

## What is a Potentiometer?

A **potentiometer** is a **three-terminal variable resistor** that can be used to vary resistance or divide voltage. It consists of:

- **VCC (Terminal 1)**
- **GND (Terminal 2)**
- **Wiper (Signal, Terminal 3)** — The sliding contact

Turning the knob moves the **wiper**, which changes the resistance between the wiper and either end terminal.

---

### Working Principle

#### 1. As a Variable Resistor (Rheostat)

- Only **two terminals** are used: one end + the wiper.
- Resistance increases or decreases based on knob position.
- Can be measured using a multimeter in resistance mode.

#### 2. As a Voltage Divider

- All **three terminals** are used.
- Wiper provides an output voltage between VCC and GND.
- Based on the formula:

$$V_{out} = V_{in} \times \frac{R_2}{R_1 + R_2}$$

Where R1 and R2 are portions of the potentiometer resistance on either side of the wiper.

---

### Applications of Potentiometers

Application	Description
<b>Volume Controls</b>	In audio devices to adjust sound level
<b>LED Brightness Control</b>	Adjust LED intensity by changing resistance

Application	Description
Sensor Calibration	Tuning sensor thresholds
Voltage Divider Circuits	To vary voltage for analog inputs

---

### Example: Controlling LED Brightness

#### Hardware Setup

- **Components:**
  - Potentiometer (10k $\Omega$ )
  - LED
  - Breadboard & Jumper Wires
  - Resistor (220 $\Omega$  – optional)
  - Power Supply or Arduino
- **Connection:**
  - **One side pin** of potentiometer  $\rightarrow$  VCC (e.g., 5V)
  - **Middle pin (wiper)**  $\rightarrow$  Analog pin (e.g., A0)
  - **Other side pin**  $\rightarrow$  GND