

Bilateral Simultaneous Conjugate Match

Gonzalez Example 3.6.1

Parameters for Example 3.6.1

$$j := \sqrt{-1} \quad dB := 1 \quad Z_0 := 50 \cdot \text{ohm} \quad Y_0 := \frac{1}{Z_0} \quad Y_0 = 2 \cdot 10^{-2} \cdot \text{siemens} \quad \lambda := 1$$

$$M := \begin{bmatrix} 0.641 & 0.057 \\ 2.058 & 0.572 \end{bmatrix} \quad \phi := \begin{bmatrix} -171.3 \cdot \text{deg} & 16.3 \cdot \text{deg} \\ 28.5 \cdot \text{deg} & -95.7 \cdot \text{deg} \end{bmatrix} \quad m := 1..2 \quad n := 1..2 \quad S_{m,n} := M_{m,n} \cdot e^{j \cdot (\phi_{m,n} \cdot \text{rad})}$$

$$\Delta := S_{1,1} \cdot S_{2,2} - S_{2,1} \cdot S_{1,2} \quad |\Delta| = 3.014 \cdot 10^{-1} \quad \arg(\Delta) = 1.099 \cdot 10^2 \cdot \text{deg}$$

$$K := \left[\frac{1 - (|S_{1,1}|)^2 - (|S_{2,2}|)^2 + (|\Delta|)^2}{2 \cdot |S_{1,2} \cdot S_{2,1}|} \right] \quad K = 1.504$$

$$B_1 := 1 + (|S_{1,1}|)^2 - (|S_{2,2}|)^2 - (|\Delta|)^2 \quad B_1 = 9.928 \cdot 10^{-1} \quad B_2 := 1 + (|S_{2,2}|)^2 - (|S_{1,1}|)^2 - (|\Delta|)^2 \quad B_2 = 8.254 \cdot 10^{-1}$$

$$C_1 := S_{1,1} - \Delta \cdot \overline{S_{2,2}} \quad C_1 = -4.781 \cdot 10^{-1} - 2.255j \cdot 10^{-2} \quad C_2 := S_{2,2} - \Delta \cdot \overline{S_{1,1}} \quad C_2 = -9.422 \cdot 10^{-2} - 3.796j \cdot 10^{-1}$$

$$\Gamma_{Ms} := \frac{B_1 - \sqrt{[B_1^2 - 4 \cdot (|C_1|)^2]}}{2 \cdot C_1} \quad \Gamma_s := \Gamma_{Ms} \quad \Gamma_{out} := S_{2,2} + \frac{S_{2,1} \cdot S_{1,2} \cdot \Gamma_s}{1 - S_{1,1} \cdot \Gamma_s}$$

$$\Gamma_{ML} := \frac{B_2 - \sqrt{[B_2^2 - 4 \cdot (|C_2|)^2]}}{2 \cdot C_2} \quad \Gamma_L := \Gamma_{ML} \quad \Gamma_{in} := S_{1,1} + \frac{S_{2,1} \cdot S_{1,2} \cdot \Gamma_L}{1 - S_{2,2} \cdot \Gamma_L}$$

Bilateral Simultaneous Conjugate Match

Gonzalez Example 3.6.1

$$\text{Mag}_\Gamma_a := \left| \frac{\Gamma_{in} - \overline{\Gamma_s}}{1 - \Gamma_{in} \cdot \Gamma_s} \right| \quad \text{VSWR}_{in} := \frac{1 + \text{Mag}_\Gamma_a}{1 - \text{Mag}_\Gamma_a}$$

$$\text{Mag}_\Gamma_b := \left| \frac{\Gamma_{out} - \overline{\Gamma_L}}{1 - \Gamma_{out} \cdot \Gamma_L} \right| \quad \text{VSWR}_{out} := \frac{1 + \text{Mag}_\Gamma_b}{1 - \text{Mag}_\Gamma_b}$$

$$G_T := \left[\frac{1 - \left| \Gamma_s \right|^2}{\left| 1 - \Gamma_{in} \cdot \Gamma_s \right|^2} \right] \cdot \left| S_{2,1} \right|^2 \cdot \left[\frac{1 - \left| \Gamma_L \right|^2}{\left| 1 - S_{2,2} \cdot \Gamma_L \right|^2} \right]$$

$$G_{T_{dB}} := 10 \cdot \log(G_T) \quad G_T = 1.375 \cdot 10^1 \quad G_{T_{dB}} = 1.138 \cdot 10^1 \text{ dB}$$

$$\left| \Gamma_s \right| = 7.619 \cdot 10^{-1} \quad \arg(\Gamma_s) = 1.773 \cdot 10^2 \text{ deg} \quad \Gamma_s = -7.611 \cdot 10^{-1} + 3.591j \cdot 10^{-2} \quad \text{Mag}_\Gamma_a = 2.121 \cdot 10^{-15} \quad \text{VSWR}_{in} = 1$$

$$\left| \Gamma_{in} \right| = 7.619 \cdot 10^{-1} \quad \arg(\Gamma_{in}) = -1.773 \cdot 10^2 \text{ deg} \quad \Gamma_{in} = -7.611 \cdot 10^{-1} - 3.591j \cdot 10^{-2}$$

$$\left| \Gamma_L \right| = 7.184 \cdot 10^{-1} \quad \arg(\Gamma_L) = 1.039 \cdot 10^2 \text{ deg} \quad \Gamma_L = -1.731 \cdot 10^{-1} + 6.972j \cdot 10^{-1} \quad \text{Mag}_\Gamma_b = 1.96 \cdot 10^{-15} \quad \text{VSWR}_{out} = 1$$

$$\left| \Gamma_{out} \right| = 7.184 \cdot 10^{-1} \quad \arg(\Gamma_{out}) = -1.039 \cdot 10^2 \text{ deg} \quad \Gamma_{out} = -1.731 \cdot 10^{-1} - 6.972j \cdot 10^{-1}$$

$$Y_{Ms} := \frac{1 - \Gamma_{Ms}}{1 + \Gamma_{Ms}} \cdot \text{siemens} \quad Y_{Ms} = 7.187 - 1.23j \cdot \text{siemens} \quad Y_{ML} := \frac{1 - \Gamma_{ML}}{1 + \Gamma_{ML}} \cdot \text{siemens} \quad Y_{ML} = 4.136 \cdot 10^{-1} - 1.192j \cdot \text{siemens}$$

Bilateral Simultaneous Conjugate Match

Gonzalez Example 3.6.1

Design For The Input Matching Network

$$\text{guess_1} := -1 \quad \text{norm_B_match_1} := \text{root} \left[\left(\left| \Gamma_{\text{in}} \right| - \left| \frac{j \cdot \text{guess_1}}{2 + j \cdot \text{guess_1}} \right| \right), \text{guess_1} \right] \quad \text{norm_B_match_1} = -2.351$$

$$\text{guess_2} := 1 \quad \text{norm_B_match_2} := \text{root} \left[\left(\left| \Gamma_{\text{in}} \right| - \left| \frac{j \cdot \text{guess_2}}{2 + j \cdot \text{guess_2}} \right| \right), \text{guess_2} \right] \quad \text{norm_B_match_2} = 2.351$$

$$Y_{A1} := 1 + j \cdot \text{norm_B_match_1} \quad \Gamma_{A1} := \frac{1 - Y_{A1}}{1 + Y_{A1}} \quad \left| \Gamma_{A1} \right| = 7.617 \cdot 10^{-1} \quad \arg(\Gamma_{A1}) = 1.396 \cdot 10^2 \cdot \text{deg}$$

$$E_{\text{line_length_1}} := \frac{(2 \cdot \pi + \arg(\Gamma_{\text{in}})) - \arg(\Gamma_{A1})}{2} \quad E_{\text{line_length_1}} = 2.155 \cdot 10^1 \cdot \text{deg}$$

$$\lambda_{\text{line_length_1}} := \frac{E_{\text{line_length_1}}}{2 \cdot \pi} \quad \lambda_{\text{line_length_1}} = 5.985 \cdot 10^{-2} \cdot \lambda \quad \text{This is the textbook solution.}$$

$$E_{\text{stub_length_1}} := \text{atan} \left[(\text{norm_B_match_1})^{-1} \right] + \frac{\pi}{2} \quad E_{\text{stub_length_1}} = 6.696 \cdot 10^1 \cdot \text{deg}$$

$$\lambda_{\text{stub_length_1}} := \frac{E_{\text{stub_length_1}}}{2 \cdot \pi} \quad \lambda_{\text{stub_length_1}} = 1.86 \cdot 10^{-1} \cdot \lambda \quad \text{Open Stub} \quad \text{This is the textbook solution.}$$

$$Y_{A2} := 1 + j \cdot \text{norm_B_match_2} \quad \Gamma_{A2} := \frac{1 - Y_{A2}}{1 + Y_{A2}} \quad \left| \Gamma_{A2} \right| = 7.617 \cdot 10^{-1} \quad \arg(\Gamma_{A2}) = -1.396 \cdot 10^2 \cdot \text{deg}$$

Bilateral Simultaneous Conjugate Match

Gonzalez Example 3.6.1

$$E_{\text{line_length_2}} := \frac{(2 \cdot \pi + \arg(\Gamma_{\text{in}})) - \arg(\Gamma_{A2})}{2}$$

$$E_{\text{line_length_2}} = 1.612 \cdot 10^2 \cdot \text{deg}$$

$$\lambda_{\text{line_length_2}} := \frac{E_{\text{line_length_2}}}{2 \cdot \pi}$$

$$\lambda_{\text{line_length_2}} = 4.477 \cdot 10^{-1} \cdot \lambda$$

This is the alternate solution.

$$E_{\text{stub_length_2}} := \text{atan}\left[\left(\text{norm_B}_{\text{match_2}}\right)^{-1}\right]$$

$$E_{\text{stub_length_2}} = 2.304 \cdot 10^1 \cdot \text{deg}$$

$$\lambda_{\text{stub_length_2}} := \frac{E_{\text{stub_length_2}}}{2 \cdot \pi}$$

$$\lambda_{\text{stub_length_2}} = 6.401 \cdot 10^{-2}$$

Shorted Stub This is the alternate solution.

Bilateral Simultaneous Conjugate Match

Gonzalez Example 3.6.1

Design For The Output Matching Network

$$\text{guess_1} := -1 \quad \text{norm_B_match_1} := \text{root} \left[\left(\left| \Gamma_{\text{out}} \right| - \left| \frac{j \cdot \text{guess_1}}{2 + j \cdot \text{guess_1}} \right| \right), \text{guess_1} \right] \quad \text{norm_B_match_1} = -2.065$$

$$\text{guess_2} := 1 \quad \text{norm_B_match_2} := \text{root} \left[\left(\left| \Gamma_{\text{out}} \right| - \left| \frac{j \cdot \text{guess_2}}{2 + j \cdot \text{guess_2}} \right| \right), \text{guess_2} \right] \quad \text{norm_B_match_2} = 2.065$$

$$\Gamma_{A1} := \frac{1 - Y_{A1}}{1 + Y_{A1}} \quad \left| \Gamma_{A1} \right| = 7.183 \cdot 10^{-1} \quad \arg(\Gamma_{A1}) = 1.359 \cdot 10^2 \cdot \text{deg}$$

$$E_{\text{line_length_1}} := \frac{(2 \cdot \pi + \arg(\Gamma_{\text{out}})) - \arg(\Gamma_{A1})}{2} \quad E_{\text{line_length_1}} = 6.007 \cdot 10^1 \cdot \text{deg}$$

$$\lambda_{\text{line_length_1}} := \frac{E_{\text{line_length_1}}}{2 \cdot \pi} \quad \lambda_{\text{line_length_1}} = 1.669 \cdot 10^{-1} \cdot \lambda \quad \text{This is the textbook solution.}$$

$$E_{\text{stub_length_1}} := \text{atan} \left[(\text{norm_B_match_1})^{-1} \right] + \frac{\pi}{2} \quad E_{\text{stub_length_1}} = 6.416 \cdot 10^1 \cdot \text{deg}$$

$$\lambda_{\text{stub_length_1}} := \frac{E_{\text{stub_length_1}}}{2 \cdot \pi} \quad \lambda_{\text{stub_length_1}} = 1.782 \cdot 10^{-1} \cdot \lambda \quad \text{Open Stub} \quad \text{This is the textbook solution.}$$

Bilateral Simultaneous Conjugate Match

Gonzalez Example 3.6.1

$$Y_{A2} := 1 + j \cdot \text{norm_B_match_2} \quad \Gamma_{A2} := \frac{1 - Y_{A2}}{1 + Y_{A2}}$$

$$|\Gamma_{A2}| = 7.183 \cdot 10^{-1} \quad \arg(\Gamma_{A2}) = -1.359 \cdot 10^2 \cdot \text{deg}$$

$$E_{\text{line_length_2}} := \frac{(2 \cdot \pi + \arg(\Gamma_{\text{out}})) - \arg(\Gamma_{A2})}{2}$$

$$E_{\text{line_length_2}} = 1.96 \cdot 10^2 \cdot \text{deg}$$

$$\lambda_{\text{line_length_2}} := \frac{E_{\text{line_length_2}}}{2 \cdot \pi}$$

$$\lambda_{\text{line_length_2}} = 5.444 \cdot 10^{-1} \cdot \lambda$$

This is the alternate solution.

$$E_{\text{stub_length_2}} := \text{atan}\left[\left(\text{norm_B_match_2}\right)^{-1}\right]$$

$$E_{\text{stub_length_2}} = 2.584 \cdot 10^1 \cdot \text{deg}$$

$$\lambda_{\text{stub_length_2}} := \frac{E_{\text{stub_length_2}}}{2 \cdot \pi}$$

$$\lambda_{\text{stub_length_2}} = 7.178 \cdot 10^{-2} \cdot \lambda$$

Shorted Stub This is the alternate solution.