Feedback Application

Hanwool Jeong

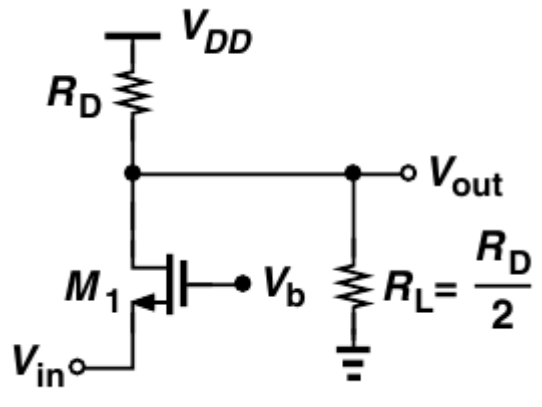
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Contents

- You remember the effect of feedback, especially for the robustness to the variation?
- There are many types of feedbacks according to the type of signal we sense, voltage or current.
- How can we “sense” and “return” voltage or current in the feedback system?
- How can we determine the polarity of the feedback system? Positive or negative?

Example 12.8

The common-gate stage of Fig. 12.10 must drive a load resistance $R_L = R_D/2$. How much does the gain change (a) without feedback, (b) with feedback?

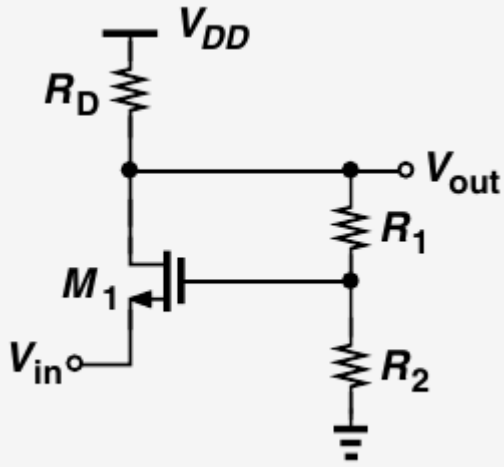


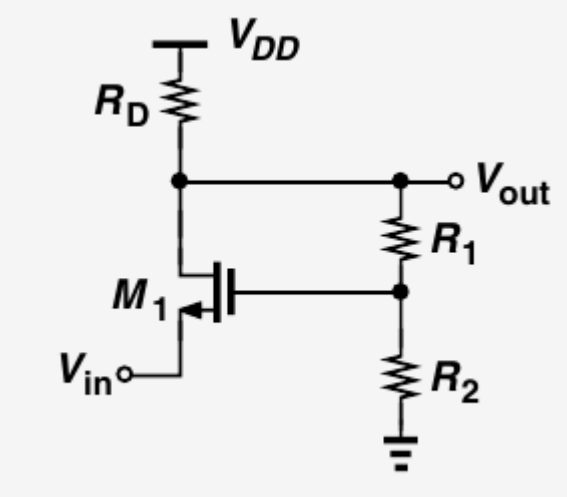
I/O Modification

- How would I/O impedance be affected by the feedback?

Example 12.7

Figure 12.10 depicts a transistor-level realization of the feedback circuit shown in Fig. 12.2. Assume $\lambda = 0$ and $R_1 + R_2 \gg R_D$ for simplicity. (a) Identify the four components of the feedback system. (b) Determine the open-loop and closed-loop voltage gain. (c) Determine the open-loop and closed-loop I/O impedances.




V_{DD}
R_D
V_{out}
R_1
M_1
V_{in}
R_2

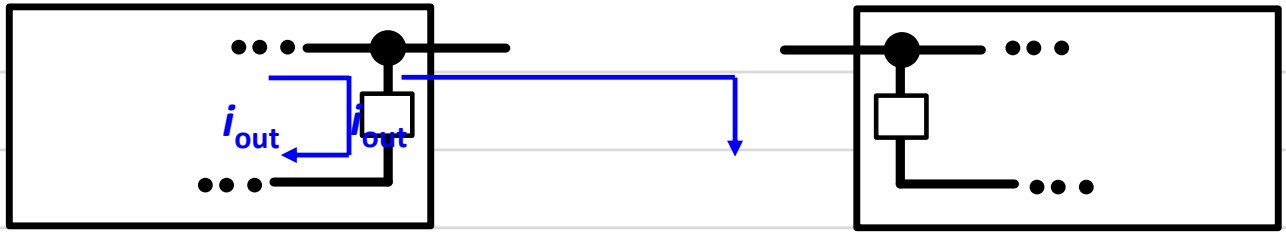
Various Types of Amplifiers

You Remember
How Current Input is Transferred?

- Generally, the circuit is connected as follows.



- You can consider the inside circuit as follows when the current is transferred.

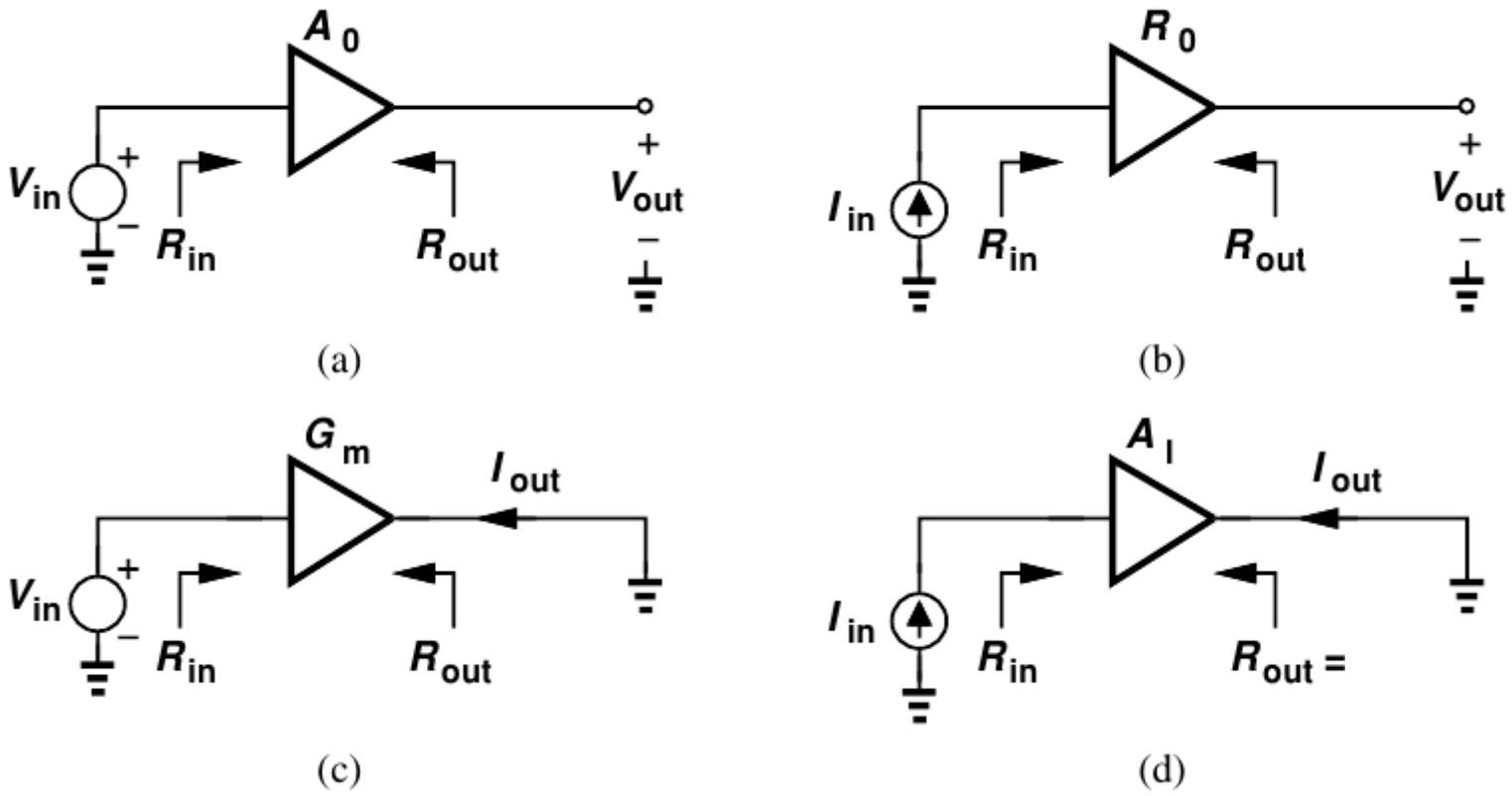


Sometimes Current Sensing is More Viable

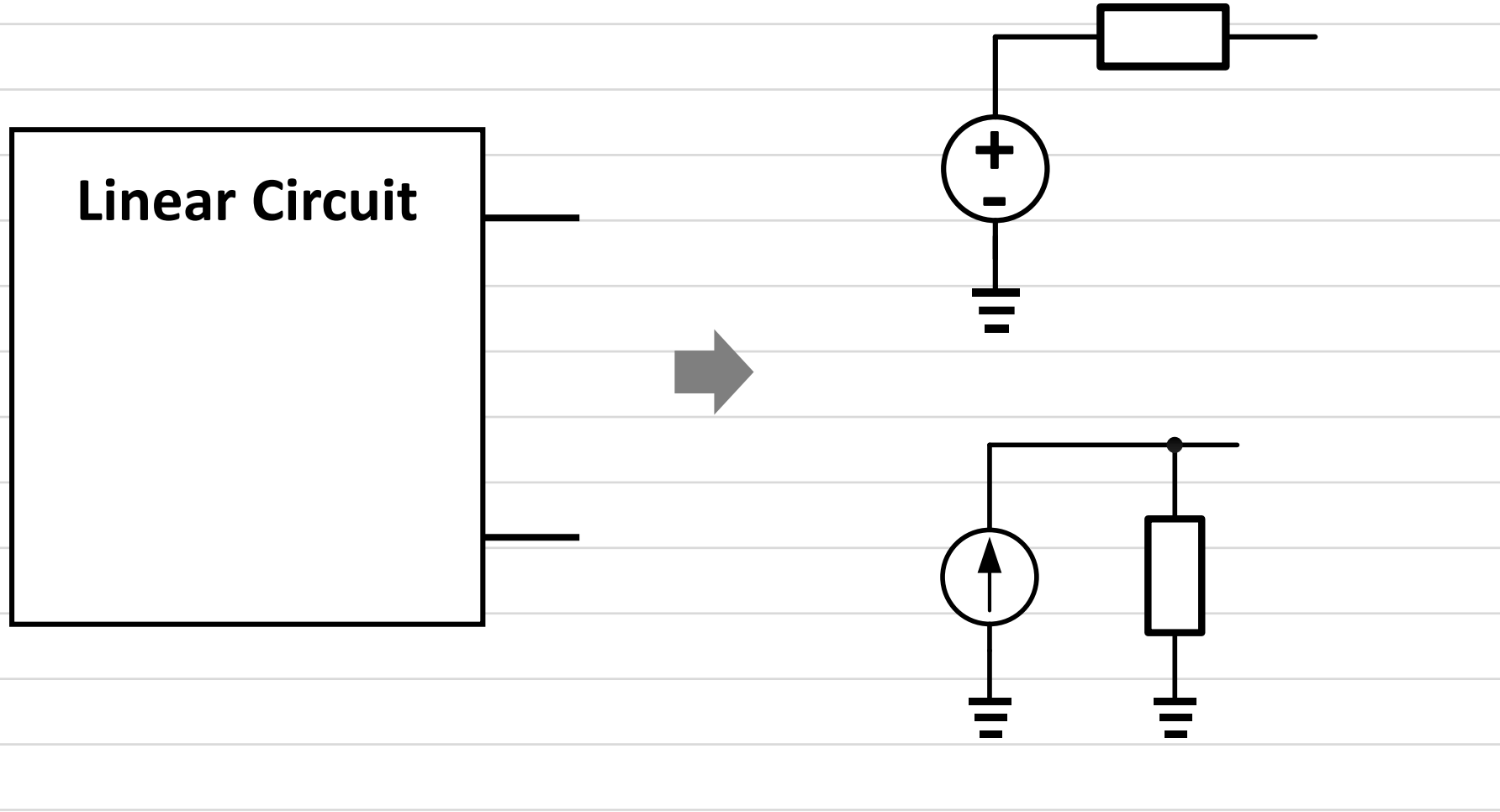
- We should see how the current is sensed



Types of Amplifiers

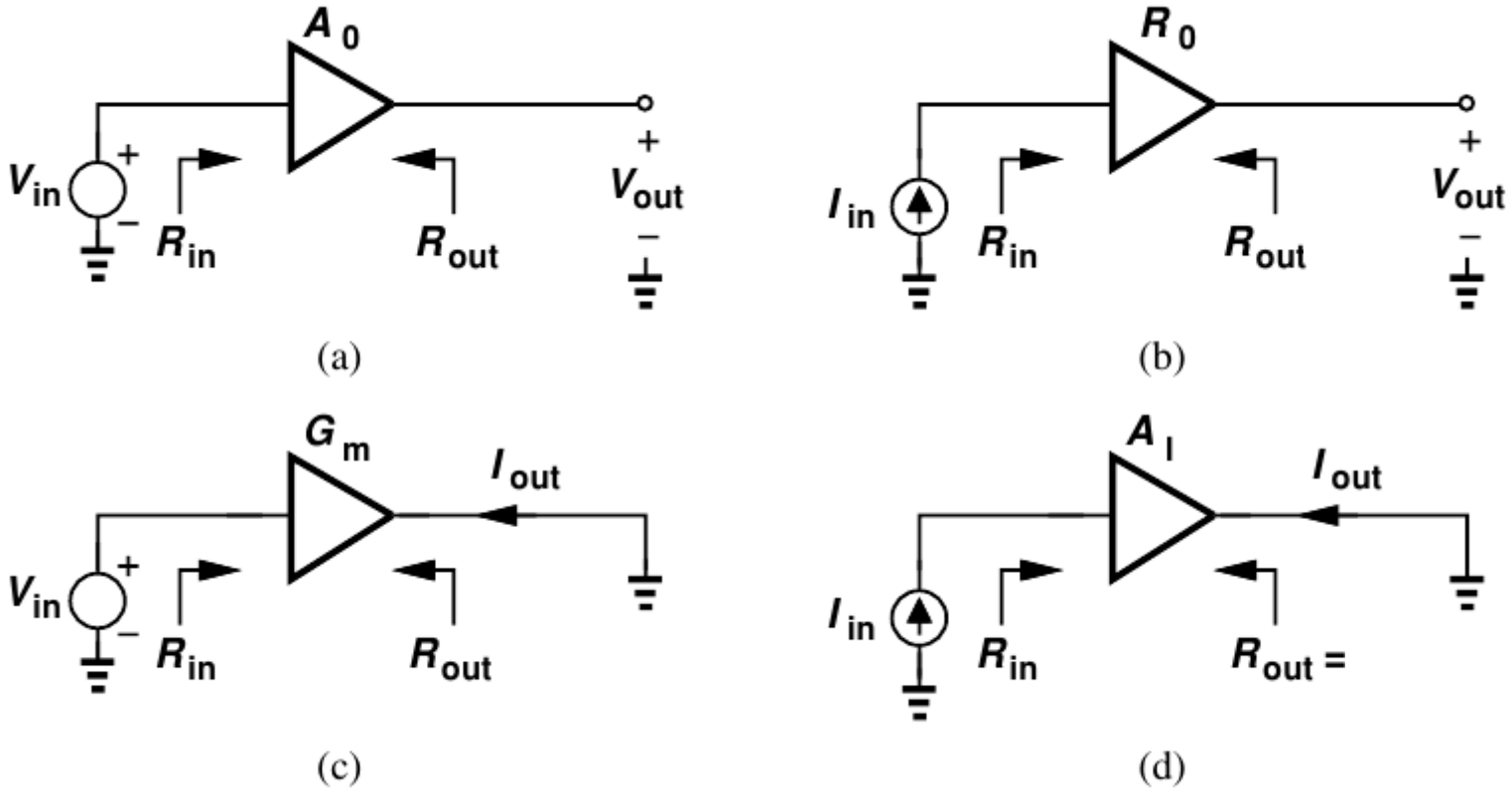


Equivalent Circuits

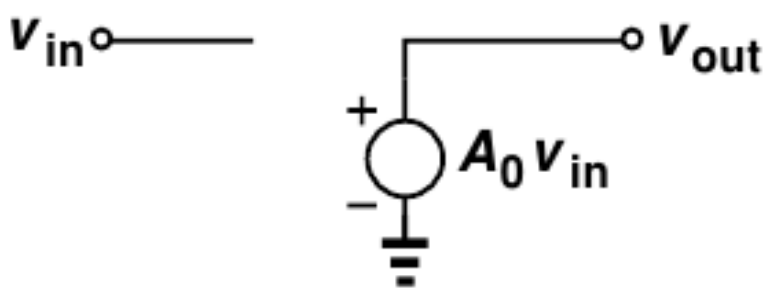
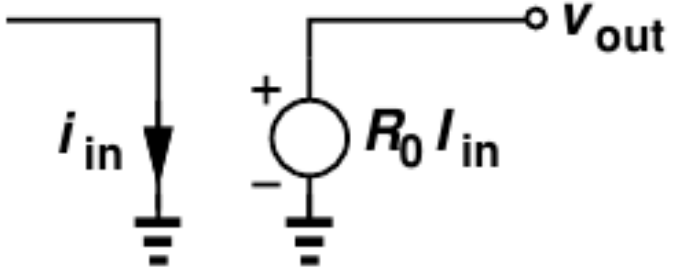
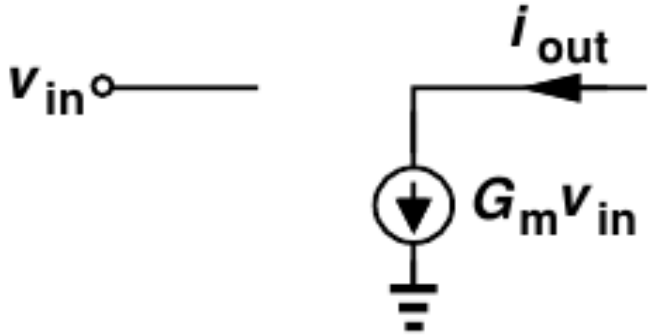
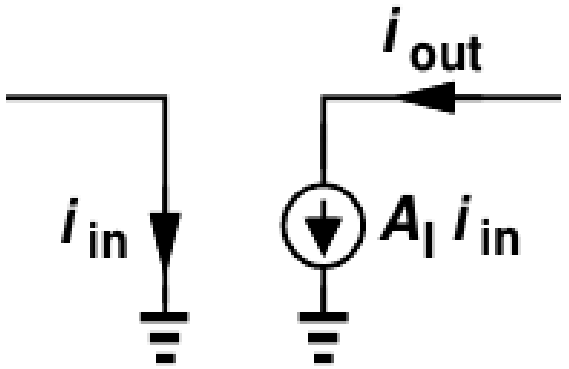


Desirable I/O Resistances

- Sensing V_{in} : High R_{in} is good. Sensing I_{in}? ➔ Small R_{in} is good!
- Sourcing V_{out} : Small Rout is good. Sourcing I_{out}? ➔ Large R_{out} is good!

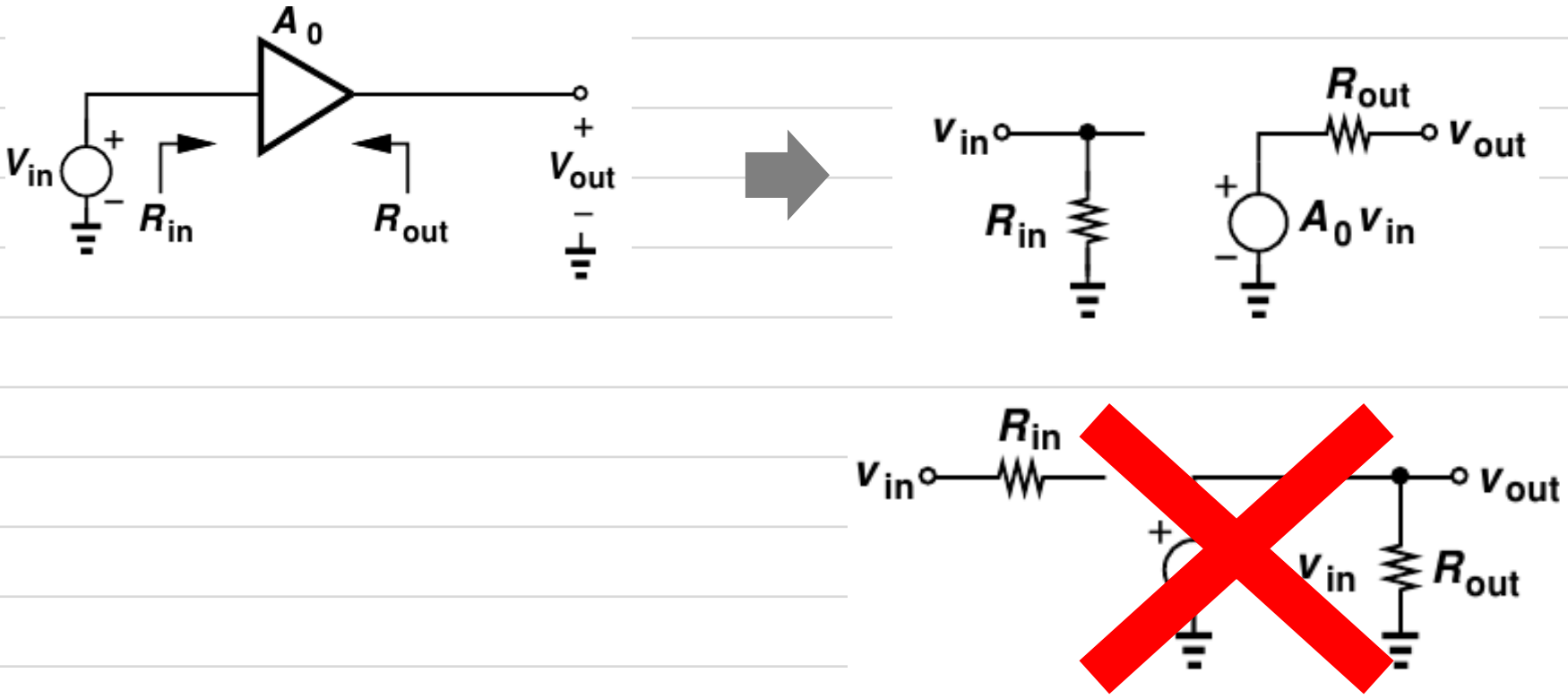


Simple Ideal Amplifier Models

Voltage Amplifier	Transimpedance amplifier
	
Transconductnace amplifier	**Current Amplifier**
	

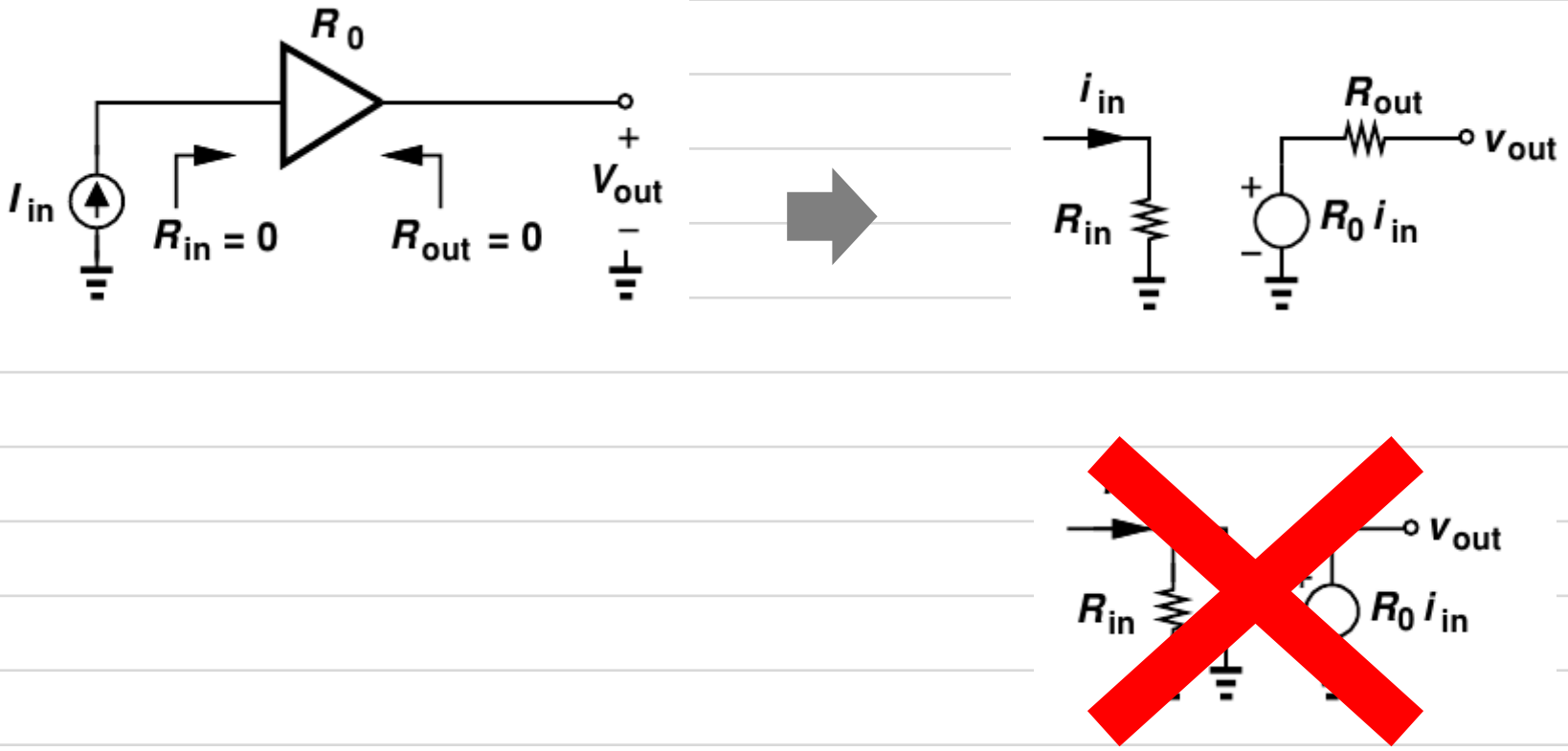
Realistic Simple Model of Voltage Amplifier

- Voltage cannot be transferred 100% in real.

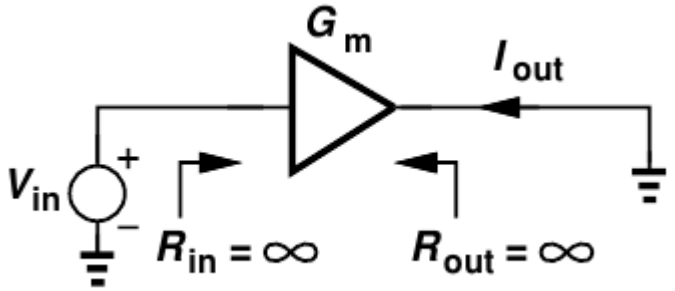


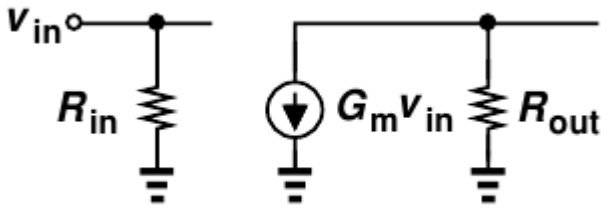
Realistic Model of Transimpedance Amplifier

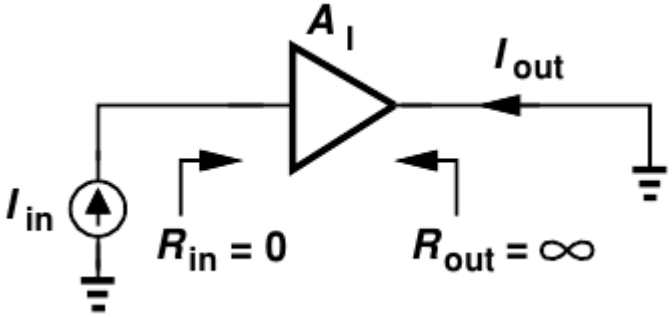
- Current cannot be transferred 100% in real.

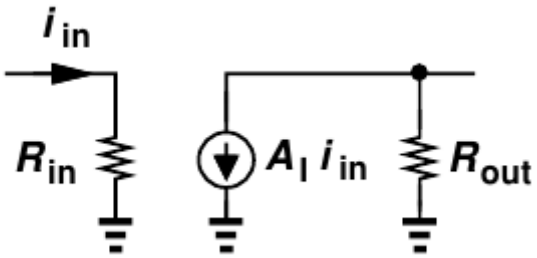


Realistic Model of Transconductance/Current Amplifier



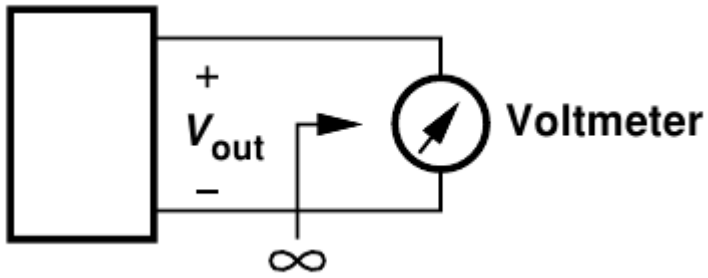


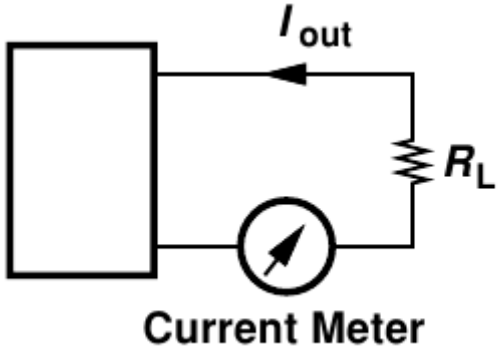




Voltmeter & Current Meter

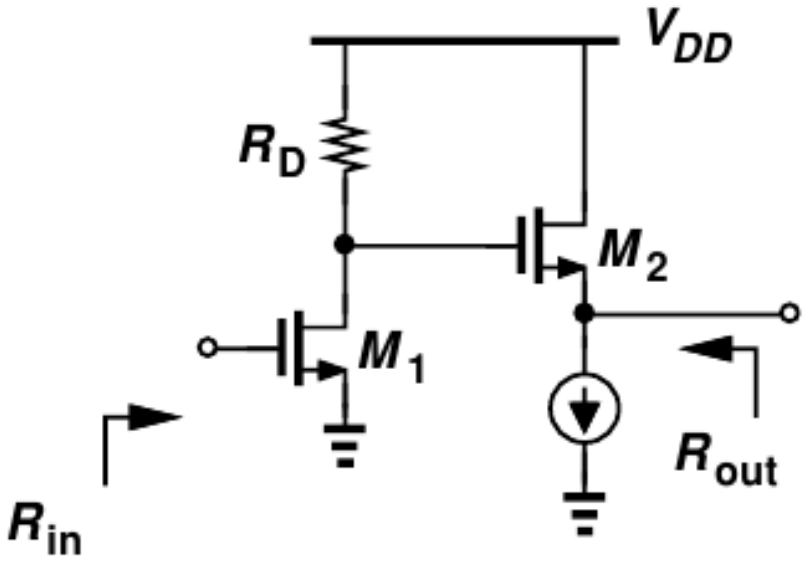
- How do we measure the voltage? What is the desirable condition of voltmeter? How about the current meter?
- Can you think of voltage/current source as well?



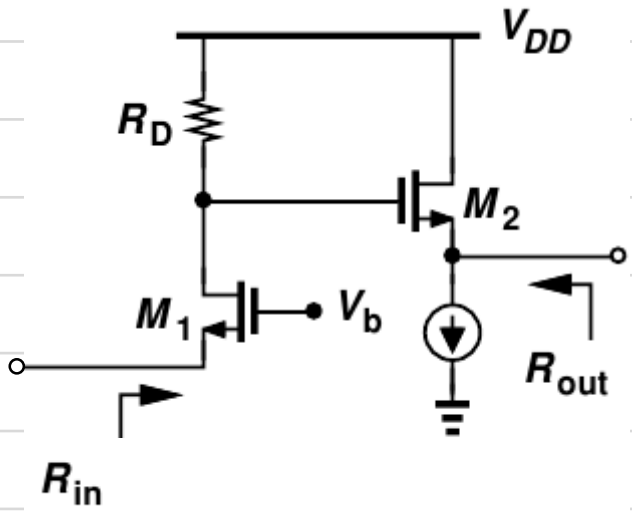


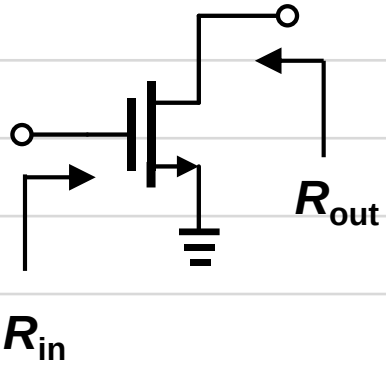
How Would You Use This?

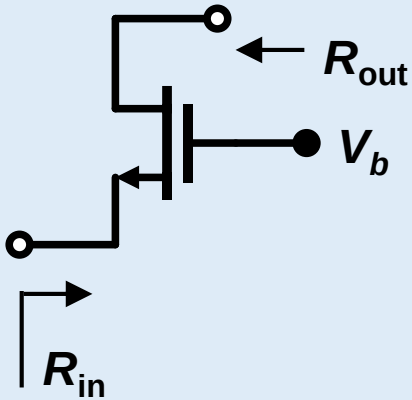
- Among V→V, I→V, V→I or I→V?
- What about gain?



How About This?



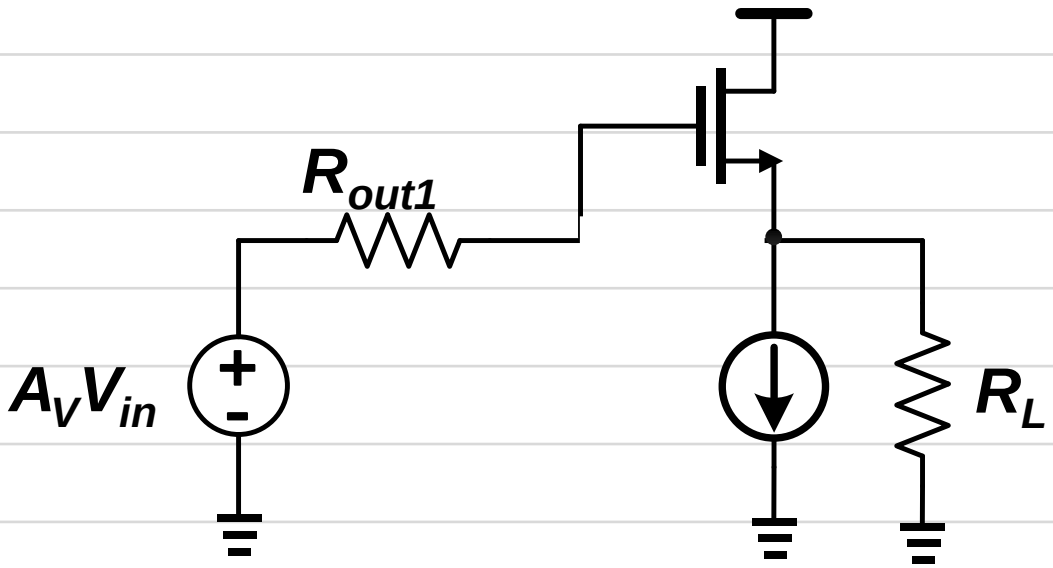




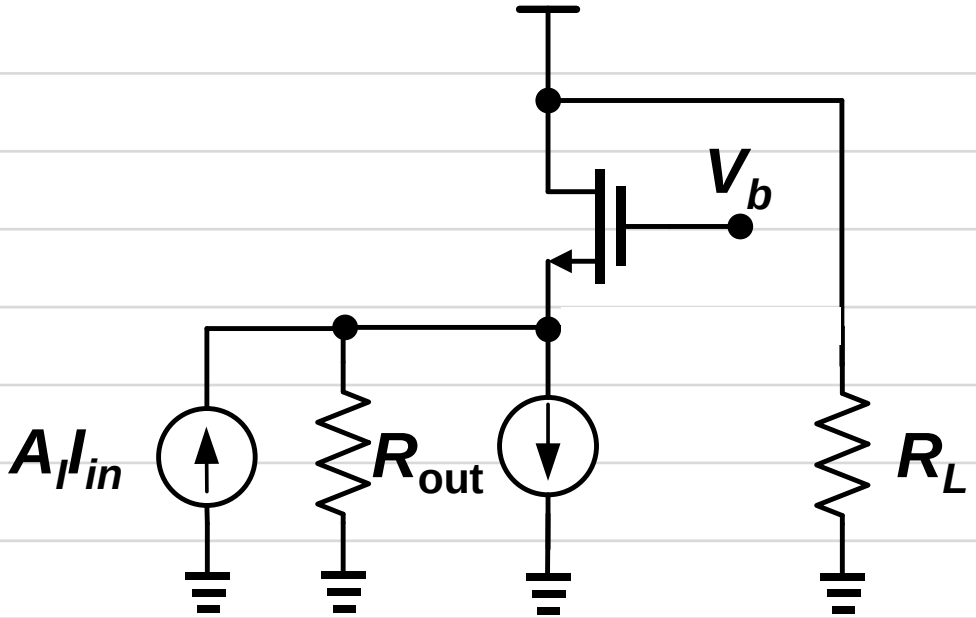
Why do we use this?

You Remember Why We Use SF?

- Source follower is useful because..

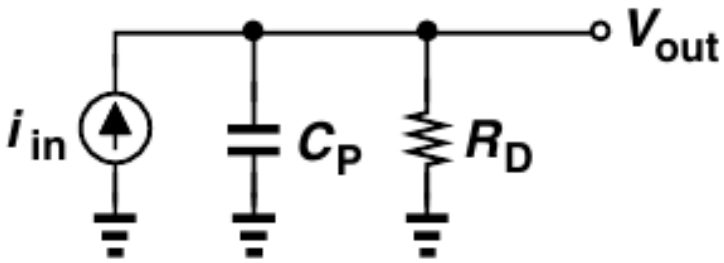


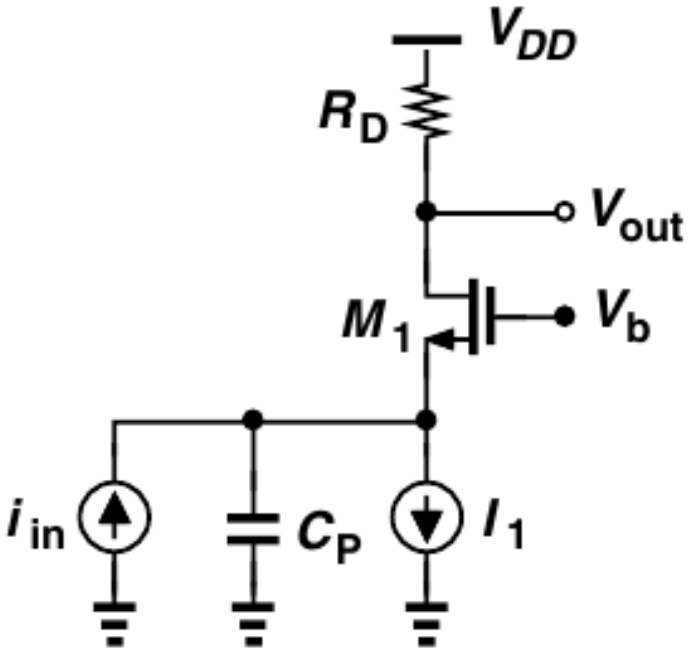
Consider Current Transfer



How About Frequency Response?

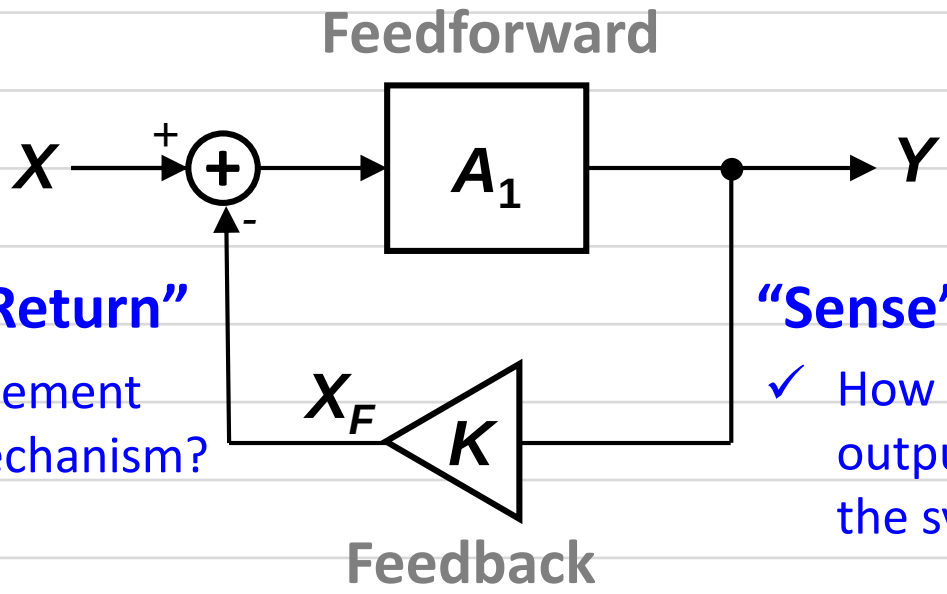
- Can you conclude something?





Sense and Return Techniques

Sense? Return?

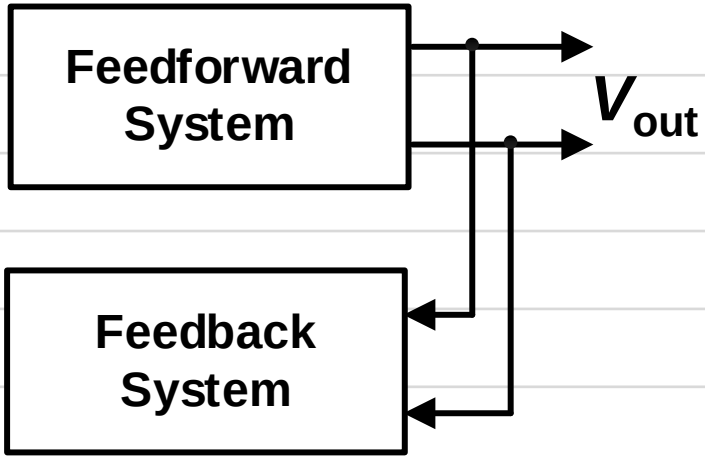


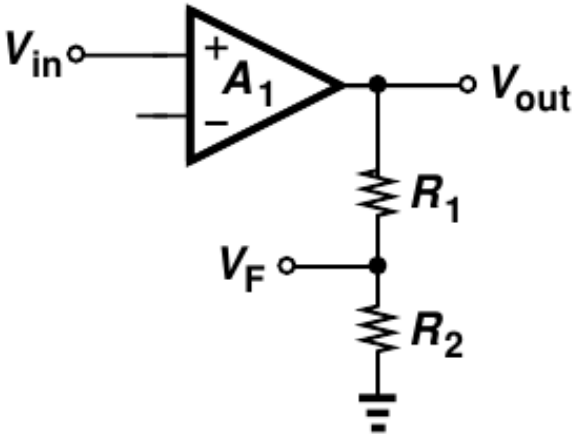
- ✓ How can we implement a comparison mechanism?
- ✓ How can we sense the output info. w/o affecting the system?

First, Focus on Sense!
Sensing Output by Voltage

- How can we sense the output as **voltage** to apply it to feedback network?

➔ What is the meaning of infinite input resistance?

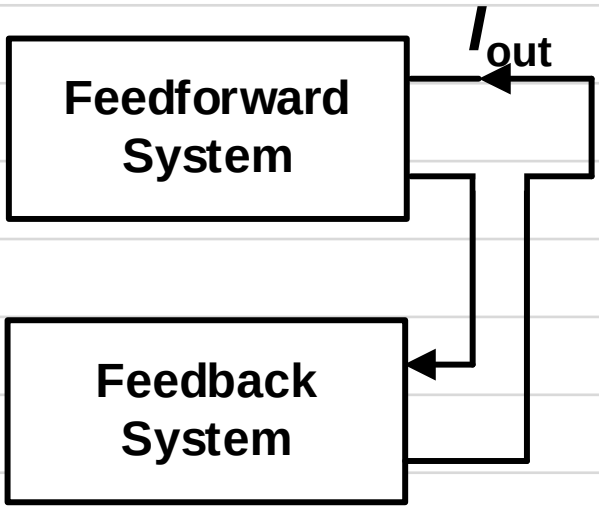


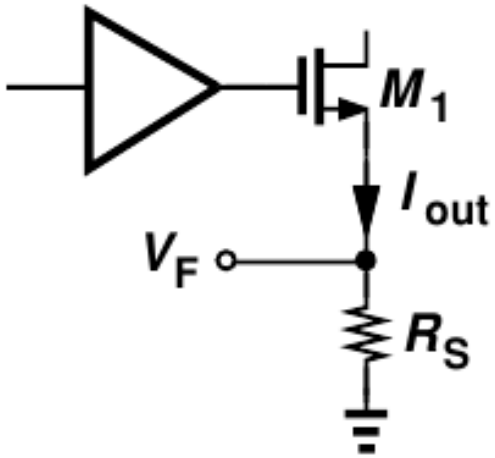


Sensing Output by Current

- How can we sense the output as **current** to apply it to feedback network?

➔ What is the desirable condition of R_{in}?



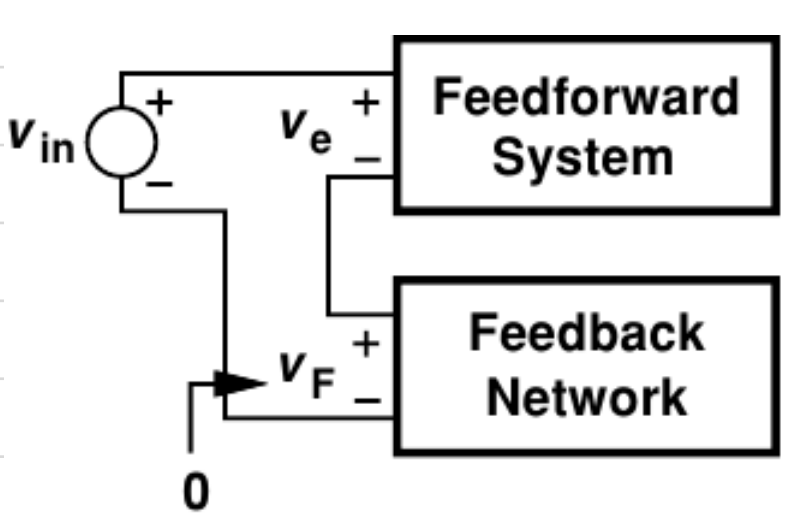


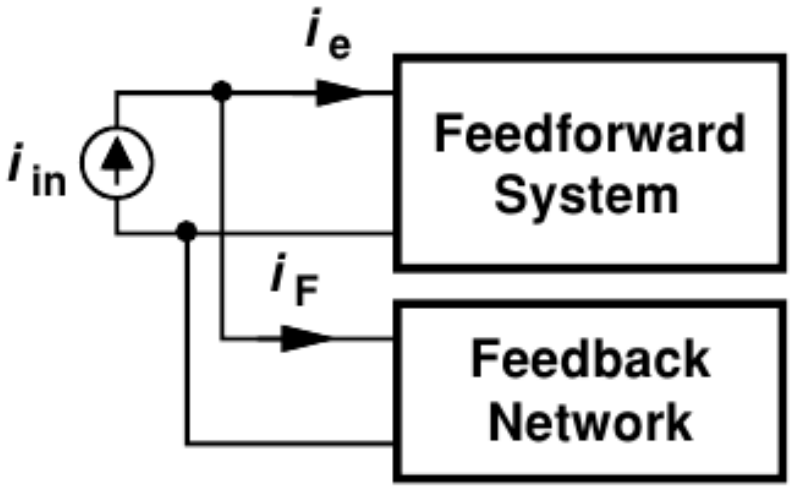
Return;
How Can We Realize Subtraction?

- That is,

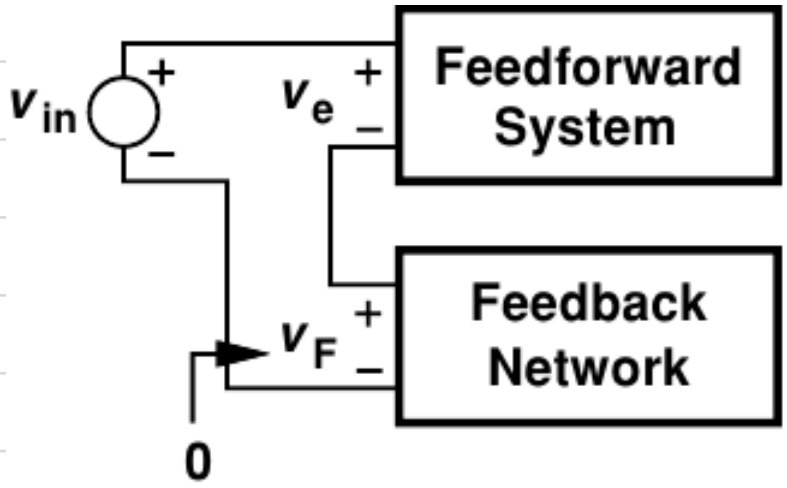
$$v_e = v_{in} - v_F. \qquad i_e = i_{in} - i_F$$

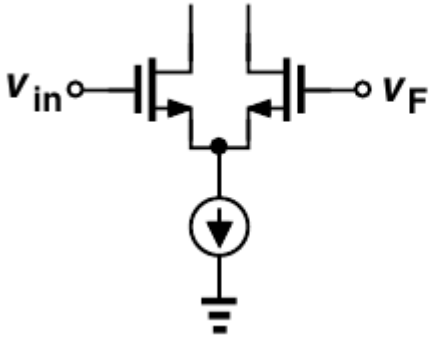
- For voltage and current return,

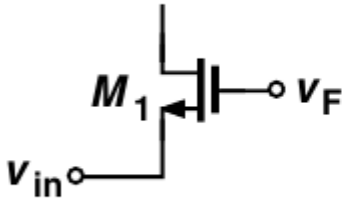


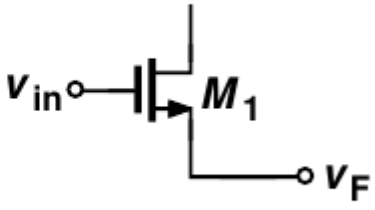


Voltage Subtraction Implementation

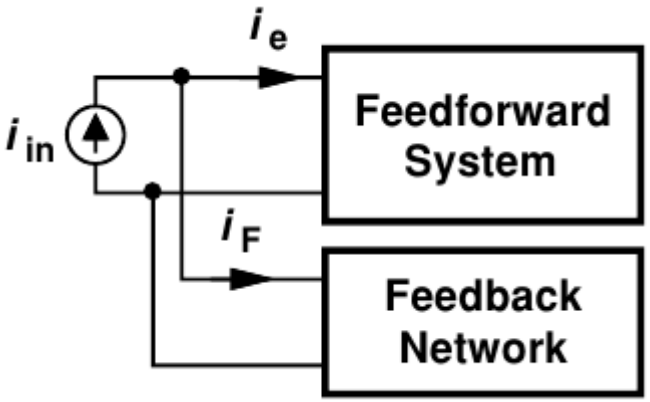


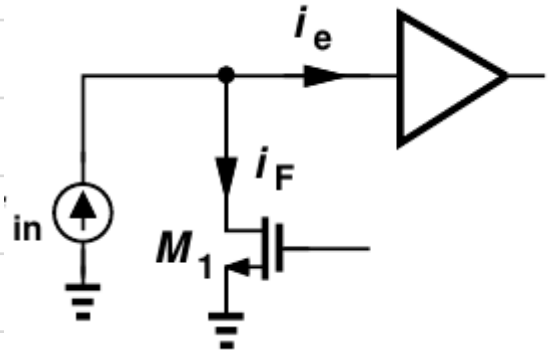


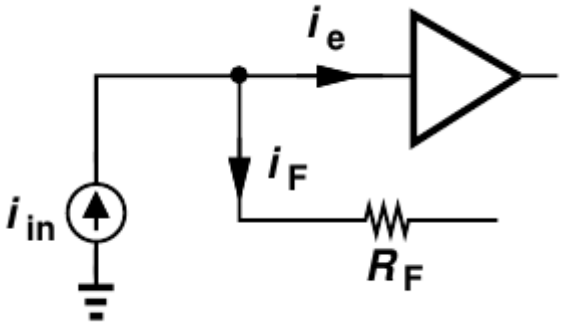




Current Subtraction Implementation

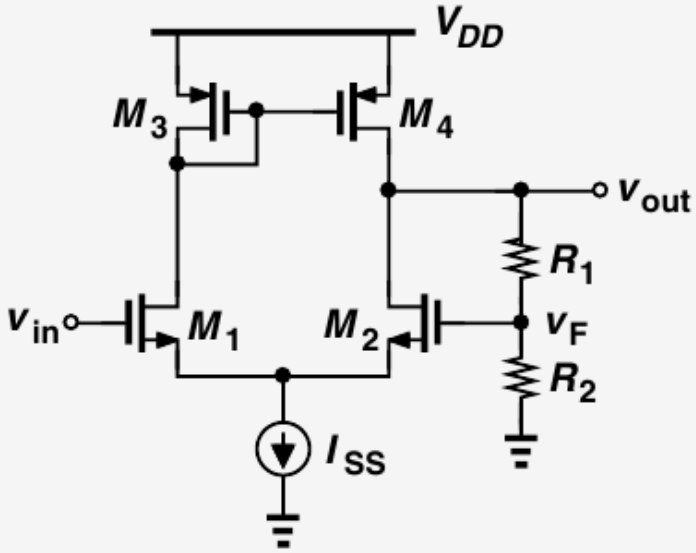






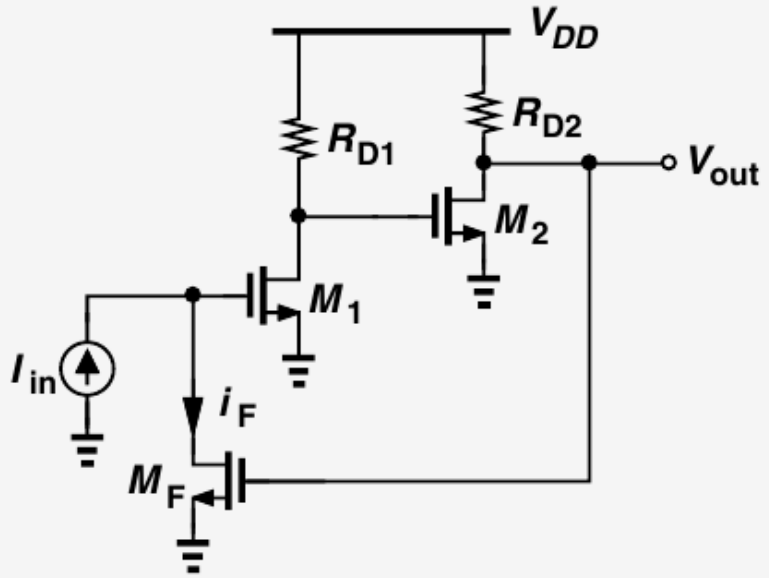
Example 12.10

Determine the types of sensed and returned signals in the circuit of Fig. 12.23.



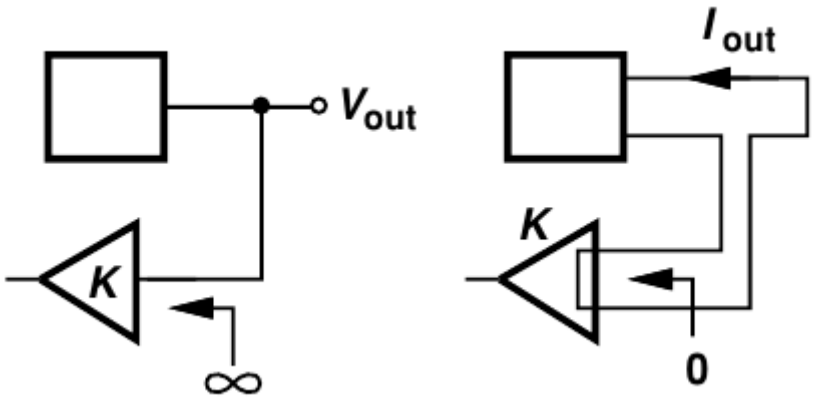
Example 12.11

Compute the feedback factor, K, for the circuit depicted in Fig. 12.24. Assume $\lambda = 0$.

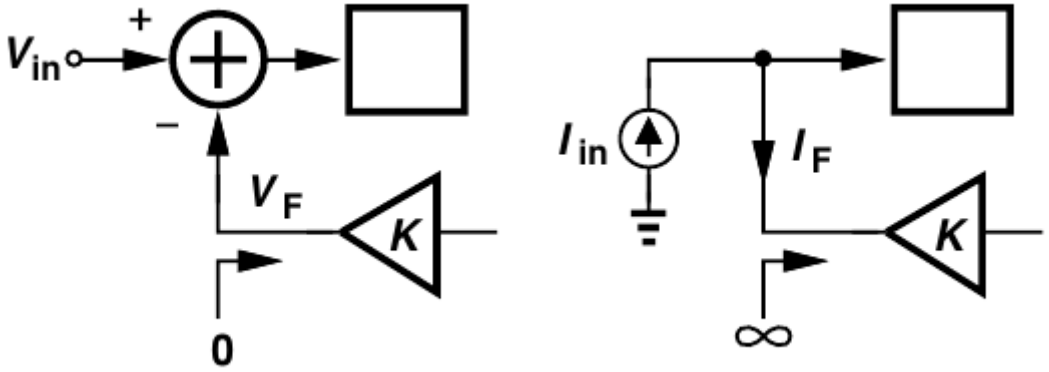


What is Good Feedback Network?

- For Sense,



- For return,



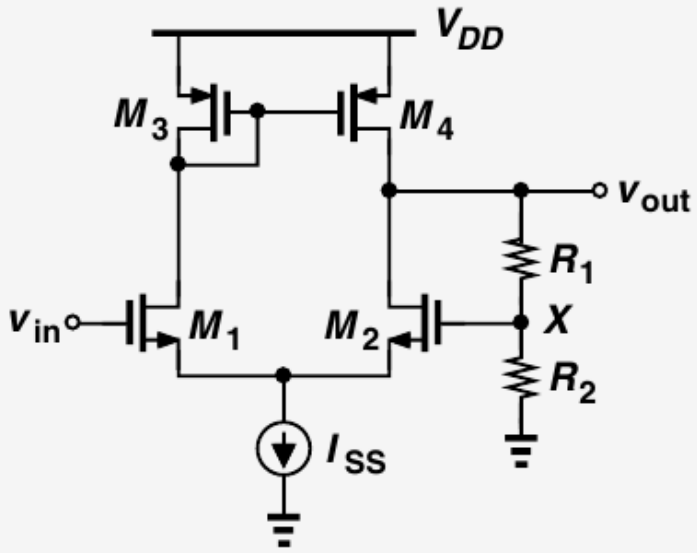
Polarity of Feedback

Determining Polarity

1) Assume the input signal goes up (or down)
2) Follow the change through the forward amplifier and the feedback network
3) Determine whether the returned quantity **opposes** or **enhances** the original "effect" produced by the input change.

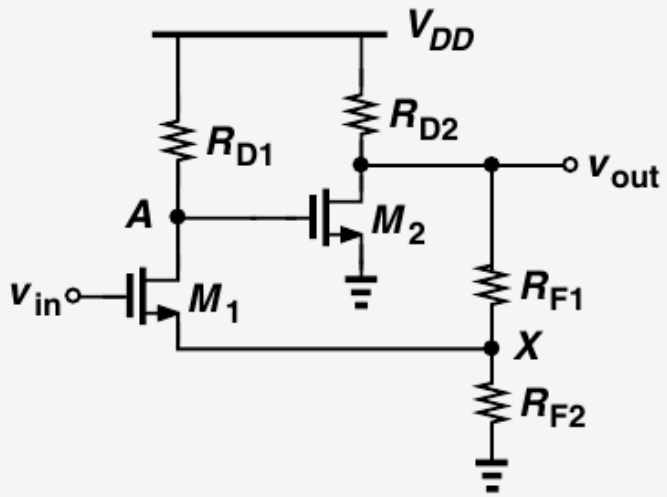
Example 12.12

Determine the polarity of feedback in the circuit of Fig. 12.26.



Example 12.13

Determine the polarity of feedback in the circuit of Fig. 12.27.



Example 12.14

Determine the polarity of feedback in the circuit of Fig. 12.28.

