2-Stage

Miller

RHPZ

Frequency response

Ps doublet

\[ \text{Common mode gain} \]

\[ \text{slowing} \]

\[ \text{2-Stage} \]

\[ \text{Compensated: } (C_c > 0) \]

\[ \omega_p = \frac{1}{R_i C_1} \]

\[ \omega_z = \frac{1}{R_o C_2} \]

\[ A_v = \frac{G_m R_o G_m R_o}{\omega_p^2} \approx \frac{(g_m)^2}{4} \]

\[ \omega_z = \frac{1}{R_o C_2} \]

\[ \text{Compensated: } (C_c > 0) \]

\[ \omega_p = \frac{G_m}{G_m + G_m + R_o} \]

\[ \omega_z = \frac{G_m}{G_m + G_m + R_o} \]

\[ \omega_z = \frac{G_m}{C_c} \]

\[ \text{Assuming } \omega_p < \omega_c \]

\[ \text{Often interested in } f = 1 \]

\[ \phi_{180}>45^\circ \]

\[ \text{Second pole (dominant pole)} \]

THINK OF THE PHASE PLT!

\[ \text{What if } f \neq 1? \]

\[ \text{May not need to compensate at all} \]

\[ |\tilde{A}(f)| \]

\[ \text{To get low stage gain, multiply by } G_m \]

\[ |\tilde{A}(f)| = |\tilde{A}_0||\tilde{A}_2| \]

\[ \text{Phase caused by } \omega_p \]

\[ \text{Phase caused by } \omega_x \]

\[ \text{Phase caused by } \omega_z \]

\[ \text{Phase caused by } \omega_c \]

\[ \text{No phase lag at } f \neq 1 \]

\[ \text{Phase caused by } \omega_c \]

\[ \text{Phase caused by } \omega_z \]

\[ \text{Phase caused by } \omega_x \]

\[ \text{Phase caused by } \omega_p \]

\[ \text{Phase caused by } \omega_0 \]

\[ \text{Phase caused by } \omega_z \]

\[ \text{Phase caused by } \omega_c \]

\[ \text{Phase caused by } \omega_x \]

\[ \text{Phase caused by } \omega_p \]

\[ \text{Phase caused by } \omega_0 \]

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\[ \text{Phase caused by } \omega_z \]

\[ \text{Phase caused by } \omega_c \]

\[ \text{Phase caused by } \omega_x \]

\[ \text{Phase caused by } \omega_p \]

\[ \text{Phase caused by } \omega_0 \]
1. @ DC Logic:

2. w > f, v

3. No more reasons to get rid of.

4. How to deal with RHHP?

   (1) Series resistance
To cancel poles, it is risky.

Remove feed-forward where 2nd stage sees $C_C$. We want $C_C$ to not affect $f_0$.

Current minor frequency response:
- Current minor has a pole $\Rightarrow$ Gain of 1st stage drops to $\frac{1}{2}$ because no more narrowing.

Calculate $G_{m1}(s)$:

$$G_{m1}(s) = \frac{-g_{m2}}{2C \omega} \left( \frac{1}{1 + s \frac{g_{m2}}{2C \omega}} \right)$$

Checks out :D