Lec 37

- Voltage - Current (Shunt - Shunt) Feedback
- Examples

Voltage - Current feedback Topologies
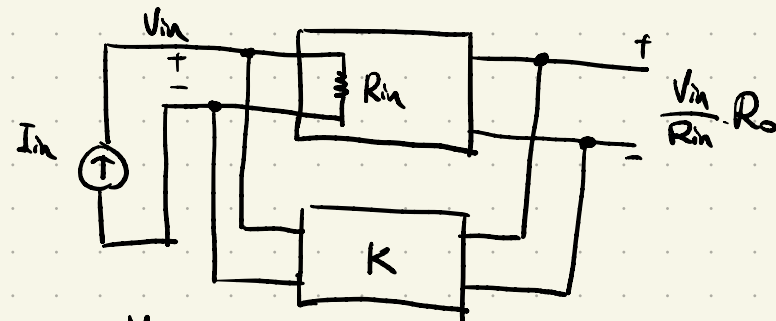
O (R_0) **Transimpedance Amp (TIA)**

$$[R_0] = \Omega$$

$$[k] = \frac{1}{\Omega}$$
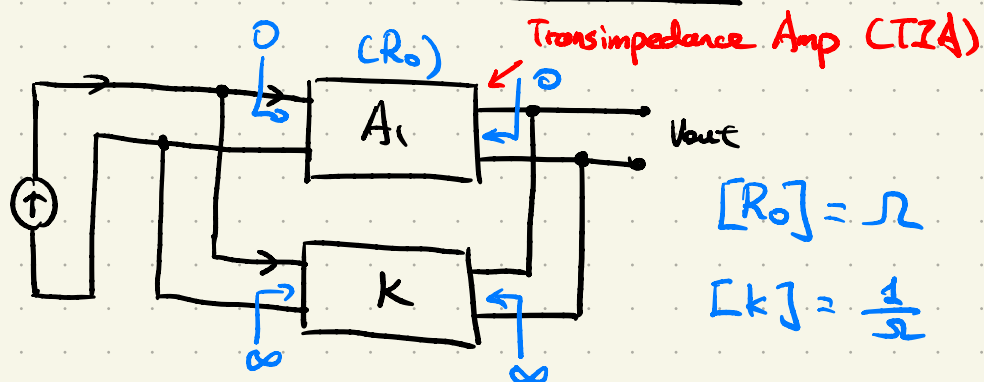
Closed-Loop Gain:

$$(I_{in} - K V_{out}) R_0 = V_{out}$$

$$\Rightarrow \quad \frac{V_{out}}{V_{in}} = \frac{R_0}{1 + K R_0}$$

Closed-Loop Input Imp. :
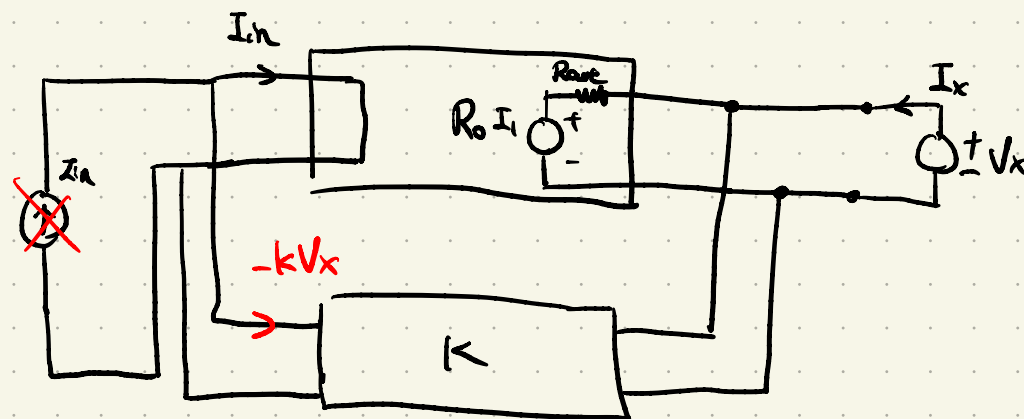

$$\frac{V_{in}}{R_{in}} \cdot R_0$$

$$\left(I_{in} - \frac{V_{in}}{R_{in}} \cdot R_0 \cdot k \right) R_{in} = V_{in}$$

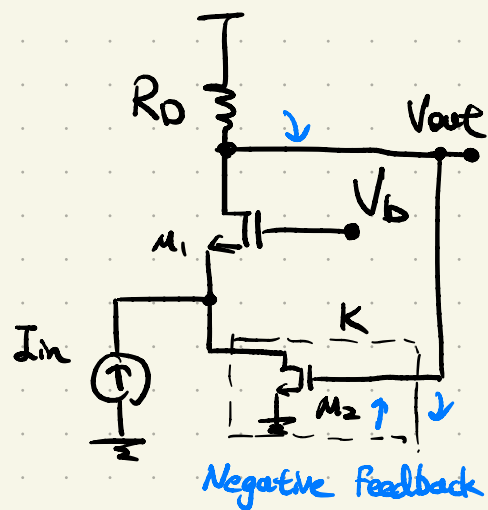$$\boxed{\frac{V_{in}}{I_{in}} = \frac{R_{in}}{1 + k R_0}}$$

Closed-Loop Output Imp.

$$I_x = \frac{V_x + K V_x R_0}{R_{out}}$$

$$\boxed{\frac{V_x}{I_x} = \frac{R_{out}}{1 + K R_0}}$$

Example

How do we return a current to the Input?

Open-Loop Gain = R_D

OL Input Imp. $R_{in} = \frac{1}{g_m}$

OL Output Imp. $R_{out} = R_D$

Closed-Loop Parameters

Negative Feedback

$K = g_{m_2}$

Closed-Loop Gain = $\dfrac{R_D}{1 + g_{m_2} R_D}$

Closed-Loop Input Imp. = $\dfrac{\frac{1}{g_m}}{1 + g_m R_D}$
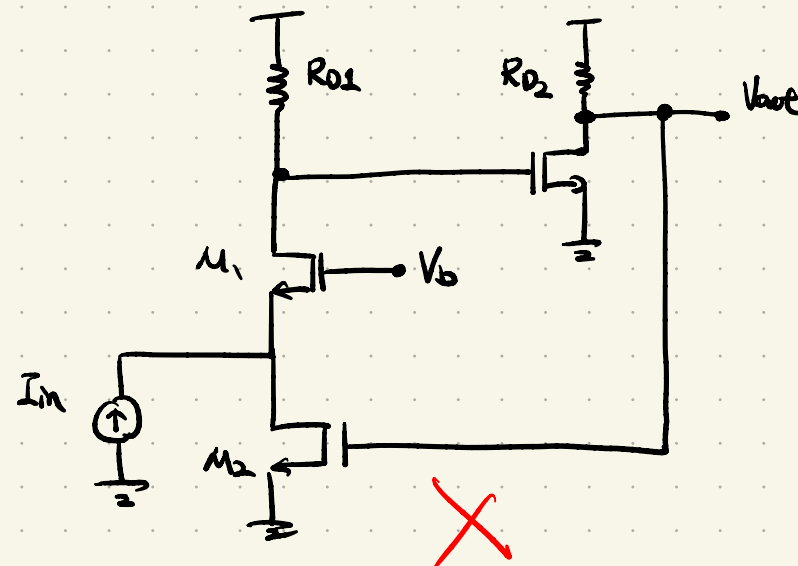
Closed-Loop Output Imp: $\dfrac{R_D}{1 + g_{m_2} R_D}$

Example

Positive Feedback