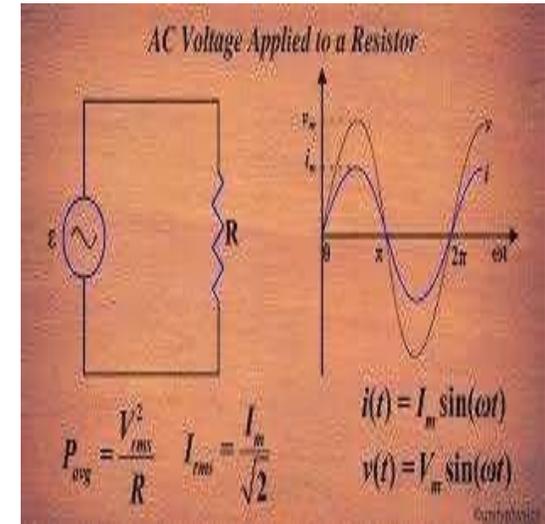


Department of Artificial Intelligence and Data Science

23EET103- Electrical Circuits and
and Electron Devices

I B.E IT / I SEMESTER

UNIT II : AC CIRCUITS



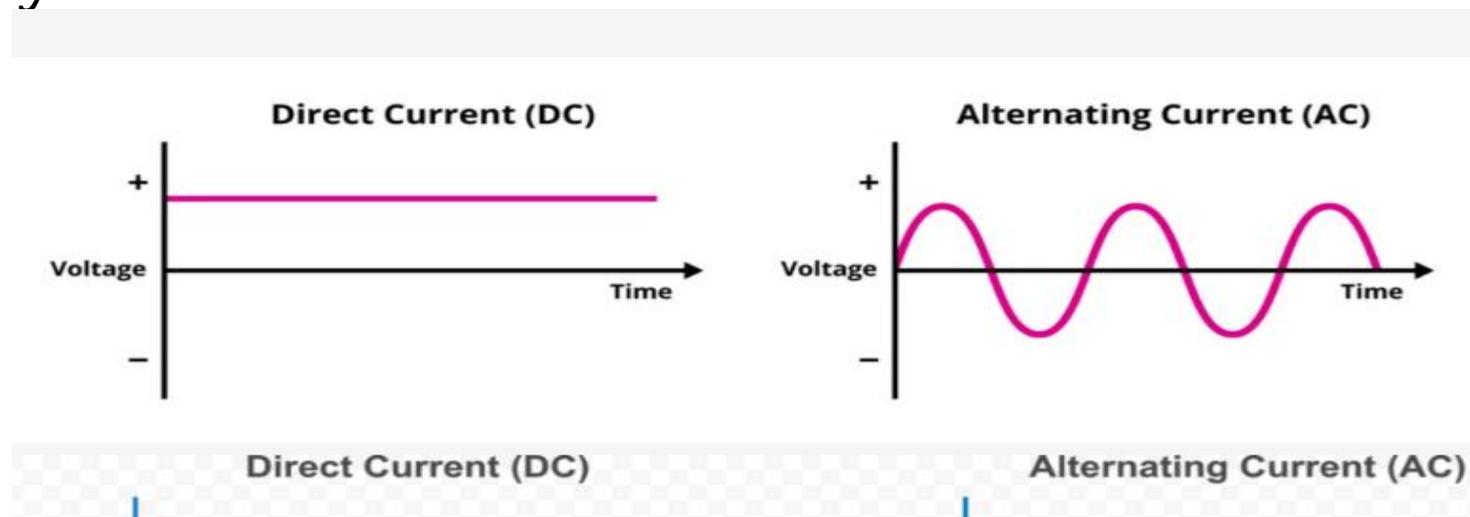
Single Phase Circuit: Waveforms, Period, Peak Value, Effective value

Let's Recall !!

- Electricity?
- Alternating Current (AC) vs Direct Current (DC)
- Waveforms: Sinusoidal, Square, Triangular
- Average Value and RMS Value

AC Circuits

- Current flows in one direction in DC circuits.
- Do you know that it is possible to alternate the current direction periodically?
- AC circuits are the type of circuits used for generating an electric current that changes its direction and magnitude periodically.



Topics for discussion

- Why AC Circuits: Waveforms, Average Value, RMS Value?
- AC Circuits: Waveform Fundamentals
- AC Circuits: Parameters and Terminologies
- Why AC Circuits: Waveforms and Parameters in Real World?

Some terminologies of AC circuits.



Amplitude: The maximum peak value that the voltage or current can take in one full cycle is known as the amplitude of the alternating quantity.

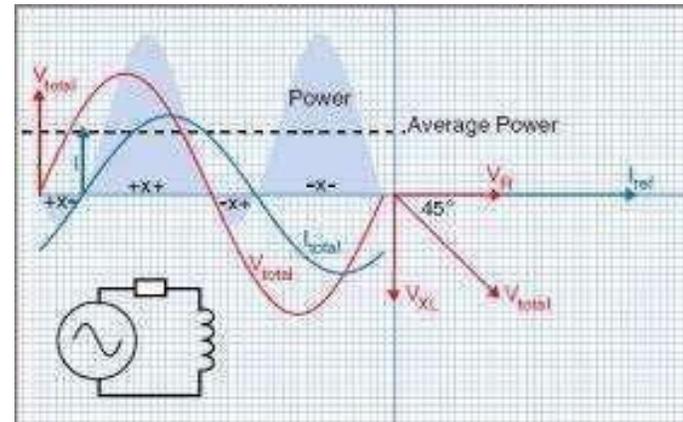
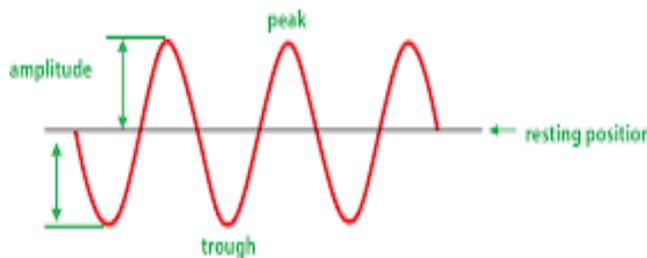
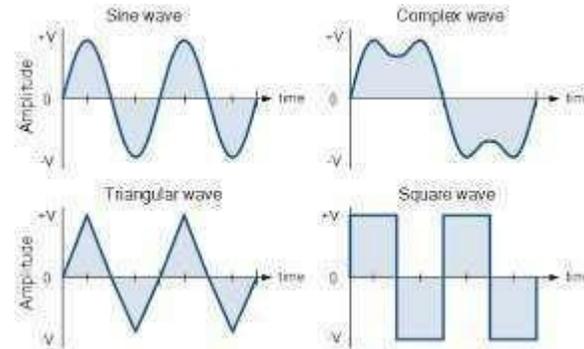
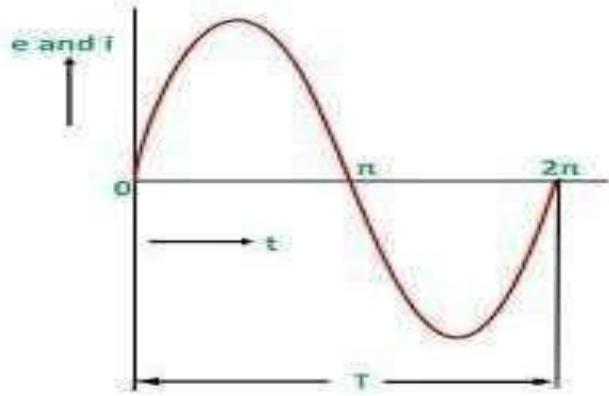
Frequency: Frequency is the number of cycles or alterations a quantity can make in one second. It is usually measured in Hertz.

Time period: The time taken by an alternating quantity like current or voltage to complete one oscillation or cycle is known as the period of that quantity.

Instantaneous Value: The value of any quantity at that particular instant of time is known as the instantaneous value of that quantity.

Waveform: Every alternating quantity when measured over a period of time creates a shape known as waveform of that quantity. This waveform is generally plotted on y axis with respect to time.

AC Circuit Parameters

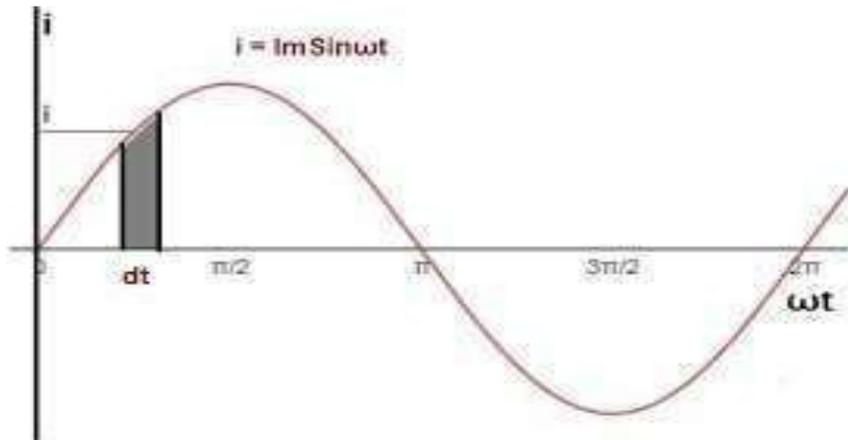
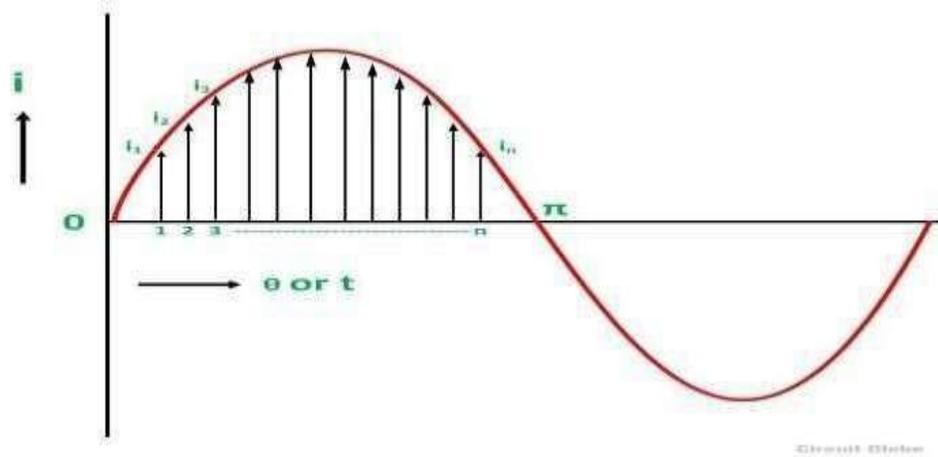


AC Waveforms Definition: A time-varying voltage or current that periodically changes direction in an AC circuit. Types of

Waveforms:

- **Sinusoidal:** Most common, used in power systems (e.g., household electricity).
 - **Square:** Used in digital electronics and switching circuits.
 - **Triangular:** Found in signal processing and testing equipment.
- Key Characteristics:
- **Frequency (f):** Number of cycles per second, measured in Hertz (Hz).
 - **Amplitude:** Peak value of the waveform.
 - **Period (T):** Time for one complete cycle ($T = 1/f$). Role in AC Circuits: Determines how energy is delivered and used in circuits.

Average Value Definition



Average Value Definition: The average of an AC waveform over one complete cycle, representing the equivalent DC value that produces the same effect. Formula for Sinusoidal Wave:

- Average Value = $(2/\pi) \times$ Peak Value (for a full cycle). Example: For a sinusoidal voltage with a peak of 10V, Average Value \approx 6.37V. Key Characteristics:

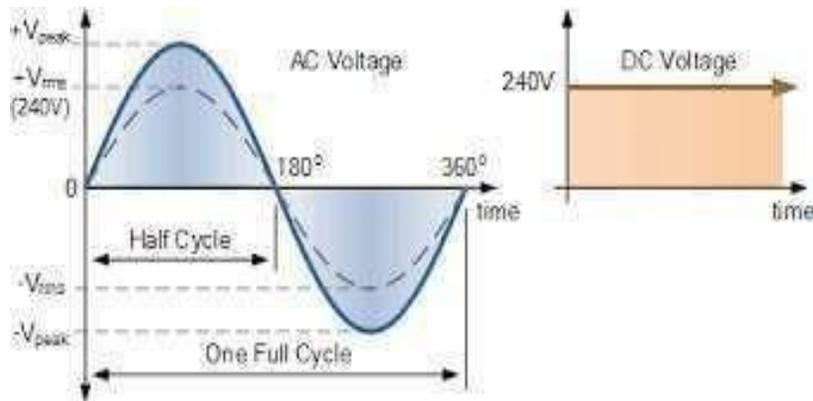
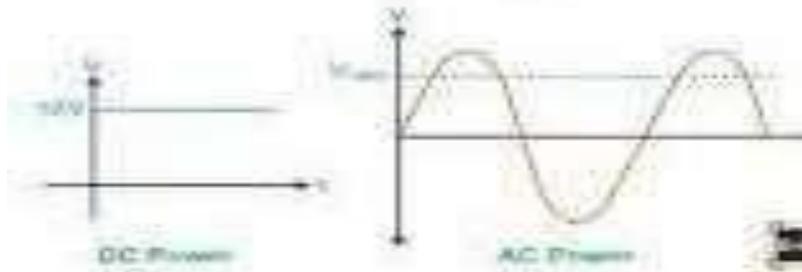
- For symmetrical waveforms (e.g., sinusoidal), the average value over a full cycle is zero due to equal positive and negative portions.

- Half-cycle average is used for practical applications (e.g., rectification). Role in AC Circuits:

- Used in rectifier circuits to calculate equivalent DC output.

Root Mean Square (RMS)

What is RMS Voltage?

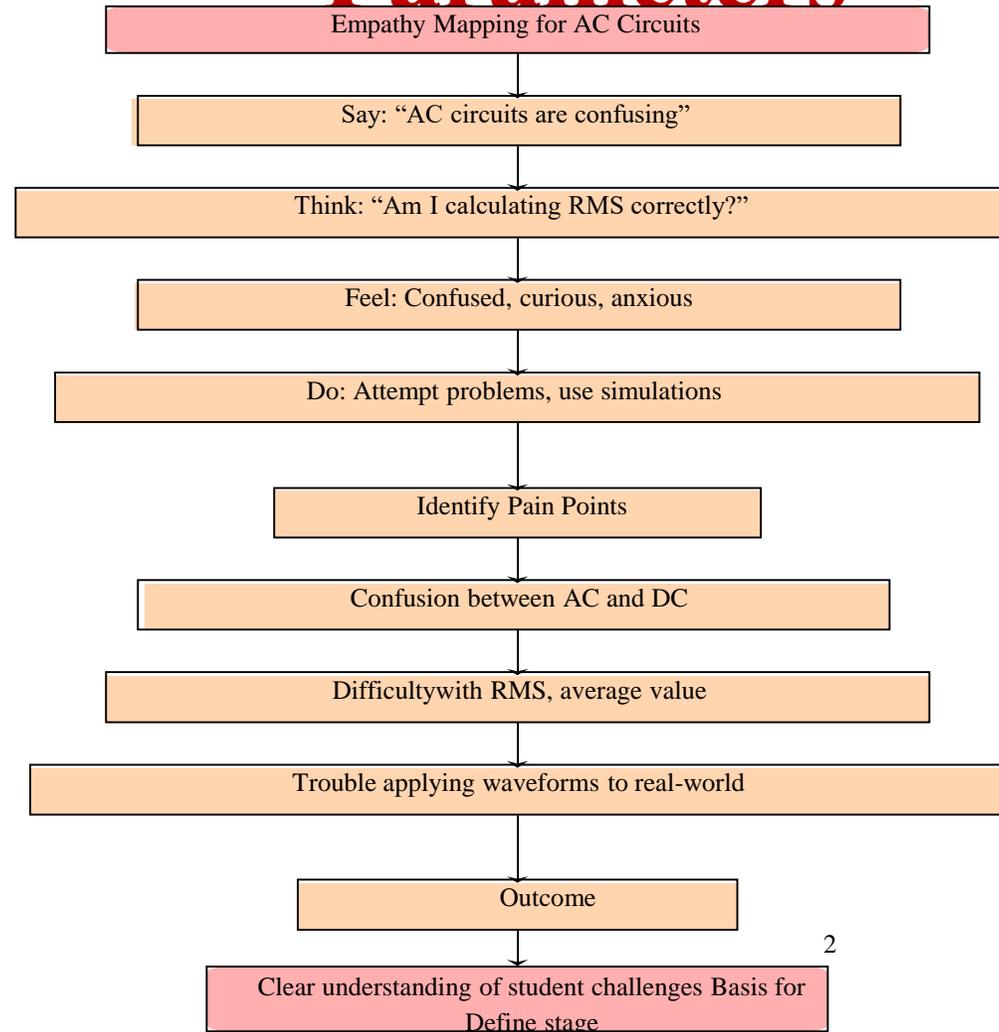


Root Mean Square (RMS) Value Definition: The effective value of an AC waveform that produces the same heating effect as a DC signal of the same magnitude. Formula for Sinusoidal Wave:

- RMS Value = Peak Value / $\sqrt{2}$ ($\approx 0.707 \times$ Peak Value). Example: For a sinusoidal voltage with a peak of 10V, RMS Value $\approx 7.07V$. Key Characteristics:
- RMS is critical for calculating power in AC circuits ($P = V_{RMS} \times I_{RMS}$).
- Applies to any waveform, though formulas vary (e.g., square wave RMS = Peak Value). Role in AC Circuits:
- Standard for measuring AC voltage and current in household and industrial systems.

AC Circuits and Parameters

*DT-
Empathize*

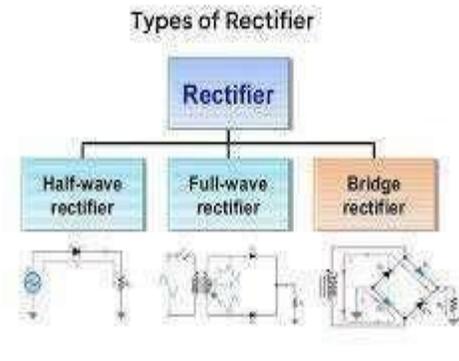
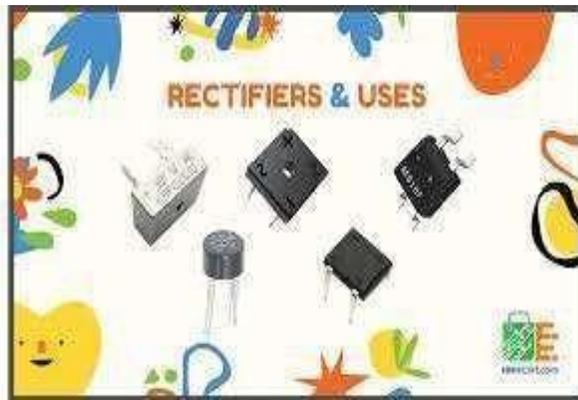
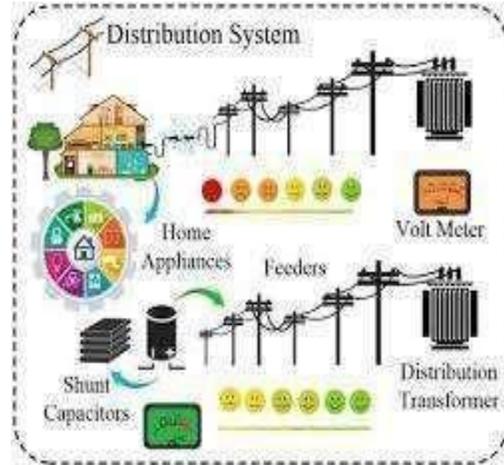


AC Circuits and Parameters

DT-Define

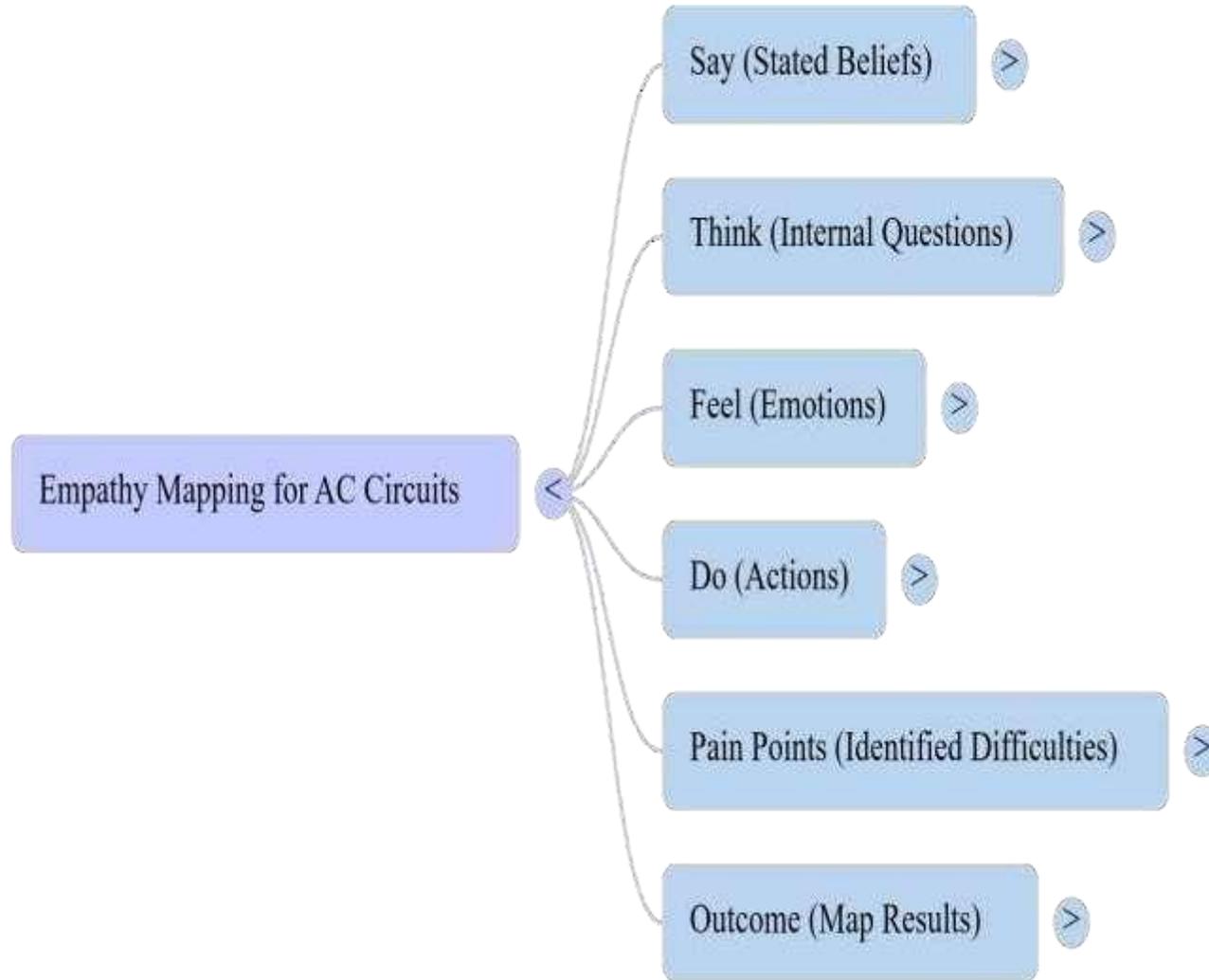
- In the Define stage of Design Thinking, the goal is to synthesize insights from the Empathy Mapping and Pain Points identified to articulate a clear problem statement that guides the development of solutions.
- Based on the provided empathy map and pain points, we will define the problem related to learning and applying Ohm's Law ($V = IR$).

Real-World Applications of AC Waveforms and Parameters



Real-World Applications of AC Waveforms and Parameters

- Power Distribution: Sinusoidal AC waveforms are used in power grids for efficient transmission over long distances.
- Electronics: Square and triangular waveforms drive digital circuits and signal generators.
- Rectifiers: Average value is critical for converting AC to DC in power supplies.
- Appliances: RMS values ensure accurate power ratings for devices like heaters and motors.



References

- • PhET Interactive Simulations – AC Circuits
 - https://phet.colorado.edu/sims/html/circuit-construction-kit-ac/latest/circuit-construction-kit-ac_en.html
- All About Circuits: AC Waveforms and RMS
 - <https://www.allaboutcircuits.com/textbook/alternating-current/chpt-1/ac-waveforms/>
- Fluke: Understanding RMS in AC Systems
 - <https://www.fluke.com/en-us/learn/blog/electrical/what-is-true-rms>

Difference Between AC and DC Circuits



Parameter	AC circuits	DC circuits
Current	The current flowing in the circuit alternates in its direction.	Current in the DC circuit flows in one direction.
Power Supply	AC generators are used in power supply.	Batteries are used as power supply.
Frequency	The circuit has a non-zero frequency.	The circuit has 0 frequency.
Losses	Power can be transferred over long distances without much power loss.	High losses are associated so long-distance communication is not possible.
Power	Reactive power is generated.	No reactive power is generated.

*Thank
you!*