

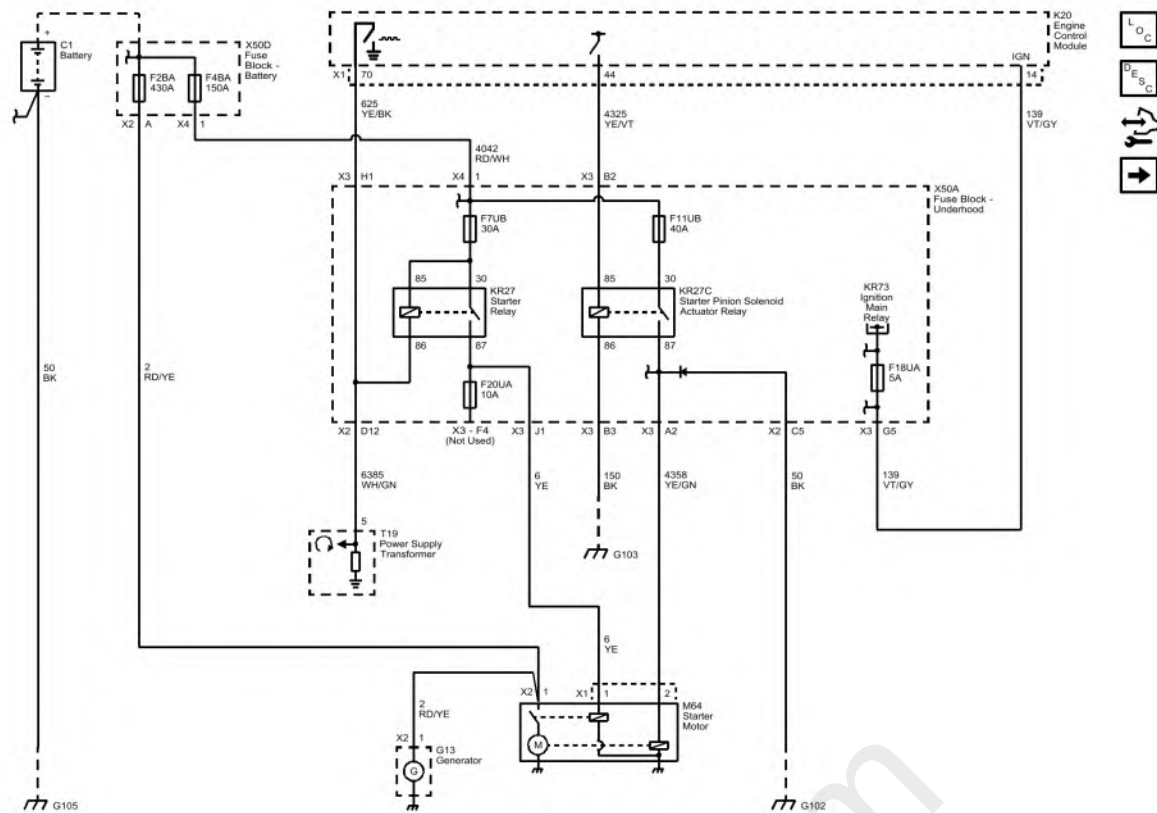
**2017 ELECTRICAL****12 V Starting and Charging - Encore, Trax****SPECIFICATIONS****FASTENER SPECIFICATIONS****Reusable Threaded Fastener Tightening Specifications****NOTE:**

*All fasteners listed in this table can be reused after removal.*

| Application                                                  | Specification      |
|--------------------------------------------------------------|--------------------|
|                                                              | Metric (English)   |
| Battery Hold Down Retainer Fastener                          | 22 N.m (16 lb ft)  |
| Battery Negative Cable Post Fastener                         | 4.5 N.m (40 lb in) |
| Battery Negative Cable to Battery Sensor (KL9)               | 11 N.m (97 lb in)  |
| Battery Negative Cable to Engine Block (LVL)                 | 22 N.m (16 lb ft)  |
| Battery Negative Cable to Frame Rail Stud Fastener           | 22 N.m (16 lb ft)  |
| Battery Negative Cable to Starter Mounting Stud (2H0, LUJ)   | 13 N.m (115 lb in) |
| Battery Negative Cable to Starter Mounting Stud (LDE)        | 17 N.m (13 lb ft)  |
| Battery Positive Cable Fastener to Starter Solenoid Fastener | 13 N.m (115 lb in) |
| Battery Positive Cable Post Fastener                         | 5 N.m (44 lb in)   |
| Battery Positive Cable to Battery Fuse Block Fastener        | 12 N.m (106 lb in) |
| Battery Positive Cable to Underhood Fuse Box Fastener        | 9 N.m (80 lb in)   |
| Battery Tray Fastener                                        | 14 N.m (124 lb in) |
| Body Harness Ground to Battery Negative Clamp                | 9 N.m (80 lb in)   |
| Engine Harness Starter Positive Cable                        | 5 N.m (44 lb in)   |
| Generator Battery Positive Cable Fastener                    | 17 N.m (13 lb ft)  |
| Generator Mounting Fastener (2H0, LUJ)                       | 35 N.m (26 lb ft)  |
| Generator Mounting Fastener (LE2, LVL)                       | 22 N.m (16 lb ft)  |
| Generator Mounting Stud (LE2)                                | 9 N.m (80 lb in)   |
| Heated Oxygen Sensor Bracket Fastener                        | 25 N.m (18 lb ft)  |
| Intake Manifold Support Bracket Fastener (2H0)               | 8 N.m (71 lb in)   |
| Starter Battery Negative Cable Ground Fastener               | 17 N.m (13 lb ft)  |
| Starter Battery Positive Cable Fastener                      | 13 N.m (115 lb in) |
| Starter Mounting Fastener (2H0, LDE, LUJ)                    | 25 N.m (18 lb ft)  |
| Starter Mounting Fastener (LE2)                              | 58 N.m (43 lb ft)  |
| Starter Mounting Fastener (LVL)                              | 22 N.m (16 lb ft)  |
| Starter Mounting Stud                                        | 25 N.m (18 lb ft)  |

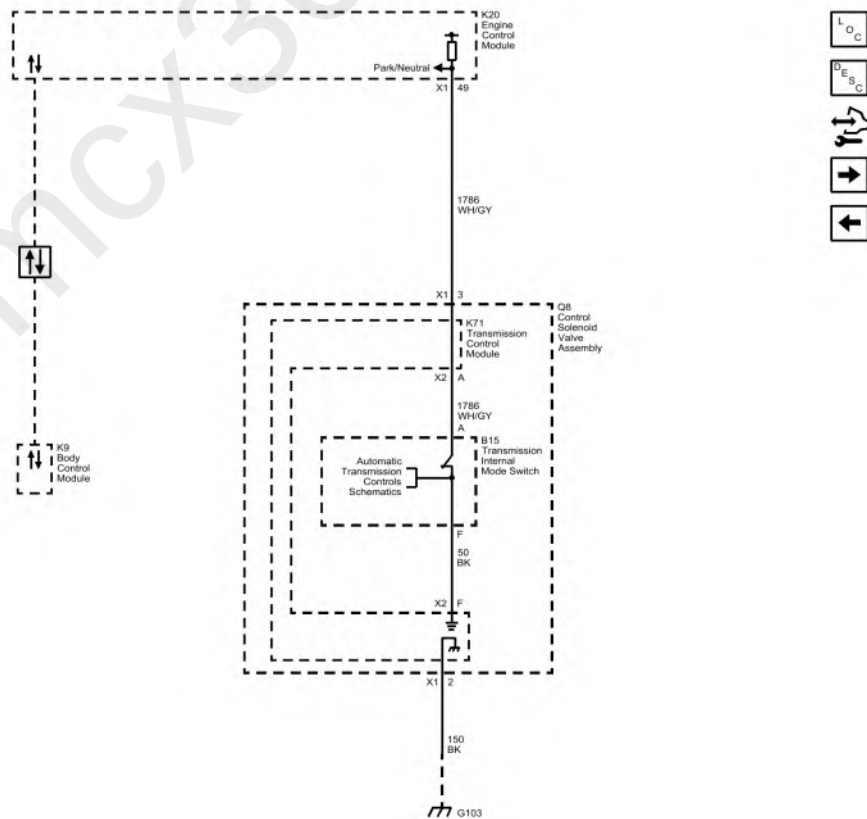
**SCHEMATIC WIRING DIAGRAMS****STARTING AND CHARGING WIRING SCHEMATICS (BUICK WITH LE2)**

Starting (Buick with LE2, page 1 of 2)



**Fig. 1: Starting (Buick with LE2, page 1 of 2)**  
 Courtesy of GENERAL MOTORS COMPANY

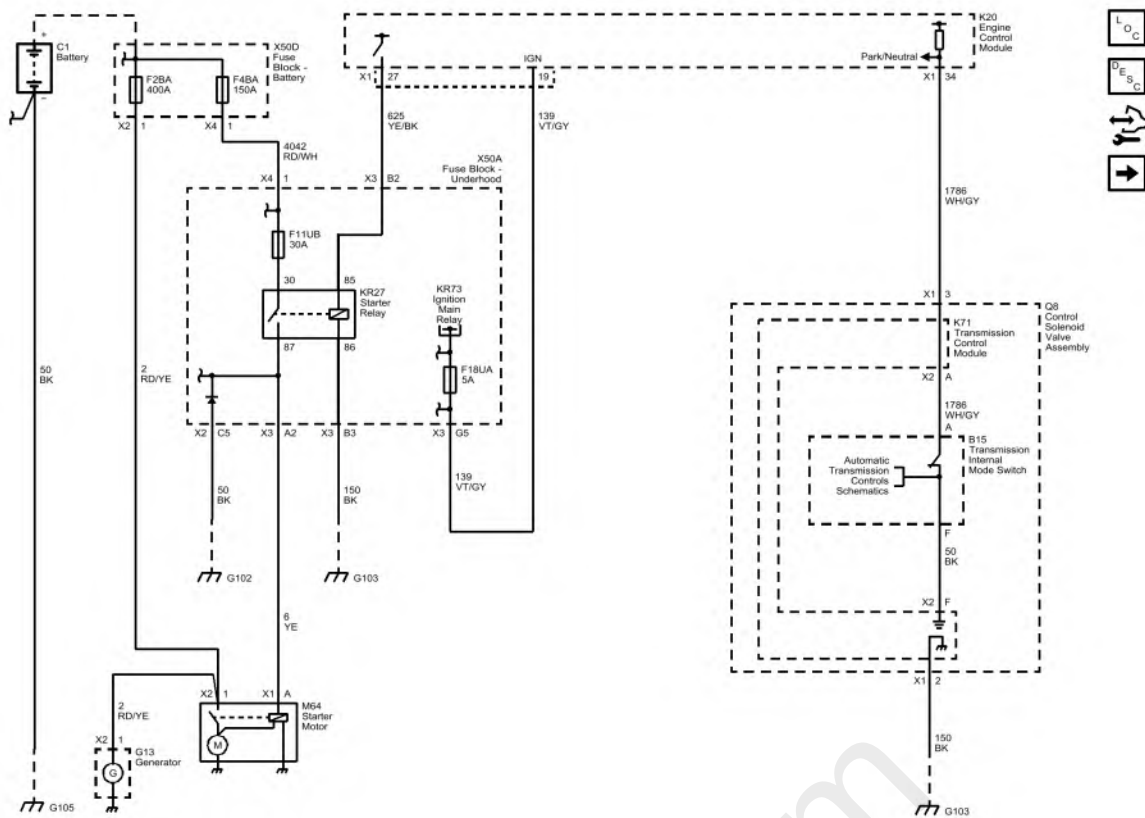
Starting (Buick with LE2, page 2 of 2)



**Fig. 2: Starting (Buick with LE2, page 2 of 2)**  
 Courtesy of GENERAL MOTORS COMPANY

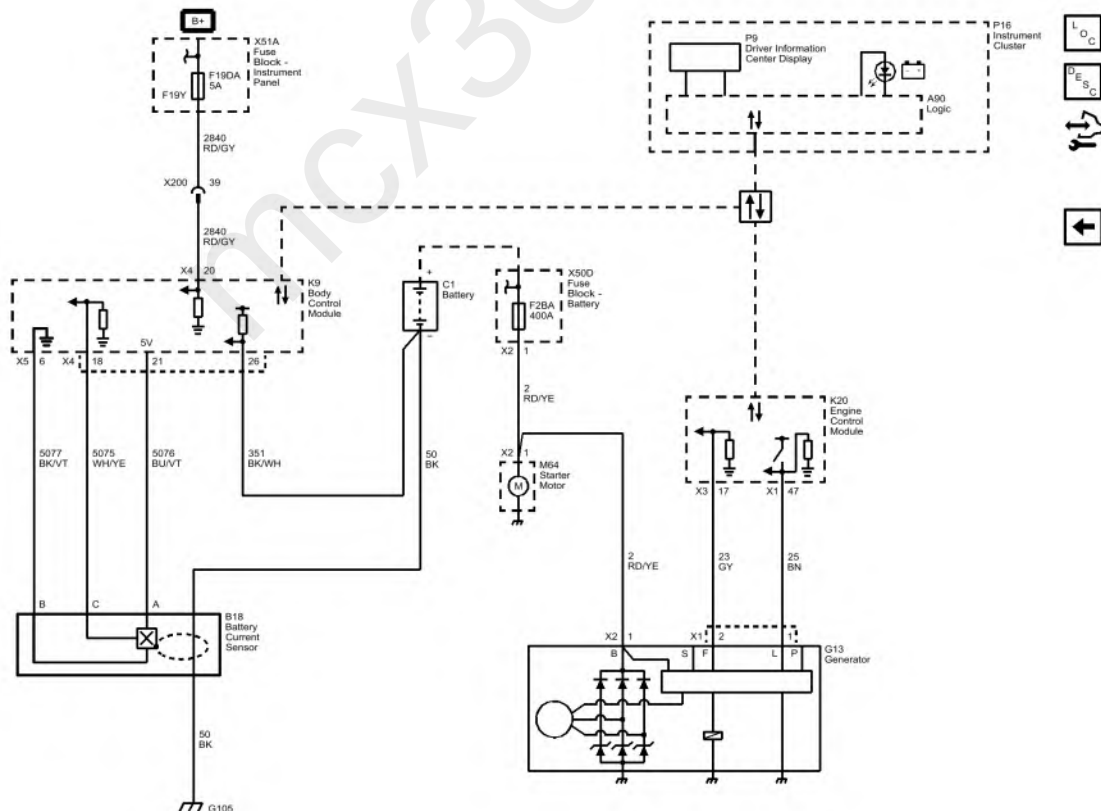
Charging (Buick with LE2)

### Starting (Buick with LUV)



**Fig. 5: Starting (Buick with LUV)**  
 Courtesy of GENERAL MOTORS COMPANY

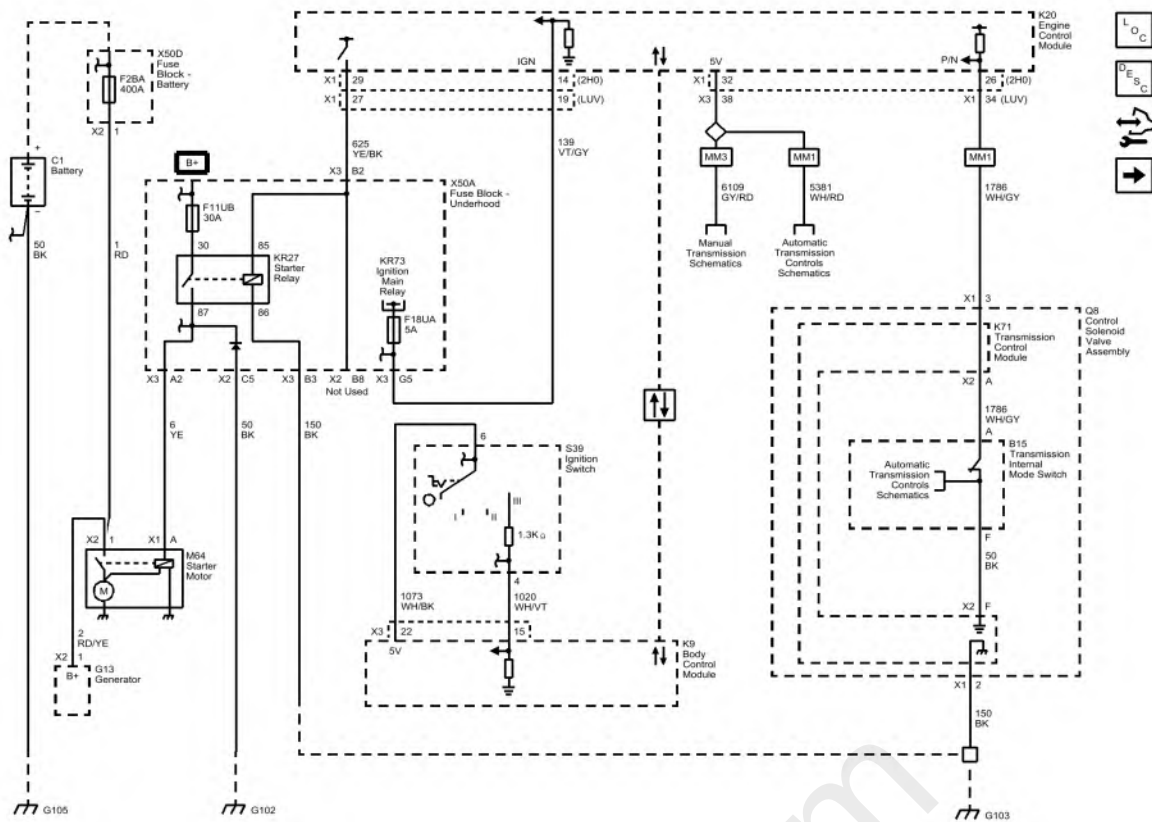
Charging (Buick with LUV)



**Fig. 6: Charging (Buick with LUV)**  
 Courtesy of GENERAL MOTORS COMPANY

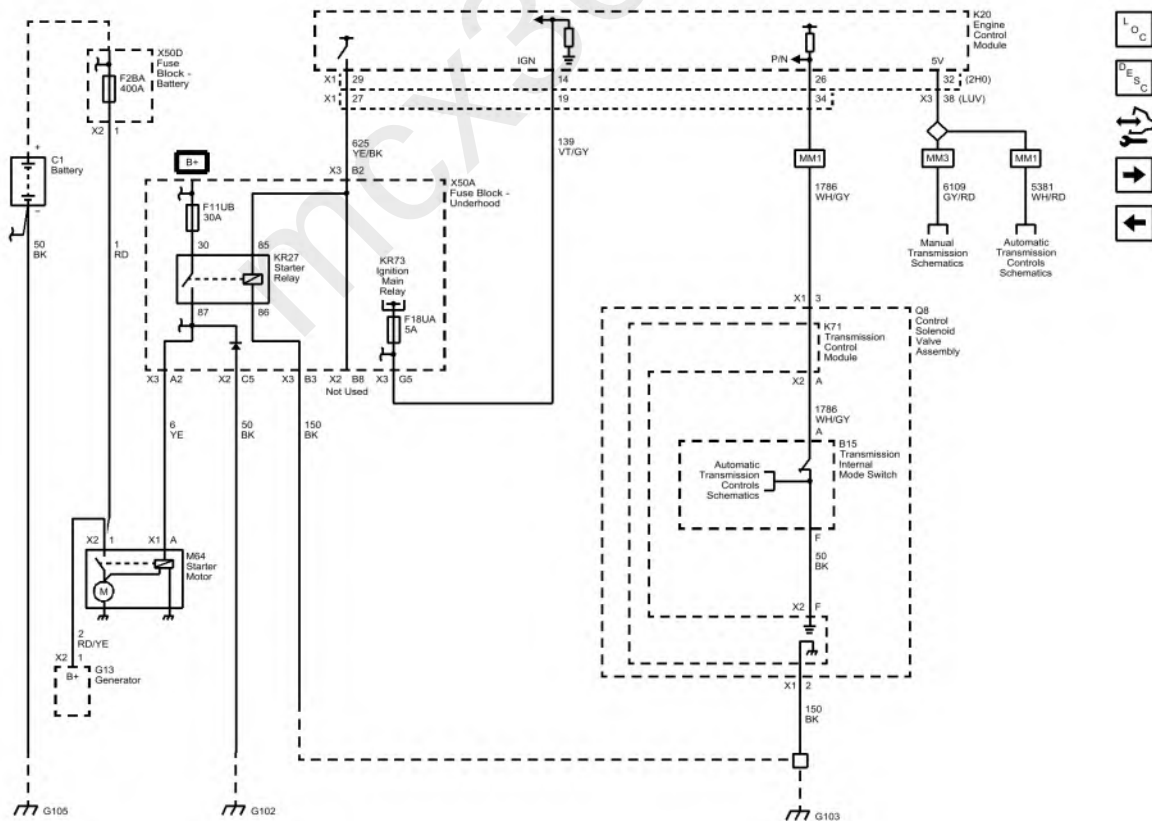
## STARTING AND CHARGING WIRING SCHEMATICS (CHEVROLET)

Starting (Chevrolet without BTM)



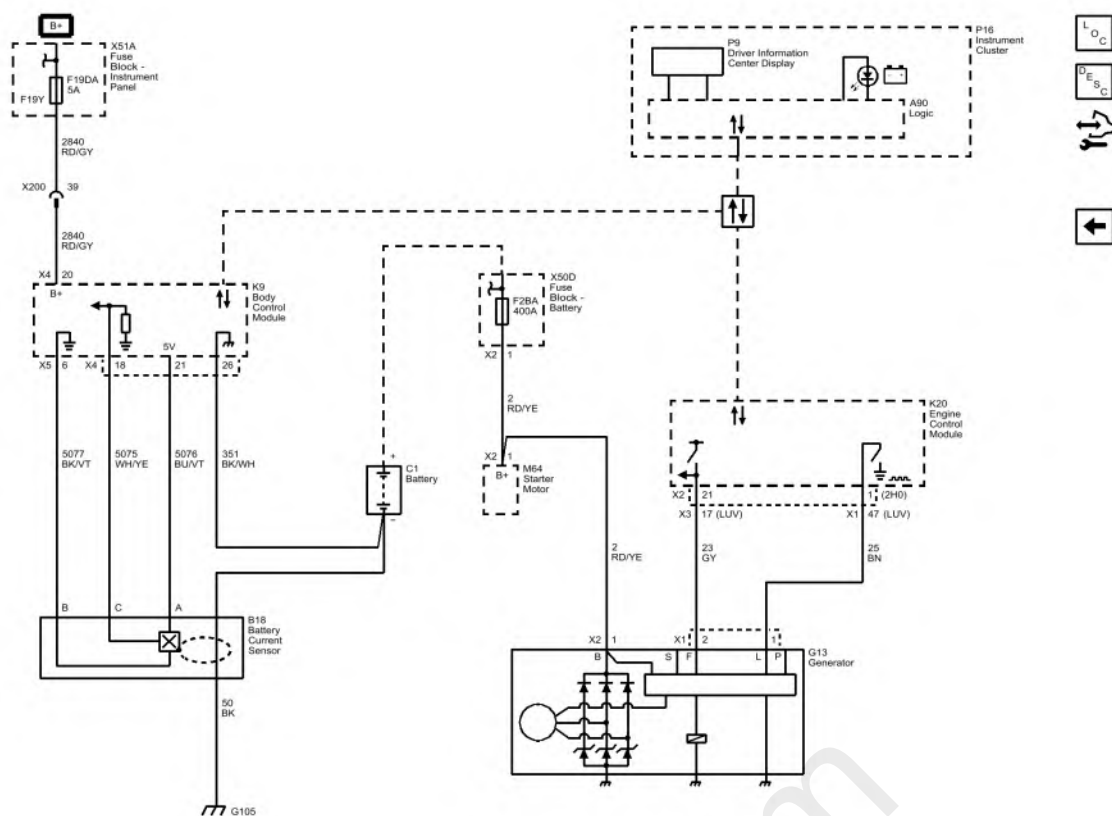
**Fig. 7: Starting (Chevrolet without BTM)**  
 Courtesy of GENERAL MOTORS COMPANY

Starting (Chevrolet with BTM)



**Fig. 8: Starting (Chevrolet with BTM)**  
 Courtesy of GENERAL MOTORS COMPANY

Charging (Chevrolet)



**Fig. 9: Charging (Chevrolet)**

Courtesy of GENERAL MOTORS COMPANY

## DIAGNOSTIC INFORMATION AND PROCEDURES

**DTC B1325, B1327-B1330, B1395, B1415, B1424, B1425, B1439, B1517, C0800, C0805, C0870, C0880, C0895, C0899, C0900, P0560, P0562, P0563, P0611, P129B, P129C, P15AE, OR P15AF: DEVICE/MODULE POWER**

### 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 B1325

Device Power Circuit Voltage

#### DTC B1327

Device Voltage Circuit

#### DTC B1328

Device Voltage Circuit

#### DTC B1329

Device Power Circuit Output

#### DTC B1330

Device Power 2 Circuit

**DTC B1395**

Control Module Voltage Reference Output 1

**DTC B1415**

Control Module Voltage Reference Output 3

**DTC B1424**

Control Module Power Circuit

**DTC B1425**

Control Module Power Circuit

**DTC B1439**

Intermittent Device Voltage

**DTC B1517**

Battery Voltage

**DTC C0800**

Device Power 1 Circuit Voltage

**DTC C0805**

Control Module Power 2 Circuit

**DTC C0870**

Control Module Voltage Reference

**DTC C0880**

Control Module Voltage Reference

**DTC C0895**

Device Voltage

**DTC C0899**

Device Voltage

**DTC C0900**

Device Voltage

**DTC P0560**

System Voltage Low

**DTC P0562**

System Voltage Low

**DTC P0563**

System Voltage High

**DTC P0611**

## **DTC P129B**

System Voltage Low

## **DTC P129C**

System Voltage High

## **DTC P15AE**

Fuel Injector Control Module System Voltage Low Voltage

## **DTC P15AF**

Fuel Injector Control Module System Voltage High Voltage

For symptom byte information refer to [Symptom Byte List](#) .

### **Circuit/System Description**

The vehicle control modules or sensors monitor the system voltage to verify the system voltage is within the normal operating range.

### **Conditions for Running the DTC**

The engine is running.

### **Conditions for Setting the DTC**

The control module or sensor detects a system voltage of less than approximately 9 V or greater than 16 V

### **Action Taken When the DTC Sets**

- A driver information center message and/or warning indicator may be displayed.
- The control module may be temporarily disabled.

### **Conditions for Clearing the DTC**

The system voltage returns to normal operating range.

### **Diagnostic Aids**

- A high or low voltage DTC set or voltage value in multiple modules/sensors indicates a concern in the charging system.
- A possible cause of this DTC could be overcharging with a battery charger or jump starting.

### **Reference Information**

Schematic Reference

### **Control Module References**

Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)** **COMPONENT CONNECTOR END VIEWS - INDEX (TRAX)**

Description and Operation

### **Charging System Description and Operation**

Electrical Information Reference

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

DTC Type Reference

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

Scan Tool Reference

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

### [Circuit/System Verification](#)

1. Ignition OFF, measure and record the battery voltage at the battery terminals.
2. Verify the battery voltage stabilizes between 12.4 and 12.8 V within a few minutes of turning the ignition OFF.

- **If battery voltage is less than 12.4 V or more than 12.8 V**

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

- **If battery voltage is between 12.4 and 12.8 V**

3. Engine running, headlights ON, measure and record the battery voltage at the battery terminals.
4. Verify the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.

- **If the voltage is not at least 1 V greater than the voltage measured in step 1 or is greater than 15 V.**

Refer to [Charging System Test](#).

- **If the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.**

5. Verify the appropriate control module battery voltage and ignition voltage parameters are available in the scan tool.

- **If parameters are not available in the scan tool**

Refer to Circuit/System Testing

- **If parameters are available in the scan tool**

6. Verify the appropriate control module scan tool battery voltage and ignition voltage parameters are within 1 V of the battery voltage.

- **If not within 1 V of the battery voltage**

Refer to Circuit/System Testing

- **If within 1 V of the battery voltage**

7. All OK.

### [Circuit/System Testing](#)

**NOTE:** Use the schematic to identify the following:

- Control modules the vehicle is equipped with
- The control module's ground, B+, and Ignition circuit terminal IDs and connectors

**NOTE:** Some control module ground circuits may require up to 20 min after the ignition is turned off before achieving a resistance reading of less than 5

**Ω. In most cases the readings will drop below 20 Ω within 1 min indicating the control module is going to sleep.**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the appropriate control module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
  - **If 10 Ω or greater**
    1. Ignition 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**
3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition 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. Ignition 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 appropriate control module.
  - **If the test lamp illuminates**
4. Ignition ON.
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ignition 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. Ignition OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the appropriate control module.
  - **If the test lamp illuminates**
6. Replace the control module.

### Repair Instructions

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

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

## DTC B1516: BATTERY CURRENT SENSOR

### Diagnostic Instructions

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

## DTC Descriptors

### DTC B1516 08

Battery Current Sensor Performance - Signal Invalid

### DTC B1516 66

Battery Current Sensor Incorrect Mounting

## Diagnostic Fault Information

| Circuit       | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------|-----------------|----------------------|------------------|--------------------|
| 5 V Reference | B1516 08        | B1516 08             | B1516 08         | -                  |
| Signal        | B1516 08        | B1516 08             | B1516 08         | B1516 08, B1516 66 |
| Low Reference | -               | B1516 08             | -                | -                  |

## Circuit/System Description

The battery current sensor is a 3-wire hall effect current sensor. The body control module (BCM) supplies 5 V and ground to the battery current sensor. The battery current sensor measures the amount of current flowing to or from the battery, and supplies a pulse width modulation (PWM) signal to the BCM.

## Conditions for Running the DTC

### B1516 08

The BCM is awake.

### B1516 66

- The BCM is awake.
- The engine is OFF.

## Conditions for Setting the DTC

### B1516 08

The battery current signal is less than 4% or greater than 96% duty cycle for 2 min.

### B1516 66

The battery current polarity is positive for 2 min.

## Action Taken When the DTC Sets

The regulated voltage control is disabled.

## Conditions for Clearing the DTC

The DTC passes when the battery current returns to the normal range for 15 s.

## Diagnostic Aids

DTC B1516 08 could be set by overcharging with a battery charger or jump starting.

## Reference Information

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

## COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE), COMPONENT CONNECTOR END VIEWS - INDEX (TRAX)

### Description and Operation

### Charging System Description and Operation

### Electrical Information Reference

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

### Scan Tool Reference

### Control Module References for scan tool information

### Circuit/System Testing

#### **B1516 08**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B18 Battery Current Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 30  $\Omega$  between the low reference circuit terminal B and ground.
  - **If 30  $\Omega$  or greater**
    1. Ignition OFF, disconnect the X5 harness connector at the K9 Body Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K9 Body Control Module.
  - **If less than 30  $\Omega$**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal A and ground.
  - **If less than 4.8 V**
    1. Ignition OFF, disconnect the X4 harness connector at the K9 Body 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  $\Omega$  in the 5V reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K9 Body Control Module.
  - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
  - **If between 4.8-5.2 V**
5. Test for 4.8-5.2 V between the signal circuit terminal C and ground.
  - **If less than 4.8 V**
    1. Ignition OFF, disconnect the X4 harness connector at the K9 Body 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  $\Omega$  in the signal circuit end to end.
    - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
    - If less than 2  $\Omega$ , replace the K9 Body Control Module.
  - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
  - **If between 4.8-5.2 V**
6. Test or replace the B18 Battery Current Sensor.

## B1516 66

1. Verify that the B18 Battery Current Sensor is installed securely around the negative battery cable, with the tape tab pointing away from the negative terminal on the C1 Battery.
  - **If the B18 Battery Current Sensor is not installed correctly**  
Remove and reinstall the B18 Battery Current Sensor properly.
  - **If the B18 Battery Current Sensor is installed correctly**
2. Replace the B18 Battery Current Sensor.

## Repair Instructions

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

- Refer to [Battery Positive and Negative Cable Replacement \(LUV\)](#)[Battery Positive and Negative Cable Replacement \(2H0\)](#)[Battery Positive and Negative Cable Replacement \(LE2\)](#)
- Refer to [Control Module References](#) for BCM replacement, programming and setup.

## DTC B151A: BATTERY CAPACITY 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 B151A 58

Battery Capacity Performance

### Circuit/System Description

The body control module (BCM) monitors the battery voltage level during an engine crank event to detect a low battery voltage condition.

### Conditions for Running the DTC

The vehicle is ON

### Conditions for Setting the DTC

A minimum crank battery voltage is less than the minimum crank battery voltage threshold for 16 consecutive crank events.

## Action Taken When the DTC Sets

A driver information center message is displayed.

## Conditions for Clearing the DTC

The DTC will clear if the minimum crank voltage is greater than the minimum crank voltage threshold during a crank event.

## Reference Information

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

## Charging System Description and Operation

Electrical Information Reference

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

Scan Tool Reference

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

## Circuit/System Verification

1. Verify DTC P0621 or P0622 is not set.
  - If DTC P0621 or P0622 is set  
Refer to [DTC P0621](#), or [DTC P0622](#)
  - If DTC P0621 or P0622 is not set
2. Perform the [Battery Inspection/Test](#).

## DTC B1527: PARASITIC LOAD

### 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 B1527 00

Parasitic Load

### Circuit/System Description

The body control module (BCM) monitors the state of charge of the electrical system.

## Conditions for Running the DTC

The ignition is in Accessory or Run mode.

## Conditions for Setting the DTC

The state of charge at ignition ON is 30% lower than when the engine was running and battery drain is more than 2 A.

## Action Taken When the DTC Sets

There is no battery telltale illuminated or DIC message displayed.

## Conditions for Clearing the DTC

- The DTC will clear if the fault does not return after 50 consecutive ignition cycles.
- The DTC will clear when run state of charge is greater than or equal to 80%.

## Reference Information

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

## [Charging System Description and Operation](#)

Electrical Information Reference

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

Scan Tool Reference

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

## Circuit/System Verification

Refer to [Battery Electrical Drain/Parasitic Load Test](#).

## **DTC P0561: SYSTEM VOLTAGE PERFORMANCE**

### Diagnostic Instructions

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

## DTC Descriptors

### **DTC P0561**

System Voltage Performance

For symptom byte information, refer to [Symptom Byte List](#).

### **Circuit/System Description**

The control module requires a switched ignition voltage input to operate. The module continuously monitors the ignition voltage.

### **Conditions for Running the DTC**

The engine speed is 400 RPM or greater.

### **Conditions for Setting the DTC**

The control module detects ignition voltage 6.5 V or less. or a variation in ignition voltage 10 V or greater.

### **Action Taken When the DTC Sets**

- DTC P0561 is a Type C DTC.

### **Conditions for Clearing the DTC**

DTC P0561 is a Type C DTC.

### **Diagnostic Aids**

- A defective vehicle battery may allow this code to set.
- A defective vehicle charging system may allow this code to set.
- You may have to drive the vehicle in order to experience a condition.
- Although this DTC could indicate an internal voltage condition within the ECM, in most cases, the ECM is not at fault. Investigate thoroughly prior to replacing the ECM.

### **Reference Information**

Schematic Reference

### **Control Module References**

Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE). COMPONENT CONNECTOR END VIEWS - INDEX (TRAX).**

Description and Operation

### **Charging System Description and Operation**

Electrical Information Reference

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

DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**Control Module References** for scan tool information

### **Circuit/System Verification**

1. Ignition ON
2. Engine running, accessories OFF

3. Test for 12.6-15.0 V between the battery positive terminal and negative terminal.

- **If not within 12.6-15.0 V**

Refer to [Charging System Test](#).

- **If within 12.6-15.0 V**

4. Verify the scan tool BCM Battery Voltage parameter is within a value of 2 V of the battery terminal voltage.

- **If not within a value of 2 V**

Refer to Circuit/System Testing.

- **If within a value of 2 V**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

6. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

7. All OK.

### Circuit/System Testing

**NOTE:** Use the schematic to identify the following:

- **Control modules the vehicle is equipped with**
- **The control modules ground, B+, and Ignition circuit terminal IDs and connectors**

**NOTE:** Some control module ground circuits may require up to 20 minutes after the ignition is turned off before achieving a resistance reading of less than 5  $\Omega$ . In most cases the readings will drop below 20  $\Omega$  between 1 minute indicating the control module is going to sleep.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the appropriate control module. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 10  $\Omega$  between each ground circuit terminal and ground.

- **If 10  $\Omega$  or greater**

1. Ignition OFF.

2. Test for less than 2  $\Omega$  in the ground circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.

- **If less than 10  $\Omega$**

3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

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

1. Ignition OFF.

2. Test for less than 2  $\Omega$  in the B+ circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , 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. Ignition 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 appropriate control module.
  - **If the test lamp illuminates**
4. Ignition ON.
  5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
      1. Ignition OFF.
      2. Test for less than 2  $\Omega$  in the ignition circuit end to end.
        - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
        - If less than 2  $\Omega$ , 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. Ignition OFF.
      2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the appropriate control module.
    - **If the test lamp illuminates**
  6. Replace the control module.

### Repair Instructions

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

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

## DTC P0615, P0616, OR P0617: STARTER RELAY CONTROL CIRCUIT (WITHOUT KL9)

### 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 P0615

Starter Relay Control Circuit

#### DTC P0616

Starter Relay Control Circuit Low Voltage

#### DTC P0617

Starter Relay Control Circuit High Voltage

### Diagnostic Fault Information

| Circuit                                                                                                           | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|-------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------------------|--------------------|
| Relay Switch B+ Terminal 30                                                                                       | 1               | 2                    | -                | -                  |
| Relay Coil Ignition Terminal 85                                                                                   | P0616           | P0615                | P0617            | -                  |
| Relay Switch Control Terminal 87                                                                                  | 2               | 2                    | 3                | -                  |
| Relay Coil Ground Terminal 86                                                                                     | -               | P0615                | -                | -                  |
| 1. Opens fuse, Starter Solenoid does not click.<br>2. Starter Solenoid does not click.<br>3. Cranks all the time. |                 |                      |                  |                    |

## **Circuit/System Description**

When the ignition is activated to start the vehicle, a discrete signal is supplied to the body control module (BCM). The BCM then sends a message to the engine control module (ECM) that crank has been requested. The ECM then verifies that the clutch pedal is pressed or the transmission is in park/neutral. If it is, the ECM then supplies 12 V to the control circuit of the starter relay. When this occurs, battery voltage is supplied through the switch of the starter relay to the starter solenoid.

## **Conditions for Running the DTC**

- The ignition is activated to START.
- The system voltage is between 9.5-18 V.

## **Conditions for Setting the DTC**

The ECM detects improper voltage on the control circuit of the starter relay.

## **Action Taken When the DTC Sets**

DTC P0615, P0616, and P0617 are C type DTCs.

## **Conditions for Clearing the DTC**

DTC P0615, P0616, and P0617 are C type DTCs.

## **Reference Information**

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUY\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

## **Starting System Description and Operation**

Electrical Information Reference

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

DTC Type Reference

## **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

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

## **Circuit/System Testing**

1. Ignition OFF and all vehicle systems OFF, disconnect the KR27 Starter Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10  $\Omega$  between the ground circuit terminal 86 and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF.

2. Test for less than 2  $\Omega$  in the ground circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.

- **If less than 10  $\Omega$**

3. Ignition ON.

4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.

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

1. Ignition OFF.

2. Test for less than 2  $\Omega$  in the B+ circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , verify the fuse is good and there is voltage at the fuse.

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

1. Ignition 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,

3. Test for infinite resistance between the control circuit terminal 87 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the M64 Starter Motor.

- **If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 85 and the ground circuit terminal 86.

**NOTE:** If the Starter Relay command is not available in the scan tool, verify the test lamps turns on and off when cycling the ignition between the OFF and CRANK position with the parking brake set and clutch pedal pressed (manual transmission) or the transmission in park (automatic transmission).

6. Verify the test lamp turns ON and OFF when commanding the Starter Relay ON and OFF with a scan tool.

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

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2  $\Omega$  in the control circuit end to end.

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

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

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

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 K20 Engine Control Module.

- **If the test lamp turns ON and OFF**

7. Ignition ON, connect a 30 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.

8. Verify the M64 Starter Motor is activated.

- **If the M64 Starter Motor does not activate**

1. Ignition OFF, disconnect the harness connector at the M64 Starter Motor.

2. Test for infinite resistance between the control circuit terminal A X1 or 1 X1 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance
3. Test for less than 2  $\Omega$  in the control circuit end to end.
    - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
    - If less than 2  $\Omega$ , replace the M64 Starter Motor.
  - **If the M64 Starter Motor activates**
9. Test or replace the KR27 Starter Relay.

## Component Testing

### Relay Test

1. Ignition OFF, disconnect the appropriate relay.
2. Test for 70-150  $\Omega$  between terminals (85 or 1) and (86 or 2).
  - **If less than 70 or greater than 150  $\Omega$**   
Replace the relay.
  - **If between 70-150  $\Omega$**
3. Test for infinite resistance between the terminals listed below:
  - (30 or 3) and (86 or 2)
  - (30 or 3) and (87 or 5)
  - (30 or 3) and (85 or 1)
  - (85 or 1) and (87 or 5)
  - (86 or 2) and (87 or 5)
  - **If less than infinite resistance**  
Replace the relay.
  - **If infinite resistance**
4. Install a 3 A fused jumper wire between relay terminal (85 or 1) and 12 V. Install a jumper wire between relay terminal (86 or 2) and ground.
5. Test for less than 5.0  $\Omega$  between terminals (30 or 3) and (87 or 5).
  - **If 5.0  $\Omega$  or greater**  
Replace the relay.
  - **If less than 5.0  $\Omega$**
6. All OK

## Repair Instructions

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

- Refer to [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#).
- Refer to [Control Module References](#) for control module replacement, programming, and setup.

## DTC P0615, P0616, OR P0617: STARTER RELAY CONTROL CIRCUIT (KL9)

### 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 P0615

### Starter Relay Control Circuit

## DTC P0616

### Starter Relay Control Circuit Low Voltage

## DTC P0617

### Starter Relay Control Circuit High Voltage

#### Diagnostic Fault Information

| Circuit                                                                            | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|------------------------------------------------------------------------------------|-----------------|----------------------|------------------|--------------------|
| Relay Switch B+ Terminal 30                                                        | 1               | 2                    | -                | -                  |
| Relay Coil IGN Terminal 85                                                         | 1               | 2                    | -                | -                  |
| Relay Switch Control Terminal 87                                                   | 2               | 2                    | 3                | -                  |
| Relay Coil Control Terminal 86                                                     | P0616           | P0615                | P0617            | -                  |
| 1. Opens fuse, starter inop.<br>2. Starter inop.<br>3. Starter spins all the time. |                 |                      |                  |                    |

#### Circuit/System Description

When the ignition is activated to start the vehicle, a discrete signal is supplied to the body control module (BCM). The BCM then sends a message to the engine control module (ECM) that crank has been requested. The ECM then verifies that the clutch pedal is pressed or the transmission is in park/neutral. If it is, the ECM then applies ground to the control circuit of the KR27 Starter Relay. When this occurs, battery voltage is supplied through the switch of the starter relay to the starter solenoid.

#### Conditions for Running the DTC

- The ignition is activated to START.
- The system voltage is between 9.5-18 V.

#### Conditions for Setting the DTC

The ECM detects improper voltage on the control circuit of the KR27 Starter Relay.

#### Action Taken When the DTC Sets

DTC P0615, P0616, and P0617 are C type DTCs.

#### Conditions for Clearing the DTC

DTC P0615, P0616, and P0617 are C type DTCs.

#### Reference Information

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)[COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

### Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)
- [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)

### DTC Type Reference

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

### Scan Tool Reference

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

### Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the KR27 Starter Relay. It may take up to 2 min for all vehicle systems to power down.
2. Ignition ON.
3. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is good and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition 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,
    3. Disconnect the X1 harness connector at the M64 Starter Motor.
    4. Test for infinite resistance between the control circuit terminal 87 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the M64 Starter Motor.
  - **If the test lamp illuminates**
4. Ignition ON, verify a test lamp illuminates between the IGN circuit terminal 85 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is good and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace KR27 Starter Relay
  - **If the test lamp illuminates**
5. Connect a test lamp between the IGN circuit terminal 85 and the control circuit terminal 86.

**NOTE:**

If the Starter Relay command is not available in the scan tool, verify the test lamp turns on and off when cycling the ignition between the OFF and CRANK position with the parking brake set and clutch pedal pressed (manual transmission) or the transmission in park (automatic transmission).

6. Verify the test lamp turns ON and OFF when commanding the Starter Relay ON and OFF with a scan tool.

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

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module and the harness connector at the T19 Power Supply Transformer, Ignition ON.

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,

3. Test for less than 2  $\Omega$  in the control circuit end to end.

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

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

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module and the harness connector at the T19 Power Supply Transformer.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module

- **If the test lamp turns ON and OFF**

7. Ignition ON, connect a 30 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.

8. Verify the M64 Starter Motor is activated.

- **If the M64 Starter Motor does not activate**

1. Ignition OFF, disconnect the X1 harness connector at the M64 Starter Motor.

2. Test for infinite resistance between the control circuit terminal 87 ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2  $\Omega$  in the control circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the M64 Starter Motor.

- **If the M64 Starter Motor activates**

9. Test or replace the KR27 Starter Relay.

## Component Testing

### Relay Test

1. Ignition OFF, disconnect the appropriate relay.

2. Test for 70-150  $\Omega$  between terminals (85 or 1) and (86 or 2).

- **If less than 70 or greater than 150  $\Omega$**

Replace the relay.

- **If between 70-150  $\Omega$**

3. Test for infinite resistance between the terminals listed below:

- (30 or 3) and (86 or 2)
- (30 or 3) and (87 or 5)
- (30 or 3) and (85 or 1)

- (85 or 1) and (87 or 5)
- (86 or 2) and (87 or 5)
- **If less than infinite resistance**

Replace the relay.

- **If infinite resistance**

4. Install a 3 A fused jumper wire between relay terminal (85 or 1) and 12 V. Install a jumper wire between relay terminal (86 or 2) and ground.

5. Test for less than 5.0  $\Omega$  between terminals (30 or 3) and (87 or 5).

- **If 5.0  $\Omega$  or greater**

Replace the relay.

- **If less than 5.0  $\Omega$**

6. All OK

### Repair Instructions

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

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

## DTC P0621: GENERATOR L-TERMINAL CIRCUIT

### Diagnostic Instructions

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

### DTC Descriptor

#### DTC P0621

Generator L-Terminal Circuit

### Diagnostic Fault Information

| Circuit              | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|----------------------|-----------------|----------------------|------------------|--------------------|
| B+                   | -               | P0621                | -                | -                  |
| Control - L Terminal | P0621           | P0621                | P0621            | -                  |
| Signal - F Terminal  | P0622           | P0622                | P0622            | P0622              |

### Circuit/System Description

The engine control module (ECM) uses the generator turn on control circuit to control the load of the generator on the engine. A high side driver in the ECM applies a duty cycled voltage to the voltage regulator. The duty cycle controls the voltage regulator to turn the field circuit on and off. The ECM monitors the state of the generator turn on control circuit. The ECM should detect low voltage on the generator turn on control circuit when the ignition is ON and the engine is off, or when the charging system malfunctions. With the engine running, the ECM should detect high voltage on the generator turn on control circuit when the duty cycle voltage is commanded high and a low voltage when the duty cycle voltage is commanded low.

### Conditions for Running the DTC

- Ignition ON, engine OFF (Prior to Ignition ON, the ignition must have been OFF for at least 5 seconds)
- The engine is running for the run test

### Conditions for Setting the DTC

- Ignition ON, engine OFF - The ECM detects greater than 3.5 V on the generator control circuit for 5 seconds.
- Engine running - The ECM detects a low voltage for 15 seconds on the generator control circuit when the duty cycle voltage is commanded high.
- Engine running - The ECM detects a high voltage for 15 seconds on the generator control circuit when the duty cycle voltage is commanded low.

### Action Taken When the DTC Sets

DTC P0621 is a type C DTC.

### Conditions for Clearing the DTC

- Ignition ON, engine OFF - Low voltage.
- Engine running - A control signal duty cycle is detected.

### Reference Information

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

### [Charging System Description and Operation](#)

Electrical Information Reference

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

DTC Type Reference

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

Scan Tool Reference

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

### Circuit/System Verification

1. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
2. Verify the DTC does not set.
  - **If the DTC sets**  
  
Refer to Circuit/System Testing.
  - **If the DTC does not set**
3. All OK.

### Circuit/System Testing

1. Verify a test lamp illuminates between the G13 Generator B+ circuit terminal A X2, B X2 or 1 X2 and ground.

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

1. Remove the test lamp and disconnect the B+ cable at the G13 Generator.

2. Test for less than 2  $\Omega$  in the B+ circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , verify the fuse is not open and there is voltage at the fuse.

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

1. Remove the test lamp, disconnect the battery negative cable, and disconnect the G13 Generator B+ cable.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace G13 Generator.

- **If the test lamp illuminates**

2. Disconnect the X1 harness connector at the G13 Generator, engine running.

3. Test for 1 V or greater between the control circuit terminal 1 and ground.

- **If less than 1 V**

1. Ignition OFF, disconnect the harness connectors at the K20 Engine Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2  $\Omega$  in the control circuit end to end.

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

- **If 1V or greater**

4. Ignition OFF, disconnect the harness connectors at the K20 Engine Control Module, Ignition ON.

5. Test for less than 1 V between the G13 Generator control circuit terminal 1 and ground.

- **If greater than 1 V**

Repair the short to voltage on the circuit.

- **If 1V or less**

6. Test or replace the G13 Generator.

## Repair Instructions

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

- Refer to [Generator Replacement \(2H0\)Generator Replacement \(LUV\)Generator Replacement \(LE2\)](#)
- Refer to [Control Module References](#) for control module replacement, programming, and setup

## DTC P0622: GENERATOR F-TERMINAL CIRCUIT

### Diagnostic Instructions

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

### DTC Descriptor

### DTC P0622

Generator F-Terminal Circuit

## Diagnostic Fault Information

| Circuit              | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|----------------------|-----------------|----------------------|------------------|--------------------|
| B+                   | -               | P0621                | -                | -                  |
| Control - L Terminal | P0621           | -                    | P0621            | -                  |
| Signal - F Terminal  | P0622           | -                    | P0622            | P0622              |

### Circuit/System Description

The engine control module (ECM) uses the generator field duty cycle signal circuit, or F-terminal circuit, to monitor the duty cycle of the generator. The generator field duty cycle signal circuit connects to high side of the field windings in the generator. A pulse width modulated (PWM) high side driver in the voltage regulator turns the field windings on and off. The ECM uses the PWM signal input to determine the generator load on the engine. This allows the ECM to adjust the idle speed to compensate for high electrical loads. The ECM monitors the status of the generator field duty cycle signal circuit. When the ignition is ON and the engine is off, the ECM should detect a duty cycle near 0%. When the engine is running, the duty cycle should be between 5-99%.

### Conditions for Running the DTC

- Ignition ON, engine OFF (Prior to Ignition ON, the ignition must have been OFF for at least 5 s)
- Engine running at less than 3,000 RPM

### Conditions for Setting the DTC

- DTC P0621 is not set
- Ignition ON, engine OFF (Prior to Ignition ON, the ignition must have been OFF for at least 5 s), the ECM detects a PWM signal that is greater than 65% for 5 s
- Engine running at less than 3,000 RPM - The ECM detects a PWM signal that is less than 5% for 30 s

### Action Taken When the DTC Sets

DTC P0622 is a type C DTC

### Conditions for Clearing the DTC

- Ignition ON, Engine OFF - Low/no PWM signal detected
- Engine running - A 5-90% duty cycle is detected

### Reference Information

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

### [Charging System Description and Operation](#)

Electrical Information Reference

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

- [Wiring Repairs](#)

DTC Type Reference

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

Scan Tool Reference

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

## [Circuit/System Verification](#)

**NOTE:** Do not have a battery charger connected during the generator testing.

1. Engine running.
2. Verify the scan tool Engine Control Module Generator F-Terminal Signal parameter is between 5-90%.
  - **If not between 5-90%**  
Refer to Circuit/System Testing.
  - **If between 5-90%**
3. Verify the scan tool Generator F-Terminal Signal parameter changes when commanding the headlamps ON and OFF.
  - **If the parameter does not change**  
Refer to Circuit/System Testing.
  - **If the parameter changes**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
  - **If the DTC sets**  
Refer to Circuit/System Testing.
  - **If the DTC does not set**
6. All OK.

## [Circuit/System Testing](#)

1. Verify a test lamp illuminates between the G13 Generator B+ circuit terminal A X1, A X2, B X2, 1 X1 or 1 X2 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Remove the test lamp and disconnect the B+ cable at the G13 Generator.
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Remove the test lamp, disconnect the battery negative cable, and disconnect the G13 Generator B+ cable.
    2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, test or replace the G13 Generator.
  - **If the test lamp illuminates**
2. Ignition Off, Disconnect the X1 harness connector at the G13 Generator, engine running.
3. Verify the scan tool Engine Control Module Generator F-Terminal Signal parameter is less than 5%.

- **If 5% or greater**
  1. Ignition OFF, disconnect the appropriate harness connector at the K20 Engine Control Module, ignition ON.
  2. Test for less than 1 V between the signal circuit terminal 2 and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K20 Engine Control Module.
  - **If less than 5%**
- 4. Install a 3 A fused jumper wire between the signal circuit terminal 2 and B+, engine running.
- 5. Verify the scan tool Engine Control Module Generator F-Terminal Signal parameter is greater than 95%.
  - **If 95% or less**
    1. Ignition OFF, remove the jumper wire, disconnect the appropriate harness connector at the K20 Engine 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  $\Omega$  in the signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
    - **If greater than 95%**
  - 6. Test or replace the G13 Generator.

### Repair Instructions

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

- Refer to [Generator Replacement \(2H0\)Generator Replacement \(LUV\)Generator Replacement \(LE2\)](#)
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup

## DTC P155E, P155F, OR P156E: DC/DC CONVERTER

### 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 P155E

DC/DC Converter Actuator Voltage Signal Message Counter Incorrect

#### DTC P155F

DC/DC Converter Performance Signal Message Counter Incorrect

#### DTC P156E

DC/DC Converter Crank Control Signal Message Counter Incorrect

### Circuit/System Description

The power supply transformer is used to boost battery voltage to sensitive loads during engine restart. It provides two voltage outputs that provide the boosted voltage. The power supply transformer communicates to the ECM, and the ECM sets faults for any mismatch between alive rolling counts and protection values.

## Conditions for Running the DTC

Engine running

## Conditions for Setting the DTC

### P155E

The ECM detects an error in the communication of the DC/DC converter actuator voltage signal for greater than 10 counts.

### P155F

The ECM detects an error in the communication of the DC/DC converter internal health signal for greater than 10 counts.

### P156E

The ECM detects an error in the communication of the DC/DC converter crank control terminal signal for greater than 10 counts.

## Action Taken When the DTC Sets

- DTC P155E, DTC P155F, and DTC P156E are type B DTCs.

## Conditions for Clearing the DTC

- DTC P155E, DTC P155F, and DTC P156E are type B DTCs.

## Reference Information

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

[Stop/Start System Description and Operation \(KL9 with LE2\)](#)

Electrical Information Reference

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

DTC Type Reference

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

Scan Tool Reference

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

## Circuit/System Verification

1. Ignition ON.
2. Verify that no other DTCs are set except for DTC P155E, DTC P155F, or DTC P156E

- If any other DTCs are set

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

- If no other DTCs are set

3. Replace the T19 Power Supply Transformer.

4. Verify DTC P155E, DTC P155F, or DTC P156E does not set while operating the vehicle within the conditions for running the DTC.

- If any of the DTCs are set

Replace the K20 Engine Control Module.

- If none of the DTCs are set

5. All OK

### Repair Instructions

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

- Refer to [Multifunction Power Supply Converter Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming, and setup

## DTC P15A3: STOP/START SELECT SWITCH CIRCUIT SIGNAL MESSAGE COUNTER INCORRECT

### Diagnostic Instructions

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

### DTC Descriptor

#### DTC P15A3 00

Stop/Start Select Switch Circuit Signal Message Counter Incorrect

### Circuit/System Description

The engine control module (ECM) receives the stop/start switch speed signal via serial data from the body control module (BCM).

### Conditions for Running the DTC

- The ignition is ON.
- The DTCs run continuously once the above condition is met.

### Conditions for Setting the DTC

The ECM receives an invalid stop/start switch status serial data message from the BCM.

### Action Taken When the DTC Sets

DTC P15A3 00 is a Type C DTC.

### Conditions for Clearing the DTC

DTC P15A3 00 is a Type C DTC.

### Reference Information

Schematic Reference

- [Starting and Charging Schematics \(Buick with LE2\)Starting and Charging Schematics \(Buick with LUV\)Starting and Charging Schematics \(Chevrolet\)](#)

Connector End View Reference

## [COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\) COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

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](#)

### [Circuit/System Verification](#)

1. Ignition ON
2. Verify no DTCs are set in the K9 Body Control Module.
  - **If any DTCs are set**  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
  - **If no DTCs are set**
3. Verify the scan tool Stop/Start Select Switch parameter changes between Active and Inactive when pressing and releasing the ECO switch.
  - **If the parameter does not change**  
Refer to Circuit/System Testing
  - **If the parameter changes**
4. All OK.

### [Circuit/System Testing](#)

1. Ignition OFF, disconnect the harness connector at the S126 Drive Mode Select Switch.
2. Test for less than 10  $\Omega$  between the ground circuit terminal 9 and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  at the ground circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.
  - **If less than 10  $\Omega$**
3. Ignition ON, verify with a scan tool the Engine Control Module Stop/Start Select Switch parameter is No.
  - **If the parameter is YES**
    1. Ignition OFF, disconnect the harness connector X3 at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground at the circuit.
      - If infinite resistance, replace the K9 Body Control Module.

- **If the parameter is NO**

4. Install a 3 A fused jumper wire between the signal circuit terminal 7 and ground. Verify the ECM scan tool Stop/Start Select Switch parameter is Yes.

- **If the parameter is NO**

1. Ignition OFF.
2. Disconnect the harness connector X3 at the K9 Body Control Module.
3. Test for less than 1 V the signal circuit and ground.
  - If greater than 1 V, repair the short to voltage.
  - If less than 1 V, replace the K9 Body Control Module.

- **If the parameter is YES**

5. Replace the S126 Drive Mode Select Switch.

### Repair Instructions

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

- Refer to [Vehicle Stability Control System Switch Replacement \(Buick\)](#), [Vehicle Stability Control System Switch Replacement \(Chevrolet\)](#).
- Refer to [Control Module References](#) for control module replacement, programming and setup.

## DTC P15FF: BATTERY MONITOR SENSOR SIGNAL MESSAGE COUNTER INCORRECT

### Diagnostic Instructions

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

### DTC Descriptor

#### DTC P15FF

Battery Monitor Sensor Signal Message Counter Incorrect

### Circuit/System Description

The battery sensor module monitors battery module performs internal diagnostics. The battery sensor module also communicates to the ECM, and the ECM sets faults for any errors in the reported alive rolling counts.

### Conditions for Running the DTC

- The system voltage is above 11.00 V
- Engine running

### Conditions for Setting the DTC

#### DTC P15FF

The battery sensor module detects an internal fault, or an error in communication of the alive rolling count is detected for greater than 10 counts.

### Action Taken When the DTC Sets

- DTC P15FF is a type B DTC.

### Conditions for Clearing the DTC

- DTC P15FF is a type B DTC.

### Reference Information

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

[Charging System Description and Operation](#)

Electrical Information Reference

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

DTC Type Reference

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

Scan Tool Reference

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

**Circuit/System Verification**

1. Ignition ON.
2. Verify DTC P15FF is not set.
  - **If the DTC is set**
    1. Replace the B110 Battery Sensor Module
  - **If the DTC is not set**
3. All OK

**Repair Instructions**

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

Refer to [Battery Sensor Replacement \(KL9\)](#) for Battery Sensor Module replacement

**DTC P058A-P058F, P16D4-P16D6, P16DC-P16DF, OR P16E1-P16E3: BATTERY SENSOR MODULE**

**Diagnostic Instructions**

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

**DTC Descriptors**

**DTC P058A**

Battery Sensor Module Performance

**DTC P058B**

Battery Sensor Module Current Monitoring Performance

**DTC P058C**

Battery Sensor Module Temperature Monitoring Performance

**DTC P058D**

Battery Sensor Module Voltage Monitoring Performance

**DTC P058E**

Battery Sensor Module Temperature Too High

**DTC P058F**

Battery Sensor Module Temperature Too Low

**DTC P16D4**

Battery Sensor Module Circuit Low Voltage

**DTC P16D5**

Battery Sensor Module Circuit High Voltage

**DTC P16D6**

Battery Sensor Module Current Low

**DTC P16DC**

Battery Sensor Monitor Timer Performance

**DTC P16DD**

Battery Sensor Module Current High

**DTC P16DE**

Battery Sensor Internal Temperature Circuit Low Voltage

**DTC P16DF**

Battery Sensor Internal Temperature Circuit High Voltage

**DTC P16E1**

Battery Sensor Module Random Access Memory (RAM)

**DTC P16E2**

Battery Sensor Module Read Only Memory (ROM)

**DTC P16E3**

Battery Sensor Module Data Incompatible Diagnostic

**Circuit/System Description**

The vehicle control module monitors the system voltage, current, and internal temperature to verify they are within the normal operating range. It also monitors ROM or RAM memory faults, and performs other internal diagnostics.

**Conditions for Running the DTC**

- The system voltage is above 9.00 V

- The ignition is not OFF

### Conditions for Setting the DTC

#### **DTC P058A**

The battery sensor module detects an internal fault.

#### **DTC P058B**

The battery sensor module detects an internal fault after comparing an induced 50  $\mu$ A current to the battery sensor module calculated current.

#### **DTC P058C**

The battery sensor module detects a difference between raw temperature values to be 10.00 Celsius or more for 8 out of 10 samples.

#### **DTC P058D**

An absolute difference of 5.00 V or more is detected between the 12 V system reference voltage measured by the ECM, and 12 V battery voltage measured by the battery sensor module for 32 out of 40 samples.

#### **DTC P058E**

The battery sensor module detects a raw temperature 2 value of 120.00 Celsius or more for 4 out of 5 samples.

#### **DTC P058F**

The battery sensor module detects a raw temperature 2 value of -43.00 Celsius or less for 4 out of 5 samples.

#### **DTC P16DC**

The battery sensor module does not properly execute wakeups while the vehicle is asleep.

#### **DTC P16DD**

The battery sensor module detects a current of greater than 1400 A.

#### **DTC P16DE**

The battery sensor module detects an internal temperature of 120.00 Celsius or more for 4 out of 5 samples.

#### **DTC P16DF**

The battery sensor module detects an internal temperature of -43.00 Celsius or less for 4 out of 5 samples.

#### **DTC P16D4**

The battery sensor module detects a voltage of less than 3 V.

#### **DTC P16D5**

The battery sensor module detects a voltage of greater than 26 V.

#### **DTC P16D6**

The battery sensor module detects a current of less than -1400 A.

#### **DTC P16E1**

The battery sensor module detects a RAM memory fault.

## **DTC P16E2**

The battery sensor module detects a ROM memory fault.

## **DTC P16E3**

The battery sensor module is not using the correct configuration information it receives from the ECM.

### **Action Taken When the DTC Sets**

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The MIL will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.
- Stop/Start system may be disabled.

### **Conditions for Clearing the DTC**

- DTC P058A, DTC P058B, DTC P058C, DTC P058D, DTC P058E, DTC P058F, DTC P16DC, DTC P16DD, DTC P16DE, DTC P16DF, DTC P16D4, DTC P16D5, DTC P16D6, DTC P16E1, DTC P16E2 and DTC P16E3 and are Type C DTCs.
- A current DTC Last Test Failed clears when the diagnostic runs and passes
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

### **Diagnostic Aids**

- A high or low voltage DTC set or voltage value in multiple modules/sensors indicates a concern in the charging system.
- A possible cause of this DTC could be overcharging with a battery charger or jump starting.
- A possible cause of this DTC is a discharged battery or a poor/intermittent connection at X1 Battery Sensor Module.

### **Reference Information**

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

### [Charging System Description and Operation](#)

Electrical Information Reference

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

DTC Type Reference

Scan Tool Reference

Control Module References for scan tool information

### Circuit/System Verification

1. Ignition OFF, measure and record the battery voltage at the battery terminals.
2. Verify the battery voltage stabilizes between 12.4 and 12.8 V within a few minutes of turning the ignition OFF.

- **If battery voltage is less than 12.4 V or more than 12.8 V**

Refer to Battery Inspection/Test.

- **If battery voltage is between 12.4 and 12.8 V**

3. Engine running, headlights ON, measure and record the battery voltage at the battery terminals.
  4. Verify the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.
- **If the voltage is not at least 1 V greater than the voltage measured in step 1 or is greater than 15 V.**

Refer to Charging System Test.

- **If the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.**

5. Refer to Circuit/System Testing.

### Circuit/System Testing

**NOTE:** Some control module ground circuits may require up to 20 min after the ignition is turned off before achieving a resistance reading of less than 5  $\Omega$ . In most cases the readings will drop below 20  $\Omega$  within 1 min indicating the control module is going to sleep.

1. Ignition OFF and all vehicle systems OFF.
2. Test for less than 2  $\Omega$  between the Negative Battery post and the B110 Battery Sensor Module clamp

- **If 2  $\Omega$  or greater**

1. Ignition OFF.

2. Test for less than 2  $\Omega$  in the ground circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.

- **If less than 2  $\Omega$**

3. Disconnect the harness connector at the B110 Battery Sensor Module.
4. Verify a test lamp illuminates between B+ circuit terminal 2 and ground.

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

1. Ignition OFF.

2. Test for less than 2  $\Omega$  in the B+ circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , 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. Ignition 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 B110 Battery Sensor Module.

- **If the test lamp illuminates**

5. Replace the B110 Battery Sensor Module.

### Repair Instructions

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

Refer to [Battery Sensor Replacement \(KL9\)](#) for Battery Sensor Module replacement

## DTC P26E4-P26E6: STARTER DRIVE PINION RELAY CONTROL CIRCUIT

### Diagnostic Instructions

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

### DTC Descriptors

#### DTC P26E4

Starter Drive Pinion Relay Control Circuit

#### DTC P26E5

Starter Drive Pinion Relay Control Circuit Low Voltage

#### DTC P26E6

Starter Drive Pinion Relay Control Circuit High Voltage

### Diagnostic Fault Information

| Circuit                                                                      | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|------------------------------------------------------------------------------|-----------------|----------------------|------------------|--------------------|
| Relay Switch B+ Terminal 30                                                  | 1               | 1                    | -                | -                  |
| Relay Coil Ignition Terminal 85                                              | P26E5           | P26E4                | P26E6            | -                  |
| Relay Switch Control Terminal 87                                             | 2               | 1                    | 2                | -                  |
| Relay Coil Ground Terminal 86                                                | -               | P26E4                | -                | -                  |
| 1. Opens fuse, Starter pinion inop.<br>2. Starter pinion spins all the time. |                 |                      |                  |                    |

### Circuit/System Description

When the ignition is activated to start the vehicle, a discrete signal is supplied to the engine control module (ECM). The ECM then verifies that the clutch pedal is pressed or the transmission is in park/neutral. If it is, the ECM then supplies 12 V to the control circuit of the starter drive pinion relay. When this occurs, battery voltage is supplied through the switch of the starter relay to the starter pinion.

### Conditions for Running the DTC

- The ignition is activated to START.
- The system voltage is between 9.5-18 V.

### Conditions for Setting the DTC

The ECM detects improper voltage on the control circuit of the starter relay.

### Action Taken When the DTC Sets

DTC P26E4, P26E5, and P26E6 are C type DTCs.

### Conditions for Clearing the DTC

DTC P26E4, P26E5, and P26E6 are C type DTCs.

## Reference Information

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#), [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

## [Starting System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)
- [Relay Replacement \(Attached to Wire Harness\)](#), [Relay Replacement \(Within an Electrical Center\)](#)

DTC Type Reference

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

Scan Tool Reference

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

## Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the KR27C Starter Pinion Solenoid Actuator Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10  $\Omega$  between the ground circuit terminal 86 and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the ground circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.
  - **If less than 10  $\Omega$**
3. Ignition ON.
4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is good and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition 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,
3. Test for infinite resistance between the control circuit terminal 87 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the M64 Starter Motor.
  - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 85 and the ground circuit terminal 86.
- NOTE:**      **If the Starter Pinion Relay command is not available in the scan tool, verify the test lamps turns on and off when cycling the ignition between the OFF and CRANK position with the parking brake set and clutch pedal pressed (manual transmission) or the transmission in park (automatic transmission).**
6. Verify the test lamp turns ON and OFF when commanding the Starter Pinion Relay ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
      1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
      2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
      3. Test for less than 2  $\Omega$  in the control circuit end to end.
        - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
        - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
    - **If the test lamp is always ON**
      1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module, ignition ON.
      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 K20 Engine Control Module.
    - **If the test lamp turns ON and OFF**
  7. Ignition ON, connect a 30 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.
  8. Verify the M64 Starter Motor is activated.
    - **If the M64 Starter Motor does not activate**
      1. Ignition OFF, disconnect the harness connector at the M64 Starter Motor.
      2. Test for infinite resistance between the control circuit terminal X1 2 or X1 B and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
      3. Test for less than 2  $\Omega$  in the control circuit end to end.
        - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
        - If less than 2  $\Omega$ , replace the M64 Starter Motor.
    - **If the M64 Starter Motor activates**
  9. Test or replace the KR27C Starter Pinion Solenoid Actuator Relay.

## Component Testing

### Relay Test

1. Ignition OFF, disconnect the appropriate relay.
2. Test for 70-150  $\Omega$  between terminals (85 or 1) and (86 or 2).
  - **If less than 70 or greater than 150  $\Omega$**

Replace the relay.

- **If between 70-150  $\Omega$**

3. Test for infinite resistance between the terminals listed below:

- (30 or 3) and (86 or 2)
- (30 or 3) and (87 or 5)
- (30 or 3) and (85 or 1)
- (85 or 1) and (87 or 5)
- (86 or 2) and (87 or 5)
- **If less than infinite resistance**

Replace the relay.

- **If infinite resistance**

4. Install a 3 A fused jumper wire between relay terminal (85 or 1) and 12 V. Install a jumper wire between relay terminal (86 or 2) and ground.

5. Test for less than 5.0  $\Omega$  between terminals (30 or 3) and (87 or 5).

- **If 5.0  $\Omega$  or greater**

Replace the relay.

- **If less than 5.0  $\Omega$**

6. All OK

### Repair Instructions

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

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

## DTC P3051, P3053, OR P3055: DC/DC CONVERTER ACTUATOR VOLTAGE SENSOR CIRCUIT 1

### Diagnostic Instructions

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

### DTC Descriptor

#### DTC P3051

DC/DC Converter Actuator Voltage Sensor Circuit 1 Low Voltage

#### DTC P3053

DC/DC Converter Actuator Voltage Sensor Circuit 1 High Voltage

#### DTC P3055

DC/DC Converter Actuator Voltage 1 Performance

### Diagnostic Fault Information

| Circuit        | Short to Ground | Open/High Resistance                                                 | Short to Voltage | Signal Performance |
|----------------|-----------------|----------------------------------------------------------------------|------------------|--------------------|
| B+ Terminal 11 | -               | P3051, P3055, U260A, B3980, B1325, U0155, U0184, U0198, U0230, U1501 | -                | -                  |

| Circuit             | Short to Ground | Open/High Resistance                     | Short to Voltage | Signal Performance |
|---------------------|-----------------|------------------------------------------|------------------|--------------------|
| B+ Terminal 8       | -               | P3052, P3056, U18D2, U18D3, U0101, U0422 | -                | -                  |
| Control Terminal 5  | B1445 0B, P3051 | B1445 04, P305E                          | P3053            | P3055              |
| Ignition terminal 4 | -               | U18A7                                    | -                | -                  |
| Ignition terminal 6 | -               | P305C                                    | -                | -                  |

### Circuit/System Description

The power supply transformer is used to boost battery voltage to sensitive loads during engine restart. It provides two voltage outputs that provide the boosted voltage. The power supply transformer communicates to the ECM. When the engine is not cranking, the power supply transformer passes through voltage from the two supply circuits. The ECM receives data about the sensed output voltages provided by the power supply transformer.

### Diagnostic Aids

- If P3055 is set, verify ECM and T19 Power Supply Converter grounds are clean and tight.
- Ground circuits for the area of customer concern are clean, tight, and in the correct location. Refer to [Ground Distribution Schematics \(Buick\)](#), [Ground Distribution Schematics \(Chevrolet\)](#), and [Harness Routing Views \(Buick\)](#), [Harness Routing Views \(Chevrolet\)](#).
- Verify all devices powered by the T19 Power Supply Transformer are operating properly.
- B+ circuit terminal 11 supplies voltage to output circuit terminal 10, function 12v regulated supply voltage 1
- B+ circuit terminal 8 supplies voltage to output circuit terminal 9, function 12v regulated supply voltage 2

### Conditions for Running the DTC

Ignition ON

### Conditions for Setting the DTC

#### P3051

The ECM detects the DC/DC converter actuator voltage 1 is less than 1 V.

#### P3053

The ECM detects the DC/DC converter actuator voltage 1 is greater than 28 V.

#### P3055

The ECM detects the difference between the ECM IGN voltage and DC/DC converter output is greater than or equal to 1 V.

### Action Taken When the DTC Sets

- DTC P3051, P3053 and P3055 are type B DTCs.

### Conditions for Clearing the DTC

- DTC P3051, P3053 and P3055 are type B DTCs.

### Reference Information

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

**COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE), COMPONENT CONNECTOR END VIEWS - INDEX (TRAX)**

Description and Operation

**Stop/Start System Description and Operation (KL9 with LE2)**

Electrical Information Reference

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

DTC Type Reference

**Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**Control Module References** for scan tool information

**Circuit/System Verification**

**NOTE:** Use schematics to determine which devices are powered up on the T19 Power Supply Transformer B+ supply circuit terminal 10 X1.

1. Ignition OFF, measure and record the battery voltage at the battery terminals.
2. Verify the battery voltage stabilizes between 12.4 and 12.8 V within a few minutes of turning the ignition OFF.
  - **If battery voltage is less than 12.4 V or more than 12.8 V**  
Refer to **Battery Inspection/Test**.
  - **If battery voltage is between 12.4 and 12.8 V**
3. Verify ECM ground is clean and tight.
4. Engine running, headlights ON, measure and record the battery voltage at the battery terminals.
5. Verify the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.
  - **If the voltage is not at least 1 V greater than the voltage measured in step 1 or is greater than 15 V.**  
Refer to **Charging System Test**.
  - **If the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.**
6. Ignition ON.
7. Verify that the appropriate devices controlled by the T19 Power Supply Transformer control circuit terminal 10 X1 turn ON when cycling the ignition ON.
  - **If the devices do not turn ON**  
Refer to Circuit/System Testing.
  - **If the devices turn ON**
8. Verify DTC P3051, P3053 or P3055 does not set.
  - **If the DTC sets**  
Refer to Circuit/System Testing.

- If the DTC does not set

9. All OK.

## Circuit/System Testing

**NOTE:** You must perform Circuit/System Verification before Circuit/System Testing.

- Ign Off and all vehicle systems OFF, disconnect harness connector at T19 Power Supply Transformer. It may take up to 2 min for all vehicle systems to power down.
- Test for less than 10 ohms between each circuit ground terminal at the T19 Power Supply Transformer listed below and ground:
  - Terminal 7
  - Terminal 12
- Disconnect harness connector at the K20 Engine Control Module.
- Test for less than 5  $\Omega$  between each ground circuit terminal and ground.
  - **If 5  $\Omega$  or greater**
    - Ignition OFF.
    - Test for less than 2  $\Omega$  in the ground circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.
  - **If less than 5  $\Omega$**
- Verify a test lamp illuminates between each of the B+ circuits at the T19 Power Supply Transformer listed below and ground:
  - Terminal 8
  - Terminal 11
  - **If the test lamp does not illuminate**
    - Ignition OFF, remove the test lamp, remove appropriate fuses.
    - Test for infinite resistance between the B+ circuit and ground.
      - less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    - Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the T19 Power Supply Transformer.
  - **If the test lamp illuminates**
- Ignition ON.
- Verify a test lamp illuminates between each of the Ign circuits at the T19 Power Supply Transformer listed below and ground:
  - Terminal 4
  - Terminal 6
  - **If the test lamp does not illuminate and the circuit fuse is good**
    - Ignition OFF, remove the test lamp.
    - Test for less than 2  $\Omega$  in the ignition circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is OK and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    - Ignition OFF, remove the test lamp.
    - Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the T19 Power Supply Transformer.
  - **If the test lamp illuminates**

8. Ignition Off. Reconnect T19 Power Supply Transformer.
9. Clear codes and operate vehicle in conditions for an autostop.
10. Verify DTC P3051, P3053, or P3055 does not set.

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

If DTC sets, replace T19 Power Supply Transformer.

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

11. All OK

### Repair Instructions

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

- Refer to [Multifunction Power Supply Converter Replacement](#) for T19 Power Supply Transformer replacement
- Refer to [Control Module References](#) for control module replacement, programming, and setup

## DTC P3052, P3054, OR P3056: DC/DC CONVERTER ACTUATOR VOLTAGE SENSOR CIRCUIT 2

### Diagnostic Instructions

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

### DTC Descriptor

#### DTC P3052

DC/DC Converter Actuator Voltage Sensor Circuit 2 Low Voltage

#### DTC P3054

DC/DC Converter Actuator Voltage Sensor Circuit 2 High Voltage

#### DTC P3056

DC/DC Converter Actuator Voltage 2 Performance

### Diagnostic Fault Information

| Circuit             | Short to Ground | Open/High Resistance                                                 | Short to Voltage | Signal Performance |
|---------------------|-----------------|----------------------------------------------------------------------|------------------|--------------------|
| B+ Terminal 11      | -               | P3051, P3055, U260A, B3980, B1325, U0155, U0184, U0198, U0230, U1501 | -                | -                  |
| B+ Terminal 8       | -               | P3052, P3056, U18D2, U18D3, U0101, U0422                             | -                | -                  |
| Control Terminal 5  | B1445 0B, P3051 | B1445 04, P305E                                                      | P3053            | P3055              |
| Ignition terminal 4 | -               | U18A7                                                                | -                | -                  |
| Ignition terminal 6 | -               | P305C                                                                | -                | -                  |

### Circuit/System Description

The power supply transformer is used to boost battery voltage to sensitive loads during engine restart. It provides two voltage outputs that provide the boosted voltage. The power supply transformer

communicates to the ECM. When the engine is not cranking, the power supply transformer passes through voltage from the two supply circuits. The ECM receives data about the sensed output voltages provided by the power supply transformer.

### Diagnostic Aids

- If P3056 is set, verify ECM and T19 Power Supply Converter grounds are clean and tight.
- Ground circuits for the area of customer concern are clean, tight, and in the correct location. Refer to [Ground Distribution Schematics \(Buick\)](#), [Ground Distribution Schematics \(Chevrolet\)](#), and [Harness Routing Views \(Buick\)](#), [Harness Routing Views \(Chevrolet\)](#).
- Verify all devices powered by the T19 Power Supply Transformer are operating properly.
- B+ circuit terminal 11 supplies voltage to output circuit terminal 10, function 12v regulated supply voltage 1
- B+ circuit terminal 8 supplies voltage to output circuit terminal 9, function 12v regulated supply voltage 2

### Conditions for Running the DTC

Ignition ON

### Conditions for Setting the DTC

#### P3052

The ECM detects the DC/DC converter actuator voltage 1 is less than 1 V.

#### P3054

The ECM detects the DC/DC converter actuator voltage 1 is greater than 28 V.

#### P3056

The ECM detects the difference between the ECM IGN voltage and DC/DC converter output is greater than or equal to 1 V.

### Action Taken When the DTC Sets

- DTC P3052, P3054 and P3056 are type B DTCs

### Conditions for Clearing the DTC

- DTC P3052, P3054 and P3056 are type B DTCs

### Reference Information

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#), [Starting and Charging Schematics \(Buick with LUV\)](#), [Starting and Charging Schematics \(Chevrolet\)](#).

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#), [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#).

Description and Operation

[Stop/Start System Description and Operation \(KL9 with LE2\)](#).

Electrical Information Reference

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

- [Wiring Repairs](#)

DTC Type Reference

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

Scan Tool Reference

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

### [Circuit/System Verification](#)

**NOTE:** Use schematics to determine which devices are powered up on the T19 Power Supply Transformer B+ supply circuit terminal 10 X1.

1. Ignition OFF, measure and record the battery voltage at the battery terminals.
2. Verify the battery voltage stabilizes between 12.4 and 12.8 V within a few minutes of turning the ignition OFF.

- If battery voltage is less than 12.4 V or more than 12.8 V

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

- If battery voltage is between 12.4 and 12.8 V

3. Verify ECM ground is clean and tight.
4. Engine running, headlights ON, measure and record the battery voltage at the battery terminals.
5. Verify the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.

- If the voltage is not at least 1 V greater than the voltage measured in step 1 or is greater than 15 V.

Refer to [Charging System Test](#).

- If the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.

6. Ignition ON.
7. Verify that the appropriate devices controlled by the T19 Power Supply Transformer control circuit terminal 10 X1 turn ON when cycling the ignition ON.

- If the devices do not turn ON

Refer to Circuit/System Testing.

- If the devices turn ON

8. Verify DTC P3052, P3054 or P3056 does not set.

- If the DTC sets

Refer to Circuit/System Testing.

- If the DTC does not set

9. All OK.

### [Circuit/System Testing](#)

**NOTE:** You must perform Circuit/System Verification before Circuit/System Testing.

1. Ign Off and all vehicle systems OFF, disconnect harness connector at T19 Power Supply Transformer. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between each circuit ground terminal at the T19 Power Supply Transformer listed below and ground:
  - Terminal 7

- Terminal 12
3. Disconnect harness connector at the K20 Engine Control Module.
  4. Test for less than 5  $\Omega$  between each ground circuit terminal and ground.
    - **If 5  $\Omega$  or greater**
      1. Ignition OFF.
      2. Test for less than 2  $\Omega$  in the ground circuit end to end.
        - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
        - If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.
    - **If less than 5  $\Omega$**
  5. Verify a test lamp illuminates between each of the B+ circuits at the T19 Power Supply Transformer listed below and ground:
    - Terminal 8
    - Terminal 11
    - **If the test lamp does not illuminate**
      1. Ignition OFF, remove the test lamp, remove appropriate fuses.
      2. Test for infinite resistance between the B+ circuit and ground.
        - less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
      3. Test for less than 2  $\Omega$  in the B+ circuit end to end.
        - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
        - If less than 2  $\Omega$ , replace the T19 Power Supply Transformer.
      - **If the test lamp illuminates**
  6. Ignition ON.
  7. Verify a test lamp illuminates between each of the Ign circuits at the T19 Power Supply Transformer listed below and ground:
    - Terminal 4
    - Terminal 6
    - **If the test lamp does not illuminate and the circuit fuse is good**
      1. Ignition OFF, remove the test lamp.
      2. Test for less than 2  $\Omega$  in the ignition circuit end to end.
        - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
        - If less than 2  $\Omega$ , verify the fuse is OK and there is voltage at the fuse.
      - **If the test lamp does not illuminate and the circuit fuse is open**
        1. Ignition OFF, remove the test lamp.
        2. Test for infinite resistance between the ignition circuit and ground.
          - If less than infinite resistance, repair the short to ground on the circuit.
          - If infinite resistance, replace the T19 Power Supply Transformer.
        - **If the test lamp illuminates**
  8. Ignition Off. Reconnect T19 Power Supply Transformer.
  9. Clear codes and operate vehicle in conditions for an autostop.
  10. Verify DTC P3052, P3054, or P3056 does not set.
    - **If any of the DTCs are set**

If DTC sets, replace T19 Power Supply Transformer.
    - **If none of the DTCs are set**
  11. All OK

## Repair Instructions

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

- Refer to [Multifunction Power Supply Converter Replacement](#) for T19 Power Supply Transformer replacement
- Refer to [Control Module References](#) for control module replacement, programming, and setup

## **DTC P305D OR P305E: DC/DC CONVERTER CRANK CONTROL CIRCUIT HIGH/LOW VOLTAGE**

### **Diagnostic Instructions**

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

### **DTC Descriptor**

#### **DTC P305D**

DC/DC Converter Crank Control Circuit High Voltage

#### **DTC P305E**

DC/DC Converter Crank Control Circuit Low Voltage

### **Diagnostic Fault Information**

| <b>Circuit</b>                                                      | <b>Short to Ground</b> | <b>Open/High Resistance</b> | <b>Short to Voltage</b> | <b>Signal Performance</b> |
|---------------------------------------------------------------------|------------------------|-----------------------------|-------------------------|---------------------------|
| Starter Relay B+                                                    | 1                      | 1                           | -                       | -                         |
| Starter Relay Control                                               | P305E, 2               | 1                           | P305D                   | -                         |
| Power Supply Transformer Control                                    | P305E, 2               | P305E                       | P305D                   | -                         |
| 1. Starter Solenoid Does Not Click<br>2. Starter spins all the time |                        |                             |                         |                           |

### **Circuit/System Description**

The power supply transformer is used to boost battery voltage to sensitive loads during engine restart. It provides two voltage outputs that provide the boosted voltage. The power supply transformer communicates to the ECM, and sends to the ECM the state of the crank control input.

### **Conditions for Running the DTC**

- Ignition ON

### **Conditions for Setting the DTC**

#### **P305D**

The ECM detects the DC/DC converter crank control is high when it should be low.

#### **P305E**

The ECM detects the DC/DC converter crank control is low when it should be high.

### **Action Taken When the DTC Sets**

- DTC P305D is a type B DTC.
- DTC P305E is a type A DTC.

### **Conditions for Clearing the DTC**

- DTC P305D is a type B DTC.
- DTC P305E is type A DTC.

## Diagnostic Aids

- DTC's can be set when programming the Engine Control Module. Please follow the programming and setup instructions if a DTC sets.

## Reference Information

### Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

### Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#), [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

### Description and Operation

[Stop/Start System Description and Operation \(KL9 with LE2\)](#)

### Electrical Information Reference

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

### DTC Type Reference

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

### Scan Tool Reference

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

## Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the KR27 Starter Relay. It may take up to 2 minutes for all vehicle systems to power down, Ignition ON.
2. Verify a test lamp illuminates between the ignition circuit terminal 85 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2  $\Omega$  in the ignition circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , refer to [Power Mode Mismatch](#).
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Connect the KR27 Starter Relay and replace the fuse.
    4. Verify the fuse does not open when connecting the KR27 Starter Relay.
      - If the fuse opens, replace the KR27 Starter Relay.
      - If the fuse is OK
    5. All OK
- **If the test lamp illuminates**

3. Ignition OFF, disconnect the harness connector at the T19 Power Supply Transformer, Ignition ON.
4. Connect a test lamp between ignition circuit terminal 85 and the control circuit terminal 86 at the KR27 Starter Relay.

**NOTE:** If the Starter Relay command is not available in the scan tool, verify the test lamps turns on and off when cycling the ignition between the OFF and CRANK position with the parking brake set and clutch pedal pressed (manual transmission) or the transmission in park (automatic transmission).

5. Verify the test lamp turns ON and OFF when commanding the KR27 Starter Relay ON and OFF with a scan tool.

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

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, Ignition ON.
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 1V
3. Test for less than 2  $\Omega$  in the control circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K20 Engine Control Module.

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

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, Ignition ON.
2. Test for infinite resistance between the control circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the K20 Engine Control Module

- **If the test lamp turns ON and OFF**

6. Connect a test lamp between the control circuit terminal 5 at the T19 Power Supply Transformer and B+.

**NOTE:** If the Starter Relay command is not available in the scan tool, verify the test lamps turns on and off when cycling the ignition between the OFF and CRANK position with the parking brake set and clutch pedal pressed (manual transmission) or the transmission in park (automatic transmission).

7. Verify the test lamp turns ON and OFF when commanding the KR27 Starter Relay ON and OFF with a scan tool.

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

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, Ignition ON.
2. Test for less than 1 V between the control circuit terminal 5 and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1V
3. Test for less than 2  $\Omega$  in the control circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K20 Engine Control Module.

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

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, Ignition ON.
2. Test for infinite resistance between the control circuit terminal 5 and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K20 Engine Control Module
- **If the test lamp turns ON and OFF**

8. Replace the T19 Power Supply Transformer

### Repair Instructions

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

- Refer to [Multifunction Power Supply Converter Replacement](#) for T19 Power Supply Transformer replacement
- Refer to [Control Module References](#) for control module replacement, programming, and setup

## SYMPTOMS - ENGINE ELECTRICAL

**NOTE:** The following steps must be completed before using the symptom tables.

- Perform [Diagnostic System Check - Vehicle](#) before using the Symptom Tables in order to verify that all of the following are true:
  - There are no DTCs set.
  - The control modules can communicate via the serial data link.
- Review the system descriptions and operations in order to familiarize yourself with the system functions. Refer to one of the following system operations:
  - [Battery Description and Operation](#)
  - [Charging System Description and Operation](#)
  - [Electrical Power Management Description and Operation](#)
  - [Starting System Description and Operation](#)

### Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the starting and charging systems. Refer to [Checking Aftermarket Accessories](#).
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

### Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#).

### Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Battery Inspection/Test](#)
- [Battery Electrical Drain/Parasitic Load Test](#)
- [Charging System Test](#)
- [Generator Noise Diagnosis](#)
- [Starter Solenoid Does Not Click \(Without KL9\) Starter Solenoid Does Not Click \(KL9\)](#)
- [Starter Solenoid Clicks, Engine Does Not Crank](#)
- [Engine Cranks Slowly](#)
- [Starter Noise Diagnosis](#)

## SYMPTOMS - STOP/START SYSTEM

**NOTE:** The following steps must be completed before using the symptom tables.

1. Perform the [Diagnostic System Check - Vehicle](#) before using the symptom tables in order to verify that all of the following are true:

- There are no DTCs set.
  - The control modules can communicate via the serial data link.
2. Review the system description and operation in order to familiarize yourself with the system functions. Refer to [Stop/Start System Description and Operation \(KL9 with LE2\)](#).

### Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the Stop/Start System. Refer to [Checking Aftermarket Accessories](#).
- Inspect the easily accessible or visible system components, for obvious damage or conditions, which may cause the symptom.

### Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#).

### Symptom List

Refer to a symptom diagnostic procedure to diagnose the symptom:

### [Stop/Start System Malfunction](#)

## BATTERY INSPECTION/TEST

### Diagnostic Instructions

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

### Diagnostic Aids

#### **NOTE:** For Warranty repairs -

**You must use regionally required battery test equipment for warranty repairs.**

**For accurate test results the battery must be disconnected from the vehicle and the equipment connected directly to the battery posts. When setting up the equipment, select "Out of Vehicle" and then the correct battery type (Flooded, AGM, or Stop/Start AGM) and rated CCA (both from the battery label) must be entered.**

- **Failure to obtain the correct connections during the test may result in a failed test on a good battery.**
- **Use the Out of Vehicle test (battery disconnected with test equipment connected directly to the posts) for each battery when testing a vehicle with dual batteries.**

### Reference Information

#### Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUY\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

#### Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

## Starting System Description and Operation

### Electrical Information Reference

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

### Scan Tool Reference

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

### Special Tools

#### EL 50313 Battery Tester

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

### Circuit/System Testing

**WARNING:** Unless directed otherwise, the ignition must be OFF with the key removed, and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.

For Vehicles equipped with OnStar<sup>®</sup> (UE1) with Back Up Battery:

The Back Up Battery is a redundant power supply to allow limited OnStar<sup>®</sup> functionality in the event of a main vehicle battery power disruption to the VCIM (OnStar<sup>®</sup> module). Do not disconnect the main vehicle battery or remove the OnStar<sup>®</sup> fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStar<sup>®</sup> module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStar<sup>®</sup> Back-Up Battery system and will discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.

1. Verify the C1 Battery case is not cracked, broken, or damaged, which may be indicated by battery acid leakage.

- **If there is any apparent damage**

Replace the C1 Battery.

- **If there is no damage**

2. Verify that the battery cables are clean and tight. The battery terminal bolts should be torqued as specified in [Fastener Specifications](#).

- **If the battery cables need to be cleaned or tightened**

Clean as required and tighten as specified.

- **If the battery cables are clean and tight**

3. Disconnect battery from the vehicle. There is no need to remove the battery from the vehicle.

4. Connect the EL-50313 directly to the battery terminal posts.
5. Select "Charging," "Diagnostic" and "Out of Vehicle" when setting up the test.
6. Select the proper battery type, Flooded, AGM or Stop/Start AGM.
7. Enter the CCA as shown on the battery label.
8. Verify the test result is not REPLACE BATTERY or BAD CELL-REPLACE

**NOTE:** Always write the test code displayed by the tester on the repair order for any warranty purposes. The number is a unique code that describes the test data for a particular battery at a particular time. The test code may occasionally repeat when you retest the same battery. More often, each test will result in a different code. Use the test code from the Out of Vehicle test.

- If the test result is REPLACE BATTERY or BAD CELL-REPLACE

Replace the C1 Battery.

- If the test result is not REPLACE BATTERY or BAD CELL-REPLACE but requires Charging

Conduct Charging System Test and Battery Electrical Drain/Parasitic Load Test

- If Battery is Ok and doesn't require Charging

All Ok

### Repair Instructions

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

- Refer to [Battery Replacement](#)

## BATTERY CHARGING

### Special Tools

EL 50313 Battery Tester

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

### Diagnostic Aids

- The charging area should be well ventilated.
- Do not charge a battery that appears to be frozen. Allow the battery to warm to room temperature and test it using the EL 50313 before charging.
- An AGM battery may be damaged if charged to more than 14.5 V.
- A Flooded Cell battery may be damaged if charged to more than 16.5 V.
- Vehicles with dual batteries must be charged individually which will result in two printouts.
- If you accidentally blind charged the battery by connecting the battery charger directly at the battery terminals, Autostop/Autostart will be disabled. Disconnect and Reconnect the Battery Sensor Module to enable Autostop/Autostart.

### Battery State of Charge

**NOTE:** Using voltage to determine the batteries state of charge is only accurate after the battery has been at rest for 24 hours. This is enough time for the acid in each cell to equalize. If the battery has been charged or discharged in the past 24 hours, the battery state of charge will only be an estimate.

The maintenance-free batteries state of charge is estimated by reading the voltage of the battery across the battery terminals. Because the voltage is affected by current flow into or out of the battery, the engine must be stopped and all electrical loads turned OFF, including parasitic loads, when checking the voltage. The voltage can also be affected if the battery has just been charged or discharged, so it is important to consider what has happened to the battery in the time just before testing. Use the following procedure to determine the battery's state of charge:

1. Be sure all electrical loads are turned OFF.
2. Determine whether the battery has been used in a vehicle or charged within the past 12 hours.
  - If the answer is no, the terminal voltage will be stabilized and no action is necessary before reading the voltage. Skip to step 3.
  - If the answer is yes, terminal voltage will not be stabilized and you should wait 12 hours since the last time the battery was used.
3. Estimate the battery temperature by determining the average temperature to which the battery has been exposed for the past 12 hours.

**NOTE:** The table is accurate to 10% only after the battery has been at rest for 12 hours.

4. Measure the battery voltage at the battery terminals. Refer to the following table to determine the state of charge according to the estimated battery temperature:

| Battery Voltage | % Charge at 0Â°,Â°C<br>(32Â°,Â°F) | % Charge at 25Â°,Â°C<br>(75Â°,Â°F) |
|-----------------|-----------------------------------|------------------------------------|
| 12.75 V         | 100%                              | 100%                               |
| 12.7 V          | 100%                              | 90%                                |
| 12.6 V          | 90%                               | 75%                                |
| 12.45 V         | 75%                               | 65%                                |
| 12.2 V          | 65%                               | 45%                                |
| 12.0 V          | 40%                               | 20%                                |

Use the state of charge information as follows:

- A battery with a state of charge that is below 65% must always be recharged before returning it to service or continuing storage.
- A battery with a state of charge that is 65% or greater is generally considered to be charged enough in order to be returned to normal service or in order to continue storage. However, if the battery is being used in slow traffic or with short drive times, or if the temperature is very hot or very cold, the battery should be fully charged, to at least 90%, before returning it to service or continuing storage.

### Charging Time Required

The time required to charge a battery will vary depending upon the following factors:

- The battery charger capacity - The higher the charger amperage, the less time it will take to charge the battery.
- The state of charge of the battery - A completely discharged battery requires more than twice as much charging time as a half charged battery. In a discharged battery with a voltage below 11 V, the battery has a very high internal resistance and may only accept a very low current at first. Later, as the charging current causes the acid content to increase in the electrolyte, the charging current will increase. Extremely discharged batteries may not activate the reversed voltage protection in some chargers. Refer to the manufacturer's instructions for operating this circuitry.
- The temperature of the battery - The colder the battery is, the more time it takes to recharge the battery. The charging current accepted by a cold battery is very low at first. As the battery warms, the charging current will increase.

### Charging Procedure

**CAUTION:** Turn OFF the ignition when connecting or disconnecting the battery

cables, the battery charger or the jumper cables. Failure to do so may damage the ECM/PCM or other electronic components.

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

When charging side-terminal batteries with the battery cables connected, connect the charger to the positive cable bolt and to a ground located away from the battery. When charging side-terminal batteries with the battery cables disconnected, install the battery side terminal adapters and connect the charger to the adapters.

1. Turn OFF the charger.
2. Ensure that all of the battery terminal connections are clean and tight.
3. Connect the charger positive lead to the battery positive terminal on the battery or the remote jumper stud underhood.

**CAUTION:** Do not connect the negative charger lead to the housings of other vehicle electrical accessories or equipment. The action of the battery charger may damage such equipment.

**NOTE:** If you connect the negative cable of the charger directly to the negative terminal of the battery, Autostop/Autostart will be disabled. Disconnect and Reconnect the Battery Sensor Module to enable Autostop/Autostart.

4. Connect the negative charger lead to a solid engine ground or to a ground stud in the engine compartment that is connected directly to the battery negative terminal, but away from the battery.
5. Select "Charging," "PDI" and "In Vehicle" when setting up the charger.
6. Select the proper battery type, Flooded, AGM, Spiral AGM or Stop/Start AGM.
7. Enter the CCA as shown on the battery label.

## BATTERY ELECTRICAL DRAIN/PARASITIC LOAD TEST

### 12 V Battery

The following procedure is for the 12 V battery only.

#### 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

Components most likely to cause a parasitic draw on the vehicles battery are switches, relays, and control modules. After the ignition is turned OFF the control modules will begin to go to sleep shut OFF. All control modules do not go to sleep at the same time, some may take up to 30 min or longer after turning the ignition off before going to sleep. Other modules may periodically wake up then go back to sleep. These are all normal conditions.

#### Diagnostic Aids

- Rule out any possible aftermarket equipment causing an unacceptable parasitic current drain. Aftermarket accessories installed into the courtesy lamp circuit can cause the inadvertent power timer in the body control module (BCM) to keep resetting. This may cause the BCM to remain awake and cause a current drain on the battery.
- Rule out customer driving habits such as regular short trips that do not allow enough time to properly charge the battery. Refer to [Battery Description and Operation](#).
- Verify that the battery and charging system are in proper working order. Refer to [Battery Charging](#), and [Charging System Test](#).

- A battery discharging for no apparent reason while the vehicle is parked can be caused by an intermittent draw, such as a module waking up, or a continuous draw, such as a dome light or stuck relay.
- Some systems and modules such as OnStar<sup>®</sup>, and regulated voltage control, if equipped, are designed to wake up, perform a task, and go back asleep at regular intervals. Refer to [Body Control System Description and Operation](#) for the system or modules description and operation.
- An engine off natural vacuum evaporative test can occur if the engine control module (ECM) determines the drive cycle has met the appropriate criteria immediately after key off. The ECM will stay awake and the vent solenoid will stay energized for as long as 45 min. The typical current draw for this is about 1 A.
- Digital OnStar generation 6 and later vehicle communication interface module do not "wake up" every 10 min for the first 48 h as the generation 5 and prior. generation 6 and later vehicle communication interface module current draw is very low, less than 40 mA, so the OnStar system is left in that state for up to the first 48 h. Parasitic draw of up to 40 mA with an occasional spike as high as 80 mA through the vehicle communication interface module for the first 48 h is normal.
- Some automatic climate control systems can remain in a semi awake state for up to three hours, actual draw amounts vary by vehicle platform but are typically not greater than 50 mA.
- An extremely low mA current level is consumed by the remote keyless entry receiver for monitoring purposes, actual system wake up only occurs when the fobs for the vehicle are used. When other devices on the same remote keyless entry operating frequency are activated, such as the 4 tire pressure monitoring sensors and other vehicle FOBs in the vicinity, the remote keyless entry receiver will have a 100 mA spike. These spikes are normal and occur too briefly to have a significant effect on battery drain. Competing signals may cause remote keyless entry performance issues such as jamming but should not cause excessive battery draw.
- If an excessive current draw is not present during initial testing, continue periodic testing over a 1-2 hour period to see if the current draw increases and stays above an unacceptable level.

**NOTE:** The battery specification listed below is a generic specification. Refer to the label on the original battery when testing the battery.

- The battery run down time will vary depending on the batteries reserve capacity. If the reserve capacity is higher, then the battery run down time may be longer. If the reserve capacity is lower, then the battery run down time may be shorter. The graph below indicates roughly how many days a 690 cold cranking amperage battery with a 110 min reserve capacity starting at 80% state of charge will last with a constant current draw until it reaches 50% state of charge. Differences in battery reserve capacity and temperature will affect the results.

| Current Drain | Days |
|---------------|------|
| 25 mA         | 33   |
| 50 mA         | 16.5 |
| 75 mA         | 11   |
| 100 mA        | 8.25 |
| 250 mA        | 3.3  |
| 500 mA        | 1.65 |
| 750 mA        | 1    |
| 1 A           | 0.8  |
| 2 A           | 0.4  |

#### Reference Information

Schematic Reference

#### [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#), [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

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

Scan Tool Reference

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

Special Tools

**EL 38758** Parasitic Draw Test Switch

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

**Circuit/System Verification**

**NOTE:**

- Most vehicle systems will go to sleep within 30 min but it can take up to 2 h before all systems power down allowing the parasitic draw test to pass. An occasional increase in the parasitic draw is normal as long as it returns within 1 s.
- Closing the door latches/ajar switch while leaving the doors open is recommended, this allows the vehicle systems to perform in a "doors closed" mode while allowing vehicle interior access that may be needed to complete the diagnostic steps.
- Locking doors will arm the vehicle content theft deterrent system if equipped. Failure to arm the system may cause a theft system fault to not be present during testing.
- There are many things that can prevent the vehicle from completely going to sleep and passing the parasitic draw test. Make sure all the conditions listed below are met before performing the parasitic current draw test.
  - Ignition OFF
  - Key out of the ignition switch - when not equipped with keyless access and start
  - Retained Accessory Power OFF - open and close the driver door after ignition OFF
  - Scan tool not communicating with a vehicle control module - in some cases it may need to be disconnected from the DLC
  - All access doors closed
  - Headlamps OFF - auto headlamps disabled
  - Any delay lighting OFF
  - If equipped with an under hood lamp disable it
  - HVAC after blow OFF
  - Any accessory that can work with ignition OFF inactive or OFF
  - Wait up to 2 min or longer, after all other listed conditions are met

**Using an Inductive Pickup Probe**

1. Connect an inductive pickup probe to the negative battery cable that can read down to 1 mA.
2. Ignition OFF, as the vehicle systems shut down test for less than 30 mA of parasitic current drain.
  - If greater than the specified range, refer to Circuit/System Testing.

**WARNING:** Refer to [Battery Disconnect Warning](#) .

**CAUTION:** When a fused jumper wire or digital multimeter is connected to the test switch terminals, always turn the test switch ON before opening any access door, turning the ignition on, or turning any accessory on. This is to prevent damaging the jumper wire or digital multimeter fuse.

**NOTE:** The switch knob on the EL 38758 switch is marked ON and OFF. When the switch knob is in the ON position, the circuit is closed and electrical current will pass through the switch. When the switch knob is in the OFF position, the circuit is open and electrical current will not pass through the switch.

1. Ignition OFF, disconnect the battery negative cable from the battery. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#).
2. Turn the EL 38758 switch knob to the OFF position.
3. Install the male end of the EL 38758 switch to the battery ground terminal.
4. Install the battery negative cable to the female end of the EL 38758 switch.
5. Turn the EL 38758 switch knob to the ON position.
6. Road test the vehicle and activate all of the accessories such as the radio and air conditioning.
7. Ignition OFF, connect a 10 A fused jumper wire to the test switch tool terminals.
8. Turn the EL 38758 switch knob to the OFF position. The current now flows through the jumper wire.
9. Check the fuse in the jumper wire. The fuse should be OK.
  - Failed: If the jumper wire fuse is blown, refer to Circuit/System Testing.
  - Passed
10. Turn the EL 38758 switch knob to the ON position. Remove the fused jumper wire.
11. Connect a DMM set to the 10 A DC scale between the test switch tool terminals.
12. Turn the EL 38758 switch knob to the OFF position. The current now flows through the DMM.
13. As the vehicle systems shut down test for less than 30 mA of parasitic current drain.
  - If greater than the specified range, refer to Circuit/System Testing.

### Circuit/System Testing

**NOTE:**

- Removing or installing a fuse, relay, or connector, to determine the area causing high parasitic draw may wake up control modules. You must wait for the control modules to go back to sleep before retesting. It is best to install any removed or disconnected components after the diagnosis is completed.
- Fuses for power mode master components such as the BCM should be removed last to avoid misdiagnosis.
- If a scan tool is connected to the DLC, either disconnect it or subtract the scan tool current draw from the DMM reading to get the actual vehicle parasitic current draw.

If the vehicle has an unacceptable amount of parasitic current draw, remove each fuse one at a time until the current draw falls to an acceptable level. A drop of more than 10-20 mA, when disabling a single system or circuit, is an indication of an overly high current draw that could be causing the battery drain. Refer to [Power Distribution Schematics \(Buick\)](#) [Power Distribution Schematics \(Chevrolet\)](#) to diagnose exactly which circuit of the suspect system is causing the high parasitic drain. The following is a list of common components that could cause a high current draw:

- Stuck switch
- Stuck relay
- Control module

## Repair Instructions

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

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

## CHARGING SYSTEM TEST

### Diagnostic Instructions

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

### Diagnostic Fault Information

| Circuit              | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|----------------------|-----------------|----------------------|------------------|--------------------|
| B+                   | -               | P0621                | -                | -                  |
| Control - L Terminal | P0621           | P0621                | P0621            | -                  |
| Signal - F Terminal  | P0622           | P0622                | P0622            | P0622              |

### Circuit/System Description

The engine control module (ECM) uses the generator turn ON control circuit to control the load of the generator on the engine. A high side driver in the ECM applies a duty cycled voltage to the voltage regulator. The duty cycle controls the voltage regulator to turn the field circuit ON and OFF. The ECM monitors the state of the generator turn ON control circuit. The ECM should detect low voltage on the generator turn on control circuit when the ignition is ON and the engine is OFF, or when the charging system malfunctions. With the engine running, the ECM should detect high voltage when the duty cycle voltage is commanded high and a low voltage when the duty cycle voltage is commanded low on the generator turn on control circuit.

The engine control module (ECM) uses the generator field duty cycle signal circuit, or F-terminal circuit, to monitor the duty cycle of the generator. The generator field duty cycle signal circuit connects to high side of the field windings in the generator. A pulse width modulated (PWM) high side driver in the voltage regulator turns the field windings on and off. The ECM uses the PWM signal input to determine the generator load on the engine. This allows the ECM to adjust the idle speed to compensate for high electrical loads. The ECM monitors the status of the generator field duty cycle signal circuit. When the ignition is ON and the engine is off, the ECM should detect a duty cycle near 0%. When the engine is running, the duty cycle should be between 5-99%.

### Reference Information

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)[COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

[Charging System Description and Operation](#)

Electrical Information Reference

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

### Circuit/System Verification

**NOTE:** Do not have a battery charger connected during the generator testing.

1. Ignition ON.
2. Verify that no G13 Generator, B18 Battery Current Sensor or B110 Battery Sensor Module DTCs are set that would cause a charging system concern.
  - **If DTCs are set**  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
  - **If no DTCs are set**
3. Verify the scan tool Body Control Module Battery Voltage parameter is 12 V or greater.
  - **If less than 12 V**  
Refer to [Battery Inspection/Test](#).
  - **If 12 V or greater**
4. Engine running, all accessories OFF.
5. Verify the scan tool Body Control Module Battery Voltage parameter continually increases when controlling the Body Control Module Generator Regulator Setpoint from 40% to 90% with a scan tool. It may take up to 10 s for the battery voltage to stabilize between each setpoint change.
  - **If the battery voltage does not continually increase**  
Refer to Circuit/System Testing.
  - **If the battery voltage continually increases**
6. All OK.

### Circuit/System Testing

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

1. Ignition OFF.
2. Test for less than 2  $\Omega$  between the G13 Generator housing and C1 Battery negative terminal.
  - **If 2  $\Omega$  or greater**  
Repair the open/high resistance in the circuit.
  - **If less than 2  $\Omega$**
3. Verify a test lamp illuminates between the G13 Generator B+ circuit terminal A X2, B X2, 1 X1 or 1 X2 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Remove the test lamp and disconnect the B+ cable at the G13 Generator
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Remove the test lamp, disconnect the C1 Battery negative cable, and disconnect the G13 Generator B+ cable.
    2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, test or replace the G13 Generator.
  - **If the test lamp illuminates**
4. Test or replace the G13 Generator.

### Repair Instructions

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

Refer to [Generator Replacement \(2H0\)](#)[Generator Replacement \(LUV\)](#)[Generator Replacement \(LE2\)](#).

## GENERATOR NOISE DIAGNOSIS

### Diagnostic Instructions

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

### Diagnostic Aids

Noise from a generator may be due to electrical or mechanical noise. Electrical noise or magnetic whine usually varies with the electrical load placed on the generator and is a normal operating characteristic of all generators. When diagnosing a noisy generator, it is important to remember that loose or misaligned components around the generator may transmit the noise into the passenger compartment and that replacing the generator may not solve the problem.

### Circuit/System Testing

1. Start the engine. Verify the noise can be heard. Compare the concern to a similar vehicle.
2. Perform a charging system test. Verify that the generator is charging properly.
3. Inspect the generator, generator mounting, wiring harness, heater hoses, A/C lines, or other accessory equipment that may be incorrectly routed or be the cause of noise being transmitted into the passenger compartment.
4. Ignition OFF, remove the engine drive belt.
5. Verify the generator, A/C compressor, water pump pulley, power steering pump, idler pulley, and tensioner pulley spin freely.
  - **If any of the pulleys do not spin freely**  
Replace the affected component.
  - **If all belt driven components spin freely**
6. Start the engine. Operate the engine for no longer than 30-40 seconds.
7. Verify that the noise goes away.
  - **If the noise is still present**  
The generator is not the cause of the noise. Refer to [Symptoms - Engine Mechanical](#) , for 1.4L (LE2) engine, [Symptoms - Engine Mechanical](#) , for 1.4L (LUJ LUV) engine, [Symptoms - Engine Mechanical](#) for 1.8L (2HO) engine.
  - **If noise is no longer present**
8. Inspect for worn accessory drive components or abnormalities such as severe cracking, bumps, or missing areas in the accessory drive belt and/or misalignment of system components

### Repair Instructions

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

- Refer to [Drive Belt Replacement](#) for the 1.4L (LE2) engine

- Refer to [Drive Belt Replacement](#) for the 1.4L (LUJ LUV) engine
- Refer to [Drive Belt Replacement](#) for the 1.8L (2HO) engine
- Refer to [Drive Belt Tensioner Replacement](#) for the 1.4L (LE2) engine
- Refer to [Drive Belt Tensioner Replacement](#) for the 1.4L (LUJ LUV) engine
- Refer to [Drive Belt Tensioner Replacement](#) for the 1.8L (2HO) engine
- Refer to [Generator Replacement \(2H0\)Generator Replacement \(LUV\)Generator Replacement \(LE2\)](#)

## STOP/START SYSTEM MALFUNCTION

### Diagnostic Instructions

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

### Circuit/System Description

The 12 volt start/stop system is used to reduced fuel consumption and emissions by automatically turning off the engine when coming to a stop and restarting when moving again. When coming to a stop, assuming no disable conditions exist, the engine will automatically turn off. The engine will automatically restart when the driver releases the brake pedal.

To eliminate unwanted infotainment system effects during engine cranking, the 12 volt start/stop system utilizes a power supply transformer that provides a steady B+ to the infotainment system though the battery saver relay. During engine cranking, system voltage may momentarily drop below 10 volts. This momentary drop in voltage may cause the vehicle infotainment to turn off and restart during a start/stop event. The power supply transformer maintains steady B+ to the infotainment system to prevent an infotainment restart during cranking.

### Diagnostic Aids

- If the driver does not fully depress the brake pedal, the vehicle may not enter Auto Stop mode.
- Auto Stop may be deactivated if any of the following conditions are present:
  - Ambient and coolant temperature correlation does not match specified values
  - Ambient temperature is less than -10Å,Å°C (14Å,Å°F)
  - Battery temperature is less than 0Å,Å°C (32Å,Å°F) or greater than 55Å,Å°C (131Å,Å°F)
  - HVAC system demand is high
  - HVAC defrost has been selected
  - Battery charge is low
  - The battery was improperly charged or jump started.

To properly charge the battery or jump start the vehicle, the negative lead of the charger must be connected to chassis ground, NOT directly to the negative battery post. Connecting to chassis ground allows current to flow through the battery sensor module during charging and be measured. Connecting directly to the negative battery post charges the battery, but the current is not measured by the battery sensor module.

- Power on Reset is active when the parameters Battery Sensor Module Battery State Information and Battery Sensor Module Reset Occurred - Using Estimated State of Charge read Not Available (Not Learned) and Yes (Estimated). Stop/start is enabled when Power on Reset is active.
- Vehicle has not been allowed to sit for at least 3 hours over 1 week.
- Parasitic current draw 100 mA or greater.
- When using a vehicle hoist to verify autostop and autostart operation, ensure the following conditions are also met:
  - Transmission gear selector is in the drive position
  - No DTCs are set

- Traction control is off

## Reference Information

### Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

### Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#), [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

### Description and Operation

[Stop/Start System Description and Operation \(KL9 with LE2\)](#)

### Electrical Information Reference

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

### Scan Tool Reference

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

### Circuit/System Verification

1. Ignition ON.
2. Test for greater than 12 V between the battery positive terminal and negative terminal.
  - **If 12 V or less**  
Refer to [Battery Inspection/Test](#).
  - **If greater than 12 V**
3. Verify no DTCs are set.
  - **If any DTCs are set**  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
  - **If no DTCs are set**
4. Verify Battery Sensor Module Battery State Information parameter reads Available (Learned) and Battery Sensor Module Reset Occurred - Using Estimated State of Charge reads No (Measured).
  - If parameters read Not Available (Not Learned) and No (Measured).
    1. Verify with customer if vehicle may have been jump started or been used to jump start another vehicle, or if the battery has been charged recently.
      - If Yes, Disconnect and reconnect the negative battery cable.
      - If No
    2. Connect a DMM to the battery terminals. Verify the battery voltage stays above 8.7 V while starting engine..
      - If 8.7 V or below refer to [Battery Inspection/Test](#)
      - If greater than 8.7 V conduct [Battery Electrical Drain/Parasitic Load Test](#) using an inductive probe.
    3. If parasitic current is less than 100 mA, replace Battery Sensor Module.
      - If parameters read Available (Learned) and No (Measured) or reads Not Available (Not Learned) and Yes (Estimated)

**NOTE:**

If parameters read Not Available (Not Learned) and Yes (Estimated) the vehicle needs to sit for 3 hours undisturbed but is not required to have the start/stop enabled. After a 3 hour Battery Sensor Module Learn the parameters Battery Sensor Module Battery State Information and Battery Sensor Module Reset Occurred - Using Estimated State of Charge change to Available (Learned) and No (Measured) after the engine is cranked.

**NOTE:**

A vehicle hoist can be used to verify the autostop and autostart operation.

5. Verify the autostop and autostart functions are functioning properly while operating the vehicle under the conditions for entering a start/stop event. Refer to [Stop/Start System Description and Operation \(KL9 with LE2\)](#).
  - **If the vehicle does not autostop or autostart**
    1. Observe the scan tool Autostop Disable Reason, Autostop Inhibit Reason, Autostart Inhibit, and Autostart Reason parameters while operating the vehicle under the conditions for entering a start/stop event. Refer to [Stop/Start Disable, Inhibit, and Restart Reasons](#). These parameters will identify the specific cause for the autostop or autostart disable.
  - **If the vehicle autostops and autostarts**
6. Verify the infotainment system remains active during a start/stop event.
  - **If the infotainment system turns off or restarts during a start/stop event.**

Refer to Circuit/System Testing - Power Supply Transformer Circuit Malfunction
  - **If the infotainment system remains active during a start/stop event**
7. All OK.

### Circuit/System Testing

#### Power Supply Transformer Circuit Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the T19 Power Supply Transformer. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10  $\Omega$  between each ground circuit terminal and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the ground circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.
  - **If less than 10  $\Omega$**
3. Ignition ON.
4. Verify a test lamp illuminates between each B+ circuit terminal and ground.
  - **If the test amp does not illuminate and the circuit fuse is good**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , 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. Ignition 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, test or replace the T19 Power Supply Transformer.
  - **If the test lamp illuminates**
5. Verify a test lamp illuminates between each ignition circuit and ground.

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

1. Ignition OFF.
2. Test for less than 2  $\Omega$  in the ignition circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , verify, refer to [Power Mode Mismatch](#).

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

1. Ignition OFF.
2. Test for infinite resistance between the ignition circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, test or replace the T19 Power Supply Transformer.

- **If the test lamp illuminates**

6. Install a test lamp between the control circuit terminal 5 and ground.

7. Verify the test lamp illuminates while cranking the engine.

- **If the test lamp does not illuminate**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module and disconnect the KR27 Starter Relay.

2. Test for infinite resistance between the control circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance

3. Test for less than 2  $\Omega$  in the control circuit end to end.

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

- **If the test lamp illuminates**

8. Test or replace the T19 Power Supply Transformer.

### Repair Instructions

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

- Refer to [Multifunction Power Supply Converter Replacement](#) for T19 Power Supply Transformer replacement
- Refer to [Control Module References](#) for control module replacement, programming, and setup

### STOP/START DISABLE, INHIBIT, AND RESTART REASONS

**NOTE:** Not all parameters may be available in all vehicles

The following Autostop Disable parameters are only valid when Engine is Running. It indicated why are we currently inhibiting autostop at that moment in time.

#### Autostop Disable

| Scantool Parameter - Current Inhibit Reason  | System State   | Description               | Expected Value | Recommended Check                                                             | Next Step                                                                                                |
|----------------------------------------------|----------------|---------------------------|----------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Autostop Disable Reason - Transmission Range | Engine Running | Transmission not in Drive | No             | Ensure transmission is in drive. Stop/start will not function in manual mode. | If OK:<br>Inform Customer - Normal Disable Condition<br>If not OK:<br>Refer to transmission diagnostics. |

| <b>Scantool<br/>Parameter -<br/>Current Inhibit<br/>Reason</b> | <b>System<br/>State</b> | <b>Description</b>                                                                                                                                                                                                                                            | <b>Expected<br/>Value</b> | <b>Recommended<br/>Check</b>                                                     | <b>Next Step</b>                                  |
|----------------------------------------------------------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------------------------------------------------------------------------------|---------------------------------------------------|
| Autostop Disable Reason - Passenger Compartment Heater On      | Engine Running          | Passenger Compartment Heater ON                                                                                                                                                                                                                               | No                        | Turn off passenger compartment heater.                                           | As Required                                       |
| Autostop Disable Reason - Driver Exited Vehicle                | Engine Running          | Seat belt unbuckled and driver's door opened.                                                                                                                                                                                                                 | No                        | Make sure driver's seatbelt is secured and driver's door latch is closed..       | As Required                                       |
| Autostop Disable Reason - 12V Start Counter Exceeded           | Engine Running          | Backup Start Performed indicates that an autostop was prevented due to the expiration of backup start counter. If the motor generator cannot autostart the ICE, a calibratable number of attempts to start the engine with the 12V starter will be performed. | No                        | Determine cause of the previous no start condition.                              | As required                                       |
| Autostop Disable Reason - Vehicle Inclination                  | Engine Running          | Vehicle Grade indicates that an autostop was prevented (or an autostart was commanded) due to the current grade level of the vehicle.                                                                                                                         | No                        | Verify vehicle is not on level ground.                                           | If not OK: Verify Multi-Axis Accelerator Sensor.  |
| Autostop Disable Reason - Remote Vehicle Start Request         | Engine Running          | Remote Start indicates the internal combustion engine has been requested to run through a remote start command.                                                                                                                                               | No                        | Verify remote start operation.                                                   | If OK: Inform Customer - Normal Disable Condition |
| Autostop Disable Reason - Acceleration Request                 | Engine Running          | Driveability indicates an autostart was command based on torque conditions requested from the driver (generally a tip-in on the throttle). When this condition is detected, autostops are disallowed.                                                         | No                        | Ensure accelerator pedal is fully released                                       | If OK: Inform Customer - Normal Disable Condition |
| Autostop Disable Reason - Transmission In Reverse              | Engine Running          | Transmission in reverse gear.                                                                                                                                                                                                                                 | No                        | Ensure transmission is in drive. Stop/start will not function in any other mode. | If OK: Inform Customer - Normal Disable Condition |

| Scantool<br>Parameter -<br>Current Inhibit<br>Reason                     | System<br>State   | Description                                                                                                                                                                                                    | Expected<br>Value | Recommended<br>Check                                                                              | Next Step                                                        |
|--------------------------------------------------------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Autostop Disable<br>Reason - Reduced<br>Engine Power<br>Active           | Engine<br>Running | Reduced Power<br>indicates that<br>AutoStops are<br>disallowed when a<br>situation has been<br>detected that causes<br>the vehicle to operate<br>with reduced power.                                           | No                | Check ECM DTC's.                                                                                  | As required.                                                     |
| Autostop Disable<br>Reason -<br>HYBRID/EV<br>Battery Pack<br>Temperature | Engine<br>Running | HV Battery Pack<br>Temperature<br>indicates Disallow<br>AutoStops/Command<br>AutoStart when<br>battery temperature is<br>high.                                                                                 | No                | Ensure parameter in<br>scan tool is not<br>indicating high.<br>Check DTC's.                       | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition |
| Autostop Disable<br>Reason -<br>Transmission<br>Range                    | Engine<br>Running | Transmission Range<br>indicates that an<br>autostop was<br>prevented (or an<br>autostart was<br>commanded) due to<br>the selected<br>transmission range.                                                       | No                | Ensure transmission<br>is in drive. Stop/start<br>will not function in<br>manual mode.            | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition |
| Autostop Disable<br>Reason - Ignition<br>Switch Start                    | Engine<br>Running | Key Forced<br>AutoStart Request:<br>The driver can<br>request an autostart in<br>park or neutral by<br>cranking the key.<br>Autostops are not<br>allowed again until<br>out of park/neutral.                   | No                | As required.                                                                                      | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition |
| Autostop Disable<br>Reason - TCM<br>Request                              | Engine<br>Running | TCM Override<br>indicates that<br>AutoStops are<br>disallowed based on<br>transmission PRNDL<br>position.                                                                                                      | No                | Ensure transmission<br>is in drive. Stop/start<br>will not function in<br>manual mode.            | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition |
| Autostop Disable<br>Reason - System<br>Optimization                      | Engine<br>Running | System Optimization<br>indicates Command<br>AutoStart based on<br>overall system<br>conditions (engine<br>speed & torque<br>optimization). When<br>this condition is<br>detected, AutoStops<br>are disallowed. | No                | Ensure vehicle is over<br>3MPH/5KMH before<br>autostop is enabled.                                | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition |
| Autostop Disable<br>Reason - System<br>Voltage Low                       | Engine<br>Running | 12V battery state of<br>function low                                                                                                                                                                           | No                | Charge and test<br>battery, operate<br>vehicle for longer<br>drives, check<br>generator operation | As Required                                                      |

| Scantool<br>Parameter -<br>Current Inhibit<br>Reason                          | System<br>State   | Description                                                                                                                                                                                  | Expected<br>Value | Recommended<br>Check                                    | Next Step                                                        |
|-------------------------------------------------------------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------------------------------------------------|------------------------------------------------------------------|
| Autostop Disable<br>Reason - Engine<br>Coolant<br>Temperature Out<br>Of Range | Engine<br>Running | Engine Coolant<br>Temperature<br>indicates that an<br>autostop was<br>prevented (or an<br>autostart was<br>commanded) due to<br>engine coolant<br>temperature out of<br>range (high or low). | No                | Ensure coolant<br>temperature isn't too<br>high or low. | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition |
| Autostop Disable<br>Reason - Catalyst<br>Test In Progress                     | Engine<br>Running | Catalyst indicates a<br>requested inhibit for<br>Catalyst monitor<br>from gas or Diesel.                                                                                                     | No                | Ensure catalyst<br>parameter isn't out of<br>range      | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition |
| Autostop Disable<br>Reason - HO2S<br>Test In Progress                         | Engine<br>Running | Oxygen Sensor<br>indicates a requested<br>inhibit for Oxygen<br>Sensor Monitor.                                                                                                              | No                | Ensure oxygen sensor<br>parameter isn't out of<br>range | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition |
| Autostop Disable<br>Reason - Misfire<br>Test In Progress                      | Engine<br>Running | Misfire Monitor<br>indicates a requested<br>inhibit for Misfire<br>Monitor.                                                                                                                  | No                | Ensure no misfire<br>detected in scan tool.             | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition |
| Autostop Disable<br>Reason - Catalyst<br>not at Operating<br>Temperature      | Engine<br>Running | Catalyst not at<br>Operating<br>Temperature                                                                                                                                                  | No                | Ensure Catalyst is<br>within operating<br>temperature   | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition |
| Autostop Disable<br>Reason - Intake<br>Manifold<br>Temperature Too<br>High    | Engine<br>Running | Engine Manifold<br>Temperature<br>indicates an inhibit<br>due to high Manifold<br>Temp.                                                                                                      | No                | Ensure Manifold<br>Temperature isn't<br>high            | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition |
| Autostop Disable<br>Reason - Engine<br>Speed Test in<br>Progress              | Engine<br>Running | Engine Speed<br>Diagnostics indicates<br>a requested inhibit<br>due to Engine Speed<br>diagnostics.                                                                                          | No                | As required                                             | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition |
| Autostop Disable<br>Reason - MAF<br>sensor Test In<br>Progress                | Engine<br>Running | Mass Air Flow<br>Diagnostics indicates<br>a requested inhibit<br>due to MAF<br>diagnostics.                                                                                                  | No                | Check ECM DTC's                                         | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition |

| <b>Scantool<br/>Parameter -<br/>Current Inhibit<br/>Reason</b>        | <b>System<br/>State</b> | <b>Description</b>                                                                                      | <b>Expected<br/>Value</b> | <b>Recommended<br/>Check</b>                                            | <b>Next Step</b>                                     |
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| Autostop Disable Reason - MAP Sensor Test In Progress                 | Engine Running          | Manifold Absolute Pressure Diagnostics indicates a requested inhibit due to MAP diagnostics.            | No                        | Check ECM DTC's                                                         | If OK:<br>Inform Customer - Normal Disable Condition |
| Autostop Disable Reason - Engine Oil Temperature Too High             | Engine Running          | Engine Oil Temp indicates an inhibit due to high Engine Oil Temp.                                       | No                        | Check Oil temperature is not too high.                                  | If OK:<br>Inform Customer - Normal Disable Condition |
| Autostop Disable Reason - Engine Stop/Start Test in Progress          | Engine Running          | Starting System indicates an inhibit due to Engine Start Stop functions.                                | No                        | Ensure control functions are done before proper function of stop/start  | If OK:<br>Inform Customer - Normal Disable Condition |
| Autostop Disable Reason - Engine Coolant Temperature Test In Progress | Engine Running          | Engine Coolant Temperature indicates a requested inhibit due to low or high Engine Coolant Temperature. | No                        | Ensure control function is done before expecting stop/start to function | If OK:<br>Inform Customer - Normal Disable Condition |
| Autostop Disable Reason - EVAP System Test In Progress                | Engine Running          | Evap System indicates a requested inhibit for Evap System Monitor                                       | No                        | Ensure control function is complete before stop/start can function      | If OK:<br>Inform Customer - Normal Disable Condition |
| Autostop Disable Reason - Fuel Injector Test In Progress              | Engine Running          | Fuel Injector Diagnostics indicates a requested inhibit due to Fuel Injector diagnostics.               | No                        | Ensure control function is complete before stop/start can function      | If OK:<br>Inform Customer - Normal Disable Condition |
| Autostop Disable Reason - Fuel Pressure Test In Progress              | Engine Running          | Fuel Pressure indicates a requested inhibit for Fuel Pressure Pump monitor.                             | No                        | Ensure control function is complete before stop/start can function      | If OK:<br>Inform Customer - Normal Disable Condition |
| Autostop Disable Reason - Fuel System Test In Progress                | Engine Running          | Fuel Systems indicates a requested inhibit for Fuel Systems monitor.                                    | No                        | Ensure control function is complete before stop/start can function      | If OK:<br>Inform Customer - Normal Disable Condition |
| Autostop Disable Reason - Parking Maneuver Detected                   | Engine Running          | Parking maneuver detection indicates a requested inhibit due to parking maneuver active.                | No                        | Check functionality after parking                                       | If OK:<br>Inform Customer - Normal Disable Condition |
|                                                                       |                         |                                                                                                         |                           |                                                                         |                                                      |

| <b>Scantool<br/>Parameter -<br/>Current Inhibit<br/>Reason</b> | <b>System<br/>State</b> | <b>Description</b>                                                                                                                                                        | <b>Expected<br/>Value</b> | <b>Recommended<br/>Check</b>                             | <b>Next Step</b>                                                                                 |
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| Autostop Disable Reason - High Engine Rotating Torque          | Engine Running          | Engine Friction indicates a requested inhibit due to cold engine, friction high.                                                                                          | No                        | Wait for vehicle to reach proper temperature             | If OK:<br>Inform Customer - Normal Disable Condition                                             |
| Autostop Disable Reason - BARO Pressure Too Low                | Engine Running          | Ambient Air Pressure indicates a requested inhibit due to low Barometric Pressure                                                                                         | No                        | Ensure barometric temperature isn't too low in scan tool | If OK:<br>Inform Customer - Normal Disable Condition                                             |
| Autostop Disable Reason - Fuel Temperature Too High            | Engine Running          | Boil Off Diagnostics indicates a requested inhibit due to Fuel Boil Off diagnostics.                                                                                      | No                        | Ensure fuel temperature isn't too high                   | If OK:<br>Inform Customer - Normal Disable Condition                                             |
| Autostop Disable Reason - System Malfunction                   | Engine Running          | Starting System indicates that a condition in the starting system has been detected that would prevent a re-start of the vehicle and thus, autostops, have been disabled. | No                        | Check ECM DTC's                                          | If OK:<br>Inform Customer - Normal Disable Condition                                             |
| Autostop Disable Reason - Turbocharger Temperature Too High    | Engine Running          | Turbo Temp indicates an inhibit due to high Turbo Temp.                                                                                                                   | No                        | Check ECM DTC's                                          | If OK:<br>Inform Customer - Normal Disable Condition                                             |
| Autostop Disable Reason - Hood Ajar                            | Engine Running          | Hood not latched                                                                                                                                                          | No                        | Ensure hood is closed and latched.                       | If OK: Refer to Hood Ajar Malfunction.<br>If not OK: close hood.                                 |
| Autostop Disable Reason - ECM Request                          | Engine Running          | ECM tasks are currently running that will not allow an autostop                                                                                                           | No                        | Autostop will function once the task is complete.        | Inform Customer - Normal Disable Condition                                                       |
| Autostop Disable Reason - Run/Crank Not Active                 | Engine Running          | Vehicle must be in Run Mode                                                                                                                                               | No                        | Verify ECM Run/Crank signal                              | If OK:<br>Inform Customer - Normal Disable Condition<br>If not OK: refer to Power Mode Mismatch. |
|                                                                |                         |                                                                                                                                                                           |                           |                                                          |                                                                                                  |

| <b>Scantool<br/>Parameter -<br/>Current Inhibit<br/>Reason</b>                        | <b>System<br/>State</b> | <b>Description</b>                                           | <b>Expected<br/>Value</b> | <b>Recommended<br/>Check</b>                                                     | <b>Next Step</b>                                                                                                 |
|---------------------------------------------------------------------------------------|-------------------------|--------------------------------------------------------------|---------------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Autostop Disable Reason - Minimum Engine Run Time Not Met                             | Engine Running          | Engine must run a minimum time before stop/start is allowed. | No                        | Autostop will function once the minimum run time is met                          | Inform Customer - Normal Disable Condition                                                                       |
| Autostop Disable Reason - Control Function Active                                     | Engine Running          | Scantool control function active                             | No                        | Release control function in scantool                                             | None                                                                                                             |
| Autostop Disable Reason - Auxiliary Transmission Fluid Pump/Accumulator Not Available | Engine Running          | Transmission aux pump or accumulator not available           | No                        | Check for transmission DTCs, refer to automatic transmission service information | As Required                                                                                                      |
| Autostop Disable Reason - Engine Coolant Temperature Out of Range                     | Engine Running          | Coolant temperature too hot or cold                          | No                        | Verify cooling temperature is within normal operating values                     | If OK: Inform Customer - Normal Disable Condition<br>If not OK: Refer to Engine Heating and Cooling diagnostics. |
| Autostop Disable Reason - Invalid Data Received                                       | Engine Running          | ECM has received invalid data                                | No                        | Check ECM DTC's                                                                  | As Required                                                                                                      |
| Autostop Disable Reason - Vehicle Speed Too High                                      | Engine Running          | Vehicle speed detected                                       | No                        | Ensure vehicle is at a complete stop                                             | If OK: Inform Customer - Normal Disable Condition<br>If not OK: refer to SI                                      |
| Autostop Disable Reason - Transmission Fluid Temperature Out of Range                 | Engine Running          | Transmission temperature too hot or cold                     | No                        | Verify transmission temperature is within normal operating values                | If OK: Inform Customer - Normal Disable Condition.<br>If not OK: Refer to transmission diagnostics.              |

| Scantool<br>Parameter -<br>Current Inhibit<br>Reason                              | System<br>State   | Description                                                                                          | Expected<br>Value | Recommended<br>Check                                                                              | Next Step                                                                                                                                          |
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| Autostop Disable<br>Reason - Brake<br>Pedal Released                              | Engine<br>Running | Brake pedal not<br>pressed (enough)                                                                  | No                | Ensure brake pedal is<br>pressed sufficiently to<br>active autostop                               | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition<br>If not OK:<br>Verify brake<br>pedal switch<br>operation<br>and<br>calibration. |
| Autostop Disable<br>Reason - Brake<br>Booster Weak<br>Vacuum                      | Engine<br>Running | Weak brake booster<br>vacuum                                                                         | No                | Ensure brake booster<br>vacuum is within<br>normal operating<br>values                            | Check<br>DTCs. Refer<br>to brake<br>booster<br>diagnostics.                                                                                        |
| Autostop Disable<br>Reason -<br>Accelerator Pedal<br>Pressed                      | Engine<br>Running | Accelerator pedal<br>pressed                                                                         | No                | Ensure accelerator<br>pedal is fully released                                                     | If OK:<br>Inform<br>Customer -<br>Normal<br>Disable<br>Condition<br>If not OK:<br>Ensure pedal<br>sensor<br>operation<br>and<br>calibration.       |
| Autostop Disable<br>Reason - A/C<br>Request                                       | Engine<br>Running | HVAC system is<br>requesting AC<br>compressor due to<br>high cabin<br>temperature and/or<br>humidity | No                | Allow cabin<br>temperature/humidity<br>to reach setpoint,<br>change setpoint, turn<br>off blower  | Inform<br>Customer -<br>Normal<br>Disable<br>Condition                                                                                             |
| Autostop Disable<br>Reason - Low-<br>Voltage Battery<br>Voltage Low               | Engine<br>Running | 12V battery voltage<br>is low                                                                        | No                | Charge and test<br>battery, operate<br>vehicle for longer<br>drives, check<br>generator operation | As Required                                                                                                                                        |
| Autostop Disable<br>Reason - Low-<br>Voltage Battery<br>State of Health<br>Low    | Engine<br>Running | 12V battery has low<br>state of health                                                               | No                | Charge and test<br>battery, operate<br>vehicle for longer<br>drives, check<br>generator operation | As Required                                                                                                                                        |
| Autostop Disable<br>Reason - Low-<br>Voltage Battery<br>State of Charge<br>Low    | Engine<br>Running | 12V battery state of<br>charge is low                                                                | No                | Charge and test<br>battery, operate<br>vehicle for longer<br>drives, check<br>generator operation | As Required                                                                                                                                        |
| Autostop Disable<br>Reason - Low-<br>Voltage Battery<br>Discharge Current<br>High | Engine<br>Running | Excessive current<br>draw is placing a<br>high demand on the<br>generator                            | No                | Check electrical<br>loads, turn off<br>unnecessary loads                                          | Inform<br>Customer -<br>Normal<br>Disable<br>Condition                                                                                             |

| <b>Scantool<br/>Parameter -<br/>Current Inhibit<br/>Reason</b> | <b>System<br/>State</b> | <b>Description</b>                                               | <b>Expected<br/>Value</b> | <b>Recommended<br/>Check</b>                       | <b>Next Step</b>                                                                                             |
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| Autostop Disable Reason - Intake Manifold Weak Vacuum          | Engine Running          | Low manifold vacuum                                              | No                        | Verify manifold vacuum                             | Check DTCs, refer to SI                                                                                      |
| Autostop Disable Reason - Engine Speed High                    | Engine Running          | High idle condition                                              | No                        | Correct cause of high idle                         | Check DTCs, refer to SI                                                                                      |
| Autostop Disable Reason - Wheel Slip Detected                  | Engine Running          | Slippery road conditions                                         | No                        | Ensure good road conditions                        | Inform Customer - Normal Disable Condition                                                                   |
| Autostop Disable Reason - Vehicle Speed Threshold Not Reached  | Engine Running          | Vehicle must reach a minimum speed                               | No                        | Operate at sufficient speeds                       | Inform Customer - Normal Disable Condition                                                                   |
| Autostop Disable Reason - Maximum Vehicle Stop Time Exceeded   | Engine Running          | Engine was shut off for maximum allowable off time               | No                        | Operate at sufficient speeds to reactivate         | Inform Customer - Normal Disable Condition                                                                   |
| Autostop Disable Reason - Starter System Malfunction           | Engine Running          | Starter System Inoperable                                        | No                        | Check ECM DTCs, refer to SI                        | As Required                                                                                                  |
| Autostop Disable Reason - System Malfunction                   | Engine Running          | Starter System Inoperable                                        | No                        | Check for Vehicle DTCs                             | As Required                                                                                                  |
| Autostop Disable Reason - Stop/Start Select Switch             | Engine Running          | Switch not enabled                                               | No                        | Turn switch on.                                    | If OK:<br>Inform Customer - Normal Disable Condition<br>If Not OK:<br>refer to Stop/Start System Malfunction |
| Autostop Disable Reason - Idle Boost Mode Active               | Engine Running          | Idle boost requested                                             | No                        | Check electrical loads, turn off unnecessary loads | Inform Customer - Normal Disable Condition                                                                   |
| Autostop Disable Reason - Generator Load High                  | Engine Running          | Excessive current draw is placing a high demand on the generator | No                        | Check electrical loads, turn off unnecessary loads | Inform Customer - Normal Disable Condition                                                                   |

| <b>Scantool Parameter - Current Inhibit Reason</b>                     | <b>System State</b> | <b>Description</b>                       | <b>Expected Value</b> | <b>Recommended Check</b>                                                              | <b>Next Step</b>                                                                                                                |
|------------------------------------------------------------------------|---------------------|------------------------------------------|-----------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Autostop Disable Reason - Clutch Pedal Applied                         | Engine Running      | Clutch pedal (manual trans) not released | No                    | Ensure clutch pedal is released                                                       | If OK:<br>Inform Customer - Normal Disable Condition<br>If not OK:<br>Refer to clutch switch diagnostic and verify calibration. |
| Autostop Disable Reason - Low-Voltage Battery Temperature Out of Range | Engine Running      | Battery temperature too cold or hot      | No                    | Ensure battery is kept within normal operating range                                  | Inform Customer - Normal Disable Condition                                                                                      |
| Autostop Disable Reason - Low-Voltage Battery State of Function Low    | Engine Running      | 12V battery state of function low        | No                    | Charge and test battery, operate vehicle for longer drives, check generator operation | As Required                                                                                                                     |

The following Autostart Inhibit parameters show why the engine is off or was turned off. There are a couple different things this can mean. Forced Off (Mostly Hybrid), Propulsion System Shutdown (Stall), Cannot Start Engine (Hybrid).

#### **Autostart Inhibit**

| <b>Scantool Parameter - Current Inhibit Reason</b> | <b>System State</b> | <b>Description</b>                                               | <b>Expected Value</b> | <b>Recommended Check</b>                          | <b>Next Step</b>                                     |
|----------------------------------------------------|---------------------|------------------------------------------------------------------|-----------------------|---------------------------------------------------|------------------------------------------------------|
| Autostart Inhibit Reason - Hood Ajar               | Engine off          | Hood not latched                                                 | No                    | Ensure hood is closed and latched.                | If not OK:<br>close hood.                            |
| Autostart Inhibit Reason - ECM Request             | Engine off          | ECM tasks are currently running that will not allow an autostart | No                    | Autostop will function once the task is complete. | Inform Customer - Normal Disable Condition           |
| Autostart Inhibit Reason - Run/Crank Not Active    | Engine off          | Vehicle must be in Run Mode                                      | No                    | Verify ECM Run/Crank signal                       | If OK:<br>Inform Customer - Normal Disable Condition |
| Autostart Inhibit Reason - System Malfunction      | Engine off          | Vehicle System Issue                                             | No                    | Check for Vehicle DTCs                            | As Required                                          |
| Autostart Inhibit Reason - Autostart Not Commanded | Engine off          | Vehicle is in a normal autostop mode                             | Yes                   | None                                              | Inform Customer - Normal Disable Condition           |
| Autostart Inhibit Reason - Crank Aborted           | Engine off          | ECM has disabled propulsion system                               | No                    | Check ECM DTCs                                    | As Required                                          |

| <b>Scantool Parameter - Current Inhibit Reason</b>                 | <b>System State</b> | <b>Description</b>                                                           | <b>Expected Value</b> | <b>Recommended Check</b>                                          | <b>Next Step</b>                                  |
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| Autostart Inhibit Reason - Control Function Active                 | Engine off          | Scantool control function active                                             | No                    | Release control function in scantool                              | As Required                                       |
| Autostart Inhibit Reason - ECM Malfunction                         | Engine off          | ECM has disabled propulsion system                                           | No                    | Check ECM DTCs                                                    | As Required                                       |
| Autostart Inhibit Reason - Autostart/Autostop Malfunction          | Engine off          | ECM has disabled propulsion system                                           | No                    | Check ECM DTCs                                                    | As Required                                       |
| Autostart Inhibit Reason - Driver Exited Vehicle                   | Engine off          | Seat belt unbuckled and driver's door opened.                                | No                    | Not in all vehicles. Verify seat belt and driver's door switches. | If OK: Inform Customer - Normal Disable Condition |
| Autostart Inhibit Reason - Engine Coolant Temperature Out of Range | Engine off          | Coolant temperature too hot or cold                                          | No                    | Verify cooling temperature is within normal operating values      | If OK: Inform Customer - Normal Disable Condition |
| Autostart Inhibit Reason - Remote Vehicle Start Disabled           | Engine off          | Remote Vehicle Start Disabled                                                | No                    | As Required                                                       | As Required                                       |
| Autostart Inhibit Reason - Calibration Override                    | Engine off          | Calibration forced to shut off by calibration                                | No                    | Verify cooling temperature is within normal operating values      | If OK: Inform Customer - Normal Disable Condition |
| Autostart Inhibit Reason - Compression Test                        | Engine off          | Engine was forced to shut off following the completion of a compression test | No                    | As Required                                                       | As Required                                       |
| Autostart Inhibit Reason - TCM Request                             | Engine off          | TCM can force the engine off depending on transmission conditions.           | No                    | As Required                                                       | If OK: Inform Customer - Normal Disable Condition |
| Autostart Inhibit Reason - Engine Stop Required                    | Engine off          | Detection of a situation that might otherwise cause a stall of the vehicle.  | No                    | As Required                                                       | As Required                                       |

The following Autostart Reasons parameters are only valid when Engine is Running. It indicates why we started the engine the last time it was autostarted.

#### **Autostart Reasons**

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| Scantool Parameter - Current Inhibit Reason                    | System State   | Description                                             | Expected Value | Recommended Check                                                                     | Next Step                                                                                        |
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| Autostart Reason - TCM Demand                                  | Engine Running | TCM has requested an autostart                          | No             | Ensure transmission is in drive. Stop/start will not function in manual mode.         | If OK: Inform Customer - Normal Disable Condition. If not OK: Refer to transmission diagnostics. |
| Autostart Reason - Reduced Engine Power Active                 | Engine Running | ECM has requested Reduced Engine Power                  | No             | Check ECM DTCs.                                                                       | As required.                                                                                     |
| Autostart Reason - Maximum Autostop Time Exceeded              | Engine Running | Maximum autostop time is limited.                       | No             | Maximum autostop time is typically 2 minutes.                                         | If OK: Inform Customer - Normal Disable Condition                                                |
| Autostart Reason - Transmission Fluid Temperature Out of Range | Engine Running | Transmission temperature too hot or cold                | No             | Verify transmission temperature is within normal operating values                     | If OK: Inform Customer - Normal Disable Condition. If not OK: Refer to transmission diagnostics. |
| Autostart Reason - System Malfunction                          | Engine Running | Vehicle System Issue                                    | No             | Check for Vehicle DTCs                                                                | As required.                                                                                     |
| Autostart Reason - Transmission in Reverse                     | Engine Running | Transmission was placed in reverse.                     | No             | Ensure transmission is in drive.                                                      | If OK: Inform Customer - Normal Disable Condition. If not OK: Refer to transmission diagnostics. |
| Autostart Reason - Invalid Data Received                       | Engine Running | ECM has received invalid data                           | No             | Check ECM DTCs.                                                                       | As required.                                                                                     |
| Autostart Reason - Vehicle Speed Too High                      | Engine Running | Vehicle speed detected                                  | No             | Ensure vehicle is at a complete stop                                                  | If OK: Inform Customer - Normal Disable Condition                                                |
| Autostart Reason - System Optimization                         | Engine Running | ECM has determined that the engine needs to be started. | No             | Check DTCs.                                                                           | If OK: Inform Customer - Normal Disable Condition                                                |
| Autostart Reason - System Voltage Low                          | Engine Running | 12V battery state of charge is low.                     | No             | Charge and test battery, operate vehicle for longer drives, check generator operation | If OK: Inform Customer - Normal Disable Condition                                                |

| <b>Scantool Parameter - Current Inhibit Reason</b>                             | <b>System State</b> | <b>Description</b>                                               | <b>Expected Value</b> | <b>Recommended Check</b>                                                         | <b>Next Step</b>                                  |
|--------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------|-----------------------|----------------------------------------------------------------------------------|---------------------------------------------------|
| Autostart Reason - Acceleration Request                                        | Engine Running      | Accelerator pedal pressed                                        | No                    | Ensure accelerator pedal is fully released                                       | If OK: Inform Customer - Normal Disable Condition |
| Autostart Reason - Minimum Engine Run Time Not Met                             | Engine Running      | Engine must run a minimum time before stop/start is allowed.     | No                    | Autostop will function once the minimum run time is met                          | Inform Customer - Normal Disable Condition        |
| Autostart Reason - Control Function Active                                     | Engine Running      | Scantool control function active                                 | No                    | Release control function in scantool                                             | As Required                                       |
| Autostart Reason - Auxiliary Transmission Fluid Pump/Accumulator Not Available | Engine Running      | Transmission aux pump or accumulator not available               | No                    | Check for transmission DTCs, refer to automatic transmission service information | As Required                                       |
| Autostart Reason - Engine Coolant Temperature Out of Range                     | Engine Running      | Coolant temperature too hot or cold                              | No                    | Verify cooling temperature is within normal operating values                     | If OK: Inform Customer - Normal Disable Condition |
| Autostart Reason - Transmission Range                                          | Engine Running      | Transmission not in Drive                                        | No                    | Ensure transmission is in drive. Stop/start will not function in manual mode.    | If OK: Inform Customer - Normal Disable Condition |
| Autostart Reason - Hood Ajar                                                   | Engine Running      | Hood not latched                                                 | No                    | Ensure hood is closed and latched.                                               | If not OK: close hood.                            |
| Autostart Reason - ECM Request                                                 | Engine Running      | ECM tasks are currently running that will not allow an autostop  | No                    | Autostop will function once the task is complete.                                | Inform Customer - Normal Disable Condition        |
| Autostart Reason - Low-Voltage Battery Discharge Current High                  | Engine Running      | Excessive current draw is placing a high demand on the generator | No                    | Check electrical loads, turn off unnecessary loads                               | Inform Customer - Normal Disable Condition        |
| Autostart Reason - Brake Pedal Released                                        | Engine Running      | Brake pedal not pressed (enough)                                 | No                    | Ensure brake pedal is pressed sufficiently to active autostop                    | If OK: Inform Customer - Normal Disable Condition |
| Autostart Reason - Brake Booster Weak Vacuum                                   | Engine Running      | Weak brake booster vacuum                                        | No                    | Ensure brake booster vacuum is within normal operating values                    | Check DTCs. Refer to brake booster diagnostics.   |
| Autostart Reason - Accelerator Pedal Pressed                                   | Engine Running      | Accelerator pedal pressed                                        | No                    | Ensure accelerator pedal is fully released                                       | If OK: Inform Customer - Normal Disable Condition |

| Scantool Parameter - Current Inhibit Reason                  | System State   | Description                                                                                                                           | Expected Value | Recommended Check                                                                      | Next Step                                         |
|--------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------|---------------------------------------------------|
| Autostart Reason - A/C Request                               | Engine Running | HVAC system is requesting AC compressor due to high cabin temperature and/or humidity                                                 | No             | Allow cabin temperature/humidity to reach setpoint, change setpoint, turn off blower   | Inform Customer - Normal Disable Condition        |
| Autostart Reason - Low-Voltage Battery Voltage Low           | Engine Running | 12V battery voltage is low                                                                                                            | No             | Charge and test battery, operate vehicle for longer drives, check generator operation  | As Required                                       |
| Autostart Reason - Driver Exited Vehicle                     | Engine Running | Seat belt unbuckled and driver's door opened.                                                                                         | No             | Not in all vehicles. Verify seat belt and driver's door switches.                      | If OK: Inform Customer - Normal Disable Condition |
| Autostart Reason - Passenger Compartment Heater On           | Engine Running | Passenger Compartment Heater On                                                                                                       | No             | Check Vehicle DTCs                                                                     | If OK: Inform Customer - Normal Disable Condition |
| Autostart Reason - Stop/Start select Switch                  | Engine Running | Stop/Start select Switch off                                                                                                          | No             | Not in all vehicles.                                                                   | If OK: Inform Customer - Normal Disable Condition |
| Autostart Reason - Driver Exited Vehicle                     | Engine Running | Seat belt unbuckled and driver's door opened.                                                                                         | No             | Not in all vehicles. Verify seat belt and driver's door switches.                      | If OK: Inform Customer - Normal Disable Condition |
| Autostart Reason - Low Voltage Battery State of Charge Low   | Engine Running | 12V battery voltage is low                                                                                                            | No             | Charge and test battery, operate vehicle for longer drives, check generator operation  | As Required                                       |
| Autostart Reason - Inclination                               | Engine Running | Vehicle Grade indicates that an autostop was prevented (or an autostart was commanded) due to the current grade level of the vehicle. | No             | As Required                                                                            | If OK: Inform Customer - Normal Disable Condition |
| Autostart Reason - Low Voltage Battery State of Function Low | Engine Running | 12V battery voltage is low                                                                                                            | No             | Charge and test battery, operate vehicle for longer drives, check generator operation. | As Required                                       |
| Autostart Reason - Remote Vehicle Start Request              | Engine Running | Remote start requested                                                                                                                | No             | As Required.                                                                           | If OK: Inform Customer - Normal Disable Condition |

| Scantool Parameter - Current Inhibit Reason                | System State   | Description                | Expected Value | Recommended Check                                                                                                                      | Next Step                                         |
|------------------------------------------------------------|----------------|----------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Autostart Reason - Ignition Switch Start                   | Engine Running | Switch Start Request       | No             | The driver can request an autostart in park or neutral by cranking the key. Autostops are not allowed again until out of park/neutral. | If OK: Inform Customer - Normal Disable Condition |
| Autostart Reason - Low Voltage Battery State of Health Low | Engine Running | 12V battery voltage is low | No             | Charge and test battery, operate vehicle for longer drives, check generator operation                                                  | As Required                                       |

## STARTER SOLENOID DOES NOT CLICK (WITHOUT KL9)

### Diagnostic Instructions

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

### Diagnostic Fault Information

| Circuit                                                                                                           | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|-------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------------------|--------------------|
| Relay Switch B+ Terminal 30                                                                                       | 1               | 2                    | -                | -                  |
| Relay Coil Ignition Terminal 85                                                                                   | P0616           | P0615                | P0617            | -                  |
| Relay Switch Control Terminal 87                                                                                  | 2               | 2                    | 3                | -                  |
| Relay Coil Ground Terminal 86                                                                                     | -               | P0615                | -                | -                  |
| 1. Opens fuse, starter solenoid does not click.<br>2. Starter solenoid does not click.<br>3. Cranks all the time. |                 |                      |                  |                    |

### Circuit/System Description

When the ignition mode switch is placed in the START position, a discrete signal is supplied to the body control module (BCM) notifying it that the ignition is in the START position. The BCM then sends a serial data message to the engine control module (ECM) that crank has been requested. The ECM then verifies that the clutch is fully depressed or the automatic transmission is in Park/Neutral. If it is, the ECM then supplies 12 V to the control circuit of the starter relay. When this occurs, battery voltage is supplied through the switch of the starter relay to the starter solenoid.

### Reference Information

#### Schematic Reference

- [Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)
- [Automatic Transmission Controls Schematics \(Buick with MNK or MNH\)](#)[Automatic Transmission Controls Schematics \(Chevrolet with MNK\)](#) for the Automatic Transmissions - 6T30/6T40/6T45/6T50 (MH8, MHB)
- [Manual Transmission Schematics \(Manual Transmission \(Chevrolet with LUV and MM3\)\)](#) for the Manual Transmission M20/M32 (MR5)

#### Connector End View Reference

### [COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)[COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

## Starting System Description and Operation

### Electrical Information Reference

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

### Scan Tool Reference

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

### Circuit/System Verification

#### Automatic Transmission

1. Ignition ON.
2. Verify that no ignition, KR27 Starter Relay, brake pedal position sensor, theft deterrent, engine, or automatic T12 Transmission DTCs are set that would cause the ECM to disable engine starting.
  - **If DTCs are set**  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
  - **If no DTCs are set**
3. Verify the scan tool BCM 5 V Ignition Switch (vehicles without push button start) or ECM Power Mode (vehicles with push button start) parameter is Crank Request while attempting to start the vehicle.
  - **If parameter does not display Crank Request**  
Refer to [Vehicle Will Not Change Power Mode](#)
  - **If parameter displays Crank Request**
4. Verify the scan tool TCM Internal Mode Switch parameter displays Park when in park.
  - **If the TCM Internal Mode Switch parameter does not indicate Park .**  
Refer to [Transmission Internal Mode Switch Logic](#)
  - **If the TCM Internal Mode Switch parameter displays Park**
5. Verify the scan tool ECM Crankshaft Position Active Counter parameter is not incrementing.
  - **If the counter increments**  
Replace the B26 Crankshaft Position Sensor.
  - **If the counter does not increment**
6. Verify the engine cranks in park or neutral.
  - **If the KR27 Starter Relay does not click or the engine does not crank**  
Refer to Circuit/System Testing.
  - **If the engine cranks**
7. All OK

#### Manual Transmission

1. Ignition ON.
2. Verify that no ignition, KR27 Starter Relay, clutch pedal position sensor, brake pedal position sensor, engine, or theft deterrent DTCs are set that would cause the ECM to disable engine

starting.

- **If DTCs are set**

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

- **If no DTCs are set**

3. Verify the scan tool BCM 5 V Ignition Switch (vehicles without push button start) or ECM Power Mode (vehicles with push button start) parameter is Crank Request while attempting to start the vehicle.

- **If parameter does not display Crank Request**

Refer to [Vehicle Will Not Change Power Mode](#)

- **If parameter displays Crank Request**

4. Ignition ON.

5. Verify the scan tool Clutch Pedal Starter Inhibit Switch parameter changed between On and Off while depressing and releasing the clutch pedal.

- **If the Clutch Pedal Starter Inhibit parameter does not change**

Refer to [Clutch Pedal Position Learn](#)

- **If the clutch pedal starter inhibit parameter does change**

6. Fully depress clutch pedal.

7. Attempt to start the vehicle.

8. Verify the scan tool ECM Crankshaft Position Active Counter parameter is not incrementing.

- **If the counter increments**

Replace the B26 Crankshaft Position Sensor.

- **If the counter does not increment**

9. Verify the crank relay does click and the engine begins cranking.

- **If the KR27 Starter Relay does not click or the engine does not begin cranking**

Refer to Circuit/System Testing.

- **If the KR27 Starter Relay does click and the engine does begin cranking**

10. All OK.

### **Circuit/System Testing**

1. Ignition ON.

2. Verify the scan tool ECM Ignition 1 Signal parameter is greater than 10 V.

- **If 10 V or less**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the ignition voltage circuits and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2  $\Omega$  in the control circuit end to end.

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

- **If greater than 10 V**

3. Ignition OFF, disconnect the KR27 Starter Relay, ignition ON.

4. Verify that a test lamp illuminates between the B+ circuit terminal 30 and ground.

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

1. Ignition OFF.

2. Test for less than 2  $\Omega$  in the B+ circuit end to end.

- If  $2\ \Omega$  or greater, repair the open/high resistance in the circuit.
- If less than  $2\ \Omega$ , 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. Ignition 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,
  3. Disconnect X1 harness connector at the M64 Starter Motor.
  4. Test for infinite resistance between the control circuit terminal 87 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the M64 Starter Motor.
  - **If the test lamp illuminates**
- 5. Ensure the parking brake is applied and the T12 Transmission is in PARK. Momentarily install a 30 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.
- 6. Verify the M64 Starter Motor is activated.
  - **If the M64 Starter Motor does not activate**
    1. Disconnect the X1 harness connector at the M64 Starter Motor.
    2. Test for less than  $2\ \Omega$  in the control circuit end to end.
      - If greater the  $2\ \Omega$ , repair the open/high resistance in the circuit.
      - If less than  $2\ \Omega$ , replace the M64 Starter Motor.
  - **If the M64 Starter Motor activates**
- 7. Test or replace the KR27 Starter Relay.

## Component Testing

### Relay Test

1. Ignition OFF.
2. Disconnect the KR27 Starter Relay.
3. Test for  $60\text{-}180\ \Omega$  between terminals 85 and 86.
  - **If not within  $60\text{-}180\ \Omega$**   
Replace the relay.
  - **If within  $60\text{-}180\ \Omega$**
4. Test for infinite resistance between the following terminals:
  - 30 and 86
  - 30 and 87
  - 30 and 85
  - 85 and 87
  - **If not infinite resistance**  
Replace the relay.
  - **If infinite resistance**
5. Install a 20 A fused jumper wire between relay terminal 85 and 12 V.
6. Install a jumper wire between relay terminal 86 and ground.
7. Test for less than  $2\ \Omega$  between terminals 30 and 87.
  - **If  $2\ \Omega$  or greater**  
Replace the relay
  - **If less than  $2\ \Omega$**
8. All OK

## Repair Instructions

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

- Refer to [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#).
- Refer to [Crankshaft Position Sensor Replacement](#)
- Refer to [Control Module References](#) for ECM replacement, programming, and setup

## STARTER SOLENOID DOES NOT CLICK (KL9)

### Diagnostic Instructions

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

### Diagnostic Fault Information

| Circuit                                                                                                                                | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|----------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------------------|--------------------|
| Starter Relay B+ Terminal 30                                                                                                           | 1               | 1                    | -                | -                  |
| Starter Relay Switch Control Terminal 87                                                                                               | 1               | 1                    | 2                | -                  |
| Starter Pinion Solenoid Actuator Relay B+ Terminal 30                                                                                  | 3               | 3                    | -                | -                  |
| Starter Pinion Solenoid Actuator Relay Switch Control Terminal 87                                                                      | 3               | 3                    | 4                | -                  |
| 1. Starter solenoid does not click<br>2. Starter spins all the time<br>3. Starter pinion inop.<br>4. Starter pinion spins all the time |                 |                      |                  |                    |

### Circuit/System Description

When the ignition mode switch is placed in the crank position, a discrete signal is supplied to the body control module (BCM) notifying it that the ignition is in the crank position. The BCM then sends a serial data message to the engine control module (ECM) that crank has been requested. The ECM then verifies that the clutch is fully depressed or the automatic transmission is in Park/Neutral. If it is, the ECM then supplies 12 V to the control circuit of the starter relay. When this occurs, battery voltage is supplied through the switch of the starter relay to the starter motor.

### Reference Information

Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

Description and Operation

### Starting System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)
- [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)

Scan Tool Reference

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

### Circuit/System Verification

1. Ignition ON.
2. Verify that no ignition, KR27 Starter Relay, clutch pedal position sensor, brake pedal position sensor, engine, or immobilizer DTCs are set that would cause the ECM to disable engine starting.
  - **If DTCs are set**  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
  - **If no DTCs are set**
3. Verify the scan tool BCM 5 V Ignition Switch (vehicles without push button start) or ECM Power Mode (vehicles with push button start) parameter is Crank Request while attempting to start the vehicle.
  - **If parameter does not display Crank Request**  
Refer to [Vehicle Will Not Change Power Mode](#)
  - **If parameter displays Crank Request**
4. Attempt to start the vehicle.
5. Verify the scan tool ECM Crankshaft Position Active Counter parameter is not incrementing.
  - **If the counter increments**  
Replace the B26 Crankshaft Position Sensor.
  - **If the counter does not increment**
6. Verify the crank relay does click and the engine begins cranking.
  - **If the KR27 Starter Relay does not click or the engine does not begin cranking**  
Refer to Circuit/System Testing.
  - **If the KR27 Starter Relay does click and the engine does begin cranking**
7. All OK

### Circuit/System Testing

1. Ignition ON.
2. Verify the scan tool ECM Ignition 1 Signal parameter is greater than 10 V.
  - **If 10 V or less**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the ignition voltage circuits and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the control circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , refer to [Power Mode Mismatch](#)
  - **If greater than 10 V**
3. Ignition OFF, disconnect the KR27 Starter Relay, ignition ON.

4. Verify that a test lamp illuminates between the B+ circuit terminal 30 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition 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,
    3. Disconnect X1 harness connector at the M64 Starter Motor.
    4. Test for infinite resistance between the control circuit terminal 87 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the M64 Starter Motor.
  - **If the test lamp illuminates**
5. Ensure the parking brake is applied and the automatic transmission is in PARK or the manual transmission is in neutral. Momentarily install a 30 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.
6. Verify the M64 Starter Motor is activated.
  - **If the M64 Starter Motor does not activate**
    1. Disconnect the X1 harness connector at the M64 Starter Motor.
    2. Test for less than 2  $\Omega$  in the control circuit end to end.
      - If greater the 2  $\Omega$ , repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the M64 Starter Motor.
  - **If the M64 Starter Motor activates**
7. Ignition OFF, disconnect the KR27C Starter Pinion Solenoid Actuator Relay, ignition ON.
8. Verify that a test lamp illuminates between the B+ circuit terminal 30 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition 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,
    3. Disconnect X1 harness connector at the M64 Starter Motor.
    4. Test for infinite resistance between the control circuit terminal 87 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the M64 Starter Motor.
  - **If the test lamp illuminates**
9. Ensure the parking brake is applied and the automatic transmission is in PARK or the manual transmission is in neutral. Momentarily install a 30 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.
10. Verify the M64 Starter Motor pinion engages.
  - **If the M64 Starter Motor pinion does not engage**
    1. Disconnect the X1 harness connector at the M64 Starter Motor.
    2. Test for less than 2  $\Omega$  in the control circuit end to end.
      - If greater the 2  $\Omega$ , repair the open/high resistance in the circuit.

- If less than 2  $\Omega$ , replace the M64 Starter Motor.

- **If the M64 Starter Motor pinion engages**

11. Test or replace the KR27 Starter Relay.

12. Ignition CRANK.

13. Verify the M64 Starter Motor is activated.

- **If the M64 Starter Motor does not activate**

Test or replace the KR27C Starter Pinion Solenoid Actuator Relay.

- **If the M64 Starter Motor activates**

14. All OK.

## Component Testing

### Relay Test

1. Ignition OFF, disconnect the appropriate relay.

2. Test for 70-150  $\Omega$  between terminals (85 or 1) and (86 or 2).

- **If less than 70 or greater than 150  $\Omega$**

Replace the relay.

- **If between 70-150  $\Omega$**

3. Test for infinite resistance between the terminals listed below:

- (30 or 3) and (86 or 2)
- (30 or 3) and (87 or 5)
- (30 or 3) and (85 or 1)
- (85 or 1) and (87 or 5)
- (86 or 2) and (87 or 5)
- **If less than infinite resistance**

Replace the relay.

- **If infinite resistance**

4. Install a 3 A fused jumper wire between relay terminal (85 or 1) and 12 V. Install a jumper wire between relay terminal (86 or 2) and ground.

5. Test for less than 5.0  $\Omega$  between terminals (30 or 3) and (87 or 5).

- **If 5.0  $\Omega$  or greater**

Replace the relay.

- **If less than 5.0  $\Omega$**

6. All OK

## Repair Instructions

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

- Refer to [Starter Replacement \(LUV\)](#)[Starter Replacement \(2H0\)](#)[Starter Replacement \(LE2-FWD\)](#)[Starter Replacement \(LE2-AWD\)](#).
- Refer to [Crankshaft Position Sensor Replacement \(AWD\)](#)[Crankshaft Position Sensor Replacement \(FWD\)](#).
- Refer to [Control Module References](#) for control module replacement, programming, and setup

## STARTER SOLENOID CLICKS, ENGINE DOES NOT CRANK

### 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.

## Reference Information

### Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

### Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

### Description and Operation

#### [Starting System Description and Operation](#)

### Electrical Information Reference

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

### Scan Tool Reference

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

### Circuit/System Testing

1. Ignition OFF, measure and record the battery voltage at the C1 Battery terminals.
2. Verify the measured voltage is between 12-15 V.
  - **If voltage is less than 12 V or greater than 15 V**  
 Refer to [Battery Inspection/Test](#).
  - **If voltage is between 12-15 V**
3. Remove the drive belts. Refer to [Drive Belt Replacement](#) , for the 1.4L (LE2) engine, [Drive Belt Replacement](#) , for the 1.4L (LUJ LUV) engine, [Drive Belt Replacement](#) for the 1.8L (2HO) engine
4. Verify the crankshaft rotates. Rotate the crankshaft by hand using the appropriate tools.
  - **If the crankshaft does not rotate**  
 Refer to [Engine Will Not Crank - Crankshaft Will Not Rotate](#) , for the 1.4L (LE2) engine, [Engine Will Not Crank - Crankshaft Will Not Rotate](#) , for the 1.4L (LUJ LUV) engine, [Engine Will Not Crank - Crankshaft Will Not Rotate](#) , for the 1.8L (2HO) engine.
  - **If the crankshaft rotates**
5. Verify the engine does not crank when attempting to start the vehicle.
  - **If the engine cranks**  
 Inspect the engine and belt drive system for mechanical binding, seized engine, or seized generator.
  - **If the engine does not crank**
6. Verify that a test lamp illuminates between the M64 Starter Motor B+ terminal 1 or A X2 and ground.

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

1. Ignition OFF.

2. Test for less than 2  $\Omega$  in the B+ circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , 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. Ignition OFF.

2. Test for greater than 100  $\Omega$  between the B+ circuit and ground.

- If 100  $\Omega$  or less, repair the short to ground on the circuit.
- If greater than 100  $\Omega$ , replace the M64 Starter Motor.

- **If the test lamp illuminates**

7. Test for less than 0.5 V between the positive battery post and M64 Starter Motor B+ terminal 1 or A X2 with the ignition in the START position.

- **If 0.5 V or greater**

Replace the positive battery cable.

- **If less than 0.5 V**

8. Test for less than 0.5 V between the negative battery post and the M64 starter motor case with the ignition in the START position.

- **If 0.5 V or greater**

Replace the negative battery cable.

- **less than 0.5 V**

9. Replace the M64 starter motor.

### Repair Instructions

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

- Refer to [Battery Positive and Negative Cable Replacement \(LUV\)](#)[Battery Positive and Negative Cable Replacement \(2H0\)](#)[Battery Positive and Negative Cable Replacement \(LE2\)](#)
- Refer to [Starter Replacement \(LUV\)](#)[Starter Replacement \(2H0\)](#)[Starter Replacement \(LE2-FWD\)](#)[Starter Replacement \(LE2-AWD\)](#)

## ENGINE CRANKS SLOWLY

### 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.

### Reference Information

#### Schematic Reference

[Starting and Charging Schematics \(Buick with LE2\)](#)[Starting and Charging Schematics \(Buick with LUV\)](#)[Starting and Charging Schematics \(Chevrolet\)](#)

#### Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#) [COMPONENT CONNECTOR END VIEWS - INDEX \(TRAX\)](#)

#### Description and Operation

[Starting System Description and Operation](#)

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

#### Scan Tool Reference

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

#### Circuit/System Verification

1. Ignition OFF, measure and record the battery voltage at the C1 Battery terminals.
2. Verify the measured voltage is between 12-15 V.
  - **If voltage is less than 12 V or greater than 15 V**  
  
Refer to [Battery Inspection/Test](#).
  - **If voltage is between 12 -15 V**
3. Verify that a test lamp illuminates between the M64 Starter Motor B+ terminal 1 or A X2 and ground.
  - **If the test lamp does not illuminate**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp illuminates**
4. Test for less than 0.5 V between the positive battery cable and terminal 1 or A X2 at the M64 Starter Motor with the ignition in the START position.
  - **If 0.5 V or greater**  
  
Replace the positive battery cable.
  - **If less than 0.5 V**
5. Test for less than 0.5 V between the negative battery cable and the M64 Starter Motor case with the ignition in the START position.
  - **If 0.5 V or greater**  
  
Replace the negative battery cable.
  - **If less than 0.5 V**
6. Remove the drive belts. Refer to [Drive Belt Replacement](#) , for the 1.4L (LE2) engine, [Drive Belt Replacement](#) , for the 1.4L (LUJ LUV) engine, [Drive Belt Replacement](#) for the 1.8L (2HO) engine.
7. Verify the engine cranks slowly when attempting to start the vehicle.
  - **If the engine cranks at normal speed**  
  
Inspect the engine and belt drive system for mechanical binding, seized generator etc.
  - **If the engine cranks slowly**
8. Replace the M64 Starter Motor.

#### Repair Instructions

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

- Refer to [Battery Positive and Negative Cable Replacement \(LUV\)](#)[Battery Positive and Negative Cable Replacement \(LE2\)](#)[Negative Cable Replacement \(2H0\)](#)[Battery Positive and Negative Cable Replacement \(LE2\)](#)
- Refer to [Battery Negative Cable Replacement \(without KL9\)](#)[Battery Negative Cable Replacement \(with KL9\)](#)
- Refer to [Starter Replacement \(LUV\)](#)[Starter Replacement \(2H0\)](#)[Starter Replacement \(LE2-FWD\)](#)[Starter Replacement \(LE2-AWD\)](#)

## STARTER NOISE DIAGNOSIS

### 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 starter motors are non-repairable. They have pole pieces that are arranged around the armature. Both solenoid windings are energized. The pull-in winding circuit is completed to the ground through the starter motor. The windings work together magnetically to pull and hold in the plunger. The plunger moves the shift lever. This action causes the starter drive assembly to rotate on the armature shaft spline as it engages with the flywheel ring gear on the engine. Moving at the same time, the plunger also closes the solenoid switch contacts in the starter solenoid. Full battery voltage is applied directly to the starter motor and it cranks the engine.

### Reference Information

Description and Operation

### [Starting System Description and Operation](#)

### Circuit/System Verification

Start the engine. Listen to the starter noise, while the engine is cranking. Compare the concern to a similar vehicle.

### Circuit/System Testing

1. Remove the flywheel inspection cover.
2. Inspect the flywheel for the following:
  - Loose flywheel bolts
  - Chipped gear teeth
  - Missing gear teeth
  - Bent flywheel
  - Debris in the bell housing
  - If not within specifications, remove the debris, tighten the flywheel bolts, or repair or replace the flywheel.
3. If all inspections were within specification, replace the starter motor.

### Repair Instructions

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

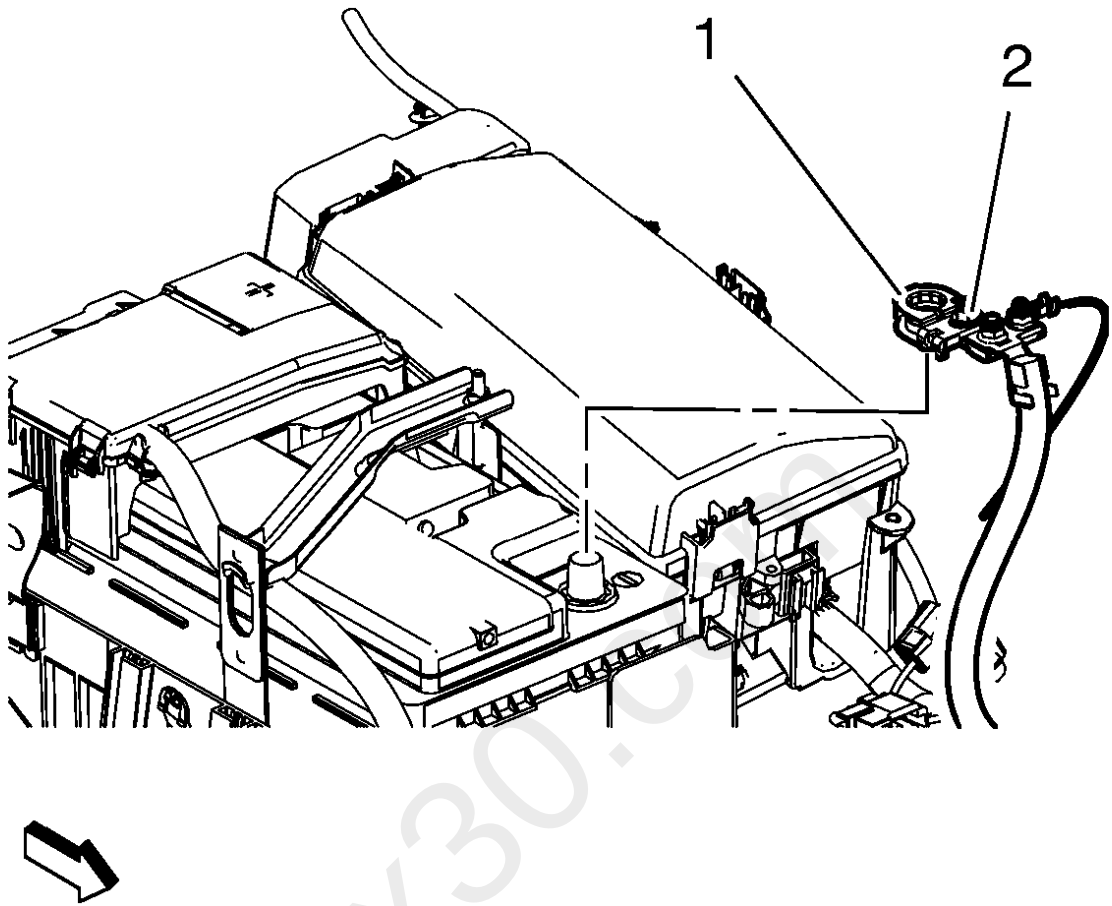
- Replace the starter, refer to the affected component's procedure for service.
- Replace the engine flywheel, refer to the affected component's procedure for service.

## REPAIR INSTRUCTIONS

## BATTERY NEGATIVE CABLE DISCONNECTION AND CONNECTION (WITHOUT KL9)

### Removal Procedure

1. Turn on the radio and record all of the customer radio station presets.
2. Ensure that all lamps and accessories are turned off.
3. Turn the ignition OFF and remove the ignition key.

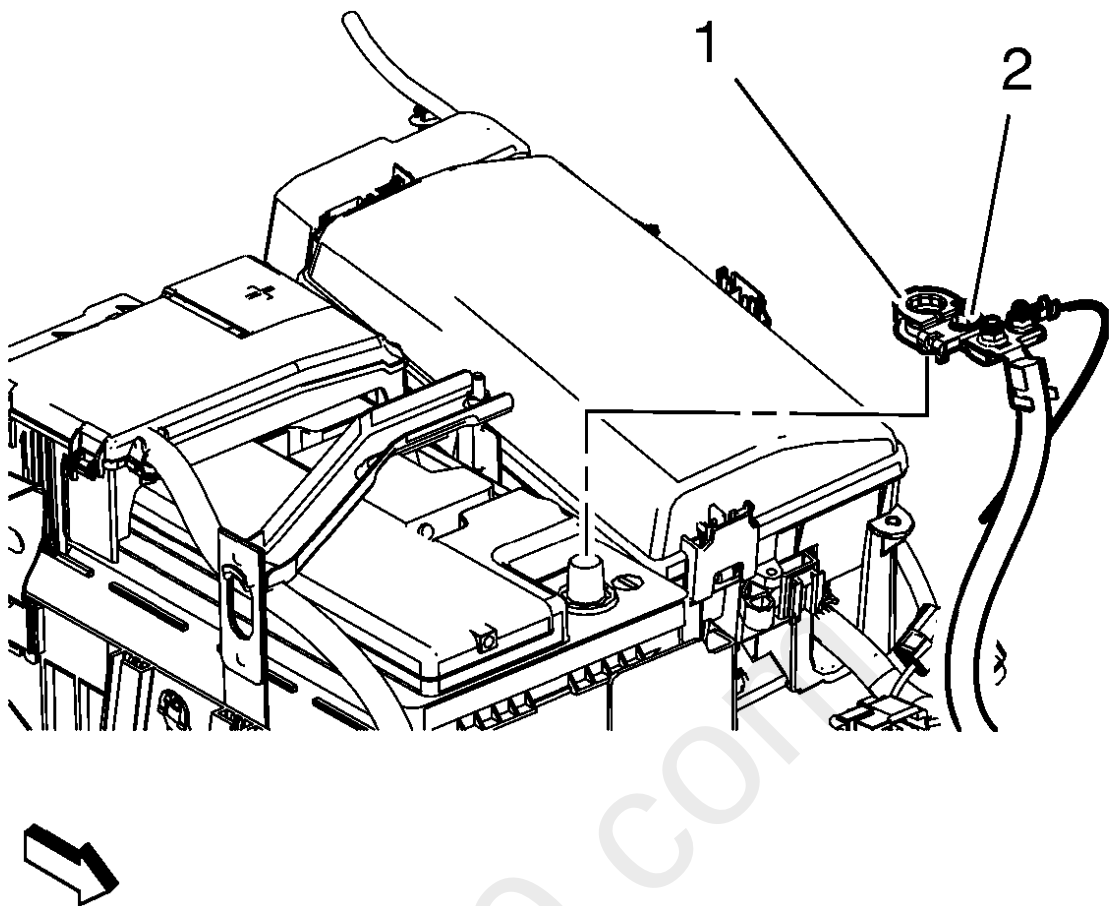


**Fig. 10: Battery Negative Cable And Nut**  
Courtesy of GENERAL MOTORS COMPANY

**WARNING:** Refer to [Battery Disconnect Warning](#) .

4. Loosen the battery negative cable nut (2).
5. Remove the battery negative cable (1) from the battery.

#### **Installation Procedure**



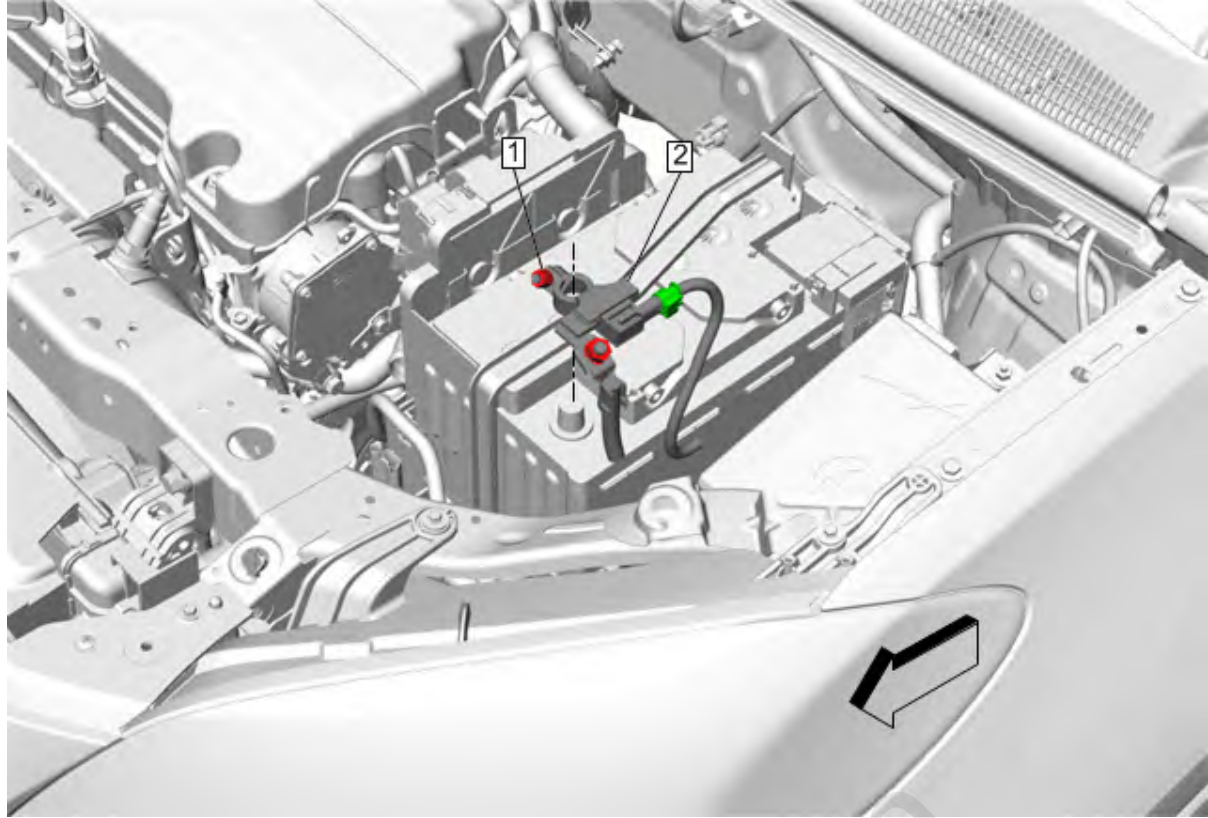
**Fig. 11: Battery Negative Cable And Nut**  
Courtesy of GENERAL MOTORS COMPANY

1. Install the battery negative cable (1) to the battery.

**CAUTION:** Refer to **Fastener Caution** .

2. Fasten the battery negative cable nut (2) and tighten the nut to 4.5 N.m (40 lb in).
3. Insert the ignition key and turn the ignition to the ON position.
4. Program all of the customer's radio station presets and set the radio clock to the current time.

### **BATTERY NEGATIVE CABLE DISCONNECTION AND CONNECTION (WITH KL9)**



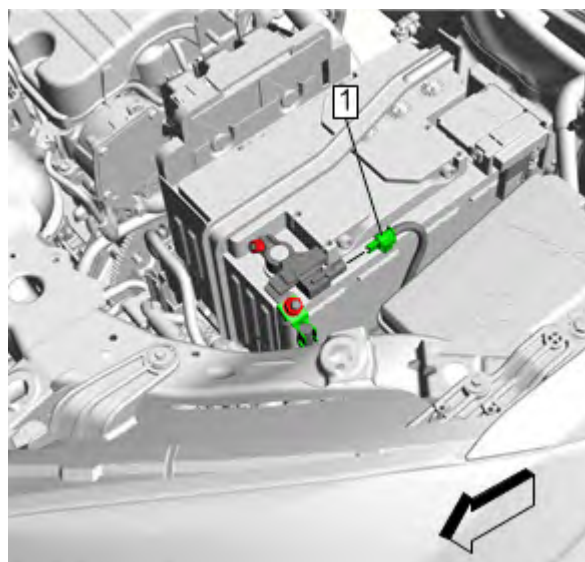
**Fig. 12: Battery Negative Cable Disconnection and Connection (with KL9)**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name                                                                                                                    |
|---------|-----------------------------------------------------------------------------------------------------------------------------------|
| 1       | <b>CAUTION:</b><br><b>Refer to <u>Fastener Caution</u> .</b><br>Battery Negative Post Clamp Nut <b>Tighten</b> 4.5 N.m (40 lb in) |
| 2       | Battery Negative Cable                                                                                                            |

## **BATTERY SENSOR REPLACEMENT (KL9)**

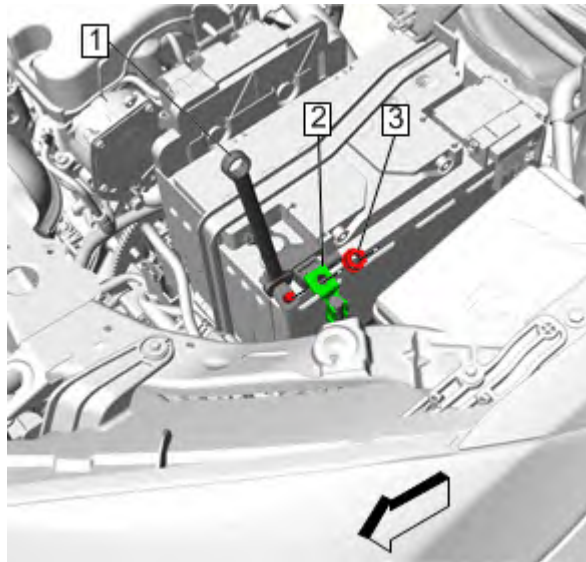
### **Removal Procedure**

1. Turn on the radio and record all of the customer radio station presets.
2. Ensure that all lamps and accessories are turned off.
3. Turn the ignition OFF and remove the ignition key.



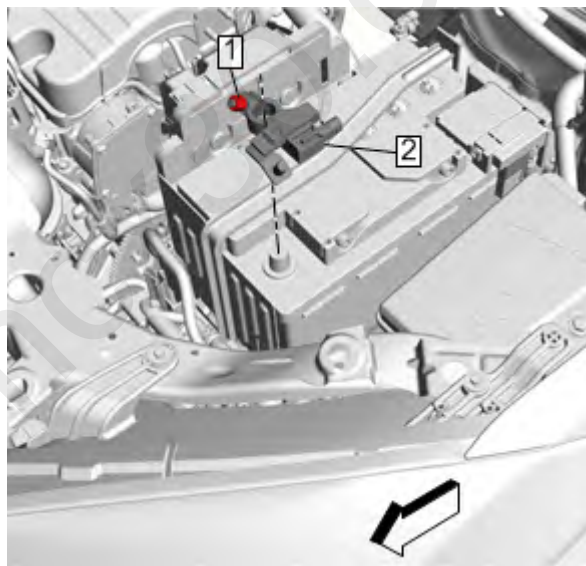
**Fig. 13: Battery Sensor Electrical Connector**  
 Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connector (1).



**Fig. 14: Battery Negative Cable And Nut**  
Courtesy of GENERAL MOTORS COMPANY

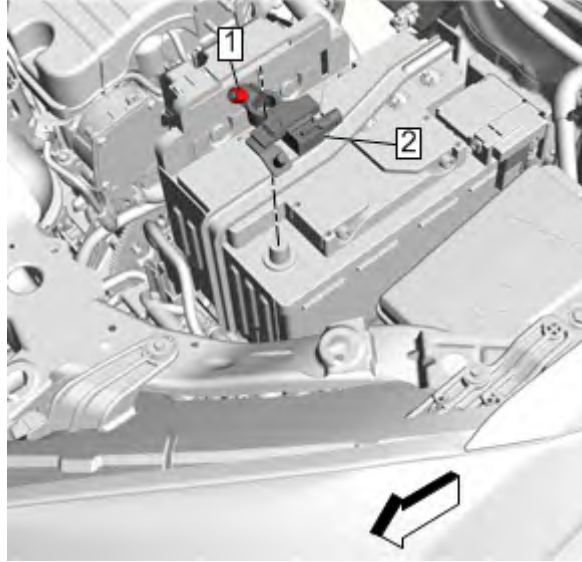
5. Use an open ended wrench to hold the battery sensor ground tab, while loosening the battery negative cable nut.
6. Remove Battery Negative Cable Nut (3)
7. Remove Battery Negative Cable (2)



**Fig. 15: Battery Sensor Module And Negative Post Clamp Nut**  
Courtesy of GENERAL MOTORS COMPANY

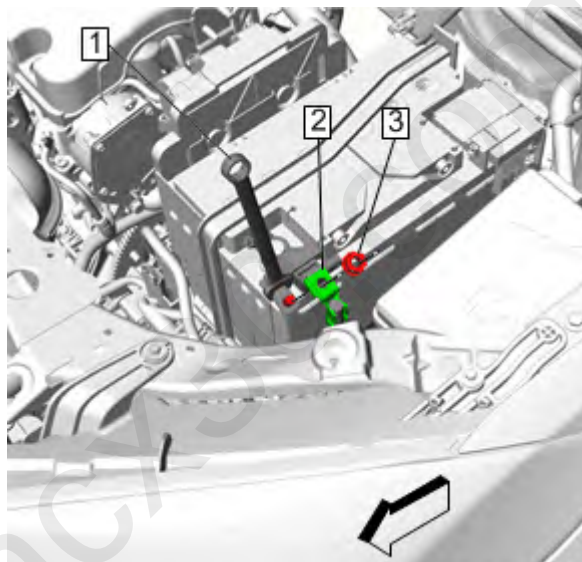
8. Loosen Battery Negative Post Clamp Nut (1)
9. Remove Battery Sensor Module (2)

### Installation Procedure



**Fig. 16: Battery Sensor Module And Negative Post Clamp Nut**  
 Courtesy of GENERAL MOTORS COMPANY

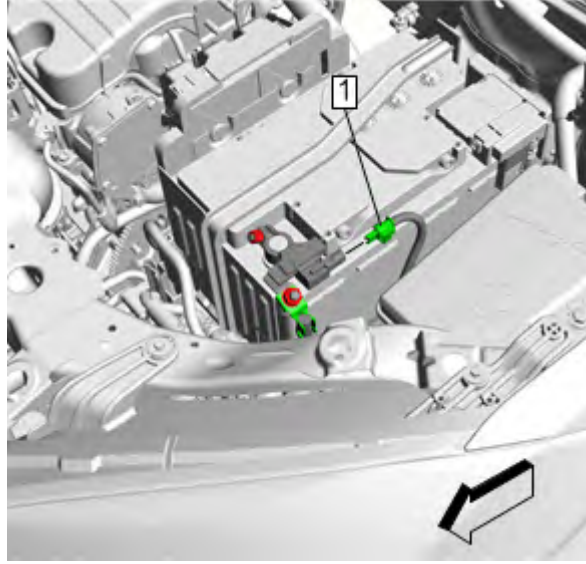
1. Install Battery Sensor Module (2)
2. Tighten Battery Negative Post Clamp Nut (1) to 4.5 N.m (40 lb in)



**Fig. 17: Battery Negative Cable And Nut**  
 Courtesy of GENERAL MOTORS COMPANY

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

3. Use an open ended wrench to hold the battery sensor ground tab, while tightening the battery negative cable nut.
4. Install Battery Negative Cable (2)
5. Install and tighten Battery Negative Cable Nut (3) to 11 N.m (97 lb in)



**Fig. 18: Battery Sensor Electrical Connector**

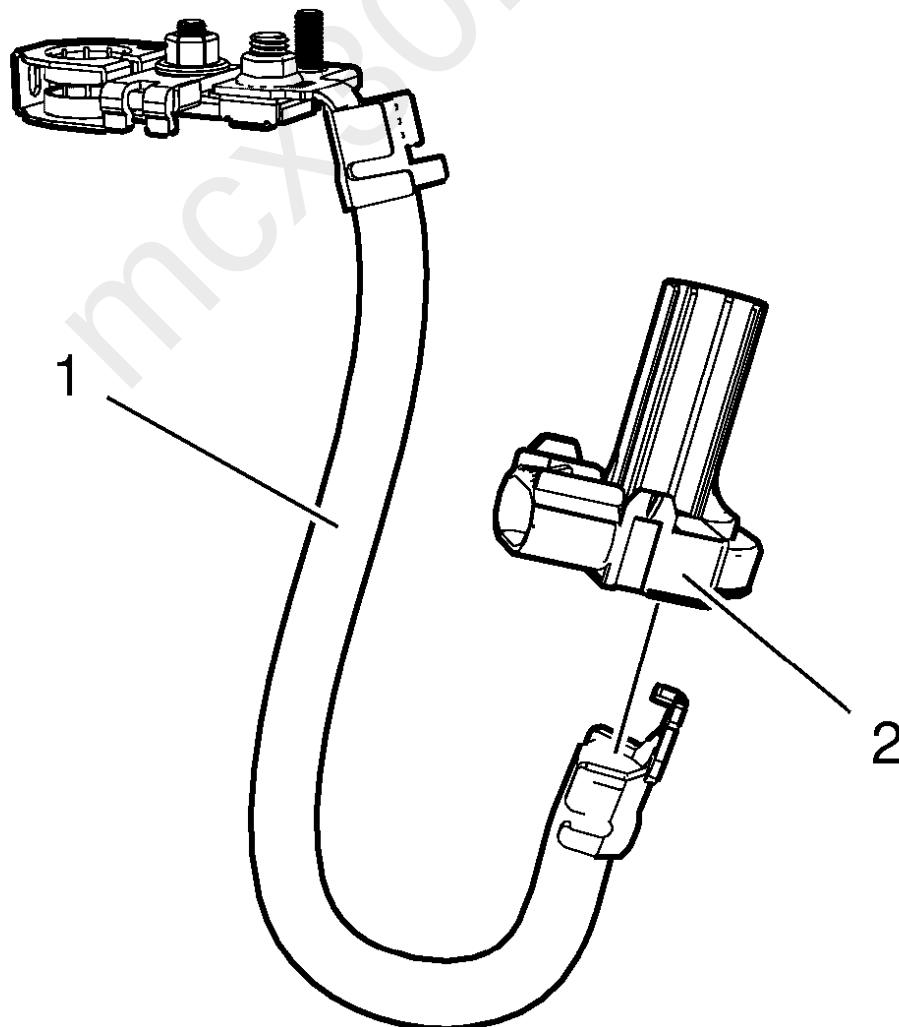
Courtesy of GENERAL MOTORS COMPANY

6. Connect the electrical connector (1).
7. Program all of the customer's radio station presets and set the radio clock to the current time.

## **BATTERY CURRENT SENSOR REPLACEMENT**

### **Removal Procedure**

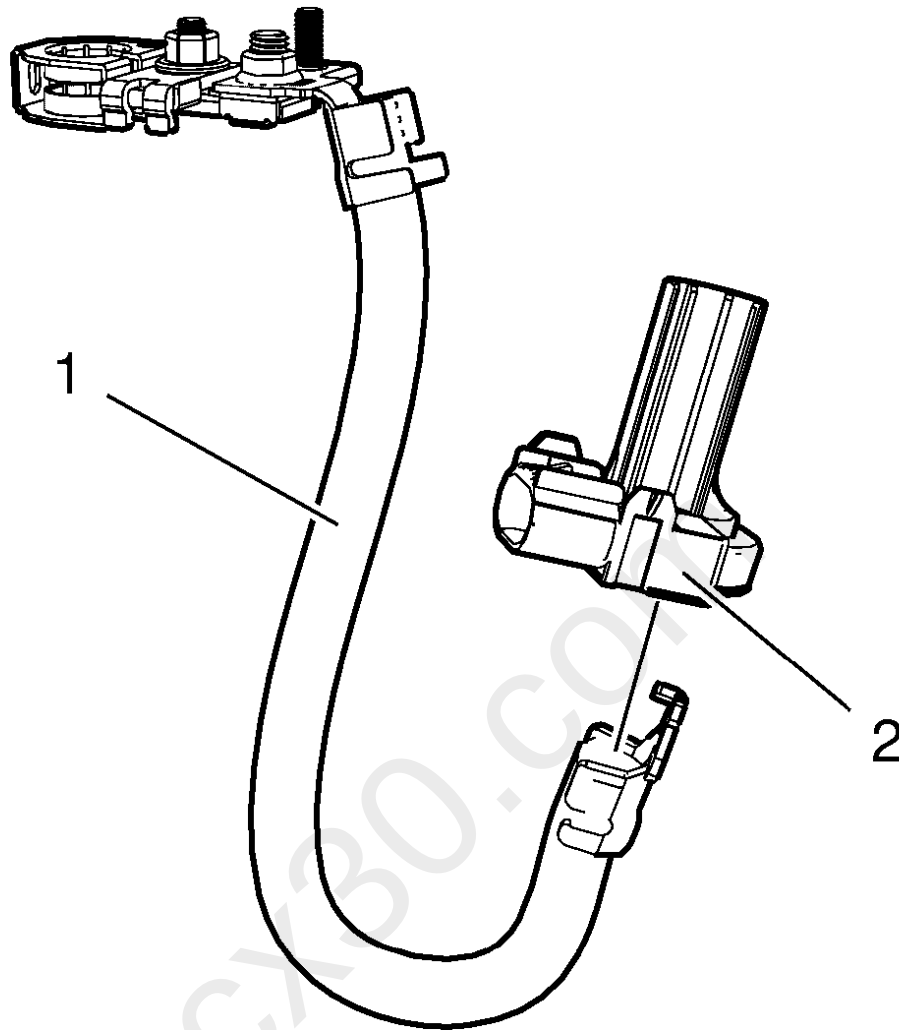
1. Remove the battery negative cable. Refer to [Battery Negative Cable Replacement \(without KL9\)](#)[Battery Negative Cable Replacement \(with KL9\)](#).



**Fig. 19: Battery Negative Cable & Current Sensor**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the current sensor (2) from the negative battery cable (1).

#### Installation Procedure



**Fig. 20: Battery Negative Cable & Current Sensor**  
Courtesy of GENERAL MOTORS COMPANY

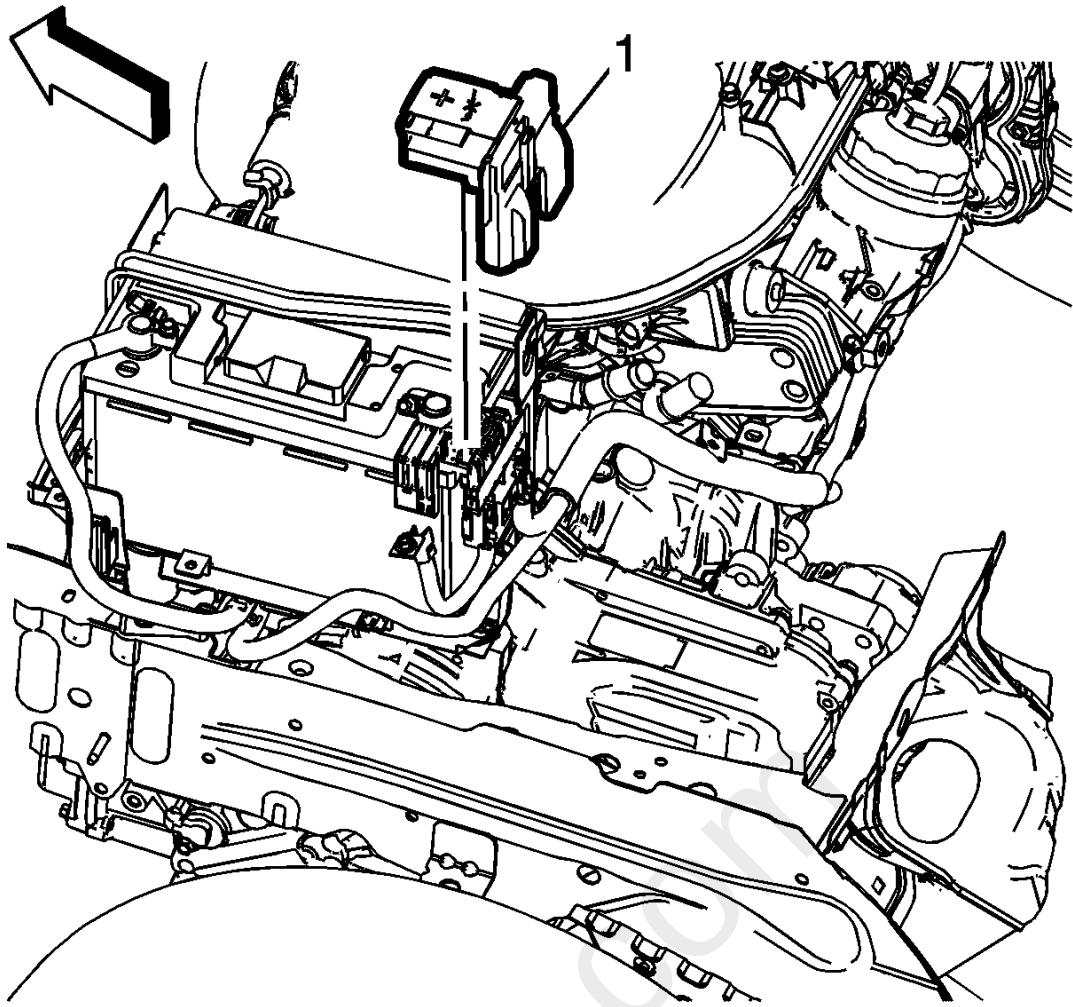
**NOTE:** Note the orientation of the battery current sensor.

1. Install the current sensor (2) to the battery negative cable (1).
2. Install the battery negative cable. Refer to [Battery Negative Cable Replacement \(without KL9\)](#)[Battery Negative Cable Replacement \(with KL9\)](#).

#### **BATTERY POSITIVE AND NEGATIVE CABLE REPLACEMENT (LUV)**

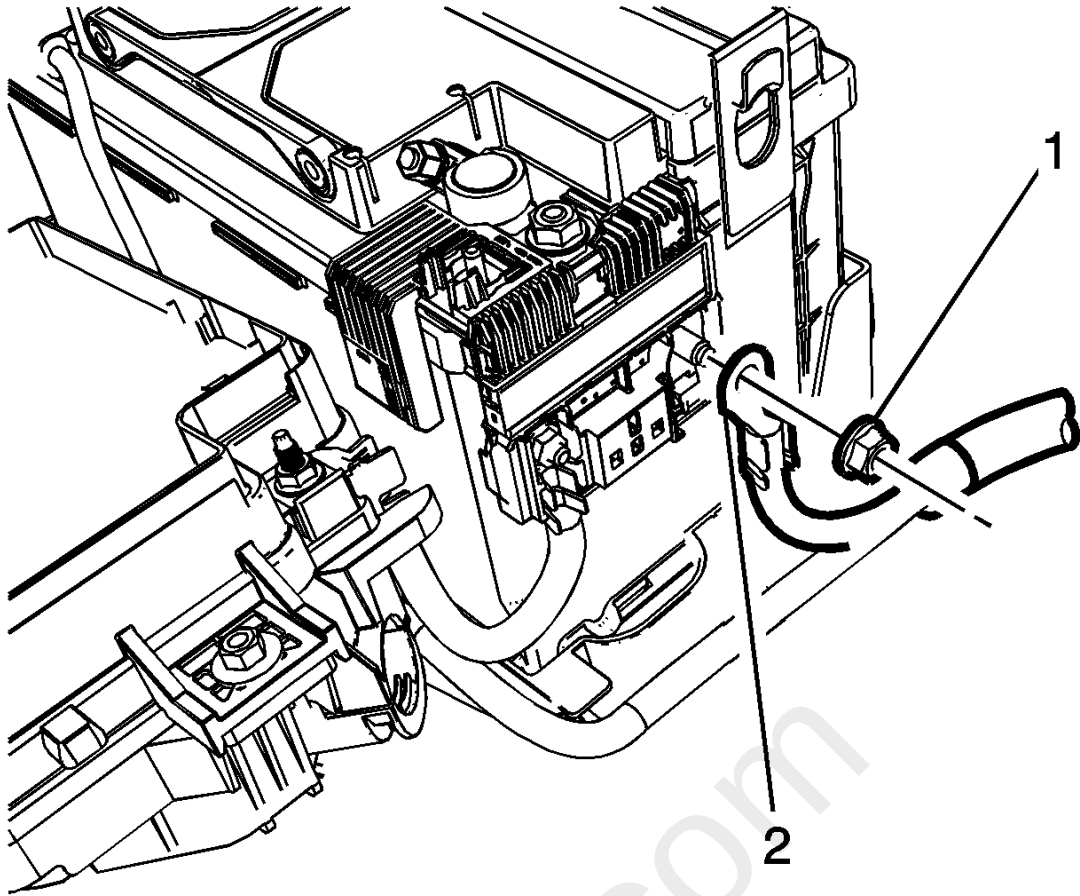
##### Removal Procedure

1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#).
2. Remove the transfer case, if equipped. Refer to [Transfer Case Replacement](#).



**Fig. 21: Battery Fuse Block Cover**  
Courtesy of GENERAL MOTORS COMPANY

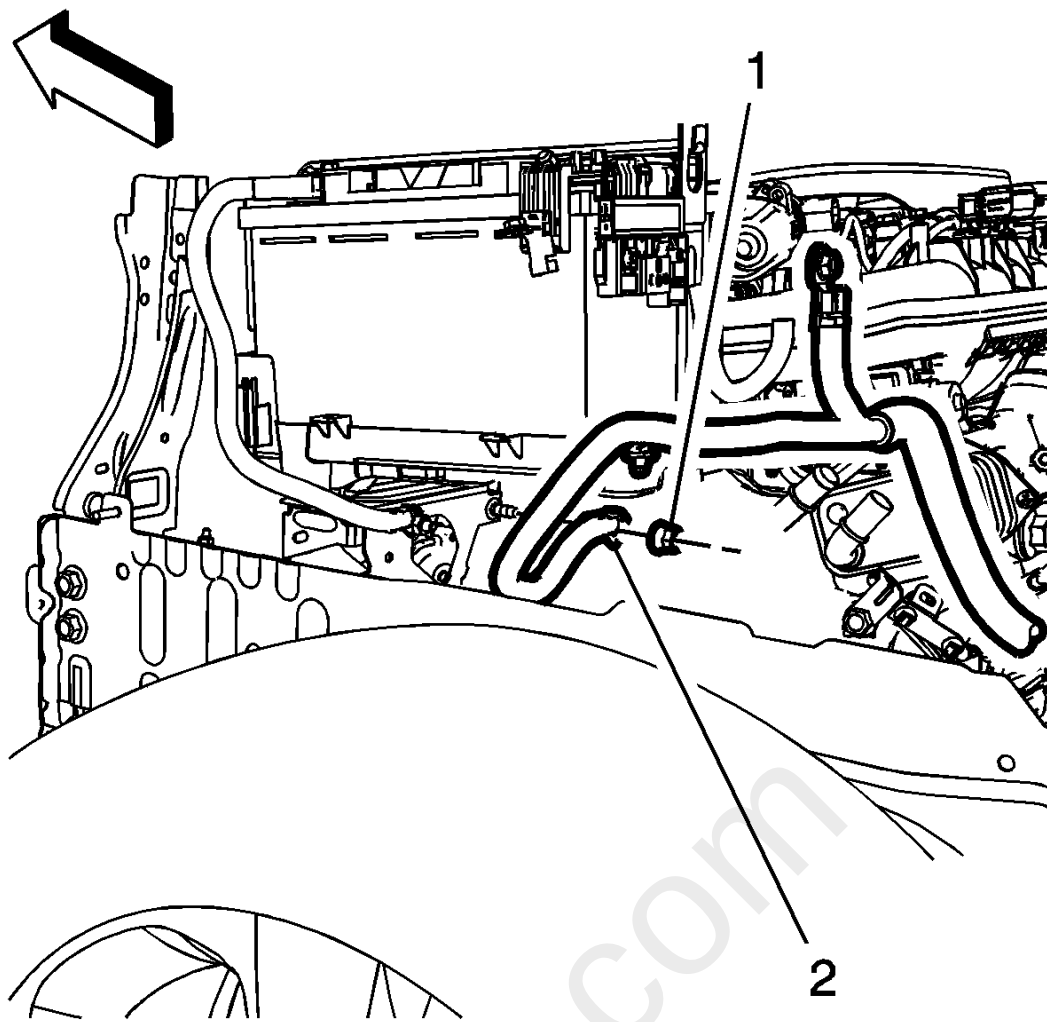
3. Remove the battery fuse block cover (1).



**Fig. 22: Positive Battery Cable And Fastener**

Courtesy of GENERAL MOTORS COMPANY

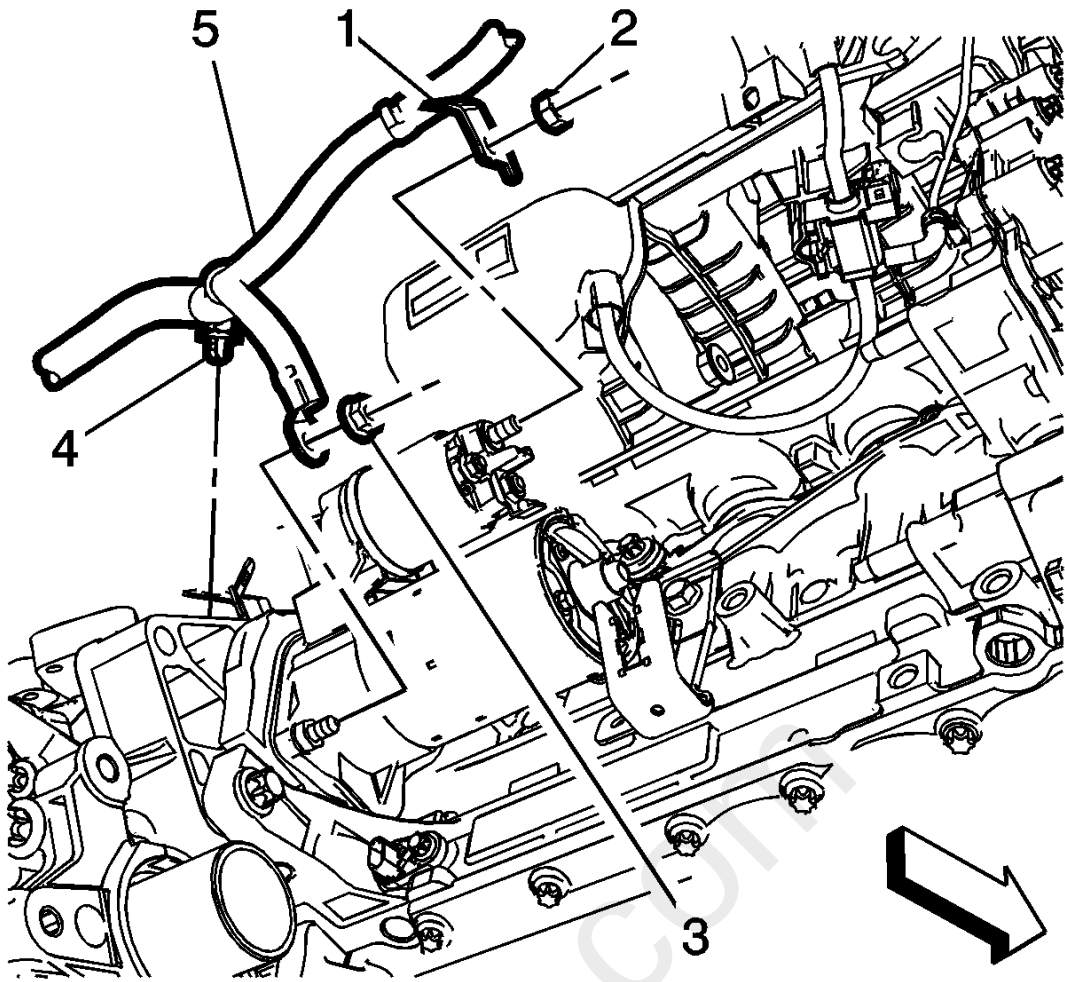
4. Remove the battery positive cable fastener (1) and remove the battery positive cable (2) from the battery fuse block.
5. Remove the battery tray. Refer to [Battery Tray Replacement](#).



**Fig. 23: Negative Battery Cable And Fastener**

Courtesy of GENERAL MOTORS COMPANY

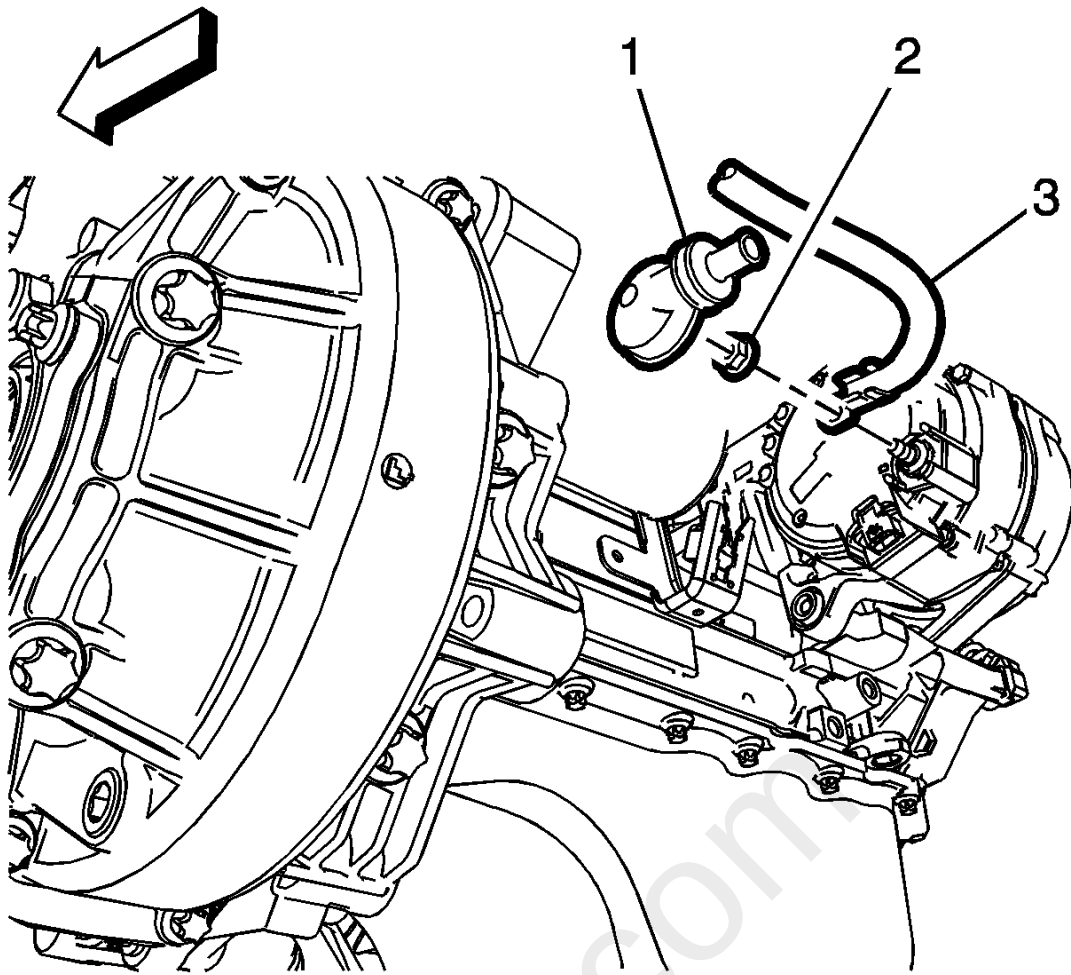
6. Remove the battery negative cable fastener (1) and remove the battery negative cable (2) from the frame stud ground.
7. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
8. Remove the drivetrain and front suspension frame transmission protector. Refer to [Drivetrain and Front Suspension Frame Transmission Protector Replacement](#) .



**Fig. 24: Battery Positive Cable And Starter Solenoid**

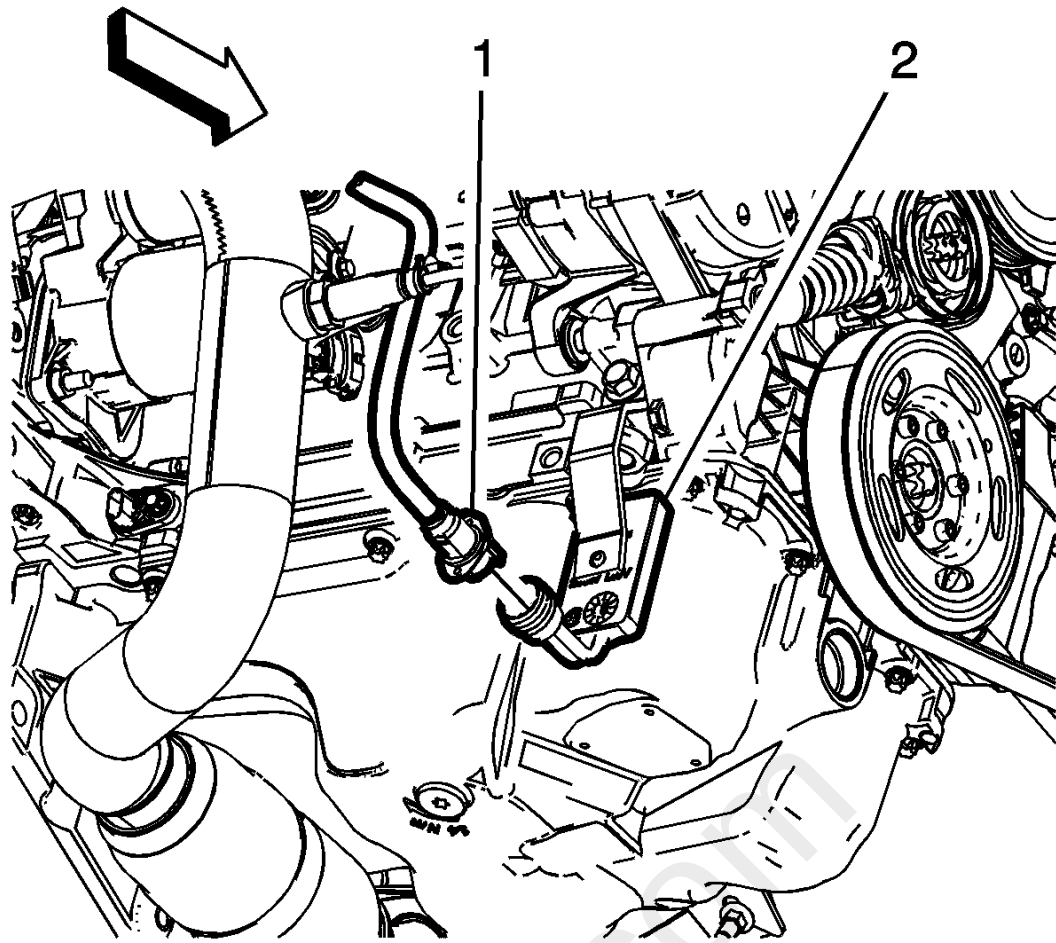
Courtesy of GENERAL MOTORS COMPANY

9. Remove the battery positive cable fastener (2) and remove the battery positive cable (1) from the starter solenoid.
10. Remove the battery negative cable fastener (3) and remove the battery negative cable (5) from the starter mounting stud.
11. Detach the battery positive and negative cable retainer (4) from the transmission bracket.



**Fig. 25: Generator Protective Cover, Battery Positive Cable And Fastener**  
Courtesy of GENERAL MOTORS COMPANY

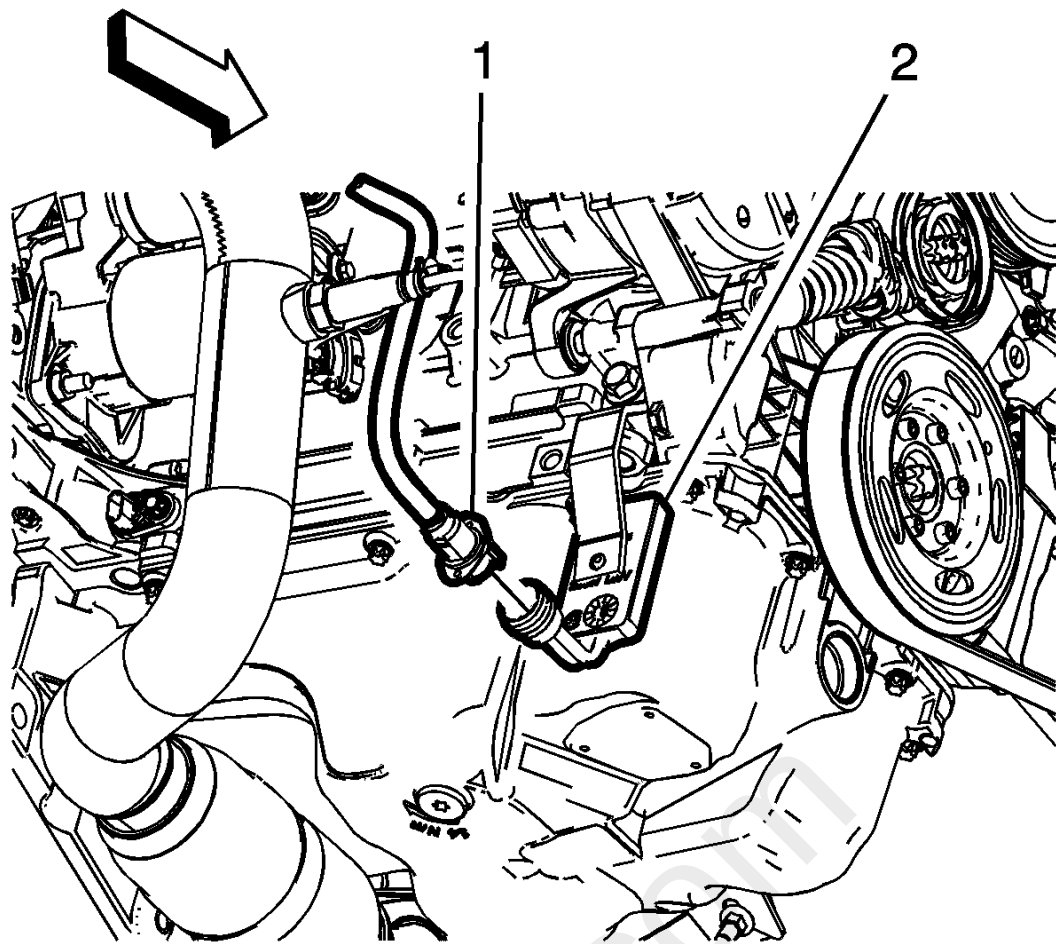
12. Remove the protective cover (1) at the back of the generator.
13. Remove the battery positive cable fastener (2) and the battery positive cable (3) from the generator B+ stud.



**Fig. 26: Oil Pan Heater And Connector**  
Courtesy of GENERAL MOTORS COMPANY

14. Remove the connector (1) to the oil pan heater (2), if equipped.
15. Remove the battery positive and negative cable.

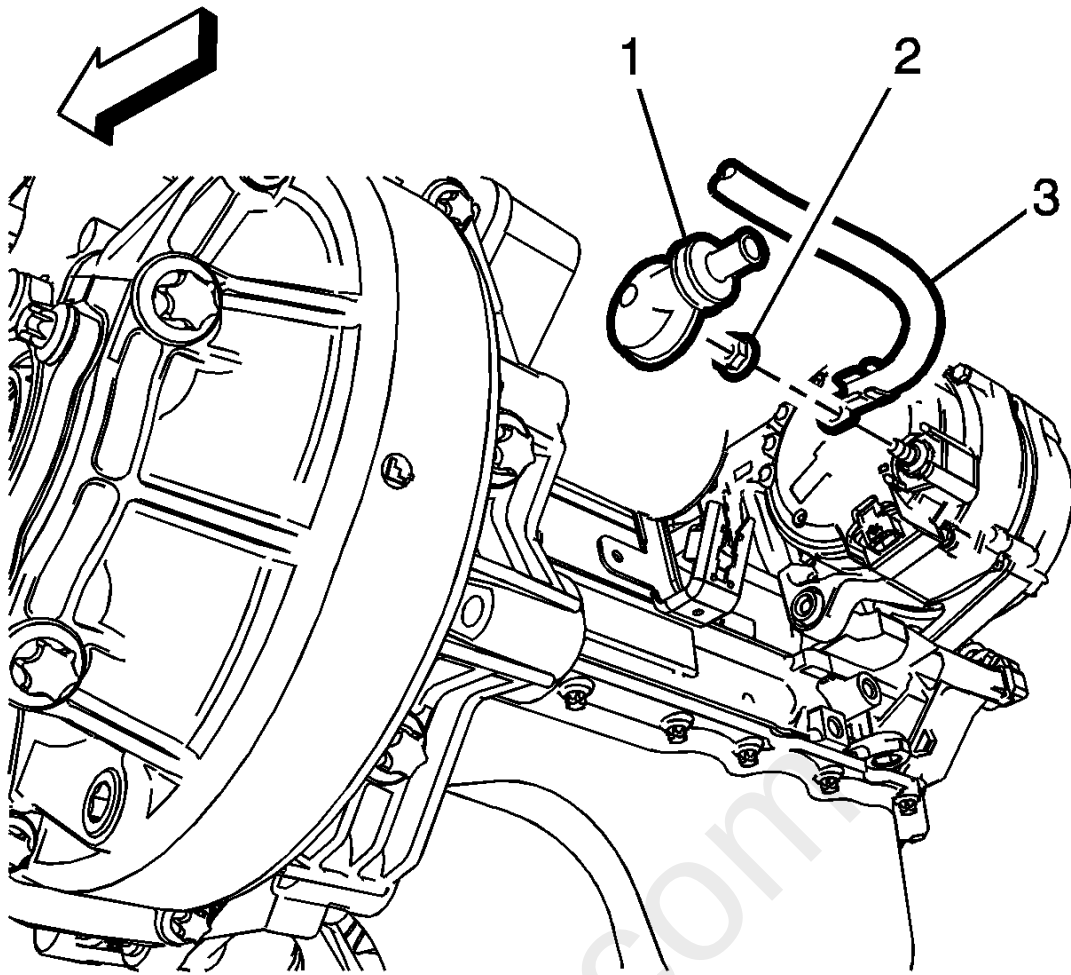
#### **Installation Procedure**



**Fig. 27: Oil Pan Heater And Connector**

Courtesy of GENERAL MOTORS COMPANY

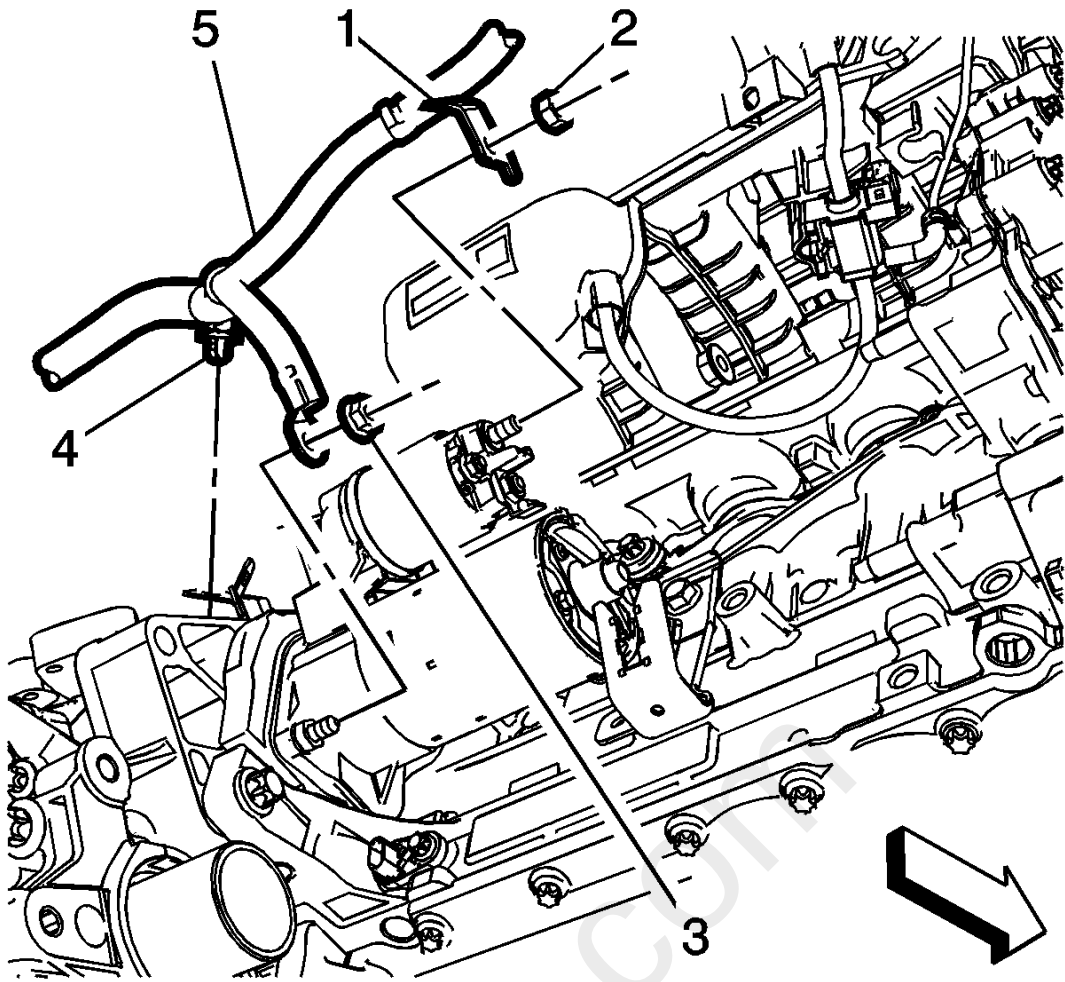
1. Install the connector (1) to the oil pan heater (2), if equipped.



**Fig. 28: Generator Protective Cover, Battery Positive Cable And Fastener**  
Courtesy of GENERAL MOTORS COMPANY

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

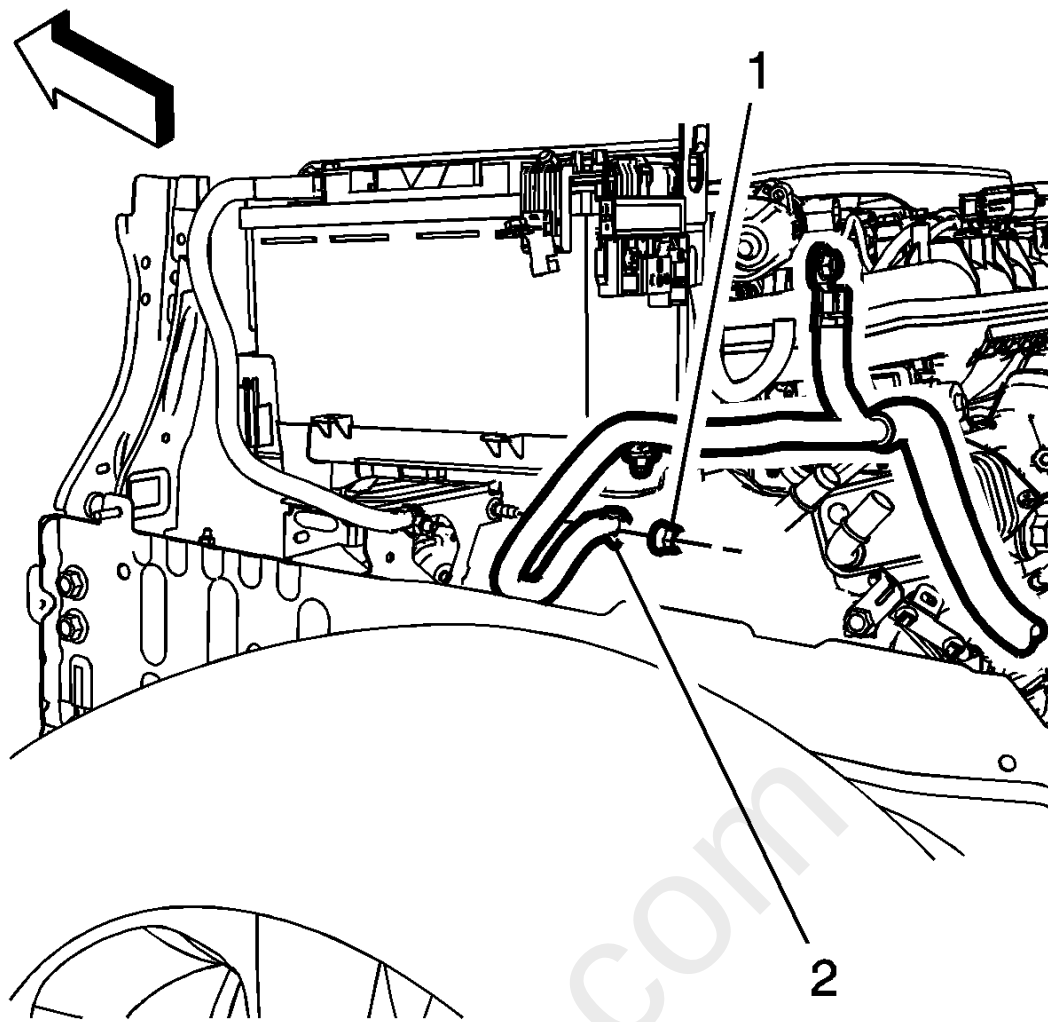
2. Install the battery positive cable (3) to the generator and tighten the fastener (2) to 17 N.m (13 lb ft).
3. Install the protective cover (1).



**Fig. 29: Battery Positive Cable And Starter Solenoid**

Courtesy of GENERAL MOTORS COMPANY

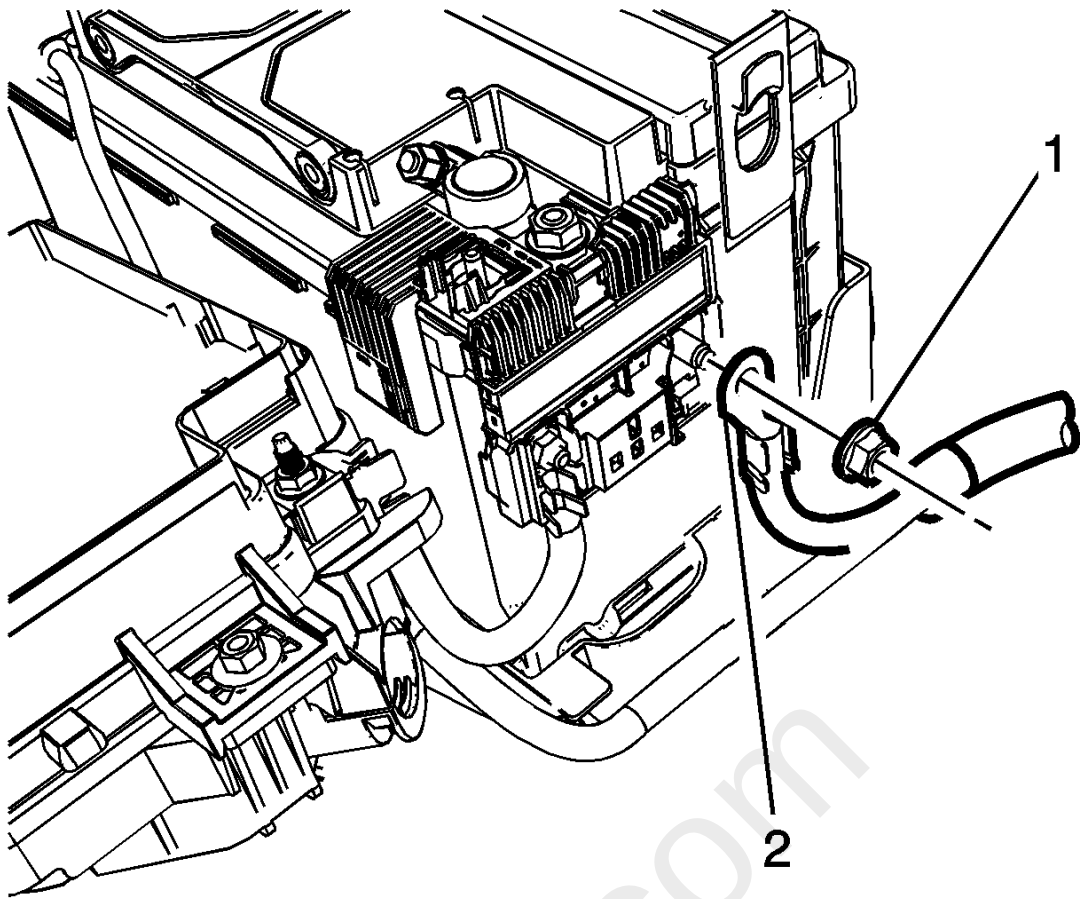
4. Install the battery positive cable terminal (1) to the starter solenoid and tighten the fastener (2) to 13 N.m (115 lb in).
5. Install the battery negative cable (5) to the starter mounting stud and tighten the fastener (3) to 13 N.m (115 lb in).
6. Install the battery positive and negative cable retainer (4) to the transmission bracket.
7. Install the transfer case, if equipped. Refer to [Transfer Case Replacement](#) .
8. Install the drivetrain and front suspension frame transmission protector. Refer to [Drivetrain and Front Suspension Frame Transmission Protector Replacement](#) .



**Fig. 30: Negative Battery Cable And Fastener**

Courtesy of GENERAL MOTORS COMPANY

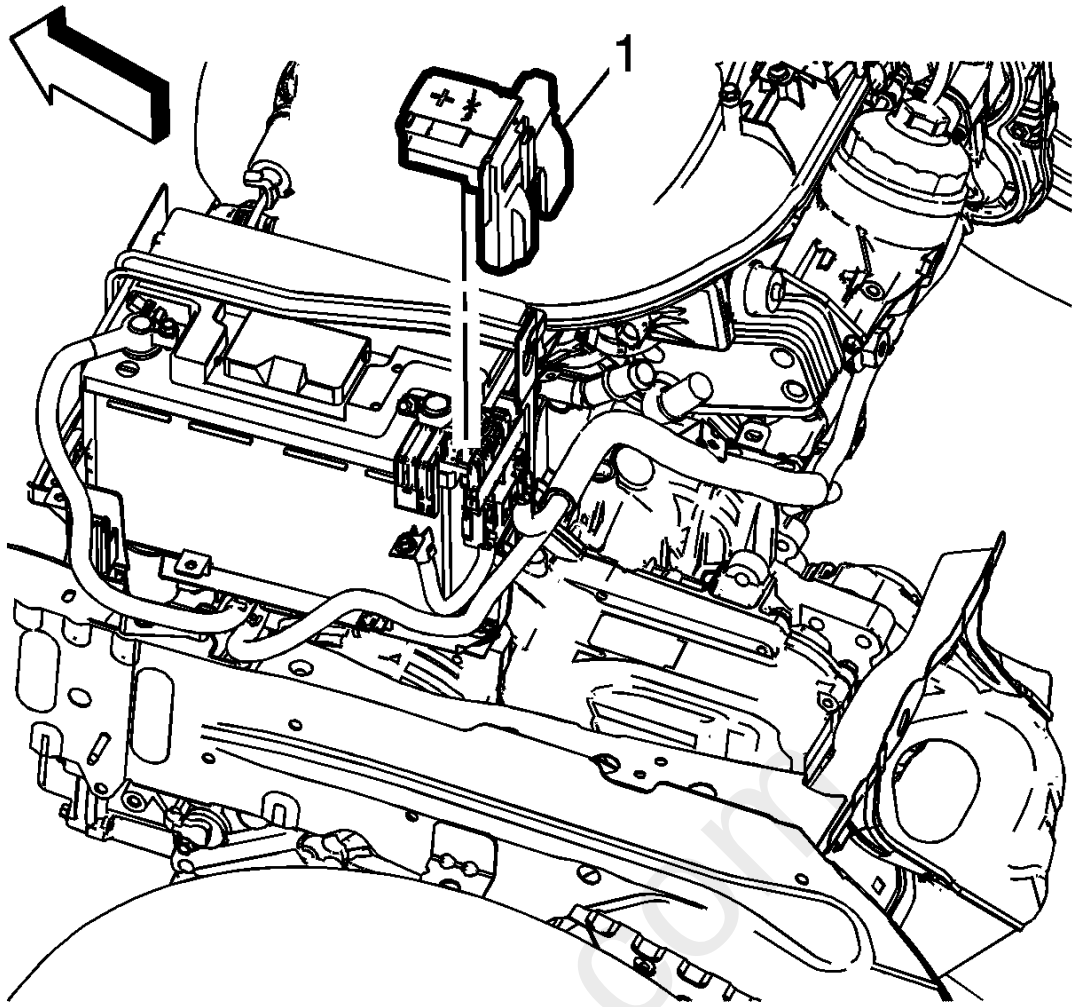
9. Install the battery negative cable (2) to the frame rail stud and tighten the fastener (1) to 9 N.m (80 lb in).
10. Install the battery tray. Refer to [Battery Tray Replacement](#).



**Fig.31: Positive Battery Cable And Fastener**

Courtesy of GENERAL MOTORS COMPANY

11. Install the battery positive cable (2) to the battery fuse block and tighten the fastener (1) to 12 N.m (106 lb in).
12. Install the transfer case, if equipped. Refer to [Transfer Case Replacement](#) .



**Fig.32: Battery Fuse Block Cover**

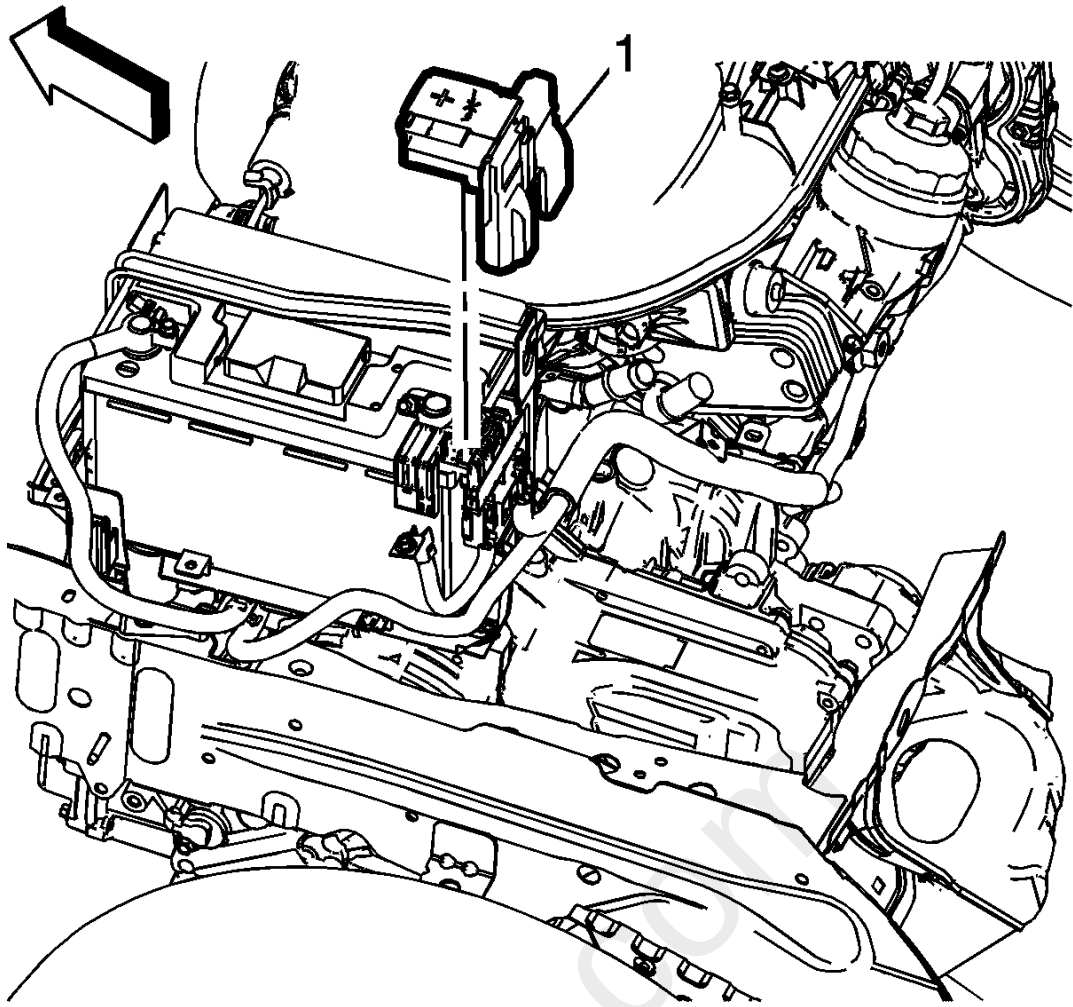
Courtesy of GENERAL MOTORS COMPANY

13. Install the battery fuse block cover (1) and install the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#).

## **BATTERY POSITIVE AND NEGATIVE CABLE REPLACEMENT (2H0)**

### **Removal Procedure**

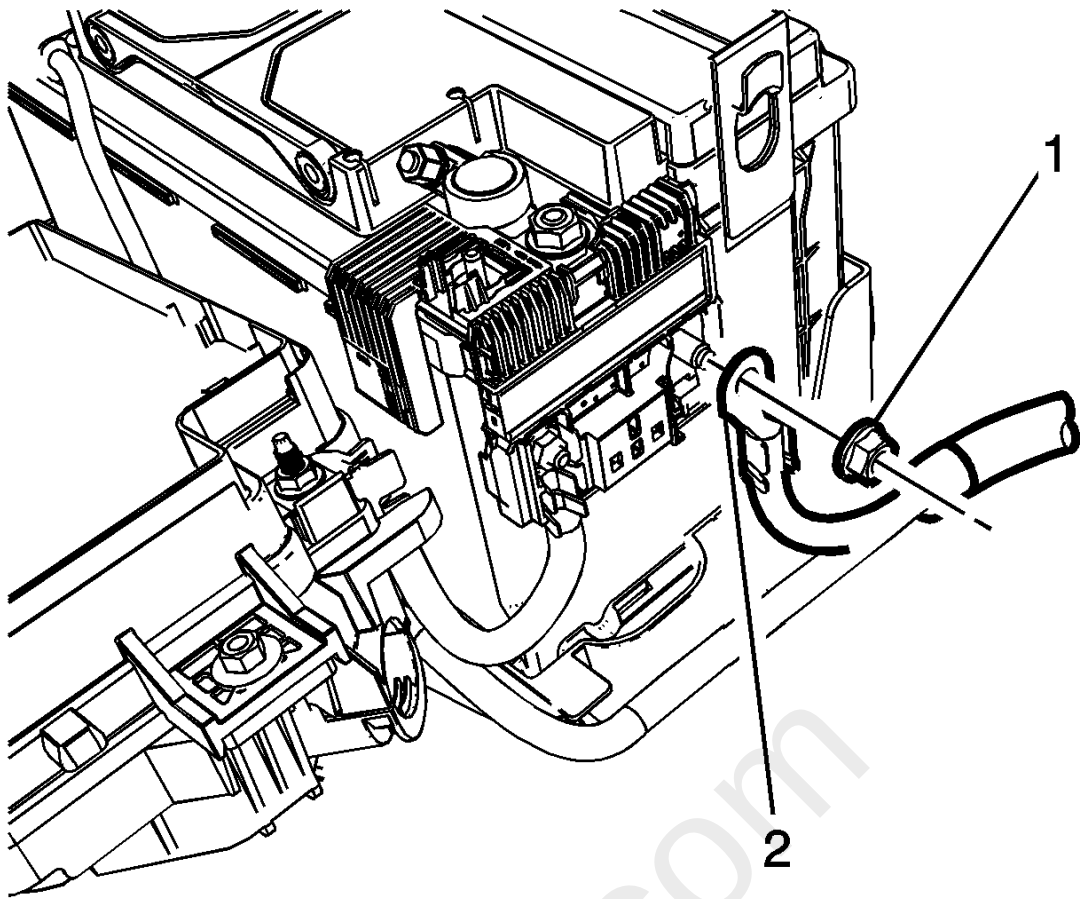
1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#).



**Fig.33: Battery Fuse Block Cover**

Courtesy of GENERAL MOTORS COMPANY

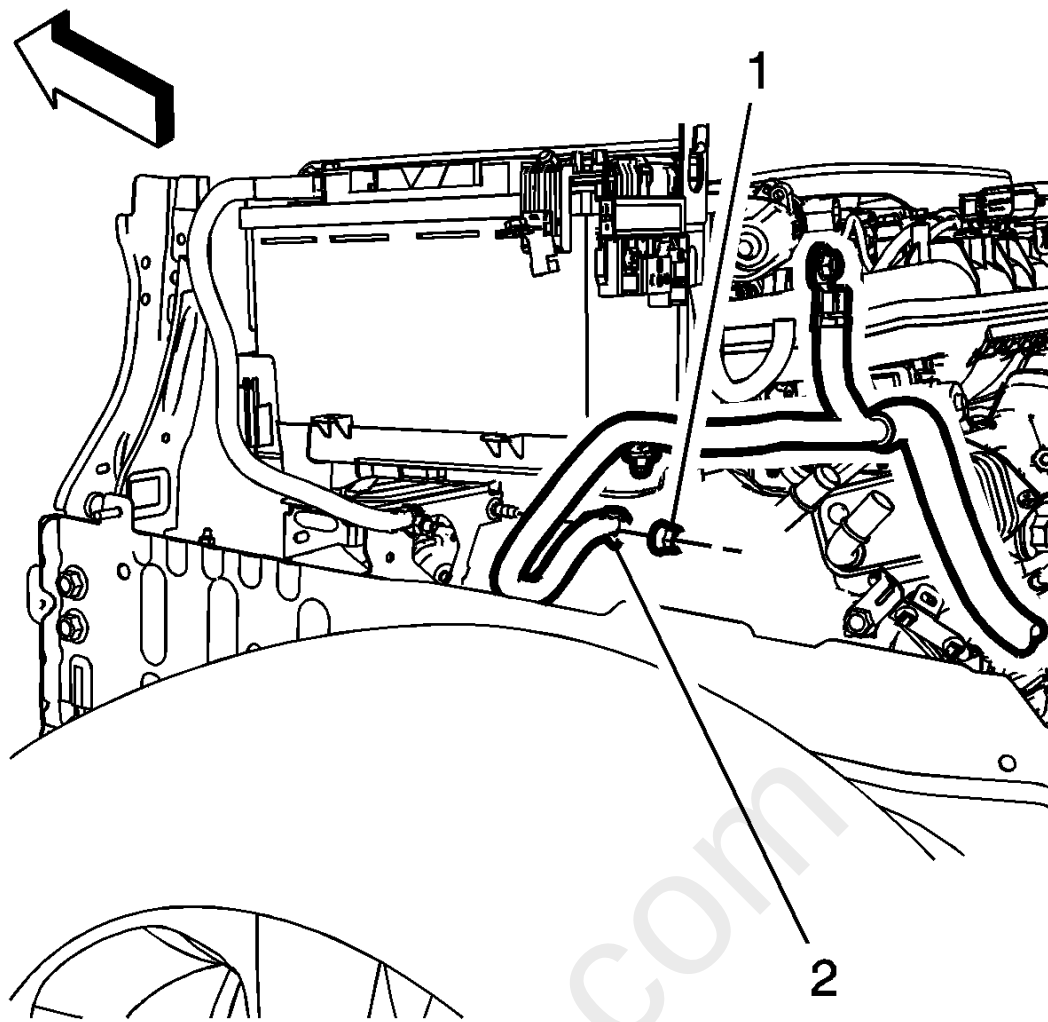
2. Remove the battery fuse block cover (1).



**Fig. 34: Positive Battery Cable And Fastener**

Courtesy of GENERAL MOTORS COMPANY

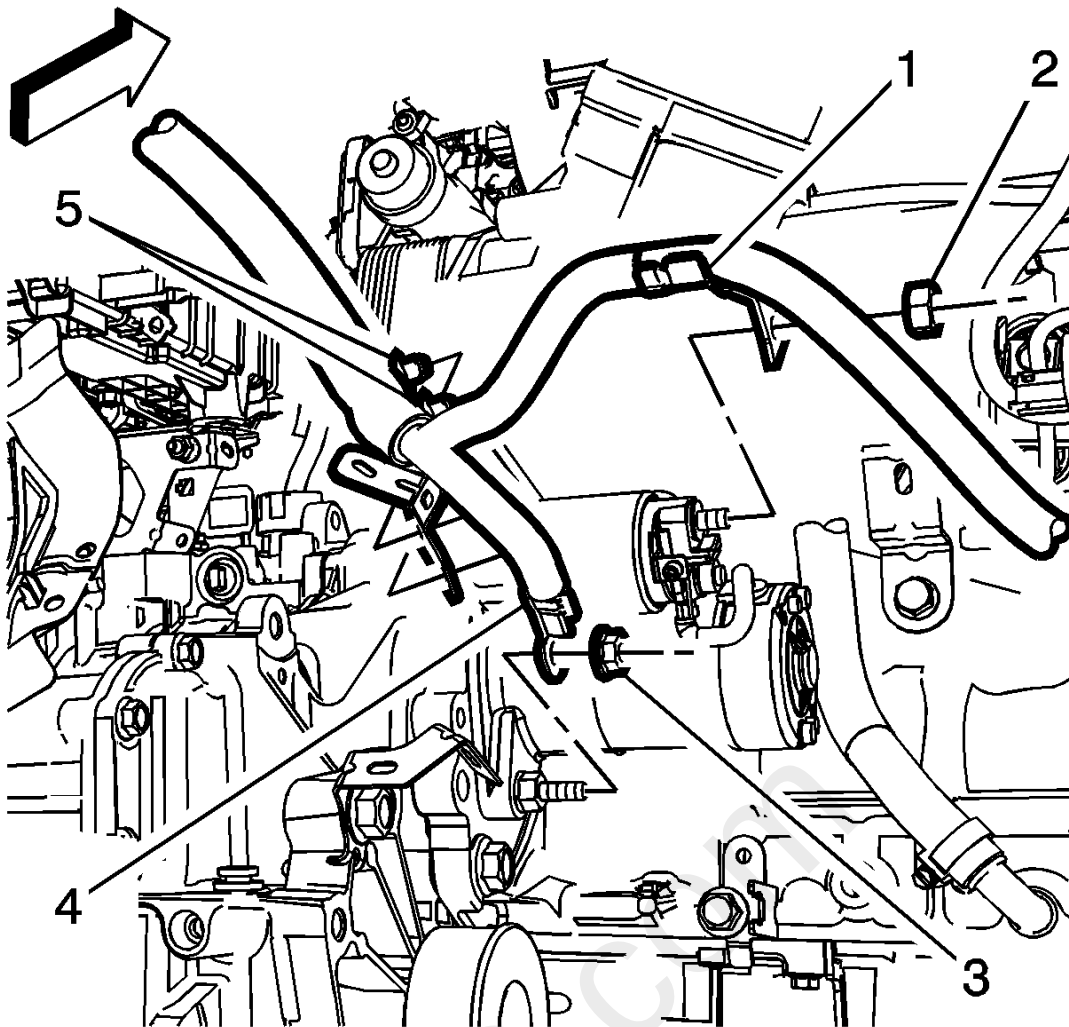
3. Remove the battery positive cable fastener (1) and remove the battery positive cable (2) from the battery fuse block.
4. Remove the battery tray. Refer to [Battery Tray Replacement](#).



**Fig. 35: Negative Battery Cable And Fastener**

Courtesy of GENERAL MOTORS COMPANY

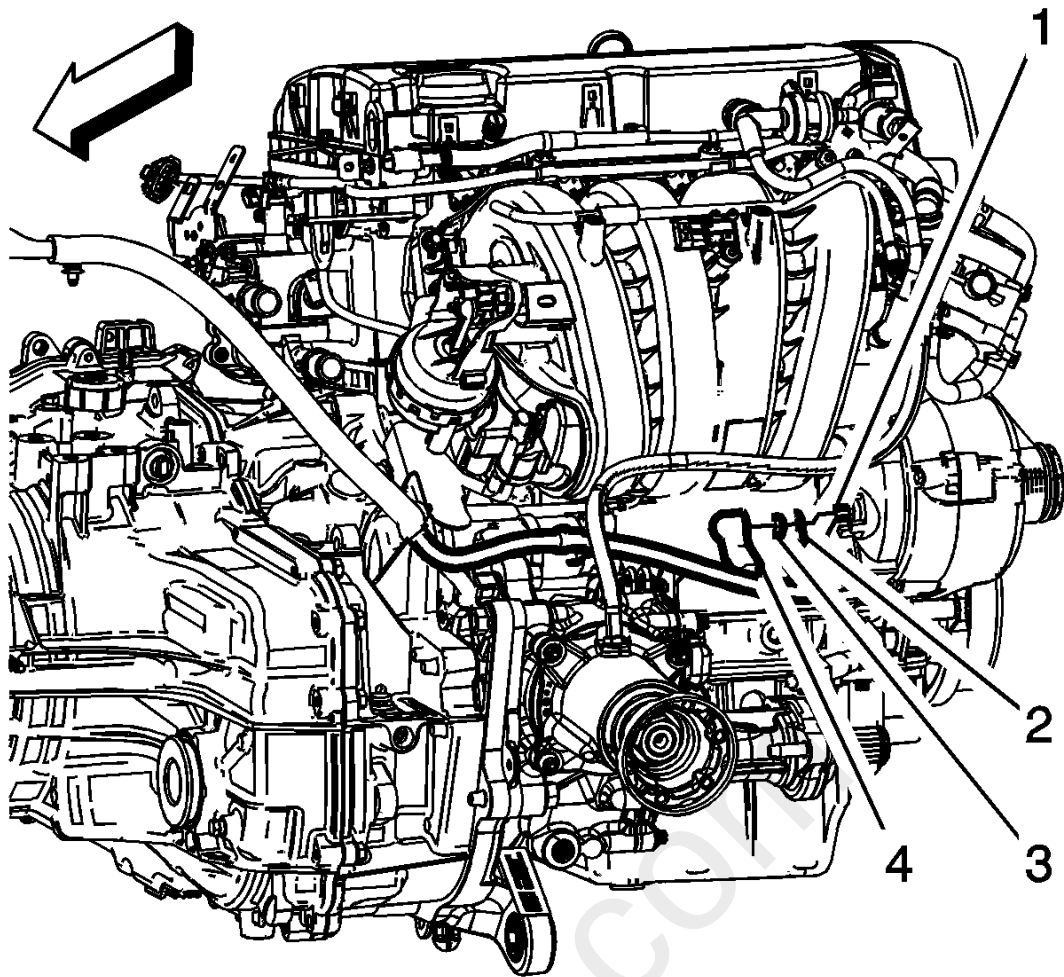
5. Remove the battery negative cable fastener (1) and remove the battery negative cable (2) from the frame stud ground.
6. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
7. Remove the drivetrain and front suspension frame transmission protector, if equipped. Refer to [Drivetrain and Front Suspension Frame Transmission Protector Replacement](#) .



**Fig. 36: Positive And Negative Battery Cables**

Courtesy of GENERAL MOTORS COMPANY

8. Remove the battery positive cable fastener (2) and remove the battery positive cable (1) from the starter solenoid.
9. Remove the battery negative cable fastener (3) and remove the battery negative cable (4) from the starter mounting stud.
10. Detach the battery positive and negative cable retainers (5) from the transmission bracket.



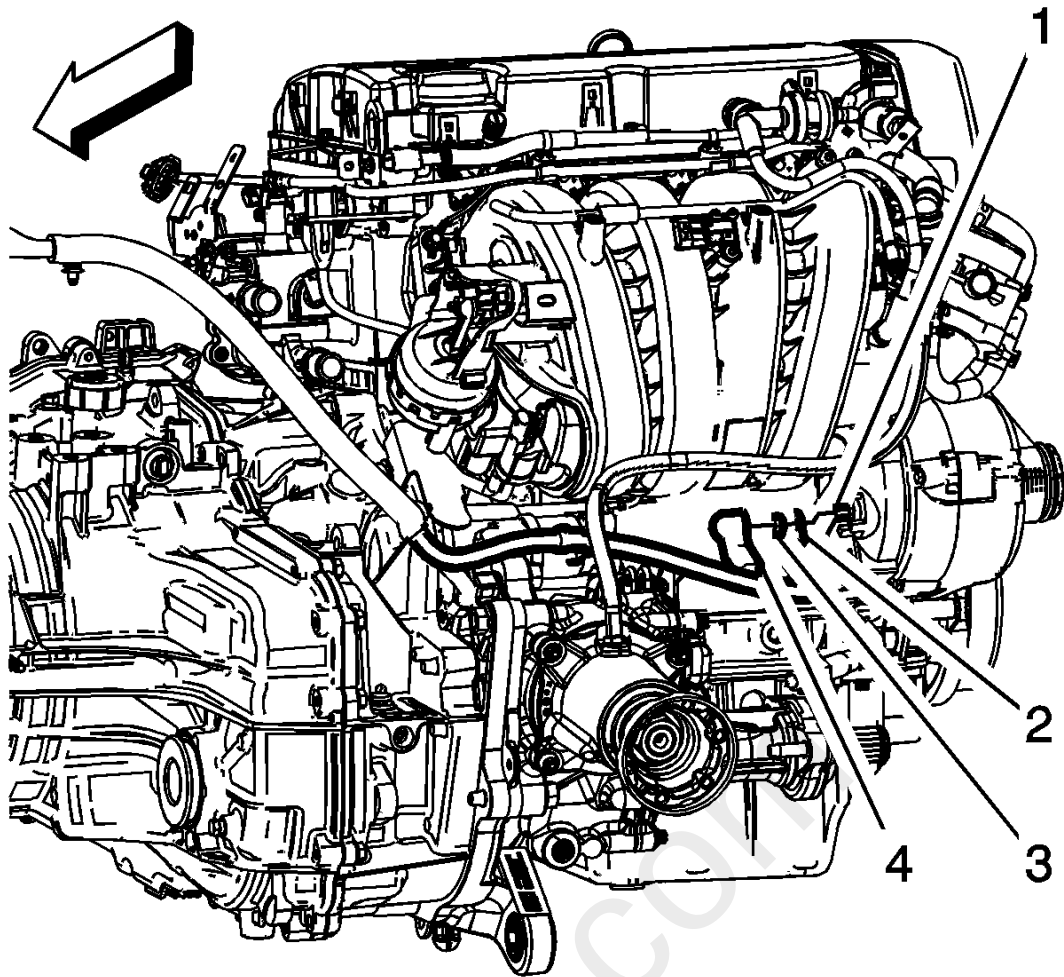
**Fig.37: Cable Retainer, Stud, Cable Fastener And Protective Boot**  
Courtesy of GENERAL MOTORS COMPANY

11. Remove the protective boot (4) and the battery positive cable fastener (3) from the generator B+ stud (1).
12. Remove the battery positive cable retainer (2) from the generator.

**NOTE:**      **Observe how the battery positive and negative cable was routed within the engine compartment.**

13. Remove the battery positive and negative cable.

### **Installation Procedure**

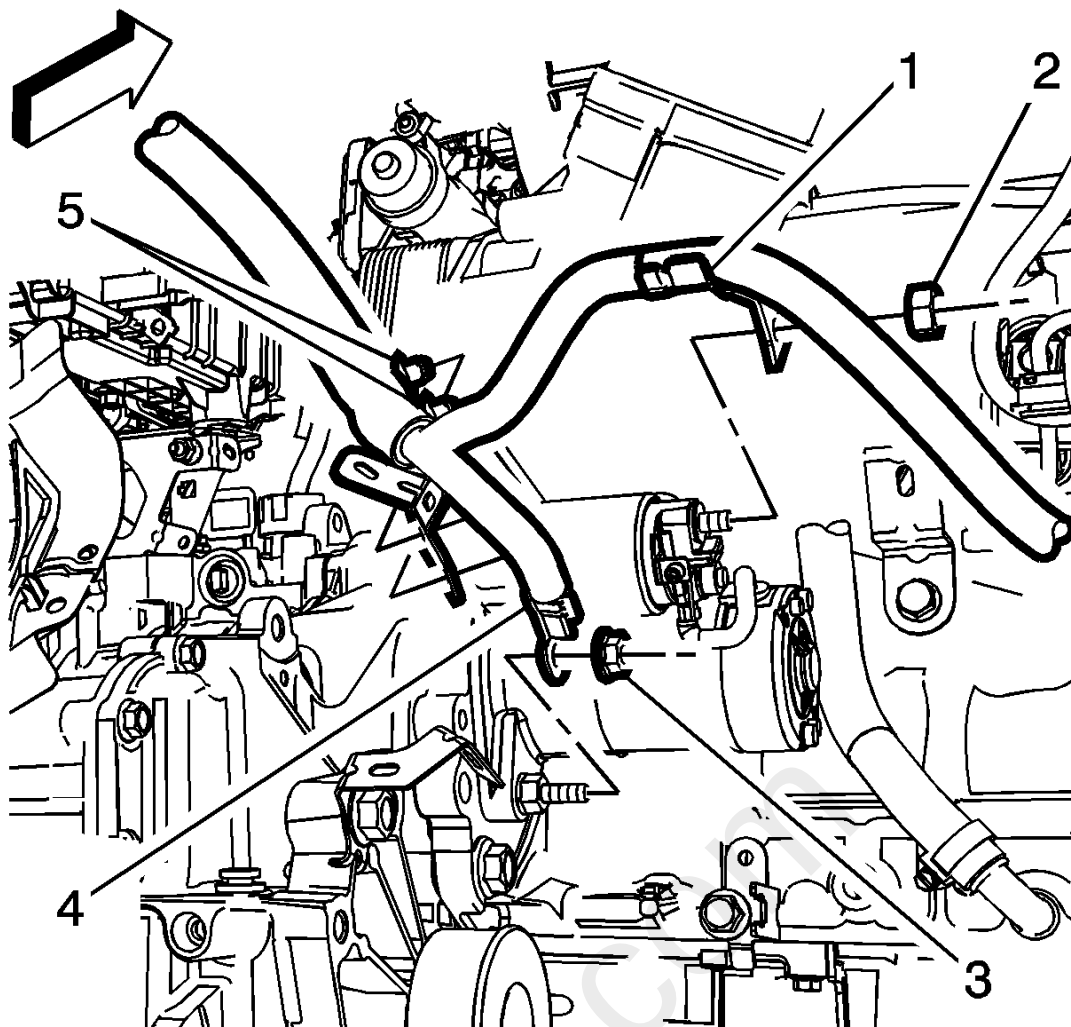


**Fig.38: Cable Retainer, Stud, Cable Fastener And Protective Boot**

Courtesy of GENERAL MOTORS COMPANY

**CAUTION:** Refer to **Fastener Caution** .

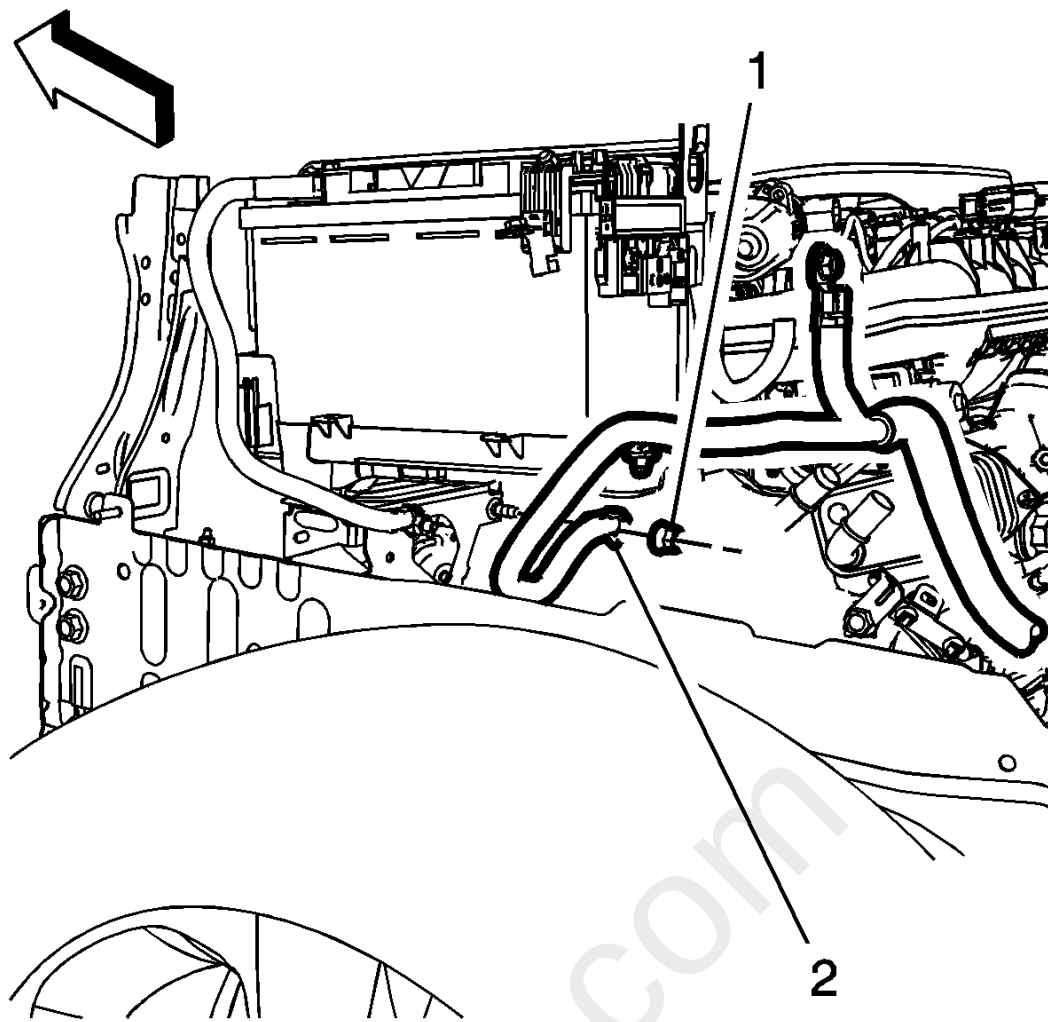
1. Install the battery positive cable retainer (2) to the generator and tighten the fastener (3) to 17 N.m (13 lb ft).
2. Install the protective boot (4).



**Fig.39: Positive And Negative Battery Cables**

Courtesy of GENERAL MOTORS COMPANY

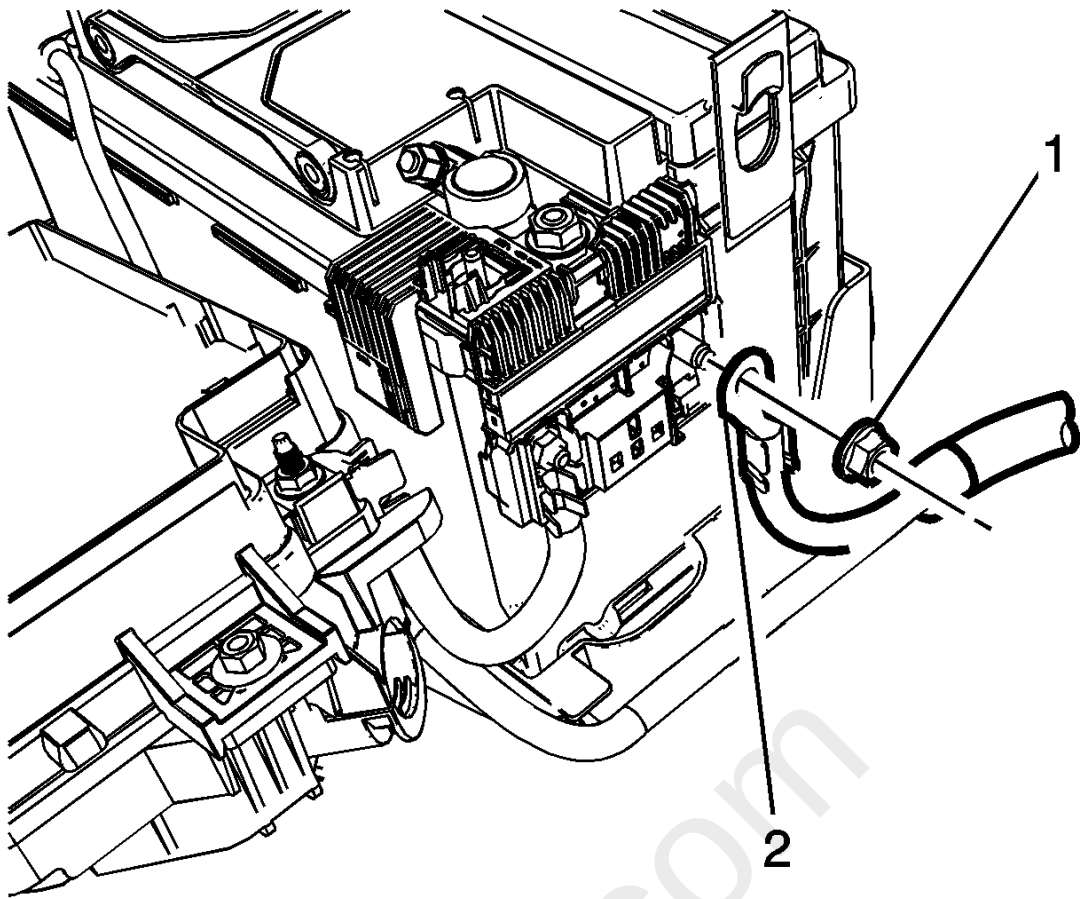
3. Install the battery positive cable terminal (1) to the starter solenoid and tighten the fastener (2) to 13 N.m (115 lb in).
4. Install the battery negative cable (4) to the starter mounting stud and tighten the fastener (3) to 13 N.m (115 lb in).
5. Install the battery positive and negative cable retainers (5) into the transmission bracket.
6. Install the drivetrain and front suspension frame transmission protector, if equipped. Refer to **[Drivetrain and Front Suspension Frame Transmission Protector Replacement](#)** .



**Fig. 40: Negative Battery Cable And Fastener**

Courtesy of GENERAL MOTORS COMPANY

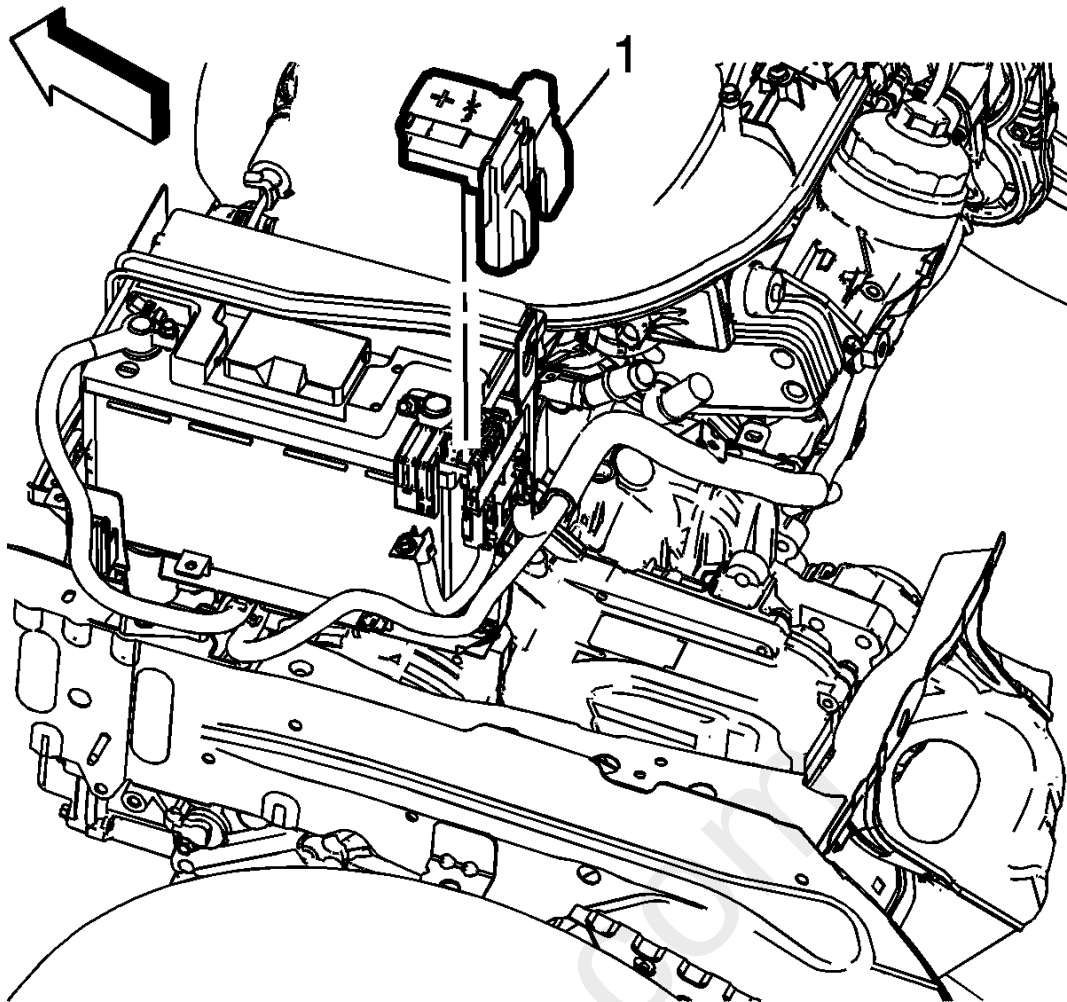
7. Install the battery negative cable (2) to the frame rail stud and tighten the fastener (1) to 9 N.m (80 lb in).
8. Install the battery tray. Refer to [Battery Tray Replacement](#).



**Fig. 41: Positive Battery Cable And Fastener**

Courtesy of GENERAL MOTORS COMPANY

9. Install the battery positive cable (2) to the battery fuse block and tighten the fastener (1) to 12 N.m (106 lb in).



**Fig. 42: Battery Fuse Block Cover**

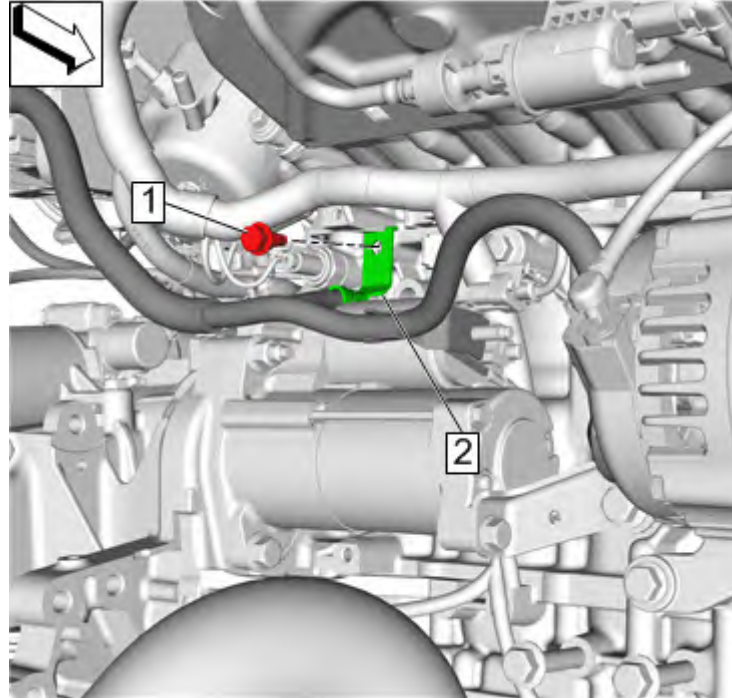
Courtesy of GENERAL MOTORS COMPANY

10. Install the battery fuse block cover (1) and install the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#).

## **BATTERY POSITIVE AND NEGATIVE CABLE REPLACEMENT (LE2)**

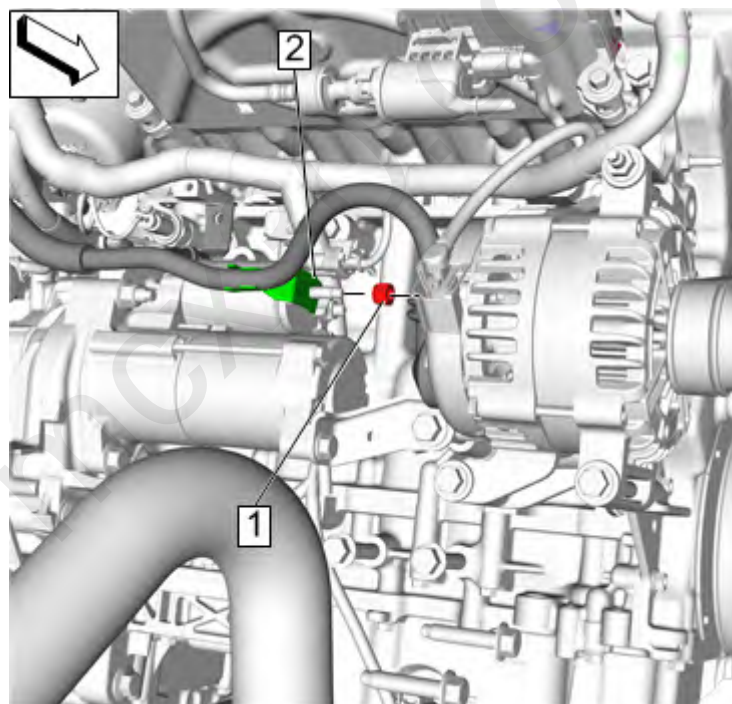
### **Removal Procedure**

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#).



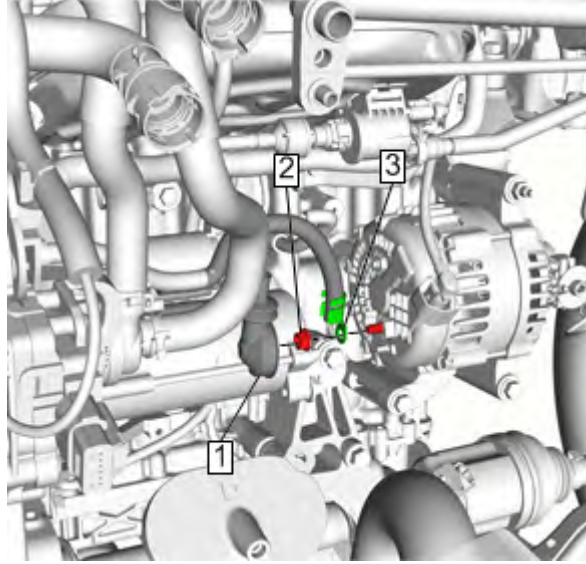
**Fig. 43: Battery Negative Cable And Fastener**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove Battery Negative Cable Ground Fastener (1)
3. Remove Battery Negative Cable (2)



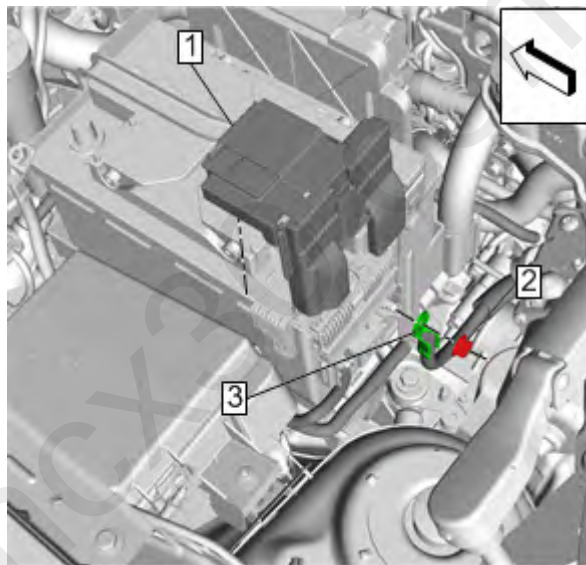
**Fig. 44: Battery Positive Cable And Nut**  
Courtesy of GENERAL MOTORS COMPANY

4. Remove Starter Solenoid Cable Nut (1)
5. Remove Battery Positive Cable (2)



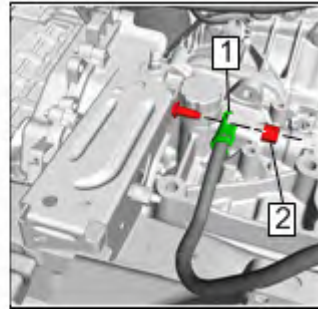
**Fig. 45: Battery Positive Cable, Protective Cap And Nut**  
 Courtesy of GENERAL MOTORS COMPANY

6. Remove the positive battery cable protective cap from the generator terminal (1).
7. Remove Battery Positive Cable Nut (2)
8. Remove Battery Positive Cable (1)



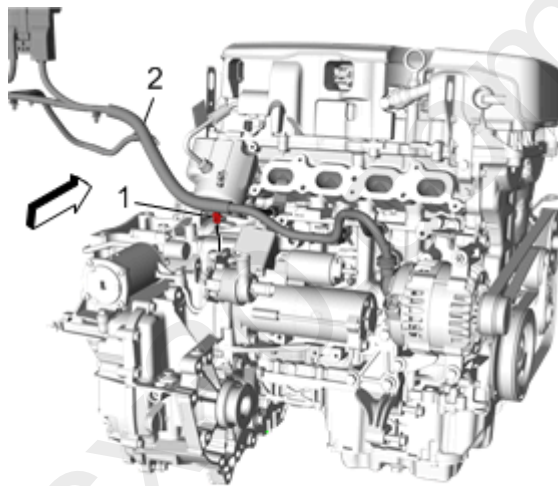
**Fig. 46: Power Distributor Fuse Block Cover, Battery Positive Cable And Nut**  
 Courtesy of GENERAL MOTORS COMPANY

9. Remove Power Distributor Fuse Block Cover (1)
10. Remove Battery Fuse Block Battery Positive Cable Nut (2)
11. Remove Battery Positive Cable (3)
12. Remove the battery tray. Refer to **Battery Tray Replacement**



**Fig. 47: Battery Negative Cable And Fastener**  
Courtesy of GENERAL MOTORS COMPANY

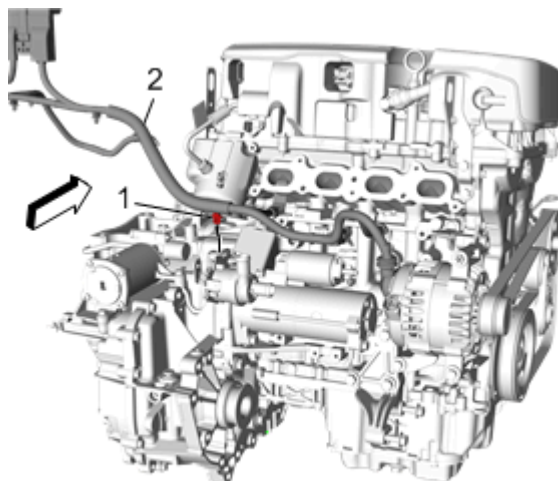
13. Remove Battery Negative Cable Frame Ground Fastener (2)
14. Remove Battery Negative Cable (1)



**Fig. 48: Battery Positive And Negative Cable**  
Courtesy of GENERAL MOTORS COMPANY

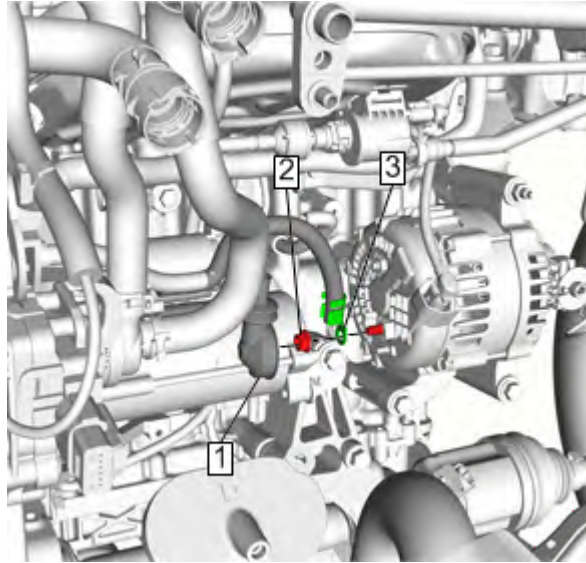
15. Remove the Battery Positive and Negative Cable Retainer (1).
16. Remove the battery positive and negative cable (2).

#### Installation Procedure



**Fig. 49: Battery Positive And Negative Cable**  
Courtesy of GENERAL MOTORS COMPANY

1. Position the battery positive and negative cable in the vehicle (2).
2. Install the retainer (1).

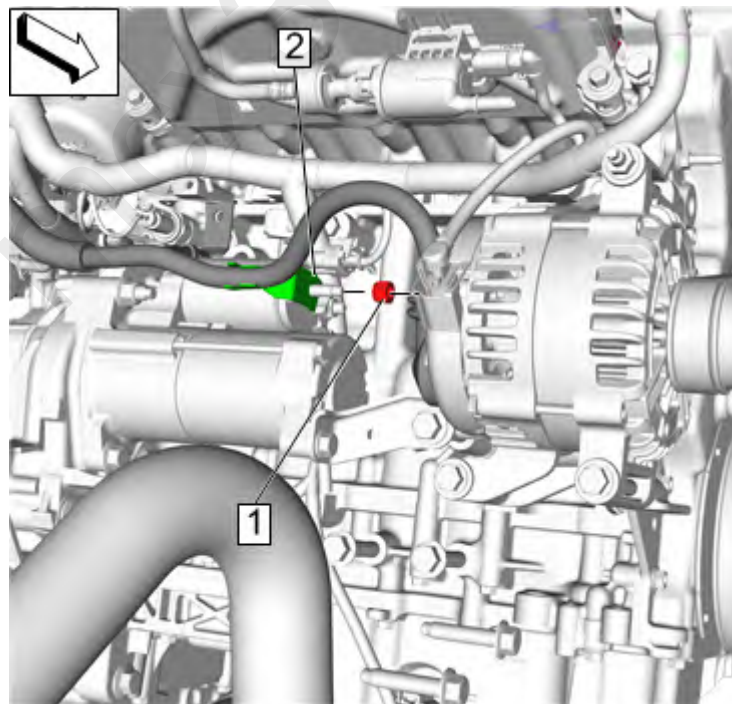


**Fig. 50: Battery Positive Cable, Protective Cap And Nut**  
Courtesy of GENERAL MOTORS COMPANY

3. Install Battery Positive Cable (3)

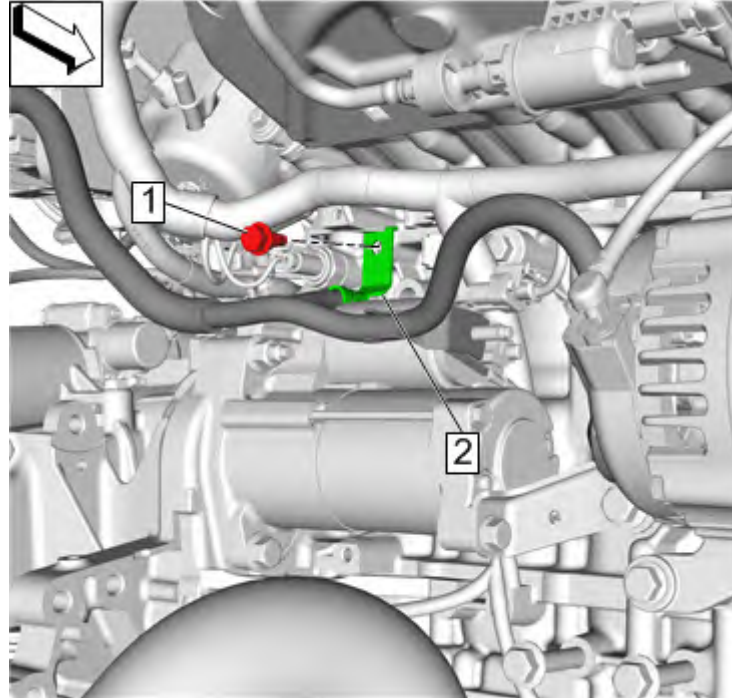
**CAUTION:** Refer to **Fastener Caution** .

4. Install and tighten Battery Positive Cable Nut (2) to 17 N.m (13 lb ft)
5. Install the positive battery cable protective cap to the generator terminal (3).



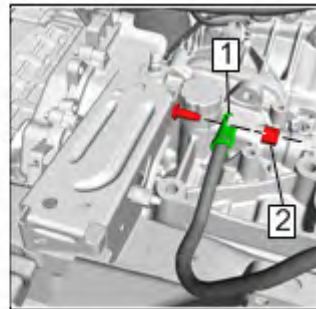
**Fig. 51: Battery Positive Cable And Nut**  
Courtesy of GENERAL MOTORS COMPANY

6. Install Battery Positive Cable (2)
7. Install and tighten Starter Positive Cable Nut (1) to 9 N.m (80 lb in)



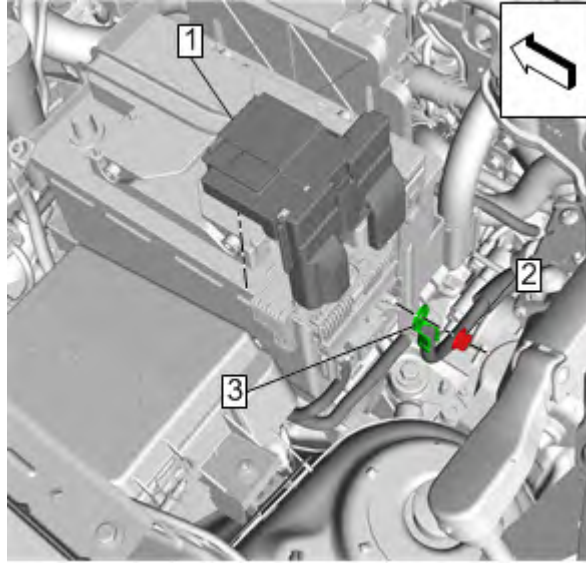
**Fig. 52: Battery Negative Cable And Fastener**  
**Courtesy of GENERAL MOTORS COMPANY**

8. Install Battery Negative Cable (2)
9. Install and tighten Battery Negative Cable Frame Ground Fastener (1) to 22 N.m (16 lb ft)



**Fig. 53: Battery Negative Cable And Fastener**  
**Courtesy of GENERAL MOTORS COMPANY**

10. Install Battery Negative Cable (1)
11. Install and tighten Battery Negative Cable Frame Ground Fastener (2) to 9 N.m (80 lb in)
12. Install the battery tray. Refer to [Battery Tray Replacement](#)
13. Install the battery. Refer to [Battery Replacement](#)



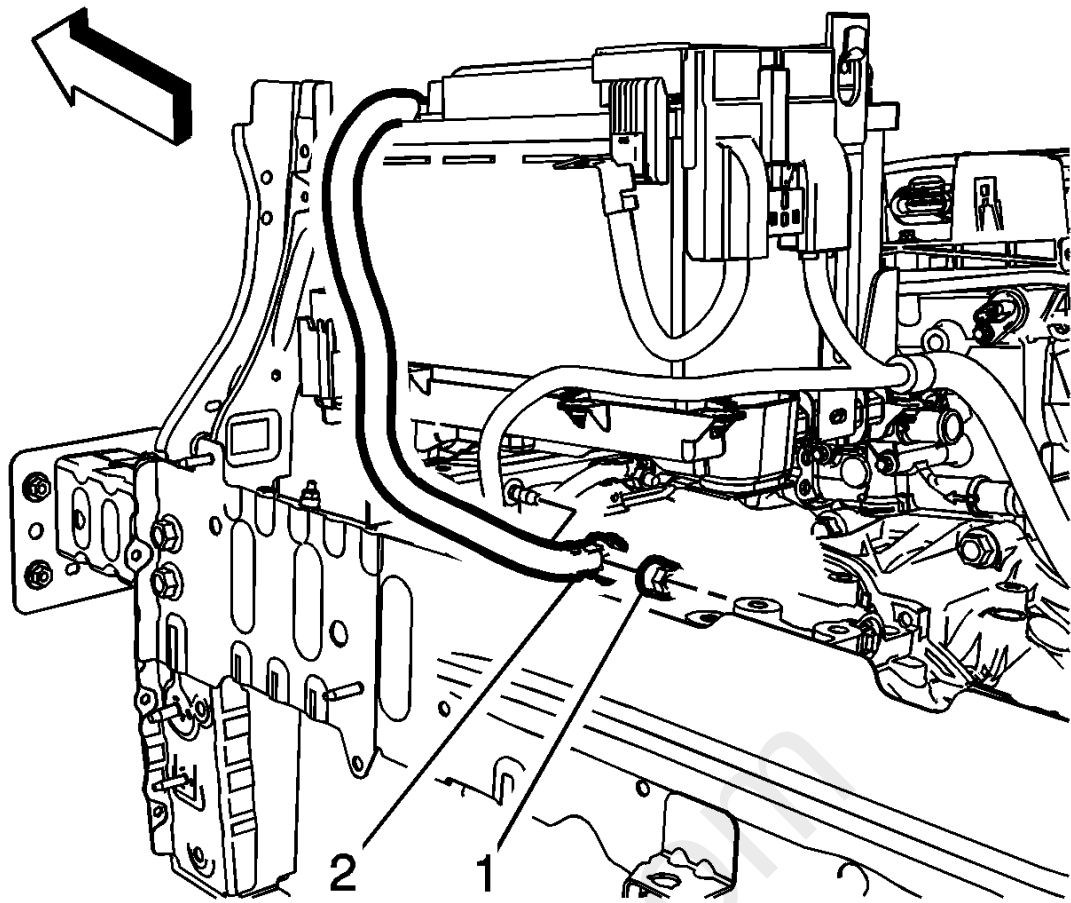
**Fig. 54: Power Distributor Fuse Block Cover, Battery Positive Cable And Nut**  
Courtesy of GENERAL MOTORS COMPANY

14. Install Battery Fuse Block Battery Positive Cable (3)
15. Install and tighten Battery Fuse Block Battery Positive Cable Nut (2) to 12 N.m (106 lb in)
16. Close the battery fuse block cover (1).
17. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#).

### **BATTERY NEGATIVE CABLE REPLACEMENT (WITHOUT KL9)**

#### **Removal Procedure**

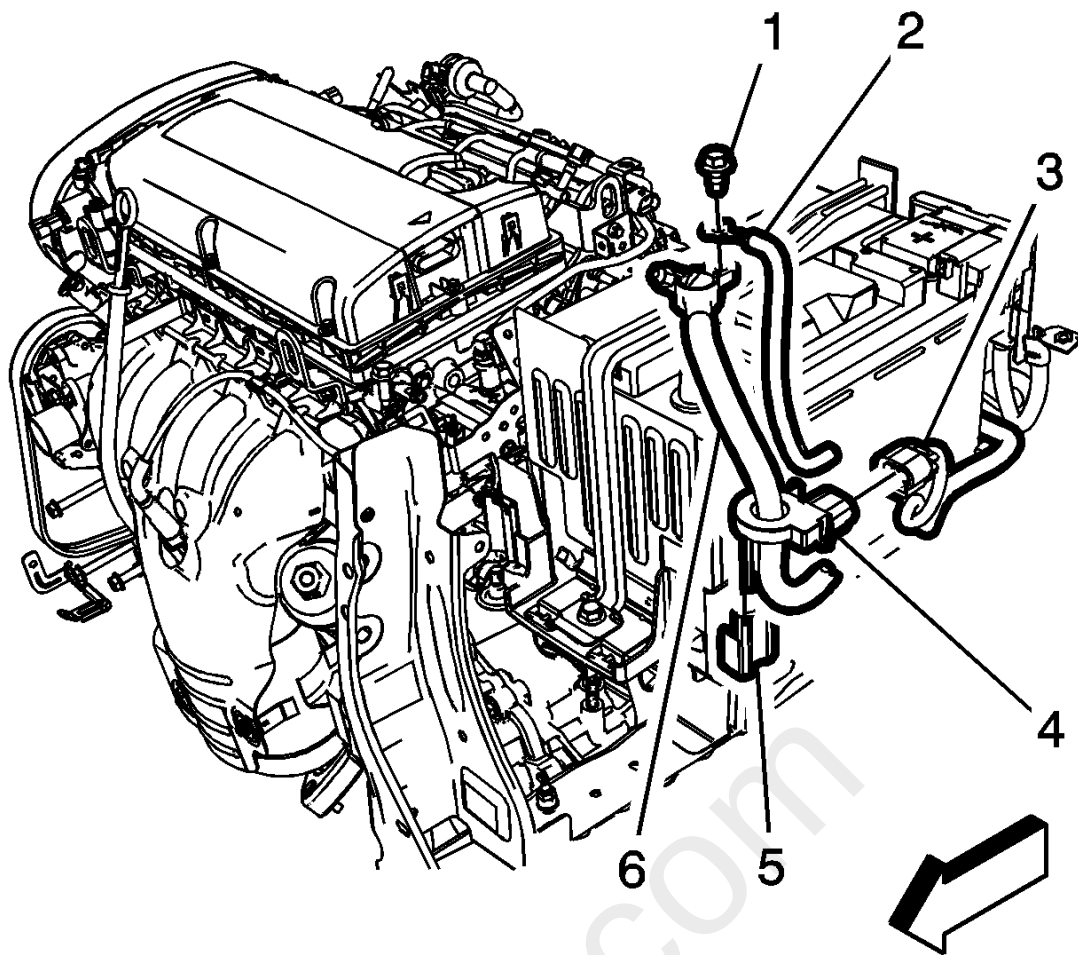
1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#).
2. Remove the battery tray. Refer to [Battery Tray Replacement](#).



**Fig. 55: Battery Ground Cable And Fastener**

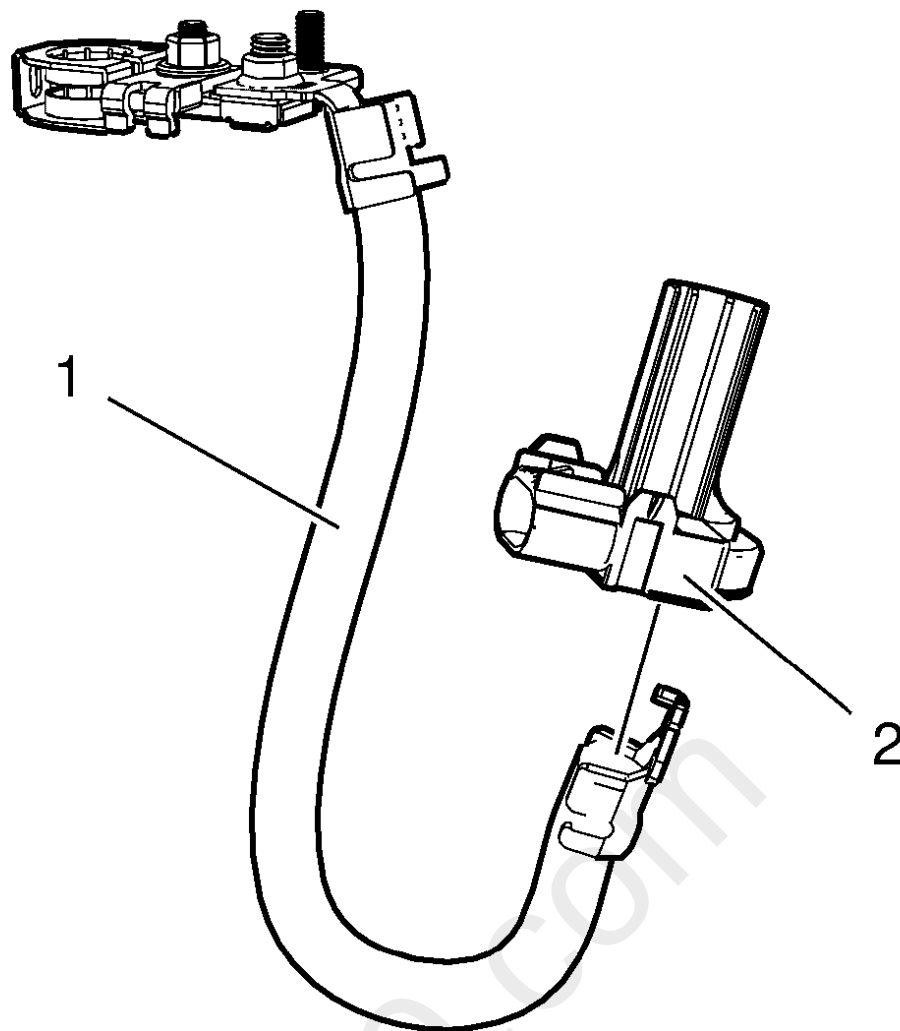
Courtesy of GENERAL MOTORS COMPANY

3. Remove the battery ground cable fastener (1).
4. Remove the battery negative cable (2).



**Fig. 56: Wiring Harness Current Sensor Connector, Cables And Fastener**  
Courtesy of GENERAL MOTORS COMPANY

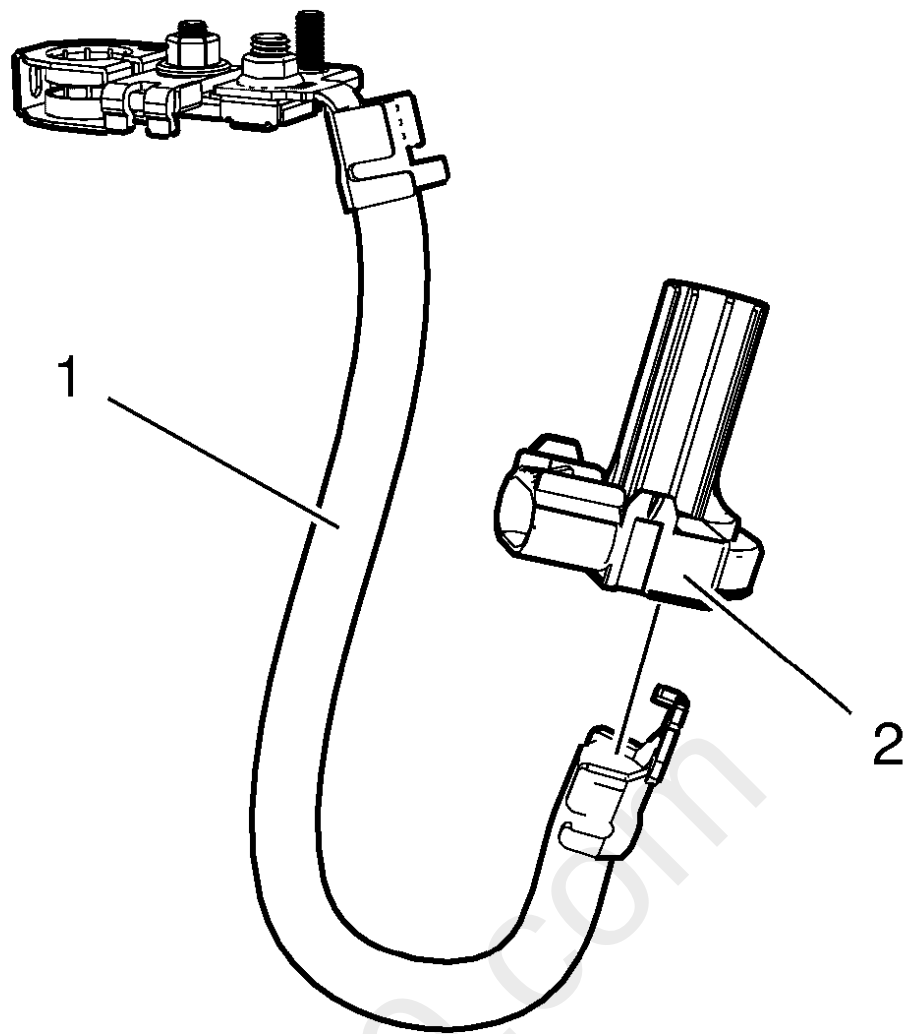
5. Disconnect the wiring harness current sensor connector (3).
6. Remove the body harness ground cable fastener (1) and the body harness ground cable (2), from the battery negative cable (6).
7. Remove the battery negative cable (6).



**Fig. 57: Battery Negative Cable & Current Sensor**  
Courtesy of GENERAL MOTORS COMPANY

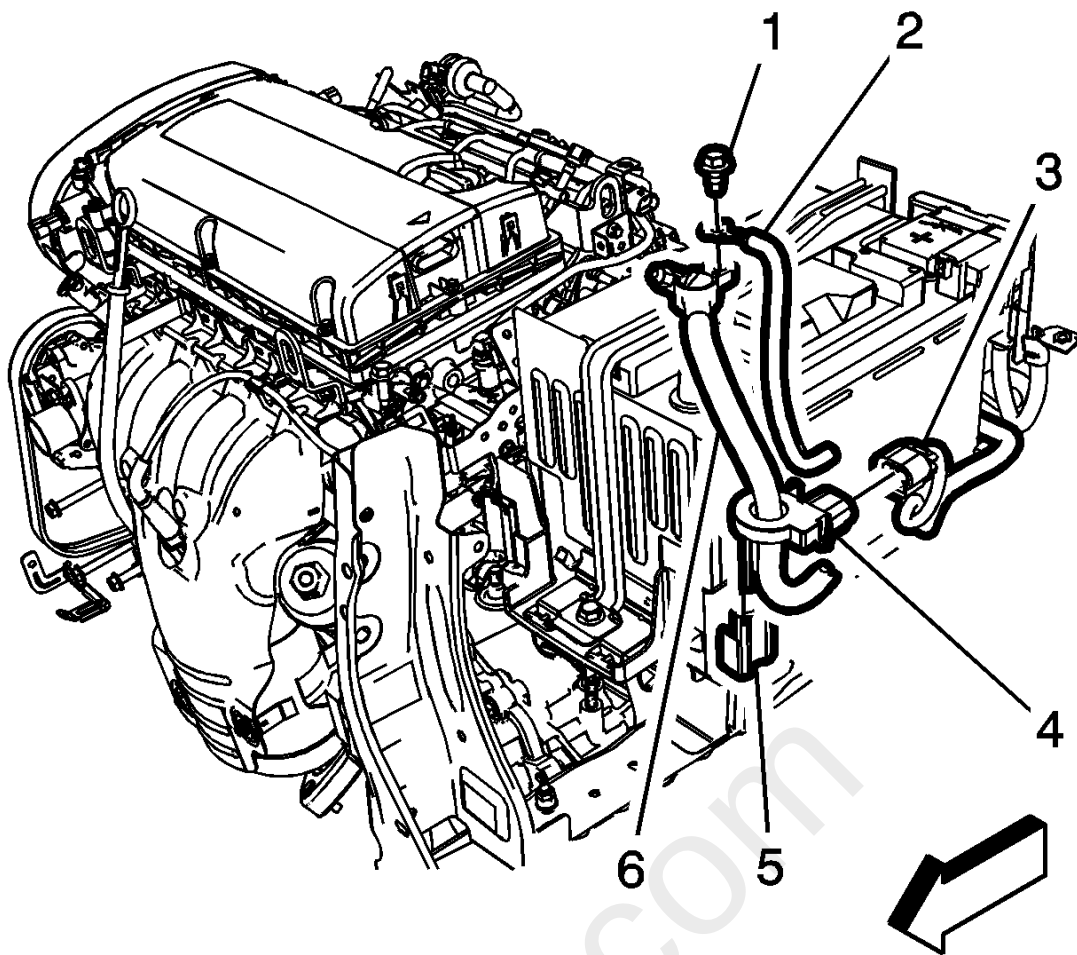
8. Remove the current sensor (2) from the battery negative cable (1).

#### **Installation Procedure**



**Fig.58: Battery Negative Cable & Current Sensor**  
**Courtesy of GENERAL MOTORS COMPANY**

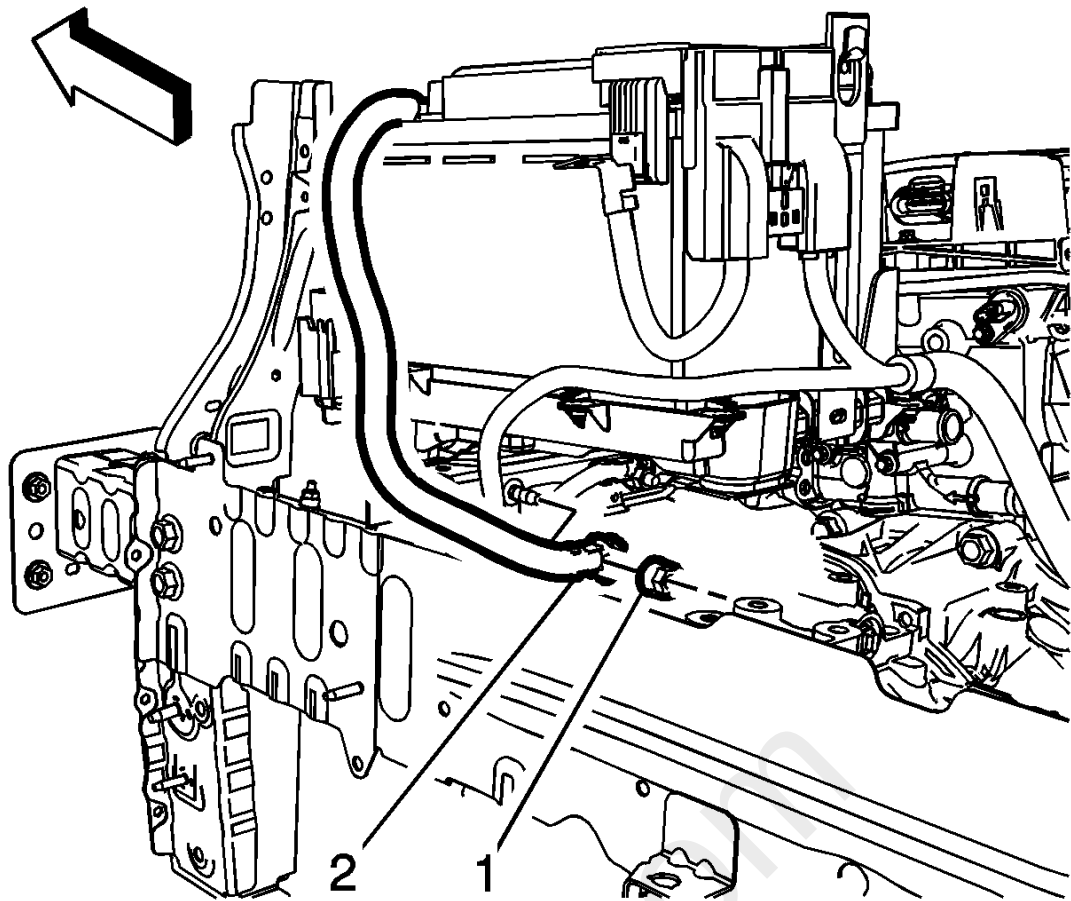
1. Install the current sensor (2) to the battery negative cable (1).



**Fig. 59: Wiring Harness Current Sensor Connector, Cables And Fastener**  
Courtesy of GENERAL MOTORS COMPANY

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

2. Install the body harness ground cable (2) to the battery negative cable (6). Tighten the fastener (1) to 9 N.m (80 lb in).
3. Connect the wiring harness current sensor connector (3).



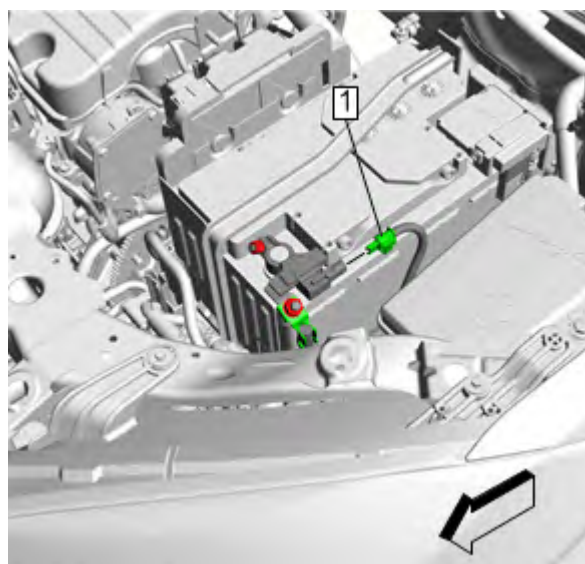
**Fig. 60: Battery Ground Cable And Fastener**

Courtesy of GENERAL MOTORS COMPANY

4. Install the battery negative cable (2) to the chassis frame stud and tighten the fastener (1) to 9 N.m (80 lb in).
5. Install the battery tray. Refer to [Battery Tray Replacement](#).
6. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#).

## **BATTERY NEGATIVE CABLE REPLACEMENT (WITH KL9)**

### **Removal Procedure**

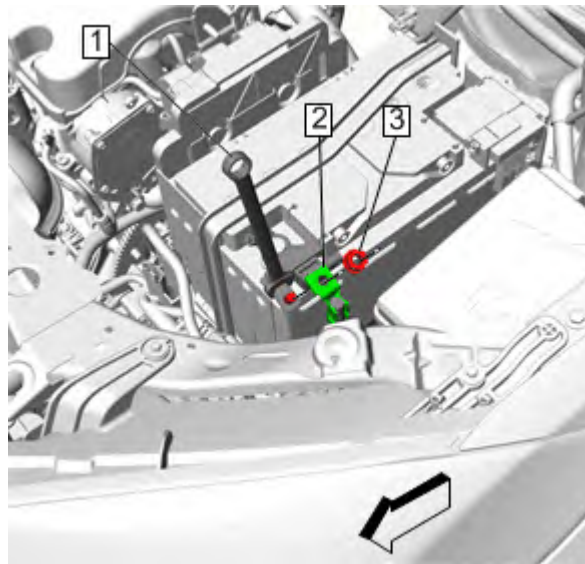


**Fig. 61: Battery Sensor Electrical Connector**

Courtesy of GENERAL MOTORS COMPANY

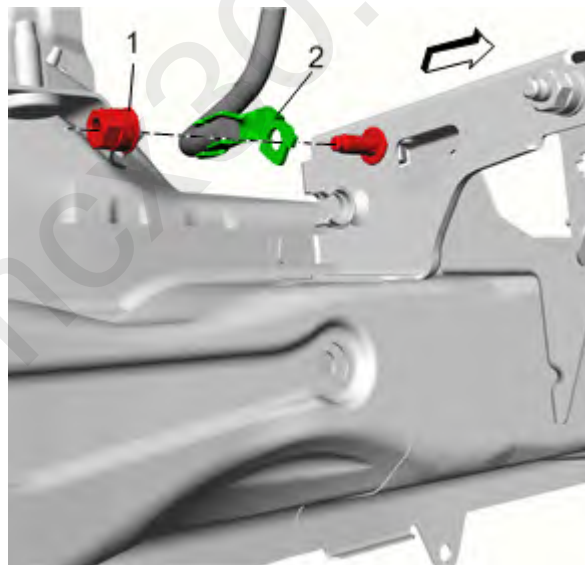
**WARNING:** Refer to [Battery Disconnect Warning](#) .

1. Disconnect the electrical connector (1).



**Fig. 62: Battery Negative Cable And Nut**  
Courtesy of GENERAL MOTORS COMPANY

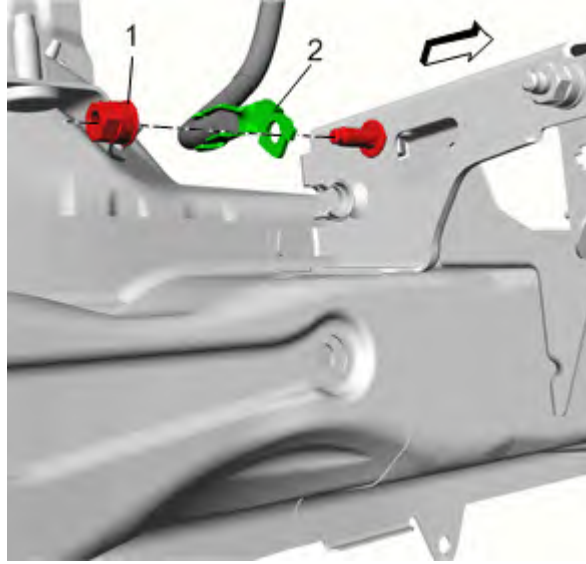
2. Use an open ended wrench to hold the battery sensor ground tab, while loosening the battery negative cable nut (3).
3. Remove Battery Negative Cable Nut (3)
4. Remove Battery Negative Cable (2)
5. Remove the battery tray. Refer to [Battery Tray Replacement](#)



**Fig. 63: Battery Negative Cable And Negative Cable Frame Ground Fastener**  
Courtesy of GENERAL MOTORS COMPANY

6. Remove Battery Negative Cable Frame Ground Fastener (1)
7. Remove Battery Negative Cable (2)

#### **Installation Procedure**

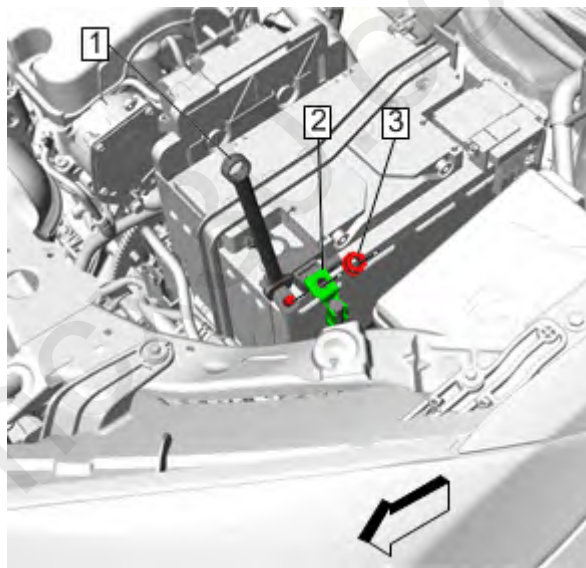


**Fig. 64: Battery Negative Cable And Negative Cable Frame Ground Fastener**  
Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Negative Cable (2)

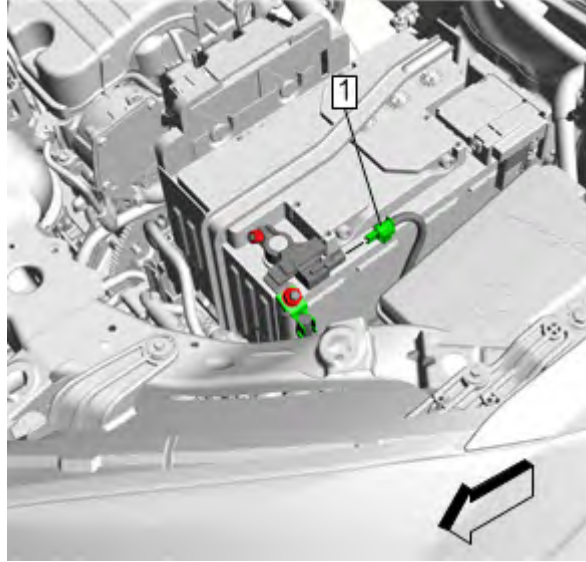
**CAUTION:** Refer to [Fastener Caution](#) .

2. Install and tighten Battery Negative Cable Frame Ground Fastener (1) to 9 N.m (80 lb in)
3. Install the battery tray. Refer to [Battery Tray Replacement](#)



**Fig. 65: Battery Negative Cable And Nut**  
Courtesy of GENERAL MOTORS COMPANY

4. Install Battery Negative Cable (2)
5. Install and tighten Battery Negative Cable Nut (3) to 11 N.m (97 lb in)



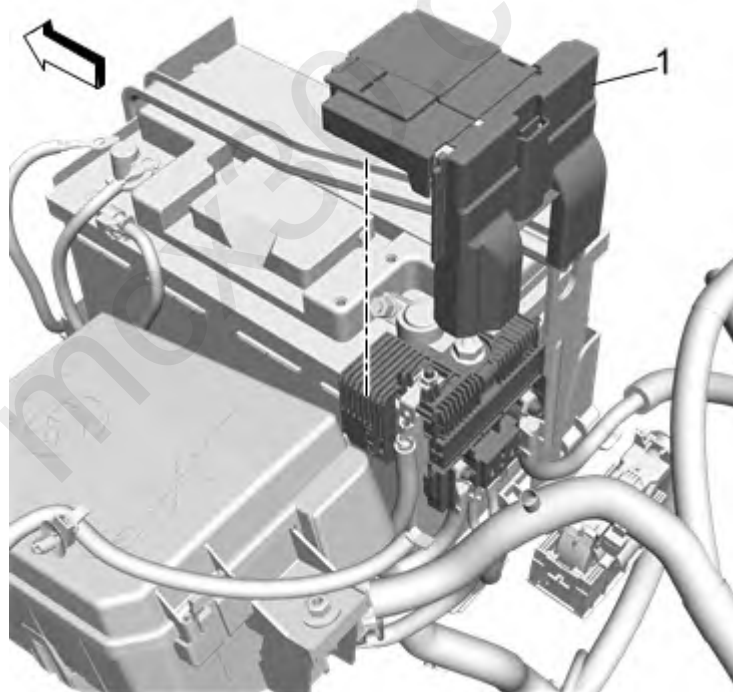
**Fig. 66: Battery Sensor Electrical Connector**  
Courtesy of GENERAL MOTORS COMPANY

6. Connect the electrical connector (1).

## **BATTERY POSITIVE CABLE JUNCTION BLOCK REPLACEMENT**

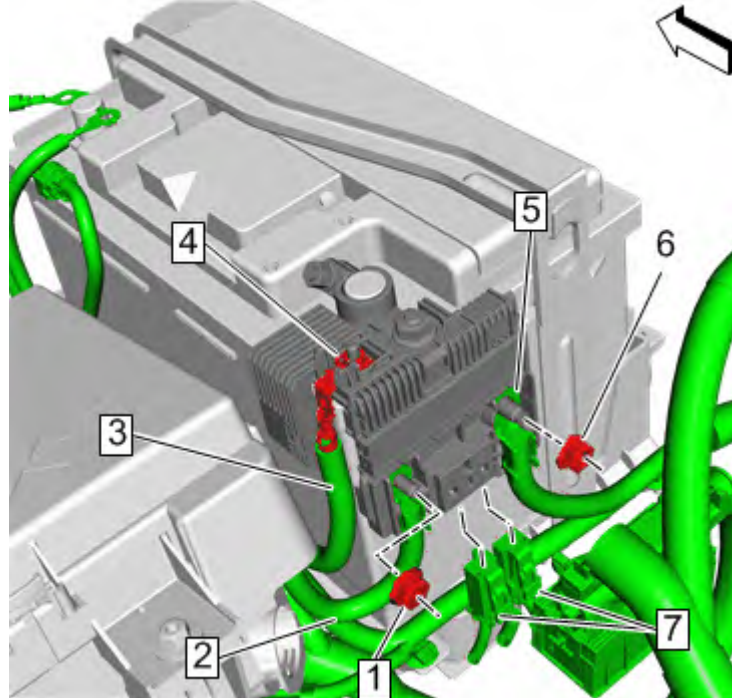
### **Removal Procedure**

1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#)



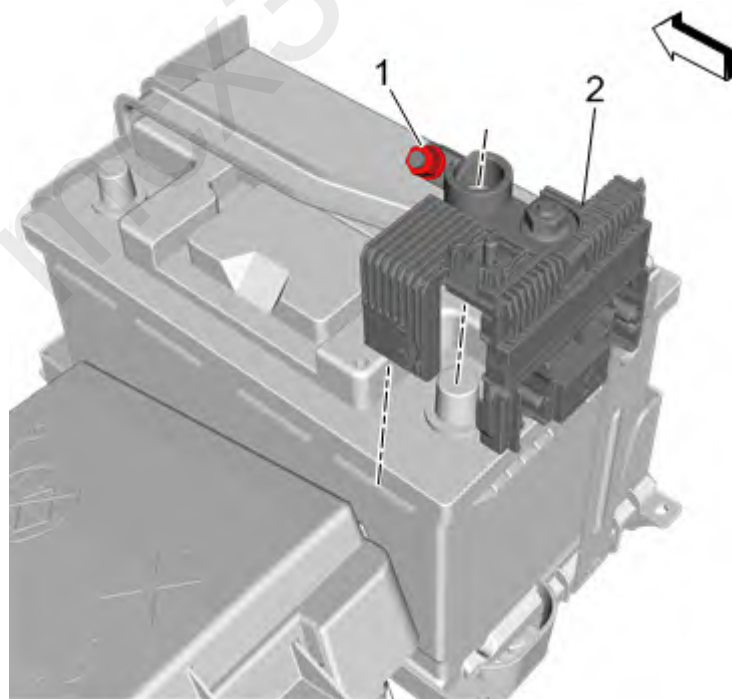
**Fig. 67: Battery Positive Cable Junction Block Cover**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove Battery Positive Cable Junction Block Cover (1)



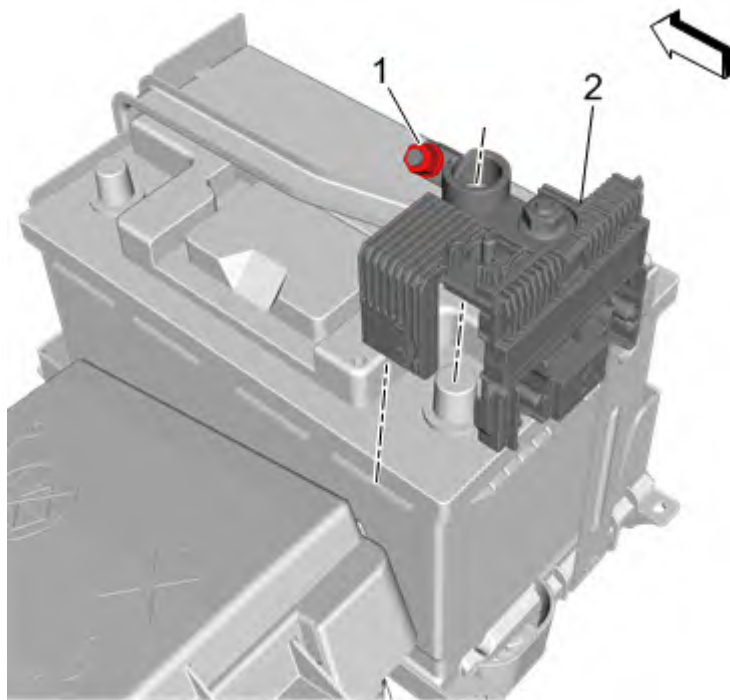
**Fig. 68: Body Harness, Battery Positive Cables, Nuts And Electrical Connectors**  
 Courtesy of GENERAL MOTORS COMPANY

3. Loosen Body Harness Terminal Nut (4)
4. Remove Body Harness (3)
5. Remove Battery Positive Cable Nut (1)
6. Remove Battery Positive Cable (2)
7. Remove Battery Positive Cable Nut (6)
8. Remove Battery Positive Cable (5)
9. Disconnect Electrical Connectors (7) (Qty: 2)



**Fig. 69: Battery Positive Cable Junction Block And Positive Post Clamp Nut**  
 Courtesy of GENERAL MOTORS COMPANY

10. Loosen Battery Positive Post Clamp Nut (1)
11. Remove Battery Positive Cable Junction Block (2)

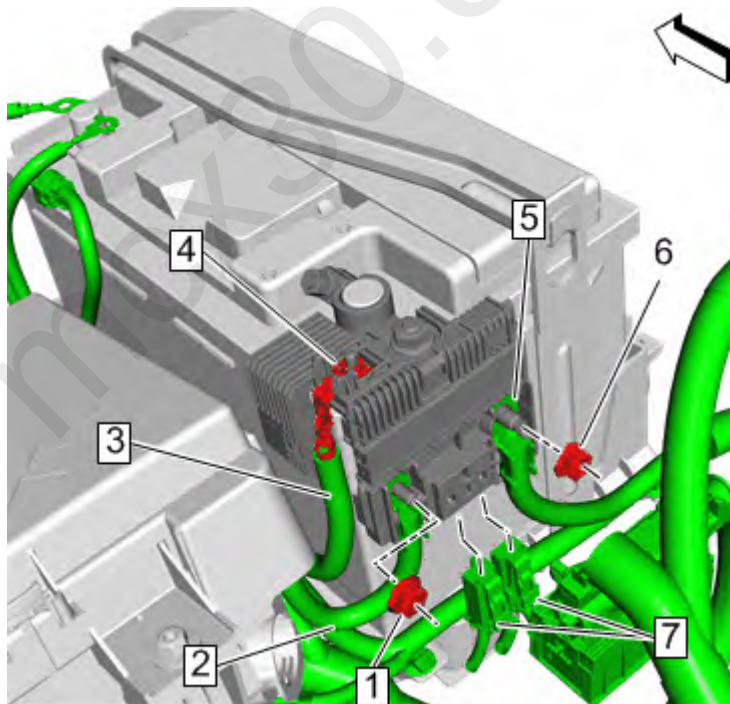


**Fig. 70: Battery Positive Cable Junction Block And Positive Post Clamp Nut**  
 Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Positive Cable Junction Block (2)

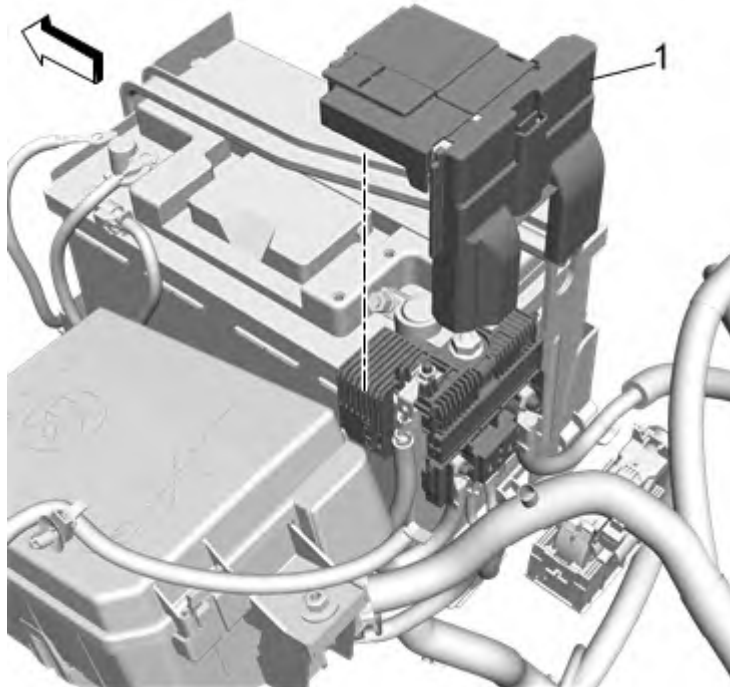
**CAUTION:** Refer to [Fastener Caution](#)

2. Tighten Battery Positive Post Clamp Nut (1) to 4.5 N.m (40 lb in)



**Fig. 71: Body Harness, Battery Positive Cables, Nuts And Electrical Connectors**  
 Courtesy of GENERAL MOTORS COMPANY

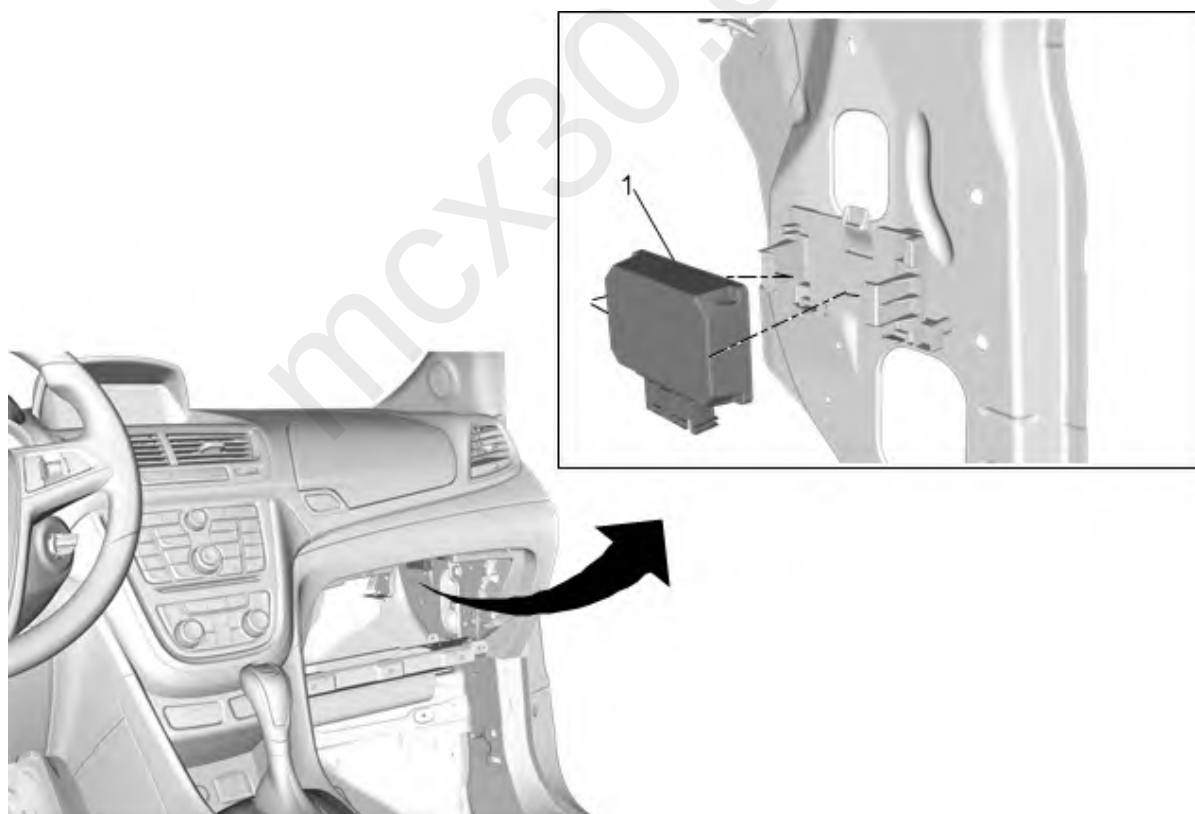
3. Install Body Harness (3)
4. Tighten Body Harness Terminal Nut (4) to 6 N.m (53 lb in)
5. Install Battery Positive Cable (2)
6. Install and tighten Battery Positive Cable Nut (1) to 9 N.m (80 lb in)
7. Install Battery Positive Cable (5)
8. Install and tighten Battery Positive Cable Nut (6) to 12 N.m (106 lb in)
9. Connect Electrical Connectors (7) (Qty: 2)



**Fig. 72: Battery Positive Cable Junction Block Cover**  
 Courtesy of GENERAL MOTORS COMPANY

10. Install Battery Positive Cable Junction Block Cover (1)
11. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#)

## **MULTIFUNCTION POWER SUPPLY CONVERTER REPLACEMENT**

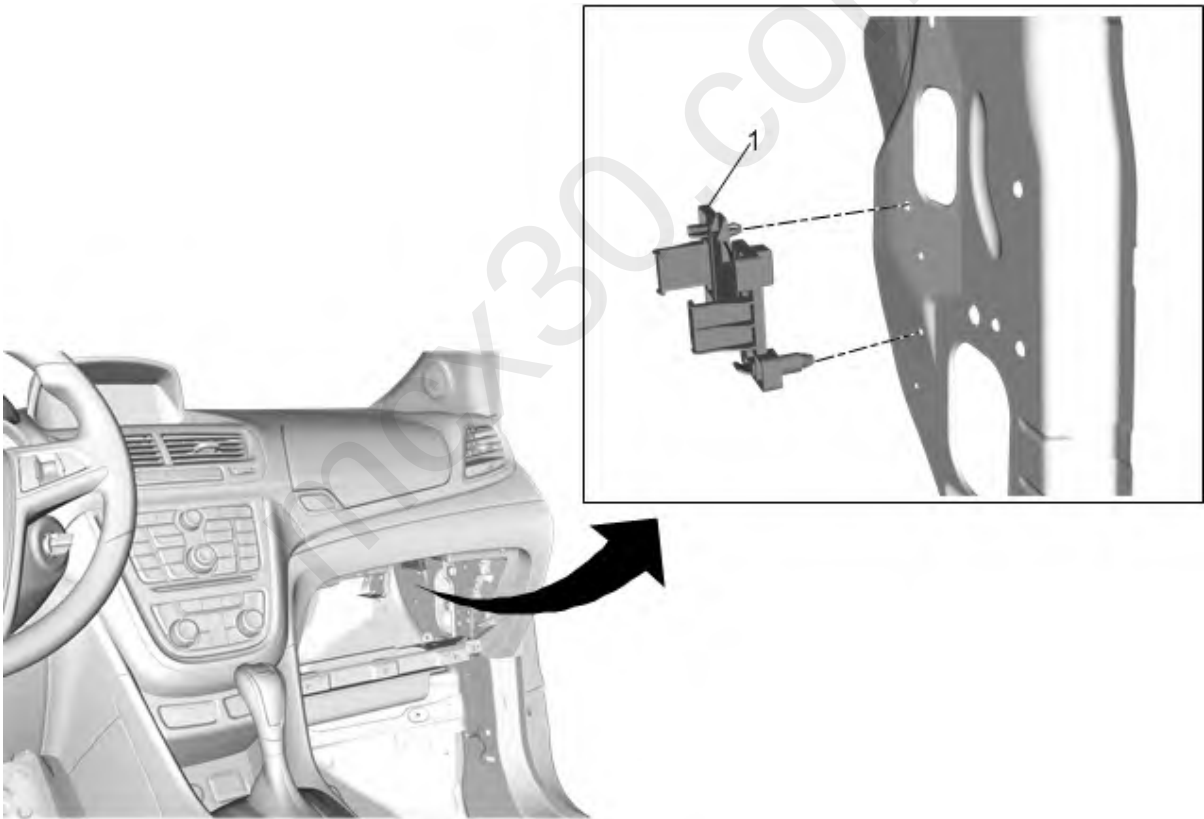


**Fig. 73: Multifunction Power Supply Converter**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name |
|---------|----------------|
|         |                |

| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b> <ol style="list-style-type: none"> <li>1. Disconnect the battery negative cable. Refer to <a href="#">Battery Negative Cable Disconnection and Connection (without KL9)</a><a href="#">Battery Negative Cable Disconnection and Connection (with KL9)</a>.</li> <li>2. Remove Communication Interface Module. Refer to <a href="#">Communication Interface Module Replacement (Chevrolet)</a> <a href="#">Communication Interface Module Replacement (Buick)</a>.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Multifunction Power Supply Converter<br><br><b>Procedure</b> <ol style="list-style-type: none"> <li>1. Disconnect the electrical connector.</li> <li>2. Disengage tabs to remove from bracket.</li> <li>3. Connect the battery negative cable. Refer to <a href="#">Battery Negative Cable Disconnection and Connection (without KL9)</a><a href="#">Battery Negative Cable Disconnection and Connection (with KL9)</a>.</li> <li>4. Refer to <a href="#">Control Module References</a> for programming and set up information, if required.</li> </ol> |

**MULTIFUNCTION POWER SUPPLY CONVERTER BRACKET REPLACEMENT**

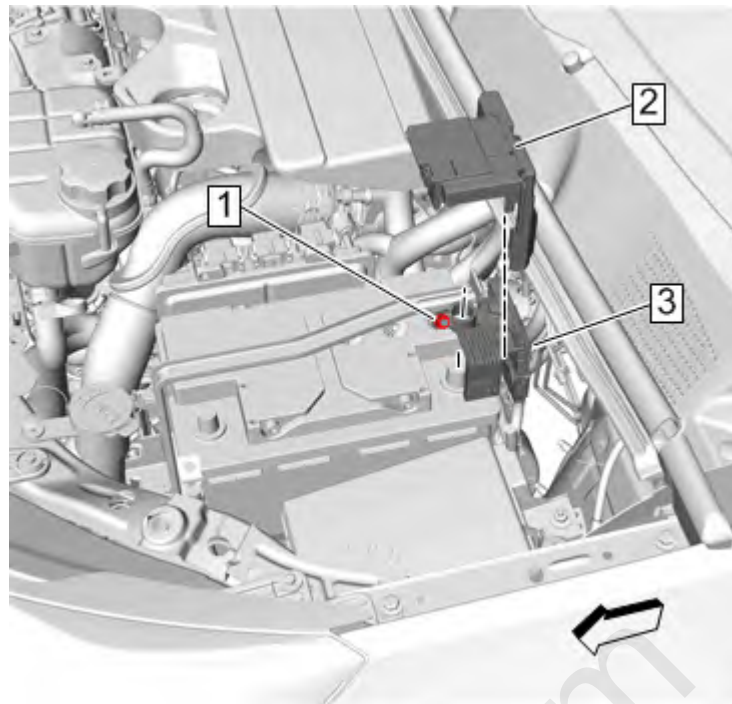


**Fig. 74: Multifunction Power Supply Converter Bracket**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout                                                                                                                                                      | Component Name                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br>Remove the multifunction power supply converter. Refer to <a href="#">Multifunction Power Supply Converter Replacement</a> . |                                                                                                                                  |
| 1                                                                                                                                                            | Multifunction Power Supply Converter Bracket<br><b>Procedure</b><br>Release the bracket from the hinge pillar inner lower panel. |

**BATTERY REPLACEMENT**

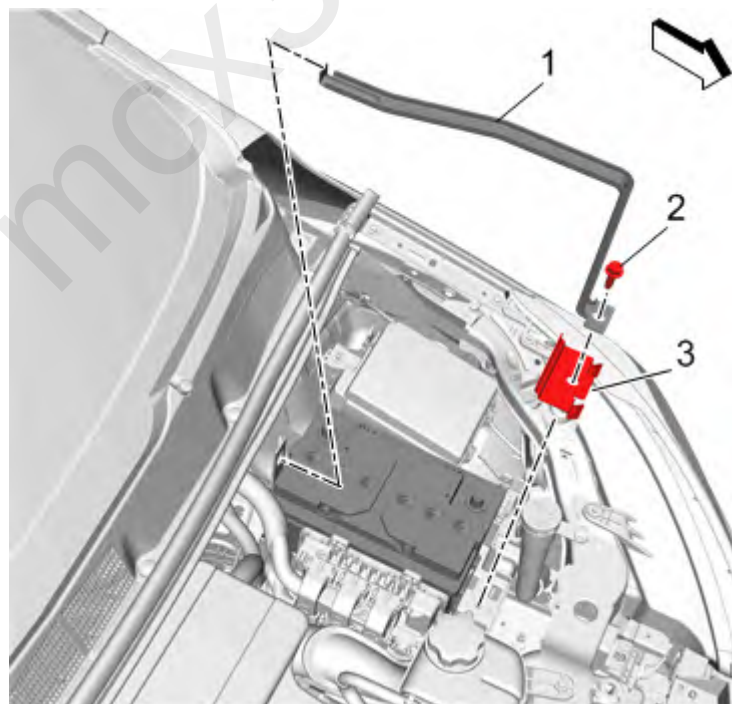
1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#)



**Fig. 75: Battery Distribution Engine Compartment Fuse Block, Cover And Battery Positive Post Clamp Nut**

Courtesy of GENERAL MOTORS COMPANY

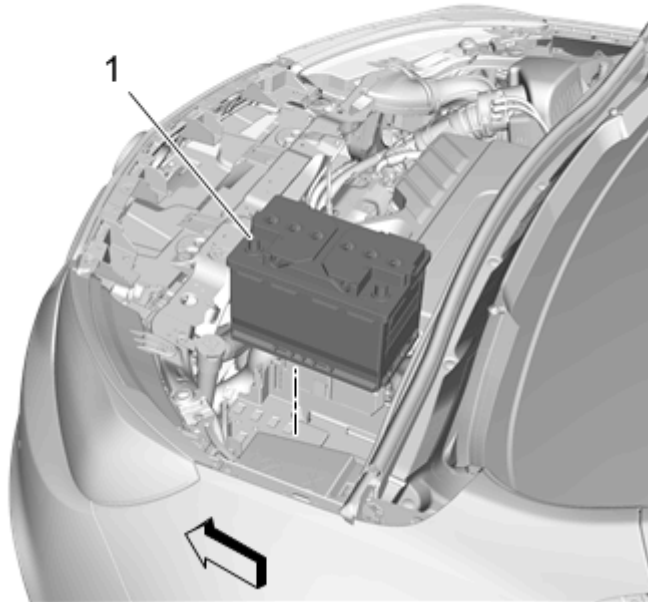
2. Remove Battery Distribution Engine Compartment Fuse Block Cover (2)
3. Loosen Battery Positive Post Clamp Nut (1)
4. Reposition away Battery Distribution Engine Compartment Fuse Block (3)



**Fig. 76: Battery Hold Down Retainers And Bolt**

Courtesy of GENERAL MOTORS COMPANY

5. Remove Battery Hold Down Retainer Bolt (2)
6. Remove Battery Hold Down Retainer (1)
7. Remove Battery Hold Down Retainer (3)

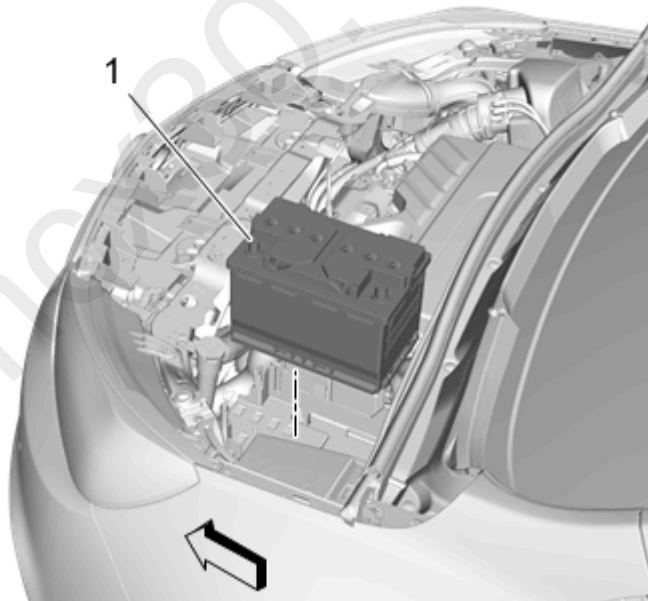


**Fig. 77: Battery.**

Courtesy of GENERAL MOTORS COMPANY

8. Remove Battery (1)

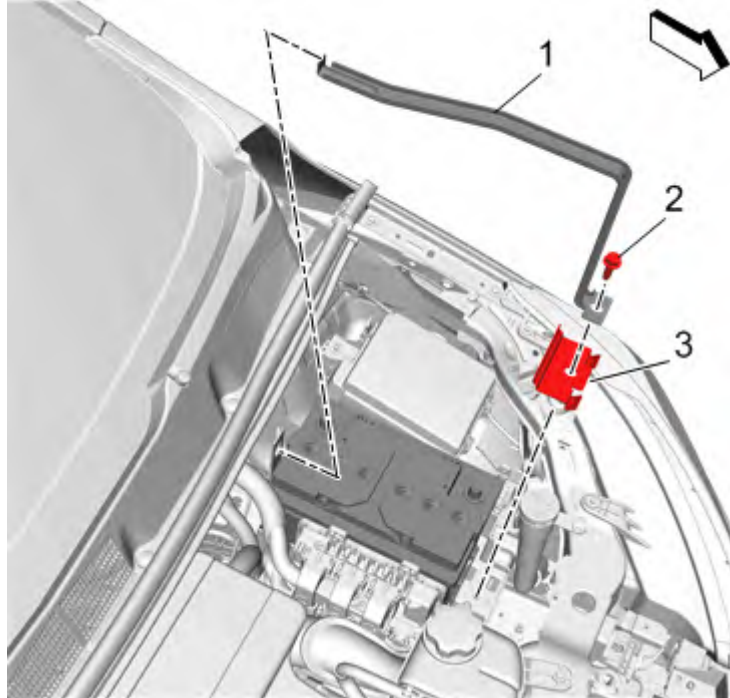
**Installation Procedure**



**Fig. 78: Battery.**

Courtesy of GENERAL MOTORS COMPANY

1. Install Battery (1)

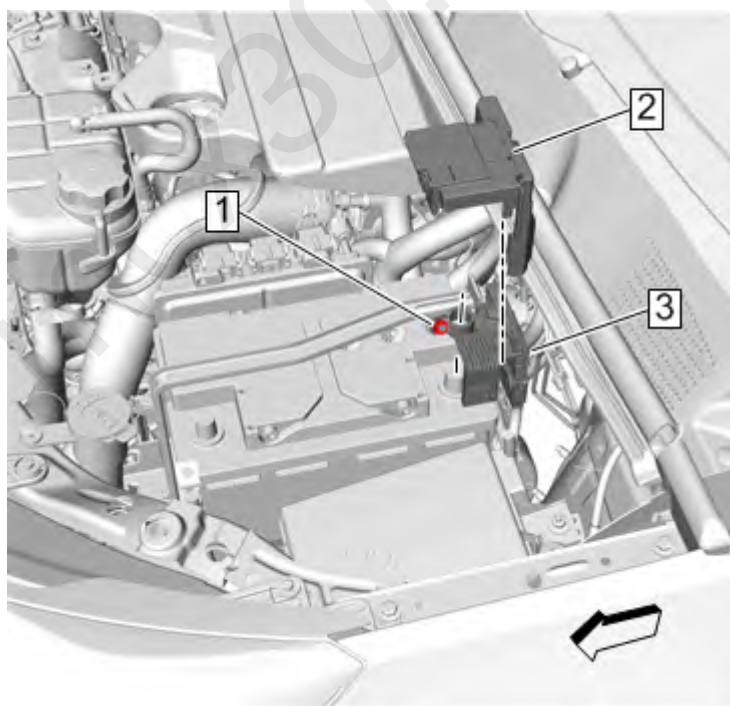


**Fig. 79: Battery Hold Down Retainers And Bolt**  
Courtesy of GENERAL MOTORS COMPANY

2. Install Battery Hold Down Retainer (3)
3. Install Battery Hold Down Retainer (1)

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

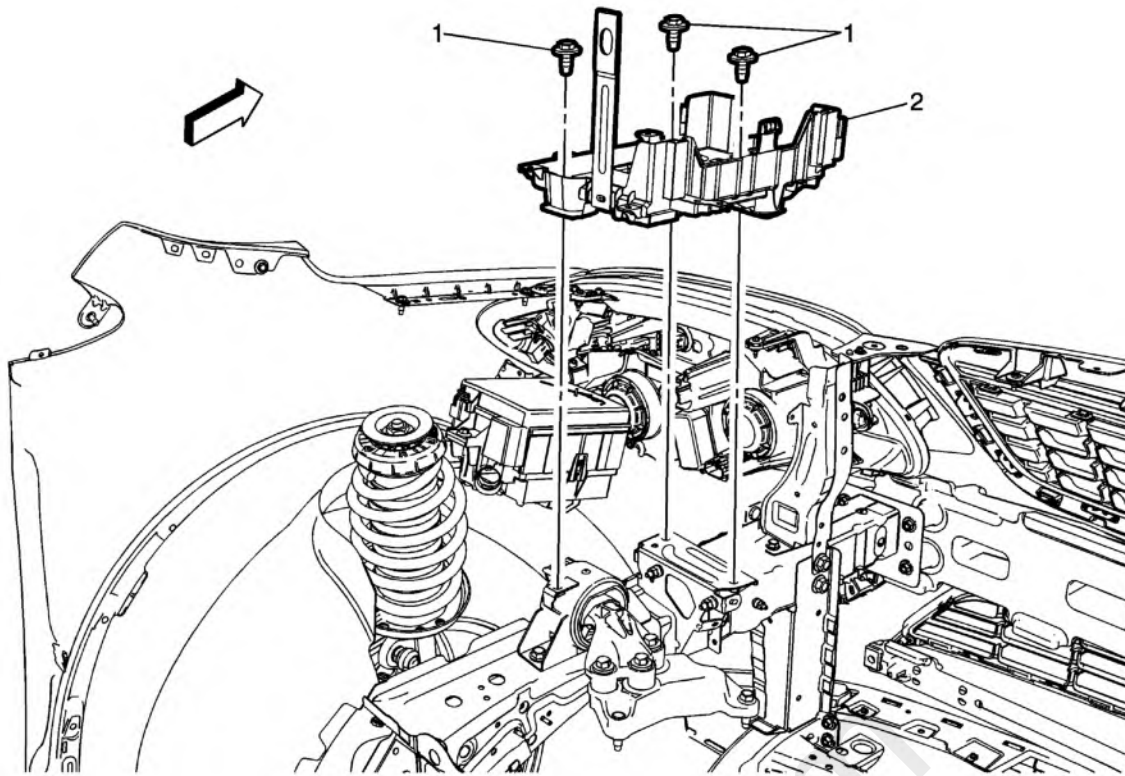
4. Install and tighten Battery Hold Down Retainer Bolt (2) to 22 N.m (16 lb ft)



**Fig. 80: Battery Distribution Engine Compartment Fuse Block, Cover And Battery Positive Post Clamp Nut**  
Courtesy of GENERAL MOTORS COMPANY

5. Install Battery Distribution Engine Compartment Fuse Block (3)
6. Tighten Battery Positive Post Clamp Nut (1) to 4.5 N.m (40 lb in)
7. Install Battery Distribution Engine Compartment Fuse Block Cover (2)
8. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#)

## BATTERY TRAY REPLACEMENT



**Fig. 81: Battery Tray.**

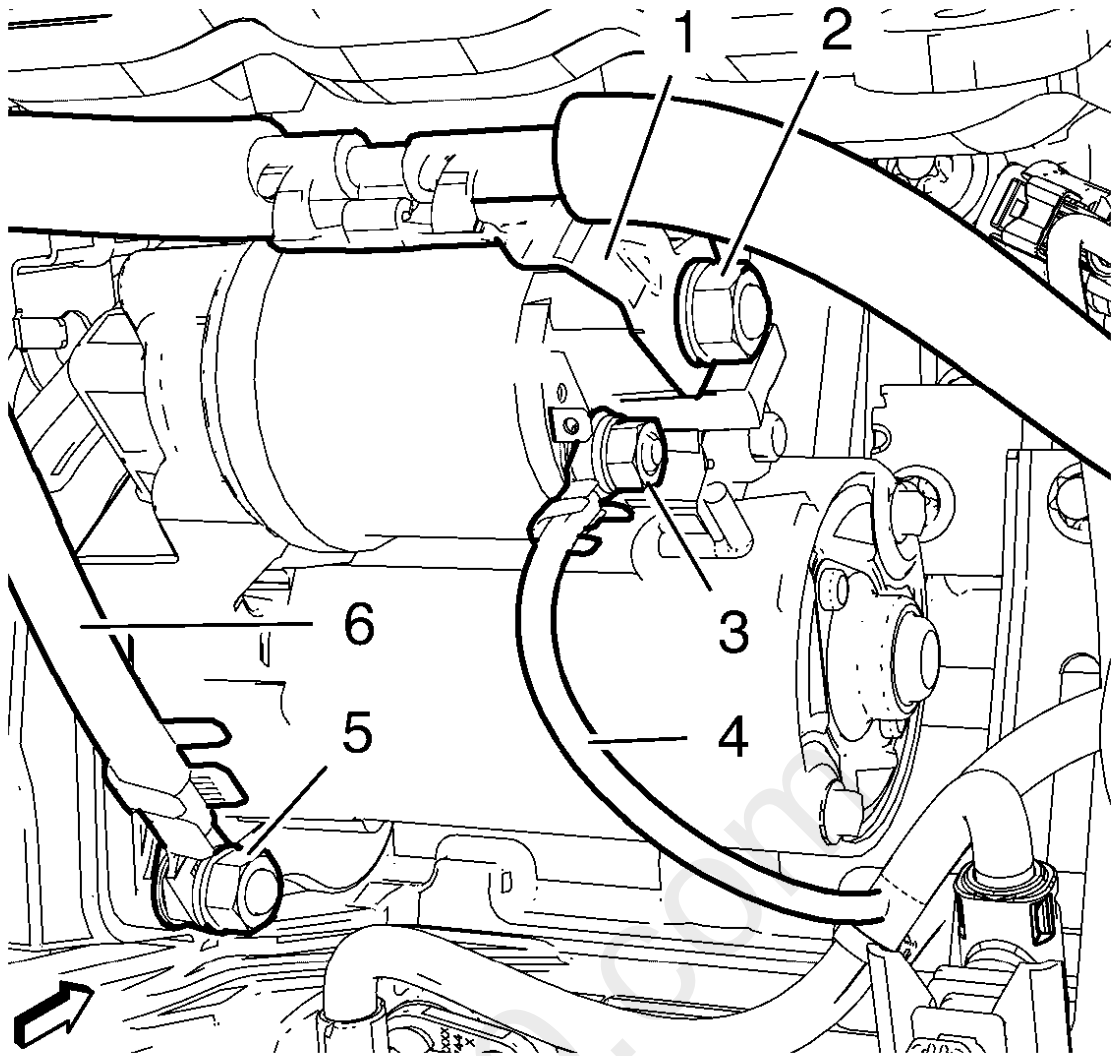
Courtesy of GENERAL MOTORS COMPANY

| Callout                                                                                                                                                                                                                                                                                                                                    | Component Name                                                                                                                                           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br><br>1. Remove the battery. Refer to <a href="#">Battery Replacement</a> .<br>2. Unclip the engine control module bracket and set aside.<br>3. Unclip the battery current sensor, if equipped, from the battery tray and set aside.<br>4. Unclip the wiring harness retainers and reposition the harnesses. |                                                                                                                                                          |
| 1                                                                                                                                                                                                                                                                                                                                          | Battery Tray Fasteners (Qty: 3)<br><br><b>CAUTION:</b><br><b>Refer to <a href="#">Fastener Caution</a> .</b><br><br><b>Tighten</b><br>14 N.m (124 lb in) |
| 2                                                                                                                                                                                                                                                                                                                                          | Battery Tray                                                                                                                                             |

## STARTER REPLACEMENT (LUV)

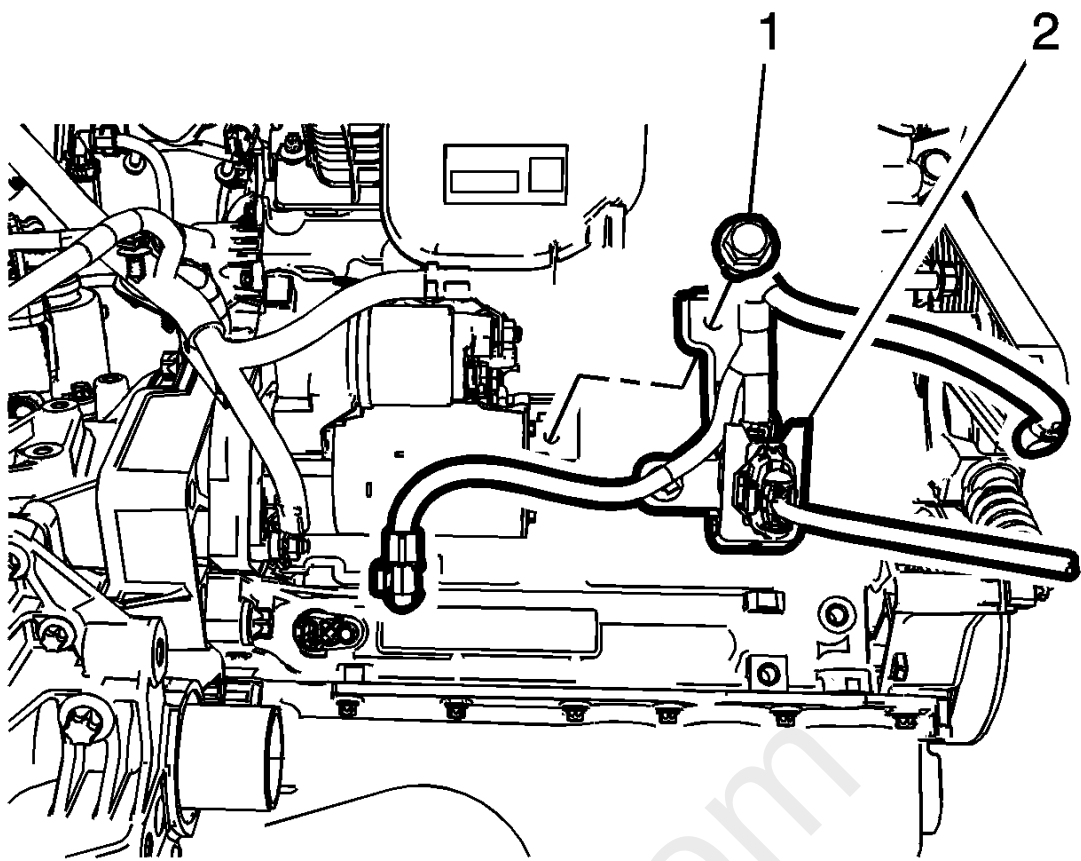
### Removal Procedure

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#).
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
3. Remove the drivetrain and front suspension frame skid transmission protector. Refer to [Drivetrain and Front Suspension Frame Transmission Protector Replacement](#) .
4. If equipped with AWD, remove the transfer case. Refer to [Transfer Case Replacement](#) .



**Fig. 82: Generator Positive Cable, Starter Positive Cable And Ground Cable**  
Courtesy of GENERAL MOTORS COMPANY

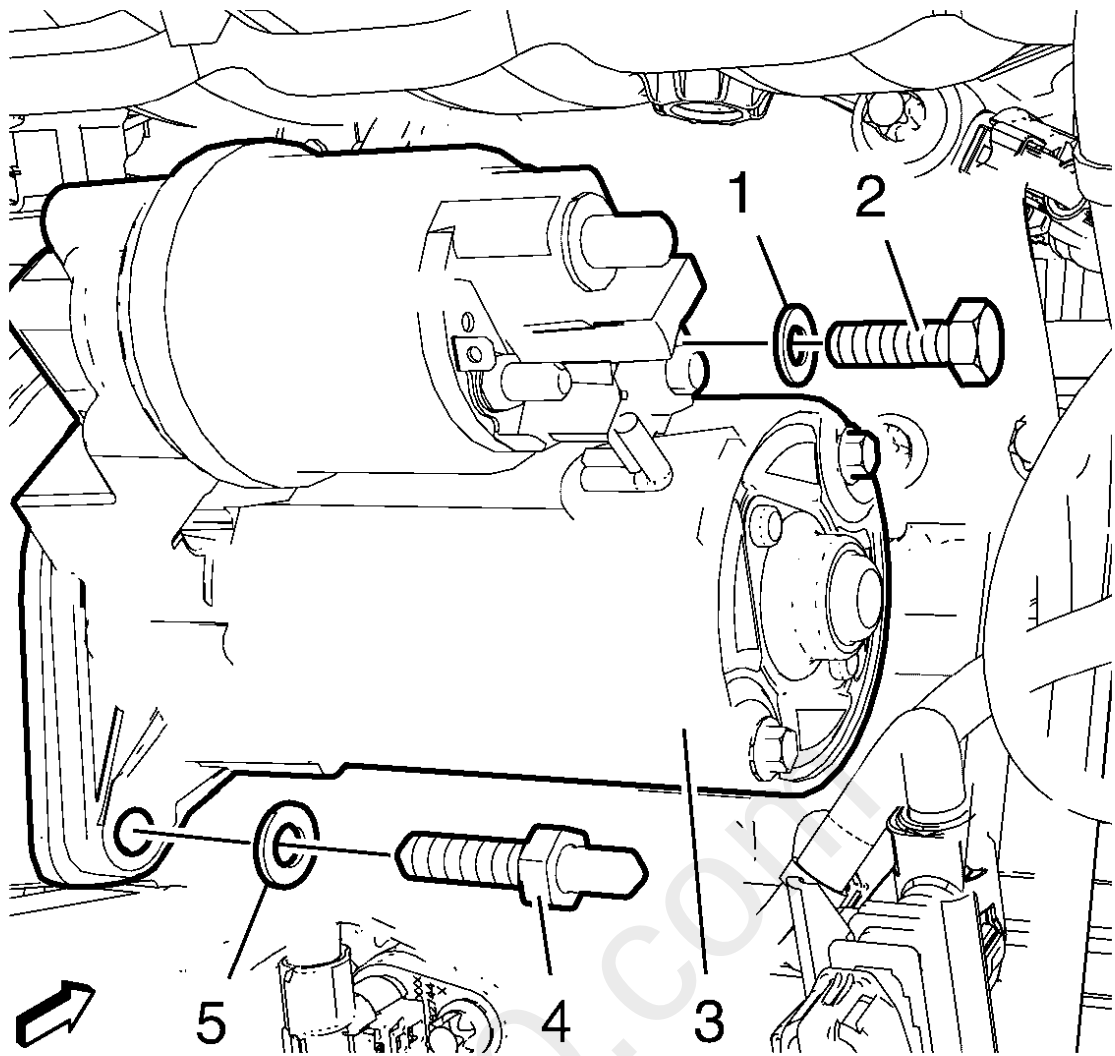
5. Remove the battery positive cable fastener (2) and the battery positive cable (1).
6. Remove the engine harness cable fastener (3) and the engine harness cable (4), from the starter solenoid.
7. Remove the battery negative ground cable fastener (5) and the battery negative cable (6).



**Fig. 83: Heated Oxygen Sensor Bracket And Fastener**

Courtesy of GENERAL MOTORS COMPANY

8. Remove the heated oxygen sensor bracket fastener (1) and set aside the bracket (2).

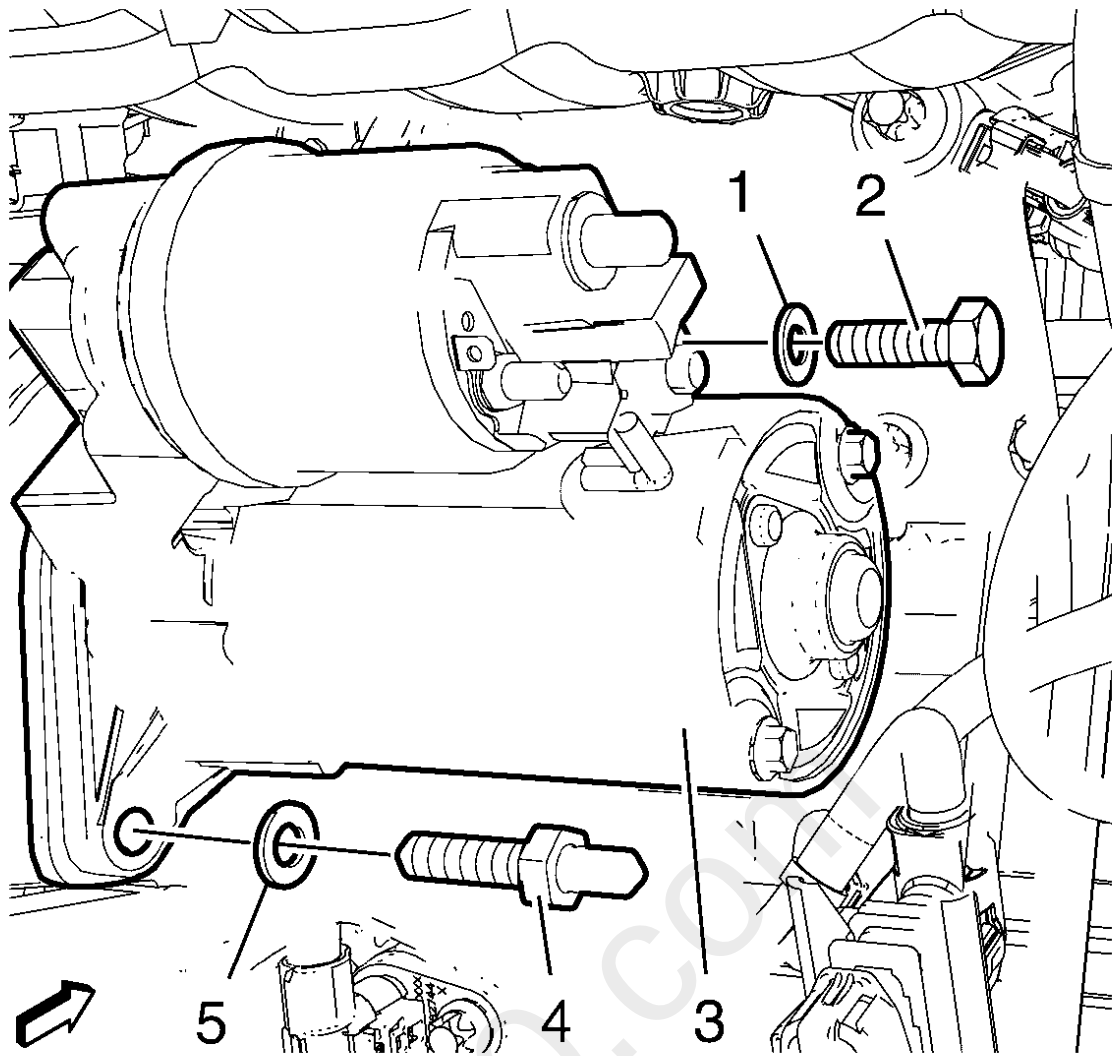


**Fig. 84: Starter And Components**

Courtesy of GENERAL MOTORS COMPANY

9. Remove the upper starter mounting fastener (2) and the washer (1).
10. Remove the starter mounting fastener stud (4) and the washer (5).
11. Remove the starter (3).

#### **Installation Procedure**



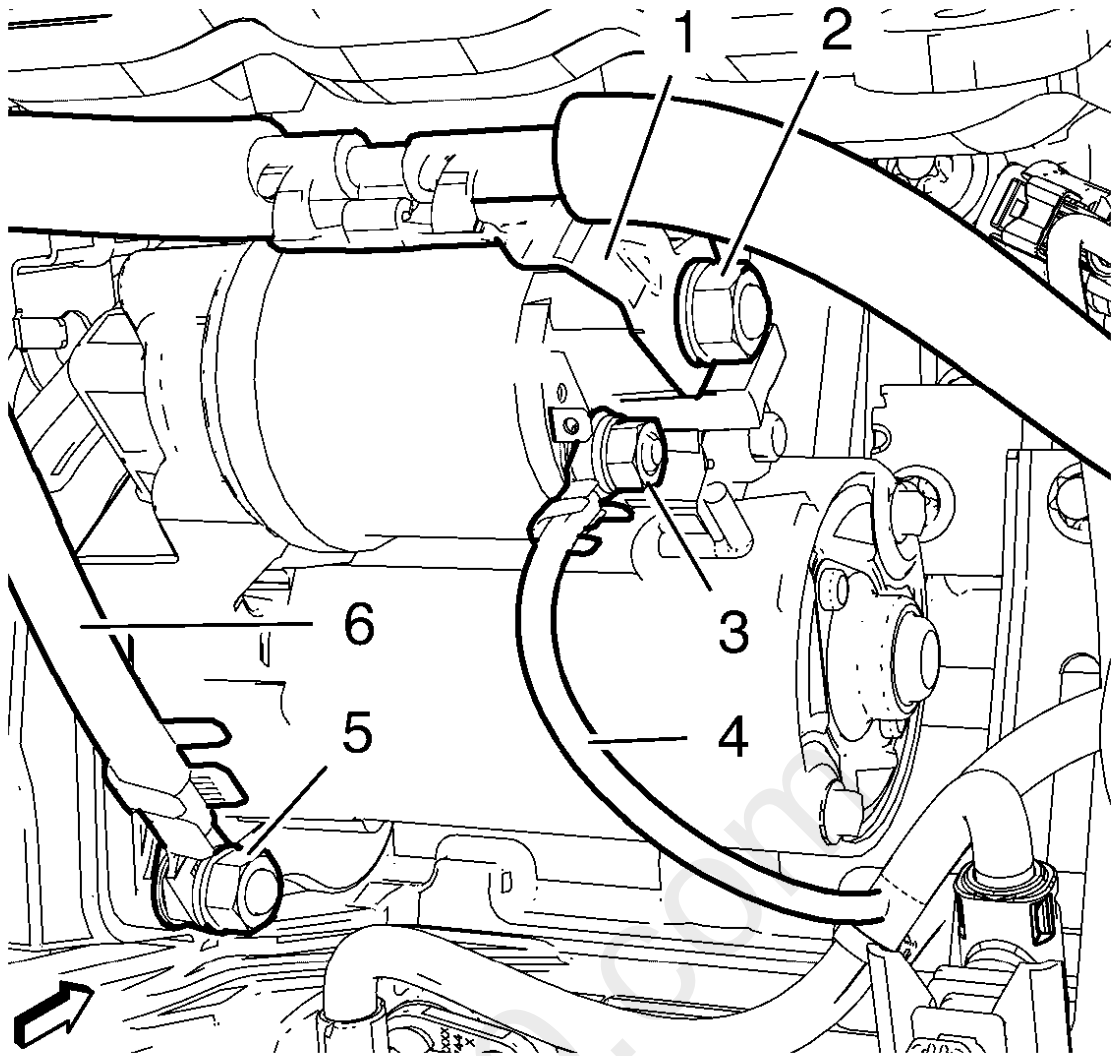
**Fig. 85: Starter And Components**

Courtesy of GENERAL MOTORS COMPANY

1. Install the starter (3).

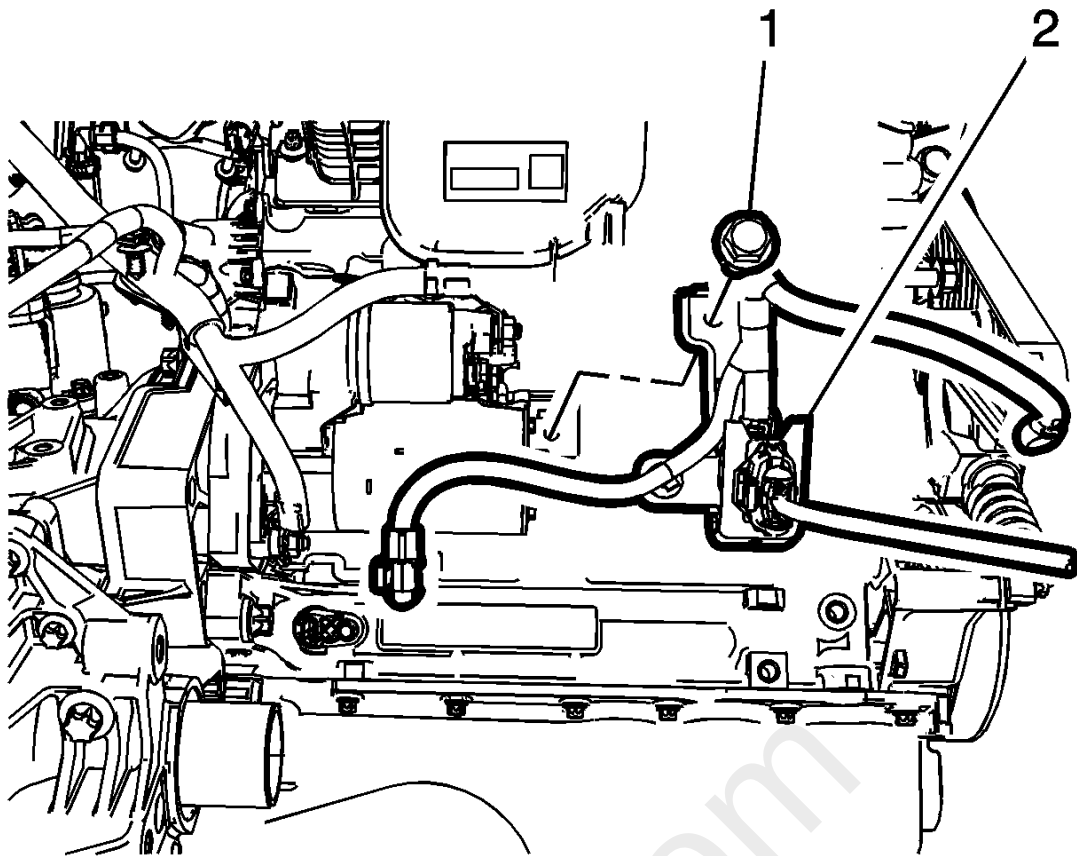
**CAUTION:** Refer to **Fastener Caution** .

2. Install the washer (5) and the starter mounting fastener stud (4). Tighten to 25 N.m (18 lb ft).
3. Install the upper starter mounting fastener (2) and the washer (1). Tighten to 25 N.m (18 lb ft).



**Fig. 86: Generator Positive Cable, Starter Positive Cable And Ground Cable**  
Courtesy of GENERAL MOTORS COMPANY

4. Install the battery negative ground cable (6) and tighten the fastener (5) to 17 N.m (13 lb ft).
5. Install the engine harness cable (4) to starter solenoid and tighten the fastener (3) to 5.5 N.m (49 lb in).
6. Install the battery positive cable (1) and tighten the fastener (2) to 13 N.m (115 lb in).



**Fig. 87: Heated Oxygen Sensor Bracket**

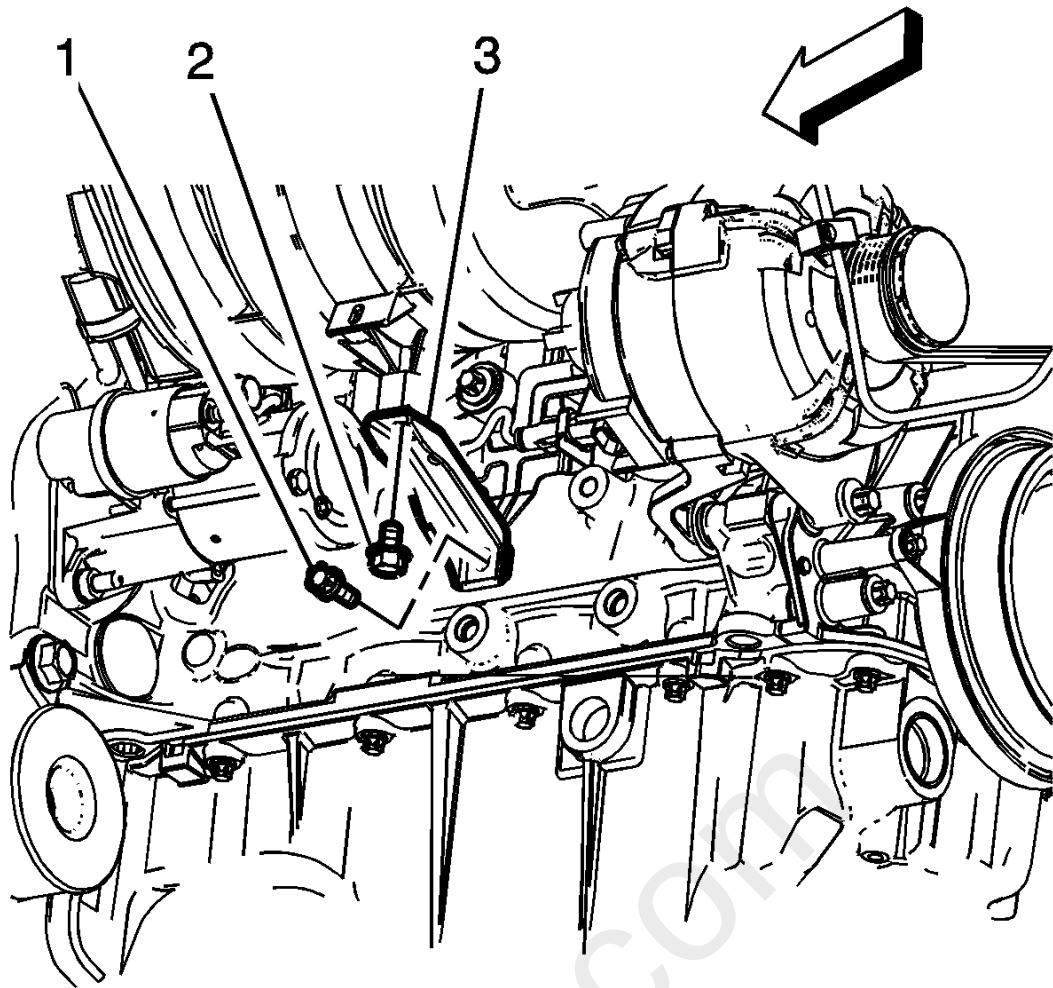
Courtesy of GENERAL MOTORS COMPANY

7. Install the heated oxygen sensor bracket (2) and tighten the fastener (1) to 22 N.m (16 lb ft).
8. If equipped with AWD, install the transfer case. Refer to [Transfer Case Replacement](#).
9. Install the drivetrain and front suspension frame transmission protector. Refer to [Drivetrain and Front Suspension Frame Transmission Protector Replacement](#).
10. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).

## **STARTER REPLACEMENT (2H0)**

### **Removal Procedure**

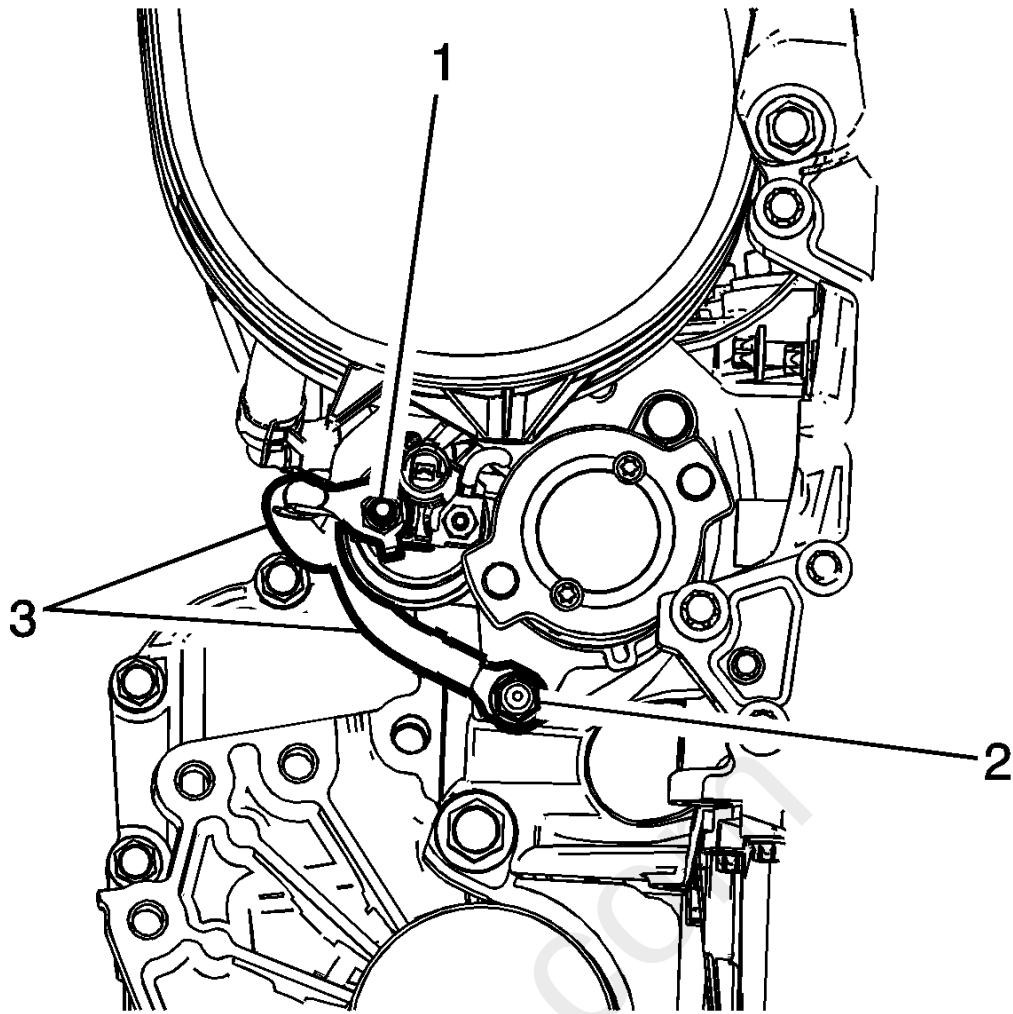
1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
3. If equipped, remove the drivetrain and front suspension frame transmission protector. Refer to [Drivetrain and Front Suspension Frame Transmission Protector Replacement](#).
4. If equipped, remove the front compartment front center insulator. Refer to [Front Compartment Front Center Insulator Replacement](#).
5. If equipped with AWD, remove the generator. Refer to [Generator Replacement \(2H0\)](#).



**Fig. 88: Intake Manifold Support And Bolts**

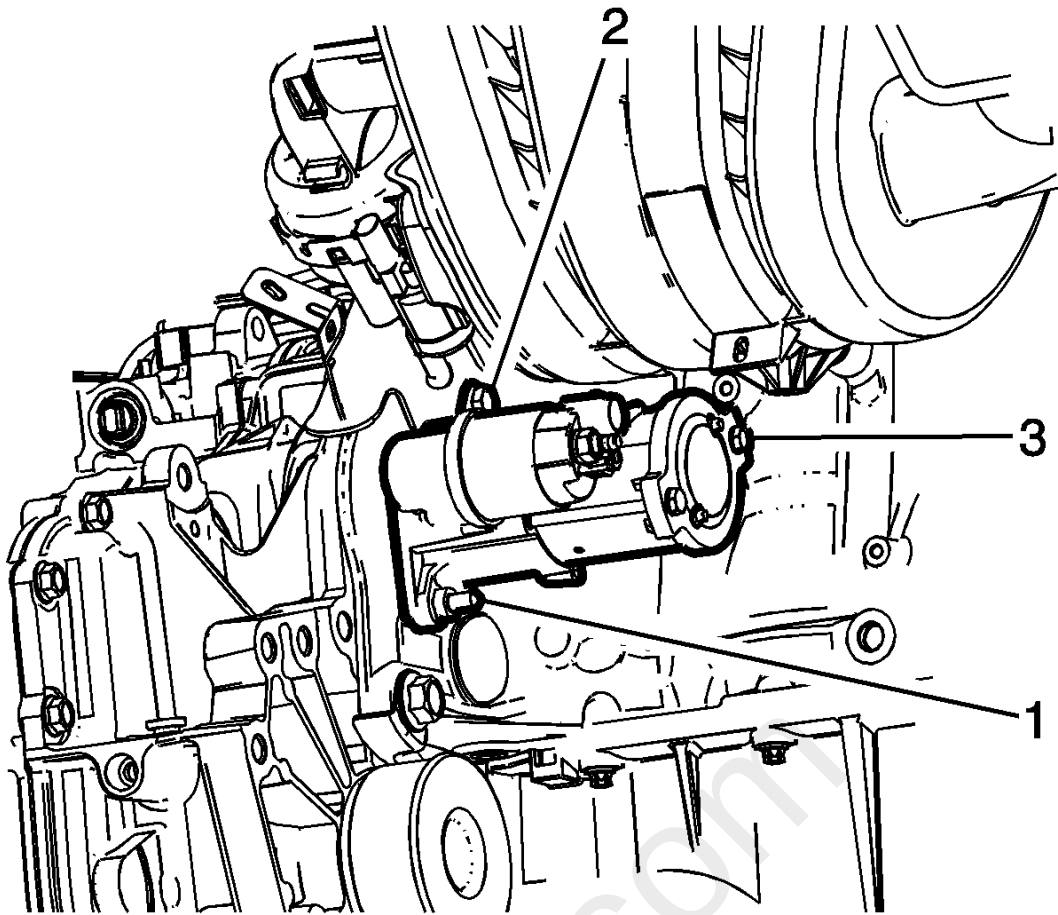
Courtesy of GENERAL MOTORS COMPANY

6. Remove the 2 intake manifold support bolts (1, 2).
7. Remove the intake manifold support (3).



**Fig. 89: Starter Solenoid, Cables And Nuts**  
Courtesy of GENERAL MOTORS COMPANY

8. Remove the starter solenoid battery positive nut (1) and the battery negative cable nut (2).
9. Remove the battery positive and negative cable (3) from the starter.

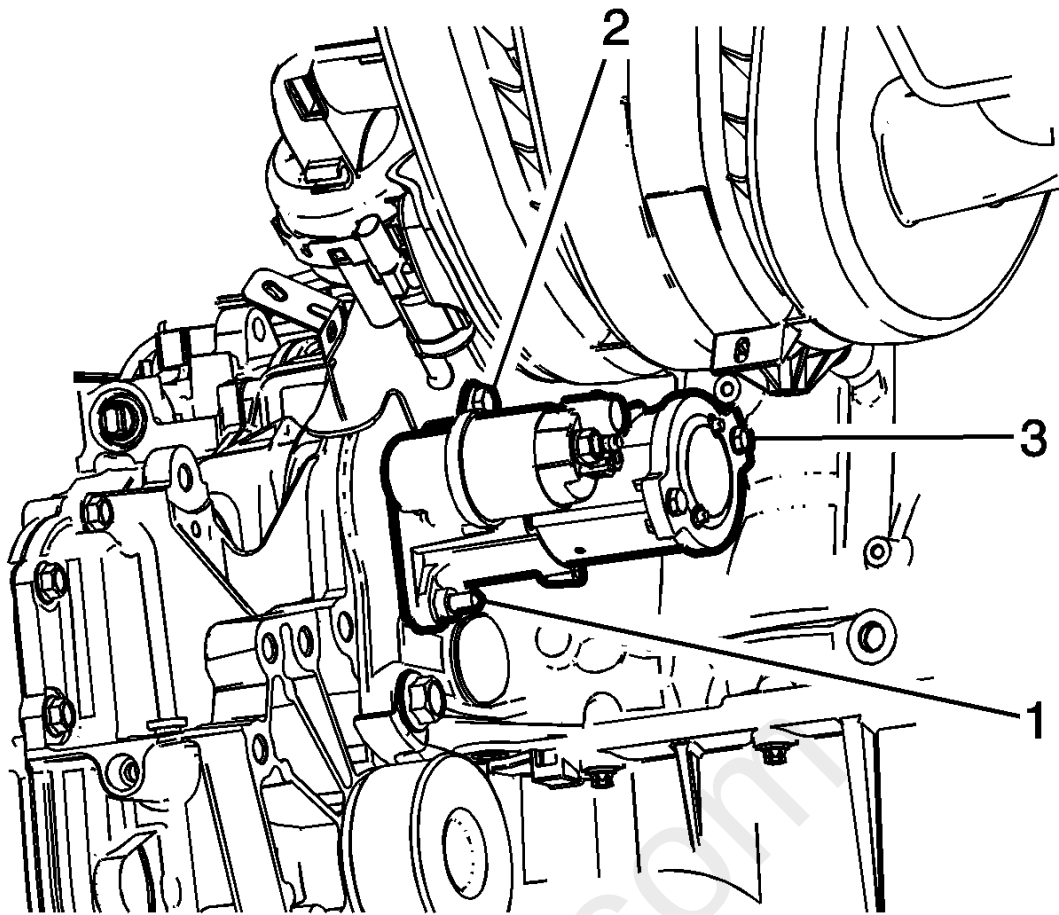


**Fig. 90: Starter, Mounting Stud And Bolt**  
Courtesy of GENERAL MOTORS COMPANY

**NOTE:** The starter mounting bolt can be accessed from between the intake manifold and the starter, with the generator removed.

10. Remove the starter mounting stud (1) and the starter mounting bolt (2).
11. Remove the starter (3) from the vehicle.
12. Disconnect and reposition the electrical connectors as necessary.
13. Transfer parts as necessary.

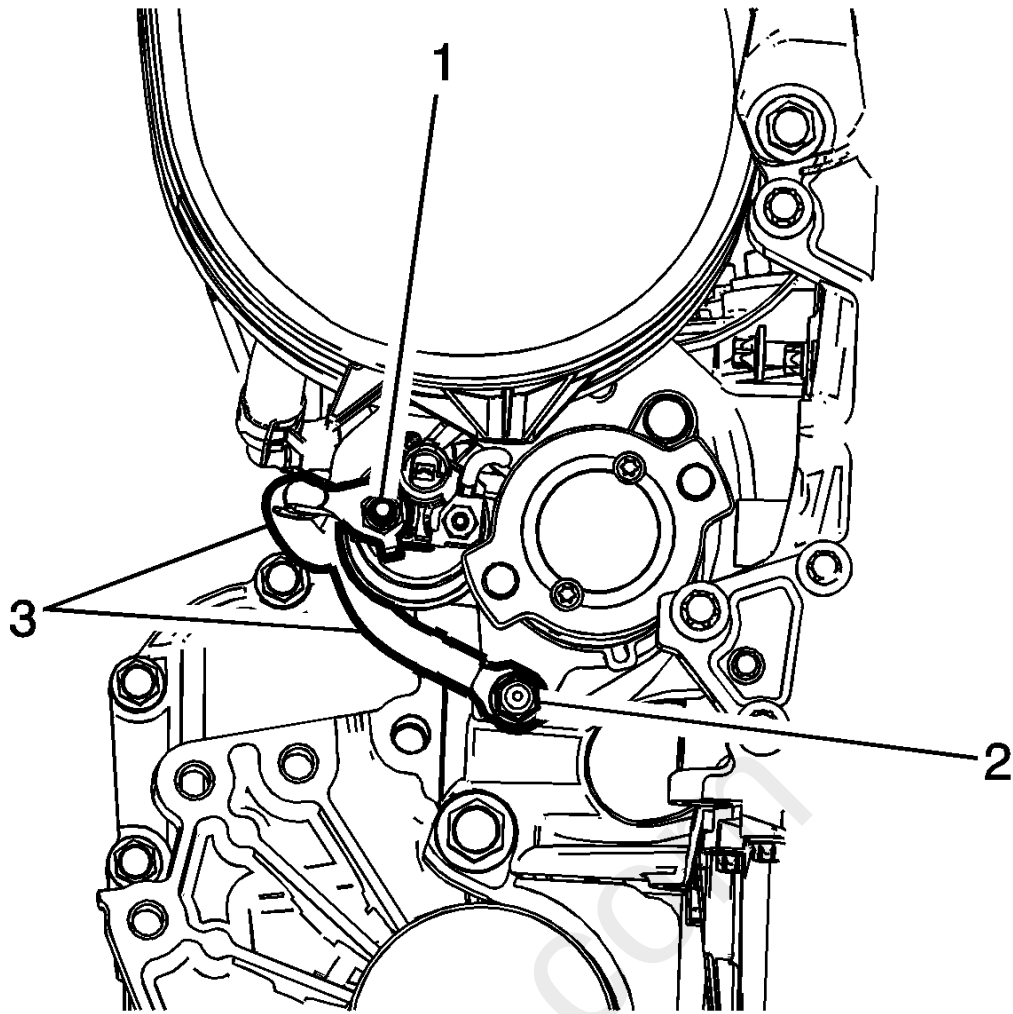
#### **Installation Procedure**



**Fig. 91: Starter, Mounting Stud And Bolt**  
Courtesy of GENERAL MOTORS COMPANY

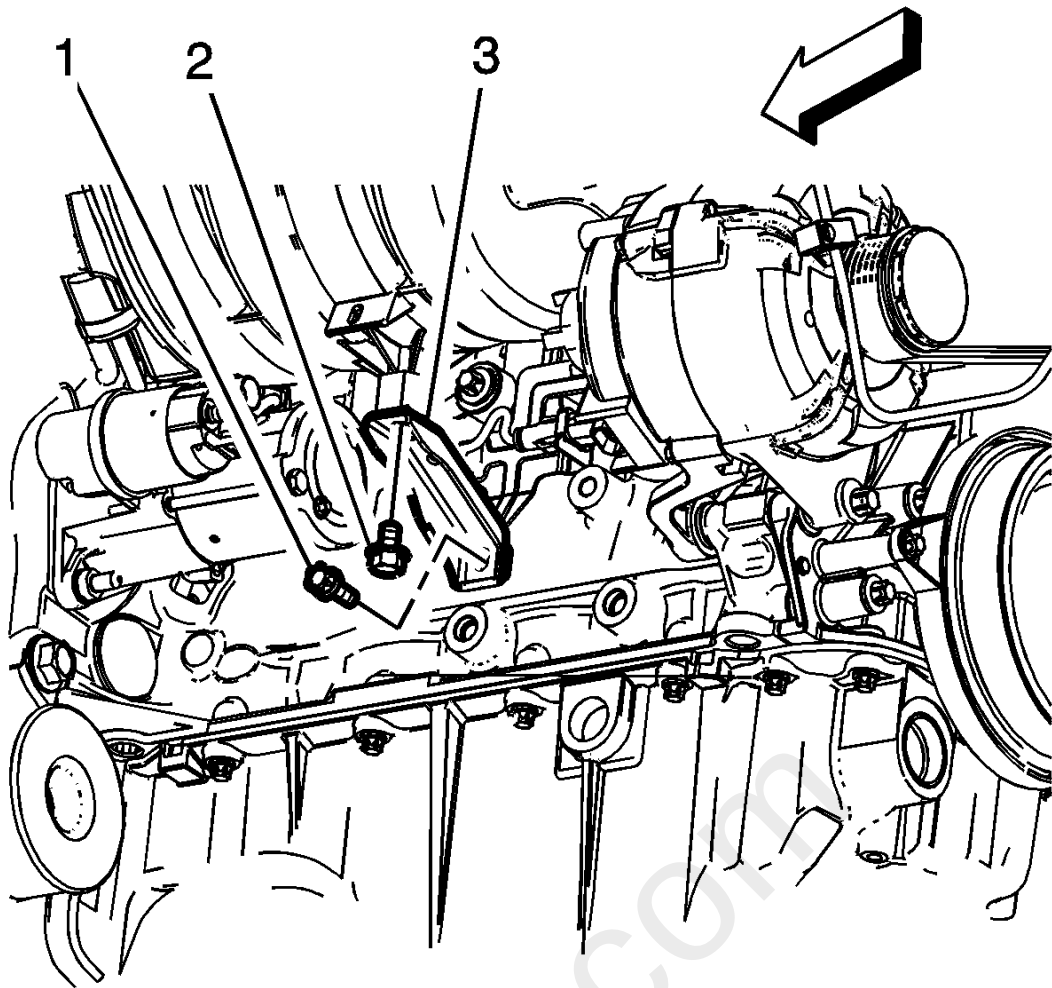
**CAUTION:** Refer to [Fastener Caution](#) .

1. Install the starter (3) into position and tighten the starter mounting bolt (2) and the starter mounting stud (1) to 25 N.m (18 lb ft).



**Fig. 92: Starter Solenoid, Cables And Nuts**  
Courtesy of GENERAL MOTORS COMPANY

2. Install the battery positive and negative cable (3), to the starter.
3. Install the battery positive cable terminal to the starter and tighten the nut (1) to 9 N.m (80 lb in).
4. Install the battery negative cable and tighten the starter nut (2) to 17 N.m (13 lb ft).



**Fig. 93: Intake Manifold Support And Bolts**

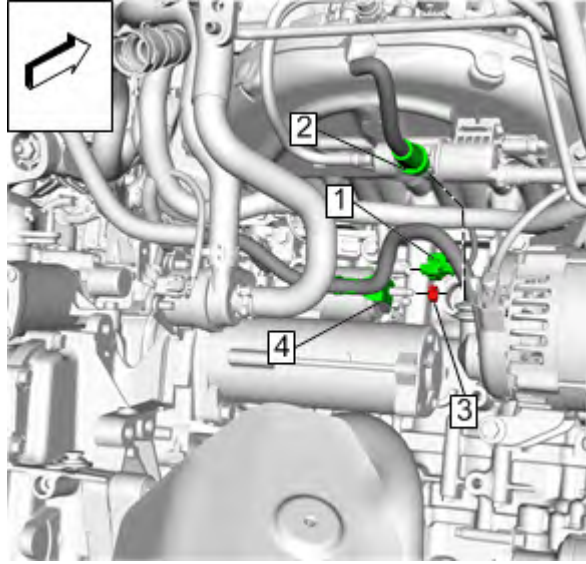
Courtesy of GENERAL MOTORS COMPANY

5. Install the intake manifold support (3) and the 2 intake manifold support bolts (1, 2) and tighten to 8 N.m (71 lb in).
6. If equipped with AWD, install the generator. Refer to [Generator Replacement \(2H0\)](#).
7. If equipped, install the front compartment front center insulator. Refer to [Front Compartment Front Center Insulator Replacement](#).
8. If equipped, install the drive train and front suspension frame transmission protector. Refer to [Drivetrain and Front Suspension Frame Transmission Protector Replacement](#).
9. Lower the vehicle.
10. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).

## **STARTER REPLACEMENT (LE2-FWD)**

### **Removal Procedure**

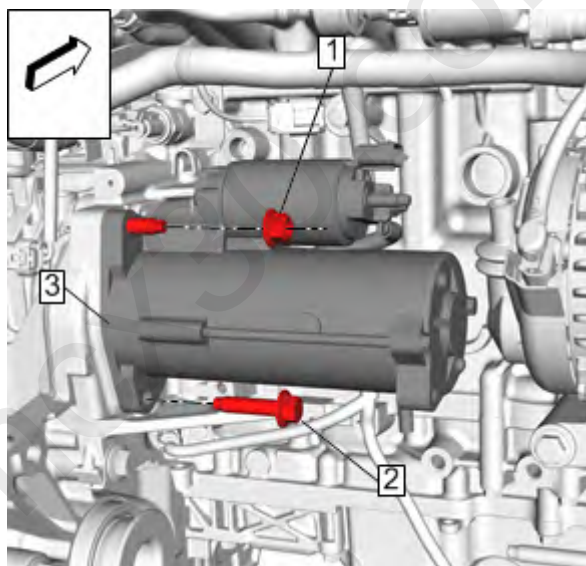
1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. Remove Front Wheel Drive Intermediate Shaft. Refer to [Front Wheel Drive Intermediate Shaft Replacement \(LE2 with MNH\)](#).



**Fig. 94: Engine Coolant Heater Cord, Electrical Connector, Battery Positive Cable And Starter Solenoid Cable Nut**

**Courtesy of GENERAL MOTORS COMPANY**

4. Disconnect the electrical connector (1).
5. {If equipped} Disconnect Engine Coolant Heater Cord (2)
6. Remove Starter Solenoid Cable Nut (3)
7. Remove Battery Positive Cable (4)

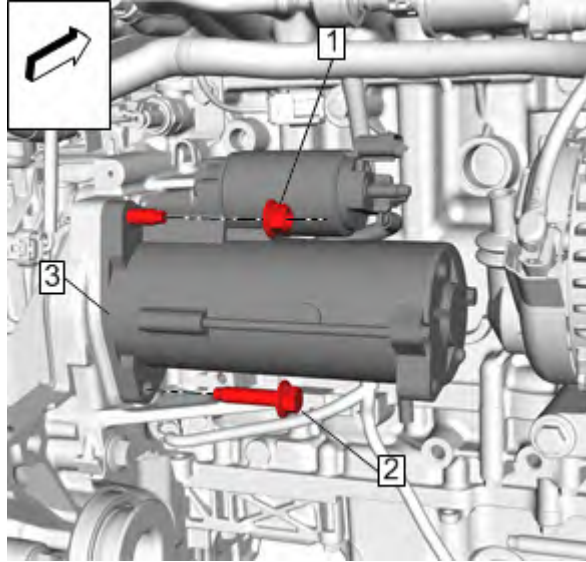


**Fig. 95: Starter And Fasteners**

**Courtesy of GENERAL MOTORS COMPANY**

8. Remove Starter Mounting Nut (1)
9. Remove Starter Mounting Bolt (2)
10. Remove Starter (3)

### **Installation Procedure**



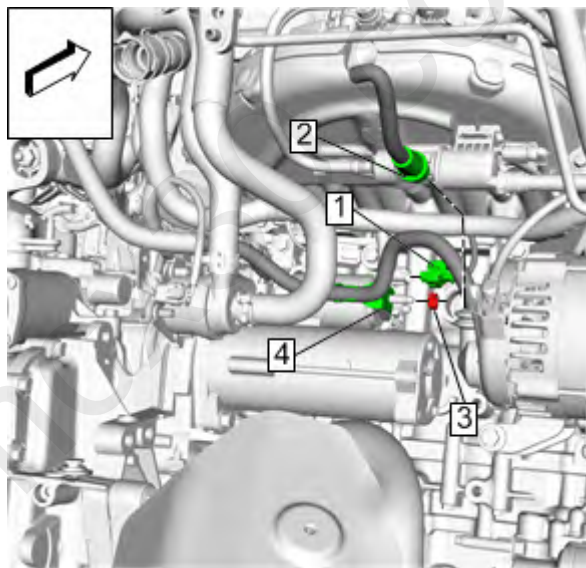
**Fig. 96: Starter And Fasteners**

Courtesy of GENERAL MOTORS COMPANY

1. Install Starter (3)

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

2. Install and tighten Starter Mounting Bolt (2) to 58 N.m (43 lb ft)
3. Install and tighten Starter Mounting Nut (1) to 58 N.m (43 lb ft)



**Fig. 97: Engine Coolant Heater Cord, Electrical Connector, Battery Positive Cable And Starter Solenoid Cable Nut**

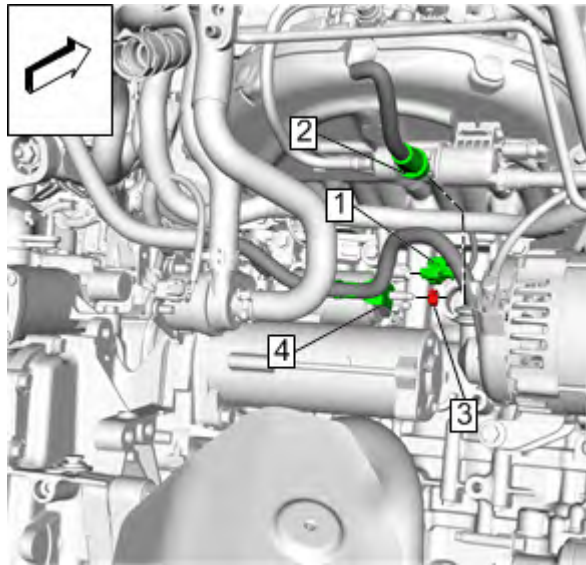
Courtesy of GENERAL MOTORS COMPANY

4. {If equipped} Connect Engine Coolant Heater Cord (2)
5. Install Battery Positive Cable (4)
6. Install and tighten Starter Solenoid Cable Nut (3) to 12.5 N.m (111 lb in)
7. Connect Electrical Connector (1)
8. Install Front Wheel Drive Intermediate Shaft. Refer to [Front Wheel Drive Intermediate Shaft Replacement \(LE2 with MNH\)](#).
9. Lower the vehicle.
10. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).

## **STARTER REPLACEMENT (LE2-AWD)**

### **Removal Procedure**

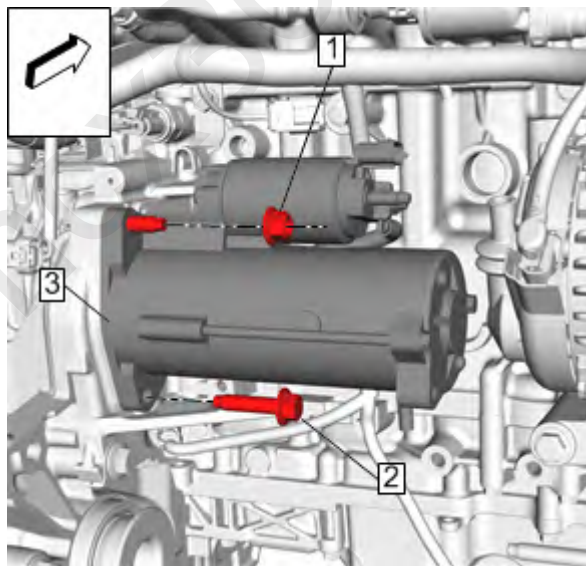
1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#)
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. Remove Transfer Case. Refer to [Transfer Case Replacement](#)



**Fig. 98: Engine Coolant Heater Cord, Electrical Connector, Battery Positive Cable And Starter Solenoid Cable Nut**

**Courtesy of GENERAL MOTORS COMPANY**

4. Disconnect the electrical connector (1).
5. {If equipped} Disconnect Engine Coolant Heater Cord (2)
6. Remove Starter Solenoid Cable Nut (3)
7. Remove Battery Positive Cable (4)

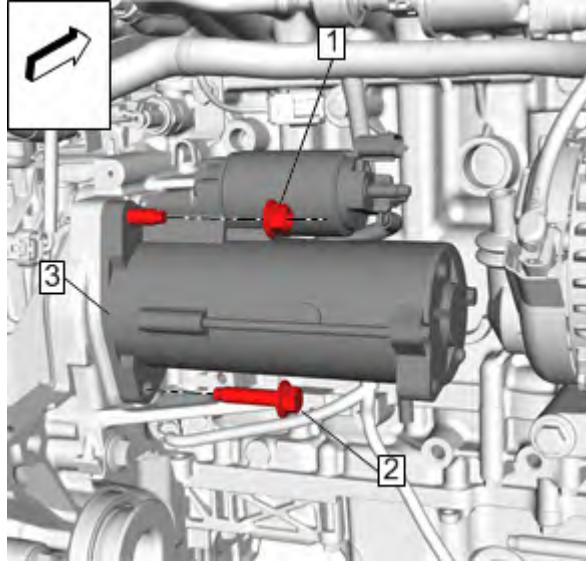


**Fig. 99: Starter And Fasteners**

**Courtesy of GENERAL MOTORS COMPANY**

8. Remove Starter Mounting Nut (1)
9. Remove Starter Mounting Bolt (2)
10. Remove Starter (3)

### **Installation Procedure**

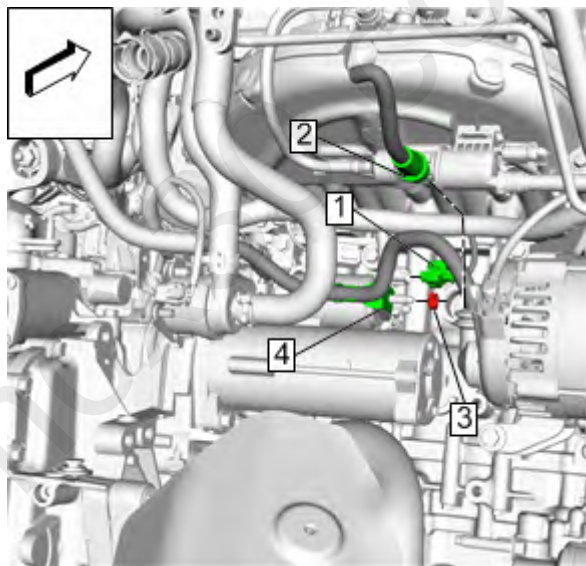


**Fig. 100: Starter And Fasteners**  
 Courtesy of GENERAL MOTORS COMPANY

1. Install Starter (3)

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

2. Install and tighten Starter Mounting Bolt (2) to 58 N.m (43 lb ft)
3. Install and tighten Starter Mounting Nut (1) to 58 N.m (43 lb ft)



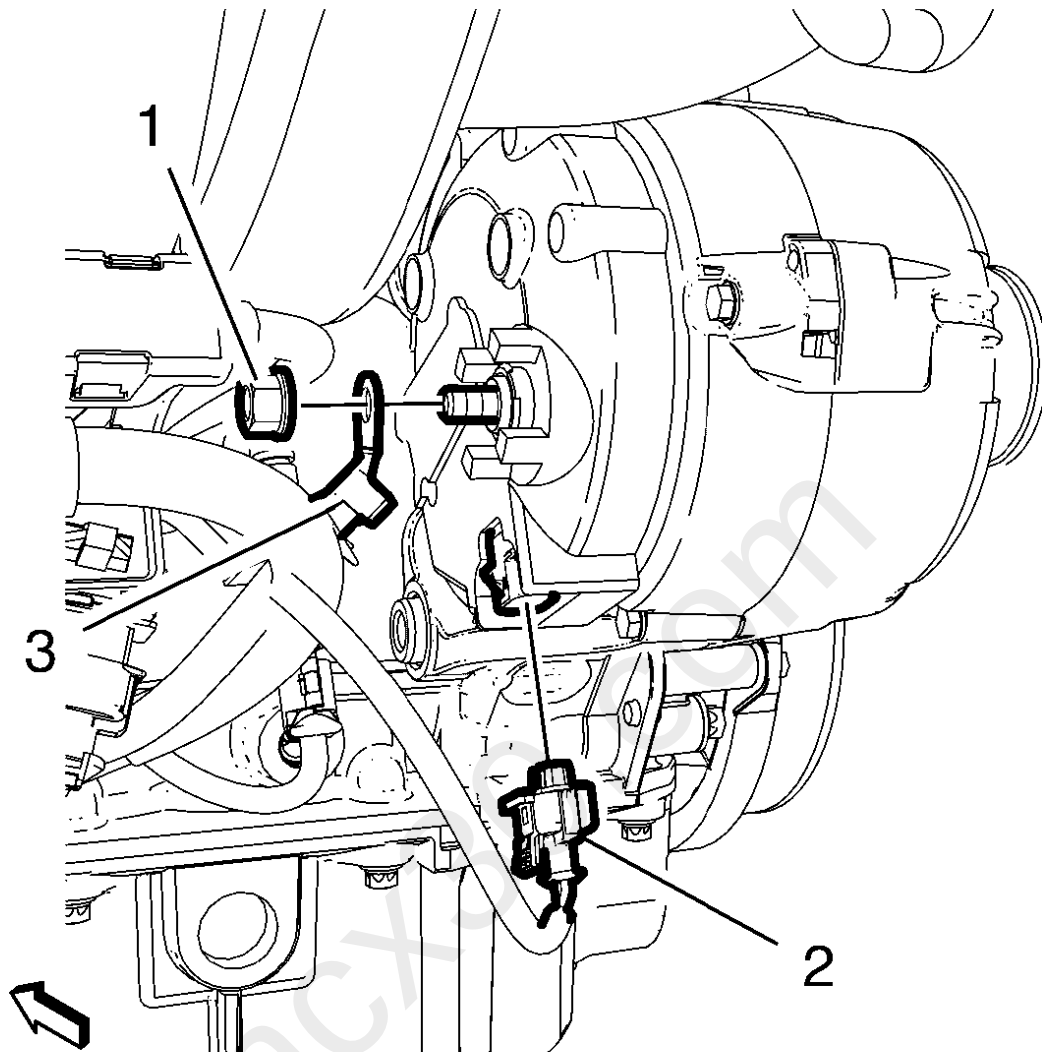
**Fig. 101: Engine Coolant Heater Cord, Electrical Connector, Battery Positive Cable And Starter Solenoid Cable Nut**  
 Courtesy of GENERAL MOTORS COMPANY

4. {If equipped} Connect Engine Coolant Heater Cord (2)
5. Install Battery Positive Cable (4)
6. Install and tighten Starter Solenoid Cable Nut (3) to 12.5 N.m (111 lb in)
7. Connect Electrical Connector (1)
8. Install Transfer Case. Refer to [Transfer Case Replacement](#)
9. Lower the vehicle.
10. Connect the negative battery cable. [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#)

## **GENERATOR REPLACEMENT (2H0)**

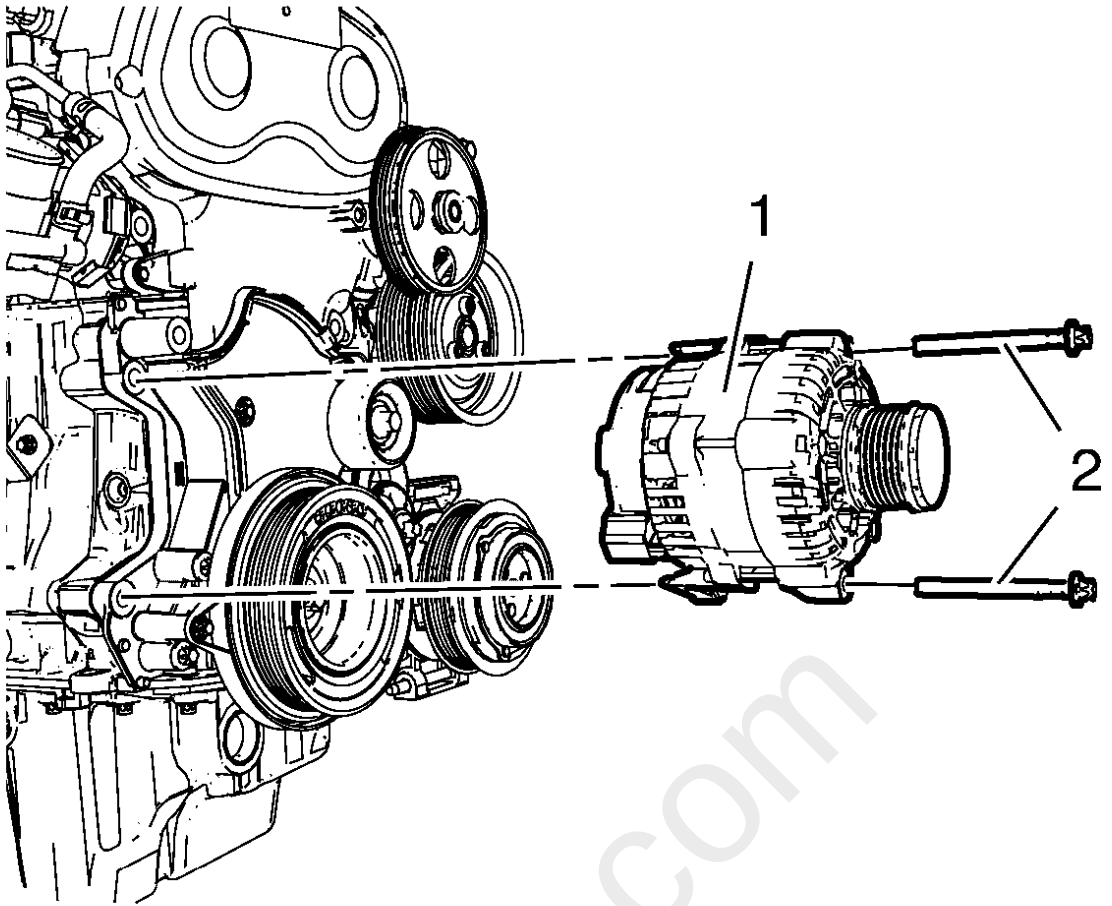
### **Removal Procedure**

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).
2. Remove the drive belt. Refer to [Drive Belt Replacement](#).
3. Remove the right front wheel drive shaft. Refer to [Front Wheel Drive Shaft Replacement - Right Side](#).



**Fig. 102: Generator Positive Cable Nut And Nut**  
Courtesy of GENERAL MOTORS COMPANY

4. Remove the generator positive cable fastener (1) and the generator positive cable (3).
5. Disconnect the generator wiring harness connector (2).

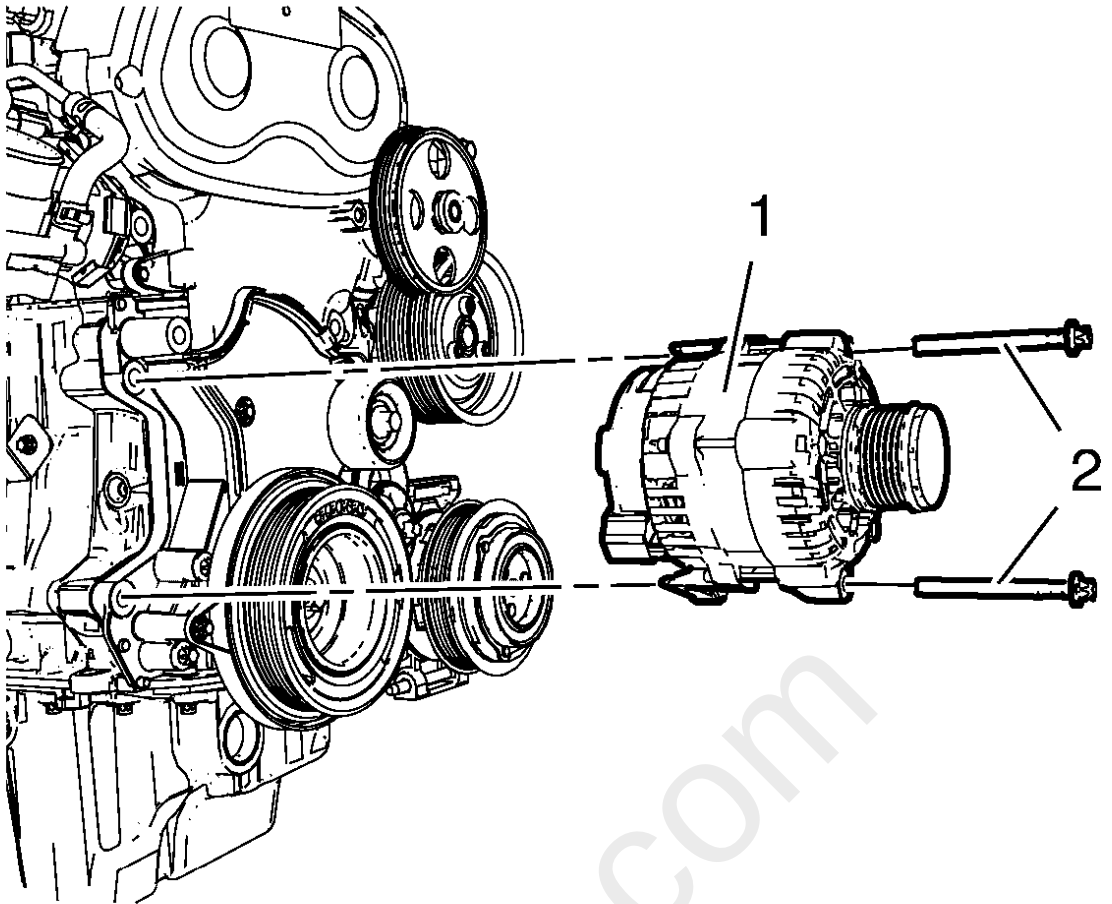


**Fig. 103: Generator And Bolts**

Courtesy of GENERAL MOTORS COMPANY

6. Remove the 2 generator fasteners (2).
7. Remove the generator (1).

#### **Installation Procedure**



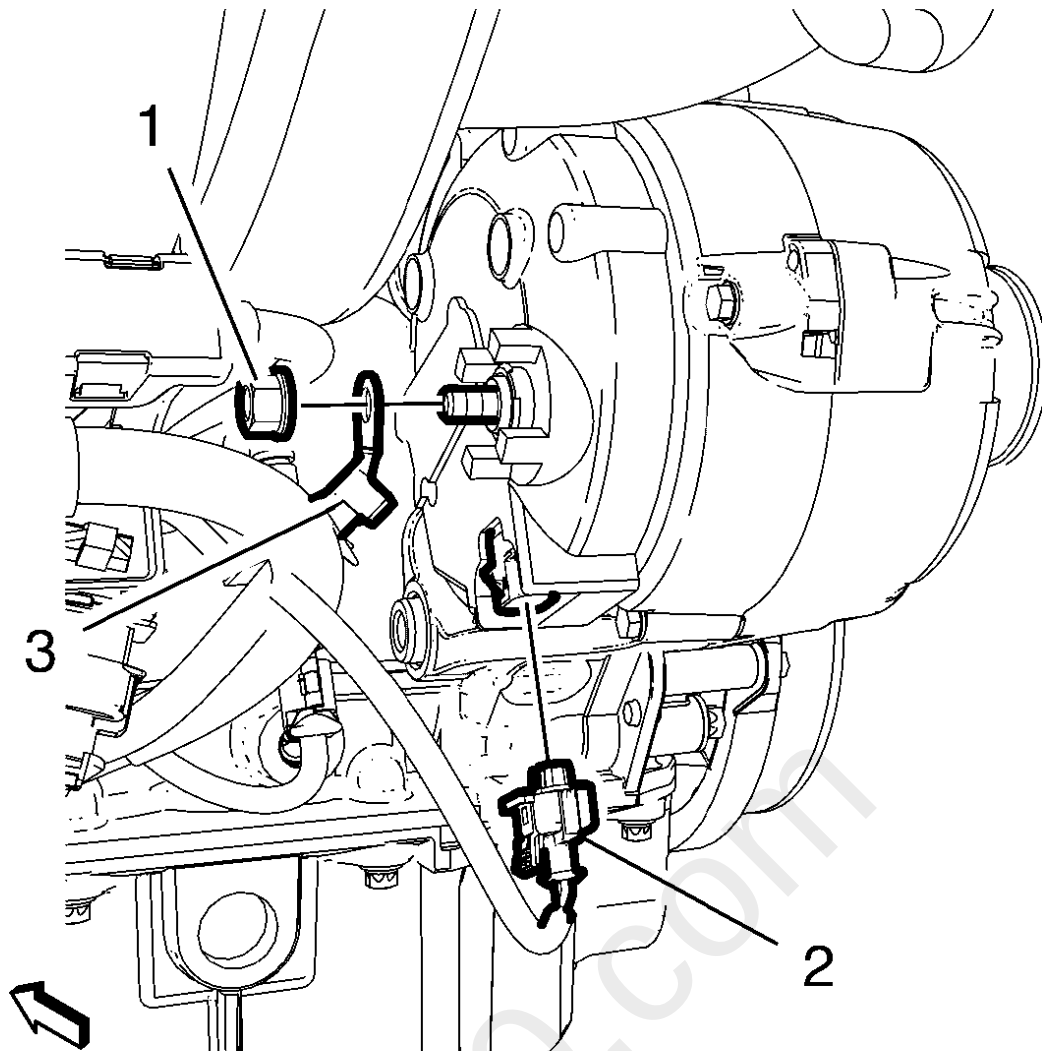
**Fig. 104: Generator And Bolts**

Courtesy of GENERAL MOTORS COMPANY

1. Install the generator (1).

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

2. Install the 2 generator fasteners (2) and tighten to 35 N.m (26 lb ft).



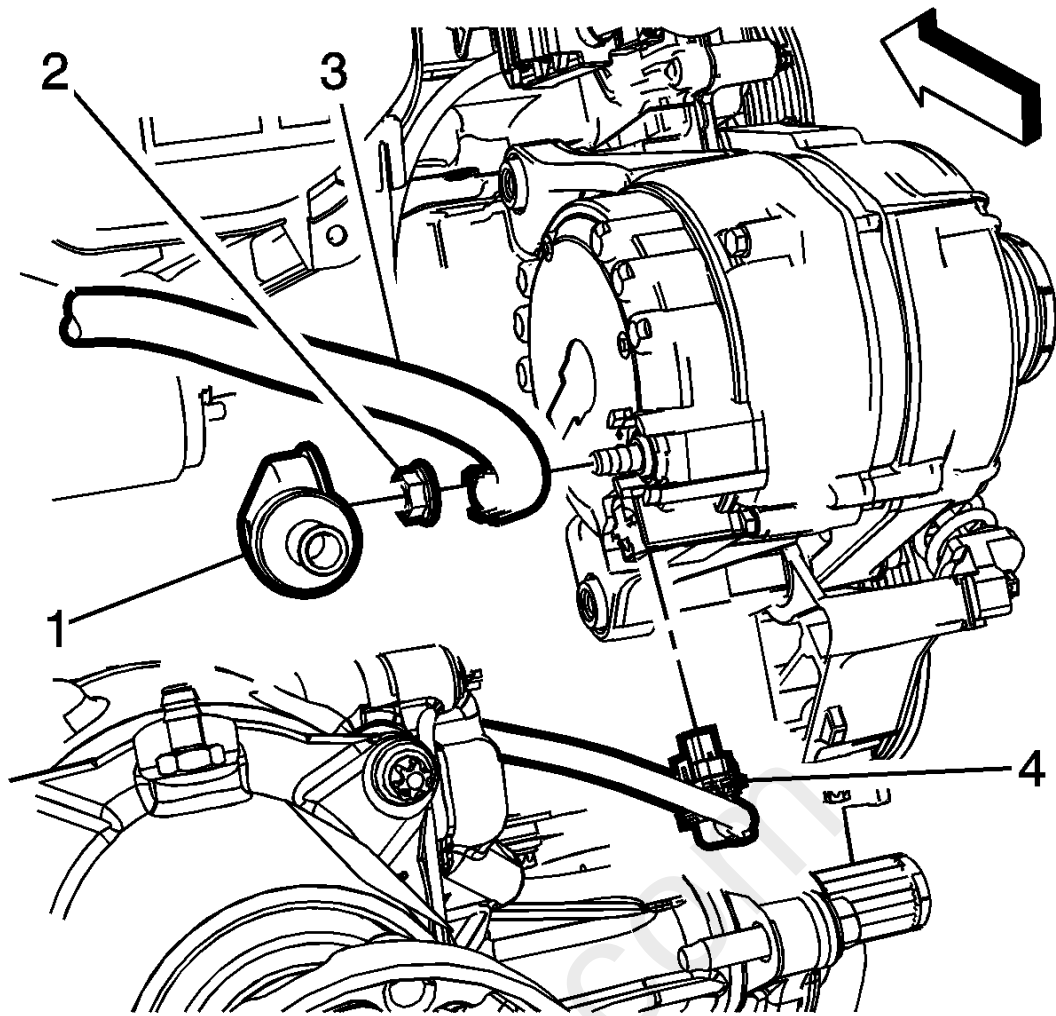
**Fig. 105: Generator Positive Cable Nut And Nut**  
 Courtesy of GENERAL MOTORS COMPANY

3. Install the battery positive cable (3) and tighten the fastener (1) to 17 N.m (13 lb ft).
4. Connect the engine wiring harness connector (2).
5. Install the right front wheel drive shaft. Refer to [Front Wheel Drive Shaft Replacement - Right Side](#).
6. Install the drive belt. Refer to [Drive Belt Replacement](#).
7. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).

## **GENERATOR REPLACEMENT (LUV)**

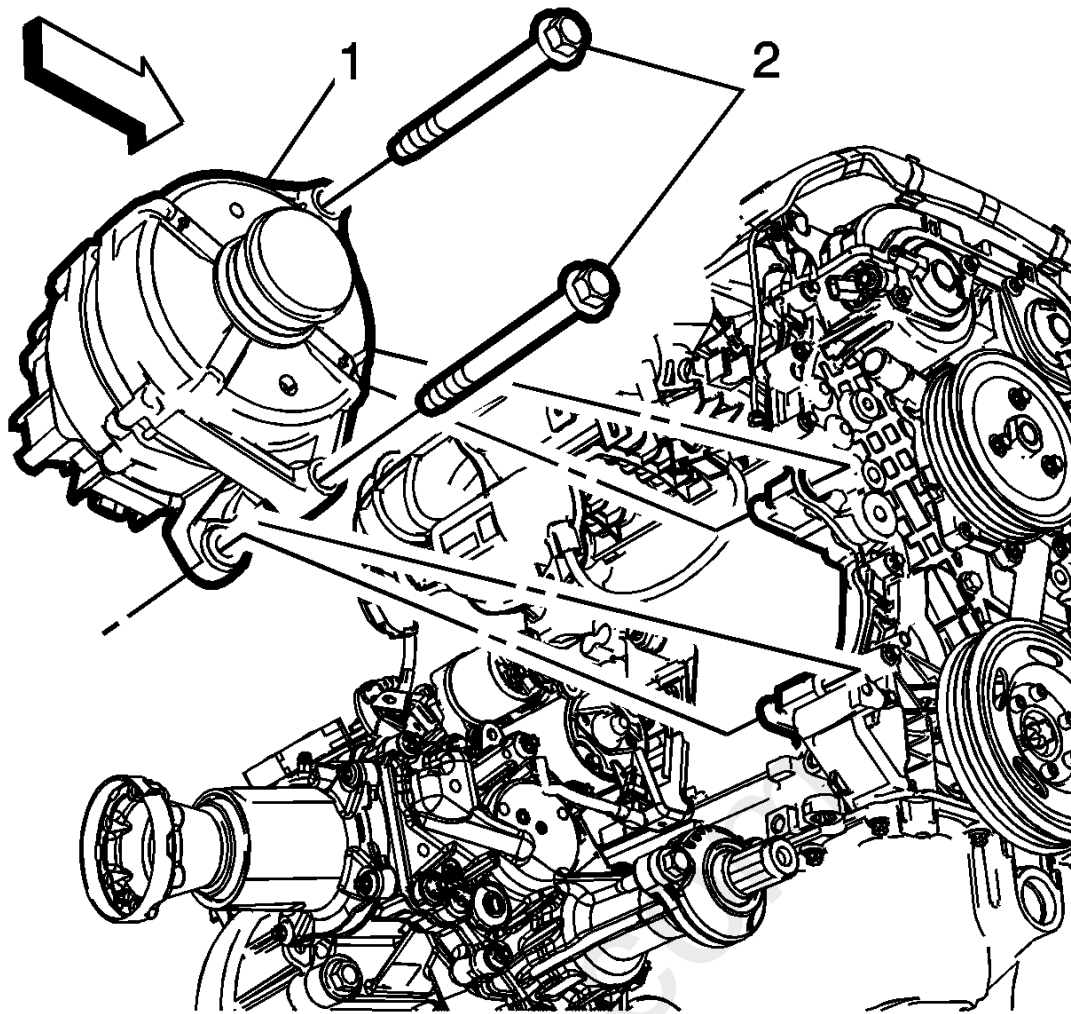
### **Removal Procedure**

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).
2. Remove the drive belt tensioner. Refer to [Drive Belt Tensioner Replacement](#).
3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
4. Remove the drivetrain and front suspension frame transmission protector. Refer to [Drivetrain and Front Suspension Frame Transmission Protector Replacement](#).



**Fig. 106: Generator, Cables And Fasteners**  
Courtesy of GENERAL MOTORS COMPANY

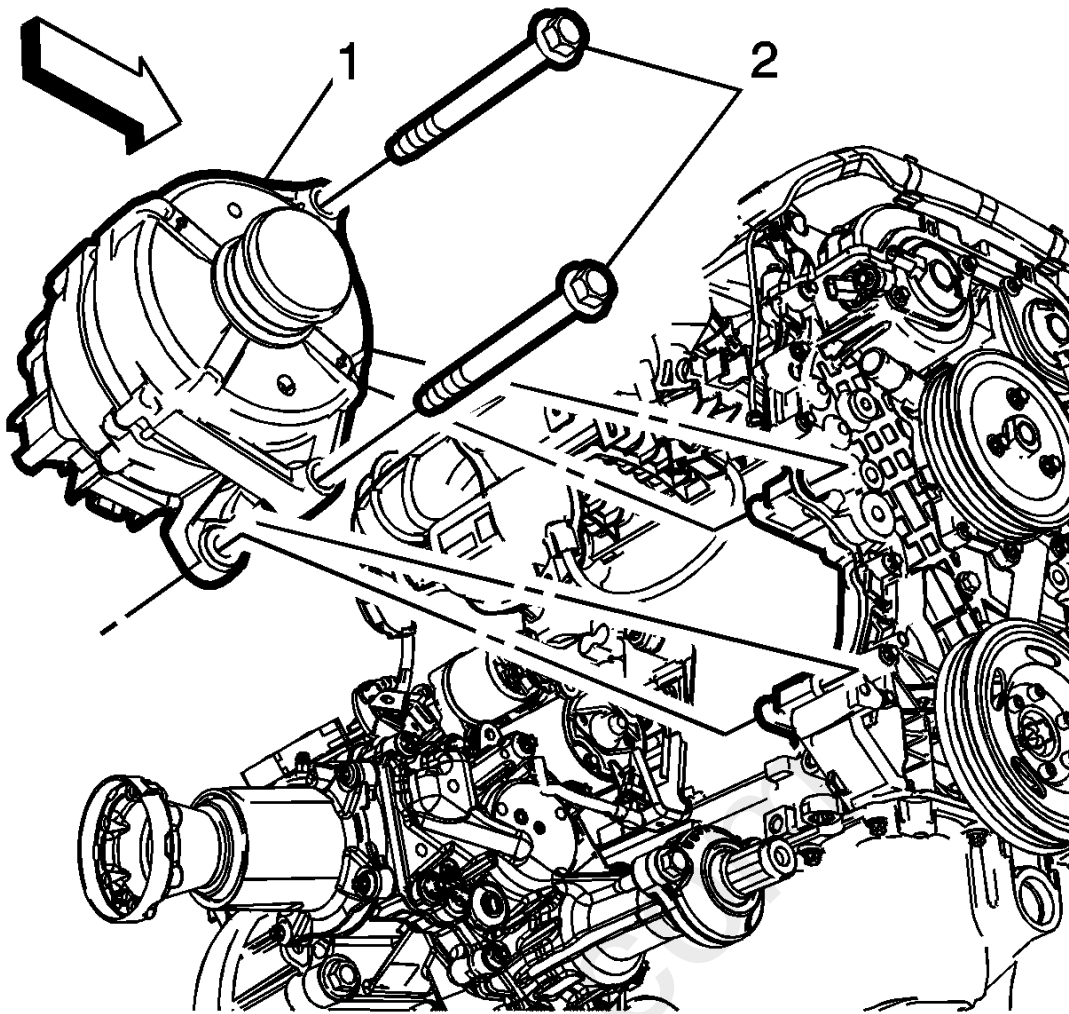
5. Disconnect the engine wiring harness connector (4).
6. Remove the protective boot (1).
7. Remove the battery positive cable fastener (2) and the battery positive cable (3).



**Fig. 107: Generator And Mounting Fasteners**  
Courtesy of GENERAL MOTORS COMPANY

8. Remove the 2 generator mounting fasteners (2).
9. Remove the generator (1) from above.

#### **Installation Procedure**

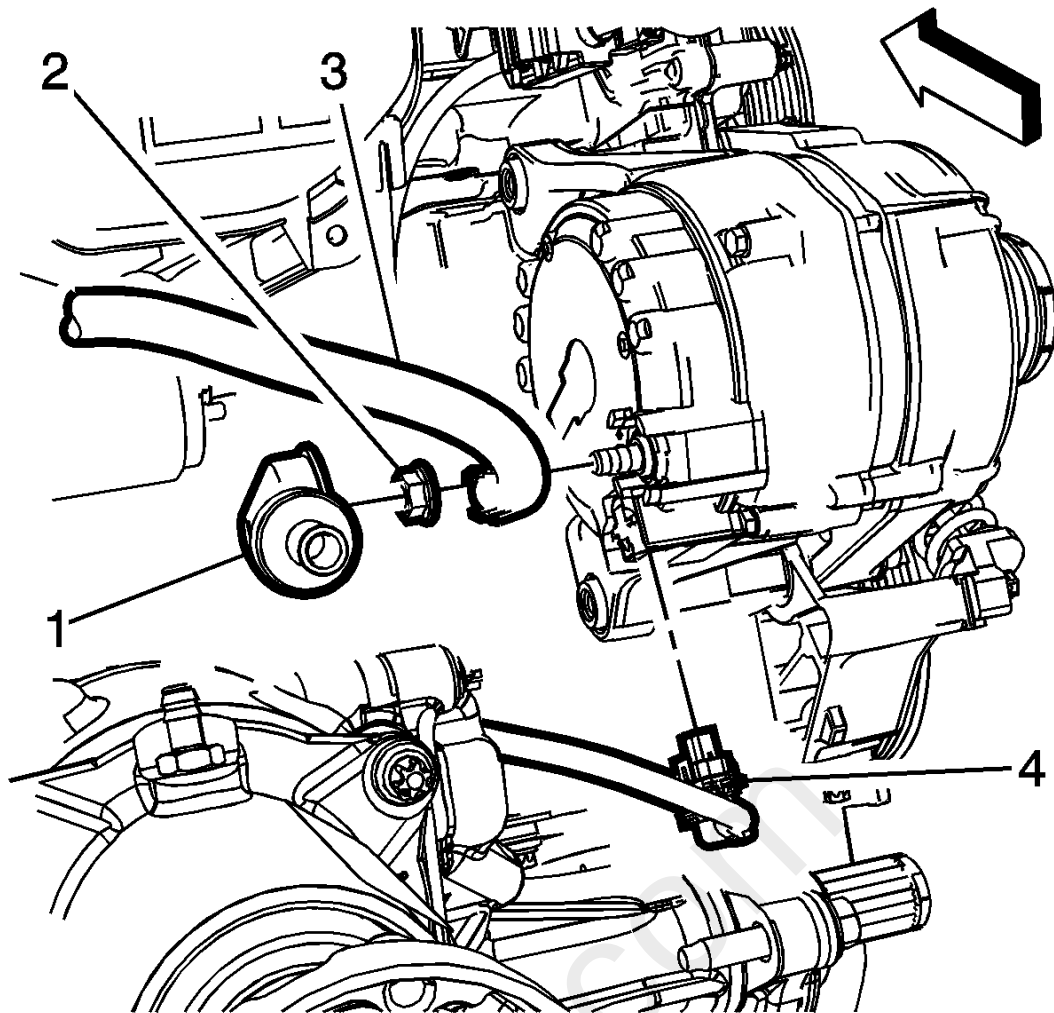


**Fig. 108: Generator And Mounting Fasteners**  
Courtesy of GENERAL MOTORS COMPANY

1. Install the generator (1) from above.

**CAUTION:** Refer to **Fastener Caution** .

2. Install the 2 generator mounting fasteners (2) and tighten to 35 N.m (26 lb ft).



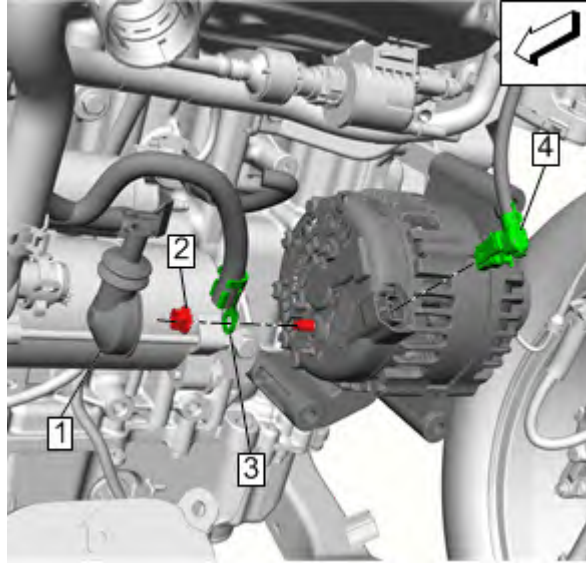
**Fig. 109: Generator, Cables And Fasteners**  
 Courtesy of GENERAL MOTORS COMPANY

3. Connect the generator wiring harness connector (4).
4. Install the generator positive cable (3) and tighten the fastener (2) to 17 N.m (13 lb ft).
5. Install the protective boot (1).
6. Install the drive belt tensioner. Refer to [Drive Belt Tensioner Replacement](#) .
7. Install the drivetrain and front suspension frame transmission protector. Refer to [Drivetrain and Front Suspension Frame Transmission Protector Replacement](#) .
8. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#).

## **GENERATOR REPLACEMENT (LE2)**

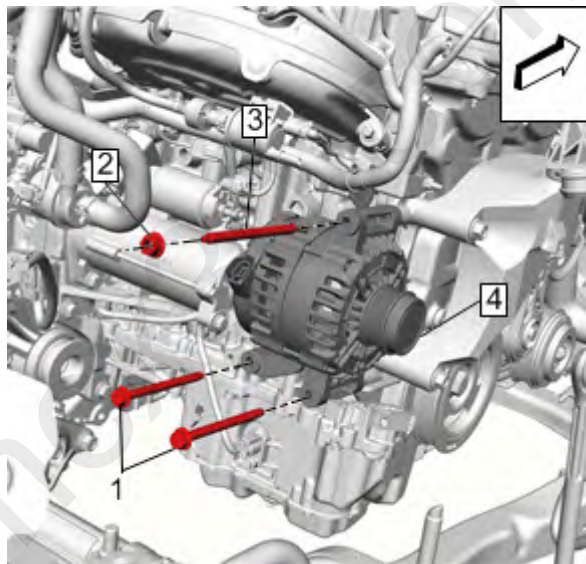
### **Removal Procedure**

1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#).
2. Remove Drive Belt. Refer to [Drive Belt Replacement](#)
3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
4. Remove Front Compartment Front Center Insulator. Refer to [Front Compartment Front Center Insulator Replacement](#)
5. Remove Front Wheel Drive Shaft-Right Side. Refer to [Front Wheel Drive Shaft Replacement - Right Side](#)



**Fig. 110: Terminal Protective Boot, Battery Positive Cable, Nut And Connector**  
 Courtesy of GENERAL MOTORS COMPANY

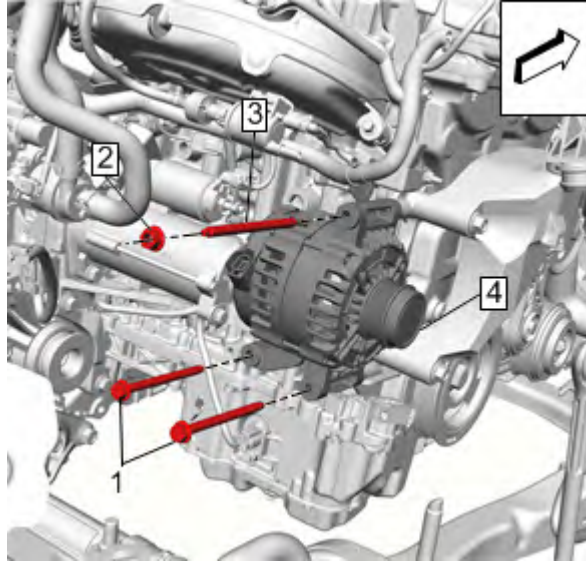
6. Remove Generator Terminal Protective Boot (1)
7. Remove Generator Nut (2)
8. Remove Battery Positive Cable (3)
9. Disconnect Electrical Connector (4)



**Fig. 111: Generator And Fasteners**  
 Courtesy of GENERAL MOTORS COMPANY

10. Remove Generator Bolts (1) (Qty: 2)
11. Remove Generator Mounting Nut (2)
12. Remove Generator Mounting Stud (3)
13. Remove Generator (4)

### Installation Procedure

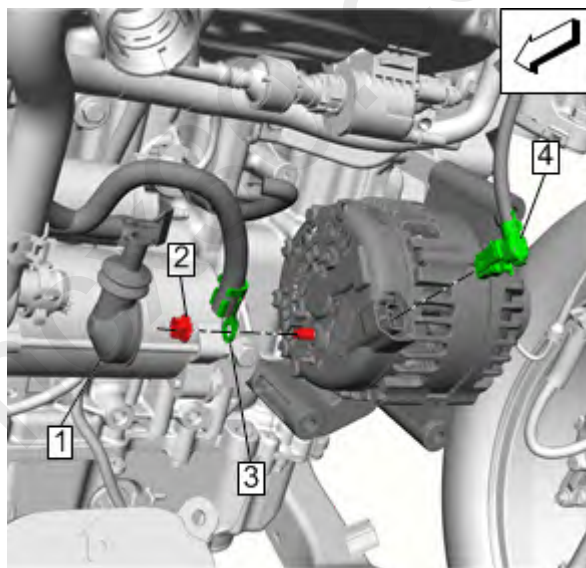


**Fig. 112: Generator And Fasteners**  
 Courtesy of GENERAL MOTORS COMPANY

1. Install Generator (4)

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

2. Install and tighten Generator Mounting Stud (3) to 9 N.m (80 lb in)
3. Install and tighten Generator Mounting Nut (2) to 22 N.m (16 lb ft)
4. Install and tighten Generator Bolts (1) (Qty: 2) to 22 N.m (16 lb ft)



**Fig. 113: Terminal Protective Boot, Battery Positive Cable, Nut And Connector**  
 Courtesy of GENERAL MOTORS COMPANY

5. Connect Electrical Connector (4)
6. Install Battery Positive Cable (3)
7. Install and tighten Battery Positive Cable Nut (2) to 17 N.m (13 lb ft)
8. Install Generator Terminal Protective Boot (1)
9. Install Drive Belt. Refer to [Drive Belt Replacement](#)
10. Install Front Wheel Drive Shaft-Right Side. Refer to [Front Wheel Drive Shaft Replacement - Right Side](#)
11. Install Front Compartment Front Center Insulator. Refer to [Front Compartment Front Center Insulator Replacement](#)
12. Lower the vehicle.
13. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#)

# DESCRIPTION AND OPERATION

## BATTERY DESCRIPTION AND OPERATION

**WARNING:** Batteries produce explosive gases, contain corrosive acid, and supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury when working near a battery:

- Always shield your eyes and avoid leaning over the battery whenever possible.
- Do not expose the battery to open flames or sparks.
- Do not allow the battery electrolyte to contact the eyes or the skin. Flush immediately and thoroughly any contacted areas with water and get medical help.
- Follow each step of the jump starting procedure in order.
- Treat both the booster and the discharged batteries carefully when using the jumper cables.

Batteries that are no longer wanted must be disposed of by an approved battery recycler and must never be thrown in the trash or sent to a landfill.

Batteries that are not part of the vehicle itself, not the battery under the hood, must only be transported on public streets for business purposes via approved hazardous material transportation procedures.

Battery storage, charging and testing facilities in repair shops must meet various requirements for ventilation, safety equipment, material segregation, etc.

The maintenance free battery is standard. There are no vent plugs in the cover. The battery is completely sealed except for 2 small vent holes in the side. These vent holes allow the small amount of gas that is produced in the battery to escape.

The battery has 3 functions as a major source of energy:

- Engine cranking
- Voltage stabilizer
- Alternate source of energy with generator overload

### Battery Low Start Vehicle Message

The body control module (BCM) monitors battery positive voltage to determine battery state of charge. If one or more of the BCM battery positive voltage terminals measure less than approximately 11.6 V compared to the BCM ground circuits, this message will display and four chimes may sound. Start the vehicle immediately. If the vehicle is not started and the battery continues to discharge, the climate controls, heated seats, and audio systems will shut off and the vehicle may require a jump start. These systems will function again after the vehicle is started.

### Battery Ratings

A battery has 2 ratings:

- Cold cranking amperage
- Amperage hours

When a battery is replaced use a battery with similar ratings. See battery specification label on the original battery.

### Amperage Hours

The amperage hour rating tells you how much amperage is available when discharged evenly over a 20 hour period. The amperage hour rating is cumulative, so in order to know how many constant amperage the battery will output for 20 h, you have to divide the amperage hour rating by 20. Example: If a battery

has an amperage hour rating of 74, dividing by 20 = 3.75. Such a battery can carry a 3.75 A load for 20 hours before dropping to 10.5 V. (10.5 V is the fully discharged level, at which point the battery needs to be recharged.) A battery with an amperage hour rating of 55 will carry a 2.75 A load for 20 hours before dropping to 10.5 V.

### Cold Cranking Amperage

The cold cranking amperage is an indication of the ability of the battery to crank the engine at cold temperatures. The cold cranking amperage rating is the minimum amperage the battery must maintain for 30 seconds at  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) while maintaining at least 7.2 V. See battery label for the cold cranking amperage rating of this battery.

## CHARGING SYSTEM DESCRIPTION AND OPERATION

### Electrical Power Management Overview

The electrical power management system is designed to monitor and control the charging system and send diagnostic messages to alert the driver of possible problems with the battery and generator. This electrical power management system primarily utilizes existing on-board computer capability to maximize the effectiveness of the generator, to manage the load, improve battery state-of-charge and life, and minimize the system's impact on fuel economy. The electrical power management system performs 3 functions:

- It monitors the battery voltage and estimates the battery condition.
- It takes corrective actions by boosting idle speeds, and adjusting the regulated voltage.
- It performs diagnostics and driver notification.

The battery condition is estimated during ignition-off and during ignition-on. During ignition-off the state-of-charge of the battery is determined by measuring the open-circuit voltage. The state-of-charge is a function of the acid concentration and the internal resistance of the battery, and is estimated by reading the battery open circuit voltage when the battery has been at rest for several hours.

The state-of-charge can be used as a diagnostic tool to tell the customer or the dealer the condition of the battery. Throughout ignition-on, the algorithm continuously estimates state-of-charge based on adjusted net amp hours, battery capacity, initial state-of-charge, and temperature.

While running, the battery degree of discharge is primarily determined by a battery current sensor, which is integrated to obtain net amp hours.

In addition, the electrical power management function is designed to perform regulated voltage control to improve battery state-of-charge, battery life, and fuel economy. This is accomplished by using knowledge of the battery state-of-charge and temperature to set the charging voltage to an optimum battery voltage level for recharging without detriment to battery life.

The Charging System Description and Operation is divided into 3 sections. The first section describes the charging system components and their integration into the electrical power management. The second section describes charging system operation. The third section describes the instrument panel cluster operation of the charge indicator, driver information center messages, and voltmeter operation.

### Charging System Components

#### Generator

The generator is a serviceable component. If there is a diagnosed failure of the generator it must be replaced as an assembly. The engine drive belt drives the generator. When the rotor is spun it induces an alternating current (AC) into the stator windings. The AC voltage is then sent through a series of diodes for rectification. The rectified voltage has been converted into a direct current (DC) for use by the vehicles electrical system to maintain electrical loads and the battery charge. The voltage regulator integral to the generator controls the output of the generator. It is not serviceable. The voltage regulator controls the amount of current provided to the rotor. If the generator has field control circuit failure, the generator defaults to an output voltage of 13.8 V.

#### Body Control Module (BCM)

The body control module (BCM) is a GMLAN device. It communicates with the engine control module (ECM) and the instrument panel cluster for electrical power management (electrical power management) operation. The BCM determines the output of the generator and sends the information to the ECM for control of the generator turn on signal circuit. It monitors the generator field duty cycle signal circuit information sent from the ECM for control of the generator. It monitors a battery current sensor, the battery positive voltage circuit, and estimated battery temperature to determine battery state of charge. The BCM performs idle boost.

### **Battery Current Sensor (If applicable)**

The battery current sensor is a serviceable component that is connected to the negative battery cable at the battery. The battery current sensor is a 3-wire hall effect current sensor. The battery current sensor monitors the battery current. It directly inputs to the BCM. It creates a 5 volt pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-95 percent. Between 0-5 percent and 95-100 percent are for diagnostic purposes.

### **Battery Sensor Module (If applicable)**

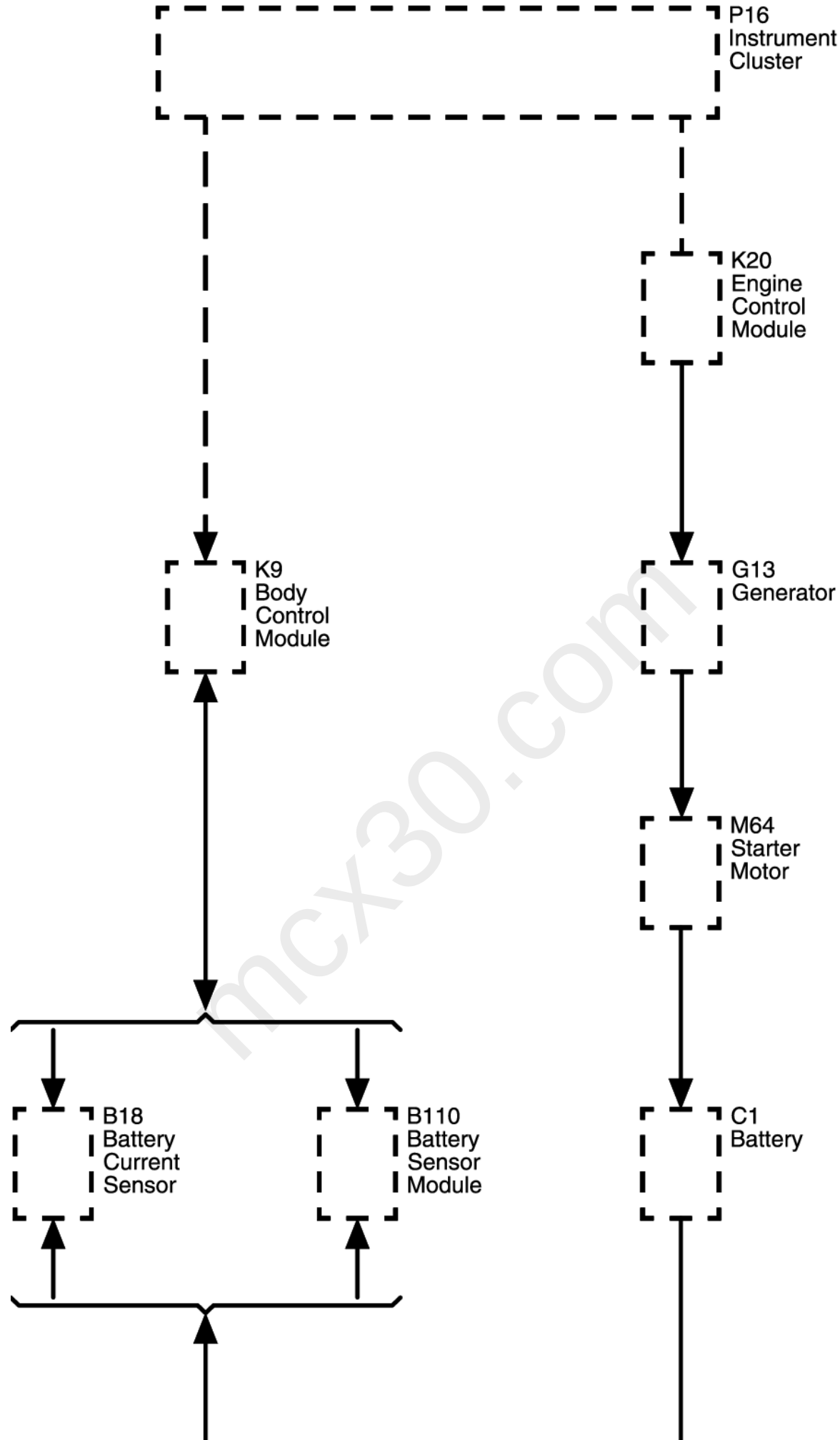
The BCM monitors the battery sensor module for battery state of current, state of health, and battery charge via the data communication bus. If the battery is determined to be in poor state of health or having a low charge, the BCM will not allow the ECM to Autostop.

### **Engine Control Module (ECM)**

When the engine is running, the generator turn-on signal is sent to the generator from the ECM, turning on the regulator. The generator's voltage regulator controls current to the rotor, thereby controlling the output voltage. The rotor current is proportional to the electrical pulse width supplied by the regulator. When the engine is started, the regulator senses generator rotation by detecting AC voltage at the stator through an internal wire. Once the engine is running, the regulator varies the field current by controlling the pulse width. This regulates the generator output voltage for proper battery charging and electrical system operation. The generator field duty terminal is connected internally to the voltage regulator and externally to the ECM. When the voltage regulator detects a charging system problem, it grounds this circuit to signal the ECM that a problem exists. The ECM monitors the generator field duty cycle signal circuit, and receives control decisions based on information from the BCM.

### **Instrument Panel Cluster**

The instrument panel cluster provides the customer notification in case a concern with the charging system. There are 2 means of notification, a charge indicator and a driver information center message of SERVICE BATTERY CHARGING SYSTEM if equipped.



**Fig. 114: Charging System Block Diagram**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name         |
|---------|------------------------|
| P16     | P16 Instrument Cluster |

| Callout | Component Name             |
|---------|----------------------------|
| K20     | K20 Engine Control Module  |
| G13     | G13 Generator              |
| M64     | M64 Starter Motor          |
| C1      | C1 Battery                 |
| B18     | B18 Battery Current Sensor |
| K9      | K9 Body Control Module     |
| B110    | B110 Battery Sensor Module |

### Charging System Operation

The purpose of the charging system is to maintain the battery charge and vehicle loads. There are 6 modes of operation and they include:

- Battery Sulfation Mode
- Charge Mode
- Fuel Economy Mode
- Head lamp Mode
- Start Up Mode
- Voltage Reduction Mode

The engine control module (ECM) controls the generator through the generator turn ON signal circuit. The ECM monitors the generator performance through the generator field duty cycle signal circuit. The signal is a pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-95 percent. Between 0-5 percent and 95-100 percent are for diagnostic purposes. The following table shows the commanded duty cycle and output voltage of the generator:

| Commanded Duty Cycle | Generator Output Voltage |
|----------------------|--------------------------|
| 10%                  | 11 V                     |
| 20%                  | 11.56 V                  |
| 30%                  | 12.12 V                  |
| 40%                  | 12.68 V                  |
| 50%                  | 13.25 V                  |
| 60%                  | 13.81 V                  |
| 70%                  | 14.37 V                  |
| 80%                  | 14.94 V                  |
| 90%                  | 15.5 V                   |

The generator provides a feedback signal of the generator voltage output through the generator field duty cycle signal circuit to the ECM. This information is sent to the body control module (BCM). The signal is PWM signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-99 percent. Between 0-5 percent and 100 percent are for diagnostic purposes.

### Battery Sulfation Mode

The BCM will enter this mode when the interpreted generator output voltage is less than 13.2 V for 45 minutes. When this condition exists the BCM will enter Charge Mode for 2-3 minutes. The BCM will then determine which mode to enter depending on voltage requirements.

### Charge Mode

The BCM will enter Charge Mode when ever one of the following conditions are met.

- The wipers are ON for more than 3 seconds.
- GMLAN (Climate Control Voltage Boost Mode Request) is true, as sensed by the HVAC control head. High speed cooling fan, rear defogger and HVAC high speed blower operation can cause the BCM to enter the Charge Mode.
- The estimated battery temperature is less than 0Å,Å°C (32Å,Å°F).

- Battery State of Charge is less than 80 percent.
- Vehicle speed is greater than 145 km/h (90 mph)
- Current sensor fault exists.
- System voltage was determined to be below 12.56 V

When any one of these conditions is met, the system will set targeted generator output voltage to a charging voltage between 13.9-15.5 V, depending on the battery state of charge and estimated battery temperature.

### Fuel Economy Mode

The BCM will enter Fuel Economy Mode when the estimated battery temperature is at least 0°C (32°F) but less than or equal to 80°C (176°F), the calculated battery current is less than 15 amperes and greater than -8 amperes, and the battery state-of-charge is greater than or equal to 80 percent. Its targeted generator output voltage is the open circuit voltage of the battery and can be between 12.5-13.1 V. The BCM will exit this mode and enter Charge Mode when any of the conditions described above are present.

### Head lamp Mode

The BCM will enter Head lamp Mode when ever the head lamps are ON (high or low beams). Voltage will be regulated between 13.9-14.5 V.

### Start Up Mode

When the engine is started the BCM sets a targeted generator output voltage of 14.5 V for 30 seconds.

### Tow/Haul Mode (If applicable)

Pressing the Tow/Haul Mode button located on the center stack, the vehicle system voltage is raised and the remote (non-vehicle) battery will be charged. Having the headlights on will raise the system voltage and if the Tow/Haul button is applied it will not serve any purpose. The voltage is regulated between 13.9-14.5 V.

### Instrument Panel Cluster Operation

#### Charge Indicator Operation

The instrument panel cluster illuminates the charge indicator and displays a warning message in the driver information center if equipped, when the one or more of the following occurs:

- The engine control module (ECM) detects that the generator output is less than 11 V or greater than 16 V. The instrument panel cluster receives a GMLAN message from the ECM requesting illumination.
- The instrument panel cluster determines that the system voltage is less than 11 V or greater than 16 V for more than 30 seconds. The instrument panel cluster receives a GMLAN message from the body control module (BCM) indicating there is a system voltage range concern.
- The instrument panel cluster performs the displays test at the start of each ignition cycle. The indicator illuminates for approximately 3 seconds.

#### Display Message: BATTERY NOT CHARGING SERVICE CHARGING SYSTEM or SERVICE BATTERY CHARGING SYSTEM

The BCM and the ECM will send a serial data message to the driver information center for the BATTERY NOT CHARGING SERVICE CHARGING SYSTEM or SERVICE BATTERY CHARGING SYSTEM message to be displayed. It is commanded ON when a charging system DTC is a current DTC. The message is turned OFF when the conditions for clearing the DTC have been met.

## ELECTRICAL POWER MANAGEMENT DESCRIPTION AND OPERATION

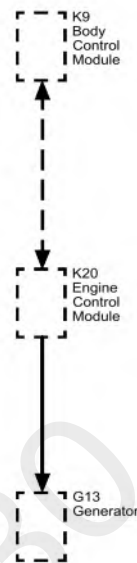
### Electrical Power Management

The electrical power management is used to monitor and control the charging system and alert the driver of possible problems within the charging system. The electrical power management system makes the most efficient use of the generator output, improves the battery state-of-charge, extends battery life, and manages system electrical loads.

The load shed operation is a means of reducing electrical loads during a low voltage or low battery state-of-charge condition.

The idle boost operation is a means of improving generator performance during a low voltage or low battery state-of-charge condition.

Each electrical power management function, either idle boost or load shed, is activated in incremental steps. For example, idle boost 1 must be active before idle boost 2 can be active. The criteria used by the body control module (BCM) to regulate electrical power management are outlined below:



**Fig. 115: Electrical Power Management Block Diagram**  
Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name            |
|---------|---------------------------|
| K9      | K9 Body Control Module    |
| K20     | K20 Engine Control Module |
| G13     | G13 Generator             |

#### Idle Boost and Load Shed With Current Sensor

| Function           | Battery Temperature Calculation                             | Battery Voltage Calculation | Amp-Hour Calculation                       | Action Taken                             |
|--------------------|-------------------------------------------------------------|-----------------------------|--------------------------------------------|------------------------------------------|
| Idle Boost 1 Start | Less Than $-15^{\circ}\text{C}$ ( $5^{\circ}\text{F}$ )     | Less Than 13 V              | -                                          | First level Idle boost requested         |
| Idle Boost 1 Start | -                                                           | -                           | Battery has a net loss greater than 0.6 Ah | First level Idle boost requested         |
| Idle Boost 1 Start | -                                                           | Less Than 11 V              | -                                          | First level Idle boost requested         |
| Idle Boost 1 End   | Greater Than $-10^{\circ}\text{C}$ ( $14^{\circ}\text{F}$ ) | Greater Than 12 V           | Battery has a net loss less than 0.2 Ah    | First level Idle boost request cancelled |

| Function           | Battery Temperature Calculation | Battery Voltage Calculation | Amp-Hour Calculation                       | Action Taken                                                                                                                                      |
|--------------------|---------------------------------|-----------------------------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Idle Boost 2 Start | -                               | -                           | Battery has a net loss greater than 1.6 Ah | Second level Idle boost requested                                                                                                                 |
| Idle Boost 2 Start | -                               | Less Than 11 V              | -                                          | Second level Idle boost requested                                                                                                                 |
| Idle Boost 2 End   | -                               | Greater Than 12 V           | Battery has a net loss less than 0.8 Ah    | Second level Idle boost request cancelled                                                                                                         |
| Load Shed 1 Start  | -                               | -                           | Battery has a net loss of 4 Ah             | Rear Defrost, Heated Mirrors, Heated Seats, HVAC cycled OFF for 20% of their cycle                                                                |
| Load Shed 1 Start  | -                               | Less Than 11 V              | -                                          | Rear Defrost, Heated Mirrors, Heated Seats, HVAC cycled OFF for 20% of their cycle                                                                |
| Load Shed 1 End    | -                               | Greater Than 12 V           | Battery has a net loss of less than 2 Ah   | Clear Load Shed 1                                                                                                                                 |
| Idle Boost 3 Start | -                               | -                           | Battery has a net loss of 10 Ah            | Third level Idle boost requested                                                                                                                  |
| Idle Boost 3 Start | -                               | Less Than 11 V              | -                                          | Third level Idle boost requested                                                                                                                  |
| Idle Boost 3 End   | -                               | Greater Than 12 V           | Battery has a net loss of less than 6.0 Ah | Third level Idle boost request cancelled                                                                                                          |
| Load Shed 2 Start  | -                               | -                           | Battery has a net loss greater than 12 Ah  | Rear Defrost, Heated Mirrors, Heated Seats, HVAC cycled OFF for 50% of their cycle. The BATTERY SAVER ACTIVE message will be displayed on the DIC |
| Load Shed 2 Start  | -                               | Less Than 11 V              | -                                          | Rear Defrost, Heated Mirrors, Heated Seats, HVAC cycled OFF for 50% of their cycle. The BATTERY SAVER ACTIVE message will be displayed on the DIC |
| Load Shed 2 End    | -                               | Greater Than 12 V           | Battery has a net loss of less than 8 Ah   | Clear Load Shed 2                                                                                                                                 |

| Function          | Battery Temperature Calculation | Battery Voltage Calculation | Amp-Hour Calculation                      | Action Taken                                                                                                                                       |
|-------------------|---------------------------------|-----------------------------|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Load Shed 3 Start | -                               | Less Than 11.9 V            | Battery has a net loss greater than 20 Ah | Rear Defrost, Heated Mirrors, Heated Seats, HVAC cycled OFF for 100% of their cycle. The BATTERY SAVER ACTIVE message will be displayed on the DIC |
| Load Shed 3 Start | -                               | Less Than 11 V              | -                                         | Rear Defrost, Heated Mirrors, Heated Seats, HVAC cycled OFF for 100% of their cycle. The BATTERY SAVER ACTIVE message will be displayed on the DIC |
| Load Shed 3 End   | -                               | Greater Than 12.6 V         | Battery has a net loss of less than 13 Ah | Clear Load Shed 3                                                                                                                                  |

#### Idle Boost and Load Shed Without Current Sensor (based on battery voltage)

| Function           | Battery Temperature Calculation                                                                                                   | Battery Voltage Calculation | Action Taken                                                                       |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------|
| Idle Boost 1 Start | Less Than -15 $\tilde{\text{A}}$ , $\hat{\text{A}}^{\circ}\text{C}$ (5 $\tilde{\text{A}}$ , $\hat{\text{A}}^{\circ}\text{F}$ )    | Less Than 13 V              | First level Idle boost requested                                                   |
| Idle Boost 1 Start | -                                                                                                                                 | Less Than 12.6 V            | First level Idle boost requested                                                   |
| Idle Boost 1 End   | Greater Than -15 $\tilde{\text{A}}$ , $\hat{\text{A}}^{\circ}\text{C}$ (5 $\tilde{\text{A}}$ , $\hat{\text{A}}^{\circ}\text{F}$ ) | -                           | First level Idle boost request cancelled                                           |
| Idle Boost 1 End   | -                                                                                                                                 | Greater Than 13 V           | First level Idle boost request cancelled                                           |
| Idle Boost 2 Start | -                                                                                                                                 | Less Than 12.4 V            | Second level Idle boost requested                                                  |
| Idle Boost 2 End   | -                                                                                                                                 | Greater Than 12.5 V         | Second level Idle boost request cancelled                                          |
| Load Shed 1 Start  | -                                                                                                                                 | Less Than 12.3 V            | Rear Defrost, Heated Mirrors, Heated Seats, HVAC cycled OFF for 20% of their cycle |
| Load Shed 1 End    | -                                                                                                                                 | Greater Than 12.4 V         | Clear Load Shed 1                                                                  |
| Idle Boost 3 Start | -                                                                                                                                 | Less Than 10 V              | Third level Idle boost requested                                                   |
| Idle Boost 3 End   | -                                                                                                                                 | Greater Than 12.3 V         | Third level Idle boost request cancelled                                           |

| Function          | Battery Temperature Calculation | Battery Voltage Calculation | Action Taken                                                                                                                                       |
|-------------------|---------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Load Shed 2 Start | -                               | Less Than 12.1 V            | Rear Defrost, Heated Mirrors, Heated Seats, HVAC cycled OFF for 50% of their cycle. The BATTERY SAVER ACTIVE message will be displayed on the DIC  |
| Load Shed 2 End   | -                               | Greater Than 12.2 V         | Clear Load Shed 2                                                                                                                                  |
| Load Shed 3 Start | -                               | Less Than 11.9 V            | Rear Defrost, Heated Mirrors, Heated Seats, HVAC cycled OFF for 100% of their cycle. The BATTERY SAVER ACTIVE message will be displayed on the DIC |
| Load Shed 3 End   | -                               | Greater Than 12.0 V         | Clear Load Shed 3                                                                                                                                  |

## STARTING SYSTEM DESCRIPTION AND OPERATION

The starter motors are non-repairable starter motors. They have pole pieces that are arranged around the armature. Both solenoid windings are energized. The pull-in winding circuit is completed to the ground through the starter motor. The windings work together magnetically to pull and hold in the plunger. The plunger moves the shift lever. This action causes the starter drive assembly to rotate on the armature shaft spline as it engages with the flywheel ring gear on the engine. Moving at the same time, the plunger also closes the solenoid switch contacts in the starter solenoid. Full battery voltage is applied directly to the starter motor and it cranks the engine.

As soon as the solenoid switch contacts close, current stops flowing thorough the pull-in winding because battery voltage is applied to both ends of the windings. The hold-in winding remains energized. Its magnetic field is strong enough to hold the plunger, shift lever, starter drive assembly, and solenoid switch contacts in place to continue cranking the engine. When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened.

When the ignition switch is released from the START position, the START relay opens and battery voltage is removed from the starter solenoid S terminal. Current flows from the motor contacts through both windings to the ground at the end of the hold-in winding. However, the direction of the current flow through the pull-in winding is now opposite the direction of the current flow when the winding was first energized.

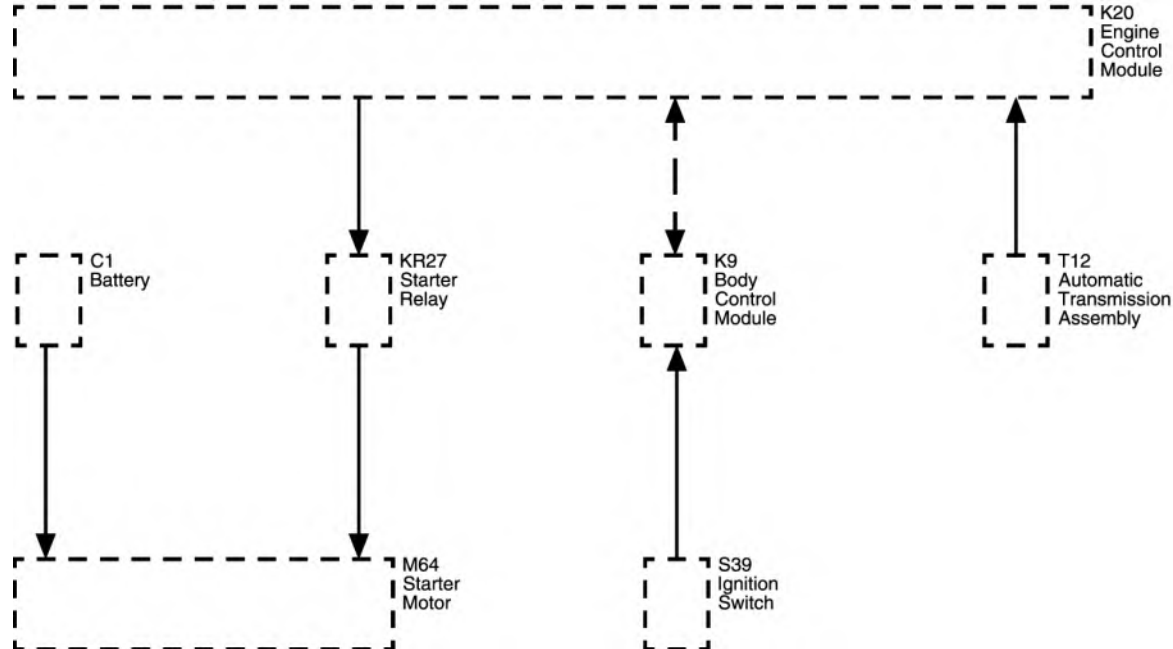
The magnetic fields of the pull-in and hold-in windings now oppose one another. This action of the windings, along with the help of the return spring, causes the starter drive assembly to disengage and the solenoid switch contacts to open simultaneously. As soon as the contacts open, the starter circuit is turned off.

### Circuit Description (Key Start)

When the ignition switch is placed in the Start position, a discrete signal is supplied to the body control module (BCM) notifying it that the ignition is in the Start position. The BCM then sends a message to the engine control module (ECM) notifying it that CRANK has been requested. The ECM verifies that the transmission is in Park or Neutral. If it is, the ECM then supplies 12 V to the control circuit of the crank relay. When this occurs, battery positive voltage is supplied through the switch side of the crank relay to the S terminal of the starter solenoid.

### With KL9

To support the increased number of engine starts, the starter motor is upgraded with a high performance electric motor and a stronger pinion engagement mechanism with reduced noise levels.



**Fig. 116: Starting System Block Diagram**  
Courtesy of GENERAL MOTORS COMPANY

| Callout | Component Name                      |
|---------|-------------------------------------|
| K20     | K20 Engine Control Module           |
| C1      | C1 Battery                          |
| KR27    | KR27 Starter Relay                  |
| K9      | K9 Body Control Module              |
| T12     | T12 Automatic Transmission Assembly |
| M64     | M64 Starter Motor                   |
| S39     | S39 Ignition Switch                 |

## STOP/START SYSTEM DESCRIPTION AND OPERATION (KL9 WITH LE2)

The Stop/Start System is used to improve fuel efficiency in stop/start driving. The vehicle automatically shuts down the engine in appropriate conditions at a traffic light, for example, resulting in zero tail pipe emissions and saving fuel which otherwise is used idling the engine when stationary. The engine instantly restarts when the driver is ready to move away.

As soon as the driver prepares to move away (by releasing the brake pedal and/or depressing the accelerator pedal), the engine will start; it only takes the system around 0.3 s to start the engine.

To support the increased number of engine starts, the starter motor is upgraded with a high performance electric motor and a stronger pinion engagement mechanism with reduced noise levels.

Along with the upgraded starter motor, advanced battery technology is required to ensure the vehicles battery can handle the frequent charge and discharge cycles common with stop/start operation. There is battery sensor module connected to the battery which continually monitors the battery charge and healthy state. The engine control module (ECM) uses this information from the battery sensor module to determine if the battery charge and health is sufficient for an Stop/Start condition.

The Stop/Start system can reduce fuel consumption and carbon dioxide (CO<sub>2</sub>) emissions by up to 5% in mixed driving conditions. In an urban environment and in heavy traffic with frequent stops the savings may increase to as much as 10%.

There are also sophisticated controls in place to help ensure the Stop/Start System does not compromise the needs of either the driver or vehicle. For the engine to shutdown, the vehicle must be below 5 km/h (3 MPH), the selector lever in position D, and brake pedal depressed. To restart, the driver simply releases the brake pedal and the enhanced starter motor engages the engine. When the engine has been shut down by the Stop/Start System, a control indicator will be illuminated in the Driver Information Center (DIC). When the engine is restarted, the control indicator in the DIC extinguishes.

To ensure neither the needs of the driver or vehicle are compromised the engine will not shut down in the following circumstances:

- Ambient and coolant temperature correlation does not match specified values.
- Ambient temperature is less than  $-10^{\circ}\text{C}$  ( $14^{\circ}\text{F}$ )
- Battery temperature is less than  $0^{\circ}\text{C}$  ( $32^{\circ}\text{F}$ ) or greater than  $55^{\circ}\text{C}$  ( $131^{\circ}\text{F}$ )
- Driver seat belt is not fastened and the drivers door is not fully closed (not applicable to vehicles in North America)
- HVAC system demand is high
- HVAC defrost has been selected
- Battery charge is low

Likewise the engine will automatically restart if:

- Driver door opened and driver seat belt unbuckled (not applicable to vehicles in North America)
- Engine hood opened
- Battery charge is low
- HVAC demand increases
- Vehicle speed increases
- Brake booster vacuum has been reduced
- Engine coolant temperature is greater than  $125^{\circ}\text{C}$  ( $257^{\circ}\text{F}$ )
- Economy mode turned OFF by driver
- Autostop time exceeded 2 min

When the Stop/Start System has shut down the engine, and the ambient temperature is below  $15^{\circ}\text{C}$  ( $59^{\circ}\text{F}$ ), the ECM will activate the Stop/Start auxiliary relay which controls the electric engine coolant pump motor to continually circulate the engine coolant through the engine while the engine is off. This is to ensure the engine and passenger compartment temperature is maintained while off. Once the Stop/Start System has restarted the engine, the ECM will turn off the electric coolant pump motor, thus allowing the engines internal coolant pump to circulate the engine coolant. The Stop/Start System is automatically activated each time the ignition switch is turned on.

Through the climate control system, the vehicle can be cycled between off, comfort, and eco air conditioning modes. In comfort mode, the priority for Stop/Start operation is on customer comfort. Depending on ambient temp, humidity, cabin temperature and cabin temperature setpoint, the least amount of autostops occur in this mode. In eco mode, the priority is on fuel economy. There are more frequent autostops with some sacrificing of cabin temperature control. With the HVAC turned off, the maximum autostops occur since there will be no A/C compressor requests.

### Autostop Criteria

The ECM will send an Autostop state message to the body control module (BCM) and shut down the engine when all of the following criteria is met. The BCM will transmit the Autostop state message to the instrument cluster which will display the Autostop indicator in the tachometer display.

- Initial minimum vehicle speed during drive cycle must be 19 km/h (12 MPH) or greater.  
Subsequent autostop minimum speed may vary from 2-10 km/h (1-6 MPH), depending on vehicle
- Ambient and engine coolant temperature correlation meets specified values.
- Ambient and transmission fluid temperature correlation meets specified values.
- Hood switch status is closed
- Driver door status is closed
- Driver seat belt status is buckled
- Brake booster vacuum is greater than 45 kPa (7 PSI)
- Transmission gear selector is in the Drive position
- Vehicle speed is less than 5 km/h (3 MPH)
- Engine speed is below 1,500 RPM

- Engine coolant temperature is less than 120Å,Å°C (248Å,Å°F)
- Ambient temperature is greater than -10Å,Å°C (14Å,Å°F)
- No A/C compressor request from HVAC (A/C or Defrost modes)
- Battery voltage greater than 12 V
- Battery state of charge greater than 75% (changes with state of health)

**Autostop Enable Ambient and Engine Coolant Temperature Table**

| Ambient Temperature | Minimum Coolant Temperature | Autostop Enable |
|---------------------|-----------------------------|-----------------|
| -10Å,Å°C (14Å,Å°F)  | 60Å,Å°C (140Å,Å°F)          | Yes             |
| 0Å,Å°C (32Å,Å°F)    | 50Å,Å°C (122Å,Å°F)          | Yes             |
| 6Å,Å°C (43Å,Å°F)    | 40Å,Å°C (104Å,Å°F)          | Yes             |
| 12Å,Å°C (54Å,Å°F)   | 30Å,Å°C (86Å,Å°F)           | Yes             |
| 20Å,Å°C (68Å,Å°F)   | 18Å,Å°C (64Å,Å°F)           | Yes             |
| 30Å,Å°C (86Å,Å°F)   | 18Å,Å°C (64Å,Å°F)           | Yes             |

### Autostart Criteria

The ECM will send an Autostart state message to the BCM. If all of the following conditions are true the ECM and BCM will restart the vehicle.

Driver Enabled Conditions that will engage Autostart:

- Driver removes pressure from the brake or depresses the accelerator pedal while the vehicle is in the forward Drive gear

System Enabled Conditions that will engage Autostart

**NOTE:** If one or more of the following conditions occur, the system will force the engine to restart.

- Brake booster vacuum is less than 40 kPa (6 PSI)
- A/C compressor request from HVAC (A/C or Defrost modes)
- Battery voltage less than 11 V
- Battery state of charge is less than 73% (changes with state of health)
- Driver door status changes to open and driver seat belt status changes to unbuckled (not applicable to vehicles in North America)
- Hood switch status changes to open
- Autostop time exceeded 2 min

If the crank time exceeds 2 s, a manual ignition switch restart will be necessary.

### System Components

#### Engine Control Module (ECM)

The engine control module (ECM) monitors the inputs from the engine coolant temperature (ECT) sensor, vehicle speed sensor (VSS), hood ajar switch, brake booster vacuum sensor, the clutch pedal position sensor, the manual transmission neutral position switch and engine speed to determine Autostart and Autostop conditions. The ECM also controls the auxiliary coolant pump motor.

#### Transmission Control Module (TCM)

The transmission control module monitors the inputs from the transmission neutral safety switch to determine the driver selected gear. This information is transmitted to the ECM via serial data to support the Auto Stop Start algorithm.

#### Engine Coolant Temperature sensor

The ECT sensor is used to determine engine operating temperature.

### **Intake Air Temperature Sensor**

The ECM uses this sensor to monitor ambient air temperature. If too cold, the Autostop will not occur.

### **Inside air temperature sensor**

The HVAC control module monitors the passenger compartment temperature sensor to determine the temperature inside the passenger compartment. The HVAC control module sends this temperature reading to the ECM on the data communication circuit. The ECM uses this temperature values to determine if a restart is required based on the temperature inside the passenger compartment.

### **Vehicle speed sensor**

The vehicle speed sensor is used to determine vehicle speed. If vehicle speed is detected above a calculated value during an Autostop condition, the ECM will start the engine.

### **Hood Ajar Switch**

If the hood switch is in the open position, the vehicle will not Autostop. If the hood is opened during Autostop, the vehicle will automatically restart.

### **Brake Booster Vacuum Sensor**

The ECM monitors vacuum in order to ensure proper power assist for the brake pedal. If the ECM determines vacuum is too low, it will restart the engine.

### **Brake Pedal Position Sensor & Accelerator Pedal Position Sensor**

The ECM monitors both the brake pedal position sensor and the accelerator pedal position sensor to determine the level of activation for each. While the accelerator pedal is in its at rest position with no pressure applied by the operator, a partially depressed Brake pedal will cause the ECM to prepare the engine for an Autostop event. When the vehicle is in an auto stop event and the status of the brake pedal position sensor changes from meeting the autostop criteria to not meeting this criteria the engine will be restarted provided all of the other conditions to allow an autostart are met. If the Accelerator pedal is moved from its at rest position the vehicle will also enter an auto start event if all other conditions to support an autostart event, except for the brake pedal position, are met.

### **Transmission Gear Shift Position Switch**

The transmission gear shift position switch is used to determine if the transmission is in the proper state to allow an auto stop/start event. The ECM will not allow Autostop until the brake is engaged, the transmission is in the forward gear position and then the vehicle slows to below the minimum speed required to allow and autostop while meeting all of the other minimum criteria to support an autostop event.

### **Coolant Pump Motor**

The ECM will turn on the auxiliary coolant pump motor during Autostop to maintain engine operating temperature and also maintain HVAC temperature. Once the engine is running, the ECM will turn off the coolant pump motor.

### **Body Control Module (BCM)**

The body control module (BCM) monitors the ECO switch in order to enable or disable the system. It is also the master of the low speed communication bus and transfers the appropriate messages to the instrument cluster and the HVAC.

### **Battery Sensor Module**

The ECM monitors the battery sensor module for battery state of current, state of health, and battery charge via the data communication bus. If the battery is determined to be in poor state of health or having a low charge, the ECM will not allow Autostop to occur.

## ECO Switch

The ECO switch can change the vehicle air conditioning mode (off, comfort, and eco). In comfort mode, the priority for Stop/Start operation is on customer comfort. In eco mode, the priority is on fuel economy.

## Power Supply Transformer

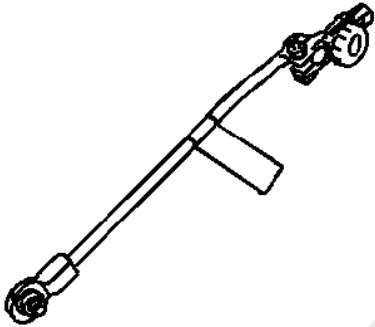
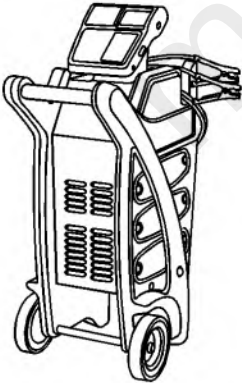
The DC to DC converter monitors battery voltage and will maintain operating voltage to the radio, instrument cluster and instrument panel displays. The DC to DC converter will provide a boosted voltage to sensitive loads during Autostart to ensure proper operation of the driver informational displays.

## Instrument Cluster

In order to differentiate between a normal engine shut down (engine speed 0 RPM) and when the engine has been shut down by the Stop/Start System, the tachometer needle will rest at the Autostop indicator icon (500 RPM point) indicating the engine has been shut down by the Stop/Start System. Once the engine is restarted, or the ECO button has disengaged Autostop, the tachometer will function normally.

## SPECIAL TOOLS AND EQUIPMENT

### SPECIAL TOOLS

| Illustration                                                                        | Tool Number/Description                                                                  |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
|   | EL 38758<br>EL 50074<br>J 38758<br>Parasitic Draw Test Switch                            |
|  | BC 800 W<br>BC 800 WP<br>EL 42000<br>EL 50076<br>J 42000<br>KM J-42000<br>Battery Tester |