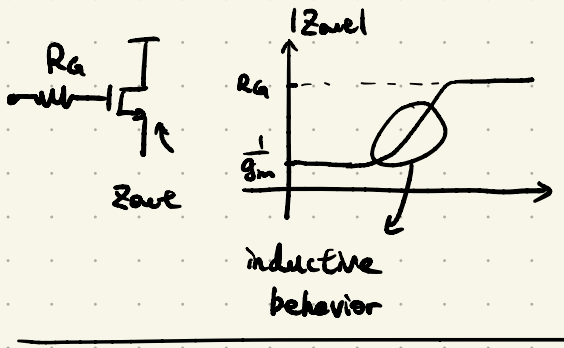
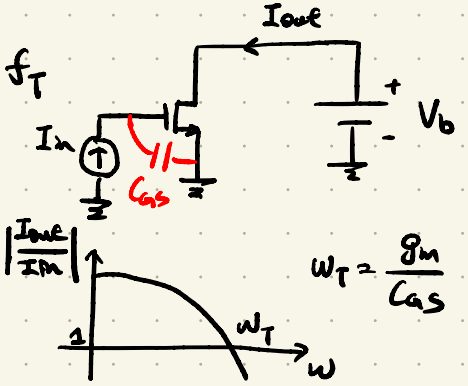
Lec 26 Additional Freq. Resp. Examples

- MOS Cascode
- CS Stage with Current-Source Load
- Cascaded Stages
- f_T Revisited

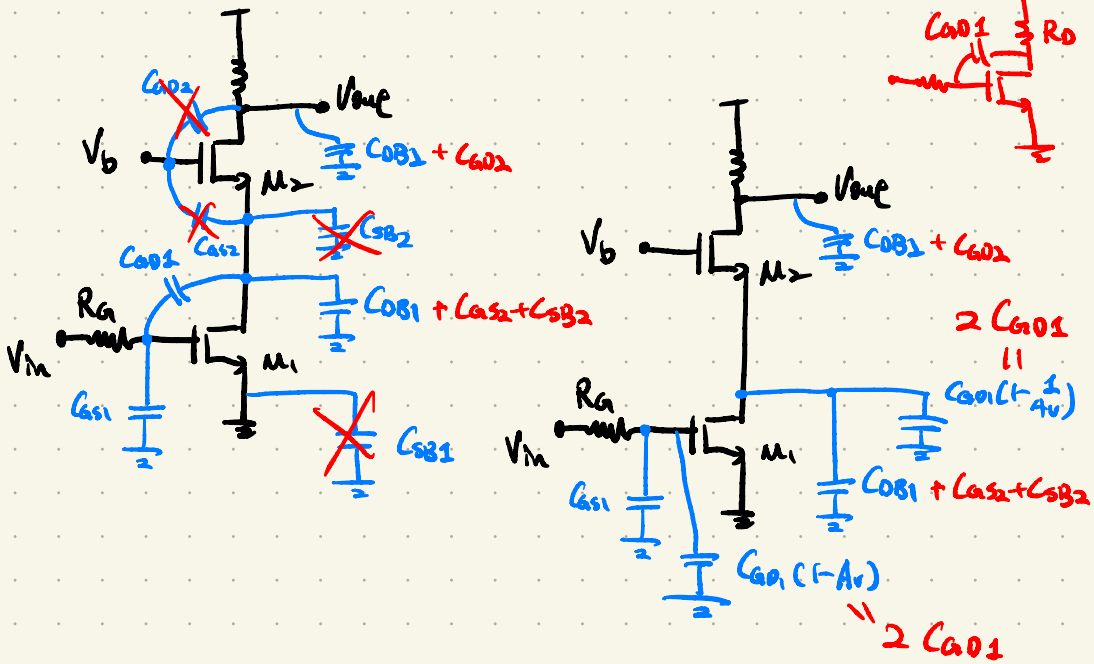
Review of Lec. 25





Mos Cascode

Find poles by inspection



$$A_V = \frac{V_B}{V_A} = -g_{m1} \times \frac{1}{g_{m2}} = -\frac{\sqrt{2\mu_n C_{ox}\left(\frac{W}{L}\right)_1 I_{D1}}}{\sqrt{2\mu_n C_{ox}\left(\frac{W}{L}\right)_2 I_{D2}}}$$

In most cases $\left(\frac{W}{L}\right)_1 = \left(\frac{W}{L}\right)_2$

$$\Rightarrow A_V = 1$$

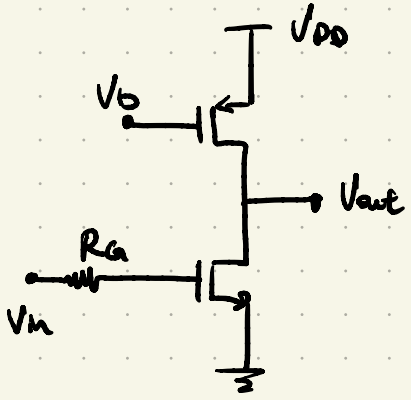
(lower miller multi. compare to CS amp.)

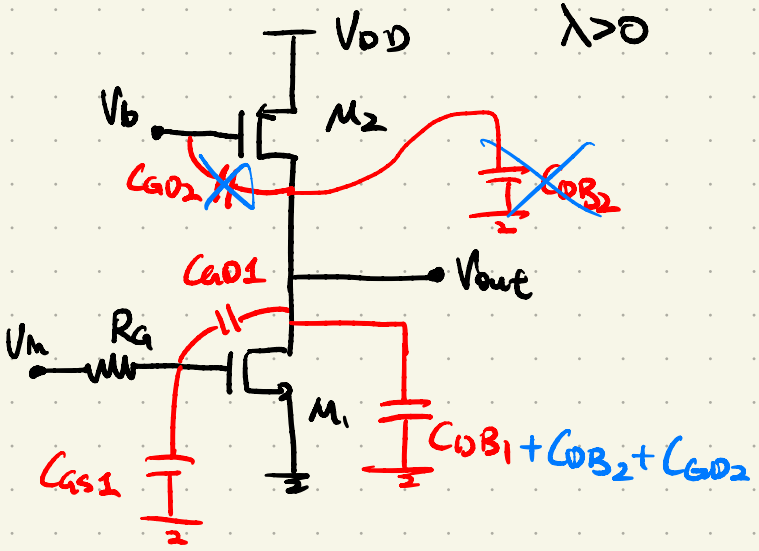
$$\omega_{p,A} = \frac{1}{R_G(C_{GS1} + 2C_{GD1})}$$

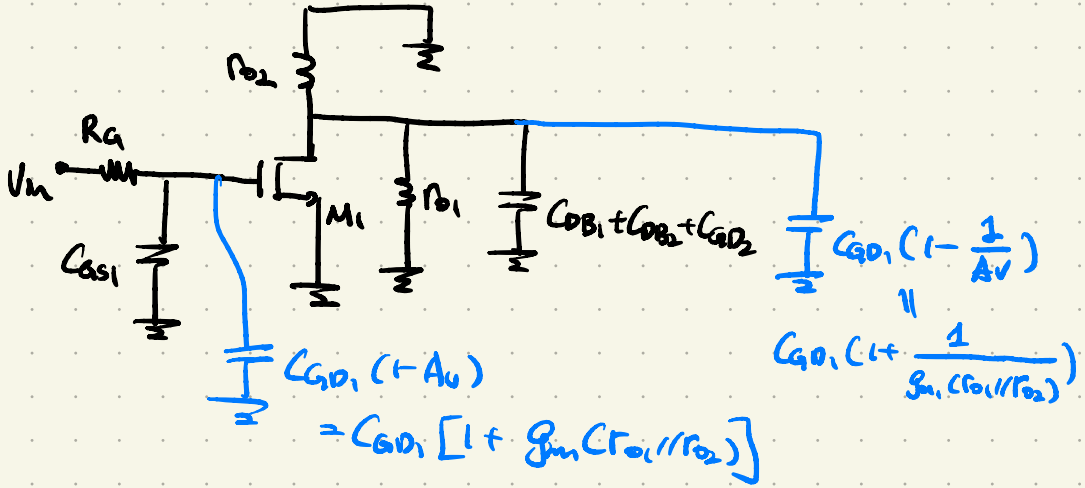
$$\omega_{p,B} = \frac{1}{\frac{1}{g_{m2}}(C_{OB1} + C_{GS2} + C_{SB2} + 2C_{GD1})}$$

$$\omega_{p,out} = \frac{1}{R_G(C_{GD2} + C_{DB2})}$$

- CS stage with Current-Source Load



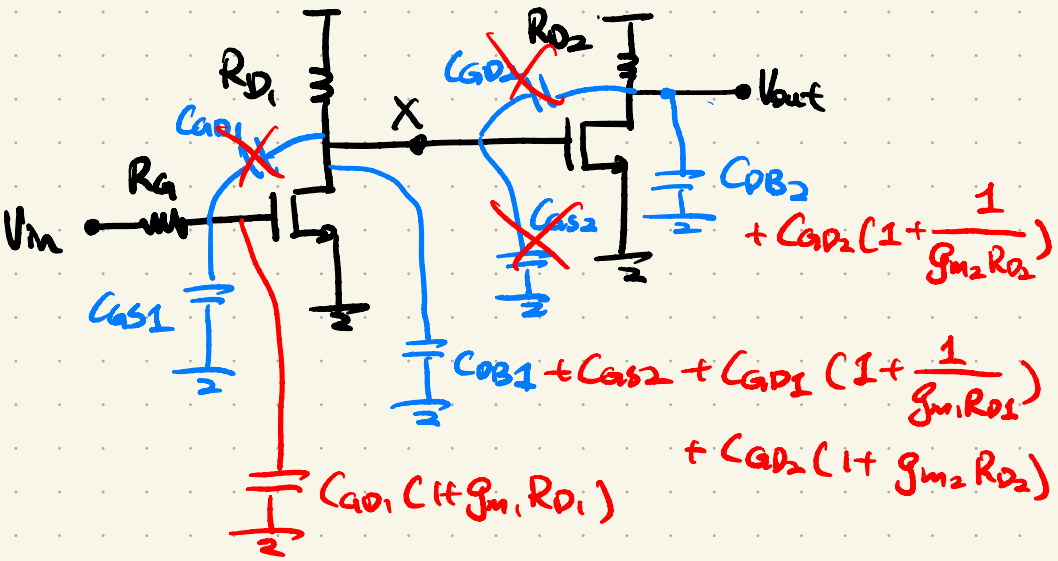




$$\omega_{p,in} = \frac{1}{R_G\left(C_{GS1} + C_{GD1}[1 + g_{m1}(r_{O1} \parallel r_{O2})]\right)}$$

$$\omega_{p,out} = \frac{1}{(r_{O1} \parallel r_{O2})\left[C_{DB1} + C_{DB2} + C_{GD2} + C_{GD1}\left(1 + \frac{1}{g_{m1}(r_{O1} \parallel r_{O2})}\right)\right]}$$

Example — Cascaded Stages



$$\omega_{p,in} = \frac{1}{\left[C_{GS1} + C_{GD1}(1 + g_{m1}R_{D1})\right]R_G}$$

$$\omega_{p,x} = \frac{1}{R_{D1}\left[C_{DB1} + C_{GS1} + C_{GD1}\left(1 + \frac{1}{g_{m1}R_{D1}}\right) + C_{GD2}(1 + g_{m2}R_{D2})\right]}$$

$$\omega_{p,out} = \frac{1}{R_{D2}\left[C_{DB2} + C_{GD2}\left(1 + \frac{1}{g_{m2}R_{D2}}\right)\right]}$$

f_T Revisited

$$f_T = \frac{g_m}{2\pi C_{GS}} = \frac{\sqrt{2\mu_n C_{ox} \frac{W}{L} I_D}}{2\pi C_{GS}}$$

what happens if $\frac{W}{L}$ is doubled?

(a) I_D is constant?

$$f_T \rightarrow \frac{f_T}{\sqrt{2}}$$

(b) I_D is doubled

$$f_T \rightarrow f_T$$

$$g_m \rightarrow 2g_m$$

$$C_{GS} \rightarrow 2C_{GS}$$