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Report Title:- Design of Inset-fed Microstrip Antenna

Objective:- The Objective of this experiment is to design a 2.4GHz inset fed microstrip antenna and observing its characterics using ADS simulation.

Structure of the Antenna: (Place the figure and describe it)

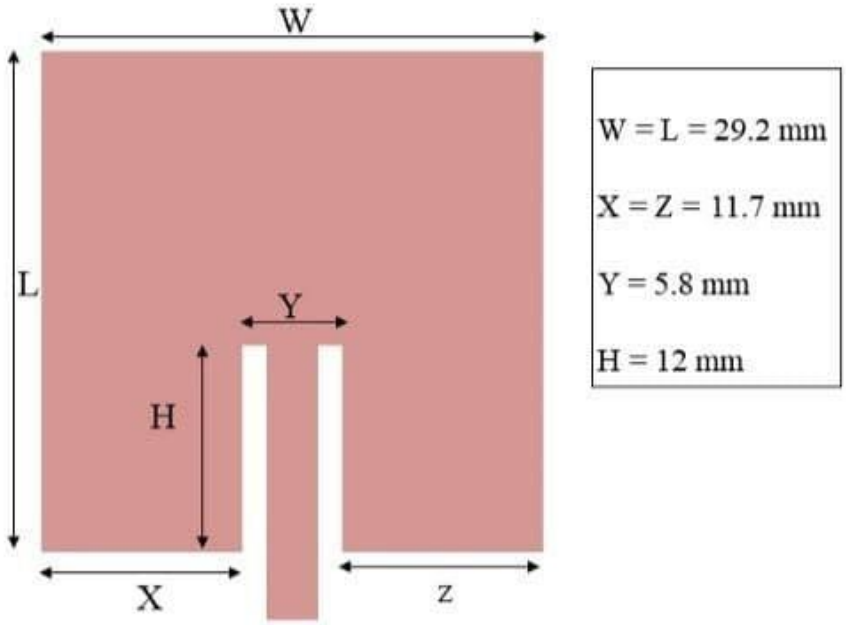
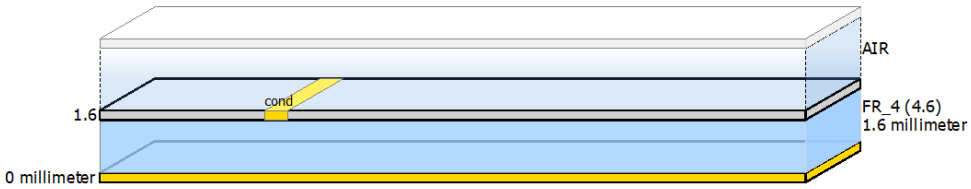


Fig.1.layout of inset fed microstrip antenna



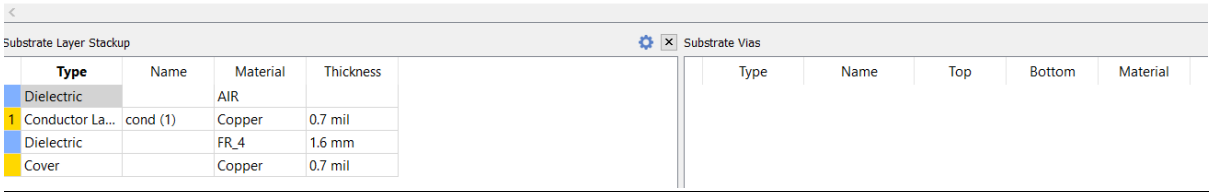


Fig.2.Substrate of inset fed microstrip fed antenna

Description:- In this type of technique,microstrip line acts as the feeding line and it is fed inside the radiating patch such that there is an air gap between feeding line and patch upto edge of the patch. By lincalc, we have to calculate the width of the feeding line for 2.4GHz frequency and 50ohm charateristics impedence .we got this 2.93mm. then, the length and width of the patch is equal and it is determined by the formula(W=L=c/(2*f*sqrt(er)) that we got is 29.2mm here. Depth of patch line into patch is,H=(.822*.5*L)=12mm.then,we got the value of width of feeding line including air gap is ,Y=(W/5)=5.8mm. Then,we determined the value of X=Z=(2*W/5)=11.7mm as in the fig-ure.Then,the substrate is used as before . The substrate is designed by FR_4 material.It's thickness ,relative permittivity and TanD values are 1.6mm, 4.6, .001 respectively. 0.7 mil cu is used as a conductor. A copper sheet is used as a ground. Upon the line,there is air dielectric.

Results

Reflection coefficient (Place the graph and describe it)

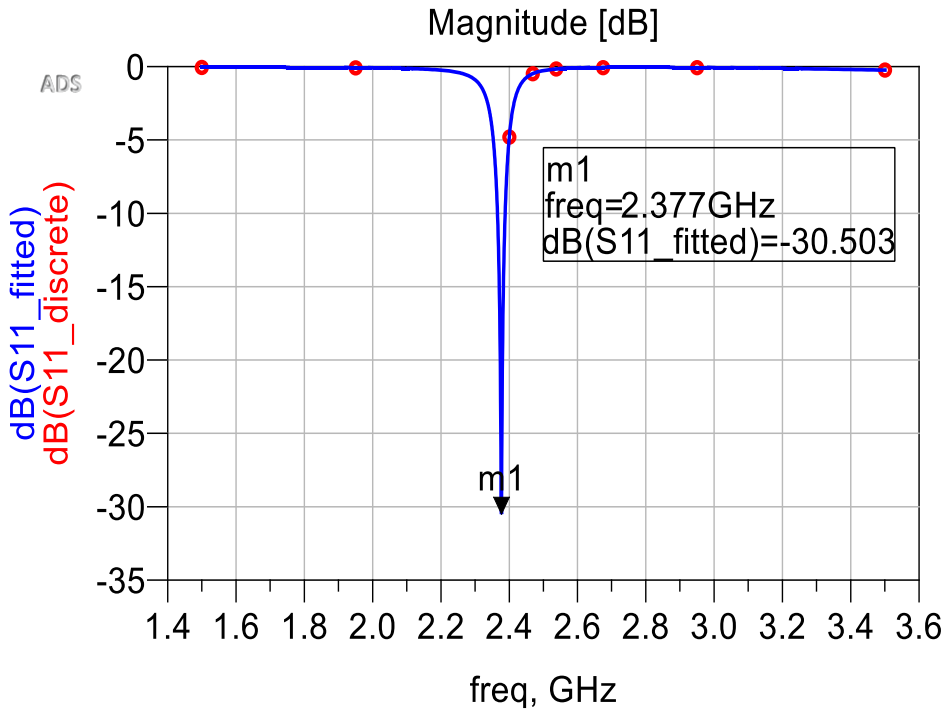


Fig.3.reflection coefficient(magnitude) vs frequency graph

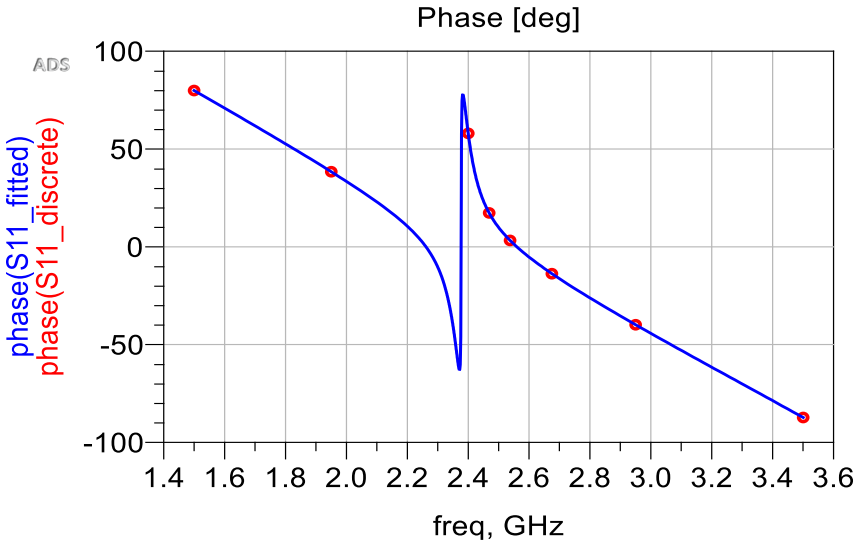


Fig.4.reflection coefficient(phase) vs frequency graph

Description:- From figure 3 we can see that the value of reflection coefficient is -30.503dB at 2.377 GHz (very near to 2.4GHz).So,we can tell that it will be a very good antenna at this frequency,As the value of reflection coefficient should be below -10dB. It will radiate maximum power at this frequency.From figure 4 we can see that at this frequency the phase is 0 degree. So, at this frequency, we will get resonace that is there will be no reactance part. It represents a very important thing that the antenna will perform well in narrow bandwidth.

Smith chart (Place the graph and describe it)

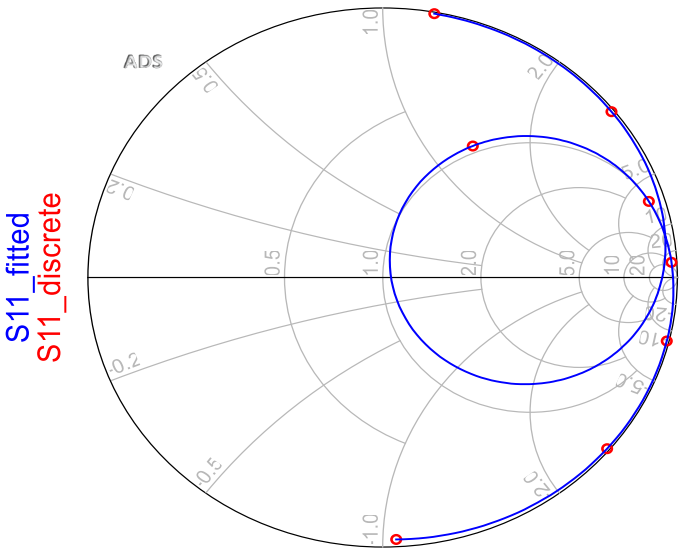


Fig.5.Smith Chart

Description:- Smith chart of the inset fed microstrip antenna is shown in the figure 5. It is connected to the reflection coefficient discussed before. We saw that the reflection coefficient graph near about 0dB(above -10dB) wasn't desired as it is due to the impedance mismatching of the antenna.By smith chart,we can understand it more precisely. If there isn't any impedance mismatching, the arc of the smith chart passes through the s=1/center. For,2.377GHz,the arc passes through near about s=1(reflection coefficient=0). At this point the value of reflection coefficient is near about zero. So,this is a indication of the antenna that it will perform very well at this frequency 2.377GHz (narrow bandwidth),otherwise performance will decrease.

Radiation pattern (2D and 3D) [Place the graph/figure and describe it]

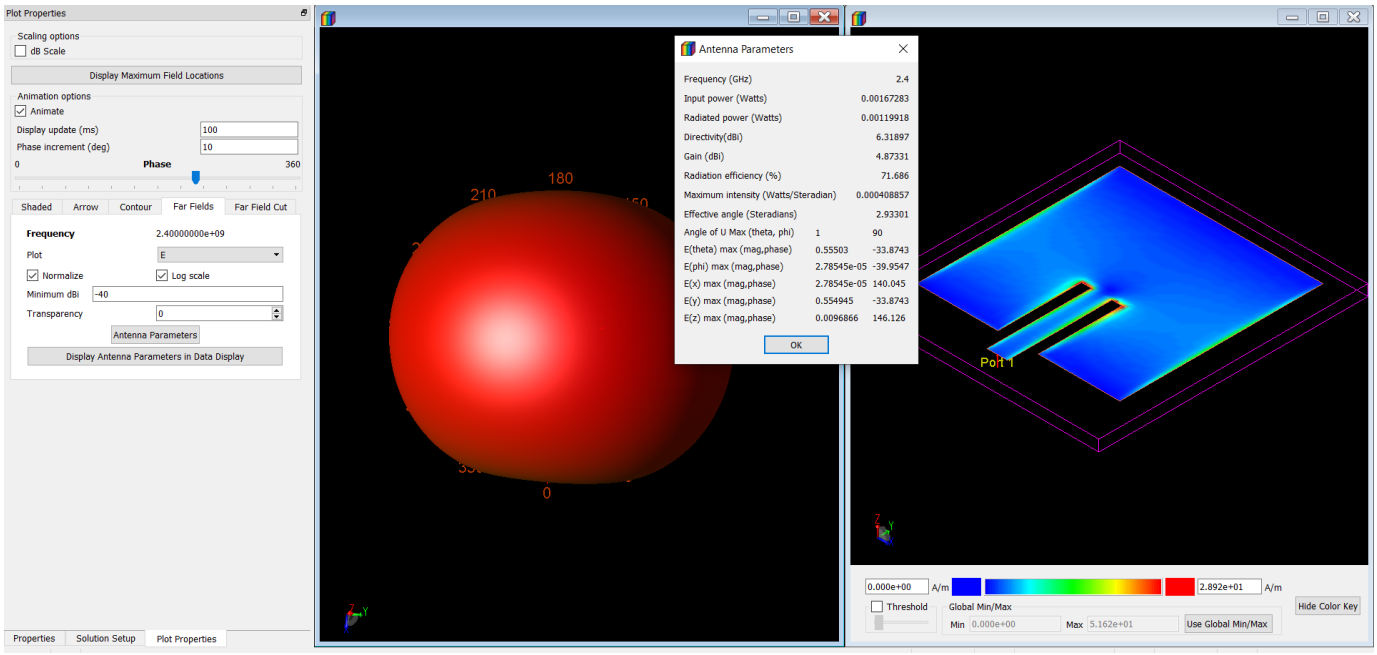


Fig.6.3D radiation pattern .

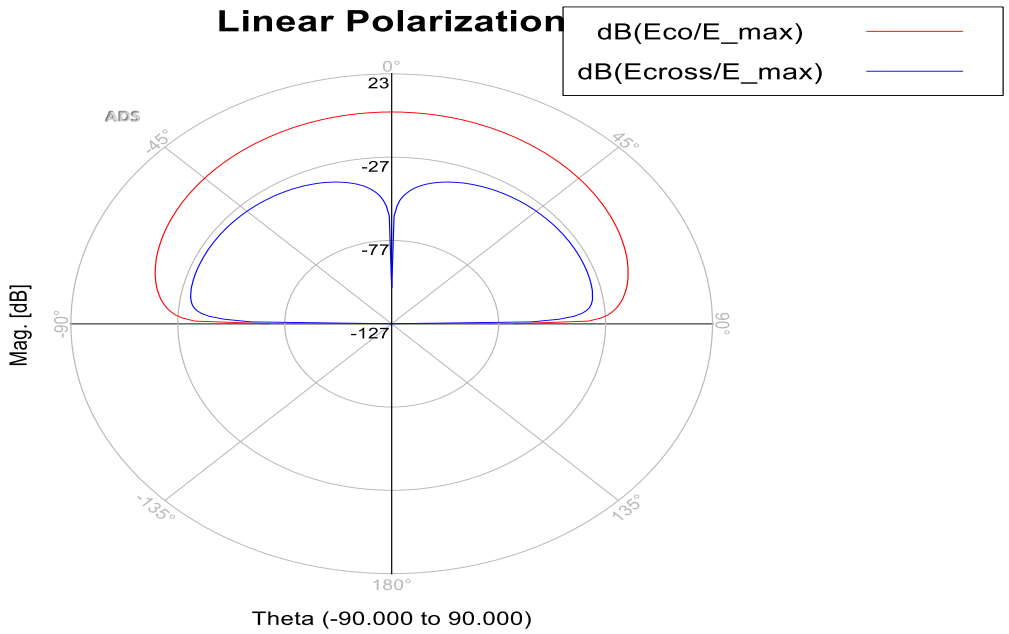


Fig.7.2D radiation pattern .

Description:- A graphical representation of the radiation properties of the antenna as a function of space coordinates is called radiation pattern. It is determined in the far field region mostly. In figure 6, there is shown the 3d radiation pattern and the current distribution of the inset fed antenna for the far field region and for the frequency 2.4GHz and various type of antenna parameters like gain,directivity,radiated power are also shown. From the direction of current we can know whether the polarization is vertical or horizontal.

In figure 7, there is shown the 2D radiation pattern of the inset fed antenna from which we see that there is significant difference between co and cross-polarization .Co polarization is desired whether cross is undesired. So, we can tell that the wave is linearly polarized otherwise co and cross component will coincide.

Task: Design and investigate the the performance of inset fed antenna. Frequency of the antenna =$\sqrt{x}$,x=last 3 digit of your student Id.

Design:-

My id is 1702009,so frequency of my antenna will 3GHZ. Firstly,By lincalc,I have to calculate the width of the feeding line for 3GHz frequency and 50ohm charateristics impedence .we got this 2.95mm as below.

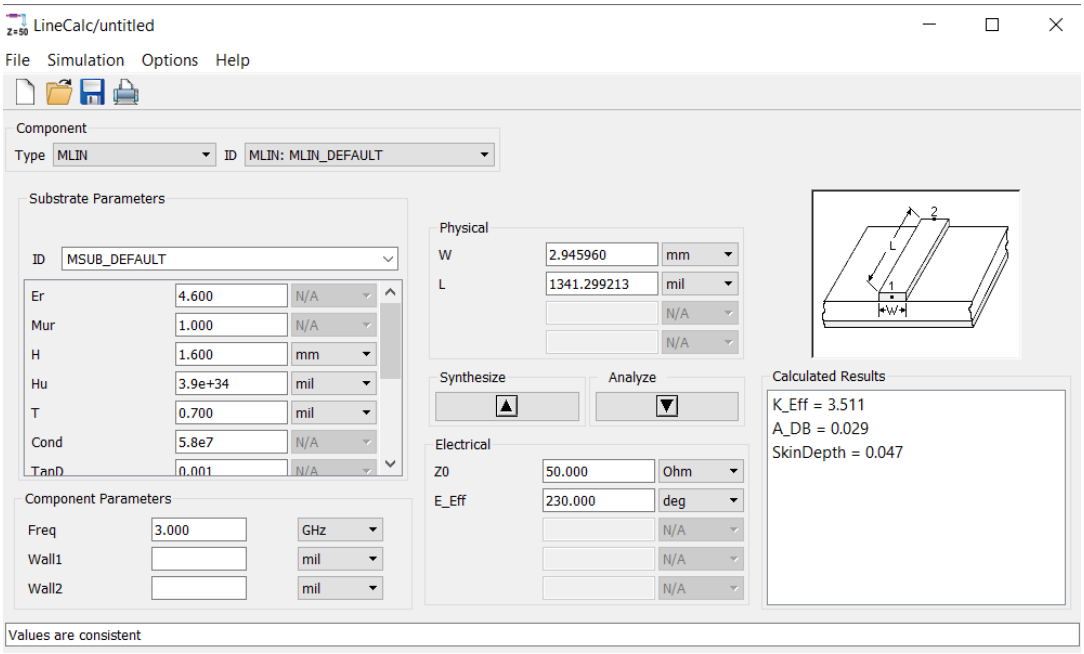


Fig.8.determining feeding line width by lincalc tools.

Then, the length and width of the patch is equal and it is determined by the formula(W=L=c/(2*f*sqrt(er)) (f=3GHz,er=4.6,c=3*10^8)that we got is 23.31mm here.

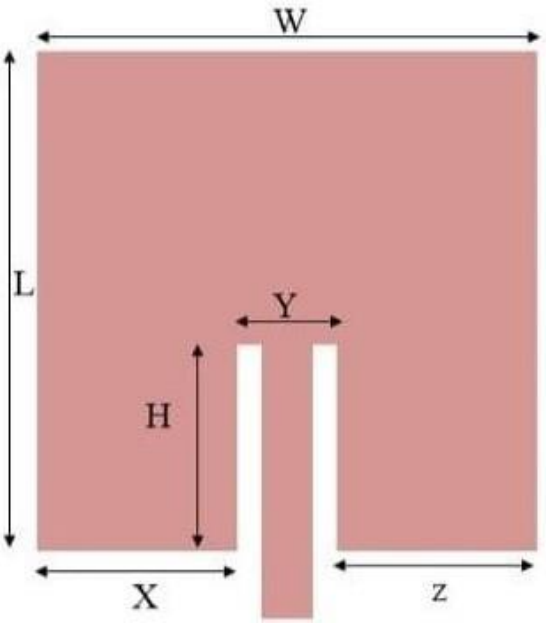
Depth of patch line into patch is,H=(.822*.5*L)=9.58mm.

then,we got the value of width of feeding line including air gap is, Y=(W/5)=4.662mm.

Then,we determined the value of X=Z=(2*W/5)=9.324mm as in the structure below.

Then,the substrate is used as before . The substrate is designed by FR_4 material.It's thickness ,relative permittivity and TanD values are 1.6mm, 4.6, .001 respectively. 0.7 mil cu is used as a conductor. A copper sheet is used as a ground. Upon the line,there is air dielectric.

So,the structure looks like:-



W=L=23.31mm

H= 9.58mm

Y= 4.662mm

X=Z= 9.324mm

Fig.9.layout of inset fed microstrip antenna

Performance:-

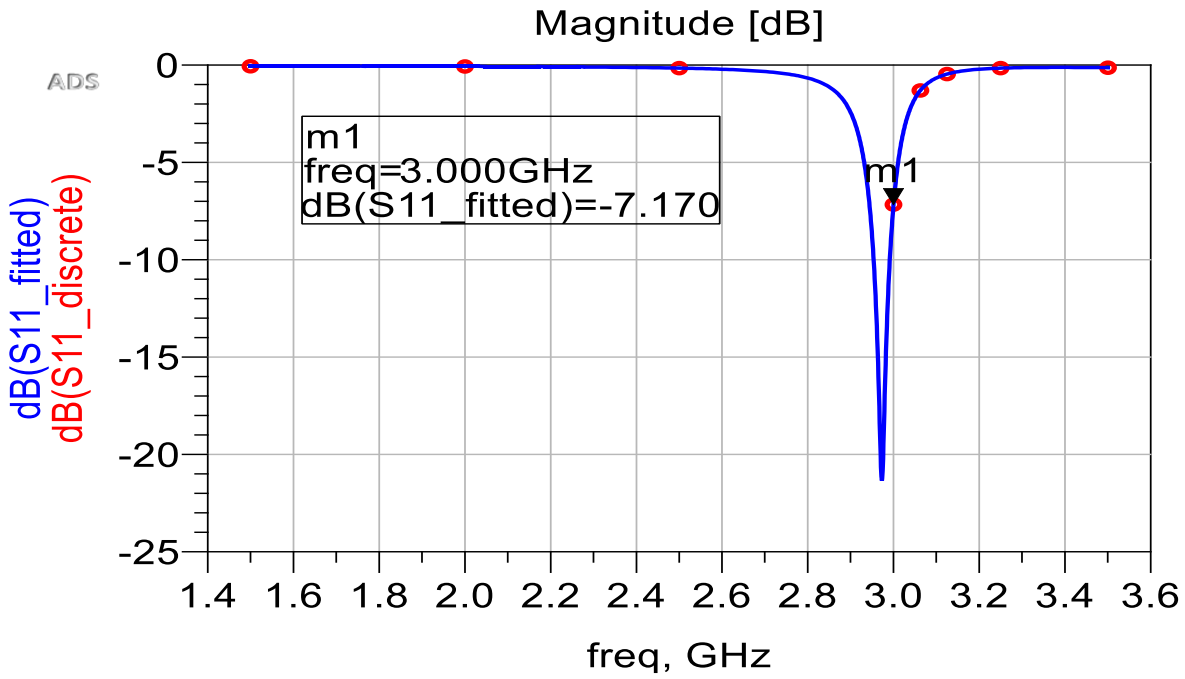


Fig.10.reflection coefficient(magnitude) vs frequency graph

Fig.11.reflection coefficient(phase) vs frequency graph

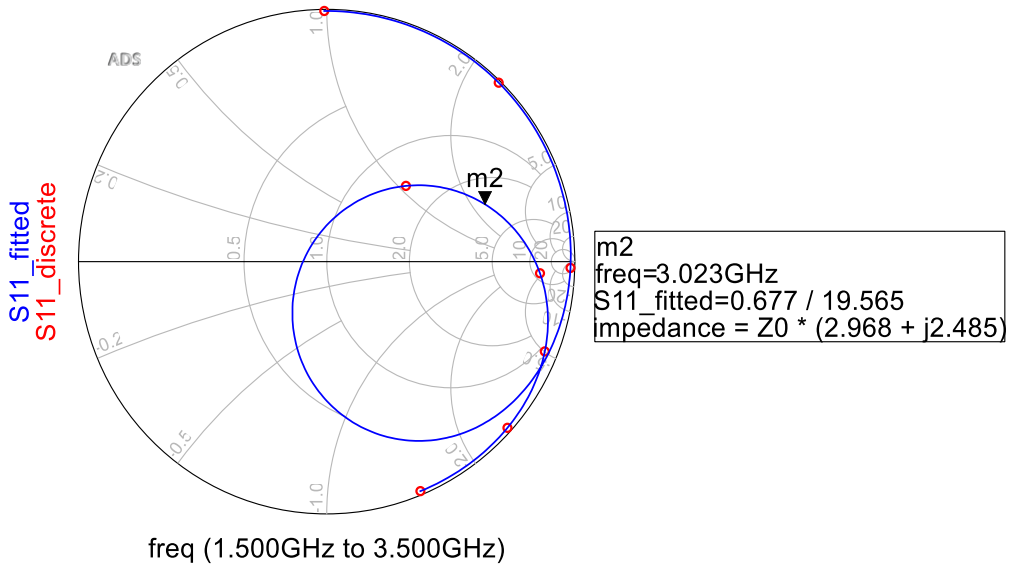


Fig.12.Smith Chart

From the figure 10,we can see that at 3GHz ,the magnitude of reflection coefficient is -7dB around. But near 3 GHz there is a frequency 2.9GHz about,in which S11 is -22dB around. Then from figure 11, we see that the resonant point will be gotten at 2.9 GHz around that is close to 3GHz. So,the antenaa will perform very well at this specific 2.9GHz frequency but performance will decrease in our desired 3GHz frequency. As mentioned before, that's why the inset fed antenna is very good for narrow bandwidth. From smith chart, we get the reflection coefficient value is .677 at 3.023GHz that is representation of bad performance in this frequency.