Pasa bajos

300 Ω

$f_c = 5\,KHz$

$f_{atenuación} = 5500\,H$

$n = 0,6$ p' la semisección

$$M = \sqrt{1 - \left(\frac{f_c}{f_\infty}\right)^2}$$

$\boxed{M = 0,416}$ ⇒ p' el M derivado

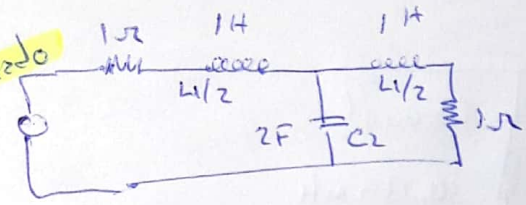
7

$a = \omega_c = 5KHz \cdot 2\pi = \boxed{31415,92\ rad/seg}$

$b = R_0 = 300\ \Omega$

$$\omega_c = \frac{2}{\sqrt{L_1 \cdot C_2}}$$

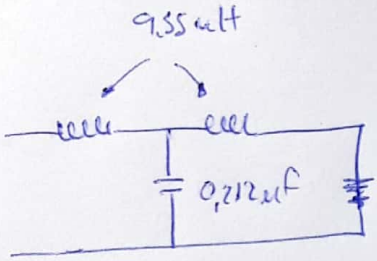
Normalizado



$$\frac{L_1}{2} = \frac{L_n \cdot b}{a} = \frac{1 \cdot 300}{31415,92} = \boxed{9,55\ mH}$$

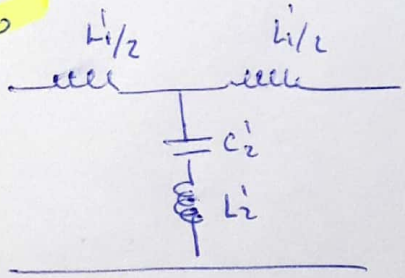
$$C_2 = \frac{C_n}{a \cdot b} = \frac{2F}{31415,92 \cdot 300} = \boxed{0,2122\ \mu f}$$

K-cite



Usamos ω | $\boxed{M = 0,416}$

M-derivado



$$\frac{L'_1}{2} = \frac{L_1 \cdot M}{2} = \boxed{3,972\ mH}$$

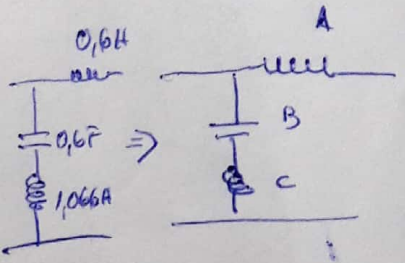
$$C'_2 = C_2 \cdot M = \boxed{88,2744\ nf}$$

$$L'_2 = L_1 \cdot \left(\frac{1 - M^2}{4M}\right) = 2,955mH \left(\frac{1 - (0,416)^2}{4 \cdot 0,416}\right) = \boxed{9,49mH}$$

Sección receptora

$a = \omega_c = 31415,92$
$b = 300$
$n = 0,6$

} Siempre usar en semisecciones el $M = 0,6$



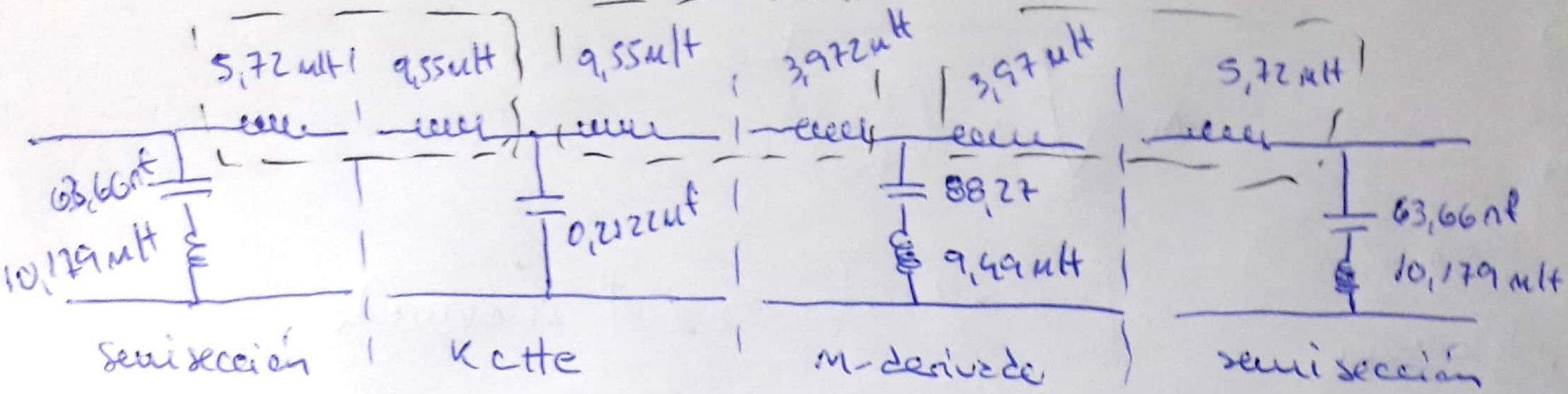
$$A = \frac{n \cdot b}{a} = \frac{0,6 \cdot 300}{31415,92} = \boxed{5,72\ mH}$$

$$B = \frac{n}{a \cdot b} = \frac{0,6}{31415,92 \cdot 300} = \boxed{63,66\ nf}$$

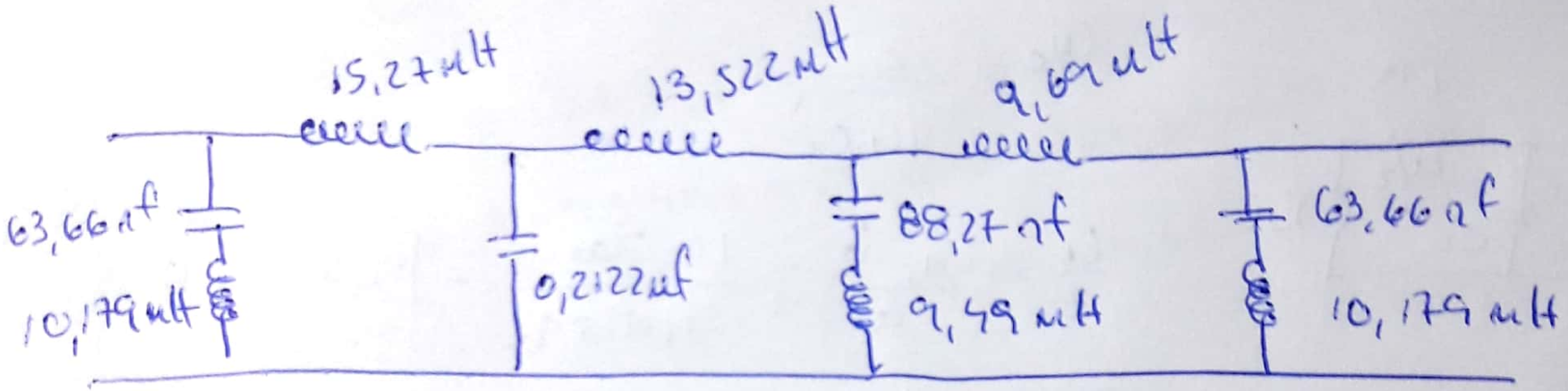
$$C = \frac{1,066 \cdot b}{a} = \frac{1,066 \cdot 300}{31415,92} = \boxed{10,179\ mH}$$

Escaneado con CamScanner

Armo el filtro



FINALMENTE



Escaneado con CamScanner

Ejemplo pasa altos

$R_0 = 600$

$f_c = 1200\,Hz$

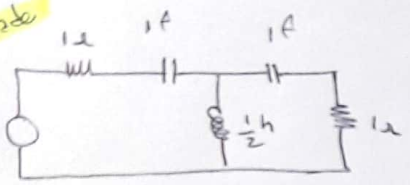
$f_\infty = 1100\,Hz$

$$m = \sqrt{1 - \left(\frac{f_\infty}{f_c}\right)^2} = 0{,}3996$$

$a = \omega_c = 2\pi f_c = 7539{,}82\ rad/seg$

$b = R_0 = 600\,\Omega$

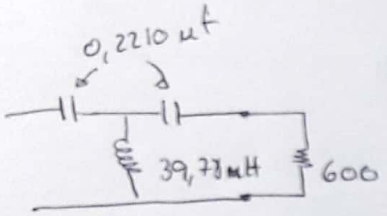
Normalizada



$$2C_1 = \frac{C_n}{a.b} = \frac{1\,f}{7539{,}82 . 600} = 0{,}2210\,\mu f$$

$$L_1 = \frac{Ln . b}{a} = \frac{0{,}5H . 600}{7539{,}82} = 39{,}788\,mH$$

K-cte

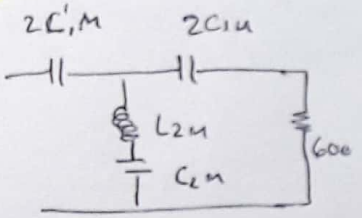


Usamos $m = 0{,}3996$

$$2C_{1M} = \frac{2C_{1\,Kctte}}{m} = \frac{0{,}2210\,\mu f.}{0{,}3996} = \boxed{0{,}553\,\mu f}$$

$$L_{2M} = \frac{L_{2\,Kctte}}{m} = \frac{39{,}78\,mH}{0{,}3996} = \boxed{99{,}549\,mH}$$

M-derivada



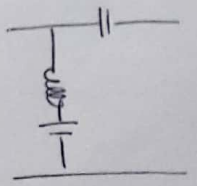
$$C_{2M} = 2C_1\left(\frac{2M}{1-M^2}\right) = 0{,}2210\,\mu f.\left(\frac{2.0{,}3996}{1-(0{,}3996)^2}\right) = \boxed{0{,}210\,\mu f}$$

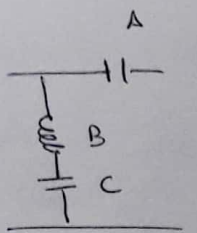
Secciones adaptadoras

$a = \omega_c = 7539{,}82\ rad/seg$

$b = R_0 = 600$

$m = 0{,}6$





$$A = \frac{2C_{1\,Kctte}}{m} = \frac{0{,}2210\,\mu f}{0{,}6} = \boxed{0{,}3683\,\mu f}$$

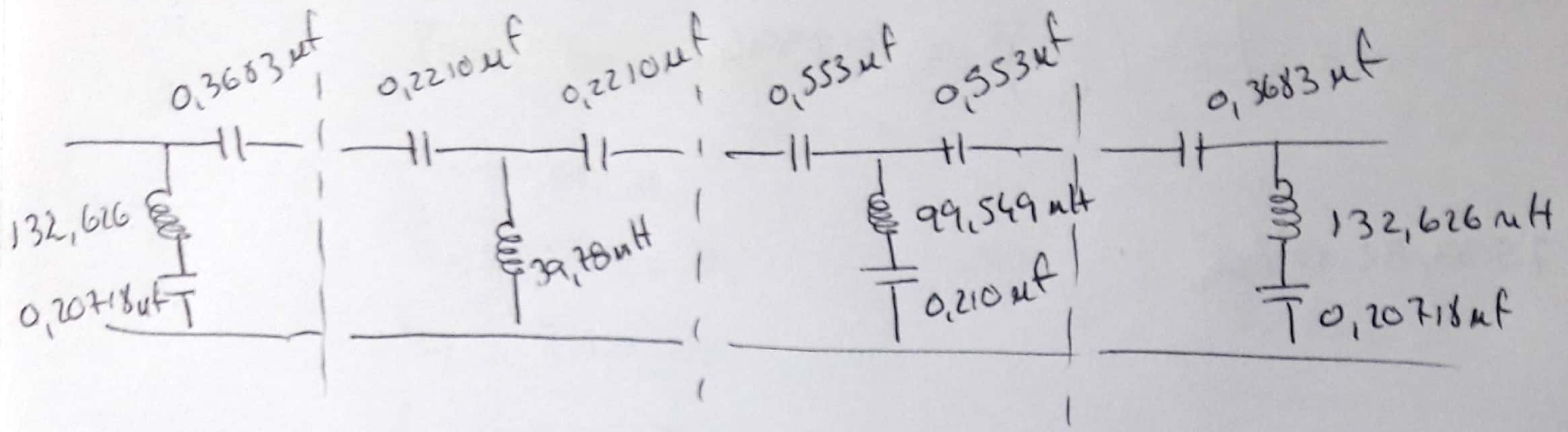
$$B = \left(\frac{L_{Kctte}}{m}\right).2 = \left(\frac{39{,}788\,mH}{0{,}6}\right).2 = \boxed{132{,}626\,mH}$$

$$C = C_{1\,Kctte}\left(\frac{2M}{1-M^2}\right) = \boxed{92.0718\,\mu f}$$

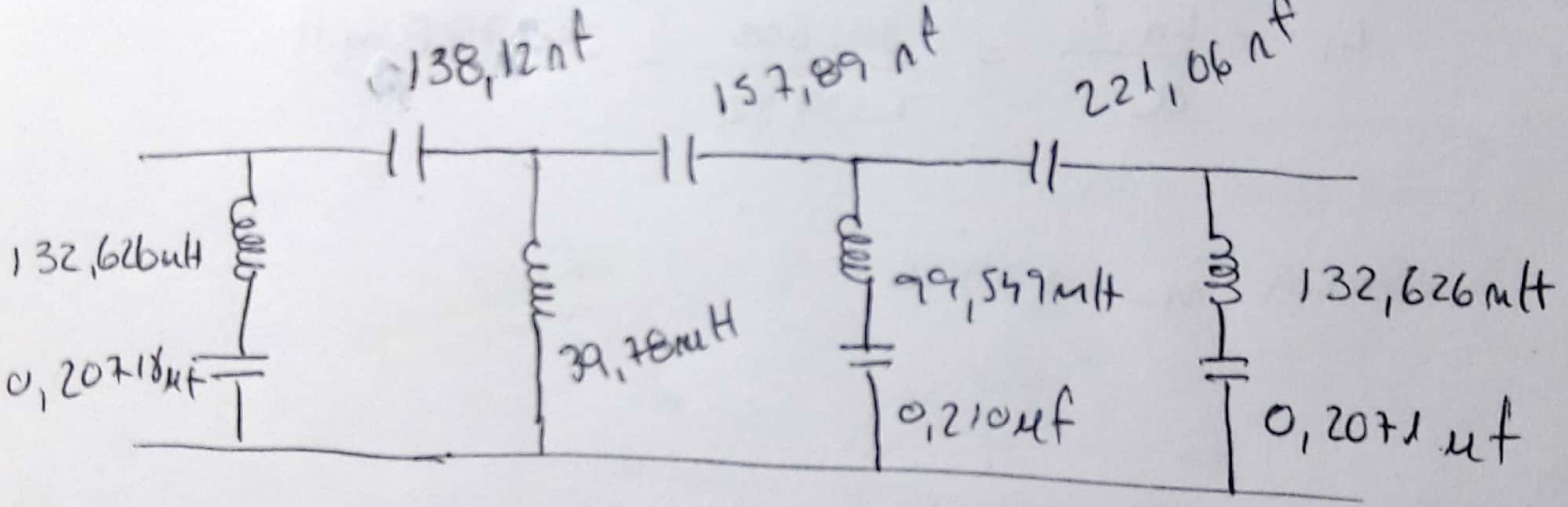
↳ ojo q' es C_1 (NO) $2C_1$

Escaneado con CamScanner

Armo el filtro



Finalmente



Escaneado con CamScanner

Pasa Banda

$R_0 = 600\ \Omega$

$f_{c1} = 3500\ Hz$

$f_{c2} = 7000\ Hz$

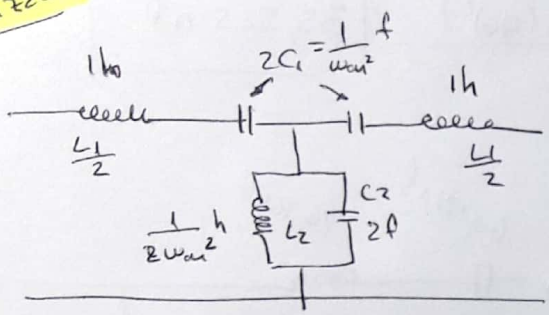
$f_{\infty} = 7300\ Hz$

$$M = \sqrt{1 - \left(\frac{BW}{BW_\infty}\right)^2}$$

$$M = \sqrt{1 - \left(\frac{\omega_{c2} - \omega_{c1}}{\omega_{c2}\cdot\frac{\omega_{\infty 2}}{\omega_{c2}} - \frac{\omega_{c1}}{\frac{\omega_\infty}{\omega_{c2}}}}\right)^2} = \sqrt{1 - \left(\frac{7000 - 3500}{7000\cdot\frac{7300}{7000} - \frac{3500}{\frac{7300}{7000}}}\right)^2}$$

$$\boxed{M = 0{,}4608}$$

normalizado



$$BW = (f_{c2} - f_{c1})2\pi = \boxed{21991{,}14\ \frac{rad}{seg}}$$

$$\frac{L_1}{2} = \frac{R_0}{BW} = \frac{600}{21991{,}14} = \boxed{27{,}283\ mH}$$

$$2C_1 = \frac{BW}{R_0\,\omega_0^2} = \frac{21991{,}14}{600\,(31100{,}18)^2} = \boxed{37{,}894\ nf}$$

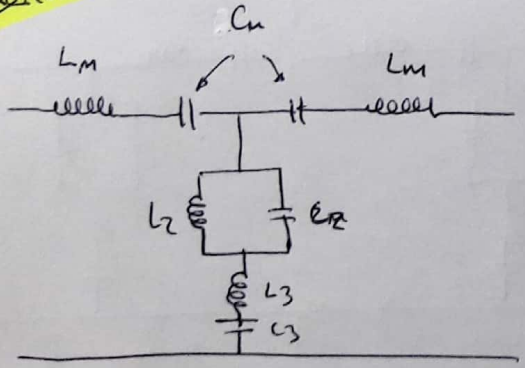
$$L_2 = \frac{R_0 BW}{2\omega_0^2} = \frac{600\cdot 21991{,}14}{2\cdot(31100{,}18)^2} = \boxed{6{,}821\ mH}$$

$$f_0 = \sqrt{f_{c1}\cdot f_{c2}} = 4949{,}74\ Hz$$

$$\omega_0 = 2\pi f_0 = \boxed{31100{,}18\ \frac{rad}{seg}}$$

$$C_2 = \frac{2}{R_0 BW} = \frac{2}{600\,(21991{,}14)} = \boxed{151{,}57\ nf}$$

M-deducido



$$L_M = \frac{L_1}{2}\cdot M = 27{,}283\ mH\cdot 0{,}4608 = \boxed{12{,}572\ mH}$$

$$C_M = \frac{2C_1}{M} = \frac{37{,}894\ nf}{0{,}4608} = \boxed{82{,}23\ nf}$$

$$L_{2M} = \frac{L_2}{M} = \frac{6{,}821\ mH}{0{,}4608} = \boxed{14{,}80\ mH}$$

$$C_{2M} = C_2\cdot M = 151{,}57\ nf\cdot 0{,}4608 = \boxed{69{,}84\ nf}$$

$$L_3 = \frac{L_1}{2}\left(\frac{1-M^2}{2M}\right) = 27{,}283\ mH\cdot\left(\frac{1-(0{,}4608)^2}{2\cdot(0{,}4608)}\right) = \boxed{23{,}317\ mH}$$

$$C_3 = 2C_1\left(\frac{2M}{1-(M)^2}\right) = 37{,}894\ nf\cdot\left(\frac{2\cdot 0{,}4608}{1-(0{,}4608)^2}\right) = \boxed{44{,}71\ nf}$$

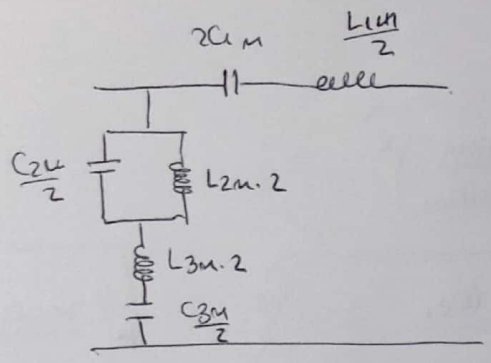
Escaneado con CamScanner

Semiseccionales

$\alpha = \omega_c =$

$b = 600$

$M = 0,6$



$\frac{L_{1M}}{2} = \frac{L_1 \text{ Kette.M}}{2} = 27,283 \times 10^{-3} \cdot 0,6 = 16,36 \text{ mH}$

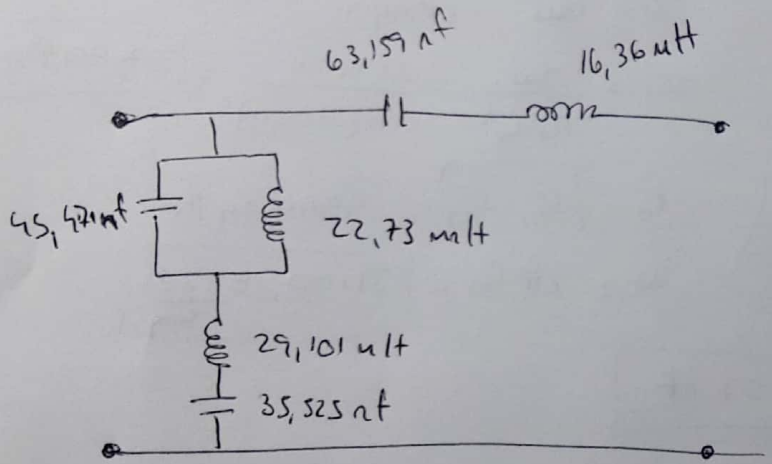
$2C_{1M} = \frac{2C_1 \text{ Kette}}{M} = \frac{37,894 \text{ nf}}{0,6} = 63,156 \text{ nf}$

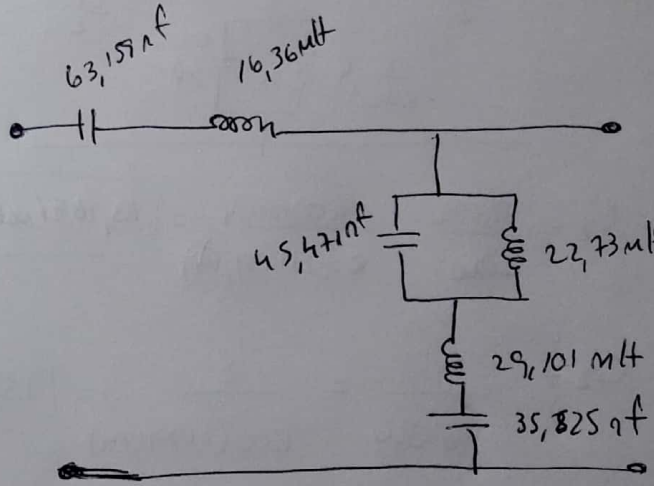
$\frac{C_{2M}}{2} = \frac{C_2 \text{ Kette.M}}{2} = \frac{151,57 \text{nf} \cdot 0,6}{2} = 45,471 \text{ nf}$

$L_{2M.2} = \frac{L_2 \text{Kette} \cdot 2}{m} = \frac{6,821 \text{mH} \cdot 2}{0,6} = 22,73 \text{ mH}$

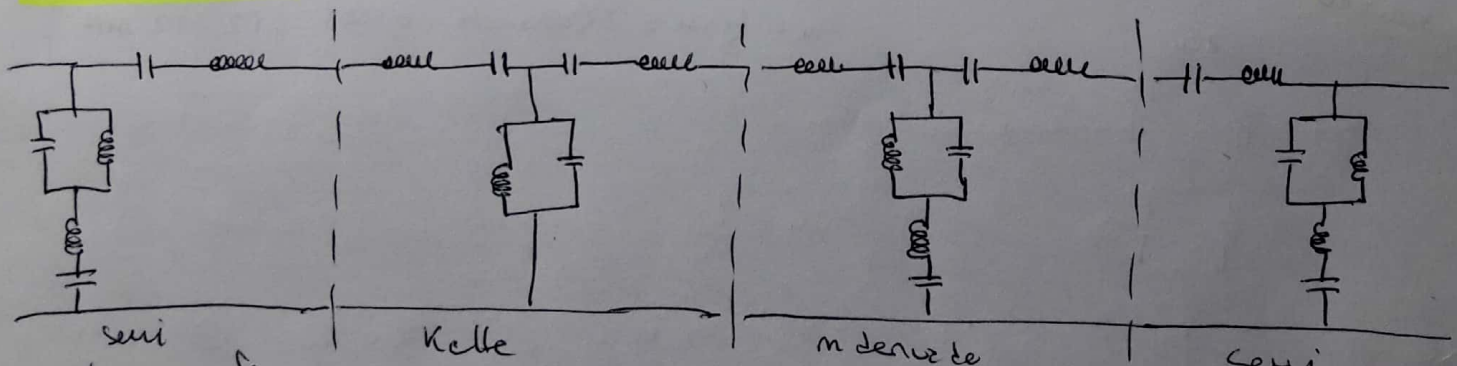
$L_{3M.2} = \left(\frac{L_1}{2} \text{Kett.} \left(\frac{1-(0,6)^2}{2.0,6}\right)\right) \cdot 2 = \left(27,283 \times 10^{-3} \cdot \left(\frac{1-(0,6)^2}{2.0,6}\right)\right) \cdot 2 = 29,101 \text{ mH}$

$\frac{C_{3M}}{2} = \frac{2C_1 \text{Kette} \left(\frac{2M}{1-M^2}\right)}{2} = \frac{37,894 \text{nf} \cdot \left(\frac{2.0,6}{1-(0,6)^2}\right)}{2} = 35,525 \text{ nf}$

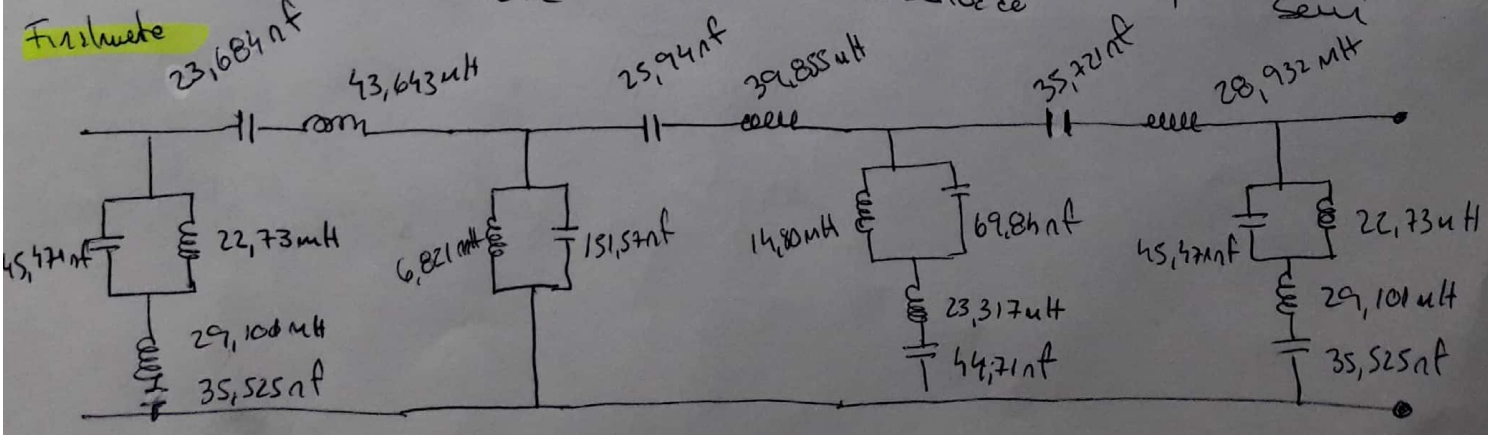




Armo el filtro



Finalmente



Escaneado con CamScanner

Eliminar Bandas

$R = 650$

$f_{c1} = 1800\ Hz$

$f_{c2} = 4800\ Hz$

$f_{\infty} = 4700\ Hz$

$$M = \sqrt{1 - \left(\frac{BW_{\infty}}{BW}\right)^2} \Rightarrow M = \sqrt{1 - \left(\frac{\omega_{\infty} - \frac{\omega_{c1}\,\omega_{c2}}{\omega_{\infty}}}{\omega_{c2} - \omega_{c1}}\right)^2}$$

$$M = \sqrt{1 - \left(\frac{4700 - \frac{1800 \cdot 4800}{4700}}{4800 - 1800}\right)^2} = \boxed{0,300}$$

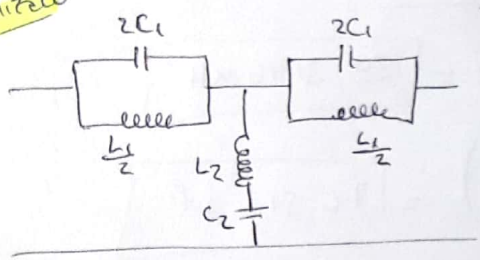
$$BW = \omega_{c2} - \omega_{c1} \Rightarrow 4800\,2\pi - 1800\,2\pi = \boxed{18849,55\ rad/seg}$$

$a = \omega_c = 18849,55\ rad/seg$

$b = R_0 = 650$

$$\omega_0 = \sqrt{\omega_{c2} \cdot \omega_{c1}} = \boxed{18468,71\ rad/seg}$$

normalizado



$$2C_1 = \frac{1}{R_0 BW} = \boxed{81,6179\ nf}$$

$$\frac{L_1}{2} = \frac{R_0 BW}{\omega_0^2} = \frac{650 \cdot 18849,55}{(18468,71)^2} = \boxed{35,920\ mH}$$

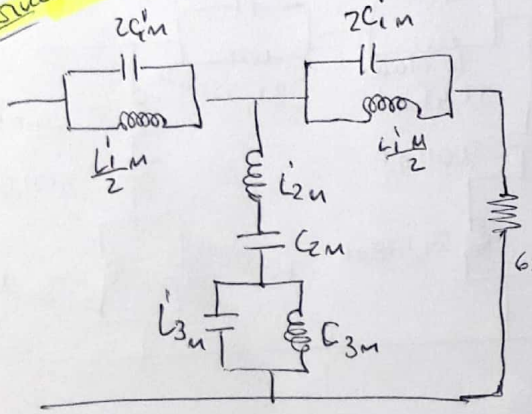
$$L_2 = \frac{R_0}{2BW} = \frac{650}{2 \cdot (18849,55)} = \boxed{17,241\ mH}$$

$$C_2 = \frac{2BW}{R_0\,\omega_0^2} = \frac{2(18849,55)}{650\,(18468,71)^2} = \boxed{170,037\ nf}$$

Kolle

Kolle ⇒

M-derivado con $M = 0,300$



$$2C'_{1M} = \frac{2C_1}{M} = \frac{81,6179 \times 10^{-9}}{0,300} = \boxed{272,059\ nf}$$

$$\frac{L'_{1M}}{2} = \frac{B_1}{2} \cdot M = 35,92\ mH \cdot 0,3 = \boxed{10,776\ mH}$$

$$L'_{2M} = \frac{L_2\ Kolle}{M} = \frac{17,241\ mH}{0,3} = \boxed{57,47\ mH}$$

$$C'_{2M} = C_2\ Kolle \cdot M = 170,037\ nf \cdot 0,3 = \boxed{51,011\ nf}$$

M-derivado

$$L'_{3M} = \frac{L_1}{2}\ Kolle \left(\frac{1 - (M)^2}{2M}\right) = 35,92\ mH \left(\frac{1 - (0,3)^2}{2 \cdot 0,3}\right) = \boxed{54,478\ mH}$$

$$C'_{3M} = 2C_1\ Kolle \left(\frac{2M}{1 - M^2}\right) = 81,6179\ nf \left(\frac{2 \cdot 0,3}{1 - (0,3)^2}\right) = \boxed{53,815\ nf}$$

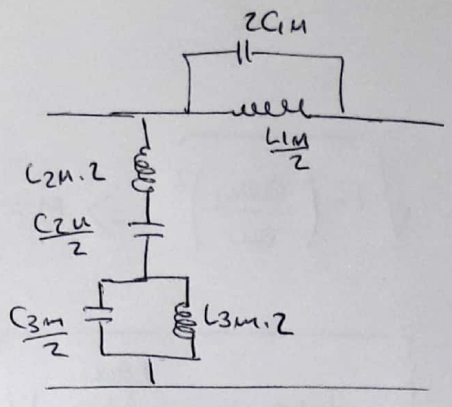
Escaneado con CamScanner

Semisección

$$\alpha = \omega_c = 18849,55 \text{ rad/seg}$$

$$b = R_0 = 650$$

$$m = 0,6$$



$$2C_{1m} = \frac{2C_{1\,Kelle}}{m} = \frac{81,6179 \times 10^{-9}}{0,6} = 136,029 \text{ nf}$$

$$\frac{L_{1m}}{2} = \frac{L_1}{2}\,Kelle \cdot m = 35,920 \times 10^{-3} \cdot 0,6 = 21,552 \text{ mH}$$

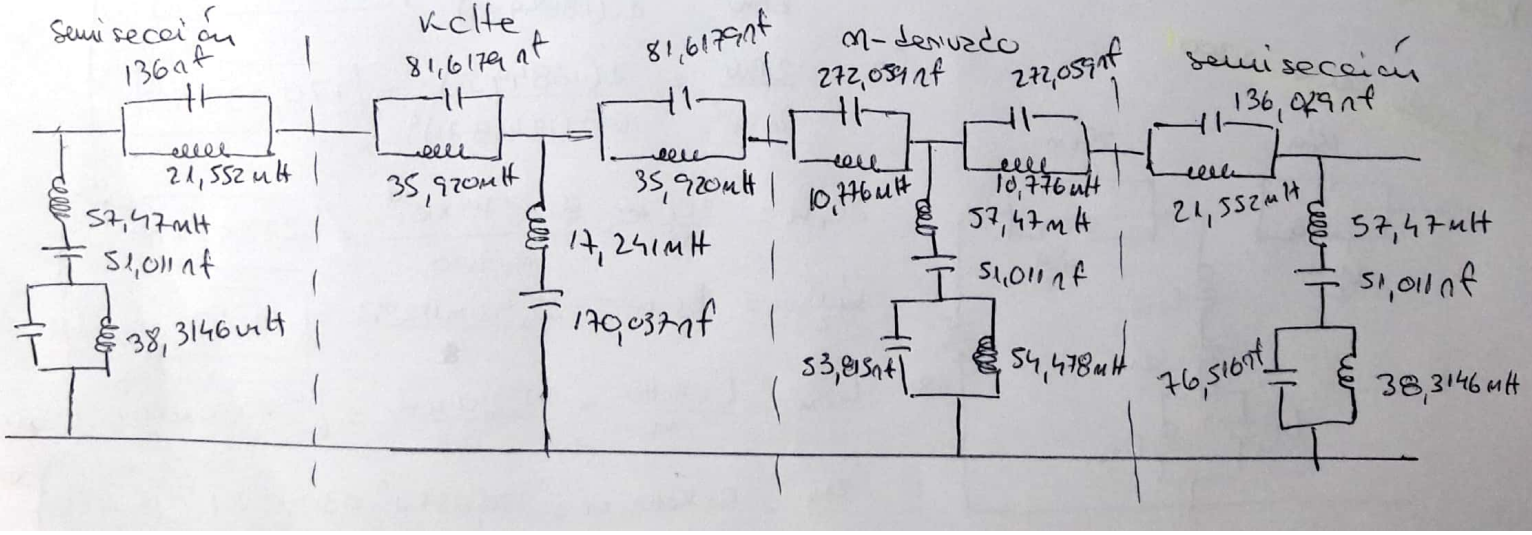
$$L_{2m.2} = \frac{L_{2\,Kelle} \cdot 2}{m} = \frac{17,241 \times 10^{-3} \cdot 2}{0,6} = 57,47 \text{ mH}$$

$$\frac{C_{2m}}{2} = \frac{C_{2\,Kelle} \cdot m}{2} = \frac{170,037 \times 10^{-9} \cdot 0,6}{2} = 51,011 \text{ nf}$$

$$L_{3m.2} = \left(\frac{L_1}{2}\,Kelle\left(\frac{1-(m)^2}{2m}\right)\right) \cdot 2 = \left(35,920 \times 10^{-3} \cdot \left(\frac{1-(0,6)^2}{2 \cdot 0,6}\right)\right) \cdot 2 = 38,3146 \text{ mH}$$

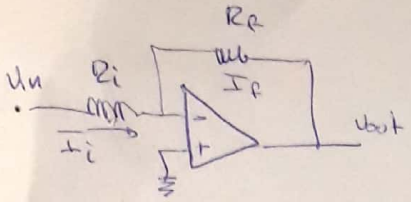
$$\frac{C_{3m}}{2} = \frac{2C_{1\,Kelle}\left(\frac{2m}{1-m^2}\right)}{2} = \frac{81,6179 \times 10^{-9} \cdot \left(\frac{2 \cdot 0,6}{1-(0,6)^2}\right)}{2} = 76,516 \text{ nf}$$

Armo filtro



Escaneado con CamScanner

Inversor

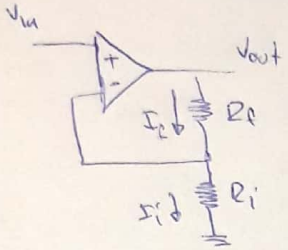


$I_i = I_f$

$V_{in} = R_i I_i$ $\quad V_{out} = -R_f \cdot I_f$

$$V_{out} = -R_f \cdot \frac{V_{in}}{R_i} \Rightarrow \boxed{\frac{V_{out}}{V_{in}} = \frac{-R_f}{R_i}}$$

No inversor



$V_{in} = V_f$ $\quad I_f = I_i$

$$I_f = \frac{V_{out} - V_{in}}{R_f} \qquad I_i = \frac{V_{in}}{R_i}$$

$$\frac{V_{in}}{R_i} = \frac{V_{out} - V_{in}}{R_f} \qquad \frac{R_f}{R_i} = \frac{V_{out} - V_{in}}{V_{in}}$$

$$\Rightarrow \boxed{\frac{V_{out}}{V_{in}} = \frac{R_f}{R_i} + 1}$$

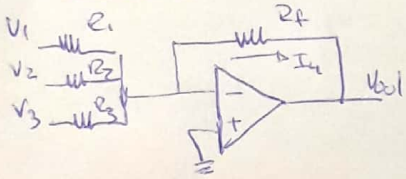
Seguidor

→ se utiliza como acoplamiento de impedancias

Ganancia unitaria $\quad V_x = V_{in}$ $\quad \boxed{A_{CL} = 1}$

$A_V = 1$ $\quad V_{out} = V_{in}$

Sumador



$I_f = I_1 + I_2 + I_3$ $\quad I_f = \frac{-V_{out}}{R_f}$ $\quad I_1 = \frac{V_1}{R_1}$ $\quad I_2 = \frac{V_2}{R_2}$ $\quad I_3 = \frac{V_3}{R_3}$

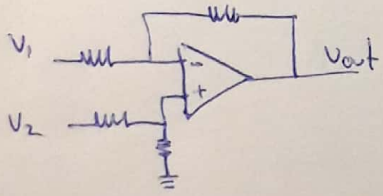
$V_f = 0$

$$\frac{-V_{out}}{R_f} = \frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}$$

$$\boxed{V_{out} = -\left(V_1 \frac{R_f}{R_1} + V_2 \frac{R_f}{R_2} + V_3 \frac{R_f}{R_3}\right)}$$

Para ser sumador
$R_1 = R_2 = R_3 = R_4$

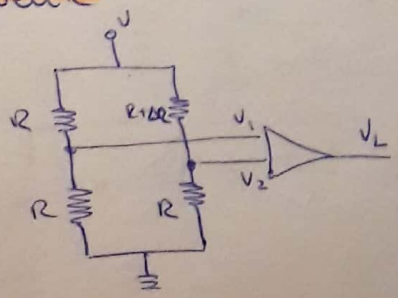
Restador



Si todas las R son iguales

$V_{out} = V_2 - V_1$

Puente



$$V_L = (V_2 - V_1)\frac{R_2}{R_1} \Rightarrow V_L = \left(\frac{VR}{2R + \Delta R} - \frac{V}{2}\right)\frac{R_2}{R_1}$$

$V_1 = \frac{V}{2}$

$V_2 = \frac{VR}{2R + \Delta R}$

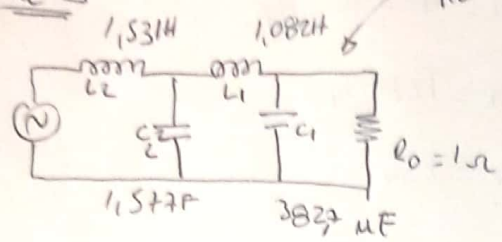
$$V_L = \frac{R_2}{R_1}\frac{V}{4}\left[\frac{-\delta}{1 + \frac{\delta}{2}}\right]$$

$\delta = \frac{\Delta R}{R}$

Si $\delta \ll 1$ $\quad V_L = -\frac{V_2}{4} \cdot \frac{R_2}{R_1} \cdot \delta$

Escaneado con CamScanner

Tema 5



si no tener nesper

Pasa bajos Butterworth

transformar a filtro pasa altos normalizado y calcular los valores de los componentes

$f_c = 437,6761 \Rightarrow \omega_c = 2\pi \cdot 437,6761 = 2750 r/seg$

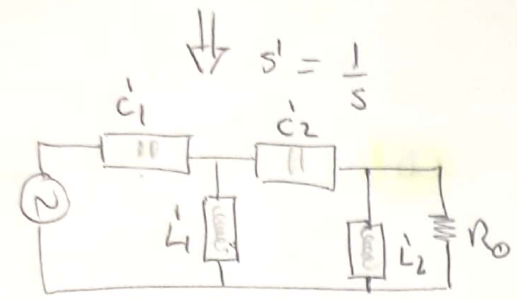
$R_0 = 600$

si tener 4 elementos $n = 4$

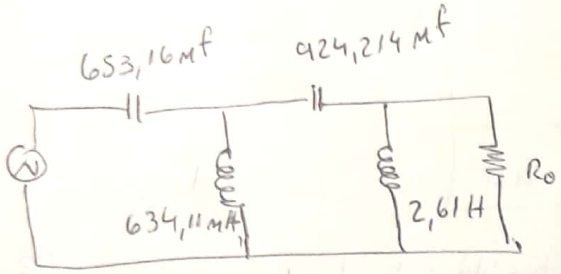
$A_{max} = 3dB$

$\varepsilon^{1/n} \simeq 1$

} sacar de la tabla por los valores que nos da



$$\frac{1}{s^4 + 2,613 s^3 + 3,414 s^2 + 2,613 s + 1} \Rightarrow \frac{s^4}{s^4 + 2,613 s^3 + 3,414 s^2 + 2,613 s + 1}$$



Pasa altos normalizados

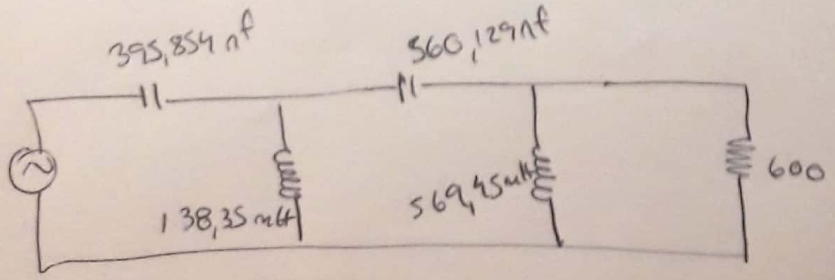
GDC

$$C_1 = \frac{\varepsilon^{1/n} \cdot C_n}{R_0 \cdot \omega_p} = \frac{653,16 mf}{600 \cdot 2750} = 395,854 nf$$

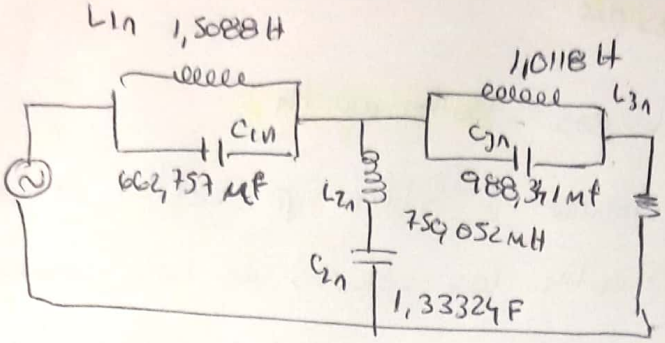
$$L_1 = \frac{L_n \cdot R_0}{\omega_c} = \frac{634,11 mH \cdot 600}{2750} = 138,35 mH$$

$$C_2 = \frac{C_{2n}}{R_0 \omega_p} = \frac{924,214 mf}{600 \cdot 2750} = 560,129 nF$$

$$L_2 = \frac{L_{2n} R_0}{\omega_c} = \frac{2,61 \cdot 600}{2750} = 569,45 mH$$



Escaneado con CamScanner



$f_{c1} = 477,465$ Hz

$f_{c2} = 1273,24$

$n_o = 250$

$\omega_{c1} = 2\pi f_{c1} = 2\pi \cdot 477,465 = 3000$ rad/seg

$\omega_{c2} = 2\pi f_{c2} = 2\pi \ 1273,24 = 8000$ rad/seg.

$\omega_o = \sqrt{\omega_{c1} \cdot \omega_{c2}} = 4898,97$ rad/seg

160C

$Bw = \omega_{c2} - \omega_{c1} = 5000$ rad/seg.

$\omega_{on}^2 = \frac{\omega_o^2}{Bw^2} = \frac{(4898,97)^2}{(5000)^2} = 0,9599 \cong 0,96$

$C_1 = \frac{C_{1n}}{R \cdot Bw} = \frac{662,757 \text{ nf}}{250 \cdot 5000} = 530,205 \text{ nf}$

$L_1 = \frac{L_{1n} \cdot R}{\omega_{on}^2 \cdot Bw} = \frac{1,5088 \text{ H} \cdot 250}{0,96 \cdot 5000} = 78,588 \text{ mH}$

$L_2 = \frac{L_{2n} \cdot R}{Bw} = \frac{750,052 \text{ mH} \cdot 250}{5000} = 37,502 \text{ mH}$

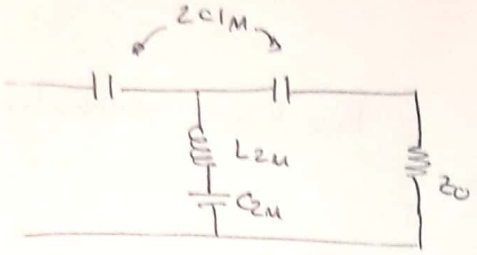
$C_2 = \frac{C_{2n}}{R \cdot Bw \cdot \omega_{on}^2} = \frac{1,333 \text{ F}}{250 \cdot 5000 \ 996} = 1,111 \text{ uf}$

$L_3 = \frac{L_{3n} \cdot R}{\omega_{on}^2 \cdot Bw} = \frac{1,0118 \text{ H} \cdot 250}{996 \ 5000} = 52,697 \text{ mH}$

$C_3 = \frac{C_{3n}}{R \cdot Bw} = \frac{988,341 \text{ mH}}{250 \cdot 5000} = 790,672 \text{ uf}$

Escaneado con CamScanner

Ejercicio N° 9 de Parcial



$2C_{1M} = 1{,}81383\ \mu f$

$L_{2M} = 27{,}7743\ mH$

$C_{2M} = 1{,}59558\ \mu f$

a) Tipo de filtro
b) $w_c = ?$
c) $f_c = ?$
d) $Z_o = ?$
e) $m = ?$
f) $w_\infty = ?$

a) Pasa alto m-derivado

$$2C_{1M} = \frac{2C_{1Kcte}}{m} \qquad 2C_{1Kcte} = 2C_{1M} \cdot m$$

$$L_{2M} = \frac{L_{2Kcte}}{m} \qquad 2C_{1Kcte} = \frac{C_{2M}}{\frac{2m}{1-m^2}}$$

$$C_{2M} = 2C_{1Kcte}\left(\frac{2m}{1-m^2}\right) \qquad 2C_{1M} \cdot m = \frac{C_{2M}}{\frac{2m}{1-m^2}} \Rightarrow 2C_{1M} \cdot m\left(\frac{2m}{1-m^2}\right) = C_{2M}$$

$$\frac{2m^2}{1-m^2} = \frac{C_{2M}}{2C_{1M}} \Rightarrow \frac{2m^2}{1-m^2} = 0{,}879 \Rightarrow 2 = \left(\frac{1}{m^2} - 1\right) 0{,}879$$

e) $$m = \sqrt{\frac{0{,}879}{2{,}879}} = \boxed{0{,}5525}$$

f) $$w_\infty = \frac{1}{\sqrt{L_{2M} C_{2M}}} = \frac{1}{\sqrt{27{,}7743\ mH \cdot 1{,}59558\ \mu f}} = \boxed{4750\ rad/seg}$$

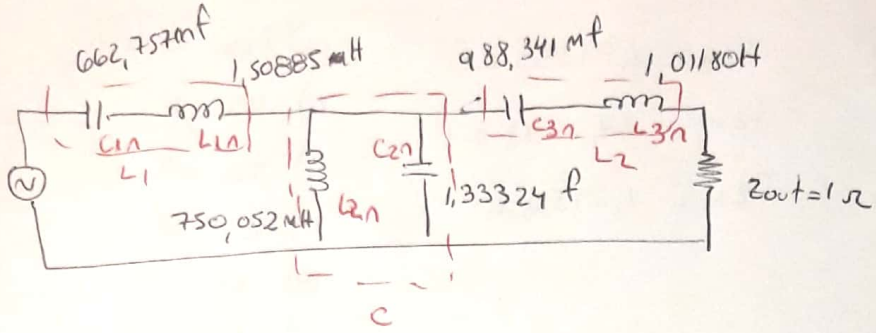
d) $$Z_o = \sqrt{\frac{2L_{2M}}{2C_{1M}}} = \sqrt{\frac{2 \cdot 27{,}7743\ mH}{1{,}81383\ \mu f}} = \boxed{175\ \Omega}$$

b) $$w_c = \frac{1}{2m\sqrt{L_{2M} \cdot C_{1M}}} = \frac{1}{2 \cdot 0{,}5525 \cdot \sqrt{27{,}7743\ mH \cdot \frac{1{,}81383}{2}}} = \boxed{5702{,}07\ \frac{rad}{seg}}$$

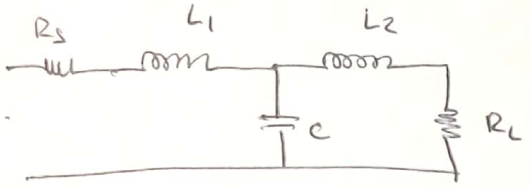
c) $$f_c = \frac{w_c}{2\pi} = \boxed{907{,}51\ Hz}$$

CORROBORADO POR SCRIPT | GDC

Escaneado con CamScanner



P252 bandr normalizado



P252 bajos normalizado } NO VA

$f_{c1} = 378,30988$ Hz

$f_{c2} = 1114,0846$ Hz

$R_0 = 600\ \Omega$

Desnormalizamos p252 $R_0 = 600$

$a = BW = 5000$

$b = z_0 = 600$

GDC

(b) $BW = (\omega_{c2} - \omega_{c1}) =$ 5000 rad/seg

(a) $\omega_0 = \sqrt{f_{c1} \cdot f_{c2}} =$ 3741,65 rad/seg

(c) $\omega_{on}^2 = \frac{\omega_0^2}{BW^2} = \frac{(3741,65)^2}{(5000)^2} = 0,5599 \simeq 0,56$

(d) $L_1 = \frac{C_{1n}}{\omega_{on}^2 . a . b} = \frac{662,757\ nf}{0,56 . 5000 . 600} =$ 394,49 nf ✓

(e) $L_2 = \frac{L_{1n} b}{a} = \frac{1,50885\ H \cdot 600}{5000} =$ 181,062 mH

(f) $L_3 = \frac{L_{2n} . b}{a . \omega_{on}^2} = \frac{750,052\ mH . 600}{5000 . 0,56} =$ 160,725 mH

(g) $C_4 = \frac{C_{2n}}{a . b} = \frac{1,33324}{5000 . 600} =$ 444,413 nf ✓

(h) $C_5 = \frac{C_{3n}}{\omega_{on}^2 . a b} = \frac{988,341\ mH}{0,56 . 5000 . 600} =$ 588,298 nf ✓

(i) $L_5 = \frac{L_{3n} . b}{a} = \frac{1,01180\ H \cdot 600}{5000} =$ 121,416 mH ✓

Escaneado con CamScanner