

2017 ELECTRICAL

Hybrid/EV Controls - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

Application
NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>
Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Seal

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Accelerator Pedal Pad Bolt	7 N.m (62 lb in)
Accessory DC Power Control Module Bolt	22 N.m (16 lb ft)
Accessory DC Power Control Module High Voltage Connector Protector Bolt	9 N.m (80 lb in)
Accessory DC Power Control Module High Voltage Connector Protector Bolt	22 N.m (16 lb ft)
Accessory DC Power Control Module High Voltage Connector Protector Nut	9 N.m (80 lb in)
Accessory DC Power Control Module Stud	22 N.m (16 lb ft)
Battery Negative Cable Extension Cable Nut	15 N.m (11 lb ft)
Battery Positive Cable and Nut	15 N.m (11 lb ft)
Drive Motor Power Inverter Module 3-Phase Cable Bolt	9 N.m (80 lb in)
Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Nut	9 N.m (80 lb in)
Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Bolt	9 N.m (80 lb in)
Drive Motor Power Inverter Module Bolt	22 N.m (16 lb ft)
Drive Motor Power Inverter Module Nut	22 N.m (16 lb ft)
Drive Motor Power Inverter Module Shield Bolt	9 N.m (80 lb in)
Drive Motor Power Inverter Module Shield Bolt	25 N.m (18 lb ft)
Engine Control Module Bracket Nut	4.7 N.m (42 lb in)
Engine Wiring Harness Bracket Bolt to Accessory DC Power Control Module	22 N.m (16 lb ft)
Generator Battery Control Wiring Junction Block Bolt	22 N.m (16 lb ft)
Generator Battery Control Wiring Junction Block Cover Lower Bolt	2.5 N.m (22 lb in)
Generator Battery Control Wiring Junction Block Cover Upper Bolt	2.5 N.m (22 lb in)
15A Fuse Nut	4.5 N.m (40 lb in)
40A Fuse Nut	4.5 N.m (40 lb in)

SCHEMATIC WIRING DIAGRAMS

Fig. 2: ECM 5-Volt and Low Reference Busses
 Courtesy of GENERAL MOTORS COMPANY

ECM Data Sensors - Throttle Controls and Override

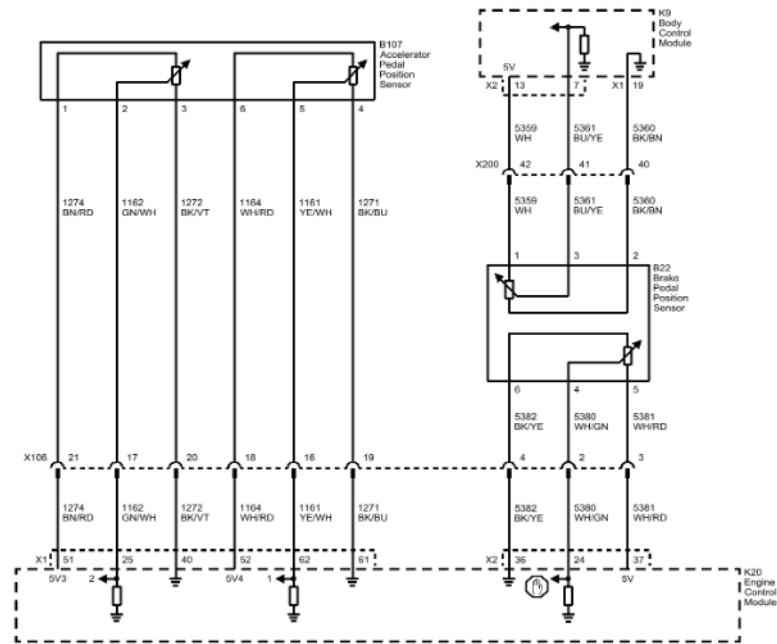


Fig. 3: ECM Data Sensors - Throttle Controls and Override
 Courtesy of GENERAL MOTORS COMPANY

ECM Controlled/Monitored Subsystem References

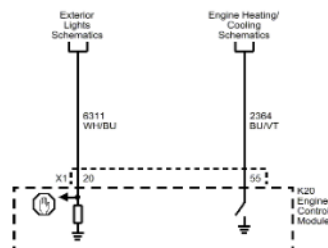


Fig. 4: ECM Controlled/Monitored Subsystem References
 Courtesy of GENERAL MOTORS COMPANY

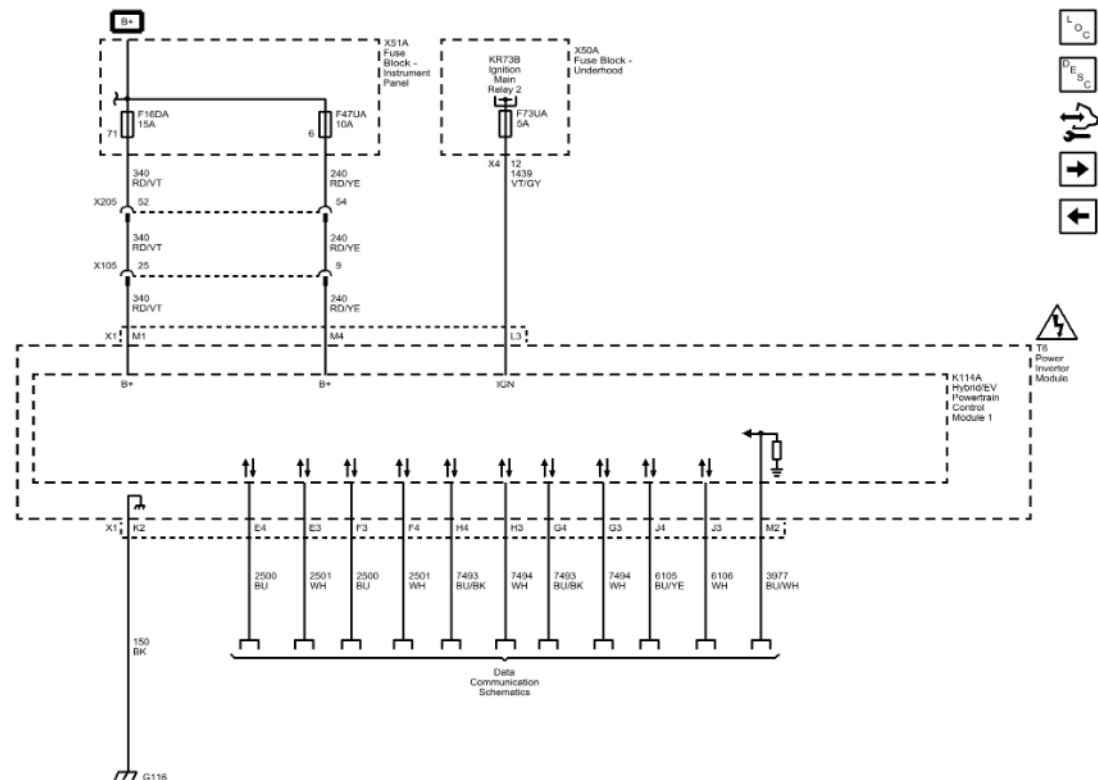


Fig. 5: Hybrid/EV Powertrain Control Module 1/Power Inverter Module Power, Ground, and Data Communication

Courtesy of GENERAL MOTORS COMPANY

Drive Mode Select Switch

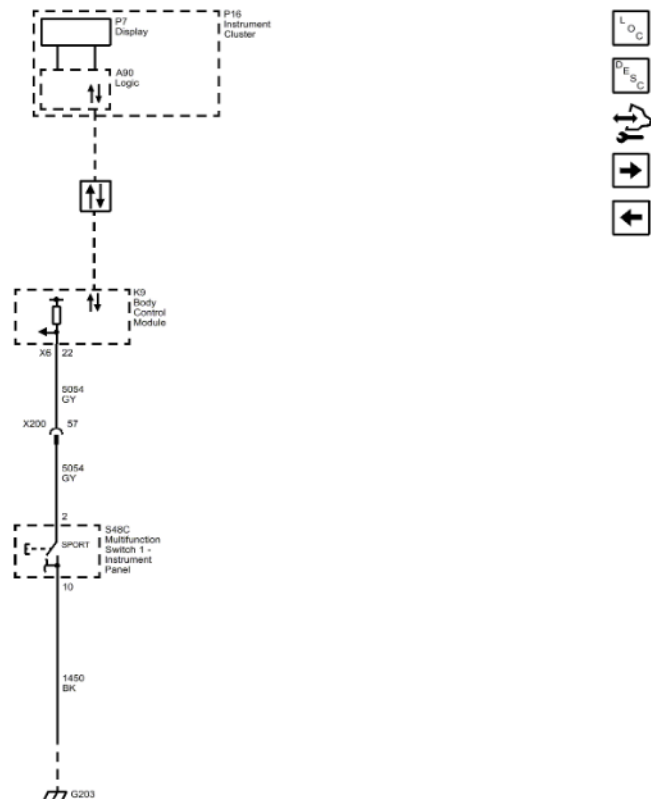


Fig. 6: Drive Mode Select Switch

Courtesy of GENERAL MOTORS COMPANY

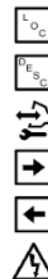
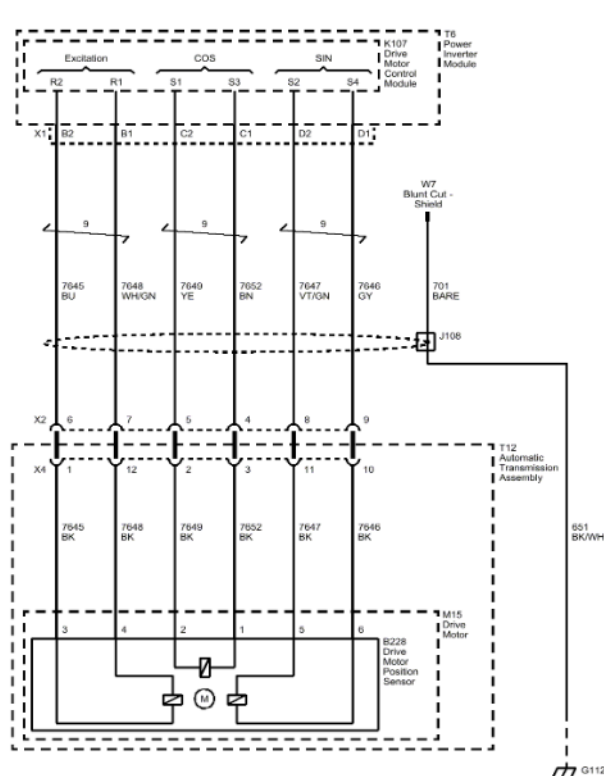


Fig. 7: Drive Motor Monitoring
Courtesy of GENERAL MOTORS COMPANY

Drive Motor and Transmission Fluid Pump Controls

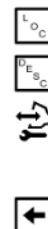
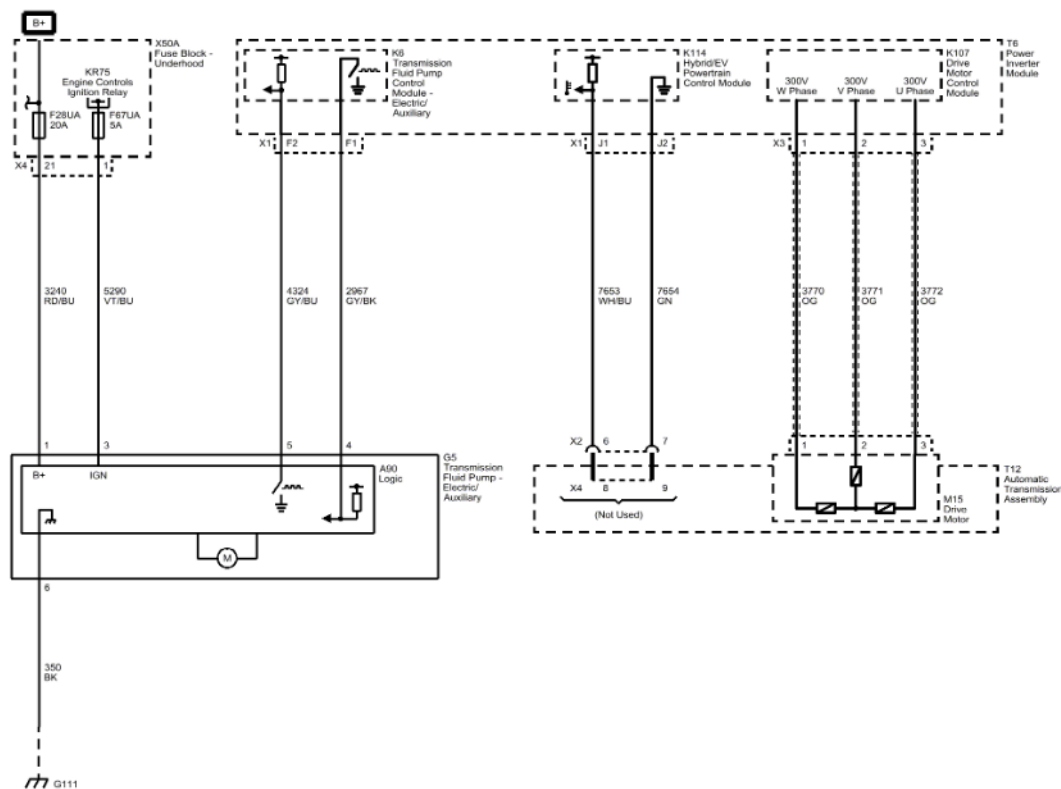


Fig. 8: Drive Motor and Transmission Fluid Pump Controls
Courtesy of GENERAL MOTORS COMPANY

COMPONENT LOCATOR

HYBRID CONTROLS ELECTRONIC COMPONENT VIEWS

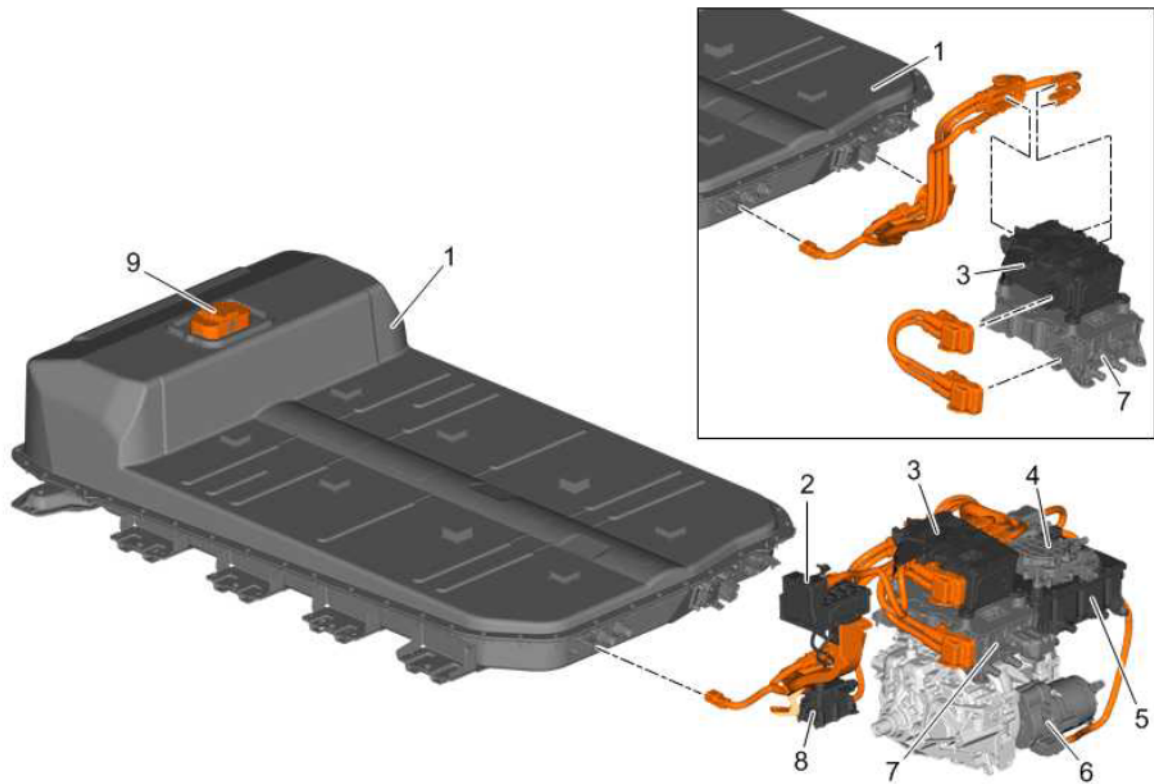


Fig. 9: Hybrid/EV Battery System Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	High Voltage Battery
2	Heater Coolant Heater
3	High Voltage Battery Disconnect Control Module Assembly
4	Accessory DC Power Control Module
5	Drive Motor Battery Charger
6	Air Conditioning and Drive Motor Battery Cooling Compressor
7	Drive Motor Power Inverter Module
8	High Voltage Battery Heater
9	Drive Motor Battery High Voltage Manual Disconnect Lever

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P057B-P057E: BRAKE PEDAL 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P057B

Brake Pedal Position Sensor Performance

DTC P057C

Brake Pedal Position Sensor Circuit Low Voltage

DTC P057D

Brake Pedal Position Sensor Circuit High Voltage

DTC P057E

Brake Pedal Position Sensor Circuit Erratic

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P057C	P057C	P057D	P057B, P057E
5 V Reference	P057C P0651	P057C	P0651	-
Low Reference	-	P057D	P057D	-

Typical Scan Tool Data

Brake Pedal Position Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle in Service Mode			
Normal Range: 0.25 - 4.75 V			
5 V Reference	0 V	0 V	-
Signal	0 V	0 V	5 V
Low Reference	-	5 V	-

Circuit/System Description

The brake pedal position (BPP) sensor is part of the one pedal driving feature. The engine control module (ECM) continuously monitors the vehicle speed and the position of the brake pedal. These two main inputs, along with other ECM inputs are used to determine if the vehicle is decelerating at the proper speed and rate with the brake pedal applied.

The BPP sensor is a six wire sensor, and is part of a dual brake position sensor. One BPP Sensor is used for the stop lamps and the other BPP Sensor is used for the one pedal driving feature. The BPP Sensor for one pedal driving communicates with the ECM. The ECM supplies a 5 V reference circuit, low reference circuit, and signal circuit to the BPP sensor. The BPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage greater than 0.25 V when the brake pedal is released to a voltage less than 4.75 V when the brake pedal is fully applied.

For information on the Stop Lamps side of the BPP Sensor, refer to [Exterior Lighting Systems Description and Operation](#).

Conditions for Running the DTC

P057B

- DTCs P0722, P0723, P077C, P077D, P182E, P1915, U0073, or U0101 are not set.
- Run/Crank voltage is greater than 10 V.
- Shift lever has been in Park at least once during key ON.
- Shift lever is not in Park.
- Vehicle speed is greater than 8 Km/h (5 mph).
- Accelerator Pedal Position is less than 5%.
- DTC runs once per key cycle when above conditions are met.

P057C, P057D, or P057E

Run/Crank voltage is greater than 10 V.

Conditions for Setting the DTC

P057B

ECM detects the BPP sensor signal is stuck in a range for greater than 1 s.

P057C

ECM detects the BPP sensor voltage is less than 0.25 V greater than 1 s.

P057D

ECM detects the BPP sensor voltage is greater than 4.75 V greater than 1 s.

P057E

ECM detects the BPP sensor value varies greater than a calibrated value for 0.50 s.

Action Taken When the DTC Sets

- P057B, P057C, P057D, and P057E are Type A DTCs.
- Cruise control is disabled.

Conditions for Clearing the DTC

P057B, P057C, P057D, and P057E are Type A DTCs

Reference Information

Schematic Reference

- [Hybrid/EV Controls Schematics](#)
- [Exterior Lights 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 Verification

NOTE: The Brake Pedal Position sensor scan tool data is located in the ECM automatic transmission data list.

1. Vehicle in Service Mode.
2. Verify DTC P0641, P0651, P0697, or P06A3 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. Transmission in Park, and service brake pedal released.

4. Verify the scan tool Brake Pedal Position Sensor Signal parameter in the ECM displays No.

- **If Yes is displayed**

Refer to Circuit/System Testing.

- **If No is displayed**

5. Verify the scan tool Brake Pedal Position Sensor Signal parameter changes as the brake pedal is applied and displays Yes on a scan tool when the brake pedal is fully applied.

- **If Yes is not displayed**

Refer to Circuit/System Testing.

- **If Yes is displayed**

6. All OK.

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification first.

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.

NOTE: All terminal references are for the vehicle harness brake pedal position sensor connector.

2. Test for less than 10 Ω between the low reference circuit terminal 6 and ground.

- **If 10 Ω or greater**

1. Disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 5 and ground.

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the 5 V 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 Ω in the 5 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle ON.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

- **If between 4.8 - 5.2 V**

5. Verify the scan tool Brake Pedal Position Sensor Signal parameter is released.

- **If released is not displayed**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle ON.
2. Test for less than 0.25 V between the signal circuit terminal 4 and ground.
 - If 0.25 V or greater, repair the short to voltage on the circuit.
 - If less than 0.25 V, replace the K20 Engine Control Module.

- **If released is displayed**

6. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the 5 V reference circuit terminal 5.
7. Verify the scan tool Brake Pedal Position Sensor parameter is applied.

- **If applied is not displayed**

1. Vehicle OFF, remove the jumper wire, and disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If applied is displayed**

8. Replace the B22 Brake Pedal Position Sensor.

Repair Instructions

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

- Refer to **Brake Pedal Position Sensor Replacement**
- Perform the **Brake Pedal Position Sensor Calibration** following the replacement of the ECM or BPP sensor, or any repair that effects the BPP sensor alignment.
- Refer to **Control Module References** for Engine Control Module replacement, programming and setup.

DTC P0601-P0604, P0606, OR P062F: CONTROL MODULE (HYBRID 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.
- Refer to **Diagnostic Procedure Instructions** to provide 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

Circuit/System Description

This is an internal fault detection of 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. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

P0601 - P0604, and P0606

The vehicle is ON.

P062F

This diagnostic is executed at system power-up; both at vehicle ON and at the start of a plug in charging event.

Conditions for Setting the DTC

P0601 - P0604, P0606, and P062F

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

- P0601 - P0604 and P0606 are Type A DTCs.
- P062F is a Type B DTC.
- P0601, P0602, P0604, and P0606 propulsion will be disabled.

Conditions for Clearing the DTC

- P0601 - P0604 and P0606 are Type A DTCs.
- P062F is a Type B DTC.

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, P0561-P0563, P1A0C, P1A0D, or P1EFC](#) .

- **If the DTC is not set**
3. Verify DTC P0602 is not set.
 - **If the DTC is set**
 1. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.
 - If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.
 - If the K114A Hybrid Powertrain Control Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC is set, replace the T6 Power Inverter Module.
 - If the DTC does not set
 4. All OK.
 - **If the DTC is not set**
 5. Verify DTC P0601, P0603, P0604, P0606, or P062F is not set.
 - **If the DTC P0601, P0603, P0604, P0606, or P062F is set**

Replace the T6 Power Inverter Module.

- If the DTC is not set

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0601-P0604, P0606, P062F, P0630, P16F3, OR P262B: CONTROL MODULE (ECM)

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.
- Refer to [Diagnostic Procedure Instructions](#) to provide 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 P0630

VIN Not Programmed or Mismatched - Engine Control Module (ECM)

DTC P16F3

Control Module Redundant Memory Performance

DTC P262B

Control Module Power Off Timer Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM). This diagnostic also addresses if the ECM is not programmed.

The ECM monitors its ability to read and write to the memory. It also monitors a timing function.

Conditions for Running the DTC

P0601, P0602, P0630, P16F3

- The vehicle is ON.
- These DTCs run continuously when the above condition is met.

P0603, P062F

- The vehicle is ON.
- These DTCs run once per ignition cycle.

P0604

- The vehicle is ON.
- DTC P0604 runs continuously when the above condition is met.

P0606

- The system voltage is greater than 11 V.
- DTC P0606 runs continuously when the above condition is met.

P262B

- Vehicle OFF.
- The ECM is not powered down.
- DTC P262B runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects an internal failure or incomplete programming.

Action Taken When the DTC Sets

- DTCs P0601, P0602, P0603, P0604, P0606, P0630, and P16F3 are Type A DTCs.
- DTCs P062F and P262B is a Type B DTC.

Conditions for Clearing the DTC

- DTCs P0601, P0602, P0603, P0604, P0606, P0630, and P16F3 are Type A DTCs.
- DTCs P062F and P262B is a Type B DTC.

Diagnostic Aids

Low voltage or a momentary loss of power or ground to the ECM may cause a DTC to set. Verify the following:

- The battery cables are clean and tight, and the battery is fully charged. Refer to [**Battery Inspection/Test**](#)
- The ECM ground circuits do not have an open or high resistance.
- The ECM power circuits do not have an open, short to ground, or high resistance.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

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

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0602 or P0630 is not set.
 - **If the DTC is set**
 1. Verify the K20 ECM has the latest calibration in Calibration Information.
 - If the K20 ECM does not have the latest calibration, program the K20 ECM.
 - If the K20 ECM has the latest calibration, replace 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. Verify DTC P0601, P0603, P0604, P0606, P062F, P16F3 or P262B is not set.
 - **If DTC P0601, P0603, P0604, P0606, P062F, P16F3 or P262B is set**

Replace the K20 ECM.
 - **If the DTC is not set**
4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for ECM replacement, programming and setup.

DTC P061B: CONTROL MODULE TORQUE CALCULATION 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P061B

Control Module Torque 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 indicated axle torque requested calculation is correct.

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Conditions for Running the DTC

- 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 P061B is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTC P061B 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 P061B is not set.
 - **If the DTC is set**

Replace the T6 Power Inverter Module.

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

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as Drive Motor Generator Power Inverter Module, replacement, setup, and programming.

DTC P0641, P0651, P0697, OR P06A3: 5 V REFERENCE 1-4 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0641

5 V Reference 1 Circuit

DTC P0651

5 V Reference 2 Circuit

DTC P0697

5 V Reference 3 Circuit

DTC P06A3

5 V Reference 4 Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference 1	P0641	P0641	P0641	P0641
5 V Reference 2	P0651	P0651	P0651	P0651
5 V Reference 3	P0697	P0697	P0697	P0697
5 V Reference 4	P06A3	P06A3	P06A3	P06A3

Circuit/System Description

The ECM has four internal 5 V reference circuits. Each 5 V internal reference circuit provides a 5 V bias voltage to the sensor it is connected to. An open, short to ground, or short to voltage on one external 5 V reference circuit can affect the component it is connected to.

Conditions for Running the DTC

DTCs P0641, P0651, P0697, and P06A3 run continuously when the Run/Crank Voltage is greater than 6.4 V for greater than 2 s.

Conditions for Setting the DTC

The ECM detects the 5 V reference 1, 2, 3, or 4 circuit is not 4.8 - 5.2 V for 0.2 s.

Action Taken When the DTC Sets

DTCs P0641, P0651, P0697, and P06A3 are Type A DTCs.

P0641

Air conditioning is disabled.

P0651

Regenerative braking is disabled.

P0697 and P06A3

- Reduced performance.
- No creep or hill hold torque when the brake pedal is released.

Conditions for Clearing the DTC

DTCs P0641, P0651, P0697, and P06A3 are Type A DTCs.

Diagnostic Aids

P0641

The 5 V reference 1 circuit provides 5 V to the A/C Refrigerant Pressure Sensor.

P0651

The 5 V reference 2 circuit provides 5 V to the Brake Pedal Switch Position Sensor.

P0697

The 5 V reference 3 circuit provides 5 V to the Accelerator Pedal Position Sensor 2.

P06A3

The 5 V reference 4 circuit provides 5 V to the Accelerator Pedal Position Sensor 1.

It may be possible to locate the fault by disconnecting one component at a time from the appropriate 5 V reference circuit while viewing the corresponding 5-volt Reference 1, 3, 4 Circuit Status parameter on the scan tool. The scan

tool parameter will change from Malfunction to OK when the source of the fault is disconnected. If all 5 V reference components have been disconnected and a fault is still indicated, the fault may exist in the wiring harness.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

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

Circuit/System Verification

1. Verify the scan tool parameters listed below display OK:

- 5 V Reference 1 Circuit Status
- 5 V Reference 2 Circuit Status
- 5 V Reference 3 Circuit Status
- 5 V Reference 4 Circuit Status
- **If not OK**

Refer to Circuit/System Testing.

- **If OK**

2. Verify the scan tool parameters listed below display 4.8 - 5.2 V:

- 5 V Reference 1
- 5 V Reference 2
- 5 V Reference 3
- 5 V Reference 4
- **If not between 4.8 - 5.2 V**

Refer to Circuit/System Testing.

- **If between 4.8-5.2 V**

3. All OK.

Circuit/System Testing

NOTE: Additional DTCs will set when disconnecting components.

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1. Vehicle in Service Mode.

2. Test for 4.8 - 5.2 V between the 5 V reference circuit terminals listed below and ground:

- B107 Accelerator Pedal Position Sensor terminal 1
- B107 Accelerator Pedal Position Sensor terminal 6
- B22 Brake Pedal Position Sensor terminal 5.
- B1 A/C Refrigerant Pressure Sensor terminal 2

• **If less than 4.8 V**

1. Vehicle Off, disconnect the harness connector at the K20 ECM.
2. Test for infinite resistance between the 5 V 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 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 ECM.

• **If greater than 5.2 V**

1. Ignition OFF, disconnect the harness connector at the K20 ECM, vehicle ON.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 ECM.

• **If between 4.8 - 5.2 V**

3. Replace the appropriate sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Accelerator Pedal Assembly Replacement](#) for B107 Accelerator Pedal Position Sensor replacement.
- Refer to [Air Conditioning Refrigerant Pressure Sensor Replacement - High Pressure](#)
- Refer to [Brake and Accelerator Pedal Assembly Replacement](#) for B201 Brake Control Brake Pedal Position Sensor replacement.
- Refer to [Brake Pedal Position Sensor Replacement](#)
- Refer to [Control Module References](#) for K20 ECM replacement, programming, and setup.

DTC P0650, P263A, OR P263B: MALFUNCTION INDICATOR LAMP (MIL) CONTROL 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0650

Malfunction Indicator Lamp (MIL) Control Circuit

DTC P263A

Malfunction Indicator Lamp (MIL) Control Circuit Low Voltage

DTC P263B

Malfunction Indicator Lamp (MIL) Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0650	P0650	-	-
MIL Control	P0650, P263A*	P0650, P263A	P263B	-
* The MIL remains ON				

Circuit/System Description

The MIL illuminates to inform the driver that a fault has occurred and a vehicle system requires service. Ignition voltage is supplied directly to the MIL and, when a fault occurs, the ECM turns the MIL ON by grounding the MIL control circuit. Under normal operating conditions, the MIL should be ON only during bulb check.

Conditions for Running the DTC

Remote Vehicle Start is not active.

P0650

Ignition voltage is greater than 11 V.

P263A and P263B

Run/Crank Voltage is greater than 11 V.

Conditions for Setting the DTC

P0650

The ECM detects low voltage during the MIL control circuit driver OFF state.

P263A

The ECM detects low voltage during the MIL control circuit driver OFF state.

P263B

The ECM detects high voltage on the MIL control circuit during the driver ON state.

Action Taken When the DTC Sets

- DTC P0650, P263A, and P263B are Type B DTCs.
- No MIL illumination.

Conditions for Clearing the DTC

DTC P0650, P263A, and P263B are Type B DTCs.

Diagnostic Aids

- If the condition is intermittent, move the related harnesses and connectors with the vehicle ON while monitoring the scan tool MIL control circuit status parameters. The MIL control circuit status parameters will change from OK or Not Run to Fault if there is a condition with the circuit or a connection.
- If the ECM detects low voltage on the MIL control circuit during the MIL control circuit driver OFF state, DTCs P0650 and DTC P263A may set simultaneously.

Reference Information

Schematic Reference

- [Hybrid/EV Controls Schematics](#)
- [Instrument Cluster Schematics](#)

Connector End View Reference

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COMPONENT CONNECTOR END VIEWS - INDEX

- [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, command the malfunction indicator lamp ON and OFF with a scan tool.
2. Verify that the malfunction indicator lamp turns ON and OFF as commanded.
 - **If the malfunction indicator lamp does not turn ON and OFF as commanded**

Refer to Circuit/System Testing.

- **If the malfunction indicator lamp turns ON and OFF as commanded**
3. Vehicle ON, command the malfunction indicator lamp ON and OFF with a scan tool.
 4. Verify that the control circuit status parameters listed below display OK or Not Run:
 - MIL Control Circuit Low Voltage Test Status
 - MIL Control Circuit Open Test Status
 - MIL Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **If OK or Not Run is displayed**
5. Vehicle ON, command the malfunction indicator lamp ON and OFF with a scan tool.
 6. Verify that the control circuit status parameters listed below display OK or Not Run:
 - MIL Control Circuit Low Voltage Test Status
 - MIL Control Circuit Open Test Status
 - MIL Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **If OK or Not Run is displayed**
7. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 - **If any DTC sets**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- **If a DTC does not set**
8. All OK.

Circuit/System Testing

1. Vehicle OFF.
2. Disconnect the X1 harness connector at the K20 ECM.
3. Vehicle in Service Mode, verify the malfunction indicator lamp does not illuminate.
 - **If the malfunction indicator lamp illuminates**

1. Test for infinite resistance between the malfunction indicator lamp control circuit X1 terminal 12 and ground.
 - If less than infinite resistance, repair the short to ground in the circuit end to end.
 - If infinite resistance
2. Replace the P16 instrument cluster.
 - **If the malfunction indicator lamp does not illuminate**
4. Connect a 3 A fused jumper wire between the malfunction indicator lamp control circuit X1 terminal 12 and ground.
5. Verify the malfunction indicator lamp illuminates.
 - **If the malfunction indicator lamp does not illuminate**
 1. Test the malfunction indicator lamp control circuit X1 terminal 12 for a short to voltage or an open/high resistance end to end.
 - If the malfunction indicator lamp control circuit X1 terminal 12 is shorted to voltage or has an open/high resistance, repair as necessary.
 - If the malfunction indicator lamp control circuit X1 terminal 12 tests normal
 2. Test the instrument cluster ignition voltage circuit for a short to ground or open/high resistance end to end.
 - If the instrument cluster ignition voltage circuit is shorted to ground or has an open/high resistance, repair as necessary.
 - If the instrument cluster ignition voltage circuit tests normal
 3. Replace the P16 instrument panel cluster.
 - **If the malfunction indicator lamp illuminates**
6. Replace the K20 ECM.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Instrument Cluster Replacement](#)
- Refer to [Control Module References](#) for K20 ECM replacement, programming, and setup.

DTC P0685-P0687, P0689, P0690, OR P1682: ENGINE CONTROLS IGNITION RELAY/IGNITION 1 SWITCH CIRCUIT 2

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0685

Engine Controls Ignition Relay Control Circuit

DTC P0686

Engine Controls Ignition Relay Control Circuit Low Voltage

DTC P0687

Engine Controls Ignition Relay Control Circuit High Voltage

DTC P0689

Engine Controls Ignition Relay Feedback Circuit Low Voltage

DTC P0690

DTC P1682

Ignition 1 Switch Circuit 2

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ - Relay Coil	P0689, P1682	P0685, P0689, P1682	-	-
B+ - Relay Switch	P0689, P1682	P0685, P0689, P1682	-	-
Control - Component	P0689, P1682	P0689, P1682	P0690, P16B3	-
Control - Relay Coil	P0686, P0690	P0685, P0689, P1682	P0685, P0687, P0689, P1682*	-

*Internal control module or component damage may occur if the circuit shorts to B+.

Circuit/System Description

Circuit	Description
B+ - Relay Coil	Supplied directly from the battery.
B+ - Relay Switch	Supplied directly from the battery.
Control - Component	The output circuit is switched to 12 V to activate the component.
Control - Relay Coil	The output circuit is switched to ground to activate the component.

Components

Component	Description
KR75 Engine Controls Ignition Relay	Relays are used to control a high power circuit with a low power signal.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal system performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the actuators accordingly.

4 ignition voltage circuits supply the ECM. The 4 circuits are supplied by 2 relay(s):

- KR73 Ignition Main Relay
- KR75 Engine Controls Ignition Relay

The ECM monitors and compares the voltages supplied by the relay(s).

Conditions for Running the DTC**P0685, P0686**

- Run/Crank voltage is greater than 5 V.
- System voltage is greater than 11 V.
- Run/Crank voltage is greater than 5 V.

THEN

- Less than 5 V for 5 s.

P0687

- Run/Crank voltage is greater than 5 V.
- System voltage is greater than 11 V.

P0689, P0690

- DTCs P0685, P0686, or P0687 are not set.
- Ignition voltage is greater than 11 V.
- Engine Controls Ignition Relay Command is On.

P1682

- Engine Controls Ignition Relay is commanded On.
- Ignition voltage is greater than 5 V.
- Run/Crank voltage is greater than 5.5 V.

Conditions for Setting the DTC

P0685, P0686, P0687

The commanded state of the driver and the actual state of the control circuit do not match for greater than 2 s.

P0689

Engine Controls Ignition Relay Feedback Circuit is less than 5 V for greater than 5 s.

P0690

Engine Controls Ignition Relay Feedback Circuit is greater than 4 V for greater than 5 s.

P1682

The following parameters are not within 3 V of each other:

- Run/Crank Voltage
- Engine Controls Ignition Relay Voltage

Actions Taken When the DTC Sets

DTCs P0685, P0686, P0687, P0689, P0690, and P1682 are Type C DTCs.

Conditions for Clearing the DTC

DTCs P0685, P0686, P0687, P0689, P0690, and P1682 are Type C DTCs.

Diagnostic Aids

If the condition is intermittent, wiggle the related wiring harnesses and connectors, with the ignition/vehicle on or engine running, while monitoring the scan tool circuit status parameters for the component. The parameters will display if there is a condition with the circuit or a connection.

Reference Information

Schematic Reference

- [Hybrid/EV Controls Schematics](#)
- [Power Distribution Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Electrical Center Identification Views](#)
- [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)

- [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](#)

[Circuit/System Verification](#)

1. Ignition - On/Vehicle - In Service Mode
2. Verify no other DTCs are set.

- **If other DTCs are set**

Refer to: [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If no other DTCs are set**

3. Ignition/Vehicle - Cycle On and Off

Verify the component produces a clicking sound: KR75 Engine Controls Ignition Relay

- **If the component does not produce a sound**

Refer to: Circuit/System Testing

- **If the component produces a sound**

4. Verify the following parameters are within 3 V of each other:

- Ignition 1 Signal
- Engine Controls Ignition Relay Feedback Signal
- **If not within 3 V of each other**

Refer to: Circuit/System Testing

- **If within 3 V of each other**

5. Verify the following parameters display OK:

- Engine Controls Ignition Relay Control Circuit Low Voltage Test Status
- Engine Controls Ignition Relay Control Circuit Open Test Status
- Engine Controls Ignition Relay Control Circuit High Voltage Test Status
- **If OK is not displayed**

Refer to: Circuit/System Testing

- **If OK is displayed**

6. 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.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **If the DTC does not set**

7. All OK.

[Circuit/System Testing](#)

1. Vehicle Off.
2. Remove the component: KR75 Engine Controls Ignition Relay
3. Verify a test lamp turns On between the test points:

- B+ circuit terminal 30 & Ground
- B+ circuit terminal 85 & Ground
- **If the test lamp does not turn On**

Replace the component: X50A Fuse Block - Underhood

- **If the test lamp turns On**

4. Ignition - On/Vehicle - In Service Mode

5. Connect a test lamp between the test points: Control circuit terminal 86 & B+ circuit

6. Perform the scan tool control function: KR75 Engine Controls Ignition Relay - On and Off

Verify the test lamp turns On and Off.

- **If the test lamp is always Off**

1. Ignition/Vehicle - Off & Remove - Test lamp

2. Disconnect the electrical connector: X1 @ K20 Engine Control Module

3. Ignition - On/Vehicle - In Service Mode

4. Test for less than 1 V between the test points: Control circuit terminal 86 @ Relay Socket & Terminal 67 @ Control module harness

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V

5. Ignition/Vehicle - Off

6. Test for less than 2 ohms between the test points: Control circuit terminal 86 @ Relay Socket & Terminal 67 @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If the test lamp is always On**

1. Ignition/Vehicle - Off & Remove - Test lamp

2. Disconnect the electrical connector: X1 @ K20 Engine Control Module

3. Test for infinite resistance between the test points: Control circuit terminal 86 @ Relay Socket & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: K20 Engine Control Module

- **If the test lamp turns On and Off**

7. Verify the fuse is not open: F66UA Fuse

- **If the fuse is open**

1. Vehicle Off.

2. Disconnect the electrical connector: X1 @ K20 Engine Control Module

3. Test for infinite resistance between the test points: Output terminal @ Fuse & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: K20 Engine Control Module

- **If the fuse is not open**

8. Ignition - On/Vehicle - In Service Mode

9. Verify a test lamp does not turn On between the test points: KR75 Engine Controls Ignition Relay Terminal 87 & Ground

- **If the test lamp turns On**

10. Disconnect the electrical connector: X1 @ K20 Engine Control Module

11. Test for less than 1 V between the test points:

- Control circuit X1 terminal 29 @ Control module harness & Ground
- Switch circuit X1 terminal 16 @ Control module harness & Ground
- If 1 V or greater - Repair the short to voltage on the circuit.

- **If the test lamp does not turn On**

12. Vehicle Off.

13. Connect a 30 A fused jumper wire between the test points: Control circuit terminal 87 & B+ circuit terminal 30
14. Ignition - On/Vehicle - In Service Mode
15. Verify the scan tool parameter: Engine Controls Ignition Relay Feedback Signal = Within 1 V of the battery voltage
 - **If not within 1 V of the battery voltage**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
 3. Test for less than 2 ohms between the test points:
 - Control circuit terminal 87 @ Relay Socket & Control circuit terminal 29 @ Control module harness
 - Control circuit terminal 87 @ Relay Socket & Control circuit terminal 16 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **If within 1 V of the battery voltage**
16. Test or replace the component: KR75 Engine Controls Ignition Relay

Component Testing

Relay Test

1. Vehicle Off.
2. Remove the component: KR75 Engine Controls Ignition Relay
3. Test for 70 to 110 ohms between the test points: Component terminal 85 & 86
 - **If not between 70 and 110 ohms**

Replace the component: KR75 Engine Controls Ignition Relay
 - **If between 70 and 110 ohms**
4. Test for infinite resistance between the test points:
 - Component terminal 30 & 85
 - Component terminal 30 & 86
 - Component terminal 30 & 87
 - Component terminal 85 & 87
 - **If less than infinite resistance**

Replace the component: KR75 Engine Controls Ignition Relay
 - **If infinite resistance**
5. Connect a 3 A fused jumper wire between the test points: Component terminal 86 & B+

Connect a jumper wire between the test points: Component terminal 85 & Ground
6. Test for less than 2 ohms between the test points: Component terminal 30 & 87
 - **If 2 ohms or greater**

Replace the component: KR75 Engine Controls Ignition Relay
 - **If less than 2 ohms**
7. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

Refer to [Control Module References](#) for control module replacement, programming, and setup. cardiagn.com

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.
- Refer to [Diagnostic Procedure Instructions](#) to provide 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.
- Vehicle is Run Crank Active for more than 0.1 s.

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](#)
- [Data Communication 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 ECM DTC P0606 is not set.
 - **If the DTC is set**

Refer to **DTC P0601-P0604, P0606, 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. Replace the K20 Engine Control 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 is set
 1. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.
 - If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.
 - If the K114A Hybrid Powertrain Control Module has the latest calibration, replace 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.
 - **If the DTC is not set**
 4. All OK.

Repair Instructions

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

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

DTC P06B1 OR P06B2: SENSOR SUPPLY VOLTAGE CIRCUIT LOW/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.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P06B1

Sensor Supply Voltage Circuit Low Voltage

DTC P06B2

Sensor Supply Voltage Circuit High Voltage

Circuit/System Description

The motor control module shares an internal 15 V reference power supply in order to operate the drive motor. 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:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

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

OR

- The controller is Awake.
- The system voltage is greater than 10.50 V AND less than 11.0 V.

Conditions for Setting the DTC

P06B1

The reference voltage is less than 8.4 V.

P06B2

The reference voltage is greater than 15.6 V.

Action Taken When the DTC Sets

P06B1 and P06B2 are Type B DTCs.

Conditions for Clearing the DTC

P06B1 and P06B2 are Type B DTCs.

Diagnostic Aids

Low voltage or a momentary loss of power or ground to the hybrid/EV powertrain control module 1 may cause a DTC to set. Verify the following:

- The battery cables are clean and tight, and the battery is fully charged. Refer to [Battery Inspection/Test](#) .
- The hybrid/EV powertrain control module 1 ground circuits do not have an open or high resistance.
- The hybrid/EV powertrain control module 1 power circuits do not have an open, short to ground, or high resistance.

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, P0561-P0563, P1A0C, P1A0D, or P1EFC](#) .

- **If the DTC is not set**

3. Verify DTC P06B1, P06B2, P06E7 or P06E8 is not set.

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

1. Verify the DTC does not set.

- If the DTC sets, replace the T6 Power Inverter Module.

- If the DTC does not set.

2. All OK.

- If none of the DTCs are set

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [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 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0A3F

Drive Motor Position Sensor Circuit

DTC P0A40

Drive Motor Position Sensor Performance

DTC P0C52

Drive Motor Position Sensor Circuit 1 Low Voltage

DTC P0C53

Drive Motor Position Sensor Circuit 1 High Voltage

DTC P0C5C

Drive Motor Position Sensor Circuit 2 Low Voltage

DTC P0C5D

Drive Motor Position Sensor Circuit 2 High Voltage

DTC P1B03

Drive Motor 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 4.2 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.

Conditions for Running the DTC

P0A3F, P0A40, or P1B03

The drive motor is operating.

P0C52, P0C53, P0C5C, or P0C5D

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 2.3 V. The motor control module cannot determine the motor position based upon the sensor signals.

P0A40

SIN or COS signal is greater than 4 V. 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

- 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.

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-52010 Jumper Harness (12 Pins)

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 X2 harness connector at the T12 Automatic Transmission Assembly.
2. Install the **DT-52010** harness to the vehicle harness side only.
3. Vehicle ON.
4. Test for 0.8 - 1.4 V between the signal circuit terminals listed below and ground:
 - Signal (COS) circuit terminal 5
 - Signal (COS) circuit terminal 4
 - Signal (SIN) circuit terminal 8
 - Signal (SIN) circuit terminal 9
 - **If less than 0.8 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 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify proper terminal contact and if OK replace the T6 Power Inverter Module.
 - **If greater than 1.4 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 0.8 - 1.4 V

NOTE: Switch DMM setting to measure AC voltage for this step.

5. Test for 3 - 4.5 V AC between the reference circuit terminals listed below:

- Terminal 6
- Terminal 7

• **If less than 3 V**

1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.

2. Test for infinite resistance between EACH 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 Ω in EACH reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify proper terminal contact and if OK replace the T6 Power Inverter Module.

• **If greater than 4.5 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 EACH 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 3 - 4.5 V**

6. 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, 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 X2 harness connector at the T12 Automatic Transmission Assembly.

4. Install the **DT-52010** jumper harness to the transmission side only.

5. Test for 5 - 20 Ω between the reference circuit terminal 6 and the reference circuit terminal 7.

• **If less than 5 Ω**

1. Disconnect the X1 harness connector at the M15 Drive Motor.

2. Test for infinite resistance between the reference circuit terminal 6 and the reference circuit terminal 7.

- If less than infinite resistance, replace the a/trans wiring harness assembly.
- If infinite resistance, replace the B228 Drive Motor Position Sensor.

• **If greater than 20 Ω**

1. Disconnect the X1 harness connector at the M15 Drive Motor.

2. Test for less than 2 Ω in the reference circuits end to end.

- If 2 Ω or greater, replace the a/trans wiring harness assembly.
- If less than 2 Ω , replace the B228 Drive Motor Position Sensor.

• **If between 5 - 20 Ω**

6. Test for 15 - 30 Ω between the signal (COS) circuit terminal 5 and the signal (COS) circuit terminal 4.

• **If less than 15 Ω**

1. Disconnect the X1 harness connector at the M15 Drive Motor.

2. Test for infinite resistance between the signal (COS) circuit terminal 5 and the signal (COS) circuit terminal 4.
 - If less than infinite resistance, replace the a/trans wiring harness assembly.
 - If infinite resistance, replace the B228 Drive Motor Position Sensor.
- **If greater than 30 Ω**
 1. Disconnect the X1 harness connector at the M15 Drive Motor.
 2. Test for less than 2 Ω in the signal circuits end to end.
 - If 2 Ω or greater, replace the a/trans wiring harness assembly.
 - If less than 2 Ω , replace the B228 Drive Motor Position Sensor.
- **If between 15 - 30 Ω**
7. Test for 15 - 30 Ω between the signal (SIN) circuit terminal 8 and the signal (SIN) circuit terminal 9.
 - **If less than 15 Ω**
 1. Disconnect the X1 harness connector at the M15 Drive Motor.
 2. Test for infinite resistance between the signal (SIN) circuit terminal 8 and the signal (SIN) circuit terminal 9.
 - If less than infinite resistance, replace the a/trans wiring harness assembly.
 - If infinite resistance, replace the B228 Drive Motor Position Sensor.
 - **If greater than 30 Ω**
 1. Disconnect the X1 harness connector at the M15 Drive Motor.
 2. Test for less than 2 Ω in the signal circuits end to end.
 - If 2 Ω or greater, replace the a/trans wiring harness assembly.
 - If less than 2 Ω , replace the B228 Drive Motor Position Sensor.
 - **If between 15 - 30 Ω**
8. Test for greater than 10,000 Ω between the terminals listed below and ground:
 - Reference terminal 6
 - Reference terminal 7
 - Signal (COS) circuit terminal 5
 - Signal (COS) circuit terminal 4
 - Signal (SIN) circuit terminal 8
 - Signal (SIN) circuit terminal 9
 - **If less than 10,000 Ω**
 1. Disconnect the X1 harness connector at the M15 Drive Motor.
 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 B228 Drive Motor Position Sensor.
 - **If 10,000 Ω or greater**
9. Test for infinite resistance between the terminals listed below:
 - Terminals 9 and 4
 - Terminals 9 and 7
 - Terminals 8 and 6
 - **If less than infinite resistance**
 1. Disconnect the X1 harness connector at the M15 Drive Motor.
 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 B228 Drive Motor Position Sensor.
 - **If infinite resistance**
10. Refer to Circuit/System Testing.

Refer to [Automatic Transmission Control Wiring Harness Removal - Transmission Case Cover](#) , or [Drive Motor Position Sensor Stator Removal](#) for A/Trans Wiring Harness Assembly or B228 Drive Motor Position Sensor replacement.

DTC P0A5E, P0A61, OR P0A64: DRIVE MOTOR PHASE U/V/W LOW 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0A5E

Drive Motor Phase U Low Current

DTC P0A61

Drive Motor Phase V Low Current

DTC P0A64

Drive Motor Phase W Low Current

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.

The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

- DTCs P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, P0BF0 are not set.
- 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 a malfunction.

Action Taken When the DTC Sets

- DTCs P0A5E, P0A61, and P0A64 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 P0A5E, P0A61, and P0A64 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 P0A5E, P0A61, and P0A64 is not set.

- If any of the DTCs are set

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.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [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: DRIVE MOTOR INVERTER 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0A78

Drive Motor Inverter Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the drive motor control module. The motor control module operates the drive motor based upon hybrid/EV powertrain control module 1 commands. The motor control module controls the speed, direction and output torque of the drive 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 module is part of the power inverter module and are not serviced separately.

Conditions for Running the DTC

- The high voltage contactor relays are closed.
- High voltage greater than 100 V.

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

- P0A78 is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

P0A78 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](#)

[Circuit/System Verification](#)

1. Vehicle ON.
2. Verify DTC P0A78 is not set.
 - **If the DTC is 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 Power Inverter Module 3 Phase Cable Replacement](#).
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the M15 Drive Motor:
 - X3 terminal 3 phase U
 - X3 terminal 2 phase V
 - X3 terminal 1 phase W
 - **If less than infinite resistance**
 1. Disconnect the 3-phase cable assembly from the transmission. Refer to [Drive Motor Power Inverter Module 3 Phase Cable Replacement](#).
 2. Test for infinite resistance between the AC circuit terminal and ground.
 - If less than infinite resistance, replace the 3-phase cable assembly.

- If infinite resistance, replace the M15 Drive Motor Stator.

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

4. Replace the T6 Power Inverter Module.

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 M15 Drive Motor Stator.

- **If the DTC does not set**

7. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Power Inverter Module 3 Phase Cable Replacement](#) for Drive Motor 1 3-Phase Cable Assembly replacement or M15 Drive Motor replacement.
- Refer to [Drive Motor Stator Removal](#) for M15 Drive Motor Stator replacement.
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0A8D OR P0A8F: 14 V POWER MODULE SYSTEM VOLTAGE LOW/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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0A8D

14 V Power Module System Voltage Low Voltage

DTC P0A8F

14 V Power Module System Voltage High Voltage

Circuit/System Description

The 14 V power module, often referred to as the accessory DC power control module, converts the high voltage (360 V) direct current (DC) to low voltage (14 V) DC to charge the 12 V battery and to operate the power accessories. The ECM controls the 14 V power module by supplying a 5 V pulse width modulated (PWM) signal through a control circuit. The ECM monitors 12 V battery voltage to ensure the 14 V power module is maintaining the desired voltage.

Conditions for Running the DTC

14 V power module is commanded ON.

Conditions for Setting the DTC

The ECM monitored battery voltage is less than or equal to 11 V for 60 s within a 75 s window.

Action Taken When the DTC Sets

- The charge indicator is illuminated.
- The 14 V power module stops supplying power to the 12 V system.
- DTCs P0A8D and P0A8F are Type C DTCs.

Conditions for Clearing the DTC

DTCs P0A8D and P0A8F are Type C DTCs.

Diagnostic Aids

An improperly fastened 150-amp in-line mega-fuse may cause this DTC to set.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Testing

1. Verify DTC P1F59, P1F5A, P1F5B, P1F5D, or P1F5E is not set.

- If the DTC is set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- If the DTC is not set

2. Perform the [DC Power Conversion Test](#).

DTC P0AC4, P1E00, P25A2, P25C9, OR P26C8: HYBRID/EV POWERTRAIN/BRAKE SYSTEM/CHASSIS - CONTROL MODULE(S) REQUESTED MIL ILLUMINATION

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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each of the diagnostic category.

DTC Descriptor

DTC P0AC4

Hybrid/EV Powertrain Control Module Requested MIL Illumination

DTC P1E00

Hybrid/EV Powertrain Control Module 2 Requested MIL Illumination

DTC P25A2

Brake System Control Module Requested MIL Illumination

DTC P25C9

Brake System Control Module 2 Requested MIL Illumination

DTC P26C8

Chassis Control Module Requested MIL Illumination

Circuit/System Description

Control modules constantly monitor the vehicle for any condition which may adversely affect vehicle performance. If a condition is detected, the module sets a DTC and sends a serial data message to the engine control module (ECM). The ECM sets a DTC to inform the technician that the module has set a DTC. The serial data message sent by the module also contains a request for the ECM to illuminate the malfunction indicator lamp (MIL).

The technician can observe the DTC that was set by the module by reviewing the ECM Freeze Frame records on the scan tool. The ECM Freeze Frame records also contain the engine operating conditions present when the DTC set.

Conditions for Running the DTC

- The vehicle is ON for greater than 3 s.
- These DTCs run continuously.

Conditions for Setting the DTC

The ECM receives a serial data message from a specific module indicating that DTC has set in the module.

Action Taken When the DTC Sets

DTCs P0AC4, P1E00, P25A2, P25C9, or P26C8 are Type A DTCs.

Conditions for Clearing the MIL/DTC

DTCs P0AC4, P1E00, P25A2, P25C9, or P26C8 are Type A DTCs.

Diagnostic Aids

Communication codes, U-codes, and P-codes that set in a module can request a DTC to be set in the ECM.

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

NOTE:

- Do not replace the engine control module for these informational DTCs.
- Correct any engine control and communication DTCs before diagnosing these DTCs.

1. Vehicle in Service Mode.
2. Verify there are no engine control or communication DTCs set.
 - If a DTC is set

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

- If a DTC is not set

3. Verify there are no DTCs set in any other control module.
 - If a DTC is set

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

- If a DTC is not set

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

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

- If the DTC does not set

6. All OK.

Repair Instructions

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

DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, OR P0BDC-P0BDE: DRIVE MOTOR INVERTER TEMPERATURE SENSOR(S)

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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0AEE

Drive Motor Inverter Temperature Sensor Performance

DTC P0AEF

Drive Motor Inverter Temperature Sensor Circuit Low Voltage

DTC P0AF0

Drive Motor Inverter Temperature Sensor 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 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

Circuit/System Description

This is an internal fault detection of the power inverter module, often called 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.

The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

P0AEE, P0BD2, and P0BDC

- P0AEF, P0AF0, P0BD3, P0BD4, P0BDD, and P0BDE are not set.
- 12 hours have elapsed since the vehicle has been ON.
- Ignition ON and more than 7 hours have elapsed since battery pack conditioning or charging has taken place.

- Transmission fluid and hybrid/EV powertrain control module 1 temperature sensor average is greater than 20Å,Å°C (68Å,Å°F).

P0AEF, P0BD3, and P0BDD

The ignition is ON.

P0AF0, P0BD4, and P0BDE

- The ignition is ON.
- Ignition 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, P0BD2, and P0BDC

- A 20Å,Å°C (68Å,Å°F) difference is observed between the individual inverter phase temperature sensor and the average of all the inverter phase temperatures.
- The above condition is present for 4.75 seconds.

P0AEF, P0BD3, and P0BDD

The inverter phase temperature sensor is greater than 159Å,Å°C (318Å,Å°F) for 2.5 seconds.

P0AF0, P0BD4, and P0BDE

The inverter phase temperature sensor is less than -45Å,Å°C (-49Å,Å°F) for 3 seconds.

Action Taken When the DTC Sets

- P0AEF, P0AF0, P0BD3, P0BD4, P0BDD, and P0BDE are Type A DTCs.
- P0AEE, P0BD2, and P0BDC are Type B DTCs.
- Power to the motor will be limited.

Conditions for Clearing the DTC

- P0AEF, P0AF0, P0BD3, P0BD4, P0BDD, and P0BDE are Type A DTCs.
- P0AEE, P0BD2, and P0BDC 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 P0AEE, P0AEF, P0AF0, P0BD2, P0BD3, P0BD4, P0BDC, P0BDD, or P0BDE is not set.
 - **If any of the DTCs are set**
 1. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set
 2. All OK.
 - **If none of the DTCs are set**
3. All OK.

Repair Instructions

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

Refer to [Control Module References](#) for T6 Drive Motor Generator Power Inverter Module replacement, programming and setup.

DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, OR P0BF0: DRIVE MOTOR 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0BE6

Drive Motor Phase U Current Sensor Performance

DTC P0BE7

Drive Motor Phase U Current Sensor Circuit Low Voltage

DTC P0BE8

Drive Motor Phase U Current Sensor Circuit High Voltage

DTC P0BEA

Drive Motor Phase V Current Sensor Performance

DTC P0BEB

Drive Motor Phase V Current Sensor Circuit Low Voltage

DTC P0BEC

Drive Motor Phase V Current Sensor Circuit High Voltage

DTC P0BEE

Drive Motor Phase W Current Sensor Performance

DTC P0BEF

Drive Motor Phase W Current Sensor Circuit Low Voltage

DTC P0BF0

Drive Motor 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

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- DTCs P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, and P0BF0 are Type A DTCs.

- Propulsion will be disabled.

Conditions for Clearing the DTC

DTCs P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, and P0BF0 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, or P0BF0 is not set.
 - **If any of the DTCs are set**
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.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to 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: DRIVE MOTOR PHASES U-V-W NOT PLAUSIBLE

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.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0BFD

Drive Motor 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 module and the hybrid/EV powertrain control module 1. The motor control module operates the drive motor based upon hybrid/EV powertrain control module 1 commands. The motor control module controls the speed, direction and output torque of the 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 transistors operates a single phase of the drive motor. Each phase is individually identified as U, V and W. The 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 149 A.

Action Taken When the DTC Sets

- P0BFD 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

P0BFD 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 Verification

1. Vehicle ON.
2. Verify DTC P0BFD 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 Power Inverter Module 3 Phase Cable Replacement](#).
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the M15 Drive Motor:
 - X3 terminal 3 phase U
 - X3 terminal 2 phase V
 - X3 terminal 1 phase W
 - **If less than infinite resistance**
 1. Disconnect the 3-phase cable assembly from the transmission. Refer to [Drive Motor Power Inverter Module 3 Phase Cable Replacement](#).
 2. Test for infinite resistance between the AC circuit terminal and ground for each phase of the M15 Drive Motor:
 - X3 terminal 3 phase U
 - X3 terminal 2 phase V
 - X3 terminal 1 phase W
 - If less than infinite resistance, replace the 3-phase cable assembly.
 - If infinite resistance, replace the M15 Drive Motor Stator.
 - **If infinite resistance for all AC circuits**
4. Replace the T6 Power Inverter Module.
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 M15 Drive Motor Stator.
 - **If the DTC does not set**
7. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Stator Removal](#) for T15 Drive Motor Stator replacement.
- Refer to [Drive Motor Power Inverter Module 3 Phase Cable Replacement](#) for Drive Motor 3-Phase Cable Assembly replacement.
- Refer to [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: DRIVE MOTOR 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0C01

Drive Motor High Current

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Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control module and the hybrid/EV powertrain control module 1. The motor control module operates the drive motor based upon hybrid/EV powertrain control module 1 commands. The motor control module controls the speed, direction and output torque of the drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. The drive motor operates utilizing 3-phase 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. The motor control module monitors the current of each phase in order to detect power inverter module overcurrent conditions. The motor control module is part of the power inverter module, and are not serviced separately.

Conditions for Running the DTC

- P0BFD, P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, and P0BF0 are not set
- The hybrid wakeup circuit is active.

Conditions for Setting the DTC

One or more phase currents are greater than 706 A.

Action Taken When the DTC Sets

- DTC P0C01 is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTC P0C01 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 Verification

1. Vehicle ON.
2. Verify DTC P0C01 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.

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 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 M15 Drive Motor:
 - X3 terminal 3 phase U
 - X3 terminal 2 phase V
 - X3 terminal 1 phase W
 - **If less than infinite resistance**
 1. Disconnect the 3-phase cable assembly from the transmission. Refer to [Drive Motor Power Inverter Module 3 Phase Cable Replacement](#).
 2. Test for infinite resistance between the AC circuit terminal and ground for each phase of the M15 Drive Motor:
 3. X3 terminal 3 phase U
 4. X3 terminal 2 phase V
 5. X3 terminal 1 phase W
 - If less than infinite resistance, replace the 3-phase cable assembly.
 - If infinite resistance, replace the M15 Drive Motor Stator.
 - **If infinite resistance for all AC circuits**
4. Replace the T6 Power Inverter Module.
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 M15 Drive Motor.
 - **If the DTC does not set**
7. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Stator Removal](#) for T15 Drive Motor Stator replacement.
- Refer to [Drive Motor Power Inverter Module 3 Phase Cable Replacement](#) for Drive Motor 3-Phase Cable Assembly replacement.
- Refer to [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: DRIVE MOTOR INVERTER SUPPLY VOLTAGE 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0C0B

Drive Motor Inverter Supply Voltage Circuit

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. The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

- Vehicle is ON or Charge Mode is active.
- The system voltage is greater than 9.5 V.

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

- P0C0B is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

P0C0B 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 P0C0B is not set.
 - **If any of the DTCs are set**
 1. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 2. All OK.
 - **If none of the DTCs are set**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [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-P0C13: DRIVE MOTOR INVERTER PHASE U/V/W 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0C11

Drive Motor Inverter Phase U High Temperature

DTC P0C12

Drive Motor Inverter Phase V High Temperature

DTC P0C13

Drive Motor Inverter Phase W High Temperature

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the drive motor control module and the hybrid/EV powertrain control module 1. The motor control module operates the drive motor based upon hybrid/EV powertrain control module 1 commands. The motor control module controls the speed, direction and output torque of the drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. The 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. The motor control module monitors the temperature of each phase in order to detect power inverter module over-temperature conditions.

Conditions for Running the DTC

- DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, P0BDC-P0BDE, P190B, or P190C is not set.
- Vehicle ON.

Conditions for Setting the DTC

The phase temperature has exceeded 97°C (206°F) for 2 seconds.

Action Taken When the DTC Sets

- DTCs P0C11, P0C12, and P0C13 are Type A DTCs.
- As the temperature increases, power to the motor will be limited.

Conditions for Clearing the DTC

DTCs P0C11, P0C12, and P0C13 are Type A DTCs.

Reference Information

Description and Operation

Drive Motor Power Inverter Module Description and Operation

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Verify DTC P0480, P0C47, P1E8C, P1E8D, P0CE9, P1F44, P1F45, or P1EC6 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. Inspect for proper coolant level in the hybrid cooling system reservoir.

- **If coolant level is low**

Refer to [Hybrid Cooling System Loss of Coolant \(Drive Motor Battery Cooling System\) Hybrid Cooling System Loss of Coolant \(Drive Motor Generator Power Inverter Module Cooling System\)](#) for Drive Motor Generator Power Inverter Module Cooling System.

- **If coolant level is OK**

3. 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**

4. Inspect for proper operation of all hybrid/EV system coolant pumps. Refer [Hybrid/EV Electronics Cooling Diagnostic \(Drive Motor Generator Power Inverter Module Cooling System\) Hybrid/EV Electronics Cooling Diagnostic \(Drive Motor Battery Cooling System\)](#) for Drive Motor Generator Power Inverter Module Cooling System.

- **If a concern is found**

Repair or replace the coolant pumps as necessary.

- **If no concern is found**

5. 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 \(Drive Motor Generator Power Inverter Module Cooling System\) Hybrid/EV Electronics Cooling Diagnostic \(Drive Motor Battery Cooling System\)](#) for Drive Motor Generator Power Inverter Module Cooling System.

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

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [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 OR P1B0F: DRIVE MOTOR 1 POSITION NOT LEARNED/LEARN INCORRECT

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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0C17

Drive Motor 1 Position Not Learned

DTC P1B0F

Drive Motor 1 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.

Conditions for Running the DTC

P0C17

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

P1B0F

- 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 150 RPM.

Condition 2

Position sensor offset value not learned because hybrid battery voltage as observed at the motor control module is less than 191 V.

Condition 3

Position sensor offset value not learned because drive motor phase to phase current difference is less than 30 A.

Action Taken When the DTC Sets

P0C17

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

P1B0F

- DTC P1B0F is a Type B DTC.
- The motor control module operates the drive motor generator using the last valid learned offset.

Conditions for Clearing the DTC

- DTC P0C17 is a Type A DTC.

- DTC P1B0F is a Type B DTC.

Diagnostic Aids

- If the vehicle is powered off while driving DTC P1B0F 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, 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.
- Intermittent appearance of DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 suggests intermittent position sensor circuit or connector problems.
- The drive motor control module 1 monitors and report the 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 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, P0A78, P0C01, P0C05, P0C0B, P0C4E, P0C52, P0C53, P0C5C, P0C5D, P1B03, or P1B0D 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

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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 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 in Circuit/System Testing.

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

4. Vehicle ON.

5. Verify DTC P0C17 or P1B0F is not set.

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

1. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.

- If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.
- If the K114A Hybrid Powertrain Control Module has the latest calibration, replace 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 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.

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 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 M15 Drive Motor:

Drive Motor

- X5 terminal 3 phase U
 - X5 terminal 2 phase V
 - X5 terminal 1 phase W
 - **If less than infinite resistance**
 1. Disconnect the 3-phase cable assembly from the transmission.
 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 Stator.
 - **If infinite resistance for all AC circuits**
4. Replace the T6 Power Inverter Module.
 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 M15 Drive Motor Stator.
 - **If the DTC does not set**
 7. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Power Inverter Module 3 Phase Cable Replacement](#) for Drive Motor 3-Phase Cable Assembly replacement.
- Refer to [Drive Motor Stator Removal](#) for T15 Drive Motor Stator replacement.
- Refer to [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 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0C19

Drive Motor Torque Delivered Performance

Circuit/System Description

The drive motor is controlled by a motor control module. The motor control module constantly monitors the requested torque and the delivered torque of the drive motor. The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

- Vehicle ON.
- DTCs P1AEC, P1AE8, P1AE9, P1B41, P1AF5, P1B0C, P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, P0BF0 are not set.
- The drive motor is commanded to develop torque greater than 148 N.m (109 lb ft).

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

- P0C19 is a Type A DTC.
- The power to the motor will be limited.

Conditions for Clearing the DTC

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

Replace the M15 Drive Motor Stator and Rotor.
 - **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Stator Removal](#) for M15 Drive Motor Stator replacement.
- Refer to [Drive Motor Rotor Removal](#)
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0C2D OR P0C2E: ELECTRIC/AUXILIARY TRANSMISSION FLUID PUMP CONTROL MODULE FEEDBACK CIRCUIT LOW/HIGH VOLTAGE

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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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0C2D

Electric/Auxiliary Transmission Fluid Pump Control Module Feedback Circuit Low Voltage

DTC P0C2E

Electric/Auxiliary Transmission Fluid Pump Control Module Feedback Circuit High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control module and the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump by providing a 12 V ground pulse width modulation (PWM) signal to the pump motor to request a specific motor speed.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

DTC P0C2D

The pulse width modulated (PWM) feedback signal measured by hybrid/EV powertrain control module 1 is less than 2% for 6 seconds.

DTC P0C2E

The pulse width modulated (PWM) feedback signal measured by hybrid/EV powertrain control module 1 is greater than 98% for 6 seconds.

Action Taken When the DTC Sets

- DTCs P0C2D and P0C2E are Type A DTCs.
- Vehicle speed will be limited, the Propulsion Power is Reduced message will be illuminated.

Conditions for Clearing the DTC

- DTCs P0C2D and P0C2E are Type A DTCs.
- The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

[Hybrid/EV Controls Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Drive Motor Power Inverter Module Description and Operation](#)

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. Verify no ECM loss of communication DTCs U0100/U1818 are set indicating that a KR75 Engine Controls Ignition Relay concern is present.
 - **If any of the DTCs were set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
 - **If the DTCs were not set**
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**
Refer to Circuit/System Testing.
 - **If the DTC is not set**
4. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G5 Transmission Fluid Pump Electric/Auxiliary.
2. Test for less than 5 Ω between the ground circuit terminal 6 and ground.
 - **If 5 Ω or greater**
Repair the open/high resistance on the ground circuit.
 - **If less than 5 Ω**
3. Vehicle ON.
4. Test for B+ between the B+ circuit terminal 1 and the ground circuit terminal 6.
 - **If less than B+**
 1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω and the fuse is blown
 - 3. Replace the G5 Transmission Fluid Pump Electric/Auxiliary.
 - **If B+**

NOTE: This ignition circuit is powered by the KR75 Engine Controls Ignition Relay.

5. Test for B+ between the ignition circuit terminal 3 and the ground circuit terminal 6.
 - **If less than B+**
 1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω and the fuse is blown

3. Replace the G5 Transmission Fluid Pump Electric/Auxiliary.

- **If B+**

6. Connect a test lamp between the enable circuit terminal 5 and the ground circuit terminal 6.

7. Vehicle OFF. Verify the test lamp is OFF.

- **If the test lamp is ON**

1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.

2. Test for less than 1 V between the pump enable circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Replace the T6 Power Inverter Module.

- **If the test lamp is OFF**

8. Vehicle ON, verify the test lamp illuminates. Command the Auxiliary Transmission Fluid Pump ON (20 - 70%) with a scan tool if necessary.

- **If the test lamp is OFF**

1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.

2. Test for infinite resistance between the enable 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 Ω in the enable circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

4. Replace the X1 harness connector at the T6 Power Inverter Module.

- **If the test lamp is ON**

9. Connect a test lamp between the control circuit terminal 4 and the B+ circuit terminal 1.

10. Verify that a test lamp changes illumination between bright (20%) and dim (70%) when commanding the Auxiliary Transmission Fluid Pump ON between 20% and 70% with a scan tool.

- **If the test lamp is always dim or does not illuminate**

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 control circuit terminal 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 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

4. Replace the T6 Power Inverter Module.

- **If the test lamp is always bright**

1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.

2. Test for infinite resistance between the control 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 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

4. Replace the T6 Power Inverter Module.

- **The test lamp changes illumination between bright (20%) and dim (70%)**

11. Remove the test lamp.

12. Verify the scan tool, Auxiliary Transmission Fluid parameter is 0%.

- **If greater than 0%**

1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.

2. Test for infinite resistance between the feedback circuit terminal 5 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Replace the T6 Power Inverter Module.
 - **If 0%**
13. Install a 3 A fused jumper wire between the feedback circuit terminal 5 and the ground circuit terminal 6.
 14. Verify the scan tool Hybrid Battery Pack Coolant Pump parameter is greater than 90%.
 - **If 90% or less**
 1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
 2. Test for less than 1 V between the feedback circuit terminal 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 Ω in the feedback circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
 4. Replace the T6 Power Inverter Module.
 - **If greater than 90%**
 15. Replace the G5 Transmission Fluid Pump Electric/Auxiliary.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Transmission Fluid Pump Removal](#) for G5 Auxiliary Transmission Fluid Pump Electric/Auxiliary, often referred to as the A/Trans Aux Fluid Pump Motor, replacement.
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, setup, and programming.

DTC P0C4E: DRIVE MOTOR 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0C4E

Drive Motor 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, 12 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.

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Conditions for Running the DTC

The vehicle is cycled OFF.

Conditions for Setting the DTC

- The position sensor total offset exceeds 15 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

- 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.
- Intermittent appearance of DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 suggests intermittent position sensor circuit or connector problems.
- Drive motor control module monitors and reports the 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 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**
 1. Perform each of the operations listed below one at a time until the fault is corrected.
 1. Replace the B228 Drive Motor Position Sensor
 2. Replace 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.

- Refer to [Drive Motor Position Sensor Stator Removal](#) for B228 Drive Motor Position Sensor replacement.
- Refer to [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 PRESENT

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.
- Refer to [Diagnostic Procedure Instructions](#) to provide 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 4 high voltage contactors. The high voltage contactors allow the high voltage DC to be connected to the vehicle or safely contained within the hybrid/EV battery pack. For more information on the high voltage contactors, refer to [Drive Motor Battery System Description](#) .

Conditions for Running the DTC

Vehicle is ON.

Conditions for Setting the DTC

The high voltage bus voltage is greater than 60 V 3.5 seconds after the contactors have been commanded open.

Action Taken When the DTC Sets

- DTC P0C76 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

- DTC P0C76 is a Type A DTC.
- The [Clear Secured High Voltage DTCs](#) reset function must be performed to prevent resetting the 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. With a scan tool, perform the [Clear Secured High Voltage DTCs](#) reset function.
4. Verify DTC P0C76 is not set.
 - **If the DTC is set**

Replace the T6 Power Inverter Module.
 - **If the DTC is not set**
5. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [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 2/1 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P150D

Supply Voltage Circuit 2 Low Voltage

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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 the motor control module and the hybrid/EV powertrain control module 1. The motor control module operates the drive motor based upon power inverter module commands. 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.

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 2.0 seconds.

P150E

Battery voltage on circuit 1 is less than 8.0 V for more than 2.0 seconds.

Action Taken When the DTC Sets

- DTC P150D and P150E are Type C DTCs.
- Propulsion will be disabled.

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**

- **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 M4 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 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , 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. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.

- If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.

- If the K114A Hybrid Powertrain Control Module has the latest calibration, replace 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 X1 harness connector at the T6 Power Inverter Module.

2. Verify a test lamp illuminates between the B+ circuit terminal M1 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 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , 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. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.

- If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.

- If the K114A Hybrid Powertrain Control Module has the latest calibration, replace 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.

Refer to [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 INCORRECT

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.
- Refer to [Diagnostic Procedure Instructions](#) to provide 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 for more than 0.5 s.
- The system voltage is above 9.5 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.
- Propulsion will be disabled.

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

Replace the K20 ECM.

- **If the DTC is not set**

3. Verify the DTC does 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.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P15FC: HYBRID/EV BATTERY CONTACTOR STATUS MESSAGE COUNTER INCORRECT

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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P15FC

Hybrid/EV Battery Contactor Status Message Counter Incorrect

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

- DTC P15FC is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTC P15FC 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 no 12V battery system voltage LOW DTCs are set or that a low 12V battery condition was not present at the time P15FC was set.

- **If any of the DTCs were set or a low 12V battery condition was present**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- If the DTCs were not set or a low 12V battery condition was not present

3. Verify DTC P15FC 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.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup.

DTC P16F3: CONTROL MODULE REDUNDANT MEMORY 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide 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 greater than 9.5 V.

Conditions for Setting the DTC

The control module has detected that when some critical data is stored it is not the same as when it is retrieved.

Action Taken When the DTC Sets

- P16F3 is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the 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 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

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.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [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 INPUT CIRCUITRY 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide 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, is a hall-effect switch attached to the transmission case within the transmission. The 5 outputs from the switch indicate which position is selected by the transmission manual shaft. Five outputs (A, B, C, P, S) are range selection inputs to the hybrid/EV powertrain control module 1. The input voltage at the modules is high when the switch is open and low when the switch is closed to ground. The state of each input is displayed on the scan tool as Internal Mode Switch A/B/C/P/S. The Internal Mode Switch Range input parameters represented are transmission range signal A, signal B, signal C, and signal P signal S. 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.
- Ignition voltage is greater than 9.5 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

- P16F4 is a Type A DTC.
- Vehicle propulsion will be disabled.

Conditions for Clearing the DTC

P16F4 is a Type A DTC.

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 P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3 is not set.
 - **If any of the DTCs are set**

Refer to **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3** .
 - **If none of the DTCs are set**
2. Verify that DTC P16F4 is not set.
 - **If the DTC is set**
 1. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.
 - If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.
 - If the K114A Hybrid Powertrain Control Module has the latest calibration, replace 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.

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

**DTC P16FF: ENGINE CONTROLS IGNITION RELAY REQUEST SIGNAL MESSAGE COUNTER
INCORRECT**

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.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P16FF

Engine Controls Ignition Relay Request Signal Message Counter Incorrect

Circuit/System Description

The Chassis Control Module sends a powertrain relay request to the ECM over serial data. The ECM sets this DTC when it detects a discrepancy in the structure of this message, causing the message integrity to be questioned.

Conditions for Running the DTC

- The propulsion system is active.
- Arbitrated battery voltage is greater than 11 V.
- Serial data communication is greater than 3 s.

Conditions for Setting the DTC

- The ECM has detected 8 engine controls ignition relay signal rolling count errors out of 10 samples.
- OR
- Continuous engine controls ignition relay signal rolling count errors for 2 s out of a 2.5 s window.

Action Taken When the DTC Sets

DTC P16FF is a Type A DTC.

Conditions for Clearing the DTC

DTC P16FF is a Type A DTC.

Diagnostic Aids

When attempting to set ECM serial data DTCs, run the vehicle in propulsion system active mode for at least 1 minute, and then shut the vehicle off for 30 seconds. Following this procedure will allow for a complete ECM shutdown.

Reference Information

Schematic Reference

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

[Control Module References](#) for scan tool information.

Circuit/System Verification

1. Run the vehicle in propulsion system active mode for 1 minute, then vehicle OFF for 30 seconds.
2. Verify DTC P16FF is not set.
 - **If the DTC is set**
 1. Verify the K20 ECM has the latest calibration in Calibration Information.
 - If the K20 ECM does not have the latest calibration, program the K20 ECM.
 - If the K20 ECM has the latest calibration, replace the K20 ECM.
 2. Verify the DTC does not set.
 - If the DTC is set, 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.

- Refer to [Control Module References](#) for ECM replacement, programming and setup.

DTC P190A-P190C: DRIVE MOTOR 1 INVERTER PHASE U/V/W TEMPERATURE ERRATIC

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P190A

Drive Motor 1 Inverter Phase U Temperature Erratic

DTC P190B

Drive Motor 1 Inverter Phase V Temperature Erratic

DTC P190C

Drive Motor 1 Inverter Phase W Temperature Erratic

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.

Conditions for Setting the DTC

The inverter phase temperature is intermittent.

Actions Taken When the DTC Sets

- DTCs P190A-P190C are Type A DTCs.
- Propulsion will be reduced.

Conditions for Clearing the DTC

DTCs P190A-P190C are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTCs P190A-P190C are not set.
 - **If any of the DTCs are set**
 1. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.
 - If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.
 - If the K114A Hybrid Powertrain Control Module has the latest calibration, replace 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.

Refer to 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 OR P1AE9: DRIVE MOTOR CONTROL MODULE HYBRID/EV BATTERY VOLTAGE SENSE CIRCUIT LOW/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.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1AE8

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

DTC P1AE9

Drive Motor 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 the drive motor control module. The 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

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is greater than 9.5 V.
- The high voltage contactor relays are closed.

Conditions for Setting the DTC

P1AE8

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

P1AE9

The drive motor control module detects high voltage sensor voltage greater than 600 V.

Action Taken When the DTC Sets

- P1AE8 and P1AE9 are Type A DTCs.
- Propulsion will be disabled.

Conditions for Clearing the DTC

P1AE8 and P1AE9 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 P1AEE is not set.
 - **If the DTC is set**
Refer to **DTC P1AEC or P1AEE**.
 - **If the DTC is not set**
3. Verify DTC P1AE8 and P1AE9 is not set.
 - **If any of the DTCs are set**
4. Verify the DTC does not set. If the DTC sets, replace the T6 Power Inverter Module.
 - **If none of the DTCs are set**
5. All OK.

Repair Instructions

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

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

DTC P1AEC OR P1AEE: DRIVE MOTOR CONTROL MODULE HYBRID/EV BATTERY SYSTEM VOLTAGE

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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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1AEC

Drive Motor Control Module Hybrid/EV Battery System Voltage

DTC P1AEE

Drive Motor 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 the drive motor control module. The 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. The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

P1AEC

The motor control module compares the motor control module voltage value with the hybrid/EV powertrain control 2 battery pack voltage value to insure accuracy.

P1AEE

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

Conditions for Running the DTC

The hybrid/EV battery system contactor relays are closed.

P1AEC

P1AE8 or P1AE9 are not set.

Conditions for Setting the DTC

P1AEC

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 high voltage sensor.

Or

A difference of more than 50 V on the high voltage circuit is detected between the motor control module and the sum of the isolation voltage sensor values.

P1AEE

Greater than 443 V on the high voltage circuit is detected by the motor control module.

Action Taken When the DTC Sets

P1AEC

- P1AEC is a Type A DTC.
- The power to the motor will be limited.

P1AEE

- P1AEE is a Type A DTC.
- Propulsion will be disabled

Conditions for Clearing the DTC

- P1AEC is a Type A DTC.
- P1AEE is a Type A DTC.

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 DTC P1AEE. History DTC P1AEE 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 or P1AEE is 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**
5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [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: DRIVE MOTOR CONTROL MODULE HYBRID/EV BATTERY VOLTAGE SYSTEM ISOLATION LOST

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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1AF0

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

Circuit/System Description

Vehicles equipped with high voltage storage and propulsion capability are designed with the high voltage circuits isolated from the vehicle chassis.

The power inverter module, often referred to as the drive motor generator power inverter module, contains the drive motor control module and the hybrid/EV powertrain control module 1. The motor control module monitors high voltage with several internal sensors. The motor control module tests for loss of isolation between each high voltage bus and vehicle chassis when the high voltage contactors are closed. The hybrid/EV powertrain control module 2 also tests the hybrid/EV battery pack for high voltage loss of isolation but when the high voltage contactors are open.

If the motor control module detects 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 component in the high voltage system.

Conditions for Running the DTC

- P1AE8, P1AE9, P1AEC, P1AF5, P1B0C, or P1B41 is not set.
- The high voltage contactor relays are closed.
- High voltage is greater than 50 V.
- Ignition is ON.
- The vehicle is not being charged or the drive motor is commanded to develop torque.

Conditions for Setting the DTC

The ratio between negative Mid-Pack Voltage and positive Mid-Pack Voltage is greater than 4.53 V or less than 0.21 V for greater than 2.5 seconds.

Action Taken When the DTC Sets

P1AF0 is a Type B DTC.

Conditions for Clearing the DTC

P1AF0 is a Type B 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 P0AA6 is not set.

- **If the DTC is set**

Refer to [DTC P0AA6 or P1AE6](#) .

- If the DTC is not set

3. Verify DTC P0A78, P0BFD or P0C01 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 is not set.

- If the DTC is set

Refer to [Loss of Isolation on the High Voltage Main Bus](#).

- If the DTCs is not set

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC P1AF4 OR P1AF5: DRIVE MOTOR CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING CIRCUIT 1 LOW/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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1AF4

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

DTC P1AF5

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

Circuit/System Description

Vehicles equipped with high voltage storage and propulsion capability are designed with the high voltage circuits isolated from the vehicle chassis.

The power inverter module, often referred to as the drive motor generator power inverter module, contains the drive motor control module. The motor control module measures hybrid battery high voltage with several internal sensors. The motor control module tests for loss of isolation between each high voltage bus and vehicle chassis. The motor control module tests for isolation when the high voltage contactor relays are closed. The hybrid/EV powertrain control module 2 also tests the hybrid/EV battery pack for high voltage loss of isolation, but only when the high voltage contactor relays are open.

Conditions for Running the DTC

P1AF4 and P1AF5

- The vehicle is ON.
- The hybrid/EV contactors are closed.
- The vehicle is not being charged or the drive motor is commanded to develop torque.

Conditions for Setting the DTC

P1AF4

The motor control module detects isolation sensor voltage less than 15 V.

P1AF5

The motor control module detects the value of the mid-pack voltage subtracted from the pack voltage is greater than 30 V.

Action Taken When the DTC Sets

DTCs P1AF4 and P1AF5 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P1AF4 and P1AF5 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 or P1AE6](#) .
 - **If the DTC is not set**
3. Verify DTC P1AF4 or P1AF5 is not set.
 - **If any of the DTCs are set**

Refer to [Loss of Isolation on the High Voltage Main Bus](#) .
 - **If the DTC is not set**
4. Verify no other DTCs are set.
 - **If any DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If no other DTCs are set**
5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC P1B0B OR P1B0C: DRIVE MOTOR CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING CIRCUIT 2 LOW/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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1B0B

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

DTC P1B0C

Drive Motor 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 the drive motor control module. The motor control module measures hybrid battery high voltage with several internal sensors. The motor control module tests for loss of isolation between each high voltage bus and vehicle chassis. The motor control module tests for isolation when the high voltage contactor relays are closed. The hybrid/EV powertrain control module 2 also tests the hybrid/EV battery pack for high voltage loss of isolation, but only when the high voltage contactor relays are open.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

P1B0B

The motor control module detects isolation sensor voltage less than 15 V.

P1B0C

The motor control module detects isolation sensor voltage greater than 30 V.

Action Taken When the DTC Sets

DTCs P1B0B and P1B0C are Type B DTCs.

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 P1B0B 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**

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC P1B0D: DRIVE MOTOR 1 CONTROL MODULE DRIVE MOTOR 1 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1B0D

Drive Motor 1 Control Module Drive Motor 1 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 control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

Vehicle is ON.

Conditions for Setting the DTC

Drive motor 1 speed is greater than 9,250 RPM.

Action Taken When the DTC Sets

- DTC P1B0D is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTC P1B0D 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 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 is not set.
 - **If any of the DTCs are set**

1. 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.
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.

Refer to [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: DRIVE MOTOR CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1B41

Drive Motor Control Module Hybrid/EV Battery Voltage Isolation Sensing Performance

Circuit/System Description

Vehicles equipped with high voltage storage and propulsion capability are designed with the high voltage circuits isolated from the vehicle chassis.

The power inverter module, often referred to as the drive motor generator power inverter module, contains the drive motor control module. The motor control module measures hybrid battery high voltage with several internal sensors. The motor control module tests for loss of isolation between each high voltage bus and vehicle chassis. The motor control module tests 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

- DTC P1AE8, P1AE9, P1B0B, P1B0C, P1AEC, P1AF5, or P1AF4 is not set.
- The vehicle is ON.
- The hybrid/EV contactors are closed.
- The vehicle is not being charged or the drive motor is commanded to develop torque.

Conditions for Setting the DTC

The difference between the voltage sensed and hybrid battery voltage is greater than 50 V.

Action Taken When the DTC Sets

DTC P1B41 is a Type B DTC.

Conditions for Clearing the DTC

DTC P1B41 is a Type B DTC.

Reference Information

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 or P1AE6** .

- **If the DTC is not set**
3. Verify DTC P1B41 is not set.
 - **If the DTC is set**

Refer to **Loss of Isolation on the High Voltage Main Bus** .

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

Repair Instructions

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

DTC P1E0A: DRIVE MOTOR CONTROL MODULE TORQUE CALCULATION 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.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1E0A

Drive Motor Control Module Torque Calculation Performance

Circuit/System Description

The motor control module performs redundant calculations of desired and achieved torque values. These values are continuously compared and should always be the same. The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

The vehicle is in RUN.

Conditions for Setting the DTC

The redundant torque calculation does not match the primary calculation.

Action Taken When the DTC Sets

- P1E0A is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

P1E0A is a Type A DTC.

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 is not set.

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

1. 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.
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.

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

DTC P1E4A: CONTROL MODULE REDUNDANT DRIVE MOTOR 1 SPEED SENSING 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.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1E4A

Control Module Redundant Drive Motor 1 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 and compares it to the motor control module's value to insure the accuracy of the hybrid/EV powertrain control module's value. 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:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

- The vehicle must be ON.
- The system voltage is greater than 9.5 V.
- DTC P1E0A is not set.

Conditions for Setting the DTC

The calculated motor speed is greater than 600 RPM different from the measured speed.

Action Taken When the DTC Sets

- DTC P1E4A is a Type B DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTC P1E4A is a Type B DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562, P0563, or P0606 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 P1E4A is 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**
5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P1F59, P1F5A, OR P1F5B: 14 VOLT POWER MODULE STATUS TERMINAL 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1F59

14 Volt Power Module Status Terminal Circuit Performance

DTC P1F5A

14 Volt Power Module Status Terminal Circuit Low Voltage

DTC P1F5B

14 Volt Power Module Status Terminal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - L Terminal	P1F5D	-	P1F5E	-
Status - F Terminal	P1F59, P1F5A	P1F59, P1F5A	P1F59, P1F5B	P1F59

Circuit/System Description

The ECM uses two circuits to control and monitor the state of the 14V power module, often referred to as the accessory DC power control module.

The control circuit functions much like the L Terminal circuit on a generator equipped vehicle. A high side driver in the ECM applies a duty cycled 5V signal to the 14V Power Module. The duty cycles controls the 14V power module output.

The status circuit functions much like the F Terminal circuit on a generator equipped vehicle. A high side driver in the 14V power module applies a duty cycled voltage to the ECM. The duty cycle indicates 14V power module internal temperature and operational condition. The ECM will detect faults on the 14V power module status circuit when the vehicle is ON.

The 14V Power Module high voltage circuit is fuse protected within the A28 hybrid/EV battery contactor assembly. The fuse protects both the T18 battery charger and the K1 14V power module. The fuse is not serviceable.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

- P1F5A: The ECM detects a 5% or lower PWM signal on the 14V power module status circuit for 8 seconds out of a 10 second window.
- P1F5B: The ECM detects a 96% or higher PWM signal on the 14V power module status circuit for 8 seconds out of a 10 second window.
- P1F59: The status circuit PWM signal is not in a valid range.

Action Taken When the DTC Sets

DTCs P1F59, P1F5A and P1F5B are type C DTCs.

Conditions for Clearing the DTC

DTCs P1F59, P1F5A and P1F5B are type C DTCs.

Reference Information

Schematic Reference

- [Starting and Charging Schematics](#)
- [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 OFF. Connect the vehicle to an AC supply to begin charging.
2. Vehicle in Service Mode.
3. Verify that DTC P0D26 is not set and that the vehicle will charge.

- **If the DTC is set or the vehicle will not charge**

Refer to [DTC P0D26](#).

- **If the DTC is not set**

NOTE: Do not have a 12V battery charger connected during the testing.

4. 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.
5. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. 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.

DTC P1F5A or P1F5B Diagnosis

NOTE: You must perform Circuit/System Verification first.

1. Verify a test lamp illuminates between the 14V Power Module B+ circuit ring terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Remove the test lamp and disconnect the B+ cable at the 14V power module.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the mega 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 and disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection](#)

2. Disconnect the 14V power module B+ cable.

3. 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 K1 14V Power Module and the mega fuse.

• **If the test lamp illuminates**

2. Disconnect the X2 harness connector at the 14V power module, vehicle ON.

3. Test for 3.0 - 5.5 V between the control circuit terminal X2-01 and ground.

• **If less than 3.0 V**

1. Vehicle OFF, disconnect the harness connectors at the K20 ECM.

2. Test for infinite resistance between the control 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 Ω in the control circuit end to end.

- If greater the 2 Ω , repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 ECM.

• **If greater than 5.5 V**

1. Vehicle OFF, disconnect the harness connectors at the K20 ECM, Vehicle ON.

2. Test for less than 1 V between the control circuit and ground.

- If greater than 1 V, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 ECM.

• **If between 3.0 - 5.5 V**

4. Vehicle OFF, disconnect the harness connectors at the K20 ECM.

5. Test for infinite resistance between the 14V power module status circuit terminal X2-03 and ground.

• **If less than infinite resistance**

Repair the short to ground on the circuit.

• **If infinite resistance**

6. Test for less than 2 Ω in the status circuit end to end.

• **If greater the 2 Ω**

Repair the open/high resistance in the circuit.

• **If less than 2 Ω**

7. Disable the high voltage for servicing at the K1 14V Power Module. Refer to [High Voltage Disabling](#) .

8. Replace the K1 14V Power Module.

9. Enable high voltage. Refer to [High Voltage Enabling](#) .

10. Verify the DTC does not set.

• **If the DTC sets**

Replace the K20 ECM.

• **If the DTC does not set**

11. All OK.

DTC P1F59 Diagnosis

NOTE: You must perform Circuit/System Verification first.

1. Disable the high voltage system for servicing the T18 Battery Charger, K1 14V Power Module and the T24 Battery Charger-DC. Refer to [High Voltage Disabling](#) .

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2. Disconnect the X3 connector at the T18 Battery Charger, the X1 connector at the K1 14V Power Module and the X6 connector at the T24 Battery Charger-DC.

3. Verify that all HV harness connector and the mating module connector terminals are free from moisture, corrosion, and arc flash damage.

- **If any terminals show signs of damage**

Replace the HV wiring harness and affected modules as necessary.

- **If no arc flash damage, moisture, or corrosion is found**

4. Test the following HV harness terminals for less than 2 Ω end to end:

- X6-A to X1-A
- X6-A to X3-A
- X6-B to X1-B
- X6-B to X3-B

- **If greater than 2 Ω**

Replace the HV wiring harness.

- **If less than 2 Ω**

5. Replace the K1 14V Power Module.

6. Enable high voltage. Refer to [High Voltage Enabling](#) .

7. Verify the DTC does not set.

- **If the DTC sets**

Replace the K20 ECM.

- **If the DTC does not set**

8. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Battery to Battery Positive Cable Replacement](#) for K1 14V Power Module/T18 Battery Charger combination cable - includes G1 A/C compressor cable.
- Refer to [Control Module References](#) for ECM or for K1 14V Power Module - often referred to as the Accessory DC Power Control Module replacement, programming, and setup.

DTC P1F5D OR P1F5E: 14 VOLT POWER MODULE L-TERMINAL CIRCUIT LOW/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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1F5D

14 Volt Power Module L-Terminal Circuit Low Voltage

DTC P1F5E

14 Volt Power Module L-Terminal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - L Terminal	P1F5D	-	P1F5E	-
Status - F Terminal	P1F59, P1F5A	P1F59, P1F5A	P1F59, P1F5B	P1F59

Circuit/System Description

The ECM uses two circuits to control and monitor the state of the 14V power module, often referred to as the accessory DC power control module. The control circuit functions much like the L Terminal circuit on a generator equipped vehicle. A high side driver in the ECM applies a duty cycled voltage to the 14V power module. The duty cycle controls the 14V power module output. The ECM monitors the state of the 14V power module control circuit. The ECM will detect faults on the 14V power module control circuit when the vehicle is ON.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

- P1F5D: The ECM detects a low voltage on the 14V power module control circuit for 8 seconds out of a 10 second window.
- P1F5E: The ECM detects a high voltage on the 14V power module control circuit for 8 seconds out of a 10 second window.

Action Taken When the DTC Sets

DTCs P1F5D and P1F5E are type C DTCs.

Conditions for Clearing the DTC

DTCs P1F5D and P1F5E are type C DTCs.

Reference Information

Schematic Reference

- [Starting and Charging Schematics](#)
- [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

NOTE: Do not have a 12V battery charger connected during the testing.

1. 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.
2. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- If the DTC does not set

3. All OK.

Circuit/System Testing

1. Verify a test lamp illuminates between the 12V B+ circuit ring terminal X3-A at the 14V power module and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Remove the test lamp and disconnect the B+ cable at the 14V power module.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , 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, disconnect the battery negative cable, and disconnect the 14V power module B+ cable.
 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 the test lamp illuminates**
2. Disconnect the X2 harness connector at the 14V power module, vehicle ON.
3. Test for 3.0 - 5.5 V between the control circuit terminal X2-01 and ground.
 - **If less than 3.0 V**
 1. Vehicle OFF, disconnect the harness connectors at the K20 ECM.
 2. Test for infinite resistance between the control 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 Ω in the control circuit end to end.
 - If greater the 2 Ω , repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 ECM.
 - **If greater than 5.5 V**
 1. Vehicle OFF, disconnect the harness connectors at the K20 ECM, Vehicle ON.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If greater than 1 V, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 ECM.
 - **If between 3.0 - 5.5 V**
4. Test or replace the K1 14V Power Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for ECM replacement, programming, and setup or for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup.

DTC P2122, P2123, P2127, P2128, OR P2138: ACCELERATOR PEDAL POSITION (APP) SENSOR 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P2122

Accelerator Pedal Position (APP) Sensor 1 Circuit Low Voltage

DTC P2123

Accelerator Pedal Position (APP) Sensor 1 Circuit High Voltage

DTC P2127

Accelerator Pedal Position (APP) Sensor 2 Circuit Low Voltage

DTC P2128

Accelerator Pedal Position (APP) Sensor 2 Circuit High Voltage

DTC P2138

Accelerator Pedal Position (APP) Sensors 1 - 2 Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accelerator Pedal Position (APP) Sensor 1 5V Reference	P2122	P2138	P06A3, P2135	P2138
Accelerator Pedal Position (APP) Sensor 2 5V Reference	P2127	P2128	P2128	P2138
Accelerator Pedal Position (APP) Sensor 1 Signal	P2122	P2122, P2138	P2123	P2138
Accelerator Pedal Position (APP) Sensor 2 Signal	P2127	P2127, P2138	P2128, P2138	P2138
Accelerator Pedal Position (APP) Sensor 1 Low Reference	-	P2123, P2138	-	P2138
Accelerator Pedal Position (APP) Sensor 2 Low Reference	-	P2128, P2138	-	P2138

Typical Scan Tool Data**APP Sensor 1**

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle is On, and accelerator pedal not depressed. Parameter Normal Range: APP Sensor 1 0.88 - 1.08V			
Accelerator Pedal Position Sensor 1 5V Reference	0.00V	0.00V	5 - 12V
Accelerator Pedal Position Sensor 1 Signal	0.00V	0.00V	5 - 12V
Accelerator Pedal Position Sensor 1 Low Reference	-	4 - 5V	-

APP Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle is On, and accelerator pedal not depressed. Parameter Normal Range: APP Sensor 2 0.39 - 0.59V			
Accelerator Pedal Position Sensor 2 5V Reference	0.00V	0.00V	1 - 3V
Accelerator Pedal Position Sensor 2 Signal	0.00V	0.00V	2 - 5V
Accelerator Pedal Position Sensor 2 Low Reference	-	4 - 5V	-

Circuit/System Description

The accelerator pedal assembly contains 2 accelerator pedal position (APP) sensors. The APP sensors are mounted to the accelerator pedal assembly and are not serviceable. The APP sensors provide a signal voltage that changes relative to pedal position. The ECM supplies each APP sensor with a 5V reference circuit, a low reference circuit,

and a signal circuit. Both the APP sensors 1 and 2 signal percentages increase as the pedal is depressed, from approximately 0% at rest to above 95% when fully depressed.

The ECM provides the accelerator pedal position or driver torque request to the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 determines how the torque output will be distributed.

Conditions for Running the DTC

P2122, P2123, P2127, P2128

- DTC P0697 is not set - P2127 or P2128.
- DTC P06A3 is not set - P2122 or P2123.
- The vehicle is ON.
- The run voltage is greater than 6.4V.
- The DTCs run continuously when the above conditions are met.

P2138

- DTCs P06A3, P0697, P2122, P2123, P2127, or P2128 are not set.
- The vehicle is ON.
- The run voltage is greater than 6.4V.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P2122

The ECM detects that the APP sensor 1 voltage is less than 0.46V for greater than 1 s.

P2123

The ECM detects that the APP sensor 1 voltage is greater than 4.7V for greater than 1 s.

P2127

The ECM detects that the APP sensor 2 voltage is less than 0.32V for greater than 1 s.

P2128

The ECM detects that APP sensor 2 voltage is greater than 2.6V for greater than 0.5 s.

P2138

The voltage difference between APP sensor 1 and APP sensor 2 exceeds a predetermined value for greater than 1 s.

Action Taken When the DTC Sets

- DTCs P2122, P2123, P2127, and P2128, and P2138 are Type A DTCs.
- ECM commands the reduced power mode.
- Creep torque and hill hold are disabled.
- Service Parking Brake light is illuminated.

Conditions for Clearing the DTC

DTCs P2122, P2123, P2127, and P2128, and P2138 are Type A DTCs.

Diagnostic Aids

- A high resistance condition on the accelerator pedal sensor circuits could cause a DTC to set.
- Ensure that the in-line harness connector seals are installed correctly. Improper installation could result in water intrusion into the connector and cause a DTC to set.

Reference Information

Schematic Reference

[Hybrid/EV Controls Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[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.

[Circuit/System Verification](#)

1. Vehicle in Service Mode.
2. Verify DTC P0641, P0697, or P06A3 is not set.
 - **If any of the DTCs are set**

Refer to [DTC P0641, P0651, P0697, or P06A3](#) for further diagnosis.
 - **If none of the DTCs are set**
3. Verify the APP Sensor 1 Circuit Status and APP Sensor 2 Circuit Status parameter displays OK.
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If OK is displayed**
4. Verify the scan tool APP Sensor 1 and 2 percent parameters are equal while performing the tests listed below:
 1. Rapidly depress the accelerator pedal from the rest position to the wide open throttle position (WOT) and release pedal. Repeat the procedure several times.
 2. Slowly depress the accelerator pedal to WOT and then slowly return the pedal to closed throttle. Repeat the procedure several times.
 - **If not equal**

Refer to Circuit/System Testing.
 - **If equal**
5. Verify that DTC P2122, P2123, P2127, P2128, or P2138 is not set.
 - **If any of the DTCs are set**

Refer to Circuit/System Testing.
 - **If none of the DTCs set**
6. 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. cardiagn.com
7. Verify DTC P2122, P2123, P2127, P2128, or P2138 is not set.

- **If any DTC sets**

Refer to Circuit/System Testing.

- **If no DTCs set**

8. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B107 accelerator pedal assembly. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 5 Ω between each low reference circuit terminal listed below and ground:

- Low reference circuit X1 terminal 4
- Low reference circuit X1 terminal 3

- **If 5 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 ECM.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 ECM.

- **If less than 5 Ω**

3. Vehicle in Service Mode.

4. Test for 4.8 - 5.2V between each 5V reference circuit terminals listed below and ground:

- 5V reference circuit terminal 1
- 5V reference circuit terminal 6

- **If less than 4.8V**

1. Vehicle OFF, disconnect the harness connector at the K20 ECM.

2. Test for infinite resistance between the 5V 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 Ω in the 5V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 ECM.

- **If greater than 5.2V**

1. Vehicle OFF, disconnect the harness connector at the K20 ECM, vehicle in Service Mode.

2. Test for less than 1V between the 5V reference circuit and ground.

- If 1V or greater, repair the short to voltage on the circuit.
- If less than 1V, replace the K20 ECM.

- **If between 4.8 - 5.2V**

5. Verify each APP sensor voltage parameter is less than 0.2V.

- **If 0.2V or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 ECM, vehicle in Service Mode.

2. Test for less than 1V between the signal circuit terminal listed below and ground:

- APP sensor 1 signal circuit terminal 5
- APP sensor 2 signal circuit terminal 2
- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 ECM.

- **If less than 0.2V**

6. Install a 3A fused jumper wire between each signal circuit terminals listed below and the 5V reference circuit terminal 1:

- APP sensor 1 signal circuit terminal 5
- APP sensor 2 signal circuit terminal 2

7. Verify the scan tool APP sensor voltage parameter is greater than 4.8V.

- **If 4.8V or less**

1. Vehicle OFF, disconnect the harness connector at the K20 ECM.
2. Test for infinite resistance between the signal circuit terminal and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 ECM.

- **If greater than 4.8V**

8. Test or replace the B107 accelerator pedal assembly.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Accelerator Pedal Assembly Replacement](#)
- Refer to [Control Module References](#) for K20 ECM replacement, programming, and setup.

DTC P2797: AUXILIARY TRANSMISSION FLUID PUMP 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide 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, utilizes a pulse-width modulated signal to control the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control module share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

- The vehicle is ON.
- The auxiliary transmission fluid pump is commanded greater than 800 RPM.

Conditions for Setting the DTC

The difference between desired and actual auxiliary transmission fluid pump speed is greater than 600 RPM for 30 seconds.

Action Taken When the DTC Sets

- DTC P2797 is a Type A DTC.
- Vehicle speed will be limited.
- Propulsion will be reduced.
- Propulsion Power is Reduced message will be illuminated.

Conditions for Clearing the DTC

DTC P2797 is a Type A DTC.

Diagnostic Aids

There should always be other hybrid/EV powertrain control module 1 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 control module 1 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**
3. Verify the DTC does not set. If the DTC sets, replace the G5 Auxiliary Transmission Fluid Pump.
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.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Transmission Fluid Pump Removal](#) for G5 Auxiliary Transmission Fluid Pump, often referred to as the A/Trans Aux Fluid Pump Motor, replacement.
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P2798 OR P2799: AUXILIARY TRANSMISSION FLUID PUMP CONTROL CIRCUIT LOW/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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P2798

Auxiliary Transmission Fluid Pump Control Circuit Low Voltage

DTC P2799

Auxiliary Transmission Fluid Pump Control Circuit High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control module and the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump by providing a 12 V ground pulse width modulation (PWM) signal to the pump motor to request a specific motor speed.

Conditions for Running the DTC

Ignition ON.

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Conditions for Setting the DTC

DTC P2798

The voltage at the hybrid/EV powertrain control module 1 output to the auxiliary transmission fluid pump control is open or shorted to ground for 4 seconds.

DTC P2799

The voltage at the hybrid/EV powertrain control module 1 output to the auxiliary transmission fluid pump control is shorted to voltage for 4 seconds.

Action Taken When the DTC Sets

- DTCs P2798 and P2799 are Type A DTCs.
- Vehicle speed will be limited, the Propulsion Power is Reduced message will be illuminated.

Conditions for Clearing the DTC

- DTCs P2798 and P2799 are Type A DTCs.
- The condition for setting the DTC is no longer present.

Diagnostic Aids

DTC P2798 may set under low 12V battery conditions. Always diagnose low 12V battery concerns first.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Power Inverter Module Description and Operation

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. Verify no 12V battery system voltage LOW DTCs are set or that a low 12V battery condition was not present at the time the DTC was set.
 - **If any of the DTCs were set or a low 12V battery condition was present**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If the DTCs were not set or a low 12V battery condition was not present**
2. Verify no ECM loss of communication DTCs U0100/U1818 are set indicating that a KR75 Engine Controls Ignition Relay concern is present.
 - **If any of the DTCs were set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If the DTCs were not set**

3. 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.
4. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC is not set**

5. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G5 Transmission Fluid Pump Electric/Auxiliary.
2. Connect a test lamp between the enable circuit terminal 5 and the ground circuit terminal 6.
3. Vehicle OFF. Verify the test lamp is OFF.

- **If the test lamp is ON**

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

- **If the test lamp is OFF**

4. Vehicle ON, verify the test lamp illuminates. Command the Auxiliary Transmission Fluid Pump ON (20 - 70%) with a scan tool if necessary.

- **If the test lamp is OFF**

1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
2. Test for infinite resistance between the enable 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 Ω in the enable circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
4. Replace the T6 Power Inverter Module.

- **If the test lamp is ON**

5. Replace the G5 Transmission Fluid Pump Electric/Auxiliary.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Transmission Fluid Pump Removal](#) for G5 Auxiliary Transmission Fluid Pump, often referred to as the A/Trans Aux Fluid Pump Motor, replacement.
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, setup, and programming.

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:

- [Accessory DC Power Control Module Description and Operation](#)
- [Drive Motor Power Inverter Module Description and Operation](#)
- [Engine Control Module \(ECM\) Description and Operation](#)
- [Electromagnetic Compatibility Description](#)
- [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](#)
- [Sport Mode Indicator Malfunction](#)

SPORT MODE INDICATOR 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide 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 monitors the signal circuit from the Sport Mode switch. When the Sport Mode switch is pressed once, the body control module will request the ECM via serial data to enable Sport Mode. The ECM will request the instrument cluster via serial data to turn the Sport Mode indicator ON to notify the driver of the activation.

When the Sport Mode switch is pressed again, the body control module will request the ECM to disable the Sport Mode. The ECM will request the instrument cluster via serial data to turn the Sport Mode Off and the instrument cluster will display Normal to notify the drive of the deactivation. The Sport Mode switch is part of the S48E Multifunction Switch-Center Console and is not serviced separately.

Reference Information

Schematic Reference

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. Vehicle in Service Mode.
2. Verify the scan tool Sport Mode parameter in the ECM Hybrid/EV data list changes between Active and Inactive while pressing and releasing the Sport Mode switch.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
3. Replace the P16 Instrument Cluster.

[Circuit/System Testing](#)

1. Vehicle OFF, scan tool disconnected, and all vehicle systems OFF, disconnect the harness connector at the S48E Multifunction Switch-Center Console. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 10 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Sport Mode parameter in the ECM Hybrid/EV data list is Inactive.
 - **If not Inactive**
 1. Vehicle OFF, disconnect the X6 harness connector at the K9 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 Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the ground circuit terminal 10.
6. Verify the scan tool Sport Mode parameter in the ECM Hybrid/EV data list is Active.
 - **If not Active**
 1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module, vehicle in service mode.
 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. Vehicle OFF.

4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

7. Test or replace the S48E Multifunction Switch-Center Console.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the S48E Multifunction Switch-Center Console.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 10 with the switch in the open position.
 - **If less than infinite resistance**

Replace the S48E Multifunction Switch-Center Console.
 - **If infinite resistance**
3. Test for less than 2 Ω between the signal circuit terminal 2 and the ground terminal 10 with the switch in the closed position.
 - **If 2 Ω or greater**

Replace the S48E Multifunction Switch-Center Console.
 - **If less than 2 Ω**
4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Instrument Cluster Replacement](#)
- Refer to [Front Floor Console Trim Plate Replacement](#) for S48E Multifunction Switch-Center Console replacement.
- Refer to [Control Module References](#) for body control module or instrument cluster replacement, programming and setup

DC POWER CONVERSION TEST

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Circuit/System Description

The 14 V power module, often referred to as the accessory DC power control module, converts the high voltage (360 V) direct current (DC) to low voltage (14 V) DC to charge the 12 V battery and to operate the power accessories.

The ECM uses two circuits to control and monitor the state of the 14 V power module, often referred to as the accessory DC power control module.

The status circuit functions much like the F Terminal circuit on a generator equipped vehicle. A high side driver in the 14 V power module applies a duty cycled voltage to the ECM. The duty cycle indicates the 14 V power module internal temperature and operational condition.

The control circuit functions much like the L Terminal circuit on a generator equipped vehicle. A high side driver in the ECM applies a duty cycled voltage to the 14 V power module. The duty cycle controls the 14 V power module output.

The 14 V power module generates more power as the commanded duty cycle increases.

Diagnostic Aids

Using a carbon pile tester is the preferred method to test the 14 V power module. The carbon pile tester can put an increasing load on the system to reach a target current level. If a carbon pile tester is not available, the alternative method is using the scan tool 14 V power module setpoint.

Reference Information

Schematic Reference

- [Starting and Charging Schematics](#)
- [Hybrid/EV Controls 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

1. Vehicle ON.
2. Verify DTC P1F59, P1F5A, P1F5B, P1F5D, or P1F5E is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If the DTCs are not set**
3. Vehicle OFF. Measure and record the C1 battery voltage at the C1 battery terminals. The C1 battery voltage should stabilize between 12.4 and 12.8 V within a few minutes of turning the vehicle OFF.
 - **If not within the specified range**

Refer to [Battery Inspection/Test](#) .
 - **If within the specified range**
4. Vehicle ON, accessories OFF.
5. 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 in step 1 but less than 15 V.
 - **If not within the specified range**

Refer to Circuit/System Testing.
 - **If within the specified range**
6. All OK.

Circuit/System Testing

NOTE: If a carbon pile tester is available, refer to With Carbon Pile Tester section. Otherwise, refer to Without Carbon Pile Tester section.

With Carbon Pile Tester

1. Vehicle ON.
2. Verify DTC P1F59, P1F5A, P1F5B, P1F5D, or P1F5E is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If the DTCs are not set**
3. Verify that no K1 14 V Power Module or B18 Battery Current Sensor 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. Test for 12.4 V or greater at room temperature across the C1 Battery terminals.
 - **If not within the specified range**

Refer to [Battery Inspection/Test](#) .
 - **If within the specified range**
6. Connect a carbon pile tester to the C1 Battery.
7. Vehicle ON, turn all accessories off. Observe the voltage reading on the tester. The voltage should read between 12.6 - 15.5 V.
8. Adjust the carbon pile tester so that the Low - Voltage Battery Current parameter on the 14 V Power Module data list of the Engine Control Module is reading 125 amps.
9. Verify the voltage reading remains between 12.6 - 15.5 V.
 - **If not within the specified range**
 1. Disconnect the X2 harness connector at the 14 V power module, vehicle ON.
 2. Test for 3.0 - 5.5 V between the control circuit terminal X2-01 and ground.
 - If less than 3.0 V
 1. Vehicle OFF, disconnect the harness connectors at the K20 ECM.
 2. Test for less than 2 Ω in the control circuit end to end.
 - If greater than 2 Ω , repair the open/high resistance in the circuit.
 - If less than 2 Ω
 3. Replace the K20 ECM.
 - If within 3.0 - 5.5 V
 3. Replace the K1 14 V Power Module.
 - **If within the specified range**
10. All OK.

Without Carbon Pile Tester

1. Vehicle ON.
2. Verify DTC P1F59, P1F5A, P1F5B, P1F5D, or P1F5E is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If the DTCs are not set**
3. Verify that no K1 14 V Power Module or B18 Battery Current Sensor 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. Test for 12.4 V or greater at room temperature across the C1 Battery terminals.

- **If not within the specified range**

Refer to [Battery Inspection/Test](#).

- **If within the specified range**

6. Vehicle ON.

7. Verify the scan tool Engine Control Module Ignition 1 Signal parameter continually increases when controlling the Engine Control Module 14 V Power Module Setpoint from 10 - 80% with a scan tool. It may take up to 10 s for the battery voltage to stabilize between each setpoint change.

- **If the battery voltage does not continually increase**

1. Disconnect the X2 harness connector at the 14 V power module, vehicle ON.

2. Test for 3.0 - 5.5 V between the control circuit terminal X2-01 and ground.

- If less than 3.0 V

1. Vehicle OFF, disconnect the harness connectors at the K20 ECM.

2. Test for less than 2 Ω in the control circuit end to end.

- If greater than 2 Ω , repair the open/high resistance in the circuit.

- If less than 2 Ω

3. Replace the K20 ECM.

- If within 3.0 - 5.5 V

3. Replace the K1 14 V Power Module.

- **If the battery voltage continually increases**

8. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for K1 14 V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup.

REPAIR INSTRUCTIONS

ENGINE CONTROL MODULE REPLACEMENT

Removal Procedure

CAUTION:

- Turn the ignition OFF when installing or removing the control module connectors and disconnecting or reconnecting the power to the control module (battery cable, powertrain control module (PCM)/engine control module (ECM)/transaxle control module (TCM) pigtail, control module fuse, jumper cables, etc.) in order to prevent internal control module damage.
- Control module damage may result when the metal case contacts battery voltage. DO NOT contact the control module metal case with battery voltage when servicing a control module, using battery booster cables, or when charging the vehicle battery.
- In order to prevent any possible electrostatic discharge damage to the control module, do not touch the connector pins or the soldered components on the circuit board.
- Remove any debris from around the control module connector surfaces before servicing the control module. Inspect the control module connector gaskets when diagnosing or replacing the control module. Ensure that the gaskets are installed correctly. The gaskets prevent contaminant intrusion into the control module.
- The replacement control module must be programmed.

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection](#)

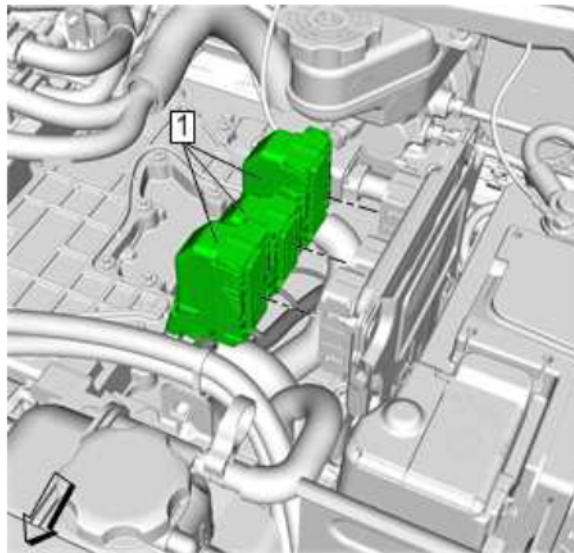


Fig. 10: Engine Control Module Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Engine Control Module Electrical Connectors (1) (Qty: 3)

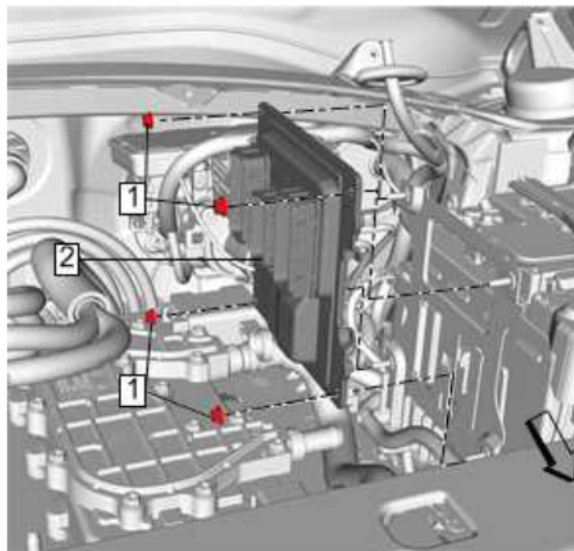


Fig. 11: Engine Control Module And Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

3. Remove Engine Control Module Bracket Nuts (1) (Qty: 4)
4. Remove Engine Control Module (2)

Installation Procedure

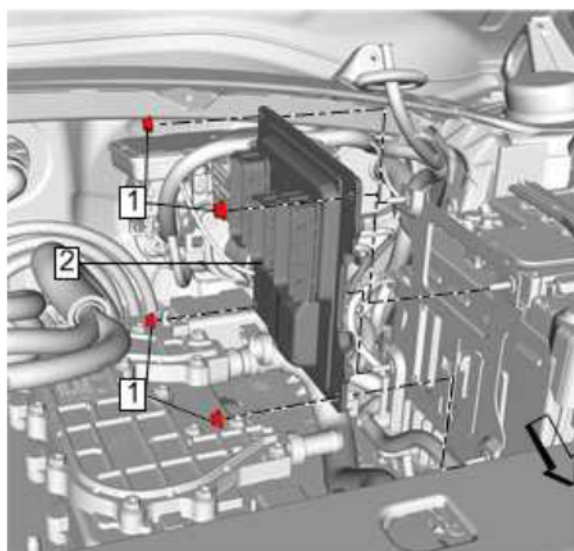


Fig. 12: Engine Control Module And Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

1. Using a flat bladed tool, release the ECM bracket retainer. Slide the ECM and bracket assembly to the battery tray.
2. Install Engine Control Module (2)

CAUTION: Refer to [Fastener Caution](#)

3. Install and tighten Engine Control Module Bracket Nuts (1) (Qty: 4) to 4.7 N.m (42 lb in)

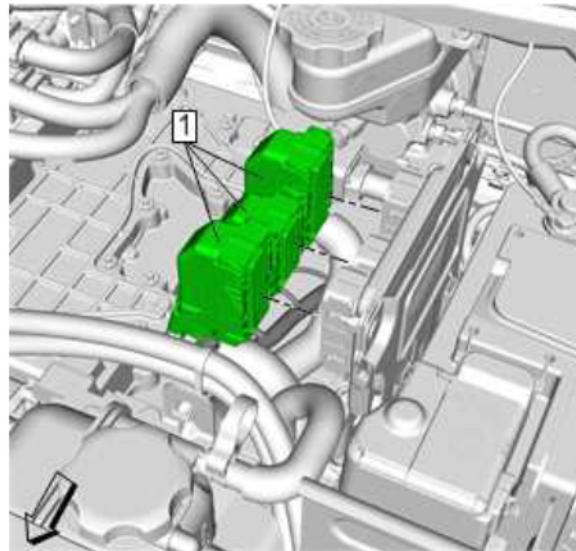


Fig. 13: Engine Control Module Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

4. Connect Engine Control Module Electrical Connectors (1) (Qty: 3)
5. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
6. If replacing the engine control module, reprogram the module. Refer to [Control Module References](#)

ENGINE CONTROL MODULE BRACKET REPLACEMENT

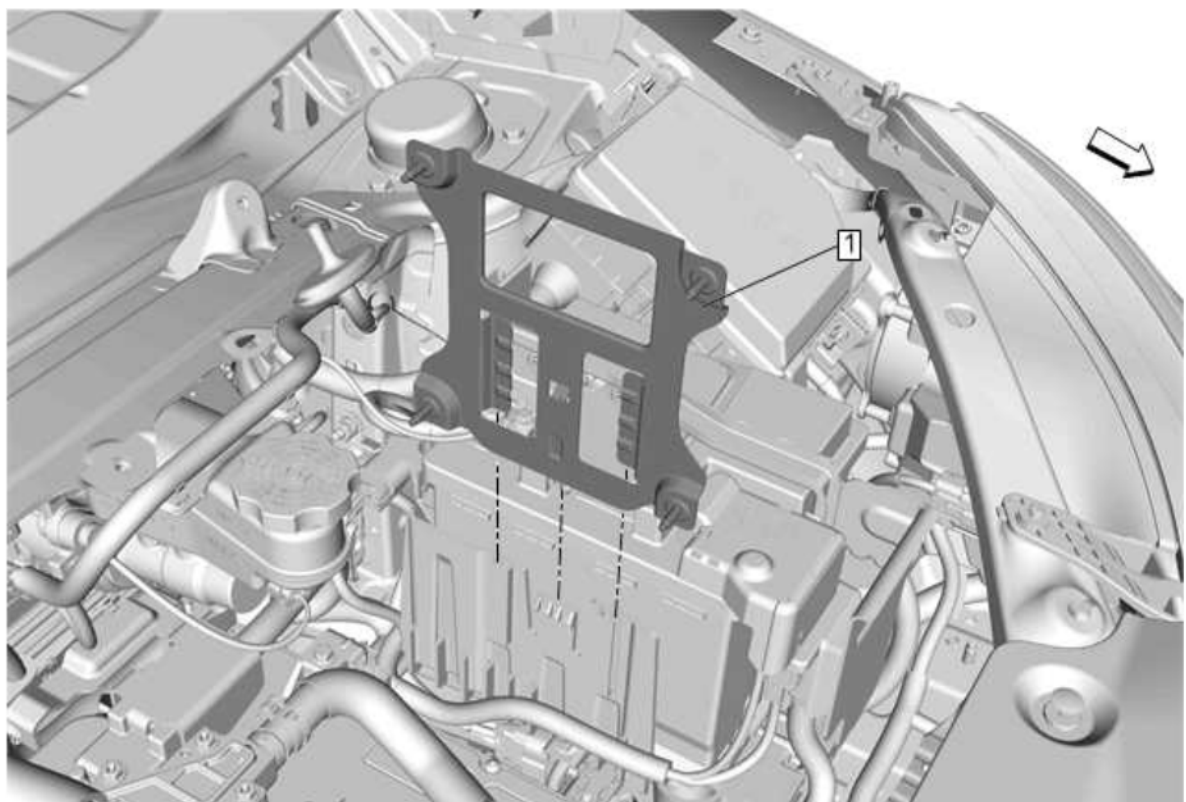


Fig. 14: Engine Control Module Bracket
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
Remove Engine Control Module. Refer to Engine Control Module Replacement	
1	Engine Control Module Bracket

DRIVE MOTOR POWER INVERTER MODULE 3 PHASE CABLE 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 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.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Remove Drive Motor Rear Mount Bracket. Refer to [Drive Motor Rear Mount Bracket Replacement](#)

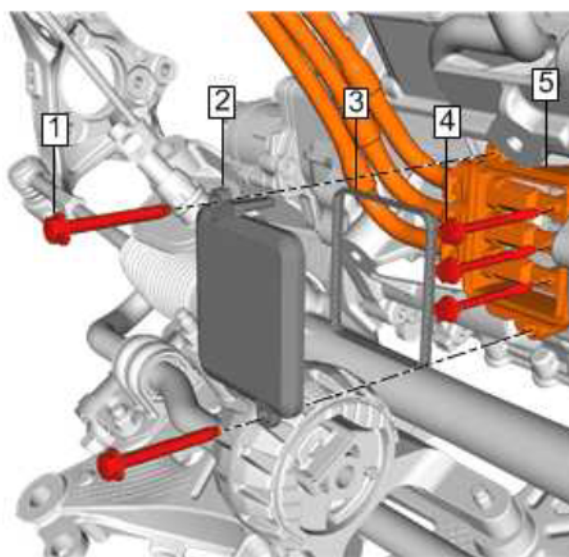


Fig. 15: Drive Motor Power Inverter Module 3-Phase Cable Connector Cover, Bolts And Seal
Courtesy of GENERAL MOTORS COMPANY

3. Remove Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Bolts (1) (Qty: 2)
4. Remove Drive Motor Power Inverter Module 3-Phase Cable Connector Cover (2)
5. Remove and DISCARD Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Seal (3)
6. Loosen Drive Motor Power Inverter Module 3-Phase Cable Bolts (4) (Qty: 3)

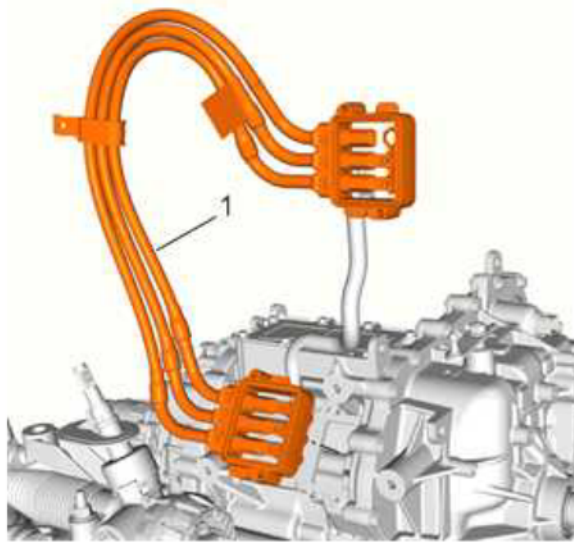


Fig. 16: Drive Motor Power Inverter Module 3-Phase Cable
 Courtesy of GENERAL MOTORS COMPANY

7. Remove Drive Motor Power Inverter Module 3-Phase Cable (1)

Installation Procedure

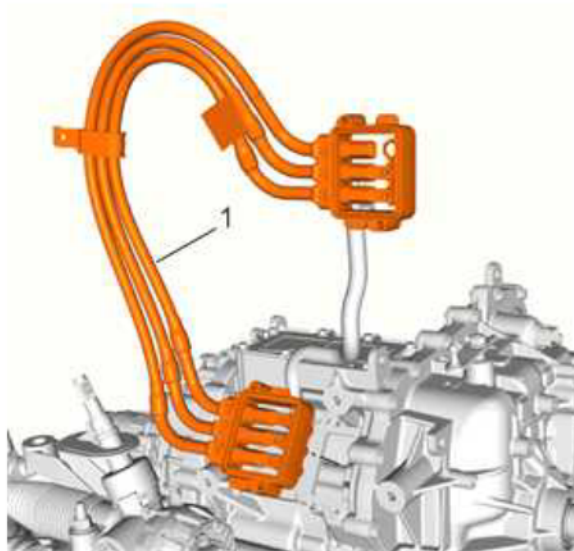


Fig. 17: Drive Motor Power Inverter Module 3-Phase Cable
 Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Power Inverter Module 3-Phase Cable (1)

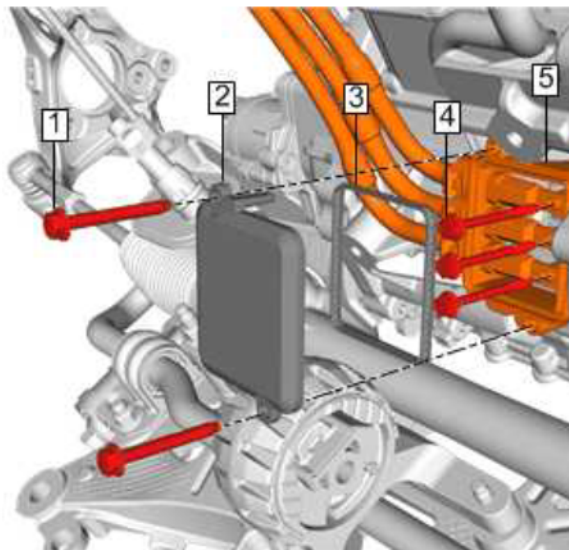


Fig. 18: Drive Motor Power Inverter Module 3-Phase Cable Connector Cover, Bolts And Seal
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#).

2. Tighten Drive Motor Power Inverter Module 3-Phase Cable Bolts (4) (Qty: 3) 9 N.m (80 lb in)
3. Install NEW Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Seal (3)
4. Install Drive Motor Power Inverter Module 3-Phase Cable Connector Cover (2)
5. Install Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Bolts (1) (Qty: 2) to 9 N.m (80 lb in)
6. Install Drive Motor Rear Mount Bracket. Refer to [Drive Motor Rear Mount Bracket Replacement](#)
7. Enable the high voltage system. Refer to [High Voltage Enabling](#)

DRIVE MOTOR 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 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.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the drive motor generator power inverter module cooling system. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
3. Remove Radiator Surge Tank Support Bracket (RESS). Refer to [Radiator Surge Tank Support Bracket Replacement \(Radiator\)](#) [Radiator Surge Tank Support Bracket Replacement \(Heater\)](#) [Radiator Surge Tank Support Bracket Replacement \(RESS\)](#)
4. Remove High Voltage Battery Control Wiring Junction Block. Refer to [High Voltage Battery Control Wiring Junction Block Replacement \(With quick charge\)](#) [High Voltage Battery Control Wiring Junction Block Replacement \(Without quick charge\)](#)

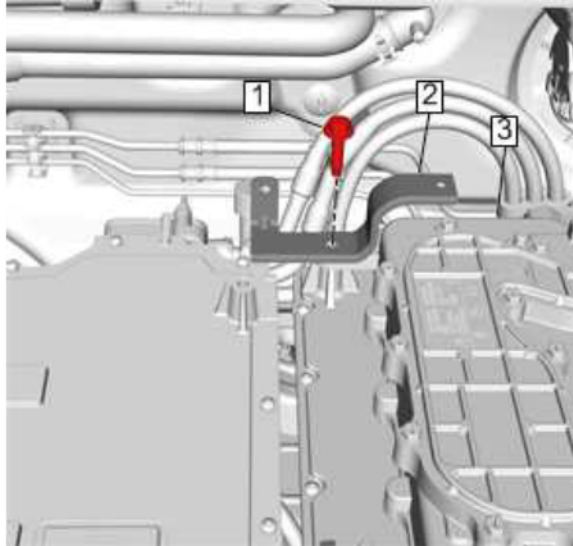


Fig. 19: Engine Wiring Harness Bracket, Bolt And Accessory DC Power Control Module
Courtesy of GENERAL MOTORS COMPANY

5. Remove Engine Wiring Harness Bracket Bolt (1) @ Accessory DC Power Control Module (3)
6. Reposition Engine Wiring Harness Bracket (2) @ Accessory DC Power Control Module (3)

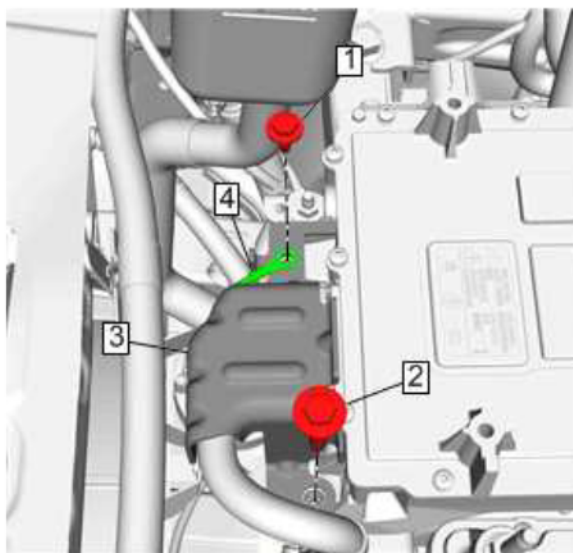
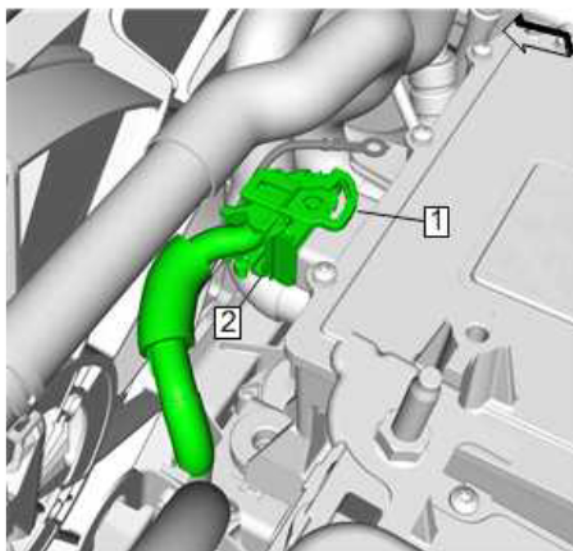


Fig. 20: Drive Motor Power Inverter Module Shield, Bolts And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

7. Remove Drive Motor Power Inverter Module Shield Bolts (1, 2)
8. Remove Ground Cable (4)
9. Remove Drive Motor Power Inverter Module Shield (3)



10. Release Engine Wiring Harness Connector Handle (1) catch, and rotate forward
11. Remove Engine Wiring Harness Connector (2)

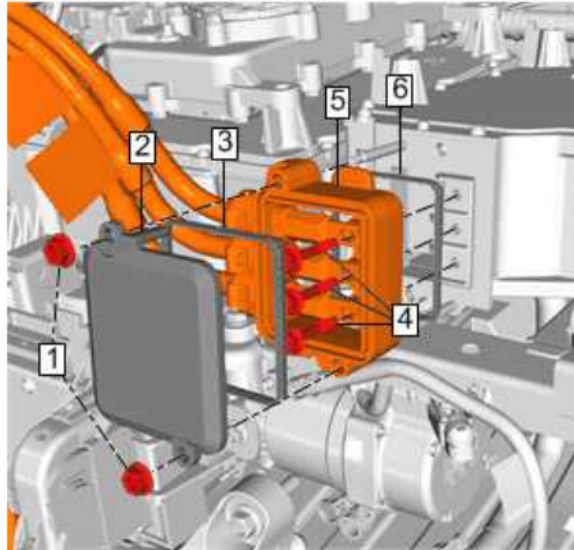


Fig. 22: Drive Motor Power Inverter Module 3-Phase Cable, Cover, Nuts, Bolts And Seals
Courtesy of GENERAL MOTORS COMPANY

12. Remove Drive Motor Power Inverter Module 3-Phase Cable Cover Nuts (1) (Qty: 2)
13. Remove Drive Motor Power Inverter Module 3-Phase Cable Cover (2)
14. Remove and DISCARD Drive Motor Power Inverter Module 3-Phase Cable Cover Seal (3)
15. Loosen Drive Motor Power Inverter Module 3-Phase Cable Bolts (4) (Qty: 3)
16. Remove Drive Motor Power Inverter Module 3-Phase Cable (5)
17. Remove and DISCARD Drive Motor Power Inverter Module 3-Phase Cable Seal (6)

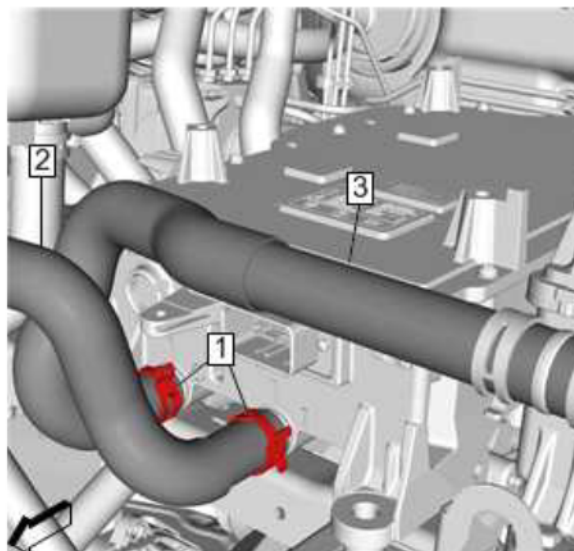


Fig. 23: Drive Motor Generator Control Module Radiator/Cooling Outlet Hoses And Clamps
Courtesy of GENERAL MOTORS COMPANY

18. Release Clamp (1) and remove Drive Motor Generator Control Module Radiator Outlet Hose (2)
19. Release Clamp (1) and remove Drive Motor Generator Control Module Cooling Outlet Hose (3)

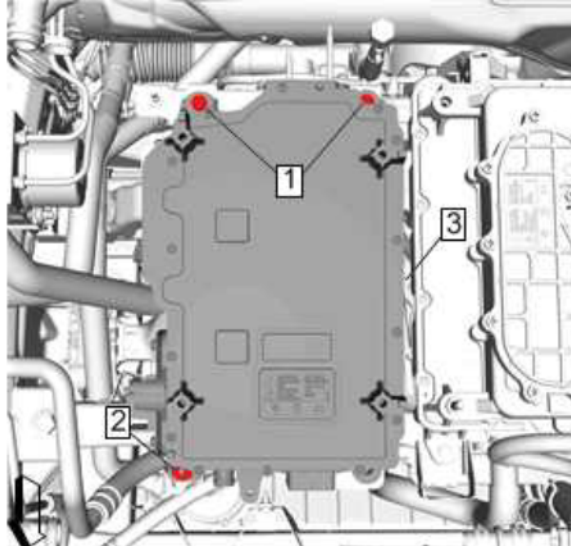


Fig. 24: Drive Motor Power Inverter Module Bolts And Nut
 Courtesy of GENERAL MOTORS COMPANY

20. Remove Drive Motor Power Inverter Module Bolts (1) (Qty: 2)
21. Remove Drive Motor Power Inverter Module Nut (2)



Fig. 25: Drive Motor Power Inverter Module
 Courtesy of GENERAL MOTORS COMPANY

22. Remove Drive Motor Power Inverter Module (1)

Installation Procedure



1. Install Drive Motor Power Inverter Module (1)

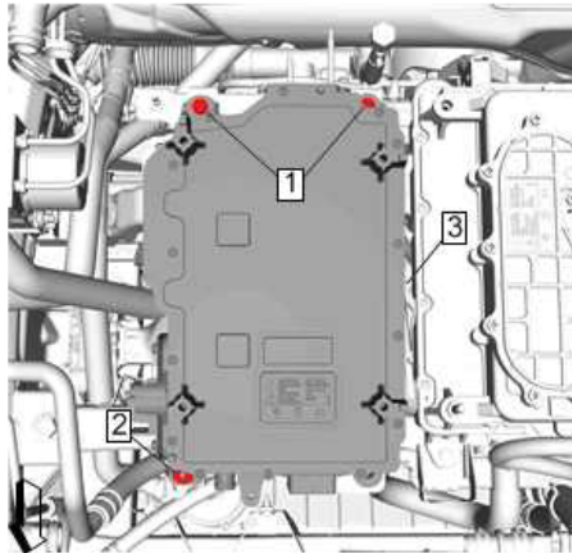


Fig. 27: Drive Motor Power Inverter Module Bolts And Nut
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Install Drive Motor Power Inverter Module Bolts (1) (Qty: 2) and tighten to 22 N.m (16 lb ft)
3. Install Drive Motor Power Inverter Module Nut (2) and tighten to 22 N.m (16 lb ft)

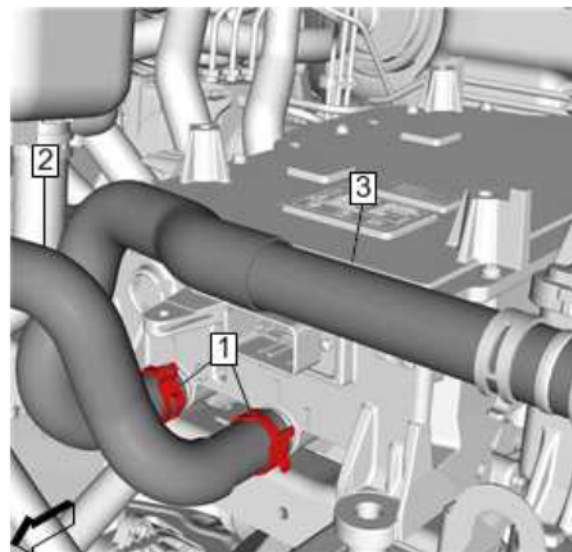


Fig. 28: Drive Motor Generator Control Module Radiator/Cooling Outlet Hoses And Clamps
Courtesy of GENERAL MOTORS COMPANY

4. Install the Drive Motor Generator Control Module Cooling Outlet Hose (3) and Engage the Clamp (1)
5. Install the Drive Motor Generator Control Module Radiator Outlet Hose (2) and Engage the Clamp (1)

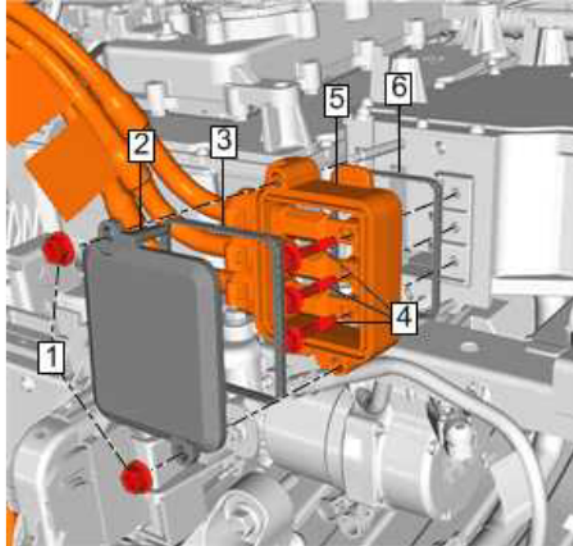


Fig. 29: Drive Motor Power Inverter Module 3-Phase Cable, Cover, Nuts, Bolts And Seals
Courtesy of GENERAL MOTORS COMPANY

6. Clean all of the gasket surfaces.
7. Install NEW Drive Motor Power Inverter Module 3-Phase Cable Seal (6)
8. Install Drive Motor Power Inverter Module 3-Phase Cable (5)

CAUTION: Refer to **Fastener Caution** .

9. Tighten Drive Motor Power Inverter Module 3-Phase Cable Bolts (4) (Qty: 3) to 9 N.m (80 lb in)
10. Install NEW Drive Motor Power Inverter Module 3-Phase Cable Cover Seal (3)
11. Install Drive Motor Power Inverter Module 3-Phase Cable Cover (2)
12. Install Drive Motor Power Inverter Module 3-Phase Cable Cover Nuts (1) (Qty: 2) and tighten to 9 N.m (80 lb in)

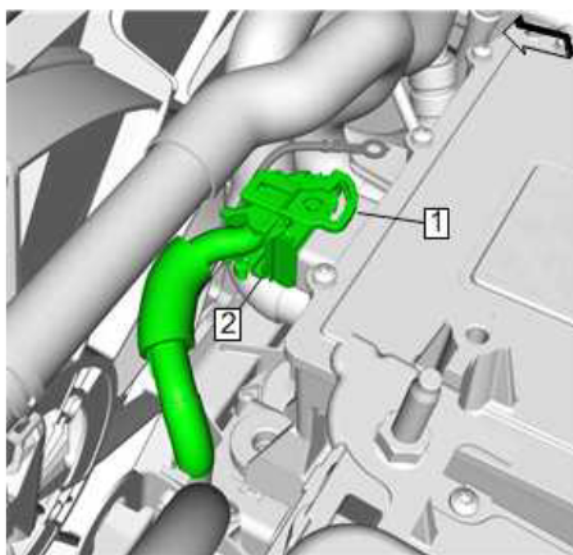


Fig. 30: Engine Wiring Harness Connector And Handle
Courtesy of GENERAL MOTORS COMPANY

13. Install Engine Wiring Harness Connector (2).
14. Lock the handle (1) into lock position.

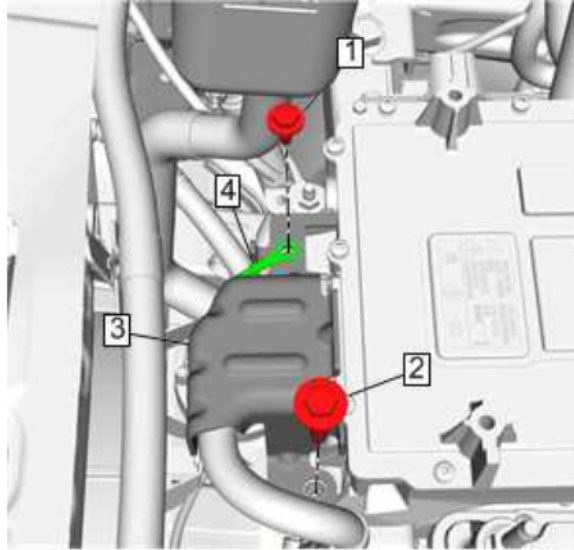


Fig. 31: Drive Motor Power Inverter Module Shield, Bolts And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

15. Install Drive Motor Power Inverter Module Shield (3)
16. Install Ground Cable (4)
17. Install Drive Motor Power Inverter Module Shield Bolt (1) and tighten to 9 N.m (80 lb in)
18. Install Drive Motor Power Inverter Module Shield Bolt (2) and tighten to 25 N.m (18 lb ft)

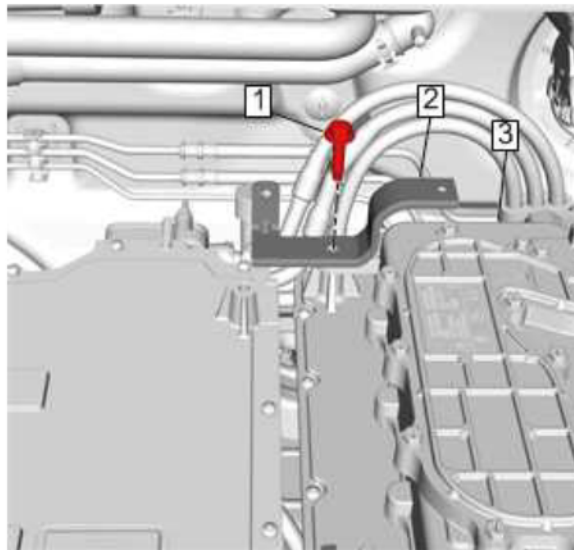


Fig. 32: Engine Wiring Harness Bracket, Bolt And Accessory DC Power Control Module
Courtesy of GENERAL MOTORS COMPANY

19. Install Engine Wiring Harness Bracket (2) @ Accessory DC Power Control Module (3)
20. Install Engine Wiring Harness Bracket Bolt (1) @ Accessory DC Power Control Module (3) and tighten to 22 N.m (16 lb ft)
21. Install High Voltage Battery Control Wiring Junction Block. Refer to [High Voltage Battery Control Wiring Junction Block Replacement \(With quick charge\)](#)[High Voltage Battery Control Wiring Junction Block Replacement \(Without quick charge\)](#)
22. Install Radiator Surge Tank Support Bracket (RESS). Refer to [Radiator Surge Tank Support Bracket Replacement \(Radiator\)](#) [Radiator Surge Tank Support Bracket Replacement \(Heater\)](#) [Radiator Surge Tank Support Bracket Replacement \(RESS\)](#)
23. Fill the drive motor generator power inverter module cooling system. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
24. Enable the high voltage system. Refer to [High Voltage Enabling](#)
25. Program the Drive Motor Power Inverter Module. Refer to [Control Module References](#)

HIGH VOLTAGE BATTERY CONTROL WIRING JUNCTION BLOCK REPLACEMENT (WITH QUICK CHARGE)

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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 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.

1. Disable High Voltage System. Refer to [High Voltage Disabling](#)

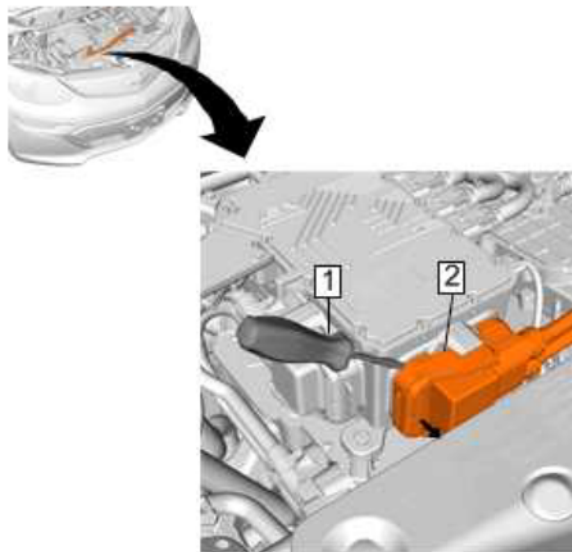


Fig. 33: Flat Blade Screwdriver And Connector Handle Lock

Courtesy of GENERAL MOTORS COMPANY

2. Using a flat blade screwdriver (1), pry the edge of the connector handle lock (2) from the holding tab.
3. Release the connector handle lock by rotating the connector handle forward.
4. With the connector handle in the release position, disconnect the high voltage charger connector, from the high power distribution module.

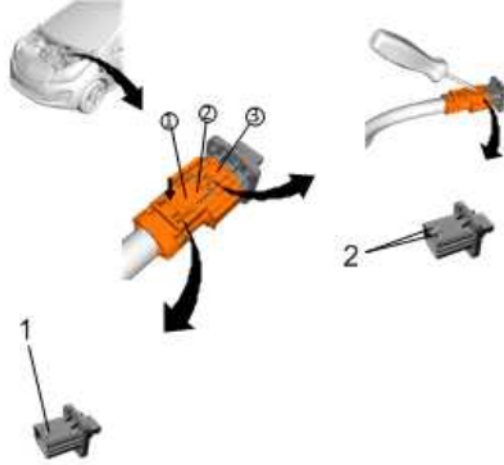


Fig. 34: First Stage Connector Tab And Connector Retaining Tabs
 Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the 2-stage high voltage connectors in the following sequence:
 - Push down on the connector tab and release the connector from the first stage connector tab (1).
 - Using a flat blade screwdriver inserted into the connector as shown, release the second stage safety catch, from the 2 connector retaining tabs (2).

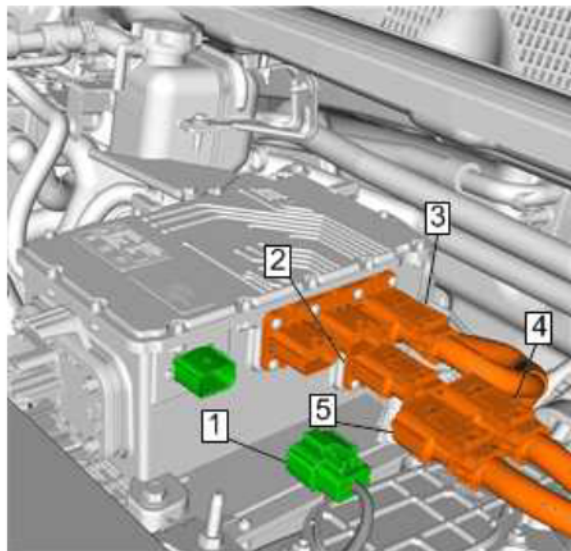


Fig. 35: Generator Battery Control Wiring Junction Block And Connectors
 Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Low Voltage connection connector (1) @ Generator Battery Control Wiring Junction Block
7. After releasing the 2-stage safety connectors, remove the A/C Control module connector (5) and Drive Motor Battery Charger & auxiliary power module connector (4) from the Generator Battery Control Wiring Junction Block.
8. Remove the RESS heater connector (3) and Drive Motor Battery Charger & auxiliary power module to RESS connector (2) from the Generator Battery Control Wiring Junction Block.

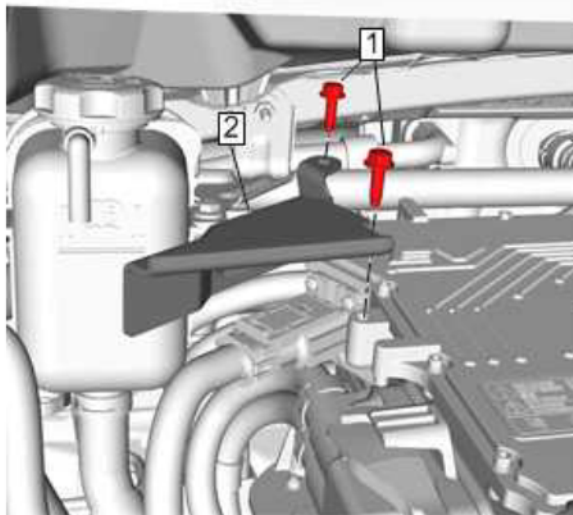


Fig. 36: Accessory DC Power Control Module High Voltage Connector Protector And Bolts
 Courtesy of GENERAL MOTORS COMPANY

9. Remove Accessory DC Power Control Module High Voltage Connector Protector Bolt (1) (Qty: 2)
10. Remove Accessory DC Power Control Module High Voltage Connector Protector (2)

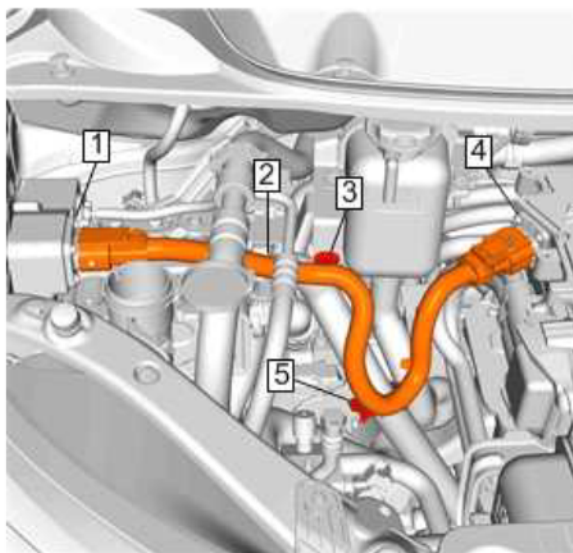


Fig. 37: Drive Motor Battery Positive and Negative Cable
 Courtesy of GENERAL MOTORS COMPANY

11. Disconnect Drive Motor Battery Positive and Negative Cable (1) @ Generator Battery Control Wiring Junction Block

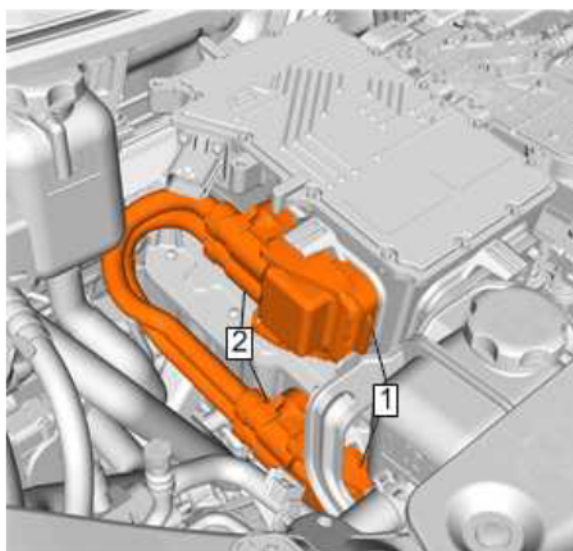


Fig. 38: Battery Positive Cable Extension Cable And Connector Handle
 Courtesy of GENERAL MOTORS COMPANY

12. Insert Small, flat bladed tool at Battery Positive Cable Extension Cable Connector Handle (1) release tab and lift to disengage
13. Remove Battery Positive Cable Extension Cable (2)

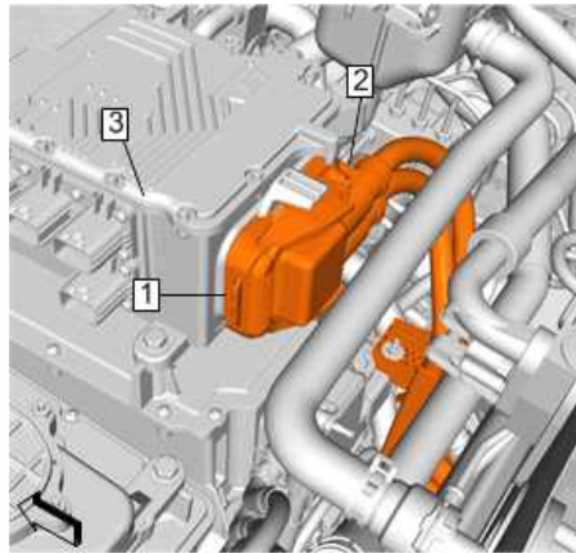


Fig. 39: 300-Volt Battery Positive and Negative Cable, Connection Handle And Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

14. Sliding 300-Volt Battery Positive and Negative Cable Connection Handle (1) Forward
15. Release 300-Volt Battery Positive and Negative Cable (2) @ Generator Battery Control Wiring Junction Block (3)

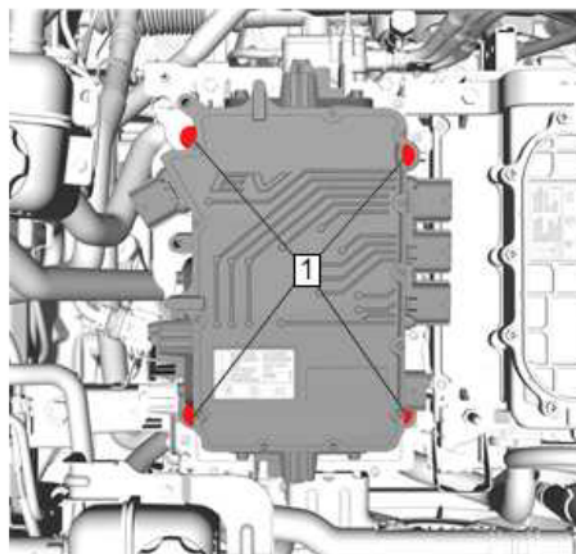


Fig. 40: Generator Battery Control Wiring Junction Block Bolts
Courtesy of GENERAL MOTORS COMPANY

16. Generator Battery Control Wiring Junction Block Bolts (1) (Qty: 4)

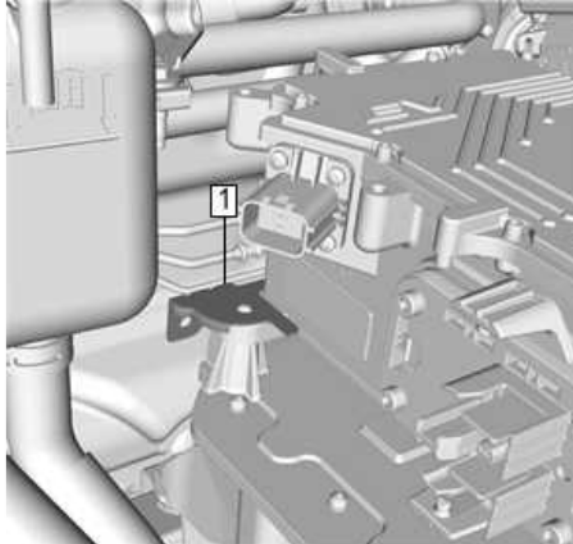


Fig. 41: Engine Wiring Harness Bracket
Courtesy of GENERAL MOTORS COMPANY

17. Remove Engine Wiring Harness Bracket (1)



Fig. 42: Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

18. Remove Generator Battery Control Wiring Junction Block (1)

Installation Procedure

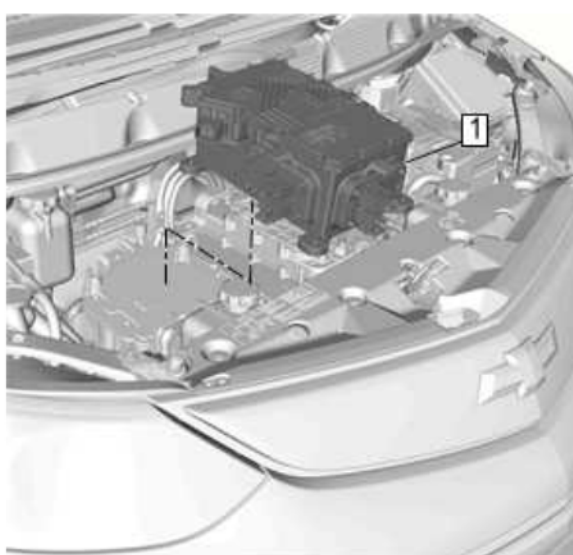


Fig. 43: Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

1. Install Generator Battery Control Wiring Junction Block (1)

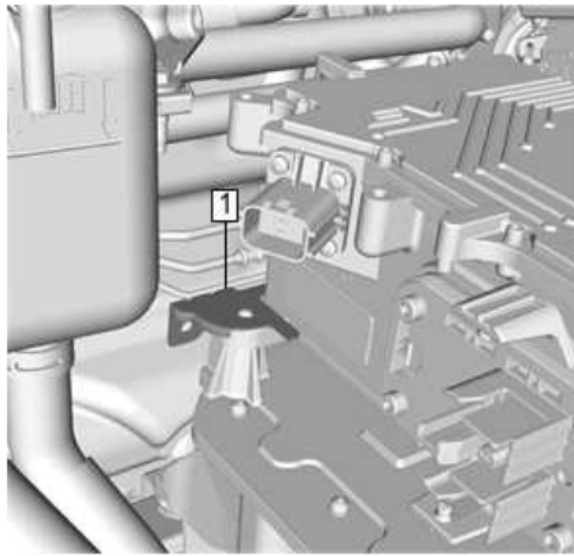


Fig. 44: Engine Wiring Harness Bracket
Courtesy of GENERAL MOTORS COMPANY

2. Install Engine Wiring Harness Bracket (1)

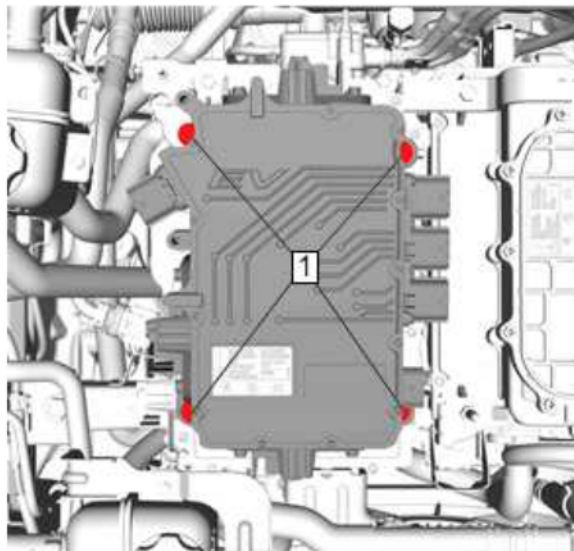


Fig. 45: Generator Battery Control Wiring Junction Block Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

3. Install Generator Battery Control Wiring Junction Block Bolts (1) (Qty: 4) and tighten to 22 N.m (16 lb ft)

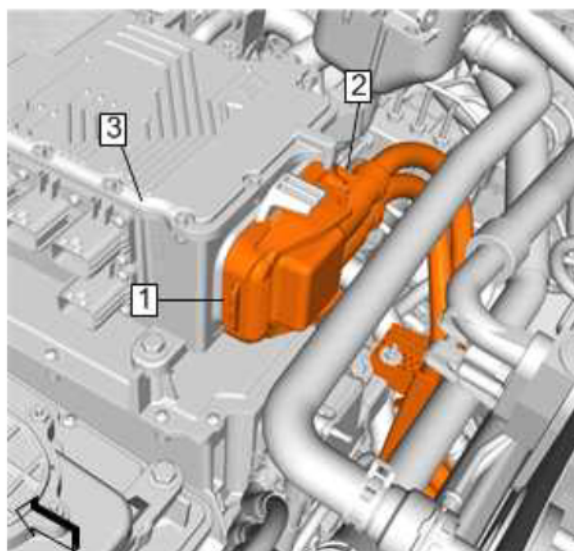


Fig. 46: 300-Volt Battery Positive and Negative Cable, Connection Handle And Generator Battery Control Wiring Junction Block

Courtesy of GENERAL MOTORS COMPANY

4. Connect 300-Volt Battery Positive and Negative Cable (2) @ Generator Battery Control Wiring Junction Block (3)

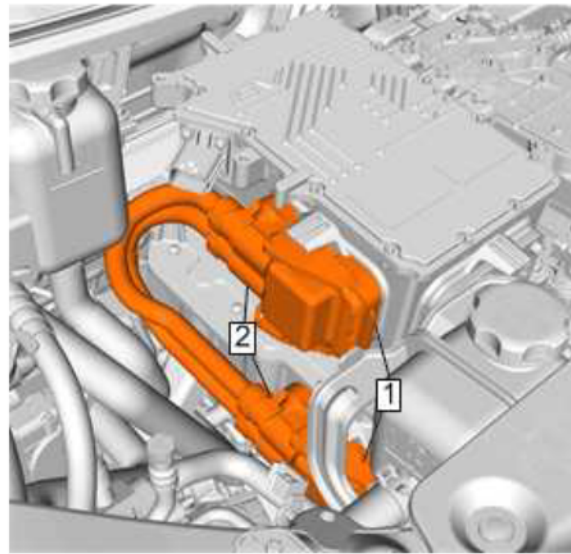


Fig. 47: Battery Positive Cable Extension Cable And Connector Handle

Courtesy of GENERAL MOTORS COMPANY

5. Connect Battery Positive Cable Extension Cable (2)

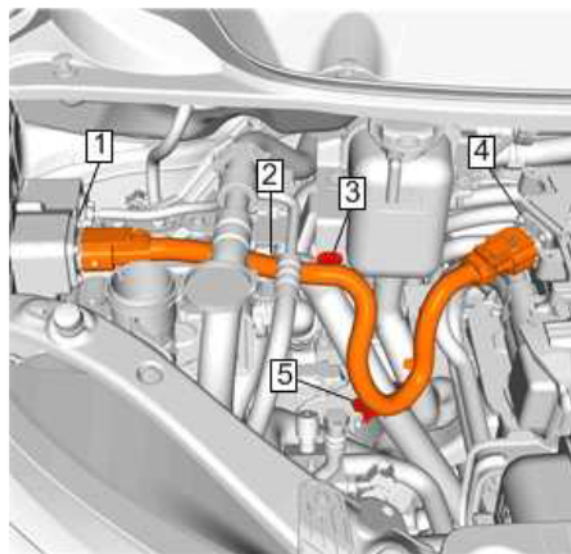


Fig. 48: Drive Motor Battery Positive and Negative Cable

Courtesy of GENERAL MOTORS COMPANY

6. Connect Drive Motor Battery Positive and Negative Cable (1) @ Generator Battery Control Wiring Junction Block

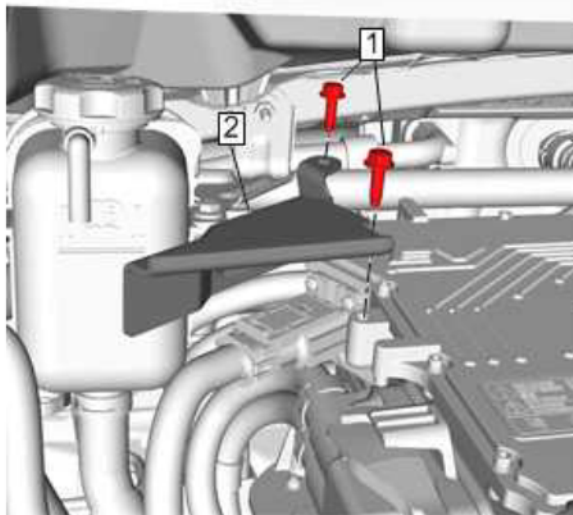


Fig. 49: Accessory DC Power Control Module High Voltage Connector Protector And Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Install Accessory DC Power Control Module High Voltage Connector Protector (2)
8. Install Accessory DC Power Control Module High Voltage Connector Protector Bolts (1) (Qty: 2) and tighten to 9 N.m (80 lb in)

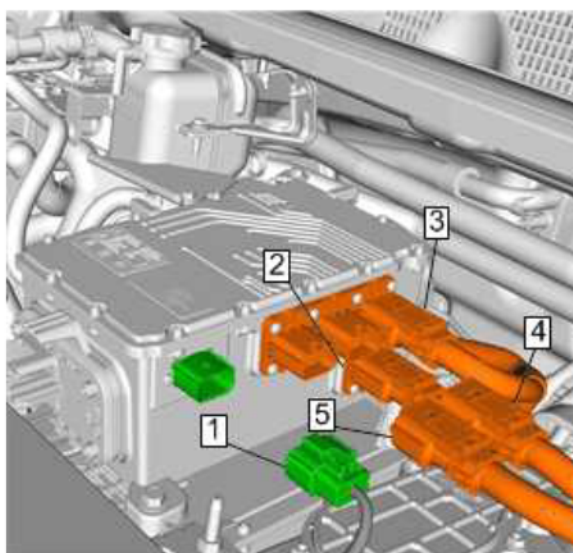


Fig. 50: Generator Battery Control Wiring Junction Block And Connectors
Courtesy of GENERAL MOTORS COMPANY

9. Install the RESS heater connector (3) and Drive Motor Battery Charger & auxiliary power module to RESS connector (2) to the Generator Battery Control Wiring Junction Block.
10. Install the A/C Control module connector (5) and Drive Motor Battery Charger & auxiliary power module connector (4) to the Generator Battery Control Wiring Junction Block.
11. Connect Low Voltage connection connector (1) @ Generator Battery Control Wiring Junction Block

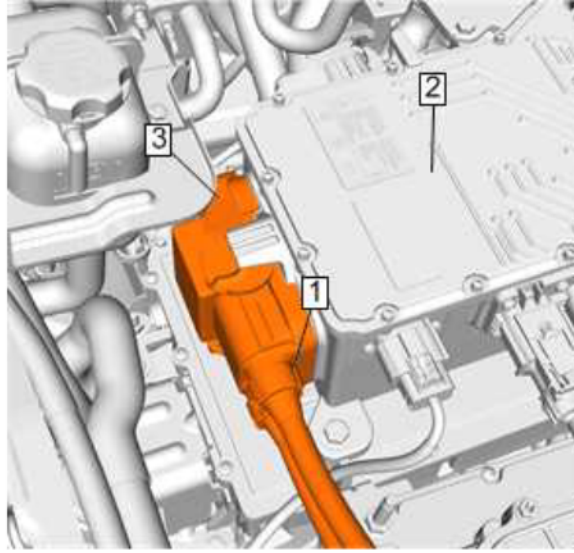


Fig. 51: Drive Motor Battery Charger Receptacle, Generator Battery Control Wiring Junction Block And Handle

Courtesy of GENERAL MOTORS COMPANY

12. Install the Drive Motor Battery Charger Receptacle (1) to the generator battery control wiring junction block (2), and lock the handle (3) into the lock position.
13. Enable High Voltage Stem. Refer to [High Voltage Enabling](#)

HIGH VOLTAGE BATTERY CONTROL WIRING JUNCTION BLOCK REPLACEMENT (WITHOUT QUICK CHARGE)

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 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.

1. Disable High Voltage System. Refer to [High Voltage Disabling](#)

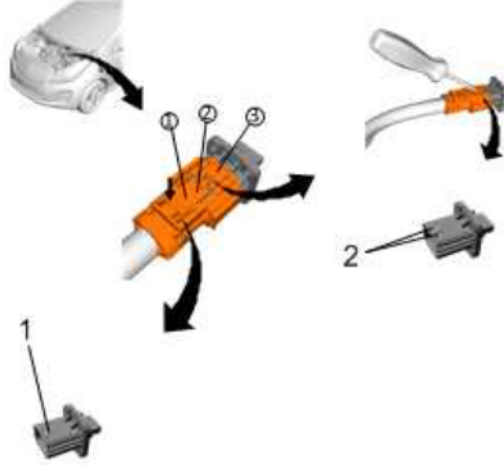


Fig. 52: First Stage Connector Tab And Connector Retaining Tabs
 Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the high voltage connectors in the following sequence:
 - Release the CPA. Push down on the connector tab, and release the connector.

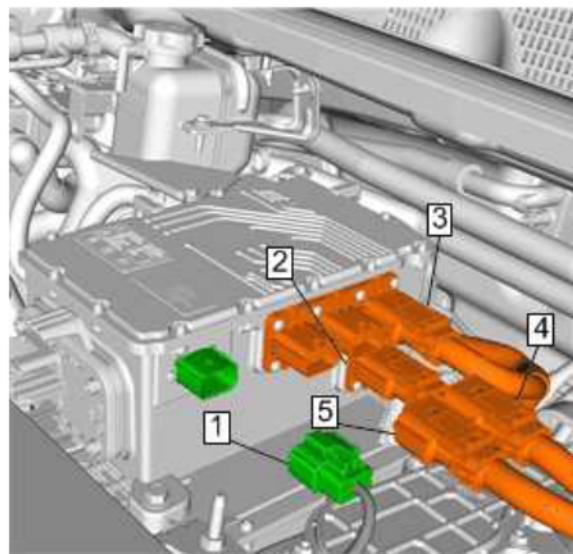
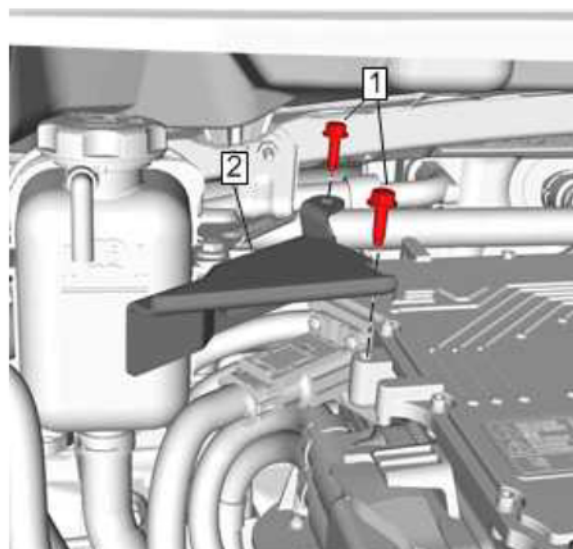


Fig. 53: Generator Battery Control Wiring Junction Block And Connectors
 Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Low Voltage connection connector (1) @ Generator Battery Control Wiring Junction Block
4. After releasing the 2-stage safety connectors, remove the A/C Control module connector (5) and Drive Motor Battery Charger & auxiliary power module connector (4) from the Generator Battery Control Wiring Junction Block.
5. Remove the RESS heater connector (3) and Drive Motor Battery Charger & auxiliary power module to RESS connector (2) from the Generator Battery Control Wiring Junction Block.



6. Remove Accessory DC Power Control Module High Voltage Connector Protector Bolts (1) (Qty: 2)
7. Remove Accessory DC Power Control Module High Voltage Connector Protector (2)

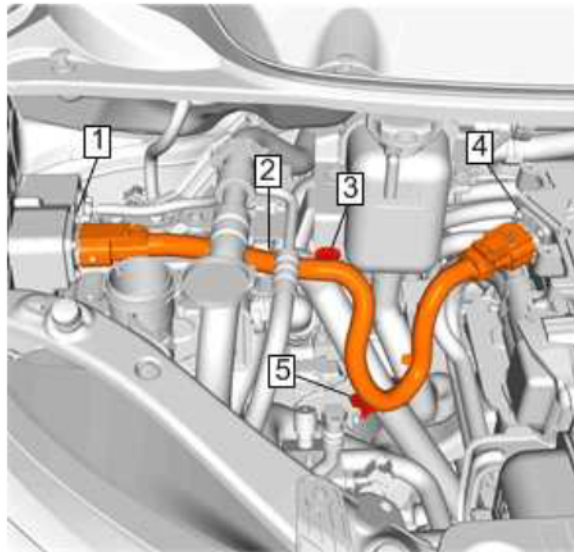


Fig. 55: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Drive Motor Battery Positive and Negative Cable (1) @ Generator Battery Control Wiring Junction Block

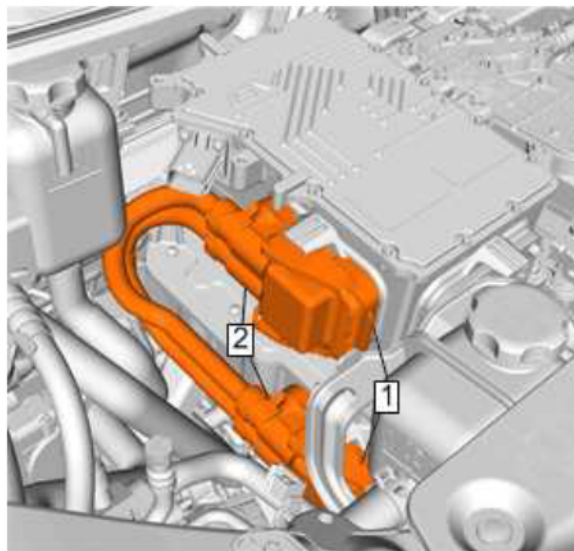


Fig. 56: Battery Positive Cable Extension Cable And Connector Handle
Courtesy of GENERAL MOTORS COMPANY

9. Insert Small, flat bladed tool at Battery Positive Cable Extension Cable Connector Handle (1) release tab and lift to disengage
10. Remove Battery Positive Cable Extension Cable (2)

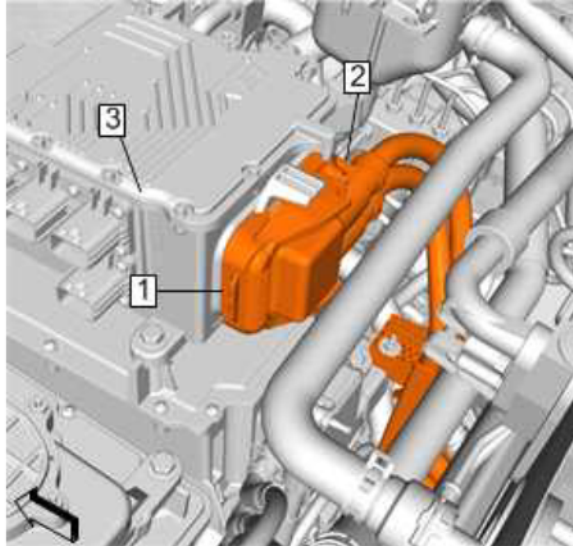


Fig. 57: 300-Volt Battery Positive and Negative Cable, Connection Handle And Generator Battery Control Wiring Junction Block

Courtesy of GENERAL MOTORS COMPANY

11. Insert Small, flat bladed tool at 300-Volt Battery Positive and Negative Cable Connection Handle (1) release tab and lift to disengage
12. Release 300-Volt Battery Positive and Negative Cable (2) @ Generator Battery Control Wiring Junction Block (3)

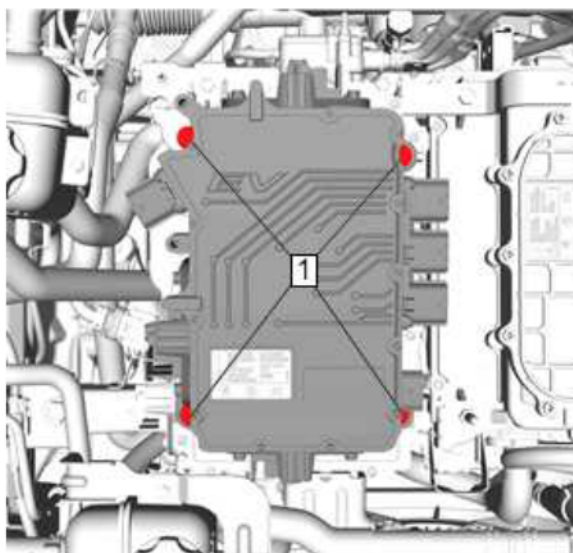
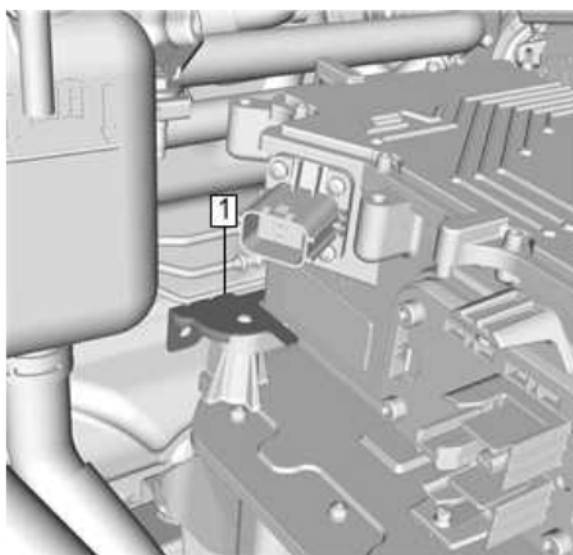


Fig. 58: Generator Battery Control Wiring Junction Block Bolts

Courtesy of GENERAL MOTORS COMPANY

13. Remove Generator Battery Control Wiring Junction Block Bolts (1) (Qty: 4)



14. Remove Engine Wiring Harness Bracket (1)

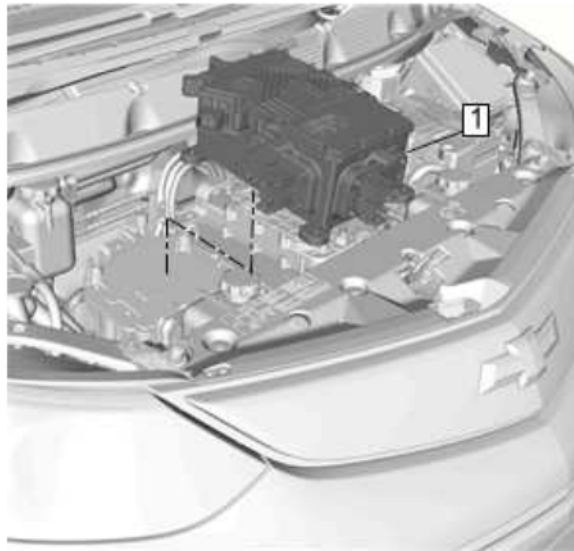


Fig. 60: Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

15. Remove Generator Battery Control Wiring Junction Block (1)

Installation Procedure

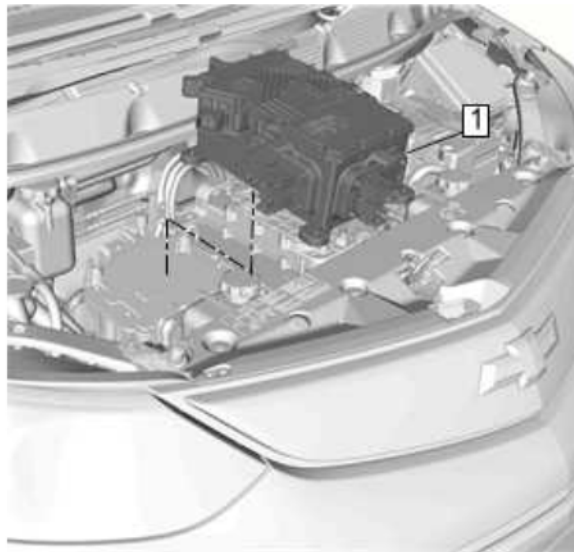


Fig. 61: Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

1. Install Generator Battery Control Wiring Junction Block (1)

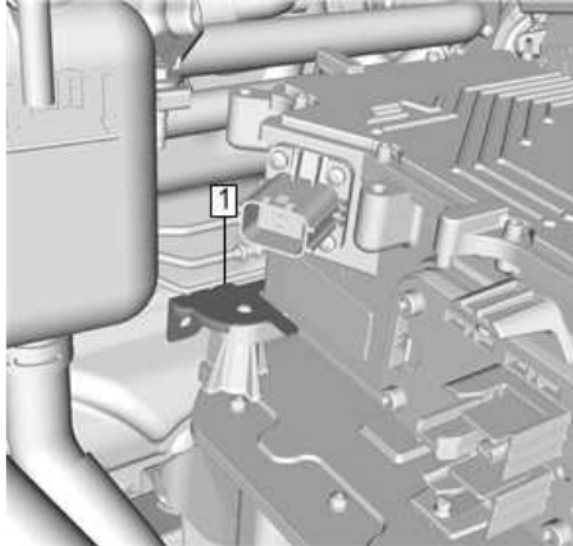


Fig. 62: Engine Wiring Harness Bracket
Courtesy of GENERAL MOTORS COMPANY

2. Install Engine Wiring Harness Bracket (1)

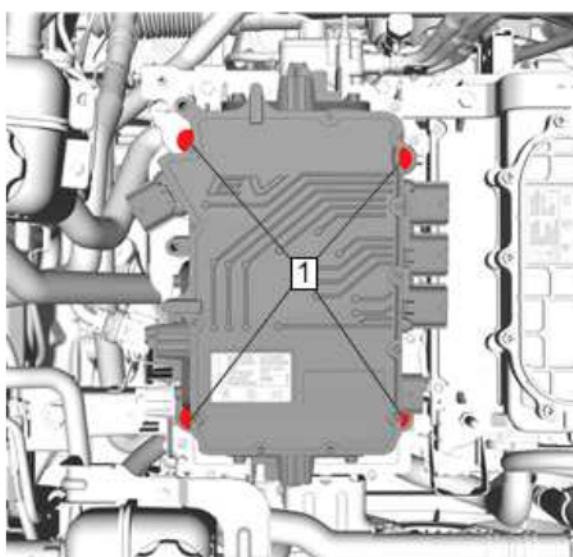


Fig. 63: Generator Battery Control Wiring Junction Block Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

3. Install Generator Battery Control Wiring Junction Block Bolts (1) (Qty: 4) and tighten to 22 N.m (16 lb ft)

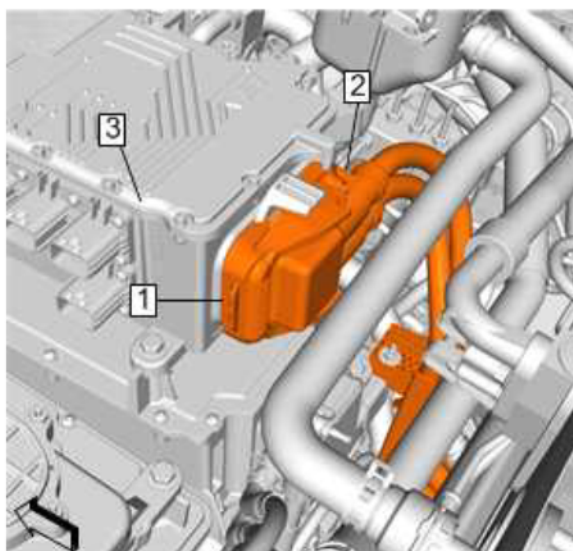


Fig. 64: 300-Volt Battery Positive and Negative Cable, Connection Handle And Generator Battery Control Wiring Junction Block

4. Connect 300-Volt Battery Positive and Negative Cable (2) @ Generator Battery Control Wiring Junction Block (3)

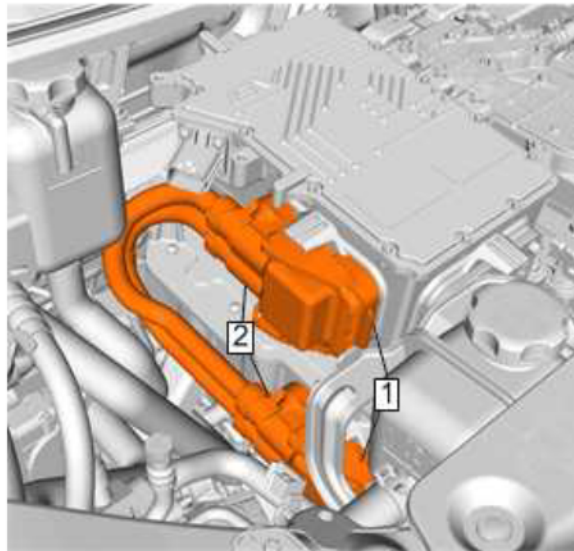


Fig. 65: Battery Positive Cable Extension Cable And Connector Handle
Courtesy of GENERAL MOTORS COMPANY

5. Connect Battery Positive Cable Extension Cable (2)

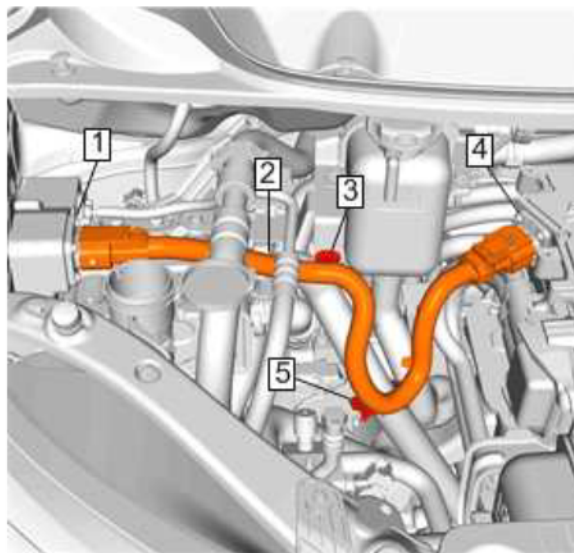


Fig. 66: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

6. Connect Drive Motor Battery Positive and Negative Cable (1) @ Generator Battery Control Wiring Junction Block

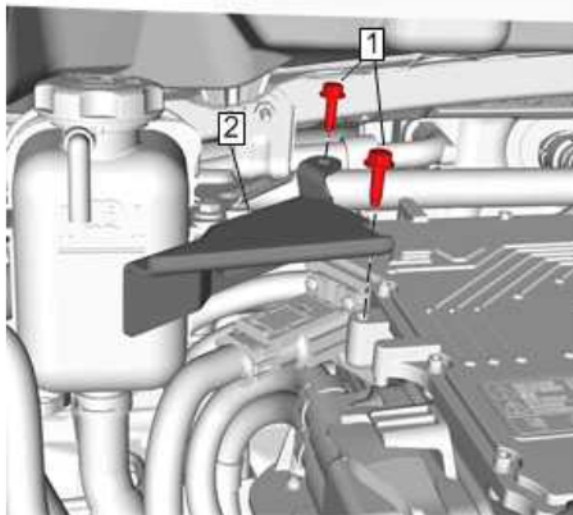


Fig. 67: Accessory DC Power Control Module High Voltage Connector Protector And Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Install Accessory DC Power Control Module High Voltage Connector Protector (2)
8. Install Accessory DC Power Control Module High Voltage Connector Protector Bolts (1) (Qty: 2) and tighten to 9 N.m (80 lb in)

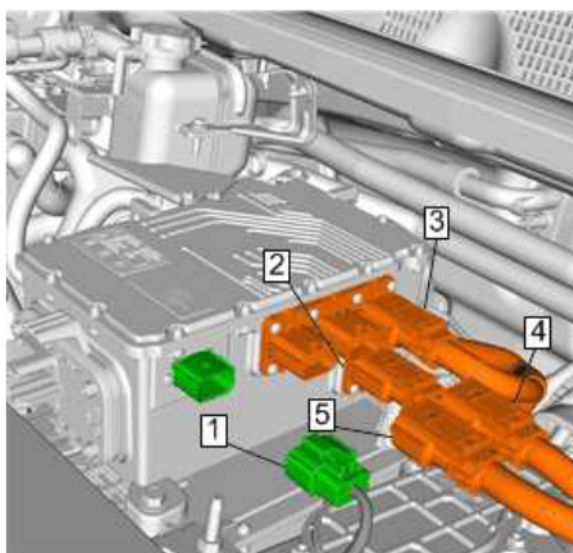


Fig. 68: Generator Battery Control Wiring Junction Block And Connectors
Courtesy of GENERAL MOTORS COMPANY

9. Install the RESS heater connector (3) and Drive Motor Battery Charger & auxiliary power module to RESS connector (2) to the Generator Battery Control Wiring Junction Block.
10. Install the A/C Control module connector (5) and Drive Motor Battery Charger & auxiliary power module connector (4) to the Generator Battery Control Wiring Junction Block.
11. Connect Low Voltage connection connector (1) @ Generator Battery Control Wiring Junction Block
12. Enable High Voltage System. Refer to [High Voltage Enabling](#)

HIGH VOLTAGE BATTERY DISCONNECT CONTROL MODULE FUSE 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 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.

1. Disable High Voltage System. Refer to [High Voltage Disabling](#)
2. Remove Generator Battery Control Wiring Junction Block. Refer to [High Voltage Battery Control Wiring Junction Block Replacement \(With quick charge\)](#) [High Voltage Battery Control Wiring Junction Block Replacement \(Without quick charge\)](#)

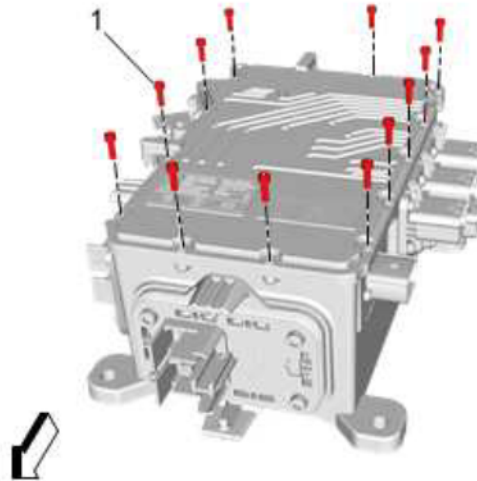


Fig. 69: Generator Battery Control Wiring Junction Block Cover Upper Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove Generator Battery Control Wiring Junction Block Cover Upper Bolts (1) (Qty: 12)

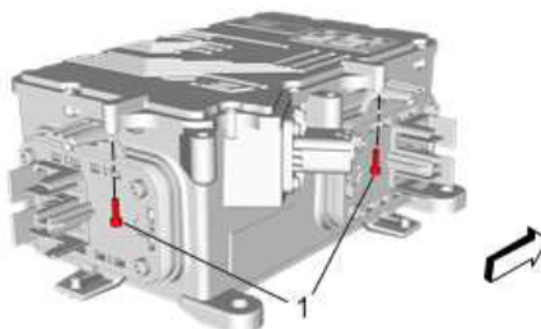


Fig. 70: Generator Battery Control Wiring Junction Block Cover Lower Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove Generator Battery Control Wiring Junction Block Cover Lower Bolts (1) (Qty: 2)

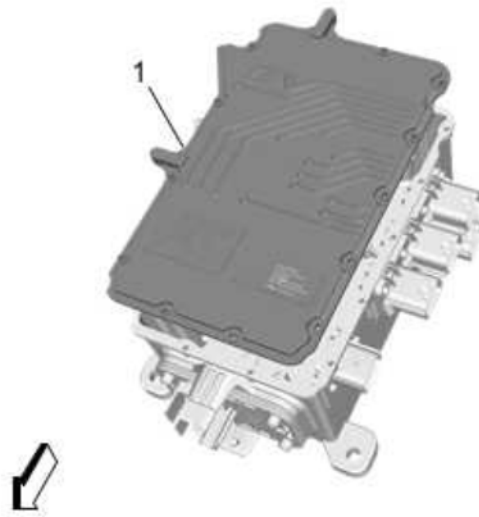


Fig. 71: Generator Battery Control Wiring Junction Block Cover
Courtesy of GENERAL MOTORS COMPANY

5. Remove Generator Battery Control Wiring Junction Block Cover (1)

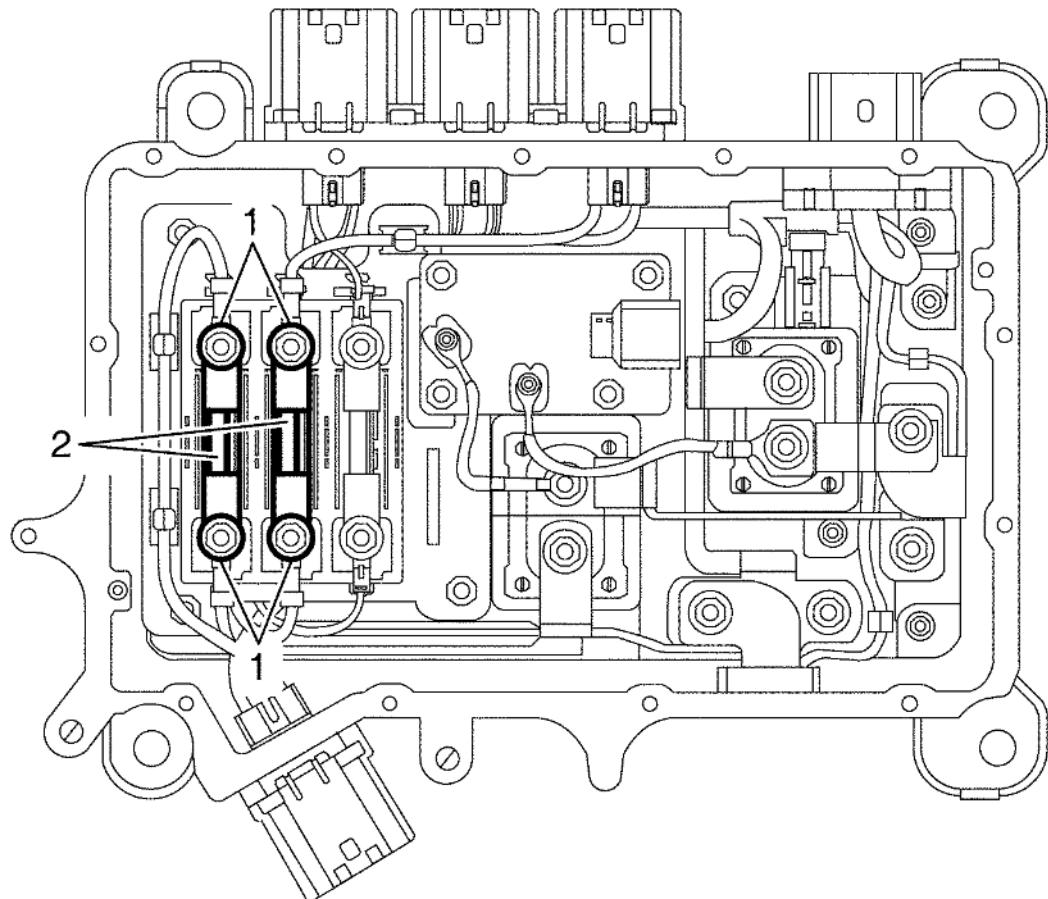


Fig. 72: 40A Fuses And Nuts
Courtesy of GENERAL MOTORS COMPANY

6. Remove 40A Fuse Nuts (1) (Qty: 4)
7. Remove 40A Fuses (2)

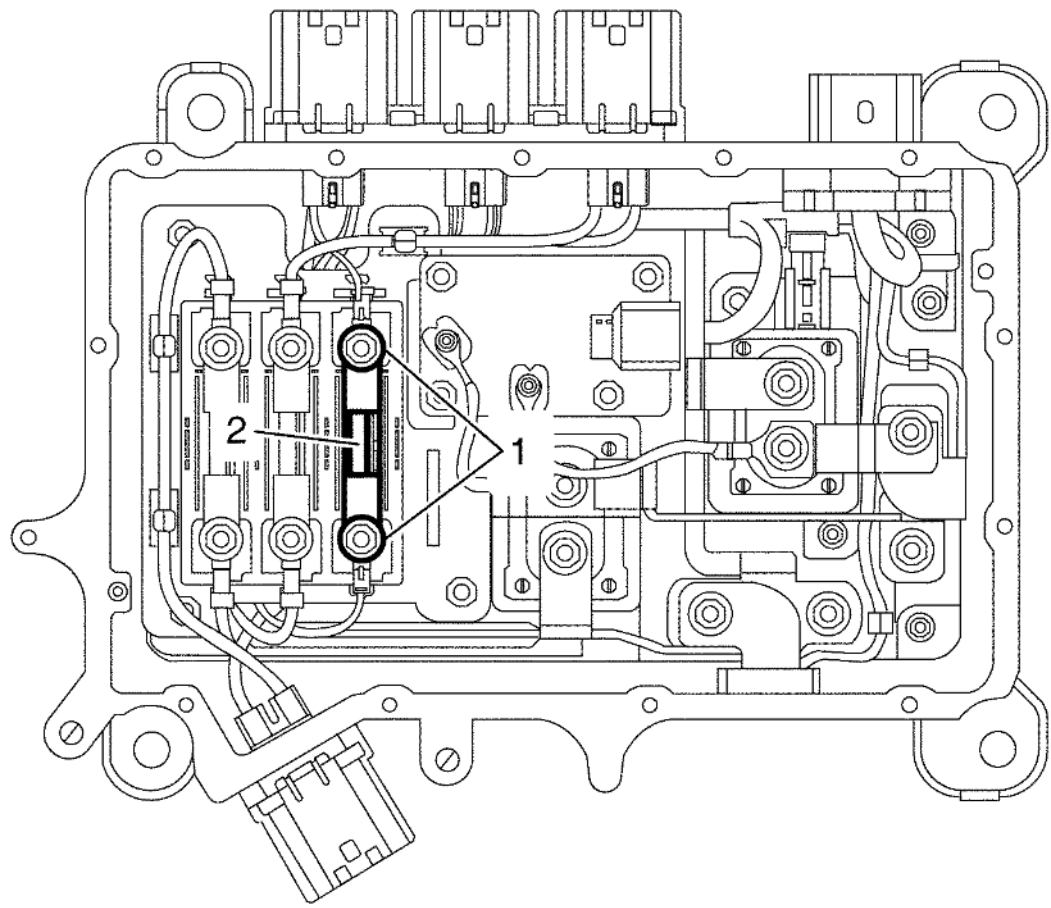


Fig. 73: 15A Fuse And Nuts

Courtesy of GENERAL MOTORS COMPANY

8. Remove 15A Fuse Nuts (1) (Qty: 2)
9. Remove 15A Fuse (2)

Installation Procedure

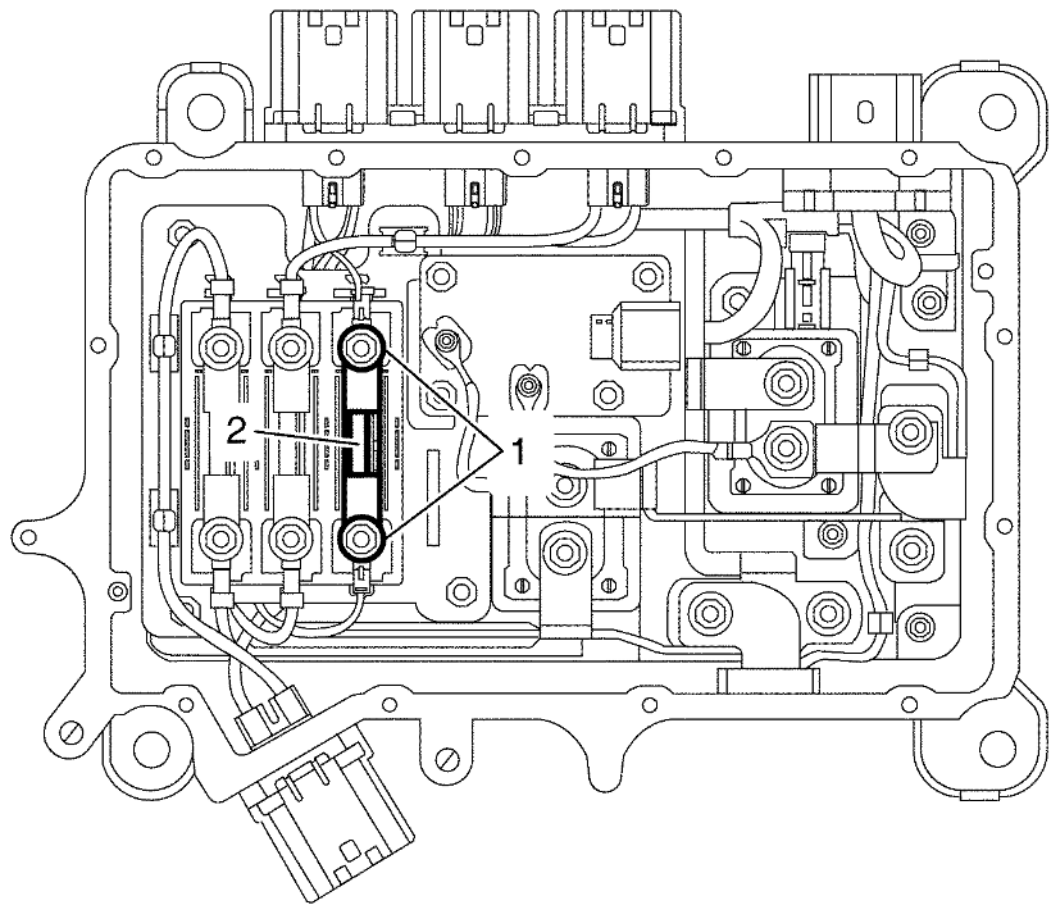


Fig. 74: 15A Fuse And Nuts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

1. Install 15A Fuse (2)
2. Install and tighten 15A Fuse Nuts (1) (Qty: 2) to 4.5 N.m (40 lb in)

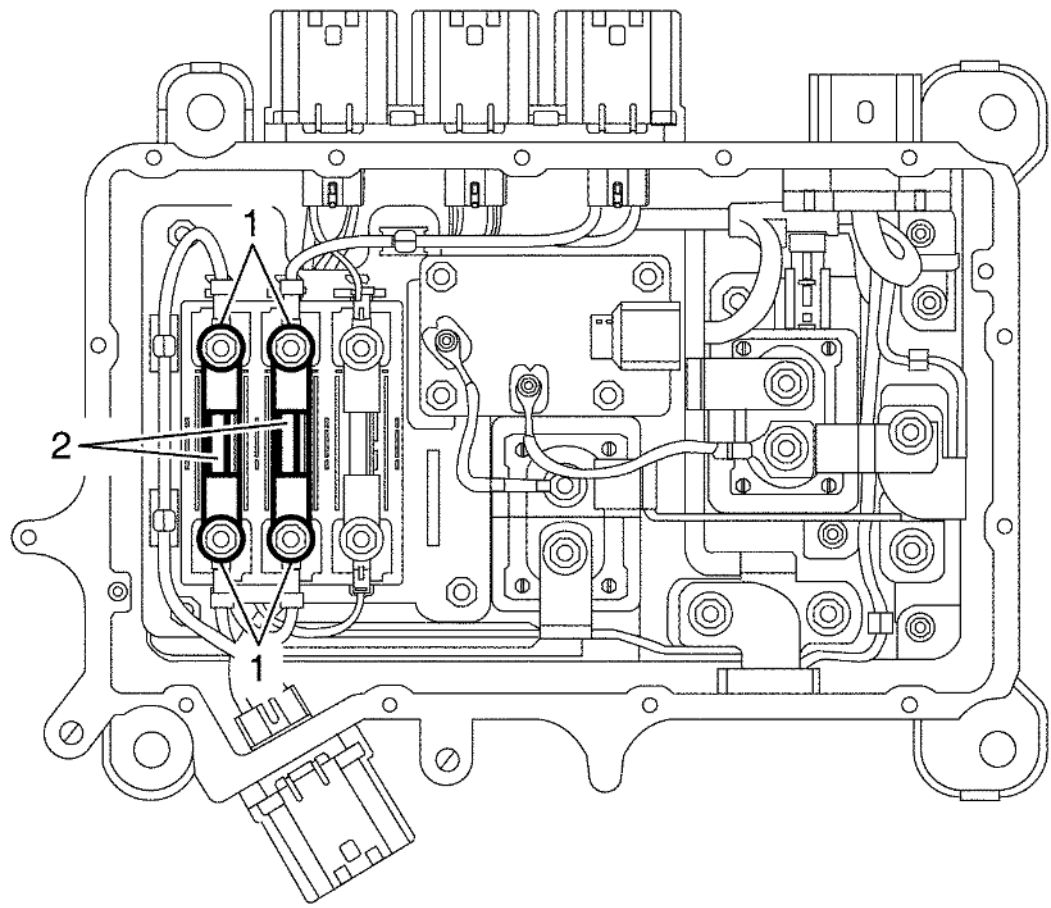


Fig. 75: 40A Fuses And Nuts

Courtesy of GENERAL MOTORS COMPANY

3. Install 40A Fuses (2)
4. Install and tighten 40A Fuse Nuts (1) (Qty: 4) to 4.5 N.m (40 lb in)

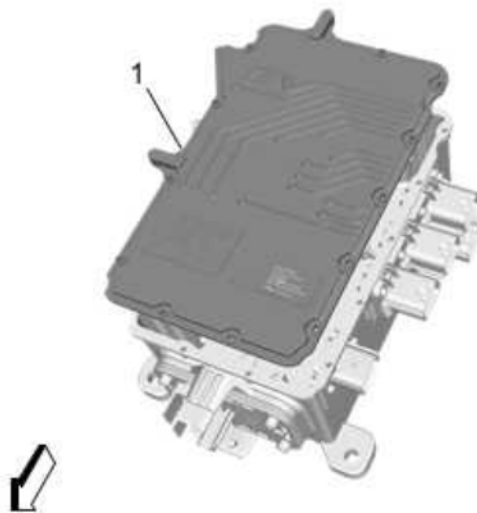


Fig. 76: Generator Battery Control Wiring Junction Block Cover

Courtesy of GENERAL MOTORS COMPANY

5. Install Generator Battery Control Wiring Junction Block Cover (1)

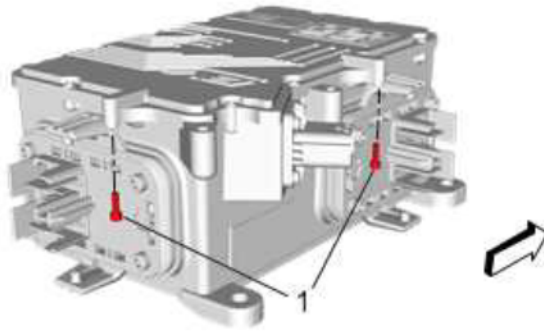


Fig. 77: Generator Battery Control Wiring Junction Block Cover Lower Bolts
 Courtesy of GENERAL MOTORS COMPANY

6. Install and tighten Generator Battery Control Wiring Junction Block Cover Lower Bolts (1) (Qty: 2) to 2.5 N.m (22 lb in)

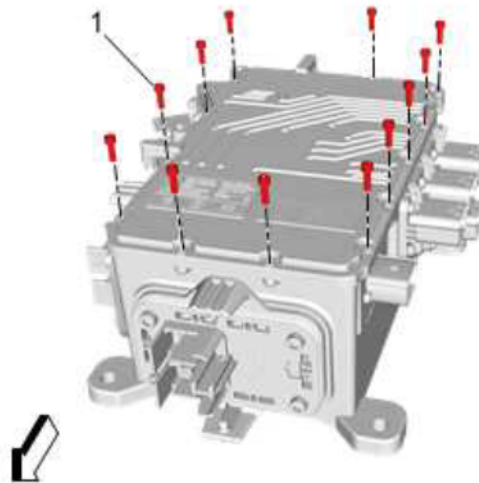


Fig. 78: Generator Battery Control Wiring Junction Block Cover Upper Bolts
 Courtesy of GENERAL MOTORS COMPANY

7. Install and tighten Generator Battery Control Wiring Junction Block Cover Upper Bolts (1) (Qty: 12) to 2.5 N.m (22 lb in)
8. Install Generator Battery Control Wiring Junction Block. Refer to [High Voltage Battery Control Wiring Junction Block Replacement \(With quick charge\)](#)[High Voltage Battery Control Wiring Junction Block Replacement \(Without quick charge\)](#)
9. Enable High Voltage System. Refer to [High Voltage Enabling](#)

ACCESSORY DC POWER CONTROL 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 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.

1. Disable High Voltage System. Refer to [High Voltage Disabling](#)
2. Drain Drive Motor Generator Power Inverter Module Cooling System. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)

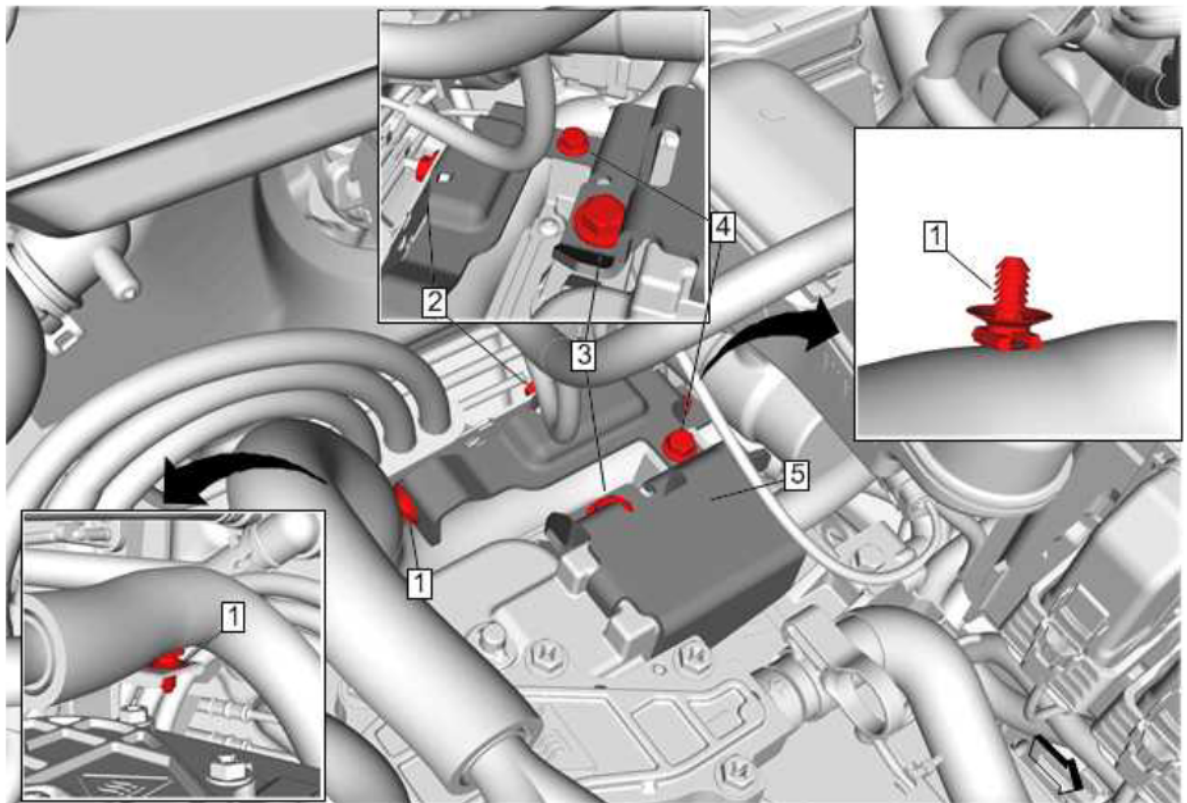


Fig. 79: DC Power Control Module High Voltage Connector Protector, Nut And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the battery to battery positive cable retainers.
4. Remove Accessory DC Power Control Module High Voltage Connector Protector Nut (2)
5. Remove Accessory DC Power Control Module High Voltage Connector Protector Bolts (3, 4)
6. Remove Accessory DC Power Control Module High Voltage Connector Protector (5)

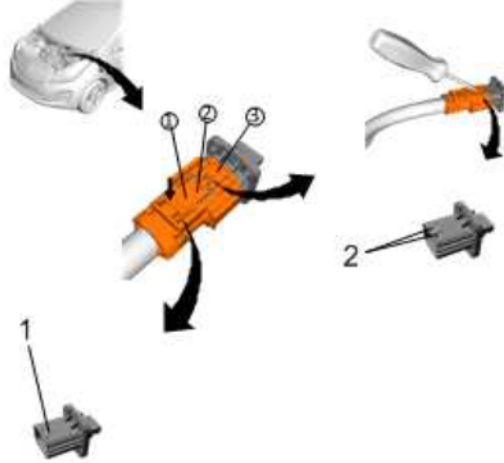


Fig. 80: First Stage Connector Tab And Connector Retaining Tabs
 Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the high voltage connectors in the following sequence:
- Release the CPA. Push down on the connector tab, and release the connector.

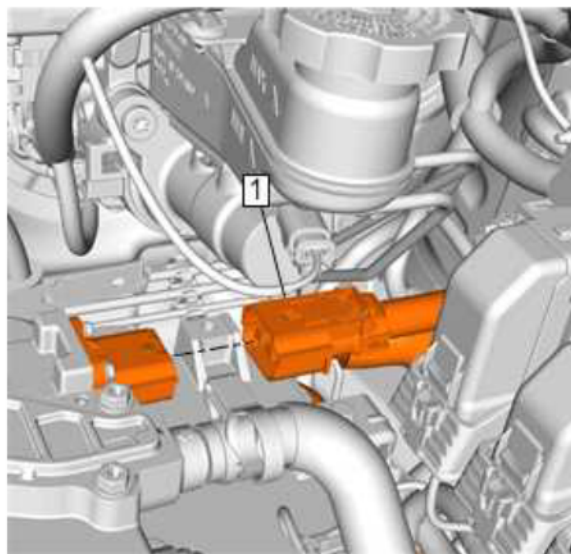


Fig. 81: Auxiliary Power Module Connector
 Courtesy of GENERAL MOTORS COMPANY

8. After releasing the 2-stage safety connectors, remove the auxiliary power module connector (1).

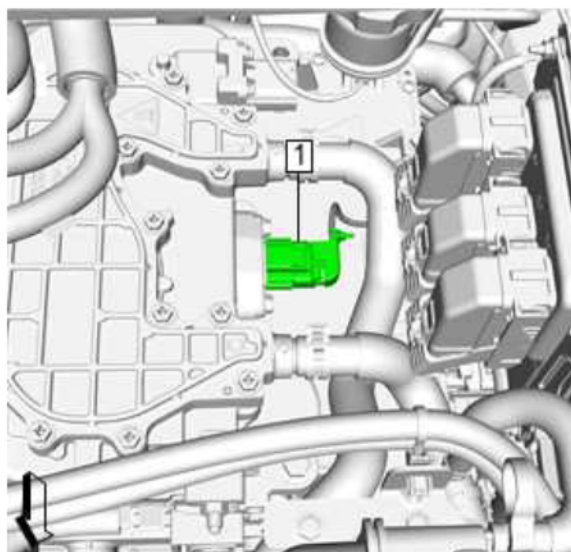


Fig. 82: Low Voltage Connection Connector
 Courtesy of GENERAL MOTORS COMPANY

9. Disconnect Low Voltage Connection Connector (1) @ Accessory DC Power Control Module

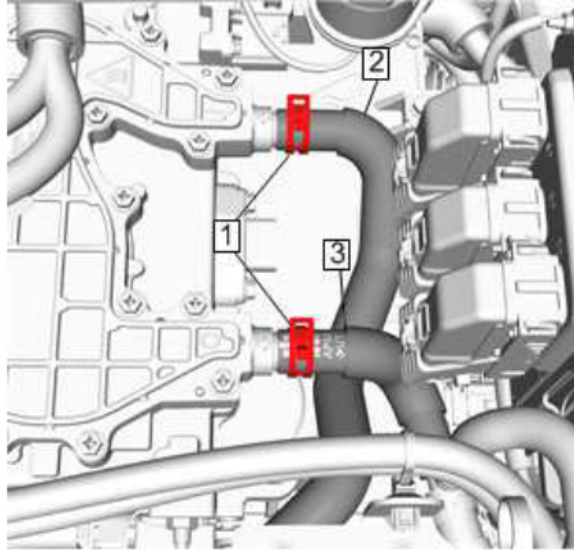


Fig. 83: Drive Motor Generator Control Module Cooling Outlet Hose, Electric Differential Drive Motor Power Inverter Module Cooling Hose And Clamps

Courtesy of GENERAL MOTORS COMPANY

10. Release Clamp (1) and Remove the Drive Motor Generator Control Module Cooling Outlet Hose (2)
11. Release Clamp (1) and Remove the Electric Differential Drive Motor Power Inverter Module Cooling Hose (3)

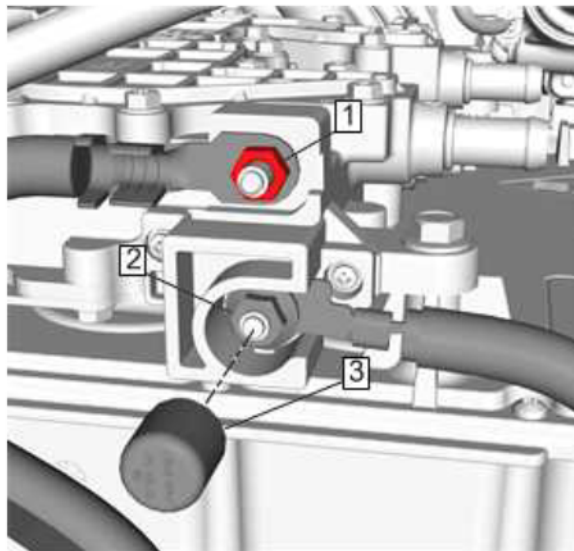


Fig. 84: Battery Negative Cable Extension Cable And Battery Positive Cable Components

Courtesy of GENERAL MOTORS COMPANY

12. Remove Battery Negative Cable Extension Cable Fastener (1)
13. Remove Battery Positive Cable Protector (3)
14. Remove Battery Positive Cable and Nut (2)
15. Remove Battery Negative Cable Extension Cable & Battery Positive Cable - Remove

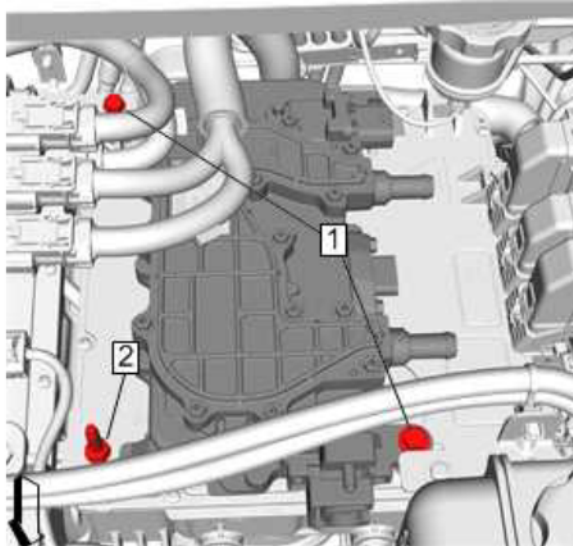


Fig. 85: Accessory DC Power Control Module Bolts And Studs
 Courtesy of GENERAL MOTORS COMPANY

16. Remove Accessory DC Power Control Module Bolts (1) (Qty: 2)
17. Remove Accessory DC Power Control Module Stud (2)

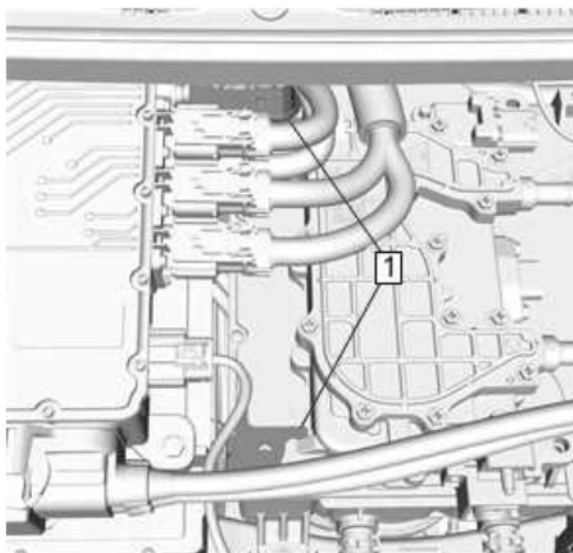


Fig. 86: Engine Wiring Harness Brackets
 Courtesy of GENERAL MOTORS COMPANY

18. Position aside Engine Wiring Harness Brackets (1) (Qty: 2)

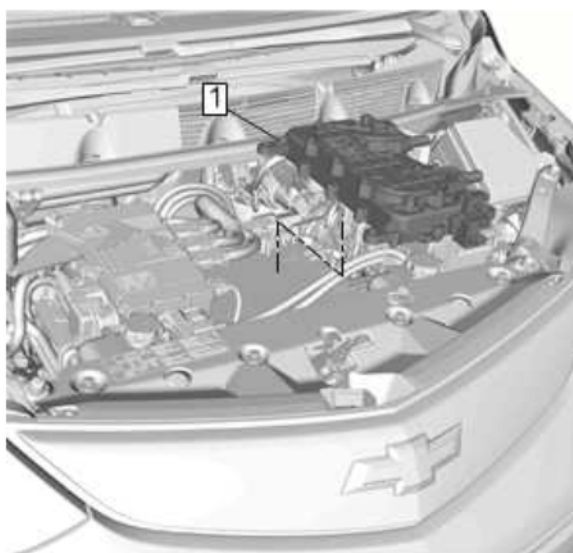


Fig. 87: Accessory DC Power Control Module
 Courtesy of GENERAL MOTORS COMPANY

19. Remove Accessory DC Power Control Module (1)

Installation Procedure

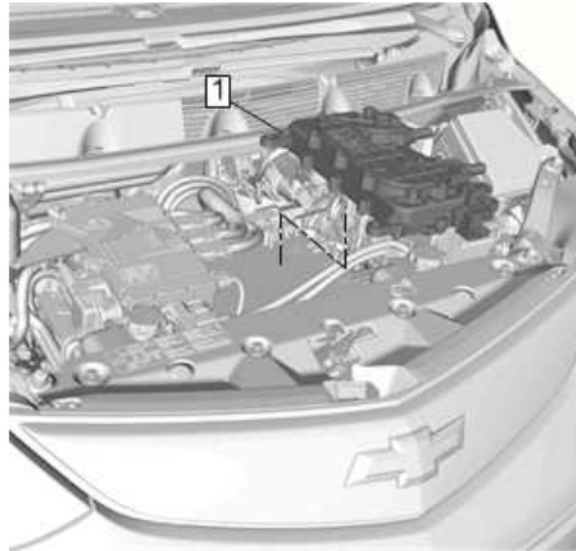


Fig. 88: Accessory DC Power Control Module
Courtesy of GENERAL MOTORS COMPANY

1. Install Accessory DC Power Control Module (1)

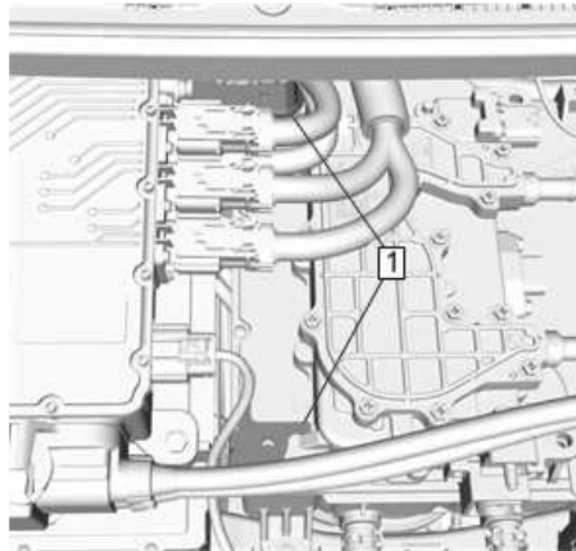
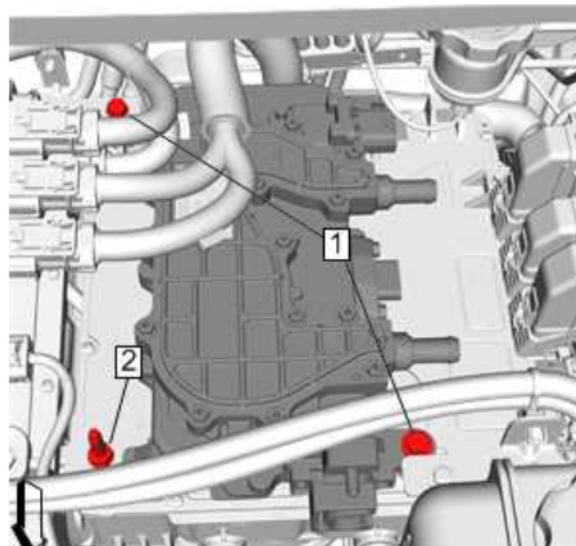


Fig. 89: Engine Wiring Harness Brackets
Courtesy of GENERAL MOTORS COMPANY

2. Install Engine Wiring Harness Brackets (1) (Qty: 2)



CAUTION: Refer to **Fastener Caution**.

3. Install Accessory DC Power Control Module Bolts (1) (Qty: 2) and tighten to 22 N.m (16 lb ft)
4. Install Accessory DC Power Control Module Stud (2) and tighten to 22 N.m (16 lb ft)

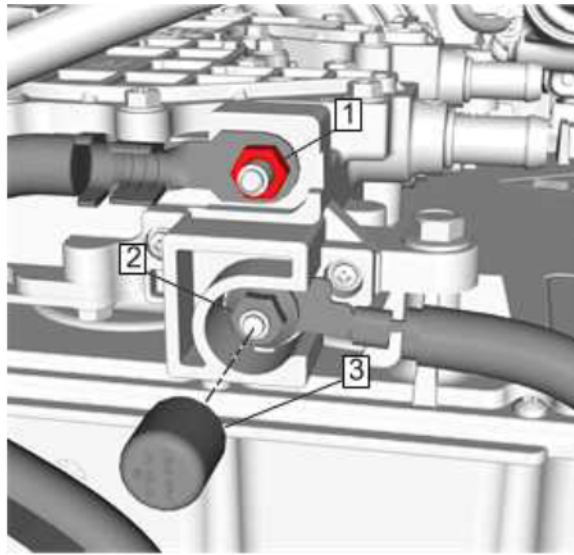


Fig. 91: Battery Negative Cable Extension Cable And Battery Positive Cable Components
Courtesy of GENERAL MOTORS COMPANY

5. Install Battery Negative Cable Extension Cable & Battery Positive Cable
6. Install and tighten Battery Positive Cable and Nut (2) to 15 N.m (11 lb ft)
7. Install Battery Positive Cable Protector (3)
8. Install and tighten Battery Negative Cable Extension Cable Fastener (1) to 15 N.m (11 lb ft)

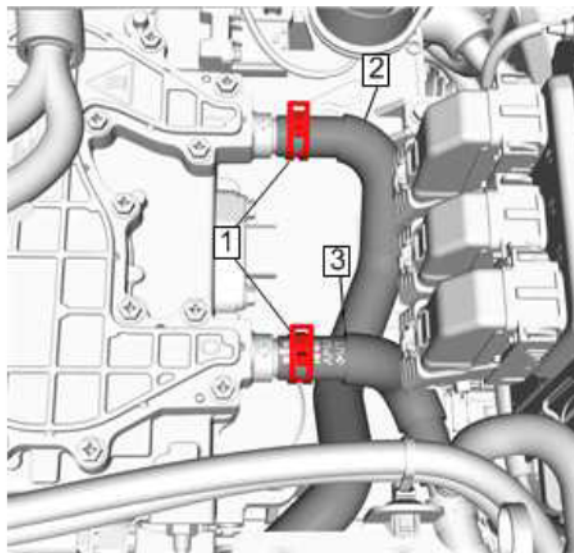


Fig. 92: Drive Motor Generator Control Module Cooling Outlet Hose, Electric Differential Drive Motor Power Inverter Module Cooling Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

9. Install the Electric Differential Drive Motor Power Inverter Module Cooling Hose (3) and Engage the Clamp (1)
10. Install the Drive Motor Generator Control Module Cooling Outlet Hose (2) and Engage the Clamp (1)

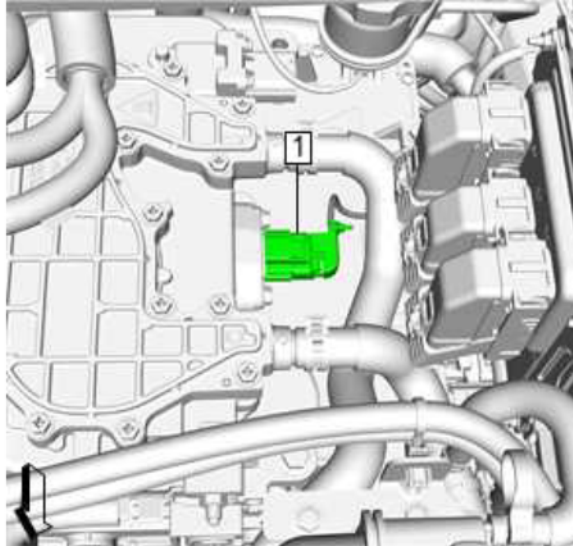


Fig. 93: Low Voltage Connection Connector
Courtesy of GENERAL MOTORS COMPANY

11. Connect Low Voltage connection connector (1) @ Accessory DC Power Control Module

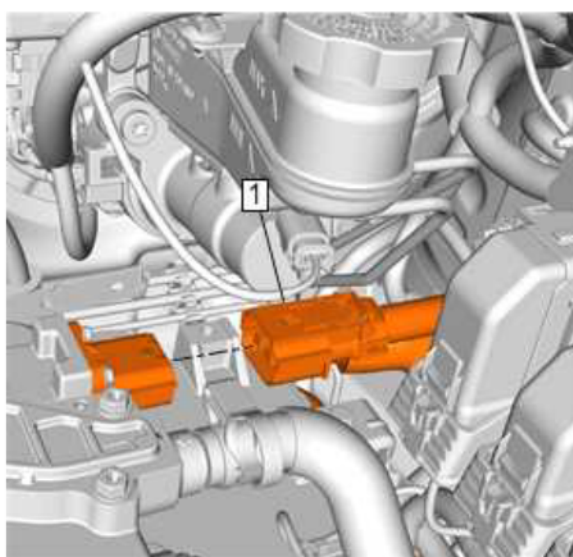


Fig. 94: Auxiliary Power Module Connector
Courtesy of GENERAL MOTORS COMPANY

12. Connect Auxiliary Power Module Connector (1)

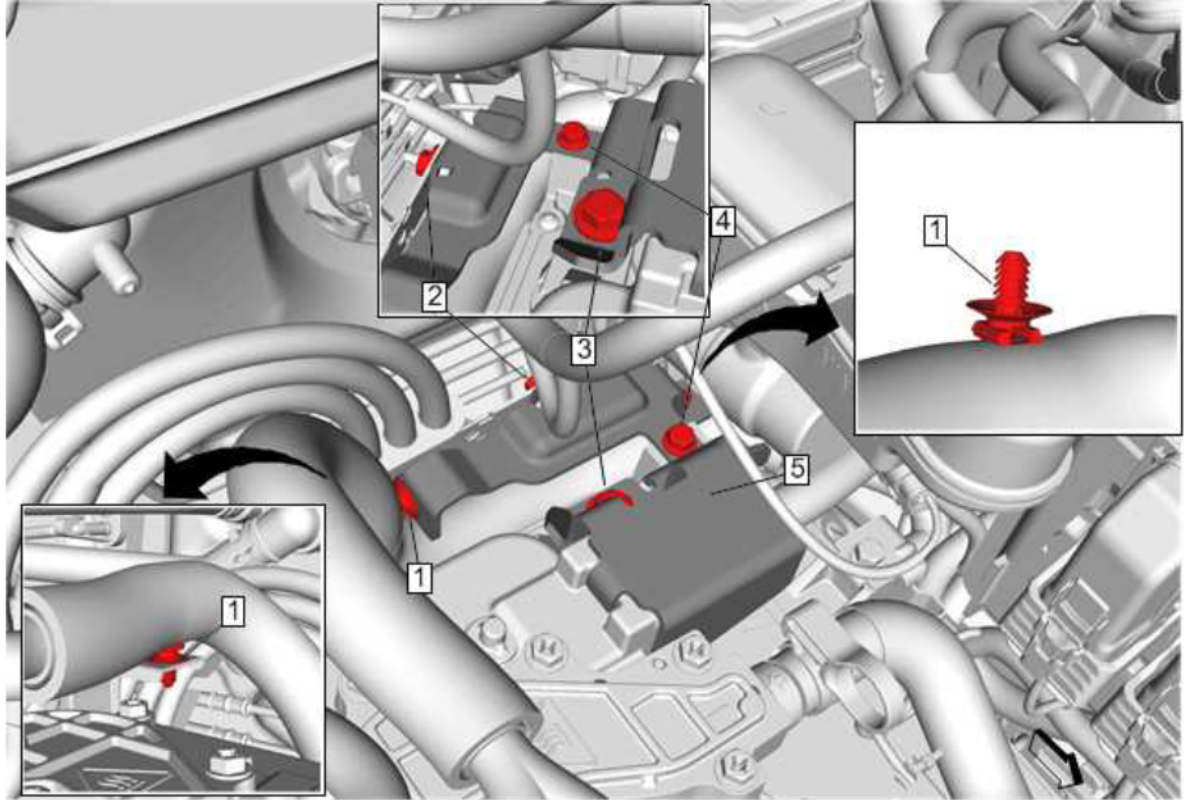


Fig. 95: DC Power Control Module High Voltage Connector Protector, Nut And Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Install Accessory DC Power Control Module High Voltage Connector Protector (5)
14. Install Accessory DC Power Control Module High Voltage Connector Protector Bolt (4) and tighten to 9 N.m (80 lb in)
15. Install Accessory DC Power Control Module High Voltage Connector Protector Bolt (3) and tighten to 22 N.m (16 lb ft)
16. Install Accessory DC Power Control Module High Voltage Connector Protector Nut (2) and tighten to 9 N.m (80 lb in)
17. Install the battery to battery positive cable retainers.
18. Fill the drive motor generator power inverter module cooling system. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
19. Enable the high voltage system. Refer to [High Voltage Enabling](#)

ACCELERATOR PEDAL ASSEMBLY REPLACEMENT

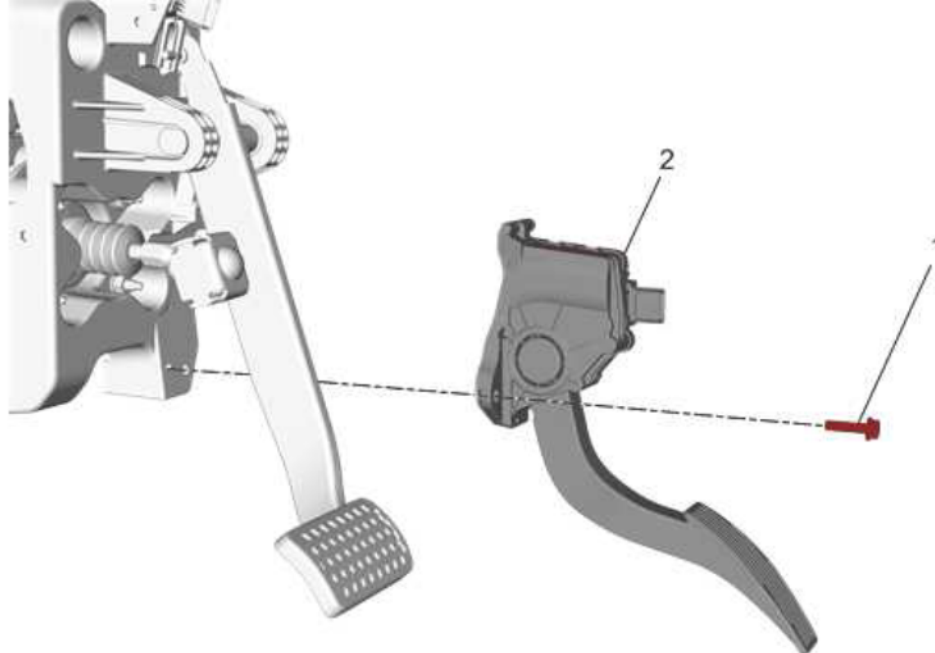


Fig. 96: Accelerator Pedal Assembly
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Accelerator Pedal Pad Bolt CAUTION: Refer to Fastener Caution . Tighten 7 N.m (62 lb in)
2	Accelerator Pedal Assembly Procedure Disconnect the electrical connector.

DESCRIPTION AND OPERATION

ACCESSORY DC POWER CONTROL MODULE DESCRIPTION AND OPERATION

Location

The 14 V power module, also called the accessory DC power control module, is located in the in the front compartment. The 14 V power module is cooled with pre-mixed Dexcool[®] circulating through a cooling system that is separate from the engine cooling system.

Operating Functions

The 14 V power module is an electronic device that takes the place of the generator on a traditional vehicle. On a hybrid or electric vehicle the 14 V power module converts high voltage (300 V) direct current (DC) to low voltage (12 V) DC for accessory electrical operation and to charge the 12 V battery.

Normally, the 14 V power module only supplies 12 V 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 the 14 V power module operation is required to sustain the 12 V battery.

The 14 V power module is capable of supplying up to 130 Amps of 12 V DC.

Communication and Hosted Diagnostics

The 14 V power module has no internal diagnostic tests and does not communicate over serial data. The engine control module (ECM) monitors and controls the 14 V power module and will report DTCs if a fault is detected.

Circuit Inputs

Inputs to the 14 V power module include the high voltage and 12 V circuits. The 14 V power module also has a pulse width modulated set point input from the engine control module (ECM). This input enables conversion of voltage from high to the desired 12 V output level.

For more information on the 12 V Battery Charging System, refer to [Charging System Description and Operation](#).

Circuit Outputs

The only outputs supported by the 14 V power module are the status feedback circuit to the engine control module (ECM) and 12 V DC which powers the 12 V components in the vehicle and charges the 12 V battery. Low voltage 12 V cables on the hybrid/EV vehicle do not require unique coloring or servicing procedures.

DRIVE MOTOR 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 contains the motor control module and the hybrid/EV powertrain control module 1. The motor control module operates the drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 also controls the auxiliary transmission fluid pump using a Pulse Width Modulated (PWM) signal. The hybrid/EV powertrain control module 1 and the motor control module share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground. The modules are flash-programmable micro-processors. 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 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 receives high voltage from DC cables connected to the battery charger DC.

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 harness connects the auxiliary transmission fluid pump to the power inverter module. This harness contains individual wires that are connected to the 3 phases of the auxiliary transmission fluid pump, and is orange in color to alert the technician to the potential presence of high voltage.

Low Voltage Circuits

The 14 V 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 12 V accessory battery.

Low Voltage (12V) Direct Current

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

Hybrid Powertrain Control Module

cardiagn.com

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 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. The hybrid/EV powertrain control module 2 is external to the drive motor generator power inverter module.

Communication and Hosted Diagnostics

The hybrid/EV powertrain control module 1 is the host controller for DTC information for the Drive motor 1 control module.

The module diagnoses its own operation and determines when a fault condition is present.

The motor control module 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
- High voltage interlock circuit

Motor Control Module

Location

The drive motor and the auxiliary transmission fluid pump motor are located within the transmission. The drive motor is controlled by the motor control module. The 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 module operates the motor based upon hybrid/EV powertrain control module 1 commands. The motor control module controls the speed, direction, and output torque of the drive motor 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 the motor control module control use to communicate, the motor control module also communicates 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.

Circuit Inputs

In addition to data parameters, the 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

The motor control module controls its respective insulated gate bipolar transistor driver board that in-turn controls the motor. The motor operates using 3 - phase AC electricity. Three cables connect the 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.

ENGINE CONTROL MODULE (ECM) DESCRIPTION AND OPERATION

The ECM on this vehicle is also called an engine control module and is used in electric, hybrid, and conventional vehicle applications. The ECM interacts with many related components and systems, and monitors them for deterioration. Diagnostics monitor the system performance and a diagnostic trouble code (DTC) sets if the system performance degrades. The ECM is part of a network and communicates with various other vehicle control modules.

Malfunction indicator lamp (MIL) operation and DTC storage are dictated by the DTC type. A DTC is ranked as a Type A, B, or C DTC. Refer to [Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#). Other system control modules may request the ECM to illuminate the MIL. In these cases there is no fault with the ECM, and a DTC will set in the ECM indicating which control module requested the MIL illumination.

The ECM is the control center of the some of the vehicle control systems. Review the components and wiring diagrams in order to determine which systems are controlled by the ECM.

The ECM constantly monitors the information from various sensors and other inputs, and controls the systems that affect vehicle performance. The ECM also performs diagnostic tests on various parts of the system and may illuminate the MIL when it detects a malfunction that affects vehicle performance. When the ECM detects a malfunction, the ECM stores a DTC. The condition area is identified by the particular DTC that is set. This aids the technician in making repairs.

ECM Function

The ECM can supply 5V or 12V to various sensors or switches. This is done through pull-up resistors to regulated power supplies within the ECM. During testing, a digital multimeter (DMM) with at least 10 megaohms input impedance is required in order to ensure accurate voltage readings.

The ECM controls the output circuits by controlling the ground or the voltage circuit through transistors or a device called a high side or low side driver.

EEPROM

The electronically erasable programmable read only memory (EEPROM) is an integral part of the ECM. The EEPROM contains program and calibration information that the ECM needs in order to control engine operation.

Special equipment, as well as the correct program and calibration for the vehicle, are required in order to reprogram the ECM, refer to [Control Module References](#) for ECM replacement, programming, and setup.

Data Link Connector (DLC)

The data link connector (DLC) provides serial data communication for ECM and vehicle diagnosis. This connector allows the technician to use a scan tool in order to monitor various serial data parameters, and display DTC information. The DLC is located on the left side of the driver's compartment, underneath the instrument panel.

Malfunction Indicator Lamp (MIL)

The electric vehicle malfunction indicator lamp (MIL) is displayed in the instrument panel cluster (IPC) during bulb check or if a fault has been detected. The MIL is controlled by the ECM and illuminates when the ECM detects a condition that affects vehicle performance or when another module on the vehicle requests MIL illumination.

ECM Service Precautions

The ECM is designed to withstand normal current draws that are associated with normal vehicle operations. However, care must be used in order to avoid overloading any of these circuits. When testing for opens or shorts, do not ground or apply voltage to any of the ECM circuits unless the diagnostic procedure instructs you to do so. These circuits should only be tested with a DMM unless the diagnostic procedure instructs otherwise.

Aftermarket (Add-On) Electrical Equipment

CAUTION: Connect any add-on electrically operated equipment to the vehicle's electrical system at the 12 V battery (power and ground) in order to prevent damage to the vehicle.

Add-on electrical equipment, even when installed to these strict guidelines, may still cause the powertrain system to malfunction. This may also include equipment not connected to the vehicle electrical system, such as portable telephones and radios. Therefore, the first step in diagnosing any powertrain condition is to eliminate all of the aftermarket electrical equipment from the vehicle. After this is done, if the problem still exists, the problem may be diagnosed in the normal manner.

Electrostatic Discharge (ESD) Damage

NOTE: In order to prevent possible electrostatic discharge damage to the ECM, DO NOT touch the connector pins on the ECM.

The electronic components that are used in the control systems are often designed to carry very low voltage. These electronic components are susceptible to damage caused by electrostatic discharge. Less than 100V of static electricity can cause damage to some electronic components. By comparison, it takes as much as 4,000 V for a person to even feel a static discharge.

There are several ways for a person to become statically charged. The most common methods of charging are by friction and by induction. An example of charging by friction is a person sliding across a car seat.

Charging by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with the opposite polarity. Static charges can cause damage, therefore, it is important to use care when handling and testing electronic components.

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 14 V 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 a Battery Electric Vehicle. It uses only an electric propulsion system to drive the vehicle at all times. Electricity is the vehicle's only source of energy.

Electric Mode

Electric Mode is the only mode of operation for this vehicle. The vehicle is powered by electrical energy stored in the high voltage hybrid/EV battery pack. The vehicle will operate in this mode until the high voltage battery has reached a low state of charge.

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.

Regenerative Braking

When the vehicle is coasting or braking, the drive motor generator 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 drive motor generator power inverter module to the hybrid/EV battery pack. Constant communication between the drive motor generator 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
	EL-52010 Jumper Harness, 12 Terminal
	cardiagn.com

Illustration	Tool Number/Description
