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# COMPARISON BETWEEN COAXIAL FED MICROSTRIP SQUARE PATCH ANTENNAS

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**Abstract** – *Microstrip antennas are used for several applications like military, commercial and space craft applications. In previous works E shaped Microstrip patch suspended antenna with a rectangular slot is designed and analyzed for radiating in the frequency band of GPS. In this paper the shape is modified to square shape and the height of the substrate and dimensions of the patch have been increased. Here the comparison of two different square patch antennas is done. The shape of proposed antennas will provide high gain which is required for the good operation of communication systems. The gains of the two antennas are 2.98dBi and 3.44dBi respectively. The substrate FR4 is used for the antennas which has dielectric constant 4.4.*

**Key Words:** Microstrip square patch antenna, coaxial feeding, circular polarization, FR4.

## 1. INTRODUCTION

GPS has fully been deploying, and has advantage and has a ground plane on other aspect. The that higher precision and low cost than other navigation system [2]. An antenna for GPS requires better overall performance, such as broadband, high gain, and beam width. So Microstrip patch antenna is used for the GPS. Microstrip antenna has more advantages than conventional antenna. It consists of a radiating patch on one side of dielectric substrate designing of an antenna satisfies some of the parameters like VSWR and return loss. If the impedance of the an antenna does not match with the impedance of a transmission line then there will be a reflection of the signals and it causes high return loss and which will leads to the bad communication [1]. To avoid the problem of return loss, the antenna impedance should be matched with the transmission line impedance [5]. There are various methods are for the impedance matching technique but this paper concentrates on comparison of two square patch antennas with coaxial feeding method and their results. In this paper the frequency used for designing an antenna is 1.575GHz which is used for GPS applications. The substrate used is FR4 epoxy which has very low cost, zero water absorbance and is easily available. The antennas are square patch antennas with substrate height 3.2mm and software used for the simulation is IE3D.

## 2. SQUARE PATCH ANTENNA

The comparison is done between two types of square patch antennas.
Square patch antenna with perturbation and another without perturbation.

### A. Square patch antenna with perturbation

In this type the two edges of the antenna are cut as shown in fig.1

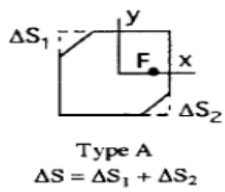


**Fig -1**: Square patch antenna with edge perturbation

The dimensions are as follows:

Ground plane: length=width= 63.6mm

Patch: length=width= 43.5mm

Feeding point: (x, y) = (11.63, 0)

Edge cut $\Delta s1=\Delta s2=9$mm. so using this simulation is done using IE3D software and results are obtained.

### B. Square patch antenna without perturbation

This is the original square patch antenna which has the following dimensions.

Ground plane: length=width= 63.82mm

Patch: length=width= 43.25mm

Feeding point: (x, y) = (5.52, 5.52)

The feeding is done at corner side of the antenna with the same value of 5.52. These dimensions are fed into IE3D simulator and the results are obtained.

## 3. COAXIAL FEEDING

It is a common technique used for feeding Microstrip patch antenna. Inner conductor of the coaxial connector extends through the dielectric and is soldered to the radiating patch, while the outer conductor is connected to the ground plane [2]. The advantage of this type of feeding scheme is that the fed can be placed at any desired location inside the patch in order to match its input impedance [4]. The major disadvantage of this type of feeding is that it will provide less bandwidth and it is very difficult to model because a hole has to be drilled inside the substrate and the connector goes outside the ground plane, so the complete planarity cannot be achieved. So in this paper the coaxial feed is done at the edge side for one antenna and at the centre for another antenna. The polarization is circular polarization which is explained in the next section.

## 4. CIRCULAR POLARIZATION

The most common feeding techniques used to generate circular polarization are dual feed and single feed. In this paper the single feed circular polarization is used. Single fed circularly polarized Microstrip antennas are the simplest antennas that can give circular polarization. In order to achieve circular polarization using only single feed two degenerate modes should be exited with equal amplitude and 90° difference [4]. Basic shapes of Microstrip patch antennas produce linear polarization so there must be some change in the design of antenna to produce circular polarization. Perturbation segments are used to split the field into two orthogonal modes with equal magnitude and 90° phase shift [4]. Therefore the circular polarization requirements are met.

## 5. RESULTS AND DISCUSSION

### A. Impedance Matching

The fig. 2 and fig. 3 show the smith charts for square patch antenna with perturbation and without perturbation respectively. The impedance matching to 50Ω for both the square patch antennas is at 1.575GHz. The antenna without perturbation is slightly inductive in nature. The antenna with perturbation is resistive in nature.

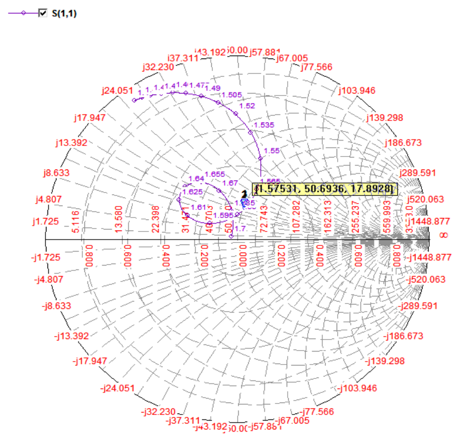


**Fig -2**: Smith chart for Antenna with perturbation.

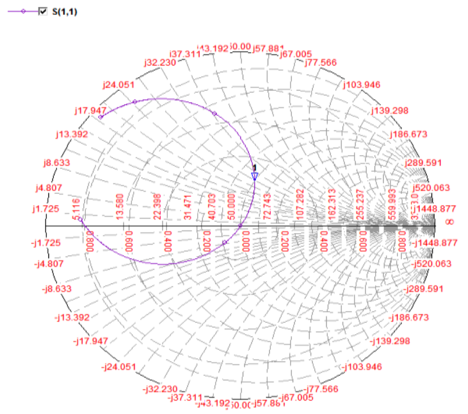


**Fig -3**: Smith chart for without perturbation

### B. Return Loss

Fig.4 and fig.5 shows the graphs of return loss for antenna with and without perturbation. The return loss for antenna with perturbation is -14.96db and that of without perturbation is -15.02db at 1.575GHz. so the return loss is almost same for both the configurations

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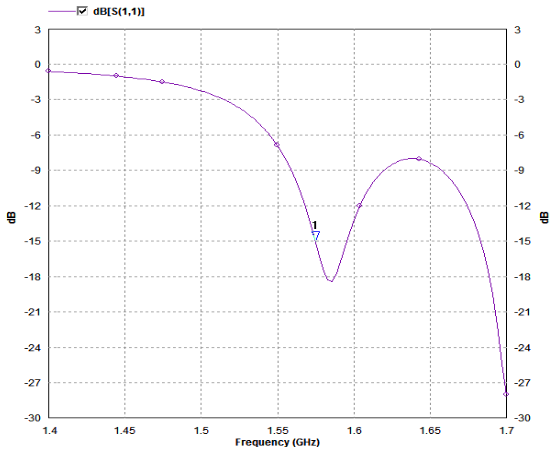
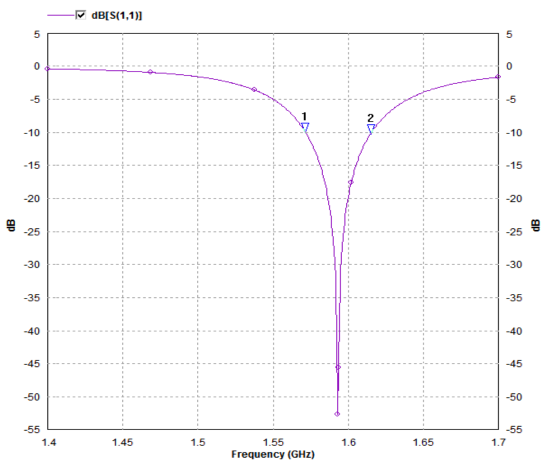



**Fig -4**: Return loss for antenna with perturbation




**-5**: Return loss for antenna without perturbation

### C. VSWR

The voltage standing wave ratio (VSWR) must be in between 1 and 2. For higher values of VSWR the antenna becomes highly mismatch. If it is equal to 1 then there is no mismatch [5]. Fig. 6 and fig. 7 shows the VSWR graphs for antenna with perturbation and without perturbation. Antenna with perturbation has VSWR of 1.42 and without perturbation has VSWR of 1.66. so the Antenna with perturbation is slightly better than without perturbation.

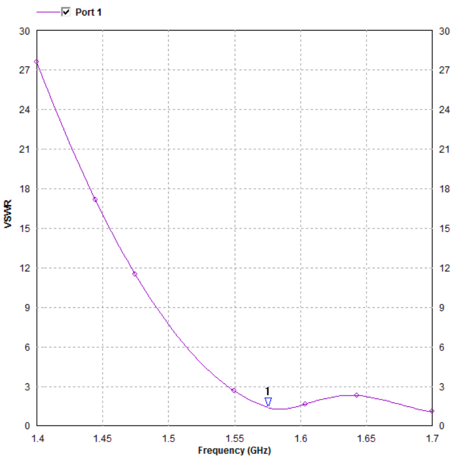



**Fig -6**: VSWR for Antenna with perturbation

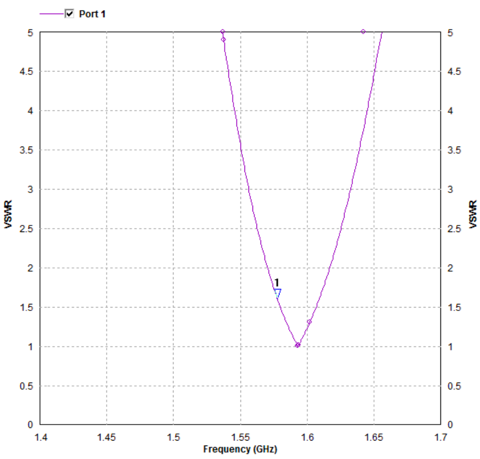



**Fig -7**: VSWR for Antenna without perturbation

### D. Elevation Gain Pattern

The fig. 8 and fig. 9 shows the 2D plot for Antenna with and without perturbation respectively. The antenna with perturbation gives almost same value of peak gain of 1.14dbi at both Etheta and Ephi curves. Similarly the antenna without perturbation gives peak gain of 1.26dbi at both Etheta and Ephi. The gain pattern of the antenna without perturbation is better than antenna with perturbation.

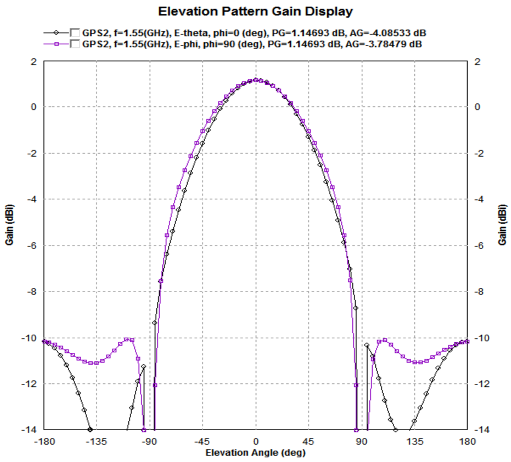



**Fig -8**: Gain pattern for antenna with perturbation

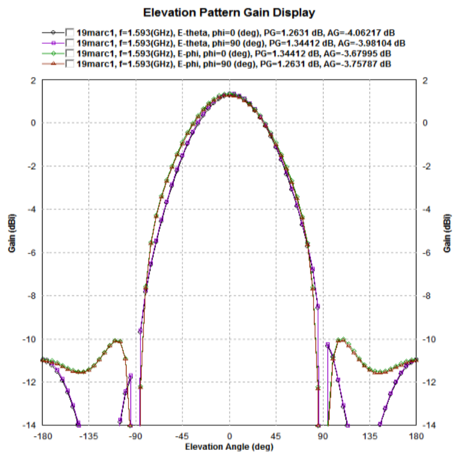



**Fig -9**: Gain pattern for antenna without perturbation

### E. GAIN OF THE ANTENNA

The gain of the standard GPS antenna is 3db. Figure 10 and Figure 11 shows the gain for antenna with perturbation and without perturbation. Square patch antenna with perturbation gives gain of 2.98 dBi and gain of antenna without perturbation is 3.44dBi.

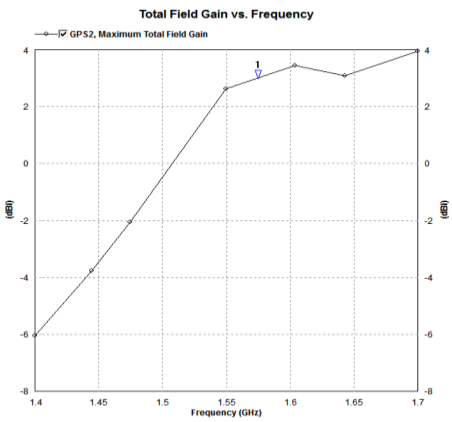



**Fig -10**: Gain vs. Frequency plot for antenna with perturbation.

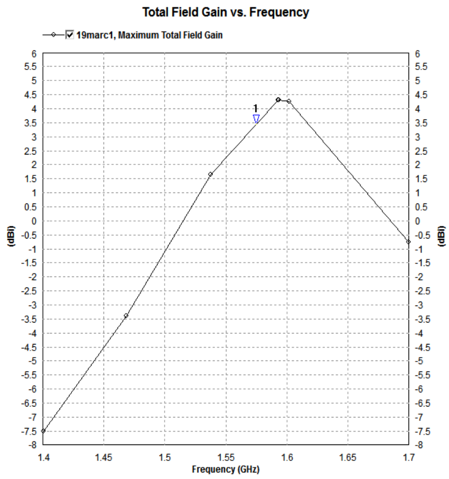



**Fig -11**: Gain vs. Frequency plot for antenna without perturbation.

**Table -1:** COMPARISON BETWEEN THE PARAMETERS OF ANTENNA WITH PERTURBATION AND WITHOUT PERTURBATION.

| Parameters | With perturbation | Without perturbation |
|---|---|---|
| Frequency | 1.575GHz | 1.575GHz |
| VSWR | 1.42 | 1.66 |
| Gain | 2.98 dBi | 3.44 dBi |
| Return Loss | -14.96. | -15.02dB |
| Bandwidth | 40MHZ | 40MHz |

## 6. CONCLUSION

Square patch antennas with perturbation at the edge and without perturbation have been successfully compared with respect to their parameters. After comparison the conclusion that can be obtained is that both the antennas are good in terms of gain and return loss. But antenna with perturbation is slightly better than antenna without perturbation in terms of VSWR.

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