

Introduction to Basic Electronics

Introduction to Basic Electronics

(A concise, easy-to-read guide for beginners)

1. What Is Electronics?

Concept	Description
Electronics	The study and application of devices that control the flow of electrons (electric charge) in circuits.
Electronic vs. Electrical	<i>Electrical</i> deals with power transmission (high voltage, high current). <i>Electronic</i> works with low-power signals, amplification, switching, and information processing.
Key Goal	Manipulate voltage, current, and resistance to perform functions such as sensing, amplification, logic, and communication.

2. Fundamental Quantities

Quantity	Symbol	Unit	Typical Range in Electronics
Voltage (potential difference)	V or U	Volt (V)	$\mu\text{V} - 100\text{V}$
Current (flow of charge)	I	Ampere (A)	$\mu\text{A} - 10\text{A}$
Resistance (opposition to current)	R	Ohm (Ω)	$\Omega - \text{M}\Omega$
Power (rate of energy use)	P	Watt (W)	$\mu\text{W} - 10\text{W}$
Capacitance (ability to store charge)	C	Farad (F) (μF , nF, pF)	pF – μF
Inductance (ability to store magnetic energy)	L	Henry (H) (μH , mH)	$\mu\text{H} - \text{mH}$

Ohm's Law – The core relationship:

[$V = I \times R$]

Power Law – Relates voltage, current, and resistance:

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$$[P = V \times I = I^2 R = \frac{V^2}{R}]$$

3. Basic Passive Components

Component	Symbol	Function	Typical Uses
Resistor	R	Limits current, creates voltage drops, sets bias points	Pull-up/down, voltage dividers, bias networks
Capacitor	C	Stores electric charge, filters AC, couples/decouples signals	Power-supply filtering, timing circuits, AC coupling
Inductor	L	Stores magnetic energy, blocks high-frequency AC, forms resonant circuits	RF filters, power supplies (chokes), transformers
Diode	D	Allows current in one direction only (rectification)	Power rectifiers, signal clipping, protection
LED (Light-Emitting Diode)	LED	Emits light when forward-biased	Indicators, displays, optical communication
Switch	—	Manually or electronically opens/closes a circuit	User input, control logic

4. Simple Circuit Building Blocks

4.1 Voltage Divider

Creates a lower voltage from a higher source.

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

- **Use:** Sensor biasing, reference voltages, level shifting.

4.2 RC Low-Pass Filter

Passes low frequencies, attenuates high frequencies.

- **Cut-off frequency:** $(f_c = \frac{1}{2\pi RC})$
- **Typical layout:** Series resistor → node → capacitor to ground.

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4.3 RL High-Pass Filter

Passes high frequencies, blocks low frequencies.

- Cut-off frequency