TAREA SEMANAL 4 BIS

$F_{CI} = 1600\,KHz$, $F_{CS} = 2500\,KHz$; $\alpha_{min} = 20\,dB$ EN $1250\,KHz$ Y $3200\,KHz$

$\underbrace{F_{CI},\ F_{CS}}_{WP}$; $\underbrace{1250\,KHz\ \text{Y}\ 3200\,KHz}_{WS}$

$\alpha_{max} = 3\,dB$

2) BUSCO LOS VALORES DE LA PLANTILLA PASA-BAJO

$W_0 = \sqrt{W_{P1} \cdot W_{P2}} \Rightarrow W_0 = \sqrt{1600\,KHz \cdot 2500\,KHz} \Rightarrow W_0 = 2\,MHz$

$W_{P1\text{-}N} = 1600\,KHz / 2\,MHz \Rightarrow W_{P1\text{-}N} = 0{,}8$; $W_{S1\text{-}N} = 0{,}625$

$W_{P2\text{-}N} = 1{,}25$; $W_{S2\text{-}N} = 1{,}6$

$BW_{\text{-}N} = W_{P2\text{-}N} - W_{P1\text{-}N} \Rightarrow BW_{\text{-}N} = 0{,}450 \rightarrow Q = W_{0\text{-}N} / BW_{\text{-}N}$

$Q = \frac{20}{9} \simeq 2{,}22$

$\Omega_{P1\text{-}N} = Q\,\frac{(W_{P1\text{-}N}^2 - 1)}{W_{P1\text{-}N}} \Rightarrow \Omega_{P1\text{-}N} = -1$

$\Omega_{P2\text{-}N} = Q\,\frac{(W_{P2\text{-}N}^2 - 1)}{W_{P2\text{-}N}} \Rightarrow \Omega_{P2\text{-}N} = 1$

$1 = \Omega_P$

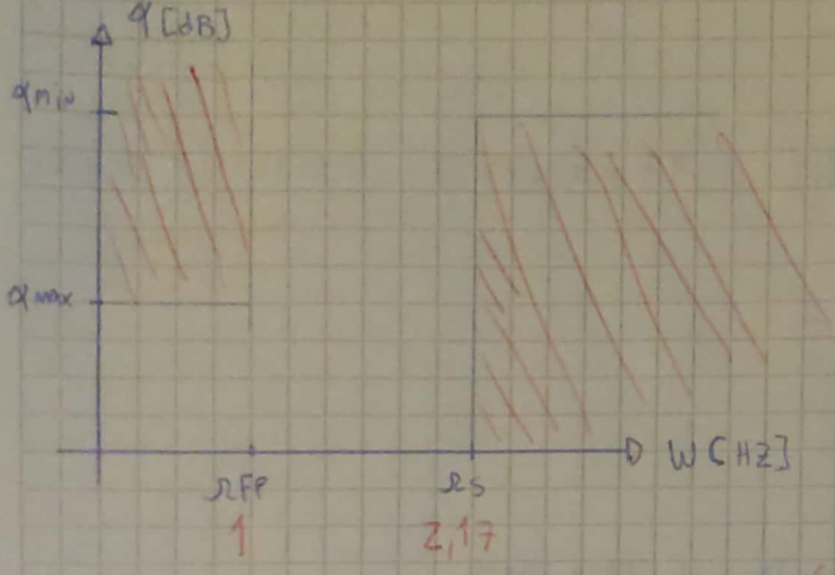
$\Omega_{S1\text{-}N} = Q\,\frac{(W_{S1\text{-}N}^2 - 1)}{W_{S1\text{-}N}} \Rightarrow \Omega_{S1\text{-}N} = -2{,}17$

$\Omega_{S2\text{-}N} = Q\,\frac{(W_{S2\text{-}N}^2 - 1)}{W_{S2\text{-}N}} \Rightarrow \Omega_{S2\text{-}N} = +2{,}17$

$\Omega_S = 2{,}17$

NOTA

PLANTILLA DEL PASABAJO



GANANCIA DE 10 dB, ENTONCES

$\alpha_{max} = 10\,dB - 3\,dB = 7\,dB$

$\alpha_{min} = 10\,dB - 20\,dB = -10\,dB$

$\varepsilon^2 = 10^{3/10} - 1$ ó $\varepsilon^2 = 10^{7/10} - 1$

$\varepsilon^2 = 0{,}9953$ ó $\varepsilon^2 = 4{,}0120$

$\varepsilon = 0{,}9976$ ó $\varepsilon = 2{,}0030$

CASO 1 CASO 2

CASO 1:

$\alpha_{min}(n) = 10 \log\left(1 + \varepsilon^2 \,\Omega s^{2n}\right)$; $\alpha_{min\,2} = 10 \log\left(1 + \varepsilon^2 \underbrace{\Omega s}_{2{,}17}{}^4\right)$

$\alpha_{min\,3} = 10 \log\left(1 + \varepsilon^2 \,\Omega s^5\right)$

$\alpha_{min\,2} = 13{,}63\ dB$

$\alpha_{min\,3} = 20{,}20\,dB \rightarrow n = 3$

CASO ②

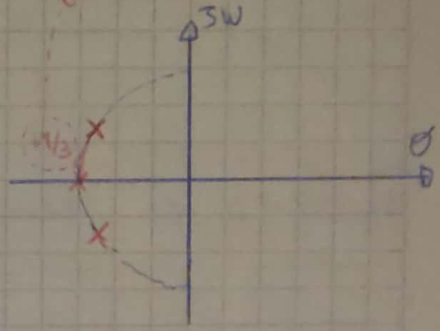
$$\alpha_{min}(2) = 10\log\left(1+\varepsilon^2 \Omega_{WS}^4\right) \Rightarrow \alpha_{min2} = 19{,}54\,dB$$

$$\alpha_{min1} = 10\log\left(1+\varepsilon^2 \Omega_S^2\right) \Rightarrow \alpha_{min1} = 12{,}98\,dB \longrightarrow n = 1$$

CASO ①

FILTRO PASA BAJOS ORDEN 3 NORMALIZADO (BUTTER) $Q = \frac{1}{2\cos(\pi/3)} = 1$

$$T(\$) = \frac{1}{\$^2 + \$ + 1} \cdot \frac{1}{\$ + 1}$$



CASO ②

" " " " 1 " (BUTTER)

$$T(\$) = \frac{1}{\$ + 1}$$

ELIJO SEGUIR POR EL CASO 1. PRIMERO LO RESUELVO CON T NORMALIZADA.

$$T_{BP}(s) = T_{LP}(\$)\Big|_{\$ = Q\frac{s^2+1}{s}} = \frac{1}{Q^2\frac{(s^2+1)^2}{s^2} + \frac{Q(s^2+1)}{s} + 1} \cdot \frac{1}{Q\frac{s^2+1}{s} + 1}$$

NOTA

$$T(s)_{BP} = \frac{s^2}{Q^2(s^4+2s^2+1)+Q(s^3+s)+s^2} \cdot \frac{s}{Q(s^2+1)+s}$$

$$T(s)_{BP} = \frac{s^2}{Q^2s^4+2Q^2s^2+Q^2+Qs^3+Qs+s^2} \cdot \frac{s}{Qs^2+Q+s}$$

$$T(s)_{BP} = \frac{1}{Q^2} \frac{s^2}{s^4+\frac{1}{Q}s^3+\left(2+\frac{1}{Q^2}\right)s^2+\frac{1}{Q}s+1} \cdot \frac{\frac{1}{Q}s}{s^2+\frac{1}{Q}s+1}$$

FACTORIZO EL DENOMINADOR: $\left(s^4+\frac{1}{Q}s^3+\left(2+\frac{1}{Q^2}\right)s^2+\frac{1}{Q}s+1\right)$

$$s^4+0{,}450\,s^3+2{,}2030\,s^2+0{,}450\,s+1=0$$

CON CALCULADORA: $\rightarrow S1 = -0{,}1342 + j\,1{,}208$

$\rightarrow S2 = -0{,}1342 - j\,1{,}208$

$\rightarrow S3 = -0{,}0908 + j\,0{,}8177$

$\rightarrow S4 = -0{,}0908 - j\,0{,}8177$

$$(s-s1)(s-s2)(s-s3)(s-s4) = (s^2+0{,}2684s+1{,}47)+(s^2+0{,}1816s+0{,}6769)$$

$$(a+jB)(a-jB) = a^2+B^2$$

$$TPB(S) = \frac{\frac{1}{Q} S}{S^2 + 0,2684S + 1,47} \cdot \frac{\frac{1}{Q} S}{S^2 + 0,1816 S + 0,6767} \cdot \frac{\frac{1}{Q} S}{S^2 + 0,450 S + 1}$$

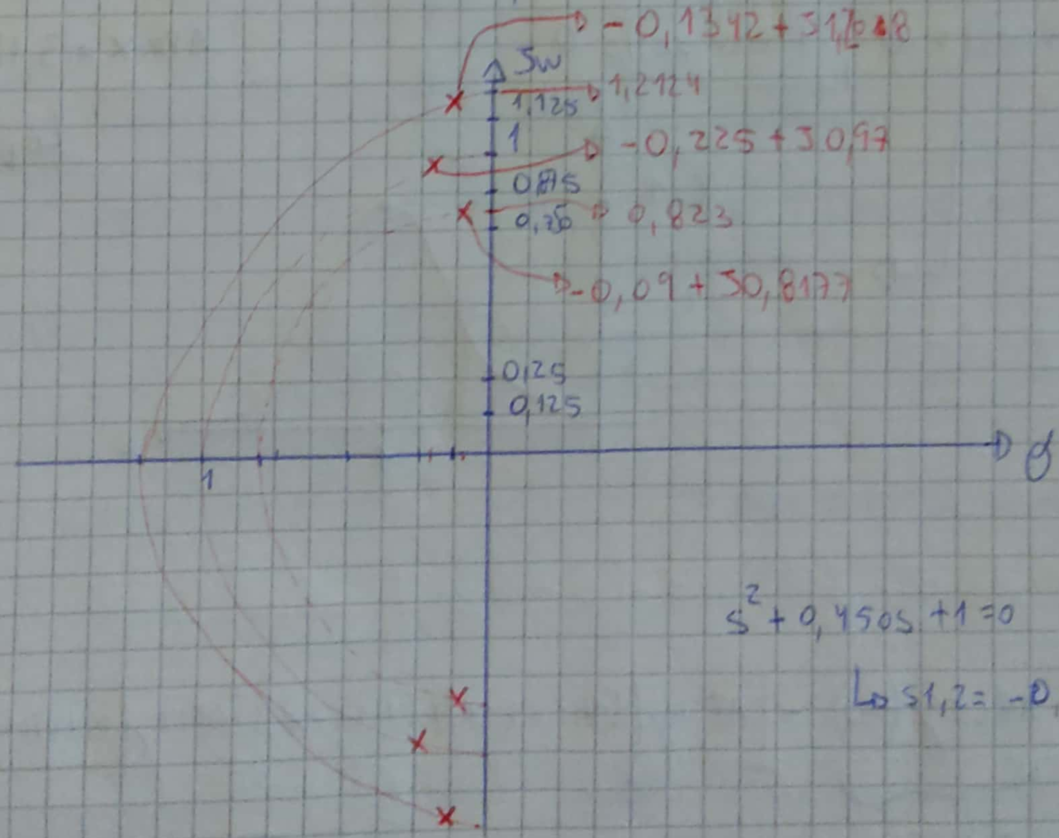
$K1 = Q \; 0,2684 \Rightarrow \boxed{K1 = 0,5960}$; $K2 = Q \cdot 0,1816 \Rightarrow \boxed{K2 = 0,4031}$

$Q \downarrow 2,22$

$$TPB(S) = \frac{1}{K1} \frac{(C1)\, K1 \frac{1}{Q} S}{S^2 + 0,2684S + 1,47} \cdot \frac{1}{K2} \frac{K2 \frac{1}{Q} S\, (C2)}{S^2 + 0,1816S + 0,6770} \cdot \frac{\frac{1}{Q} S\, (C3)}{S^2 + 0,450S + 1}$$

$C1 \cdot C2 \cdot C3 = K$

b) $w_{01} = \sqrt{1,47} \Rightarrow w_{01} = 1,2124$; $w_{02} = \sqrt{0,67} \Rightarrow w_{02} = 0,823$; $w_{03} = 1$



$S^2 + 0,450S + 1 = 0$

$\hookrightarrow S_{1,2} = -0,225 \pm j0,97$

$\frac{w_{01}}{Q1} = 0,2684$; $Q1 = 4,508$; $Q2 = 4,53$; $Q3 = 2,22$

c)

MODULO:

$$T_{PB}(w) = \left(T_{PB}(s)\right)\Big|_{s=jw} = 4{,}1624 \cdot \frac{0{,}26845jw}{-w^2+0{,}26845jw+1{,}47} \cdot \frac{0{,}1816jw}{-w^2+0{,}1816jw+0{,}67} \cdot \frac{0{,}450jw}{-w^2+jw0{,}450+1} \; K$$

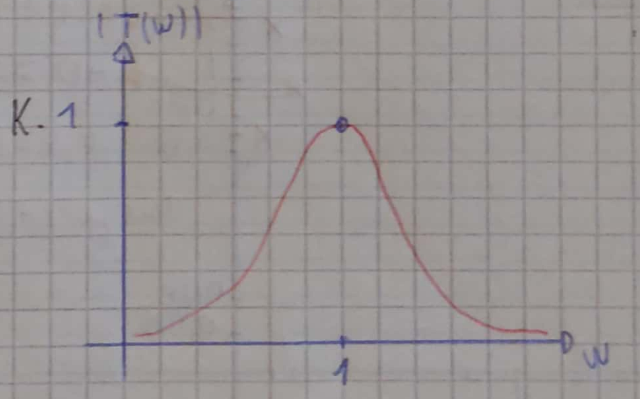
$$|TB(w_0)| = 4{,}1624 \cdot \frac{0{,}2684}{\sqrt{0{,}47^2+0{,}2684^2}} \cdot \frac{0{,}1816}{\sqrt{0{,}33^2+0{,}1816^2}} \cdot \frac{\cancel{0{,}450}^{\,1}}{\cancel{0{,}450}} \; K$$

$w_0 = 1$

$$|TB(w=1)| = 4{,}1624 \cdot 0{,}4959 \cdot 0{,}4821 \simeq 0{,}99 \simeq 1 \cdot K$$

DEBERÍA SER APROX $= 3{,}16$ → 10dB

$$|TB(w \to \infty)| = 0 \; ; \; |TB(w=0)| = 0$$

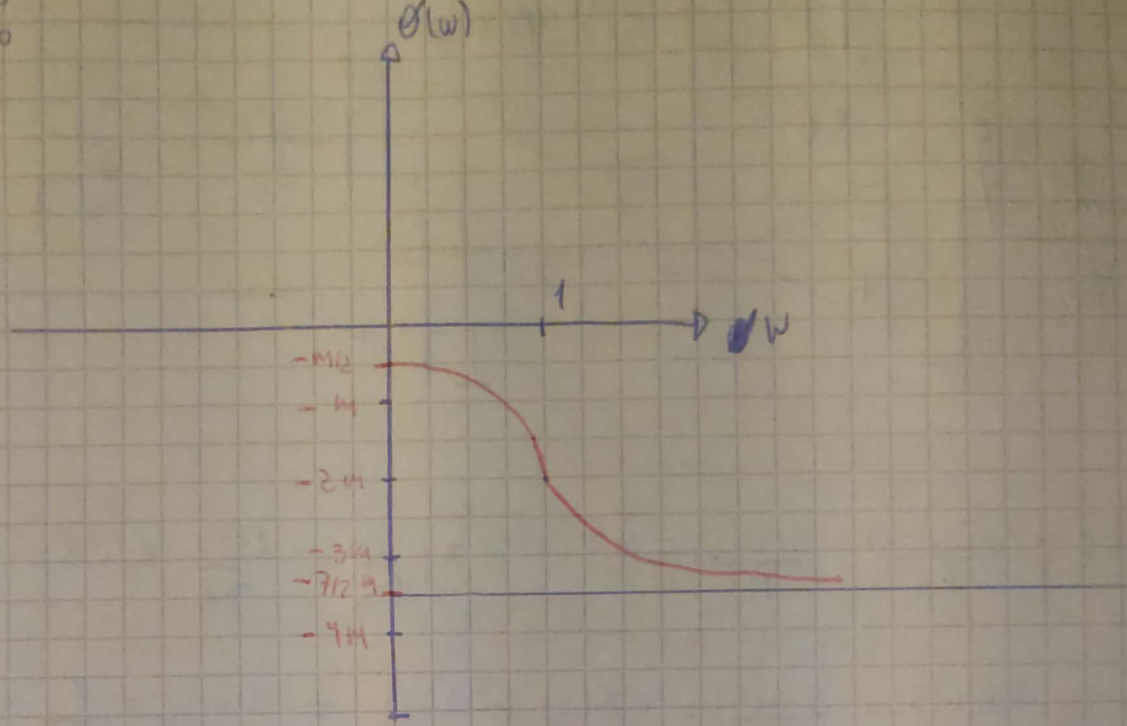


FASE:

$$\varnothing(w) = \underbrace{\mathrm{ARCTG}(-\infty)}_{-\pi/2} - \left[\mathrm{ARCTG}\left((0{,}2684w)/(1{,}47-w^2)\right) + \mathrm{ARCTG}\left[0{,}1816w/(0{,}67-w^2)\right] + \mathrm{ARCTG}\left[0{,}450w/(1-w^2)\right]\right]$$

$\varphi(w=0) = -M/2$, $\varphi(w \to \infty) = -M/2 - 3M = -\frac{7}{2}M$

$\varphi(\frac{w}{w_0} = 1) = -M.2$



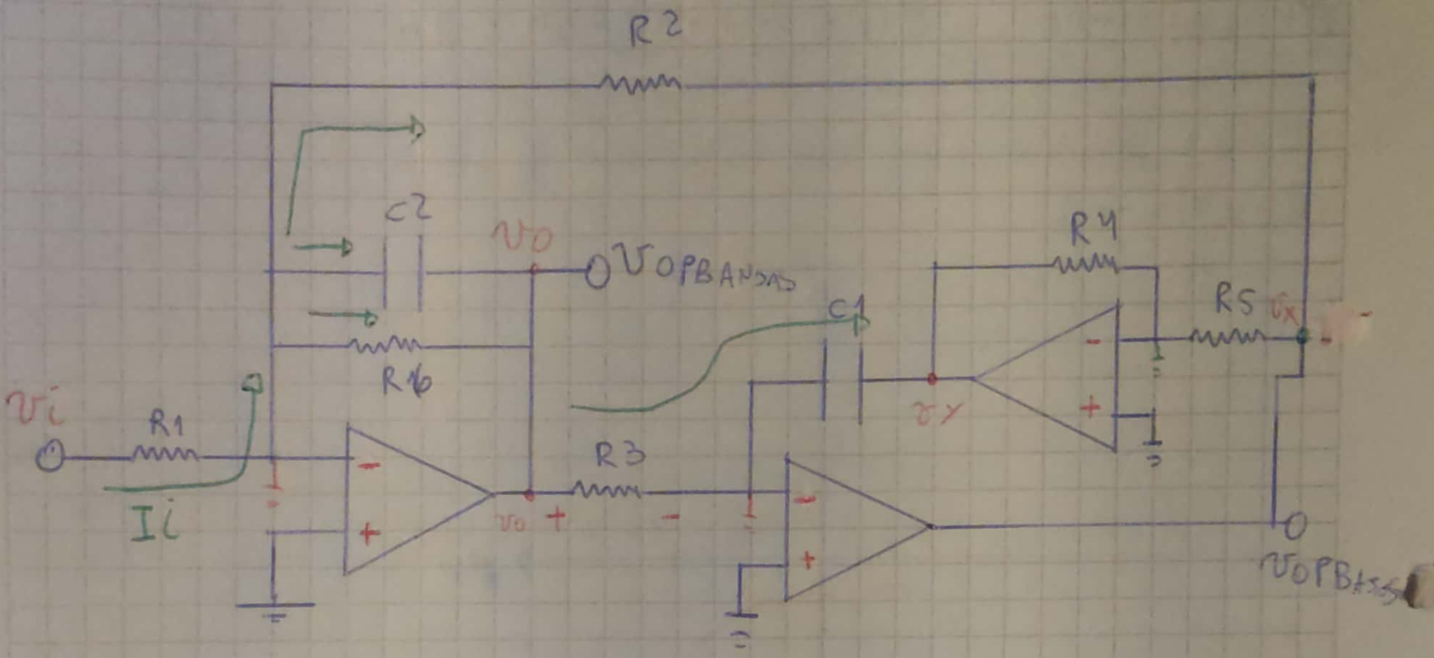
EN EL CASO DE CALCULAR A PARTIR DE UN FILTRO DE MAX. PLANICIDAD:

$$T_{PB}(s) = \frac{1}{s + s + 1} \qquad \frac{1}{s+1}$$

→ PRACTICAMENTE LO MISMO

$$\varepsilon^{-1/3} = 0{,}9976^{-1/3} \Rightarrow \varepsilon^{-1/3} \cong 1$$

d) ACKERBERG-MOSSBERG



$R4 = R5$; $\frac{v_{R3}(s)}{R3} = \frac{v_o(s)}{R3} = -v_{C1}(s)\, sC1$; $\frac{v_x}{R5} = -\frac{v_y}{R4} \Rightarrow v_x = -v_y$

$$v_{R3}(s) = \frac{v_o(s)}{R3} = v_x(s)\, sC1 \quad (1) \quad \Rightarrow \quad v_x(s) = \frac{1}{sC1R3}\, v_o(s) \quad (2)$$

$$v_i(s)\cdot\frac{1}{R1} = -\left[\frac{1}{R6}v_o + sC2\, v_o + \frac{1}{R2}v_x\right] \quad (3)$$

(2) en (3) $\Rightarrow \frac{1}{R1}v_i(s) = -\left[\frac{1}{R6} + sC2 + \frac{1}{R2}\frac{1}{sC1R3}\right] v_o(s)$

$$\frac{1}{R1}v_i(s) = \frac{s^2C1C2R2R3R6 + sC1R2R3 + R6}{sC1R2R3R6}\, v_o(s) \to T(s) = \frac{\frac{1}{R1}\cdot sC1R2R3R6}{s^2C1C2R2R3R6 + sC1R2R3 + R6}$$

$$T(S) = \frac{S \frac{1}{C_2 R_1} \frac{R_6}{R_1}}{S^2 + \frac{1}{C_2 R_6} S + \frac{1}{C_1 C_2 R_2 R_3}}$$

K $\quad \omega_0^2 \quad \frac{\omega_0}{Q}$

$$T(S) = \frac{K\, \omega_0/Q \; S}{S^2 + \frac{\omega_0}{Q} S + \omega_0^2} \; ; \; \omega_0 = \frac{1}{C_1 C_2 R_2 R_3}$$

$$\frac{\omega_0}{Q} = \frac{1}{C_2 R_6} \; ; \; K = \frac{R_6}{R_1}$$

NORMALIZAMOS:

$\omega_0 = 1 \rightarrow C_1 C_2 R_2 R_3 = 1 \; ; \; R_2 = R_3 = 1 \; ; \; C_1 . C_2 = 1 \; ; \; R_6 = 1$

$\frac{\omega_0}{Q} = \frac{1}{C_2 R_6} \Rightarrow C_2 = Q/\omega_0 \; , \; C_1 = \omega_0/Q \; ; \; K = \frac{R_6}{R_1} \Rightarrow R_1 = 1/K$

$K_{dB} = 10\,dB \; ; \; F_0 = 2\,MHz \Rightarrow \Omega\, \omega = 2\pi F_0 = 2\pi . 2\,MHz$; NECESITO UNA GANANCIA DE 10dB

$\hookrightarrow 2.10^6\,Hz$

$\hookrightarrow K^3 = 3,16$ OSEA 3,16 APROX

DESNORMALIZAMOS PARA CADA ETAPA

$K = 1,47 \rightarrow$ CADA ETAPA

ETAPA 1: $Q_1 = ? \; ; \; \frac{\omega_{01}}{Q_1} = 0,2684$; $Q_1 = 4,50$; $R_6 = 1K\Omega$

$\omega_{01} = 1,21$

$\Omega z = 1K\Omega \; ; \; K = \frac{1}{R_1} \rightarrow R_1 = \frac{1}{K} \rightarrow R_1 = \frac{1}{K} \Omega z = 680,27\,\Omega \rightarrow$ PARA TODAS LAS ETAPAS

$C_1 = \frac{1}{Q_1} \cdot \frac{1,21}{\Omega \omega\, \Omega z} = 21,39\,pF \; ; \; C_2 = \frac{Q_1}{1,21} \frac{1}{\Omega \omega_0\, \Omega z} \Rightarrow C_2 = 295,95\,pF$

$R_2 = R_3 = \Omega z = 1K\Omega$

ETAPA 2:

$Q_2 = ?$; $\frac{\omega_0}{Q_2} = 0,1816 \Rightarrow Q_2 = 4,51$

$C_1 = \frac{1}{Q_2} \frac{0,82}{\Omega 2 \Omega \omega} \Rightarrow C_1 = 14,46 \text{ pF}$; $C_2 = \frac{Q_2}{0,82} \frac{1}{\Omega 2 \Omega \omega} \Rightarrow C_2 = 437,68 \text{ pF}$

$R_2 = R_6 = 1 K\Omega$; $R_1 = 680,27 \Omega$; $R_6 = 1 K\Omega$

ETAPA 3:

$Q_3 = 2,22 \rightarrow C_1 = \frac{1}{Q_3} \frac{1}{\Omega \omega_0 \Omega 2} \Rightarrow C_1 = 35,84 \text{ pF}$

$C_2 = Q_3 \frac{1}{\Omega \omega_0 \Omega 2} \Rightarrow C_2 = 176,662 \text{ pF}$

$R_2 = R_3 = 1 K\Omega$; $R_1 = 680,27 \Omega$; $R_6 = 1 K\Omega$