slew rate

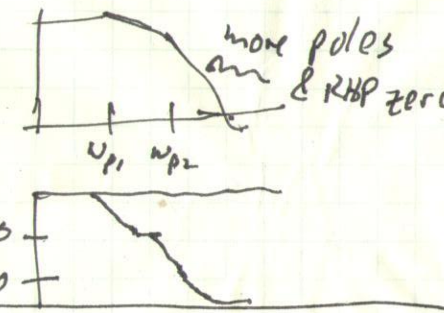
compensation

Compensation

1 stage - probably not a problem

- if it is just add cap at output

2 stage - almost always a problem



Keep away from -180 when $|A_v|=1$ } PM

How to compensate?

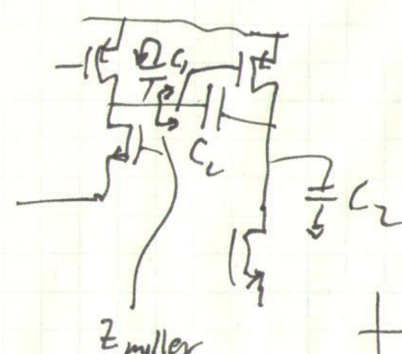
- push 2nd pole higher. Hard!
  lower output cap or resistance
- lower gain - bad

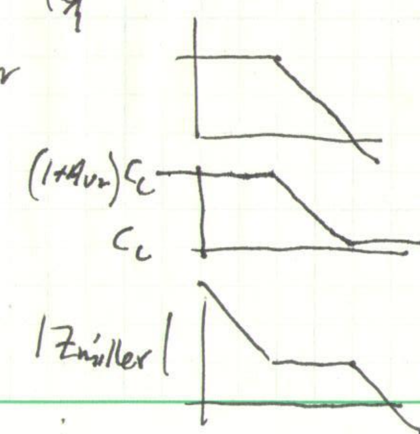
push 1st pole lower. Hit w_u before w_{p2}
fine, but lowers useful bandwidth

- split poles push w_{p1} ← w_{p2} →

magic!

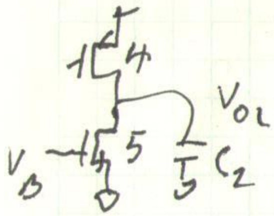
Last time





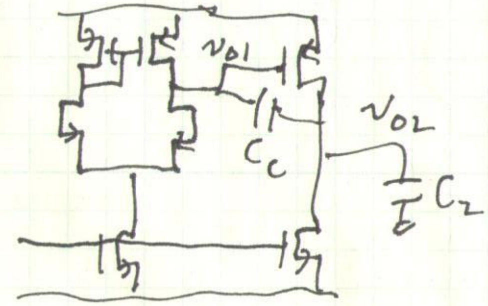
Slew rate - nonlinear effect when

1 or more transistor turns off



slewing negative $\frac{dv_{o2}}{dt} = \frac{-i_{d5}}{C_{o2}}$

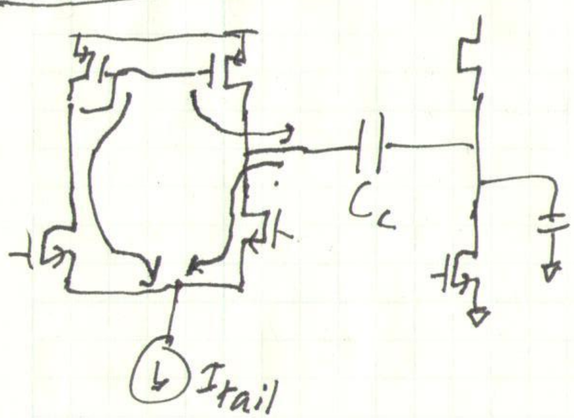
with C_c



$v_{o2} = v_{o1} + v_c$

$$\frac{dv_{o2}}{dt} = \underbrace{\frac{dv_{o1}}{dt}}_{\frac{1}{A_2}\frac{dv_{o2}}{dt}} + \frac{dv_c}{dt}$$

limits $\frac{dv_{o2}}{dt}$!



$$\omega_{p1} = \frac{1}{R_{01} C_{TOT1}} \qquad C_{TOT1} = C_1 + C_c(1 + A_{V2,0})$$

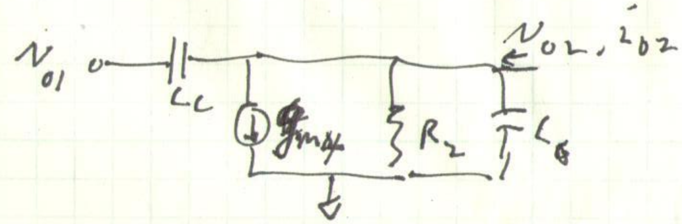
$$\omega_{p2} = \frac{G_{m2}}{C_1 + C_2 + \frac{C_1 C_2}{C_c}}$$

$$\approx \frac{G_{m2}}{C_1 + C_2} \quad \text{iff } C_c \gg C_1 \text{ or } C_c \gg C_2$$

2 other high freq issues

RHP zero from C_c

pole/zero doublet from mirror

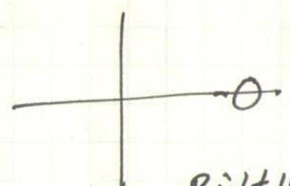


$$G_{m2} = \left.\frac{i_{02}}{v_{01}}\right|_{v_{02}=0} \quad g_{m4} v_{01} + (v_{02} - v_{01}) sC_c = i_{02}$$

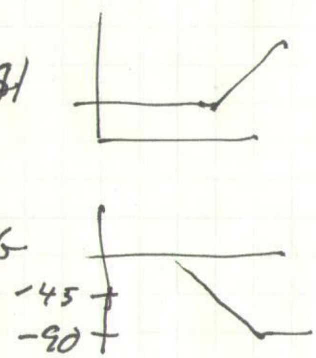
$$(g_{m4} - sC_c) v_{01} = i_{02}$$

$$G_{m2} = \frac{i_{02}}{v_{01}} = g_{m4} - sC_c = g_{m4}(1 + s/\omega_z)$$

$$\omega_z = -\frac{g_{m4}}{C_c}$$



Right Half plane zero



negative phase from RHP zero!