Electrical Formulas

Conversion Formulas

Area of Circle = πr^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 π
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 - 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
$RT = 1/(1/R_1 + 1/R_2 + 1/R_3 + ...)$
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

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

π (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