

COMPARITIVE STUDY OF INSET FED RECTANGULAR MICROSTRIP PATCH ANTENNA WITH SQUARE MICROSTRIP PATCH ANTENNA

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Abstract:-Technological trend has focused much effort into The design of a Micro strip patch antenna. In this work, the Pattern of two designs of a Micro strip patch antenna have been analyzed and studied. This paper compares the performance of two types of micro-strip patch antenna having Square and Rectangular shape at a frequency of 5 GHz and analyze their performance. The results show that the performance of the antenna will be best in case of rectangular shape patch antenna. These results can be very useful while designing micro-strip patch antenna.

Keywords: - Square patch, Rectangular patch, Substrate materials, and Micro-strip patch antenna

I. INTRODUCTION

Antennas play a very important role in the field of wireless communications. Some of them are Parabolic Reflectors, Patch Antennas, Slot Antennas, and Folded Dipole Antennas. Each type of antenna is good in their own properties and usage. We can say Antennas are the backbone and almost everything in the wireless communication without which the world could have not reached at this age of technology. The micro-strip patch antenna [1-3] is a type of radio antenna with a low profile that can be mounted on a flat surface. These antennas consist of a flat rectangular sheet or "patch" of metal, mounted over a larger sheet of metal called as ground plane.

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The assembly is usually contained inside a plastic Radom, This protects the antenna structure from damage. These antennas have several advantages [1] over other antennas such as low profile, low weight, relatively low manufacturing cost, simple fabrication process, polarization diversity and can be easily modified and customize.

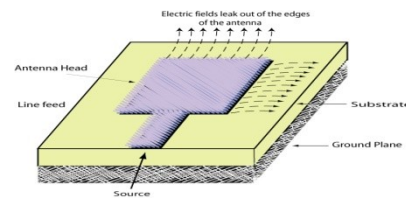


Fig 1: Rectangular micro strip patch antenna

II. DESIGN CALCULATIONS

2.1. Length of patch

$$L = \frac{c}{2f_0\sqrt{\epsilon_r}} \quad \text{eq. (1)}$$

2.2. Effective dielectric constant

$$\epsilon_{\text{reff}} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2} \left(1 + 12h/w\right) \quad \text{eq. (2)}$$

2.3. Width

$$W = \frac{c}{2f_0\sqrt{\frac{\epsilon_r + 1}{2}}} \quad \text{eq. (3)}$$

2.4. Length extension

$$\Delta L = 0.412 \left[\frac{\epsilon_{\text{reff}} + 0.3}{\epsilon_{\text{reff}} - 0.258} \right] \left[\frac{w/h + 0.264}{w/h + 0.8} \right] \quad \text{eq. (4)}$$

2.5. Effective length of the patch

$$L_{\text{eff}} = L + \Delta L \quad \text{eq. (5)}$$

2.6. Ground plane dimensions

$$L_g = W_g = 6h + L \quad \text{eq. (6)}$$

Ground plane calculation, equation (6) for Square patch antenna

$$W_g = 6h + L \quad \text{eq. (7)}$$

$$L_g = 6h + L \quad \text{eq. (8)}$$

Ground plane calculation, equations (7) & (8) for rectangular patch antenna

Dimensions	Rectangular	Square
Operating frequency	5 GHz	5 GHz
Dielectric Constant	3.2 (GML)	3.2 (GML)
Length of the patch L	16.53 mm	16.53 mm
Width of the patch W	20.70 mm	16.53 mm
Thickness (t) of the substrate	0.762 mm	0.762 mm
Model for analysis	Transmission line TLM	Transmission line TLM
Substrate length	21.102 mm	21.102 mm
Substrate width	25.272 mm	21.102 mm

III. PROCESS FLOW CHART

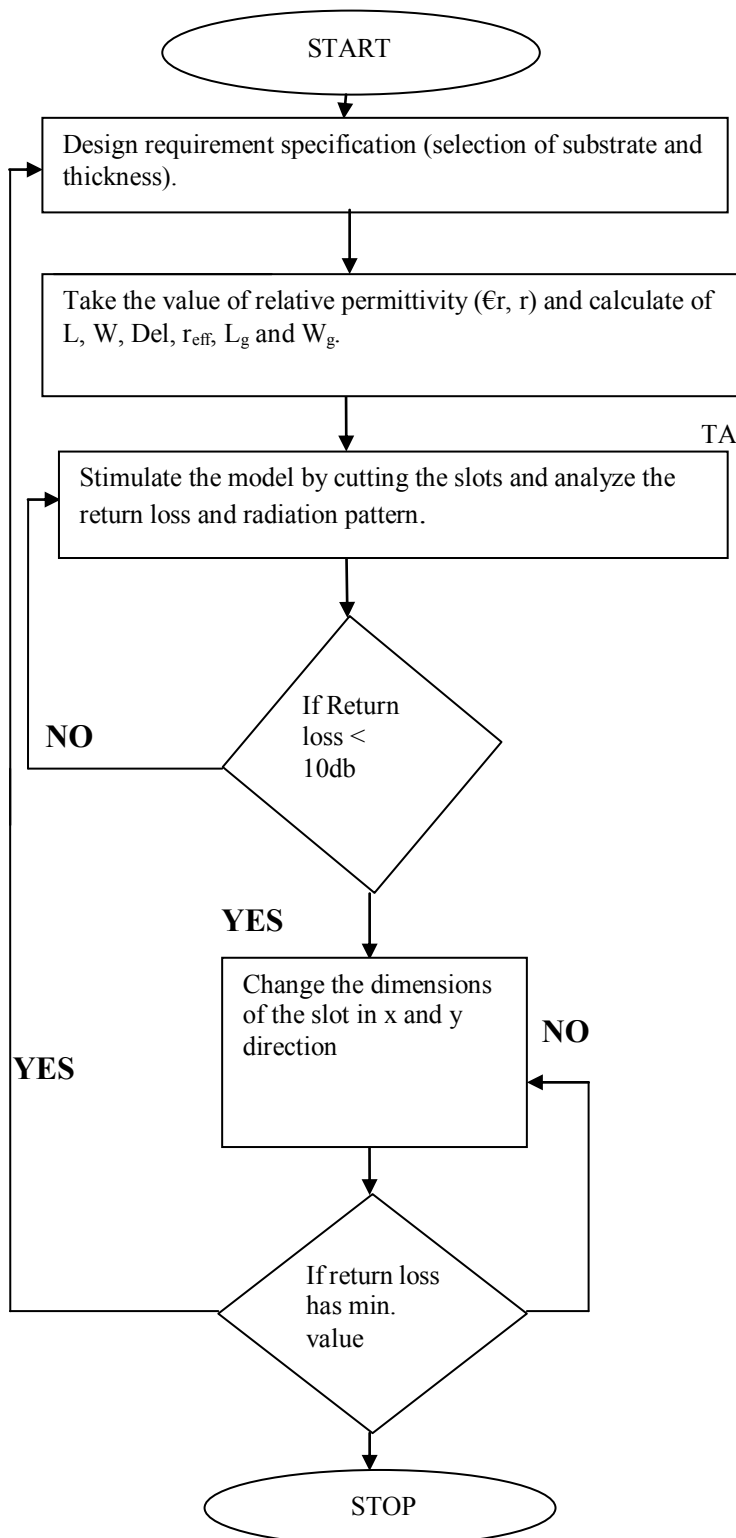


TABLE 1: COMPARISON OF PHYSICAL DIMENSIONS

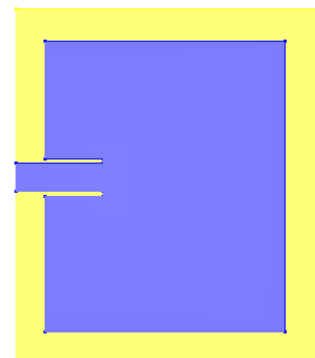


Fig 2: Rectangular patch antenna

Iteration patch	Resonance Frequency (Fr) GHz	Return loss S11 (db)	Antenna efficiency (%)	Radiation efficiency (%)	Directivity (dbi)	Gain (dbi)	Bandwidth (%)
Rectangular	4.985	-36.906	87.694	87.815	6.141	5.571	4.252
Square	5.017	-38.492	85.732	86.022	5.879	5.211	4.02

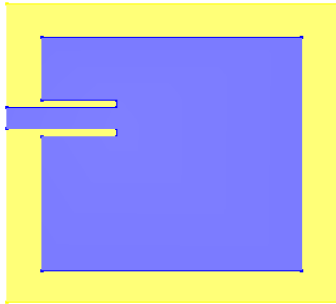


Fig 3: Square patch antenna

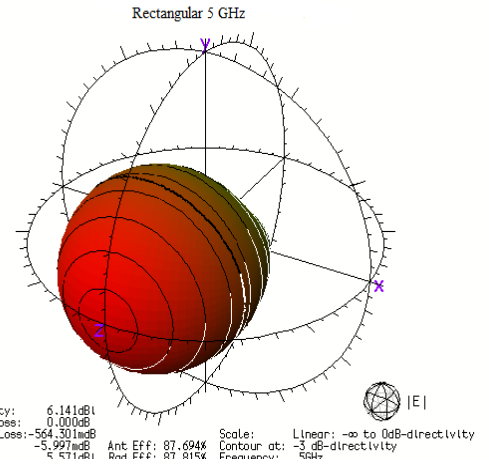


Fig 5: Radiation pattern for Rectangular patch antenna

Table 2: Comparison table for Patch Antenna Performance

IV. SIMULATED RESULTS

4.1 Rectangular Patch Antenna

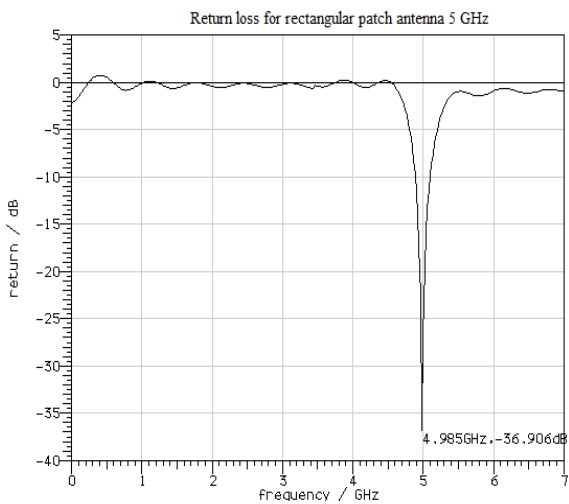


Fig 4: Return loss for Rectangular Patch antenna

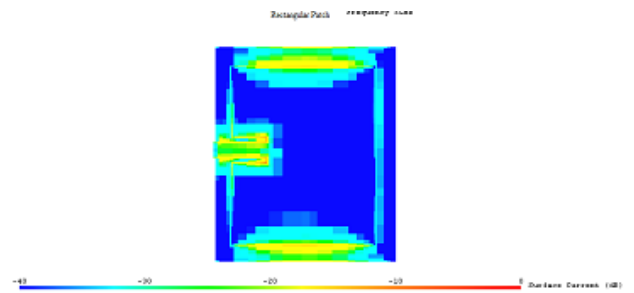


Fig 6: Surface current distribution for Rectangular Patch Antenna

4.2 Square Patch Antenna

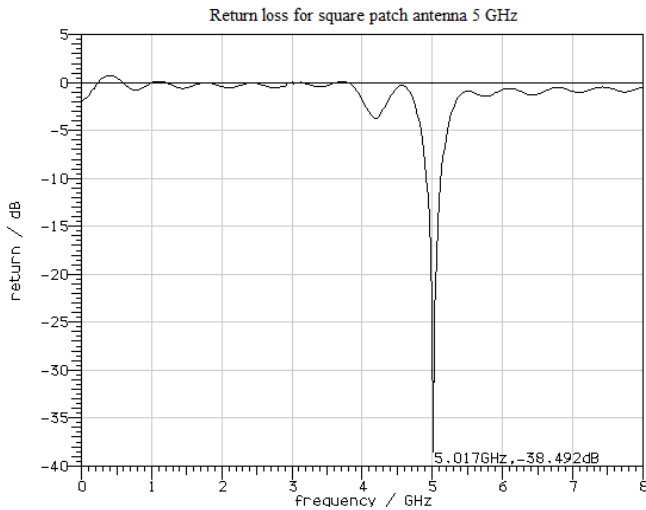


Fig 7: Return loss for Square patch antenna

V. Comparitive Return Loss for Rectangular and Square Patch Antenna

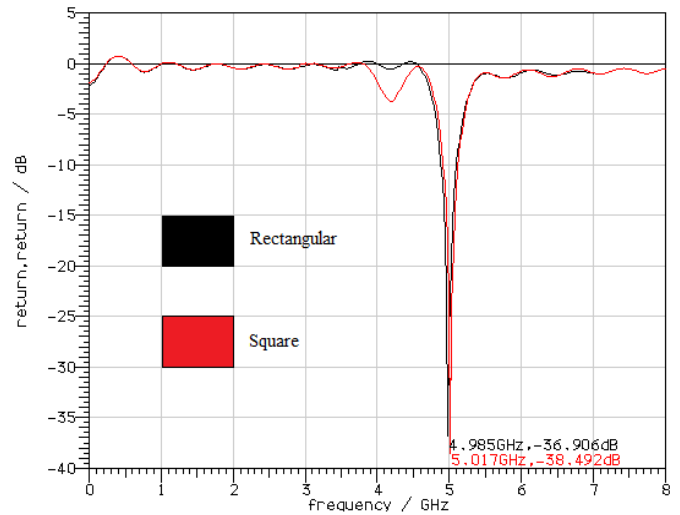


Fig 10: Comparitive Return Loss for Rectangular and Square Patch Antenna

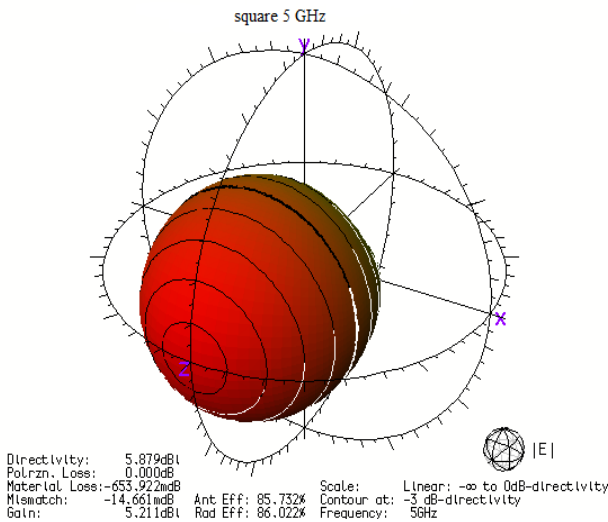


Fig 8: Radiation pattern for Square

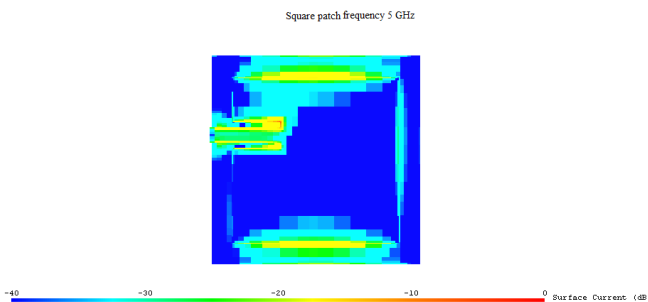


Fig 9: Surface current distribution for Square

VI. RESULT AND CONCLUSION:

As we can see from the Table 2 that except for the return loss all other parameters of both the patch antenna the values of the rectangular patch antenna are much higher than as compared to square antenna. Though the resonance frequency for rectangular antenna has a higher shift of 1.015 as compared to shift of .017 for square antenna. Main point to observe about is the position of inset feed location for rectangular it is in the middle of the patch where as for square it has a to be shifted in upwards on Y axis.

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