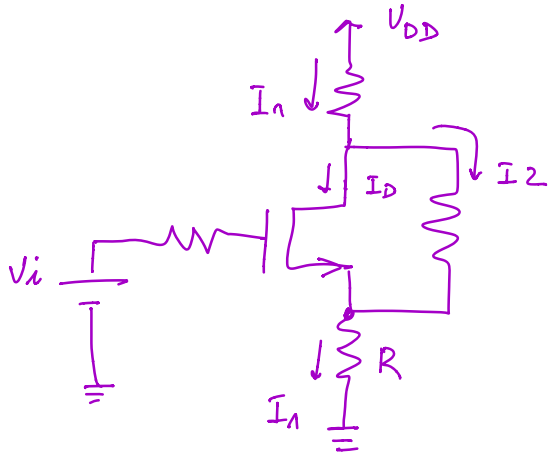


$$V_i - R I_1 = V_{GS}$$

$$I_1 = I_D + I_2 = I_D + \frac{V_{DS}}{R}$$

$$V_{DD} = R I_1 2 + V_{DS}$$

$$V_{DD} = 2 R \left(I_D + \frac{V_{DS}}{R} \right) + V_{DS}$$

$$\boxed{V_{DD} = 2 R I_D + 3 V_{DS}}$$

$$V_{GS} = V_i - R\left(I_D + \frac{V_{DS}}{R}\right) =$$

$$= \boxed{V_i - RI_D - V_{DS} = V_{GS}}$$

Supongo corte $\Rightarrow$ $I_D = 0 \Rightarrow V_i - V_{DS} = V_{GS}$

$$V_{DD} = 3V_{DS} \Rightarrow V_{DS} = \frac{V_{DD}}{3}$$

$$V_i - \frac{V_{DD}}{3} = V_{GS}$$

$V_{DD} = 15\,V$

$V_i = 8\,V$

$V_T = 2\,V$

$8 - 5 = V_{GS} = 3 > 2 = V_T$

NO CORTE

Supongo sat.

$$I_D = \frac{k}{2}\left(V_{GS} - V_T\right)^2 = \frac{k}{2}\left[8 - 2 - RI_D - V_{DS}\right]^2$$

$$15 = 2RI_D + 3V_{DS} \Rightarrow V_{DS} = \frac{15 - 2RI_D}{3}$$

$$I_D = \frac{k}{2}\left[6 - RI_D - \frac{15 + 2RI_D}{3}\right]^2 =$$

$$= \frac{k}{2}\left[6 - RI_D - 5 + \frac{2}{3}RI_D\right]^2 =$$

$$\frac{k}{2}\left[1 - \frac{1}{3}RI_D\right]^2 = \frac{k}{2}\left[1 + \frac{1}{9}R^2I_D^2 - \frac{2}{3}RI_D\right)$$

$$= I_D$$

$k = 2\,10^{-3}$ → $V_{GS} = 2'53$

$V_{DS} = 4'06\,V$ ⇒ $V_{GS} - V_T$

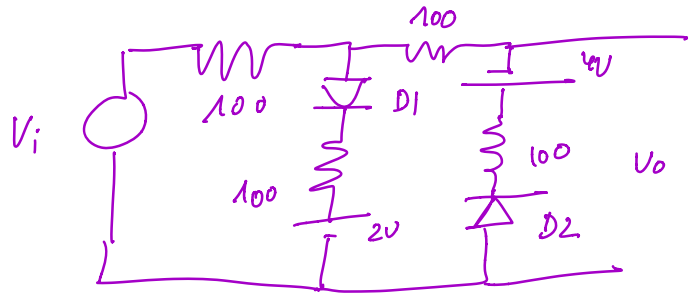
$V_T = 2V$

$I_D = 0'28\,mA$

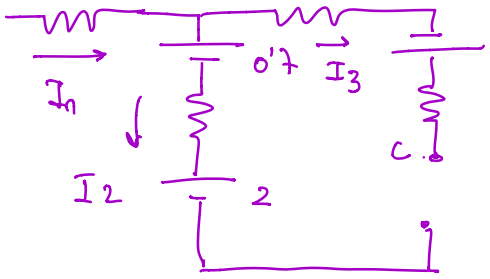
$R = 5k\Omega$

$I_1 = 1'09\,mA$

$I_2 = 0'812\,mA$



D1 ON D2 OFF



$I_3 = 0$

$I_1 = I_2$

$$V_o = 0'7 + 100\, I + 2 = 0'7 + 100\,\frac{(V_i - V_o)}{100} + 2$$

$$V_o = 2'7 + V_i - V_o \Rightarrow 2V_o = V_i + 2'7$$

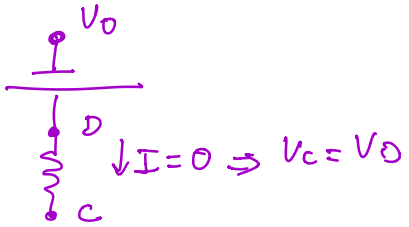
$$V_o = \frac{1}{2}(V_i + 2'7)$$

Se cumple si $I > 0 \Rightarrow V_i - V_o > 0$

$$V_i - \frac{1}{2}(V_i + 2'7) > 0 \qquad \boxed{V_i > 2'7V}$$

D2 OFF si $V_{d2} < 0'7V$

$V_{d2} = 0 - V_C$ y



y $V_D - V_0 = 4V \Rightarrow$

$V_D = 4V + V_0$

$$V_{d2} = -4V - V_0 = -4V - \frac{1}{2}(V_i + 2'7) < 0'7$$

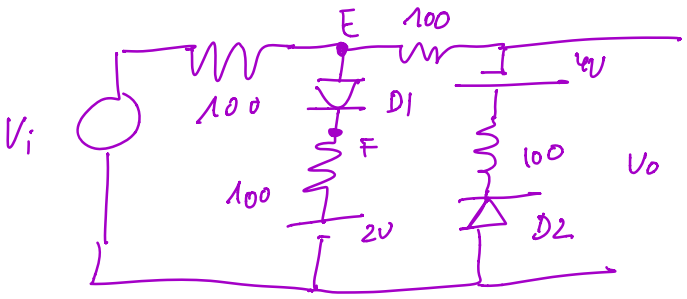
$$-\frac{1}{2}V_i - 4V - 1'35V < 0'7$$

$$-\frac{1}{2}V_i < 0'7 + 4 + 1'35 = 6'05$$

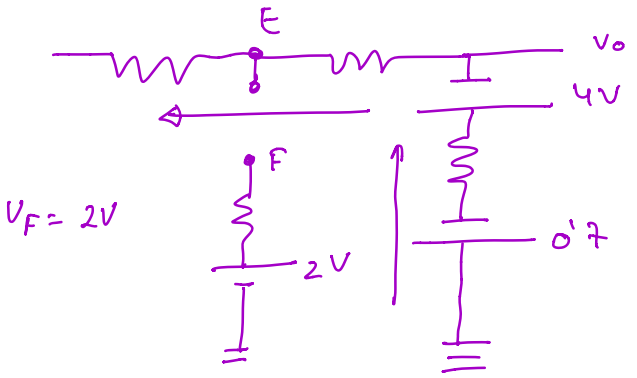
$$-\frac{1}{2}V_i < 6'05 \Rightarrow \boxed{V_i > -12'1V}$$

Las 2 condiciones se dan a la vez

si $V_i > 2'7V$



D2 ON D1 OFF



$$V_o - V_i = 200\,I \Rightarrow I = \frac{V_o - V_i}{200}$$

$$0 - V_o = 0'7 + 4 + 100I = 4'7 + 100\,I = 4'7 + \frac{V_o - V_i}{2}$$

$$-V_o = 4'7 + \frac{V_o - V_i}{2} \Rightarrow -2V_o = 9'4 + V_o - V_i$$

$$-3V_o = 9'4 - V_i \Rightarrow \boxed{V_o = \left(\frac{V_i - 9'4}{3}\right)}$$

Para D2 se cumple si $I > 0$

$$\frac{V_o - V_i}{200} > 0 \Rightarrow V_o > V_i \Rightarrow \frac{V_i - 9'4}{3} > V_i$$

$$V_i - 9'4 > 3V_i \Rightarrow -9'4 > 2V_i$$

$$-4'7 > V_i \qquad \boxed{V_i < -4'7\,V}$$

Para D1 se cumple si $V_{d1} < 0'7\,V$

$V_{d1} = V_E - 2V$ $\qquad V_E - V_i = 100\,I$

$$V_E = V_i + 100\,I =$$

$$= V_i + 100\left(\frac{V_o - V_i}{200}\right)$$

$$= V_i + \frac{V_o}{2} - \frac{V_i}{2} = \frac{V_i + V_o}{2}$$

$$V_E = \frac{V_i + V_o}{2} = \frac{V_i}{2} + \frac{1}{2}\left(\frac{V_i - 9'4}{3}\right) = \frac{V_i}{2} + \frac{V_i}{6} - \frac{9'4}{6} =$$

$$= 2\frac{V_i}{3} - \frac{9'4}{6} = V_E$$

$$V_{d1} = V_E - 2V = \frac{2V_i}{3} - \frac{9'4}{6} - 2 = \frac{2}{3}V_i - 3'57$$

$$V_{d1} < 0'7 \Rightarrow \frac{2}{3}V_i - 3'57 < 0'7$$

$$\frac{2}{3}V_i < 4'27 \Rightarrow V_i < 6'4V$$

¿Cuándo se dan las 2 a la vez?

D2 ON si $V_i < -4'7V$

D1 OFF si $V_i < 6'4V$

} D2 ON y D1 OFF si $V_i < -4'7V$