

# Understanding Basic Electrical Concepts

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Quick reference guide for students, hobbyists, and anyone new to electricity.

### 1. Fundamental Quantities

| Symbol | Quantity                                      | Unit             | Common Symbolic Representation  |
|--------|-----------------------------------------------|------------------|---------------------------------|
| V      | Voltage (Electric potential difference)       | Volt (V)         | $V = W/Q$                       |
| I      | Current (Flow of charge)                      | Ampere (A)       | $I = Q/t$                       |
| R      | Resistance (Opposition to current)            | Ohm ( $\Omega$ ) | $R = V/I$                       |
| P      | Power (Rate of energy transfer)               | Watt (W)         | $P = V \cdot I = I^2 R = V^2/R$ |
| C      | Capacitance (Ability to store charge)         | Farad (F)        | $C = Q/V$                       |
| L      | Inductance (Ability to store magnetic energy) | Henry (H)        | $L = \Phi/I$                    |

### 2. Ohm's Law

- Formula:**  $V = I \times R$
- Interpretation:** The voltage across a resistor is proportional to the current flowing through it.
- Usage:** Solve for any one variable when the other two are known.

### 3. Power Relationships

| Situation      | Formula             | When to Use                |
|----------------|---------------------|----------------------------|
| General power  | $P = V \times I$    | Any circuit                |
| Resistive load | $P = I^2 R$         | Known current & resistance |
| Voltage-driven | $P = \frac{V^2}{R}$ | Known voltage & resistance |

### 4. Series vs. Parallel Circuits

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## 4.1 Series Connection

- **Current:** Same through all components.
- **Voltage:** Splits proportionally to resistance.
- **Total Resistance:** ( $R_{\text{total}} = R_1 + R_2 + \dots + R_n$ )

## 4.2 Parallel Connection

- **Voltage:** Same across each branch.
  - **Current:** Splits inversely proportional to resistance.
  - **Total Conductance:** ( $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_n}$ )
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## 5. Energy and Charge

- **Charge (Q):** Measured in coulombs (C).  $1\text{C} = 1\text{A}\cdot\text{s}$ .
  - **Energy (W):** Measured in joules (J).  $1\text{J} = 1\text{W}\cdot\text{s}$ .
  - **Relationship:** ( $W = V \times Q$ ) (energy delivered by a voltage source moving charge Q).
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## 6. Basic Passive Components

| Component Symbol |   | Primary Function                | Typical Equation           |
|------------------|---|---------------------------------|----------------------------|
| Resistor         | R | Limits current, drops voltage   | ( $V = I R$ )              |
| Capacitor        | C | Stores electric field energy    | ( $I = C \frac{dV}{dt}$ )  |
| Inductor         | L | Stores magnetic field energy    | ( $V = L \frac{dI}{dt}$ )  |
| Diode            | — | Allows current in one direction | ( $I \approx I_S (e^{V_D}$ |