ELG3336
Lab. 1: Inverting Operational Amplifier

TA: Mahfuz
upal41@gmail.com

10 September 2014

Objectives

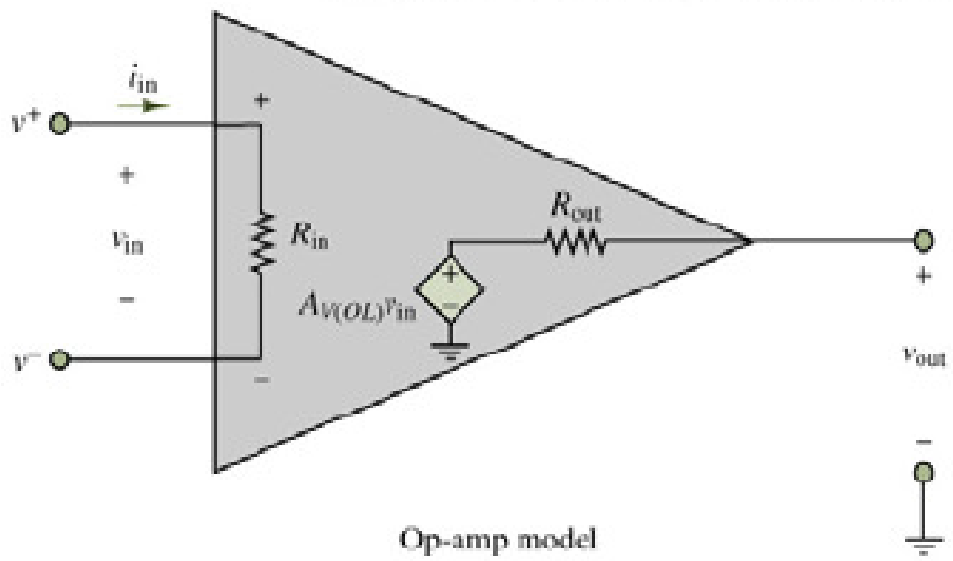
- The main objectives of this experiment are
  - To introduce operational amplifier (Op-Amp) circuits
  - To illustrate the power supply regulation properties of operational amplifiers
- The experiment will help the students to learn inverting amplification system using Op-Amp.

Theory

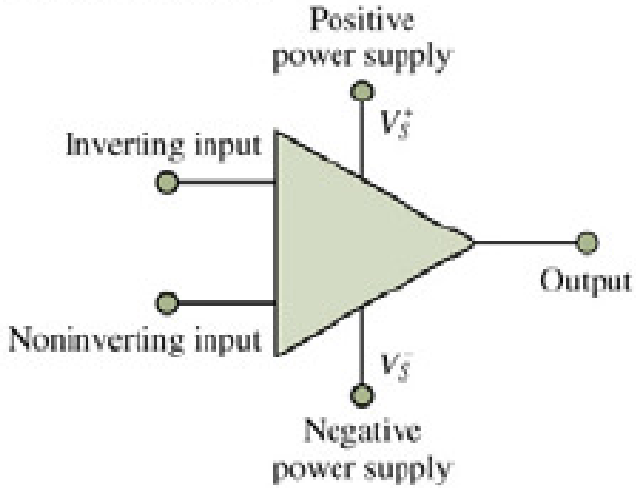
- Chapter 8 of the textbook provides related theory of Op-Amp inverting amplifier.

Op-Amp Internal Circuit

- Refer to the lab document.



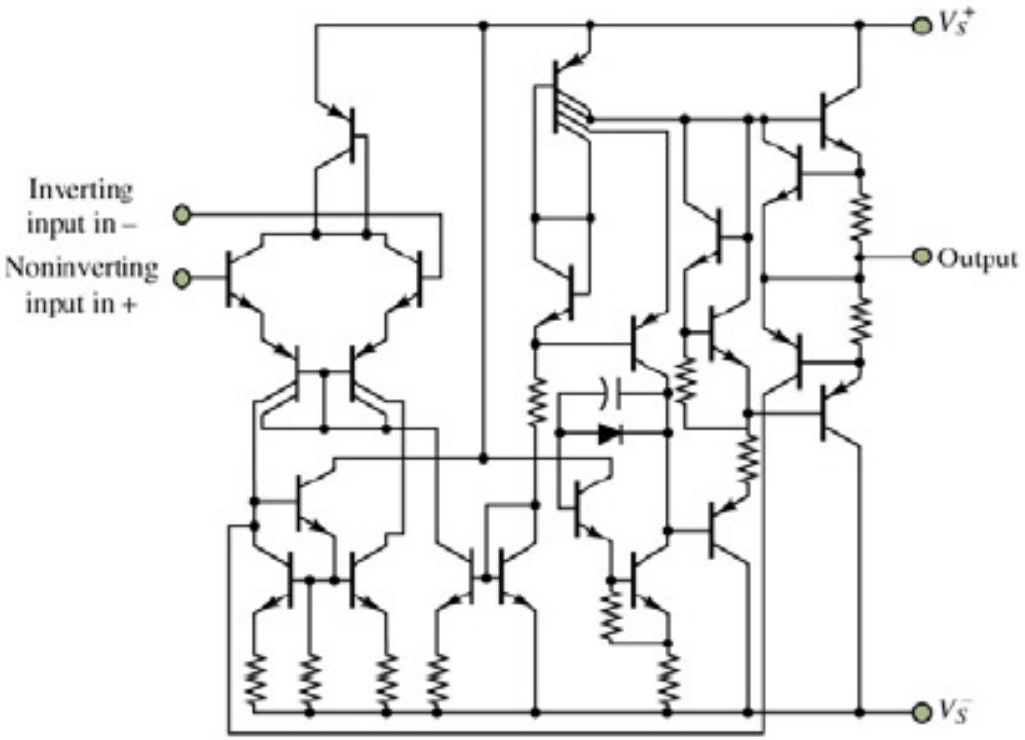
Op-amp model



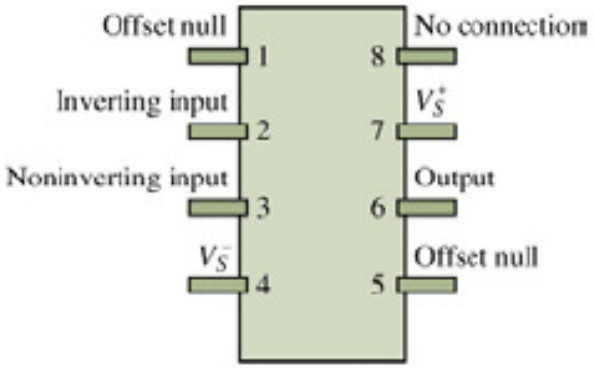
Simplified circuit symbol

Op-Amp Internal Circuit

- Refer to the lab document.



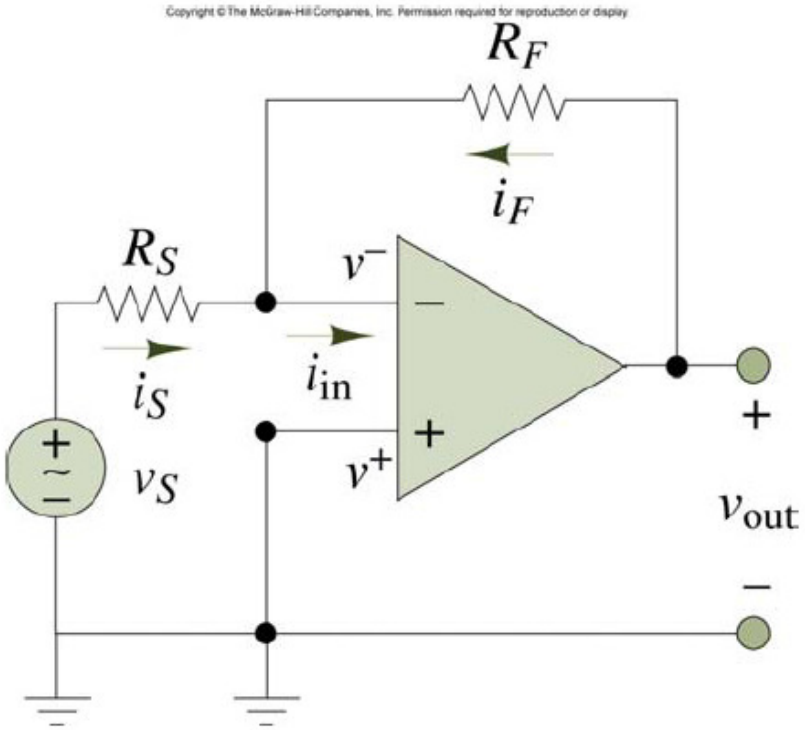
IC op-amp diagram



Integrated-circuit operational amplifier (IC op-amp)

Op-Amp Inverting Amplifier

- Output signal is an inverted and an amplified version of the input signal.



Inversion

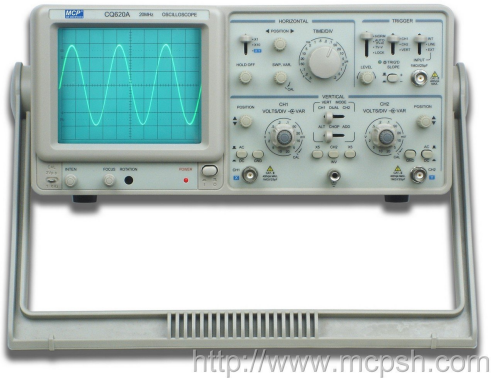
Amplification ratio

$$v_{out} = -\frac{R_F}{R_S} v_s$$

(Inverting Amplifier Closed-loop Gain)

Introduction to Lab Equipment

- We have explained the functionalities of oscilloscope, signal generator, DC power supply, and multi-meter.



Oscilloscope

Signal generator

Introduction to Lab Equipment

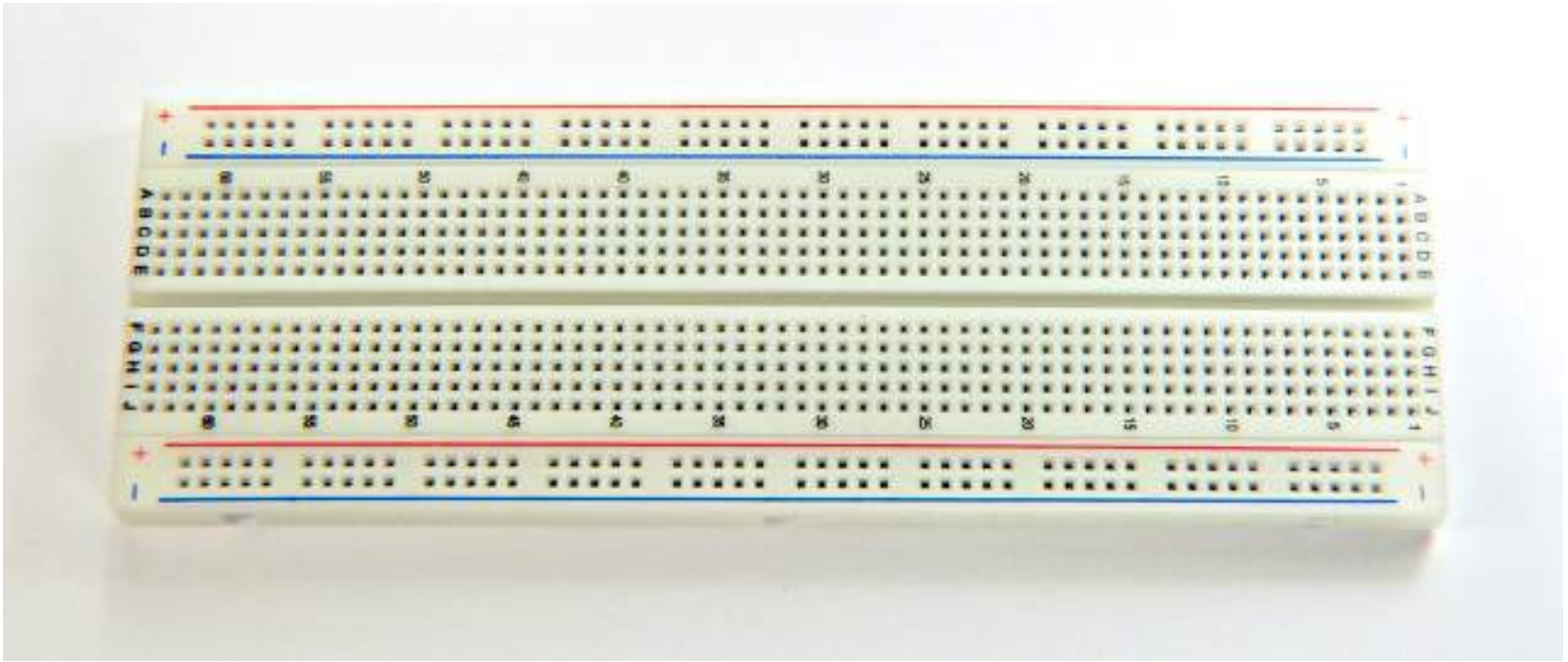
- We have explained the functionalities of oscilloscope, signal generator, DC power supply, and multi-meter.

Multimeter

DC power supply

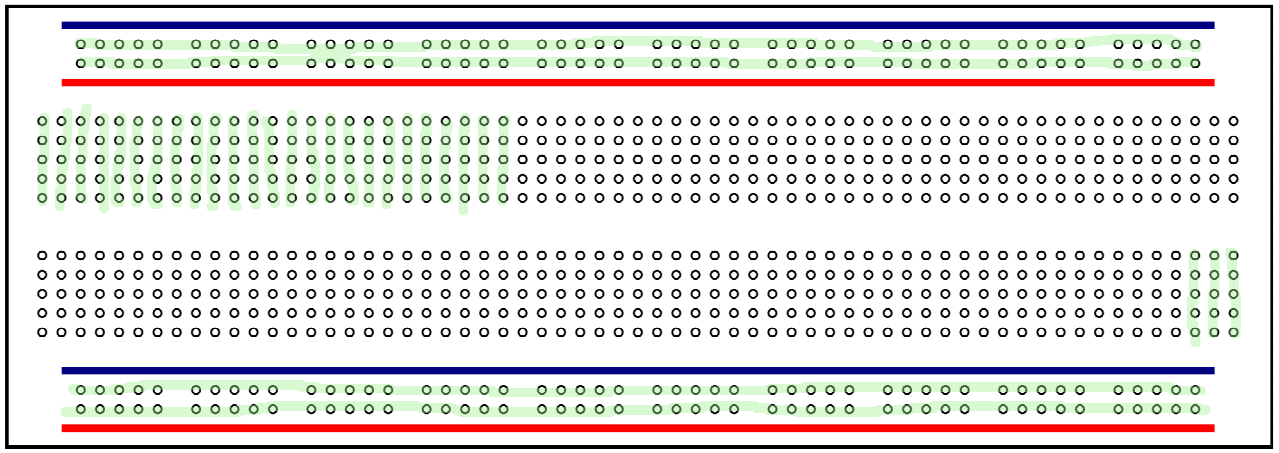
Breadboard

- Row-wise and column-wise connections



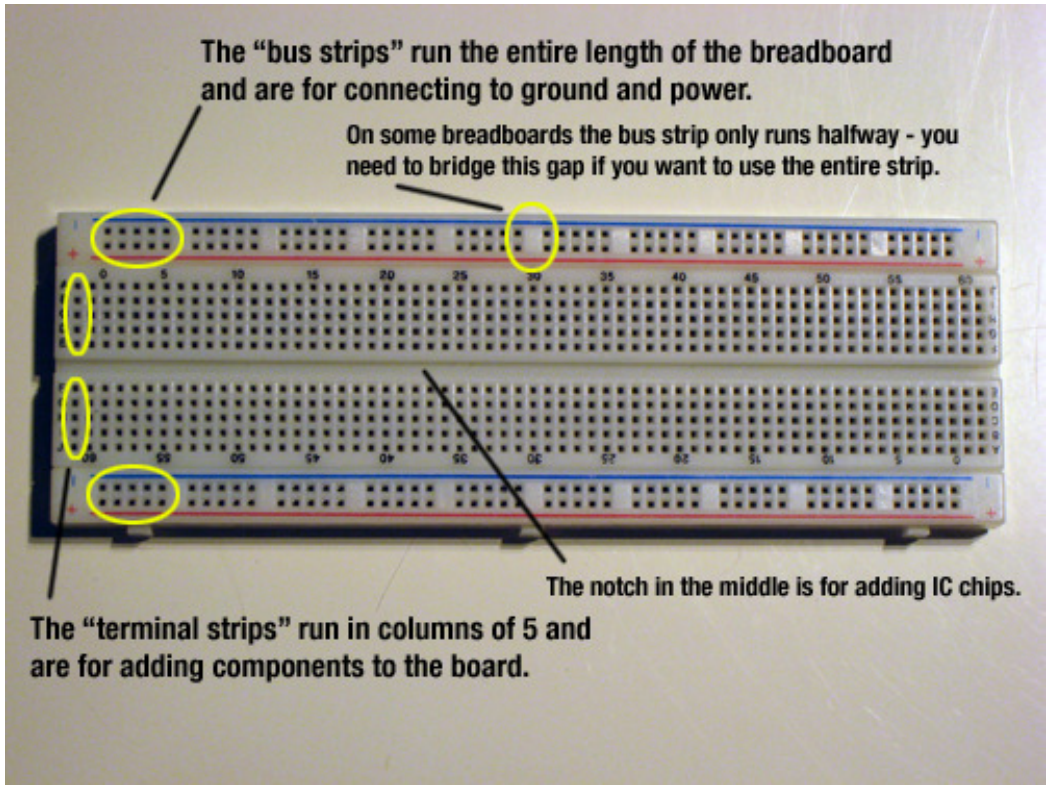
Breadboard

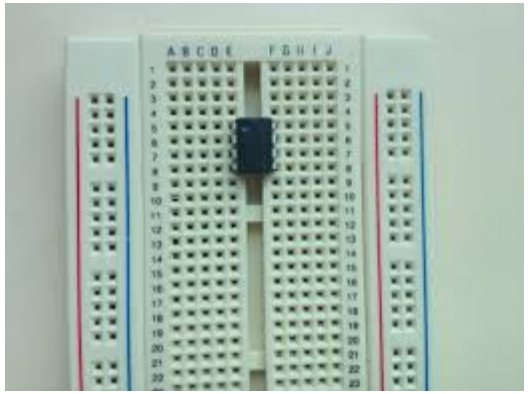
- Row-wise and column-wise connections



Breadboard

- Row-wise and column-wise connections





Source: Google Search (image)

Equipment / Parts

- DC power supply
- Multimeter
- Oscilloscope
- Function generator (signal generator)
- Resistances: Take $\mathbf{R_F \approx 20R_S}$
- Breadboard

Lab Tasks

- Task 1
  - Set the input V_s to a sine wave with frequency 100 Hz and peak-to-peak amplitude 2 V.
  - Record output signal when bias voltage is **±15 Volts** at pins 4 and 7.
  - Measure the peak-to-peak output voltage.
  - Find amplification (ratio of $V_{out\ (p\text{-}p)}$ to $V_{in\ (p\text{-}p)}$)
  - Take picture of (or draw) input and output channels on the same plot.
  - Find if there is any phase difference between input and output signals.

Lab Tasks

- Task 2: Effects of V_{sat}
  - Reduce the power supply to **±10 Volts**
  - Repeat Task 1.

Lab Tasks

- Task 3: Effects of frequency
  - Return to **±15 V** and change the frequency to 100 kHz and see what happens.
  - Repeat Task 1.

Report

- Submit a report on your findings.
- Show the input-output signals on the same plot and indicate the amplification, in Tasks 1, 2, and 3.
- Comment on how circuit behaviour changes when the power supply changes (Task 2).
- Comment on how circuit behaviour changes when the frequency changes (Task 3).

References

- ELG3336 textbook
- ELG3336 lab document available at
  - http://www.site.uottawa.ca/~rhabash/ELG3331LAB1.pdf
- Images used in this presentation have been borrowed from the ELG3336 lab document and searching through Google. Sources of the figures are acknowledged.

Thank you.

- Ask us your questions. Make sure you understand the experiment completely.