

Introduction to Electronics

Introduction to Electronics – Quick Reference Notes

1. What Is Electronics?

- **Definition:** Branch of physics and engineering that deals with the flow and control of electrons in various media (conductors, semiconductors, vacuum).
 - **Goal:** Design, analyze, and build circuits that process information, power devices, or sense the environment.
 - **Key Idea:** Use **components** (resistors, capacitors, transistors, etc.) to manipulate voltage, current, and charge.
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2. Basic Electrical Quantities

Quantity	Symbol	Unit	Relationship
Voltage (Potential Difference)	V	Volt (V)	Energy per charge
Current (Flow of Charge)	I	Ampere (A)	Charge per time
Resistance	R	Ohm (Ω)	Opposition to current
Power	P	Watt (W)	($P = VI = I^2R = \frac{V^2}{R}$)
Capacitance	C	Farad (F)	Ability to store charge
Inductance	L	Henry (H)	Ability to store magnetic energy

3. Fundamental Laws

1. Ohm's Law

$$[V = I \times R]$$

2. Kirchhoff's Voltage Law (KVL)

Sum of voltages around any closed loop = 0.

3. Kirchhoff's Current Law (KCL)

Sum of currents entering a node = sum leaving it.

4. Power Law

$$[P = V \times I]$$

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4. Core Components

Component	Symbol	Function	Typical Use
Resistor	R	Limits current, drops voltage	Biasing, voltage dividers
Capacitor	C	Stores electric charge	Filtering, timing, coupling
Inductor	L	Stores magnetic energy	Filters, energy storage, transformers
Diode	D	Allows current in one direction	Rectification, protection
Transistor (BJT/MOSFET)	Q	Switches or amplifies signals	Logic gates, amplifiers
Integrated Circuit (IC) –		Combines many transistors & passive parts	Microcontrollers, op?amps, logic families

5. Types of Circuits

Category	Description	Example
Passive	Only resistors, capacitors, inductors (no gain)	RC low?pass filter
Active	Contains active devices (transistors, ICs)	Op?amp amplifier
Digital	Binary logic levels (0/1)	Microcontroller board
Analog	Continuous voltage/current variations	Audio pre?amp
Mixed?Signal	Combines analog & digital blocks	ADC/DAC front?end

6. Common Circuit Topologies

1. **Series** – Same current flows, voltages add.
Use: Voltage dividers, string LEDs.
2. **Parallel** – Same voltage across branches, currents add.
Use: Power distribution, load sharing.
3. **Voltage Divider** – Two resistors in series provide a selectable output voltage:
$$[V_{out} = V_{in} \frac{R_2}{R_1 + R_2}]$$
4. **Current Mirror** – Paired transistors copy a reference current to