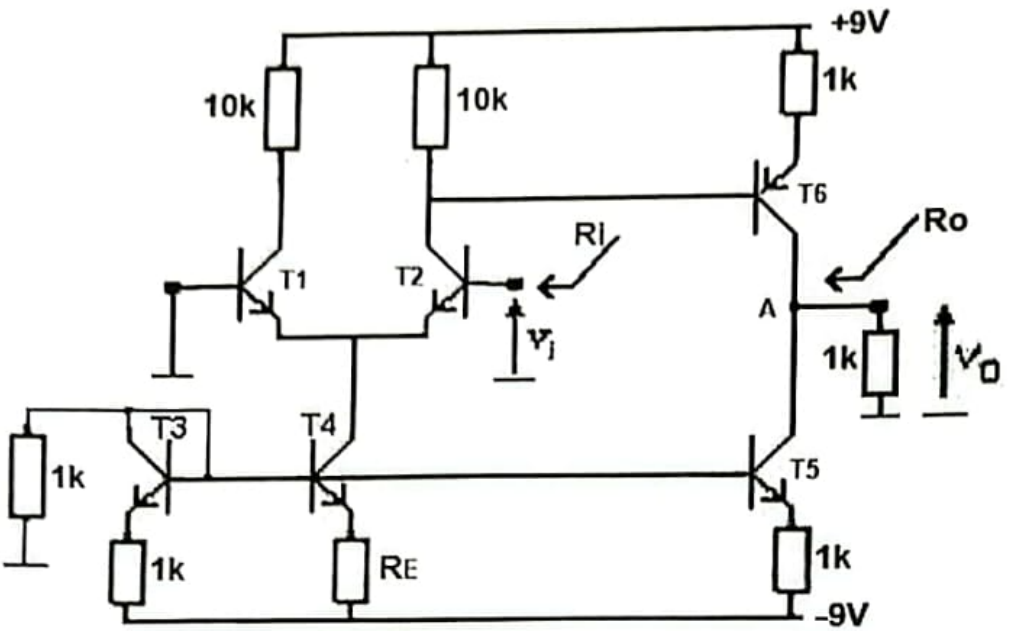
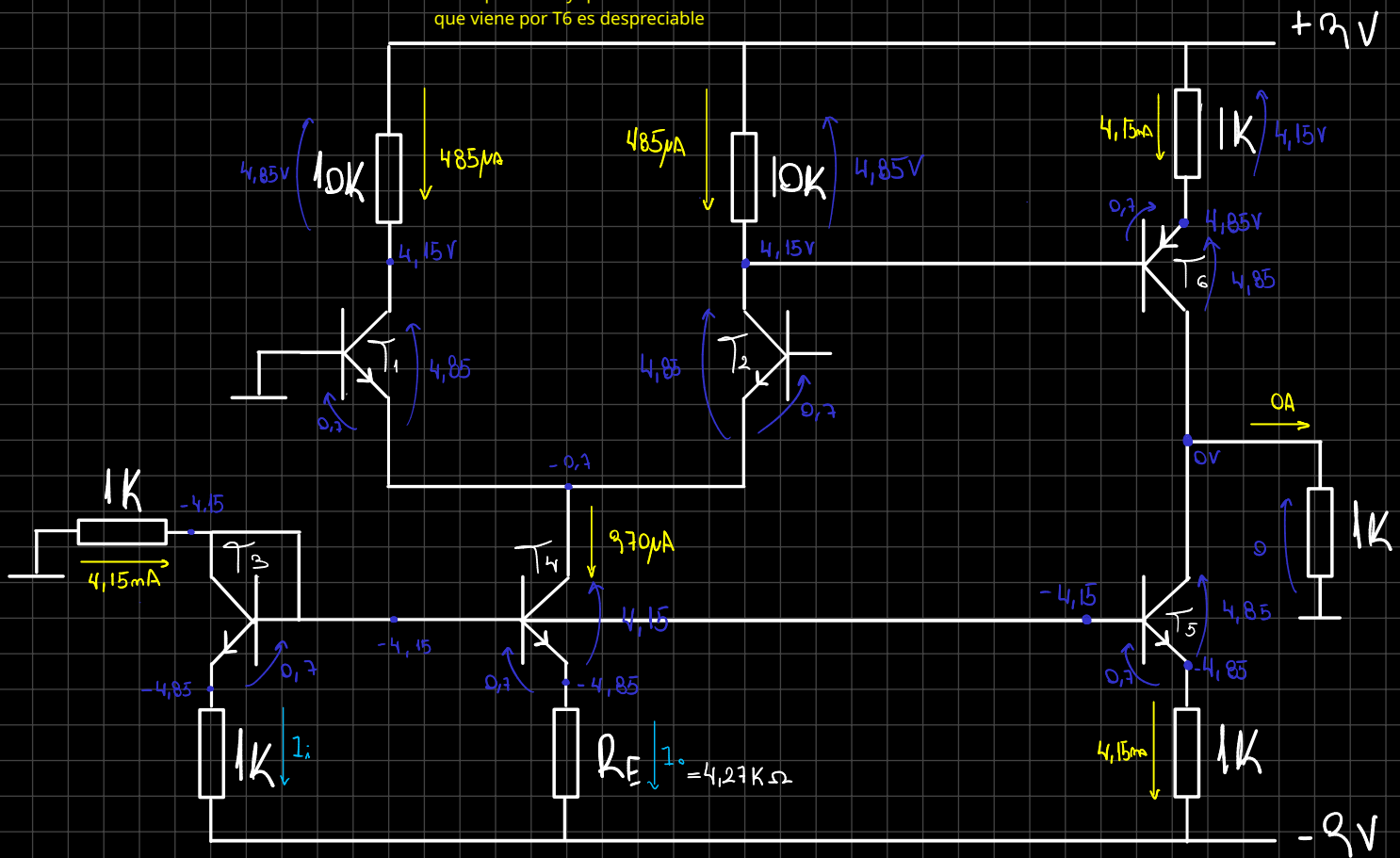
1.- $\beta = 100$; $V_A = 100V$; $C_\mu = 1pF$; $f_T = 100MHz$; $r_x = 100\Omega$



considero que los tbj estan bien apareados y que la corriente que viene por T6 es despreciable



$1K\, I_i + 0,7 - 0,7 - I_o R_E = 0$

$I_o = I_i \frac{1K}{R_E} \Rightarrow R_E = \frac{I_i}{I_o} \cdot 1K = 4,27K\Omega$

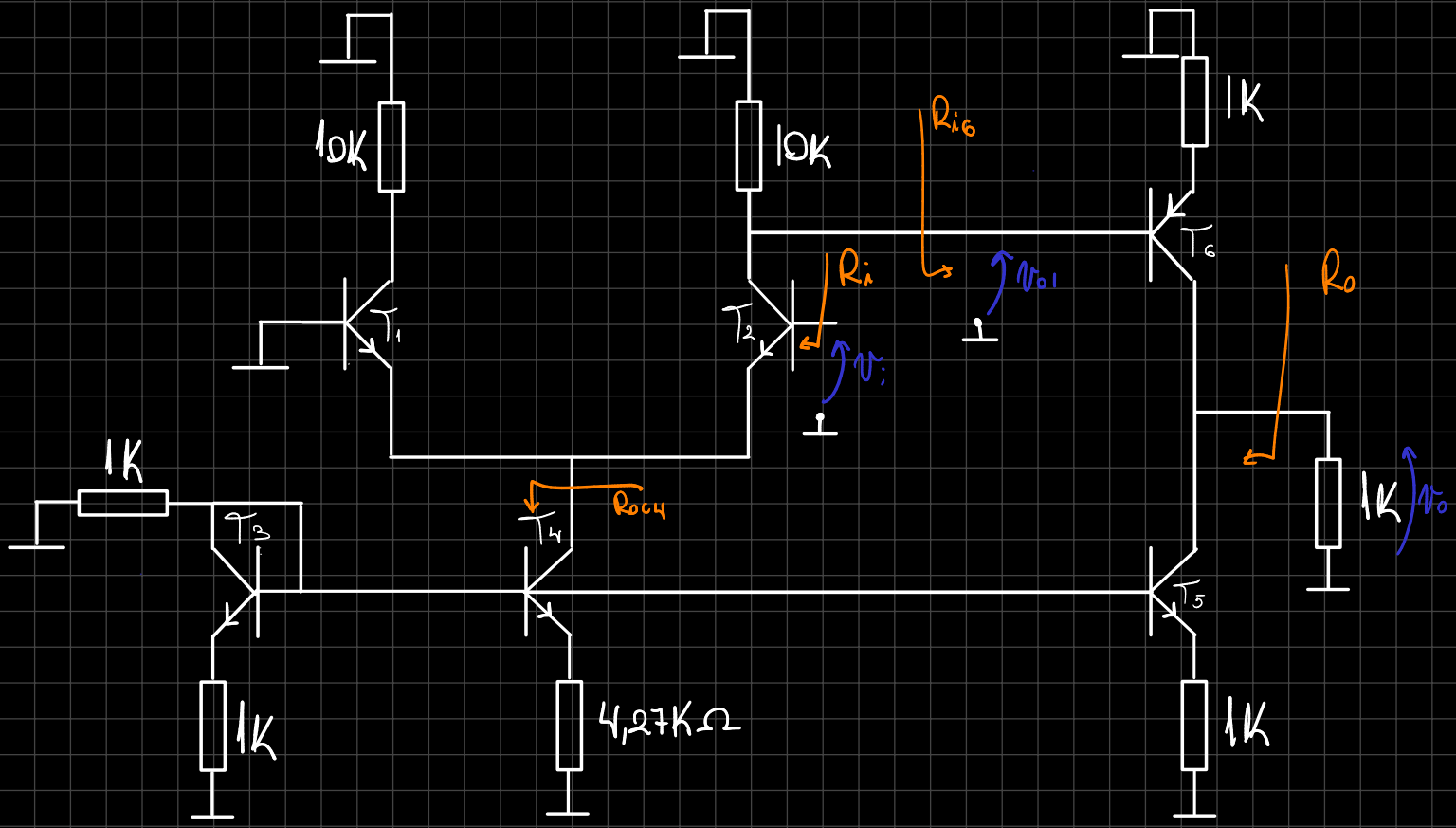
Parámetros de señal

T	I_c	g_m	r_π	r_o	C_μ	C_π
1,2	485μ	19,4m	5,15K	206K	1p	298p
5,6	4,15m	166m	602	24K	1p	263p
4	970μ	38,8m	2,57K	103K	1p	60p

$$f_T = \frac{1}{2\pi} \frac{g_m}{C_\pi + C_\mu}$$

$$f_T 2\pi (C_\pi + C_\mu) = g_m$$

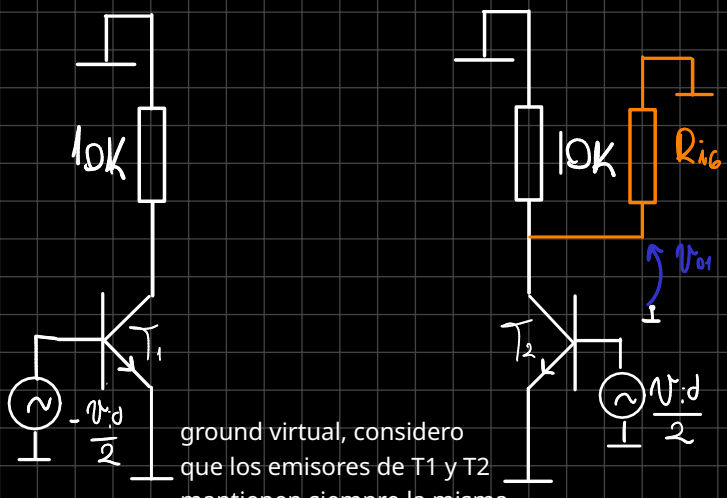
$$C_\pi + C_\mu = \frac{g_m}{f_T \cdot 2\pi} \Rightarrow C_\pi = \frac{g_m}{f_T \cdot 2\pi} - C_\mu$$



$$v_{id} = v_{b1} - v_{b2} \qquad v_{ic} = \frac{(v_{b1} + v_{b2})}{2}$$

A_{vd} : Tomo como si fueran dos etapas, la primera el par diferencial y la segunda el amplificador T6-T5

$$A_{vd} = \frac{v_o}{v_{id}} = \frac{v_{o1}}{v_{id}} \cdot \frac{v_o}{v_{o1}}$$



ground virtual, considero que los emisores de T1 y T2 mantienen siempre la misma tension

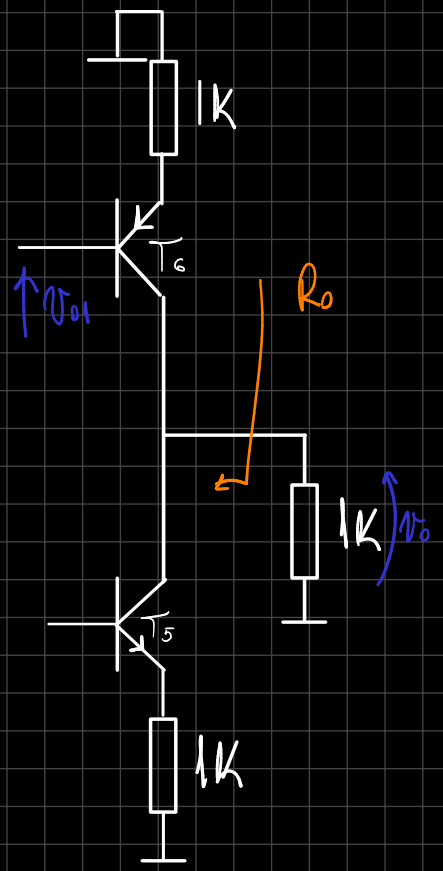
$$A_{vd1} = \frac{v_{o1}}{v_{id}} = \frac{-g_{m_2}(10K // R_{i6})\frac{v_d}{2}}{v_d}$$

$$A_{vd1} = \frac{-g_{m_2}(10K // R_{i6})}{2} = -88,18$$

($10K // R_{i6} \approx 9,09K$)

$$R_{i6} = r_{\pi 6} + \beta \cdot 1K$$

$$= 602 + 100K = 100,6K\Omega$$



$$\frac{v_o}{v_{o1}} = \frac{-g_{m6} v_{be} \left(1K // \frac{r_{o6}}{2}(1+g_m 1K)\right)}{v_{be} + g_{m6} v_{be} 1K}$$

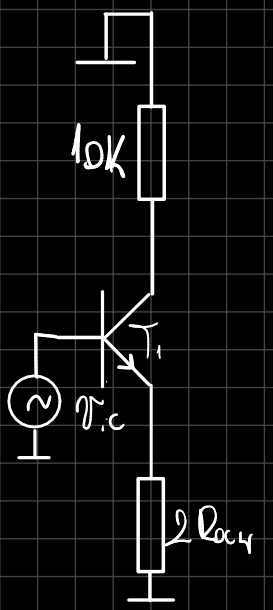
$2M\Omega$

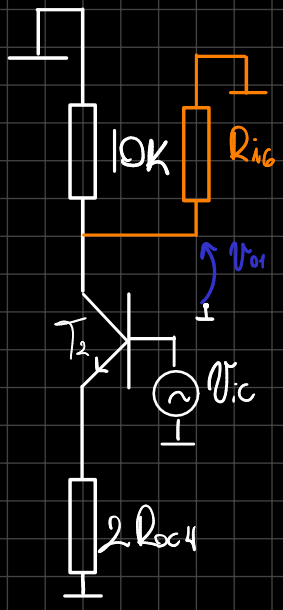
$$= \frac{-\left(1K // \frac{r_{o6}}{2}(1+g_m 1K)\right)}{\underbrace{1/g_{m6}}_{6} + 1K}$$

$$= -\frac{1K}{1K} = -1$$

$$A_{Vd} = (-88,18).(-1) = 88,18$$

A_{Vc}: Para este tengo que tener en cuenta las resistencias que ven desde los emisores T1 y T2. La ganancia de la segunda etapa es la misma.





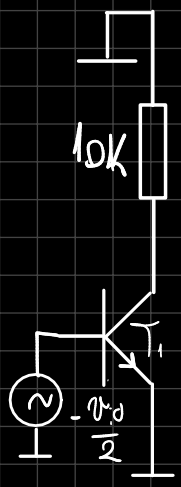
Emisor Común Realimentado.

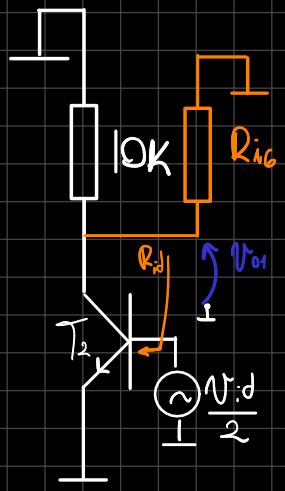
$$\frac{v_{o1}}{v_{ic}} \Downarrow = \frac{-10K // R_{iG}}{2R_{oc4}} = -264,2\mu$$

$$A_{Vc} = \frac{v_o}{v_{ic}} = \frac{v_{o1}}{v_{ic}} \cdot \frac{v_o}{v_{o1}} = 264,2\mu$$

$$R_{oc4} = r_{o4}(1 + g_{m4}.4,27k) = 17,2M\Omega$$

$$RRMC: 20\log\left(\frac{88,18}{264,2\mu}\right) = 110,46\,dB$$

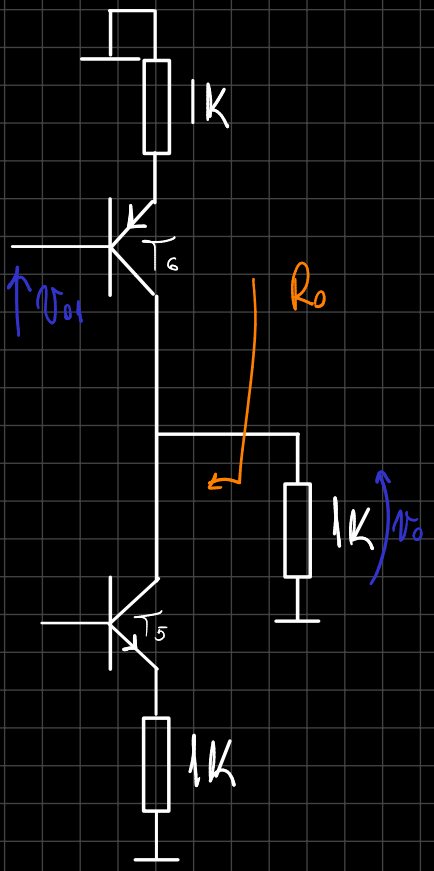




$$i_{id} = \frac{v_{id}}{2} \cdot r_{\pi 2}$$

$$R_{id} = \frac{v_{id}}{i_{id}} = 2 r_{\pi 2}$$

Como $v_i = v_{id}$, $R_i = 2 r_{\pi 2} = 10{,}3K$

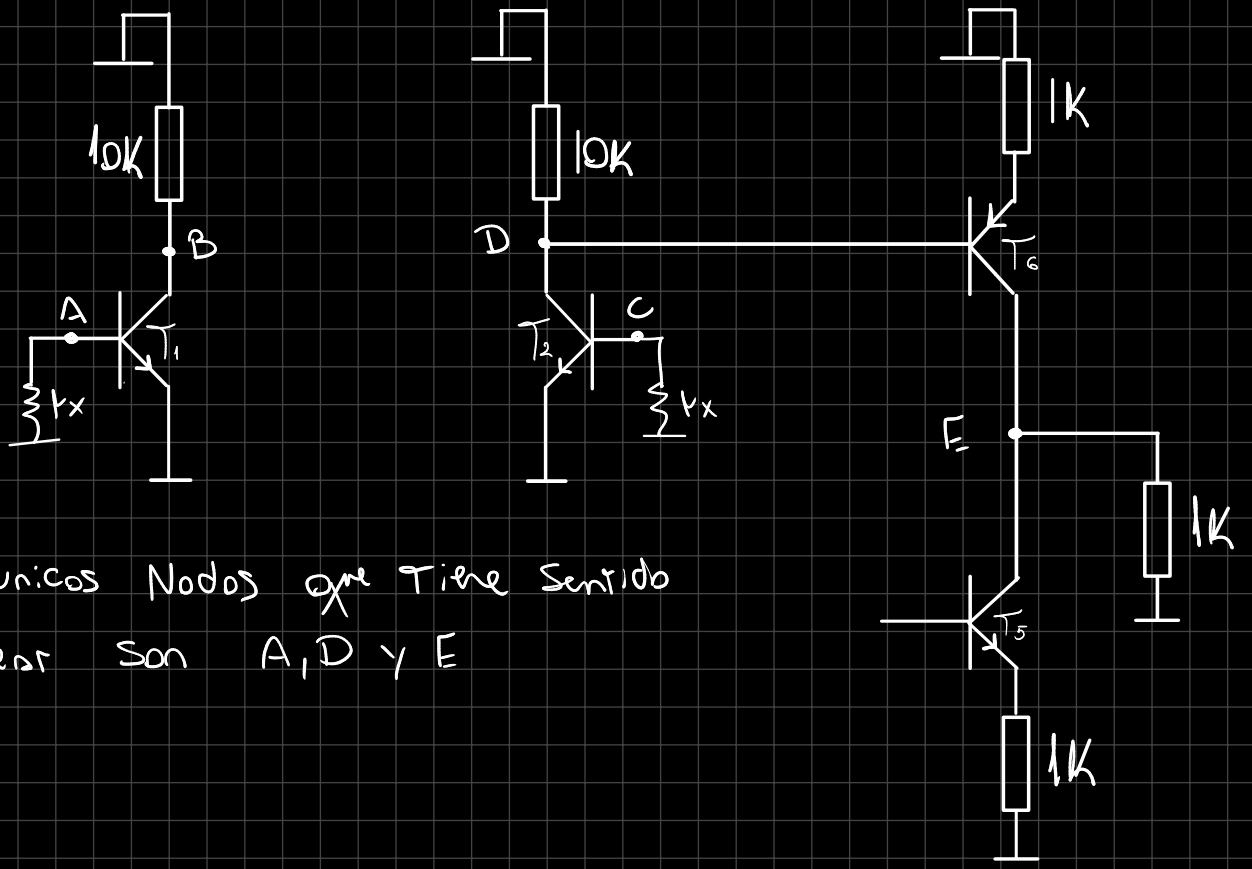


$$R_o = R_{oc6} // R_{oc5} = \frac{R_{oc6}}{2} = 2 M\Omega$$

Como $v_{id} = v_i$ y $v_{ic} = \frac{v_i}{2}$

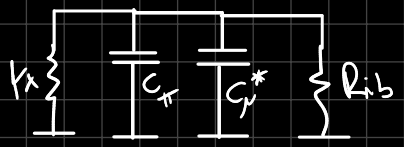
$$A_v = A_{vd} v_i + \underbrace{A_{vc} \frac{v_i}{2}}_{0} = A_{vd} = 88{,}18$$

R_{TD} En Frecuencia



Los unicos Nodos que Tiene Sentido plantear son A, D y E

A)



$$C_\mu^* = C_\mu (1 - (-g_m \cdot 10k))$$

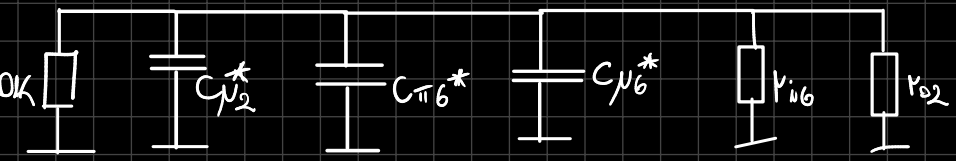
$$C_\mu^* = C_\mu (1 + 194) = 195\,pF$$

$r_\pi = 5{,}15K$

$$\tau_A = (195\,pF + 23{,}8\,pF)(r_x \,//\, R_{ib}) = 22\,nS$$

($r_x \,//\, R_{ib} \approx 98\,\Omega$)

D)

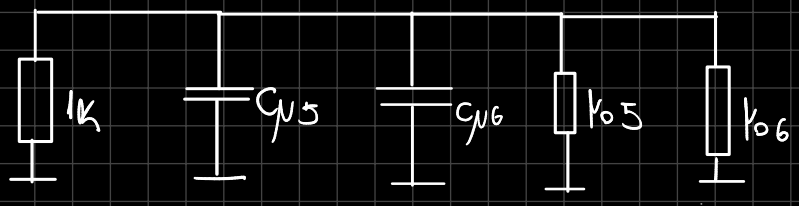


$$C_{\mu 2}^* = C_{\mu 2}, \quad C_{\pi 6}^* = \left(1 - \frac{g_{m6} \cdot 1K}{1 + g_{m6} \cdot 1K}\right), \quad C_{\mu 6}^* = C_{\mu 6}\left(1 - \frac{r_o}{r_{o1}}\right)$$

($\frac{g_{m6} \cdot 1K}{1 + g_{m6} \cdot 1K} \approx 1$, $C_{\pi 6}^* \approx 0$, $\frac{r_o}{r_{o1}} \approx 2$)

$$\tau_D = (C_{\mu 2} + 2C_{\mu 6})(10K \,//\, r_{i6} \,//\, r_{o2}) = 2p \cdot 9{,}09K = 18\,nS$$

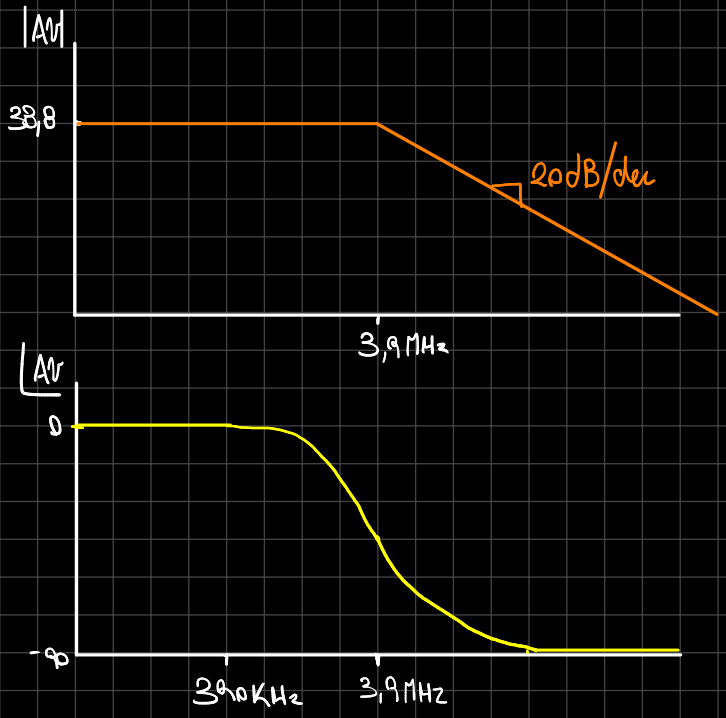
E)



$$\tau_E = (C_{\mu 5} + C_{\mu 6})(1K \,//\, r_{o5} \,//\, r_{o6}) = 2pF \cdot 1K\Omega = 2nS$$

Los nodos Dominantes son A) y D)

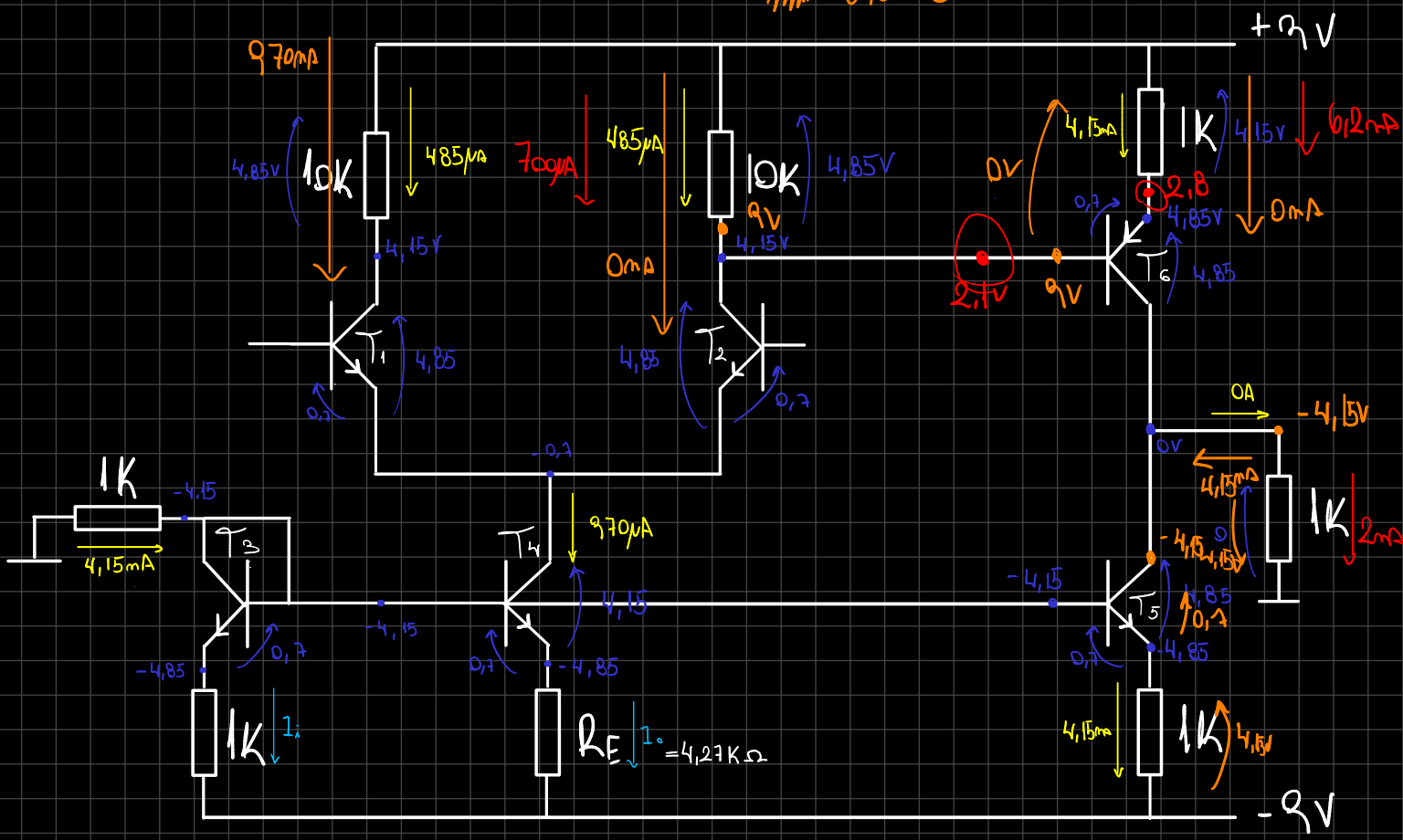
$$\tau_H = \tau_A + \tau_D = 40nS \qquad f_H = \frac{1}{2\pi \tau_H} = 3,9MHz$$



Característica De Gran Señal.

$V_{id} > 0$

$V_{id} < 0$



Plantear Saturación de T_6

$9V - 1K i_r - 0,7 - 1K(i_r - 4,15mA) = 0$

$9V - 1K i_r - 0,7 - 1K i_r + 4,15 \cdot 1K$

Límite Superior: **2V**

$9 - 0,7 + 4,15 = 2K i_r$

$i_r = 6,225mA$

$4,15 \rightarrow 50$

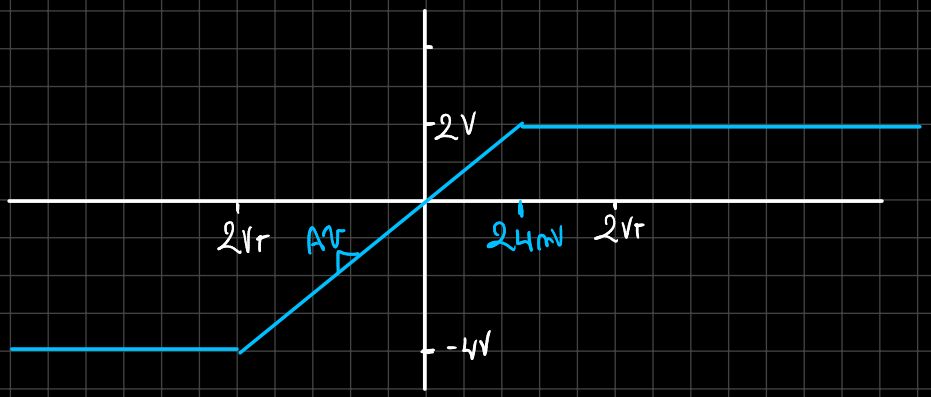
$2 \rightarrow x$

$x = 24mV$

Límite Inf.

$i_o = i_r - 4,15mA = 2,075mA$

4,15V



Voff:

$$V_{off} = V_{be1} - V_{be2}$$

$$R_{C1} = \left(1 + \frac{2}{100}\right) R_{C2}$$

$$I_{C1} = \frac{I_{C2}}{\left(1 + \frac{2}{100}\right)}$$

$$I_c = I_s\, e^{\frac{V_{be}}{V_T}}$$

$$Ln\left(\frac{I_c}{I_s}\right) = \frac{V_{be}}{V_T}$$

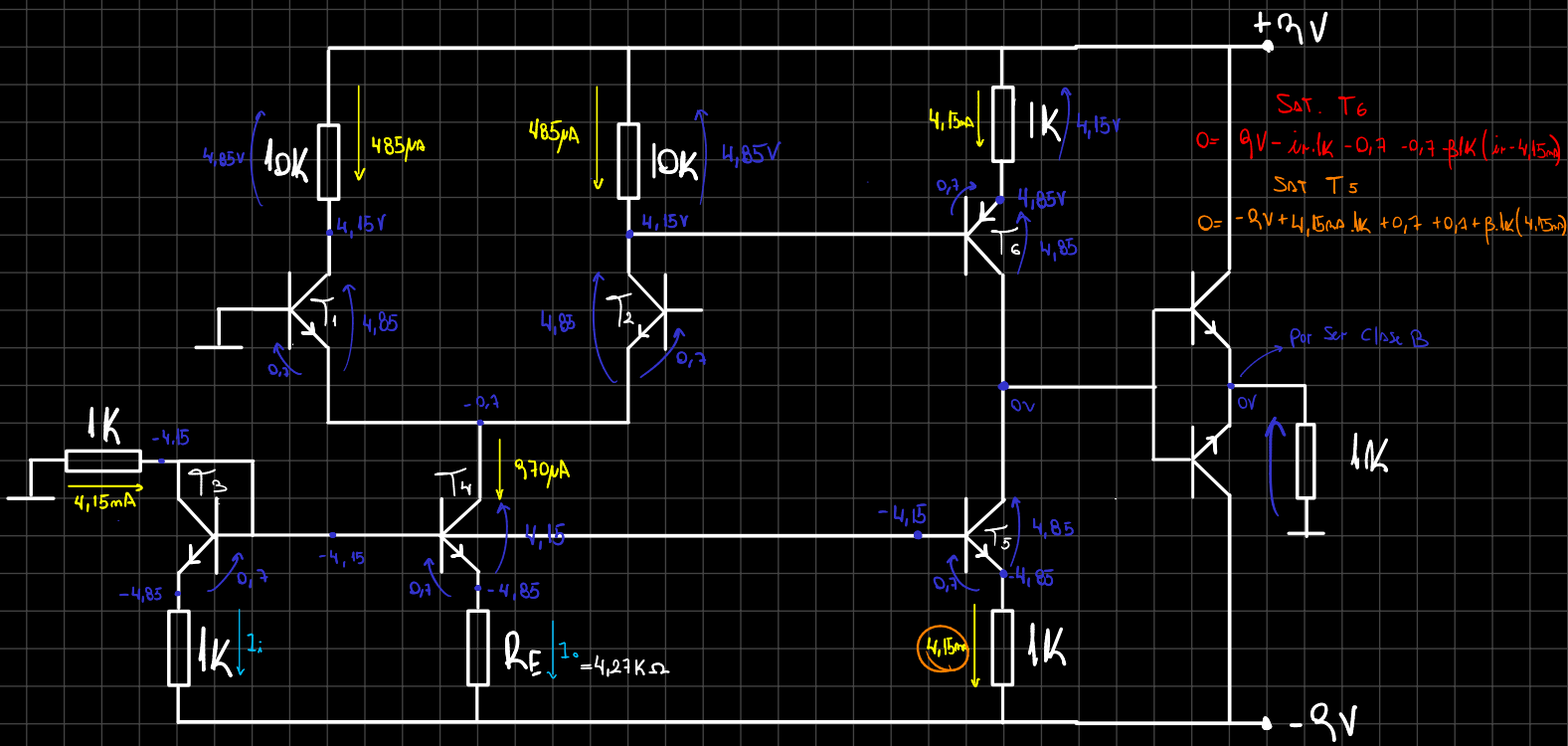
$$V_T Ln\left(\frac{I_c}{I_s}\right) = V_{be}$$

$$V_{off} = V_{T1} Ln\left(\frac{I_{C1}}{I_{S1}}\right) - V_{T2} Ln\left(\frac{I_{C2}}{I_{S2}}\right)$$ } Asumo Todo I_{Con1} menos I_c

$$V_{off} = V_T \left(Ln(I_{c1}) - \cancel{Ln(I_{S1})} - Ln(I_{c2}) + \cancel{Ln(I_{S2})} \right)$$

$$V_{off} = V_T \left(Ln\left(\frac{I_{C1}}{I_{C2}}\right)\right) = V_T Ln\left(\frac{1}{1 + 2/100}\right) = \pm 495\,\mu V$$

Clase B



Sat. T_6

$$0 = 9V - i_N \cdot 1K - 0,7 - 0,7 - \beta 1K (i_N - 4,15mA) \Rightarrow 9V - 1,4 - i_N (1K + \beta 1K) + \beta 1K \cdot 4,15mA = 0$$

Sat T_5

$$0 = -9V + 4,15mA \cdot 1K + 0,7 + 0,1 + \beta \cdot 1K (4,15mA - i_N)$$

$$= -9V + 1,4 + 4,15mA \cdot 1K + \beta \cdot 1K (4,15mA - i_N)$$

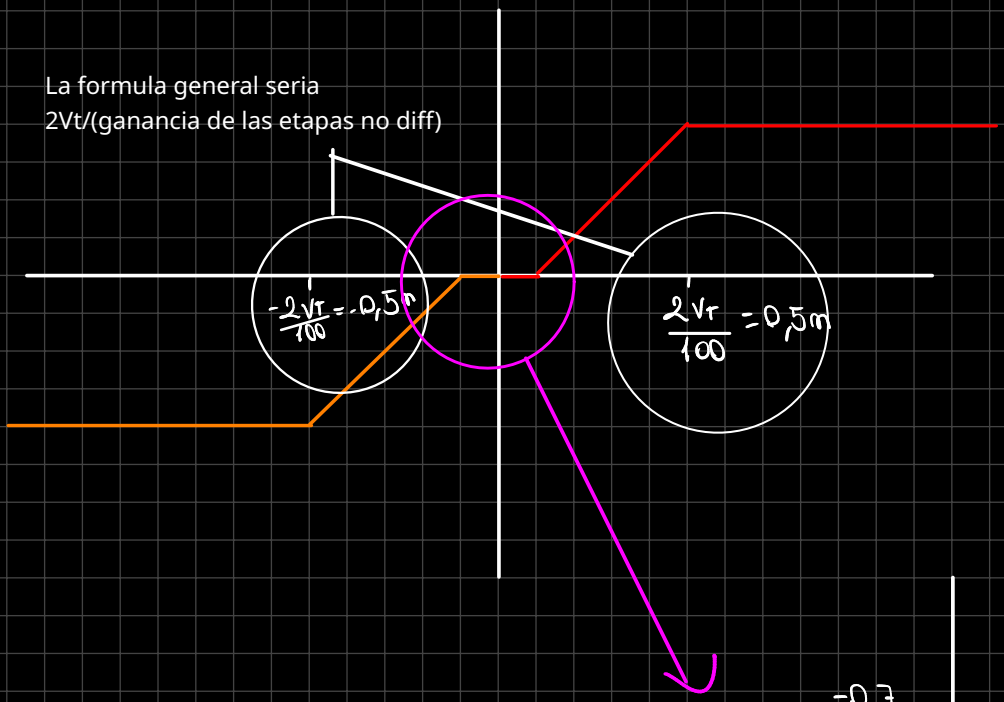
$$i_N = \frac{9 - 1,4 + \beta 1K \cdot 4,15mA}{1K + \beta 1K} = 4,184mA$$

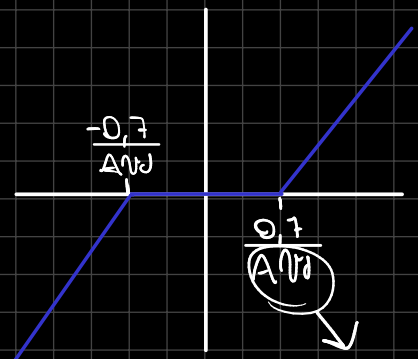
$$V_o = \beta \cdot 1K (i_N - 4,15mA) = 3,4V$$

$$i_N = \frac{-9 + 1,4 + 4,15 + \beta \cdot 4,15}{\beta \cdot 1K} = 4,115\,mA$$

$$V_o = \beta \cdot 1K (4,15mA - 4,115mA) = -3,5V$$

La formula general seria
2Vt/(ganancia de las etapas no diff)





El avd es el que sacas considerando la carga del clase B