



Renewable Energy Terms

Ohm's Law— Basic Electrical Equation

Ian Woofenden

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Derivation: Named for Georg Simon Ohm, 19th century German physicist and mathematician. Ohm made key discoveries about the nature of electricity.

In previous columns, I've covered volts, amps, and ohms. Now it's time to talk about all three together, and their relationship to each other. Voltage is electrical "pressure"—it's the push that makes electrons move. Amperage is the *rate* of electron flow—the number of electrons per second passing a point. An ohm is the unit of electrical resistance—the "drag" on electron flow.

Or as a friend in Texas says about her grandson, "Volts are Matthew's determination, amps are how quickly he can get to where he is trying to go, and ohms are his denim pants and the carpet, which slow down his crawling considerably."

There is a direct relationship between volts, amps, and ohms that is fundamental to electrical theory. It is described in what we call *Ohm's Law*. Written as an equation, it's generally shown as $E = I \times R$.

E in the equation stands for "electromotive force"—voltage. **I** stands for electrical "intensity"—amperage. And **R** stands for resistance—ohms (Ω). So the equation could be written $V = A \times \Omega$, or volts equals amps times ohms.

If it's true that $E = I \times R$, it's also true that $I = E \div R$, and $R = E \div I$. Take a look at the diagram below. Cover any one of the three elements of the equation with your finger—this is the element you are trying to solve for. The remaining two elements give you the rest of the equation. If one element is above the other, divide the top one by the bottom one. If the remaining two elements are beside each other, multiply them.

So if you cover the **I**, you are left with **E** over **R**. This means that $I = E \div R$, or in other words, that amperage equals voltage divided by resistance.

Play around with the equation and the diagram, and try to get your brain around the concepts. It should improve your understanding of basic electrical principles. It takes time to grasp what this equation is saying, and there's no substitute for thinking it through repeatedly.

Practically speaking, Ohm's Law tells us that higher voltage gives us more push, and that we can move more electrons with this higher pressure, given the same resistance. It also tells us that lowering resistance is key, since the electron flow at a given voltage is directly proportional to the resistance in the conductors.

If Matthew's determination increases, his grandma better not leave the breakables within reach for very long. And he may soon figure out that if he gets rid of those pants that are dragging him down, he'll outrun his grandma more often. Ohm's Law does have some technical exceptions, as does Grandma's. But I'll leave bending these laws to serious electrical nerds, and to Matthew.

Access

Ian Woofenden, PO Box 1001, Anacortes, WA 98221
Fax: 360-293-7034 • ian.woofenden@homepower.com

