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Battery Charging Conditions

The following conditions may be observed during cold-start voltage tests until temperatures of electrical system components stabilize. The time it takes to reach optimum voltage and amps will vary with engine speed, load, and ambient temperature.

Maintenance/Low Maintenance Lead-Acid Battery:

Traditional lead acid batteries require lowest charge voltage of all vehicle battery chemistries. Battery cells must be maintained by periodically topping off with distilled water as required.

Maintenance-free Lead-Acid Battery:

Maintenance-free batteries are similar to Maintenance/Low Maintenance batteries, but may require slightly higher charge voltage.

Deep-cycle/Marine Maintenance-free Battery:

Charge acceptance of these batteries may display characteristics similar to maintenance-free batteries and may charge faster due to generally lower capacity relative to size.

AGM (Absorbed Glass Mat) Maintenance-free Battery:

These dry-cell batteries respond better than standard maintenance-free batteries. If battery state of charge (SOC) drops to 75% or less, batteries should be recharged to 95% or higher separately from engine 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, but may require higher charge voltage and will draw significant current (<100 amps) when under 50% SOC.

Lithium Battery:

Lithium batteries have unique charging characteristics that differ from lead acid. These batteries require charging systems configured specifically for lithium battery chemistries. Contact CEN for more information on lithium battery charging systems and components.

Testing Guidelines

Professional service technicians rely on the following guidelines when testing electrical components.

Voltage testing:

- Set meter to proper scale and type (AC or DC).
- Be sure to zero the meter scale or identify the meter burden by touching meter leads together. Meter burden must be subtracted from final reading obtained.
- Be sure the meter leads touch source area only. Prevent short circuit damage to test leads or source by not allowing meter leads to touch other pins or exposed wires in test area.
- Be sure to use CEN tools designed especially for troubleshooting CEN alternators when available.

Resistance (ohm) testing:

- Set meter to proper scale.
- Be sure to zero the meter scale or identify the meter burden by touching meter leads together. Meter burden must be subtracted from final reading obtained.
- Be sure meter leads touch source area only. Allowing fingers or body parts to touch meter leads or source during reading may alter reading.
- Be sure reading is taken when source is at 70°F. Readings taken at higher temperatures will increase the reading. Conversely, readings taken at lower temperatures will decrease the reading.
- Be sure to test directly at the source. Testing through extended harnesses or cable extensions may increase the reading.
- "OL" as referenced in this document refers to open circuit: "infinite" resistance, typically in very high kilo- or megaohm range depending on meter and settings.

Diode testing:

- Diodes allow current to flow in one direction only. Typical voltage drop in forward bias can range from 0.1-0.85V. Meter should read OL in reverse bias. Check meter user manual for meter-specific testing guidelines.

Voltage drop testing:

- Measure voltage between B+ on alternator or power source and B- (ground) on alternator or source. Record reading. Move to batteries or other power source and measure again between B+ and B- terminals on battery or other power source. The difference between the two readings represents voltage lost within circuit due to, but not limited to, inadequate cable gauge or faulty connections.
- Voltage drop measurements must be taken with all electrical loads or source operating.

Dynamic/Live testing (Connecting power and ground to component to test operation/function out of circuit):

- Connect jumper leads directly and securely to power source contacts of component being tested.
- Make any connection to power and ground at power supply or battery source terminals. Do not make connection at component source terminals, as that may create an arc and damage component source terminals.



CEN N1233-2 Alternator Description and Operation

N1233-2 28 V (260 A) alternator is self-rectifying. All windings and current-transmitting components are non-moving, so there are no brushes or slip rings to wear out.

When controlled by the N3140 regulator, this alternator becomes externally energized through the E terminal, connected to a switched power source to turn on regulator. See wiring diagram. N3140 regulator has:

- D+ terminal to provide signal to vehicle electrical system, confirming alternator operation.
- R terminal to provide an optional AC voltage tap.
- overvoltage cutout (OVCO). Regulators with OVCO (overvoltage cutout) will trip at vehicle electrical system voltages **above 33 volts** that exist longer than 3 seconds. OVCO feature detects high voltage and reacts by signaling relay in F+ alternator circuit to open. This turns off alternator. Restarting engine resets OVCO circuit. Regulator regains control of alternator output voltage.

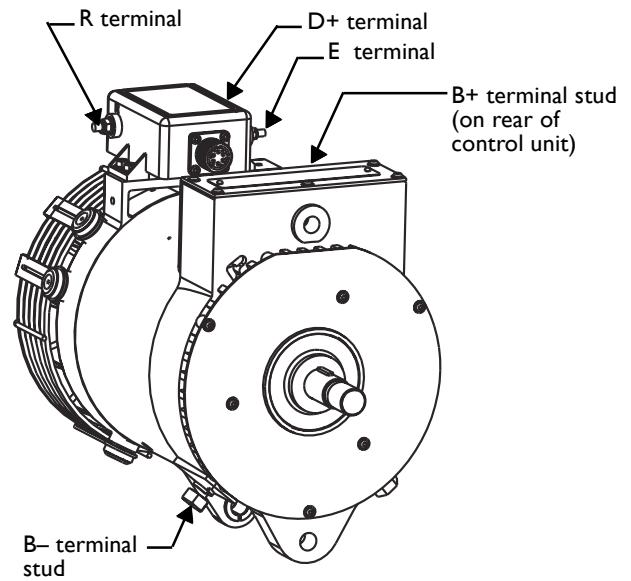


Figure 1 — N1233-2 Alternator Terminals (N3140 Regulator Attached to Alternator)

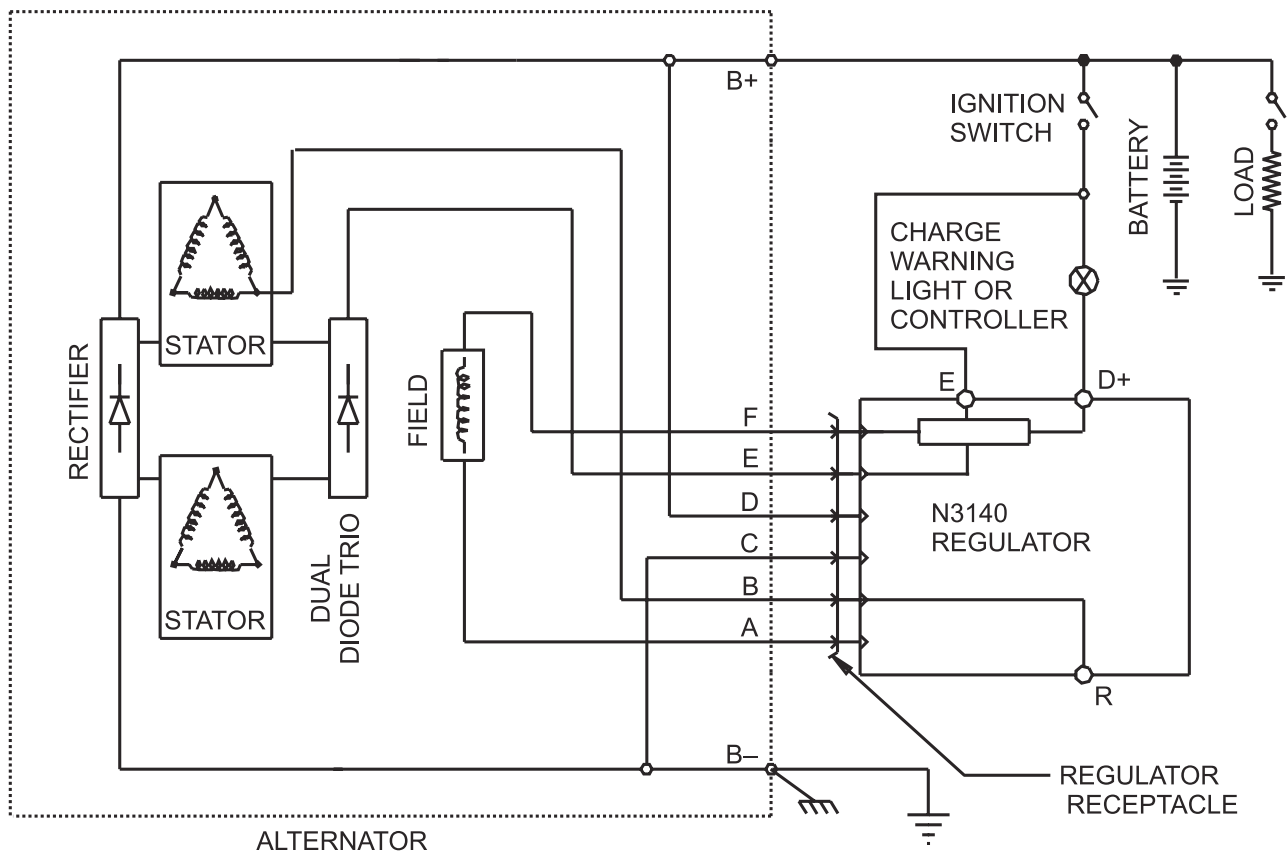


Figure 2 — N1233-2 Alternator with N3140 Regulator



A. Tools and Equipment for Job

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

B. Identification Record

List the following for proper troubleshooting:

- Alternator model number _____
- Regulator model number _____
- Setpoints listed on regulator _____

C. Preliminary Check-out

Check symptoms in Table 1 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 and/or regulator.
High Voltage Output	Check: wrong regulator. Check: high regulator setpoint. Check: defective regulator. Check: alternator.
No Voltage Output	Check: broken drive belt. Check: battery voltage at alternator output terminal. Check: defective alternator and/or regulator. Check: lost residual magnetism in self-energizing alternator. Go to Chart 1, page 4.

D. Basic Troubleshooting

1. Inspect charging system components for damage

Check connections at B- cable, B+ 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 B+ terminal and black lead to alternator B- terminal. Clamp inductive ammeter on B+ cable.

5. Operate vehicle

Observe charge voltage.

CAUTION

If charge voltage is above 33 volts, immediately shut down system. Electrical system damage may occur if charging system is allowed to operate at high voltage. Go to Table 1 at left.

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.

9. Check OVCO circuit

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

If OVCO circuit repeats cutout a second time in short succession and shuts off alternator F+ circuit, try third restart. If OVCO circuit repeats cutout, go to Chart 2, page 5.



Section 3: Advanced Troubleshooting (cont.)

Chart 2 – No Alternator Output – Test OVCO Circuit

With engine off, unplug alternator-to-regulator harness. Connect DMM red lead to pin A on harness plug. Connect black lead to pin F on same plug. Does resistance measure about 1.2 (\pm 0.2) ohms?

Yes

No

Connect DMM red lead to pin A on alternator-to-regulator harness plug. Connect black lead to alternator B- terminal. Does continuity exist?

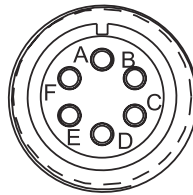
Yes

No

Regulator is defective.

Alternator is defective.

Alternator is defective.



PIN CONNECTIONS

Pin A	F-
Pin B	Phase
Pin C	B-
Pin D	B+
Pin E	D+
Pin F	F+

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 Distributor, please contact us at:

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