

LAB 7: OP-AMP AND BASIC OP-AMP CIRCUITS

1. Goals

- Understand the principle of an operational amplifier (op-amp).
- Know how to build up and analyze basic op-amp circuits.

2. Exercises

Exercise 1. Build up and analyze the working principle of the comparator circuit shown in Figure 1. Regarding the polarity of an op-amp, set $V^+ = 10\text{ V}$ and $V^- = 0\text{ V}$.

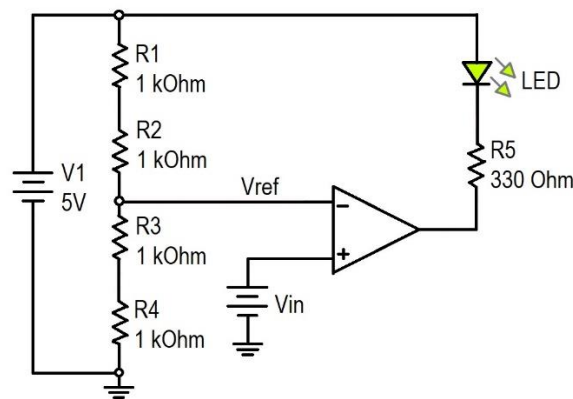


Figure 1. Circuit diagram of a comparator.

Requirements:

- Implement the circuit in Figure 1 on the breadboard.
- Make sure that we can vary the reference voltage (V_{REF}) at the level of 0 V, 1.25 V, 2.5 V, 3.75 V, and 5 V.
- Use a DC power supply to provide the input voltage V_{in} . Gradually increase V_{in} from 0 V to V_{REF} . Observe the brightness of the LED and notice its ON/OFF status. Give valid explanations for the observations.

Exercise 2. Build up and analyze the working principle of the inverting and non-inverting operational amplifiers shown in Figure 2. Regarding the polarity of an op-amp, set $V^+ = 10\text{ V}$ and $V^- = -10\text{ V}$.

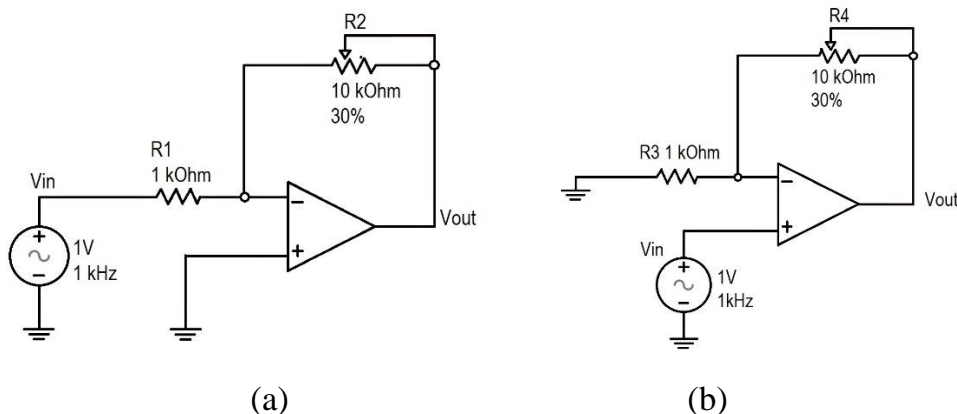


Figure 2. Circuit diagram of (a) inverting amplifier and (b) non-inverting amplifier.

Requirements:

- Implement the circuits in Figure 2.
- Use a pulse generator to provide the input voltage V_{in} (amplitude = 1 V, frequency = 1 kHz).
- Set the variable resistor R2 and R4 for 1 k Ω , 2 k Ω , 3 k Ω , and 5 k Ω , respectively.
- Use an oscilloscope to display the input and output voltages. Determine the amplification factor of the circuits and compare it with the theoretical calculation.

Exercise 3. Implement the voltage-sensing circuit shown in Figure 3 on a breadboard. Regarding the polarity of an op-amp, set $V^+ = 10$ V and $V^- = 0$ V.

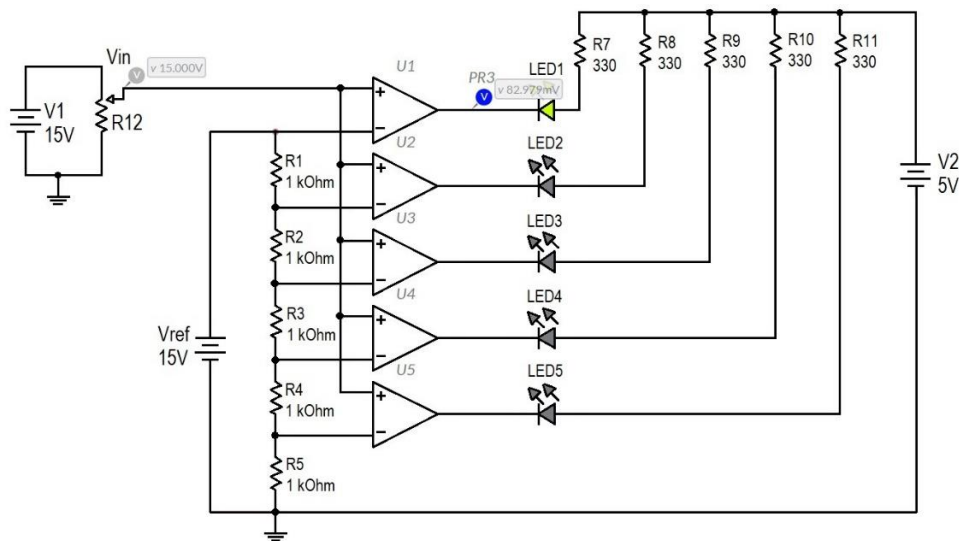


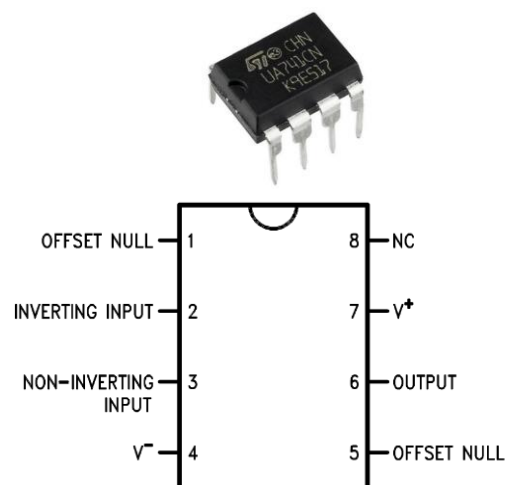
Figure 3. The voltage-sensing circuit.

Requirements:

- Explain the working principle of the circuit in Figure 3.
- Observe and explain the range of V_{in} that makes LED3 ON.

Components and devices needed for the lab:

Components and devices	Description	Amount
Op-amp	IC 741	2
Resistor	330 Ω / 1 k Ω	1/4
Variable resistor	1-10 k Ω	1
DC power supply	Aditeg PS-3030DD	1
Pulse generator	UNI-T UTC962E	1
Oscilloscope	OWON SDS1102	1
Breadboard		1
Wire		Few
Multimeter		1



Datasheet of LM741 is [here](#).