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Voltage and current are two basic ideas in electronics and electrical engineering. They help us understand how electricity works and are important for the functioning of electrical circuits and devices. Let’s look at each one in an easy way:

Voltage

Voltage is the force or pressure that pushes electric charges through a wire or circuit.
Just like water needs pressure to flow through a pipe, electric current needs voltage to move through a conductor. It tells us how much “push” the electricity.

Voltage is the electric potential difference between two points in a circuit.

It represents the amount of work needed to move a unit charge from one point to another.

$$V = \frac{W}{Q}$$

Where,

- V = Voltage
- W = Work done or energy supplied (in joules)
- Q = Charge (in coulombs)

It is also known as electric potential difference or electromotive force (EMF).

Unit of Voltage

SI unit of voltage – **Volt** (It symbolized as **V**)

CGS unit of voltage – **Statvolt**

$$1 \text{ statV} \approx 299.79 \text{ volts} (\text{V})$$

Definition of Volt

One volt is defined as the potential difference between two points in a circuit when **one joule of energy** is used to move **one coulomb of charge** between those points.

Volt means **how much energy each unit of charge gets** to move through a circuit.

$$V=\frac{J}{C}$$

Voltage in series circuit

In a **series circuit**, the total voltage is the **sum of the individual voltages** across each component. If a 12 V supply is connected across two resistors, the voltage will split (e.g., 7 V + 5 V)

$$V_{\text{total}} = V_1 + V_2 + V_3 + \dots$$

Voltage in parallel circuit

In a **parallel circuit**, the voltage across **each branch is the same as the supply voltage**. If a 12 V supply is connected to three parallel branches, each branch gets 12 V.

$$V_{\text{across each branch}} = V_{\text{total}}$$

Current

Electric current is the flow of tiny charged particles (electrons) through a wire. It simply tells how much charge is moving and how fast it is moving in a circuit. Just like water flow in a pipe, current is the “flow” of electricity inside a conductor.

Electric current is the rate at which electric charge flows through a conductor or circuit.

$$I = \frac{Q}{t}$$

Where,

- I = Current (in amperes)
- Q = Charge (in coulombs)
- t = Time (in seconds)

Unit of Current

SI unit of current – **Ampere** (It symbolized as **A**)

CGS unit of current – **biot (Bi),** also known as the **abampere (abA).**

$$1 \text{ biot} (\text{abA}) = 10 \text{ amperes} (\text{A})$$

Definition of Ampere

It is defined as the amount of electric charge flowing through a conductor **at the rate of one coulomb per second**.

Ampere tells **how much electric charge flows every second** in a circuit.

Current in series circuit

In a **series circuit**, the same current flows through every component. There is only one path for current, so it cannot split. If 2A flows in a series circuit, every component gets 2A.

$$I_{\text{total}} = I_1 = I_2 = I_3 = \dots$$

Current in parallel circuit

In a **parallel circuit**, the current splits into different branches. The total current is the sum of the currents in all branches. If the supply gives 5A and there are two branches, it might divide as 3A + 2A.

$$I_{\text{total}} = I_1 + I_2 + I_3 + \dots$$

Types of Current

Electric current can mainly be classified into two primary types:

1. **Direct Current (DC)**– Flow of current is unidirectional (in one direction)
2. **Alternating Current (AC)**– The current reverses direction periodically.

Difference between AC and DC current:

Features	AC (Alternating Current)	DC (Direct Current)
Flow Direction	Reverses periodically	Flows in one direction
Waveform	Sinusoidal (common)	Straight/pulsating
Frequency	50/60 Hz	0 Hz
Quantitative values	AC uses RMS Value as its current varies periodically and the average over one full cycle becomes zero.	DC uses Average Value because its magnitude remains constant over time
Transmission	Suitable for long distance	Not ideal for long distance
Source Example	Power station, alternator	Battery, solar panel
Usage	Homes & industries	Electronics, EVs, gadgets

Difference between Voltage and Current:

Features	Voltage	Current
Meaning	Electric potential difference	Flow of electric charge
Represents	Pressure or push	Rate of flow of electrons
Symbol	V	I
Unit	Volt (V)	Ampere (A)
Measurement Device	Voltmeter	Ammeter
Field Created	Voltage creates an electrostatic field.	Current creates a magnetic field.
Formula	V= Work done/Charge	I= Charge/ Time
Existence	Can exist without current	Cannot exist without voltage

FAQs

What kills Voltage or Current?

It is current (I) that actually kills, not voltage alone.
Voltage is only the *force* that pushes current, but current flowing through the human body is what causes harm—like heart failure, muscles contraction, and burns. However, voltage is the reason current can pass through the body, so both are related.

What is the relationship between voltage and current?

They are related by Ohm's Law: V= I X R

Is voltage dangerous or current?

Both can be dangerous, but **current causes the actual harm** to the human body. Voltage provides the force that makes current flow.

Can current flow without voltage?

Generally no. Current needs voltage to flow, except in special conditions like superconductors.

Why is voltage called electric pressure?

Because it acts like pressure that pushes charges, similar to how water pressure pushes water in a pipe.

Why does a high voltage not always mean high current?

Current flow also depends on resistance. Higher resistance can reduce current even if voltage is high.

Related Topics:

- What is Resistor?
- Electrical Active and Passive Components
- Electrical Units
- Basic Electrical Formulas
- Different Values in Electrical Engineering