method [6] makes use of C-Foam PK substrate, which has a dissipation factor of 0.001 and a dielectric constant of 1.04, which is comparable to that of air. In the simulation, an equilateral triangle patch radiator operates at 1.8GHz, a crucial frequency in the contemporary wireless and communication age. It maintains the antenna's broadside radiation characteristics by forcing the resonator to run in its basic mode and leaving its higher order mode unaltered. By using a substrate with a low dielectric constant and carefully choosing the T-notch on the patch surface, a 2.9dB gain boost is obtained. In this paper we introduce coaxial-fed equilateral triangular patch antenna with rectangular notches on the sides of triangle and substrate material as FR-4 which operates at 3.5GHz frequency with enhanced gain of 21.09dB. Coaxial feed method is frequently employed in microstrip patch antennas [7], [8]. Coaxial connectors are utilised for feeding in this approach [10]. The coaxial connector's centre conductor wire is attached directly to the radiating patch, while the outside conductor is soldered to the ground plane. This feeding approach has the benefit of allowing the feed point to be positioned anywhere within the radiating patch so that it matches the input impedance.

II. ANTENNA CONFIGURATION

The shape of a basic triangular microstrip patch antenna is seen in Fig. 1. The dimensions of ground plane were taken as 100 mm x 80 mm with substrate thickness as 1.7 mm and side of equilateral triangle as 70 mm. The gain obtained with this antenna is 10.52dB and the frequency is obtained as 2.36GHz.To improve the gain and obtain frequency at 3.5GHz we propose a rectangular notched triangular shaped antenna. It illustrates the suggested gain-enhanced antenna arrangement. The ground plane's dimensions are determined to be 31.80mm x 35.1mm which is rectangular in shape. The Coaxial feed was made in several phases, first being the ground cut, that is, removing a cylindrical vacuum part from the ground having radius equal to 1.1512 mm. Then inserting an inner pin made of copper(annealed) all the way to the patch having radius 0.5 mm. After that a portion outside the innermost pin is filled with Teflon up to the height of the ground. And finally the outermost portion of the cylinder is filled with copper (up to the ground height) completing the whole cylindrical feed as shown in figure 2. 11.4 mm from the bottom edge of the triangle and 3 mm toward positive x axis is the ideal coaxial feed location to achieve matching conditions and maximum radiation at 3.5GHz as shown in the figure 3. A 3.5GHz centre frequency has been devised for the rectangular-notch equilateral triangular shape as shown in the figure 4. An equilateral triangular patch with side measurements of 25.67 mm, height from ground plane of h = 1.6 mm, ϵ_r = 4.3, and t = 0.04 mm is used in the suggested construction. Notches are placed at center of each edge with length = 6.42 mm and width = 0.7 mm.

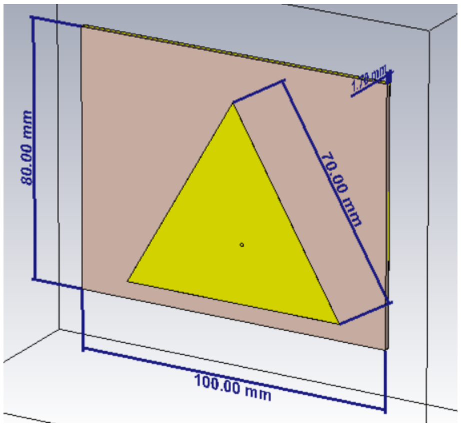

Fig. 1. Basic triangular patch

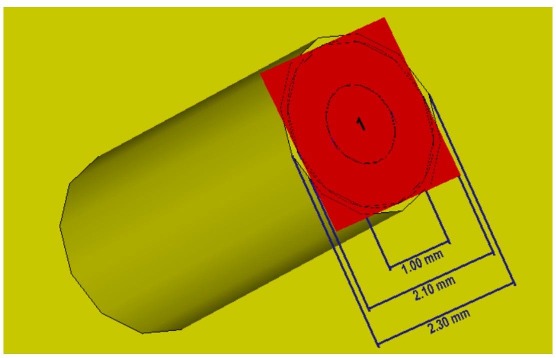

Fig. 2. Coaxial feed

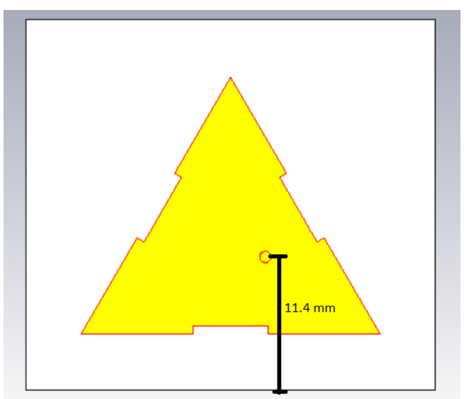

Fig. 3. Coaxial feed location

III. Results and Discussion

Increase the operating frequency results from decreasing the patch dimensions. When the rectangular notch is introduced, the gain is improved and the result is in lengthening the surface current density's route length of the consequently reducing the operating frequency, to basic mode. After maximising each of these variables, the basic mode operation can be accomplished simultaneously at 3.5 GHz frequency with a higher gain as shown in the figure 6. The notched rectangular antenna shows a greater gain of 21.09dB compared to the antenna's gain

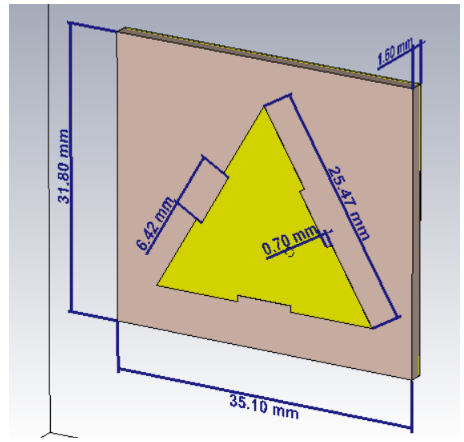

Fig. 4. Rectangular notched triangular patch antenna

without a notch. We get VSWR value of 1.19 as shown in the figure 7. Farfield directivity for Phi=0, Phi=90, and Theta=90 is also shoen in figures 8, 9, 10 respectively.

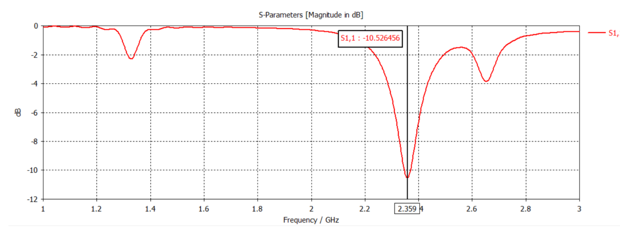

Fig. 5. Basic triangular patch antenna gain and frequency

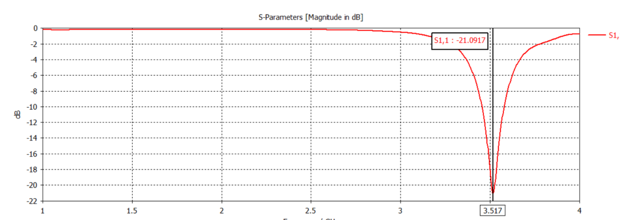

Fig. 6. Rectangular notched triangular patch antenna gain and frequency

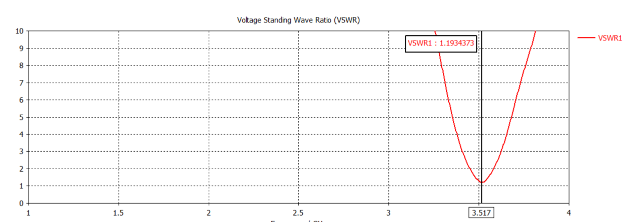

Fig. 7. Rectangular notched triangular patch antenna VSWR

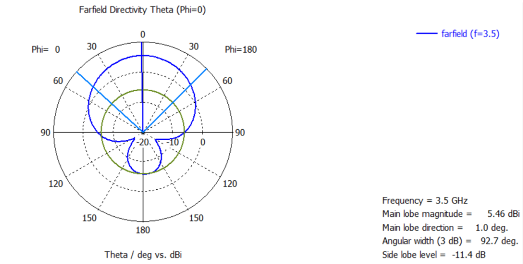

Fig. 8. Farfield directivity Phi=0

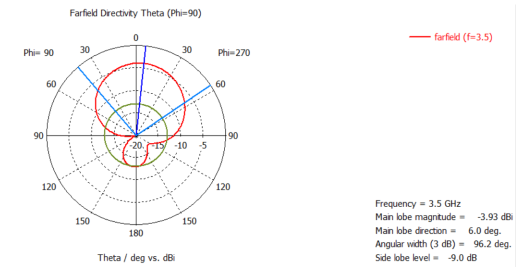

Fig. 9. Farfield directivity Phi=90

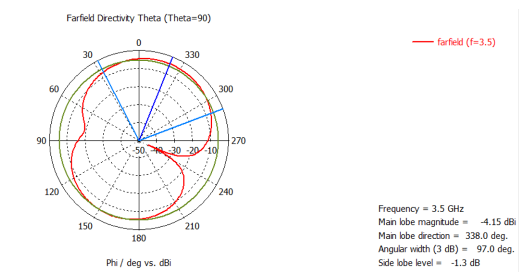

Fig. 10. Farfield directivity Theta=90

IV. Conclusion

Directivity and gain of two different types of microstrip patch antennas are compared. The results show that the gain increase of the rectangular-notched patch is approximately 21.09 dB and the VSWR is obbtained as 1.19. It is brought on by a patch procedure that involves reducing the substrate material's dielectric constant and cutting a rectangular notch of an appropriate size. Greater benefit is obtained at the cost of a patch area with more rectangular notches.

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