700 Series Troubleshooting Guide for C715 and C716 Alternators

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 if ignored.

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 with medium amps.
  - — 3-5 minutes into charge cycle, higher system volts and reduced amps.
  - — 5-10 minutes into charge cycle, system volts are at, or nearly at, regulator setpoint, and amps are reduced to a minimum.
  - — Low maintenance battery has same characteristics with slightly longer recharge times.
- Maintenance-free battery:
  - — Immediately after engine start, system volts are lower than regulator setpoint with low amps.
  - — 15-30 minutes into charge cycle, still low volts and low amps.
  - — 15-30 minutes into charge cycle, volts increase several tenths. Amps increase gradually, then quickly to medium to high amps.
  - — 20-35 minutes into charge cycle, volts increase to setpoint and amps decrease.
- 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.

Charge Volt and Amp Values

The volt and amp levels are a function of the battery-state of charge. If batteries are in a state of discharge, as after extended cranking time to start the engine, the system volts, when measured after the engine is started will be lower than the regulator set point and the system amps will be high. This is a normal condition for the charging system. The measured values of system volts and amps will depend on the level of battery discharge, in other words, the greater the battery discharge level the lower the system volts and higher the system amps will be. The volt and amp readings will change and system volts reading will increase up to regulator set point and the system amps will decrease to low level (depending on other loads) as the batteries recover and become fully charged.

- **Low Amps:** A 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:** A system amps value which can cause the battery temperature to rise above the 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 amps rates.
- **High Amps:** A system amps value which can cause the battery temperature to rise above adequate charging temperature within 2-3 hours. To prevent battery damage the charge amps should be reduced when the 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:** A voltage value obtained when the charging system is operating. This value will be higher than battery voltage and must never exceed the regulator voltage set point.
- **B+ Voltage:** A voltage value obtained when measuring voltage at battery positive terminal or alternator B+ terminal.
- **Surface Charge:** A higher than normal battery voltage occurring when the battery is removed from a battery charger. The surface charge must be removed to determine true battery voltage and state of charge.
- **Significant Magnetism:** A change in the strength or intensity of a magnetic field present in the 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:** A normal condition which occurs when the load demand on the alternator is greater than rated alternator output at given rotor shaft RPM.

CEN C715 and C716 Alternators

Description and Operation

The **C715** alternator (14 V, 360 A) and **C716** alternator (14 V, 400 A) are internally rectified. 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 either an ignition switch or an energize switch (commonly an oil pressure 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.

A2-128 regulator used with all units has R terminal for optional AC voltage tap. A 15.5 V regulator set-point is available for battery isolator applications.

Electromagnetic interference (EMI) is suppressed with internal filters to acceptable levels defined by the Society of Automotive Engineers (SAE) specification J1113/41. A2-128 regulator 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.

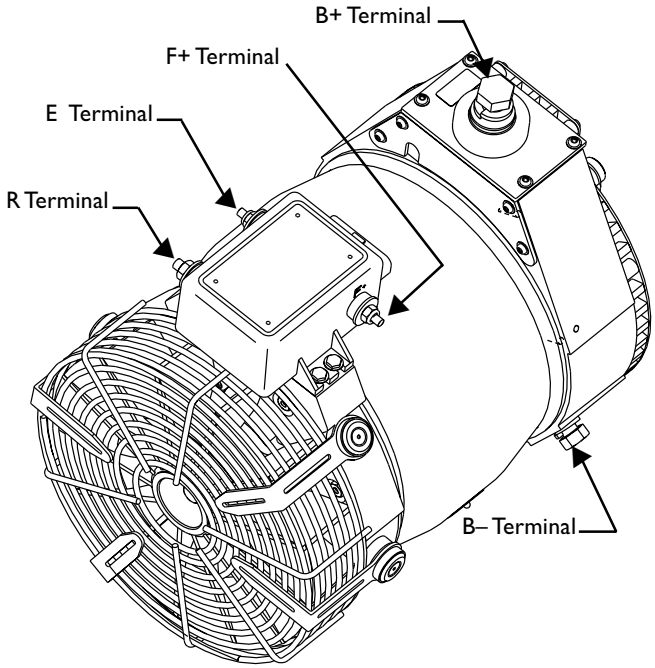

Figure 1 — C715/C716 Alternator with A2-128 Regulator

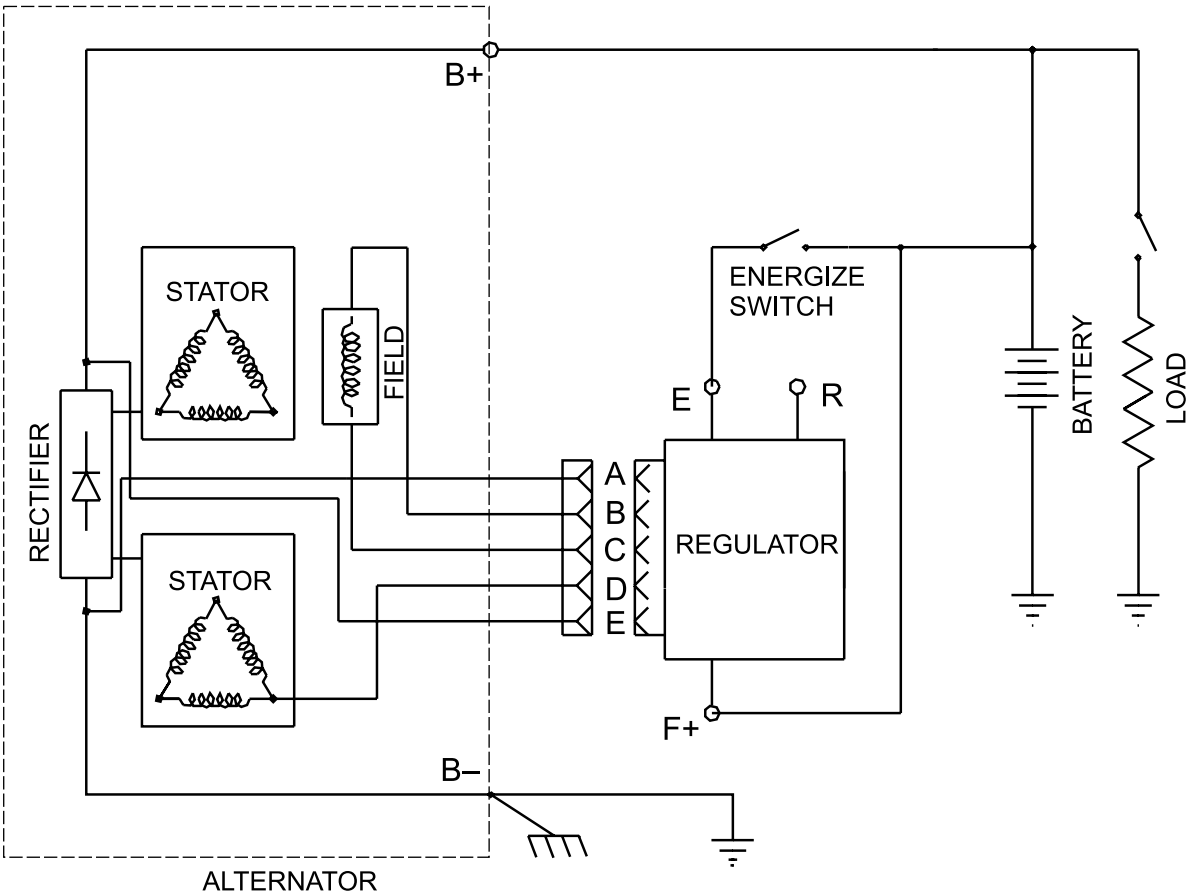

Figure 2 — C715/C716 Wiring Diagram

A. Tools and Equipment for Job

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

B. Identification Record

Complete the following for proper troubleshooting:

❑ Alternator model number _____

❑ Regulator model number _____

❑ Setpoints listed on regulator _____

C. Preliminary Check-out

Check condition of items 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.

D. Basic Troubleshooting

1. **Inspect charging system components for damage**
   Check connections at B– cable, B+ cable, and regulator harness. Repair or replace any damaged component before troubleshooting.

2. **Inspect 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.

4. **Determine if battery isolator is used in charging circuit**
   Check vehicle wiring diagram. If so, you must jumper out isolator before troubleshooting. See Chart 1 on page 4 for details.

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.

   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 at left.

   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 4.

START HERE Chart 1 – System Circuit

Is there a battery isolator in the system?

Yes	No

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.

For "no voltage output" condition:
- with **energize switch**, go to Chart 2, page 5.
- with **ignition switch**, go to Chart 3, page 6.

Chart 2 – No Alternator Output – **Energize Switch** – Test Charging Circuit

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

Test for battery voltage at B+ terminal on alternator to ground, then at F+ terminal on regulator to ground. Does battery voltage exist?

- No → Repair vehicle wiring as necessary. Continue test.
- Yes → Jumper B+ terminal on alternator to E terminal on regulator. Touch shaft with steel tool to detect significant magnetism. Is shaft magnetized?
  - No → Unplug alternator-to-regulator harness. Plug CEN Regulator Bypass Adapter A10-129 into harness plug. Make sure black lead does not touch ground. Clip red lead to B+ terminal on alternator. (If Adapter is not available, connect jumper wire from socket B on harness to alternator B+ terminal.) Does spark occur at alternator B+ terminal?
    - Yes → Disconnect Adapter or jumper wire. Alternator is defective.
    - No → Touch black lead to ground on alternator case. (If Adapter is not available, connect jumper wire from socket C on harness to ground.) Spark will occur at ground. Touch steel tool to shaft to detect significant magnetism. Is shaft magnetized?
      - No → Disconnect Adapter or jumper wire. Alternator is defective.
      - Yes → Disconnect Regulator Bypass Adapter or jumper wire. Connect DMM red lead to socket E in alternator-to-regulator plug. Connect black lead to socket A in same plug. Does battery voltage exist?
        - Yes → Regulator is defective.
        - No → Alternator is defective.
  - Yes → Go to energize switch on engine in E circuit. Test for battery voltage going into energize switch from battery. Does battery voltage exist?
    - No → Repair vehicle circuit to energize switch. Continue test.
    - Yes → Make sure jumper wire from alternator B+ terminal to regulator E terminal is still attached. Test for battery voltage at energize switch E terminal connection. Does battery voltage exist at energize switch?
      - Yes → E circuit from regulator to energize switch is good. Energize switch is defective.
      - No → Repair vehicle circuit from E teminal on regulator to energize switch on engine.

Vehicle charging circuit test is complete. Remove jumper wire. Run engine and re-test charging circuit for operation.

SOCKET CONNECTIONS
Socket A B–
Socket B Field +
Socket C Field –
Socket D Phase (R)
Socket E B+

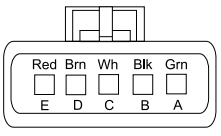

Figure 3 – Alternator-to-Regulator Harness Plug

Chart 3 – No Alternator Output – **Ignition Switch** – Test Charging Circuit

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

Test for battery voltage at B+ terminal on alternator to ground, then at F+ terminal on regulator to ground. Does battery voltage exist?

- No → Repair vehicle wiring as necessary. Continue test.
- Yes → Jumper B+ terminal on alternator to E terminal on regulator. Touch shaft with steel tool to detect significant magnetism. Is shaft magnetized?
  - Yes → Disconnect jumper. Apply 12 V test light to regulator E terminal and ground. Does light glow brightly?
    - No → Repair wiring or ignition switch.
    - Yes → Run vehicle. Does charge voltage exist?
      - Yes → System operating normally.
      - No → Jumper B+ terminal on alternator to regulator E terminal. Does charge voltage exist?
        - Yes → Repair wiring or ignition switch.
        - No → Contact CEN Service Department for assistance.
  - No → Unplug alternator-to-regulator harness. Plug CEN Regulator Bypass Adapter A10-129 into harness plug. Make sure black lead does not touch ground. Clip red lead to B+ terminal on alternator. (If Adapter is not available, connect jumper wire from socket B on harness to alternator B+ terminal.) Does spark occur at alternator B+ terminal?
    - Yes → Disconnect Adapter or jumper wire. Alternator is defective.
    - No → Touch black lead to ground on alternator case. (If Adapter is not available, connect jumper wire from socket C on 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 alternator-to-regulator plug. Connect black lead to socket A in same plug. Does battery voltage exist?
        - Yes → Regulator is defective.
        - No → Alternator is defective.
      - No → Disconnect Adapter or jumper wire. Alternator is defective.

SOCKET CONNECTIONS

Socket A	B–
Socket B	Field +
Socket C	Field –
Socket D	Phase (R)
Socket E	B+

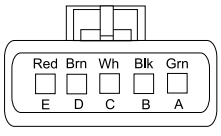

Figure 4 – Alternator-to-Regulator Harness Plug

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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