ANTENNAS AND WAVE PROPAGATION

LAB ASSIGNMENT 5

EXPERIMENT 5

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BATCH: 2018-2022
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AIM: Design a quarter wave transmission feed line MSA for 2.4 GHz.

Theory: In this experiment we will be forming a Micro Strip Antenna with a quarter wave transmission Feedline.

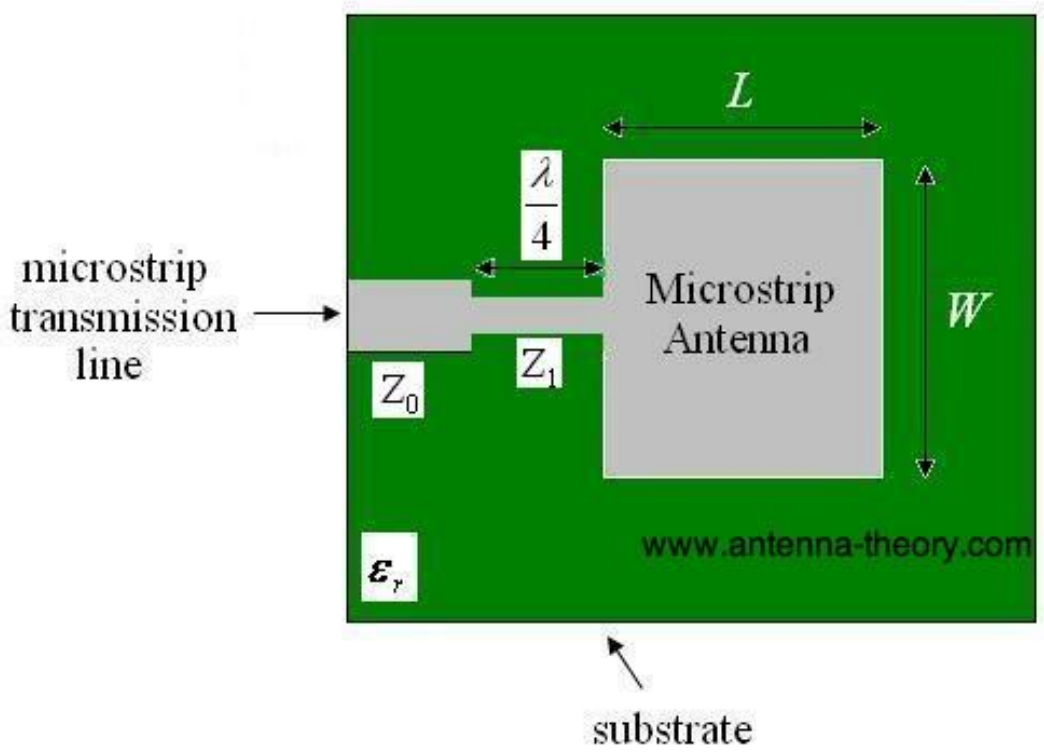
The microstrip antenna can also be matched to a transmission line of characteristic impedance Z0 by using a quarter-wavelength transmission line of characteristic impedance Z1 as shown in Figure.

The goal is to match the input impedance (Zin) to the transmission line (Z0). If the impedance of the antenna is ZA, then the input impedance viewed from the beginning of the quarter-wavelength line becomes input impedance viewed from a quarter-wavelength

$$Z_{in} = Z_0 = \frac{Z_1^2}{Z_A}$$

This input impedance Zin can be altered by selection of the Z1, so that Zin=Z0 and the antenna is impedance matched. The parameter Z1 can be altered by changing the width of the quarter-wavelength

strip. The wider the strip is, the lower the characteristic impedance (Z0) is for that section of line.



The quarter wave length transmission line is used for the matching purposes of the impedance. It is known as stub matching of the load impedance.

A quarter-wave impedance transmission line, often written as λ/4 impedance transformer, is a transmission line or waveguide used in electrical engineering of length one-quarter wavelength (λ), terminated with some known impedance. It presents at its input the dual of the impedance with which it is terminated.

$$\Gamma = \frac{Z_{in}(\omega) - Z_0}{Z_{in}(\omega) + Z_0}$$

$$\mathrm{VSWR} = \frac{V_{max}}{V_{min}} = \frac{1 + |\Gamma|}{1 - |\Gamma|}$$

Calculations:

Width formula of the ground and Patch:

$$W = \frac{1}{2f_r\sqrt{\mu_0\varepsilon_0}}\sqrt{\frac{2}{\varepsilon_r+1}} = \frac{v_0}{2f_r}\sqrt{\frac{2}{\varepsilon_r+1}}$$

Length formula of the ground and Patch:

$$L = \frac{1}{2f_r\sqrt{\varepsilon_{reff}}\sqrt{\mu_0\varepsilon_0}} - 2\Delta L$$

Lamda formula for Ground Plane and transmission feedline:

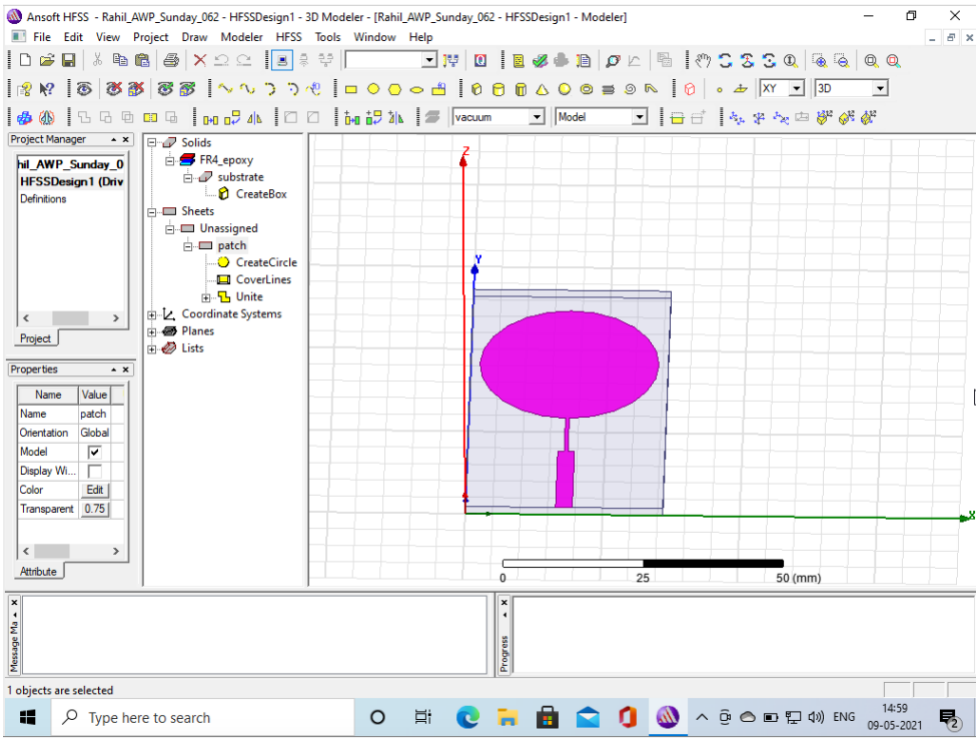
Lambda = C x f

Software Specifications:

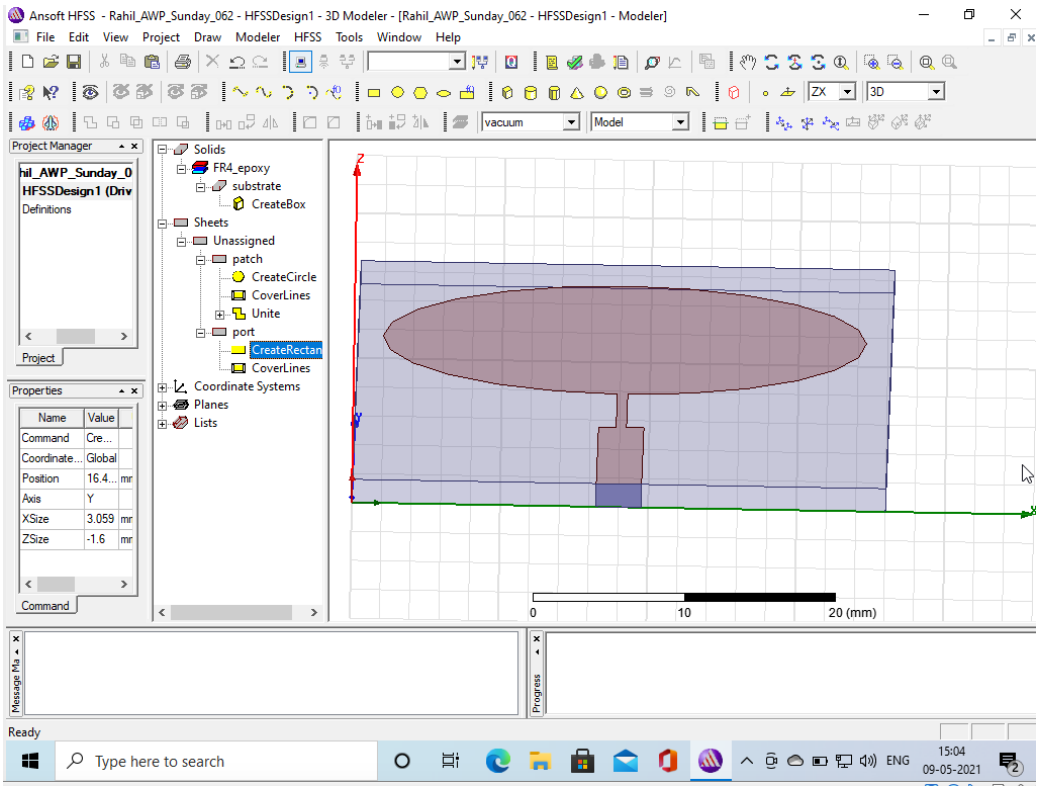
Operating System: Windows 10 Virtual Machine OS
Software: HFSS Version 13
KIT: Antenna Design Kit

Procedure and Outputs of the design:

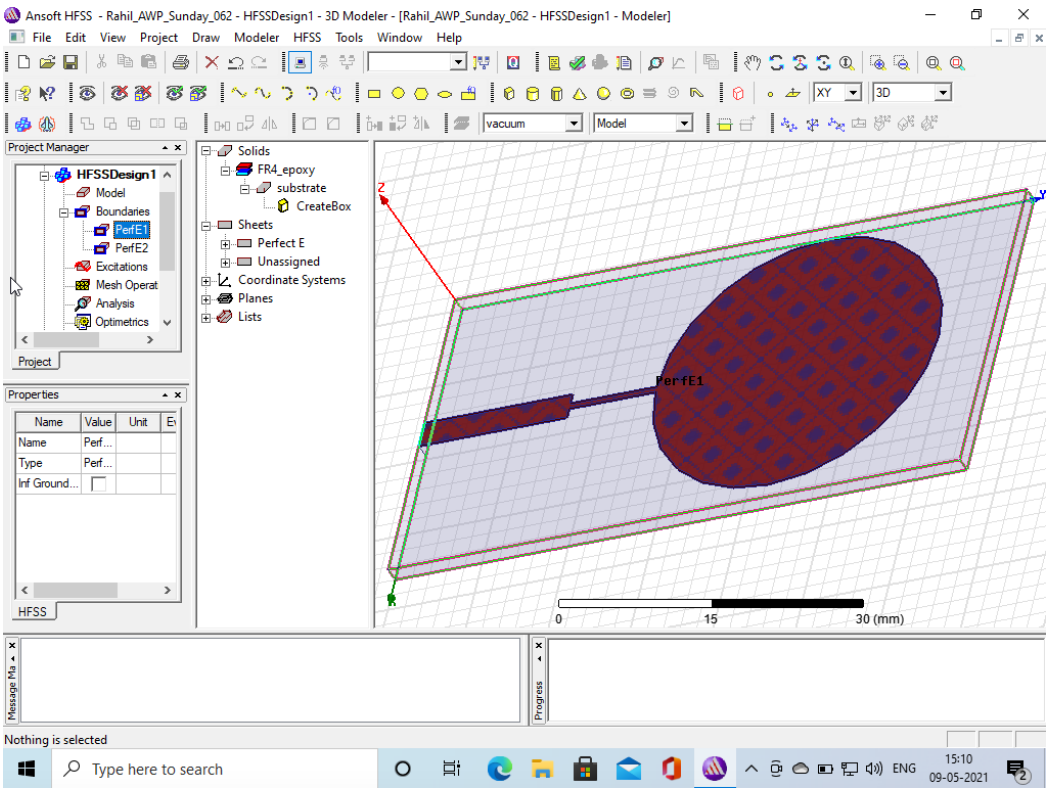
1. We will first design a substrate of the design.
2. Then we design a circular patch of the design.
3. Then we have to create the transmission feed line with the calculation of lambda/4 and lamda.
4. It Is important to use the formula of length, width and lamda values to ensure accurate results.

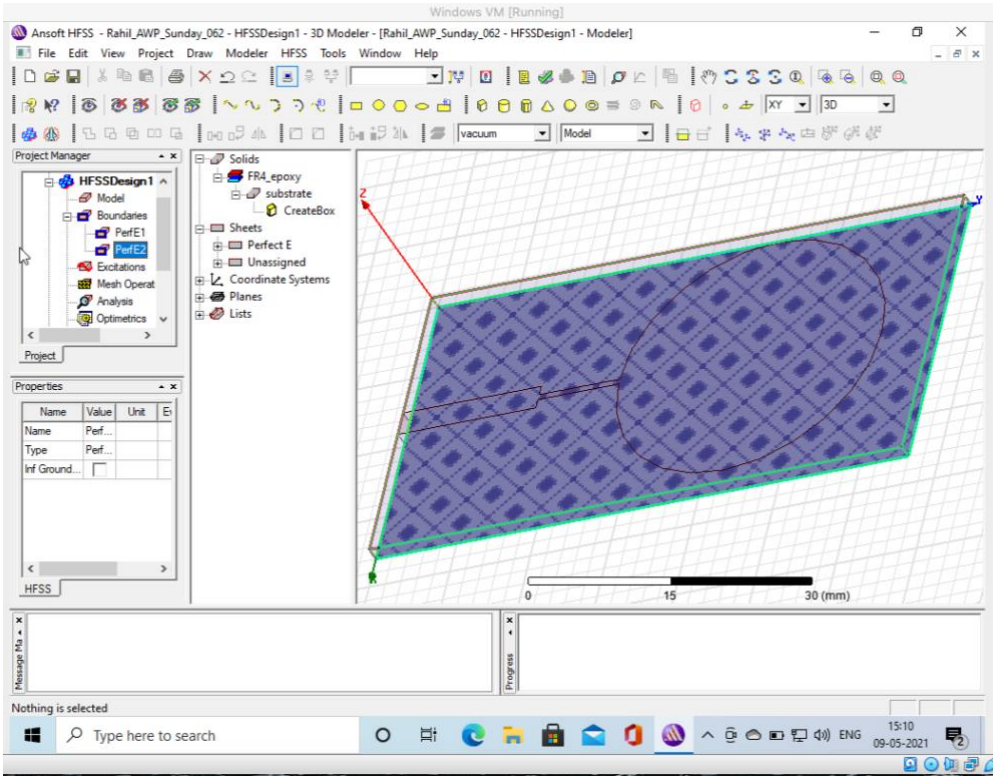


5. Then after designing the feedline we will calculate and design the patch of the Antenna.



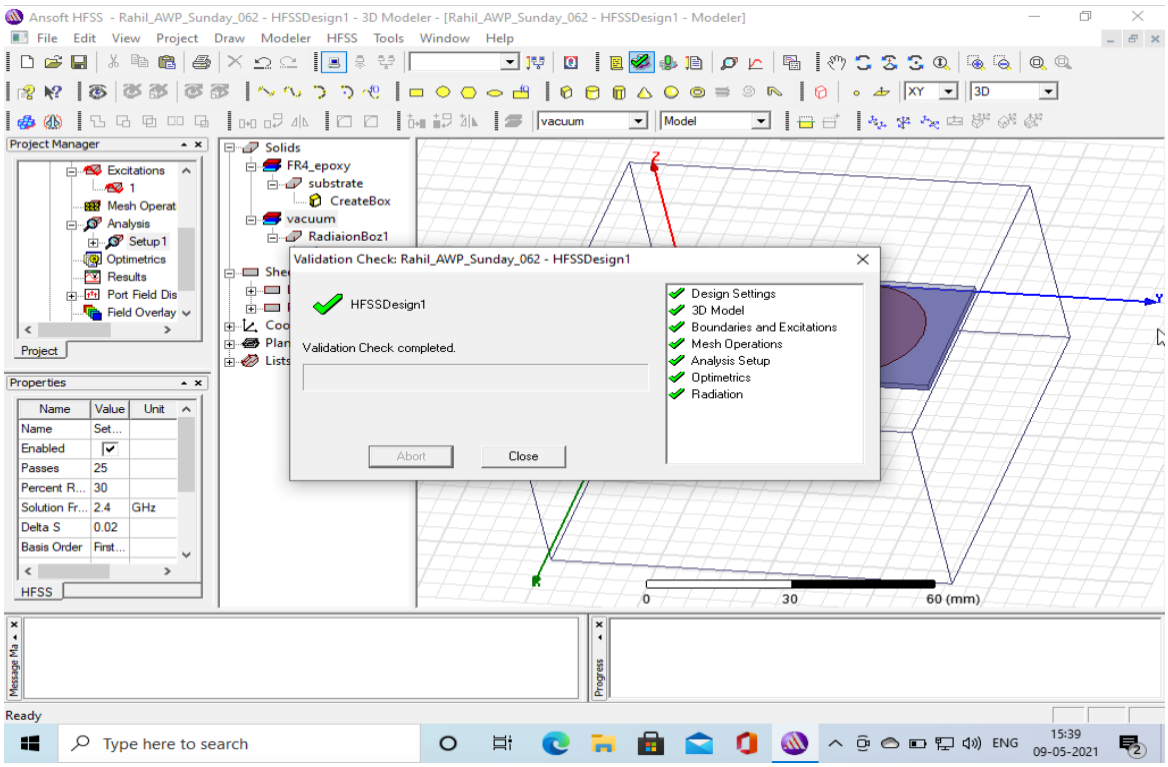
6. Then we will design the ground to our design.
7. Apply boundary to the Patch and Ground essentially Perfect E as shown below.



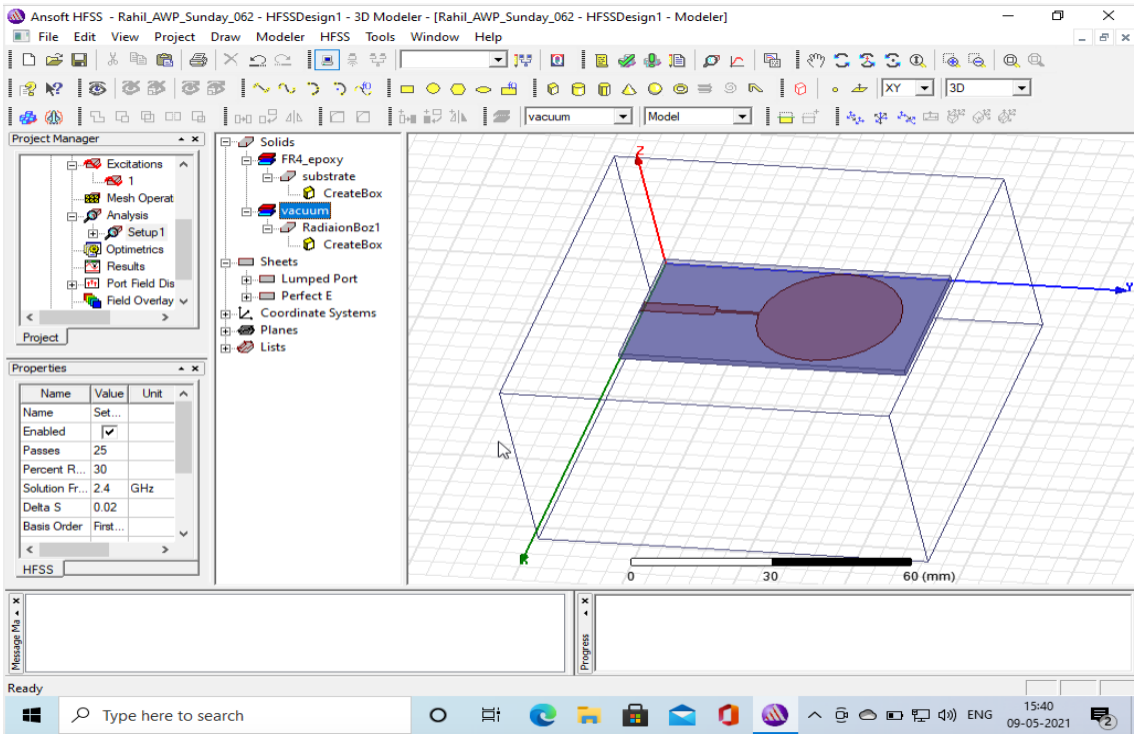


8. Then we will apply excitation to the Patch using Lumped Port.

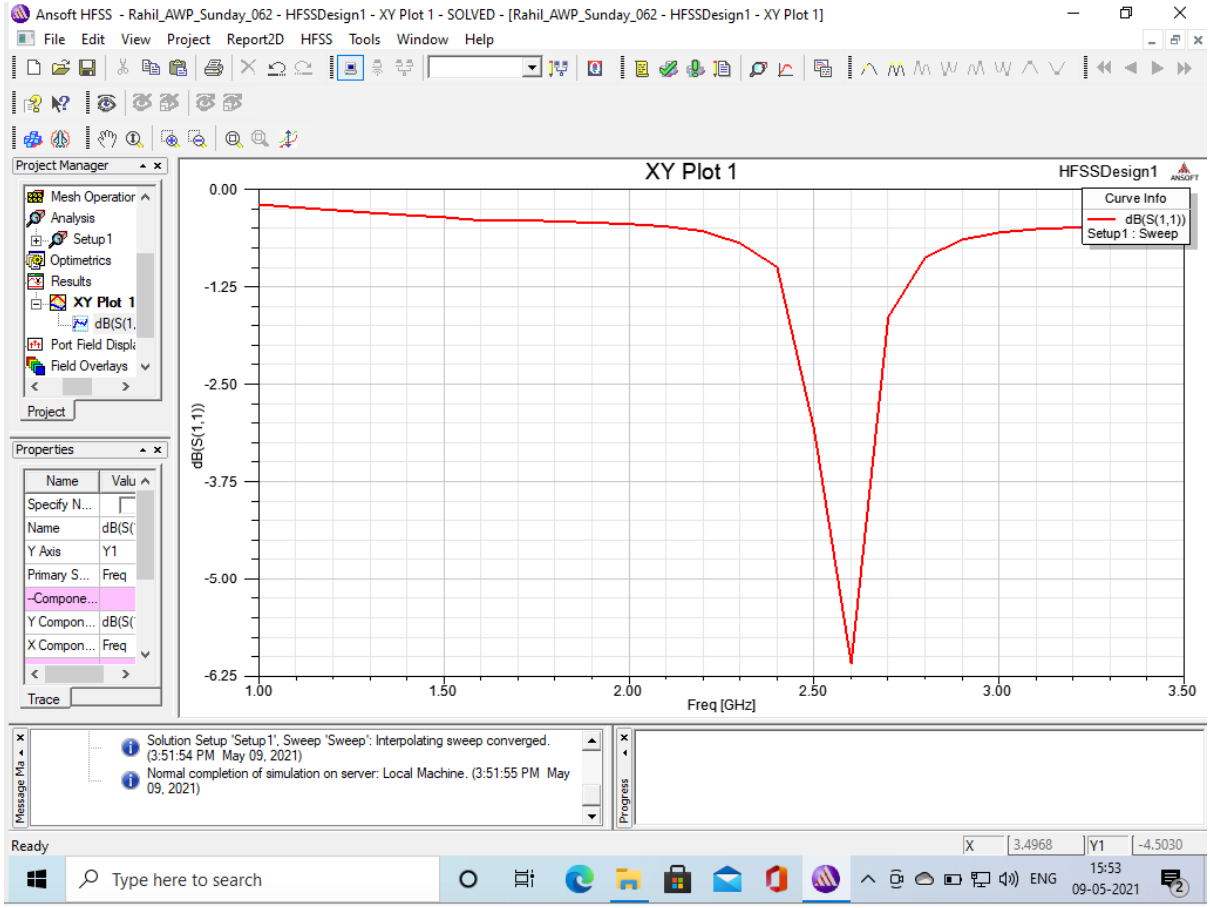
9. Design a box around the Antenna and apply radiation to it.
10. Click on Validate all as shown below.



11. Final Design of **a quarter wave transmission feed line MSA for 2.4 GHz.**



12.S Parameter plot of the Antenna.



CONCLUSION: From this experiment we have learnt how to design a quarter wave transmission feedline Micro Strip Patch Antenna for 2.4 GHz.