Chapter 38 of the Society of Broadcast Engineers

SBE

EL PASO - LAS CRUCES - JUAREZ

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AUGUST 2025

NEWS

AC or DC: which is better?

Your gadgets run on direct current, but the electricity in your home is alternating current. What's up with that?

AS THE STORY goes, the rock band AC/DC took its name from a label on an old sewing machine in the Young brothers' home. It must have meant that the machine could run on either alternating-current or direct-current electricity. Today, all the newfangled electronic devices in our homes run only on DC power—even lighting fixtures, now that LEDs have replaced incandescent bulbs.

But wait. The electricity that comes out of your wall socket is *alternating* current. That means each device needs to convert AC power to DC, as well as reducing the voltage to the much lower levels used in digital circuits. So you might well ask: Wouldn't it make more sense to have DC outlets in your home? That's a great question, and it's actually one that sparked a big debate back in the early days of electrification. Thomas Edison favored DC circuits, but Nikola Tesla thought AC circuits were the way to go. Clearly Tesla won that argument. Let's see why!

What Is Electricity?

Electricity is a flow of electrons through a conducting material like a metal wire. You can kind of think of the electrical grid as a system of rivers and streams with current flowing through them. In a river, a difference in elevation causes water to move downhill; in a power line, the force driving the current is *voltage*—a difference in potential energy between two points in a circuit.

That analogy works for direct current, anyway. But in most grids, electrical power is transmitted with alternating voltage. That means the negative and positive poles flip back and forth, causing the electrons to endlessly lurch forward and backward instead of traveling in a continuous stream.

As you can imagine, that makes alternating current more complicated to deal with. So Edison had a point: Direct current is much simpler. In fact, anyone can make a DC circuit. All you need is a battery and a wire to connect the positive and negative electrodes. You can even make your own battery. Just get two different metals, like zinc and copper, and stick them in opposite ends of a potato. The acid in the potato juice reacts differently with the two metals, creating a tiny amount of voltage—enough to light up a small LED. DC is easy.

Direct-Current Toaster

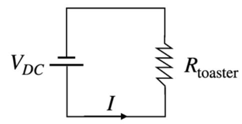
For example, suppose you wanted to create a DC toaster. A toaster is basically a box with a wire inside that gets hot when current runs through it. And let's say this toaster requires 1,000 watts of power. Oh, power? hat's the time (**t**) rate of energy (**E**). So if you put 1 joule of energy into a wire in 1 second, that would be 1 watt of power (**P**):

$$P = \frac{\Delta E}{\Delta t}$$

For electrical power in particular, we can calculate that as the product of the electric current (**I**) and the voltage (**V**):

$$P = IV$$

With that, we can draw a simple toaster circuit diagram:



The nichrome wire inside the toaster is *not* a good conductor. It impedes the flow of current, causing the wire to heat up. So it's basically a device for converting electrical energy into thermal energy. In the diagram above, **R** stands for the amount of resistance, which is measured in ohms.

So let's say our DC power supply runs at 10 volts. We can use this to find the level of resistance needed to get our toast nice and toasty. There is a relationship between the current (**I**) and voltage (**V**) for a resistor called Ohm's law, and that gives us the following expression for power:

$$V = IR \qquad I = \frac{V}{R}$$

$$P = IV = \frac{V^2}{R}$$

With 10 volts, we need a resistance of 0.1 ohms (which is tiny) to get a power of 1,000 watts. But wait—it's not just the heating element inside that creates resistance in the circuit. The power cord that you plug into the wall also has resistance. The copper wire inside the cord is a good conductor, but the length of the cord itself increases the resistance.

To make things easy, imagine that the power cord also has a 0.1-ohm resistance, so the total resistance in the circuit is 0.2 ohms. That means we'd get a lower electrical current, and the power to the toaster would be just 250 watts. That's going to be some un-toasty toast.

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EL PASO, TX SBE CHAPTER 38 MEETING MINUTE

DATE 07/08/2025 LOCATION: ZOOM AT ANTONIO'S

MEETING CALLED TO ORDER: 11:00 AM, BY ANTONIO CASTRO. WE WERE 8 (EIGHT) ATTENDANTS.

REPORT OF THE SECRETARY: ***NO*** MINUTES ON THE JUNE 2025 NEWSLETTER BECAUSE THERE WAS NO MEETIING DUE TO ENNES WORKSSHOP. ACCEPTED BY ANTHONY PORRAS, SECONDED BY MARK JOHNSON.

REPORT OF THE TREASURER: $ 1,263.30 IN THE BANK AFTER ENNES WOORKSHP SPONSORSHIP AND REBATE CHECK. ACCEPTED BY MARK JOHNSON, SECONDED BY MICHAEL RIVERA.

REPORT OF THE CERTIFICATION COMMITTEE: REMINDER TO MICHAEL RIVERA FOR HIS APPLICATION.

REPORT OF THE MEMBERSHIP COMMITTEE: ELIAS VENTANILLA TO INVITE "TELEMUNDO 48" AS SUSTAINING MEMBER.
DAVID SANDERFORD RETURNED IN HONOR OF HIS DAD, MATH SANDERFORD, FORMER "MARSAND"

REPORT OF THE FREQUENCY COORDINATOR COMMITTEE:
NO REPORT.

REPORT OF THE SCHOLARSHIP COMMITTEE: NO REPORT.

REPORT OF THE WEBSITE COMMITTEE: NO VIISITORS SHOWN.

REPORT OF THE EAS CHAIRMAN: TEXAS AND NEW MEXICO EAS MONTHLY TESTS RIGHT ON SCHEDULE.. POSSIBLE EAS SEMINAR TO BE ORGANIZED BY KLAQ AT THE KFOX STUDIOS (IF APROVED).

REPORT OF THE PROGRAM COMMITTEE: NO REPORT

NEW BUSINESS OR ANY ITEMS FOR THE CHAPTER INTEREST:: NEXT MEETING TO HOLD NEW OFFICERS ELECTION.

OTHER. COMANCHE PEAK ACCESS ROAD WHASHED OUT..

NEXT MEETING DATE AND LOCATION: AUGUST 12 AT NOON AT THE COMO'S ITALIAN RESTAURANT.

MEETING ADJOURNED: AT 11:22 AM.

AUGUST PROGRAM

THERE WAS A MEETING FOR THE MONTH 0F JULY IN THE ZOOM MODE FROM ANTONIOS.

NO PRESEENTATION THIS TIME, ONLY THE BASIC AND REGULARS.

NOW FOR AUGUST, WE WILL MEET LIVE AND BODY PRESENT

WHEN: TUESDAY AUGUST 12, 2025.

WHEN: COMO'S"ITALIAN RESTAURANT

TIME: FROM 12:00 PM (NOON)

SEE YOU THERE !!

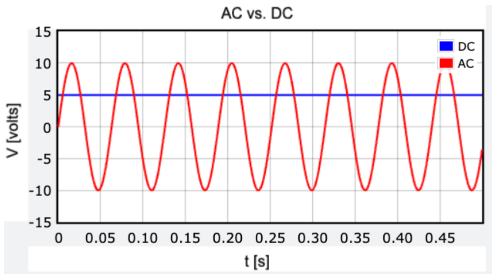
To fix this, we have to increase the voltage of the power source. Let's ramp that up to 100 volts. In that case our toaster could be 10 ohms, so the 0.1-ohm power cord won't matter much. Well, it's not a problem for a 3-foot power cord in your home. But what about the transmission lines from the power station to your town? These can be over 100 kilometers long.

With much longer wires you get much more resistance, which means those wires will get hot and waste energy. Again, the solution is to use a higher-voltage source. Remember **P = IV** ? That says you can deliver the same power by having a stupid-high voltage with stupid-low current.

Yes, you solve one problem and it just makes another problem. Suppose the wall outlet is 10,000-volt DC. Oh, but you want to charge your phone, and it needs 5-volt DC. How do you do that? OK, there is a way to make it work. You could put a large resistor in series with your phone and it would convert electrical energy to heat. But again, that's just throwing away energy.

Alternating-Current Toaster

So what happens if we switch to alternating current? Remember, AC circuits are created by flipping the positive and negative poles back and forth, so the voltage alternates between a positive value and a negative value (meaning the direction of electron flow changes). Here is a plot of voltage as a function of time for the two types of current.



The DC source has a constant voltage, so that's the flat blue line above. The AC source (red) has a voltage that oscillates between +10 and –10 volts, and there are times when the voltage is actually zero. In this made-up example, you can see that the voltage switches eight times in half a second. Real household AC varies, but in the US it averages around 120 volts (plus and minus) with a frequency of 60 hertz.

If we take our toaster and plug it into a 60-Hz AC outlet, it'll run just fine. Since it works by just making a wire hot, it doesn't matter if it has DC or AC current—either way it gets hot. Same for incandescent light bulbs. In fact, they're really not very different from toasters; it's just that the thin tungsten wire in a bulb gets so hot (up to 4,500 degrees F) that it glows and produces light.

AC Power Is More Efficient

With AC, we still have the same problem with long power lines. You need to have high voltage and low current so you don't lose too much energy from hot wires. But AC has a nice advantage: It's easy to take that high voltage and change it to a low voltage. This is possible because of the oscillating nature of the current and Faraday's law of induction.

Faraday's law says that if you change the strength of a magnetic field inside a loop of wire, you will produce an electric current. In the clip below, you can see that when I stick a strong magnet into a coil of wire or pull it out, the current level (measured in amps) jumps up.

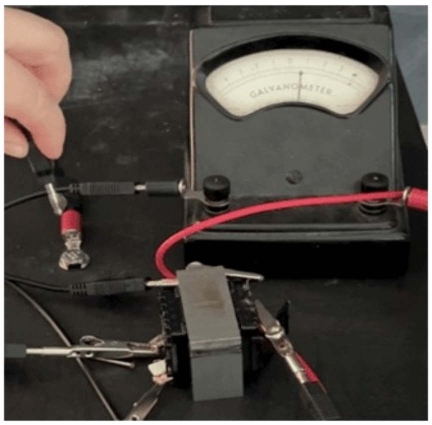
:

: You can also do this without a magnet if you use two coils of wire. In the video below, I’m connecting and disconnecting a little coin battery to a primary coil. (You can’t see the coils, but they’re inside the small gray box in the foreground.)

The secondary coil isn’t connected to any power source. But the changing current in the primary coil makes a changing magnetic field, and that induces a current in the secondary coil. Even with this tiny battery you can see that I get a big induced current. Check it out:

But that’s not all! We can change the *voltage* induced in the second coil by changing the ratio of the number of loops in each coil. If the induced coil has 100 loops and the primary coil has 1,000 loops, the induced voltage will be 100/1,000 or 0.1 times the input. If you reverse that, you can get an output voltage that is 10 times the input.

We call this a transformer (because it transforms the voltage). They are kind of a big deal. Here's what a small one looks like inside:



This is one of those “power bricks” that all your gadgets use to plug into a wall socket. The two coils are side by side, and you can see that the one on the right has more “turns” than the one on the left. So, if you have a 120-volt AC input, the output will be lower (in this case it's 12 volts). There's some other stuff in there that takes that lower-voltage AC and turns it into a DC output; that's called a voltage rectifier.

Just to be clear, you can't use an AC transformer with a DC circuit. I mean it's technically possible to take a DC input, convert it to AC, and then transform it—but why do the extra stuff when you can just deliver AC power to houses? That's exactly what we do. When you see those giant high-voltage transmission lines, they are super-high-voltage AC circuits.

So here's how it works. You have some power station that runs on fossil fuels or hydroelectric or whatever. You need to make this an AC output and then ramp up the voltage to something crazy like 100,000 volts. This means you can send it on the long power lines at very low current so there isn't much power loss.

When a power line gets to a town, it goes into a substation. This is basically just another giant transformer that reduces the AC voltage to something more manageable, like 10,000 volts. Finally, the current goes through one more transformer to get it to the 240-volt AC that enters your house. Big appliances like clothes dryers use the whole 240 V, and for your electrical outlets that gets cut in half to give you 120 V.

But none of this would be possible with DC power. It just wouldn't be practical. AC rules!