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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.



## N1301 Alternator Description and Operation

The N1301 alternator is a hinge mount, negative ground alternator rated at 28V, 220A. It is self-rectifying and brushless; all windings and current carrying components are stationary, so there are no brushes or slip rings to wear out. Output voltage can be adjusted to compensate for climate conditions. N1301 alternators are salt water resistant and suitable for marine applications.

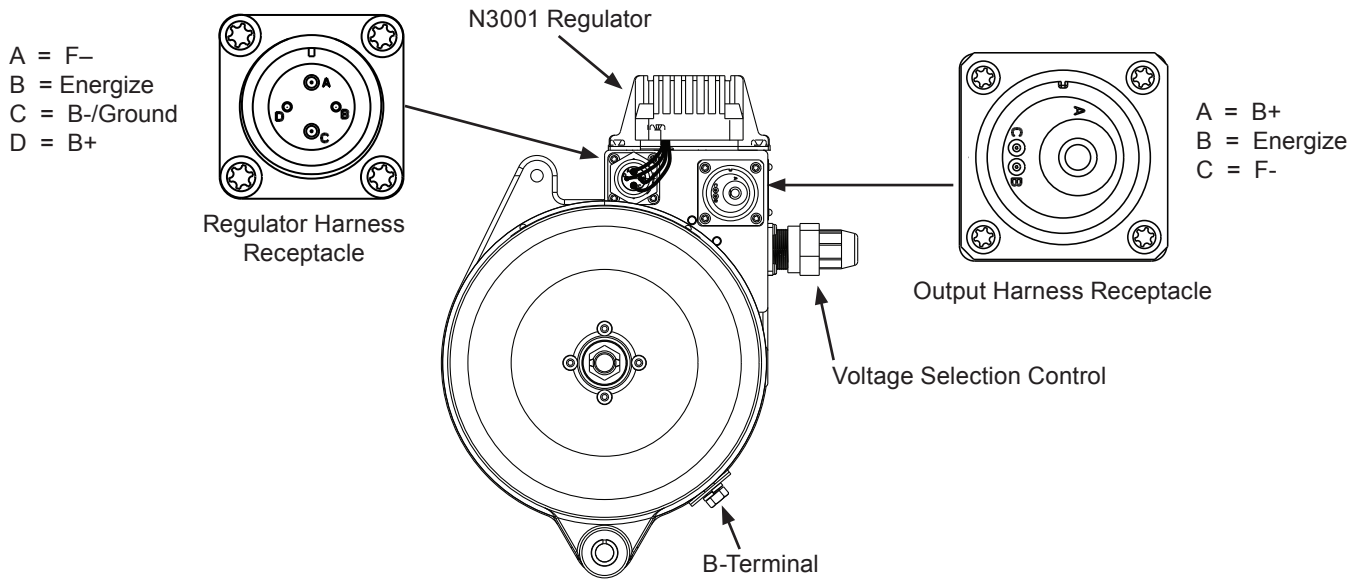


Figure 1: N1301 Alternator Connections

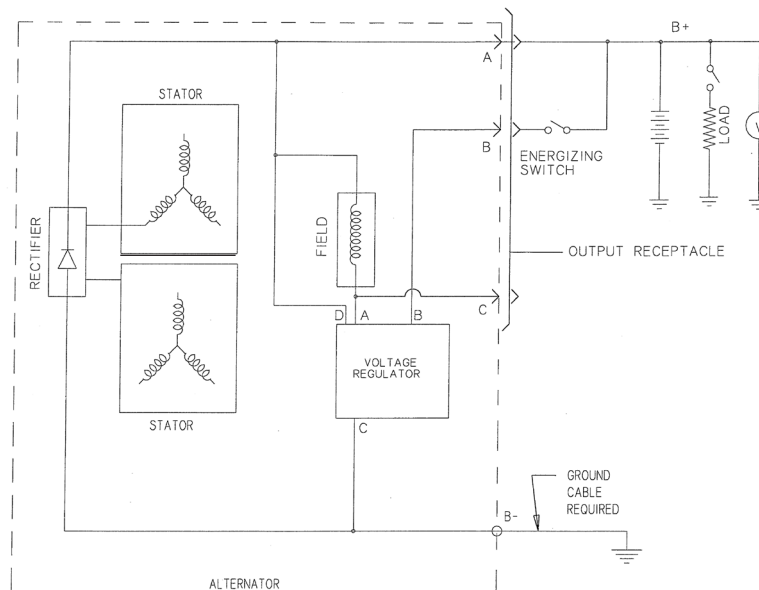


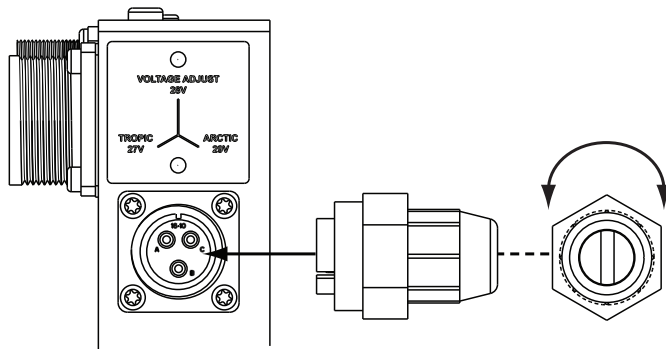
Figure 2: N1301 Alternator Wiring Diagram



### Voltage Setpoint Selection

Charging voltage can be adjusted to compensate for climate conditions as follows:

1. Twist voltage selection control adapter on alternator counterclockwise and remove from receptacle. See Figure 1 on page 2 for adapter location.
2. Re-install adapter so line on face of adapter points toward desired voltage printed on label above receptacle. Make sure adapter is locked in place. See Figure 3.



SWITCH POSITION	VOLTAGE SETPOINT
Factory Setting (25° C – 45° C)	27.7 V
TROPIC (>45° C)	27.0 V
ARCTIC (< 25° C)	29.1 V

Figure 3: Voltage Setpoint Selection Control

### Voltage Regulator

#### Description and Operation

The N3001 voltage regulator is a flat temperature compensating regulator that mounts directly on the alternator housing. The regulator adjusts charge voltage as necessary to maintain setpoint voltage, determined by setpoint voltage adapter on alternator. Factory setting is 27.7 V. Regulator is activated when it receives an ignition/energize signal from the vehicle, usually via oil pressure switch or multiplex system.

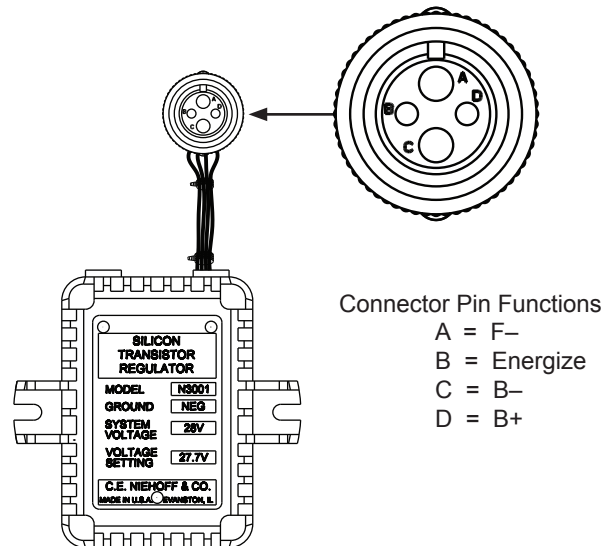


Figure 4: N3001 Voltage Regulator



## 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 setpoints listed on regulator: \_\_\_\_\_

## Preliminary Check-out

Check symptoms in Table 2 below and correct if necessary.

**NOTICE** *Failure to check for the conditions listed in Table 2 below will result in erroneous test results in the troubleshooting charts.*

CONDITION:	CHECK FOR:
<b>Low voltage output</b>	<ul style="list-style-type: none"> <li>• Loose drive belt.</li> <li>• Low battery state of charge.</li> <li>• Load on system exceeds rated output of alternator.</li> <li>• Low voltage setpoint.</li> <li>• Faulty wiring or poor ground path.</li> <li>• Faulty alternator or regulator.</li> <li>• Wrong regulator installed.</li> </ul>
<b>High voltage output</b>	<ul style="list-style-type: none"> <li>• High regulator setpoint.</li> <li>• Faulty regulator.</li> <li>• Faulty alternator.</li> </ul>
<b>No voltage output</b>	<ul style="list-style-type: none"> <li>• Broken drive belt.</li> <li>• Faulty alternator output terminal connection.</li> <li>• Faulty alternator or regulator.</li> </ul>

## 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. Check drive belt. Repair or replace belt as necessary.
4. Determine battery voltage and state of charge. If batteries are discharged, recharge or replace batteries. Electrical system cannot be properly tested unless batteries are charged 95% or higher.
5. Connect meters to alternator:
  - a. Connect DMM red lead to alternator B+ terminal on alternator output harness receptacle. Refer to Figure 1 on page 2 for terminal location.
  - b. Connect DMM black lead to alternator B– terminal. Refer to Figure 1 on page 2 for terminal location.
  - c. Clamp inductive ammeter onto B+ cable.
4. 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 setpoint voltage and charge amps remain at lowest value for 10 minutes.
  - a. If voltage is at or below setpoint, allow charging system to operate for several minutes to normalize operating temperature.
  - b. If charge voltage exceeds 32 volts, shut down system immediately.

**CAUTION** *Damage to electrical system may occur if charging system is allowed to operate above 32V for more than 3 seconds.*

3. If charge voltage does not increase within 10 minutes, go to Chart 1 on page 5.

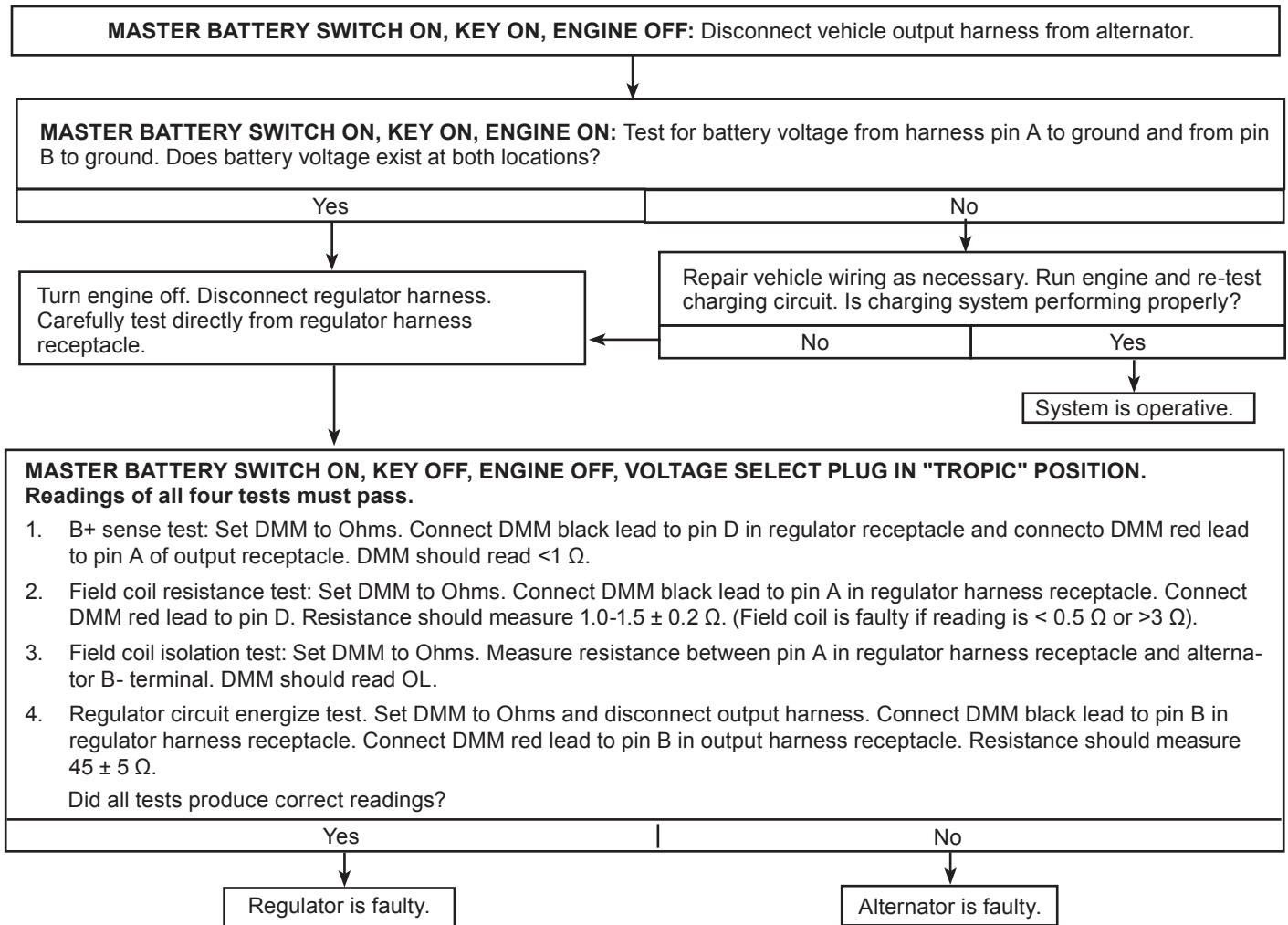


## Section C: Advanced Troubleshooting

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

- TEST MEASUREMENTS ARE TAKEN FROM CONNECTORS 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.

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



A = F-  
B = Energize  
C = B-/Ground  
D = B+

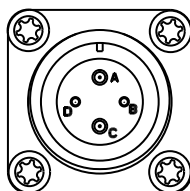


Figure 5: Regulator Harness Receptacle Pins

A = B+  
B = Energize  
C = F-

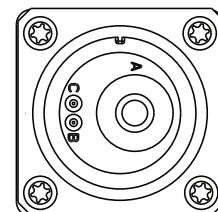


Figure 6: Output Harness Receptacle Pins



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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