Document ID: 1964740

Overview

The drive motor generator power inverter module assembly converts high voltage direct current (DC) electrical energy to 3 phase alternating current (AC) electrical energy. The accessory DC power control module converts high voltage DC electric energy into low voltage (14V) and intermediate voltage (42V) in order to charge the vehicles accessory battery and supply electric energy to the 42V power steering system. The accessory DC power control module and power inverter module are fastened together and are referred to as the drive motor generator control module assembly. The drive motor generator control module assembly is cooled with pre-mixed Dexcool® circulating through a cooling system that is separate from the engine cooling system. The hybrid cooling system utilizes a heat exchanger at the front of the vehicle and electric pumps to circulate the coolant. The engine control module (ECM) monitors a temperature sensor in the hybrid cooling system and operates the radiator fan and the hybrid coolant pumps in response to system temperature.

High Voltage Circuits

Direct Current (DC)

The drive motor generator control module assembly is connected to each pole of the high voltage, direct current (DC) drive motor generator battery. Both of the negative and positive high voltage DC battery poles are isolated from the vehicle chassis by a specific amount of resistance. Each high voltage DC cable is switched ON or OFF by a high voltage, high current contactor relay contained within the drive motor generator battery assembly. All high voltage DC negative and positive DC cables are individually shielded and orange in color to alert the technician to the potential presence of high voltage. The electric air conditioning compressor modulehigh voltage DC cables are externally connected at the drive motor generator control module assembly. The accessory DC power control module and power inverter module share an internal connection that supplies the accessory DC power control module with high voltage DC current.

Three Phase Alternating Current (AC)

Three cables connect each motor generator to the power inverter module. Each individually shielded cable is orange in color to alert the technician to the potential presence of high voltage.

Intermediate and Low Voltage Circuits

The accessory DC power control module converts high voltage 300V DC current into both intermediate voltage, 42V, and low voltage, 12V, current.

Intermediate Voltage 42V Direct Current

Intermediate voltage 42V cables are individually shielded and are blue in color to alert the technician to the

potential presence of intermediate voltage.

Low Voltage (12V) Direct Current

Low voltage (12V) cables on the hybrid-electric vehicle do not require unique coloring or servicing procedures.

Drive Motor Generator Power Inverter Module Assembly

Overview

Contained within the power inverter module assembly are the hybrid powertrain control module, and two motor control modules. Each motor control module controls its respective motor generator. All three modules are flash-programmable micro-processors.

Hybrid Powertrain Control Module

Location

The hybrid powertrain control module is a non-serviceable, flash-programmable micro-processor contained within the power inverter module assembly.

Operating Functions

The hybrid powertrain control module is the main controller of hybrid operation. The hybrid powertrain control module determines when to perform hybrid operation modes such as engine Auto-stop and regenerative braking. The hybrid powertrain control module also operates in conjunction with the battery energy control module to determine when to enable and disable the DC high voltage circuits. Each motor control module operates the applicable electric motor generator based upon hybrid powertrain control module commands.

Communication and Hosted Diagnostics

The hybrid powertrain control module is the host controller for diagnostic trouble code (DTC) information for the following control modules:

- Accessory DC power control module
- Battery energy control module
- Motor control module 1
- Motor control module 2
- Auxiliary transmission fluid pump control module

These modules diagnose their own operation and determine when a fault condition is present. Diagnostic status is communicated to the hybrid powertrain control module through the following circuits:

- accessory DC power control module utilizes the GM Hi-speed, Hybrid LAN communication circuit
- Battery energy control module utilizes the GM Hi-speed, Hybrid LAN communication circuit
- Each motor control module and the hybrid powertrain control module exchange information and commands

on the SPI bus internal communication circuit as well as the hi-speed hybrid GMLAN communication circuit.
- Auxiliary transmission fluid pump control module utilizes a dedicated diagnostic status circuit

In the event a hosted module communicates a fault condition, the hybrid powertrain control module will determine if hybrid operation is effected and notify the vehicle operator by requesting the MIL illuminate and/or by displaying a hybrid service required message. In addition, the hybrid powertrain control module will store the associated DTC information for retrieval by a scan tool. Some hosted modules may require an ignition cycle to clear certain DTCs from the hybrid powertrain control module.

Circuit Inputs

In addition to GMLAN parameters, the hybrid powertrain control module directly monitors the following signal circuits:

- Transmission shift selector internal mode switch (IMS) Direction and Park/Neutral switch signals
- Engine crankshaft position (CKP) sensor signal
- Auxiliary transmission fluid pump diagnostic circuit
- High voltage interlock circuit (HVIC)

Circuit Outputs

In addition to GMLAN and SPI bus commands, the hybrid powertrain control module directly controls the following output circuits:

- Auxiliary transmission fluid pump control circuit
- Battery energy control module high voltage contactor relay pulse width modulated (PWM) control circuit

Motor Control Module 1 and 2

Location

Each electric motor generator located within the transmission assembly is controlled by its own motor control module flash-programmable, micro-processor. Each motor control module is contained within the power inverter module. Also contained within the power inverter module is the hybrid powertrain control module micro-processor.

Operating Functions

Each motor control module operates the applicable electric motor generator based upon hybrid powertrain control module commands. Each motor control module controls the speed, direction and output torque of its respective traction motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors (IGBTs).

Communication and Hosted Diagnostics

In addition to the internal SPI bus communication circuit between the hybrid powertrain control module and each motor control module, the motor control modules also communicate on the Hi-speed and Hybrid GMLAN communication circuits. The motor control module does not store its own diagnostic trouble code (DTC) information. The hybrid powertrain control module will store motor control module associated DTC information for retrieval by a scan tool. The scan tool can communicate directly with each motor control module in order to retrieve data parameters only.

Circuit Inputs

In addition to GMLAN parameters, each motor control module monitors its respective motor generator for voltage, current, speed, direction and temperature. Additionally, the motor control module monitors the IGBT components for temperature and proper operation. Some of the motor control module operation data is shared with the hybrid powertrain control module.

Circuit Outputs

Each motor control module controls its respective IGBT driver board that in-turn controls each motor generator. The motor generators operate using three-phase alternating current (AC) electricity. Three cables connect each motor generator to the power inverter module. Each individually shielded cable is orange in color to alert the technician that the potential for high voltage is present.

Accessory DC Power Control Module

Location

The accessory DC power control module is affixed to and located underneath the power inverter module. It is fastened to the power inverter module with external mounting fasteners and 2 internal high voltage circuit connection fasteners. The accessory DC power control module shares a coolant passage with the power inverter module and as such is gasketed to the power inverter module.

Operating Functions

The accessory DC power control module is the device which converts high voltage (300V) direct current (DC) to low voltage (12V) DC for accessory electrical operation and to charge the 12 volt accessory battery. The accessory DC power control module also converts high voltage DC to intermediate (42V) DC to supply the electric power steering system with voltage. The accessory DC power control module is capable of supplying up to 175 Amps of 12 volt DC and up to 50 Amps of 42 volt DC. In Jump Assist mode the accessory DC power control module converts 12 volt DC to high voltage DC to charge the high voltage hybrid batteries. The accessory DC power control module is capable of supplying up to 2.7 Amps at 290 volts DC on the high voltage circuit when operating in Jump Assist. An external 12V DC battery charger is required during the Jump Assist mode because the accessory DC power control module and vehicle controllers may draw as much as 80 Amps of current from the vehicles 12 volt DC system.

Communication and Hosted Diagnostics

The accessory DC power control module has internal diagnostic tests that run at both power-up and during operation. All DTCs from the accessory DC power control module are reported to and hosted by the hybrid powertrain control module. The accessory DC power control module communicates directly only with the hybrid powertrain control module and only on the high speed hybrid GMLAN communication circuit.

Circuit Inputs

Inputs supported by the accessory DC power control module include the high voltage and 12 volt circuits. The accessory DC power control module also monitors various internal components for current, voltage and temperature. The accessory DC power control module is also connected to the high speed hybrid GMLAN communication circuit. An individual 12 volt discrete circuit powers ON the accessory DC power control module. The accessory DC power control module will not begin conversion of voltage however, until the appropriate GMLAN enable signal is communicated to it by the hybrid powertrain control module.

Circuit Outputs

The only outputs supported by the accessory DC power control module are the 12 volt and 42 volt conversion during normal vehicle operation and high voltage conversion during Jump Assist.