BATTERY SYSTEM - DESCRIPTION AND OPERATION

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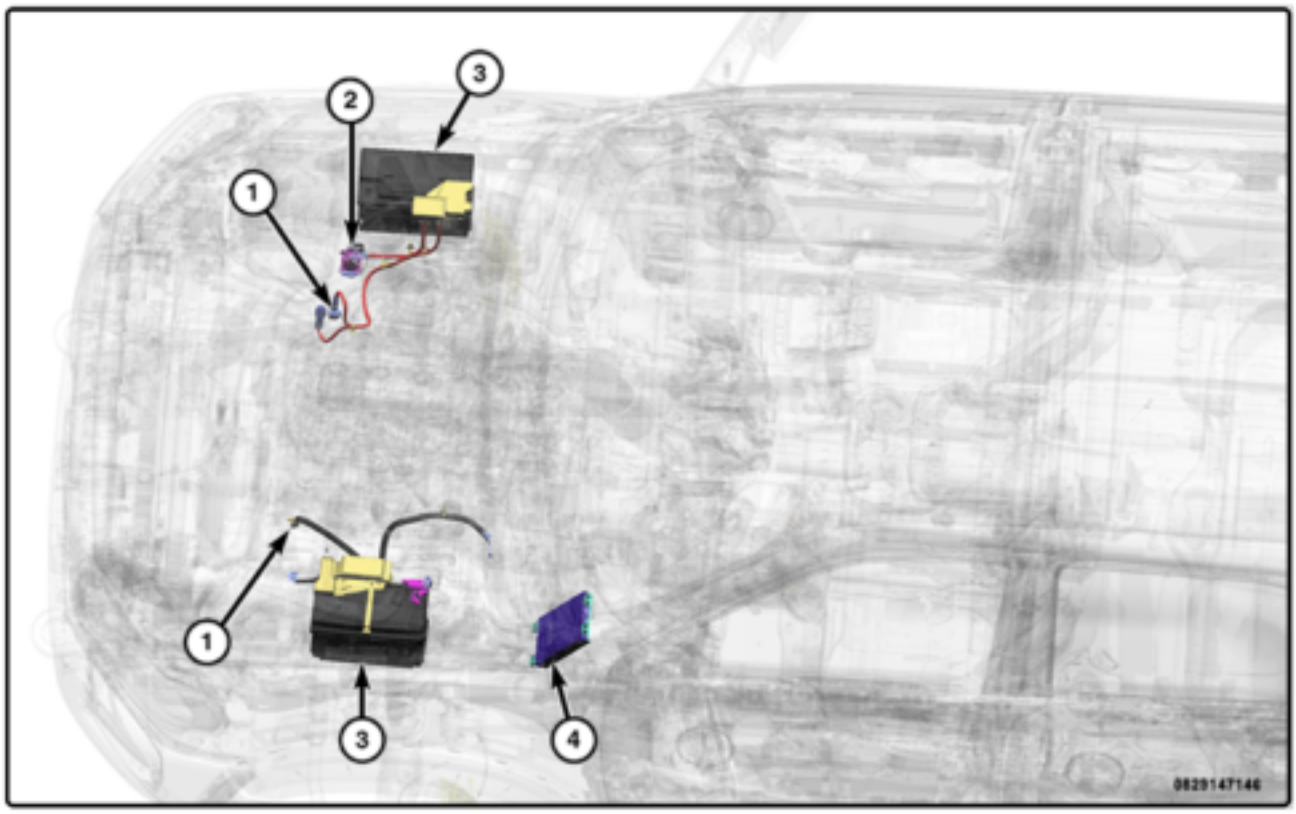
DESCRIPTION



NOTE:
Dual battery system shown, single battery system similar.

Component Index

1.	**Battery Cables**
2.	**Air Intake Heater Relay** - Diesel application
3.	**Batteries**
4.	**Body Control Module (BCM)**
—	**Intelligent Battery Sensor (IBS)**

OPERATION

Air Intake Heater Relay

Component Index

The Air Intake Heater Relay is for diesel applications, on a cold start the relay is engaged by the Powertrain Control Module (PCM) to heat the incoming air.

Batteries

Component Index

The battery is designed to store electrical energy in a chemical form. When an electrical load is applied to the terminals of the battery, an electrochemical reaction occurs. This reaction causes the battery to discharge electrical current from its terminals. As the battery discharges, a gradual chemical change takes place within each cell. The sulfuric acid in the electrolyte combines with the plate materials, causing both plates to slowly change to lead sulfate. At the same time, oxygen from the positive plate material combines with hydrogen from the sulfuric acid, causing the electrolyte to become mainly water. The chemical changes within the battery are caused by the movement of excess or free electrons between the positive and negative plate groups. This movement of electrons produces a flow of electrical current through the load device attached to the battery terminals.

As the plate materials become more similar chemically, and the electrolyte becomes less acid, the voltage potential of each cell is reduced. However, by charging the battery with a voltage higher than that of the battery itself, the battery discharging process is reversed. Charging the battery gradually changes the sulfated lead plates back into sponge lead and lead dioxide, and the water back into sulfuric acid. This action restores the difference in the electron charges deposited on the plates, and the voltage potential of the battery cells. For a battery to remain useful, it must be able to produce high-amperage current over an extended period. A battery must also be able to accept a charge so that its voltage potential may be restored.

The battery is vented to release excess hydrogen gas that is created when the battery is being charged or discharged. However, even with these vents, hydrogen gas can collect in or around the battery. If hydrogen gas is exposed to flame or sparks, it may ignite. If the electrolyte level is low, the battery may arc internally and explode.

Battery Cables

Component Index

The battery cables connect the battery terminal posts to the vehicle electrical system. These cables also provide a path back to the battery for electrical current generated by the charging system for restoring the voltage potential of the battery. The female battery terminal clamps on the ends of the battery cable wires provide a strong and reliable connection of the battery cable to the battery terminal posts. The terminal pinch bolts allow the female terminal clamps to be tightened around the male terminal posts on the top of the battery. The eyelet terminals secured to the opposite ends of the battery cable wires from the female battery terminal clamps provide secure and reliable connection of the battery cables to the vehicle electrical system.

The battery cables are serviced as a component of the wiring harness.

Body Control Module (BCM)

Component Index

The BCM is the gateway for all bus communications needing to be gated from one bus network to a different bus network.

The BCM obtains battery voltage information from the IBS over the Local Interface Network (LIN) bus. The BCM is the LIN master for the IBS and manages the IBS initialization, LIN communication, signal gating and IBS diagnostics

Load Shedding

Using the LIN, the BCM communicates with the IBS to provide load shedding. Load shedding is activated under the following conditions:

- The engine must be running with an engine speed equal to or higher than 400 Revolutions Per Minute (RPM) for greater than 50 seconds.
- The battery State of Charge (SOC) supplied signal value sent by the IBS over the LIN bus to the BCM must be less than or equal to 55%.
- The battery voltage measured by the IBS and supplied to the BCM over the LIN bus must be less than or equal to 12.2 volts.

When the vehicle is in a load shed operating state, the BCM will bus a signal to the Instrument Panel Cluster (IPC) to illuminate the “Battery Saver On” indicator.

If the battery SOC rises to a level equal to or greater than 65% and the battery voltage rises to 13 volts or higher, load shedding will begin to reverse itself putting the vehicle back to a normal operating state.

Any transition of the ignition state will rest all of the load shed output signals and therefore cancel load shedding operation.

Battery Critical State

If the battery SOC is equal to or less than 35% and the battery voltage is equal to or less than 11.8 volts, a “Battery Reached Critical State” output signal is broadcast by the BCM. Another condition to set this output signal is that the battery voltage is less than or equal to 10.9 volts and the state of charge is less than or equal to 55%.

When the battery reaches critical state, only electrical loads essential to vehicle operation are allowed to be turned on. The following actions are recommended to be taken:

- Heated seats and the heated steering wheel are disabled for the duration of the ignition cycle
- Rear defroster and heated mirrors time out in 30 seconds each time the customer turns them on for the duration of the ignition cycle
- The Heating, Ventilation, and Air Conditioning (HVAC) system is allowed only minimal loads for visibility requirements, for the duration of the ignition cycle
- The Power Inverter Module (PIM) is disabled for the duration of the ignition cycle
- Audio and Telematic systems will only allow minimal loads for communications and emergency requirements for the duration of the ignition cycle

There is no load shed recovery for a battery critical state and the vehicle operation will remain in this state until the ignition is cycled.

Inputs

- LIN communication from the IBS

Outputs

- IBS LIN communication for strategy management
- Battery voltage information and state are gated from the LIN and the BCM broadcasts this information on both the Controller Area Network-Chassis (CAN-C) and the CAN-Interior High Speed (CAN-IHS) data bus networks
- Load shedding management to the relevant nodes on all bus networks

Intelligent Battery Sensor (IBS)

Component Index

The IBS serves two primary purposes. The first is to provide the Powertrain Control Module (PCM) with both immediate and historical calculated battery information, so the PCM can control the charging system. The second purpose is to provide calculated data to the BCM for operation of the load-shedding feature. A fused power circuit and the bus are connected to the IBS though a two-terminal connector.

The IBS contains a low value resistor, or shunt. The shunt creates a voltage drop, which is read by an internal microcontroller to determine the current flow in and out of the battery. In addition to the shunt, the IBS contains a sensor to monitor the battery's temperature. Data gathered by the IBS, including temperature, voltage, and current measurements, are transmitted over a communication bus to the BCM, which is the LIN master node of the IBS. In addition to real-time measurements, the IBS transmits some calculated battery data over the bus, including SOC and State of Function (SOF). These values are calculated by storing measurements over time.

- SOC = Battery state of charge (or SOC) is expressed as a percentage. The IBS calculates the SOC based on measured voltage, charge and discharge rates. Therefore, SOC is not a direct percentage of battery voltage.
- SOF = Battery State of Function (or SOF) is a calculated prediction of the lowest voltage the battery will drop to during engine cranking.

The battery sensor is readable and diagnosable by using the diagnostic scan tool which can display all of the available parameters needed for vehicle servicing or troubleshooting.

When the IBS is powered up for the first time or is powered after a battery disconnect, it enters a "recalibration" phase, where the IBS must recognize the type of battery and its characteristics and state. This information is sent to the IBS by the BCM. In this phase the tolerances on the state functions (SOC, SOF) are greater than in normal working condition. When the IBS is disconnected from the battery, the device loses its stored memory. When power is restored, the IBS starts a relearn process. Until the relearn process is complete, accurate battery state information is unavailable to other vehicle systems. The IBS relearn process requires one start and at least 4 hours with the vehicle off, electrical system asleep. Remember, the relearn process is restarted every time power is reconnected to the IBS.