



## ***ELECTRICAL EQUATIONS***

### **Capacitors**

Capacitive Reactance in Ohms =  $X_C = 1/(2 \times 3.14 \times f \times C)$

Parallel Impedance in Ohms =  $Z = X_{C1} + X_{C2} + X_{C3}...$

Series Impedance in Ohms =  $Z = 1/(1/X_{C1} + (1/X_{C2})...$

### **Current, Amperes (I)**

Single-Phase =  $I = P/E$

Three-Phase =  $I = P/(E_{L-L} \times 1.732)$

### **Efficiency**

Efficiency =  $\text{Output}/\text{Input}$

Input =  $\text{Output}/\text{Efficiency}$

Output =  $\text{Input} \times \text{Efficiency}$

### **Inductors**

Inductive Reactance in Ohms =  $X_L = 2 \times 3.14 \times f \times L$

Parallel Impedance in Ohms =  $Z = 1/(1/X_{L1} + (1/X_{L2}) + (1/X_{L3}))$

Series Impedance in Ohms =  $Z = X_{L1} + X_{L2} + X_{L3}$

### **Impedance (Z)**

Impedance in Ohms =  $Z = \sqrt{[R^2 + (X_L^2 - X_C^2)]}$



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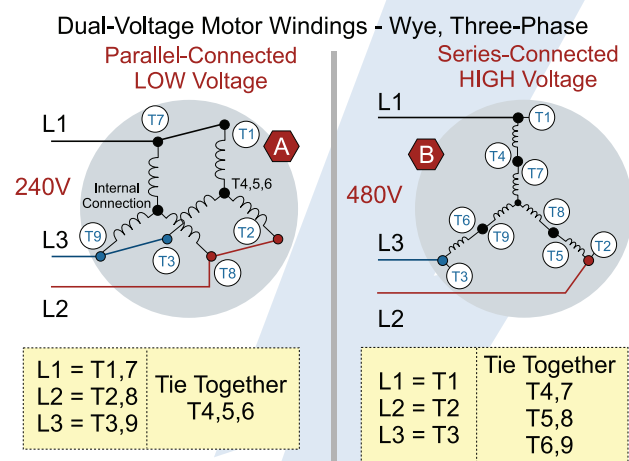
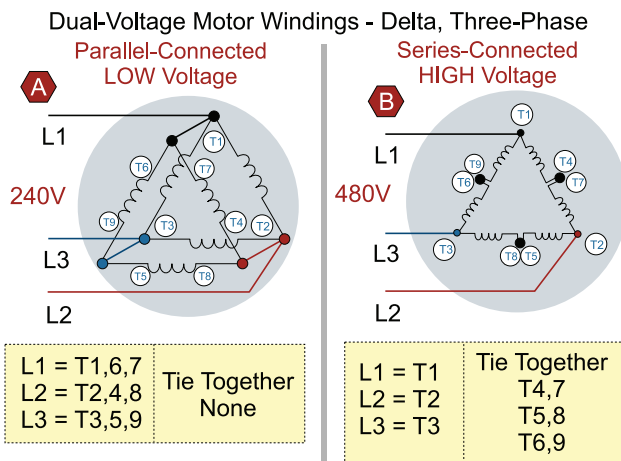
## Motor FLA/Watts

$$\text{FLA, Single-Phase} = (\text{hp} \times 746\text{W}) / (\text{E} \times \text{Eff} \times \text{PF})$$

$$\text{FLA, Three-Phase} = (\text{hp} \times 746\text{W}) / (\text{E} \times 1.732 \times \text{Eff} \times \text{PF})$$

$$\text{Watts} = \text{Horsepower} \times 746\text{W}$$

## Motors, Dual-Voltage



## Neutral Current

Single-Phase, 120/240V System:  $I_{\text{Neutral}} = \text{Line 1} - \text{Line 2}$

Three-Phase, 120/208V, 4-wire Wye Connected System:

$$I_{\text{Neutral}} = \sqrt{(I_{L1}^2 + I_{L2}^2 + I_{L3}^2) - ((I_{L1} \times I_{L2} + I_{L2} \times I_{L3} + I_{L1} \times I_{L3}))}$$



# **ELECTRICAL EQUATIONS**

## Parallel Circuit Resistance

$$R_T = \text{Resistance/Number of Resistors} \quad R_T = (R_1 \times R_2)/(R_1+R_2)$$

$$R_T = 1/(1/R_1 + 1/R_2 + 1/R_3)$$

## Power Factor

$$PF = W/VA$$

$$VA = W/PF$$

$$W = VA \times PF$$

## Series Circuit Resistance

$$R_T = R_1 + R_2 + R_3...$$

$$E_T = E_1 + E_2 + E_3...$$

## Short-Circuit Calculation

$$\text{Short-Circuit Current} = \text{Secondary Amperes/Transformer Z\%}$$

## Temperature Conversions

$$C^\circ = 5/9 \times (\text{Temp } F^\circ - 32^\circ)$$

$$F^\circ = (9/5 \times \text{Temp } C^\circ) + 32^\circ$$

## Transformers, Single-Phase

$$I_{\text{Primary}} = \text{Transformer VA}/E_{L-L}$$

$$I_{\text{Secondary}} = \text{Transformer VA}/E_{L-L}$$

$$\text{Transformer VA} = E_{L-L} \times I_{\text{Secondary}}$$



## ***ELECTRICAL EQUATIONS***

### **Transformers, Three-Phase**

$$I_{\text{Primary}} = \text{Transformer VA} / (E_{\text{L-L}} \times 1.732)$$

$$I_{\text{Secondary}} = \text{Transformer VA} / (E_{\text{L-L}} \times 1.732)$$

$$\text{Transformer VA} = (E_{\text{L-L}} \times 1.732) \times I_{\text{Secondary}}$$

### **Turns Ratio**

$$\text{Turns Ratio} = \text{Primary Volts} : \text{Secondary Volts}$$

$$\text{Secondary Volts} = \text{Primary Volts} / \text{Turns Ratio}$$

$$\text{Primary Volts} = \text{Secondary Volts} \times \text{Turns Ratio}$$

### **Volt-Amperes**

$$\text{Single-Phase} = \text{VA} = E \times I$$

$$\text{Three-Phase} = \text{VA} = (E_{\text{L-L}} \times 1.732) \times I$$

### **Voltages**

$$\text{Peak Voltage} = \text{Effective (RMS) Voltage} \times 1.414$$

$$\text{Effective (RMS) Voltage} = \text{Peak Voltage} \times 0.707$$

$$\text{High-Leg Voltage} = V_{\text{L-to-N}} \times 1.732$$



# ***ELECTRICAL***

## ***EQUATIONS***

### **Voltage Drop, Single-Phase**

$$\text{Voltage Drop} = (2 \times K \times I \times D)/\text{Cmil}$$

$$\text{Wire Size} = (2 \times K \times I \times D)/\text{VD}$$

$$\text{Distance} = \text{Cmil} \times \text{VD}/(2 \times K \times I)$$

$$K = \text{Cu, } 12.90\Omega - \text{Al, } 21.20\Omega$$

### **Voltage Drop, Three-Phase**

$$\text{Voltage Drop} = (1.732 \times K \times I \times D)/\text{Cmil}$$

$$\text{Wire Size} = (1.732 \times K \times I \times D)/\text{VD}$$

$$\text{Distance} = \text{Cmil} \times \text{VD}/(1.732 \times K \times I)$$

$$K = \text{Cu, } 12.90\Omega - \text{Al, } 21.20\Omega$$

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For Professional Electrical Services, Contact Us:

Email: [MainOffice@MDMarineElectric.com](mailto:MainOffice@MDMarineElectric.com)

Phone: (253) 383-9983

Website: [www.mdmarineelectric.com](http://www.mdmarineelectric.com)