

2017 ELECTRICAL

Hybrid/EV Energy Storage - Component Locator - Disassembled Views - Bolt EV

DISASSEMBLED VIEWS

BATTERY COVER ASSEMBLY

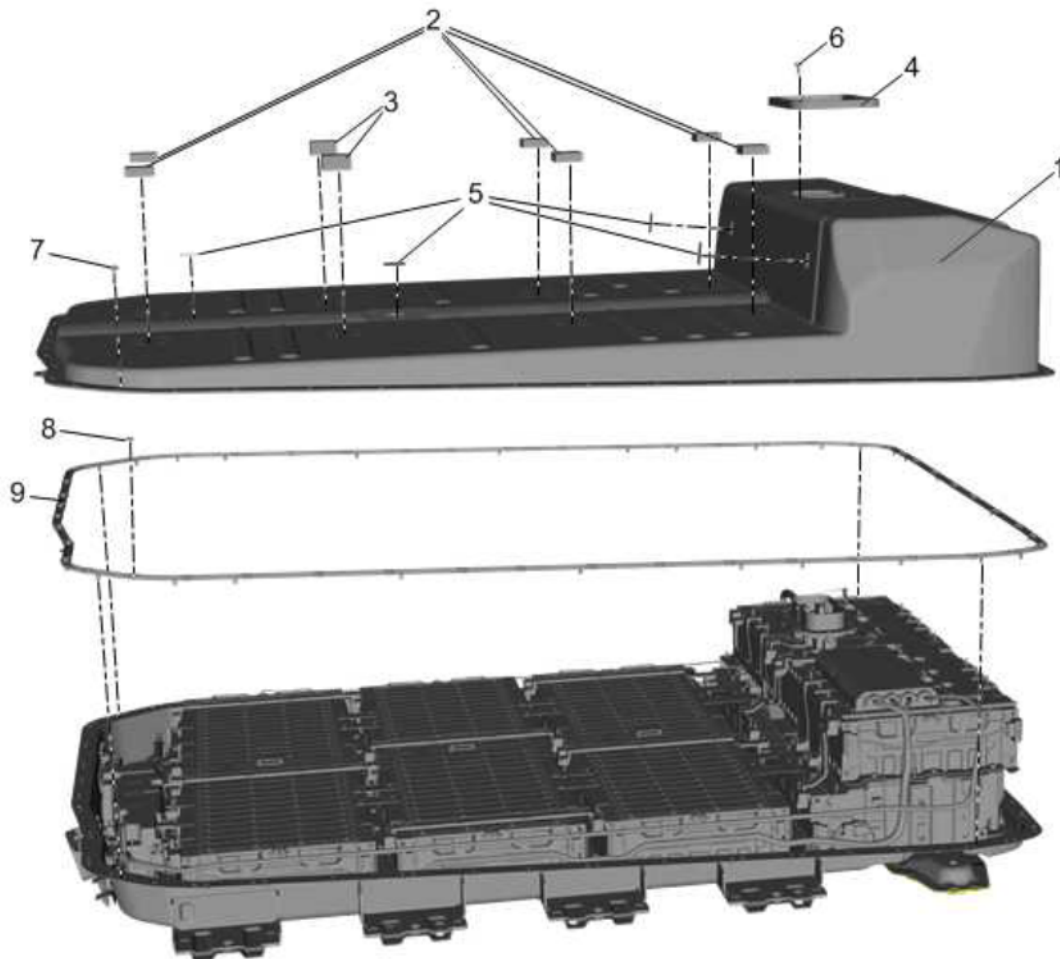


Fig. 1: Battery Cover

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	High Voltage Battery Cover
2	Snubber Type 1
3	Snubber Type 2
4	Manual Disconnect Insulator
5	Valve Vent
6	Bolt
7	Bolt
8	Sealing Gasket Washer
9	Battery Sealing Gasket

BATTERY HARNESS MODULE ASSEMBLY

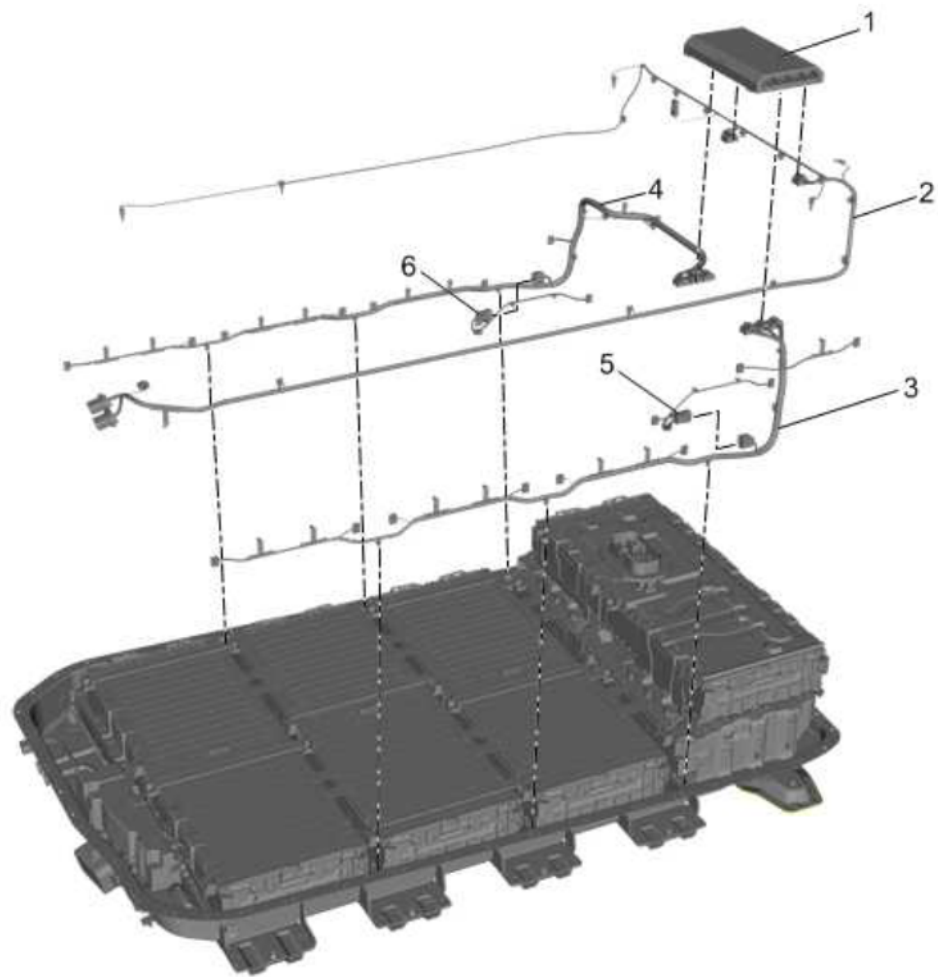


Fig. 2: Battery Harness Module

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Battery Energy Control Module
2	Wiring Control Harness Assembly
3	Wiring Sensing Harness Assembly-Left
4	Wiring Sensing Harness Assembly-Right
5	Wiring Sensing Harness Assembly-Left Sub
6	Wiring Sensing Harness Assembly-Right Sub

BATTERY CABLE ASSEMBLY

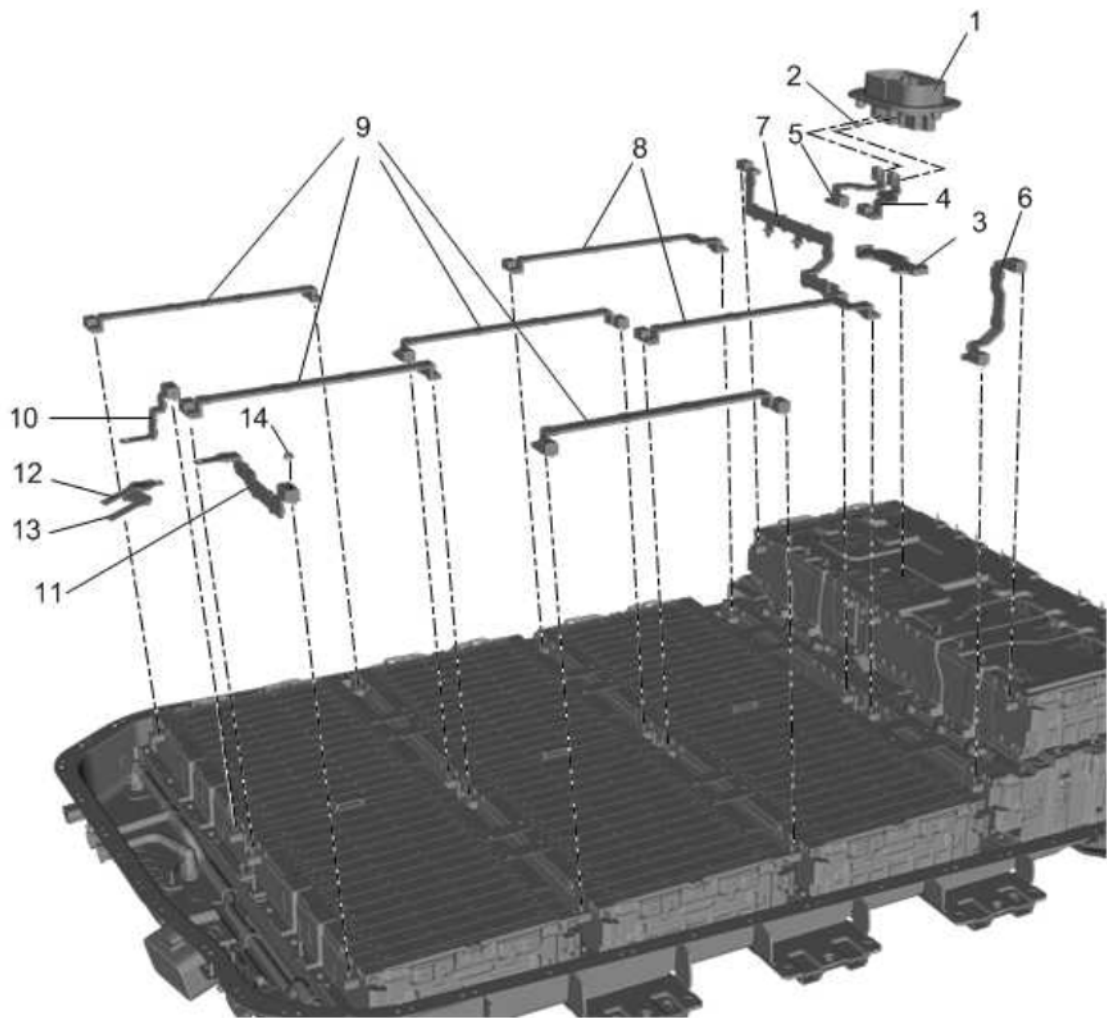


Fig. 3: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manual Disconnect Base
2	Bolt
3	Insulation Pad-Manual Disconnect
4	High Voltage Battery Disconnect Negative Cable Assembly
5	High Voltage Battery Disconnect Positive Cable Assembly
6	High Voltage Battery Positive and Negative Cable Assembly
7	High Voltage Battery Positive and Negative Cable Assembly
8	High Voltage Battery Positive and Negative Cable Assembly
9	High Voltage Battery Positive and Negative Cable Assembly
10	High Voltage Battery to Disconnect Relay Negative Cable Assembly
11	High Voltage Battery to Disconnect Relay Positive Cable Assembly
12	High Voltage Battery Negative Cable Assembly
13	High Voltage Battery Positive Cable Assembly
14	Nut

BATTERY CELL ASSEMBLY

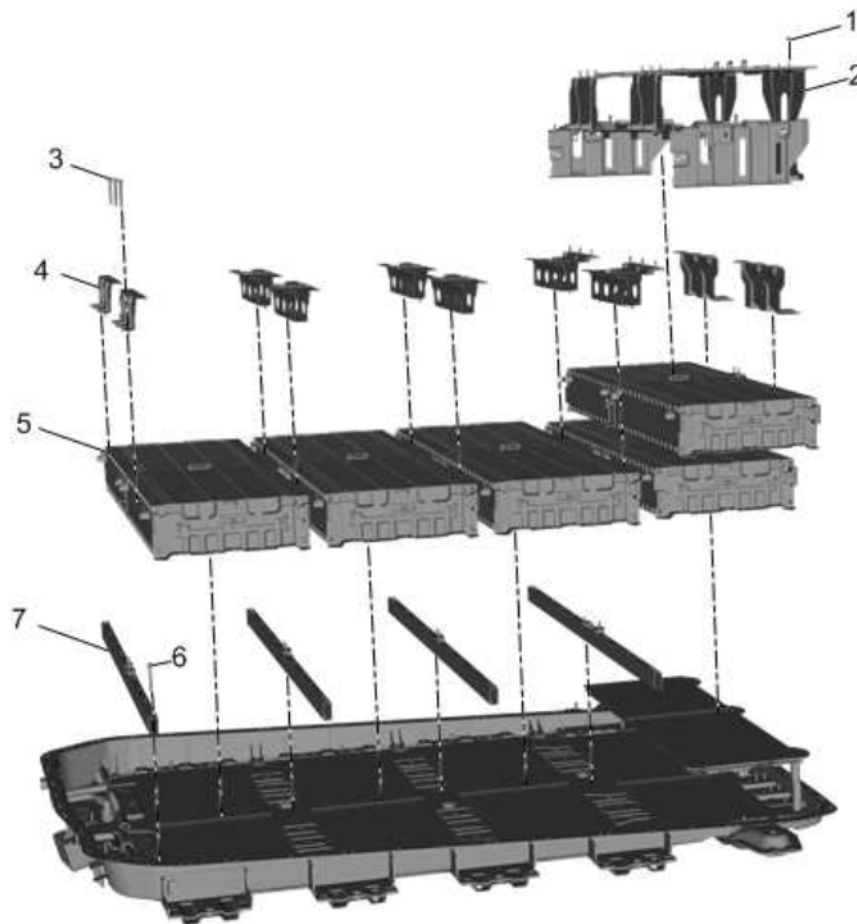


Fig. 4: Battery Cell

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Bolt
2	Cell Bracket Assembly
3	Bolt
4	Cell Battery Frame Plate Assembly
5	High Voltage Battery Cell Module
6	Bolt
7	High Voltage Battery Cell Module Reinforcement

BATTERY CONNECTOR ASSEMBLY

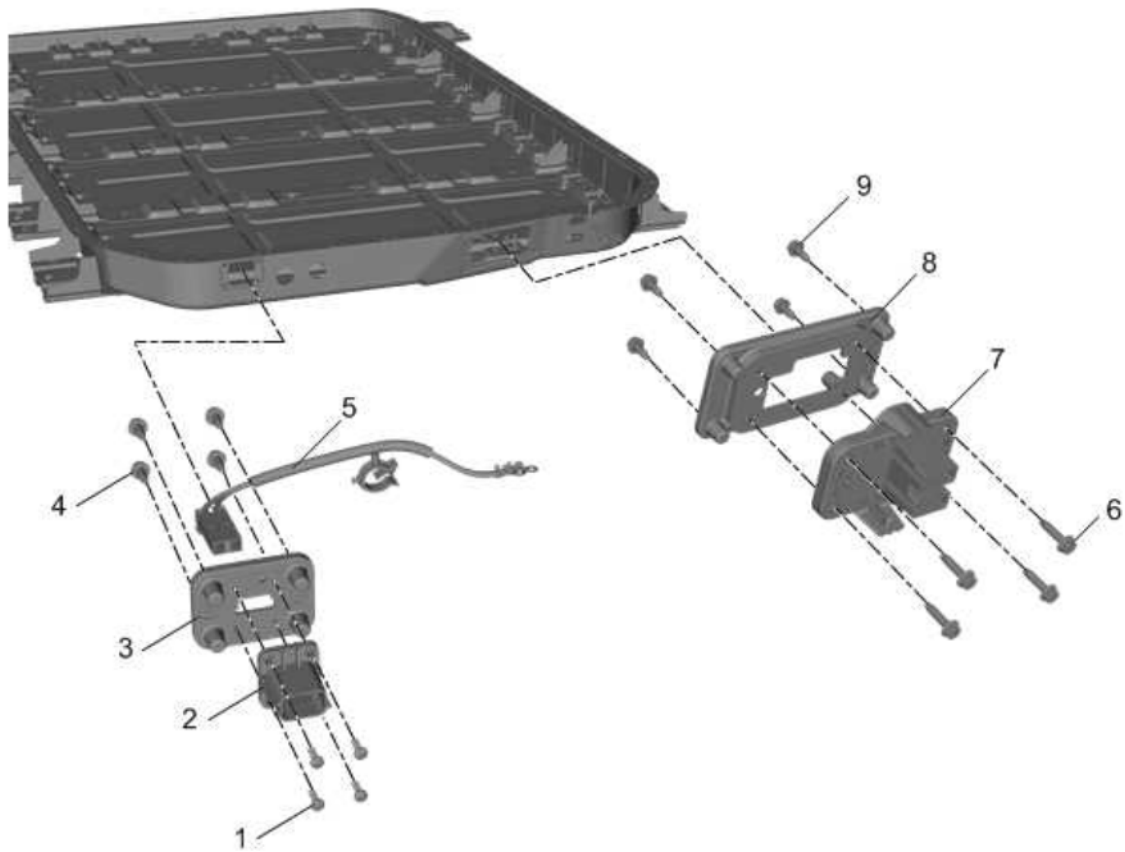


Fig. 5: Battery Connector

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Bolt
2	High Voltage X4 Connector Header
3	High Voltage X4 Connector Block Assembly
4	Bolt
5	High Voltage X4 Connector Cable Assembly
6	Bolt
7	High Voltage X3 Connector Assembly
8	High Voltage X3 Connector Block Assembly
9	Bolt

BATTERY COOLING ASSEMBLY

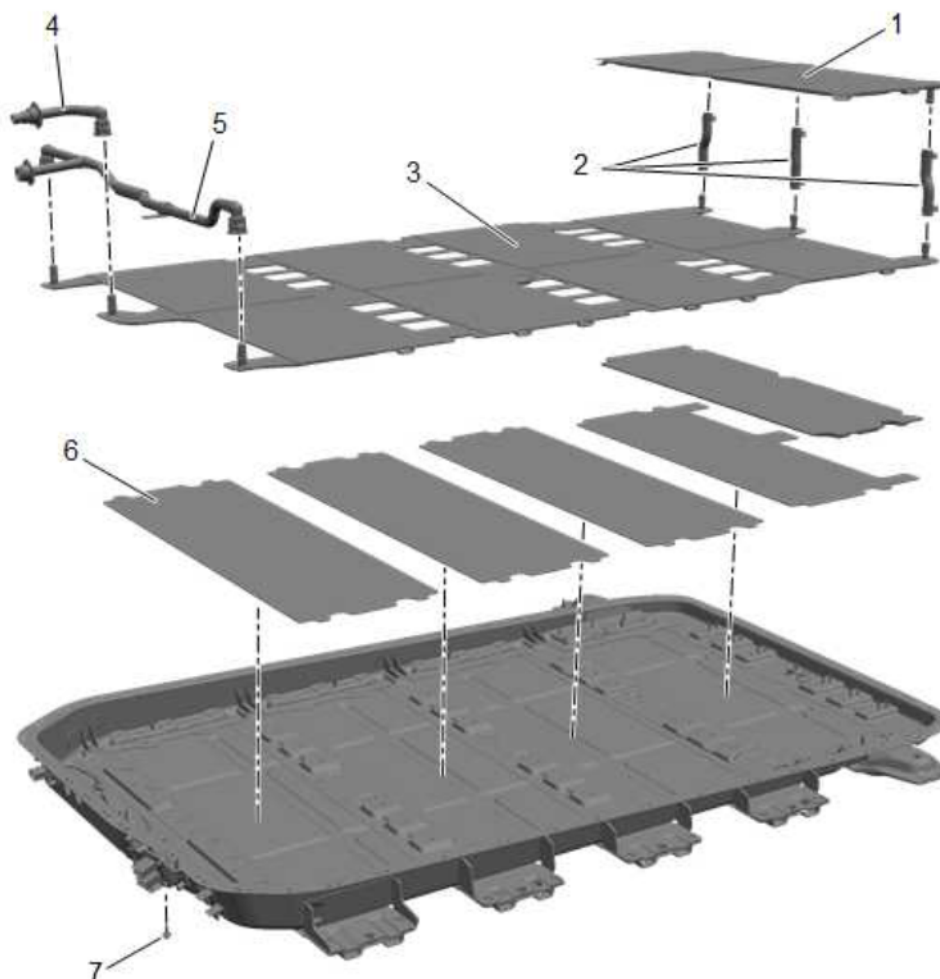


Fig. 6: Battery Cooling

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Cooling Plate-Upper
2	Cooling Hose
3	Cooling Plate-Lower
4	Cell Battery Cooling Manifold Assembly-Outlet
5	Cell Battery Cooling Manifold Assembly-Inlet
6	Insulation Pad

HIGH VOLTAGE BATTERY DISCONNECT RELAY ASSEMBLY

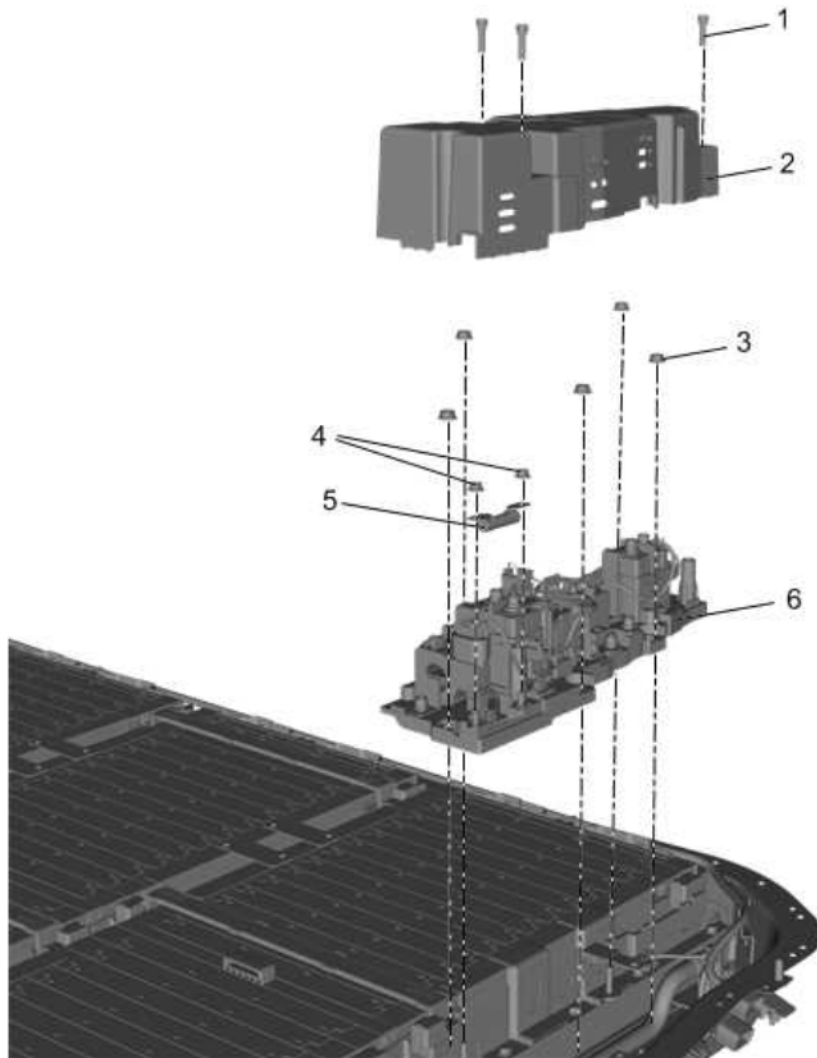


Fig. 7: High Voltage Battery Disconnect Relay
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Bolt
2	High Voltage Battery Disconnect Relay Cover
3	Nut
4	Nut
5	High Voltage Battery Disconnect Relay Fuse
6	High Voltage Battery Disconnect Relay Assembly

2017 ELECTRICAL

Hybrid/EV Energy Storage - Description and Operation - Bolt EV

DESCRIPTION AND OPERATION

DRIVE MOTOR BATTERY SYSTEM DESCRIPTION

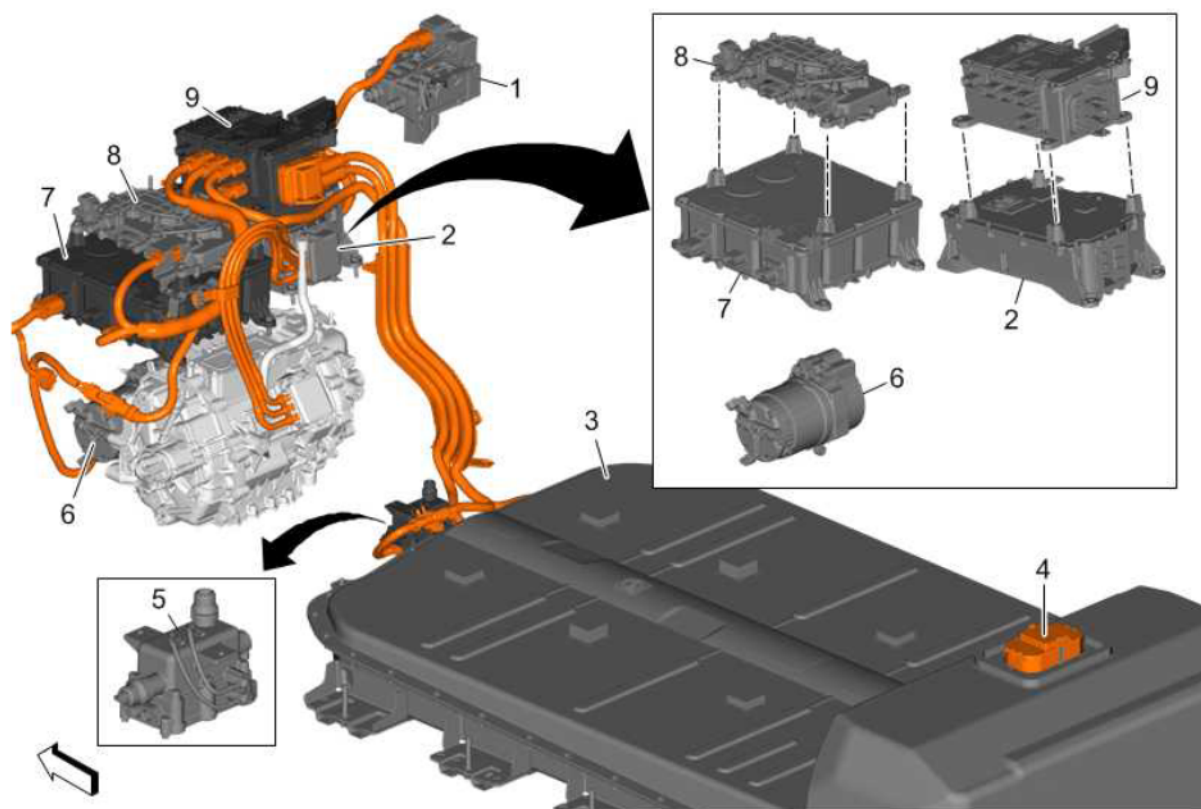


Fig. 1: Drive Motor Battery System

Courtesy of GENERAL MOTORS COMPANY

Callout	Schematic Reference or Generic Name	Scan Tool Reference	Service Information Part Name or Electronic Part Catalog Name
1	K10 Coolant Heater Control Module	Electric Passenger Compartment Heater parameters hosted by Hybrid Powertrain Control Module 2	Heater Coolant Heater
2	T6 Power Inverter Module	- Hybrid Powertrain Control Module - Drive Motor Control Module 1	Drive Motor Power Inverter Module
3	A4 Hybrid/EV Battery Pack	Not Applicable	High Voltage Battery
4	S15 Manual Service Disconnect	Not Applicable	Drive Motor Battery High Voltage Manual Disconnect Lever
5	E54 Hybrid/EV Battery Pack Coolant Heater	Hybrid/EV Battery Pack Heater parameters hosted by Hybrid Powertrain Control Module 2	High Voltage Battery Heater

Callout	Schematic Reference or Generic Name	Scan Tool Reference	Service Information Part Name or Electronic Part Catalog Name
6	G1 A/C Compressor	Electric A/C Compressor Control Module	Air Conditioning Compressor
7	T18 Battery Charger	Battery Charger parameters hosted by Hybrid Powertrain Control Module 2	Drive Motor Battery Charger
8	K1 14V Power Module	14V Power Module	Accessory DC Power Control Module
9	T24 Battery Charger - DC	DC Charging Control Module (CBT)	High Voltage Battery Control Wiring Junction Block

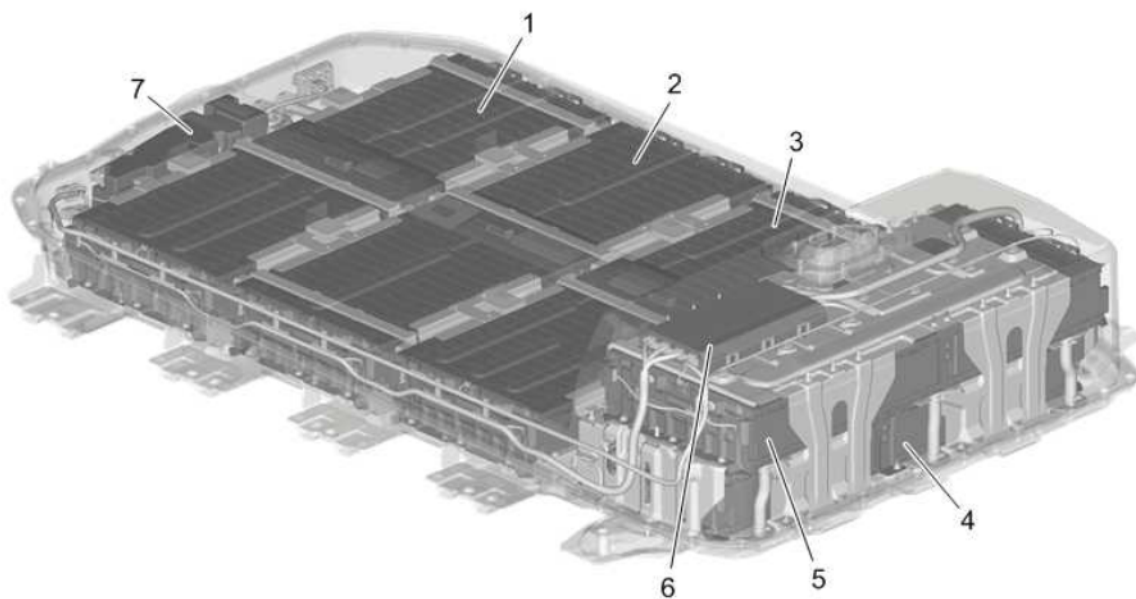


Fig. 2: Hybrid/EV Battery Internal Components
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Internal Components

Callout	Schematic Reference or Generic Name	Scan Tool Reference	Service Information Part Name
1	C4A Hybrid/EV Battery Section 1	Not Applicable	Cell Battery Module (Row 1, 3)
2	C4B Hybrid/EV Battery Section 2	Not Applicable	Cell Battery Module (Row 2)
3	C4C Hybrid/EV Battery Section 3	Not Applicable	Cell Battery Module (Row 1, 3)
4	C4D Hybrid/EV Battery Section 4	Not Applicable	Cell Battery Module (Row 4)
5	C4E Hybrid/EV Battery Section 5	Not Applicable	Cell Battery Module (Row 5)
6	K16 Battery Energy Control Module	Battery Energy Control Module	Battery Energy Control Module
7	A28 Hybrid/EV Battery Contactor Assembly	Not Applicable	High Voltage Battery Disconnect Relay

Hybrid/EV Battery Section/Row, Cell Modules and Groups

Section (Row)	Cell Module	Cell Group
C4A Hybrid/EV Battery Section 1(Row 1)	C5A Hybrid/EV Battery Module 1*	10
		9
		8
		7
		6
		5
		4
		3
		2
		1
	C5K Hybrid/EV Battery Module 10	87
		88
		89
		90
		91
		92
		93
		94
		95
		96
C4B Hybrid/EV Battery Section 2(Row 2)	C5B Hybrid/EV Battery Module 2*	11
		12
		13
		14
		15
		16
		17
		18
		19
		20
	C5J Hybrid/EV Battery Module 9	86
		85
		84
		83
		82
		81
		80
		79
		78
		77
C4C Hybrid/EV Battery Section 3(Row 3)	C5C Hybrid/EV Battery Module 3*	30
		29
		28
		27
		26
		25
		24
		23
		22
		21

Section (Row)	Cell Module	Cell Group
	C5H Hybrid/EV Battery Module 8	67
		68
		69
		70
		71
		72
		73
		74
		75
		76
C4D Hybrid/EV Battery Section 4(Row 4)	C5D Hybrid/EV Battery Module 4*	31
		32
		33
		34
		35
		36
		37
		38
		39
		40
	C5G Hybrid/EV Battery Module 7	66
		65
		64
		63
		62
		61
		60
		59
C4E Hybrid/EV Battery Section 5(Row 5)	C5E Hybrid/EV Battery Module 5*	41
		42
		43
		44
		45
		46
		47
		48
	C5F Hybrid/EV Battery Module 6	49
		50
		51
		52
		53
		54
		55
		56
		57
		58
*On right side of section (row)		

Overview

The high voltage hybrid/EV battery contains 288 individual lithium-ion cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid/EV battery assembly. These cell groups are electrically connected in series. Each individual cell group is rated at

3.65 V, for a nominal system voltage of 350 V direct current. The battery cell groups are electrically joined to form 10 distinct electrical modules. There are eight electrical modules comprised of 10 cell groups and two electrical modules comprised of 8 cell groups. Two battery cell modules are physically mounted together to form a section/row. Section/row 1 and 3 are interchangeable while section/row 2, 4 and 5 are unique to their location. With the exception of section/row 5, the two battery cell modules are not electrically connected within their respective section/row. The hybrid/EV battery pack contains a total of six battery temperature sensors mounted to certain battery cell modules. The hybrid/EV battery pack also contains a coolant inlet temperature sensor. Refer to [Hybrid/EV Cooling System Description and Operation](#).

Located within the high voltage Hybrid/EV battery pack, the K16 battery energy control module monitors the temperature, current and voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on the end of the battery cell module. A voltage sense harness joins this connector to the K16 battery energy control module.

The K16 battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the K16 battery energy control module to the K114B hybrid powertrain control module 2 through serial data. The K114B hybrid powertrain control module 2 is the host controller for K16 battery energy control module diagnostic trouble code information.

Location

The high voltage hybrid/EV battery is installed from beneath the vehicle. The K16 battery energy control module, a current sensor, and the high voltage contactors are located within the hybrid battery assembly. The K114B hybrid powertrain control module 2 is mounted within the passenger compartment, beneath the right front seat.

High Voltage Control

The hybrid/EV battery contains 4 high voltage contactors. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor and a precharge negative high voltage contactor. The high voltage contactors are located within the A28 hybrid/EV battery contactor assembly.

In order to prevent large in-rush current to capacitors located in the vehicles high voltage components, the contactors close in a specific precharge sequence controlled by the K114B hybrid/EV powertrain control module 2.

Contactor Close Sequence (Precharge)

1. Plug-In Charge Positive Contactor
2. Main Positive Contactor
3. Precharge Negative Contactor

NOTE: Wait for bus high voltage to attain almost the same level as hybrid/EV battery voltage.

4. Main Negative Contactor
5. The precharge contactor opens when bus voltage and hybrid/EV battery voltage are equal.

Thermal Management

The hybrid/EV battery is cooled and heated with pre-mixed DEX-COOLÂ®, which is a 50/50 mixture of DEX-COOLÂ® and de-ionized water. A refrigerant/coolant heat exchanger (chiller) and the G1 A/C compressor cools down the high voltage hybrid/EV battery. A high voltage heater can also heat the coolant entering the hybrid/EV battery when needed. Thermal transfer occurs between the bottom of the Hybrid/EV Battery Modules and coolant plates that circulate the heated or cooled coolant. Refer to [Hybrid/EV Cooling System Description and Operation](#), and [Disassembled Views](#) in Hybrid/EV Ignition.com Energy Storage.

Loss of Isolation Description

Vehicles equipped with high voltage storage and propulsion capability are designed with the high voltage circuits isolated from the vehicle chassis. If either the positive or negative high voltage Direct Current (DC) circuits or any of the high voltage Alternating Current (AC) phase circuits lose this isolation to the vehicle chassis, one or more diagnostic trouble codes (DTCs) may set.

Similar to typical 12V vehicle systems, loss of isolation can be as simple as a direct conductor-to-chassis short. Unlike 12V systems however, the potential within high voltage systems means that insulation breakdown is also a cause for loss of isolation. Therefore diagnosis for isolation loss requires testing with high voltage potential. Special insulation testing meters that utilize their own built-in high voltage are used to test the isolation capability of high voltage components and circuits. Additionally, monitoring certain scan tool parameters when high voltage is active may also help to identify which high voltage components and circuits may have lost their chassis isolation.

Vehicle Loss of Isolation Detection

The vehicle performs two independent tests for isolation:

1. Passive isolation testing which is performed within the power inverter module by the hybrid powertrain control module 1.
2. Active isolation testing which is performed within the Hybrid/EV battery pack by the hybrid powertrain control module 2.

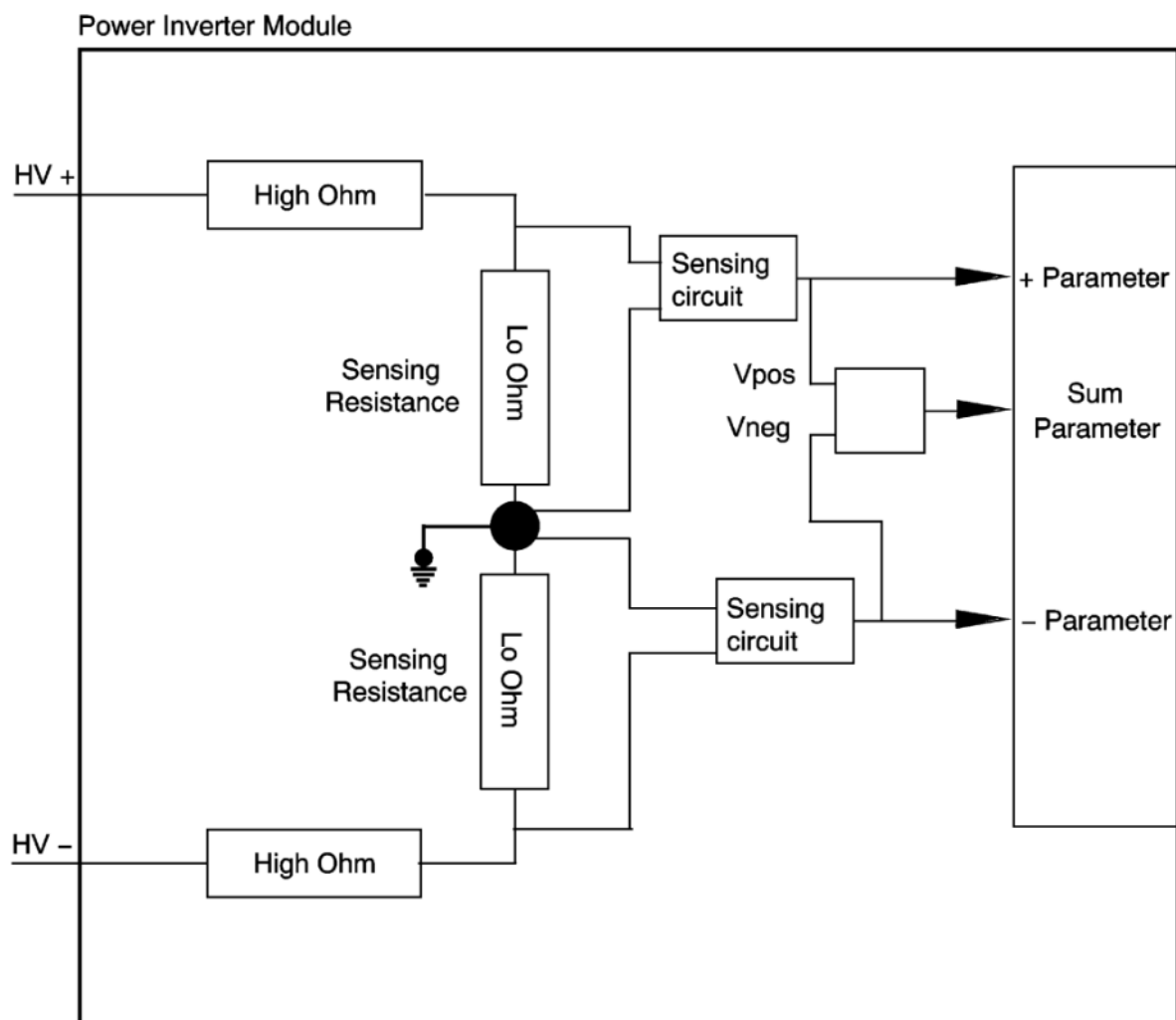
Passive Isolation Testing

Fig. 3: Power Inverter Module Operation Graph

Courtesy of GENERAL MOTORS COMPANY

The power inverter module continuously performs isolation testing whenever high voltage to the module is present. The power inverter module has one isolation sensing circuit although the drive motor and aux

pump control modules monitor and display the sensor data redundantly. The Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters give a real-time indication of Isolation status. Under normal operating conditions each of the parameters will indicate about half of the total Hybrid/EV battery pack high voltage potential. When a loss of isolation condition is observed, the Voltage scan tool parameter values will shift in respect to each other. When the voltage shift exceeds a set ratio, DTCs P1AF0, P1AF2, or P1E22 will set.

NOTE: Some high voltage components contain internal switching or inverter circuits that can interrupt a portion of their high voltage circuitry. If such a component, for example the passenger cabin heater, is OFF its complete internal circuitry is not being monitored. Likewise, these internally switched components cannot be fully tested off-vehicle with the Insulation Testing Meter EL-50772 , EL-50774 , or equivalent.

Scan Tool Parameters

- Drive Motor Positive Supply Isolation Voltage
- Aux Trans Fluid Pump Positive Supply Isolation Voltage
- Drive Motor Negative Isolation Voltage
- Aux Trans Fluid Pump Negative Supply Isolation Voltage

The power inverter module isolation sensing circuit communicates one value, which is displayed redundantly by different modules. The data within the parameters for each module is identical.

Isolation Loss between HV Components and Chassis, Positive Side*

Isolation between HV Bus and Chassis	Normal Vehicle	10M	5M	1M	500K	200K Approximate DTC set	100K	None - Direct Short
Positive Isolation Parameter*	198V	180V	165V	110V	75V	35V	20V	0V
Negative Isolation Parameter*	192V	210V	225V	280V	315V	355V	370V	390V
Difference Between Parameters	0 - 15V	30V	60V	170V	240V	320V	350V	390V

*Typical values observed with a fully charged pack, 390V. A short to the positive bus is shown, a short to the negative bus would display inverted voltages of similar value.

Active Isolation Testing

Active isolation testing is dedicated to monitoring the internal Hybrid/EV battery pack HV circuits. The battery energy control module switches fixed resistors between the high voltage system and vehicle chassis. The difference between the switched-to-chassis and the unswitched state is used to calculate a resistance-to-chassis value. When resistance-to-chassis decreases below a set value, DTC P0AA6 will set.

Active isolation testing occurs when the main high voltage contactor relays are open. For this reason most testing of the Hybrid/EV battery pack occurs just after the vehicle is shut off following a drive trip. The Isolation Test Resistance scan tool parameter indicates the resistance-to-chassis calculation determined when the last Active isolation test was performed.

High Voltage System

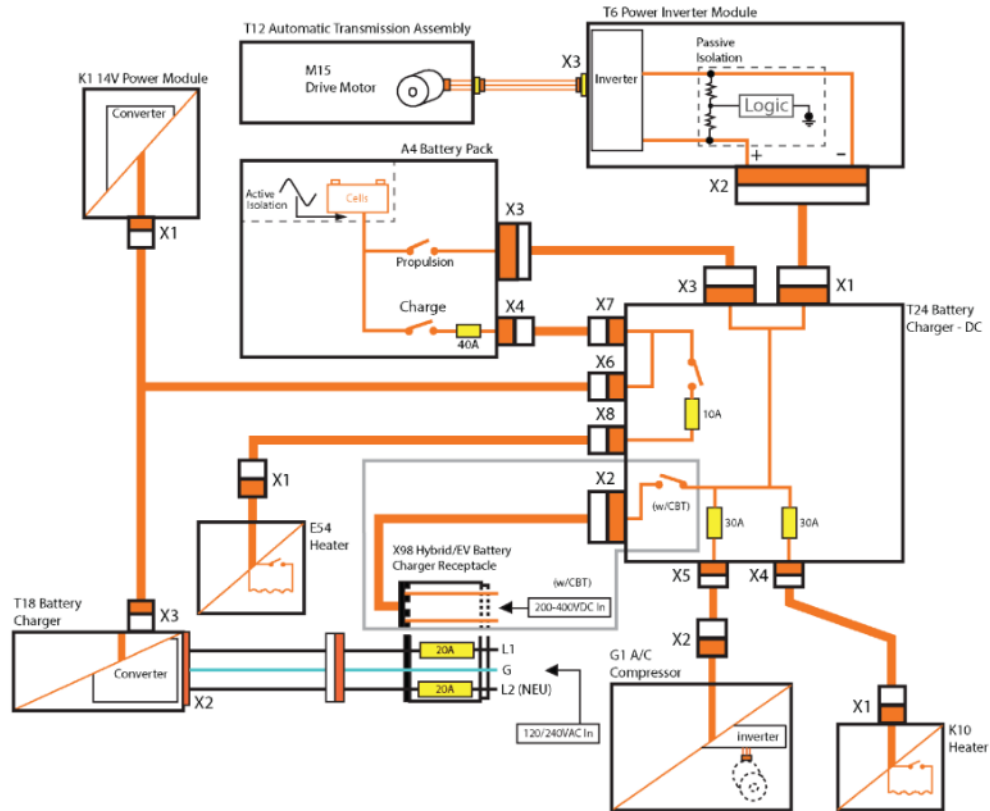


Fig. 4: High Voltage System
 Courtesy of GENERAL MOTORS COMPANY

2017 ELECTRICAL

Hybrid/EV Energy Storage - Diagnostic Information and Procedures - Bolt EV

DIAGNOSTIC INFORMATION AND PROCEDURES

HIGH VOLTAGE SAFETY

The High Voltage Safety procedure will perform the following tasks:

- Identify precautions when performing service or inspections.
- Identify labels for components, wire harness, and connectors.
- Identify high voltage insulation glove inspection procedure.

When applicable, additional region-specific high voltage service requirements and/or Dangers will be located in the General Information, Safety Regulations service category and take precedence over the information presented here.

General High Voltage Dangers

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.

NOTE: For European Region, a face shield is required in place of safety glasses.

WARNING: High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.

NOTE: For European Region, a special voltage tester such as the EL-52229 may be required. A multimeter that can measure current is prohibited.

WARNING: This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

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

Precautions when Performing Service or Inspections

- Always verify that the high voltage has been disabled before working on or around high voltage components, wires, cables, or harnesses.
- Remove all metal objects such as rings and watches.
- The **EL-48900** HEV safety kit contains safety cones. Place the safety cones around the vehicle to alert other technicians that you are working on the high voltage system.
- Remove all keyless entry transmitters and the manual service disconnect from the vehicle and secure in a place outside the vehicle.
- Always wear certified and tested high voltage insulation gloves when inspecting or testing any high voltage wires and components.
- Use the "One Hand" rule whenever possible:
 - Work with only one hand.
 - Keep the other hand behind your back.
- DO NOT carry any metal objects such as a mechanical pencil or a measuring tape that could fall and cause a short circuit.
- After removing ring-terminal style high voltage wires, protect and insulate the terminal ends immediately with the **EL-50209** high voltage terminal cover and UL® Listed or equivalent insulation tape rated at a minimum of 600 V.
- Always tighten the high voltage terminal fasteners to the specified torque. Insufficient or excessive torque will cause malfunctions or damage.
- After finishing work on the high voltage systems and before reinstalling the high voltage manual disconnect, inspect for the following:
 - Verify high voltage system integrity and that all connectors are installed.
 - Verify that all tools or loose components have been removed.

Labels for Components, Wire Harness, and Connectors

The wire harnesses and cables for high voltage circuits are encased in an orange colored covering. In addition, high voltage components such as the Energy Storage System and high voltage cables are affixed with "High Voltage" red danger and orange warning labels.

High Voltage Insulation Glove Inspection Procedure

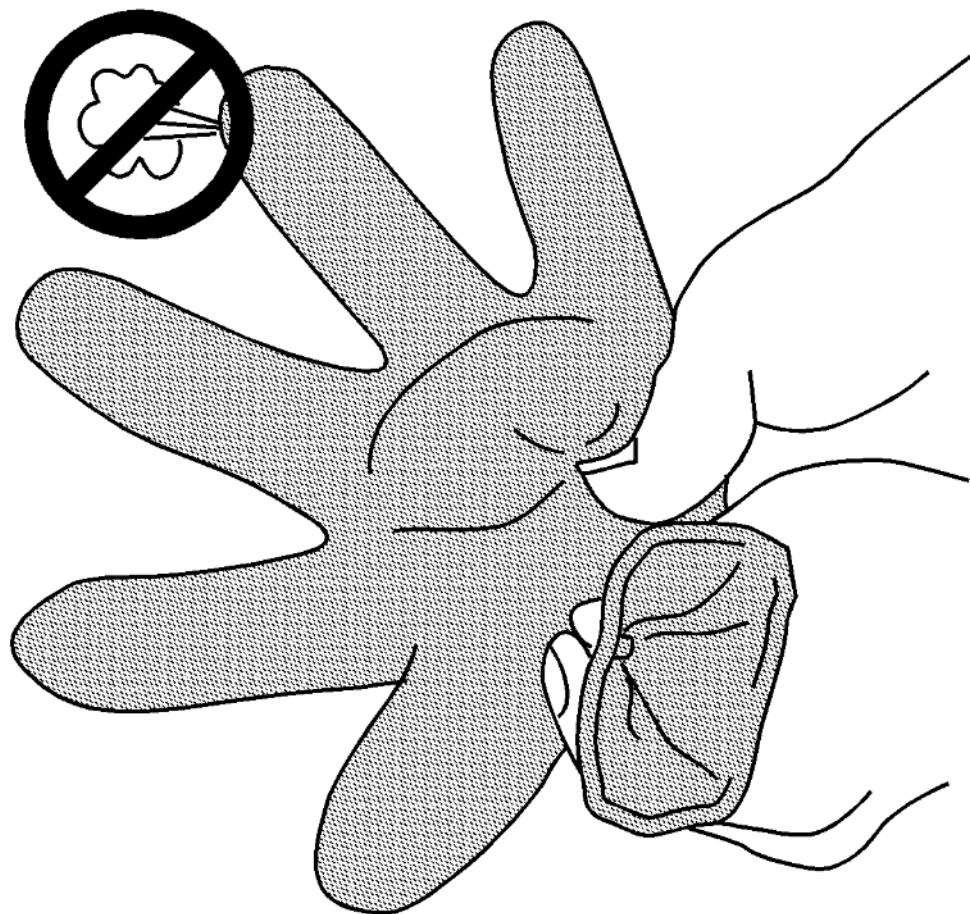


Fig. 1: Glove Inspection Procedure

Courtesy of GENERAL MOTORS COMPANY

The following procedure visually and functionally inspects the insulation gloves to be used while performing service on high voltage systems. This inspection procedure should be performed prior to any procedure that requires the use of class "0" insulation gloves rated at 1000 V.

1. Remove glove from leather protector.
2. Trap air in the glove and seal opening. Pinch or roll the opening closed tightly to prevent any air loss.
3. Press glove to increase pressure.
4. Inspect for the following conditions:

- Pin holes
- Air leaks
- Wear, tears, or abrasions
- Damp or wet material
- Expired certification
- **If any of the above conditions are met**

Do not use the gloves.

- **If none of the above conditions are met**

5. All OK. Gloves are OK to use.

HIGH VOLTAGE DISABLING

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.

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Circuit/System Description

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.

The High Voltage Disabling procedure utilizes two possible methods to disable high voltage:

NOTE: **The High Voltage Disable procedure, regardless of the method, only de-energizes the high voltage circuits and components outside of the Hybrid/EV battery pack, dangerous voltage levels always exist within the Hybrid/EV battery pack.**

1. Scan Tool Method: The on-vehicle control module software, initiated by the GDS2 scan tool, disables and discharges high voltage outside of the Hybrid/EV battery pack.
2. DMM Method: If the GDS2 Scan Tool Method does not complete or cannot be implemented, A DMM-based physical measurement method is performed at certain high voltage connectors.

A successful GDS2 Scan Tool High Voltage Disable Procedure will:

1. Perform an analysis of the vehicle condition by verifying specific DTCs have run and passed.
2. Calculate the high voltage isolation resistance to the vehicle chassis.
3. Open the high voltage contactor relays and discharge the high voltage system by setting a crash event lockout. When this stage is reached the **Clear Secured High Voltage DTCs** procedure will have to be performed to enable the system again.
4. Latch a Service Lockout condition to prevent unintended enabling of the high voltage system.
5. Instruct you when to remove the manual service disconnect.
6. Indicate successful high voltage disabling by:
 - Displaying a PROCEDURE COMPLETE message on the scan tool
 - Displaying a CHECK VEHICLE'S HIGH VOLTAGE STATUS message on the scan tool which will require you to verify:
 1. Vehicle is displaying an Instrument Cluster DIC message.
 2. Vehicle is sounding a continuous audible response from the vehicle Pedestrian Alert alarm.
 3. High Voltage Inverter Voltage parameter on scan tool indicates system high voltage has been lowered to a safe level.

An Unsuccessful GDS2 Scan Tool High Voltage Disable Procedure:

If vehicle conditions DO NOT permit the GDS2 scan tool procedure to complete, you will have to verify high voltage disabling by measuring the applicable connectors for safe voltage level with a DMM.

Diagnostic Aids

Review the **High Voltage Connectors** information for connector identification and the approved procedures for disconnecting and connecting high voltage connectors.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

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

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

Circuit Testing

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

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Testing

WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not.

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

1. Review the high voltage safety information. Refer to [High Voltage Safety](#).

NOTE: Ensure the 12V battery is fully charged and tested prior to continuing.

2. Disconnect and remove all 12 V Battery Chargers and the Charge Cable from the X98 Hybrid Battery Charger Receptacle.

NOTE: If vehicle conditions do not allow for GDS2 scan tool usage, proceed to GDS2 Scan Tool Procedure Unsuccessful below.

3. Access the GDS2 scan tool High Voltage Disable Procedure located under HPCM2 Control Functions.
4. Perform the actions as specified within the GDS2 scan tool procedure.

NOTE: If at any point the GDS2 scan tool displays a "PROCEDURE UNSUCCESSFUL" warning message or you lose communication, stop the GDS2 procedure and proceed to GDS2 Scan Tool Procedure Unsuccessful below.

5. WHEN INSTRUCTED by the GDS2 procedure, remove the S15 Manual Service Disconnect. Refer to [Drive Motor Battery High Voltage Manual Disconnect Lever Replacement](#). Place the S15 Manual Service Disconnect in a secure place outside the vehicle. Cover the exposed high voltage opening with UL listed, or equivalent, insulation tape rated at a minimum of 600 V.
6. Verify the GDS2 scan tool procedure completed successfully by observing a GDS2 scan tool "PROCEDURE COMPLETE" message followed by a "CHECK VEHICLE'S HIGH VOLTAGE STATUS" message. Verify these messages are combined with ALL the following conditions:
 - A Continuous Audible Vehicle Response of the Pedestrian Alert alarm
 - DIC message
 - High Voltage Inverter Voltage parameter on scan tool indicates system high voltage is less than 10 volts
 - If the procedure was unsuccessful

Proceed to GDS2 Scan Tool Procedure Unsuccessful below.

- If the procedure successfully completed

1. Turn the vehicle power mode to OFF.

NOTE: Disconnecting the 12 V battery is the only method to deactivate the audible

vehicle response. If the 12 V battery is reconnected while the S15 Manual Service Disconnect is removed, the audible vehicle response will continue for several minutes.

2. Disconnect the 12 V battery. Refer to [Battery Negative Cable Disconnection and Connection](#).

NOTE: You will have to perform the Clear Secured High Voltage DTCs GDS2 scan tool procedure in order to re-enable the high voltage system upon completion of the required vehicle servicing.

3. The high voltage circuits and components OUTSIDE of the Hybrid/EV battery pack are now disabled/discharged.

NOTE: Print the High Voltage Disable Confirmation table if necessary. Circle Steps Completed to identify which components have been disabled.

High Voltage Disable Confirmation Table

Was the GDS2 Scan Tool Procedure SUCCESSFUL?	Circle One:	NO	YES
	If YES, all high voltage external of the A4 Hybrid/EV Battery Pack is now disabled. Fill-out and Print form as necessary. If NO, perform GDS2 Scan Tool Procedure Unsuccessful steps as required		
Confirm GDS2 Scan Tool Procedure Unsuccessful Steps Completed Below			
High Voltage Components you wish to Disable	GDS2 Scan Tool Procedure Unsuccessful Steps that must be completed	Steps Completed	
- General Vehicle Servicing around or near but not directly at high voltage components - T6 Power Inverter Module and connectors - T12 Transmission and connectors - A4 Hybrid/EV Battery Pack - external 300V cables A4 Hybrid/EV Battery Pack to T24 Battery Charger - DC	Steps 1 - 19	NO	YES
K1 14V Power Module	Steps 1 - 24*	NO	YES
T18 Battery Charger	Steps 1 - 24*	NO	YES
300V cable - T24 Battery Charger - DC to K1 14V Power Module and T18 Battery Charger	Steps 1 - 24*	NO	YES
K10 Heater	Steps 1 - 24*	NO	YES
300V cable - T24 Battery Charger - DC to K10 Heater	Steps 1 - 24*	NO	YES
G1 A/C Compressor	Steps 1 - 24*	NO	YES
300V cable - T24 Battery Charger - DC to G1 A/C Compressor	Steps 1 - 24*	NO	YES
E54 Heater	Steps 1 - 24*	NO	YES
300V cable - T24 Battery Charger - DC to E54 Heater	Steps 1 - 24*	NO	YES
T24 Battery Charger - DC	Steps 1 - 24*	NO	YES
*Perform testing at each component as applicable			
Technician:			
VIN:			
License Plate:			

GDS2 Scan Tool Procedure Unsuccessful

NOTE: If the GDS2 Scan Tool Procedure was unsuccessful, follow the steps below as applicable.

1. Remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Attempt to start the vehicle with the Ignition Mode Switch.

- If the vehicle enters Propulsion System Active mode or the engine starts

Locate and remove all keyless entry transmitters from within the vehicle and return to the beginning of the GDS2 Scan Tool Procedure Unsuccessful procedure.

- If the vehicle did not enter Propulsion System Active mode and the engine did not start

NOTE: The 12 V battery must be disconnected to ensure proper test results.

NOTE: You must ensure Battery Maintenance Mode is not active before disconnecting the 12V battery.

3. Disconnect the 12 V battery. Refer to [Battery Negative Cable Disconnection and Connection](#) .
4. Remove the S15 Manual Service Disconnect. Refer to [Drive Motor Battery High Voltage Manual Disconnect Lever Replacement](#) . Place the S15 Manual Service Disconnect in a secure place outside the vehicle. Cover the exposed high voltage opening with ULÂ® listed, or equivalent, insulation tape rated at a minimum of 600 V.

NOTE: 5 min must elapse before removing any high voltage connectors. Removal of non high voltage components is allowed during this wait time.

5. Wait 5 min before continuing, to allow the high voltage capacitors to discharge.

NOTE: A 9 V DC battery or the vehicles 12 V battery can be used to test the DMM.

6. Verify the test DMM by measuring a known good 9 to 12 V battery.

- If the DMM does not properly measure the test battery

Repair or replace the DMM and repeat all voltage measurements.

- If the DMM properly measures the test battery

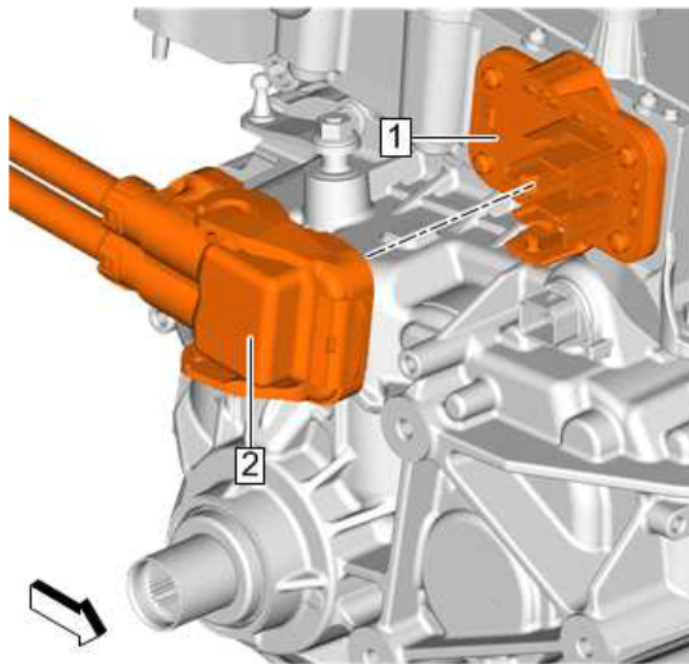


Fig. 2: T6 Power Inverter Module Connector And T24 Battery Charger - DC High Voltage Harness Connector

Courtesy of GENERAL MOTORS COMPANY

- NOTE:**
- Wear your High Voltage Insulation gloves until you have determined that a high voltage exposure risk is no longer present.
 - Inspect the High Voltage DC connection seal for deformation or damage. Inspect the High Voltage DC connector for seal residue or debris. Always replace damaged seals and clean seal remnants from the connector with a non-marring tool.

7. Disconnect the T24 Battery Charger - DC high voltage harness connector (2) at the T6 Power Inverter Module.

NOTE: 5 min must have elapsed since removing the S15 Manual Service Disconnect before continuing to allow the high voltage capacitors to discharge and ensure

8. Verify the voltage measures less than 3 V at the T6 Power Inverter Module connector (1) at the following points:
- High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
 - **If 3 V or greater**

Leave the DMM connected to the terminals until the voltage drops below 3 V to allow the high voltage capacitors to discharge. Continue to the next step once the voltage is below 3 V.

- **If less than 3 V**

9. Verify the voltage measures less than 3 V at the HV DC harness connector (2) to the T6 Power Inverter Module at the following points:

- High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
- **If 3 V or greater**

There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack. Refer to [Hybrid/EV Battery Voltage Present](#).

- **If less than 3 V**

10. Raise the vehicle and remove the underbody forward air deflector.

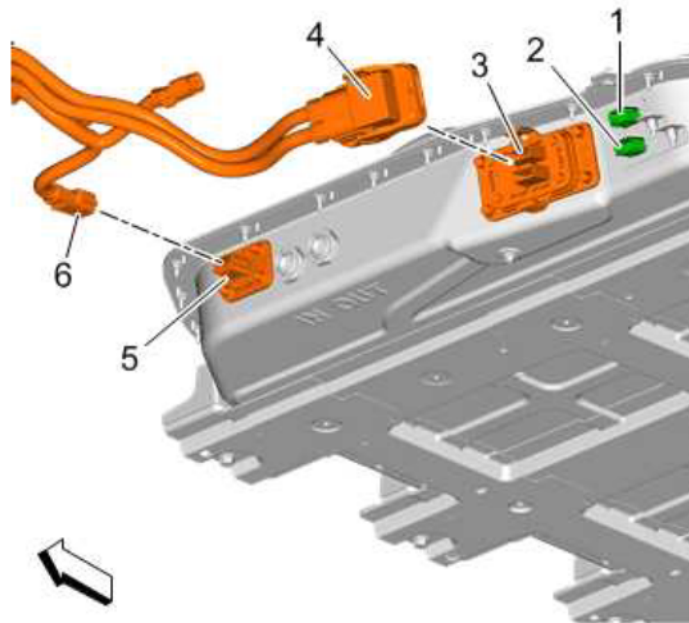


Fig. 3: A4 Hybrid/EV Battery Pack Connectors, T18/T24 Battery Charger Harness Connectors And Low Voltage Harness Connectors

Courtesy of GENERAL MOTORS COMPANY

11. Disconnect the low voltage harness connectors (1, 2) at the A4 Hybrid/EV Battery Pack.
12. Disconnect the T18 Battery Charger harness connector (6) at the A4 Hybrid/EV Battery Pack.
13. Verify the voltage measures less than 3 V at the A4 Hybrid/EV Battery Pack connector (5) at the following points:
- High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
 - **If 3 V or greater**

There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack. Refer to [Hybrid/EV Battery Voltage Present](#).

- **If less than 3 V**

14. Verify the voltage measures less than 3V at the T18 Battery Charger harness connector (6) at the following points:

- High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
- **If 3 V or greater**

Leave the DMM connected to the terminals until the voltage drops below 3 V to allow the high voltage capacitors to discharge. Continue to the next step once the voltage is below 3 V.

- **If less than 3 V**

15. Disconnect the T24 Battery Charger - DC connector (4) at the A4 Hybrid/EV Battery Pack.

16. Verify the voltage measures less than 3 V at the T24 Battery Charger - DC harness connector (4) at the following points:

- High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
- **If 3 V or greater**

Leave the DMM connected to the terminals until the voltage drops below 3 V to allow the high voltage capacitors to discharge. Continue to the next step once the voltage is below 3 V.

- **If less than 3 V**

17. Verify the voltage measures less than 3 V at the A4 Hybrid/EV Battery Pack connector (3) at the following points:

- High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
- **If 3 V or greater**

There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack. Refer to [Hybrid/EV Battery Voltage Present](#).

- **If less than 3 V**

NOTE: Discard any 300 V Battery Positive and Negative cable connector seal that may be deformed or damaged. Replace any seal that is deformed, missing, or damaged.

NOTE: A 9 V DC battery or the vehicles 12 V battery can be used to test the DMM.

18. Verify the test DMM by measuring a known good 9 to 12 V battery.

- **If the DMM does not properly measure the test battery**

Repair or replace the DMM and repeat all voltage measurements.

- **If the DMM properly measures the test battery**

19. The high voltage connectors at the A4 Hybrid/EV battery pack are now discharged. You may perform A4 Hybrid/EV battery pack removal and exit the High Voltage Disabling procedure at this time but you MUST continue if additional high voltage component service is required.

- **If you do not need to perform additional high voltage component service**

HV Disable for T6 power inverter module, T12 Transmission and A4 Hybrid battery pack is complete.

- **If you need to perform additional high voltage component service**

20. Disconnect the high voltage connector(s) at the component(s) to be serviced.

21. Verify the voltage measures less than 3 V at the Module-side connector at the following points:

- High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
- **If 3 V or greater**

Leave the DMM connected to the terminals until the voltage drops below 3 V to allow the high voltage capacitors to discharge. Continue to the next step once the voltage is below 3 V.

- **If less than 3 V**

22. Repeat the previous step at all high voltage module connectors for any additional high voltage components requiring service.
23. Verify the test DMM by measuring a known good 9 to 12 V battery.
 - **If the DMM does not properly measure the test battery**
Repair or replace the DMM and repeat all voltage measurements.
 - **If the DMM properly measures the test battery**
24. High voltage is disabled/discharged at all TESTED modules.

HIGH VOLTAGE ENABLING

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.

Circuit/System Description

The High Voltage Enabling procedure will perform the following tasks:

- Identify how to enable high voltage.
- Verify high voltage system integrity and that all connectors are installed.

Diagnostic Aids

Review the [High Voltage Connectors](#) information for connector identification and the approved procedures for disconnecting and connecting high voltage connectors.

Reference Information

Schematic Reference

[Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Drive Motor Battery System Description](#)

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 Testing

WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not.

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

1. Review the high voltage safety information prior to performing the High Voltage Enabling procedure. Refer to [High Voltage Safety](#)
2. Ensure that the 12 V battery is disconnected. Refer to [Battery Negative Cable Disconnection and Connection](#)

NOTE:

- Always tighten the high voltage fasteners to the specified torque. Insufficient or excessive torque will cause malfunctions or damage.
- The high voltage connectors that have been disconnected do not require a specific sequence when connecting.

3. After finishing work on the high voltage systems and before installing the S15 Manual Service Disconnect, inspect for the following:
 - Verify that all tools or loose components have been removed.
 - Inspect any disconnected 300 V Battery Positive and Negative cable seals for being deformed, missing, or damaged. Replace any seals that are deformed, missing, or damaged.
 - Verify high voltage system integrity and that all connectors are installed.
 - Verify that all high voltage interlock circuit connectors and covers are installed.
 - Install any components or connectors that have been removed or replaced during diagnosis.
4. Install the S15 Manual Service Disconnect (1). Refer to [Drive Motor Battery High Voltage Manual Disconnect Lever Replacement](#)
5. Connect the 12 V battery. Refer to [Battery Negative Cable Disconnection and Connection](#).
6. Vehicle in Service Mode.
7. Verify if the A4 Hybrid/EV Battery Pack or the K16 Battery Energy Control Module has been replaced.
 - **If the A4 Hybrid/EV Battery Pack or the K16 Battery Energy Control Module has been replaced**
 Program the K16 Battery Energy Control Module. Refer to [Battery Energy Control Module Programming and Setup](#). Continue to the next step once programming is complete.
 - **If the A4 Hybrid/EV Battery Pack or the K16 Battery Energy Control Module has not been replaced**
8. Verify if the [High Voltage Disabling](#) procedure performed prior to vehicle repair utilized the GDS2 scan tool method.
 - **If the GDS2 scan tool high voltage disabling procedure was performed, the high voltage contactor relays are in a lockout state.**
 Perform the [Clear Secured High Voltage DTCs](#) procedure and return to the next step.
 - **If the DMM Method high voltage disabling procedure was performed**
9. Vehicle in Service Mode, perform the driver window express learn and clear all DTC Information with a scan tool. Refer to [Window Motor Programming - Express Function](#).
10. Vehicle OFF and all vehicle systems OFF. It may take up to 5 min for all vehicle systems to power down.
11. Vehicle in Service Mode.
12. Verify with a scan tool no DTCs are set.
 - **If any DTCs are set**
 Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
 - **If no DTCs are set**
13. Vehicle ON.
14. Vehicle OFF and wait 5 min.
15. Vehicle in Service Mode. Verify with the scan tool the Hybrid/EV Powertrain Control Module and K114B Hybrid/EV Powertrain Control Module 2 DTC Information that the following DTCs have Ran Since Code Clear and have not set:

- Motor position sensor learn DTC P0C17.
- Contactor DTCs P0AD9, P0ADD, P0D0A, and P1EBD.
- Discharge and Pre-charge DTCs P0C76, P0C78, P0AFB, and P3061.
- High voltage loss of isolation DTCs P0AA6, P1AE6, and P1AF0.
- **If any DTCs are set**

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

• **If the DTCs have Not Ran Since Code Clear**

1. Review and operate the vehicle according to the applicable DTC Conditions for Running and ensure the DTCs run and pass.
2. Verify with the scan tool the Hybrid/EV Powertrain Control Module and K114B Hybrid/EV Powertrain Control Module 2 DTC Information that the specified DTCs have Ran Since Code Clear and have not set:
 - If any DTCs are set, refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - If the DTCs have Ran and Passed

3. Test drive the vehicle and verify no DTCs are set.

• **If the DTCs have Ran and Passed**

16. Test drive the vehicle and verify no DTCs are set.

EL-48571 HIGH VOLTAGE BATTERY PIN OUT BOX REFERENCE

Section (Row)	Cell Module	Cell Group	EL-48571 Harness	EL-48571 Selector Switch Position
C4A Hybrid/EV Battery Section 1 (Row 1)	C5A Hybrid/EV Battery Module 1*	10	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	B, 10
		9		B, 9
		8		B, 8
		7		B, 7
		6		A, 6
		5		A, 5
		4		A, 4
		3		A, 3
		2		A, 2
		1		A, 1
	C5J Hybrid/EV Battery Module 10	87	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	A, 1
		88		A, 2
		89		A, 3
		90		A, 4
		91		A, 5
		92		A, 6
		93		B, 7
		94		B, 8
		95		B, 9
		96		B, 10
C4B Hybrid/EV Battery Section 2 (Row 2)	C5B Hybrid/EV Battery Module 2*	11	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	C, 13
		12		C, 14
		13		C, 15
		14		C, 16
		15		C, 17
		16		C, 18
		17		D, 19
		18		D, 20
		19		D, 21
		20		D, 22
	C5I Hybrid/EV Battery Module 9	86	EL-48571-63 X1 at Forward	D, 22
		85		D, 21

Section (Row)	Cell Module	Cell Group	EL-48571-63 connector, X2 at Aft connector** Harness	EL-48571-61 Selector Switch Position
		84	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	D, 20
		83		D, 19
		82		C, 18
		81		C, 17
		80		C, 16
		79		C, 15
		78		C, 14
		77		C, 13
C4C Hybrid/EV Battery Section 3 (Row 3)	C5C Hybrid/EV Battery Module 3*	30	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	B, 10
		29		B, 9
		28		B, 8
		27		B, 7
		26		A, 6
		25		A, 5
		24		A, 4
		23		A, 3
		22		A, 2
		21		A, 1
	C5H Hybrid/EV Battery Module 8	67	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	A, 1
		68		A, 2
		69		A, 3
		70		A, 4
		71		A, 5
		72		A, 6
		73		B, 7
		74		B, 8
		75		B, 9
		76		B, 10
C4D Hybrid/EV Battery Section 4 (Row 4)	C5D Hybrid/EV Battery Module 4*	31	EL- 48571-61	A, 1
		32		A, 2
		33		A, 3
		34		A, 4
		35		A, 5
		36		A, 6
		37		B, 7
		38		B, 8
		39		B, 9
		40		B, 10
	C5G Hybrid/EV Battery Module 7	66	EL-48571-62	B, 8
		65		B, 7
		64		A, 6
		63		A, 5
		62		A, 4
		61		A, 3
		60		A, 2
		59		A, 1
C4E Hybrid/EV Battery Section 5 (Row 5)	C5E Hybrid/EV Battery Module 5*	41	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	C, 15
		42		C, 16
		43		C, 17
		44		C, 18
		45		D, 19
		46		D, 20
		47		D, 21

Section (Row)	Cell Module	Cell Group	EL-48571 Harness	EL-48571 Selector Switch Position
		48		D, 22
	C5F Hybrid/EV Battery Module 6	49	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	A, 1
		50		A, 2
		51		A, 3
		52		A, 4
		53		A, 5
		54		A, 6
		55		B, 7
		56		B, 8
		57		B, 9
		58		B, 10
*On right side of section (row)				
**Reversed connection will result in inaccurate results				

HIGH VOLTAGE CONNECTORS

Connector Type Identification

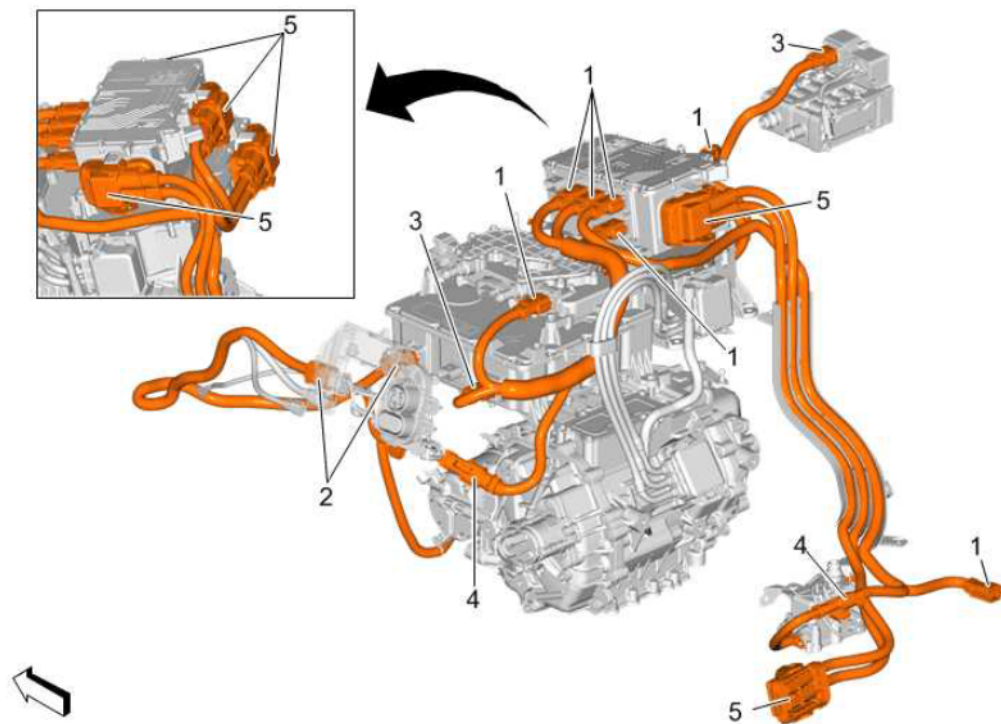


Fig. 4: Connector Type Identification

Courtesy of GENERAL MOTORS COMPANY

Connector Type		Connector Location								
		T6 Power Inverter Module	A4 Hybrid/EV Battery Pack	G1 A/C Compressor	K10 Coolant Heater Control Module	E54 Hybrid/EV Battery Pack Coolant Heater	K1 14V Power Module	T18 Battery Charger	T24 Battery Charger - DC	X98 Hybrid/EV Battery Charger Receptacle
Callout	Connector									
1	HV280 1 Click	-	X4	-	-	-	X1	-	X4, X5, X6, X7, X8	-
2	HV280	-	-	-	-	-	-	X2	-	X1
3	AMP+HVA280	-	-	-	X1	-	-	X3	-	-
4	MP280	-	-	X2	-	X1	-	-	-	-

Connector Type		Connector Location								
		T6 Power Inverter Module	A4 Hybrid/EV Battery Pack	G1 A/C Compressor	K10 Coolant Heater Control Module	E54 Hybrid/EV Battery Pack Coolant Heater	K1 14V Power Module	T18 Battery Charger	T24 Battery Charger - DC	X98 Hybrid/EV Battery Charger Receptacle
Callout	Connector									
5	PP2000 90 NFS	X2	X3	-	-	-	-	-	X1, X2, X3	-

WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

Review the high voltage safety information. Refer to [High Voltage Safety](#).

HVA280 1 Click Connector Procedure

HVA280 1 click Disconnect Procedure

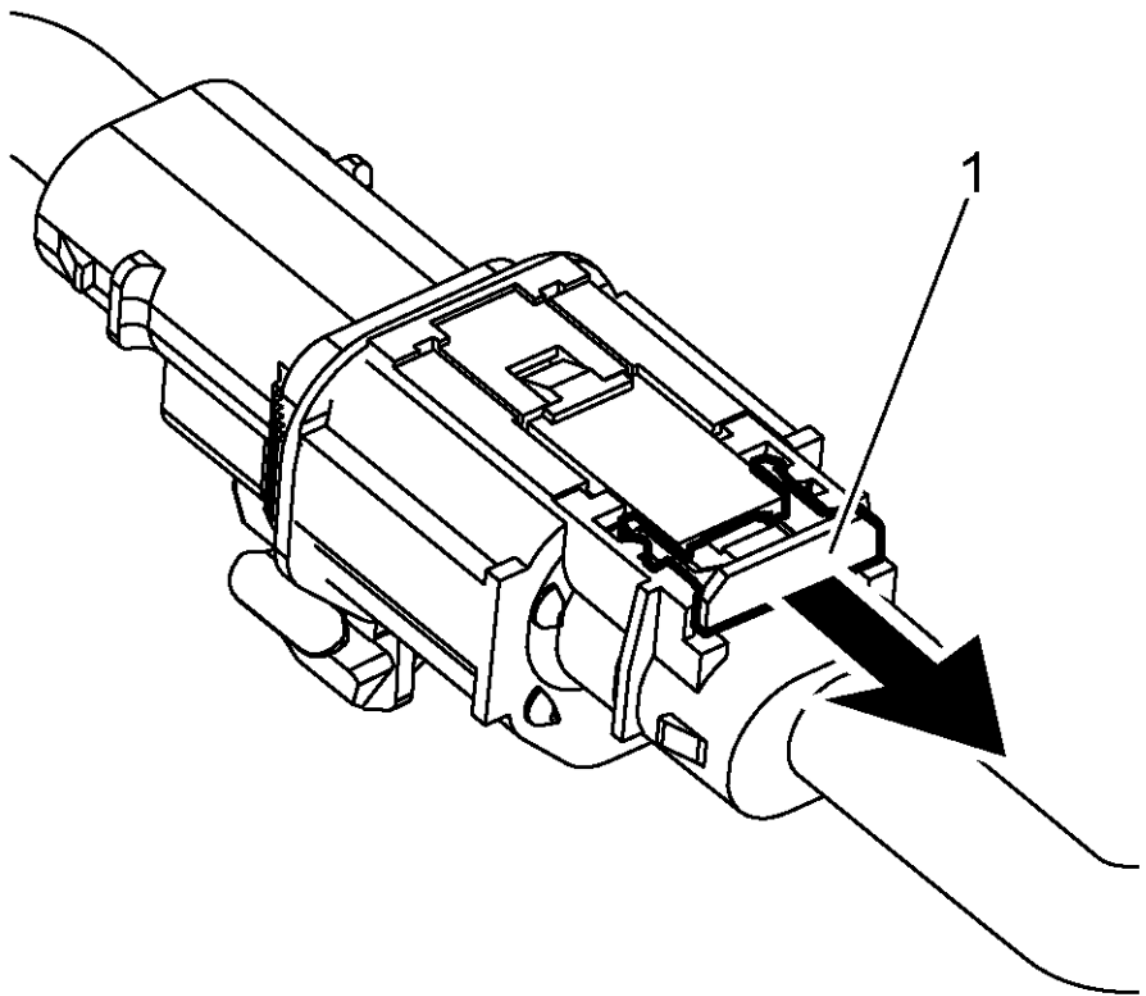


Fig. 5: Connector Position Assurance (CPA) Tab
 Courtesy of GENERAL MOTORS COMPANY

1. Pull the connector position assurance (CPA) tab (1) back from the locked position to the pre-stage position. There will be an audible click sound when the CPA tab is in the correct position.

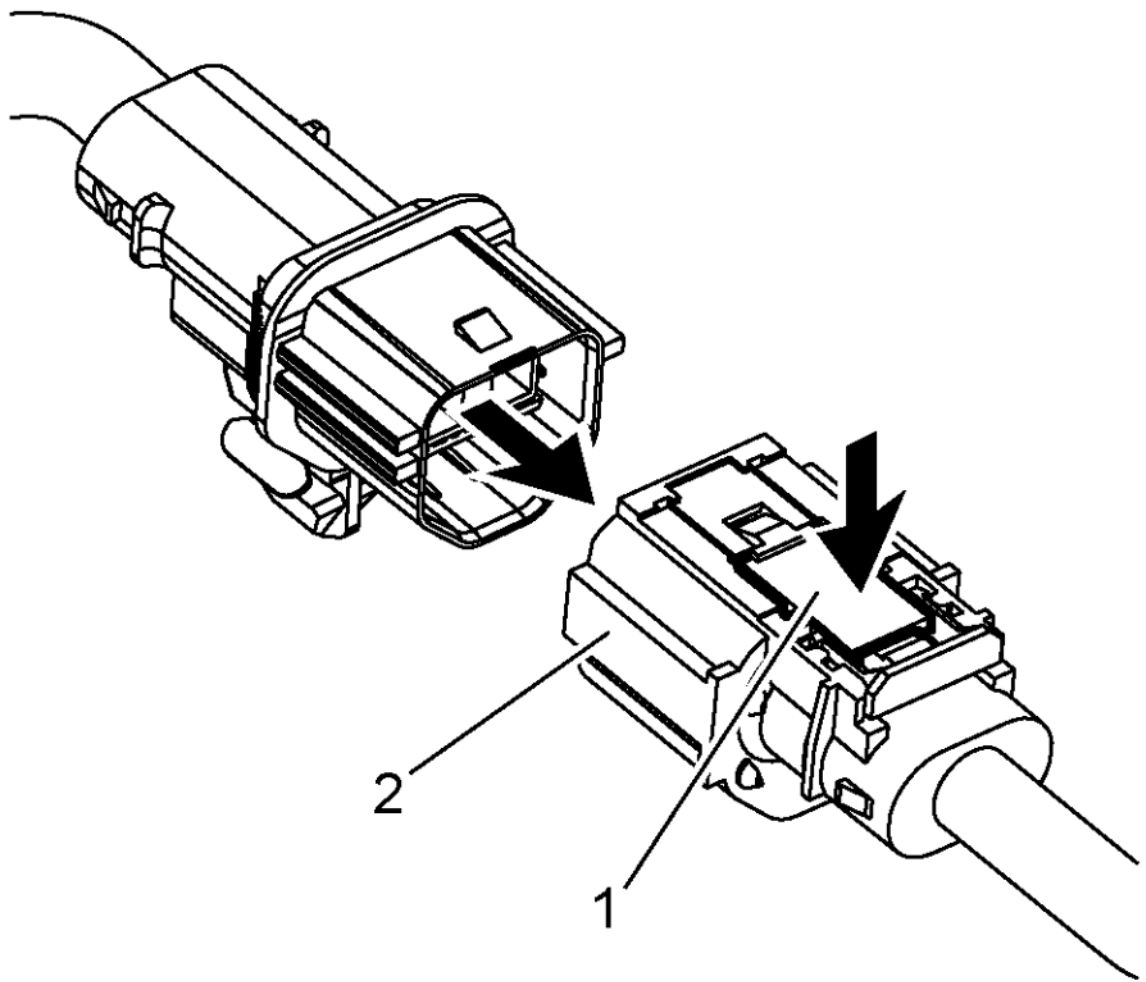


Fig. 6: Primary Lock Feature And Female Connector
Courtesy of GENERAL MOTORS COMPANY

2. Depress the primary lock feature (1) to release the lock and pull back on the female connector (2) to disconnect the connector completely.

HVA280 1 click Connect Procedure

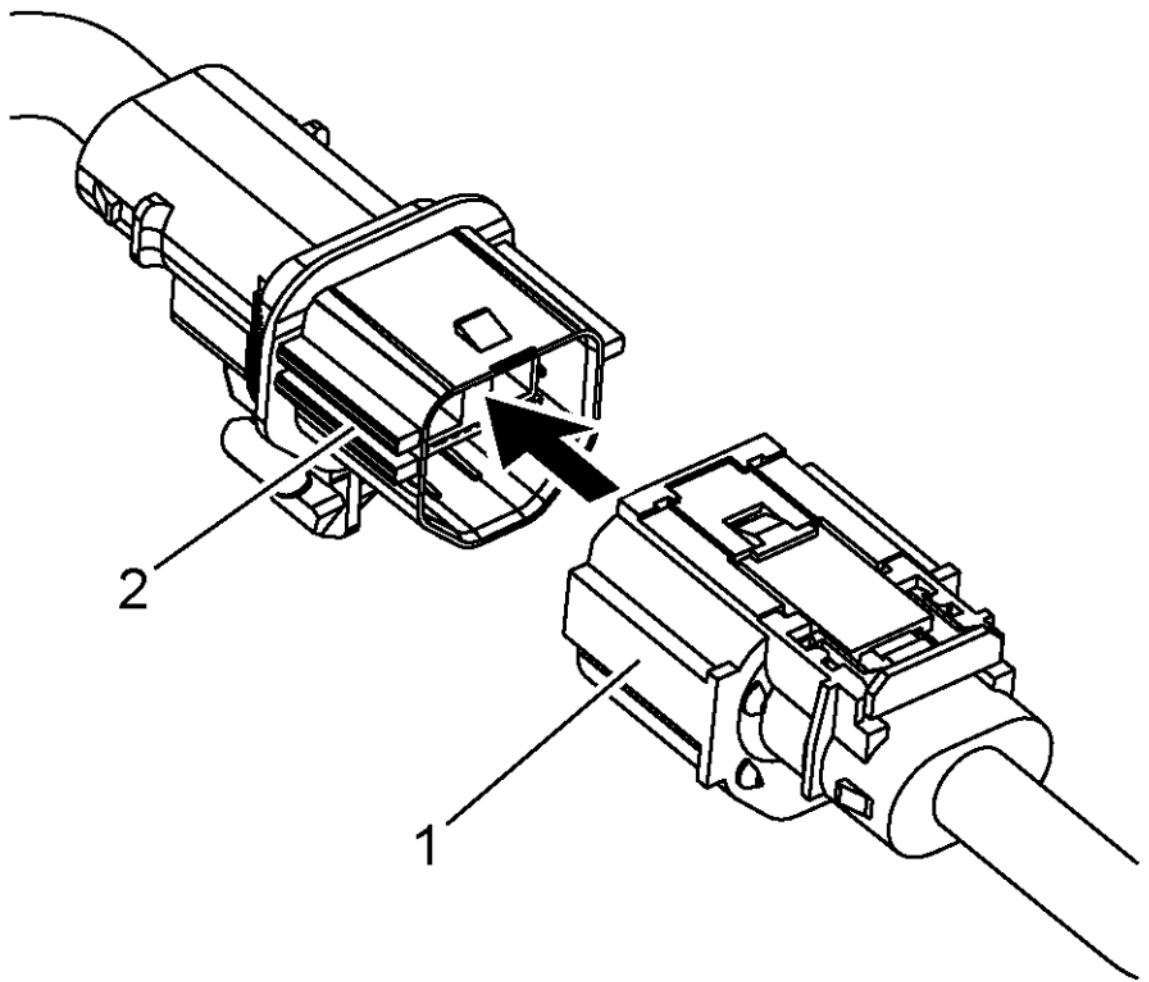


Fig. 7: Index Features

Courtesy of GENERAL MOTORS COMPANY

1. Align the connector with the index features (2) and install the connector by pushing on the sides of the connector (1). There will be an audible click sound when the connector lock is secured.

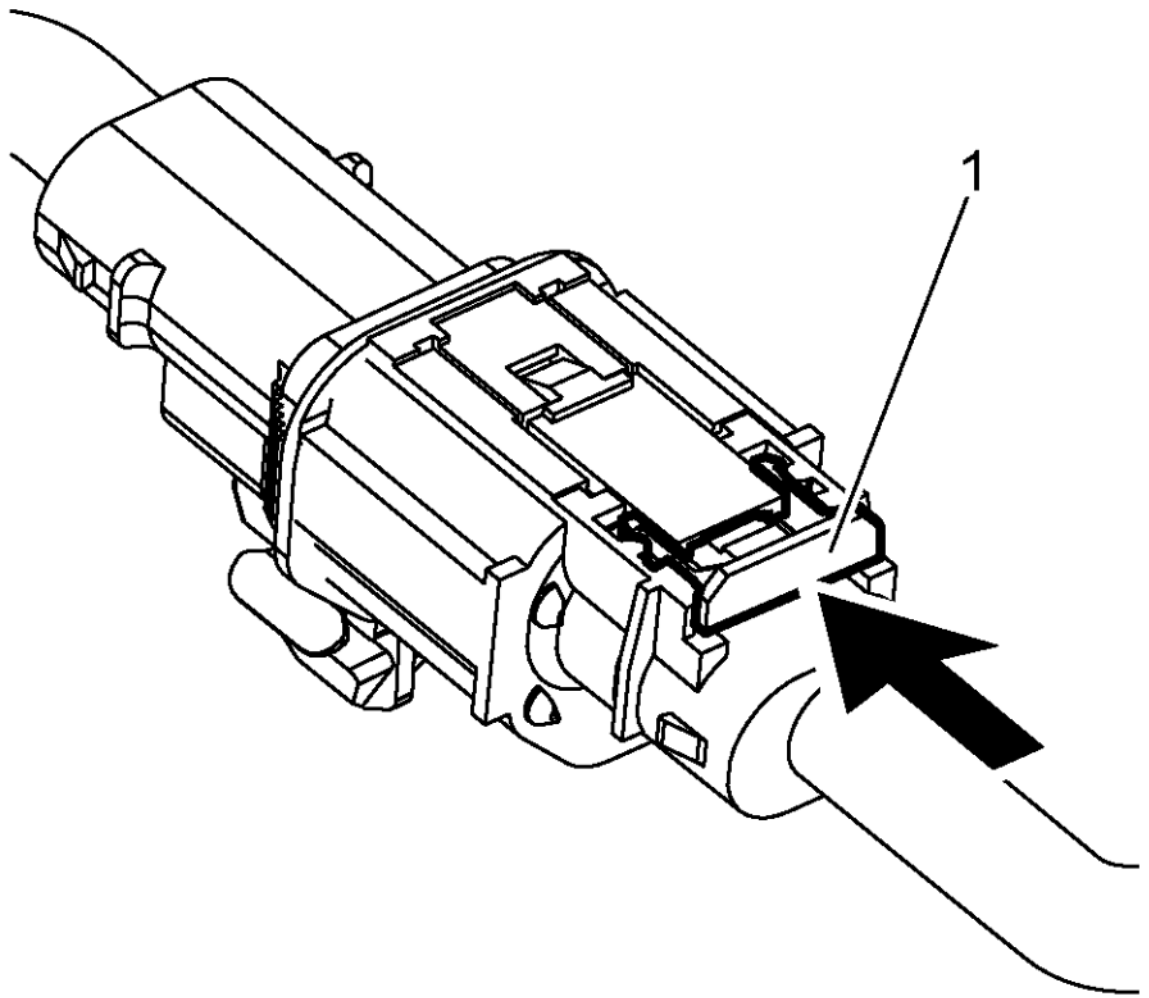


Fig. 8: CPA Tab

Courtesy of GENERAL MOTORS COMPANY

2. Push the CPA tab (1) to lock the connector in the full-stage position. There will be an audible click sound when the CPA tab is secured.

HV280 Connector Procedure

HV280 Disconnect Procedure

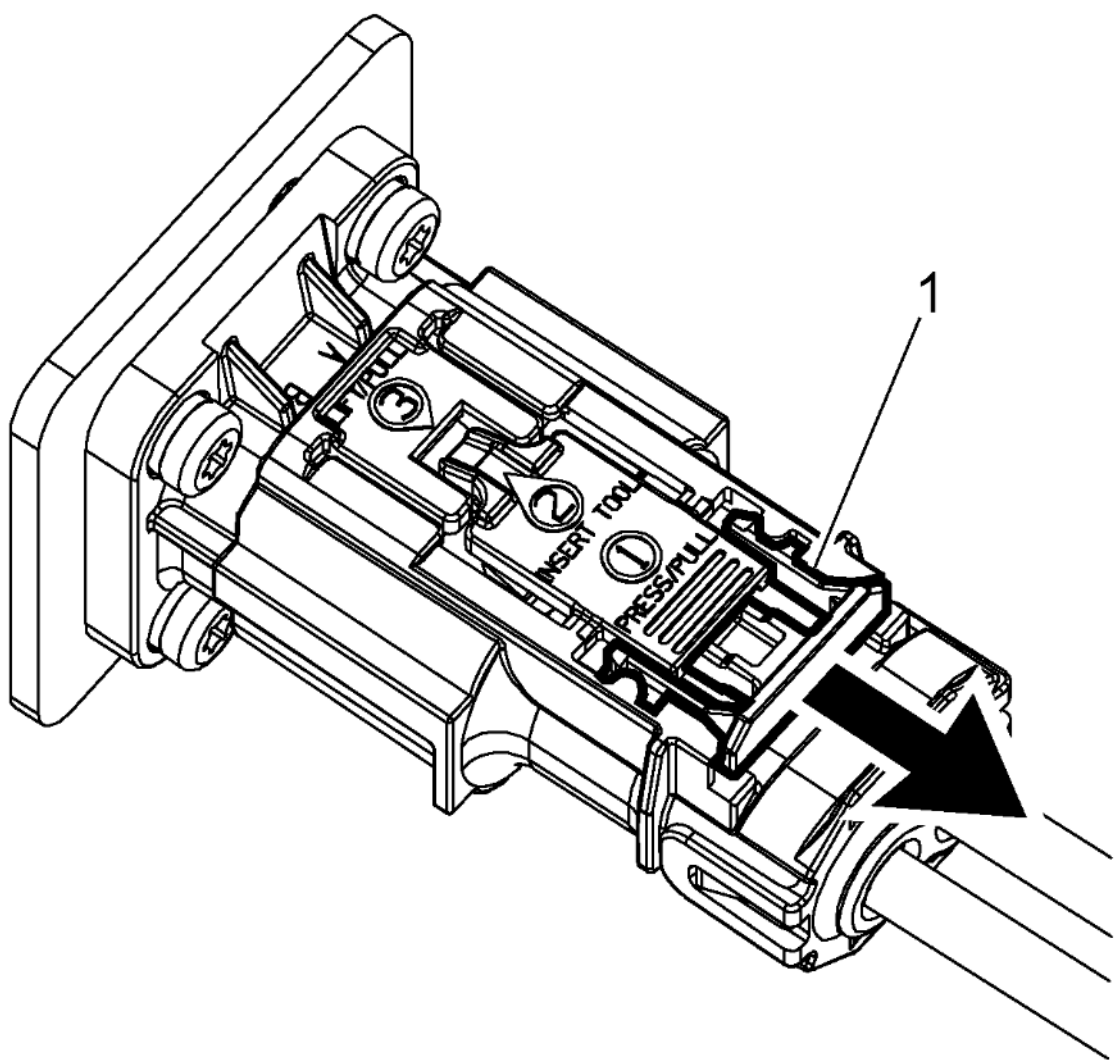


Fig. 9: Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

1. Pull the connector position assurance (CPA) (1) tab back from the locked position to the pre-stage position. There will be an audible click sound when the CPA tab is in the correct position.

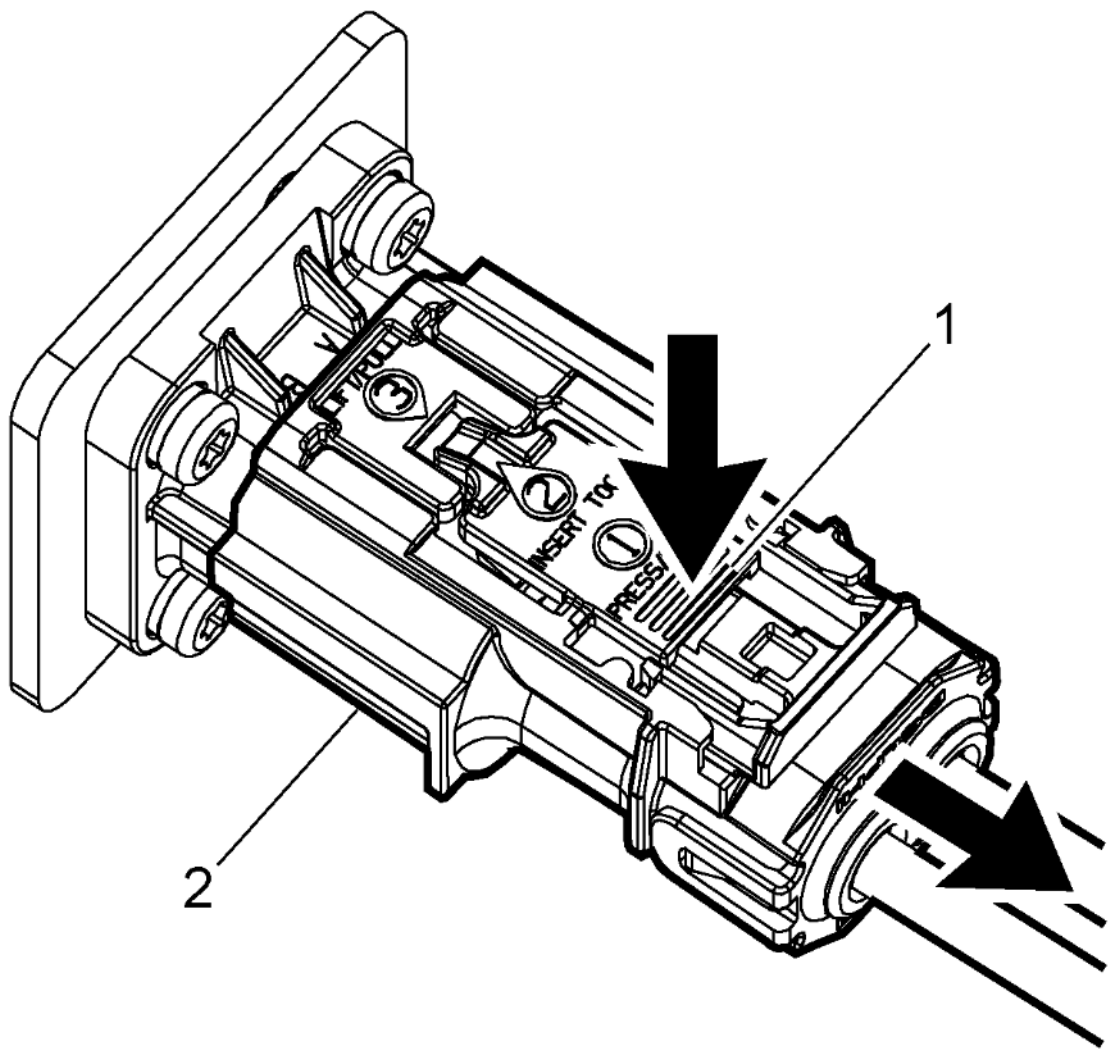


Fig. 10: Female Connector And Female Connector Lock
Courtesy of GENERAL MOTORS COMPANY

NOTE: Pull on the sides of the connectors only. The connector will stop in a partial-mate position when performing the next step.

2. Press firmly on the back of the female connector lock (1) and hold down, while pulling the female connector (2) assembly halfway apart, until the connector is in the partial-mate position.

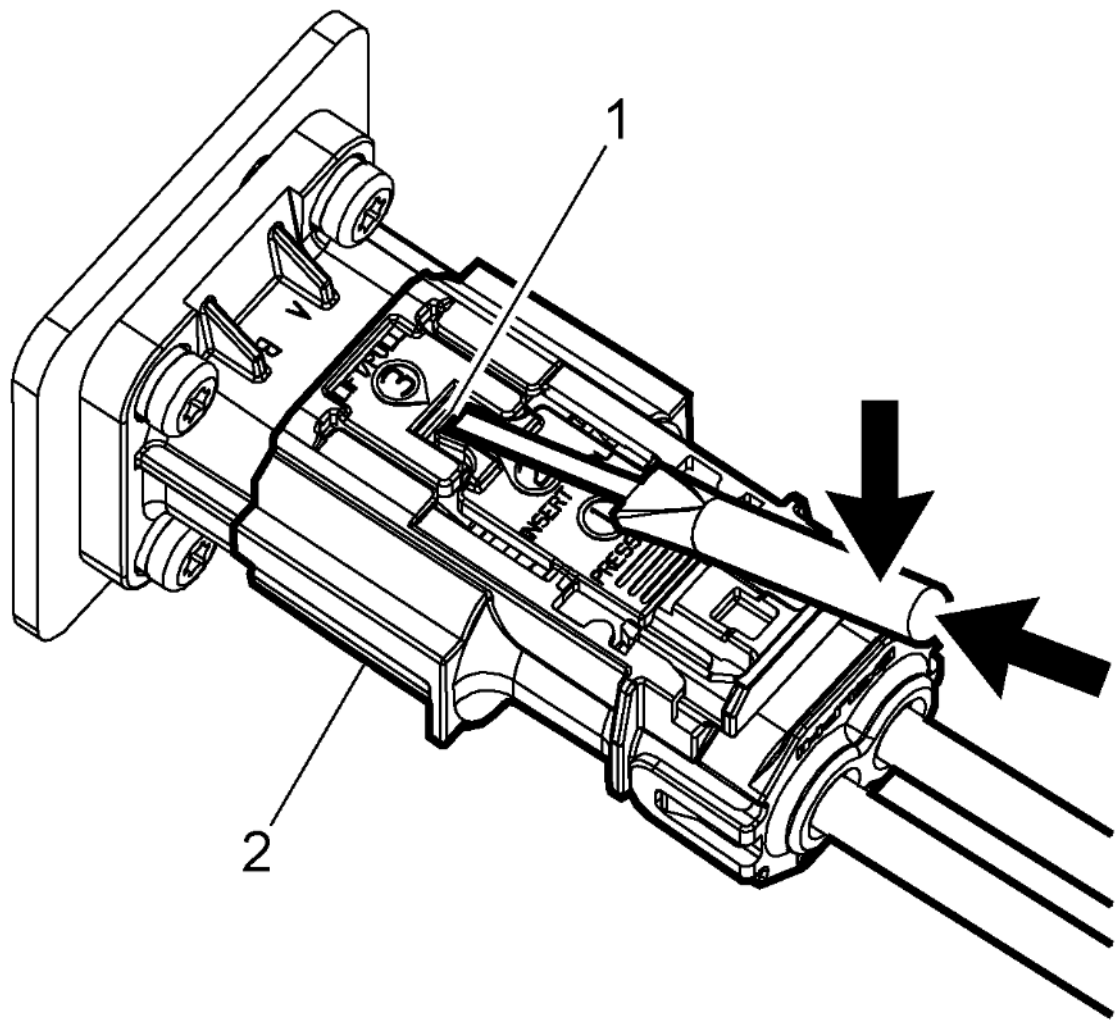


Fig. 11: Second Connector Lock And Female Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE: If the connector does not separate easily when pulled after the second connector lock is released, check that both sides of the second connector lock have been released.

3. Insert a suitable tool into the slot under the second connector lock (1). Using the tool as a lever, release the female connector by gently raising the second connector lock. An audible click or clicks will be heard on both sides of the connector as the second lock is released.
4. Remove the tool and pull the female connector (2) to fully disconnect.

HV280 Connect Procedure

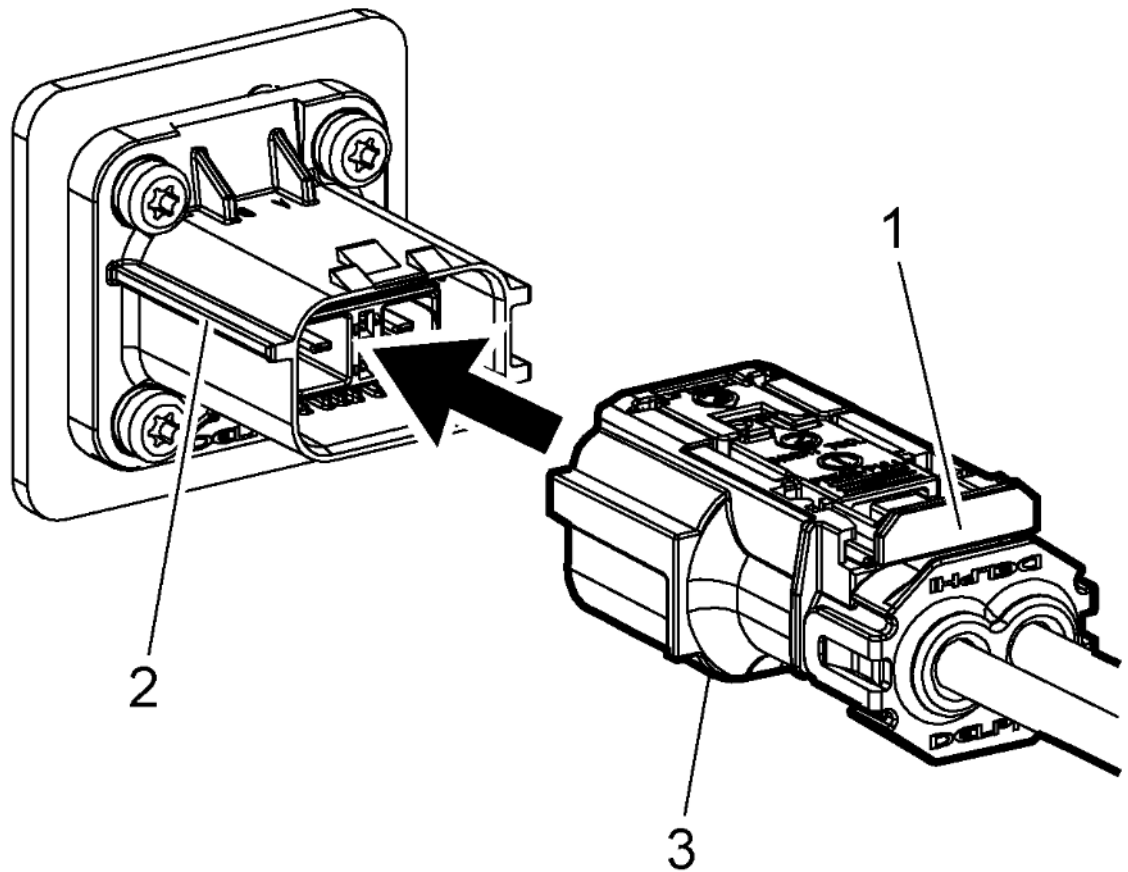


Fig. 12: Connector Position Assurance (CPA) Tab, Index Guides And Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Ensure the CPA tab (1) is in the pre-stage position.
- The connector will be fully mated when a series of 2 audible clicks is heard.

1. Align the connector with the index features (2) and install the connector by pushing on the sides of the connector (3).

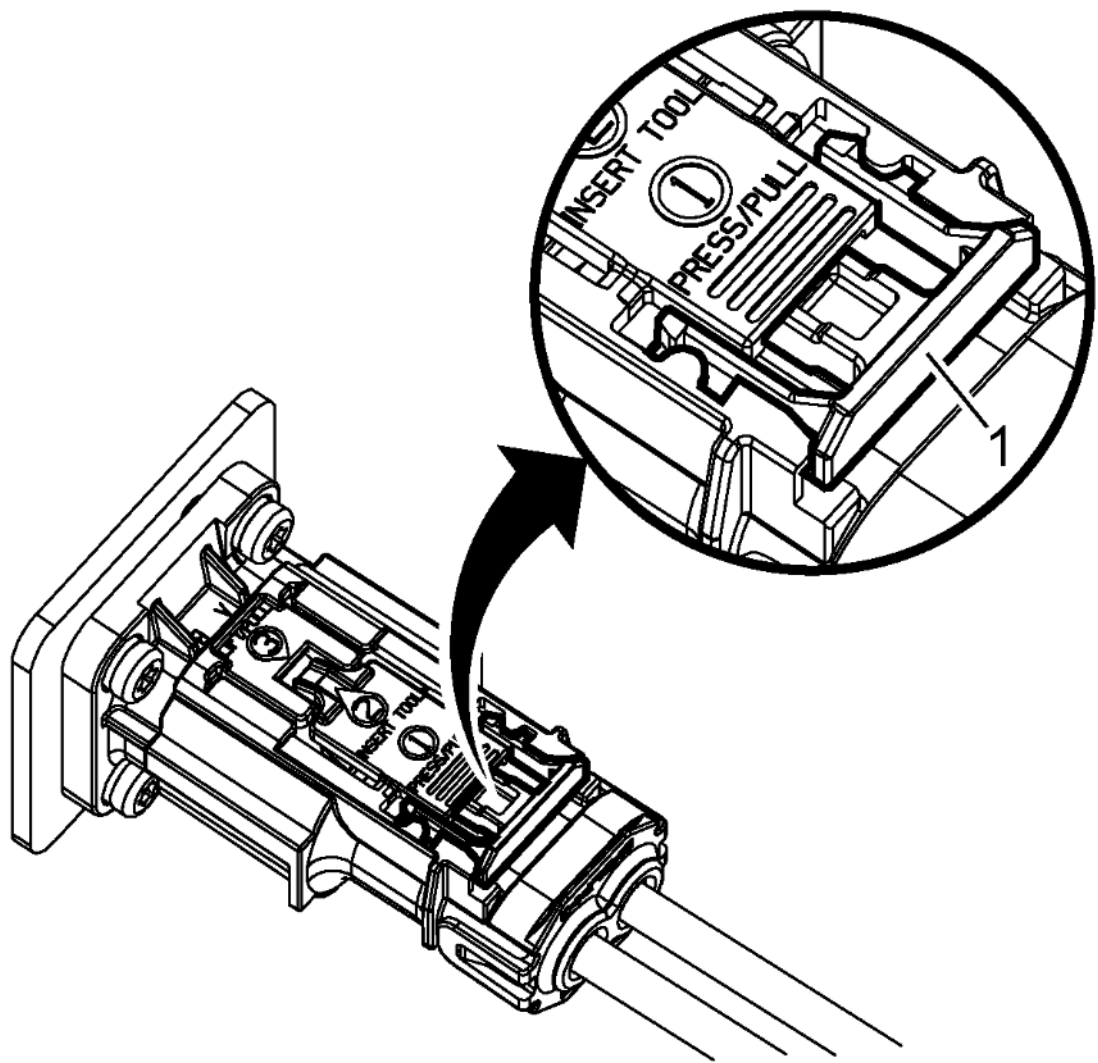


Fig. 13: Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

NOTE: There will be an audible click sound when the CPA tab is placed in the locked position. The CPA tab and connector body touch when fully seated.

2. Push the CPA tab (1) forward from the pre-stage position to the locked position.

AMP+HVA280 Connector Procedure

AMP+HVA280 Disconnect Procedure

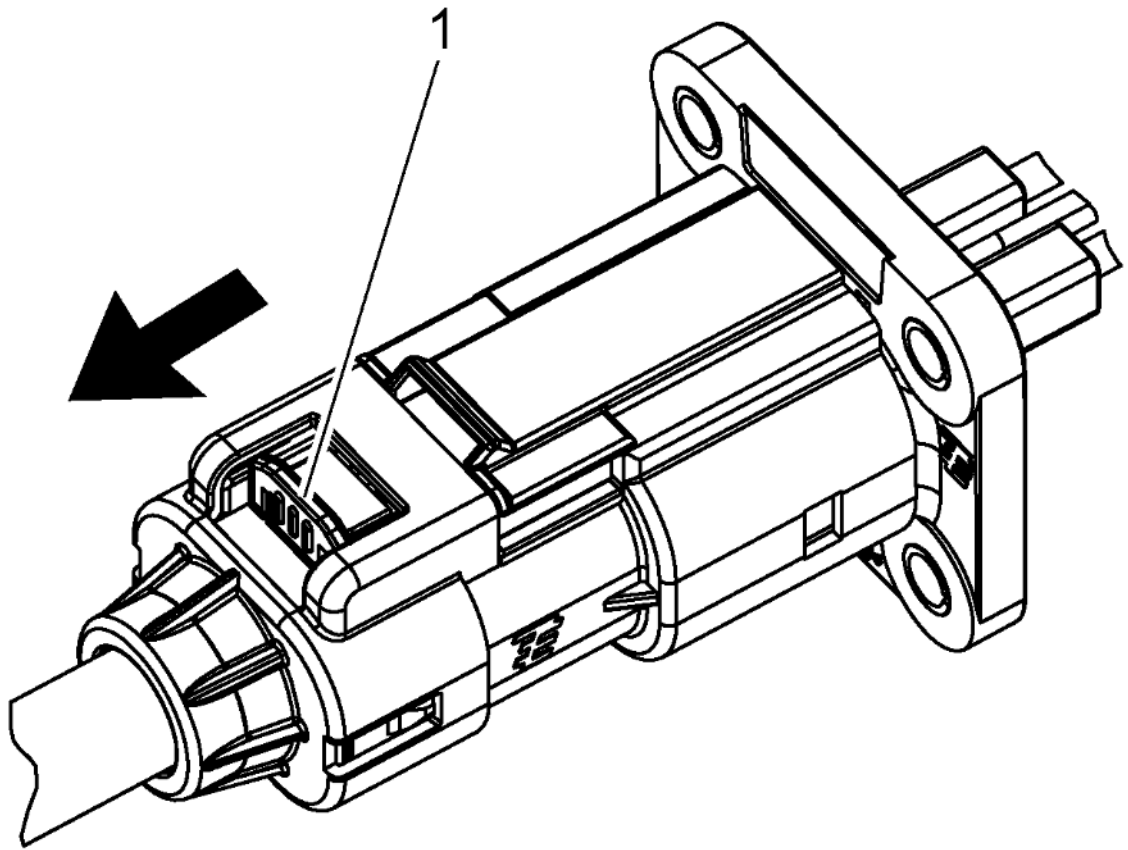


Fig. 14: Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

1. Pull the connector position assurance (CPA) (1) tab back from the locked position to the pre-stage position. There will be an audible click sound when the CPA tab is in the correct position.

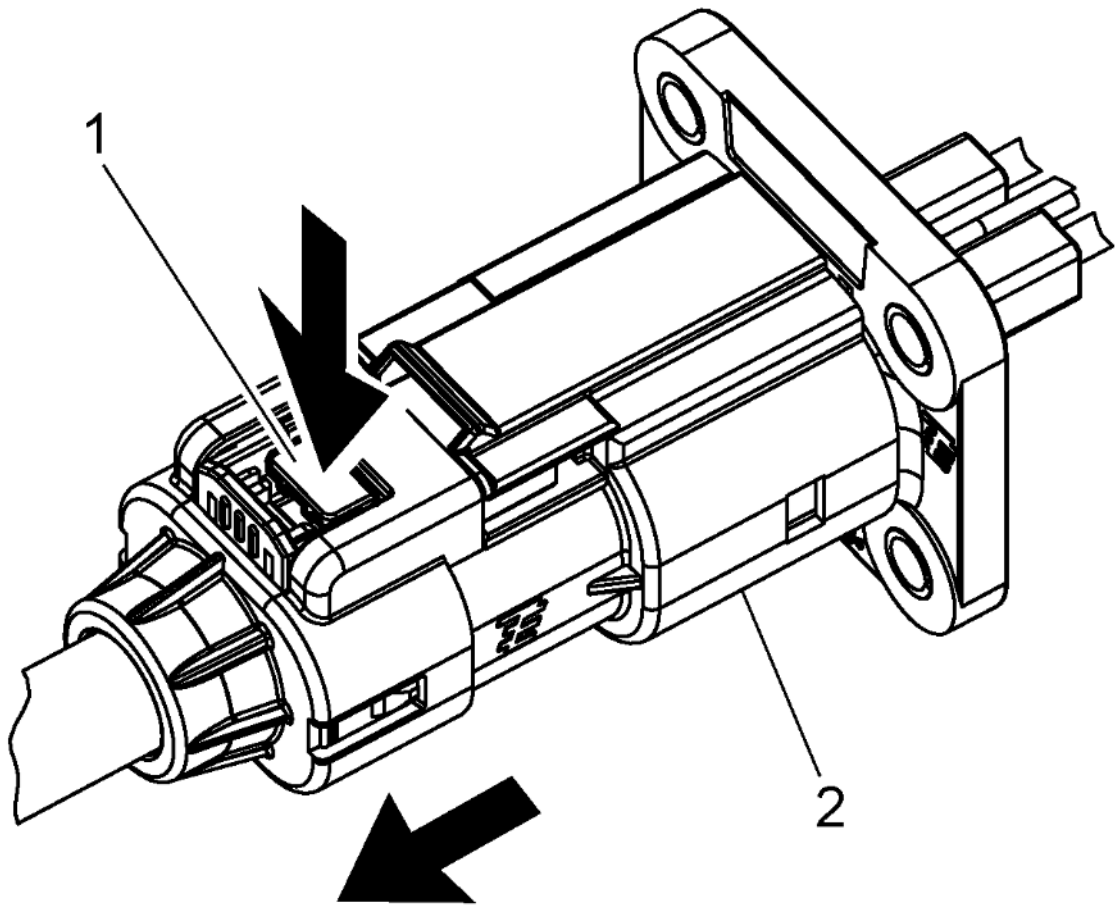


Fig. 15: Female Connector Lock And Female Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE: Pull on the sides of the connectors only. The connector will stop in a partial-mate position when performing the next step.

2. Press firmly on the back of the female connector lock (1) and hold down, while pulling the female connector (2) assembly halfway apart, until the connector is in the partial-mate position.

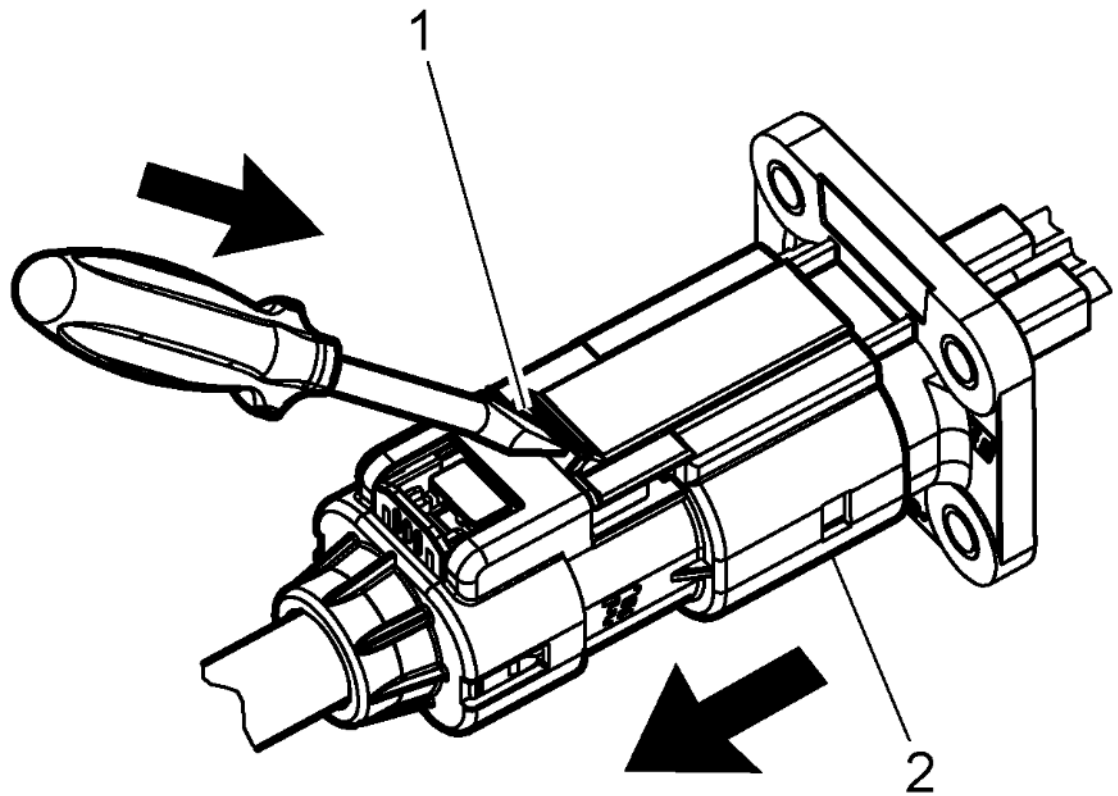


Fig. 16: Depressing Second Connector Lock To Disconnect Female Connector
Courtesy of GENERAL MOTORS COMPANY

3. Insert a suitable tool into the slot (1) and depress the second connector lock. An audible click will be heard as the second lock is released.
4. Remove the tool and pull the female connector (2) to fully disconnect.

AMP+HVA280 Connect Procedure

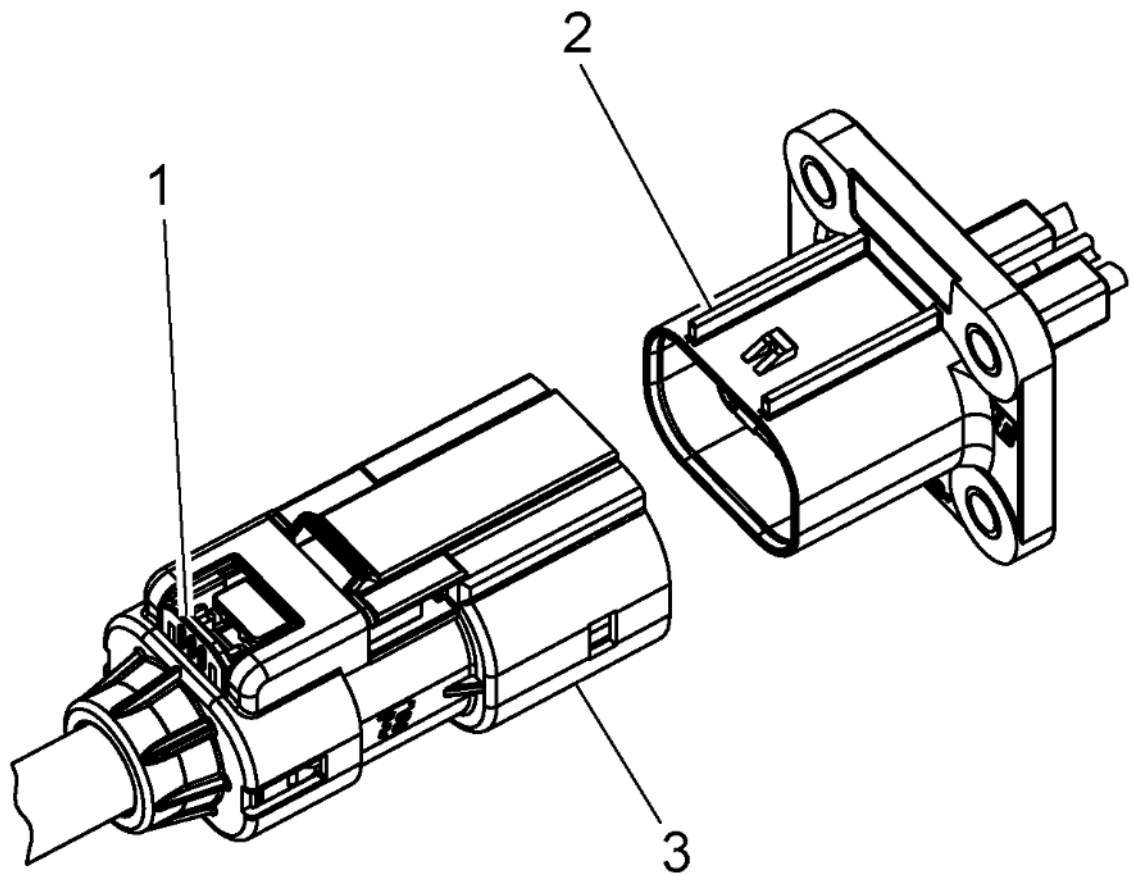


Fig. 17: Connector Position Assurance (CPA) Tab, Index Guides And Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Ensure the CPA tab (1) is in the pre-stage position.
- The connector will be fully mated when a series of two audible clicks is heard.

1. Align the connector with the index features (2) and install the connector by pushing on the sides of the connector (3).

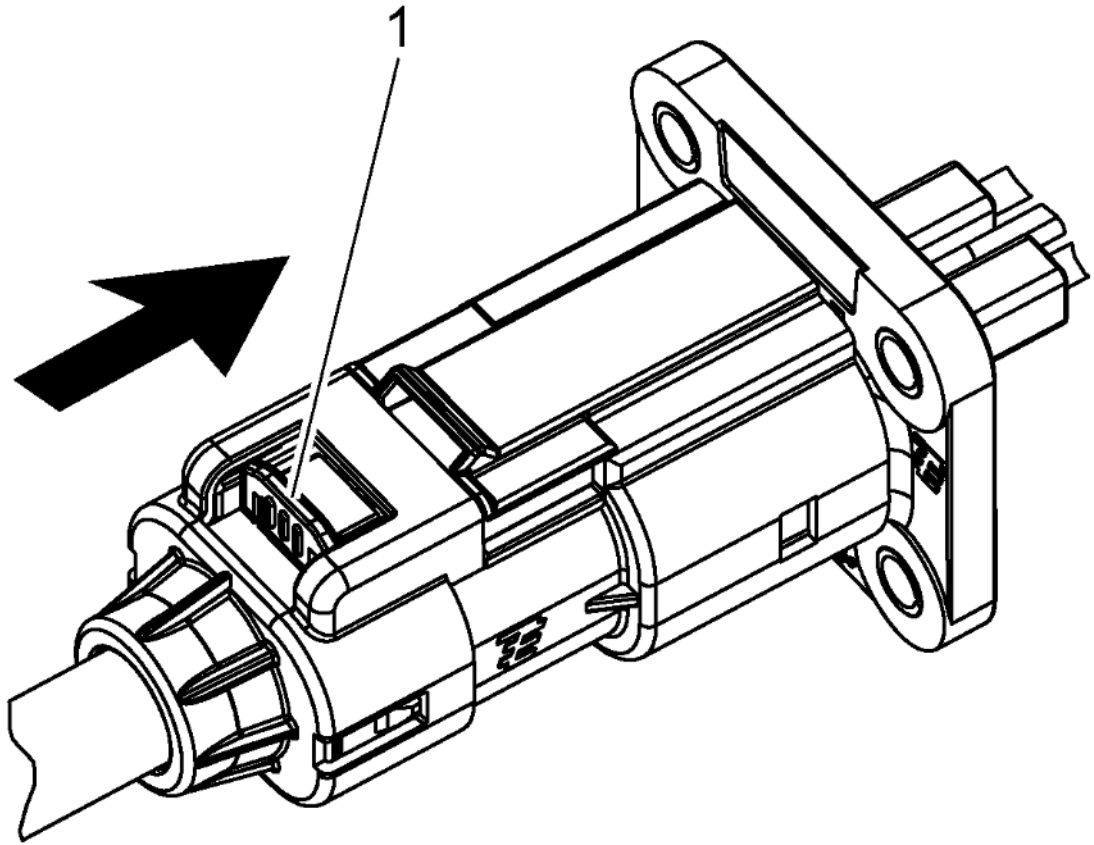


Fig. 18: Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

NOTE: There will be an audible click sound when the CPA tab is placed in the locked position. The CPA tab and connector body touch when fully seated.

2. Push the CPA tab (1) forward from the pre-stage position to the locked position.

MP280 Connector Procedure

MP280 Disconnect Procedure

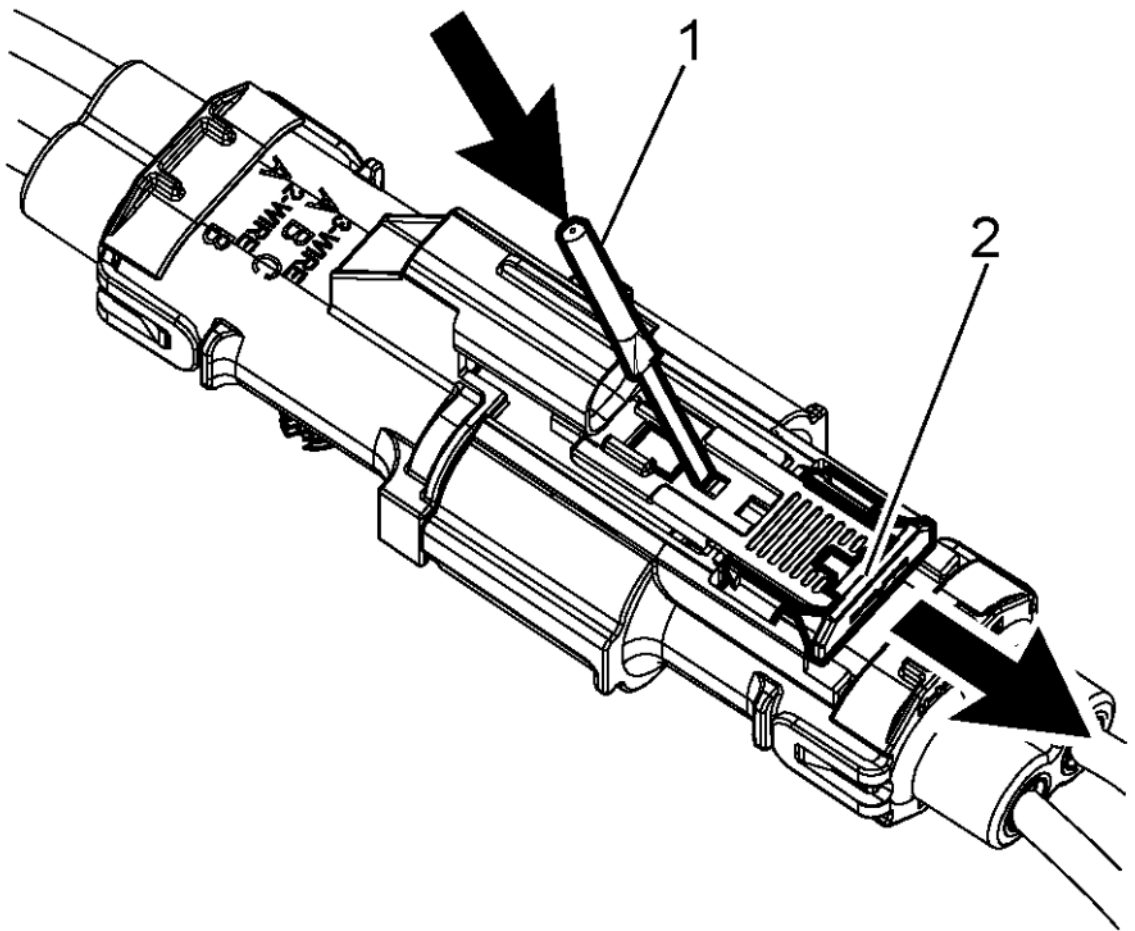


Fig. 19: Suitable Tool To Release Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

1. Insert a suitable tool (1) and press firmly to release the connector position assurance (CPA) lock. Pull the CPA tab (2) back from the locked position to the pre-stage position. There will be an audible click sound when the CPA tab is in the correct position.

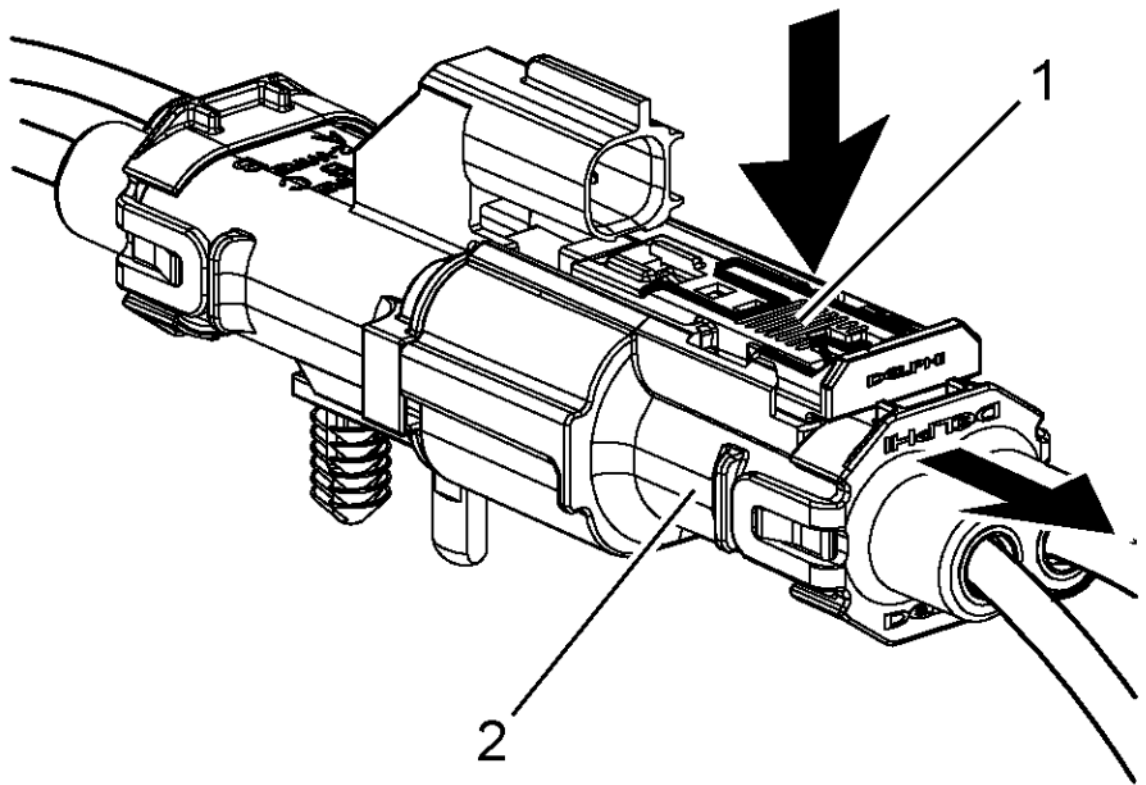


Fig. 20: Connector Lock And Female Connector
Courtesy of GENERAL MOTORS COMPANY

2. Depress the connector lock (1) and hold down. Keep the lock depressed and pull the female connector (2) apart to disconnect.

MP280 Connect Procedure

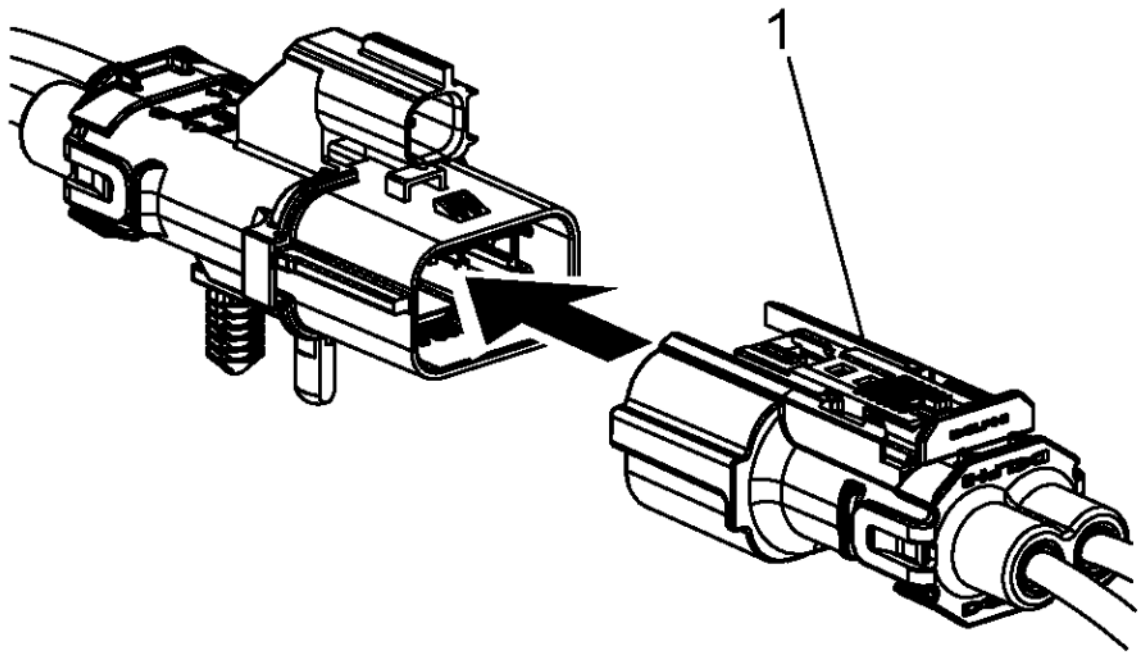


Fig. 21: Connector

Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure the CPA tab is in the pre-stage position.

1. Align the connector (1) with the index features and install the connector. There will be an audible click sound when the connector is in the correct position.

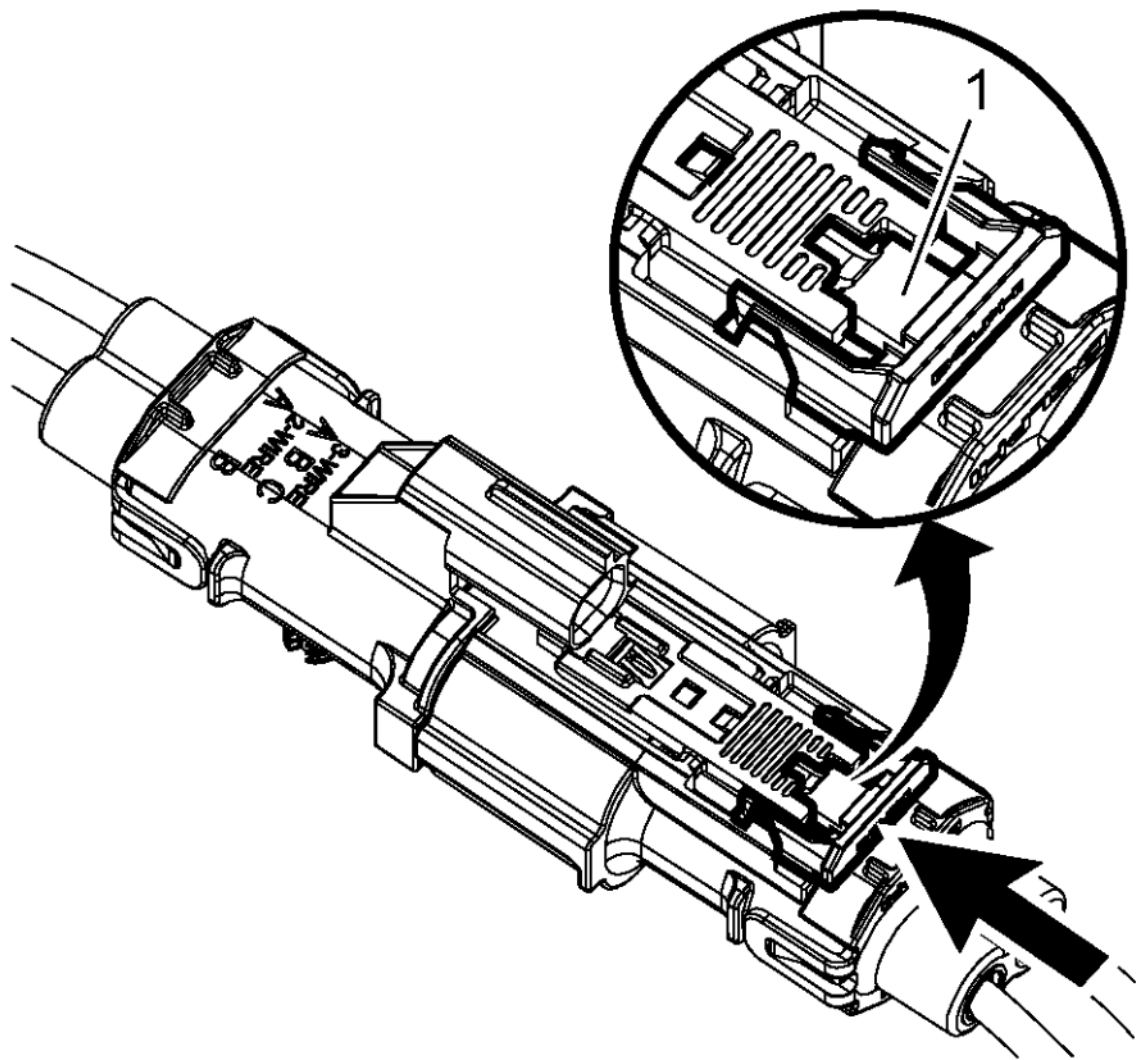


Fig. 22: Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

2. Push the CPA tab (1) to lock the connector in the full-stage position. There will be an audible click sound when the CPA tab is in the correct position.

PP2000 90 NFS Connector Procedure

PP2000 90 NFS Disconnect Procedure

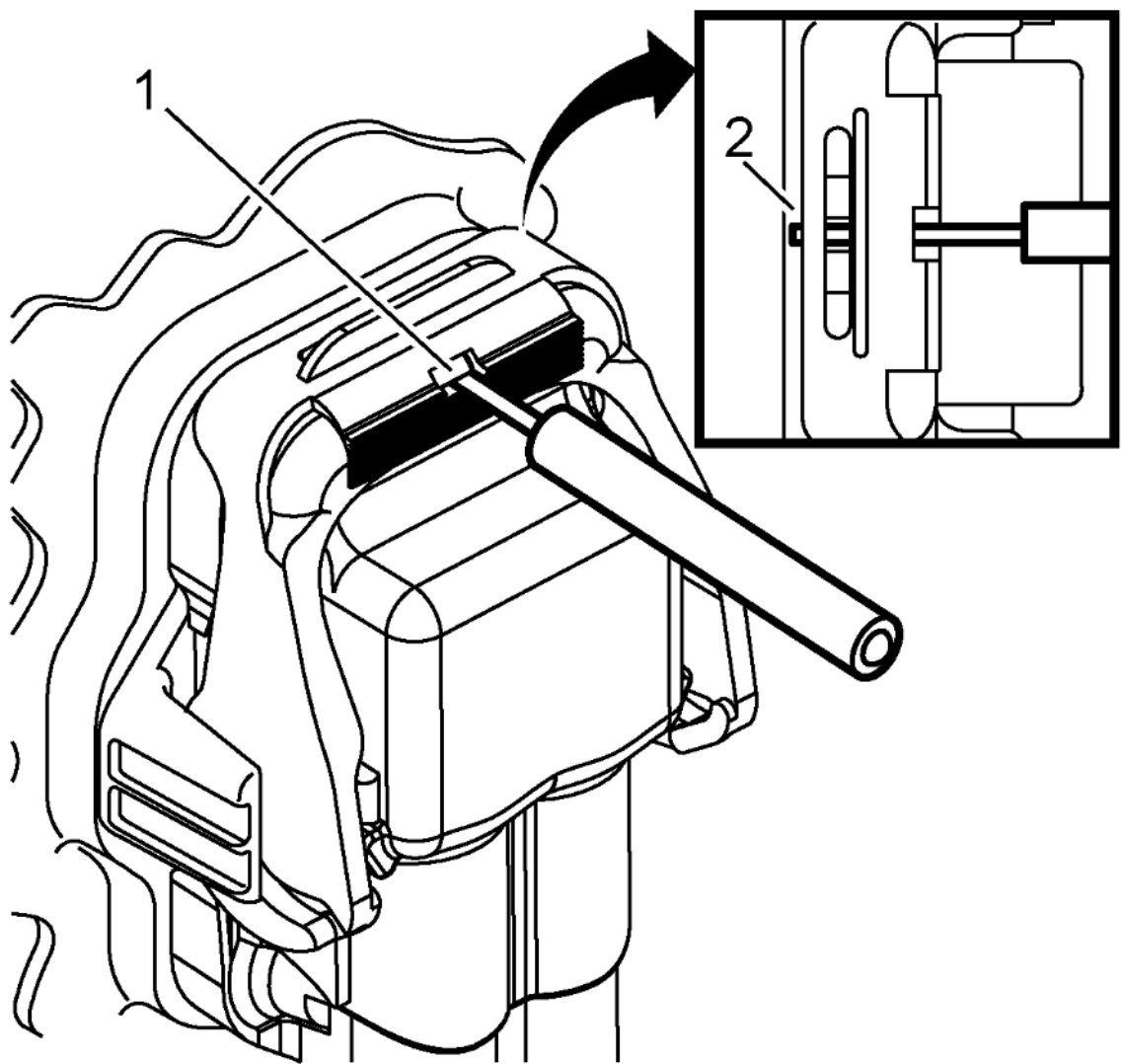


Fig. 23: Using Tool Through Opening To Unlock Lever
Courtesy of GENERAL MOTORS COMPANY

1. Place a suitable tool, such as a small flat-blade screwdriver, through the opening (1) at the front of the lever, and extend the tip down to near the base of the connector (2).
2. Rotate the tool slightly in either direction to unlock the lever.

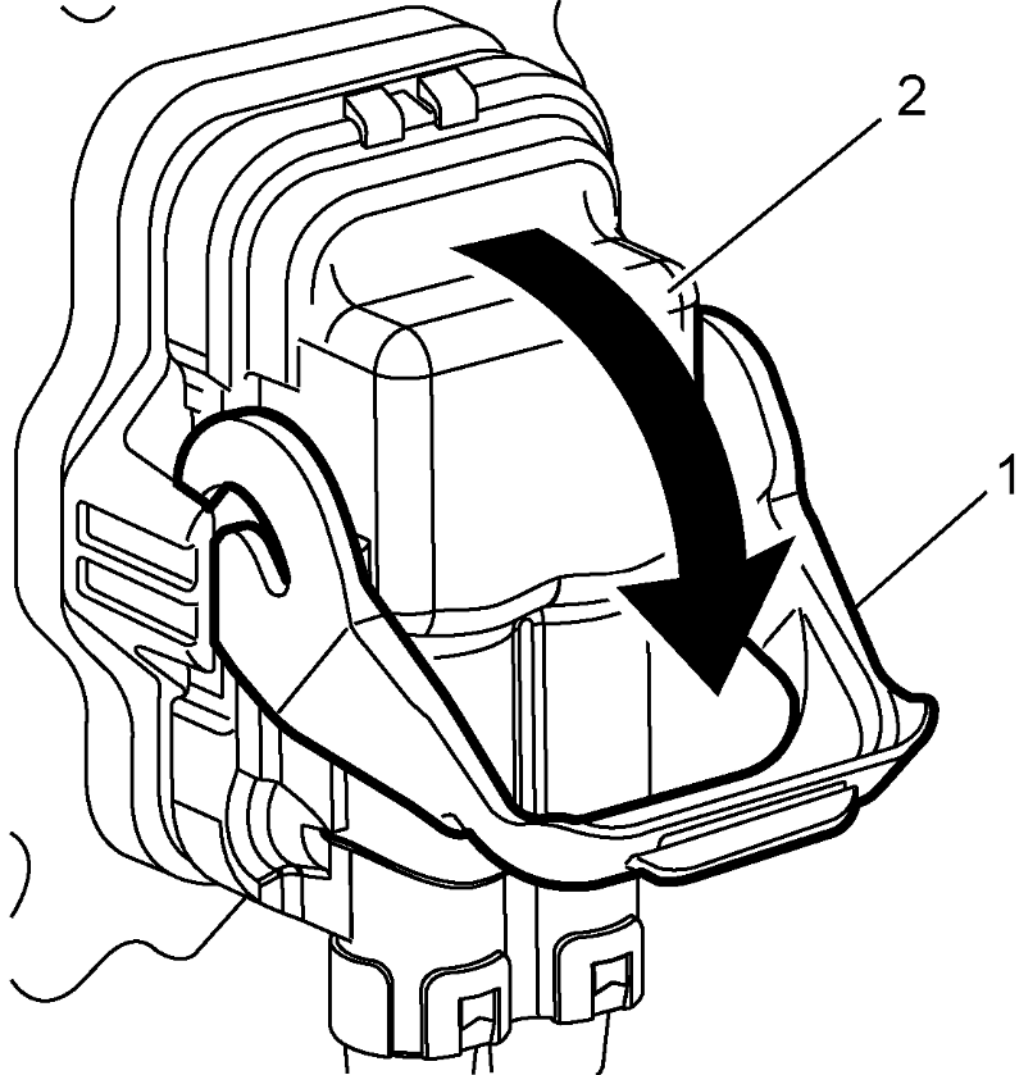


Fig. 24: Lever And Female Connector

Courtesy of GENERAL MOTORS COMPANY

3. Rotate the lever (1) to place the connector in a partial-mate position.
4. Remove the female connector (2) to complete the disconnection.

NOTE: Always clean seal remnants from the connector with a non-marring tool.

5. Inspect the High Voltage DC harness connector for seal residue or debris. Clean as necessary.
6. Inspect the High Voltage DC header connector seal for deformation or damage. Replace the DC connector header when seal damage is observed.

PP2000 90 NFS Connect Procedure

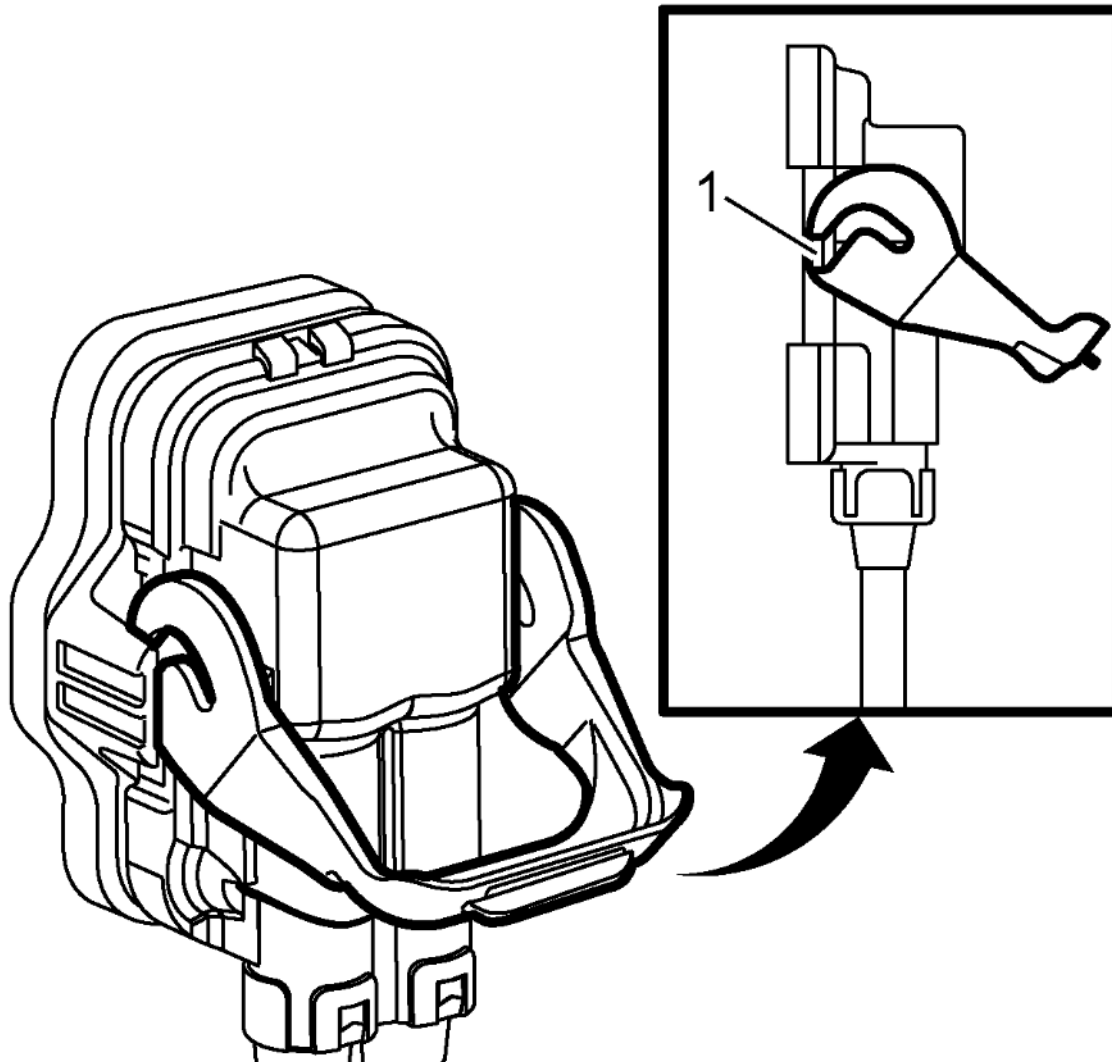


Fig. 25: Lever In Pre-Stage Assembly Position
Courtesy of GENERAL MOTORS COMPANY

1. Ensure the lever is in the pre-stage assembly position (1).

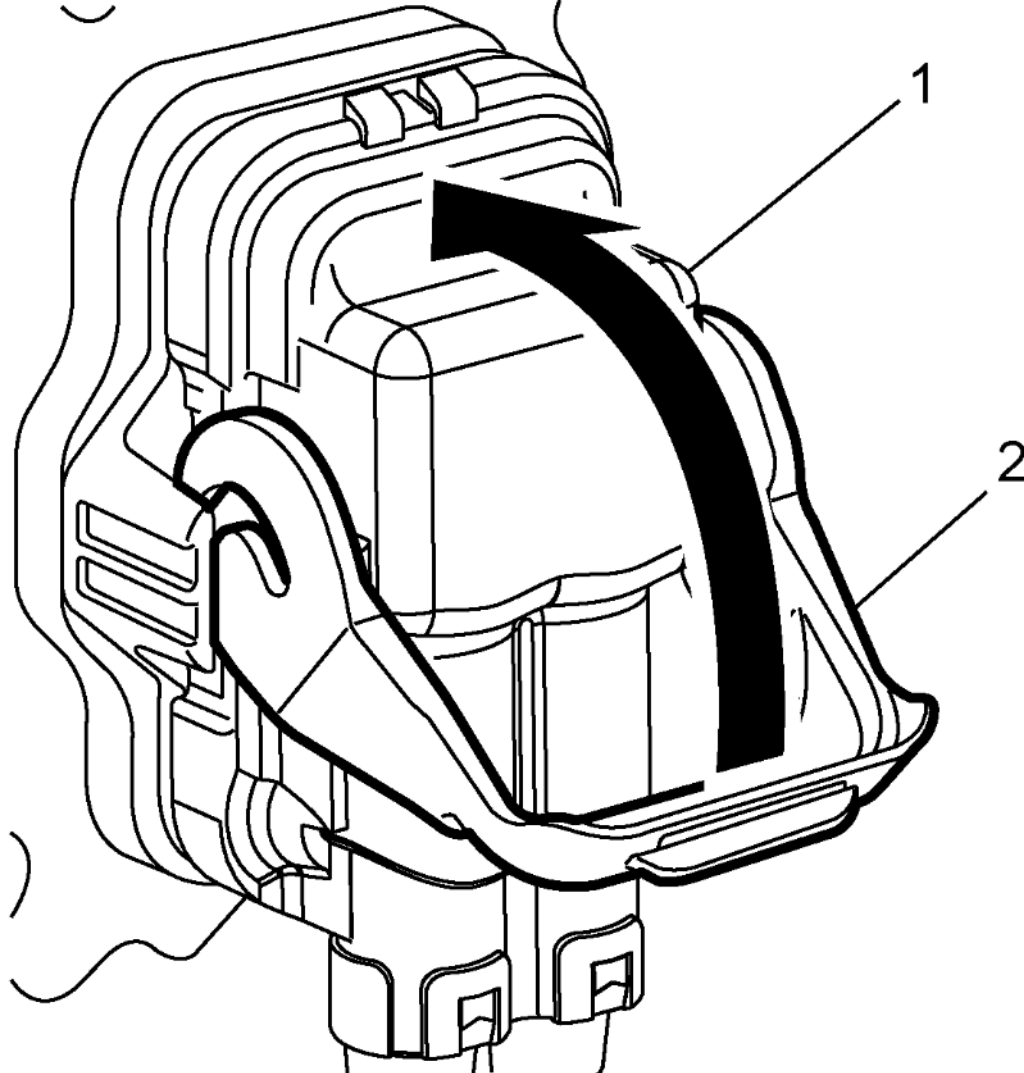


Fig. 26: Female Connector And Lever

Courtesy of GENERAL MOTORS COMPANY

2. Install the female connector (1) in the partial-mate position.
3. Rotate the lever (2) to place the connector in the full-mate position. There will be a very audible click sound when the lever locks in the full-stage position.

DTC P0A0C OR P0A0D: HIGH VOLTAGE SYSTEM INTERLOCK 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 P0A0C

High Voltage System Interlock Circuit Low Voltage

DTC P0A0D

High Voltage System Interlock Circuit High Voltage

Circuit/System Description

A high voltage interlock circuit is used to determine if access to high voltage components or connectors is being attempted. The opening of these high voltage components causes the high voltage interlock circuit to open. The hybrid/EV powertrain control module 2 sources about 5 V on the high voltage interlock circuit 1 loop. When the hybrid/EV powertrain control module 2 detects a loss of high voltage interlock circuit current, the high voltage contactors are commanded open.

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The high voltage interlock circuit monitors for integrity of the S15 Manual Service Disconnect.

Conditions for Running the DTC

P0A0C

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV powertrain control module 2 is commanding 5 V on the high voltage interlock circuit.

P0A0D

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV powertrain control module 2 is commanding 0 V on the high voltage interlock signal circuit.

OR

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV powertrain control module 2 is commanding 5 V on the high voltage interlock signal circuit.

Conditions for Setting the DTC

P0A0C

The hybrid/EV powertrain control module 2 detects high voltage interlock circuit 5 V low reference voltage is less than 30% of the commanded 5 V signal voltage.

P0A0D

- The hybrid/EV powertrain control module 2 detects high voltage interlock circuit 5 V low reference voltage is greater than 24% of the commanded 0 V signal voltage for 62.5 ms.

OR

- The hybrid/EV powertrain control module 2 detects high voltage interlock circuit 5 V low reference voltage is greater than 44% of the commanded 5 V signal voltage for 75 ms.

Action Taken When the DTC Sets

- DTCs P0A0C and P0A0D are Type A DTCs.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors.

Conditions for Clearing the DTC

DTCs P0A0C and P0A0D are Type A DTCs.

Diagnostic Aids

- Test for a fully engaged hybrid battery pack high voltage S15 manual service disconnect whenever an open or intermittent high voltage interlock circuit condition is observed. The hybrid battery pack high voltage manual disconnect lever must be pressed down fully in order to completely engage the high voltage interlock circuit terminals.
- With all monitored high voltage components engaged and the High Voltage Interlock Circuit is Energized, observe the scan tool hybrid/EV powertrain control module 2 High Voltage Interlock Circuit Status parameter for a PASS status. To help identify intermittent conditions, manipulate the monitored components and inline connectors. An open interlock circuit will display a FAIL status.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

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- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

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

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

[Circuit/System Verification](#)

1. Verify all monitored high voltage components and connectors are connected.
2. Vehicle in Service Mode.
3. Observe the hybrid/EV powertrain control module 2 High Voltage Interlock Circuit Status parameter. Verify the parameter indicates a PASS condition.

- **The parameter indicates a FAIL condition**

Refer to Circuit/System Testing.

- **The parameter indicates a PASS condition**

4. 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 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.

NOTE: An S15 Manual Service Disconnect that is not fully engaged may result in an intermittent DTC P0A0C.

1. Disable high voltage at the A4 hybrid/EV battery pack. Refer to **High Voltage Disabling** procedure.
2. Verify that terminal 1 and terminal 2 of the S15 Manual Service Disconnect are not bent or broken and are OK.
 - **If not OK**

Replace the S15 Manual Service Disconnect.
 - **If OK**
3. Test for 35 - 45 Ω between terminal 1 and terminal 2 of the S15 Manual Service Disconnect.
 - **If not within the specified range**

Replace the S15 Manual Service Disconnect.
 - **If within the specified range**
4. With the S15 Manual Service Disconnect removed, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
5. Test for infinite resistance between each of the terminals listed below and ground;
 - Terminal 45
 - Terminal 47
 - **If less than infinite resistance**

Repair the short to ground on the appropriate circuit.
 - **If infinite resistance**
6. Test for less than 10 Ω between the low reference circuit terminal 45 at the K114B Hybrid/EV Powertrain Control Module 2 and terminal 2 at the X21 Manual Service Disconnect Receptacle.
 - **If 10 Ω or greater**
 1. Disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
 2. Test for less than 10 Ω between the low reference circuit terminal 45 at the K114B Hybrid/EV Powertrain Control Module 2 and terminal 2 X358 harness connector.
 - If 10 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 10 Ω , replace the A4 Hybrid/EV Battery Pack internal harness.
 - **If less than 10 Ω**
7. Test for less than 10 Ω between the 5 V signal circuit terminal 47 at the K114B Hybrid/EV Powertrain Control Module 2 and terminal 1 at the X21 Manual Service Disconnect Receptacle.
 - **If not within the specified range**
 1. Disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
 2. Test for less than 10 Ω between the 5 V signal circuit terminal 47 at the K114B Hybrid/EV Powertrain Control Module 2 and terminal 1 X358 harness connector.
 - If 10 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 10 Ω
 3. Replace the A4 Hybrid/EV Battery Pack internal harness.
 - **If within the specified range**
8. Install the S15 Manual Service Disconnect ensuring the lever is fully engaged.
9. Connect the 12 V battery. Vehicle in Service Mode.
10. Test for less than 1 V between terminals listed below and ground;
 - Terminal 45
 - Terminal 47
 - **If 1 V or greater**

Repair the short to voltage in the circuit.
 - **If less than 1 V**
11. Vehicle OFF. Disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
12. Test for 35 - 45 Ω between the 5 V signal circuit terminal 1 and low reference terminal 2 X358 harness connector.
 - **If not within the specified range**

Replace the A4 Hybrid/EV Battery Pack internal harness.

- If within the specified range

13. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

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

- Refer to [Drive Motor Battery High Voltage Manual Disconnect Lever Replacement](#) for S15 Manual Service Disconnect
- Refer to [Drive Motor Battery Control Module Wiring Harness Replacement](#) for A4 Hybrid/EV Battery Pack internal harness
- Refer to [Control Module References](#) for K114B Hybrid/EV Powertrain Control Module 2 replacement, programming and setup.

DTC P0A7F: HYBRID/EV BATTERY PACK LIFE

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 P0A7F

Hybrid/EV Battery Pack Life

Circuit/System Description

The hybrid/EV powertrain control module 2 calculates the high voltage battery pack capability and determines the high voltage battery pack end of life.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is at least 10.2 V.
- Hybrid battery temperature is greater than 20Â°C (68Â°F).
- Hybrid battery temperature is less than 50Â°C (122Â°F).
- Hybrid battery state of charge is between 30% and 100%.
- When the hybrid/EV powertrain control module 2 calculates the actual battery power has exceeded the power limits multiplied by seconds of duration is greater than 50%.
- None of the following DTCs are set: P0A9C, P0A9D, P0A9E, P0ABB, P0ABC, P0ABD, P0AC1, P0AC2, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0AF8, P0BC3, P0BC4, P0BC5, P0C34, P0C35, P0C36, P1A07, P1E8E, P1E8F, P1E90, P1E91, P1E93, P1E94, P1E95, P1E96, P1E97, P1E99, P1E9A, P1E9B, P1E9C, P1E9D, P1E9F, P1EA0, P1EA1, P1EA2, P1EA3, P1EA5, P1EB1, P1EB2, P1EB3, P1EB4, P1EB5, P1EBA, P1EBB, U0111, U185A, U2401, U2603, U2604, U2605, or U2606.

Conditions for Setting the DTC

- Battery voltage and current is varying. Requires more than 10 minutes of city driving.
- When the hybrid/EV powertrain control module 2 calculates the power limits is less than the KW end of life power threshold.

Action Taken When the DTC Sets

DTC P0A7F is a type B DTC.

Conditions for Clearing the DTC

DTC P0A7F is a type B DTC.

Diagnostic Aids

Removing the manual service disconnect without being specifically instructed to do so during the High Voltage Disabling procedure may cause a DTC P0A7F to set.

[Reference Information](#)

Schematic Reference

[Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

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- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

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

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

[Circuit/System Verification](#)

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

The High Voltage Disabling procedure 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.

NOTE: Removal of the manual service disconnect outside of the High Voltage Disabling procedure may cause a DTC P0A7F to set.

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1. Verify that no other DTCs are set.

- If any other DTCs are set

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

- No other DTCs are set

2. Verify DTC P0A7F is set.

- If DTC P0A7F is set

1. Clear the DTC. Vehicle OFF, disconnect the 12 V battery. Refer to [Battery Negative Cable Disconnection and Connection](#)
2. Wait 30 seconds. Reconnect the 12 V battery. Refer to [Battery Negative Cable Disconnection and Connection](#)
3. Review and operate the vehicle according to the DTC Conditions for Running. Operate the vehicle for more than 10 minutes of city driving.
4. Verify that DTC P0A7F does not reset.

- If DTC P0A7F resets

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
2. Remove the A4 Hybrid/EV Battery Pack cover. Refer to [Battery Upper Cover Replacement](#).
3. Inspect all internal high voltage busbar/cable terminals for arc-flash damage.
 - If high voltage terminal damage is present, replace the effected components.
 - If high voltage terminal damage is not present, replace the A4 hybrid/EV battery pack.

- If DTC P0A7F does not reset

5. All OK.

- If DTC P0A7F is not set

3. All OK.

Repair Instructions

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

Refer to [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#) [Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#) [Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, OR P1EC3: HYBRID/EV BATTERY OR BATTERY CHARGING SYSTEM

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 P0AA1

Hybrid/EV Battery Positive Contactor Circuit Stuck Closed

DTC P0AA4

Hybrid/EV Battery Negative Contactor Circuit Stuck Closed

DTC P0AD9

Hybrid/EV Battery Positive Contactor Control Circuit

DTC P0ADD

Hybrid/EV Battery Negative Contactor Control Circuit

DTC P0AE4

DTC P0D0A

Battery Charging System Positive Contactor Control Circuit

DTC P0D09

Battery Charging System Positive Contactor Stuck Open

DTC P1EBD

Battery Charging System Contactor(s) Stuck Open

DTC P1EC0

Hybrid/EV Battery System Contactor(s) Stuck Open

DTC P1EC3

Hybrid/EV Battery Pack Heater Transistor Control Circuit

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor and a precharge negative high voltage contactor. A transistor within the T24 Battery Charger controls the battery heater high voltage negative circuit. The contactors and transistor close and open in a specific sequence controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for each high voltage contactor/transistor. Ground is provided through a vehicle ground external of the high voltage battery.

Conditions for Running the DTC

P0AA1

- The main negative contactor is open.
- The main positive contactor has been open for more than 2 minutes.
- The charger positive contactor has been open for more than 2 minutes.
- None of the following DTCs are set; P0ABB, P0ABC, P0ABD, P0AF8, or P1A07.

P0AA4

- The main negative contactor is open.
- The main positive contactor has been open for more than 2 minutes.
- The charger positive contactor has been open for more than 2 minutes.

P0AD9, P0ADD, P0AE4, P0D0A, P1EC3 and P1EBD

The 12 V battery voltage is greater than 10.2 V.

P0D09

- The precharge contactor is closed.
- The negative contactor is open.
- The charger contactor is closed.
- Negative bus voltage is greater than 40 V.

P1EC0

- The 12 V battery voltage is greater than 10.2 V.
- The main positive and negative contactors have been closed.
- The charger positive contactor is closed.
- None of the following DTCs are set; P1AE8, P1AE9, or P1AEC.

Conditions for Setting the DTC

P0AA1

The positive bus voltage is greater than 30 V.

P0AA4

The negative bus voltage is greater than 30 V.

P0AD9, P0ADD and P0D0A

The hybrid/EV powertrain control module 2 has detected an open or short to voltage in the control circuit for the corresponding contactor.

P0AE4

The hybrid/EV powertrain control module 2 has detected a short to voltage in the control circuit.

P0D09

The battery charger sensed voltage is less than 10 V.

P1EBD

The battery charger sensed voltage is less than 80% of hybrid/EV battery voltage.

P1EC0

The main bus voltage is less than 80% of hybrid/EV battery voltage.

P1EC3

The hybrid/EV powertrain control module 2 has detected an open, short to ground or short to voltage in the heater transistor control circuit.

Actions Taken When the DTC Sets

- DTCs P0D09, P1EBD, or P1EC0 are type A DTCs.
- DTCs P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D0A, or P1EC3 are type B DTCs.

Conditions for Clearing the DTC

- DTCs P0D09, P1EBD, or P1EC0 are type A DTCs.
- DTCs P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D0A, or P1EC3 are type B DTCs.

Diagnostic Aids

DTC P1EC3 will prevent battery heating and the vehicle will be unable to start in cold weather with battery temperatures below -25°C (-13°F).

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

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[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 that DTC P0AD9, P0ADD, P0AE4, P0D0A, or P1EC3 is not set.
 - **If any of the DTCs are set**
Refer to Circuit/System Testing, specific to the DTC or DTCs set.
 - **If none of the DTCs are set**
3. Verify that DTC P0AA1 and/or P0AA4 is set without any of the above contactor Control Circuit DTCs.
 - **If the DTC is set**
Replace the A28 Hybrid/EV Battery Contactor Assembly.
 - **If the DTC is not set**
4. Connect the drive motor battery charger cable. Verify DTC P0D26 is not set and the vehicle will charge.
 - **If the DTC is set and the vehicle will not charge**
Refer to [DTC P0D26](#).
 - **If the DTC is not set and the vehicle charges**
5. Verify that DTC P0C78 is not set.
 - **If the DTC is set**
Refer to [DTC P0C78 or P3061](#).
 - **If the DTC is not set**

NOTE: The following setup steps must be performed exactly in order to exercise the contactors.

6. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
7. OPEN the driver door using outside door handle. Leave driver door OPEN.

NOTE: The parking lamps must remain ON throughout the remainder of the contactor steps.

8. Turn ON the parking lamps.

NOTE: DO NOT press the power button and enter Vehicle in Service Mode.

9. Command the Hybrid/EV Battery Contactors ALL OPEN with a scan tool.
10. Disconnect the S15 Manual Service Disconnect.

NOTE: DO NOT use the Release Control button to turn OFF any of the contactors. Once the Release Control button is pushed the Circuit/System Verification will need to be restarted from the beginning.

11. Command the Hybrid/EV Battery Negative Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.
12. Verify the Hybrid/EV Battery Negative Contactor should be heard closing and opening.
 - **If the Hybrid/EV Battery Negative Contactor does not open and close**

Refer to Circuit/System Testing.

- **If the Hybrid/EV Battery Negative Contactor does open and close**

13. Command the Hybrid/EV Battery Positive Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.

14. Verify the Hybrid/EV Battery Positive Contactor should be heard closing and opening.

- **If the Hybrid/EV Battery Positive Contactor does not open and close**

Refer to Circuit/System Testing.

- **If the Hybrid/EV Battery Positive Contactor does open and close**

15. Command the Hybrid/EV Battery Precharge Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.

16. Verify the Hybrid/EV Battery Precharge Contactor should be heard opening and closing.

- **If the Hybrid/EV Battery Precharge Contactor does not open and close**

Refer to Circuit/System Testing.

- **If the Hybrid/EV Battery Precharge Contactor does open and close**

17. Command the Hybrid/EV Battery Charger Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.

18. Verify the Hybrid/EV Battery Charger Contactor should be heard opening and closing.

- **If the Hybrid/EV Battery Charger Contactor does not open and close**

Refer to Circuit/System Testing.

- **If the Hybrid/EV Battery Charger Contactor does open and close**

19. All OK.

Circuit/System Testing

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

DTC P0AD9, P0ADD, P0AE4, or P0D0A Contactor Diagnosis

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.

2. Disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.

3. Test for less than 10 Ω between the ground circuit terminal 10 and ground.

- **If more than 10 Ω**

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 10 Ω**

4. Disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.

5. Verify that a test lamp illuminates between the A4 Hybrid/EV Battery Pack harness B+ circuit terminal 1 X357 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

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. Vehicle OFF.

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 K16 Battery Energy Control Module and hybrid/EV battery pack internal wiring harness.

- **If the test lamp illuminates**

6. Vehicle in Service Mode.

7. Verify that a test lamp does not illuminate between each A4 Hybrid/EV Battery Pack harness connector control circuit terminals listed below and ground:

- Terminal 3 X358
- Terminal 4 X358
- Terminal 5 X358
- Terminal 7 X358
- **If the test lamp illuminates on any circuit**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.

- **If the test lamp does not illuminate on all circuits**

8. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2.

9. Test for infinite resistance between each A4 Hybrid/EV Battery Pack harness connector control circuit terminals listed below and ground:

- Terminal 3 X358
- Terminal 4 X358
- Terminal 5 X358
- Terminal 7 X358
- **If less than infinite resistance on either circuit**

Repair the short to ground on the circuit.

- **If infinite resistance on both circuits**

10. Test for less than 2 Ω between the harness connector terminals listed below:

- Terminal 3 X358 at the A4 Hybrid/EV Battery Pack and terminal 9 X1 at the K114B Hybrid Powertrain Control Module 2
- Terminal 4 X358 at the A4 Hybrid/EV Battery Pack and terminal 6 X1 at the K114B Hybrid Powertrain Control Module 2
- Terminal 7 X358 at the A4 Hybrid/EV Battery Pack and terminal 8 X1 at the K114B Hybrid Powertrain Control Module 2
- Terminal 5 X358 at the A4 Hybrid/EV Battery Pack and terminal 3 X1 at the K114B Hybrid Powertrain Control Module 2
- **If 2 Ω or greater on any circuit**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω on all circuits**

11. Replace the A28 Hybrid/EV Battery Contactor Assembly.

12. Verify that DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D0A, P0D09, P1EBD, P1EC0, P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- **If any of the DTCs set**

Replace the K114B Hybrid Powertrain Control Module 2.

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

13. All OK.

P1EC3 - Hybrid/EV Battery Pack Heater Transistor Diagnosis

1. Vehicle OFF, disconnect the X9 low voltage harness connector at the T24 Battery Charger.

2. Vehicle in Service Mode.

3. Verify that a test lamp does not illuminate between the T24 Battery Charger harness control circuit terminal 6 and ground.

- **If the test lamp illuminates**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.
- **If the test lamp does not illuminate**
4. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2.
5. Test for infinite resistance between the T24 Battery Charger harness control circuit terminal 6 and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**

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**
6. Replace the T24 Battery Charger.
7. Verify that DTC P1EC3 does not set while operating the vehicle within the Conditions for Running the DTC.
 - **If the DTC is set**

Replace the K114B Hybrid Powertrain Control Module 2.
 - **If the DTC is not set**
8. All OK.

Repair Instructions

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

- Refer to [High Voltage Battery Disconnect Relay Replacement](#) for A28 Hybrid/EV battery contactor assembly replacement.
- Refer to [High Voltage Battery Control Wiring Junction Block Replacement \(With quick charge\)](#) [High Voltage Battery Control Wiring Junction Block Replacement \(Without quick charge\)](#) for T24 battery charger replacement.
- Refer to [Control Module References](#) for K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0AA6 OR P1AE6: HYBRID/EV BATTERY AND/OR BATTERY ENERGY CONTROL MODULE

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 P0AA6

Hybrid/EV Battery Voltage System Isolation Lost

DTC P1AE6

Battery Energy Control Module Hybrid/EV Battery Voltage Isolation Sensor Circuit

Circuit/System Description

The vehicle is equipped with a high voltage isolation monitor feature. The purpose of the battery energy control module high voltage isolation monitor circuit is to test the resistance between the high voltage positive and negative direct current (DC) bus and chassis ground. The battery energy control module isolation monitoring method is sometimes referred to as

the active isolation monitor. The hybrid powertrain control module 2 requests the battery energy control module to perform this test. Measurement values are reported to the hybrid powertrain control module 2, which makes the determination of an isolation fault.

The isolation check for P0AA6 Hybrid Battery Voltage System Isolation Lost runs when all the contactors are open. This check monitors isolation in the battery system. This check runs only once during the time that the hybrid powertrain control module 2 is awake and runs after the contactors have been open for 35 seconds. This monitor typically runs when the vehicle is turned off after a drive. It could also run when the vehicle is first started, if there is a long enough period between the hybrid powertrain control module 2 waking up and the main contactors closing.

The battery energy control module runs an internal self check of this sensor circuit. When this test fails, DTC P1AE6 will be set.

Conditions for Running the DTC

P0AA6

- The hybrid powertrain control module 2 and battery energy control module are awake and communicating
- All the contactors have been open for 35 s.

P1AE6

- The 12 V battery voltage is greater than 9 V.
- The hybrid powertrain control module 2 and battery energy control module are awake and communicating.
- The hybrid powertrain control module 2 has requested the battery energy control module to run the isolation test.
- The main contactors are open.
- DTC U185B is not set.

Conditions for Setting the DTC

P0AA6

- The battery energy control module has detected active isolation resistance is less than 265K Ω if P0AA6 has not failed, or less than 318K Ω if P0AA6 has failed at least once.
- 5 out of 10 tests have failed, one test is run per Hybrid/EV powertrain control module 2 wake-up cycle.

P1AE6

The battery energy control module has detected a fault with the active isolation sensing circuits.

Actions Taken When the DTC Sets

P0AA6 and P1AE6 are Type A DTCs.

Conditions for Clearing the DTC

- P0AA6 and P1AE6 are Type A DTCs.
- P0AA6 requires one passing test at greater than 318K Ω resistance.

Diagnostic Aids

- A single high voltage contactor stuck closed may set this DTC.
- Liquid intrusion into the hybrid/EV battery pack may cause P0AA6 or P1AE6 to set.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#) .

Circuit/System Verification

1. Verify that DTC P0A7E, P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0C32, P0D0A, P0D09, P1EBD, P1EC0 or P1EC3 is not set.

- **If any DTC is set**

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

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

2. Verify that DTC P1AE6 is set and P0AA6 is not set.

- **If DTC P1AE6 is set without DTC P0AA6**

1. Verify the K114B Hybrid Powertrain Control Module 2 has the latest calibration in Calibration Information.

- If the K114B Hybrid Powertrain Control Module 2 does not have the latest calibration, program the K114B Hybrid Powertrain Control Module 2 first, and then also replace the K16 Battery Energy Control Module.
- If the K114B Hybrid Powertrain Control Module 2 has the latest calibration

2. Replace the K16 Battery Energy Control Module.

- **If both DTCs are set, or only DTC P0AA6 is set**

3. Verify with a scan tool the hybrid powertrain control module 2, Isolation Test Resistance parameter is greater than 318k Ω .

- **If the parameter is 318k Ω or less**

Refer to Circuit/System Testing.

- **If the parameter is greater than 318k Ω**

4. 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 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. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
2. Replace the A4 Hybrid/EV Battery Pack.

Repair Instructions

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

- Refer to [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#) [Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#) [Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#) for A4 Hybrid/EV Battery Pack replacement.
- Refer to [Control Module References](#) for K16 battery energy control module replacement, programming and setup.

DTC P0ABB, P0ABC, OR P0ABD: HYBRID/EV BATTERY VOLTAGE SENSOR

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 P0ABB

Hybrid/EV Battery Voltage Sensor Performance

DTC P0ABC

Hybrid/EV Battery Voltage Sensor Circuit Low Voltage

DTC P0ABD

Hybrid/EV Battery Voltage Sensor Circuit High Voltage

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors individual cell voltage readings from the battery energy control module. The battery energy control module monitors the voltage of the 96 battery cell groups. Voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on each end of the of the battery module. A voltage sense harness joins this connector to the battery energy control module.

Conditions for Running the DTC

P0ABB

- The hybrid/EV powertrain control module 2 and battery energy control module are awake and communicating.
- No other DTCs are set.

P0ABC and P0ABD

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- The hybrid/EV powertrain control module 2 and battery energy control module are awake and communicating.

- The 12 V battery voltage is greater than 10.2 V.
- DTC P1A07 is not set.

Conditions for Setting the DTC

P0ABB

The hybrid/EV powertrain control module 2 detects difference of 12 V between the average cell group voltage multiplied by 96 and the voltage measured at battery side of the main contactors.

P0ABC

The battery energy control module detects the terminal voltage is less than 24 V on the battery side of the main contactors.

P0ABD

The battery energy control module detects the terminal voltage is greater than 479 V on the battery side of the main contactors.

Actions Taken When the DTC Sets

- DTCs P0ABB, P0ABC, and P0ABD are Type A DTCs.
- The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

DTCs P0ABB, P0ABC, and P0ABD are Type A DTCs.

Diagnostic Aids

- The hybrid/EV battery pack high voltage manual service disconnect is out, not installed correctly, or a blown manual service disconnect fuse may cause P0ABB and/or P0ABC to set.
- The hybrid/EV battery pack high voltage manual service disconnect was removed, out of sequence, or was out during a service procedure with the 12 V battery connected may cause P0ABB and/or P0ABC to set.

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

- The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

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

Special Tools

- **EL-48571** High Voltage Battery Pin Out Box
- **EL-48571-63** Pinout Box Adapter
- **EL-48900** HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#) .

[Circuit/System Verification](#)

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set.
 - **If any DTCs are set**

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

- **If no other DTCs are set**
3. Verify and record with a scan tool, the battery energy control module Hybrid Battery Pack Terminal 1 Voltage parameter and the hybrid/EV powertrain control module 2 Hybrid Battery Pack Voltage parameters are between 205 - 419 V and within 12 V of each other.
 - **If not within the specified range and not within 12 V of each other**

Refer to Circuit/System Testing.

- **If within the specified range and within 12 V of each other**
4. 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 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.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#)
2. Remove the S15 Manual Service Disconnect.
3. Test for less than 10 Ω across the S15 Manual Service Disconnect fuse terminals.

- **If 10 Ω or greater**

Replace the S15 Manual Service Disconnect.

- **If less than 10 Ω**

4. Remove the A4 hybrid/EV battery pack cover. Refer to [Battery Upper Cover Replacement](#).

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

5. Disconnect all K16 battery energy control module connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).
6. Inspect the harness connectors and the K16 battery energy control module connectors for corrosion.

- **If corrosion is present**

Replace the Hybrid/EV Battery Pack Internal Harness and the K16 Battery Energy Control Module as applicable.

- **If corrosion is not present**

NOTE: The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group.

7. Disconnect the harness connectors at C5A Hybrid/EV Battery Module 1 and C5J Hybrid/EV Battery Module 10.
8. Inspect the harness connectors and the appropriate C5A and C5J Hybrid/EV Battery module connectors for corrosion.

- **If corrosion is present**

Replace the A4 Hybrid/EV Battery Pack Internal Harness and the C4A Hybrid/EV Battery Section 1.

- **If corrosion is not present**

9. Connect the **EL-48571** High Voltage Battery Pin Out Box with the **EL-48571-63** adapter to the C5A Hybrid/EV Battery Module 1 connectors. Refer to [EL-48571 High Voltage Battery Pin Out Box Reference](#) for proper X1, X2 orientation.
10. Insert the DMM probes into the **EL-48571** High Voltage Battery Pin Out Box test cavities.
11. Measure and record the voltage of each of the cell groups by cycling the **EL-48571** High Voltage Battery Pin Out Box through each of the switch positions. Refer to [EL-48571 High Voltage Battery Pin Out Box Reference](#).
12. Verify each cell group voltage reading is between 3.28-4.16 V.

- **If not within the specified range**

Replace the C4A Hybrid/EV Battery Section 1.

- **If within the specified range**

13. Verify each cell group voltage reading is within 0.03 V of each other.

- **If greater than 0.03 V**

Replace the C4A Hybrid/EV Battery Section 1.

- If 0.03 V or less

14. Connect the **EL-48571** High Voltage Battery Pin Out Box with the **EL-48571-63** adapter to the C5J Hybrid/EV Battery Module 10 connectors. Refer to [EL-48571 High Voltage Battery Pin Out Box Reference](#) for proper X1, X2 orientation.
15. Insert the DMM probes into the **EL-48571** High Voltage Battery Pin Out Box test cavities.
16. Measure and record the voltage of each of the cell groups by cycling the **EL-48571** High Voltage Battery Pin Out Box through each of the switch positions. Refer to [EL-48571 High Voltage Battery Pin Out Box Reference](#).
17. Verify each cell group voltage reading is between 3.28-4.16 V.

- **If not within the specified range**

Replace the C4A Hybrid/EV Battery Section 1.

- **If within the specified range**

18. Verify each cell group voltage reading is within 0.03 V of each other.

- **If greater than 0.03 V**

Replace the C4A Hybrid/EV Battery Section 1.

- **If 0.03 V or less**

19. Replace the Hybrid/EV Battery Pack Internal Harness and the K16 Battery Energy Control Module.

Repair Instructions

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

- Refer to [Cell Battery Module Replacement \(Row 1\)](#) [Cell Battery Module Replacement \(Row 2\)](#) [Cell Battery Module Replacement \(Row 3\)](#) [Cell Battery Module Replacement \(Row 4\)](#) [Cell Battery Module Replacement \(Row 5\)](#) for C4A Hybrid/EV Battery Section 1 replacement.
- Refer to [Drive Motor Battery Sensor Module Wiring Harness Replacement \(Left\)](#) [Drive Motor Battery Sensor Module Wiring Harness Replacement \(Right\)](#) [Drive Motor Battery Sensor Module Wiring Harness Replacement \(LH, Sub\)](#) [Drive Motor Battery Sensor Module Wiring Harness Replacement \(RH, Sub\)](#) for Hybrid/EV Battery Pack Internal Harness replacement.
- Refer to [Control Module References](#) for K16 battery energy control module replacement, programming and setup.

DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, OR P1EBB: HYBRID/EV BATTERY LOW/HIGH RESOLUTION 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 Descriptor

DTC P0AC1

Hybrid/EV Battery Low Resolution Current Sensor Circuit Low Voltage

DTC P0AC2

Hybrid/EV Battery Low Resolution Current Sensor Circuit High Voltage

DTC P0B10

Hybrid/EV Battery High Resolution Current Sensor Circuit Low Voltage

DTC P0B11

Hybrid/EV Battery High Resolution Current Sensor Circuit High Voltage

DTC P0B13

Hybrid/EV Battery Low Resolution Current Sensor - High Resolution Current Sensor Not Plausible

DTC P1EBA

Hybrid/EV Battery Low Resolution Current Sensor Exceeded Learning Limit

DTC P1EBB

Hybrid/EV Battery High Resolution Current Sensor Exceeded Learning Limit

Circuit/System Description

The hybrid/EV battery current sensor is mounted inside the hybrid/EV battery pack. The negative high voltage cable that goes to the main contactor relay passes through the hybrid/EV battery pack current sensor. The hybrid/EV battery pack current sensor detects the amperage that flows in and out of the hybrid/EV batteries. The battery energy control module supplies and monitors a 5 V reference signal to the hybrid/EV battery pack current sensor. The hybrid/EV battery pack current sensor returns a signal between 0 and 5 V to the battery energy control module. The hybrid/EV battery pack current sensor signal is in proportion to the amperage going in and out of the hybrid/EV battery pack. The hybrid/EV battery pack current sensor has 2 measurement ranges in order to maintain accuracy. The ranges are low resolution and high resolution. The measurement ranges of the hybrid/EV battery pack current sensor have some overlap with each other. A signal voltage of the high resolution hybrid/EV battery pack current sensor greater than 2.5 V indicates that the hybrid/EV battery is being charged, and a signal voltage less than 2.5 V indicates discharging. A signal voltage of the low resolution hybrid/EV battery pack current sensor greater than 3.24 V indicates that the hybrid/EV battery is being charged and a signal voltage less than 3.24 V indicates discharging. The high resolution measures from -20 to +20 A. The low resolution measures from -500 to +230 A.

Conditions for Running the DTC

P0AC1, P0AC2, P0B10, and P0B11

- The 12 V battery voltage is greater than 10.2 V.
- The battery energy control module is awake and communicating.

P0B13

- The hybrid/EV battery low resolution current sensor or the hybrid/EV battery high resolution current sensor value is between -20 and +20 A.
- None of the following DTCs are set: P0AC1, P0AC2, P1EBA, P0B10, P0B11, P1EBB, U0111, U185A.

P1EBA and P1EBB

- Runs during battery energy control module initialization.
- The 12 V battery voltage is greater than 10.2 V.
- The high voltage main and charger contactors are open (during wake-up).
- DTC U185B is not set.

Conditions for Setting the DTC

P0AC1

The battery energy control module detects that the hybrid/EV battery pack current sensor low resolution is less than -555 A.

P0AC2

The battery energy control module detects that the hybrid/EV battery pack current sensor low resolution is greater than +285 A.

P0B10

The battery energy control module detects that the hybrid/EV battery pack current sensor high resolution is less than -23 A.

P0B11

The battery energy control module detects that the hybrid/EV battery pack current sensor high resolution is greater than +23 A.

P0B13

The difference between the Hybrid/EV Battery's low resolution current sensor value and its high resolution current sensor value is greater than 10 A.

P1EBA

The battery energy control module detects that the Pack Current Low Resolution Offset is greater than the calibration Low Resolution Offset of 8 A.

P1EBB

The battery energy control module detects that the Pack Current High Resolution Offset is greater than the calibration High Resolution Offset of 2.5 A.

Action Taken When the DTC Sets

- DTC P0AC1, P0AC2, P0B10, P0B11, P1EBA and P1EBB are type A DTCs.
- The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

DTC P0AC1, P0AC2, P0B10, P0B11, P1EBA and P1EBB are type A DTCs.

Diagnostic Aids

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

Refer to [Battery Energy Control Module Replacement](#) .

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System 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

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

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50214** Low Voltage Jumper Harness Extension

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Vehicle in Service Mode, all accessories OFF.

NOTE: Typical current in a parked vehicle with the Vehicle in Service Mode and all accessories OFF is between 1 A and 10 A.

2. Verify the scan tool battery energy control module Hybrid/EV Battery Pack Low Resolution Current Sensor parameter is between -555 A and +285 A and changes with the amount of current draw on the hybrid/EV battery pack.

- If not within the specified range

Refer to Circuit/System Testing.

- If within the specified range

NOTE: Typical current in a parked vehicle with the Vehicle in Service Mode and all accessories OFF is between 1 A and 10 A.

3. Verify the scan tool Hybrid/EV Battery Pack High Resolution Current Sensor parameter is between -23 A and +23 A, and changes with the amount of current draw on the hybrid/EV battery pack.

- If not within the specified range

Refer to Circuit/System Testing.

- If within the specified range

4. 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 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. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
2. Remove the A4 Hybrid/EV Battery Pack cover. Refer to [Battery Upper Cover Replacement](#).

3. Connect the **EL-50214** low voltage jumper harness extension.
4. Disconnect the A28 Hybrid/EV Battery Contactor Assembly connector.
5. Connect the 12 V battery, vehicle OFF.
6. Test for less than 10 Ω between the low reference circuit terminal 13 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy 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 K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).
 - **If less than 10 Ω**
7. Vehicle in Service Mode.
8. Test for 4.8 - 5.5 V between the 5 V reference circuit terminal 12 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy 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 K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).
 - **If greater than 5.5 V**
 1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy Control Module, vehicle in Service Mode.
 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 K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).
 - **If within the specified range**
9. Verify the scan tool Hybrid/EV Battery Pack High Resolution Current Sensor parameter is less than 0 A.
 - **If 0 A or greater**
 1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the A28 Hybrid/EV battery contactor assembly connector signal circuit terminal 14 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).
 - **If less than 0 A**
10. Install a 3 A fused jumper wire between the A28 Hybrid/EV battery contactor assembly connector signal circuit terminal 14 and the 5 V reference circuit terminal 12.
11. Verify the scan tool Hybrid/EV Battery Pack High Resolution Current Sensor parameter is greater than 0 A.
 - **If 0 A or less**
 1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy Control 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 , replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).

- **If greater than 0 A**

12. Verify the scan tool Hybrid/EV Battery Pack Low Resolution Current Sensor parameter is less than 100 A.

- **If 100 A or greater**

1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the A28 Hybrid/EV battery contactor assembly connector signal circuit terminal 11 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).

- **If less than 100 A**

13. Install a 3 A fused jumper wire between the A28 Hybrid/EV battery contactor assembly connector signal circuit terminal 11 and the 5 V reference circuit terminal 12.

14. Verify with a scan tool, the Hybrid/EV Battery Pack Low Resolution Current Sensor parameter is greater than 100 A.

- **If less than 100 A**

1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy Control 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 , replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).

- **If 100 A or greater**

15. Replace the B30 Hybrid/EV Battery Pack Current Sensor.

Repair Instructions

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

- Refer to [High Voltage Battery Disconnect Relay Replacement](#) for B30 Hybrid/EV Battery Pack Current Sensor replacement
- Refer to [Drive Motor Battery Control Module Wiring Harness Replacement](#)
- Refer to [Control Module References](#) for K16 battery energy control module replacement, programming, and setup.

DTC P0AF8: HYBRID SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0AF8

Hybrid System Voltage

Circuit/System Description

The high voltage hybrid/EV battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid/EV battery assembly. These cell groups are electrically

connected in series. Each individual cell group is rated at 3.65 V, for a nominal system voltage of 350 V direct current. The battery cell groups are electrically joined to form 10 distinct electrical modules.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at connectors located on the side of the battery cell module. A voltage sense harness joins this connector to the battery energy control module.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

- The hybrid/EV battery main contactors are closed.
- None of the following DTCs are set; P0ABB, P0ABC, P0ABD, P1A07, P1AE8, P1AE9, P1AEA, P1AEB, P1AEC, P1AED, P1E20, P1E21, P1E28, or U1817.

OR

- Battery charging is active.
- None of the following DTCs are set; P0ABB, P0ABC, P0ABD, P1AF5, P1B0C, P1B41, P1B42, P1B44, P1ED1, P1EF1, P1E1B, U1817.

Conditions for Setting the DTC

- The difference between the Hybrid/EV Battery pack voltage and the hybrid/EV powertrain control module 1 bus voltage is greater than 16 V.

OR

- The difference between the Hybrid/EV Battery pack voltage and the charger module's bus voltage is greater than 16 V.

Action Taken When the DTC Sets

- DTC P0AF8 is a type A DTC.
- The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

DTC P0AF8 is a type A DTC.

Diagnostic Aids

- An open high voltage fuse for the T18 Battery Charger may cause DTC P0AF8 to set.
- DTC P1EC0 may set a DTC P0AF8 if the vehicle is ON or vehicle in service mode while the contactors are stuck OPEN

Reference Information

Schematic Reference

- [Hybrid/EV Energy Storage Schematics](#)
- [Plug-In Charging Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

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

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

[Circuit/System Verification](#)

1. Verify that no other DTCs are set.

- **If any DTCs are set**

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

- **If no DTCs are set**

2. Ensure the battery charge cord is not connected.

3. Vehicle ON.

NOTE: The contactors must be closed.

4. Verify with a scan tool, the hybrid/EV powertrain control module High Voltage Circuit and the battery energy control module Hybrid/EV Battery Pack Terminal 1 Voltage are within 16 V of each other and DTC P0AF8 did not reset.

- **If the parameters are not within 16 V of each other or DTC P0AF8 is set**

Refer to Circuit/System Testing, Battery Main Bus Diagnostics.

- **If the parameters are within 16 V of each other and DTC P0AF8 is not set**

5. Connect the battery charge cord.

6. Verify with a scan tool, the hybrid/EV powertrain control module 2 Battery Charger High Output and the battery energy control module Hybrid Battery Pack Terminal 1 Voltage are within 16 V of each other and DTC P0AF8 did not reset.

- **If the parameters are not within 16 V of each other or DTC P0AF8 is set**

Refer to Circuit/System Testing, Battery Charger Bus Diagnostics.

- **If the parameters are within 16 V of each other and DTC P0AF8 is not set**

7. 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 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.

Battery Charger Bus Diagnostics

1. Vehicle OFF, disable the high voltage at the T18 Battery Charger and the T24 Battery Charger-DC. Refer to [High Voltage Disabling](#).
2. Disconnect the T18 Battery Charger high voltage DC connector.
3. Disconnect the K1 14 V Power Module high voltage connector.
4. Disconnect the T24 Battery Charger-DC high voltage connectors X6 and X7.
5. Disconnect the X4 harness connector at the A4 Hybrid/EV Battery Pack.
6. Test for infinite resistance between the High voltage DC (+360 V) positive terminal A and the high voltage DC (-360 V) negative terminal B X4 harness connector.

- **If less than infinite resistance**

Replace the high voltage DC cables. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

- **If infinite resistance**

7. Test for less than 10 Ω between the terminals listed below:
 - High voltage DC (-360 V) negative terminal B X7 harness connector at the T24 Battery Charger-DC and the high voltage DC (-360 V) negative terminal B X4 harness connector at the A4 Hybrid/EV Battery Pack.
 - High voltage DC (+360 V) positive terminal A X7 harness connector at the T24 Battery Charger-DC and the high voltage DC (+360 V) negative terminal A X4 harness connector at the A4 Hybrid/EV Battery Pack.

- **If 10 Ω or greater**

Replace the high voltage DC cables. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

- **If less than 10 Ω**

8. Test for less than 10 Ω between the terminals listed below:
 - High voltage DC (-360 V) negative terminal B X6 harness connector at the T24 Battery Charger-DC and the high voltage DC (-360 V) negative terminal B X3 harness connector at the T18 Battery Charger.
 - High voltage DC (+360 V) positive terminal A X6 harness connector at the T24 Battery Charger-DC and the high voltage DC (+360 V) negative terminal A X3 harness connector at the T18 Battery Charger.

- **If 10 Ω or greater**

Replace the high voltage DC cables. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

- **If less than 10 Ω**

NOTE: The T18 battery charger Fuse is located within the A28 Hybrid/EV Battery Contactor Assembly.

9. Replace the T18 Battery Charger, K1 14 V Power Module and the T18 Battery Charger fuse, if open.
10. Verify that DTC P0AF8 does not set while operating the vehicle within the Conditions for Running the DTC.
 - **If DTC P0AF8 sets**
Replace the T24 Battery Charger-DC.
 - **If DTC P0AF8 does not set**
11. Verify that DTC P0AF8 does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC P0AF8 sets**

Replace the A28 Hybrid/EV Battery Contactor Assembly.

- **If DTC P0AF8 does not set**

12. All OK.

Battery Main Bus Diagnostics

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module, A4 Hybrid/EV Battery Pack and T24 Battery Charger-DC. Refer to [High Voltage Disabling](#).
2. Disconnect the X3 harness connector at the A4 Hybrid/EV Battery Pack.
3. Disconnect the X2 high voltage connector at the T6 power inverter module.
4. Disconnect the X1 and X3 connectors at the T24 Battery Charger-DC.
5. Test for infinite resistance between the High voltage DC (+360 V) positive terminal A and the high voltage DC (-360 V) negative terminal B X3 connector at the A4 Hybrid/EV Battery Pack, harness side.

- **If less than infinite resistance**

Replace the high voltage DC cables. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

- **If infinite resistance**

6. Test for infinite resistance between the High voltage DC (+360 V) positive terminal A and the high voltage DC (-360 V) negative terminal B X2 connector at the T6 Power Inverter Module, harness side.

- **If less than infinite resistance**

Replace the high voltage DC cables. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

- **If infinite resistance**

7. Test for infinite resistance between the High voltage DC (+360 V) positive terminal A and the high voltage DC (-360 V) negative terminal B X1 connector at the T24 Battery Charger - DC, module side.

- **If less than infinite resistance**

Replace the T24 Battery Charger-DC. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

- **If infinite resistance**

8. Test for less than 10 Ω between the terminals listed below:

- High voltage DC (-360 V) negative terminal B X3 harness connector at the A4 Hybrid/EV Battery Pack and the high voltage DC (-360 V) negative terminal B X3 harness connector at the T24 Battery Charger-DC.
- High voltage DC (+360 V) positive terminal A X3 harness connector at the A4 Hybrid/EV Battery Pack and the high voltage DC (+360 V) negative terminal A X3 harness connector at the T24 Battery Charger-DC.

- **If 10 Ω or greater**

Replace the high voltage DC cables. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

- **If less than 10 Ω**

9. Test for less than 10 Ω between the terminals listed below:

- High voltage DC (-360 V) negative terminal B X2 harness connector at the T6 Power Inverter Module and the high voltage DC (-360 V) negative terminal B X1 harness connector at the T24 Battery Charger-DC.
- High voltage DC (+360 V) positive terminal A X2 harness connector at the T6 Power Inverter Module and the high voltage DC (+360 V) negative terminal A X1 harness connector at the T24 Battery Charger-DC.

- **If 10 Ω or greater**

Replace the high voltage DC cables. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

- **If less than 10 Ω**

10. Test for less than 10 Ω between the terminals listed below:

- High voltage DC (-360 V) negative terminal B X3 module connector at the T24 Battery Charger-DC and the high voltage DC (-360 V) negative terminal B X1 module connector at the T24 Battery Charger-DC.
- High voltage DC (+360 V) positive terminal A X3 module connector at the T24 Battery Charger-DC and the high voltage DC (+360 V) negative terminal A X1 module connector at the T24 Battery Charger-DC.
- **If 10 Ω or greater**

Replace the T24 Battery Charger-DC. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.

- **If less than 10 Ω**

11. Replace the T6 Power Inverter Module.

12. Verify that DTC P0AF8 does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC P0AF8 sets**

Replace the A28 Hybrid/EV Battery Contactor Assembly.

- **If DTC P0AF8 does not set**

13. All OK.

Repair Instructions

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

- Refer to **300-Volt Battery Positive and Negative Cable Replacement (Generator Battery Control Wiring Junction Block to Drive Motor Battery)**
- Refer to **Drive Motor Battery Charger Replacement (Except Dubai) Drive Motor Battery Charger Replacement (Dubai)** for T18 Battery Charger replacement.
- Refer to **Accessory DC Power Control Module Replacement** for K1 14 V Power Module replacement.
- Refer to **High Voltage Battery Disconnect Relay Fuse Replacement** for T18 battery charger fuse replacement.
- Refer to **High Voltage Battery Control Wiring Junction Block Replacement (With quick charge) High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)** for T24 Battery Charger-DC replacement.
- Refer to **High Voltage Battery Disconnect Relay Replacement** for A28 hybrid/EV battery contactor assembly replacement.
- Refer to **Control Module References** for T6 power inverter module replacement, programming and setup.

DTC P0AFA OR P0AFB: HYBRID/EV BATTERY 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 Descriptor

DTC P0AFA

Hybrid/EV Battery System Voltage Low Voltage

DTC P0AFB

Hybrid/EV Battery System Voltage High Voltage

Circuit/System Description

The high voltage hybrid/EV battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid/EV battery assembly. These cell groups are electrically connected in series. Each individual cell group is rated at 3.65 V, for a nominal system voltage of 350 V direct current. The battery cell groups are electrically joined to form 10 distinct electrical modules.

Located within the high voltage Hybrid/EV battery pack, the K16 battery energy control module monitors the temperature, current and voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on the end of the battery cell module. A voltage sense harness joins this connector to the K16 battery energy control module.

Conditions for Running the DTC

- The battery energy control module is awake and communicating.
- None of the following DTCs are set; P0ABB, P0ABC, P0ABD, U0111, U185A.

Conditions for Setting the DTC

P0AFA

The Hybrid Battery Pack Voltage is less than 168.1 V when at temperatures of 9°C (48°F) or less.

OR

The Hybrid Battery Pack Voltage is less than 174.5 V when temperatures of greater than 9°C (48°F).

P0AFB

The Hybrid Battery Pack Voltage is greater than 438 V when at temperatures of 19°C (66°F).

OR

The Hybrid Battery Pack Voltage is greater than 441 V when at temperatures of greater than 19°C (66°F).

Action Taken When the DTC Sets

DTCs P0AFA and P0AFB are type A DTCs.

DTC P0AFB

Once the vehicle has been turned OFF, the hybrid/EV powertrain control module 2 will not CLOSE the high voltage contactors until the DTC has been cleared.

Conditions for Clearing the DTC

- DTCs P0AFA and P0AFB are type A DTCs.
- The Clear Secured High Voltage DTCs reset function must be performed with a scan tool before clear codes.

Diagnostic Aids

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

The hybrid/EV battery pack high voltage manual service disconnect is not installed correctly, or a blown manual service disconnect fuse will cause P0AFA to set.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

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

Special Tools

- **EL-48571** High Voltage Battery Pin Out Box
- **EL-48571-63** Pinout Box Adapter
- **EL-48900** HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

[Circuit/System Verification](#)

1. Vehicle in Service Mode.

2. Verify that DTC P0AA1, P0AD9, P0ADD, P0AE2, P0AE4, P0B3B, P0B3C, P0B3D, P0B3E, P0B40, P0B41, P0B42, P0B43, P0B45, P0B46, P0B47, P0B48, P0B4A, P0B4B, P0B4D, P0B4C, P0B4F, P0B50, P0B51, P0B52, P0B54, P0B55, P0B56, P0B57, P0B59, P0B5A, P0B5B, P0B5C, P0B5E, P0B60, P0B5F, P0B61, P0B63, P0B64, P0B65, P0B66, P0B69, P0B68, P0B6A, P0B6D, P0B6B, P0B6E, P0B70, P0B6F, P0B72, P0B74, P0B73, P0B75, P0B77, P0B78, P0B79, P0B7A, P0B7D, P0B7C, P0B7E, P0B7F, P0B81, P0B82, P0B83, P0B84, P0B86, P0B87, P0B88, P0B89, P0B8B, P0B8C, P0B8D, P0B8E, P0B90, P0B91, P0B92, P0B93, P0B95, P0B96, P0B97, P0B98, P0B9A, P0B9B, P0B9C, P0B9D, P0B9F, P0BA1, P0BA0, P0BA2, P0BA4, P0BA5, P0BA6, P0BA7, P0BA9, P0BAA, P0BAB, P0BAC, P0BAE, P0BAF, P0BB0, P0BB1, P0BB3, P0BB4, P0BB5, P0BB6, P0BB8, P0BB9, P0BBA, P0BBB, P0D0A, P0D11, P1B16, P1B17, P1B18, P1B19, P1B1A, P1B1B, P1B1C, P1B1D, P1B1E, P1B1F, P1B20, P1B21, P1B22, P1B23, P1B24, P1B25, P1B26, P1B27, P1B28, P1B29, P1B2B, P1B2A, P1B2C, P1B2D, P1B45, P1B46, P1B47, P1B48, P1B49, P1B4A, P1B4B, P1B4C, P1B4D, P1B4E, P1B4F, P1B50, P1B51, P1B52, P1B53, P1B54, P1B55, P1B56, P1B57, P1B58, P1B59, P1B5A, P1B5B, P1B5C, P1B5D, P1B5E, P1B5F, P1B60, P1B61, P1B62, P1B63, P1B64, P1B65, P1B66, P1B67, P1B68, P1B69, P1B6A, P1B6B, P1B6C, P1B6D, P1B6E, P1B6F, P1B70, P1B71, P1B72, P1B73, P1B74, P1B75, P1B76, P1B77, P1B78, P1B79, P1B7A, P1B7B, P1B7C, P1B7D, P1B7F, P1B7E, P1B80, P1B81, P1B82, P1B83, P1B84, P1B85, P1B86, P1B87, P1B88, P1B89, P1B8A, P1B8B, P1B8C, P1B8D, P1B8E, P1B8F, P1B90, P1B91, P1B92, P1B93, P1B94, P1B95, P1B97, P1B96, P1B98, P1B99, P1B9A, P1B9B, P1B9C, P1B9D, P1B9E, P1B9F, P1BA0, P1BA1, P1BA2, P1BA3, P1BA4, P1BA5, P1BA6, P1BA7, P1BA8, P1BA9, P1BAB, P1BAA, P1BAC, P1BAD, P1BAE, P1BAF, P1BB0, P1BB1, P1BB2, P1BB3, P1BB4, P1BB5, P1BB6, P1BB7, P1BB8, P1BB9, P1BBA, P1BBB, P1BBC, P1BBD, P1BBE, P1BBF, P1BC0, P1BC1, P1BC2, P1BC3, P1BC4, P1BC5, P1BC6, P1BC7, P1BC8, P1BC9, P1BCA, P1BCB, P1BCC, P1BCE, P1BCD, P1BCF, P1BD0, P1BD2, P1BD1, P1BD3, P1BD4, P1BD5, P1BD6, P1BD7, P1BD8, P1BD9, P1BDA, P1BDB, P1BDD, P1BDC, P1BDE, P1BDF, P1BE1, P1BE0, P1BE3, P1BE2, P1BE4, P1BE5, P1BE6, P1BE7, P1BE8, P1BE9, P1BEA, P1BEB, P1BEC, P1BED, P1BEE, P1BF0, P1BEF, P1BF1, P1BF2, P1BF4, P1BF3, P1BF5, P1BF4, P1BF7, P1BF8, P1BF9, P1BFA, P1BFB, P1BFC, P1BFD, P1BFE, P1E01, P1E02, P1E03, P1E04, P1E05, P1E06, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E62, P1E61, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6D, P1E6C, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E76, P1E75, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, P1EBC, P1EBF, P1EC0, P1EC3, P1EC4, P1EC5, U2603, U2604, U2605, U2606, or U2401 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 the scan tool Hybrid/EV Battery Pack Terminal 1 Voltage is between 168.1 - 441 V.

- **If not within the specified range**

Refer to Circuit/System Testing, Hybrid Battery Pack Voltage Diagnosis.

- If within the specified range

4. 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 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. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#)
2. Remove the S15 manual service disconnect.
3. Test for less than 10 Ω across the S15 manual service disconnect fuse terminals.
 - If 10 Ω or greater

Replace the S15 manual service disconnect and repeat Circuit/System Verification.

- If less than 10 Ω
4. Remove the A4 hybrid/EV battery pack cover. Refer to [Battery Upper Cover Replacement](#).
 5. Install a known good S15 manual service disconnect.

WARNING: High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.

NOTE: You are testing high voltage.

6. Test for 168 - 441 V between the negative (300 V) C5A and positive (300 V) C5K at the A28 Hybrid/EV Battery Contactor Assembly.

- If not within the specified range

Replace the A4 Hybrid/EV Battery Pack. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

- If within the specified range

7. Replace the K16 Battery Energy Control Module. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

Repair Instructions

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

- Refer to [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#) [Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#) [Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
- Refer to [Control Module References](#) for K16 battery energy control module replacement, programming and setup.

DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, OR P1E4C-P1E8B: HYBRID/EV BATTERY 1-96 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 P0B3B

Hybrid/EV Battery 1 Circuit

DTC P0B3C

Hybrid/EV Battery 1 Circuit Performance

DTC P0B3D

Hybrid/EV Battery 1 Circuit Low Voltage

DTC P0B3E

Hybrid/EV Battery 1 Circuit High Voltage

DTC P0B40

Hybrid/EV Battery 2 Circuit

DTC P0B41

Hybrid/EV Battery 2 Circuit Performance

DTC P0B42

Hybrid/EV Battery 2 Circuit Low Voltage

DTC P0B43

Hybrid/EV Battery 2 Circuit High Voltage

DTC P0B45

Hybrid/EV Battery 3 Circuit

DTC P0B46

Hybrid/EV Battery 3 Circuit Performance

DTC P0B47

Hybrid/EV Battery 3 Circuit Low Voltage

DTC P0B48

Hybrid/EV Battery 3 Circuit High Voltage

DTC P0B4A

Hybrid/EV Battery 4 Circuit

DTC P0B4B

Hybrid/EV Battery 4 Circuit Performance

DTC P0B4C

Hybrid/EV Battery 4 Circuit Low Voltage

DTC P0B4D

Hybrid/EV Battery 4 Circuit High Voltage

DTC P0B4F

Hybrid/EV Battery 5 Circuit

DTC P0B50

Hybrid/EV Battery 5 Circuit Performance

DTC P0B51

Hybrid/EV Battery 5 Circuit Low Voltage

DTC P0B52

Hybrid/EV Battery 5 Circuit High Voltage

DTC P0B54

Hybrid/EV Battery 6 Circuit

DTC P0B55

Hybrid/EV Battery 6 Circuit Performance

DTC P0B56

Hybrid/EV Battery 6 Circuit Low Voltage

DTC P0B57

Hybrid/EV Battery 6 Circuit High Voltage

DTC P0B59

Hybrid/EV Battery 7 Circuit

DTC P0B5A

Hybrid/EV Battery 7 Circuit Performance

DTC P0B5B

Hybrid/EV Battery 7 Circuit Low Voltage

DTC P0B5C

Hybrid/EV Battery 7 Circuit High Voltage

DTC P0B5E

Hybrid/EV Battery 8 Circuit

DTC P0B5F

Hybrid/EV Battery 8 Circuit Performance

DTC P0B60

Hybrid/EV Battery 8 Circuit Low Voltage

DTC P0B61

Hybrid/EV Battery 8 Circuit High Voltage

DTC P0B63

Hybrid/EV Battery 9 Circuit

DTC P0B64

Hybrid/EV Battery 9 Circuit Performance

DTC P0B65

Hybrid/EV Battery 9 Circuit Low Voltage

DTC P0B66

Hybrid/EV Battery 9 Circuit High Voltage

DTC P0B68

Hybrid/EV Battery 10 Circuit

DTC P0B69

Hybrid/EV Battery 10 Circuit Performance

DTC P0B6A

Hybrid/EV Battery 10 Circuit Low Voltage

DTC P0B6B

Hybrid/EV Battery 10 Circuit High Voltage

DTC P0B6D

Hybrid/EV Battery 11 Circuit

DTC P0B6E

Hybrid/EV Battery 11 Circuit Performance

DTC P0B6F

Hybrid/EV Battery 11 Circuit Low Voltage

DTC P0B70

Hybrid/EV Battery 11 Circuit High Voltage

DTC P0B72

Hybrid/EV Battery 12 Circuit

DTC P0B73

Hybrid/EV Battery 12 Circuit Performance

DTC P0B74

Hybrid/EV Battery 12 Circuit Low Voltage

DTC P0B75

Hybrid/EV Battery 12 Circuit High Voltage

DTC P0B77

Hybrid/EV Battery 13 Circuit

DTC P0B78

Hybrid/EV Battery 13 Circuit Performance

DTC P0B79

Hybrid/EV Battery 13 Circuit Low Voltage

DTC P0B7A

Hybrid/EV Battery 13 Circuit High Voltage

DTC P0B7C

Hybrid/EV Battery 14 Circuit

DTC P0B7D

Hybrid/EV Battery 14 Circuit Performance

DTC P0B7E

Hybrid/EV Battery 14 Circuit Low Voltage

DTC P0B7F

Hybrid/EV Battery 14 Circuit High Voltage

DTC P0B81

Hybrid/EV Battery 15 Circuit

DTC P0B82

Hybrid/EV Battery 15 Circuit Performance

DTC P0B83

Hybrid/EV Battery 15 Circuit Low Voltage

DTC P0B84

Hybrid/EV Battery 15 Circuit High Voltage

DTC P0B86

Hybrid/EV Battery 16 Circuit

DTC P0B87

Hybrid/EV Battery 16 Circuit Performance

DTC P0B88

Hybrid/EV Battery 16 Circuit Low Voltage

DTC P0B89

Hybrid/EV Battery 16 Circuit High Voltage

DTC P0B8B

Hybrid/EV Battery 17 Circuit

DTC P0B8C

Hybrid/EV Battery 17 Circuit Performance

DTC P0B8D

Hybrid/EV Battery 17 Circuit Low Voltage

DTC P0B8E

Hybrid/EV Battery 17 Circuit High Voltage

DTC P0B90

Hybrid/EV Battery 18 Circuit

DTC P0B91

Hybrid/EV Battery 18 Circuit Performance

DTC P0B92

Hybrid/EV Battery 18 Circuit Low Voltage

DTC P0B93

Hybrid/EV Battery 18 Circuit High Voltage

DTC P0B95

Hybrid/EV Battery 19 Circuit

DTC P0B96

Hybrid/EV Battery 19 Circuit Performance

DTC P0B97

Hybrid/EV Battery 19 Circuit Low Voltage

DTC P0B98

Hybrid/EV Battery 19 Circuit High Voltage

DTC P0B9A

Hybrid/EV Battery 20 Circuit

DTC P0B9B

Hybrid/EV Battery 20 Circuit Performance

DTC P0B9C

Hybrid/EV Battery 20 Circuit Low Voltage

DTC P0B9D

Hybrid/EV Battery 20 Circuit High Voltage

DTC P0B9F

Hybrid/EV Battery 21 Circuit

DTC P0BA0

Hybrid/EV Battery 21 Circuit Performance

DTC P0BA1

Hybrid/EV Battery 21 Circuit Low Voltage

DTC P0BA2

Hybrid/EV Battery 21 Circuit High Voltage

DTC P0BA4

Hybrid/EV Battery 22 Circuit

DTC P0BA5

Hybrid/EV Battery 22 Circuit Performance

DTC P0BA6

Hybrid/EV Battery 22 Circuit Low Voltage

DTC P0BA7

Hybrid/EV Battery 22 Circuit High Voltage

DTC P0BA9

Hybrid/EV Battery 23 Circuit

DTC P0BAA

Hybrid/EV Battery 23 Circuit Performance

DTC P0BAB

Hybrid/EV Battery 23 Circuit Low Voltage

DTC P0BAC

Hybrid/EV Battery 23 Circuit High Voltage

DTC P0BAE

Hybrid/EV Battery 24 Circuit

DTC P0BAF

Hybrid/EV Battery 24 Circuit Performance

DTC P0BB0

Hybrid/EV Battery 24 Circuit Low Voltage

DTC P0BB1

Hybrid/EV Battery 24 Circuit High Voltage

DTC P0BB3

Hybrid/EV Battery 25 Circuit

DTC P0BB4

Hybrid/EV Battery 25 Circuit Performance

DTC P0BB5

Hybrid/EV Battery 25 Circuit Low Voltage

DTC P0BB6

Hybrid/EV Battery 25 Circuit High Voltage

DTC P0BB8

Hybrid/EV Battery 26 Circuit

DTC P0BB9

Hybrid/EV Battery 26 Circuit Performance

DTC P0BBA

Hybrid/EV Battery 26 Circuit Low Voltage

DTC P0BBB

Hybrid/EV Battery 26 Circuit High Voltage

DTC P1B16

Hybrid/EV Battery 27 Circuit Performance

DTC P1B17

Hybrid/EV Battery 27 Circuit Low Voltage

DTC P1B18

Hybrid/EV Battery 27 Circuit High Voltage

DTC P1B19

Hybrid/EV Battery 28 Circuit Performance

DTC P1B1A

Hybrid/EV Battery 28 Circuit Low Voltage

DTC P1B1B

Hybrid/EV Battery 28 Circuit High Voltage

DTC P1B1C

Hybrid/EV Battery 29 Circuit Performance

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Hybrid/EV Battery 29 Circuit Low Voltage

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Hybrid/EV Battery 29 Circuit High Voltage

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Hybrid/EV Battery 30 Circuit Performance

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Hybrid/EV Battery 27 Circuit

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Hybrid/EV Battery 28 Circuit

DTC P1B2A

Hybrid/EV Battery 29 Circuit

DTC P1B2B

Hybrid/EV Battery 30 Circuit

DTC P1B2C

Hybrid/EV Battery 31 Circuit

DTC P1B2D

Hybrid/EV Battery 32 Circuit

DTC P1B45

Hybrid/EV Battery 33 Circuit Performance

DTC P1B46

Hybrid/EV Battery 33 Circuit Low Voltage

DTC P1B47

Hybrid/EV Battery 33 Circuit High Voltage

DTC P1B48

Hybrid/EV Battery 34 Circuit Performance

DTC P1B49

Hybrid/EV Battery 34 Circuit Low Voltage

DTC P1B4A

Hybrid/EV Battery 34 Circuit High Voltage

DTC P1B4B

Hybrid/EV Battery 35 Circuit Performance

DTC P1B4C

Hybrid/EV Battery 35 Circuit Low Voltage

DTC P1B4D

Hybrid/EV Battery 35 Circuit High Voltage

DTC P1B4E

Hybrid/EV Battery 36 Circuit Performance

DTC P1B4F

Hybrid/EV Battery 36 Circuit Low Voltage

DTC P1B50

Hybrid/EV Battery 36 Circuit High Voltage

DTC P1B51

Hybrid/EV Battery 37 Circuit Performance

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Hybrid/EV Battery 44 Circuit Low Voltage

DTC P1B68

Hybrid/EV Battery 44 Circuit High Voltage

DTC P1B69

Hybrid/EV Battery 45 Circuit Performance

DTC P1B6A

Hybrid/EV Battery 45 Circuit Low Voltage

DTC P1B6B

Hybrid/EV Battery 45 Circuit High Voltage

DTC P1B6C

Hybrid/EV Battery 46 Circuit Performance

DTC P1B6D

Hybrid/EV Battery 46 Circuit Low Voltage

DTC P1B6E

Hybrid/EV Battery 46 Circuit High Voltage

DTC P1B6F

Hybrid/EV Battery 47 Circuit Performance

DTC P1B70

Hybrid/EV Battery 47 Circuit Low Voltage

DTC P1B71

Hybrid/EV Battery 47 Circuit High Voltage

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DTC P1B7A

Hybrid/EV Battery 50 Circuit High Voltage

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Hybrid/EV Battery 51 Circuit Performance

DTC P1B7C

Hybrid/EV Battery 51 Circuit Low Voltage

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Hybrid/EV Battery 51 Circuit High Voltage

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Hybrid/EV Battery 52 Circuit Performance

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Hybrid/EV Battery 52 Circuit Low Voltage

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Hybrid/EV Battery 56 Circuit Performance

DTC P1B8B

Hybrid/EV Battery 56 Circuit Low Voltage

DTC P1B8C

Hybrid/EV Battery 56 Circuit High Voltage

DTC P1B8D

Hybrid/EV Battery 57 Circuit Performance

DTC P1B8E

Hybrid/EV Battery 57 Circuit Low Voltage

DTC P1B8F

Hybrid/EV Battery 57 Circuit High Voltage

DTC P1B90

Hybrid/EV Battery 58 Circuit Performance

DTC P1B91

Hybrid/EV Battery 58 Circuit Low Voltage

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Hybrid/EV Battery 58 Circuit High Voltage

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Hybrid/EV Battery 59 Circuit Performance

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Hybrid/EV Battery 59 Circuit Low Voltage

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Hybrid/EV Battery 60 Circuit Performance

DTC P1B97

Hybrid/EV Battery 60 Circuit Low Voltage

DTC P1B98

Hybrid/EV Battery 60 Circuit High Voltage

DTC P1B99

Hybrid/EV Battery 61 Circuit Performance

DTC P1B9A

Hybrid/EV Battery 61 Circuit Low Voltage

DTC P1B9B

Hybrid/EV Battery 61 Circuit High Voltage

DTC P1B9C

Hybrid/EV Battery 62 Circuit Performance

DTC P1B9D

Hybrid/EV Battery 62 Circuit Low Voltage

DTC P1B9E

Hybrid/EV Battery 62 Circuit High Voltage

DTC P1B9F

Hybrid/EV Battery 63 Circuit Performance

DTC P1BA0

Hybrid/EV Battery 63 Circuit Low Voltage

DTC P1BA1

Hybrid/EV Battery 63 Circuit High Voltage

DTC P1BA2

Hybrid/EV Battery 64 Circuit Performance

DTC P1BA3

Hybrid/EV Battery 64 Circuit Low Voltage

DTC P1BA4

Hybrid/EV Battery 64 Circuit High Voltage

DTC P1BA5

Hybrid/EV Battery 65 Circuit Performance

DTC P1BA6

Hybrid/EV Battery 65 Circuit Low Voltage

DTC P1BA7

Hybrid/EV Battery 65 Circuit High Voltage

DTC P1BA8

Hybrid/EV Battery 66 Circuit Performance

DTC P1BA9

Hybrid/EV Battery 66 Circuit Low Voltage

DTC P1BAA

Hybrid/EV Battery 66 Circuit High Voltage

DTC P1BAB

Hybrid/EV Battery 67 Circuit Performance

DTC P1BAC

Hybrid/EV Battery 67 Circuit Low Voltage

DTC P1BAD

Hybrid/EV Battery 67 Circuit High Voltage

DTC P1BAE

Hybrid/EV Battery 68 Circuit Performance

DTC P1BAF

Hybrid/EV Battery 68 Circuit Low Voltage

DTC P1BB0

Hybrid/EV Battery 68 Circuit High Voltage

DTC P1BB1

Hybrid/EV Battery 69 Circuit Performance

DTC P1BB2

Hybrid/EV Battery 69 Circuit Low Voltage

DTC P1BB3

Hybrid/EV Battery 69 Circuit High Voltage

DTC P1BB4

Hybrid/EV Battery 70 Circuit Performance

DTC P1BB5

Hybrid/EV Battery 70 Circuit Low Voltage

DTC P1BB6

Hybrid/EV Battery 70 Circuit High Voltage

DTC P1BB7

Hybrid/EV Battery 71 Circuit Performance

DTC P1BB8

Hybrid/EV Battery 71 Circuit Low Voltage

DTC P1BB9

Hybrid/EV Battery 71 Circuit High Voltage

DTC P1BBA

Hybrid/EV Battery 72 Circuit Performance

DTC P1BBB

Hybrid/EV Battery 72 Circuit Low Voltage

DTC P1BBC

Hybrid/EV Battery 72 Circuit High Voltage

DTC P1BBD

Hybrid/EV Battery 73 Circuit Performance

DTC P1BBE

Hybrid/EV Battery 73 Circuit Low Voltage

DTC P1BBF

Hybrid/EV Battery 73 Circuit High Voltage

DTC P1BC0

Hybrid/EV Battery 74 Circuit Performance

DTC P1BC1

Hybrid/EV Battery 74 Circuit Low Voltage

DTC P1BC2

Hybrid/EV Battery 74 Circuit High Voltage

DTC P1BC3

Hybrid/EV Battery 75 Circuit Performance

DTC P1BC4

Hybrid/EV Battery 75 Circuit Low Voltage

DTC P1BC5

Hybrid/EV Battery 75 Circuit High Voltage

DTC P1BC6

Hybrid/EV Battery 76 Circuit Performance

DTC P1BC7

Hybrid/EV Battery 76 Circuit Low Voltage

DTC P1BC8

Hybrid/EV Battery 76 Circuit High Voltage

DTC P1BC9

Hybrid/EV Battery 77 Circuit Performance

DTC P1BCA

Hybrid/EV Battery 77 Circuit Low Voltage

DTC P1BCB

Hybrid/EV Battery 77 Circuit High Voltage

DTC P1BCC

Hybrid/EV Battery 78 Circuit Performance

DTC P1BCD

Hybrid/EV Battery 78 Circuit Low Voltage

DTC P1BCE

Hybrid/EV Battery 78 Circuit High Voltage

DTC P1BCF

Hybrid/EV Battery 79 Circuit Performance

DTC P1BD0

Hybrid/EV Battery 79 Circuit Low Voltage

DTC P1BD1

Hybrid/EV Battery 79 Circuit High Voltage

DTC P1BD2

Hybrid/EV Battery 80 Circuit Performance

DTC P1BD3

Hybrid/EV Battery 80 Circuit Low Voltage

DTC P1BD4

Hybrid/EV Battery 80 Circuit High Voltage

DTC P1BD5

Hybrid/EV Battery 81 Circuit Performance

DTC P1BD6

Hybrid/EV Battery 81 Circuit Low Voltage

DTC P1BD7

Hybrid/EV Battery 81 Circuit High Voltage

DTC P1BD8

Hybrid/EV Battery 82 Circuit Performance

DTC P1BD9

Hybrid/EV Battery 82 Circuit Low Voltage

DTC P1BDA

Hybrid/EV Battery 82 Circuit High Voltage

DTC P1BDB

Hybrid/EV Battery 83 Circuit Performance

DTC P1BDC

Hybrid/EV Battery 83 Circuit Low Voltage

DTC P1BDD

Hybrid/EV Battery 83 Circuit High Voltage

DTC P1BDE

Hybrid/EV Battery 84 Circuit Performance

DTC P1BDF

Hybrid/EV Battery 84 Circuit Low Voltage

DTC P1BE0

Hybrid/EV Battery 84 Circuit High Voltage

DTC P1BE1

Hybrid/EV Battery 85 Circuit Performance

DTC P1BE2

Hybrid/EV Battery 85 Circuit Low Voltage

DTC P1BE3

Hybrid/EV Battery 85 Circuit High Voltage

DTC P1BE4

Hybrid/EV Battery 86 Circuit Performance

DTC P1BE5

Hybrid/EV Battery 86 Circuit Low Voltage

DTC P1BE6

Hybrid/EV Battery 86 Circuit High Voltage

DTC P1BE7

Hybrid/EV Battery 87 Circuit Performance

DTC P1BE8

Hybrid/EV Battery 87 Circuit Low Voltage

DTC P1BE9

Hybrid/EV Battery 87 Circuit High Voltage

DTC P1BEA

Hybrid/EV Battery 88 Circuit Performance

DTC P1BEB

Hybrid/EV Battery 88 Circuit Low Voltage

DTC P1BEC

Hybrid/EV Battery 88 Circuit High Voltage

DTC P1BED

Hybrid/EV Battery 89 Circuit Performance

DTC P1BEE

Hybrid/EV Battery 89 Circuit Low Voltage

DTC P1BEF

Hybrid/EV Battery 89 Circuit High Voltage

DTC P1BF0

Hybrid/EV Battery 90 Circuit Performance

DTC P1BF1

Hybrid/EV Battery 90 Circuit Low Voltage

DTC P1BF2

Hybrid/EV Battery 90 Circuit High Voltage

DTC P1BF3

Hybrid/EV Battery 91 Circuit Performance

DTC P1BF4

Hybrid/EV Battery 91 Circuit Low Voltage

DTC P1BF5

Hybrid/EV Battery 91 Circuit High Voltage

DTC P1BF6

Hybrid/EV Battery 92 Circuit Performance

DTC P1BF7

Hybrid/EV Battery 92 Circuit Low Voltage

DTC P1BF8

Hybrid/EV Battery 92 Circuit High Voltage

DTC P1BF9

Hybrid/EV Battery 93 Circuit Performance

DTC P1BFA

Hybrid/EV Battery 93 Circuit Low Voltage

DTC P1BFB

Hybrid/EV Battery 93 Circuit High Voltage

DTC P1BFC

Hybrid/EV Battery 94 Circuit Performance

DTC P1BFD

Hybrid/EV Battery 94 Circuit Low Voltage

DTC P1BFE

Hybrid/EV Battery 94 Circuit High Voltage

DTC P1E01

Hybrid/EV Battery 95 Circuit Performance

DTC P1E02

Hybrid/EV Battery 95 Circuit Low Voltage

DTC P1E03

Hybrid/EV Battery 95 Circuit High Voltage

DTC P1E04

Hybrid/EV Battery 96 Circuit Performance

DTC P1E05

Hybrid/EV Battery 96 Circuit Low Voltage

DTC P1E06

Hybrid/EV Battery 96 Circuit High Voltage

DTC P1E4C

Hybrid/EV Battery 33 Circuit

DTC P1E4D

Hybrid/EV Battery 34 Circuit

DTC P1E4E

Hybrid/EV Battery 35 Circuit

DTC P1E4F

Hybrid/EV Battery 36 Circuit

DTC P1E50

Hybrid/EV Battery 37 Circuit

DTC P1E51

Hybrid/EV Battery 38 Circuit

DTC P1E52

Hybrid/EV Battery 39 Circuit

DTC P1E53

Hybrid/EV Battery 40 Circuit

DTC P1E54

Hybrid/EV Battery 41 Circuit

DTC P1E55

Hybrid/EV Battery 42 Circuit

DTC P1E56

Hybrid/EV Battery 43 Circuit

DTC P1E57

Hybrid/EV Battery 44 Circuit

DTC P1E58

Hybrid/EV Battery 45 Circuit

DTC P1E59

Hybrid/EV Battery 46 Circuit

DTC P1E5A

Hybrid/EV Battery 47 Circuit

DTC P1E5B

Hybrid/EV Battery 48 Circuit

DTC P1E5C

Hybrid/EV Battery 49 Circuit

DTC P1E5D

Hybrid/EV Battery 50 Circuit

DTC P1E5E

Hybrid/EV Battery 51 Circuit

DTC P1E5F

Hybrid/EV Battery 52 Circuit

DTC P1E60

Hybrid/EV Battery 53 Circuit

DTC P1E61

Hybrid/EV Battery 54 Circuit

DTC P1E62

Hybrid/EV Battery 55 Circuit

DTC P1E63

Hybrid/EV Battery 56 Circuit

DTC P1E64

Hybrid/EV Battery 57 Circuit

DTC P1E65

Hybrid/EV Battery 58 Circuit

DTC P1E66

Hybrid/EV Battery 59 Circuit

DTC P1E67

Hybrid/EV Battery 60 Circuit

DTC P1E68

Hybrid/EV Battery 61 Circuit

DTC P1E69

Hybrid/EV Battery 62 Circuit

DTC P1E6A

Hybrid/EV Battery 63 Circuit

DTC P1E6B

Hybrid/EV Battery 64 Circuit

DTC P1E6C

Hybrid/EV Battery 65 Circuit

DTC P1E6D

Hybrid/EV Battery 66 Circuit

DTC P1E6E

Hybrid/EV Battery 67 Circuit

DTC P1E6F

Hybrid/EV Battery 68 Circuit

DTC P1E70

Hybrid/EV Battery 69 Circuit

DTC P1E71

Hybrid/EV Battery 70 Circuit

DTC P1E72

Hybrid/EV Battery 71 Circuit

DTC P1E73

Hybrid/EV Battery 72 Circuit

DTC P1E74

Hybrid/EV Battery 73 Circuit

DTC P1E75

Hybrid/EV Battery 74 Circuit

DTC P1E76

Hybrid/EV Battery 75 Circuit

DTC P1E77

Hybrid/EV Battery 76 Circuit

DTC P1E78

Hybrid/EV Battery 77 Circuit

DTC P1E79

Hybrid/EV Battery 78 Circuit

DTC P1E7A

Hybrid/EV Battery 79 Circuit

DTC P1E7B

Hybrid/EV Battery 80 Circuit

DTC P1E7C

Hybrid/EV Battery 81 Circuit

DTC P1E7D

Hybrid/EV Battery 82 Circuit

DTC P1E7E

Hybrid/EV Battery 83 Circuit

DTC P1E7F

Hybrid/EV Battery 84 Circuit

DTC P1E80

Hybrid/EV Battery 85 Circuit

DTC P1E81

Hybrid/EV Battery 86 Circuit

DTC P1E82

Hybrid/EV Battery 87 Circuit

DTC P1E83

Hybrid/EV Battery 88 Circuit

DTC P1E84

Hybrid/EV Battery 89 Circuit

DTC P1E85

Hybrid/EV Battery 90 Circuit

DTC P1E86

Hybrid/EV Battery 91 Circuit

DTC P1E87

Hybrid/EV Battery 92 Circuit

DTC P1E88

DTC P1E89

Hybrid/EV Battery 94 Circuit

DTC P1E8A

Hybrid/EV Battery 95 Circuit

DTC P1E8B

Hybrid/EV Battery 96 Circuit

Circuit/System Description

The high voltage hybrid/EV battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid/EV battery assembly. These cell groups are electrically connected in series. Each individual cell group is rated at 3.65 V, for a nominal system voltage of 350 V direct current. The battery cell groups are electrically joined to form 10 distinct electrical modules.

Located within the high voltage Hybrid/EV battery pack, the K16 battery energy control module monitors the temperature, current and voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on the end of the battery cell module. A voltage sense harness joins this connector to the K16 battery energy control module.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at connectors located on the end of the battery module. A voltage sense harness joins these connectors to the battery energy control module.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC**Hybrid/EV Battery Circuit Open DTCs**

- Vehicle ON.
- The hybrid/EV battery energy control module is awake and communicating.
- None of the following DTCs are set; U0111 or U185A.

Hybrid/EV Battery Circuit Performance, Hybrid/EV Battery Circuit Low Voltage and Hybrid/EV Battery Circuit High Voltage DTCs:

- Vehicle ON.
- The hybrid/EV battery energy control module is awake and communicating.
- None of the following DTCs are set: P0B3B, P0B40, P0B45, P0B4A, P0B4F, P0B54, P0B59, P0B5E, P0B63, P0B68, P0B6D, P0B72, P0B77, P0B7C, P0B81, P0B86, P0B8B, P0B90, P0B95, P0B9A, P0B9F, P0BA4, P0BA9, P0BAE, P0BB3, P0BB8, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6D, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, P1E8B, P1F86, P1F87, P1F88, P1F89, P1F8A, P1F8B, P1F8C, P1F8D, P1F8E, P1F8F, P1F90, P1F91, P1F92, P1F93, P1F94, P1F95, U0111, or U185A

Conditions for Setting the DTC**Battery Circuit**

- P0B3B, P0B40, P0B45, P0B4A, P0B4F, P0B54, P0B59, P0B5E, P0B63, P0B68, P0B6D, P0B72, P0B77, P0B7C, P0B81, P0B86, P0B8B, P0B90, P0B95, P0B9A, P0B9F, P0BA4, P0BA9, P0BAE, P0BB3, P0BB8, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6D, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, P1E8B, P1F86, P1F87, P1F88, P1F89, P1F8A, P1F8B, P1F8C, P1F8D, P1F8E, P1F8F, P1F90, P1F91, P1F92, P1F93, P1F94, P1F95, U0111, or U185A

P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, P1E8B are Type A DTCs.

- The hybrid/EV battery energy control module detects high resistance on the circuit.

Circuit Performance

- P0B3C, P0B41, P0B46, P0B4B, P0B50, P0B55, P0B5A, P0B5F, P0B64, P0B69, P0B6E, P0B73, P0B78, P0B7D, P0B82, P0B87, P0B8C, P0B91, P0B96, P0B9B, P0BA0, P0BA5, P0BAA, P0BAF, P0BB4, P0BB9, P1B19, P1B1F, P1B25, P1B45, P1B48, P1B4B, P1B4E, P1B51, P1B54, P1B57, P1B5A, P1B5D, P1B60, P1B63, P1B66, P1B69, P1B6C, P1B6F, P1B72, P1B75, P1B78, P1B7B, P1B7E, P1B81, P1B84, P1B87, P1B8A, P1B8D, P1B90, P1B93, P1B96, P1B99, P1B9C, P1B9F, P1BA2, P1BA5, P1BA8, P1BAB, P1BAE, P1BB1, P1BB4, P1BB7, P1BBA, P1BBD, P1BC0, P1BC3, P1BC6, P1BC9, P1BCC, P1BCF, P1BD2, P1BD5, P1BD8, P1BDB, P1BDE, P1BE1, P1BE4, P1BE7, P1BEA, P1BED, P1BF0, P1BF3, P1BF6, P1BF9, P1BFC, P1E01, P1E04 are Type A DTCs.
- The faulted cell group does not change voltage.

Low Voltage

- P0B3D, P0B42, P0B47, P0B4C, P0B51, P0B56, P0B5B, P0B60, P0B65, P0B6A, P0B6F, P0B74, P0B79, P0B7E, P0B83, P0B88, P0B8D, P0B92, P0B97, P0B9C, P0BA1, P0BA6, P0BAB, P0BB0, P0BB5, P0BBA, P1B17, P1B1A, P1B1D, P1B20, P1B23, P1B26, P1B46, P1B4C, P1B4F, P1B52, P1B55, P1B58, P1B5B, P1B5E, P1B61, P1B64, P1B67, P1B6A, P1B6D, P1B70, P1B73, P1B76, P1B79, P1B7C, P1B7F, P1B82, P1B85, P1B88, P1B8B, P1B8E, P1B91, P1B94, P1B97, P1B9A, P1B9D, P1BA0, P1BA3, P1BA6, P1BA9, P1BAC, P1BAF, P1BB2, P1BB5, P1BB8, P1BBB, P1BBE, P1BC1, P1BC4, P1BC7, P1BCA, P1BCD, P1BD0, P1BD3, P1BD6, P1BD9, P1BDC, P1BDF, P1BE2, P1BE5, P1BE8, P1BEB, P1BEE, P1BF1, P1BF4, P1BF7, P1BFA, P1BFD, P1E02, P1E05 are Type A DTCs.
- Any hybrid/EV battery voltage signal is less than 1.75 V.

High Voltage

- P0B3E, P0B43, P0B48, P0B4D, P0B52, P0B57, P0B5C, P0B61, P0B66, P0B6B, P0B70, P0B75, P0B7A, P0B7F, P0B84, P0B89, P0B8E, P0B93, P0B98, P0B9D, P0BA2, P0BA7, P0BAC, P0BB1, P0BB6, P0BBB, P1B18, P1B1B, P1B1E, P1B21, P1B24, P1B27, P1B47, P1B4A, P1B4D, P1B50, P1B53, P1B56, P1B59, P1B5C, P1B5F, P1B62, P1B65, P1B68, P1B6B, P1B6E, P1B71, P1B74, P1B77, P1B7A, P1B7D, P1B80, P1B83, P1B86, P1B89, P1B8C, P1B8F, P1B92, P1B95, P1B98, P1B9B, P1B9E, P1BA1, P1BA4, P1BA7, P1BAA, P1BAD, P1BB0, P1BB3, P1BB6, P1BB9, P1BBC, P1BBF, P1BC2, P1BC5, P1BC8, P1BCB, P1BCE, P1BD1, P1BD4, P1BD7, P1BDA, P1BDD, P1BE0, P1BE3, P1BE6, P1BE9, P1BEC, P1BEF, P1BF2, P1BF5, P1BF8, P1BFB, P1BFE, P1E03, P1E06 are Type A DTCs.
- Any hybrid/EV battery voltage signal is greater than 4.58 V.

Action Taken When the DTC Sets

- DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06 or P1E4C-P1E8B are type A DTCs.
- If any performance DTCs are set, the vehicle will operate in a reduced power mode.
- Battery Circuit, Low Voltage or High Voltage DTCs set: Once the vehicle has been turned OFF, the hybrid/EV powertrain control module 2 will not CLOSE the high voltage contactors until the DTC has been cleared.

Conditions for Clearing the DTC

- DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06 or P1E4C-P1E8B are type A DTCs.
- Battery Circuit, Low Voltage or High Voltage DTCs set: The **Clear Secured High Voltage DTCs** reset function must be performed with a scan tool before clear codes.

Diagnostic Aids

CAUTION:

The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.

3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group and corresponding DTC.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48571** High Voltage Battery Pin Out Box
- **EL-48571-61** Pinout Box Adapter
- **EL-48571-62** Pinout Box Adapter
- **EL-48571-63** Pinout Box Adapter
- **EL-48900** HEV Safety Kit

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

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Hybrid/EV Battery 1 - 96 voltages are between 3.28-4.16 V and all readings are within 0.03 V of each other.
 - **If not between 3.28-4.16 V or not within 0.03 V of each other**
Refer to Circuit/System Testing.
 - **If between 3.28-4.16 V and within 0.03 V of each other**
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 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. Vehicle OFF, disable high voltage at the A4 hybrid/EV battery pack. Refer to [High Voltage Disabling](#)
2. Remove the A4 hybrid/EV battery pack cover. Refer to [Battery Upper Cover Replacement](#).

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

3. Disconnect all K16 battery energy control module connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).

4. Inspect the harness connectors and the K16 battery energy control module connectors for corrosion.

- If corrosion is present

Replace the Hybrid/EV Battery Pack Internal Harness and the K16 Battery Energy Control Module as applicable.

- If corrosion is not present

NOTE: The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group and corresponding DTC.

5. Disconnect the harness connectors at the appropriate C5 Hybrid/EV Battery Module as indicated by the voltages observed during Circuit/System Verification.

6. Inspect the harness connectors and the C5 Hybrid/EV Battery Module connectors for corrosion.

- If corrosion is present

Replace the Hybrid/EV Battery Pack Internal Harness and the C4 Hybrid/EV Battery Section, as applicable.

- If corrosion is not present

7. Connect the EL-48571 High Voltage Battery Pin Out Box with the EL-48571-61, EL-48571-62, or EL-48571-63 adapter to the battery module. Refer to [EL-48571 High Voltage Battery Pin Out Box Reference](#) for proper X1, X2 orientation.

8. Insert the DMM probes into the EL-48571 test cavities.

9. Measure and record the voltage of each of the cell groups by cycling the EL-48571 through each of the switch positions. Refer to [EL-48571 High Voltage Battery Pin Out Box Reference](#)

10. Verify each cell group voltage reading is between 3.28-4.16 V.

- **If not within the specified range**

Replace the appropriate C4 Hybrid/EV Battery Section.

- **If within the specified range**

11. Verify each cell group voltage reading is within 0.03 V of each other.

- **If greater than 0.03 V**

Replace the appropriate C4 Hybrid/EV Battery Section.

- **If 0.03 V or less**

NOTE: Perform the following testing at the hybrid/EV battery pack internal wiring harness connector.

12. Test for infinite resistance between each appropriate voltage sense circuit terminals and ground.

- **If less than infinite resistance**

Replace the Hybrid/EV Battery Pack Internal Harness.

- **If infinite resistance**

13. Test for less than 2 Ω in each appropriate voltage sense circuits end to end.

- **If 2 Ω or greater**

Replace the Hybrid/EV Battery Pack Internal Harness.

- **If less than 2 Ω**

14. Replace the K16 Battery Energy Control Module.

Repair Instructions

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

- Refer to [Cell Battery Module Replacement \(Row 1\)](#) [Cell Battery Module Replacement \(Row 2\)](#) [Cell Battery Module Replacement \(Row 3\)](#) [Cell Battery Module Replacement \(Row 4\)](#) [Cell Battery Module Replacement \(Row 5\)](#) for C4 hybrid/EV battery section replacement
- Refer to [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#) [Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#) [Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
- Refer to [Drive Motor Battery Sensor Module Wiring Harness Replacement \(Left\)](#) [Drive Motor Battery Sensor Module Wiring Harness Replacement \(Right\)](#) [Drive Motor Battery Sensor Module Wiring Harness Replacement \(LH, Sub\)](#) [Drive Motor Battery Sensor Module Wiring Harness Replacement \(RH, Sub\)](#) for hybrid/EV battery pack internal harness replacement
- Refer to [Control Module References](#) for K16 hybrid/EV battery energy control module replacement, programming and setup.

DTC P0C78 OR P3061: HYBRID/EV BATTERY PRECHARGE

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 P0C78

Hybrid/EV Battery System Precharge Time Too Long

DTC P3061

Hybrid/EV Battery Precharge High Current

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor and a precharge negative high voltage contactor. The contactors close and open in a specific sequence controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for the high voltage contactors. Ground is provided through the case ground.

In order to prevent large in-rush current, system bus high voltage is routed through a pre-charge resistor whenever high voltage is commanded ON. The hybrid/EV powertrain control module 2 monitors the time and current it takes the system bus voltage to attain the same level as the battery pack voltage. If it takes too long, or too much current flows, a DTC is set.

Conditions for Running the DTC

P0C78

- Battery voltage sensor has not failed.
- Bus voltage sensor has not failed.
- Contactor status is Precharging.
- Cabin heating is Off.

P3061

- Battery voltage sensor has not failed.
- Battery current sensor has not failed.
- Precharge is active.

Conditions for Setting the DTC

P0C78

The bus voltage has not reached 95% of battery voltage or is greater than 105% within 700 ms of the contactors closing.

P3061

The bus current is greater than 3 amps for 88 ms during precharge.

Actions Taken When the DTC Sets

- DTC P0C78 and P3061 are type A DTCs.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors.

Conditions for Clearing the DTC

DTC P0C78 and P3061 are type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- **[COMPONENT CONNECTOR END VIEWS - INDEX](#)**
- **[INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)**

Description and Operation

Drive Motor Battery System 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. Record the freeze frame/failure records.
2. Vehicle in Service Mode.
3. Verify that DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D0A, or P1EC3 is not set.
 - **If any of the DTCs are set**

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

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

NOTE: The following setup steps must be performed exactly in order to exercise the contactors.

4. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
5. OPEN the driver door using outside door handle. Leave driver door OPEN.

NOTE: The parking lamps must remain ON throughout the remainder of the contactor steps.

6. Turn ON the parking lamps.

NOTE: DO NOT press the power button and enter Vehicle in Service Mode.

7. Command the Hybrid/EV Battery Contactors ALL OPEN with a scan tool.
8. Disconnect the S15 Manual Service Disconnect.

NOTE: DO NOT use the Release Control button to turn OFF any of the contactors. Once the Release Control button is pushed the Circuit/System Verification will need to be restarted from the beginning.

9. Command the Hybrid/EV Battery Negative Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.
10. Verify the Hybrid/EV Battery Negative Contactor should be heard closing and opening.
 - **If the Hybrid/EV Battery Negative Contactor does not open and close**
Refer to Circuit/System Testing, Contactor Function Diagnosis.
 - **If the Hybrid/EV Battery Negative Contactor does open and close**
11. Command the Hybrid/EV Battery Positive Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.
12. Verify the Hybrid/EV Battery Positive Contactor should be heard closing and opening.
 - **If the Hybrid/EV Battery Positive Contactor does not open and close**
Refer to Circuit/System Testing, Contactor Function Diagnosis.
 - **If the Hybrid/EV Battery Positive Contactor does open and close**
13. Command the Hybrid/EV Battery Precharge Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.
14. Verify the Hybrid/EV Battery Precharge Contactor should be heard opening and closing.
 - **If the Hybrid/EV Battery Precharge Contactor does not open and close**

Refer to Circuit/System Testing, Contactor Function Diagnosis.

- **If the Hybrid/EV Battery Precharge Contactor does open and close**

15. Command the Hybrid/EV Battery Charger Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.

16. Verify the Hybrid/EV Battery Charger Contactor should be heard opening and closing.

- **If the Hybrid/EV Battery Charger Contactor does not open and close**

Refer to Circuit/System Testing, Contactor Function Diagnosis.

- **If the Hybrid/EV Battery Charger Contactor does open and close**

17. Test for less than 10 Ω across the S15 manual service disconnect fuse terminals.

- **If 10 Ω or greater**

Obtain a new S15 manual service disconnect and Refer to Circuit/System Testing, High Voltage System Bus Diagnosis without DTC P0D26.

- **If less than 10 Ω**

18. Vehicle OFF.

19. Install the S15 Manual Service Disconnect.

20. Clear the DTC information. Vehicle OFF and wait 5 minutes. Vehicle ON, verify DTC P0C78 or P3061 do not set.

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

NOTE: The vehicle must remain OFF to prevent DTC P0C78 from running.

1. Vehicle OFF. Wait 5 minutes.

2. Connect the drive motor battery charger cable.

3. Verify DTC P0D26 is not set and the vehicle will charge.

- If the DTC is set and the vehicle will not charge, Refer to Circuit/System Testing, High Voltage System Bus Diagnosis with DTC P0D26.
- If the DTC is not set and the vehicle charges, Refer to Circuit/System Testing, High Voltage System Bus Diagnosis without DTC P0D26.

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

21. 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 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.

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

Contact Function Diagnosis

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
3. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
 - **If greater than 10 Ω**
 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 10 Ω**
4. Disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.
5. Verify that a test lamp illuminates between the A4 Hybrid/EV Battery Pack harness B+ circuit terminal 1 X357 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 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. Vehicle OFF.
 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 K16 Battery Energy Control Module and hybrid/EV battery pack internal wiring harness.
 - **If the test lamp illuminates**
6. Vehicle in Service Mode.
7. Verify that a test lamp does not illuminate between each A4 Hybrid/EV Battery Pack harness connector control circuit terminals listed below and ground:
 - Terminal 3 X358
 - Terminal 4 X358
 - Terminal 5 X358
 - Terminal 7 X358
 - **If the test lamp illuminates on any circuit**
 1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.
 - **If the test lamp does not illuminate on all circuits**
8. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2.
9. Test for infinite resistance between each A4 Hybrid/EV Battery Pack harness connector control circuit terminals listed below and ground:
 - Terminal 3 X358
 - Terminal 4 X358
 - Terminal 5 X358
 - Terminal 7 X358
 - **If less than infinite resistance on either circuit**

Repair the short to ground on the circuit.
 - **If infinite resistance on both circuits**
10. Test for less than 2 Ω between the harness connector terminals listed below:
 - Terminal 3 X358 at the A4 Hybrid/EV Battery Pack and terminal 9 X1 at the K114B Hybrid Powertrain Control Module 2

- Terminal 4 X358 at the A4 Hybrid/EV Battery Pack and terminal 6 X1 at the K114B Hybrid Powertrain Control Module 2
- Terminal 7 X358 at the A4 Hybrid/EV Battery Pack and terminal 8 X1 at the K114B Hybrid Powertrain Control Module 2
- Terminal 5 X358 at the A4 Hybrid/EV Battery Pack and terminal 3 X1 at the K114B Hybrid Powertrain Control Module 2
- **If 2 Ω or greater on any circuit**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω on all circuits**

11. Replace the A28 Hybrid/EV Battery Contactor Assembly.

12. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC P0C78 or P3061 sets**

Replace the K114B Hybrid Powertrain Control Module 2.

- **If DTC P0C78 or P3061 does not set**

13. All OK.

High Voltage System Bus Diagnosis with DTC P0D26

1. Disable the high voltage for servicing at the A4 Battery Pack, K1 14V Power Module and the T18 Battery Charger. Refer to [High Voltage Disabling](#).
2. Disconnect the X3 connector at the T18 Battery Charger and the X1 connector at the K1 14V Power Module.
3. Verify that all HV harness connector and 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 effected modules as necessary.

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

NOTE: This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.

4. Test the K1 14 V Power Module X1 terminals for greater than 10K Ω , X1-A to X1-B.

- **If 10K Ω or less**

1. Replace the K1 14V Power Module.

2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC P0C78 or P3061 sets**

Replace the A28 Hybrid/EV Battery Contactor Assembly.

- **If DTC P0C78 or P3061 does not set**

3. All OK.

- **If greater than 10K Ω**

NOTE: This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.

5. Test the T18 Battery Charger terminals for greater than 10K Ω , X3-1 to X3-2.

- **If 10K Ω or less**

1. Replace the T18 Battery Charger.

2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- If DTC P0C78 or P3061 sets

Replace the A28 Hybrid/EV Battery Contactor Assembly.

- If DTC P0C78 or P3061 does not set

3. All OK.

- **If greater than 10K Ω**

6. Remove and open the A4 Battery Pack. Refer to [Battery Upper Cover Replacement](#).

7. Inspect the High Voltage bus bars for loose/damaged terminal fasteners.

- **If a terminal concern is found**

Replace all affected components.

- **If no internal concerns are observed**

8. Replace the A28 Hybrid/EV Battery Contactor Assembly.

9. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC P0C78 or P3061 sets**

Replace the K114B Hybrid Powertrain Control Module 2.

- **If DTC P0C78 or P3061 does not set**

10. All OK.

High Voltage System Bus Diagnosis without DTC P0D26

1. Disable the high voltage for servicing at the A4 Battery Pack, G1 A/C Compressor, T6 Power Inverter Module, T24 Battery Charger and the K10 Coolant Heater. Refer to [High Voltage Disabling](#).

2. Disconnect the X2 connector at the T6 Power Inverter Module, the X1 and X3 connectors at the T24 Battery Charger and the X3 connector at the A4 Battery Pack.

3. Verify that all HV harness connector and 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 effected modules as necessary.

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

NOTE: This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.

4. Test the T6 Power Inverter Module X2 terminals for greater than 10K Ω , X2-A to X2-B.

- **If 10K Ω or less**

1. Replace the T6 Power Inverter Module.

2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- If DTC P0C78 or P3061 sets

Replace the A28 Hybrid/EV Battery Contactor Assembly.

- If DTC P0C78 or P3061 does not set

3. All OK.

- **If greater than 10K Ω**

NOTE: This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.

5. Test the K10 Coolant Heater X1 terminals for greater than 10K Ω , X1-1 to X1-2.

- **If 10K Ω or less**

1. Replace the K10 Coolant Heater Control Module.

2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- If DTC P0C78 or P3061 sets

Replace the A28 Hybrid/EV Battery Contactor Assembly.

- If DTC P0C78 or P3061 does not set

3. All OK.

- **If greater than 10K Ω**

NOTE: This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.

6. Test the G1 A/C Compressor X2 terminals for greater than 10K Ω , X2-A to X2-B.

- **If 10K Ω or less**

1. Replace the G1 A/C Compressor.

2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- If DTC P0C78 or P3061 sets

Replace the A28 Hybrid/EV Battery Contactor Assembly.

- If DTC P0C78 or P3061 does not set

3. All OK.

- **If greater than 10K Ω**

7. Test the following T24 Battery Charger terminals for less than 2 Ω , terminal to terminal:

- X1-A to X3-A

- X1-B to X3-B

- **If 2 Ω or greater**

Replace the T24 Battery Charger.

- **If less than 2 Ω**

8. Remove and open the A4 Battery Pack. Refer to [Battery Upper Cover Replacement](#).

9. Inspect the High Voltage bus bars for loose/damaged terminal fasteners.

- **If a terminal concern is found**

Replace all affected components.

- **If no internal concerns are observed**

10. Replace the A28 Hybrid/EV Battery Contactor Assembly and the K16 Battery Energy Control Module.

11. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC P0C78 or P3061 sets**

Replace the K114B Hybrid Powertrain Control Module 2.

- **If DTC P0C78 or P3061 does not set**

12. All OK.

Repair Instructions

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

- Refer to [High Voltage Battery Control Wiring Junction Block Replacement \(With quick charge\)](#) [High Voltage Battery Control Wiring Junction Block Replacement \(Without quick charge\)](#) for T24 battery charger

replacement

- Refer to [Air Conditioning and Drive Motor Battery Cooling Compressor Replacement](#) for G1 A/C compressor replacement
- Refer to [Heater Coolant Heater Replacement](#) for K10 coolant heater replacement
- Refer to [High Voltage Battery Disconnect Relay Replacement](#) for A28 Hybrid/EV Battery Contactor Assembly
- Refer to [Control Module References](#) for K16 battery energy control module, T6 power inverter module, K1 14V power module, or K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, OR P3040: BATTERY ENERGY CONTROL MODULE 5 V REFERENCE CIRCUIT AND/OR HYBRID/EV BATTERY INTERFACE CONTROL MODULE 1-12 5 V REFERENCE CIRCUIT

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 P1A07

Battery Energy Control Module 5 V Reference Circuit

DTC P1E93

Hybrid/EV Battery Interface Control Module 1 5 V Reference Circuit

DTC P1E99

Hybrid/EV Battery Interface Control Module 2 5 V Reference Circuit

DTC P1E9F

Hybrid/EV Battery Interface Control Module 3 5 V Reference Circuit

DTC P1EA5

Hybrid/EV Battery Interface Control Module 4 5 V Reference Circuit

DTC P1FC3

Hybrid/EV Battery Interface Control Module 5 5 V Reference Circuit

DTC P1FC4

Hybrid/EV Battery Interface Control Module 6 5 V Reference Circuit

DTC P1FC5

Hybrid/EV Battery Interface Control Module 7 5 V Reference Circuit

DTC P1FC6

Hybrid/EV Battery Interface Control Module 8 5 V Reference Circuit

DTC P1FC7

Hybrid/EV Battery Interface Control Module 9 5 V Reference Circuit

DTC P1FC8

Hybrid/EV Battery Interface Control Module 10 5 V Reference Circuit

DTC P3035

Hybrid/EV Battery Interface Control Module 11 5 V Reference Circuit

DTC P3040

Hybrid/EV Battery Interface Control Module 12.5 V Reference Circuit

Circuit/System Description

The hybrid battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid battery assembly.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at connectors located on the end of each battery module. A voltage sense harness joins these connectors to the battery energy control module.

The battery energy control module contains internal interface control modules that monitor specific cell groups.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

P1A07

- The battery energy control module is awake and communicating.
- The 12 V battery voltage greater than or equal to 9 V.

P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, and P3040

- The battery energy control module is awake and communicating.
- None of the following DTCs are set; U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, U2624

Conditions for Setting the DTC

P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, and P3040

The battery energy control module has detected an internal 5V reference circuit voltage is less than 2.8 V or greater than 3.2 V.

Actions Taken When the DTC Sets

- DTCs P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, and P3040 are Type A DTCs.
- The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

DTCs P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, and P3040 are Type A DTCs.

Reference Information

Description and Operation

Drive Motor Battery System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

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For equivalent regional tools, refer to Special Tools.

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. Verify that DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, or P3040 is not set.
 - If DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, or P3040 is set
 1. Disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
 2. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).
 - If none of the DTCs are set
2. All OK.

Repair Instructions

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

Refer to [Control Module References](#) for K16 battery energy control module programming and setup.

DTC P1B3F OR P1B40: HIGH VOLTAGE SYSTEM INTERLOCK 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 P1B3F

High Voltage System Interlock Circuit 2 Low Voltage

DTC P1B40

High Voltage System Interlock Circuit 2 High Voltage

Circuit/System Description

A high voltage interlock circuit is used to determine if access to high voltage components or connectors is being attempted. The opening of these high voltage components causes the high voltage interlock circuit to open. The hybrid/EV powertrain control module 2 sources about 5 V on the high voltage interlock circuit loop. When the hybrid/EV powertrain control module 2 detects a loss of high voltage interlock circuit current, the high voltage contactors are commanded open.

The T6 Power Inverter Module and the T24 Battery Charger Module - DC each contain 35 - 45 Ω resistors in order to detect attempted bypassing of the high voltage interlock circuit.

The high voltage interlock circuit 2 monitors for integrity of the following components:

- T24 Battery Charger - DC high voltage connectors - CBT only*:
 - X1
 - X2

- X3

- T6 Power Inverter Module high voltage DC harness connector

*w/o CBT the high voltage interlock circuit 2 connects to the T24 Battery Charger - DC but does not monitor any high voltage connectors.

Conditions for Running the DTC

P1B3F

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV powertrain control module 2 is commanding 5 V on the high voltage interlock circuit.

P1B40

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV powertrain control module 2 is commanding 0 V on the high voltage interlock signal circuit.

OR

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV powertrain control module 2 is commanding 5 V on the high voltage interlock signal circuit.

Conditions for Setting the DTC

P1B3F

The hybrid/EV powertrain control module 2 detects high voltage interlock circuit 5 V low reference voltage is less than 24% of the commanded 5 V signal voltage.

P1B40

- The hybrid/EV powertrain control module 2 detects high voltage interlock circuit 5 V low reference voltage is greater than 24% of the commanded 0 V signal voltage.

OR

- The hybrid/EV powertrain control module 2 detects high voltage interlock circuit 5 V low reference voltage is greater than 44% of the commanded 5 V signal voltage.

Action Taken When the DTC Sets

- DTCs P1B3F and P1B40 are Type A DTCs.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors when vehicle speed is less than 5 km/h (3 mph).

Conditions for Clearing the DTC

DTCs P1B3F and P1B40 are Type A DTCs.

Diagnostic Aids

With all monitored high voltage components engaged and the Battery Charging System High Voltage Interlock Circuit is energized, observe the scan tool hybrid/EV powertrain control module 2 Battery Charging System High Voltage Interlock Circuit Status parameter for a PASS status. To help identify intermittent conditions, manipulate the monitored components and inline connectors. An open interlock circuit will display a FAIL status.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Verify all monitored high voltage components and connectors are connected.
2. Vehicle in Service Mode.
3. Observe the hybrid/EV powertrain control module 2 Battery Charging System High Voltage Interlock Circuit Status parameter. Verify the parameter indicates a PASS condition.
 - **The parameter indicates a FAIL condition**
Refer to Circuit/System Testing.
 - **The parameter indicates a PASS condition**
4. 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 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.

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1. Disable high voltage at the T24 Battery Charger - DC and the T6 Power Inverter Module. Refer to [High Voltage Disabling](#) procedure.

2. Verify the vehicle is not equipped with RPO CBT.
 - **If the vehicle is equipped with RPO CBT**
 - 1. Disconnect T24 Battery Charger-DC high voltage connectors X1, X2 and X3, if not already removed during the High Voltage Disabling procedure. Verify that the high voltage interlock circuit terminals at each high voltage connector - harness side are not bent or broken and are OK.
 - If not OK, replace the applicable high voltage harness.
 - If OK
 - 2. Test for less than 10 Ω between the high voltage interlock circuit terminals at each high voltage connector - harness side.
 - If 10 Ω or greater, replace the applicable high voltage harness.
 - If less than 10 Ω
 - 3. Reconnect the T24 Battery Charger high voltage connector X1, X2 and X3 and continue.
 - **If the vehicle is NOT equipped with RPO CBT or steps 2.1 - 2.3 have passed**
3. Disconnect the T24 Battery Charger-DC connector X9.
4. Test for 35 - 45 Ω between the 5 V signal circuit terminal 7 and the low reference circuit terminal 12 at T24 Battery Charger-DC connector X9, module side.
 - **If not within the specified range**

Replace the T24 Battery Charger-DC.
 - **If within the specified range**
5. Test for infinite resistance between each of the terminals listed below and ground:
 - Terminal 7, module side
 - Terminal 12, module side
 - **If less than infinite resistance**

Replace the T24 Battery Charger-DC.
 - **If infinite resistance**
6. Disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
7. Test for less than 10 Ω between the 5 V signal circuit terminal 67 at the K114B Hybrid/EV Powertrain Control Module 2 connector X1 and T24 Battery Charger-DC X9 terminal 7.
 - **If 10 Ω or greater**

Repair the open/high resistance in the circuit.
 - **If less than 10 Ω**
8. Test for infinite resistance between K114B Hybrid/EV Powertrain Control Module 2 harness connector X1 terminal 67 and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
9. Disconnect T6 Power Inverter Module connector X1.
10. Test for less than 10 Ω between the 5 V signal circuit terminal 12 at the T24 Battery Charger-DC and terminal G2 at the T6 Power Inverter Module connector X1.
 - **If 10 Ω or greater**

Repair the open/high resistance in the circuit.
 - **If less than 10 Ω**
11. Test for infinite resistance between the 5 V signal circuit terminal 12 at the T24 Battery Charger-DC and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
12. Test for less than 10 Ω between the low reference circuit terminal 65 at the K114B Hybrid/EV Powertrain Control Module 2 and terminal G1 at the T6 Power Inverter Module connector X1.

- **If 10 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 10 Ω**

13. Test for infinite resistance between low reference circuit terminal 65 at the K114B Hybrid/EV Powertrain Control Module 2 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

14. Disconnect T6 Power Inverter Module high voltage connector X2, if not already removed during the High Voltage Disabling procedure. Verify that the high voltage interlock circuit terminals at the high voltage connector - harness side, are not bent or broken and are OK.

- **If not OK**

Replace the high voltage harness.

- **If OK**

15. Test for less than 10 Ω between the high voltage interlock circuit terminals at the high voltage connector - harness side.

- **If 10 Ω or greater**

Replace the high voltage harness.

- **If less than 10 Ω**

16. Reconnect T6 Power Inverter Module high voltage connector X2.

17. Test for 35 - 45 Ω between the 5 V signal circuit terminal G2 and low reference terminal G1 at T6 Power Inverter Module connector X1, module side.

- **If not within the specified range**

Replace the T6 Power Inverter Module.

- **If within the specified range**

18. Test for infinite resistance between each of the terminals listed below and ground:

- Terminal G2, module side
- Terminal G1, module side
- **If less than infinite resistance**

Replace the T6 Power Inverter Module.

- **If infinite resistance**

19. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

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

- Refer to [300-Volt Battery Positive and Negative Cable Replacement \(Generator Battery Control Wiring Junction Block to Drive Motor Battery\)](#) for high voltage harness replacement
- Refer to [High Voltage Battery Control Wiring Junction Block Replacement \(With quick charge\) High Voltage Battery Control Wiring Junction Block Replacement \(Without quick charge\)](#) for T24 battery charger-DC replacement.
- Refer to [Control Module References](#) for T6 power inverter module or K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, OR P3041: HYBRID/EV BATTERY INTERFACE CONTROL MODULE 1-12 CELL BALANCING CIRCUIT

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 P1E92

Hybrid/EV Battery Interface Control Module 1 Cell Balancing Circuit

DTC P1E98

Hybrid/EV Battery Interface Control Module 2 Cell Balancing Circuit

DTC P1E9E

Hybrid/EV Battery Interface Control Module 3 Cell Balancing Circuit

DTC P1EA4

Hybrid/EV Battery Interface Control Module 4 Cell Balancing Circuit

DTC P1FC9

Hybrid/EV Battery Interface Control Module 5 Cell Balancing Circuit

DTC P1FCA

Hybrid/EV Battery Interface Control Module 6 Cell Balancing Circuit

DTC P1FCB

Hybrid/EV Battery Interface Control Module 7 Cell Balancing Circuit

DTC P1FCC

Hybrid/EV Battery Interface Control Module 8 Cell Balancing Circuit

DTC P1FCD

Hybrid/EV Battery Interface Control Module 9 Cell Balancing Circuit

DTC P1FCE

Hybrid/EV Battery Interface Control Module 10 Cell Balancing Circuit

DTC P3036

Hybrid/EV Battery Interface Control Module 11 Cell Balancing Circuit

DTC P3041

Hybrid/EV Battery Interface Control Module 12 Cell Balancing Circuit

Circuit/System Description

The high voltage hybrid/EV battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid/EV battery assembly.

To maintain a similar state of charge on the cell groups, the hybrid/EV powertrain control module 2 looks at the cell group voltages and determines which cell groups need energy removed in order to maintain the battery groups at a similar state of charge. This is known as cell balancing. There is a transistor switched resistor wired in parallel with the cell group internal to the hybrid/EV battery interface control module portion of the battery energy control module. The hybrid/EV powertrain control module 2 sends a command to the hybrid/EV battery energy control module to begin cell balancing.

Conditions for Running the DTC

- The hybrid/EV battery energy control module is awake and communicating.
- The high voltage fault circuit diagnostic is not running.
- The cell balancing circuit is greater than 3.0 V.

- None of the following DTCs are set, P1E8E, P1E94, P1E9A, P1EA0, P1FBD, P1FBE, P1FBF, P1FC0, P1FC1, P1FC2, P3037, P3042, U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, or U2624.

Conditions for Setting the DTC

The battery energy control module has detected an internal cell balancing switch fault.

Actions Taken When the DTC Sets

- DTCs P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCB, P1FCC, P1FCD, P1FCE, P3036, and P3041 are Type A DTCs.
- Cell balancing is disabled.
- The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

DTCs P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCB, P1FCC, P1FCD, P1FCE, P3036, and P3041 are Type A DTCs.

Reference Information

Description and Operation

Drive Motor Battery System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

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

The High Voltage Disabling procedure will perform the following tasks:

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

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

1. Verify that no other DTCs are set.

- If any other DTCs are set

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

- If no other DTCs are set

2. Verify that DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCB, P1FCC, P1FCD, P1FCE, P3036, or P3041 is set.

- DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCB, P1FCC, P1FCD, P1FCE, P3036 or P3041 is set

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1. Disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).

2. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).

- 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 K16 battery energy control module replacement, programming and setup.

DTC P1EAB OR P1EAC: BATTERY ENERGY CONTROL MODULE HYBRID/EV BATTERY CELL HIGH VOLTAGE AND/OR HYBRID/EV BATTERY CELL OVERVOLTAGE SIGNAL CIRCUIT 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 P1EAB

Battery Energy Control Module Hybrid/EV Battery Cell High Voltage

DTC P1EAC

Hybrid/EV Battery Cell Overvoltage Signal Circuit Performance

Circuit/System Description

The 2nd protection circuit is a redundant method to monitor cell group overvoltage. The 2nd protection circuit is the actual hardwire signal from the battery energy control module to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 monitors this line to determine when a cell group overvoltage condition exists, independently of the cell group diagnostic trouble codes transmitted via serial data from the battery energy control module to the hybrid powertrain control module 2.

The 2nd protection self test diagnostic is used to check the signal circuit. The battery energy control module performs this test, once, every power up cycle. When run/crank input signal transitions high and after a calibrated delay, the battery energy control module informs the hybrid/EV powertrain control module 2, via serial data communication bus that it is about to run the diagnostics on the 2nd protection circuit. The battery energy control module then proceeds to command, via internal serial data, each of its internal battery interface control modules to run the check on its hardwire output. Each of the battery interface control modules pulls the signal circuit low and releases it, in sequence. If any pulses are missing, the battery energy control module sets a related fault, and sends this information to the hybrid/EV powertrain control module 2 on the serial data. Additionally, the hybrid powertrain control module 2 monitors the 2nd protection circuit for opens, shorts to ground and shorts to voltage.

Conditions for Running the DTC

P1EAB

- The battery energy control module and hybrid/EV powertrain control module 2 are awake and communicating.
- DTC P0B3D, P0B42, P0B47, P0B4C, P0B51, P0B56, P0B5B, P0B60, P0B65, P0B6A, P0B6F, P0B74, P0B79, P0B7E, P0B83, P0B88, P0B8D, P0B92, P0B97, P0B9C, P0BA1, P0BA6, P0BAB, P0BB0, P0BB5, P0BBA, P1B17, P1B1A, P1B1D, P1B20, P1B23, P1B26, P1B46, P1B49, P1B4C, P1B4F, P1B52, P1B55, P1B58, P1B5B, P1B5E, P1B61, P1B64, P1B67, P1B6A, P1B6D, P1B70, P1B73, P1B76, P1B79, P1B7C, P1B7F, P1B82, P1B85, P1B88, P1B8B, P1B8E, P1B91, P1B94, P1B97, P1B9A, P1B9D, P1BA0, P1BA3, P1BA6, P1BA9, P1BAC, P1BAF, P1BB2, P1BB5, P1BB8, P1BBB, P1BBE, P1BC1, P1BC4, P1BC7, P1BCA, P1BCD, P1BD0, P1BD3, P1BD6, P1BD9, P1BDC, P1BDF, P1BE2, P1BE5, P1BE8, P1BEB, P1BEE, P1BF1, P1BF4, P1BF7, P1BFA, P1BFD, P1E02, P1E05, P0B3E, P0B43, P0B48, P0B4D, P0B52, P0B57, P0B5C, P0B61, P0B66, P0B6B, P0B70, P0B75, P0B7A, P0B7F, P0B84, P0B89, P0B8E, P0B93, P0B98, P0B9D, P0BA2, P0BA7, P0BAC, P0BB1, P0BB6, P0BBB, P1B18, P1B1B, P1B1E, P1B21, P1B24, P1B27, P1B47, P1B4A, P1B4D, P1B50, P1B53, P1B56, P1B59, P1B5C, P1B5F, P1B62, P1B65, P1B68, P1B6B, P1B6E, P1B71, P1B74, P1B77, P1B7A, P1B7D, P1B80, P1B83, P1B86, P1B89, P1B8C, P1B8F, P1B92, P1B95, P1B98, P1B9B, P1B9E, P1BA1, P1BA4, P1BA7, P1BAA, P1BAD, P1BB0, P1BB3, P1BB6, P1BB9, P1BBC, P1BBF, P1BC2, P1BC5, P1BC8, P1BCB, P1BCE, P1BD1, P1BD4, P1BD7, P1BDA, P1BDD, P1BE0, P1BE3, P1BE6, P1BE9, P1BEC, P1BEF, P1BF2, P1BF5, P1BF8,

P1BFB, P1BFE, P1E03, P1E06, P0B3B, P0B40, P0B45, P0B4A, P0B4F, P0B54, P0B59, P0B5E, P0B63, P0B68, P0B6D, P0B77, P0B7C, P0B81, P0B86, P0B8B, P0B95, P0B9A, P0B9F, P0BA4, P0BA9, P0BAE, P0BB3, P0BB8, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E86, P1E87, P1E88, P1E89, P1E8A, U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, U2624, P1EB1, P1EB2, P1EB3, P1EB4, P1EB5, P1FA6, P1FA7, P1FA8, P1FA9, P1FAA, P1FAB, P3030, P303B, U0111, or U185A is not set

- The 12 V battery voltage is greater than or equal to 10.2 V.
- Vehicle must be cycled from Vehicle OFF to Vehicle ON.
- Vehicle is ON for greater than 5 seconds.
- Hybrid powertrain control module 1 detects high voltage bus is greater than 312 V.
- Battery charging is not active.

P1EAC

- The battery energy control module and hybrid/EV powertrain control module 2 are awake and communicating.
- DTC U0111 or U185A is not set.
- The 12 V battery voltage greater than or equal to 10.2 V.
- Vehicle must be cycled from Vehicle OFF to Vehicle ON.
- Vehicle is ON for greater than 5 seconds.

Conditions for Setting the DTC

P1EAB

A cell group voltage of greater than 4.5 V is detected.

OR

The hybrid powertrain control module 2 has detected a fault with the 2nd protection circuit.

P1EAC

The hybrid/EV powertrain control module 2 has detected a fault with the 2nd protection circuit.

Action Taken When the DTC Sets

DTCs P1EAB and P1EAC are type A DTCs.

P1EAB

Once the vehicle has been turned OFF, the hybrid/EV powertrain control module 2 will lock out the high voltage contactors until the **Clear Secured High Voltage DTCs** procedure has been performed.

P1EAC

The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

- DTCs P1EAB and P1EAC are type A DTCs.
- Vehicle Power cycled from ON to OFF after code clear.

P1EAB

After the repair for DTC P1EAB, with a scan tool, perform the **Clear Secured High Voltage DTCs** repair instruction.

Diagnostic Aids

CAUTION:

The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group and corresponding DTC.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50214** Low Voltage Jumper Harness Extension

Equivalent regional tools: [Special Tools](#) .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0B3B, P0B3D, P0B3E, P0B40, P0B42, P0B43, P0B45, P0B47, P0B48, P0B4A, P0B4C, P0B4D, P0B4F, P0B51, P0B54, P0B52, P0B56, P0B57, P0B59, P0B5B, P0B5C, P0B5E, P0B60, P0B61, P0B63, P0B65, P0B66, P0B68, P0B6A, P0B6B, P0B6D, P0B6F, P0B70, P0B72, P0B74, P0B75, P0B77, P0B79, P0B7A, P0B7C, P0B7E, P0B7F, P0B81, P0B83, P0B84, P0B86, P0B88, P0B89, P0B8B, P0B8D, P0B8E, P0B90, P0B92, P0B93, P0B95, P0B97, P0B98, P0B9A, P0B9C, P0B9D, P0B9F, P0BA1, P0BA2, P0BA4, P0BA6, P0BA7, P0BA9, P0BAB, P0BAC, P0BAE, P0BB0, P0BB1, P0BB3, P0BB5, P0BB6, P0BB8, P0BBA, P0BBB, P1B17, P1B18, P1B1A, P1B1B, P1B1D, P1B1E, P1B20, P1B21, P1B23, P1B24, P1B26, P1B27, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1B46, P1B47, P1B4A, P1B4C, P1B4D, P1B4F, P1B50, P1B52, P1B53, P1B55, P1B56, P1B58, P1B59, P1B5B, P1B5C, P1B5E, P1B5F, P1B61, P1B64, P1B62, P1B65, P1B67, P1B68, P1B6A, P1B6B, P1B6D, P1B6E, P1B70, P1B71, P1B73, P1B74, P1B76, P1B77, P1B79, P1B7A, P1B7C, P1B7D, P1B7F, P1B80, P1B82, P1B83, P1B85, P1B86, P1B88, P1B89, P1B8B, P1B8C, P1B8E, P1B8F, P1B91, P1B92, P1B94, P1B95, P1B97, P1B98, P1B9A, P1B9B, P1B9D, P1B9E, P1BA0, P1BA1, P1BA3, P1BA4, P1BA6, P1BA7, P1BA9, P1BAA, P1BAC, P1BAD, P1BAF, P1BB0, P1BB2, P1BB3, P1BB5, P1BB6, P1BB8, P1BB9, P1BBB, P1BBE, P1BBF, P1BC1, P1BC2, P1BC4, P1BC5, P1BC7, P1BC8, P1BCA, P1BCB, P1BCD, P1BCE, P1BD0, P1BD1, P1BD3, P1BD4, P1BD6, P1BD7, P1BD9, P1BDA, P1BDC, P1BDD, P1BDF, P1BE0, P1BE2, P1BE3, P1BE5,

P1BE6, P1BE8, P1BE9, P1BEB, P1BEC, P1BEE, P1BEF, P1BF1, P1BF2, P1BF4, P1BF5, P1BF7, P1BF8, P1BFA, P1BFB, P1BFD, P1BFE, P1E02, P1E03, P1E05, P1E06, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6D, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, U2603, U2604, U2605, or U2606 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 that DTC P1EAB or P1EAC is not set.

- If DTC P1EAB or P1EAC is set

Refer to Circuit/System Testing

- If DTC P1EAB or P1EAC is not set

4. 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 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. Vehicle in Service Mode.

2. Verify the hybrid/EV powertrain control module 2 scan tool Maximum Hybrid/EV Battery Module Voltage parameter is 4.5 V or less.

- If greater than 4.5 V

Replace the A4 Hybrid/EV Battery Pack.

- If 4.5 V or less

3. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).

NOTE: Connecting the 12 V battery with the manual service disconnect removed will set DTCs.

4. Connect the 12 V battery. Disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack. Vehicle in Service Mode. cardiagn.com

5. Test for 4.8 - 5.2 V between the signal circuit terminal 9 and ground.

- **If less than 4.8 V**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid Powertrain Control Module 2.
 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 , replace the K114B Hybrid Powertrain Control Module 2. After the repair, with a scan tool, perform the [Clear Secured High Voltage DTCs](#) repair instruction.
- **If 5.2 V or greater**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid Powertrain Control Module 2. 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, replace the K114B Hybrid Powertrain Control Module 2. After the repair, with a scan tool, perform the [Clear Secured High Voltage DTCs](#) repair instruction.
- **If between 4.8 - 5.2 V**
 6. Vehicle OFF, remove the A4 Hybrid/EV Battery Pack Cover. Refer to [Battery Upper Cover Replacement](#).
 7. Connect **EL-50214** Low Voltage Jumper Harness Extension. Disconnect the X8 harness connector at the K16 Battery Energy Control Module. Vehicle in Service Mode.
 8. Test for 4.8 - 5.2 V between the signal circuit terminal 8 and ground.
 - **If not within the specified range**

Replace the Hybrid/EV Battery Pack Internal Harness. After the repair, with a scan tool, perform the [Clear Secured High Voltage DTCs](#) repair instruction.
 - **If within the specified range**
 9. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).

Repair Instructions

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

- Refer to [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\) Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\) Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#) for A4 Hybrid/EV Battery Pack replacement.
- Refer to [Drive Motor Battery Control Module Wiring Harness Replacement](#) for hybrid/EV battery pack internal harness replacement
- Refer to [Control Module References](#) for K16 battery energy control module or K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1EAD-P1EB0 OR P3240-P3253: HYBRID/EV BATTERY INTERFACE CONTROL MODULE 1-12 CELL OVERVOLTAGE

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 P1EAD

Hybrid/EV Battery Interface Control Module 1 Cell Overvoltage Signal Circuit

DTC P1EAE

Hybrid/EV Battery Interface Control Module 2 Cell Overvoltage Signal Circuit

DTC P1EAF

Hybrid/EV Battery Interface Control Module 3 Cell Overvoltage Signal Circuit

DTC P1EB0

Hybrid/EV Battery Interface Control Module 4 Cell Overvoltage Signal Circuit

DTC P3240

Hybrid/EV Battery Interface Control Module 1 Cell Overvoltage

DTC P3241

Hybrid/EV Battery Interface Control Module 2 Cell Overvoltage

DTC P3242

Hybrid/EV Battery Interface Control Module 3 Cell Overvoltage

DTC P3243

Hybrid/EV Battery Interface Control Module 4 Cell Overvoltage

DTC P3244

Hybrid/EV Battery Interface Control Module 5 Cell Overvoltage

DTC P3245

Hybrid/EV Battery Interface Control Module 5 Cell Overvoltage Signal Circuit

DTC P3246

Hybrid/EV Battery Interface Control Module 6 Cell Overvoltage

DTC P3247

Hybrid/EV Battery Interface Control Module 6 Cell Overvoltage Signal Circuit

DTC P3248

Hybrid/EV Battery Interface Control Module 7 Cell Overvoltage

DTC P3249

Hybrid/EV Battery Interface Control Module 7 Cell Overvoltage Signal Circuit

DTC P324A

Hybrid/EV Battery Interface Control Module 8 Cell Overvoltage

DTC P324B

Hybrid/EV Battery Interface Control Module 8 Cell Overvoltage Signal Circuit

DTC P324C

Hybrid/EV Battery Interface Control Module 9 Cell Overvoltage

DTC P324D

Hybrid/EV Battery Interface Control Module 9 Cell Overvoltage Signal Circuit

DTC P324E

Hybrid/EV Battery Interface Control Module 10 Cell Overvoltage

DTC P324F

DTC P3250

Hybrid/EV Battery Interface Control Module 11 Cell Overvoltage

DTC P3251

Hybrid/EV Battery Interface Control Module 11 Cell Overvoltage Signal Circuit

DTC P3252

Hybrid/EV Battery Interface Control Module 12 Cell Overvoltage

DTC P3253

Hybrid/EV Battery Interface Control Module 12 Cell Overvoltage Signal Circuit

Circuit/System Description

The hybrid battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid battery assembly.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at connectors located on the end of the battery module. A voltage sense harness joins these connectors to the battery energy control module.

The battery energy control module contains internal interface control modules that monitor specific cell groups.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

P1EAD, P1EAE, P1EAF, P1EB0, P3240, P3241, P3242, P3243, P3244, P3245, P3246, P3247, P3248, P3249, P324A, P324B, P324C, P324D, P324E, P324F, P3250, P3251, P3252, and P3253

- The battery energy control module is awake and communicating.
- The 12 V battery voltage greater than or equal to 10.2 V.
- The high voltage bus as measured by the hybrid powertrain control module 1 is greater than 312V.
- None of the following DTCs are set; P0B3B, P0B40, P0B45, P0B4A, P0B4F, P0B54, P0B59, P0B5E, P0B63, P0B68, P0B6D, P0B72, P0B77, P0B7C, P0B81, P0B86, P0B8B, P0B90, P0B95, P0B9A, P0B9F, P0BA4, P0BA9, P0BAE, P0BB3, P0BB8, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6D, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, P1E8B, U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, or U2624.

Conditions for Setting the DTC

P1EAD, P1EAE, P1EAF, P1EB0, P3245, P3247, P3249, P324B, P324D, P324F, P3251, and P3253

The battery energy control module has not detected a response from the internal interface control module overvoltage signal circuit test that occurs within 50 seconds of key-ON.

P3240, P3241, P3242, P3243, P3244, P3246, P3248, P324A, P324C, P324E, P3250, and P3252

The battery energy control module has detected a cell group voltage of greater than 4.5V.

OR

The battery energy control module detects a failure of the internal interface control module overvoltage signal circuit.

Actions Taken When the DTC Sets

DTCs P1EAD, P1EAE, P1EAF, P1EB0, P3240, P3241, P3242, P3243, P3244, P3245, P3246, P3247, P3248, P3249, P324A, P324B, P324C, P324D, P324E, P324F, P3250, P3251, P3252, and P3253 are Type A DTCs.

Conditions for Clearing the DTC

DTCs P1EAD, P1EAE, P1EAF, P1EB0, P3240, P3241, P3242, P3243, P3244, P3245, P3246, P3247, P3248, P3249, P324A, P324B, P324C, P324D, P324E, P324F, P3250, P3251, P3252, and P3253 are Type A DTCs.

Reference Information

Description and Operation

Drive Motor Battery System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

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

Circuit/System Verification

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

The High Voltage Disabling procedure will perform the following tasks:

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

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

1. Verify that DTC P1EAD, P1EAE, P1EAF, P1EB0, P3245, P3247, P3249, P324B, P324D, P324F, P3251, or P3253 is not set.
 - **If DTC P1EAD, P1EAE, P1EAF, P1EB0, P3245, P3247, P3249, P324B, P324D, P324F, P3251, or P3253 is set**
 1. Disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**.
 2. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
 - **If none of the DTCs are set**
2. Verify that DTC P3240, P3241, P3242, P3243, P3244, P3246, P3248, P324A, P324C, P324E, P3250, or P3252 is not set.
 - **If DTC P3240, P3241, P3242, P3243, P3244, P3246, P3248, P324A, P324C, P324E, P3250, or P3252 is set**
 1. Disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**.
 2. Replace the A4 Hybrid/EV Battery Pack.
 - **If none of the DTCs are set**
3. All OK.

Repair Instructions

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

- Refer to [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\) Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\) Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#) for A4 Hybrid/EV Battery Pack replacement
- Refer to [Control Module References](#) for K16 battery energy control module programming and setup.

DTC P1FD5-P1FF2, P3038-P303A, OR P3043-P3045: HYBRID/EV BATTERY INTERFACE CONTROL MODULE 1-12 VOLTAGE SENSOR

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 P1FD5

Hybrid/EV Battery Interface Control Module 1 Voltage Sensor Circuit Low Voltage

DTC P1FD6

Hybrid/EV Battery Interface Control Module 2 Voltage Sensor Circuit Low Voltage

DTC P1FD7

Hybrid/EV Battery Interface Control Module 3 Voltage Sensor Circuit Low Voltage

DTC P1FD8

Hybrid/EV Battery Interface Control Module 4 Voltage Sensor Circuit Low Voltage

DTC P1FD9

Hybrid/EV Battery Interface Control Module 5 Voltage Sensor Circuit Low Voltage

DTC P1FDA

Hybrid/EV Battery Interface Control Module 6 Voltage Sensor Circuit Low Voltage

DTC P1FDB

Hybrid/EV Battery Interface Control Module 7 Voltage Sensor Circuit Low Voltage

DTC P1FDC

Hybrid/EV Battery Interface Control Module 8 Voltage Sensor Circuit Low Voltage

DTC P1FDD

Hybrid/EV Battery Interface Control Module 9 Voltage Sensor Circuit Low Voltage

DTC P1FDE

Hybrid/EV Battery Interface Control Module 10 Voltage Sensor Circuit Low Voltage

DTC P1FDF

Hybrid/EV Battery Interface Control Module 1 Voltage Sensor Circuit High Voltage

DTC P1FE0

Hybrid/EV Battery Interface Control Module 2 Voltage Sensor Circuit High Voltage

DTC P1FE1

Hybrid/EV Battery Interface Control Module 3 Voltage Sensor Circuit High Voltage

DTC P1FE2

Hybrid/EV Battery Interface Control Module 4 Voltage Sensor Circuit High Voltage

DTC P1FE3

Hybrid/EV Battery Interface Control Module 5 Voltage Sensor Circuit High Voltage

DTC P1FE4

Hybrid/EV Battery Interface Control Module 6 Voltage Sensor Circuit High Voltage

DTC P1FE5

Hybrid/EV Battery Interface Control Module 7 Voltage Sensor Circuit High Voltage

DTC P1FE6

Hybrid/EV Battery Interface Control Module 8 Voltage Sensor Circuit High Voltage

DTC P1FE7

Hybrid/EV Battery Interface Control Module 9 Voltage Sensor Circuit High Voltage

DTC P1FE8

Hybrid/EV Battery Interface Control Module 10 Voltage Sensor Circuit High Voltage

DTC P1FE9

Hybrid/EV Battery Interface Control Module 1 Voltage Sensor Performance

DTC P1FEA

Hybrid/EV Battery Interface Control Module 2 Voltage Sensor Performance

DTC P1FEB

Hybrid/EV Battery Interface Control Module 3 Voltage Sensor Performance

DTC P1FEC

Hybrid/EV Battery Interface Control Module 4 Voltage Sensor Performance

DTC P1FED

Hybrid/EV Battery Interface Control Module 5 Voltage Sensor Performance

DTC P1FEE

Hybrid/EV Battery Interface Control Module 6 Voltage Sensor Performance

DTC P1FEF

Hybrid/EV Battery Interface Control Module 7 Voltage Sensor Performance

DTC P1FF0

Hybrid/EV Battery Interface Control Module 8 Voltage Sensor Performance

DTC P1FF1

Hybrid/EV Battery Interface Control Module 9 Voltage Sensor Performance

DTC P1FF2

Hybrid/EV Battery Interface Control Module 10 Voltage Sensor Performance

DTC P3038

DTC P3039

Hybrid/EV Battery Interface Control Module 11 Voltage Sensor Circuit High Voltage

DTC P303A

Hybrid/EV Battery Interface Control Module 11 Voltage Sensor Circuit Performance

DTC P3043

Hybrid/EV Battery Interface Control Module 12 Voltage Sensor Circuit Low Voltage

DTC P3044

Hybrid/EV Battery Interface Control Module 12 Voltage Sensor Circuit High Voltage

DTC P3045

Hybrid/EV Battery Interface Control Module 12 Voltage Sensor Circuit Performance

Circuit/System Description

The hybrid battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid battery assembly.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at connectors located on the end of the battery module. A voltage sense harness joins these connectors to the battery energy control module.

The battery energy control module contains internal interface control modules that monitor specific cell groups.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

P1FD5, P1FD6, P1FD7, P1FD8, P1FD9, P1FDA, P1FDB, P1FDC, P1FDD, P1FDE, P1FDF, P1FE0, P1FE1, P1FE2, P1FE3, P1FE4, P1FE5, P1FE6, P1FE7, P1FE8, P3038, P3039, P3043, and P3044

- The hybrid/EV battery energy control module and hybrid/EV powertrain control module 2 are awake and communicating.
- None of the hybrid/EV battery energy control module loss of communication with hybrid/EV battery interface control module 1 - 12 DTCs are set.
- None of the hybrid/EV battery interface control module 1 - 12 performance DTCs are set.

P1FE9, P1FEA, P1FEB, P1FEC, P1FED, P1FEE, P1FEF, P1FF0, P1FF1, P1FF2, P303A, and P3045

- The hybrid/EV battery energy control module and hybrid/EV powertrain control module 2 are awake and communicating.
- None of the hybrid/EV battery energy control module loss of communication with hybrid/EV battery interface control module 1 - 12 DTCs are set.
- None of the hybrid/EV battery interface control module 1 - 12 performance DTCs are set.
- None of the hybrid/EV battery 1 - 96 circuit low voltage DTCs are set.
- None of the hybrid/EV battery 1 - 96 circuit high voltage DTCs are set.
- None of the hybrid/EV battery 1 - 96 circuit DTCs are set.

Conditions for Setting the DTC

P1FD5, P1FD6, P1FD7, P1FD8, P1FD9, P1FDA, P1FDB, P1FDC, P1FDD, P1FDE, P3038, and P3043

A hybrid/EV battery interface control module has detected the voltage sum of 8 cell groups in a section are less than 1.5 V.

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P1FDF, P1FE0, P1FE1, P1FE2, P1FE3, P1FE4, P1FE5, P1FE6, P1FE7, P1FE8, P3039, and P3044

A hybrid/EV battery interface control module has detected the voltage sum of 8 cell groups in a section are greater than 48.5 V.

P1FE9, P1FEA, P1FEB, P1FEC, P1FED, P1FEE, P1FEF, P1FF0, P1FF1, P1FF2, P303A, and P3045

A hybrid/EV battery interface control module has detected a deviation between the module voltage sum of a half section minus the voltage sum of 8 individual cell groups in a section is greater than 0.6 V

Actions Taken When the DTC Sets

- DTCs P1FD5, P1FD6, P1FD7, P1FD8, P1FD9, P1FDA, P1FDB, P1FDC, P1FDD, P1FDE, P1FDF, P1FE0, P1FE1, P1FE2, P1FE3, P1FE4, P1FE5, P1FE6, P1FE7, P1FE8, P1FE9, P1FEA, P1FEB, P1FEC, P1FED, P1FEE, P1FEF, P1FF0, P1FF1, P1FF2, P3038, P3039, P303A, P3043, P3044, and P3045 are Type A DTCs.
- The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

DTCs P1FD5, P1FD6, P1FD7, P1FD8, P1FD9, P1FDA, P1FDB, P1FDC, P1FDD, P1FDE, P1FDF, P1FE0, P1FE1, P1FE2, P1FE3, P1FE4, P1FE5, P1FE6, P1FE7, P1FE8, P1FE9, P1FEA, P1FEB, P1FEC, P1FED, P1FEE, P1FEF, P1FF0, P1FF1, P1FF2, P3038, P3039, P303A, P3043, P3044, and P3045 are Type A DTCs.

Reference Information

Description and Operation

Drive Motor Battery System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#) .

Circuit/System Verification

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

The High Voltage Disabling procedure will perform the following tasks:

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

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

1. Verify that DTC P1FD5-P1FF2, P3038, P3039, P303A, or P3043-P3045 is not set.
 - **If DTC P1FD5-P1FF2, P3038, P3039, P303A, or P3043-P3045 is set**
 1. Vehicle OFF, disable high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
 2. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#) .
 - **If none of the DTCs are set**
2. All OK.

Repair Instructions

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

Refer to [Control Module References](#) for K16 battery energy control module replacement, programming and setup.

DTC P1F17: SYSTEM ISOLATION/IMPACT SENSOR FAULT - HYBRID/EV BATTERY SYSTEM CONTACTORS OPEN

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 P1F17

System Isolation/Impact Sensor Fault - Hybrid/EV Battery System Contactors Open

Circuit/System Description

The hybrid/EV powertrain control module 2 will set DTC P1F17 if the hybrid/EV powertrain control module 1 has detected a passive loss of isolation, the supplemental inflatable restraint sensors are not working or has lost communications with the hybrid/EV powertrain control module 1 and the supplemental inflatable restraint module.

Conditions for Running the DTC

Vehicle ON.

Conditions for Setting the DTC

- P1AF0, P1AF2, or P1E22 is set in the hybrid/EV powertrain control module 1.
- The supplemental inflatable restraint module roll over, air bag, or inertia sensors are not working.

OR

- P1AF0, P1AF2, or P1E22 is set in the hybrid/EV powertrain control module 1.
- DTC U184E is set.

OR

- The hybrid/EV powertrain control module 2 has lost communications with the hybrid/EV powertrain control module 1.
- DTC U184E is set.

OR

- The hybrid/EV powertrain control module 2 has lost communications with the hybrid/EV powertrain control module 1.
- The supplemental inflatable restraint module roll over, air bag, or inertia sensors are not working.

Action Taken When the DTC Sets

- DTC P1F17 is a type A DTC.
- All of the contactors will be prevented from closing.

Conditions for Clearing the DTC

- DTC P1F17 is a type A DTC.
- The [Clear Secured High Voltage DTCs](#) reset function must be performed with a scan tool before clear codes.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

[Drive Motor Battery System 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 that no other DTCs are set.
 - **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
 - **If none of the DTCs are set**
3. Verify that DTC P1F17 is not set.
 - **If DTC P1F17 is set**
 1. Verify the K36 Inflatable Restraint Sensing And Diagnostic Module is programmed with the correct software calibration.
 - If the correct software is not installed, program the K36 Inflatable Restraint Sensing And Diagnostic Module.
 - If the correct software is installed
 2. Perform the [Clear Secured High Voltage DTCs](#) repair instruction.
 3. Verify that DTC P1F17 does not set while operating the vehicle within the Conditions for Running the DTC.
 - If DTC P1F17 is set, replace the K114B Hybrid Powertrain Control Module 2.
 - If DTC P1F17 is not set
 - **If DTC P1F17 is not set**
4. All OK.

[Repair Instructions](#)

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

Refer to [Control Module References](#) for hybrid/EV powertrain control module 2 and inflatable restraint sensing and diagnostic module replacement, programming and setup.

DTC P1FF4: SYSTEM ISOLATION/IMPACT SENSOR FAULT - HYBRID/EV BATTERY SYSTEM CONTACTORS OPEN

[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 P1FF4

System Isolation/Impact Sensor Fault - Hybrid/EV Battery System Contactors Open

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Circuit/System Description

The hybrid/EV powertrain control module 2 will set DTC P1FF4 if the hybrid/EV powertrain control module 1 has detected a passive loss of isolation, the supplemental inflatable restraint sensors are not working or has lost communications with the hybrid/EV powertrain control module 1 and the supplemental inflatable restraint module.

Conditions for Running the DTC

- Vehicle ON.
- The 12 V battery voltage is greater than 9 V.

Conditions for Setting the DTC

- P0AA1 and P301C is set.
- OR
- P0AA4 and P301D is set.
- OR
- P301C and P301D is set.

Action Taken When the DTC Sets

- DTC P1FF4 is a type A DTC.
- All of the contactors will be prevented from closing.
- Charging is disabled.

Conditions for Clearing the DTC

- DTC P1FF4 is a type A DTC.
- The **DC Charging Disabled Reset** function must be performed with a scan tool before clear codes.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System 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 that no other DTCs are set.
 - **If any other DTCs are set**

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

- **If no other DTCs are set**

2. Verify the K36 Inflatable Restraint Sensing And Diagnostic Module is programmed with the correct software calibration.

- **If the correct software is not installed**

Program the K36 Inflatable Restraint Sensing And Diagnostic Module. Refer to [Control Module References](#)

- **If the correct software is installed**

3. Perform the [High Voltage System Inspection](#)

4. Perform the [DC Charging Disabled Reset](#) .

5. If DTC P1FF4 is set, clear the DTC. Review and operate the vehicle according to the DTC Conditions for Running. Verify that DTC P1FF4 does not reset and no other DTCs are set.

- **If any other DTCs are set**

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

- **If DTC P1FF4 is set**

Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If no DTCs are set**

6. All OK.

Repair Instructions

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

Refer to [Control Module References](#) for hybrid/EV powertrain control module 2 and inflatable restraint sensing and diagnostic module replacement, programming and setup.

LOSS OF ISOLATION ON THE HIGH VOLTAGE MAIN BUS

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.

Circuit/System Description

Vehicles equipped with high voltage energy storage are designed with the high voltage circuits isolated from the vehicle chassis. If either the positive or negative high voltage Direct Current (DC) circuits or any of the high voltage Alternating Current (AC) phase circuits lose this isolation to the vehicle chassis, one or more diagnostic trouble codes (DTCs) may set.

The vehicle utilizes Passive and Active isolation testing to determine the amount of isolation between the high voltage and the chassis.

Passive isolation testing is performed within the power inverter module and tests whenever the high voltage main contactors are closed. Utilizing a high impedance resistor network, passive isolation detection monitors all high voltage components including the hybrid/EV battery pack and isolation loss results in DTCs P1AF0, P1AF2 and/or P1E22. Real-time status of passive isolation detection can be determined by observing the delta between the Positive Supply Isolation Voltage and Negative Supply Isolation Voltage scan tool parameters. The parameters are displayed by any of the Motor Control Modules and can also be observed in certain hybrid powertrain control module 2 data lists.

Active isolation testing is performed by the hybrid powertrain control module 2 and tests after the high voltage main contactors open. Utilizing an injected AC signal, active isolation detection monitors the internal Hybrid/EV battery pack as well as the charging system direct current (DC) high voltage circuits and isolation loss results in DTCs P0AA6 or P0DAA. Status for the prior active isolation detection event can be determined by observing the hybrid powertrain control module 2 Isolation Test Resistance scan tool parameter. Real-time status observation requires the HPCM2 scan tool control function Hybrid/EV Battery Pack Isolation Test.

Diagnosis for isolation requires testing with high voltage potential. Special insulation testing multimeters such as the **EL-50772** utilize their own internal high voltage and must be used to test the isolation capability of high voltage components

Diagnostic Aids**Prior to disabling high voltage:**

Monitoring certain scan tool parameters when high voltage is active may help to identify which high voltage components and circuits have lost their chassis isolation. The Vehicle Information selection within the HPCM2 scan tool Data Display contains many parameters related to isolation diagnosis. The Drive Motor Control Module Positive Supply Isolation Voltage and Drive Motor Control Module Negative Supply Isolation Voltage parameters provide a real-time indication of isolation status. The parameters will shift in respect to one another relative to the level of isolation loss. The greater the delta, or difference, between parameters, the less isolation exists between high voltage and the vehicle chassis.

Isolation Loss between HV Components and Chassis, Positive Side*

Isolation between HV Bus and Chassis	Normal Vehicle	10M	5M	1M	500K	200K Approximate Passive Isolation DTC set point	100K	None - Direct Short
Positive Isolation Parameter*	198V	180V	165V	110V	75V	35V	20V	0V
Negative Isolation Parameter*	192V	210V	225V	280V	315V	355V	370V	390V
Delta Between Parameters	0 - 15V	30V	60V	170V	240V	320V	350V	390V
*Typical values observed with a fully charged pack, 390V. A short to the positive bus is shown, a short to the negative bus would display inverted voltages of similar value.								

Certain isolation loss concerns may only appear during high moisture environmental conditions. Drive the vehicle thru an underbody spraying-style car wash while monitoring the delta between Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters.

Isolation loss might only occur when a high voltage device is active. Use the High Voltage Component Test Method table and operate each HV component while monitoring the delta between Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters.

High Voltage Component Test Methods

HV Component	Scan Tool Parameter	Most Complete Test Method
G1 Electric A/C Compressor	Power Requested by Electric A/C Compressor from Hybrid/EV Battery Pack (HPCM2)	HVAC Cabin Controls and monitor parameter Isolation Voltages Delta
K10 Coolant Heater	Power Requested by Electric Passenger Compartment Heater from Hybrid/EV Battery Pack (HPCM2)	HVAC Cabin Controls and monitor parameter Isolation Voltages Delta
E54 Battery Heater*	Hybrid/EV Battery Pack Heater Power Command (HPCM2)	Hybrid/EV Battery Pack Heater Power GDS2 Scan Tool Control Function (HPCM2) and monitor parameter Isolation Voltages Delta Review the DTC P1EC6 Conditions for Running and monitor parameter Isolation Voltages Delta while heater is commanded ON
T18 Battery Charger	N/A - Active During Charge	Insulation Multimeter
T24 Battery Charger - DC (CBT)	N/A - Active During Charge and Active with High Voltage Enabled	Insulation Multimeter
T24 Battery Charger - DC (w/o CBT)	N/A - Always Active with High Voltage Enabled	Insulation Multimeter
K1 14V Power Module	14V Module High Voltage Circuit Current (HPCM1)	Insulation Multimeter
T6 Power Inverter Module	N/A - Always Active with High Voltage Enabled	Insulation Multimeter
M15 Drive Motor	N/A - Always Active with High Voltage Enabled	Insulation Multimeter

HV Component	Scan Tool Parameter	Most Complete Test Method
A4 Battery Pack - Internal Side of Contactors	Isolation Concern Results in DTC P0AA6/P0DAA	
*Because the E54 Battery Heater is always connected to the positive bus, an isolation fault may result in a delta decrease when commanded ON.		

After disabling high voltage:

High Voltage cables disconnected at each end from their respective modules must be tested with the insulation meter connected to their shield circuit and not to vehicle chassis.

The **EL-50772** insulation meter, when set to the 500V scale, indicates 550M Ω when measuring infinite or open circuit conditions. An equivalent meter may display 'infinite' value in a different manner.

Reference Information

Schematic Reference

- [Hybrid/EV Energy Storage Schematics](#)
- [Hybrid/EV Controls Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

[Hybrid/EV System High Voltage Isolation Description](#) for:

- Passive Isolation circuit detail
- Active Isolation circuit detail
- Complete High Voltage system schematic

Electrical Information Reference

Troubleshooting With an Insulation Multimeter

Scan Tool Reference

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

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50772** Insulation Multimeter

For equivalent regional tools, refer to [Special Tools](#) .

Circuit/System Verification

1. Remove all vehicle chargers.
2. Vehicle ON.
3. Verify that DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3 is not set.
 - **If any DTC is set**
Refer to [DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3](#).
 - **If none of the DTCs are set**
4. Verify that DTC P0AA6 or P1AE6 is not set.
 - **If any DTC is set**
Refer to [DTC P0AA6 or P1AE6](#).
 - **If none of the DTCs are set**

5. Vehicle ON. Confirm propulsion system is active with battery positive and negative high voltage contactors closed. You cannot continue with loss of isolation diagnosis if high voltage is not active.

- **If high voltage is not active**

Diagnose and repair appropriate DTCs and repeat Circuit/System Verification. Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **If high voltage is active**

NOTE: Isolation related parameters from several modules can all be observed in hybrid powertrain control module 2, Data Display, Vehicle Information.

6. Vehicle ON, observe the scan tool Drive Motor Positive Supply Isolation Voltage and the Drive Motor Negative Supply Isolation Voltage scan tool parameters.

7. Is the delta, or difference, between the Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters greater than 15 volts?

- **If the delta is greater than 15 volts**

Using the High Voltage Component Test Methods table as a guide, observe and record which components are active. Refer to Circuit/System Testing.

- **If the delta is 15 volts or less**

8. Using the High Voltage Component Test Method table as a guide, turn ON devices one at a time while monitoring the isolation voltage delta.

9. Is the delta between the Drive Motor Positive Supply Isolation Voltage and the Drive Motor Negative Supply Isolation Voltage scan tool parameters greater than 15 volts when a component is active?

- **If the delta is greater than 15 volts**

Observe and record which components are active. Refer to Circuit/System Testing.

- **If the delta is 15 volts or less**

10. Turn the vehicle OFF, open and close the drivers door and wait 2 minutes.

11. PRESS and HOLD the brake pedal and activate the HPCM2 scan tool control function Hybrid/EV Battery Pack Isolation Test. The battery pack isolation test will complete in less than a minute. Verify the Isolation Test Resistance parameter when the test is complete is greater than 600K Ω .

- **If the resistance is 600K Ω or less**

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

- **If the resistance is greater than 600K Ω**

12. Vehicle OFF. Connect the vehicle charge cord-AC. Ensure charge mode is active.

13. With charge mode already active, Vehicle ON and observe the scan tool Drive Motor Positive Supply Isolation Voltage and the Drive Motor Negative Supply Isolation Voltage scan tool parameters.

14. Is the delta between the Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters greater than 15 volts?

- **If the delta is greater than 15 volts**

Refer to Circuit/System Testing.

- **If the delta is less than 15 volts**

15. All OK, review Diagnostic Aids.

Circuit/System Testing

WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not.

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

WARNING: This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

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

NOTE: Wear your High Voltage Insulation gloves until you have determined that a high voltage exposure risk is no longer present.

1. Vehicle OFF, disable the high voltage for every high voltage component. Refer to [High Voltage Disabling](#).
2. Ensure only the **EL-50772** Insulation Multimeter or equivalent is used with this procedure. Select the Isolation Test setting, then select the 500V range. Refer to [Troubleshooting With an Insulation Multimeter](#) for important usage instructions.
3. Print the Complete High Voltage system schematic to assist you in your testing. Refer to [Hybrid/EV System High Voltage Isolation Description](#).
4. Print the Component Isolation Test Table below.

NOTE:

- You may test components in any order, if you identified a component in Circuit/System Verification that affects the isolation delta, test that component first.
- The component should be disconnected from all other high voltage components when testing.
- Test cables between their high voltage terminals and the cable shield, not chassis ground.
- Test HV modules/components between their high voltage terminals and the module case if conductive or chassis ground if not conductive.
- Test from the components positive high voltage terminal to the shield or chassis ground and then the negative high voltage terminal to the shield or chassis ground, never test from the positive high voltage terminal to the negative high voltage terminal.
- Print the Component Isolation Test Table and record your testing results.

5. Test and record the minimum resistance between each components high voltage terminals and the shield or case/chassis ground as indicated by the Component Isolation Test table.
6. Replace any component that tests less than the expected resistance at any terminal.

Component Isolation Test Table

Component	Component Setup	Insulation Multimeter Test Point	EL-50772 Expected Results	Actual Result
NOTE: High Voltage MUST be disabled and S15 Manual Service Disconnect removed prior to testing any components. Refer to Circuit/System Verification and Circuit/System Testing.				
A4 Battery Pack - X3	Test battery pack side	DC Neg- HV terminal to battery pack ground strap	550M Ω	$\hat{A}$
		DC Pos+ HV terminal to battery pack ground strap	550M Ω	$\hat{A}$
A4 Battery Pack - X4	Test battery pack side	DC Neg- HV terminal to battery pack ground strap	550M Ω	$\hat{A}$

		Insulation Multimeter Test Point	EL-50772 Expected Results	Actual Result
Component	Component Setup			
NOTE: High Voltage MUST be disabled and S15 Manual Service Disconnect removed prior to testing any components. Refer to Circuit/System Verification and Circuit/System Testing.				
G1 Electric A/C Compressor	None	DC Pos+ HV terminal to battery pack ground strap	550M Ω	Â
		DC Neg- HV terminal to case/chassis	550M Ω*	Â
		DC Pos+ HV terminal to case/chassis	550M Ω*	Â
K10 Coolant Heater	Plug one coolant port and fill with coolant	DC Neg- HV terminal to case/chassis	550M Ω	Â
		DC Pos+ HV terminal to case/chassis	550M Ω	Â
E54 Battery Heater	Plug one coolant port and fill with coolant	DC Neg- HV terminal to case/chassis	550M Ω	Â
		DC Pos+ HV terminal to case/chassis	550M Ω	Â
T18 Battery Charger - X3 - module side	None	DC Neg- HV terminal to case/chassis	550M Ω	Â
		DC Pos+ HV terminal to case/chassis	550M Ω	Â
NOTE: Except RPO CBT connector X2 T24 Battery Charger - DC - X1 and X3 thru X8 - module side	All high voltage connectors on component disconnected	DC Neg- HV terminal to case/chassis	550M Ω	Â
		DC Pos+ HV terminal to case/chassis	550M Ω	Â
NOTE: RPO CBT Only T24 Battery Charger - DC - X2- module side	All high voltage connectors on component disconnected	DC Neg- HV terminal to case/chassis	Greater than 15M Ω	Â
		DC Pos+ HV terminal to case/chassis	Greater than 15M Ω	Â
K1 14V Power Module	None	DC Neg- HV terminal to case/chassis	Greater than 100M Ω	Â
		DC Pos+ HV terminal to case/chassis	Greater than 100M Ω	Â
T6 Power Inverter Module - module side	M15 Drive Motor 3 phase AC HV cable terminals disconnected	DC Neg- HV terminal to case/chassis	1.1M - 1.3M Ω	Â
		DC Pos+ HV terminal to case/chassis	1.1M - 1.3M Ω	Â
		3 phase AC HV terminal U to case/chassis	1.1M - 1.3M Ω	Â
		3 phase AC HV terminal V to case/chassis	1.1M - 1.3M Ω	Â
		3 phase AC HV terminal W to case/chassis	1.1M - 1.3M Ω	Â
M15 Drive Motor	3 phase AC HV cable terminals disconnected	3 phase AC HV terminal U, V, or W to transmission case	550M Ω*	Â
300V Battery Positive and Negative Cable - G1 Electric A/C Compressor to T24 Battery Charger-DC	Disconnect cable at both ends	DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
300V Battery Positive and Negative Cable - K10 Heater to T24 Battery Charger-DC	Disconnect cable at both ends	DC Neg- HV terminal to cable shield	550M Ω	Â

		Insulation Multimeter Test Point	EL-50772 Expected Results	Actual Result
Component	Component Setup			
NOTE: High Voltage MUST be disabled and S15 Manual Service Disconnect removed prior to testing any components. Refer to Circuit/System Verification and Circuit/System Testing.				
300V Battery Positive and Negative Cable - E54 Heater to T24 Battery Charger-DC	Disconnect cable at both ends	DC Pos+ HV terminal to cable shield	550M Ω	Â
		DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
300V Battery Positive and Negative Cable - T18 Battery Charger to K1 14V power Module and T24 Battery Charger-DC	Disconnect cable at all three modules	DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
300V Battery Positive and Negative Cable - T6 Power Inverter Module to T24 Battery Charger-DC	Disconnect cable at both ends	DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
300V Battery Positive and Negative Cable - A4 Battery Pack X3 to T24 Battery Charger-DC X3	Disconnect cable at both ends	DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
300V Battery Positive and Negative Cable - A4 Battery Pack X4 to T24 Battery Charger-DC X7	Disconnect cable at both ends	DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
NOTE: RPO CBT ONLY. 300V Battery Positive and Negative Cable - X98 Hybrid/EV Battery Charger Receptacle to T24 Battery Charger-DC X2	Charge Cord removed	DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
3 phase AC cable - T6 Power Inverter Module to M15 Drive Motor	Disconnect cable at both ends	3 phase AC HV terminal U to cable shield	550M Ω	Â
		3 phase AC HV terminal V to cable shield	550M Ω	Â
		3 phase AC HV terminal W to cable shield	550M Ω	Â
* There may be up to a 5 second delay for proper test results to be displayed, always press and hold the EL-50772 test button until maximum measurement values are observed.				

Repair Instructions

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

- Refer to [300-Volt Battery Positive and Negative Cable Replacement \(Generator Battery Control Wiring Junction Block to Drive Motor Battery\)](#)
- Refer to [Air Conditioning and Drive Motor Battery Cooling Compressor Replacement](#)
- Refer to [Heater Coolant Heater Replacement](#)
- Refer to [Accessory DC Power Control Module Replacement](#)
- Refer to [Drive Motor Rotor Removal](#) , and [Drive Motor Stator Removal](#) for drive motor replacement.
- Refer to [Drive Motor Power Inverter Module 3 Phase Cable Replacement](#)
- Refer to [High Voltage Battery Control Wiring Junction Block Replacement \(With quick charge\)](#) [High Voltage Battery Control Wiring Junction Block Replacement \(Without quick charge\)](#) for T24 Batter Charger-DC.
- Refer to [High Voltage Battery Disconnect Relay Replacement](#) for BDU replacement.

- Refer to [Drive Motor Battery Charger Replacement \(Except Dubai\) Drive Motor Battery Charger Replacement \(Dubai\)](#)
- Refer to [Drive Motor Battery Charger Receptacle Replacement \(Except Dubai with quick charge\) Drive Motor Battery Charger Receptacle Replacement \(Except Dubai without quick charge\) Drive Motor Battery Charger Receptacle Replacement \(Dubai only with quick charge\) Drive Motor Battery Charger Receptacle Replacement \(Dubai only without quick charge\)](#)
- Refer to [High Voltage Battery Heater Replacement](#)
- Refer to [Control Module References](#) for the T6 power inverter module replacement, programming and setup.

HYBRID/EV BATTERY 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.

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or safely contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor and precharge negative high voltage contactor. The contactors close and open in a specific sequence controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for each high voltage contactor. Ground is provided through a vehicle ground external of the high voltage battery.

Reference Information

Schematic Reference

[Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [Testing for Intermittent Conditions and Poor Connections](#)

Description and Operation

[Drive Motor Battery System Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

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

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Testing

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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.

WARNING: This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

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

1. Review the high voltage safety information prior to performing the High Voltage Disabling procedure. Refer to [High Voltage Safety](#).
2. Verify the High Voltage Disabling procedure has been performed and the S15 manual service disconnect has been removed.

- The procedure has not been performed

Refer to [High Voltage Disabling](#) before continuing to the next step.

- The procedure has been performed

NOTE: Connecting the 12 V battery while leaving the S15 manual service disconnect out will set DTCs. Clear these DTCs after all repairs are complete.

3. Disconnect the low voltage (X357) and (X358) harness connectors at the A4 Hybrid/EV Battery Pack. Connect the 12 V battery. Vehicle in Service Mode.
4. Test for less than 9.5 V at the following points and ground:
 - X358, Terminal 3
 - X358, Terminal 4
 - X358, Terminal 5
 - X358, Terminal 7
 - If 9.5 V or greater
 1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.
 - If less than 9.5 V
5. Vehicle OFF.

NOTE: • Wear your High Voltage Insulation gloves until you have determined that a

high voltage exposure risk is no longer present.

- A 9 V battery or the vehicle's 12 V battery can be used to test the DMM.

6. Test the DMM by measuring a known good 9 to 12 V battery.

- **If the DMM does not properly measure the test battery**

Repair or replace the DMM and repeat all voltage measurements.

- **If the DMM does properly measure the test battery**

7. Replace the A4 Hybrid/EV Battery Pack. There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack.

Repair Instructions

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

Refer to [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#) [Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#) [Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#) for A4 hybrid/EV battery pack replacement.

TROUBLESHOOTING WITH AN INSULATION MULTIMETER

Special Tools

EL-50772 Insulation Multimeter

For regional equivalent tools, refer to [Special Tools](#)

Diagnosis for isolation loss requires insulation testing with high voltage potential. Special multimeters that utilize their own built-in high voltage, such as the **EL-50772** Insulation Multimeter, test the isolation capability of high voltage components and circuits. Understanding an insulation multimeter and how it functions is necessary to obtain proper test results.

How to Use the Insulation Multimeter

1. Read all instructions and warnings that came with your insulation multimeter.

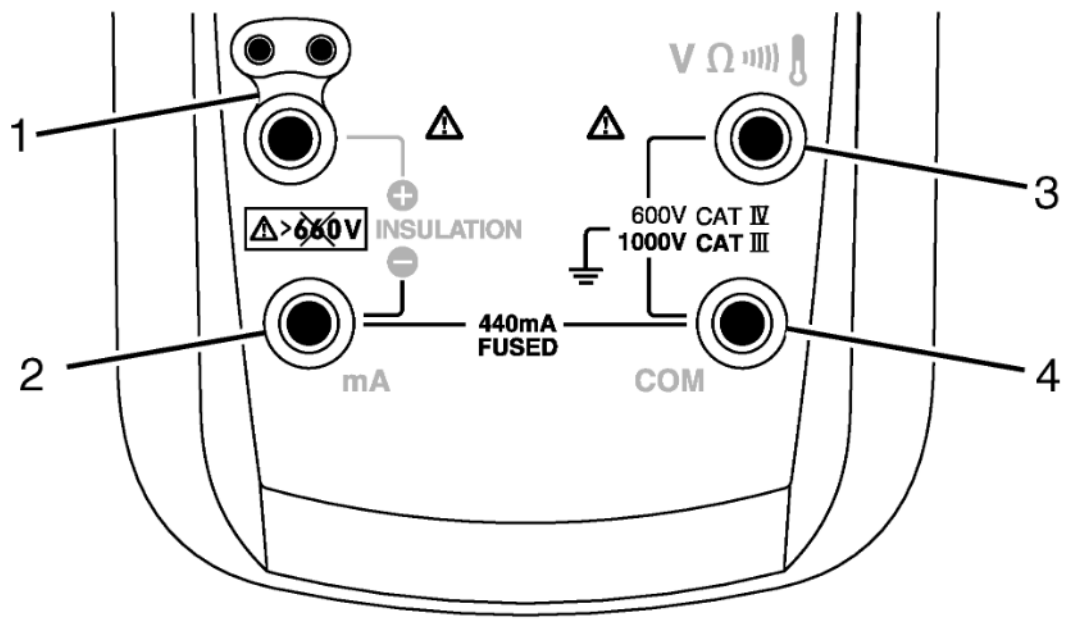


Fig. 27: Ports

Courtesy of GENERAL MOTORS COMPANY

2. Plug into the correct ports (1, 2) for insulation testing. This is easy to get wrong especially if you use the **EL-50772** for standard DMM testing too. Do NOT use ports (3, 4) for insulation testing.
3. Always test at the 500V range.

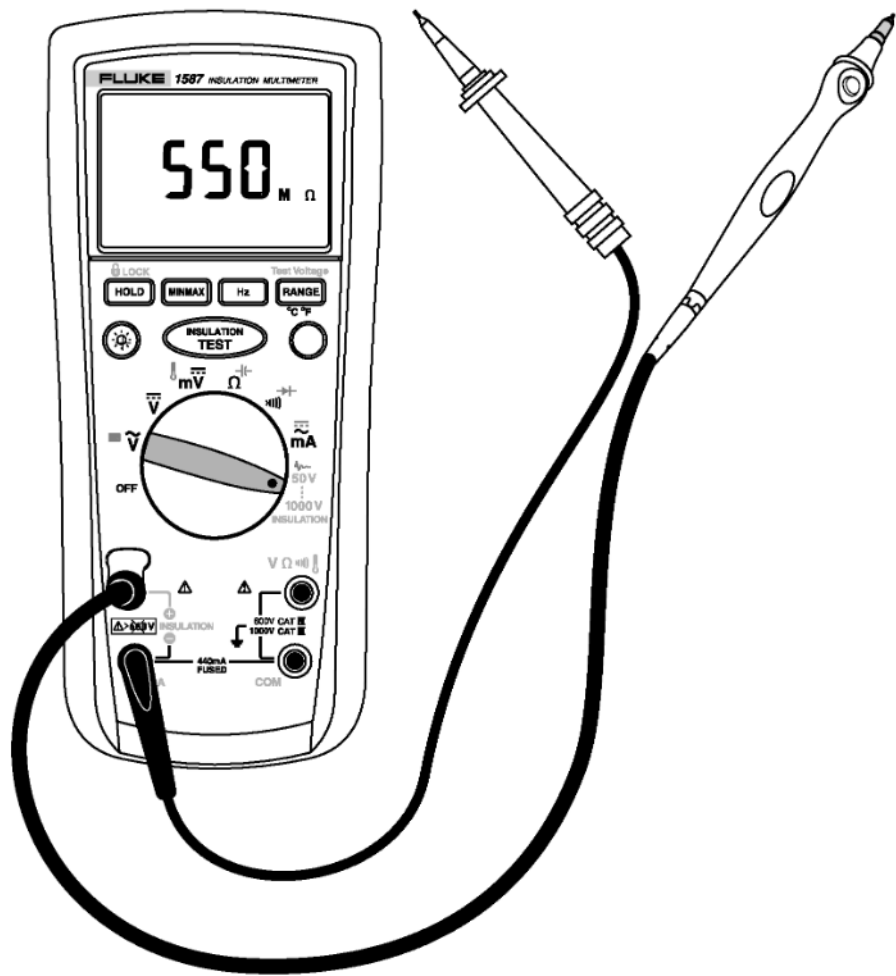


Fig. 28: Insulation Multimeter (550)

Courtesy of GENERAL MOTORS COMPANY

4. With the test leads not connected to anything, press and hold test button to know how your meter displays an infinite measurement. The EL-50772 will display 550M Ω when measuring an open circuit while set to the 500V range.

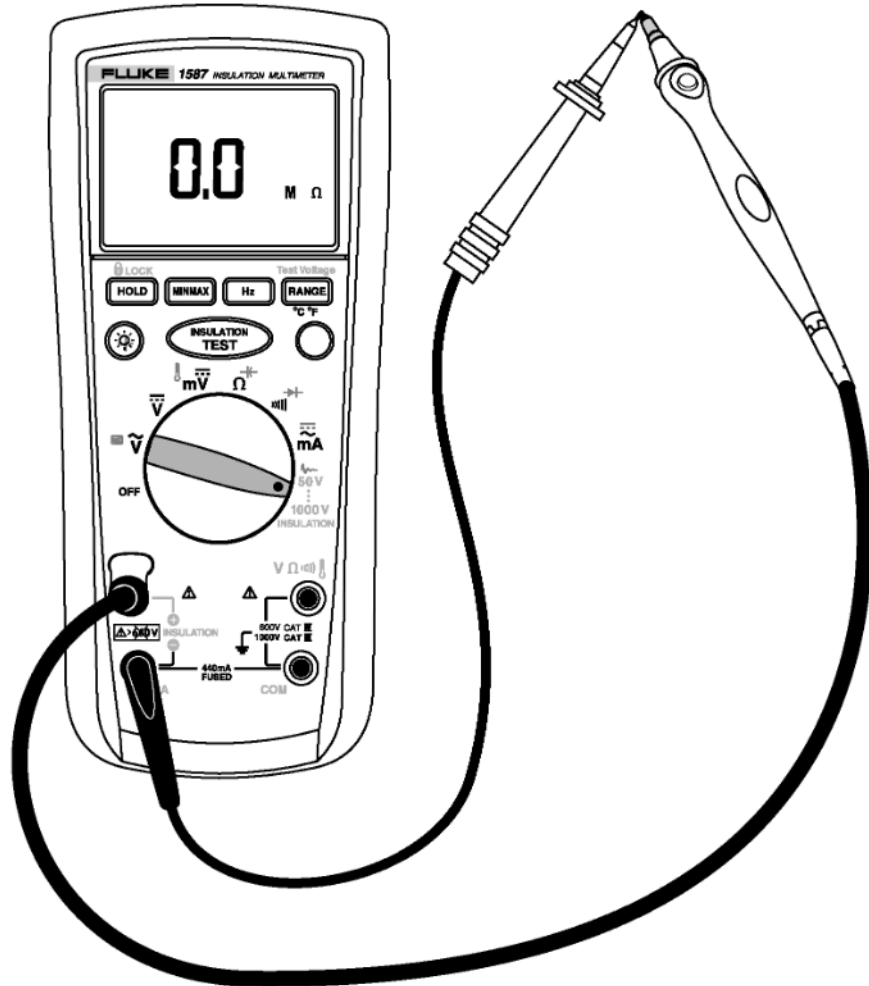


Fig. 29: Insulation Multimeter (0.0)

Courtesy of GENERAL MOTORS COMPANY

5. With the test leads connected together, press and hold test button to know how your meter displays continuity. The EL-50772 will display 0.0 Ω .

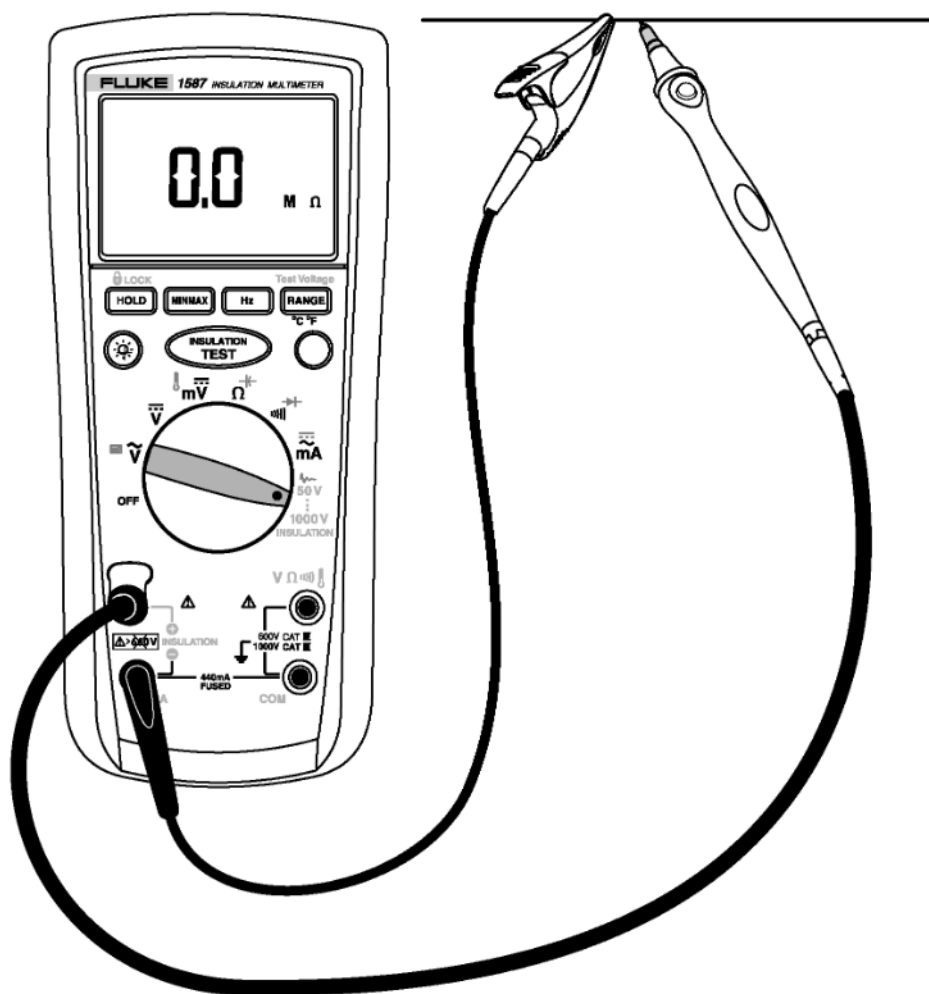


Fig. 30: Insulation Multimeter (0.0)

Courtesy of GENERAL MOTORS COMPANY

6. When performing insulation testing you need a good ground reference. When possible use an alligator clamp to attach the ground lead. Typically, the reference point will be to vehicle chassis except cable testing which requires connection to the cable shield termination at the connector and not to the chassis.
7. Verify your ground connection prior to every test measurement at a suitable ground location near your test point. The **EL-50772** should display 0.0 Ω, indicating continuity.
8. When testing components with large capacitance or inductance, such as certain modules and larger motor stators, it may be necessary to hold the test for a few seconds until the maximum resistance value is displayed.

RECHARGEABLE ENERGY STORAGE SYSTEM SMOKE TEST

Special Tools

- **EL-52015** Volt Battery Smoke Test Leak Adapters
- **GE 41413-A** Evaporative Emissions System Tester (EEST)

Equivalent regional tools: [Special Tools](#)

1. Remove the drive motor battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#) [Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#) [Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

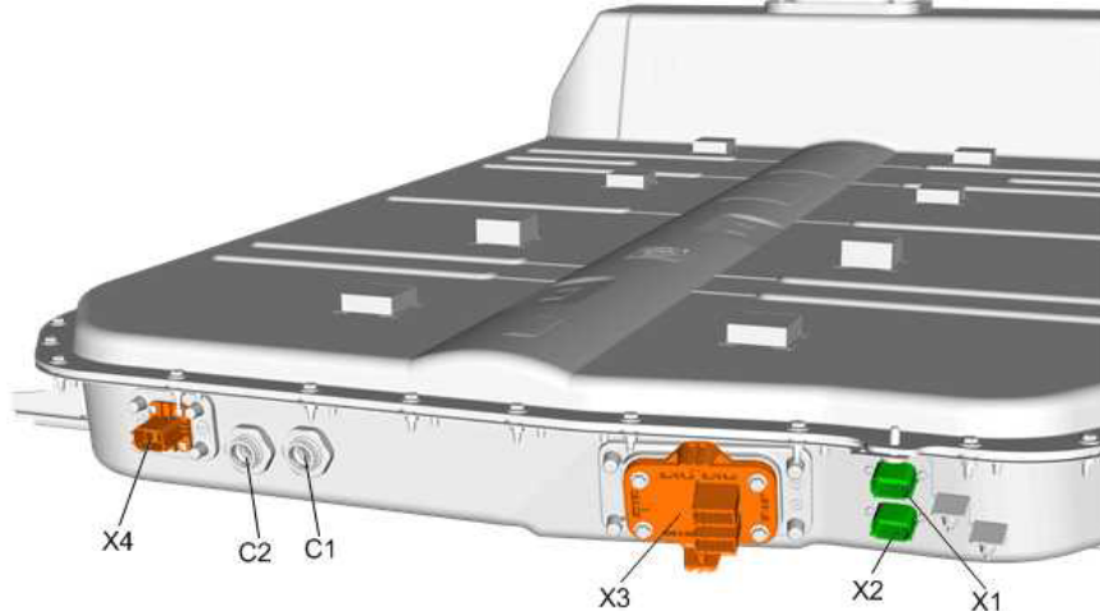


Fig. 31: Drive Motor Battery Connectors

Courtesy of GENERAL MOTORS COMPANY

2. Install the **EL-52015** Drive Motor Battery smoke test leak adapters to the following Drive Motor Battery Connectors:

- X1
- X2
- X3

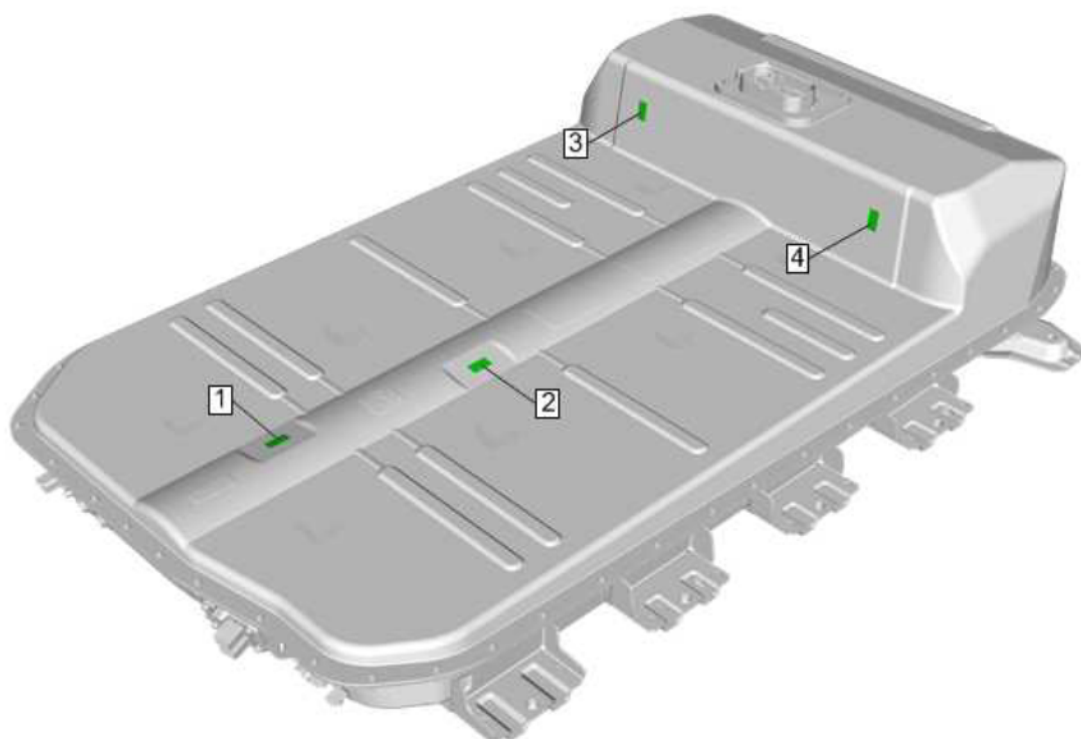


Fig. 32: Gore Patches

Courtesy of GENERAL MOTORS COMPANY

NOTE: Duct tape is not recommended because of damage to the Gore patches when removing.

3. Cover all gore patches (1, 2, 3 and 4) with tape.

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NOTE: It is not recommended to use the tester in an outside repair bay area because wind

and sunlight may affect temperature and your ability to see the smoke.

4. Turn OFF any fans that may cause air movement around or near the Drive Motor Battery.



Fig. 33: Drive Motor Battery Connector X4
Courtesy of GENERAL MOTORS COMPANY

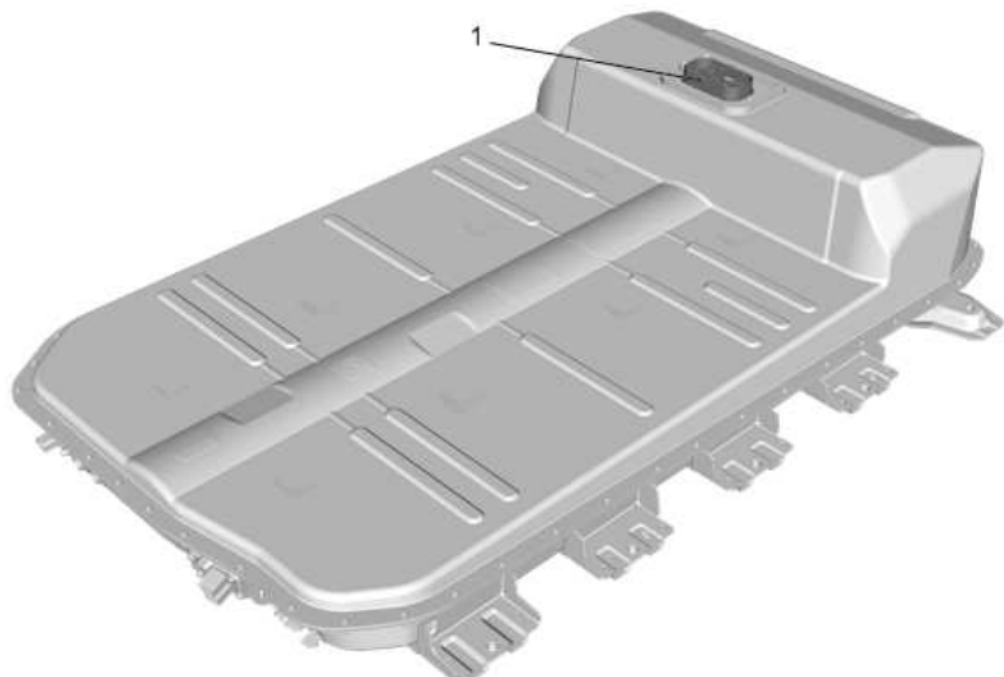
5. Install the **GE 41413-A** Evaporative Emissions System Tester (EEST) to connector (X4).

NOTE: Completely unwind the smoke hose from the bracket for optimal tester performance.

6. Turn the nitrogen/smoke valve on the control panel to smoke.

NOTE: The remote switch operates in a push ON, push OFF fashion.

7. Press and release the remote switch to activate the tester and inject smoke into the Drive Motor Battery.



8. Soak/Fill the RESS with smoke for FIVE MINUTES until smoke is observed from the manual service disconnect connector (1).
 9. Install the manual service disconnect lever. Refer to **Drive Motor Battery High Voltage Manual Disconnect Lever Replacement**
 10. Introduce smoke into the Drive Motor Battery for up to THREE MINUTES. Using a high-intensity white light, look for any visible smoke emitting anywhere from the Drive Motor Battery.
 11. Press and release the remote switch to deactivate the tester.
 12. Repair any visible leaks by retightening the fasteners or by resealing any areas.
 13. Retest the Drive Motor Battery, to ensure repair has been completed.
 14. Remove the masking tape from the gore patches (1, 2, 3 and 4).
 15. Remove the manual service disconnect lever. Refer to **Drive Motor Battery High Voltage Manual Disconnect Lever Replacement**
 16. Open the nitrogen tank valve and turn the nitrogen/smoke valve on the control panel to Nitrogen.
 17. Press and release the remote switch to activate the tester and inject nitrogen into the Drive Motor Battery for FIVE MINUTES, verify no smoke is coming from the vent.
 18. Remove all old vents from the Drive Motor Battery.
 19. Install NEW Gore patches (P/N 20791600), replacing the old vents.
 20. Disconnect the tester and remove the adapters from the Drive Motor Battery.
 21. Install the drive motor battery. Refer to **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**
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2017 ELECTRICAL

Hybrid/EV Energy Storage - Repair Instructions - Bolt EV

REPAIR INSTRUCTIONS

HIGH VOLTAGE SYSTEM INSPECTION

Circuit/System Description

WARNING: Damage to a Lithium Ion hybrid/EV battery pack could result in fire, loss of electrical isolation or exposure to high voltage. Until the high voltage system inspection has been completed, store the vehicle with hybrid/EV battery pack installed outside in a secure area away from buildings and other vehicles and protected from rain, snow and other moisture. Remove the hybrid/EV battery pack high voltage manual disconnect lever and store it in a secure place outside the vehicle. Cover the exposed high voltage opening with ULÂ® listed, or equivalent, insulation tape rated at a minimum of 600 V.

Failure to follow these precautions could result in personal injury, death and property damage.

The Inspection Process

The high voltage system and Hybrid/EV battery pack inspection process consists of two levels of inspection:

1. Component Initial Inspection
2. High Voltage Operation Inspection

Results of the inspection processes may result in:

- Hybrid/EV Battery Depower
- Repair, or replacement and recycling of the Hybrid/EV Battery
- Replacement of high voltage components

Vehicle Collision Detection/High Voltage Lockout

The supplemental inflatable restraint system supplements the protection offered by the seat belts. The supplemental inflatable restraint sensing and diagnostic module determines the severity of a collision with the assistance of impact sensors located at strategic points on the vehicle. The hybrid powertrain control module 2 will open the high voltage contactor relays, placing the vehicle in a high voltage lockout state and disabling the vehicle whenever a crash event of sufficient intensity has been detected.

The supplemental inflatable restraint module transmits through serial data to the hybrid powertrain control module 2 both the crash event status and whenever a sensor fault is detected.

NOTE: The Crash Event Detected/Air Bag Deployed high voltage lockout state will remain active until cleared by the Clear Secured High Voltage DTCs procedure.

A complete inspection of the high voltage system must be performed if the vehicle has been involved in a collision.

High Voltage Battery Moisture Exposure

The Lithium Ion hybrid/EV battery pack should be depowered whenever internal components have been exposed to moisture, whether due to vehicle flood, coolant leakage within the hybrid/EV battery pack

assembly, etc.

Reference Information

Schematic Reference

- [Hybrid/EV Energy Storage Schematics](#)
- [Hybrid/EV Controls Schematics](#)
- [Plug-In Charging Schematics](#)

Description and Operation

[Drive Motor Battery System Description](#)

Scan Tool Reference

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

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50332** EV/HEV Battery Service Tool
- **J-35616-35** Test Probes

Equivalent regional tools: [Special Tools](#) .

Component Initial Inspection

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.

WARNING: High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.

WARNING: This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test

equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

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

1. Disconnect the 12 V battery.
2. Remove the S15 Manual Service Disconnect. If vehicle damage does not allow for access to the S15 Manual Service Disconnect, remove the damaged portion of the vehicle until such time as the S15 Manual Service Disconnect can be removed.
3. Inspect the Hybrid/EV battery pack for evidence of exposure to fire, either directly or in close proximity.

- **If exposure to fire is evident**

1. Depowering of the Hybrid/EV battery pack is recommended. Maintain post-crash 50 foot vehicle isolation until depowering completion. See Battery Depower after inspection is complete.

NOTE: Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).

2. After depowering, repair or replace and recycle battery as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
3. Continue with inspection.

- **If not exposed to fire**

4. Inspect the Hybrid/EV battery pack enclosure for damage including foreign object intrusion.

- **If damage is evident**

1. Depowering of the Hybrid/EV battery pack and/or damaged module section is recommended. Maintain post-crash 50 foot vehicle isolation until depowering completion. See Battery Depower after inspection is complete.

NOTE: Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).

2. After depowering, repair or replace and recycle battery as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
3. Continue with inspection.

- **If not damaged**

5. Inspect the vehicle for exposure to water at a level higher than the vehicle rocker panel.

- **If the vehicle was exposed to flood**

1. Remove the battery drain plug, capture and discard any drained fluid.
2. Lift the vehicle rear slightly to assist in fluid extraction.

- **If fluid is present**

1. Depowering of the Hybrid/EV battery pack is recommended. Maintain post-crash 50 foot vehicle isolation until depowering completion. See Battery Depower after inspection is complete.

NOTE: Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).

2. After depowering, repair or replace and recycle battery as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.

3. Continue with inspection.

- If fluid was not present

Install a new drain plug and continue with inspection.

- **If the vehicle was not flooded**

6. Inspect the battery coolant system for proper level.

- **If battery coolant level is low**

1. Verify if the low coolant is the result of system damage external of the A4 Hybrid/EV battery pack.

- If the cooling system external of the A4 Hybrid/EV Battery Pack is not damaged and/or leaking

1. Remove the battery drain plug, capture and discard any drained fluid.

2. Lift the vehicle rear slightly to assist in fluid extraction.

- If fluid is present

3. Depowering of the Hybrid/EV battery pack is recommended. Maintain post-crash 50 foot vehicle isolation until depowering completion. See Battery Depower after inspection is complete.

NOTE: **Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).**

4. After depowering, repair or replace and recycle battery as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.

5. Continue with inspection.

- If fluid is not present

6. Install a new drain plug and continue with inspection.

- If the cooling system external of the A4 Hybrid/EV Battery Pack is damaged and/or leaking

2. Continue with inspection.

- **If the battery coolant system is at the proper level**

NOTE: **Post-crash 50 foot vehicle isolation is no longer required if the Hybrid/EV battery pack did not exhibit damage assessed in the steps above.**

7. Inspect each high voltage component listed below for visible damage. Record the results on the High Voltage Component Inspection Table below.

- E54 Hybrid/EV Battery Pack Coolant Heater
- G1 Electric A/C Compressor
- K1 14 V Power Module
- K10 Coolant Heater Control Module
- S15 Manual Service Disconnect
- T6 Power Inverter Module
- T18 Battery Charger
- T24 Battery Charger
- Transmission case
- All High voltage orange cables

- **If any high voltage component inspection failed and Hybrid/EV battery Depower is recommended**

Disconnect the damaged components from the high voltage bus before attempting in-vehicle depowering of the Hybrid/EV battery pack. In extreme cases depowering may need to occur by connecting directly within the Hybrid/EV battery pack with the cover removed. See Battery Depower below.

- **If any high voltage component inspection failed and Hybrid/EV battery Depower is NOT recommended**
- 1. Perform the [High Voltage Disabling](#) procedure and replace the damaged components before attempting to operate the vehicle.
- 2. Once you have confirmed or repaired all high voltage component visual integrity, perform High Voltage Operation Inspection below.
- **If all high voltage component inspection passed**

Perform High Voltage Operation Inspection below.

High Voltage Component Inspection Table

High Voltage Component	Inspection (passed/failed)
E54 Hybrid/EV Battery Pack Coolant Heater	^
G1 Electric A/C Compressor	^
K1 14 V Power Module	^
K10 Coolant Heater Control Module	^
S15 Manual Service Disconnect	^
T6 Power Inverter Module	^
T18 Battery Charger	^
T24 Battery Charger	^
Transmission case	^
All High voltage orange cables	^

High Voltage Operation Inspection

NOTE: The vehicle must have a functioning 12 V system and serial data communications to continue.

1. Verify you have successfully passed the Component Initial Inspection.
 - **If the Component Initial Inspection has failed or not been performed**
DO NOT CONTINUE. Restart the Inspection procedure.
 - **If the Component Initial Inspection has passed**
2. Install the S15 Manual Service Disconnect. Refer to [Drive Motor Battery High Voltage Manual Disconnect Lever Replacement](#).
3. Connect the 12 V battery.
4. Vehicle in Service Mode. With a scan tool select the Hybrid/EV powertrain Control Module 2, Hybrid Battery Pack Contactor Open Reasons data list. Verify if either the Crash Event Detected or Air Bag Deployed parameters indicate YES.
 - **If either parameter displays YES**
The high voltage contactors may be prevented from closing. The vehicle will not start. Perform the Clear Secured High Voltage DTCs procedure and proceed to the next step.
 - **If BOTH parameters indicate NO**
5. Vehicle ON. With a scan tool check for the following HV system DTCs: Contactor DTCs P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D0A, P0D09, P1EBD, P1EC0, P1EC3, Isolation DTCs P0AA6, P1AE6, P1AF0, or P1AF2, Precharge DTCs P0C76, P0C78 or P3061.
 - **If any DTCs are set**
Perform the applicable DTC diagnosis/repair. refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
 - **If any of the listed DTCs have not run**
Review the applicable Conditions for Running the DTC.

- If all the specified DTCs have ran and passed

High Voltage System Inspection passed.

Battery Depower

WARNING: Damage to a Lithium Ion hybrid/EV battery pack could result in fire, loss of electrical isolation or exposure to high voltage. Store the vehicle with hybrid/EV battery pack installed or the hybrid/EV battery pack assembly outside in a secure area away from buildings and other vehicles and protected from rain, snow and other moisture until the hybrid/EV battery pack has been discharged. Remove the hybrid/EV battery pack high voltage manual disconnect lever and store it in a secure place outside the vehicle. Cover the exposed high voltage opening with UL® listed, or equivalent, insulation tape rated at a minimum of 600 V. Contact the GM Technical Assistance Center for discharge instructions prior to storage and shipping of the hybrid/EV battery pack.

Failure to follow these precautions could result in personal injury, death and property damage.

NOTE: Depowering of the battery:

- Will NOT reduce battery voltage to a safe level. The battery will contain high voltage after depower procedure is complete.
- Reduces the state of charge to the lowest level thus reducing the likelihood of a battery fire.
- Requires special tool EL-50332 battery service tool.
- Allows for future recovery of the battery after an internal battery inspection and/or repair is completed.

NOTE: Depowering is not required if hybrid/EV battery pack voltage as either monitored by the hybrid powertrain control module 2 scan tool Hybrid/EV Battery Pack High Voltage parameter or measured with a DMM directly across the battery terminals is 285 volts or less.

NOTE: With a full state of charge, the depower process for the complete Hybrid/EV battery pack make take up to 20 hours to complete. You may stop or pause the process at any time.

Depowering can occur with the Hybrid/EV battery pack in or out of the vehicle. You can configure the **EL-50332** connections to the Hybrid/EV battery pack at any of the following locations:

- High Voltage T24 Battery Charger connection under hood with **EL-50332-335** *
- High Voltage connection at Hybrid/EV Battery Pack with **EL-50332-335** *
- Directly at battery section/cell module terminals with **EL-50332-170**

*Also requires connection to the contactor relay control circuits with **EL-50332-325** .

The **EL-50332** can be 12 V powered for instances when outlet power is not available. Use the following to operate from a 12 V power source:

- **EL-50332-160** 12 V Auxiliary Power Cable
- **EL-50332-165** 12 V Auxiliary Clamps Adapter Cable

In-Vehicle or Hybrid/EV Battery Pack Cover Installed Depower Instructions

NOTE:

- The **EL-50332** will close the Hybrid/EV battery pack contactors. You must verify the vehicles high voltage system integrity prior

to enabling high voltage. Disconnect visually damaged high voltage components/cables from the high voltage system before attempting in-vehicle depowering.

- You must be able to connect to the hybrid/EV battery pack low voltage connectors.
- Wear your Personal Protective Equipment for the duration of the battery depower event.

1. Ensure the integrity of the vehicles high voltage system.
2. Connect the **EL-50332** to the contactor control circuits at the hybrid/EV battery pack low voltage connectors with the **EL-50332-270** interface module and **50332-325** harness.
3. Connect the **EL-50332** to the applicable high voltage connector.
4. Install the manual service disconnect lever.
5. Follow the **EL-50332** on-screen prompts until depower is completed.

NOTE: Post-crash 50 foot vehicle isolation is no longer required upon successful depower completion.

6. Remove the manual service disconnect lever.

NOTE: Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).

7. Repair, replace or recycle the hybrid/EV battery pack as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
8. Replace any damaged components noted in the High Voltage Component Inspection before attempting to operate the vehicle.
9. Perform the High Voltage Operation Inspection before attempting to operate the vehicle.

Hybrid/EV Battery Pack Cover Removed Depower Instructions

1. Connect the **EL-50332-145** Black HV Banana Jack Cable, **EL-50332-150** Red HV Banana Jack Cable, **EL-50332-155** Green HV Banana Jack Cable, and **EL-50332-170** High Voltage Alligator Clamps harness to the applicable battery section/cell module terminals and ground. If depowering all battery sections/cell modules install the manual service disconnect lever.
2. Follow the **EL-50332** on-screen prompts until depower is completed.

NOTE: Post-crash 50 foot vehicle isolation is no longer required upon successful depower completion.

3. Remove the manual service disconnect lever.

NOTE: Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).

4. Repair, replace or recycle the hybrid/EV battery pack as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
5. Replace any damaged components noted in the High Voltage Component Inspection before attempting to operate the vehicle.
6. Perform the High Voltage Operation Inspection before attempting to operate the vehicle.

DRIVE MOTOR BATTERY HIGH VOLTAGE MANUAL DISCONNECT LEVER REPLACEMENT

Removal Procedure

cardiagn.com

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. Remove Rear Seat Cushion [Rear Seat Cushion Removal and Installation](#)

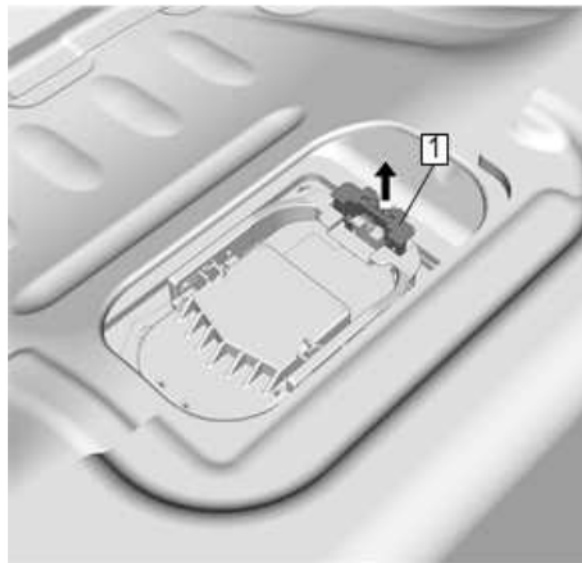


Fig. 1: Lever CPA

Courtesy of GENERAL MOTORS COMPANY

2. Lift up the lever CPA (1).

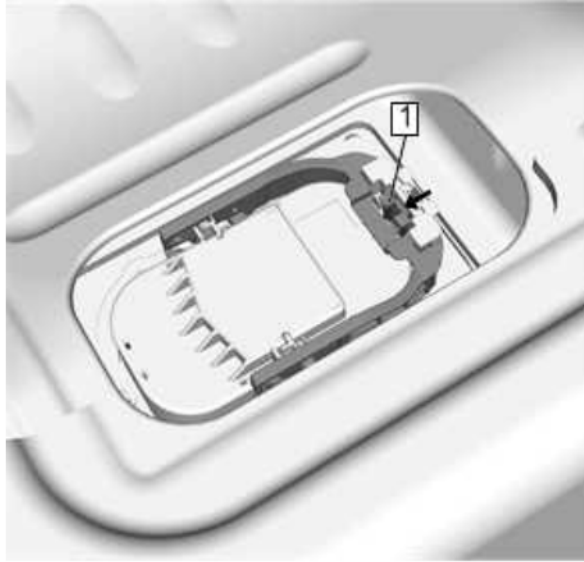


Fig. 2: Lever Button Inward

Courtesy of GENERAL MOTORS COMPANY

3. Push the lever button inward (1).

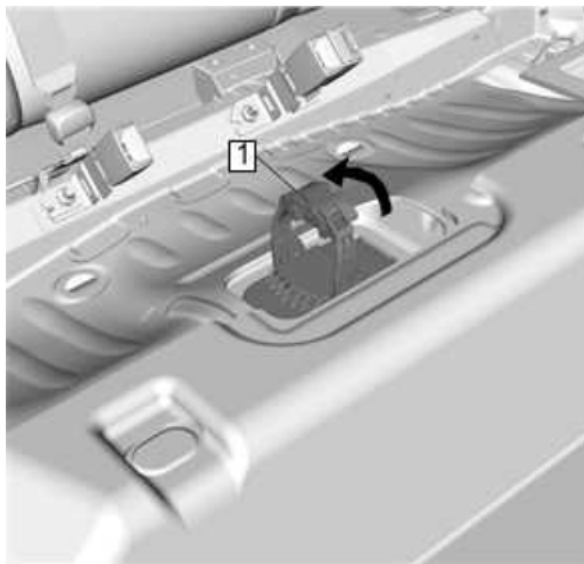


Fig. 3: Drive Motor Battery High Voltage Manual Disconnect Lever

Courtesy of GENERAL MOTORS COMPANY

4. Lift Upwards Drive Motor Battery High Voltage Manual Disconnect Lever (1)

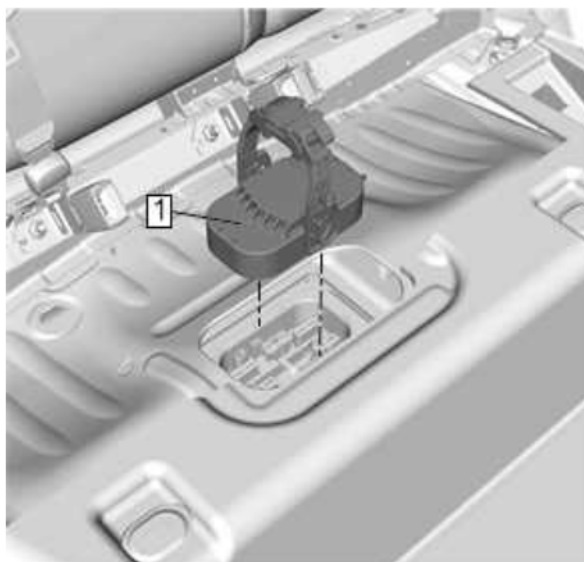


Fig. 4: Drive Motor Battery High Voltage Manual Disconnect Lever

Courtesy of GENERAL MOTORS COMPANY

5. Remove Drive Motor Battery High Voltage Manual Disconnect Lever (1)

Installation Procedure

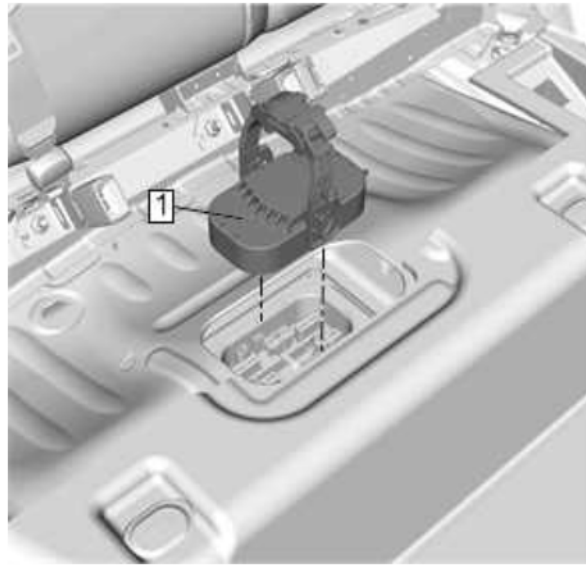


Fig. 5: Drive Motor Battery High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery High Voltage Manual Disconnect Lever (1)

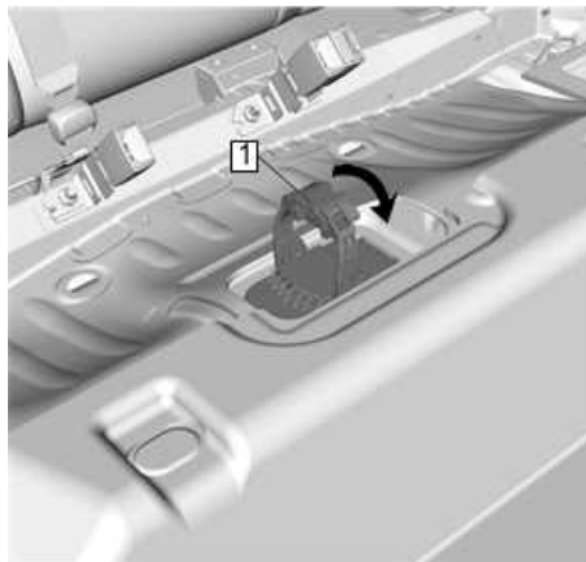
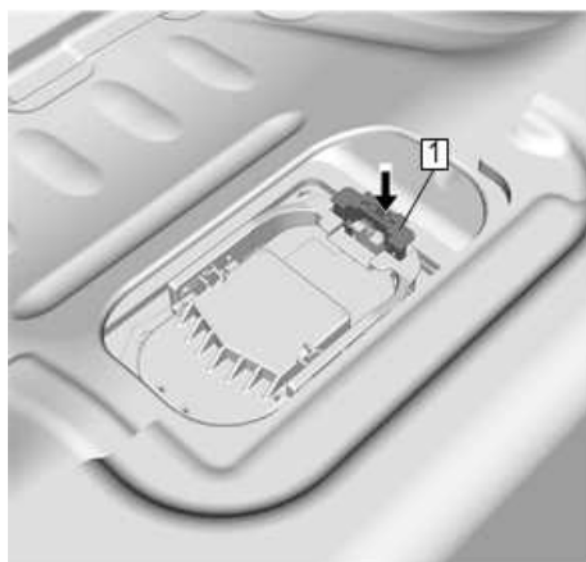


Fig. 6: Drive Motor Battery High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

2. Engage Drive Motor Battery High Voltage Manual Disconnect Lever (1)



3. Push and engage the lever CPA (1).
4. Install Rear Seat Cushion [Rear Seat Cushion Removal and Installation](#)
5. Enable the high voltage system. [High Voltage Enabling](#)

HIGH VOLTAGE BATTERY HIGH VOLTAGE MANUAL DISCONNECT CONNECTOR 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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. [Battery Upper Cover Replacement](#)

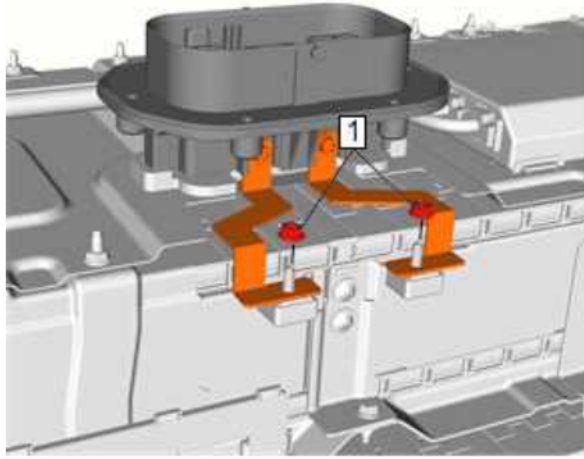


Fig. 8: Battery Cable Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Remove the battery cable bolts. (1) [2x]

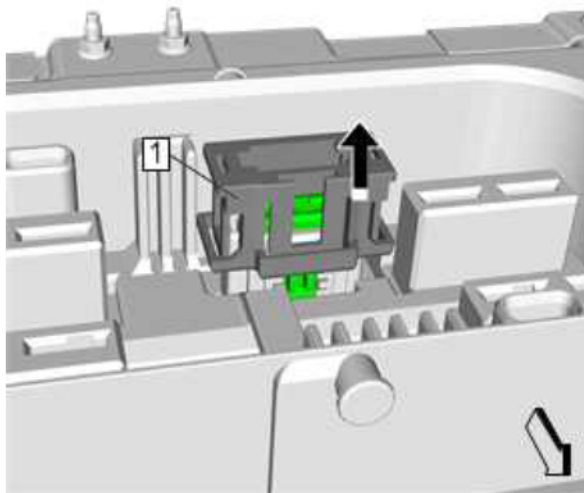


Fig. 9: Connector Guide

Courtesy of GENERAL MOTORS COMPANY

4. Slightly release the connector guide (1) from the manual service disconnect connector. Do not need to remove it completely.

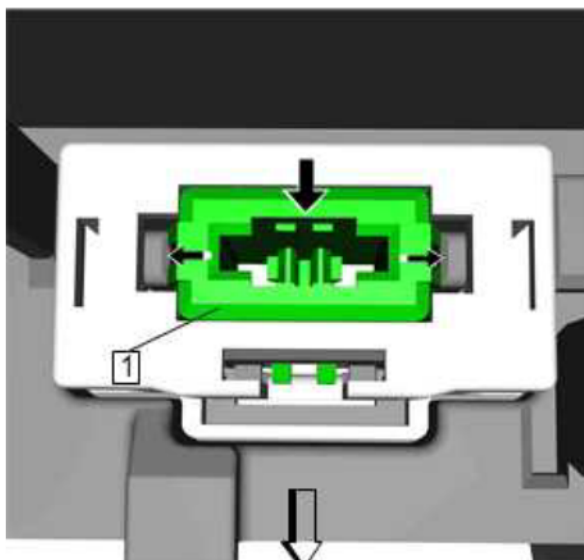


Fig. 10: Connector

Courtesy of GENERAL MOTORS COMPANY

5. While pushing the connector tabs to the side direction, push down the connector (1) and remove it.

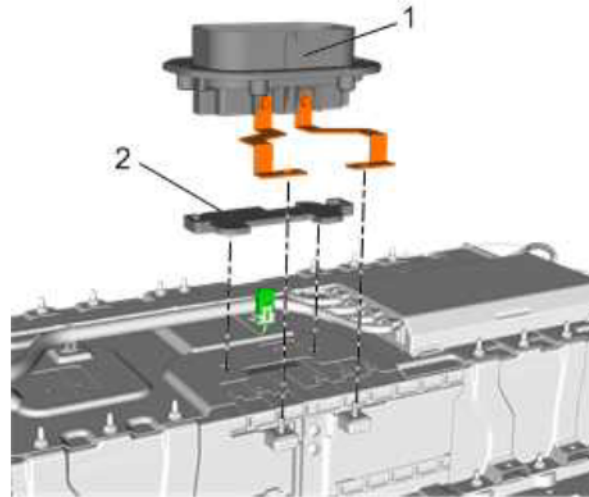


Fig. 11: Connector And Connector Insulator

Courtesy of GENERAL MOTORS COMPANY

6. Remove the high voltage battery high voltage manual disconnect connector (1) with the battery cable.
7. Remove the high voltage battery high voltage manual disconnect connector insulator (2).

Installation Procedure

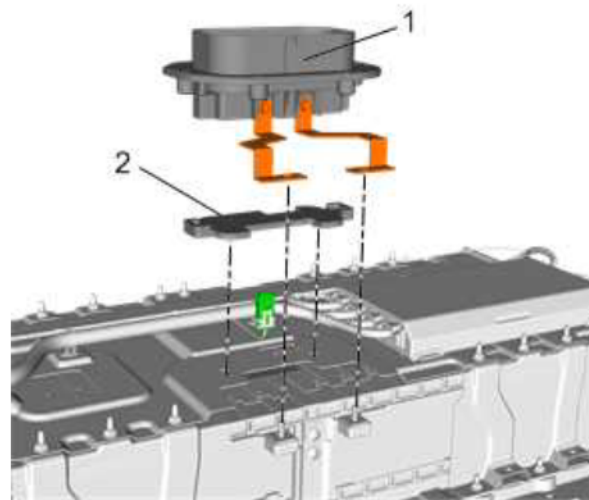


Fig. 12: Connector And Connector Insulator

Courtesy of GENERAL MOTORS COMPANY

1. Install the high voltage battery high voltage manual disconnect connector insulator (2).
2. Install the high voltage battery high voltage manual disconnect connector (1) with the battery cable.
3. Connect the electrical connector to the high voltage battery high voltage manual disconnect connector.

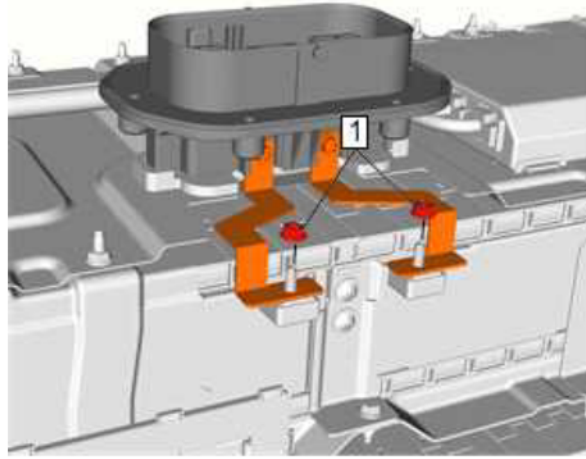


Fig. 13: Battery Cable Bolts

Courtesy of GENERAL MOTORS COMPANY

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

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

NOTE: Cover the battery cell stud with protective tape that is UL® listed or insulation tape rated at a minimum of 600V.

4. Tighten the battery cable bolts. (1) 9 N.m (80 lb in)
5. Tighten the battery cable bolts again. (1) 9 N.m (80 lb in).
6. [Battery Upper Cover Replacement](#)
7. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

HIGH VOLTAGE BATTERY TRAY 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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. Remove the battery upper cover. [Battery Upper Cover Replacement](#)

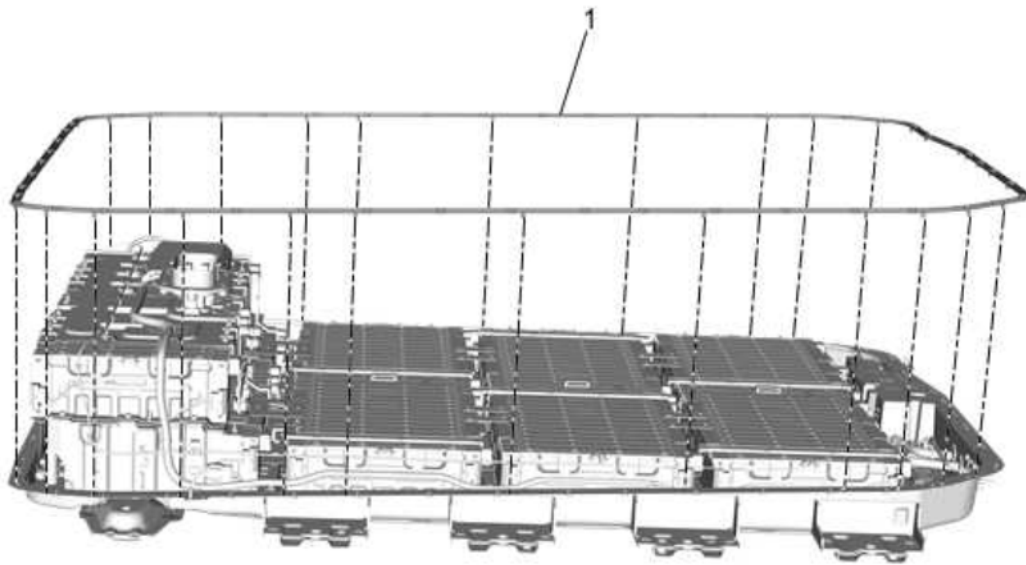


Fig. 14: Battery Cover Seal

Courtesy of GENERAL MOTORS COMPANY

3. Remove the battery cover seal (1). [Battery Cover Seal Replacement](#)

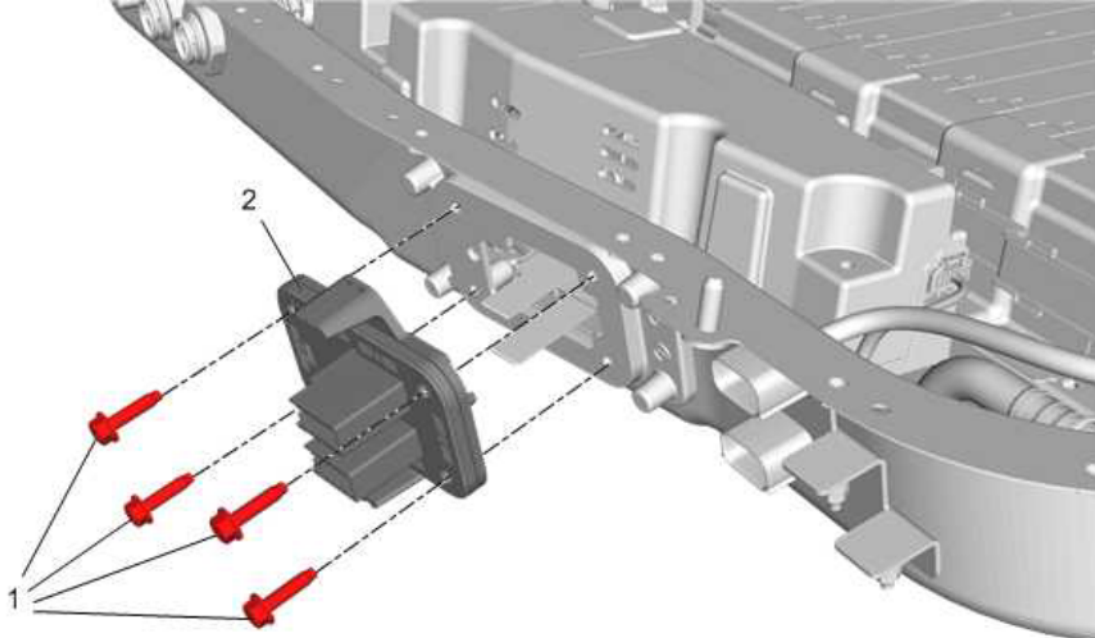


Fig. 15: High Voltage Battery Connector X3
 Courtesy of GENERAL MOTORS COMPANY

4. Remove the high voltage battery connector X3 (2). **High Voltage Connector Replacement (X3)**

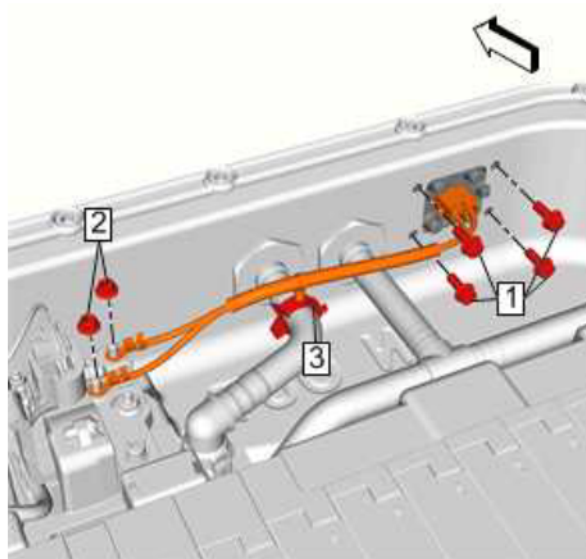


Fig. 16: High Voltage Battery Connector X4
 Courtesy of GENERAL MOTORS COMPANY

5. Remove the high voltage battery connector X4. **High Voltage Connector Replacement (X4)**

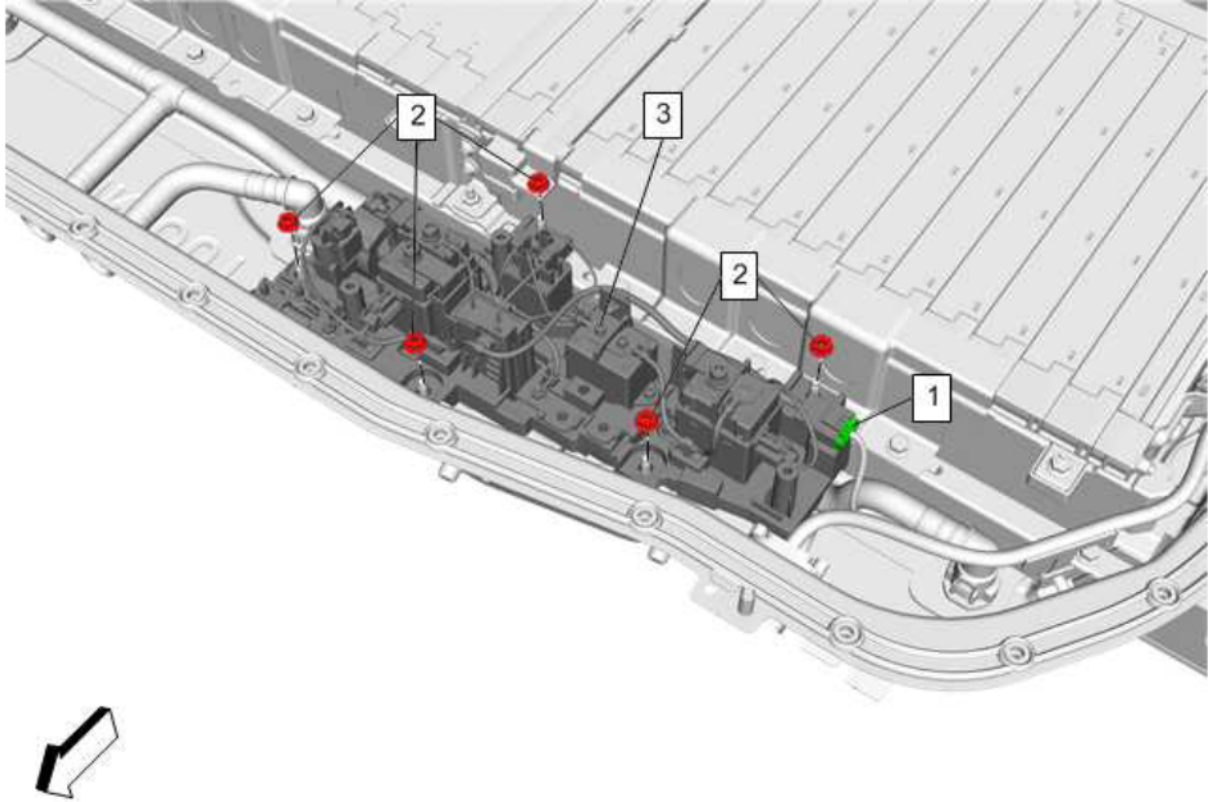


Fig. 17: High Voltage Battery Disconnect Relay Assembly

Courtesy of GENERAL MOTORS COMPANY

6. Remove the high voltage battery disconnect relay assembly (3). **High Voltage Battery Disconnect Relay Replacement**

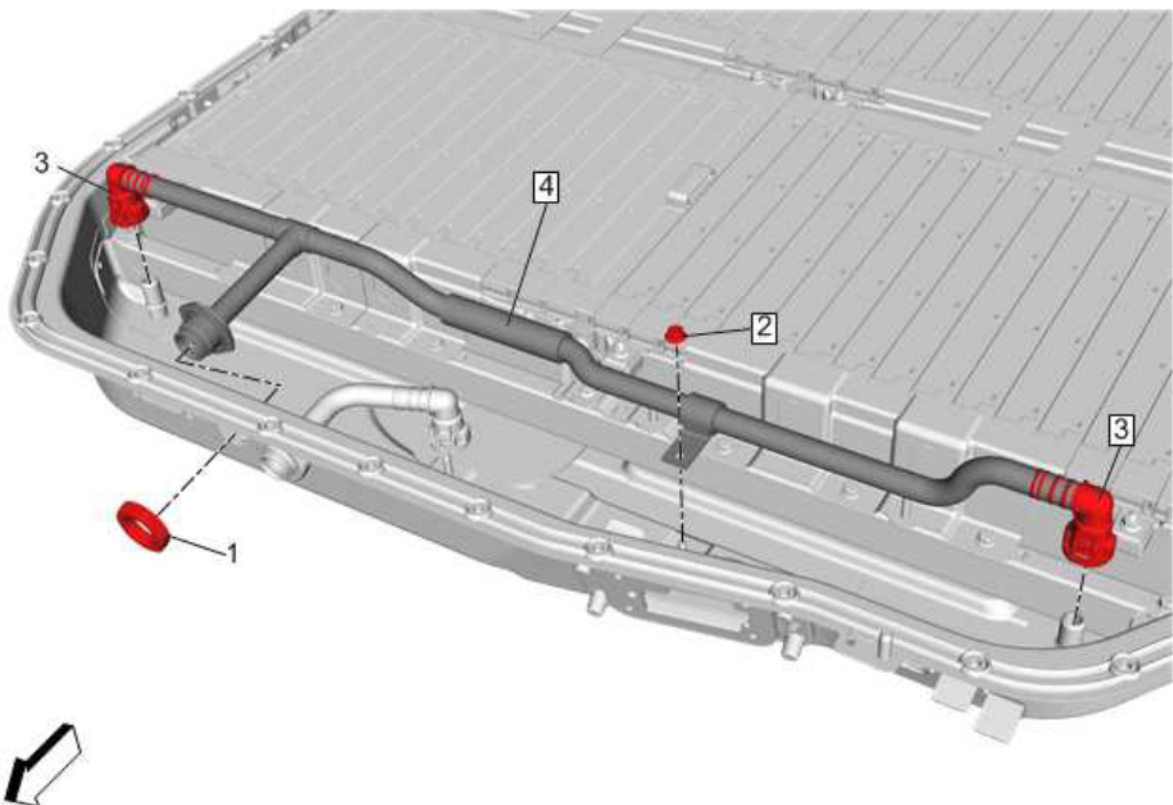


Fig. 18: Drive Motor Battery Coolant Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

7. Remove the drive motor battery coolant inlet hose (4) from the drive motor battery tray. **Drive Motor Battery Coolant Inlet Hose Replacement**

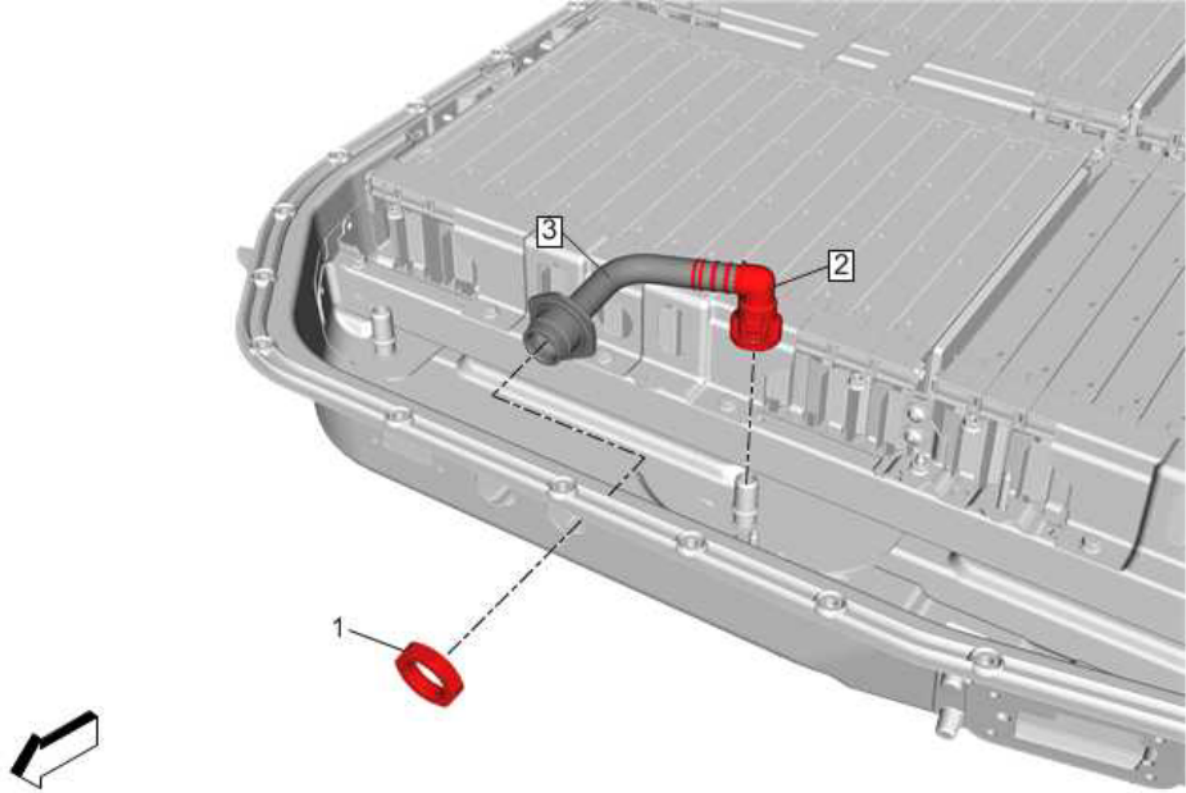


Fig. 19: Drive Motor Battery Coolant Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

8. Remove the drive motor battery coolant outlet hose (3) from the drive motor battery tray. [Drive Motor Battery Coolant Outlet Hose Replacement](#)
9. Remove all the cell battery modules. [Cell Battery Module Replacement \(Row 1\)](#)[Cell Battery Module Replacement \(Row 2\)](#)[Cell Battery Module Replacement \(Row 3\)](#)[Cell Battery Module Replacement \(Row 4\)](#)[Cell Battery Module Replacement \(Row 5\)](#)

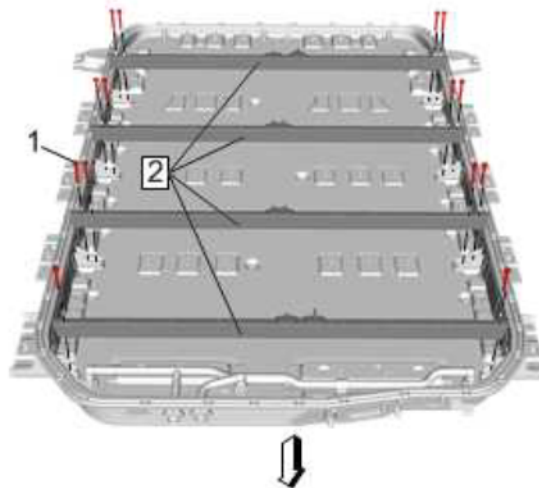


Fig. 20: Tube Bolts And Tube Assemblies

Courtesy of GENERAL MOTORS COMPANY

NOTE: Tube assembly number 4 is directional. Need to mark orientation of it within the battery tray before removing.

10. Remove the tube bolts (1) and the tube assemblies (2).

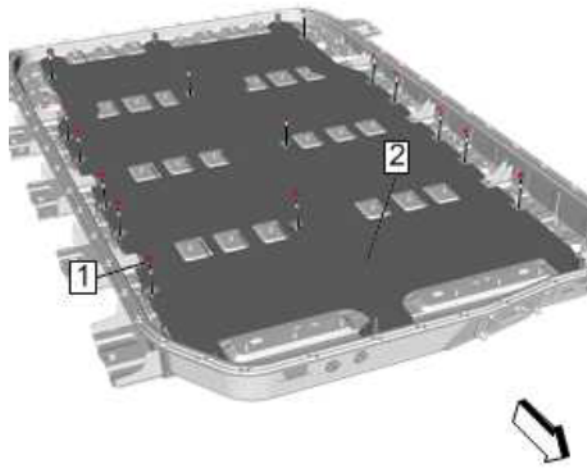


Fig. 21: Cooling Plate Nuts And Plate
 Courtesy of GENERAL MOTORS COMPANY

11. Remove the cooling plate nuts (1) and the plate (2).

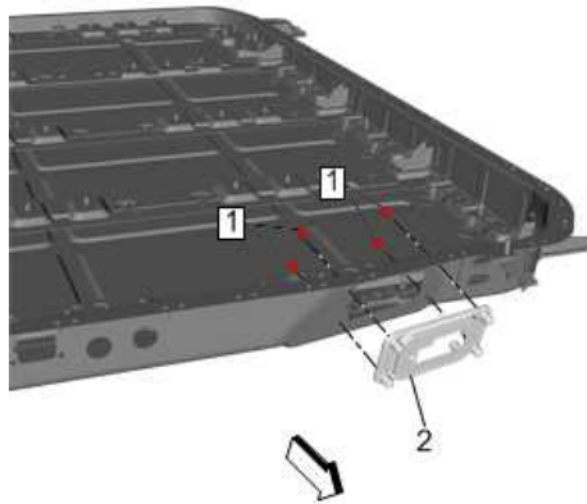


Fig. 22: High Voltage Battery Connector X3 Die Casting Block Bolts
 Courtesy of GENERAL MOTORS COMPANY

12. Remove the high voltage battery connector X3 die casting block bolts (1) and the block (2).

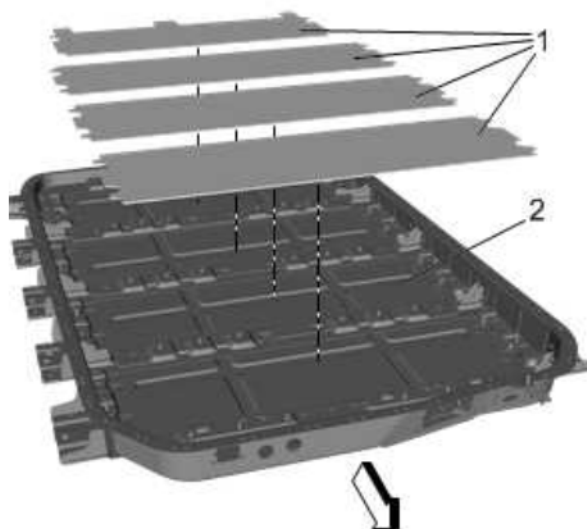


Fig. 23: Insulation Pads
 Courtesy of GENERAL MOTORS COMPANY

13. Remove the insulation pads (1)
14. Replace the high voltage battery tray (2) if needed.

Installation Procedure

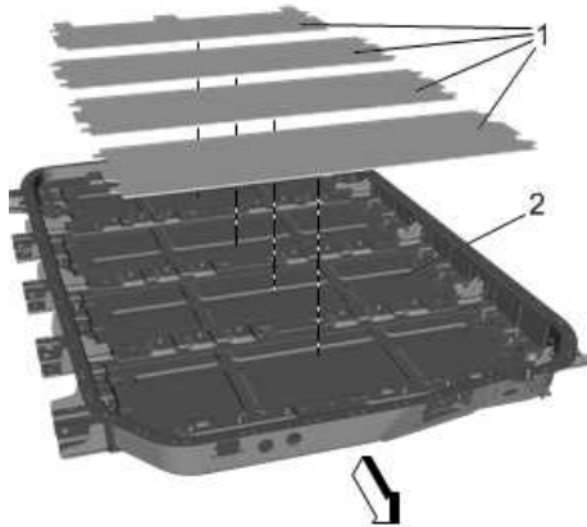


Fig. 24: Insulation Pads

Courtesy of GENERAL MOTORS COMPANY

1. Install the insulation pads (1).

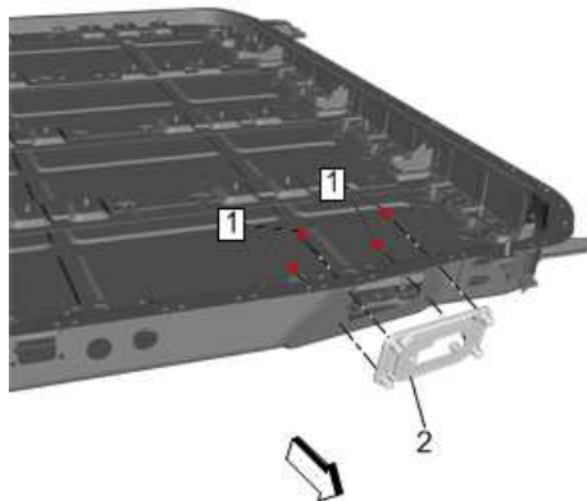


Fig. 25: High Voltage Battery Connector X3 Die Casting Block Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Install the high voltage connector X3 die casting block bolts (1) and the block (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

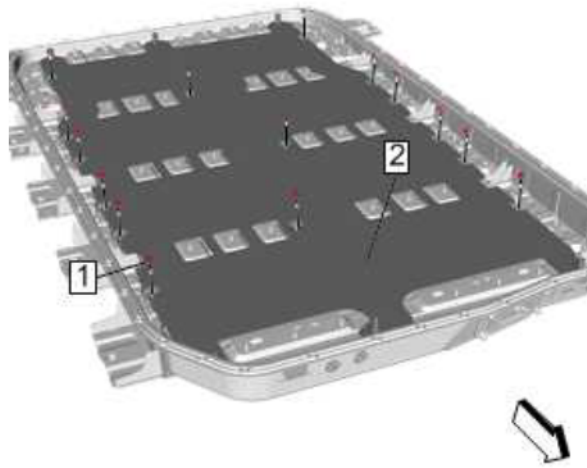


Fig. 26: Cooling Plate Nuts And Plate
Courtesy of GENERAL MOTORS COMPANY

3. Install the cooling plate nuts (1) and the plate (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

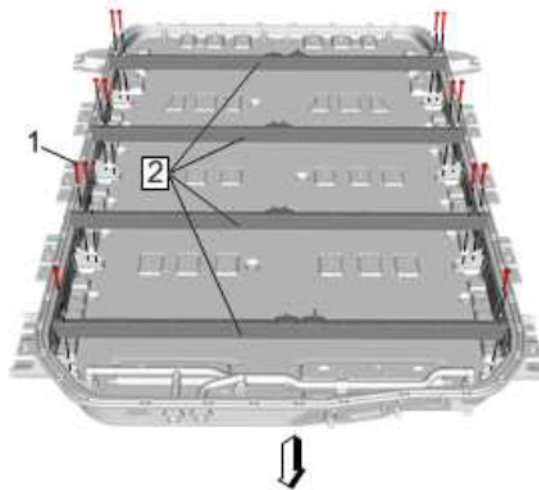


Fig. 27: Tube Bolts And Tube Assemblies
Courtesy of GENERAL MOTORS COMPANY

4. Install the tube bolts (1) and the tube assemblies (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

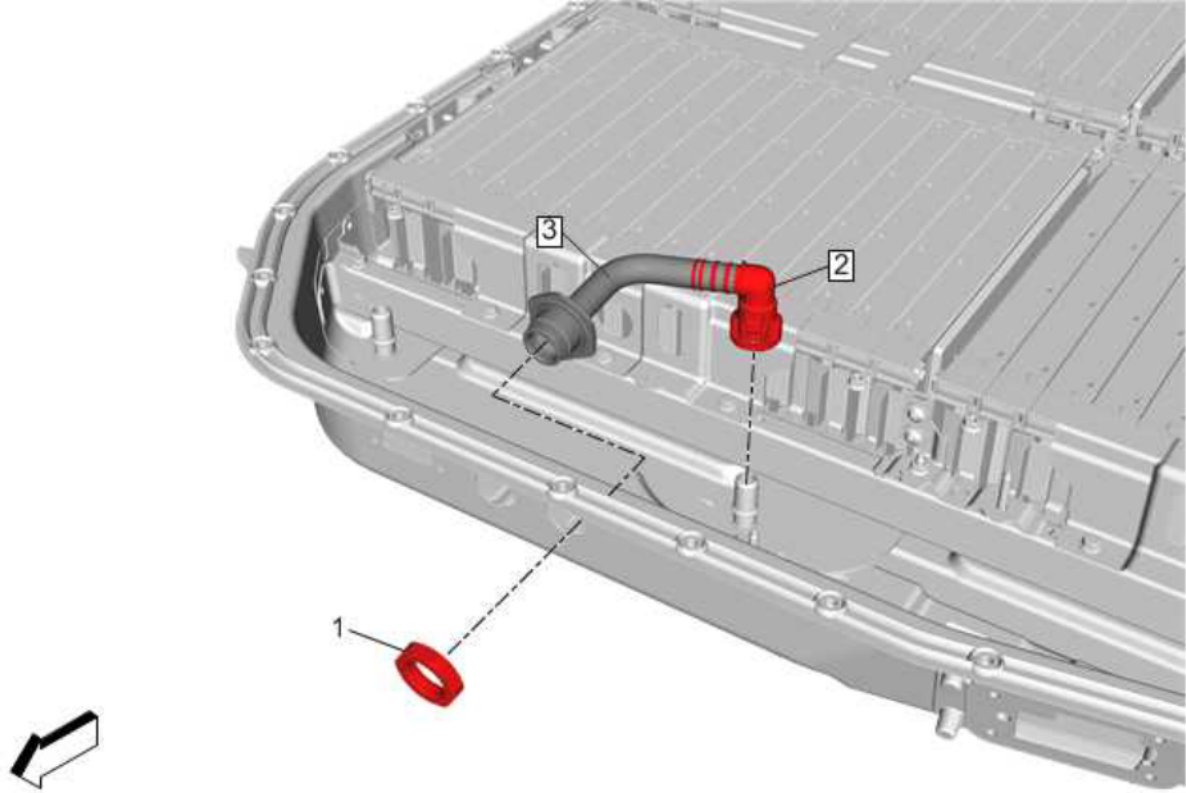


Fig. 28: Drive Motor Battery Coolant Outlet Hose
 Courtesy of GENERAL MOTORS COMPANY

5. Install the drive motor battery coolant outlet hose (3) to the drive motor battery tray. **Drive Motor Battery Coolant Outlet Hose Replacement**

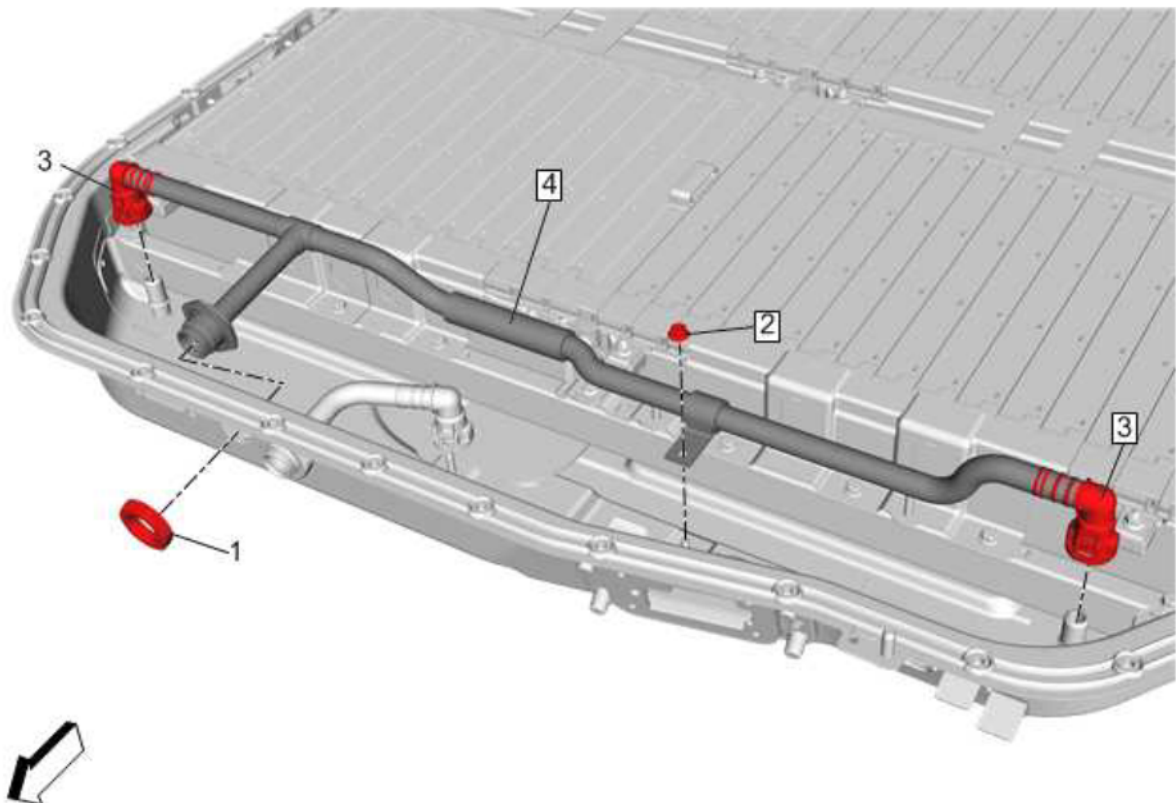


Fig. 29: Drive Motor Battery Coolant Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

6. Install the drive motor battery coolant inlet hose (4) to the drive motor battery tray. **Drive Motor Battery Coolant Inlet Hose Replacement**
7. Install all the cell battery modules. **Cell Battery Module Replacement (Row 1)Cell Battery Module Replacement (Row 2)Cell Battery Module Replacement (Row 3)Cell Battery Module Replacement (Row 4)Cell Battery Module Replacement (Row 5)**

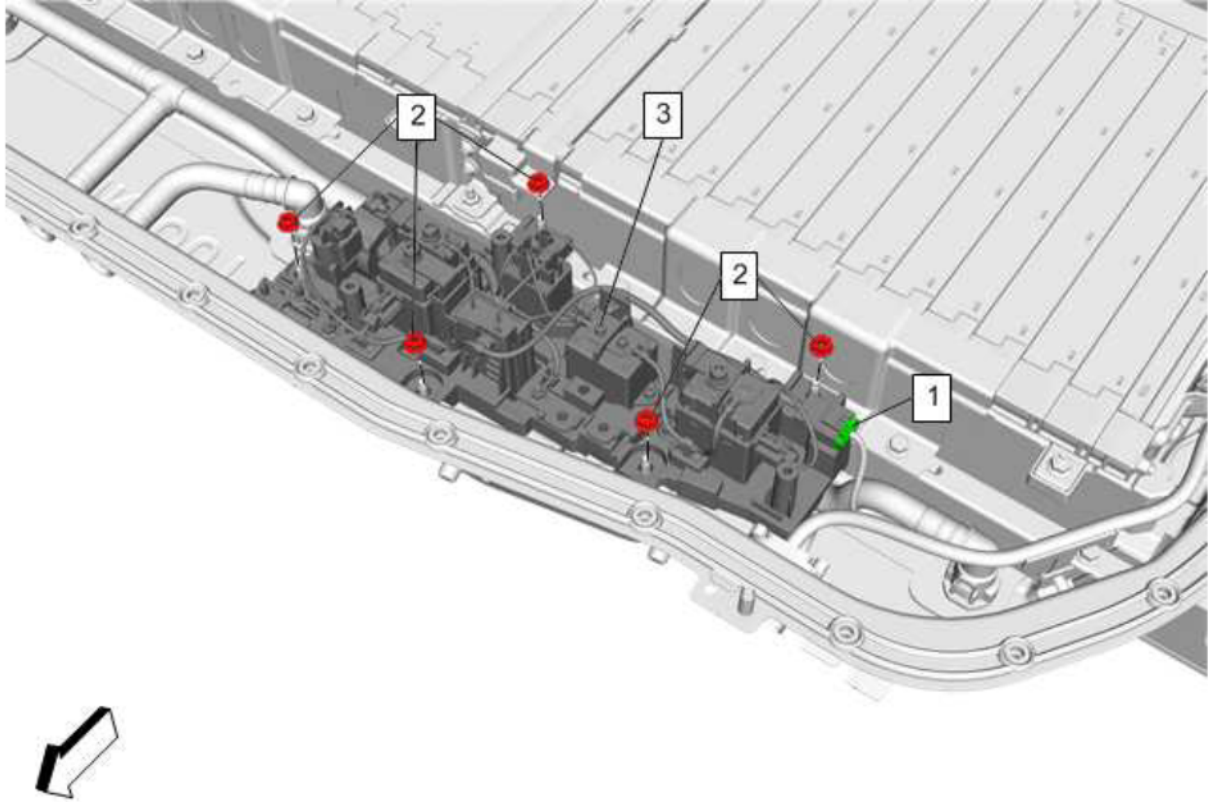


Fig. 30: High Voltage Battery Disconnect Relay Assembly

Courtesy of GENERAL MOTORS COMPANY

8. Install the high voltage battery disconnect relay assembly (3). **High Voltage Battery Disconnect Relay Replacement**

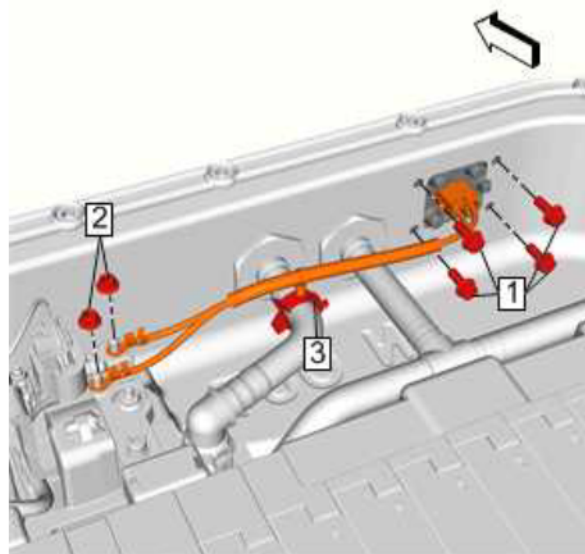


Fig. 31: High Voltage Battery Connector X4

Courtesy of GENERAL MOTORS COMPANY

9. Install the high voltage battery connector X4 assembly (4). **High Voltage Connector Replacement (X4)**

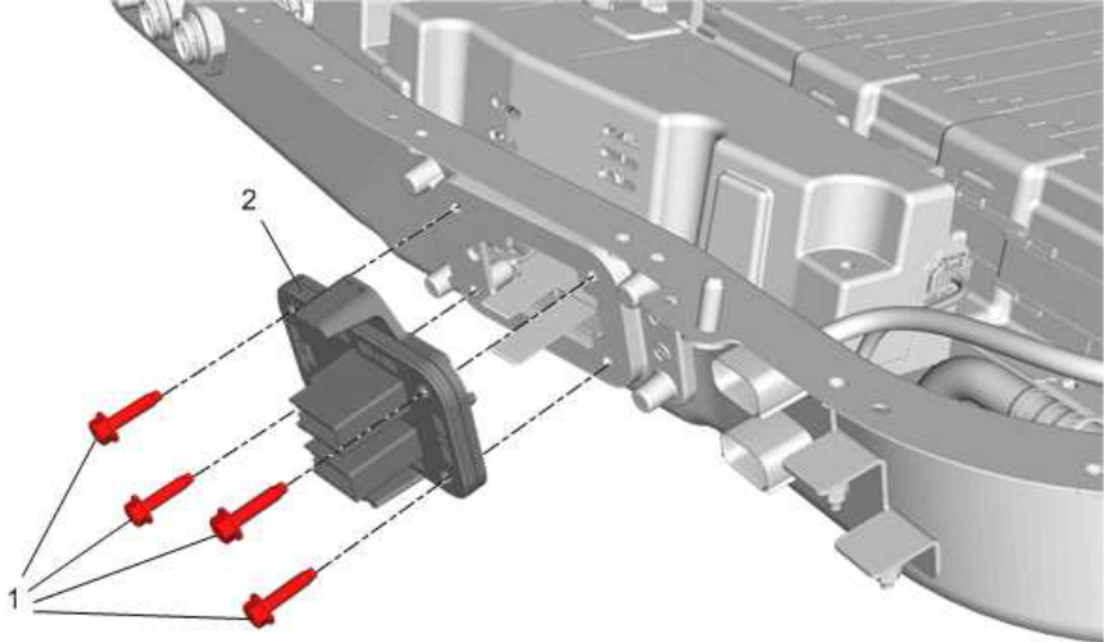


Fig. 32: High Voltage Battery Connector X3
 Courtesy of GENERAL MOTORS COMPANY

10. Install the high voltage battery connector X3 (2). [High Voltage Connector Replacement \(X3\)](#)

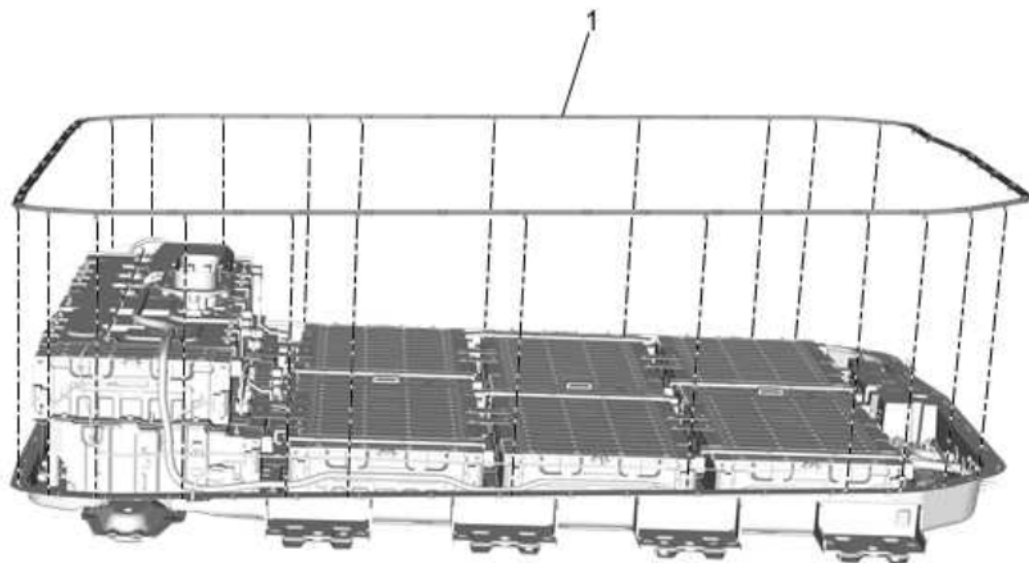


Fig. 33: Battery Cover Seal
 Courtesy of GENERAL MOTORS COMPANY

11. Install the battery cover seal (1). [Battery Cover Seal Replacement](#)
12. Install the battery upper cover. [Battery Upper Cover Replacement](#)
13. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)
[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built](#)

BATTERY COVER SEAL REPLACEMENT

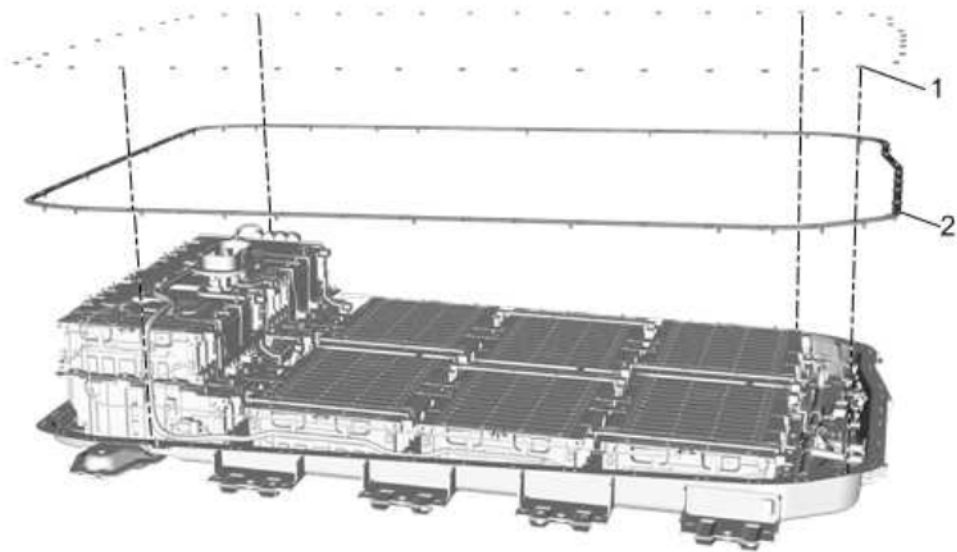


Fig. 34: Battery Cover Seal
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death. WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. Preliminary Procedure 1. Remove the drive motor battery. <u>Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)</u><u>Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)</u><u>Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)</u> 2. Remove the battery upper cover. <u>Battery Upper Cover Replacement</u> 3. Clean the sealing surface using acetone, toluene or methyl ethyl ketone.	
1	Battery Cover Seal Washer Procedure If needed, replace the old washer to new one. NOTE: Washers are not included with a new seal.
2	Battery Cover Seal NOTE: Make sure the seal washers are in battery upper cover bolt holes.

BATTERY ENERGY 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. cardiagn.com
- 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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. Remove the battery upper cover. [Battery Upper Cover Replacement](#)

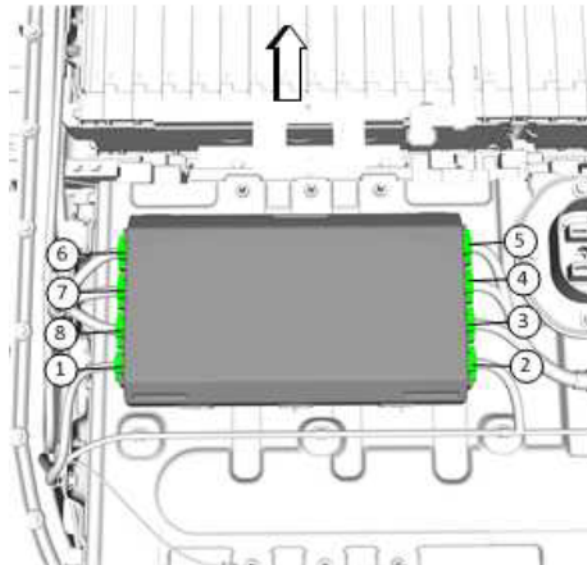


Fig. 35: Battery Energy Control Module Connectors In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: The battery energy control module may be damaged if the connector removal and installation sequence is not followed. If the battery energy control module is damaged, it must be replaced.

3. Disconnect the battery energy control module connectors in the sequence shown.

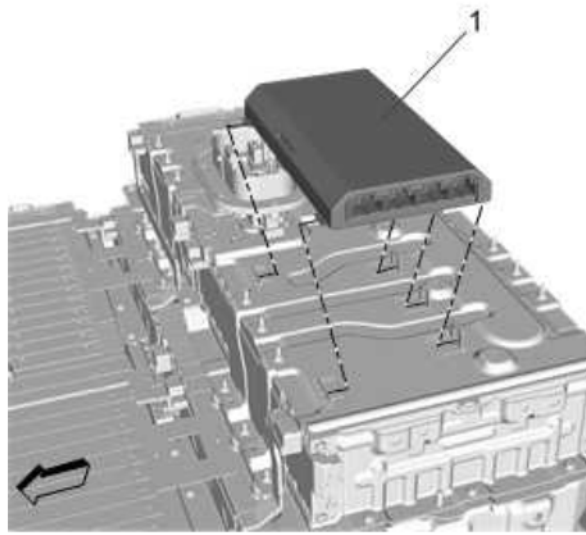


Fig. 36: Battery Energy Control Module
Courtesy of GENERAL MOTORS COMPANY

4. Remove the battery energy control module (1).

Installation Procedure

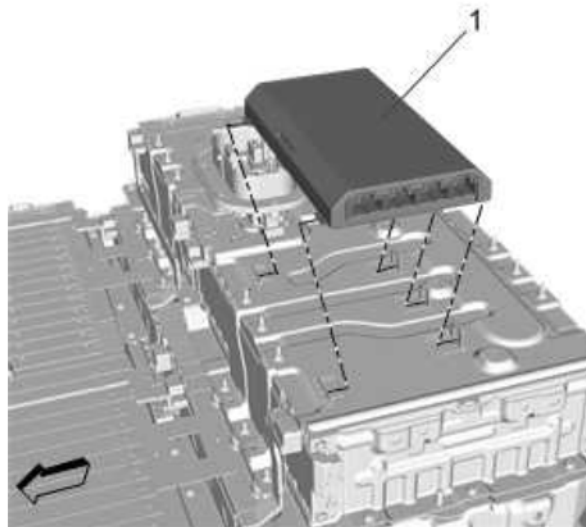
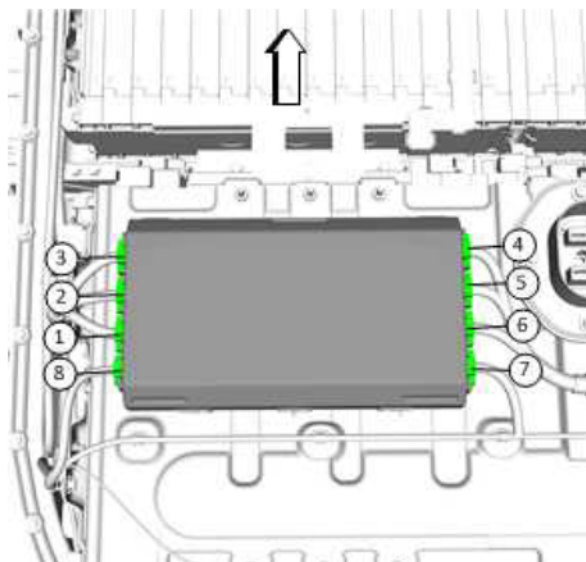


Fig. 37: Battery Energy Control Module
Courtesy of GENERAL MOTORS COMPANY

1. Install the battery energy control module (1).



CAUTION: The battery energy control module may be damaged if the connector removal and installation sequence is not followed. If the battery energy control module is damaged, it must be replaced.

2. Connect the battery energy control module connectors in the sequence shown to the battery energy control module.
3. Install the battery upper cover. [Battery Upper Cover Replacement](#)
4. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

300-VOLT BATTERY POSITIVE AND NEGATIVE CABLE REPLACEMENT (GENERATOR BATTERY CONTROL WIRING JUNCTION BLOCK TO DRIVE MOTOR BATTERY)

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. [High Voltage Disabling](#)
2. Remove High Voltage Battery Control Wiring Junction Block [High Voltage Battery Control Wiring Junction Block Replacement \(With quick charge\)](#) [High Voltage Battery Control Wiring Junction Block Replacement \(Without quick charge\)](#)
3. Remove Drivetrain and Front Suspension Frame [Drivetrain and Front Suspension Frame Removal and Installation](#)

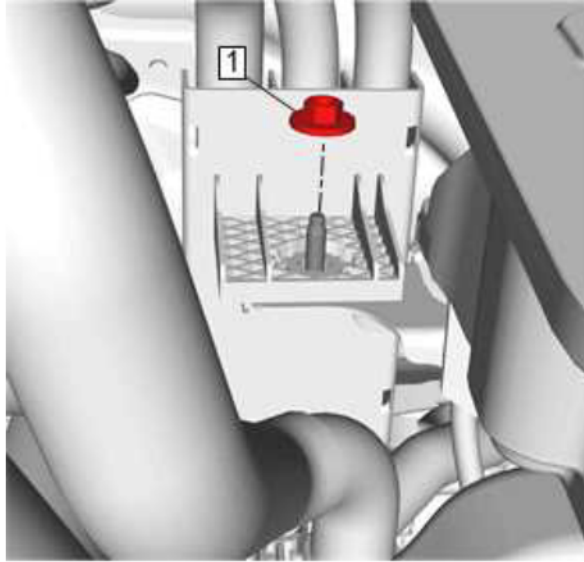


Fig. 39: High Voltage Cable Channel Nut
 Courtesy of GENERAL MOTORS COMPANY

4. Remove High Voltage Cable Channel Nut (1)

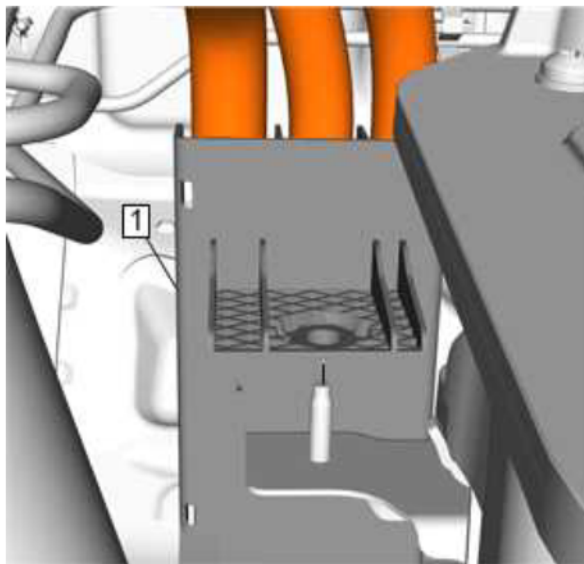


Fig. 40: High Voltage Cable Channel
 Courtesy of GENERAL MOTORS COMPANY

5. Remove High Voltage Cable Channel @Stud
6. Raise and support the vehicle.

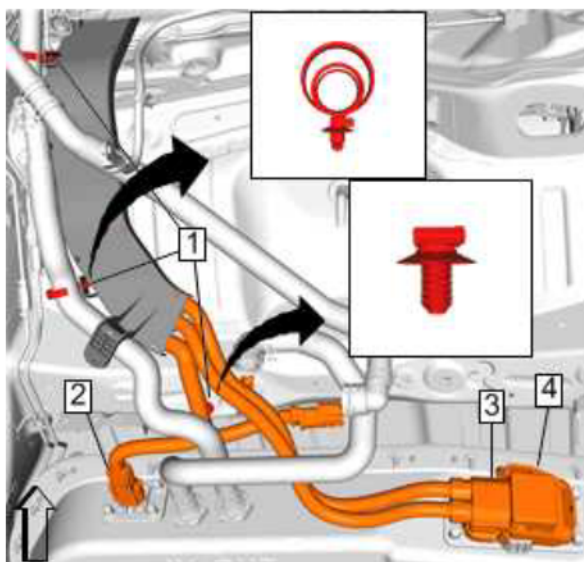


Fig. 41: RESS Heater Connector And Retainer
 Courtesy of GENERAL MOTORS COMPANY

7. Remove Retainer(1)
8. Disconnect RESS Heater Connector (2)
9. Sliding Forward 300-Volt Battery Positive and Negative Cable Electrical Connector Handle (4)
10. Release 300-Volt Battery Positive and Negative Cable(3)

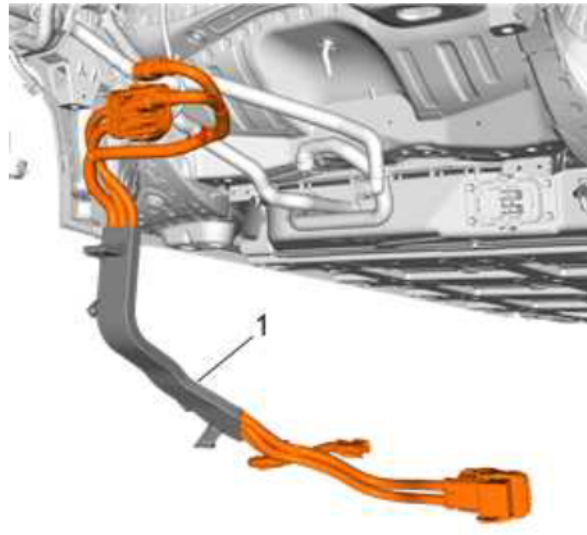


Fig. 42: 300-Volt Battery Positive And Negative Cable
Courtesy of GENERAL MOTORS COMPANY

11. Remove 300-Volt Battery Positive and Negative Cable

Installation Procedure

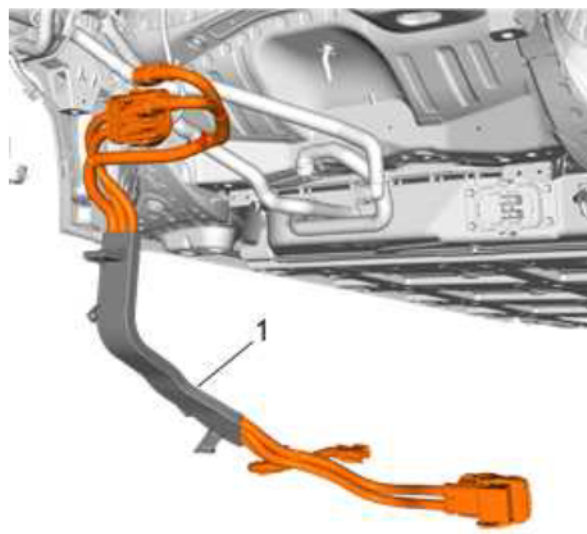


Fig. 43: 300-Volt Battery Positive And Negative Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install 300-Volt Battery Positive and Negative Cable

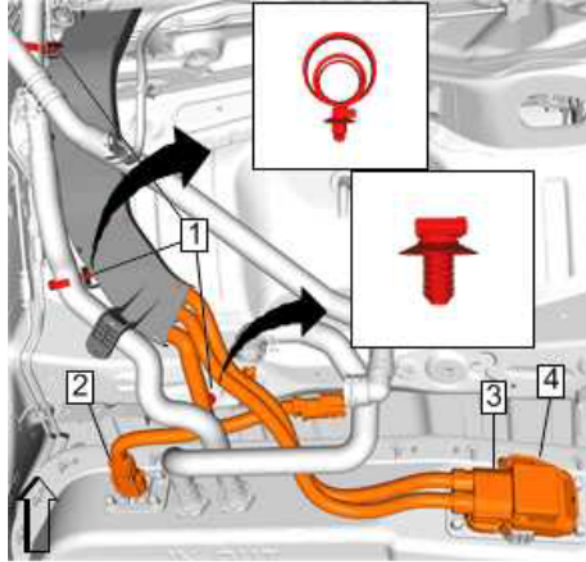


Fig. 44: RESS Heater Connector And Retainer
Courtesy of GENERAL MOTORS COMPANY

2. Install 300-Volt Battery Positive and Negative Cable(3)
3. Connect RESS Heater Connector (2)
4. Install Retainer(1)
5. Lower the vehicle.

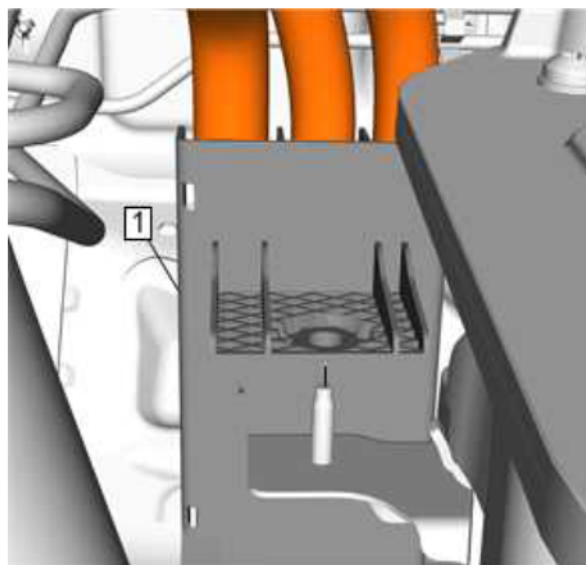
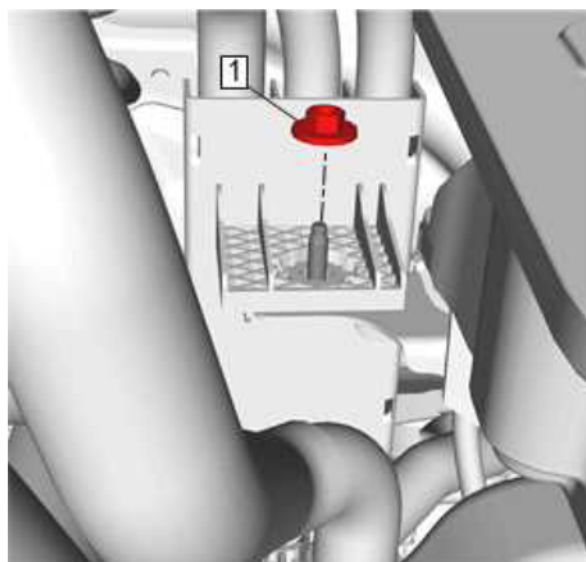


Fig. 45: High Voltage Cable Channel
Courtesy of GENERAL MOTORS COMPANY

6. Install High Voltage Cable Channel @Stud



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

7. Install High Voltage Cable Channel Nut (1) 9 N.m (80 lb in)
8. Install Drivetrain and Front Suspension Frame [Drivetrain and Front Suspension Frame Removal and Installation](#)
9. Install High Voltage Battery Control Wiring Junction Block [High Voltage Battery Control Wiring Junction Block Replacement \(With quick charge\)](#) [High Voltage Battery Control Wiring Junction Block Replacement \(Without quick charge\)](#)
10. Enable the high voltage system. [High Voltage Enabling](#)

BATTERY TO BATTERY POSITIVE 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. [High Voltage Disabling](#)
2. Remove Battery Tray [Battery Tray Replacement](#)

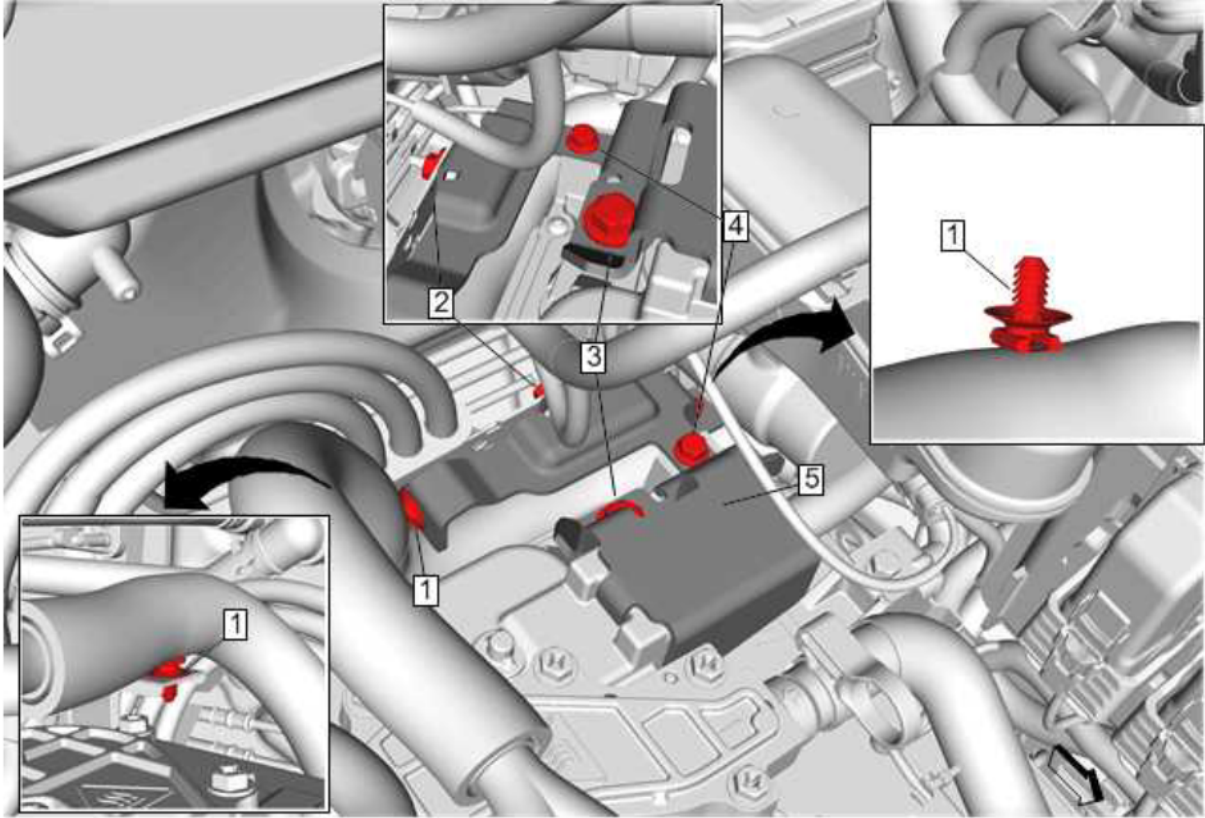


Fig. 47: DC Power Control Module High Voltage Connector Protector, Nut And Bolts
 Courtesy of GENERAL MOTORS COMPANY

3. Remove Battery Positive Cable Retainer (1)
4. Remove Accessory DC Power Control Module High Voltage Connector Protector Nut(2)
5. Remove Accessory DC Power Control Module High Voltage Connector Protector Bolt(3),(4)
6. Remove Accessory DC Power Control Module High Voltage Connector Protector(5)

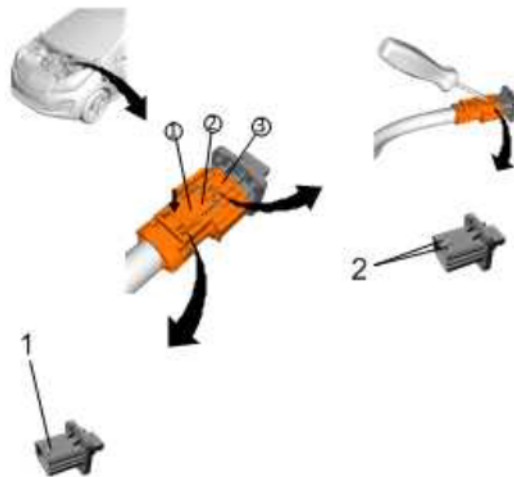


Fig. 48: First Stage Connector Tab And Connector Retaining Tabs
 Courtesy of GENERAL MOTORS COMPANY

7. 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).

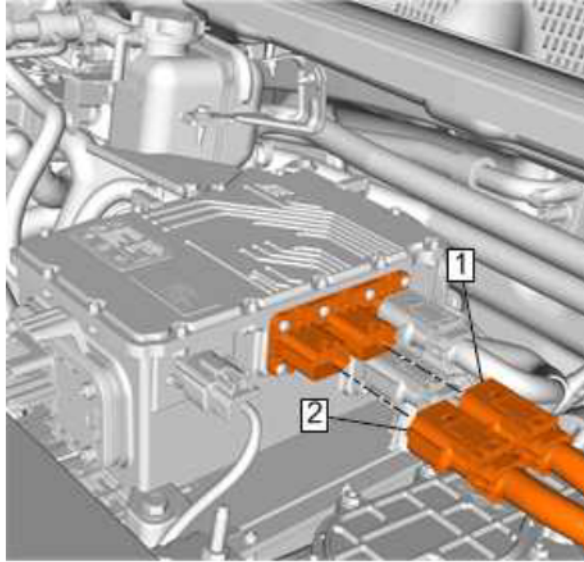


Fig. 49: Air Conditioning And Drive Motor Battery Cooling Compressor Connector
 Courtesy of GENERAL MOTORS COMPANY

8. After releasing the connectors, remove the air conditioning and drive motor battery cooling compressor connector (2) and the drive motor battery charger & accessory DC power control module connector (1) from the high voltage battery disconnect control module assembly.

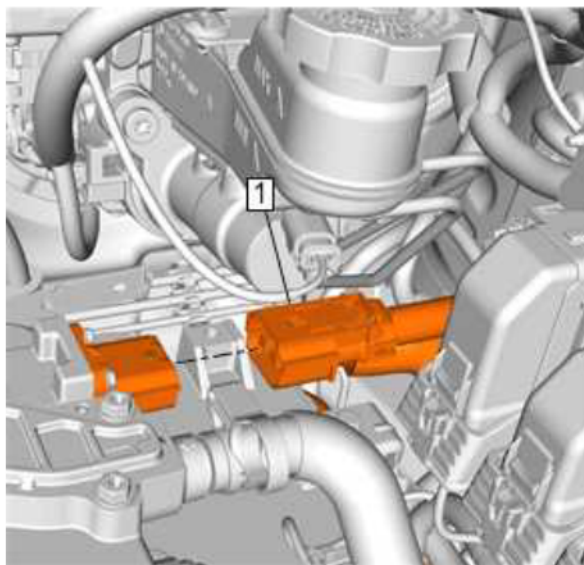
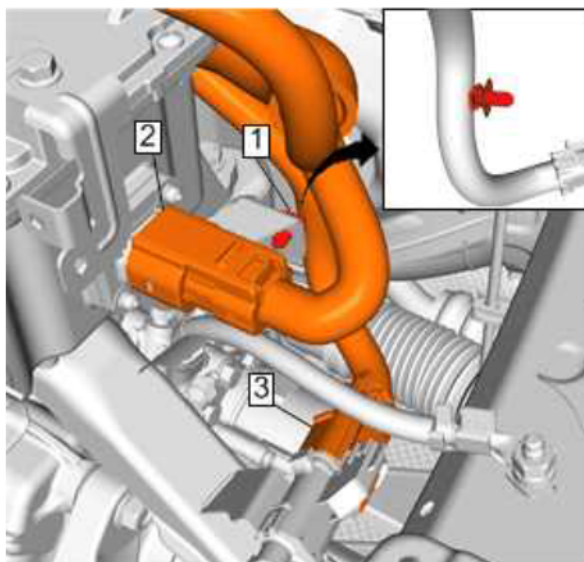


Fig. 50: Auxiliary Power Module Connector
 Courtesy of GENERAL MOTORS COMPANY

9. After releasing the connectors, remove the accessory DC power control module connector (1).



10. Remove the accessory DC power control module to drive motor battery charger cable retainer (1).
11. After releasing the 2-stage safety connectors, remove the drive motor battery charger electrical connector (2) and the air conditioning and drive motor battery cooling compressor connector (3).

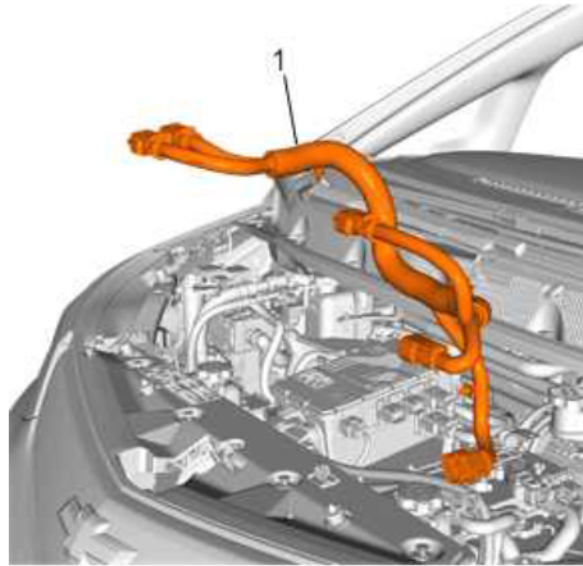


Fig. 52: Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

12. Remove the battery to battery positive cable.

Installation Procedure

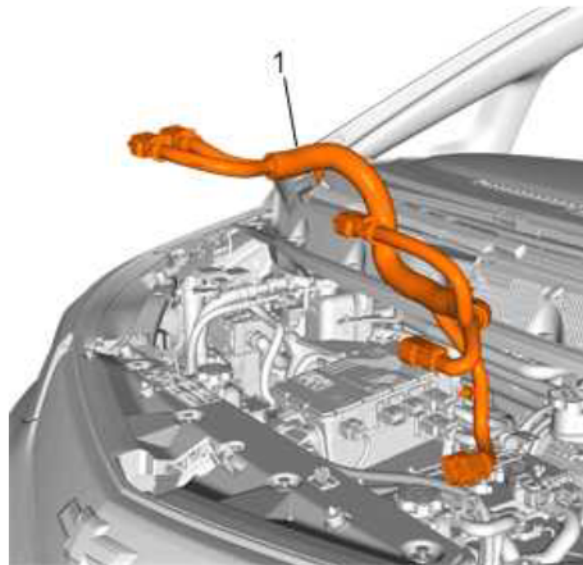


Fig. 53: Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install the battery to battery positive cable.

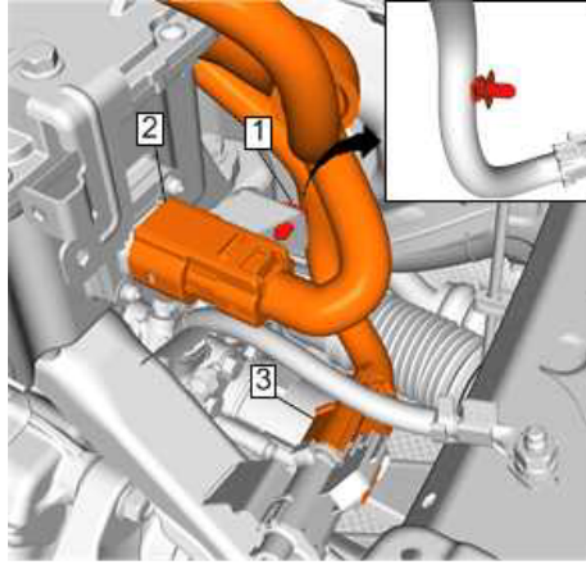


Fig. 54: Drive Motor Battery Charger Cable Retainer And Cooling Compressor Connector
 Courtesy of GENERAL MOTORS COMPANY

2. Install the drive motor battery charger electrical connector (2) and the air conditioning and drive motor battery cooling compressor connector (3).
3. Remove the accessory DC power control module to drive motor battery charger cable retainer (1).

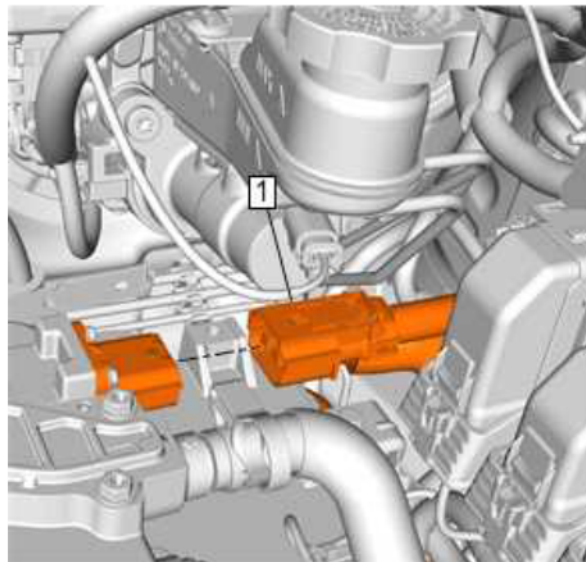
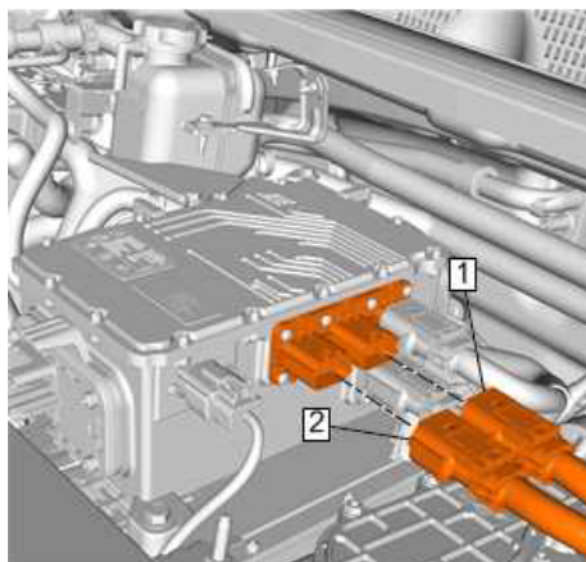
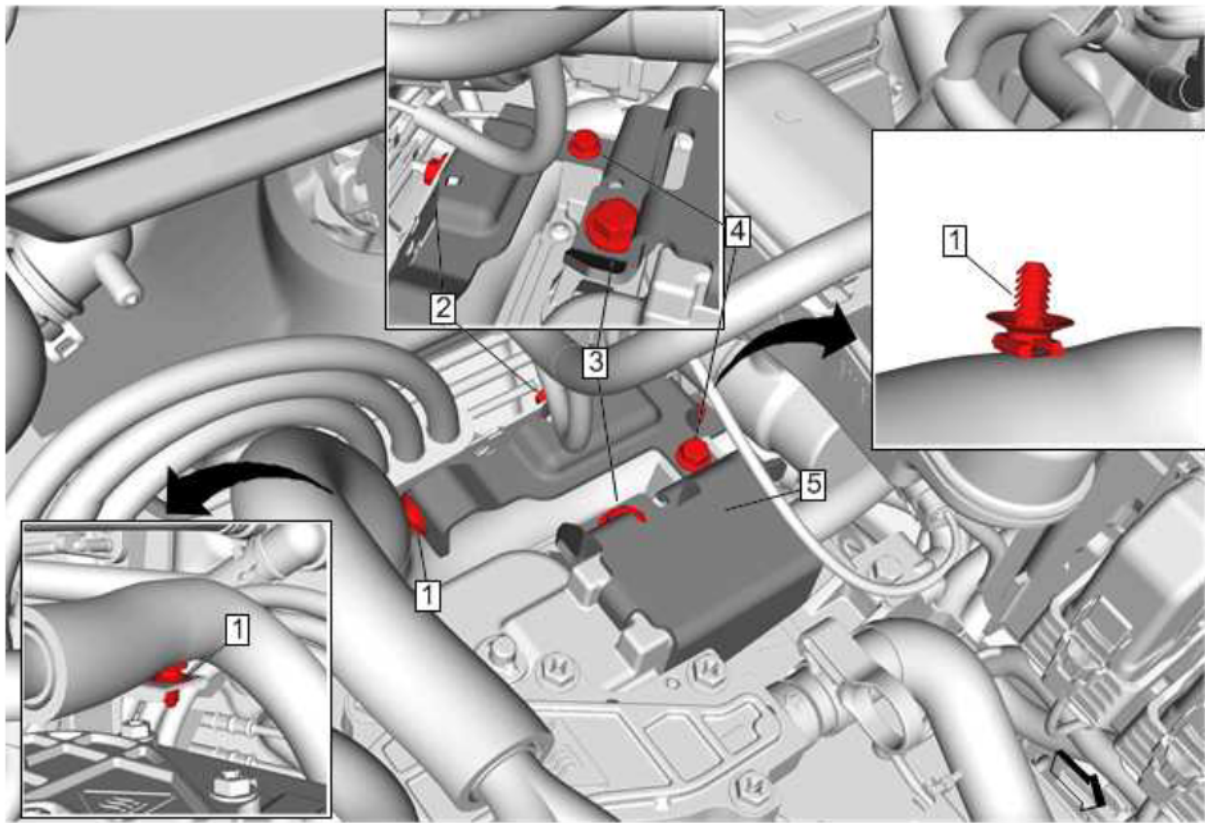


Fig. 55: Auxiliary Power Module Connector
 Courtesy of GENERAL MOTORS COMPANY

4. Install the accessory DC power control module connector (1).



5. Install the air conditioning and drive motor battery cooling compressor connector (2) and the drive motor battery charger & accessory DC power control module connector (1) to the high voltage battery disconnect control module assembly.



[Fig. 57: DC Power Control Module High Voltage Connector Protector, Nut And Bolts](#)
Courtesy of GENERAL MOTORS COMPANY

6. Install Accessory DC Power Control Module High Voltage Connector Protector(5)

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

7. Install Accessory DC Power Control Module High Voltage Connector Protector Bolt(4) 9 N.m (80 lb in)
8. Install Accessory DC Power Control Module High Voltage Connector Protector Bolt(3) 22 N.m (16 lb ft)
9. Install Accessory DC Power Control Module High Voltage Connector Protector Nut(2) 9 N.m (80 lb in)
10. Install Battery Positive Cable Retainer (1)
11. Install Battery Tray [Battery Tray Replacement](#)
12. Enable the high voltage system. [High Voltage Enabling](#)

CELL BATTERY MODULE REPLACEMENT (ROW 1)

Special Tools

EL-48264 Battery Lift Tool

For equivalent regional tools, refer to [Special Tools](#) .

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:

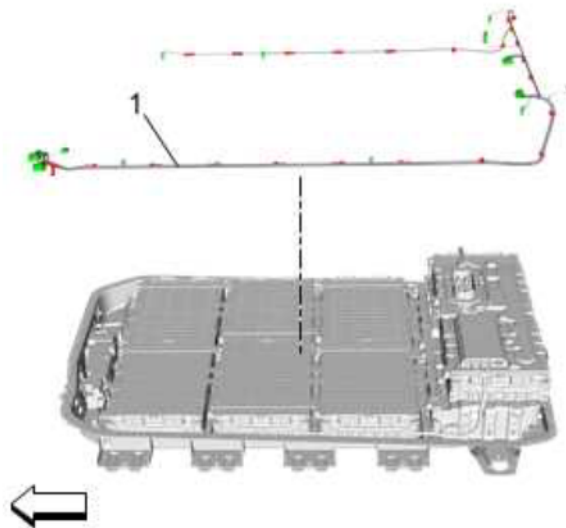
- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. Remove the battery upper cover. [Battery Upper Cover Replacement](#)



[Fig. 58: Drive Motor Battery Control Module Wiring Harness](#)
Courtesy of GENERAL MOTORS COMPANY

3. Remove the drive motor battery control module wiring harness (1). [Drive Motor Battery Control Module Wiring Harness Replacement](#)

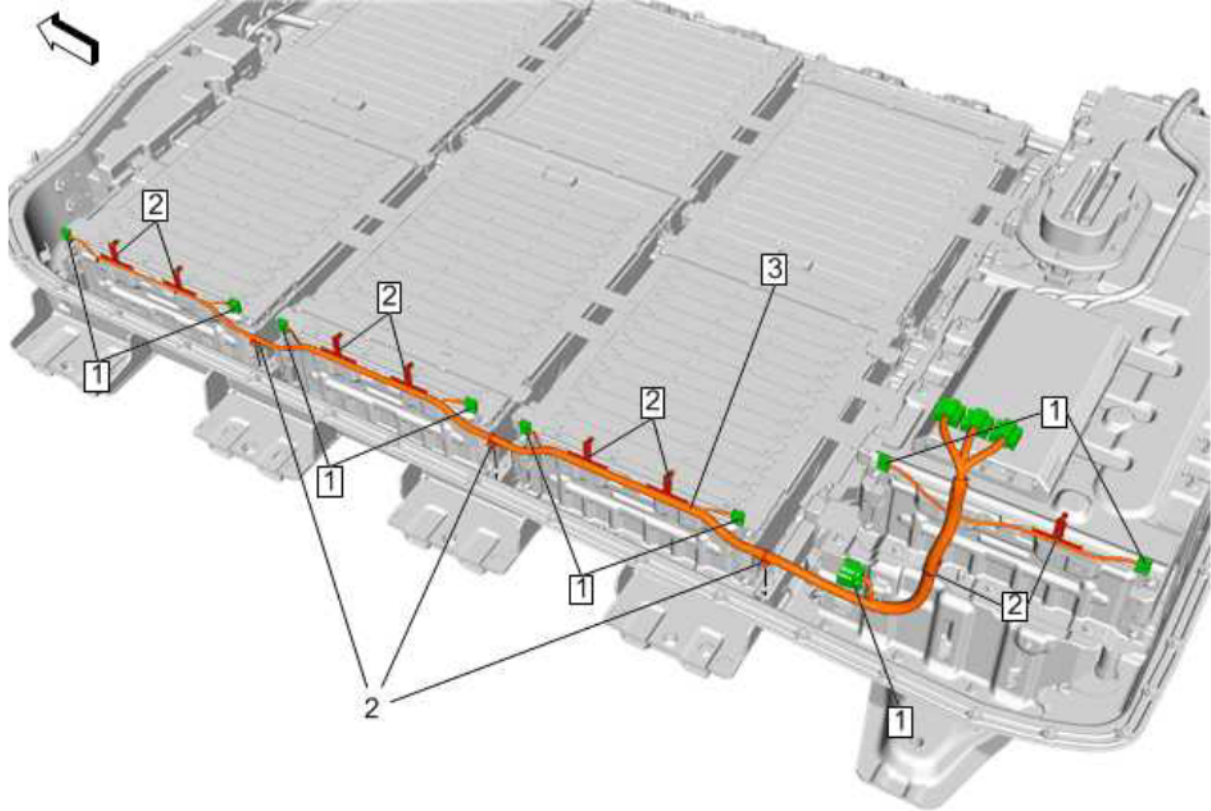


Fig. 59: Drive Motor Battery Sensor Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

4. Remove the drive motor battery sensor module wiring harness (3) - left side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)****Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)**

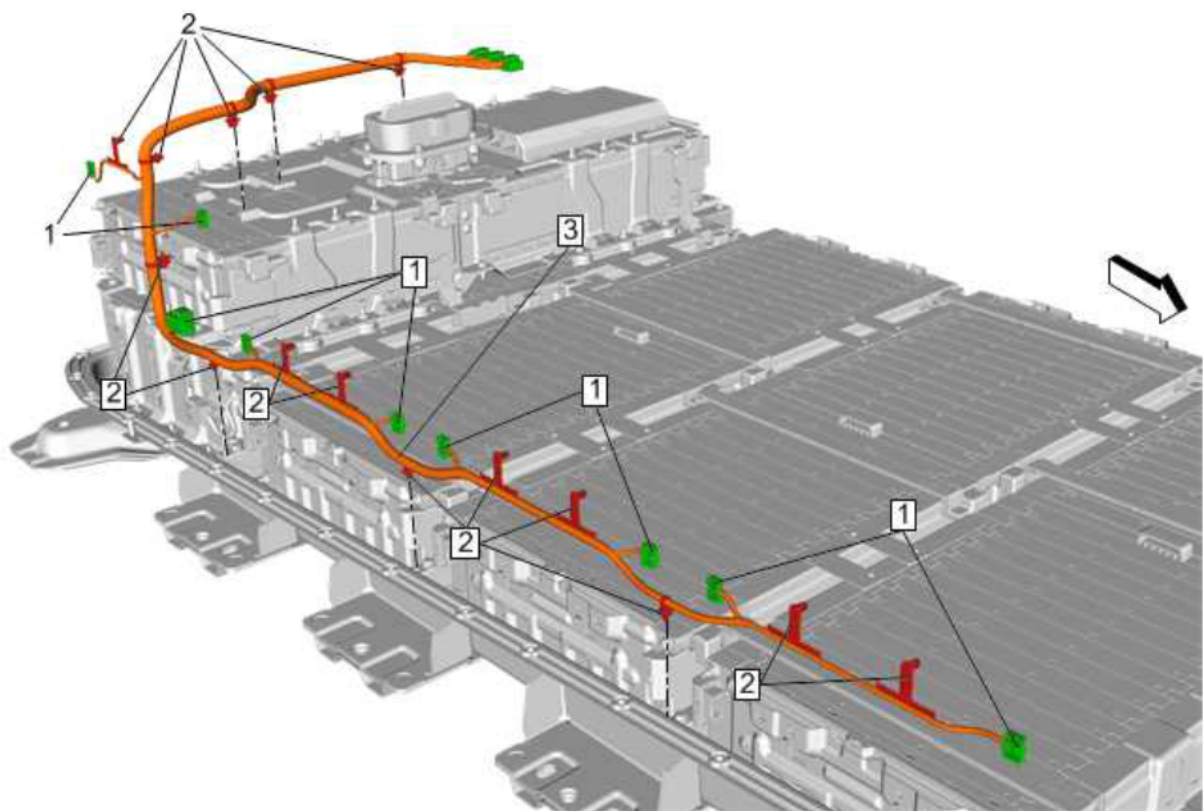


Fig. 60: Drive Motor Battery Sensor Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

5. Remove the drive motor battery sensor module wiring harness (3) - right side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)****Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)**

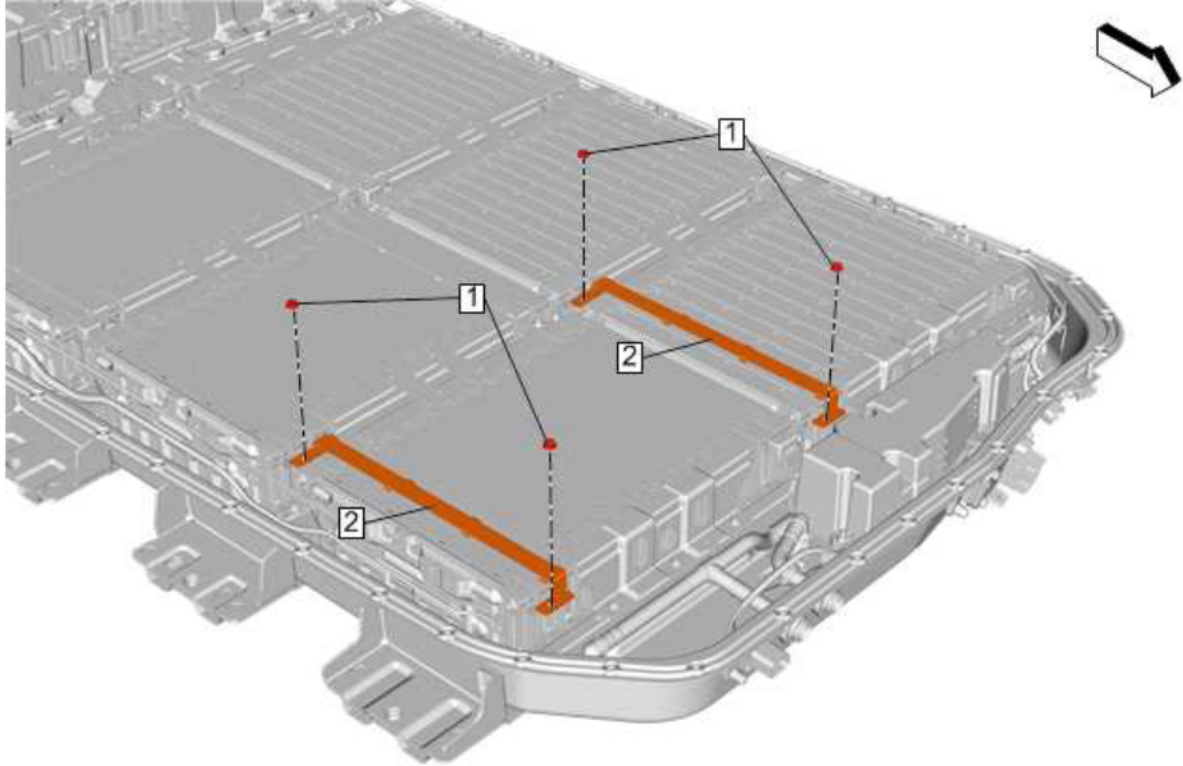
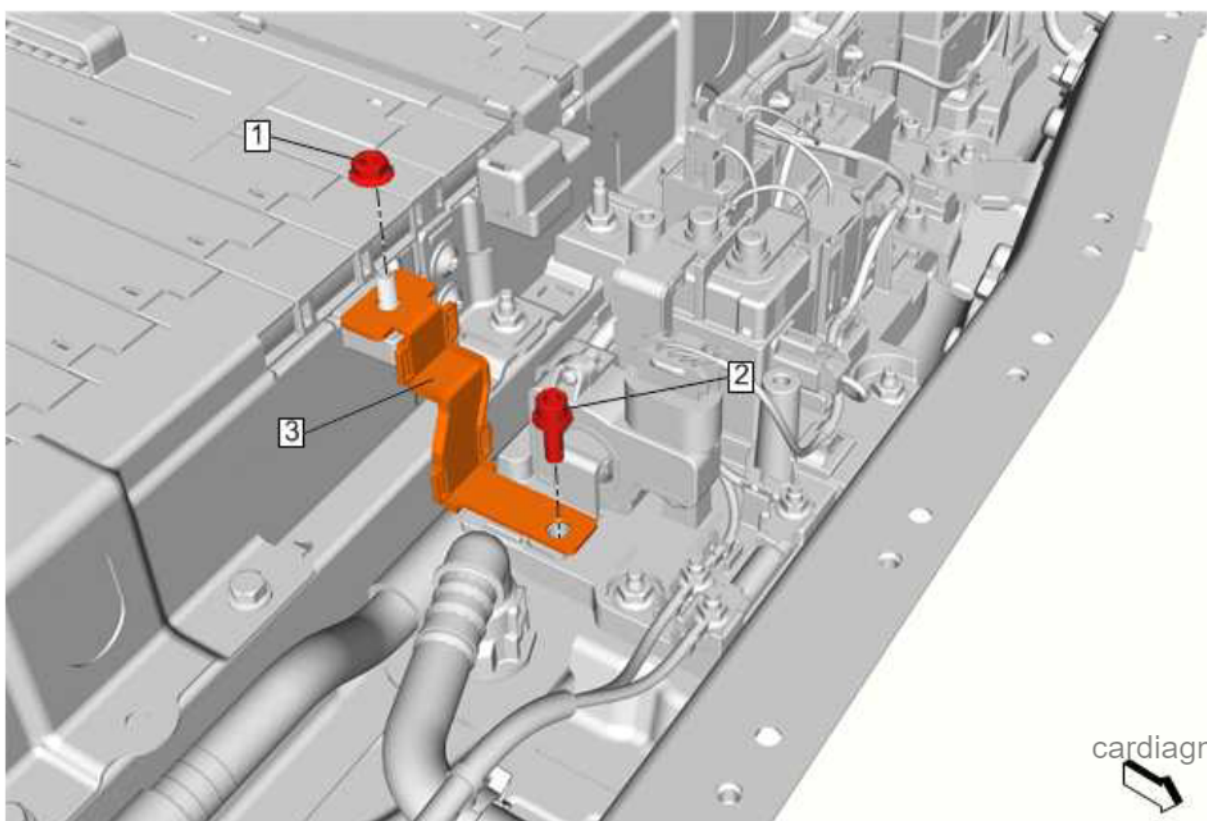


Fig. 61: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

6. Remove the battery cable (2) - bus bar, cell battery module 1 to cell battery module 2. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)



7. Remove the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, negative. [Battery Cable Replacement \(Bus Bar, Cell Battery Module 3 to Cell Battery Module 4\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 1 to Cell Battery Module 2\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 2 to Cell Battery Module 3\)](#)[Battery Cable Replacement \(Bus Bar, X3, Positive & Negative\)](#)

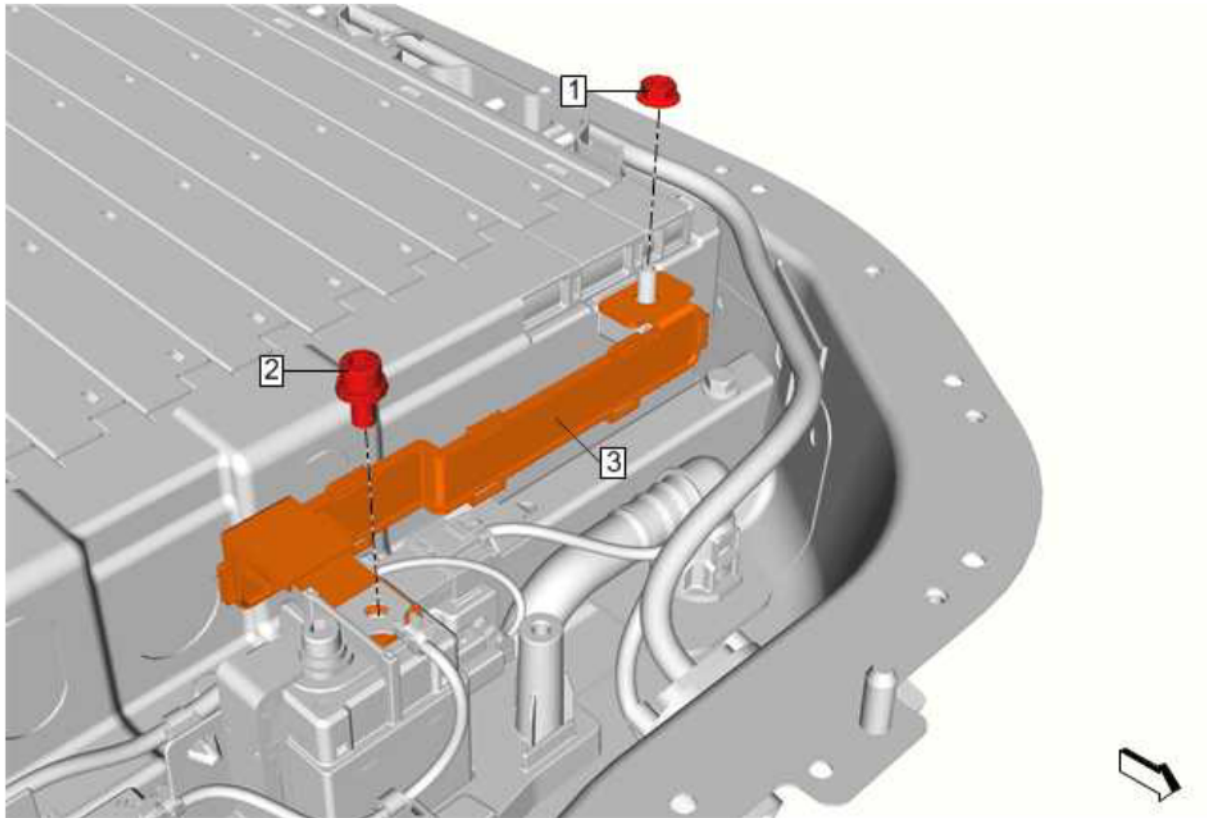


Fig. 63: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

8. Remove the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, positive. [Battery Cable Replacement \(Bus Bar, Cell Battery Module 3 to Cell Battery Module 4\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 1 to Cell Battery Module 2\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 2 to Cell Battery Module 3\)](#)[Battery Cable Replacement \(Bus Bar, X3, Positive & Negative\)](#)

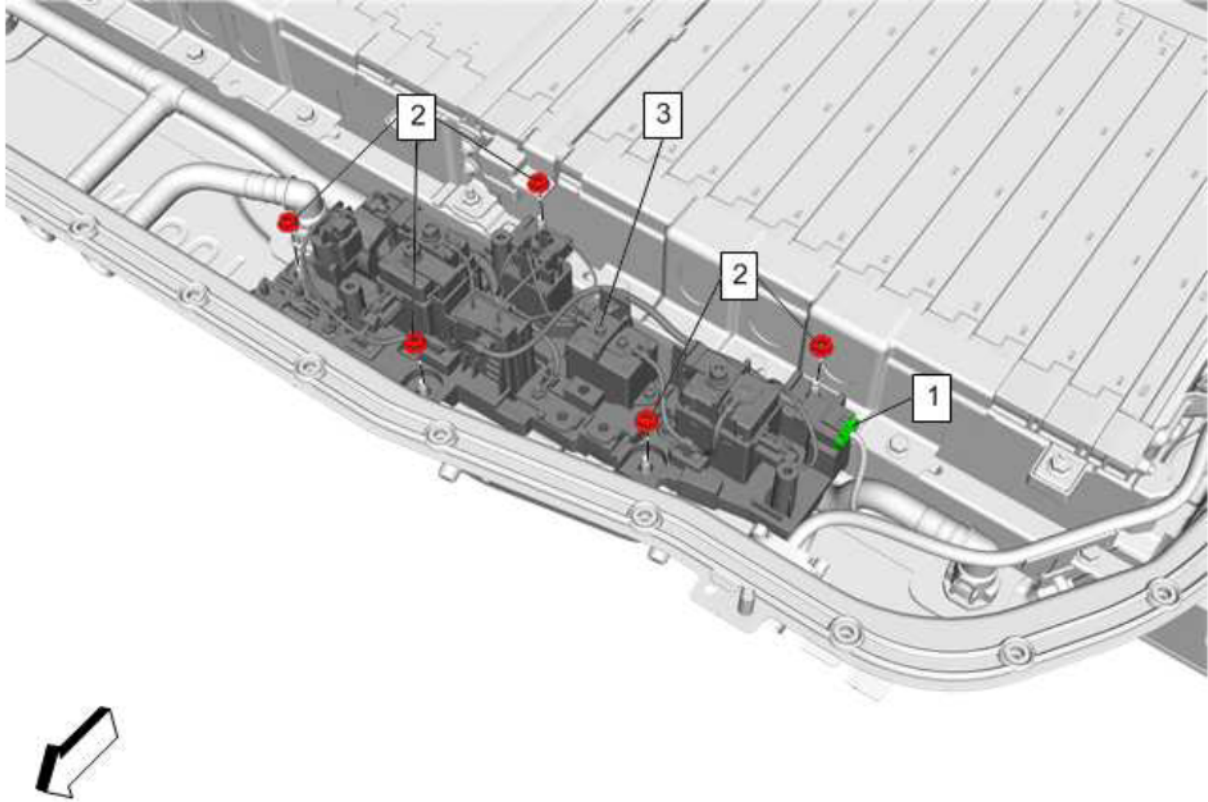


Fig. 64: High Voltage Battery Disconnect Relay Assembly

Courtesy of GENERAL MOTORS COMPANY

9. Remove the high voltage battery disconnect relay assembly (3). **High Voltage Battery Disconnect Relay Replacement**

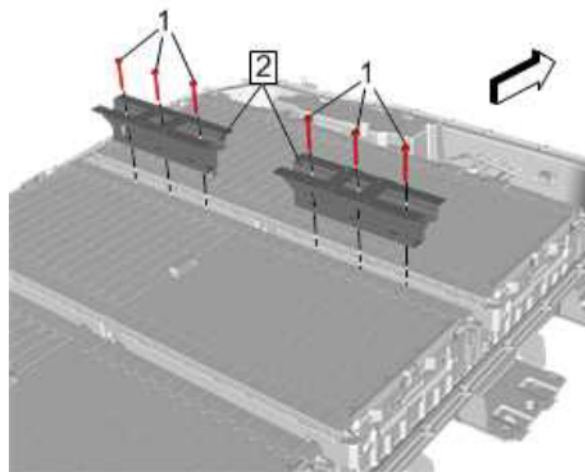


Fig. 65: Cell Battery Module Bracket Bolts And Brackets

Courtesy of GENERAL MOTORS COMPANY

10. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).

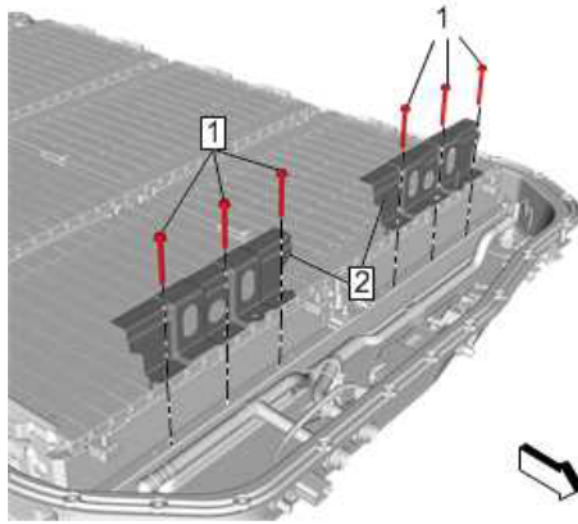


Fig. 66: Cell Battery Module Bracket Bolts And Brackets
 Courtesy of GENERAL MOTORS COMPANY

11. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).

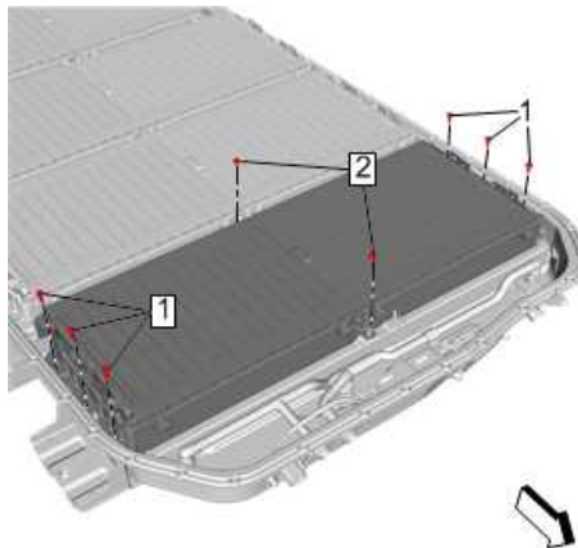


Fig. 67: Cell Battery Module Side Bolts And Nuts
 Courtesy of GENERAL MOTORS COMPANY

12. Remove the cell battery module side bolts (1) [6x].
13. Remove the cell battery module securing nuts (2) [2x].

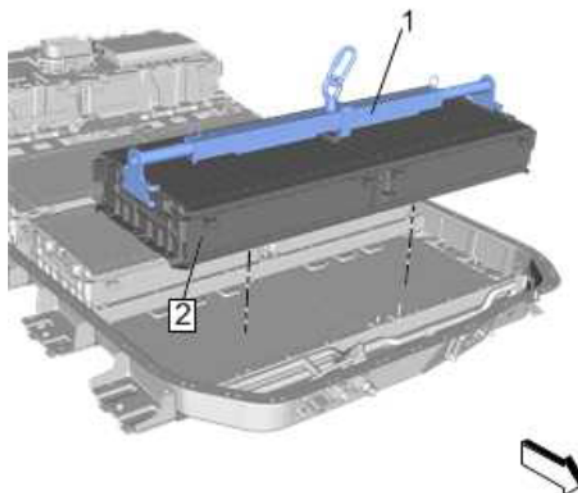


Fig. 68: Battery Lift Tool And Lift Cell Battery
 Courtesy of GENERAL MOTORS COMPANY

14. Use the **EL-48264** Battery Lift Tool (1) to lift the cell battery (2).

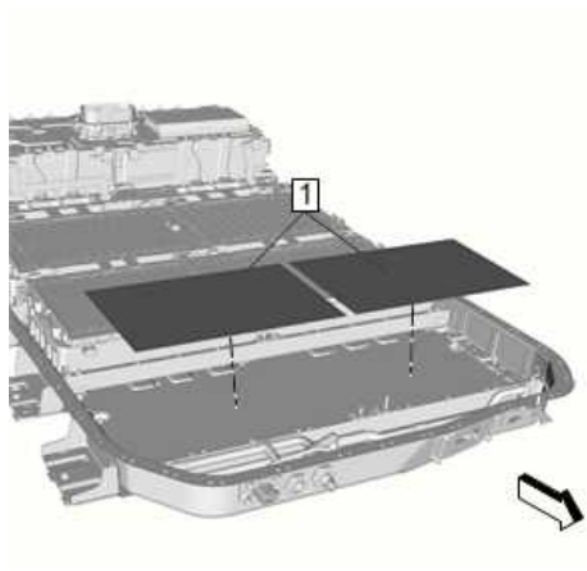


Fig. 69: Thermal Pads

Courtesy of GENERAL MOTORS COMPANY

15. Remove the thermal pads (1).

Installation Procedure

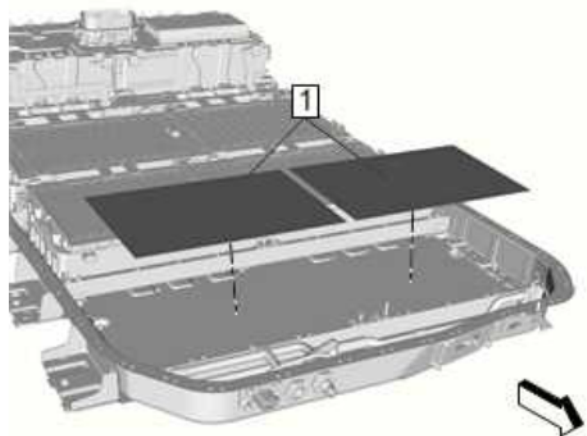


Fig. 70: Thermal Pads

Courtesy of GENERAL MOTORS COMPANY

NOTE: When installing the thermal pad, ensure there are no air bubbles during installation on the cold plate.

1. Install the thermal pads (1).

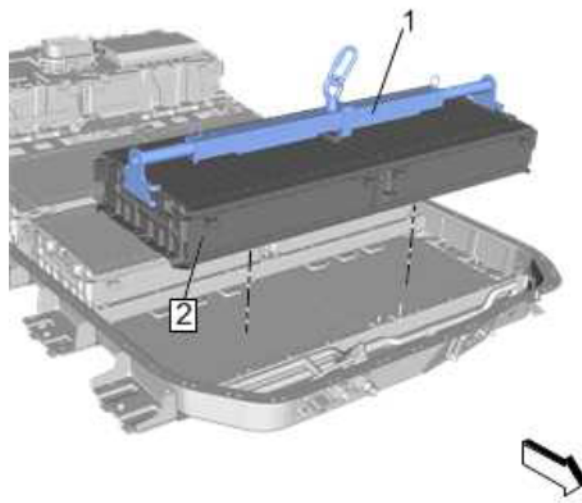


Fig. 71: Battery Lift Tool And Lift Cell Battery
 Courtesy of GENERAL MOTORS COMPANY

2. Use the **EL-48264** Battery Lift Tool (1) to install the cell battery (2).

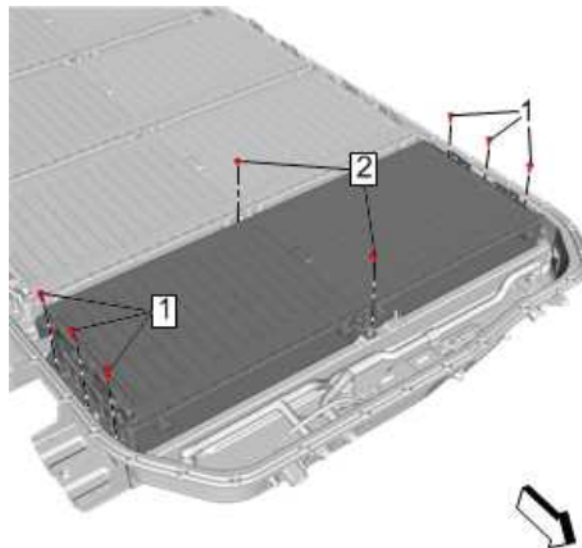


Fig. 72: Cell Battery Module Side Bolts And Nuts
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

3. Tighten the cell battery module securing nuts (2) [2x] to 9 N.m (90 lb in).
4. Tighten the cell battery module side bolts (1) [6x] to 9 N.m (80 lb in).

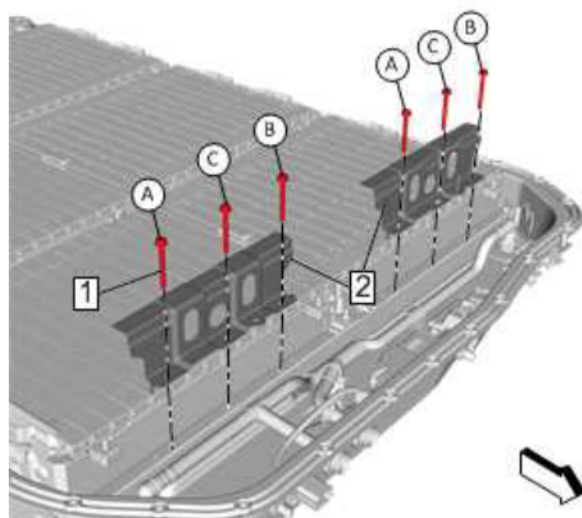


Fig. 73: Cell Battery Module Bracket Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the cell battery module bracket bolts in the sequence shown.

5. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

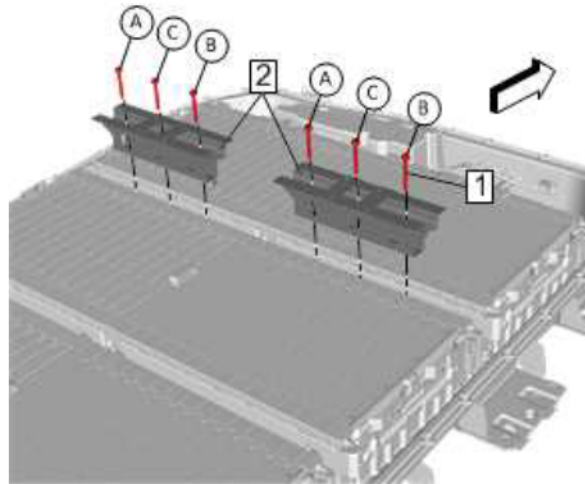


Fig. 74: Cell Battery Module Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the cell battery module bracket bolts in the sequence shown.

6. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

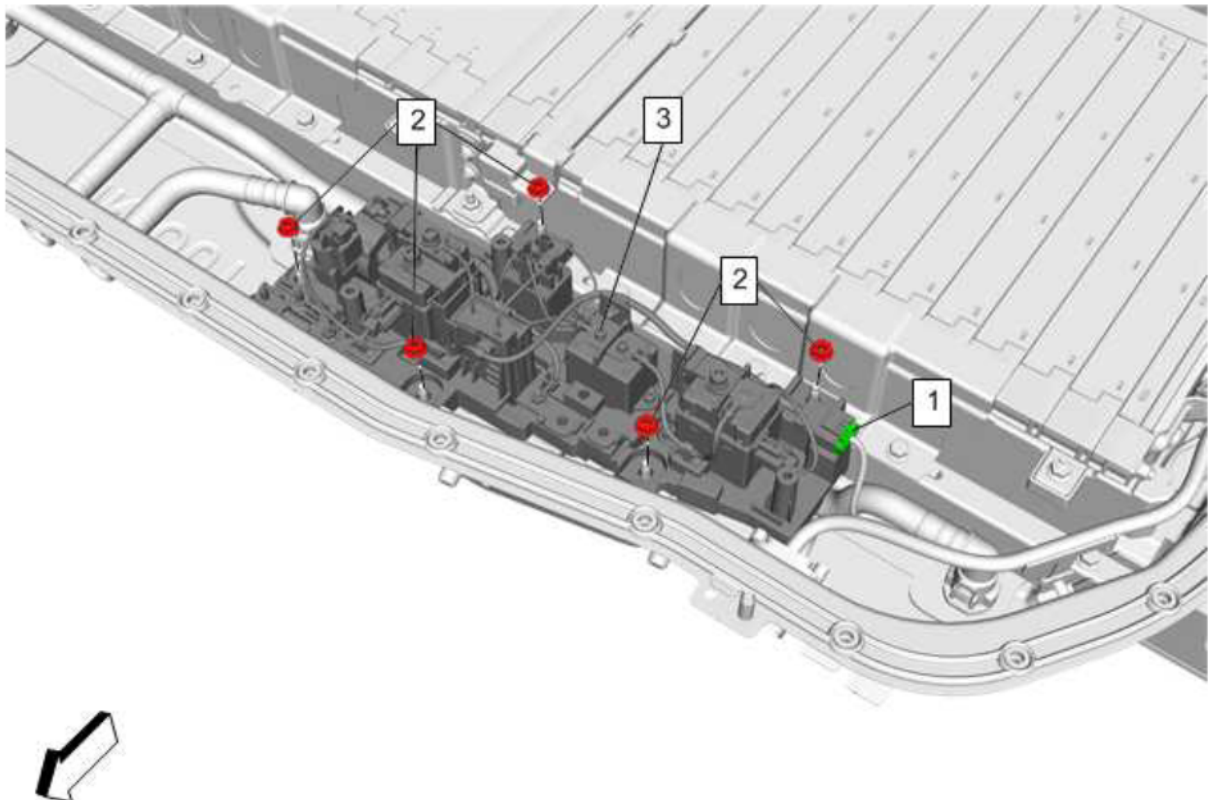


Fig. 75: High Voltage Battery Disconnect Relay Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Install the high voltage battery disconnect relay assembly (3). **High Voltage Battery Disconnect Relay Replacement**

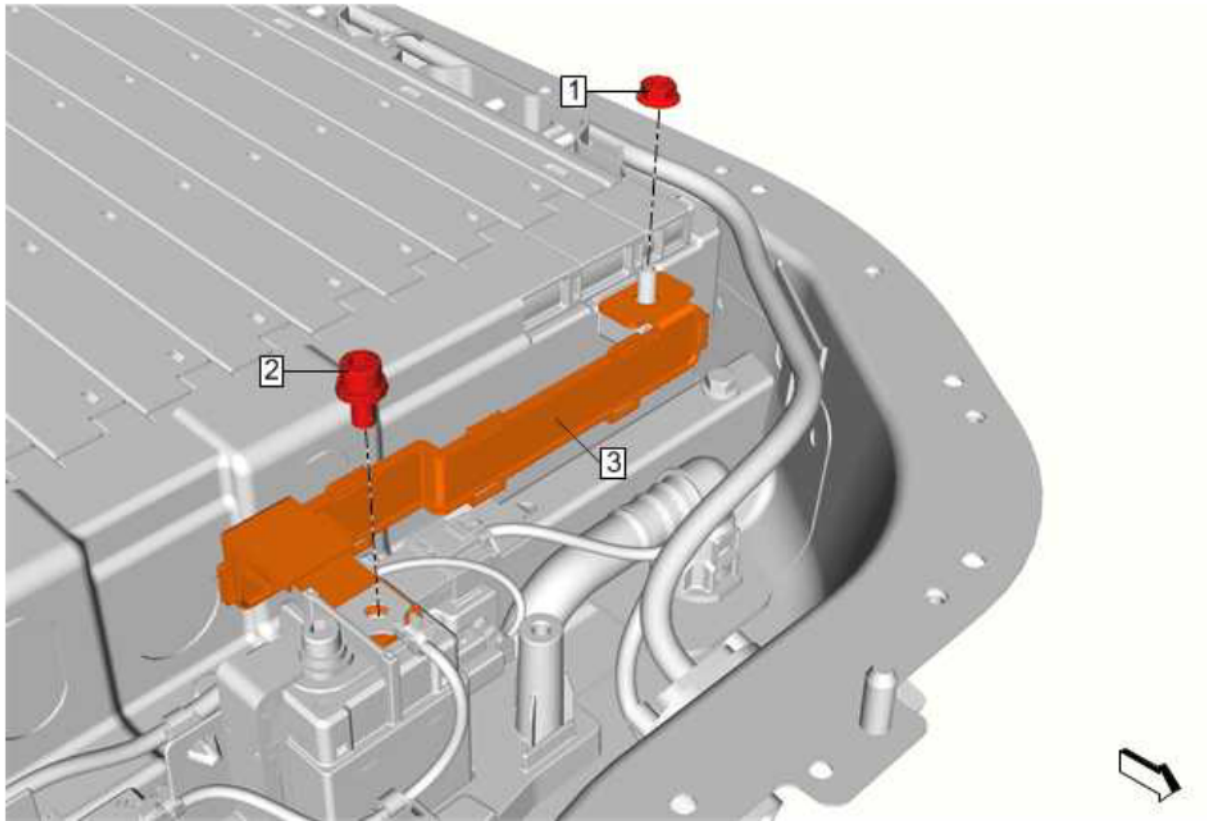


Fig. 76: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

8. Install the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, positive. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)****Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)****Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)****Battery Cable Replacement (Bus Bar, X3, Positive & Negative)**

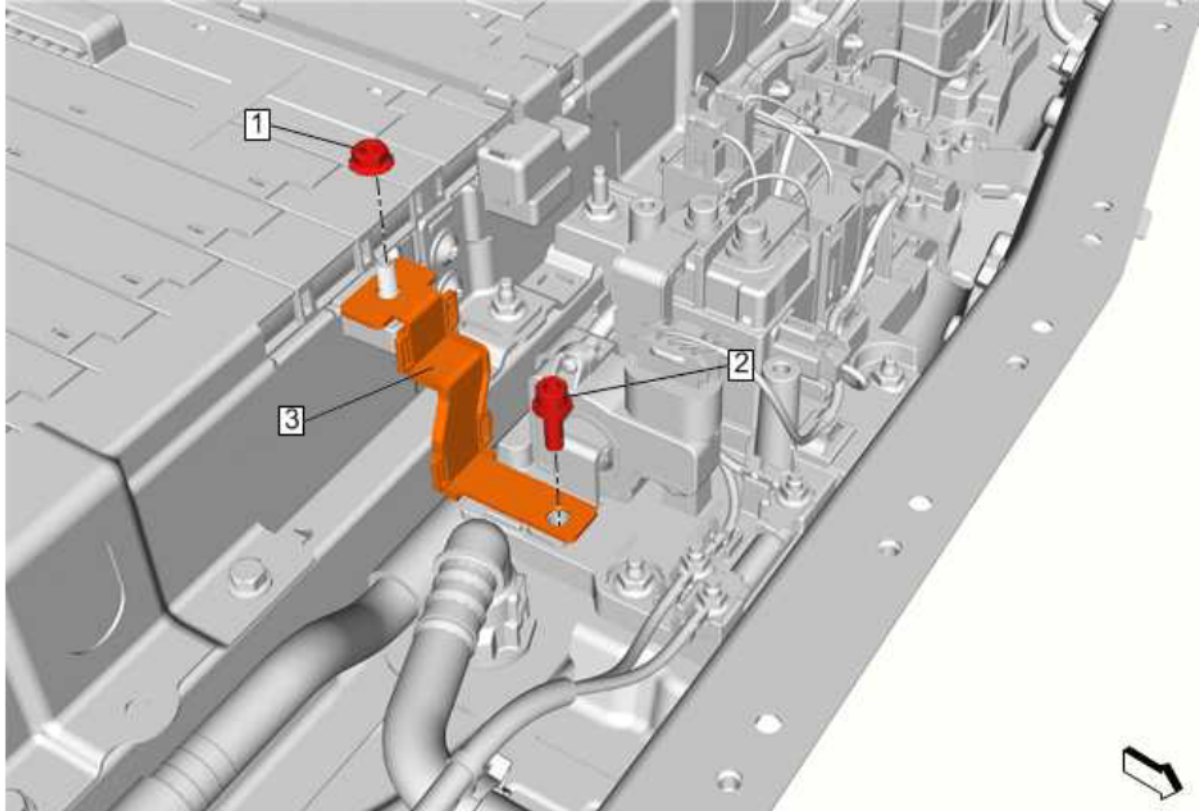
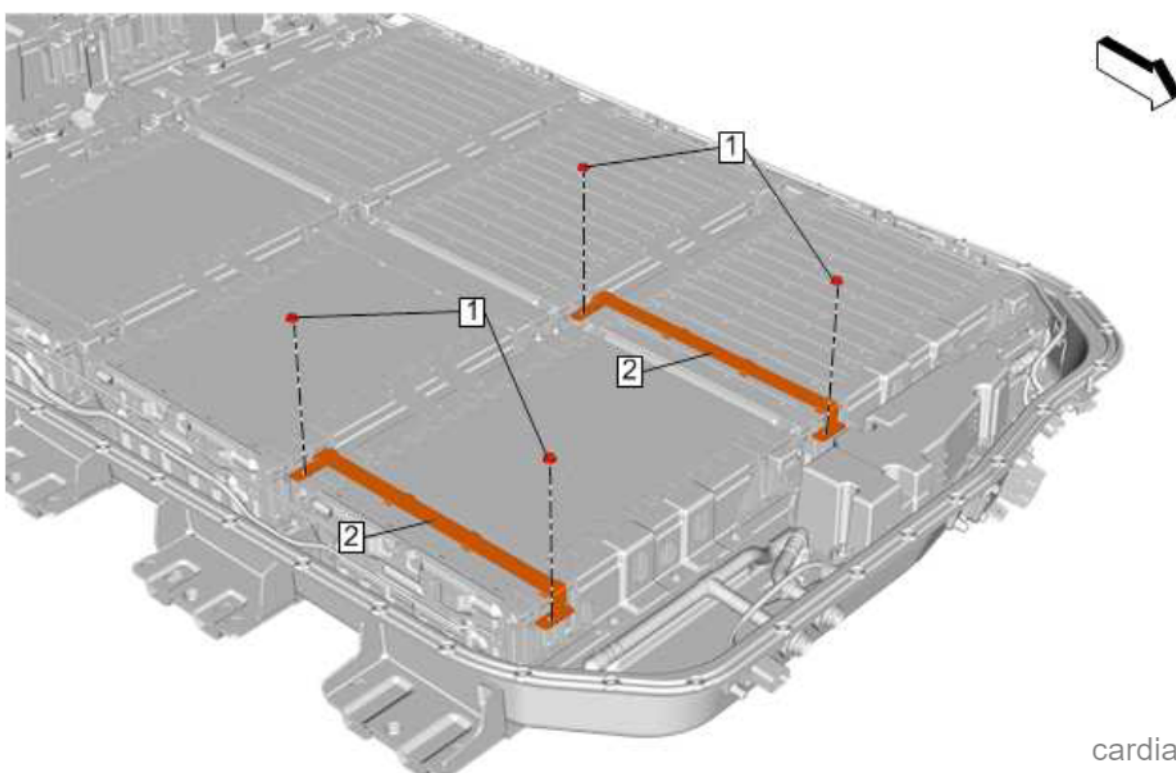


Fig. 77: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

9. Install the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, negative. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)



10. Install the battery cable (2) - bus bar, cell battery module 1 to cell battery module 2. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)****Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)****Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)****Battery Cable Replacement (Bus Bar, X3, Positive & Negative)**

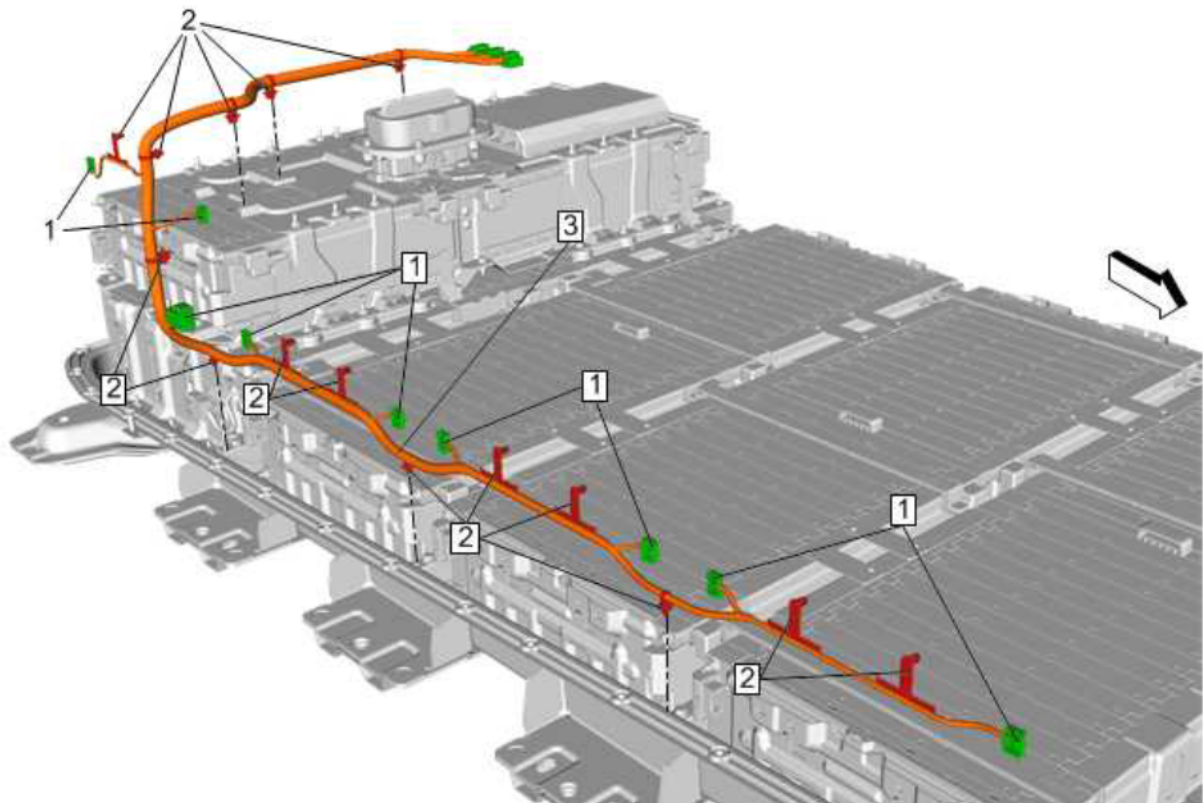


Fig. 79: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

11. Install the drive motor battery sensor module wiring harness (3) - right side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)****Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)****Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)****Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)**

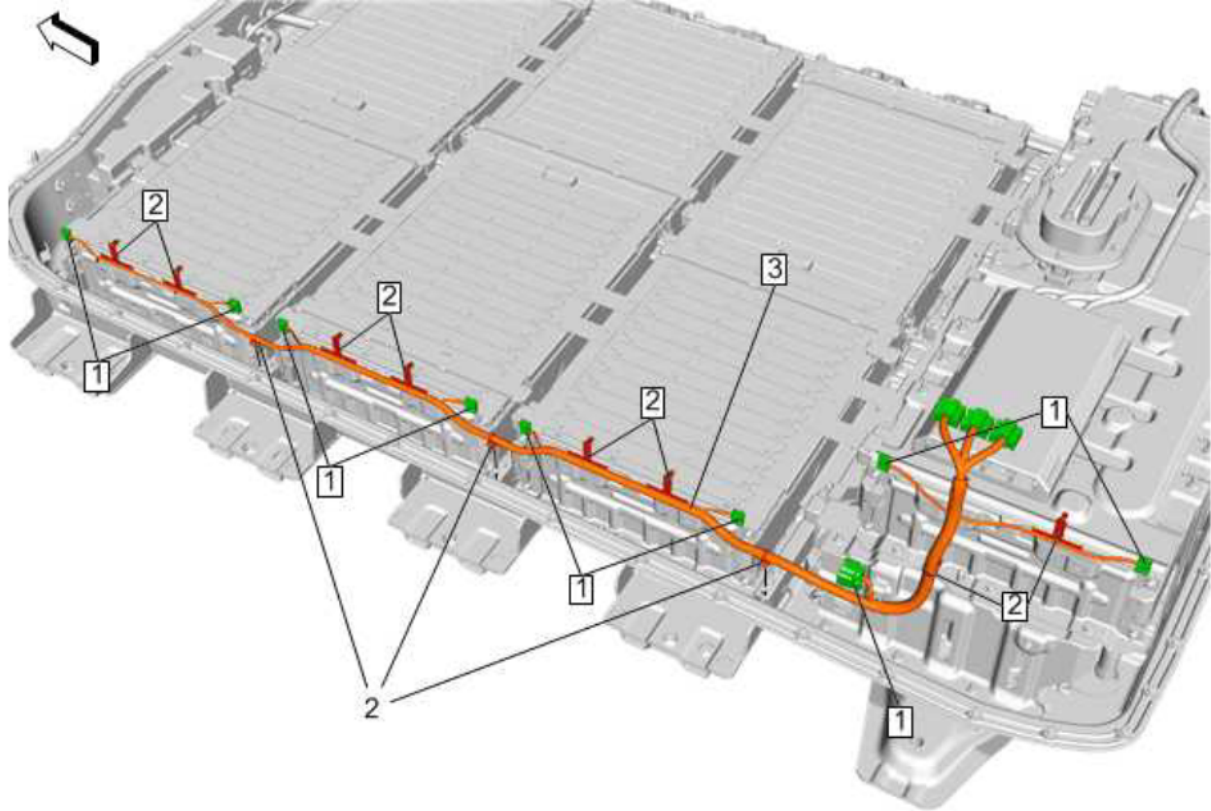


Fig. 80: Drive Motor Battery Sensor Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

12. Install the drive motor battery sensor module wiring harness (3) - left side. [Drive Motor Battery Sensor Module Wiring Harness Replacement \(Left\)](#)[Drive Motor Battery Sensor Module Wiring Harness Replacement \(Right\)](#)[Drive Motor Battery Sensor Module Wiring Harness Replacement \(LH, Sub\)](#)[Drive Motor Battery Sensor Module Wiring Harness Replacement \(RH, Sub\)](#)

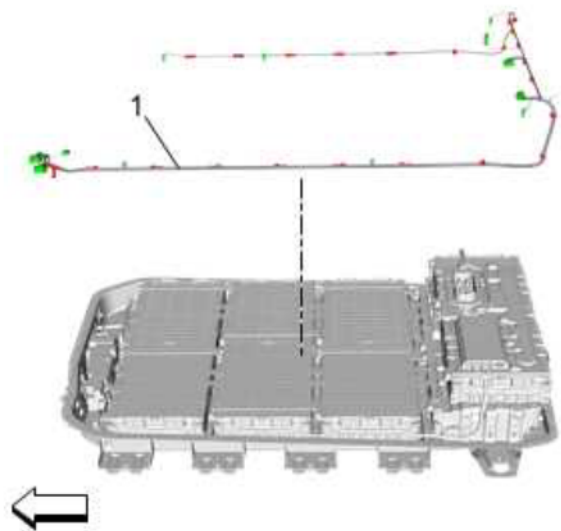


Fig. 81: Drive Motor Battery Control Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

13. Install the drive motor battery control module wiring harness (1). [Drive Motor Battery Control Module Wiring Harness Replacement](#)
14. Perform the cell battery balancing if replaced. [Hybrid/EV Battery Cell Balancing](#)
15. Install the battery upper cover. [Battery Upper Cover Replacement](#)
16. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

17. Reprogram the battery energy control module. [Battery Energy Control Module Programming and Setup](#)
18. Program the hybrid powertrain control module 2. [Hybrid Powertrain Control Module 2 Programming and Setup](#)
19. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. [Hybrid/EV Battery Pack Capacity Learn](#)

NOTE: Refer to Diagnostic Aids to determine when, if required procedure should be performed.

CELL BATTERY MODULE REPLACEMENT (ROW 2)

Special Tools

EL-48264 Battery Lift Tool

For equivalent regional tools, refer to [Special Tools](#).

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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. Remove the battery upper cover. [Battery Upper Cover Replacement](#)

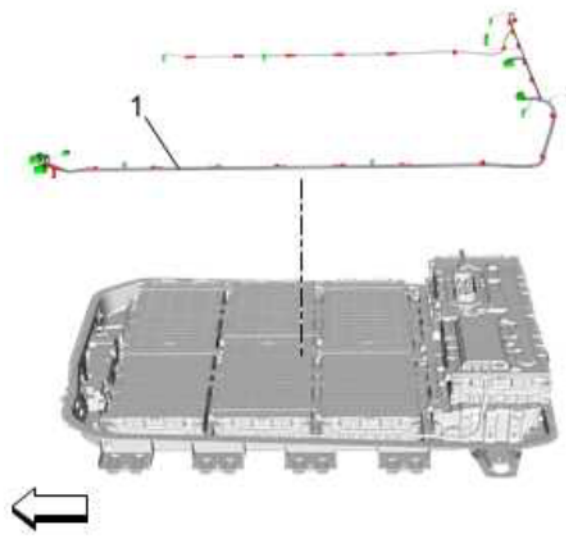


Fig. 82: Drive Motor Battery Control Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

3. Remove the drive motor battery control module wiring harness (1). **Drive Motor Battery Control Module Wiring Harness Replacement**

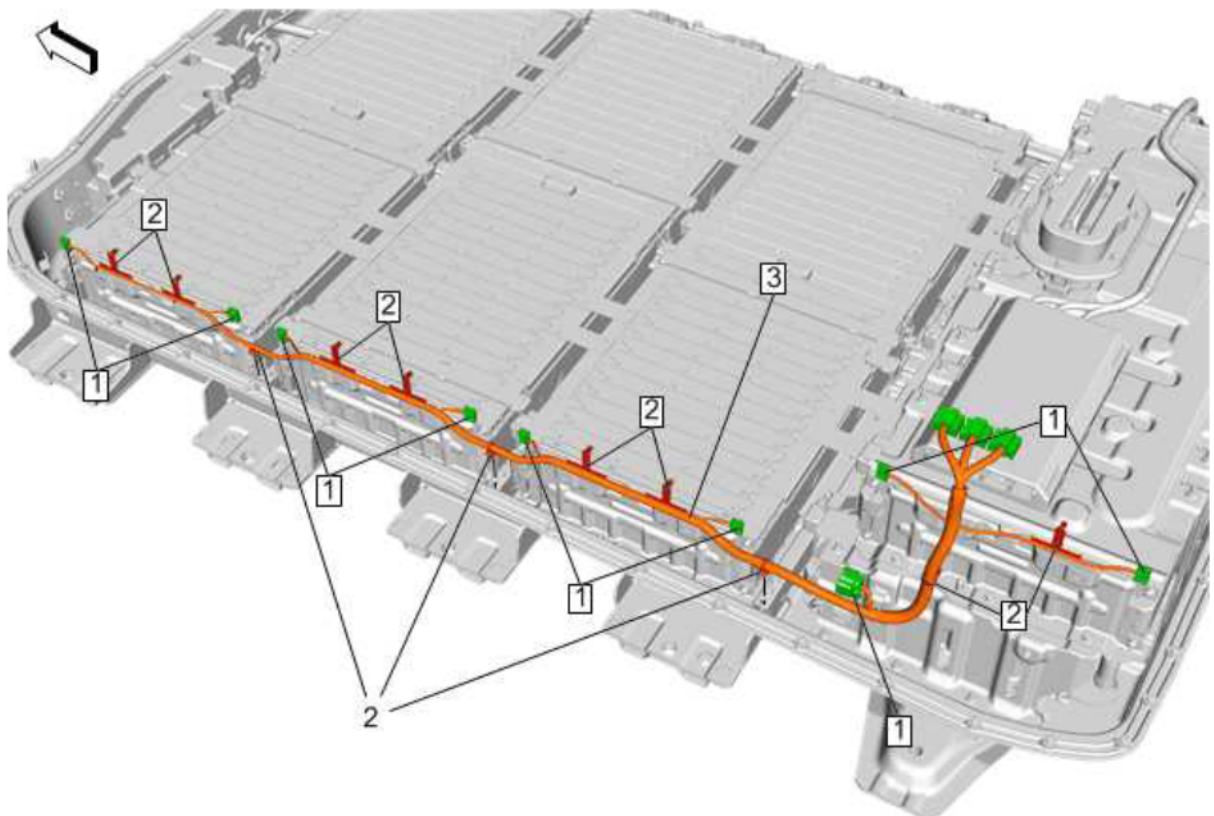


Fig. 83: Drive Motor Battery Sensor Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

4. Remove the drive motor battery sensor module wiring harness (3) - left side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)****Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)****Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)****Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)**

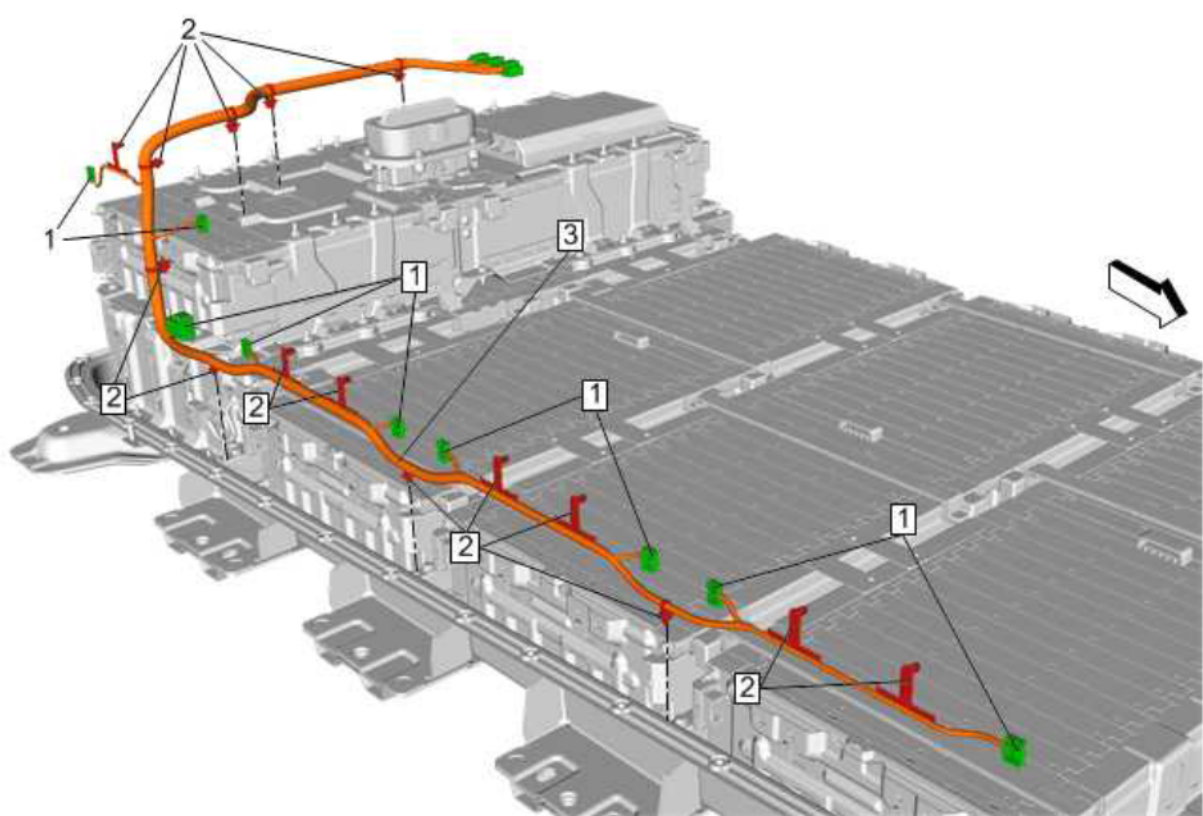


Fig. 84: Drive Motor Battery Sensor Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

5. Remove the drive motor battery sensor module wiring harness (3) - right side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)****Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)****Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)****Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)**

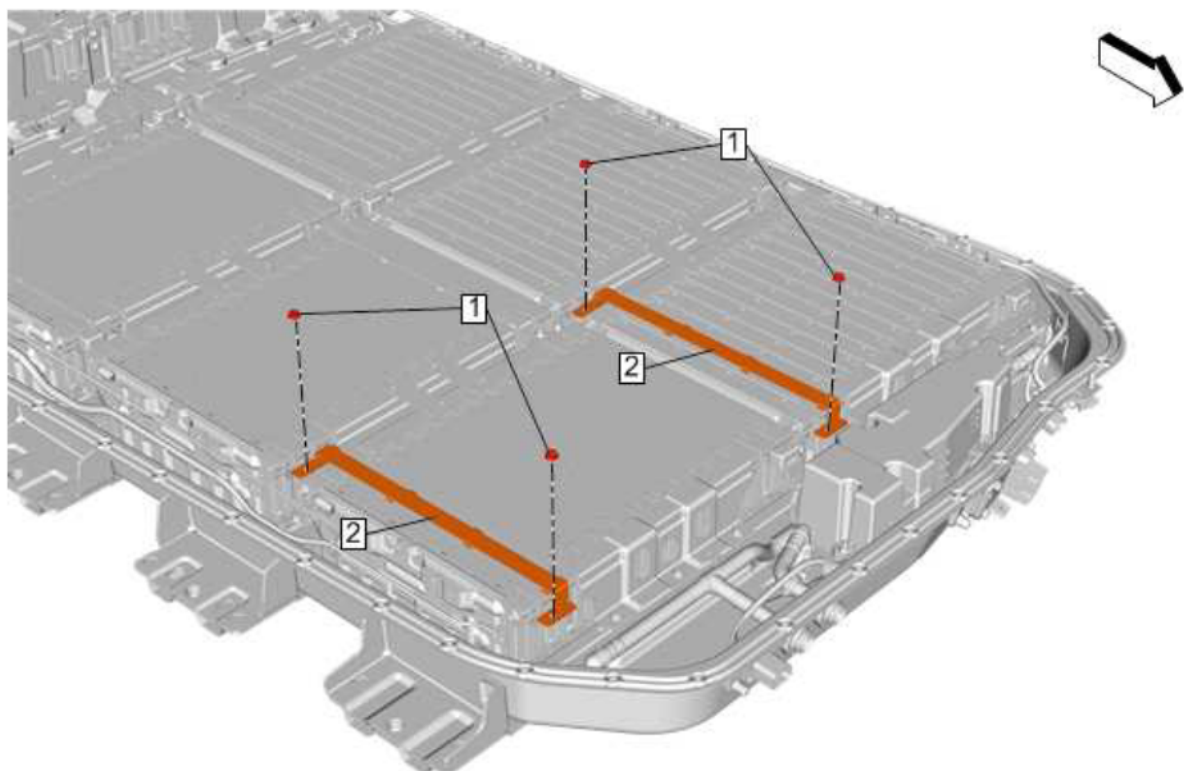


Fig. 85: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

6. Remove the battery cable (2) - bus bar, cell battery module 1 to cell battery module 2. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable**

Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

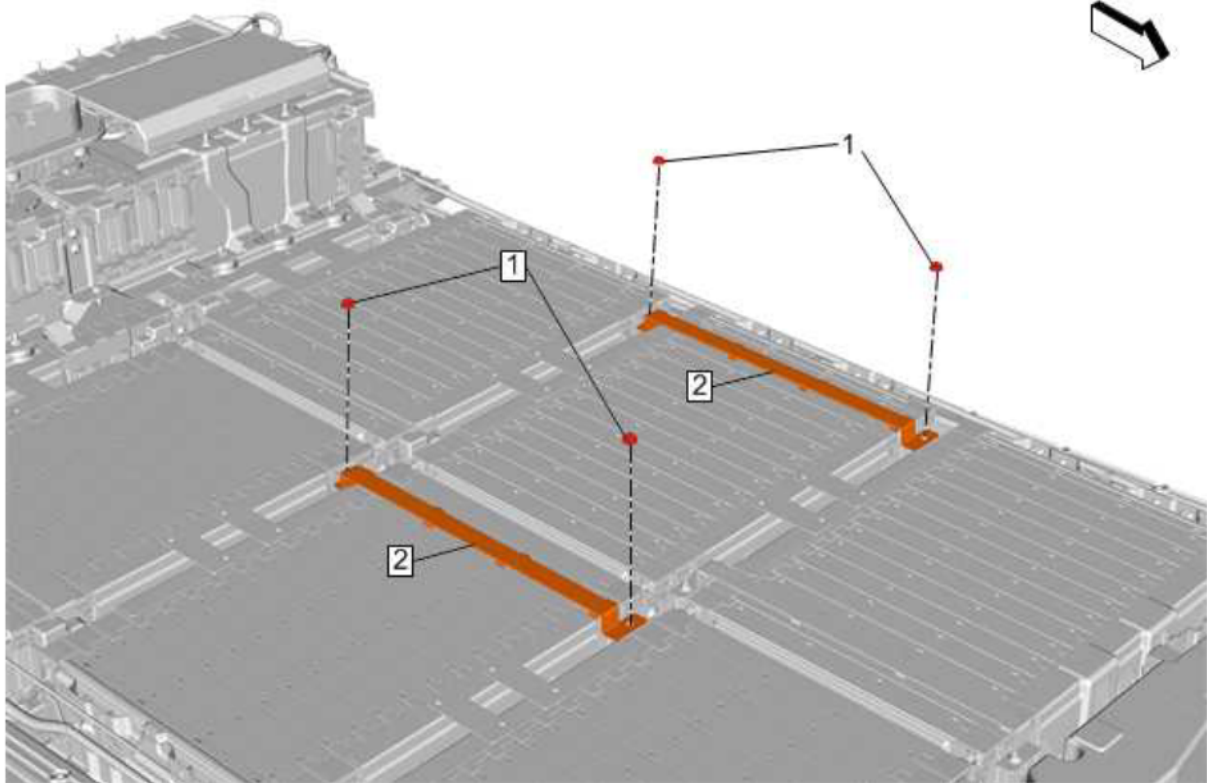


Fig. 86: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

7. Remove the battery cable (2) - bus bar, cell battery module 2 to cell battery module 3. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

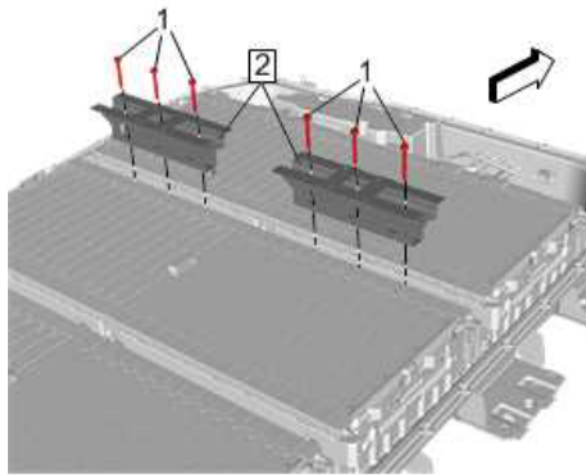


Fig. 87: Cell Battery Module Bracket Bolts And Brackets
 Courtesy of GENERAL MOTORS COMPANY

8. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).

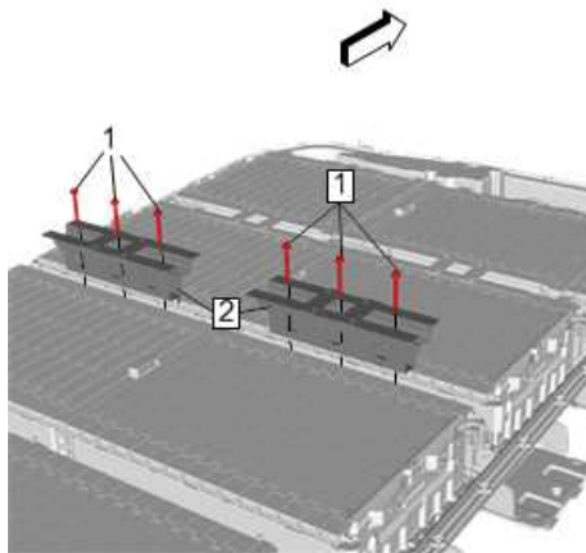


Fig. 88: Cell Battery Module Bracket Bolts And Brackets
 Courtesy of GENERAL MOTORS COMPANY

9. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).

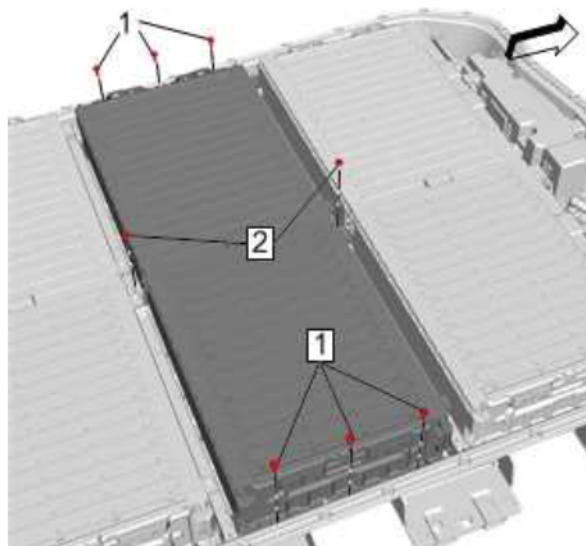


Fig. 89: Cell Battery Module Side Bolts And Nuts
 Courtesy of GENERAL MOTORS COMPANY

10. Remove the cell battery module side bolts (1) [6x].
11. Remove the cell battery module securing nuts (2) [2x].

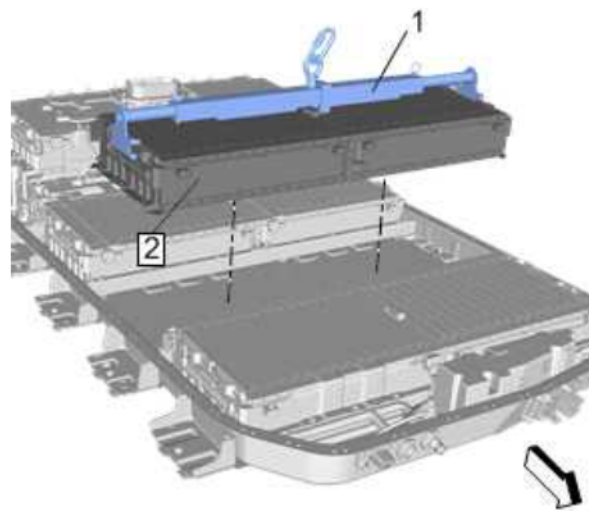


Fig. 90: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

12. Use the **EL-48264** Battery Lift Tool (1) to lift the cell battery (2).

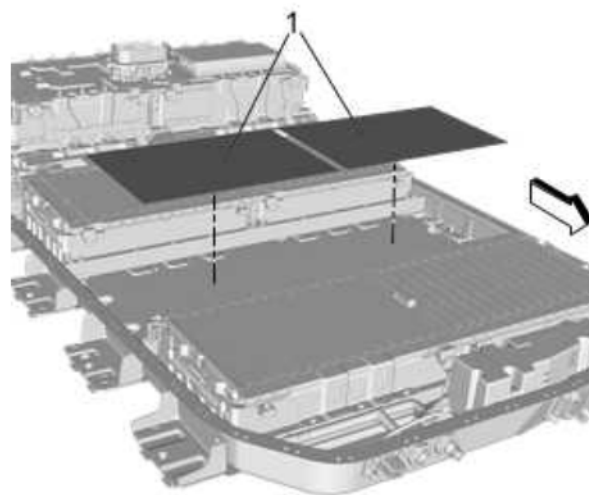


Fig. 91: Thermal Pads
Courtesy of GENERAL MOTORS COMPANY

13. Remove the thermal pads (1).

Installation Procedure

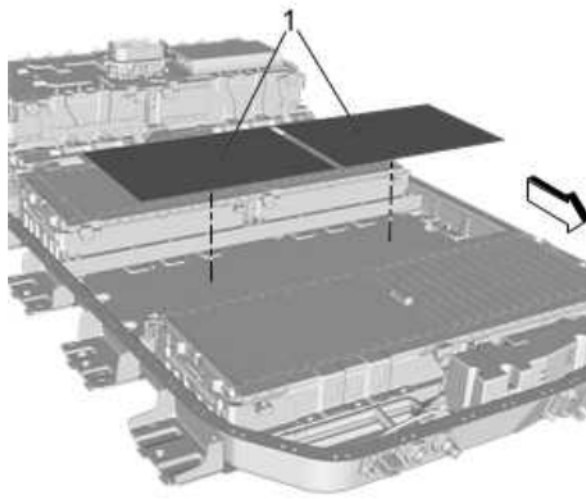


Fig. 92: Thermal Pads

Courtesy of GENERAL MOTORS COMPANY

NOTE: When installing the thermal pad, ensure there are no air bubbles during installation on the cold plate.

1. Install the thermal pads (1).

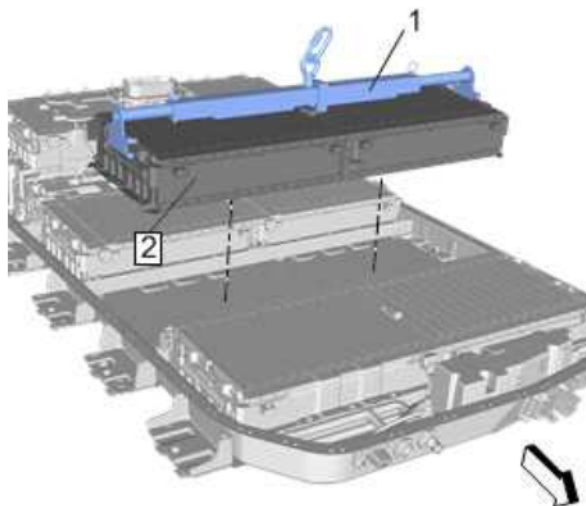
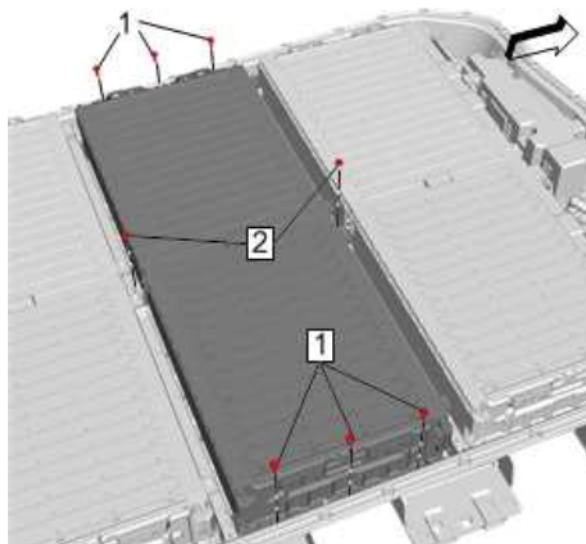


Fig. 93: Battery Lift Tool And Cell Battery

Courtesy of GENERAL MOTORS COMPANY

2. Use the **EL-48264** Battery Lift Tool (1) to install the cell battery (2).



CAUTION: Fastener Caution .

3. Tighten the cell battery module securing nuts (2) [2x] to 9 N.m (80 lb in).
4. Tighten the cell battery module side bolts (1) [6x] to 9 N.m (80 lb in).

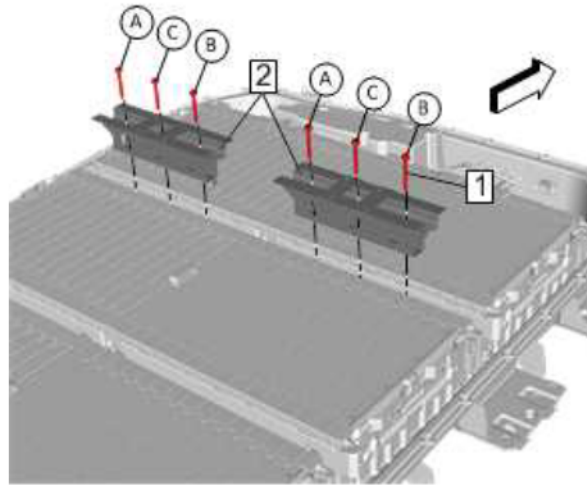


Fig. 95: Cell Battery Module Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the cell battery module bracket bolts in the sequence shown.

5. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in)

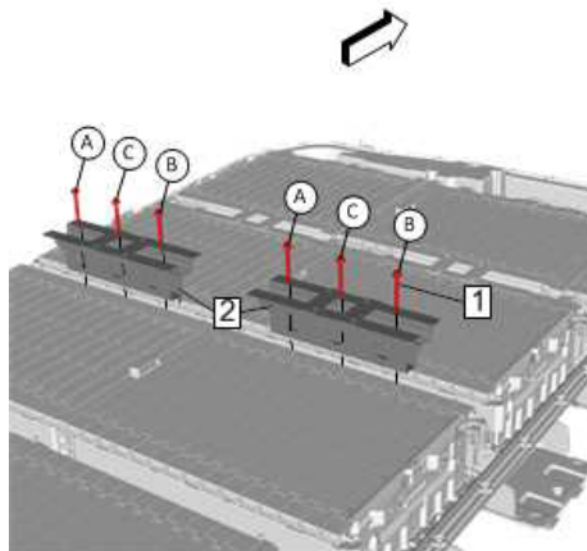


Fig. 96: cell battery module bracket bolts And brackets
Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the cell battery module bracket bolts in the sequence shown.

6. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in)

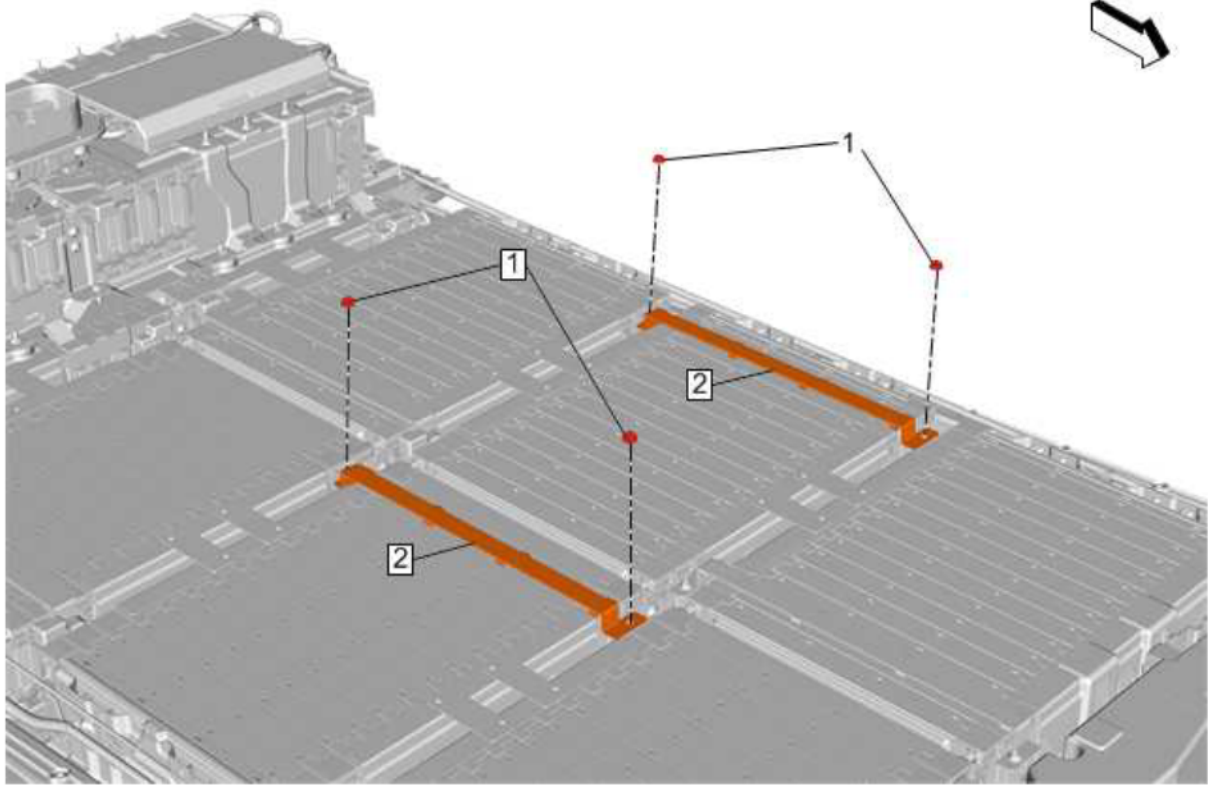
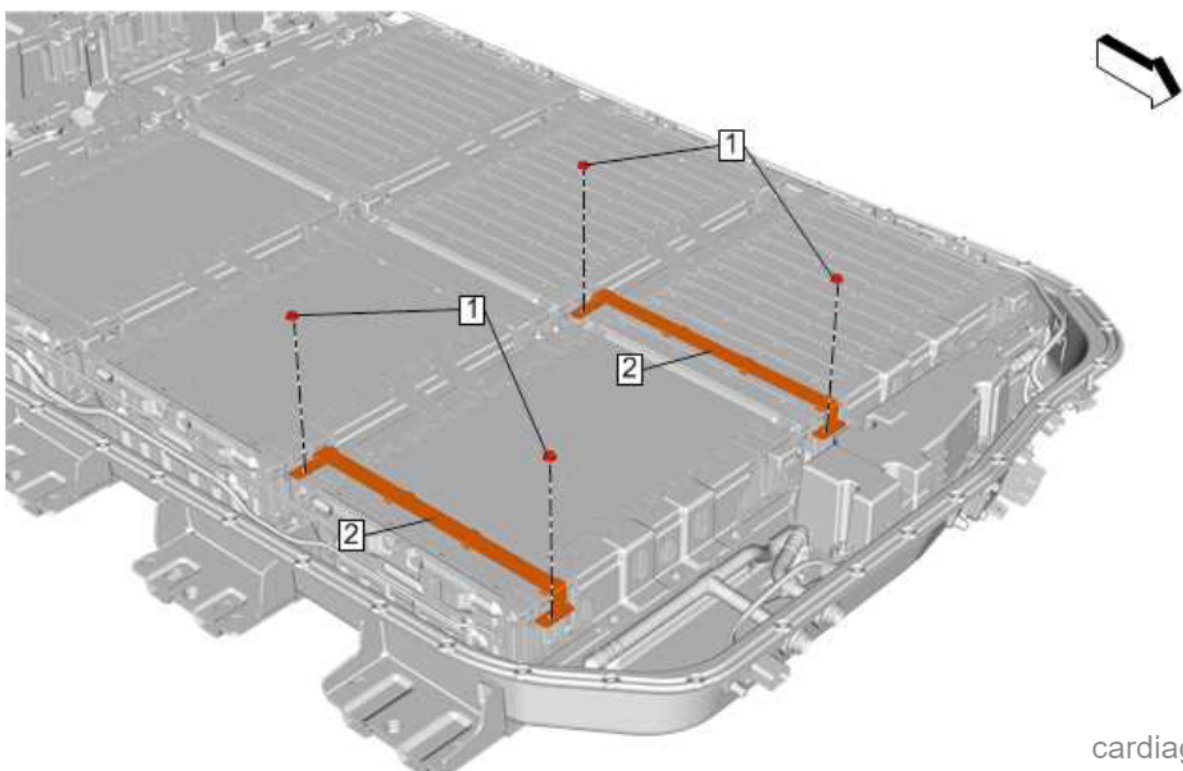


Fig. 97: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

7. Install the battery cable (2) - bus bar, cell battery module 2 to cell battery module 3. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)****Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)****Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)****Battery Cable Replacement (Bus Bar, X3, Positive & Negative)**



8. Install the battery cable (2) - bus bar, cell battery module 1 to cell battery module 2. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)****Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)****Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)****Battery Cable Replacement (Bus Bar, X3, Positive & Negative)**

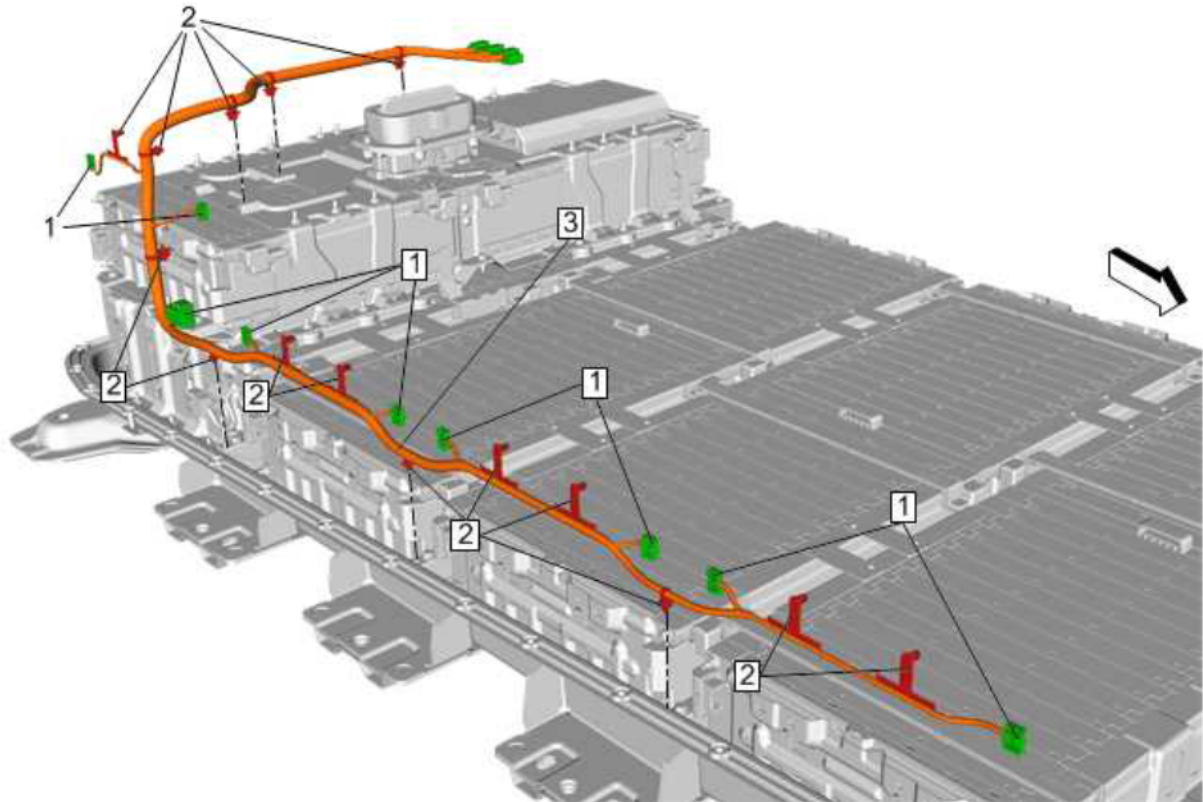


Fig. 99: Drive Motor Battery Sensor Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

9. Install the drive motor battery sensor module wiring harness (3) - right side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)****Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)****Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)****Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)**

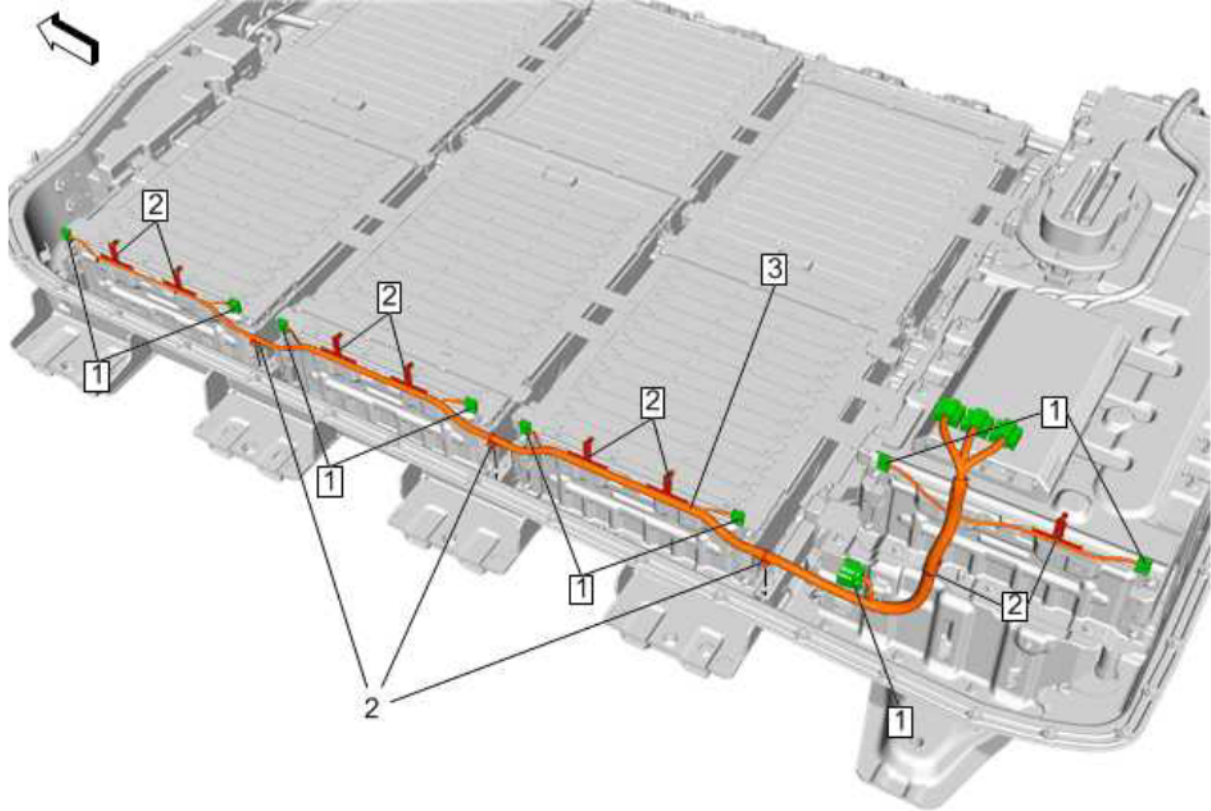


Fig. 100: Drive Motor Battery Sensor Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

10. Install the drive motor battery sensor module wiring harness (3) - left side. [Drive Motor Battery Sensor Module Wiring Harness Replacement \(Left\)](#)[Drive Motor Battery Sensor Module Wiring Harness Replacement \(Right\)](#)[Drive Motor Battery Sensor Module Wiring Harness Replacement \(LH, Sub\)](#)[Drive Motor Battery Sensor Module Wiring Harness Replacement \(RH, Sub\)](#)

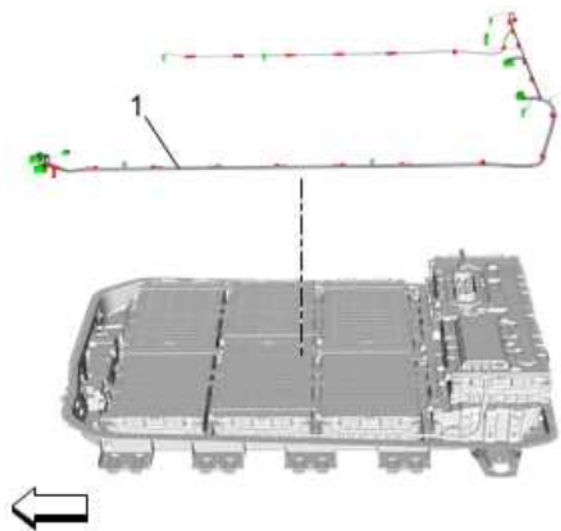


Fig. 101: Drive Motor Battery Control Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

11. Install the drive motor battery control module wiring harness (1). [Drive Motor Battery Control Module Wiring Harness Replacement](#)
12. Perform the cell battery balancing if replaced. [Hybrid/EV Battery Cell Balancing](#)
13. Install the battery upper cover. [Battery Upper Cover Replacement](#)
14. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

15. Reprogram the battery energy control module. [Battery Energy Control Module Programming and Setup](#)
16. Program the hybrid powertrain control module 2. [Hybrid Powertrain Control Module 2 Programming and Setup](#)
17. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. [Hybrid/EV Battery Pack Capacity Learn](#)

NOTE: Refer to Diagnostic Aids to determine when, if required procedure should be performed.

CELL BATTERY MODULE REPLACEMENT (ROW 3)

Special Tools

EL-48264 Battery Lift Tool

For equivalent regional tools, refer to [Special Tools](#).

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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. Remove the battery upper cover. [Battery Upper Cover Replacement](#)

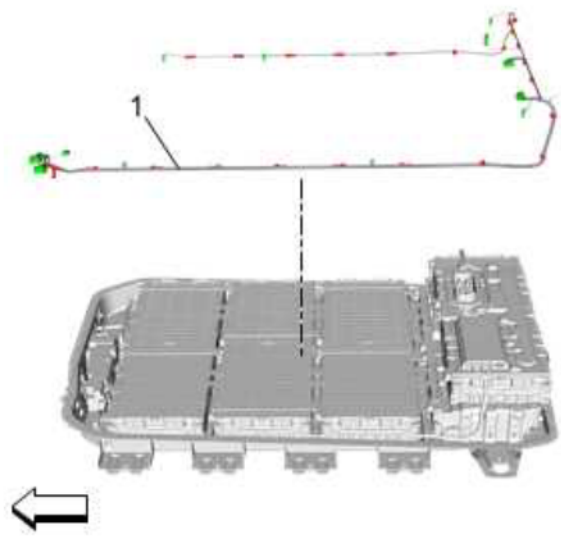


Fig. 102: Drive Motor Battery Control Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

3. Remove the drive motor battery control module wiring harness (1). **Drive Motor Battery Control Module Wiring Harness Replacement**.

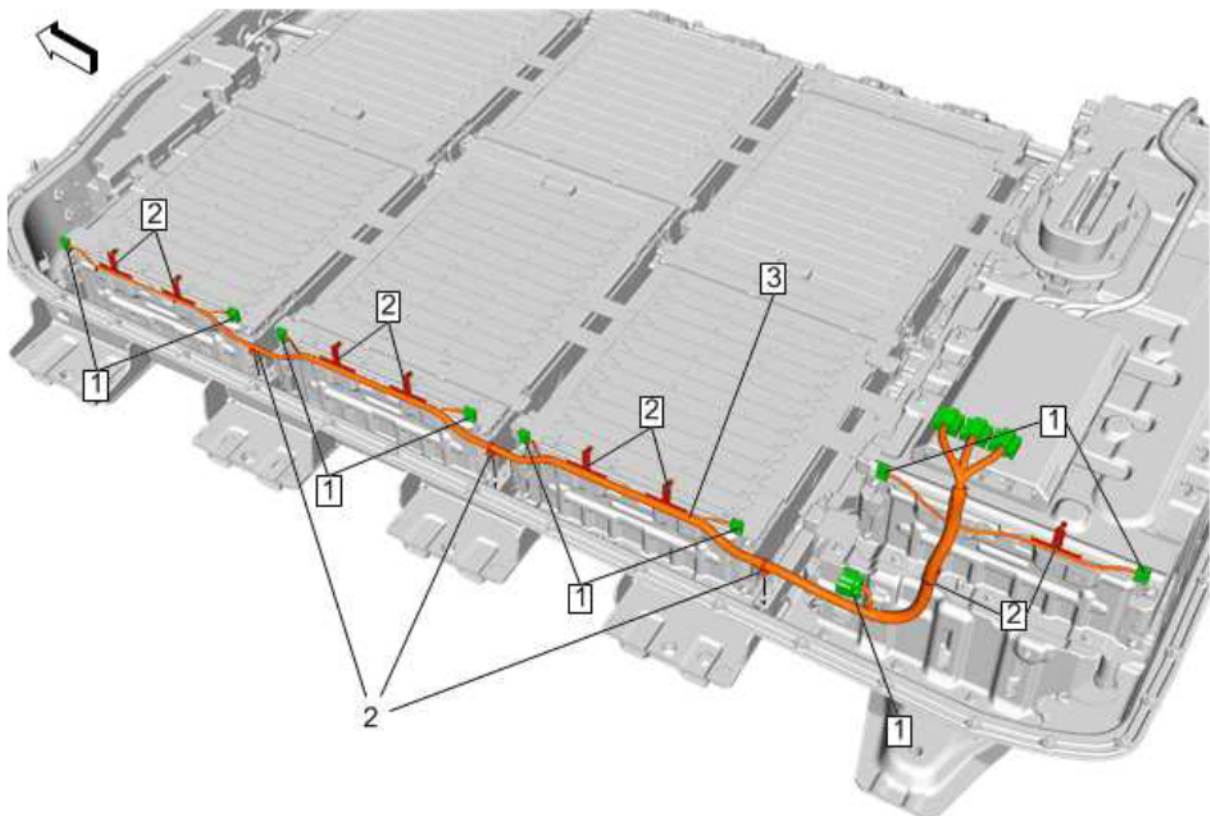


Fig. 103: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

4. Remove the drive motor battery sensor module wiring harness (3) - left side. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)****Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)****Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)****Battery Cable Replacement (Bus Bar, X3, Positive & Negative).**

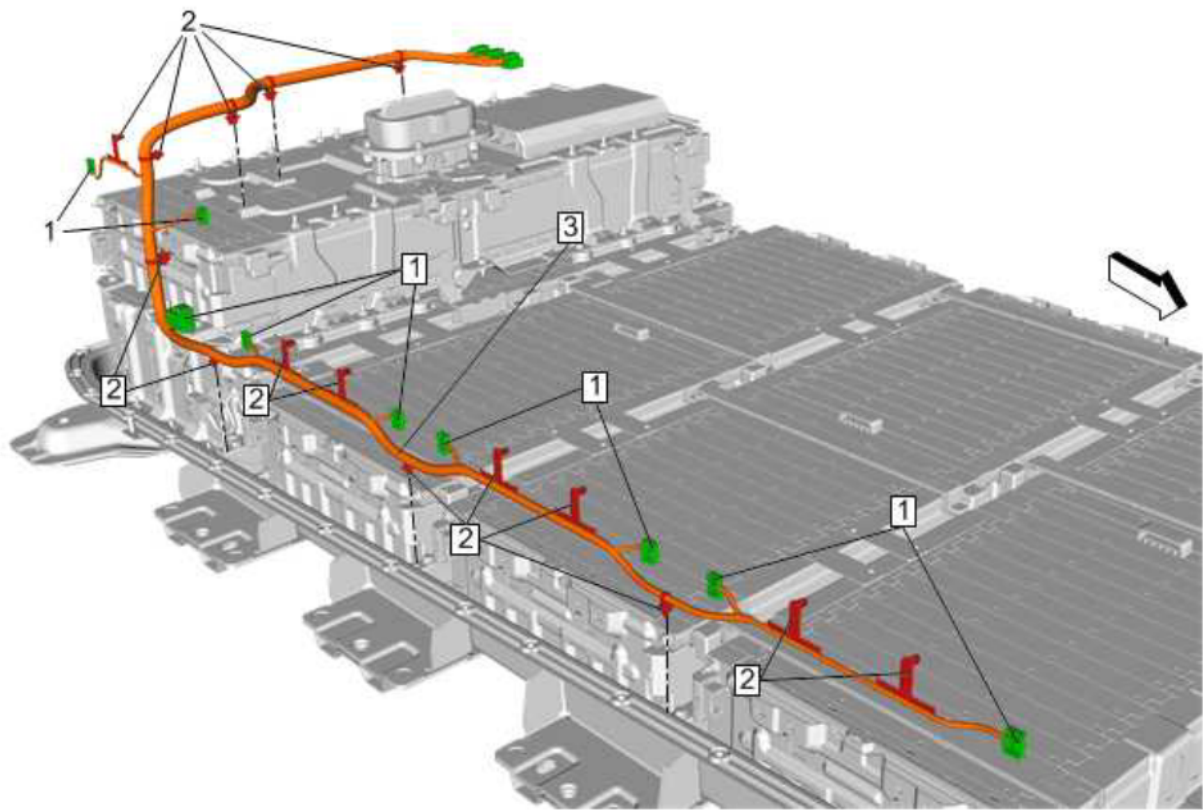


Fig. 104: Drive Motor Battery Sensor Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

5. Remove the drive motor battery sensor module wiring harness (3) - right side. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

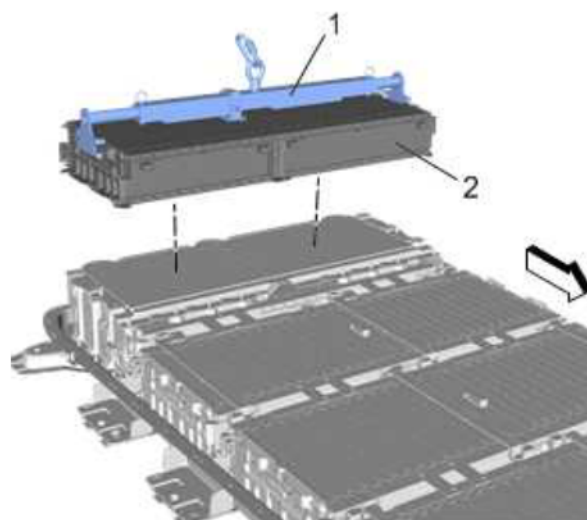


Fig. 105: Battery Lift Tool And Cell Battery

Courtesy of GENERAL MOTORS COMPANY

6. Remove the row 5 cell battery module (2). Cell Battery Module Replacement (Row 1)Cell Battery Module Replacement (Row 5)

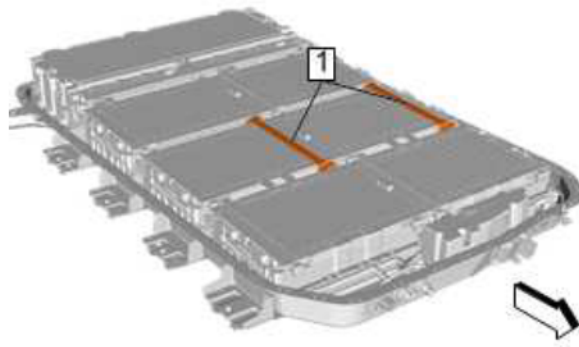


Fig. 106: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

7. Remove the battery cable (1) - bus bar, cell battery module 2 to cell battery module 3. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)****Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)****Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)****Battery Cable Replacement (Bus Bar, X3, Positive & Negative)**

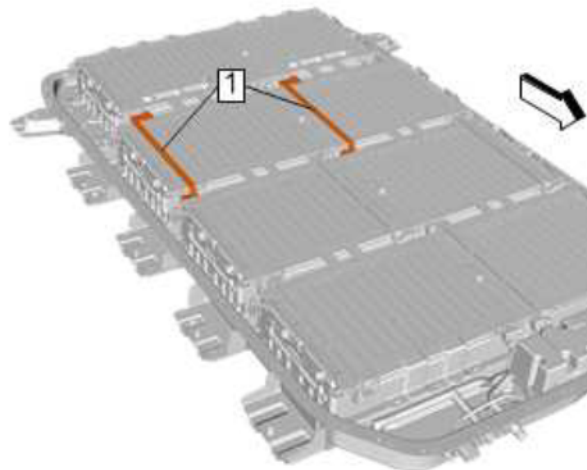


Fig. 107: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

8. Remove the battery cable (1) - bus bar, cell battery module 3 to cell battery module 4. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)****Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)****Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)****Battery Cable Replacement (Bus Bar, X3, Positive & Negative)**

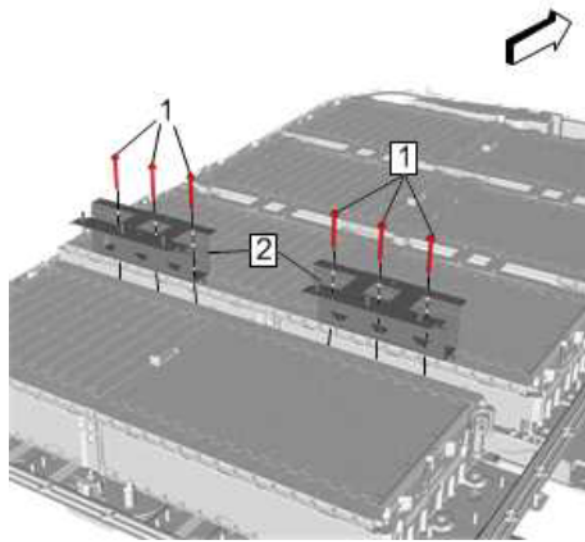


Fig. 108: Cell Battery Module Bracket Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

9. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).

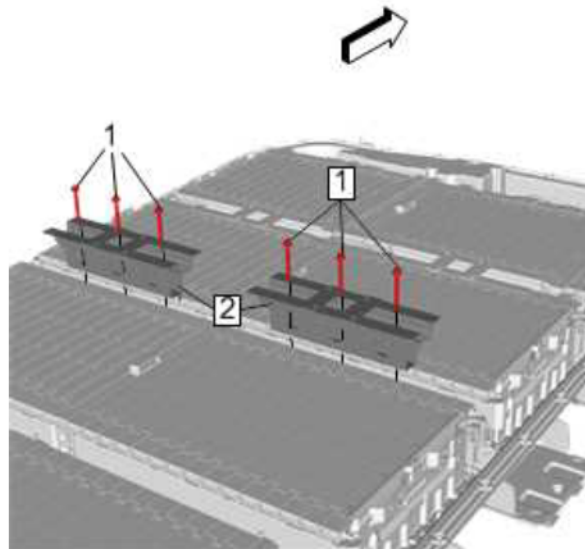


Fig. 109: Cell Battery Module Bracket Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

10. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).

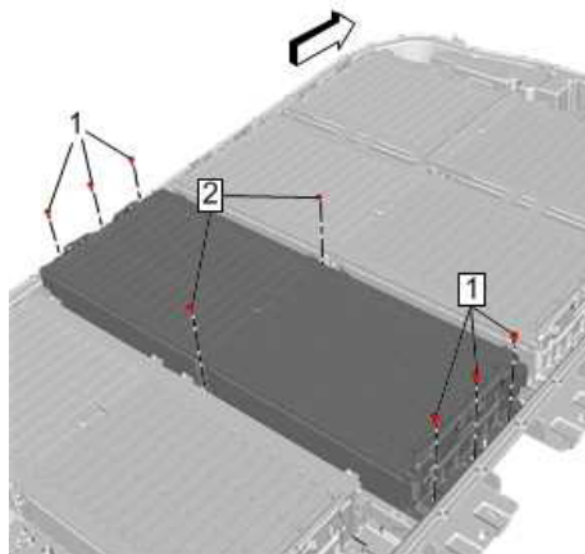


Fig. 110: Cell Battery Module Side Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

11. Remove the cell battery module side bolts (1) [6x].
12. Remove the cell battery module securing nuts (2) [2x].

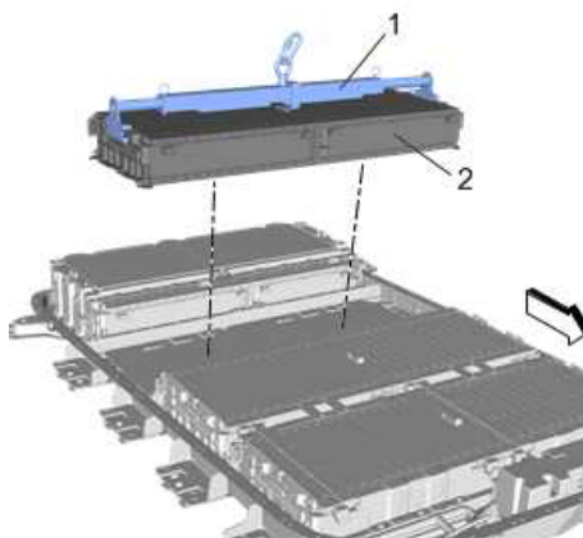


Fig. 111: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

13. Use the **EL-48264** Battery Lift Tool (1) to lift the cell battery (2).

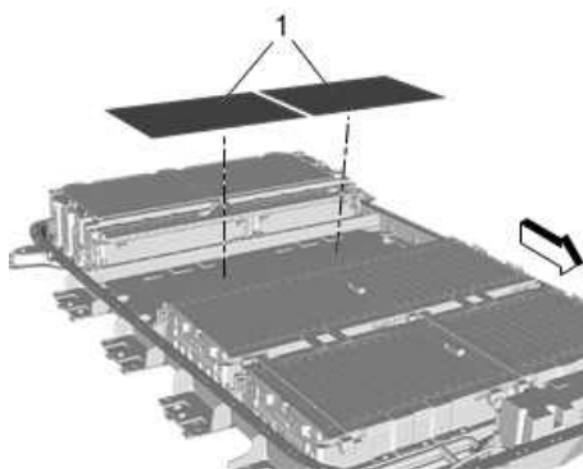


Fig. 112: Thermal Pads
Courtesy of GENERAL MOTORS COMPANY

14. Remove the thermal pads (1).

Installation Procedure

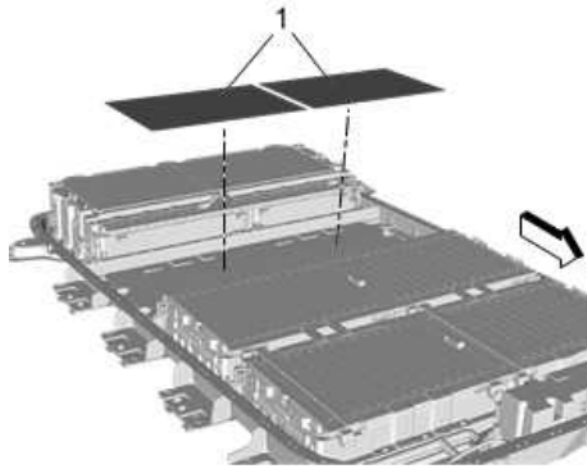


Fig. 113: Thermal Pads

Courtesy of GENERAL MOTORS COMPANY

NOTE: When installing the thermal pad, ensure there are no air bubbles during installation on the cold plate.

1. Install the thermal pads (1).

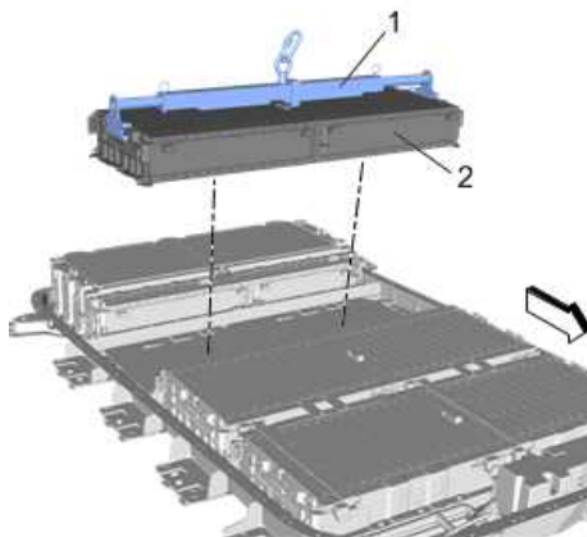


Fig. 114: Battery Lift Tool And Cell Battery

Courtesy of GENERAL MOTORS COMPANY

2. Use the **EL-48264** Battery Lift Tool (1) to install the cell battery (2).

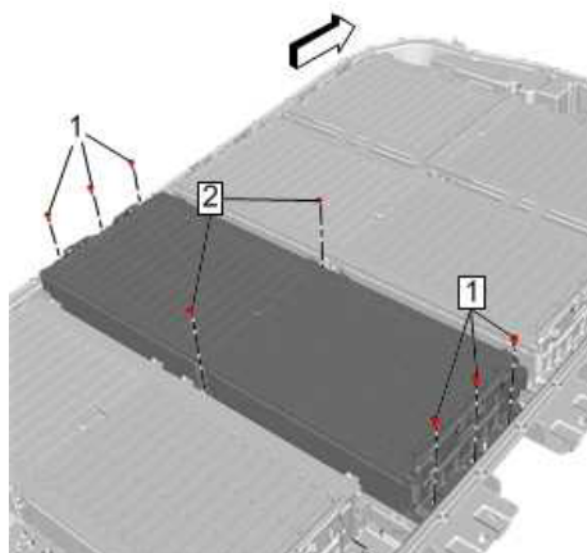


Fig. 115: Cell Battery Module Side Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

3. Tighten the cell battery module securing nuts (2) [2x] to 9 N.m (80 lb in).
4. Tighten the cell battery module side bolts (1) [6x] to 9 N.m (80 b in).

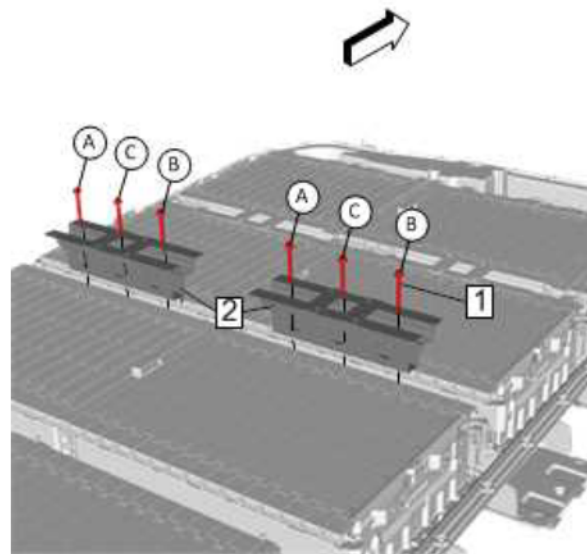


Fig. 116: cell battery module bracket bolts And brackets
Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the cell battery module bracket bolts in the sequence shown.

5. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in)

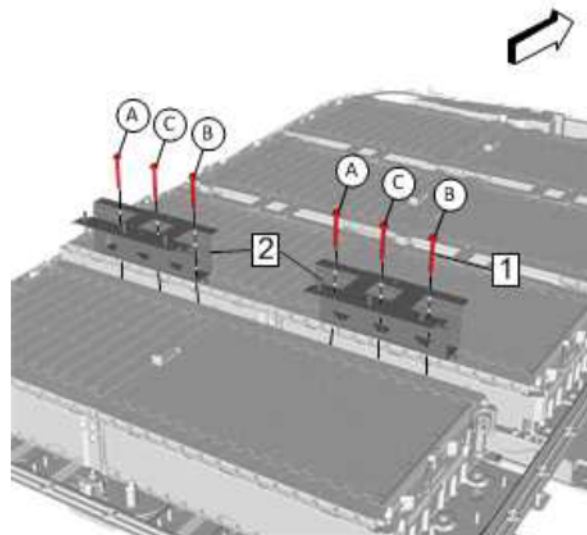


Fig. 117: Cell Battery Module Bracket Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the cell battery module bracket bolts in the sequence shown.

NOTE: See the OUT sign on the bracket and this sign should be outside.

6. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in)

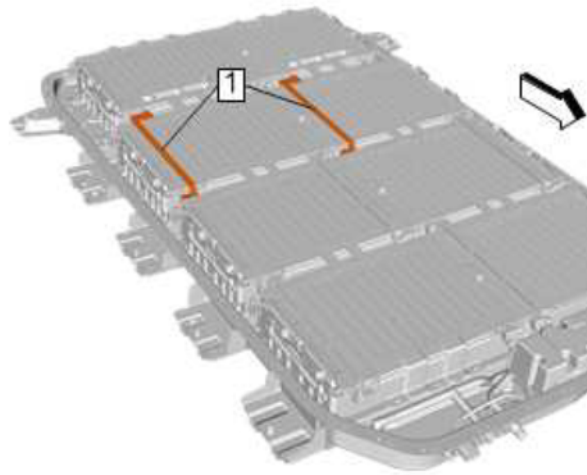


Fig. 118: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

7. Install the battery cable (1) - bus bar, cell battery module 3 to cell battery module 4. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)****Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)****Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)****Battery Cable Replacement (Bus Bar, X3, Positive & Negative).**

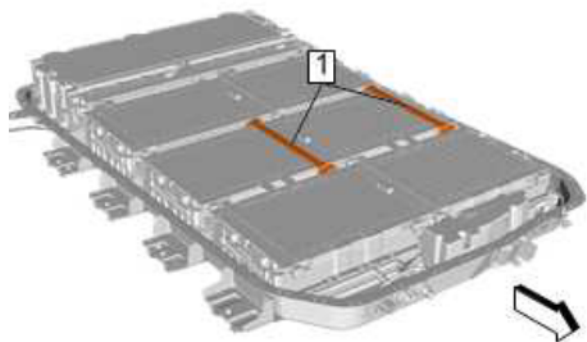


Fig. 119: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

8. Install the battery cable (1) - bus bar, cell battery module 2 to cell battery module 3. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)****Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)****Battery Cable Replacement (Bus Bar, X3, Positive & Negative).**

Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

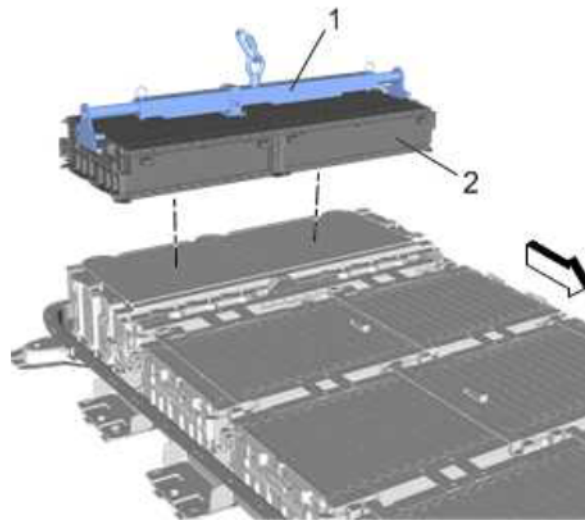


Fig. 120: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

9. Install the row 5 cell battery module (2). Cell Battery Module Replacement (Row 5)

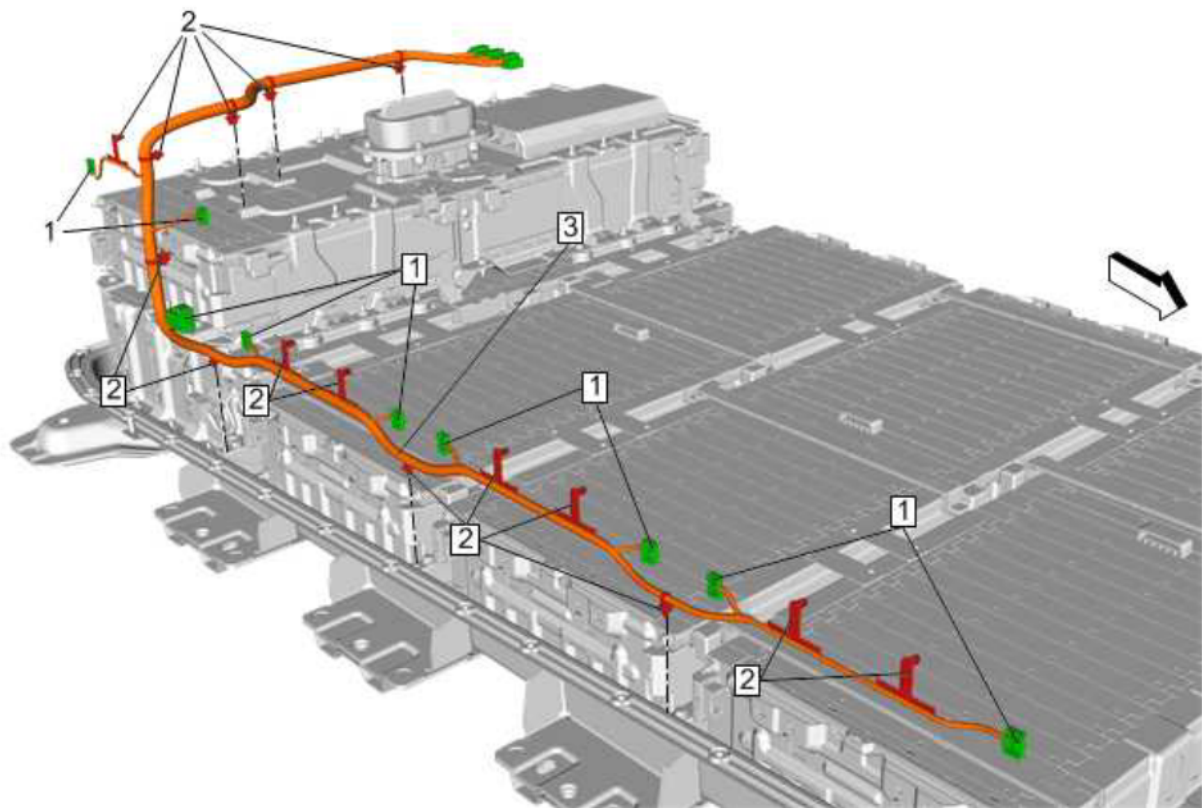


Fig. 121: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

10. Install the drive motor battery sensor module wiring harness (3) - right side. Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub).

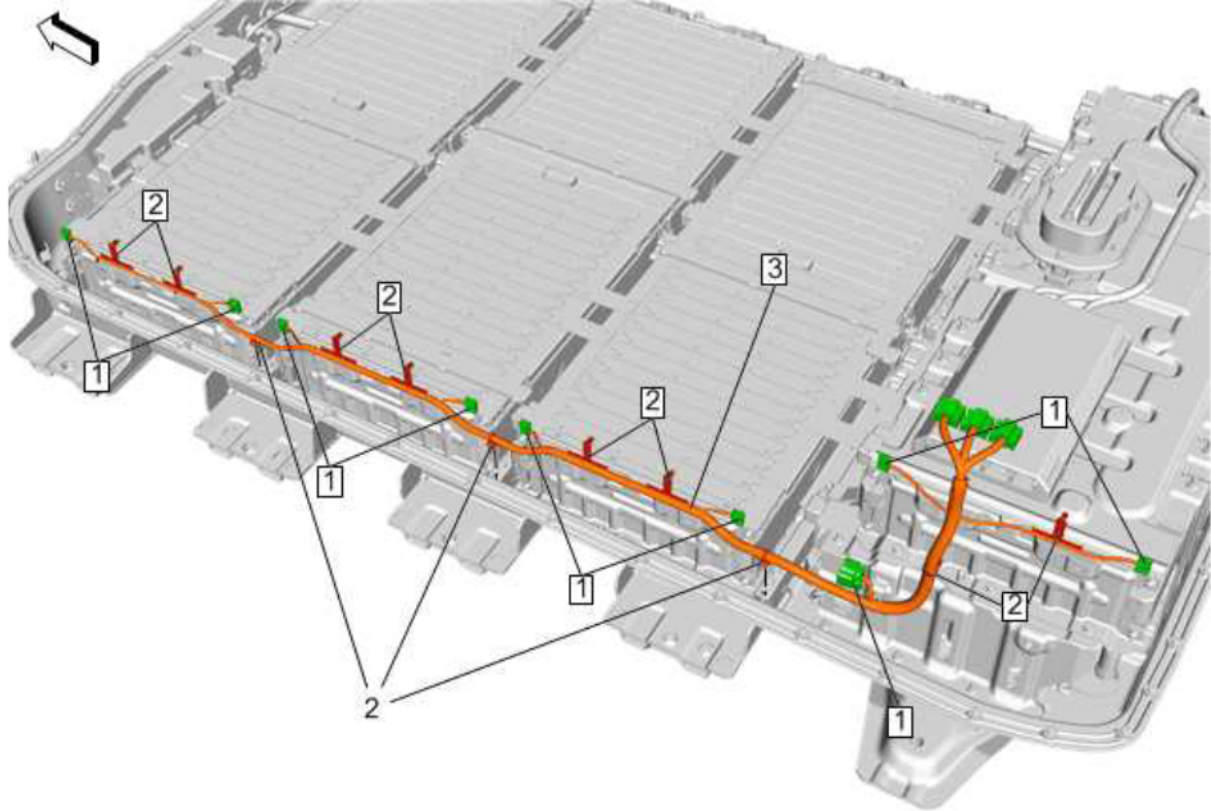


Fig. 122: Drive Motor Battery Sensor Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

11. Install the drive motor battery sensor module wiring harness (3) - left side. [Drive Motor Battery Sensor Module Wiring Harness Replacement \(Left\)](#)[Drive Motor Battery Sensor Module Wiring Harness Replacement \(LH, Sub\)](#).

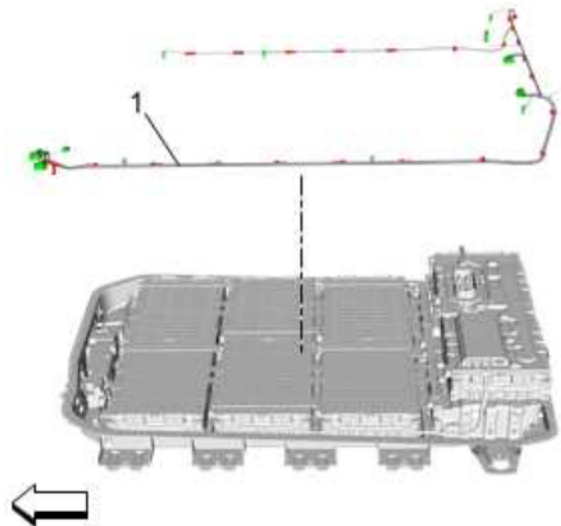


Fig. 123: Drive Motor Battery Control Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

12. Install the drive motor battery control module wiring harness (1). [Drive Motor Battery Control Module Wiring Harness Replacement](#).
13. Perform the cell battery balancing if replaced. [Hybrid/EV Battery Cell Balancing](#).
14. Install the battery upper cover. [Battery Upper Cover Replacement](#)
15. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
16. Reprogram the battery energy control module. [Battery Energy Control Module Programming and Setup](#)

17. Program the hybrid powertrain control module 2. [Hybrid Powertrain Control Module 2 Programming and Setup](#)

18. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. [Hybrid/EV Battery Pack Capacity Learn](#)

NOTE: Refer to Diagnostic Aids to determine when, if required procedure should be performed.

CELL BATTERY MODULE REPLACEMENT (ROW 4)

Special Tools

EL-48264 Battery Lift Tool

For equivalent regional tools, refer to [Special Tools](#).

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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. Remove the battery upper cover. [Battery Upper Cover Replacement](#)

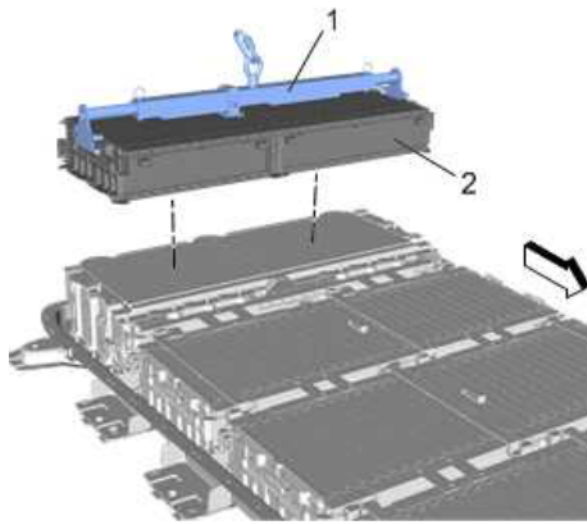


Fig. 124: Battery Lift Tool And Cell Battery
 Courtesy of GENERAL MOTORS COMPANY

3. Remove the row 5 cell battery module (2). [Cell Battery Module Replacement \(Row 5\)](#)

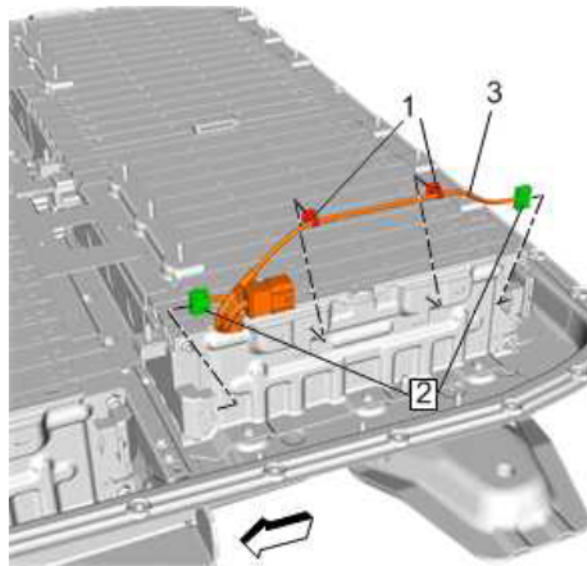


Fig. 125: Drive Motor Battery Sensor Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

4. Remove the drive motor battery sensor module wiring harness (3) - LH, Sub. [Drive Motor Battery Sensor Module Wiring Harness Replacement \(Left\)](#)[Drive Motor Battery Sensor Module Wiring Harness Replacement \(LH, Sub\)](#).

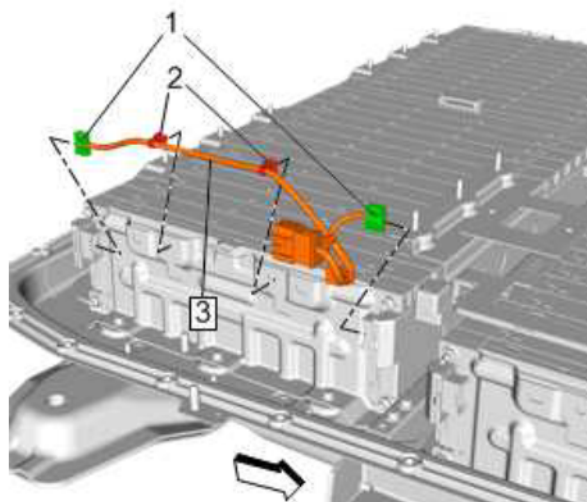


Fig. 126: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

5. Remove the drive motor battery sensor module wiring harness (3) - RH, Sub. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub).**

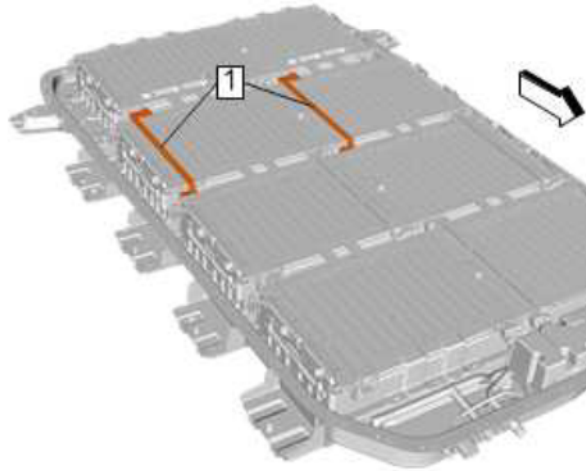


Fig. 127: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

6. Remove the battery cable (1) - bus bar, cell battery module 3 to cell battery module 4. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).**

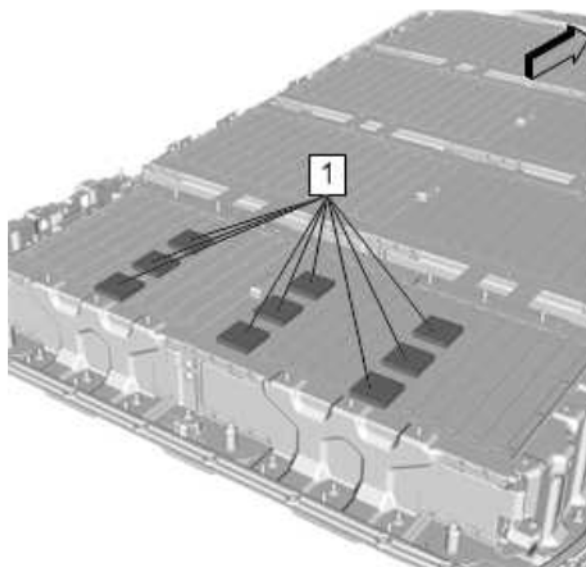


Fig. 128: Snubbers
Courtesy of GENERAL MOTORS COMPANY

7. Remove the snubbers (1).

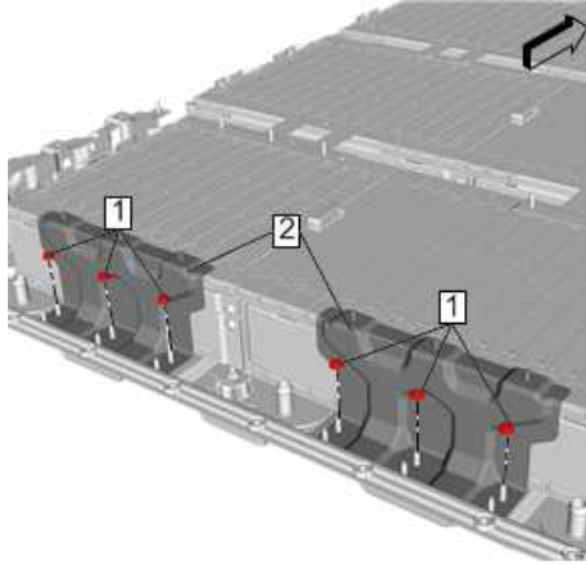


Fig. 129: Cell Battery Securing Nuts

Courtesy of GENERAL MOTORS COMPANY

8. Remove the cell battery securing nuts (1) [6x] and the one side rear panels (2).

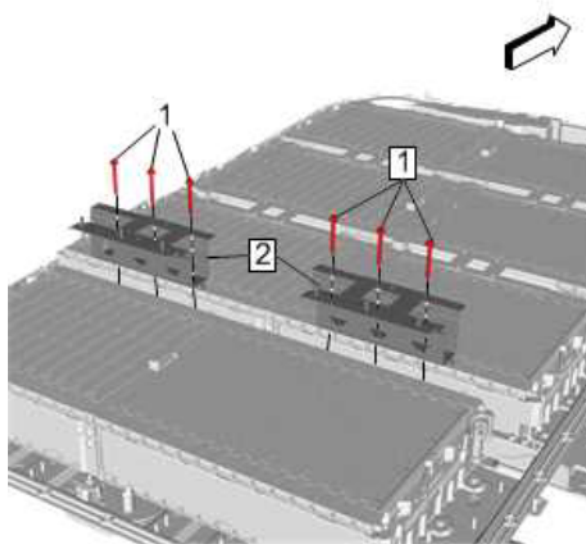


Fig. 130: Cell Battery Module Bracket Bolts And Brackets

Courtesy of GENERAL MOTORS COMPANY

9. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).

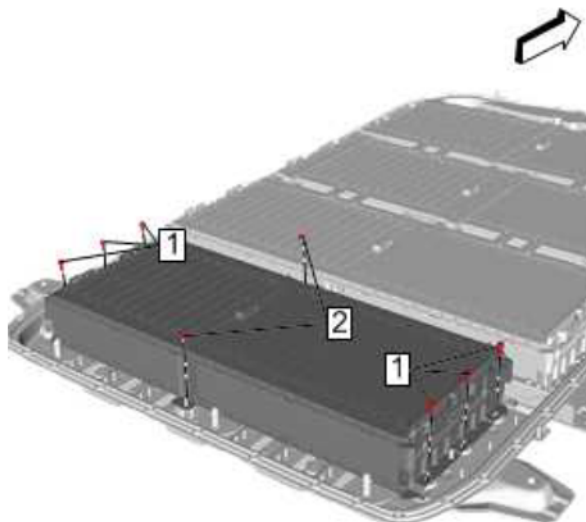


Fig. 131: Cell Battery Module Side Bolts

Courtesy of GENERAL MOTORS COMPANY

10. Remove the cell battery module side bolts (1) [6x].
11. Remove the cell battery module securing nuts (2) [2x].

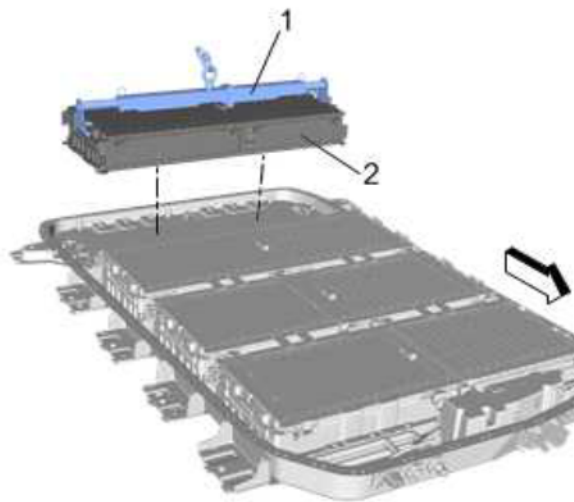


Fig. 132: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

12. Use the **EL-48264** Battery Lift Tool (1) to lift the cell battery (2).

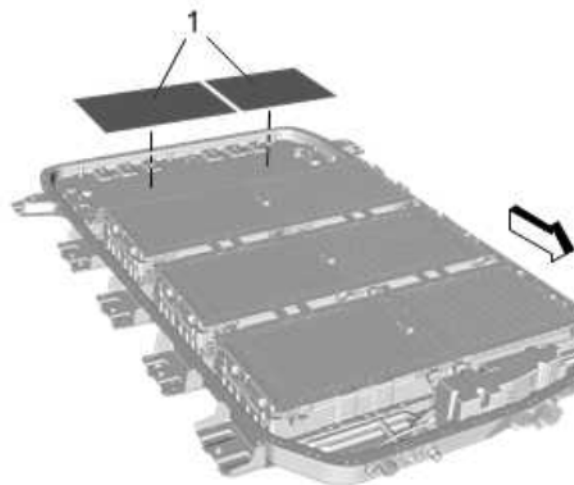


Fig. 133: Thermal Pads
Courtesy of GENERAL MOTORS COMPANY

13. Remove the thermal pads (1).

Installation Procedure

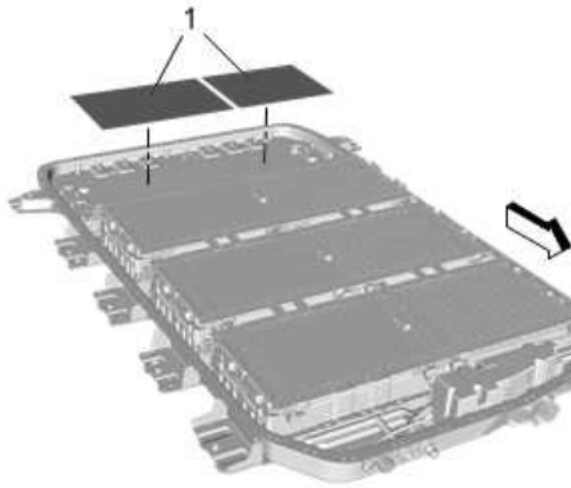


Fig. 134: Thermal Pads

Courtesy of GENERAL MOTORS COMPANY

NOTE: When installing the thermal pad, ensure there are no air bubbles during installation on the cold plate.

1. Install the thermal pads (1).

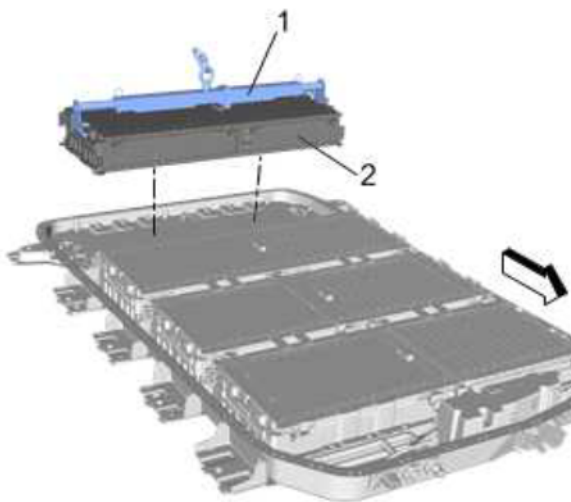
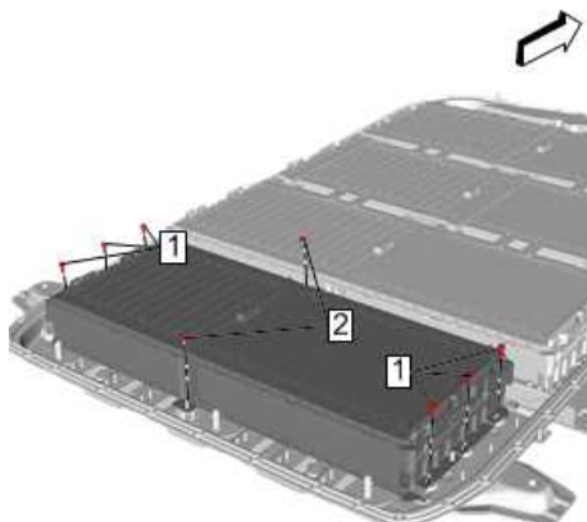


Fig. 135: Battery Lift Tool And Cell Battery

Courtesy of GENERAL MOTORS COMPANY

2. Use the **EL-48264** Battery Lift Tool (1) to install the cell battery (2).



CAUTION: **Fastener Caution**

3. Tighten the cell battery module securing nuts (2) [2x] to 9 N.m (80 lb in).
4. Tighten the cell battery module side bolts (1) [6x] to 9 N.m (80 lb in)

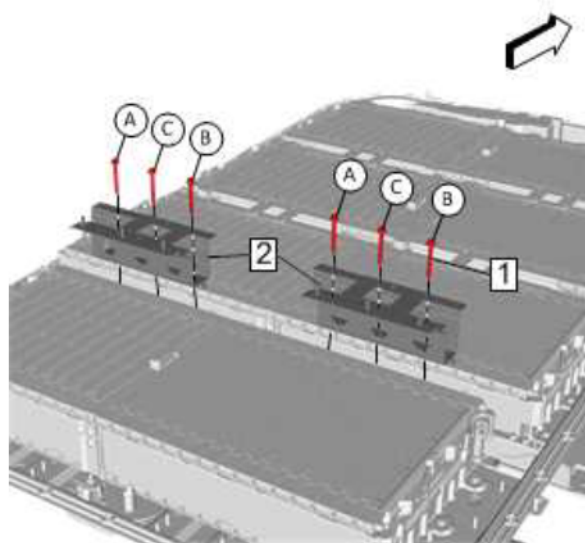


Fig. 137: Cell Battery Module Bracket Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the cell battery module bracket bolts in the sequence shown.

NOTE: See the OUT sign on the bracket and this sign should be outside.

5. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

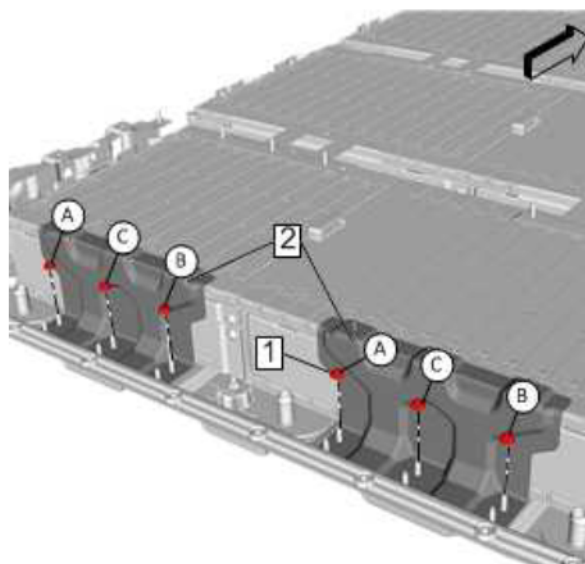


Fig. 138: Cell Battery Securing Nuts And One Side Rear Panel
Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the cell battery securing nuts in the sequence shown.

6. Install the cell battery securing nuts (1) [6x] and the one side rear panel (2). Tighten the fasteners (1) to 9 N.m (80 lb in)

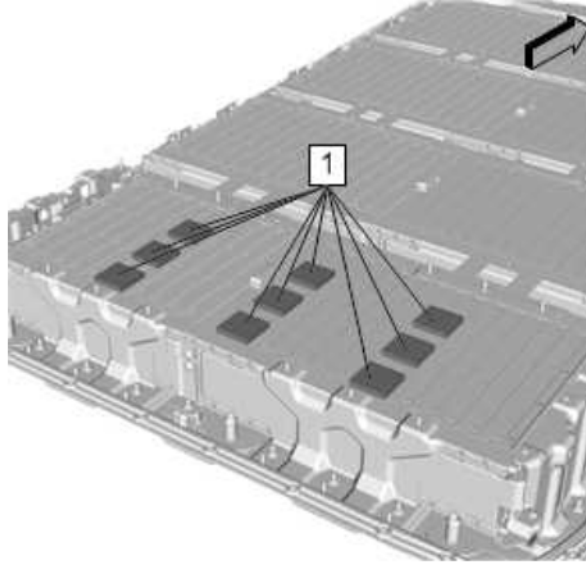


Fig. 139: Snubbers

Courtesy of GENERAL MOTORS COMPANY

7. Install the snubbers (1).

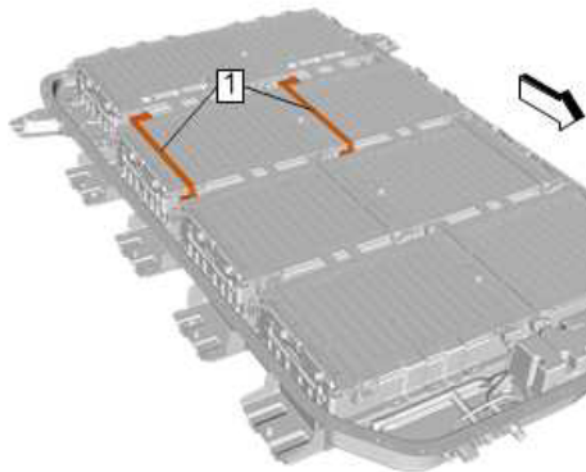


Fig. 140: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

8. Install the battery cable (1) - bus bar, cell battery module 3 to cell battery module 4. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)****Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)****Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)****Battery Cable Replacement (Bus Bar, X3, Positive & Negative).**

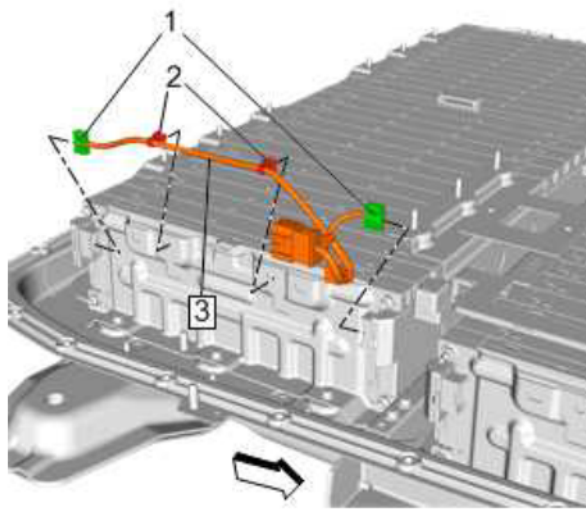


Fig. 141: Drive Motor Battery Sensor Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

9. Install the drive motor battery sensor module wiring harness (3) - RH, Sub. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub).**

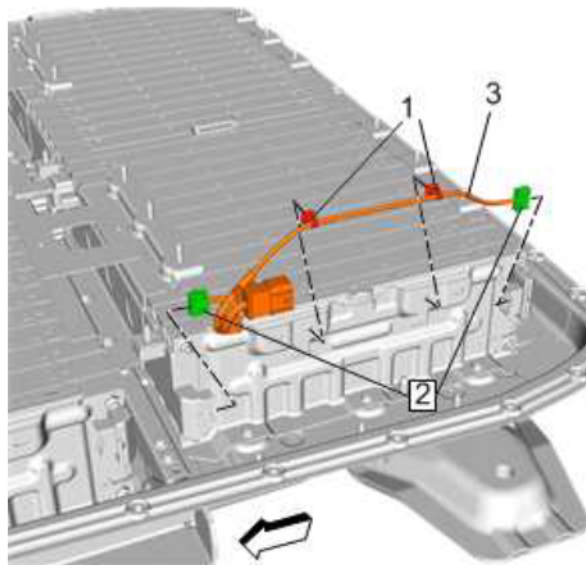
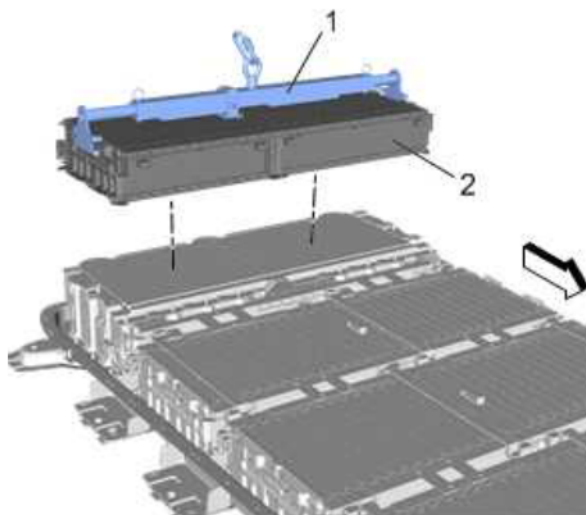


Fig. 142: Drive Motor Battery Sensor Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

10. Install the drive motor battery sensor module wiring harness (3) - LH, Sub. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub).**



11. Install the row 5 cell battery module (2). [Cell Battery Module Replacement \(Row 5\)](#)
12. Perform the hybrid battery pack coolant passage leak test. [Hybrid Battery Pack Coolant Passage Leak Test](#).
13. Perform the cell battery balancing if replaced. [Hybrid/EV Battery Cell Balancing](#).
14. Install the battery upper cover. [Battery Upper Cover Replacement](#)
15. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
16. Reprogram the battery energy control module. [Battery Energy Control Module Programming and Setup](#)
17. Program the hybrid powertrain control module 2. [Hybrid Powertrain Control Module 2 Programming and Setup](#)
18. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. [Hybrid/EV Battery Pack Capacity Learn](#)

NOTE: Refer to Diagnostic Aids to determine when, if required procedure should be performed.

CELL BATTERY MODULE REPLACEMENT (ROW 5)

Special Tools

EL-48264 Battery Lift Tool

For equivalent regional tools, refer to [Special Tools](#).

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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. Remove the battery upper cover. [Battery Upper Cover Replacement](#)

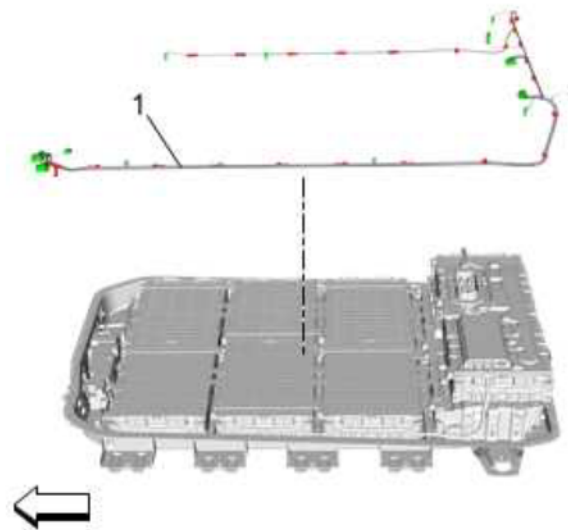


Fig. 144: Drive Motor Battery Control Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

3. Remove the drive motor battery control module wiring harness (1). [Drive Motor Battery Control Module Wiring Harness Replacement](#).

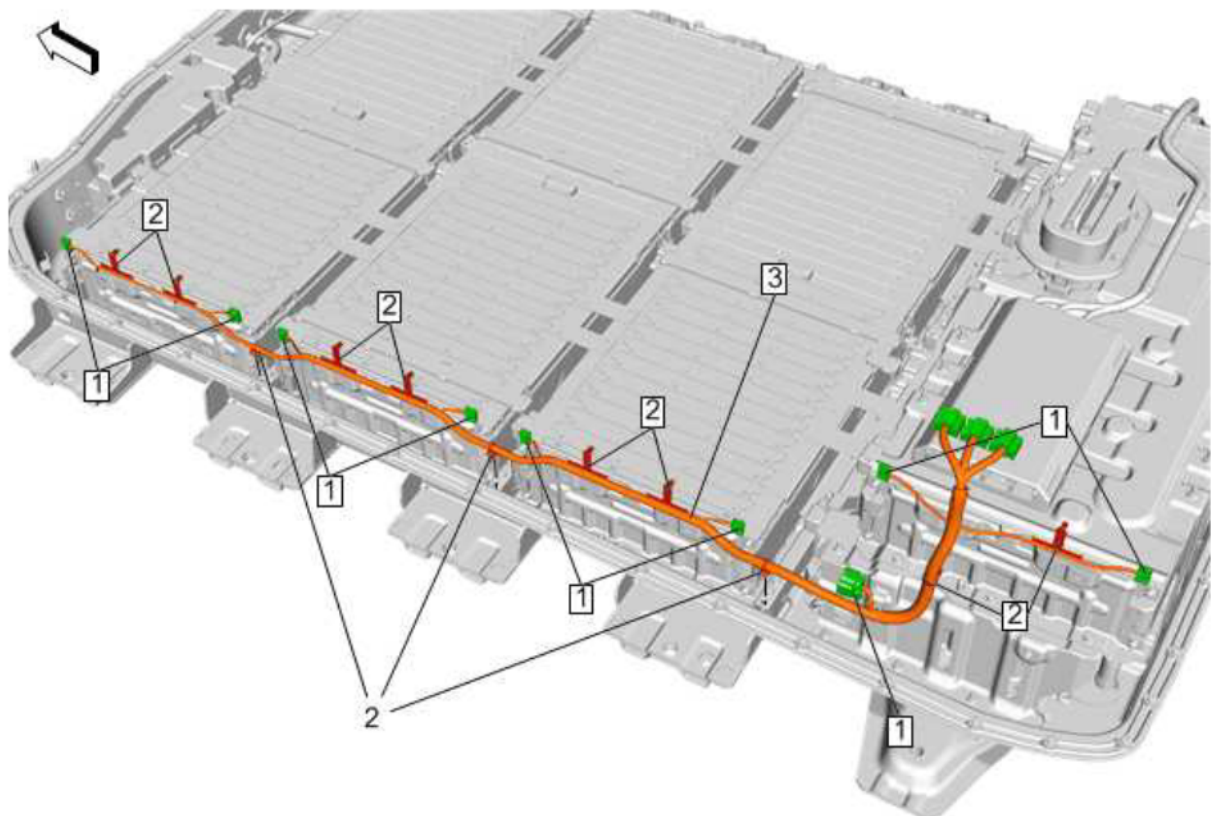


Fig. 145: Drive Motor Battery Sensor Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

4. Remove the drive motor battery sensor module wiring harness (3) - left side. [Battery Cable Replacement \(Bus Bar, Cell Battery Module 3 to Cell Battery Module 4\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery Disconnect](#)

Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

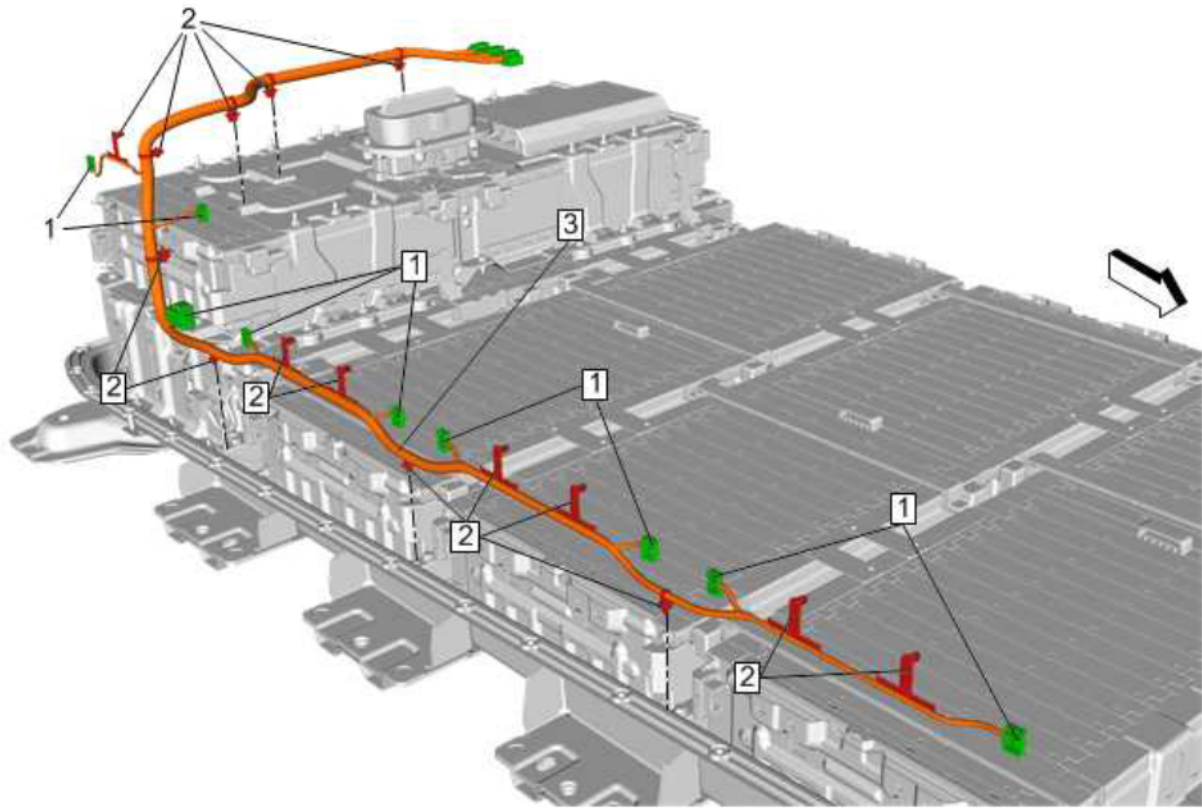
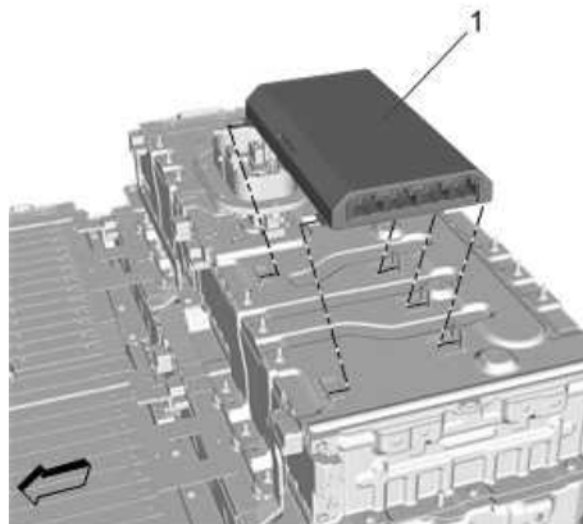


Fig. 146: Drive Motor Battery Sensor Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

5. Remove the drive motor battery sensor module wiring harness (3) - right side. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).



6. Remove the battery energy control module (1). Battery Energy Control Module Replacement.

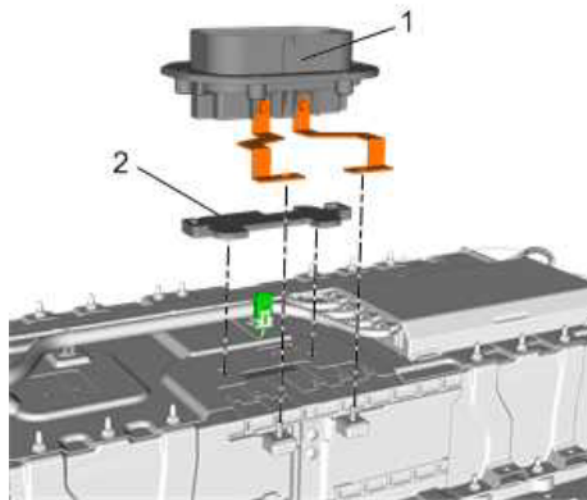


Fig. 148: Connector And Connector Insulator
Courtesy of GENERAL MOTORS COMPANY

7. Remove the high voltage battery high voltage manual disconnect connector (1). High Voltage Battery High Voltage Manual Disconnect Connector Replacement.

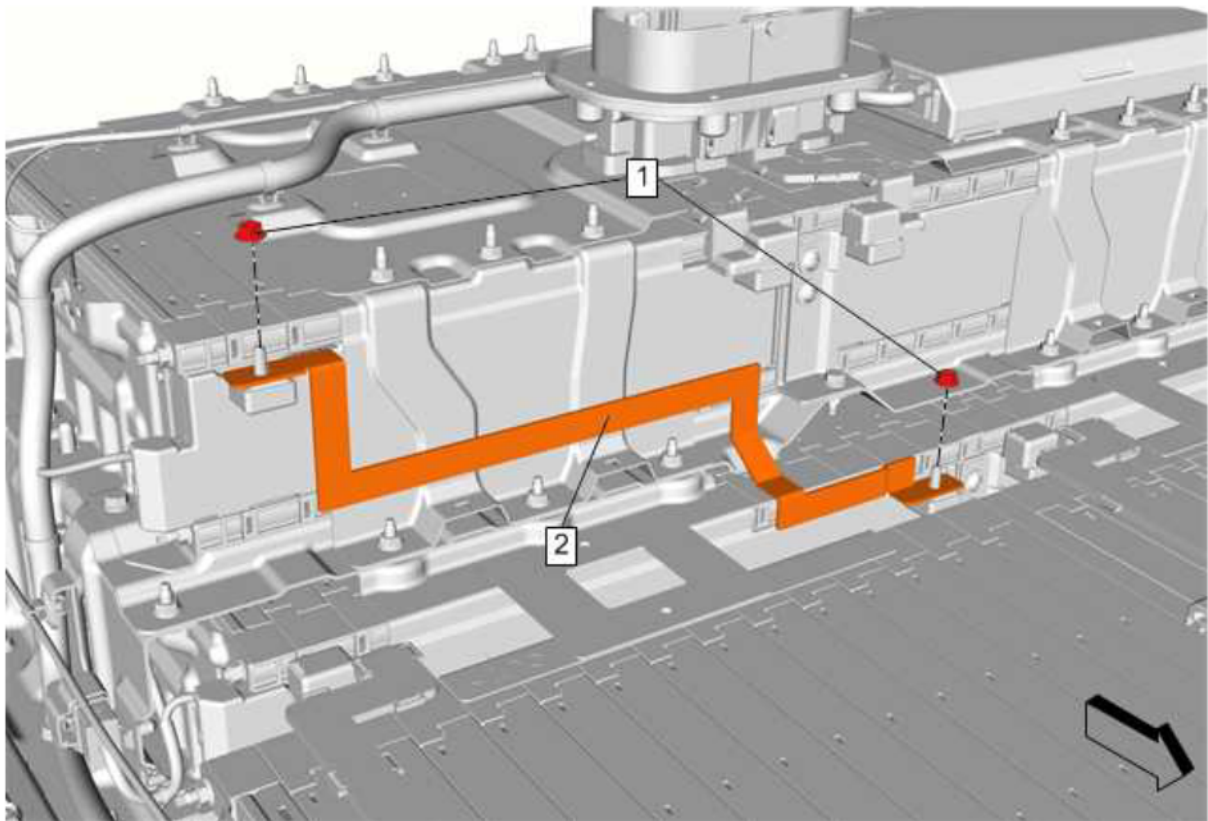


Fig. 149: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

8. Remove the battery cable (2) - bus bar, cell battery module 4 to cell battery module 5, RH.
Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)
Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)
Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)
Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)
Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)
Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)
Battery Cable Replacement (Bus

Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

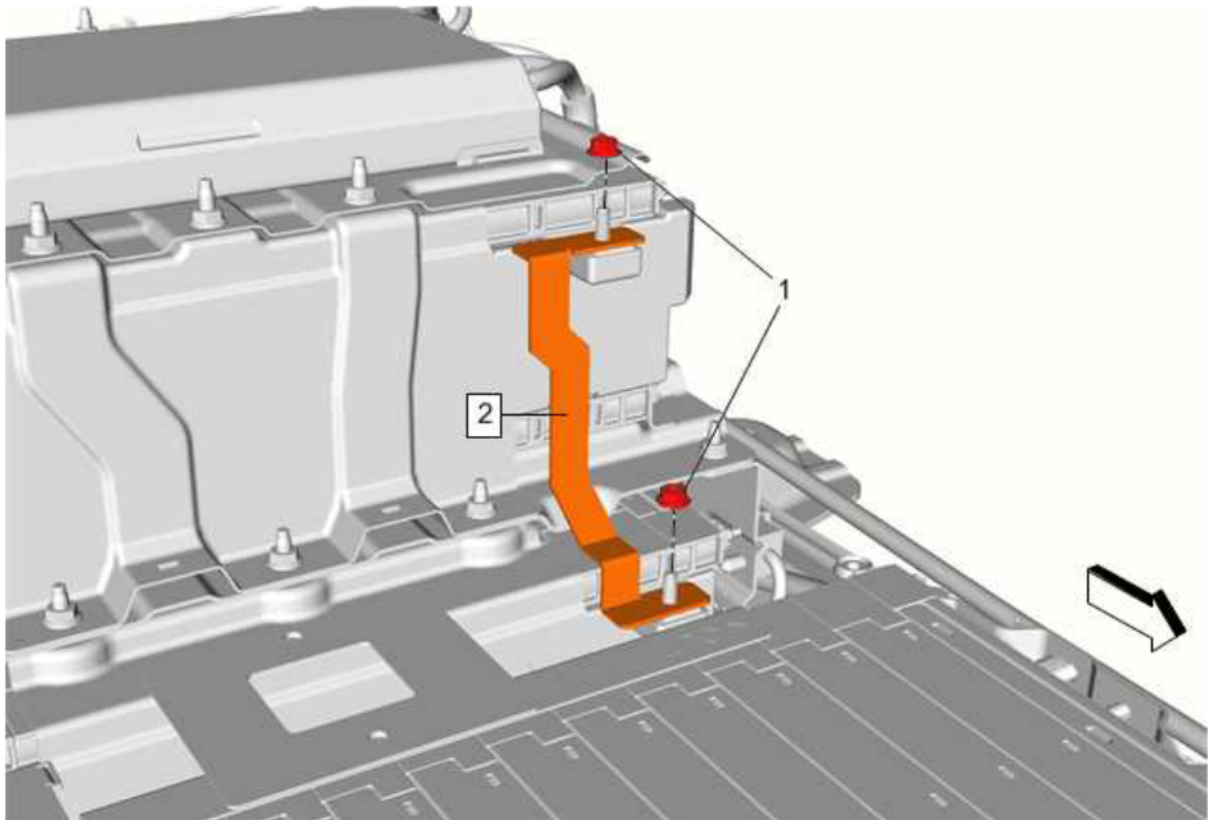


Fig. 150: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

9. Remove the battery cable (2) - bus bar, cell battery module 4 to cell battery module 5, LH.
Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

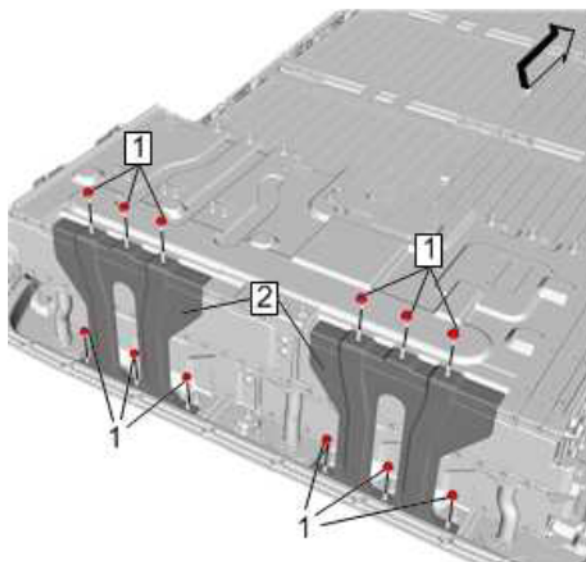


Fig. 151: Cell Battery Securing Nuts And Cell Battery Rear Bracket
Courtesy of GENERAL MOTORS COMPANY

10. Remove the cell battery securing nuts (1) [12x] and the row 5 cell battery rear bracket (2).

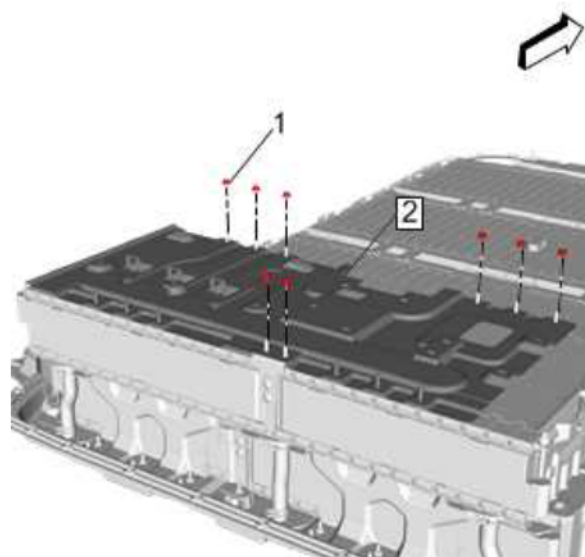


Fig. 152: Cell Battery Securing Nuts And Cell Battery Upper Bracket
Courtesy of GENERAL MOTORS COMPANY

11. Remove the cell battery securing nuts (1) [8x] and the row 5 cell battery upper bracket (2).

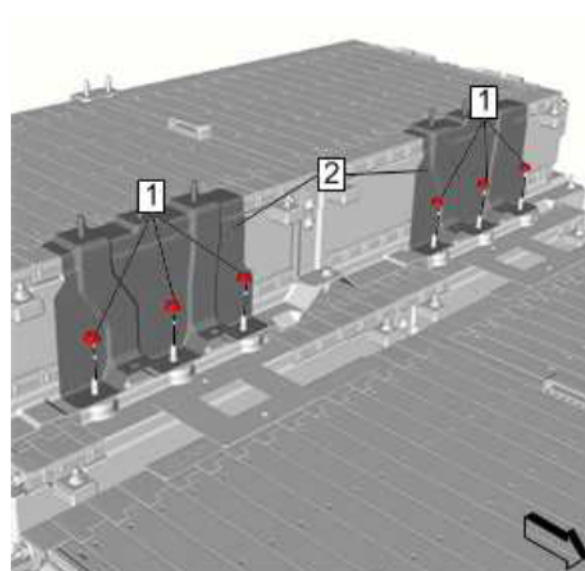


Fig. 153: Cell Battery Securing Nuts And Cell Battery Front Bracket
Courtesy of GENERAL MOTORS COMPANY

12. Remove the cell battery securing nuts (1) [6x] and the row 5 cell battery front bracket (2).

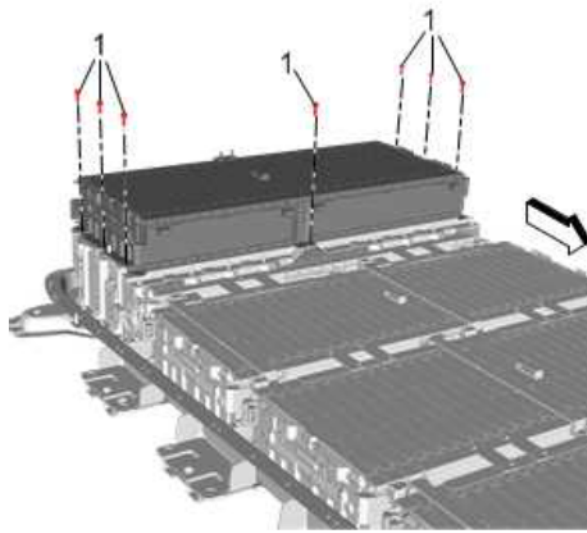


Fig. 154: Cell Battery Securing Bolts
 Courtesy of GENERAL MOTORS COMPANY

13. Remove the row 5 cell battery securing bolts (1) [7x].

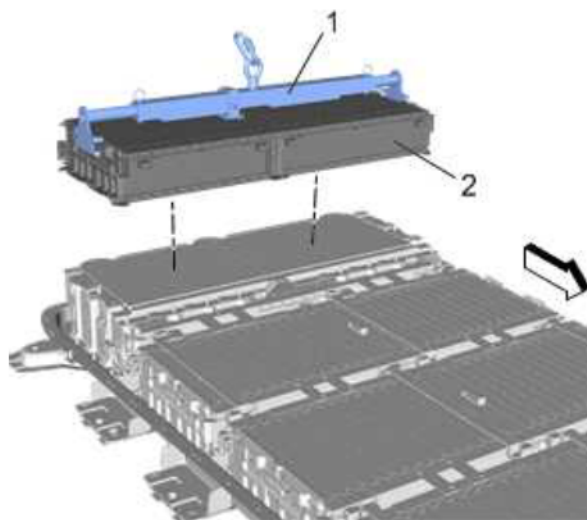


Fig. 155: Battery Lift Tool And Cell Battery
 Courtesy of GENERAL MOTORS COMPANY

14. Use the **EL-48264** Battery Lift Tool (1) to lift the cell battery (2).

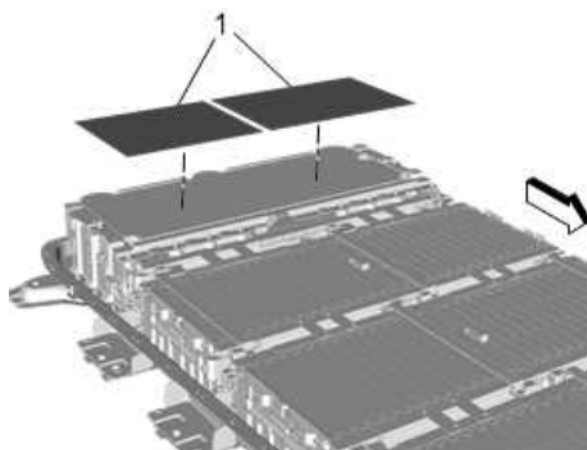


Fig. 156: Thermal Pads
 Courtesy of GENERAL MOTORS COMPANY

15. Remove the thermal pads (1).

Installation Procedure

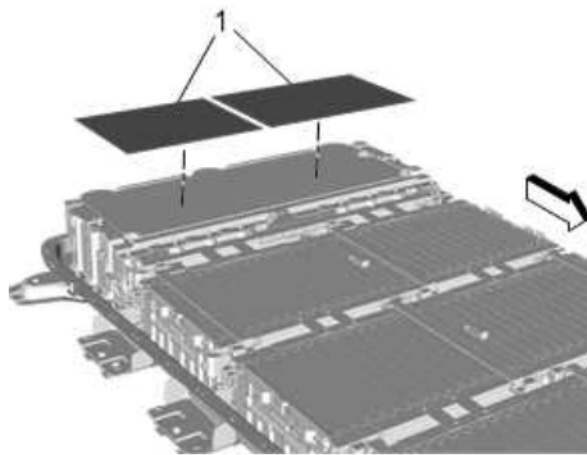


Fig. 157: Thermal Pads

Courtesy of GENERAL MOTORS COMPANY

NOTE: When installing the thermal pad, ensure there are no air bubbles during installation on the cold plate.

1. Install the thermal pads (1).

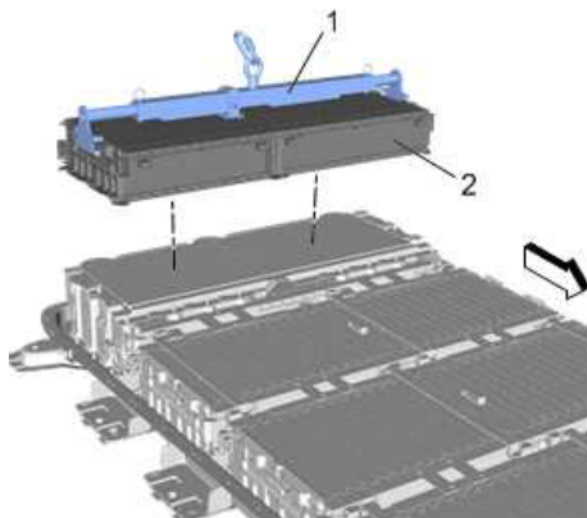


Fig. 158: Battery Lift Tool And Cell Battery

Courtesy of GENERAL MOTORS COMPANY

2. Use the **EL-48264** Battery Lift Tool (1) to install the cell battery (2).

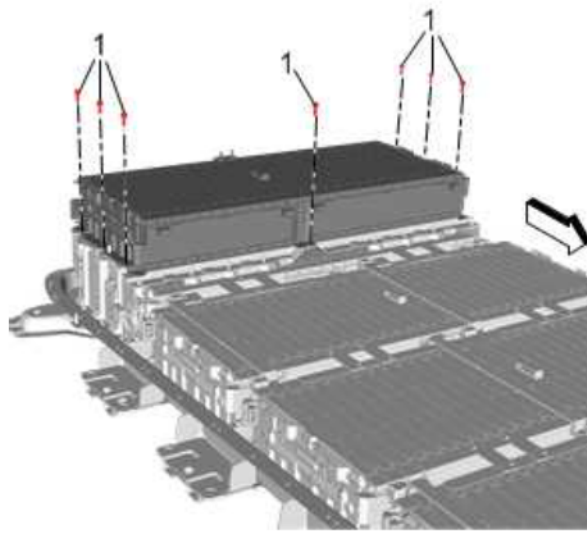


Fig. 159: Cell Battery Securing Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution .

3. Install the row 5 cell battery securing bolts (1) [7x] to 9 N.m (80 lb in).

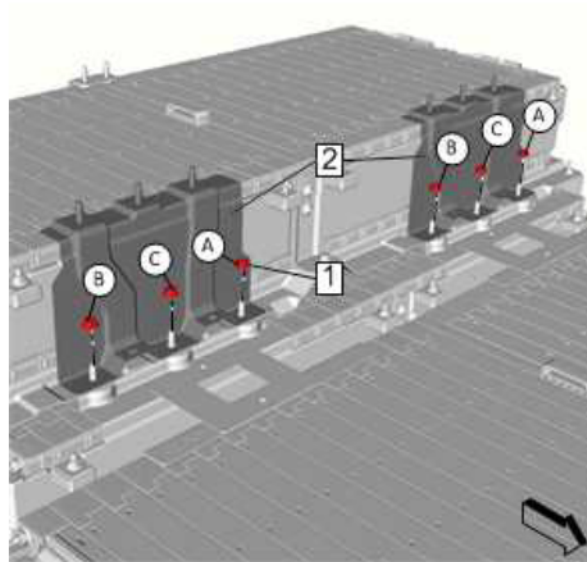


Fig. 160: Cell Battery Securing Nuts In Sequence
Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the cell battery securing nuts in the sequence shown.

4. Install the cell battery securing nuts (1) [6x] and the row 5 cell battery front bracket (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

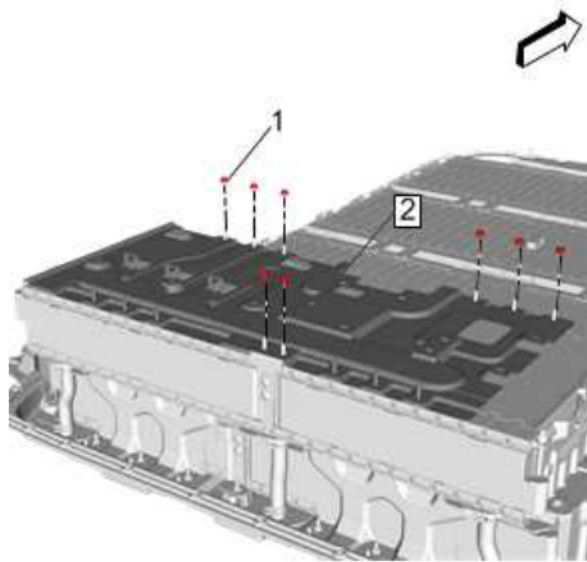


Fig. 161: Cell Battery Securing Nuts And Cell Battery Upper Bracket
 Courtesy of GENERAL MOTORS COMPANY

5. Install the cell battery securing nuts (1) [8x] and the row 5 cell battery upper bracket (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

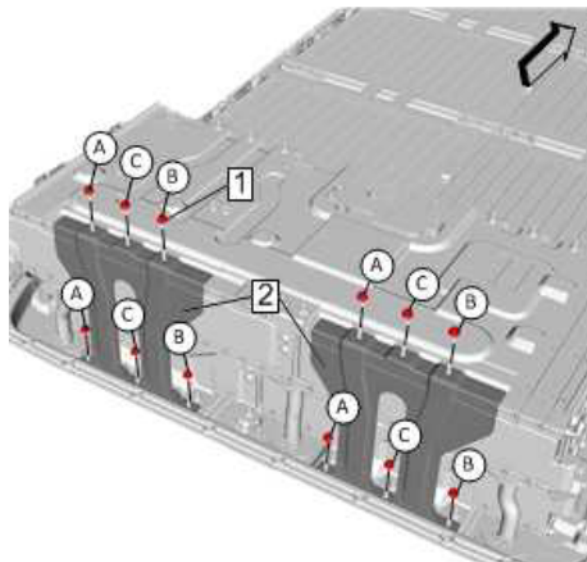


Fig. 162: Cell Battery Securing Nuts In Sequence
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the cell battery securing nuts in the sequence shown.

6. Install the cell battery securing nuts (1) [12x] and the row 5 cell battery rear bracket (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

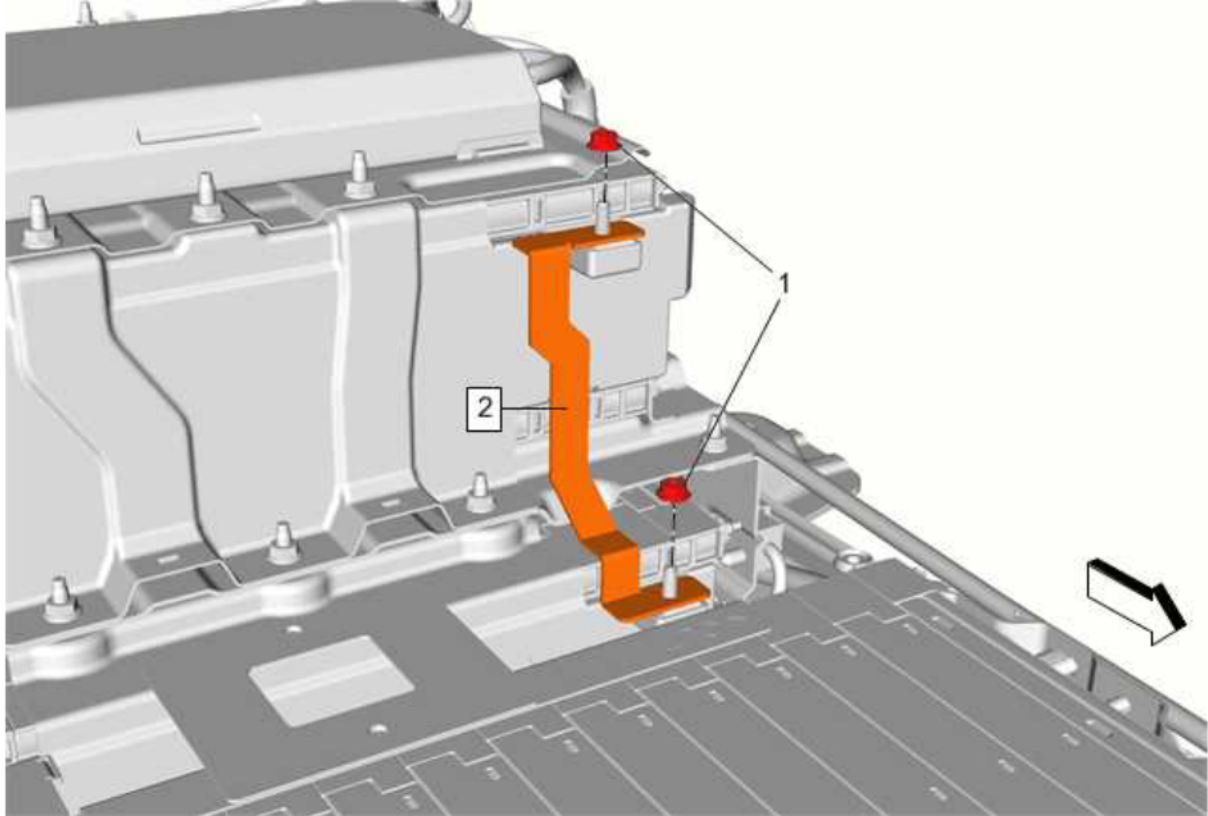
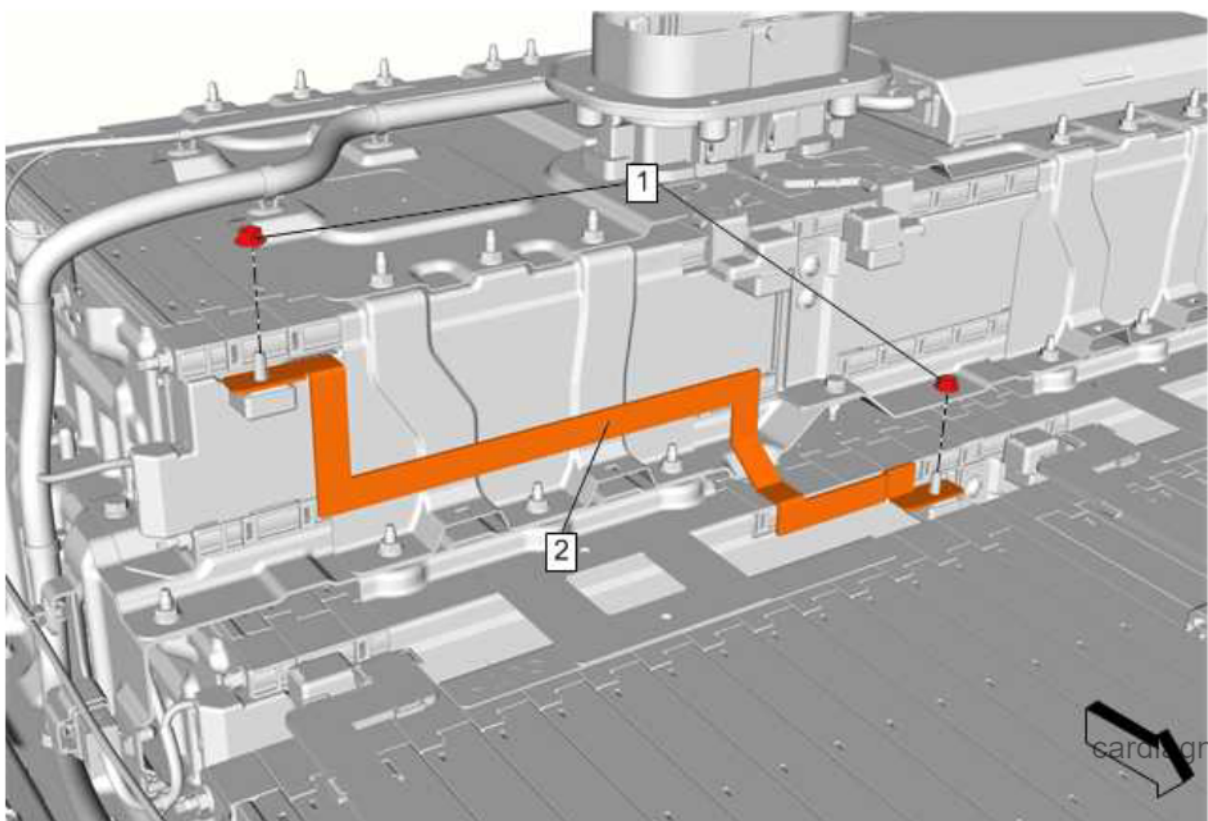


Fig. 163: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

7. Install the battery cable (2) - bus bar, cell battery module 4 to cell battery module 5, LH. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).



8. Install the battery cable (2) - bus bar, cell battery module 4 to cell battery module 5, RH. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)****Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)****Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)****Battery Cable Replacement (Bus Bar, X3, Positive & Negative).**

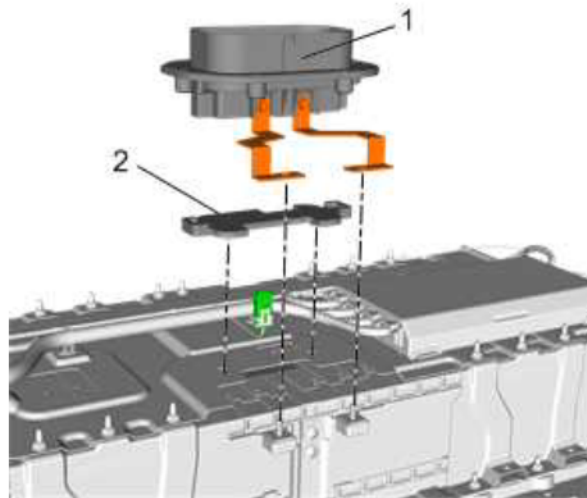


Fig. 165: Connector And Connector Insulator

Courtesy of GENERAL MOTORS COMPANY

9. Install the high voltage battery high voltage manual disconnect connector (1). **High Voltage Battery High Voltage Manual Disconnect Connector Replacement.**

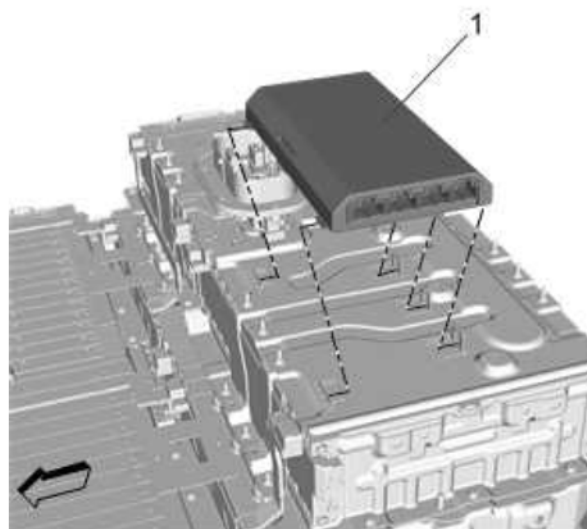


Fig. 166: Battery Energy Control Module

Courtesy of GENERAL MOTORS COMPANY

10. Install the battery energy control module (1). **Battery Energy Control Module Replacement.**

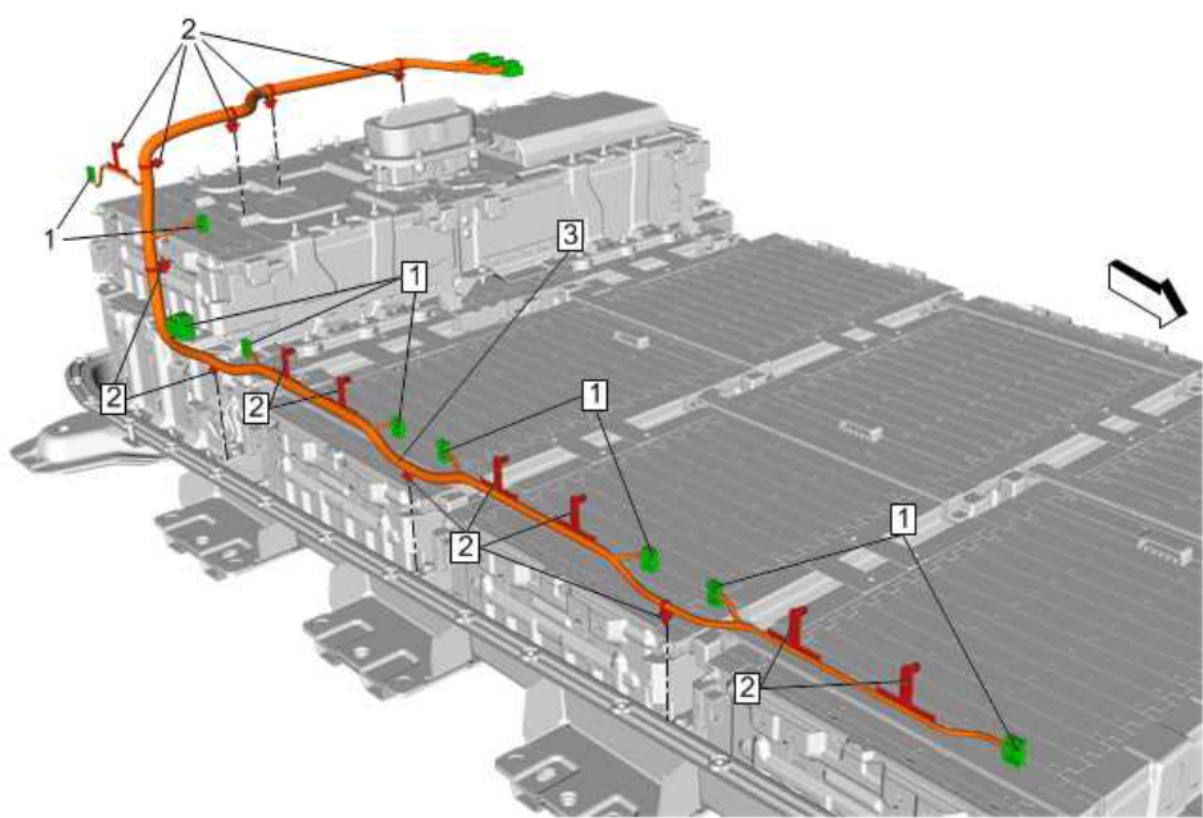


Fig. 167: Drive Motor Battery Sensor Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

11. Install the drive motor battery sensor module wiring harness (3) - right side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)****Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)**.

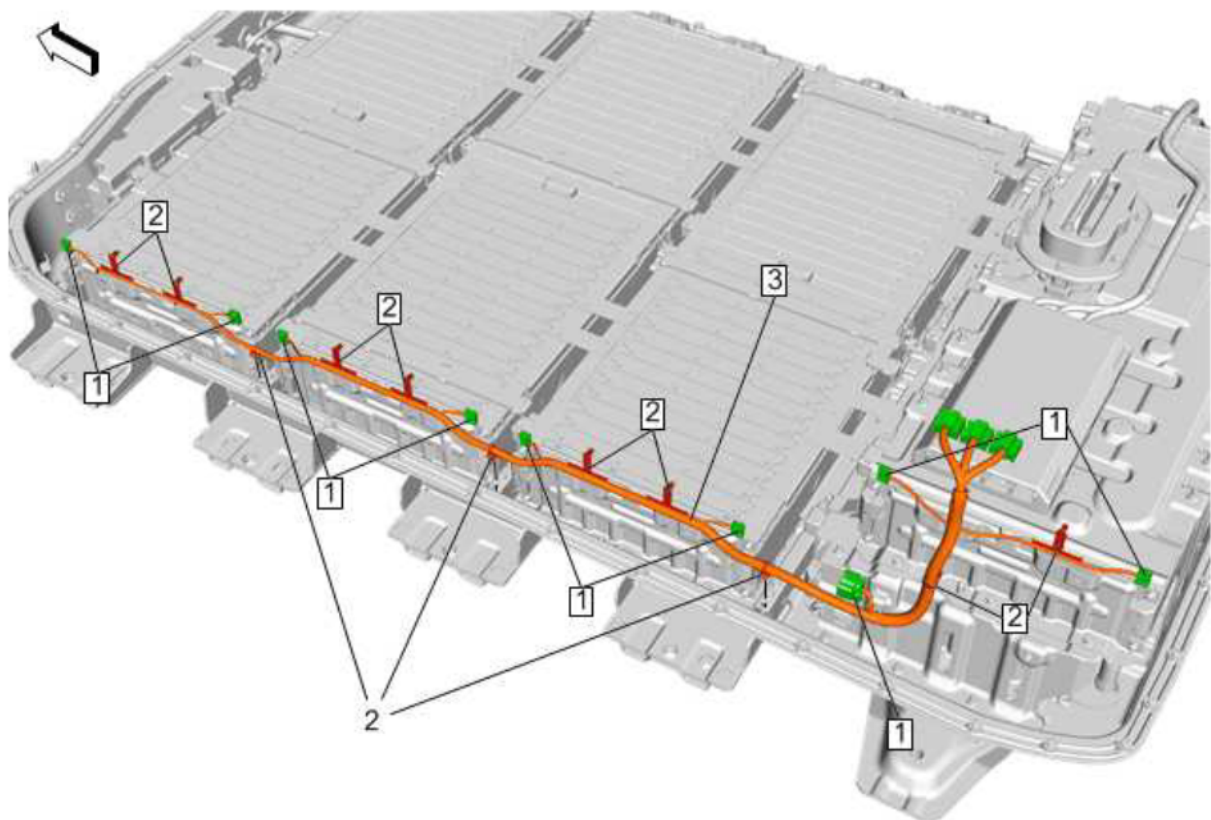


Fig. 168: Drive Motor Battery Sensor Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

12. Install the drive motor battery sensor module wiring harness (3) - left side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)****Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)**.

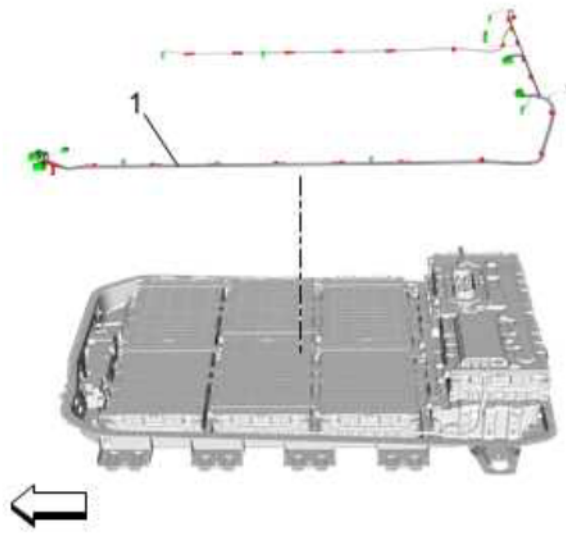


Fig. 169: Drive Motor Battery Control Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

13. Install the drive motor battery control module wiring harness (1). **Drive Motor Battery Control Module Wiring Harness Replacement**.
14. Perform the cell battery balancing if replaced. **Hybrid/EV Battery Cell Balancing**.
15. Install the battery upper cover. **Battery Upper Cover Replacement**
16. Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**
17. Reprogram the battery energy control module. **Battery Energy Control Module Programming and Setup**
18. Program the hybrid powertrain control module 2. **Hybrid Powertrain Control Module 2 Programming and Setup**
19. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. **Hybrid/EV Battery Pack Capacity Learn**

NOTE: Refer to Diagnostic Aids to determine when, if required procedure should be performed.

HIGH VOLTAGE CONNECTOR REPLACEMENT (X3)

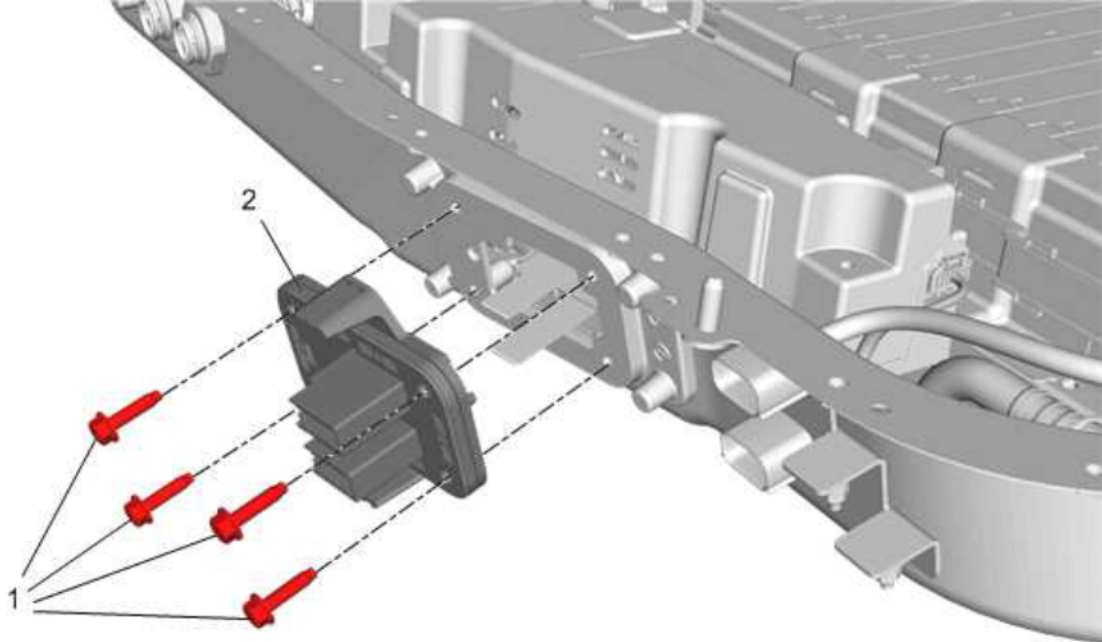


Fig. 170: High Voltage Battery Connector X3
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death. WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. Preliminary Procedure 1. Disable the high voltage system. High Voltage Disabling 2. Disconnect the X3 harness connector by rotating the connector handle until 90 degrees.	
cardiagn.com	

Callout	Component Name
1	High Voltage Battery X3 Connector Block Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. Tighten 9 N.m (80 lb in)
2	High Voltage Battery Connector X3 1. Slowly and gently slide X3 connector out from the high voltage battery. 2. Enable the high voltage system. High Voltage Enabling

HIGH VOLTAGE CONNECTOR REPLACEMENT (X4)

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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. Remove Battery Upper Cover [Battery Upper Cover Replacement](#)



Fig. 171: High Voltage Battery Disconnect Relay Cover
 Courtesy of GENERAL MOTORS COMPANY

3. Remove the high voltage battery disconnect relay cover (2). **High Voltage Battery Disconnect Relay Replacement**

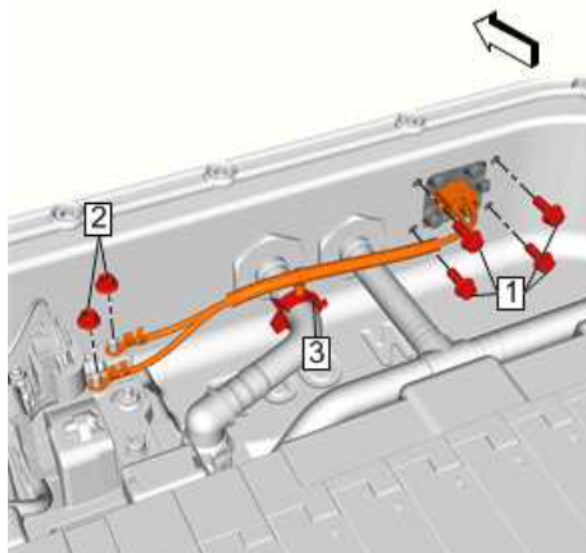


Fig. 172: High Voltage Battery Connector X4
 Courtesy of GENERAL MOTORS COMPANY

4. Remove the high voltage battery connector X4 die casting block bolts (1)
5. Remove the high voltage battery connector X4 harness nuts (2)
6. Detach the clip (3).



NOTE: High voltage battery connector X4 connector head and harness assembly can not be separated.

7. Remove the high voltage battery connector X4 (1) from the drive motor battery tray.

Installation Procedure

1. When installing the OLD X4 high voltage connector, follow the step 3 - 5 and 10 - 12.
2. When replacing the X4 high voltage connector with NEW one, follow the step 6 - 12.

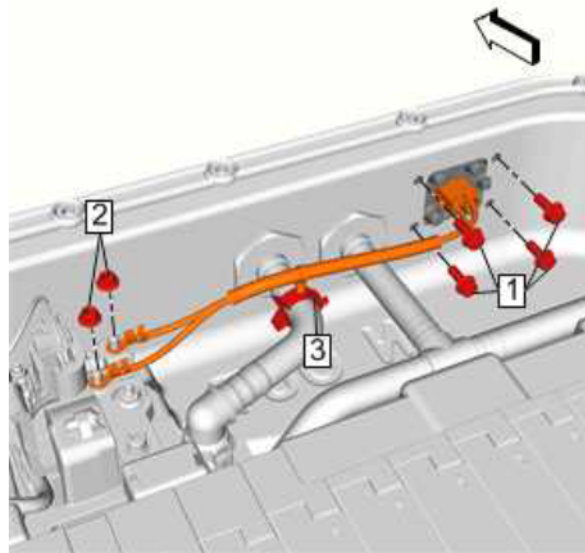


Fig. 174: High Voltage Battery Connector X4
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution**.

3. Attach the clip (3).
4. Install the high voltage battery connector X4 harness nuts (2). Tighten the fasteners (1) to 4.5 N.m (40 lb in).
5. Install the high voltage battery connector X4 die casting block bolts (1). Tighten the fasteners (1) to 9 N.m (80 lb in).

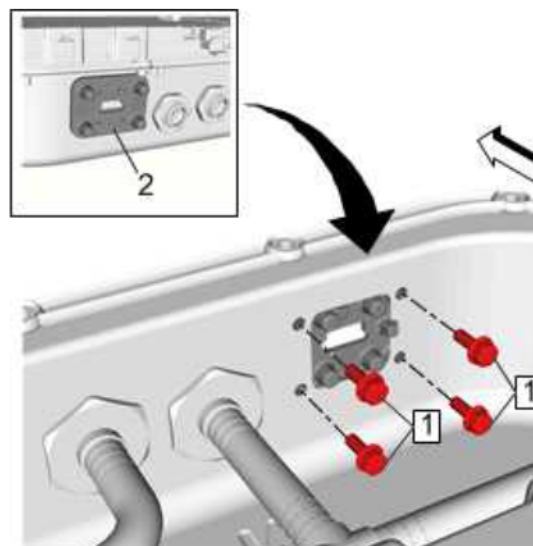


Fig. 175: High Voltage Battery Connector X4 Die Casting Block Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install the high voltage battery connector X4 die casting block bolts (1) and the block (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

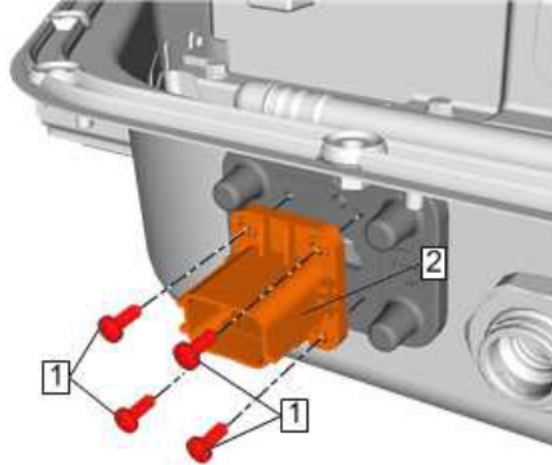


Fig. 176: High Voltage Battery Connector X4 Head Screws
 Courtesy of GENERAL MOTORS COMPANY

7. Install the high voltage battery connector X4 head screws (1) and X4 head (2). Tighten the fasteners (1) to 25 N.m (22 lb in).

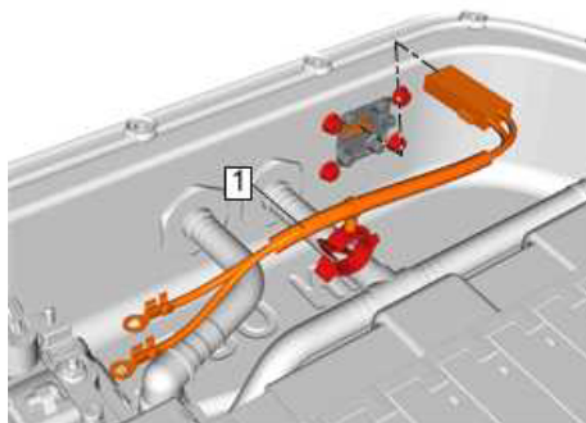


Fig. 177: Slide wiring harness into connector block
 Courtesy of GENERAL MOTORS COMPANY

8. Slide the wiring harness (1) into the X4 connector block.

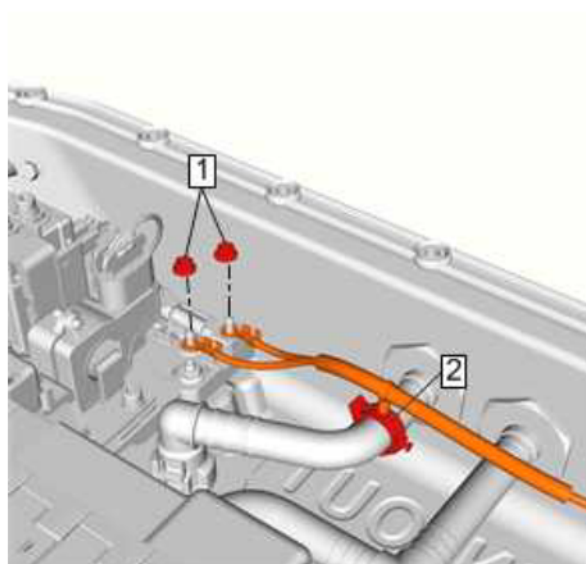


Fig. 178: High Voltage Connector X4 Harness Nuts
 Courtesy of GENERAL MOTORS COMPANY

9. Install the high voltage battery connector X4 harness nuts (1) and clip (2). Tighten the fasteners (1) to 4.5 N.m (40 lb in).
10. Perform second pass and tighten the fasteners (1) to 4.5 N.m (40 lb in).

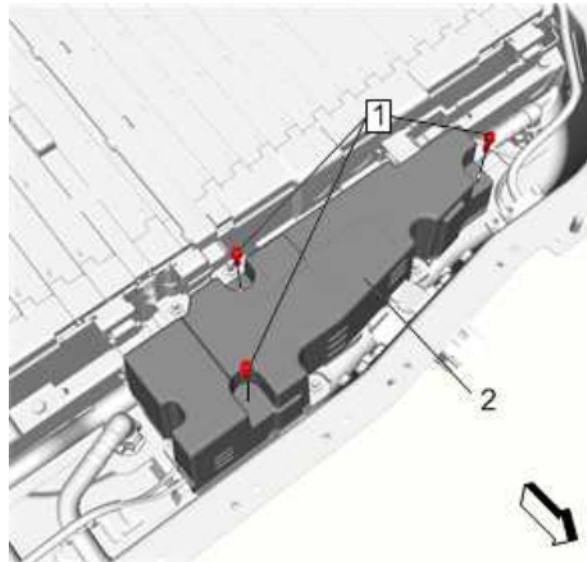


Fig. 179: High Voltage Battery Disconnect Relay Cover
Courtesy of GENERAL MOTORS COMPANY

11. Install the high voltage battery disconnect relay cover (2). [High Voltage Battery Disconnect Relay Replacement](#)
12. Install Battery Upper Cover [Battery Upper Cover Replacement](#)
13. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

HIGH VOLTAGE BATTERY DISCONNECT RELAY 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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. Remove the battery upper cover. [Battery Upper Cover Replacement](#)

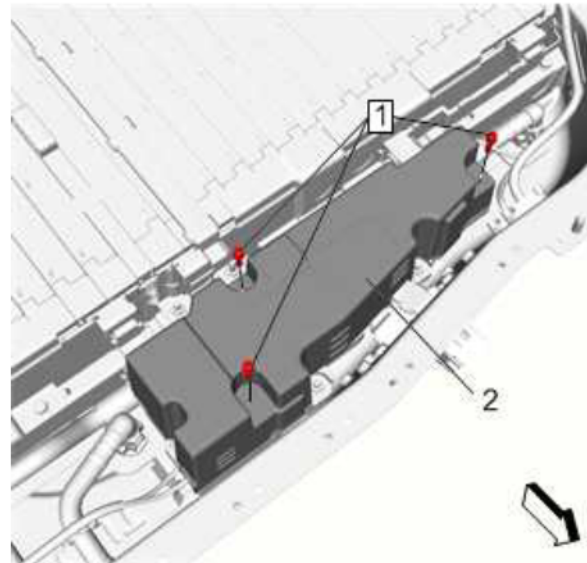


Fig. 180: High Voltage Battery Disconnect Relay Cover
Courtesy of GENERAL MOTORS COMPANY

3. Remove the high voltage battery disconnect relay cover bolts (1) and the cover (2).

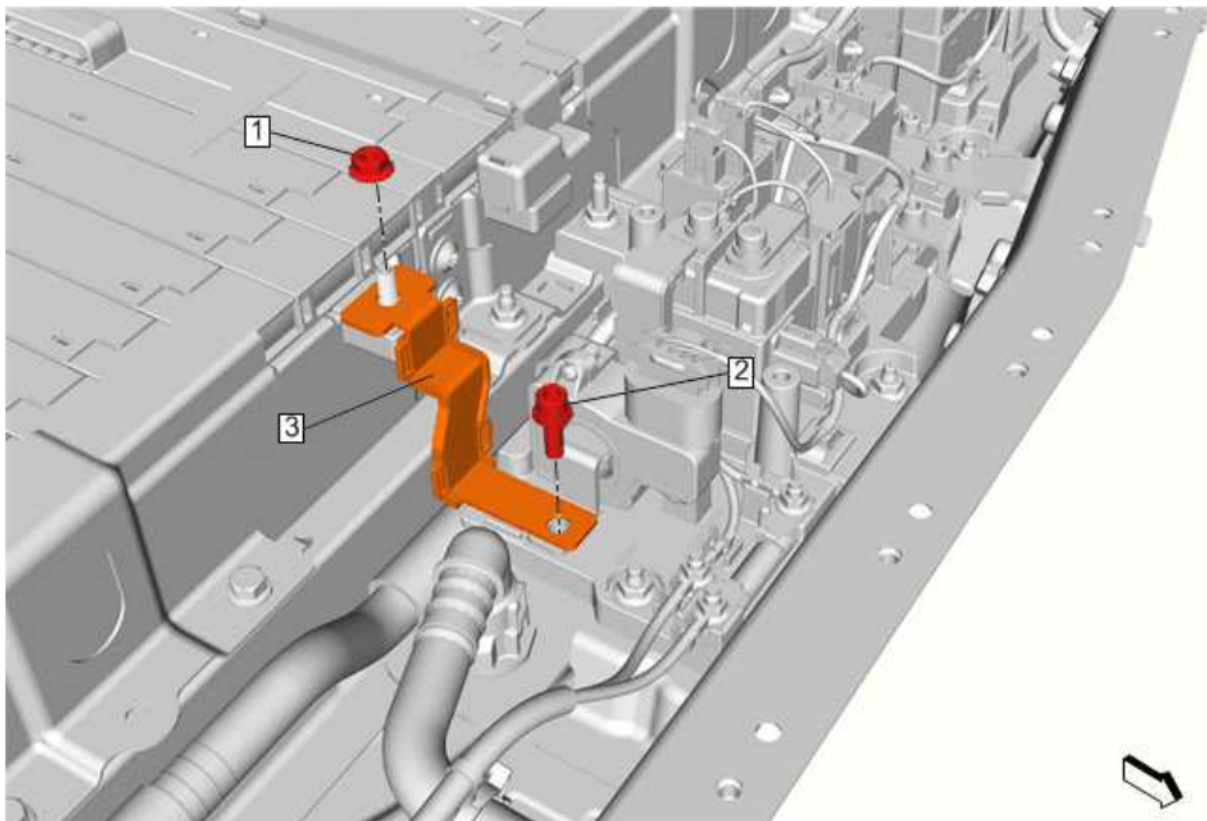


Fig. 181: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

4. Remove the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, negative. [Battery Cable Replacement \(Bus Bar, Cell Battery Module 3 to Cell Battery Module 4\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH\)](#)

Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

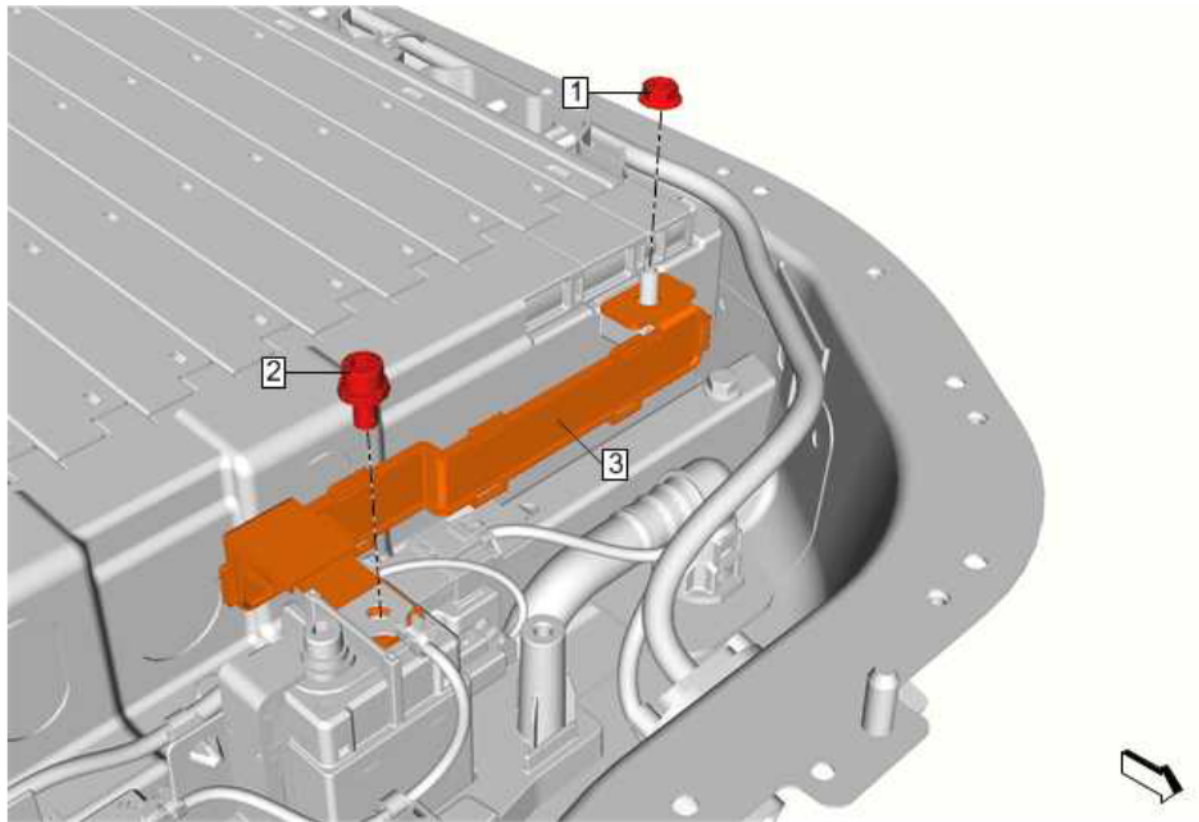


Fig. 182: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

5. Remove the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, positive. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

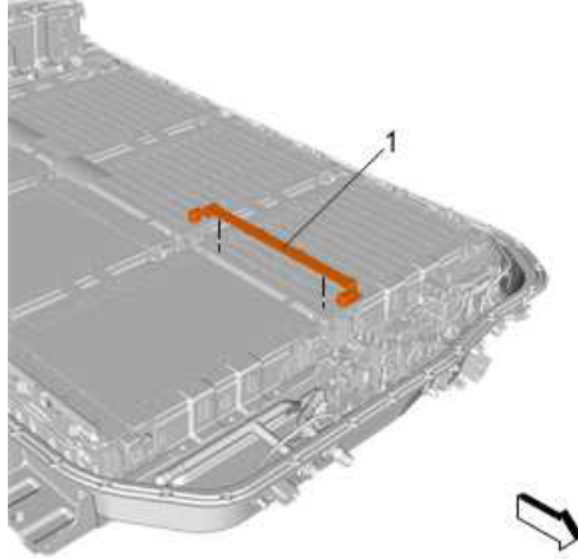


Fig. 183: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

6. Remove the battery cable (1) - bus bar, cell battery module 1 to cell battery module 2. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

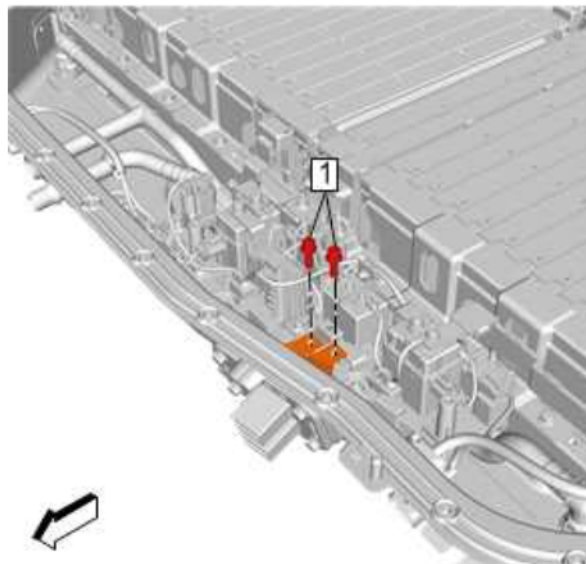


Fig. 184: Battery Cable Bolt

Courtesy of GENERAL MOTORS COMPANY

7. Remove Battery Cable Bolt (1)

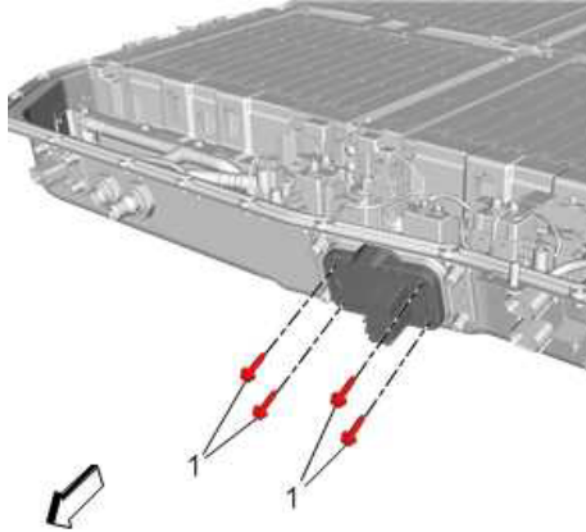


Fig. 185: High Voltage Battery X3 Connector Block Bolt
 Courtesy of GENERAL MOTORS COMPANY

8. Remove High Voltage Battery X3 Connector Block Bolt (1)

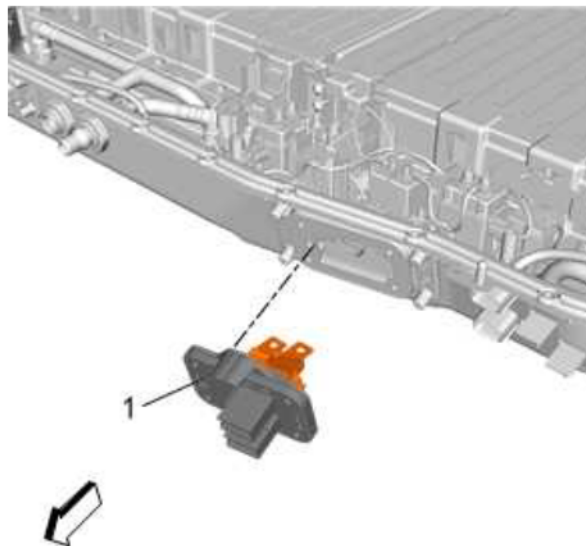


Fig. 186: High Voltage Battery X3 Connector With Battery Cables
 Courtesy of GENERAL MOTORS COMPANY

9. Remove the high voltage battery X3 connector (1) with battery cables.

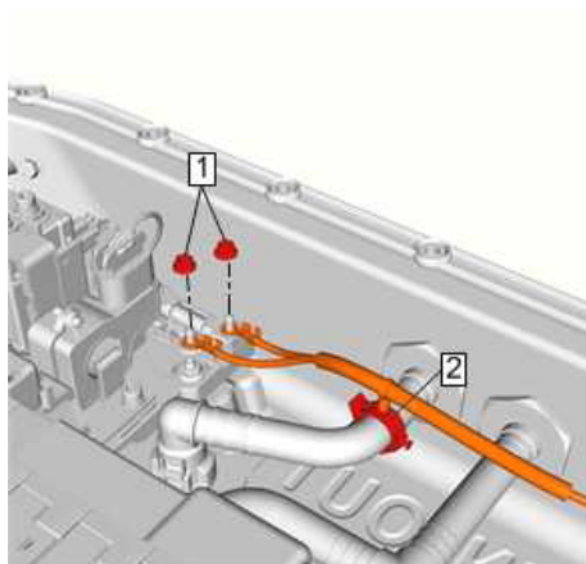


Fig. 187: High Voltage Connector X4 Harness Nuts
 Courtesy of GENERAL MOTORS COMPANY

10. Remove the high voltage connector X4 harness nuts (1). [High Voltage Connector Replacement \(X4\)](#)

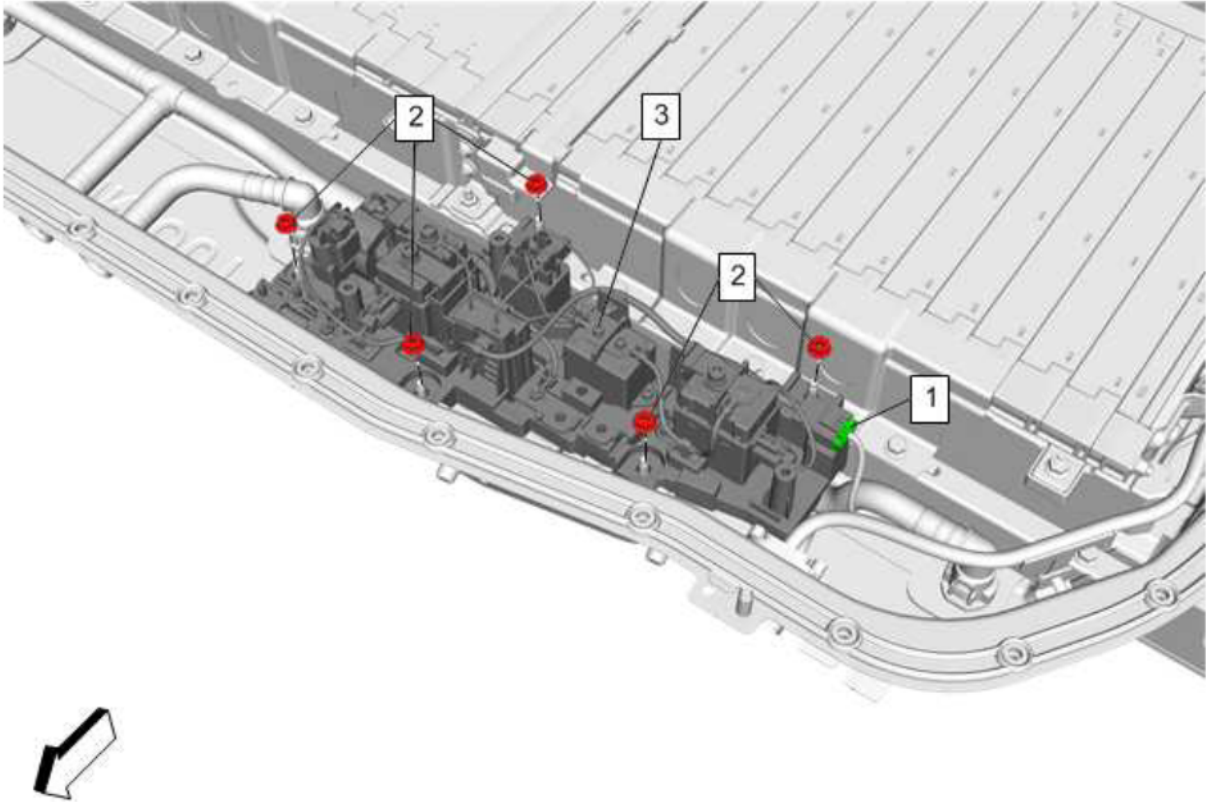


Fig. 188: High Voltage Battery Disconnect Relay Assembly
Courtesy of GENERAL MOTORS COMPANY

11. Disconnect the drive motor battery control module wiring harness connector (1).
12. Remove the high voltage battery disconnect relay assembly nuts (2)
13. Remove the high voltage battery disconnect relay assembly (3).

Installation Procedure

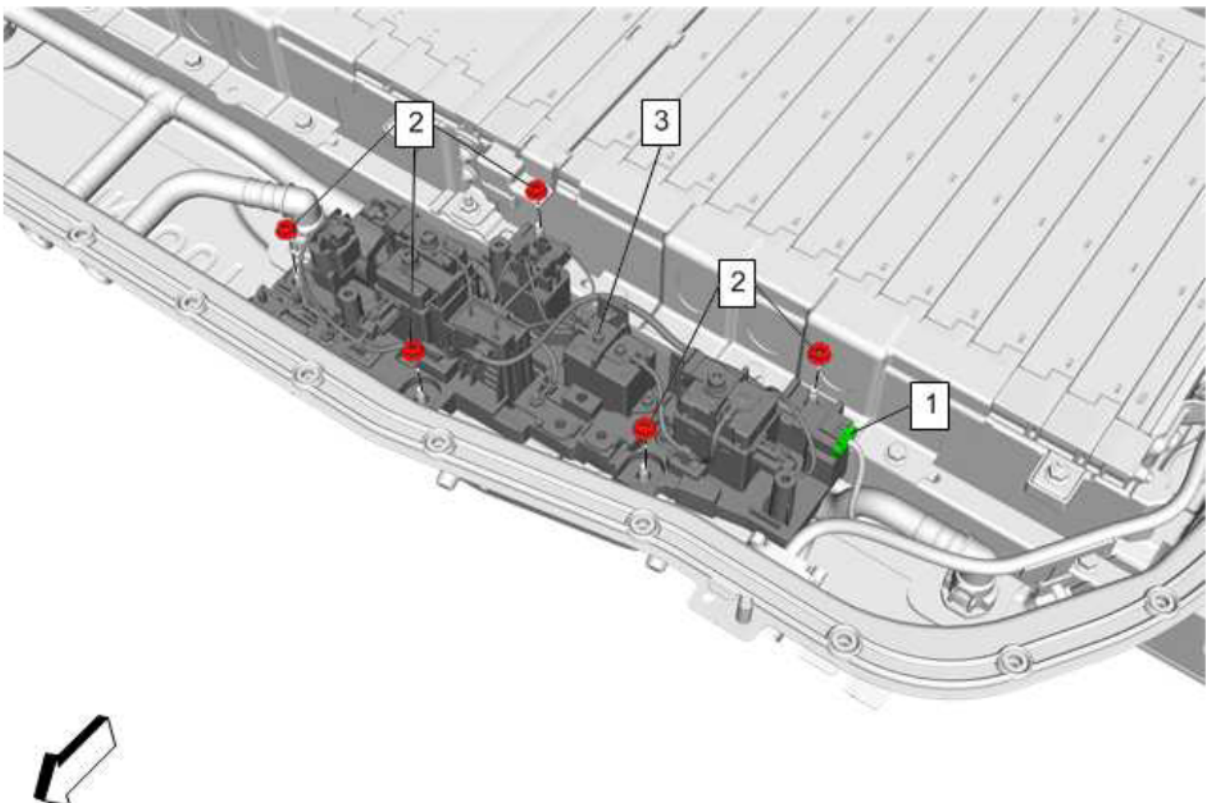


Fig. 189: High Voltage Battery Disconnect Relay Assembly
Courtesy of GENERAL MOTORS COMPANY

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

1. Install the high voltage battery disconnect relay assembly (3).
2. Tighten the high voltage battery disconnect relay assembly nuts (2) 9 N.m (80 lb in).
3. Connect the drive motor battery control module wiring harness connector (1).

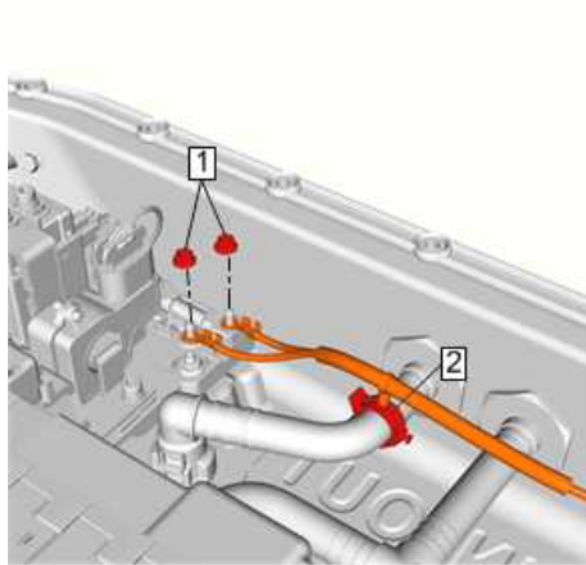


Fig. 190: High Voltage Connector X4 Harness Nuts

Courtesy of GENERAL MOTORS COMPANY

4. Install the high voltage connector X4 harness nuts (1) [High Voltage Connector Replacement \(X4\)](#)

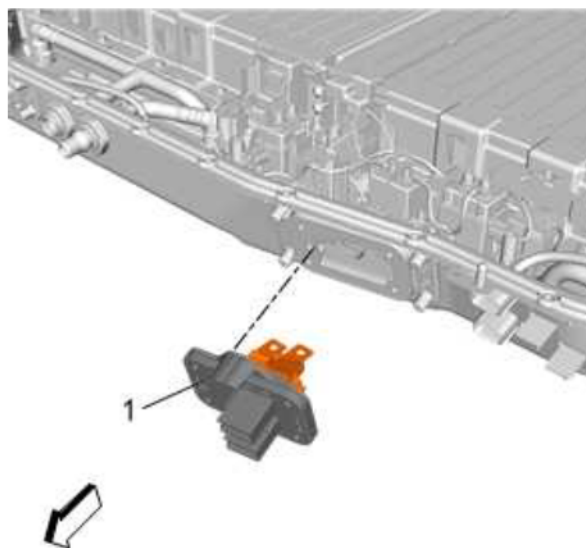


Fig. 191: High Voltage Battery X3 Connector With Battery Cables

Courtesy of GENERAL MOTORS COMPANY

5. Install the high voltage battery X3 connector (1) with battery cables.

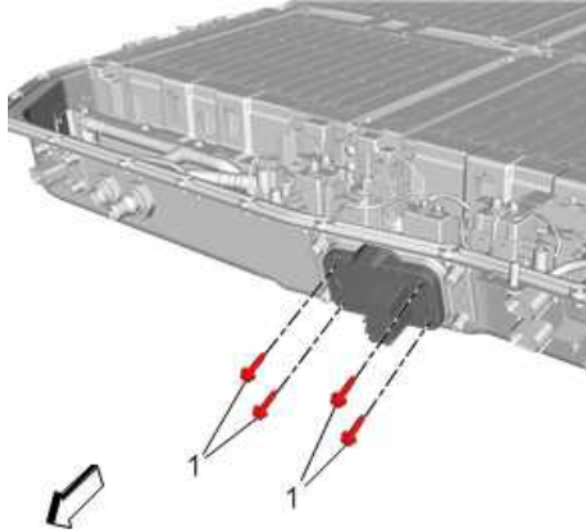


Fig. 192: High Voltage Battery X3 Connector Block Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Install High Voltage Battery X3 Connector Block Bolt (1) and tighten 9 N.m (80 lb in)

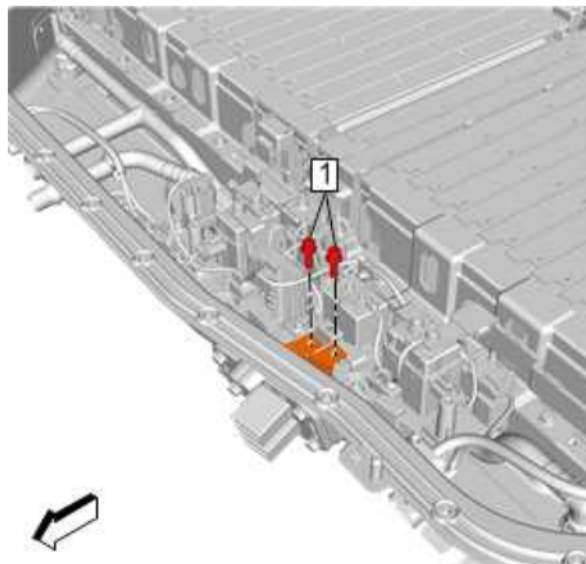
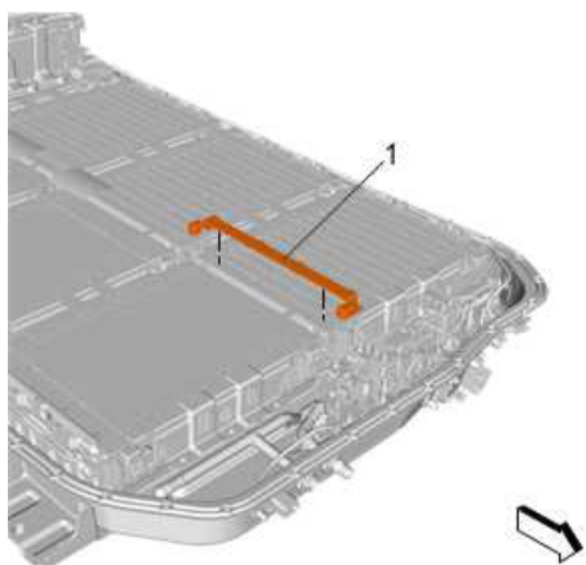


Fig. 193: Battery Cable Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Install Battery Cable Bolt (1) and tighten

7.1. First Pass: 9 N.m (80 lb in)

7.2. Final Pass: 9 N.m (80 lb in)



8. Install the battery cable (1) - bus bar, cell battery module 1 to cell battery module 2. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)****Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)****Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)****Battery Cable Replacement (Bus Bar, X3, Positive & Negative)**

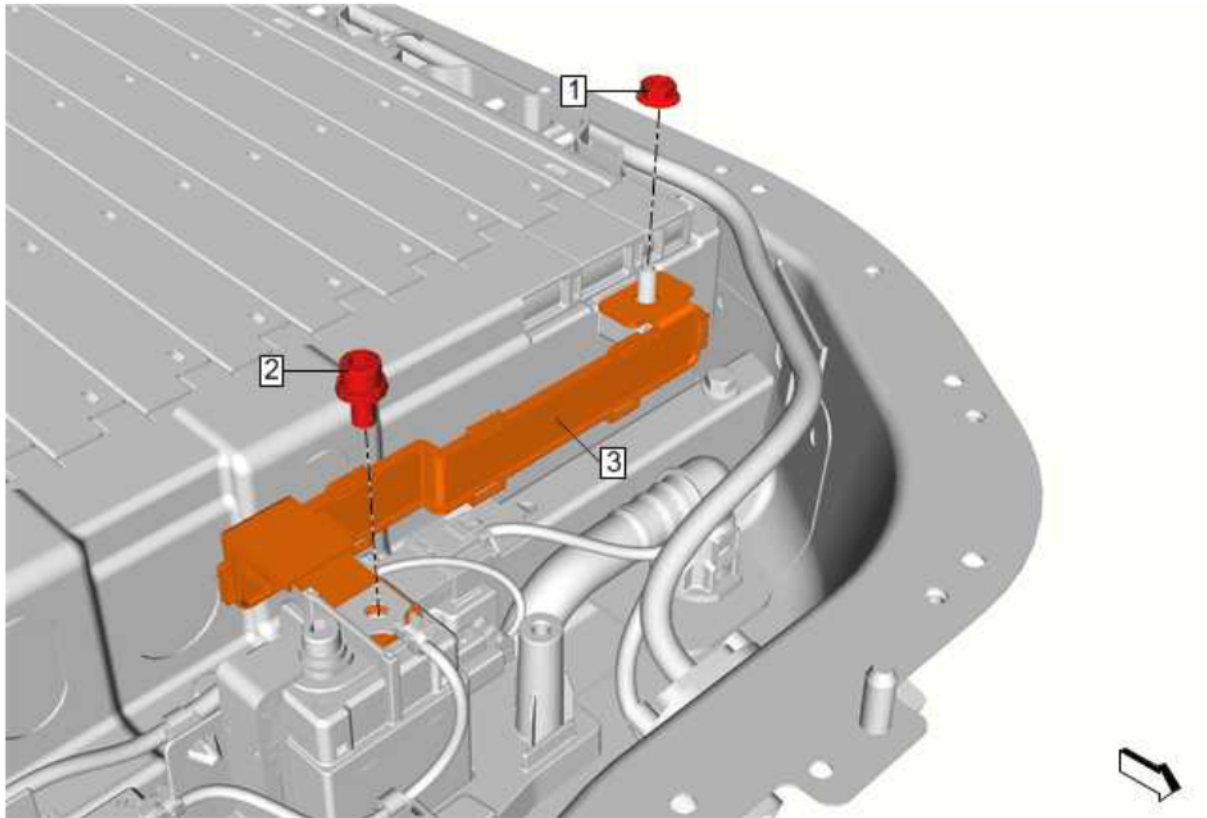


Fig. 195: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

9. Install the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, positive. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)****Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)****Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)****Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)****Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)****Battery Cable Replacement (Bus Bar, X3, Positive & Negative)**

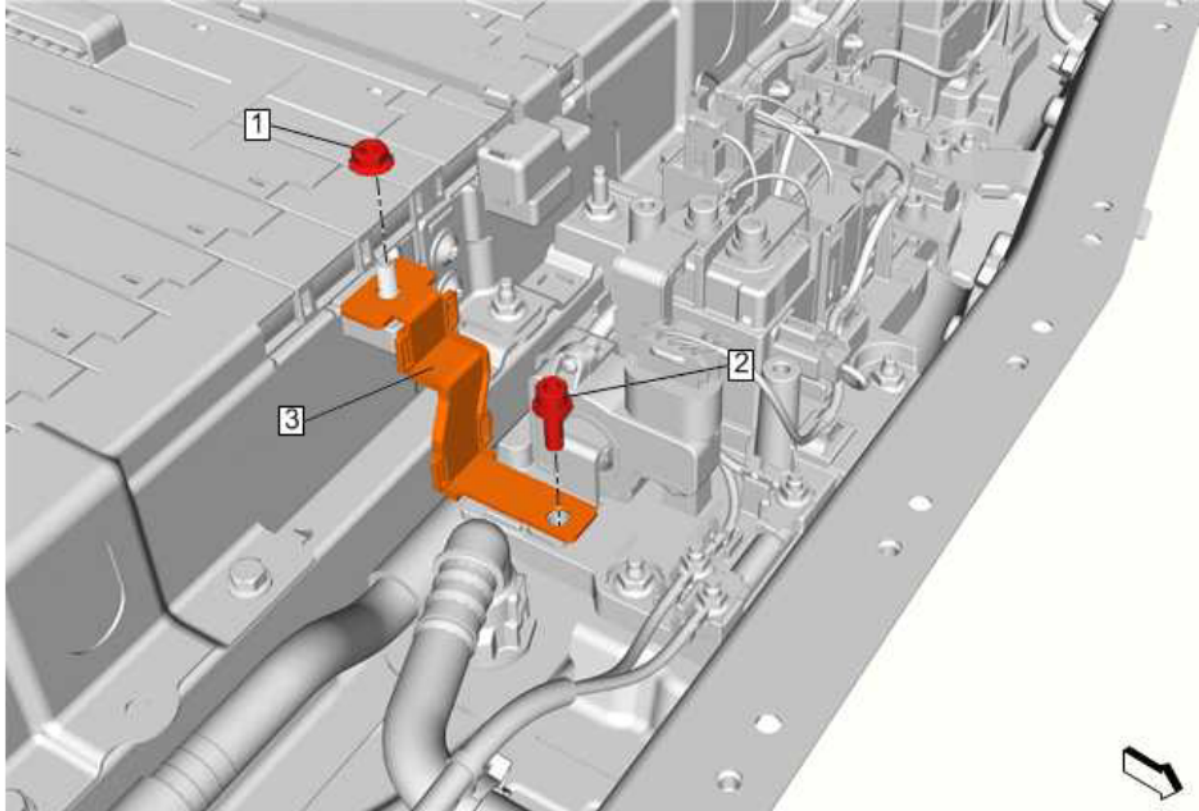


Fig. 196: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

10. Install the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, negative. [Battery Cable Replacement \(Bus Bar, Cell Battery Module 3 to Cell Battery Module 4\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative\)](#)[Battery Cable Replacement \(Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 1 to Cell Battery Module 2\)](#)[Battery Cable Replacement \(Bus Bar, Cell Battery Module 2 to Cell Battery Module 3\)](#)[Battery Cable Replacement \(Bus Bar, X3, Positive & Negative\)](#)

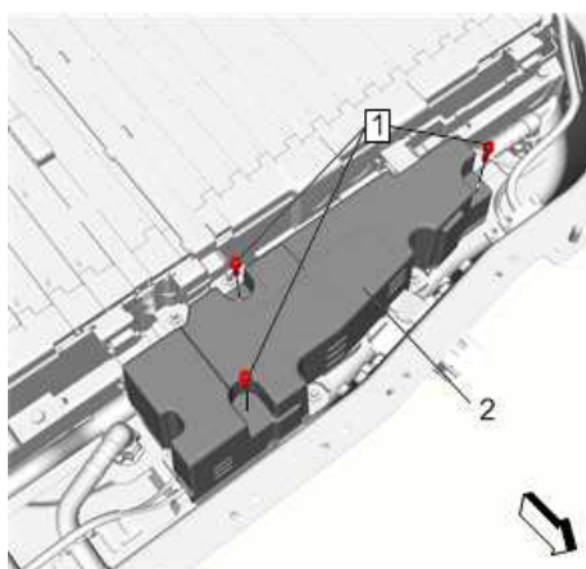


Fig. 197: High Voltage Battery Disconnect Relay Cover

Courtesy of GENERAL MOTORS COMPANY

11. Install the high voltage battery disconnect relay cover (2).
12. Tighten the high voltage battery disconnect relay cover bolts (1) to 4.5 N.m (40 lbin)
13. Install the battery upper cover. [Battery Upper Cover Replacement](#)

14. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

HIGH VOLTAGE BATTERY DISCONNECT RELAY FUSE REPLACEMENT

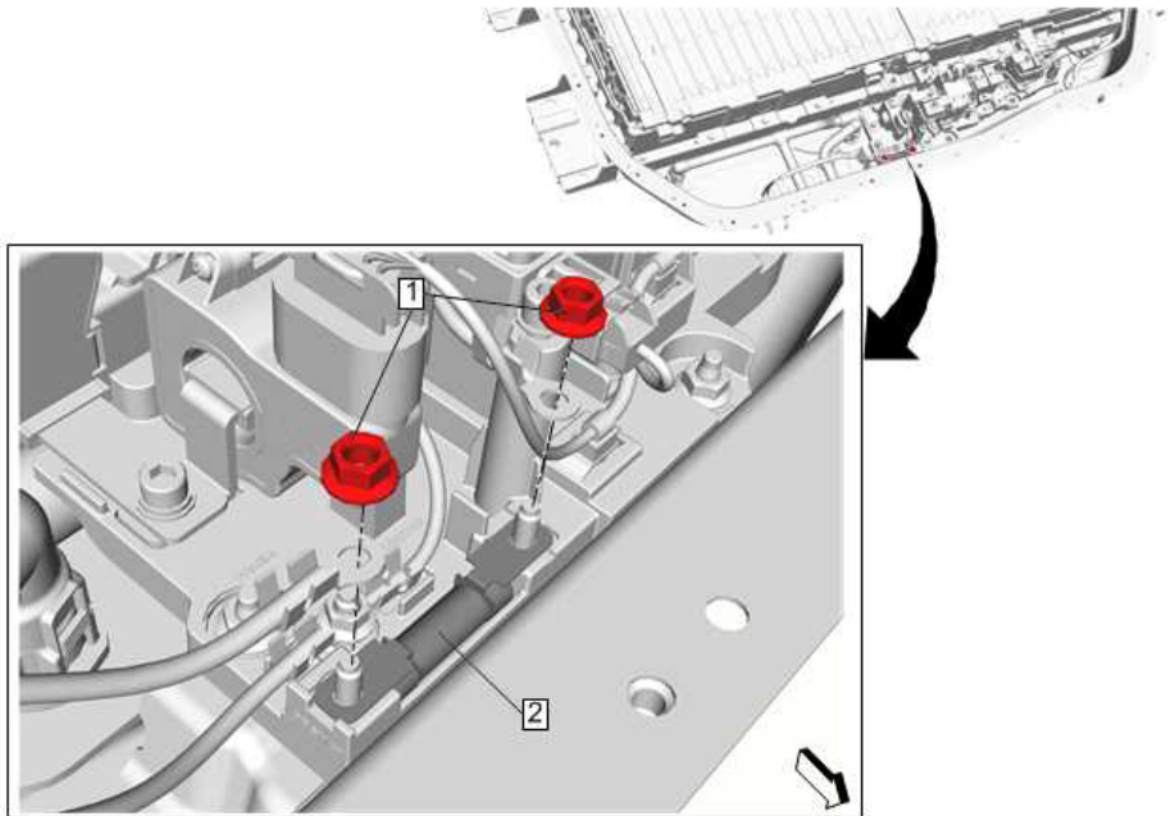


Fig. 198: High Voltage Battery Disconnect Relay Fuse
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death. WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. Preliminary Procedure 1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254) 2. Remove the battery upper cover. Battery Upper Cover Replacement 3. Remove the high voltage battery disconnect relay cover. High Voltage Battery Disconnect Relay Replacement	
1	High Voltage Battery Disconnect Relay Fuse Nut (Qty: 2) CAUTION: Fastener Caution NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. Procedure 1. Tighten the nuts to 4.5 N.m (40 lb in). 2. Tighten the nuts to 4.5 N.m (40 lb in) again.
2	High Voltage Battery Disconnect Relay Fuse

DRIVE MOTOR BATTERY POSITIVE AND NEGATIVE 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. [High Voltage Disabling](#)

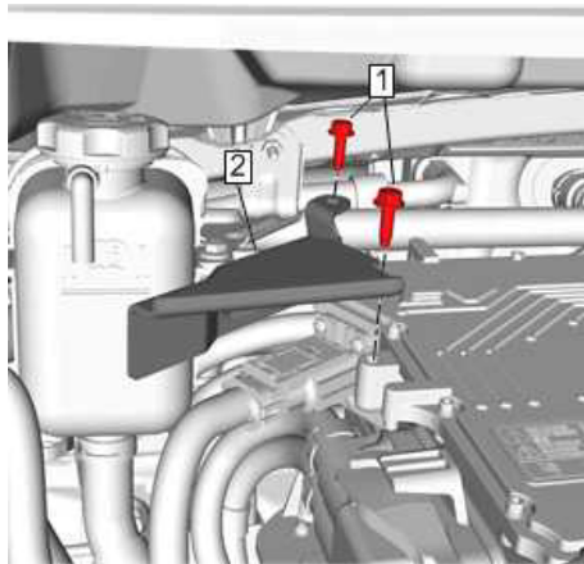


Fig. 199: Accessory DC Power Control Module High Voltage Connector Protector And Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Remove Accessory DC Power Control Module High Voltage Connector Protector Bolt(1)
3. Remove Accessory DC Power Control Module High Voltage Connector Protector(2)

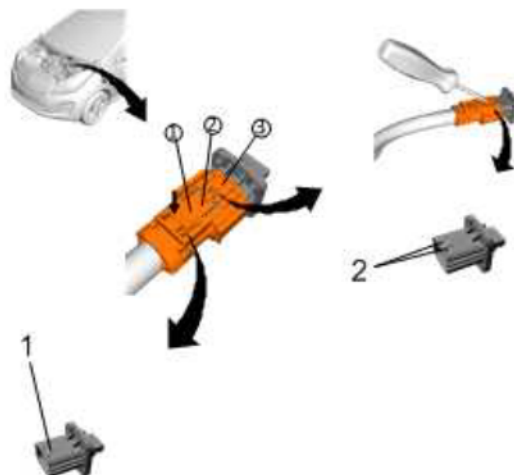


Fig. 200: First Stage Connector Tab And Connector Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

4. 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).

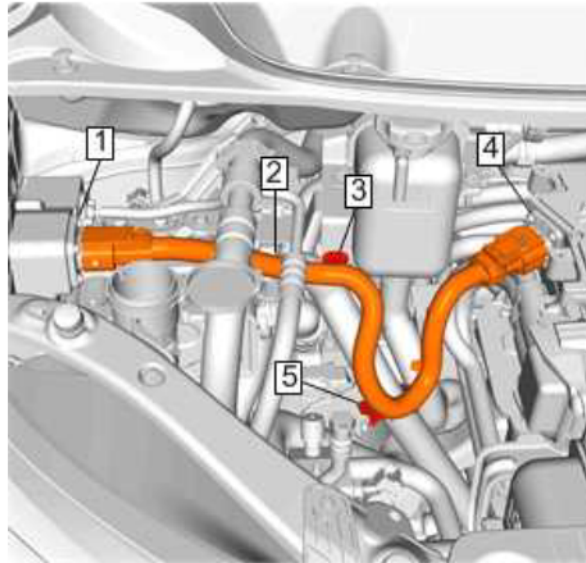


Fig. 201: Drive Motor Battery Positive and Negative Cable

Courtesy of GENERAL MOTORS COMPANY

5. Detach Drive Motor Battery Positive and Negative Cable Retainer (3)
6. Unclip Drive Motor Battery Positive and Negative Cable Retainer (5)
7. Disconnect the drive motor battery positive and negative cable (2) from the high voltage battery disconnect control module assembly (4) and heater coolant heater assembly (1).
8. Remove Drive Motor Battery Positive and Negative Cable (2)

Installation Procedure

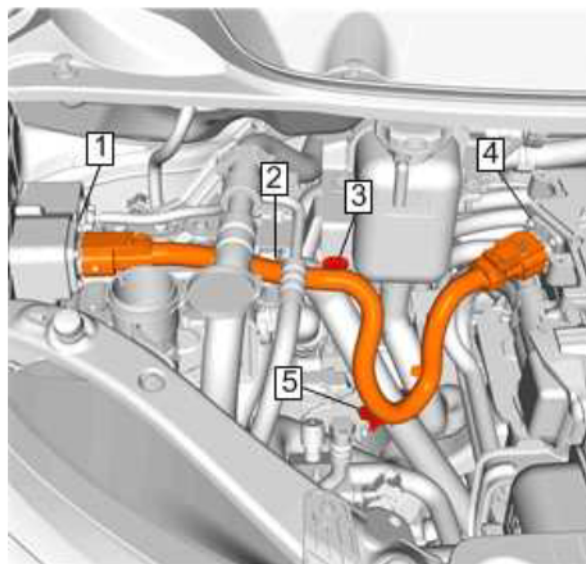


Fig. 202: Drive Motor Battery Positive and Negative Cable

Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Positive and Negative Cable (2)
2. Attach Drive Motor Battery Positive and Negative Cable Retainer (3)
3. Install Drive Motor Battery Positive and Negative Cable Retainer (5)
4. Connect the drive motor battery positive and negative cable (2) to the high voltage battery disconnect control module assembly (4) and heater coolant heater assembly (1).

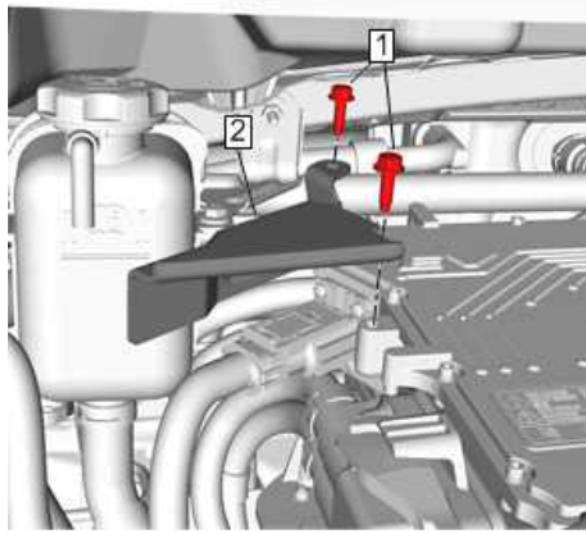


Fig. 203: Accessory DC Power Control Module High Voltage Connector Protector And Bolts
Courtesy of GENERAL MOTORS COMPANY

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

5. Install Accessory DC Power Control Module High Voltage Connector Protector (2)
6. Install Accessory DC Power Control Module High Voltage Connector Protector Bolt (1) 9 N.m (80 lb in)
7. Enable the high voltage system. [High Voltage Enabling](#)

DRIVE MOTOR BATTERY POSITIVE AND NEGATIVE RELAY 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. [High Voltage Disabling](#)
2. Remove Front Wheelhouse Liner [Front Wheelhouse Liner Replacement](#)

3. Remove Battery Tray [Battery Tray Replacement](#)

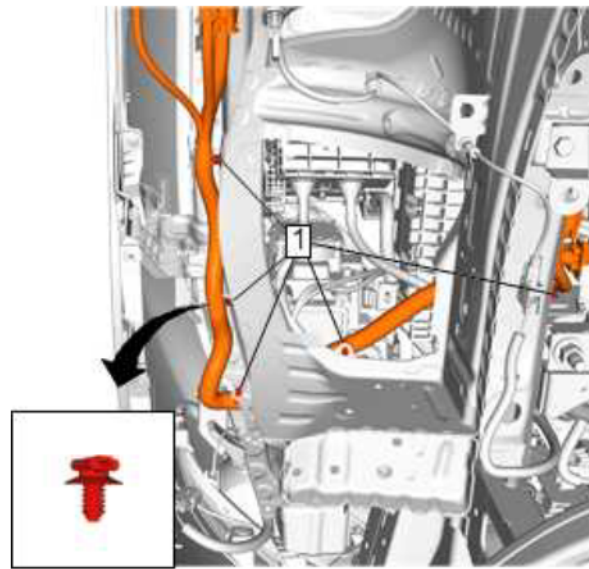


Fig. 204: Drive Motor Battery Positive and Negative Relay Cable Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Remove Drive Motor Battery Positive and Negative Relay Cable Retainer

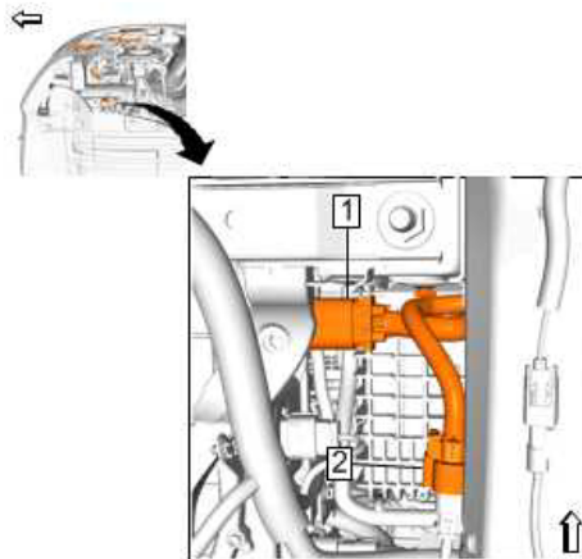


Fig. 205: Drive Motor Battery Charger
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector@Drive Motor Battery Charger(1)

6. Disconnect Electrical Connector@Body Wiring Harness(2)

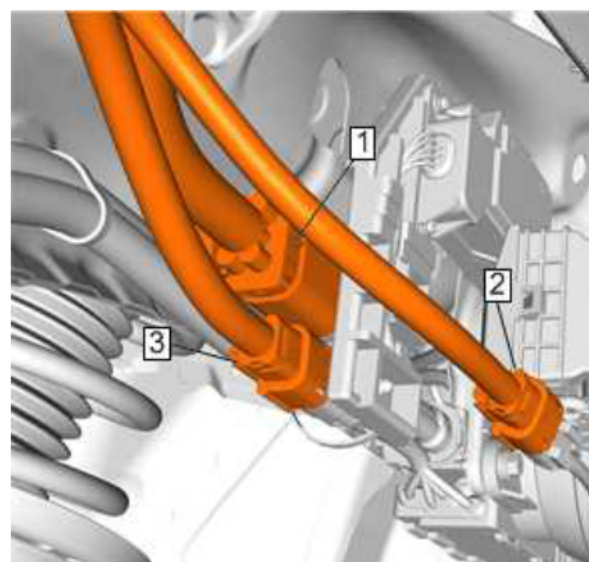


Fig. 206: Drive Motor Battery Charger Receptacle And Charge Port Door Ajar Switch
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Electrical Connector@Drive Motor Battery Charger Receptacle(1, 3)
8. Disconnect Electrical Connector@Charge Port Door Ajar Switch(2)

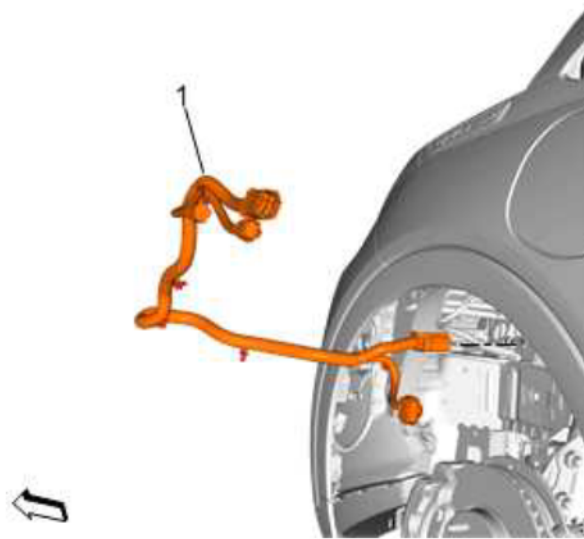


Fig. 207: Drive Motor Battery Positive And Negative Relay Cable
Courtesy of GENERAL MOTORS COMPANY

9. Remove Drive Motor Battery Positive and Negative Relay Cable (1)

Installation Procedure

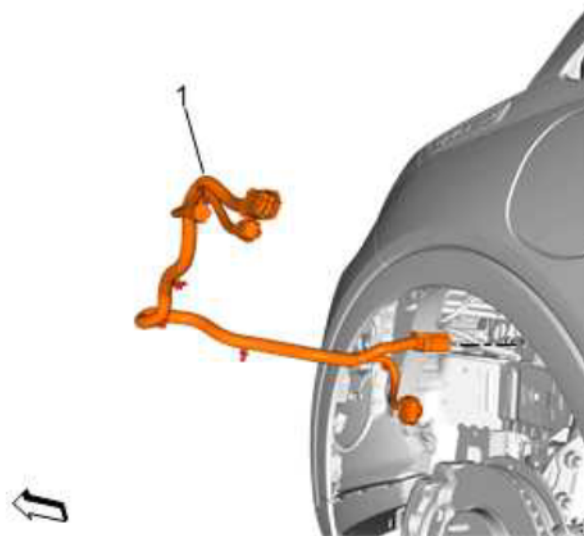


Fig. 208: Drive Motor Battery Positive And Negative Relay Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Positive and Negative Relay Cable (1)

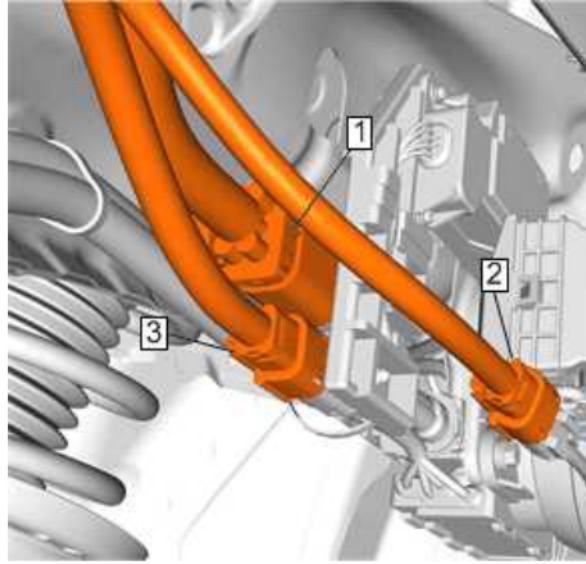


Fig. 209: Drive Motor Battery Charger Receptacle And Charge Port Door Ajar Switch
 Courtesy of GENERAL MOTORS COMPANY

2. Connect Electrical Connector@Drive Motor Battery Charger Receptacle (1, 3)
3. Connect Electrical Connector@Charge Port Door Ajar Switch (2)

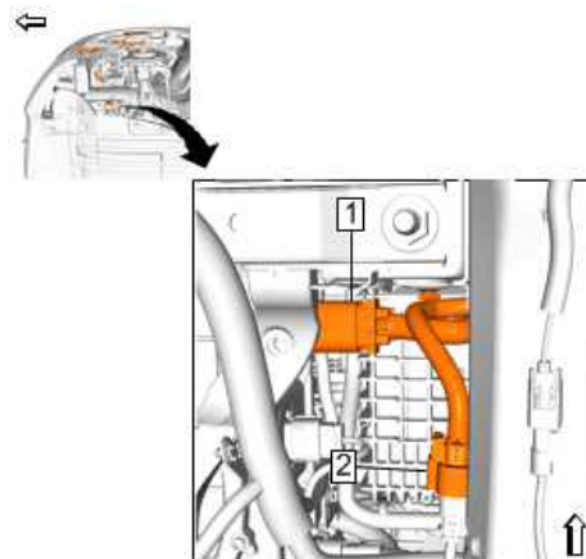
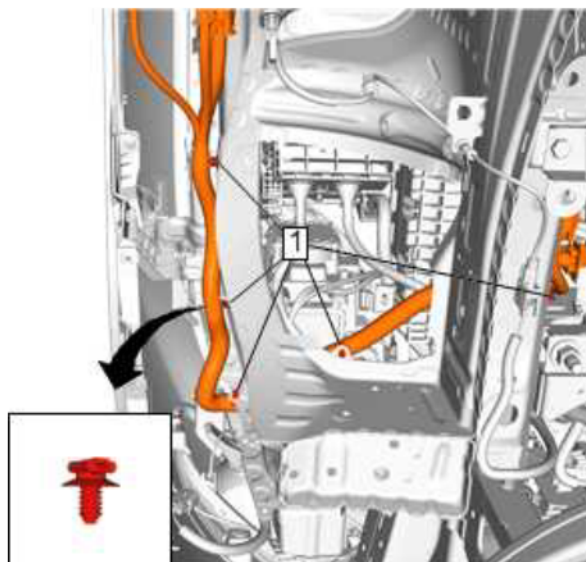


Fig. 210: Drive Motor Battery Charger
 Courtesy of GENERAL MOTORS COMPANY

4. Connect Electrical Connector@Drive Motor Battery Charger (1)
5. Connect Electrical Connector@Body Wiring Harness (2)



6. Install Drive Motor Battery Positive and Negative Relay Cable Retainer
7. Install Battery Tray [Battery Tray Replacement](#)
8. Install Front Wheelhouse Liner [Front Wheelhouse Liner Replacement](#)
9. Enable the high voltage system. [High Voltage Enabling](#)

DRIVE MOTOR BATTERY CONTROL MODULE WIRING HARNESS 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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. Remove the battery upper cover. [Battery Upper Cover Replacement](#)

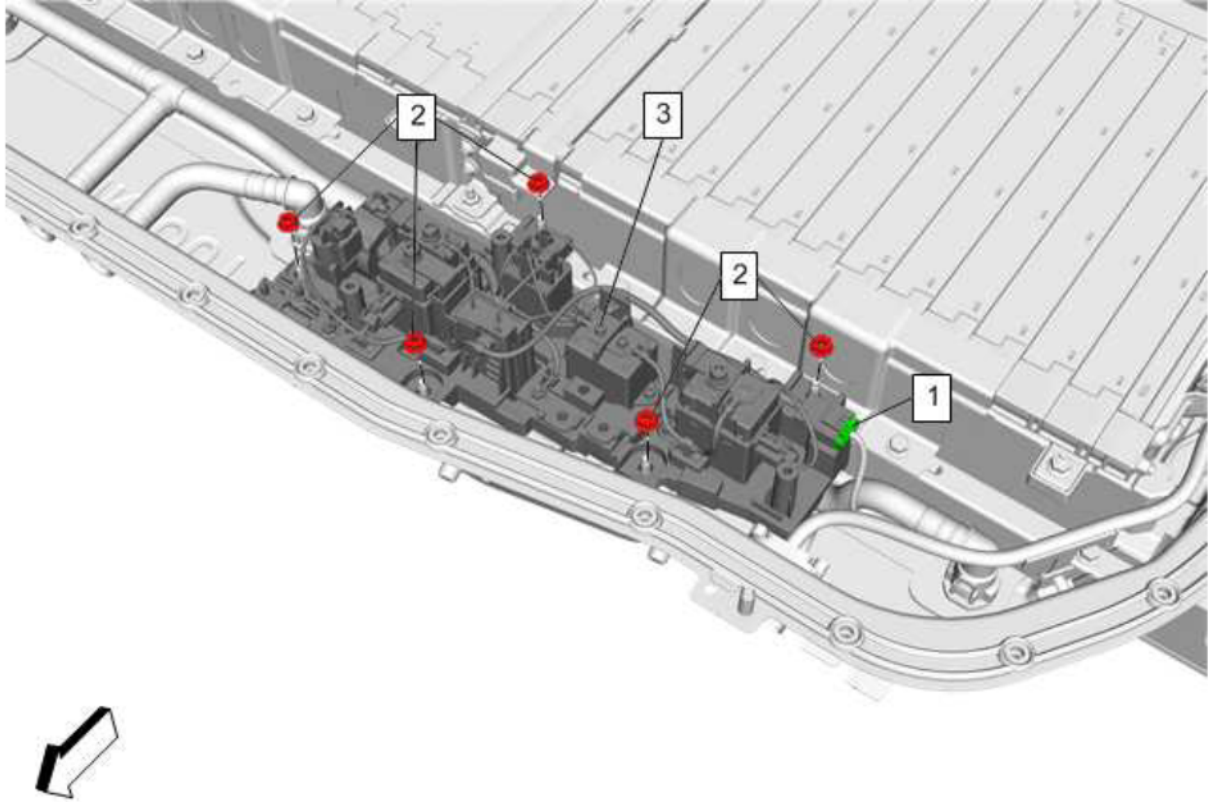


Fig. 212: High Voltage Battery Disconnect Relay Assembly
 Courtesy of GENERAL MOTORS COMPANY

3. Remove High Voltage Battery Disconnect Relay (3) **High Voltage Battery Disconnect Relay Replacement**

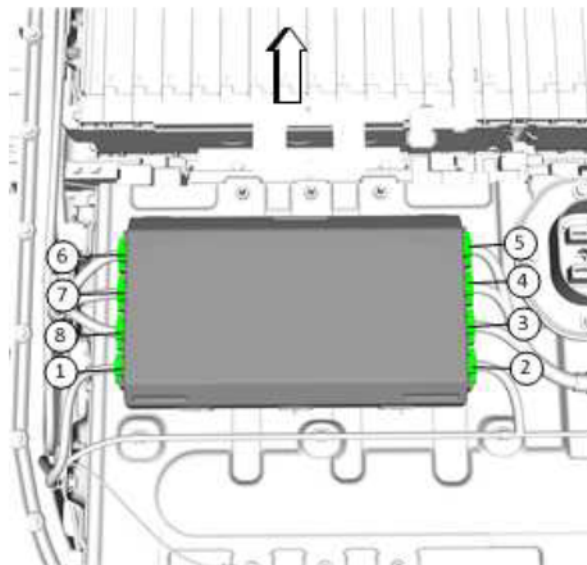


Fig. 213: Battery Energy Control Module Connectors In Sequence
 Courtesy of GENERAL MOTORS COMPANY

- CAUTION:** The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:
1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
 2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
 3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

4. Disconnect the battery energy control module connectors in the sequence shown.

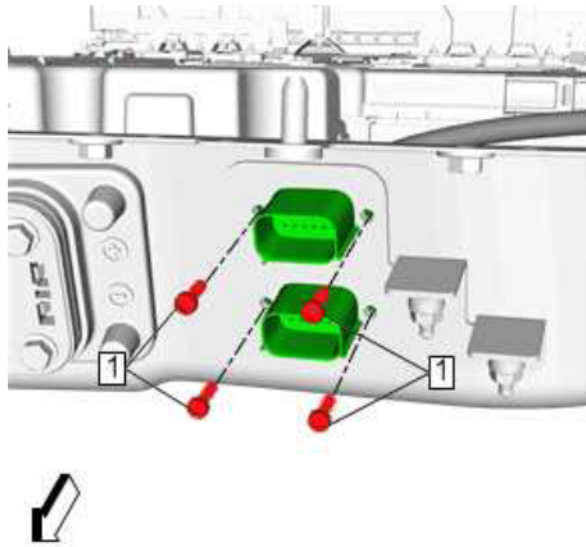


Fig. 214: Fasteners

Courtesy of GENERAL MOTORS COMPANY

5. Remove the fasteners (1) from the wiring harness connector.

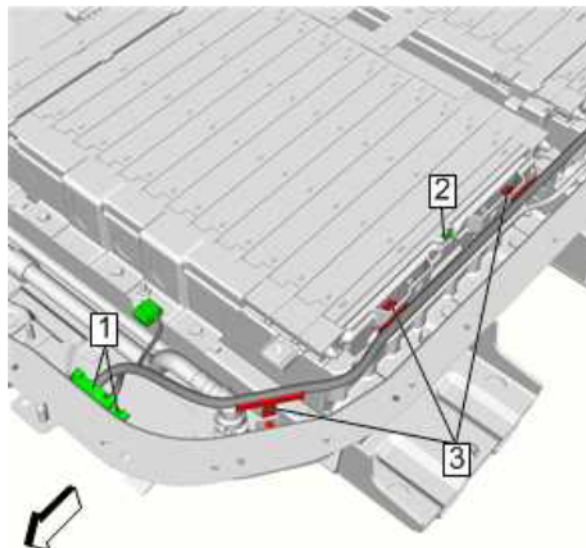


Fig. 215: Drive Motor Battery Control Module Wiring Harness Connectors

Courtesy of GENERAL MOTORS COMPANY

6. Remove the drive motor battery control module wiring harness connectors (1).

7. Remove the battery cell temperature sensor (2) from the battery section.

8. Detach the wiring harness retainers (3).

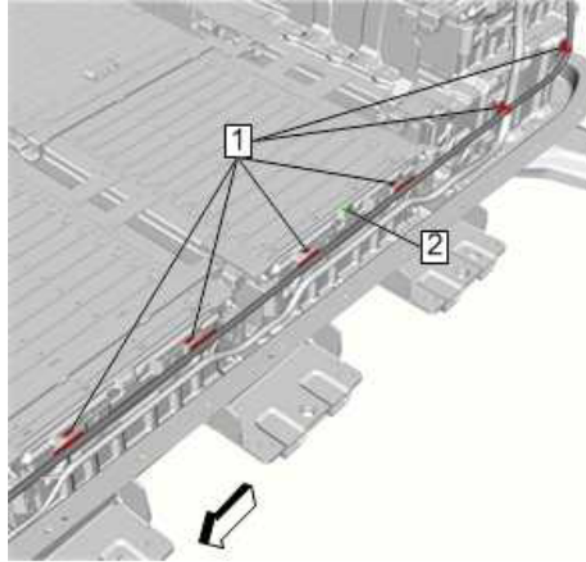


Fig. 216: Wiring Harness Retainers
 Courtesy of GENERAL MOTORS COMPANY

9. Detach the wiring harness retainers (1)
10. Remove the battery cell temperature sensor (2) from the battery section.

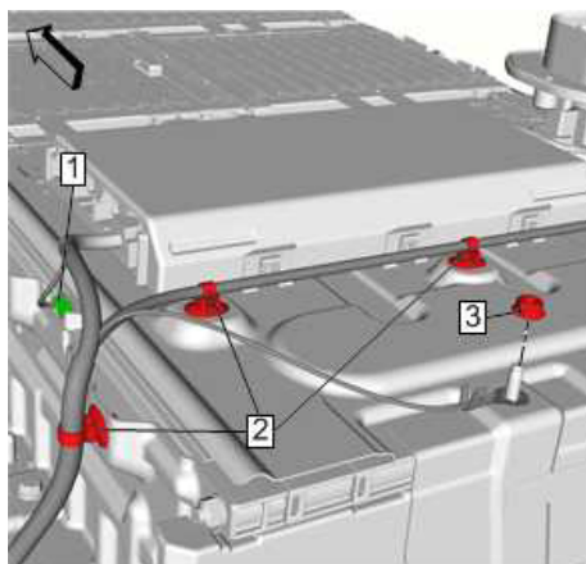
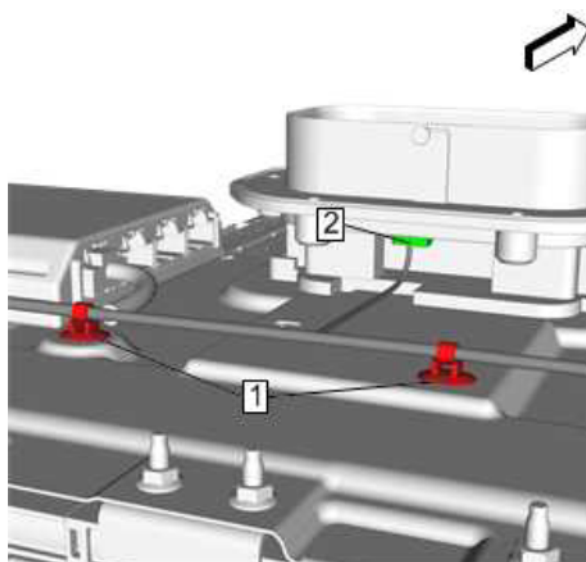


Fig. 217: Battery Cell Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

11. Remove the battery cell temperature sensor (1) from the battery section.
12. Detach the wiring harness retainers (2)
13. Remove the fastener (3) and the wiring harness ground terminal.



14. Detach the wiring harness retainers (1)
15. Disconnect the electrical connector (2) from the high voltage battery high voltage manual disconnect connector. Refer to the below step 16 and 17.

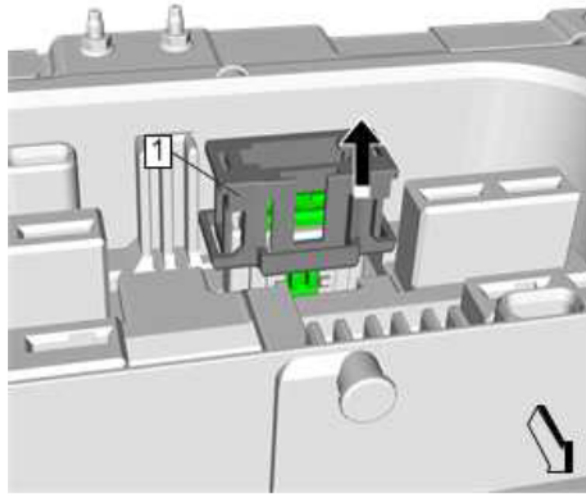


Fig. 219: Connector Guide
Courtesy of GENERAL MOTORS COMPANY

16. Slightly pick up the connector guide (1). Do not need to remove it completely.

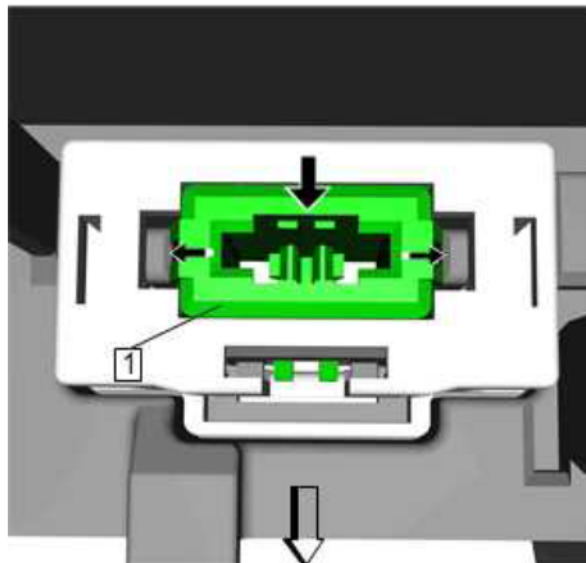


Fig. 220: Connector
Courtesy of GENERAL MOTORS COMPANY

17. While pushing the connector tabs to the side direction, push down the connector (1) and remove it.

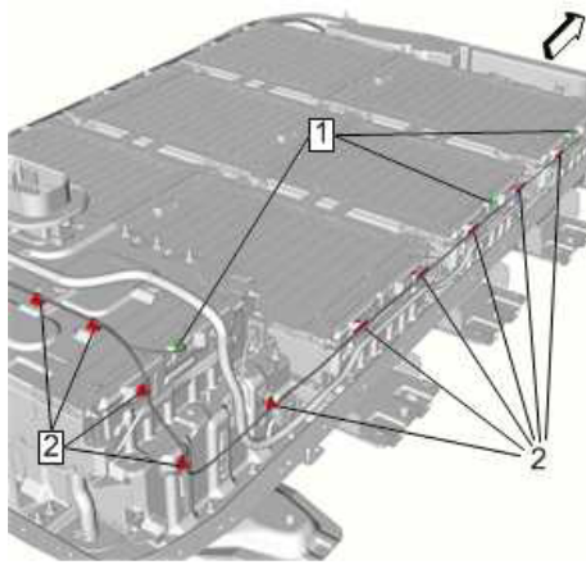


Fig. 221: Battery Cell Temperature Sensors
 Courtesy of GENERAL MOTORS COMPANY

18. Remove the battery cell temperature sensors (1) from the battery sections.
19. Detach the wiring harness retainers (2).

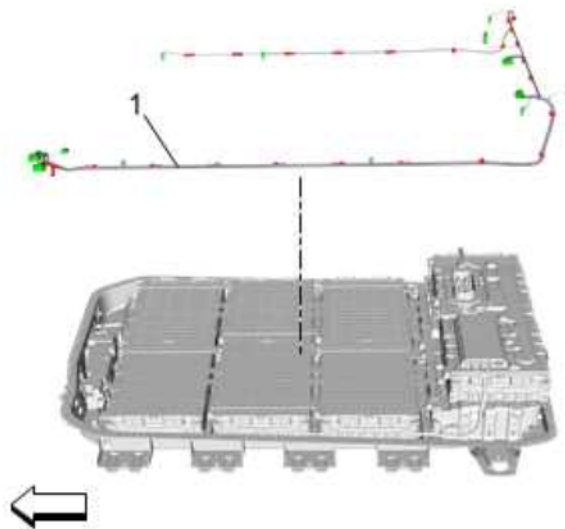


Fig. 222: Drive Motor Battery Control Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Note the routing of the harness within the drive motor battery.

20. Remove the drive motor battery control module wiring harness (1) from the drive motor battery.

Installation Procedure

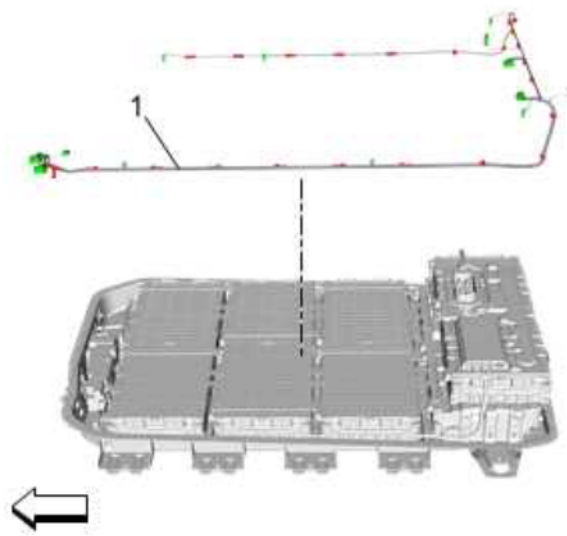


Fig. 223: Drive Motor Battery Control Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

1. Install the drive motor battery control module wiring harness (1) to the drive motor battery.

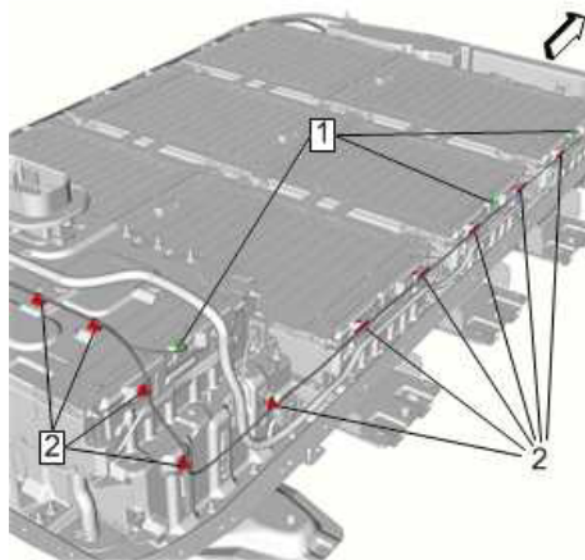


Fig. 224: Battery Cell Temperature Sensors
 Courtesy of GENERAL MOTORS COMPANY

2. Install the battery cell temperature sensors (1) into the battery sections.
3. Attach the harness retainers (2) to the bracket.

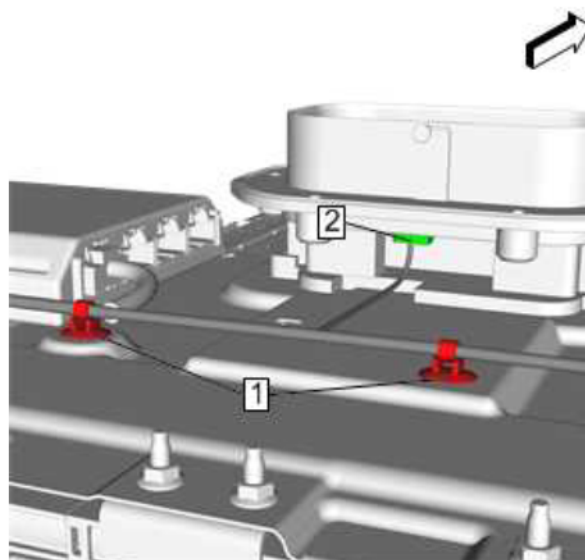


Fig. 225: Wiring Harness Retainers
 Courtesy of GENERAL MOTORS COMPANY

4. Connect the electrical connector (2) to the high voltage battery high voltage manual disconnect connector.
5. Attach the harness retainers (1) to the bracket.

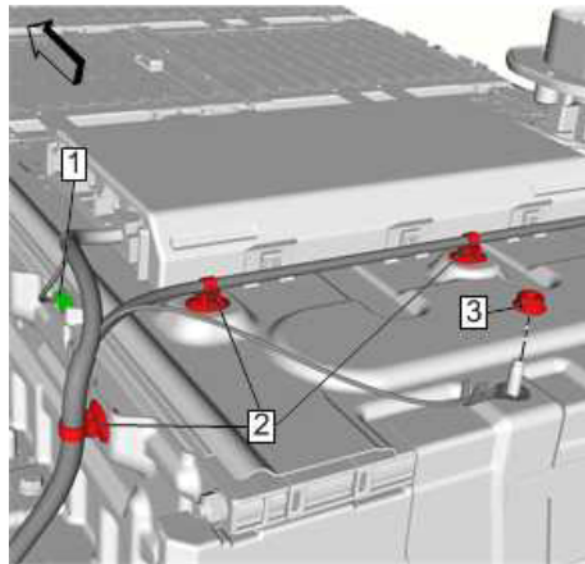


Fig. 226: Battery Cell Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

6. Tighten the drive motor battery control module wiring harness ground terminal nut (3) to 6 N.m (53 lb in).
7. Install the battery cell temperature sensor (1) into the battery section.
8. Attach the harness retainers (2).

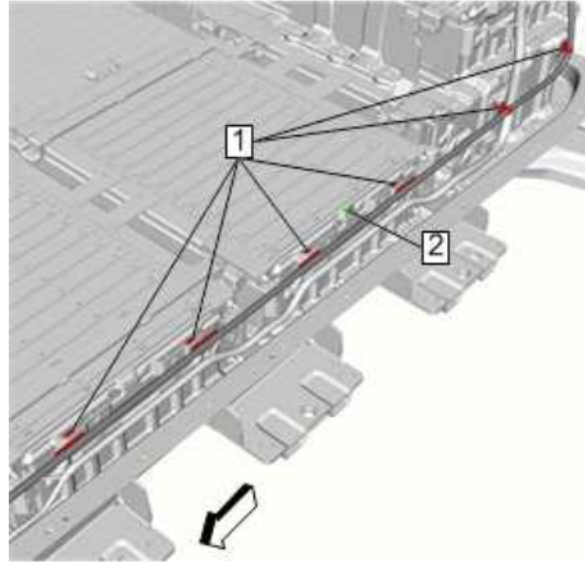


Fig. 227: Wiring Harness Retainers
Courtesy of GENERAL MOTORS COMPANY

9. Install the battery cell temperature sensor (2) into the battery section.
10. Attach the harness retainers (1).

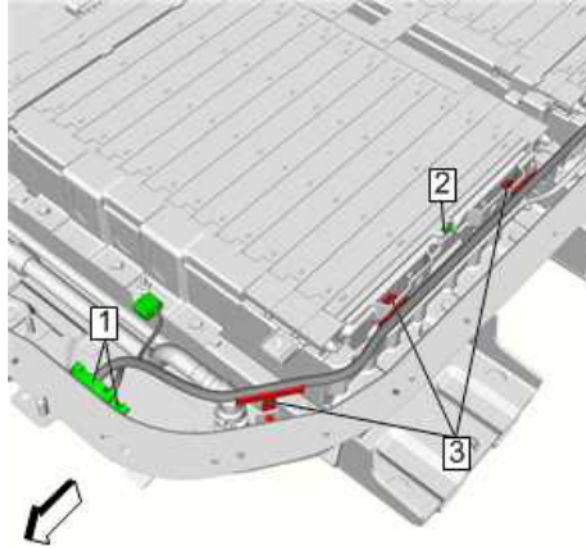


Fig. 228: Drive Motor Battery Control Module Wiring Harness Connectors
 Courtesy of GENERAL MOTORS COMPANY

11. Install the drive motor battery control module wiring harness connectors (1)
12. Install the battery cell temperature sensor (2) into the battery section.
13. Attach the wiring harness retainers (3)

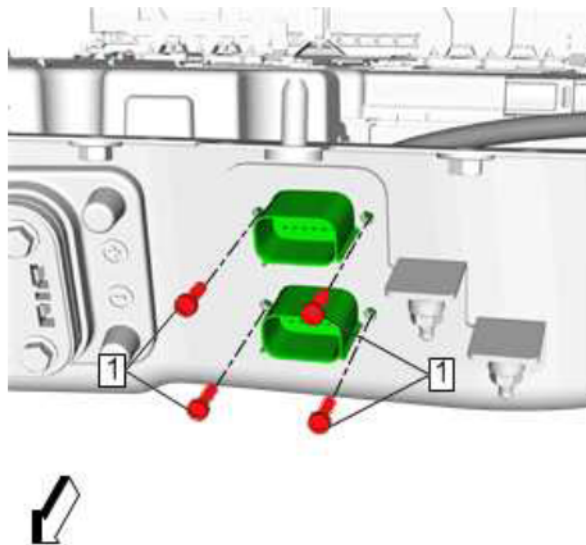
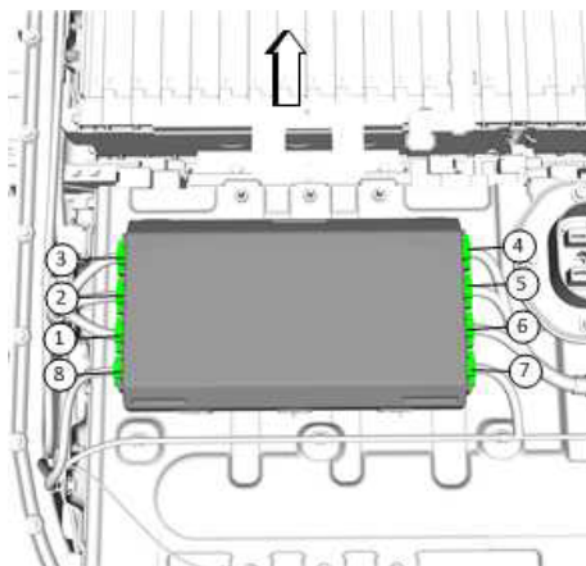


Fig. 229: Fasteners
 Courtesy of GENERAL MOTORS COMPANY

14. Tighten the fasteners (1) to the wiring harness connectors to 1.7 N.m (15 lb in).



CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

15. Connect the battery energy control module connectors in the sequence shown to the battery energy control module.

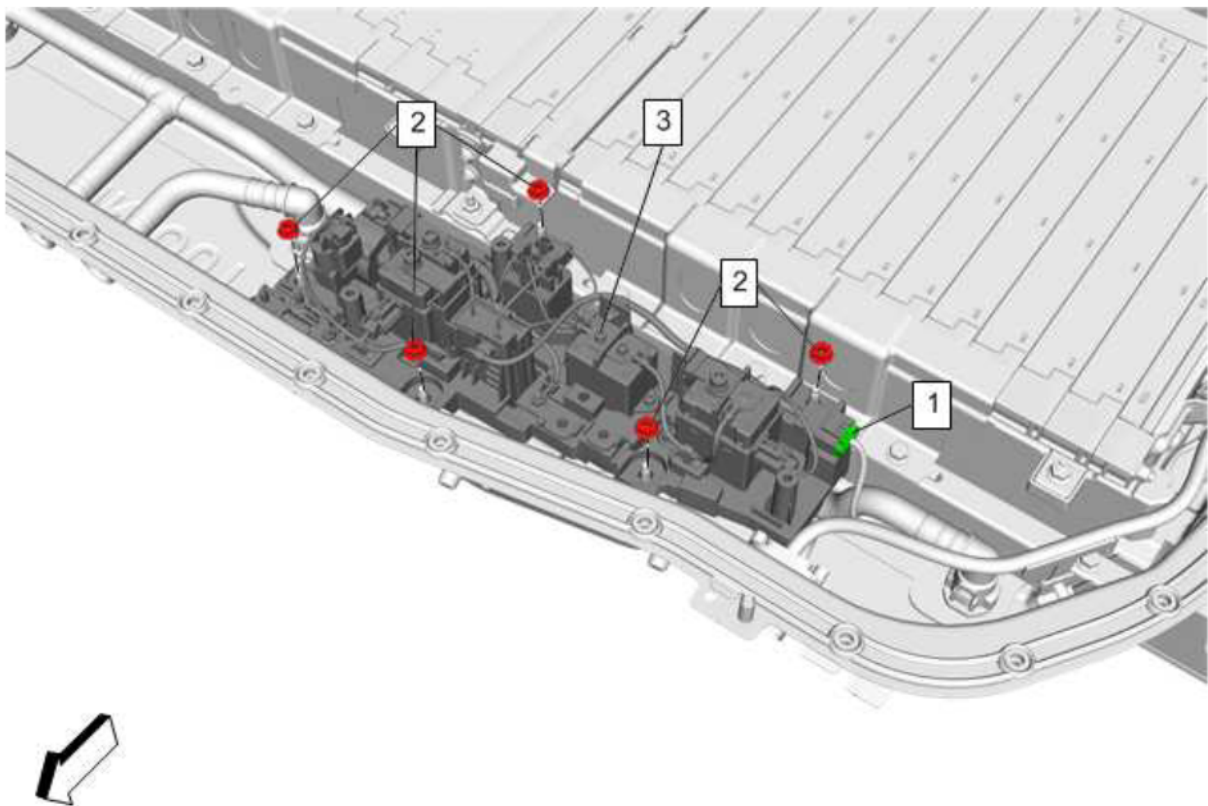


Fig. 231: High Voltage Battery Disconnect Relay Assembly
Courtesy of GENERAL MOTORS COMPANY

16. Install High Voltage Battery Disconnect Relay (3) [High Voltage Battery Disconnect Relay Replacement](#)
17. Install the battery upper cover. [Battery Upper Cover Replacement](#)
18. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

DRIVE MOTOR BATTERY SENSOR MODULE WIRING HARNESS REPLACEMENT (LEFT)

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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. Remove the battery upper cover. [Battery Upper Cover Replacement](#)

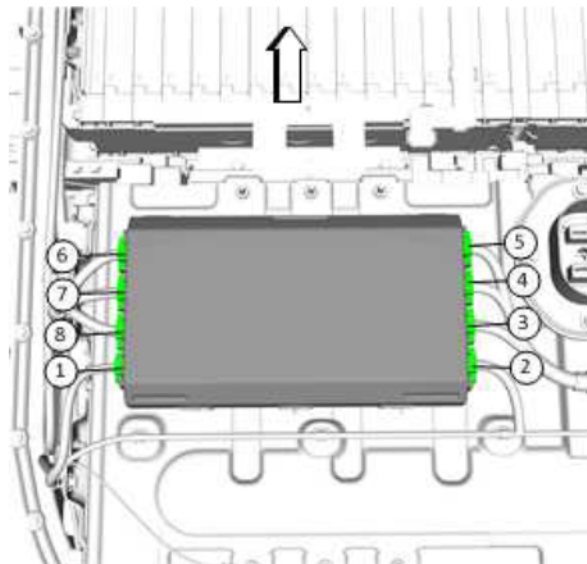


Fig. 232: Battery Energy Control Module Connectors In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module cardiagn.com connectors prior to disconnecting any Hybrid/EV battery

section connector.

2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors **ONLY** in the sequence provided in Repair Instructions.

3. Disconnect the battery energy control module connectors in the sequence shown.

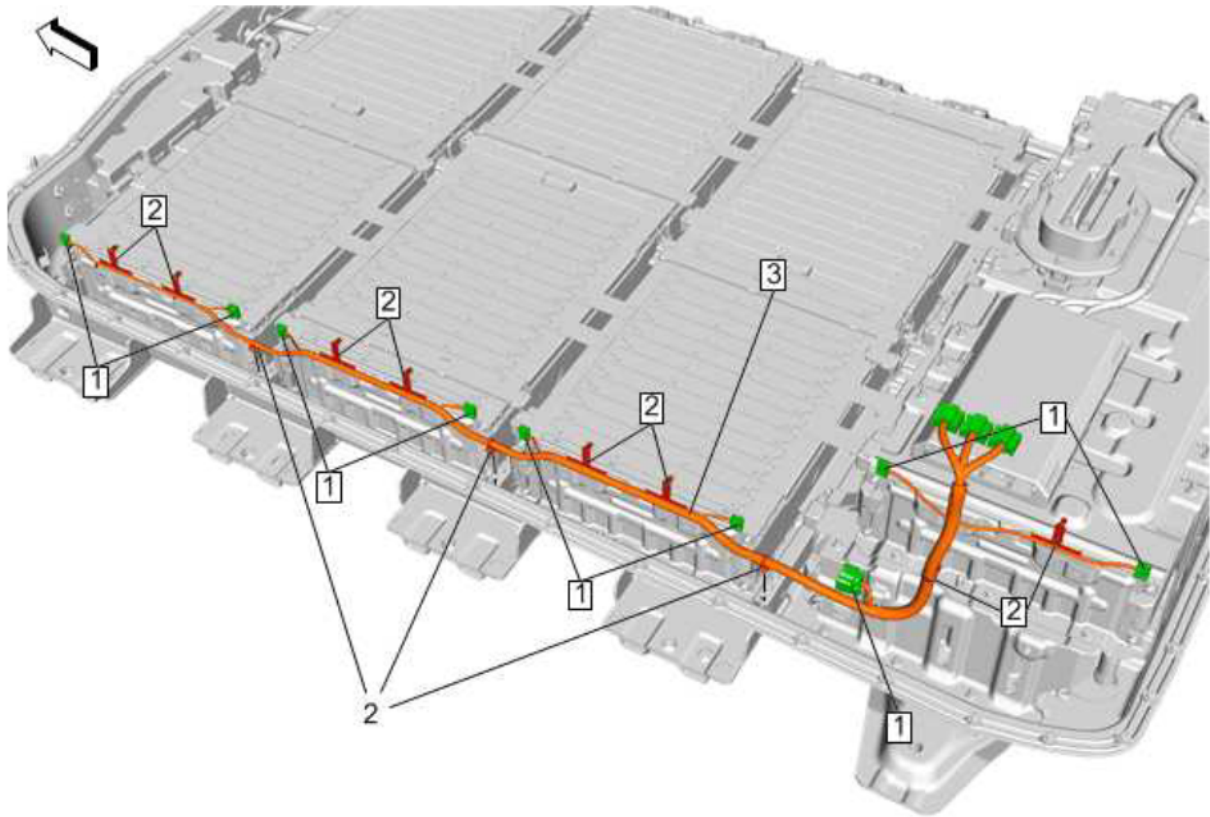


Fig. 233: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connectors (1)
5. Detach the wiring harness retainers (2)
6. Remove the drive motor battery sensor module wiring harness (3).

Installation Procedure

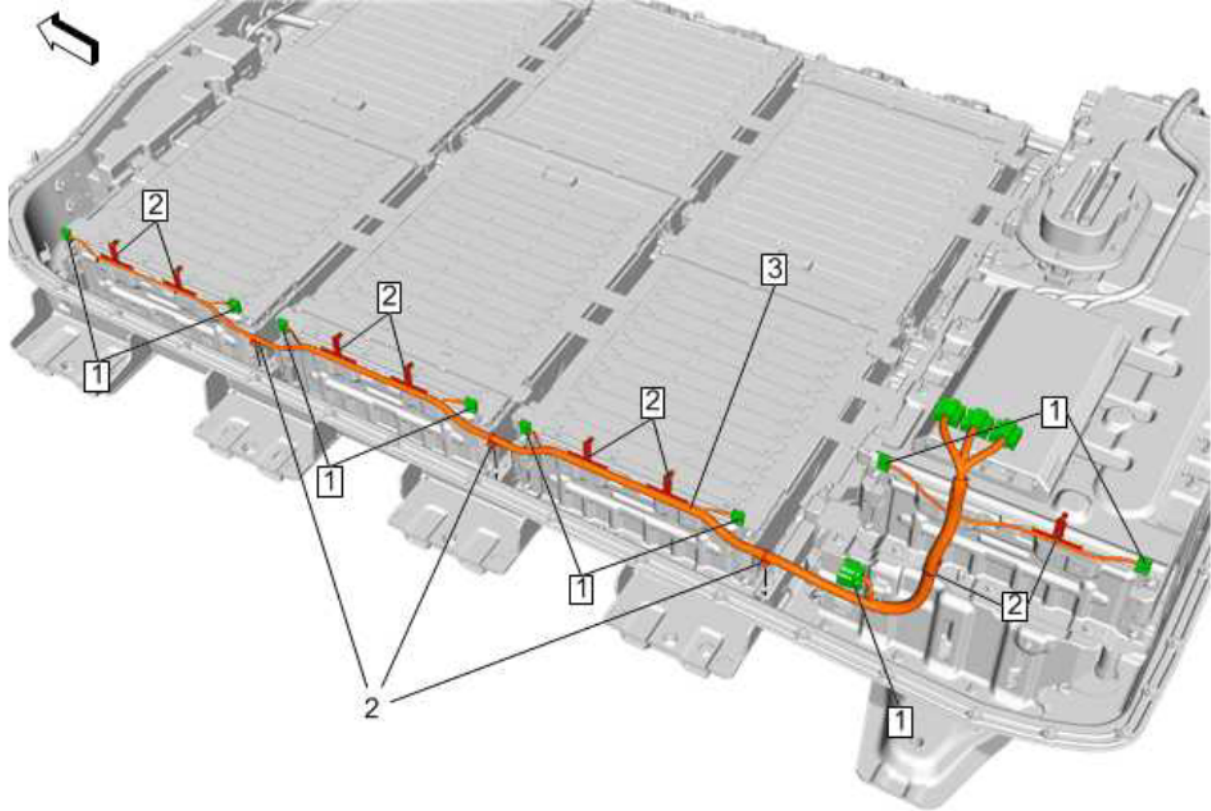


Fig. 234: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

1. Install the drive motor battery sensor module wiring harness (3).
2. Attach the wiring harness retainers (2)
3. Connect the electrical connectors (1)

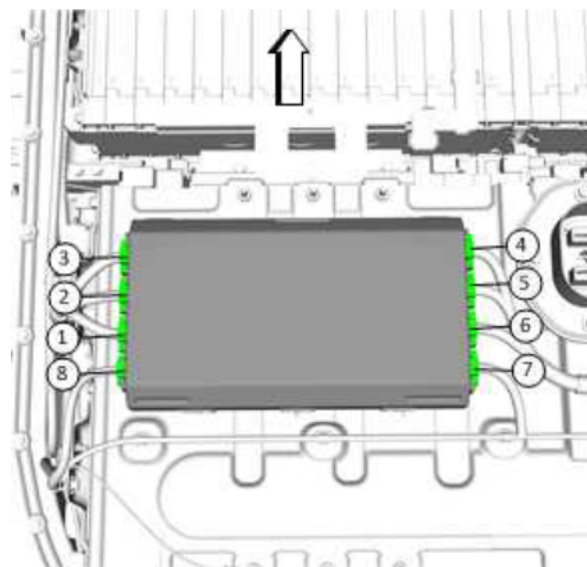


Fig. 235: Battery Energy Control Module Connectors In Sequence
Courtesy of GENERAL MOTORS COMPANY

- CAUTION:** The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:
1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
 2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.

3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.
4. Connect the battery energy control module connectors in the sequence shown to the battery energy control module.
5. Install the battery upper cover. [Battery Upper Cover Replacement](#)
6. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

DRIVE MOTOR BATTERY SENSOR MODULE WIRING HARNESS REPLACEMENT (RIGHT)

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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. Remove the battery upper cover. [Battery Upper Cover Replacement](#)

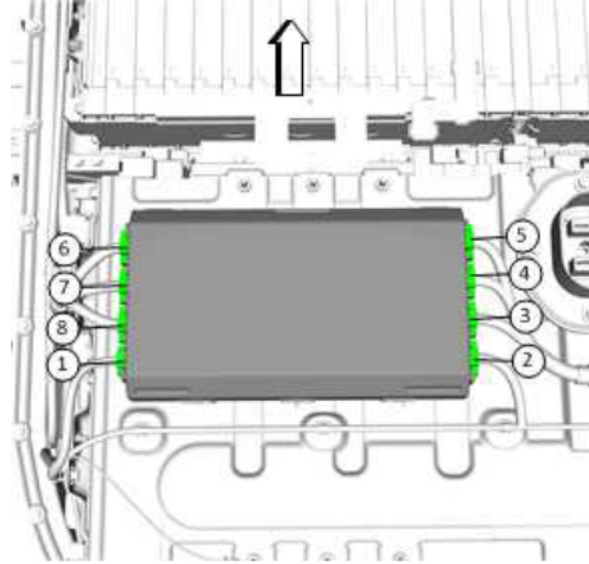


Fig. 236: Battery Energy Control Module Connectors In Sequence
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

3. Disconnect the battery energy control module connectors in the sequence shown.

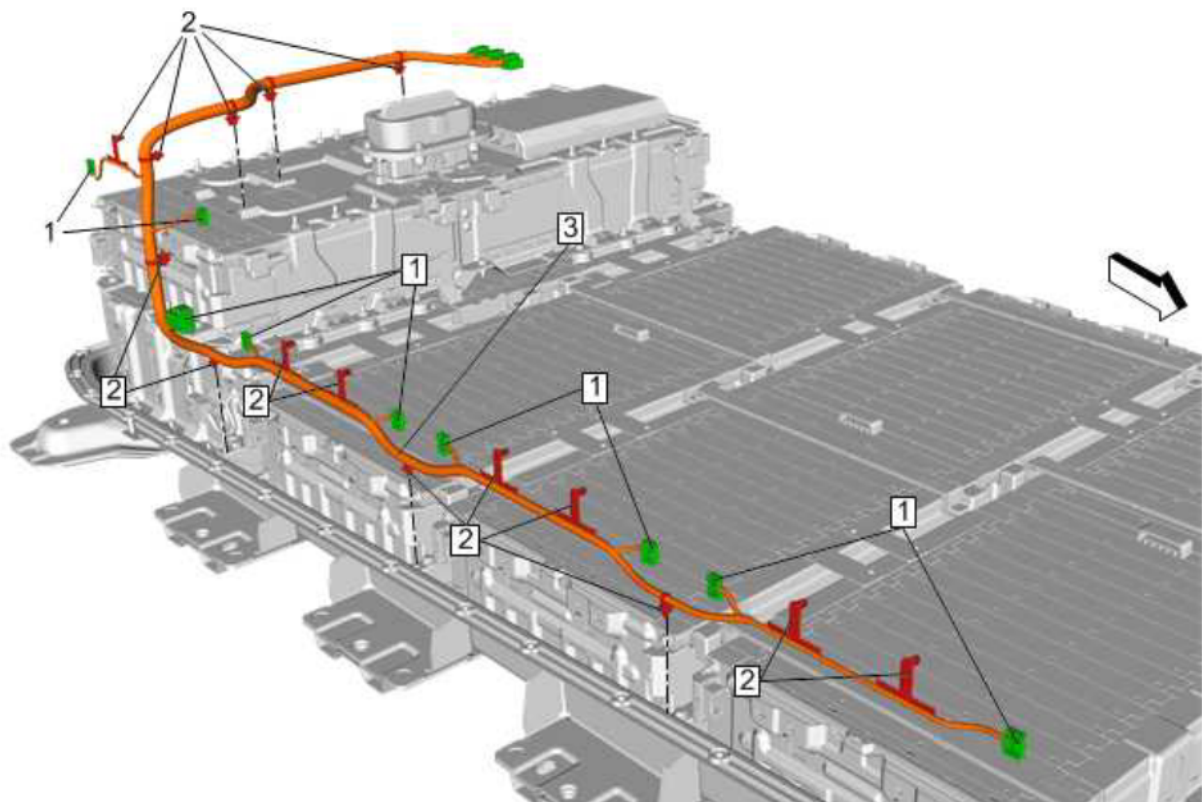


Fig. 237: Drive Motor Battery Sensor Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connectors (1)
5. Detach the wiring harness retainers (2)
6. Remove the drive motor battery sensor module wiring harness (3).

Installation Procedure

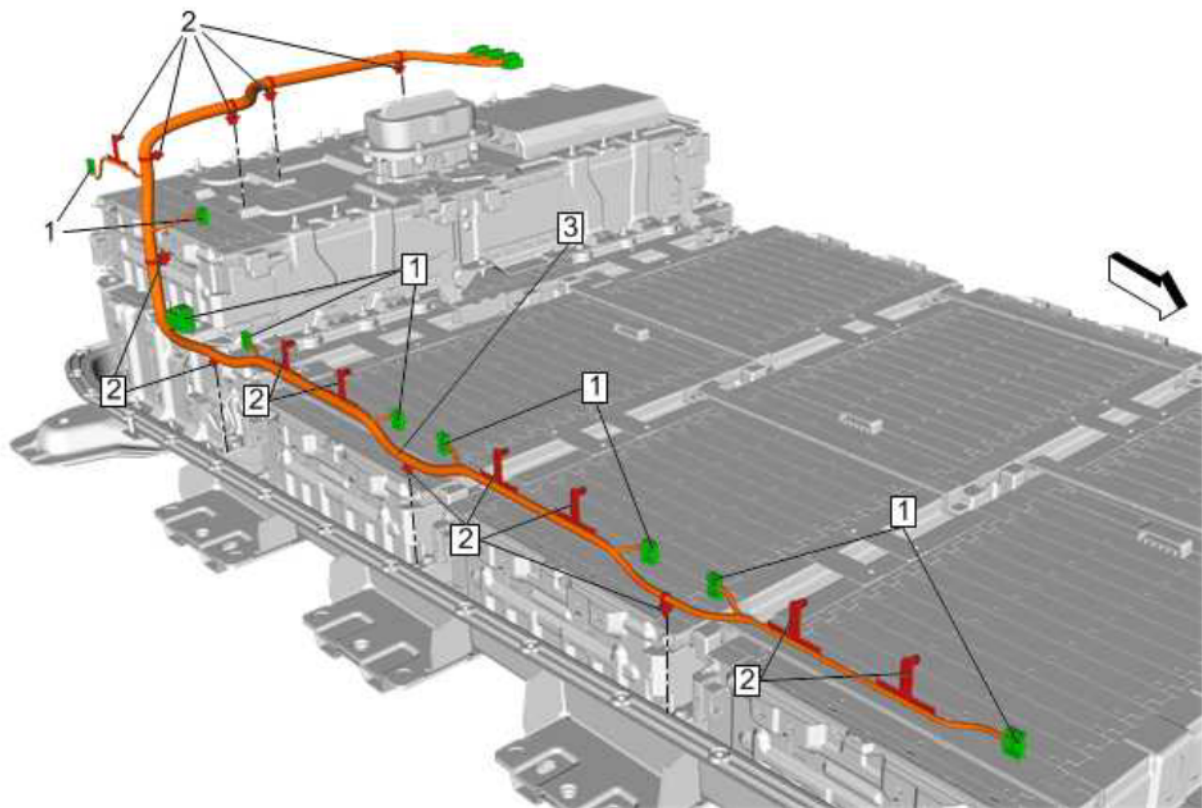


Fig. 238: Drive Motor Battery Sensor Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

1. Install the drive motor battery sensor module wiring harness (3).
2. Attach the wiring harness retainers (2)
3. Connect the electrical connectors (1)

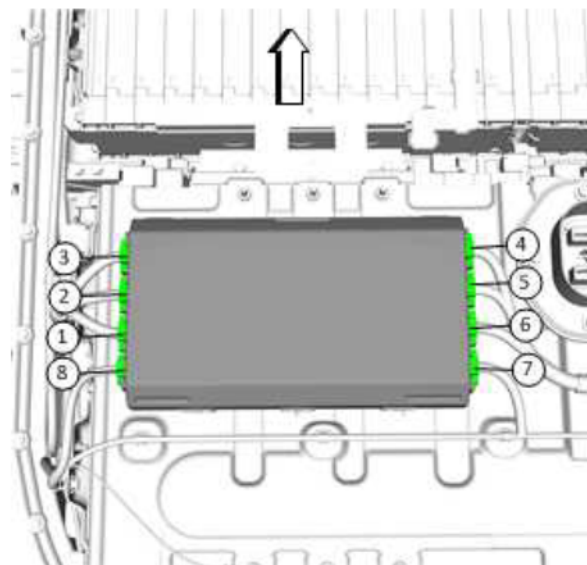


Fig. 239: Battery Energy Control Module Connectors In Sequence
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.
4. Connect the battery energy control module connectors in the sequence shown to the battery energy control module.
5. Install the battery upper cover. [Battery Upper Cover Replacement](#)
6. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

DRIVE MOTOR BATTERY SENSOR MODULE WIRING HARNESS REPLACEMENT (LH, SUB)

Special Tools

- BO-38185 Hose Clamp Pliers

For equivalent regional tools, refer to [Special Tools](#).

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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

2. Remove the battery upper cover. [Battery Upper Cover Replacement](#)

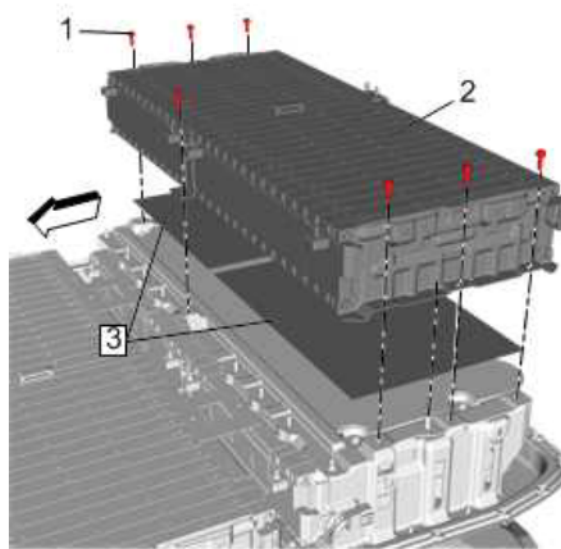


Fig. 240: Cell Battery Module

Courtesy of GENERAL MOTORS COMPANY

3. Remove row 5 cell battery module (2). [Cell Battery Module Replacement \(Row 1\)](#)[Cell Battery Module Replacement \(Row 2\)](#)[Cell Battery Module Replacement \(Row 3\)](#)[Cell Battery Module Replacement \(Row 4\)](#)[Cell Battery Module Replacement \(Row 5\)](#)

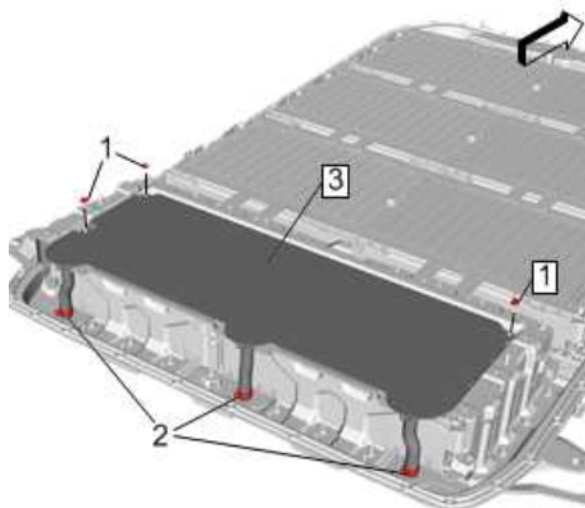


Fig. 241: Cell Battery Cooling Plate Securing Nuts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the cell battery cooling plate securing nuts (1).
5. Reposition the cell battery cooling hose clamps (2), using **BO-38185** hose clamp pliers.
6. Remove the cell battery cooling plate (3).

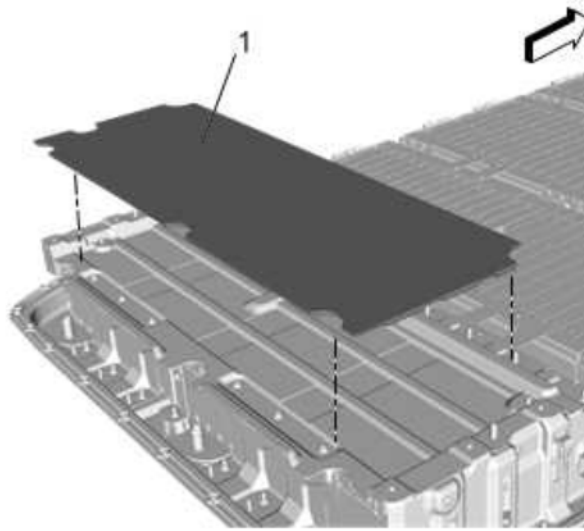


Fig. 242: Insulation Pad

Courtesy of GENERAL MOTORS COMPANY

7. Remove the insulation pad (1).

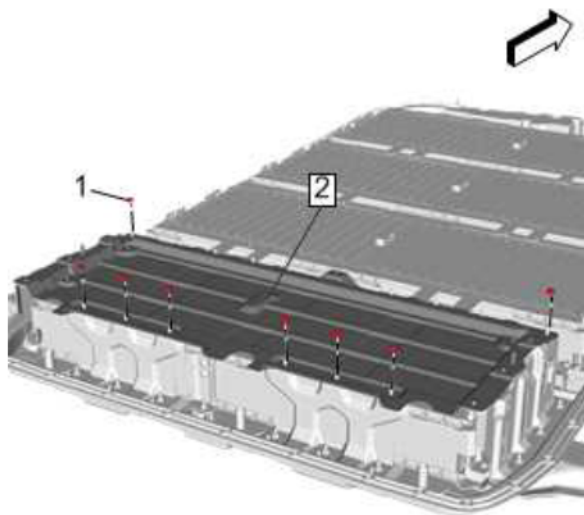


Fig. 243: Cell Battery Securing Nuts

Courtesy of GENERAL MOTORS COMPANY

8. Remove the cell battery securing nuts (1) and the cell battery upper panel (2).

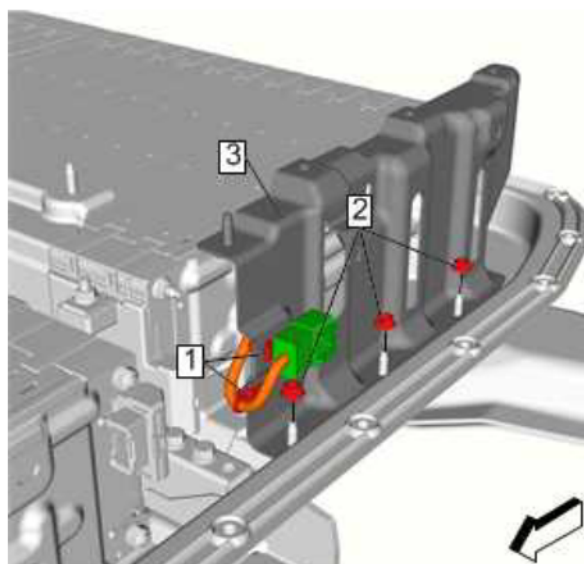


Fig. 244: Cell Battery Securing Nuts

Courtesy of GENERAL MOTORS COMPANY

9. Detach the left subordinate drive motor sensor module wiring harness retainers (1).
10. Remove the cell battery securing nuts (2).
11. Remove the drive motor battery rear left side panel (3).

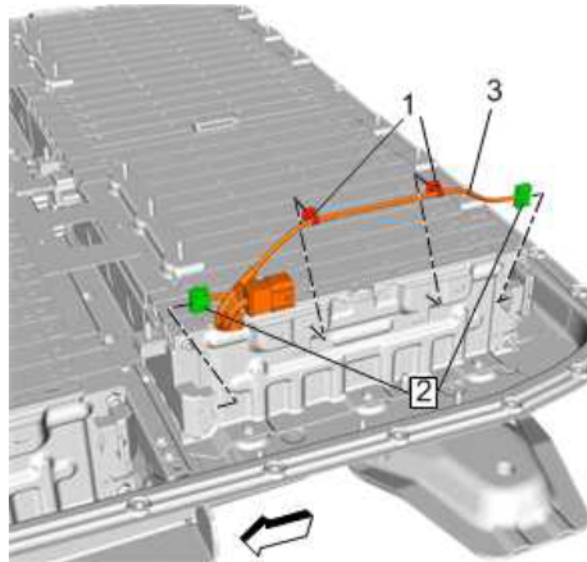


Fig. 245: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

12. Detach the wiring harness retainers (1).
13. Disconnect the electrical connectors (2).
14. Remove the left subordinate drive motor sensor module wiring harness (3).

Installation Procedure

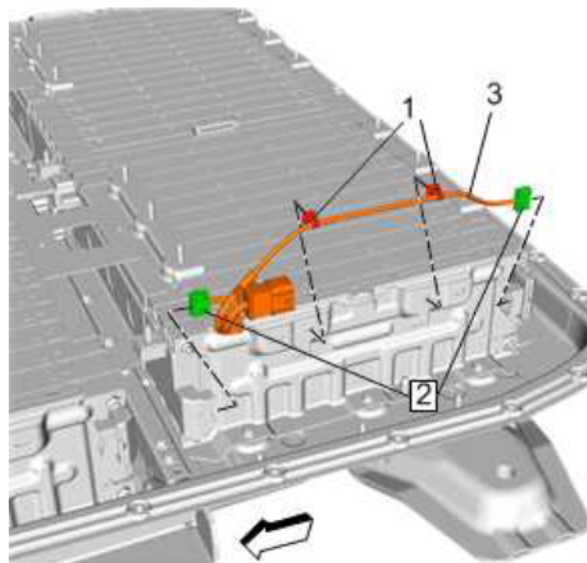


Fig. 246: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

1. Install the left subordinate drive motor sensor module wiring harness (3).
2. Connect the electrical connectors (2)
3. Attach the wiring harness retainers (1)

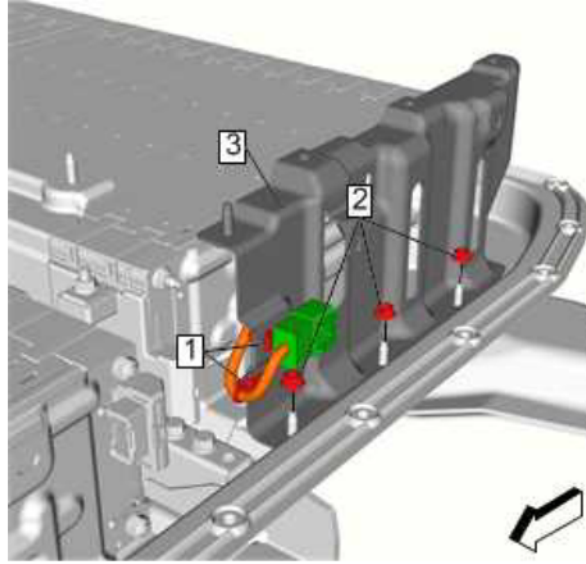


Fig. 247: Cell Battery Securing Nuts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

4. Install the drive motor battery rear left side panel (3).
5. Tighten the cell battery securing nuts (2) 9 N.m (80 lb in).
6. Attach the left subordinate drive motor sensor module wiring harness retainers (1).

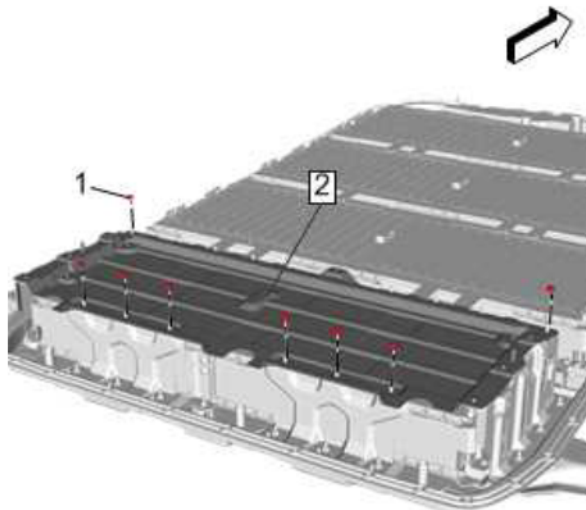


Fig. 248: Cell Battery Securing Nuts

Courtesy of GENERAL MOTORS COMPANY

7. Install the cell battery securing nuts (1) and the cell battery upper panel (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

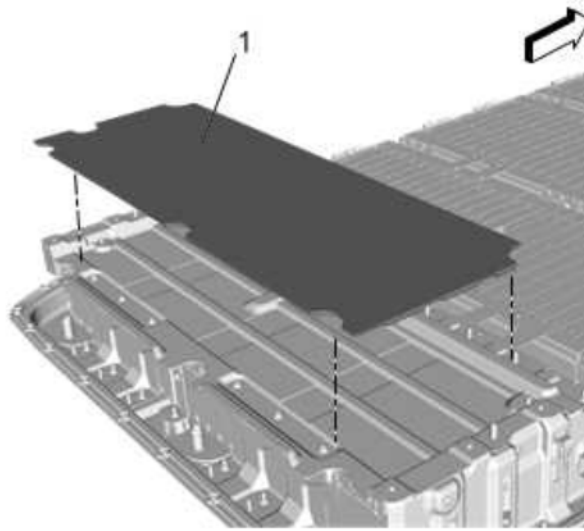


Fig. 249: Insulation Pad

Courtesy of GENERAL MOTORS COMPANY

8. Install the insulation pad (1).

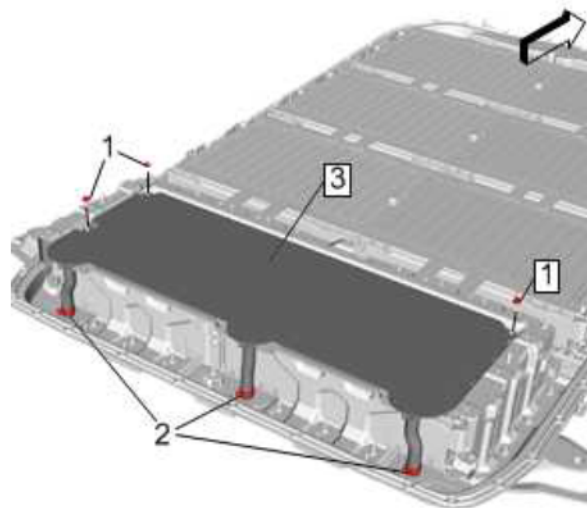
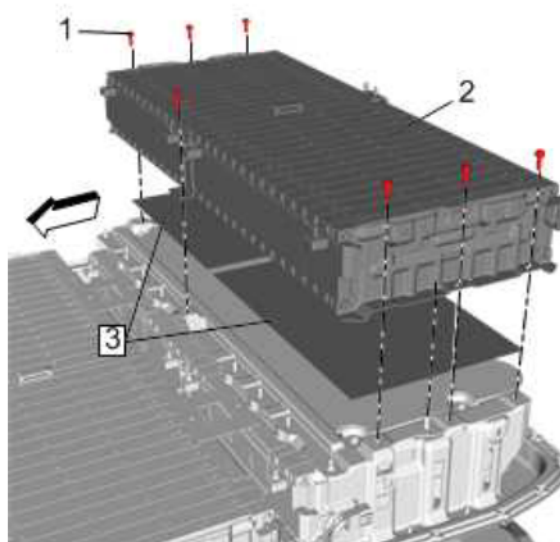


Fig. 250: Cell Battery Cooling Plate Securing Nuts

Courtesy of GENERAL MOTORS COMPANY

9. Install the cell battery cooling plate (3).
10. Position the cell battery cooling hose clamps (2), using **BO-38185** hose clamp pliers.
11. Tighten the cell battery cooling plate securing nuts (1) 9 N.m (80 lb in).



12. Install row 5 cell battery module (2). [Cell Battery Module Replacement \(Row 1\)](#)[Cell Battery Module Replacement \(Row 2\)](#)[Cell Battery Module Replacement \(Row 3\)](#)[Cell Battery Module Replacement \(Row 4\)](#)[Cell Battery Module Replacement \(Row 5\)](#)
13. Perform the hybrid battery pack coolant passage leak test. [Hybrid Battery Pack Coolant Passage Leak Test](#)
14. Perform the cell battery balancing if replaced. [Hybrid/EV Battery Cell Balancing](#)
15. Install the battery upper cover. [Battery Upper Cover Replacement](#)
16. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

DRIVE MOTOR BATTERY SENSOR MODULE WIRING HARNESS REPLACEMENT (RH, SUB)

Special Tools

- BO-38185 Hose Clamp Pliers

For equivalent regional tools, refer to [Special Tools](#) .

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. Remove the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)
2. Remove the battery upper cover. [Battery Upper Cover Replacement](#)

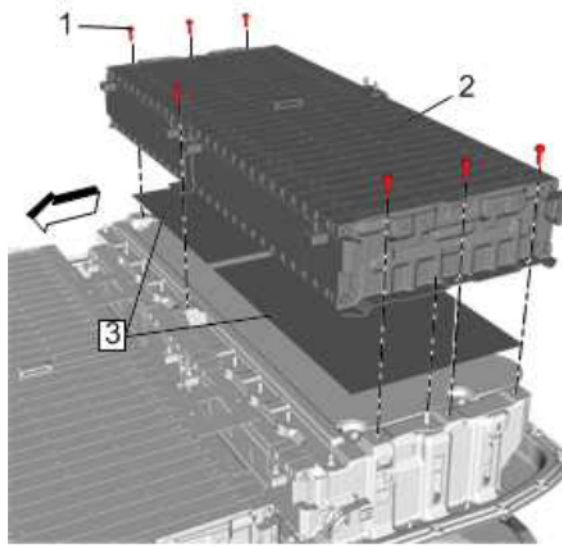


Fig. 252: Cell Battery Module

Courtesy of GENERAL MOTORS COMPANY

3. Remove row 5 cell battery module (2). [Cell Battery Module Replacement \(Row 1\)](#)[Cell Battery Module Replacement \(Row 2\)](#)[Cell Battery Module Replacement \(Row 3\)](#)[Cell Battery Module Replacement \(Row 4\)](#)[Cell Battery Module Replacement \(Row 5\)](#)

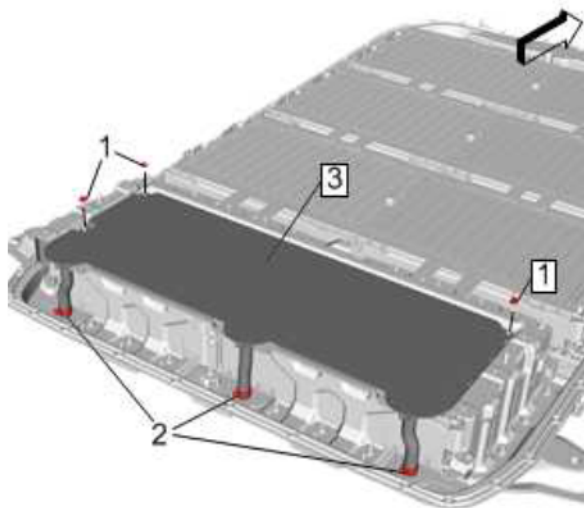


Fig. 253: Cell Battery Cooling Plate Securing Nuts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the cell battery cooling plate securing nuts (1)
5. Reposition the cell battery cooling hose clamps (2), using **BO-38185** hose clamp pliers.
6. Remove the cell battery cooling plate (3).

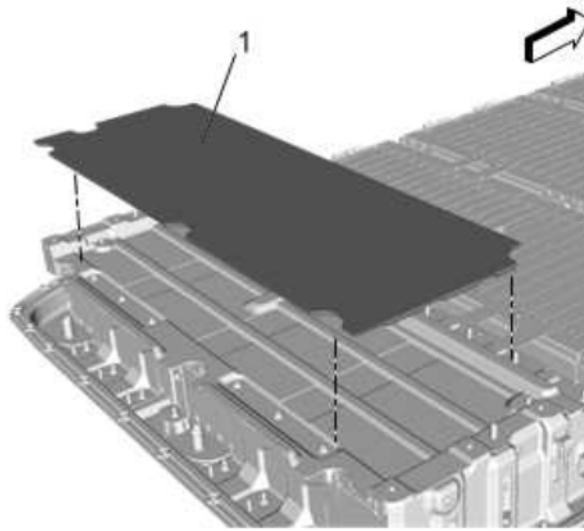


Fig. 254: Insulation Pad

Courtesy of GENERAL MOTORS COMPANY

7. Remove the insulation pad (1).

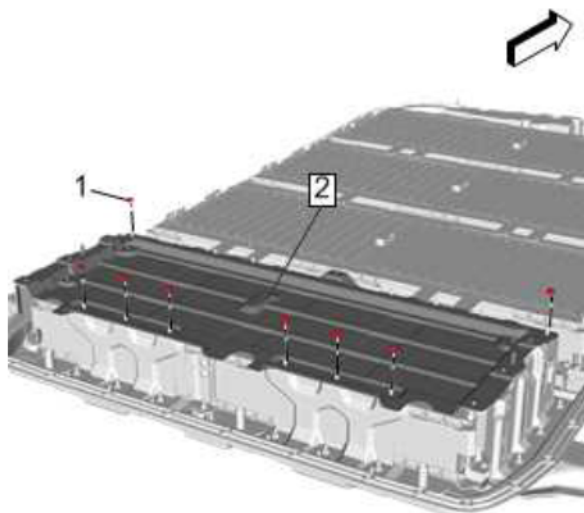


Fig. 255: Cell Battery Securing Nuts

Courtesy of GENERAL MOTORS COMPANY

8. Remove the cell battery securing nuts (1) and the cell battery upper panel (2).

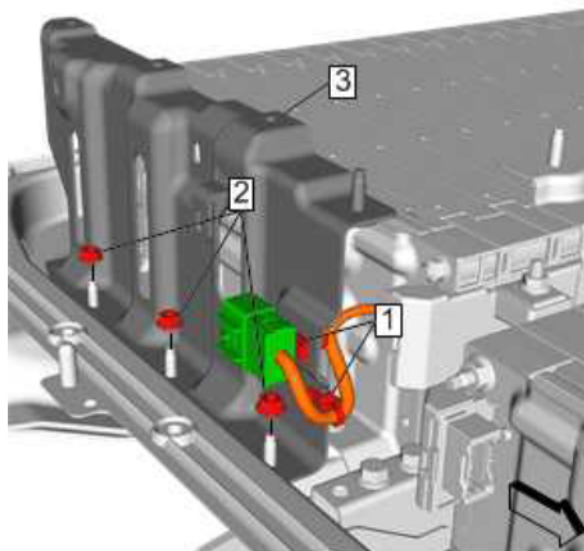


Fig. 256: Right Subordinate Drive Motor Sensor Module Wiring Harness Retainers

Courtesy of GENERAL MOTORS COMPANY

9. Detach the right subordinate drive motor sensor module wiring harness retainers (1)
10. Remove the cell battery securing nuts (2)
11. Remove the drive motor battery rear right side panel (3).

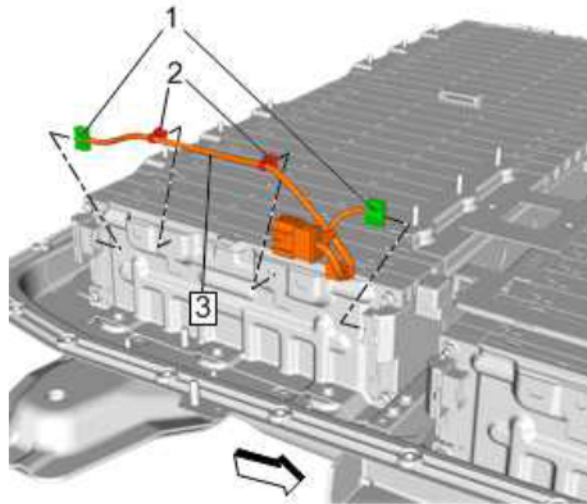


Fig. 257: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

12. Detach the wiring harness retainers (2)
13. Disconnect the electrical connectors (1)
14. Remove the left subordinate drive motor sensor module wiring harness (3).

Installation Procedure

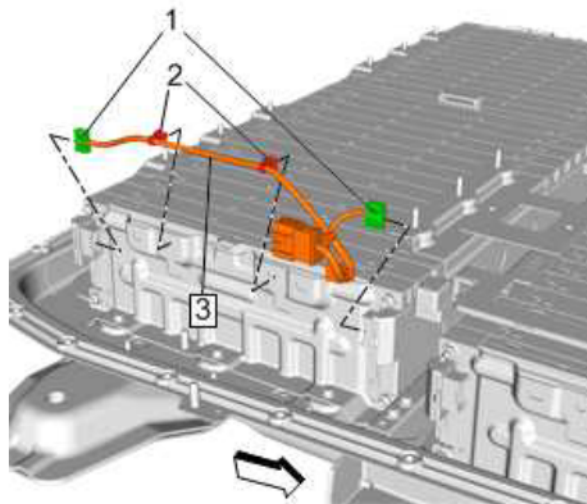


Fig. 258: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

1. Install the right subordinate drive motor sensor module wiring harness (3).
2. Connect the electrical connectors (1)
3. Attach the wiring harness retainers (2)

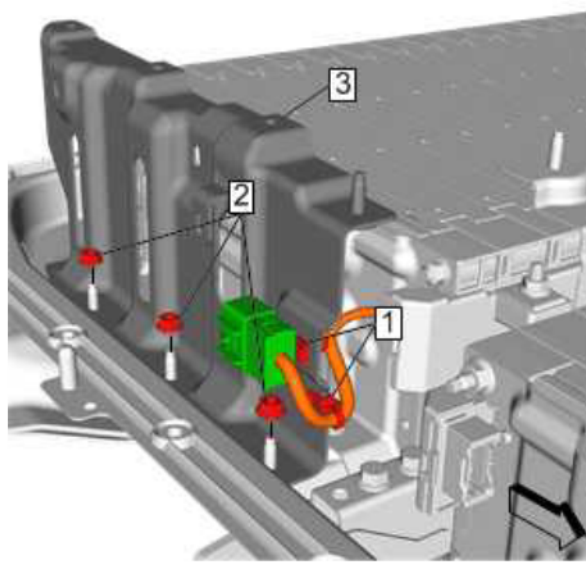


Fig. 259: Right Subordinate Drive Motor Sensor Module Wiring Harness Retainers
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

4. Install the drive motor battery rear left side panel (3).
5. Tighten the cell battery securing nuts (2) 9 N.m (80 lb in).
6. Attach the right subordinate drive motor sensor module wiring harness retainers (1)

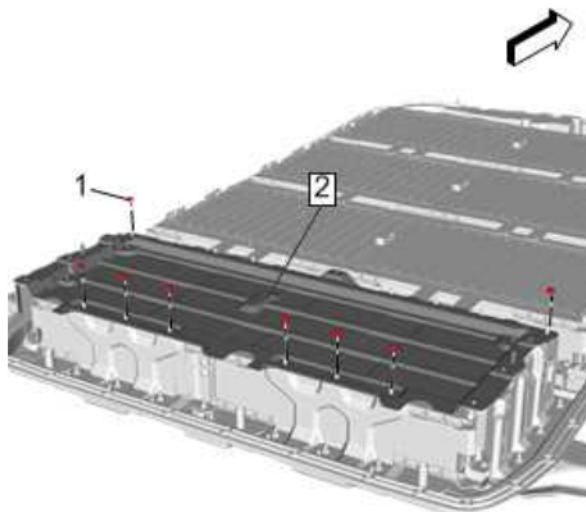


Fig. 260: Cell Battery Securing Nuts
 Courtesy of GENERAL MOTORS COMPANY

7. Install the cell battery securing nuts (1) and the cell battery upper panel (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

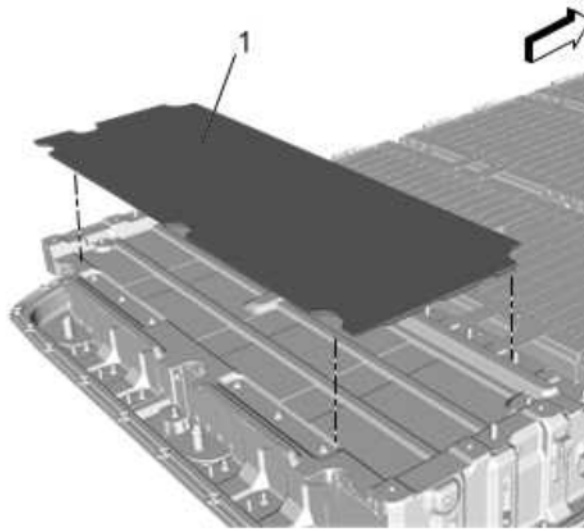


Fig. 261: Insulation Pad

Courtesy of GENERAL MOTORS COMPANY

8. Install the insulation pad (1).

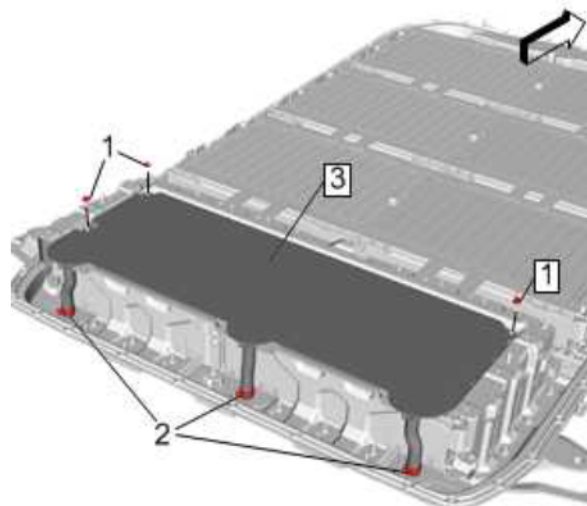


Fig. 262: Cell Battery Cooling Plate Securing Nuts

Courtesy of GENERAL MOTORS COMPANY

9. Install the cell battery cooling plate (3).
10. Position the cell battery cooling hose clamps (2), using **BO-38185** hose clamp pliers.
11. Tighten the cell battery cooling plate securing nuts (1) 9 N.m (80 lb in).

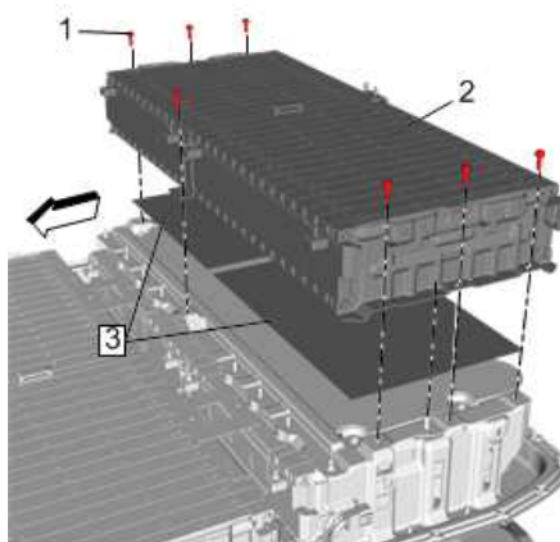


Fig. 263: Cell Battery Module
Courtesy of GENERAL MOTORS COMPANY

12. Install row 5 cell battery module (2). [Cell Battery Module Replacement \(Row 1\)](#)[Cell Battery Module Replacement \(Row 2\)](#)[Cell Battery Module Replacement \(Row 3\)](#)[Cell Battery Module Replacement \(Row 4\)](#)[Cell Battery Module Replacement \(Row 5\)](#)
13. Perform the hybrid battery pack coolant passage leak test. [Hybrid Battery Pack Coolant Passage Leak Test](#)
14. Perform the cell battery balancing if replaced. [Hybrid/EV Battery Cell Balancing](#)
15. Install the battery upper cover. [Battery Upper Cover Replacement](#)
16. Install the drive motor battery. [Drive Motor Battery Replacement and Shipping Preparation \(Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254\)](#)[Drive Motor Battery Replacement and Shipping Preparation \(New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254\)](#)

BATTERY POSITIVE CABLE EXTENSION CABLE REPLACEMENT

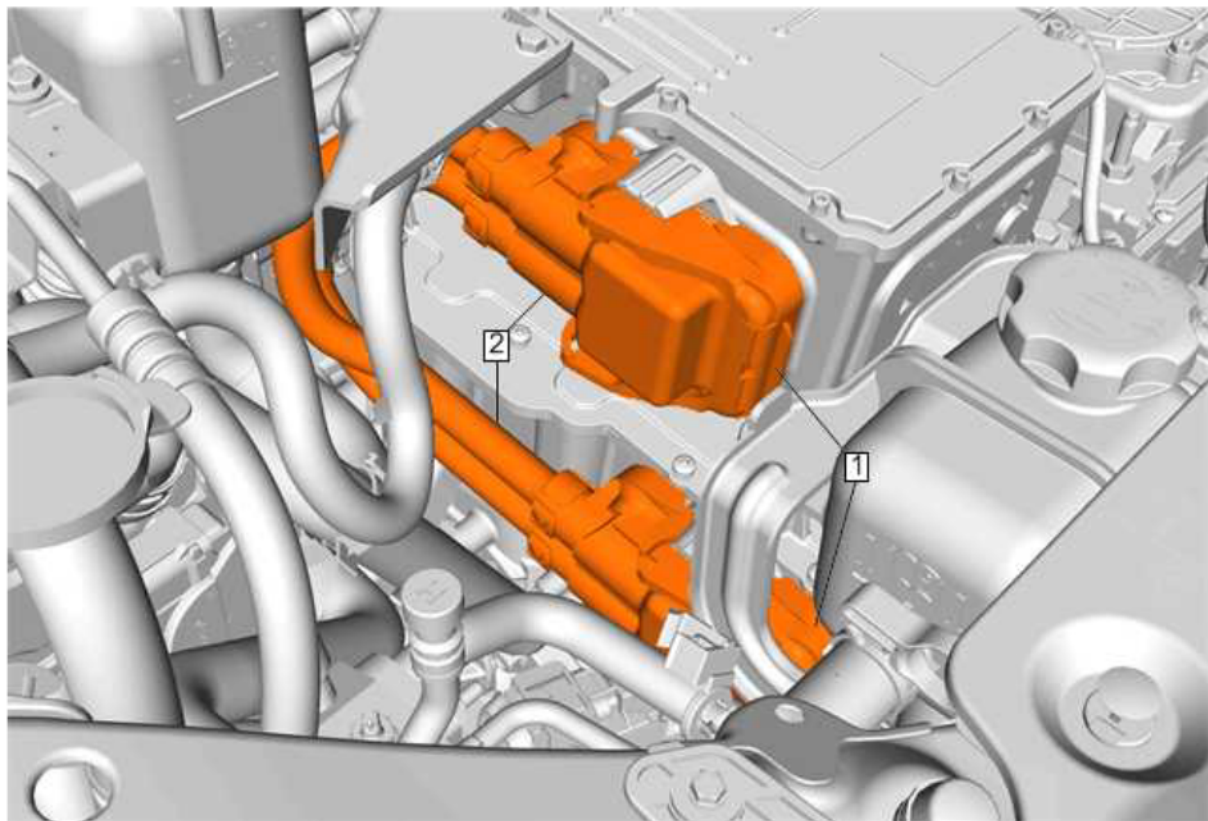


Fig. 264: Battery Positive Cable Extension Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death. WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. Preliminary Procedures 1. Disable the high voltage system. High Voltage Disabling	
1	Battery Positive Cable Extension Cable Connector Procedure Insert Small, flat bladed tool, release tab and lift to disengage
2	Battery Positive Cable Extension Cable

BATTERY CABLE REPLACEMENT (BUS BAR, CELL BATTERY MODULE 3 TO CELL BATTERY MODULE 4)

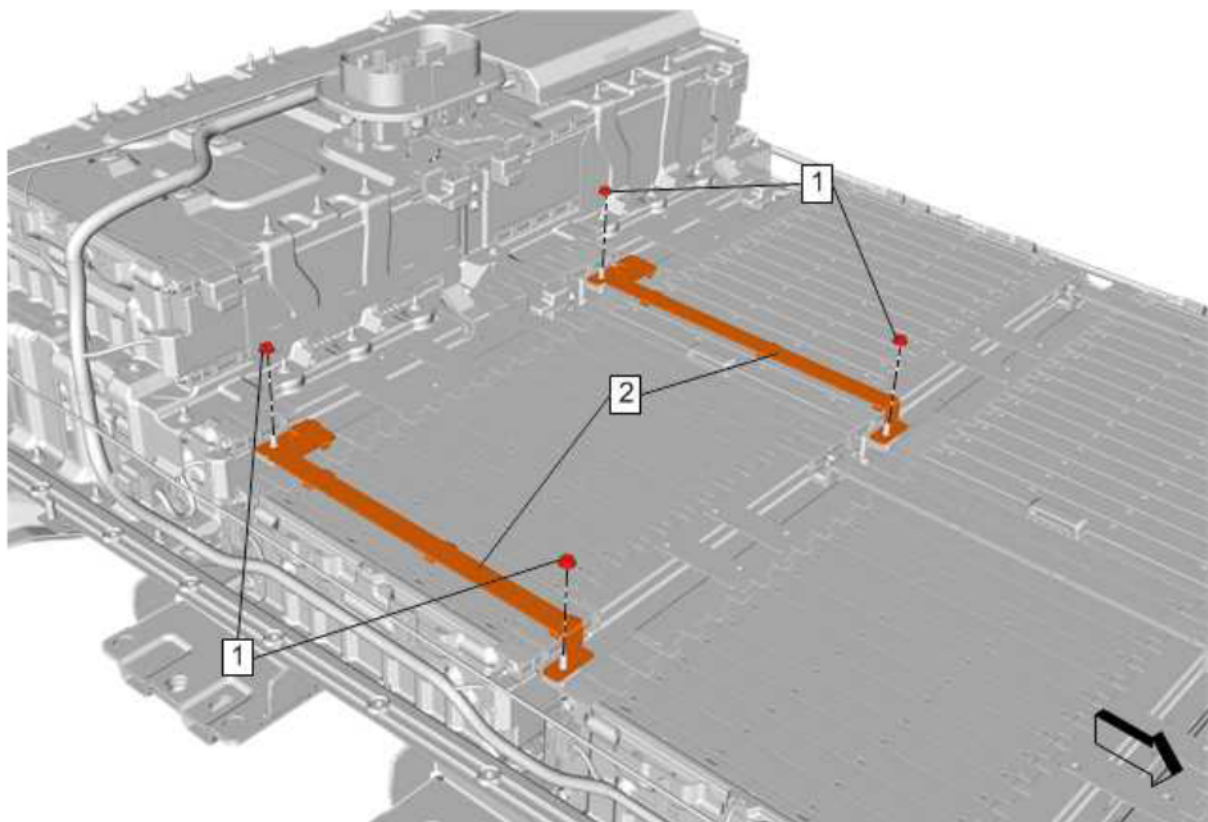


Fig. 265: Battery Cable (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death. WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. Preliminary Procedures 1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254) 2. Battery Upper Cover Replacement	
1	Battery Cable Nut (Qty: 4) CAUTION: Refer to Fastener Caution . NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. NOTE: Cover the battery cell stud with protective tape that is UL® listed or insulation tape rated at a minimum of 600V. Procedure 1. Tighten the nuts to 9 N.m (80 lb in). 2. Tighten the nuts again to 9 N.m (80 lb in).
2	Battery Cable (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4) (Qty: 2) Procedure Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

BATTERY CABLE REPLACEMENT (BUS BAR, CELL BATTERY MODULE 4 TO CELL BATTERY MODULE 5, LH)

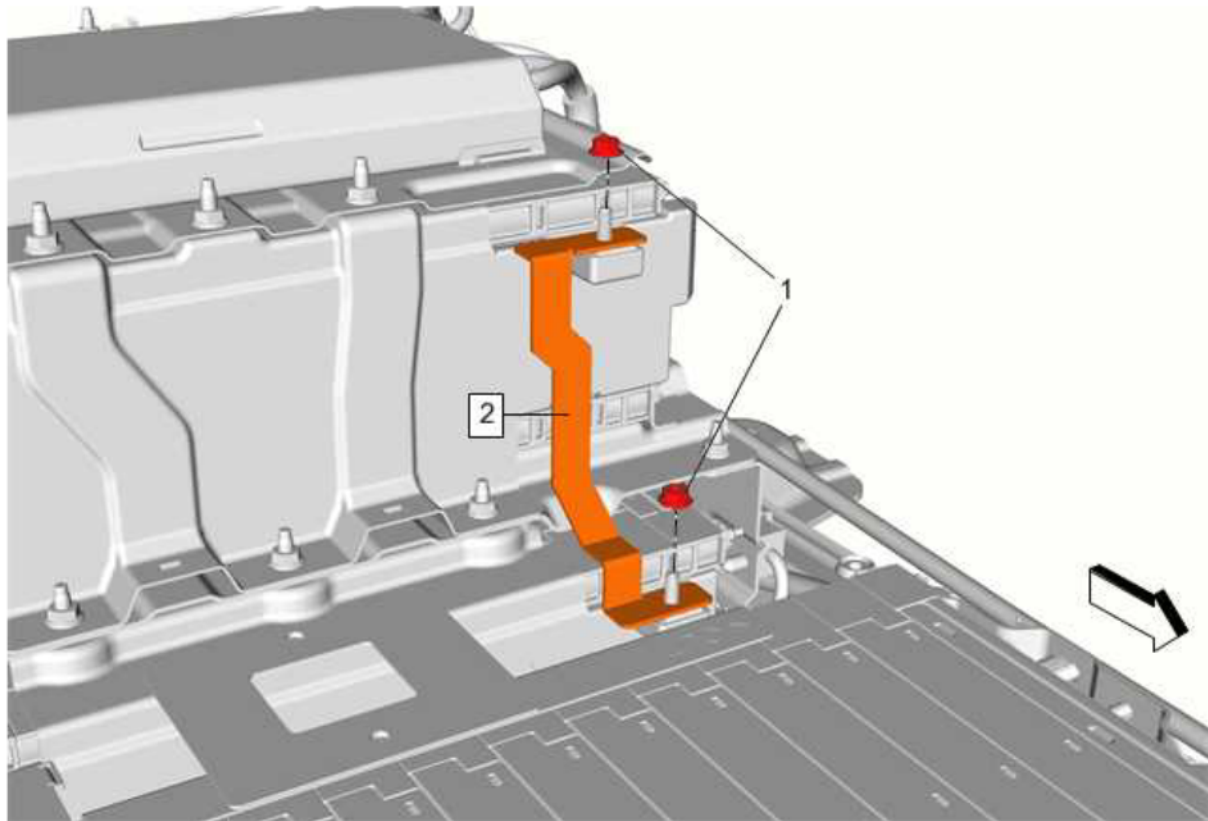


Fig. 266: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.	
WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:	
• Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not.	
Failure to follow the procedure exactly as written may result in serious injury or death.	
Preliminary Procedures	
1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254) 2. Battery Upper Cover Replacement	

Callout	Component Name
1	Battery Cable Nut (Qty: 2) CAUTION: Refer to Fastener Caution . NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. NOTE: Cover the battery cell stud with protective tape that is UL® listed or insulation tape rated at a minimum of 600V. Procedure 1. Tighten the nuts to 9 N.m (80 lb in). 2. Tighten the nuts again to 9 N.m (80 lb in).
2	Battery Cable (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH) Procedure Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

BATTERY CABLE REPLACEMENT (BUS BAR, CELL BATTERY MODULE 4 TO CELL BATTERY MODULE 5, RH)

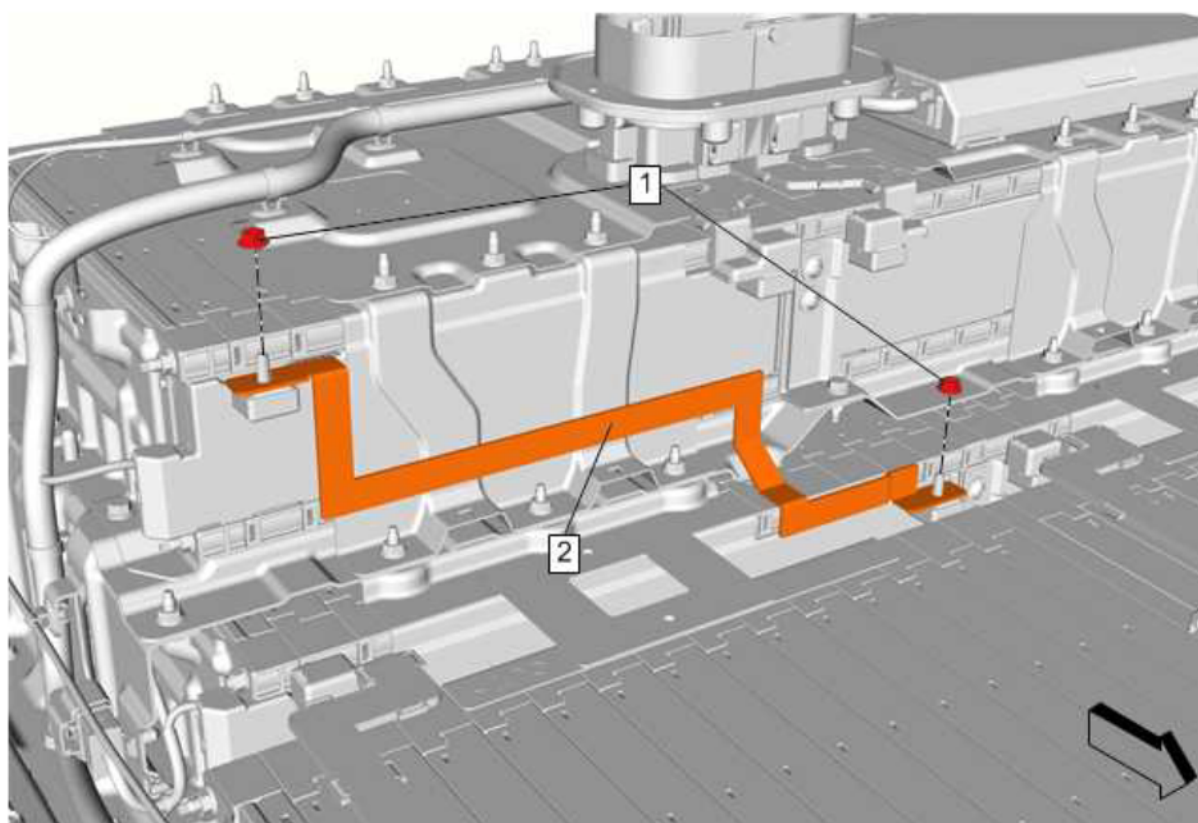


Fig. 267: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death. WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. Preliminary Procedures 1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254) 2. Battery Upper Cover Replacement	
1	Battery Cable Nut (Qty: 2) CAUTION: Refer to Fastener Caution . NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. NOTE: Cover the battery cell stud with protective tape that is UL® listed or insulation tape rated at a minimum of 600V. Procedure 1. Tighten the nuts to 9 N.m (80 lb in). 2. Tighten the nuts again to 9 N.m (80 lb in).
2	Battery Cable (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH) Procedure Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

**BATTERY CABLE REPLACEMENT (BUS BAR, BATTERY TO HIGH VOLTAGE BATTERY
DISCONNECT RELAY ASSEMBLY, NEGATIVE)**

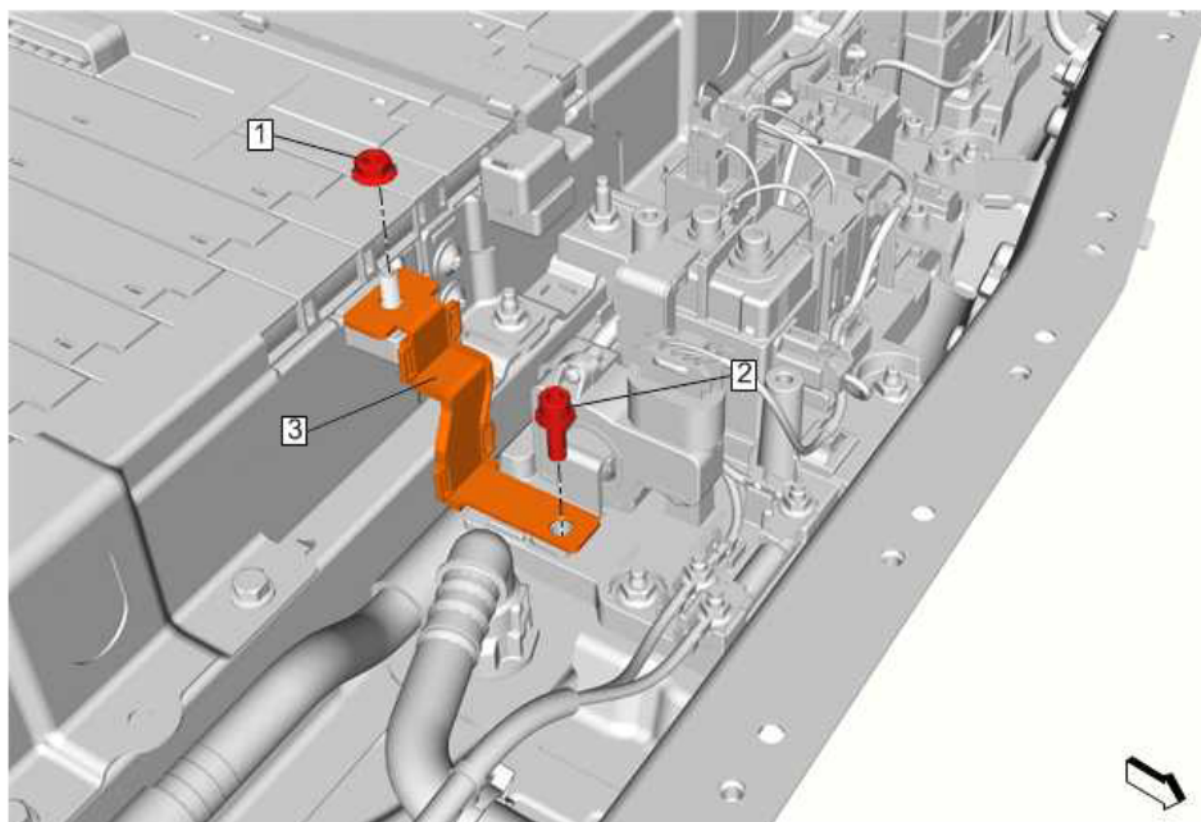


Fig. 268: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
	WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death. WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. Preliminary Procedures 1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254) 2. Battery Upper Cover Replacement 3. Remove the high voltage battery disconnect relay cover. High Voltage Battery Disconnect Relay Replacement
1	Battery Cable Nut CAUTION: Refer to Fastener Caution . NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. NOTE: Cover the battery cell stud with protective tape that is UL® listed or insulation tape rated at a minimum of 600V. Procedure 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).

Callout	Component Name
2	Battery Cable Bolt NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. Procedure 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).
3	Battery Cable (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative) Procedure Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

BATTERY CABLE REPLACEMENT (BUS BAR, BATTERY TO HIGH VOLTAGE BATTERY DISCONNECT RELAY ASSEMBLY, POSITIVE)

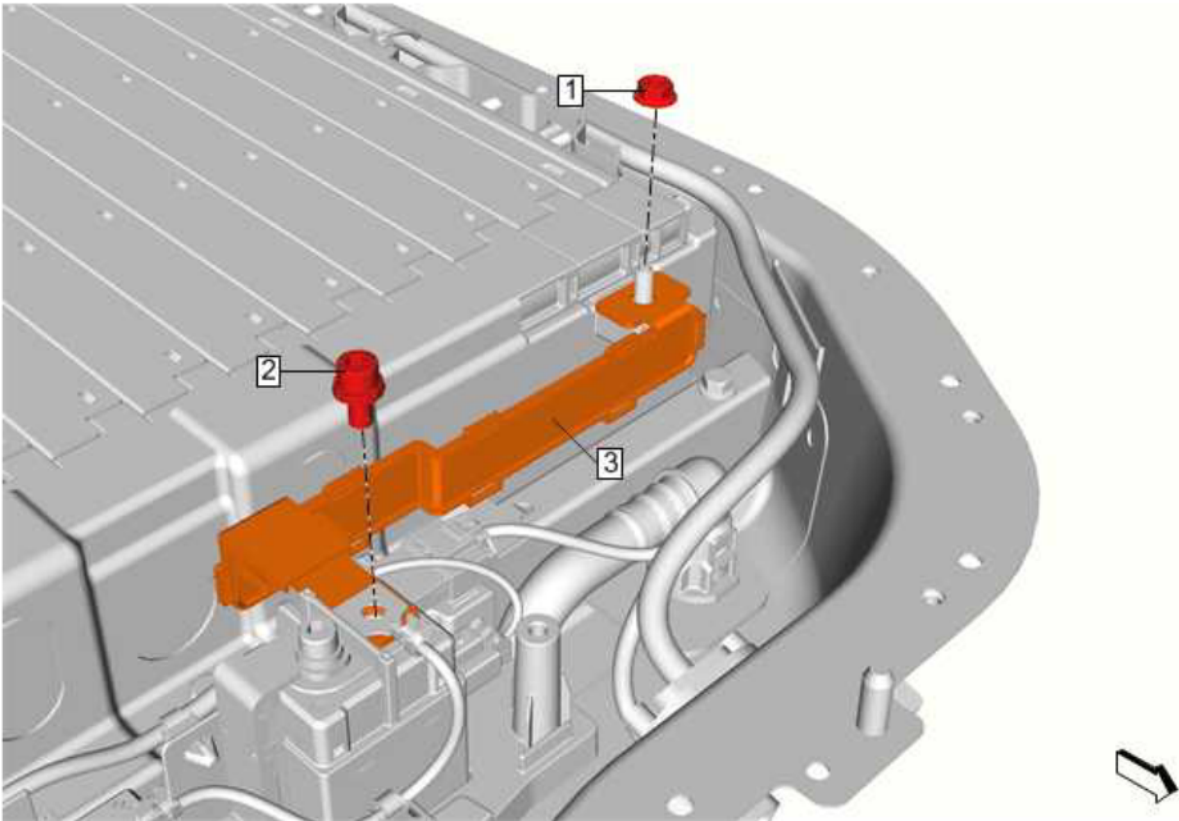


Fig. 269: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
	WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death. WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. Preliminary Procedures 1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254) 2. Battery Upper Cover Replacement 3. Remove the high voltage battery disconnect relay cover. High Voltage Battery Disconnect Relay Replacement
1	Battery Cable Nut CAUTION: Refer to Fastener Caution . NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. NOTE: Cover the battery cell stud with protective tape that is ULÂ® listed or insulation tape rated at a minimum of 600V. Procedure 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).

Callout	Component Name
2	Battery Cable Bolt NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. Procedure 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).
3	Battery Cable (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive) Procedure Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

BATTERY CABLE REPLACEMENT (BUS BAR, BATTERY TO HIGH VOLTAGE BATTERY HIGH VOLTAGE MANUAL DISCONNECT, NEGATIVE)

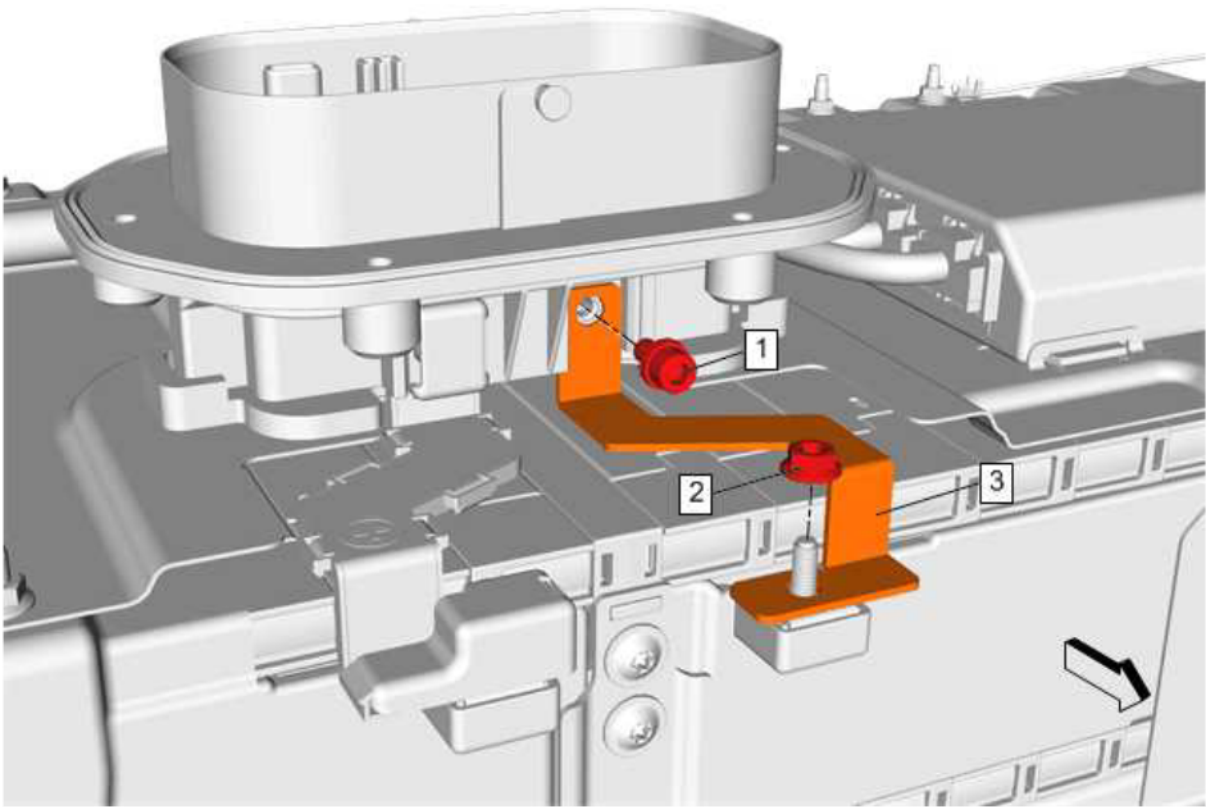


Fig. 270: Battery Cable (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
	WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death. WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. Preliminary Procedures 1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254) 2. Battery Upper Cover Replacement
1	Battery Cable Bolt CAUTION: Refer to Fastener Caution . NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. Procedure 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).

Callout	Component Name
2	Battery Cable Nut NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. NOTE: Cover the battery cell stud with protective tape that is UL® listed or insulation tape rated at a minimum of 600V. Procedure 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).
3	Battery Cable (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative) Procedure Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

BATTERY CABLE REPLACEMENT (BUS BAR, BATTERY TO HIGH VOLTAGE BATTERY HIGH VOLTAGE MANUAL DISCONNECT, POSITIVE)

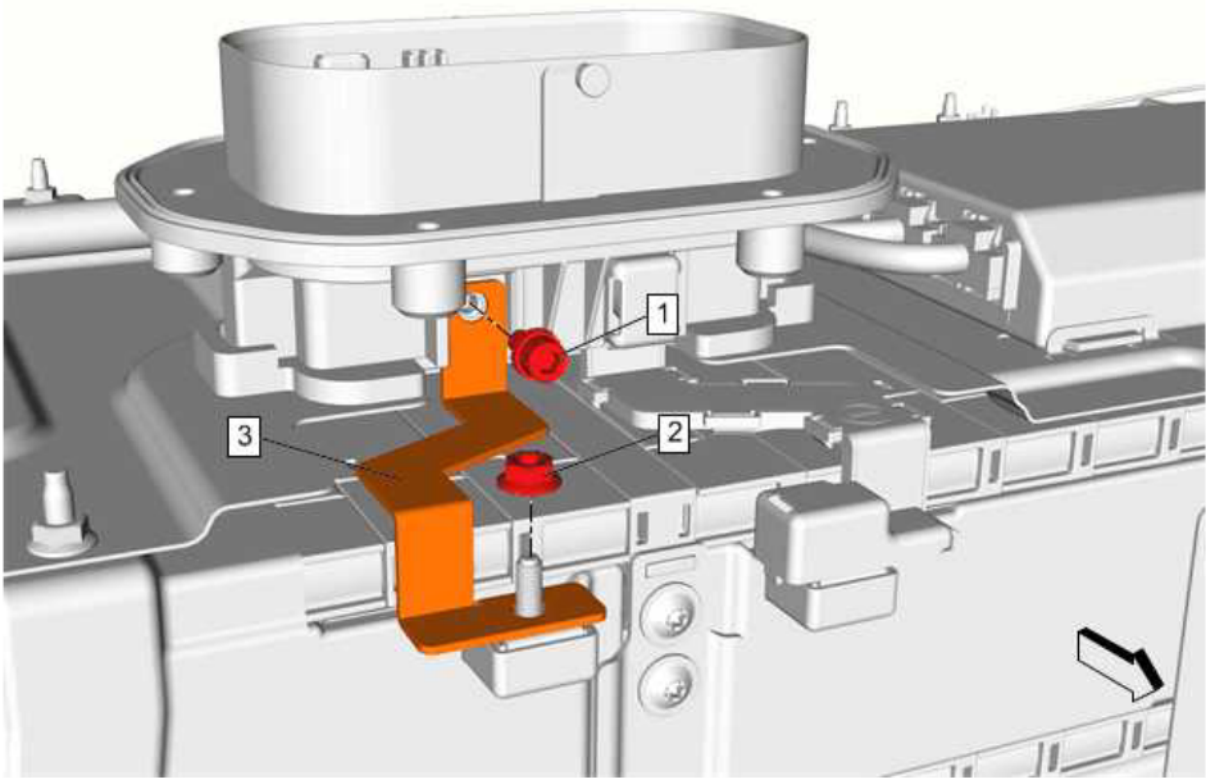


Fig. 271: Battery Cable (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
	WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death. WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. Preliminary Procedures 1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254) 2. Battery Upper Cover Replacement
1	Battery Cable Bolt CAUTION: Refer to Fastener Caution . NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. Procedure 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).

Callout	Component Name
2	Battery Cable Nut NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. NOTE: Cover the battery cell stud with protective tape that is UL® listed or insulation tape rated at a minimum of 600V. Procedure 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).
3	Battery Cable (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive) Procedure Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

BATTERY CABLE REPLACEMENT (BUS BAR, CELL BATTERY MODULE 1 TO CELL BATTERY MODULE 2)

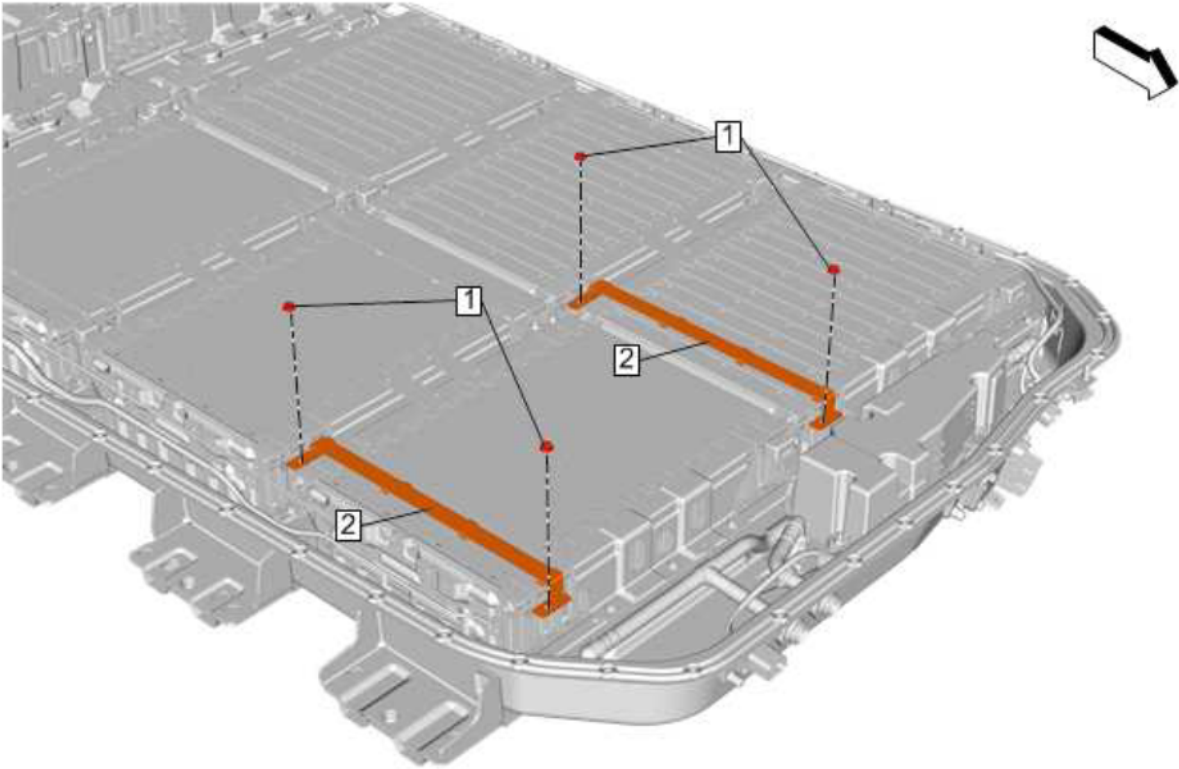


Fig. 272: Battery Cable
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
	WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death. WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. Preliminary Procedures 1. Remove the drive motor battery. <u>Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)</u><u>Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)</u><u>Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)</u> 2. <u>Battery Upper Cover Replacement</u>
1	Battery Cable Nut (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. NOTE: Cover the battery cell stud with protective tape that is UL® listed or insulation tape rated at a minimum of 600V. Procedure 1. Tighten the nuts to 9 N.m (80 lb in). 2. Tighten the nuts again to 9 N.m (80 lb in).
2	Battery Cable (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2) (Qty: 2) Procedure Install the drive motor battery. <u>Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)</u><u>Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)</u><u>Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)</u>

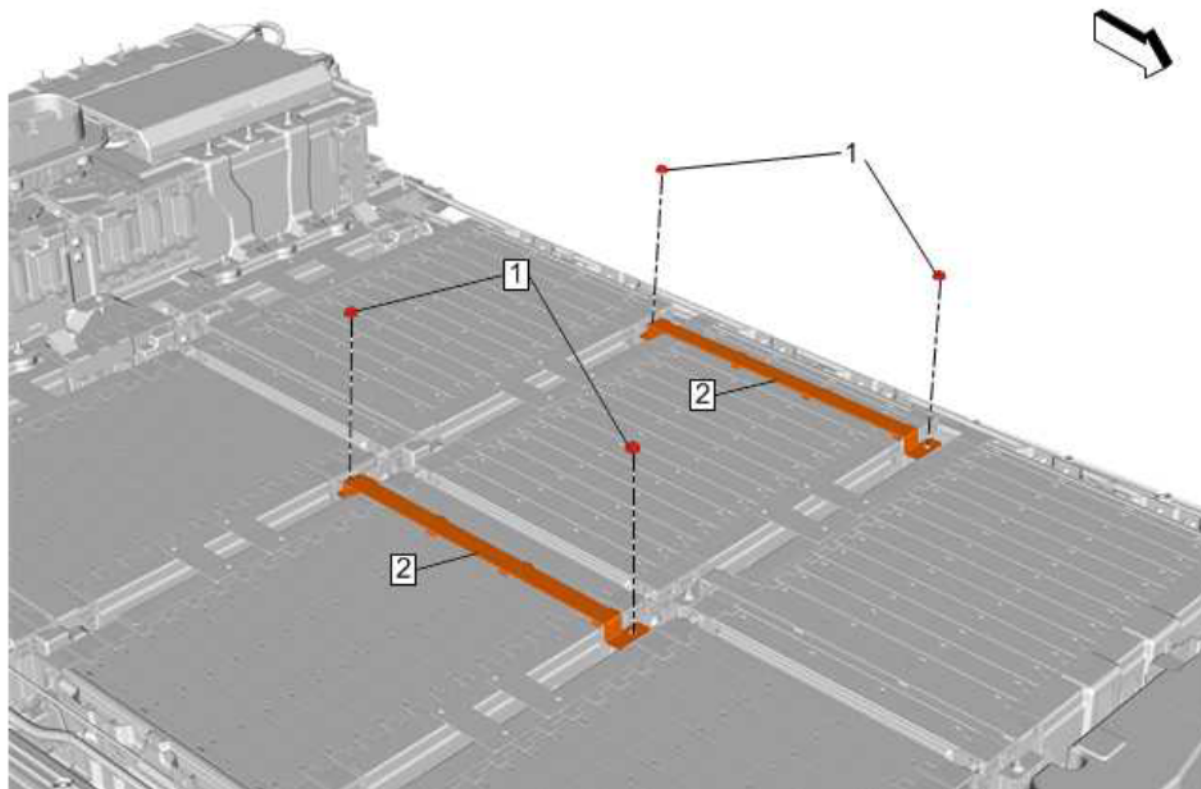


Fig. 273: Battery Cable

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.	
WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:	
• Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not.	
Failure to follow the procedure exactly as written may result in serious injury or death.	
Preliminary Procedures	
1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254) 2. Battery Upper Cover Replacement	

Callout	Component Name
1	Battery Cable Nut (Qty: 2) CAUTION: Refer to Fastener Caution . NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly. NOTE: Cover the battery cell stud with protective tape that is UL® listed or insulation tape rated at a minimum of 600V. Procedure 1. Tighten the nuts to 9 N.m (80 lb in). 2. Tighten the nuts again to 9 N.m (80 lb in).
2	Battery Cable (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3) Procedure Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

BATTERY CABLE REPLACEMENT (BUS BAR, X3, POSITIVE & NEGATIVE)

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. iaagn.com

2. Remove Battery Upper Cover [Battery Upper Cover Replacement](#)

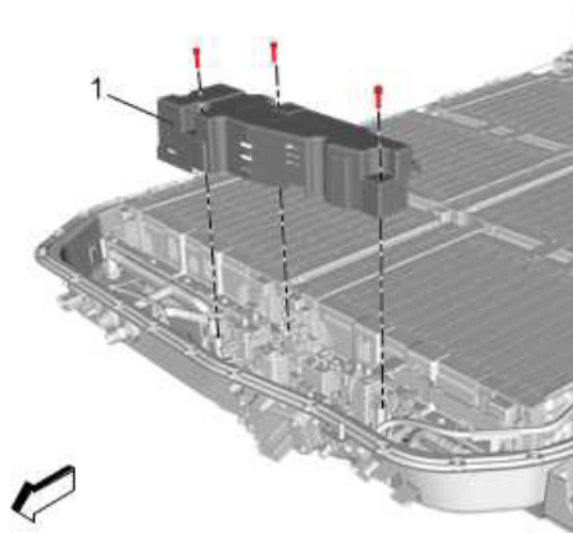


Fig. 274: High Voltage Battery Disconnect Relay Cover
Courtesy of GENERAL MOTORS COMPANY

3. Remove High Voltage Battery Disconnect Relay Cover (1) [High Voltage Battery Disconnect Relay Replacement](#)

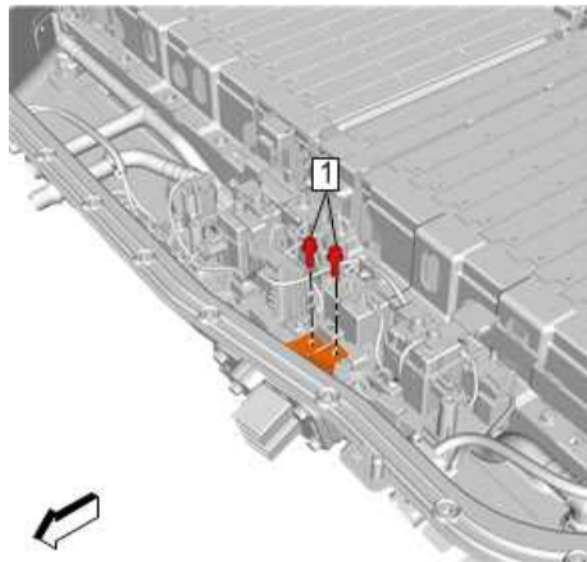


Fig. 275: Battery Cable Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove Battery Cable Bolt (1)

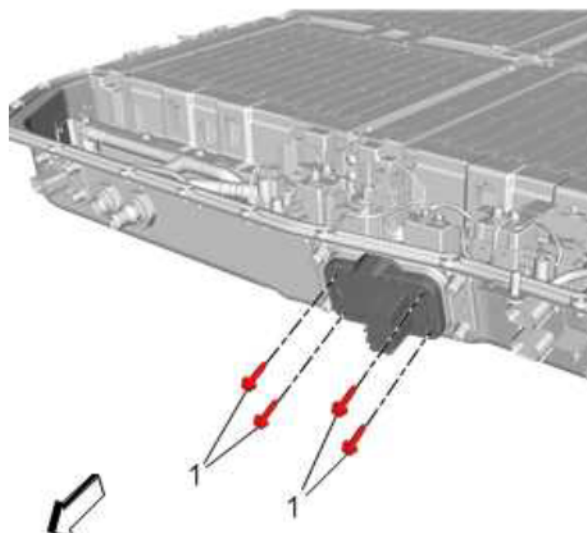


Fig. 276: High Voltage Battery X3 Connector Block Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Remove High Voltage Battery X3 Connector Block Bolt (1)

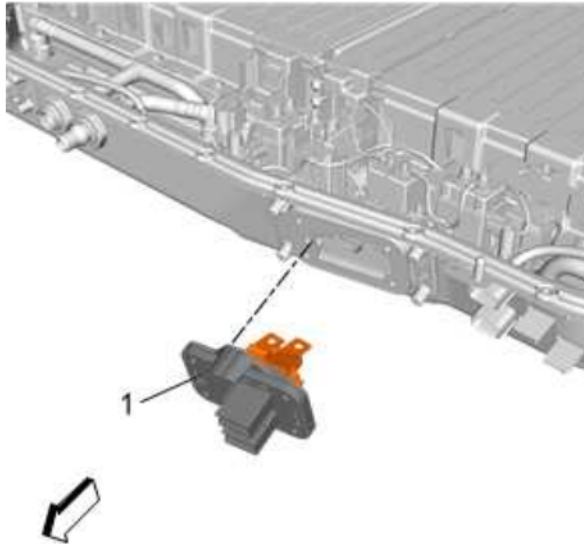


Fig. 277: High Voltage Battery X3 Connector With Battery Cables
Courtesy of GENERAL MOTORS COMPANY

6. Remove the high voltage battery X3 connector (1) with battery cables.

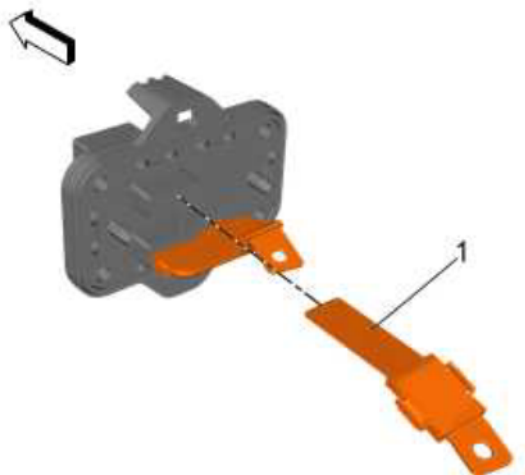


Fig. 278: Battery Cable - Bus Bar, X3, Positive
Courtesy of GENERAL MOTORS COMPANY

7. Remove the battery cable - Bus Bar, X3, Positive (1) from the high voltage battery X3 connector.

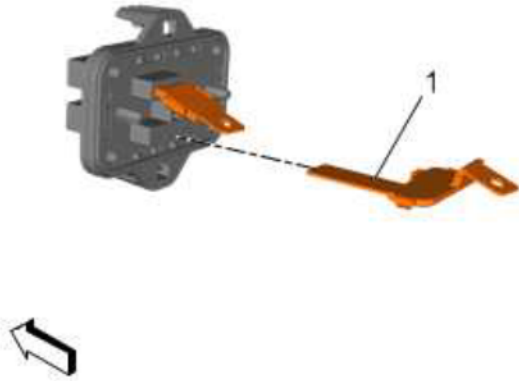


Fig. 279: Battery Cable - Bus Bar, X3, Negative
Courtesy of GENERAL MOTORS COMPANY

8. Remove the battery cable - Bus Bar, X3, Negative (1) from the high voltage battery X3 connector.

Installation Procedure

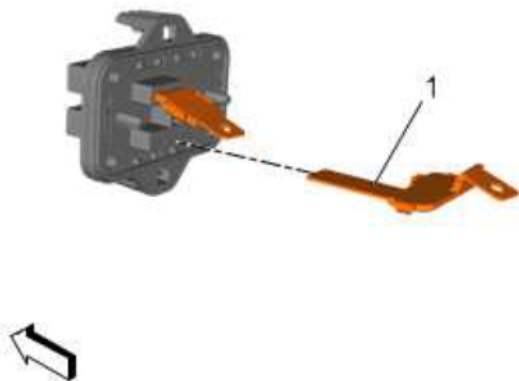


Fig. 280: Battery Cable - Bus Bar, X3, Negative
Courtesy of GENERAL MOTORS COMPANY

1. Install the battery cable - Bus Bar, X3, Negative (1) to the high voltage battery X3 connector.

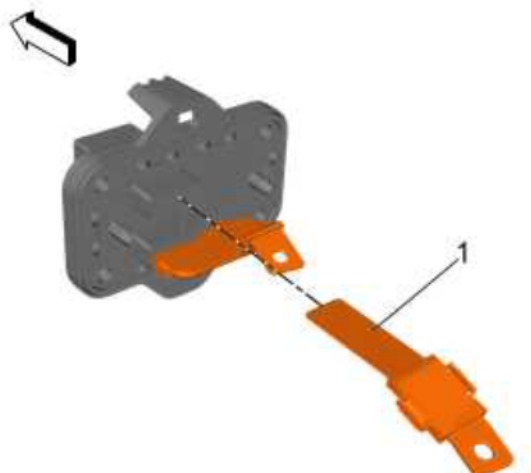


Fig. 281: Battery Cable - Bus Bar, X3, Positive
Courtesy of GENERAL MOTORS COMPANY

2. Install the battery cable - Bus Bar, X3, Positive (1) to the high voltage battery X3 connector.

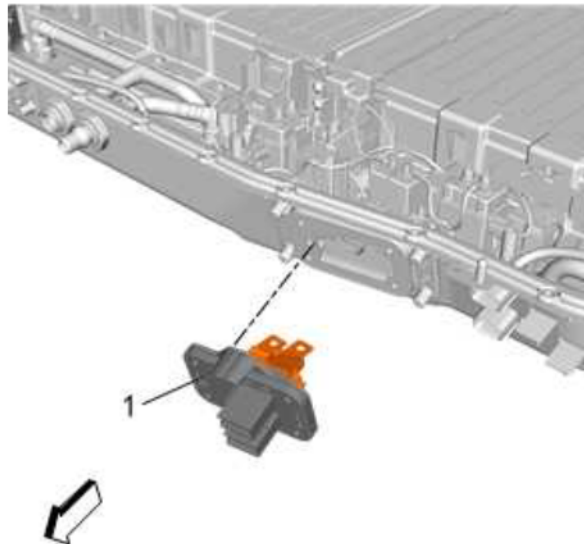


Fig. 282: High Voltage Battery X3 Connector With Battery Cables
Courtesy of GENERAL MOTORS COMPANY

3. Install the high voltage battery X3 connector (1) with battery cables.

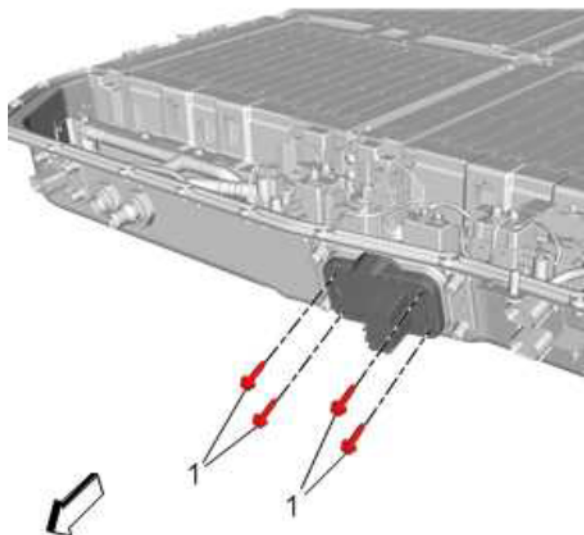


Fig. 283: High Voltage Battery X3 Connector Block Bolt
Courtesy of GENERAL MOTORS COMPANY

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

4. Install High Voltage Battery X3 Connector Block Bolt (1) and tighten 9 N.m (80 lb in)

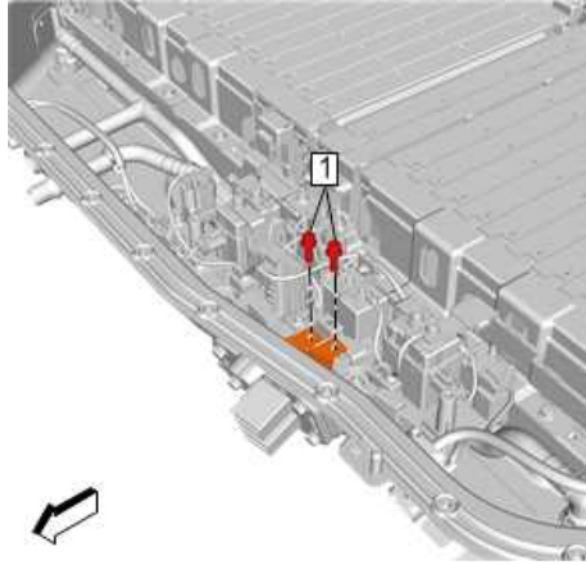


Fig. 284: Battery Cable Bolt

Courtesy of GENERAL MOTORS COMPANY

5. Install Battery Cable Bolt (1) and tighten

4.1. First Pass: 9 N.m (80 lb in)

4.2. Final Pass: 9 N.m (80 lb in)

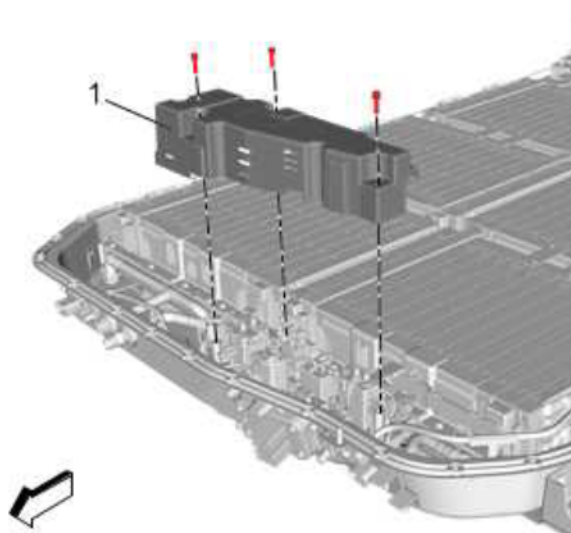


Fig. 285: High Voltage Battery Disconnect Relay Cover

Courtesy of GENERAL MOTORS COMPANY

6. Install High Voltage Battery Disconnect Relay Cover (1) **High Voltage Battery Disconnect Relay Replacement**

7. Install Battery Upper Cover **Battery Upper Cover Replacement**

8. Enable the high voltage system. **High Voltage Enabling**

BATTERY UPPER COVER REPLACEMENT

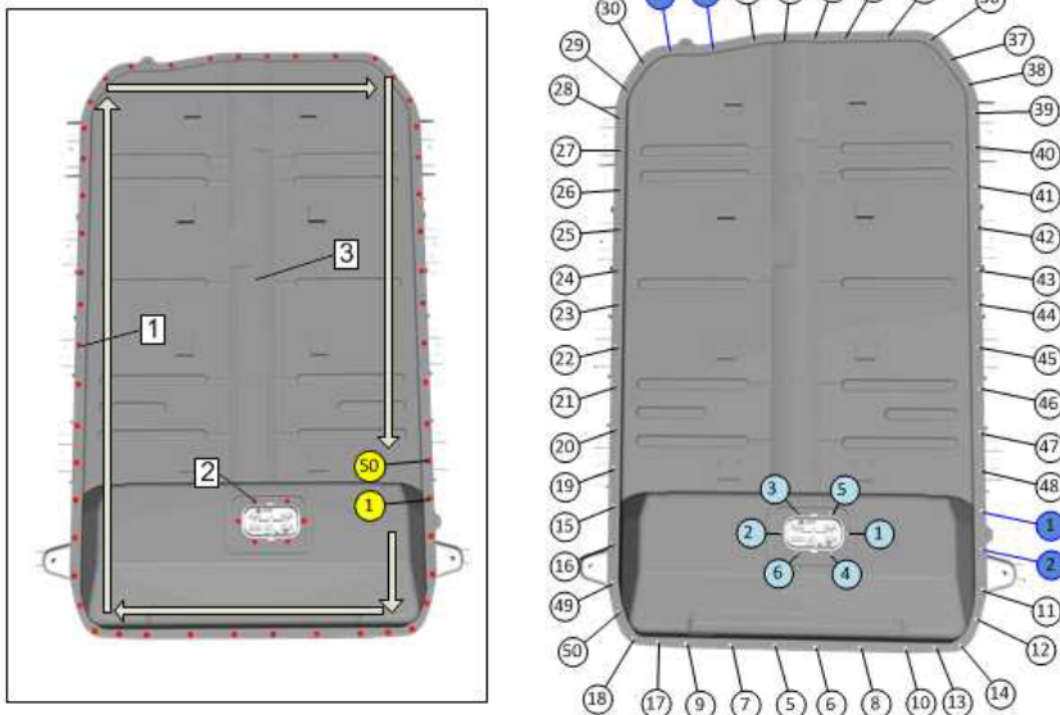


Fig. 286: Battery Upper Cover

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death. WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 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 at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. Preliminary Procedure Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)	

Callout	Component Name
1	Battery Upper Cover Fastener (Qty: 50) CAUTION: Refer to Fastener Caution . Procedure 1. When removing the bolts, follow the release sequence shown in the above left graphic. 2. Tighten the cover fasteners in the sequence shown in the above right graphic. 3. Loosely tighten the No. 1~4 bolts first. 4. Tighten the No. 1~50 bolts to 2.5 N.m (22 lb in). 5. Tighten the No. 1~50 bolts to 9 N.m (80 lb in) again.
2	High Voltage Disconnect Connector Fastener (Qty: 6) Tighten 9 N.m (80 lb in) Procedure Tighten the fasteners in the sequence shown in the above right graphic.
3	Battery Upper Cover Procedure 1. If needed, replace the battery upper cover. 2. If needed, replace the battery cover seal. Battery Cover Seal Replacement 3. Perform the rechargeable energy storage system smoke test. Rechargeable Energy Storage System Smoke Test 4. Perform the hybrid/EV battery system verification. Hybrid/EV Battery System Verification 5. Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

DRIVE MOTOR BATTERY REPLACEMENT AND SHIPPING PREPARATION (OLD DESIGN BATTERY PACK IN VEHICLES BUILT BEFORE 1G1FX6S06H4163254)

Special Tools

- GE-52418 Lifting Table
- GE-52200 Lifting Table
- EL-51102 High Voltage Battery Lift Bar Tilter
- EL-51102 - 10 Hanging Bars and Shackles
- EL-51102 - 20 High Voltage Battery Lift Bar Tilter Eye-Nut Kit
- EL-51102 - 40 Battery Lifting Strap
- EL-51102 - 50 Battery Lifting Strap

For equivalent regional tools, refer to [Special Tools](#) .

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. [High Voltage Disabling](#)
2. Remove the front compartment air deflector. [Front Compartment Air Deflector Replacement](#)
3. Drain the drive motor battery cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)

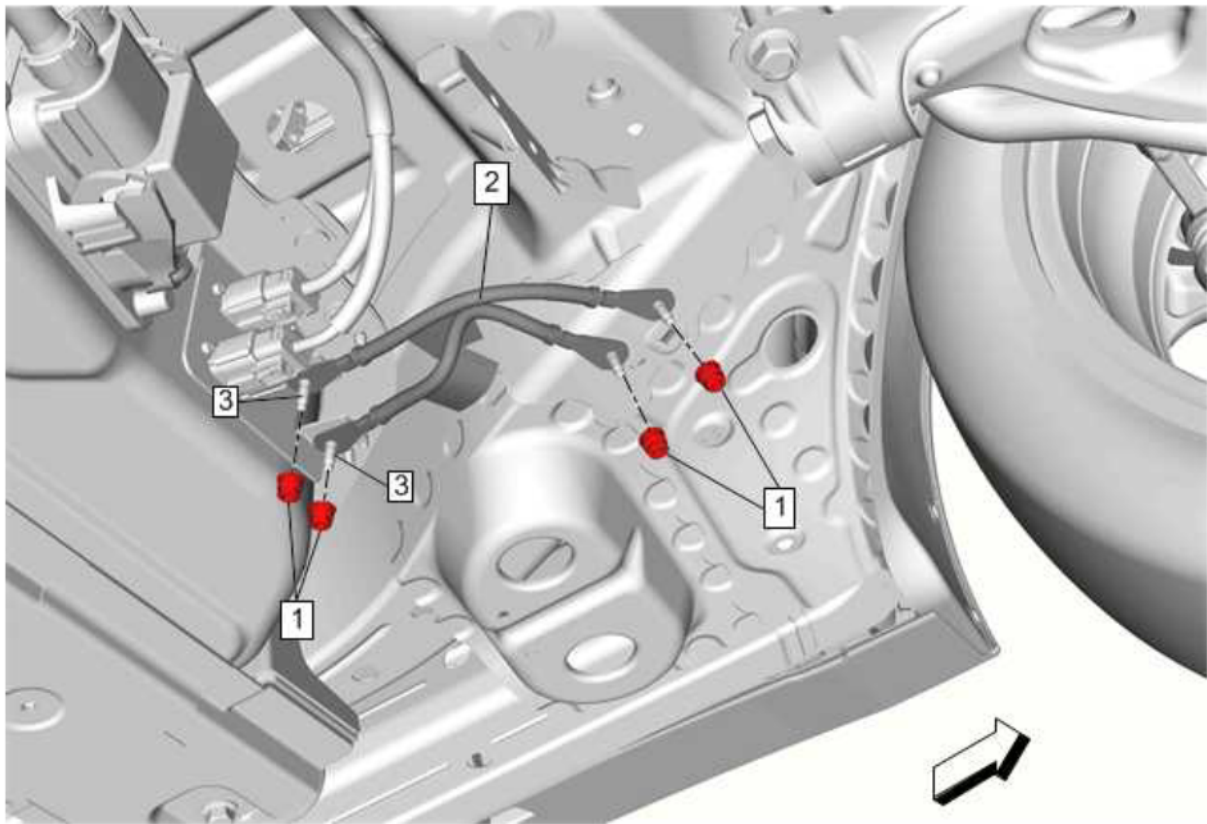


Fig. 287: Battery Negative Cable

Courtesy of GENERAL MOTORS COMPANY

4. Remove the battery negative cable (2) from the high voltage battery and body structure. [Battery Negative Cable Replacement \(High Voltage Battery to Body Structure\)](#) [Battery Negative Cable Replacement \(12V Battery to Body Structure\)](#)

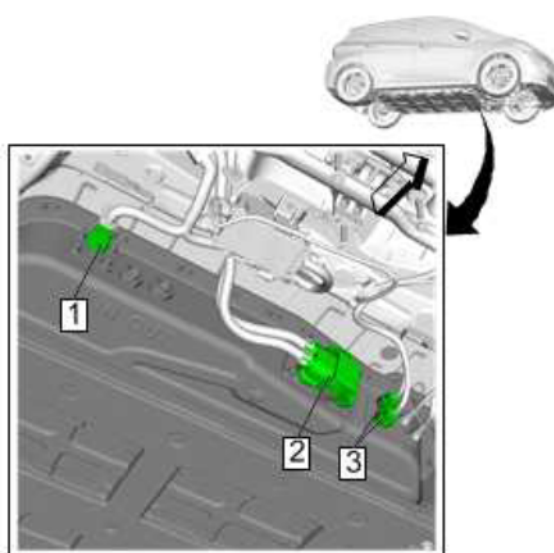


Fig. 288: High Voltage Battery Connector
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the X4 high voltage battery connector (1) from the drive motor battery.
6. Disconnect the X3 high voltage battery connector (2) from the drive motor battery by rotating the connector handle until 90 degrees.
7. Disconnect the body wiring harness connectors (3) from the drive motor battery.

WARNING: To avoid any vehicle damage, serious personal injury or death:

- When major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.
- When performing work in the engine compartment or under the vehicle, ensure that the hood is fully open, or opened to its secondary latch. When the hood is opened to the secondary latch, the vehicle will disable the remote start features from the key fob and OnStar mobile app. Failure to open the hood, or open the hood to the secondary latch while doing a repair in the engine compartment or under the vehicle can result in inadvertent vehicle starting which could result in personal injury or damage to a vehicle.

CAUTION: Perform the following steps before beginning any vehicle lifting or jacking procedure:

- Remove or secure all of the vehicle contents in order to avoid any shifting or any movement that may occur during the vehicle lifting or jacking procedure.
- The lifting equipment or the jacking equipment weight rating must meet or exceed the weight of the vehicle and any vehicle contents.
- The lifting equipment or the jacking equipment must meet the operational standards of the lifting equipment or jacking equipment manufacturer.
- Perform the vehicle lifting or jacking procedure on a clean, hard, dry, level surface.
- Perform the vehicle lifting or jacking procedure only at the identified lift points. DO NOT allow the lifting equipment or jacking equipment to contact any other vehicle components.

Failure to perform the previous steps could result in damage to the lifting equipment or the jacking equipment, the vehicle, and/or the vehicle contents.

8. During drive motor battery removal, vehicle weight will be redistributed and may cause the vehicle to become unstable on the hoist. To avoid the vehicle potentially falling off secure the vehicle to lift/hoist arms with straps.

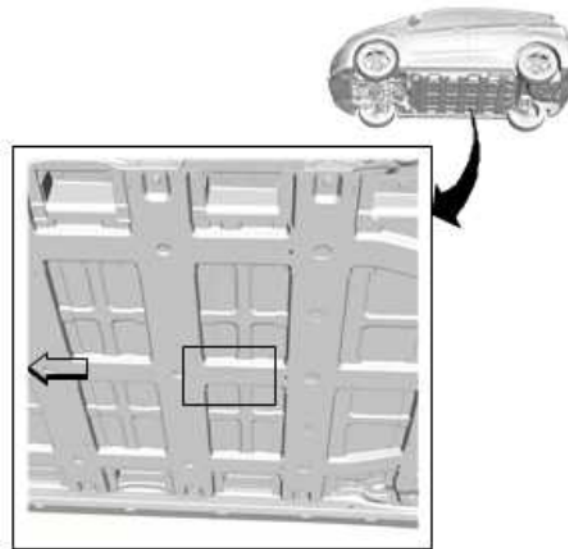


Fig. 289: Lifting Table

Courtesy of GENERAL MOTORS COMPANY

NOTE: There is C.G (Center of Gravity) mark on the drive motor battery tray to locate your lift table.

NOTE: The high voltage battery mass is approximately 450 kg (1000 lbs)

9. Position a **GE-52418** Lifting Table or **GE-52200** Lifting Table and raise the lifting table into position.

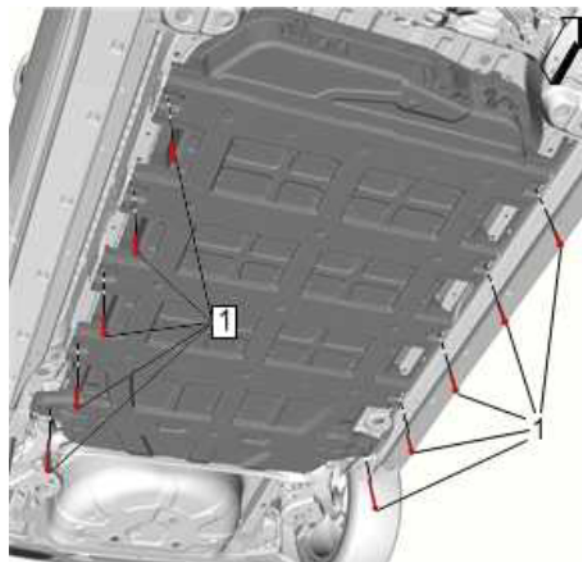


Fig. 290: Drive Motor Battery Mounting Fasteners

Courtesy of GENERAL MOTORS COMPANY

NOTE: Verify ALL connectors are removed from the drive motor battery.

NOTE: Confirm the locking MSD cap/cover required in some regions will pass through the vehicle floor panel. If not, the MSD cap/cover should be removed during Battery Pack lowering from vehicle then reinstalled once the pack is out.

NOTE: Ensure all fasteners are removed before lowering the support table fixture with the drive motor battery.

10. Remove the drive motor battery mounting fasteners (1).



Fig. 291: Lifting Table With Drive Motor Battery
Courtesy of GENERAL MOTORS COMPANY

WARNING: When removing the high voltage battery, only use the recommended lift table with straps capable of holding 1000kg (2204.62 lbs). Failure to use the appropriate lift table and straps could cause the battery to fall and may result in personal injury or death.

11. Slowly lower the lifting table (1) with the drive motor battery (2).
12. Secure the high voltage battery to the lifting table with straps.
13. Cover the manual disconnect tape.

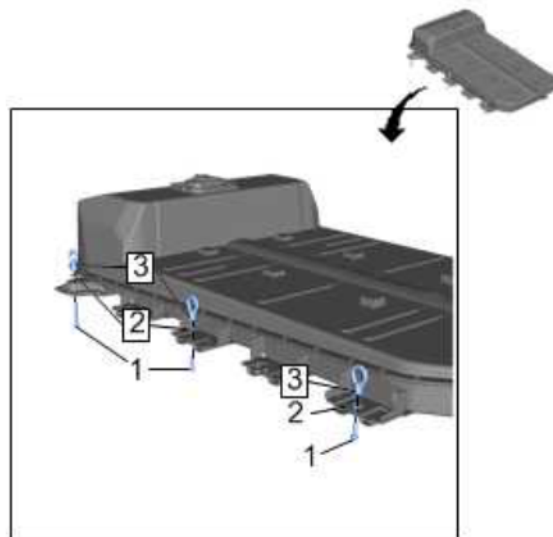


Fig. 292: 3 Eye-Nut, Washer And Bolts
Courtesy of GENERAL MOTORS COMPANY

14. Using the **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit install the 3 eye-nut (3), washers (2) and bolts (1). Tighten the bolts (1) to 9 N.m (80 lb in).

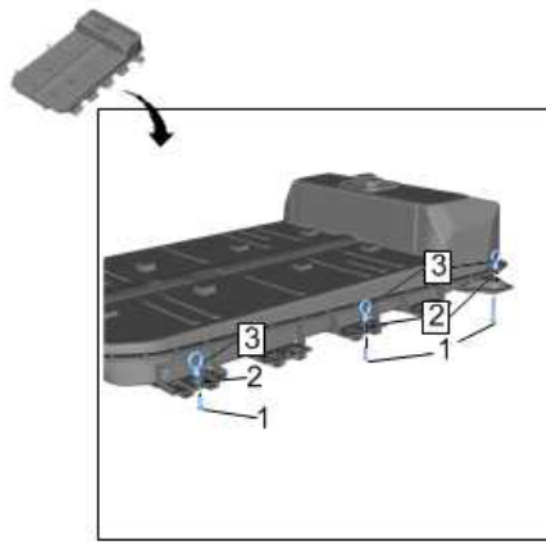


Fig. 293: 3 Eye-Nut, Washer And Bolts

Courtesy of GENERAL MOTORS COMPANY

15. Using the **EL-51102 - 20 High Voltage Battery Lift Bar Tilter Eye-Nut Kit** install the 3 eye-nut (3), washers (2) and bolts (1). Tighten the bolts (1) to 9 N.m (80 lb in).

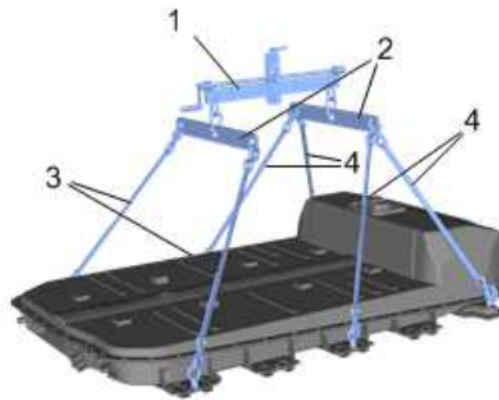


Fig. 294: High Voltage Battery Lift Bar Tilter

Courtesy of GENERAL MOTORS COMPANY

16. Attach the **EL-51102 High Voltage Battery Lift Bar Tilter** (1) to a suitable lifting crane.
17. Position the **EL-51102 High Voltage Battery Lift Bar Tilter** and **EL-51102 - 10 Hanging Bars and Shackles** (2) over the high voltage battery as shown.
18. Install the **EL-51102 - 40 Battery Lifting Strap** (3) and the **EL-51102 - 50 Battery Lifting Strap** (4) to transport the drive motor battery to a secure area.

NOTE: Make sure the drive motor battery is balanced when hung from the lifting straps before moving with a crane or chain block to a support table.

NOTE: As part of the battery removal process, all coolant should be drained from the battery pack.

NOTE: If internal repairs are being performed on the battery, all coolant should be drained from the battery pack to ensure coolant does not drain from the hoses during repairs.

19. Install 2 coolant plugs into the coolant lines. Coolant plugs can be removed from the NEW service battery assembly.

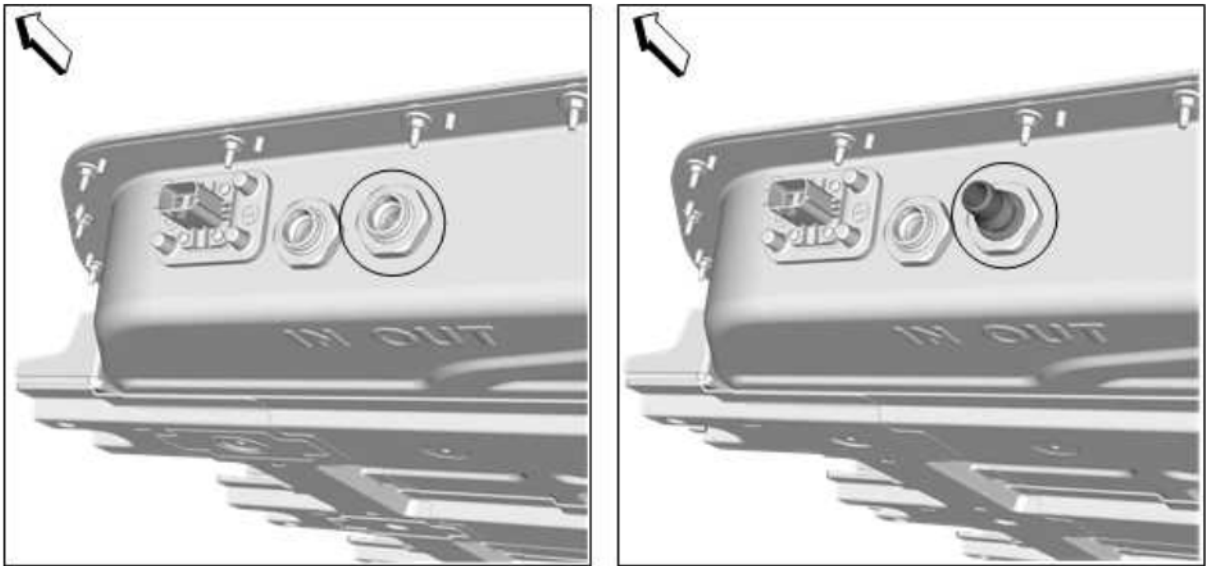


Fig. 295: New/ Old Battery Versions

Courtesy of GENERAL MOTORS COMPANY

1. Check if the drive motor battery pack is OLD version battery or NEW version battery.
 - 1.1 OLD version battery has a female type battery cooler outlet port like upper left picture.
 - 1.2 NEW version battery has a male type battery cooler outlet port like upper right picture.

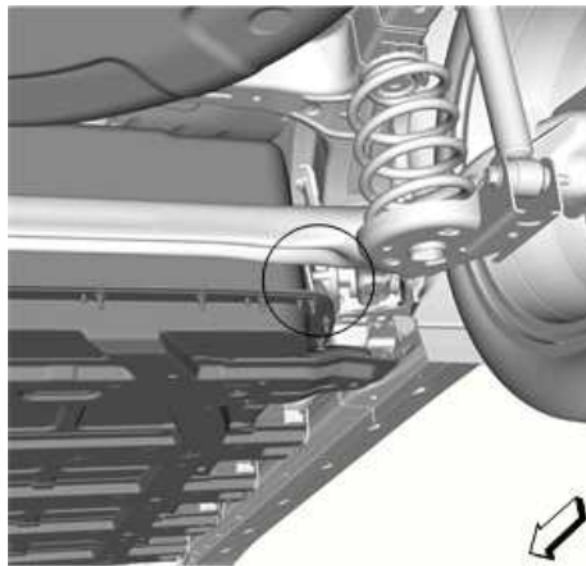


Fig. 296: Rear Of Drive Motor Battery And Rear Suspension Bushing Bolts

Courtesy of GENERAL MOTORS COMPANY

2. Avoid making contact between the rear of the drive motor battery and the rear suspension bushing bolts.



Fig. 297: Lifting Table With Drive Motor Battery
 Courtesy of GENERAL MOTORS COMPANY

3. Secure high voltage battery to the lifting table with straps.
4. With the drive motor battery (2) on the **GE-52418** Lifting Table or **GE-52200** Lifting Table (1), slowly raise the lifting table.
5. Release the straps.

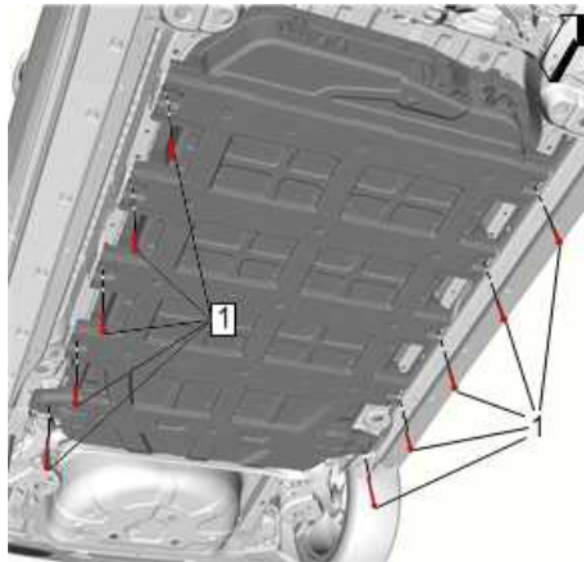


Fig. 298: Drive Motor Battery Mounting Fasteners
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

6. Snugly tighten the outside mounting fasteners (1).
7. Lower the lifting table.
8. Tighten the fasteners (1) to 56 N.m (41 lb ft).

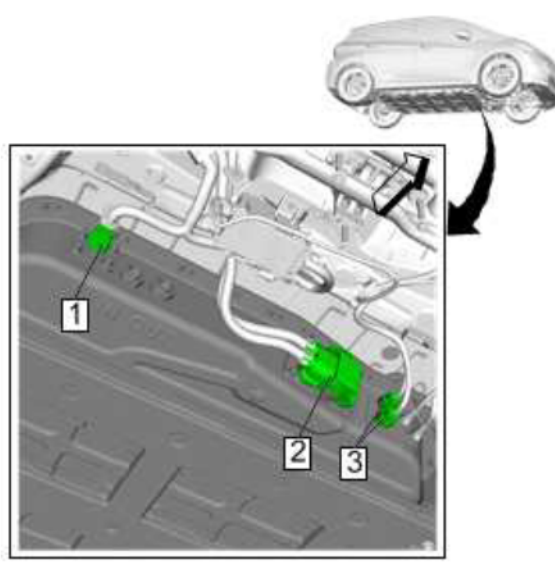


Fig. 299: High Voltage Battery Connector
 Courtesy of GENERAL MOTORS COMPANY

9. Connect the body wiring harness connectors (3) to the drive motor battery.
10. Connect the X3 high voltage connector (2) to the drive motor battery.
11. Connect the X4 high voltage connector (1) to the drive motor battery.

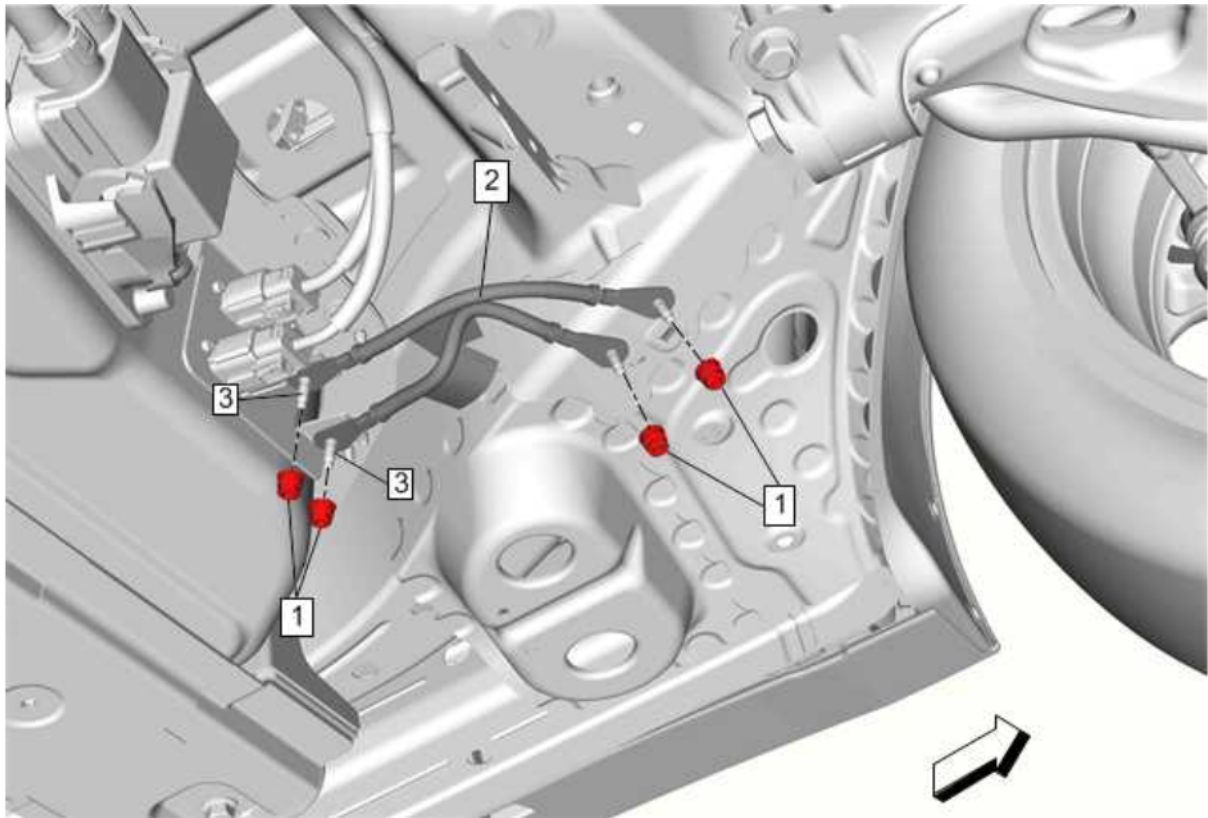


Fig. 300: Battery Negative Cable
 Courtesy of GENERAL MOTORS COMPANY

12. Install the battery negative cable (2) to the high voltage battery and body structure. **Battery Negative Cable Replacement (High Voltage Battery to Body Structure) Battery Negative Cable Replacement (12V Battery to Body Structure)**
13. Untie the straps that is installed to avoid the vehicle potentially falling off from the lift/hoist.
14. Fill the drive motor battery cooling system. **Drive Motor Battery Cooling System Draining and Filling**
15. Check the cooling system for leaks. **Hybrid Cooling System Leak Test**
16. Install the front compartment air deflector. **Front Compartment Air Deflector Replacement**
17. Enable the high voltage system. **High Voltage Enabling**

18. Reprogram the battery energy control module. [Battery Energy Control Module Programming and Setup](#)
19. Program the hybrid powertrain control module 2. [Hybrid Powertrain Control Module 2 Programming and Setup](#)
20. Clear the secured high voltage DTCs. [Clear Secured High Voltage DTCs](#)
21. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. [Hybrid/EV Battery Pack Capacity Learn](#)

NOTE: Refer to Diagnostic Aids to determine when, if required procedure should be performed.

DRIVE MOTOR BATTERY REPLACEMENT AND SHIPPING PREPARATION (NEW DESIGN BATTERY PACK IN VEHICLES BUILT BEFORE 1G1FX6S06H4163254)

Special Tools

- GE-52418 Lifting Table
- GE-52200 Lifting Table
- EL-51102 High Voltage Battery Lift Bar Tilter
- EL-51102 - 10 Hanging Bars and Shackles
- EL-51102 - 20 High Voltage Battery Lift Bar Tilter Eye-Nut Kit
- EL-51102 - 40 Battery Lifting Strap
- EL-51102 - 50 Battery Lifting Strap

For equivalent regional tools, refer to [Special Tools](#) .

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. [High Voltage Disabling](#)
2. Remove the front compartment air deflector. [Front Compartment Air Deflector Replacement](#)
3. Drain the drive motor battery cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)

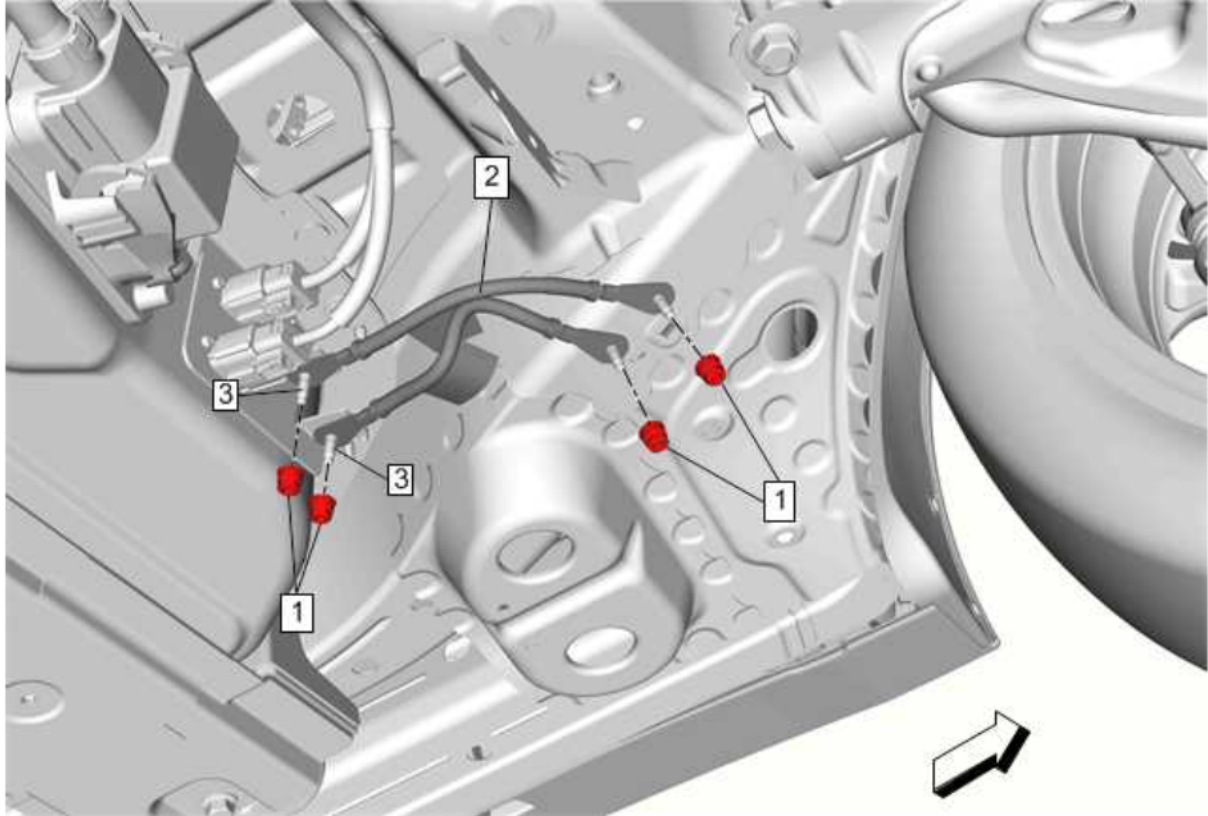


Fig. 301: Battery Negative Cable

Courtesy of GENERAL MOTORS COMPANY

4. Remove the battery negative cable (2) from the high voltage battery and body structure. **Battery Negative Cable Replacement (High Voltage Battery to Body Structure)** **Battery Negative Cable Replacement (12V Battery to Body Structure)**

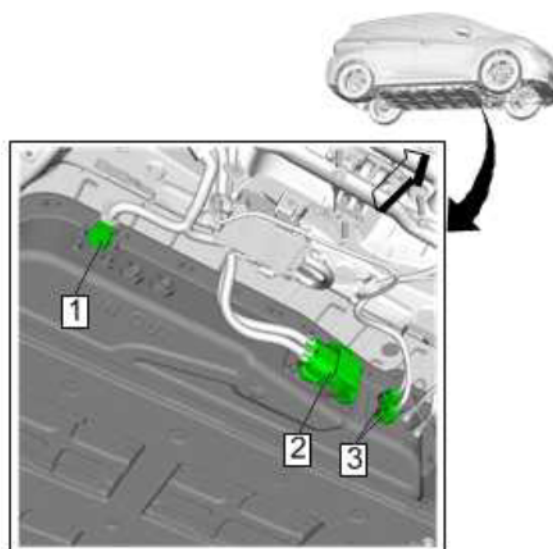


Fig. 302: High Voltage Battery Connector

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the X4 high voltage battery connector (1) from the drive motor battery.
6. Disconnect the X3 high voltage battery connector (2) from the drive motor battery by rotating the connector handle until 90 degrees.
7. Disconnect the body wiring harness connectors (3) from the drive motor battery.

WARNING: To avoid any vehicle damage, serious personal injury or death:

- When major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

- When performing work in the engine compartment or under the vehicle, ensure that the hood is fully open, or opened to its secondary latch. When the hood is opened to the secondary latch, the vehicle will disable the remote start features from the key fob and OnStar mobile app. Failure to open the hood, or open the hood to the secondary latch while doing a repair in the engine compartment or under the vehicle can result in inadvertent vehicle starting which could result in personal injury or damage to a vehicle.

CAUTION: Perform the following steps before beginning any vehicle lifting or jacking procedure:

- Remove or secure all of the vehicle contents in order to avoid any shifting or any movement that may occur during the vehicle lifting or jacking procedure.
- The lifting equipment or the jacking equipment weight rating must meet or exceed the weight of the vehicle and any vehicle contents.
- The lifting equipment or the jacking equipment must meet the operational standards of the lifting equipment or jacking equipment manufacturer.
- Perform the vehicle lifting or jacking procedure on a clean, hard, dry, level surface.
- Perform the vehicle lifting or jacking procedure only at the identified lift points. DO NOT allow the lifting equipment or jacking equipment to contact any other vehicle components.

Failure to perform the previous steps could result in damage to the lifting equipment or the jacking equipment, the vehicle, and/or the vehicle contents.

8. During drive motor battery removal, vehicle weight will be redistributed and may cause the vehicle to become unstable on the hoist. To avoid the vehicle potentially falling off secure the vehicle to lift/hoist arms with straps.

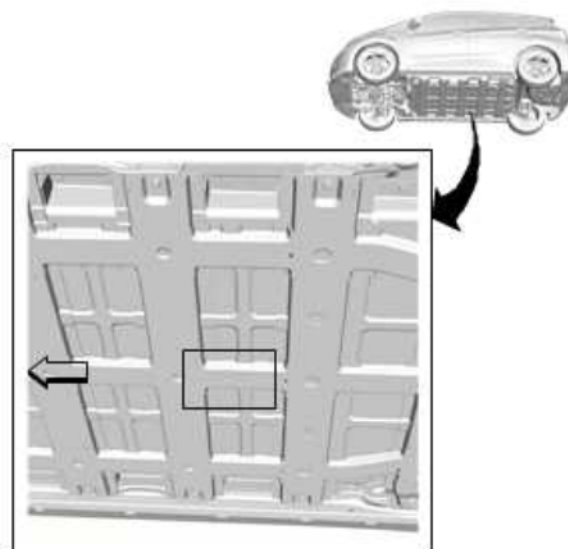


Fig. 303: Lifting Table

Courtesy of GENERAL MOTORS COMPANY

NOTE: There is C.G (Center of Gravity) mark on the drive motor battery tray to locate your lift table.

NOTE: The high voltage battery mass is approximately 450 kg (1000 lbs)

9. Position a **GE-52418** Lifting Table or **GE-52200** Lifting Table and raise the lifting table into position.

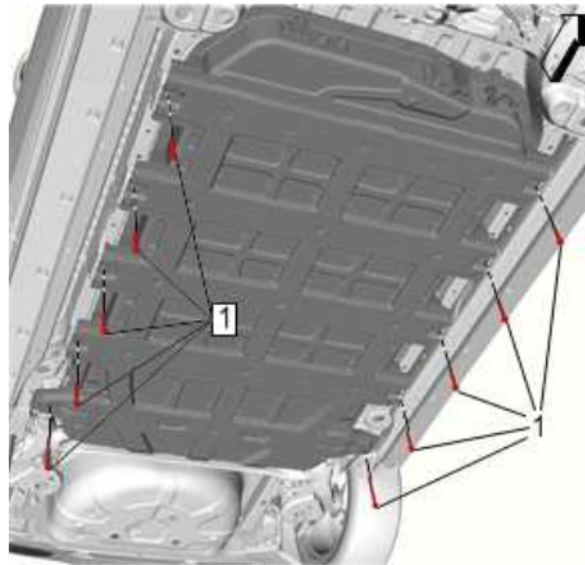


Fig. 304: Drive Motor Battery Mounting Fasteners

Courtesy of GENERAL MOTORS COMPANY

- NOTE:** Verify ALL connectors are removed from the drive motor battery.
- NOTE:** Confirm the locking MSD cap/cover required in some regions will pass through the vehicle floor panel. If not, the MSD cap/cover should be removed during Battery Pack lowering from vehicle then reinstalled once the pack is out.
- NOTE:** Ensure all fasteners are removed before lowering the support table fixture with the drive motor battery.

10. Remove the drive motor battery mounting fasteners (1).



Fig. 305: Lifting Table With Drive Motor Battery

Courtesy of GENERAL MOTORS COMPANY

- WARNING:** When removing the high voltage battery, only use the recommended lift table with straps capable of holding 1000kg (2204.62 lbs). Failure to use the appropriate lift table and straps could cause the battery to fall and may result in personal injury or death.

11. Slowly lower the lifting table (1) with the drive motor battery (2).
12. Secure the high voltage battery to the lifting table with straps.

13. Cover the manual disconnect tape.

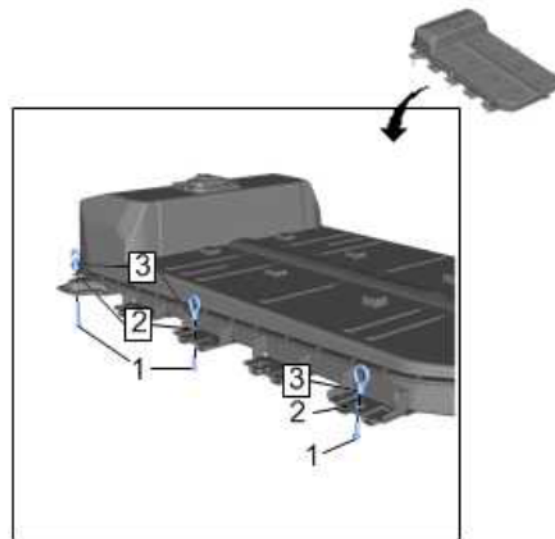


Fig. 306: 3 Eye-Nut, Washer And Bolts

Courtesy of GENERAL MOTORS COMPANY

14. Using the **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit install the 3 eye-nut (3), washers (2) and bolts (1). Tighten the bolts (1) to 9 N.m (80 lb in).

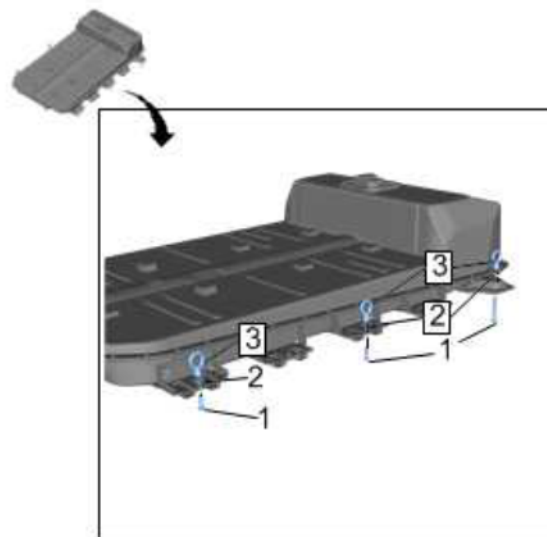


Fig. 307: 3 Eye-Nut, Washer And Bolts

Courtesy of GENERAL MOTORS COMPANY

15. Using the **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit install the 3 eye-nut (3), washers (2) and bolts (1). Tighten the bolts (1) to 9 N.m (80 lb in).

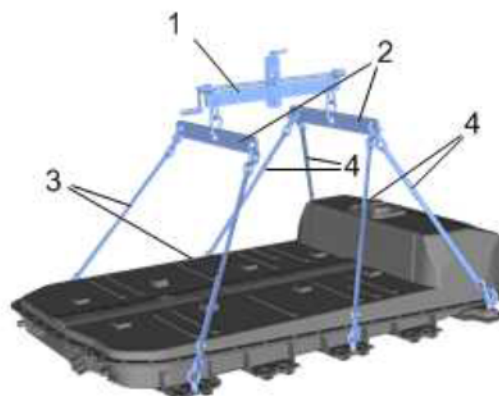


Fig. 308: High Voltage Battery Lift Bar Tilter
Courtesy of GENERAL MOTORS COMPANY

16. Attach the **EL-51102** High Voltage Battery Lift Bar Tilter (1) to a suitable lifting crane.
17. Position the **EL-51102** High Voltage Battery Lift Bar Tilter and **EL-51102 - 10** Hanging Bars and Shackles (2) over the high voltage battery as shown.
18. Install the **EL-51102 - 40** Battery Lifting Strap (3) and the **EL-51102 - 50** Battery Lifting Strap (4) to transport the drive motor battery to a secure area.

NOTE: Make sure the drive motor battery is balanced when hung from the lifting straps before moving with a crane or chain block to a support table.

NOTE: As part of the battery removal process, all coolant should be drained from the battery pack.

NOTE: If internal repairs are being performed on the battery, all coolant should be drained from the battery pack to ensure coolant does not drain from the hoses during repairs.

19. Install 2 coolant plugs into the coolant lines. Coolant plugs can be removed from the NEW service battery assembly.

Installation Procedure

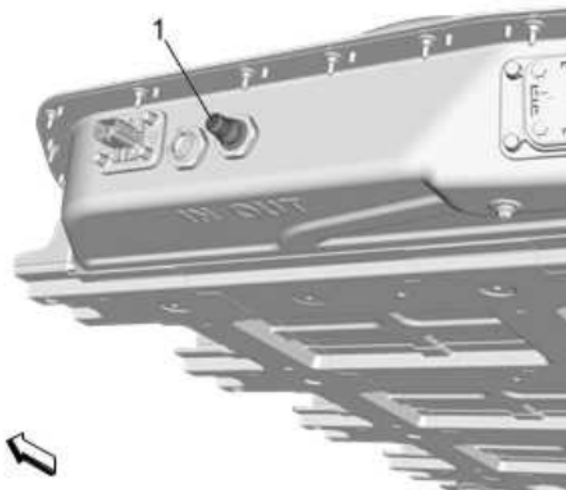


Fig. 309: Drive Motor Battery Coolant Cooler Outlet Port
Courtesy of GENERAL MOTORS COMPANY

NOTE: NEW version battery pack has a male type battery coolant outlet port.

1. Check if the drive motor battery coolant cooler outlet port (1) is male type.

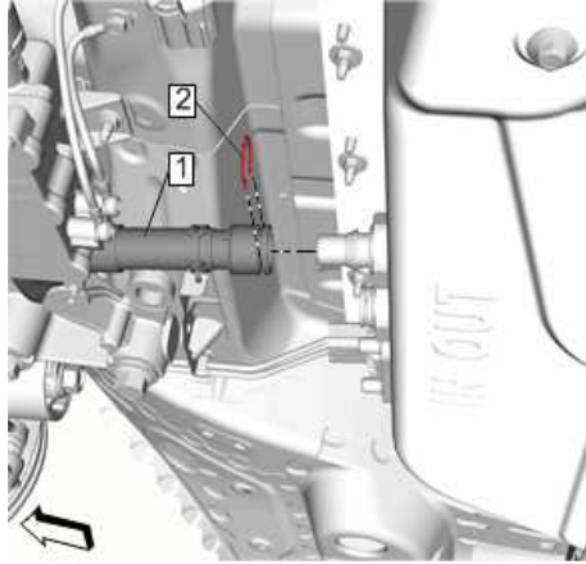


Fig. 310: Drive Motor Battery Coolant Cooler Outlet Hose And Clip (2nd Design Battery Pack)

Courtesy of GENERAL MOTORS COMPANY

2. If necessary, at the vehicle, replace the male type drive motor battery coolant cooler outlet hose with the female type outlet hose (1). **Drive Motor Battery Coolant Cooler Outlet Hose Replacement (CHILLER TO RESS)**

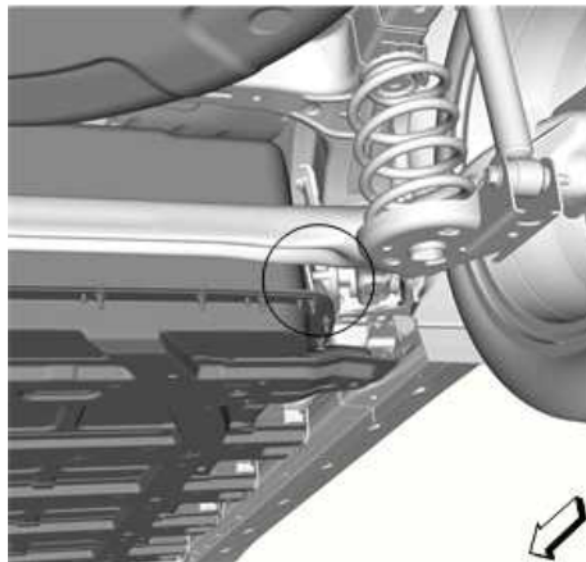


Fig. 311: Rear Of Drive Motor Battery And Rear Suspension Bushing Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Avoid making contact between the rear of the drive motor battery and the rear suspension bushing bolts.



Fig. 312: Lifting Table With Drive Motor Battery
Courtesy of GENERAL MOTORS COMPANY

4. Secure high voltage battery to the lifting table with straps.
5. With the drive motor battery (2) on the **GE-52418** Lifting Table or **GE-52200** Lifting Table (1), slowly raise the lifting table.
6. Release the straps.

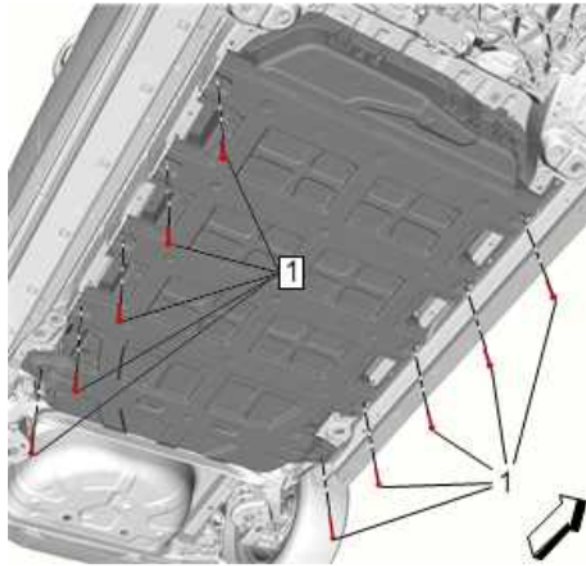


Fig. 313: Outside Mounting Fasteners
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

7. Snugly tighten the outside mounting fasteners (1).
8. Lower the lifting table.
9. Tighten the fasteners (1) to 56 N.m (41 lb ft).

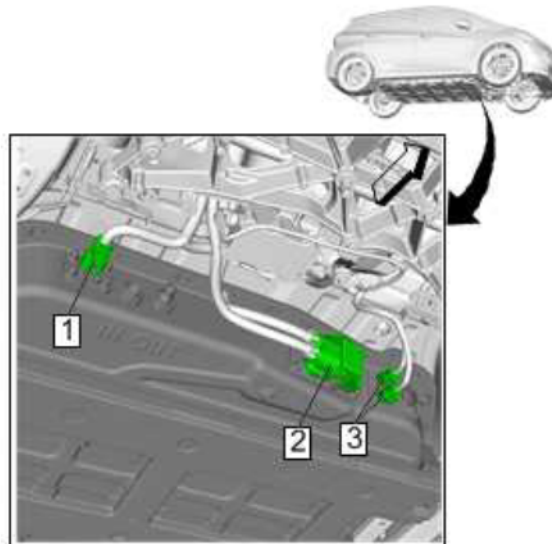


Fig. 314: Body Wiring Harness Connectors And High Voltage Connector
Courtesy of GENERAL MOTORS COMPANY

10. Connect the body wiring harness connectors (3) to the drive motor battery.
11. Connect the X3 high voltage connector (2) to the drive motor battery.
12. Connect the X4 high voltage connector (1) to the drive motor battery.

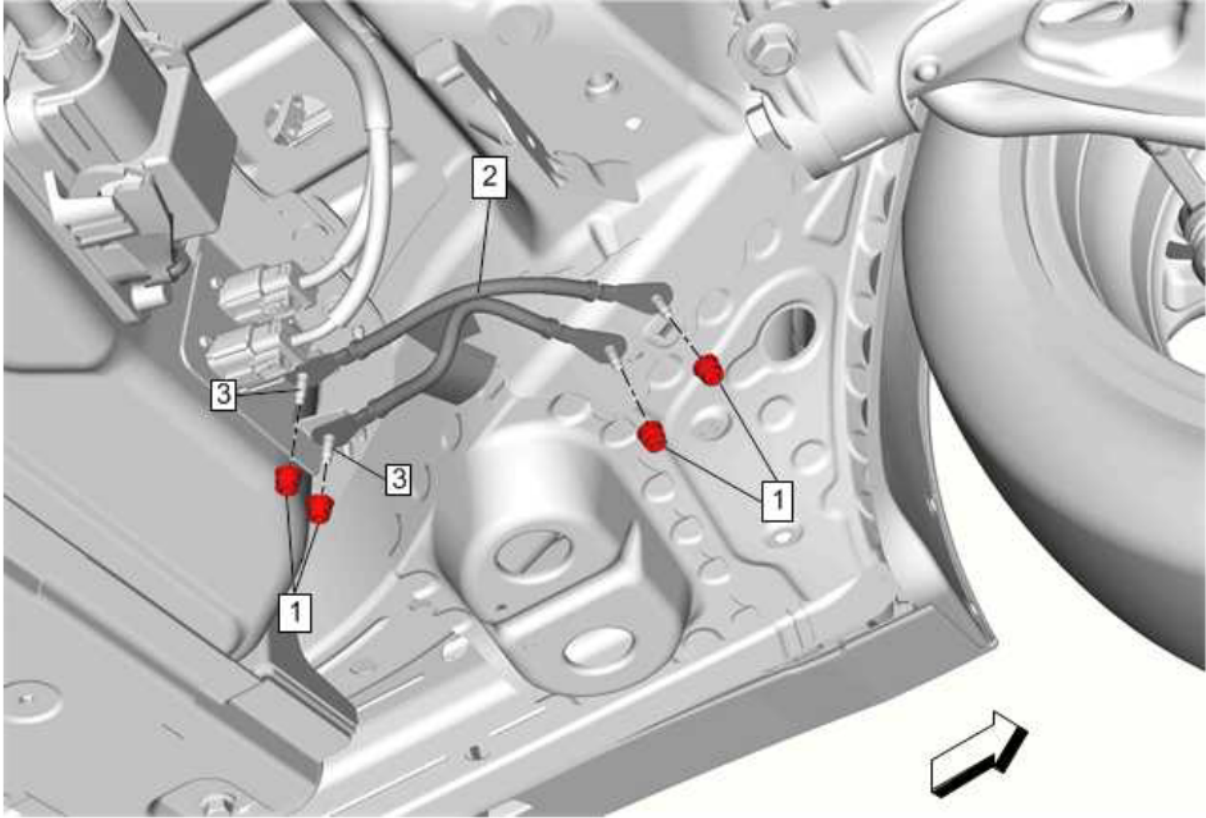


Fig. 315: Battery Negative Cable

Courtesy of GENERAL MOTORS COMPANY

13. Install the battery negative cable (2) to the high voltage battery and body structure. [Battery Negative Cable Replacement \(High Voltage Battery to Body Structure\)](#) [Battery Negative Cable Replacement \(12V Battery to Body Structure\)](#)
14. Untie the straps that is installed to avoid the vehicle potentially falling off from the lift/hoist.
15. Fill the drive motor battery cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)
16. Check the cooling system for leaks. [Hybrid Cooling System Leak Test](#)
17. Install the front compartment air deflector. [Front Compartment Air Deflector Replacement](#)
18. Enable the high voltage system. [High Voltage Enabling](#)
19. Reprogram the battery energy control module. [Battery Energy Control Module Programming and Setup](#)
20. Program the hybrid powertrain control module 2. [Hybrid Powertrain Control Module 2 Programming and Setup](#)
21. Clear the secured high voltage DTCs. [Clear Secured High Voltage DTCs](#)
22. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. [Hybrid/EV Battery Pack Capacity Learn](#)

NOTE: Refer to Diagnostic Aids to determine when, if required procedure should be performed.

DRIVE MOTOR BATTERY REPLACEMENT AND SHIPPING PREPARATION (NEW DESIGN BATTERY PACK IN VEHICLES BUILT AFTER 1G1FX6S06H4163254)

Special Tools

- GE-52418 Lifting Table
- GE-52200 Lifting Table
- EL-51102 High Voltage Battery Lift Bar Tilter
- EL-51102 - 10 Hanging Bars and Shackles
- EL-51102 - 20 High Voltage Battery Lift Bar Tilter Eye-Nut Kit
- EL-51102 - 40 Battery Lifting Strap
- EL-51102 - 50 Battery Lifting Strap

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. [High Voltage Disabling](#)
2. Remove the front compartment air deflector. [Front Compartment Air Deflector Replacement](#)
3. Drain the drive motor battery cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)

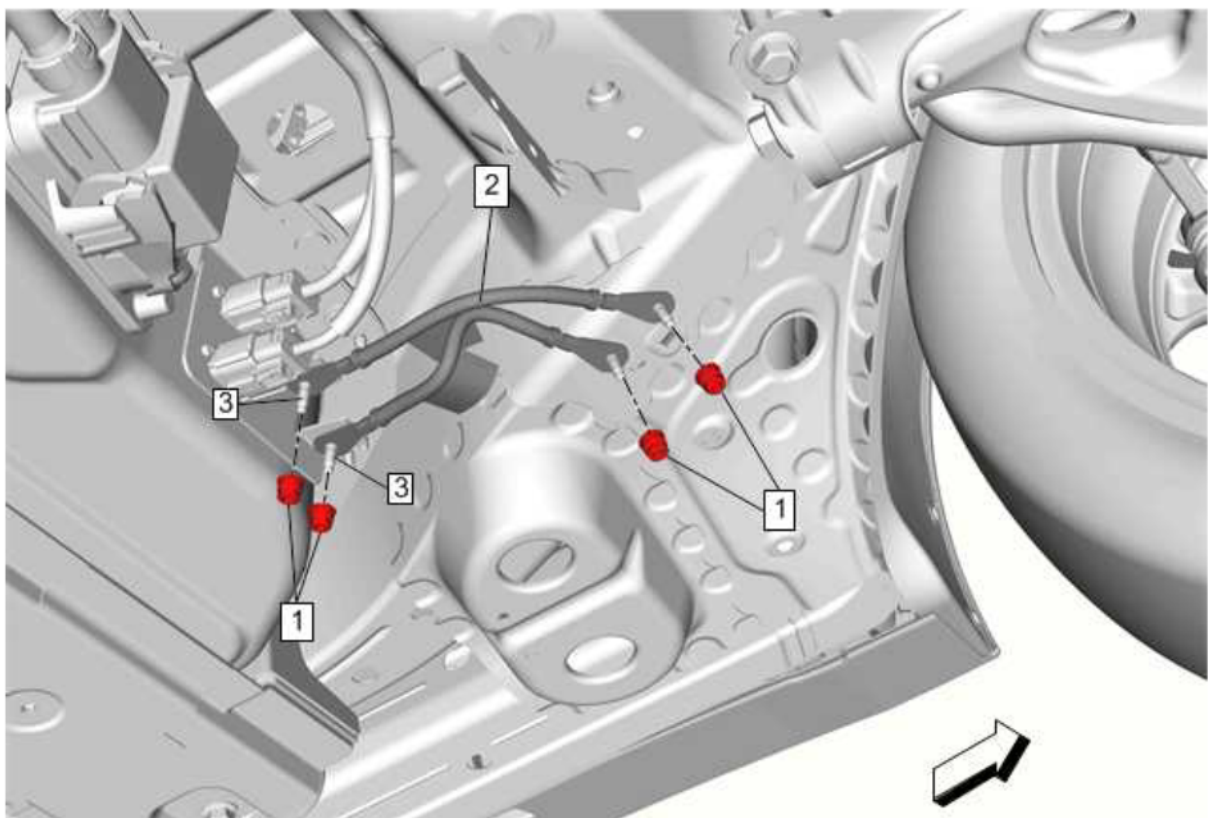


Fig. 316: Battery Negative Cable
Courtesy of GENERAL MOTORS COMPANY

4. Remove the battery negative cable (2) from the high voltage battery and body structure. **Battery Negative Cable Replacement (High Voltage Battery to Body Structure)** **Battery Negative Cable Replacement (12V Battery to Body Structure)**

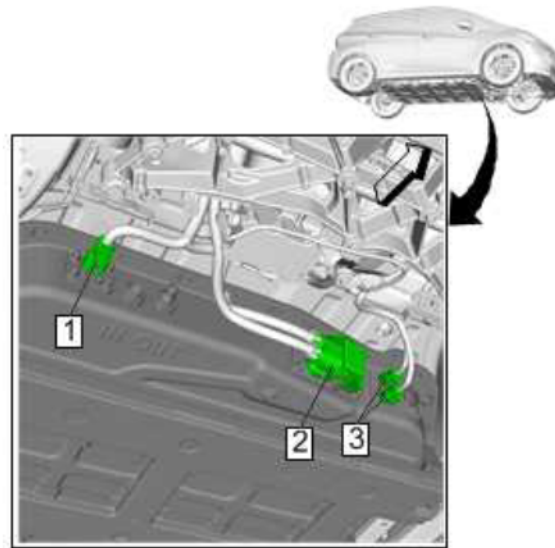


Fig. 317: Body Wiring Harness Connectors And High Voltage Connector
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the X4 high voltage battery connector (1) from the drive motor battery.
6. Disconnect the X3 high voltage battery connector (2) from the drive motor battery by rotating the connector handle until 90 degrees.
7. Disconnect the body wiring harness connectors (3) from the drive motor battery.

WARNING: To avoid any vehicle damage, serious personal injury or death:

- When major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.
- When performing work in the engine compartment or under the vehicle, ensure that the hood is fully open, or opened to its secondary latch. When the hood is opened to the secondary latch, the vehicle will disable the remote start features from the key fob and OnStar mobile app. Failure to open the hood, or open the hood to the secondary latch while doing a repair in the engine compartment or under the vehicle can result in inadvertent vehicle starting which could result in personal injury or damage to a vehicle.

CAUTION: Perform the following steps before beginning any vehicle lifting or jacking procedure:

- Remove or secure all of the vehicle contents in order to avoid any shifting or any movement that may occur during the vehicle lifting or jacking procedure.
- The lifting equipment or the jacking equipment weight rating must meet or exceed the weight of the vehicle and any vehicle contents.
- The lifting equipment or the jacking equipment must meet the operational standards of the lifting equipment or jacking equipment manufacturer.
- Perform the vehicle lifting or jacking procedure on a clean, hard, dry, level surface.

- Perform the vehicle lifting or jacking procedure only at the identified lift points. DO NOT allow the lifting equipment or jacking equipment to contact any other vehicle components.

Failure to perform the previous steps could result in damage to the lifting equipment or the jacking equipment, the vehicle, and/or the vehicle contents.

8. During drive motor battery removal, vehicle weight will be redistributed and may cause the vehicle to become unstable on the hoist. To avoid the vehicle potentially falling off secure the vehicle to lift/hoist arms with straps.

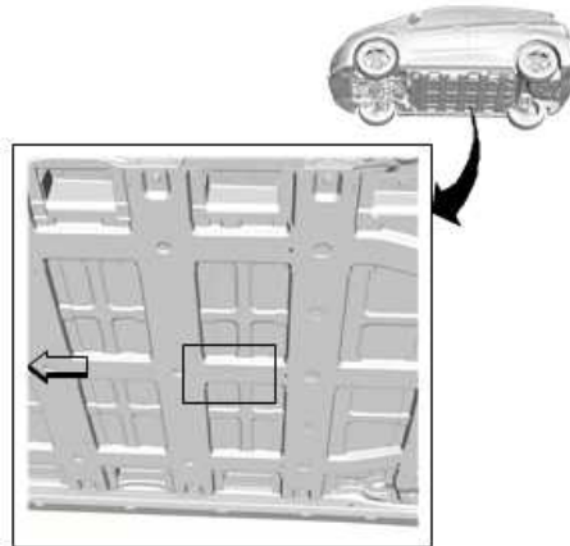


Fig. 318: Lifting Table

Courtesy of GENERAL MOTORS COMPANY

NOTE: There is C.G (Center of Gravity) mark on the drive motor battery tray to locate your lift table.

NOTE: The high voltage battery mass is approximately 450 kg (1000 lbs)

9. Position a **GE-52418** Lifting Table or **GE-52200** Lifting Table and raise the lifting table into position.

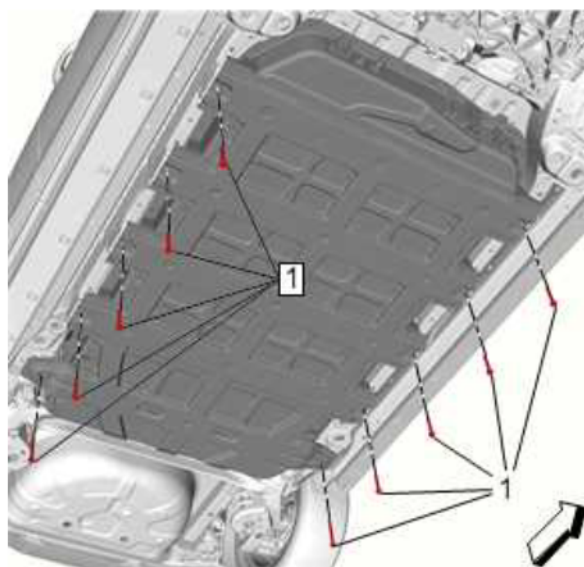


Fig. 319: Outside Mounting Fasteners

Courtesy of GENERAL MOTORS COMPANY

NOTE: Verify ALL connectors are removed from the drive motor battery.

NOTE: Confirm the locking MSD cap/cover required in some regions will

pass through the vehicle floor panel. If not, the MSD cap/cover should be removed during Battery Pack lowering from vehicle then reinstalled once the pack is out.

NOTE: Ensure all fasteners are removed before lowering the support table fixture with the drive motor battery.

10. Remove the drive motor battery mounting fasteners (1).



Fig. 320: Lifting Table With Drive Motor Battery.
Courtesy of GENERAL MOTORS COMPANY

WARNING: When removing the high voltage battery, only use the recommended lift table with straps capable of holding 1000kg (2204.62 lbs). Failure to use the appropriate lift table and straps could cause the battery to fall and may result in personal injury or death.

11. Slowly lower the lifting table (1) with the drive motor battery (2).
12. Secure the high voltage battery to the lifting table with straps.
13. Cover the manual disconnect tape.

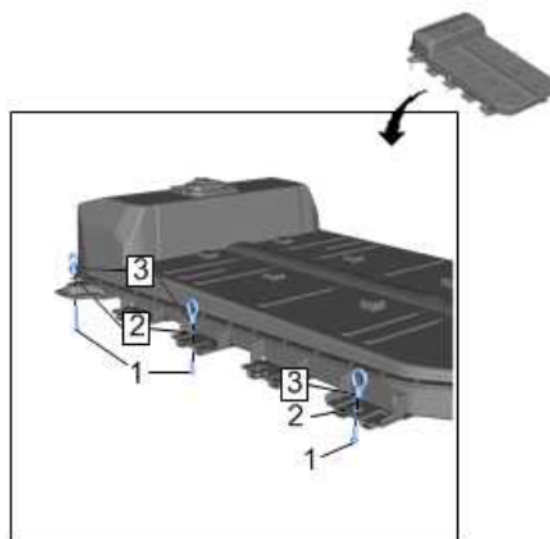


Fig. 321: 3 Eye-Nut, Washer And Bolts
Courtesy of GENERAL MOTORS COMPANY

14. Using the **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit install the 3 eye-nut (3), washers (2) and bolts (1). Tighten the bolts (1) to 9 N.m (80 lb in).

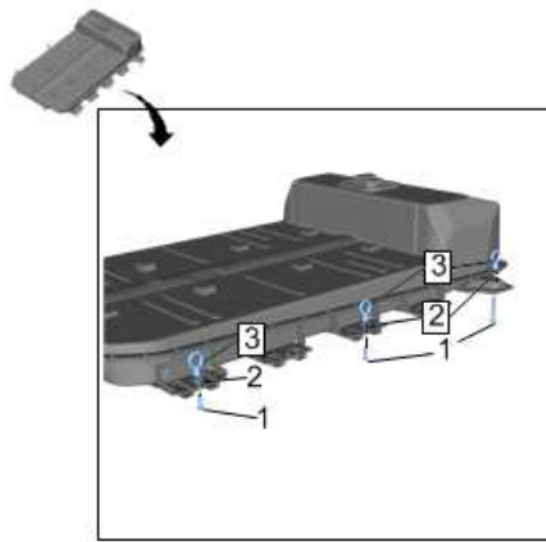


Fig. 322: 3 Eye-Nut, Washer And Bolts

Courtesy of GENERAL MOTORS COMPANY

15. Using the **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit install the 3 eye-nut (3), washers (2) and bolts (1). Tighten the bolts (1) to 9 N.m (80 lb in).

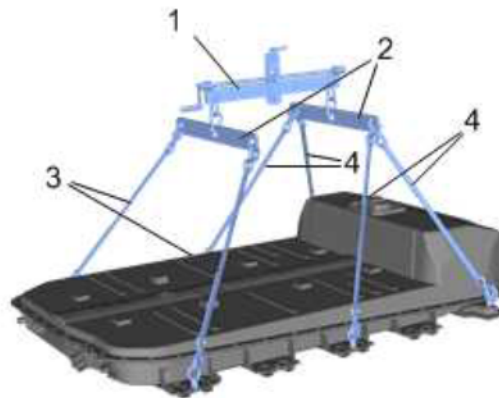


Fig. 323: High Voltage Battery Lift Bar Tilter

Courtesy of GENERAL MOTORS COMPANY

16. Attach the **EL-51102** High Voltage Battery Lift Bar Tilter (1) to a suitable lifting crane.
17. Position the **EL-51102** High Voltage Battery Lift Bar Tilter and **EL-51102 - 10** Hanging Bars and Shackles (2) over the high voltage battery as shown.
18. Install the **EL-51102 - 40** Battery Lifting Strap (3) and the **EL-51102 - 50** Battery Lifting Strap (4) to transport the drive motor battery to a secure area.

NOTE: Make sure the drive motor battery is balanced when hung from the lifting straps before moving with a crane or chain block to a support table.

NOTE: As part of the battery removal process, all coolant should be drained from the battery pack.

NOTE: If internal repairs are being performed on the battery, all coolant should be drained from the battery pack to ensure coolant does not drain from the hoses during repairs.

19. Install 2 coolant plugs into the coolant lines. Coolant plugs can be removed from the NEW service battery assembly.

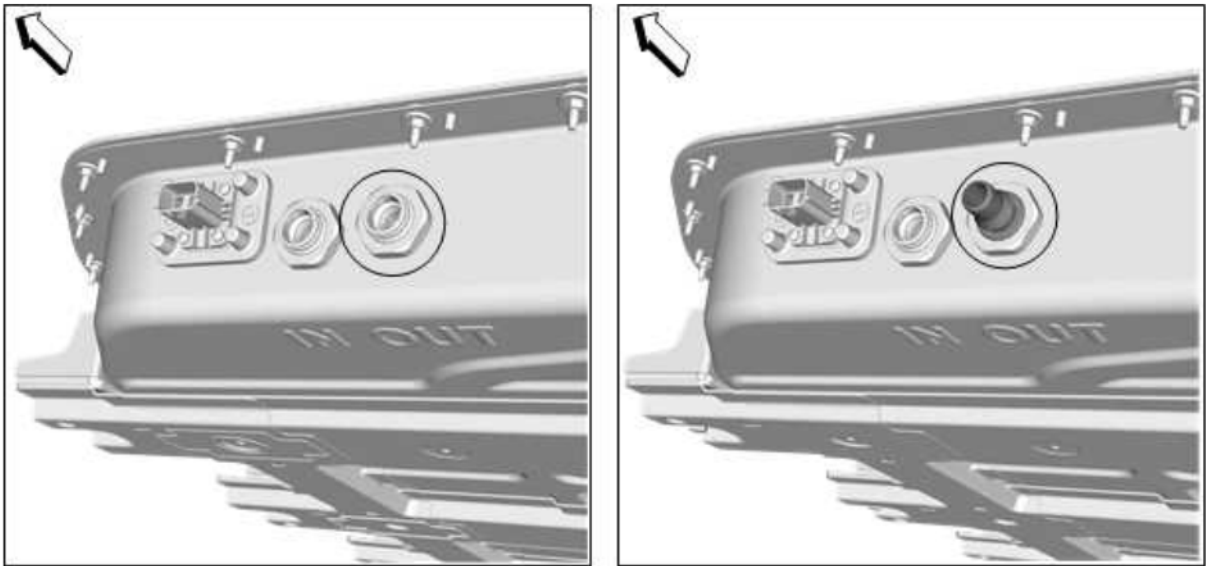


Fig. 324: New/ Old Battery Versions

Courtesy of GENERAL MOTORS COMPANY

1. Check if the drive motor battery pack is OLD version battery or NEW version battery.
 - 1.1 OLD version battery has a female type battery cooler outlet port like upper left picture.
 - 1.2 NEW version battery has a male type battery cooler outlet port like upper right picture.

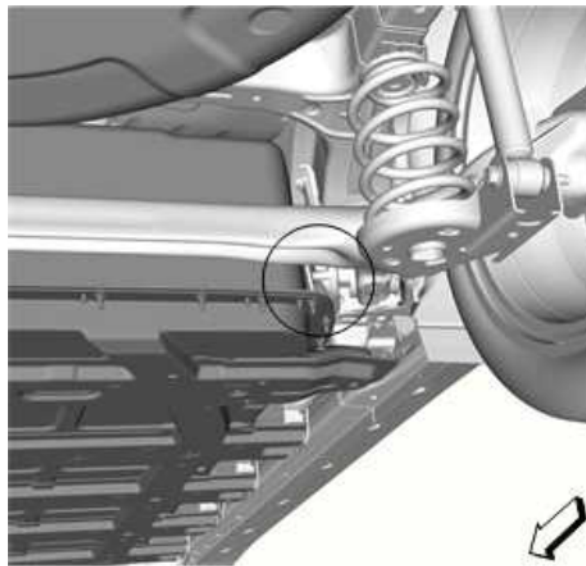


Fig. 325: Rear Of Drive Motor Battery And Rear Suspension Bushing Bolts

Courtesy of GENERAL MOTORS COMPANY

2. Avoid making contact between the rear of the drive motor battery and the rear suspension bushing bolts.



Fig. 326: Lifting Table With Drive Motor Battery
 Courtesy of GENERAL MOTORS COMPANY

3. Secure high voltage battery to the lifting table with straps.
4. With the drive motor battery (2) on the **GE-52418** Lifting Table or **GE-52200** Lifting Table (1), slowly raise the lifting table.
5. Release the straps.

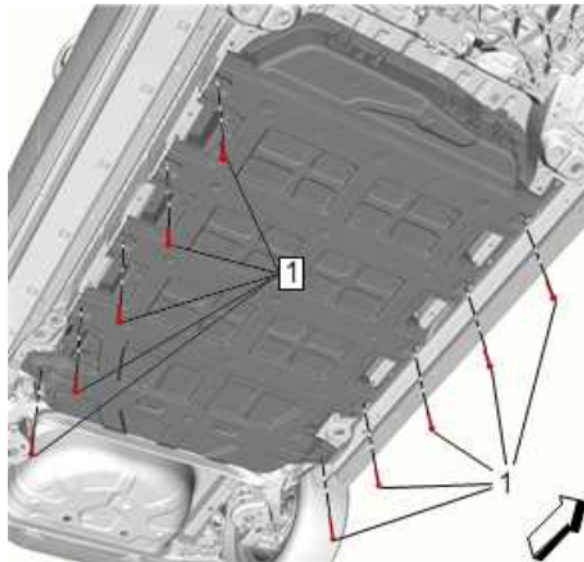


Fig. 327: Outside Mounting Fasteners
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

6. Snugly tighten the outside mounting fasteners (1).
7. Lower the lifting table.
8. Tighten the fasteners (1) to 56 N.m (41 lb ft).

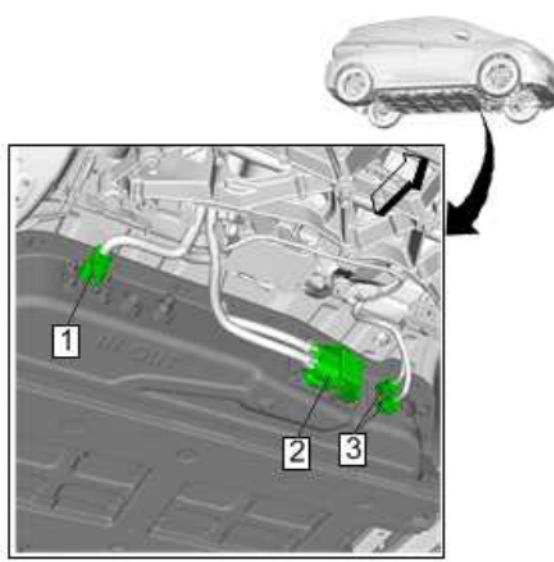


Fig. 328: Body Wiring Harness Connectors And High Voltage Connector
 Courtesy of GENERAL MOTORS COMPANY

9. Connect the body wiring harness connectors (3) to the drive motor battery.
10. Connect the X3 high voltage connector (2) to the drive motor battery.
11. Connect the X4 high voltage connector (1) to the drive motor battery.

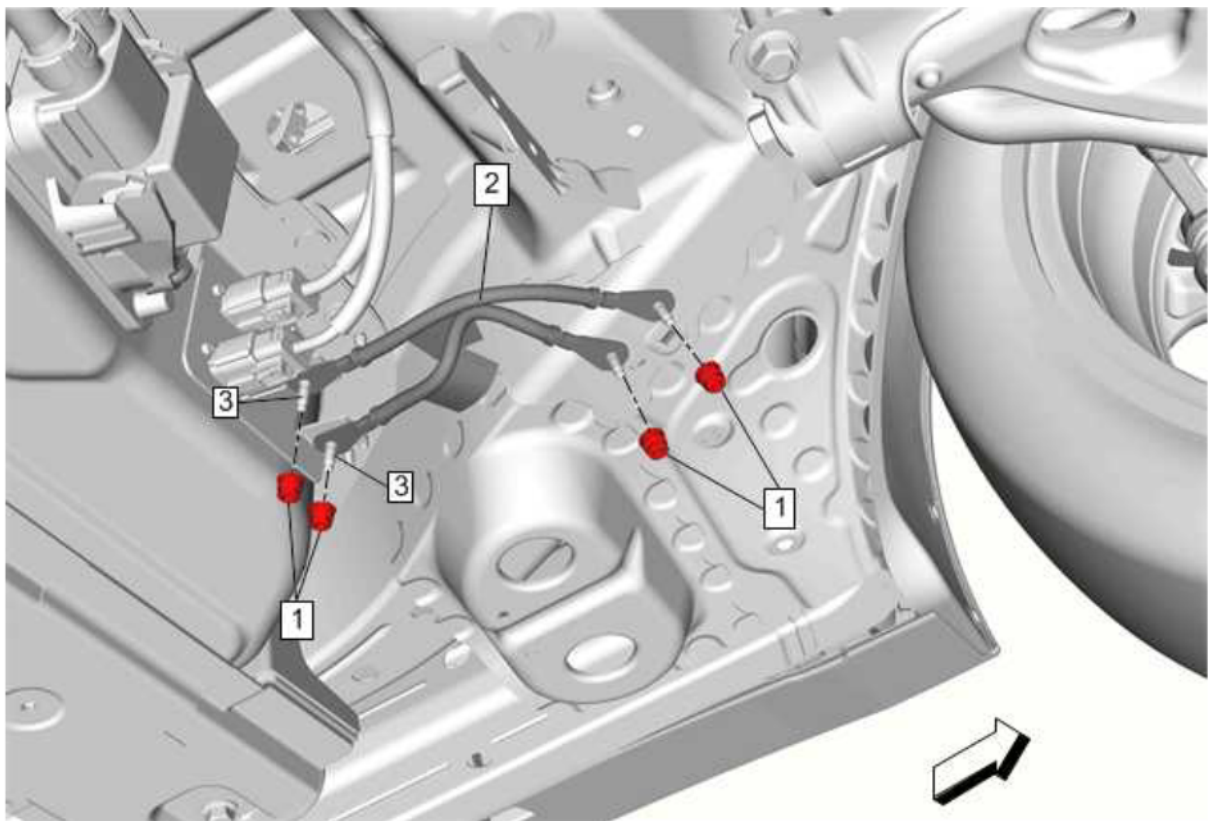


Fig. 329: Battery Negative Cable
 Courtesy of GENERAL MOTORS COMPANY

12. Install the battery negative cable (2) to the high voltage battery and body structure. **Battery Negative Cable Replacement (High Voltage Battery to Body Structure) Battery Negative Cable Replacement (12V Battery to Body Structure)**
13. Untie the straps that is installed to avoid the vehicle potentially falling off from the lift/hoist.
14. Fill the drive motor battery cooling system. **Drive Motor Battery Cooling System Draining and Filling**
15. Check the cooling system for leaks. **Hybrid Cooling System Leak Test**
16. Install the front compartment air deflector. **Front Compartment Air Deflector Replacement**
17. Enable the high voltage system. **High Voltage Enabling**

18. Reprogram the battery energy control module. [Battery Energy Control Module Programming and Setup](#)
19. Program the hybrid powertrain control module 2. [Hybrid Powertrain Control Module 2 Programming and Setup](#)
20. Clear the secured high voltage DTCs. [Clear Secured High Voltage DTCs](#)
21. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. [Hybrid/EV Battery Pack Capacity Learn](#)

NOTE: Refer to Diagnostic Aids to determine when, if required procedure should be performed.

CLEAR SECURED HIGH VOLTAGE DTCS

Circuit/System Description

The hybrid powertrain control modules 1 and 2 independently monitor for high voltage safety conditions such as airbag deploy events and certain high voltage system faults. When either module identifies one of these conditions, a DTC may set and the vehicle is placed into a 'high voltage lockout' state. While in the lockout state, the high voltage contactor relays are prevented from closing.

The purpose of the high voltage lockout state is to allow for high voltage system inspection prior to re-enabling. A complete inspection of the high voltage system and components must be performed if the vehicle has been involved in a collision. Perform the [High Voltage System Inspection](#) procedure, if necessary, prior to clearing a Secured High Voltage DTCs/lockout state.

Diagnostic Aids

- The following conditions may result in a HV lockout state without a corresponding DTC:
 - High voltage component replacement
 - Low 12 V battery event
 - SPS programming event
 - Airbag deployment/crash event detected: The Inflatable Restraint Sensing and Diagnostic Module may or may not set a DTC but will continue to broadcast a crash event status until reset.
- Performing a scan tool DTC Clear may clear the diagnostic that set the HV lockout state, but will not reset the lockout.
- Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.
- The Clear Secured High Voltage DTCs procedure must be completed when the following components, as applicable, are replaced:
 - K16 Hybrid/EV Battery Energy Control Module
 - K112A - K112H Hybrid/EV Battery Interface Control Module
 - A4 Hybrid/EV Battery Pack
 - K114A Hybrid/EV Powertrain Control Module 1
 - K114B Hybrid/EV Powertrain Control Module 2

Contactor Open Reasons Reset

The hybrid/EV powertrain control module 2, Hybrid/EV Battery Contactor Open Reasons scan tool parameter list identifies all past events that commanded contactors open. The parameters can only be reset by either reprogramming the hybrid/EV powertrain control module 2 or by performing the scan tool Hybrid/EV Battery Contactor Open Reasons Reset function. To aid in possible future intermittent diagnosis, the parameters should be reset to NO once all diagnostic procedures are successfully completed.

Scan Tool Hybrid/EV Battery Contactor Open Reasons Reset Function

NOTE: The hybrid/EV system must be able to enter a Propulsion Active state.

1. Complete the Circuit System Verification and Testing as necessary.
2. Remove any chargers and as applicable, the charge cord.
3. Vehicle OFF, wait 5 minutes.

NOTE: It is not necessary to completely remove the S15 Manual Service Disconnect.

4. Disengage the S15 Manual Service Disconnect to the first position to open the high voltage interlock loop circuit.
5. Service Mode, enable the scan tool reset function.
6. Vehicle OFF, wait 5 minutes.
7. Fully engage the S15 Manual Service Disconnect.
8. Start the vehicle and Clear Vehicle DTCs.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Vehicle ON.
2. With a scan tool, verify the Hybrid/EV Powertrain Control Module 2 parameters Hybrid/EV Battery Positive Contactor Command and Hybrid/EV Battery Negative Contactor Command each indicate Closed.
 - **If the contactors are not commanded Closed**
Refer to Circuit/System Testing.
 - **If the contactors are commanded Closed**
3. A Secured High Voltage DTC HV lockout state is not present. All OK.

Circuit/System Testing

The Clear Secured High Voltage DTCs reset process requires scan tool interaction with **two or three different control modules in sequence** and can be completed using the following steps:

1. Install **EL-49642** SPS programming support tool.
2. Vehicle in Service Mode. With a scan tool select the Hybrid/EV Powertrain Control Module 2, Hybrid Battery Pack Contactor Open Reasons data list. Verify if either the Crash Event Detected or Air Bag Deployed parameters indicate YES.
 - **If either parameter displays YES**
 1. Perform the [High Voltage System Inspection](#) procedure.
 2. If the results of the inspection procedure support enabling of the high voltage system, perform the Inflatable Restraint and Sensing Diagnostic Module function Reset High Voltage Disable Request After Crash Event Detected.
 3. Turn the vehicle OFF for 5 minutes.
 4. Proceed to next step.
 - **If BOTH parameters indicate NO**
3. Vehicle in Service Mode. With a scan tool, clear All DTCs.

NOTE: A command reject may appear on the scan tool after the first Clear Secured High Voltage DTCs request. If this occurs, ignore this command reject and continue to the next step.

4. With a scan tool, select Hybrid/EV Powertrain Control Module 2 Control Functions list. Select Clear Secured High Voltage DTCs and follow the on-screen instructions waiting 45 seconds before exiting the screen.
5. With a scan tool, select Hybrid/EV Powertrain Control Module Control Functions list. Select Clear Secured High Voltage DTCs. Select Continue button waiting 45 seconds before exiting the screen.
6. With a scan tool, select Hybrid/EV Powertrain Control Module 2 Control Functions list. Select Clear Secured High Voltage DTCs and follow the on-screen instructions.
7. With a scan tool, clear All DTCs.
8. Allow the Hybrid/EV powertrain Control Modules to enter sleep mode by performing the following:
 1. Turn the vehicle OFF.
 2. Ensure the scan tool is not communicating with any control modules by returning to the Home screen.
 3. Ensure the scan tool is accessible without having to open doors or otherwise cause control module wake-up.
 4. Shut all doors. Do NOT depress the brake pedal or activate any vehicle controls such as the parking lights, fuel door release, etc.

NOTE: Sleep mode is usually entered within two minutes after shutting off the vehicle. However, activating vehicle features such as Refuel Mode may extend this time up to 30 minutes.

5. Wait 5 minutes with the vehicle in the prescribed condition so that the modules may enter sleep mode.
9. With a scan tool, verify the Hybrid/EV Powertrain Control Module 2 has gone to sleep by ensuring communication is not present.
 - **If communication is present**
Repeat the previous step.
 - **If communication is not present**
10. Start the vehicle.
11. Verify that no DTCs are set.
 - **If any DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
 - **If no DTCs are set**
12. All OK.

HYBRID/EV BATTERY PACK CAPACITY LEARN

Circuit/System Description

The Hybrid Powertrain Control Module 2 learns the battery capacity as the Hybrid/EV battery pack is discharged and charged. Once learned, the capacity value is allowed to change over a long period of time, as the battery ages.

Replacement of the battery pack, all battery sections or the Hybrid Powertrain Control Module 2 requires capacity learning at a faster rate than normal.

To enable hardware replacement, the Hybrid Powertrain Control Module 2 can be placed into a fast learn mode with the scan tool.

Activating the fast Capacity Learn mode will reset the battery capacity to a much lower value and subsequent charge/discharge cycles will then learn the capacity back up to the proper value. Initially this may have a noticeable effect on EV range until the capacity learning for the new hardware begins. It may take several battery pack depletions and charges for a maximum EV range to be learned/displayed.

Diagnostic Aids

The Hybrid/EV Battery Pack Capacity Learn procedure must be completed when the following components are replaced:

- Hybrid Powertrain Control Module 2
- Hybrid/EV Battery Pack
- All battery sections

Whenever the Hybrid/EV Battery Pack Capacity Learn is activated the vehicle needs to be operated in a normal manner in order to learn an accurate battery capacity value.

NEVER disconnect the 12V battery supply to the vehicle or the Hybrid Powertrain Control Module 2 after initially activating the Hybrid/EV Battery Pack Capacity Learn. Loss of 12V power will force the Hybrid Powertrain Control Module 2 to store the current capacity value as accurate and will also disable fast learning. The process needs to complete without 12V battery interruption for the best results. Repeat the Hybrid/EV Battery Pack Capacity Learn any time 12V battery interruption occurs prior to operating the vehicle by driving and/or charging. It is possible to observe whether an update has occurred by looking at the battery capacity after charging and/or driving the vehicle.

Hybrid/EV Battery Pack Capacity Learn

NOTE: Hybrid/EV Battery Pack Capacity Learn should **ONLY** be activated when the battery pack, **ALL** battery sections or the Hybrid Powertrain Control Module 2 has been replaced.

The Hybrid/EV Battery Pack Capacity Learn procedure can be activated with a scan tool using the following steps:

1. Vehicle On
2. With a scan tool, select Hybrid Powertrain Control Module 2 Configuration/Reset Functions. Select the Learn Functions -Hybrid/EV Battery Pack Capacity Learn and command a Learn.
3. Observe and record the alphanumeric value in the Hybrid/EV Battery Pack Capacity scan tool parameter.
4. Connect the vehicle charge cord and completely charge the hybrid/EV battery pack.
5. The vehicle is OK to return to the customer. Inform the customer that their EV range will continue to learn as the vehicle is operated normally. Longer drive trips followed by full charging will allow the fastest learn.
6. If the customer returns with an EV Range concern, contact technical assistance.

HYBRID/EV BATTERY CELL BALANCING

Diagnostic Instructions

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

Circuit/System Description

Hybrid/EV Battery Cell Balancing

The **EL-50332** Hybrid/EV Battery Service Tool is used to match the voltage level of a replacement battery section to the existing battery sections following a service event. The tool will charge or discharge the replacement section, as required, based on measured cell group voltage data. The **EL-50332** requires feedback from the battery energy control module during the balancing process. Communication is through the A4 Hybrid/EV Battery Pack connectors and a low voltage interface harness provided with the **EL-50332** Hybrid/EV Battery Service Tool. The charging and discharging is performed by direct alligator clamp connection to the replacement battery module positive and negative terminals.

Each battery section contains two battery cell modules. With the exception of section/row 5, the two battery cell modules are not electrically connected within their respective section/row and will need to be balanced individually and sequentially. Refer to [Drive Motor Battery System Description](#) .

Reference Information

Schematic Reference

[Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Drive Motor Battery System Description](#)

Special Tools

- EL-50332 Hybrid/EV Battery Service Tool
- EL-50332-105 Universal Fuse Box
- EL-50332-120 High Voltage Interface Cable
- EL-50332-125 Vehicle Interface Module Low Voltage 24-Pin Cable
- EL-50332-145 Black Banana Jack Cable
- EL-50332-150 Red Banana Jack Cable
- EL-50332-155 Green Banana Jack Cable
- EL-50332-170 High Voltage Alligator Clamps
- EL-50332-175 120 V Power Cable
- EL-50332-180 250 V Power Cable - AUS
- EL-50332-185 250 V Power Cable - EU/Korea
- EL-50332-270 Vehicle Interface Module 2
- EL-50332-325 Low Voltage Communication Harness

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.

WARNING: High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.

WARNING: This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test

equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

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

WARNING: Damage to a Lithium Ion hybrid/EV battery pack could result in fire, loss of electrical isolation or exposure to high voltage. Until the high voltage system inspection has been completed, store the vehicle with hybrid/EV battery pack installed outside in a secure area away from buildings and other vehicles and protected from rain, snow and other moisture. Remove the hybrid/EV battery pack high voltage manual disconnect lever and store it in a secure place outside the vehicle. Cover the exposed high voltage opening with UL® listed, or equivalent, insulation tape rated at a minimum of 600 V.

Failure to follow these precautions could result in personal injury, death and property damage.

EL-50332 Configuration Procedure

NOTE: Depending on the state of charge variation of the replacement section/row and the remaining battery pack sections, the balance process may take up to 40 hours to complete. You may stop or pause the process at any time. Regardless of your progress through the procedure, whenever restarting the EL-50332 you will always be required to connect to the first module, if only for a momentary voltage check.

NOTE: Before balancing a battery section, make sure all of the external EL-50332 components and cables are in good condition and working order.

1. Connect the EL-50332-145 black cable, EL-50332-150 red cable, and EL-50332-155 green cable to the EL-50332-105 fuse box.
2. Connect the EL-50332-120 cable to the EL-50332-105 fuse box.
3. Connect the EL-50332-120 cable to the EL - 50332 service tool.
4. Connect the EL-50332-325 harness to the EL-50332-270 vehicle interface module 2.
5. Connect the EL-50332-125 24-pin cable to the EL-50332-270 vehicle interface module 2.
6. Connect the EL-50332-125 24-pin cable to the EL-50332 service tool.

Cell Balance Procedure

NOTE: Refer to the Special Tools for the correct regional power cord.

1. Connect the appropriate regional power cord to the EL-50332 service tool.
2. Connect the appropriate regional power cord into a known good power outlet.
3. Turn ON the EL - 50332 service tool using the power switch.
4. At the MAIN MENU, select SECTION BALANCE, press the SELECT soft key.
5. At the TYPE menu, select Bolt EV, press the NEXT soft key.
6. At the TARGET menu, select service replacement section (row) to be balanced, press the NEXT soft key.

Connection Procedure Module 1 of 2

1. Connect the EL-50332-155 green cable to the A4 Hybrid/EV Battery Pack ground G350.

NOTE: Observe the EL - 50332 screen to identify which module of the

section/row to balance first.

2. Connect the **EL-50332-145** black cable to the module negative stud to be balanced. Refer to [Hybrid/EV Energy Storage Schematics](#) for Hybrid Battery Sections 1 - 5.
3. Connect the **EL-50332-150** red cable to the module positive stud to be balanced. Refer to [Hybrid/EV Energy Storage Schematics](#) for Hybrid Battery Sections 1 - 5.
4. Press the NEXT soft key.
5. Connect the **EL-50332-325** harness to the A4 Hybrid/EV Battery Pack.

Balancing Procedure Module 1 of 2

1. Press the NEXT soft key.

NOTE: The EL - 50332 will now balance the selected module by charging/discharging, as appropriate. Target voltage will be based on measured pack cell group voltages. Initial balancing will be in a constant current mode - max 5 amp charge, 7.5 amp discharge. The tool will transition to a constant voltage mode - decreasing current near the end of the event.

2. An audible tone will sound at the end of balancing or in the event of a fault condition.
 - If a fault condition was detected, refer to the **EL - 50332** Hybrid/EV Battery Service Tool Instruction Manual.
 - If a fault condition was not detected
3. Module balancing completed successfully and the second module will need to be balanced. Observe the **EL - 50332** screen to identify the next module to connect.

Connection Procedure Module 2 of 2

1. Connect the **EL-50332-155** green cable to the A4 Hybrid/EV Battery Pack ground G350.
2. Connect the **EL-50332-145** black cable to the second module negative stud to be balanced. Refer to [Hybrid/EV Energy Storage Schematics](#) for Hybrid Battery Sections 6 - 10.
3. Connect the **EL-50332-150** red cable to the second module positive stud to be balanced. Refer to [Hybrid/EV Energy Storage Schematics](#) for Hybrid Battery Sections 6 - 10.

Balancing Procedure Module 2 of 2

1. Press the NEXT soft key.

NOTE: The EL - 50332 will now balance the selected module by charging/discharging, as appropriate. Target voltage will be based on measured pack cell group voltages. Initial balancing will be in a constant current mode - max 5 amp charge, 7.5 amp discharge. The tool will transition to a constant voltage mode - decreasing current near the end of the event. A warranty code and pack voltage current data will be displayed at the conclusion of the balancing event.

2. An audible tone will sound at the end of balancing or in the event of a fault condition.
 - If a fault condition was detected, refer to the **EL - 50332** Hybrid/EV Battery Service Tool Instruction Manual.
 - If a fault condition was not detected
3. Section balancing completed successfully.
7. At the Completed menu, press the NEXT soft key. Record warranty code. Press the EXIT soft key.
8. All OK.

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

Circuit/System Description

Hybrid/EV Battery System Verification

The **EL-50332** Hybrid/EV Battery Service Tool communicates with the battery energy control module through the A4 Hybrid/EV Battery Pack X357 and X358 connectors. The tool displays battery cell group voltages along with the calculated voltage difference between the highest and lowest readings. The tool also displays the temperatures read by the thermistors located within the battery sections. By reviewing this data, technicians can verify circuit integrity within the A4 Hybrid/EV Battery Pack prior to attaching the Hybrid/EV Battery Cover.

Diagnostic Aids

Hybrid/EV Battery System Verification requires that the battery pack is removed from the vehicle and that the battery energy control module contains software. If you are installing a service replacement battery energy control module, connect the battery pack to the vehicle with the **EL-52014** Low Voltage Jumper Harness Extension and program the battery energy control module prior to performing Hybrid/EV Battery System Verification. Perform the [Clear Secured High Voltage DTCs](#) procedure after successfully programming the service replacement battery energy control module.

Reference Information

Schematic Reference

[Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

[Testing for Intermittent Conditions and Poor Connections](#)

Description and Operation

[Drive Motor Battery System Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

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

Special Tools

- **EL - 50332** Hybrid/EV Battery Service Tool
- **EL - 50332 - 125** Vehicle Interface Module Low Voltage 24-Pin Cable
- **EL - 50332 - 175** 120 V Power Cable
- **EL-50332-180** 250 V Power Cable - AUS
- **EL-50332-185** 250 V Power Cable - EU/Korea
- **EL - 50332 - 270** Vehicle Interface Module 2

- EL - 50332 - 325 Low Voltage Communication Harness
- EL-52014 Low Voltage Jumper Harness Extension

For equivalent regional tools, refer to [Special Tools](#)

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.

WARNING: High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.

WARNING: This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

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

WARNING: Damage to a Lithium Ion hybrid/EV battery pack could result in fire, loss of electrical isolation or exposure to high voltage. Until the high voltage system inspection has been completed, store the vehicle with hybrid/EV battery pack installed outside in a secure area away from buildings and other vehicles and protected from rain, snow and other moisture. Remove the hybrid/EV battery pack high voltage manual disconnect lever and store it in a secure place outside the vehicle. Cover the exposed high voltage opening with UL® listed, or equivalent, insulation tape rated at a minimum of 600 V.

Failure to follow these precautions could result in personal injury, death and property damage.

NOTE: Before performing the Hybrid/EV Battery System Verification, make sure all of the external EL-50332 components are in good condition and working order.

1. Connect the EL-50332-125 24-pin cable to the EL-50332-270 vehicle interface module 2.
2. Connect the EL-50332-125 24-pin cable to the EL-50332 service tool.

NOTE: Refer to the Special Tools for the correct regional power cord.

3. Connect the appropriate regional power cord to the EL-50332 service tool.
4. Connect the appropriate regional power cord into a known good power outlet.

5. Power ON the **EL-50332** service tool using the power switch.

6. At the MAIN MENU, select PACK INFO, press the SELECT soft key.

NOTE: **Selecting One-shot will take and display a single snapshot of the battery parameters, selecting Continuous will display live parameter values.**

7. At the PACK INFO TYPE, select ONE-SHOT, press the NEXT soft key.

8. At the MANUFACTURER menu, select correct BRAND, press the NEXT soft key.

9. At the MODEL menu, select correct MODEL, press the NEXT soft key.

10. At the COMM CONNECTION menu, select HYBRID BATTERY CONTACTOR ASSEMBLY, press the NEXT soft key.

11. Connect the **EL-50332-325** low voltage communication harness to the A4 Hybrid/EV Battery Pack.

12. Connect the **EL-50332-325** low voltage communication harness to the **EL-50332-270** vehicle interface module 2, press the NEXT soft key.

13. At the PACK INFO menu, scroll down to the DELTA VCELL parameter. Record and verify the DELTA VCELL is less than 0.1 V.

- **If the DELTA VCELL is 0.1 V or greater**

1. At the PACK INFO menu, press the EXIT soft key to end the Hybrid/EV Battery System Verification.

2. Remove the **EL-50332-325** low voltage communication harness from the A4 Hybrid/EV Battery Pack.

3. Verify any repairs performed are complete and that all connections are secure.

NOTE: **Recheck the EL - 50332 cable connections by beginning at step 1 of the Hybrid/EV Battery System Verification.**

4. Retest the Hybrid/EV Battery System Verification once all repairs have been rechecked.

- **The DELTA VCELL is less than 0.1 V**

14. Record and verify all of the battery temperature sensor readings are within 6Â°C (10.8Â°F) of each other.

- **If any of the battery temperature sensor readings are 6Â°C (10.8Â°F) or greater of each other**

1. At the PACK INFO menu, press the EXIT soft key to end the Hybrid/EV Battery System Verification.

2. Remove the **EL-50332-325** low voltage communication harness from the A4 Hybrid/EV Battery Pack.

3. Verify any repairs performed are complete and that all connections are secure.

NOTE: **Recheck the EL - 50332 cable connections by beginning at step 1 of the Hybrid/EV Battery System Verification.**

4. Retest the Hybrid/EV Battery System Verification once all repairs have been rechecked.

- **The battery temperature sensor readings are within 6Â°C (10.8Â°F) of each other**

15. All OK.

2017 ELECTRICAL

Hybrid/EV Energy Storage - Schematic and Routing Diagrams - Hybrid/EV Energy Storage Schematics - Bolt EV

SCHEMATIC WIRING DIAGRAMS

HYBRID/EV ENERGY STORAGE WIRING SCHEMATICS

Battery Energy and Interface Control Module Power, Ground, and Data Communication

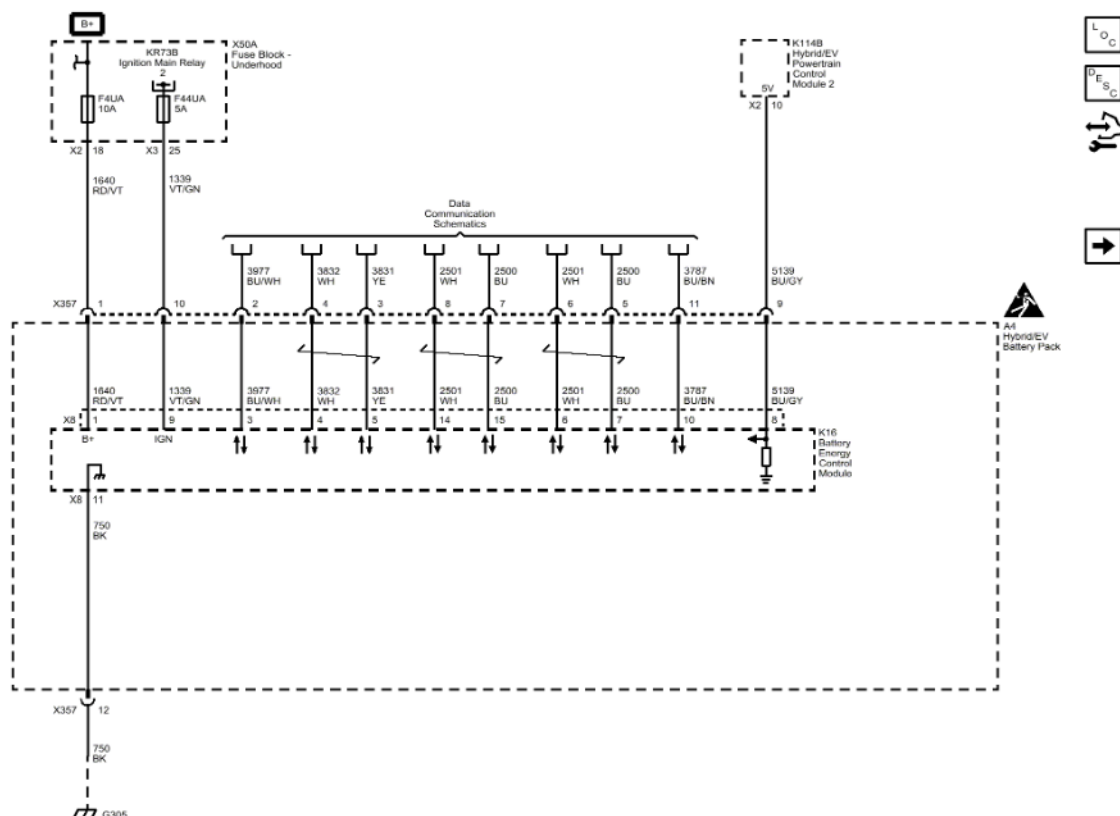


Fig. 1: Battery Energy and Interface Control Module Power, Ground, and Data Communication
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Module Powertrain Control Module 2 Power, Ground and Data Communication

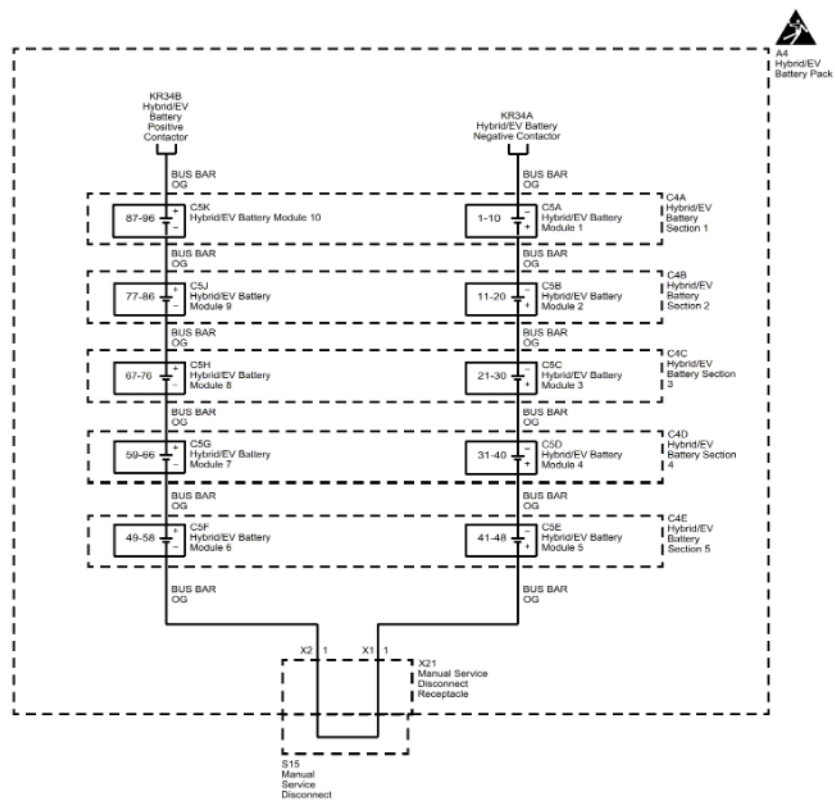


Fig. 4: Hybrid/EV Battery Bussing
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 1

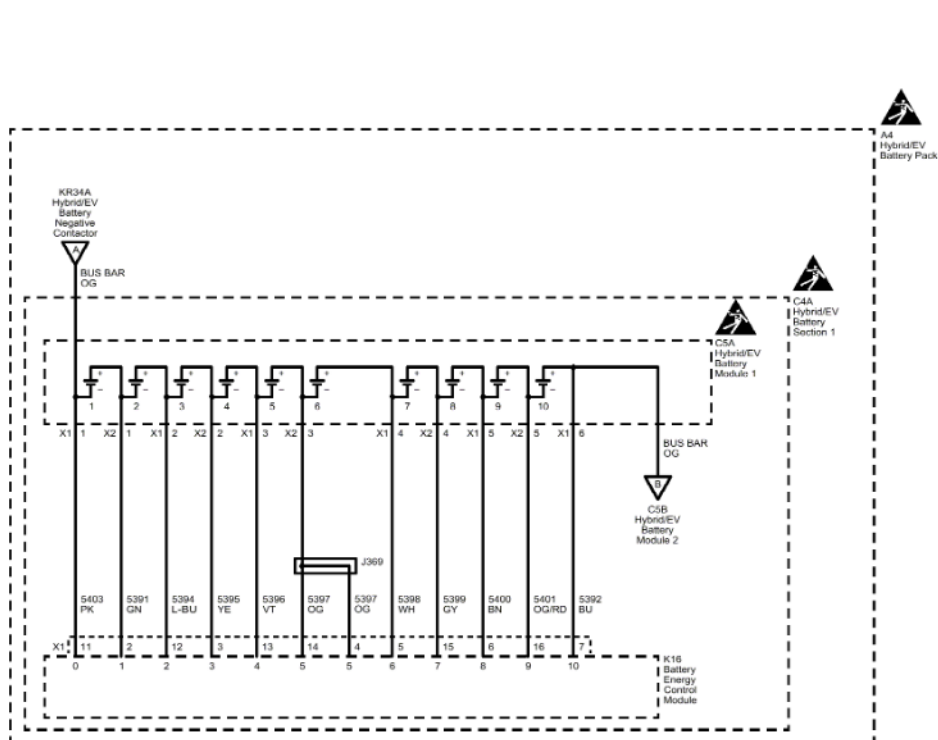


Fig. 5: Hybrid/EV Battery Module 1
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 2

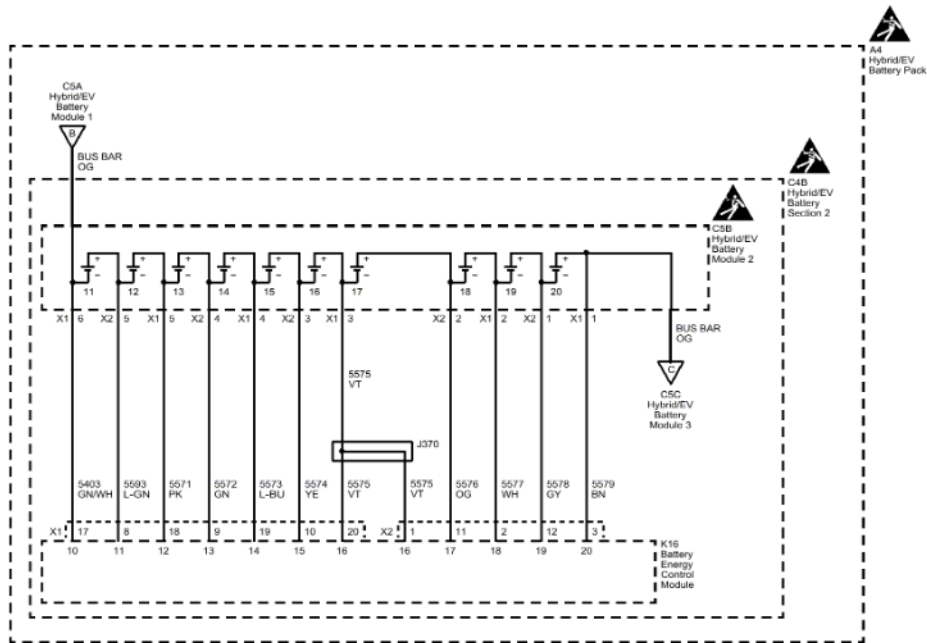


Fig. 6: Hybrid/EV Battery Module 2
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 3

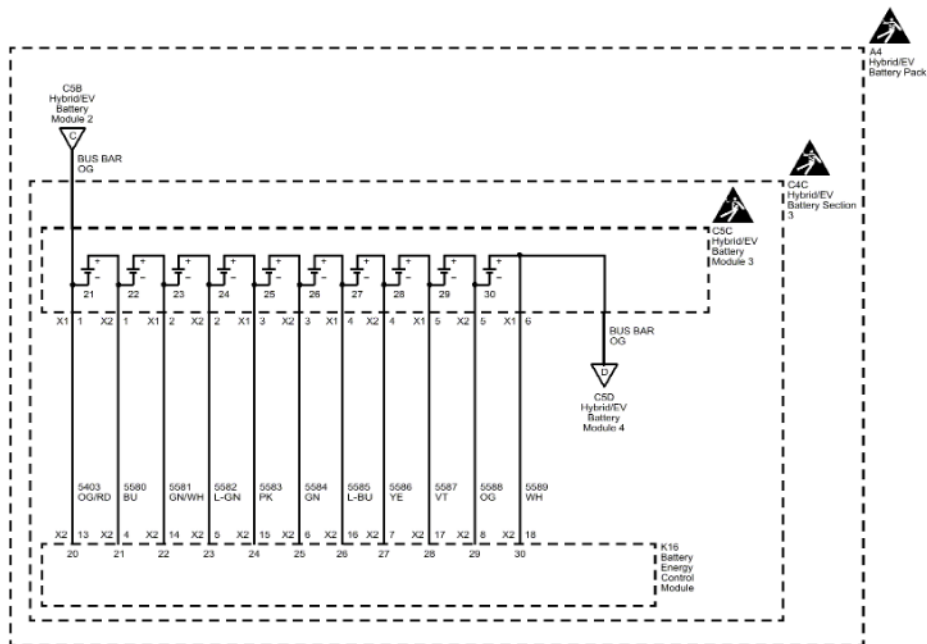


Fig. 7: Hybrid/EV Battery Module 3
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 4

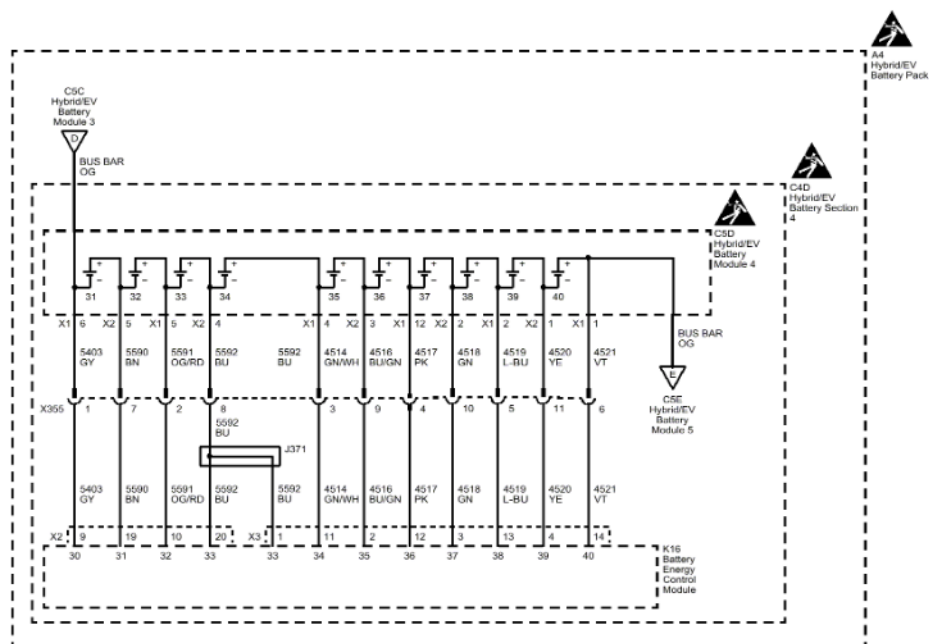


Fig. 8: Hybrid/EV Battery Module 4
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 5

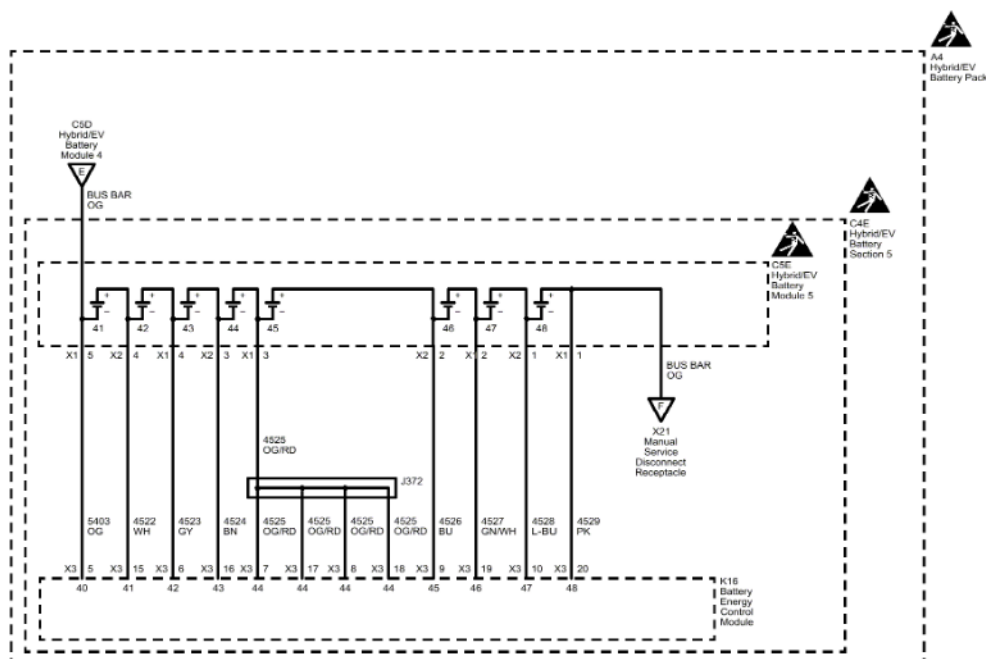
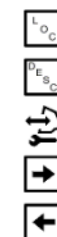
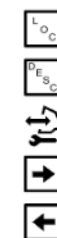


Fig. 9: Hybrid/EV Battery Module 5
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 6 and Manual Service Disconnect



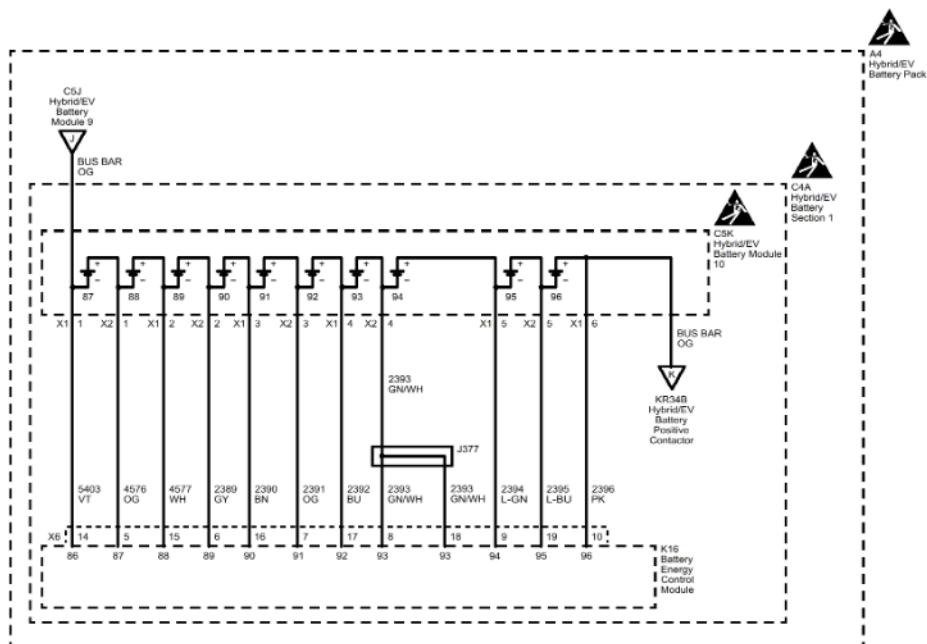


Fig. 14: Hybrid/EV Battery Module 10
Courtesy of GENERAL MOTORS COMPANY

High Voltage Contactors - High Voltage Positive

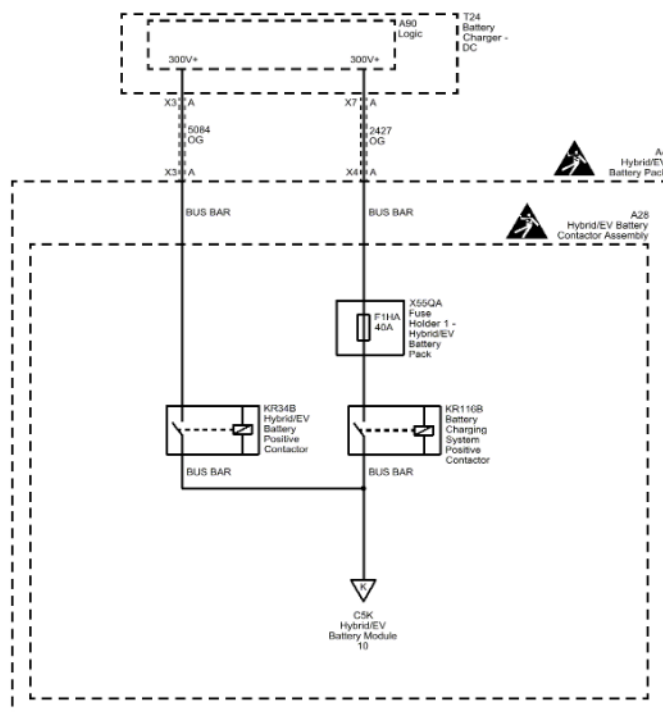


Fig. 15: High Voltage Contactors - High Voltage Positive
Courtesy of GENERAL MOTORS COMPANY

High Voltage Contactors - High Voltage Negative

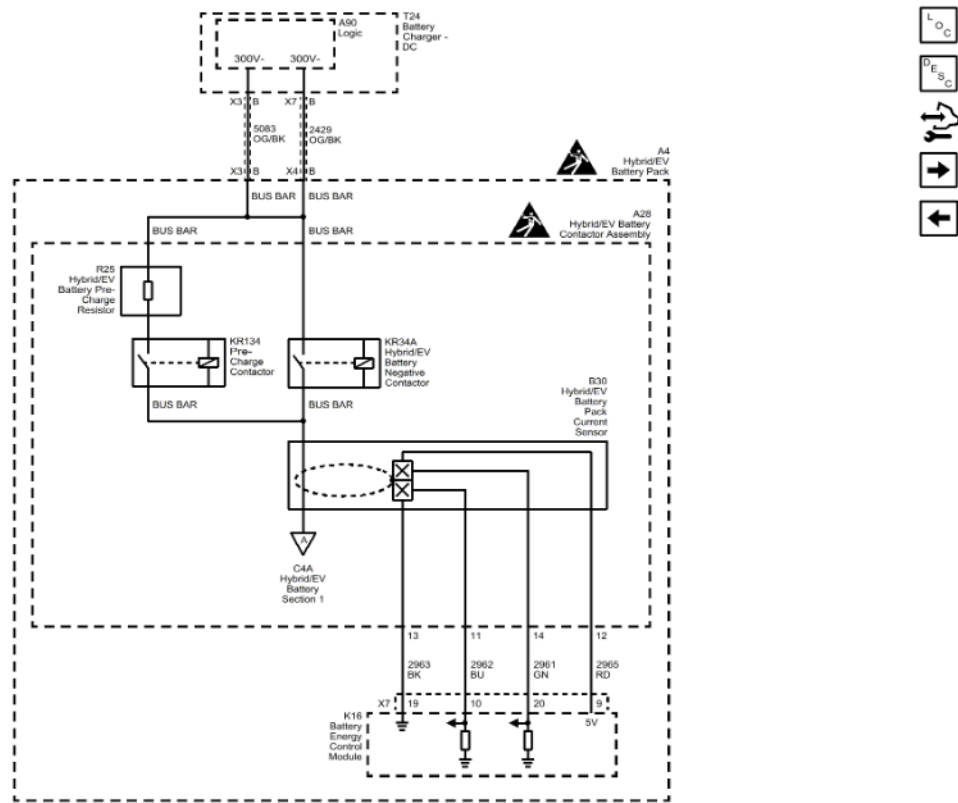


Fig. 16: High Voltage Contactors - High Voltage Negative
Courtesy of GENERAL MOTORS COMPANY

High Voltage Contactors - Control

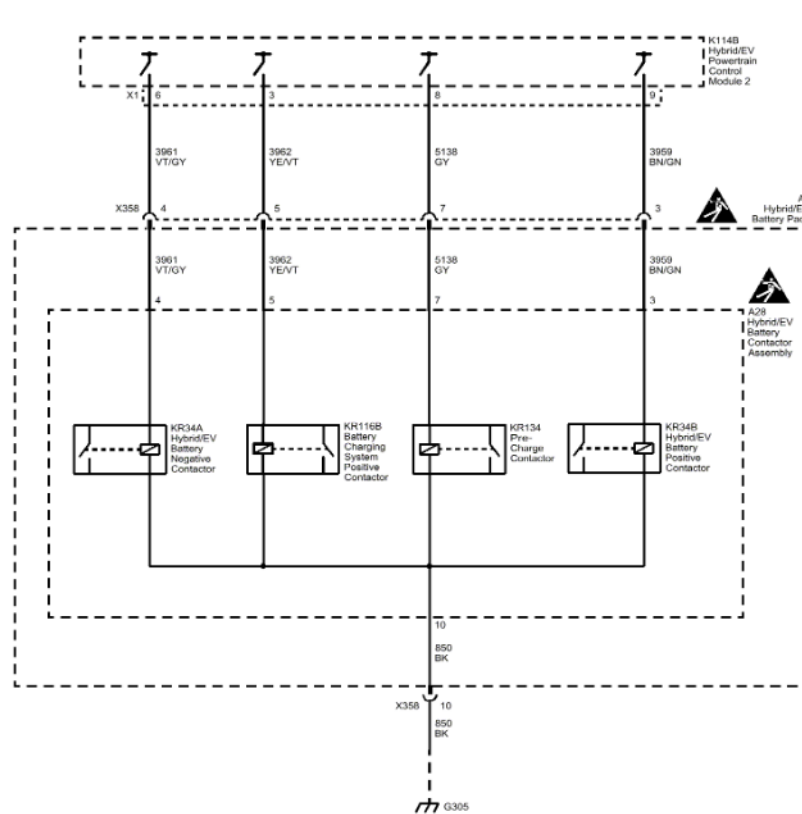


Fig. 17: High Voltage Contactors - Control
Courtesy of GENERAL MOTORS COMPANY

High Voltage Cable Connections (Except CBT)

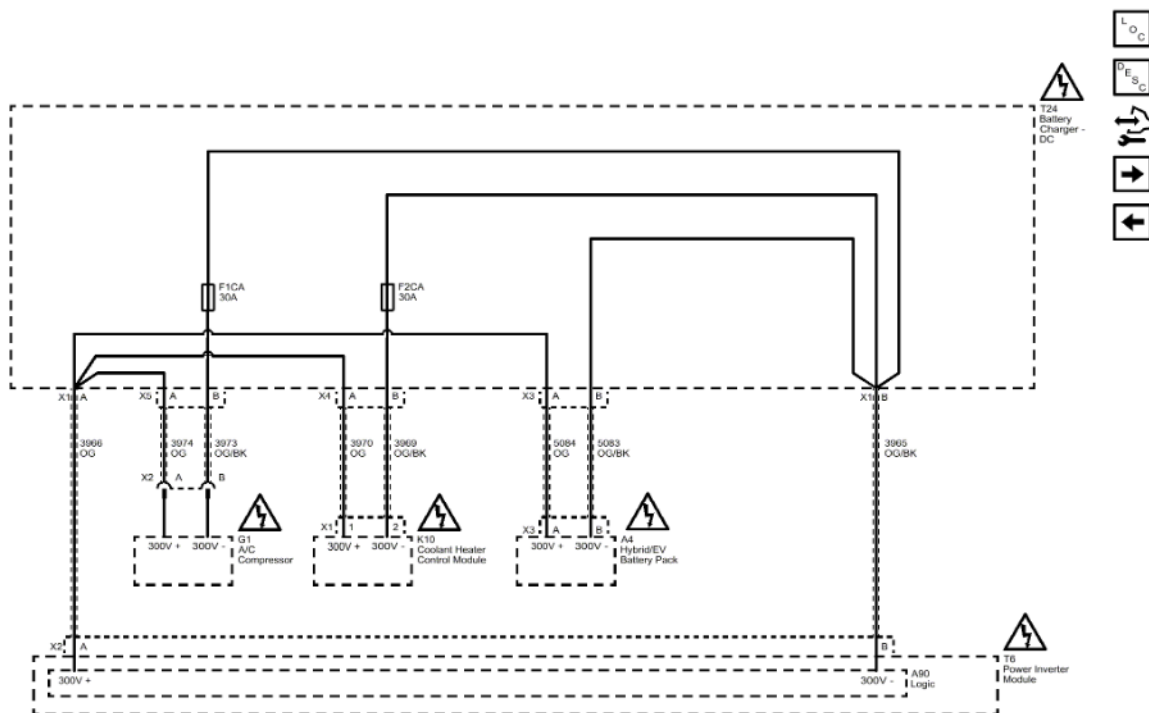


Fig. 18: High Voltage Cable Connections (Except CBT)
Courtesy of GENERAL MOTORS COMPANY

High Voltage Cable Connections (CBT)

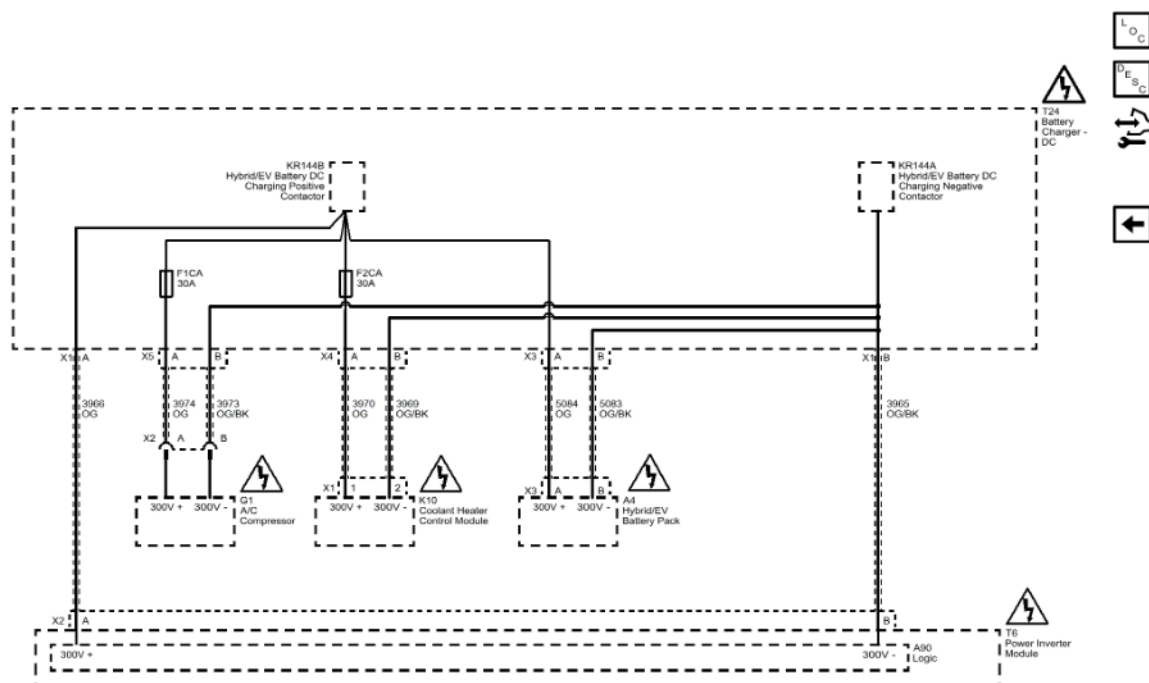


Fig. 19: High Voltage Cable Connections (CBT)
Courtesy of GENERAL MOTORS COMPANY

2017 ELECTRICAL

Hybrid/EV Energy Storage - Special Tools and Equipment - Special Tools - Bolt EV

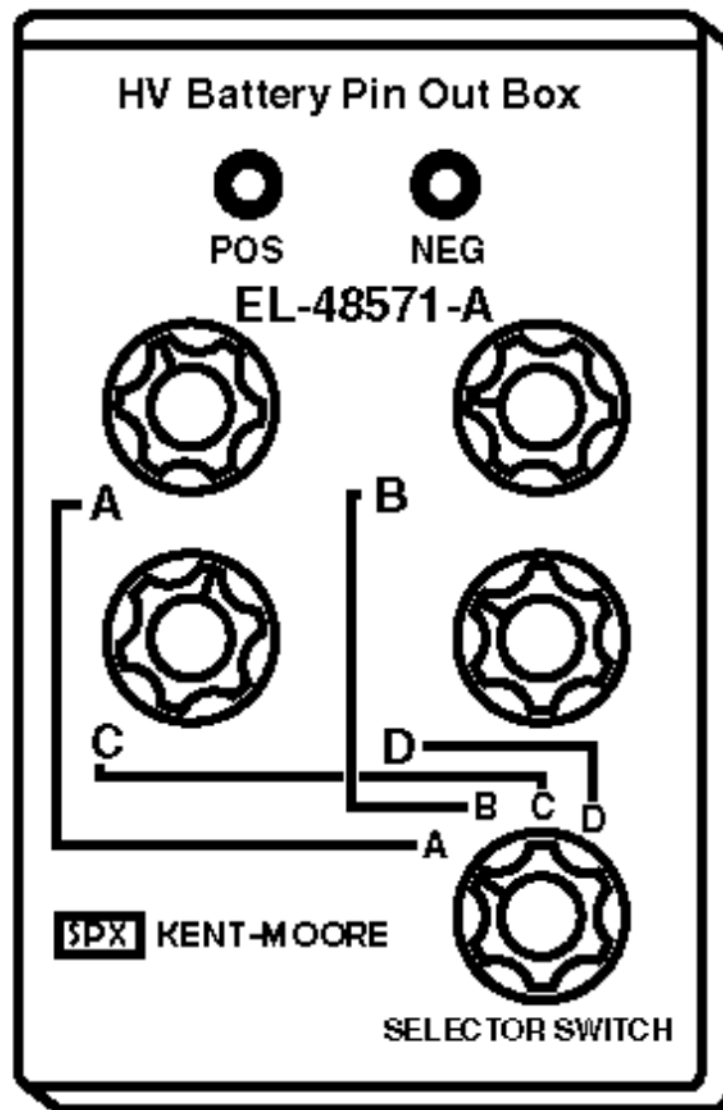
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	BO-38185 J 38185 Hose Clamp Pliers

Illustration	Tool Number/ Description
 A photograph of a blue metal lifting adapter, model EL-48264. The adapter is a long, rectangular bar with a hook attached to one end. Above the bar, there are several bolts and nuts, and two L-shaped metal brackets. The background is white.	EL-48264 Battery Pack Lifting Adapter

Illustration	Tool Number/ Description
	EL-48264-100 Battery Section Lifting Adapter



EL-48571-A
High Voltage
Battery Pin
Out Box

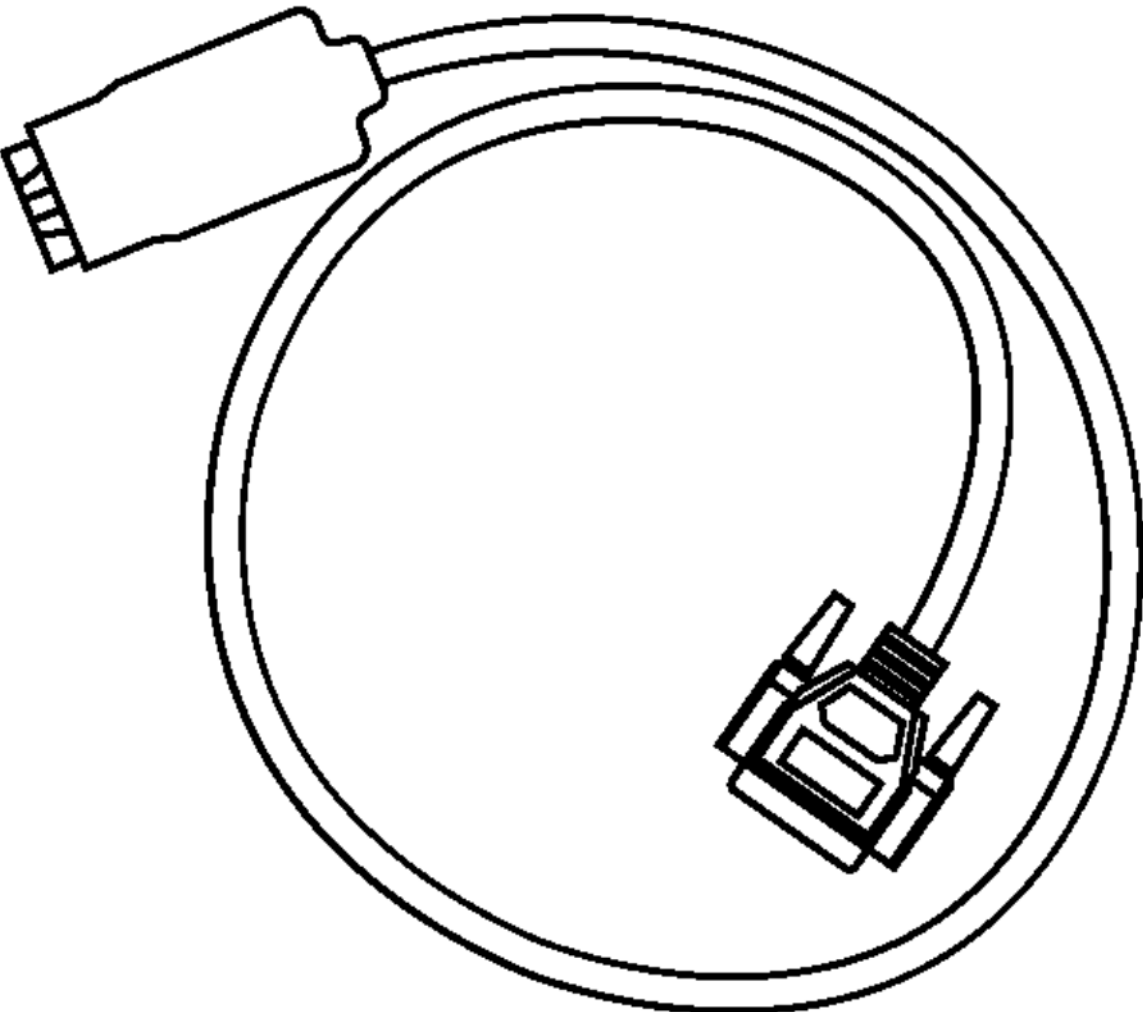
Illustration	Tool Number/ Description
	EL-48571-61 Pinout Box Adapter

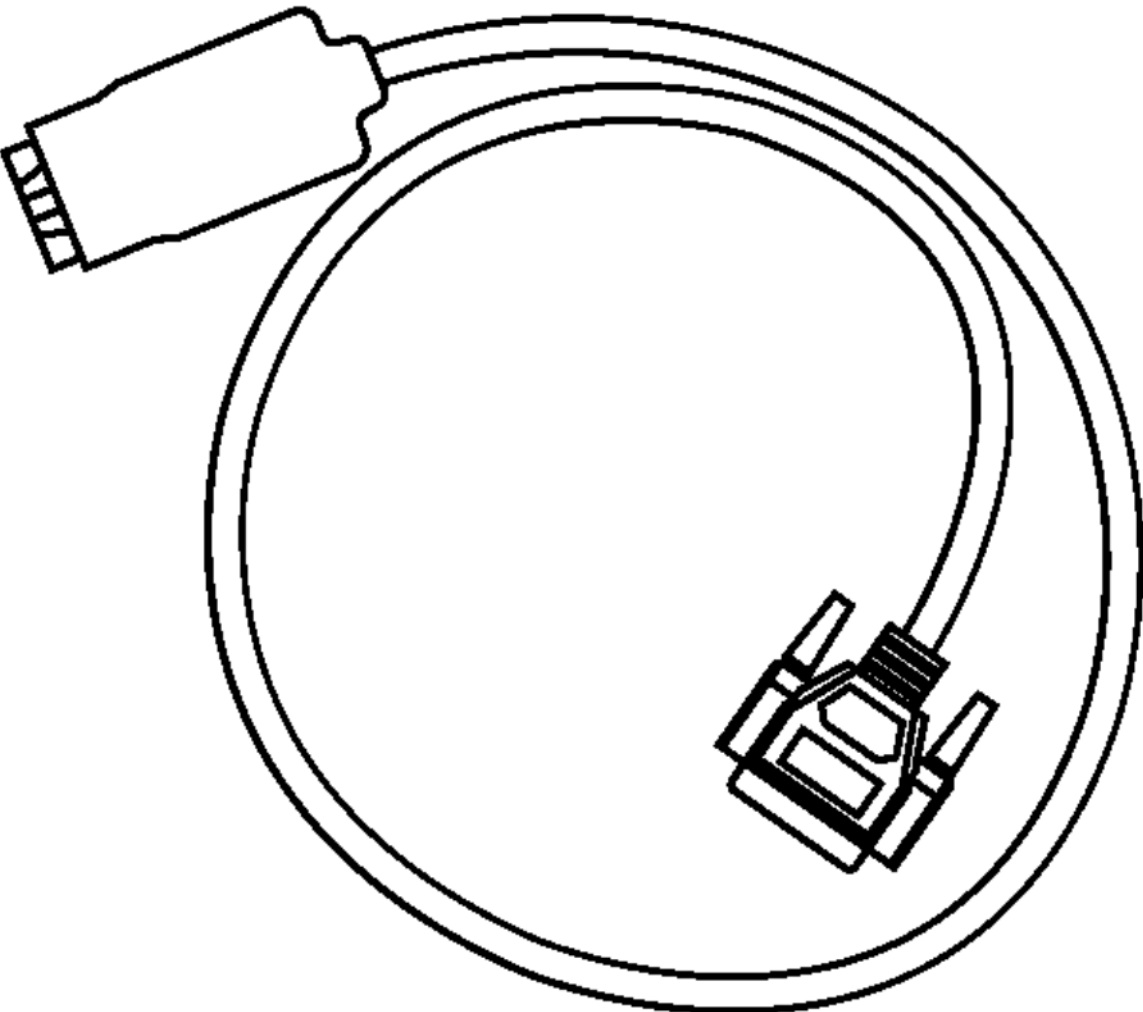
Illustration	Tool Number/ Description
	EL-48571-62 Pinout Box Adapter

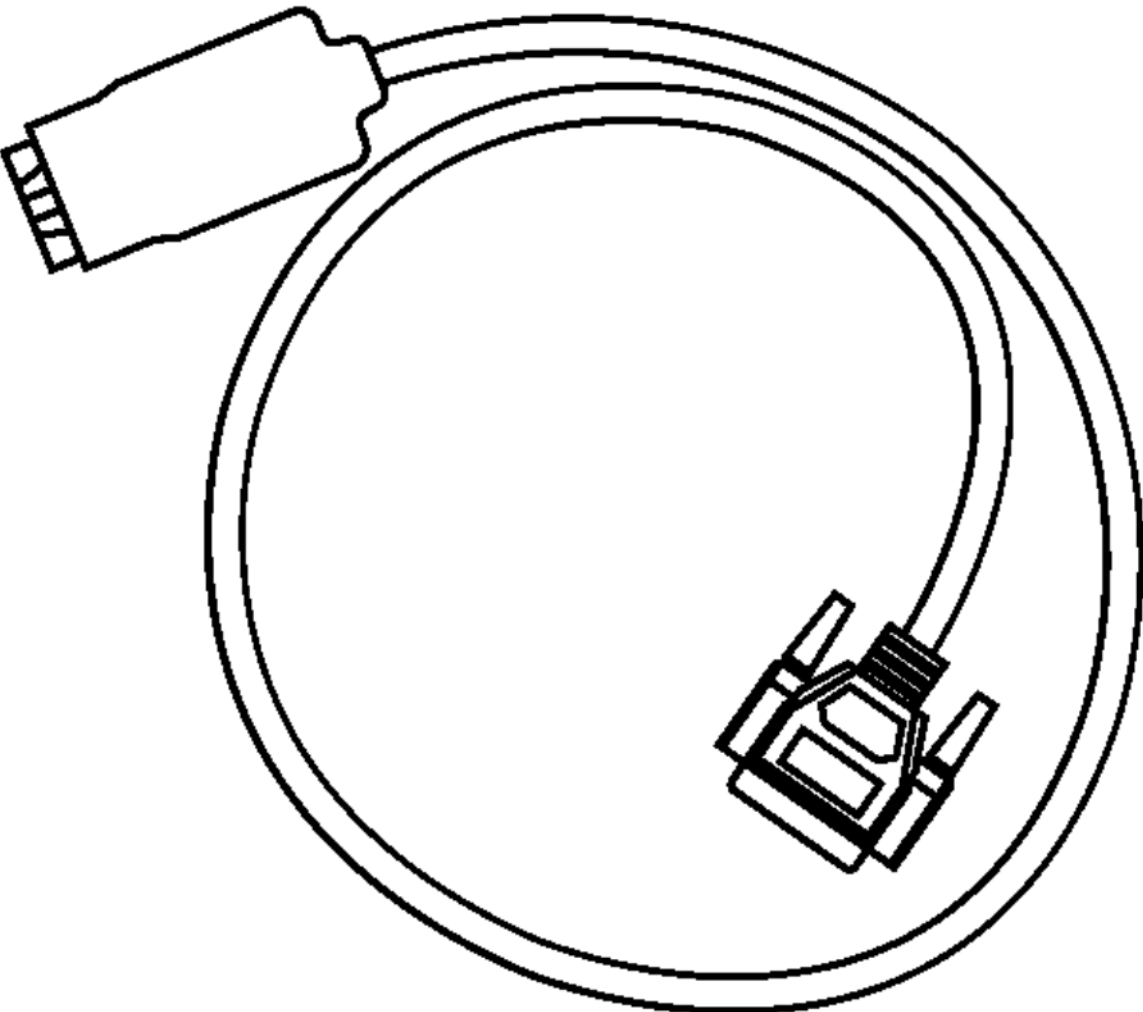
Illustration	Tool Number/ Description
	EL-48571-63 Pinout Box Adapter

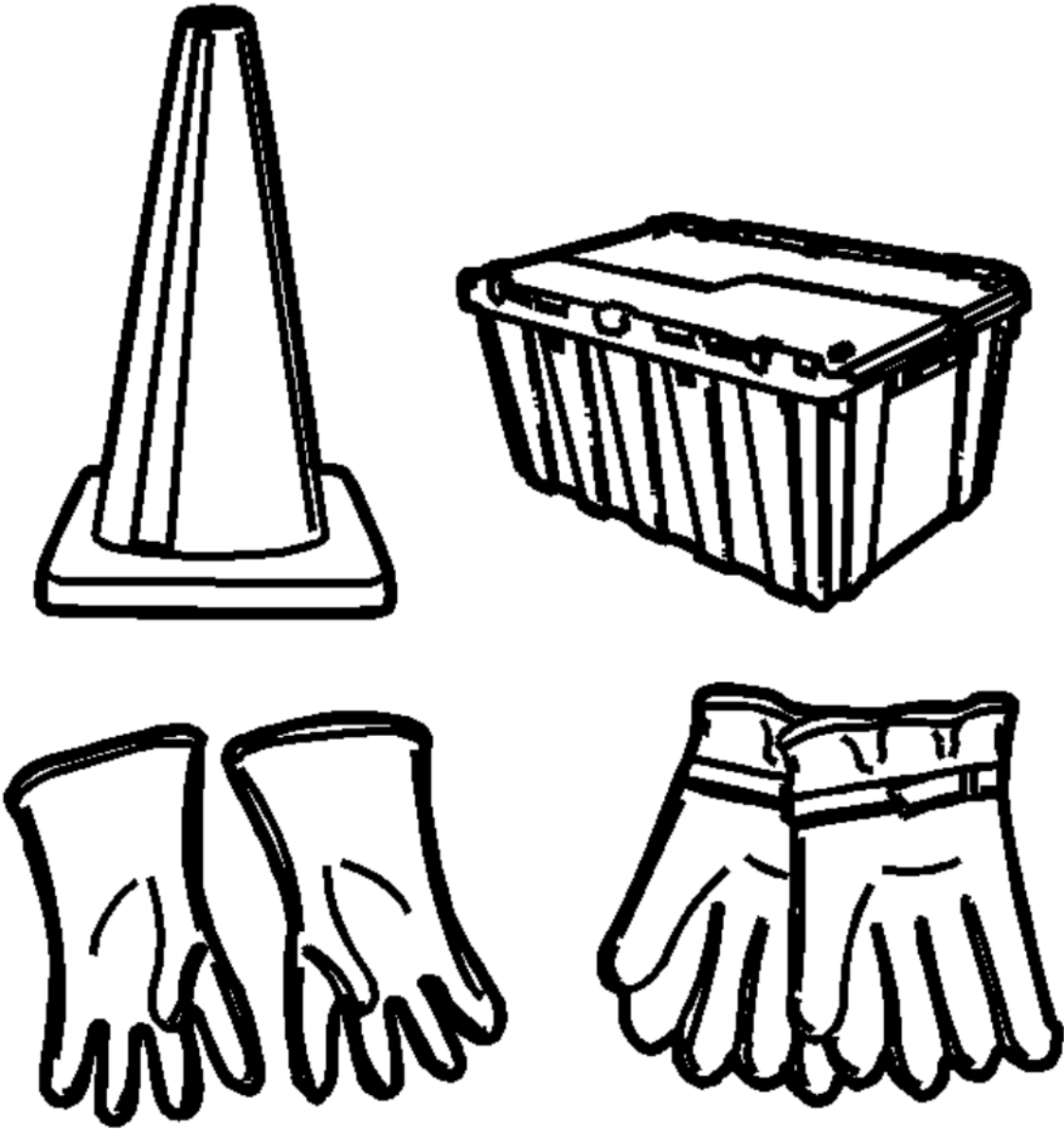
Illustration	Tool Number/ Description
 The illustration shows four items: a traffic cone in the top left, a rectangular plastic storage bin with vertical ridges in the top right, a pair of short gloves in the bottom left, and a pair of long gloves in the bottom right.	EL-48900 HEV Safety Kit

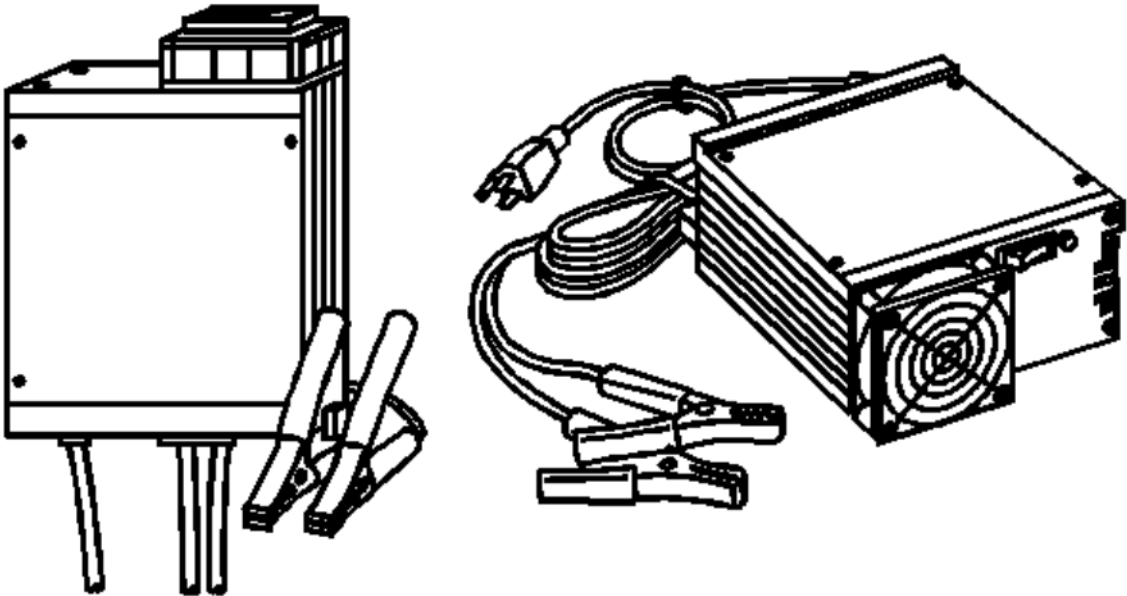
Illustration	Tool Number/ Description
	EL-49642 EL-50113 SPS Programming Support Tool

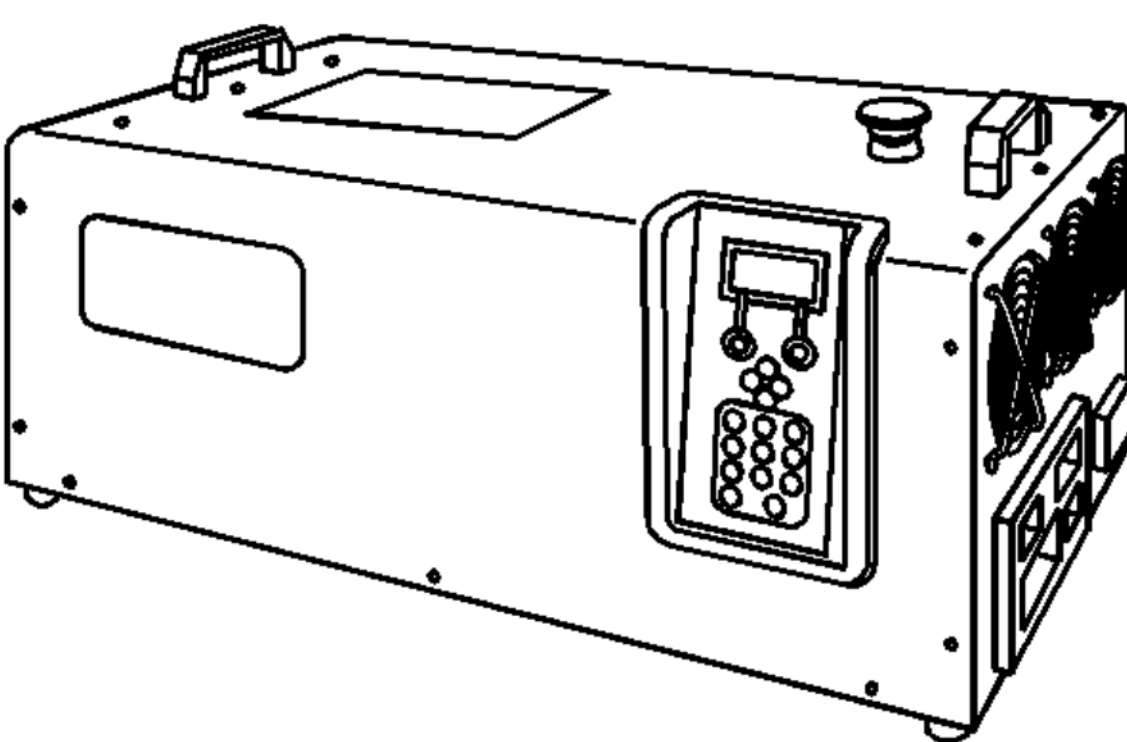
Illustration	Tool Number/ Description
	EL-50332 Hybrid/EV Battery Service Tool

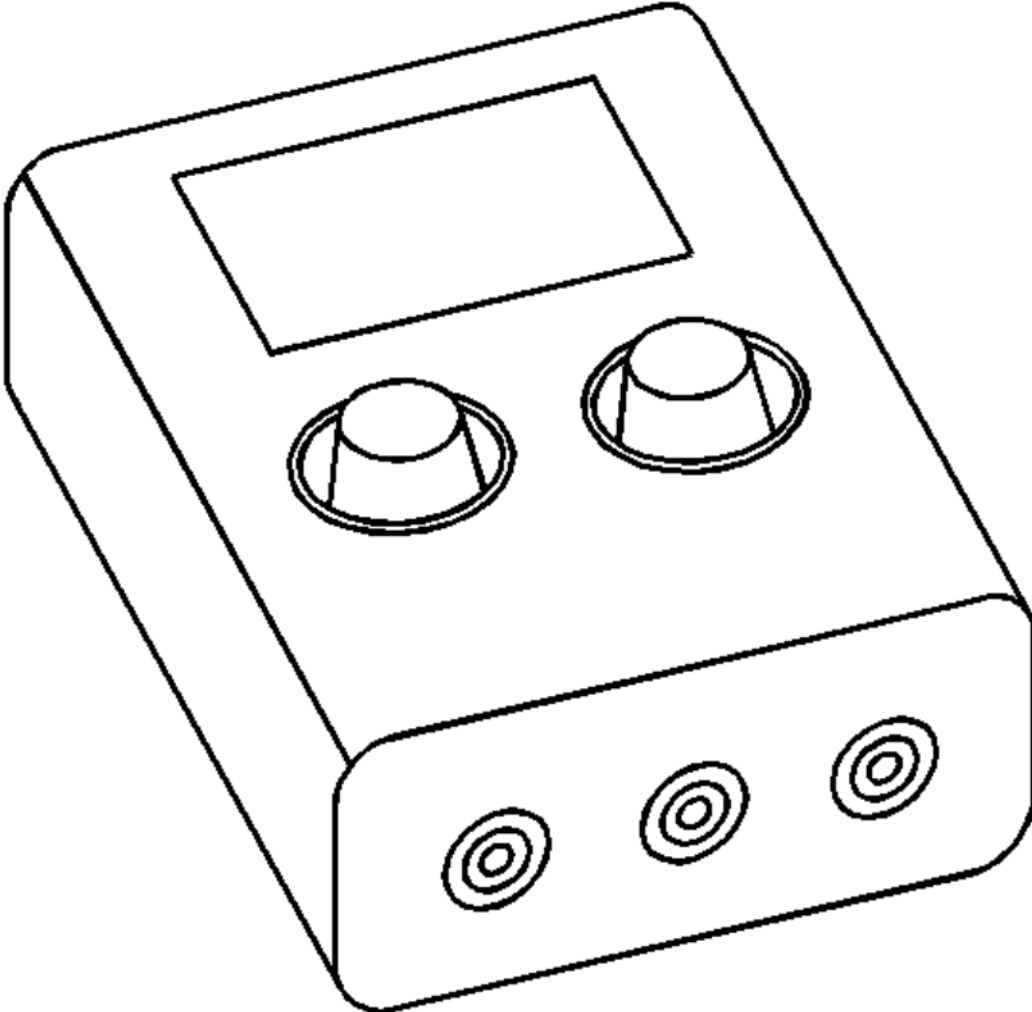
Illustration	Tool Number/ Description
	EL-50332- 105 Universal Fuse Box

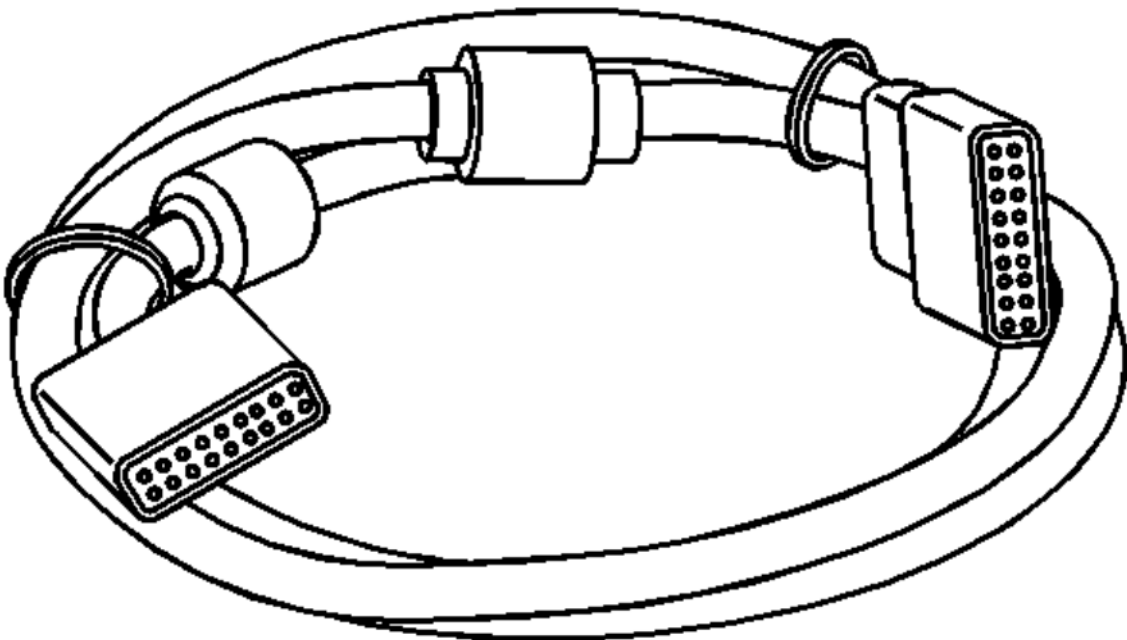
Illustration	Tool Number/ Description
	EL-50332- 125 Vehicle Interface Module Low Voltage 24- Pin Cable

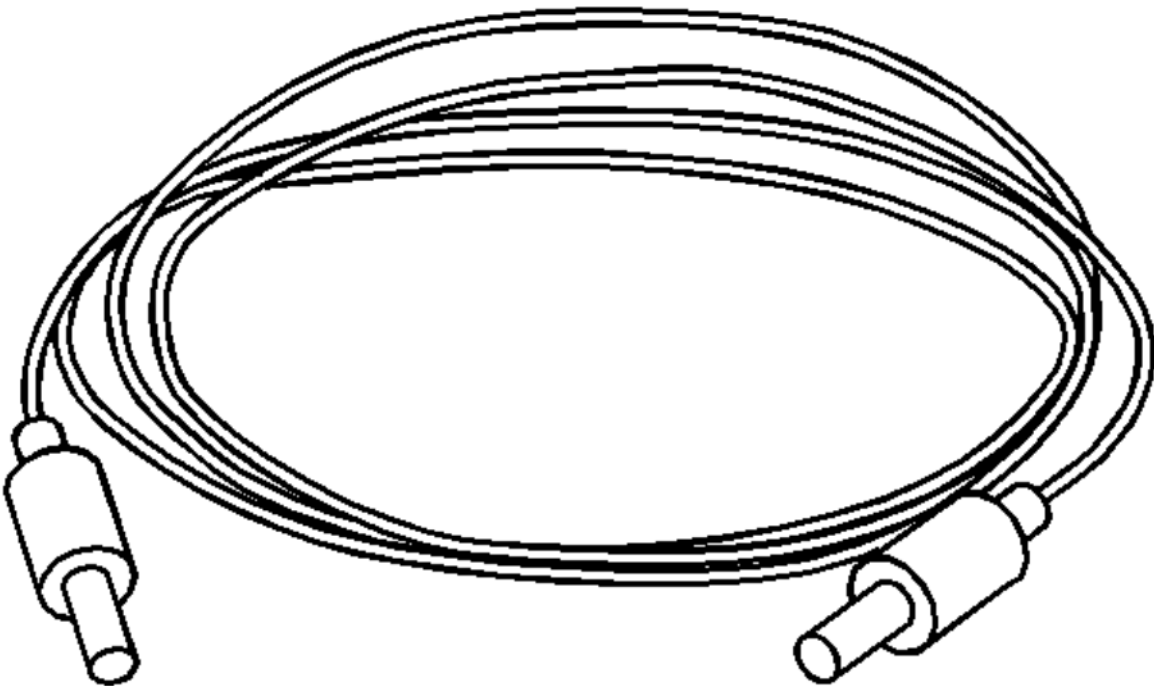
Illustration	Tool Number/ Description
	EL-50332- 145 Black Banana Jack Cable

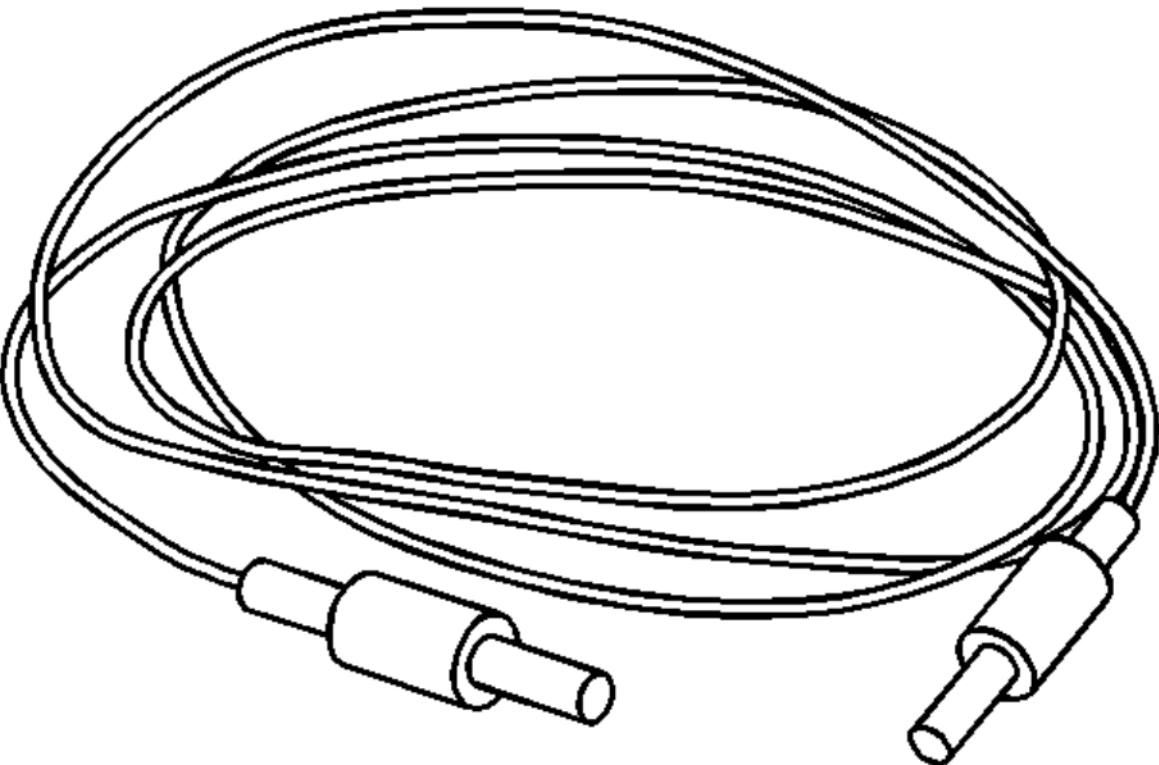
Illustration	Tool Number/ Description
	EL-50332- 150 Red Banana Jack Cable

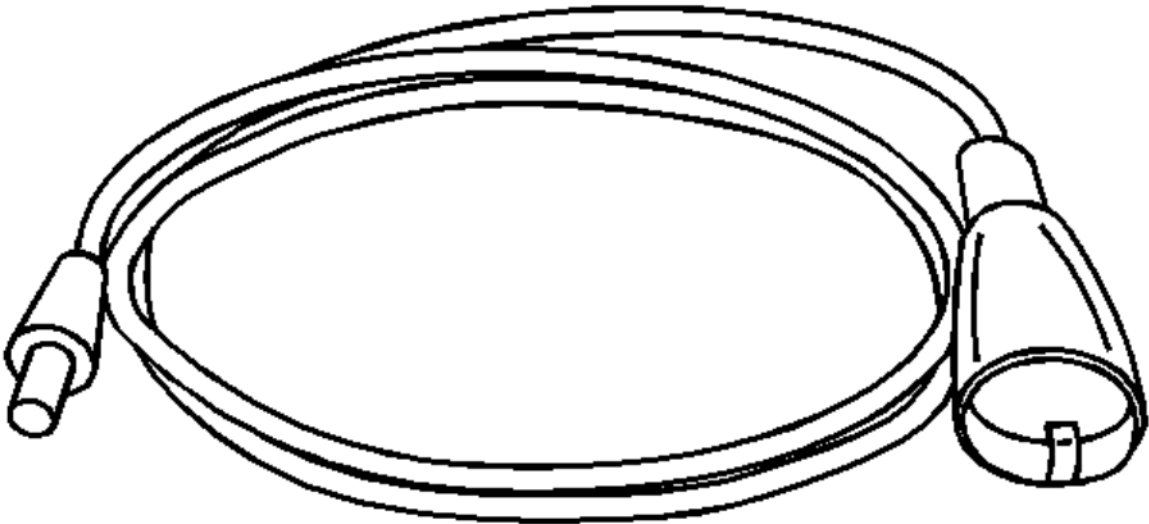
Illustration	Tool Number/ Description
	EL-50332- 155 Green Banana Jack Cable

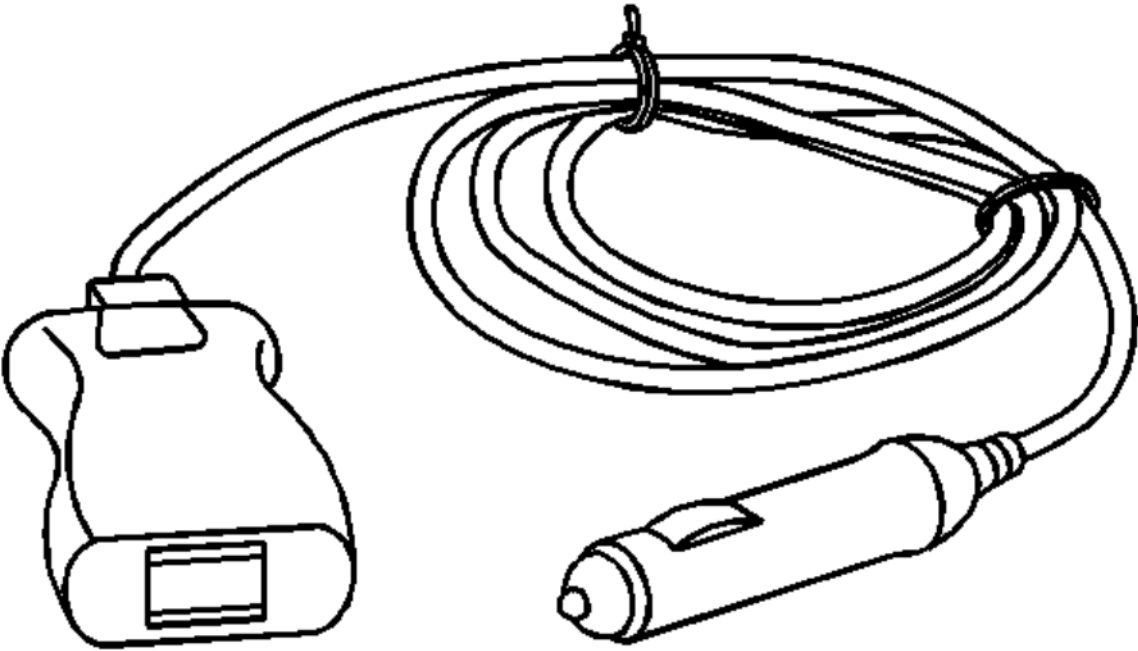
Illustration	Tool Number/ Description
	EL-50332- 160 12 V Auxiliary Power Cable

Illustration	Tool Number/ Description
	EL-50332- 165 12 V Auxiliary Clamps Adapter Cable

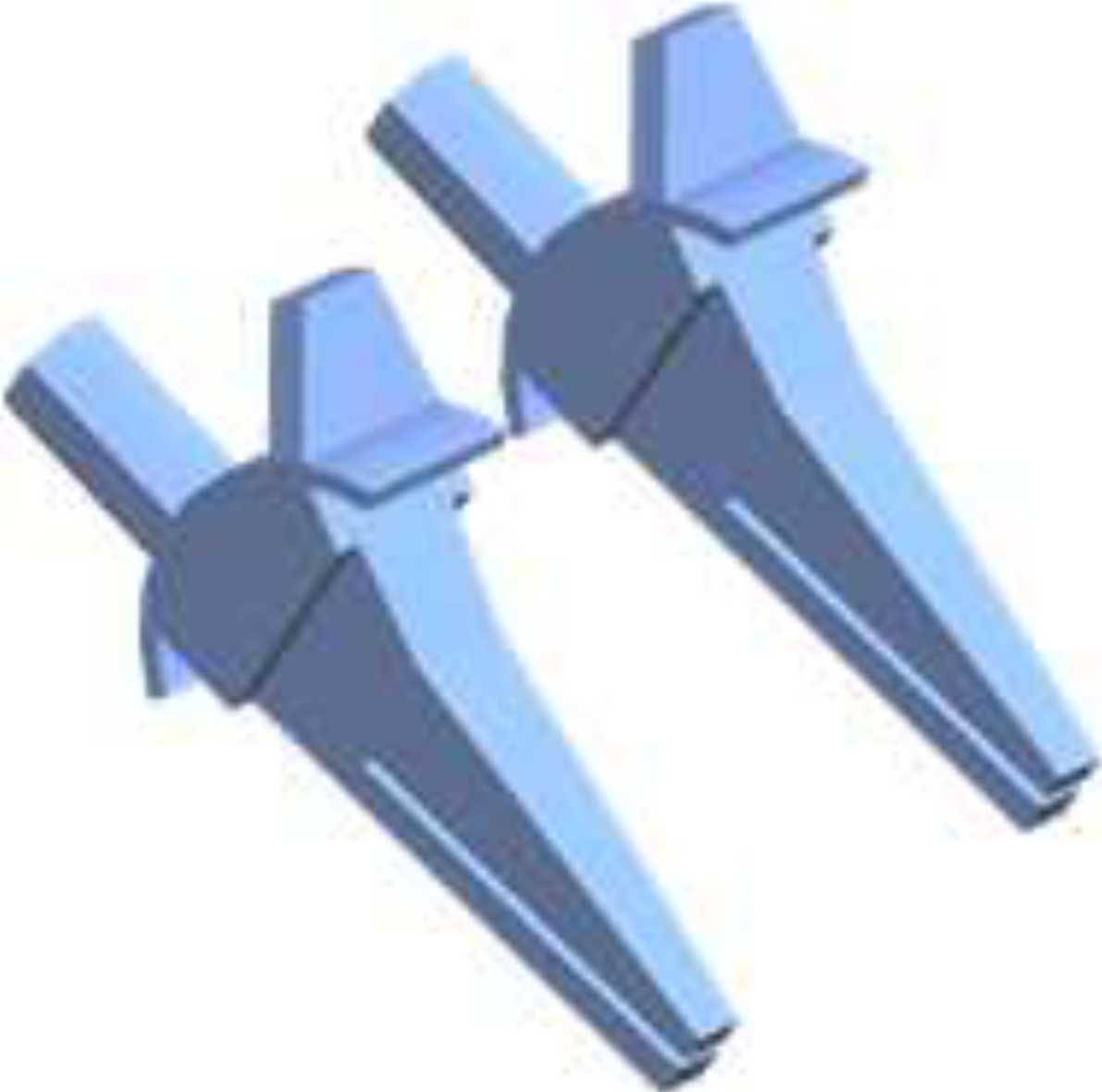
Illustration	Tool Number/ Description
 A 3D rendering of two blue high-voltage alligator clamps. Each clamp has a long, tapered metal jaw with a pointed tip and a black plastic handle with a textured grip. The handles are connected to the jaws by a black plastic hinge mechanism. The clamps are shown from a slightly elevated perspective, angled towards the bottom right.	EL-50332-170 High Voltage Alligator Clamps

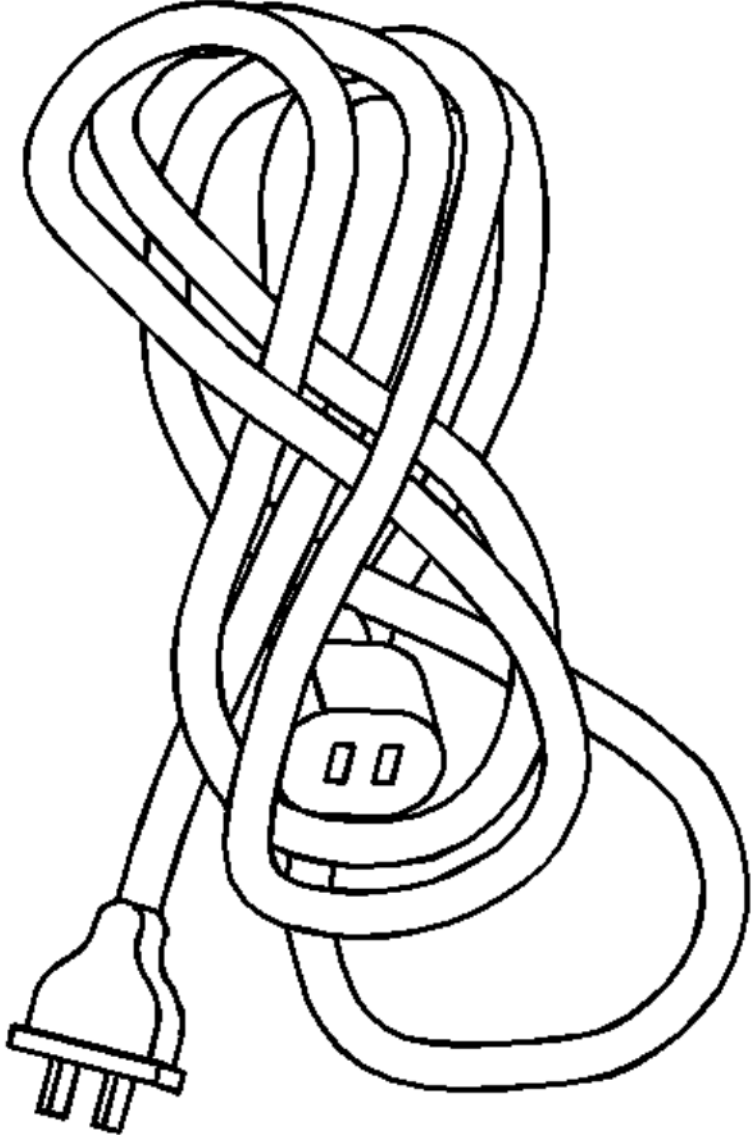
Illustration	Tool Number/ Description
	EL-50332- 175 120 V Power Cable

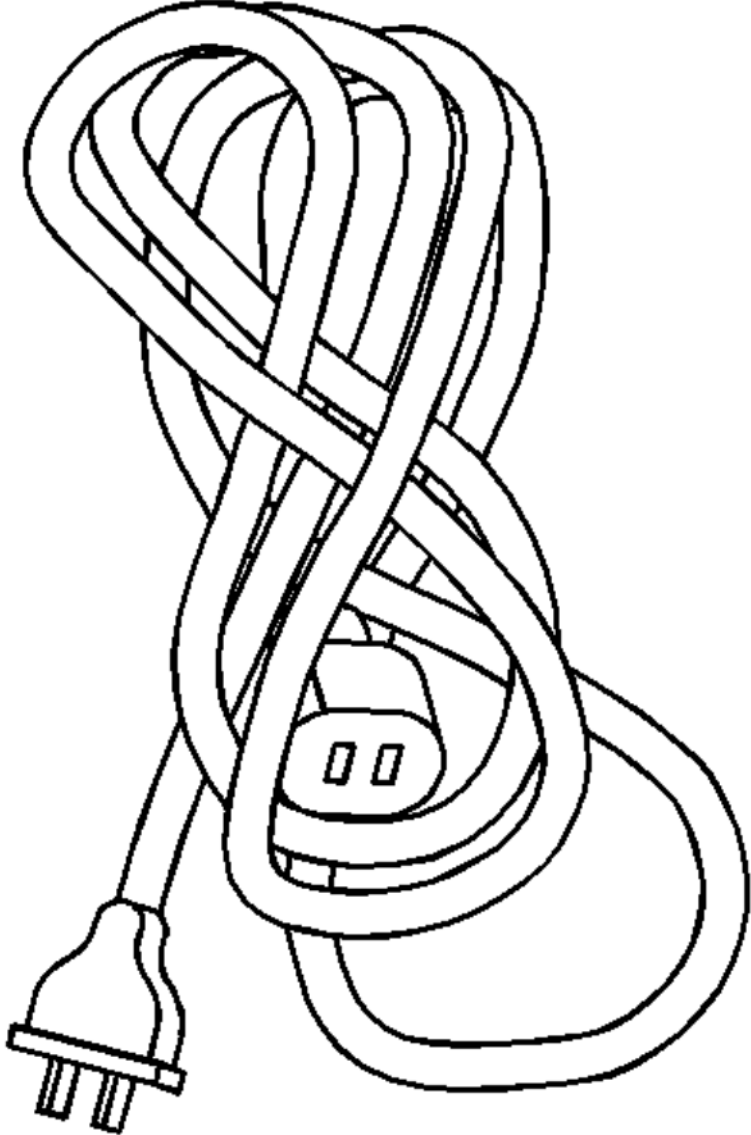
Illustration	Tool Number/ Description
	EL-50332- 180 250 V Power Cable - AUS

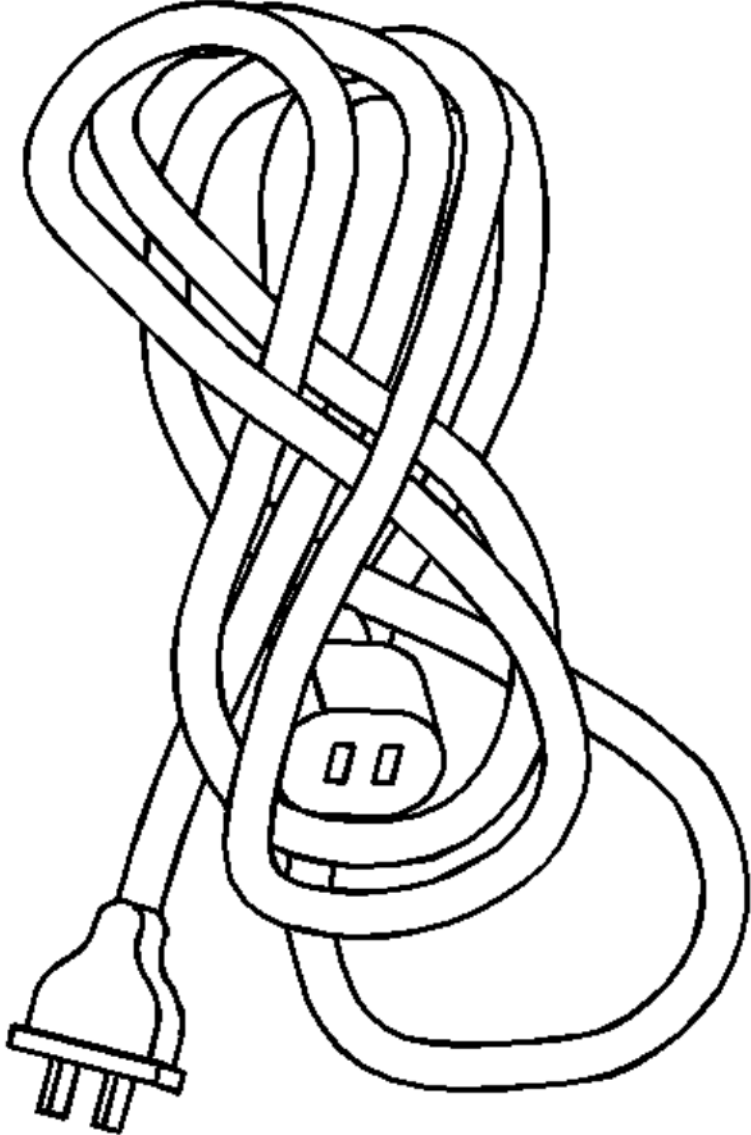
Illustration	Tool Number/ Description
	EL-50332- 185 250 V Power Cable - EU/Korea

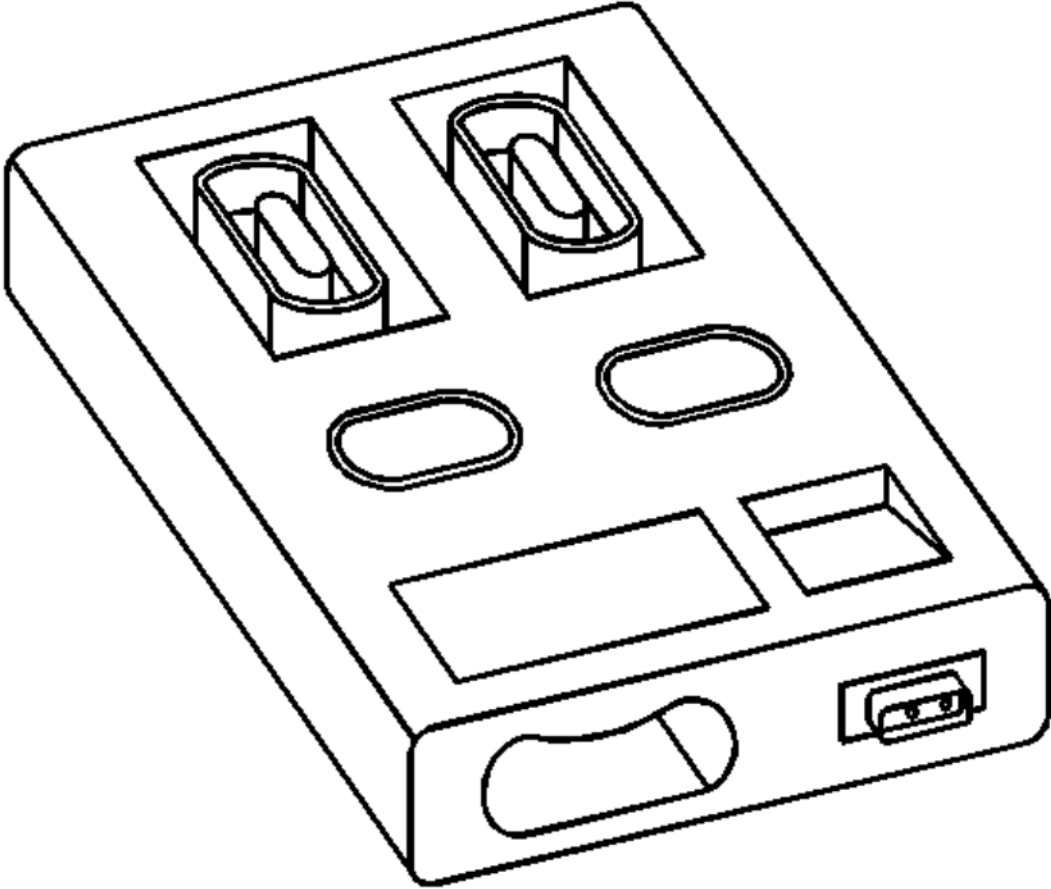
Illustration	Tool Number/ Description
	EL-50332-270 Vehicle Interface Module 2

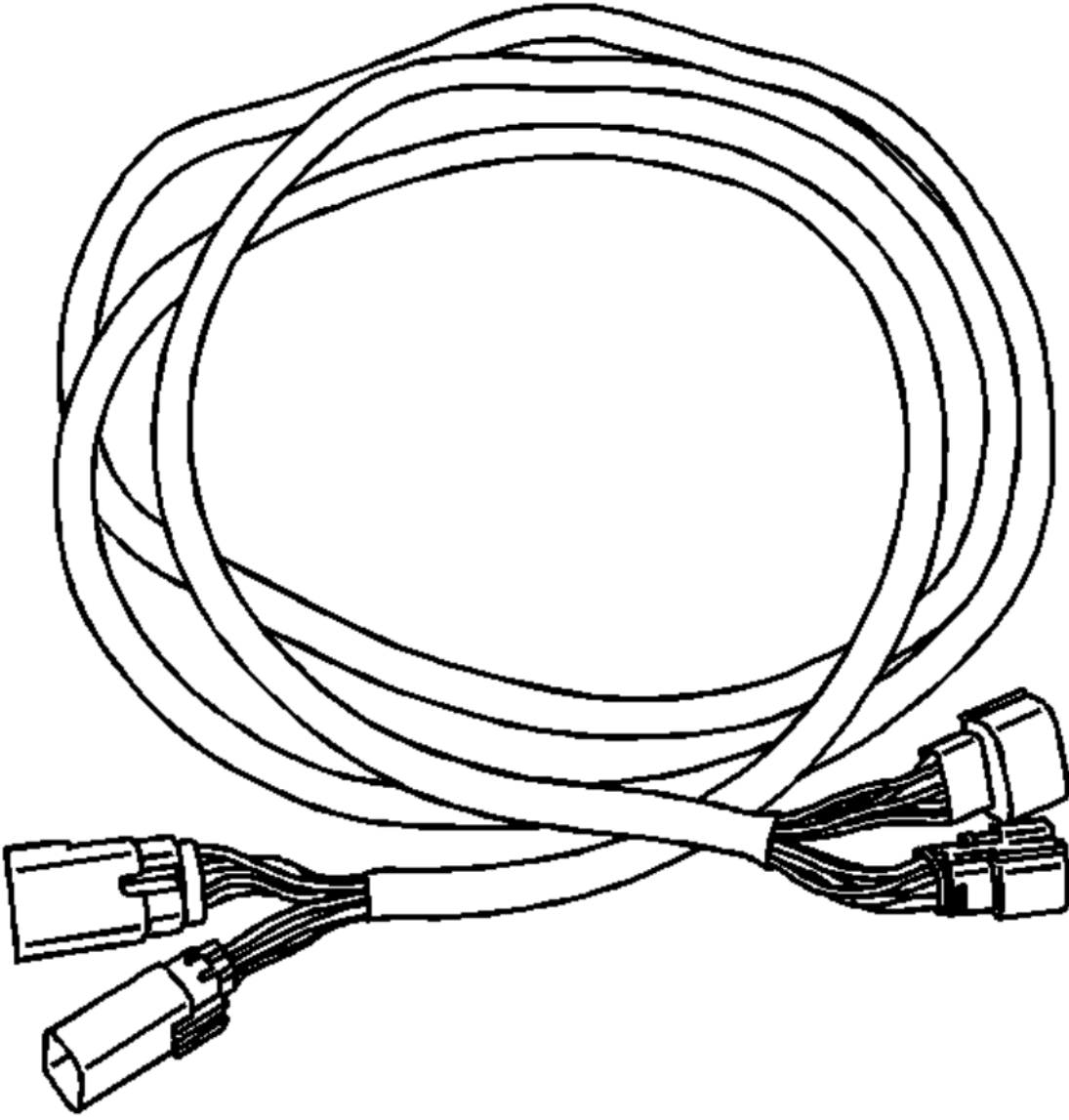
Illustration	Tool Number/ Description
	EL-50332-325 Low Voltage Adapter Harness

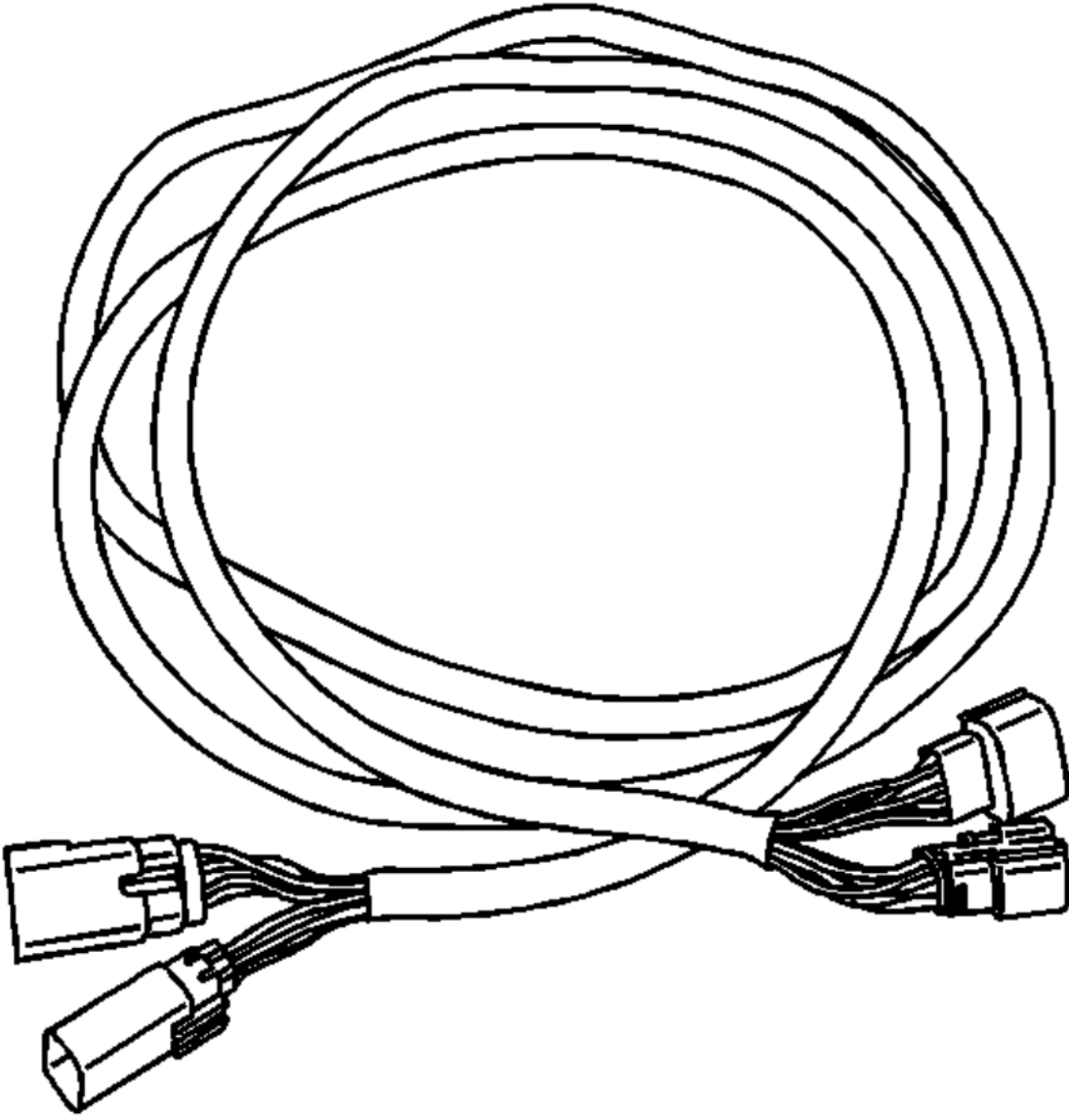
Illustration	Tool Number/ Description
	EL-50332-335 High Voltage Adapter Harness

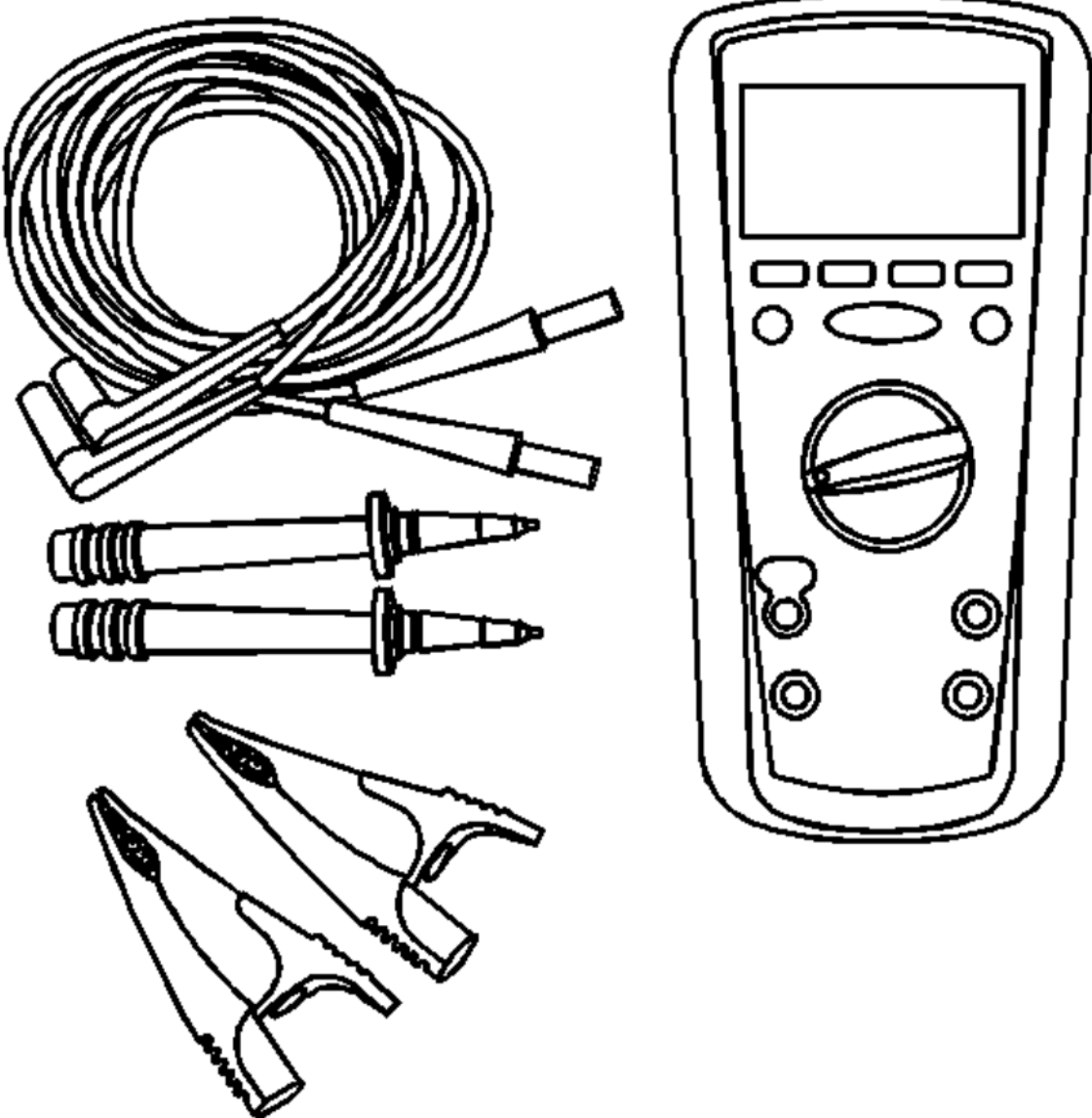
Illustration	Tool Number/ Description
	EL-50772 Insulation Multimeter

Illustration	Tool Number/ Description
	EL-51102 High Voltage Battery Lift Bar Tilter

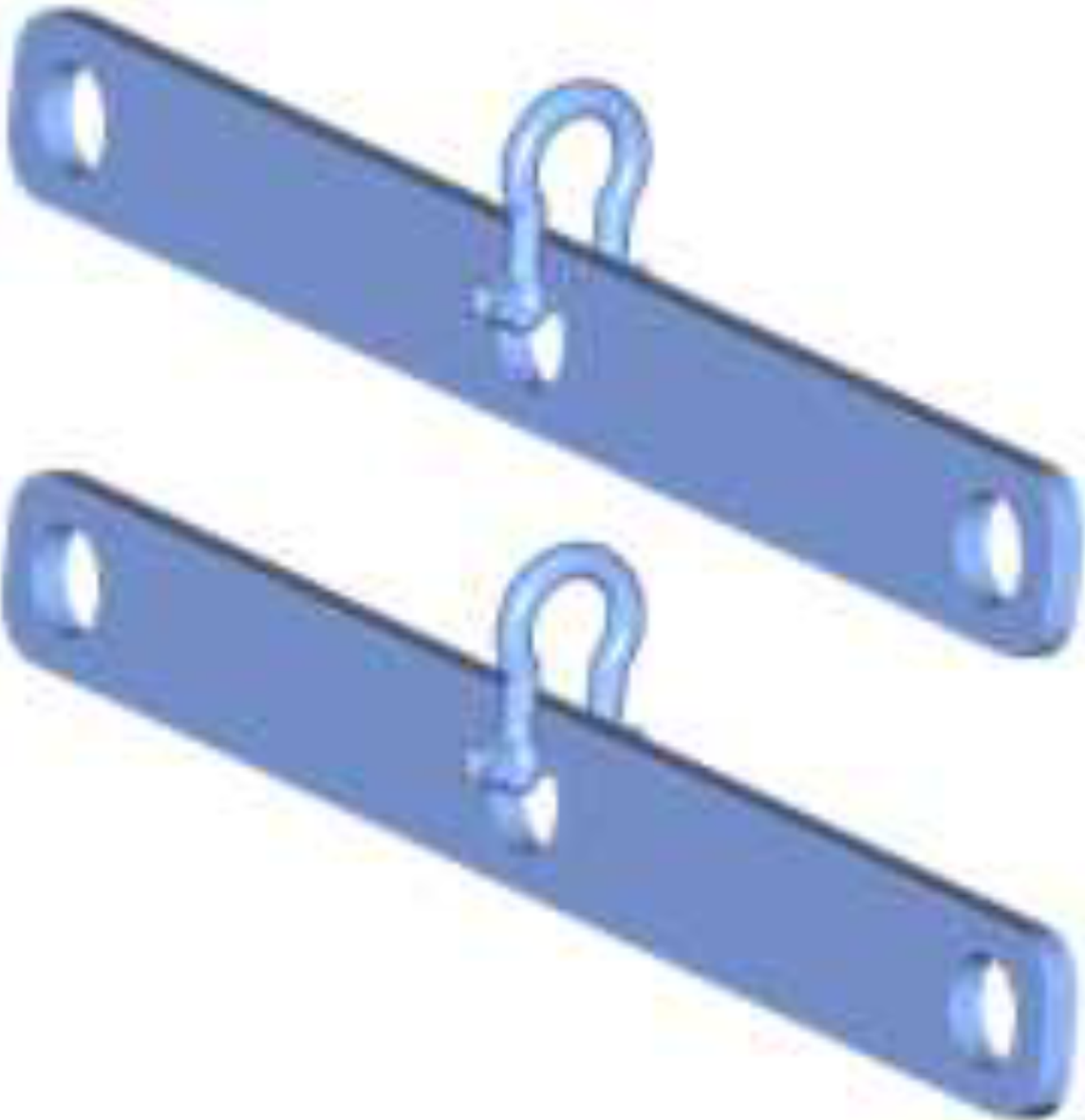
Illustration	Tool Number/ Description
	EL-51102-10 High Voltage Battery Lift Bar Hanging Bars and Shackles

Illustration	Tool Number/ Description
 The illustration shows six blue eye-bolts arranged in two rows of three. Below them are ten blue bolts of varying lengths, some with hexagonal heads and others with flat heads, and ten blue washers arranged in two rows of five.	EL-51102-20 High Voltage Battery Lift Bar Eye-Bolt Kit

Illustration	Tool Number/ Description
	EL-51102-40 High Voltage Battery Lift Bar Straps

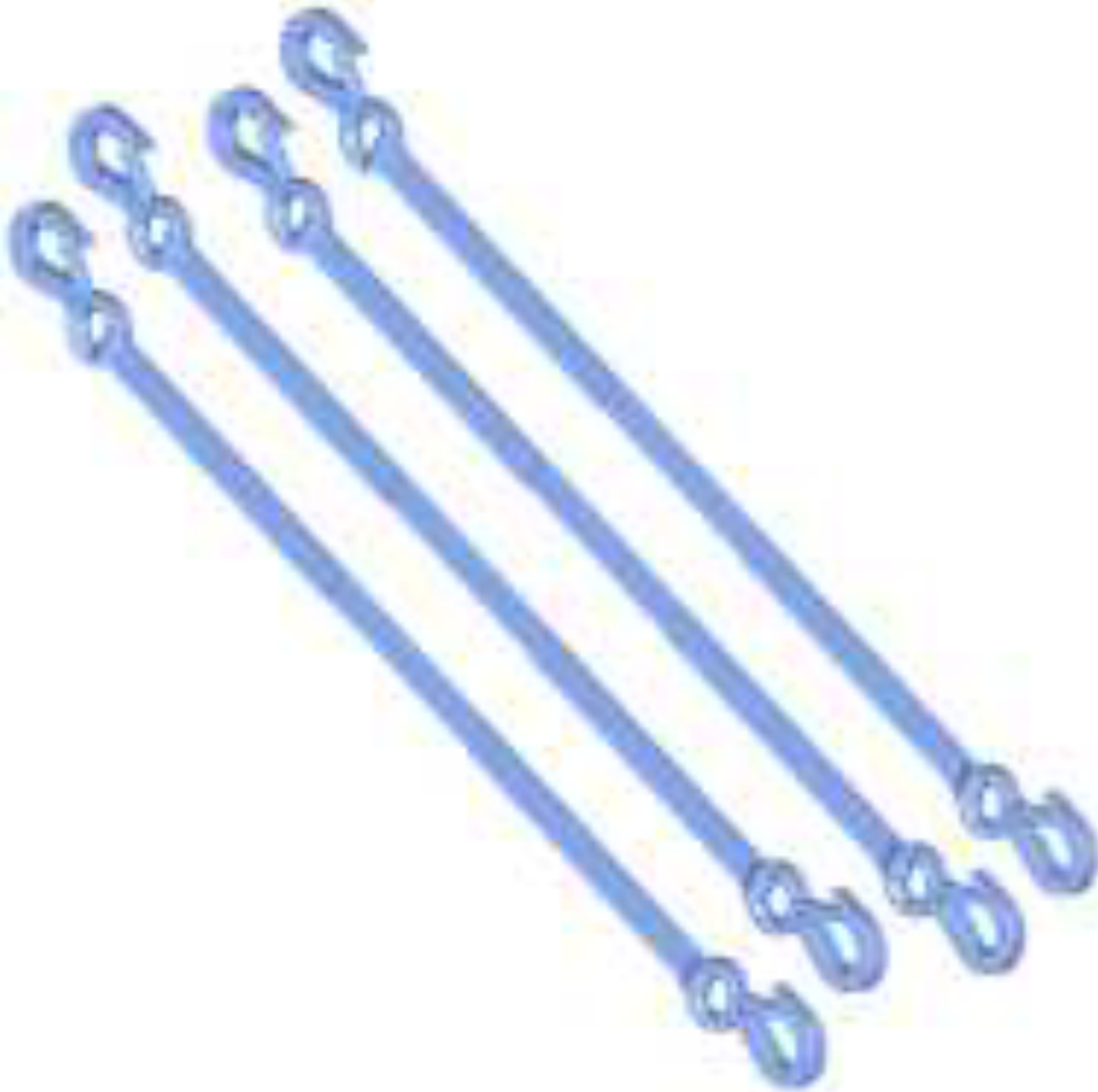
Illustration	Tool Number/ Description
	EL-51102-50 High Voltage Battery Lift Bar Straps

Illustration	Tool Number/ Description
	EL-52014 Low Voltage Test Harness

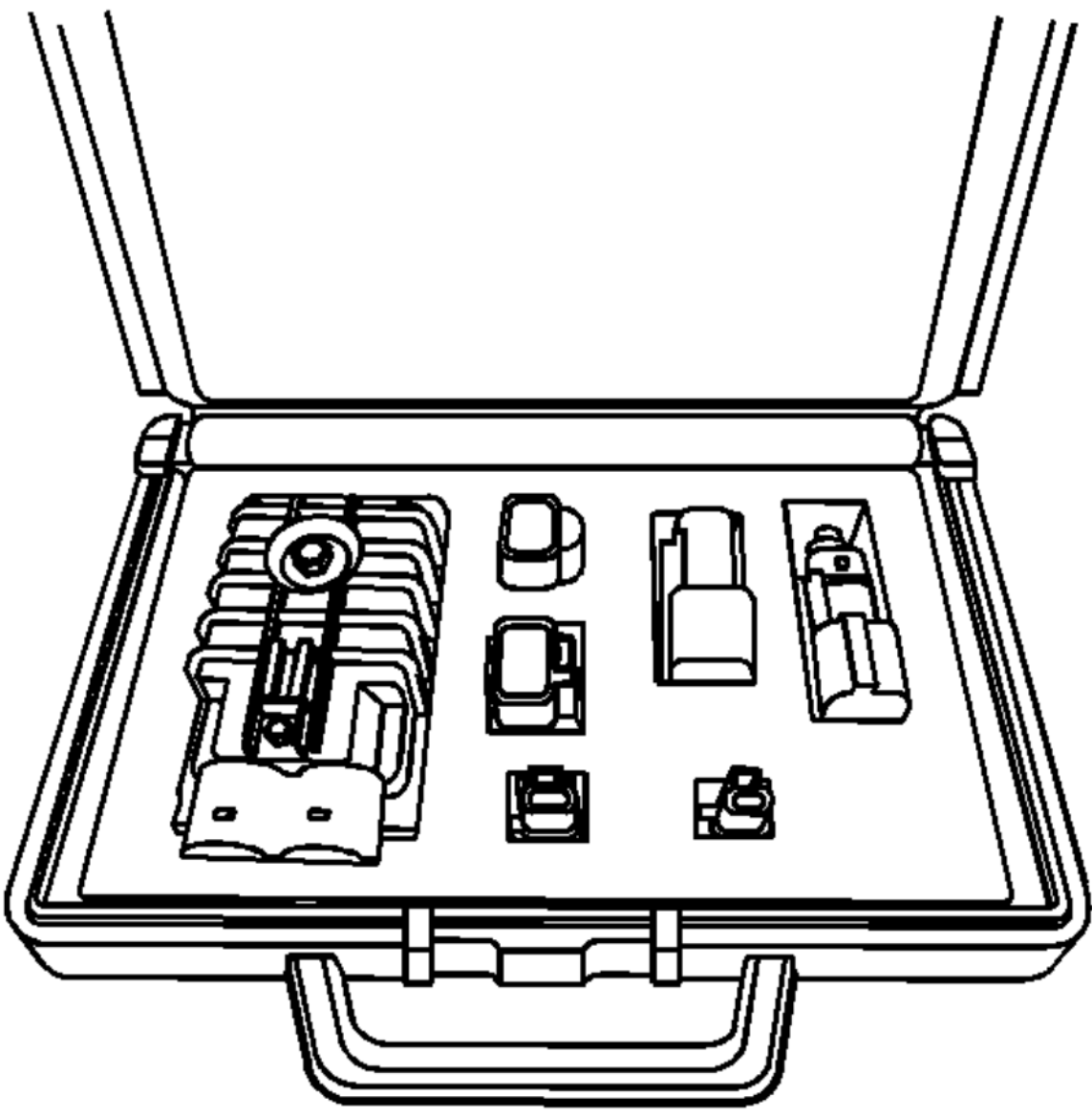
Illustration	Tool Number/ Description
	EL-52015 Battery Smoke Test Leak Adapters

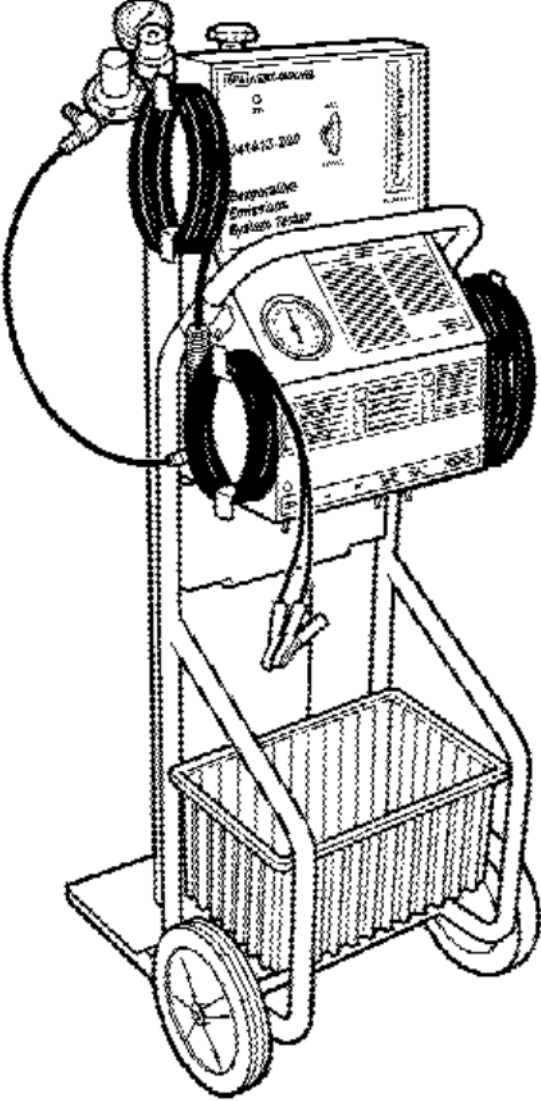
Illustration	Tool Number/ Description
	GE-41413-A J 41413-A Evaporative Emissions System Tester
	GE-52200 Lifting Table

Illustration	Tool Number/ Description
 A blue manual scissor lift with a black platform and four casters. The platform is divided into two sections by a central vertical line. The lift is shown in a slightly raised position, with the scissor mechanism visible underneath. The frame is made of blue metal, and the casters are black with blue hubs. A small red emergency stop button is located on the right side of the base.	

Illustration	Tool Number/ Description
	GE-52418 Lifting Table - Korea

2017 ELECTRICAL**Hybrid/EV Energy Storage - Specifications - Fastener Specifications - Bolt EV****SPECIFICATIONS****FASTENER SPECIFICATIONS****Reusable Threaded Fastener Tightening Specifications**

Application	Specification
	Metric (English)
NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
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 - Lower	9 N.m (80 lb in)
Accessory DC Power Control Module High Voltage Connector Protector Bolt - Upper	22 N.m (16 lb ft)
Accessory DC Power Control Module High Voltage Connector Protector Nut	9 N.m (80 lb in)
Battery Cable Bolt	9 N.m (80 lb in)
Battery Cable Nut	9 N.m (80 lb in)
Battery Upper Cover Fastener	9 N.m (80 lb in)
Cell Battery Cooling Plate Securing Nuts	9 N.m (80 lb in)
Cell Battery Module Bracket Bolt	9 N.m (80 lb in)
Cell Battery Module Securing Bolt	9 N.m (80 lb in)
Cell Battery Module Securing Nut	9 N.m (80 lb in)
Cell Battery Module Side Bolt	9 N.m (80 lb in)
Cooling Plate Nut	9 N.m (80 lb in)
Drive Motor Battery Bolt	56 N.m (41 lb ft)
Drive Motor Battery Control Module Wiring Harness Connector Screw	1.7 N.m (15 lb in)
Drive Motor Battery Control Module Wiring Harness Ground Terminal Fastener	6 N.m (53 lb in)
High Voltage Battery Connector X3 Die Casting Block Bolt	9 N.m (80 lb in)
High Voltage Battery Connector X4 Die Casting Block Bolt	9 N.m (80 lb in)
High Voltage Battery Connector X4 Harness Nut	4.5 N.m (40 lb in)
High Voltage Battery Connector X4 Head Screw	2.5 N.m (22 lb in)
High Voltage Battery Disconnect Relay Assembly Nuts	9 N.m (80 lb in)
High Voltage Battery Disconnect Relay Cover Bolt	4.5 N.m (40lb in)
High Voltage Battery Disconnect Relay Fuse Nut	5 N.m (44 lb in)
High Voltage Battery High Voltage Manual Disconnect Connector Bolt	9 N.m (80 lb in)
High Voltage Battery X3 Connector Block Bolt	9 N.m (80 lb in)
High Voltage Cable Channel Nut	9 N.m (80 lb in)
Tube Bolt	9 N.m (80 lb in)

