



Contents

Section A: Wiring Diagram2
Section B: Basic Troubleshooting4
Section C: Advanced Troubleshooting5

Hazard Definitions

CAUTION *Indicates presence of hazards that will or can cause minor personal injury or damage to equipment.*

NOTICE Indicates special instructions on installation, operation or maintenance that are important but not related to personal injury hazards.

Required Tools and Equipment

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

Battery Conditions

NOTICE Battery conditions may be observed during cold-start voltage tests until temperatures of electrical system components stabilize.

Maintenance/Low Maintenance Battery

- Immediately after engine starts, system volts are lower than regulator setpoint and amp output is medium.
- 3–5 minutes into charge cycle, system voltage increase and 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 as maintenance battery but slightly longer recharge time.

Maintenance-free Battery

- Immediately after engine starts, system volts are lower than regulator setpoint and charging amps are low.
- Volts and amps remain low when charge cycle begins.
- After alternator energizes, voltage increases by several tenths. Amps increase to medium-to-high levels.
- Volts will increase to setpoint and amps will decrease. Time required to reach optimum voltage and amps 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 batteries. If battery state of charge drops to 75% or less, recharge batteries to 95% or higher separately from engine charging system to avoid damaging charging system components and provide best overall performance. Charge acceptance may display characteristics similar to maintenance batteries.

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).
- Zero meter scale or identify meter burden by touching meter leads together. Meter burden must be subtracted from final reading obtained.
- Be sure meter leads touch power 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.
- Use CEN tools designed especially for troubleshooting CEN alternators when available.

Resistance (ohms) testing:

- Set meter to proper scale.
- Zero the meter scale or identify meter burden by touching meter leads together. Meter burden must be subtracted from final reading obtained.
- Be sure meter leads touch power source area only. Do not allow fingers or body parts to touch meter leads or power source during reading.
- Take reading when power source is at 70° F/21° C. Readings taken at higher temperatures will increase reading. Conversely, readings taken at lower temperatures will decrease reading.
- Test directly at power source. Testing through extended harnesses or cable extensions may increase reading.

Voltage drop testing:

- Measure voltage between B+ on alternator or power source and B- (ground) on alternator or source. Record reading. Move to batteries or other power source and measure again between B+ and B- terminals on battery or other power source. The difference between the two readings represents voltage lost within circuit due to but is 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.

- Connect jumper leads directly and securely to power source contacts of component being tested.
- Make any connection to power and ground at 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.

Section A: Description and Operation



C850 Alternator Description and Operation

The CEN C850 28 V (550 A) alternator is an internally-rectified, brushless alternator. All windings and current-carrying components are stationary, so there are no brushes or slip rings to wear out.

Voltage regulator is activated when it receives an ignition/energize signal from vehicle usually via oil pressure switch or multiplex system. The regulator monitors alternator shaft rotation and provides field current only when it detects the alternator shaft rotating at a suitable speed.

After the regulator detects shaft rotation, it gradually applies field current, preventing an abrupt mechanical load on accessory drive system. Soft start may take up to 20 seconds after rotation and energize signals are sensed.

Refer to Figure 1 for alternator terminal locations. Refer to Figure 2 for alternator-to-regulator harness plug socket outputs.

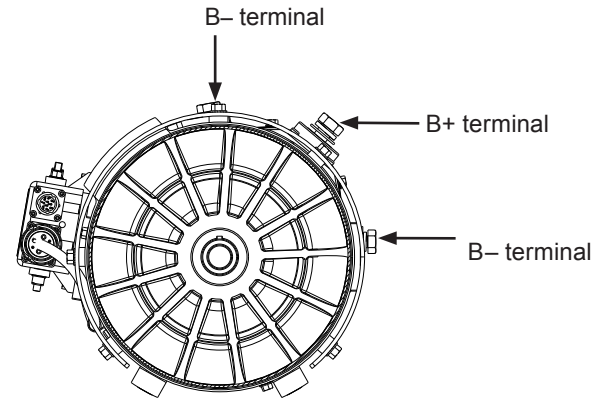


Figure 1: C850 Alternator Terminals

- A = B+
- B = F1+
- C = F2+
- D = B+
- 1 = B+ Sense
- 2 = B-
- 3 = Phase (AC)
- 4 = Temp Sense

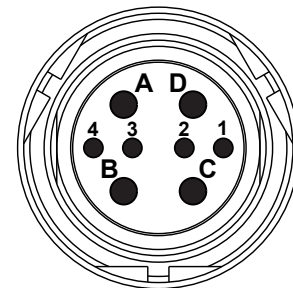
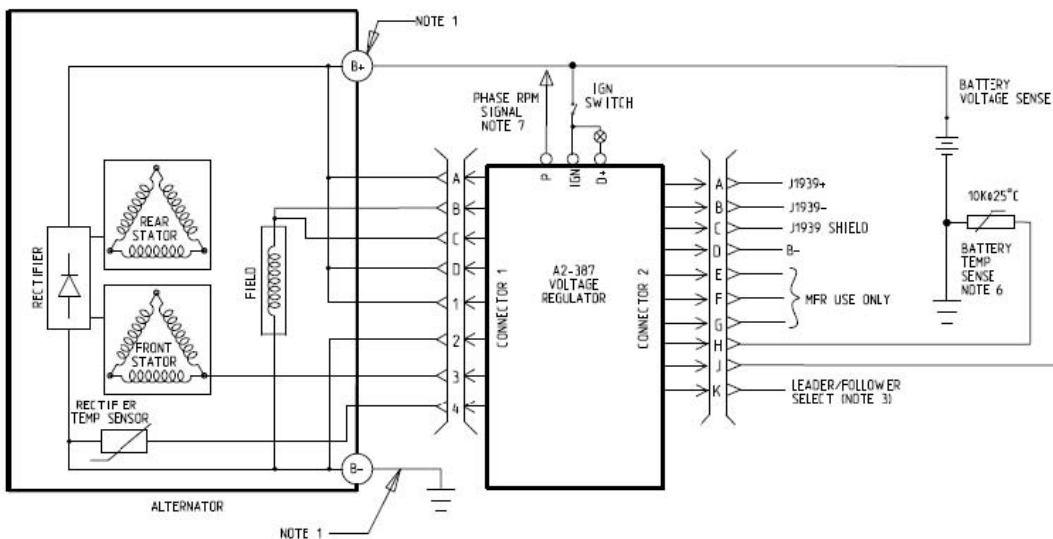


Figure 2: Alternator-to-Regulator Harness Plug Socket Outputs



NOTES:

1. Voltage drop at 550 amps between B+ terminal and battery shall not exceed 0.4 Volts. Ground cable should follow the same rule.
2. Connections to terminals "Phase," "D+," and to connector 2 are optional

Figure 3: C850 Alternator with Regulator, Wiring Diagram



Section A: Description and Operation (cont)

A2-387 Voltage Regulator

Description and Operation

The CEN A2-387 voltage regulator can be mounted directly on a C850 alternator. It may be used with or without a J1939/temperature sense harness. The A2-387 regulator features include:

- Overvoltage circuit cutoff (OVCO) that disables regulator when voltage above 32 volts is detected for more than 3 seconds.
- Temperature/voltage compensation that senses ambient temperature within the battery box and adjusts output voltage as necessary to maintain voltage set point when used with temp/voltage sensing harness.
- Battery voltage compensation when used with compatible voltage sensing harness is connected to battery bank. Regulator will boost voltage up to 1 volt to compensate for voltage drop across cabling to batteries.
- Overvoltage cutout (OVCO). Regulator will trip OVCO when system voltage rises above 32 V for longer than 3 seconds. OVCO feature detects high voltage and reacts by disconnecting field and turning off alternator. Restarting engine or waiting until system voltage drops below 28 V will reset OVCO circuit.
- P (phase) terminal that can provide optional AC voltage tap. P terminal signal frequency (Hz) x 10 = alternator shaft rpm.
- D+ terminal that can provide DC voltage signal to vehicle electrical system, confirming alternator operation.

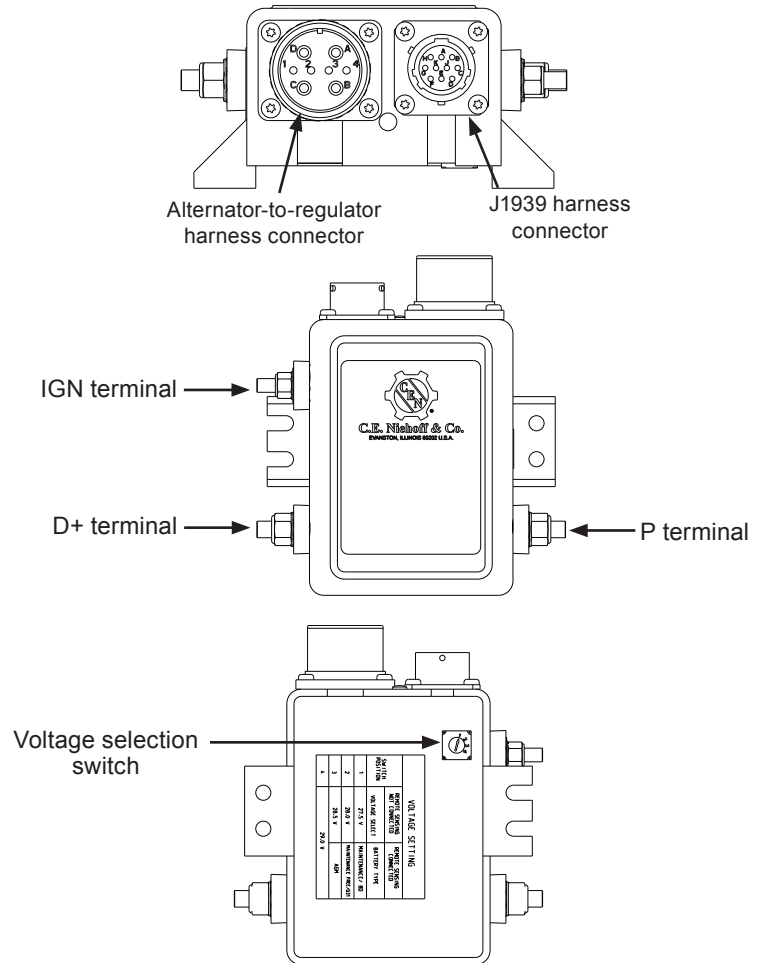


Figure 4: A2-387 Voltage Regulator

TABLE 2: A2-387 Regulator LED Indications		
LED COLOR	ALTERNATOR / REGULATOR STATUS	REQUIRED ACTION
GREEN (Solid)	Alternator and regulator operating normally.	No action required.
GREEN (Flashing)	Surge suppression circuit disabled; alternator still charging battery.	No action required.
AMBER (Solid)	Voltage is below 25.0 V	If voltage is at or below regulator setpoint, allow charging system to operate for several minutes to normalize operating temperature. If charge voltage does not increase within 10 minutes, go to Chart 1 on page 5.
AMBER (Flashing)	No rotation detected.	Power down and restart alternator. If LED remains flashing amber, perform troubleshooting procedures on page 5.
RED (Solid)	Field coil out of specification.	Power down and restart alternator. If LED remains solid red, perform troubleshooting procedures on page 5.
RED (Flashing)	OVCO condition detected.	Power down and restart alternator. If LED remains flashing red, refer to OVCO troubleshooting procedure on page 4.

NOTE: LED off = No power/output.

Section B: Basic Troubleshooting



Required Tools and Equipment

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

Identification Record

Enter the following information in the spaces provided for identification records.

- Alternator model number: _____
- Regulator model number: _____
- Voltage setpoints listed on regulator: _____

Preliminary Check-out

Check symptoms in Table 1 below and correct if necessary.

TABLE 1: Preliminary Charging System Check-Out	
CONDITION:	CHECK FOR:
Low Voltage Output	Low battery state of charge. Load on system exceeds rated output of alternator. Faulty wiring or poor ground path. Faulty alternator or regulator. Wrong regulator installed.
High Voltage Output	Faulty regulator. Faulty alternator.
No Voltage Output	No energize signal at IGN terminal on regulator. Faulty alternator B+ terminal connection. Faulty alternator or regulator.

Basic Troubleshooting

1. Inspect charging system components for damage. Check connections at B– cable, B+ cable, and regulator harness. Check 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. Determine battery type, voltage, and state of charge. Batteries must be all the same type. If batteries are discharged, recharge or replace batteries. Electrical system cannot be properly tested unless batteries are charged 95% or higher. See page 1 for details.

4. Connect meters to alternator:
 - Connect DMM red lead to alternator B+ terminal.
 - Connect DMM black lead to alternator B– terminal.
 - Clamp inductive ammeter onto B+ cable.
5. Operate vehicle and observe charge voltage. Charge voltage should increase and charge amps should decrease. Battery is considered fully charged when charge voltage is at regulator setpoint and charge amps remain at lowest value for 10 minutes.

If voltage is at or below regulator setpoint, allow charging system to operate for several minutes to normalize operating temperature. If charge voltage does not increase within 10 minutes, go to Chart 1 on page 5.

CAUTION *If voltage exceeds 32 V, shut down system immediately. Damage to electrical system may occur if charging system is allowed to operate above 32 V for more than 3 seconds.*

Check for OVCO Condition

- 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 vehicle electrical system, including loose battery cables. 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, go to Chart 2 on page 6 to test OVCO circuit.



Chart 1: No Alternator Output – Test Charging Circuit

CAUTION

When performing the following steps, make sure probes do not touch other sockets, as this may create an arc and damage plug.

- TEST MEASUREMENTS ARE TAKEN AT ALTERNATOR HARNESS PLUG. Test measurements from an extended harness plug may affect results.
- IF AVAILABLE, CONNECT A CEN A10-151 IN-LINE TEST TOOL TO HARNESS PLUG AND CONDUCT TESTS FROM A10-151 SOCKETS. Otherwise perform all tests directly from harness plug sockets.
- CHECK CONDITION OF FUSES IN REMOTE MOUNTED REGULATOR HARNESS BEFORE TESTING.
- BEFORE TESTING, VERIFY THE FOLLOWING AND REPAIR/REPLACE IF NOT TO SPECIFICATION:
 - Batteries for state-of-charge (24.5-28.0 V), condition, and secure connections.
 - Master battery switch for function.

Shut down vehicle, then restart engine. Wait until system voltages stabilizes. Does alternator function normally?

Yes
Regulator responded to overvoltage condition. See "Check for OVCO Condition" on page 4.

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

Repair vehicle wiring as necessary. Run engine and re-test charging circuit. Is charging system performing properly?

MASTER BATTERY SWITCH OFF, KEY OFF, ENGINE OFF: Disconnect alternator-to-regulator harness at regulator and perform ALL tests in table below at harness plug. If ANY expected values are not obtained, unit indicated in "TESTED CIRCUIT" column is faulty.

TEST NO.	METER SYMBOL & SCALE	METER (+)	METER (-)	TESTED CIRCUIT	EXPECTED VALUE
1	VDC	Socket A	Socket 2	Regulator B+, B-	Battery voltage
2	VDC	Socket D	Socket 2	Regulator B+, B-	Battery voltage
3	VDC	Socket 1	Socket 2	Regulator B+, B-	Battery voltage
4	Ohms Ω	Socket B	Socket 2	Alt. Field Coil	1 – 1.5 ohms
5	Ohms Ω	Socket C	Socket 2	Alt. Field Coil	1 – 1.5 ohms
6	Diode →	Socket 3	Socket 2	Alt. AC	Blocking
7	Diode →	Socket 2	Socket 3	Alt. AC	Flow
8	Diode →	Socket 3	Sockets A, D, 1	Alt. AC	Flow
9	Diode →	Sockets A, D, 1	Socket 3	Alt. AC	Blocking
10	Ohms Ω	Socket 4	Socket 2	Harness/temp sensor	60K-130K ohms

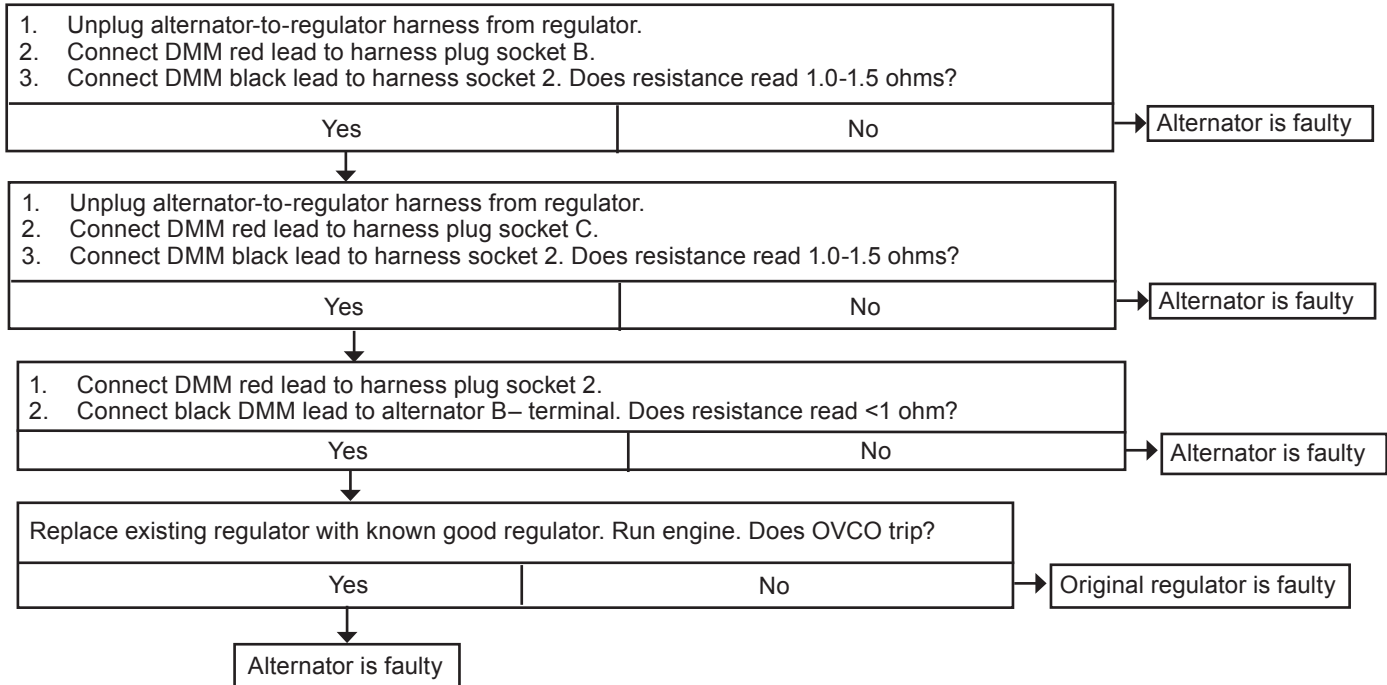
NOTICE

DO NOT MODIFY THIS CHART

Section C: Advanced Troubleshooting (CONT'D)



Chart 2: Test OVCO Circuit



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:
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