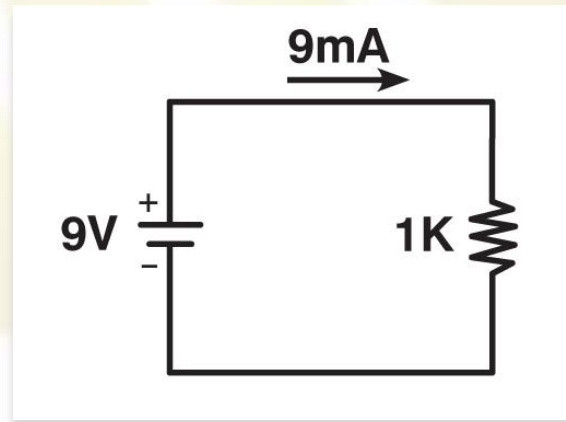


Topic 1 - RF Components and Basic Concepts

1.3 - V-I-F-Z-P

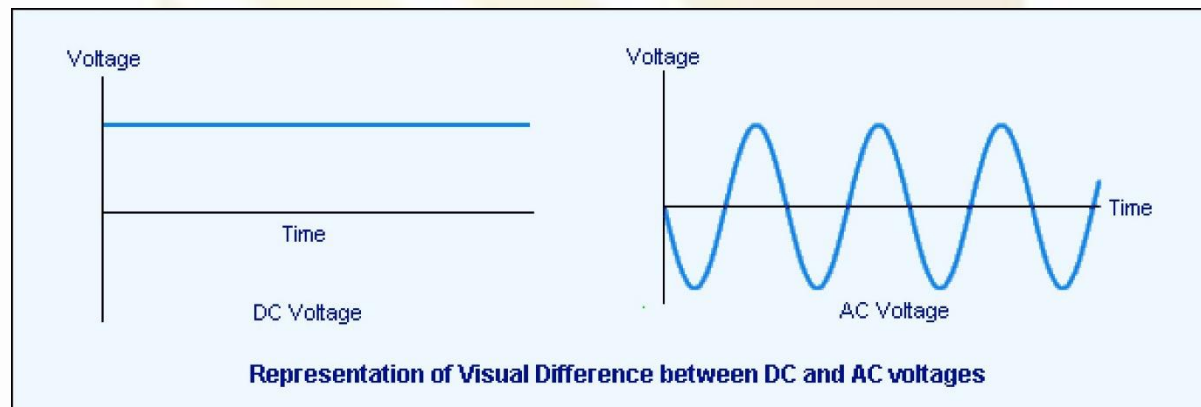
Ohm's Law

- The potential difference (voltage) across an ideal conductor is proportional to the current through it.
- The constant of proportionality is called the "resistance", R. **Ohm's Law** is given by: $V = I R$ where V is the potential difference between two points which include a resistance R.



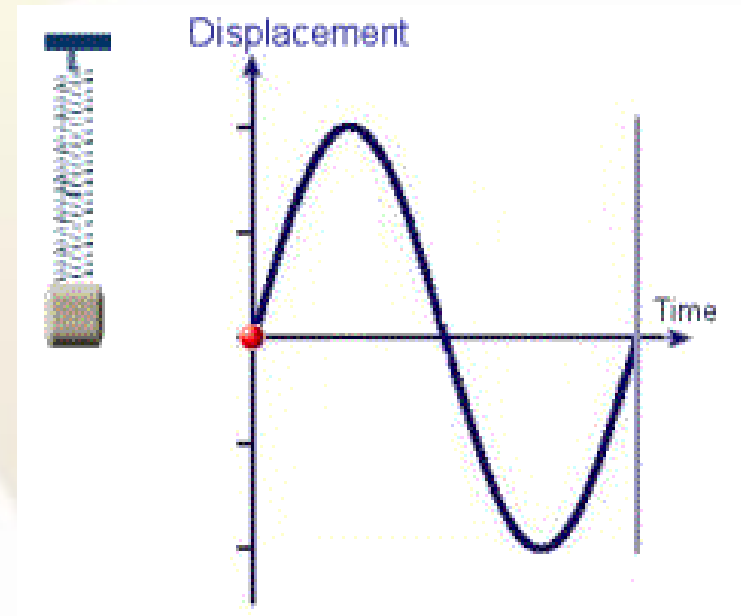
DC and AC Voltage

- In **direct current** (DC), the electric charge (current) only flows in one direction.
- Electric charge in **alternating current** (AC), on the other hand, changes direction periodically. The voltage in AC circuits also periodically reverses because the current changes direction.

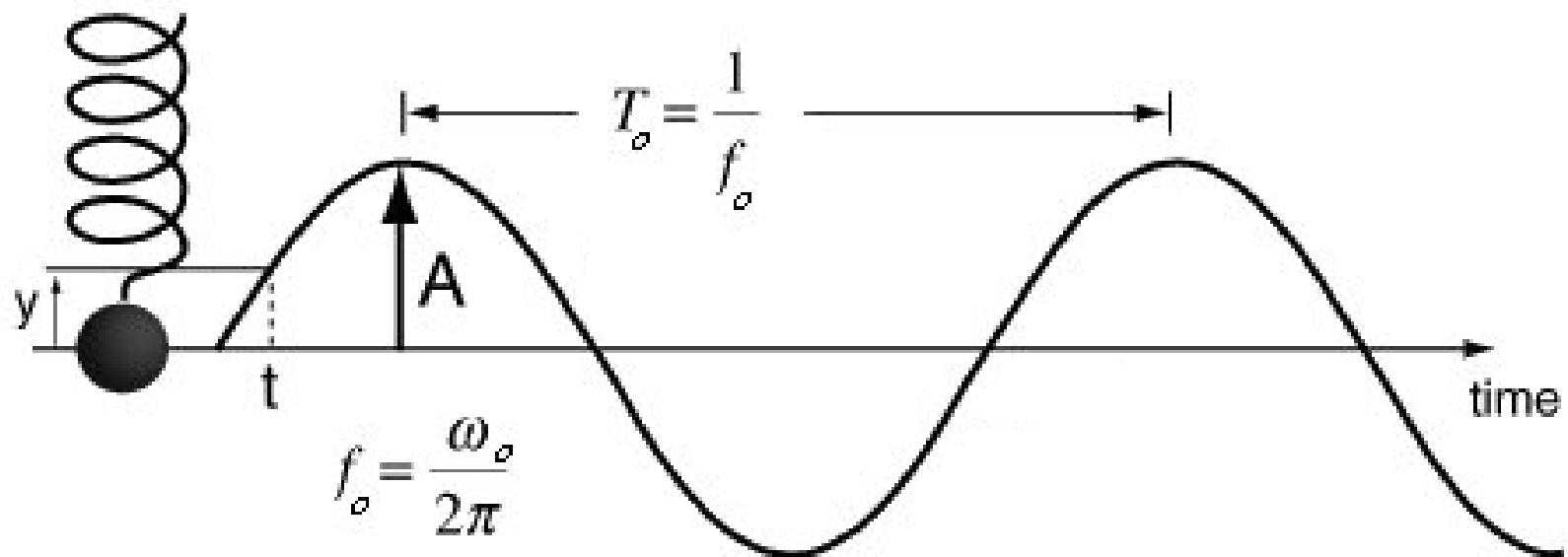


Frequency

- **Frequency** is the number of occurrences of a repeating event per unit time.
- The **period** is the duration of time of one cycle in a repeating event
- f = Regular Frequency
- T = Period = $1/f$
- ω = Angular frequency = $2\pi f$



$$y = A \sin \omega_o t$$



Impedance

- Impedance, represented by the symbol Z , is a measure of the opposition to electrical flow. It is measured in ohms.
- For DC systems, impedance and resistance are the same, defined as the voltage across an element divided by the current ($R = V/I$).
- Impedance in an AC system is still measured in ohms and represented by the equation $Z = V/I$, but V and I are frequency-dependent.

Power

RF Design Theory and Principles (RAHRF201) Section 1

- **Electric power** is the rate, per unit time, at which **electrical** energy is transferred by an **electric** circuit.

$$P = \frac{VQ}{t} = V.I$$

Example

- Calculate Power for $V_{dc} = 1V$ and $R=50\text{ Ohm}$
- What is the current of 50 ohm resistance which consumes 1W power ?

dB and dBm

The **decibel (dB)** is a logarithmic unit used to express the ratio of two values of a physical quantity. One of these values is often a standard reference value.

- $P_{dB} = 10 \log_{10}\left(\frac{P}{1W}\right)$

- If $P=1$ w it means $P_{dB} = 0$

- If we make power twice dB power increases 3 dB $P_{dB2} = 10 \log_{10}(2P) = 3 + 10 \log_{10}(P)$

- Ratio will become subtraction in dB domain , $power\ Ratio = \frac{P_2}{P_1}$

- $Ratio_{(dB)} = 10 \log_{10}\left(\frac{P_2}{P_1}\right) = 10 \log(P_2) - 10 \log(P_1) = P_2(dB) - P_1(dB)$

dB and dBm

dBm (sometimes dB_{mW} or decibel-milliwatts) is an abbreviation for the **power** ratio in decibels (dB) of the measured **power** referenced to one milliwatt (mW)

$$P_{dBm} = 10 \log_{10}\left(\frac{P}{1mW}\right) = 10 \log_{10}(P) + 30$$

➤ If P=10 mW it means P_{dBm} = 10

Example

Resistor of 50 ohms has 2 volts on its terminal

Find power in Watts and dBm

