電磁波與天線導論 HW9

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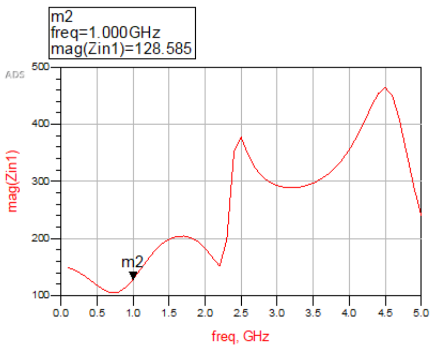
Q1

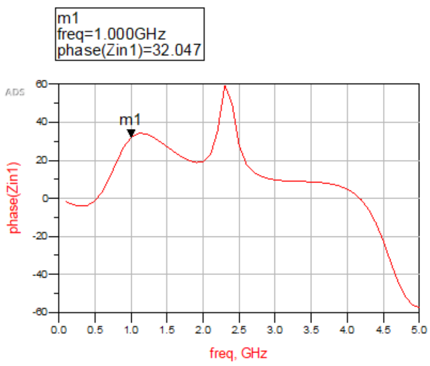
(a)

$$Y_1 = \frac{1}{jwL_1 + \frac{1}{jwC_3}}$$
$$Y_2 = jwC_1$$
$$Y^1 = Y_1 + Y_2$$
$$Z_{in}^1 = Z_0 \frac{\frac{1}{Y^1} + jZ_0 tan(36^\circ)}{Z_0 + j\frac{1}{Y^1} tan(36^\circ)}$$
$$Y^2 = \frac{1}{R_3} + \frac{1}{Z_{in}^1}$$
$$Z_{in}^2 = Z_0 \frac{\frac{1}{Y^2} + jZ_0 tan(25^\circ)}{Z_0 + j\frac{1}{Y^2} tan(25^\circ)}$$
$$Z_{in} = R_4 + Z_{in}^2 = 108.99 + j68.228(\Omega) - < ans >$$
$$\Gamma = \frac{Z_{in} - Z_0}{Z_{in} + Z_0} = 0.4688 + j0.2279 - < ans >$$

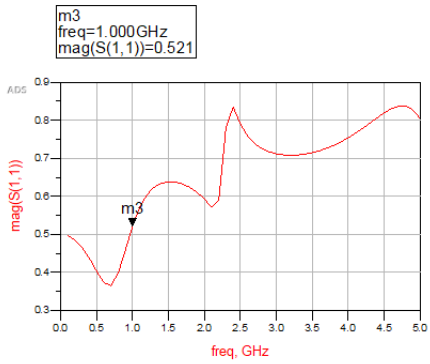
(b)

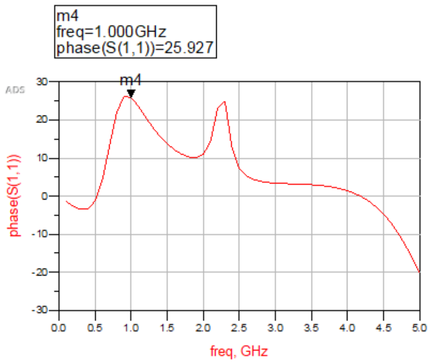
> input impedance





> reflection


m3
freq=1.000GHz
mag(S(1,1))=0.521
ADS
mag(S(1,1))
freq, GHz
m3


m4
freq=1.000GHz
phase(S(1,1))=25.927
ADS
phase(S(1,1))
freq, GHz
m4

$$T \quad network:$$
$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$
$$Z_{11} = \frac{V_1}{I_1}|_{I_2=0} = \frac{1}{Y_A} + \frac{1}{Y_B}$$
$$Z_{12} = \frac{V_1}{I_2}|_{I_1=0} = \frac{V_2}{I_2}\frac{\frac{1}{Y_B}}{\frac{1}{Y_A}+\frac{1}{Y_B}} = \frac{1}{Y_B}$$
$$Z_{21} = Z_{12}$$
$$Z_{22} = \frac{V_2}{I_2}|_{I_1=0} = \frac{1}{Y_A} + \frac{1}{Y_B}$$
$$Z \quad matrix: \begin{bmatrix} \frac{Y_A+Y_B}{Y_AY_B} & \frac{1}{Y_B} \\ \frac{1}{Y_B} & \frac{Y_A+Y_B}{Y_AY_B} \end{bmatrix} - < ans >$$
$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$$
$$Y \quad matrix: Z^{-1} = \begin{bmatrix} \frac{Y_A(Y_A+Y_B)}{Y_AY_B} & -\frac{Y_A^2}{2Y_A+Y_B} \\ -\frac{Y_A^2}{2Y_A+Y_B} & \frac{Y_A(Y_A+Y_B)}{Y_AY_B} \end{bmatrix} - < ans >$$
$$\pi \quad network:$$
$$Z_A = \frac{\frac{1}{Y_A^2}+\frac{2}{Y_AY_B}}{\frac{1}{Y_B}} = \frac{2Y_A+Y_B}{Y_A^2}$$
$$Z_B = \frac{\frac{1}{Y_A^2}+\frac{2}{Y_AY_B}}{\frac{1}{Y_A}} = \frac{2Y_A+Y_B}{Y_AY_B}$$
$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$$
$$Y_{11} = Y_{22} = \frac{1}{Z_A} + \frac{1}{Z_B} = \frac{Y_A(Y_A+Y_B)}{2Y_A+Y_B}$$
$$Y_{12} = Y_{21} = \frac{1}{Z_A} = \frac{Y_A^2}{2Y_A+Y_B}$$
$$Y \quad matrix: \begin{bmatrix} \frac{Y_A(Y_A+Y_B)}{2Y_A+Y_B} & \frac{Y_A^2}{2Y_A+Y_B} \\ \frac{Y_A^2}{2Y_A+Y_B} & \frac{Y_A(Y_A+Y_B)}{2Y_A+Y_B} \end{bmatrix} - < ans >$$
$$Z \quad matrix: \begin{bmatrix} \frac{Y_A+Y_B}{Y_AY_B} & -\frac{1}{YB} \\ -\frac{1}{YB} & \frac{Y_A+Y_B}{Y_AY_B} \end{bmatrix} - < ans >$$

Q3

$$Z_{in} = \frac{1}{\frac{1}{z}+\frac{1}{z_0}} = \frac{z_0z}{z+z_0}$$
$$S_{11} = S_{22} = \frac{Z_{in}-z_0}{Z_{in}+z_0} = \frac{-z_0}{2z+z_0} - < ans >$$
$$S_{12} = S_{21} = 1 - < ans >$$