# TROUBLESHOOTING AN ELECTRICAL PROBLEM? SKIP THE SPAGHETTI AND TRY THIS  PART 5

**By: Rob Siegel**

There is an easy, straightforward way to approach electrical troubleshooting, and it's astonishing how many people don't know it.

In my recent multi-part series on automotive electrical systems (which included primers on how electricity works and how to use a multimeter), I gave a short troubleshooting example in which I used a multimeter to verify that voltage was present. If a device—say, an electric motor—isn't working, first determine if voltage is reaching it when the switch that powers the device is turned on. If voltage *is* present at the device's positive terminal, test for continuity between the wire to the device's negative terminal and ground (first the body of the car, and then the negative battery terminal). If it passes those tests, conduct a voltage drop test to check for a high resistance failure. If the voltage drop test shows no problem, the device is toast.

But as I said earlier, there is an easier way to troubleshoot the problem: wire the device (our hypothetical electric motor) to the battery and see if it spins. It's that simple.

Let me back up a step. It is close to catechism in the automotive electrical world that 1) you need a wiring diagram to begin troubleshooting, and 2) most electrical problems are due to bad grounds, whose locations are listed on the wiring diagram. I will risk being labeled a heretic and say that I've found both of these things to be overstated to the point of falsehood (not unlike the almost-always-faulty advice that, if your Check Engine Light is on, tightening your gas cap will make the light go out). I will also candidly admit that I, who literally wrote an electrical book, hate looking at wiring diagrams. They make my brain hurt. It's like trying to read spaghetti.

Instead of automatically reaching for a wiring diagram and "checking the grounds"—a process that entails locating where the ring terminals at the ends of the ground wires are screwed to the body of the car, removing the screw, and cleaning the connection—think of the circuit as divided into two

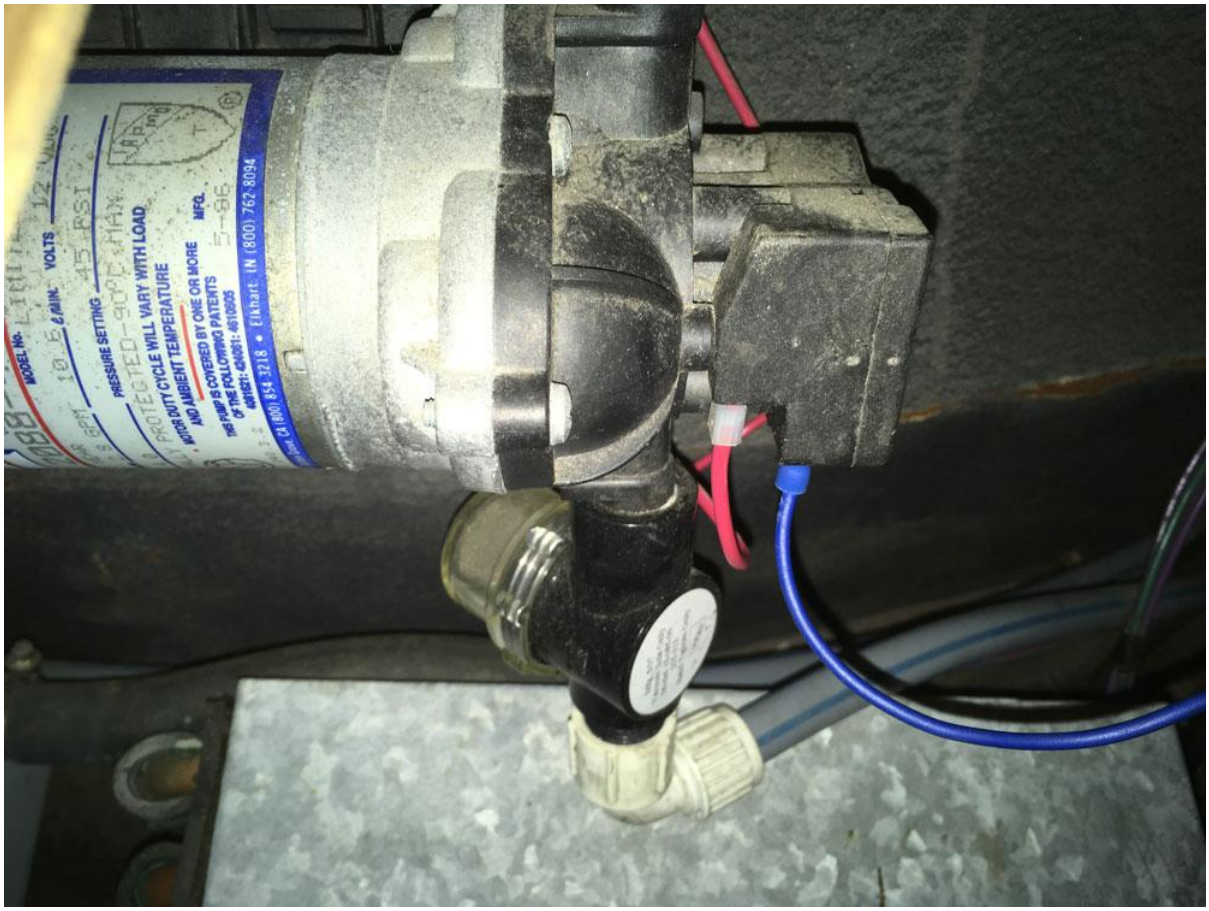
pieces: the devise and “the wiring.” The latter refers to everything in the circuit that isn’t the device itself: any switches, relays, sensors, control modules, wire, and connectors, and, yes, “the grounds.”

Continuing with my electric motor example, I first need to determine if it’s dead. Should I immediately hop online and search the Internet until I find the best price for a new motor? Or instead, should I spend a few evenings learning the ins and outs of how the motor is wired and how all the relays and sensors have to correctly conspire in order to turn the thing on? The second option may require poring over enthusiast forums and, yes, procuring and understanding a wiring diagram, but it saves you from ordering a new motor.

I recently waded through this process while preparing for a road trip and realized that the steps I took provided a nearly perfect example of the utility of the *test-the-device-directly* troubleshooting technique.

I bought a small RV, a 1996 Winnebago Rialta, which is basically a Volkswagen Eurovan with a camper body on it. It had a punch list of needed repairs on both the vehicle and RV systems, but things were basically working. Two days before my wife and I were to take our first trip, I disinfected the fresh water tank with chlorine. I needed to activate the fresh water pump and open up the faucets so the disinfectant could course through all the spigots, but when I hit the switch to turn on the pump, nothing happened. I was puzzled because the pump had been working the day before.

I searched online for the fresh water pump and learned that it’s a hundred-dollar part. I immediately launched into *test-the-device-directly* mode. I took a length of 12-gauge wire, crimped a ring terminal on one end and a spade terminal on the other, attached the ring terminal to the battery positive terminal, pulled the wire off the pump’s positive terminal, and slid the spade terminal of my test wire onto it. (Note that this can be done without crimping connectors onto the ends, but it’s safer doing it this way. You really don’t want an unfused wire, connected directly to battery positive, slipping and dead-shorting itself to ground).

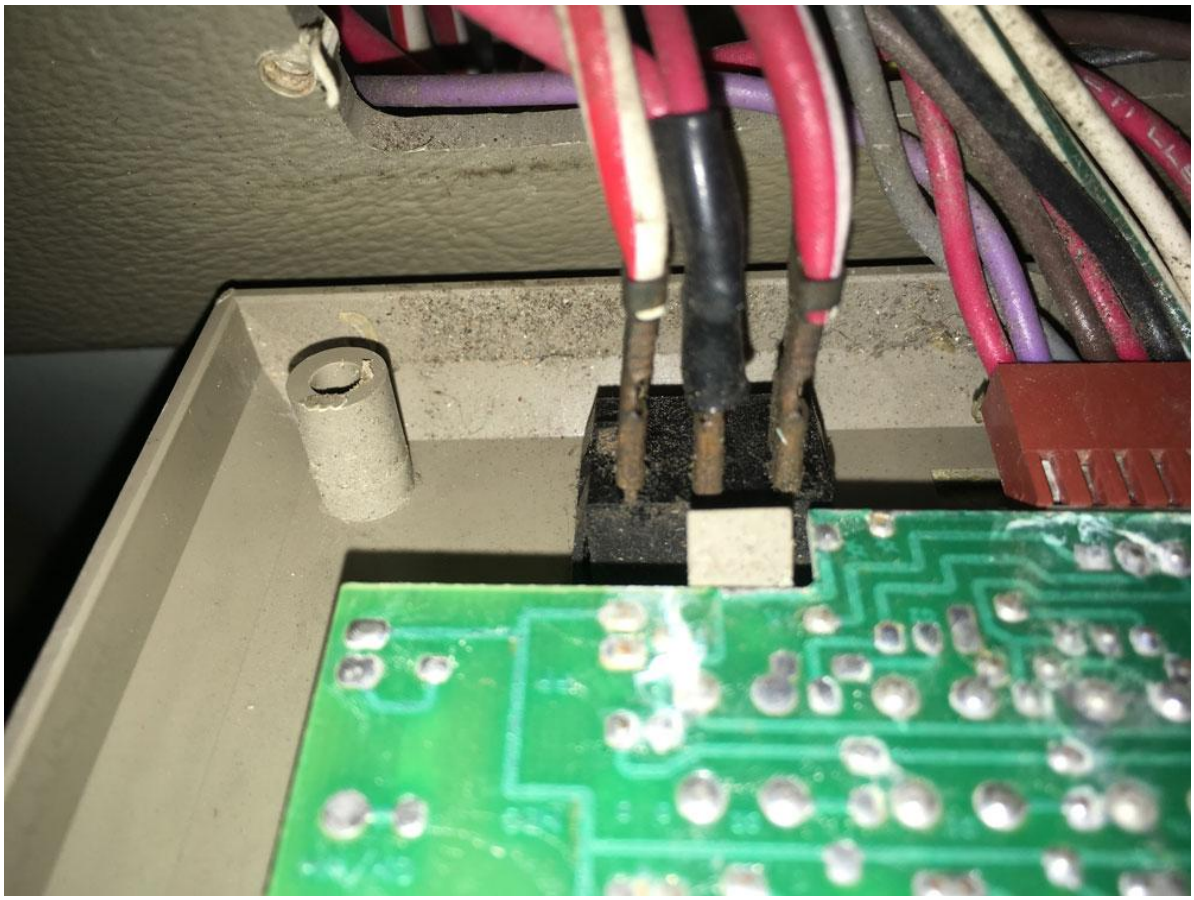



Hot-wiring an electric motor directly to the battery

With the pump wired directly to the battery, it immediately began whirring reassuringly. (Note that if it *didn't* immediately spin when wired this way, I would've done the same thing on the negative side to be certain a ground path went directly from the motor to the negative battery terminal.) Nothing was wrong with the pump, so I didn't need to drop everything and order a new one.

That meant that the problem was in "the wiring," by which I mean the circuit's ability to deliver power (12 volts DC) to the pump and return it to ground. So I checked for the presence of voltage at the pump. I took the multimeter, set it to measure DC voltage, pulled off the positive wire to the pump, touched the red probe to the terminal on the end of the wire, held the black probe against ground (more challenging than you'd think in a fiberglass-bodied RV; you need to be sure the metal you're holding the black probe against is in fact a valid ground), and discovered that there was indeed no voltage.

I first verified that there wasn't a separate fuse for the pump (there wasn't), then began inspecting the switch that turns on the pump. I unscrewed the panel the switch is on and expose its back, and I was surprised to find that rather than being a single-pole single-throw switch with two wires, where the switch simply makes or breaks the connection, it was a single-pole double-throw switch with three wires. One wire had voltage on it; the other two did not. But, strangely, when I threw the switch into the other position, *no* wires had voltage.



Why would a simple on-off switch require three wires instead of two?

Now this is the point where you *might* need a wiring diagram. But instead of searching online for one, I posted this question to a Rialta forum: "Why are there three wires instead of two going to the switch on the Rialta's fresh water pump?" Within 10 minutes, someone replied, "There are two switches. The second one is in the outdoor shower (the spigot on the outside for washing off sand). They're wired like two light switches at two entrances to a kitchen, where either switch can turn the circuit on or off, but whether the 'on' setting is up or down changes." I never knew that second switch was there, but as soon as I read the post, I understood the wiring. I went to the outdoor shower,

toggled the second switch, and the pump fired right up. This switch probably hadn't been used in years, and some corrosion had likely gotten into the contacts.

This is a great example of the benefits of user forums. Someone else has usually experienced the same problem that you're dealing with. Plus, had I procured a wiring diagram, I would have spent an hour poring over it, finding both switches, and then struggling to understand why there were two and how they were wired. I think I can assure you that the wiring diagram would not have simply told me, "They're wired like two light switches at two entrances to a kitchen."

So, yes, there are times when you'll need a wiring diagram. You may even need to "check your grounds." But many times, by verifying the status of the device in the circuit, whether or not it's good, and then looking on an enthusiast forum, you'll be spared many squint-eyed hours looking at spaghetti. It literally saved me from a headache.

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Rob Siegel has been writing the column *The Hack Mechanic*™ for BMW CCA *Roundel* Magazine for 30 years. His new book, *Ran When Parked: How I Road-Tripped a Decade-Dead BMW 2002tii a Thousand Miles Back Home, and How You Can, Too*, is available here on Amazon. In addition, he is the author of *Memoirs of a Hack Mechanic* and *The Hack Mechanic*™ *Guide to European Automotive Electrical Systems*. Both are available from Bentley Publishers and Amazon. Or you can order personally inscribed copies through Rob's website: www.robsiegel.com.