



Tutorial for Automated Design System (ADS)

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In this tutorial we will see how to use ADS.

We see in this tutorial how to do Single-Stub Shunt matching

We see how to use Smith Chart and also Rectangular to get matching

To Start ADS in the SUN lab

•type: "hpads" to run the program

If display environment is not matched for ADS, set your environment as following.

Add to your .cshrc file:

```
#hpeesof (ads 1.3) config
```

```
setenv HPEESOF_DIR /opt/hpeesof
```

```
set path = ( $path $HPEESOF_DIR/bin)
```

```
setenv HPEESOF_KEY $HPEESOF_DIR/licenses/hpeesof.key
```

•source .cshrc

•type: "hpads" to run the program

To Start ADS in the EM lab (PC)

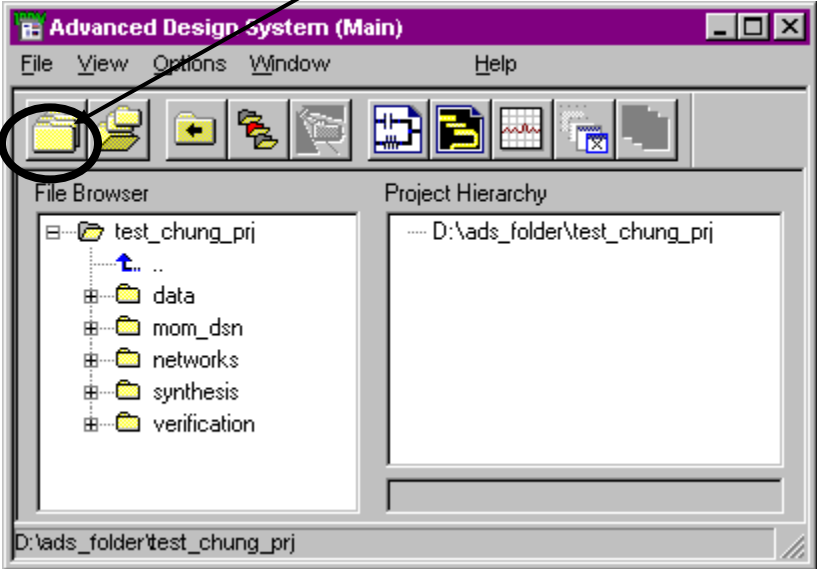
Double Click on ADS icon: Advanced System Design.

Table of Contents

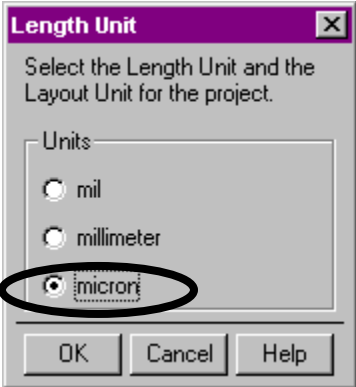
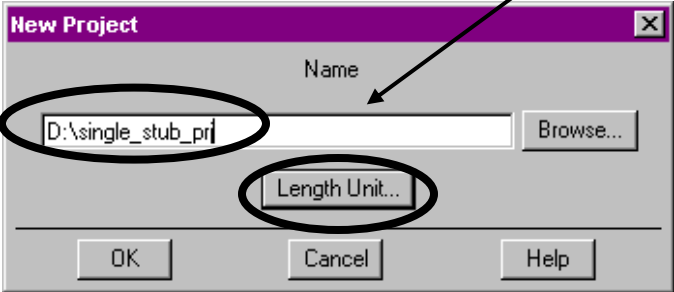
1. Create a NEW Project Directory.....	4
2. Open a Schematic Window	5
3. Get parts and Paste.....	5
4. Copy/Paste and Move a part.....	6
5. Calculate length and width of MLIN with Line Calculation Tool	7
6. Change Component Parameters.....	8
7. Add MTEE part, Change width of MTEE and Move Text of a part.....	9
8. Add Open Circuit Stub (MLOC)	10
9. Calculate the length of MLOC and Change Parameters of Open Circuit Stub (MLOC)	11
10. Add Term, R and L.....	12
11. Add S Parameter.....	13
12. Add MSUB.....	14
13. Saving and Simulation of the Circuit.....	15
14. Open a Data Display Window, and Rectangular Plot in the Data Display Window	16
15. Select S(1,1)/Plot Magnitude Parameter	17
16. Add Marker on S(1,1) graph	18
17. Tuning Parameters	19
18. Fine Tuning Parameters.....	20
19. Changing Impedance to Admittance.....	21
20. Tuning with Smith Chart	22
21. Matching with Admittance.....	23

1. Create a NEW Project Directory.

- Create a new project by clicking on New Directory icon

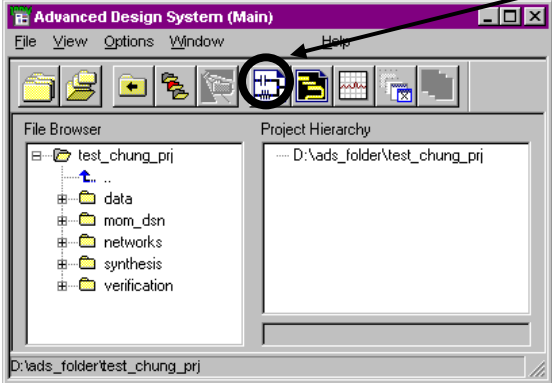


- Then, you will have the window below. Click on Length Unit and select 'micron'. Click on 'OK' on Length Unit window.
- Then, Type the directory name that you want. Click 'OK'



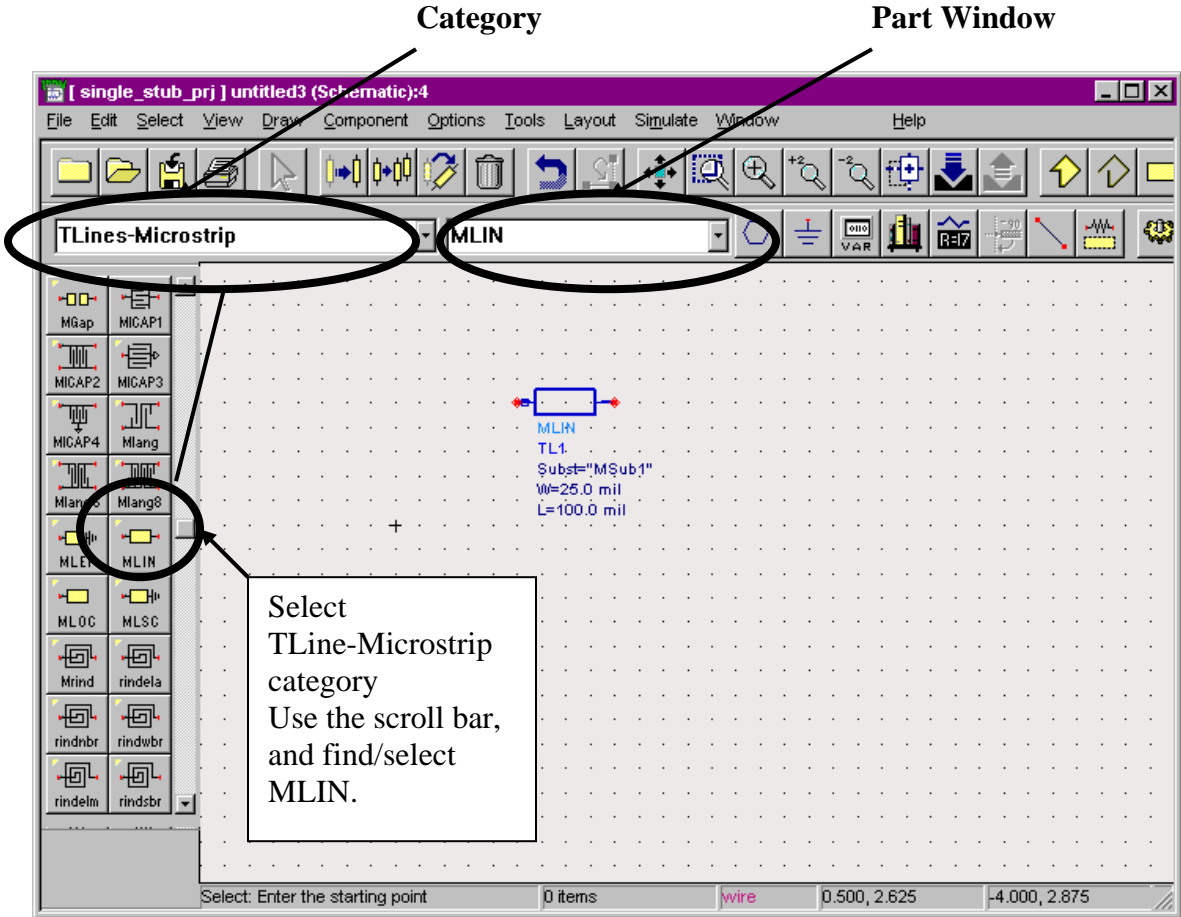
2. Open a Schematic Window

- Click on the icon ‘New Schematic Window’



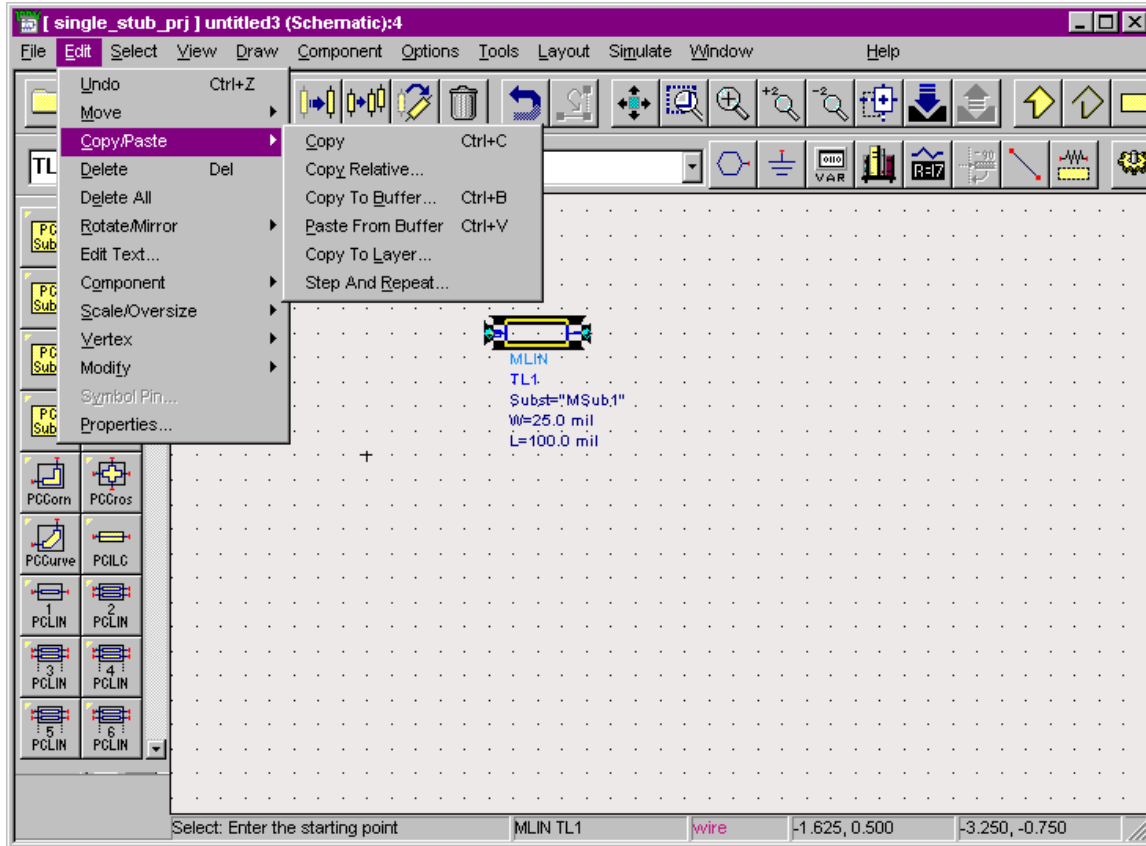
3. Get parts and Paste

- On the Schematic Window: get a part MLIN under Tlines-Microstrip category, or type ‘MLIN’ in the **part window**.
- Then, paste the part on the center of the window by clicking left mouse button.
- To stop adding the part, push ESC key, or select ‘End command ESC’ in the menu by clicking right mouse button.



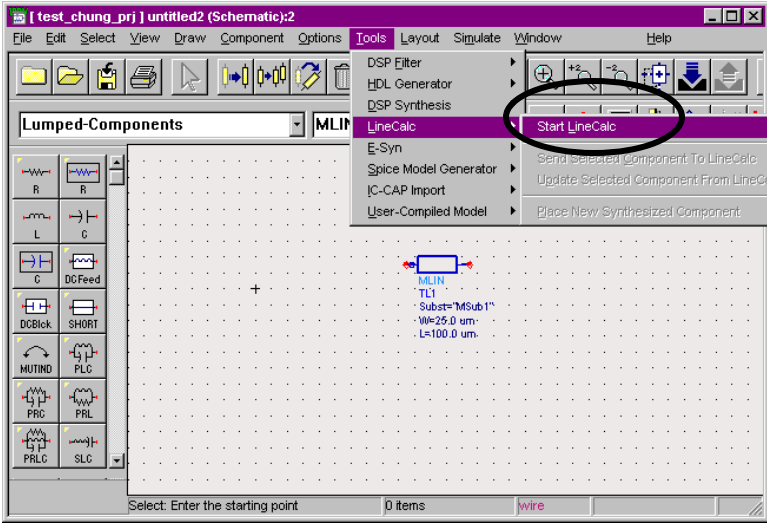
4. Copy/Paste and Move a part

- Highlight/select the part that you want to copy, and click on copy under edit.
- Click on left mouse button at the place to paste.
- To move a part, select a part and drag the part.

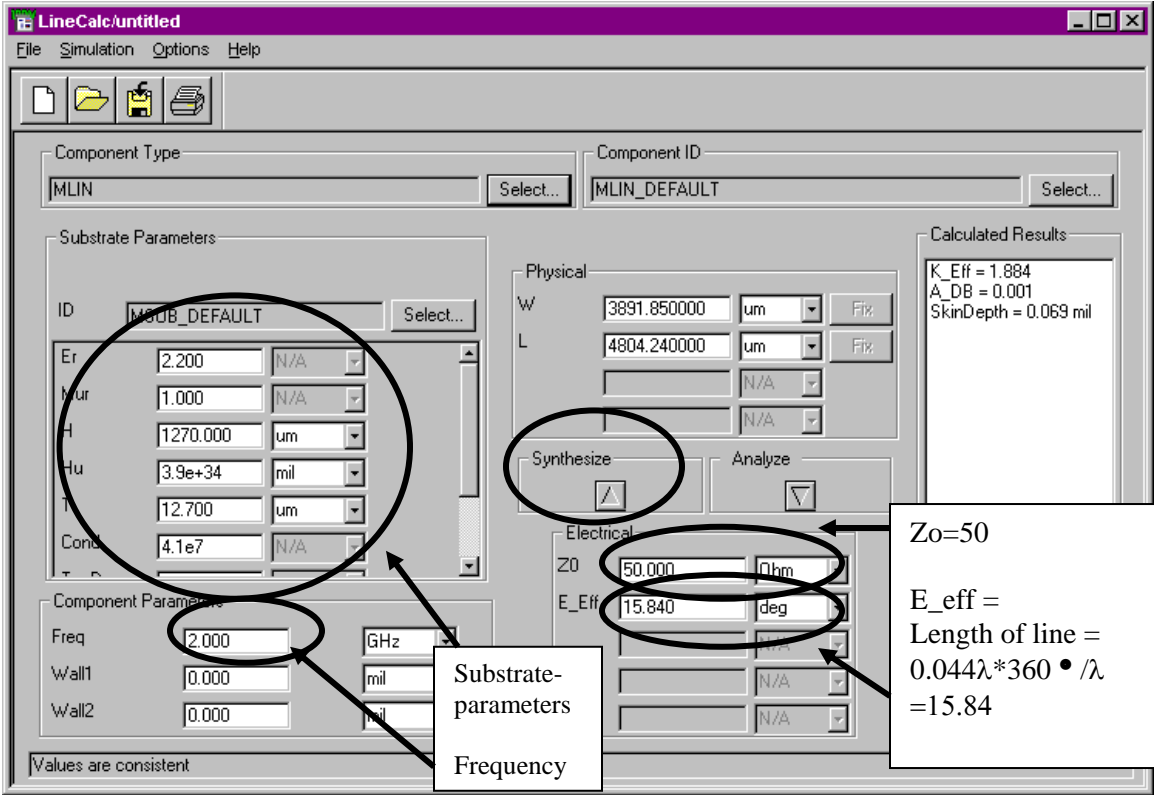


5. Calculate length and width of MLIN with Line Calculation Tool

- Select/highlight the part and click on Start Line Calc under Tool/LineCalc menu.

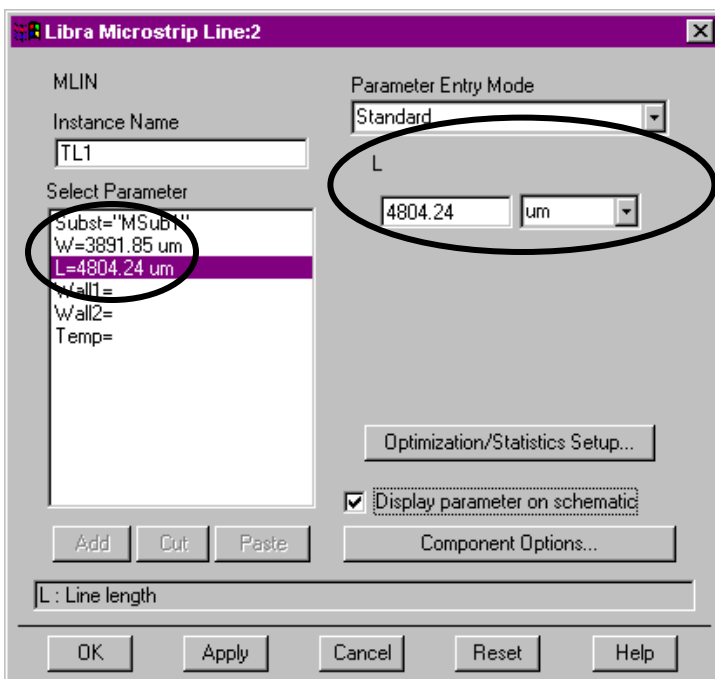
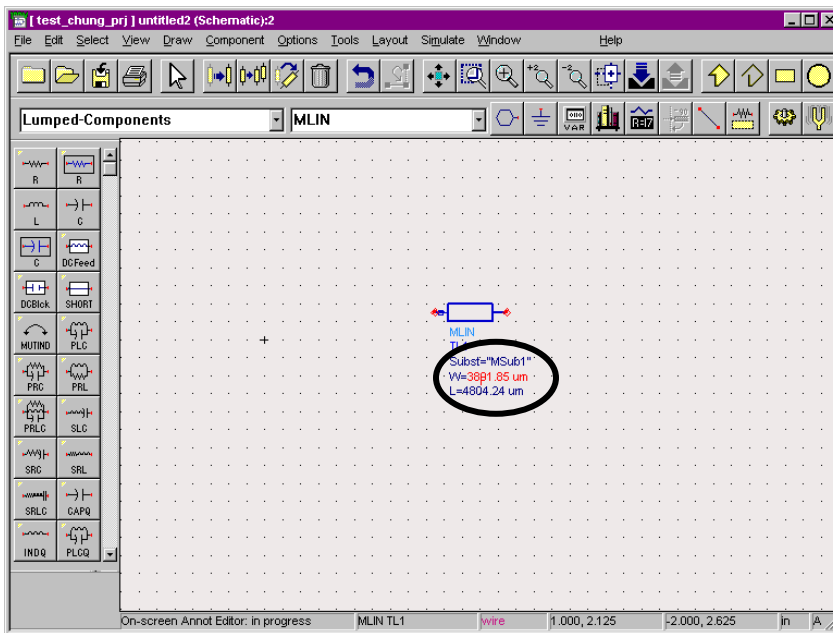


- Insert substrate parameters: H=1270um, T=12.7um, Er=2.2 (Match with your substrate parameters).
- Type in Zo=50ohm, Frequency=2GHz and E_eff value.
- Click on Synthesize arrow. It will calculate W and L for you. (Check Unit =um)



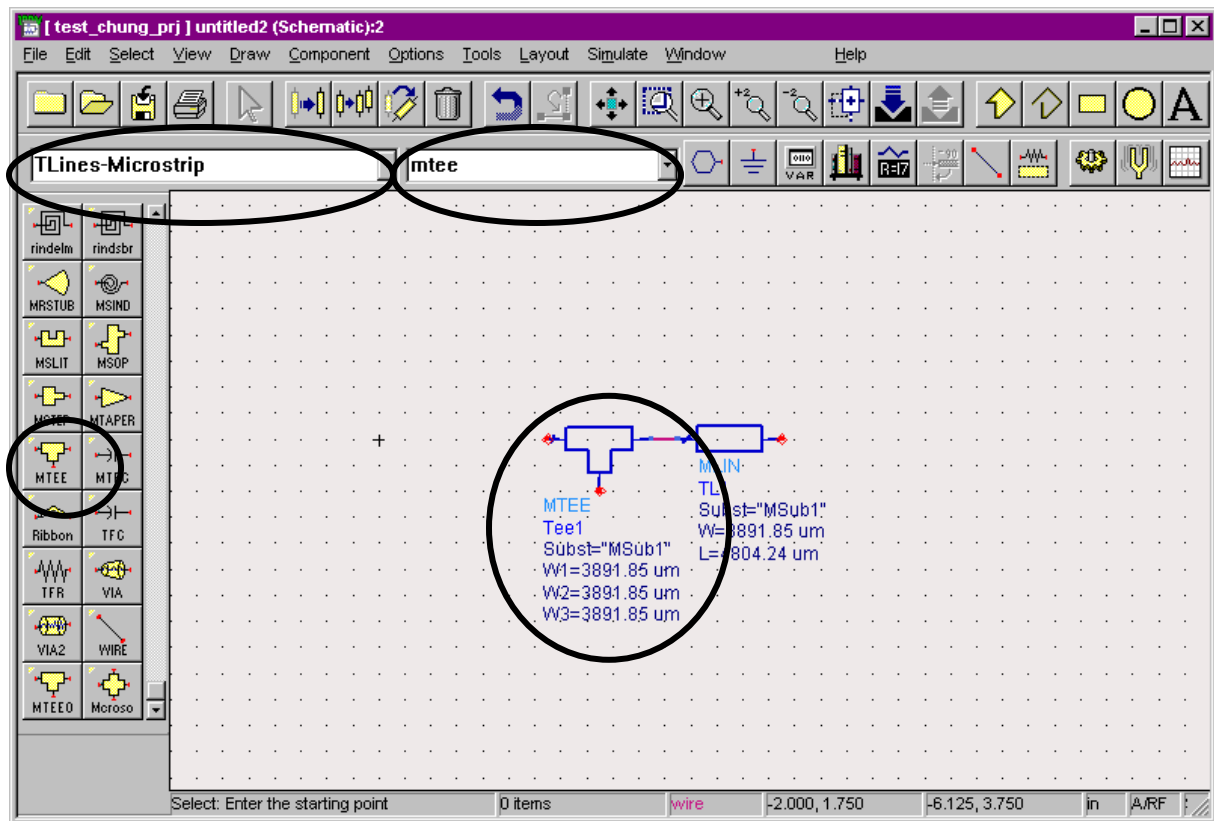
6. Change Component Parameters

- Either double click on the part or select the part & click right mouse button (Then, click on 'Edit component parameters')
- You can change the part parameters on the Schematic Window by click on the value of W or L.
- Change width (W=3891.85um) and length (L=4804.24), from the numbers (W, L) in LineCalc window.



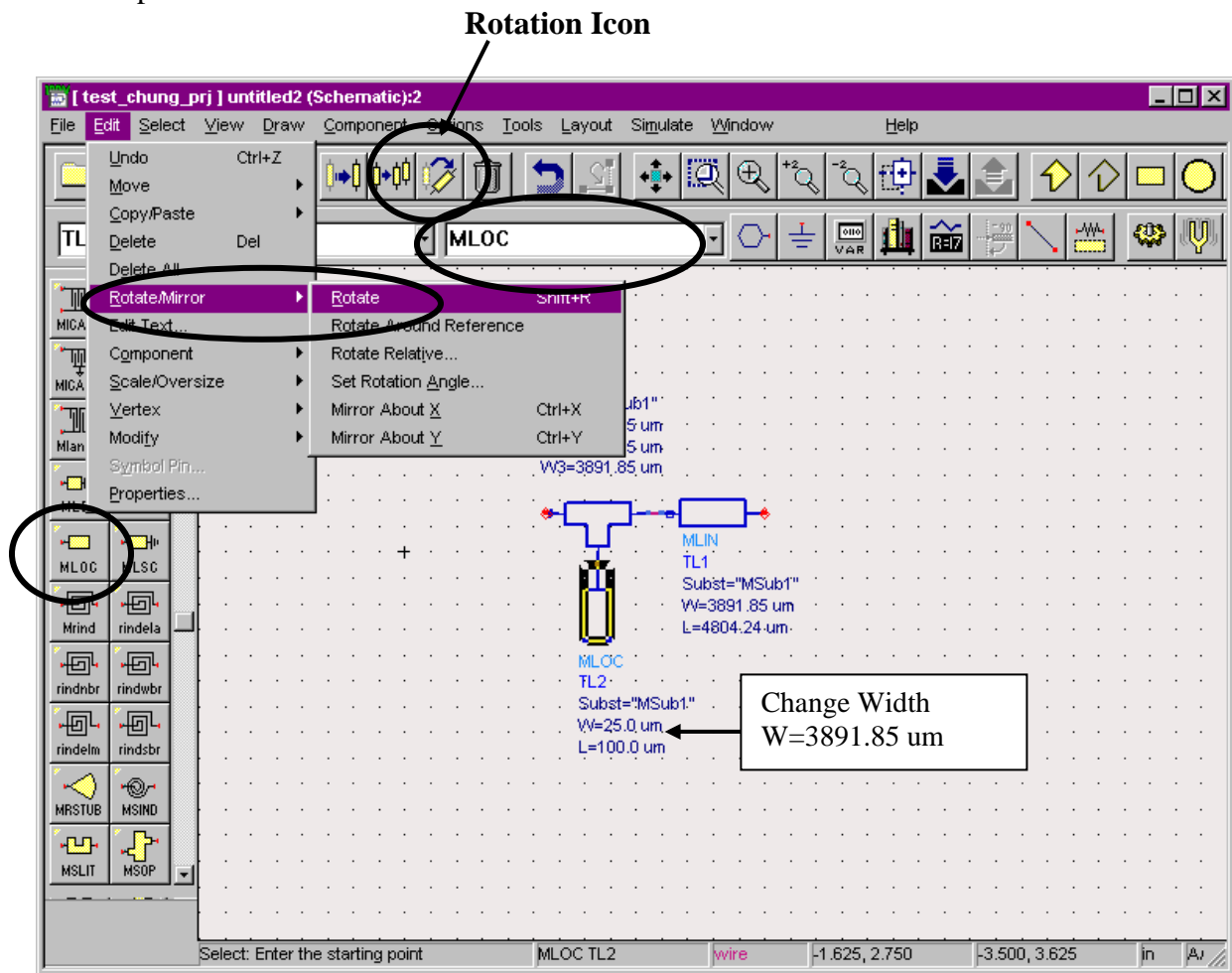
7. Add MTEE part, Change width of MTEE and Move Text of a part

- On the Schematic Window: get a part MTEE under Tlines-Microstrip category, or type 'MTEE' in the **part window**.
- Then, paste the part on the center of the window by clicking left mouse button (Connect to MLIN).
- To stop adding the part, push ESC key, or select 'End command ESC' by clicking right mouse button
- Change Width of MTEE is 3891.85 um.
- To move a text box of a part, push F5 and click on the part. Then, move the text box and place.



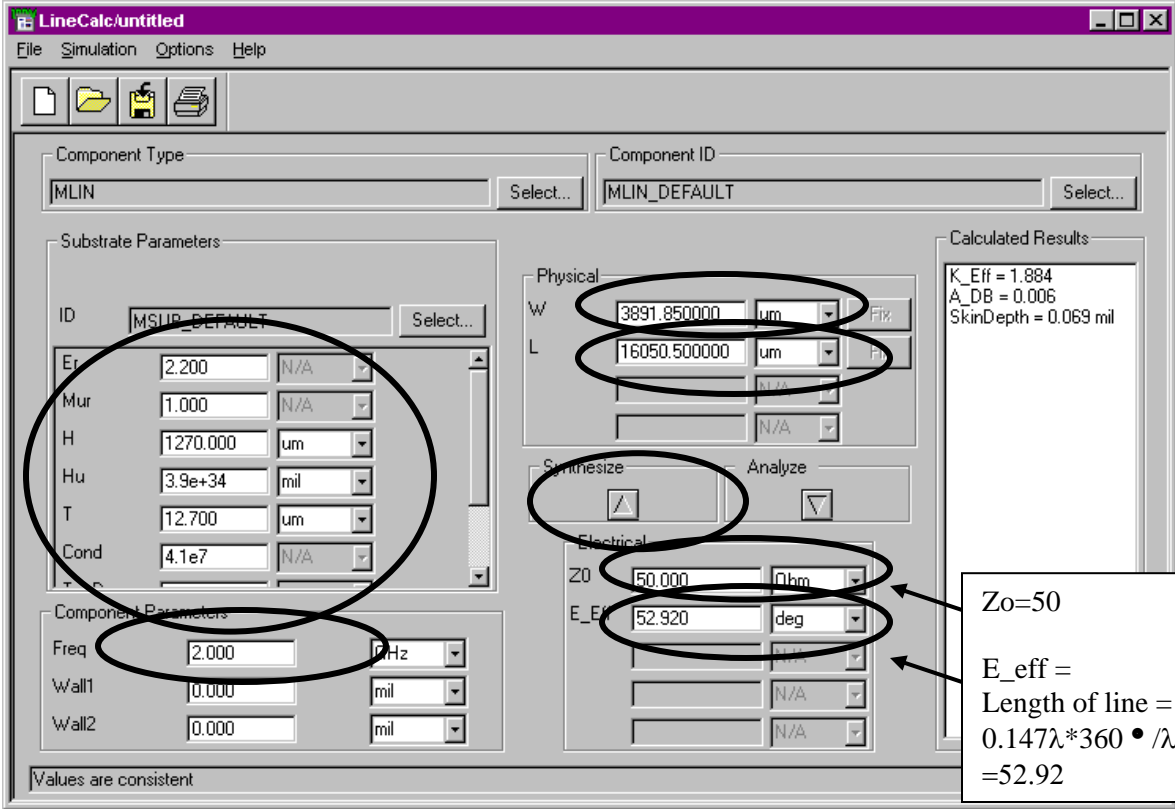
8. Add Open Circuit Stub (MLOC)

- On the Schematic Window: get a part MLOC under Tlines-Microstrip category, or type 'MLOC' in the **part window**.
- Then, connect to the MTEE part.
- To stop adding the part, push ESC key, or select 'End command ESC' by clicking right-side mouse button
- Change Width of MLOC (3891.85um).
- **To rotate** a part after paste the part, select/highlight the part and click on Rotate under Edit menu, or click on Rotation icon. Then, move the mouse and rotate the part/paste.
- To move a text box of a part, push F5 and click on the part. Then, move the text box and place.

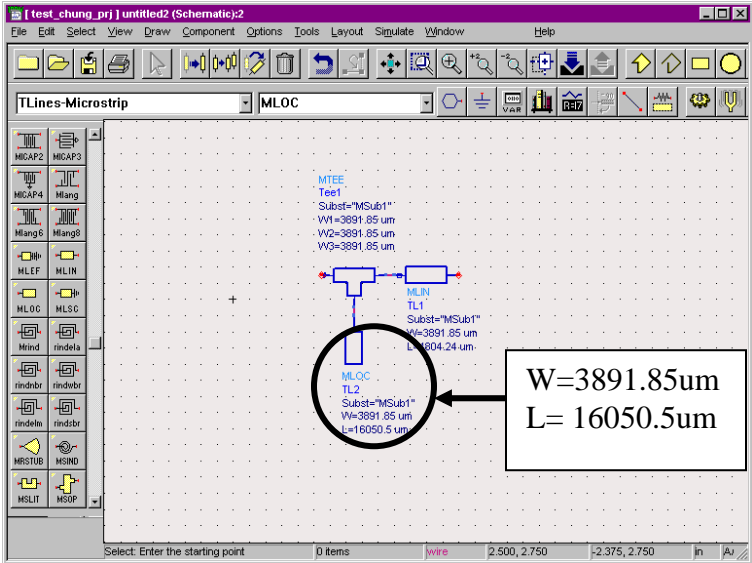


9. Calculate the length of MLOC and Change Parameters of Open Circuit Stub (MLOC)

- Select/highlight the part and click on Start Line Calc under Tool/LineCalc menu.
- Insert substrate parameters: H=1270um, T=12.7um, Er=2.2 (Match with your substrate parameters). Frequency =2 GHz. Verify the units of parameters.
- Type in Zo=50 ohm, Frequency=2GHz and E_eff value=52.920.
- Click on Synthesize arrow. It will calculate L for you (given W=3891.85um).

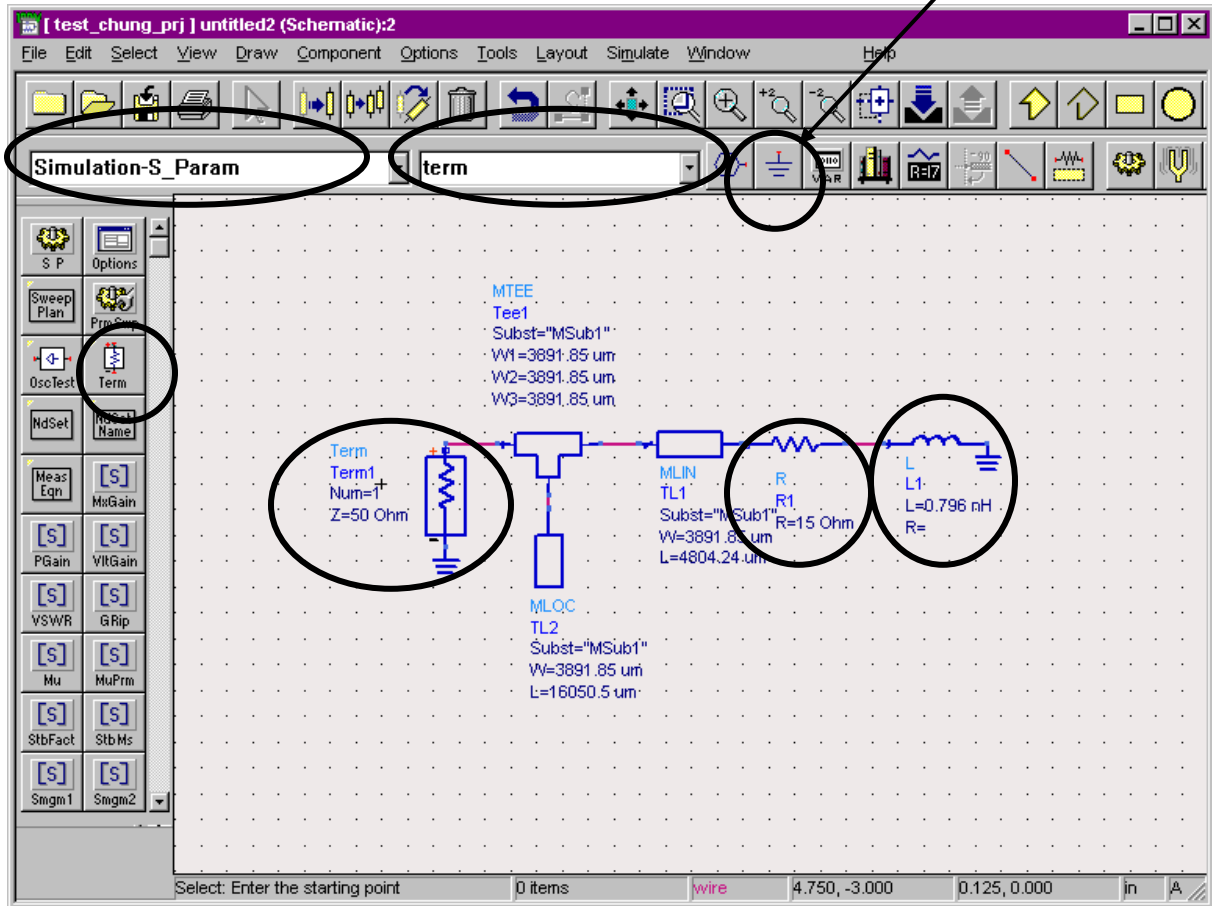


- Change the parameters of MLOC (W=3891.85um, L = 16050.5um from LineCalc window)



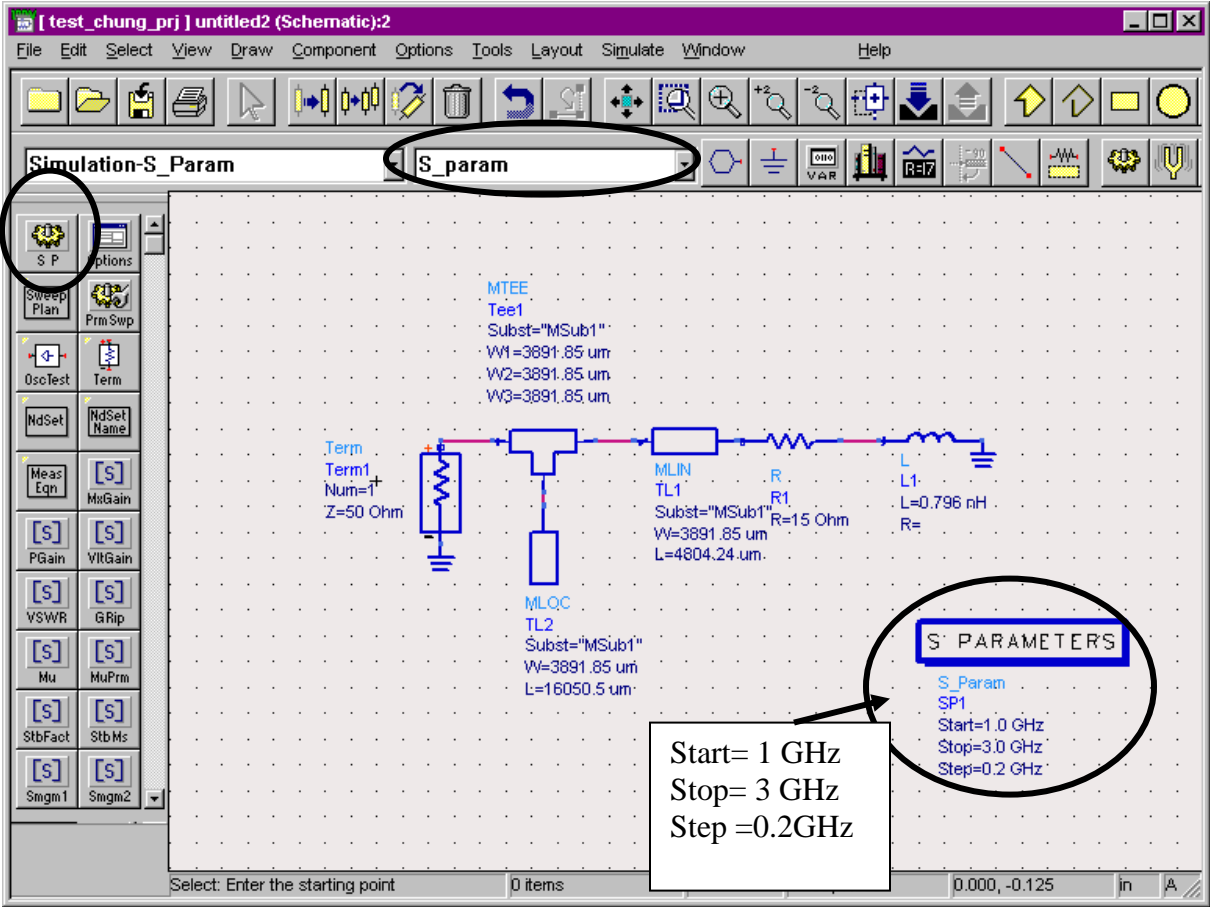
10. Add Term, R and L.

- On the Schematic Window: get a part TERM under Simulation-Sparam category, or type 'Term' in the **part window**. (Get R and L from Lumped-Components category, Ground from next to the part window.)
- Then, paste the parts as shown in Figure.
- Change values: Z=50ohm for Term, R=15ohm, L=0.796nH (This gives $Z=15+j10$).
- To move a text box of a part, push F5 and click on the part. Then, move the text box and place.



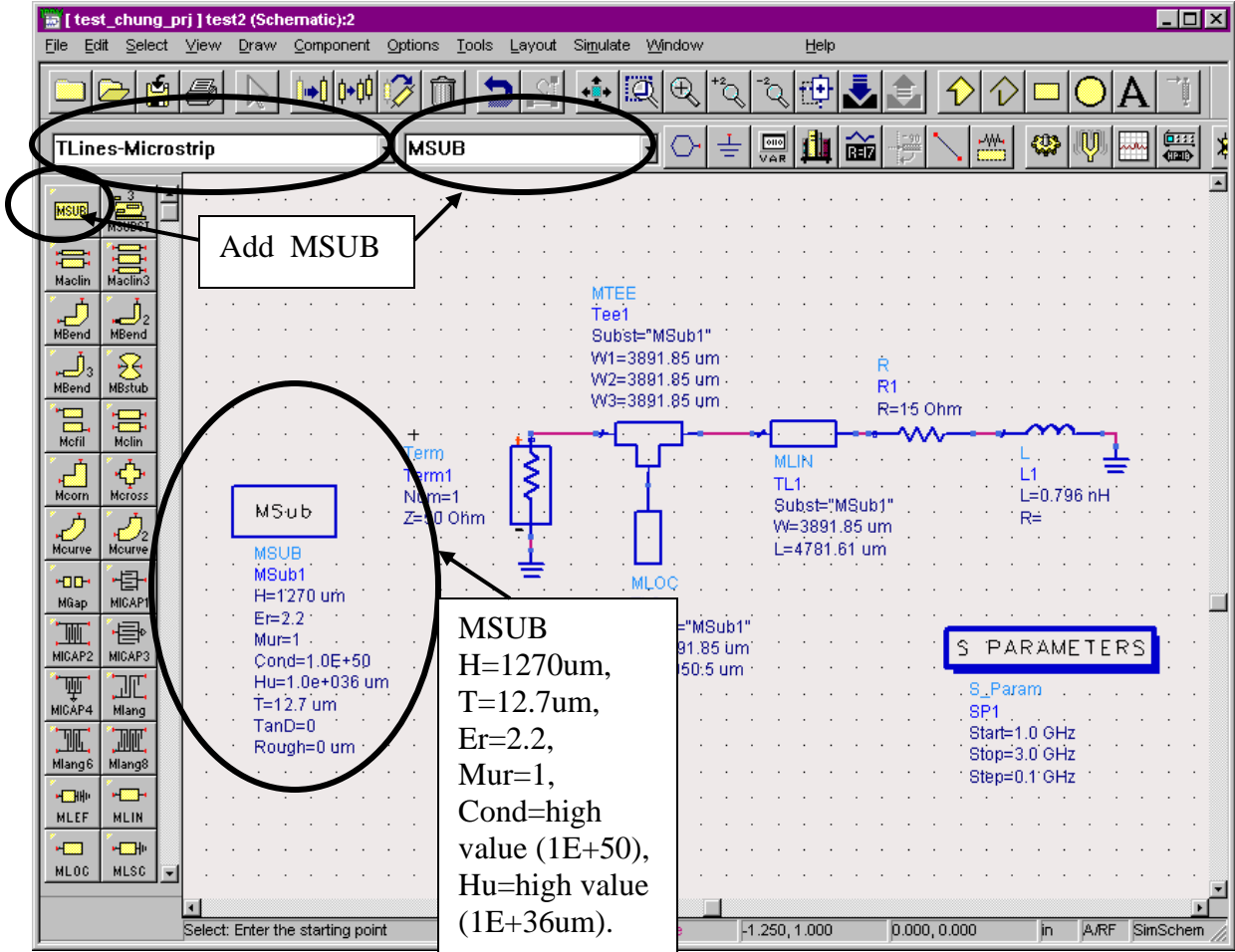
11. Add S Parameter

- On the Schematic Window: get a part S P under Simulation-Sparam, or type 'S_param' in the **part window**.
- Then, paste the part as shown in Figure.
- Change parameters of the S Parameter part. Start = 1GHz, Stop=3GHz and Step=0.2GHz.



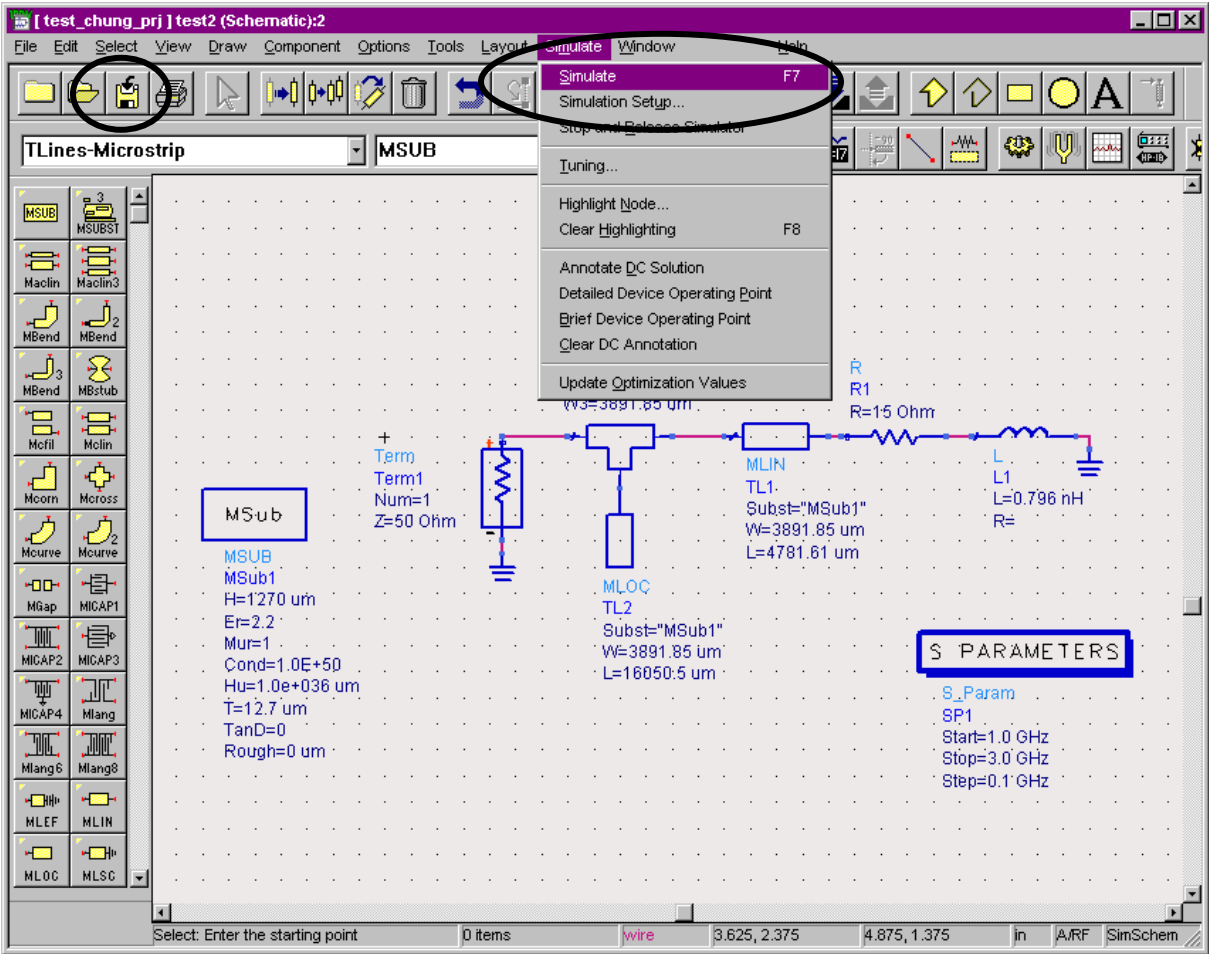
12. Add MSUB

- On the Schematic Window: get a part MSUB under Tlines-Microstrip category manually, or type 'MSUB' in the **part window**.
- Then, paste the part as shown in Figure.
- Change MSUB parameters of the part. H=1270um, T=12.7um, Er=2.2, Mur=1, Cond=high value (1E+50), Hu=high value (1E+36um).



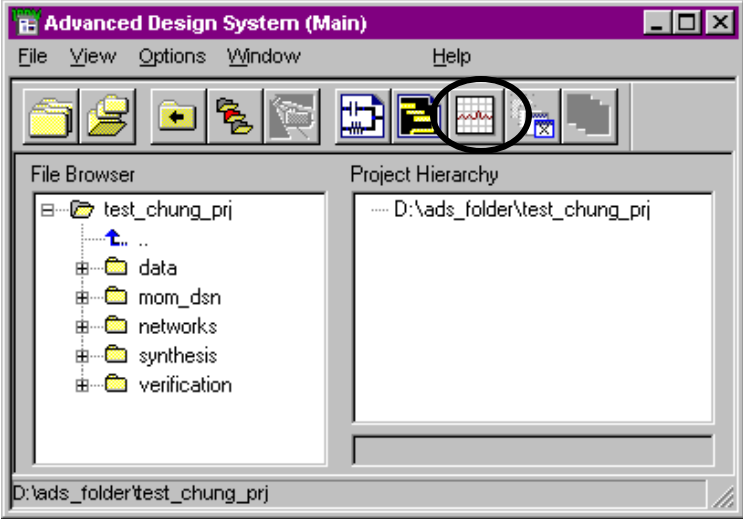
13. Saving and Simulation of the Circuit

- Click on save icon and click on simulate. (If you save your file not in the current project directory, you cannot simulate.)

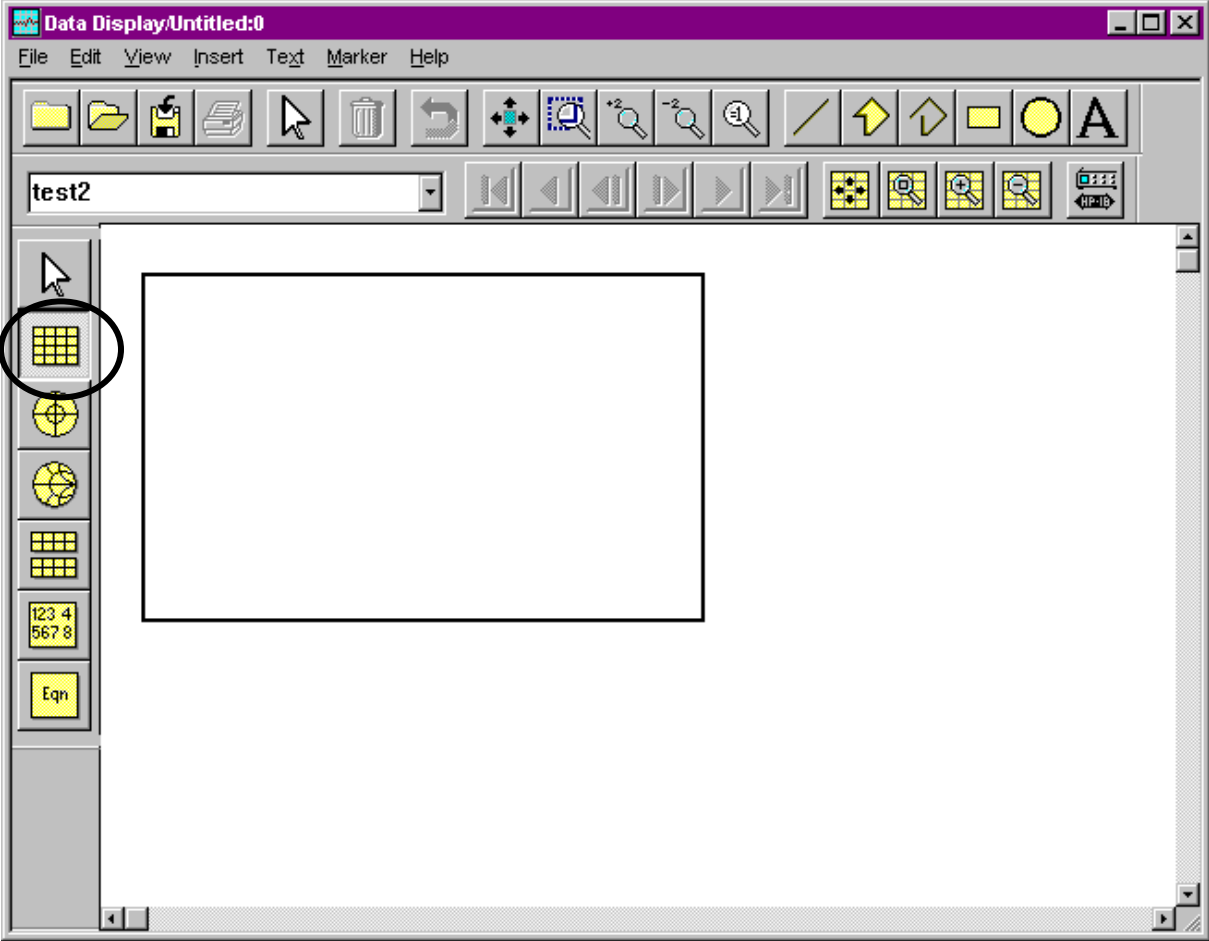


14. Opening a Data Display Window, and Rectangular Plot in the Data Display Window.

- Click on New Data Display Window. Then, click on 'Rectangular Plot' icon in the data display window. Place the rectangular plot window in the data display window.

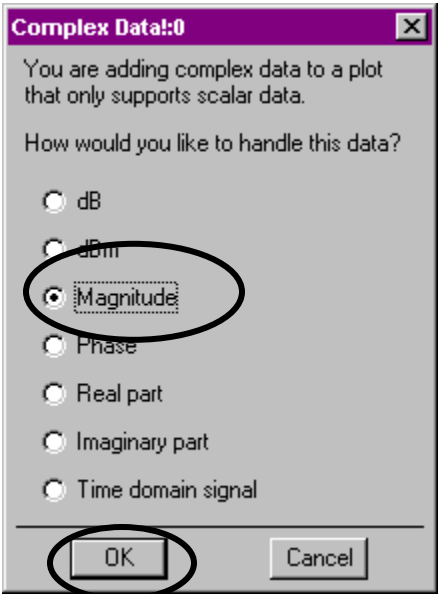
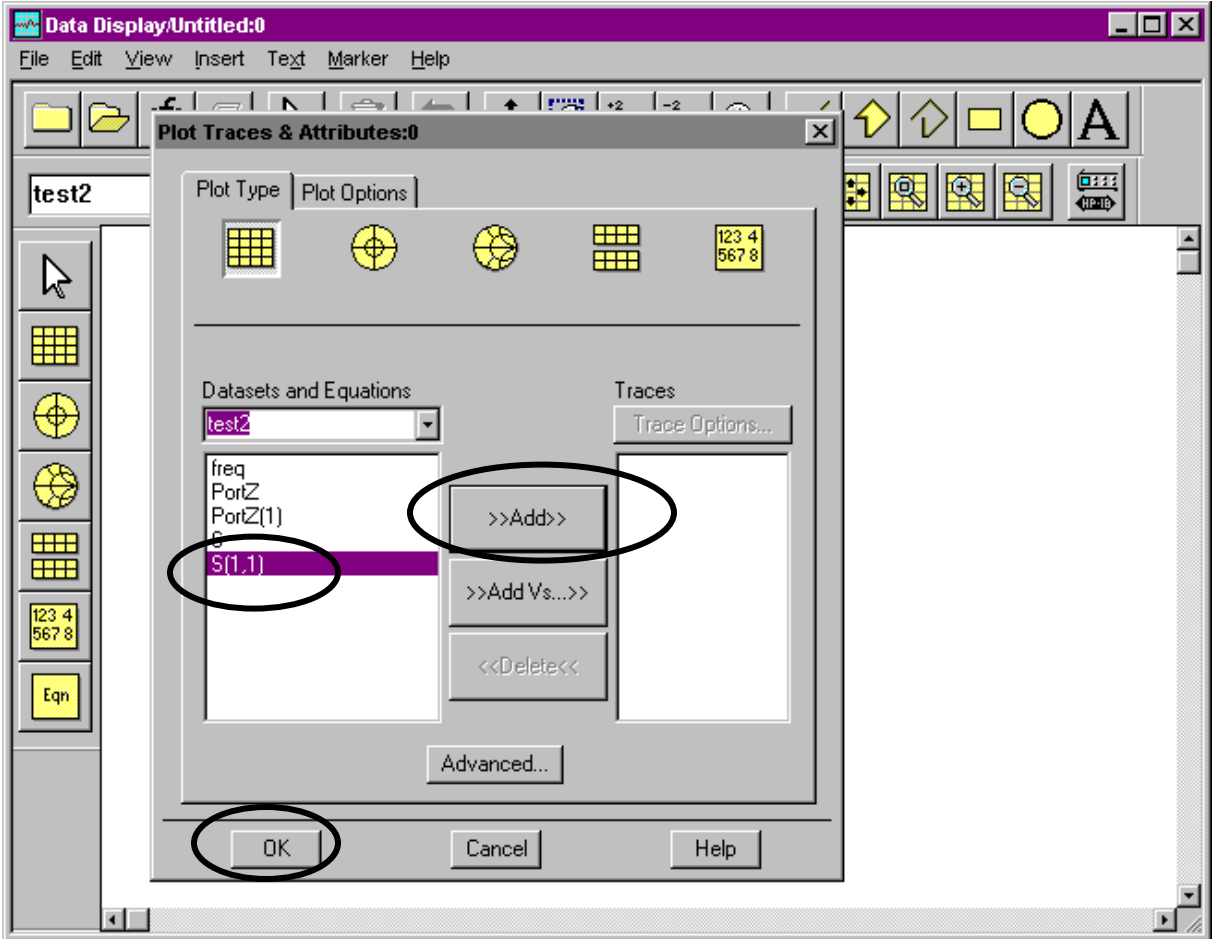


• Data Display Window.



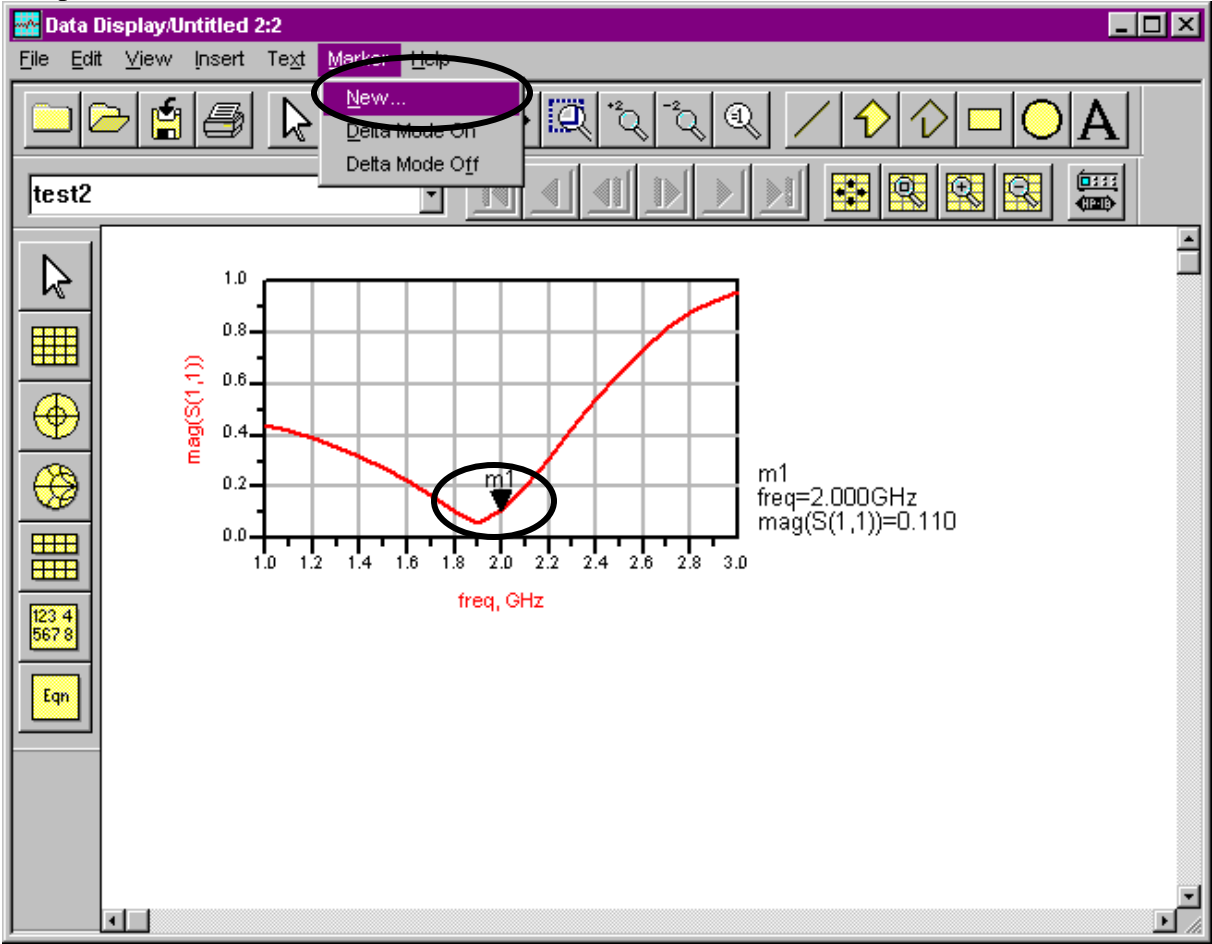
15. Select S(1,1)/Plot Magnitude Parameter

- Select S(1,1) parameter, and click on ADD.
- Select Magnitude option in Complex Data window. Click on 'OK'.
- Click on 'OK' on Plot Trace & Attributes window.



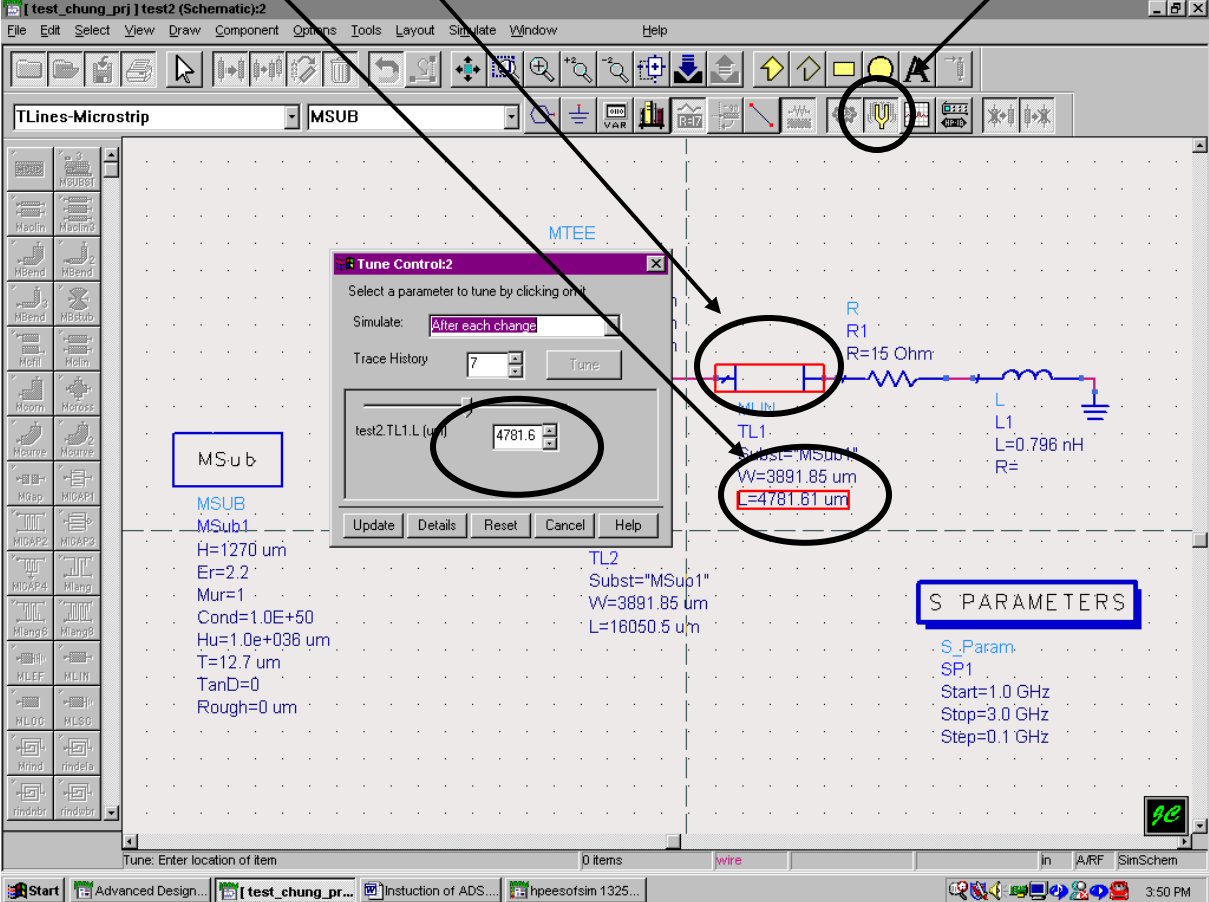
16. Adding Marker on S(1,1) graph.

- Click on New under Marker menu, and click on the point on the graph where you want to put a marker. (Put it on 2GHz.)



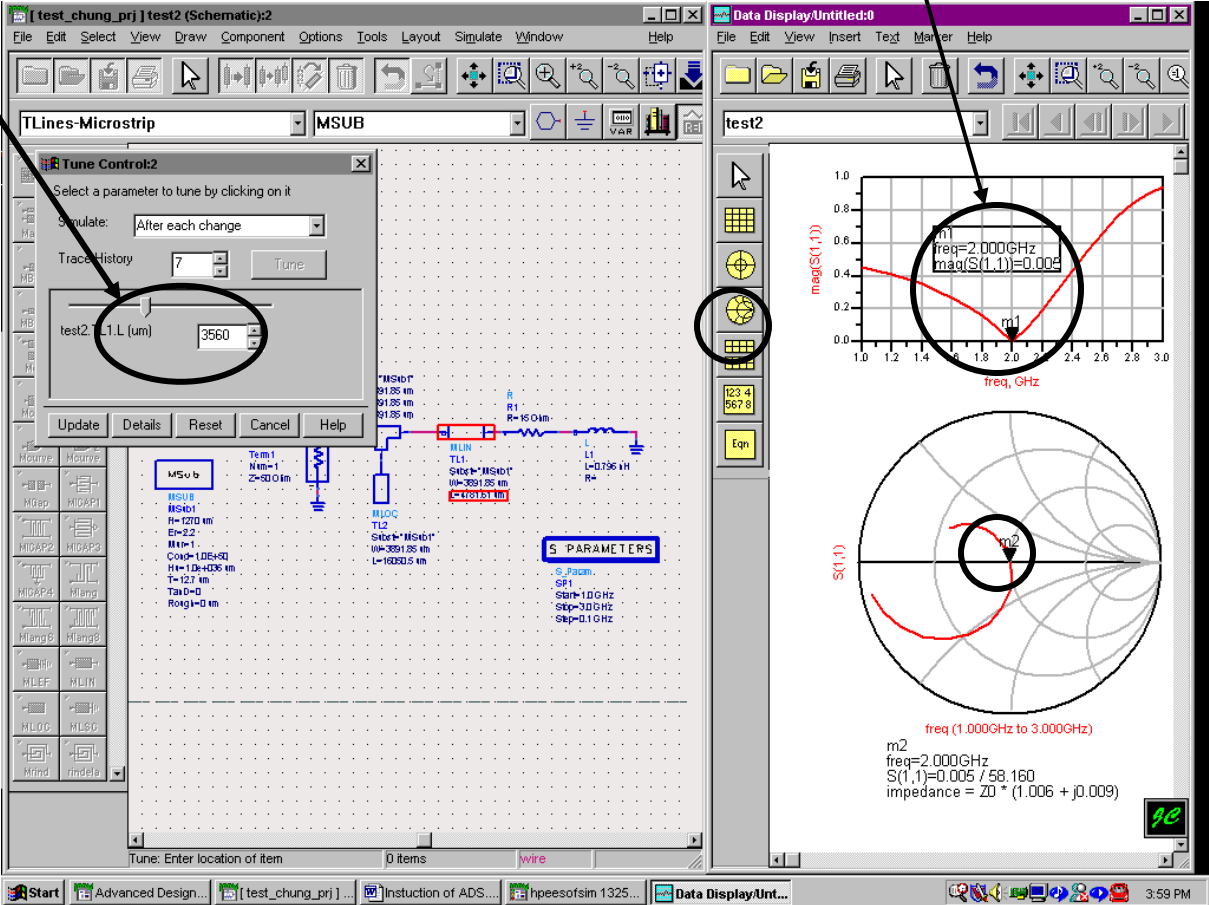
17. Tuning Parameters.

- Select/highlight the MLIN part in the center of Schematic window, and Click on Turn Parameters.
- Select only L parameter on Text part of MLIN by clicking on L.



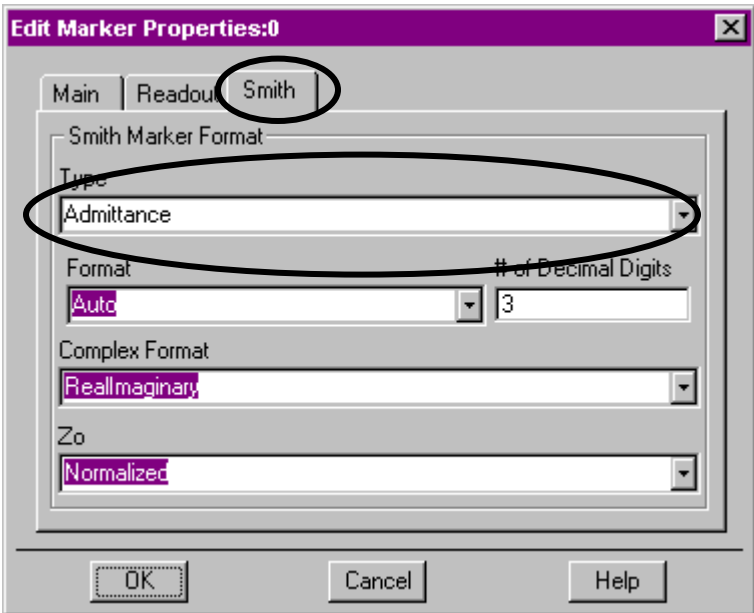
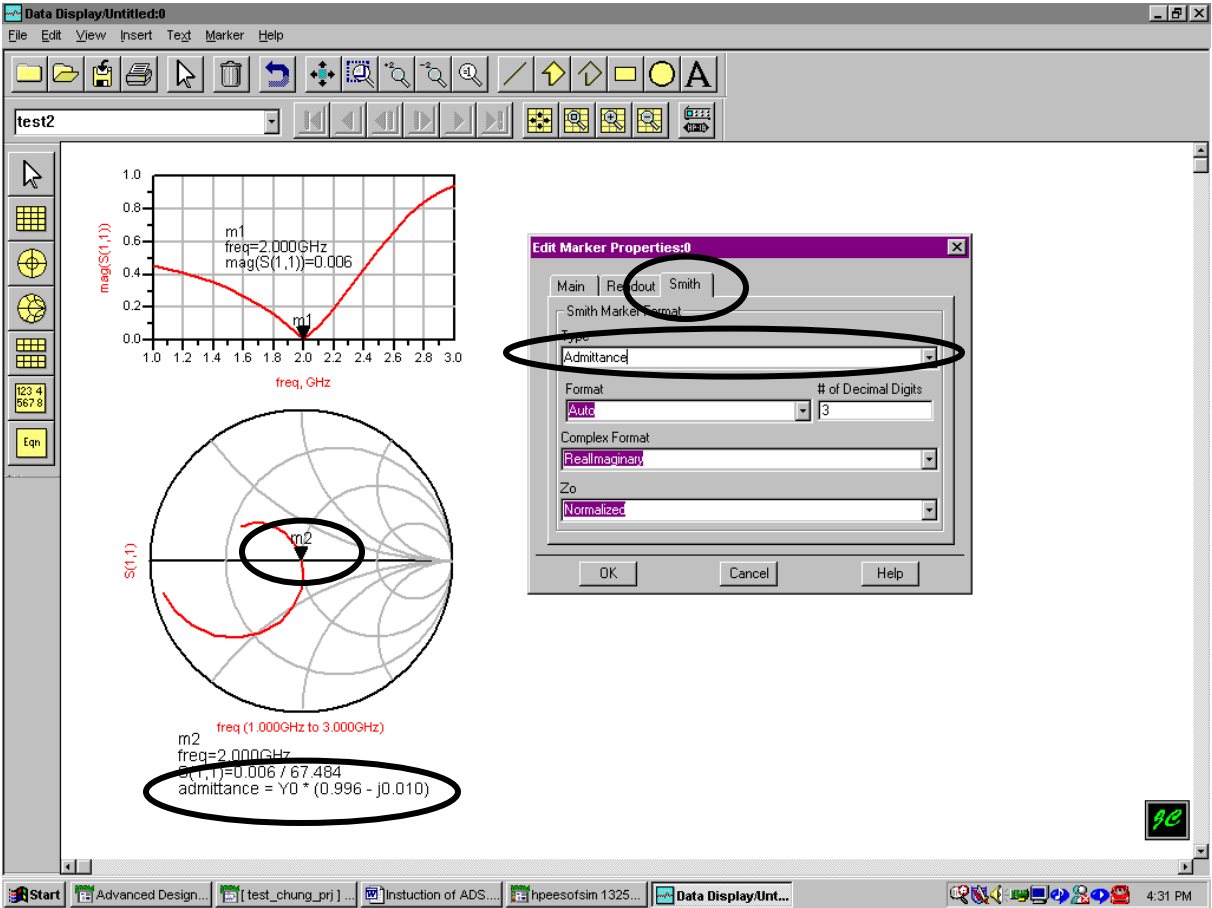
18. Fine Tuning Parameters.

- Then change the length of MLIN in Tune Control window, and look at the graph.
- Repeat this until the graph touches the minimum point on 2.0 GHz.
- To see the results on Smith chart on data display window, click on Smith chart icon and add S(1,1) like in Section 14. (Add a Marker on 2GHz in the Smith Chart. See Section 15.)



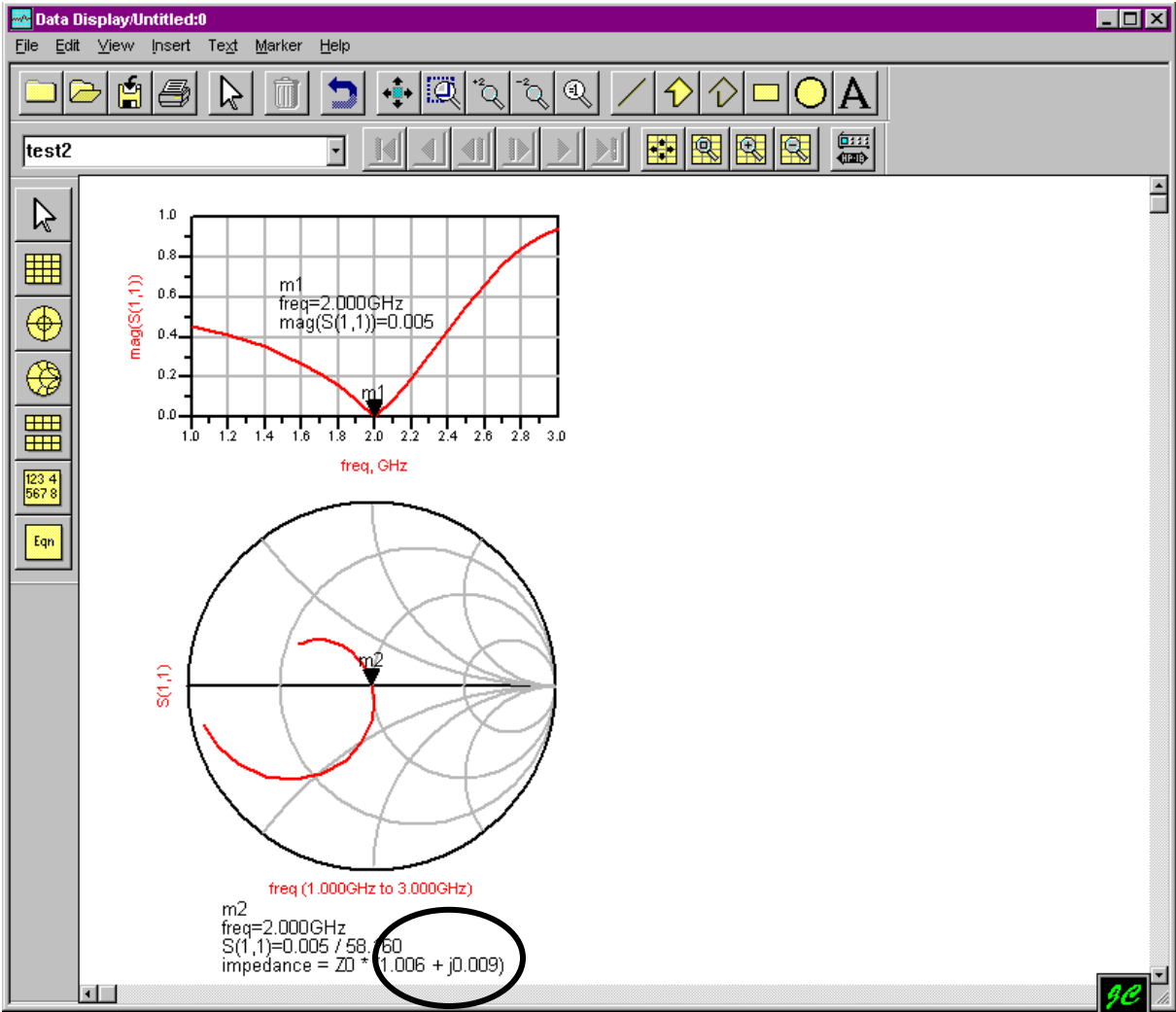
19. Changing Impedance to Admittance.

- Double click on marker on 2GHz on either S11 amplitude data or on Smith chart.
- Change the Edit marker to Smith and Change type as Admittance.



20. Tuning with Smith Chart

- If you are using Smith chart instead of using S11 amplitude data, control length of MLIN until the real part of the admittance is 1.
- Then change the length of MLOC until the imaginary part of admittance is 0.
- After matching the length of MLIN, the point on 2GHz should be at the center.



21. Matching with Admittance

- Repeat the process of changing lengths. Real part almost equal to 1, and imaginary part almost equal to zero. Change the length of MLIN and see the results (S11, Smith Chart)

