

# Battery Drain

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When your car battery goes dead overnight, usually either the battery is at the end of its life span, or you left something on, such as a light. Occasionally something is drawing power that's not of your doing. This is a parasitic draw, and it can cause the same result as leaving the headlights on: a dead battery in the morning.

## Steps

1. Remove the negative side battery cable from the negative battery terminal.
2. Connect the black wire to the com input on the multimeter and the red wire to the 10A or 20A input on the multimeter. The meter needs to be able to read at least a 2 or 3 amps for this test to work. So connecting the red wire to the mA input on the multimeter won't work.
3. Attach a multimeter (set the dial on the multimeter to measure Amps as per multimeter's instructions) between the negative cable and the negative battery post. Wait a few seconds to several minutes for the car to go into sleep mode - i.e. when you make the contact with the ammeter, the cars computer systems "wake up". After a bit of time they will go back to "sleep".
4. If the ammeter is reading over 25-50 milliamps, something is using too much battery power.
5. Go to the fuse panel(s) and remove fuses, one at a time. Pull the main fuses (higher amp ratings) last. Be sure to observe the ammeter after pulling each fuse.
6. Watch for the ammeter to drop to acceptable drain. The fuse that reduces the drain is the draw. Consult the owners' manual or service manual to find what circuits are on that fuse.
7. Check each device (circuit) on that fuse. Stop each lamp, heater, etc. to find the drain.
8. Repeat steps 1&2 to test your repair. The ammeter will tell you exact numbers.

A parasitic drain is when an electrical device is using battery power when the car is closed, and the ignition key removed. Therefore, when doing this test make sure that the dome light, under hood light, trunk light, etc. are **off**.

# Diagnosing A Car Battery That Runs Down

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You go to start your car and discover the engine won't crank because the battery is dead. Now what? You get somebody to give you a jump start, or you connect the battery to a charger and charge it up until it has enough juice to start your engine.

The next morning you go to start your car again, and the same thing happens. The battery has run down and the engine won't crank. What is wrong?

### WHY A CAR BATTERY RUNS DOWN

A car battery can run down for any of several reasons:

- You accidentally left the lights on or some other accessory that pulls power from the battery even when the ignition key is off.
- The battery is not being recharged while the vehicle is being driven (you have a charging problem)
- There is a key off parasitic electrical drain on the battery because a relay is sticking, a module is not shutting down, or there is a shorted diode in the alternator.
- Your battery is old and will not hold a charge anymore. The battery needs to be replaced.

### CHECK BATTERY VOLTAGE AND STATE OF CHARGE

The first things you want to check are the battery and the output of the charging system (alternator). One way to do this is to turn on the headlights. If the headlights come on with normal brightness, the no-crank problem is probably not the battery, but a bad starter relay or solenoid, a poor wiring connection between the relay/solenoid and starter, or a bad starter. If the headlights are dim or do not come on at all, you need to check battery voltage and charging output.

For this, you will need a voltmeter. Select the 12 or 20 volt scale, and connect the volt meter red positive test lead to the battery positive (+) terminal, and the black negative test lead to the battery negative (-) terminal.

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*Checking base battery voltage with a voltmeter.*

A fully charged battery should read about 12.6 volts. If the battery reads 12.4 volts or less, it is low (discharged) and needs to be recharged.

## **Battery Voltage and State of Charge:**

<b>12.68v</b>	<b>100%</b>
<b>12.45v</b>	<b>75%</b>
<b>12.24v</b>	<b>50%</b>
<b>12.06v</b>	<b>25%</b>
<b>11.89v</b>	<b>0%</b>

*(NOTE: these readings are at 80 degrees F. Battery voltage readings will drop with temperature roughly 0.01 volts for every 10 degrees F.)*

*(At 30 degrees F. a fully charged battery will measure about 12.588 volts, and at zero degrees F it will measure about 12.516 volts.)*

## **CHECK CAR BATTERY CHARGING VOLTAGE**

After charging the battery or jump starting the car, connect the voltmeter to the battery the same as before and not the charging voltage. A charging system that is operating normally should produce about 13.5 to 14.5 or more volts at idle. If the charging voltage is less than 13.5 volts, the alternator is not putting out enough current to keep the battery charged. You should have the alternator tested (or bench tested at an auto parts store). If the current output is not up to specifications, replace the alternator.



*Charging voltage with engine idling should be 13.5 to 14.5 volts.*

After the battery has been recharged, the battery should also be tested to see if it is capable of holding a charge. This can be done with a hand-held [electronic battery tester or a conventional load tester](#). The

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tester will tell you if the battery is good or bad. NOTE: Load testers require the battery to be fully charged for accurate test results. By comparison, most electronic testers will give reliable test results even if the battery is not fully charged. If the battery fails a load test, it needs to be replaced.

Average car battery life is only about four to five years, and can be as little as three years in really hot climates (like Arizona and Florida). So if your battery is more than four or five years old, chances are it has reached the end of its useful service life and needs to be replaced, if it is not holding a charge and the charging system is working normally.

## KEY-OFF CAR BATTERY DRAIN

If your car battery is less than six years old and tests okay, and the charging system is working normally, your battery may be running down because of a key-off current drain.

When you shut the engine off, turn off the lights and remove the key from the ignition switch, the electrical load on the battery should drop to almost nothing. On older cars that do not have computers or other onboard electronic modules, the key-off load on the battery is typically only a few milliamps (if it has a clock or a digital radio), or it may drop to zero (no load at all). But on late model vehicles with [computers](#) and numerous electronic modules, the key-off drain on the battery can range from 20 to 50 milliamps, to as much as 300 to 400 milliamps. On some Fords, the electrical system will continue to pull as much as 850 milliamps (almost 1 amp) for up to 20 minutes or more after the ignition has been turned off.

The key-off current drain is used by the modules to keep their memories alive. The chips that store certain settings and learned information are called the "Keep Alive Memory" (KAM).

Many modules have internal timers that either turn off the module to put it into a "sleep mode," or power down the module to a "standby mode" to reduce the parasitic power drain on the battery after a predetermined length of time when the key is turned off. Some of these modules power down in steps and time out at different rates.

If the battery runs down (or is disconnected), KAM information can be lost. Computers and modules may reset to a "default" setting after the battery is recharged or reconnected, but you may notice some changes in the way your vehicle runs and drives, and you may have to reset the radio channels, clock and other memory presets. Worse yet, on some vehicles the climate control system, power windows or radio may not function at all until they are reset using a special "relearn" procedure or a dealer scan tool. On many BMW, Audi, Acura and VW models, for example, the radio won't work if the battery has been disconnected or run dead until the factory security code has been reentered. [Read This](#) before you disconnect or replace a battery on a late model vehicle.

When disconnecting or replacing a car battery on a late model vehicle, therefore, it is important to keep a steady voltage supply to the modules to preserve the KAM settings. This can be done by plugging a backup battery into the cigarette lighter, or attaching a backup battery or battery charger to the car's battery cables BEFORE the cables are disconnected.



*Key-Off current drain should be less than 50 mA after 1 hour.*

## MEASURING CAR BATTERY CURRENT DRAIN

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As a rule, the parasitic drain on most late model vehicles should be less than 50 milliamps one hour after the vehicle has been shut off and left undisturbed. But this is a rule of thumb only. Always refer to the vehicle manufacturer's key-off electrical drain specifications if available (some vehicle manufacturers have no published specifications).

Keep in mind, though, that opening a door, the trunk or turning anything on can wake up various modules and start the timer countdown all over again. So if you want to check the parasitic draw on the battery, leave the hood open (or the trunk if the battery is located in the back).

Current drain can be measured with a digital multimeter (DMM) using the ammeter function one of two ways: by measuring current flow between a battery post and one of the cables, or by using a clamp-on inductive amp probe. The latter requires a somewhat expensive amp probe, but is faster and easier because you don't have to disconnect a battery cable or use a battery backup to maintain the Keep Alive Memory in the vehicle's computers and electronics.

## **To measure current drain without an inductive amp probe:**

1. Set the DMM to read milliamps (mA). If the meter is not auto-ranging, select the 100 or 1000 mA scale.

NOTE: the DMM should have a 10 amp fuse in it to protect the meter from possible damage if there is a large current drain on the battery.

2. Plug a battery backup into the cigarette lighter (or attach a backup battery or power supply to the battery cables) to protect KAM while disconnecting the battery cable.
3. Disconnect one of the battery cables and connect the DMM test leads to the cable and battery post.
4. Unplug the battery backup and note the current reading on the DMM.

NOTE: Do NOT remove the DMM test leads until you have plugged the battery backup in the cigarette lighter or reconnected the battery backup to the battery cables, otherwise you will lose the KAM if power is disrupted.

## **To measure current drain with an inductive amp probe:**

1. Set the DMM to read millivolts (mV). If the meter is not auto-ranging, select the 100 or 1000 mV scale. Set the switch on the amp probe to either 10 mV or 100 mV per amp (10mV per amp is the best setting for reading key-off drains).
2. Clamp the amp probe around one of the battery cables.
3. Note the current reading on the meter.

Also note: Some amp probes can read directly without the need for a DMM.

## **CAUSES OF EXCESSIVE CURRENT DRAIN**

Causes of excessive current drain from a car battery include things like lights that remain on (trunk and hood lights, interior lights, brake lights, etc.) and also [relays](#) that may be stuck on, or modules that are not going to sleep or powering down.

A fuel pump relay that sticks on may keep the fuel pump running after the engine is shut off. A switch or relay that powers a rear window defogger can stick on, pulling current from the battery after the ignition is off. An electronic suspension module, [ABS module](#) or keyless entry module may remain active long after it should have powered down.

An accessory such as a DVD player, game console or cell phone charger left plugged into a rear seat power receptacle may be pulling power from the battery. So before you spend a lot of time trying to figure

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out where the amps are disappearing, check all of the vehicle's power receptacles to see if something is plugged in that may be using power.

## FINDING THE CAUSE OF THE CURRENT DRAIN

If the key-off current reading is above specifications (typically, more than 50 mA one hour after the vehicle has been shut off), the current drain is too high. It's time to start pulling fuses and relays to find the fault.



*Remove fuses and relays one at a time to find circuit that is draining the battery.*

Refer to your vehicle owner's manual or a wiring diagram to identify the fuses and relays. Then pull the fuses and relays one at a time until the current reading drops. Avoid pulling the fuses for the PCM or other KAM-sensitive modules until you have checked all of the other circuits.

Once you've found the circuit that is causing the excessive current drain, check the relay, switch, module or other components in the circuit and replace as needed.

Sometimes a bad alternator diode can cause a car battery to run down. A good diode should only pass current in one direction. If it leaks current in the opposite direction, it may keep the charging circuit on when the engine is not running, causing the battery to run down. This kind of problem can be diagnosed several ways. If your voltmeter has an AC (alternating current) scale, switch to that scale and observe the charging voltage with the engine running. If the meter shows any AC voltage, one or more diodes are leaking and the alternator needs to be replaced. The alternator's output can also be observed as a waveform on a digital storage oscilloscope (DSO) or an alternator tester that measures ripple voltage to detect this kind of problem. Or, just disconnect the alternator overnight and see if the battery stills run down. If the battery drain stops, you have found the problem. Replace the alternator.