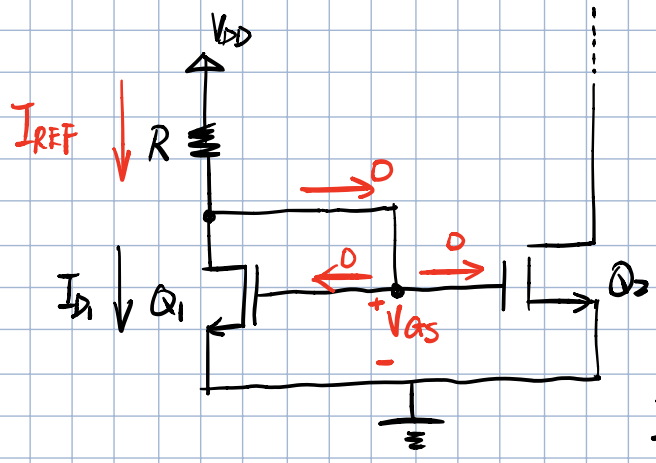
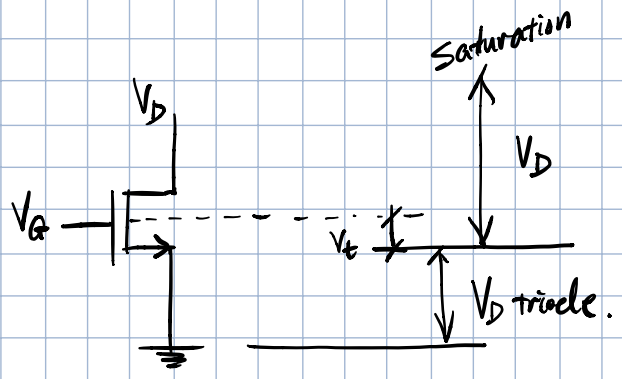
Current mirror





Q_1 is in saturation mode.

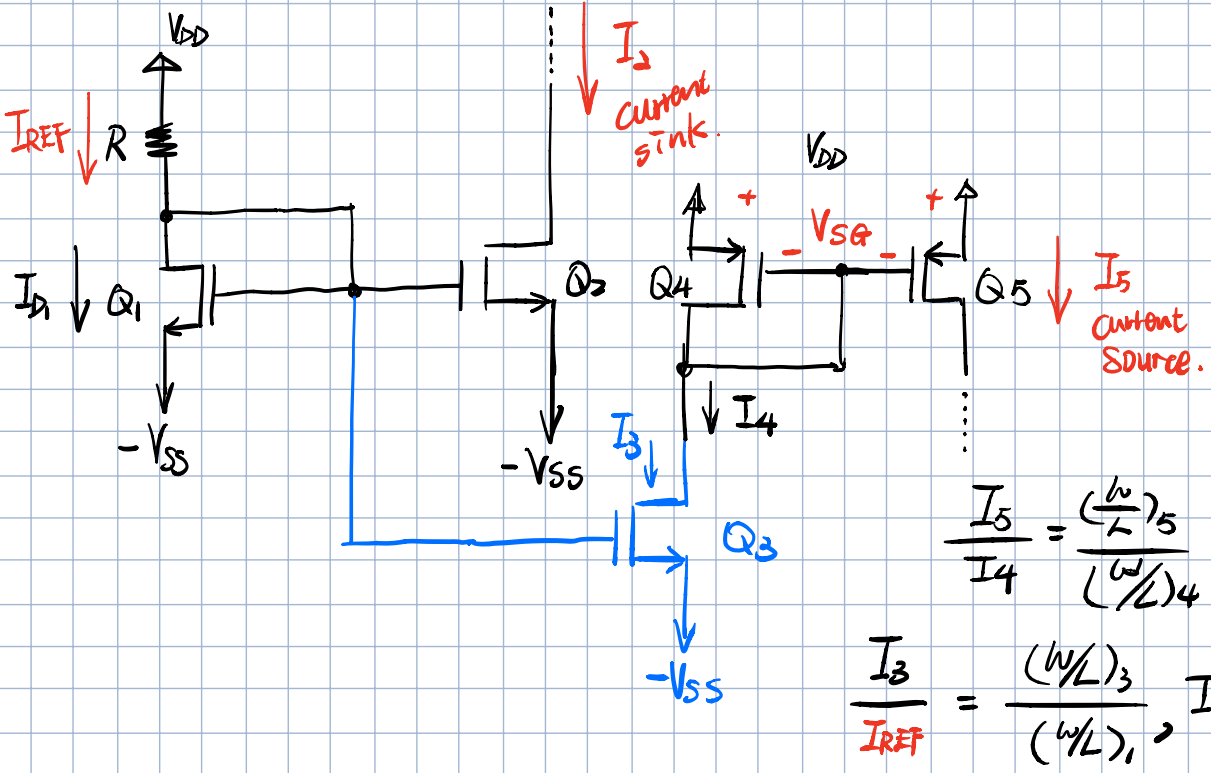
$$I_{D1} = \tfrac{1}{2} k_n' \left(\frac{W}{L}\right)_1 (V_{GS} - V_t)^2$$

$$I_{REF} = \frac{V_{DD} - V_{GS}}{R}$$

If Q_2 can be kept in saturation mode.

$$I_{D2} = \tfrac{1}{2} k_n' \left(\frac{W}{L}\right)_2 (V_{GS} - V_t)^2$$

$$\boxed{\frac{I_{D2}}{I_{REF}} = \frac{(W/L)_2}{(W/L)_1}}$$



$$\frac{I_5}{I_4} = \frac{(W/L)_5}{(W/L)_4}$$

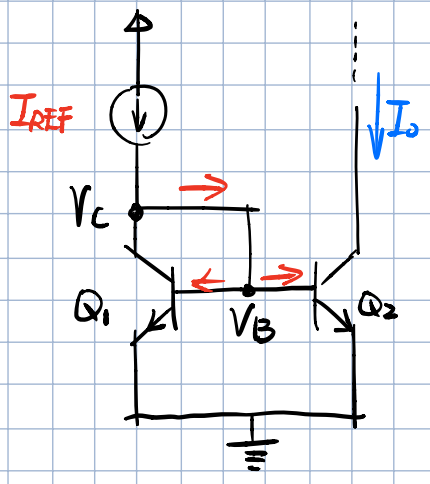
$$\frac{I_3}{I_{REF}} = \frac{(W/L)_3}{(W/L)_1}, \quad I_3 = I_4.$$

$$\therefore \frac{I_5}{I_{REF}} = \frac{(W/L)_5}{(W/L)_4} \times \frac{(W/L)_1}{(W/L)_3}$$

I_3 is the reference current for the Q4-Q5 current mirror

All transistors must be in saturation mode

BJT current mirror

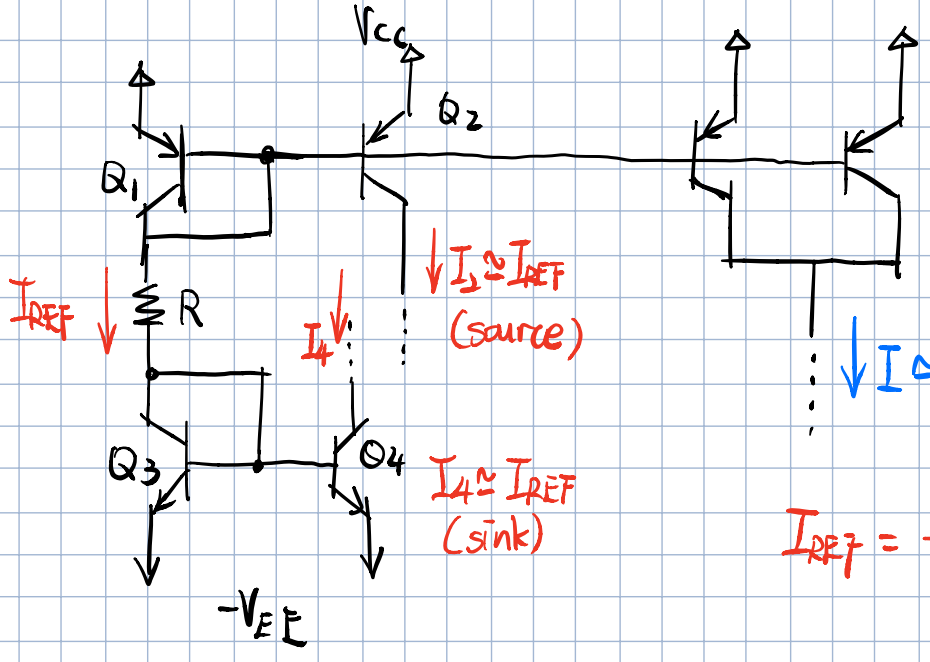


for very large β

$I_o \simeq I_{REF}$ (for matching W/L)

Q_1 & Q_2 are in active mode.

All trans. are matched (large β)



$$I_{REF} = \frac{V_{CC} + V_{EE} - 2 \times 0.7}{R}$$