

# Electrical Formulas

## Conversion Formulas

Area of Circle =  $\pi r^2$

Breakeven Dollars = Overhead Cost \$/Gross Profit %

Busbar Ampacity AL = 700A Sq. in. and CU = 1000A Sq. in.

Centimeters = Inches x 2.54

Inch = 0.0254 Meters

Inch = 2.54 Centimeters

Inch = 25.4 Millimeters

Kilometer = 0.6213 Miles

Length of Coiled Wire = Diameter of Coil (average) x Number of Coils x  $\pi$

Lightning Distance in Miles = Seconds between flash and thunder/4.68

Meter = 39.37 Inches

Mile = 5280 ft, 1760 yards, 1609 meters, 1.609 km

Millimeter = 0.03937 Inch

Selling Price = Estimated Cost  $\$/ (1 - \text{Gross Profit \%})$

Speed of Sound (Sea Level) = 1128 fps or 769 mph

Temp C = (Temp F - 32)/1.8

Temp F = (Temp C x 1.8) + 32

Yard = 0.9144 Meters

## Electrical Formulas Based on 60 Hz

Capacitive Reactance ( $X_C$ ) in Ohms =  $1/(2\pi f C)$

Effective (RMS) AC Amperes = Peak Amperes x 0.707

Effective (RMS) AC Volts = Peak Volts x 0.707

Efficiency (percent) = Output/Input x 100

Efficiency = Output/Input

Horsepower = Output Watts/746

Inductive Reactance ( $X_L$ ) in Ohms =  $2\pi f L$

Input = Output/Efficiency

Neutral Current (Wye) =  $\sqrt{A^2 + B^2 + C^2 - (AB + BC + AC)}$

Output = Input x Efficiency

Peak AC Volts = Effective (RMS) AC Volts x  $\sqrt{2}$

Peak Amperes = Effective (RMS) Amperes x  $\sqrt{2}$

Power Factor (PF) = Watts/VA

VA (apparent power) = Volts x Ampere or Watts/Power Factor

VA 1-Phase = Volts x Amperes

VA 3-Phase = Volts x Amperes x  $\sqrt{3}$

Watts (real power) Single-Phase = Volts x Amperes x Power Factor

Watts (real power) Three-Phase = Volts x Amperes x Power Factor x  $\sqrt{3}$

## Parallel Circuits

Note 1: Total resistance is always less than the smallest resistor

$$RT = 1/(1/R_1 + 1/R_2 + 1/R_3 + \dots)$$

Note 2: Total current is equal to the sum of the currents of all parallel resistors

Note 3: Total power is equal to the sum of power of all parallel resistors

Note 4: Voltage is the same across each of the parallel resistors

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## Series Circuits

Note 1: Total resistance is equal to the sum of all the resistors

Note 2: Current in the circuit remains the same through all the resistors

Note 3: Voltage source is equal to the sum of voltage drops of all resistors

Note 4: Power of the circuit is equal to the sum of the power of all resistors

## Transformer Amperes

Secondary Amperes 1-Phase = VA/Volts

Secondary Amperes 3-Phase = VA/Volts x  $\sqrt{3}$

Secondary Available Fault 1-Phase = VA/(Volts x %impedance)

Secondary Available Fault 3-Phase = VA/(Volts x  $\sqrt{3}$  x %Impedance)

Delta 4-Wire: Line Amperes = Phase (one winding) Amperes x  $\sqrt{3}$

Delta 4-Wire: Line Volts = Phase (one Winding) Volts

Delta 4-Wire: High-Leg Voltage (L-to-G) = Phase (one winding) Volts x 0.5 x  $\sqrt{3}$

Wye: Line Volts = Phase (one winding) Volts x  $\sqrt{3}$

Wye: Line Amperes = Phase (one winding) Amperes

## Voltage Drop

VD (1-Phase) = 2KID/CM

VD (3-Phase) =  $\sqrt{3}$  KID/CM

CM (1-Phase) = 2KID/VD

CM (3-Phase) =  $\sqrt{3}$  KID/VD

## Code Rules

Breaker/Fuse Ratings – 240.6(A)

Conductor Ampacity – 310.15 and Table 310.16

Equipment Grounding Conductor – 250.122

Grounding Electrode Conductor – 250.66

Motor Conductor Size – 430.22 (Single) 430.24 (Multiple)

Motor Short-Circuit Protection – 430.52

Transformer Overcurrent Protection – 450.3

$\pi$  (Pi) = (3.142 approximately),  $\sqrt{2}$  = 1.414 (approximately),  $\sqrt{3}$  = 1.732 (approximately),  $f$  = Frequency,  $r$  = radius,  $d$  = diameter,  $C$  = Capacitance (farads),  
 $L$  = Inductance (henrys),  $CM$  = Circular Mils (Chapter 9, Table 8),  $VD$  = Volts Drop,  $K$  = (12.9 ohms CU) (21.2 ohms AL),  $I$  = Amperes of load,  $D$  = Distance in ft one way

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