Common electrical units used in formulas and equations are:

- Volts - The units of electrical potential or motive force. The force is required to send one ampere of current through one ohm of resistance.
- Ohms - The units of resistance. One ohm is the resistance offered to the passage of one ampere when impelled by one volt.
- Amperes - The units of current. One ampere is the current which onevolt can send through a resistance of one ohm.
- Watts - The unit of electrical energy or power. One watt is the product of one ampere and one volt. One ampere of current flowing under the force of one volt gives one watt of energy.
- Volt Amperes - The product of the volts and amperes as shown by a voltmeter and ammeter. In direct current systems, volt ampere is the same as watts or the energy delivered. In alternating current systems, the volts and amperes may or may not be 100% synchronous. When synchronous, the volt amperes equal the watts on a wattmeter. When not synchronous, volt amperes exceed watts. More about reactive power.
- Kilovolt Ampere - One kilovolt ampere - KVA - is equal to 1,000 volt amperes.
- Power Factor - is the ratio of watts to volt amperes.

Electric Power Formulas

$W = E\ I$ *(1a)*

$W = R\ I^2$ *(1b)*

$W = E^2 / R$ *(1c)*

where

W = power (Watts)

E = voltage (Volts)

I = current (Amperes)

R = resistance (Ohms)

Electric Current Formulas

$I = E / R$ *(2a)*

$I = W / E$ *(2b)*

$I = (W / R)^{1/2}$ *(2c)*

Electric Resistance Formulas

$R = E / I$ *(3a)*

$R = E^2 / W$ (3b)

$R = W / I^2$ (3c)

Electrical Potential Formulas - Ohms Law

Ohms law can be expressed as:

$E = R\ I$ (4a)

$E = W / I$ (4b)

$E = (W\ R)^{1/2}$ (4c)

Example - Ohm's law

A 12 volt battery supplies power to a resistance of 18 ohms.

$I = (12\ Volts) / (18\ ohms)$

$= \underline{0.67}\ Ampere$

Electrical Motor Formulas

Electrical Motor Efficiency

$\mu = 746\ P_{hp} / W_{input}$ (5)

where

μ = *efficiency*

P_{hp} = *output horsepower (hp)*

W_{input} = *input electrical power (Watts)*

or alternatively

$\mu = 746\ P_{hp} / (1.732\ E\ I\ PF)$ (5b)

Electrical Motor - Power

$W_{3\text{-}phase} = (E\ I\ PF\ 1.732) / 1{,}000$ (6)

where

$W_{3\text{-}phase}$ = *electrical power 3-phase motor (kW)*

PF = power factor electrical motor

Electrical Motor - Amps

$I_{3\text{-}phase} = (746\ P_{hp}) / (1.732\ E\ \mu\ PF)$ (7)

where

$I_{3\text{-}phase}$ = *electrical current 3-phase motor (Amps)*

PF = power factor electrical motor