■HYBRID VEHICLE HIGH-VOLTAGE SAFETY MEASURES

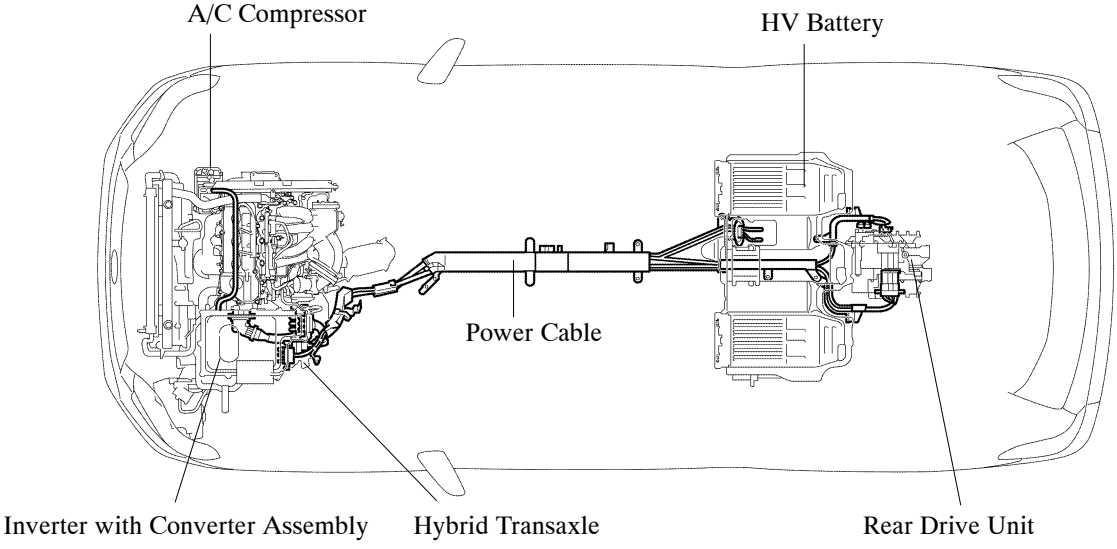
1. General

Hybrid vehicles have a high-voltage electrical circuits. Hybrid vehicles have been developed with consideration given to the protection of drivers and technicians against electrocution.

- High-voltage safety is comprised of two points: “Insulation of High-voltage Circuits” and “Cutoff of High-voltage Circuits”. The hybrid system also detects whether or not a decrease in insulation resistance has occurred between the high-voltage system and body ground.

2. Insulation of High-voltage Circuits

- High-voltage circuits are used between the HV battery, inverter with converter assembly, hybrid transaxle and rear drive unit. Each of these items is connected by the power cables and is electrically insulated using cases and covers.
- Cables are also shielded using a mesh conductor built into the electrical insulation of the wires. The shielding is grounded to the chassis of the vehicle and the main purpose is to prevent electromagnetic interference.

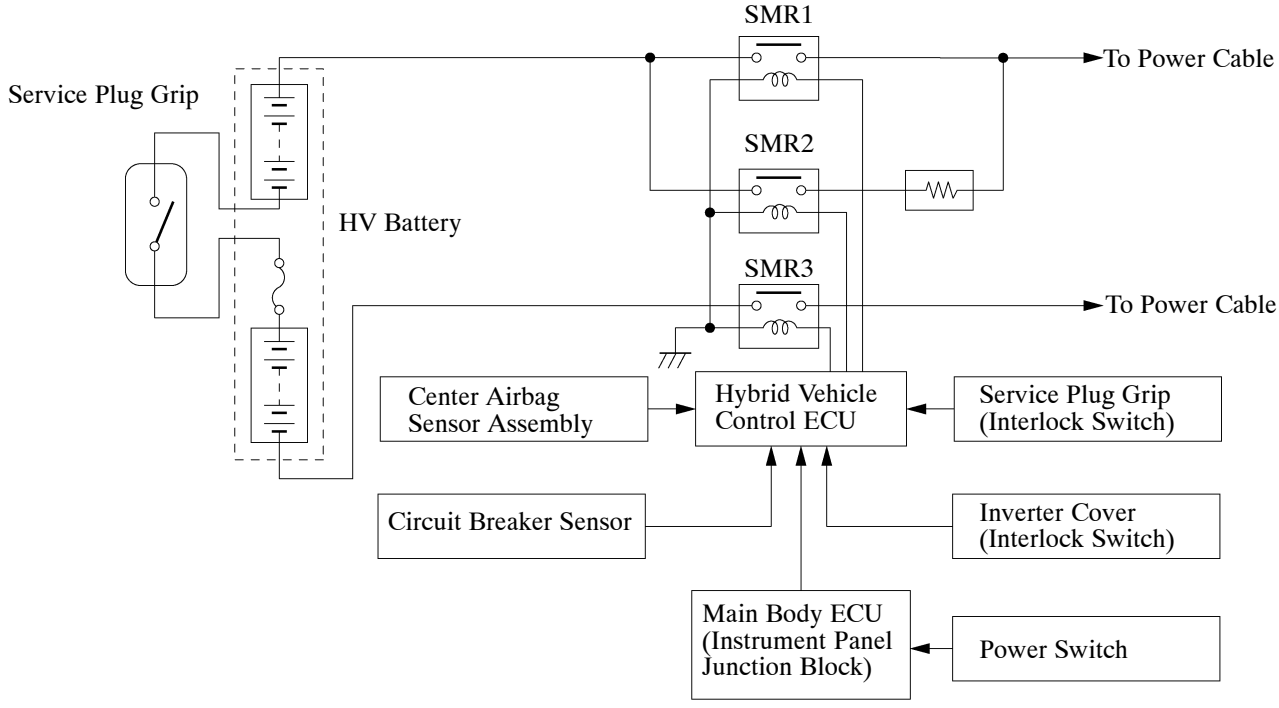


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3. Cut-off of High-voltage Circuits

- When any of the conditions below occurs, the SMRs (System Main Relays) are automatically shut off by the hybrid vehicle control ECU.
  - Power source off
  - Any airbag is deployed
  - Inverter cover is removed (interlock circuit is opened).
  - Service plug grip handle is raised partway (interlock circuit is opened)*.
  - A specified malfunction occurs.

  *: The service plug grip should never be removed when the vehicle is in the READY state.
- The service plug grip is used to cut off the high-voltage circuit manually for when service is to be performed on the vehicle.



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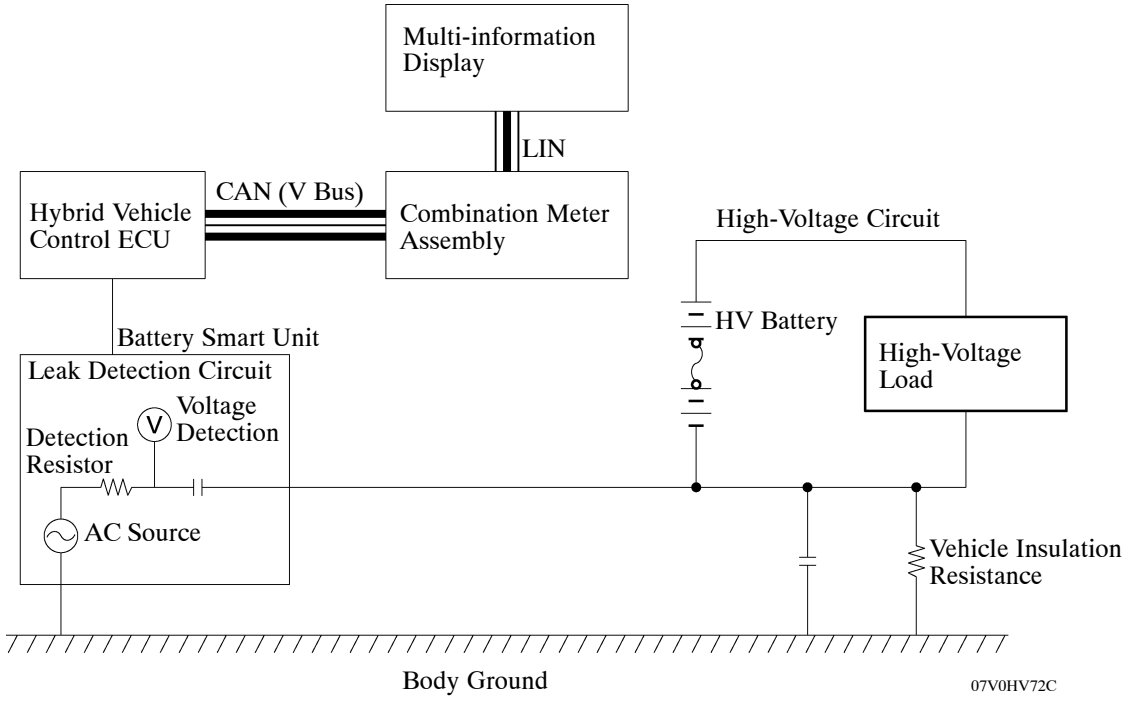
Service Tip

Discharge of the capacitor in the inverter with converter assembly

A charge remains in the high-voltage capacitor in the inverter with converter assembly after the high voltage circuits are shut down. When servicing a hybrid vehicle, after the service plug grip is removed, wait at least 5 minutes to allow the capacitor in the inverter to discharge before beginning work.

4. Detection of Insulation Resistance Decrease

- The "leak detection circuit", is built in the battery smart unit. The leak detection circuit constantly monitors that the insulation resistance between high-voltage circuits and body ground is maintained.
- If the insulation resistance decreases below a specified level, a DTC (Diagnostic Trouble Code) is stored, and the driver was informed of the abnormality condition by the multi-information display.
- The leak detection circuit has an AC source and it causes a small amount of AC to flow to the high-voltage circuit (positive and negative).
- AC flows as shown in the following illustration, via a detection resistor, a capacitor, and body ground.
- The more vehicle insulation resistance decreases, the more voltage drops at the detection resistor and the lower the waves of AC. The insulation resistance value (Tester data name: Short Wave Highest Value) is detected based on the amplitude of AC waves.



Insulation Resistance Decrease Detection System