

EE2019

Note Title

3/1/2019

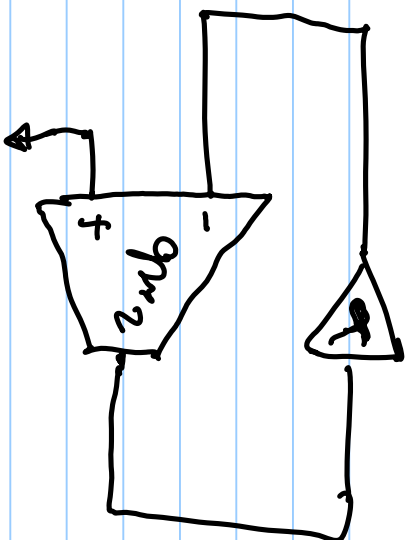
$$\omega_{p1} = \frac{-1}{g_{m2} R_{o2} (R_{o1} C_c)}$$

$$\omega_{p2} = \frac{-\frac{\omega_{o1} (\omega_{o2} + C_c)}{\omega_{o1} + C_c} + \omega_{o2} + \frac{C_c}{\omega_{o1} + C_c} g_{m2}}{X}$$

$$\omega_{o2} + \frac{C_c \omega_{o1}}{\omega_{o1} + C_c}$$

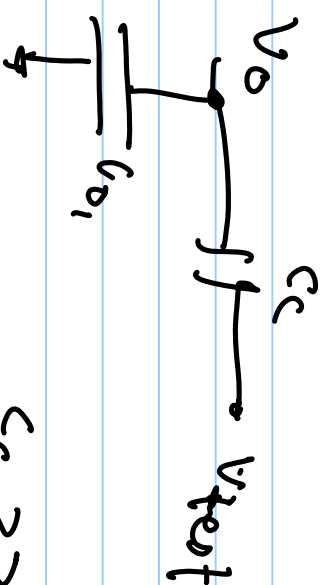
$$= \frac{\frac{C_c}{\omega_{o1} + C_c} g_{m2}}{\omega_{o2} + \frac{C_c \omega_{o1}}{\omega_{o1} + C_c}} = \frac{\text{transconductance}}{\text{capacitance}}$$

dominant term



$$g_m = \frac{\partial I_o}{\partial V_{in}}$$

$$g_m \rightarrow g_{m2}$$

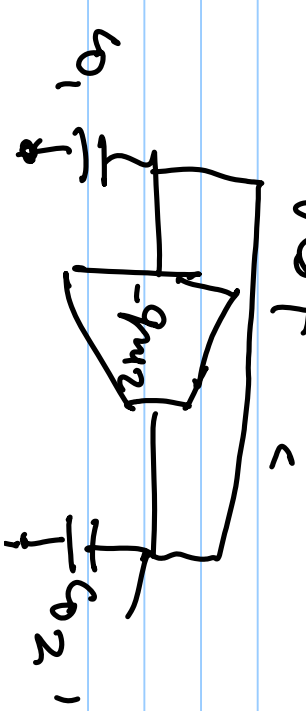


$$V_o = \frac{C_c}{C_{01} + C_c} V_{test}$$

$$C_c \gg C_{01}, \quad V_o = V_{test}$$

$$C_c \gg C_{01}$$

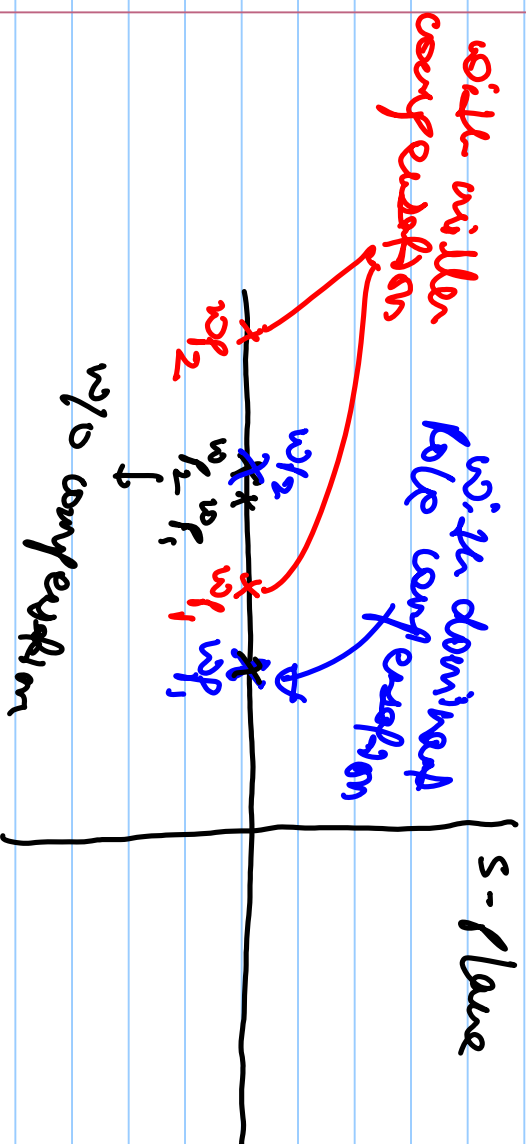
$$\omega f_2 = \frac{g_{m2}}{C_{02} + C_{01}}$$



$$\omega_{p1} = \frac{1}{g_{m2} R_{O2} R_{O1} C_c}$$

$$\omega_{p2} = \frac{g_{m2}}{\omega_{O2} + \omega_{O1}}$$

$$\omega_{p1} \ll \omega_{p2}$$



$$w_{yfb} = A_o \times w_{p_1} = g_{m_1} \cancel{g_{m_2}} \cancel{R_{o_1}} \cancel{R_{o_2}} \times \left(\frac{1}{\cancel{g_{m_2}} \cancel{A_{o_2}} \times \cancel{R_{o_1}} \cancel{C_E}} \right) = \frac{g_{m_1}}{C_C}$$

$$w_{yfb} = \frac{g_{m_1}}{C_C}$$

$$w_{f_2} = \frac{g_{m_2}}{w_{o_2} + w_{o_1}}$$

$$\begin{aligned} PM &= 180^\circ - 90^\circ - \tan^{-1} \frac{w_{yfb}}{w_{f_2}} \\ &= 90^\circ - \tan^{-1} \frac{w_{yfb}}{w_{f_2}} \end{aligned}$$

$$f_M = \tan^{-1} \frac{\omega p_2}{\omega_{ngb}}$$

$$\frac{\omega p_2}{\omega_{ngb}} = \frac{g_{m2} / \omega_1 + \omega_2}{g_{m1} / c_c} = \frac{g_{m2}}{g_{m1}} \left(\frac{c_c}{\omega_1 + \omega_2} \right)$$

$$g_{m1} = 100 \mu A/V, \quad g_{m2} = 100 \mu A/V$$

$$\omega_1 = 10 \text{ PF}, \quad \omega_2 = 10 \text{ PF}$$

$$f_M = 60^\circ$$

$$60^\circ = \tan^{-1} \frac{g_{m2}}{g_{m1}} \frac{c_c}{\omega_1 + \omega_2}$$

$$\tan \phi_o = \frac{g_{m2}}{g_{m1}} \frac{C_c}{\omega_1 + C_c} = 1.7$$

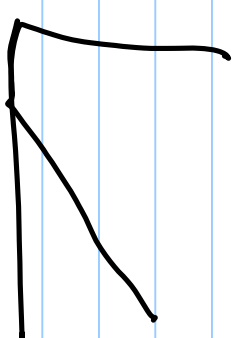
$$C_c = 1.7 (10 \text{ pF} + 10 \text{ pF}) = 34 \text{ pF}$$

$$W_{ugh} = \frac{g_{m1}}{C_c} = \frac{100 \mu}{34 \text{ pF}} \approx 3 \text{ Mrad/sec}$$

C_c required in Miller compensation is much smaller compared to dominant pole compensation.

R.H.P zero is ignored so far

$$\frac{V_{O_2}}{V_{i,w}} = \frac{q_{m_1} q_{m_2}}{G_{O_2} G_{O_2}} \frac{(1 - \frac{C_c}{q_{m_2}} s)}{(1 + s/\omega_1)(1 + s/\omega_2)}$$



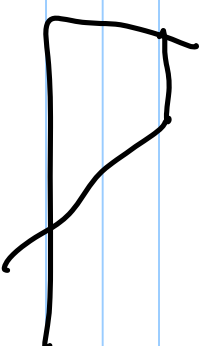
$$H(s) = 1 - s/\omega_2$$

$$\omega_2 = \frac{q_{m_2}}{C_c}$$

$$H(s) = \frac{1}{1 + s/\omega_0}$$

$$P_M = \tan^{-1} \frac{\omega \rho_2}{\omega_{ngb}} - \tan^{-1} \frac{\omega_{ngb}}{\omega_2}$$

$$\omega_{ngb} = \frac{q_{m_1}}{C_c}, \quad \omega_2 = \frac{q_{m_2}}{C_c}$$



$$P_M = \tan^{-1} \frac{\omega \rho_2}{\omega_{ngb}} - \tan^{-1} \frac{q_{m_1}}{q_{m_2}}$$

$$P_{H_2} = 60^\circ - \text{few}^{-1} = 15^\circ$$

$$p_{m2} > p_{m1}$$

In order to achieve good phase margin in presence of K.H.P zero (w_z),

① Increase C_c to reduce w_{ng} so that $w_{ng} \ll w_z \rightarrow$ reduce w_{ng}

② Increase p_{m2} so that $\frac{p_{m1}}{p_{m2}} \ll 1 \rightarrow$ higher w_{ng} .