CUADRIPOLO

Resumen Fórmulas.

- Cuadripolo tipo T:

Adaptador de impedancia (Z) y atenuador.

$Z_{11} = Z_1 + Z_2 \qquad Z_{12} = Z_2 \qquad Z_{22} = Z_2 + Z_3$

$\text{Det } Z = Z_{11} \cdot Z_{22} - Z_{12} \cdot Z_{21} = Z_{11} \cdot Z_{22} - (Z_{12})^2$

$\boxed{A = \frac{Z_{11}}{Z_{12}}}$	$\boxed{B = \frac{\text{Det } Z}{Z_{12}}}$	$\boxed{C = \frac{1}{Z_{12}}}$	$\boxed{D = \frac{Z_{22}}{Z_{12}}}$
[Adimensional]	[Ω]	$\left[\frac{1}{\Omega}\right]$	[Adimensional]

$$Z_{in} = Z_{im1} = \sqrt{\frac{A \cdot B}{C \cdot D}} = \frac{\frac{A+B}{Z_{im2}}}{\frac{C+D}{Z_{im2}}} = \sqrt{Z_{in_{oc}} \cdot Z_{in_{sh}}}$$

$$Z_{out} = Z_{im2} = \sqrt{\frac{B \cdot D}{A \cdot C}}$$

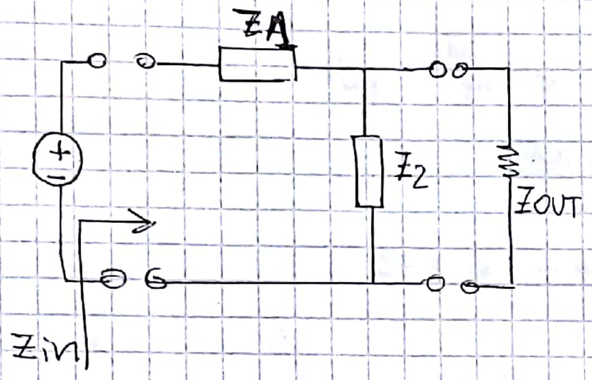
- Función de Propagación: $\sqrt{\frac{A}{D}} \cdot \left(\sqrt{\frac{A}{D}} + \sqrt{(A \cdot D) - 1)}\right)$

- Atenuación:

$$Ln\left[\sqrt{\frac{Z_{im1}}{Z_{im2}}} \cdot \left(\sqrt{(A \cdot D)} + \sqrt{(A \cdot D - 1)}\right)\right] \text{ [neper]}$$

Convierto de Neper a dB: 1 Neper = 8,685889638 [dB] = 8,6899999 2096. Valor en Neper = [dB]

"Atenuador tipo L"



$$Z_1 = Z_{K2}\left(1 - \frac{1}{e^{\alpha}}\right)$$

$$Z_2 = Z_{K2}\left(\frac{1}{e^{\alpha} - 1}\right)$$

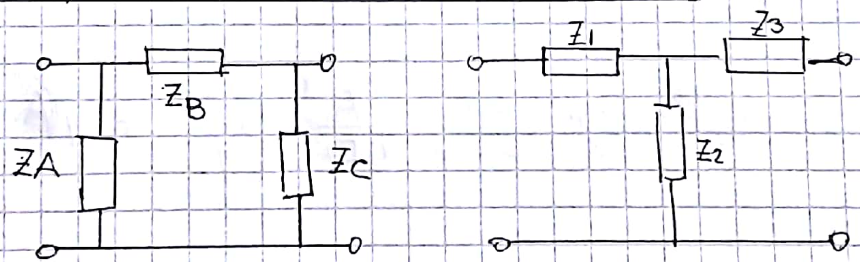
$$e^{\alpha} = \frac{E_{in}}{E_{OUT}} = \frac{I_{in}}{I_{OUT}}$$

Si $\begin{cases} Z_{in} = Z_{OUT} \rightarrow \text{Atenuador} \\ Z_{in} \neq Z_{OUT} \rightarrow \text{Adaptador} \end{cases}$

$$Ln\left(\frac{R_1}{R_2} + 1\right) = \alpha$$

Transformación de Cuadripolo.

$\left.\begin{matrix} \pi \text{ a } T \\ \Delta \text{ a } Y \end{matrix}\right\}$



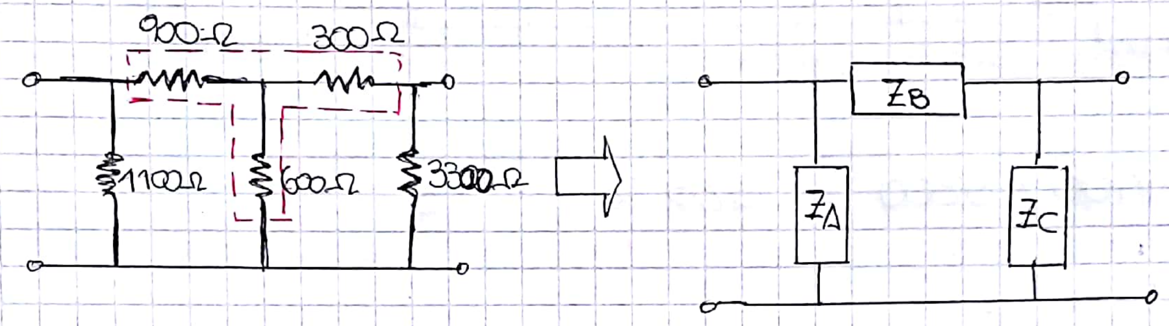
$$Z_1 = \frac{Z_A \cdot Z_B}{Z_A + Z_B + Z_C} \qquad Z_2 = \frac{Z_A \cdot Z_C}{Z_A + Z_B + Z_C} \qquad Z_3 = \frac{Z_B \cdot Z_C}{Z_A + Z_B + Z_C} \Bigg\} \Delta \rightarrow Y$$

$$Z_A = \frac{\Delta Z_T}{Z_3} \qquad Z_B = \frac{\Delta Z_T}{Z_2} \qquad Z_C = \frac{\Delta Z_T}{Z_1} \Bigg\} Y \rightarrow \Delta$$

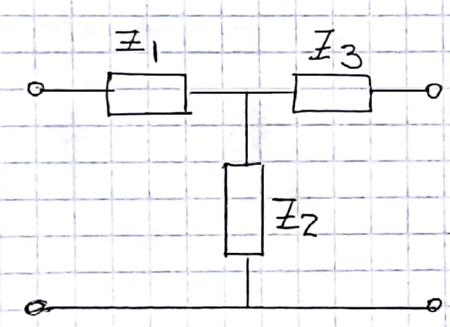
$$\Delta Z_T = Z_1 \cdot Z_2 + Z_1 \cdot Z_3 + Z_2 \cdot Z_3$$

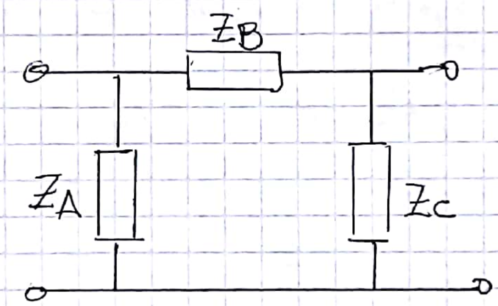
Examen 2020 | Cuadripolo
Mica

Calcular el valor de los componentes de un cuadripolo del tipo "π" equivalente.



- Paso de T a π:





$Z_1 = 900\,\Omega$

$Z_2 = 600\,\Omega$

$Z_3 = 300\,\Omega$

$\Delta Z_T = Z_1 . Z_2 + Z_1 . Z_3 + Z_2 . Z_3$

$\Delta Z_T = 900.600 + 900.300 + 300.600$

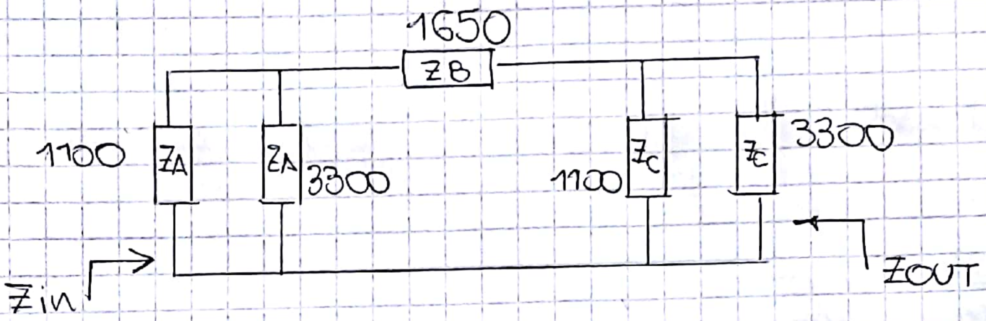
$\Delta Z_T = 990.000$

$$Z_A = \frac{\Delta Z_T}{Z_3} = \frac{990.000}{300} = 3300$$

$$Z_B = \frac{\Delta Z_T}{Z_2} = \frac{990.000}{600} = 1650$$

$$Z_C = \frac{\Delta Z_T}{Z_1} = \frac{990.000}{900} = 1100$$

Scanned by CamScanner



$$Z'_A = 1100 // 3300 = 825\,\Omega = Z'_C$$

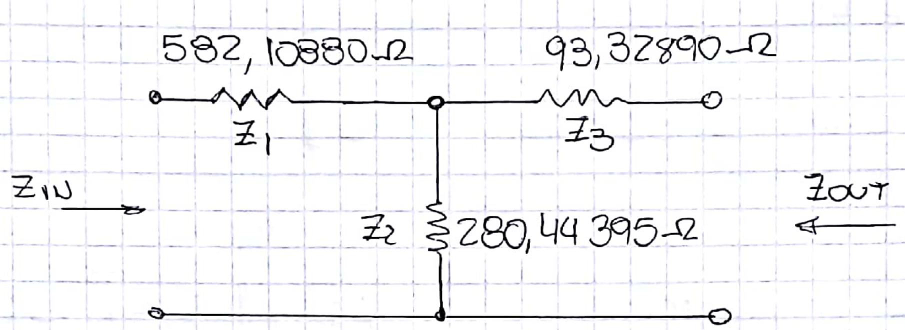
$$Z'_B = 1650\,\Omega$$

$$Z_{in_{oc}} = (Z'_A + Z'_B) // Z'_C = 2475 // 825 = 618{,}75\,\Omega$$

$$Z_{out_{oc}} = (Z'_C + Z'_B) // Z'_A = 2475 // 825 = 618{,}75\,\Omega$$

Final 2020
Mica

Cuadripolo.



A) Tipo de Cuadripolo: ADAPTADOR DE Z Y ATENUADOR

B) Justifique su respuesta: El cuadripolo es asimétrico.

C) En base a sus respuestas sobre los items A) y B) Determine el valor de la impedancia de entrada

$Z_{11} = Z_1 + Z_2 = 862,55275$

$Z_{12} = Z_{21} = Z_2 = 280,44395$

$Z_{22} = Z_2 + Z_3 = 373,77285$

$\Delta Z = (Z_{11} . Z_{22}) - (Z_{12})^2 = 243749,9906$

$A = \frac{Z_{11}}{Z_{12}} = 3,075668$ [Adimensional]

$B = \frac{\Delta Z}{Z_{12}} = 869,1576$ [Ω]

$C = \frac{1}{Z_2} = 0,0035657$ [mho]

$D = \frac{Z_{22}}{Z_{21}} = 1,33278$ [Adimensional]

$$Z_{IN} = \sqrt{\frac{A.B}{C.D}} = 750,00 \ [\Omega]$$

$$Z_{OUT} = \sqrt{\frac{B.D}{A.C}} = 325,001 \ [\Omega]$$

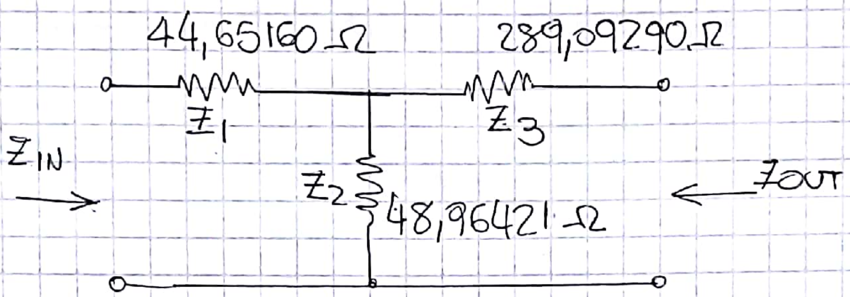
Función de Propagación: $= \sqrt{\frac{A}{D}} \cdot \left(\sqrt{A.D} + \sqrt{(A.D) - 1} \right) = 5,75$ [Adim]

F) Constante de Atenuación: en Nepers y dB

$\alpha = Ln(\text{Fun\_prop}) = 1,7480$ Nepers

$\alpha = 20 \log(\text{Fun\_prop}) = -15,1836$ dB (debería ser Negativo)

Final Rojos idem al Parcial | Cuadripolo | 2020



A) Tipo de cuadripolo: ADAPTADOR DE Z Y ATENUADOR

B) Justifique su respuesta: El Cuadripolo es Asimétrico ✓

C) Impedancia de Entrada Z_{IN}.

$Z_{11} = Z_1 + Z_2 = 93,6158$

$Z_{12} = Z_{21} = Z_2 = 48,96421$

$Z_{22} = Z_2 + Z_3 = 338,05711$

$\Delta Z = (Z_{11} \cdot Z_{22}) - (Z_{12})^2 = 29249,9963$

$A = \frac{Z_{11}}{Z_{12}} = 1,9119$ [Adim.] $B = \frac{\Delta Z}{Z_{12}} = 597,375$ [Ω] /

$C = \frac{1}{Z_2} = 0,0204$ [mho] $D = \frac{Z_{22}}{Z_{21}} = 6,9042$ [Adim] ✓

$Z_{IN} = \sqrt{\frac{A \cdot B}{C \cdot D}} = 90$ [Ω] / $Z_{OUT} = \sqrt{\frac{B \cdot D}{A C}} = 324,997$ [Ω] /

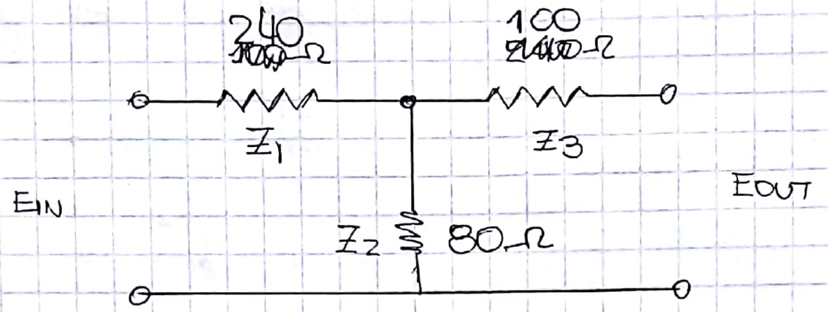
$Func\_prop = \sqrt{\frac{A}{D}} \cdot \left(\sqrt{A \cdot D} + \sqrt{(A \cdot D) - 1}\right) = 3,75$ [Adim] ✓

$\alpha = Ln(Fun\_prop) = 1,3217$ nepers. ✓

$\alpha = 20 \log(Fun\_prop) = -11,48$

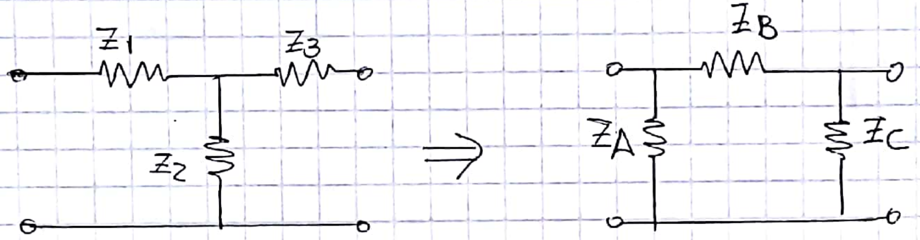
Parcial 2020 — Cuadripolo

Indique los valores de admitancia:



T a π

- Paso de Estrella a Triangulo



$$\Delta Z_T = Z_1 . Z_2 + Z_1 . Z_3 + Z_2 . Z_3$$

$$= 240 . 80 + 240 . 100 + 80 . 100 = 51200$$

$$Z_A = \frac{\Delta Z_T}{Z_3} = 512\ \Omega \qquad Z_B = \frac{\Delta Z_T}{Z_2} = 640\ \Omega \qquad Z_C = \frac{\Delta Z_T}{Z_1} = 213{,}33\ \Omega$$

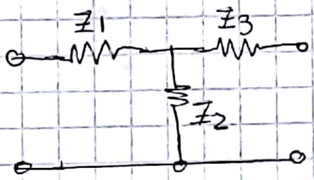
$$Y_{11} = \frac{1}{Z_A} + \frac{1}{Z_B} = 3{,}515 \text{ mili-siemens}$$

$$Y_{12} = Y_{21} = \frac{1}{Z_B} = 1{,}562 \text{ mil-siemens}$$

$$Y_{22} = \frac{1}{Z_C} + \frac{1}{Z_B} = 6{,}250 \text{ mili-siemens.}$$

Dada la matriz de los Parámetros de Transmisión Inversa de un cuadripolo pasivo, determine el valor de las impedancias, que formarán un cuadripolo del tipo "T"

$$EFGH = \begin{vmatrix} 4 & 3300 \\ 0{,}0033 & 3 \end{vmatrix}$$



$Z_1 = 600$ ✓

$Z_2 = 300$ ✓

$Z_3 = 900$ ✓

$$EFGH = \begin{vmatrix} D & B \\ C & \Delta \end{vmatrix} = \begin{vmatrix} 4 & 3300 \\ 0{,}0033 & 3 \end{vmatrix} \Rightarrow$$

$A = 3$

$B = 3300$

$C = 0{,}0033$

$D = 4$

$Z_{11} = Z_1 + Z_2$

$$\boxed{Z_1 = \frac{A}{C} - Z_2}$$

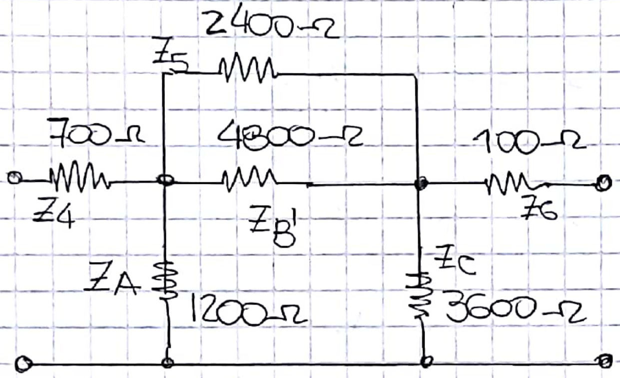
como $Z_{12} = Z_{21} = \boxed{Z_2 = \frac{1}{C}} = 300\,\Omega$ ✓

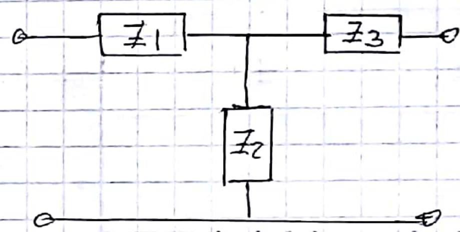
$$Z_1 = \frac{3}{0{,}0033} - 300 \Rightarrow Z_1 = 600\,\Omega$$ ✓

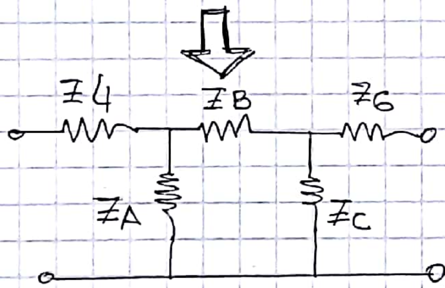
$$\boxed{Z_3 = \frac{D}{C} - Z_2} = \frac{4}{0{,}0033} - 300 \Rightarrow Z_3 = 900\,\Omega$$ ✓

Parcial 2020 | Cuadripolo.

- Calcule valor de los componentes de un cuadripolo T equivalente
- ¿ Compruebe sus resultados indicando el valor de la impedancia de entrada de cada circuito, con la salida a circuito abierto ($Z_{IN\,oc}$) y de la impedancia de salida de cada circuito con la entrada a circuito abierto ($Z_{OUT\,oc}$)







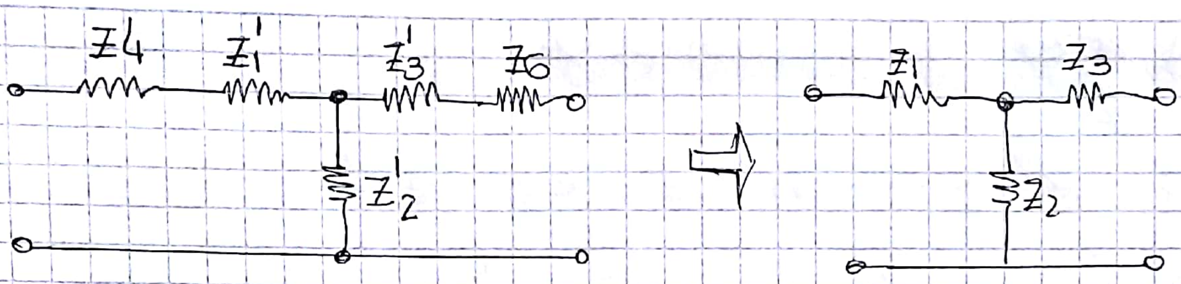
$$Z_B = Z_B' \,//\, Z_5 = 4800 \,//\, 2400$$

$$Z_B = 1600\ \Omega$$

$$Z_1' = \frac{Z_A \cdot Z_B}{Z_A + Z_B + Z_6} = \frac{1200 \cdot 1600}{1200 + 1600 + 3600} = 300$$

$$Z_2' = \frac{Z_A \cdot Z_C}{Z_A + Z_B + Z_C} = \frac{1200 \cdot 3600}{6400} = 675$$

$$Z_3' = \frac{Z_B \cdot Z_C}{Z_A + Z_B + Z_C} = \frac{1600 \cdot 3600}{6400} = 900$$



$$Z_1 = Z_1' + Z_4 = 300 + 700 = 1000\,\Omega \quad \checkmark$$

$$Z_2 = Z_2' = 675\,\Omega \quad \checkmark$$

$$Z_3 = Z_3' + Z_6 = 900 + 100 \Rightarrow Z_3 = 1000\,\Omega$$

$$\boxed{Z_{IN_{OC}} = Z_1 + Z_2} = 1000 + 675 = 1675\,\Omega$$

$$\boxed{Z_{OUT_{OC}} = Z_2 + Z_3} = 675 + 1000 = 1675\,\Omega$$