



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 if ignored.

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 or low maintenance battery:
 - Immediately after engine starts, system volts are lower than regulator setpoint with medium amps.
 - 3-5 Minutes into charge cycle, system volts are higher and amps are dropping.
 - 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 charging amps.
 - 15-30 minutes into charge cycle, volts and amps are still low.
 - 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 setpoint 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 setpoint 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 setpoint.
- **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 NI224-1/NI224-2/NI224-3 Alternators

Description and Operation

N1224 28 V 260 A/14 V 140 A dual voltage alternator is internally rectified. All windings and current-conducting components are non-moving, so there are no brushes or slip rings to wear out. Energize switch (commonly an oil pressure switch or ignition switch) activates regulator. Field coil is then energized when rotation is detected. Upper voltage (28 V) is rectified with standard diodes. Lower voltage (14 V) circuit output current is controlled by SCRs. Alternator output current is self-limiting and will not exceed rated capacity of alternator.

N3221 regulator provided with N1224-1 alternator, **N3229** regulator provided with N1224-2 alternator, and **N3232** regulator provided with N1224-3 alternator

- are flat temperature compensated. Setpoint is 28.0 ± 1.0 V and 14.0 ± 0.5 V at all temperatures.
- provide 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.
- maintain alternator steady-state output voltage at regulated settings as vehicle electrical loads are switched on and off.

In addition, **N3232** regulator provided with N1224-3 alternator

- limits alternator output to 200 A.
- automatically determines operating mode (see Chart 5).

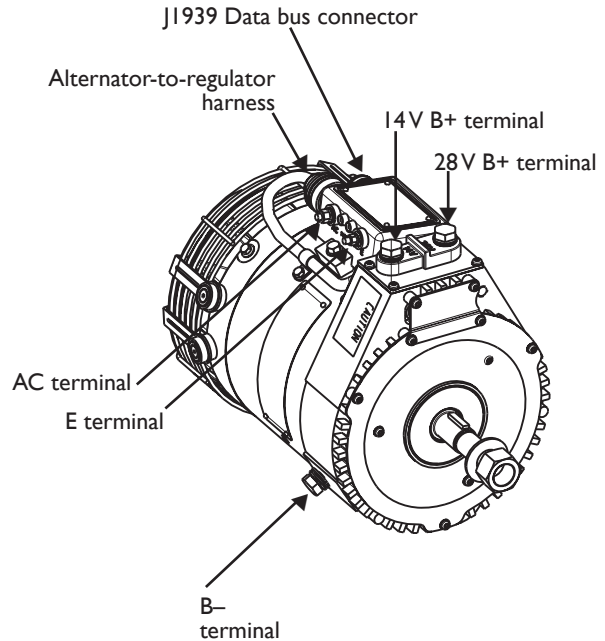


Figure 1 — Alternator and Regulator Terminals

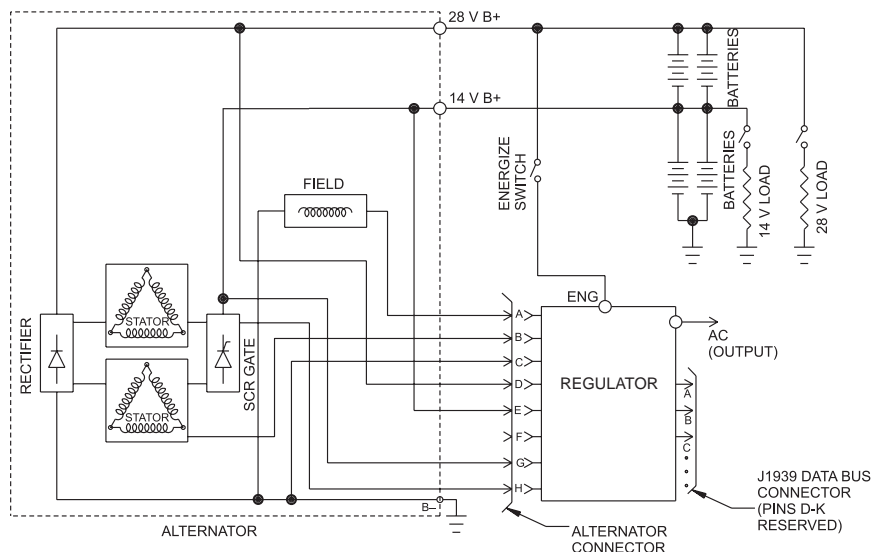


Figure 2 — NI224-1 Alternator with N3221 Regulator/NI224-2 Alternator with N3229 Regulator/NI224-3 Alternator with N3232 Regulator



N3221/N3229/N3232 Regulator

DESCRIPTION AND OPERATION

N3221/N3229/N3232 Regulators with OVCO are attached directly to the outside of alternator. Regulator setpoint has flat temperature compensation. Voltage setpoint is 28.0 ± 1.0 V and 14.0 ± 0.5 .

Once generating power, the alternator will continue to do so, even if external energize signal is removed. Once energize signal is removed, the alternator will shut down approximately 5 seconds after it stops rotating.

Main diagnostic feature of regulators consists of two tricolored (red, amber, green) LEDs located on the side of the regulator. One LED indicates 28 V system performance, the other LED indicates 14 V system performance. The two LEDs work independently of each other. See Table 1 for diagnostic features and LED explanations.

OVCO (overvoltage cutout) will trip at any of the following conditions:

- 14 V side trips at voltage **higher** than regulator setpoint that exists longer than 3 seconds of reading voltage above 16 V. OVCO feature detects overvoltage and reacts by disabling the alternator field circuit. This turns off alternator (14 V LED is steady RED light). OVCO circuit will reset by either:
 - Restarting engine (regulator regains control of alternator output voltage) OR
 - System voltage falling below 11 V. OVCO will automatically reset.

- 28 V side trips at voltage **higher** than regulator setpoint that exists longer than 3 seconds of reading voltage above 32 V. OVCO feature detects overvoltage and reacts by disabling the alternator field circuit. This turns off alternator (28 V LED is steady RED light). OVCO circuit will reset by either:
 - Restarting engine (regulator regains control of alternator output voltage) OR
 - System voltage falling below 22 V. OVCO will automatically reset.

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, including loose battery cables, both positive and negative. If battery disconnects from system, it could cause overvoltage 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, 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, check color of LED while engine is running.

28 V RED LED - go to Chart 3, page 7.

14 V RED LED - go to Chart 4, page 7.

TABLE 1 – N3221/N3229/N3232 Regulator LED Operation Modes

LED COLOR	STATUS
OFF	Regulator is not energized. Measure E terminal voltage. If voltage above 21 V, regulator is defective.
FLASHING Green	Respective system voltage is at regulated setting and operating under control.
Amber	Respective system voltage is below regulated setting. Alternator is not producing power or circuit is overloaded. See Chart 1 on page 6 for 28 V systems, Chart 2 on page 7 for 14 V systems.
Red	Respective system voltage is above regulated setting. This may occur intermittently with voltage transients or with system faults.
STEADY Red	Alternator is shut down and is not producing power for either voltage. 28 V side trips after 3 seconds of reading voltage above 32 V. 14 V side trips after 3 seconds of reading voltage above 16 V. Regulator remains in this mode until reset by restarting engine or if system voltage drops below 22 V or 11 V, respectively. See Chart 3 on page 7 for 28V systems, Chart 4 for 14 V systems.



CAN/J1939 Interface

DESCRIPTION AND OPERATION

The CEN N3221, N3229, and N3232 digital regulators are compatible with SAE J1939 communications standard for vehicle networking.

CEN uses MIL-STD connector MS3112E12-10P to interface between the regulator and the vehicle J1939 databus. Mating connector is MS3116E12-10S or equivalent. If this connection is not used, it must be sealed with connector cap and chain MS3181-12CA or equivalent-supplied with all regulators. Connector pinout is shown in Table 2. Message content is shown in Table 4.

Pin	Identification
A	J1939+
B	J1939-
C	J1939/SHLD
D	Mfr use only
E	Mfr use only
F	Mfr use only
G	Mfr use only
H	unused
J	unused
K	unused

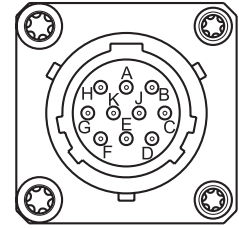


Figure 3 – J1939 Connector Pins

Regulator Readout	Expected Reading	Action If Expected Reading Not Present
Alternator Output Voltage 28 V	27–29 V	See Chart 1, page 6.
Alternator Output Voltage 14 V	13.5–14.5 V	See Chart 1, page 6.
Alternator Speed	1200 to 8000 RPM	Check drive belt and charging system connections.
Regulator Temperature	Less than 257 F/125°C	Decrease load on alternator.
Alternator Output	0–100%	Varies with load.
Charging System Hours	>0 hours	Check drive belt and charging system connections.

PGN	Name	1	2	3	4	5	6	7	8
FED5	Alt. Speed	ALT RPM							
FEF7	Alt. Voltage	24 V OUTPUT			12 V OUTPUT				
FEA7	Temperature				REG TEMP				
FFC8	Proprietary #1	ALT LOAD	STATUS	OVCO TRIP COUNT	REG HOUR METER		REG MINS (0-59)		

Notes:

Unused bytes broadcast as 0xff.

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 5 and correct as necessary.

TABLE 5 – 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 and/or regulator.
High Voltage Output	Check: wrong regulator. Check: defective regulator. Check: alternator.
No Voltage Output	Check: presence of energize signal. Check: battery voltage at alternator output terminal. Check: defective alternator and/or regulator.
No 14 V Output	Go to “Flashing Amber” in Chart 2, page 7.

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 5 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 6.



Chart 1 – 28 V LED Flashing AMBER – No 28V Alternator Output – Test Charging Circuit

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

Test for battery voltage at alternator 28 V B+ terminal. Does battery voltage exist?

Yes	No
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Repair vehicle wiring as necessary. Continue test.

Jumper 28 V B+ terminal on alternator to E terminal on regulator. Wait 10 seconds. Run engine. Does alternator charge and is 28 V LED flashing GREEN?

Yes	No
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Turn off engine, leave key on. Remove jumper wire. Go to E terminal on regulator. Test for battery voltage going into E terminal from battery. Does battery voltage exist?

Yes	No
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Repair vehicle circuit to E terminal. Vehicle charging circuit test is complete.

Run engine and re-test charging circuit for operation.

CAUTION

When performing the following test, connect jumper wire away from pin A or not at pin A. Spark may erode pin.

Turn off engine, leave key on. Connect jumper wire from pin A in alternator-to-regulator harness plug to B+ terminal on alternator. Spark will occur. Touch steel tool to shaft to detect significant magnetism. Is shaft magnetized?

Yes	No
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Alternator is defective.



PIN CONNECTIONS

- Pin A F+
- Pin B AC
- Pin C B-
- Pin D 28V B+
- Pin E 14V B+
- Pin F Unused
- Pin G +14V Kelvin
- Pin H SCR Gate

Figure 4 – Alternator-to-Regulator Harness Plug

Set DMM to diode test. Connect DMM red lead to pin C on harness plug. Connect black lead to alternator B+ terminal. Reverse leads. Meter should read OL in one direction, and voltage drop in the other direction. Do tests prove out?

Yes	No
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Regulator is defective.

Alternator is defective.



Chart 2 – 14 V LED Flashing AMBER – No 14 V Alternator Output – Test Circuit

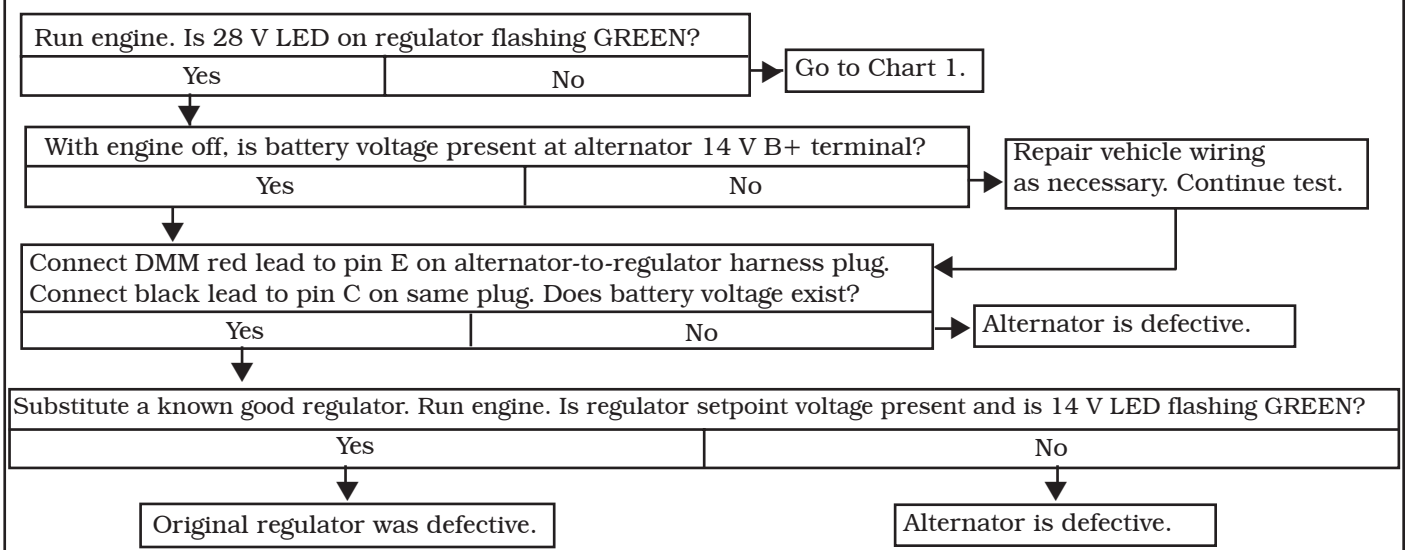


Chart 3 – 28 V LED Steady RED– No Alternator Output – Test OVCO Circuit

Remove 28V and 14V positive battery cables AT BATTERY PACK before proceeding.

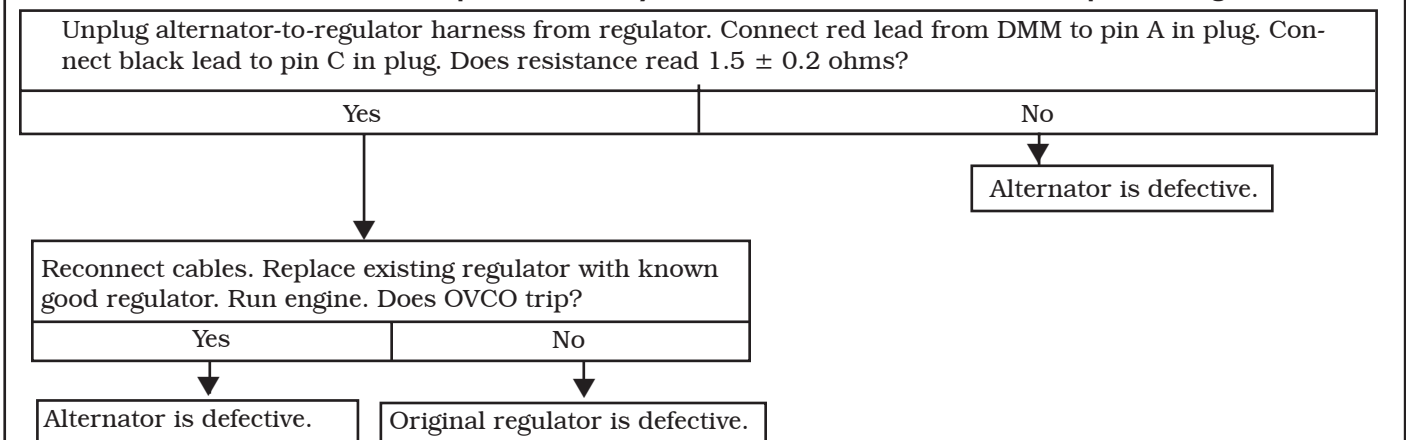


Chart 4 – 14 V LED Steady RED– No Alternator Output – Test OVCO Circuit

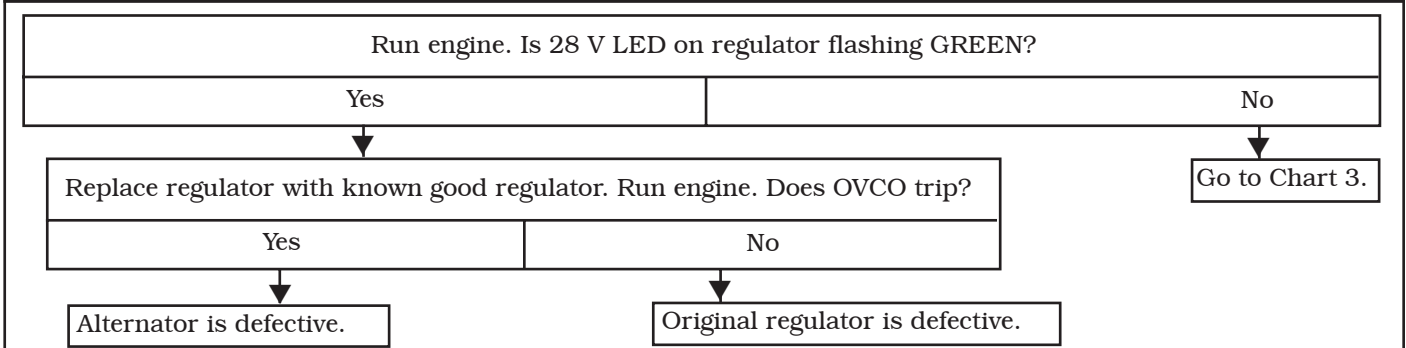




Chart 5 – Auto Select of Operating Mode (N3232 Only)

After power up, measure voltage on alternator 14 V output terminal. Is this voltage greater than 5 V?

Yes

No

Alternator will operate in dual voltage mode with 200 A output limit on 28 V and 140 A output limit on 14 V to a combined total of 200A.

Alternator will operate in single voltage mode with 200 A output limit on 28 V. No 14 V output.

Both diagnostic LEDs will flash per Table 1.

Only 28 V diagnostic LED will flash per Table 1.

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:

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