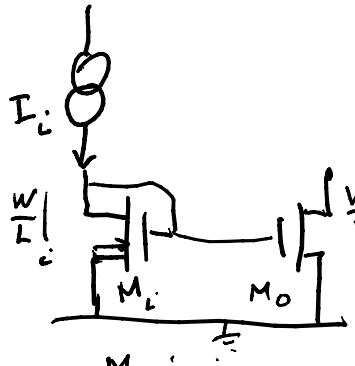
03/03/09
EE303



$$I_o = \left(\frac{\frac{W}{L}\Big|_o}{\frac{W}{L}\Big|_i}\right) I_i$$

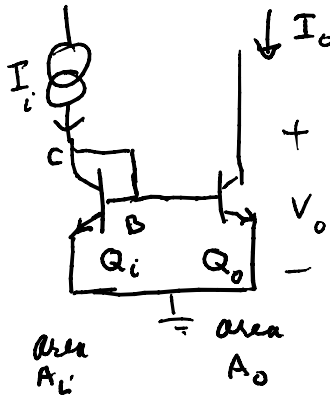
need M_o in saturation

M_i is in saturation

$V_{DS} \geq V_{GS} - V_{TO}$ ($V_{TO} > 0$)

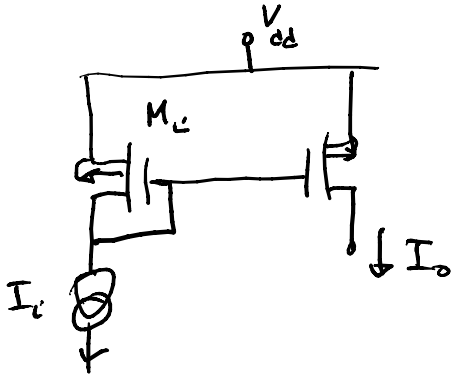
$\| \; V_{DS}$

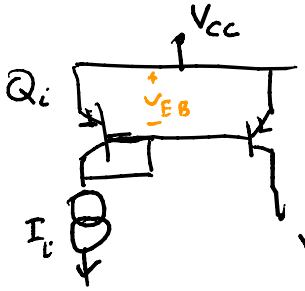
holds



$$I_o \approx \frac{A_o}{A_i} I_i$$

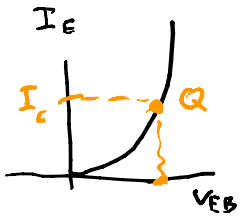
current sinks

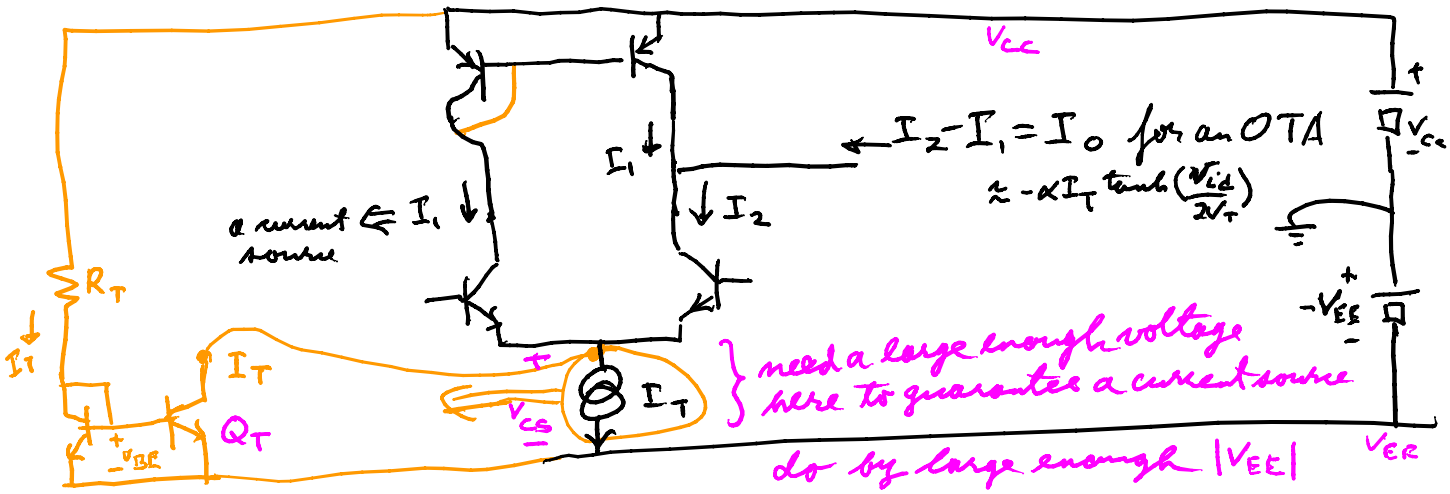


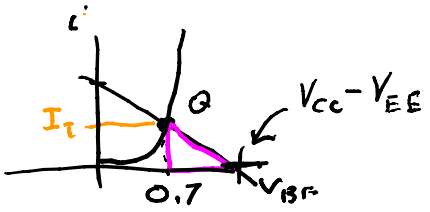


uses PNP

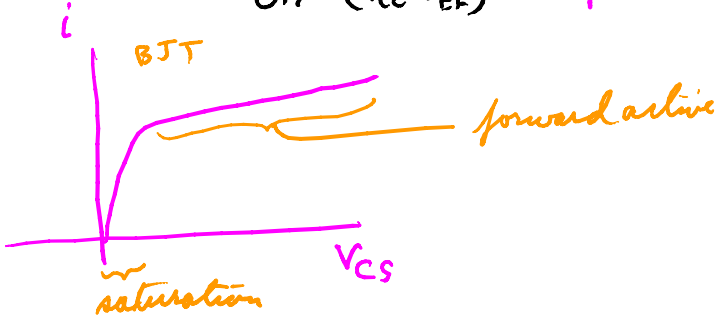
current source

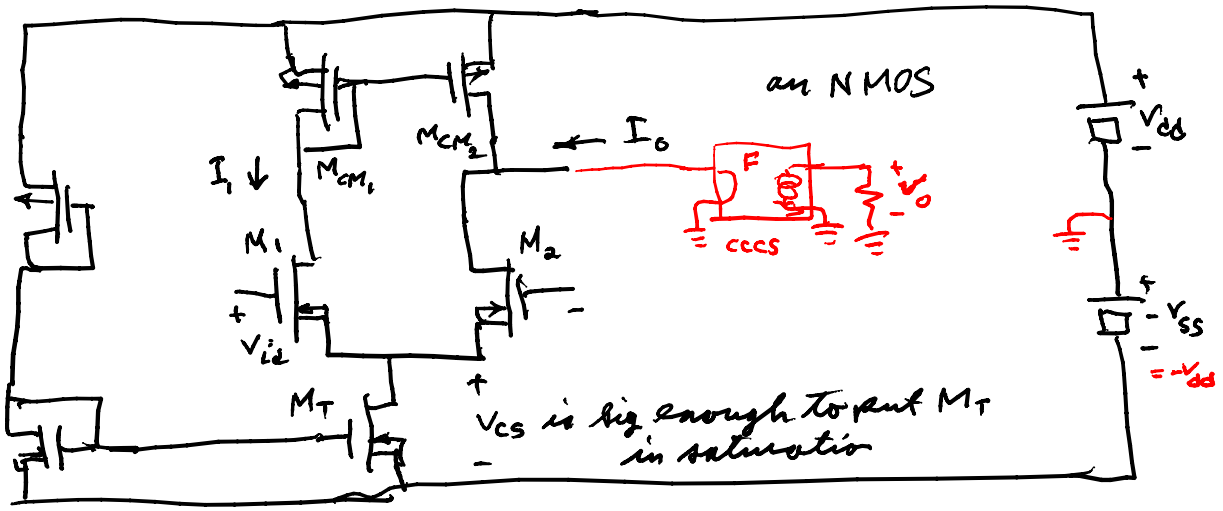






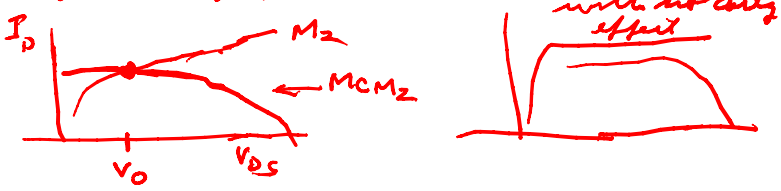
$$\text{slope} = -\frac{(I_T - 0)}{0.7 - (V_{CC} - V_{EE})} = -\frac{1}{R_T}$$



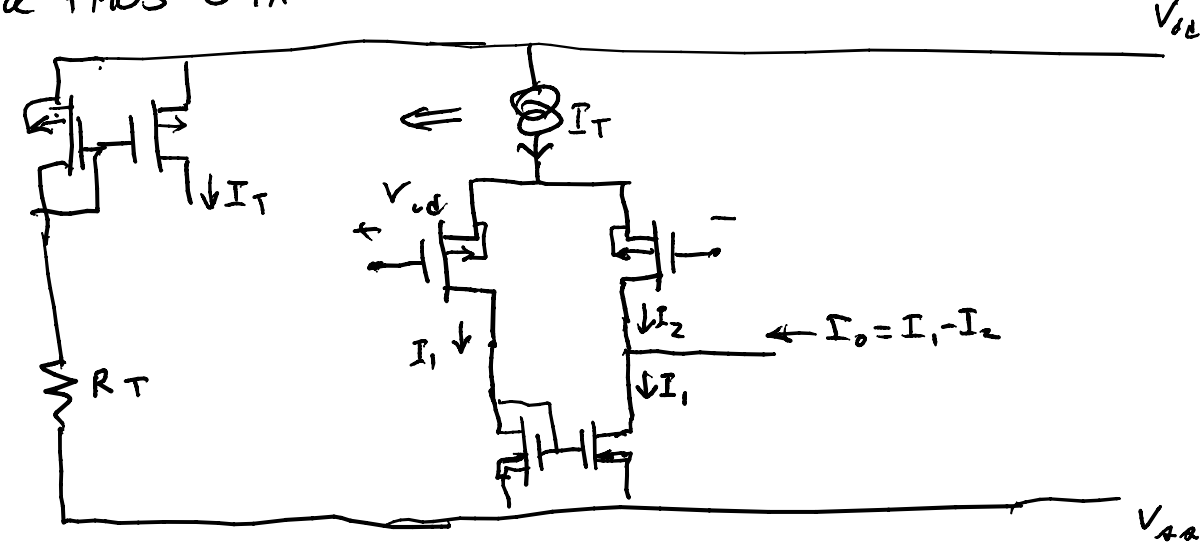


if $I_o = 0$ is held then not an OTA $\Rightarrow$ goes to a VCVS

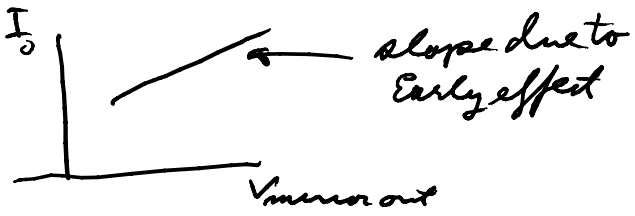
here $-I_{D_{MCM_2}} = I_{D_{M_2}}$ by the Early effect a voltage is determined

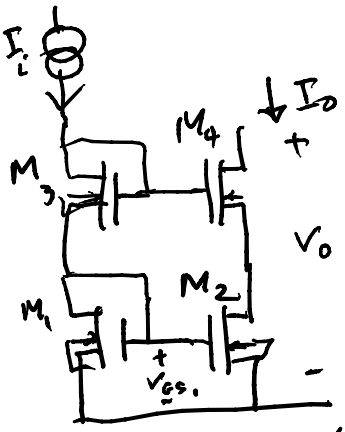


a PMOS OTA

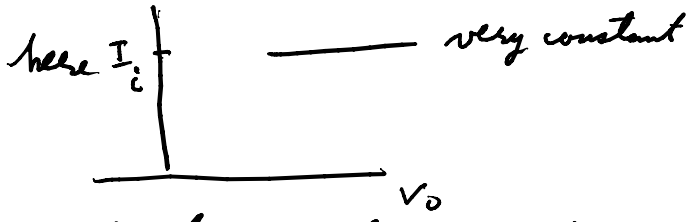


Better current mirrors:



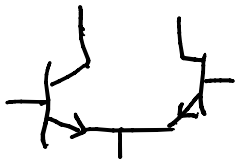


cascode current mirror



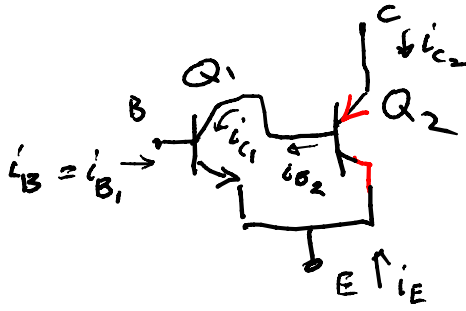
here M_4 absorbs variations in V_o so that M_2 has a constant V_{DS} which guarantees $I_o = I_i$

For BJT diff pair input



due to the base current we want to minimize the base current we use the Darlington connection

Darlington



$$i_{C_1} = \beta_1 i_{B_1} = \beta_1 i_B$$

$$i_C = i_{C_2} = \beta_2 i_{B_2} = \beta_2 i_{C_1}$$

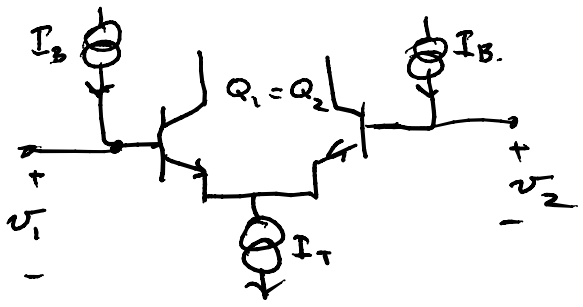
$$= \beta_2 (\beta_1 \cdot i_B)$$

$$i_C = \beta_1 \beta_2 \cdot i_B$$

$$\beta \approx \beta_1 \beta_2 \qquad \text{if } \beta_1 = \beta_2 = 100$$

$$\beta = 10^4$$

For the BJT differential pair we need bias current for the input transistors



$$v_{id} = v_1 - v_2$$