MISR UNIVERSITY FOR SCIENCE AND TECHNOLOGY
COLLEGE OF ENGINEERING
MECHATRONICS DEPARTMENT

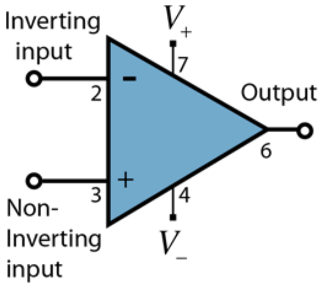
MTE 405 SENSORS AND MEASUREMENTS

LAB 1 – SPRING 2020

Lab 1

Goals Of The Lab

Introduction to Sensors and Signal Conditioning with Virtual Prototyping



Review on operational amplifiers

Introduction to temperature sensors

Lab 1

Preliminary Flow Of The Course

Expected Goals Reached

Measuring Physical Parameters	Data Acquisition	Going Smart	Signal Logging (Project)
Simulation and Datasheet Reading	Arduino Analog Reading	Inter Integrated Circuit Communication (I2C)	Delivering a PC based multi sensors logging.
Signal Conditioning	Data Display	Serial Peripheral Interface (SPI)	
Improving Measurements	Live embedded system measurements	Serial Communication	

Lab 1

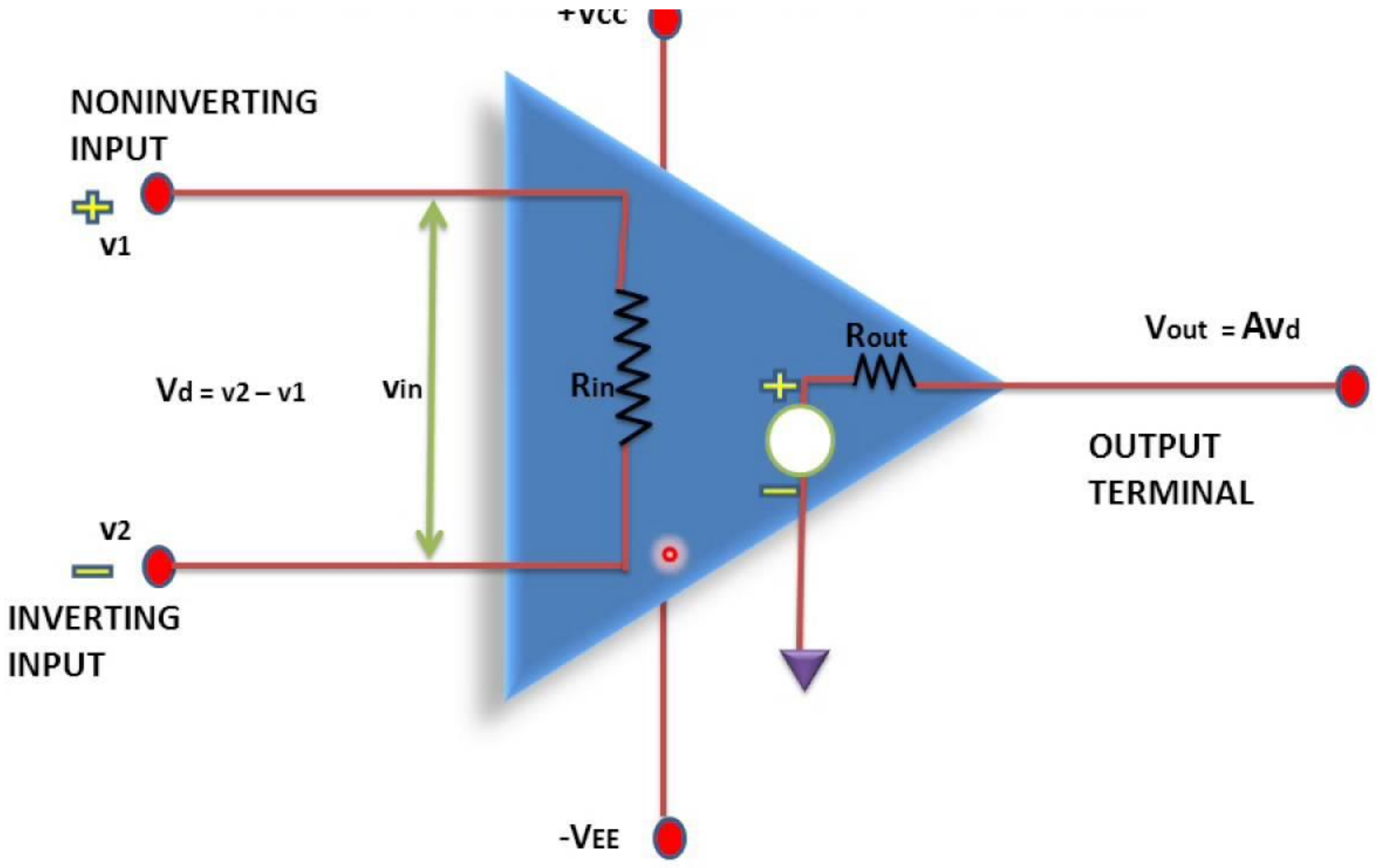
Signal Conditioning

Review on operational amplifiers

Commonly Used Configurations

Amplifiers most frequently used :

- Inverting Amplifier.
- Non-Inverting Amplifier.
- Differential
- Amplification of AC signal with single supply.



Lab 1

Software For Simulation

Needed for all labs

01 **Electronics Simulation**
Proteus 8.7 or higher

02 **Arduino IDE**
For data acquisition labs

03 **Visual Studio 2017**
With VSMicro Ardiuno Addin installed.

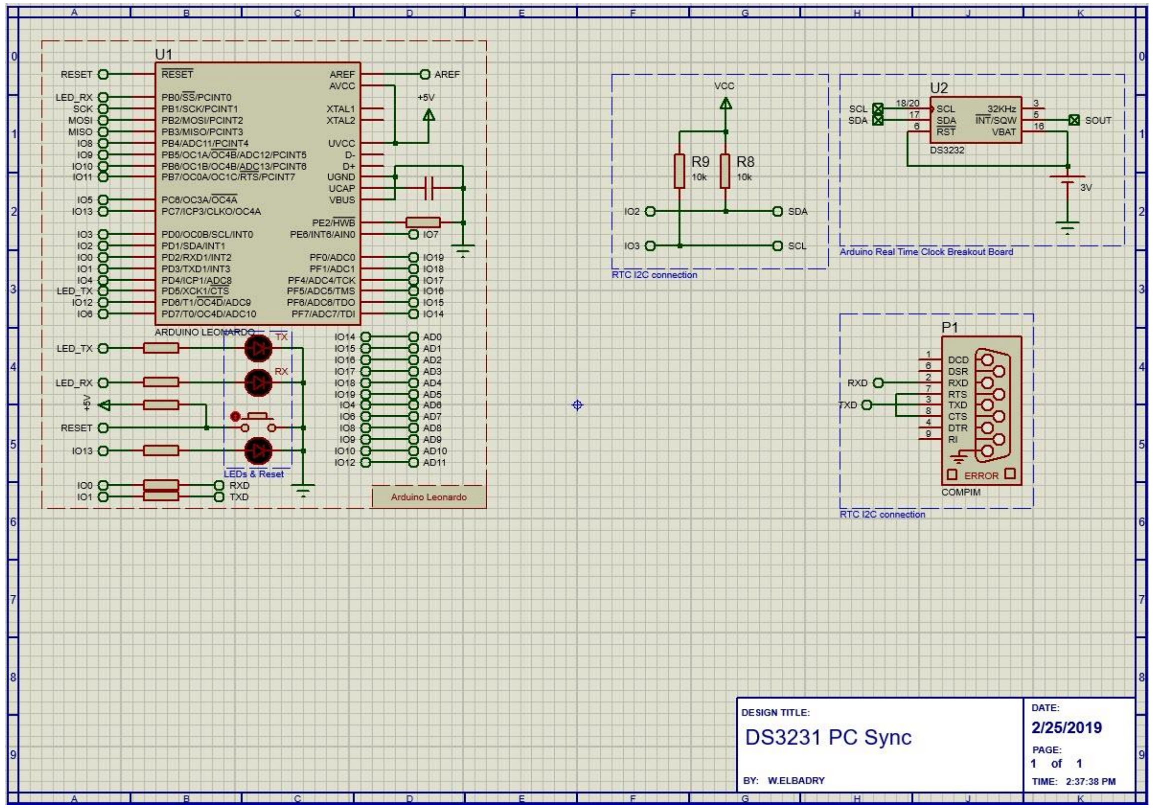
04 **LabVIEW 2018**
Optional for PC data acquisition

05 **MATLAB**
Optional for data processing

Student must install software in advance before attending any lab

Software For Simulation

Needed for all labs



01

Electronics Simulation

Proteus 8.7 or higher

Version 8.8 SP1 is highly recommended

(not mandatory)

Lab 1

Operational Amplifier

- Amplification. $V_o = V_i * G, G > 1$
- Attenuation. $V_o = V_i * G, G < 1$
- Buffering. $V_o = V_i * G, G = 1$
- Filtering (active filters). $V_o = V_i * G, f_c = \frac{1}{j\omega RC}$

Where :

V_i ... *Input voltage*

V_o ... *Output voltage*

G ... *Amplifier Gain*

f_c ... *Cutoff frequency*

R *and* C ... *filter parameters*

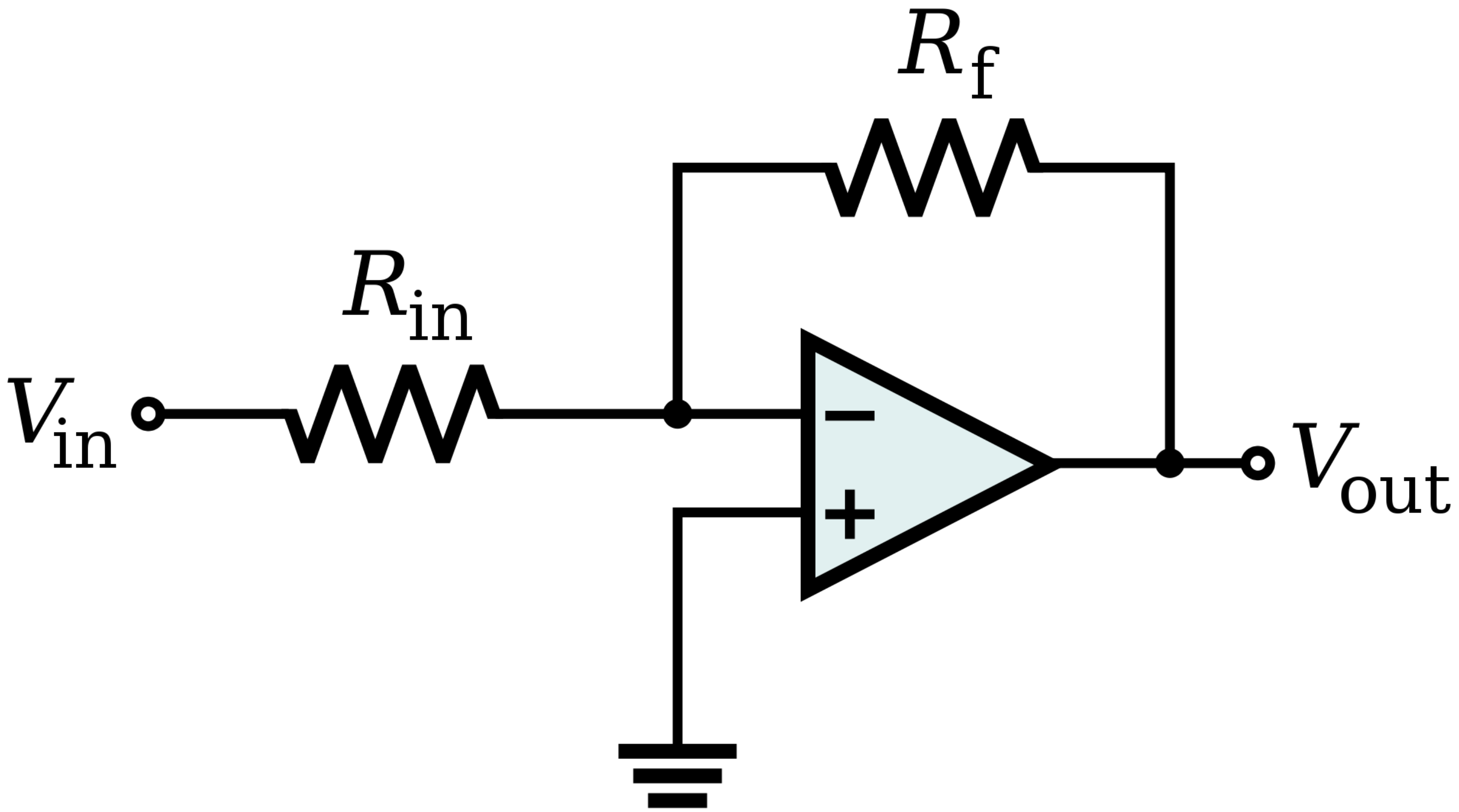
Lab 1

Signal Conditioning

Exercise 1

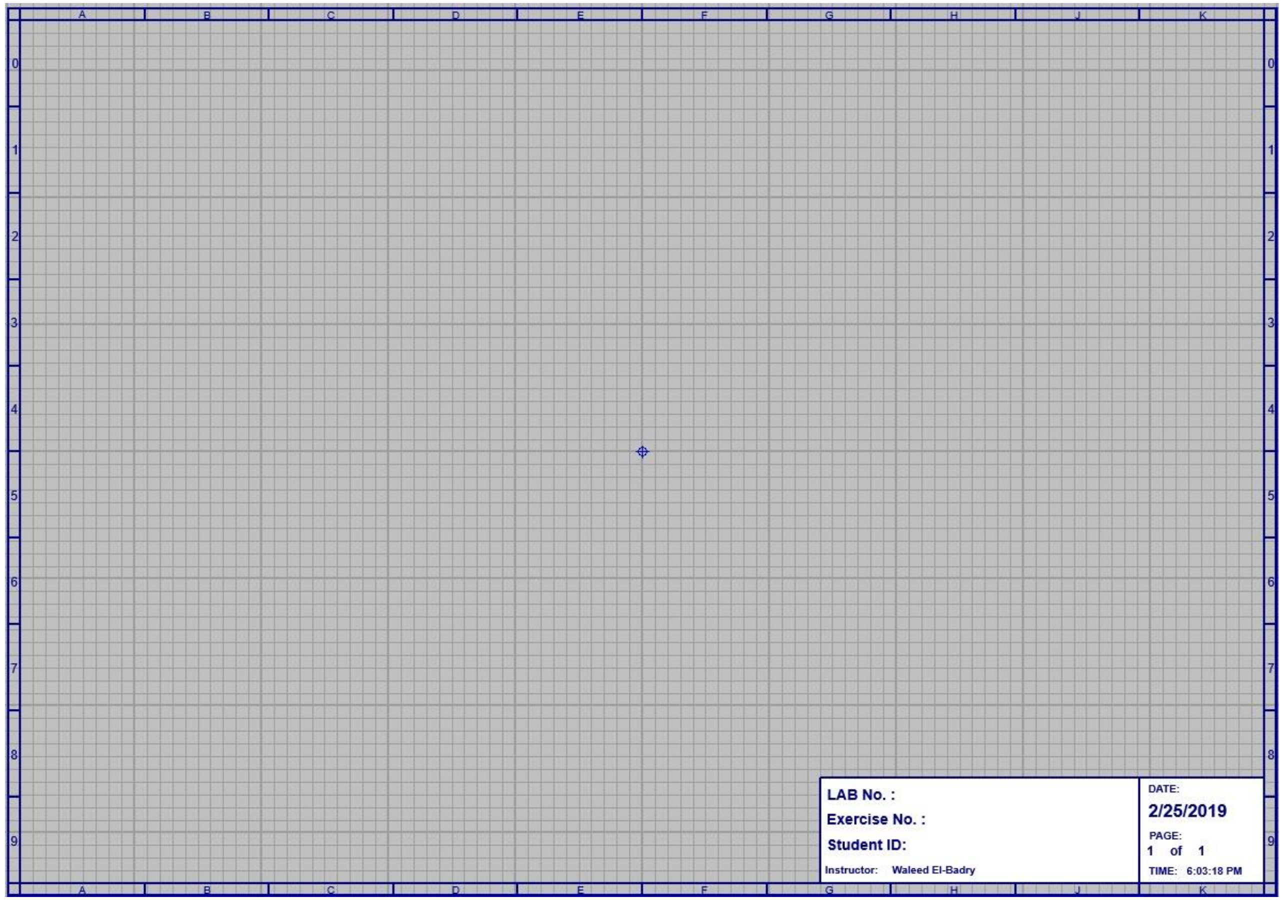
Inverting Amplifier

1. Amplification.
2. Attenuation.
3. Buffering



Lab 1

Proteus Course Template

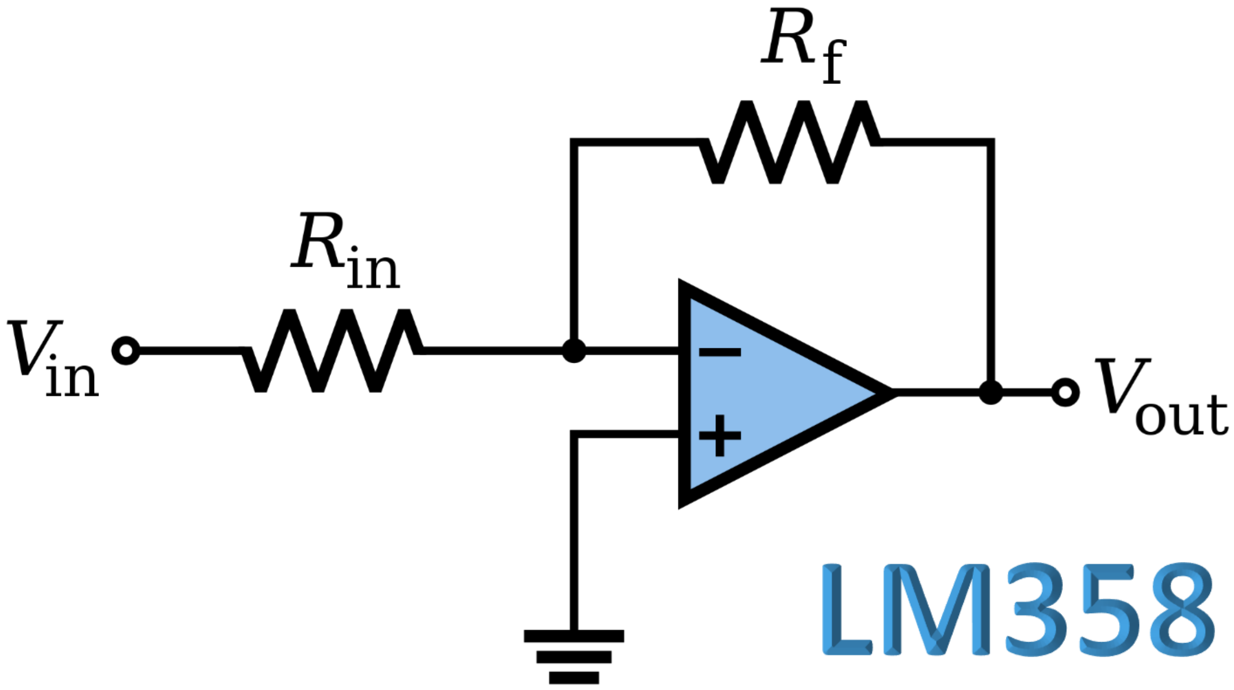


MTE 405 Template (*available on course repository*)

Exercise 1 – Inverting Amplifier

Using Proteus ISIS schematic capture, apply inverting amplifier circuits with G = 10 , 0.1 and 1 respectively

$$V_o = -\frac{R_f}{R_i}$$



Lab 1

Exercise 1 – Inverting Amplifier

Product Folder | Sample & Buy | Technical Documents | Tools & Software | Support & Community

TEXAS INSTRUMENTS

LM158-N, LM258-N, LM2904-N, LM358-N

SNOSBT3I – JANUARY 2000 – REVISED DECEMBER 2014

LMx58-N Low-Power, Dual-Operational Amplifiers

1 Features

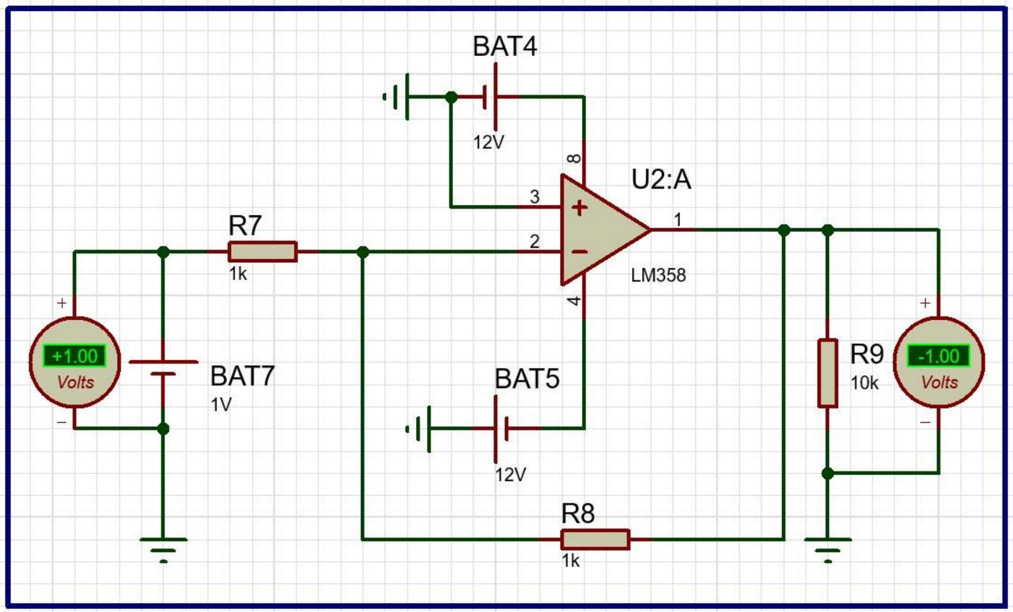
- Available in 8-Bump DSBGA Chip-Sized Package, (See AN-1112, SNVA009)
- Internally Frequency Compensated for Unity Gain
- Large DC Voltage Gain: 100 dB
- Wide Bandwidth (Unity Gain): 1 MHz (Temperature Compensated)
- Wide Power Supply Range:
  - Single Supply: 3V to 32V
  - Or Dual Supplies: ±1.5V to ±16V
- Very Low Supply Current Drain (500 μA)—Essentially Independent of Supply Voltage

3 Description

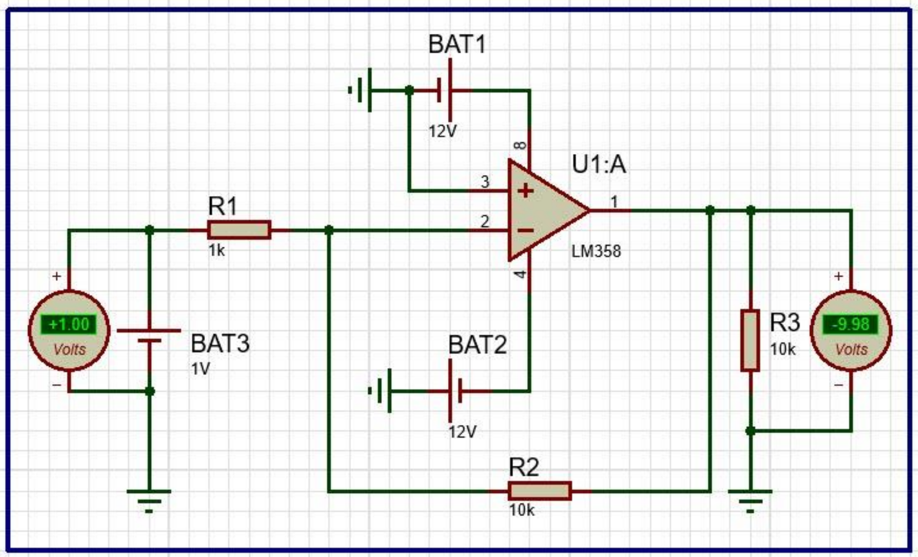
The LM158 series consists of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, dc gain blocks and all the conventional op-amp circuits which now can be more easily implemented in single power supply systems. For example, the LM158 series can be directly operated off of the standard

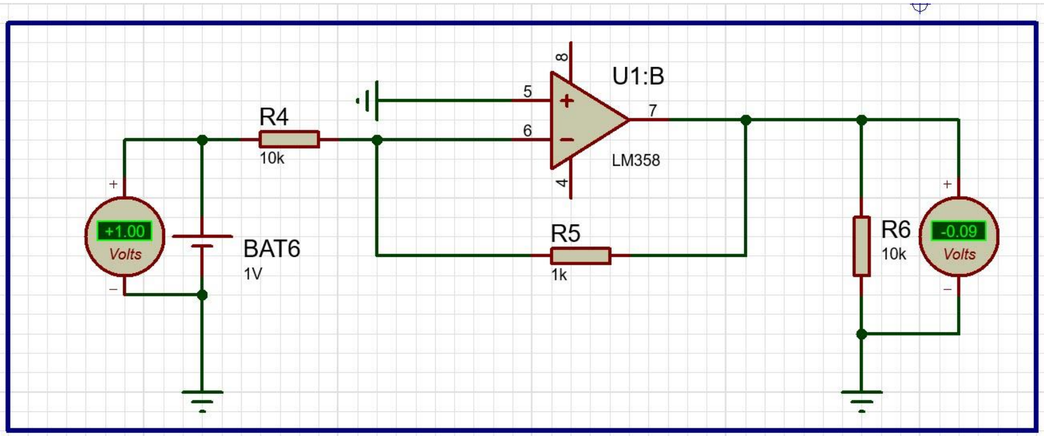
Exercise 1 – Inverting Amplifier



Inverting Amplifier
G = 1



Inverting Amplifier
G = 10



Inverting Amplifier
G = 0.1

- Why there is a loss in output voltage ?
- Does the output voltage vary with load ?
- What is the constraint of using inverting configuration ?

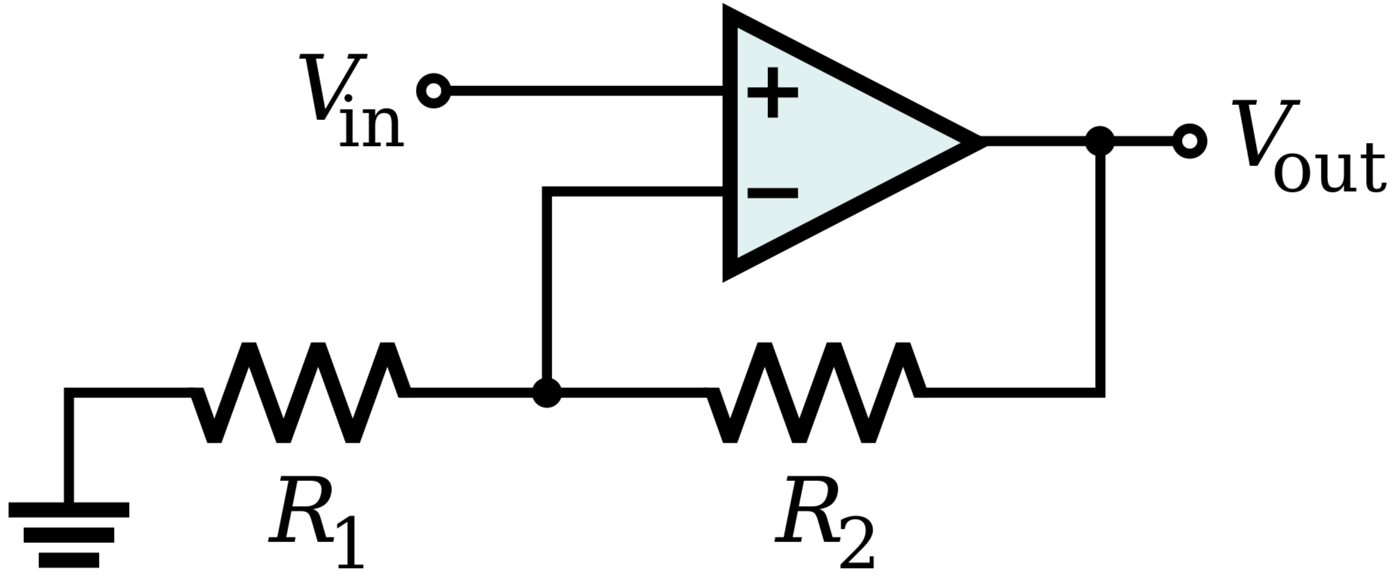
Lab 1

Signal Conditioning

Exercise 2

Non-Inverting Amplifier

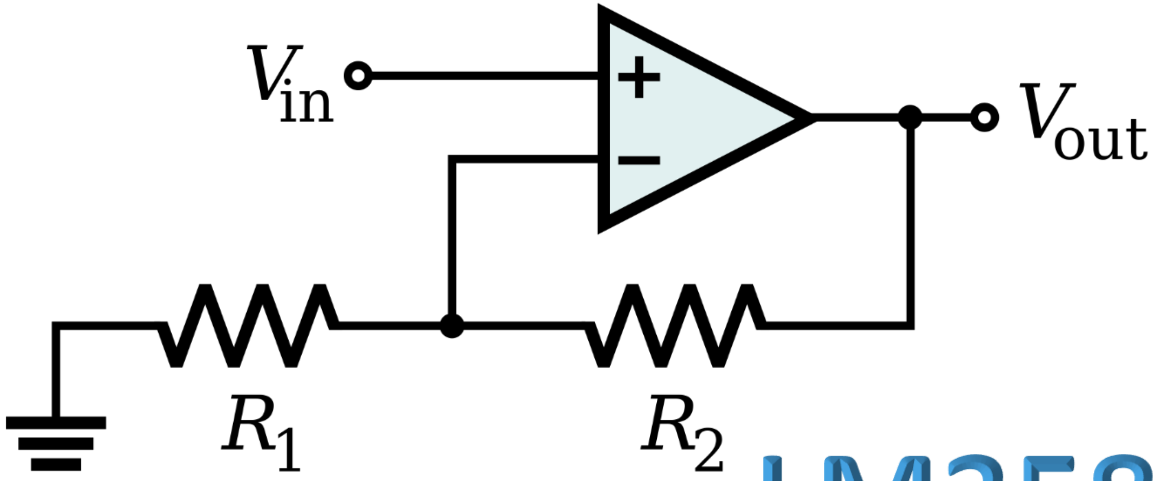
1. Amplification.
2. ~~Attenuation~~.
3. Buffering



Exercise 2 – Non-Inverting Amplifier

Using Proteus ISIS schematic capture, apply non-inverting amplifier circuits with G = 10 and G = 1 respectively

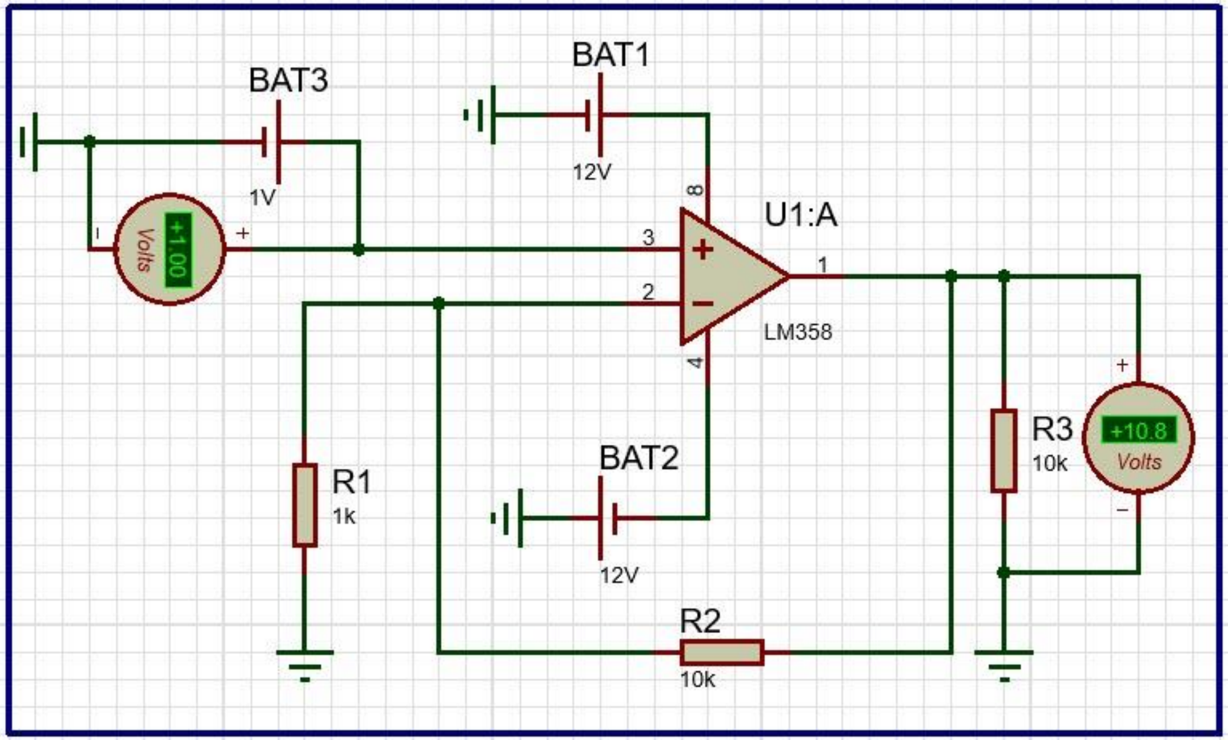
$$V_o = 1 + \frac{R_2}{R_1}$$



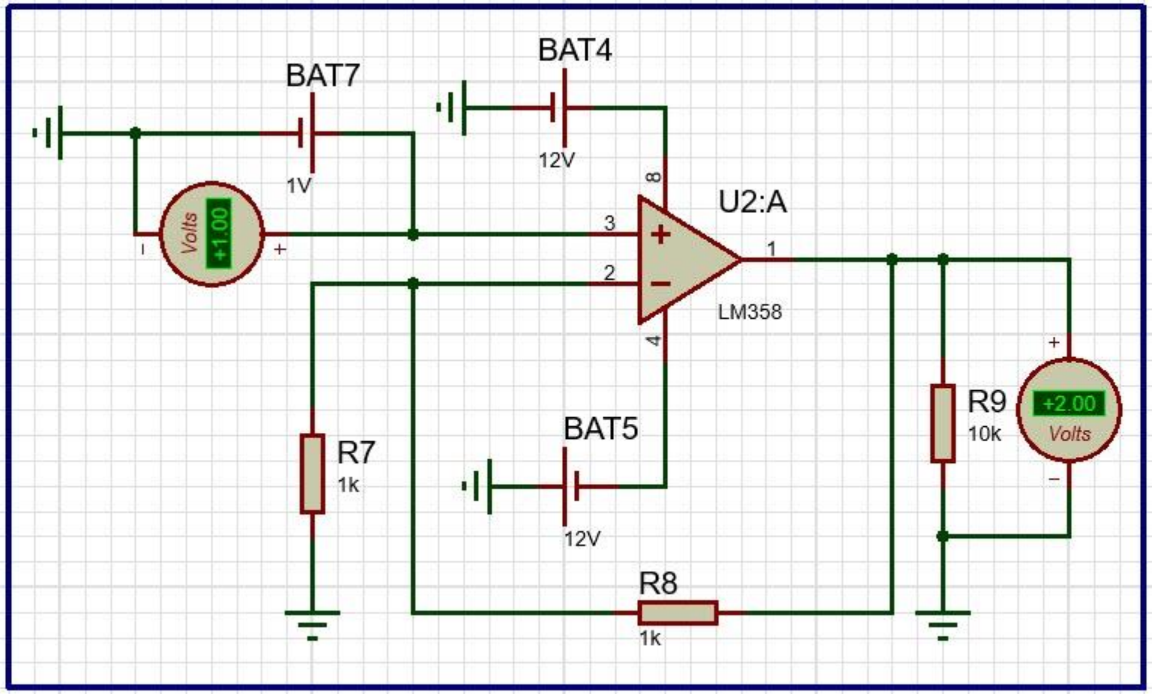
LM358

Lab 1

Exercise 2 – Non-Inverting Amplifier



Non-Inverting Amplifier
G = 10



Non-Inverting Amplifier
G = 1

- Is it better than non-inverting ?
- Do you notice any disadvantage ?

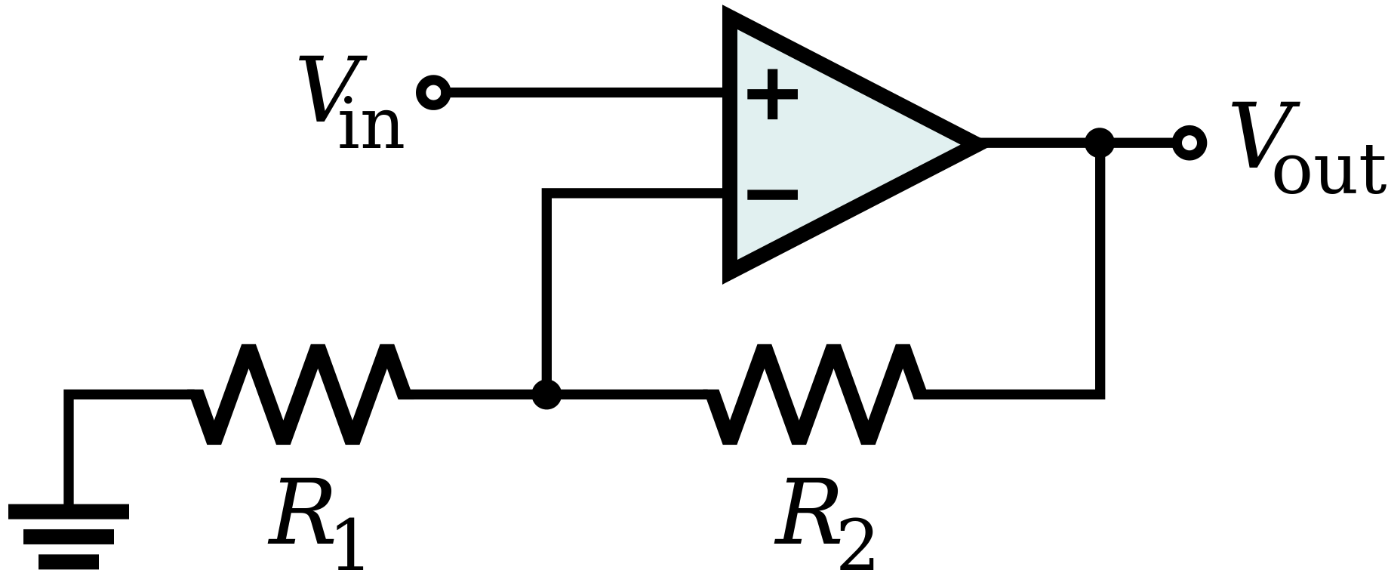
Lab 1

Signal Conditioning

Exercise 3

Differential Amplifier

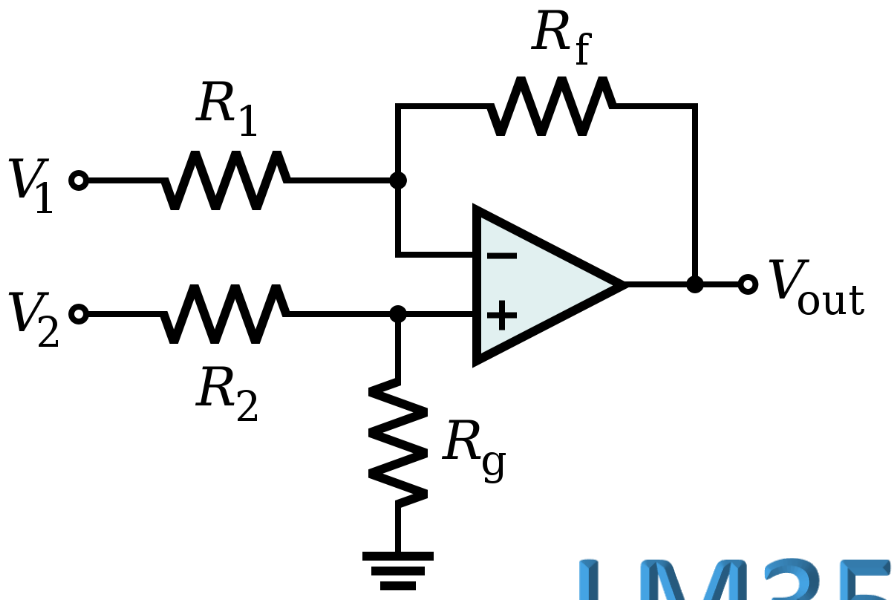
1. Difference to Single Ended
2. Attenuation.
3. Amplification
4. Buffering



Exercise 3 – Differential Amplifier

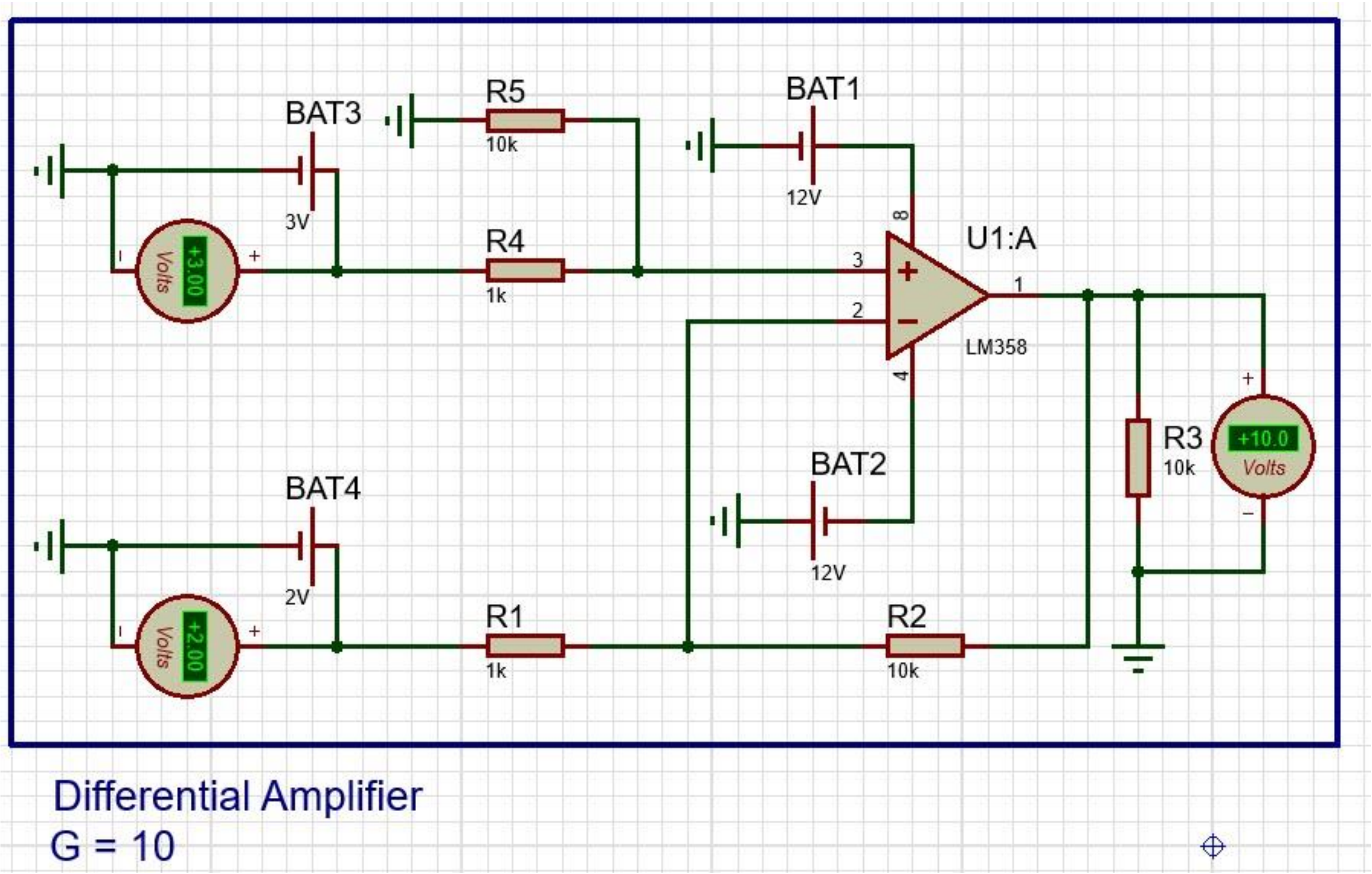
Using Proteus ISIS schematic capture, apply differential amplifier circuits with G = 10

$$V_o = \frac{R_f}{R_1}\,(v_1 - v_2)$$



LM358

Exercise 3 – Differential Amplifier



- Did you get the concept of differential to single ended ?
- We will need this configuration when using Wheatstone bridge ?

END OF LAB 1