

BASIC ELECTRICAL THEORY STUDY GUIDE

BASIC PROPERTIES OF ELECTRICITY

- These properties of electricity are interrelated; A change in voltage and/or current produces a change in power
- They are affected by properties of circuits and components (Resistance, Capacitance and Inductance)

VOLTAGE

E

VOLTS

V

- Electrical pressure, or electrical force which "pushes" current through a circuit or component

CURRENT

I

AMPS

A

- The amount of electrical flow (Number of electrons passing a point in a period of time)

POWER

P

WATTS

W

- Power represents how much electrical work is being done
- Power is a product (multiplication) of Voltage (E) and Current (I)
- Power can be derived from Voltage (E) and Resistance (R), or Current (I) and Resistance (R)

$$P = I \times E$$

$$P = E^2 \div R$$

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

BASIC PROPERTIES OF CIRCUITS AND COMPONENTS

- These properties of circuits and components are *physical* properties;
- They are not affected by properties of electricity (Voltage, Current and Power)
- Resistors, Capacitors and Inductors have specific values of Resistance, Capacitance and Inductance

RESISTANCE

R

OHMS

Ω

- Resistance is opposition to current flow

CAPACITANCE

C

FARADS

F

- Capacitance opposes *change in voltage*, by storing energy in the form of *electric charge*

INDUCTANCE

L

HENRYS

H

- Inductance opposes *change in current*, by storing energy in the form of a *magnetic field*

PROPERTIES SPECIFIC TO ALTERNATING CURRENT (AC)

POWER	TRUE POWER	Power consumed by the load	P_t or P_{true}	WATTS	W
	APPARENT POWER	Power provided by the source	P_a or $P_{apparent}$	Volt-Amps	VA (kVA)
	POWER FACTOR	Ratio of P_t to P_a ($pf = P_t \div P_a$)	pf	n/a	% or Decimal #
	REACTIVE POWER	Power caused by capacitance and inductance	P_r or $P_{reactive}$	Volt-Amps Reactive	VAR (kVAR)

FREQUENCY

f

HERTZ

Hz

- Number of Cycles Per Second (CPS) of the AC sine wave; 60 Hz in North America; 50 Hz is most of the world

REACTANCE

X

OHMS

Ω

CAPACITIVE REACTANCE

X_c

OHMS

Ω

- Opposition to current flow in an AC circuit due to capacitance; $X_c \downarrow$ as frequency $\uparrow$

$$X_c = \frac{1}{2\pi f C}$$

INDUCTIVE REACTANCE

X_L

OHMS

Ω

- Opposition to current flow in an AC circuit due to inductance; $X_L \uparrow$ as frequency $\uparrow$

$$X_L = 2\pi f L$$

IMPEDANCE

Z

OHMS

Ω

- Total opposition to current flow in an AC circuit; Varies with frequency (f)
- Includes Resistance (R), Capacitive Reactance (X_c), and Inductive Reactance (X_L)

$$Z = \sqrt{R^2 + (X_L - X_c)^2}$$

BASIC CIRCUIT ARRANGEMENTS

SERIES

PARALLEL

- Current flows through components *sequentially*
- Current is *constant* through components in series
- Voltage varies across components

- Current flows through branches *simultaneously*
- Voltage is *constant* across parallel branches
- Current varies through individual branches

OHM'S LAW

- Relationship between Voltage (E), Current (I) and Resistance (R)
- It can be expressed using the three formulas below
- Impedance (Z) must be substituted for Resistance (R) in AC circuits that have capacitive and inductive properties

$$E = I \times R$$

$$I = E \div R$$

$$R = E \div I$$

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