How Much Electrical Power Do You Need?

"How much electrical power do I need?" is a question that comes up often regarding generator use or solar power. It is even important for simple house wiring. The important thing is to find the maximum current that may be needed. If you have more than one appliance in a circuit, it is important to find the power needed for all the appliances so damage will not occur if all are turned on at the same time.

The two primary components in electrical power are current and voltage. Electrical appliances have rated voltage, current, and power associated with them. Simply adding up all of the power or current ratings of the appliances will tell you how much power you need. Power sources such as generators will give a power rating in watts. Electrical wiring is rated by the current it can carry.

Power is either AC (alternating current) or DC (direct current). To simplify, AC comes from the power company and DC comes from batteries, solar panels, or AC converters. Generators can produce AC or DC current. Current values vary with the device and the load on the device. Current is measured in amps but is sometimes stated in milliamps (1/1000 of an amp).

Voltage is measured in volts and generally comes in several values. In the United States, the most common values are 120 volts AC, 240 volts AC, 12 volts DC, and 24 volts DC. Other values are used for certain situations but are not common in the household setting. Standard wall outlet voltage is 120 volts; large items like some stoves and air conditioners use 220 volts. Certain types of lighting, such as spot lighting, operate at a lower voltage. These units use a transformer to step down the voltage to the proper level for lighting.

Power is the rate at which a device can do work. Electrical power is measured in watts but sometimes will be stated as milliwatts (1/1000 of a watt) or kilowatts (1000 watts). AC power can be either single phase or three phase. Household appliances are single phase. Three phase is used to power large industrial motors. This publication addresses calculating single phase or DC power only.

Another consideration is the differences between apparent power and real power. This publication deals with apparent power. Apparent power is the mathematical relationship of power, maximum current, and maximum voltage. Real power is more difficult to measure, but the values obtained are never higher than apparent power. These differences can cause some problems when calculating power for motors. Generators generally give power in terms of apparent power. Apparent power should be stated in terms of volt amps, but is frequently stated in terms of watts. Most generators list power in apparent power due to the difficulty in using real power. This will not cause problems as long as a system is not stressed to 100 percent of the rated power.

Device labels should contain the voltage and either or both power and current. The relationship between power voltage and current is expressed as follows:

voltage x current = power

If you know voltage and current, you can calculate power by multiplying voltage by current in amps. If current is in milliamps, divide the result by 1000. The result is in watts of power.

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Occasionally you will encounter a product or device labeled in VA (volt amps). This designator is similar to watts. KVA (kilovolt amps) is kilowatts (1000 watts).

If you know voltage and power, you can calculate current by dividing power by voltage. This will give you current in amps.

When you first turn on an appliance with an electric motor, the motor will draw significantly more current—three to five times more—than stated on the label. You must make allowances for this. Generators and inverters usually have a surge rating that tells the maximum power that can be drawn for a short period. Fuses and circuit breakers will generally allow excess current to flow for a short time before deactivating the circuit.

So how much power do you need to run your appliances? For a given voltage, you will have a maximum power and current. Use the equation above to determine how much power you need. For multiple appliances, add the current or power of each to get the maximum power or current needed. All units must be the same. The number you obtain should be less than the circuit that is supplying the power. You should not attempt to run a power supply at 100 percent, although short surges to this level are acceptable.

Examples

You have three 120-volt appliances. Their labels indicate they draw 1 amp, 2 amps, and 5 amps, respectively. The total current would be 1 + 2 + 5 = 8 amps. From this, power can be calculated by multiplying voltage and current: 120 x 8 = 960 watts.

For three 220-volt appliances, the labels state that their power is 100 watts, 300 watts, and 600 watts. The total power would be 100 + 300 + 600 = 1000 watts. To find current, divide power by voltage: 1000/220 = 4.54 amps.

If you have mixed power and current, you must convert them to one or the other. For example, your 120-volt appliances are rated at 2 amps, 320 watts, and 450 watts. You must convert all three to current or to watts. For this example, we will convert to watts. The 2-amp item is multiplied by 120 volts to give 240 watts. Then, add the power ratings (240 + 320 + 450) to get a total of 1010 watts. The current would be 1010/120 = 8.42 amps.