Hazard Definitions

These terms are used to bring attention to presence of hazards of various risk levels or to important information concerning product life.

CAUTION — Indicates presence of hazards 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 C510 Alternator Description and Operation

C510 14 V (280 A) 3-phase brushless alternator uses an externally mounted rectifier and regulator. All windings and current-transmitting components are non-moving, so there are no brushes or slip rings to wear out. This unit is externally energized through an energize switch, which activates regulator. Field coil is then energized. Regulator maintains alternator output voltage at regulated setting as vehicle electrical loads are switched on and off. Alternator output current is self-limiting and will not exceed rated capacity of alternator.

A2-136 external regulator furnished with all units has R terminal for optional AC voltage tap. Optional 15.5 V regulator setpoint is available for battery isolator applications.

A8-201 or **A8-205** external rectifier allows for mounting in engine compartment. A8-205 rectifier suppresses electromagnetic interference (EMI) with internal filters to acceptable levels defined by the Society of Automotive Engineers (SAE) specification J1113/41. A8-205 rectifier will not reduce EMI from sources such as antennas, poor cable routing practice, or other electronic devices that cause EMI. If EMI continues, consult an electromagnetic compliance (EMC) specialist to determine EMI source.

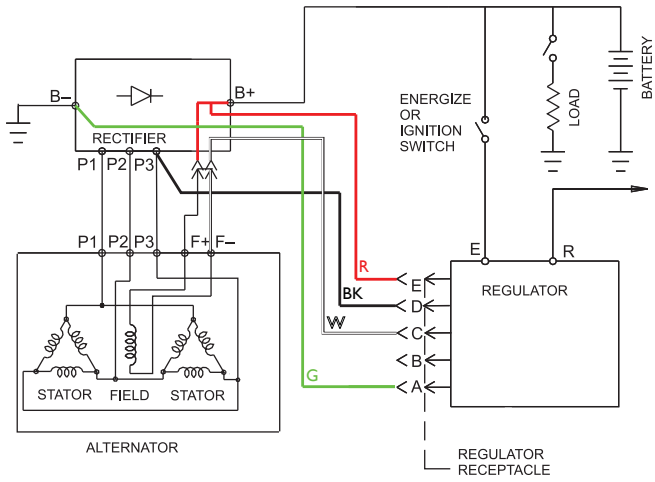

Figure 1 — C510 Wiring Diagram

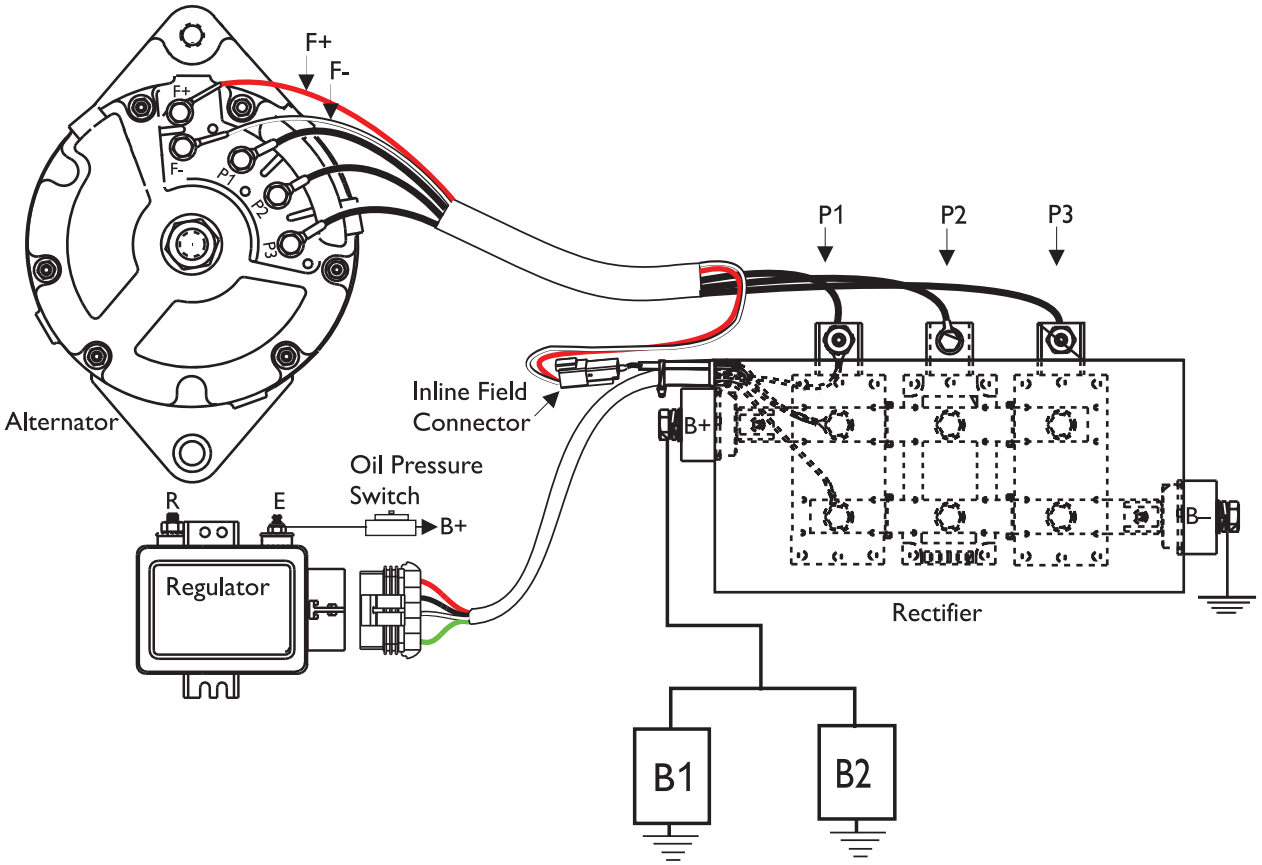

Figure 2 — C510 Terminal Locations

CEN C540 Alternator Description and Operation

C540 14 V (300 A) 3-phase brushless alternator uses an externally mounted rectifier and regulator. All windings and current-transmitting components are non-moving, so there are no brushes or slip rings to wear out. This units is externally energized through an energize switch, which activates regulator. Field coil is then energized. Regulator maintains alternator output voltage at regulated setting as vehicle electrical loads are switched on and off. Alternator output current is self-limiting and will not exceed rated capacity of alternator.

A2-136 external regulator furnished with all units has R terminal for optional AC voltage tap. Optional 15.5 V regulator setpoint is available for battery isolator applications.

A8-205 external rectifier allows for mounting in engine compartment. A8-205 rectifier suppresses electromagnetic interference (EMI) with internal filters to acceptable levels defined by the Society of Automotive Engineers (SAE) specification J1113/41. A8-205 rectifier will not reduce EMI from sources such as antennas, poor cable routing practice, or other electronic devices that cause EMI. If EMI continues, consult an electromagnetic compliance (EMC) specialist to determine EMI source.

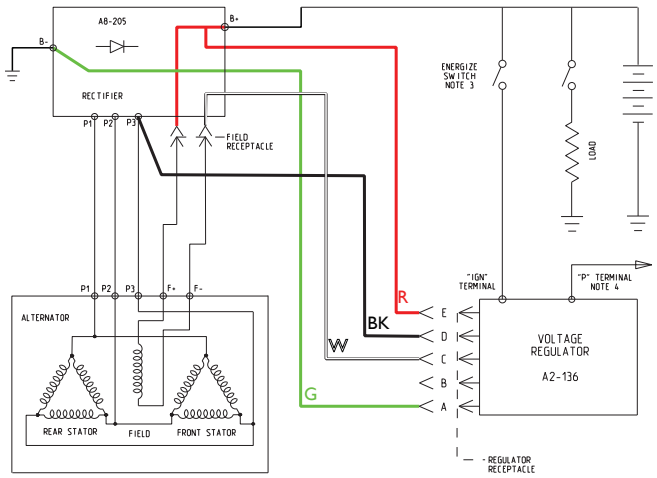

Figure 3 — C540 Wiring Diagram

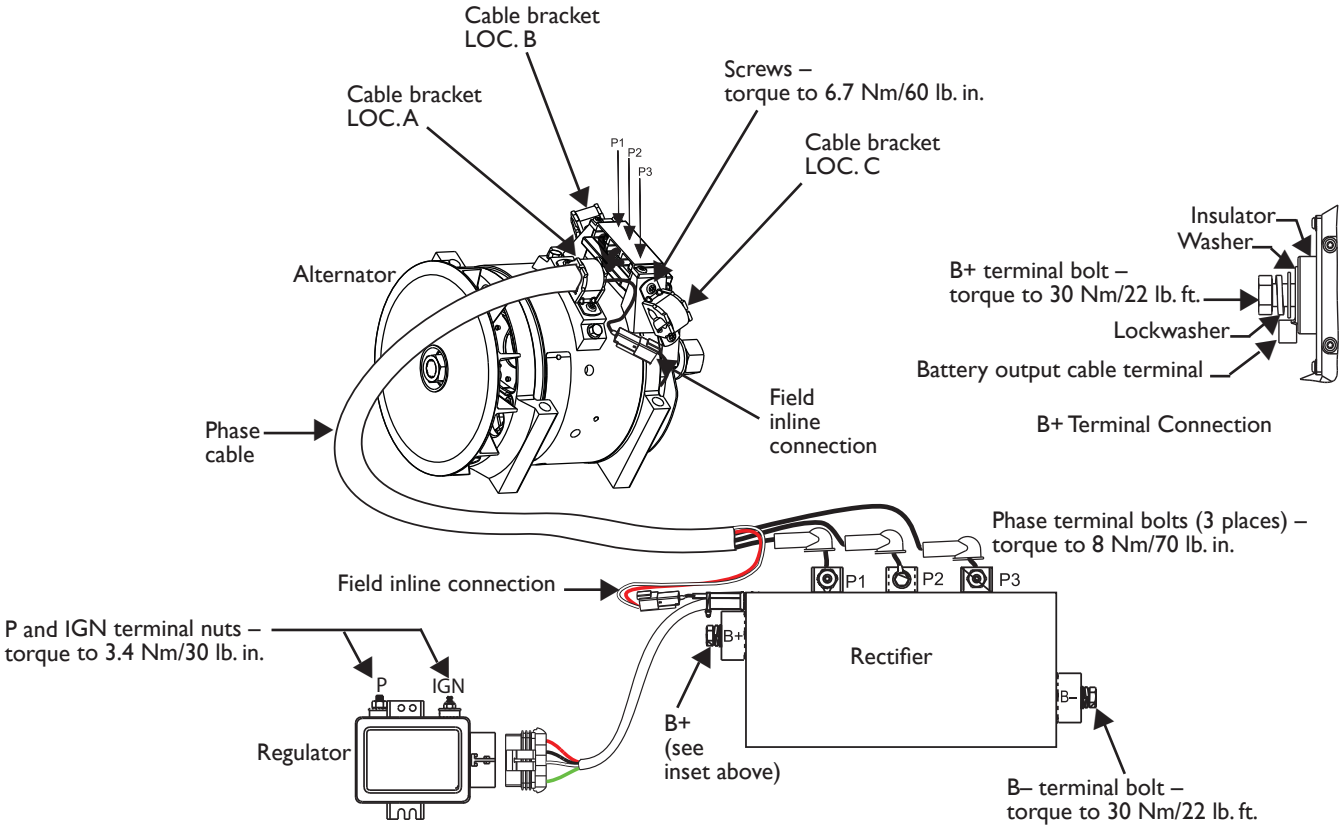

Figure 4 — C540 Terminal Locations

Tools and Equipment for Job

- Digital Multimeter (DMM)
- Ammeter (digital, inductive
- CEN Regulator Bypass Adapter A10-129
- Jumper wire

Identification Record

❒ Alternator model number_____

❒ Rectifier model number _____

❒ Regulator model number _____

❒ Setpoints listed on regulator _____

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, rectifier, or regulator. Check: loss of phase winding. See Chart 1, page 5.
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, rectifier, and/or regulator.

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, rectifier harness, 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. **Determine if battery isolator is used in charging circuit**
   Check vehicle wiring diagram. If so, the isolator must be jumpered out before troubleshooting. See Chart 1 on page 5 for details.
6. **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.
7. **Operate vehicle**
   Observe charge voltage.

   CAUTION If charge voltage is above 16.5 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.
8. **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.
9. **Battery** is considered fully charged if charge voltage is at regulator setpoint and charge amps remain at lowest value for 10 minutes.
10. **If charging system** is not performing properly, go to Chart 1 on page 5.

START HERE

Chart 1 – System Circuit

Is there a battery isolator in the system?

- **Yes** → Install temporary jumper between one battery terminal and alternator terminal on isolator. Use minimum 12 AWG wire.

  CAUTION Do not operate charging system more than two minutes with jumper installed. Charging system voltage will be abnormally high and damage other components.

- **No**

For "low voltage output" condition: go to Chart 2 below.

For "no voltage output" condition: go to Chart 3, page 7.

Chart 2 – Low Voltage Output – Alternator Not Keeping Up with Load

Operate engine at idle, battery as sole load, no other loads applied. Measure charge voltage at battery posts (B+ to B-) and output voltage at rectifier B+ and B– terminals. Measure charge amps entering battery and charge amps out of alternator at rectifier B+ terminal.
Is difference in voltages greater than 0.2 V and amp difference less than 20 A?

- **Yes** → Inspect harnesses and connections for corrosion. Repair/replace as necessary. Repeat test. Voltage value should be less than 0.1 V.
- **No**

Increase engine speed to 1200 rpm, battery as sole load, no other loads applied, meters attached as in box above. Increase load to 75, 150 and 280 A.
Does voltage remain steady?

- **Yes** → Re-test charging system.
- **No**

Measure AC voltage from terminals: P1 to P2, P2 to P3, and P3 to P1 on rectifier.
Are voltages within 5% of each other?

- **Yes** → Re-test charging system.
- **No** → Start test at top of page 6.

Chart 2 – Low Voltage Output – Alternator Not Keeping Up with Load (cont'd)

RECTIFIER TEST

The following will test modules inside rectifier:

1. Disconnect all battery cables.
2. Disconnect harness leads to rectifier terminals P1, P2 and P3.
3. Disconnect B+ and B– cables from rectifier.
4. Unplug rectifier-to-regulator harness.
5. Unplug alternator field circuit harness connector.
6. Use DMM set to diode tester. Meter readings should not vary more than 10%, test to test.
7. If expected reading is not obtained, diode inside module is most likely defective. Diode modules are individually replaceable. Consult CEN authorized service distributor for more information.
8. If tests indicate rectifier is good, alternator is defective. Consult CEN authorized service distributor for more information.

TABLE 2 – Diode Test

Positive (Red) Meter Lead on	Negative (Black) Meter Lead on	Correct Result on Meter	What You Are Measuring
P1, P2, P3 terminals on rectifier, one at a time.	B+ terminal on rectifier.	Uniform voltage drop across each positive diode.	Positive side diode is conducting.
B+ terminal on rectifier.	P1, P2, P3 terminals on rectifier, one at a time.	DMM will read OL (out of limits).	Positive side diode is blocking.
P1, P2, P3 terminals on rectifier, one at a time.	B– terminal on rectifier.	DMM will read OL (out of limits).	Negative side diode is blocking.
B– terminal on rectifier.	P1, P2, P3 terminals on rectifier, one at a time.	Uniform voltage drop across each negative diode.	Negative side diode is conducting.

Chart 3 – No Alternator Output – Test Charging Circuit

STATIC TEST – ENGINE OFF, BATTERY SWITCH ON, KEY ON

Test for battery voltage at B+ terminal on rectifier. Does battery voltage exist?

- No → Repair vehicle wiring as necessary. Continue test.
- Yes → With engine running: Does battery voltage exist at rectifier B+ terminal and regulator E or IGN terminal?
  - Yes → Test for charge voltage at B+ terminal on rectifier. Does charge voltage exist?
    - Yes → Vehicle charging circuit test is complete. Run engine and re-test charging circuit for operation.
    - No → Shut off engine.
  - No → Jumper B+ terminal on rectifier to E or IGN terminal on regulator.
    - Test for charge voltage at B+ terminal on rectifier. Does charge voltage exist?
      - Yes → Repair vehicle ignition circuit.
      - No → Shut off engine.

Shut off engine.

Unplug rectifier-to-regulator harness. Plug CEN Regulator Bypass Adapter A10-129 into harness plug and momentarily (1 second) touch black lead to ground on alternator case. (If no Adapter is available, connect jumper wire from pin C on the harness to ground). Spark will occur at ground. Touch steel tool to shaft to detect significant magnetism. Is shaft magnetized?

- Yes → Disconnect Regulator Bypass Adapter or jumper wire. Connect DMM red lead to socket E in rectifier-to-regulator plug. Connect black lead to socket A in same plug. Does battery voltage exist?
  - Yes → Regulator is defective.
  - No → Rectifier is defective.
- No → Unplug inline field connector. Check resistance across two sockets on alternator side of connector. Does resistance measure 0.9 to 1.1 ohms?
  - Yes → Disconnect Regulator Bypass Adapter or jumper wire. Connect DMM red lead to socket E in rectifier-to-regulator plug. Connect black lead to socket A in same plug. Does battery voltage exist?
    - Yes → Regulator is defective.
    - No → Rectifier is defective.
  - No → Check resistance across F+ and F– terminals on alternator. Does resistance measure 0.9 to 1.1 ohms?
    - Yes → Wiring harness is defective.
    - No → Alternator is defective.

SOCKET CONNECTIONS

Socket A	B–
Socket B	Not Used
Socket C	Field –
Socket D	Phase AC
Socket E	B+

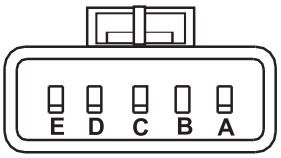

Figure 3 – Rectifier-to-Regulator Harness Plug

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*