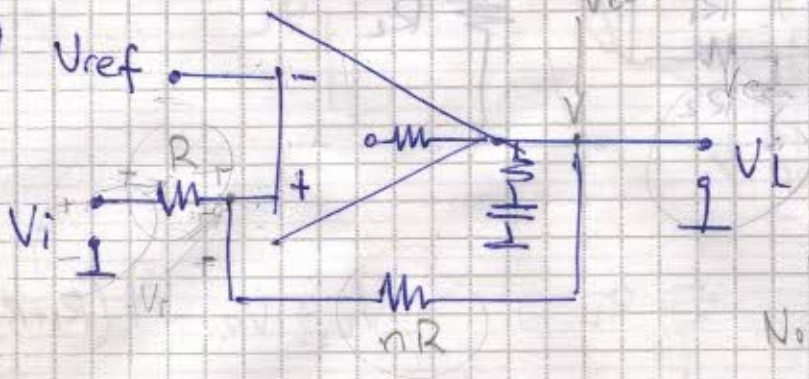
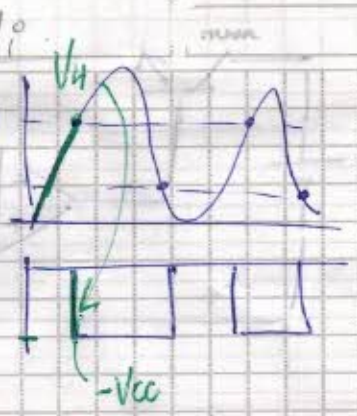
FECHA (1)

FINAL GONZALEZ.

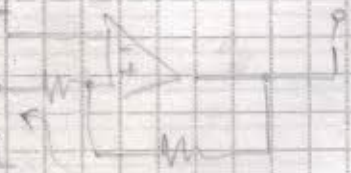
1)





Realim Positiva
No puedo analizar como el negativa.

$V_o = 15V$ para $V_i = V_H$



$$V_o = A_\infty (V_P - V_N) = A(V_i - V_{ref})$$

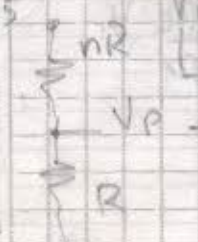
$$V_i - I(R+nR) - 15V = 0$$

$$V_o - I(R+nR) - V_i = 0$$

$$\frac{V_o - V_i}{R+nR} = I \;;\; V_P = I \cdot R = \frac{(V_o - V_i)R}{R+nR}$$

$$V_P = \frac{(V_o - V_i)}{1+n}$$

-15/15



V_{cc} V_{cc} V_H

$$V_o = A_\infty \left(\frac{(V_o - V_i)}{1+n} - V_{ref} \right)$$

$$-(V_{cc} + V_{ref})(1+n) + V_{cc} = V_H$$

$$-V_{cc} - V_{ref} - nV_{cc} - nV_{ref} + V_{cc} = V_H$$

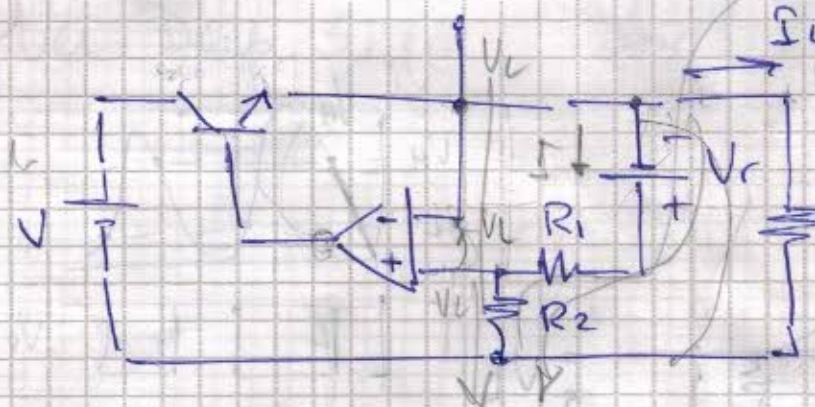
$$-V_{ref}(1+n) - nV_{cc} = V_H$$

$$-V_{ref}(1+n) - V_{cc} \cdot n = V_H \qquad V_H = V_{reg\alpha}$$

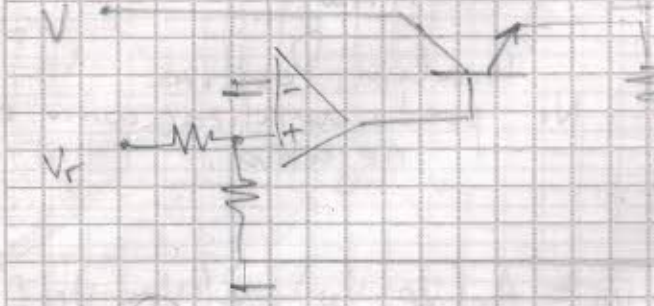
$$-V_{ref}(1+n) + V_{cc}\, n = V_L \qquad (\alpha)$$

$$V_L = -\frac{V_{cc}}{n} + V_{reg}\left(\frac{n+1}{n}\right) \qquad V_H = \frac{V_{cc}}{n} + V_{reg}\left(\frac{n+1}{n}\right)$$

2)



$$V' = -\left(\frac{R_1+R_2}{R_1}\right)$$



$$V_L + V_R - I(R_1+R_2) = 0$$

$$V_P = \frac{V_L + V_R}{R_1+R_2} R_2$$

V_L

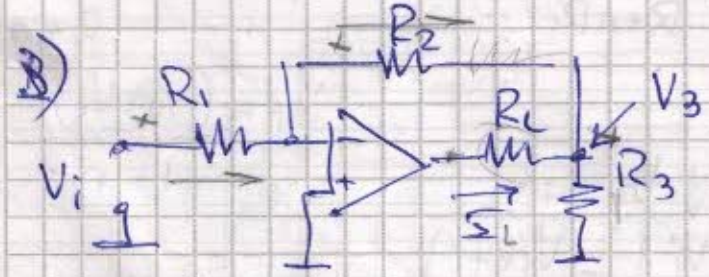
$$\frac{V_R}{R_1} = \frac{V_L}{R_2}$$

$V_L =$

$$V_L + V_r - V_{R1} - V_R = 0$$

$$V_r = V_{R1} = IR_1 \quad / \quad I = \frac{V_r}{R_1} = \frac{V_L}{R_2} \Rightarrow V_L = \frac{R_L}{R_1} V_r$$

3)

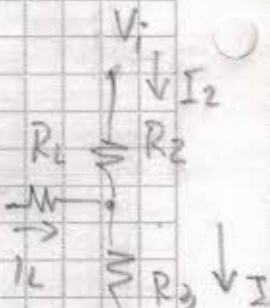


$I_L = f(V_i)$

$I_1 = I_2$

ⓐ $* I_1 = \frac{V_i - 0}{R_1}$ $\quad \downarrow V_n = V_P$

ⓑ $* I_2 = \frac{0 - V_3}{R_2}$



ⓒ $* I_T = I_L + I_2 = I_L - \frac{V_3}{R_2}$

$I_T R_3 = V_3 = R_3 I_L - \frac{V_3 R_3}{R_2}$

$V_3 \left(1 + \frac{R_3}{R_2}\right) = R_3 I_L$

$V_3 = \frac{R_3 I_L}{\quad}$ en ⓑ

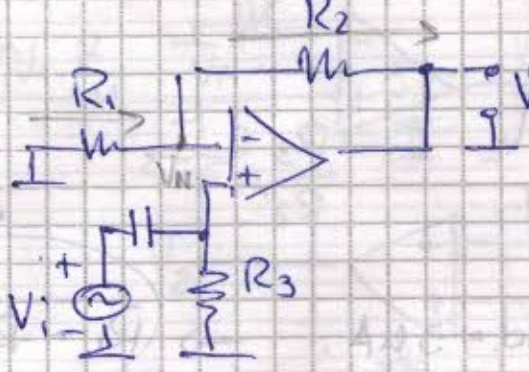
$I_1 = I_2$

$\frac{V_i}{R_1} = -\frac{R_3 I_L}{1 + R_3/R_2} \cdot \frac{1}{R_2}$

$\frac{V_i}{R_1} = -\frac{R_3 I_L}{\quad}$

$$I_L = -V_i \frac{R_3 + R_2}{R_3 \cdot R_1} = \left[-\frac{V_1}{R_1} \left(1 + \frac{R_2}{R_3} \right) \right]$$

4)



$V_L(s)$

$I_1 = I_2$

$$\frac{0 - V_N}{Z_1} = \frac{V_N - V_L}{R_2}$$

$$V_L = R_2 \left(\frac{V_N}{R_2} + \frac{V_N}{R_1} \right)$$

$$V_L = V_N \left(1 + \frac{R_2}{R_1} \right)$$

V_P

$V_N = V_P$; $V_P = \frac{V_i R_3}{Z}$ $\quad V_P = \frac{V_i R_3 \cdot sC}{sCR_3 + 1} =$

$Z = R_3 + \frac{1}{sC} = \frac{sCR_3 + 1}{sC}$

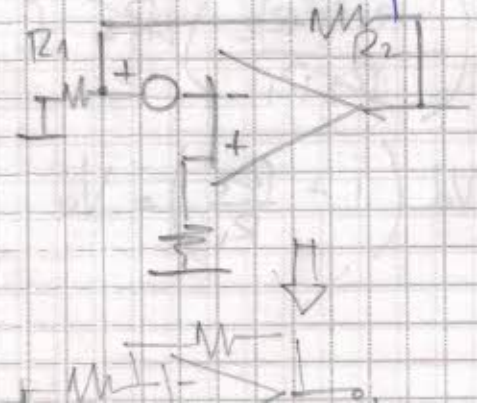
$$V_P = \frac{R_3 V_i \, sC}{(CR_3)\left[s + \frac{1}{CR_3} \right]}$$

$$V_P = \frac{s}{s + 1/CR_3} V_i \quad \therefore \quad V_L = \left(1 + \frac{R_2}{R_1} \right) V_P$$

F.P.A

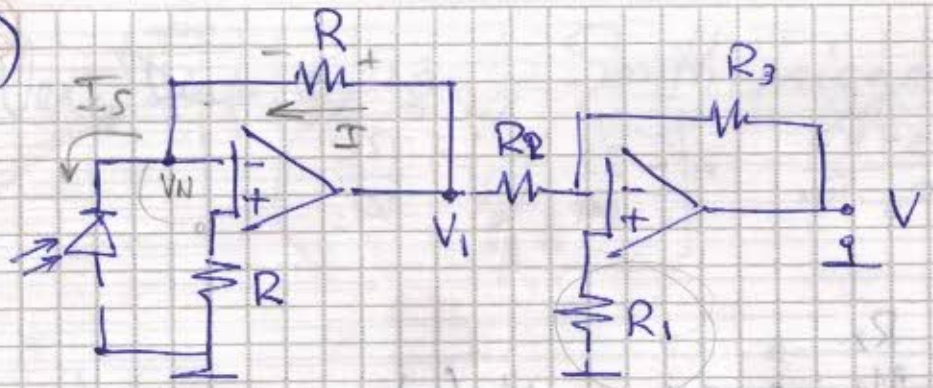
$$\boxed{\frac{V_L}{V_i} = \left(1 + \frac{R_2}{R_1} \right) \frac{s}{s + 1/CR_3}}$$

- Determinar efectos del Vos en el circuito anterior



$$V_{OS}\left(1 + \frac{R_2}{R_1}\right) = V_{OS_L}$$

5)



$V = f(I)$?

$V_1 - I_S R = 0$

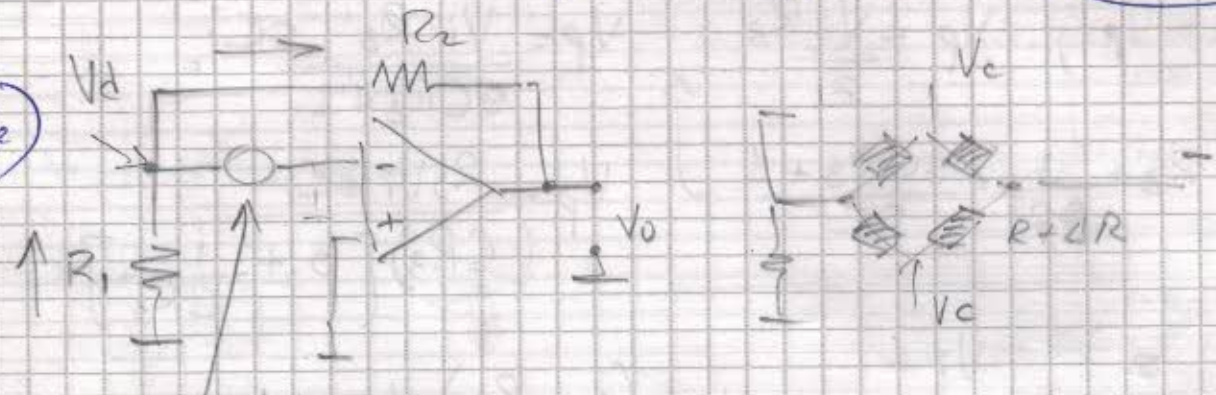
$V_1 = I_S R$

$V = -\frac{R_3}{R_2} V_1 = -\frac{R_3}{R_2} R I_S$

Reduzc
Ipo

— Diseñar $V = 3V$ p/ $id = 3\mu A$. → $R_1 = R_2 // R_3$

6)



Puente Weatstone

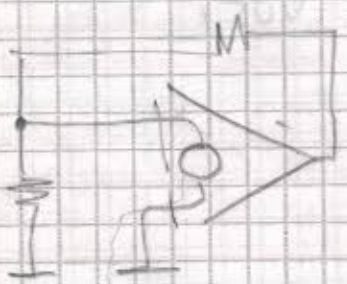
$E_1 - E_2 = \frac{V \Delta R}{4R}$ ∴

$V_0 = f(Vd)$

$I_1 = I_2 \quad I_1 = \frac{-Vd}{R_1} \quad ; \quad I_2 = \frac{Vd - V_0}{R_2}$

$-\frac{Vd}{R_1} = \frac{Vd - V_0}{R_2} \quad \therefore \quad \frac{V_0}{R_2} = Vd\left(\frac{1}{R_2} + \frac{1}{R_1}\right) F$

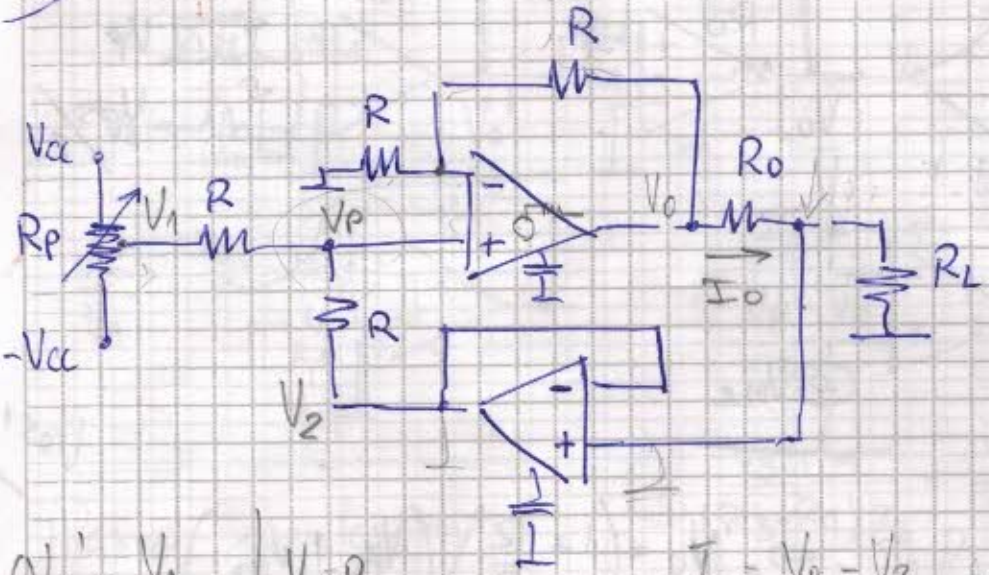
$V_0 = Vd\left(\frac{R_1 + R_2}{R_2 R_1}\right) R_2$



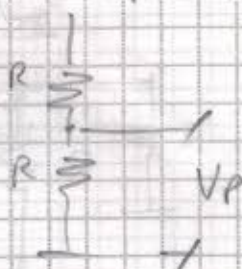
$Vd\left(1 + \frac{R_2}{R_1}\right) = V_0$

FECHA

6) $V_1 = \left(1 + \frac{R}{R}\right) V_p = 2V_p$



$V_1 \circ V_2$



$$\begin{cases} V_p' = \frac{V_1}{2} \;\Big|\; V_2 = 0 \\ V_p'' = \frac{V_2}{2} \;\Big|\; V_1 = 0 \end{cases}$$

$$I_o = \frac{V_o - V_2}{R_o} \Rightarrow I_o R_o = V_o - V_2$$

$$V_2 = V_o - I_o R$$

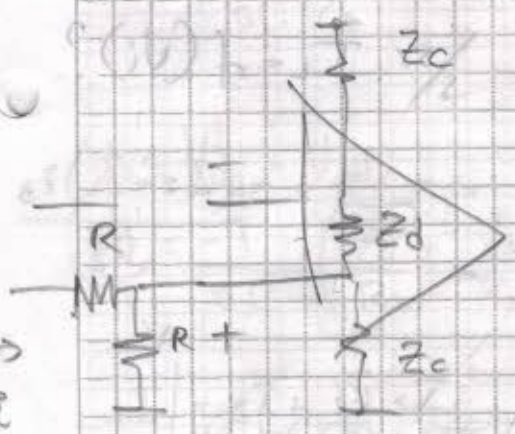
$$V_o = 2V_p = V_1 + V_2$$

$$V_p = \frac{1}{2}(V_1 + V_2) \circledast$$

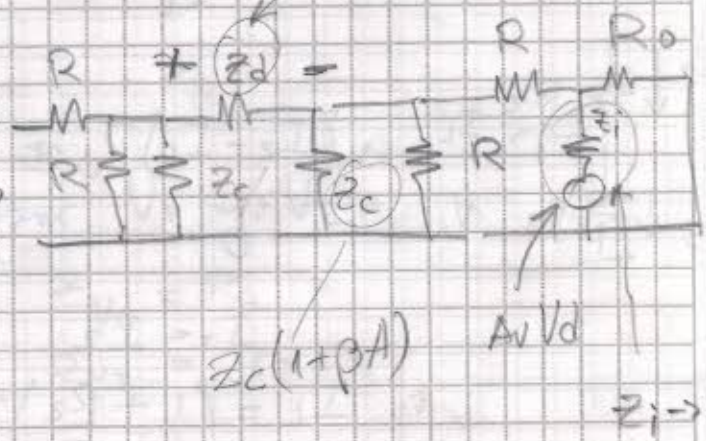
$$V_2 = V_1 + V_2 - I_o R_o$$

$$V_1 = I_o R_o$$

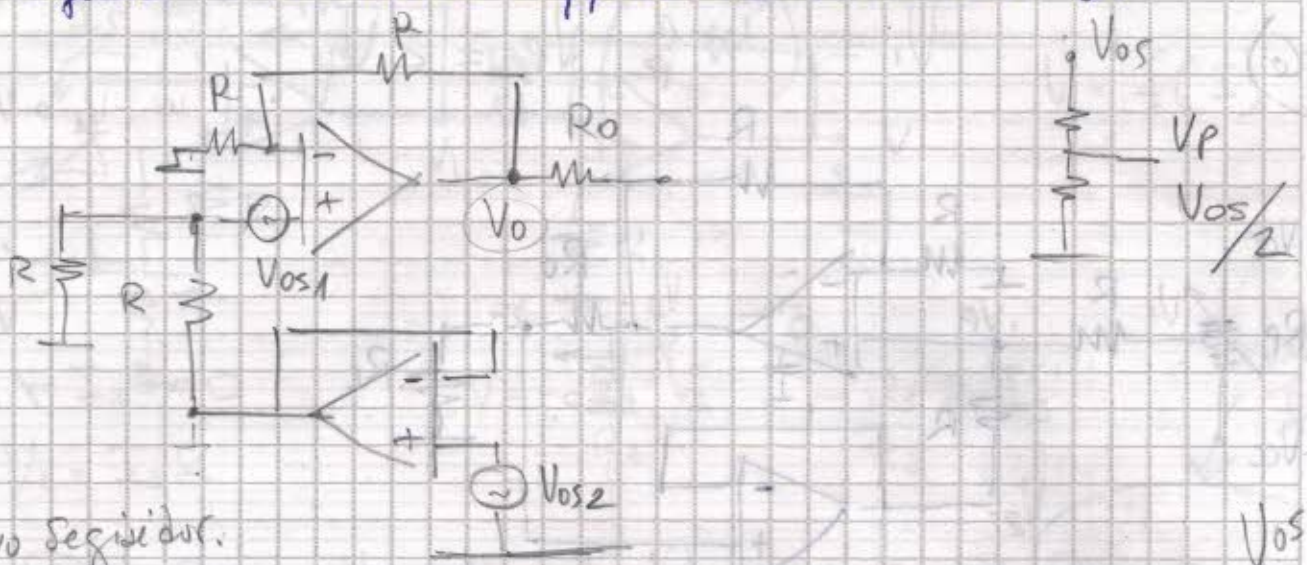
$$I_o = \frac{V_1}{R_o}$$



$\Rightarrow$



- Efecto Tensión de offset de 1mV en V_o



- Pasivo seguidor.

$V_{p_1} = V_{os1}/2$

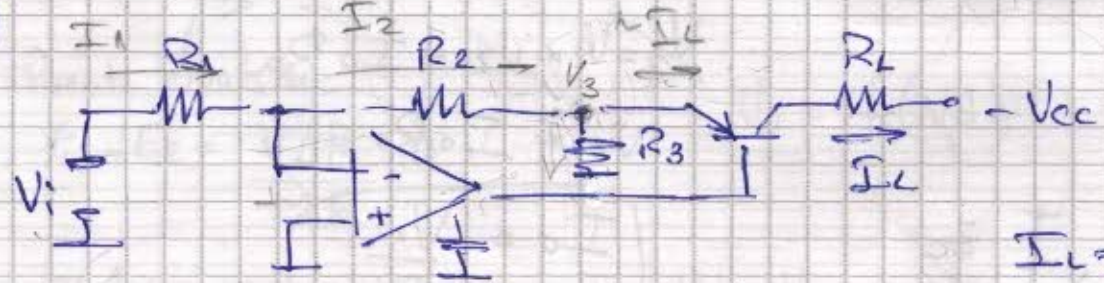
- Pasivo V_{os1} $\therefore V_{p_2} = V_{os2}$

$$\Rightarrow V_o = \left(1 + \frac{R}{R}\right)\left(V_{p_1} + V_{p_2}\right)$$

$$V_o = 2\left(V_{os1}/2 + V_{os2}\right) = 2 \cdot \frac{3}{2} V_{os}$$

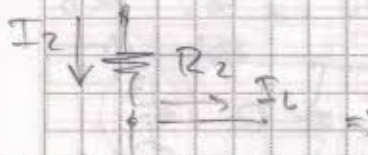
$$V_o = 3\,V_{os} = \boxed{3\,mV}$$

7)



$I_L = f(V_i)$?

$I_1 = I_2$ * $I_1 = \frac{V_i}{R_1}$; $I_2 = \frac{V_p - V_3}{R_2} = \frac{-V_3}{R_2} = -\frac{(I_2 - I_L)R_3}{R_2}$



$\Rightarrow (I_2 - I_L)R_3$ (*)

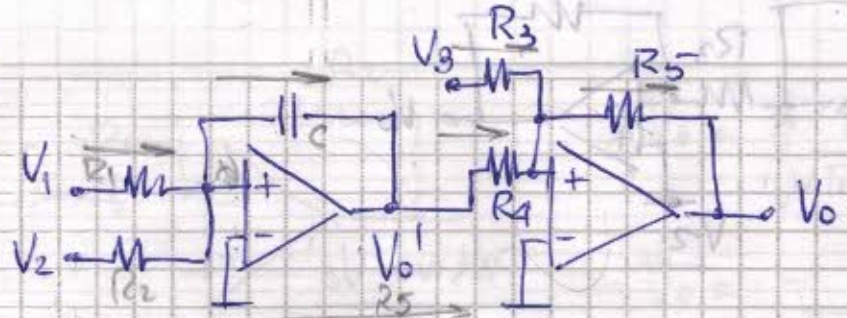
$$I_2\frac{R_2}{R_3} + I_2 = I_L$$

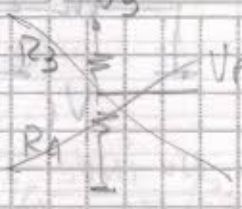
$$I_2 = \frac{I_L}{1 + \frac{R_2}{R_3}} \quad (*)$$

$I_1 = I_2$

$$\boxed{I_L = \left(1 + \frac{R_2}{R_3}\right)\frac{V_i}{R_1}}$$

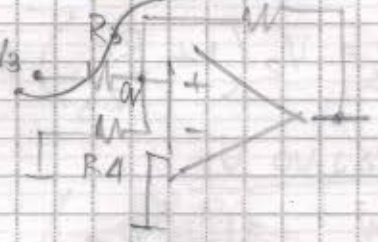
8)





$\frac{V_3 R_4}{R_3+R_4}$

$\frac{V_0}{V_3}$



$I_3 = I_5$

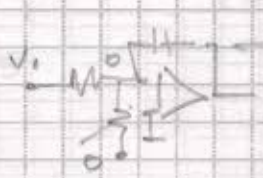
$$\frac{V_p - V_n}{R_3} = \frac{V_p - V_0}{R_5}$$

$$\frac{V_3 R_4}{(R_3+R_4)R_3} = \frac{V_3 R_4}{R_3+R_4} - \frac{V_0}{R_3+R_4}$$

$$V_0 = \frac{V_3 R_4}{R_3+R_4}\left(\frac{1}{R_3}+1\right)$$

Pasivo fuentes y ver topologías

Pasivo V_2:



$$-V_1 \frac{1}{sCR_1} = V_{01}$$

Pasivo V_1:

$$-V_2 \frac{1}{sCR_2} = V_{02}$$

$$V_0' = V_{02} + V_{01}$$

$$V_0' = \frac{-1}{sC}\left(\frac{V_2}{R_2} + \frac{V_1}{R_1}\right)$$

Pasivo V_0'

$$V_0 = -V_3 \frac{R_5}{R_3}$$

Pasivo V_3

$$V_0 = -V_0' \frac{R_5}{R_4}$$

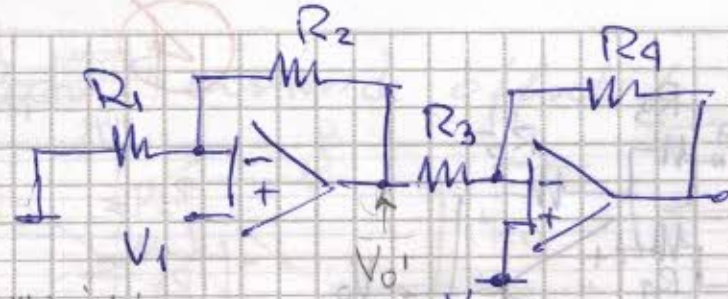
$$V_0 = -V_3 \frac{R_5}{R_3} + \frac{R_5}{sCR_4}\left(\frac{V_2}{R_2} + \frac{V_1}{R_1}\right)$$

- Impedancias vistas por V_1 y V_2

V_p masa virtual $\Rightarrow$ $Z_{V_1} = R_1$

$Z_{V_2} = R_2$

9)



TOPOLOG. NO INV.

$$V_o' = V_1\left(1+\frac{R_2}{R_1}\right)$$

PASIVO V_o'

$$V_{o_1} = V_2\left(1+\frac{R_4}{R_3}\right) \text{ N. INV.}$$

PASIVO V_2

$$V_{o_2} = -V_o'\left(\frac{R_4}{R_3}\right) \text{ INV.}$$

$$V_o = V_{o_1} + V_{o_2} = V_2\left(1+\frac{R_4}{R_3}\right) - V_o'\left(\quad\right)$$

$$\textcircled{*}\quad V_o = \left(1+\frac{R_4}{R_3}\right)V_2 - V_1\left(1+\frac{R_2}{R_1}\right)\left(\frac{R_4}{R_3}\right)$$

Condición.

$$\rightarrow V_o = (V_2 - V_1)\left(1+\frac{R_4}{R_3}\right)$$

$$\Rightarrow \left(1+\frac{R_2}{R_1}\right)\left(\frac{R_4}{R_3}\right) = 1+\frac{R_4}{R_3}$$

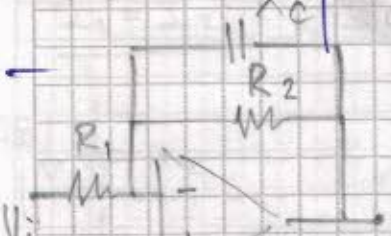
$$\frac{R_4}{R_3} + \frac{R_2}{R_1}\frac{R_4}{R_3} = 1 + \frac{R_4}{R_3} \Rightarrow \frac{R_2}{R_1}\frac{R_4}{R_3} = 1 \nearrow \frac{R_2}{R_1} = \frac{R_3}{R_4}$$

$$R_1R_3 = R_2R_4$$

Condición

$$\begin{cases} R_2 = R_3 \\ R_1 = R_4 \end{cases}$$

9) Diseñar para fre. corte inferior seg. 100 Hz



$Z = X_c // R_2$ superior 10.000 Hz

$$V_o = -\left(\frac{Z}{R_1}\right)V_i \qquad Z = \frac{\frac{R_2}{SC}}{1+R_2CS} = \frac{R_2}{1+RCS}$$

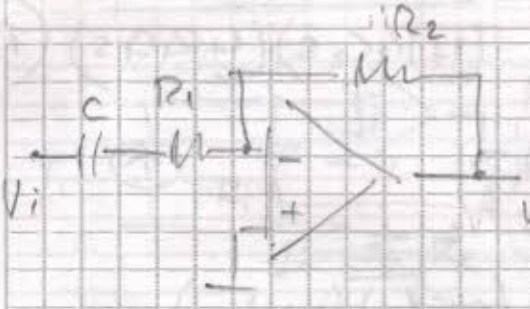
$$V_o = \frac{-R_2 V_i}{(1+SC(R_2))R_1}$$

GFB

$$V_o = \frac{-R_2/R_1}{CR_2\left(S+\frac{1}{CR_2}\right)}$$

FPB @ 10000 Hz : $C_1R_2 = \frac{1}{2\pi f_{HIGH}}$

* GANANCIA = 10 ∴ $R_2 = 10$



$$V_o = -\frac{R_2}{R_1 + X_C} V_i$$

$$V_o = \frac{-R_2 V_i}{R_1 + \frac{1}{sC}} = \frac{-R_2 V_i}{\frac{R_1 sC + 1}{sC}}$$

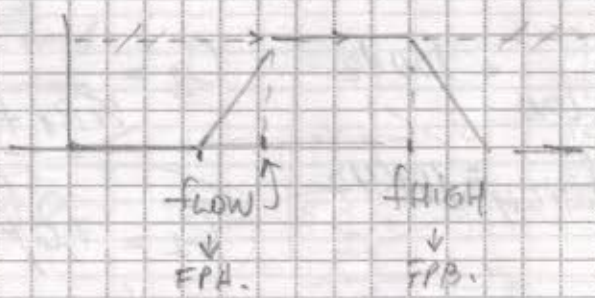
$$V_o = \frac{-R_2 C s}{R_1 C s + 1} V_i$$

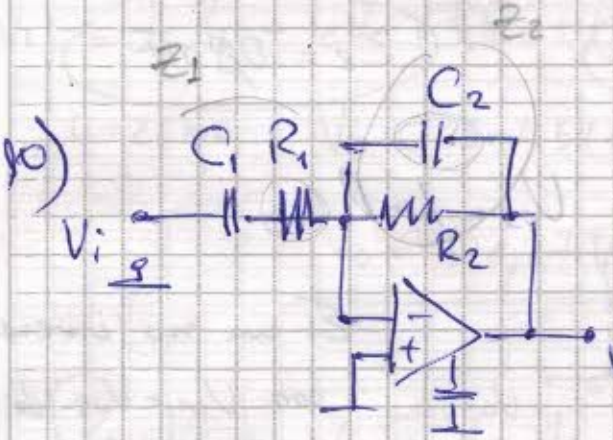
$$V_o = \frac{-R_2 C s}{R_1 C \left(s + \frac{1}{R_1 C}\right)}$$

$$\frac{-R_2}{R_1} \frac{V_i}{1 + \frac{1}{R_1 C s}} = V_o$$

PPA @ 100 Hz $\therefore CR_1 = \frac{1}{2\pi f_{LOW}}$

$$V_o = \frac{(-R_2/R_1)\, s}{s + \frac{1}{R_1 C}}$$

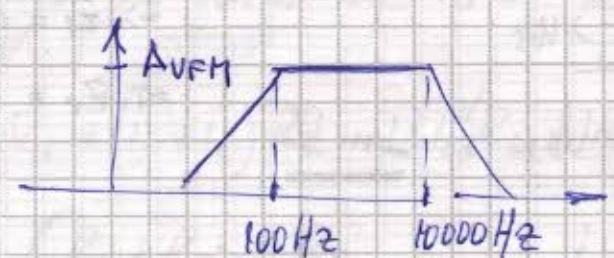




Z_i @ ~~frec med.~~ = 1 kΩ

A_V @ FM = 20

- Diseñar:



$\therefore$ FPA @ f = 100 Hz

FPB @ f = 10.000 Hz.

$$Z_1 = R_1 + \frac{1}{sC_1} \qquad Z_2 = \frac{\frac{R_2}{sC_2}}{1 + R_2 C_2 s} = \frac{R_2}{1 + R_2 C_2 s}$$

$$V_o = -\frac{Z_2}{Z_1} V_i = -\frac{\frac{R_2}{1+R_2C_2s}}{\frac{1+R_1C_1s}{sC_1}} V_i = \frac{-R_2C_1s}{(1+R_2C_2s)(1+R_1C_1s)} V_1$$

$$V_o = \frac{-R_2C_1s\,V_i}{R_1C_1R_2C_2\left(s+\frac{1}{C_1R_1}\right)\left(s+\frac{1}{C_2R_2}\right)} = \frac{-\left(\frac{1}{R_1C_2}\right)s\,V_1}{\left(s+\frac{1}{C_1R_1}\right)\left(s+\frac{1}{C_2R_2}\right)}$$

FPA FPB

$G_{FPB_{FM}} = -R_2/R_1 = G_{FPA}$

A frec. Med despreció C_1 y C_2 (C_2 Cortos, C_2 C. Abierto)

$Z_i = R_1 = \underline{1k\Omega}$

$R_2 = G_{FM} \cdot R_1 = 20 \cdot 1k\Omega = \underline{20k\Omega}$

$f_{low} = 100Hz$ | $C_1 = \frac{1}{2\pi R_1 f_{low}}$; $C_2 = \frac{1}{2\pi f_{High} R_2}$

$f_{HIGH} = 10kHz$ | $C_1 = 1{,}6\mu F$ | $C_2 = 0{,}8nF$

- V_2 de salida para un $V_{os} = 1mV$.

Pasivo V_i

$Z_1 = \infty$

V_{os_2}

V_{os}

Es un no inversor con $V_{in} = V_{os}$ de c.c

$\Rightarrow Z_1 = \infty$ en C.C

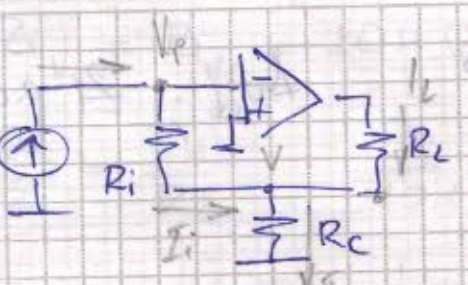
$\Rightarrow Z_2 = R_2 // \infty = R_2$

$V_{os_2} = \left(1 + \frac{Z_2}{Z_1}\right) V_{os} = V_{os} = \underline{\underline{1mV}}$

($\frac{Z_2}{Z_1} \to 0$)

Ver diap. 65

11)



$A_i = \frac{i_L}{i_i}$?

a* $I_i + I_L = I_c$

$V_p = 0 = I_i R_i + I_c R_c$

$I_i R_i = -I_c R_c$

b* $I_c = -I_i \frac{R_i}{R_c}$

b en a: $I_L = I_c - I_i$

$I_L = -I_i \left(\frac{R_i}{R_c} + 1\right) \Rightarrow A_i = -\left(\frac{R_i}{R_c} + 1\right)$

$A_i = -\left(\frac{10K}{1K} + 1\right) = 11$

- $V_{sat\ salida\ AO\ TR} = 1.5\ V$
- $i_{L\ máx\ AO} = 25mA\ @ \pm 15V$

$i_{L\ max}$ y i_{max} si (R_i=10K; R_c=1K; R_L=5K)

$i_{max} = \frac{I_{L\ máx}}{A_i} = \frac{25\ mA}{11} = 2,27mA$

$V_0 = I_L R_L + I_c R_c = I_L R_L + (I_i - I_L) R_c$

$I_L = 25mA \quad V_0 = 25mA \cdot 5K + (-22,73 \cdot 1K)$

$V_0 = 102,27\ V$ → Supera el límite de Tensión de salida $V_{cc} - V_{sat}$ (15V - 1.5)V

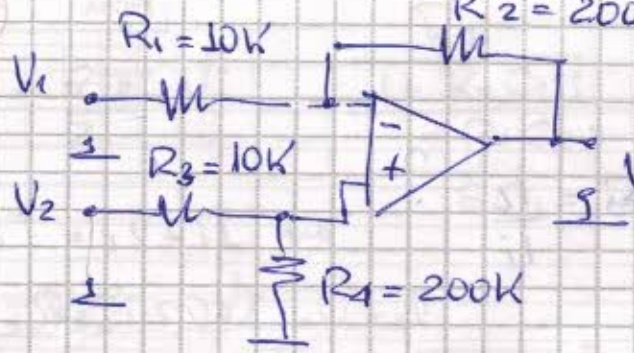
- Pantimos al revés de $V_0 = 15 - 1,5 = \underline{13,5V}$

$V_0 = I_L R_L + (i_i + i_L) R_c = i_L (R_L + R_c) + \left(-i_i \frac{R_c}{R_i + R_c}\right)$

$V_0 = i_L \left(R_L + R_c - \frac{R_c}{R_i + R_c}\right) \therefore i_L = \frac{V_0}{R_L + R_c - \frac{R_c}{R_i + R_c}} = \frac{13,5V}{5909}$

Diap. 10.

(2)



A_{V_d} ; Zi p.d/generador

1) Pasivo V_2 : Queda un inversor $\Rightarrow V_o' = -V_1 \frac{R_2}{R_1}$ *

2) Pasivo V_1 : " " no inversor $\Rightarrow V_o'' = V_p \left(1 + \frac{R_2}{R_1}\right)$

$$V_p = \frac{R_4}{R_3+R_4} V_2 \Rightarrow V_o'' = \frac{R_4}{R_3+R_4} V_2 \left(1 + \frac{R_2}{R_1}\right)$$

$$V_o'' = \frac{R_4}{R_3} \frac{V_2}{\left(1 + \frac{R_4}{R_3}\right)} \left(1 + \frac{R_2}{R_1}\right) \quad \text{Si } \frac{R_2}{R_1} = \frac{R_4}{R_3} \therefore V_o'' = \frac{R_4}{R_3} V_2 \ *$$

Superposición : $V_o = V_o' + V_o'' = V_2 \frac{R_4}{R_3} - V_1 \frac{R_2}{R_1}$

Pero $\frac{R_2}{R_1} = \frac{R_4}{R_3}$ $\therefore \boxed{V_{o_{dif}} = \frac{R_2}{R_1}(V_2 - V_1)}$

$R_1 = R_3 = 10K$
$R_2 = R_4 = 200K$ $\rightarrow V_{o_{dif}} = \frac{200}{10}(V_2 - V_1) \rightarrow \boxed{A_{dif} = 20}$

- $Zi_{V_1} = \underline{R_1 = 10K}$
- $Zi_{V_2} = R_3 + R_4 = \underline{210K\Omega}$

Zi_{V_2} : R_3 — $Z_{id}(1+\beta A_v)$ * — V_2 ; R_2 ; R_4 — Z_{ic} — Z_{ic} — R_1

$Z_{id}(1+\beta A_v)$ → oneado en ser

Determinar Resist. entrada (sin variar Ganancia) p

- $Zi_{V_1} = Zi_{V_2} = 10K\Omega$

$\frac{R_2}{R_1} = \frac{R_4}{R_3}$ $\quad \frac{R_2}{10K} = 20$; $R_4 + R_3 = 10K$

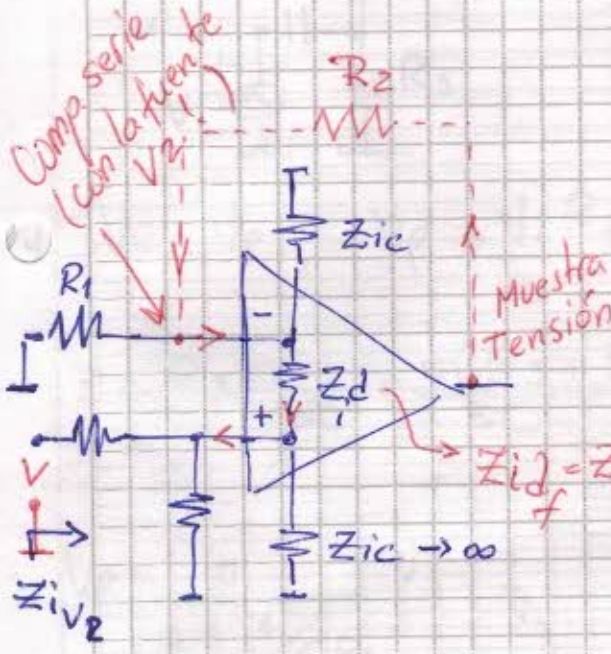
$R_4 = 10K - R_3$

$\frac{R_2}{10K} = \frac{10K - R_3}{R_3} = 20 \rightarrow R_2 = 20 \cdot 10K\Omega = 200K\Omega$

$\rightarrow 20R_3 = 10K - R_3$

$R_3 = \frac{10K}{21} = 476\Omega$

$R_4 = 10K - 476\Omega = 95$



• NO INVERSOR (M. TENS. COMP. S

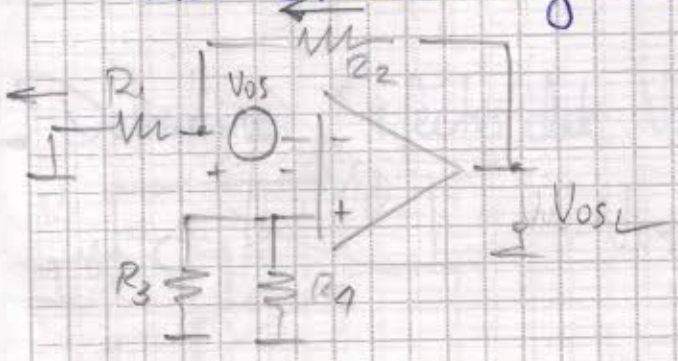
$Zi_f = Zi(1+\beta$ ↳ ∞

• INVERSOR (M. TEN COMP.

$Zi_f = \frac{Zi}{1+\beta A}$ ↳ 0

- Si $V_{OS} = 5mV$ Calcular V_{OS_L}:

Para Circuito original y el recalculado.



$\frac{V_{OS_L} - V_{OS}}{R_2} = \frac{V_{OS}}{R_1}$

$V_{OS_L} = V_{OS}\frac{R_2}{R_1} + V_{OS}$

$V_{OS_L} = V_{OS}\left(1 + \frac{R_2}{R_1}\right)$

En ambos casos V_{OS} es lo mismo $5mV(1+20) = 21mV$