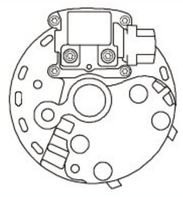
TECH BASICS 5

FORD 2G (IAR) CHARGING SYSTEMS



Ford introduced the 2G alternator in 1984. The voltage regulator is attached to the rear housing. There are two different wiring schemes used, which depend on whether the vehicle has a charge-light or only a charge-gauge. ***FIGURE 1*** shows the components and wiring for a charge-light system. Gauge-only systems will be discussed in the next section. Here's a list of the components as shown in ***FIGURE 1*** and some common problems. You should read this list and familiarize yourself with the parts no matter which system you are troubleshooting.

A **Battery** -- should be fully charged and load tested before diagnosing any charging problem

B **Starter relay** -- isn't part of the charging system, but serves as a connection point for the fusible link and the positive battery cable.

C **Charging system fuse** -- located in the fuse box. It may also protect other dash warning lights and gauges.

D **Fusible link** -- protects the wire to the alternator ***BAT*** terminals and the voltage regulator ***A*** terminal. This harness is a common problem area. The fusible link can be bad or it can be corroded away. The connection where the wire branches off to the ***A*** terminal of the voltage regulator is also prone to corrosion which can cause low voltage or no voltage at the ***A*** terminal. Opening the harness and repairing the connection is the fix here.

E **Ignition switch**

F **Resistor** -- allows current to flow in case of bulb failure. *Not used in gauge-only vehicles.*

G **Indicator Light** -- bulb can fail. *Not used in gauge-only vehicles*.

H **Voltage regulator and plug** -- Use dielectric grease on all connections.

I **Alternator** -- be sure to clean corrosion off the grounding areas where the alternator mounts.

J **Rectifier Plug --** see section titled "Changing the Rectifier Plug".

K **Electric choke** -- always check the routing of the choke wire. It's common to find it melted to the exhaust manifold or snagged under a valve cover from the last valve cover gasket change.

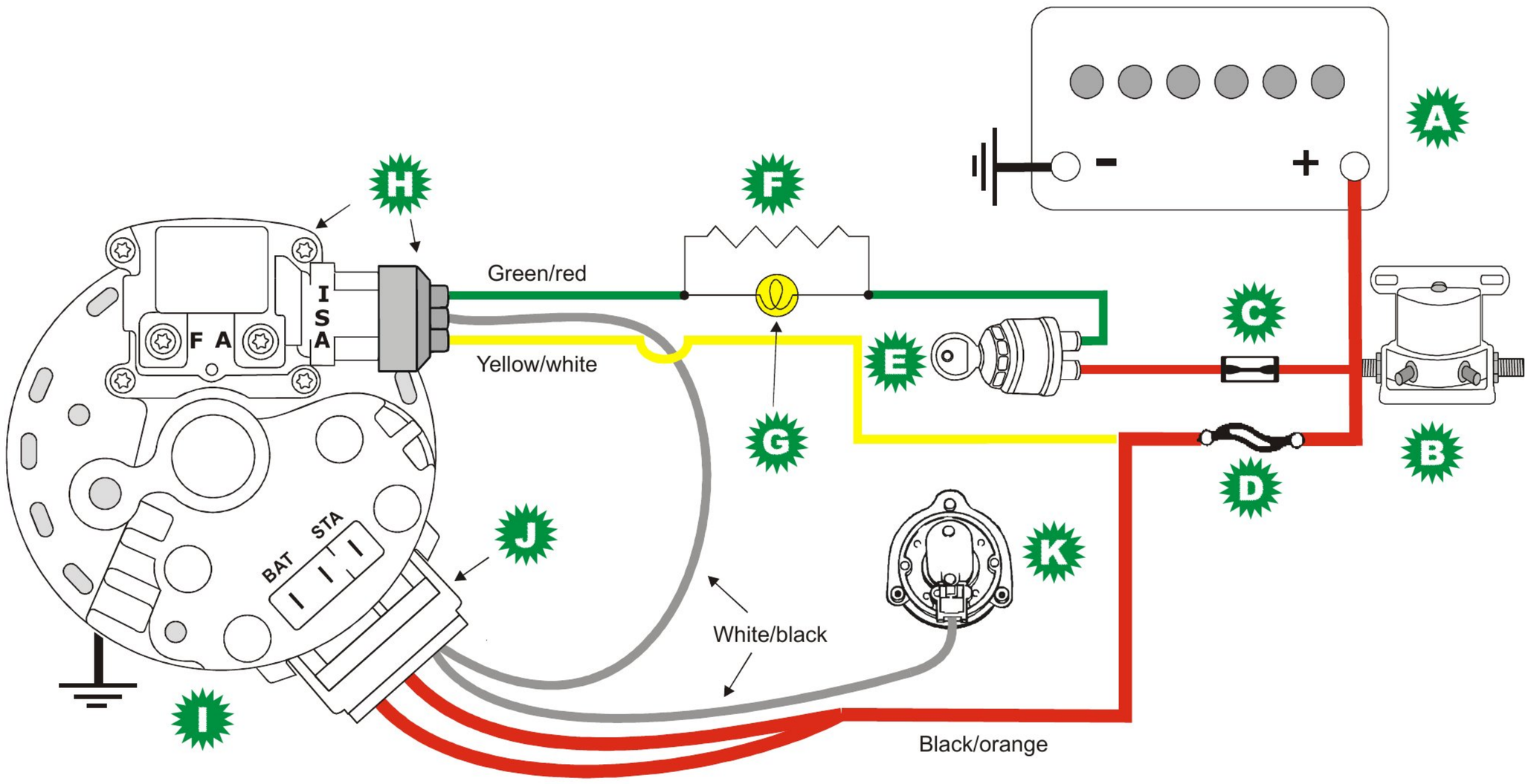


Figure 1 -- Components of a typical 2G charging system with a charge-light

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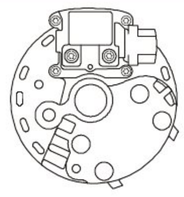

CHARGE-LIGHT SYSTEM - How it Works

The system with a charge-light has <u>two stages</u> of operation.

The first stage is KOEO (Key on, Engine off)

During **KOEO** current flows from the battery ⇨ through the fuse ⇨ through the ignition switch ⇨ through the charge-light/resistor ⇨ to the voltage regulator ***I*** terminal.

What's the resistor for? It's there as a backup for the charge-light bulb. If the filament in the bulb breaks, current will bypass the bulb and still get to the ***I*** terminal on the voltage regulator. Without the resistor, a blown charge-light bulb could disable the charging system!

As soon as the voltage regulator "sees" current at the ***I*** terminal, it directs current from the ***A*** terminal to the rotor which causes it to become an electromagnet.

That's it for **KOEO**. The charge-light is on and the alternator is energized. It's time to start it up.

KOEO current flow

- Regulator grounds the "I" terminal
- Regulator uses current from "A" terminal to energize the rotor

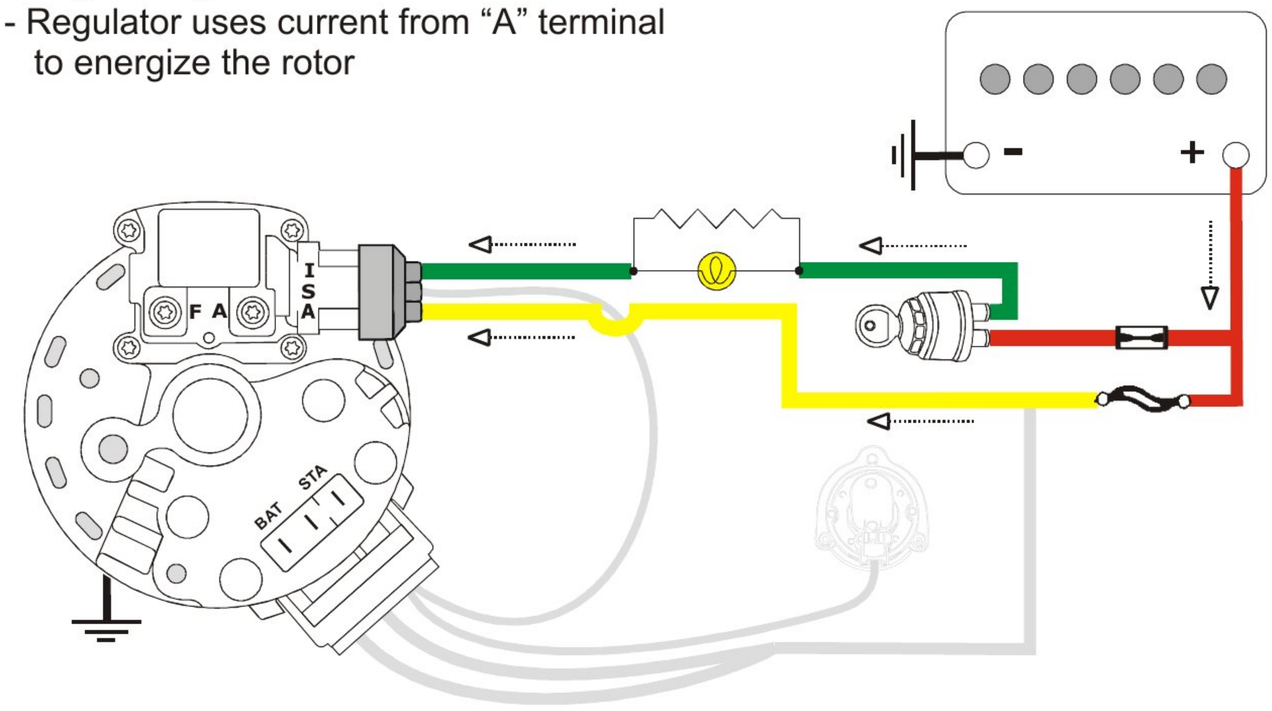

Figure 2 - Charge-light system KOEO (key on, engine off)

The second stage is KOER (Key on, Engine running)

As soon as the alternator starts charging, it sends current out the ***STA*** terminal.

The current leaving the ***STA*** terminal is not at full charging-system voltage. On a good alternator, it will always measure about one-half the alternator charging voltage. For example, if you measure 14.0 volts across the battery, the ***STA*** voltage at the alternator will be approximately 7.0 volts.

The ***STA*** terminal output serves two purposes. On a carbureted engine with an electric choke, it powers the choke heater element. It also goes to the voltage regulator ***S*** terminal. As soon as the voltage regulator senses voltage at the ***S*** terminal, it opens the connection between the ***I*** terminal and ground, thereby turning off the charge-light.

KOER current flow

- Alternator "STA" terminal produces ½ voltage output to electric choke heater and regulator "S" terminal.
- Regulator opens "I" terminal and charge-light goes out.
- Alternator-produced current flows from "BAT" terminals to the battery.
- Regulator controls alternator output.

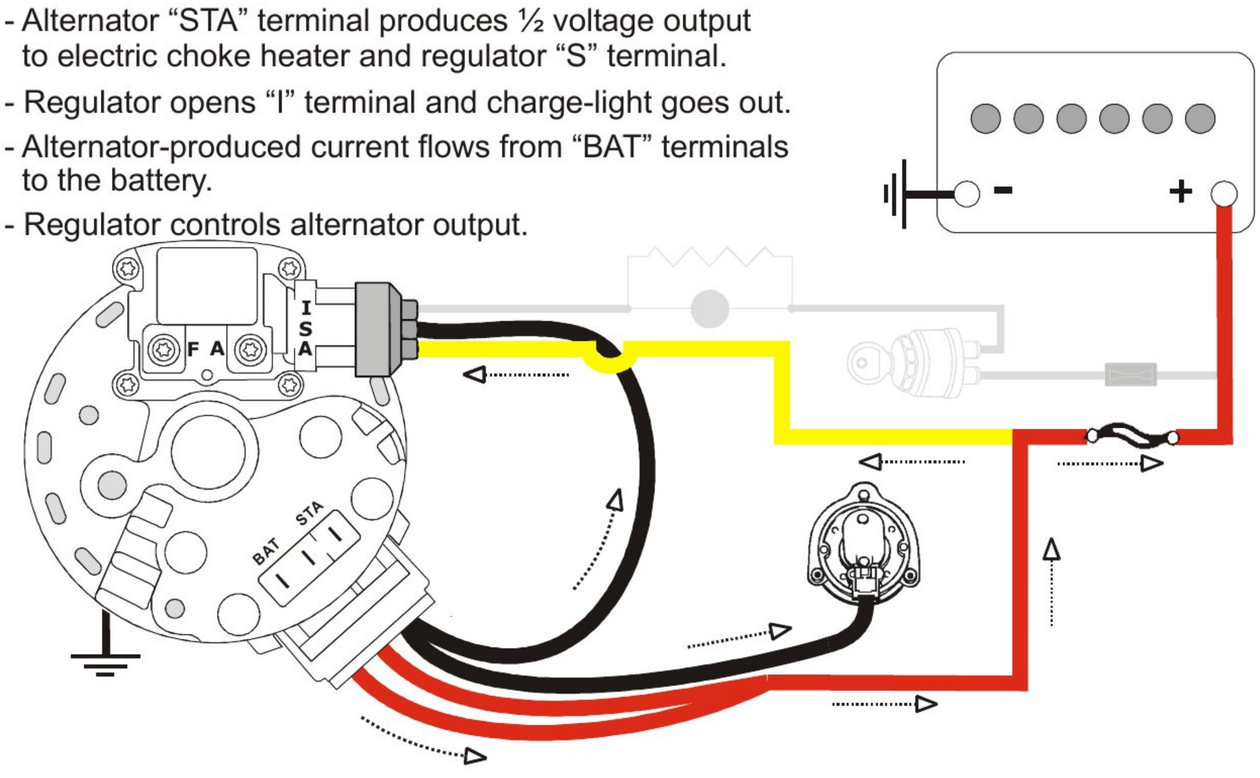

Figure 3 - Charge-light system KOER (key on, engine running)

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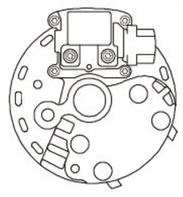

GAUGE-ONLY SYSTEM - How it works

Gauge-only systems have <u>two stages</u> of operation.

The first stage is KOEO (Key on, Engine off)

During **KOEO** current flows from the battery ⇨ through the fuse ⇨ through the ignition switch ⇨ to the voltage regulator ***S*** terminal.

As soon as the voltage regulator "sees" current at the ***S*** terminal, it directs current from the ***A*** terminal to the rotor which causes it to become an electromagnet.

The voltage regulator ***I*** terminal is not used in gauge-only systems.

That's it for **KOEO**. The alternator is energized. It's time to start it up.

KOEO current flow

- Ignition switch sends power to the regulator "S" terminal
- Regulator uses current from "A" terminal to energize the rotor

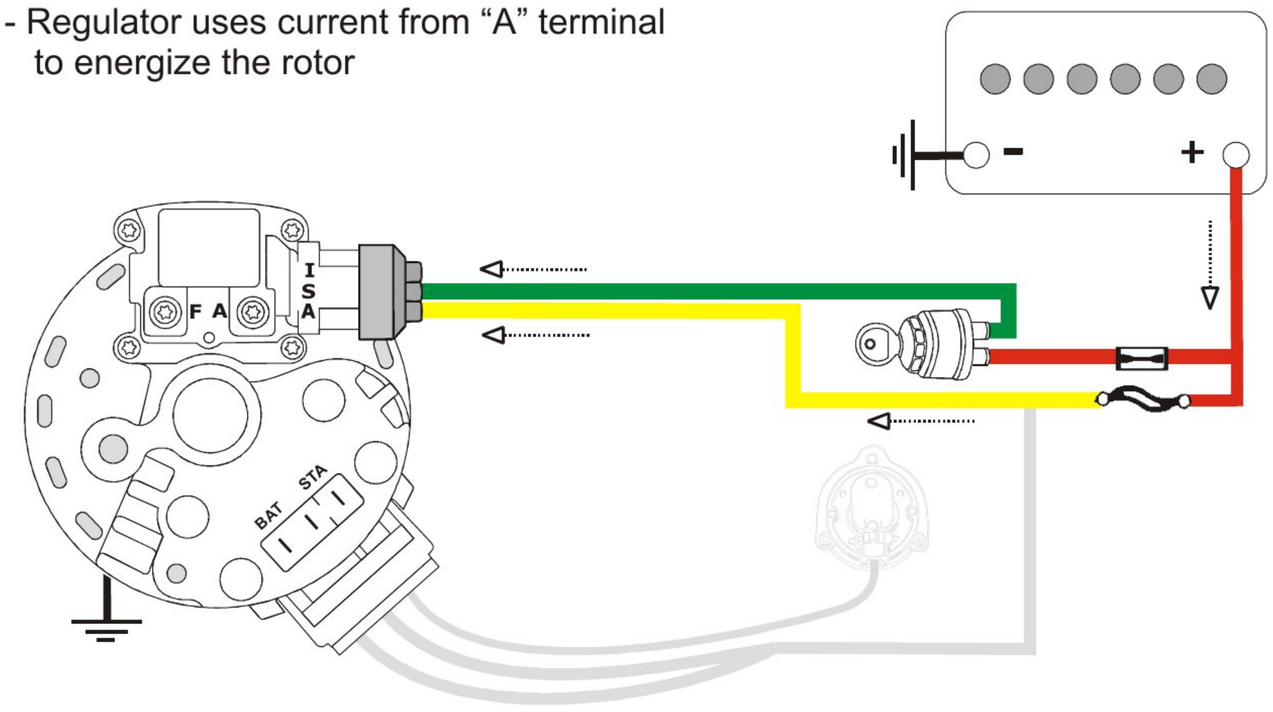

Figure 4 - Gauge-only system KOEO (key on, engine off)

The second stage is KOER (Key on, Engine running)

As soon as the alternator starts charging, it sends current out the rectifier plug ***STA*** terminal. The current leaving the rectifier plug ***STA*** terminal is not full charging-system voltage. On a good alternator, it will always measure about one-half the alternator charging voltage. For example, if you measure 14.0 volts across the battery, the rectifier plug ***STA*** voltage at the alternator will be approximately 7.0 volts.

The ***STA*** terminal output serves only one purpose on gauge-only systems. On a carbureted engine with an electric choke, it powers the choke heater element. It is not used on fuel injected vehicles.

KOER current flow

- Ignition switch sends power to the regulator "S" terminal
- Alternator "STA" terminal produces ½ voltage to the electric choke heater.
- Alternator-produced current flows from "BAT" terminals to the battery.
- Regulator controls alternator output.

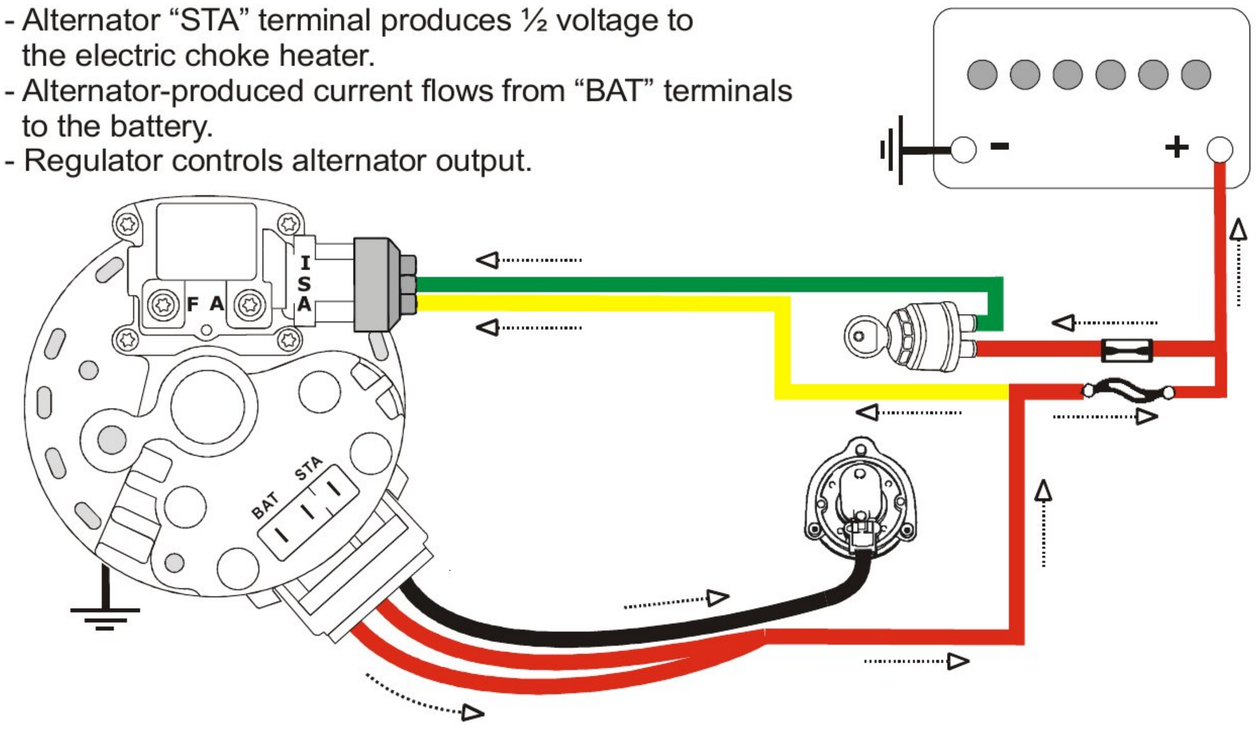

Figure 5 - Gauge-only system KOER (key on, engine running)

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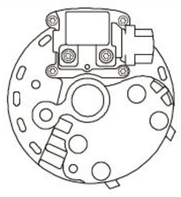

HOW TO TEST AND REPAIR

START BY DOING A CHARGING SYSTEM TEST.

Step 1. The battery must be fully charged and load tested. The engine must be off. Be sure the alternator belt is properly tensioned. Connect the negative lead of a voltmeter to the negative battery post and the positive voltmeter lead to the positive battery post. Write down this reading - it will be referred to as "base voltage". Do <u>both</u> of the following tests:

LOAD TEST: Start the engine. Turn the headlights on and the heater/ac motor to high. Increase engine speed to 2000 RPM. Check the voltage across the battery terminals. See chart for results.

LOAD TEST VOLTAGE READINGS:	*RESULT:*
Voltage increases at least 0.5 volts over "base voltage"	***Pass***
Voltage does not increase at least 0.5 volts over "base voltage"	***Fail***

NO-LOAD TEST: Turn off the accessories, decrease engine speed to 1500 RPM and check the voltage across the battery terminals again. See chart for results.

NO-LOAD TEST VOLTAGE READINGS:	*RESULT:*
Voltage is less than 2.0 volts over "base voltage"	***Pass***
Voltage is more than 2.0 volts over "base voltage"	***Fail***

- ✓ ***If both LOAD TEST and NO-LOAD TEST Pass and charge-light is out (if present),*** the charging system is working correctly.
- ✓ ***If LOAD TEST Fails***, skip to ***Step 2***.
- ✓ ***If NO-LOAD TEST Fails***, the alternator is faulty. Repair and repeat ***Step 1***.

Steps 2 - 4 are performed with the <u>engine off</u>

Step 2. Remove the rectifier plug. Use a voltmeter or a test-light and check for power at both ***BAT*** wires in the rectifier plug (not the alternator). If both have power, then skip to ***Step 3***. If neither has power, check the fusible link. If only one has power, check the harness connection where both wires are spliced together.

Step 3. ***CHARGE-LIGHT SYSTEM:*** Remove the voltage regulator plug from the alternator. Turn the key to the "run" position (engine off). Use a voltmeter or a test-light and check for power at both the ***I*** and the ***A*** terminals of the voltage regulator plug (not the alternator). If there is no power to the ***A*** terminal of the voltage regulator plug, check for a broken wire or a poor connection (often it's where the wire splices into the ***BAT*** wire). If the voltage regulator ***I*** terminal does not have power, the most likely cause is a bad fuse. If the fuse is good, it's time to start checking for unusual problems. Check for corroded connectors, corroded fuse box terminals, cut wires, loose plug at the instrument cluster or a bad ignition switch. What about the bulb? A bad bulb will not prevent power from flowing to the regulator plug ***I*** terminal, since the resistor offers an alternate path. The time to test the bulb is after restoring power to the regulator plug ***I*** terminal. Just ground the ***I*** terminal from the voltage regulator plug and the charge-light will come on if the bulb is good. Reconnect the plug to the voltage regulator. Make certain the key is still in the "run" position (engine off). If the charge-light comes on, go to ***Step 4***. If the charge-light does not come on, the alternator is faulty. Replace the alternator and repeat ***Step 1***.

Step 4. ***CHARGE-LIGHT SYSTEM:*** Start the engine. Do the following test at idle, with the engine warm and all alternator plugs reconnected. If the engine has an electric choke, unplug it. Probe the wires and test the voltage at the ***S*** wire and the ***A*** wire of the voltage regulator. The ***S*** wire should be about one-half the voltage of the ***A*** wire. If no voltage or low voltage is present at the voltage regulator ***S*** wire, the alternator if faulty. Replace and repeat ***Step 1***. Don't forget to reconnect the choke wire! When you have verified correct voltage, go to ***Step 5***.

GAUGE-ONLY SYSTEM: Start the engine. Do the following test at idle, with the engine warm and all alternator plugs reconnected. If the engine has an electric choke, unplug it. Test the voltage at the electric choke plug and the voltage regulator ***A*** terminal. The electric choke plug voltage should be about one-half the voltage of the

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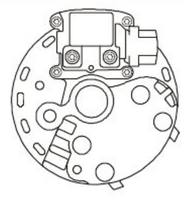


A terminal. If no voltage is present at the electric choke plug, check the voltage directly at the rectifier plug ***STA*** wire on the alternator. If correct voltage is at the rectifier plug, repair the wire. If there is no voltage or low voltage directly at the rectifier plug, the alternator is faulty. Replace and repeat ***Step 1***. Don't forget to reconnect the choke wire! When you have verified correct voltage, go to ***Step 6***.

Step 5. ***CHARGE-LIGHT SYSTEM:*** Reconnect everything and start the engine. Is the charge-light off? If the charge-light is still on, then the alternator is faulty. Replace the alternator and repeat ***Step 1***. At this point, you have verified every function of the system. Go to ***Step 7***.

Step 6. ***GAUGE-ONLY SYSTEM:*** Turn the key to the "run" position. Remove the voltage regulator plug and, using a voltmeter or a test-light, check for power at the voltage regulator plug ***S*** terminal (not the alternator). If the voltage regulator plug ***S*** terminal does not have power, the most likely cause is a bad fuse. If the fuse is good, it's time to start checking for unusual problems. Check for corroded connectors, corroded fuse box terminals, cut wires or a bad ignition switch. When there is power at the voltage regulator plug ***S*** terminal, go to ***Step 7***.

Step 7. ***CHARGE-LIGHT SYSTEM or GAUGE-ONLY SYSTEM:*** Be sure all wires are reconnected and run the engine at 1500 RPM for several minutes or until battery voltage stabilizes. Repeat the ***LOAD*** and ***NO-LOAD*** tests done in ***Step 1***. If both pass you are done.

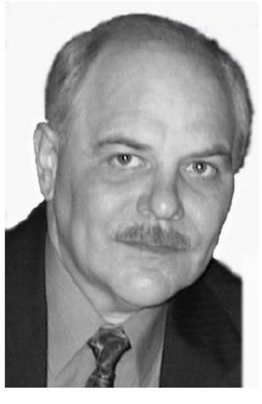
If the system fails the ***LOAD*** test, the alternator is faulty. Replace the alternator.
If the system fails the ***NO-LOAD*** test, the alternator is faulty. Replace the alternator.

The final test is to verify that the entire system is working correctly. Repeat the ***LOAD*** and ***NO-LOAD*** tests done in ***Step 1***.

CHANGING THE RECTIFIER PLUG

The weakest part of the 2G charging system is the rectifier plug. Inside the plug are small spade connectors. Two of the connectors are attached to the thick black/orange wires and carry the current the alternator produces. These connectors do not age well. The extreme conditions under the hood can cause them to lose holding tension and/or to corrode. When this happens, excessive resistance is created at the terminals and extreme heat is generated. This heat is so intense that it can cause the plug to melt. In extreme cases it can cause a fire. Since it's impossible to see inside the plug, we recommend changing the rectifier plug whenever a 2G alternator is replaced. Replacement plugs are available in a kit that contains a new plug, crimp on connectors, heat-shrink tubing (to insulate the connections) and dielectric grease (to spread on the terminals and seal out oxygen). Order part number 49-2100. Be sure to follow all instructions carefully.

About the author:



This Tech Basics guide was written by Wesley S. Grueninger. Wes has been in the rebuilding industry since 1975, the year he started Auto Lab. Auto Lab specializes in remanufacturing import alternators and starters in addition to stocking a full line of domestic units. Many hours of research have gone into the Tech Basics series and we want to hear from you if you have any suggestions or comments. Contact us at autolab@execpc.com.

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