Parameters for Problem 5b

$j := \sqrt{-1}$ $dB := 1$ $G_p := 9 \cdot dB$

$M := \begin{bmatrix} 0.53 & 0.09 \\ 2.93 & 0.4 \end{bmatrix}$ $\phi := \begin{bmatrix} 178 \cdot deg & 48 \cdot deg \\ 76 \cdot deg & -56 \cdot deg \end{bmatrix}$ $m := 1 .. 2 \quad n := 1 .. 2$ $S_{m,n} := M_{m,n} \cdot e^{j \cdot \left(\phi_{m,n} \cdot rad \right)}$

$\Delta := S_{1,1} \cdot S_{2,2} - S_{2,1} \cdot S_{1,2}$ $|\Delta| = 5.235 \cdot 10^{-2}$ $\arg(\Delta) = -4.788 \cdot 10^{1} \circ deg$

$K := \left[\dfrac{1 - \left(|S_{1,1}|\right)^2 - \left(|S_{2,2}|\right)^2 + \left(|\Delta|\right)^2}{2 \cdot |S_{1,2} \cdot S_{2,1}|} \right]$ $K = 1.065$

$g_p := \dfrac{10^{(.1 \cdot G_p)}}{\left(|S_{2,1}|\right)^2}$ $r_p := \dfrac{\sqrt{1 - 2 \cdot K \cdot |S_{1,2} \cdot S_{2,1}| \cdot g_p + \left(|S_{1,2} \cdot S_{2,1}|\right)^2 \cdot g_p^2}}{\left| 1 + g_p \cdot \left[\left(|S_{2,2}|\right)^2 - \left(|\Delta|\right)^2 \right] \right|}$ $C_p := \dfrac{\overline{g_p \cdot S_{2,2} - \Delta \cdot \left(\overline{S_{1,1}} \right)}}{1 + g_p \cdot \left[\left(|S_{2,2}|\right)^2 - \left(|\Delta|\right)^2 \right]}$

$r_p = 6.413 \cdot 10^{-1}$ $C_p = 1.963 \cdot 10^{-1} + 2.839j \cdot 10^{-1}$ $|C_p| = 3.452 \cdot 10^{-1}$ $\arg\left(C_p\right) = 5.535 \cdot 10^{1} \circ deg$

$\theta := 0 \cdot deg, 20 \cdot deg .. 360 \cdot deg$ $\Gamma_L(\theta) := C_p + r_p \cdot e^{j \cdot \theta}$ $\Gamma_{in}(\theta) := S_{1,1} + \dfrac{S_{2,1} \cdot S_{1,2} \cdot \Gamma_L(\theta)}{1 - S_{2,2} \cdot \Gamma_L(\theta)}$ $\Gamma_s(\theta) := \overline{\Gamma_{in}(\theta)}$

$$\Gamma_{out}(\theta) := S_{2,2} + \frac{S_{2,1} \cdot S_{1,2} \cdot \Gamma_s(\theta)}{1 - S_{1,1} \cdot \Gamma_s(\theta)} \qquad MAG\_\Gamma_b(\theta) := \left| \frac{\Gamma_{out}(\theta) - \overline{\Gamma_L(\theta)}}{1 - \Gamma_{out}(\theta) \cdot \Gamma_L(\theta)} \right| \qquad VSWR_{out}(\theta) := \frac{1 + MAG\_\Gamma_b(\theta)}{1 - MAG\_\Gamma_b(\theta)}$$

$$\theta := ((55.35 - 180) \cdot deg) \qquad \Gamma_L := C_p + r_p \cdot e^{j \cdot \theta} \qquad \Gamma_{in} := S_{1,1} + \frac{S_{2,1} \cdot S_{1,2} \cdot \Gamma_L}{1 - S_{2,2} \cdot \Gamma_L}$$

$$\Gamma_s := \overline{\Gamma_{in}} \qquad \Gamma_{out} := S_{2,2} + \frac{S_{2,1} \cdot S_{1,2} \cdot \Gamma_s}{1 - S_{1,1} \cdot \Gamma_s}$$

$$MAG\_\Gamma_a := \left| \frac{\Gamma_{in} - \overline{\Gamma_s}}{1 - \Gamma_{in} \cdot \Gamma_s} \right| \qquad MAG\_\Gamma_b := \left| \frac{\Gamma_{out} - \overline{\Gamma_L}}{1 - \Gamma_{out} \cdot \Gamma_L} \right| \qquad VSWR_{in} := \frac{1 + MAG\_\Gamma_a}{1 - MAG\_\Gamma_a}$$

$$G_T := \left[\frac{1 - \left(\left| \Gamma_s \right|\right)^2}{\left(\left| 1 - \Gamma_{in} \cdot \Gamma_s \right|\right)^2} \right] \cdot \left(\left| S_{2,1} \right|\right)^2 \cdot \left[\frac{1 - \left(\left| \Gamma_L \right|\right)^2}{\left(\left| 1 - S_{2,2} \cdot \Gamma_L \right|\right)^2} \right] \qquad VSWR_{out} := \frac{1 + MAG\_\Gamma_b}{1 - MAG\_\Gamma_b}$$

$$G_P := \left[\frac{1}{\left[1 - \left(\left| \Gamma_{in} \right|\right)^2\right]} \right] \cdot \left(\left| S_{2,1} \right|\right)^2 \cdot \left[\frac{1 - \left(\left| \Gamma_L \right|\right)^2}{\left(\left| 1 - S_{2,2} \cdot \Gamma_L \right|\right)^2} \right] \qquad G_A := \left[\frac{1 - \left(\left| \Gamma_s \right|\right)^2}{\left(\left| 1 - S_{1,1} \cdot \Gamma_s \right|\right)^2} \right] \cdot \left(\left| S_{2,1} \right|\right)^2 \cdot \left[\frac{1}{\left[1 - \left(\left| \Gamma_{out} \right|\right)^2\right]} \right]$$

$\frac{\theta}{deg} =$	$VSWR_{out}(\theta) =$
0	6.537
$2 \cdot 10^1$	6.537
$4 \cdot 10^1$	6.537
$6 \cdot 10^1$	6.537
$8 \cdot 10^1$	6.537
$1 \cdot 10^2$	6.537
$1.2 \cdot 10^2$	6.537
$1.4 \cdot 10^2$	6.537
$1.6 \cdot 10^2$	6.537
$1.8 \cdot 10^2$	6.537
$2 \cdot 10^2$	6.537
$2.2 \cdot 10^2$	6.537
$2.4 \cdot 10^2$	6.537
$2.6 \cdot 10^2$	6.537
$2.8 \cdot 10^2$	6.537
	537

Answers for Problem 5b

$\left| \Gamma_s \right| = 4.602 \cdot 10^{-1}$ $\qquad$ $\arg\left(\Gamma_s\right) = -1.778 \cdot 10^2 \cdot \text{deg}$ $\qquad$ $\Gamma_s = -4.599 \cdot 10^{-1} - 1.779j \cdot 10^{-2}$

$\left| \Gamma_{in} \right| = 4.602 \cdot 10^{-1}$ $\qquad$ $\arg\left(\Gamma_{in}\right) = 1.778 \cdot 10^2 \cdot \text{deg}$ $\qquad$ $\Gamma_{in} = -4.599 \cdot 10^{-1} + 1.779j \cdot 10^{-2}$

$\left| \Gamma_{out} \right| = 5.604 \cdot 10^{-1}$ $\qquad$ $\arg\left(\Gamma_{out}\right) = -5.535 \cdot 10^1 \cdot \text{deg}$ $\qquad$ $\Gamma_{out} = 3.187 \cdot 10^{-1} - 4.61j \cdot 10^{-1}$

$\left| \Gamma_L \right| = 2.961 \cdot 10^{-1}$ $\qquad$ $\arg\left(\Gamma_L\right) = -1.246 \cdot 10^2 \cdot \text{deg}$ $\qquad$ $\Gamma_L = -1.684 \cdot 10^{-1} - 2.436j \cdot 10^{-1}$

$\text{MAG\_}\Gamma_a = 0$ $\qquad\qquad$ $\text{VSWR}_{in} = 1$

$\text{MAG\_}\Gamma_b = 7.346 \cdot 10^{-1}$ $\qquad$ $\text{VSWR}_{out} = 6.537$

$G_A = 1.726 \cdot 10^1$ $\qquad$ $10 \cdot \log\left(G_A\right) = 1.237 \cdot 10^1 \cdot \text{dB}$

$G_P = 7.943$ $\qquad$ $10 \cdot \log\left(G_P\right) = 9 \cdot \text{dB}$

$G_T = 7.943$ $\qquad$ $10 \cdot \log\left(G_T\right) = 9 \cdot \text{dB}$