Formulas

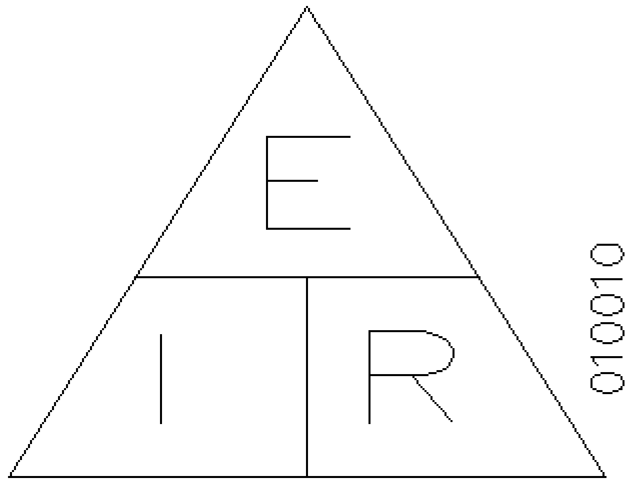
Ohm's Law

:

$$E = I \times R$$

$$I = E \div R$$

$$R = E \div I$$



Remember:

E = voltage, in Volts
I = current, in Amperes
R = resistance, in Ohms

Ohms Law for Series Circuits:

Resistance in Series:

$$R_t = R_1 + R_2 + R_3 + ...$$

where:

R_t = total resistance in series
R_1, R_2 .... are individual resistors

Voltage in a Series Circuit:

$$E_t = E_1 + E_2 + E_3 ....$$

where:

E_t = total voltage applied to the circuit
E_1, E_2, ... = the voltage drops across the individual resistors

Rule: In a series circuit the total voltage drop equals the sum of the individual voltage drops.

Current in a Series Circuit:

$$I_t = I_1 = I_2 = I_3 \ldots.$$

where

I_t current in the series circuit

I_1, I_2, ... currents through each resistor which are the same as the total current

Rule: There is only one path for current to flow in a series circuit, therefore the same current flows everywhere in the circuit and is always the same as the total current.

Ohms Law for Parallel Circuits:

Resistance in Parallel:

There are two formulas.

1. If only two resistors are in parallel, use the following formula:

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$$

2. If more than two resistors, use the following formula:

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}} \ldots\ldots$$

Note: The total resistance in parallel is always less than the value of the smallest resistor.

Voltage in a Parallel Circuit:

$$E_T = E_1 = E_2 \ldots. = E_N$$

Note: Voltage is common to all elements in a parallel circuit.

Current in a Parallel Circuit:

$$I_T = I_1 + I_2 + \ldots\ldots + I_N$$

Note: the total current is the sum of all the individual currents flowing in all of the various branches of the parallel circuit.

Power:

$$P = E \times I$$

$$P = I^2 \times R$$

$$P = \frac{E^2}{R}$$

Where:
- P = power in Watts
- E = voltage in Volts
- I = current in Amperes

Inductors:

Inductors in Series:

$$L_T = L_1 + L_2 + \ldots. + L_N$$

Note: same formula as resistors in series

Inductors in Parallel:

1

$$L_T = \cfrac{1}{\cfrac{1}{L_1} + \cfrac{1}{L_2} + \dots + \cfrac{1}{L_N}}$$

Note: same formula as resistors in parallel.

Capacitors:

Capacitors in Parallel:

$$C_T = C_1 + C_2 + \dots + C_N$$

Note: same formula as resistors in series.

Capacitors in Series:

$$C_T = \cfrac{1}{\cfrac{1}{C_1} + \cfrac{1}{C_2} + \dots + \cfrac{1}{C_N}}$$

Note: same formula as resistors in parallel.

Reactance:

Inductive Reactance:

$$X_L = 2 \times PI \times f \times L$$

Where:
- X = inductive reactance in ohms
- 2 × PI = 6.28
- f = frequency in hertz
- L = inductance in henries

Capacitive Reactance:

$$X_C = \frac{1}{2 \times PI \times f \times C}$$

Where:
- X = capacitive reactance in ohms
- 2 × PI = 6.28
- f = frequency in hertz
- C = capacitance in farads

Resonance:

$$f_R = \frac{1}{2 \times PI \times SQRT\ (L \times C)}$$

Where:
- f = resonance frequency
- 2 PI = 6.28
- L = inductance in henrys
- C = capacitance in farads
- SQRT is short for Square Root

Wavelength:

$$Wavelength = \frac{c}{f}$$

$$c = \frac{Wavelength}{f}$$

Where:
- Wavelength is in metres
- f = frequency in Hertz
- c = speed of light (300 000 000 metres/second)

This can be simplified if we consider frequency in megahertz:

$$f = \frac{300}{\text{Wavelength}}$$

$$\text{Wavelength} = \frac{300}{f}$$

Where:
- Wavelength is in metres
- f = frequency in Hertz
- c = speed of light (300 000 000 metres/second)

Remember: this is for a full wavelength. Divide by two for a half wavelength.

Frequency and Period Relationships:

$$\text{frequency} = \frac{1}{\text{time}}$$

$$f = \frac{1}{t}$$

$$\text{time} = \frac{1}{\text{frequency}}$$

$$t = \frac{1}{f}$$

Where:
- t is the time, called *period* in this case
- f is the frequency

Example: what is the frequency of a waveform having a period of 0.001 seconds?

```
      1
f = ---
```

```
          t

            1
     f = -------
          0.001 (sec)

     f = 1 000 (Hz)
```

Example: what is the period of a signal of 500 Hz?

```
          1
     t = ---
          f

           1
     t = -----
          500  (Hz)

     t = 0.002 (seconds)
```

(this is the time it takes for 1 cycle to occur.)