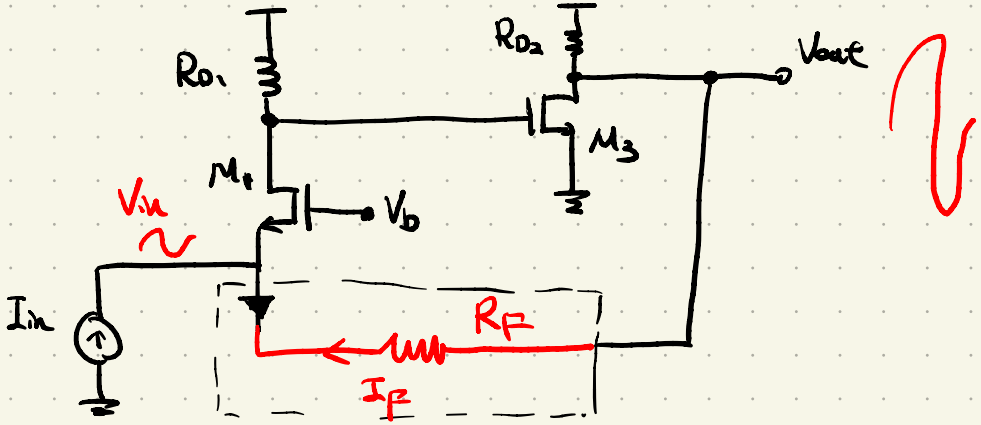
Lec 38

- Example of Voltage - Current Feedback
- Current - Voltage Feedback

Example



Observation:

- A good TIA has a low input imp.
  $\Rightarrow$ a small input voltage
- A good TIA has a high gain
  $\Rightarrow$ a large output voltage

$$I_F = \frac{V_{out} - V_{in}}{R_F} \approx \frac{V_{out}}{R_F}$$

Closed-Loop Parameters?

Open-Loop Parameters: $\text{Gain} = \frac{V_{out}}{V_x} \cdot \frac{V_x}{V_{in}}$

$$= R_{D1}(-g_{m3}R_{D2})$$

$$\text{Input Imp.} = \frac{1}{g_{m1}} \qquad \text{Output Imp.} = R_{D2}$$

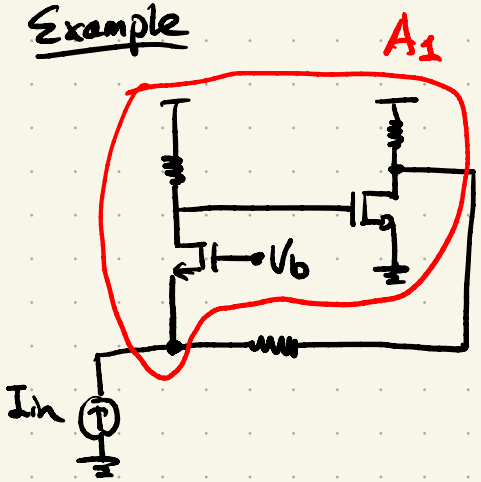
$$K = -\frac{1}{R_F}$$

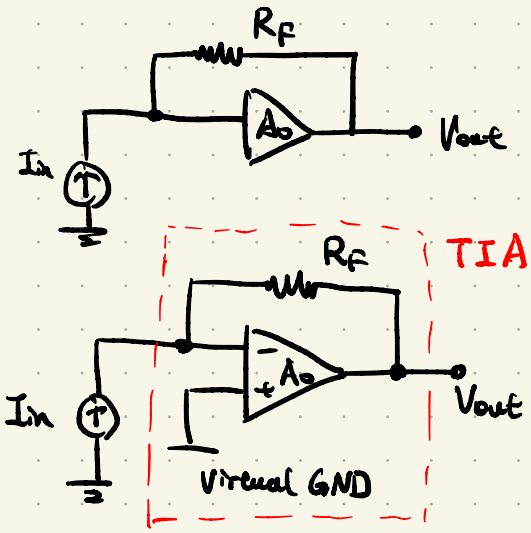
$$\text{Closed-Loop Gain} = \frac{-g_{m3}R_{D2}R_{D1}}{1 + \frac{1}{R_F}(+g_{m3}R_{D2}R_{D1})}$$

$$\text{--- Input Imp} = \frac{1/g_{m1}}{1 + \frac{g_{m3}R_{D2}R_{D1}}{R_F}}$$

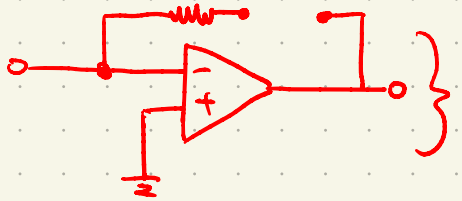
$$\text{--- Output Imp} = \frac{R_{D2}}{1 + \frac{g_{m3}R_{D2}R_{D1}}{R_F}}$$

Example



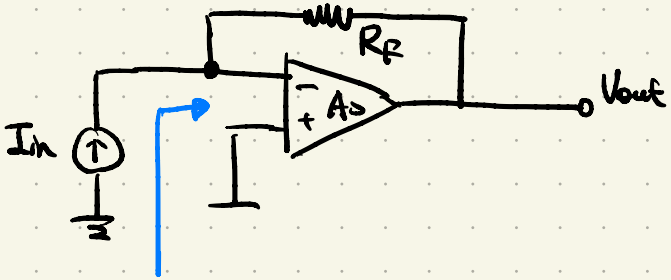


Open-Loop Parameters



Defer this, Later.

Closed-Loop Parameters

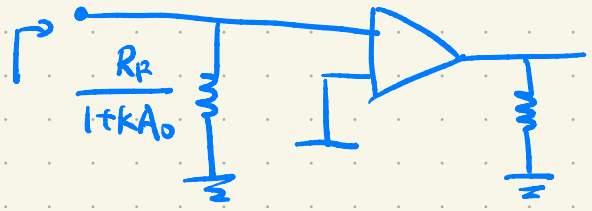


$$\frac{V_{out}}{V_{in}} = -I_{in}$$

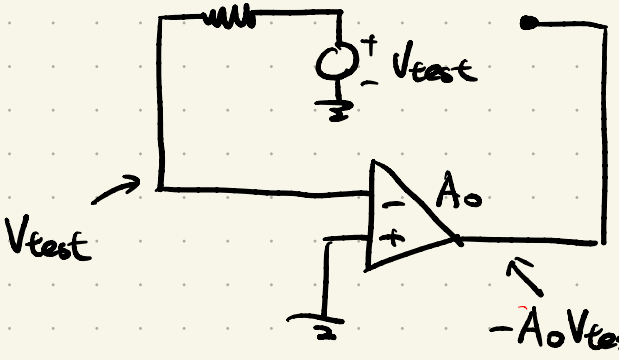
$$\Rightarrow \frac{V_{out}}{I_{in}} = -R_F$$

Miller's:

$$\text{Input Imp.} = \frac{R_F}{1+A_0}$$



Q. Find the loop gain of the circuit.

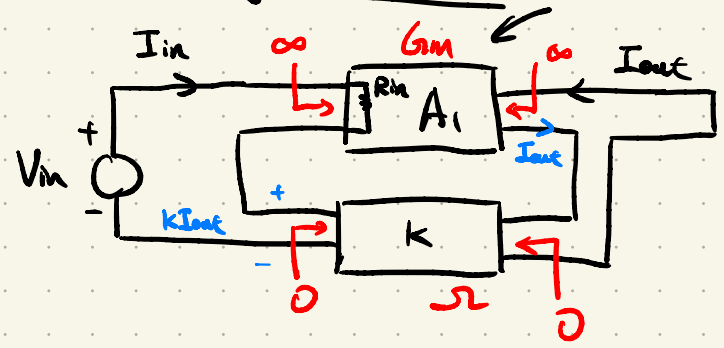


$$\frac{V_R}{V_{test}} = -A_0$$

Loop Gain = A_0

Current – Voltage Feedback

Transconductance Amp.



Closed-Loop Gain:

$$(V_{in} - kI_{out})G_m = I_{out} \Rightarrow \frac{I_{out}}{V_{in}} = \frac{G_m}{1+kG_m}$$

Closed Loop Input Imp:

$$V_{in} - (I_{in}R_{in})G_mk = I_{in}R_{in}$$

$$\Rightarrow \frac{V_{in}}{I_{in}} = R_{in}(1+G_mK)$$