Troubleshoot Car Electrical Problem

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Troubleshooting electrical problems can be a frustrating task, but it does not have to be if you keep a few simple rules in mind: Every circuit needs a power source; most electrical devices require a minimum voltage to function correctly; and all circuits require continuity. Consequently, most electrical problems are caused by low voltage (or no voltage), excessive resistance or a loss of continuity.

SAFETY CONSIDERATIONS

Safety is always an important consideration when working on automotive electrical systems. Except for the high voltage side of the ignition system, and the high voltage battery and circuits in hybrid vehicles, there is NO danger of being shocked. Twelve volts (12v DC) is not enough to be felt. The danger is accidentally shorting out a hot circuit and damaging the wiring, PCM or other onboard electronics, or starting a fire.

CAUTION: If your vehicle is a hybrid with a high voltage battery, there is a risk of being shocked if you come into direct contact with the high voltage battery, wiring or other hybrid components. for more information on this subject, see Hybrid Safety Hazards

CAUTION: When doing electrical repairs or replacing electrical or electronic component, the battery should ALWAYS be disconnected to eliminate any risk of

causing an accidental short. Disconnecting the battery will cause most PCMs to forget their learned settings. This may cause driveability issues or require a special "relearn" procedure with a scan tool, so to avoid this kind of hassle use a 9 volt "memory saver" that plugs into the vehicle's power receptacle (cigarette lighter) to maintain voltage to the battery, or connect a 9 volt alkaline battery to the PCM power supply.

For more information on safety, see Battery Safety .

ELECTRICAL CIRCUIT CHECKS

All electrical circuits require voltage to operate the components connected to that circuit. So if there is no voltage, there is no function. The first order of business when troubleshooting electrical problems, therefore, is to check for the presence of voltage at the load point in the circuit.

The load point is the element that the circuit is supposed to power, such as a light bulb, wiper motor, blower motor, idle stop solenoid or whatever. And, all you need to quick check it is a voltmeter or a 12-volt test light that glows when there is voltage. A voltmeter is the best tool for this purpose because it will give you an exact reading, but a test light is OK for performing quick voltage checks.

Using a test light is a quick way to check for voltage, but a voltmeter is more accurate.

Suppose you find no voltage at the load point. Ah ha, you have discovered your first clue about the problem. Check the fuse, fuse link or circuit breaker that protects the circuit, or the power relay that supplies voltage to the circuit.

If the problem is a blown fuse, replacing the fuse may restore power temporarily, but unless the underlying cause for the overload is found and corrected, your "fix" probably will not last. Whatever you do, do not substitute a fuse of greater capacity. A larger fuse may be able to handle a greater load but the wiring and the rest of the circuit cannot. A circuit designed for a 20 amp fuse is designed to handle a maximum of 20 amps. Period.

A faulty circuit breaker or an open relay will have the same effect as a blown fuse. Circuit breakers are often used to protect circuits that may experience brief periods of overloading such as an A/C compressor clutch.

The easiest way to check a circuit breaker is to bypass it with a jumper wire. Your jumper wire should have a replaceable inline fuse to protect the circuit against damage. Use a fuse of no greater capacity than what the circuit itself uses. If you do not know, use a 5- or 10-amp fuse to be safe. If the circuit works when you bypass the circuit breaker, you have isolated the problem. Replace the circuit breaker.

This same basic test can also be used to check a questionable relay. A relay is nothing more than a remote switch that uses an electromagnet to close a set of contact points. When the relay magnet is supplied with voltage, the points close and battery voltage is routed through the main circuit. Relays are often used in circuits to reduce the amount of wiring that is required, and to reduce the current that flows through the primary control switch. Thus, a relatively low amperage (make that cheap) switch, timer or sensor can be used to turn a much higher capacity relay on and off.

VOLTAGE CHECKS FOR CAR ELECTRICAL PROBLEMS

Every electrical device also requires a certain amount of voltage to operate. A light bulb will glow with reduced brilliance as the voltage drops. But for some components, there is a threshold voltage below which it will not operate at all. A starter motor may crank the engine more slowly with reduced voltage but, if the battery voltage is too low, it may not crank at all. Minimum threshold voltage is especially critical for such components as solenoids (which need a certain amount of voltage to overcome spring resistance), relays, timers, buzzers, horns, fuel injectors (which are solenoids, too) and most electronics (the ignition module, computer and radio).

Checking the load point for full battery voltage will tell you whether or not sufficient voltage is getting through, and to do that you need a voltmeter. The battery itself should be at least 70 percent charged and read 12.43 volts or higher (12.66 volts is fully charged). If the battery is low, it should be recharged and tested. The output of the charging system should also be checked, and be about 1.5 to 2.0 volts higher than battery base voltage (around 14 to 14-1/2 volts). If the battery is OK, your voltmeter should read within 1 volt of battery voltage at the circuit load point in any given circuit.

Low circuit voltage is usually caused by excessive resistance at some point in the wiring. Usually this means a loose or corroded connector, a faulty switch or relay or poor ground. To find the point of high resistance, use your voltmeter to do a "voltage drop test" at various points throughout the circuit. If the voltmeter shows a drop of more than a 0.4 volts across any connector, switch or ground contact, it means trouble. Ideally, the voltage drop should be no more than 0.1 volts.

If low voltage is detected in a number of circuits, do a voltage drop test across the battery terminals and engine/body ground straps. Loose or corroded battery cables and

ground straps are a common cause of voltage-related problems. Clean and tighten the battery cables and/or ground straps, as needed.

Sometimes undersized wiring can cause low voltage. It is not something you will find in many original equipment wiring circuits, but it is a common mistake that is made in many do-it-yourself wiring installations for aftermarket accessories. The higher the amp load in the circuit, the larger the required gauge size for the wiring.

Wiring Gauge Sizes and Amp Loads

The following list includes recommended wire gauge sizes for various amp loads:

NOTE: These values are for copper wire at a maximum temperature of 140 degrees F (60 degrees C)).

Wire size	Amp Capacity
18	6
16	8
14	15
12	20
10	30
8	40
6	50
4	70
3	85
2	95

ELECTRICAL CONTINUITY TESTS

Every electrical circuit requires a complete circuit to operate. Voltage to the load will not do any good unless there is also a complete ground path to the battery. The ground path in the case of all metal-bodied cars is the body itself. In plastic-bodied cars, a separate ground wire is needed to link the load to the chassis. In either case, a poor ground connection has the same effect as an open switch. The circuit is not complete so current does not flow.

To check wiring continuity, you need an ohmmeter or a self-powered test light. An ohmmeter is the better choice because it displays the exact amount of resistance between any two test points. A test light, on the other hand, will glow when there is continuity but the intensity of the bulb may vary depending on the amount of resistance in the circuit. But it is OK for making quick checks.

Never use an ohmmeter to check resistance in a live circuit. Make sure there is no voltage in the circuit by disconnecting it from its power source, by pulling the fuse or by testing downstream from the circuit switch or relay. Ohmmeters cannot handle normal battery voltage and, should you accidentally complete a circuit through the meter, you may damage your meter.

Ohmmeters are great for measuring circuit resistance but you have to use care when checking electronic components. An ohmmeter works by applying a small voltage through its test leads, and this voltage can be enough to damage some electronic components (such as the oxygen sensor). Special high impedance 10,000 mega-ohmmeters should be used for electronics testing.

Tracing wires is not as easy as it looks because the circuit wire will sometimes change color after passing through a connector, switch or relay. Always refer to a wiring diagram when possible. This way you will know how the wires are routed and what colors are used.

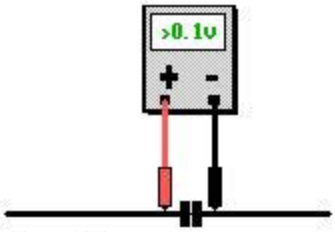
FINDING ELECTRICAL FAULTS

Now that we have covered some basic troubleshooting techniques, what is the best way to find an electrical fault fast? It depends on the nature of the problem.

For a "dead" circuit, the first thing to look for is voltage at the load point. Use your voltmeter or 12-volt test light to check for voltage. If there is voltage, the problem is either a bad ground connection or the component itself has failed. Check the ground connection with your ohmmeter. If the ground connection is good, the fault is inside the component. If there is no voltage in the "hot" wire to the component, then the problem is in the wiring. Trace back through the fuse panel (or relay or circuit breaker) until you find voltage. Now look for an open or short that is preventing the current from reaching its correct destination.

Next comes bad connections. The resistance created by a loose or corroded connection will cause a voltage drop that can have an adverse effect on circuit components. An ohmmeter can be used to check non-powered circuit connections for excess resistance, but a better method is to use a voltmeter to check for a voltage drop across a connection.

VOLTAGE DROP



Check for voltage drop across the connector
A good reading is less than 0.1 volt

The voltmeter leads are connected on either side of the circuit component or connection that is being tested. If a connection is loose or corroded, it will create resistance and produce a reading on the voltmeter. As stated earlier, a voltage drop of more than 0.4 volts means trouble, and ideally it should be 0.1 volts or less.

For more information about voltage drop testing, Click Here

The worst kind of electrical problem to troubleshoot is an intermittent one. Everything works fine in the shop but as soon as the customer gets the car back it starts to act up again. An intermittent open or short is usually the result of something heating up and breaking (or making) contact, or something that is loose and is making periodic contact.

Loose or corroded connections and switches are often responsible for this kind of problem, so try jiggling the wires and circuit switch to see if it changes circuit voltage or resistance. A wire that is rubbing and has chaffed away some of its insulation can make intermittent contact causing a short, so again wiggling suspicious wires will often reveal the problem.

Temperature-sensitive intermittent shorts or opens can be the hard to identify because you frequently have to simulate the exact circumstances that cause them to happen. Sometimes you can assume what is happening by the nature of the problem. But it is always more satisfying (and assuring) to duplicate the problem so you know for sure what is wrong.

When does the problem occur? Does it only happen when the engine is hot or after the circuit has been on for a period of time? Using a hot air gun or hair dryer to heat wires, connectors, switches and relays can sometimes help identify troublesome components.

Environmental factors often play havoc with electrical systems, too. Road splash or water leaking through a crack in the cowl, under the windshield or around a grommet can sometimes short out a circuit. Look for obvious signs of corrosion or leakage, and if you find none check the condition of nearby weather seals.

A final note on repairing electrical faults: When splicing wires do not just twist them together and wrap electrical tape around the connection. Use a solderless crimp-on connector, or twist the wires together, solder them and use shrink wrap electrical insulation tubing to seal the repair.

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