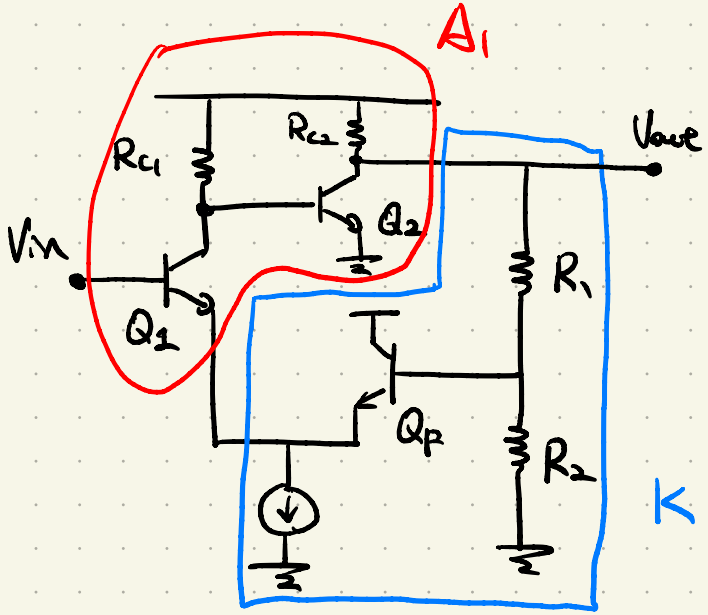
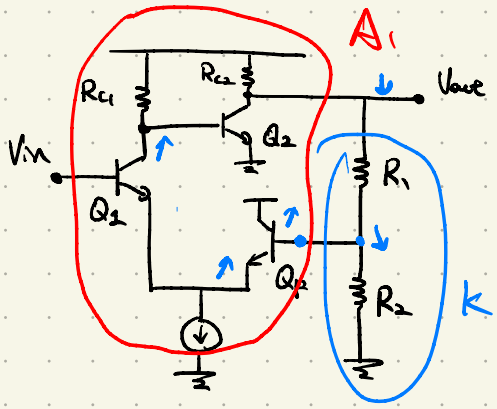
Lec 36

- Additional Examples of Voltage-Voltage Feedback
- Summary of Voltage-Voltage Feedback Circuits

Example



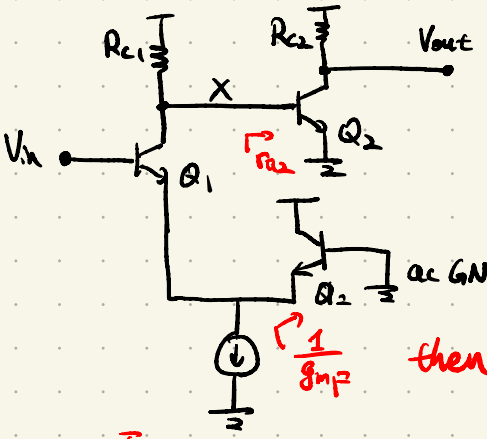


Negative Feedback

R_1+R_2 : large

$V_A = \infty$

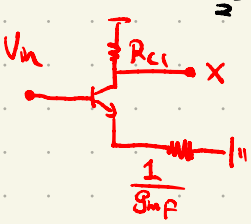
① Find the open-loop parameters



$$\frac{V_{out}}{V_{in}} = \frac{V_{out}}{X} \cdot \frac{X}{V_{in}}$$

$$\frac{V_{out}}{X} = -g_{m2} R_{c2}$$

then $$A_1 = \frac{R_{c1} \parallel r_{\pi 2}}{2} \times g_{m2} R_{c2}$$



$$\frac{X}{V_{in}} = -\frac{R_{c1} \parallel r_{\pi 2}}{\frac{1}{g_{m1}} + \frac{1}{g_{mF}}}$$

$(g_{m1} \approx g_{mF})$

$$R_{in} = r_{\pi 1} + (\beta+1)\frac{1}{g_{mF}}$$

$$= 2 r_{\pi 1}$$

$$R_{out} = R_{c2}$$

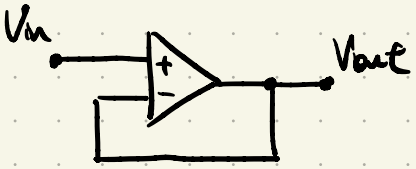
$$\text{Closed-Loop Gain} = \frac{A_1}{1+kA_1}$$

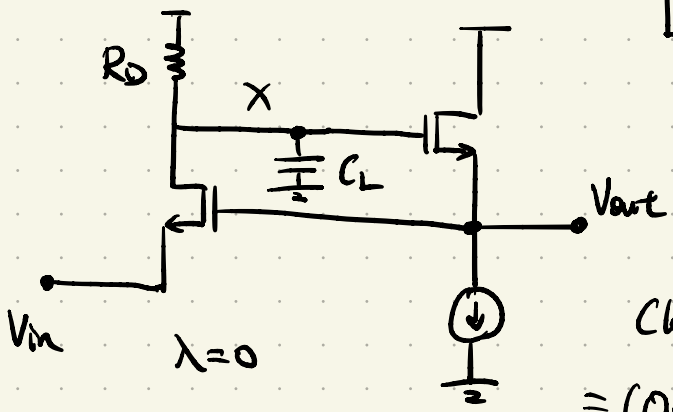
$$k \approx \frac{R_2}{R_1+R_2}$$

$$\text{CL. Input Imp.} = 2r_{\pi 1}(1+kA_1)$$

$$\text{CL Output Imp.} = \frac{R_{c2}}{1+kA_1}$$

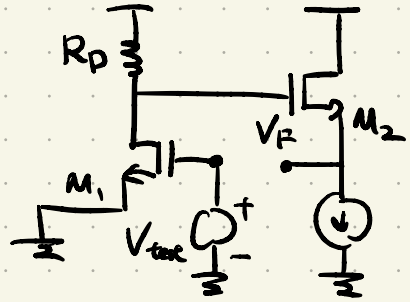
Example





Closed-Loop BW
= (Open-Loop BW)
(1 + loop gain)

$$\text{Open-Loop BW} = \text{Pole Freq} = \frac{1}{R_D C_L} = \omega_p$$



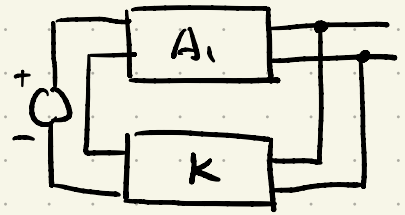
$$\frac{V_F}{V_{test}} = -g_{m1} R_D$$

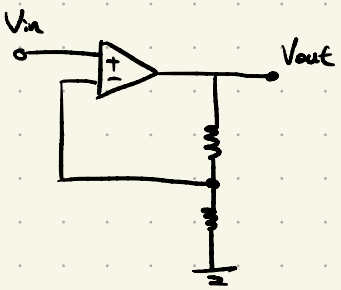
Loop gain $= g_{m1} R_D$

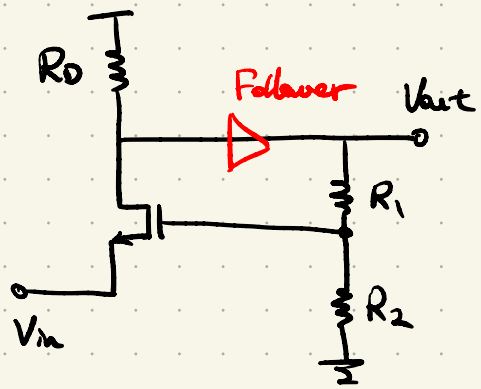
$g_{m1} R_D \gg 1$

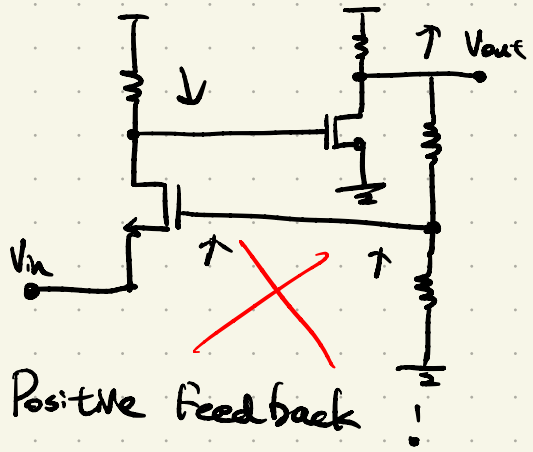
$$\text{Closed-Loop BW} = \frac{1}{R_D C_L}(1 + g_m R_D) \approx \frac{g_{m1}}{C_L}$$

Summary of Voltage-Voltage Feedback Circuits

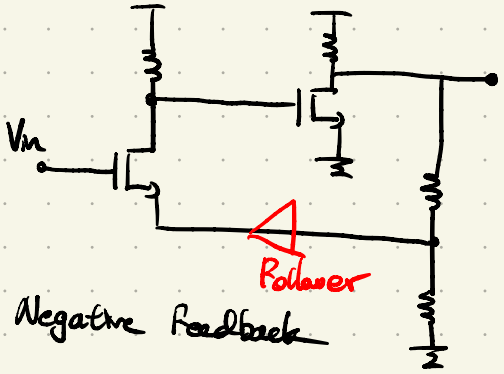








Positive feedback !



Negative Feedback