

Experiment – 5: Simulation of Circular Microstrip Antenna

1. **Aim:** To design and analyze a circular microstrip patch antenna.
2. **Objective:** Design, Simulate and Analyze a microstrip fed circular patch antenna (CMSA) using ANSYS.

3. Requirements

- ANSYS Software

4. Pre-experiment Exercise:

Brief Theory

Microstrip antennas have profound applications especially in the field of medical, military, mobile and satellite communications. Their utilization has become diverse because of their small size and light weight. The patch may be in a variety of shapes, but rectangular and circular are the most common because ease of analysis and fabrication, attractive radiation characteristics, especially low cross polarization. After rectangular patch the next configuration is the circular patch (as shown in figure 1) which has varying applications as a single patch element as well as in arrays. The circular patch has only one degree of freedom to control i.e. radius of the patch.

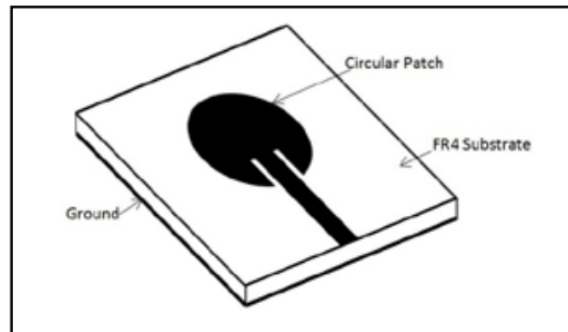


Fig. 1: Circular Patch Antenna

In order to design a rectangular microstrip patch, the following design procedure is used:

The radius of the patch is given by

$$a = \frac{F}{\left\{1 + \frac{2h}{\pi \epsilon_r F} \left[\ln \left(\frac{\pi F}{2h} \right) + 1.7726 \right] \right\}^{1/2}}$$

where

$$F = \frac{8.791 \times 10^9}{f_r \sqrt{\epsilon_r}}$$

5. Laboratory Exercise

A. Design Calculations:

Sr. No.	Parameter	Value
1.	Resonant Frequency (f_o)	
2.	Radius of the patch (a)	

B. Procedure:

- 1) Open HFSS and create new project
- 2) Create a substrate of required size.
- 3) Use to draw option to draw a circular patch on the substrate, edit the parameters of the circular patch drawn using *Create Circle* option.
- 4) Similarly use the draw option to draw the rectangular feed, edit the parameters of the feed using *Create Rectangle* option.
- 5) Use the *Unite* option to join the patch and the feed.
- 6) Draw the ground plane, and then assign *PerfE* boundaries to both the patch and the ground.
- 7) Select the required substrate from the library.
- 8) Create a Lumped Excitation Port and then draw the radiation box of required dimensions, also assign radiation boundaries.
- 9) Add the required simulation set up, proceed with validation check, save the file and simulate the circular patch antenna structure.
- 10) Open the S_{11} graph and interpret the same, add markers to find the resonant frequency and the bandwidth.

6. Post Experiment Exercise:

6.1 Results:

Sr. No.	Parameter	Theoretical values	Simulation Result
1.	Resonant frequency (f_o)		

2.	% Bandwidth	-	
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6.2 Conclusion

6.3 Questions:

1. Explain microstrip patch antenna along with its characteristics and applications.
2. Explain the working of microstrip antenna with the help of transmission line model.