Wŏrd Pow´ẽr

Renewable Energy Terms

Circuit—Electrical Path

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Derivation: From Latin circumire, *to go around.*

The derivation of this electrical term says it all. To be a circuit, it has to "go around." Moving electrons do the work in what we call "electricity." But they aren't moving from point A (battery or utility power station) to point B (your loads) and stopping or being "used up." They are moving in a circle through the source, to the load, and back to where they started again. (Yes, techies, I'm glossing over the distinction between DC and AC. Stay tuned.)

To have an operable circuit, there needs to be not only a path from the energy source to the load, but a path from the load back to the source. Think of a circuit as a conveyor belt or a bicycle chain, moving the electrons that are part of the copper or aluminum conductor around and around in a big circle. Push the chain forward at any point, and the whole thing will start moving.

An even better analogy for a circuit is blood flow in the body. The heart is like a battery or generator, and blood is like electrons being pumped around a complete circuit, doing the work of keeping the body cleaned and oxygenated on the way.

One simple circuit uses a flashlight battery, two wires, and a flashlight bulb. Connect a wire from the positive end of the battery to the positive terminal on the bulb. Then run another wire from the negative terminal (usually the outer case) of the bulb to the negative end of the battery. You now have a complete circuit, and if there is energy stored in the battery, the bulb will light up. The electrochemical energy in the battery pushes electrons in the wires around the loop.

If you disconnect one of the wires anywhere in this circuit, you'll have what we call an "open circuit." The electrons can't flow, and the light bulb will go out. This is exactly what you do whenever you turn off a light switch in your house. You are opening the circuit, which makes it impossible for electrons to flow.

Now imagine another scenario with our battery setup. Take the bulb out of the circuit, and connect the two wires that you removed from the bulb to each other. You now have a direct loop from the battery's positive end to its negative end. This is called a "short circuit" (or "short").

I like to think of a load (the bulb in this case) as a valve that regulates the flow of electrons. Each load allows electrons to pass at a certain rate (we call it amperage). But if there is no load in the circuit, the only limitation on electron flow is the resistance of the wire and the voltage of the source. So all the energy in the battery tries to flow through the wires in a hurry. This often results in melted wires (or a fire burning your house down) and then an open circuit, or a fuse or breaker opening the circuit.

Some basic principles govern circuits. Key among them are Kirchoff's Laws. They state two key things: The voltage drops in a circuit are equal to the supply voltage, and for every electron that enters a part of the circuit, one electron leaves that part of the circuit. The electrons flowing around the circuit do not build up anywhere. It's like water in a hose—you cannot compress the water.

Voltage is similar to pressure. In your garden hose, some pressure is lost to the friction in the hose and to running the oscillating device in your sprinkler. Wires have some resistance too, and this reduces the voltage. Loads also present resistance to the source voltage. All the resistances in the electrical circuit make voltage drops, and these voltage drops will add up to the input voltage.

Unlike your garden hose, an electrical circuit is a closed system. And electrons are not exactly like water. You won't be spilling electrons out on the floor if you cut open your lamp cord and hold it up to drain. As Kirchoff's Laws state—electron in; electron out.

It's important to understand that the generator and battery are not *making* electrons. The electrons (charged particles) are already in the material of the wire. The generator and battery are just pumping the electrons through the circuit. Also, the load is not "using up" the electrons. They are doing work as they pass through the load, but just as many come out as go in.

There are different types of circuits, and I'll be talking about them in upcoming columns. But they all have to allow electrons to flow in a complete loop. From simple flashlight circuits to complex industrial wiring plans, it all boils down to electrons "going around."

Access

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