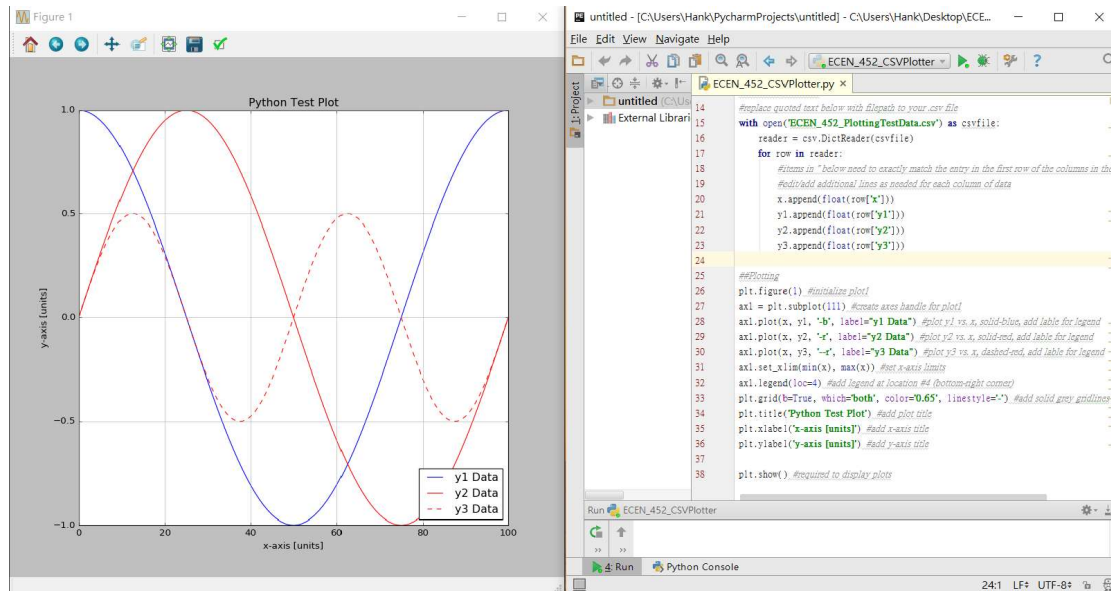


# ECEN 452 LAB 1

1.



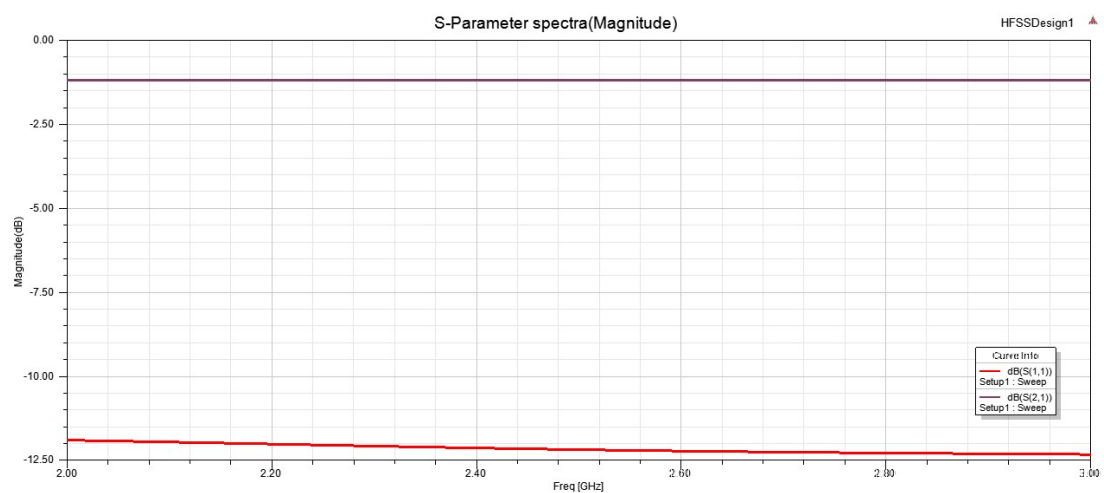
2.

linhung1

3.

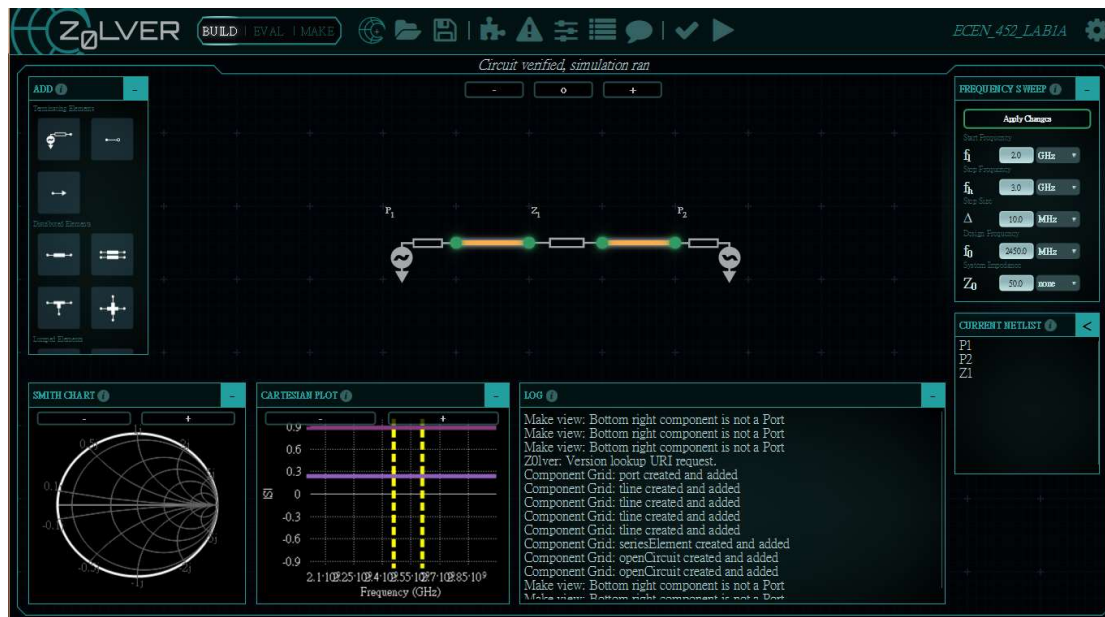
HFSS-

Simulation result for file "ECEN\_452\_Lab1.hfss"

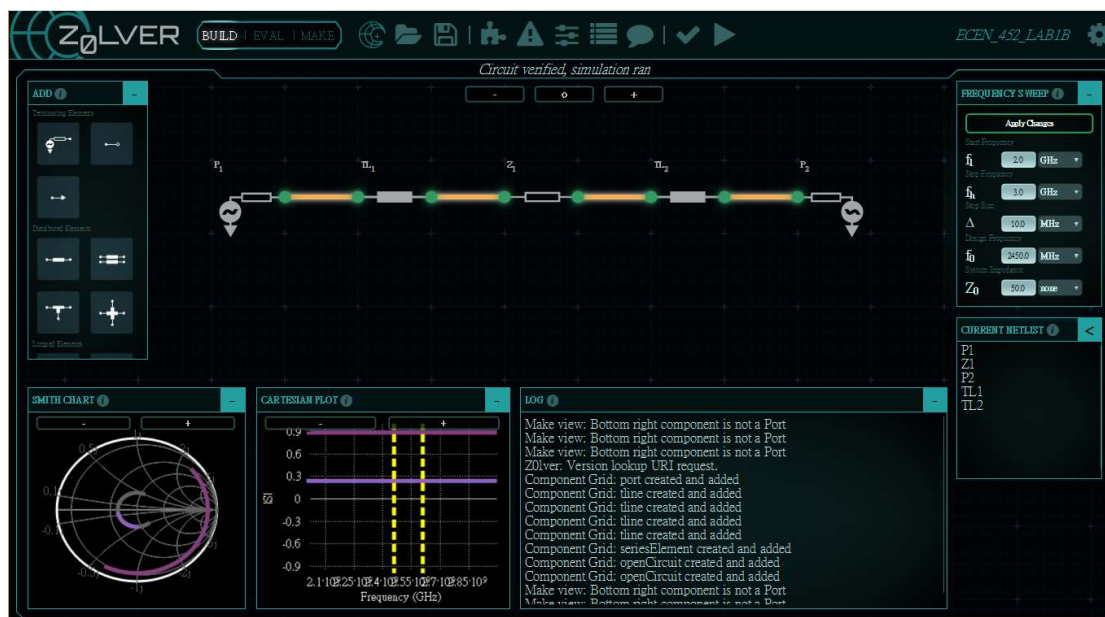


Z0lver-

Simulation model and result for file "ECEN\_452\_Lab1a.zov"



Simulation model and result for file "ECEN\_452\_Lab1b.zov"



4.

4. two port S parameter

$S_{11} = \frac{10 + j25}{10 + j25 + 100} \approx 0.24 \angle 55.4^\circ$   
 $S_{21} = \frac{100}{110 + j25} \approx 0.89 \angle -12.8^\circ$

Symmetric  $\therefore S_{11} = S_{22}, S_{21} = S_{12}$

$[S] = \begin{bmatrix} 0.24 \angle 55.4^\circ & 0.89 \angle -12.8^\circ \\ 0.89 \angle -12.8^\circ & 0.24 \angle 55.4^\circ \end{bmatrix}$

$\begin{bmatrix} 1 & 10 + j25 \\ 0 & 1 \end{bmatrix} \Rightarrow [AB] = \begin{bmatrix} 1 & 26.9 \angle 68.2^\circ \\ 0 & 1 \end{bmatrix}$

5.

5.

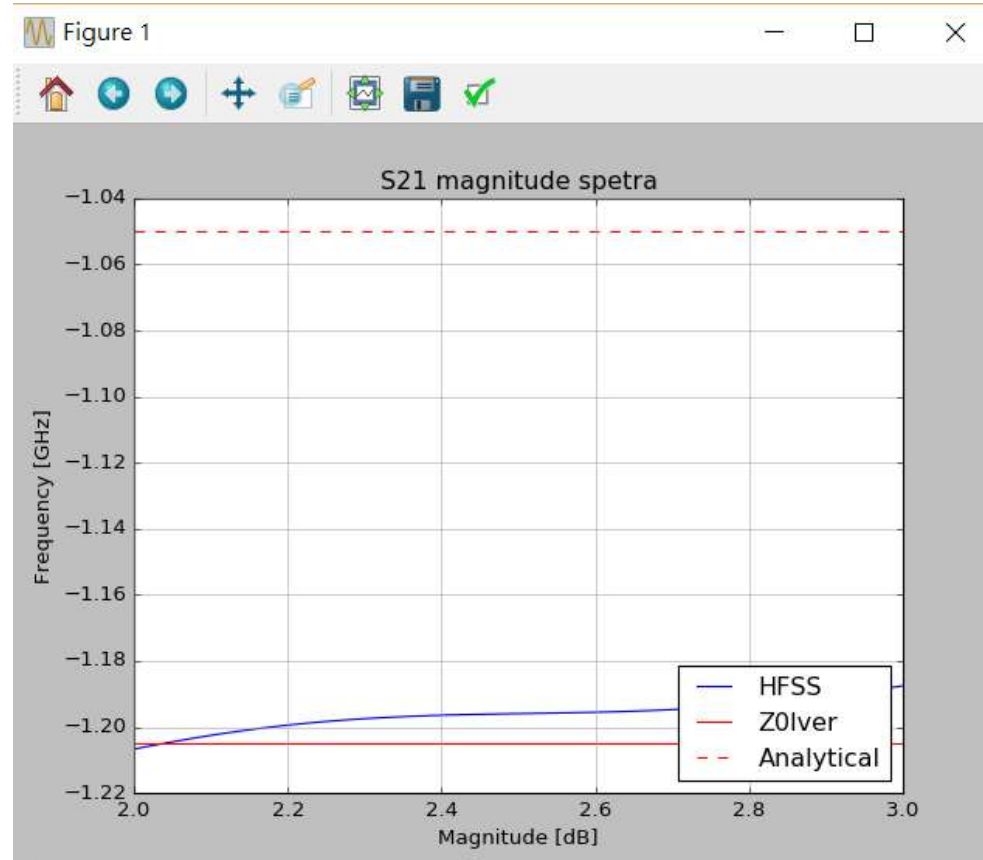
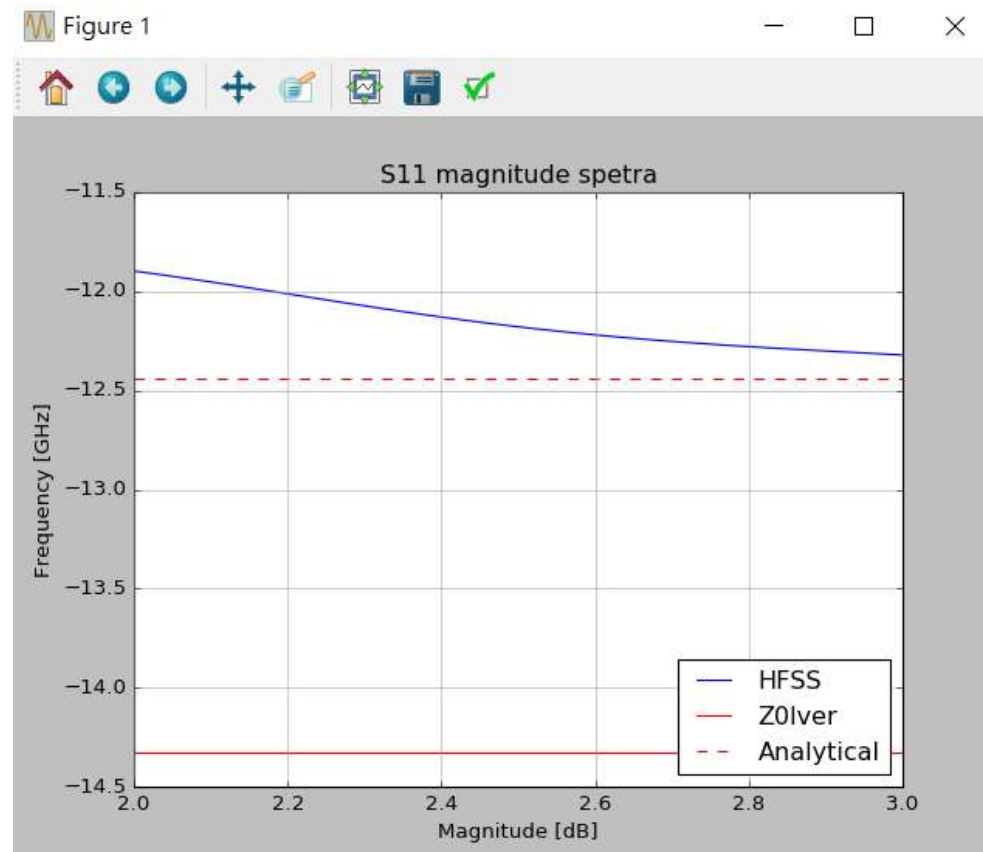
$S' = \begin{bmatrix} S_{11} e^{-j2\theta_1} & S_{12} e^{-j(\theta_1 + \theta_2)} \\ S_{21} e^{-j(\theta_1 + \theta_2)} & S_{22} e^{-j2\theta_2} \end{bmatrix}$

$\theta_1 = \beta l_1 = \frac{2\pi}{\lambda} \cdot 0.8\lambda = 1.6\pi \Rightarrow 288^\circ$

$\theta_2 = \beta l_2 = \frac{2\pi}{\lambda} \cdot 0.25\lambda = 0.5\pi \Rightarrow 90^\circ$

$\Rightarrow [S'] = \begin{bmatrix} 0.24 \angle -160.6^\circ & 0.89 \angle -308.22^\circ \\ 0.89 \angle -308.22^\circ & 0.24 \angle -160.6^\circ \end{bmatrix}$

6.



7.

	FR4	Duroid 5880	Duroid 6006	Duroid 6010.2
$\epsilon_r$	4.4	2.2	6.15	10.2
Tan $\delta$	0.025	0.0004	0.0021	0.0023

8.

	Type N	SMA	3.5 mm	2.92 mm	2.4 mm	1.85 mm
Type N	Y	N	N	N	N	N
SMA	N	Y	Y	Y	N	N
3.5 mm	N	Y	Y	Y	N	N
2.92 mm	N	Y	Y	Y	N	N
2.4 mm	N	N	N	N	Y	Y
1.85 mm	N	N	N	N	Y	Y