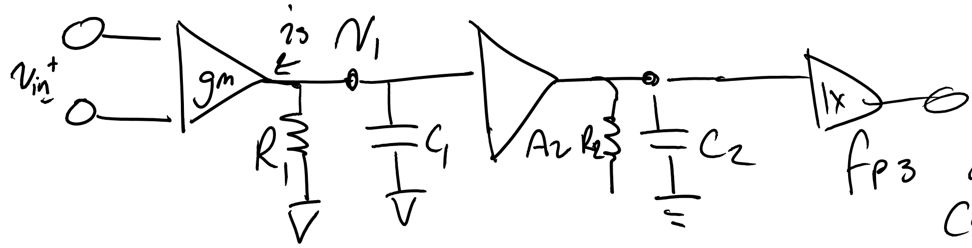
Discussion 10 Cory

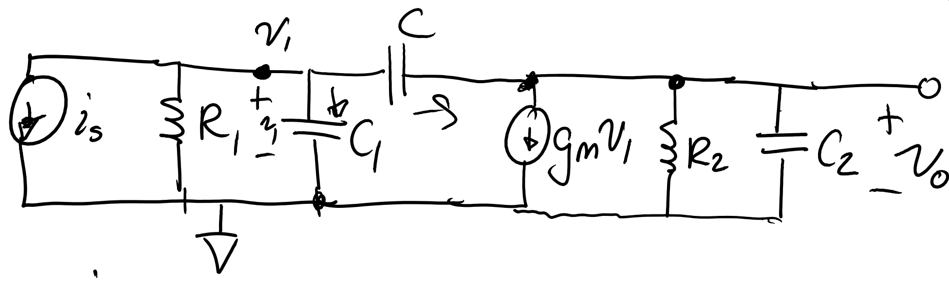
Wednesday, April 17, 2013 4:12 PM

Pole splitting

$-G_{m_1} R_1$



f_{p3} stays constant w/ C changes



$= \frac{1}{sC}$

$$-i_s = \frac{v_1}{R_1} + v_1 C_1 s + (v_1 - v_o) \cdot Cs$$

$$g_m v_1 + \frac{v_o}{R_2} + v_o C_2 s + (v_o - v_1) \cdot Cs$$

$\downarrow v_1$

Zero @ gm/C

Pg. 640 of G+M

$$\frac{v_o}{i_s} = \frac{(g_m - Cs) R_2 R_1}{1 + s\left[(C_2 + C)R_2 + (C_1 + C)R_1 + g_m R_2 R_1 C\right] + s^2 \cdot R_2 R_1 \underbrace{(C_2 C_1 + C C_2 + C C_1)}}$$

assume a two pole system

$$A(s) = \frac{a_o}{(1 - s/p_1)(1 - s/p_2)}$$

denom: does not Look like this

$$D(s) = (1 - s/p_1)(1 - s/p_2)$$

$$= 1 - s/ - \cancel{s/} + s^2$$

$$P_1 \quad P_2 \quad \overline{P_1 P_2}$$

assume $P_1 << P_2$

$$D(s) \simeq \boxed{1 - \frac{s}{P_1} + \frac{s^2}{P_1 P_2}} \Leftarrow P_2 = \frac{s^2}{P_1}$$

$$P_1 = \frac{-1}{(C_2 + C)R_2 + (C_1 + C)R_1 + \underbrace{g_m R_2 R_1 C}_{\text{this term is the biggest}}}$$

$$\boxed{P_1 = -\frac{1}{\underbrace{g_m R_2}_{\text{gain of 2nd stage}} R_1 C}} \Leftarrow \text{the same as miller multiplucation}$$

$$\frac{1}{RC} \rightarrow \frac{-1}{R_1 C_M} = \frac{-1}{R_1 C \cdot g_m R_2}$$

Now Look @ P_2

$$P_2 = -\frac{g_m C}{C_2 C_1 + C(C_2 + C_1)} \Leftarrow$$ increasing C will increase the pole

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$$\frac{s^2 R_2 R_1 (C_2 C_1 + C C_2 + C C_1)}{P_1} = P_2$$

$$P_2 = -\frac{1}{\ldots}$$

$R_o \cdot C_T$

↑ output resistance w/ negative feedback from C

C_T is total Cap from V_o to gnd (through C)

$$R_o = \frac{R_2}{1+T} \Rightarrow$$

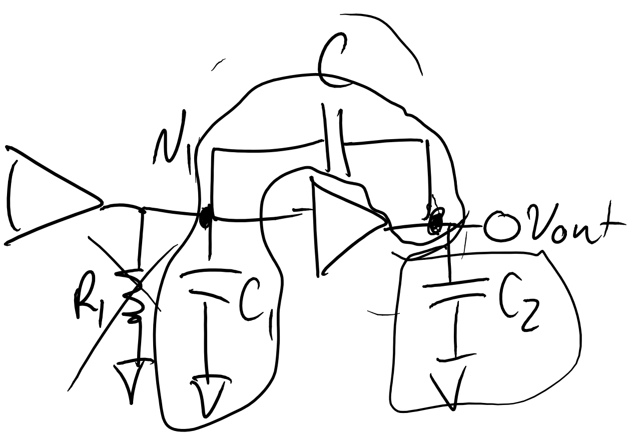
Open Loop Gain = $G_m R_{out}$

open Loop R = R_{out}

$$T = g_m R_2 f$$

Closed Loop Gain $= \dfrac{G_m R_{out}}{1 + G_m R_{out} f}$

Closed Loop R $= \dfrac{R_{out}}{1 + G_m R_{out} f}$



how does V_{out} feedback to V_1

@ HF $Z_{C_1} << Z_{R_1}$

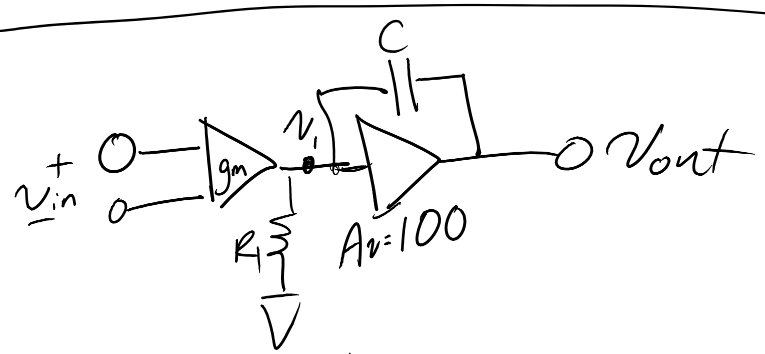
$$f = \frac{C}{C + C_1}$$

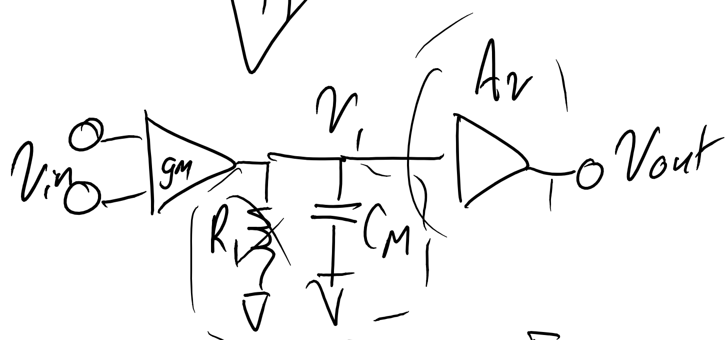
$$R_o = \frac{R_2}{1 + \underbrace{g_m R_2 f}_{\text{Large}}} \approx \frac{1}{g_m f} = \boxed{\frac{C + C_1}{g_m C} = R_o}$$

$$R_O = \frac{R_2}{1+\underbrace{g_m R_2 f}_{\text{Large}}} \approx \frac{1}{g_m f} = \boxed{\frac{C+C_1}{g_m C} = R_O}$$

$$C_T = C_2 + \frac{C \cdot C_1}{C+C_1} = \frac{CC_2 + C_1C_2 + CC_1}{C + C_1}$$

$$P_2 = -\frac{1}{R_O C_T} = \boxed{\frac{-g_m C}{C_2 C_1 + C(C_1 + C_2)}}$$





Approach:

① find open Loop TF

② Solve for ω_x where $|TF| = \frac{1}{f}$: ω_x

③ plug ω_x into CL eqn $\frac{a(s)}{1+a(s)\cdot f}$ and take magnitude @ ω_x

@ high F $Z_{CM} << R_1$

$$\frac{V_1}{v_{in}} = \frac{-g_m}{sC_M}$$

V_o A_v

$v_1 \quad \overline{(1 - s/\omega_2)}$

$$C_M = A_v \cdot C$$

$$a(s) = \frac{v_{out}}{v_{in}} = \frac{-g_m \cancel{A_v}}{s \cdot \cancel{A_v} C \, (1 - s/\omega_2)} = \frac{-1}{\frac{sC}{g_m}(1 - s/\omega_2)}$$

$$\approx \frac{1}{\left(1 - \frac{sC}{g_m}\right)\left(1 - s/\omega_2\right)}$$

≥ 1 @ GX freq.

set $|a(s)| = \frac{1}{f}$

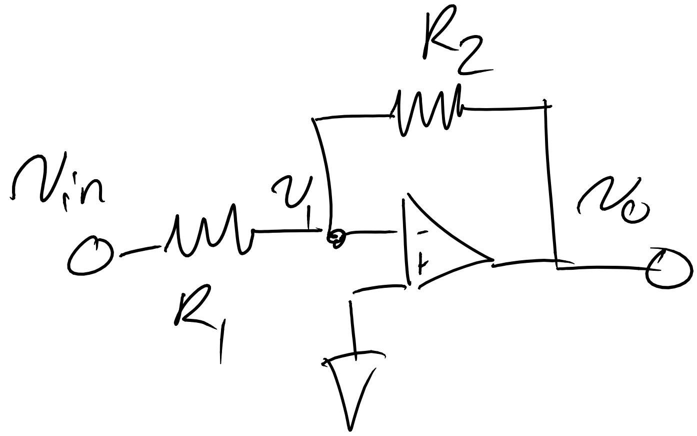
$$f|a(s)| = 1$$

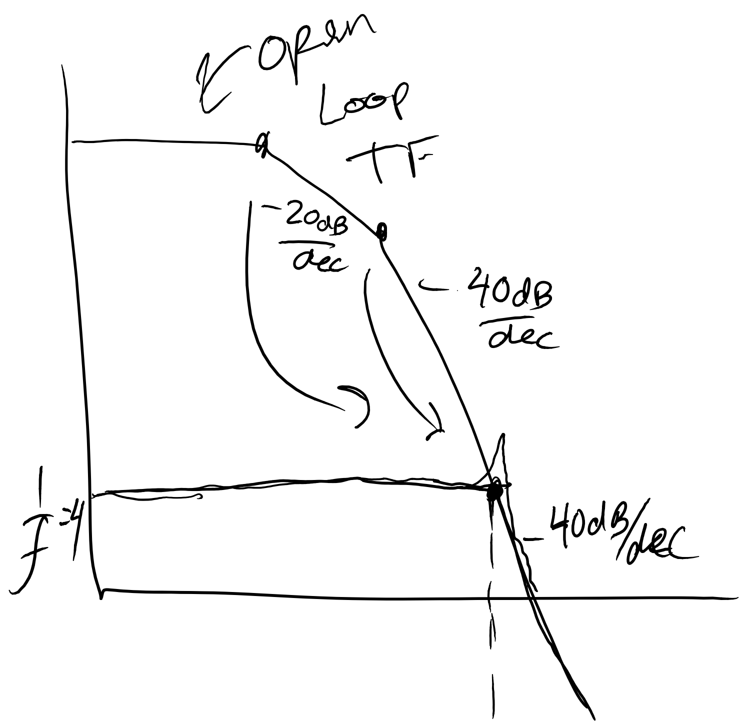
find freq that satisfies this

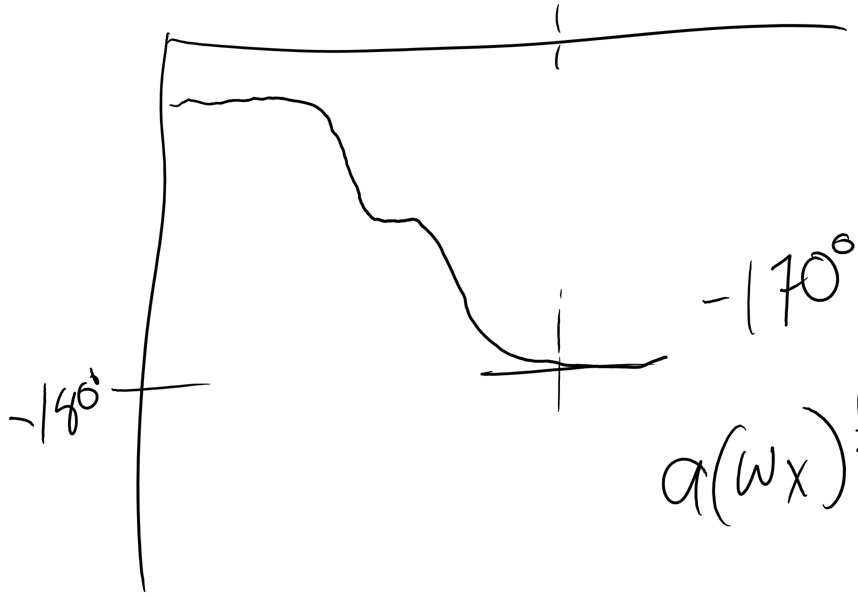
$$|a(s)| = \frac{1}{f}, \quad \angle(a(s)) = ?$$

$$\left|A(\omega_x)\right| = \left|\frac{a(s)}{1 + a(s) f}\right| = \left|\frac{\frac{1}{f}\angle ?}{1 + 1\angle ?}\right| = \boxed{\frac{1}{f} \cdot \text{factor}}$$

Max amplitude







$a(\omega_x) = 1\angle -178°$