

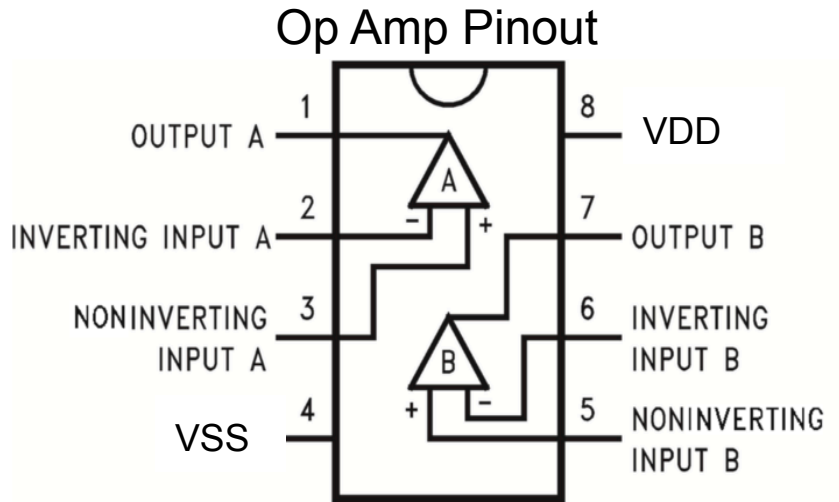
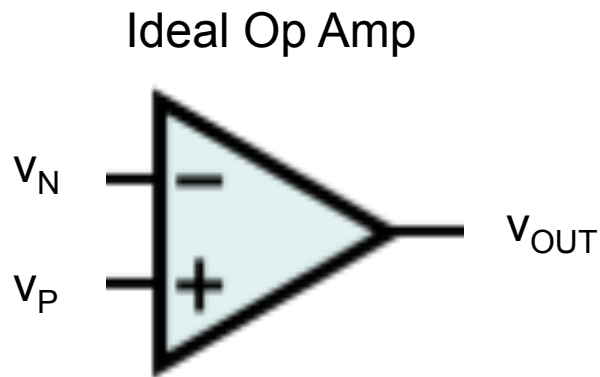
Build your first circuit

EE16b
Spring 2017

Introduction

- Now that we have learned about debugging, it's time to build our first circuit of the semester.
- Make sure you take the debug quiz:
<http://tinyurl.com/debugLabQuiz>

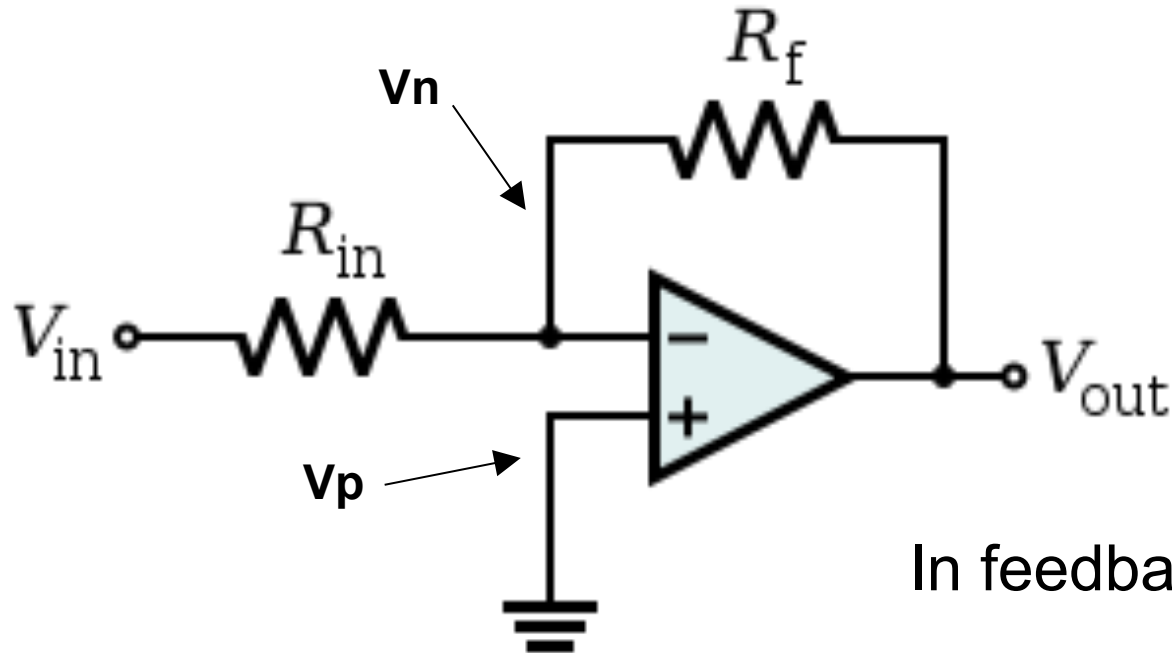
Operational Amplifier (Op Amp)



- v_N = Inverting Input
- v_P = Noninverting Input
- $v_{OUT} = A_V(v_P - v_N)$
 - A_V is very large

- Op Amps are active device
 - Output is bounded by rails
- For 0 to 5V signals
 - $VDD = 5V$
 - $VSS = GND$
- For -5 to 5V signals
 - $VDD = 5V$
 - $VSS = -5V$

Inverting Amplifier



In feedback, $v_N = v_P$.

$$v_P = 0 \Rightarrow v_N = 0$$

$$i_{in} = (V_{in} - v_N) / R_{in} = V_{in} / R_{in}$$

$$V_{out} = -R_f * i_{in}$$

$$V_{out} = -V_{in} * (R_f / R_{in})$$

Build your first Circuit on the breadboard!

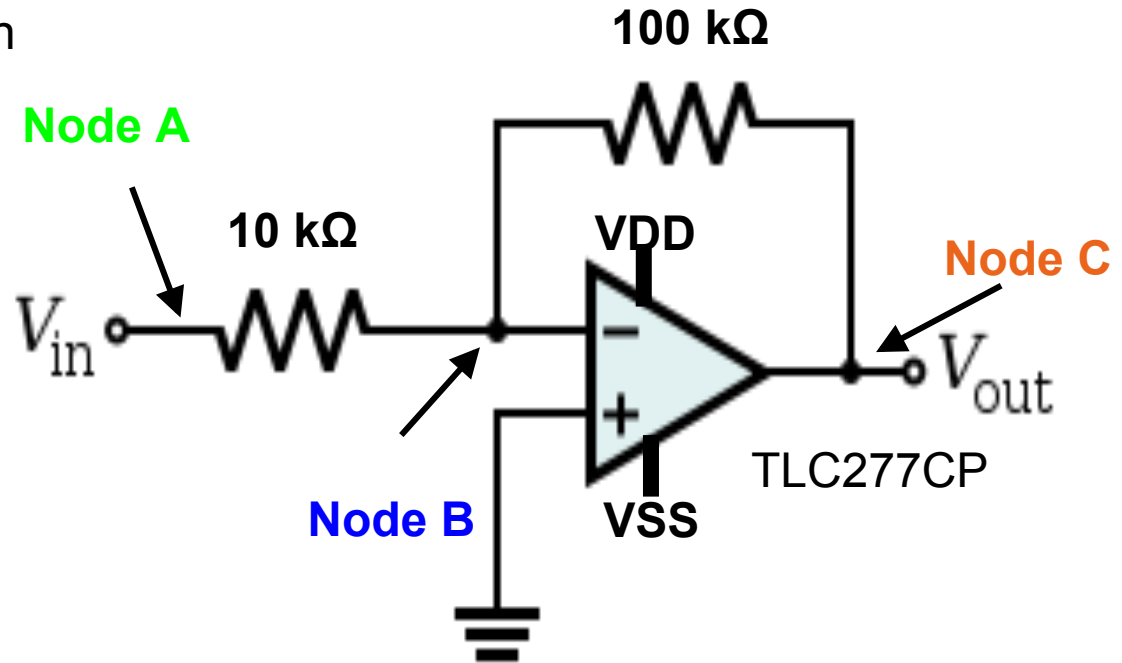
Build the inverting amplifier shown

Test your amplifier using a sinusoidal signal:

- 1 kHz
- 100 mVpp
- 0 mV offset

Use the oscilloscope to prove V_{in} and V_{out} simultaneously

Question: What should VDD and VSS be? See slide 3.
(Hint: what is the range of the input signal?)



Questions

You should be able to answer these questions (your GSI might ask):

1. What is it?

2. What does it do to the input signal?

3. How can you change the gain?

Questions Continued

What happens when you:

- 1. Flip the polarity (ie: switch the inputs to the +/- terminals)*
- 2. Change the resistance ratio*
- 3. Short “+” and “-” inputs*
- 4. What is the max gain? (hint: what is the maximum amplitude?)*
- 5. What happen if Op Amp $V_{ss} = -1V$?*
- 6. Keeping R_f/R_i constant, Does the resistors value matter? (ex: $100k\Omega/10k\Omega$ same as $100\Omega/10\Omega$?)*

Exercise in Debugging:

- Now, swap circuits with a neighboring lab group
 - Change one thing on your neighbor's bread board (move a wire, disconnect a wire, remove a component)
 - Don't short anything!
- Swap back and try to figure out what was changed!

Before you leave..

- *Turn off all lab equipment*
- *Clean up your station!!*
 - *Leave the station as you found it!*
 - *You need to get checked off by your GSI*
- *For Checkoff:*
 - *Show your GSI both the input and output signals on your oscilloscope*
 - *Show your GSI your completed quiz*
 - *Show your GSI your order confirmation for your TI opamps*
 - *Be prepared to answer some questions*