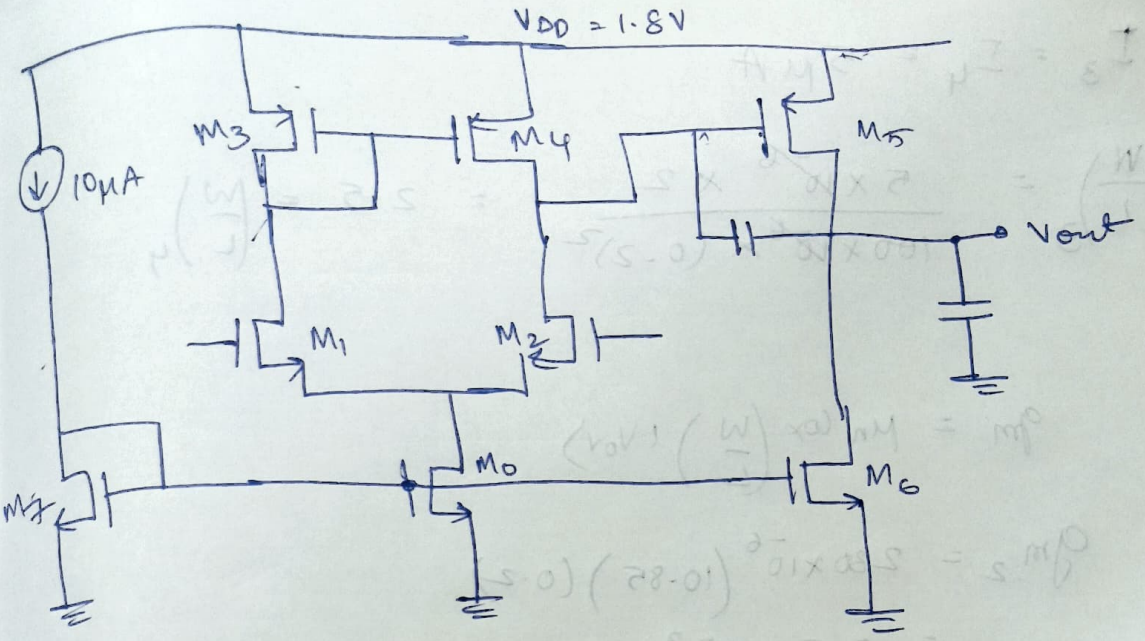
Sharanya.M 230108048



$I_{ref} = \cancel{10\mu A}$ $1\mu A$ so that $I_{tail} = 10\mu A$

$V_{ov} = 0.2\,V$

$\mu_n C_{ox} = 230\ \mu A/V^2$ $\mu_p C_{ox} = 100\ \mu A/V^2$

$I_7 = \frac{1}{2}\left(\frac{W}{L}\right)_7 \mu_n C_{ox} (V_{ov})^2$

$10 = \frac{1}{2} \times 230 \times 0.2^2 \times \left(\frac{W}{L}\right)_7$

$\left(\frac{W}{L}\right)_7 = 2.17$ [For M_7 $\frac{W}{L} = 2.17$]

$\left(\frac{W}{L}\right)_0 = 10\left(\frac{W}{L}\right)_7 = 21.7$

$\left(\frac{W}{L}\right)_1 = \left(\frac{W}{L}\right)_2 = \frac{2 \times I_{tail}}{(\mu_n C_{ox})(V_{ov})^2} = \frac{1}{2}\left(\frac{W}{L}\right)_{tail/0}$

$= 10.85$

$I_3 = I_4 = 5\mu A$

$$\left(\frac{W}{L}\right)_3 = \frac{5 \times 10^{-6} \times 2}{100 \times 10^{-6} \times (0.2)^2} = 2.5 = \left(\frac{W}{L}\right)_4$$

$$g_m = \mu_n C_{ox} \left(\frac{W}{L}\right)(V_{OV})$$

$$g_{m_2} = 230 \times 10^{-6} (10.85)(0.2)$$
$$= 0.5 \times 10^{-3}$$

$$g_{m_4} = 100 \times 10^{-6} \left(\frac{W}{L}\right)_4 (0.2)$$
$$= 100 \times 10^{-6} (2.5)(0.2)$$
$$= 5 \times 10^{-5} = 0.05 \times 10^{-3}$$

$$\text{gain} = g_{m_2}(r_{on} \| r_{op})$$
$$= 0.5 \times 10^{-3} \left(\frac{1}{2\lambda I_D}\right) \quad \lambda = 0.1$$

1.75

$$= \frac{2.5 \times 10^{-3}}{5 \times 10^{-6}} = 0.5 \times 10^3$$

10000

$$= 500$$

(on simulation I actually got

This gives 53.9 dB gain

Using 2nd stage we can cross 60 dB gain

$A_{net} = A_1 A_2$

$A_2 = 2$

$$\frac{2 g_{m_p}(r_{op} \| r_{on})}{} = \frac{\mu_p C_{ox} \left(\frac{W}{L}\right)_5 (0.2)^2}{2(0.1) \times 10 \times 10^{-6}}$$

$$= \frac{100 \times \left(\frac{W}{L}\right)_5 (0.2)}{2(0.1) \times 10}$$

$$2 = 10 \left(\frac{W}{L}\right)_5$$

$I_6 = 10\mu A$

$$\left(\frac{W}{L}\right)_6 = \left(\frac{W}{L}\right)_6 = 21.7$$

$$I_6 = I_5 \Rightarrow \left(\frac{W}{L}\right)_5 = \frac{2I_5}{\mu_p C_{ox} (V_{ov})^2}$$

$$= \frac{2 \times 10 \times 10^{-6}}{230 \times 10^{-6} \times (0.2)^2}$$

$$= 2.17$$