WARNING

Before troubleshooting any CEN products, the service technician should:
- read, understand, and agree to follow all information contained in this troubleshooting guide.
- understand the operational characteristics of the electrical charging system components to be tested.
- be proficient at the use of tools and test equipment used in troubleshooting CEN products.

Hazard Definitions

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

WARNING — Indicates presence of hazard(s) that can cause severe personal injury, death, or substantial property damage if ignored.

CAUTION — Indicates presence of hazards that will or can cause minor personal injury or property damage.

Table of Contents

Tools and Equipment

- Digital Multimeter (DMM)
- Ammeter (digital, inductive)
- Jumper wires
- CEN 5-pin Round Inline Harness Test Tool A10-140

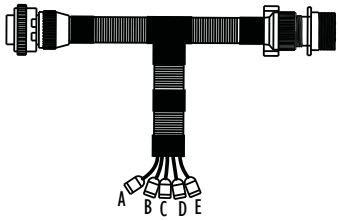

Figure 1—CEN 5-pin Round Inline Harness Test Tool A10-140

Testing Guidelines

Professional service technicians rely on the following guidelines when testing electrical components.

Voltage testing:

- Set meter to proper scale and type (AC or DC).
- Be sure to zero the meter scale or identify the meter burden by touching meter leads together. Meter burden must be subtracted from final reading obtained.
- Be sure the meter leads touch source area only. Prevent short circuit damage to test leads or source by not allowing meter leads to touch other pins or exposed wires in test area.
- Be sure to use CEN tools designed especially for troubleshooting CEN alternators when available. See page 1 for more information.

Resistance (ohm) testing:

- Set meter to proper scale.
- Be sure to zero the meter scale or identify the meter burden by touching meter leads together. Meter burden must be subtracted from final reading obtained.
- Be sure the meter leads touch source area only. Prevent altering the reading by not allowing fingers or body parts to touch meter leads or source during reading.
- Be sure reading is taken when source is at 70°F. Readings taken at higher temperatures will increase the reading. Conversely, readings taken at lower temperatures will decrease the reading.
- Be sure to test directly at the source. Testing through extended harnesses or cable extensions may increase the reading.

Voltage drop testing:

- Measure voltage between B+ on alternator or source and B- (ground) on alternator or source. Record obtained reading. Move to batteries or other source and measure again between B+ and B- terminals on battery or other source. Difference between the two readings represents voltage lost within the circuit due to but not limited to inadequate cable gage or faulty connections.
- Voltage drop measurements must be taken with all electrical loads or source operating.

Dynamic/Live testing:

Definition: Connecting power and ground to a component to test operation/function out of circuit.

1. Be sure to connect jumper leads directly and securely to source contacts of the component being tested.
2. Be sure to make any connection to power and ground at the power supply or battery source terminals. Do not make connection at component source terminals as that may create an arc and damage component source terminals.

CEN C505, C527, C531, and C534 Alternators/Regulators Description and Operation

C505, C527, C531, and C534 14 V (360 A) alternators are internally rectified. All windings and current-transmitting components are non-moving, so there are no brushes or slip rings to wear out.

- When controlled by the **A2-334** (C505, C527 or C531 alternator-mounted) or **A2-335** (C527 or C531 remote-mounted) regulator, after engine is running, the alternator is externally energized when the battery master switch on the vehicle is turned on and regulator receives energize signal through IGN terminal. Regulator monitors alternator rotation and provides field current only when it detects alternator shaft rotating at or above idle speed. After regulator detects alternator rotation, it gradually applies field current, preventing an abrupt mechanical load on accessory drive system. The soft start may take up to 20 seconds.
- When controlled by the **A2-343** (C527 alternator-mounted), **A2-348** (C527, C531, or C534 alternator-mounted) or **A2-350** (C527, C531, or C534 remote-mounted) regulator, the alternator is externally energized when the battery master switch on the vehicle is turned on and provides power to the regulators through the IGN circuit; can also operate without vehicle connection to the IGN circuit, and instead provide power by sensing rotation through the regulator's AC circuit.

After field coil is energized. AC is rectified into DC output through diodes in rectifier housing and supplied to the battery through the alternator B+ circuit. See schematic diagrams on pages 4 and 5. Alternator output current is self-limiting and will not exceed rated capacity of alternator. Regulator maintains alternator output voltage at pre-determined regulated setting (see Table 1 or 2 below for setpoints) as vehicle electrical loads are switched on and off.

A2-334 and **A2-335** regulators furnished with some units include:

- External IGN terminal for energize connection.
- P terminal that can provide optional AC voltage tap. P terminal signal frequency (Hz) x 10 = alternator shaft rpm.
- Tricolored LED. See page 6.
- Regulator fixed (flat temperature compensation) setpoints shown in Table 1 are selected based on battery type. Battery type selection and battery maintenance/function are the sole responsibilities of the customer.

Table 1 — A2-334 & A2-335 Regulator Setpoint Switch Position		
Voltage Setpoint (±0.2 V)*		Battery Type*
Position 1	14.0 V	Maintenance (D Category)
Position 2	14.4 V	Maintenance-free (Group 31)
Position 3	14.8 V	Maintenance-free (Group 31)
Position 4	15.5 V	Battery Isolator in Charging System

* Voltage setpoint can depend on temperature or climate condition, as well as battery type. If boiling or excessive gassing occurs with higher voltage setpoint, change to next lower voltage setpoint.

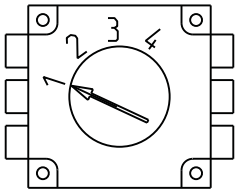

Figure 2—Voltage Setpoints

A2-343, A2-348, and **A2-350** regulators furnished with some units includes:

- *(A2-343 only)* No external terminals, only a special 3-pin vehicle harness connector providing one pin for optional AC voltage tap (PHASE OUT), one pin for DC voltage signal to vehicle electrical system confirming alternator operation (D+), and one pin for the ignition connection (IGN). This regulator can function with or without vehicle ignition. When necessary, IGN circuit in vehicle 3-pin harness is connected to vehicle ignition to provide battery voltage when engine is running. Circuit should be off (no voltage present) when vehicle ignition is off or engine is not running.
- *(A2-348 & A2-350 only)* P terminal that can provide optional AC voltage tap. P terminal signal frequency (Hz) x 10 = alternator shaft rpm.
- *(All models)* Overvoltage cutout (OVCO). See pages 6-7.
- *(All models)* Tricolored LED. See page 6.
- *(All models)* Battery type selection and battery maintenance/function are the sole responsibilities of the customer.
- *(All models)* Temperature-voltage sense/J1939 connector to be used with optional harness.
  - — When temperature-voltage sense/J1939 harness is not connected, regulator will operate in fixed voltage setting determined by the select switch position on the bottom of the regulator. See Column 2 in Table 2.
  - — When temperature-voltage sense/J1939 harness is connected, regulator will automatically optimize the charge voltage for battery type based on temperature. Also, vehicle manufacturer-requested functions of J1939 interface are available through connector. See Column 3 in Table 2.

Table 2 — A2-343, A2-348, & A2-350 Regulator Voltage/Battery Switch Position		
Switch Position	T-VS/J1939 Harness **Not** Connected (Voltage Select)	T-VS/J1939 Harness Connected (Battery Select)
Position 1	13.8 V	Maintenance (D Category)
Position 2	14.0 V	Maintenance-free (Group 31)
Position 3	14.3 V	AGM
Position 4	14.5 V	***DO NOT USE POSITION # 4***

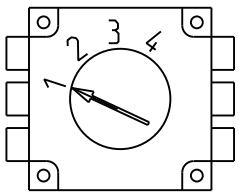

Figure 3—Voltage Setpoints/ Battery Selection

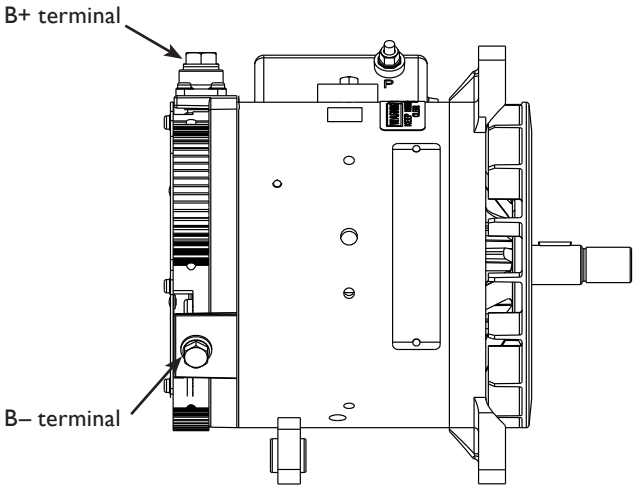

Figure 4—C505 Alternator with A2-334 Regulator Terminals

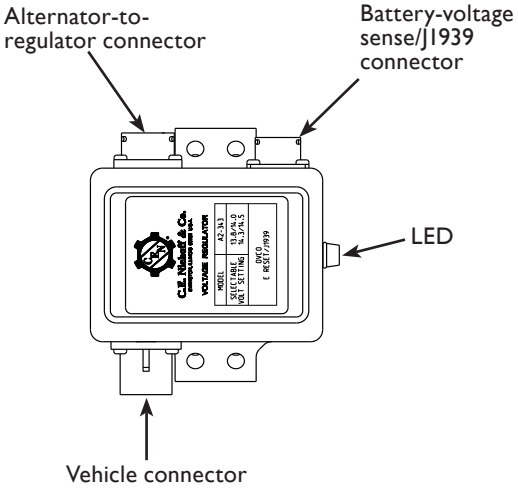

Figure 7 — A2-343 Regulator Connections

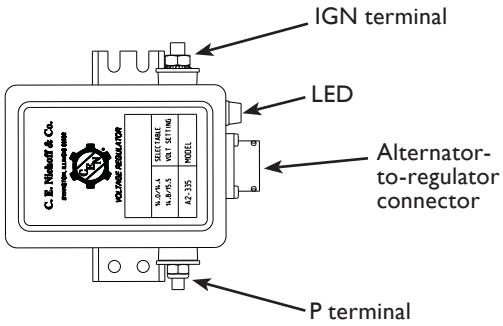

Figure 5 — A2-334/A2-335 Regulator Terminals (A2-335 shown)

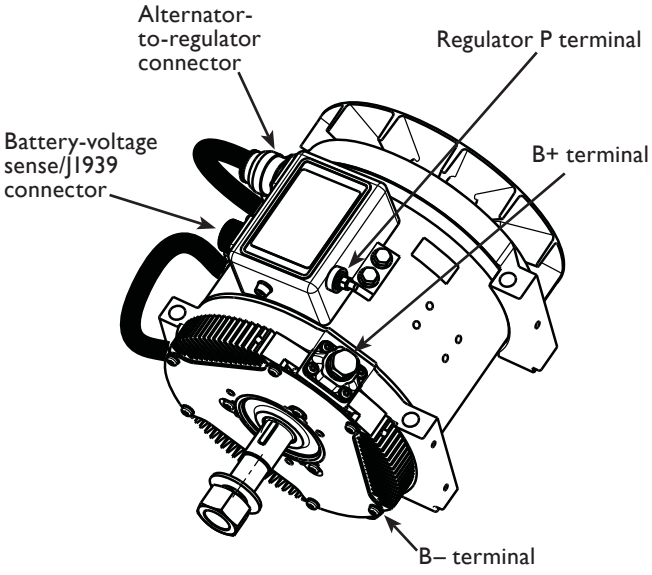

Figure 6 — C527/C531 Alternator with A2-348/A2-350 Regulator Terminals (A2-348 shown)

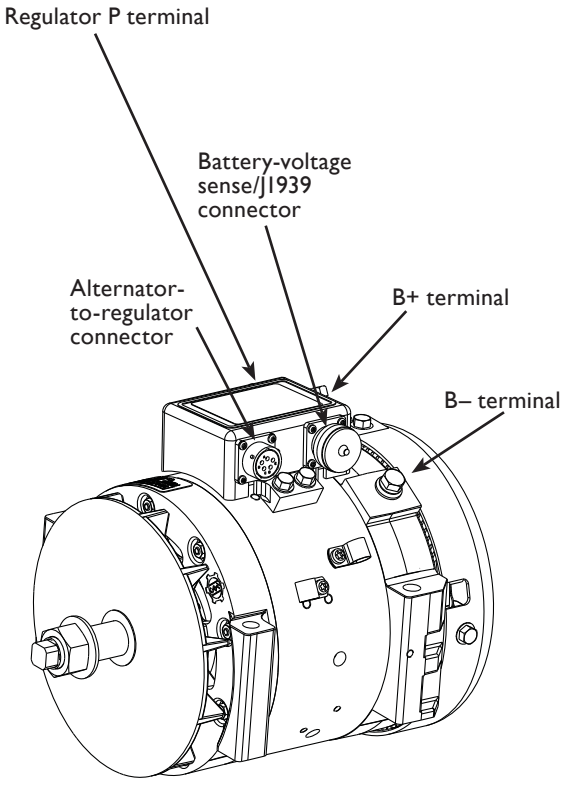

Figure 8 — C534 Alternator with A2-348/A2-350 Regulator Terminals (A2-348 shown)

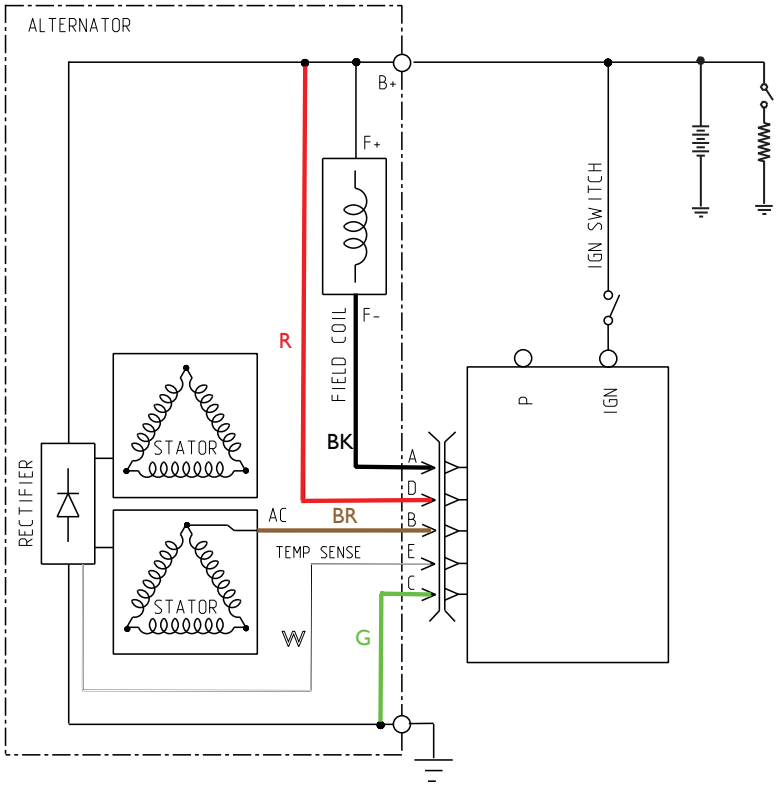

Figure 9 — C505, C527, and C531 w/A2-334/A2-335 Regulator Schematic Diagram

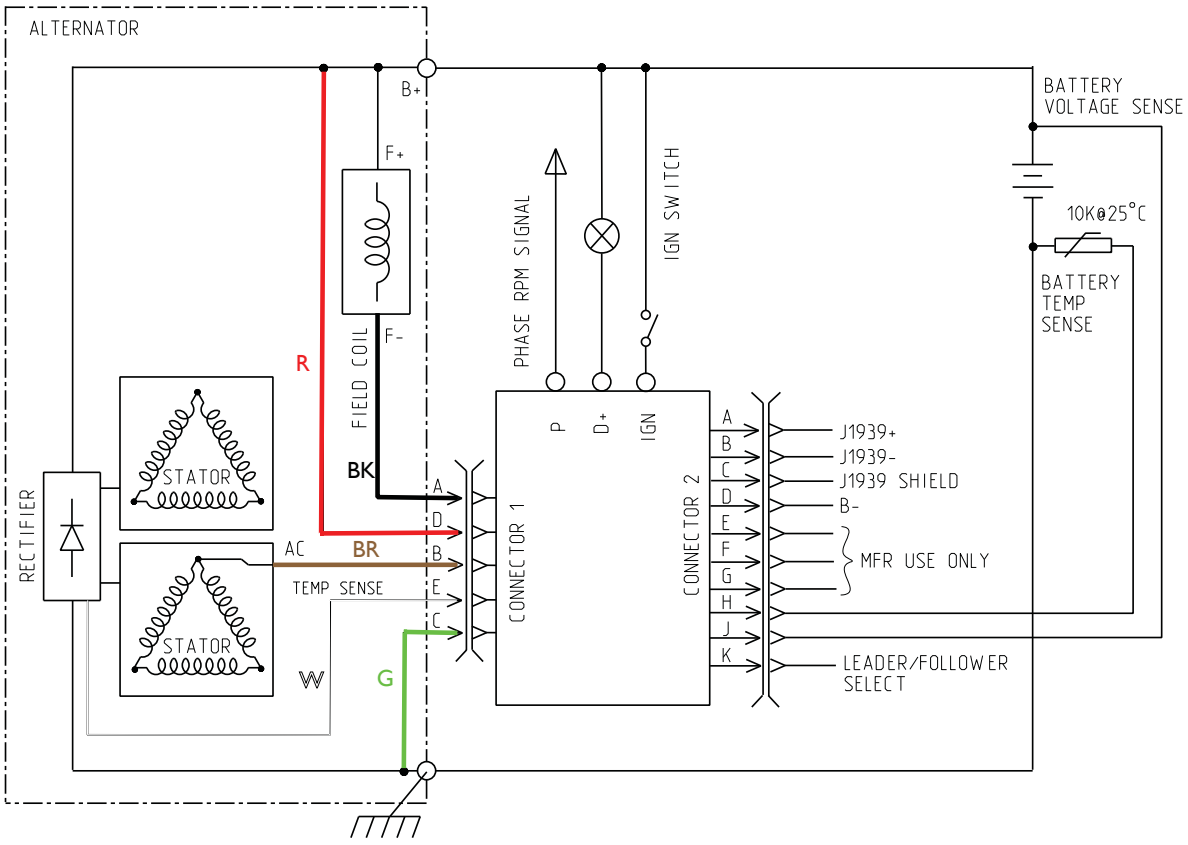

Figure 10 — C527 w/A2-343 Regulator Schematic Diagram

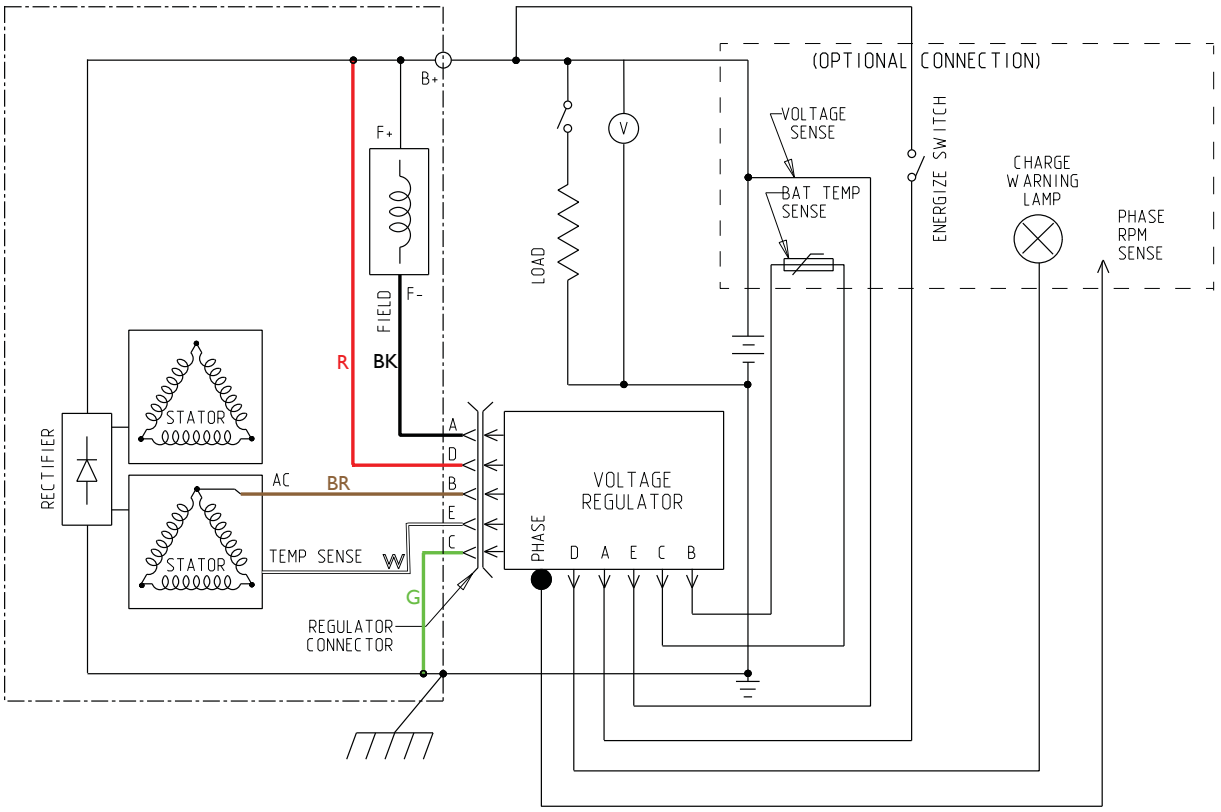

Figure 11 — C527, C531, and C534 w/A2-348/A2-350 Regulator Schematic Diagram

A2-334 and A2-335 Regulator Troubleshooting

A2-334 regulator is mounted directly to the outside of the alternator. **A2-335** regulator is mounted remotely on the vehicle and connected to alternator with extended wiring harnesses.

Main diagnostic feature of regulators consists of a tricolored (green, amber, red) LED located on the end of the regulator. The LED works like a voltmeter, measuring charging voltage. See Table 3 for diagnostic features and LED explanations.

TABLE 3 – A2-334 & A2-335 Regulator LED Diagnostics with Engine On*

LED COLOR		STATUS	ACTION
GREEN	Solid	Alternator and regulator operating normally.	No action required.
AMBER	Flashing *	Alternator fault — No output.*	Replace alternator.*
	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.
RED	Flashing	System voltage higher than setpoint.	May occur during normal load switching.
OFF		No power to ignition or regulator is defective.	Go to Chart on page 8.

* LED will flash AMBER for one minute upon start-up/shutdown—if regulator does not sense alternator rotation, regulator will time out.

A2-343, A2-348, and A2-350 Regulator Troubleshooting

A2-343 and **A2-348** regulators are mounted directly to the outside of the alternator. **A2-350** regulator is mounted remotely on the vehicle and connected to alternator with extended wiring harnesses.

Main diagnostic feature of regulators consists of a tricolored (green, amber, red) LED located on the end of the regulator. The LED works like a voltmeter, measuring charging voltage. See Table 4 for diagnostic features and LED explanations.

These regulators have OVCO (overvoltage cutout) that will trip at vehicle electrical system voltage above 16 volts that exists longer than 3 seconds. OVCO feature detects high voltage and reacts by signaling relay in alternator 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 to 11.5 V. Regulator then regains control of alternator output voltage.

An additional temperature-voltage sense/J1939 harness may or may not be used with the A2-343, A2-348, and A2-350 regulators:

- When optional temperature-voltage sense/J1939 harness is not connected, regulator will operate in fixed voltage setting determined by the select switch position on the bottom of the regulator (see page 2).
- When optional temperature-voltage sense/J1939 harness is connected, regulator will automatically optimize the charge voltage for battery type selected based on temperature. See page 2. Also, vehicle manufacturer-requested functions of J1939 interface are available through connector.

TABLE 4 — A2-343, A2-348, & A2-350 Regulator LED Diagnostics with Engine On*

LED COLOR		STATUS	ACTION
GREEN	Solid	Alternator and regulator operating normally.	No action required.
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.	Indicates voltage above setpoint but below OVCO threshold (less than 16 volts).
	Flashing	OVCO tripped.	Indicates voltage exceeds 16 V for more than 3 seconds. System diagnosis required. See "OVCO Troubleshooting" section on page 7.
OFF		No power to ignition or regulator is defective.	Go to Chart on page 8.

* LED will flash AMBER for one minute upon start-up/shutdown—if regulator does not sense alternator rotation, regulator will time out.

Temperature-Voltage Sense/J1939 Harness Troubleshooting

To verify temperature sense function on T-VS/J1939 harness:

1. With master battery switch on, key on, engine on, and loads off, apply a warm air source (such as a hair dryer, not to heat above 120°F) to battery negative terminal of harness. Charge voltage should decrease as temperature increases. If charge voltage increases or shows no change as temperature increases, go to step 2.
2. If charge voltage increases or shows no change as temperature increases from step 1:
   a. With master battery switch on, key off, and engine off, check for battery voltage across pin E in 5-pin connector (pin J in 10-pin connector) on T-VS/J1939 harness and ground with meter in VDC scale. If no battery voltage exists, entire harness is defective and must be replaced. If battery voltage exists, go to step 2b.
   b. With master battery switch on, key off, and engine off, check for a resistance reading of 5-15K Ohms at 70°F (20°C) across pin B in 5-pin connector (pin H in 10-pin connector) on T-VS/J1939 harness and ground with meter in K Ohm scale. (Note: If ambient temperature is higher, resistance will measure less than listed and vice versa.) If test fails, see CEN Service Bulletin SB27. If test passes, go to chart on page 8.

OVCO 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, check that pin A in alternator-to-regulator harness is not shorted to B–. If it is shorted, alternator is defective. If not, regulator is defective.

No Alternator Output – Test Charging Circuit

- **TEST MEASUREMENTS ARE TAKEN ON HARNESS PLUG AT ALTERNATOR. TEST MEASUREMENT AT AN EXTENDED HARNESS PLUG MAY AFFECT RESULTS.**
- **REMOTE-MOUNTED REGULATORS: CHECK CONDITION OF FUSES IN WIRING HARNESS BEFORE TROUBLE-SHOOTING.**
- **BEFORE STARTING DIAGNOSTIC SEQUENCE, VERIFY THE FOLLOWING AND REPAIR/REPLACE IF NOT TO SPEC:**
  —BATTERIES FOR STATE-OF-CHARGE (12.3-12.6 V), CONDITION, AND SECURE CONNECTIONS
  —MASTER BATTERY SWITCH FOR FUNCTION

MASTER BATTERY SWITCH ON, KEY ON, ENGINE ON: Test for battery voltage at B+ terminal on alternator to ground, then at IGN terminal on regulator to ground (See page 2 for more information).
Does battery voltage exist at both locations?

Yes → ***ENGINE OFF:*** Disconnect 5-pin alternator-to-regulator harness plug at regulator and connect CEN A10-140 inline test tool to harness plug end only. Make sure connections are secure.

No → Repair vehicle wiring as necessary. Run engine and re-test charging circuit. Is charging system performing properly?

- **No** → ***ENGINE OFF:*** Disconnect 5-pin alternator-to-regulator harness plug at regulator and connect CEN A10-140 inline test tool to harness plug end only. Make sure connections are secure.
- **Yes** → System is operative.

MASTER BATTERY SWITCH ON, KEY OFF, ENGINE OFF: Readings of all five tests must pass.

1. Battery voltage test: Connect DMM red lead to socket D in test tool. Connect DMM black lead to socket C in test tool. Battery voltage should exist.
2. Field coil resistance test: Set DMM to ohms test. Field resistance between socket A in test tool and B+ terminal on alternator should measure nominal 1.0-1.5 ± 0.2 ohms. Field coil is defective if reading is less than 0.5 ohms or greater than 3 ohms.
3. Significant magnetism test:
   a. Insert one end of jumper wire in socket A in test tool. Momentarily (1 sec.) touch other end of jumper wire to alternator B– terminal. Spark will occur at B– terminal. Touch steel tool to shaft to detect significant magnetism.
   b. Remove jumper wire.
4. Phase supply test: Set DMM to diode test. Connect DMM black lead to socket B in test tool. Connect red lead to alternator B+ terminal. DMM should read blocking in this direction. Then reverse leads. DMM should read flow in this direction. Repeat for socket B and B– terminal. Tests should read flow in one direction and blocking in the other direction.
5. Alternator temperature sensor circuit test: Set DMM to ohms test. Sensor resistance between socket E in test tool and B– terminal on alternator should measure 80-130K ohms at 70°F (20°C). Note: If ambient temperature is higher, resistance will measure less than listed and vice versa.

- **Yes** → Regulator is defective.
- **No** → Alternator is defective.

SOCKET CONNECTIONS

Socket A	F–
Socket B	Phase
Socket C	B –
Socket D	B+
Socket E	Temp sense

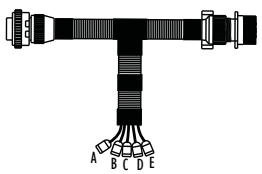

Figure 12 – CEN 5-pin A10-140 Inline Harness Tool Socket Connections