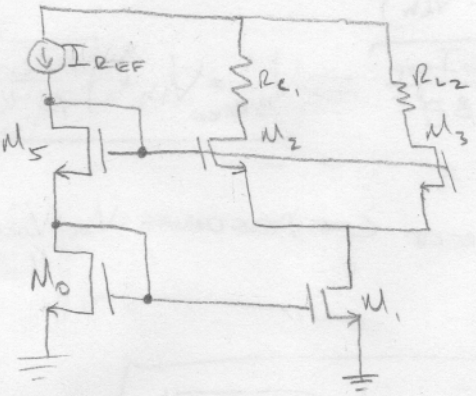
* TO GENERATE V_{BIAS_2} WITHOUT AN ADDITIONAL CURRENT SOURCE I WILL USE THE TOPOLOGY BELOW:



$V_{OV,0}$

$$I_{REF} = \frac{\beta}{2}\left(\frac{W}{L}\right)_5 \left(V_{BIAS_2} - 2.5\sqrt{I_{REF}} - V_{th}\right)^2$$

$$\left(\frac{W}{L}\right)_5 = \frac{2 I_{REF}}{\beta\left(V_{BIAS_2} - 2.5\sqrt{I_{REF}} + V_{th} - V_{th}\right)^2}$$

$$\boxed{\left(\frac{W}{L}\right)_5 = \frac{2 I_{REF}}{\beta\left(2.5\sqrt{I_{REF}} + V_{th}\right)^2}}$$

* SENSITIVE TO PROCESS VARIATION.

* THIS CIRCUIT IS SENSITIVE TO V_{BIAS} BECAUSE IT DIRECTLY AFFECTS THE CURRENT (AND HENCE THE TRANSCONDUCTANCE AND GAIN) THROUGH M_2 & M_3.

PART 5: (FIG 3)

* BECAUSE THE REFERENCE CURRENT HOLDS V_{BIAS_2} FIXED, THE SOURCE VOLTAGES OF M_2 & M_3 CANNOT CHANGE LIKE IN PART 3. THUS THE CURRENT THROUGH M_1 WILL BE MUCH MORE STABLE.

USING PARAMETERS FROM PART 4:

$V_{OV,0}$

$$I_{REF} = \frac{\beta}{2}\left(\frac{W}{L}\right)_4 \left(V_{BIAS_2} - 2.5\sqrt{I_{REF}} - V_{th}\right)^2$$

$$\left(\frac{W}{L}\right)_4 = \frac{2 I_{REF}}{\beta\left(V_{BIAS_2} - 2.5\sqrt{I_{REF}} - V_{th}\right)^2}$$

$$= \frac{2 I_{REF}}{\beta\left(2.5\sqrt{I_{REF}} + V_{th} - V_{th}\right)^2}$$

$$= \frac{2 I_{REF}}{6.25\beta I_{REF}}$$

$$\left(\frac{W}{L}\right)_4 = 10 \Rightarrow \boxed{W_4 = 2.5\mu m \quad L_4 = 0.25\mu m}$$

PART 6 (ADD. CREDIT)

$$V_{OV_2} = 2.5\sqrt{2 I_{REF}}$$

$$V_{BIAS_2} = 2.5\sqrt{2}\sqrt{I_{REF}} + V_{th} + 2.5\sqrt{I_{REF}}$$

$$V_{BIAS_2} = 60.35\sqrt{I_{REF}} + V_{th}$$

$$I_{REF} = \frac{\beta}{2}\left(\frac{W}{L}\right)_4 \left(V_{BIAS_2} - 2.5\sqrt{I_{REF}} - V_{th}\right)^2$$

$$\left(\frac{W}{L_4}\right) = \frac{2 I_{REF}}{\beta\left(35.35\sqrt{I_{REF}}\right)^2}$$

$$\boxed{\left(\frac{W}{L}\right)_4 = 5}$$

$$\boxed{W_4 = 1.25\mu m \quad L_4 = 0.25\mu m}$$