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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 Battery:**

- Immediately after engine starts, system volts are lower than regulator setpoint and amp output is medium.
- After alternator energizes, voltage will increase by several tenths. Amps increase gradually to medium-to-high levels.
- 3–5 minutes into charge cycle, system voltage increase and amps decrease.
- 5–10 minutes into charge cycle, system volts increase to or near regulator set point. Amps decrease to a minimum.
- Has same characteristics as maintenance battery, but has slightly longer recharge time.

**Maintenance-free 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.

**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 gage 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.

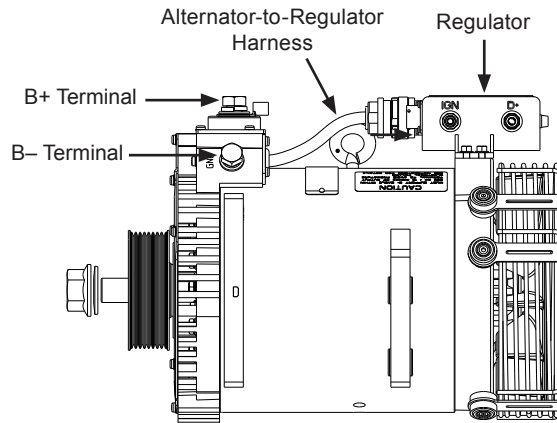


**C736 Alternator  
Description and Operation**

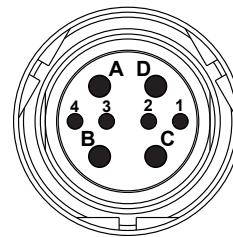
The GEN model C736 is a negative ground alternator rated at 28 volts, 370 amps. It is self-rectifying and brushless, so all windings and current-carrying components are stationary, and therefore are no brushes or slip rings to wear out.

Depending on voltage regulator model used, charging system is energized by self-excitation or when regulator IGN terminal receives an ignition/energize signal from the vehicle, usually via oil pressure switch or multiplex system (see page 3 for regulator features). The regulator monitors alternator shaft rotation and provides field current only when it detects the alternator shaft rotating at a suitable speed.

After the regulator detects shaft rotation, it gradually applies field current, preventing an abrupt mechanical load on accessory drive system. Soft start may take up to 20 seconds after rotation and energize signals are sensed.

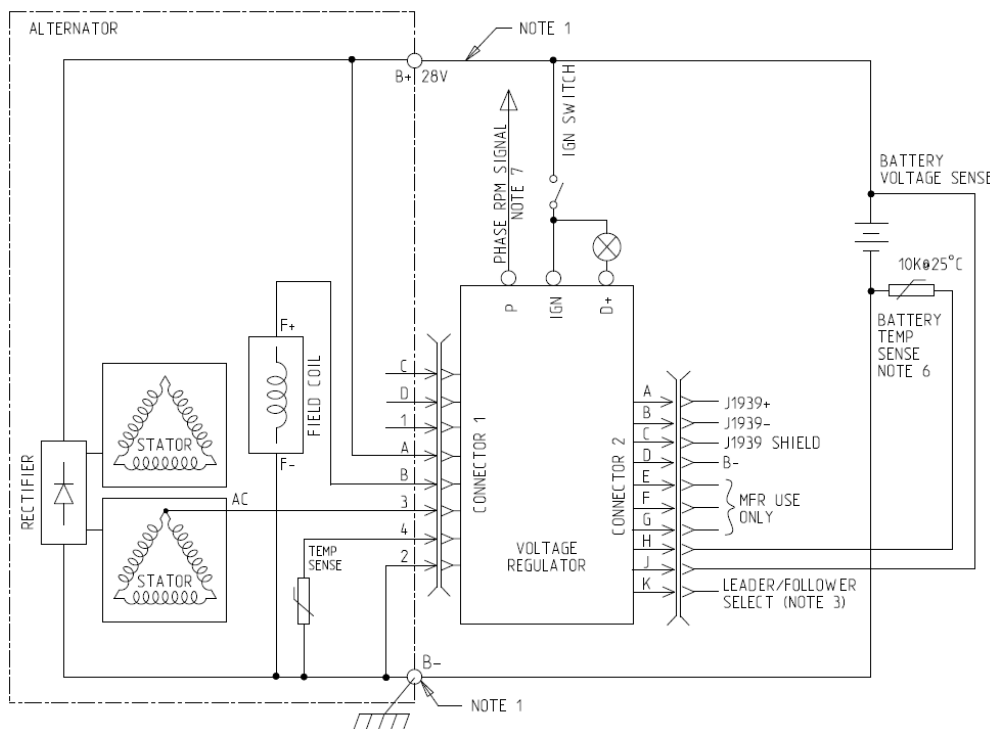


**Figure 1: C736 Alternator**



- Socket A = B+
- Socket B = F+
- Socket C = Not used
- Socket D = Not used
- Socket 1 = Not used
- Socket 2 = B-
- Socket 3 = Phase
- Socket 4 = Temp sense

**Figure 2: Alternator-to-Regulator Harness Plug Sockets**



**NOTES:**

1. Voltage drop at 370 amperes between alternator B+ terminal and battery B+ terminal shall not exceed 0.4 volts. Ground cable should follow the same rule.
2. Connections to terminals "P," "D+," "IGN" and to connector 2 are optional.
3. For leader regulator configuration, leave pin K on connector 2 unconnected. For follower regulator configuration, connect pin K to pin D

**Figure 3: C736 Alternator Wiring Diagram**



### Regulator Description and Operation

Smart regulators furnished with some units include:

- IGN terminal (required on some models, optional on others) on regulator is connected to vehicle ignition to provide battery voltage when engine is running. Circuit should be off (no voltage present) when vehicle ignition is off or engine is not running.
- P terminal that can provide optional AC voltage tap. P terminal signal frequency (Hz) x 10 = alternator shaft RPM.
- D+ terminal that can provide DC voltage signal to vehicle electrical system, confirming alternator operation.
- Overvoltage cutout (OVCO) circuit. See Table 2 below.
- Tri-colored status indicator LED. See page 4.
- J1939/temperature-voltage sense harness receptacle. When A9-4036 temperature/voltage sense harness is connected, regulator will automatically optimize the charge voltage for battery type, based on temperature. Charging system information can also be broadcast via J1939 through this connector.

**NOTICE** When optional temperature/voltage sense harness is not connected, regulator will operate in fixed voltage setting determined by select switch position on bottom of regulator. See Table 1.

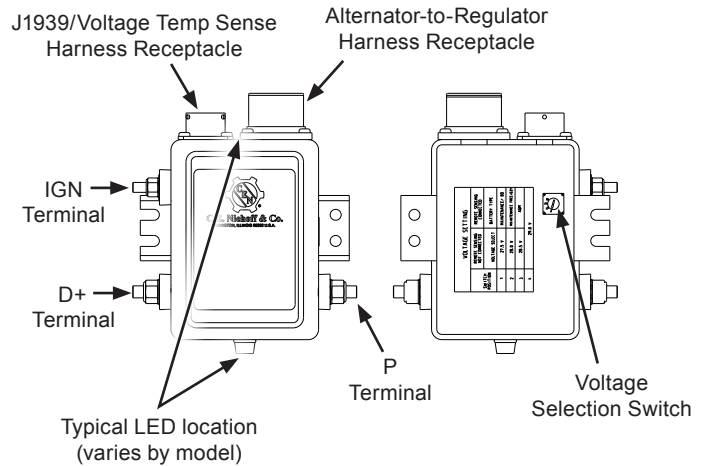


Figure 4: Regulator External Features

Setting	Remote Sensing Not Connected	Remote Sensing Connected
1	27.5 V	Maintenance (D Category)
2	28.0 V	Maintenance-free (Group 31)
3	28.5 V	AGM
4	29.0 V Flat	

LED COLOR	ALTERNATOR / REGULATOR STATUS	REQUIRED ACTION
GREEN (Solid)	Alternator and regulator operating normally.	No action required.
GREEN (Flashing)	Surge suppression circuit disabled; alternator still charging battery.	No action required.
AMBER (Solid)	Voltage is below 25.0 V	If voltage is at or below regulator setpoint, allow charging system to operate for several minutes to normalize operating temperature. If charge voltage does not increase within 10 minutes, perform troubleshooting procedures on page 5.
AMBER (Flashing)	No rotation detected.	Power down and restart alternator. If LED remains flashing amber, perform troubleshooting procedures on page 5.
RED (Solid)	Field coil out of specification	Power down and restart alternator. If LED remains solid red, perform troubleshooting procedures on page 5.
RED (Flashing)	OVCO condition detected.	Power down and restart alternator. If LED remains flashing red, refer to basic OVCO troubleshooting procedure on page 6.

NOTE: LED off = No power/output.



## Required Tools and Equipment

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

## Identification Record

Enter the following information in the spaces provided for identification records.

Alternator model number: \_\_\_\_\_

Regulator model number: \_\_\_\_\_

Voltage set points listed on regulator: \_\_\_\_\_

## Preliminary Check-out

Check symptoms in Table 3 below and correct if necessary.

CONDITION:	CHECK FOR:
<b>Low Voltage Output</b>	Low battery state of charge. Load on system exceeds rated output of alternator. Faulty wiring or poor ground path. Faulty alternator or regulator. Wrong pulley installed. Wrong regulator installed.
<b>High Voltage Output</b>	Faulty regulator. Faulty alternator.
<b>No Voltage Output</b>	No energize signal at IGN terminal on regulator. Faulty alternator B+ terminal connection. Faulty alternator or regulator.

## Basic Troubleshooting

1. Inspect charging system components for damage. Check connections at B– cable, B+ cable, and regulator harness. Check regulator terminal wiring from regulator to vehicle components. Repair or replace any damaged component before electrical troubleshooting.
2. Inspect vehicle battery connections. Connections must be clean and tight.
3. Inspect belt for wear and condition.

4. Determine battery type, voltage, and state of charge. Batteries must be all the same type. If batteries are discharged, recharge or replace batteries. Electrical system cannot be properly tested unless batteries are charged 95% or higher. See page 1 for details.
5. Connect meters to alternator:
6. Connect DMM red lead to alternator B+ terminal.
7. Connect DMM black lead to alternator B– terminal.
8. Clamp inductive ammeter onto alternator B+ cable.
9. Operate vehicle and observe charge voltage. Charge voltage should increase and charge amps should decrease. Battery is considered fully charged when charge voltage is at regulator set point and charge amps remain at lowest value for 10 minutes.
10. If voltage is at or below regulator set point, allow charging system to operate for several minutes to normalize operating temperature. If charge voltage does not increase within 10 minutes, go to Chart 1 on page 5.

**CAUTION** *If voltage exceeds 32 V, shut down system immediately. Damage to electrical system may occur if charging system is allowed to operate above 32 V for more than 3 seconds.*

## Check for OVCO Condition

1. Shut down vehicle and restart engine. If alternator functions normally after restart, a no output condition was normal response of voltage regulator to high voltage condition.
2. Inspect vehicle electrical system, including loose battery cables. If battery disconnects from system, it could cause high voltage condition in electrical system, causing OVCO circuit to trip.
3. 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.
4. If OVCO circuit repeats cutout a second time in short succession and shuts off alternator, follow troubleshooting procedures in chart 2 on page 6.

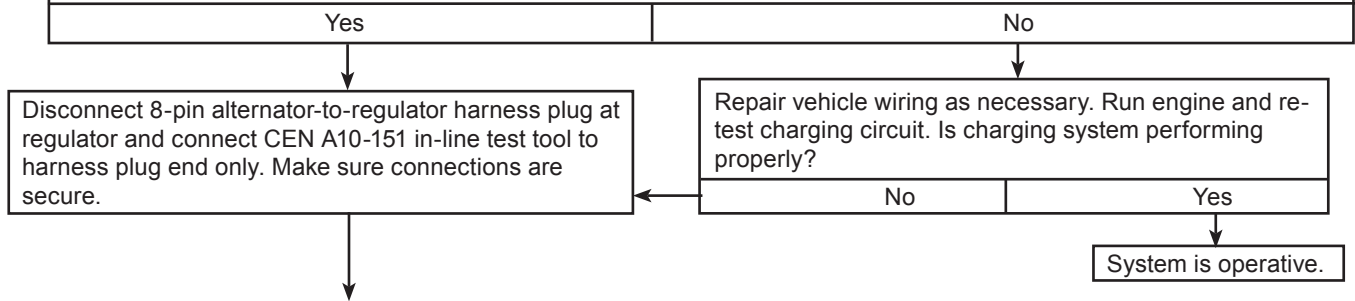


**Chart 1: No Alternator Output – Test Charging Circuit**

- TEST MEASUREMENTS ARE TAKEN ON HARNESS PLUG AT ALTERNATOR. TAKING MEASUREMENTS FROM AN EXTENDED HARNESS PLUG MAY AFFECT RESULTS.
- FOR REMOTE-MOUNTED REGULATOR, CHECK CONDITION OF HARNESS FUSES BEFORE TROUBLESHOOTING.
- BEFORE STARTING DIAGNOSTIC SEQUENCE, VERIFY THE FOLLOWING AND REPAIR/REPLACE IF NOT TO SPEC:
  - BATTERIES FOR STATE-OF-CHARGE (25.0-28.0 V), CONDITION, AND SECURE CONNECTIONS.
  - MASTER BATTERY SWITCH FOR FUNCTION.
  - J1939 INTERCONNECT HARNESS FOR FUNCTION IF USED IN PARALLEL-OPERATION SYSTEM.

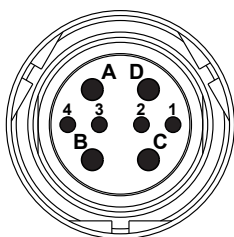
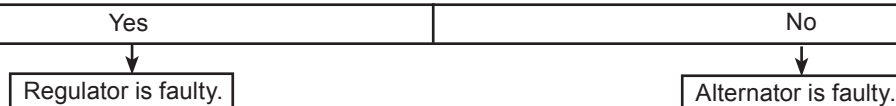
**CAUTION** MAKE SURE METER PROBES DO NOT TOUCH OTHER PINS AND CAUSE AN ARC THAT MAY DAMAGE PINS AND HARNESS WIRING.

**MASTER BATTERY SWITCH ON, KEY ON, ENGINE ON:** Test for battery voltage at B+ terminal on alternator to ground, then at IGN terminal (if required by regulator) on regulator to ground. Does battery voltage exist at both locations?



**MASTER BATTERY SWITCH ON, KEY OFF, ENGINE OFF:** Readings of all four tests must pass.

1. Battery voltage test: Connect DMM red lead to socket A in test tool. Connect DMM black lead to socket 2 in A10-151 in-line test tool. Battery voltage should exist.
2. Field coil resistance test: Set DMM to ohms test. Resistance between sockets B and 2 in test tool should measure nominal  $1.0-1.5 \pm 0.5$  ohms. Field coil is defective if reading is less than 0.5 ohms or greater than 3 ohms.
3. Phase signal test: Set DMM to diode test. Connect DMM black lead to socket 3 in test tool. Connect red lead to alternator B+ terminal. DMM should read OL in this direction. Reverse leads. DMM should read diode voltage drop in this direction. Repeat for socket 3 and alternator B- terminal. Tests should read diode voltage drop in one direction and OL in the other direction.
4. Temperature sensor test: Set DMM to Ohms test. Measure resistance between alternator B- terminal and socket 4. Resistance should read between 60k and 130k ohms at room temperature.



- Socket A = B+
- Socket B = F+
- Socket C = Not used
- Socket D = Not used
- Socket 1 = Not used
- Socket 2 = B-
- Socket 3 = Phase
- Socket 4 = Temp sense

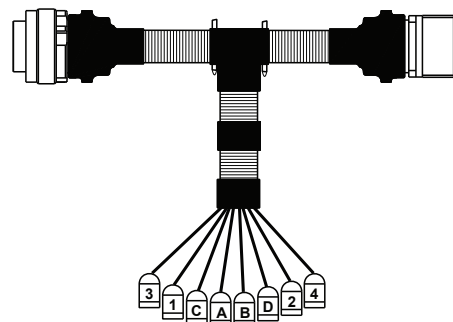
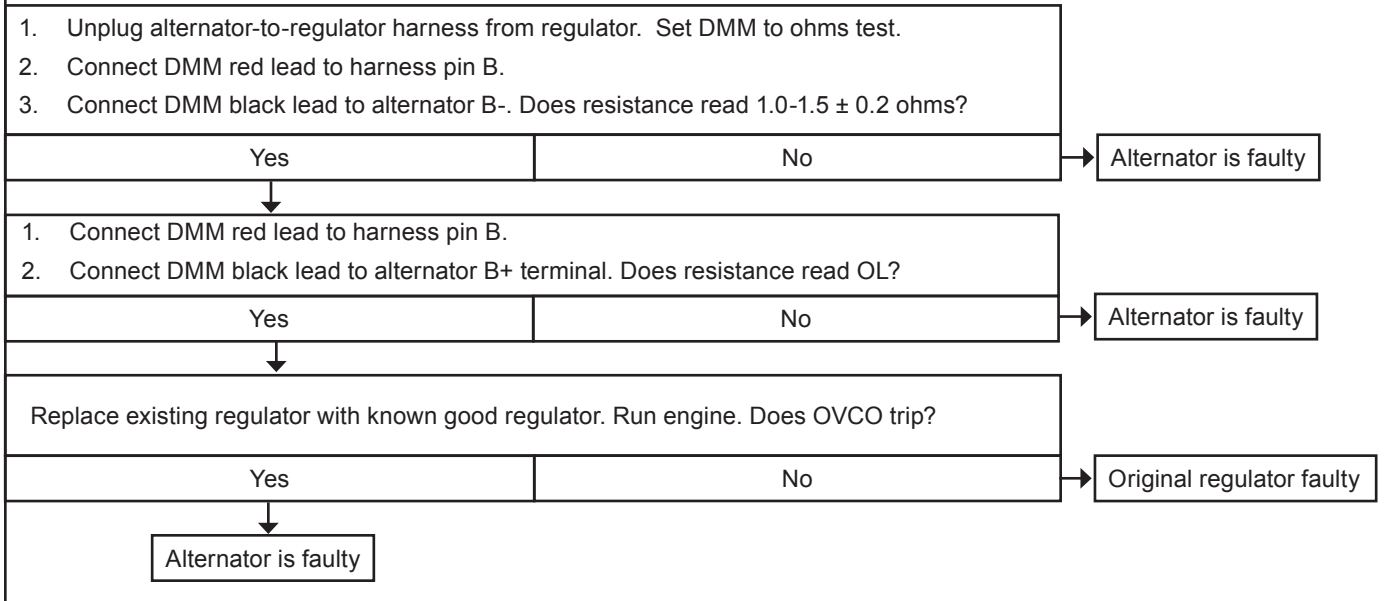


Figure 5: CEN 8-pin A10-151 In-line Harness Tool Socket Connections



## Chart 2: Test OVCO Circuit



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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