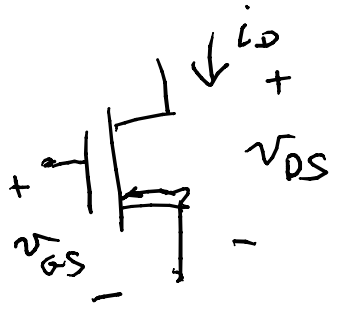
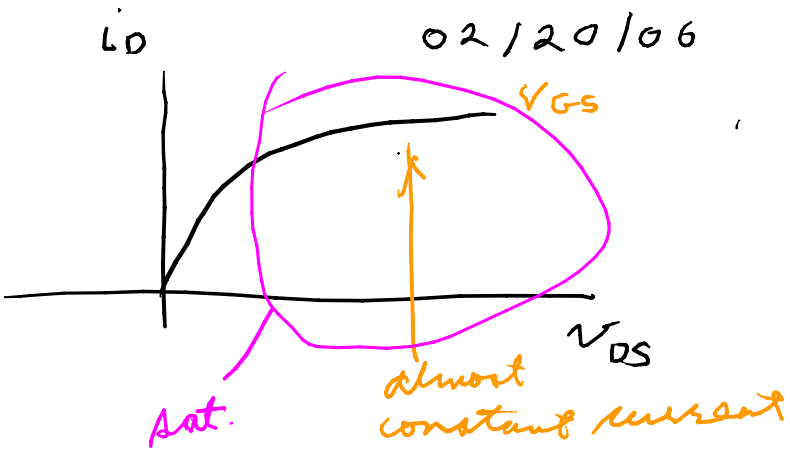
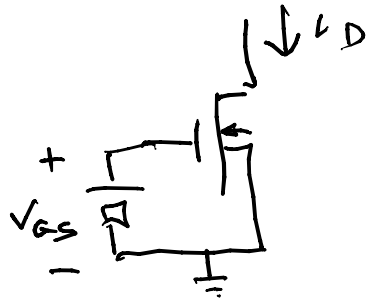
EE303
02/20/06







$$I_{S_p} = I_{D_n} = -I_{D_p}$$

$$= \frac{KP_p}{2}\frac{W_p}{L_p}\left((V_{DD}-V_G)-|VTO_p|\right)^2 = \frac{KP_n}{2}\frac{W_n}{L_n}\left(V_G - VTO_n\right)^2$$

$$\frac{W_p}{L_p} = \left(\frac{W_n}{L_n}\right)\cdot\frac{KP_n}{KP_p}\left(\frac{V_G - VTO_n}{(V_{DD}-V_G)-|VTO|_p}\right)^2$$

V_G determined by output current if $\frac{W_n}{L_n}$ is known

Ex: $KP_n = 5.05\times10^{-5}\ A/V^2$, $KP_p = 1.91\times10^{-5}\ A/V^2$

$VTO_n = 0.86V$, $VTO_p = -0.89V$

if desire $1\,mA = I_{out} \Rightarrow +\sqrt{\frac{1\times10^{-3}}{5.05\times10^{-5}}\times\frac{L_n}{W_n}\Big|_{out}} + VTO_n = V_G$ | output n

$V_G = 0.86 + 2\times\sqrt{10^{-1}\times\frac{L}{W}\Big|_{n\,out}}$ choose $\frac{W}{L}\Big|_{n\,out} = 10$

$\Rightarrow V_G = 0.86 + 0.2 = 1.06\text{V}$

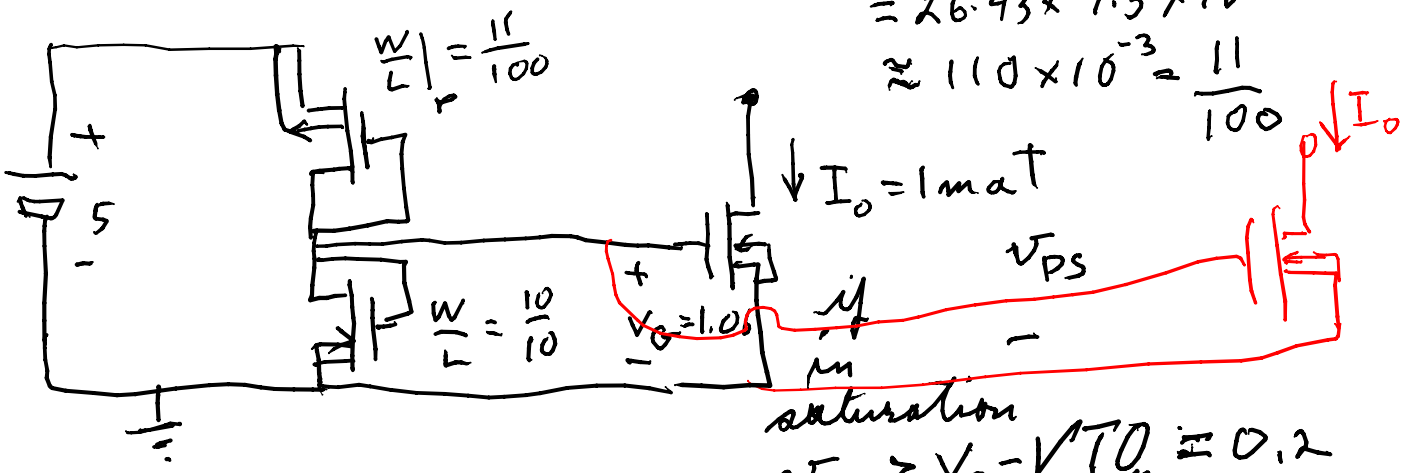
assume $V_{DD} = 5 \Rightarrow$

$$\left.\frac{W}{L}\right|_{P_2} = 10 \times \frac{5.05}{1.91}\left(\frac{0.2}{5 - 1.06 - 0.89}\right)^2 = 26.43\left(\frac{0.2}{3.05}\right)^2$$

$$= 26.43(0.066)^2$$

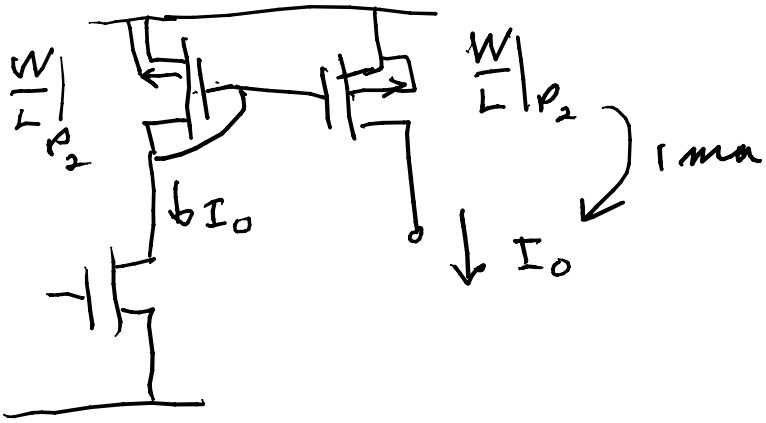
$$= 26.43 \times 4.3 \times 10^{-3}$$

$$\approx 110 \times 10^{-3} = \frac{11}{100}$$

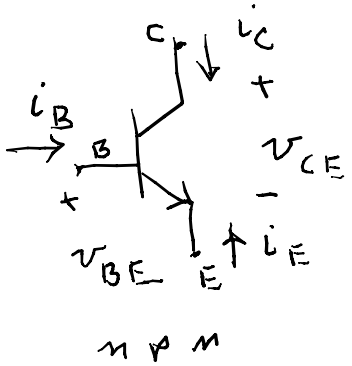


$v_{DS} \geq V_G - VTO_n = 0.2$

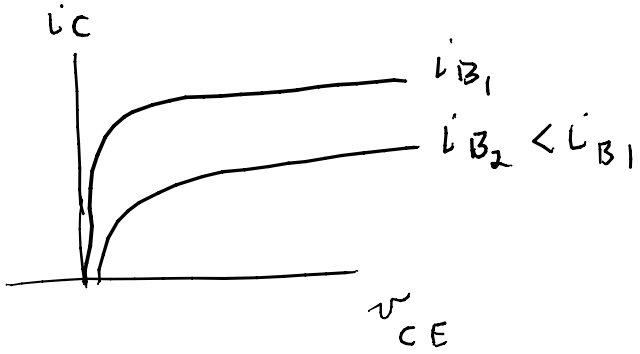
a current sink



BJT's



npn



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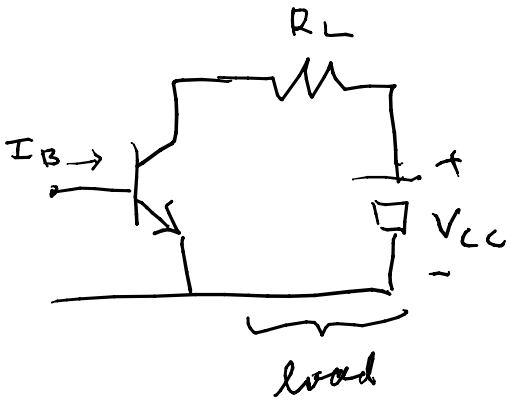

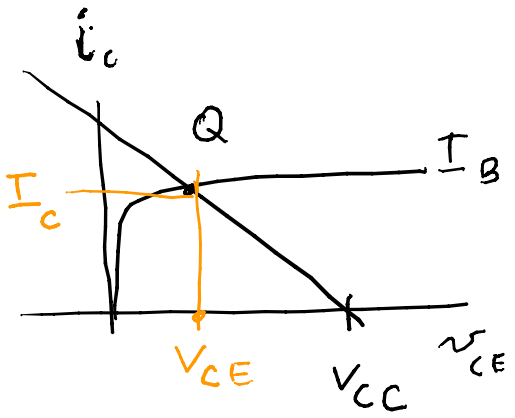

$$i_c = I_C + \left.\frac{\partial i_C}{\partial i_B}\right|_Q (i_B - I_B) + \left.\frac{\partial i_C}{\partial v_{CE}}\right|_Q (v_{CE} - V_{CE}) + \text{high orders (to drops)}$$