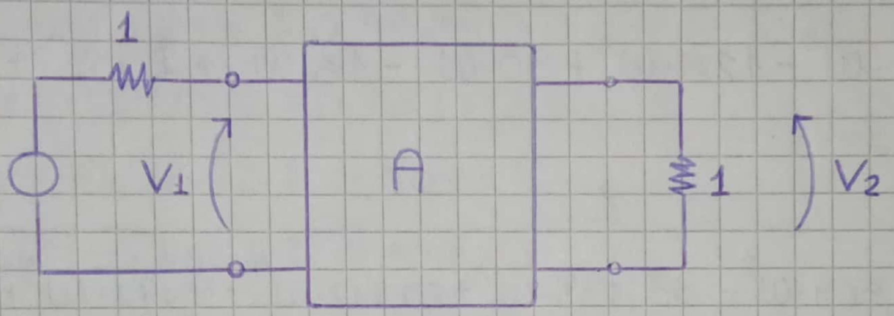
TS 15

Diseñe el cuadripolo A para que se comporte como

Filtro Pasabajos Chebyshev de 4° orden, 1dB riple

No disipativo

Normalizado en frecuencia e impedancia



$$|T(s)|^2 = \frac{1}{1 + \xi^2 \omega^{2N}}$$

Calculo ξ

$$10^{\frac{1\,dB}{10}} = \xi^2 + 1$$

$$\xi^2 = 0,2589$$

$$C_m(\omega) = 2\omega \cdot C_{m-1}(\omega) - C_{m-2}(\omega)$$

$$C_4 = 2\omega \cdot C_3(\omega) - C_2(\omega)$$

$$C_3 = 4\omega^3 - 3\omega$$

$$C_2 = 2\omega^2 - 1$$

$$C_4 = 2\omega(4\omega^3 - 3\omega) - 2\omega^2 + 1$$

$$C_4 = 8\omega^4 - 6\omega^2 - 2\omega^2 + 1$$

$$\hookrightarrow C_4 = 8\omega^4 - 8\omega^2 + 1$$

$$|T(\omega)|^2 = \frac{1}{1 + C_n^2(\omega)}$$

$$= \frac{1}{1 + (8\omega^4 - 8\omega^2 + 1)^2}$$

$$|T(\omega)|^2 = \frac{1}{(64\cdot\omega^8 - 128\cdot\omega^6 + 80\cdot\omega^4 - 16\cdot\omega^2 + 1)\cdot\xi^2 + 1}$$

$$|T(\omega)|^2 = \frac{1}{16{,}569\cdot\omega^8 - 33{,}139\cdot\omega^6 + 20{,}712\cdot\omega^4 - 4{,}142\cdot\omega^2 + 1{,}258}$$

$$|T(s)|^2 = \frac{1}{16{,}569\cdot s^8 + 33{,}139\cdot s^6 + 20{,}712\cdot s^4 + 4{,}142\cdot s^2 + 1{,}258}$$

$$|S_{21}|^2 = \frac{1}{16{,}569\cdot s^8 + 33{,}139\cdot s^6 + 20{,}712\cdot s^4 + 4{,}142\cdot s^2 + 1{,}258}$$

$$|S_{11}|^2 = 1 - |S_{21}|^2$$

$$|S_{11}|^2 = \frac{16{,}569\cdot s^8 + 33{,}139\cdot s^6 + 20{,}712\cdot s^4 + 4{,}142\cdot s^2 + 0{,}258}{16{,}569\cdot s^8 + 33{,}139\cdot s^6 + 20{,}712\cdot s^4 + 4{,}142\cdot s^2 + 1{,}258}$$

Busco los polos y ceros

Ceros

$P_1 = 1,9427 \cdot 10^{-8} \pm 0,9238\, J$

$P_2 = -1,9427 \cdot 10^{-8} \pm 0,9238\, J$

$P_3 = 6,5444 \cdot 10^{-9} \pm 0,3826\, J$

$P_4 = -6,5444 \cdot 10^{-9} \pm 0,3826\, J$

Se puede notar que se puede despreciar la parte real

Polos

$Z_1 = 0,1395 \pm 0,9833\, J$

$Z_2 = -0,1395 \pm 0,9833\, J$

$Z_3 = 0,3368 \pm 0,4073\, J$

$Z_4 = -0,3368 \pm 0,4073\, J$

Utilizo la función "ZPK2TF" para obtener la S_{11} con los polos y ceros en el semiplano izquierdo

$$S_{11} = \frac{S^4 + S^2 + 0,125}{S^4 + 0,9528 \cdot S^3 + 1,4539 \cdot S^2 + 0,7426 \cdot S + 0,2756}$$

Busco la Z_1 siendo:

$$Z_1 = \frac{S_{11} + 1}{1 - S_{11}}$$

$$Z_1 = \frac{S^4 + S^2 + 0,125 + (S^4 + 0,9528 \cdot S^3 + 1,4539 \cdot S^2 + 0,7426 \cdot S + 0,2756}{S^4 + 0,9528 \cdot S^3 + 1,4539 \cdot S^2 + 0,7426 \cdot S + 0,2756 - S^4 - S^2 - 0,125}$$

$$Z_1 = \frac{2 \cdot S^4 + 0{,}9528 \cdot S^3 + 2{,}4539 \cdot S^2 + 0{,}7426 \cdot S + 0{,}4006}{0{,}9528 \cdot S^3 + 0{,}4539 \cdot S^2 + 0{,}7426 \cdot S + 0{,}1506}$$

Utilizo el método de Cauer para sintetizar

$$\begin{array}{l|l} 2 \cdot S^4 + 0{,}9528 \cdot S^3 + 2{,}4539 \cdot S^2 + 0{,}7426 \cdot S + 0{,}4 & 0{,}9528 \cdot S^3 + 0{,}4539 \cdot S^2 + 0{,}7426 \cdot S + 0{,}1506 \\ \hline 2 \cdot S^4 + 0{,}9527 \cdot S^3 + 1{,}5587 \cdot S^2 + 0{,}3161 \cdot S & 2{,}099 \cdot S \\ \hline + 0{,}8952 \cdot S^2 + 0{,}4265 \cdot S + 0{,}4006 & \end{array}$$

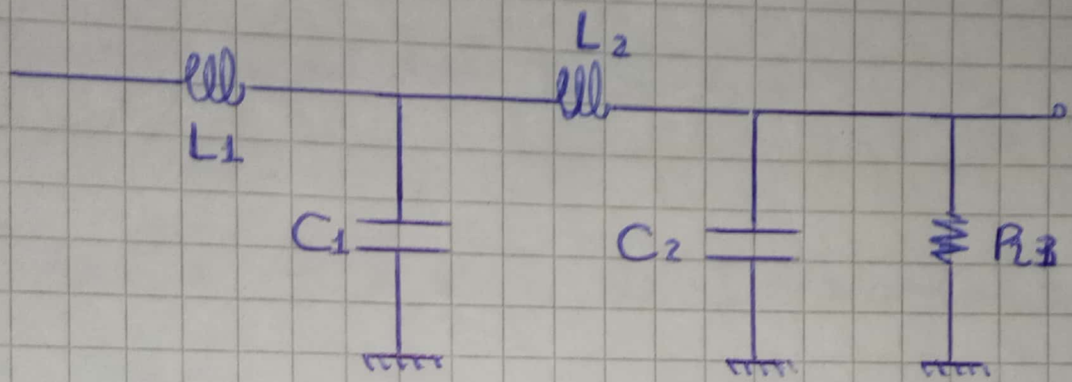
$$\begin{array}{l|l} 0{,}9528 \cdot S^3 + 0{,}4539 \cdot S^2 + 0{,}7426 \cdot S + 0{,}1506 & 0{,}8952 \cdot S^2 + 0{,}4265 \cdot S + .. \\ \hline 0{,}9528 \cdot S^3 + 0{,}4539 S^2 & 1{,}0643 \cdot S \\ \hline 0{,}3162 \cdot S + 0{,}1506 & \end{array}$$

$$\begin{array}{l|l} 0{,}8952 \cdot S^2 + 0{,}4265 \cdot S + 0{,}4006 & 0{,}3162 \cdot S + 0{,}1506 \\ \hline & 2{,}8311 \cdot S \\ 0{,}4006 & \end{array}$$

$$\begin{array}{l|l} 0{,}3162 \cdot S + 0{,}1506 & 0{,}4006 \\ \hline & 0{,}7893 \cdot S \\ 0{,}1506 & \end{array}$$

$$\begin{array}{l|l} 0{,}4006 & 0{,}1506 \\ \hline & 2{,}6602 \end{array}$$

Finalmente



$L_1 = 2{,}099$ $L_2 = 2{,}8311$ $R_3 = 2{,}6602$

$C_1 = 1{,}0643$ $C_2 = 0{,}7893$