Caution: In a full field state, voltage can quickly rise above 16 volts. Before beginning diagnosis, turn off all vehicle accessories and lamps. Any time voltage climbs to 16 volts or higher, quickly disable the charging system by opening the field circuit and/or turning the ignition key to the off position. While electronics are protected from voltage spikes, extended high voltage can cause electronics damage, premature bulb failure and potentially battery explosion. Observe all standard safety practices and do not allow a vehicle to run for an extended time with voltage beyond normal system voltage.

Chrysler Application: Diagnostics for Alternator with Computer Controlled Charging System

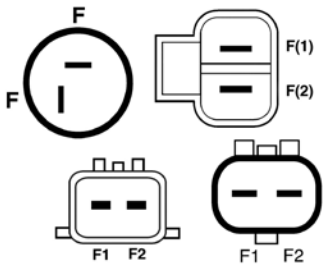
Chrysler computer-controlled charging systems set powertrain codes for field control circuit faults, as well as high and low voltage codes. These codes can reduce diagnostic time by focusing on specific circuits. This Technical Service Bulletin will address diagnosis from an under the hood testing perspective to help supplement the results of scan tool diagnosis.

Before you begin, ensure the battery is fully charged and passes capacity and/or load testing. Also inspect all wiring and connectors, check the alternator clutch pulley (if equipped) and verify belt condition using a belt wear gauge.

Chrysler alternators have external field terminal access. Testing an alternator independently from the control circuit is a straightforward task with only minor variation. However, when the alternator operates properly, the focus turns to control circuit and module diagnosis.

Multiple Field Terminals (Figure 1)

Figure 1 shows a collection of connectors used on Chrysler alternators up to 2008. The terminals are labeled "F" for field: (F1) and (F2) or (F+) and (F-). Any indication of polarity does not affect alternator operation. Either wire can be hooked to either F terminal. When full power and ground are directly hooked to the field terminals it will operate at maximum output or full field.



(Figure 1)

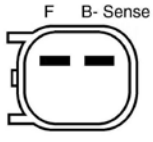
To test the alternator separate from the control circuit:

1. Disconnect the 2-pin alternator connector.
2. Using insulated leads to prevent unintended shorts, attach one alternator field terminal to a known good ground.
3. Attach the second field terminal to one end of a fused jumper wire (10 amp fuse) and place the other end near a voltage source—but do not attach it yet.
4. Set up your voltmeter to monitor charging system voltage. (Black lead to known good ground; red lead to the B+ post of the alternator.)
5. Start the engine and bring to about 1500 RPM.
6. While closely monitoring charging system voltage, attach the fused jumper wire to positive post on the battery.

The result: The alternator is considered functional if voltage rises above battery voltage. If voltage rises to 16 volts or higher, quickly disconnect the fused jumper wire to prevent system damage. If the voltage does not rise, it is an indication of alternator failure. However before replacing the alternator, verify alternator power and ground circuits.

Single Field Terminal (Figure 2)

In 2008, Chrysler alternators began using a single field terminal. Figure 2 shows the latest design connector, which can be visually identified by the connector tab location, or by the proximity of the terminals to the connector body. These applications have a single field wire. The second terminal is labeled "B," "Sense" or "Kelvin sense," and used by the PCM to monitor charging voltage. The procedure for testing these units is the same as as for the multiple field terminal—except you will not perform step 2. There is no external ground connection to the field and there is no connection made to the "sense" terminal.



Terminal Markings
F = Field
B = Kelvin Sense

(Figure 2)

Setpoint Regulation

To maintain the desired voltage setpoint, the regulator (PCM) controls either the power or ground circuit of the rotor to maintain the proper magnetic field strength. The required current flow of the rotor varies based on vehicle demand, battery state of charge and engine RPM. Chrysler applications have used both A and B side regulation.

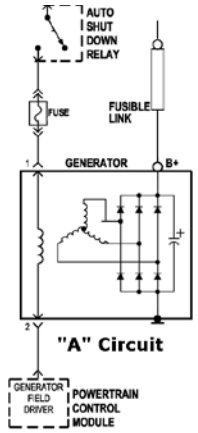
- **A circuit**: Power is applied to one field terminal either from the automatic shutdown relay or directly from the PCM (Pin 1 of Figure 3). On the second field terminal, ground to the rotor is varied by the PCM with a duty cycle to maintain the desired setpoint (Pin 2 of Figure 3).
- **B circuit**: Ground is applied to one field terminal (Pin 1 of Figure 4). On the second field terminal, battery voltage to the rotor is varied by the PCM with a duty cycle to maintain the desired setpoint (Pin 2 of Figure 4 or Pin 1 of Figure 5).

Diagnosis of control circuits

Dual field applications can be A or B side controlled, based upon application. Consult the wiring diagram for your application to verify A or B side regulation. Single field applications are always B side controlled.

Dual Field "A" circuit (Figure 3)

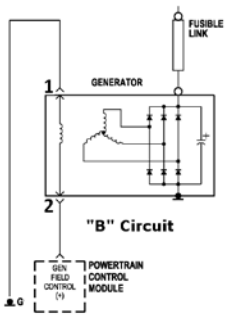
Back probe both field terminals at the alternator. With the engine running at 1500 RPM, monitor the wires. One field wire should be near system voltage (within .5 volts) at all times (Pin 1 of Figure 3). If it is any other value, repair the voltage supply circuit. The other field wire will vary based on battery state of charge and load (Pin 2 of Figure 3). Monitor the field control circuit while adding and removing loads. The voltage should rise with increasing loads. If the voltage remains high and does not fluctuate with changing loads, the field wire is shorted to power, open or the PCM circuitry is failed. If the voltage remains low, verify alternator operation and/or repair the field circuit for short to ground.



(Figure 3)

Dual Field "B" circuit (Figure 4)

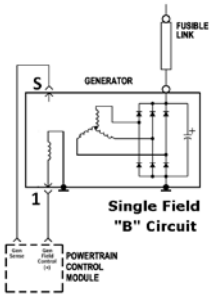
Back probe both field terminals at the alternator. With the engine running at 1500 RPM, monitor the wires. One field wire should be between .05 and .5 volts at all times (Pin 1 of Figure 4). If it is greater than .5 volts repair the field ground. If it is 0 volts, then verify voltage on the second field wire and/or test the alternator. The second field wire will vary based on battery state of charge and load (Pin 2 of Figure 4). Monitor the circuit while adding and removing loads. The voltage should rise with increasing loads. If the voltage remains high and does not fluctuate with load, check the harness for a short to power.If the voltage is 0 volts (within .5 volts), the field wire is open shorted to ground or the PCM control circuit is failed.



(Figure 4)

Single Field "B" circuit (Figure 5)

Back probe the field terminal at the alternator (Pin 1 of Figure 5). With the engine running at 1500 RPM, monitor the circuit. The circuit will vary based on battery state of charge and load. The voltage should rise with increasing loads. If the voltage remains high and does not fluctuate with load, check the harness for a short to power. If the voltage is 0 volts (within .5 volts), the field wire is open shorted to ground or the PCM control circuit is failed.

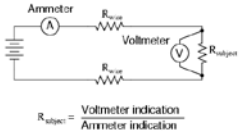


(Figure 5)

Kelvin Sense (Figure 6)

By definition, a Kelvin connection is a means of making precision electrical potential contact with a current carrying component or reference point in such a way that eliminates or greatly reduces the effect of contact resistance. It is a very precise way to measure voltage. In order to get a very precise reading, the Kelvin Sense terminal is directly wired to the rectifier plate. The PCM directly monitors this circuit that has no current flow and, therefore, no voltage drop. Inside the alternator, the sense circuit does have a 2.4K ohm resistor to protect it from shorts to ground, but because the circuit has no intended ground path, there is no current flow.

After completion of any charging system repairs, it is critical to perform power and ground voltage drop tests to help ensure root cause has been repaired. (See our Dec. 2015 issue for more on voltage drop tests.)



(Figure 6)