FILTROS M-DERIVADOS

DEFINICIÓN :

EL FILTRO M-DERIVADO, SE OBTIENE A PARTIR DEL FILTRO DE K-CONSTANTE Y SE EMPLEA EN CASCADA CON ESTOS.

ESPECIFICACIONES :

DEBE CUMPLIR CON LAS SIGUIENTES CONDICIONES :

A. TENER IGUAL IMPEDANCIA CARACTERÍSTICA QUE EL FILTRO DE K-CONSTANTE.

B. TENER IGUAL BANDA DE FRECUENCIA Y POR LO TANTO LAS MISMAS FRECUENCIAS DE CORTE QUE EL FILTRO DE K-CTE.

A. IMPEDANCIAS CARACTERÍSTICAS IGUALES

PARTIMOS DE LA Zo DE UN CUADRIPOLO TIPO “T”

$$Z_{OT} = \sqrt{Z_{IN_{OC}} \bullet Z_{IN_{SH}}} = \sqrt{Z_{OUT_{OC}} \bullet Z_{OUT_{SH}}} =$$

$$Z_{OT} = \sqrt{Z_{1K} \bullet Z_{2K} + \frac{Z_{1K}^{2}}{4}} =$$

$$\boxed{Z_{OT} = \sqrt{\frac{Z_{1K}}{2} \bullet \left(2 \bullet Z_{2K} + \frac{Z_{1K}}{2}\right)}} \qquad (1)$$

INTRODUCIMOS UN COEFICIENTE REAL $0 < m \leq 1$

$$Z_{OT} = \sqrt{\frac{m\, Z_{1K}}{2} \bullet \left(2 \bullet Z_{2K} + \frac{Z_{1K}}{2}\right) \frac{1}{m}} \qquad (2)$$

DE LA ECUACIÓN (1) DEFINIMOS LA Zo DE UNA SECCIÓN M-DERIVADA :

$$Z_{OT} = \sqrt{\frac{Z_{1K}}{2} \bullet \left(2 \bullet Z_{2K} + \frac{Z_{1K}}{2} \right)} \qquad (1)$$

$$Z_{OTm} = \sqrt{\frac{Z_{1Km}}{2} \bullet \left(2 \bullet Z_{2Km} + \frac{Z_{1Km}}{2} \right)} \qquad (3)$$

DADO QUE $Z_{OT} = Z_{OTm}$, IGUALANDO (2) Y (3) :

$$Z_{OT} = \sqrt{\frac{Z_{1Km}}{2} \bullet \left(2 \bullet Z_{2Km} + \frac{Z_{1Km}}{2} \right)} = Z_{OTm} = \sqrt{\frac{mZ_{1K}}{2} \bullet \left(2 \bullet Z_{2K} + \frac{Z_{1K}}{2} \right) \frac{1}{m}}$$

$$\frac{Z_{1Km}}{2} \bullet \left(2 \bullet Z_{2Km} + \frac{Z_{1Km}}{2} \right) = \frac{mZ_{1K}}{2} \bullet \left(2 \bullet Z_{2K} + \frac{Z_{1K}}{2} \right) \frac{1}{m} \qquad (4)$$

DE LA ECUACIÓN (4) DESPEJANDO OBTENEMOS :

$$\frac{Z_{1Km}}{2} = \frac{m \bullet Z_{1K}}{2} \quad \therefore \quad \boxed{Z_{1Km} = m \bullet Z_{1K}}$$

DE LA ECUACIÓN (4) ADEMÁS:

$$\left(2 \bullet Z_{2Km} + \frac{Z_{1Km}}{2}\right) = \left(2 \bullet Z_{2K} + \frac{Z_{1K}}{2}\right)\frac{1}{m}$$

DESPEJANDO DE LA ÚLTIMA EXPRESIÓN :

$$\boxed{Z_{2Km} = \frac{Z_{2K}}{m} + Z_{1K}\left(\frac{1-m^2}{4m}\right)}$$

B. MISMA BANDA PASANTE

EN LOS FILTROS DE K-CTE TENEMOS :

$$|X_K| = \left.\begin{matrix} \nearrow +1 \\ \searrow -1 \end{matrix}\right\}$$ **(EN LAS FRECUENCIAS DE CORTE)**

$$|X_K| = 0 \longrightarrow$$ **(DENTRO DE LA BANDA PASANTE)**

EN LA SECCION DE K-CTE :

$$\boxed{X_K = \sqrt{\frac{Z_{1K}}{4 * Z_{2K}}}}$$

Y EN LA m-DERIVADA SERÁ :

$$\boxed{X_{Km} = \sqrt{\frac{Z_{1Km}}{4 * Z_{2Km}}}}$$

$$X_{Km} = \sqrt{\frac{m\ Z_{1K}}{4 * \left(\frac{Z_{2K}}{m} + Z_{1K} \bullet \frac{1-m^2}{4m} \right)}} = \sqrt{\frac{m\ Z_{1K}}{\frac{4\ Z_{2K}}{m} * \left(1 + \frac{Z_{1K}}{4\ Z_{2K}} \bullet \left(1-m^2\right) \right)}}$$

$$X_{Km} = \sqrt{\frac{Z_{1K} \quad m^2}{4\ Z_{2K} * \left(1 + \frac{Z_{1K}}{4\ Z_{2K}} \bullet \left(1-m^2\right) \right)}}$$

Recordando $X_K{}^2 = \frac{Z_{1K}}{4\ Z_{2K}}$

$$X_{Km} = \sqrt{\frac{X_K{}^2 \quad m^2}{\left(1 + X_K{}^2 \bullet \left(1-m^2\right)\right)}}$$

$$\boxed{X_{Km} = \frac{X_K \quad m}{\sqrt{1 + X_K{}^2 \bullet \left(1-m^2\right)}}}$$

Cuando $X_K \rightarrow \infty$

$X_{Km} \rightarrow$ valor finito Real

$$\therefore \quad \boxed{\left. X_{Km} \right|_{X_K \rightarrow \infty} = \frac{m}{\sqrt{1-m^2}}}$$

LA EXPRESIÓN DE X_K PARA OBTENER $X_{Km} \rightarrow \infty$ RECORDANDO QUE $X_K = j\,|X_K|$ ESTARA DADA POR :

$$X_{Km} = j\frac{|X_K|\ m}{\sqrt{1-|X_K|^2 \bullet (1-m^2)}} = j\frac{|X_K|\ m}{0} = \infty$$

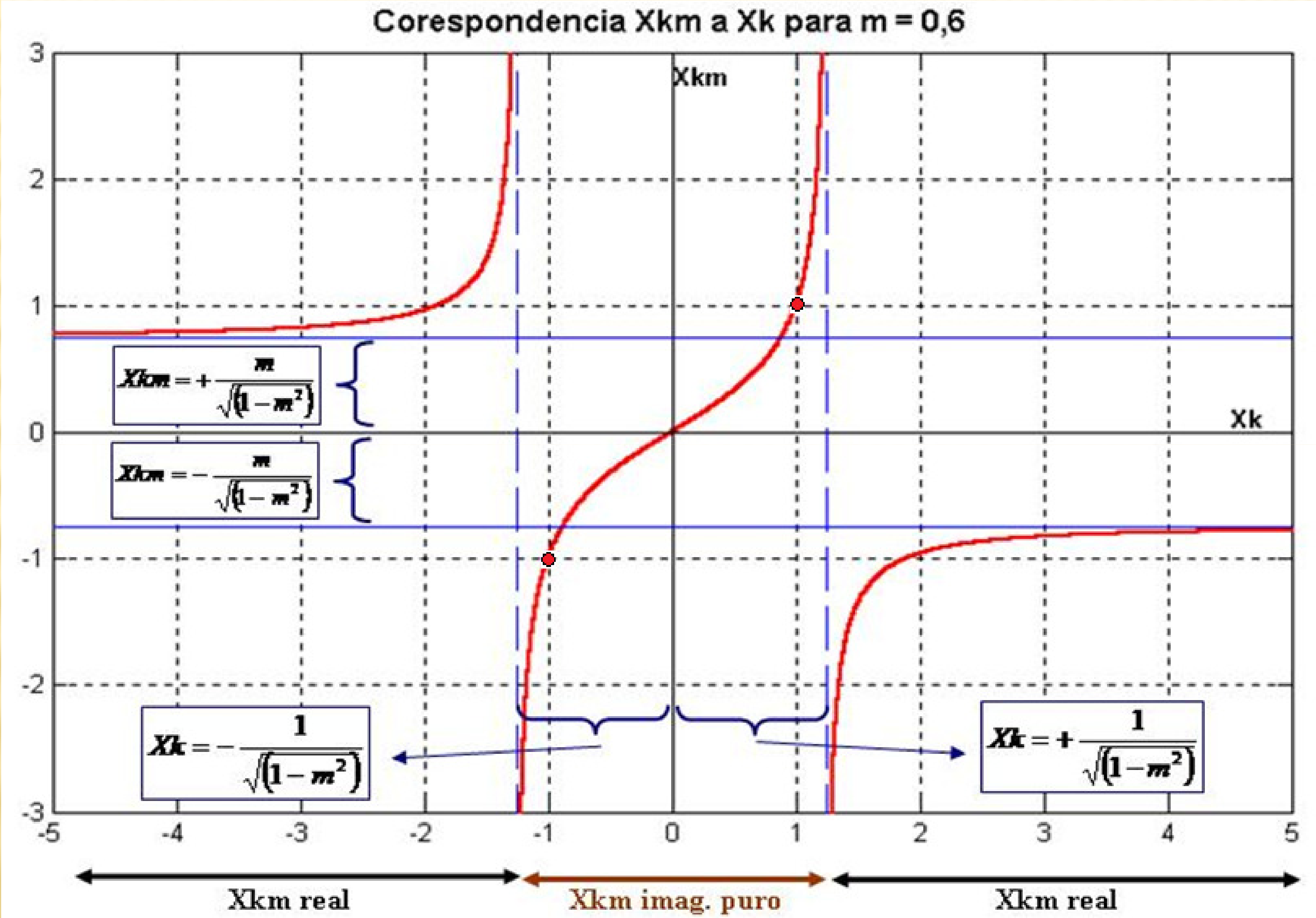
$$1-|X_K|^2 \bullet (1-m^2) = 0 \qquad \therefore \qquad |X_K|^2 \bullet (1-m^2) = 1$$

$$|X_K|^2 = \frac{1}{(1-m^2)} \qquad \therefore \qquad |X_K| = \frac{1}{\pm\sqrt{(1-m^2)}}$$

TOMANDO m = 0,6 (VALOR MUY UTILIZADO) TENEMOS

$$|X_K| = \frac{1}{\pm\sqrt{(1-m^2)}} = \frac{1}{\pm\sqrt{(1-0{,}6^2)}} = \pm\frac{1}{0{,}8} = \pm\ 1{,}25$$

CURVA DE CORRESPONDENCIA ENTRE X_K Y X_{Km}



Curvas obtenidas con programa CORRESPONDENCIA_XK_XKM_06 .m en MATLAB

DETERMINACIÓN DE α y β EN FILTROS M-DERIVADOS

$$X_K = senh\frac{\gamma}{2} = j\ [X_K] = \sqrt{\frac{Z_{1K}}{4*Z_{2K}}}$$

POR SIMILITUD CON LOS FILTROS DE K-CTE ESCRIBIMOS :

$$X_{Km} = j[X_{Km}] = \sqrt{\frac{Z_{1Km}}{4*Z_{2Km}}} = senh\frac{\alpha}{2}*\cos\frac{\beta}{2} + j\cosh\frac{\alpha}{2}*sen\frac{\beta}{2}$$

EN LA ZONA EN QUE X_{Km} ES IMAGINARIO PURO SUCEDE QUE :

$$|X_K| = \frac{1}{\pm\sqrt{(1-m^2)}}$$

$$senh\frac{\alpha}{2}*\cos\frac{\beta}{2} = 0 \quad \left\{ \begin{array}{l} \alpha = 0 \\ \\ \beta = \pm\Pi \end{array} \right.$$

LA PARTE REAL DE senh (γ/2)
DEBE SER CERO :

$$senh\frac{\alpha}{2}*\cos\frac{\beta}{2}=0$$

ESTO OCURRE SI : $\alpha=0 \qquad ó \qquad \beta=\pm\Pi$

PARA $\alpha=0 \quad\rightarrow\quad \cosh\alpha=1$

$$X_{Km}=\cancel{j}\left[X_{Km}\right]=\cancel{j}\cancelto{1}{\cosh\frac{\alpha}{2}}*sen\frac{\beta}{2} \qquad \therefore \qquad \beta=2\ sen^{-1}\left[X_{Km}\right]$$

VÁLIDO PARA
-1 ≤ |XKM | ≤ +1

PARA $\beta=\pm\Pi \quad\rightarrow\quad sen\ \beta/_{2}=\pm1$

$$X_{Km}=\cancel{j}\left[X_{Km}\right]=\cancel{j}\cancelto{1}{\cosh\frac{\alpha}{2}}*sen\frac{\beta}{2} \qquad \therefore \qquad \alpha=2\ \cosh^{-1}\left[X_{Km}\right]$$

VÁLIDO PARA
|XKM| ≥ ± 1

EN LA ZONA EN QUE X_{Km} ES REAL, LA PARTE IMAGINARIA DE senh (γ/2) DEBE SER CERO :

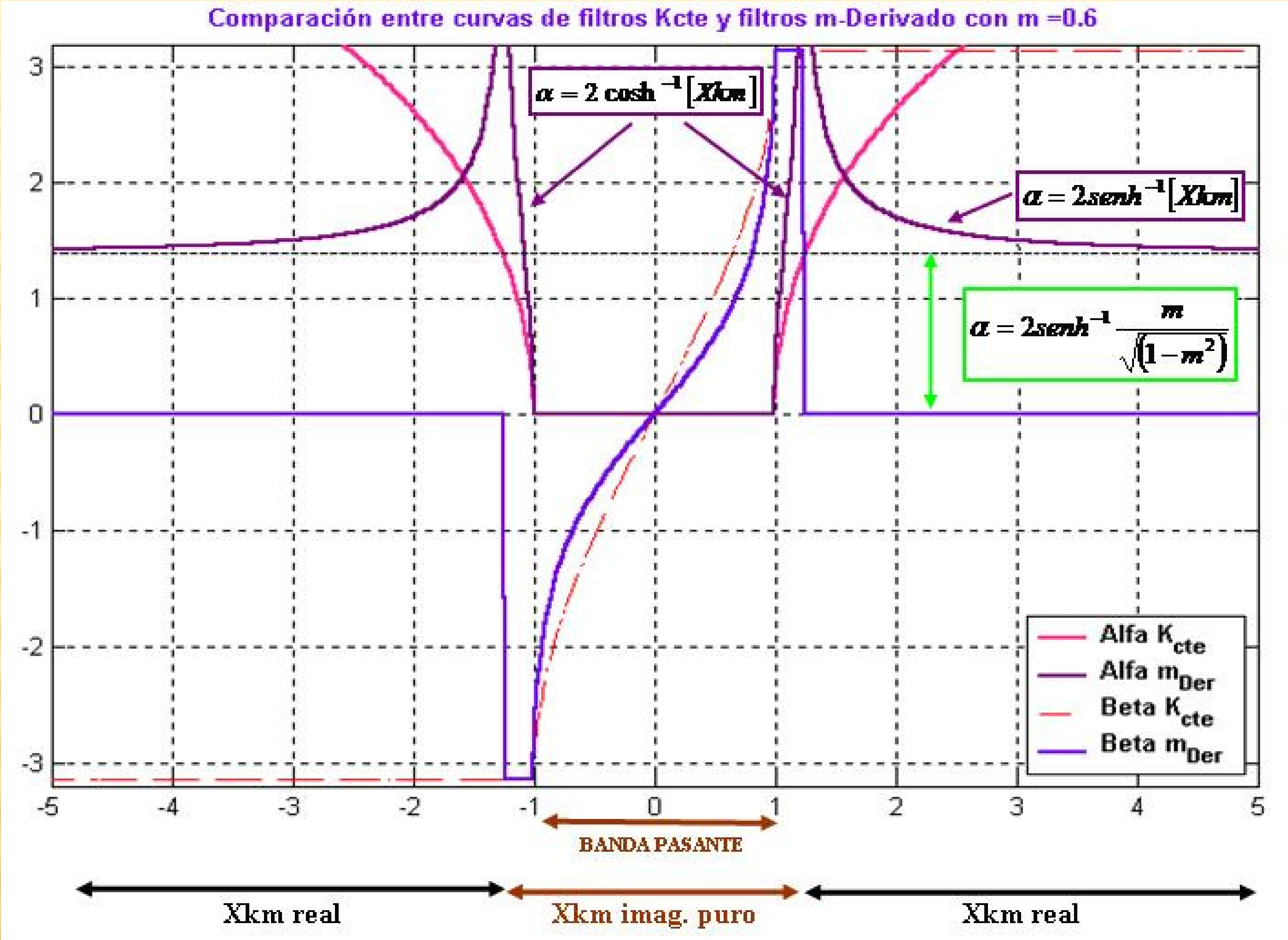
$$\boxed{X_{Km} = j[X_{Km}] = \sqrt{\frac{Z_{1Km}}{4 * Z_{2Km}}} = senh\frac{\alpha}{2} * \cos\frac{\beta}{2} + j\cosh\frac{\alpha}{2} * sen\frac{\beta}{2}}$$

$$\boxed{\cosh\frac{\alpha}{2} * sen\frac{\beta}{2} = 0}$$

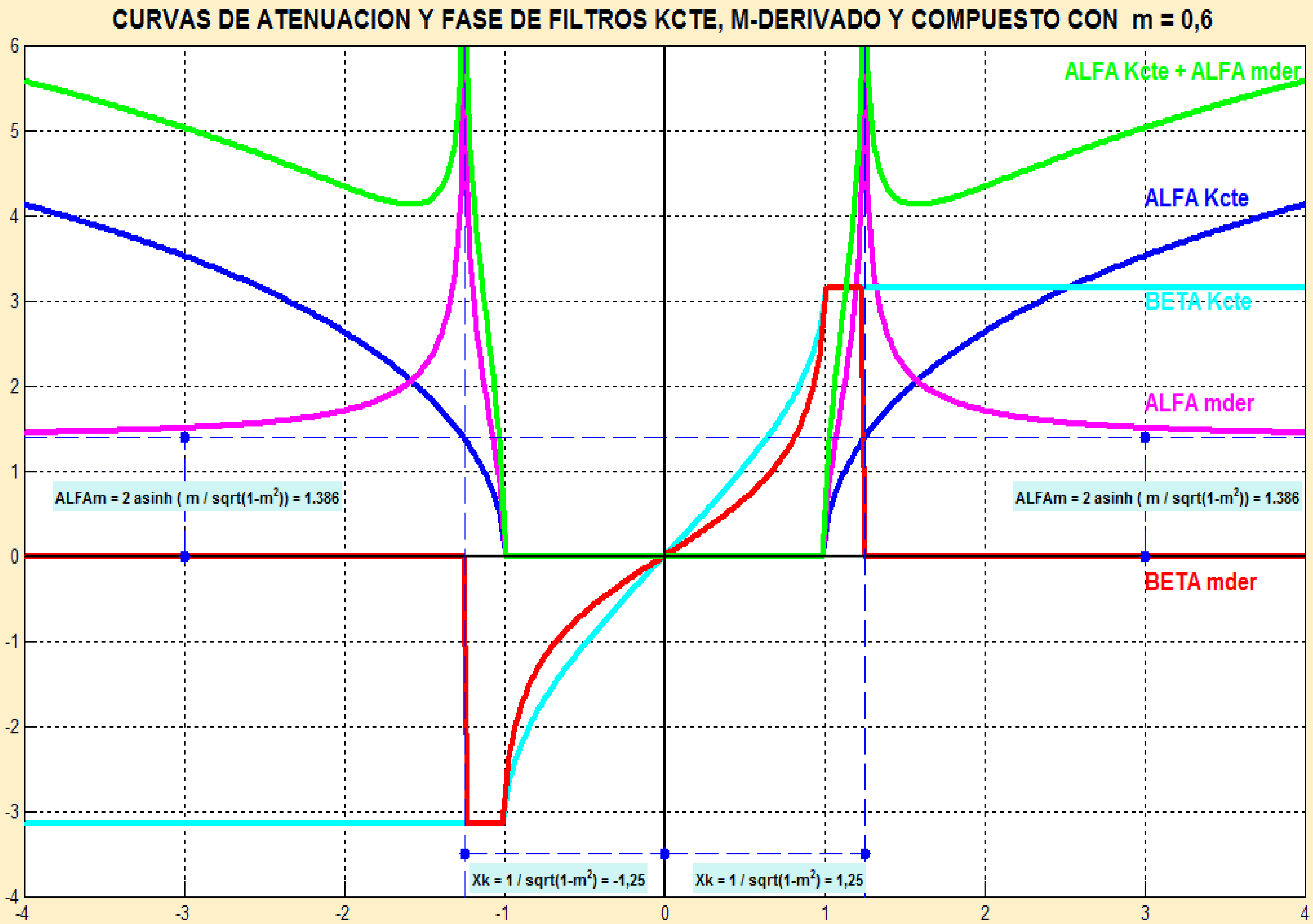
ESTO OCURRE CUANDO : $\beta = 0$

ENTONCES EN ESTA ZONA :

$$\boxed{X_{Km} = j\,[X_{Km}] = senh\frac{\alpha}{2} * \cancelto{1}{\cos\frac{\beta}{2}} \quad \therefore \quad \alpha = 2\ senh^{-1}[X_{Km}]}$$

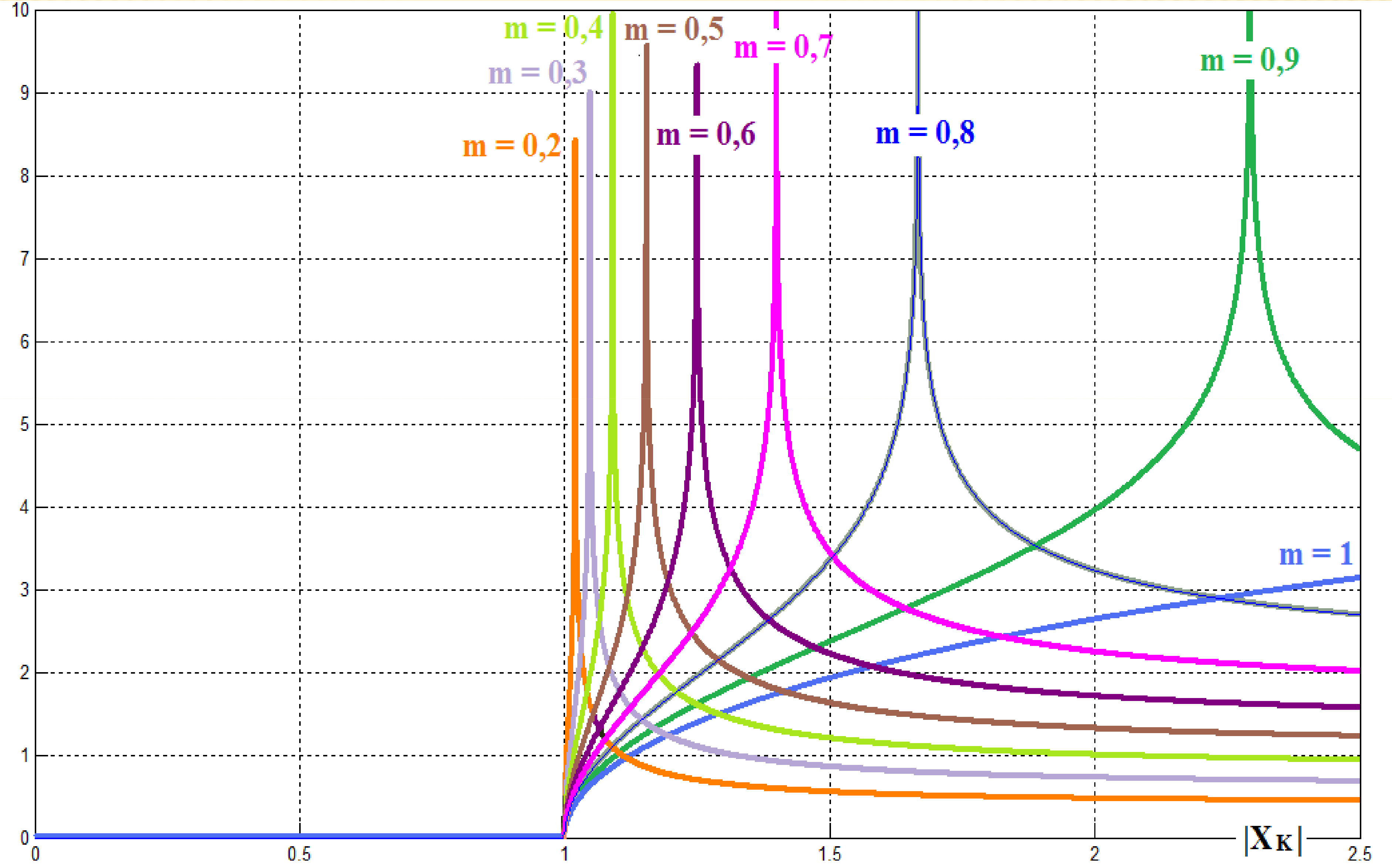


Curvas obtenidas con programa KCTE_M_06 .m en MATLAB



CURVAS DE ATENUACION Y FASE DE FILTROS KCTE, M-DERIVADO Y COMPUESTO CON m = 0,6
ALFA Kcte + ALFA mder
ALFA Kcte
BETA Kcte
ALFA mder
BETA mder
ALFAm = 2 asinh (m / sqrt(1-m²)) = 1.386
ALFAm = 2 asinh (m / sqrt(1-m²)) = 1.386
Xk = 1 / sqrt(1-m²) = -1,25
Xk = 1 / sqrt(1-m²) = 1,25

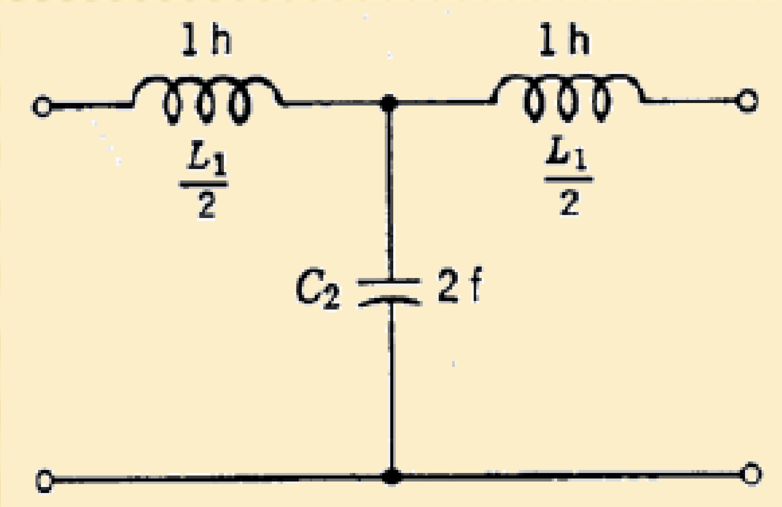
CURVAS DE ATENUACIÓN DE FILTROS KCTE Y m-DERIVADOS

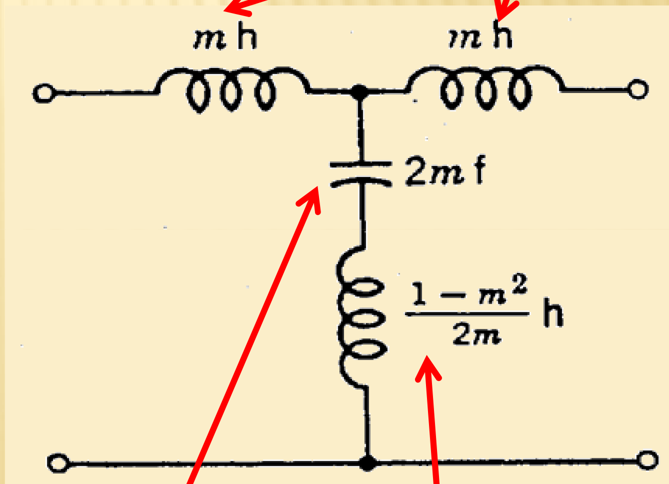


DISEÑO DE FILTRO PASA-BAJOS m-DERIVADO

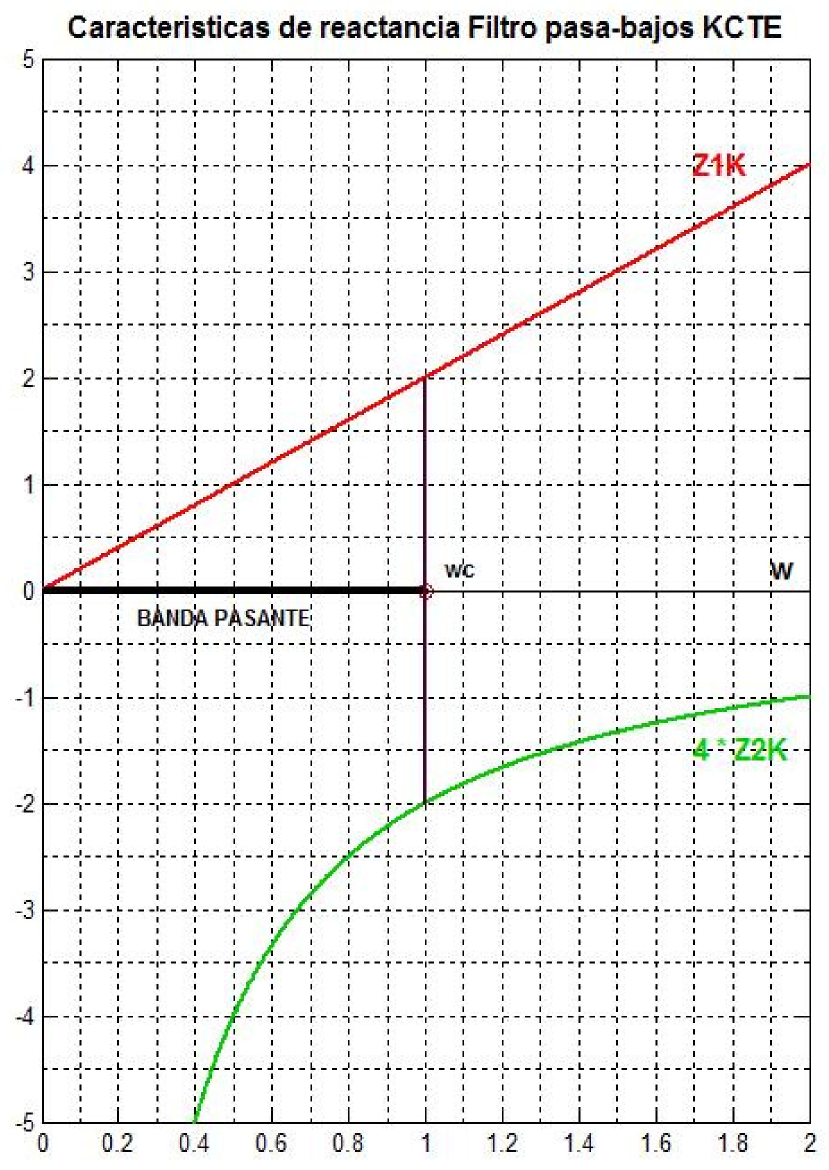
PARTIMOS DE UN FILTRO PASA BAJOS DE K_{KTE} Y APLICAMOS NORMALIZACIÓN :

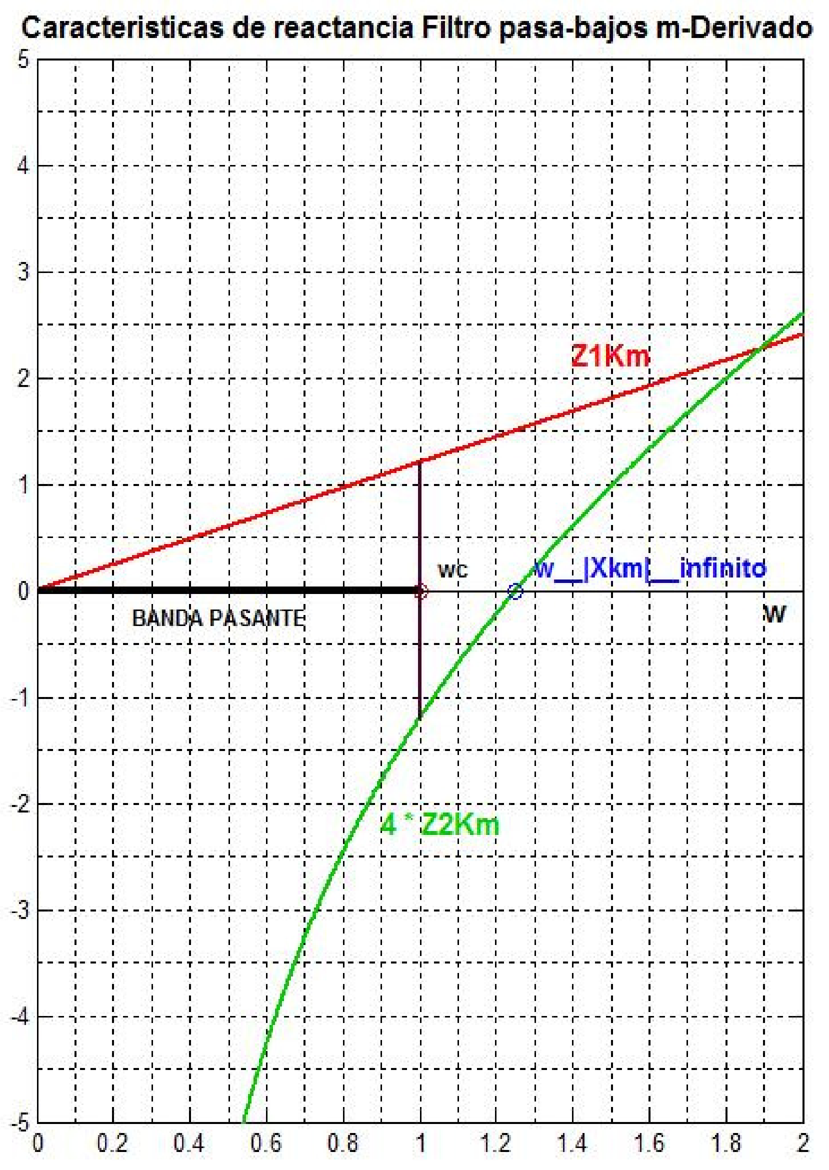
$$Z_{1Km} = m \bullet Z_{1K} = m \bullet pL = p\, mL$$





$$Z_{2Km} = \frac{Z_{2K}}{m} + Z_{1K}\left(\frac{1-m^2}{4m}\right) = \frac{1}{P\, mC} + P\, L\left(\frac{1-m^2}{4m}\right)$$



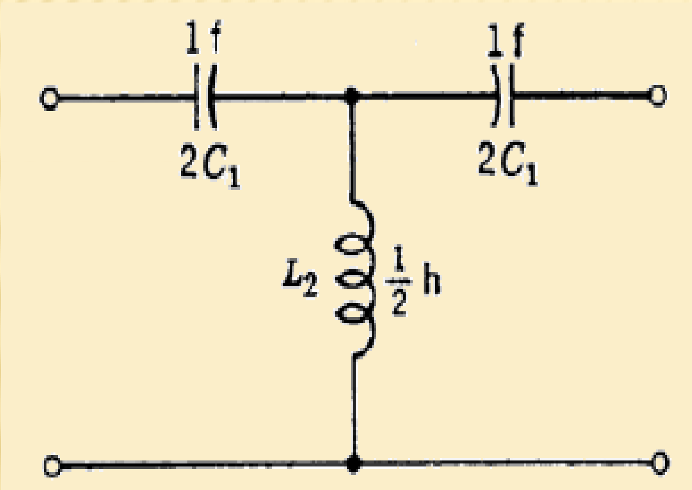


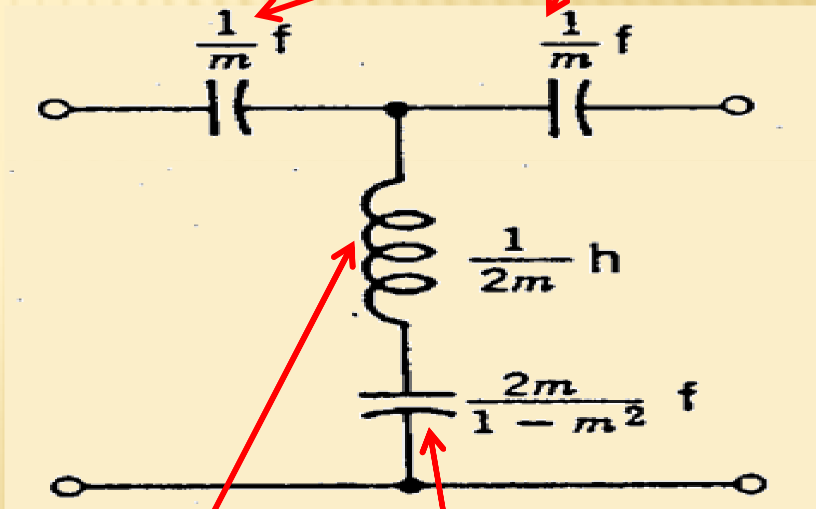
Curvas obtenidas con programa CURVAS_REACTANCIAS_K_M.m en MATLAB

DISEÑO DE FILTRO PASA-ALTOS m-DERIVADO

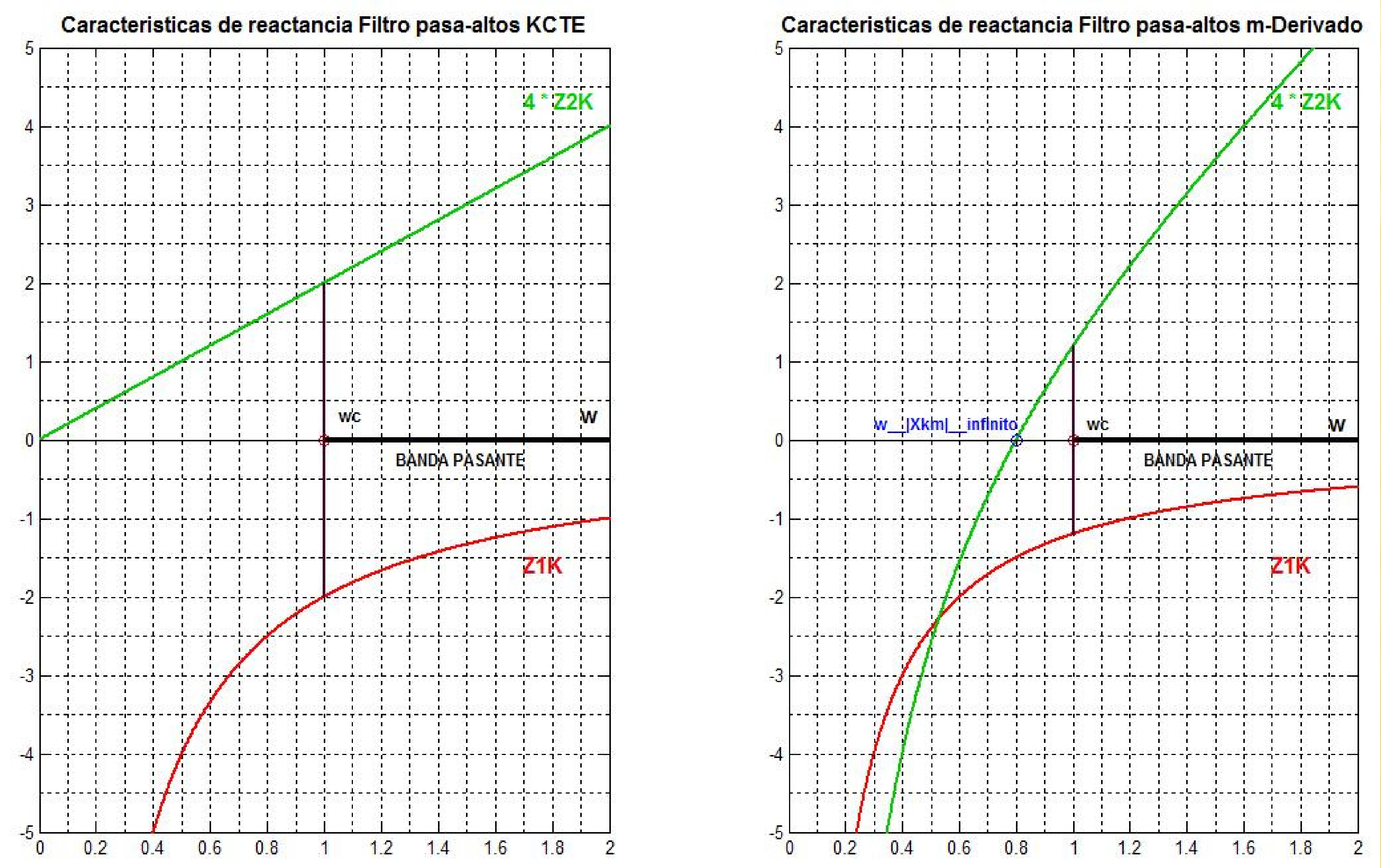
PARTIMOS DE UN FILTRO PASA ALTOS DE K_{KTE} Y APLICAMOS NORMALIZACIÓN :

$$Z_{1Km} = m \bullet Z_{1K} = m \frac{1}{PC} = \frac{1}{P \frac{C}{m}}$$





$$Z_{2Km} = \frac{Z_{2K}}{m} + Z_{1K}\left(\frac{1-m^2}{4m}\right) = P\frac{L}{m} + \frac{1}{P\,C\left(\frac{4m}{1-m^2}\right)}$$

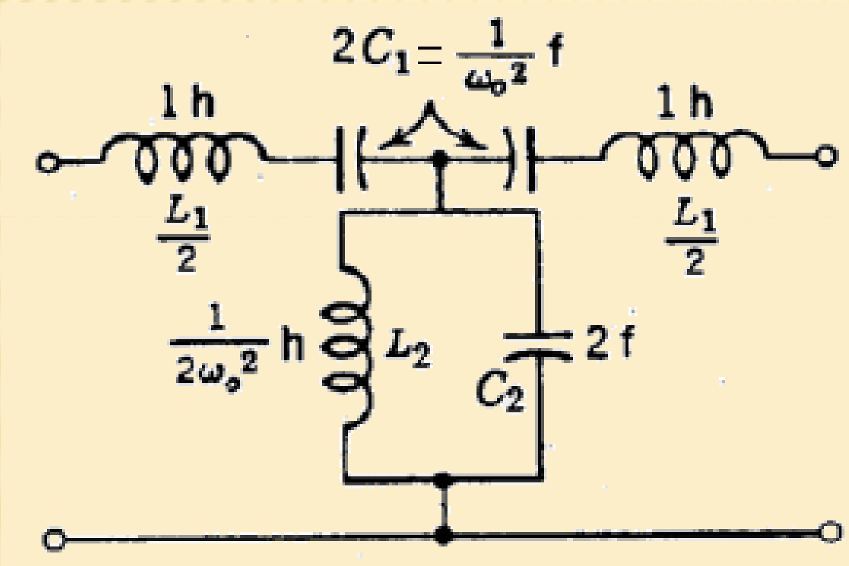


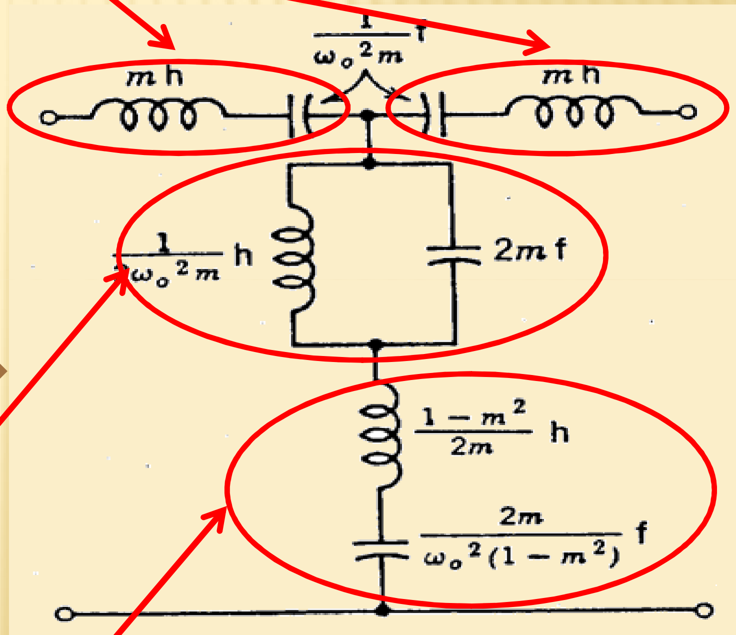
Curvas obtenidas con programa CURVAS_REACTANCIAS_K_M.m en MATLAB

DISEÑO DE FILTRO PASA-BANDA m-DERIVADO

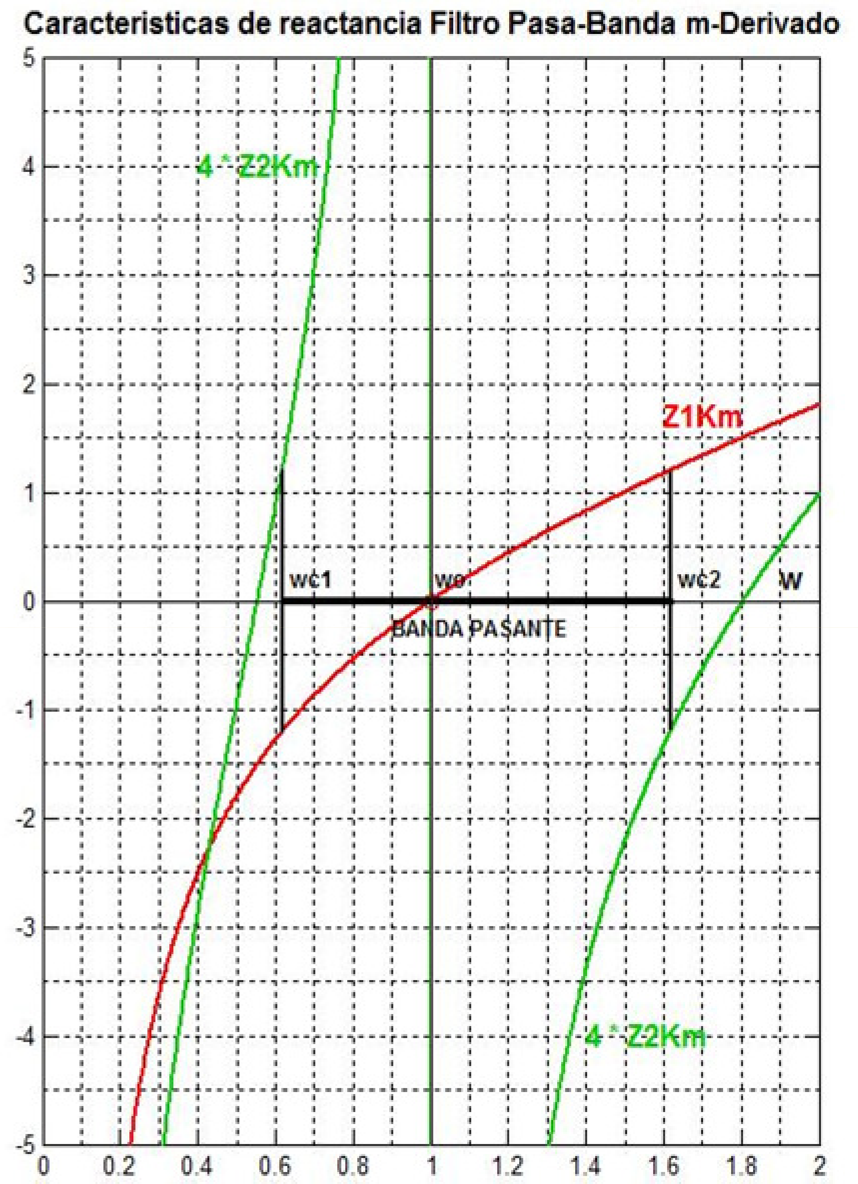
PARTIMOS DE UN FILTRO PASA BANDA DE K_{KTE} Y APLICAMOS NORMALIZACIÓN :

$$Z_{1Km} = m \bullet Z_{1K}$$





$$Z_{2Km} = \frac{Z_{2K}}{m} + Z_{1K}\left(\frac{1-m^2}{4m}\right)$$

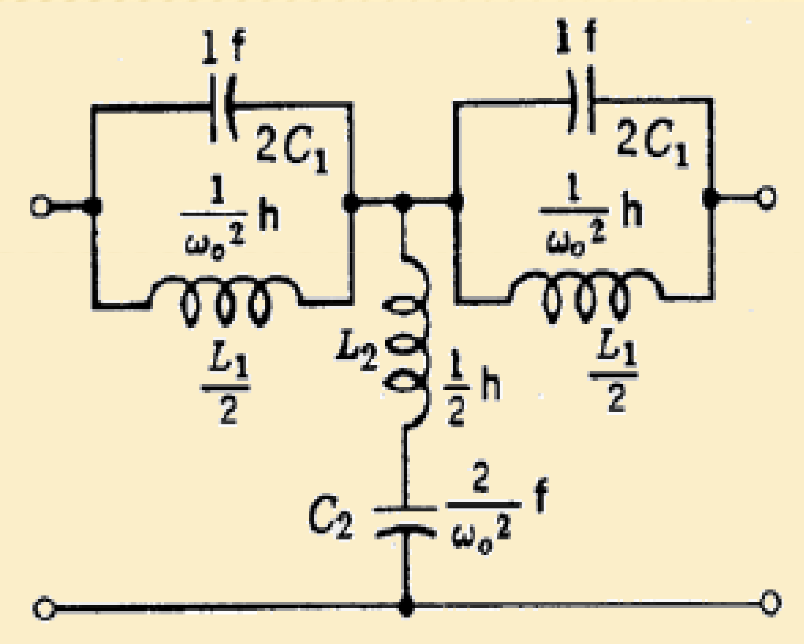


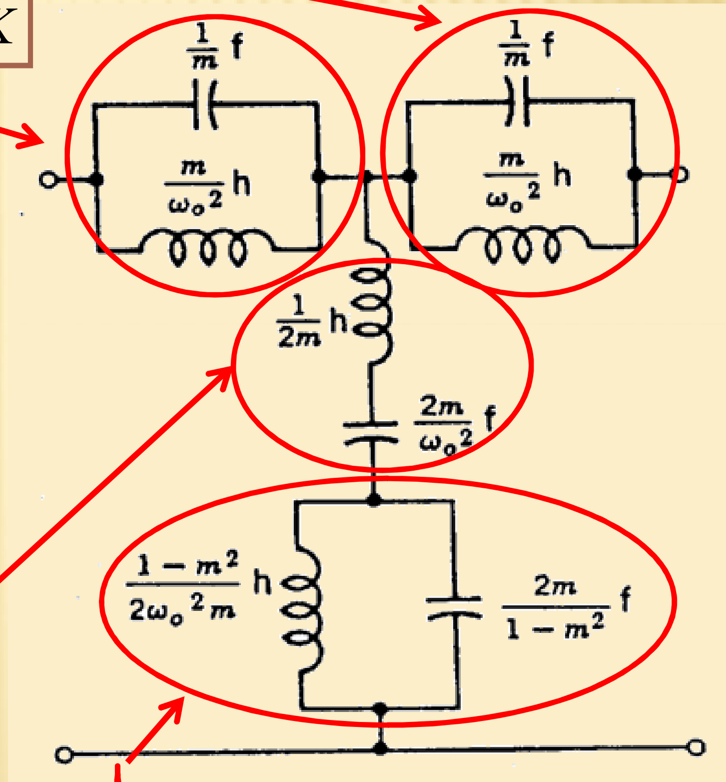
Curvas obtenidas con programa CURVAS_REACTANCIAS_K_M.m en MATLAB

DISEÑO DE FILTRO ELIMINA-BANDA m-DERIVADO

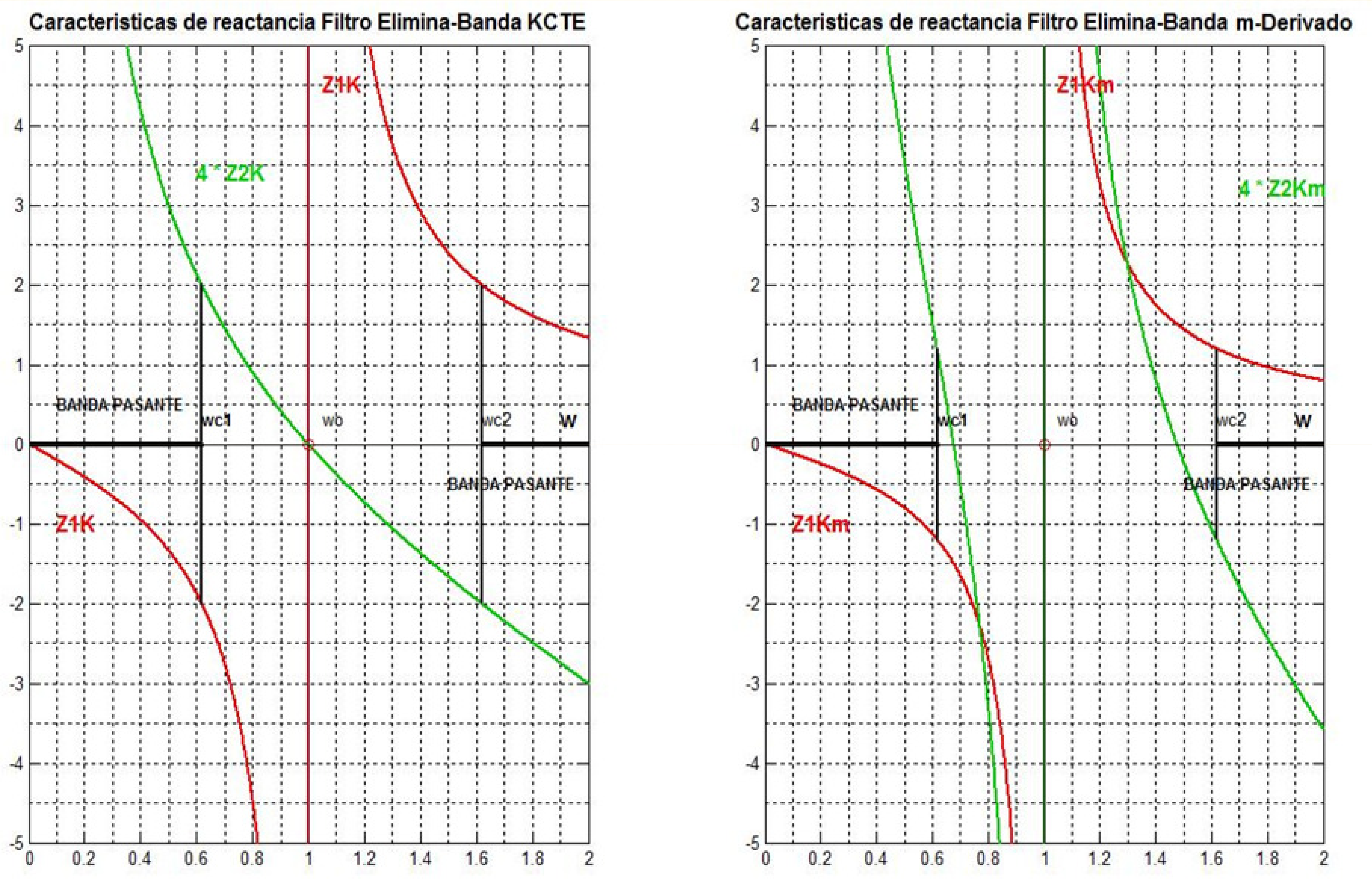
PARTIMOS DE UN FILTRO ELIMINA BANDA DE K_{KTE} Y APLICAMOS NORMALIZACIÓN :

$$Z_{1Km} = m \bullet Z_{1K}$$





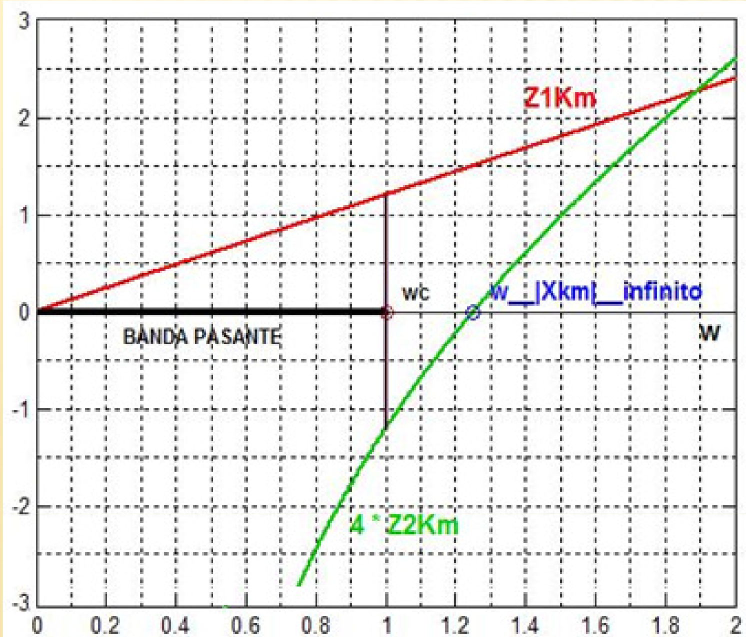
$$Z_{2Km} = \underbrace{\frac{Z_{2K}}{m}} + \underbrace{Z_{1K}\left(\frac{1-m^2}{4m}\right)}$$



Curvas obtenidas con programa CURVAS_REACTANCIAS_K_M.m en MATLAB

DETERMINACIÓN DEL VALOR DE m A PARTIR DE ω_c Y ω_∞

PARTIMOS DE LAS CURVAS DE REACTANCIA DE UN FILTRO PASA BAJOS DE K_{KTE} .



DONDE $4\,Z_{2KM} = 0$ SE PRODUCE LA ATENUACIÓN INFINITA ($\alpha = \infty$) y CORREPONDE A $X_{KM\infty}$.

$$Z_{2Km} = \frac{Z_{2K}}{m} + Z_{1K}\left(\frac{1-m^2}{4m}\right) = 0$$

$$\frac{Z_{1K}}{Z_{2K}} = -\frac{4}{1-m^2}$$

$$\frac{\omega_\infty L_1}{-\dfrac{1}{\omega_\infty C_2}} = -\frac{4}{1-m^2}$$

$$\omega_\infty = \frac{2}{\sqrt{L_1 \bullet C_2}} \bullet \frac{1}{\sqrt{1-m^2}}$$

DE LA ÚLTIMA EXPRESIÓN :

$$\omega_\infty = \frac{2}{\sqrt{L_1 \bullet C_2}} \bullet \frac{1}{\sqrt{1-m^2}}$$

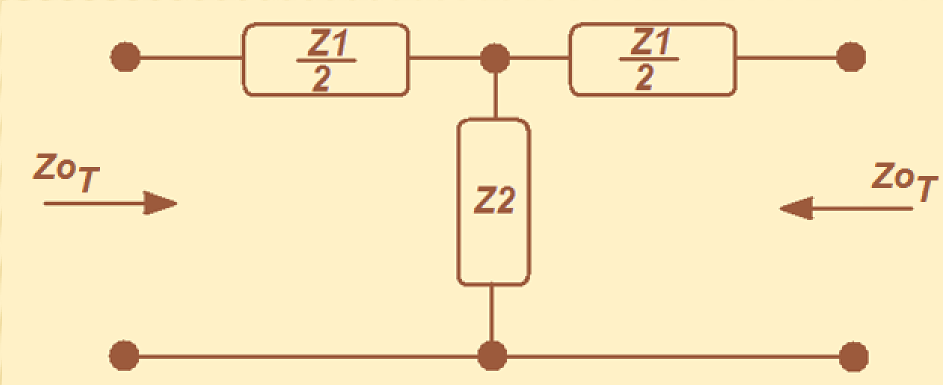
$$\omega_C\big|_{pb}$$

$$\omega_\infty = \omega_C\big|_{pb} \bullet \frac{1}{\sqrt{1-m^2}}$$

DESPEJANDO :

$$m = \sqrt{1-\left(\frac{\omega_C}{\omega_\infty}\right)^2} = \sqrt{1-\left(\frac{f_C}{f_\infty}\right)^2}$$

IMPEDANCIA CARACTERÍSTICA EN FILTROS TIPO "T" Y "Π" DE K_{CTE}



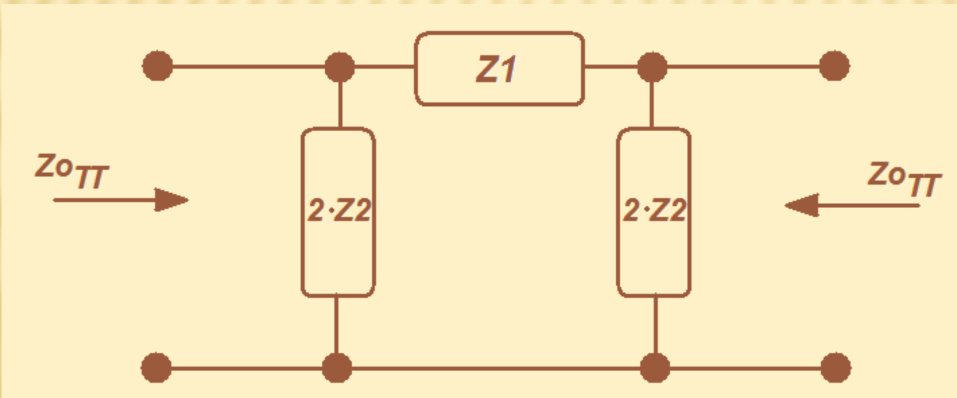
$$Zo_T = \sqrt{Z_1 \times Z_2} \times \sqrt{1 + \frac{Z_1}{4Z_2}}$$

$$Zo_T = Ro \times \sqrt{1 - |X_K|^2}$$

EN FILTROS DE K-CONSTANTE TENEMOS QUE :

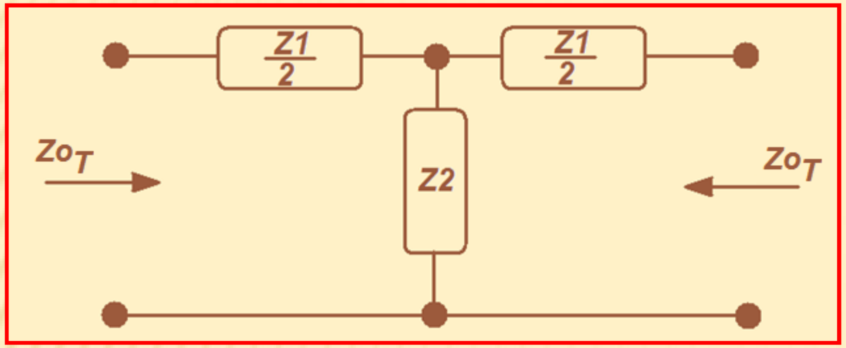
$$Ro = \sqrt{Z_1 \times Z_2}$$

$$-|X_K|^2 = \frac{Z_1}{4Z_2}$$

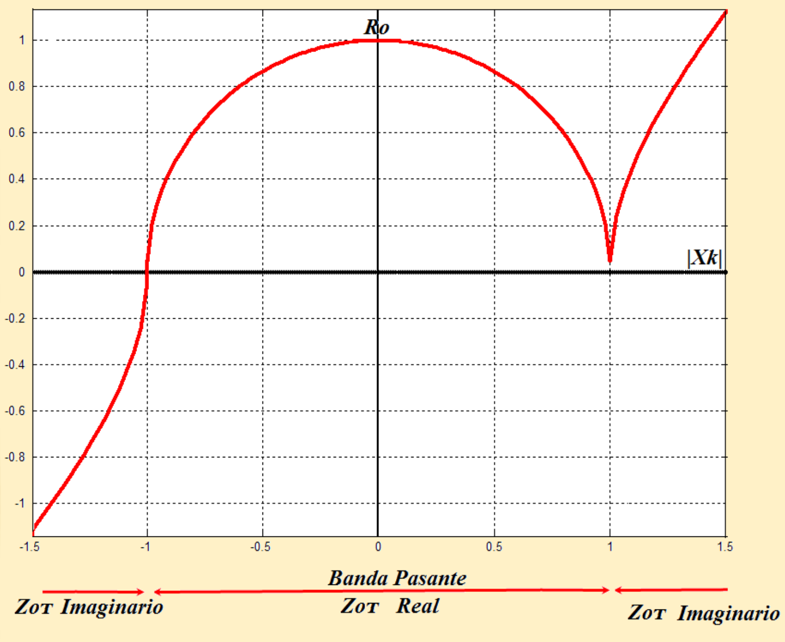


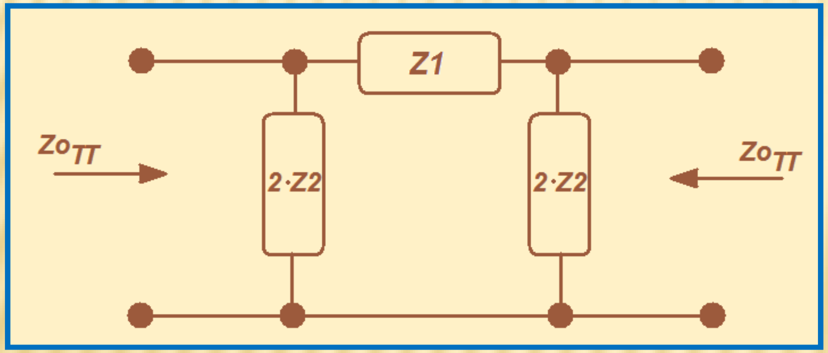
$$Zo_\pi = \frac{\sqrt{Z_1 \times Z_2}}{\sqrt{1 + \frac{Z_1}{4Z_2}}}$$

$$Zo_\pi = \frac{Ro}{\sqrt{1 - |X_K|^2}}$$

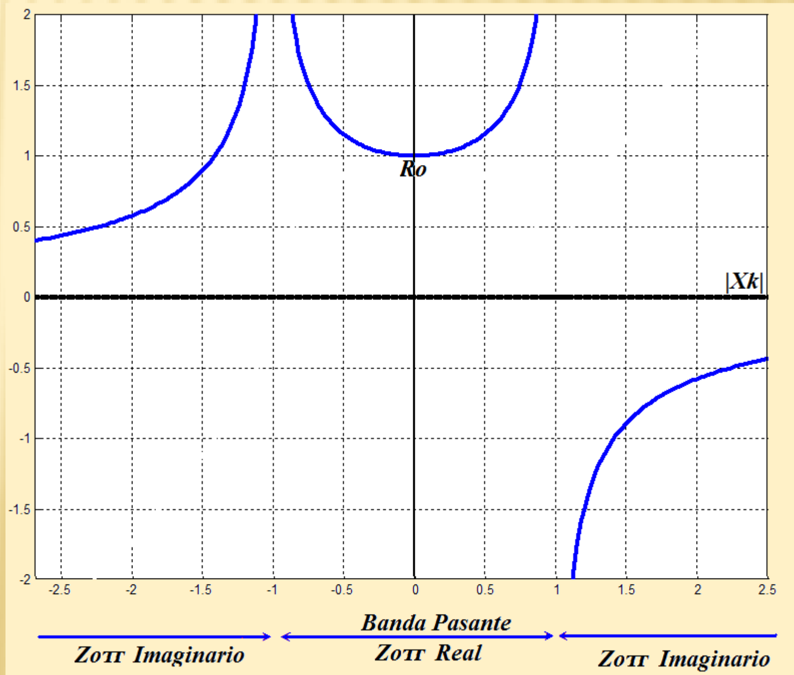


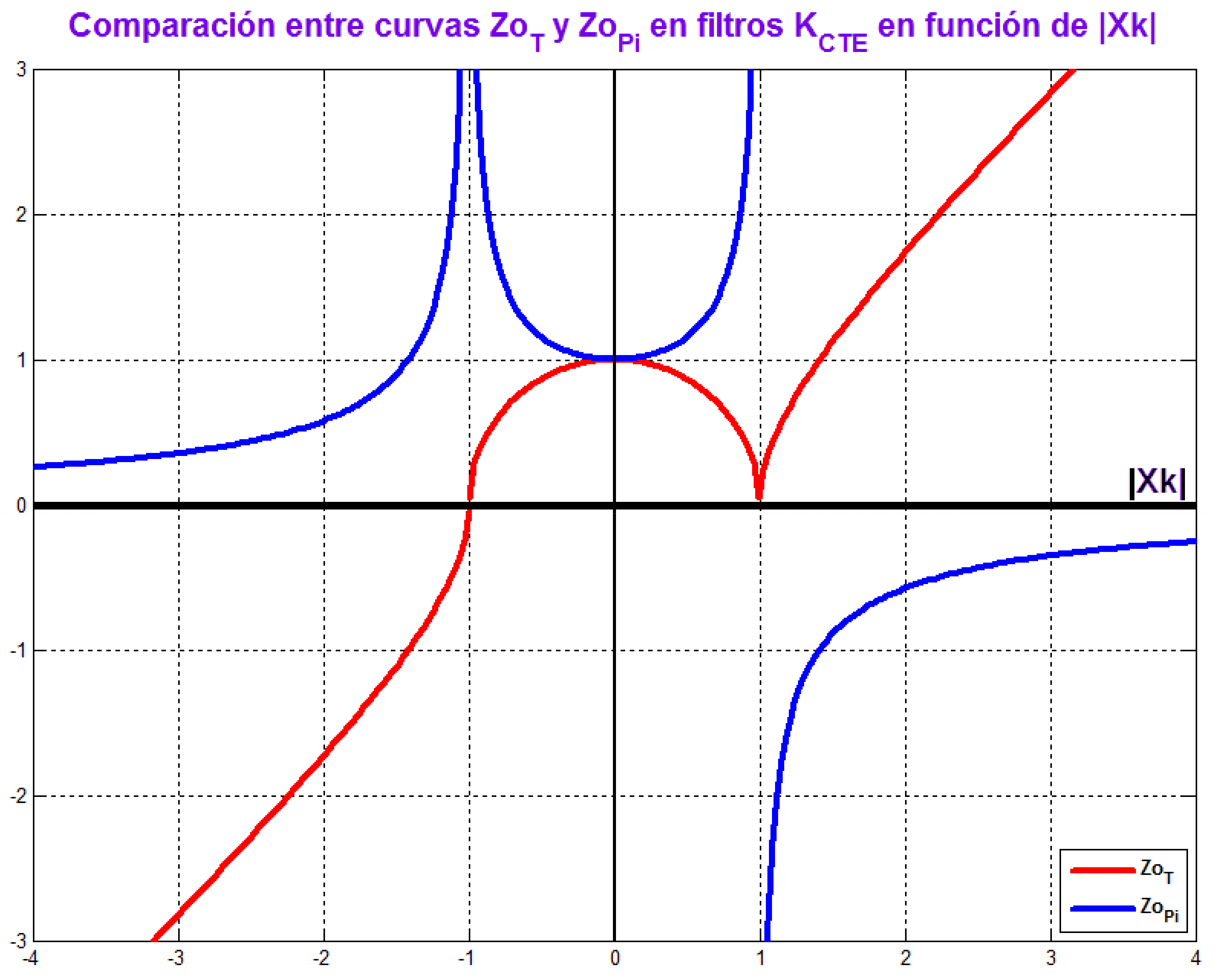
$$Zo_T = Ro \times \sqrt{1 - |X_K|^2}$$





$$Zo_\pi = \frac{Ro}{\sqrt{1 - |X_K|^2}}$$





Curvas obtenidas con programa Zok_T_PI.m en MATLAB

IMPEDANCIA CARACTERÍSTICA DE UN FILTRO TIPO "Π" m-DERIVADO

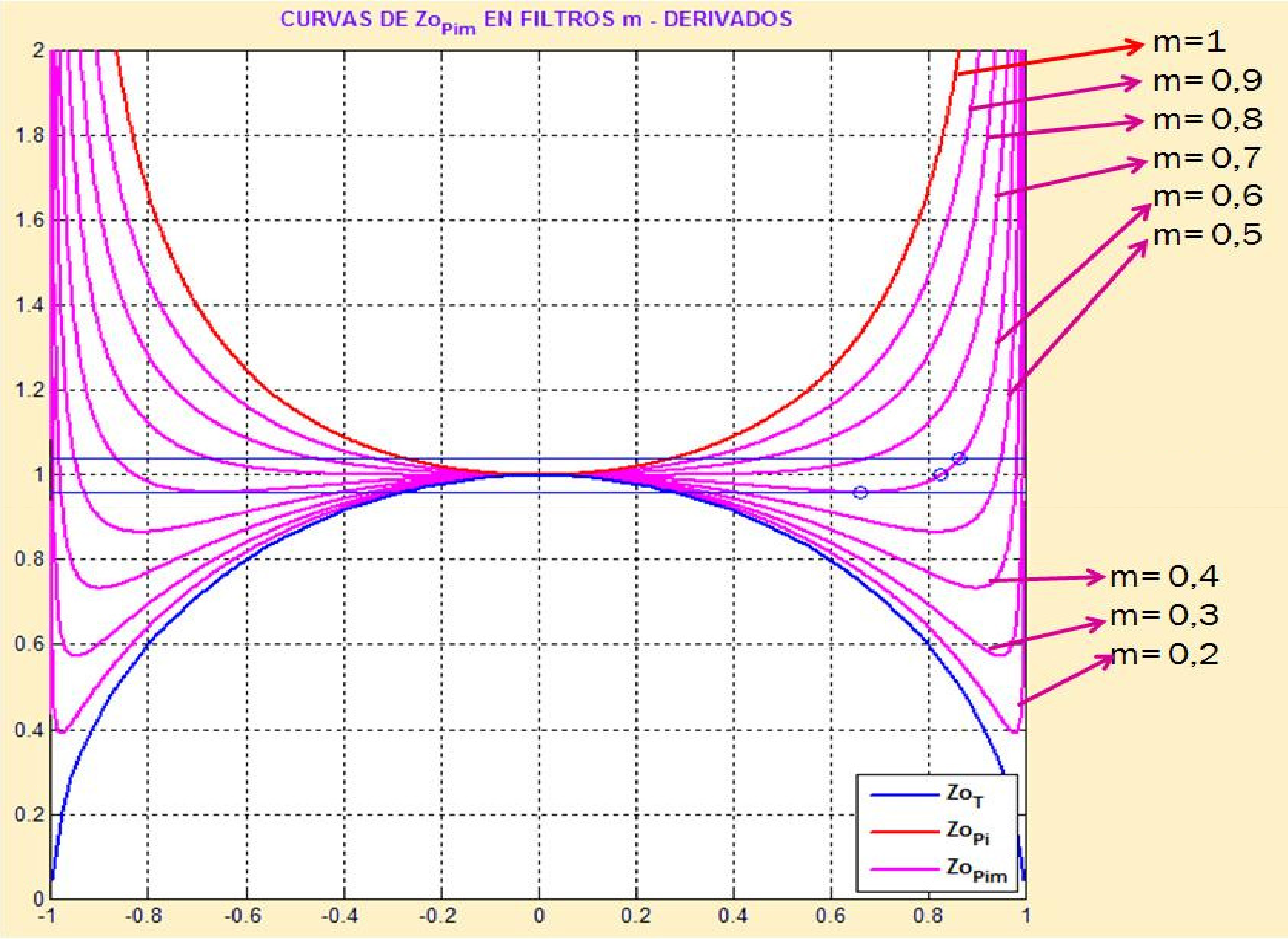
$$Z_{O\Pi m} = \frac{\sqrt{Z_{1Km} \times Z_{2Km}}}{\sqrt{1 + \frac{Z_{1Km}}{4Z_{2Km}}}}$$

$$Z_{1Km} = m \bullet Z_{1K}$$

$$Z_{2Km} = \frac{Z_{2K}}{m} + Z_{1K}\left(\frac{1 - m^2}{4m}\right)$$

REEMPLAZANDO Y OPERANDO NOS QUEDA :

$$Z_{O\Pi m} = \frac{Ro}{\sqrt{1 - \left|X_K\right|^2}} \bullet \left[1 - \left|X_K\right|^2 \bullet \left(1 - m^2\right)\right]$$



Curvas obtenidas con programa Zom_PI.m en MATLAB

PARTIENDO DE LA EXPRESIÓN :

$$\boxed{Z_{O\Pi m} = \frac{Ro}{\sqrt{1-|X_K|^2}} \bullet \left[1-|X_K|^2 \bullet \left(1-m^2\right)\right]}$$

DERIVANDO CON RESPECTO A |Xк| E IGUALANDO A CERO

$$\boxed{\frac{d\left(Z_{O\Pi m}\right)}{d|X_K|} = 0} \Rightarrow \boxed{|X_K|_{\min} = \pm\sqrt{\frac{1-2m^2}{1-m^2}}}$$

VALOR DE |Xк| PARA EL CUAL LA Zопm ES MÍNIMA

PARA |Xк| = |XK|minimo

$$\boxed{Z_{O\Pi m}\Big|_{(\text{minimo})} = 2 \bullet Ro \bullet m\,\sqrt{1-m^2}}$$

PARA $m = 0,6$

$$\boxed{Z_{O\Pi m}\Big|_{(\text{minimo})} = 0,96\Big|_{m=0,6}}$$

LA TOLERANCIA ε SE DEFINE COMO LA DIFERENCIA ENTRE LA IMPEDANCIA CARACTERÍSTICA DE UN FILTRO M DERIVADO EN CONFIGURACIÓN PI CUANDO $|X_K| = 0$ Y LA MISMA IMPEDANCIA CUANDO $|X_K| = |X_K|$minimo DIVIDIDO POR EL VALOR DE Ro .

$$\boxed{\varepsilon = \frac{Z_{O\Pi m}\Big|_{\left(|X_K|=0\right)} - Z_{O\Pi m}\Big|_{\left(|X_K|=|X_K|_{\min imo}\right)}}{Ro}}$$

$$\boxed{\varepsilon = \frac{\cancel{Ro} - 2\bullet \cancel{Ro}\bullet m\,\sqrt{1-m^2}}{\cancel{Ro}}}$$

$$\boxed{\varepsilon = 1 - 2\bullet m\,\sqrt{1-m^2}}$$

PARA $m = 0{,}6$

$$\boxed{\varepsilon = 0{,}04\Big|_{m=0,6}}$$

PARA OBTENER EL VALOR DE $Z_{O\Pi m}$ (máximo) HACEMOS :

$$\boxed{Z_{O\Pi m}\Big|_{(\text{maximo})} = Ro + \varepsilon}$$

$$\boxed{Z_{O\Pi m}\Big|_{(\text{maximo})} = Ro + \frac{\left(Ro - 2 \bullet Ro \bullet m \bullet \sqrt{1 - m^2}\right)}{Ro}}$$

$$\boxed{Z_{O\Pi m}\Big|_{(\text{maximo})} = Ro \bullet \left[1 + \left(1 - 2 \bullet m \bullet \sqrt{1 - m^2}\right)\right]}$$

PARA $m = 0,6$

$$\boxed{Z_{O\Pi m}\Big|_{(\text{maximo})} = 1,04\Big|_{m=0,6}}$$

PARA OBTENER EL VALOR DE $|Xk|$ *PARA CADA VALOR DE* $Z_{O\Pi m}$ *CON* $m = 0{,}6$ *, DESPEJAMOS DE LA SIGUIENTE EXPRESIÓN EL VALOR DE* $|Xk|$ *:*

$$\boxed{Z_{O\Pi m} = \frac{Ro}{\sqrt{1-|X_K|^2}} \bullet \left[1-|X_K|^2 \bullet \left(1-m^2\right)\right]}$$

$$Z_{O\Pi m} \bullet \sqrt{1-|X_K|^2} = Ro \bullet \left[1-|X_K|^2 \bullet \left(1-m^2\right)\right] \qquad pero \quad Ro = 1$$

$$Z_{O\Pi m}{}^2 \bullet \left(1-|X_K|^2\right) = \left\{1 \bullet \left[1-|X_K|^2 \bullet \left(1-m^2\right)\right]\right\}^2$$

$$Z_{O\Pi m}{}^2 - Z_{O\Pi m}{}^2 |X_K|^2 = \left[1 - 2 \bullet |X_K|^2 \bullet \left(1-m^2\right) + |X_K|^4 \bullet \left(1-m^2\right)^2\right]$$

$$\boxed{|X_K|^4 \bullet \left(1-m^2\right)^2 + |X_K|^2 \bullet \left[Z_{O\Pi m}{}^2 - 2 \bullet \left(1-m^2\right)\right] + \left(1 - Z_{O\Pi m}{}^2\right) = 0}$$

DE LA ÚLTIMA EXPRESIÓN :

$$\boxed{\left|X_K\right|^4 \bullet \left(1-m^2\right)^2 + \left|X_K\right|^2 \bullet \left[Z_{O\Pi m}{}^2 - 2\bullet\left(1-m^2\right)\right] + \left(1-Z_{O\Pi m}{}^2\right) = 0}$$

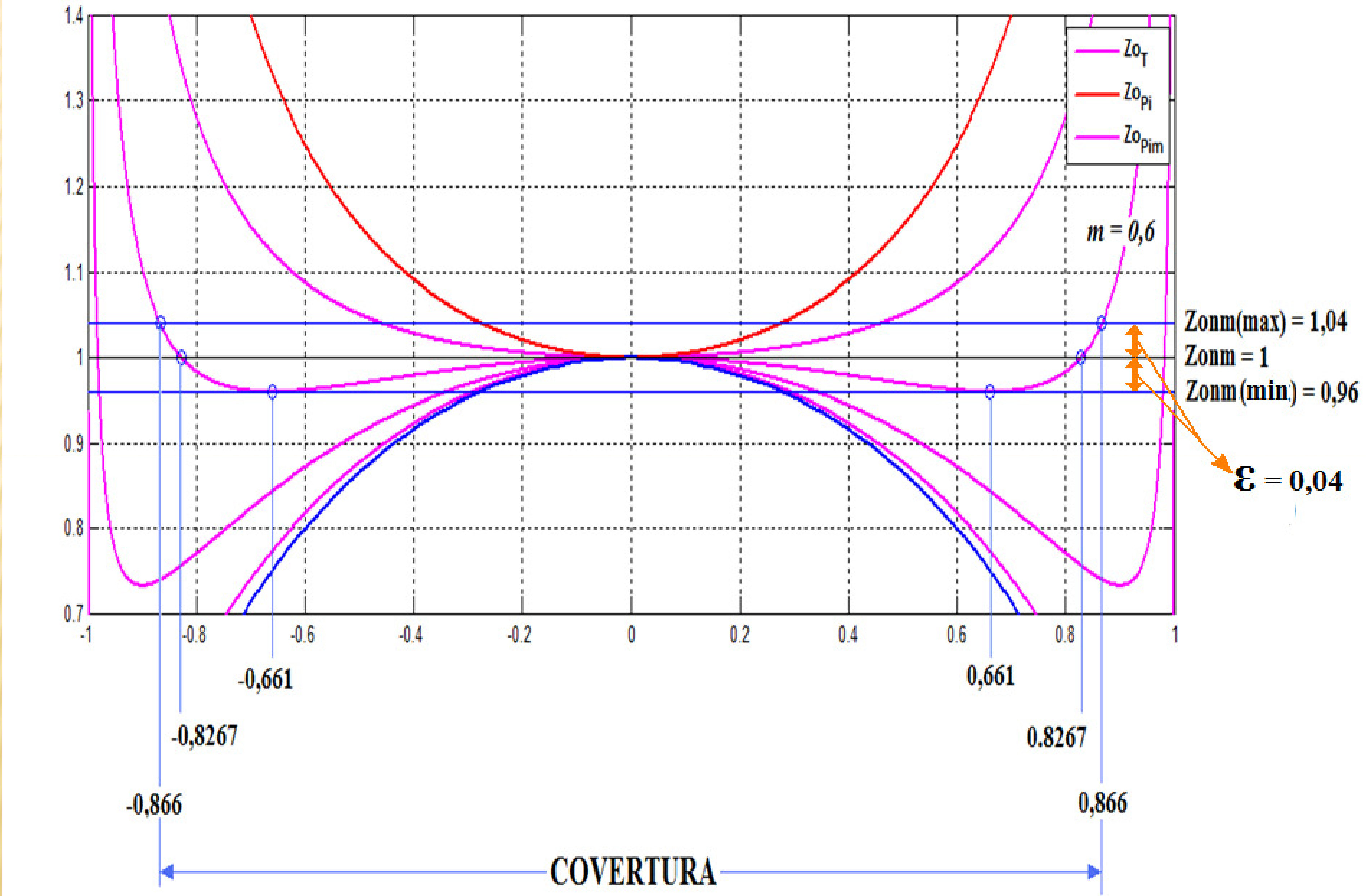
OBTENEMOS LOS VALORES DE $|X_K|$ PARA CADA VALOR NOTABLE DE $Z_{O\Pi m}$:

$$\left|X_K\right|_{Z_{O\Pi m}=0,96} = \pm 0,66143 \quad \Rightarrow \quad Z_{O\Pi m(\mathrm{MINIMO})}$$

$$\left|X_K\right|_{Z_{O\Pi m}=1} = \pm 0,8267 \quad \Rightarrow \quad Z_{O\Pi m(Ro)}$$

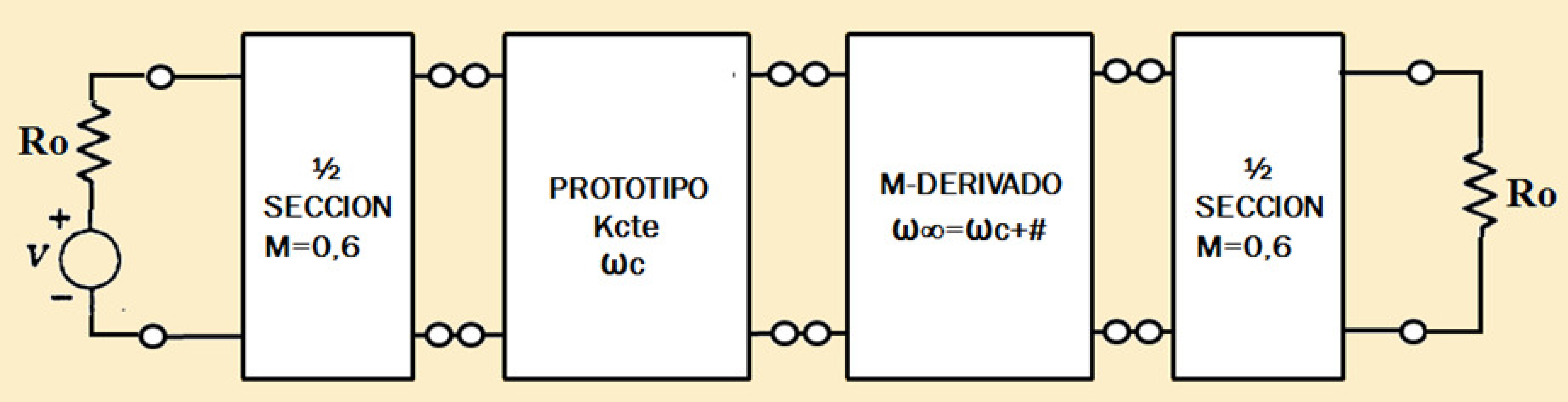
$$\left|X_K\right|_{Z_{O\Pi m}=1,04} = \pm 0,86602 \quad \Rightarrow \quad Z_{O\Pi m(\mathrm{MAXIMO})}$$

EL ÚLTIMO VALOR DEFINE LA COVERTURA = 86,6% PARA $m = 0,6$

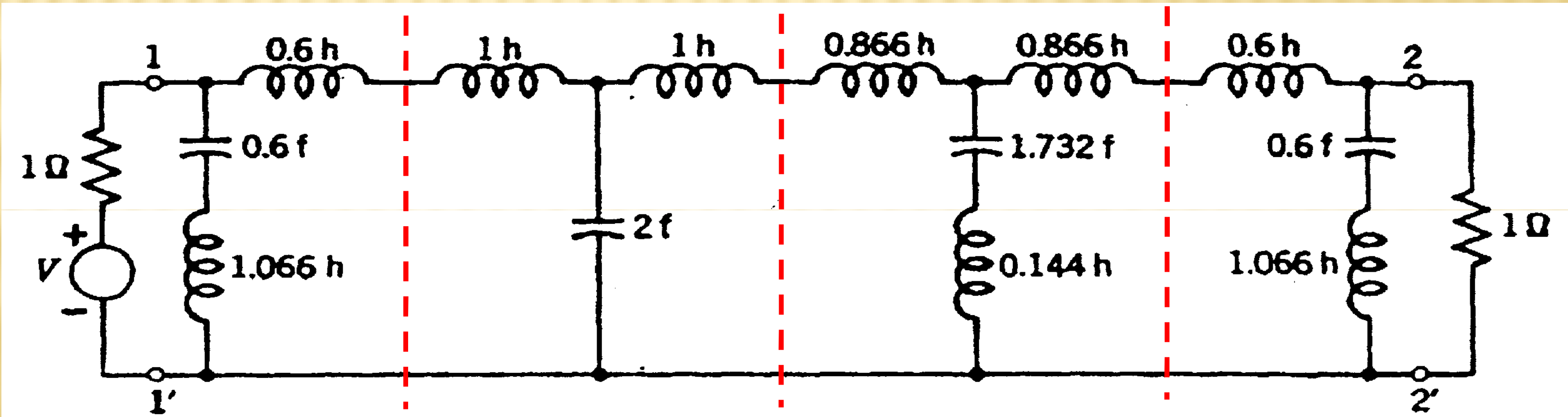


Zo_T
Zo_{Pi}
Zo_{Pim}
m = 0,6
Zonm(max) = 1,04
Zonm = 1
Zonm(min) = 0,96
ε = 0,04
-0,661
0,661
-0,8267
0.8267
-0,866
0,866
COVERTURA

FORMATO DE FILTRO COMPUESTO

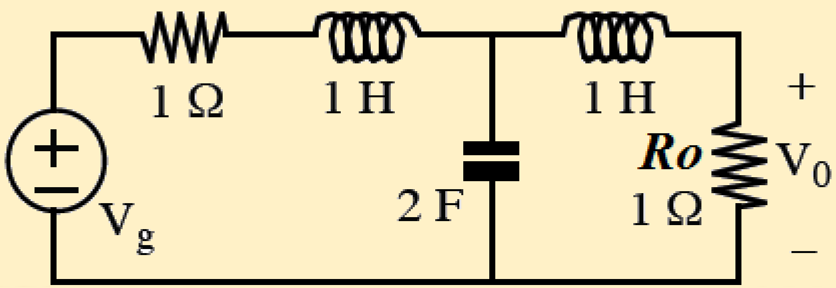


EJEMPLO FILTRO PASA BAJOS COMPUESTO NORMALIZADO Y $\omega_\infty = 2$ [rps]



EJEMPLO : DISEÑE UN FILTRO PASA BAJOS COMPUESTO CON FRECUENCIA DE CORTE $f_c = 1[KHz]$, $f_\infty=1{,}05\ [KHz]$ y $Z_o=600$ Ohms. EMPLEE SECCIONES DE TERMINACIÓN CON $m=0{,}6$.

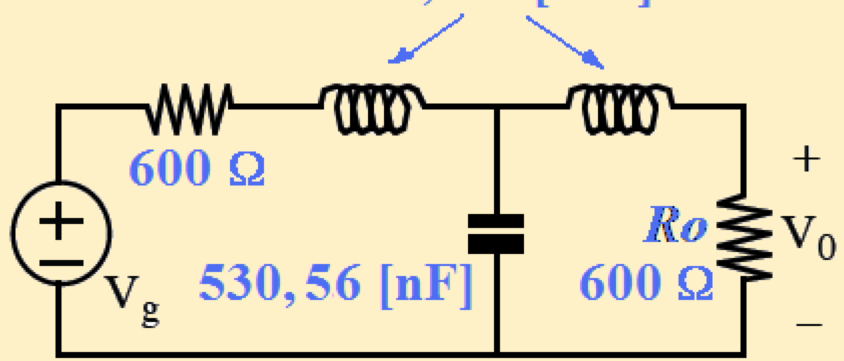
CÁLCULO DE LA SECCIÓN DE KCTE :



$\omega_c = 1$ rad/s

$$b = Ro = 600[\Omega] \quad y$$

$$a = \omega_C = 2\Pi \bullet f_C = 6283{,}185 \left[{rad}/{seg} \right]$$



$\omega_c = 6283{,}516$ rad/s

$$\frac{L_1}{2} = \frac{\frac{L_{1N}}{2} \bullet b}{a} = \frac{1 \bullet 600}{6283{,}185} = 95{,}492 \quad [mH]$$

$$C_2 = \frac{C_{2N}}{a \bullet b} = \frac{2}{6283{,}185 \bullet 600} = 530{,}516 \quad [nF]$$

COMPROBACION :

$$\omega_C = \frac{2}{\sqrt{L_1 \bullet C_2}} = \frac{2}{\sqrt{0{,}095 \bullet 2 \bullet 530{,}51 \bullet 10^{-9}}} \cong 6283{,}185\ [rps]$$

CÁLCULO DE LA SECCIÓN m-DERIVADA PARA fc=1,05 [KHz] :

RECORDANDO :

$$m=\sqrt{1-\left(\frac{\omega_C}{\omega_\infty}\right)^2}=\sqrt{1-\left(\frac{f_C}{f_\infty}\right)^2}=\sqrt{1-\left(\frac{1000}{1050}\right)^2}=0{,}305$$

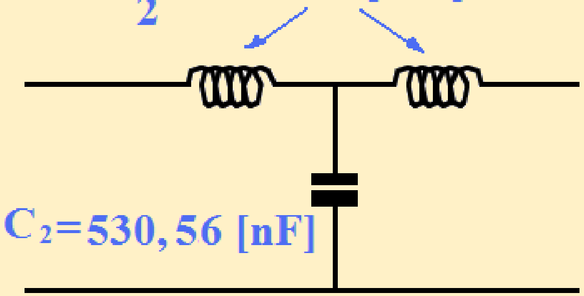
Y LAS RELACIONES:

$$Z_{1Km}=m\bullet Z_{1K}$$

$$Z_{2Km}=\frac{Z_{2K}}{m}+Z_{1K}\left(\frac{1-m^2}{4m}\right)$$

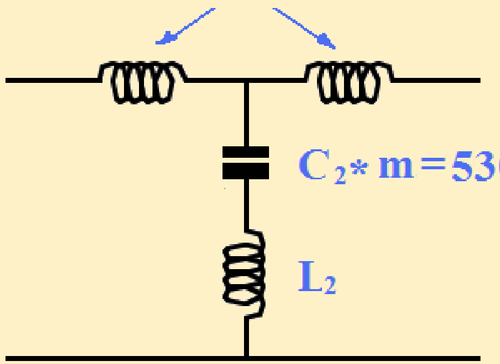
CÁLCULAMOS LA SECCIÓN m-DERIVADA PARA fc=1,05 [KHz] A PARTIR DE LA SECCIÓN DE KCTE

$\frac{L_1}{2}$ = 95,492 [mH]



C_2=530,56 [nF]

$\frac{L_1}{2}$ * m = 95,492 * 0,305 = 29,12 [mH]



C_2* m = 530,56 * 0,305 = 161,82 [nF]

L_2

$$L_2 = L_1 * \frac{1 - m^2}{4\ m} = 190{,}994 * \frac{1 - 0{,}305^2}{4 * 0{,}305} = 141{,}98\ [\mathrm{mH}]$$

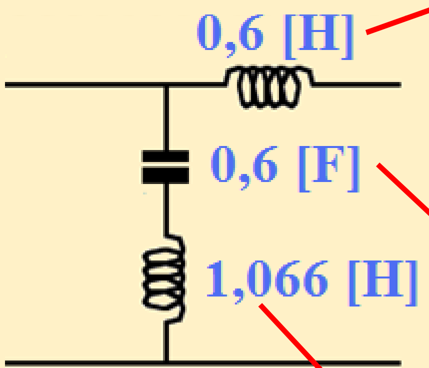
CÁLCULO DE LA SECCIÓN m-DERIVADA TIPO Π ADAPTADORA :

CÁLCULAMOS LA SEMI-SECCIÓN m-DERIVADA CON m=0,6 A PARTIR DE LA SEMI-SECCIÓN m-DERIVADA NORMALIZADA:

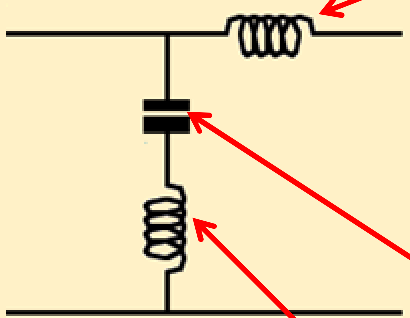
APLICAMOS CONCEPTO DE NORMALIZACIÓN, RECORDANDO :

$$b = Ro = 600[\Omega] \quad y$$

$$a = \omega_C = 2\Pi \bullet f_C = 6283{,}185 \left[{}^{rad}\!/_{seg}\right]$$



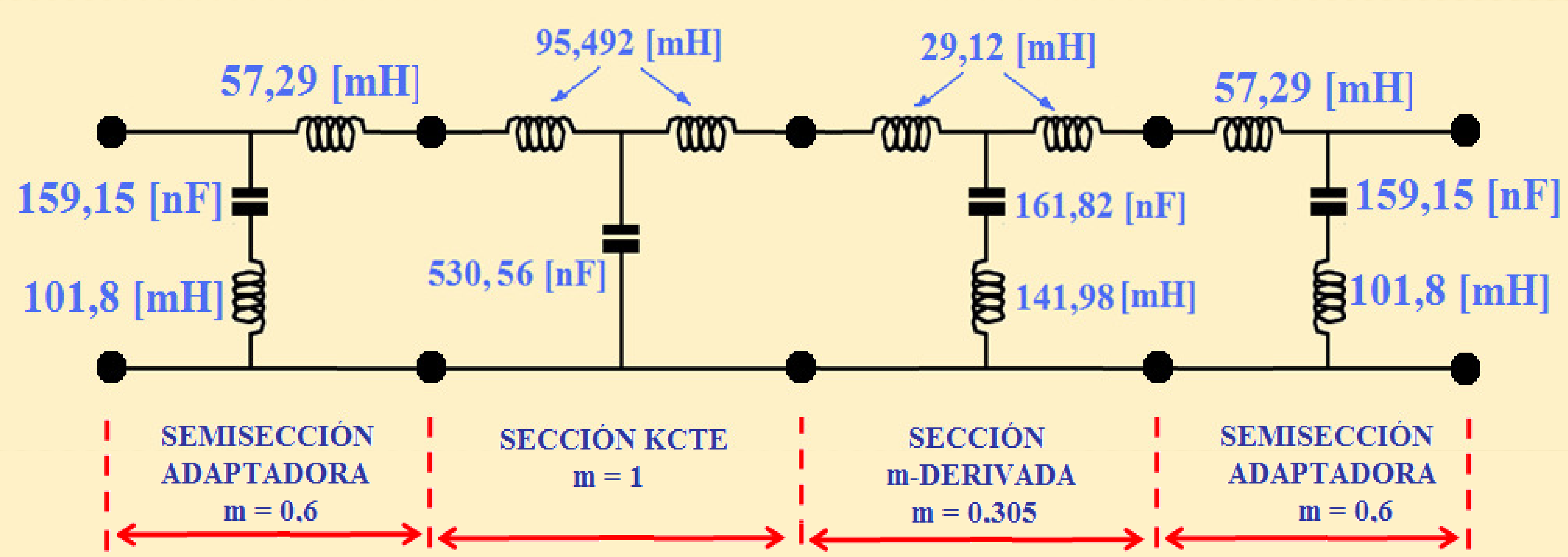
$$\frac{0{,}6 * b}{a} = \frac{0{,}6 * 600}{6283{,}185} = 57{,}29\ [mH]$$



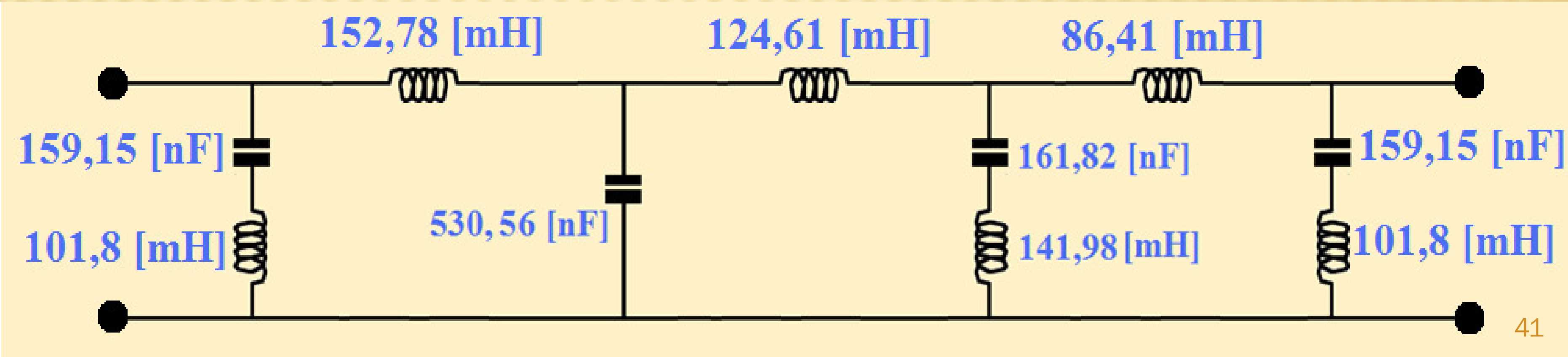
$$\frac{0{,}6}{a * b} = \frac{0{,}6}{6283{,}185 * 600} = 159{,}15\ [nF]$$

$$\frac{1{,}066 * b}{a} = \frac{1{,}066 * 600}{6283{,}185} = 101{,}8\ [mH]$$

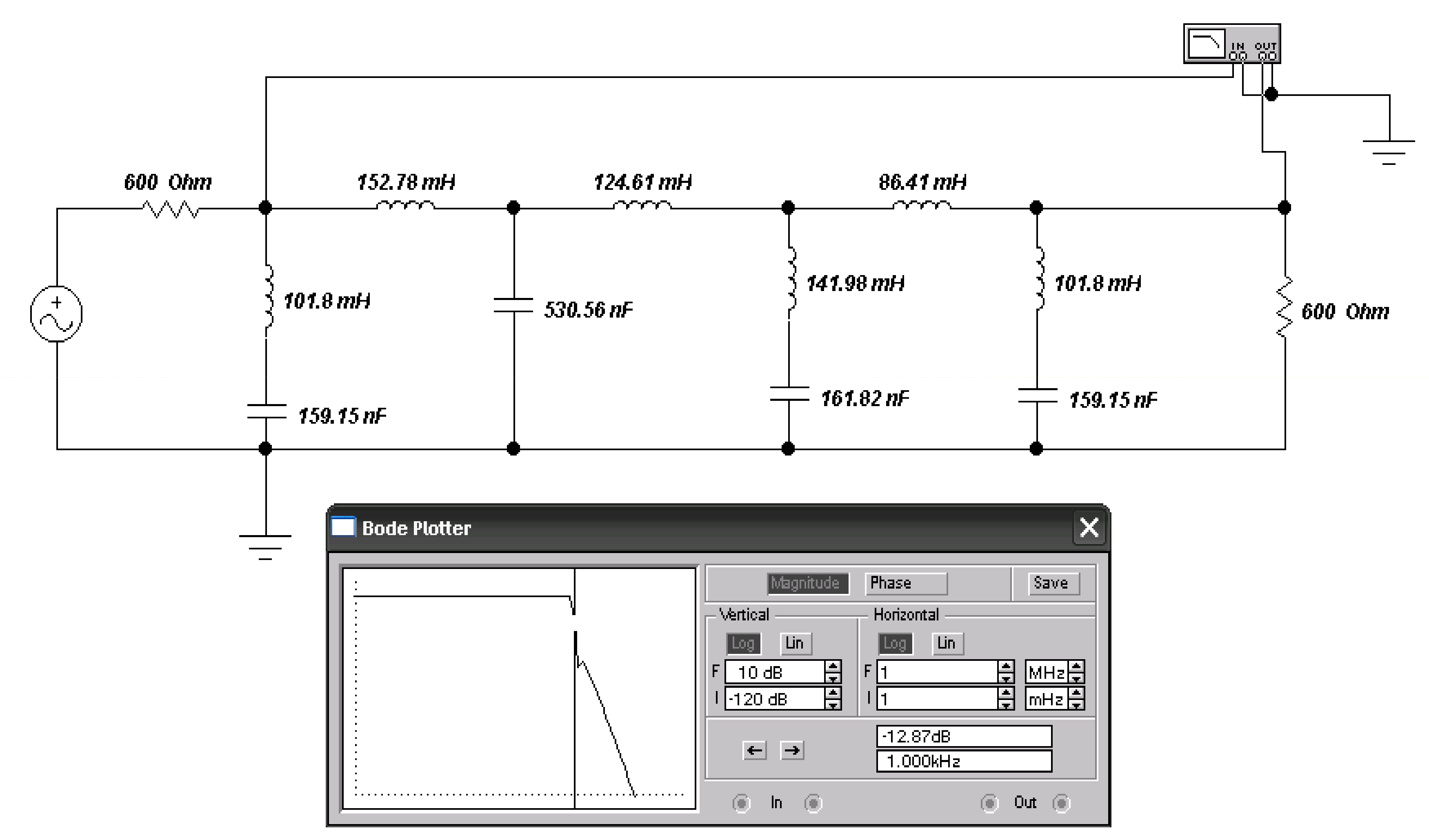
FINALMENTE EL FILTRO COMPUESTO PROPUESTO ES TAL , COMO EL DE LA FIGURA :



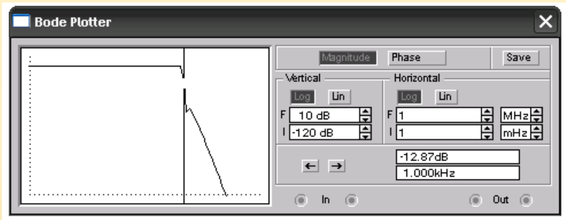
POR ÚLTIMO :

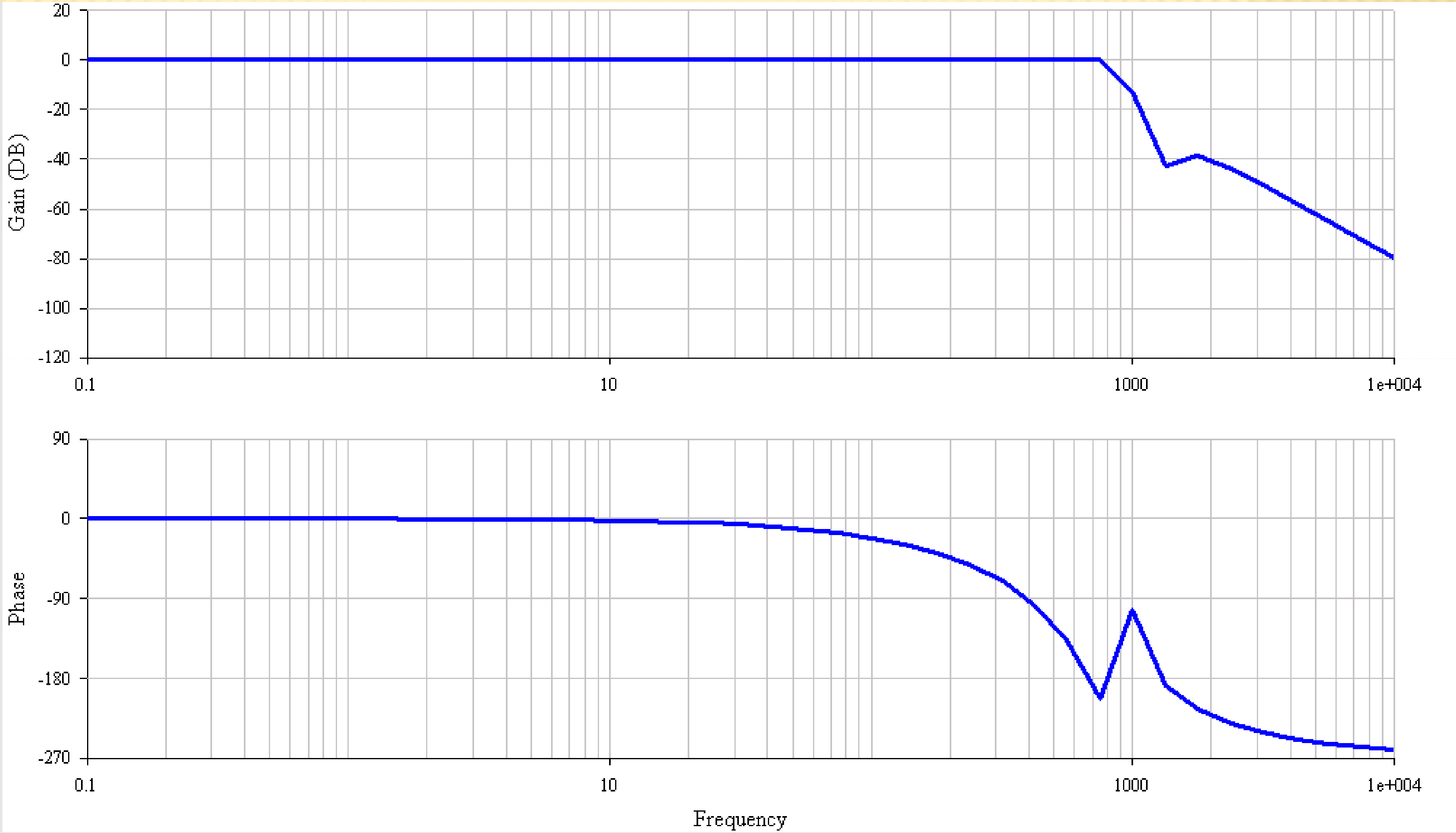


CIRCUITO SIMULADO MEDIANTE EWB5 :



CURVAS OBTENIDAS MEDIANTE EWB5 :





FIN DE LA PRESENTACIÓN

GRACIAS !