

# CHARGING SYSTEM

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## GENERAL INFORMATION

### OVERVIEW

The battery, starting, and charging systems operate with one another, and must be tested as a complete system. To allow the vehicle to start and charge properly, all of the components involved in these three systems must perform within specifications.

Group 8A in this service manual covers the battery, Group 8B covers the starting system, and Group 8C covers the charging system. Refer to Group 8W, Wiring Diagrams for complete circuit descriptions and diagrams. When attempting to diagnose any of these systems, it is important to keep their interdependency in mind.

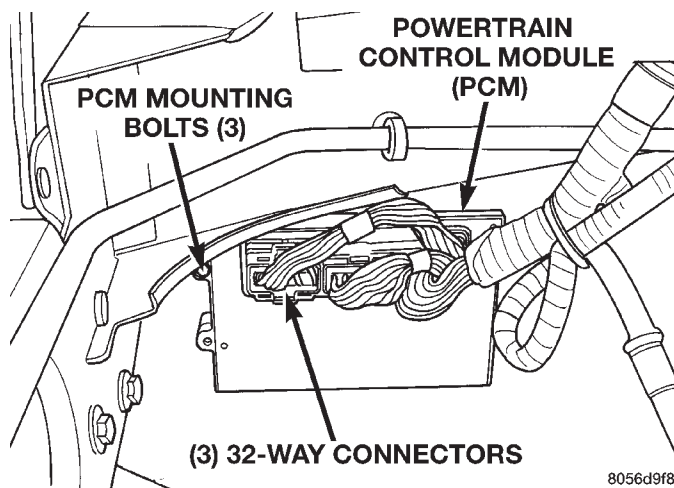
Certain charging system circuits are monitored by On-Board Diagnostics (OBD) built into the Powertrain Control Module (PCM) (Fig. 1). Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for certain failures it detects. Refer to On-Board Diagnostics in Group 25, Emission Control System for a complete list of DTC's and for information necessary to access a DTC.

## DESCRIPTION AND OPERATION

### CHARGING SYSTEM OPERATION

The charging system consists of:

- Generator
- Electronic Voltage Regulator (EVR) circuitry within the Powertrain Control Module (PCM) (Fig. 1).
- Ignition switch (refer to Group 8D, Ignition System for information)
- Battery (refer to Group 8A, Battery for information)
- Battery temperature sensor
- Generator Lamp (if equipped)



**Fig. 1 Powertrain Control Module (PCM) Location**

- Voltmeter (refer to Group 8E, Instrument Panel and Gauges for information)
- Wiring harness and connections (refer to Group 8W, Wiring for information)

The charging system is turned on and off with the ignition switch. The system is on when the engine is running and the ASD relay reacted. When the ASD relay is on, voltage is supplied to the ASD relay sense circuit at the PCM. This voltage is connected through the PCM and supplied to one of the generator field terminals (Gen. Source +) at the back of the generator.

The amount of DC current produced by the generator is controlled by the EVR (field control) circuitry contained within the PCM. This circuitry is connected in series with the second rotor field terminal and ground.

A battery temperature sensor, located in the battery tray housing, is used to sense battery temperature. This temperature data, along with data from monitored line voltage, is used by the PCM to vary the battery charging rate. This is done by cycling the

## DESCRIPTION AND OPERATION (Continued)

ground path to control the strength of the rotor magnetic field. The PCM then compensates and regulates generator current output accordingly.

All vehicles are equipped with On-Board Diagnostics (OBD). Some OBD-sensed systems, including EVR (field control) circuitry, are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for certain failures it detects. Refer to On-Board Diagnostics in Group 25, Emission Control System for more DTC information.

Operation of the generator lamp is controlled by the PCM.

## GENERATOR

The generator is belt-driven by the engine using a serpentine type drive belt. It is serviced only as a complete assembly. If the generator fails for any reason, the entire assembly must be replaced.

As the energized rotor begins to rotate within the generator, the spinning magnetic field induces a current into the windings of the stator coil. Once the generator begins producing sufficient current, it also provides the current needed to energize the rotor.

The Y type stator winding connections deliver the induced AC current to 3 positive and 3 negative diodes for rectification. From the diodes, rectified DC current is delivered to the vehicle electrical system through the generator battery and ground terminals.

Although the generators appear the same externally, different generators with different output ratings are used on this vehicle. Be certain that the replacement generator has the same output rating and part number as the original unit. Refer to Generator Ratings in the Specifications section at the back of this group for amperage ratings and part numbers.

Noise emitting from the generator may be caused by: worn, loose or defective bearings; a loose or defective drive pulley; incorrect, worn, damaged or misadjusted fan drive belt; loose mounting bolts; a misaligned drive pulley or a defective stator or diode.

## BATTERY TEMPERATURE SENSOR

The battery temperature sensor is used to determine the battery temperature and control battery charging rate. This temperature data, along with data from monitored line voltage, is used by the Powertrain Control Module (PCM) (Fig. 1) to vary the battery charging rate. System voltage will be higher at colder temperatures and is gradually reduced at warmer temperatures. On diesel powered vehicles, only one sensor is used (dual batteries) and is located under the battery on the drivers side of vehicle.

## ELECTRONIC VOLTAGE REGULATOR

The Electronic Voltage Regulator (EVR) is not a separate component. It is actually a voltage regulating circuit located within the Powertrain Control Module (PCM) (Fig. 1). The EVR is not serviced separately. If replacement is necessary, the PCM must be replaced.

**Operation:** The amount of DC current produced by the generator is controlled by EVR circuitry contained within the PCM. This circuitry is connected in series with the generators second rotor field terminal and its ground.

Voltage is regulated by cycling the ground path to control the strength of the rotor magnetic field. The EVR circuitry monitors system line voltage and battery temperature (refer to Battery Temperature Sensor for more information). It then compensates and regulates generator current output accordingly. Also refer to Charging System Operation for additional information.

## REMOVAL AND INSTALLATION

### GENERATOR

#### REMOVAL

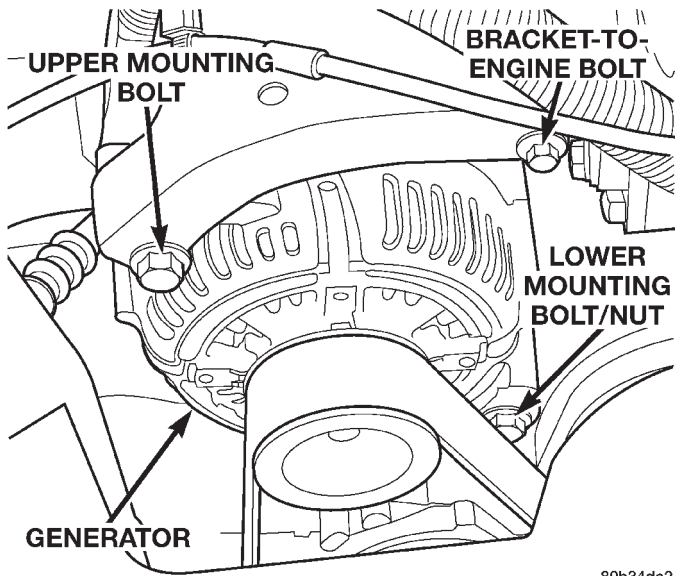
**WARNING: DISCONNECT BOTH NEGATIVE BATTERY CABLES FROM BOTH BATTERIES BEFORE REMOVING BATTERY OUTPUT WIRE (B+ WIRE) FROM REAR OF GENERATOR. FAILURE TO DO SO CAN RESULT IN INJURY OR DAMAGE TO ELECTRICAL SYSTEM.**

- (1) Disconnect both negative battery cables at both batteries.
- (2) Remove generator drive belt. Refer to Group 7, Cooling System for procedure.
- (3) Loosen (but do not remove) generator mounting bracket-to-engine bolt (Fig. 2).
- (4) Remove upper generator mounting bolt and lower mounting bolt/nut (Fig. 2).
- (5) Position generator for access to wire connectors.
- (6) Remove nuts from harness holddown, battery (B+) terminal, ground terminal and 2 field terminals. Remove wire connectors (Fig. 3).
- (7) Remove generator from vehicle.

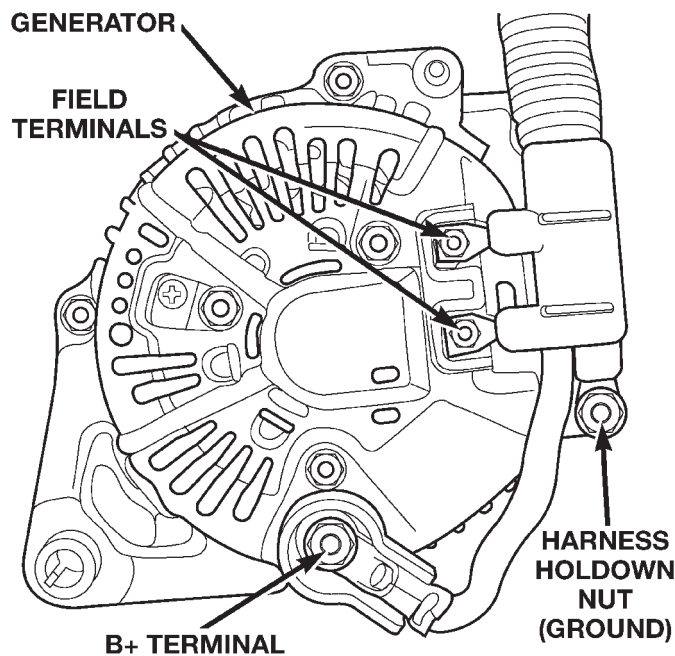
#### INSTALLATION

- (1) Position generator to engine and install wiring to rear of generator. Tighten all wiring fasteners as follows:
  - Battery (B+) terminal nut—8.5 N·m (75 in. lbs.)
  - Ground terminal nut—8.5 N·m (75 in. lbs.)
  - Harness holddown nut—8.5 N·m (75 in. lbs.)

## REMOVAL AND INSTALLATION (Continued)



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**Fig. 2 Remove/Install Generator—Diesel Engine**

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**Fig. 3 Remove/Install Generator Electrical Connectors—Diesel Engine**

- Field terminal nuts—2.8 N·m (25 in. lbs.)
- (2) Install generator mounting fasteners and tighten as follows:
- Generator upper mounting bolt—Diesel powered engines—54 N·m (40 ft. lbs.)
  - Generator pivot bolt/nut—Diesel powered engines—54 N·m (40 ft. lbs.)
  - Generator mounting bracket-to-engine bolt—Diesel powered engines—24 N·m (18 ft. lbs.)

**CAUTION:** Never force a belt over a pulley rim using a screwdriver. The synthetic fiber of the belt can be damaged.

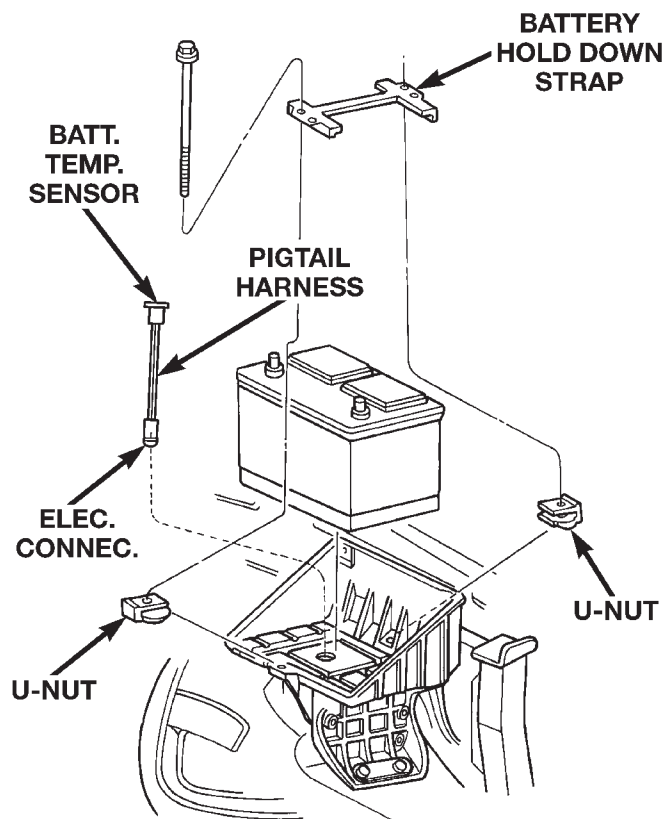
**CAUTION:** When installing a serpentine accessory drive belt, the belt **MUST** be routed correctly. The water pump will be rotating in the wrong direction if the belt is installed incorrectly, causing the engine to overheat. Refer to belt routing label in engine compartment, or refer to Belt Schematics in Group 7, Cooling System.

(3) Install generator drive belt. Refer to Group 7, Cooling System for procedure.

(4) Install both negative battery cables to both batteries.

**BATTERY TEMPERATURE SENSOR**

The battery temperature sensor is located under the vehicle battery (Fig. 4) and is attached (snapped into) a mounting hole on battery tray. On models equipped with a diesel engine (dual batteries), only one sensor is used. The sensor is located under the battery on drivers side of vehicle.



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**Fig. 4 Battery Temperature Sensor Location**

REMOVAL AND INSTALLATION (Continued)

REMOVAL

- (1) Remove battery. Refer to Group 8A, Battery for procedures.
- (2) Disconnect sensor pigtail harness from engine wire harness.
- (3) Pry sensor straight up from battery tray mounting hole.

INSTALLATION

- (1) Feed pigtail harness through mounting hole in top of battery tray and press sensor into top of tray (snaps in).
- (2) Connect pigtail harness.
- (3) Install battery. Refer to Group 8A, Battery for procedures.

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
Generator Upper Mounting Bolt	
—Diesel Engine. . . . .	54 N·m (40 ft. lbs.)
Generator Pivot Bolt/Nut	
—Diesel Engine . . . . .	54 N·m (40 ft. lbs.)
Generator Mounting	
Bracket-to-Engine Bolt	
—Diesel Engine . . . . .	24 N·m (18 ft. lbs.)
Battery Terminal Nut. . . . .	.85 N·m (75 in. lbs.)
Ground Terminal Nut. . . . .	.85 N·m (75 in. lbs.)
Harness Hold-down Nut. . . . .	.85 N·m (75 in. lbs.)
Field Terminal Nuts . . . . .	2.8 N·m (25 in. lbs.)

GENERATOR RATINGS

TYPE	PART NUMBER	RATED SAE AMPS	ENGINES	MINIMUM TEST AMPS
DENSO	56027221	136	5.9L DIESEL	120