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 Drop or Sag**: Normal condition occurring when the load demand on alternator is greater than rated alternator output at given rotor shaft RPM.

---

**Battery Conditions**

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 ampere 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.
CEN C612/C617/C624 Alternators
Description and Operation
C612/C617/C624 28 V (240 A) alternators are self-rectifying and self-energized. All windings and current-transmitting components are non-moving, so there are no brushes or slip rings to wear out.

When controlled by the A2-141 regulator, these alternators become self-energizing through internal diode trios. Residual magnetic field induces small voltage in stator and energizes field coil. Field coil continues receiving incremental voltage until full voltage is achieved. AC is rectified into DC output through diodes. Regulator controls voltage output. Regulator has:
- D+ terminal to provide a signal to vehicle electrical system, confirming alternator operation
- P terminal to provide an optional AC voltage tap.

Figure 1 — C612/C617 Alternator Terminals
Figure 2 — C624 Alternator Terminals
Figure 3 — C612/C617/C624 Alternator Wiring Diagram
CEN C621 Alternator
Description and Operation

C621 28 V (220 A) alternators are self-rectifying and self-energized. All windings and current-transmitting components are non-moving, so there are no brushes or slip rings to wear out.

When controlled by the A2-141 regulator, these alternators become self-energizing through internal diode trios. Residual magnetic field induces small voltage in stator and energizes field coil. Field coil continues receiving incremental voltage until full voltage is achieved. AC is rectified into DC output through diodes. Regulator controls voltage output. Regulator has:

- D+ terminal to provide a signal to vehicle electrical system, confirming alternator operation
- P terminal to provide an optional AC voltage tap.

Figure 4 — C621 Alternator Terminals

Figure 5 — C621 Alternator Wiring Diagram
Section B: Basic Troubleshooting

Tools and Equipment for Job
- Digital Multimeter (DMM)
- Ammeter (digital, inductive)
- Jumper wires
- CEN Regulator Bypass Adapter A10-129

Identification Record
List the following for proper troubleshooting:
- Alternator model number _________________________
- Regulator model number ________________________
- Setpoints listed on regulator ______________________

Preliminary Check-out
Check symptoms in Table 1 and correct if necessary.

<table>
<thead>
<tr>
<th>TABLE 1 – System Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYMPTOM</td>
</tr>
<tr>
<td>Low Voltage Output</td>
</tr>
</tbody>
</table>

Notice
Failure to check for the following conditions will result in erroneous test results in the troubleshooting charts.

Basic Troubleshooting
1. **Inspect charging system components for damage**
   Check connections at B– cable, B+ cable, and regulator harness. Also check connections at 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 as necessary.

4. **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.

5. **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.

6. **Operate vehicle**
   Observe charge voltage. If charge voltage is above 32 volts, immediately shut down system. Electrical system damage may occur if charging system is allowed to operate at high voltage. Go to Table 1. If voltage is at or below regulator setpoint, let charging system operate for several minutes to normalize operating temperature.

7. **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.

8. **Battery**
   is considered fully charged if charge voltage is at regulator setpoint and charge amps remain at lowest value for 10 minutes.

9. **If charging system**
   is not performing properly, go to Chart 1, page 5.
### Chart 1 – No Output

<table>
<thead>
<tr>
<th>Self-energized alternator may have lost magnetism. Touch steel tool to shaft to detect any magnetism. Is shaft magnetized?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Momentarily (1 sec.) jumper D+ terminal on regulator to B+ terminal on alternator. Touch shaft with steel tool to detect significant magnetism. Is shaft magnetized?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unplug alternator-to-regulator harness. Connect DMM across socket A and socket E in harness plug. Does battery voltage exist?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set DMM to diode test. Connect black lead of DMM to socket B in harness plug. Connect red lead to B+ terminal on alternator. DMM should read OL. Reverse leads. DMM should also read OL.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set DMM to Diode Test. Connect DMM red lead to socket D on alternator-to-regulator harness plug. Connect black lead to alternator B+ terminal. Does continuity exist?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Regulator is defective.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Install a jumper from B+ terminal on alternator to socket B in harness plug. Momentarily (1 sec.) jumper socket C to B– terminal on alternator. Touch shaft with steel tool to detect significant magnetism. Is shaft magnetized?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternator is defective.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Regulator is defective.</th>
</tr>
</thead>
</table>

---

**Figure 6 – 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:

C. E. Niehoff & Co. • 2021 Lee Street • Evanston, IL 60202 USA
TEL: 800.643.4633 USA and Canada • TEL: 847.866.6030 outside USA and Canada • FAX: 847.492.1242
E-mail us at service@CENiehoff.com