Electronics and Electromagnetism

Lab 4: Current-Voltage (I-V) Characteristics and Resistor Applications

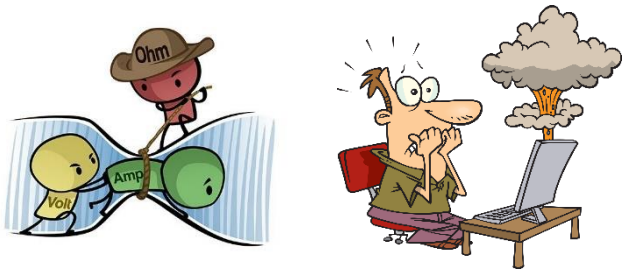
Purpose

In this Lab, we will start by discussing the **Current-Voltage (I-V)** responses of different circuit elements and test our understanding with an experiment to prove Ohm's law for resistors. After that we will be doing experiments to understand the behavior of series and parallel resistor circuits. We will then make use of variable resistors such as Light Dependent Resistors (LDRs) to build interesting and fun-to-do circuits.

Current-Voltage (I-V) Curves

A current–voltage characteristic or **I–V curve (current–voltage curve)** is a relationship, typically represented as a chart or graph, between the electric current through a circuit, device, or material, and the corresponding voltage, or potential difference across it. Electronic engineers use these charts to determine basic parameters of an electronic device and to model its behavior in an electrical circuit.

We all know that as per **Ohm's law, V= I×R** and therefore a **linear I-V response** is expected for a **FIXED resistance value**. In the real world however, when the material inside resistors heats up, it will have more resistance and the slope will be steepened. It will no longer obey Ohm's law. When materials are cold, it keeps the atoms and their electrons quiet and calm. When the material heats up, the atoms and their electrons move and wiggle (kinetic energy) creating more heat and chaos inside the material.



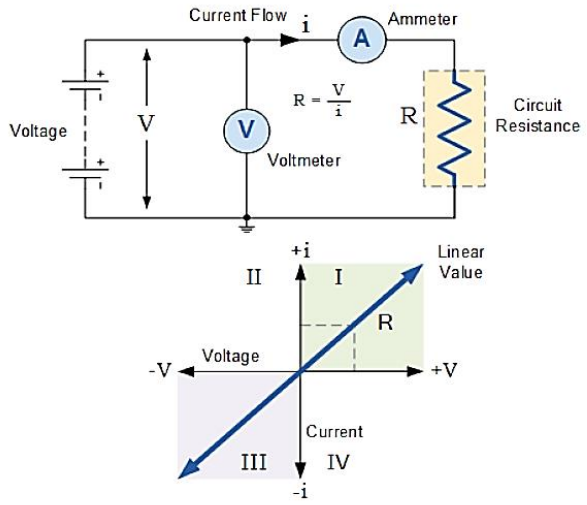


Figure 1: Ideal Resistor behavior

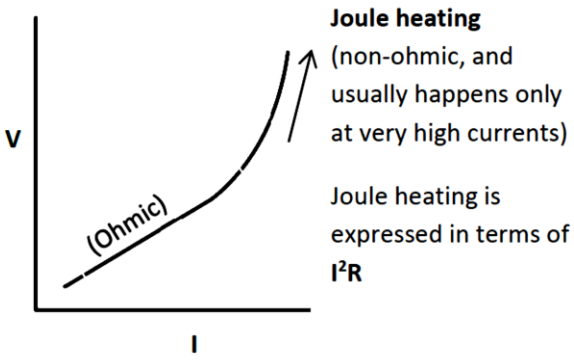


Figure 2: Non-Ideal Resistor behavior

Variable Resistors

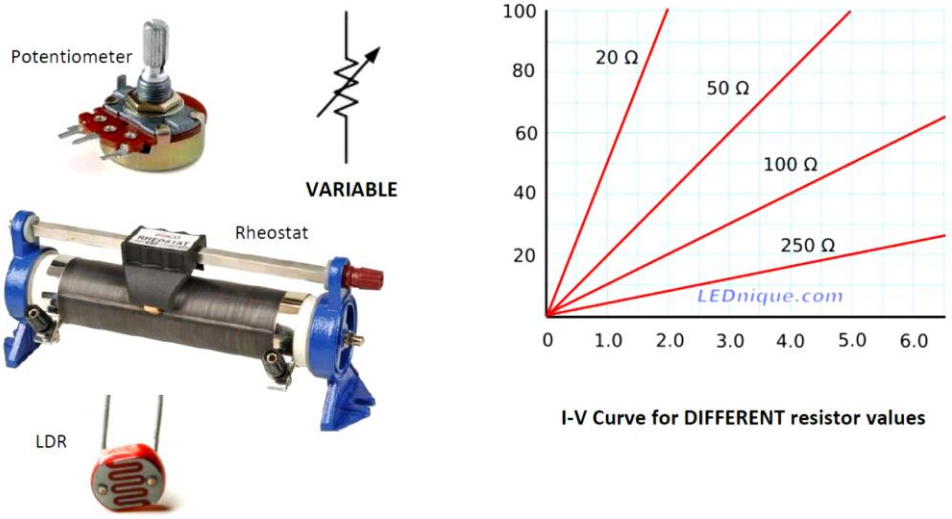
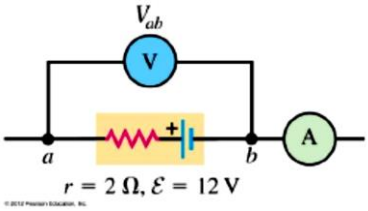


Figure 3: Variable Resistor Characteristics

Resistance

The property of a material that opposes the flow of electric current. Also, the Resistance is the ability of a circuit which opposes current. Wood, Glass, Mica and Rubber etc. are the example for the resistive materials. The unit of the resistance is **Ohm (Ω)** where $1\Omega = 1V/1I$ derived from the Ohm's law.

When **one ampere (A)** of current is flowing through a conductor, Ohm is the measurement quantity of resistance, which produces one joule of energy (in the form of heat) in one



Ohm's Law

$$V = IR$$

Resistors in series and parallel

When two or more resistors are connected in series, the equivalent resistance is given by

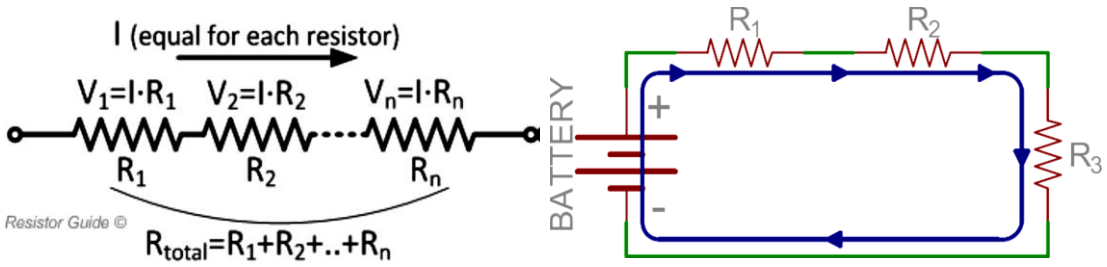


Figure 4: Resistors in Series connection

When two more resistors are connected in parallel, the equivalent resistance is given by

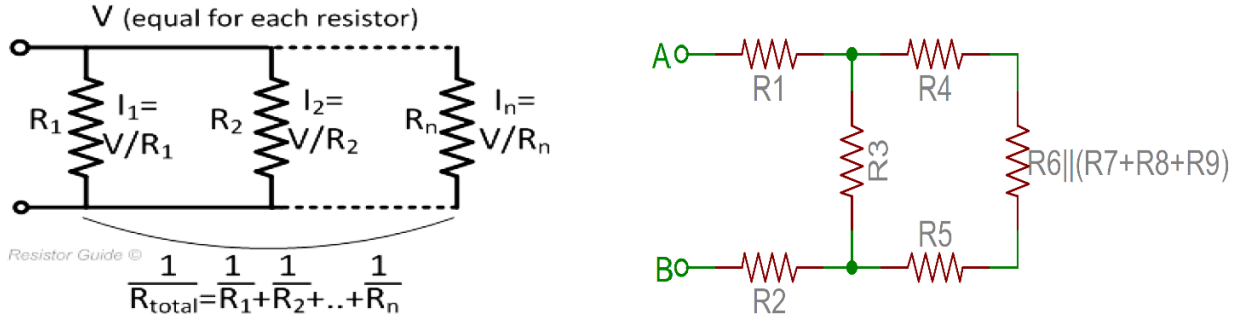


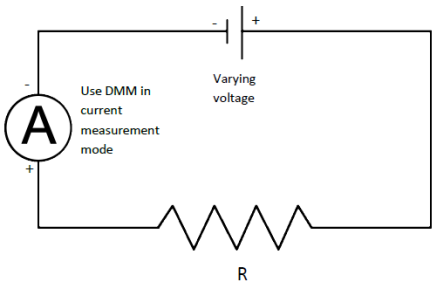
Figure 5: Resistors in Series connection

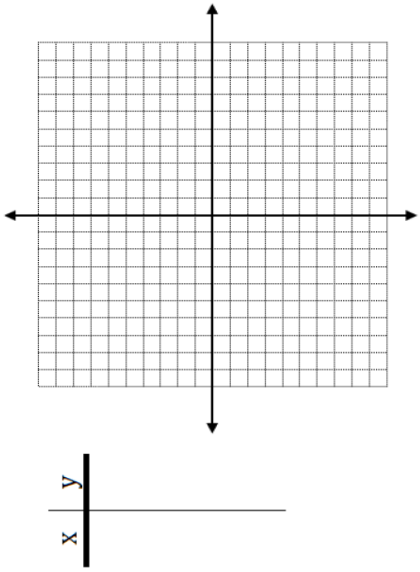
Task 1

You are provided with a 100Ω and a 1kΩ resistor. Construct the simple resistor circuits

1) A circuit with R = 100 Ω
2) A circuit with R = 1KΩ

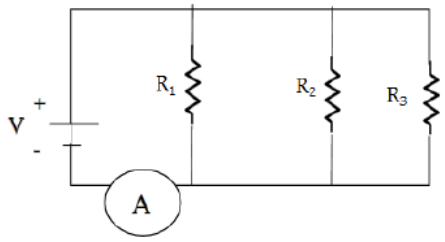
as shown below and then plot the IV curve for each resistor in the Graph provided on the next page. Remember to plot voltage on the X-axis and current on the Y-axis. If you haven't already learned how to use your DMM in the current measuring mode, this will be a good time to practice! **(Procedure and Observations required)**





Task 2

Construct the Parallel Circuit as in the above figure. Set the Power Supply to 6V use the given R1, R2, R3(choose any). **(Observations required)**



1. Calculate the theoretical Req(equivalent). (Exercises under task 2)

2. Measure Req and compare with theoretical Req (Exercises under task 2)

3. Measure the Current through the circuit and record that. What have you noticed about the current? (Exercises under task 2)

Task 3

Your task is to design a light dimmer circuit; therefore, you have given an LED, power supply, bread board, crocodile clip connector wires and jumper wires. Identify the missing component that requires to build your circuit. You can request the identified component from your TAs or the instructor. You must work with in the groups and no outside help from either TAs or instructor, however you can read previous lab material. (Observations required)

Task 4

Using task3 circuit, add another component that can activate your circuit either in dark or in light. Identify the component and request from TAs (observation required)