Hazard Definitions

These terms are used to bring attention to presence of hazard(s) of various risk levels or to important information concerning product life.

CAUTION — Indicates presence of hazard(s) that will or can cause minor personal injury or property damage.

NOTICE — Indicates special instructions on installation, operation or maintenance that are important but not related to personal injury hazards.

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Battery Conditions

NOTICE — Until temperatures of electrical system components stabilize, these conditions may be observed during cold-start voltage tests.

- **Maintenance/Low Maintenance Battery**
  - — Immediately after engine starts, system volts are lower than regulator setpoint, amps are medium.
  - — 3–5 minutes into charge cycle, system volts increase, amps decrease.
  - — 5–10 minutes into charge cycle, system volts increase to, or near, regulator setpoint and amps decrease to a minimum.
  - — Low maintenance battery has same characteristics with slightly longer recharge times.
- **Maintenance-free Battery**
  - — Immediately after engine starts, system volts are lower than regulator setpoint, low charging amps.
  - — Once charge cycle begins, low volts and low amps are still present.
  - — After alternator energizes, voltage will increase several tenths. Amps will increase gradually, then quickly, to medium to high amps.
  - — Finally, volts will increase to setpoint and amps will decrease.

  The time it takes to reach optimum voltage and amperage will vary with engine speed, load, and ambient temperature.
- **High-cycle Maintenance-free Battery**
  These batteries respond better than standard maintenance-free. Charge acceptance of these batteries may display characteristics similar to maintenance batteries.
- **AGM (Absorbed Glass Mat) Maintenance-free Battery**
  These dry-cell batteries respond better than standard maintenance-free. If battery state of charge drops to 75% or less, batteries should be recharged to 95% or higher separately from the engine's charging system to avoid damaging charging system components and to provide best overall performance. Charge acceptance of these batteries may display characteristics similar to maintenance batteries.

Battery Charge Volt and Amp Values

Volt and amp levels fluctuate depending on the battery state of charge. If batteries are in a state of discharge—as after extended cranking time to start the engine—system volts will measure lower than the regulator setpoint after the engine is restarted and system amps will measure higher. This is a normal condition for the charging system; the greater the battery discharge level, the lower the system volts and the higher the system amps. The volt and amp readings will change as batteries recover and become fully charged: system volts will increase to regulator setpoint and system amps will decrease to low level (depending on other loads).

- **Low Amps:** Minimum or lowest charging system amp value required to maintain battery state of charge, obtained when testing the charging system with a fully charged battery and no other loads applied. This value will vary with battery type.
- **Medium Amps:** System amps value which can cause the battery temperature to rise above adequate charging temperature within 4-8 hours of charge time. To prevent battery damage, the charge amps should be reduced when battery temperature rises. Check battery manufacturer's recommendations for proper charge amp rates.
- **High Amps:** System amps value which can cause the battery temperature to rise above adequate charging temperature within 2-3 hours of charge time. To prevent battery damage, the charge amps should be reduced when battery temperature rises. Check battery manufacturer's recommendations for proper charge amp rates.
- **Battery Voltage:** Steady-state voltage value as measured with battery in open circuit with no battery load. This value relates to battery state of charge.
- **Charge Voltage:** Voltage value obtained when the charging system is operating. This value will be higher than battery voltage and must never exceed the regulator voltage setpoint.
- **B+ Voltage:** Voltage value obtained when measuring voltage at battery positive terminal or alternator B+ terminal.
- **Surface Charge:** Higher than normal battery voltage occurring when the battery is disconnected from battery charger. The surface charge must be removed to determine true battery voltage and state of charge.
- **Significant Magnetism:** Change in strength or intensity of a magnetic field present in alternator rotor shaft when the field coil is energized. The magnetic field strength when the field coil is energized should feel stronger than when the field is not energized.
- **Voltage Droop or Sag:** Normal condition occurring when the load demand on alternator is greater than rated alternator output at given rotor shaft RPM.

CEN N1609 Alternator Description and Operation

N1609 28 V (570 A) alternator is internally rectified. All windings and current-transmitting components are non-moving, so there are no brushes or slip rings to wear out. Energize switch activates regulator. Field coil is then energized.

After engine is running, **N3240**, **N3243** or **N3256** regulator furnished with some units receives energize signal. Regulator monitors alternator rotation and provides field current only when it detects alternator shaft rotating at suitable speed.

After regulator detects alternator rotation, it gradually applies field current, preventing an abrupt mechanical load on accessory drive system.

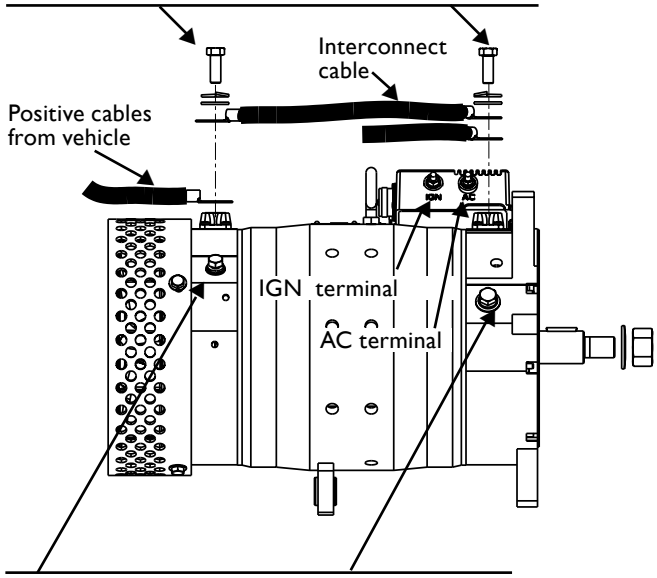
The soft start may take up to 10 seconds at full electrical load.

These regulators:

- are negative temperature compensated.
- maintain alternator output voltage at regulated settings as vehicle electrical loads are switched on and off.
- provide overvoltage cutout (OVCO).
- are equipped with remote battery temperature and voltage sensing circuits. If no external sensors are used, the regulator will regulator the alternator voltage based on the position of voltage select switch on the backside of the regulator. When sensors are used they will optimize the charging voltage, so the voltage select switch should be positioned according to the type and location of batteries.

N3243 regulator also provides limp home capability when regulator detects a problem in the alternator/ regulator. Restarting engine will reset regulator.

B+ connections on alternator
Both positive cables must be connected together at battery positive potential when alternator is installed in vehicle and during operation. Interconnect cable is not part of vehicle cabling.



B– connections on alternator
Both ground cables must be connected together at battery ground potential when alternator is installed in vehicle and during operation. Interconnect cable is not part of vehicle cabling.

Figure 1 — N1609 Alternator and Regulator Terminals

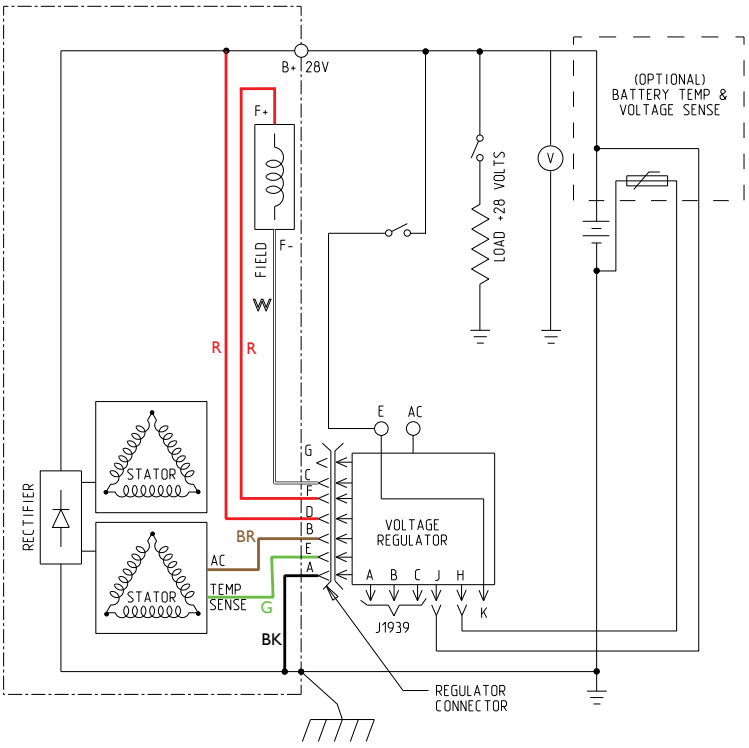


Figure 2 — N1609 Wiring Diagram

Tools and Equipment for Job

- Digital Multimeter (DMM)
- Ammeter (digital, inductive)
- Jumper wires

Identification Record

List the following for proper troubleshooting:

❑ Alternator model number _____

❑ Regulator model number _____

❑ Setpoint listed on regulator _____

Preliminary Check-out

Check symptoms in Table 3 and correct if necessary.

TABLE 1 – System Conditions

SYMPTOM	ACTION
Low Voltage Output	Check: loose drive belt; low battery state of charge. Check: current load on system is greater than alternator can produce. Check: defective wiring or poor ground path; low regulator setpoint. Check: defective alternator or regulator.
High Voltage Output	Check: wrong regulator. Check: high regulator setpoint. Check: defective regulator. Check: alternator.
No Output	Check: broken drive belt. Check: battery voltage at alternator output terminal. Check: defective alternator or regulator.

Basic Troubleshooting

1. **Inspect charging system components for damage**
   Check connections at B– cables, B+ cables, B+ interconnect cable, B– interconnect cable, and alternator-to-regulator harness. Repair or replace any damaged component before troubleshooting.
2. **Inspect all vehicle battery connections**
   Connections must be clean and tight.
3. **Determine battery voltage and state of charge**
   If batteries are discharged, recharge or replace batteries as necessary. Electrical system cannot be properly tested unless batteries are charged 95% or higher. In addition, open circuit voltages must be within ± 0.2 V.
4. **Connect meters to alternator**
   Connect red lead of DMM to alternator anti-drive end B+ terminal and black lead to alternator anti-drive end B– terminal. Clamp inductive ammeter on anti-drive end B+ cable.
5. **Operate vehicle**
   Observe charge voltage at batteries with engine running (nom. 27-28 V).

   CAUTION

   If charge voltage is above 32 V, immediately shut down system. Electrical system damage may occur if charging system is allowed to operate at excessive voltage. Go to Table 1.

   If voltage is at or below regulator setpoint, let charging system operate for several minutes to normalize operating temperature.
6. **Observe charge volts and amps**
   Charge voltage should increase and charge amps should decrease. If charge voltage does not increase within ten minutes, continue to next step.
7. **Batteries** are considered fully charged if charge voltage is at regulator setpoint and charge amps remain at lowest value for 10 minutes.
8. **If charging system** is not performing properly, go to Chart 1, page 4.

N3243 Regulator

DESCRIPTION AND OPERATION

N3243 regulator with OVCO is attached directly to the outside of alternator.

Main diagnostic feature of regulator consists of a green-lensed LED located on the side of the regulator. LED works like a voltmeter, measuring charging voltage. See Table 2 for diagnostic features and LED explanations.

Regulator will trip OVCO when system voltage rises above 31.5 V for longer than 2 seconds. OVCO feature detects high voltage and reacts by signaling relay in field circuit to open, turning off alternator. Restarting engine or waiting until system voltage drops to setpoint will reset OVCO circuit.

TABLE 2—N3243 Regulator LED Indications and Status

Indication	Status
GREEN ON steady	Normal regulator operation. Alternator is producing output.
GREEN FLASHING	OVCO activated
Off (Clear)	Regulator is not working/ energize signal is not present at IGN terminal.

N3240 and N3256 Regulator

DESCRIPTION AND OPERATION

N3240 and N3256 regulators with OVCO are attached directly to the outside of alternator.

Main diagnostic feature of the regulator is a bicolored LED next to the harness receptacle on regulator. LED works like a voltmeter, measuring charging voltage. See Tables 3 and 4 for diagnostic features and LED explanations.

Regulator will trip OVCO when system voltage rises above 31.5 V for longer than 2 seconds. OVCO feature detects high voltage and reacts by signaling relay in field circuit to open, turning off alternator. Restarting engine or waiting until system voltage drops to setpoint will reset OVCO circuit.

TABLE 3—N3240 Regulators LED Indications and Status

Indication	Status
GREEN ON steady	Normal regulator operation. Alternator is producing output.
GREEN FLASHING	Regulator waiting for alternator to begin rotation.
AMBER ON steady	System voltage is high.
AMBER FLASHING	OVCO activated.
Off (Clear)	Regulator is not working/ energize signal is not present at IGN terminal.

NOTE: N3240 regulator–if any other color appears or if unsure of the color, verify voltage at alternator.

Troubleshooting

Shut down vehicle and restart engine. If alternator functions normally after restart, a “no output condition” was normal response of voltage regulator to overvoltage condition. Inspect condition of electrical system, including loose battery cables, both positive and negative. If battery disconnects from system, it could cause overvoltage condition in electrical system, causing OVCO circuit to trip.

If you have reset alternator once, and electrical system returns to normal charge voltage condition, there may have been a one time, overvoltage spike that caused OVCO circuit to trip.

If OVCO circuit repeats cutout a second time in short succession and shuts off alternator field circuit, try third restart. If OVCO circuit repeats cutout a third time, check color of LED while engine is running and go to Chart 2, page 6.

TABLE 4—N3256 Regulators LED Indications and Status

Indication	Status
GREEN ON steady	Normal regulator operation. Alternator is producing output.
GREEN FLASHING	Regulator waiting for alternator to begin rotation.
AMBER ON steady	Voltage below setting and during 10 second ramp up.
AMBER FLASHING	Regulator has shut down due to overvoltage.
Off (Clear)	Regulator is not working/ energize signal is not present at IGN terminal.

Chart 1 – No Alternator Output – Test Charging Circuit

Shut down vehicle and restart engine or wait until system voltage drops below setpoint. Does alternator function normally after restart?

- Yes → Regulator responded to overvoltage condition. Go to Chart 2 on page 5 to troubleshoot OVCO.
- No →

Shut off engine. With key off, engine off: Test for battery voltage at alternator 28 V B+ terminal. Does battery voltage exist?

- Yes →
- No → Repair vehicle battery circuit wiring as necessary. Continue test.

With key on, engine running: Test for battery voltage between IGN terminal on regulator and alternator B– terminal. Does 28 V battery voltage exist?

- Yes →
- No → Repair vehicle ignition circuit wiring as necessary. Continue test.

With key off, engine off: Remove alternator-to-regulator harness from regulator. Test for battery voltage across sockets D and A in harness plug. Does 28 V battery voltage exist?

- Yes →
- No → Alternator is defective.

With DMM, check resistance across field coil. Connect red lead of DMM to socket C in alternator-to-regulator harness plug. Connect black lead to socket F in plug. Does meter show 1.5 ± 0.2 ohms?

- Yes →
- No → Alternator is defective.

Install a jumper wire from socket F in alternator-to-regulator harness plug to B+ terminal on alternator. Momentarily (1 sec.) jumper socket C to B– terminal on alternator. Spark will occur. Touch steel tool to shaft to detect significant magnetism. Is shaft magnetized?

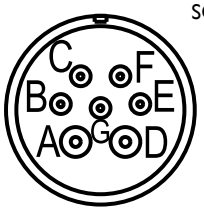
- Yes →
- No → Alternator is defective.

Test phase signal going into regulator (AC). Set meter to diode tester:

Connect red lead of DMM to socket A of alternator-to-regulator harness plug and black lead to socket B of plug. Meter should show voltage drop value.

Then reverse meter lead connections. Meter should show OL (blocking).

- Yes → Regulator is defective.
- No → Alternator is defective.



SOCKET CONNECTIONS

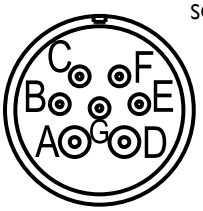
- A ➡ B–
- B ➡ AC
- C ➡ F–
- D ➡ B+
- E ➡ Alt Temp Sense
- F ➡ F+
- G ➡ Not used

Figure 3 – Alternator-to-Regulator Harness Plug

Chart 2 – No Alternator Output – Test OVCO Circuit

Unplug alternator-to-regulator harness from regulator. Connect red lead from DMM to socket C in plug. Connect black lead to socket F in plug. Does resistance read 1.5 ± 0.2 ohms?

- No → Alternator is defective.
- Yes → With red lead from DMM connected to socket C in plug, connect black lead to B– terminal. Does resistance read OL (out of limits)?
  - No → Alternator is defective.
  - Yes → Replace existing regulator with known good regulator. Run engine. Does OVCO trip?
    - Yes → Alternator is defective.
    - No → Original regulator is defective.



SOCKET CONNECTIONS

- A ➡ B–
- B ➡ AC
- C ➡ F–
- D ➡ B+
- E ➡ Alt Temp Sense
- F ➡ F+
- G ➡ Not used

Figure 4 – Alternator-to-Regulator Harness Plug

If you have questions about your alternator or any of these test procedures, or if you need to locate a Factory Authorized Service Dealer, please contact us at:

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