Chapter 6 - The Operational Amplifier

Lecture 18

Sections 6.2-6.3

MEMS 0031 Electrical Circuits

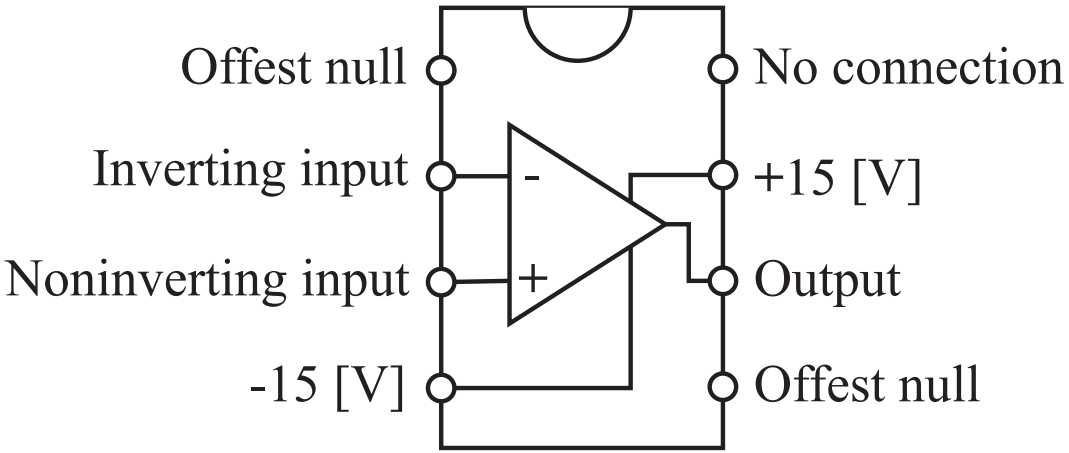
Mechanical Engineering and Materials Science Department
University of Pittsburgh

Student Learning Objectives

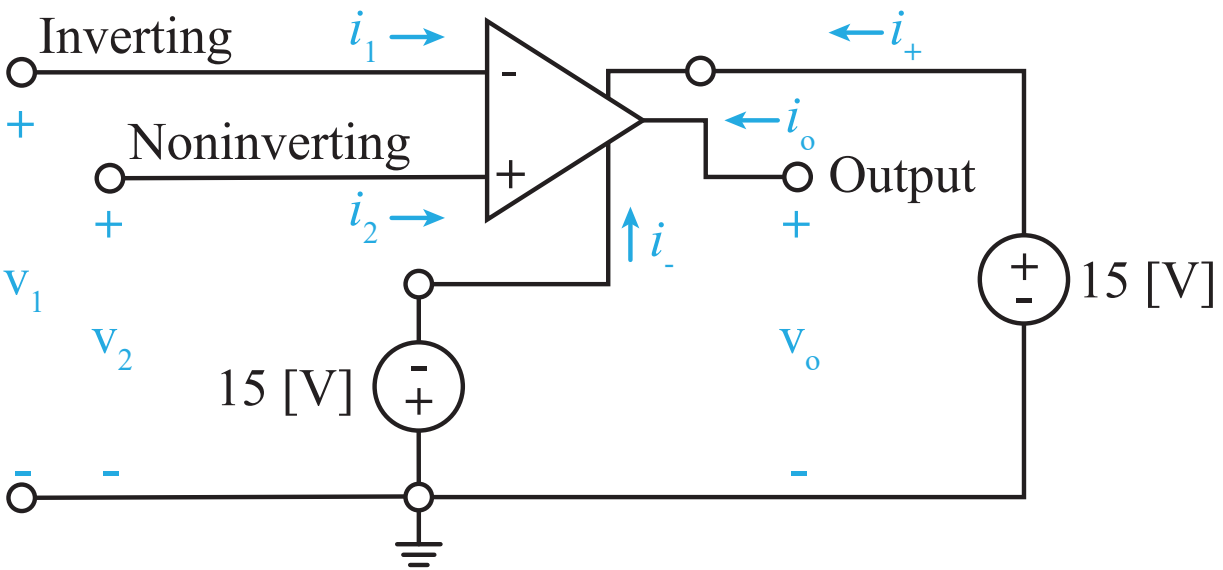
At the end of the lecture, students should be able to:

- Understand the operation of an operational amplifier
- Understand and apply the two main assumptions when modeling operational amplifiers, as well as the three requirements for an operational amplifier to operate in the linear range

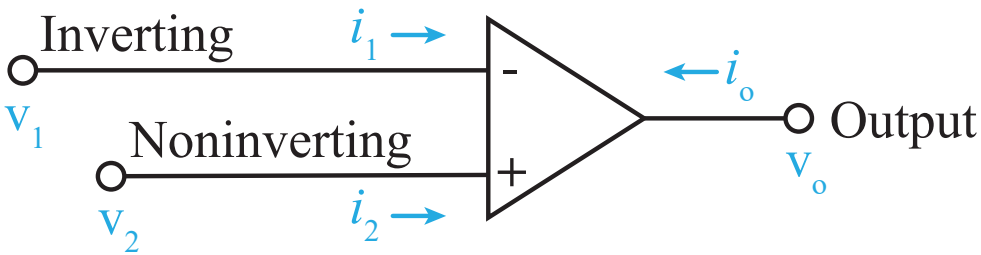
Op-amp



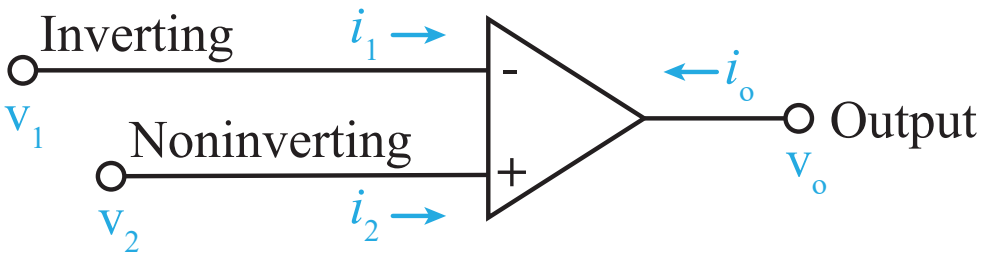
Op-amp Anatomy



Ideal Op-amp

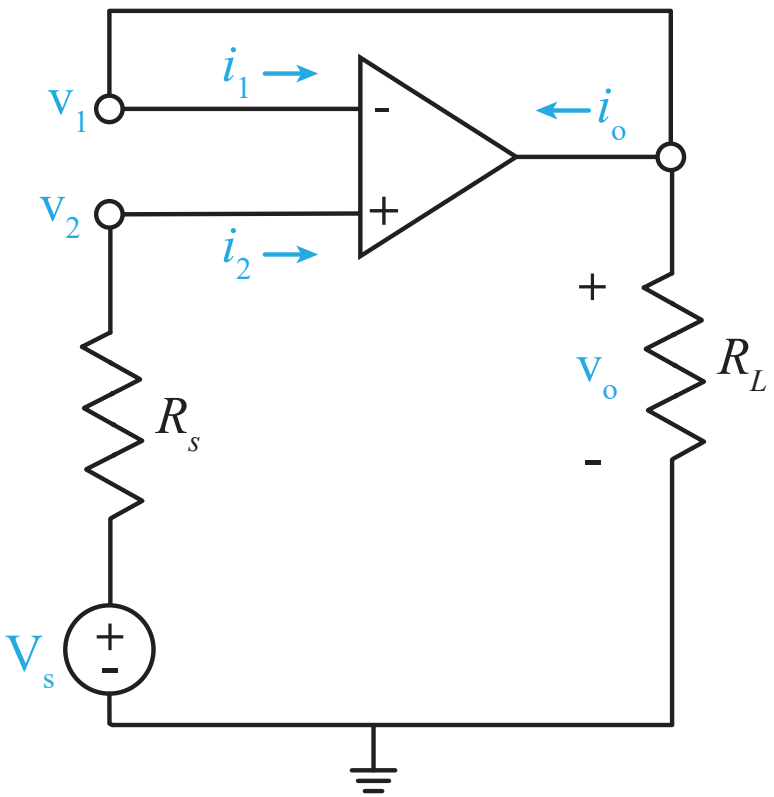


Ideal Op-amp Cont'd



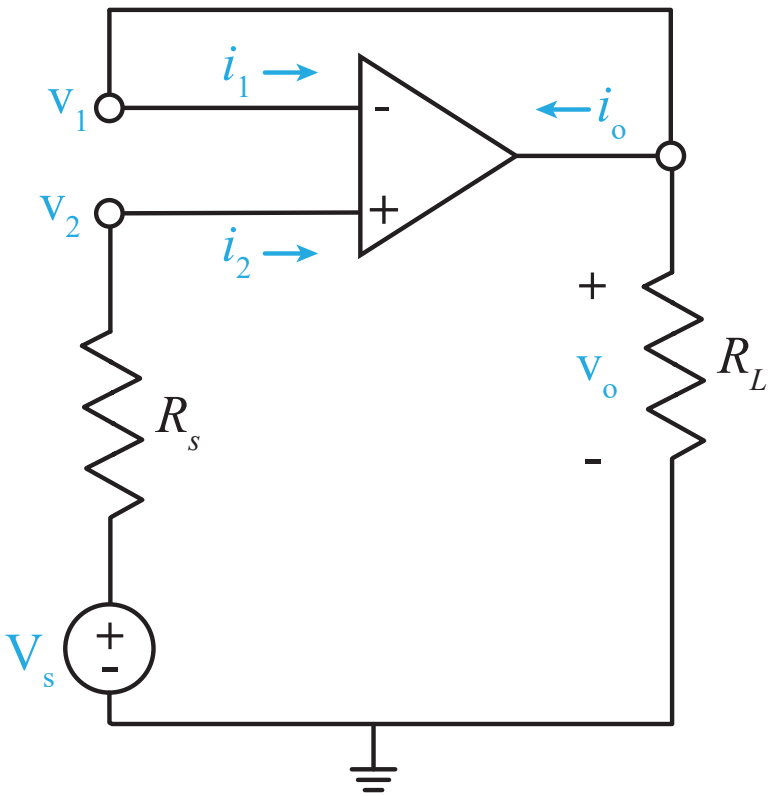
Example #1

- Solve for v_o and i_o given V_s=10 [V] and R_L=20 [kΩ]



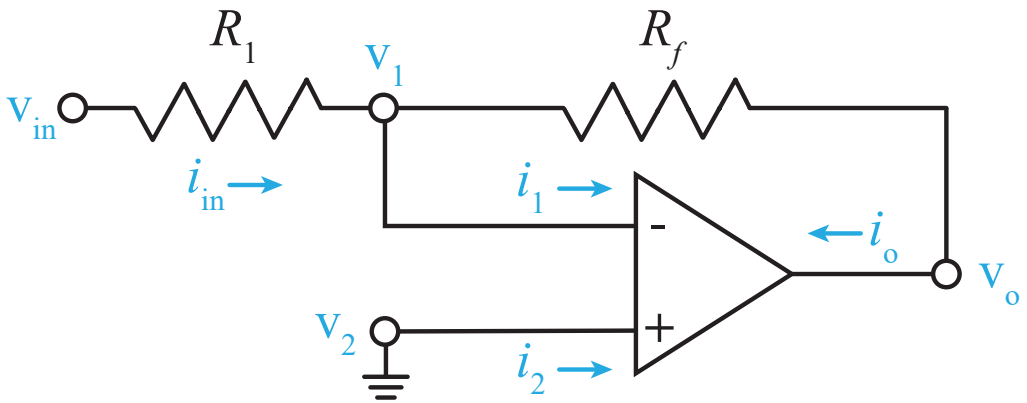
Example #2

- Given V_{sat}=14 [V], i_{sat}=2 [mA] and SR=0.5 [V/μs], determine if the operation is ideal



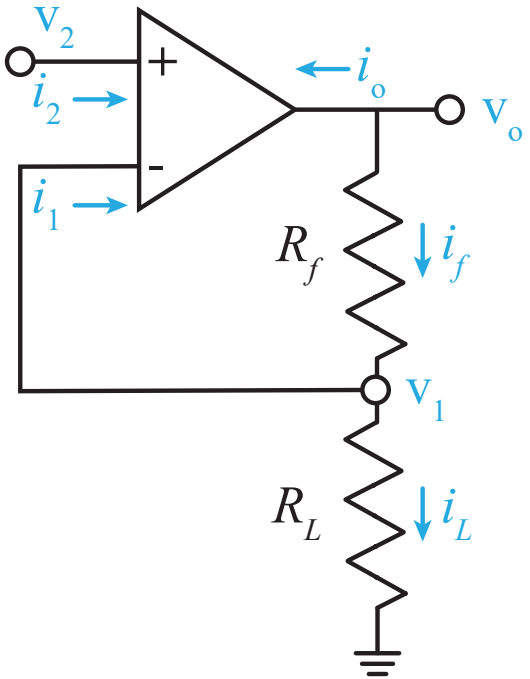
Example #3

- Find v_o, assuming ideal behavior



Example #4

- Find v_o, assuming ideal behavior



Student Learning Objectives

At the end of the lecture, students should be able to:

- Understand the operation of an operational amplifier
  - An Op-amp is able to manipulate an input signal (amplify or attenuate).
- Understand and apply the two main assumptions when modeling operational amplifiers, as well as the three requirements for an operational amplifier to operate in the linear range
  - It is assumed the input currents into the inverting and non-inverting terminals is zero, and that the potential at said terminals is the same. For linear behavior, the output voltage and current must be less than the saturation, and the time-rate-of-change of the output voltage must be less than the slew rate.

Suggested Problems

- 6.3-1, 6.3-2, 6.3-3, 6.3-6, 6.3-7, 6.3-8, 6.3-10, 6.3-15