

## Renewable Energy Terms

# Watts = Volts x Amps Power Equation

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**Derivation:** *The watt, volt, and amp are named after three well-known people in the history of energy—James Watt, Alessandro Volta, and Andre Ampere. This equation does not seem to have a formal name, so I'll just call it the "power equation."*

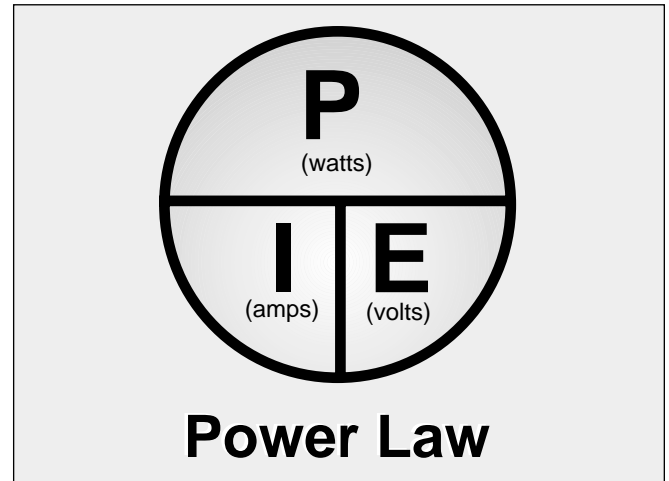
To understand the power equation, you need to understand what power is. Power is the rate at which energy is generated or used. Though no analogy is perfect, energy is like miles traveled, while power is like the rate of travel—miles per hour.

Power is measured in watts. When we see a 50 watt lightbulb, we know it uses energy at a certain rate. Technically, a watt is equal to one joule per second. But the important thing is that a watt is a rate of energy use or generation, not an amount of energy used or generated. Instead of saying "a lot of power," we should say "high power" or "a large value of power," so it's clear that power is a rate, not a blob of stuff. We should never say that power "flows," since power itself is a rate of flow. Energy can flow, but power doesn't.

Two things go into the flow rate of electrical energy. One is the "pressure," and the other is the rate of charge flow. We call electrical "pressure" voltage—it's the push that makes charges flow. And we call the rate of charge flow amperage—an amp is a certain number of charges passing a point in one second.

You might remember from my column in *HP77* that there's a direct relationship between volts, amps, and ohms. Well, there's a similar relationship between watts, volts, and amps (in DC circuits and resistive AC circuits). Take a look at the power equation diagram. Cover the unit you want to solve for, and the remaining

two units will give you the rest of the equation. If one is above the other, divide. If the remaining two are beside each other, multiply.



So there are really three forms of the same equation:

**Watts = Volts x Amps**  
**Volts = Watts ÷ Amps**  
**Amps = Watts ÷ Volts**

We can use this equation to do lots of common electrical computations. For example, if a motor is drawing 20 amps at 12 volts, we know that it's using energy at the rate of 240 watts (watts = volts x amps). If a lightbulb is drawing 100 watts at 4 amps, we can conclude that the voltage is 25 volts (volts = watts ÷ amps). And if we have a 150 watt lightbulb running on 120 volts, we know that it is drawing 1.25 amps (amps = watts ÷ volts).

We can also play with the values within the equation. If you run a 100 watt lightbulb directly from your 12 volt battery bank, it will draw 8.3 amps (amps = watts ÷ volts). If you run another 100 watt lightbulb through your 120 volt inverter, it will only draw 0.83 amps (amps = watts ÷ volts). The same amount of energy flow results in both cases, but the higher voltage means that the amperage is proportionally lower.

This only scratches the surface of the usefulness of this formula, and I'm glossing over some technical distinctions and exceptions. I continue to find applications for the formula as I learn more about electricity and renewable energy systems, and I expect you will too.

### Access

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