# Optimization of Microstrip Patch Antenna on C Band and X Band with Radome Effect

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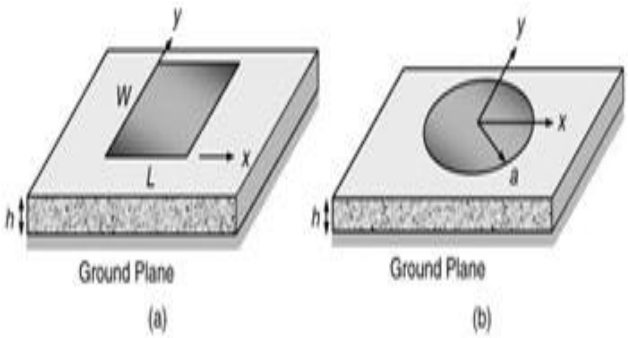
## ABSTRACT
Microstrip patch antenna is versatile and vast field of antenna theory. A particular aspect of work done in this field is presented. In addition a different antenna configuration that improve electrical performance and sustainability is described. We analyzed microstrip antenna in IE3D by finite moment of method. The proposed antenna designs have been analyzed between 1GHz to 20 GHz. When the proposed antenna design of different geometries (i.e. Rectangular, Triangular and Circular) were examined for the two dielectrics i.e. RT duroid 5870 with dielectric constant 2.33, loss tangent 0.0005 and Ferro A6M, LTCC with dielectric constant 5.9, loss tangent 0.0012 the results are : For rectangular geometry return losses = -22 dB, VSWR = 1.238, Z = 60.83 Ω at 6 GHz; For triangular geometry return losses = -12.2 dB, VSWR = 1.648, Z = 78.35 Ω at 10 GHz, For circular geometry return losses = -15.5 dB, VSWR = 1.409, Z = 36.65 Ω at 10 GHz.

## General Terms
Rectangular microstrip patch antenna, Triangular patch antenna, Circular patch antenna.

## Keywords
Microstrip antenna , IE3D Simulator, Dielectric substrate, Losses.

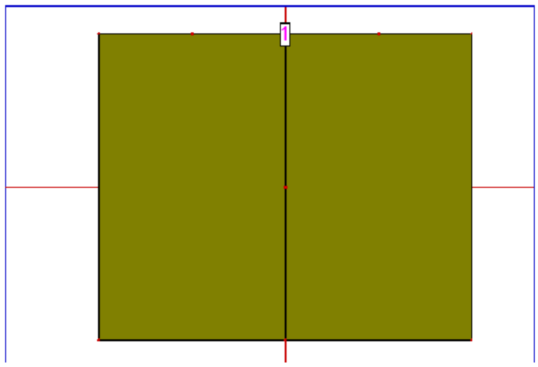
## 1. INTRODUCTION
Different geometries of patch antenna have been investigated by the researchers. In those studies, they have not employed any dielectric substrate in the form of radome above the patch. This radome protects the patch from environmental losses and uplifts the antenna performance. Triangular patch with radome is least investigated geometry. In this paper we have analyzed all the three geometries and tried to find out at which feed point geometries will give better return loss. For our detected feed point, we have checked out all remaining parameters for it such as dB and phase of S parameter, magnitude and phase of Y parameter, magnitude and phase of Z for S parameter, magnitude and phase of Z parameter, real and imaginary part of Y parameter, real and imaginary part of Z, Smith chart and VSWR.



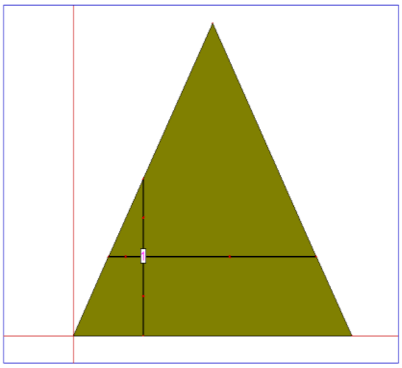

**(a) Rectangular micro strip patch antenna (b) Circular micro strip patch antenna**

## 2. EFFECTIVE PARAMETER
Radomes, also known as RADAR domes, are protective dielectric coverings or a dielectric shells that encloses an antenna. The principal purpose of a radome is to shield the antenna and associated equipment from the environment. This improves system availability since the antenna is not affected by winds, rain, or ice. Typical applications include antennas for radar, telemetry, tracking, cellular communications, surveillance, and radio astronomy.
A dielectric or ferrite coating on the surface of an antenna can alter the electromagnetic characterstic, provide electrical insulation and protect the antenna from environment. Some ferrite and dielectric ceramic coatings can allow certain antenna designs to be reduced in size or height while providing acceptable radiation characteristic.

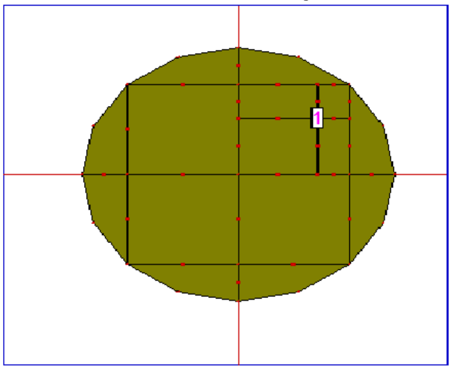
## 3. PROPOSED ANTENNA DESIGN
### (a) For Rectangular Geometry



### (b) For Triangular Geometry



## (c) For Circular Geometry

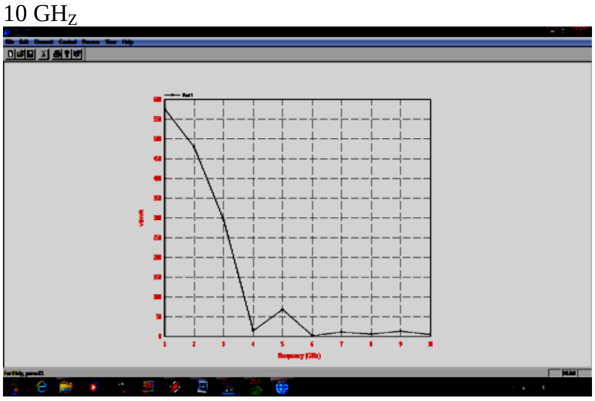


# 4. SIMULATED MICROSTRIP RECTANGULAR PATCH ANTENNA IN IE3D SIMULATOR FOR RT DUROID 5870 AND FERRO A6M, LTCC CONSIDERING RADOME EFFECT

## *(1) VSWR VS FREQUENCY (IN GH$_Z$)*

## (a) For Rectangular Geometry

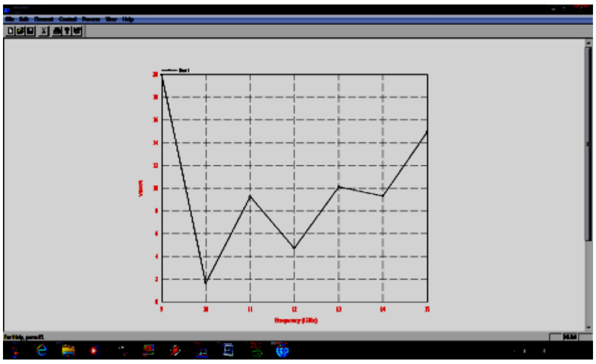
VSWR IS EFFECTIVE AND MINIMUM BETWEEN 1 TO 10 GH$_Z$



For proposed design the value of VSWR is effective between 1GHz to 10 GHz, for this value return loss is minimum. At 6GHz return loss is -22dB and VSWR is 1.238, which is minimum value.

## (b) For Triangular Geometry

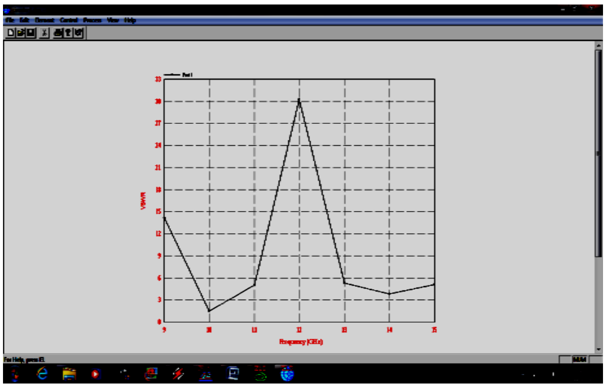
VSWR IS EFFECTIVE AND MINIMUM BETWEEN 1GHz TO 15GHz



For the proposed design the value of VSWR is effective between 1GHz to 15GHz, for this value the value of return loss is mimimum. At 10GHz the value of return loss is -12.2dB at 10GHz and VSWR is 1.648, which is minimum for this geometry.

## (d) For Circular Geometry

VSWR IS EFFECTIVE AND MINIMUM BETWEEN 1 TO 15 GHz

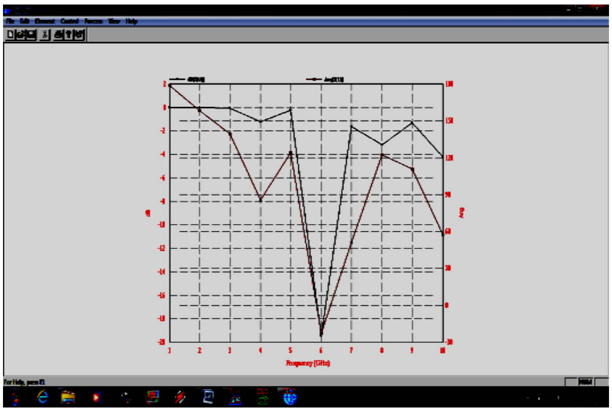


For proposed design the value of VSWR is effective between 1GHz to 15 GHz, for this value return loss is minimum. At 10GHz return loss is -15.5dB and VSWR is 1.4089, which is minimum value.

## *(2) RETURN LOSS VS FREQUENCY (IN GHz)*

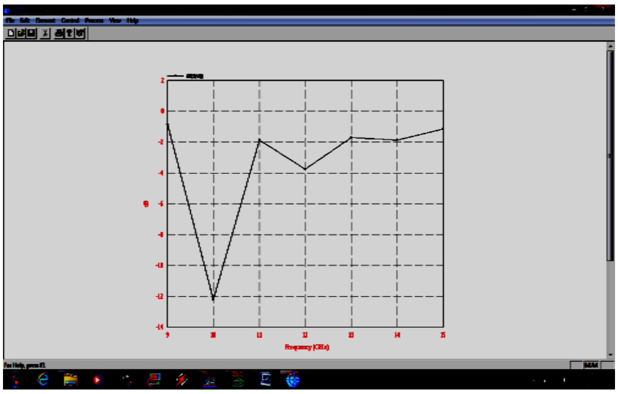
## (a) For Rectangular Geometry

At frequency of 6GHz the value of return loss is -22dB.



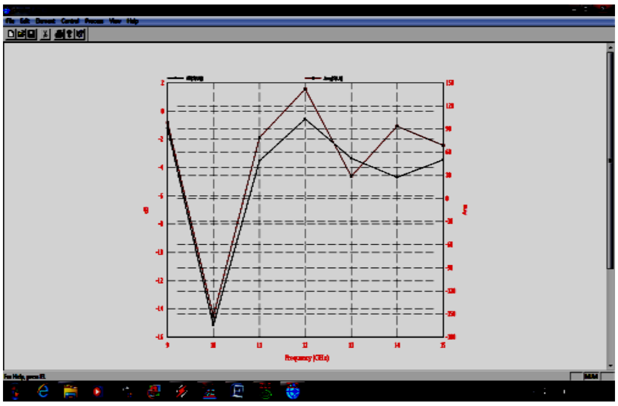
### (b) For Triangular Geometry

At frequency of 10GHz the value of return loss is -12.2dB.



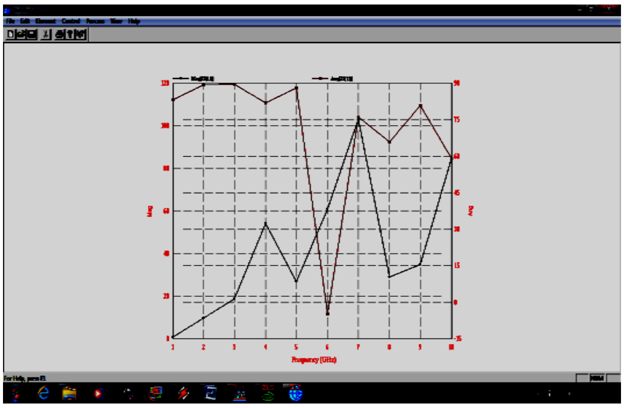
### (c) For Circular Geometry

At frequency of 10GHz the value of return loss is -15.5dB.

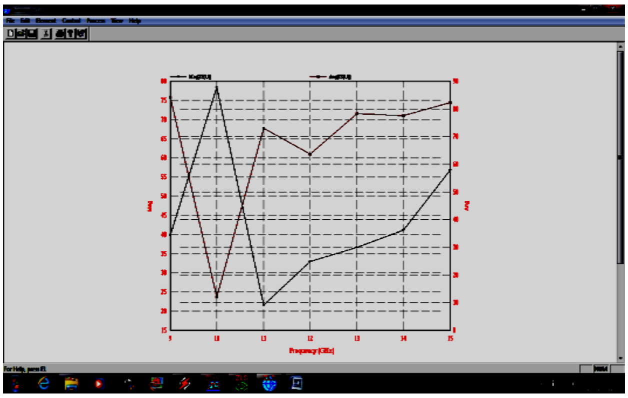


## *(3) S PARAMETER (magnitude in dB and phase) VS FREQUENCY IN GHz*

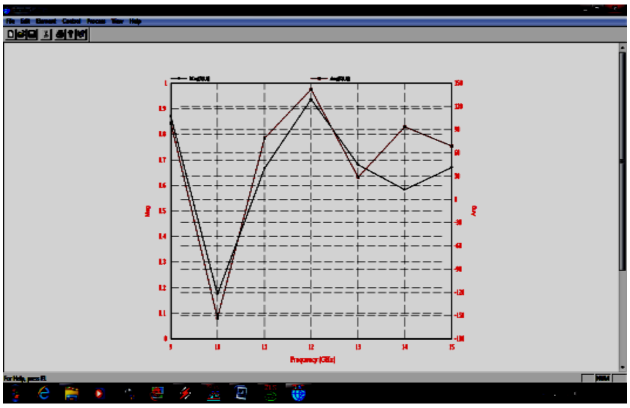
### (a) For Rectangular Geometry



### (b) For Triangular Geometry

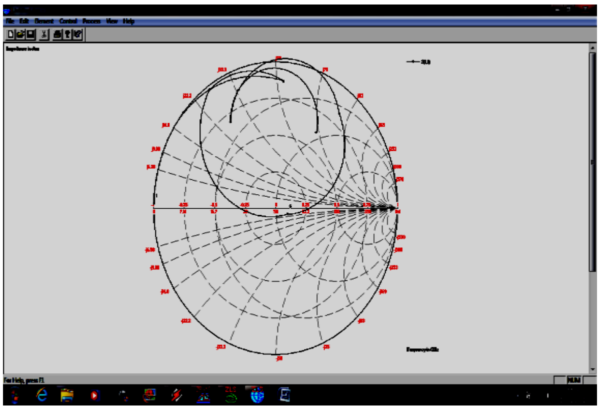


### (c) For Circular Geometry

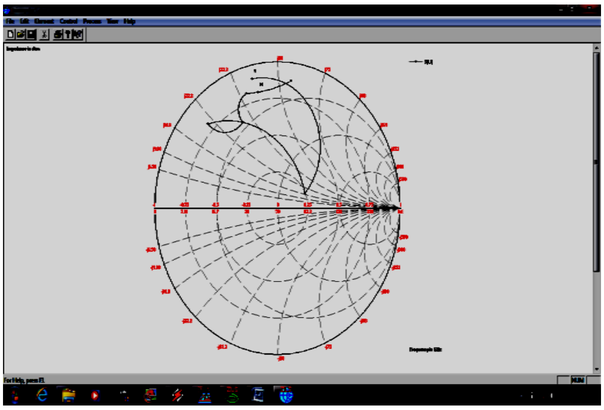


## *(3) SMITH CHART FOR DIFFERENT MEASUREMENT*

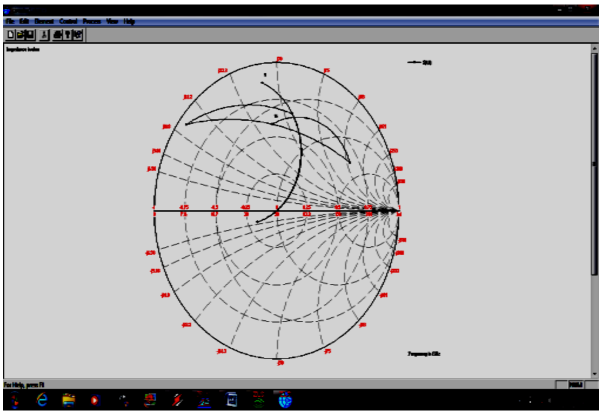
### (a) For Rectangular Geometry



### (b) For Triangular Geometry



### (c) For Circular Geometry



## SIMULATION TABLE:-

### ( a) For Rectangular Geometry

| S.No | Co-ordinates | Result in dB |
|---|---|---|
| 1 | ( 0 , 0 ) | -17dB |
| 2 | (15,10.5) | -20.5 dB |
| 3 | (15,0) | -18 dB |
| 4 | (15,-10.5) | -20 dB |
| 5 | **(0,-10.5)** | **-22 dB at 6 GHz** |
| 6 | (-15,-10.5) | -21 dB |
| 7 | (-15,0) | -18 dB |
| 8 | (-15,10.5) | -20 dB |
| 9 | **(0, 10.5)** | **-22dB** |
| 10 | (0,5.25) | -16dB |
| 11 | (7.5,0) | -17 dB |
| 12 | (0,-5.25) | -16 dB |
| 13 | (-7.5,0) | -17 dB |
| 14 | (7.5,5.25) | -5.5 dB |
| 15 | (7.5,-5.25) | -5.5 dB |

### (b) For Triangular Geometry

| S.No | Co-ordinates | Result |
|---|---|---|
| 1. | ( 0 , 0 ) | -7.1 dB |
| 2. | ( 15 , 0 ) | -7.2 dB |
| 3. | (30 , 0 ) | -7.1 dB |
| 4. | (22.5,12.99) | -7.5 dB |
| 5. | (15,25.98) | -7.1dB |
| 6. | (7.5,12.99) | -7.6 dB |
| 7. | (15,12.99) | -6.5 dB |
| 8. | (7.55,6.6) | -12.2 dB at 10 GHz |
| 9. | (22.5,6.6) | -11.99dB |
| 10. | (15,19.45) | -6.0 dB |
| 11. | (11.2,13.05) | -7.1 dB |
| 12. | (18.7, 13.05) | -7.1 dB |
| 13. | (15,6.55 ) | -3.1 dB |

## (c) For Circular Geometry

| S.No | Co-ordinates | Results |
|---|---|---|
| 1. | ( 0 , 0 ) | -10 dB |
| 2. | (5.3 , 0 ) | -8.5 dB |
| 3. | (10.6 , 0 ) | -6.8 dB |
| 4. | (12.8 , 0 ) | -6.0 dB |
| 5. | (15 , 0 ) | -14 dB |
| 6. | (0 , 5.3 ) | -14 dB |
| 7. | (0 , 10.6 ) | -6.9 dB |
| 8. | (0 , 12.7 ) | -10 dB |
| 9. | (0 , 15 ) | -14.1 dB |
| 10. | (5.3 , 10.6 ) | -10.2 dB |
| 11. | **(5.7 , 13.9)** | **-15.5 dB at 10 GHz** |
| 12. | (10.6 , 10.6 ) | -14.9 dB |
| 13. | **(13.9 , 5.7 )** | **-15.5 dB** |
| 14. | (5.3 , 5.3 ) | -9.0 dB |
| 15. | (-5.3 , 0 ) | -8.9 dB |
| 16. | (-10.6 , 0 ) | -6.8 dB |

## 5. CONCLUSION

All the three geometries of patch antenna are investigated including the radome effect. Results are found to be best in case of rectangular patch antenna. However the feed positions which produce the remarkable results lie on edge of rectangular patch. In case of circular geometry we get the optimum result at diametrical opposite points. In case of triangular geometry the results are not as good as in case of both rectangular as well as circular patch. This suggests that if we implement these feed points in practical application, we can obtain optimized result.

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