

TEST YOUR UNDERSTANDING OF ELECTRICAL SYSTEMS

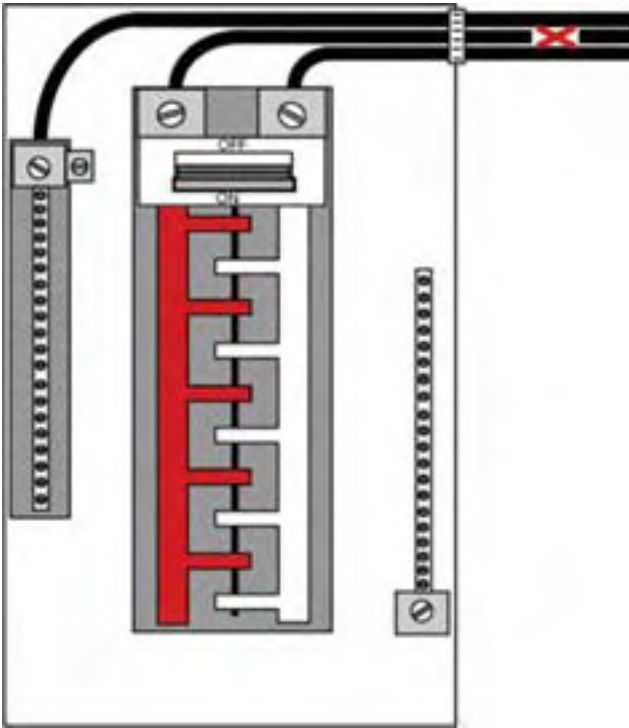


Figure 1
The buss bars of an electrical service panel are interwoven so every other full-sized breaker (from top to bottom) draws power from the opposite phase.

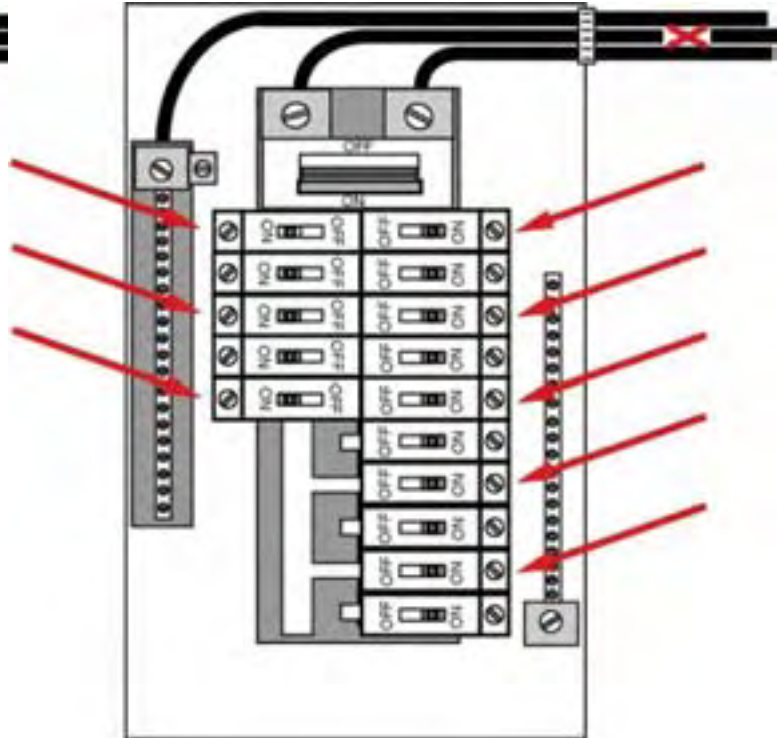


Figure 2
When one phase of the power is lost, every other breaker loses power. The loss of power is not just to the breakers on one side of the panel.

During a recent hot summer afternoon, the power went out in the Fire Findings' neighborhood. Well, that's not quite right. Some of the power went out.

Four neighbors discovered the power worked in some rooms of their homes but not in all rooms. Some lights and appliances worked, others didn't. Central air conditioning units and computers quit, but someone's electric clothes' dryer continued operating.

No, nothing started a fire, but use this case study to test your knowledge of electrical systems. Was this strange situation the electrical utility company's problem or did something happen in someone's home to create the dilemma?

This was a pretty confusing situation for neighbors. Most rushed to check their service panels to see if they'd tripped breakers. After all, it was 95 degrees in the shade and everyone wanted their air conditioners operating again. But one neighbor, whose window air conditioner kept running, didn't know a problem occurred.

How could this situation happen? The simple answer is that everyone in the neighborhood lost one phase of the electrical service coming to their homes.

If you check the electrical service coming to your house, you'll find three lines leading from the nearest pole to your house. Two of those lines are ener-

gized. The third is not: It's the neutral conductor.

Each of the energized lines has a potential of 120 volts to ground. But since they are 180 degrees out of phase with each other, they have 240-volt potential to each other. That's how you get 240-volt power to supply central air conditioners, electric water heaters, computers and ranges.

If you lose power in one of those phases, all of the 120-volt circuits supplied by that phase go dead. The circuits supplied by the other phase are still energized (Figures 1 and 2).

Thus, many of the lights in our building went out, but many didn't. And

since there was no 240-volt potential across the two energized lines - only one was energized - the 240-volt appliances didn't work.

Thus, central air conditioners quit working. The neighbor with the 120-volt window air conditioner, though, continued to stay comfortable because his unit just happened to be supplied power on the phase that was still energized.

So what caused the problem? In this case, one transformer supplied all five homes so the power company's transformer had to be the problem.

A single high-voltage line energizes a transformer. The transformer reduces voltage - in our case from 7,200 volts to 120 volts - and uses a center tap on the transformer to draw off power that's 180 degrees out of phase with each other.

Somewhere in the transformer, the windings supplying one phase of the service burned open. Thus, one phase of power worked but not the other. That meant some 120-volt circuits worked, but others didn't. And there was no way to get 240 volts with that configuration, so none of the 240-volt appliances

worked.

Wait a minute. How about that electric clothes' dryer that continued operating?

Yes, it is a 240-volt dryer, but the heater element is the only portion of a dryer that operates on 240 volts. The motor and

timer use 120 volts - power supplied by just one phase of the 240 supply. Since the phase that supplied the motor and timer happened to be the phase that was still energized, the dryer continued operating.

Or at least it looked like it did. Since the heating element was designed to operate at 240 volts but was only energized with 120 volts, it put out

very little heat. So while the clothes revolved in the dryer drum, they weren't really drying.

So, did this problem present a potential fire cause? Probably not, but it's an excellent test of your understanding of residential electrical systems.

Fire Findings Laboratories, L.L.C.

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