



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 C653/C653A and C625 Alternators

Description and Operation

C653/C653A and **C625** 28 V (260 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 controlled by the **A2-146** or **A2-153** 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.

When controlled by the **A2-214** regulator, these alternators become externally energized through the IGN terminal, connected to a switched power source to turn on regulator. See wiring diagram, Figure 5 on page 3. Regulator has:

- D+ terminal that can provide signal to vehicle electrical system, confirming alternator operation.
- P terminal that can provide an optional AC voltage tap.
- Overvoltage cutout (OVCO). See page 6.
- Green lens LED. See page 6.

When **C653** alternator is controlled by the **A2-338** regulator, the alternator becomes self-energized through sensing of alternator rotation through AC circuit. Residual magnetic field induces small voltage in stator and energizes field coil. Field coil continues receiving incremental voltage until full voltage is achieved. Regulator controls voltage output. See wiring diagram, Figure 4 on page 3. A2-338 regulator has:

- P terminal that can provide optional AC voltage tap.
- D+ terminal that can provide DC voltage signal to vehicle electrical system, confirming alternator operation.
- Overvoltage cutout (OVCO) function. See page 10.
- Tricolored LED. See page 10.
- T terminal to connect optional A9-4011 temperature sense lead to adjust regulator setpoint to maintain charge voltage (or negative temperature compensation) by sensing ambient temperature within the battery box. If temperature sense lead is not connected, the regulator will operate at 27.5 V.

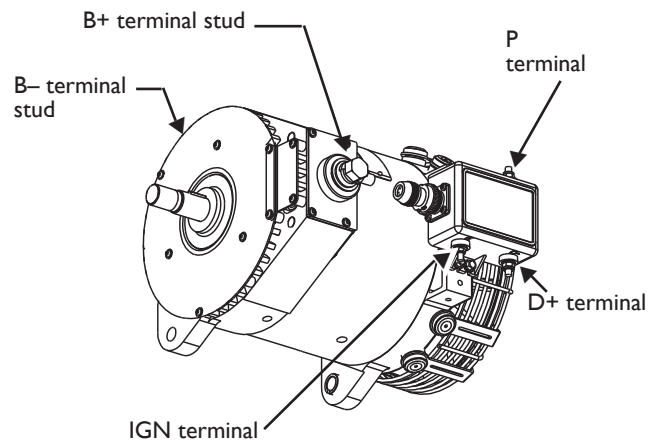


Figure 1 — C625 Alternator Terminals

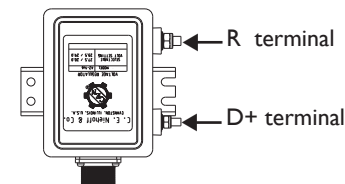


Figure 2 — A2-146 and A2-153 Regulator Terminals (Also Used with C653, C653A)

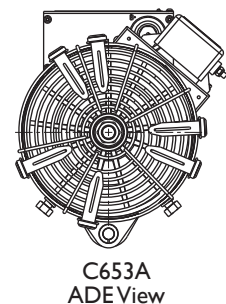
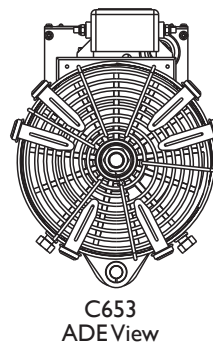
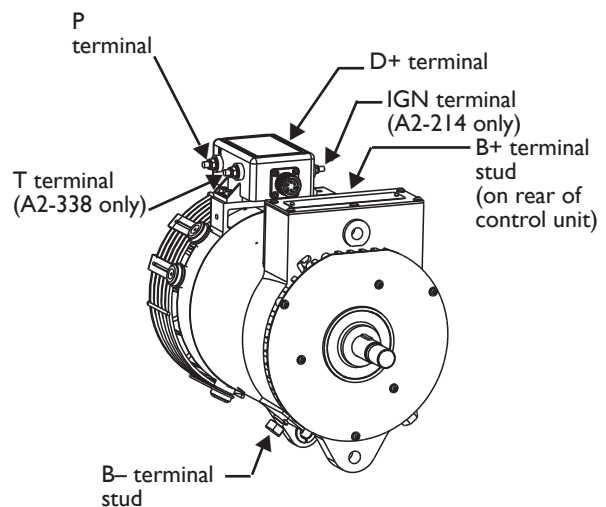


Figure 3 — C653/C653A Alternator Terminals

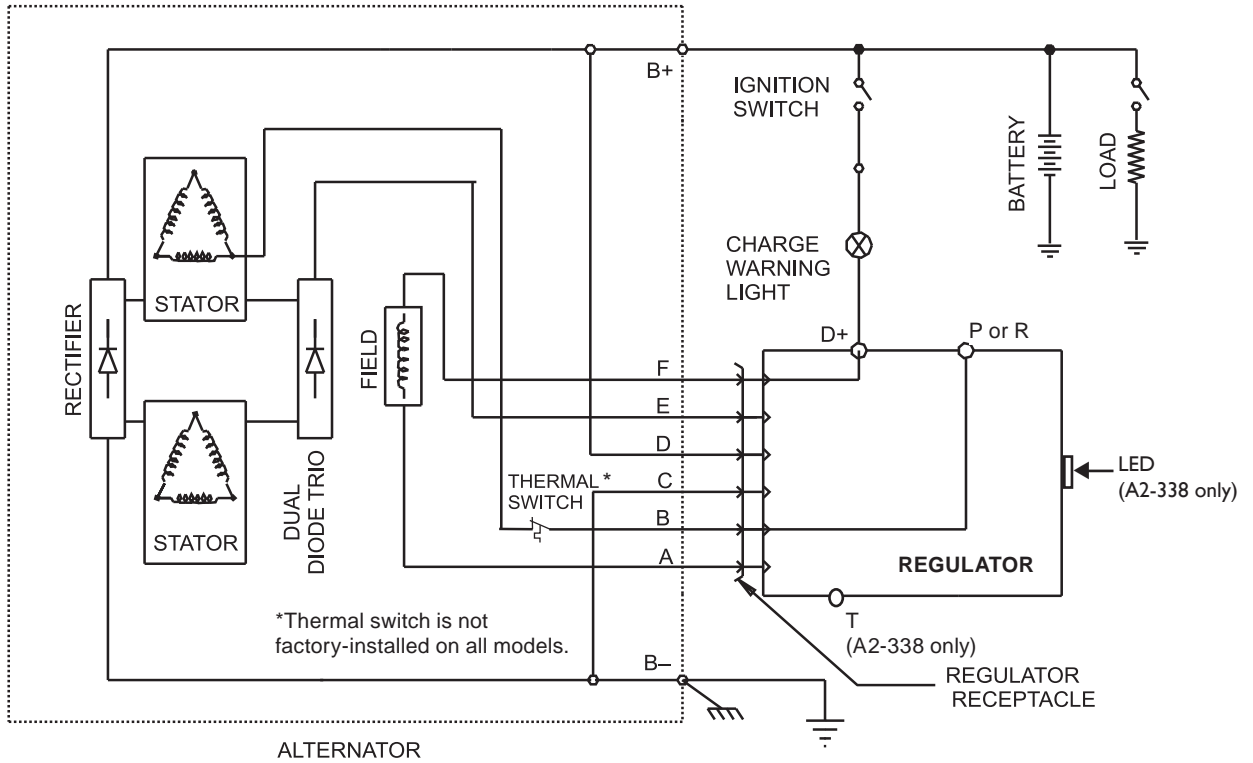


Figure 4 — C653/C653A Alternators with A2-146 or A2-153 or A2-338 Regulator

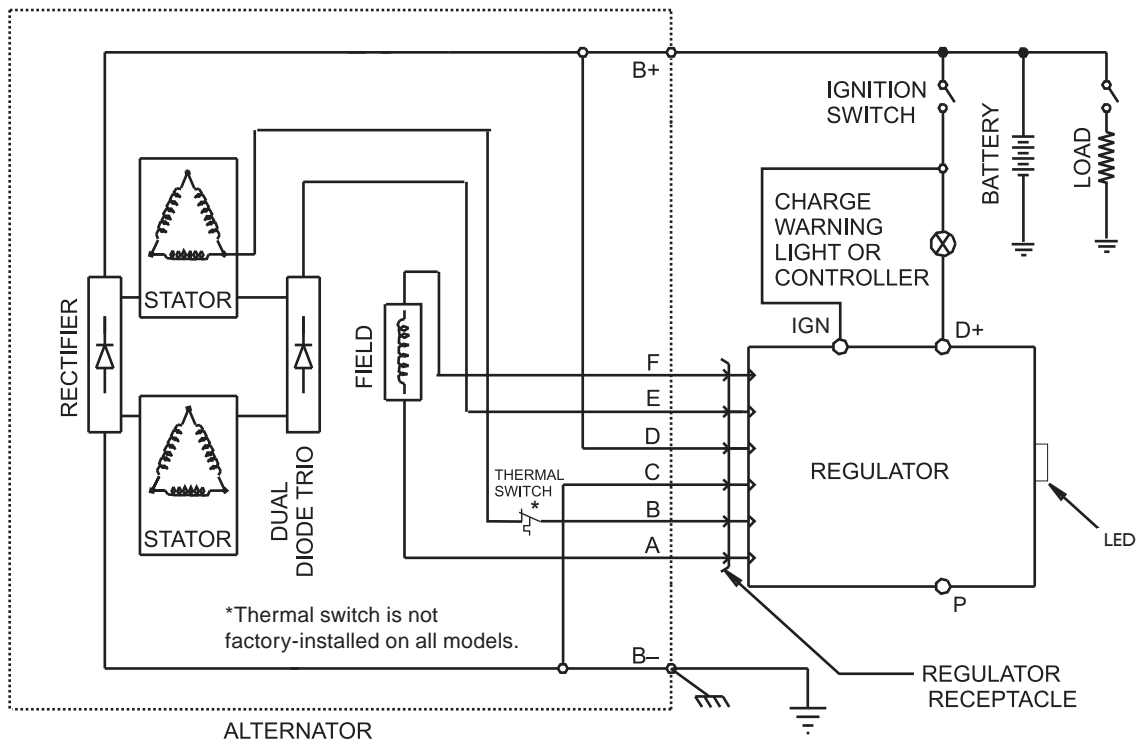


Figure 5 — C653/C653A and C625 Alternators with A2-214 Regulator

Section B: Basic Troubleshooting



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 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 or regulator. Check: wrong regulator.
High Voltage Output	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. Go to: <ul style="list-style-type: none"> • Chart 1, page 5, for A2-146/A2-153 • Chart 2, page 7, for A2-214 • Chart 5, page 11, for A2-338

NOTICE

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

Basic Troubleshooting

- 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.
- Inspect vehicle battery connections**
Connections must be clean and tight.
- Check drive belt**
Repair or replace as necessary.
- 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.
- 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.
- Operate vehicle**
Observe charge voltage.

CAUTION

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.
- 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.
 - Battery** is considered fully charged if charge voltage is at regulator setpoint and charge amps remain at lowest value for 10 minutes.
 - If charging system** is not performing properly, go to:
 - Chart 1, page 5, for A2-146/A2-153
 - Chart 3, page 8, for A2-214
 - Chart 5, page 11, for A2-338



A2-214 Regulator

DESCRIPTION AND OPERATION

A2-214 regulator is either attached directly to the outside of alternator or remote-mounted.

Main diagnostic feature of regulator is a green lens LED located on the front of the regulator. LED indicates whether regulator has been energized. See Table 2 for LED indication and status.

Regulators with OVCO (overvoltage cutout) will trip at vehicle electrical system voltages **above** 32 volts that exist longer than 3 seconds. OVCO feature detects high voltage and reacts by signaling the F+ alternator circuit to open. This turns off alternator. Restarting engine resets OVCO circuit. Regulator regains control of alternator output voltage.

INDICATION	STATUS
ON steady	Normal regulator operation. Alternator is producing output.
FLASHING	Regulator is receiving energize signal. LED will flash until alternator produces output.
OFF	Regulator is not receiving energize signal or OVCO has tripped.

TROUBLESHOOTING

Shut down vehicle and restart engine. If alternator functions normally after restart, a “no output condition” was normal response of voltage regulator to “high voltage” condition. Inspect condition of electrical system, including loose battery cables, both positive and negative. If battery disconnects from system, it could cause “high voltage” condition in electrical system, causing OVCO circuit to trip.

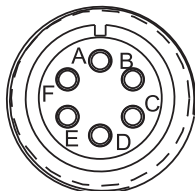
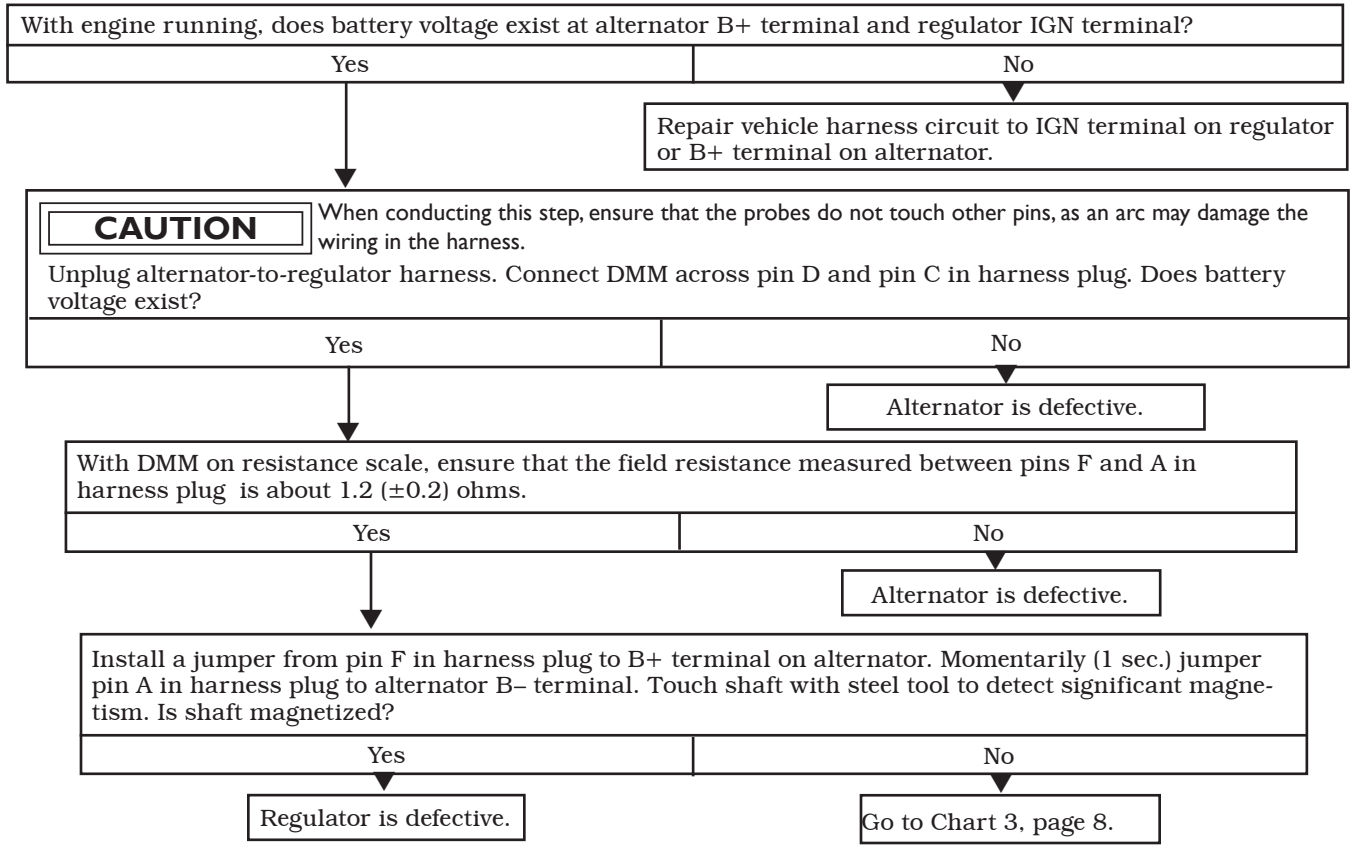
If you have reset alternator once and electrical system returns to normal charge voltage condition, there may have been a one time, high voltage spike, causing OVCO circuit to trip.

If OVCO circuit repeats cutout a second time in short succession and shuts off alternator F+ circuit, try third restart. If OVCO circuit repeats cutout, go to page 8.

REMOTE-MOUNTED REGULATORS: CHECK CONDITION OF FUSE IN WIRING HARNESS BEFORE TROUBLESHOOTING



Chart 2 – No Alternator Output – **Quick Diagnostic**



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 3 – No Alternator Output – Test Charging Circuit

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

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

Yes	No
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With engine running: Test for battery voltage at regulator IGN terminal. Does battery voltage exist?

Yes	No
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Repair vehicle wiring as necessary. Continue test.

Repair vehicle wiring as necessary. Re-test.

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
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Alternator is defective.

Turn off battery switch. Disconnect B+ battery cable from alternator. 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
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Alternator is defective.

Reconnect B+ battery cable to alternator. Turn on battery switch. Set DMM to Diode Test. Connect red lead to pin B in harness plug. Connect black lead to B+ terminal on alternator. Does continuity exist?

Yes	No
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C625 Alternator: Alternator is defective.
C653 Alternator: Proceed to Chart 4, page 9.

With DMM on resistance scale, ensure that the field resistance measured between pins F and A in harness plug is about 1.2 (± 0.2) ohms.

Yes	No
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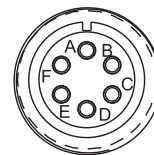
Alternator is defective.

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
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Regulator is defective.

Alternator is defective.



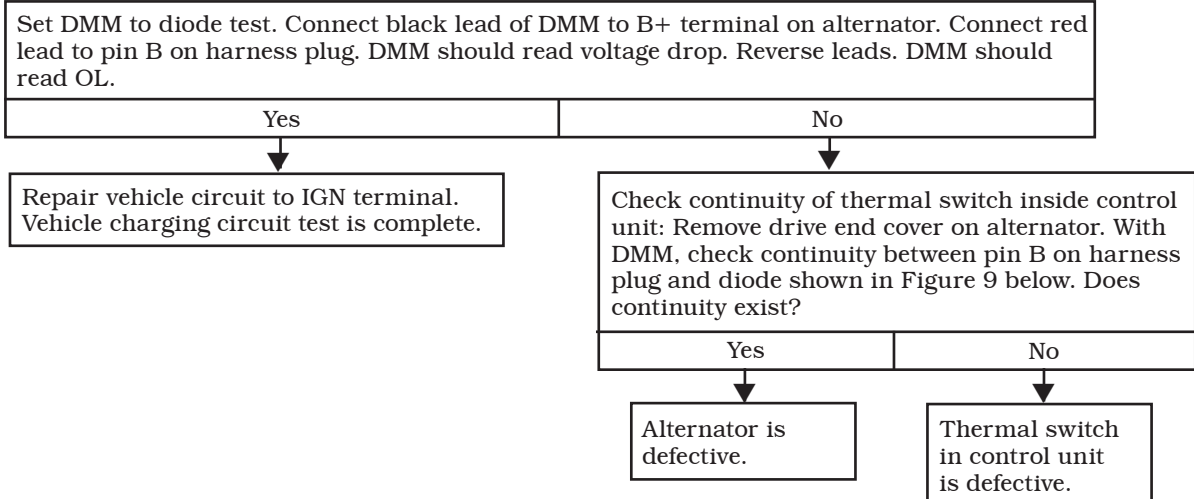
- PIN CONNECTIONS**
- Pin A F-
 - Pin B Phase
 - Pin C B-
 - Pin D B+
 - Pin E D+
 - Pin F F+

Figure 8 – Alternator-to-Regulator Harness Plug



Section D: A2-214 Advanced Troubleshooting (CONT'D)

Chart 4 – Continuation of Chart 3 as Noted



USE THIS DIODE

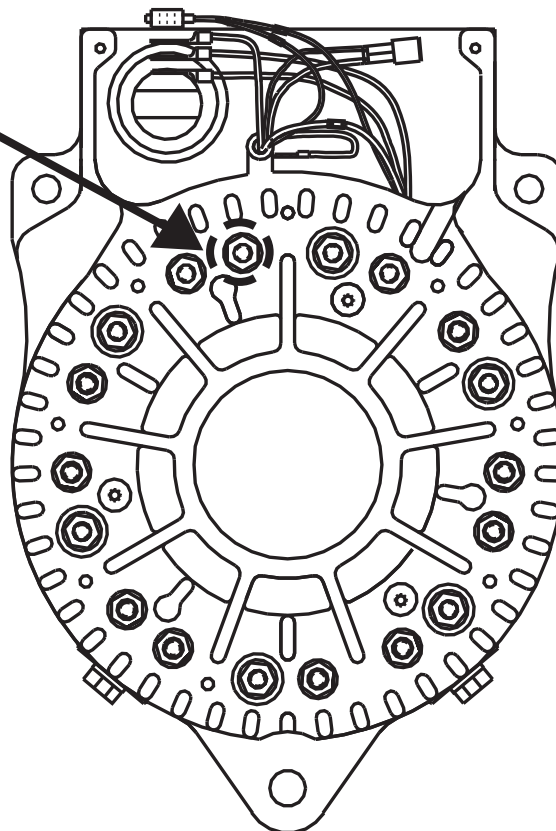


Figure 9 – Diode Arrangement inside C653 Drive End Housing



**A2-338 Regulator
Description and Operation**

A2-338 regulator is attached directly to the outside of alternator. A9-4011 temperature sense lead may or may not be used with this regulator. See below.

Main diagnostic feature of the regulator is a tricolored LED next to the harness receptacle on regulator. LED works like a voltmeter, measuring charging voltage. See Table 3 for diagnostic features and LED explanations.

This regulator has OVCO (overvoltage cutout) that will trip at vehicle electrical system voltage above 33 volts that exists longer than 3 seconds. OVCO feature detects high voltage and reacts by signaling field circuit to open. This turns off alternator (LED is flashing RED). OVCO circuit is reset when engine is restarted or when system voltage drops below 26.5 V.

When the A9-4011 temperature sense lead is not in use, the regulator will operate at 27.5 V.

When A9-4011 temperature sense lead is in use, the lead senses the ambient temperature within the battery box and regulator will adjust charge voltage based on battery temperature—the higher the battery temperature, the lower the charge voltage.

Troubleshooting

Shut down vehicle and restart engine. If alternator functions normally after restart, a “no output condition” was normal response of voltage regulator to “high voltage” condition. Inspect condition of electrical system, including loose battery cables, both positive and negative. If battery disconnects from system, it could cause “high voltage” condition in electrical system, causing OVCO circuit to trip.

If you have reset alternator once, and electrical system returns to normal charge voltage condition, there may have been a one time, high voltage spike, causing OVCO circuit to trip.

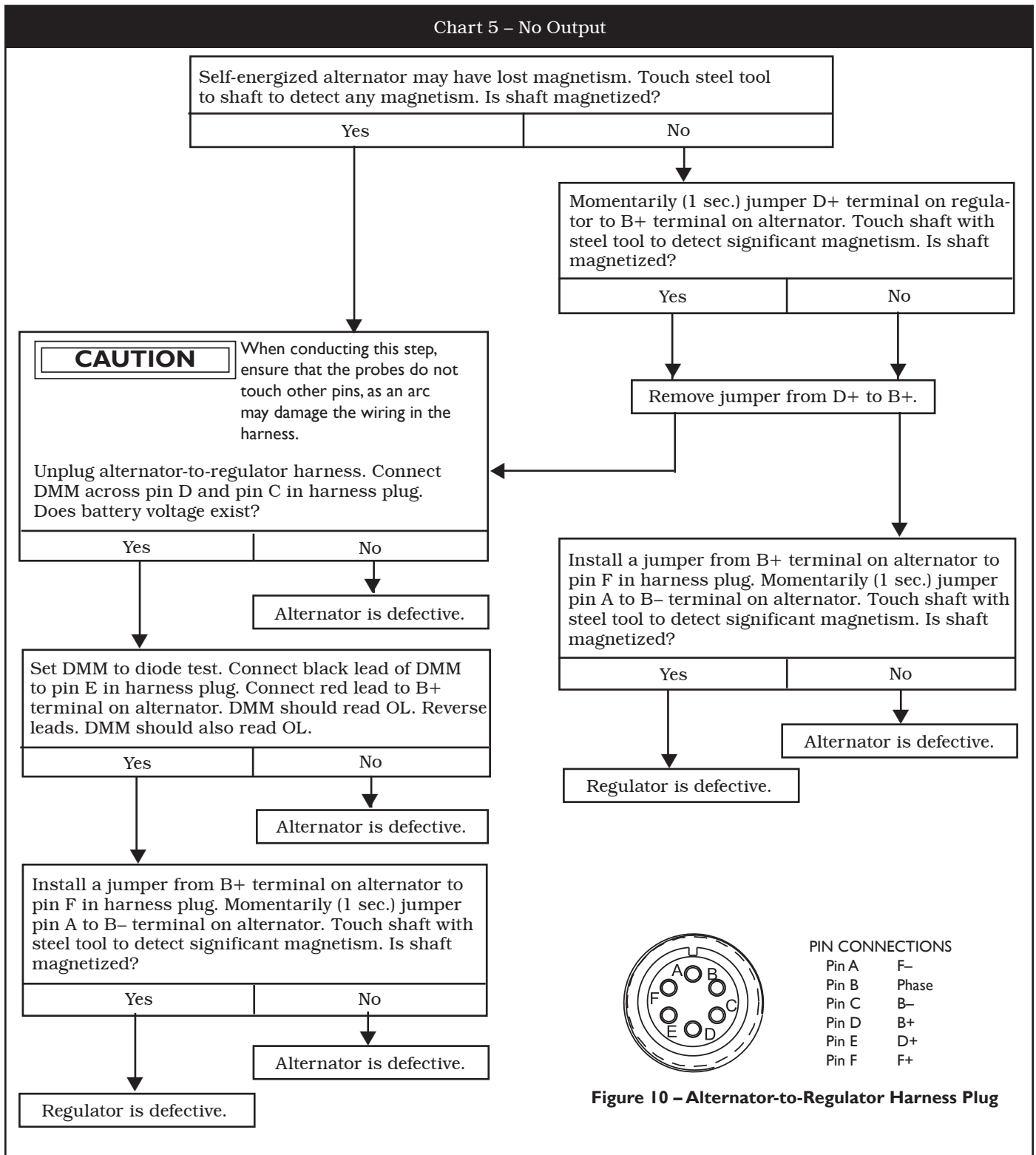
If OVCO circuit repeats cutout a second time in short succession and shuts off alternator field circuit, try third restart. If OVCO circuit repeats cutout, go to Chart 5, page 11.

TABLE 3 – A2-338 Regulator Diagnostics

LED COLOR		STATUS	ACTION
GREEN	Solid	Alternator and regulator operating normally.	No action required.
	Flashing	Regulator is in soft start mode.	Wait 10 seconds until alternator achieves full rotation.
AMBER	Solid	Low system voltage — Electrical load exceeds alternator rating at present rotor speed.	When loads decrease or speed increases, LED should be solid GREEN. If not, check drive belt and charging system connections.
	Flashing	Alternator fault — No output.	Replace alternator.
RED	Solid	High system voltage – May occur during normal load switching.	If solid more than 3 seconds, OVCO will trip, disabling charging system. LED will flash RED.
	Flashing	OVCO tripped.	Overvoltage condition. Attempt reset. System diagnosis required. Go to Chart 5, page 11.



Chart 5 – No Output



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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