CONTENTS

Battery Charging Conditions

The following conditions may be observed during cold-start voltage tests until temperatures of electrical system components stabilize. The time it takes to reach optimum voltage and amps will vary with engine speed, load, and ambient temperature.

Maintenance/Low Maintenance Lead-Acid Battery:

Traditional lead acid batteries require lowest charge voltage of all vehicle battery chemistries. Battery cells must be maintained by periodically topping off with distilled water as required.

Maintenance-free Lead-Acid Battery:

Maintenance-free batteries are similar to Maintenance/ Low Maintenance batteries, but may require slightly higher charge voltage.

Deep-cycle/Marine Maintenance-free Battery:

Charge acceptance of these batteries may display characteristics similar to maintenance-free batteries and may charge faster due to generally lower capacity relative to size.

AGM (Absorbed Glass Mat) Maintenance-free Battery:

These dry-cell batteries respond better than standard maintenance-free batteries. If battery state of charge (SOC) drops to 75% or less, batteries should be recharged to 95% or higher separately from engine 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, but may require higher charge voltage and will draw significant current (<100 amps) when under 50% SOC.

Lithium Battery:

Lithium batteries have unique charging characteristics that differ from lead acid. These batteries require charging systems configured specifically for lithium battery chemistries. Contact CEN for more information on lithium battery charging systems and components.

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.

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 meter leads touch source area only. Allowing fingers or body parts to touch meter leads or source during reading may alter 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.
- "OL" as referenced in this document refers to open circuit: "infinite" resistance, typically in very high kilo- or megaohm range depending on meter and settings.

Diode testing:

- Diodes allow current to flow in one direction only. Typical voltage drop in forward bias can range from 0.1-0.85V. Meter should read OL in reverse bias. Check meter user manual for meter-specific testing guidelines.

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 not limited to, inadequate cable gauge or faulty connections.
- Voltage drop measurements must be taken with all electrical loads or source operating.

Dynamic/Live testing (Connecting power and ground to 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.

CEN N1240-3/N1243-2 Alternators Description and Operation

N1240-3 and N1243-2 28 V 260 A alternators are internally rectified. All windings and current-conducting components are non-moving, so there are no brushes or slip rings to wear out.

After engine is running, **N3218** regulator receives energize signal. 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.

N3218 regulator used with these units also

- is negative temperature compensated. Setpoint is 28.8 ± 0.5 V at 72 F when configured to operate with 6TMF type batteries.
- provides overvoltage cutout (OVCO). Regulator will trip OVCO when system voltage rises above setpoint by 3 V for longer than 3 seconds. OVCO feature detects high voltage and reacts by opening alternator field circuit and turning off alternator. Restarting engine or waiting until system voltage drops 5 V below setpoint will reset OVCO circuit.
- maintains alternator steady-state output voltage at regulated settings as vehicle electrical loads are switched on and off.

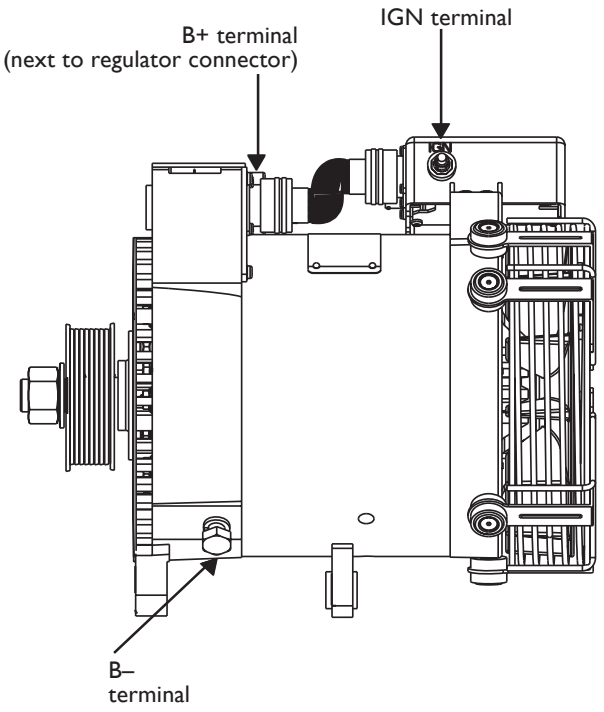


Figure 1 — N1240-3/N1243-2 Alternators and N3218 Regulator Terminals

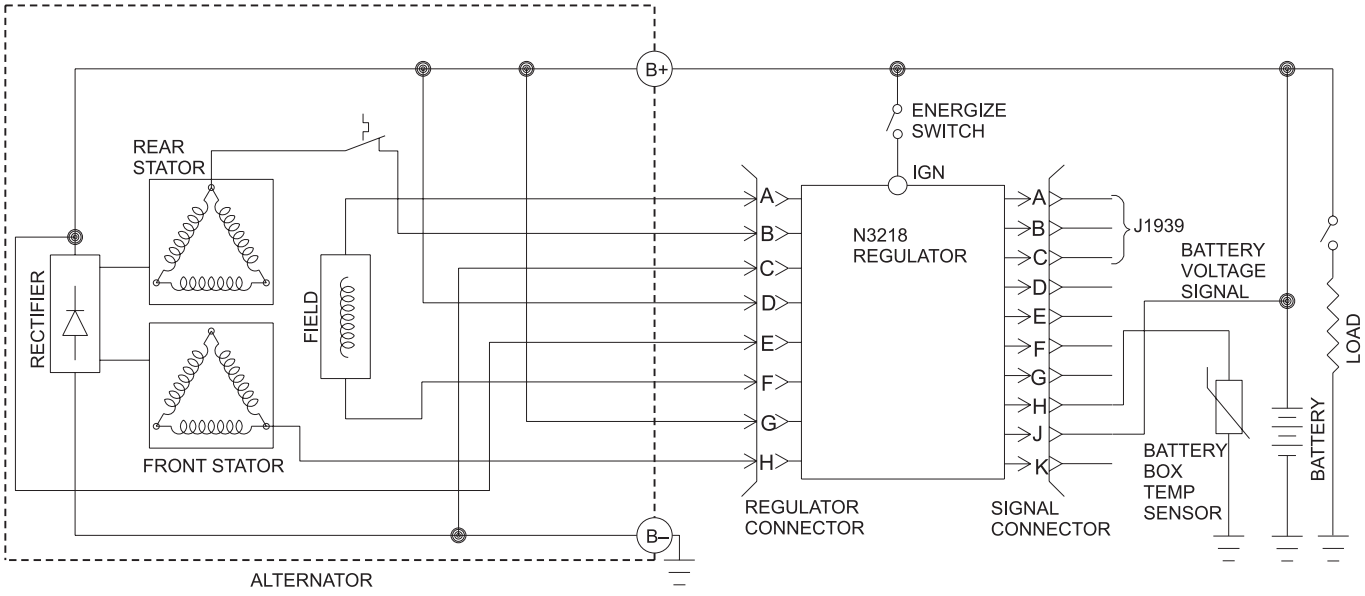


Figure 2 — N1240-3/N1243-2 Alternators with N3218 Regulator

CAN/J1939 Interface

DESCRIPTION AND OPERATION

The CEN N3218 digital regulator is compatible with SAE J1939 communications standard for vehicle networking.

CEN uses MIL-STD connector MS3112E12-10P to interface between the N3218 and the vehicle J1939 databus and battery box sensors. Mating connector is MS3116E12-10S or equivalent. If this connection is not used, it must be sealed with connector cover MS3181-12CA or equivalent. Connector pinout is shown in Table 1. Message content is shown in Table 2.

Battery box sensing inputs connect to battery pack positive terminal (pin J) and battery box thermistor (pin H). Thermistor is 10K NTC with 32650Ω at 0ºC, 10000Ω at 25ºC, 3601Ω at 50ºC and 1% interchangeability. Thermistor location should be chosen so that it closely represents battery case temperature. Thermistor connects between pin H and vehicle chassis, battery pack negative terminal, or negative bus bar. If either sensing input (pin H or J) is not used, regulator will default to internal temperature and alternator voltage.

TABLE 1 – J1939 Connector Circuit Identification

Pin	Identification
A	J1939+
B	J1939–
C	J1939/SHLD
D	B–/GND
E	Mfr use only
F	Mfr use only
G	Mfr use only
H	Ext. Temp. Sense
J	Ext. Voltage Sense
K	unused

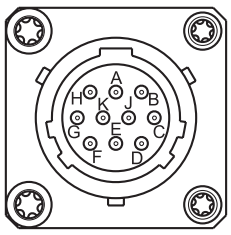


Figure 3 – J1939 Connector Pins

TABLE 2 – N3218 Regulator/J1939 Readout Diagnostics (see Table 3)

Regulator Readout	Expected Reading	Action If Expected Reading Not Present
Alternator Speed	1500 to 8000 RPM	Check belts and pulley.
Alternator Voltage	26 to 30 V (when charging)	Check alternator drive and regulator IGN signal.
Battery Voltage	26 to 30 V (when charging)	Check battery box voltage sense signal.
Regulator Temp.	–40 to 125ºC	Check regulator.
Alternator Current	0 to 300 A	Check alternator output cabling.
Alternator Load	0 to 100%	Check alternator output cabling.
Battery Temp.	–40 to 80ºC	Check battery box thermistor.
Stator Voltages	10 to 18 V (when charging)	Check alternator belts and output.

Table 3 — Message Data

PGN	Name	1 (1)	2	3	4	5	6	7	8
FED5	Alt. Speed	Alt. Speed							
FEF7	Alt. Voltage			Alt. Voltage				Batt. Voltage	
FEA7	Alt. Temp.				Reg. Temp.				
FFC8	Proprietary #1	Alt. Current		(2)	(2)	Alt. Hrs.		Load	Batt. Temp.
FFC9	Proprietary #2	(2)	(2)	OVCO Count	(2)	(2)	(2)	(2)	(2)
FFCA	Proprietary #3	Stator 1 Voltage		Stator 2 Voltage					

Notes:
(1) Byte 1 broadcast closest to CAN frame ID.

(2) Contact C. E. Niehoff & Co. for definition of custom proprietary message content.

A. Tools and Equipment for Job

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

B. Identification Record

List the following for proper troubleshooting:

❑ Alternator model number _____

❑ Regulator model number _____

C. Preliminary Check-out

Check symptoms in Table 4 and correct as necessary.

TABLE 4 – 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. Check: defective alternator and/or regulator.
High Voltage Output	Check: defective regulator. Check: alternator.
No Voltage Output	Check: presence of energize signal to E terminal on regulator. Check: battery voltage at alternator output terminal. Check: defective alternator and/or regulator.

D. Basic Troubleshooting

1. **Inspect charging system components**
   Check connections at ground cables, positive cables, and regulator harness. Repair or replace any damaged component before troubleshooting.
2. **Inspect connections of vehicle batteries**
   Connections must be clean and tight.
3. **Determine battery type, voltage, and state of charge**
   Batteries must be all the same type for system operation. If batteries are discharged, recharge or replace batteries as necessary. Electrical system cannot be properly tested unless batteries are charged 95% or higher. See page 1 for details.
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 33 volts, immediately shut down system. Electrical system damage may occur if charging system is allowed to operate at excessive voltage. Go to Table 4 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.

TROUBLESHOOTING

Shut down vehicle and restart engine. If alternator functions normally after restart, a “no output condition” was normal response of voltage regulator to overvoltage condition. Inspect condition of electrical system.

If you have reset alternator once, and electrical system returns to normal charge voltage condition, there may have been a one time, overvoltage spike that caused 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 a third time, go to Chart 1, page 5.

Chart 1 – No Alternator Output – Quick Diagnostic

With engine running: Does battery voltage exist at alternator B+ terminal and regulator IGN terminal?

- Yes → With key off, engine off: Does battery voltage exist at alternator B+ terminal?
- No → Repair vehicle harness circuit to IGN terminal on regulator or B+ terminal on alternator.

With key off, engine off: Does battery voltage exist at alternator B+ terminal?

- Yes → With key off, engine off: Unplug alternator-to-regulator harness. Connect DMM on DC volt scale across pins C and D. Does battery voltage exist?
- No → Repair vehicle harness circuit to B+ terminal on alternator.

With key off, engine off: Unplug alternator-to-regulator harness. Connect DMM on DC volt scale across pins C and D. Does battery voltage exist?

- Yes → With DMM on resistance scale, does the field resistance between pins F and A in harness plug measure about 1.4 (±0.2) ohms?
- No → Alternator is defective.

With DMM on resistance scale, does the field resistance between pins F and A in harness plug measure about 1.4 (±0.2) ohms?

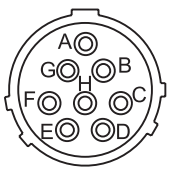
- Yes → Set DMM to diode test. Check continuity of thermal switch and rear stator diodes: Connect red lead to pin B in harness plug. Connect black lead to alternator B+ terminal. Meter should read one diode drop (approx. 0.6 to 0.9 V). Disconnect leads. Connect red lead to alternator B– terminal. Connect black lead to pin B. Meter should read one diode drop (approx. 0.6 to 0.9 V).
- No → Alternator is defective.

Set DMM to diode test. Check continuity of thermal switch and rear stator diodes: Connect red lead to pin B in harness plug. Connect black lead to alternator B+ terminal. Meter should read one diode drop (approx. 0.6 to 0.9 V). Disconnect leads. Connect red lead to alternator B– terminal. Connect black lead to pin B. Meter should read one diode drop (approx. 0.6 to 0.9 V).

- Yes → Set DMM to diode test. Check continuity of front stator diodes: Connect red lead to pin H in harness plug. Connect black lead to alternator B+ terminal. Meter should read one diode drop (approx. 0.6 to 0.9 V). Disconnect leads. Connect red lead to alternator B– terminal. Connect black lead to pin H. Meter should read one diode drop (approx. 0.6 to 0.9 V).
- No → Alternator is defective.

Set DMM to diode test. Check continuity of front stator diodes: Connect red lead to pin H in harness plug. Connect black lead to alternator B+ terminal. Meter should read one diode drop (approx. 0.6 to 0.9 V). Disconnect leads. Connect red lead to alternator B– terminal. Connect black lead to pin H. Meter should read one diode drop (approx. 0.6 to 0.9 V).

- Yes → Go to Page 6 to continue.
- No → Alternator is defective.



PIN CONNECTIONS

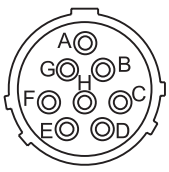
Pin A	F–
Pin B	Phase 1
Pin C	GND/B–
Pin D	B+
Pin E	Kelvin –
Pin F	F+
Pin G	Kelvin +
Pin H	Phase 2

Figure 4 – Alternator-to-Regulator Harness Plug

Chart 1 cont'd from Page 5 – No Alternator Output – **Quick Diagnostic**

With DMM on resistance scale: Connect red lead to pin E in harness plug. Connect black lead to alternator B+ terminal. Meter should read 0 ohms. Change pin E to pin G. Meter should read 0 ohms.

- Yes → Momentarily (1 sec.) jumper pin F in harness plug to alternator B+ terminal. Touch shaft with steel tool to detect significant magnetism. Is shaft magnetized?
  - Yes → Regulator is defective.
  - No → Alternator is defective.
- No → Alternator is defective.



PIN CONNECTIONS

Pin A	F–
Pin B	Phase 1
Pin C	GND/B–
Pin D	B+
Pin E	Kelvin –
Pin F	F+
Pin G	Kelvin +
Pin H	Phase 2

Figure 5 – Alternator-to-Regulator Harness Plug