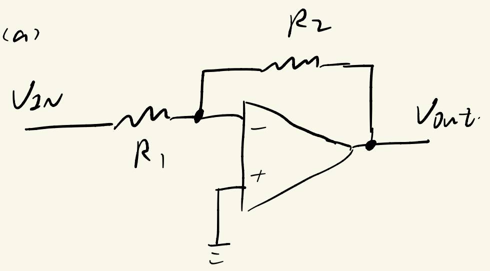
8-1 (a)

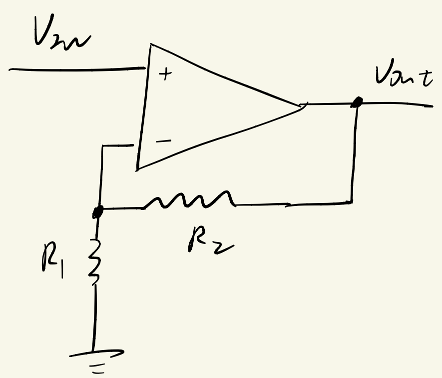


$$A_{open} = \frac{R_2}{R_1+R_2} A_0$$

$$\beta = \frac{R_2}{R_1}$$

$$\text{loop gain} = \beta A = \frac{R_1}{R_2} A_{open} = \frac{R_1}{R_1+R_2} A_0$$

$$A_{CL} = \frac{A_{open}}{1 + \text{loop gain}} = \frac{\frac{R_2}{R_1+R_2} A_0}{1 + \frac{R_1}{R_1+R_2} A_0}$$



$$A_{open} = A_0$$

$$\beta = \frac{R_1}{R_1+R_2}$$

$$\text{loop gain} = \beta A_{open} = \frac{R_1}{R_1+R_2} A_0$$

$$A_{CL} = \frac{A_{open}}{1+\text{loop gain}} = \frac{A_0}{1+\frac{R_1}{R_1+R_2}A_0}$$

(b) $R_1 = 10k\Omega$. $|A_{CL}| = 10$

对于左图：

$$A_{CL} = \frac{\frac{R_2}{R_1+R_2}A_0}{1+\frac{R_1}{R_1+R_2}A_0} = 10. =$$

$A_0 = \infty \rightarrow \quad A_{CL} = \frac{R_2}{R_1} = 10. \quad R_2 = 100k\Omega$

$A_0 = 1000 \rightarrow \quad A_{CL} = 10, \quad R_2 = 101.11k\Omega$

$A_0 = 200 \rightarrow \quad A_{CL} = 10 \quad R_2 = 105.79k\Omega$

对于右图.

$$A_{CL} = \frac{A_0}{1+\frac{R_1}{R_1+R_2}A_0}$$

$A_0 = \infty \rightarrow \quad A_{CL} = 10 = \frac{R_1+R_2}{R_1} = 1+\frac{R_2}{R_1}$

$R_2 = 9R_1 = 90k\Omega$

$A_0 = 1000 \rightarrow R_2 = 91.01k\Omega$

$A_0 = 200 \rightarrow R_2 = 95.26\,k\Omega$

(C) $A_0 = 800.$ $A_{CL} = \dfrac{800}{1+\dfrac{10}{10+91.01}\times 800} = 9.975$

percentage $= \dfrac{10-9.975}{10} = 0.25\%$

$A_0 = 160$ $A_{CL} = \dfrac{160}{1+\dfrac{10}{10+95.26}\times 160} = 9.87626$

percentage $= \dfrac{10-9.876265}{10} = 1.23\%$

8.2 $f_{-3dB}|_{cascade} = \sqrt{2^{\frac{1}{N}} - 1} \cdot f_{-3dB}|_{stage}$.

$f_{-3dB}|_{stage} = (1+\beta A_0)w_0 A_0 = 1000Hz$

$w_0 = 20k$

$f_{-3dB}|_{cascade} = \sqrt{2^{\frac{1}{N}} - 1} \cdot f_{-3dB}|_{stage}$ $f_{-3dB}|_{cascode} = 10^6 Hz$.

$A_{stage} = (A_{stage})^N A_{cascude} = 10^3$

$N=2$

$A_{stage} = \sqrt{1000} = 31.6228$.

$1+A_0\beta = 31.6228$

$f_{-3dB}|_{stage} = (1+\beta A_0)w_0 = 632456$

$f_{-3dB}|_{cascode} = \sqrt{2^{\frac{1}{N}} - 1}\ f_{-3dB}|_{stage} = 407025$

$N=3$

$A_{stage} = 10$.

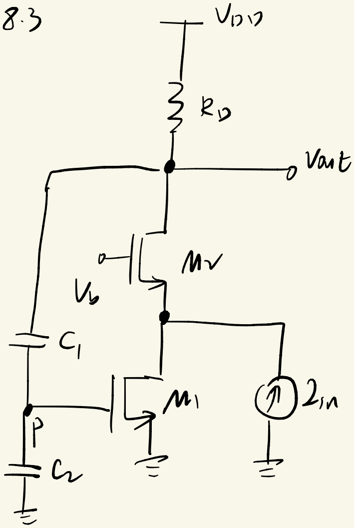
$1+A_0\beta = 100$

$f_{-3dB}|_{stege} = (1+\beta A_0)w_0 = 2\times10^6$

$f_{-3dB}|_{cascode} = \sqrt{2^{\frac{1}{N}}-1}\ f_{-3dB}|_{stage} = 1.02\ MHz$

$\beta = 0.099$

8.3



$\left(\frac{W}{L}\right)_1 = 100 \quad \left(\frac{W}{L}\right)_2 = 200 \quad R_D = 2k\Omega.$

$C_2 = 3C_1 \quad \mu_n C_{ox} = 50\times10^{-6}\ A/V^2 \quad V_{TH} = 0.7V$

$\gamma = \beta = 0.$

(a) VCF

(b) loop gain $= \beta A_0 = \frac{C_2}{C_1+C_2} \cdot g_{m1} \cdot R_D$

(c). $R_{in\,closed} = \frac{1}{g_{m2}} \cdot \frac{1}{1+g_{m1}R_D\frac{C_1}{C_1+C_2}} = 50\,\Omega$

$$g_{m1} = \sqrt{I \cdot 2\mu_n C_{ox}\left(\frac{W}{L}\right)_1}$$

$$g_{m2} = \sqrt{I \cdot 2\mu_n C_{ox}\left(\frac{W}{L}\right)_2} = \sqrt{2}\,g_{m1}$$

$$\frac{1}{\sqrt{2}g_{m1}} \quad \frac{1}{1+g_{m1} \cdot \frac{1}{4}\times2\times10^3} = 50$$

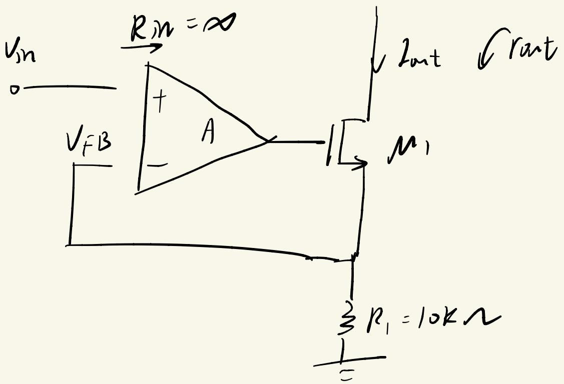
$$\frac{1}{50} = \sqrt{2}g_{m1}(1+g_{m1}500)$$

$$500\sqrt{2}g_{m1}^2 + \sqrt{2}g_{m1} - \frac{1}{50} = 0$$

$$g_{m1} = \frac{-\sqrt{2}+\sqrt{2+\frac{1}{50}\times4\times500\sqrt{2}}}{1000\sqrt{2}} = 4.4115\times10^{-3}\,S$$

$$I = \frac{g_{m1}^2}{2\mu_n C_{ox}\left(\frac{W}{L}\right)_1} = 1.94613\,mA$$

8.4



$\mu_n C_{ox} = 50 \times 10^{-6}\ A/V^2 \qquad V_{TH} = 0.7V.$

(a) $V_{in} \longleftrightarrow +$

$V_{FB} \longleftrightarrow -$

CVF

(b) $V_{in,DC} = 1V. \qquad A_0 = \infty$

$$I_D = \frac{V_{FB}}{R_1} = \frac{V_{in,DC}}{R_1} = \frac{1}{10k\Omega} = 10^{-4}A$$

$$g_{m1} = \sqrt{2I_D \mu_n C_{ox}\frac{W}{L}} = \sqrt{2\times 10^{-4}\times 50\times 10^{-6}\times 200} = 1.414\times 10^{-3}S$$

$$r_o = \frac{1}{\lambda I_D} = \frac{1}{0.1\times 10^{-4}} = 10^5\Omega$$

(c) $G_{open} = \dfrac{i_{out}}{v_{in}} = \dfrac{A g_m}{1+g_m R_S} = 4.67\,mS$

$G_{loop} = A \cdot \dfrac{g_m R_S}{1+g_m R_S} = 46.7$

$G_{CL} = \dfrac{G_{open}}{1+G_{loop}} = 97.9\,\mu S$

(d) $r_{out,open} = g_m r_o R_S + r_o + R_S = 1.61 \times 10^6\,\Omega$

$r_{out,close} = r_{out,open}(1+G_{loop}) = 76.96 \times 10^6\,\Omega$