2014 Engine

Hybrid/EV Controls - ELR

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
300-Volt Battery Positive and Negative Cable Bolt (Drive Motor Battery-to-APM Module)	9 N.m	80 lb in
300-Volt Battery Positive and Negative Cable Bolt (Drive Motor Battery-to-Inverter)	9 N.m	80 lb in
Accessory DC Power Control Module Bolts	19 N.m	14 lb ft
Accessory DC Power Control Module Nuts	22 N.m	16 lb ft
Accessory DC Power Control Module Ground Cable Nut	22 N.m	16 lb ft
Accessory DC Power Control Module to Battery Fuse Block Nut	22 N.m	16 lb ft
Accessory DC Power Control Module Nut to Rear Floor Panel Nut	10 N.m	89 lb in
Drive Motor Generator Power Inverter Module Bolts	9 N.m	80 lb in
Drive Motor Generator Power Inverter Module Cover Bolts	9 N.m	80 lb in
Drive Motor Generator Power Inverter Module Fitting Bolts	3 N.m	27 lb in
Drive Motor Power Inverter Module Cable Replacement - First Position	9 N.m	80 lb in
Drive Motor Power Inverter Module Cable Replacement - Second Position	9 N.m	80 lb in
Drive Motor Generator Power Inverter Module Ground Cable Bolt	9 N.m	80 lb in
Engine Wiring Harness Ground Cable Bolt	9 N.m	80 lb in
High Voltage Interlock Loop Connector Bolts	6 N.m	53 lb in

SCHEMATIC WIRING DIAGRAMS

HYBRID/EV CONTROLS WIRING SCHEMATICS

Power, Ground and Data Communication

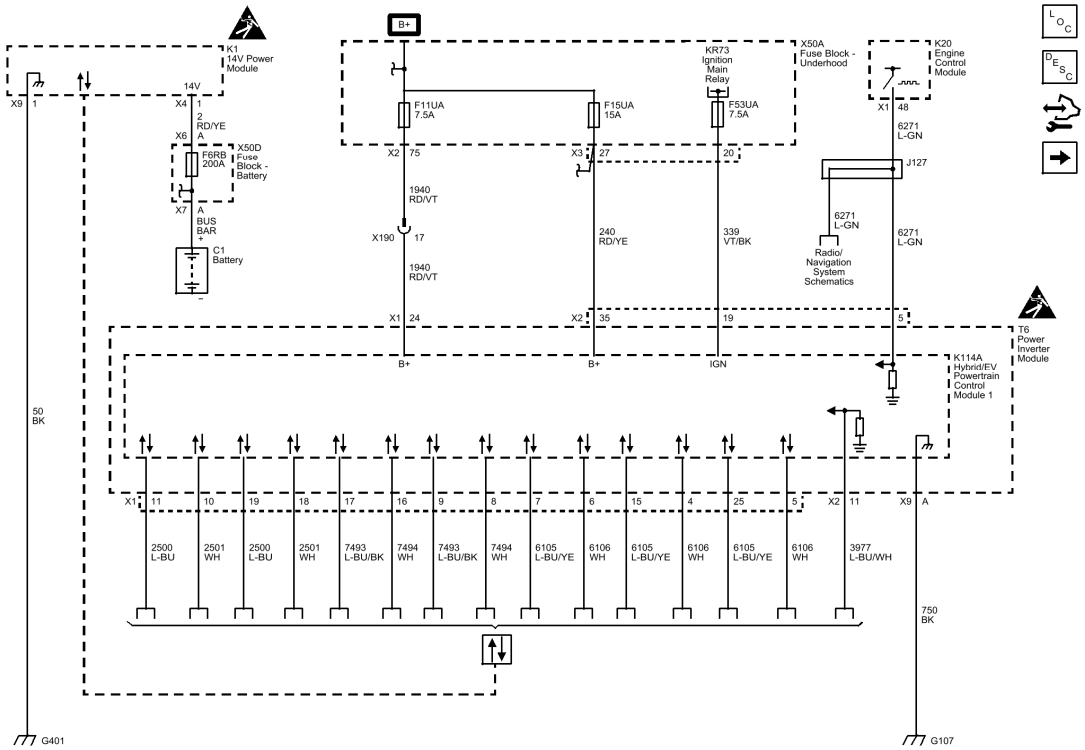


Fig. 1: Power, Ground and Data Communication
Courtesy of GENERAL MOTORS COMPANY

Drive Motor Monitoring

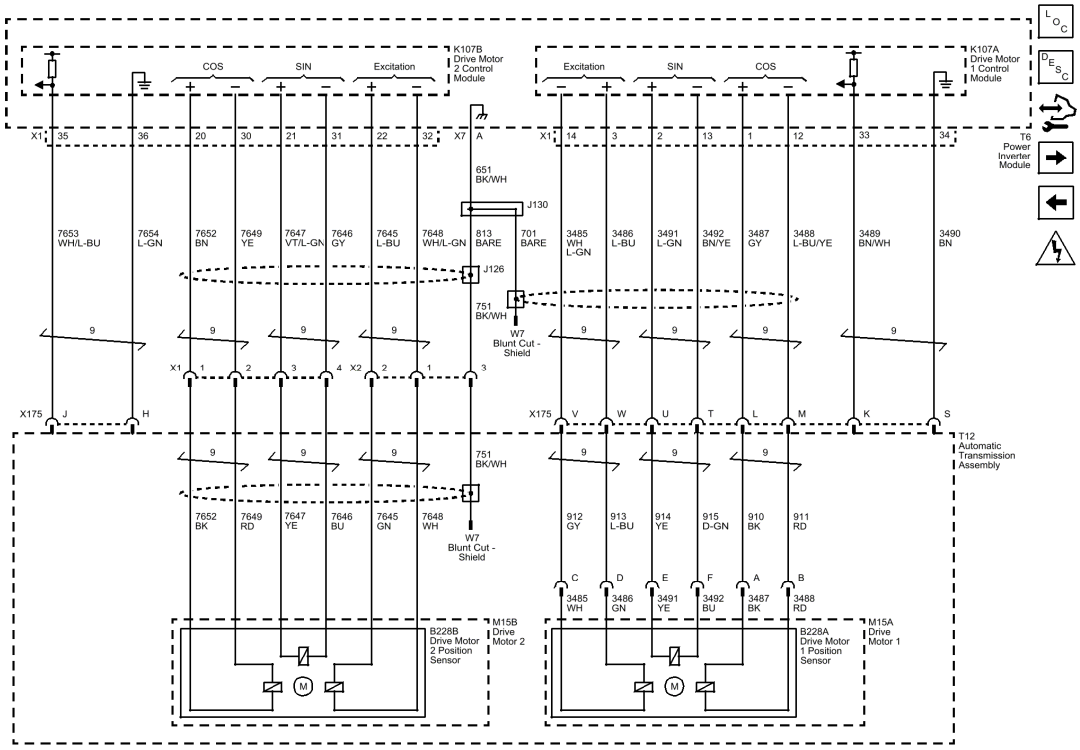


Fig. 2: Drive Motor Monitoring
Courtesy of GENERAL MOTORS COMPANY

Battery Contactor Status and Transmission Internal Mode Switch

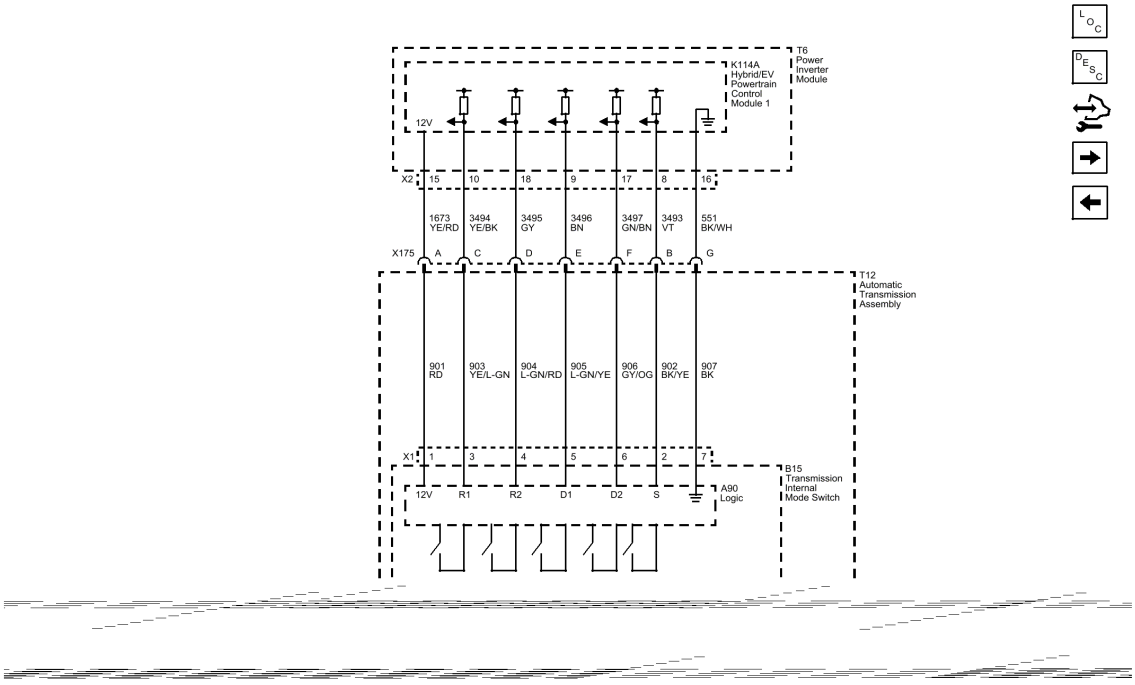


Fig. 3: Battery Contactor Status and Transmission Internal Mode Switch
Courtesy of GENERAL MOTORS COMPANY

Drive Motors and Auxiliary Transmission Fluid Pump Controls

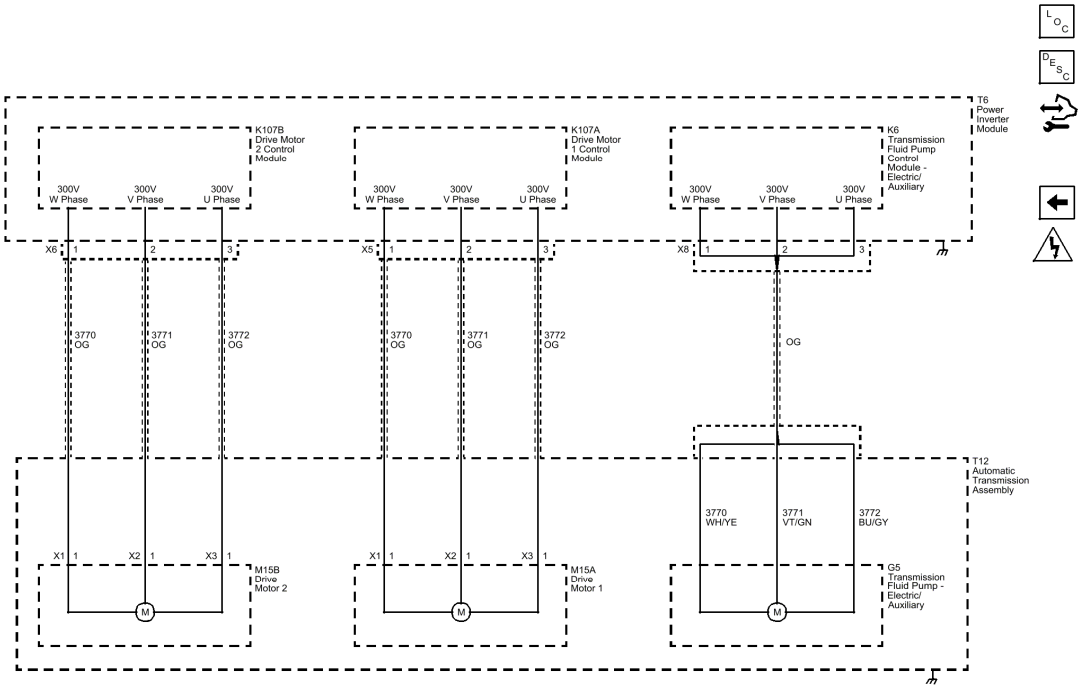


Fig. 4: Drive Motors and Auxiliary Transmission Fluid Pump Controls
Courtesy of GENERAL MOTORS COMPANY

COMPONENT LOCATOR

HYBRID CONTROLS ELECTRONIC COMPONENT VIEWS

Hybrid Control Electronic Component Views

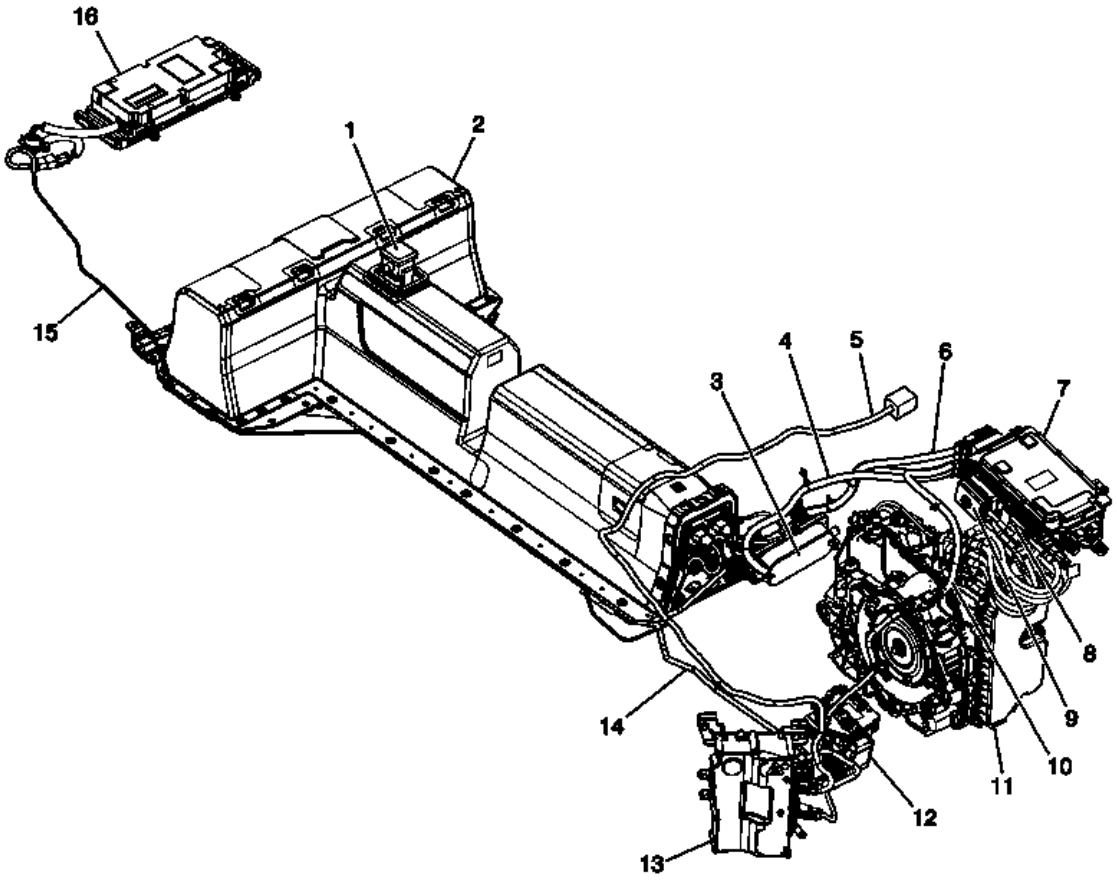


Fig. 5: Hybrid Control Electronic Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Battery High Voltage Manual Disconnect Lever
2	Drive Motor Battery Assembly
3	Heater Coolant Heater
4	Battery Positive and Negative (300 V) Cable Assembly - Inverter to Coolant Heater
5	Battery Positive and Negative (300 V) Cable Assembly - Charger to Charge Receptacle
6	Battery Positive and Negative (300 V) Cable Assembly - Inverter to Drive Motor Battery
7	Drive Motor Power Inverter Module Assembly
8	Drive Motor Power Inverter Module 3 Phase Cable Assembly - B
9	Drive Motor Power Inverter Module 3 Phase Cable Assembly - A
10	Battery Positive and Negative (300 V) Cable Assembly - Inverter to Cooling Compressor

11	Automatic Transmission
12	AC and Drive Motor Battery Cooling Compressor Assembly
13	Drive Motor Battery Charger Assembly
14	Battery Positive and Negative (300 V) Cable Assembly - Drive Motor Battery to Charger
15	Battery Positive and Negative (300 V) Cable Assembly - Drive Motor Battery to APM Module
16	Accessory DC Power Control Module Assembly

High Voltage Ring Terminal Locator

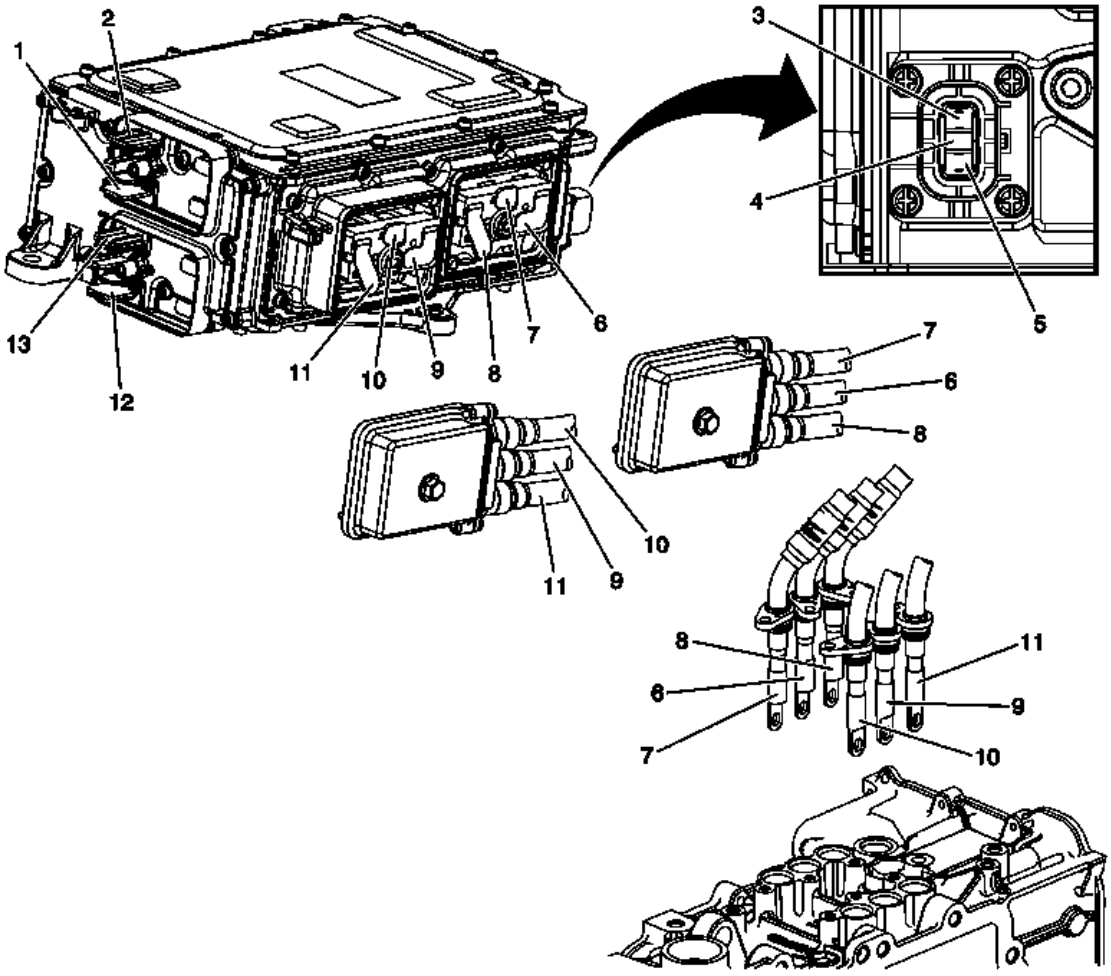


Fig. 6: High Voltage Ring Terminal Locations
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Generator Battery 300 V B-
2	Drive Motor Generator Battery 300 V B+

3	Auxiliary Transmission Fluid Pump Phase U
4	Auxiliary Transmission Fluid Pump Phase V
5	Auxiliary Transmission Fluid Pump Phase W
6	Drive Motor 2 Phase V
7	Drive Motor 2 Phase U
8	Drive Motor 2 Phase W
9	Drive Motor 1 Phase V
10	Drive Motor 1 Phase U
11	Drive Motor 1 Phase W
12	Cabin Conditioning 300 V B+
13	Cabin Conditioning 300 V B-

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC P0335 or P0336	DTC P0335 Crankshaft Position Sensor Circuit DTC P0336 Crankshaft Position Sensor Performance
DTC P0506 or P0507	DTC P0506 Idle Speed Low DTC P0507 Idle Speed High
DTC P0601-P0604, P0606, P062F, P1EB6, or P1EB7 (Hybrid/EV Powertrain Control Module 1)	DTC P0601 Control Module Read Only Memory Performance DTC P0602 Control Module Not Programmed DTC P0603 Control Module Long Term Memory Reset DTC P0604 Control Module Random Access Memory Performance DTC P0606 Control Module Processor Performance DTC P062F Control Module Long Term Memory Performance DTC P1EB6 Drive Motor 1 Control Module Long Term Memory Reset DTC P1EB7 Drive Motor 2 Control Module Long Term Memory Reset
DTC P061A or P061B	DTC P061A Control Module Torque System Circuitry Performance DTC P061B Control Module Torque Calculation Performance
DTC P06AF	DTC P06AF Torque Management System Performance - Forced Engine Shutdown
DTC P06B1, P06B2, P06B4, P06B5, P06E7, or P06E8	DTC P06B1 Sensor Supply Voltage Circuit 1 Low Voltage DTC P06B2 Sensor Supply Voltage Circuit 1 High Voltage DTC P06B4 Sensor Supply Voltage Circuit 2 Low Voltage DTC P06B5 Sensor Supply Voltage Circuit 2 High Voltage DTC P06E7 Sensor Supply Voltage Circuit 3 Low Voltage DTC P06E8 Sensor Supply Voltage Circuit 3 High Voltage
DTC P0A1B or P0A1C	DTC P0A1B Drive Motor 1 Control Module Performance DTC P0A1C Drive Motor 2 Control Module Performance
DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or	DTC P0A3F Drive Motor 1 Position Sensor Circuit DTC P0A40 Drive Motor 1 Position Sensor Performance

P1B03	DTC P0C52 Drive Motor 1 Position Sensor Circuit 1 Low Voltage DTC P0C53 Drive Motor 1 Position Sensor Circuit 1 High Voltage DTC P0C5C Drive Motor 1 Position Sensor Circuit 2 Low Voltage DTC P0C5D Drive Motor 1 Position Sensor Circuit 2 High Voltage DTC P1B03 Drive Motor 1 Position Sensor Circuit Tracking Lost
DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04	DTC P0A45 Drive Motor 2 Position Sensor Circuit DTC P0A46 Drive Motor 2 Position Sensor Performance DTC P0C57 Drive Motor 2 Position Sensor Circuit 1 Low Voltage DTC P0C58 Drive Motor 2 Position Sensor Circuit 1 High Voltage DTC P0C61 Drive Motor 2 Position Sensor Circuit 2 Low Voltage DTC P0C62 Drive Motor 2 Position Sensor Circuit 2 High Voltage DTC P1B04 Drive Motor 2 Position Sensor Circuit Tracking Lost
DTC P0A78 or P0A79	DTC P0A78 Drive Motor 1 Inverter Performance DTC P0A79 Drive Motor 2 Inverter Performance
DTC P0A89	DTC P0A89 14V Power Module Current Sensor Circuit High Current
DTC P0A8D-P0A8F	DTC P0A8D 14V Power Module System Voltage Low Voltage DTC P0A8E 14V Power Module System Voltage High Voltage DTC P0A8F 14V Power Module System Voltage Performance
DTC P0AB9	DTC P0AB9 Hybrid/EV System Performance
DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3	DTC P0AEE Drive Motor Inverter Temperature Sensor 1 Performance DTC P0AEF Drive Motor Inverter Temperature Sensor 1 Circuit Low Voltage DTC P0AF0 Drive Motor Inverter Temperature Sensor 1 Circuit High Voltage DTC P0AF3 Drive Motor Inverter Temperature Sensor 2 Performance DTC P0AF4 Drive Motor Inverter Temperature Sensor 2 Circuit Low Voltage DTC P0AF5 Drive Motor Inverter Temperature Sensor 2 Circuit High Voltage DTC P0BD2 Drive Motor Inverter Temperature Sensor 3 Performance DTC P0BD3 Drive Motor Inverter Temperature Sensor 3 Circuit Low Voltage DTC P0BD4 Drive Motor Inverter Temperature Sensor 3 Circuit High Voltage DTC P0BD7 Drive Motor Inverter Temperature Sensor 4 Performance DTC P0BD8 Drive Motor Inverter Temperature Sensor 4 Circuit Low Voltage DTC P0BD9 Drive Motor Inverter Temperature Sensor 4 Circuit High Voltage DTC P0BDC Drive Motor Inverter Temperature Sensor 5 Performance DTC P0BDD Drive Motor Inverter Temperature Sensor 5 Circuit Low Voltage DTC P0BDE Drive Motor Inverter Temperature Sensor 5 Circuit High Voltage DTC P0BE1 Drive Motor Inverter Temperature Sensor 6 Performance DTC P0BE2 Drive Motor Inverter Temperature Sensor 6 Circuit Low

	Voltage DTC P0BE3 Drive Motor Inverter Temperature Sensor 6 Circuit High Voltage
DTC P0B0D	DTC P0B0D Auxiliary Transmission Fluid Pump Control Module Performance
DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC	DTC P0BE6 Drive Motor 1 Phase U Current Sensor Performance DTC P0BE7 Drive Motor 1 Phase U Current Sensor Circuit Low Voltage DTC P0BE8 Drive Motor 1 Phase U Current Sensor Circuit High Voltage DTC P0BEA Drive Motor 1 Phase V Current Sensor Performance DTC P0BEB Drive Motor 1 Phase V Current Sensor Circuit Low Voltage DTC P0BEC Drive Motor 1 Phase V Current Sensor Circuit High Voltage DTC P0BEE Drive Motor 1 Phase W Current Sensor Performance DTC P0BEF Drive Motor 1 Phase W Current Sensor Circuit Low Voltage DTC P0BF0 Drive Motor 1 Phase W Current Sensor Circuit High Voltage DTC P0BF2 Drive Motor 2 Phase U Current Sensor Performance DTC P0BF3 Drive Motor 2 Phase U Current Sensor Circuit Low Voltage DTC P0BF4 Drive Motor 2 Phase U Current Sensor Circuit High Voltage DTC P0BF6 Drive Motor 2 Phase V Current Sensor Performance DTC P0BF7 Drive Motor 2 Phase V Current Sensor Circuit Low Voltage DTC P0BF8 Drive Motor 2 Phase V Current Sensor Circuit High Voltage DTC P0BFA Drive Motor 2 Phase W Current Sensor Performance DTC P0BFB Drive Motor 2 Phase W Current Sensor Circuit Low Voltage DTC P0BFC Drive Motor 2 Phase W Current Sensor Circuit High Voltage
DTC P0BFD or P0BFE	DTC P0BFD Drive Motor 1 Phases U-V-W Not Plausible DTC P0BFE Drive Motor 2 Phases U-V-W Not Plausible
DTC P0C01 or P0C04	DTC P0C01 Drive Motor 1 High Current DTC P0C04 Drive Motor 2 High Current
DTC P0C05 or P0C08	DTC P0C05 Drive Motor 1 Phase U-V-W Circuits DTC P0C08 Drive Motor 2 Phase U-V-W Circuits
DTC P0C0B or P0C0E	DTC P0C0B Drive Motor 1 Inverter Supply Voltage Circuit DTC P0C0E Drive Motor 2 Inverter Supply Voltage Circuit
DTC P0C11-P0C16	DTC P0C11 Drive Motor 1 Inverter Phase U High Temperature DTC P0C12 Drive Motor 1 Inverter Phase V High Temperature DTC P0C13 Drive Motor 1 Inverter Phase W High Temperature DTC P0C14 Drive Motor 2 Inverter Phase U High Temperature DTC P0C15 Drive Motor 2 Inverter Phase V High Temperature DTC P0C16 Drive Motor 2 Inverter Phase W High Temperature
DTC P0C17, P0C18, P1B0F, or P1B10	DTC P0C17 Drive Motor 1 Position Not Learned DTC P0C18 Drive Motor 2 Position Not Learned

	DTC P1B0F Drive Motor 1 Position Learn Incorrect DTC P1B10 Drive Motor 2 Position Learn Incorrect
DTC P0C19	DTC P0C19 Drive Motor 1 Torque Delivered Performance
DTC P0C1A	DTC P0C1A Drive Motor 2 Torque Delivered Performance
DTC P0C20	DTC P0C20 Auxiliary Transmission Fluid Pump Phase U-V-W Circuits
DTC P0C28	DTC P0C28 Auxiliary Transmission Fluid Pump High Current
DTC P0C4E	DTC P0C4E Drive Motor 1 Position Exceeded Learning Limit
DTC P0C4F	DTC P0C4F Drive Motor 2 Position Exceeded Learning Limit
DTC P0C76	DTC P0C76 Hybrid/EV Battery System High Voltage Present
DTC P150D or P150E	DTC P150D Supply Voltage Circuit 2 Low Voltage DTC P150E Supply Voltage Circuit 1 Low Voltage
DTC P15F0	DTC P15F0 Engine Torque Delivered Signal Message Counter Incorrect
DTC P15F1	DTC P15F1 Axle Torque Request Signal Message Counter Incorrect
DTC P15F2	DTC P15F2 Engine Torque Command Signal Message Counter Incorrect
DTC P16E0	DTC P16E0 Engine Performance - No Torque Detected
DTC P16F2 (Hybrid/EV Powertrain Control Module 1)	DTC P16F2 Control Module Transmission Direction Switch Input Circuitry Performance
DTC P16F3 (Hybrid/EV Powertrain Control Module 1)	DTC P16F3 Control Module Redundant Memory Performance
DTC P16F4 (Hybrid/EV Powertrain Control Module 1)	DTC P16F4 Control Module Transmission Range Switch Input Circuitry Performance
DTC P16F6 (Hybrid/EV Powertrain Control Module 1)	DTC P16F6 Control Module Transmission Range Calculation Performance
DTC P179A	DTC P179A Auxiliary Transmission Fluid Pump Overspeed
DTC P181C-P181F, P183A-P183E, P184A, or P184B	DTC P181C Internal Mode Switch 2 R1 Circuit Low Voltage DTC P181D Internal Mode Switch 2 R1 Circuit High Voltage DTC P181E Internal Mode Switch 2 R2 Circuit Low Voltage DTC P181F Internal Mode Switch 2 R2 Circuit High Voltage DTC P183A Internal Mode Switch 2 D1 Circuit Low Voltage DTC P183B Internal Mode Switch 2 D1 Circuit High Voltage DTC P183C Internal Mode Switch 2 D2 Circuit Low Voltage DTC P183D Internal Mode Switch 2 D2 Circuit High Voltage DTC P183E Internal Mode Switch 2 Invalid Range DTC P184A Internal Mode Switch 2 S Circuit Low Voltage DTC P184B Internal Mode Switch 2 S Circuit High Voltage
DTC P183F	DTC P183F Internal Mode Switch 1-2 Not Plausible
DTC P1A4F, P1A50-P1A54, P1ADC, or P1ADD	DTC P1A4F Drive Motor 1 Control Module Not Programmed DTC P1A50 Drive Motor 1 Control Module Random Access Memory DTC P1A51 Drive Motor 1 Control Module Read Only Memory DTC P1A52 Drive Motor 2 Control Module Not Programmed

	DTC P1A53 Drive Motor 2 Control Module Random Access Memory DTC P1A54 Drive Motor 2 Control Module Read Only Memory DTC P1ADC Drive Motor 1 Control Module Long Term Memory Performance DTC P1ADD Drive Motor 2 Control Module Long Term Memory Performance
DTC P1A56	DTC P1A56 Hybrid/EV System Voltage Discharge Circuit
DTC P1A71-P1A73	DTC P1A71 14V Power Module Temperature Sensor 2 Performance DTC P1A72 14V Power Module Temperature Sensor 2 Circuit Low Voltage DTC P1A73 14V Power Module Temperature Sensor 2 Circuit High Voltage
DTC P1A90-P1A92	DTC P1A90 14V Power Module Temperature Sensor 1 Performance DTC P1A91 14V Power Module Temperature Sensor 1 Circuit Low Voltage DTC P1A92 14V Power Module Temperature Sensor 1 Circuit High Voltage
DTC P1ABC or P1ABD	DTC P1ABC 14V Power Module Hybrid/EV Battery System Voltage Low Voltage DTC P1ABD 14V Power Module Hybrid/EV Battery System Voltage High Voltage
DTC P1ADE, P1ADF, P1AE0, or P1AE1	DTC P1ADE Drive Motor 1 Control Module System Voltage Low Voltage DTC P1ADF Drive Motor 1 Control Module System Voltage High Voltage DTC P1AE0 Drive Motor 2 Control Module System Voltage Low Voltage DTC P1AE1 Drive Motor 2 Control Module System Voltage High Voltage
DTC P1AE8, P1AE9, P1AEA, or P1AEB	DTC P1AE8 Drive Motor 1 Control Module Hybrid/EV Battery Voltage Sense Circuit Low Voltage DTC P1AE9 Drive Motor 1 Control Module Hybrid/EV Battery Voltage Sense Circuit High Voltage DTC P1AEA Drive Motor 2 Control Module Hybrid/EV Battery Voltage Sense Circuit Low Voltage DTC P1AEB Drive Motor 2 Control Module Hybrid/EV Battery Voltage Sense Circuit High Voltage
DTC P1AEC-P1AEF	DTC P1AEC Drive Motor 1 Control Module Hybrid/EV Battery System Voltage DTC P1AED Drive Motor 2 Control Module Hybrid/EV Battery System Voltage DTC P1AEE Drive Motor 1 Control Module Hybrid/EV Battery System Voltage High Voltage DTC P1AEF Drive Motor 2 Control Module Hybrid/EV Battery System Voltage High Voltage
DTC P1AF0 or P1AF2	DTC P1AF0 Drive Motor 1 Control Module Hybrid/EV Battery Voltage

	System Isolation Lost DTC P1AF2 Drive Motor 2 Control Module Hybrid/EV Battery Voltage System Isolation Lost
DTC P1AF4-P1AF7	DTC P1AF4 Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 Low Voltage DTC P1AF5 Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 High Voltage DTC P1AF6 Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 Low Voltage DTC P1AF7 Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 High Voltage
DTC P1B0B or P1B0C	DTC P1B0B Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 Low Voltage DTC P1B0C Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 High Voltage
DTC P1B0D or P1B0E	DTC P1B0D Drive Motor 1 Control Module Drive Motor 1 Overspeed DTC P1B0E Drive Motor 2 Control Module Drive Motor 2 Overspeed
DTC P1B15	DTC P1B15 Regenerative Braking Torque Request Signal Message Counter Incorrect
DTC P1B41 or P1B42	DTC P1B41 Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Performance DTC P1B42 Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Performance
DTC P1B43 or P1B44	DTC P1B43 Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 Low Voltage DTC P1B44 Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 High Voltage
DTC P1BFF or P1E23-P1E25	DTC P1BFF Auxiliary Transmission Fluid Pump Control Module Not Programmed DTC P1E23 Auxiliary Transmission Fluid Pump Control Module Random Access Memory DTC P1E24 Auxiliary Transmission Fluid Pump Control Module Long Term Memory Performance DTC P1E25 Auxiliary Transmission Fluid Pump Control Module Read Only Memory
DTC P1E0A or P1E0B	DTC P1E0A Drive Motor 1 Control Module Torque Calculation Performance DTC P1E0B Drive Motor 2 Control Module Torque Calculation Performance
DTC P1E0E	DTC P1E0E 14V Power Module Not Programmed
DTC P1E19 or P1E1A	DTC P1E19 Auxiliary Transmission Fluid Pump Control Module System Voltage Low Voltage DTC P1E1A Auxiliary Transmission Fluid Pump Control Module System Voltage High Voltage
DTC P1E1B-P1E1F	DTC P1E1B Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Performance

	DTC P1E1C Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 Low Voltage DTC P1E1D Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 High Voltage DTC P1E1E Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 Low Voltage DTC P1E1F Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 High Voltage
DTC P1E20-P1E22	DTC P1E20 Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Sense Circuit Low Voltage DTC P1E21 Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Sense Circuit High Voltage DTC P1E22 Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage System Isolation Lost
DTC P1E27 or P1E28	DTC P1E27 Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery System Voltage High Voltage DTC P1E28 Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery System Voltage
DTC P1E29	DTC P1E29 Auxiliary Transmission Fluid Pump Control Module Calculated Motor Position Performance
DTC P1E2A-P1E2F or P1E30-P1E32	DTC P1E2A Auxiliary Transmission Fluid Pump Phase U Current Sensor Circuit Low Voltage DTC P1E2B Auxiliary Transmission Fluid Pump Phase U Current Sensor Circuit High Voltage DTC P1E2C Auxiliary Transmission Fluid Pump Phase U Current Sensor Performance DTC P1E2D Auxiliary Transmission Fluid Pump Phase V Current Sensor Circuit Low Voltage DTC P1E2E Auxiliary Transmission Fluid Pump Phase V Current Sensor Circuit High Voltage DTC P1E2F Auxiliary Transmission Fluid Pump Phase V Current Sensor Performance DTC P1E30 Auxiliary Transmission Fluid Pump Phase W Current Sensor Circuit Low Voltage DTC P1E31 Auxiliary Transmission Fluid Pump Phase W Current Sensor Circuit High Voltage DTC P1E32 Auxiliary Transmission Fluid Pump Phase W Current Sensor Performance
DTC P1E33	DTC P1E33 Auxiliary Transmission Fluid Pump Phase U-V-W Current Sensors Not Plausible
DTC P1E34-P1E36	DTC P1E34 Auxiliary Transmission Fluid Pump Inverter Temperature Sensor Circuit High Voltage DTC P1E35 Auxiliary Transmission Fluid Pump Inverter Temperature Sensor Circuit Low Voltage DTC P1E36 Auxiliary Transmission Fluid Pump Inverter Temperature Sensor Performance

DTC P1E37	DTC P1E37 Auxiliary Transmission Fluid Pump Inverter High Temperature
DTC P1E38	DTC P1E38 Auxiliary Transmission Fluid Pump Inverter Supply Voltage Circuit
DTC P1E39	DTC P1E39 Auxiliary Transmission Fluid Pump Inverter Performance
DTC P1E3A	DTC P1E3A Auxiliary Transmission Fluid Pump Motor Torque Delivered Performance
DTC P1E3E or P1E3F	DTC P1E3E 14V Power Module Random Access Memory DTC P1E3F 14V Power Module Read Only Memory
DTC P1E40-P1E42	DTC P1E40 14V Power Module Hybrid/EV Battery System Voltage Performance DTC P1E41 14V Power Module Hybrid/EV Battery System Overvoltage Sensing Circuit DTC P1E42 14V Power Module Hybrid/EV Battery System High Voltage
DTC P1E43 or P1E44	DTC P1E43 14V Power Module System Overvoltage Sensing Circuit DTC P1E44 14V Power Module System High Voltage
DTC P1E45	DTC P1E45 14V Power Module Temperature Sensors 1-2 Not Plausible
DTC P1E46 or P1E48	DTC P1E46 14V Power Module Temperature Sensor 1 High Temperature Sensing Circuit DTC P1E48 14V Power Module Temperature Sensor 2 High Temperature Sensing Circuit
DTC P1E4A or P1E4B	DTC P1E4A Control Module Redundant Drive Motor 1 Speed Sensing Circuit DTC P1E4B Control Module Redundant Drive Motor 2 Speed Sensing Circuit
DTC P1EA8	DTC P1EA8 14V Power Module Hybrid/EV Battery System Low Voltage
DTC P1EA9	DTC P1EA9 14V Power Module System Low Voltage
DTC P1EB8	DTC P1EB8 Auxiliary Transmission Fluid Pump Control Module Long Term Memory Reset
DTC P2797	DTC P2797 Auxiliary Transmission Fluid Pump Performance

DTC P0335 OR P0336: CRANKSHAFT POSITION SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0335

Crankshaft Position Sensor Circuit

DTC P0336

Crankshaft Position Sensor Performance

Circuit/System Description

The crankshaft position sensor circuits consist of an engine control module (ECM) supplied 5 V reference circuit, low reference circuit, and an output signal circuit. The crankshaft position sensor is an internally magnetic biased digital output integrated circuit sensing device. The sensor detects magnetic flux changes of the teeth and slots of a 58-tooth reluctor wheel on the crankshaft. Each tooth on the reluctor wheel is spaced at 60-tooth spacing, with 2 missing teeth for the reference gap. The crankshaft position sensor produces an ON/OFF DC voltage of varying frequency, with 58 output pulses per crankshaft revolution. The frequency of the crankshaft position sensor output depends on the velocity of the crankshaft. The crankshaft position sensor sends a digital signal, which represents an image of the crankshaft reluctor wheel, to the ECM as each tooth on the wheel rotates past the crankshaft position sensor. The ECM uses each crankshaft position signal pulse to determine crankshaft speed and decodes the crankshaft reluctor wheel reference gap to identify crankshaft position. This information is then used to determine the optimum ignition and injection points of the engine. The ECM also uses crankshaft position sensor output information to determine the camshaft relative position to the crankshaft, to control camshaft phasing, and to detect cylinder misfire.

The ECM also generates and sends a replicated signal over a dedicated line to the hybrid/EV powertrain control module 1.

The hybrid/EV powertrain control module 1 uses crankshaft speed and position to confirm internal combustion engine (ICE) status in various modes; for example to confirm Autostart and Autostop functionality. In addition to the signal sent over the dedicated line, this information is also sent from the ECM to the hybrid/EV powertrain control module 1 over serial data. The serial data status will be used by the hybrid/EV powertrain control module 1 in the event of a failure of this circuit.

Conditions for Running the DTC

P0335 or P0336

The vehicle is ON.

Conditions for Setting the DTC

P0335

No signal from the crank sensor for more than 2 seconds.

P0336

The signal from the crank sensor is invalid for more than 1 second.

Action Taken When the DTC Sets

DTCs P0335 and P0336 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0335 and P0336 are Type B DTCs.

Diagnostic Aids

A high resistance ground for either the power inverter module, often referred to as the drive motor generator power inverter module, or the ECM may cause these DTCs to set intermittently. Inspect all grounds for good, secure connections.

Reference Information

Schematic Reference

- **Hybrid/EV Controls Schematics**
- **Engine Controls Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Electronic Ignition System Description**
- **Hybrid Modes of Operation Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-35616** Terminal Test Kit
- **EL-38522** Variable Signal Generator

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Verify that ECM DTC P0335 or P0336 is not set.
   - **If any of the DTCs are set**

     Refer to **DTC P0335 or P0336** .

   - **If none of the DTCs are set**
2. Engine Running, observe the hybrid/EV powertrain control module Engine Speed parameter with a scan tool.
3. Verify the Engine Speed parameter displays the current engine speed, matching the tachometer and/or the ECM Engine Speed parameter.
   - **If the hybrid/EV powertrain control module Engine Speed parameter displays a value other than the current engine speed**

     Refer to Circuit/System Testing.

   - **If the Engine Speed parameter displays a value matching the current engine speed**
4. All OK

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the X1 harness connector at the K20 ECM.
3. Using the **EL 35616** terminal test kit , connect the **EL 38522** variable signal generator red lead to the Crankshaft 60X Sensor Signal circuit terminal 48 at the harness. Connect the **EL 38522** variable signal generator black lead to ground.
4. Set the **EL 38522** variable signal generator SIGNAL to 12v, FREQUENCY to 30 Hz, and DUTY CYCLE to NORMAL, 50 percent. Plug power cord in to vehicle being tested or another power source.
5. Vehicle ON.

NOTE: With the variable signal generator set at 30 Hz, the Crankshaft Position Active Counter should cycle from 0-255 in 8.5 seconds.

6. Verify with a scan tool the hybrid/EV powertrain control module Crankshaft Position Active Counter parameter displays a constantly changing value.
   - **If parameter does not display a constantly changing value**

1. Vehicle OFF, disconnect **EL 38522** variable signal generator red and black leads, disconnect the X2 harness connector at the T6 power inverter module, vehicle ON.
2. Test for less than 1 V between the signal circuit terminal 5 and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V.
3. Vehicle OFF.
4. Test for infinite resistance between the signal circuit terminal 5 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance.
5. Test for less than 2 ohms in the signal circuit end to end.
    - If 2 ohms or greater, repair the open/high resistance in the circuit.
    - If less than 2 ohms, replace the T6 power inverter module.

- **If parameter displays a constantly changing value**

7. Replace the K20 ECM.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for engine control module or T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0506 OR P0507: IDLE SPEED ERROR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0506

Idle Speed Low

DTC P0507

Idle Speed High

Circuit/System Description

The hybrid/EV powertrain control module 1 determines the engine speed which is based on the hybrid/EV

battery pack state of charge. The engine control module (ECM) achieves throttle positioning by providing a pulse width modulated voltage to the throttle actuator motor. The throttle blade is spring loaded in both directions, and the default position is slightly open. The hybrid/EV powertrain control module 1 can detect a condition where the engine is cranking but does not start or has stalled, or if the engine speed does not match the commanded speed.

The throttle actuator control (TAC) motor is controlled by the ECM. The DC motor located in the throttle body drives the throttle blade. In order to decrease engine speed, along with spark and fuel delivery changes the ECM commands the throttle closed reducing air flow into the engine and the engine speed decreases. In order to increase engine speed, the ECM commands the throttle plate open allowing more air to pass the throttle plate. If the hybrid/EV powertrain control module 1 detects the actual engine speed is not within a predetermined range of the commanded engine speed, this DTC sets.

Conditions for Running the DTC

- DTCs P0722, P077B, P0A3F, P0A40, P0A45, P0A46, P0C52, P0C53, P0C57, P0C58, P0C5C, P0C5D, P0C61, P0C62, P1B03, P1B04, P215C are not set.
- The system voltage is between 9-32 volts.
- The accelerator pedal position is valid.
- The accelerator pedal position is less than 1 percent.
- The engine has been running for greater than 60 seconds.
- The vehicle speed is less than 1 km/h (.6 mph).
- The barometric pressure (BARO) is greater than 70 kPa (11 psi).
- The engine coolant temperature (ECT) is greater than 60-125°C (140-257°F).
- The intake air temperature (IAT) is warmer than -20°C (-4°F).
- The commanded engine speed is steady within 25 RPM.
- A scan tool output control is not active.
- DTCs P0506 or P0507 run continuously when the above conditions are met for greater than 10 seconds.

Conditions for Setting the DTC

P0506

The actual engine speed is at least 75 RPM less than the commanded engine speed.

P0507

The actual engine speed is at least 150 RPM greater than the commanded engine speed.

Action Taken When the DTC Sets

DTCs P0506 and P0507 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0506 and P0507 are Type B DTCs.

Diagnostic Aids

- A stalling condition can cause DTC P0506 to set.
- An intermittent vehicle speed sensor (VSS) signal can cause DTC P0507 to set.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify no other DTCs are set.
   - **If any other DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If no other DTCs are set**
2. Verify none of the conditions listed below exist:

   P0506

   - Excess deposits in the Q38 Throttle Body. Refer to **Throttle Body Inspection and Cleaning** .

- Restricted exhaust
- Mechanical conditions that limit engine speed
- Parasitic load on the engine - For example, a transmission condition, a belt driven accessory condition.
  - **If a condition exists**

    Repair as necessary.

  - **If no condition exists**

3. All OK

P0507

- Vacuum leaks
- A throttle valve that does not close correctly
- Verify the correct operation of the crankcase ventilation system. Inspect for the following conditions:
  - The routing of the positive crankcase ventilation (PCV) system
  - Vacuum leaks in the PCV system
  - **If a condition exists**

    Repair as necessary.

  - **If no condition exists**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC P0601-P0604, P0606, P062F, P1EB6, OR P1EB7: CONTROL MODULE MEMORY (HYBRID/EV POWERTRAIN CONTROL MODULE 1)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0601

Control Module Read Only Memory Performance

DTC P0602

Control Module Not Programmed

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0606

Control Module Processor Performance

DTC P062F

Control Module Long Term Memory Performance

DTC P1EB6

Drive Motor 1 Control Module Long Term Memory Reset

DTC P1EB7

Drive Motor 2 Control Module Long Term Memory Reset

Circuit/System Description

This is an internal fault detection of the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is greater than 9.5V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTCs P0601-P0604, P0606, P061A, P061B, P062F, P1EB6, and P1EB7 are Type A DTCs.

- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0601-P0604, P0606, P061A, P061B, P062F, P1EB6, and P1EB7 are Type A DTCs.

Reference Information

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 is not set.
   - **If the DTC is set**

     Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0562, P0563, P1A0C, P1A0D, or P1EFC** .

   - **If the DTC is not set**
3. Verify DTC P0601, P0602, P0603, P0604, P0606, P061A, P061B, P062F, P1EB6, or P1EB7 is not set.
   - **If any of the DTCs are set**
     1. Program the T6 Power Inverter Module.
     2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
     3. All OK
   - **If none of the DTCs are set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P061A OR P061B: CONTROL MODULE TORQUE SYSTEM

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P061A

Control Module Torque System Circuitry Performance

DTC P061B

Control Module Torque Calculation Performance

Circuit/System Description

The hybrid/EV powertrain control module 1 is responsible for vehicle torque management. To accomplish this, the hybrid/EV powertrain control module 1 constantly monitors all aspects of requested and actual delivered torque from involved controllers. If a torque management fault is detected, propulsion power will be reduced or shut down. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. This fault is handled inside the power inverter module and no external circuits are involved.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is at least 9.5 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTCs P061A or P061B are Type A DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P061A and P061B are Type A DTCs.

Reference Information

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 is not set.
   - **If the DTC is set**

     Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0562, P0563, P1A0C, P1A0D, or P1EFC** .

   - **If the DTC is not set**
3. Verify DTC P061A or P061B is not set.
   - **If any of the DTCs are set**

     Replace the T6 Power Inverter Module.

   - **If none of the DTCs are set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P06AF: TORQUE MANAGEMENT SYSTEM

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P06AF

Torque Management System Performance - Forced Engine Shutdown

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors a state of health message that the ECM transmits to verify the ECM is functioning properly. The hybrid/EV powertrain control module 1 is part of the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately.

Conditions for Running the DTC

The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 1 does not detect a valid state of health message from the ECM.

Action Taken When the DTC Sets

- DTC P06AF is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P06AF is a Type A DTC.

Reference Information

Schematic Reference

- **Hybrid/EV Controls Schematics**
- **Engine Controls Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0606 is not set.
   - **If the DTC is set**

     Refer to **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B (ECM)** .

   - **If the DTC is not set**
3. Verify DTC P06AF is not set.
   - **If the DTC is set**
     1. Program the T6 Power Inverter Module.
     2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
     3. Verify the DTC does not set.
        - If the DTC sets, continue to Circuit/System Testing.
        - If the DTC does not set.
     4. All OK
   - **If the DTC is not set**
4. All OK

Circuit/System Testing

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

1. Vehicle OFF, remove the F103 Power Inverter Module Assembly Cable Cover. Refer to **Drive Motor Generator Power Inverter Module Cover Replacement**.
2. Disconnect the X1 harness connector at the T6 Power Inverter Module and disconnect the X1 harness at the K20 ECM.

3. Test for less than 2 ohms on the serial data circuits listed below end to end.
   - T6 Power Inverter Module X1 connector terminal 10 to K20 ECM X1 connector terminal 43
   - T6 Power Inverter Module X1 connector terminal 11 to K20 ECM X1 connector terminal 29
   - **If 2 ohms or greater**

     Repair the open/high resistance in the circuit.

   - **If less than 2 ohms**
4. Replace the K20 ECM.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
   - **If the DTC sets**

     Replace the T6 Power Inverter Module.

   - **If the DTC does not set**
7. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K20 ECM or T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P06B1, P06B2, P06B4, P06B5, P06E7, OR P06E8: SENSOR SUPPLY VOLTAGE CIRCUIT 1-3

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P06B1

Sensor Supply Voltage Circuit 1 Low Voltage

DTC P06B2

Sensor Supply Voltage Circuit 1 High Voltage

DTC P06B4

Sensor Supply Voltage Circuit 2 Low Voltage

DTC P06B5

Sensor Supply Voltage Circuit 2 High Voltage

DTC P06E7

Sensor Supply Voltage Circuit 3 Low Voltage

DTC P06E8

Sensor Supply Voltage Circuit 3 High Voltage

Circuit/System Description

The motor control modules share an internal 15 V reference power supply in order to operate the drive motor sensors processors. This fault is handled inside the power inverter module, often referred to as the drive motor generator power inverter module, and no external circuits are involved. The control modules listed below are part of the power inverter module and are not serviced separately:

- Auxiliary transmission fluid pump control module
- Drive motor 1 control module
- Drive motor 2 control module
- Hybrid/EV powertrain control module 1

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is 8-18 V.

Conditions for Setting the DTC

P06B1, P06B4, or P06E7

The reference voltage is less than 12 V for 1 second.

P06B2, P06B5, or P06E8

The reference voltage is greater than 18 V for 1 second.

Action Taken When the DTC Sets

- DTCs P06B1, P06B2, P06B4, P06B5, P06E7, and P06E8 are Type A DTCs.

- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P06B1, P06B2, P06B4, P06B5, P06E7, and P06E8 are Type A DTCs.

Diagnostic Aids

This DTC may set due to low 12 V system voltage.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P06B1, P06B2, P06B4, P06B5, P06E7, or P06E8 is not set.
    - **If any of the DTCs are set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    3. All OK
    - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0A1B OR P0A1C: DRIVE MOTOR 1/2 CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0A1B

Drive Motor 1 Control Module Performance

DTC P0A1C

Drive Motor 2 Control Module Performance

Circuit/System Description

The power inverter module is often referred to as the drive motor generator power inverter module. This is a fault detection of the power inverter module's internal motor control modules. This fault is handled inside the power inverter module; no external circuits are involved. The motor control modules are part of the power inverter module and are not serviced separately.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTCs P0A1B and P0A1C are Type A DTCs.
- The power inverter module requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0A1B and P0A1C are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0A1B or P0A1C is not set.
    - **If any of the DTCs are set**

1. Program the T6 Power Inverter Module.
2. Verify the DTC does not set.
    - If the DTC sets, replace the T6 Power Inverter Module.
    - If the DTC does not set.
3. All OK
    - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, OR P1B03: DRIVE MOTOR 1 POSITION SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0A3F

Drive Motor 1 Position Sensor Circuit

DTC P0A40

Drive Motor 1 Position Sensor Performance

DTC P0C52

Drive Motor 1 Position Sensor Circuit 1 Low Voltage

DTC P0C53

Drive Motor 1 Position Sensor Circuit 1 High Voltage

DTC P0C5C

Drive Motor 1 Position Sensor Circuit 2 Low Voltage

DTC P0C5D

Drive Motor 1 Position Sensor Circuit 2 High Voltage

DTC P1B03

Drive Motor 1 Position Sensor Circuit Tracking Lost

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Reference* - Excitation	P0A3F	P0A3F	P0A3F	P1B03, P0A40
Signal* - SIN	P0C52	P0A3F	P0C53, P0A3F	P1B03, P0A40
Signal* - COS	P0C5C	P0A3F	P0C5D, P0A3F	P1B03, P0A40
*Represents a differential circuit consisting of a pair of wires. See Circuit/System Description and schematic for detailed description.				

Circuit/System Description

The drive motor position sensor is monitored by the motor control module. The motor control module monitors the angular position, speed and direction of the drive motor rotor based upon the signals of the resolver-type position sensor. The position sensor contains a drive coil, two driven coils, and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor. At vehicle ON, the motor control module outputs a 7 V AC, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The motor control module then monitors the two driven coil circuits for return signals-Sine and Cosine waveforms, often referred to as SIN and COS. The position of the irregular metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coil signals allows the motor control module to determine the exact position, speed and direction of the drive motor rotor. The drive motor 1 position sensor is serviceable separately from the drive motor assembly.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

P0C52, P0C5C

Circuit voltage is less than 0.5 V.

P0C53, P0C5D

Circuit voltage is greater than 4.5 V.

P0A3F

SIN or COS signal is less than 2.3V. The motor control module cannot determine the motor position based upon the sensor signals.

P0A40

SIN or COS signal is greater than 4V. The motor control module detects a degraded motor position sensor signal.

P1B03

The motor control module is unable to track the motor position based upon the sensor signals.

Action Taken When the DTC Sets

- For Type A DTCs, The hybrid/EV powertrain control module 1 commands Generator Function Inoperative state. The vehicle will continue to run in electric mode if there is sufficient hybrid/EV battery state of charge.
- DTCs P0A3F, P0A40, and P1B03 are Type A DTCs.
- DTCs P0C52, P0C53, P0C5C, and P0C5D are Type B DTCs.

Conditions for Clearing the DTC

- DTCs P0A3F, P0A40, and P1B03 are Type A DTCs.
- DTCs P0C52, P0C53, P0C5C, and P0C5D are Type B DTCs.

Diagnostic Aids

- The drive motor position sensor circuits operate at very low current. These circuits are susceptible to moisture intrusion, corrosion, and terminal damage. Extreme care must be taken when probing terminals and manipulating harnesses. Poor terminal connections can result in intermittent operation.
- If the customer comments that the problem occurs only during moist environmental conditions: rain, snow, vehicle wash, etc., inspect the sensor wiring for signs of water intrusion.
- The sensor circuit loops are a twisted pair with each pair covered in a foil shield. The shield circuits outside of the transmission are grounded to a stud on the power inverter module, often referred to as the drive motor generator power inverter module.
- The drive motor position sensor harness circuits are shielded. Improperly grounded shield circuits may cause inaccurate sensor signals.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

DT-44152 Jumper Harness

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Testing

NOTE: You must perform the Component Testing before proceeding with Circuit/System Testing.

1. Vehicle OFF, disconnect the X175 harness connector at the transmission.
2. Install the **DT-44152** jumper harness to the vehicle harness side only.
3. Vehicle ON.
4. Test for 0.6-1.6 V between the signal circuit terminals listed below and ground:
   - Signal (COS) circuit terminal U
   - Signal (COS) circuit terminal T
   - Signal (SIN) circuit terminal L
   - Signal (SIN) circuit terminal M
   - **If less than 0.6 V**
     1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
     2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 ohms in the signal circuit end to end.
    - If 2 ohms or greater, repair the open/high resistance in the circuit.
    - If less than 2 ohms, replace the T6 Power Inverter Module.

- **If greater than 1.6 V**

1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module, Vehicle ON.
2. Test for less than 1 V between the signal circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the T6 Power Inverter Module.

- **If between 0.6-1.6 V**

5. Test for 6-8 V DC between the reference circuit terminals listed below and ground:
    - Terminal V
    - Terminal W
    - **If less than 6 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
    2. Test for infinite resistance between the reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 ohms in the reference circuit end to end.
        - If 2 ohms or greater, repair the open/high resistance in the circuit.
        - If less than 2 ohms, replace the T6 Power Inverter Module.
    - **If greater than 8 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module, Vehicle ON.
    2. Test for less than 1 V DC between the reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the T6 Power Inverter Module.
    - **If between 6-8 V**
6. Verify DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 is not set.
    - **If any of the DTCs are set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set
    3. All OK.
    - **If none of the DTCs are set**
7. All OK.

Component Testing

NOTE: If the a/trans wiring harness assembly circuits fail the circuit tests, replace the harness; do not repair.

1. Vehicle ON.
2. Verify that DTC P1AF0, P1AF2, P1B43, P1B44, P1E1E, P1E22, P1B0B, or P1B0C is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
3. Vehicle OFF, disconnect the X175 harness connector at the transmission.
4. Install the **DT-44152** jumper harness to the transmission side only.
5. Test for 10-25 ohms between the reference circuit terminal V and the reference circuit terminal W.
   - **If less than 10 ohms**
   1. Disconnect the X1 harness connector at the M15A Drive Motor 1.
   2. Test for infinite resistance between the reference circuit terminal V and the reference circuit terminal W.
      - If less than infinite resistance, replace the a/trans wiring harness assembly.
      - If infinite resistance, replace the B228A Drive Motor 1 Position Sensor.
   - **If greater than 25 ohms**
   1. Disconnect the X1 harness connector at the M15A Drive Motor 1.
   2. Test for less than 2 ohms in the reference circuits end to end.
      - If 2 ohms or greater, replace the a/trans wiring harness assembly.
      - If less than 2 ohms, replace the B228A Drive Motor 1 Position Sensor.
   - **If between 10-25 ohms**
6. Test for 15-45 ohms between the signal (COS) circuit terminal U and the signal (COS) circuit terminal T.
   - **If less than 15 ohms**
   1. Disconnect the X1 harness connector at the M15A Drive Motor 1.
   2. Test for infinite resistance between the signal (COS) circuit terminal U and the signal (COS) circuit terminal T.
      - If less than infinite resistance, replace the a/trans wiring harness assembly.
      - If infinite resistance, replace the B228A Drive Motor 1 Position Sensor.
   - **If greater than 45 ohms**
   1. Disconnect the X1 harness connector at the M15A Drive Motor 1.
   2. Test for less than 2 ohms in the signal circuits end to end.
      - If 2 ohms or greater, replace the a/trans wiring harness assembly.
      - If less than 2 ohms, replace the B228A Drive Motor 1 Position Sensor.
   - **If between 15-45 ohms**
7. Test for 15-45 ohms between the signal (SIN) circuit terminal L and the signal (SIN) circuit terminal M.

- **If less than 15 ohms**

1. Disconnect the X1 harness connector at the M15A Drive Motor 1.
2. Test for infinite resistance between the signal (SIN) circuit terminal L and the signal (SIN) circuit terminal M.
    - If less than infinite resistance, replace the a/trans wiring harness assembly.
    - If infinite resistance, replace the B228A Drive Motor 1 Position Sensor.

- **If greater than 45 ohms**

1. Disconnect the X1 harness connector at the M15A Drive Motor 1.
2. Test for less than 2 ohms in the signal circuits end to end.
    - If 2 ohms or greater, replace the a/trans wiring harness assembly.
    - If less than 2 ohms, replace the B228A Drive Motor 1 Position Sensor.

- **If between 15-45 ohms**

8. Test for greater than 10,000 ohms between the terminals listed below and ground:
    - Reference circuit terminal V
    - Reference circuit terminal W
    - Signal (COS) circuit terminal U
    - Signal (COS) circuit terminal T
    - Signal (SIN) circuit terminal L
    - Signal (SIN) circuit terminal M
    - **If less than 10,000 ohms**

    1. Disconnect the X1 harness connector at the M15A Drive Motor 1.
    2. Test for less than infinite resistance between the appropriate terminal and ground.
        - If less than infinite resistance, replace the a/trans wiring harness assembly.
        - If infinite resistance, replace the B228A Drive Motor 1 Position Sensor.

    - **If 10,000 ohms or greater**

9. Test for infinite resistance between the terminals listed below:
    - Terminals V and U
    - Terminals V and L
    - Terminals U and L
    - **If less than infinite resistance**

    1. Disconnect the X1 harness connector at the M15A Drive Motor 1.
    2. Test for less than infinite resistance between the appropriate terminals.
        - If less than infinite resistance, replace the a/trans wiring harness assembly.
        - If infinite resistance, replace the B228A Drive Motor 1 Position Sensor.

    - **If infinite resistance**

10. Refer to Circuit/System Testing.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Position Sensor Stator Removal** for B228A Drive Motor 1 Position Sensor, often referred to as the Generator Position Sensor Stator (Unit A), replacement
- **Automatic Transmission Wiring Harness and Output Speed Sensor Removal** for A/Trans Wiring Harness Assembly replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup

DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, OR P1B04: DRIVE MOTOR 2 POSITION SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0A45

Drive Motor 2 Position Sensor Circuit

DTC P0A46

Drive Motor 2 Position Sensor Performance

DTC P0C57

Drive Motor 2 Position Sensor Circuit 1 Low Voltage

DTC P0C58

Drive Motor 2 Position Sensor Circuit 1 High Voltage

DTC P0C61

Drive Motor 2 Position Sensor Circuit 2 Low Voltage

DTC P0C62

Drive Motor 2 Position Sensor Circuit 2 High Voltage

DTC P1B04

Drive Motor 2 Position Sensor Circuit Tracking Lost

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Reference* - Excitation	P0A45	P0A45	P0A45	P1B04, P0A46
Signal* - SIN	P0A45, P0C57	P0A45	P0C58, P0A45	P1B04, P0A46
Signal* - COS	P0A45, P0C61	P0A45	P0C62, P0A45	P1B04, P0A46
*Represents a differential circuit consisting of a pair of wires. See Circuit/System Description and schematic for detailed description.				

Circuit/System Description

The drive motor position sensor is monitored by the motor control module. The motor control module monitors the angular position, speed and direction of the drive motor rotor based upon the signals of the resolver-type position sensor. The position sensor contains a drive coil, two driven coils and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor. At vehicle ON, the motor control module outputs a 7 V AC, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The motor control module then monitors the two driven coil circuits for return signals-Sine and Cosine waveforms, often referred to as SIN and COS. The position of the irregular metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coils signals allows the motor control module to determine the exact position, speed and direction of the drive motor rotor. The drive motor 2 position sensor is serviceable separately from the drive motor assembly.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

P0C57 or P0C61

Circuit voltage is less than 0.5 V.

P0C58 or P0C62

Circuit voltage is greater than 4.5 V.

P0A45

SIN or COS signal is less than 2.3V. The motor control module cannot determine the motor position based upon the sensor signals.

P0A46

SIN or COS signal is greater than 4V. The motor control module detects a degraded motor position sensor

signal.

P1B04

The motor control module is unable to track the motor position based upon the sensor signals.

Action Taken When the DTC Sets

- For Type A DTCs, drive motor 2 control module stops requesting power for drive motor 2.
- DTCs P0A45, P0A46, and P1B04 are Type A DTCs.
- DTCs P0C57, P0C58, P0C61, and P0C62 are Type B DTCs.

Conditions for Clearing the DTC

- DTCs P0A45, P0A46, and P1B04 are Type A DTCs.
- DTCs P0C57, P0C58, P0C61, and P0C62 are Type B DTCs.

Diagnostic Aids

- The drive motor position sensor circuits operate at very low current. These circuits are susceptible to moisture intrusion, corrosion, and terminal damage. Extreme care must be taken when probing terminals and manipulating harnesses. Poor terminal connections can result in intermittent operation.
- If the customer comments that the problem occurs only during moist environmental conditions: rain, snow, vehicle wash, etc., inspect the sensor wiring for signs of water intrusion.
- The sensor circuit loops are a twisted pair with each pair covered in a foil shield. The shield circuits outside of the transmission are grounded to a stud on the power inverter module, often referred to as the drive motor generator power inverter module.
- The drive motor position sensor harness circuits are shielded. Improperly grounded shield circuits may cause inaccurate sensor signals.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE:

- **You must perform the Component Testing before proceeding with Circuit/System Testing.**
- **The B228B Drive Motor 2 Position Sensor connectors are external to the transmission.**

1. Vehicle OFF, disconnect the X1 and X2 harness connectors at the B228B Drive Motor 2 Position Sensor.
2. Vehicle ON.
3. Test for 0.6-1.6 V between the signal circuit terminals listed below and ground:
   - Signal (SIN) circuit terminal 1 X1
   - Signal (SIN) circuit terminal 2 X1
   - Signal (COS) circuit terminal 3 X1
   - Signal (COS) circuit terminal 4 X1
   - **If less than 0.6 V**
   1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 ohms in the signal circuit end to end.
      - If 2 ohms or greater, repair the open/high resistance in the circuit.
      - If less than 2 ohms, replace the T6 Power Inverter Module.
   - **If greater than 1.6 V**
   1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module, Vehicle ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the T6 Power Inverter Module.
   - **If between 0.6-1.6V**
4. Test for 6-8 V DC between the reference circuit terminals listed below and ground:

- X2 Terminal 1
- X2 Terminal 2

- **If less than 6 V**

1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
2. Test for infinite resistance between the reference circuit and ground.
   - If less than infinite resistance, repair the short to ground on the circuit.
   - If infinite resistance
3. Test for less than 2 ohms in the reference circuit end to end.
   - If 2 ohms or greater, repair the open/high resistance in the circuit.
   - If less than 2 ohms, replace the T6 Power Inverter Module.

- **If greater than 8 V**

1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module, Vehicle ON.
2. Test for less than 1 V DC between the reference circuit and ground.
   - If 1 V or greater, repair the short to voltage on the circuit.
   - If less than 1 V, replace the T6 Power Inverter Module.

- **If between 6-8 V**

5. Vehicle OFF, connect the X1 and X2 harness connectors at the B228B Drive Motor 2 Position Sensor, vehicle ON.
6. Verify DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04 is not set.
   - **If any of the DTCs are set**
   1. Program the T6 Power Inverter Module.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the T6 Power Inverter Module.
      - If the DTC does not set
   3. All OK.
   - **If none of the DTCs are set**
7. All OK.

Component Testing

NOTE:

- **If the B228B Drive Motor 2 Position Sensor circuits fail the circuit tests, replace the component; do not repair.**
- **The B228B Drive Motor 2 Position Sensor connectors are external to the transmission.**

1. Vehicle ON.
2. Verify that DTCs P1AF0, P1AF2, P1B43, P1E1E, P1E22 P1B0B, or P1B0C is not set.
   - **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

3. Vehicle OFF, disconnect the X2 harness connector at the B228B Drive Motor 2 Position Sensor.
4. Test for 10-25 ohms between the reference circuit terminal 1 and the reference circuit terminal 2.
   - **If not within the specified range**

     Replace the B228B Drive Motor 2 Position Sensor.

   - **If within the specified range**
5. Disconnect the X1 harness connector at the B228B Drive Motor 2 Position Sensor.
6. Test for 15-45 ohms between the signal (COS) circuit terminal 3 X1 and the signal (COS) circuit terminal 4 X1.
   - **If not within the specified range**

     Replace the B228B Drive Motor 2 Position Sensor.

   - **If within the specified range**
7. Test for 15-45 ohms between the signal (SIN) circuit terminal 1 X1 and the signal (SIN) circuit terminal 2 X1.
   - **If not within the specified range**

     Replace the B228B Drive Motor 2 Position Sensor.

   - **If within the specified range**
8. Test for greater than 10,000 ohms between the terminals listed below and ground:
   - Reference circuit terminal 1 X2
   - Reference circuit terminal 2 X2
   - Signal (SIN) circuit terminal 1 X1
   - Signal (SIN) circuit terminal 2 X1
   - Signal (COS) circuit terminal 3 X1
   - Signal (COS) circuit terminal 4 X1
   - **If less than 10,000 ohms**

     Replace the B228B Drive Motor 2 Position Sensor.

   - **If 10,000 ohms or greater**
9. Test for infinite resistance between the terminals listed below:
   - Reference circuit terminal 1 X2 and signal (SIN) circuit terminal 1 X1
   - Reference circuit terminal 1 X2 and signal (COS) circuit terminal 3 X1
   - Signal (SIN) circuit terminal 1 X1 and signal (COS) circuit terminal 3 X1

- **If less than infinite resistance**

  Replace the B228B Drive Motor 2 Position Sensor.

- **If infinite resistance**

10. Refer to Circuit/System Testing.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Stator Drive Motor Position Sensor Replacement** for B228B Drive Motor 2 Position Sensor replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0A78 OR P0A79: DRIVE MOTOR 1/2 INVERTER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0A78

Drive Motor 1 Inverter Performance

DTC P0A79

Drive Motor 2 Inverter Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control modules and the hybrid/EV powertrain control module 1. Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls the speed, direction and output torque of its respective drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each drive motor operates utilizing 3-phase alternating current (AC) electricity. Each insulated gate bipolar transistor operates a single phase of the drive motor. Each phase is individually identified as U, V and W. Each motor control module monitors the current of each phase in order to detect power inverter module over current conditions.

Conditions for Running the DTC

The high voltage contactor relays are closed.

Conditions for Setting the DTC

The motor control module detects excessive current flow through the switched portion of the insulated gate bipolar transistor.

Action Taken When the DTC Sets

- DTCs P0A78 and P0A79 are Type A DTCs.
- The power inverter module requests hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0A78 and P0A79 are Type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0A78 or P0A79 is not set.
    - **If any of the DTCs are set**
    1. Clear the DTC, vehicle OFF for 2 minutes to allow all control modules to shut down.
    2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle

within the conditions that you observed from the Freeze Frame/Failure Records data.

3. Verify the DTC does not set.
   - If the DTC sets, continue to Circuit/System Testing.
   - If the DTC does not set.
4. All OK
   - **If none of the DTCs are set**

3. All OK

Circuit/System Testing

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Remove the 3-phase cable assembly from the T6 Power Inverter Module. Refer to **Drive Motor Generator Power Inverter Module Replacement**.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the appropriate M15 Drive Motor:

   Drive Motor 1

   - X5 terminal 3 phase U
   - X5 terminal 2 phase V
   - X5 terminal 1 phase W

   Drive Motor 2

- X6 terminal 3 phase U
- X6 terminal 2 phase V
- X6 terminal 1 phase W

If less than infinite resistance

1. Disconnect the appropriate 3-phase cable assembly from the transmission. Refer to **Generator Rotor and Stator Removal - Unit A** , or **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** .
2. Test for infinite resistance between the AC circuit terminal and ground and between the AC circuit terminal and the aluminum cable mounting block.
   - If less than infinite resistance, replace the 3-phase cable assembly.
   - If infinite resistance, replace the M15 Drive Motor.

If infinite resistance for all AC circuits

4. Verify the DTC does not set.

If the DTC sets

1. Perform each of the operations listed below one at a time until the fault is corrected.
   1. Program the T6 Power Inverter Module.
   2. Replace the T6 Power Inverter Module.
   3. Replace the M15 Drive Motor.
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Repeat the DTC check.

If the DTC does not set

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Rotor and Stator Removal - Unit A** for Drive Motor 1 or Drive Motor 1 3-Phase Cable Assembly replacement
- **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** for Drive Motor 2 or Drive Motor 2 3-Phase Cable Assembly replacement
- **Control Module References** for Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0A89: 14V POWER MODULE CURRENT SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0A89

14V Power Module Current Sensor Circuit High Current

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, monitors output current. This sensor is internal to the 14V power module and is not serviced separately from the control module.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

The sensor signal is out of range for greater than 5 seconds.

Action Taken When the DTC Sets

- The 14V power module stops supplying power to the 12V system.
- DTC P0A89 is a Type C DTC.

Conditions for Clearing the DTC

DTC P0A89 is a Type C DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0A89 is not set.
    - **If the DTC is set**
    1. Program the K1 14V Power Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the K1 14V Power Module.
        - If the DTC does not set.

3. All OK
   - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup.

DTC P0A8D-P0A8F: 14V POWER MODULE SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0A8D

14V Power Module System Voltage Low Voltage

DTC P0A8E

14V Power Module System Voltage High Voltage

DTC P0A8F

14V Power Module System Voltage Performance

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, constantly monitors system input and output voltage. This sensor is internal to the 14V power module and is not serviced separately from the control module.

The accessory wake up serial data 2 signal originates in the hybrid/EV powertrain control module 2 and is routed to several independent modules, including the 14V power module.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

DTC P0A8D or P0A8E

The sensor signal is out of range for greater than 5 seconds.

P0A8F

The sensor signal is out of range for greater than 5 seconds.

or

Accessory wake up serial data 2 signal is not reaching the 14V power module.

Action Taken When the DTC Sets

- The 14V power module may stop supplying power to the 12V system.
- DTCs P0A8D, P0A8E, or P0A8F are Type C DTCs.

Conditions for Clearing the DTC

DTCs P0A8D, P0A8E, or P0A8F are Type C DTCs.

Diagnostic Aids

- This DTC may set due to low 12 V system voltage.
- A poor connection at the B+ terminal of the 14V power module or an open or improperly fastened 200A mega fuse in the X50D fuse block may cause this DTC to set.
- Problems with the high voltage connection between the hybrid/EV battery pack and the 14V power module will prevent 12V system charging and should be addressed first.

Reference Information

Schematic Reference

- **Starting and Charging Schematics**
- **Data Communication Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Accessory DC Power Control Module Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC P1EA8, P1ABC, or P1ABD is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
2. Verify DTC P1EA9 is not set.
   - **If the DTC is set**

     Refer to **DTC P1EA9**.

   - **If the DTC is not set**
3. Verify DTC P2537 is not set.
   - **If the DTC is set**

     Refer to **DTC P2537** .

   - **If the DTC is not set**
4. Verify DTC P0A8D, P0A8E, or P0A8F is not set.
   - **If DTC P0A8D or P0A8E is set**

     Replace the K1 14V Power Module.

   - **If DTC P0A8F is set**

     Refer to Circuit/System Testing.

   - **If none of the DTCs are set**
5. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the X2 harness connector at the K1 14V Power Module. It may take up to 2 min for all vehicle systems to power down.
2. Vehicle in Service Mode.

NOTE: The setting of DTC P0A8F without DTC P2537 suggests that the 14V power module is the only module not receiving the accessory wake up serial data 2 signal.

3. Verify a test lamp illuminates between the ignition circuit terminal 10 and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, remove the test lamp, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 2 ohms on the ignition circuit end to end and repair the open/high resistance in the circuit.
   - **If the test lamp illuminates**
4. Replace the K1 14V Power Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup

DTC P0AB9: HYBRID/EV SYSTEM PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0AB9

Hybrid/EV System Performance

Circuit/System Description

This vehicle does not use a 12V starter motor to crank the internal combustion engine. A much more powerful 300V motor located within the transmission is utilized to crank the engine. This motor, drive motor 1, can rotate the engine to operating speed (800 RPM) within just a few hundred milliseconds. The hybrid/EV powertrain

control module 1 can detect a condition where the engine is cranking but does not start or has stalled.

Conditions for Running the DTC

Drive motor 1 is cranking the engine.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 1 detects that crankshaft position sensor engine speed has not risen above the commanded cranking speed indicating the engine has failed to start, or the hybrid/EV powertrain control module 1 detects crankshaft position sensor engine speed has fallen below a specific minimum speed indicating the engine has stalled.

Action Taken When the DTC Sets

DTC P0AB9 is a Type A DTC.

Cranks But Does Not Start

When system commands engine Crank, the hybrid/EV powertrain control module 1 will command drive motor 1 to rotate the engine. The drive motor will continue to rotate the engine at a specific RPM until the engine starts and causes increased engine RPM. The hybrid/EV powertrain control module 1 will cease engine rotation if an increase in engine RPM is not observed after several seconds. This function may have the appearance of a start/stall condition.

Engine Stall

If a stall occurs after a successful engine start, the hybrid/EV powertrain control module 1 will recognize the drop in engine RPM and command drive motor 1 to maintain engine RPM in an attempt to restart the engine. Drive motor 1 will continue to rotate the engine until the hybrid/EV powertrain control module 1 commands it to stop. The engine may be rotated for many minutes after the actual engine stall condition occurred and is typically stopped only after the hybrid/EV battery state of charge gets too low. This function may have the appearance of a running engine.

Conditions for Clearing the DTC

DTC P0AB9 is a Type A DTC.

Diagnostic Aids

Any condition that causes the engine to stall and/or not start may set this DTC. Possible conditions include:

- Fuel conditions such as low level, low pressure, or contamination.
- Engine conditions such as low compression.
- Restricted exhaust or air intake systems.
- Loose or disconnected grounds.

Always inspect for DTCs that would cause an engine stall and/or no start condition.

This DTC may set if the vehicle is powered off while driving.

Circuit/System Verification

1. Vehicle ON. Operate the hood release to open the hood. The engine should start and run.
2. Verify the engine starts and runs.
   - **If the engine fails to start**

     Diagnose the engine system. Refer to **Engine Cranks But Does Not Run** .

   - **If the engine starts**
3. Verify DTC P0AB9 is not set.
   - **If the DTC is set**
     1. Program the T6 Power Inverter Module.
     2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
     3. All OK
   - **If the DTC is not set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, OR P0BE1-P0BE3: DRIVE MOTOR INVERTER TEMPERATURE SENSOR 1-6

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0AEE

Drive Motor Inverter Temperature Sensor 1 Performance

DTC P0AEF

Drive Motor Inverter Temperature Sensor 1 Circuit Low Voltage

DTC P0AF0

Drive Motor Inverter Temperature Sensor 1 Circuit High Voltage

DTC P0AF3

Drive Motor Inverter Temperature Sensor 2 Performance

DTC P0AF4

Drive Motor Inverter Temperature Sensor 2 Circuit Low Voltage

DTC P0AF5

Drive Motor Inverter Temperature Sensor 2 Circuit High Voltage

DTC P0BD2

Drive Motor Inverter Temperature Sensor 3 Performance

DTC P0BD3

Drive Motor Inverter Temperature Sensor 3 Circuit Low Voltage

DTC P0BD4

Drive Motor Inverter Temperature Sensor 3 Circuit High Voltage

DTC P0BD7

Drive Motor Inverter Temperature Sensor 4 Performance

DTC P0BD8

Drive Motor Inverter Temperature Sensor 4 Circuit Low Voltage

DTC P0BD9

Drive Motor Inverter Temperature Sensor 4 Circuit High Voltage

DTC P0BDC

Drive Motor Inverter Temperature Sensor 5 Performance

DTC P0BDD

Drive Motor Inverter Temperature Sensor 5 Circuit Low Voltage

DTC P0BDE

Drive Motor Inverter Temperature Sensor 5 Circuit High Voltage

DTC P0BE1

Drive Motor Inverter Temperature Sensor 6 Performance

DTC P0BE2

Drive Motor Inverter Temperature Sensor 6 Circuit Low Voltage

DTC P0BE3

Drive Motor Inverter Temperature Sensor 6 Circuit High Voltage

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

P0AEE, P0AF3, P0BD2, P0BD7, P0BDC, and P0BE1

- Vehicle ON after the vehicle has been OFF for 6 hours.
- Temperature average of the inverter phase temperature sensors is greater than 12°C (10°F).
- Motor temperature sensor is greater than -40°C (-40°F).
- DTCs P0AEF, P0AF0, P0AF4, P0AF5, P0BD3, P0BD4, P0BD8, P0BD9, P0BDD, P0BDE, P0BE2, and P0BE3 are not set.

P0AEF, P0AF4, P0BD3, P0BD8, P0BDD, and P0BE2

The vehicle is ON.

P0AF0, P0AF5, P0BD4, P0BD9, P0BDE, and P0BE3

- The vehicle is ON.
- Motor temperature is greater than -40°C (-40°F). If motor temperature is less than -40°C (-40°F) at

vehicle ON, the drive motor must operate at greater than 20 N.m (14.75 lb ft) for a cumulative time of 1.5 minutes before the DTC will run.

Conditions for Setting the DTC

P0AEE, P0AF3, P0BD2, P0BD7, P0BDC, and P0BE1

- A 20°C (36°F) difference is observed between the individual inverter phase temperature sensor and the average of the power electronics coolant and transmission fluid temperatures.
- The above condition is present for 4 seconds.

P0AEF, P0AF4, P0BD3, P0BD8, P0BDD, and P0BE2

The inverter phase temperature sensor is greater than 130°C (266°F) for 3 seconds.

P0AF0, P0AF5, P0BD4, P0BD9, P0BDE, and P0BE3

The inverter phase temperature sensor is less than -58°C (-72°F) for 3 seconds.

Action Taken When the DTC Sets

- DTCs P0AEE, P0AEF, P0AF0, P0AF3, P0AF4, P0AF5, P0BD2, P0BD3, P0BD4, P0BD7, P0BD8, P0BD9, P0BDC, P0BDD, P0BDE, P0BE1, P0BE2 and P0BE3 are Type A DTCs.
- The power inverter module requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0AEE, P0AEF, P0AF0, P0AF3, P0AF4, P0AF5, P0BD2, P0BD3, P0BD4, P0BD7, P0BD8, P0BD9, P0BDC, P0BDD, P0BDE, P0BE1, P0BE2 and P0BE3 are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0AEE, P0AEF, P0AF0, P0AF3, P0AF4, P0AF5, P0BD2, P0BD3, P0BD4, P0BD7, P0BD8, P0BD9, P0BDC, P0BDD, P0BDE, P0BE1, P0BE2, or P0BE3 is not set.
    - **If any of the DTCs are set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.

- If the DTC does not set.

3. All OK
   - **If none of the DTCs are set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module replacement, programming, and setup

DTC P0B0D: AUXILIARY TRANSMISSION FLUID PUMP CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0B0D

Auxiliary Transmission Fluid Pump Control Module Performance

Circuit/System Description

This is a fault detection of the auxiliary transmission fluid pump control module. This control module is part of the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTC P0B0D is a Type A DTC.

- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P0B0D is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0B0D is not set.
    - **If the DTC is set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    3. All OK
    - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, OR P0BFA-P0BFC: DRIVE MOTOR 1/2 PHASE U CURRENT SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0BE6

Drive Motor 1 Phase U Current Sensor Performance

DTC P0BE7

Drive Motor 1 Phase U Current Sensor Circuit Low Voltage

DTC P0BE8

Drive Motor 1 Phase U Current Sensor Circuit High Voltage

DTC P0BEA

Drive Motor 1 Phase V Current Sensor Performance

DTC P0BEB

Drive Motor 1 Phase V Current Sensor Circuit Low Voltage

DTC P0BEC

Drive Motor 1 Phase V Current Sensor Circuit High Voltage

DTC P0BEE

Drive Motor 1 Phase W Current Sensor Performance

DTC P0BEF

Drive Motor 1 Phase W Current Sensor Circuit Low Voltage

DTC P0BF0

Drive Motor 1 Phase W Current Sensor Circuit High Voltage

DTC P0BF2

Drive Motor 2 Phase U Current Sensor Performance

DTC P0BF3

Drive Motor 2 Phase U Current Sensor Circuit Low Voltage

DTC P0BF4

Drive Motor 2 Phase U Current Sensor Circuit High Voltage

DTC P0BF6

Drive Motor 2 Phase V Current Sensor Performance

DTC P0BF7

Drive Motor 2 Phase V Current Sensor Circuit Low Voltage

DTC P0BF8

Drive Motor 2 Phase V Current Sensor Circuit High Voltage

DTC P0BFA

Drive Motor 2 Phase W Current Sensor Performance

DTC P0BFB

Drive Motor 2 Phase W Current Sensor Circuit Low Voltage

DTC P0BFC

Drive Motor 2 Phase W Current Sensor Circuit High Voltage

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the drive motor generator power inverter module and no external circuits are involved.

Conditions for Running the DTC

The control module runs the program to detect an internal fault when the Hybrid wake-up circuit is active.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTCs P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, P0BF0, P0BF2, P0BF3, P0BF4, P0BF6, P0BF7, P0BF8, P0BFA, P0BFB and P0BFC are Type A DTCs.
- The power inverter module requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, P0BF0, P0BF2, P0BF3, P0BF4, P0BF6, P0BF7, P0BF8, P0BFA, P0BFB and P0BFC are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, P0BF0, P0BF2, P0BF3, P0BF4, P0BF6, P0BF7, P0BF8, P0BFA, P0BFB or P0BFC is not set.
   - **If any of the DTCs are set**
   1. Program the T6 Power Inverter Module.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the T6 Power Inverter Module.
      - If the DTC does not set.
   3. All OK
   - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0BFD OR P0BFE: DRIVE MOTOR 1-2 PHASES U-V-W

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0BFD

Drive Motor 1 Phases U-V-W Not Plausible

DTC P0BFE

Drive Motor 2 Phases U-V-W Not Plausible

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control modules and the hybrid/EV powertrain control module 1. Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls the speed, direction and output torque of its respective drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each drive motor operates utilizing 3-phase alternating current (AC) electricity. Each insulated gate bipolar transistor operates a single phase of the drive motor. Each phase is individually identified as U, V and W. Each motor control module monitors the current of each phase in order to detect power inverter module over current conditions.

Because all the motor generator phase circuits are electrically joined together, they should each flow about the same amount of current. The motor control modules perform a mathematical calculation to verify that the phase current sensors are accurate. If the U-V-W phase current sensors indicate about the same amount of phase current, the sum of the calculation should be near zero. If the U-V-W phase currents are not similar, this DTC will set.

Conditions for Running the DTC

- The vehicle is ON.
- The high voltage contactor relays are closed.

Conditions for Setting the DTC

The sum of the 3 phase current sensors is greater than 156 A.

Action Taken When the DTC Sets

- DTCs P0BFD and P0BFE are Type A DTCs.
- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0BFD and P0BFE are Type A DTCs.

Diagnostic Aids

These DTCs may be set during a stall.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0BFD or P0BFE is not set.
   - **If any of the DTCs are set**
   1. Clear the DTC, vehicle OFF for 2 minutes to allow all control modules to shut down.
   2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
   3. Verify the DTC does not set.
      - If the DTC sets, continue to Circuit/System Testing.
      - If the DTC does not set.
   4. All OK
   - **If none of the DTCs are set**
3. All OK

Circuit/System Testing

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**

- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module cable connections.
2. Remove the 3-phase cable assembly from the T6 Power Inverter Module. Refer to **Drive Motor Generator Power Inverter Module Replacement**.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the appropriate M15 Drive Motor:

   Drive Motor 1

   - X5 terminal 3 phase U
   - X5 terminal 2 phase V
   - X5 terminal 1 phase W

   Drive Motor 2

   - X6 terminal 3 phase U
   - X6 terminal 2 phase V
   - X6 terminal 1 phase W
   - **If less than infinite resistance**

   1. Disconnect the appropriate 3-phase cable assembly from the transmission. Refer to **Generator Rotor and Stator Removal - Unit A** , or **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** .
   2. Test for infinite resistance between the AC circuit terminal and ground and between the AC circuit terminal and the aluminum cable mounting block.
      - If less than infinite resistance, replace the 3-phase cable assembly.
      - If infinite resistance, replace the M15 Drive Motor.

   - **If infinite resistance for all AC circuits**

4. Verify the DTC does not set.
   - **If the DTC sets**

   1. Perform each of the operations listed below one at a time until the fault is corrected.
      1. Program the T6 Power Inverter Module.
      2. Replace the T6 Power Inverter Module.
      3. Replace the M15 Drive Motor.
   2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle

within the conditions that you observed from the Freeze Frame/Failure Records data.

3. Repeat the DTC check.
   - **If the DTC does not set**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Rotor and Stator Removal - Unit A** for Drive Motor 1 or Drive Motor 1 3-Phase Cable Assembly replacement
- **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** for Drive Motor 2 or Drive Motor 2 3-Phase Cable Assembly replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C01 OR P0C04: DRIVE MOTOR 1/2 HIGH CURRENT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0C01

Drive Motor 1 High Current

DTC P0C04

Drive Motor 2 High Current

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control modules and the hybrid/EV powertrain control module 1. Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls the speed, direction and output torque of its respective drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each drive motor operates utilizing 3-phase alternating current (AC) electricity. Each insulated gate bipolar transistor operates a single phase of the drive motor. Each phase is individually identified as U, V and W. Each motor control module monitors the current of each phase in order to detect power inverter module over current conditions.

Conditions for Running the DTC

The hybrid wakeup circuit is active.

Conditions for Setting the DTC

One or more phase currents are greater than 725 A.

Action Taken When the DTC Sets

- DTCs P0C01 and P0C04 are Type A DTCs.
- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0C01 and P0C04 are Type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0C01 or P0C04 is not set.
    - **If any of the DTCs are set**
    1. Clear the DTC, vehicle OFF for 2 minutes to allow all control modules to shut down.
    2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
    3. Verify the DTC does not set.
        - If the DTC sets, continue to Circuit/System Testing.
        - If the DTC does not set.

4. All OK
   - **If none of the DTCs are set**
3. All OK

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Remove the 3-phase cable assembly from the T6 Power Inverter Module. Refer to **Drive Motor Generator Power Inverter Module Replacement**.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the appropriate M15 Drive Motor:

Drive Motor 1

- X5 terminal 3 phase U
- X5 terminal 2 phase V
- X5 terminal 1 phase W

Drive Motor 2

- X6 terminal 3 phase U
- X6 terminal 2 phase V
- X6 terminal 1 phase W

- **If less than infinite resistance**

1. Disconnect the appropriate 3-phase cable assembly from the transmission. Refer to **Generator Rotor and Stator Removal - Unit A** , or **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** .
2. Test for infinite resistance between the AC circuit terminal and ground and between the AC circuit terminal and the aluminum cable mounting block.
   - If less than infinite resistance, replace the 3-phase cable assembly.
   - If infinite resistance, replace the M15 Drive Motor.

- **If infinite resistance for all AC circuits**

4. Verify the DTC does not set.
   - **If the DTC sets**

1. Perform each of the operations listed below one at a time until the fault is corrected.
   1. Program the T6 Power Inverter Module.
   2. Replace the T6 Power Inverter Module.
   3. Replace the M15 Drive Motor.
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Repeat the DTC check.

   - **If the DTC does not set**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Rotor and Stator Removal - Unit A** for Drive Motor 1 or Drive Motor 1 3-Phase Cable Assembly replacement
- **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** for Drive Motor 2 or Drive Motor 2 3-Phase Cable Assembly replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C05 OR P0C08: DRIVE MOTOR 1/2 PHASE U-V-W

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0C05

Drive Motor 1 Phase U-V-W Circuits

DTC P0C08

Drive Motor 2 Phase U-V-W Circuits

Circuit/System Description

Each drive motor is controlled by a motor control module. The drive motor utilizes 3 phase AC electricity. The drive motor stator coil is comprised of three phase circuits. The phase circuits are identified as phase U, phase V, and phase W. The U-V-W phase circuits are connected in a wye configuration. This means each phase is connected at a single, central point. The motor control modules monitor a current sensor connected to each drive motor phase. The current sensor is part of the drive motor assembly and is not serviced separately. The motor control module is part of the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately.

Conditions for Running the DTC

- The Hybrid Wakeup circuit is active.
- Inverter voltage is greater than 35V.
- The motor control module has applied greater than or equal to 23A to the drive motor.

Conditions for Setting the DTC

The motor control module detects at least one U-V-W phase current sensor is less than 9 A.

Action Taken When the DTC Sets

- DTCs P0C05 and P0C08 are Type A DTCs.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTCs P0C05 and P0C08 are Type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- **Circuit Testing**

- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing at the T6 Power Inverter Module cable connections.
2. Remove the 3-phase cable assembly from the T6 Power Inverter Module. Refer to **Drive Motor Generator Power Inverter Module Replacement**.
3. Test for less than 0.5 ohms between each phase of the appropriate M15 Drive Motor by measuring between the following AC circuit terminals:
   - Phase U and phase V
   - Phase U and phase W
   - **If 0.5 ohms or greater**
   1. Verify the 3-phase cable assembly terminal fasteners at the M15 Drive Motor rotor are properly torqued and do not have arc-flash damage. Refer to **Generator Rotor and Stator Removal - Unit A** , or **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** .
      - If any fasteners were loose and no arc-flash damage is present, torque the fasteners and re-assemble the vehicle.
      - If any fasteners were loose and arc-flash damage is present, replace the M15 Drive Motor and the 3-phase cable assembly.

- If all fasteners were properly torqued and no arc-flash damage is present

1. Disconnect the 3-phase cable assembly from the transmission. Refer to **Generator Rotor and Stator Removal - Unit A** , or **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** .
2. Test for less than 0.5 ohms on each cable of the 3-phase cable assembly end to end.
   - If 0.5 ohms or greater, replace the 3-phase cable assembly.
   - If less than 0.5 ohms, replace the M15 Drive Motor.

- **If less than 0.5 ohms**

4. Replace the M15 Drive Motor.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
   - **If the DTC sets**

     Replace the T6 Power Inverter Module.

   - **If the DTC does not set**
7. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Rotor and Stator Removal - Unit A** for Drive Motor 1 or Drive Motor 1 3-Phase Cable Assembly replacement
- **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** for Drive Motor 2 or Drive Motor 2 3-Phase Cable Assembly replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C0B OR P0C0E: DRIVE MOTOR 1/2 INVERTER SUPPLY VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0C0B

Drive Motor 1 Inverter Supply Voltage Circuit

DTC P0C0E

Drive Motor 2 Inverter Supply Voltage Circuit

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control modules and the hybrid/EV powertrain control module 1. Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls the speed, direction and output torque of its respective drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each drive motor operates utilizing 3-phase alternating current (AC) electricity. Each insulated gate bipolar transistor operates a single phase of the drive motor. Each phase is individually identified as U, V and W. Each motor control module monitors the current of each phase in order to detect power inverter module over current conditions.

Conditions for Running the DTC

- Vehicle is ON or Charge Mode is active.
- High voltage is greater than 100V.

Conditions for Setting the DTC

The control module does not detect voltage at the insulated gate bi-polar transistor bias supply.

Action Taken When the DTC Sets

- DTCs P0C0B and P0C0E are Type A DTCs.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTCs P0C0B and P0C0E are Type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0C0B or P0C0E is not set.
   - **If any of the DTCs are set**
   1. Clear the DTC, vehicle OFF for 2 minutes to allow all control modules to shut down.
   2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
   3. Verify the DTC does not set.
      - If the DTC sets, continue to Circuit/System Testing.
      - If the DTC does not set.
   4. All OK
   - **If none of the DTCs are set**
3. All OK

Circuit/System Testing

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module cable connections.
2. Remove the 3-phase cable assembly from the T6 Power Inverter Module. Refer to **Drive Motor**

Generator Power Inverter Module Replacement.

3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the appropriate M15 Drive Motor:

   Drive Motor 1

   - X5 terminal 3 phase U
   - X5 terminal 2 phase V
   - X5 terminal 1 phase W

   Drive Motor 2

   - X6 terminal 3 phase U
   - X6 terminal 2 phase V
   - X6 terminal 1 phase W

   - **If less than infinite resistance**

   1. Disconnect the appropriate 3-phase cable assembly from the transmission. Refer to **Generator Rotor and Stator Removal - Unit A** , or **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** .
   2. Test for infinite resistance between the AC circuit terminal and ground and between the AC circuit terminal and the aluminum cable mounting block.
      - If less than infinite resistance, replace the 3-phase cable assembly.
      - If infinite resistance, replace the M15 Drive Motor.

   - **If infinite resistance for all AC circuits**

4. Verify the DTC does not set.

   - **If the DTC sets**

   1. Perform each of the operations listed below one at a time until the fault is corrected.
      1. Program the T6 Power Inverter Module.
      2. Replace the T6 Power Inverter Module.
      3. Replace the M15 Drive Motor.
   2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
   3. Repeat the DTC check.

   - **If the DTC does not set**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Rotor and Stator Removal - Unit A** for Drive Motor 1 or Drive Motor 1 3-Phase Cable Assembly replacement

- **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** for Drive Motor 2 or Drive Motor 2 3-Phase Cable Assembly replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C11-P0C16: DRIVE MOTOR 1/2 INVERTER PHASE U HIGH TEMPERATURE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0C11

Drive Motor 1 Inverter Phase U High Temperature

DTC P0C12

Drive Motor 1 Inverter Phase V High Temperature

DTC P0C13

Drive Motor 1 Inverter Phase W High Temperature

DTC P0C14

Drive Motor 2 Inverter Phase U High Temperature

DTC P0C15

Drive Motor 2 Inverter Phase V High Temperature

DTC P0C16

Drive Motor 2 Inverter Phase W High Temperature

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two drive motor control modules and the hybrid/EV powertrain control module 1. Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls the speed, direction and output torque of its respective drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors . Each drive

motor operates utilizing 3 phase AC. Each insulated gate bipolar transistor operates a single phase of the drive motor. Each phase is individually identified as U, V and W. Each motor control module monitors the temperature of each phase in order to detect power inverter module over-temperature conditions.

Conditions for Running the DTC

P0C11-P0C16

Vehicle ON.

P0C11

DTC P0AEE is not set.

P0C12

DTC P0BDC is not set.

P0C13

DTC P0BD2 is not set.

P0C14

DTC P0AF3 is not set.

P0C15

DTC P0BD7 is not set.

P0C16

DTC P0BE1 is not set.

Conditions for Setting the DTC

The phase temperature has exceeded 98°C (208°F) for 5 seconds.

Action Taken When the DTC Sets

- DTCs P0C11, P0C12, P0C13, P0C14, P0C15 and P0C16 are Type A DTCs.
- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0C11, P0C12, P0C13, P0C14, P0C15 and P0C16 are Type A DTCs.

Reference Information

Description and Operation

- **Drive Motor Generator Power Inverter Module Description and Operation**
- **Drive Motor Generator Control Module Cooling System Description and Operation**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON, observe the scan tool ECM Engine Coolant Temperature (ECT) parameter in freeze frame data.
2. Verify the Engine Coolant Temperature parameter was below 125°C (257°F) when the DTC set.
   - **If the ECT was 125°C (257°F) or greater when the DTC set**

     Refer to **Symptoms - Engine Cooling** and correct that concern first.

   - **If the ECT was below 125°C (257°F) when the DTC set**
3. Inspect for proper coolant level in the hybrid cooling system reservoir.
   - **If coolant level is low**

     Refer to **Hybrid Cooling System Loss of Coolant (Power Electronics)** , **Hybrid Cooling System Loss of Coolant (Battery)** .

   - **If coolant level is OK**
4. Inspect the hybrid/EV cooling system radiator for debris or obstruction.
   - **If a concern is found**

     Repair or replace the restricted or damaged components as necessary.

   - **If no concern is found**
5. Inspect for proper operation of all hybrid/EV system coolant pumps. Refer **Hybrid/EV Electronics Cooling Diagnostic** .
   - **If a concern is found**

     Repair or replace the coolant pumps as necessary.

   - **If no concern is found**
6. Command the cooling fans through all operating speeds.
   - **If the cooling fans do not operate in all speeds**

Refer to **Hybrid/EV Electronics Cooling Diagnostic** .

- **If the cooling fans operate in all speeds**

7. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C17, P0C18, P1B0F, OR P1B10: DRIVE MOTOR 1/2 POSITION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0C17

Drive Motor 1 Position Not Learned

DTC P0C18

Drive Motor 2 Position Not Learned

DTC P1B0F

Drive Motor 1 Position Learn Incorrect

DTC P1B10

Drive Motor 2 Position Learn Incorrect

Circuit/System Description

The drive motor position sensor is monitored by the drive motor control module. The motor control module monitors the angular position, speed and direction of the drive motor rotor based upon the signals of the resolver-type position sensor. The position sensor contains a drive coil, two driven coils and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor generator. At vehicle ON, the motor control module outputs a 7 V AC, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The

motor control module then monitors the two driven coil circuits for a return signal. The position of the irregular metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coils signals allows the motor control module to determine the exact position, speed and direction of the drive motor rotor.

A measurement called offset is needed for accurate determination of the motor position. Offset is the relationship between the position sensor and the drive motor generator output shaft. Whenever the vehicle is cycled to OFF, the motor control module attempts to learn the offset of the drive motor position sensor by rapidly oscillating the motor and observing the position sensor signals.

The motor control module will attempt to learn the position at hybrid wake-up, vehicle ON only if no valid offset value has ever been learned. The non-learned condition would normally occur only after a motor control module reprogramming event. The control modules listed below are part of the power inverter module, often referred to as the drive motor generator power inverter module, and are not serviced separately:

- Auxiliary transmission fluid pump control module
- Drive motor 1 control module
- Drive motor 2 control module
- Hybrid/EV powertrain control module 1

Conditions for Running the DTC

P0C17, P0C18

- Vehicle is cycled from OFF to ON.
- The motor control module has no valid drive motor position sensor offset value in memory.

P1B0F, P1B10

- Vehicle is cycled from ON to OFF.
- The motor control module has learned a valid drive motor position sensor offset value at least once.

Conditions for Setting the DTC

Condition 1

Position sensor offset value not learned because drive motor speed is greater than 50 RPM.

Condition 2

Position sensor offset value not learned because hybrid battery voltage as observed at the motor control module is less than 192V.

Condition 3

Position sensor offset value not learned because drive motor phase to phase current difference is less than 15 A.

Action Taken When the DTC Sets

P0C17, P0C18

- DTCs P0C17 and P0C18 are Type A DTCs.
- Propulsion is disabled. The vehicle cannot operate without a previously stored offset value or the ability to learn offset.

P1B0F, P1B10

- DTCs P1B0F and P1B10 are Type B DTCs.
- The motor control module operates the drive motor generator using the last valid learned offset.

Conditions for Clearing the DTC

- DTCs P0C17 and P0C18 are Type A DTCs.
- DTCs P1B0F and P1B10 are Type B DTCs.

Diagnostic Aids

- If the vehicle is powered off while driving, DTC P1B0F or P1B10 may set.
- The drive motor position sensor circuits operate at very low current. These circuits are susceptible to moisture intrusion, corrosion, and terminal damage. Extreme care must be taken when probing terminals and manipulating harnesses. Poor terminal connections can result in intermittent operation.
- If the customer comments that the problem occurs only during moist environmental conditions: rain, snow, vehicle wash, etc., inspect the sensor wiring for signs of water intrusion.
- The sensor circuit loops are a twisted pair with each pair covered in a foil shield. The shield circuits outside of the transmission are grounded to a stud on the power inverter module.
- The drive motor position sensor harness circuits are shielded. Improperly grounded shield circuits may cause inaccurate sensor signals.
- Intermittent appearance of DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 for drive motor 1 or DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04 for drive motor 2 suggests intermittent position sensor circuit or connector problems.
- Drive motor control modules 1 and 2 monitor and report their respective Drive Motor Position Sensor Offset Learn Status. This information can be observed using a scan tool. Status is updated during the transition from vehicle ON to vehicle OFF during normal conditions. Alternating, and possibly intermittent, appearance of "Not Run," "Learn Failed Motor Speed Not Zero," and "Motor Current Incorrect" suggests intermittent position sensor circuit or connector problems.
- Intermittent appearance of "Motor Current Incorrect" suggests loose 3-phase cable assembly connections at the power inverter module or drive motor.

Drive Motor 1/2 Position Sensor Offset Learn Status Descriptions

Drive Motor Position Sensor Offset Learn Status	Description	May Be Caused By

Not Run	Not run yet, waiting for key off	NA
	Aborted run due to detecting high voltage too low or motor speed too high	Key off while rolling, drive motor position sensor circuit problems, or high voltage system problems
	Ran but failed due to out of range values	Resolver or drive motor problems
Learn Successful	Position offset learned and stored successfully	NA
Learn Failed Motor Speed Not Zero	Speed high during offset learn but not before	Drive motor position sensor circuit problems
Learn Failed - High Voltage Too Low	High voltage contactors opened during offset learn	High voltage system problems
Motor Current Incorrect	Low current on 3-phase circuits between power inverter module and drive motor	Drive motor, power inverter module, or 3-phase cable assembly problem

Reference Information

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTCs P0A3F, P0A40, P0A45, P0A46, P0A78, P0A79, P0C01, P0C04, P0C05, P0C08, P0C0B, P0C0E, P0C4E, P0C4F, P0C52, P0C53, P0C57, P0C58, P0C5C, P0C5D, P0C61, P0C62, P1B03, P1B04, P1B0D, or P1B0E is not set.
   - **If any of the DTCs are set**
   - Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
   - **If none of the DTCs are set**

   NOTE: When turning vehicle OFF, open and close the driver door and wait 1 minute to allow all modules to shut down.

3. Cycle vehicle power 4 times, using a scan tool to monitor the state of the appropriate Drive Motor Position Sensor Offset Learn Status.
   - **If Drive Motor Position Sensor Offset Learn Status showed Motor Current Incorrect all 4 cycles**

     Refer to 3-Phase Circuit Malfunction.

   - **If Drive Motor Position Sensor Offset Learn Status did not show Motor Current Incorrect all 4 cycles**

4. Vehicle ON.
5. Verify DTC P0C17, P0C18, P1B0F, or P1B10 is not set.
    - **If any of the DTCs are set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set
    3. All OK.
    - **If none of the DTCs are set**
6. All OK.

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing

3-Phase Circuit Malfunction

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Remove the 3-phase cable assembly from the T6 Power Inverter Module. Refer to **Drive Motor Generator Power Inverter Module Replacement**.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the appropriate M15 Drive Motor:

Drive Motor 1

- X5 terminal 3 phase U
- X5 terminal 2 phase V
- X5 terminal 1 phase W

Drive Motor 2

- X6 terminal 3 phase U
- X6 terminal 2 phase V
- X6 terminal 1 phase W

- **If less than infinite resistance**

1. Disconnect the appropriate 3-phase cable assembly from the transmission. Refer to **Generator Rotor and Stator Removal - Unit A** , for drive motor 1 or **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** for drive motor 2.
2. Test for infinite resistance between the AC circuit terminal and ground and between the AC circuit terminal and the aluminum cable mounting block.
   - If less than infinite resistance, replace the 3-phase cable assembly.
   - If infinite resistance, replace the M15 Drive Motor.

- **If infinite resistance for all AC circuits**

4. Verify the DTC does not set.
   - **If the DTC sets**

1. Perform each of the operations listed below one at a time until the fault is corrected.
   1. Program the T6 Power Inverter Module.
   2. Replace the T6 Power Inverter Module.
   3. Replace the M15 Drive Motor.
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Repeat the DTC check.
   - **If the DTC does not set**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Generator Rotor and Stator Removal - Unit A** for Drive Motor 1 or Drive Motor 1 3-Phase Cable Assembly replacement
- **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** for Drive Motor 2 or Drive Motor 2 3-Phase Cable Assembly replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0C19: DRIVE MOTOR 1 TORQUE DELIVERED PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0C19

Drive Motor 1 Torque Delivered Performance

Circuit/System Description

Each drive motor is controlled by a motor control module. The motor control module constantly monitors the requested torque and the delivered torque of its respective drive motor. The motor control module is part of the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately.

Conditions for Running the DTC

- Vehicle ON.
- Drive motor 1 is commanded to develop torque.

Conditions for Setting the DTC

The motor control module has detected that drive motor torque is not being delivered as expected.

Action Taken When the DTC Sets

- DTC P0C19 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P0C19 is a Type A DTC.

Diagnostic Aids

Because the engine and drive motor 1 are mechanically connected through a planetary gear set, an engine condition that requires drive motor 1 to consume excessive current while trying to rotate the engine may cause this DTC to set such as:

- Extreme braking during regeneration may cause this DTC to be set in history.

- Seized or binding engine
- Seized or binding accessory drive belt

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON. Operate the hood release to open the hood. The engine should start and run.
2. Verify the engine is not seized or binding.
    - **If the engine is seized or binding**

      Refer to **Symptoms - Engine Mechanical** .

    - **If the engine is not seized or binding**
3. Verify DTC P0C19 is not set.
    - **If the DTC is set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    3. All OK
    - **If the DTC is not set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0C1A: DRIVE MOTOR 2 TORQUE DELIVERED PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0C1A

Drive Motor 2 Torque Delivered Performance

Circuit/System Description

Each drive motor is controlled by a motor control module. The motor control module constantly monitors the requested torque and the delivered torque of its respective drive motor. The motor control module is part of the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately.

Conditions for Running the DTC

- Vehicle ON.
- Drive motor 2 is commanded to develop torque.

Conditions for Setting the DTC

The motor control module has detected that drive motor torque is not being delivered as expected.

Action Taken When the DTC Sets

- DTC P0C1A is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P0C1A is a Type A DTC.

Diagnostic Aids

Extremely hard braking during regeneration may cause this DTC to be set in history.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0C1A is not set.
    - **If the DTC is set**

1. Program the T6 Power Inverter Module.
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Verify the DTC does not set.
    - If the DTC sets, replace the T6 Power Inverter Module.
    - If the DTC does not set.
4. All OK
    - **If the DTC is not set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C20: AUXILIARY TRANSMISSION FLUID PUMP PHASE U-V-W

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0C20

Auxiliary Transmission Fluid Pump Phase U-V-W Circuits

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon drive motor generator power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The motors utilize 3 phase AC electricity. The motor stator coil is comprised of three phase circuits. The phase circuits are identified as phase U, phase V, and phase W. The U-V-W phase circuits are connected in a wye configuration. This means each phase in the motor stator is connected at a single, central point. The motor control modules monitor a current sensor connected to each motor phase. The current sensors are part of the motor control module assembly and are not serviced separately. The motor control modules are part of the power inverter module and are not serviced separately.

Conditions for Running the DTC

- The vehicle is ON.
- The motor control module has applied current to the auxiliary transmission fluid pump.

Conditions for Setting the DTC

The motor control module detects at least one U-V-W phase current sensor is less than 1.0 A.

Action Taken When the DTC Sets

- DTC P0C20 is a Type A DTC.
- Vehicle propulsion will be disabled.

Conditions for Clearing the DTC

DTC P0C20 is a Type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**

- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Disconnect the X8 connector at the T6 Power Inverter Module.
3. Test for infinite resistance between the terminals listed below and ground for each phase of the G5 Auxiliary Transmission Fluid Pump:
   - Terminal 3 phase U
   - Terminal 2 phase V
   - Terminal 1 phase W
   - **If less than infinite resistance**

     Replace the G5 Auxiliary Transmission Fluid Pump.

   - **If infinite resistance**
4. Test for less than 6 ohms between each phase by measuring between the following AC circuit terminals listed below:
   - Terminal 1 phase W to Terminal 2 phase V
   - Terminal 1 phase W to Terminal 3 phase U
   - Terminal 2 phase V to Terminal 3 phase U
   - **If 6 ohms or greater**

     Replace the G5 Auxiliary Transmission Fluid Pump.

   - **If less than 6 ohms**
5. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Auxiliary Fluid Pump Motor and Fluid Pump Disassemble** Table 1: Electric Auxiliary Pump Drive Motor Removal for G5 Auxiliary Transmission Fluid Pump, often referred to as the A/Trans Aux Fluid Pump Motor, replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0C28: AUXILIARY TRANSMISSION FLUID PUMP HIGH CURRENT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0C28

Auxiliary Transmission Fluid Pump High Current

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The motors utilize 3 phase AC electricity. The motor stator coil is comprised of three phase circuits. The phase circuits are identified as phase U, phase V, and phase W. The U-V-W phase circuits are connected in a wye configuration. This means each phase is connected at a single, central point. The motor control modules monitor a current sensor connected to each motor phase. The current sensor is part of the motor assembly and is not serviced separately. The motor control modules are part of the power inverter module and are not serviced separately.

Conditions for Running the DTC

Vehicle is ON.

Conditions for Setting the DTC

One or more phase currents are greater than 35 A.

Action Taken When the DTC Sets

- DTC P0C28 is a Type A DTC.
- Vehicle propulsion will be disabled.

Conditions for Clearing the DTC

DTC P0C28 is a Type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Disconnect the X8 harness connector at the T6 Power Inverter Module.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the G5 Auxiliary Transmission Fluid Pump:
   - X8 terminal 3 phase U
   - X8 terminal 2 phase V
   - X8 terminal 1 phase W
   - **If less than infinite resistance**

     Replace the G5 Auxiliary Transmission Fluid Pump.

   - **If infinite resistance**

4. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Auxiliary Fluid Pump Motor and Fluid Pump Disassemble** Table 1: Electric Auxiliary Pump Drive Motor Removal for G5 Auxiliary Transmission Fluid Pump , often referred to as the A/Trans Aux Fluid Pump Motor, replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C4E: AUXILIARY TRANSMISSION FLUID PUMP HIGH CURRENT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0C4E

Drive Motor 1 Position Exceeded Learning Limit

Circuit/System Description

The drive motor position sensor is monitored by the drive motor control module. The motor control module monitors the angular position, speed and direction of the drive motor rotor based upon the signals of the resolver-type position sensor. The position sensor contains a drive coil, two driven coils and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor generator. At vehicle ON, the motor control module outputs a 7 V AC, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The motor control module then monitors the two driven coil circuits for a return signal. The position of the irregular metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coils signals allows the motor control module to determine the exact position, speed and direction of the drive motor rotor.

A measurement called offset is needed for accurate determination of the motor position. Offset is the relationship between the position sensor and the drive motor generator output shaft. Whenever the vehicle is cycled to OFF, the motor control module attempts to learn the offset of the drive motor position sensor by rapidly oscillating the motor and observing the position sensor signals.

The control modules listed below are part of the power inverter module, often referred to as the drive motor generator power inverter module, and are not serviced separately:

- Auxiliary transmission fluid pump control module
- Drive motor 1 control module
- Drive motor 2 control module
- Hybrid/EV powertrain control module 1

Conditions for Running the DTC

- The vehicle is cycled OFF.
- Drive motor generator speed is less than 20 RPM.
- DC High Voltage is greater than 192V.

Conditions for Setting the DTC

- The position sensor total offset exceeds 30 degrees during the learning process.
- The current learned value differs from the previous learned value by greater than 10 degrees.

Action Taken When the DTC Sets

DTC P0C4E is a Type A DTC.

Conditions for Clearing the DTC

DTC P0C4E is a Type A DTC.

Diagnostic Aids

This DTC sets when the drive motor control module is unable to learn the position of the drive motor. When this DTC sets, or after replacement of a drive motor position sensor, drive motor, or power inverter module, it is possible that a special wide angle learn needs to occur. This wide angle learn occurs when the drive motor control module sees a programming event on the High Speed GMLAN bus.

For intermittent appearance of DTCs:

- The drive motor position sensor circuits operate at very low current. These circuits are susceptible to moisture intrusion, corrosion, and terminal damage. Extreme care must be taken when probing terminals and manipulating harnesses. Poor terminal connections can result in intermittent operation.
- If the customer comments that the problem occurs only during moist environmental conditions: rain, snow, vehicle wash, etc., inspect the sensor wiring for signs of water intrusion.
- The sensor circuit loops are a twisted pair with each pair covered in a foil shield. The shield circuits outside of the transmission are grounded to a stud on the power inverter module.
- The drive motor position sensor harness circuits are shielded. Improperly grounded shield circuits may cause inaccurate sensor signals.
- Intermittent appearance of DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 suggests intermittent position sensor circuit or connector problems.

- Drive motor control modules 1 and 2 monitor and report their respective Drive Motor Position Sensor Offset Learn Status. This information can be observed using a scan tool. Status is updated during the transition from vehicle ON to vehicle OFF during normal conditions. Alternating, and possibly intermittent, appearance of "Not Run," "Learn Failed Motor Speed Not Zero," and "Motor Current Incorrect" suggests intermittent position sensor circuit or connector problems.

Drive Motor 1/2 Position Sensor Offset Learn Status Descriptions

Drive Motor Position Sensor Offset Learn Status	Description	May Be Caused By
Not Run	Not run yet, waiting for key off	NA
	Aborted run due to detecting high voltage too low or motor speed too high	Key off while rolling, drive motor position sensor circuit problems, or high voltage system problems
	Ran but failed due to out of range values	Resolver or drive motor problems
Learn Successful	Position offset learned and stored successfully	NA
Learn Failed Motor Speed Not Zero	Speed high during offset learn but not before	Drive motor position sensor circuit problems
Learn Failed - High Voltage Too Low	High voltage contactors opened during offset learn	High voltage system problems
Motor Current Incorrect	Low current on 3-phase circuits between power inverter module and drive motor	Drive motor, power inverter module, or 3-phase cable assembly problem

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 is not set.
   - **If any of the DTCs are set**

     Refer to **DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03**.

   - **If none of the DTCs are set**
3. Verify DTC P0C4E is not set.
   - **If the DTC sets**

     NOTE: Reprogramming the T6 Power Inverter Module will initialize a wide angle learn. Using the SPS Replace and Program option will force the controllers within the T6 Power Inverter Module to be reprogrammed, even if current software is up to date.

     1. Perform each of the operations listed below one at a time until the fault is corrected.
        1. Program the T6 Power Inverter Module using the SPS Replace and Program option.

           NOTE: Check for physical damage on the position sensor and drive motor and replace any damaged component first.

        2. Replace the B228A Drive Motor 1 Position Sensor, and if the DTC still sets, program the T6 Power Inverter Module using the SPS Replace and Program option.
        3. Replace the M15A Drive Motor 1, and if the DTC still sets, program the T6 Power Inverter Module using the SPS Replace and Program option.
        4. Replace and program the T6 Power Inverter Module.
     2. Repeat the DTC check in step 3.
   - **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Position Sensor Stator Removal** for B228A Drive Motor 1 Position Sensor, often referred to as the Generator Position Sensor Stator (Unit A), replacement
- **Generator Rotor and Stator Removal - Unit A** for Drive Motor 1 replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C4F: DRIVE MOTOR 2 POSITION EXCEEDED LEARNING LIMIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0C4F

Drive Motor 2 Position Exceeded Learning Limit

Circuit/System Description

The drive motor position sensor is monitored by the drive motor control module. The motor control module monitors the angular position, speed and direction of the drive motor rotor based upon the signals of the resolver-type position sensor. The position sensor contains a drive coil, two driven coils and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor generator. At vehicle ON, the motor control module outputs a 7 V AC, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The motor control module then monitors the two driven coil circuits for a return signal. The position of the irregular metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coils signals allows the motor control module to determine the exact position, speed and direction of the drive motor rotor.

A measurement called offset is needed for accurate determination of the motor position. Offset is the relationship between the position sensor and the drive motor generator output shaft. Whenever the vehicle is cycled to OFF, the motor control module attempts to learn the offset of the drive motor position sensor by rapidly oscillating the motor and observing the position sensor signals.

The control modules listed below are part of the power inverter module, often referred to as the drive motor generator power inverter module, and are not serviced separately:

- Auxiliary transmission fluid pump control module
- Drive motor 1 control module
- Drive motor 2 control module
- Hybrid/EV powertrain control module 1

Conditions for Running the DTC

- The vehicle is cycled OFF.
- Drive motor generator speed is less than 20 RPM.
- DC High Voltage is greater than 192V.

Conditions for Setting the DTC

- The position sensor offset total exceeds 30 degrees during the learning process.

- The current learned value differs from the previous learned value by greater than 10 degrees.

Action Taken When the DTC Sets

DTC P0C4F is a Type A DTC.

Conditions for Clearing the DTC

DTC P0C4F is a Type A DTC.

Diagnostic Aids

This DTC sets when the drive motor control module is unable to learn the position of the drive motor. When this DTC sets, or after replacement of a drive motor position sensor, drive motor, or power inverter module, it is possible that a special wide angle learn needs to occur. This wide angle learn occurs when the drive motor control module sees a programming event on the High Speed GMLAN bus.

For intermittent appearance of DTCs:

- The drive motor position sensor circuits operate at very low current. These circuits are susceptible to moisture intrusion, corrosion, and terminal damage. Extreme care must be taken when probing terminals and manipulating harnesses. Poor terminal connections can result in intermittent operation.
- If the customer comments that the problem occurs only during moist environmental conditions: rain, snow, vehicle wash, etc., inspect the sensor wiring for signs of water intrusion.
- The sensor circuit loops are a twisted pair with each pair covered in a foil shield. The shield circuits outside of the transmission are grounded to a stud on the power inverter module.
- The drive motor position sensor harness circuits are shielded. Improperly grounded shield circuits may cause inaccurate sensor signals.
- Intermittent appearance of DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04 suggests intermittent position sensor circuit or connector problems.
- Drive motor control modules 1 and 2 monitor and report their respective Drive Motor Position Sensor Offset Learn Status. This information can be observed using a scan tool. Status is updated during the transition from vehicle ON to vehicle OFF during normal conditions. Alternating or intermittent display of "Not Run," "Learn Failed Motor Speed Not Zero," and "Motor Current Incorrect" suggests intermittent position sensor circuit or connector problems.

Drive Motor 1/2 Position Sensor Offset Learn Status Descriptions

Drive Motor Position Sensor Offset Learn Status	Description	May Be Caused By
Not Run	Not run yet, waiting for key off	NA
	Aborted run due to detecting high voltage too low or motor speed too high	Key off while rolling, drive motor position sensor circuit problems, or high voltage system problems
	Ran but failed due to out of range values	Resolver or drive motor problems

Learn Successful	Position offset learned and stored successfully	NA
Learn Failed Motor Speed Not Zero	Speed high during offset learn but not before	Drive motor position sensor circuit problems
Learn Failed - High Voltage Too Low	High voltage contactors opened during offset learn	High voltage system problems
Motor Current Incorrect	Low current on 3-phase circuits between power inverter module and drive motor	Drive motor, power inverter module, or 3-phase cable assembly problem

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04 is not set.
   - **If any of the DTCs are set**

     Refer to **DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04**.

   - **If none of the DTCs are set**
3. Verify DTC P0C4F is not set.
   - **If the DTC sets**

NOTE: Reprogramming the T6 Power Inverter Module will initialize a wide angle learn. Using the SPS Replace and Program option will force the controllers within the T6 Power Inverter Module to be reprogrammed, even if current software is up to date.

1. Perform each of the operations listed below one at a time until the fault is corrected.
    1. Program the T6 Power Inverter Module using the SPS Replace and Program option.

        NOTE: Check for physical damage on the position sensor and drive motor and replace any damaged component first.

    2. Replace the B228B Drive Motor 2 Position Sensor, and if the DTC still sets, program the T6 Power Inverter Module using the SPS Replace and Program option.
    3. Replace the M15B Drive Motor 2, and if the DTC still sets, program the T6 Power Inverter Module using the SPS Replace and Program option.
    4. Replace and program the T6 Power Inverter Module.
2. Repeat the DTC check in step 3.
    - **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Stator Drive Motor Position Sensor Replacement** for B228B Drive Motor 2 Position Sensor replacement
- **Drive Motor Generator Rotor, Stator, and Output Sun Gear Shaft Removal - Unit B** for Drive Motor 2 replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C76: HYBRID/EV BATTERY SYSTEM HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0C76

Hybrid/EV Battery System High Voltage Present

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors system high voltage via the battery energy control module. The battery energy control module will diagnose its own systems and determine when a fault condition

is present. Diagnostics and system status is communicated from the battery energy control module to the hybrid/EV powertrain control module 2 through serial data. The hybrid/EV powertrain control module 2 is the host controller for diagnostic trouble code (DTC) information.

The hybrid/EV battery pack contains 5 high voltage contactors and 2 transistors. The high voltage contactors allow the high voltage DC to be connected to the vehicle or safely contained within the hybrid/EV battery pack. The 5 high voltage contactors are a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor, charge negative high voltage contactor, and multi-function high voltage contactor. The 2 transistors are the precharge transistor and heater transistor. These contactors/transistors close and open in sequence and are controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for the high voltage contactors/transistors. Ground is provided through the case ground.

Conditions for Running the DTC

- Vehicle is ON.
- The system voltage is at least 10 V.

Conditions for Setting the DTC

The high voltage bus voltage is greater than 200 V 3.5 seconds after the contactors have been commanded open.

Action Taken When the DTC Sets

DTC P0C76 is a Type A DTC.

Conditions for Clearing the DTC

DTC P0C76 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Verify the contactors are operating normally. Refer to **Hybrid\EV Battery Voltage Present** .
   - **If the contactors are not operating properly**

     Repair as necessary.

   - **If the contactors are operating properly**
2. Vehicle ON.
3. Verify DTC P0C76 is not set.

- **If the DTC is set**

  Replace the T6 Power Inverter Module.

- **If the DTC is not set**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P150D OR P150E: SUPPLY VOLTAGE CIRCUIT 1/2 LOW

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P150D

Supply Voltage Circuit 2 Low Voltage

DTC P150E

Supply Voltage Circuit 1 Low Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

P150D

Battery voltage on circuit 2 is less than 8.0 V for more than 2.5 seconds.

P150E

Battery voltage on circuit 1 is less than 8.0 V for more than 2.5 seconds.

Action Taken When the DTC Sets

DTC P150D and P150E are Type C DTCs.

Conditions for Clearing the DTC

DTC P150D and P150E are Type C DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Testing

1. Vehicle ON.
2. Verify DTC P0562 or P0563 is not set.
    - **If any of the DTCs are set**

      Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0562, P0563, P1A0C, P1A0D, or P1EFC**.

- **If none of the DTCs are set**

3. Verify DTC P150D or P150E is not set.
   - **If DTC P150D is set**
   1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
   2. Verify a test lamp illuminates between the B+ circuit terminal 24 and ground.
      - If the test lamp does not illuminate and the circuit fuse is good
      1. Remove the test lamp.
      2. Test for less than 2 ohms in the B+ circuit end to end.
         - If 2 ohms or greater, repair the open/high resistance in the circuit.
         - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
      - If the test lamp does not illuminate and the circuit fuse is open
      1. Remove the test lamp.
      2. Test for infinite resistance between the B+ circuit and ground.
         - If less than infinite resistance, repair the short to ground on the circuit.
         - If infinite resistance, replace the T6 Power Inverter Module.
      - If the test lamp illuminates
   3. Program the T6 Power Inverter Module.
   4. Verify the DTC does not set.
      - If the DTC sets, replace the T6 Power Inverter Module.
      - If the DTC does not set
   5. All OK.
   - **If DTC P150E is set**
   1. Vehicle OFF, disconnect the X2 harness connector at the T6 Power Inverter Module.
   2. Verify a test lamp illuminates between the B+ circuit terminal 35 and ground.
      - If the test lamp does not illuminate and the circuit fuse is good
      1. Remove the test lamp.
      2. Test for less than 2 ohms in the B+ circuit end to end.
         - If 2 ohms or greater, repair the open/high resistance in the circuit.
         - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
      - If the test lamp does not illuminate and the circuit fuse is open
      1. Remove the test lamp.
      2. Test for infinite resistance between the B+ circuit and ground.
         - If less than infinite resistance, repair the short to ground on the circuit.
         - If infinite resistance, replace the T6 Power Inverter Module.
      - If the test lamp illuminates
   3. Program the T6 Power Inverter Module.
   4. Verify the DTC does not set.

- If the DTC sets, replace the T6 Power Inverter Module.
- If the DTC does not set

5. All OK.
   - **If none of the DTCs are set**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P15F0: ENGINE TORQUE DELIVERED SIGNAL MESSAGE COUNTER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P15F0

Engine Torque Delivered Signal Message Counter Incorrect

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor monitors the data to verify that the indicated engine torque delivered calculation is correct.

Conditions for Running the DTC

- Vehicle is ON.
- The system voltage is 8-18 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTC P15F0 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P15F0 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P15F0 is not set.
    - **If the DTC is set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    3. All OK
    - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P15F1: AXLE TORQUE REQUEST SIGNAL MESSAGE COUNTER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P15F1

Axle Torque Request Signal Message Counter Incorrect

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor monitors the data to verify that the indicated axle torque requested calculation is correct.

Conditions for Running the DTC

- Vehicle is ON.
- The system voltage is 8-18 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTC P15F1 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P15F1 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P15F1 is not set.
    - **If the DTC is set**
        1. Program the T6 Power Inverter Module.

2. Verify the DTC does not set.
    - If the DTC sets, replace the T6 Power Inverter Module.
    - If the DTC does not set.
3. All OK
    - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P15F2: ENGINE TORQUE COMMAND SIGNAL MESSAGE COUNTER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P15F2

Engine Torque Command Signal Message Counter Incorrect

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM). The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 sends an engine torque requested message to the ECM over the serial data circuits. The ECM monitors the data to verify the indicated engine torque requested calculation is correct. The ECM processor monitors the data to verify that the engine torque command is correct.

Conditions for Running the DTC

- Vehicle is ON.
- The system voltage is 8-18 V.
- DTC U1817 is not set.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTC P15F2 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P15F2 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

NOTE: Diagnose and repair any communication DTCs prior to performing this testing.

1. Vehicle ON.
2. Verify DTC P15F2 is not set.
   - **If the DTC is set**
     1. Program the K20 ECM.
     2. Verify the DTC does not set.
        - If the DTC sets, replace the K20 ECM.
        - If the DTC does not set.
     3. All OK
   - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K20 ECM replacement, programming, and setup

DTC P16E0: ENGINE PERFORMANCE - NO TORQUE DETECTED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P16E0

Engine Performance - No Torque Detected

Circuit/System Description

This vehicle does not use a 12V starter motor to crank the internal combustion engine. A much more powerful 300V motor located within the transmission is utilized to crank the engine. This motor, drive motor 1, can rotate the engine to operating speed (800 RPM) within just a few hundred milliseconds. The hybrid/EV powertrain control module 1 can detect a condition where the engine is cranking but does not start or has stalled.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is at least 10 V.
- DTC U0100 is not set.
- Engine running.
- Fuel Level is NOT Low.
- No Fuel Level sensor DTCs set.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 1 expected the engine to be supplying torque but no torque is detected.

Action Taken When the DTC Sets

DTC P16E0 is a Type A DTC.

Conditions for Clearing the DTC

DTC P16E0 is a Type A DTC.

Diagnostic Aids

Any condition that causes the engine to stall and/or not start may set this DTC. Possible conditions include:

- Fuel conditions such as low pressure or contamination.
- Engine conditions such as low compression.
- Restricted exhaust or air intake systems.

Always inspect for DTCs that would cause an engine stall and/or no start condition.

Reference Information

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON. Operate the hood release to open the hood. The engine should start and run.
2. Verify the engine starts.
   - **If the engine fails to start**

     Diagnose the engine system. Refer to **Engine Cranks But Does Not Run** .

   - **If the engine starts**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC P16F2: CONTROL MODULE TRANSMISSION DIRECTION SWITCH INPUT (HYBRID/EV POWERTRAIN CONTROL MODULE 1)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P16F2

Control Module Transmission Direction Switch Input Circuitry Performance

Circuit/System Description

The hybrid/EV powertrain control module 1 compares the transmission internal mode switch, often referred to as the automatic transmission manual shift shaft position switch, requested direction to other data to verify that the indicated direction range switch calculation is correct.

Conditions for Running the DTC

- The vehicle is ON.
- Ignition voltage is greater than 9.5 V.

Conditions for Setting the DTC

Condition 1

- No transmission internal mode switch failure DTCs are set.
- A valid transmission internal mode switch direction is indicated by the internal mode switch circuits does not match the direction indicated by the hybrid/EV powertrain control module 1 software calculation.

Condition 2

- No transmission internal mode switch failure DTCs are set.
- Two valid transmission internal mode switch directions are indicated at the same time.

Condition 3

- One transmission internal mode switch direction switch circuit has failed.
- The hybrid/EV powertrain control module 1 calculates a transmission direction based upon the remaining transmission internal mode switch circuits but it does not match the direction indicated by the hybrid/EV powertrain control module 1 software.

Condition 4

- Multiple transmission internal mode switch directions are indicated and one transmission internal mode switch circuit has failed.
- Based upon the remaining transmission internal mode switch circuits the hybrid/EV powertrain control module 1 calculated two directions at the same time.

Condition 5

More than one transmission internal mode switch circuit has failed and the hybrid/EV powertrain control module 1 cannot calculate a transmission direction.

Action Taken When the DTC Sets

- DTC P16F2 is a Type A DTC.

- The hybrid/EV powertrain control module 1 requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P16F2 is a Type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P181C, P181D, P181E, P181F, P183A, P183B, P183C, P183D, P183E, P184A or P184B is not set.
    - **If any of the DTCs are set**

      Refer to **DTC P181C-P181F, P183A-P183E, P184A, or P184B**.

    - **If none of the DTCs are set**
3. Verify DTC P16F2 is not set.
    - **If the DTC is set**
    1. Program the T6 Power Inverter Module.

2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Verify the DTC does not set.
   - If the DTC sets, replace the T6 Power Inverter Module.
   - If the DTC does not set.
4. All OK
   - **If the DTC is not set**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, setup and programming

DTC P16F3: CONTROL MODULE REDUNDANT MEMORY (HYBRID/EV POWERTRAIN CONTROL MODULE 1)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P16F3

Control Module Redundant Memory Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor stores identical data in two locations and compares the data to verify that the stored data is correct.

Conditions for Running the DTC

The system voltage is 8-18 V.

Conditions for Setting the DTC

The control module has detected that data identical when stored is not the same when retrieved.

Action Taken When the DTC Sets

- DTC P16F3 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P16F3 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1AC6, P0335, or any communication U-code DTC is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
3. Verify DTC P16F3 is not set.
   - **If the DTC is set**
     1. Program the T6 Power Inverter Module.
     2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
     3. All OK
   - **If the DTC is not set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P16F4: CONTROL MODULE TRANSMISSION RANGE SWITCH (HYBRID/EV POWERTRAIN CONTROL MODULE 1)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P16F4

Control Module Transmission Range Switch Input Circuitry Performance

Circuit/System Description

The transmission internal mode switch, often referred to as the automatic transmission manual shift shaft position switch, contains two sliding hall-effect switch assemblies attached to the control valve body within the transmission. The 9 outputs from the switches indicate which position is selected by the transmission manual shaft. Four outputs (A, B, C, P) are range selection inputs to the transmission control module (TCM). Five outputs (R1, R2, D1, D2, S) are direction selection inputs to the hybrid/EV powertrain control module 1. The Range input signals are represented as TCM scan tool parameters Internal Mode Switch A, B, C, and P. The Direction input signals are represented as Hybrid Powertrain Control Module scan tool parameters Internal Mode Switch 2 - R1, R2, D1, D2, and S. The input voltage at the modules is high when a switch is open and low when a switch is closed to ground. Each control module independently supplies power and ground to its respective switch assembly.

The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 compares the transmission internal mode switch requested direction to other data to verify that the indicated direction and range switch calculation is correct.

Conditions for Running the DTC

- The vehicle is ON.
- Ignition voltage is greater than 9.5 V.

Conditions for Setting the DTC

Condition 1

The transmission direction, indicated by both the transmission internal mode switch range and direction switch circuits, are valid but do not match.

Condition 2

- One transmission internal mode switch circuit has failed.
- The hybrid/EV powertrain control module 1 calculates a transmission direction based upon the remaining transmission internal mode switch circuits.
- The calculated hybrid/EV powertrain control module 1 transmission direction does not match the direction indicated by the transmission internal mode switch range switch circuits.

Condition 3

- One transmission internal mode switch circuit has failed.
- The hybrid/EV powertrain control module 1 calculates a transmission direction based upon the remaining transmission internal mode switch circuits.
- The transmission internal mode switch range switch indicates a transitional position.

Condition 4

- One transmission internal mode switch circuit has failed.
- The hybrid/EV powertrain control module 1 calculates a transmission direction based upon the remaining transmission internal mode switch circuits.
- The TCM has indicated the transmission internal mode switch range switch parameter is invalid.

Condition 5

- More than one transmission internal mode switch circuit has failed and the hybrid/EV powertrain control module 1 cannot calculate a transmission direction.
- The transmission internal mode switch range switch indicates a transitional position.

Condition 6

- More than one transmission internal mode switch circuit has failed and the hybrid/EV powertrain control module 1 cannot calculate a transmission direction.
- The TCM has indicated the transmission internal mode switch range switch parameter is invalid.

Action Taken When the DTC Sets

- DTC P16F4 is a Type A DTC.
- Vehicle propulsion will be disabled. The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P16F4 is a Type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC P181C, P181D, P181E, P181F, P183A, P183B, P183C, P183D, P183E, P184A, or P184B is not set.
   - **If any of the DTCs are set**

     Refer to **DTC P181C-P181F, P183A-P183E, P184A, or P184B**.

   - **If none of the DTCs are set**
2. Verify DTC P1824, P182A, P182B, P182C, P182D, P182E, P182F, P1838, or P1839 is not set.
   - **If any of the DTCs are set**

     Refer to **DTC P1824, P182A-P182F, P1838, or P1839** .

   - **If none of the DTCs are set**
3. Verify that DTC P16F4 is not set.
   - **If the DTC is set**
     1. Program the T6 Power Inverter Module.
     2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
     3. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.

- If the DTC does not set

4. All OK
   - **If the DTC is not set**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup.

DTC P16F6: CONTROL MODULE TRANSMISSION RANGE CALCULATION PERFORMANCE (HYBRID/EV POWERTRAIN CONTROL MODULE 1)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P16F6

Control Module Transmission Range Calculation Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor monitors the data to verify that the commanded range state calculation is correct.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is 8-18 V.

Conditions for Setting the DTC

The control module has detected the commanded transmission range state is not correct based upon internal calculations or by a comparison to input or output torque conditions.

Action Taken When the DTC Sets

- DTC P16F6 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P16F6 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P16F6 is not set.
    - **If the DTC is set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    3. All OK
    - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, setup, and programming

DTC P179A: AUXILIARY TRANSMISSION FLUID PUMP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P179A

Auxiliary Transmission Fluid Pump Overspeed

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid powertrain control module. Two of the motor control modules operate their respective drive motor generator based upon drive motor generator power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump motor. The hybrid powertrain control module and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

The vehicle is ON or the power inverter module is awake.

Conditions for Setting the DTC

An auxiliary transmission fluid pump motor speed of greater than 6500 RPM has been detected.

Action Taken When the DTC Sets

DTC P179A is a Type A DTC.

Conditions for Clearing the DTC

DTC P179A is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P179A is not set.
    - **If the DTC is set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    3. All OK

- **If the DTC is not set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P181C-P181F, P183A-P183E, P184A, OR P184B: INTERNAL MODE SWITCH 2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P181C

Internal Mode Switch 2 R1 Circuit Low Voltage

DTC P181D

Internal Mode Switch 2 R1 Circuit High Voltage

DTC P181E

Internal Mode Switch 2 R2 Circuit Low Voltage

DTC P181F

Internal Mode Switch 2 R2 Circuit High Voltage

DTC P183A

Internal Mode Switch 2 D1 Circuit Low Voltage

DTC P183B

Internal Mode Switch 2 D1 Circuit High Voltage

DTC P183C

Internal Mode Switch 2 D2 Circuit Low Voltage

DTC P183D

Internal Mode Switch 2 D2 Circuit High Voltage

DTC P183E

Internal Mode Switch 2 Invalid Range

DTC P184A

Internal Mode Switch 2 S Circuit Low Voltage

DTC P184B

Internal Mode Switch 2 S Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal R1	P181C	P181D	P181D	-
Signal R2	P181E	P181F	P181F	-
Signal D1	P183A	P183B	P183B	-
Signal D2	P183C	P183D	P183D	-
Signal S	P184A	P184B	P184B	-
Low Reference	-	P183E	-	-

Circuit/System Description

The transmission internal mode switch, often referred to as the automatic transmission manual shift shaft position switch, contains two sliding hall-effect switch assemblies attached to the control valve body within the transmission. The 9 outputs from the switches indicate which position is selected by the transmission manual shaft. Four outputs (A, B, C, P) are range selection inputs to the transmission control module (TCM). Five outputs (R1, R2, D1, D2, S) are direction selection inputs to the hybrid/EV powertrain control module 1. The Range input signals are represented as TCM scan tool parameter Internal Mode Switch A/B/C/P. The Direction input signals are represented as hybrid powertrain control module scan tool parameters Internal Mode Switch 2 - R1, R2, D1, D2, and S. The input voltage at the modules is high when a switch is open and low when a switch is closed to ground. Each control module independently supplies power and ground to its respective switch assembly.

The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately.

Conditions for Running the DTC

- The vehicle is ON for at least 5 seconds.
- The ignition voltage is greater than 9.0 V.

Conditions for Setting the DTC

The transmission internal mode switch direction switch state does not match a selected gear for 5 seconds.

Action Taken When the DTC Sets

DTCs P181C, P181D, P181E, P181F, P183A, P183B, P183C, P183D, P183E, P184A and P184B are Type B DTCs.

Conditions for Clearing the DTC

DTCs P181C, P181D, P181E, P181F, P183A, P183B, P183C, P183D, P183E, P184A and P184B are Type B DTCs.

Diagnostic Aids

The transmission internal mode switch can be damaged by electric current exceeding 25 mA. Test the transmission internal mode switch for an open condition whenever a short to voltage condition is observed.

Reference Information

Schematic Reference

- **Hybrid/EV Controls Schematics**
- **Automatic Transmission Controls Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

DT-44152 Jumper Harness

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Vehicle ON.
2. Verify the scan tool hybrid powertrain control module Internal Mode Switch 2 - D1, D2, R1, R2, and S parameters match those in the Internal Mode Switch 2 Parameters table below for each gear selector position. Record any discrepancies.
   - **If any parameter shows an incorrect state**

     Refer to Circuit/System Testing.

   - **If all parameters show correct states**
3. All OK.

Internal Mode Switch 2 Parameters

Parameter	Selector Position				
	Park	Reverse	Neutral	Drive	Manual
Internal Mode Switch 2 - D1	HIGH	HIGH	LOW	LOW	LOW
Internal Mode Switch 2 - D2	LOW	LOW	HIGH	HIGH	HIGH
Internal Mode Switch 2 - R1	HIGH	LOW	LOW	HIGH	HIGH
Internal Mode Switch 2 - R2	LOW	HIGH	HIGH	LOW	LOW
Internal Mode Switch 2 - S	LOW	HIGH	LOW	HIGH	HIGH

Circuit/System Testing

1. Vehicle OFF, disconnect the X175 20-way harness connector at the transmission. Additional DTCs may set.
2. Install the **DT-44152** jumper harness to the vehicle harness side only.
3. Test for less than 2 ohms between the low reference circuit terminal G and ground.
   - **If 2 ohms or greater**
     1. Disconnect the X2 harness connector at the T6 Power Inverter Module.
     2. Test for less than 2 ohms in the low reference circuit end to end.
        - If 2 ohms or greater, repair the open/high resistance in the circuit.
        - If less than 2 ohms, replace the T6 Power Inverter Module.
   - **If less than 2 ohms**
4. Vehicle ON.

5. Verify each scan tool hybrid powertrain control module parameter, Internal Mode Switch 2 - D1/D2/R1/R2/S, displays HIGH.
    - **If any parameter displays LOW**
    1. Vehicle OFF.
    2. Disconnect the X2 harness connector at the T6 Power Inverter Module.
    3. Test for infinite resistance between the appropriate signal circuit terminal listed below and ground:
    - Parameter D1 - terminal E
    - Parameter D2 - terminal F
    - Parameter R1 - terminal C
    - Parameter R2 - terminal D
    - Parameter S - terminal B
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the T6 Power Inverter Module.
    - **If all parameters display HIGH**
6. Vehicle ON.
7. Install a 3 A fused jumper wire between the low reference circuit terminal G and each signal terminal listed below one at a time:
    - Parameter D1 - terminal E
    - Parameter D2 - terminal F
    - Parameter R1 - terminal C
    - Parameter R2 - terminal D
    - Parameter S - terminal B
8. Verify each scan tool hybrid powertrain control module parameter, Internal Mode Switch 2 - D1/D2/R1/R2/S, displays LOW when grounded.
    - **If any parameter displays HIGH when grounded**
    1. Vehicle OFF.
    2. Disconnect the X2 harness connector at the T6 Power Inverter Module.
    3. Test for less than 2 ohms in the appropriate signal circuit end to end.
        - If 2 ohms or greater, repair the open/high resistance in the circuit.
        - If less than 2 ohms
    4. Vehicle ON.
    5. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the T6 Power Inverter Module.
    - **If all parameters display LOW when grounded**
9. Refer to Component Testing.

Component Testing

1. Vehicle OFF, disconnect the X175 20-way harness connector at the transmission. Additional DTCs may set.
2. Install the **DT-44152** jumper harness to the transmission side only.
3. Parking brake applied, transmission in PARK.
4. Test for less than 2 ohms between the low reference circuit terminal G and each signal circuit terminal listed below:
    - Signal D2 - Terminal F
    - Signal R2 - Terminal D
    - Signal S - Terminal B
    - **If 2 ohms or greater**
    1. Disconnect the X1 harness connector at the B15 Transmission Internal Mode Switch.
    2. Test for less than 2 ohms in the low reference circuit and the appropriate signal circuit end to end.
        - If 2 ohms or greater, replace the a/trans wiring harness.
        - If less than 2 ohms, replace the B15 Transmission Internal Mode Switch.
    - **If less than 2 ohms**
5. Test for infinite resistance between the low reference circuit terminal G and each signal circuit terminal listed below:
    - Signal D1 - Terminal E
    - Signal R1 - Terminal C
    - **If less than infinite resistance**
    1. Disconnect the X1 harness connector at the B15 Transmission Internal Mode Switch.
    2. Test for infinite resistance between the low reference circuit and the signal circuit.
        - If less than infinite resistance, replace the a/trans wiring harness.
        - If infinite resistance, replace the B15 Transmission Internal Mode Switch.
    - **If infinite resistance**
6. Transmission in NEUTRAL.
7. Test for less than 2 ohms between the low reference circuit terminal G and each signal circuit terminal listed below:
    - Signal D1 - Terminal E
    - Signal R1 - Terminal C
    - **If 2 ohms or greater**
    1. Disconnect the X1 harness connector at the B15 Transmission Internal Mode Switch.
    2. Test for less than 2 ohms in the signal circuit end to end.
        - If 2 ohms or greater, replace the a/trans wiring harness.
        - If less than 2 ohms, replace the B15 Transmission Internal Mode Switch.
    - **If less than 2 ohms**
8. Test for infinite resistance between the low reference circuit terminal G and each signal circuit terminal listed below:

- Signal D2 - Terminal F
- Signal R2 - Terminal D
  - **If less than infinite resistance**
  1. Disconnect the X1 harness connector at the B15 Transmission Internal Mode Switch.
  2. Test for infinite resistance between the low reference circuit and the signal circuit.
     - If less than infinite resistance, replace the a/trans wiring harness.
     - If infinite resistance, replace the B15 Transmission Internal Mode Switch.
  - **If infinite resistance**

9. Transmission in REVERSE.
10. Test for infinite resistance between the low reference circuit terminal G and the signal S circuit terminal B.
    - **If less than infinite resistance**
    1. Disconnect the X1 harness connector at the B15 Transmission Internal Mode Switch.
    2. Test for infinite resistance between the low reference circuit and the signal circuit.
       - If less than infinite resistance, replace the a/trans wiring harness.
       - If infinite resistance, replace the B15 Transmission Internal Mode Switch.
    - **If infinite resistance**
11. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Manual Shift Shaft Position Switch and Fluid Level Control Valve Removal** , and **Manual Shift Shaft Position Switch and Fluid Level Control Valve Installation** for B15 Transmission Internal Mode Switch, often referred to as the Automatic Transmission Manual Shift Shaft Position Switch, replacement
- **Automatic Transmission Wiring Harness and Output Speed Sensor Removal** , and **Automatic Transmission Wiring Harness and Output Speed Sensor Installation** for A/Trans Wiring Harness Assembly replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup

DTC P183F: INTERNAL MODE SWITCH 1-2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P183F

Internal Mode Switch 1-2 Not Plausible

Circuit/System Description

The transmission internal mode switch, often referred to as the automatic transmission manual shift shaft position switch, contains two sliding hall-effect switch assemblies attached to the control valve body within the transmission. The 9 outputs from the switches indicate which position is selected by the transmission manual shaft. Four outputs (A, B, C, P) are range selection inputs to the transmission control module (TCM). Five outputs (R1, R2, D1, D2, S) are direction selection inputs to the hybrid/EV powertrain control module 1. The Range input signals are represented as TCM scan tool parameter Internal Mode Switch A, B, C, and P. The Direction input signals are represented as hybrid powertrain control module scan tool parameters Internal Mode Switch 2 - R1, R2, D1, D2, and S. The input voltage at the modules is high when a switch is open and low when a switch is closed to ground. Each control module independently supplies power and ground to its respective switch assembly.

The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 compares the transmission internal mode switch requested direction to other data to verify that the indicated direction and range switch calculation is correct.

Conditions for Running the DTC

- The vehicle is ON.
- DTCs P181C-P181F, P1824, P182A-P182F, P183A-P183E, P1838, P1839, P184A, and P184B are not set.

Conditions for Setting the DTC

The transmission internal mode switch direction state does not match the transmission internal mode switch range state.

Action Taken When the DTC Sets

DTC P183F is a Type A DTC.

Conditions for Clearing the DTC

DTC P183F is a Type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P181C, P181D, P181E, P181F, P183A, P183B, P183C, P183D, P183E, P184A or P184B is not set.
   - **If any of the DTCs are set**

     Refer to **DTC P181C-P181F, P183A-P183E, P184A, or P184B**.

   - **If none of the DTCs are set**
3. Verify DTC P183F is not set.
   - **If the DTC is set**
     1. Program the T6 Power Inverter Module.
     2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
     3. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
     4. All OK
   - **If the DTC is not set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1A4F, P1A50-P1A54, P1ADC, OR P1ADD: DRIVE MOTOR 1/2 CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1A4F

Drive Motor 1 Control Module Not Programmed

DTC P1A50

Drive Motor 1 Control Module Random Access Memory

DTC P1A51

Drive Motor 1 Control Module Read Only Memory

DTC P1A52

Drive Motor 2 Control Module Not Programmed

DTC P1A53

Drive Motor 2 Control Module Random Access Memory

DTC P1A54

Drive Motor 2 Control Module Read Only Memory

DTC P1ADC

Drive Motor 1 Control Module Long Term Memory Performance

DTC P1ADD

Drive Motor 2 Control Module Long Term Memory Performance

Circuit/System Description

The drive motor control modules are internal to the power inverter module, often referred to as the drive motor generator power inverter module, and are not serviced separately. This fault is handled inside the drive motor control modules and no external circuits are involved.

Conditions for Running the DTC

- The vehicle is ON.
- Ignition voltage is 8-18 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction or a service module has been installed but not yet programmed.

Action Taken When the DTC Sets

- DTCs P1A4F, P1A50, P1A51, P1A52, P1A53, P1A54, P1ADC and P1ADD are Type A DTCs.
- The power inverter module requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1A4F, P1A50, P1A51, P1A52, P1A53, P1A54, P1ADC and P1ADD are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1A4F, P1A50, P1A51, P1A52, P1A53, P1A54, P1ADC and P1ADD is not set.
    - **If any of the DTCs are set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    3. All OK
    - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1A56: HYBRID/EV SYSTEM VOLTAGE DISCHARGE CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1A56

Hybrid/EV System Voltage Discharge Circuit

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains DC high voltage capacitors and a resistor circuit intended to discharge the electrical energy stored within those capacitors. Whenever the high voltage contactors are opened, the hybrid/EV powertrain control module 1 connects the internal resistor circuit across the capacitor circuit. The level of the high voltage is monitored by the hybrid/EV powertrain control module 1 before and after the resistor circuit has been connected. If the voltage level remains high for too long, the hybrid/EV powertrain control module 1 sets this DTC and then commands the motor control modules to connect the drive motor 3 phase circuits across the DC high voltage positive and negative circuits thereby discharging the capacitors.

Conditions for Running the DTC

- The Vehicle is ON.
- The system voltage is at least 10 V.
- No high voltage DC sensor DTCs are present.
- High Voltage Contactors are commanded Open.

Conditions for Setting the DTC

Within 500 milliseconds after commanding contactors open, the high voltage bus voltage fails to decrease by at least 75 V.

Action Taken When the DTC Sets

- DTC P1A56 is a Type C DTC.
- The motor control modules are commanded to discharge the capacitor through the drive motor 3 phase stator circuits.

Conditions for Clearing the DTC

DTC P1A56 is a Type C DTC.

Diagnostic Aids

A high-pitched whine may emanate from the transmission assembly whenever the HV DC capacitance is discharged through the drive motor stator circuits.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1A56 is not set.
   - **If the DTC is set**
   1. Program the T6 Power Inverter Module.
   2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
   3. Verify the DTC does not set.
      - If the DTC sets, replace the T6 Power Inverter Module.
      - If the DTC does not set.
   4. All OK
   - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1A71-P1A73: 14V POWER MODULE TEMPERATURE SENSOR 2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1A71

14V Power Module Temperature Sensor 2 Performance

DTC P1A72

14V Power Module Temperature Sensor 2 Circuit Low Voltage

DTC P1A73

14V Power Module Temperature Sensor 2 Circuit High Voltage

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, constantly monitors system temperature, to protect against overheat conditions. The module also monitors the function of the temperature sensors. These sensors are internal to the 14V power module and are not serviced separately from the control module.

Conditions for Running the DTC

The Vehicle is ON.

Conditions for Setting the DTC

DTC P1A71, P1A72, or P1A73: The sensor signal is out of range for greater than 5 seconds.

Action Taken When the DTC Sets

DTCs P1A71, P1A72, and P1A73 are Type C DTCs.

Conditions for Clearing the DTC

DTCs P1A71, P1A72, and P1A73 are Type C DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1A71, P1A72, or P1A73 is not set.
   - **If any of the DTCs are set**
     1. Program the K1 14V Power Module.
     2. Verify the DTC does not set.

- If the DTC sets, replace the K1 14V Power Module.
- If the DTC does not set.

3. All OK
   - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup.

DTC P1A90-P1A92: 14V POWER MODULE TEMPERATURE SENSOR 1

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1A90

14V Power Module Temperature Sensor 1 Performance

DTC P1A91

14V Power Module Temperature Sensor 1 Circuit Low Voltage

DTC P1A92

14V Power Module Temperature Sensor 1 Circuit High Voltage

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, constantly monitors system temperature to protect against overheat conditions. The module also monitors the function of the temperature sensors. These sensors are internal to the 14V power module and are not serviced separately from the control module.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

DTC P1A90, P1A91, or P1A92: The sensor signal is out of range for greater than 5 seconds.

Action Taken When the DTC Sets

DTCs P1A90, P1A91, or P1A92 are Type C DTCs.

Conditions for Clearing the DTC

DTCs P1A90, P1A91, or P1A92 are Type C DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1A90, P1A91, or P1A92 is not set.
    - **If any of the DTCs are set**
    1. Program the K1 14V Power Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the K1 14V Power Module.
        - If the DTC does not set.
    3. All OK
    - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup

DTC P1ABC OR P1ABD: 14V POWER MODULE HYBRID/EV BATTERY SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1ABC

14V Power Module Hybrid/EV Battery System Voltage Low Voltage

DTC P1ABD

14V Power Module Hybrid/EV Battery System Voltage High Voltage

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, constantly monitors system input and output voltage. This sensor is internal to the 14V power module and is not serviced separately from the control module.

Conditions for Running the DTC

The Vehicle is ON and the hybrid/EV battery contactors are closed.

Conditions for Setting the DTC

- DTC P1ABC or P1ABD: The high voltage sensor detects voltage less than 50V for 5 seconds.
- DTC P1ABD: The high voltage sensor detects voltage greater than 500V for 5 seconds.

Action Taken When the DTC Sets

DTCs P1ABC and P1ABD are Type C DTCs.

Conditions for Clearing the DTC

DTCs P1ABC and P1ABD are Type C DTCs.

Diagnostic Aids

- The symptom causing this DTC may prevent the 14V power module from charging the 12V battery, which would eventually result in low 12 V system voltage.
- The 300V+ circuit includes a maxi-fuse located at the hybrid/EV battery pack. An open fuse would cause DTC P1ABC. This fuse is tested as part of a continuity check of the entire circuit in Circuit/System Testing.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

Accessory DC Power Control Module Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: To accurately diagnose the charging system, the C1 Battery must be fully charged and capable of passing the Battery Inspection/Test.

1. Perform the **Battery Inspection/Test** .
2. Verify DTC P1ABC or P1ABD is not set.
    - **If any of the DTCs are set**
    1. Vehicle OFF, disconnect the drive motor battery charger cable from the X98 Hybrid/EV Battery Charger Receptacle.
    2. Measure and record the C1 Battery voltage at the C1 Battery terminals.
    3. Vehicle ON, accessories OFF.
    4. Measure and record the C1 Battery voltage at the C1 Battery terminals. The voltage should be at least 1 V greater than the voltage measured previously but less than 15 V.
        - If not within the specified range, refer to Circuit/System Testing.
        - If within the specified range
    5. Program the K1 14V Power Module.
    6. Verify the DTC does not set.
        - If the DTC sets, replace the K1 14V Power Module.

- If the DTC does not set

7. All OK.
   - **If none of the DTCs are set**
3. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Vehicle OFF, disable the high voltage at the K1 14V Power Module and the T6 Power Inverter Module. Refer to **High Voltage Disabling** .

NOTE: During high voltage disabling, the X1 connector at the K1 14V Power Module and the X3 connector at the T6 Power Inverter Module should have been disconnected. The following test assumes that additional high voltage connectors, including those at the A4 Hybrid/EV Battery Pack, are still connected.

2. Test for less than 10 ohms between the 300V circuit terminals listed below:
   - 300V+: K1 14V Power Module circuit terminal A X1 and T6 Power Inverter Module circuit terminal 2 X3
   - 300V-: K1 14V Power Module circuit terminal B X1 and T6 Power Inverter Module circuit terminal 1 X3
   - **If 10 ohms or greater**

     Repair the open/high resistance in the circuit.

- **If less than 10 ohms**

3. Verify DTC P1ABC or P1ABD is not set.
   - **If any of the DTCs are set**
   1. Program the K1 14V Power Module.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the K1 14V Power Module.
      - If the DTC does not set
   3. All OK.
   - **If none of the DTCs are set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Battery Charger and 14 V Power Module Maxi Fuse Replacement**
- **Control Module References** for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup

DTC P1ADE, P1ADF, P1AE0, OR P1AE1: DRIVE MOTOR 1/2 CONTROL MODULE SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1ADE

Drive Motor 1 Control Module System Voltage Low Voltage

DTC P1ADF

Drive Motor 1 Control Module System Voltage High Voltage

DTC P1AE0

Drive Motor 2 Control Module System Voltage Low Voltage

DTC P1AE1

Drive Motor 2 Control Module System Voltage High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

The Vehicle is ON.

Conditions for Setting the DTC

DTCs P1ADE and P1AE0

Motor control module ignition-voltage is less than or equal to 10 V for 5 seconds.

DTCs P1ADF and P1AE1

Motor control module ignition voltage is greater than 18 Volts for 5 seconds.

Action Taken When the DTC Sets

DTCs P1ADE, P1ADF, P1AE0 and P1AE1 are Type C DTCs.

Conditions for Clearing the DTC

DTCs P1ADE, P1ADF, P1AE0 and P1AE1 are Type C DTCs.

Diagnostic Aids

A battery charger or vehicle jump start may have set DTCs P1ADF or P1AE1.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 or P0563 is not set.

- **If any of the DTCs are set**

  Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0562, P0563, P1A0C, P1A0D, or P1EFC** .

- **If none of the DTCs are set**

3. Verify DTC P1ADE, P1ADF, P1AE0, or P1AE1 is not set.
   - **If any of the DTCs are set**
     1. Program the T6 Power Inverter Module.
     2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
     3. All OK
   - **If the DTC is not set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1AE8, P1AE9, P1AEA, OR P1AEB: DRIVE MOTOR 1/2 CONTROL MODULE HYBRID/EV BATTERY VOLTAGE SENSE CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1AE8

Drive Motor 1 Control Module Hybrid/EV Battery Voltage Sense Circuit Low Voltage

DTC P1AE9

Drive Motor 1 Control Module Hybrid/EV Battery Voltage Sense Circuit High Voltage

DTC P1AEA

Drive Motor 2 Control Module Hybrid/EV Battery Voltage Sense Circuit Low Voltage

DTC P1AEB

Drive Motor 2 Control Module Hybrid/EV Battery Voltage Sense Circuit High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two drive motor control modules. Each drive motor control module monitors its internal high voltage sensor for correct operation, no external circuits are involved. The modules listed below are part of the power inverter module and are not serviced separately.

- Hybrid/EV powertrain control module 1
- Motor control module 1
- Motor control module 2

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is 8-18 V.
- The high voltage contactor relays are closed.

Conditions for Setting the DTC

P1AE8 and P1AEA

With the hybrid/EV battery system contactors closed, the drive motor control module detects high voltage sensor voltage less than 30V.

P1AE9 and P1AEB

The drive motor control module detects high voltage sensor voltage greater than 500V.

Action Taken When the DTC Sets

- DTCs P1AE8, P1AE9, P1AEA and P1AEB are Type A DTCs.
- The hybrid/EV powertrain control module 1 commands the battery energy control module to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1AE8, P1AE9, P1AEA and P1AEB are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1AE8, P1AE9, P1AEA, or P1AEB is not set.
    - **If any of the DTCs are set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    3. All OK
    - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, setup, and programming

DTC P1AEC-P1AEF: DRIVE MOTOR 1/2 CONTROL MODULE HYBRID/EV BATTERY SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1AEC

Drive Motor 1 Control Module Hybrid/EV Battery System Voltage

DTC P1AED

Drive Motor 2 Control Module Hybrid/EV Battery System Voltage

DTC P1AEE

Drive Motor 1 Control Module Hybrid/EV Battery System Voltage High Voltage

DTC P1AEF

Drive Motor 2 Control Module Hybrid/EV Battery System Voltage High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module contains two drive motor control modules. Each motor control module measures hybrid battery high voltage with several internal sensors. The hybrid/EV powertrain control module 2 also monitors high voltage with several internal sensors. The hybrid/EV powertrain control module 2 high voltage measurement is broadcast over serial data.

P1AEC and P1AED

The motor control modules compare the values in order to verify the hybrid battery high voltage measurement is accurate.

P1AEE and P1AEF

The motor control modules monitors for high voltage that is greater than the system allows during normal operation.

Conditions for Running the DTC

- The hybrid/EV battery system contactor relays are closed.
- Ignition voltage is 8 V and no more than 18 V.

P1AEC

DTCs P1AE8 or P1AE9 are not set.

P1AED

DTCs P1AEA or P1AEB are not set.

Conditions for Setting the DTC

P1AEC and P1AED

A difference of more than 40 V on the high voltage circuit is detected between the hybrid/EV powertrain control module 1 and the hybrid/EV powertrain control module 2.

AND

A difference of more than 50 V on the high voltage circuit is detected between the motor control module and the hybrid/EV powertrain control module 2.

P1AEE and P1AEF

Greater than 463 V on the high voltage circuit is detected by the motor control module.

Action Taken When the DTC Sets

- DTCs P1AEC and P1AED are Type B DTCs.
- DTCs P1AEE and P1AEF are Type A DTCs.
- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

- DTCs P1AEC and P1AED are Type B DTCs.
- DTCs P1AEE and P1AEF are Type A DTCs.

Diagnostic Aids

Conditions such as loss of battery energy control module power or ground or removal of the high voltage manual disconnect while the vehicle was driving could create a voltage surge that may set DTCs P1AEE and P1AEF. History DTCs P1AEE and P1AEF may indicate that the high voltage contactor relays opened while large current flow was present.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0ABB, P0ABC, or P0ABD is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Verify DTC P1AEC, P1AED, P1AEE, or P1AEF is not set.
    - **If any of the DTCs are set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.

3. All OK
   - **If none of the DTCs are set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P1AF0 OR P1AF2: DRIVE MOTOR 1/2 CONTROL MODULE HYBRID/EV BATTERY VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1AF0

Drive Motor 1 Control Module Hybrid/EV Battery Voltage System Isolation Lost

DTC P1AF2

Drive Motor 2 Control Module Hybrid/EV Battery Voltage System Isolation Lost

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. Each motor control module monitors high voltage with several internal sensors. The motor control modules test for loss of isolation between each high voltage bus and vehicle chassis. The motor control modules test for high voltage isolation when the high voltage contactors are closed. The hybrid/EV powertrain control module 2 only tests the hybrid/EV battery pack for high voltage loss of isolation when the high voltage contactors are open.

If the motor control modules detect an isolation fault on either the positive or negative high voltage bus, the hybrid/EV powertrain control module 1 reports a fault. The isolation fault may be caused by any of the following components included in the high voltage system:

- 14V power module

- Air conditioning control module
- Hybrid/EV powertrain control module 2
- Cabin heater control module
- Hybrid/EV battery pack coolant heater
- Power inverter module

Conditions for Running the DTC

- The high voltage contactor relays are closed.
- High voltage is greater than 50 V.
- Ignition voltage is 8-18 V.
- DTCs P1AE8, P1AE9, P1AEA, P1AEB, P1AEC, or P1AED are not set.

Conditions for Setting the DTC

The ratio between negative Mid-Pack Voltage and positive Mid-Pack Voltage is greater than 4.53 for greater than 5 seconds.

Action Taken When the DTC Sets

DTCs P1AF0 and P1AF2 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P1AF0 and P1AF2 are Type B DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1F0E is not set.
   - **If the DTC is set**

     Refer to **DTC P0AA6, P1AE6, or P1F0E** .

   - **If the DTC is not set**
3. Verify DTC P0A78, P0A79, P0BFD, P0BFE, P0C01, or P0C04 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
4. Verify DTC P1AF0 or P1AF2 is not set.
   - **If any of the DTCs are set**

     Refer to **Loss of Isolation on the High Voltage Main Bus** .

   - **If none of the DTCs are set**
5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC P1AF4-P1AF7: DRIVE MOTOR 1/2 CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING CIRCUIT 1

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1AF4

Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 Low Voltage

DTC P1AF5

Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 High Voltage

DTC P1AF6

Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 Low Voltage

DTC P1AF7

Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two drive motor control modules. Each motor control module measures hybrid battery high voltage with several internal sensors. The motor control modules test for loss of isolation between each high voltage bus and vehicle chassis. The motor control modules test for isolation when the high voltage contactor relays are closed. The hybrid/EV powertrain control module 2 only tests the hybrid/EV battery pack for high voltage loss of isolation when the high voltage contactor relays are open.

Conditions for Running the DTC

P1AF4 and P1AF6

- The Vehicle is ON.
- The hybrid/EV contactors are closed.

P1AF5

- The Vehicle is ON.
- DTCs P1AE8 or P1AE9 not set.

P1AF7

- The Vehicle is ON.
- DTCs P1AEA or P1AEB not set.

Conditions for Setting the DTC

P1AF4 and P1AF6

The motor control module detects isolation sensor voltage less than 20V.

P1AF5 and P1AF7

The motor control module detects the value of the mid-pack voltage subtracted from the pack voltage is greater than 40V.

Action Taken When the DTC Sets

- DTCs P1AF4, P1AF5, P1AF6 and P1AF7 are Type B DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1AF4, P1AF5, P1AF6 and P1AF7 are Type B DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0AA6 is not set.
   - **If the DTC is set**

     Refer to **DTC P0AA6, P1AE6, or P1F0E** .

   - **If the DTC is not set**
3. Verify DTC P1AF4, P1AF5, P1AF6, or P1AF7 is not set.
   - **If any of the DTCs are set**
     1. Program the T6 Power Inverter Module.
     2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
     3. All OK
   - **If none of the DTCs are set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1B0B OR P1B0C: DRIVE MOTOR 1/2 CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING CIRCUIT 2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1B0B

Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 Low Voltage

DTC P1B0C

Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two drive motor control modules. Each motor control module measures hybrid battery high voltage with several internal sensors. The motor control modules test for loss of isolation between each high voltage bus and vehicle chassis. The motor control modules test for isolation when the high voltage contactor relays are closed. The hybrid/EV powertrain control module 2 only tests the hybrid/EV battery pack for high voltage loss of isolation when the high voltage contactor relays are open.

Conditions for Running the DTC

The vehicle is ON.

P1B0C

DTC P1AE8 or P1AE9 is not set.

Conditions for Setting the DTC

P1B0B

The motor control module detects isolation sensor voltage less than 20 V.

P1B0C

The motor control module detects isolation sensor voltage greater than 40 V.

Action Taken When the DTC Sets

- DTCs P1B0B and P1B0C are Type B DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1B0B and P1B0C are Type B DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1BOB or P1B0C is not set.
   - **If any of the DTCs are set**

     Refer to **Loss of Isolation on the High Voltage Main Bus** .

   - **If none of the DTCs are set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC P1B0D OR P1B0E: DRIVE MOTOR 1 CONTROL MODULE DRIVE MOTOR 1 OVERSPEED/DRIVE MOTOR 2 CONTROL MODULE DRIVE MOTOR 2 OVERSPEED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1B0D

Drive Motor 1 Control Module Drive Motor 1 Overspeed

DTC P1B0E

Drive Motor 2 Control Module Drive Motor 2 Overspeed

Circuit/System Description

The drive motor position sensor is monitored by the drive motor control module. The drive motor control module monitors the angular position, speed and direction of the drive motor based upon the signals of the resolver-type position sensor. The position sensor allows the drive motor control module to determine the exact position, speed and direction of the drive motor. The motor control modules are part of the power inverter module, often referred to as the drive motor generator power inverter module, and are not serviced separately.

Conditions for Running the DTC

- Vehicle is ON.
- Drive motor control module temperature and voltage out of range DTCs have not set.

Conditions for Setting the DTC

P1B0D

Drive motor 1 speed is greater than 6,300 RPM.

P1B0E

Drive motor 2 speed is greater than 9,500 RPM.

Action Taken When the DTC Sets

- DTCs P1B0D and P1B0E are Type A DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1B0D and P1B0E are Type A DTCs.

Diagnostic Aids

- The drive axle and drive motor 2 are connected mechanically through a planetary gear set, any condition that allows the front wheel drive shaft to rotate too fast while the transmission is in gear may cause DTC P1B0E to set. Ask the operator if the vehicle was subjected to downhill coasting at an excessive speed.
- A transmission mechanical failure that occurs during high drive motor generator torque may cause these DTCs to set.
- Repeated drive motor operation at speeds in excess of the DTC limits may cause deterioration of the drive motor magnets.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify no other Hybrid Transmission DTCs are set.
    - **If other Hybrid Transmission DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no other Hybrid Transmission DTCs are set**
3. Verify DTC P1B0D or P1B0E is not set.
    - **If any of the DTCs are set**
    1. Program the T6 Power Inverter Module.
    2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
    3. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.

- If the DTC does not set.

4. All OK
   - **If none of the DTCs are set**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1B15: REGENERATIVE BRAKING TORQUE REQUEST SIGNAL MESSAGE COUNTER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1B15

Regenerative Braking Torque Request Signal Message Counter Incorrect

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor monitors the data to verify that the indicated brake torque request calculation is correct.

Conditions for Running the DTC

- The vehicle is ON for 1 second.
- The system voltage is 8-18 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTC P1B15 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P1B15 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1B15 is not set.
    - **If the DTC is set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    3. All OK
    - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1B41 OR P1B42: DRIVE MOTOR 1/2 CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1B41

Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Performance

DTC P1B42

Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two drive motor control modules. Each drive motor control module monitors its internal high voltage sensor for correct operation, no external circuits are involved. The modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Motor control module 1
- Motor control module 2
- Auxiliary transmission fluid pump control module

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is 8-18 V.
- The high voltage contactor relays are closed.

P1B41

DTC P1AE8, P1AE9, P1B0B, or P1B0C is not set.

P1B42

DTC P1AEA, P1AEB, P1B43, or P1B44 is not set.

Conditions for Setting the DTC

The difference between the voltage sensed and hybrid battery voltage is greater than 40V.

And

The difference between the voltage sensed and the high voltage measured is greater than 50V.

Action Taken When the DTC Sets

- DTCs P1B41 and P1B42 are Type B DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open

the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1B41 and P1B42 are Type B DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1B41 or P1B42 is not set.
   - **If any of the DTCs are set**
     1. Program the T6 Power Inverter Module.
     2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
     3. All OK
   - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1B43 OR P1B44: DRIVE MOTOR 2 CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING CIRCUIT 2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1B43

Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 Low Voltage

DTC P1B44

Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two drive motor control modules. Each drive motor control module monitors its internal high voltage sensor for correct operation, no external circuits are involved. The modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Motor control module 1
- Motor control module 2
- Auxiliary transmission fluid pump control module

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is 8-18 V.
- The high voltage contactor relays are closed.

Conditions for Setting the DTC

P1B43

The drive motor control module detects isolation sensor voltage less than 20 V.

P1B44

The drive motor control module detects isolation sensor voltage greater than 40 V.

Action Taken When the DTC Sets

- DTCs P1B43 and P1B44 are Type B DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1B43 and P1B44 are Type B DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1B43 or P1B44 is not set.
    - **If any of the DTCs are set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    3. All OK
    - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1BFF OR P1E23-P1E25: AUXILIARY TRANSMISSION FLUID PUMP CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1BFF

Auxiliary Transmission Fluid Pump Control Module Not Programmed

DTC P1E23

Auxiliary Transmission Fluid Pump Control Module Random Access Memory

DTC P1E24

Auxiliary Transmission Fluid Pump Control Module Long Term Memory Performance

DTC P1E25

Auxiliary Transmission Fluid Pump Control Module Read Only Memory

Circuit/System Description

This is an internal fault detection of the auxiliary transmission fluid pump control module. The modules listed below are internal to the power inverter module, often referred to as the drive motor generator power inverter module, and are not serviced separately. These faults are handled inside the hybrid/EV powertrain control module 1 and no external circuits are involved.

- Auxiliary transmission fluid pump control module
- Drive motor 1 control module
- Drive motor 2 control module
- Hybrid/EV powertrain control module 1

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is 8-18 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction, or a control module was not programmed after replacement.

Action Taken When the DTC Sets

- DTCs P1BFF, P1E23, P1E24, and P1E25 are Type A DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1BFF, P1E23, P1E24, and P1E25 are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 is not set.
    - **If the DTC is set**

      Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0562, P0563, P1A0C, P1A0D, or P1EFC** .

    - **If the DTC is not set**
3. Verify DTC P1BFF, P1E23, P1E24, or P1E25 is not set.
    - **If any of the DTCs are set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    3. All OK
    - **If none of the DTCs are set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E0A OR P1E0B: DRIVE MOTOR 1/2 CONTROL MODULE TORQUE CALCULATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E0A

Drive Motor 1 Control Module Torque Calculation Performance

DTC P1E0B

Drive Motor 2 Control Module Torque Calculation Performance

Circuit/System Description

The motor control modules perform redundant calculations of desired and achieved torque values. These values are continuously compared and should always be the same.

Conditions for Running the DTC

Ignition voltage is 8-18V.

Conditions for Setting the DTC

The redundant torque calculation does not match the primary calculation.

Action Taken When the DTC Sets

- DTCs P1E0A and P1E0B are Type A DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1E0A and P1E0B are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify no transmission or motor control module DTCs are set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
3. Verify DTC P1E0A or P1E0B is not set.
   - **If any of the DTCs are set**
   1. Program the T6 Power Inverter Module.
   2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
   3. Verify the DTC does not set.
      - If the DTC sets, replace the T6 Power Inverter Module.
      - If the DTC does not set.
   4. All OK

- **If none of the DTCs are set**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E0E: 14V POWER MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1E0E

14V Power Module Not Programmed

Conditions for Running the DTC

- The vehicle is ON.
- Ignition voltage is greater than 10 volts.

Conditions for Setting the DTC

A new service replacement 14V power module, often referred to as the accessory DC power control module, contains a unique manufacturing calibration. This DTC will be current when a new 14V power module is installed on a vehicle prior to the Service Programming System (SPS) event. The DTC will remain current until the 14V power module has undergone a successful program. Once the program event is completed, the DTC goes into history and can be cleared.

Action Taken When the DTC Sets

- The 14V power module stops supplying power to the 12 V system.
- DTC P1E0E is a Type C DTC.

Conditions for Clearing the DTC

DTC P1E0E is a Type C DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Description and Operation

Accessory DC Power Control Module Description and Operation

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E0E is not set.
    - **If the DTC is set**
    1. Program the K1 14V Power Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the K1 14V Power Module.
        - If the DTC does not set.
    3. All OK
    - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup

DTC P1E19 OR P1E1A: AUXILIARY TRANSMISSION FLUID PUMP CONTROL MODULE SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E19

Auxiliary Transmission Fluid Pump Control Module System Voltage Low Voltage

DTC P1E1A

Auxiliary Transmission Fluid Pump Control Module System Voltage High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

DTC P1E19

System voltage is less than or equal to 10 V for 1 second.

DTC P1E1A

System voltage is greater than or equal to 18 V for 1 second.

Action Taken When the DTC Sets

DTCs P1E19 and P1E1A are Type C DTCs.

Conditions for Clearing the DTC

DTCs P1E19 and P1E1A are Type C DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 or P0563 is not set.
    - **If any of the DTCs are set**

Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0562, P0563, P1A0C, P1A0D, or P1EFC** .

- **If none of the DTCs are set**

3. Verify DTC P1E19 or P1E1A is not set.
   - **If any of the DTCs are set**
   1. Program the T6 Power Inverter Module.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the T6 Power Inverter Module.
      - If the DTC does not set.
   3. All OK
   - **If none of the DTCs are set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E1B-P1E1F: AUXILIARY TRANSMISSION FLUID PUMP CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E1B

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Performance

DTC P1E1C

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 Low Voltage

DTC P1E1D

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 High Voltage

DTC P1E1E

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 Low Voltage

DTC P1E1F

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The motor control modules and the hybrid/EV powertrain control module 1 are part of the power inverter module and are not serviced separately.

Each motor control module measures hybrid/EV battery high voltage with several internal sensors. The motor control modules test for loss of isolation between each high voltage and vehicle chassis. The motor control modules test for isolation when the high voltage contactor relays are closed. The hybrid/EV powertrain control module 2 only tests the hybrid battery assembly for high voltage loss of isolation when the high voltage contactor relays are open.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is at least 9 V.

Conditions for Setting the DTC

P1E1B

The motor control module detects a correlation difference between the mid pack isolation sensor and overall pack voltage.

P1E1C and P1E1E

The motor control module detects isolation sensor voltage less than 20 V.

P1E1D and P1E1F

The motor control module detects isolation sensor voltage greater than 40 V.

Action Taken When the DTC Sets

DTCs P1E1B, P1E15C, P1E1D, P1E1E, and P1E1F are Type B DTCs.

Conditions for Clearing the DTC

DTCs P1E1B, P1E15C, P1E1D, P1E1E, and P1E1F are Type B DTCs.

Reference Information

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E1B, P1E1C, P1E1D, P1E1E, or P1E1F is not set.
    - **If any of the DTCs are set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    3. All OK
    - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E20-P1E22: AUXILIARY TRANSMISSION FLUID PUMP CONTROL MODULE HYBRID/EV BATTERY VOLTAGE SENSE CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E20

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Sense Circuit Low Voltage

DTC P1E21

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Sense Circuit High Voltage

DTC P1E22

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage System Isolation Lost

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. Each drive motor control module monitors its internal high voltage sensor for correct operation; no external circuits are involved. The motor control modules and the hybrid/EV powertrain control module 1 are part of the power inverter module and are not serviced separately.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is 8-18 V.
- The high voltage contactor relays are closed.

Conditions for Setting the DTC

P1E20

The drive motor control module detects high voltage sensor voltage less than 30 V.

P1E21

The drive motor control module detects high voltage sensor voltage greater than 500 V.

P1E22

The drive motor control module detects an isolation fault between the battery pack and chassis ground.

Action Taken When the DTC Sets

- DTCs P1E20 and P1E21 are Type A DTCs.
- DTC P1E22 is a Type B DTC.

Conditions for Clearing the DTC

- DTCs P1E20 and P1E21 are Type A DTCs.
- DTC P1E22 is a Type B DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

P1E20 or P1E21

1. Vehicle ON.
2. Verify DTC P1E20 or P1E21 is not set.
    - **If any of the DTCs are set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    3. All OK
    - **If none of the DTCs are set**
3. All OK

P1E22

1. Vehicle ON.
2. Verify DTC P1E22 is not set.
    - **If the DTC is set**

      Refer to **Loss of Isolation on the High Voltage Main Bus** .

    - **If the DTC is not set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, also called the power inverter module, replacement, programming, and setup

DTC P1E27 OR P1E28: AUXILIARY TRANSMISSION FLUID PUMP CONTROL MODULE HYBRID/EV BATTERY SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E27

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery System Voltage High Voltage

DTC P1E28

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery System Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. Each drive motor control module monitors its internal high voltage sensor for correct operation; no external circuits are involved. The motor control modules and the hybrid/EV powertrain control module 1 are part of the power inverter module and are not serviced separately.

Conditions for Running the DTC

DTC P1E27

- The vehicle is ON.
- High voltage contactors are closed.

DTC P1E28

- The vehicle is ON.
- High voltage contactors are closed.
- DTC P1E20 or P1E21 is not set.

Conditions for Setting the DTC

DTC P1E27

The motor control module detects High Voltage greater than 463 V.

DTC P1E28

The motor control module detects a correlation fault while comparing the mid pack and overall pack voltage.

Action Taken When the DTC Sets

- DTC P1E27 is a Type A DTC.
- DTC P1E28 is a Type B DTC.

Conditions for Clearing the DTC

- DTC P1E27 is a Type A DTC.
- DTC P1E28 is a Type B DTC.

Diagnostic Aids

This DTC may set due to low 12 V system voltage.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 is not set.
    - **If the DTC is set**

      Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0562, P0563, P1A0C, P1A0D, or P1EFC** .

    - **If the DTC is not set**
3. Verify DTC P1E27 or P1E28 is not set.

- **If any of the DTCs are set**

1. Program the T6 Power Inverter Module.
2. Verify the DTC does not set.
   - If the DTC sets, replace the T6 Power Inverter Module.
   - If the DTC does not set.
3. All OK

- **If the DTC is not set**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E29: AUXILIARY TRANSMISSION FLUID PUMP CONTROL MODULE CALCULATED MOTOR POSITION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1E29

Auxiliary Transmission Fluid Pump Control Module Calculated Motor Position Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground. The motor control modules and the hybrid/EV powertrain control module 1 are part of the power inverter module and are not serviced separately.

The auxiliary transmission fluid pump control module uses sensorless control to estimate motor speed and position from the phase current sensors.

Conditions for Running the DTC

The vehicle is ON or the power inverter module is awake.

Conditions for Setting the DTC

The auxiliary transmission fluid pump control module detects a fault.

Action Taken When the DTC Sets

DTC P1E29 is a Type A DTC.

Conditions for Clearing the DTC

DTC P1E29 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P179A, P1E20, P1E21, P1E22, P1E27, P1E28, P1E1C, P1E1D, P1E1E, P1E1F, P1E1B, P1E29, P1E34, P1E35, or P1E36 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
3. Verify DTC P1E29 is not set.
   - **If the DTC is set**
     1. Program the T6 Power Inverter Module.
     2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
     3. All OK
   - **If the DTC is not set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator

Power Inverter Module, replacement, programming, and setup

DTC P1E2A-P1E2F OR P1E30-P1E32: AUXILIARY TRANSMISSION FLUID PUMP PHASE U/V/W CURRENT SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E2A

Auxiliary Transmission Fluid Pump Phase U Current Sensor Circuit Low Voltage

DTC P1E2B

Auxiliary Transmission Fluid Pump Phase U Current Sensor Circuit High Voltage

DTC P1E2C

Auxiliary Transmission Fluid Pump Phase U Current Sensor Performance

DTC P1E2D

Auxiliary Transmission Fluid Pump Phase V Current Sensor Circuit Low Voltage

DTC P1E2E

Auxiliary Transmission Fluid Pump Phase V Current Sensor Circuit High Voltage

DTC P1E2F

Auxiliary Transmission Fluid Pump Phase V Current Sensor Performance

DTC P1E30

Auxiliary Transmission Fluid Pump Phase W Current Sensor Circuit Low Voltage

DTC P1E31

Auxiliary Transmission Fluid Pump Phase W Current Sensor Circuit High Voltage

DTC P1E32

Auxiliary Transmission Fluid Pump Phase W Current Sensor Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor generator based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. This is an internal fault detection of the power inverter module. This fault is handled inside the power inverter module and no external circuits are involved.

Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls its respective motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each motor operates utilizing 3-phase alternating current AC electricity. Each insulated gate bipolar transistor operates a single phase of the drive motor generator. Each phase is individually identified as U, V, and W. Each motor control module monitors the current of each phase in order to detect out of range current conditions.

Because each individual motor's phase circuits are electrically joined together, the phases normally flow about the same amount of current. The motor control module performs a mathematical calculation to verify that the phase current sensors are accurate. If the U-V-W phase current sensors indicate about the same amount of phase current, the sum of the calculation should be near zero. If the U-V-W phase currents are not similar, this DTC will set.

Conditions for Running the DTC

The vehicle is ON or the module is awake.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTCs P1E2A, P1E2B, P1E2C, P1E2D, P1E2E, P1E2F, P1E30, P1E31, and P1E32 are Type A DTCs.
- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1E2A, P1E2B, P1E2C, P1E2D, P1E2E, P1E2F, P1E30, P1E31, and P1E32 are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E2A, P1E2B, P1E2C, P1E2D, P1E2E, P1E2F, P1E30, P1E31, or P1E32 is not set.
   - **If any of the DTCs are set**
   1. Program the T6 Power Inverter Module.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the T6 Power Inverter Module.
      - If the DTC does not set.
   3. All OK
   - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E33: AUXILIARY TRANSMISSION FLUID PUMP PHASE U-V-W CURRENT SENSORS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1E33

Auxiliary Transmission Fluid Pump Phase U-V-W Current Sensors Not Plausible

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump.

Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls its respective motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each motor operates utilizing 3-phase alternating current AC electricity. Each insulated gate bipolar transistor operates a single phase of the

drive motor. Each phase is individually identified as U, V and W. Each motor control module monitors the current of each phase in order to detect out-of-range current conditions.

Because each individual motor's phase circuits are electrically joined together, the phases normally flow about the same amount of current. The motor control module performs a mathematical calculation to verify that the phase current sensors are accurate. If the U-V-W phase current sensors indicate about the same amount of phase current, the sum of the calculation should be near zero. If the U-V-W phase currents are not similar, this DTC will set.

Conditions for Running the DTC

- The vehicle is ON or the module is awake.
- The high voltage contactor relays are closed.

Conditions for Setting the DTC

The sum of the 3-phase current sensors is greater than 5 A.

Action Taken When the DTC Sets

DTC P1E33 is a Type A DTC.

Conditions for Clearing the DTC

DTC P1E33 is a Type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Disconnect the X8 harness connector at the T6 Power Inverter Module.
3. Test for infinite resistance between the each of the AC circuit terminals listed below and ground for each phase of the G5 Auxiliary Transmission Fluid Pump:
   - X8 terminal 3 phase U
   - X8 terminal 2 phase V
   - X8 terminal 1 phase W
   - **If less than infinite resistance**

     Replace the G5 Auxiliary Transmission Fluid Pump.

   - **If infinite resistance**
4. Replace the T6 Power Inverter Module.
5. Verify DTC P1E33 does not set.
   - **If the DTC sets**

     Replace the G5 Auxiliary Transmission Fluid Pump.

   - **If the DTC does not set**
6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Auxiliary Fluid Pump Motor and Fluid Pump Disassemble** Table 1: Electrical Auxiliary Pump Drive Motor Removal for G5 Auxiliary Transmission Fluid Pump , often referred to as the A/Trans Aux Fluid Pump Motor, replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E34-P1E36: AUXILIARY TRANSMISSION FLUID PUMP INVERTER TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E34

Auxiliary Transmission Fluid Pump Inverter Temperature Sensor Circuit High Voltage

DTC P1E35

Auxiliary Transmission Fluid Pump Inverter Temperature Sensor Circuit Low Voltage

DTC P1E36

Auxiliary Transmission Fluid Pump Inverter Temperature Sensor Performance

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

- The vehicle is ON or the module is awake.
- Motor temperature is greater than -40°C (-40°F). If motor temperature is less than -40°C (-40°F) at vehicle ON, the drive motor must operate at greater than 20 N.m (14.75 lb ft) for a cumulative time of 1.5 minutes before the DTC will run.

Conditions for Setting the DTC

P1E34

The inverter phase temperature sensor is less than -58°C (-72°F) for 3 seconds. If the fault is detected at the start of a drive cycle the DTC will set after 600 seconds.

P1E35

The inverter phase temperature sensor is greater than 130°C (266°F) for 3 seconds.

P1E36

A 20°C (36°F) difference is observed between the individual inverter phase temperature sensor and the average of the Hybrid Electronics Coolant Temperature and the Transmission Fluid Temperature.

Action Taken When the DTC Sets

DTCs P1E34, P1E35, and P1E36 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P1E34, P1E35, and P1E36 are Type B DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E34, P1E35, or P1E36 is not set.
    - **If any of the DTCs are set**
    1. Program the T6 Power Inverter Module.
    2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
    3. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    4. All OK
    - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E37: AUXILIARY TRANSMISSION FLUID PUMP INVERTE TEMPERATURE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1E37

Auxiliary Transmission Fluid Pump Inverter High Temperature

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The inverter temperature sensor is part of the power inverter module and is not serviced separately.

Conditions for Running the DTC

- The vehicle is ON and propulsion is active.
- DTC P1E36 is not set.

Conditions for Setting the DTC

The pump inverter temperature sensor is greater than 98°C (208°F).

Action Taken When the DTC Sets

- DTC P1E37 is a Type B DTC.
- The hybrid/EV powertrain control module 1 commands the engine into derate mode.

Conditions for Clearing the DTC

DTC P1E37 is a Type B DTC.

Diagnostic Aids

- Ask about the customer's driving habits, trailer towing, etc.
- Ensure the engine cooling system is functioning normally.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E36 is not set.
   - **If the DTC is set**

     Refer to **DTC P1E34-P1E36**.

   - **If the DTC is not set**
3. Verify that DTC P0C11, P0C12, P0C13, P0C14, P0C15, or P0C16 is not set.
   - **If any of the DTCs are set**

     Refer to **DTC P0C11-P0C16**.

   - **If none of the DTCs are set**
4. Verify DTC P1E37 is not set.
   - **If the DTC is set**
     1. Program the T6 Power Inverter Module.
     2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
     3. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
     4. All OK
   - **If the DTC is not set**
5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E38: AUXILIARY TRANSMISSION FLUID PUMP INVERTER SUPPLY VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1E38

Auxiliary Transmission Fluid Pump Inverter Supply Voltage Circuit

Circuit/System Description

The power inverter motor, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

- Vehicle is ON or Charge Mode is active.
- High voltage is greater than 100V.

Conditions for Setting the DTC

The control module does not detect voltage at the insulated gate bi-polar transistor bias power supply.

Action Taken When the DTC Sets

- DTC P1E38 is a Type A DTC.
- Propulsion is disabled.

Conditions for Clearing the DTC

DTC P1E38 is a Type A DTC.

Diagnostic Aids

To assist in troubleshooting and duplicating intermittent failure conditions, observe the Freeze Frame/Failure

Records data. This is especially important to do before programming or replacing the power inverter module.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module or the T12 Transmission.

2. Disconnect the X8 harness connector at the T6 Power Inverter Module.
3. Test for infinite resistance between the each of the AC circuit terminals listed below and ground for each phase of the G5 Auxiliary Transmission Fluid Pump:
   - X8 terminal 3 phase U
   - X8 terminal 2 phase V
   - X8 terminal 1 phase W
   - **If less than infinite resistance**

     Replace the G5 Auxiliary Transmission Fluid Pump.

   - **If infinite resistance**
4. Verify DTC P1E38 does not set.
   - **If the DTC sets**
   1. Perform each of the operations listed below one at a time until the fault is corrected.
      1. Program the T6 Power Inverter Module.
      2. Replace the T6 Power Inverter Module.
      3. Replace the G5 Auxiliary Transmission Fluid Pump.
   2. Repeat the DTC check.
   - **If the DTC does not set**
5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Auxiliary Fluid Pump Motor and Fluid Pump Disassemble** Table 1: Electrical Auxiliary Pump Drive Motor Removal for G5 Auxiliary Transmission Fluid Pump, often referred to as the A/Trans Aux Fluid Pump Motor, replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E39: AUXILIARY TRANSMISSION FLUID PUMP INVERTER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1E39

Auxiliary Transmission Fluid Pump Inverter Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. Each motor control module controls its respective motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each insulated gate bipolar transistor assembly is monitored for fault conditions. The motor control modules are part of the power inverter module and are not serviced separately.

Conditions for Running the DTC

- Vehicle is ON or Charge Mode is active.
- High voltage is greater than 100V.

Conditions for Setting the DTC

The motor control module detects excessive current flow through the switched portion of the insulated gate bipolar transistor.

Action Taken When the DTC Sets

- DTC P1E39 is a Type A DTC.
- Propulsion is disabled.

Conditions for Clearing the DTC

DTC P1E39 is a Type A DTC.

Diagnostic Aids

To assist in troubleshooting and duplicating intermittent failure conditions, observe the Freeze Frame/Failure Records data. This is especially important to do before programming or replacing the power inverter module.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module or the T12 Transmission.
2. Disconnect the X8 harness connector at the T6 Power Inverter Module.
3. Test for infinite resistance between the each of the AC circuit terminals listed below and ground for each phase of the G5 Auxiliary Transmission Fluid Pump:
   - X8 terminal 3 phase U
   - X8 terminal 2 phase V
   - X8 terminal 1 phase W
   - **If less than infinite resistance**

     Replace the G5 Auxiliary Transmission Fluid Pump.

   - **If infinite resistance**

4. Verify DTC P1E39 does not set.
    - **If the DTC sets**
    1. Perform each of the operations listed below one at a time until the fault is corrected.
        1. Program the T6 Power Inverter Module.
        2. Replace the T6 Power Inverter Module.
        3. Replace the G5 Auxiliary Transmission Fluid Pump.
    2. Repeat the DTC check.
    - **If the DTC does not set**
5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Auxiliary Fluid Pump Motor and Fluid Pump Disassemble** Table 1: Electrical Auxiliary Pump Drive Motor Removal for G5 Auxiliary Transmission Fluid Pump, often referred to as the A/Trans Aux Fluid Pump Motor, replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E3A: AUXILIARY TRANSMISSION FLUID PUMP MOTOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1E3A

Auxiliary Transmission Fluid Pump Motor Torque Delivered Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is between 11.0-16.0 V.
- Auxiliary transmission fluid pump torque command is greater than 6.8 N.m (5 lb ft).

Conditions for Setting the DTC

The actual auxiliary transmission fluid pump speed is more than 200 RPM different from the commanded speed.

Action Taken When the DTC Sets

DTC P1E3A is a Type A DTC.

Conditions for Clearing the DTC

DTC P1E3A is a Type A DTC.

Diagnostic Aids

There should always be other hybrid/EV powertrain or motor control module DTCs set along with DTC P1E3A. Always diagnose other DTCs before addressing this DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Verify that no other hybrid/EV powertrain or motor control module DTC is set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
2. Verify DTC P1E3A is not set.
    - **If the DTC is set**
    1. Program the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets.
        1. Replace the G5 Auxiliary Transmission Fluid Pump.
        2. Verify the DTC does not set.
            - If the DTC sets, replace the T6 Power Inverter Module.

- If the DTC does not set

3. All OK
   - If the DTC is not set.

3. All OK
   - **If the DTC is not set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Auxiliary Fluid Pump Motor and Fluid Pump Disassemble** Table 1: Electrical Auxiliary Pump Drive Motor Removal for G5 Auxiliary Transmission Fluid Pump , often referred to as the A/Trans Aux Fluid Pump Motor, replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E3E OR P1E3F: 14V POWER MODULE MEMORY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E3E

14V Power Module Random Access Memory

DTC P1E3F

14V Power Module Read Only Memory

Circuit/System Description

This is an internal fault detection of the 14V power module, often referred to as the accessory DC power control module. This fault is handled inside the 14V power module and no external circuits are involved.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is at least 9.5 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

DTCs P1E3E and P1E3F are Type C DTCs.

Conditions for Clearing the DTC

DTCs P1E3E and P1E3F are Type C DTCs.

Reference Information

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E3E or P1E3F is not set.
    - **If any of the DTCs are set**
    1. Program the K1 14V Power Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the K1 14V Power Module.
        - If the DTC does not set.
    3. All OK
    - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup.

DTC P1E40-P1E42: 14V POWER MODULE HYBRID/EV BATTERY SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E40

14V Power Module Hybrid/EV Battery System Voltage Performance

DTC P1E41

14V Power Module Hybrid/EV Battery System Overvoltage Sensing Circuit

DTC P1E42

14V Power Module Hybrid/EV Battery System High Voltage

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, constantly monitors system input and output voltage. This sensor is internal to the 14V power module and is not serviced separately from the control module.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

Voltage greater than 450V has been detected.

Action Taken When the DTC Sets

- DTCs P1E40, P1E41, and P1E42 are Type C DTCs.
- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1E40, P1E41, and P1E42 are Type C DTCs.

Diagnostic Aids

DTCs P1E41 and P1E42 may indicate that the high voltage contactor relays may have opened while large current flow was present. Conditions such as loss of hybrid/EV powertrain control module 2 power or ground or removal of the high voltage manual disconnect while the vehicle was driving could create a voltage surge that may set this DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E40, P1E41, or P1E42 is not set.
   - **If any of the DTCs are set**
   1. Program the K1 14V Power Module.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the K1 14V Power Module.
      - If the DTC does not set.
   3. All OK
   - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup

DTC P1E43 OR P1E44: 14V POWER MODULE SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E43

14V Power Module System Overvoltage Sensing Circuit

DTC P1E44

14V Power Module System High Voltage

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, constantly monitors system input and output voltage. This sensor is internal to the 14V power module and is not serviced separately from the control module.

Conditions for Running the DTC

The hybrid/EV powertrain control module 1 commands the 14V power module to begin charging.

Conditions for Setting the DTC

Voltage greater than 18V has been detected on the 14V circuit.

Action Taken When the DTC Sets

DTCs P1E43 and P1E44 are Type C DTCs.

Conditions for Clearing the DTC

DTCs P1E43 and P1E44 are Type C DTCs.

Diagnostic Aids

A battery charger or vehicle jump start may have set this DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E43 or P1E44 is not set.
    - **If any of the DTCs are set**
    1. Program the K1 14V Power Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the K1 14V Power Module.
        - If the DTC does not set.
    3. All OK

- **If none of the DTCs are set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup

DTC P1E45: 14V POWER MODULE TEMPERATURE SENSORS 1-2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1E45

14V Power Module Temperature Sensors 1-2 Not Plausible

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, constantly monitors system temperature, to protect against overheat conditions. The module also monitors the function of the temperature sensors. These sensors are internal to the 14V power module and are not serviced separately from the control module.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

Sensor 1 and sensor 2 values vary by greater than 30°C.

Action Taken When the DTC Sets

DTC P1E45 is a Type C DTC.

Conditions for Clearing the DTC

DTC P1E45 is a Type C DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E45 is not set.
   - **If the DTC is set**
   1. Program the K1 14V Power Module.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the K1 14V Power Module.
      - If the DTC does not set.
   3. All OK
   - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup.

DTC P1E46 OR P1E48: 14V POWER MODULE TEMPERATURE SENSOR 1/2 HIGH TEMPERATURE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E46

14V Power Module Temperature Sensor 1 High Temperature Sensing Circuit

DTC P1E48

14V Power Module Temperature Sensor 2 High Temperature Sensing Circuit

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, constantly monitors system temperature to protect against overheat conditions. The module also monitors the function of the temperature sensors. These sensors are internal to the 14V power module and are not serviced separately from the control module.

The 14V power module is an air cooled component. The 14V power module vent fan is controlled by the hybrid/EV powertrain control module 2.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

The sensor signal is out of range for greater than 5 seconds.

Action Taken When the DTC Sets

- DTC P1E46 is a Type C DTC.
- DTC P1E48 is a Type C DTC.

Conditions for Clearing the DTC

- DTC P1E46 is a Type C DTC.
- DTC P1E48 is a Type C DTC.

Reference Information

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1FF5, P1FF9, or P1FFA is not set.
    - **If any of the DTCs are set**

Refer to **DTC P1FF5, P1FF9, or P1FFA** .

- **If none of the DTCs are set**

NOTE: Airflow can be checked by feeling at the output duct in the rear trunk compartment underneath the floor stowage trim panel.

3. Verify the scan tool Hybrid Powertrain Control Module 2 14V Power Module Fan Speed parameter and actual airflow increase and decrease when commanding the 14V Power Module Fan between 10%-90% with a scan tool.
   - **If the fan operates improperly or airflow is obstructed**

     Refer to **14 V Power Module Cooling Fan Malfunction** .

   - **If the fan operates properly and airflow is unobstructed**
4. Verify DTC P1E46 or P1E48 is not set.
   - **If any of the DTCs are set**
   1. Program the K1 14V Power Module.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the K1 14V Power Module.
      - If the DTC does not set
   3. All OK.
   - **If none of the DTCs are set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup

DTC P1E4A OR P1E4B: CONTROL MODULE REDUNDANT DRIVE MOTOR 1/2 SPEED SENSING

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E4A

Control Module Redundant Drive Motor 1 Speed Sensing Circuit

DTC P1E4B

Control Module Redundant Drive Motor 2 Speed Sensing Circuit

Circuit/System Description

The drive motor position sensor is monitored by the motor control module. The motor control module monitors the angular position, speed and direction of the drive motor based upon the signals of the resolver-type position sensor. The position sensor allows the motor control module to determine the exact position, speed and direction of the drive motor. The hybrid/EV powertrain control module 1 also calculates motor speed. This fault is handled inside the power inverter module, often referred to as the drive motor generator power inverter module, and no external circuits are involved.

Conditions for Running the DTC

This diagnostic runs one time at vehicle ON.

Conditions for Setting the DTC

The calculated motor speed is greater than 400 RPM different from the measured speed.

Action Taken When the DTC Sets

- DTC P1E4A is a Type A DTC.
- DTC P1E4B is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

- DTC P1E4A is a Type A DTC.
- DTC P1E4B is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 or P0563 is not set.
    - **If any of the DTCs are set**

Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0562, P0563, P1A0C, P1A0D, or P1EFC** .

- **If none of the DTCs are set**

3. Verify DTC P1E4A or P1E4B is not set.
   - **If any of the DTCs are set**
   1. Program the T6 Power Inverter Module.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the T6 Power Inverter Module.
      - If the DTC does not set.
   3. All OK
   - **If none of the DTCs are set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1EA8: 14V POWER MODULE HYBRID/EV BATTERY SYSTEM LOW VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1EA8

14V Power Module Hybrid/EV Battery System Low Voltage

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, constantly monitors system input and output voltage. This sensor is internal to the 14V power module and is not serviced separately from the control module.

Conditions for Running the DTC

The hybrid/EV powertrain control module 1 commands the 14V power module to begin charging.

Conditions for Setting the DTC

Hybrid/EV Battery Pack voltage less than 200V has been detected.

Action Taken When the DTC Sets

DTC P1EA8 is a Type C DTC.

Conditions for Clearing the DTC

DTC P1EA8 is a Type C DTC.

Diagnostic Aids

The symptom causing this DTC may prevent the 14V power module from charging the 12 V battery, which would eventually result in low 12 V system voltage.

Reference Information

Description and Operation

Accessory DC Power Control Module Description and Operation

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

NOTE: To accurately diagnose the charging system, the C1 Battery must be fully charged and capable of passing the Battery Inspection/Test.

1. Perform the **Battery Inspection/Test** .
2. Vehicle ON.
3. Verify DTC P0AFA is not set.
   - **If the DTC is set**

     Refer to **DTC P0AFA or P0AFB** .

   - **If the DTC is not set**
4. Verify DTC P1ABC or P1ABD is not set.
   - **If any of the DTCs are set**

     Refer to **DTC P1ABC or P1ABD**.

   - **If none of the DTCs are set**

5. Verify DTC P1EA8 is not set.
   - **If the DTC is set**
     1. Program the K1 14V Power Module.
     2. Verify the DTC does not set.
        - If the DTC sets, replace the K1 14V Power Module.
        - If the DTC does not set.
     3. All OK
   - **If the DTC is not set**
6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup

DTC P1EA9: 14V POWER MODULE SYSTEM LOW VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1EA9

14V Power Module System Low Voltage

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, monitors its 14-volt circuit when it is enabled. This DTC sets when the 14-volt circuit in the 14V power module is below this minimum level at the time it is enabled. 14V power module functions will run only when a 14V power module enable message from the hybrid/EV powertrain control module 1 is active on the serial data circuit.

Conditions for Running the DTC

The hybrid/EV powertrain control module 1 commands the 14V power module to begin charging.

Conditions for Setting the DTC

The 14 volt circuit at the 14V power module is below 7.0 volts when attempting to begin charging.

Action Taken When the DTC Sets

- DTC P1EA9 is a Type C DTC.
- The 14V power module will not allow 14 volt conversion to begin in this condition.

Conditions for Clearing the DTC

- DTC P1EA9 is a Type C DTC.
- The 14 volt circuit at the 14V power module is above 7 volts.

Diagnostic Aids

- A poor connection at the B+ terminal of the 14V power module or an open or improperly fastened 200A mega fuse in the X50D fuse block may cause this DTC to set.
- Problems with the high voltage connection between the hybrid/EV battery pack and the 14V power module will prevent 12 V system charging and should be addressed first.

Reference Information

Schematic Reference

- **Power Distribution Schematics**
- **Starting and Charging Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Accessory DC Power Control Module Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: To accurately diagnose the charging system, the C1 Battery must be fully charged and capable of passing the Battery Inspection/Test.

1. Perform the **Battery Inspection/Test** .
2. Vehicle OFF. Disconnect the C1 Battery. Refer to **Battery Negative Cable Disconnection and Connection** .

NOTE: The X4 harness connector at the 14V power module is connected to the positive terminal of the 12V battery through a 200 A fuse. When disconnected, the harness connector must be isolated from ground or any other conductor to prevent electrical spark when the 12V battery ground is reconnected.

3. Disconnect the B+ X4 cable connector at the K1 14V Power Module.
4. Connect a test lamp between the C1 Battery positive terminal and the X4 terminal at the K1 14V Power Module.
5. Reconnect the C1 Battery. Refer to **Battery Negative Cable Disconnection and Connection** . Vehicle ON.
6. Measure and record the voltage between the X4 terminal at the K1 14V Power Module and ground.
7. Verify the scan tool Hybrid Powertrain Control Module Low-Voltage Circuit Voltage parameter in the 14V Power Module data list is within 0.5V of the voltage recorded in the previous step.
   - **If the voltage is not within the specified range**

     Replace the K1 14V Power Module.

   - **If the voltage is within the specified range**
8. Vehicle OFF, remove the test lamp.
9. Test for less than 2 ohms in the B+ circuit between the X4 cable connector and the C1 Battery positive terminal.
   - **If 2 ohms or greater**

     Repair the open/high resistance in the circuit.

   - **If less than 2 ohms**
10. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Battery Positive and Negative Cable Replacement (B + APM Module to Battery Fuse Block)** , **Battery Positive and Negative Cable Replacement (APM Module Ground Cable)** for B+ APM Module to Battery Fuse Block.

- **Control Module References** for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup

DTC P1EB8: AUXILIARY TRANSMISSION FLUID PUMP CONTROL MODULE LONG TERM MEMORY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1EB8

Auxiliary Transmission Fluid Pump Control Module Long Term Memory Reset

Circuit/System Description

This is an internal fault detection of the motor control module. The motor control module is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. This fault is handled inside the hybrid/EV powertrain control module 1 and motor control modules, and no external circuits are involved.

Conditions for Running the DTC

This diagnostic runs one time at vehicle ON.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

DTC P1EB8 is a Type A DTC.

Conditions for Clearing the DTC

DTC P1EB8 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 or P0563 is not set.
   - **If any of the DTCs are set**

     Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0562, P0563, P1A0C, P1A0D, or P1EFC** .

   - **If none of the DTCs are set**
3. Verify DTC P1EB8 is not set.
   - **If the DTC is set**
     1. Program the T6 Power Inverter Module.
     2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set
     3. All OK
   - **If the DTC is not set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P2797: AUXILIARY TRANSMISSION FLUID PUMP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P2797

Auxiliary Transmission Fluid Pump Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three

motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is between 11.0 and 16.0 V.

Conditions for Setting the DTC

The actual auxiliary transmission fluid pump speed is 650 RPM less than the commanded speed.

Action Taken When the DTC Sets

DTC P2797 is a Type A DTC.

Conditions for Clearing the DTC

DTC P2797 is a Type A DTC.

Diagnostic Aids

There should always be other hybrid/EV powertrain or motor control module DTCs set along with DTC P2797. Always diagnose other DTCs before addressing this DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Verify that no other hybrid/EV powertrain or motor control module DTC is set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
2. Verify DTC P2797 is not set.
   - **If the DTC is set**
     1. Program the T6 Power Inverter Module.
     2. Verify the DTC does not set.

- If the DTC sets.

1. Replace the G5 Auxiliary Transmission Fluid Pump.
2. Verify the DTC does not set.
   - If the DTC sets, replace the T6 Power Inverter Module.
   - If the DTC does not set.
3. All OK
   - If the DTC does not set.

3. All OK
   - **If the DTC is not set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Auxiliary Fluid Pump Motor and Fluid Pump Disassemble** Table 1: Electrical Auxiliary Pump Drive Motor Removal for G5 Auxiliary Transmission Fluid Pump , often referred to as the A/Trans Aux Fluid Pump Motor, replacement
- **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

SYMPTOMS - HYBRID CONTROLS

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions.

   Refer to the following procedures:

   - **Drive Motor Generator Power Inverter Module Description and Operation**
   - **High Voltage Monitoring Systems Description**
   - **Hybrid Modes of Operation Description**
   - **Drive Motor Battery System Description**
   - **Transmission General Description**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Hybrid System. Refer to **Checking**

Aftermarket Accessories .

- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

DC Power Conversion Test

DRIVE MODE SELECT SWITCH MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	Stuck in Normal Mode	Stuck in Normal Mode	Stuck in Normal Mode	P1762
Ground	Stuck in Normal Mode	Stuck in Normal Mode	Stuck in Normal Mode	P1762

Circuit/System Description

The body control module (BCM) monitors the state of the drive mode switch status. The BCM sends the drive mode switch signal message to the ECM over the serial data circuits. The ECM uses this message to determine the following driver selected mode of operation:

- Normal
- Sport
- Mountain
- Hold, some models

Reference Information

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the drive mode changes between Normal, Mountain, and Sport when pressing the Drive Mode Switch.
    - **If the state does not change**

      Refer to Circuit/System Testing.

    - **If the state changes**
3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S126 Drive Mode Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 4 and ground
    - **If 10 ohms or greater**
    1. Vehicle OFF.
    2. Test for less than 2 ohms in the ground circuit end to end.
        - If 2 ohms or greater, repair the open/high resistance in the circuit.
        - If less than 2 ohms, repair the open/high resistance in the ground connection.
    - **If less than 10 ohms**
3. Vehicle ON.
4. Test for 12V between the signal circuit terminal 1 and ground.
    - **If not 12V**
    1. Vehicle OFF, disconnect the harness connector at the K9 X6 Body Control Module.

2. Test for infinite resistance between the signal circuit terminal 22 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the K9 Body Control Module.
- **If 12V**

5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 4.
6. Verify the Drive Mode Status changes state.
    - **If the Drive Mode Status does not change state**
    1. Vehicle OFF, disconnect the harness connector at the K9 X6 Body Control Module, Vehicle ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 ohms in the signal circuit end to end.
        - If 2 ohms or greater, repair the open/high resistance in the circuit.
        - If less than 2 ohms, replace the K9 Body Control Module.
    - **If Drive Mode Status does change state**
7. Test or replace the S126 Drive Mode Switch.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the S126 Drive Mode Switch.
2. Test for infinite resistance between the signal terminal 1 and the ground terminal 4 with the switch in the open position.
    - **If less than infinite resistance**

      Replace the S126 Drive Mode Switch.

    - **If infinite resistance**
3. Test for less than 2 ohms between the signal terminal 1 and the ground terminal 4 with the switch in the closed position.
    - **If 2 ohms or greater**

      Replace the S126 Drive Mode Switch.

    - **If less than 2 ohms**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for Body Control Module replacement, programming, and setup

- **Radio Control Assembly Replacement** for Drive Mode Switch Replacement

DC POWER CONVERSION TEST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, converts high voltage (300V) direct current (DC) to low voltage (14V) DC to charge the 12V battery and power accessories. The 14V power module receives a wake-up signal on a discrete line from the hybrid/EV powertrain control module 2 when the vehicle is ON. After a successful initialization, the 14V power module receives an enable command from the hybrid/EV powertrain control module 1 over the serial data circuits to begin power conversion.

Diagnostic Aids

- A poor connection at the B+ terminal of the 14V power module or improperly fastened 200 A mega fuse in the X50D fuse block may reduce current flow and cause charging system problems, possibly without setting any DTCs.
- A low 12 V battery voltage may prevent the charging system from initializing.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Accessory DC Power Control Module Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

NOTE: To accurately diagnose the charging system, the C1 Battery must be fully charged and capable of passing the Battery Inspection/Test.

1. Perform the **Battery Inspection/Test** .
2. Vehicle ON.
3. Verify that no DTCs are set that would cause a charging system concern.
   - **If an applicable DTC is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If no applicable DTCs are set**
4. Vehicle OFF.
5. Measure and record the C1 Battery voltage at the C1 Battery terminals. The C1 Battery voltage should stabilize within a few minutes of turning the vehicle OFF.
6. Vehicle ON, accessories OFF.
7. Measure and record the C1 Battery voltage at the C1 Battery terminals. The voltage should be at least 1 V greater than the voltage measured previously but less than 15 V.
   - **If not within the specified range**

     Refer to Circuit/System Testing.

   - **If within the specified range**
8. All OK

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Vehicle OFF.
2. Connect a carbon pile tester to the C1 Battery.
3. Vehicle ON, turn all accessories off. Observe the voltage reading on the tester and the Hybrid Powertrain Control Module Low-Voltage Circuit Voltage parameter in the 14V Power Module data list. The voltage should read between 12.6-15.5V.
4. Adjust the carbon pile tester so that the Hybrid Powertrain Control Module Low-Voltage Circuit Current parameter in the 14V Power Module data list is reading 160 A.
5. Verify the voltage reading remains between 12.6-15.5V.
   - **If not within the specified range**

Replace the K1 14V Power Module.

- **If within the specified range**

6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup

REPAIR INSTRUCTIONS

DRIVE MOTOR GENERATOR POWER INVERTER MODULE COVER REPLACEMENT

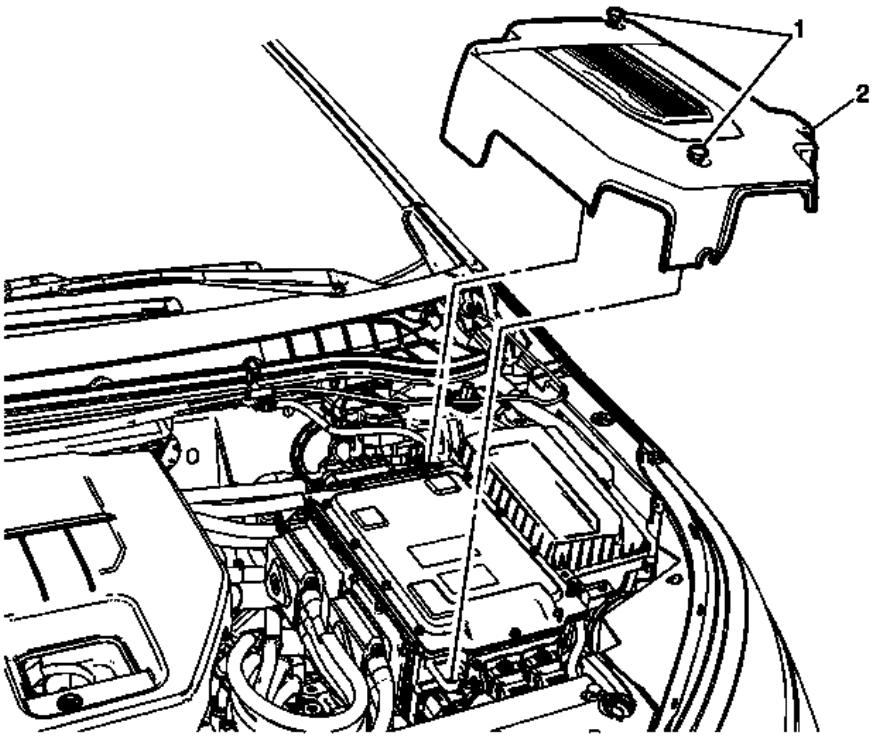


Fig. 7: Drive Motor Generator Power Inverter Module Cover
Courtesy of GENERAL MOTORS COMPANY

Drive Motor Generator Power Inverter Module Cover Replacement

Callout	Component Name
	Drive Motor Generator Power Inverter Module Cover Fastener (Qty: 2) **CAUTION:**

1	**Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)
2	Drive Motor Generator Power Inverter Module Cover

DRIVE MOTOR GENERATOR POWER INVERTER MODULE REPLACEMENT

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Disable the high voltage system. Refer to **High Voltage Disabling** .
2. Remove the power inverter module cover. Refer to **Drive Motor Generator Power Inverter Module Cover Replacement**.

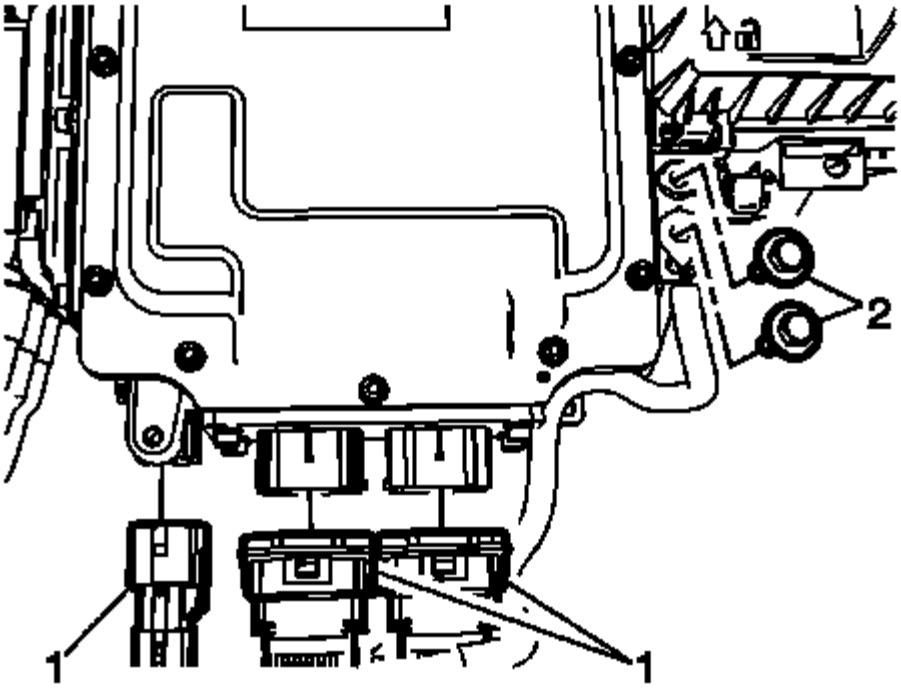


Fig. 8: Motor Generator Power Inverter Module Connectors
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the electrical connectors (1).
4. Remove the shield circuit harness ground fasteners (2) and reposition the ground cables.
5. Disconnect the coolant pipes from the power inverter module. Refer to **Drive Motor Power Inverter Module Cooling Inlet Hose Replacement** , and . **Drive Motor Generator Control Module Radiator Outlet Hose Replacement** .

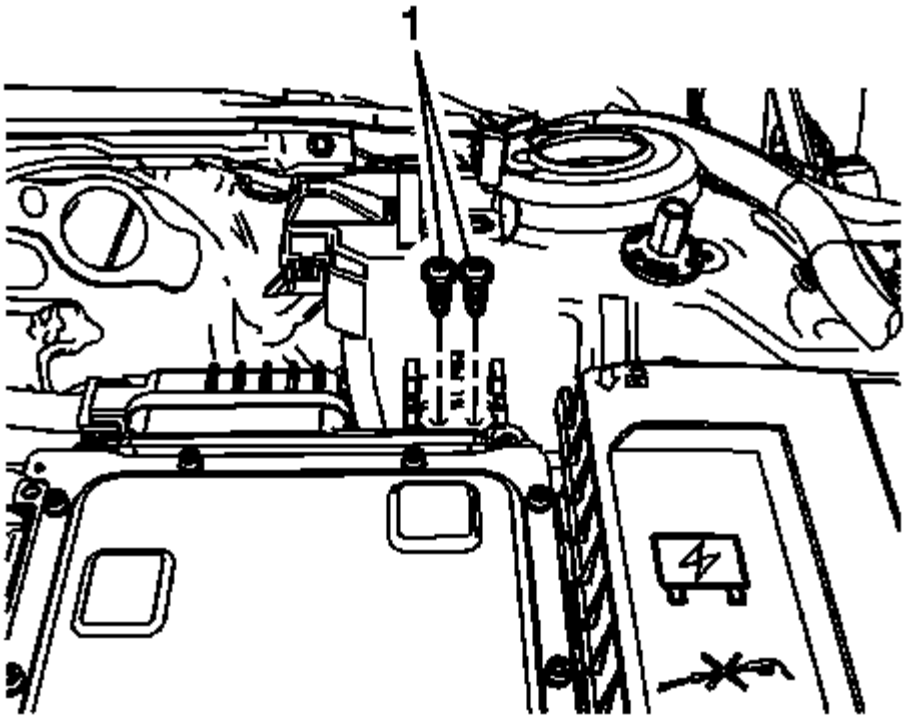


Fig. 9: High Voltage Interlock Loop Connector Fasteners
Courtesy of GENERAL MOTORS COMPANY

6. Remove the high voltage interlock loop connector fasteners (1) and reposition the connector.

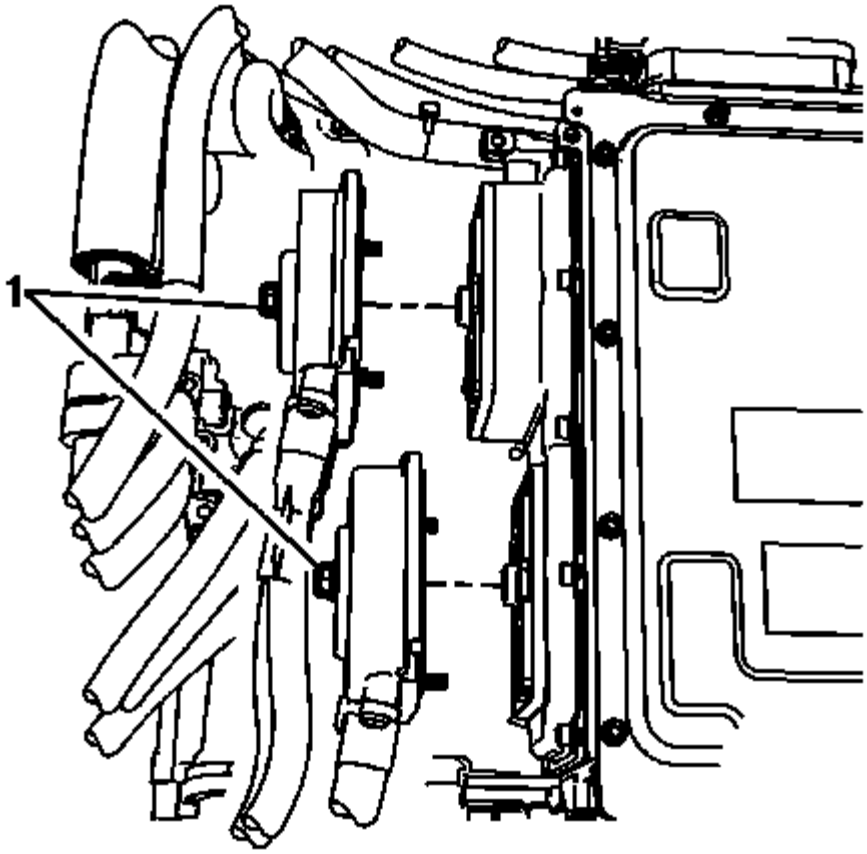


Fig. 10: Phase Cable Fasteners And Cables
Courtesy of GENERAL MOTORS COMPANY

7. Remove the three-phase cable fasteners (1) and reposition the cables.
8. Discard the cable housing seals and the cable fastener seals.

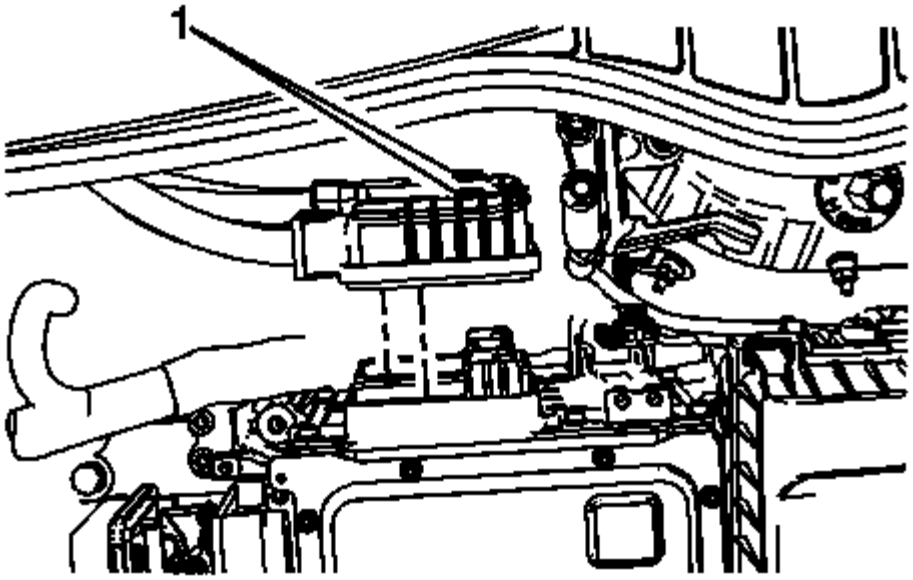


Fig. 11: Locating 300 Volt Cable Fasteners
Courtesy of GENERAL MOTORS COMPANY

NOTE: The top cable should already be removed when the high voltage disabling was performed.

9. Remove the 300-Volt cable fasteners (1) and reposition the cables.
10. Discard the 300-Volt cable connector seals.

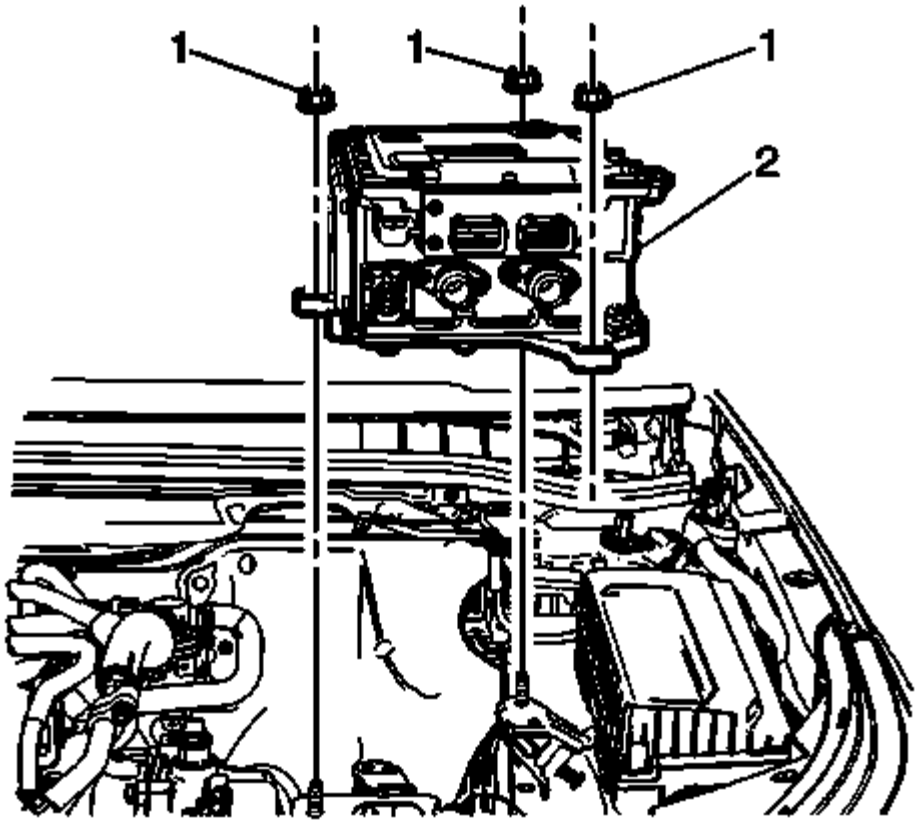


Fig. 12: Power Inverter Fasteners And Drive Motor Power Inverter Control Module
Courtesy of GENERAL MOTORS COMPANY

11. Remove the power inverter fasteners (1) and drive motor power inverter control module (2).

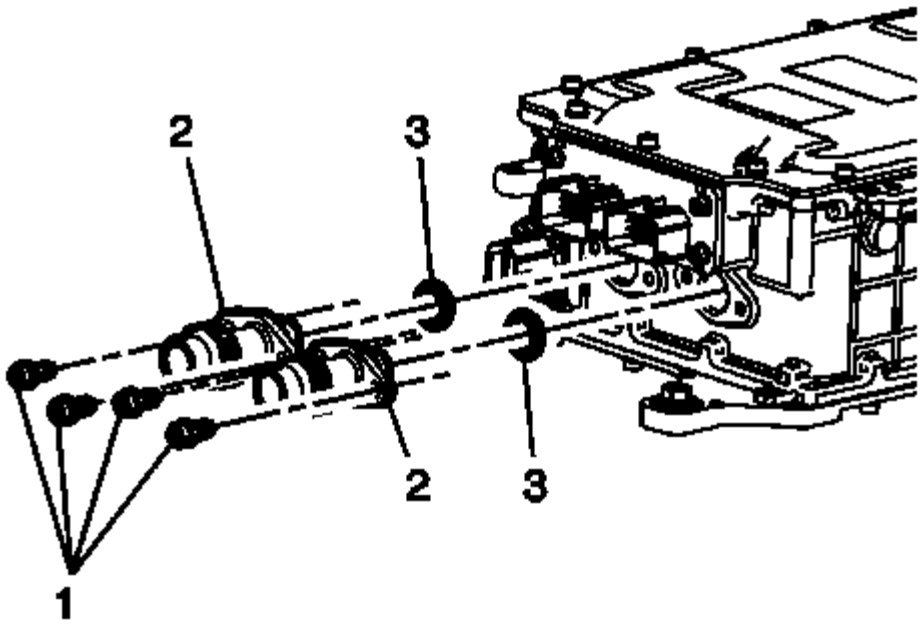


Fig. 13: Coolant Fitting Fasteners
Courtesy of GENERAL MOTORS COMPANY

NOTE: Replacement power inverter module comes pre-assembled with new coolant fittings. Replace coolant fittings only if necessary.

12. Remove the coolant fitting fasteners (1) , the coolant fittings (2), and use NEW seals (3).

Installation Procedure

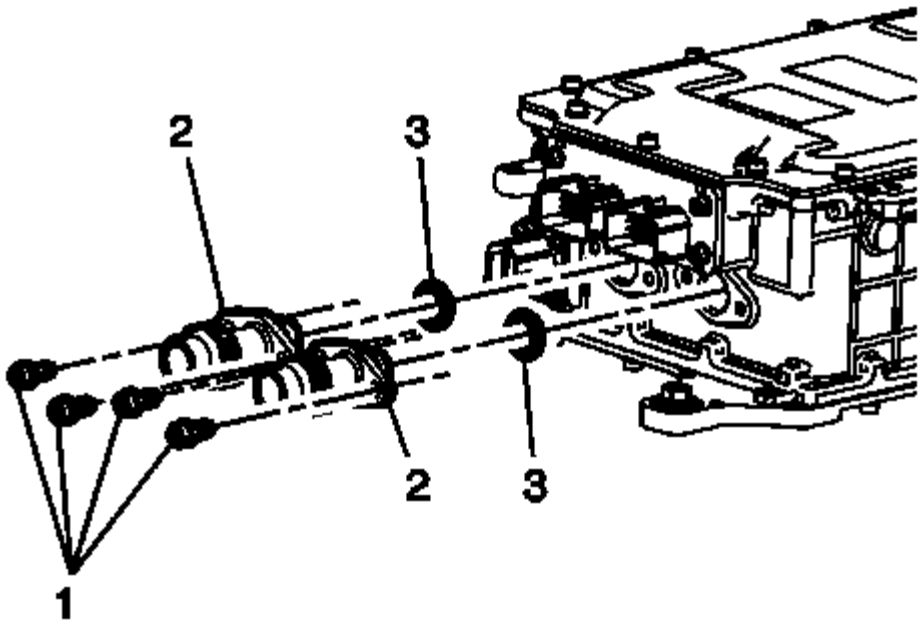


Fig. 14: Coolant Fitting Fasteners
Courtesy of GENERAL MOTORS COMPANY

NOTE: It is possible to install the coolant fittings 180° out of position. Ensure the larger alignment tab is facing downwards.

1. Install NEW coolant tube seals (3) and the coolant fittings (2).
2. Tighten the coolant tube fasteners to 3 N.m (27 lb in).

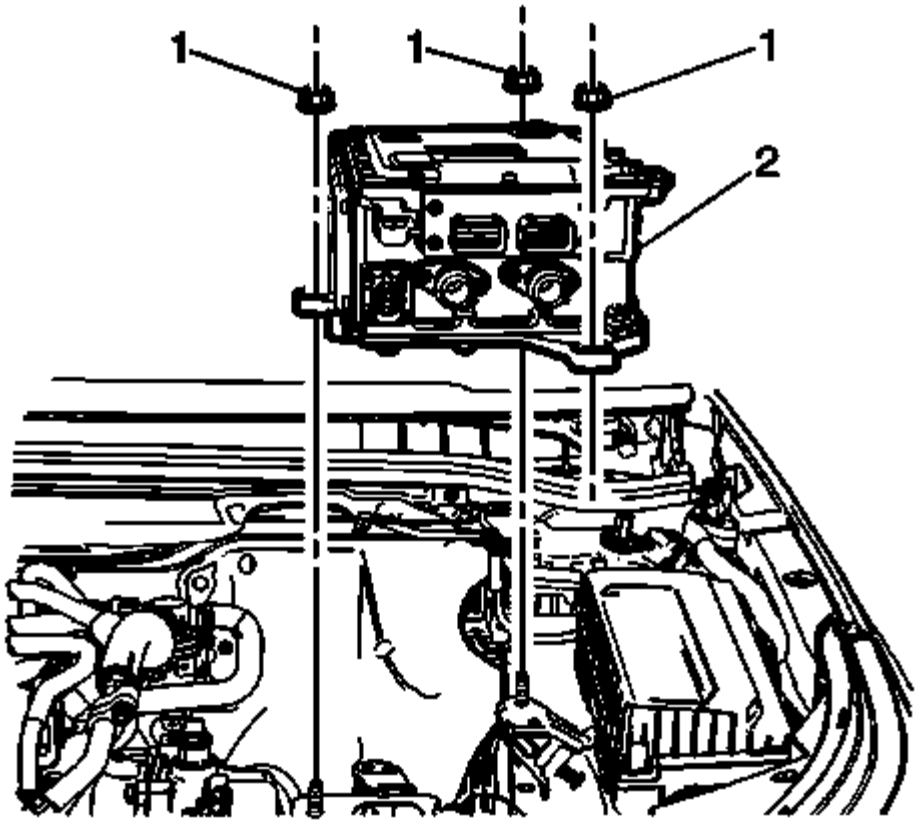


Fig. 15: Power Inverter Fasteners And Drive Motor Power Inverter Control Module
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

3. Install the drive motor power inverter control module (2) and tighten the fasteners (1) to 9 N.m (80 lb in).

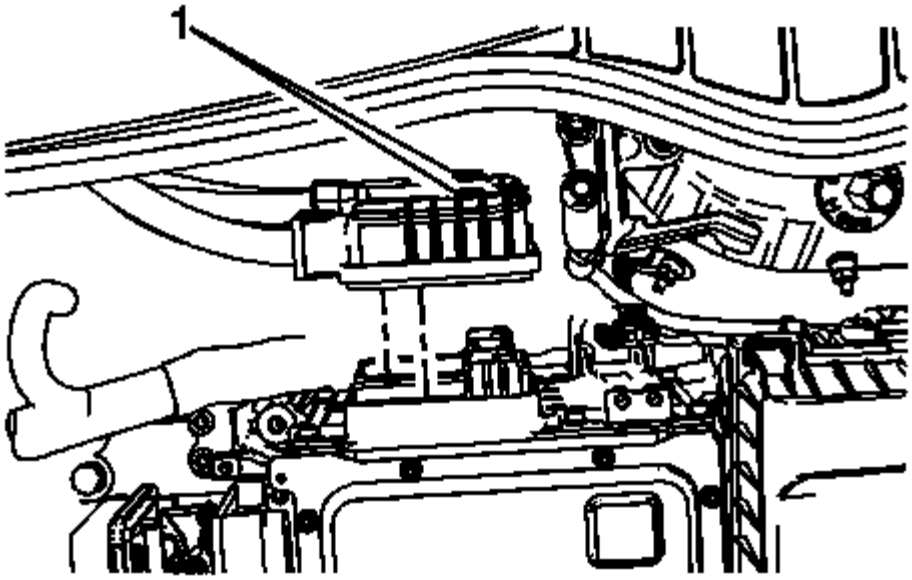


Fig. 16: Locating 300 Volt Cable Fasteners
Courtesy of GENERAL MOTORS COMPANY

NOTE: Start the 300-Volt cable fasteners by hand.

4. Install the 300-Volt cables with NEW seals and tighten the fasteners (1) to 9 N.m (80 lb in).

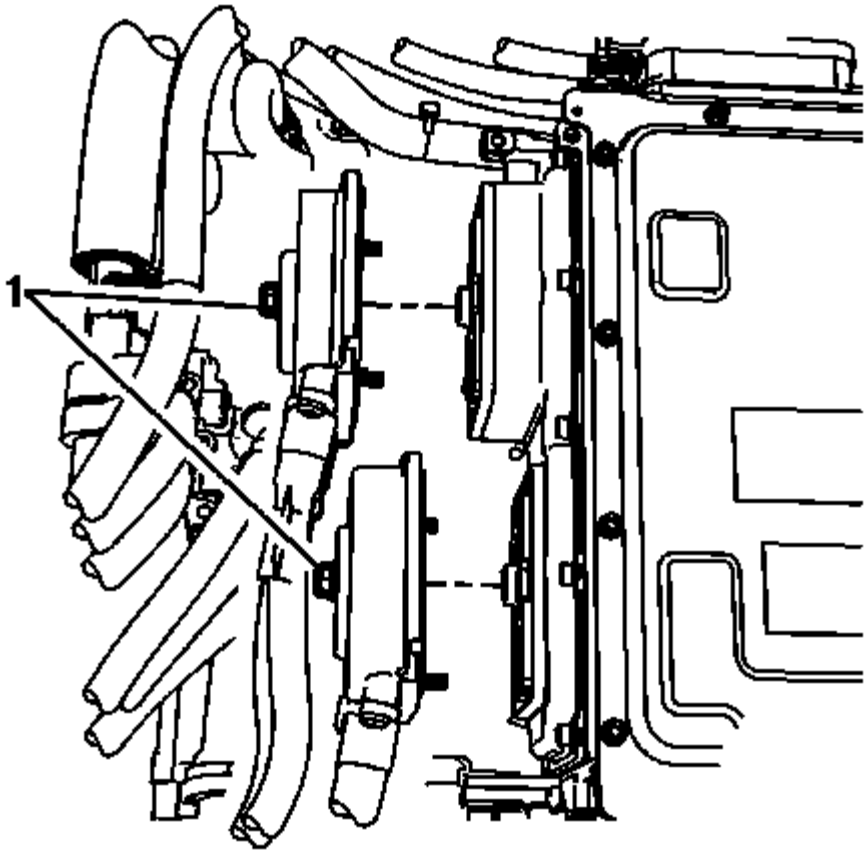


Fig. 17: Phase Cable Fasteners And Cables
Courtesy of GENERAL MOTORS COMPANY

5. With NEW connector housing and fastener seals, install the three-phase cables and tighten the fasteners (1) to 9 N.m (80 lb in).

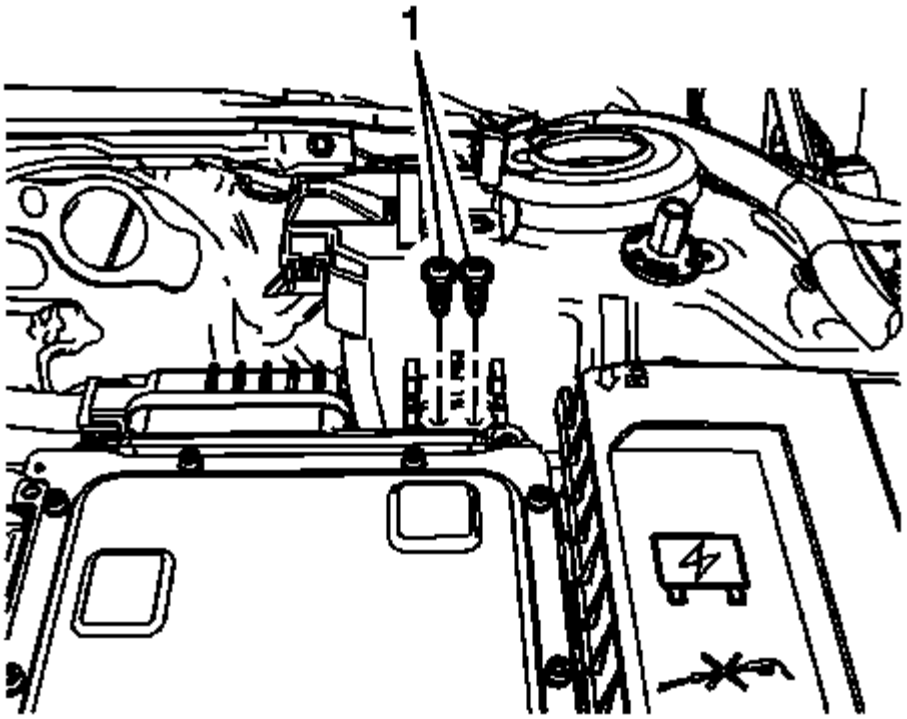


Fig. 18: High Voltage Interlock Loop Connector Fasteners
Courtesy of GENERAL MOTORS COMPANY

6. Install the high voltage interlock loop connector fasteners (1) and tighten to 6 N.m (53 lb in).

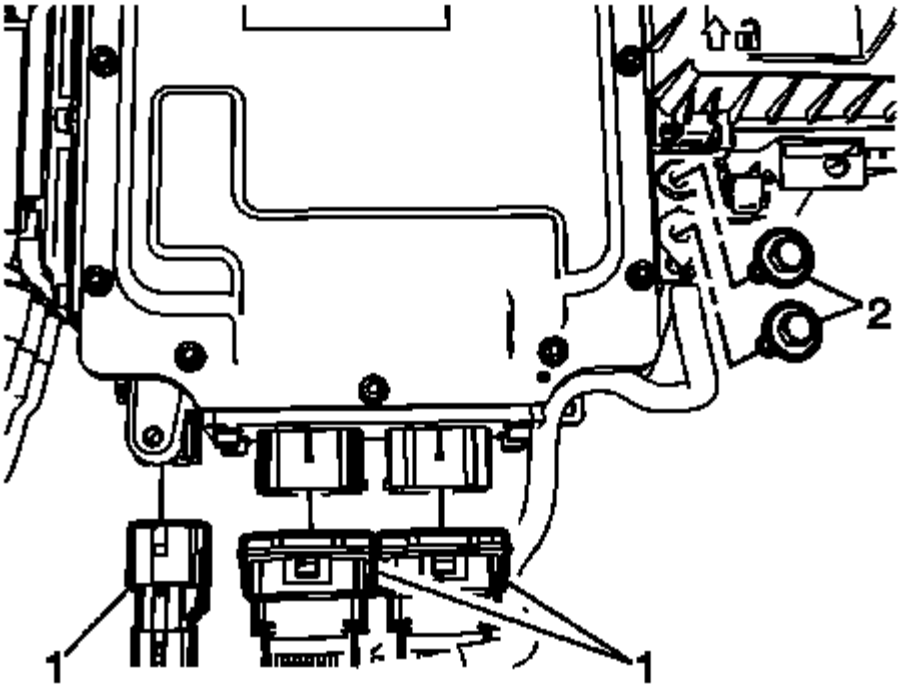


Fig. 19: Motor Generator Power Inverter Module Connectors
Courtesy of GENERAL MOTORS COMPANY

7. Connect the coolant pipes to the power inverter module. Refer to **Drive Motor Power Inverter Module Cooling Inlet Hose Replacement** , and . **Drive Motor Generator Control Module Radiator Outlet Hose Replacement** .
8. Fill the cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling** .
9. Install the ground strap fasteners (2) and tighten to 9 N.m(80 lb in).
10. Connect the electrical connectors (1).
11. Install the power inverter module cover. Refer to **Drive Motor Generator Power Inverter Module Cover Replacement**.
12. Enable the high voltage system. Refer to **High Voltage Enabling** .
13. For control module programming and setup procedures, refer to **Control Module References** .

ACCESSORY DC POWER CONTROL MODULE REPLACEMENT

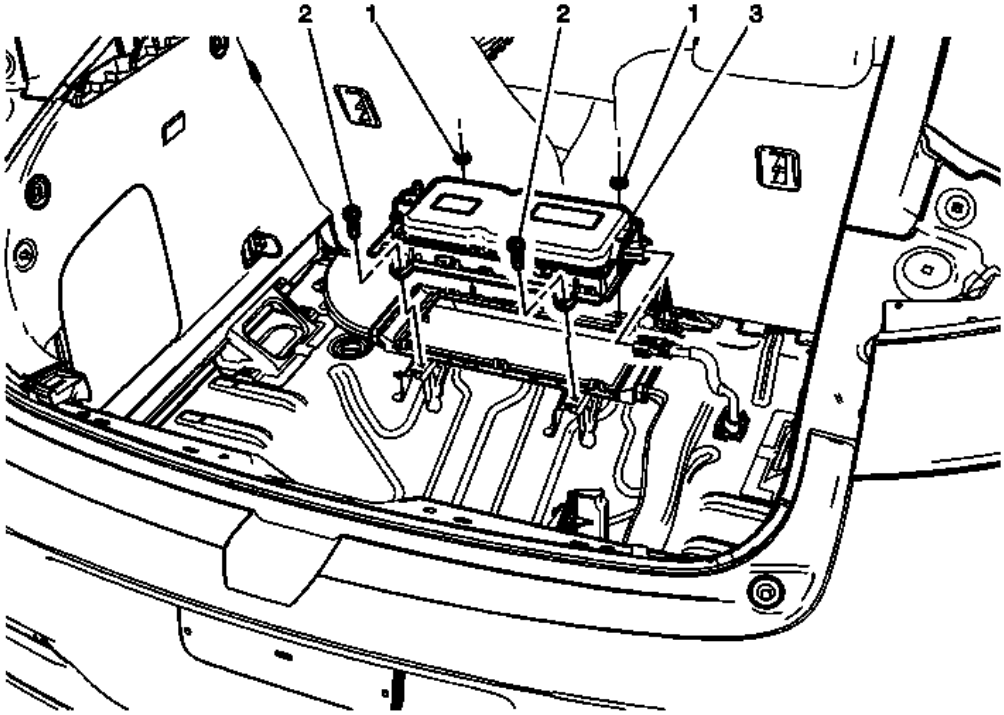


Fig. 20: Accessory DC Power Control Module
Courtesy of GENERAL MOTORS COMPANY

Accessory DC Power Control Module Replacement

Callout	Component Name

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the**

high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Preliminary Procedures

1. Disable the high voltage system. Refer to **High Voltage Disabling** .
2. Disconnect the negative and positive cables from the accessory DC power control module. Refer to **Battery Positive and Negative Cable Replacement (B + APM Module to Battery Fuse Block)** , **Battery Positive and Negative Cable Replacement (APM Module Ground Cable)** .

1	Accessory DC Power Control Module Nut (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 22 N.m (16 lb ft)
2	Accessory DC Power Control Module Bolt (Qty: 2) **Tighten** 19 N.m (14 lb ft)
3	Accessory DC Power Control Module **Procedures** 1. Disconnect the high voltage connector from the right side of the module. 2. Disconnect the electrical connector from the front of the module. 3. Unclip the accessory DC power control module from the cooling tray.

DESCRIPTION AND OPERATION

ACCESSORY DC POWER CONTROL MODULE DESCRIPTION AND OPERATION

Location

The 14V power module, also called the accessory DC power control module, is located in the rear trunk compartment underneath the floor stowage trim panel. It is attached to the chassis with four fasteners and connected to a plastic cooling duct. The 14V power module has a high voltage pigtail that passes through the floor of the rear compartment and connects to a high voltage cable that comes from the hybrid/EV battery pack. Also connected to the 14V power module are the 12V cables, + positive and - negative, and a signal connector for serial data.

Operating Functions

The 14V power module is an electronic device that takes the place of the generator on a traditional vehicle. On

a hybrid or electric vehicle the 14V power module converts high voltage (300V) direct current (DC) to low voltage (12V) DC for accessory electrical operation and to charge the 12V battery.

Normally, the 14V power module only supplies 12V DC when the vehicle is under a normal drive cycle. However there are certain instances when the vehicle is being charged through a standard wall socket where the14V power module operation is required to sustain the 12V battery.

The 14V power module is capable of supplying up to 180 Amps of 12V DC.

Communication and Hosted Diagnostics

The 14V power module has internal diagnostic tests that run at both power-up and during operation. All DTCs from the 14V power module are reported to and hosted by the hybrid/EV powertrain control module 1. The 14V power module only communicates with the hybrid/EV powertrain control module 1 and only over serial data.

Circuit Inputs

Inputs to the 14V power module include the high voltage and 12V circuits. The 14V power module also has two 12V discrete inputs, Accessory and Run/Crank, either one has to be at a high level in order for it to wake up. The 14V power module is connected to the powertrain expansion communication bus and communicates with the hybrid/EV powertrain control module 1. The 14V power module monitors various internal components for current, voltage and temperature. The 14V power module will not begin supplying 12V DC until:

- Either the Accessory input or Run/Crank input are high, and
- The appropriate serial data enable signal is communicated by the hybrid/EV powertrain control module 1.

The 14V power module will not begin conversion of voltage however, until the appropriate serial data enable signal is sent by the hybrid/EV powertrain control module 1.

For more information on the 12V Battery Charging System, refer to **Charging System Description and Operation** .

Circuit Outputs

The only outputs supported by the 14V power module are serial data communications and 12V DC which powers the 12V components in the vehicle and charges the 12V battery. Low voltage 12V cables on the hybrid/EV vehicle do not require unique coloring or servicing procedures.

DRIVE MOTOR GENERATOR POWER INVERTER MODULE DESCRIPTION AND OPERATION

Overview

The power inverter module, often referred to as the drive motor generator power inverter module, converts high voltage direct current (DC) electrical energy to 3 phase alternating current (AC) electrical energy. The power inverter module 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 power inverter module is connected to the positive and negative terminals of the high voltage DC hybrid/EV battery pack. 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 bus is switched ON or OFF by a high voltage, high current contactor relay contained within the hybrid/EV battery pack. 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 high voltage DC cables are externally connected at the power inverter module.

Three Phase Alternating Current (AC)

Three individual cables connect each phase of the drive motor to the power inverter module. Each individually shielded cable is orange in color to alert the technician to the potential presence of high voltage. A single shielded cable connects the auxiliary transmission fluid pump to the power inverter module. This cable contains 3 individual wires that are connected to the 3 phases of the auxiliary transmission fluid pump. The cable is orange in color to alert the technician to the potential presence of high voltage.

Low Voltage Circuits

The 14V power module, also called the accessory DC power control module, is the device which converts high voltage (300V) DC to low voltage (12V) DC for accessory electrical operation and to charge the 12V accessory battery.

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

Overview

The power inverter module contains 3 motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motors based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground. All four modules are flash-programmable micro-processors.

Hybrid Powertrain Control Module

Location

The hybrid/EV powertrain control module 1 is a non-serviceable, flash-programmable micro-processor contained within the power inverter module.

Operating Functions

The hybrid/EV powertrain control module 1 is the main controller of powertrain operation. The hybrid/EV powertrain control module 1 determines when to perform normal operating modes such as electric mode, extended range mode, and regenerative braking. The hybrid/EV powertrain control module 1 also operates in conjunction with the hybrid/EV powertrain control module 2 to determine when to enable and disable the DC high voltage circuits. Each motor control module operates the applicable motor based upon hybrid/EV powertrain control module 1 commands.

Communication and Hosted Diagnostics

The hybrid/EV powertrain control module 1 is the host controller for DTC information for the following control modules:

- 14V power module
- Drive motor 1 control module
- Drive motor 2 control module
- Auxiliary transmission fluid pump control module

These modules diagnose their own operation and determine when a fault condition is present. The 14V power module communicates diagnostic status to the hybrid/EV powertrain control module 1 over serial data.

All 3 motor control modules and the hybrid/EV powertrain control module 1 exchange information and commands on a serial peripheral interface bus internal communication circuit as well as the hi-speed hybrid GMLAN communication circuit.

In the event a hosted module communicates a fault condition, the hybrid/EV powertrain control module 1 will determine if one or more operating modes are affected and notify the vehicle operator by requesting the MIL illuminate and/or by displaying a message in the Driver Information Center. In addition, the hybrid/EV powertrain control module 1 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/EV powertrain control module 1.

Circuit Inputs

In addition to data parameters, the hybrid/EV powertrain control module 1 directly monitors the following signal circuits:

- Transmission internal mode switch direction and Park/Neutral switch signals
- Crankshaft position sensor signal
- High voltage interlock circuit

Motor Control Modules

Location

Both of the drive motors and the auxiliary transmission fluid pump motor are located within the transmission. They are each controlled by their own motor control module; each module is a 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/EV powertrain control module 1 micro-processor.

Operating Functions

The motor control modules operate their respective motors based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls the speed, direction, and output torque of its respective drive motor or the auxiliary transmission fluid pump through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors.

Communication and Hosted Diagnostics

In addition to the internal serial peripheral interface bus communication circuit that the hybrid/EV powertrain control module 1 and each motor control module control use to communicate, the motor control module also communicate on the hi-speed and hybrid serial data circuits. The motor control module does not store its own Diagnostic Trouble Code (DTC) information. The hybrid/EV powertrain control module 1 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 data parameters, each motor control module monitors its respective motor for voltage, current, speed, direction and temperature. Additionally, the motor control module monitors the insulated gate bipolar transistor components for temperature and proper operation. Some of the motor control module operation data is shared with the hybrid/EV powertrain control module 1.

Circuit Outputs

Each motor control module controls its respective insulated gate bipolar transistor driver board that in-turn controls each motor. The motors operate using 3-phase AC electricity. 3 cables connect each drive motor 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. A single shielded cable connects the auxiliary transmission fluid pump to the power inverter module. This cable contains 3 individual wires that are connected to the 3 phases of the auxiliary transmission fluid pump. The cable is orange in color to alert the technician to the potential presence of high voltage.

Accessory DC Power Control Module

Location

The 14V power module, often referred to as the accessory DC power control module is located in the rear compartment. Refer to **Accessory DC Power Control Module Description and Operation** for description and operation information.

ELECTROMAGNETIC COMPATIBILITY DESCRIPTION

Overview

Vehicles are typically subject to certain legal requirements that limit the amount of electromagnetic interference (EMI) that can be generated by the vehicles electronic devices. Additionally, the electronic devices within the vehicle must be able to withstand a certain amount of EMI without affecting their operation. EMI is generated whenever electrical current flows through a circuit. The amount of EMI generated, or amplitude, is usually dependent upon the amount of current flow, amperage, and the on-off pattern of current flow through the circuit, frequency. The EMI requirements are generally referred to as electromagnetic compatibility.

There are many ways of ensuring the vehicle meets electromagnetic compatibility requirements. These include:

- Adding capacitors and resistors to certain electrical circuits
- Regulating the frequency at which a component may operate
- Shielding the wires, cables and components

Circuit Design

The power inverter module, often referred to as the drive motor generator power inverter module, and the 14V power module, often referred to as the accessory DC power control module, each contain filter capacitors connected to the high voltage circuits. These capacitors are necessary to reduce the voltage spikes that occur as a result of the switching of current On and Off. Reducing voltage spikes reduces EMI. The frequency of current switching is also closely regulated. Too high a frequency can cause an increase in EMI generation.

Wiring/Cable Design

Different types of wire/cable shielding methods are utilized in the vehicle. Common types of circuit shielding include twisted-pair and internal braid or foil. Twisted pair is typically used in circuits such as serial data circuits. The wire pair is twisted together at a particular turns-per-length ratio. Shielded cable is utilized for all other circuits requiring either protection from external EMI or to reduce EMI radiation of the cable itself into other nearby components or circuits.

High Voltage Cable

- 300-Volt Battery Positive and Negative Cable
- Drive Motor Generator Power Inverter Module 3 Phase Cable Assembly
- Air Conditioning and Drive Motor Battery Cooling Compressor

The high voltage cables utilize internal braid shielding. Typically, both ends of the internal braid shield are attached to chassis ground. All of the high voltage, internally shielded cables are grounded at their cable end attachment points. Mounting blocks, where used, perform the shield to chassis ground connection. Connection points not serviced with a mounting block utilize a separate ring terminal.

Low and Intermediate Voltage Wiring

The signal circuits for the transmission sensors utilize shielding protection. The drive motor position sensor

circuits utilize internal foil shielding. The wiring harness external of the transmission assembly is connected to chassis ground with ring terminals at the power inverter module. The internal transmission wiring harness is attached to chassis ground with a ring terminal at the valve body assembly.

The auxiliary transmission fluid pump 3 phase cables utilize internal foil shielding. The wiring harness shield is connected to chassis ground within the power inverter module.

Component Shielding

Certain components utilize their structure to effectively shield EMI. Metal covers, chassis grounded metal cases and electro-magnetically conductive gaskets may all be part of a components electromagnetic compatibility design.

Shielding Loss

A loss of proper shielding may result in poor AM band radio reception and/or incorrect sensor circuit readings depending upon the location of the shield loss. Damage that has penetrated to the insulated conductor of high voltage cables is not repairable. Minor damage to the outer sheathing can be repaired, refer to **Drive Motor Power Inverter Module 3 Phase Cable Inspection** , . Certain Low and Intermediate voltage shielded wiring harnesses may be repairable. Refer to **Wiring Repairs** , and **Splicing Twisted or Shielded Cable** .

HIGH VOLTAGE MONITORING SYSTEMS DESCRIPTION

The hybrid/EV system monitors several high voltage components for attempted access. Additionally, a minimum amount of isolation resistance is maintained at all times between both negative and positive poles of the hybrid/EV battery and the vehicle chassis. Microprocessors internal to the power inverter module, often referred to as the drive motor generator power inverter module, and the hybrid/EV powertrain control module 2 monitor the hybrid/EV system for access and loss of isolation.

High Voltage Interlock Circuit

The high voltage interlock circuit is a wire loop that passes through certain high voltage components. The high voltage interlock circuit is used to determine if access to high voltage components is being attempted. The opening of these high voltage components causes the high voltage interlock circuit to open. The hybrid/EV system may react to the loss of high voltage interlock circuit continuity by opening the high voltage contactor relays and discharging the high voltage capacitors. The high voltage interlock circuit signal is generated by the hybrid/EV powertrain control module 2. The high voltage interlock circuit status is monitored by the hybrid/EV powertrain control module 2, the hybrid/EV powertrain control module 1, and each drive motor control module.

High Voltage DC Chassis Isolation

The hybrid/EV system monitors the electrical potential between each high voltage bus and the vehicle chassis. High voltage should always be isolated from the vehicle chassis by a certain amount of resistance to avoid the potential for a life threatening current path. In the event that a high voltage leak path to the vehicle chassis is detected, the hybrid/EV system will set a diagnostic trouble code (DTC). High voltage DC chassis isolation is monitored by the drive motor control modules and the hybrid/EV powertrain control module 2.

Testing for loss of isolation requires special tools and procedures. Because of the high voltage present in the

hybrid/EV system, a loss of isolation may occur due to insulation breakdown. Insulation breakdown typically occurs only when high voltages and/or current is present. Conditions such as insulation breakdown cannot be diagnosed with a typical DMM because high voltage is not used by the DMM when measuring resistance.

HYBRID MODES OF OPERATION DESCRIPTION

Vehicle Operating Modes Description

This vehicle is an Extended Range Electric Vehicle. It uses an electric propulsion system to drive the vehicle at all times. Electricity is the vehicle's primary source of energy, while gasoline is the secondary source.

The vehicle has two modes of operation - Electric and Extended Range. In both modes, the vehicle is propelled by the electric motors that are internal to the transmission. Electrical energy is converted into mechanical energy to drive the wheels and propel the vehicle. The vehicle's performance remains the same in either mode.

This overview is not a comprehensive list of all aspects of the Extended Range Electric Vehicle. Refer to Automatic Transmission 4ET50 **Electronic Component Description** for information regarding transmission operation. More detailed and comprehensive information is also available through the dealer training program.

Electric Mode

Electric Mode is the primary mode of operation for this vehicle. While in Electric mode, the vehicle is powered by electrical energy stored in the high voltage hybrid/EV battery pack. The vehicle can operate in this mode for a range of up to 40-80 km (25-50 miles) until the battery has reached a low state of charge.

Extended Range Mode

When the vehicle reaches the end of its electric range, it switches to Extended Range Mode. In this mode, electricity is produced by the drive motor, which is driven by the internal combustion engine (ICE). This secondary source of electric power extends the vehicle range. Operation will continue in extended range mode until the vehicle can be plugged in to recharge the hybrid/EV battery pack and restore electric mode.

The hybrid/EV battery pack will continue to provide some power and work together with the ICE to provide peak performance when it is required, such as driving up a steep incline or during high acceleration. The hybrid/EV battery pack will not be recharged while in extended range mode.

Internal Combustion Engine (ICE) Starting

This vehicle does not use a 12 V starter motor to crank the ICE. A much more powerful 300 V motor, drive motor 1, located within the transmission is utilized to crank the ICE. Drive motor 1 can rotate the ICE to operating speed (800 RPM) within just a few hundred milliseconds. This allows near-instant starting of the ICE.

The vehicle's on-board computers determine when the ICE needs to run. Some of the normal vehicle conditions that force the ICE to run are:

- The hybrid/EV battery pack has a low state of charge
- The hood is open or not completely latched

- The ICE is needed to maintain the hybrid/EV battery pack temperature
- The ICE needs to run for maintenance
- Extremely low ambient temperatures

When the hood is open, the ICE will run without turning off. The hybrid/EV battery pack is neither charged nor discharged when this occurs.

Some hybrid/EV battery pack faults will cause the ICE to run without turning off.

Service Mode

Service Mode is available for service and diagnostics and to verify the proper operation of the MIL and may be required for emission inspection purposes. With vehicle OFF, and the brake pedal not applied, pressing and holding the POWER button for more than 5 seconds will place the vehicle in Service Mode. The instruments and audio systems will operate as they do in ON, but the vehicle will not be able to be driven. The propulsion system will not start in Service Mode.

Engine Unavailable

If the vehicle runs out of fuel, or the power inverter module has detected the ICE will not start due to a malfunction, the vehicle can continue to be driven in Electric Mode.

Maintenance Modes

Engine Maintenance Mode

Engine Maintenance Mode runs the engine to keep it in good working condition when the vehicle has been operated in Electric Mode only for a prolonged period. Engine Maintenance Mode will run the ICE, even if the hybrid/EV battery pack state of charge is sufficient to operate the vehicle in Electric Mode.

Fuel Maintenance Mode

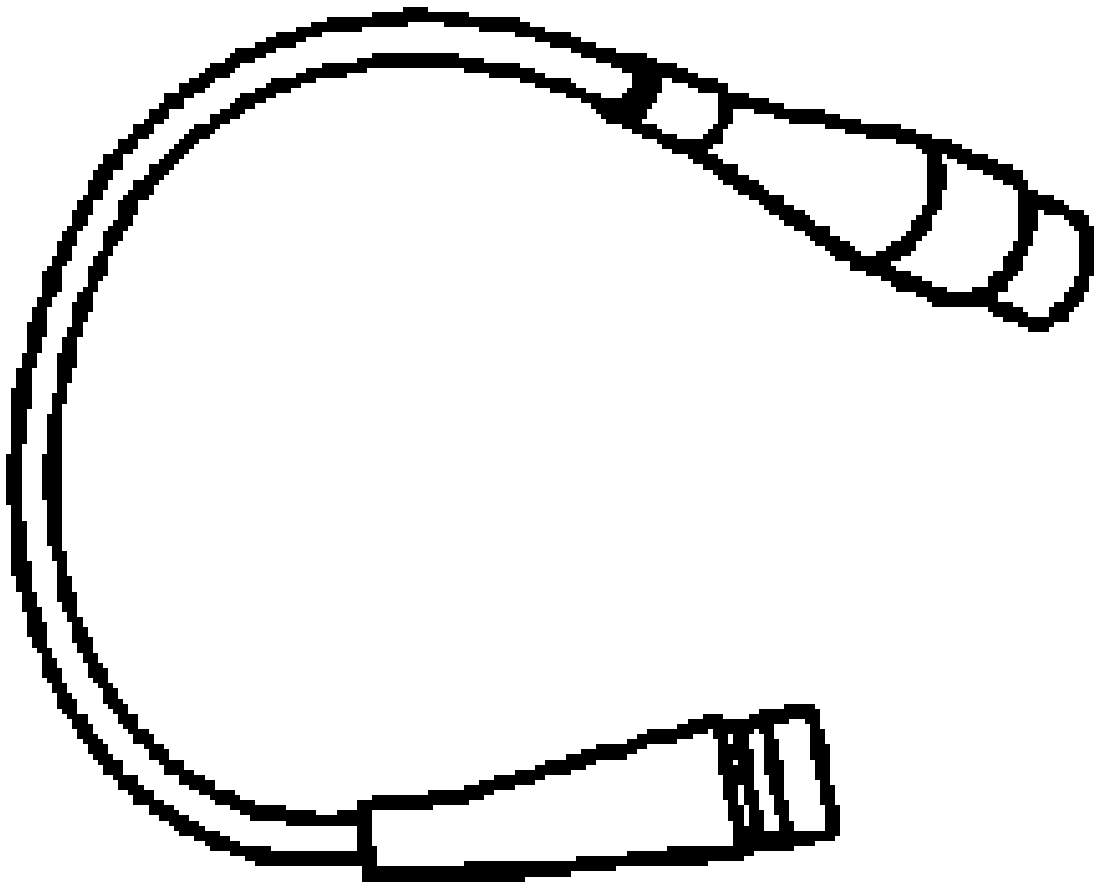
When only Electric Mode is used for a prolonged period, Fuel Maintenance Mode will run the ICE to use up old fuel. The ICE will run until enough fresh fuel is added or a low fuel level is detected. During Fuel Maintenance Mode the ICE may cycle on and off.

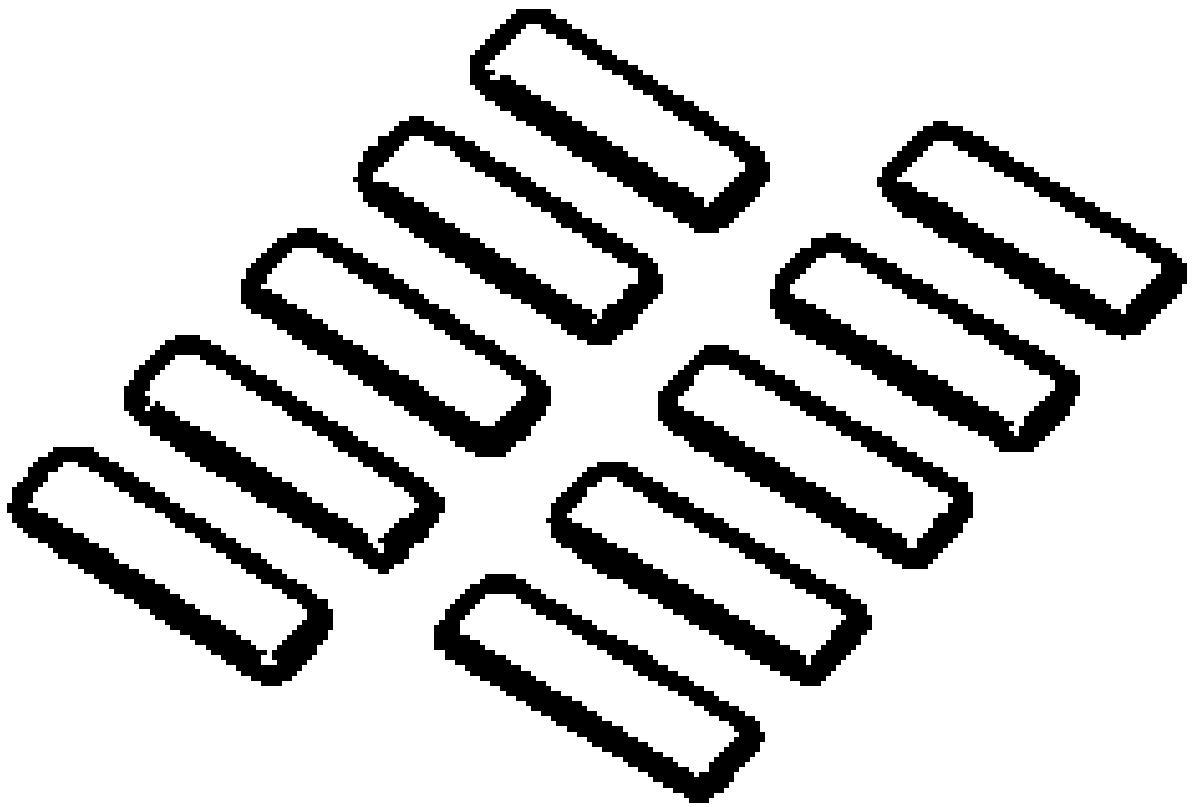
Regenerative Braking

When the vehicle is coasting or braking the power inverter module may operate the drive motor as a generator in an Electrical Generation Mode. Operating as an electrical generator, the drive motor exerts a driveline load that helps to slow the vehicle. The electrical energy that the drive motor creates is transferred by the power inverter module to the hybrid/EV battery pack. Constant communication between the power inverter module and the electronic brake control module allows the blending of regenerative braking force with hydraulic braking force.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	DT-44152 Jumper Harness, 20 Terminal



EL-48569
Terminal
Covers