Electrical Circuits
Ohm,s Law & Temp. Effect
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الأفكار الرئيسية

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1- Electrical Units

quantity	symbol	unit	Symbol
Voltage	V	Volt	V
Current	I	Ampere	A
Resistance	R	Ohm	Ω
Power	P	Watt	W
Capacitance	C	Farad	F
inductance	L	Henery	H

2 - multiplers and submultiplers

Prefix	Name	Meaning (multiply by)
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}

1- Voltage- **E**

Electromotive **force** or pressure, which is, required to **move** the electrons through the circuit.

Measured in Volts (V)

2- Current = **I**

"Intensity" of current flow, the flow of electrons through a conductor

Measured in Ampere (A)

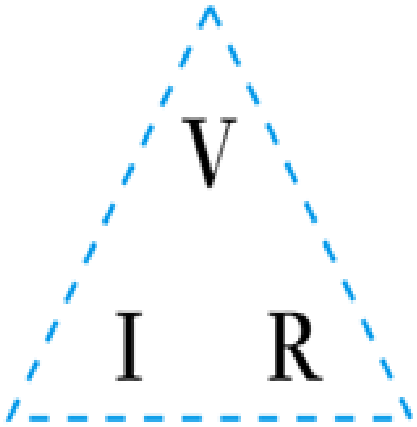
3-Resistance - **R**

Resistance **opposition** to the flow of current

R is measured in **Ohms**

5 - Ohm,s Law

- *The current flowing in a conductor is directly proportional to the applied voltage V and inversely proportional to its resistance R*



$V = IR$

$I = V/R$

$R = V/I$

Three Variable of ohm,s Law

- $V\,(E) = I \times R$
- $I = \frac{V}{R}$

$R = \frac{V}{I}$

examp. What E is needed for a circuit with a R of 1.2K ohms and a I of .03 amps.

$$E = I \times R$$

$$= .03A \times 1.2K \text{ ohms}$$

$$= 36 \text{ volts}$$

example: How much I could flow through a 36 ohm R in a car radio powered by a 12V battery?

$$I = E/R$$
$$= 12V/36 \text{ ohms}$$
$$= 1/3A \text{ or } .33A$$

Example: The current(I) flow through a (R) is 0.3A. The measured(E) drop across the R is 600V.
What is the value of the R?

$$R = E/I$$
$$= 600V/0.3A$$
$$= 2000 \text{ ohms}$$
$$\text{or } 2K \text{ ohms}$$

6 - Resistance

Resistance (R)

The resistance of any materials is depend on four factor

1- The length (L) in meter (m)

2- cross – sec tion area (A) in sequar – meter (m^2)

3 –The nature (type) of material

4 – The temperature

$$R = \rho \frac{L}{A}$$

Where (ρ) is the resistivity in Ω . m

Conductance

Conductance

is the reciprocal of resistance and denoted by (G) and it unit is mho or Siemens (S) and defined as the ability of material to allow the flow of charge

$$G = \frac{1}{R} = \frac{I}{V}$$

$$G = \frac{1}{R} = \frac{1}{\rho}\frac{A}{L} = \sigma\frac{A}{L}$$

Where (σ) is the conductivity and has unit mho / meter

Example - 1

Example :

What is the resistance of 3 km length of wire with cross – section area 6 m m^2 and resistivity 1.8 $\mu\Omega$

L= 3 km = 3000 m

A = 6 m m^2 $= 6 * 10^{-6}\, m^2$

$\rho = 1.8\mu\Omega\, cm = 1.8 * 10^{-6} * 10^{-2}$ Ω.m

$R = \rho \frac{L}{A} = 1.8 * 10^{-8} \frac{3000}{6*10^{-6}} = 9\ \Omega$

Example - 2

Example:
What is the voltage across the resistor 220 kΩ when the current 125 μA

$E = IR = 125 * 10^{-6} * 220 * 10^{3} = 27.5\ \Omega$

Example :

What is the current through 24 Ω when connected to 12 V

$I = \frac{V}{R} = \frac{12}{24} = 0.5\ A$

7-Temperature Effect,s on Resistors

Effect of temperature on Resistance

$$\frac{R2}{R1} = \frac{T2 - T0}{T1 - T0}$$

$$\alpha_1 = \frac{1}{T1 - T0}$$

$$Rt = R1\,(\,1 + \alpha 1\,(\,t2 - t1\,)$$

Where

R2 = Resistance at t2

R1 =Resistance at t1

$\alpha o = Temperature\ coefficient$

Example - 3

Example:

Aluminnum conductor has resistance (0.25 Ω) at 10°C ,

Find its resistance at 60 °C .

$$\frac{R2}{R1} = \frac{T2-T0}{T1-T0}$$

$$\frac{R2}{0.25} = \frac{65-(-236)}{10-(-236)} = \frac{301}{246}$$

$$R2 = 0.25\left[\frac{301}{246}\right] = 0.31\ \Omega$$

Example - 4

Example : Deter mine the temperature of the Tungsten filment of 100 w light bulb , if the resistance at 20 °C Is 11.7 Ω and the light is on , the resistance is 144 Ω.

$$\frac{R2}{R1} = \frac{T2-T0}{T1-T0}$$

$$T2 = \frac{R2}{R1}(T1 - T2) + To$$

$$T2 = \frac{144}{11.7}(20 - (-202) + (-202) = 2530\ °C$$

Example - 5

A –Find the value of ($\alpha 1$) at (40 ℃) for copper wire

B – Use the result of (a) Find the resistance of copper wire at 75 ℃ , if its resistance is 30 Ω at 40 ℃

$$A - \quad \alpha 1 = \frac{1}{T1 - T0} = \frac{1}{40 - (-234.5)} = \frac{1}{274.5} = 0.0036 \ C$$

$$B - \quad R2 = R1 [\, 1 + \alpha 1 \, (T2 - T1)\,] = 30 [\, 1 + 0.0036 \, (75 - 40)\,] = 33.8 \ \Omega$$