

Introduction to Resistance

Lesson #2



Background Information

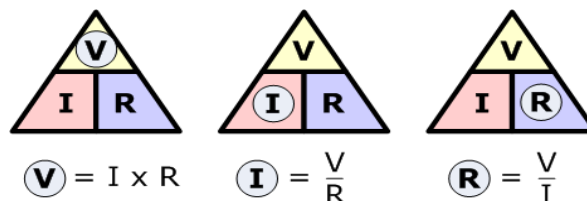
Resistance refers to electrical friction between the electric current and the material it is flowing through. Resistance limits or controls the flow of electricity. In a circuit, resistance can vary with the length of the wire, the thickness of the wire and the metal used to make the wire. Copper, aluminum and silver, metals used in conducting wires, all have different resistance. Resistors are devices, with a set resistance, that can be placed in circuits to reduce or control the flow of current. Any load in a circuit also has resistance.

Multiple resistors can be included in a circuit in series or parallel.

- If a circuit has several resistors in **series**, find the total resistance by adding the resistance for each resistor. The resistors serve as a “**voltage dividing network**” because the current stays the same across the circuit, but the voltage is divided by the resistors. Each resistor increases the resistance.
- When resistors are used in **parallel**, they become a “**current dividing network.**” In a parallel circuit, the voltage across each resistor (and each branch of the circuit) is the same value, but the current is divided. Therefore, the current flowing through each resistor is only part of the total current in the circuit.

Terms:

1. **Ohms** measure electric resistance. George Ohm discovered that the current flowing through a material is proportional to the voltage. For example, if the voltage doubled, the current also doubled. The resistance of the material remains the same. This relationship is called Ohm’s Law. If you know any two measurements, the third can be calculated. Voltage = Current X Resistance ($V = A \times \Omega$)



2. A **diode** is an electric component made of semiconductors that conduct electricity in one direction. It has low (ideally zero) resistance to the flow of current in one direction, and high (ideally infinite) resistance in the other direction. Diodes can be used to block current in one direction.
3. An **LED** is a light emitting diode. It has a positively charged component and a negatively charged component. The positive layer has “holes” or openings for electrons to move through. The negative layer has free electrons. When electricity strikes the semiconductor, it activates the flow of electrons from the negative layer to the positive layer. Because of this fact, LED’s only work in one direction in a circuit. The electrons emit light as they flow through the positively charged “holes.”

4. Electric **power** is the rate at which energy is produced or consumed. It is the amount of current flowing due to an applied voltage. Power is measured in **watts (W)**. $\text{Power} = \text{Voltage} \times \text{Current}$ or $W = V \times I$

5. Power is an instantaneous measurement and describes the amount of electricity it takes to start or operate a load for one second. When a load, for example a lamp, functions for more than one second, we have to take into account the time that it operates. **Electrical energy** is how we evaluate how a power system works over time. $\text{Electrical Energy} = \text{Power} \times \text{Time}$ and is measure in watt-hours (Wh). One watt-hour is a very small unit of energy. Utility companies bill consumers by the kilowatt-hour (kWh), where one kilowatt-hour equals 1,000 watt-hours.

Note for the resistors in Snap Circuits Pro: The “k” in the part label equals 1,000 Ω .

Part Number	Part Label	Actual Resistance
R1	100 Ω	100 Ω
R2	1K Ω	1,000 Ω
R3	5.1K Ω	5,100 Ω
R4	10K Ω	10,000 Ω
R5	100K Ω	100,000 Ω