Power inverter explained

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The only trouble is, though many of our appliancesare designed to work with AC, small-scale power generators often produce DC. Thatmeans if you want to run something like an AC-powered gadget from aDC car battery in a mobile home, you need a device that will convertDC to AC—an inverter, as it"s called. Let"s take a closerlook at these gadgets and find out how they work!

Photo: A detail of the electronic circuit inside a power inverter developed at NREL. Photo by Werner Slocum courtesy ofUS Department of Energy/NREL (DoE/NREL) (photo id #148966).

When science teachers explain the basic idea of electricity to usas a flow of electrons, they"re usually talking about directcurrent (DC). We learn that the electrons work a bit like a lineof ants, marching along with packets of electrical energy in the sameway that ants carry leaves. That"s a good enough analogy forsomething like a basic flashlight, where we have a circuit (anunbroken electrical loop) linking a battery, a lamp, and a switch andelectrical energy is systematically transported from the battery tothe lamp until all the battery"s energy is depleted.

The answer is actually quite simple. Imagine the cablesrunning between the lamp and the wall packed full of electrons. Whenyou flick on the switch, all the electrons filling the cablevibrate back and forth in the lamp"s filament—and that rapidshuffling about converts electrical energy into heat and makes thelamp bulb glow. The electrons don"t necessarily have to run in circle to transport energy:in AC, they simply "run on the spot."

Animation: What"s the difference between DC and AC electricity? Suppose you have to vacuum a room. Directcurrent is a bit like working from one side to the other in a straight line; alternating current is like going back and forth onthe spot. Both get the job done, albeit in slightly different ways!

One of Tesla"s legacies (and that of his business partner GeorgeWestinghouse, boss of the Westinghouse Electrical Company) is thatmost of the appliances we have in our homes are specifically designedto run from AC power. Appliances that need DC but have to take powerfrom AC outlets need an extra piece of equipment called a rectifier,typically built from electronic components calleddiodes, to convert from AC to DC.

Photo: A typical electricity inverter. This one is made by Xantrex/Trace Engineering. Photo by Warren Gretz courtesy of US Department of Energy/NREL (DoE/NREL).

Of course the kind of inverters you buy in electrical stores don"t work quitethis way, though some are indeed mechanical: they use electromagneticswitches that flick on and off at high speed to reverse the

currentdirection. Inverters like this often produce what"s known as asquare-wave output: the current is either flowing one way or theopposite way or it"s instantly swapping over between the two states:

These kind of sudden power reversals are quite brutal for some forms of electrical equipment normal AC power, the current gradually swaps from one direction to the other in a sine-wave pattern, like this:

Electronic inverters can be used to produce this kind of smoothly varying AC output from aDC input. They use electronic components called inductors andcapacitors to make the output current rise and fall more graduallythan the abrupt, on/off-switching square wave output you get with abasic inverter.

Photo: A selection of electricity inverters that can be used with renewable energy generating equipment, such as solar cells and micro-wind turbines. Photo by Warren Gretz courtesy ofUS Department of Energy/NREL (DoE/NREL).

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