C.E. Niehoff & Co.

C627, C628, C631, C656, C657, C658, C671 and C680 Alternator Troubleshooting Guide

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.

Table of Contents

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, 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 rates of charge amps.
- **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 rates of charge amps.
- **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 C656, C657, C658, C671, and C680 Alternator Description and Operation

C656, C657, C658, and C671 14 V (400 A) and **C680** 14 V (430 A) alternators are self-rectifying. All windings and current-transmitting components are non-moving, so there are no brushes or slip rings to wear out.

When C656 is controlled by the **A2-149** regulator, this alternator becomes self-energizing through internal diode trios in the drive end housing. Residual magnetic field induces small voltage in stator and energizes field coil. Field coil continues receiving incremental voltage until full voltage is achieved. See Figure 1. AC is rectified into DC output through diodes. Regulator controls voltage output. A2-149 regulator has a D+ terminal to provide a signal to vehicle electrical system, confirming alternator operation, and an R terminal to provide an optional AC voltage tap.

When C656, C657, C658, and C680 are controlled by the **A2-155** regulator, these alternators become externally energized through the IGN terminal connected to a switched power source to turn on regulator. See Figure 2. A2-155 regulator has a P terminal to provide an optional AC voltage tap.

CEN C627, C628, and C631 Alternator Description and Operation

C627 14 V (340A), **C628** 14 V (290 A), and **C631** 14 V (350 A) alternators are self-rectifying. All windings and current-transmitting components are non-moving, so there are no brushes or slip rings to wear out.

When C627, C628, and C631 are controlled by the **A2-155** regulator, these alternators become externally energized through the IGN terminal connected to a switched power source to turn on regulator. See Figure 2. A2-155 regulator has a P terminal to provide an optional AC voltage tap. Regulator can be mounted on the drive end or anti-drive end housing.

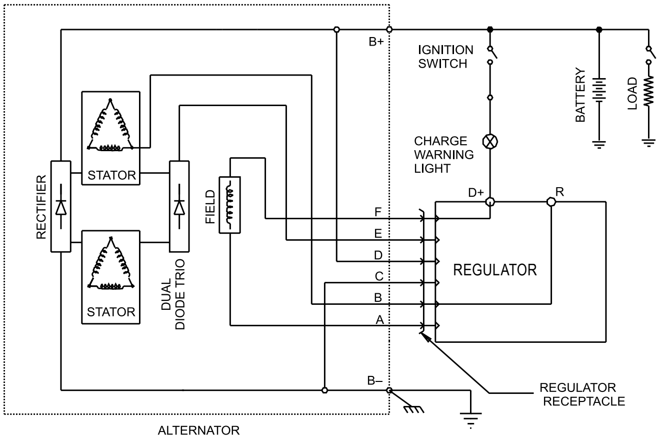


Figure 1 — Alternator with A2-149 Regulator

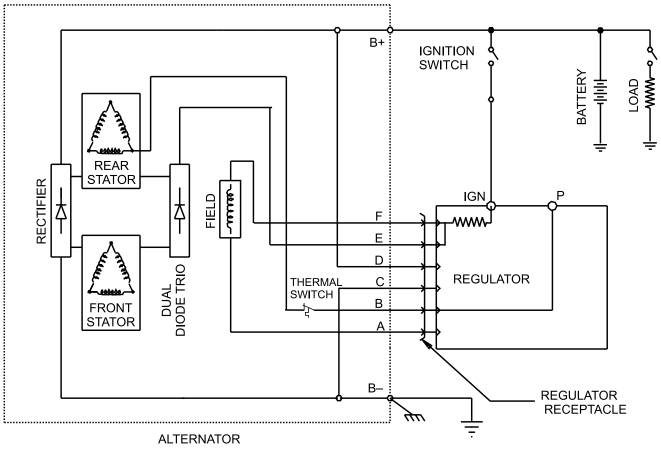


Figure 2 — Alternator with A2-155 Regulator

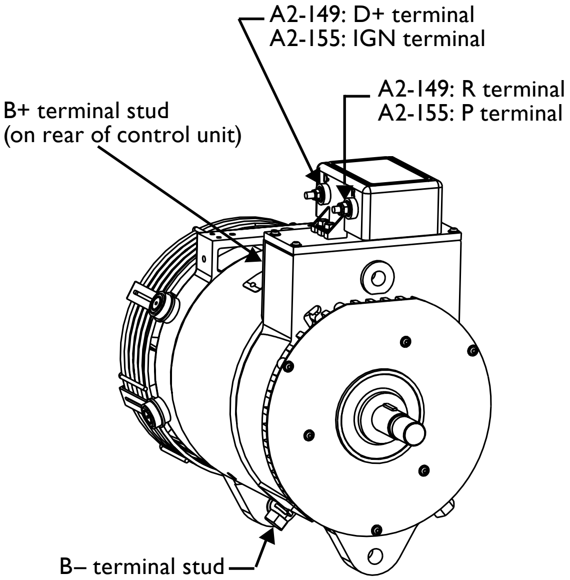


Figure 3 — C627/C628/C631/C656/C657 Alternator Terminals

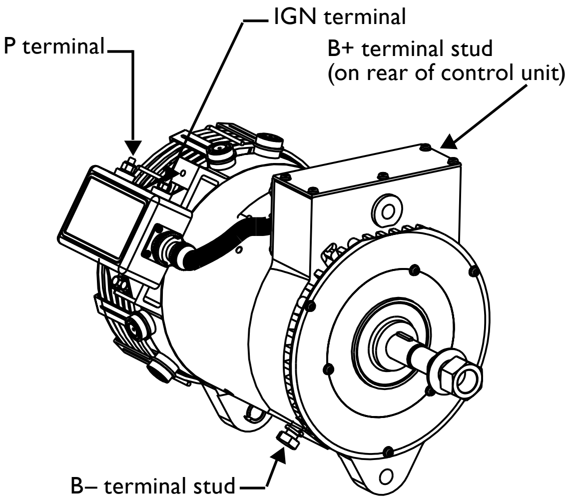


Figure 4 — C658 Alternator Terminals

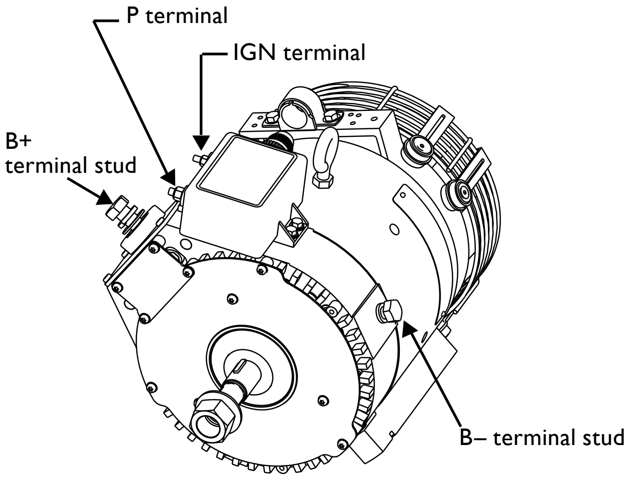


Figure 5 — C671 Alternator Terminals

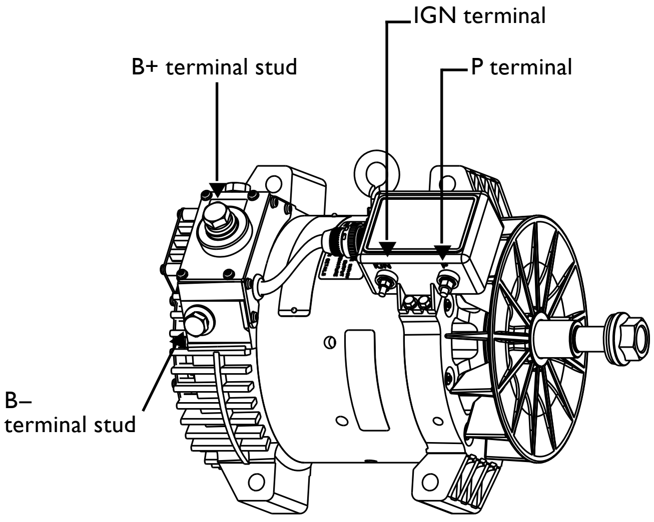


Figure 6 — C680 Alternator Terminals

Tools and Equipment for Job

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

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 I – 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 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 or regulator. Check: lost residual magnetism in self-energizing alternator. A2-149 regulator: Chart 1 A2-155 regulator: Chart 2

Basic Troubleshooting

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

2. **Inspect all vehicle battery connections**
   Connections must be clean and tight.

3. **Determine battery voltages and states 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. In addition, open circuit voltages must be within ± 0.2 V.

4. **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.

5. **Operate vehicle**
   Observe charge voltage.

   CAUTION

   If charge voltage is above 16 volts, immediately shut down system. Electrical system damage may occur if charging system is allowed to operate at high voltage. Go to Table I at left.

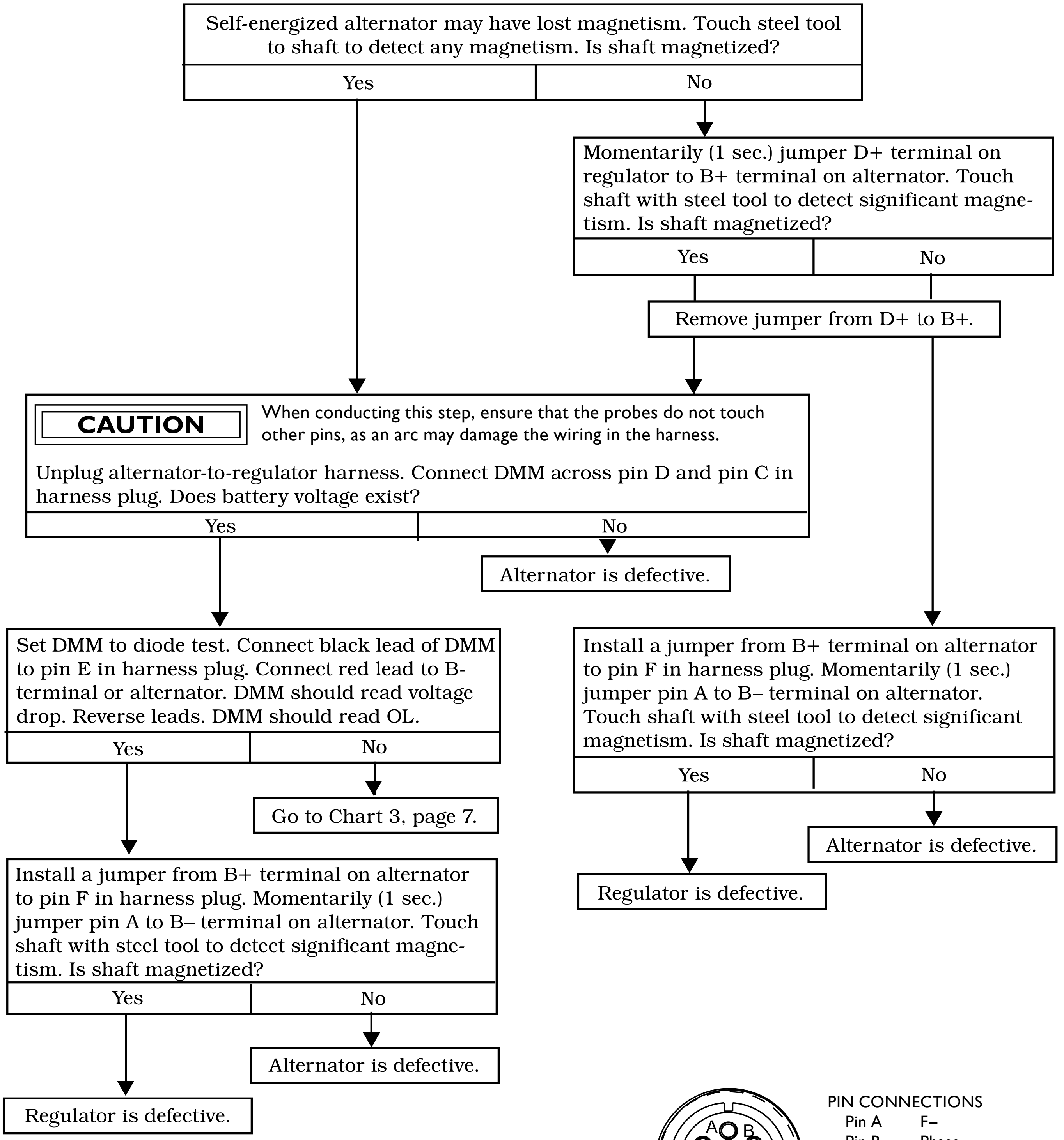
   If voltage is at or below regulator setpoint, let charging system operate for several minutes to normalize operating temperature.

6. **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.

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

8. **If charging system** is not performing properly, go to Chart 1, page 5, for A2-149 regulator or Chart 2, page 6, for A2-155 regulator.

Chart 1 – No Output: **A2-149 Only**



Self-energized alternator may have lost magnetism. Touch steel tool to shaft to detect any magnetism. Is shaft magnetized?

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?

Remove jumper from D+ to B+.

CAUTION When conducting this step, ensure that the probes do not touch other pins, as an arc may damage the wiring in the harness.

Unplug alternator-to-regulator harness. Connect DMM across pin D and pin C in harness plug. Does battery voltage exist?

Alternator is defective.

Set DMM to diode test. Connect black lead of DMM to pin E in harness plug. Connect red lead to B- terminal or alternator. DMM should read voltage drop. Reverse leads. DMM should read OL.

Go to Chart 3, page 7.

Install a jumper from B+ terminal on alternator to pin F in harness plug. Momentarily (1 sec.) jumper pin A to B– terminal on alternator. Touch shaft with steel tool to detect significant magnetism. Is shaft magnetized?

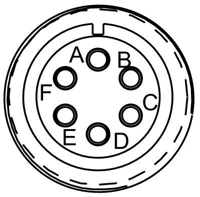
Alternator is defective.

Regulator is defective.

Install a jumper from B+ terminal on alternator to pin F in harness plug. Momentarily (1 sec.) jumper pin A to B– terminal on alternator. Touch shaft with steel tool to detect significant magnetism. Is shaft magnetized?

Regulator is defective.

Alternator is defective.

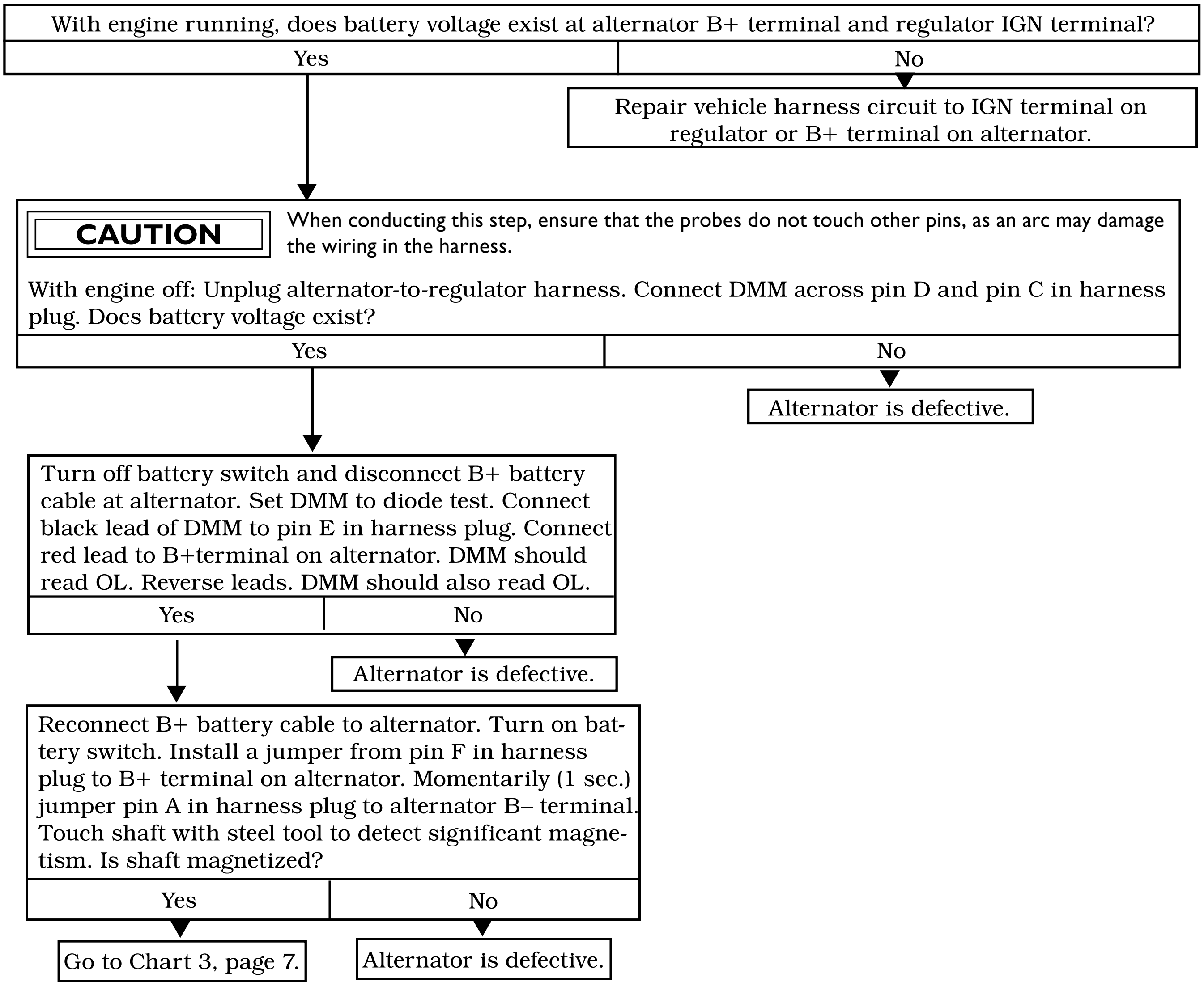


PIN CONNECTIONS

Pin A	F–
Pin B	Phase
Pin C	B–
Pin D	B+
Pin E	D+
Pin F	F+

Figure 7 – Alternator-to-Regulator Harness Plug

Chart 2 – No Output: **A2-155 Only**



With engine running, does battery voltage exist at alternator B+ terminal and regulator IGN terminal?

Yes

No

Repair vehicle harness circuit to IGN terminal on regulator or B+ terminal on alternator.

CAUTION When conducting this step, ensure that the probes do not touch other pins, as an arc may damage the wiring in the harness.

With engine off: Unplug alternator-to-regulator harness. Connect DMM across pin D and pin C in harness plug. Does battery voltage exist?

Yes

No

Alternator is defective.

Turn off battery switch and disconnect B+ battery cable at alternator. Set DMM to diode test. Connect black lead of DMM to pin E in harness plug. Connect red lead to B+terminal on alternator. DMM should read OL. Reverse leads. DMM should also read OL.

Yes

No

Alternator is defective.

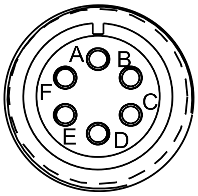
Reconnect B+ battery cable to alternator. Turn on battery switch. Install a jumper from pin F in harness plug to B+ terminal on alternator. Momentarily (1 sec.) jumper pin A in harness plug to alternator B– terminal. Touch shaft with steel tool to detect significant magnetism. Is shaft magnetized?

Yes

No

Go to Chart 3, page 7.

Alternator is defective.



PIN CONNECTIONS

Pin A	F–
Pin B	Phase
Pin C	B–
Pin D	B+
Pin E	D+
Pin F	F+

Figure 8 – Alternator-to-Regulator Harness Plug

Chart 3 – Continuation of Chart 1 and 2 as Noted

Set DMM to diode test. Connect black lead of DMM to B+ terminal on alternator. Connect red lead to pin B on harness plug. DMM should read voltage drop. Reverse leads. DMM should read OL.

- Yes → Regulator is defective.
- No → Check continuity of thermal switch inside control unit: Remove drive end cover on alternator. With DMM, check continuity between pin B on harness plug and diode shown in Figure 9 below. Does continuity exist?
  - Yes → Alternator is defective.
  - No → Thermal switch in control unit is defective.

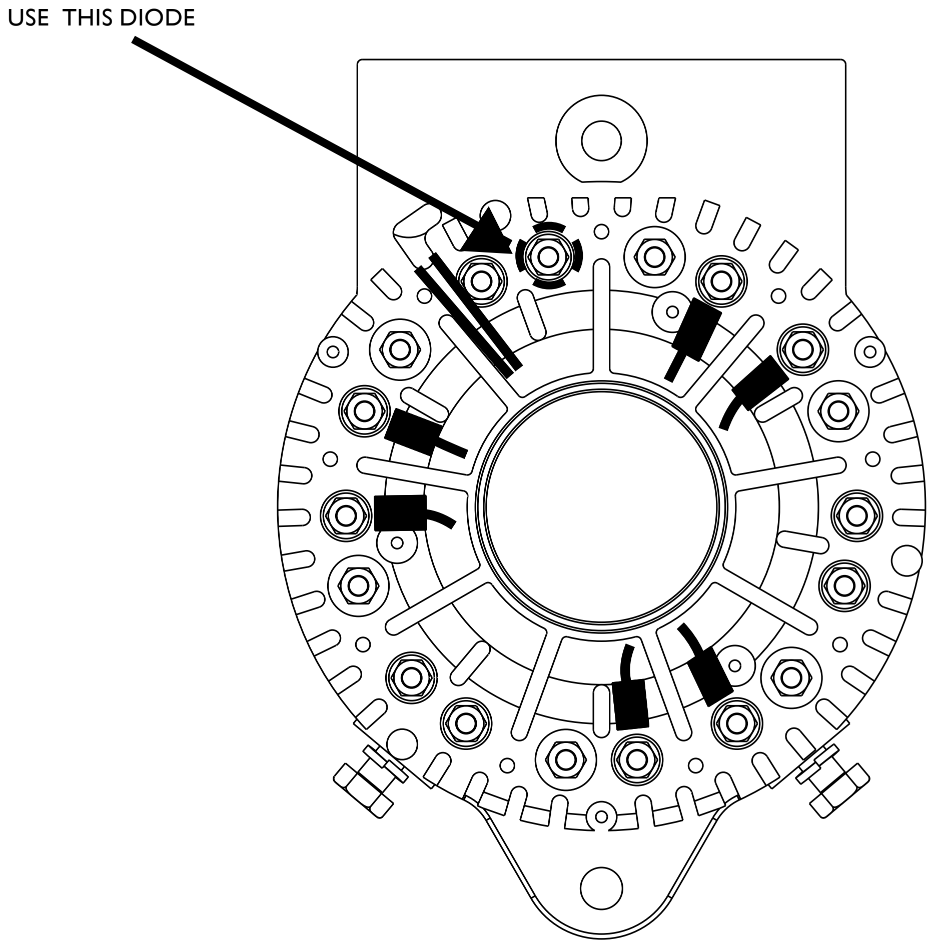


Figure 9 – Diode Arrangement Inside Drive End Housing

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:
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Page 7