

## 2004 ENGINE

### Engine Electrical - Vue

## SPECIFICATIONS

### FASTENER TIGHTENING SPECIFICATIONS

#### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Battery Hold Down Retaining Bolt	15 N.m	11 lb ft
Battery Negative Cable Terminal Bolt	17 N.m	13 lb ft
Battery Positive Cable Nut	17 N.m	13 lb ft
Battery Positive Cable Terminal Bolt	17 N.m	13 lb ft
Battery Tray Bolts	15 N.m	11 lb ft
Engine Mount Bolts	50 N.m	37 lb ft
Generator Bolts (L61)	22 N.m	16 lb ft
Generator Bolts (L66)	44 N.m	33 lb ft
Generator Terminal Nut (L61)	20 N.m	15 lb ft
Generator Terminal Nut (L66)	12 N.m	106 lb in
Ground Cable to Side Rail Bolt	20 N.m	15 lb ft
Ground to Transmission Nut	10 N.m	89 lb in
Remote Battery Terminal Nut	17 N.m	13 lb ft
Starter Motor Bolts (L61)	40 N.m	30 lb ft
Starter Motor Bolts (L66)	44 N.m	33 lb ft
Starter Solenoid B Terminal Nut	10 N.m	89 lb in
Starter-to-Engine Bolts	40 N.m	30 lb ft
Starter-to-Transmission Bolts	44 N.m	33 lb ft
S Terminal Nut	5 N.m	44 lb in
UHJB Bracket Nuts	12 N.m	106 lb in

### BATTERY USAGE

#### Battery Usage

Application	Specification
L61	
Cold Cranking Amperage	525 A
Reserve Capacity Rating	90 Minutes
Amp Hour Rating	54 AH
Replacement Battery Number	86-7YR
L66	

Cold Cranking Amperage	600 A
Reserve Capacity Rating	90 Minutes
Amp Hour Rating	54 AH
Replacement Battery Number	75-6YR

## STARTER MOTOR USAGE

### Starter Motor Usage

Application	Model
L61	PG-260D
L81	PG-260D

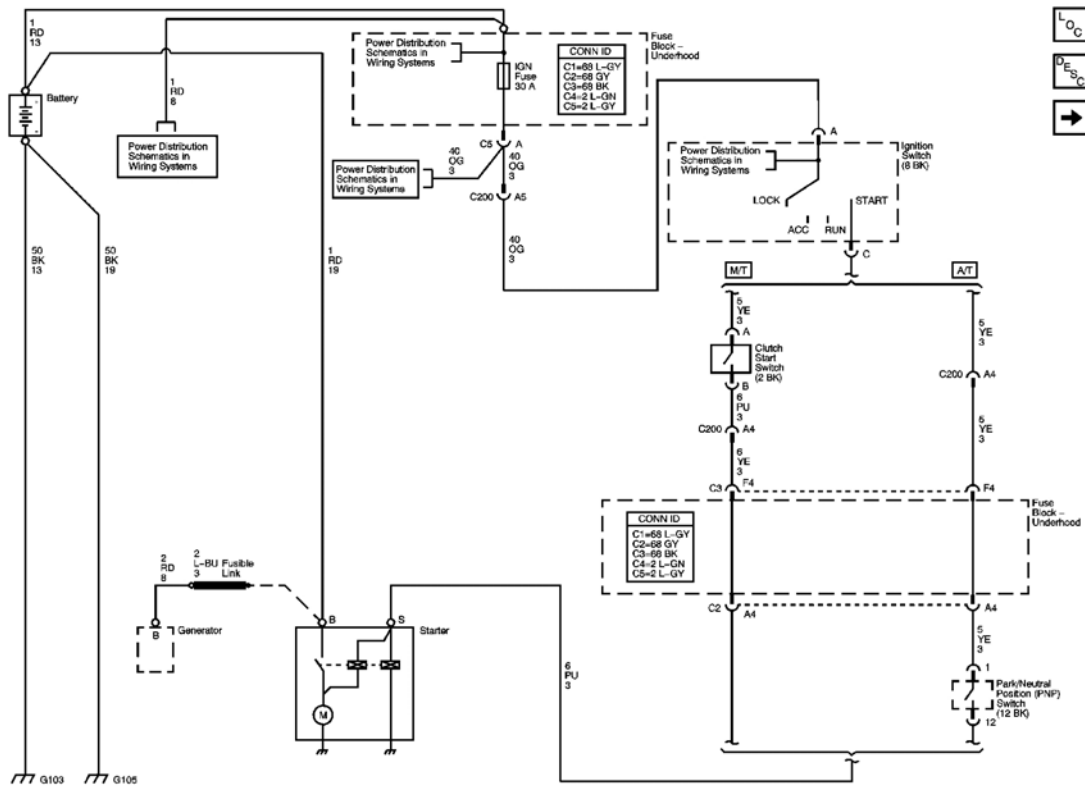
## GENERATOR USAGE

### Generator Usage

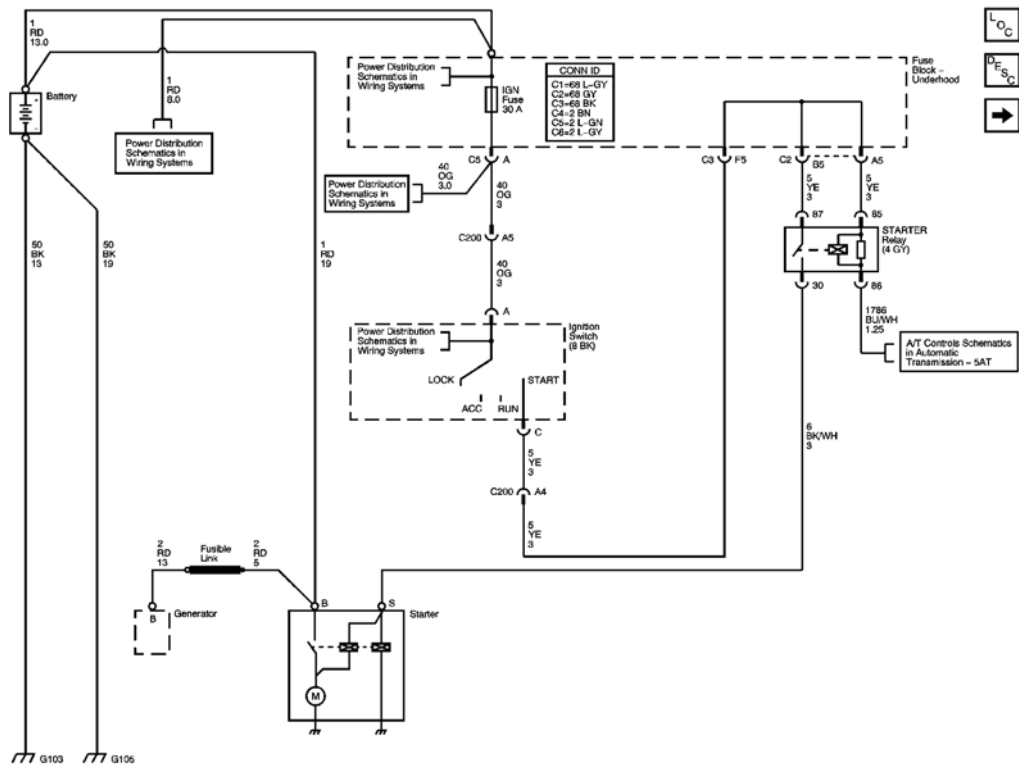
Application	Specification
2.2L (L61)	
Generator Model	Valeo SG10
Rated Output	105 A
3.5L (L66)	
Generator Model	Valeo SG12
Rated Output	125 A
Load Test Output	87 A

## SCHEMATIC AND ROUTING DIAGRAMS

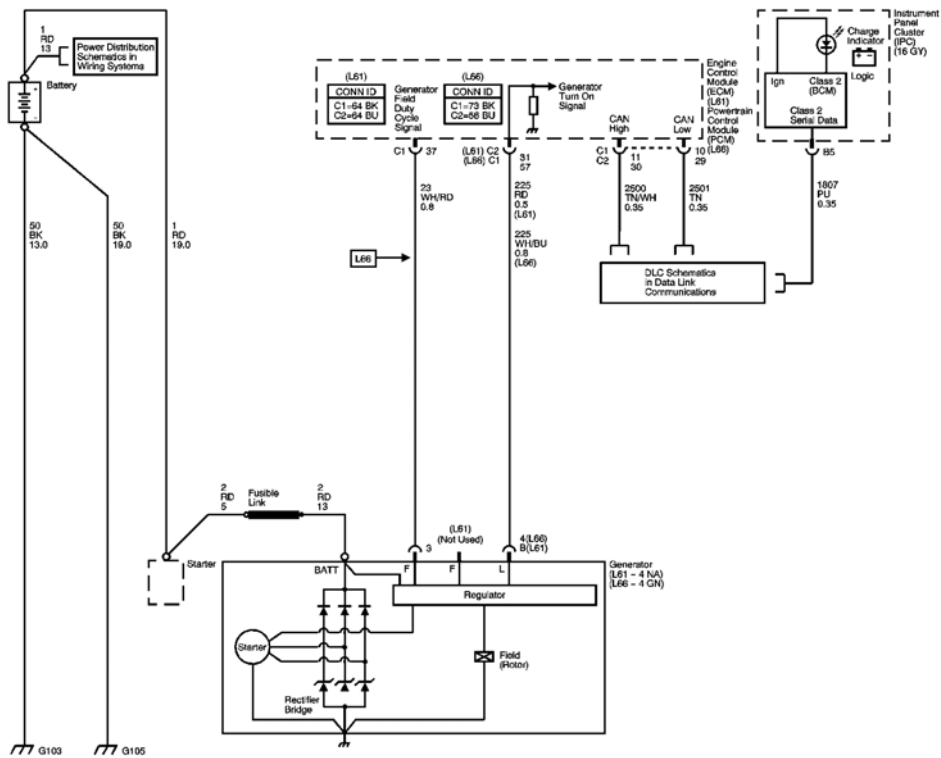
### STARTING AND CHARGING SCHEMATICS



**Fig. 1: Starting - L61 Schematics**  
 Courtesy of GENERAL MOTORS CORP.



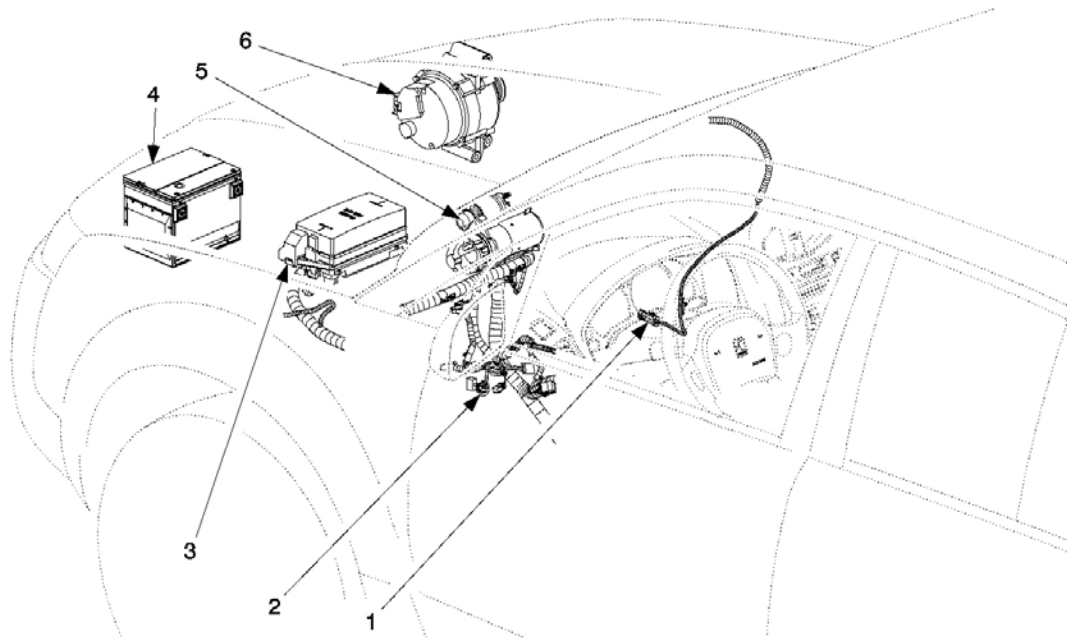
**Fig. 2: Starting - L66 Schematics**  
 Courtesy of GENERAL MOTORS CORP.



**Fig. 3: Charging and Indicators**  
 Courtesy of GENERAL MOTORS CORP.

## COMPONENT LOCATOR

## ENGINE ELECTRICAL COMPONENT VIEWS



**Fig. 4: Starting and Charging Components**  
 Courtesy of GENERAL MOTORS CORP.

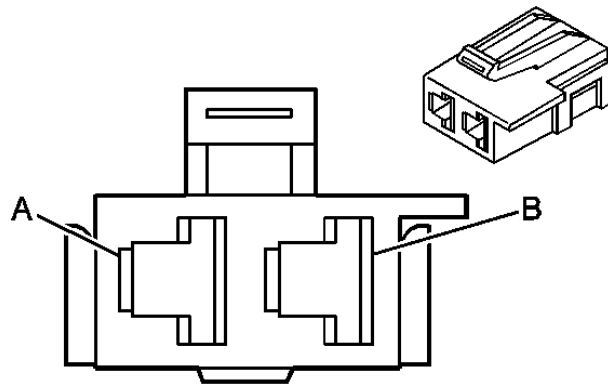
**Callouts For Fig. 4 Component View**

Callout	Component Name
1	Ignition Switch
2	Park/Neutral Position (PNP) Switch
3	Underhood Fuse Block
4	Battery
5	Starter
6	Generator

**ENGINE ELECTRICAL CONNECTOR END VIEWS**

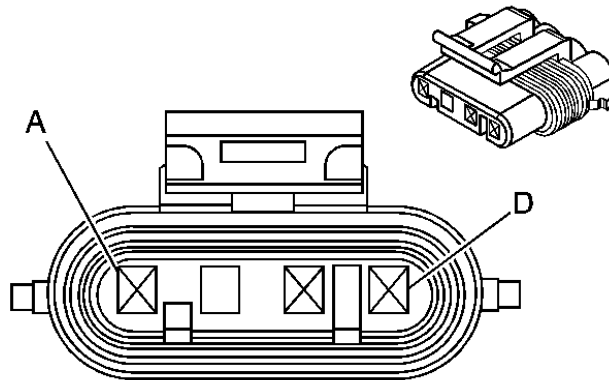
**Clutch Start Switch (w/M/T) Connector End View**





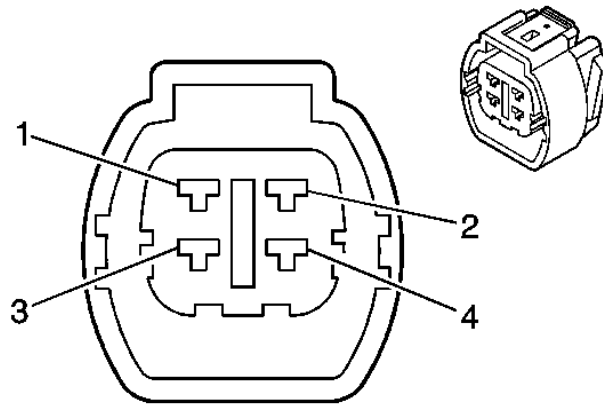
<b>Connector Part Information</b>		<ul style="list-style-type: none"> <li>• 12034417</li> <li>• 2-Way F Metri-Pack 480 Series (BK)</li> </ul>	
Pin	Wire Color	Circuit No.	Function
A	YE	5	Crank Voltage
B	PU	6	Starter Solenoid Crank Voltage

#### Generator (w/L61) Connector End View



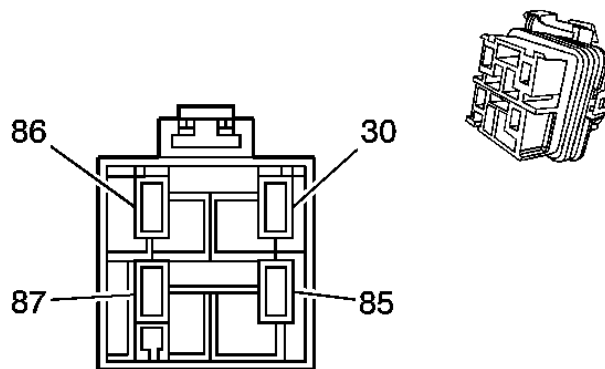
<b>Connector Part Information</b>		<ul style="list-style-type: none"> <li>• 12186566</li> <li>• 4-Way F Metri-Pack 150 Series Sealed (NA)</li> </ul>	
Pin	Wire Color	Circuit No.	Function
A	-	-	Not Used
B	RD	225	Generator Turn On Signal
C-D	-	-	Not Used

### Generator (w/L66) Connector End View



Connector Part Information		<ul style="list-style-type: none"> <li>• 6189-0545</li> <li>• 4-Way F HX Series (GN)</li> </ul>	
Pin	Wire Color	Circuit No.	Function
1-2	-	-	Not Used
3	WH/RD	23	Generator Field Duty Cycle Signal
4	WH/BU	225	Generator Turn On Signal

### Starter Relay (w/L66) Connector End View



Connector Part Information		<ul style="list-style-type: none"> <li>• 13008060</li> <li>• 4-Way F (GY)</li> </ul>	
Pin	Wire Color	Circuit No.	Function
30	BK/WH	6	Starter Solenoid Crank Voltage



85	YE	5	Crank Voltage
86	BU/WH	1786	Park/Neutral Signal
87	YE	5	Crank Voltage

## DIAGNOSTIC INFORMATION AND PROCEDURES

### DIAGNOSTIC STARTING POINT - ENGINE ELECTRICAL

Begin the system diagnosis with the **Diagnostic System Check - Engine Electrical** . The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

### DIAGNOSTIC SYSTEM CHECK - ENGINE ELECTRICAL

#### Test Description

The numbers below refer to the step numbers on the diagnostic table.

**3:** Lack of communication may be due to a partial malfunction of the class 2 serial data circuit or GM Lan circuit or due to a total malfunction of the class 2 serial data circuit. The specified procedure will determine the particular condition.

**4:** The symptom list in Symptoms will determine the correct diagnostic procedure to use.

**5:** The presence of DTCs which begin with "U" indicate some other module is not communicating. The specified procedure will compile all the available information before tests are performed.

#### Diagnostic System Check - Engine Electrical

Step	Action	Yes	No
1	Perform the Battery Inspection/Test. Refer to <b>Battery Inspection/Test (Side Terminal Battery)</b> <b>Battery Inspection/Test (Top Post Terminal Battery)</b> . Does the battery pass the test?	Go to <b>Step 2</b>	-
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF.  Does the scan tool power up?	Go to <b>Step 3</b>	Go to <b>Scan Tool Does Not Power Up</b> in Data Link Communications

3	<ol style="list-style-type: none"> <li>1. Turn ON the ignition, with the engine OFF.</li> <li>2. Attempt to communicate with each of the following modules on the class 2 serial data circuit: <ul style="list-style-type: none"> <li>• The body control module (BCM)</li> <li>• The engine control module (ECM)</li> </ul> </li> </ol> <p>Does the scan tool communicate with any module on the class 2 serial data circuit?</p>	Go to <b>Step 4</b>	Go to <b><u>Scan Tool Does Not Communicate with Class 2 Device</u></b> in Data Link Communications
4	<ol style="list-style-type: none"> <li>1. Select the Display DTCs function for the BCM and PCM.</li> <li>2. Record all of the displayed DTCs, the DTC status, and the module which set the DTC.</li> </ol> <p>Does the scan tool display any DTCs?</p>	Go to <b>Step 5</b>	Go to <b><u>Symptoms - Engine Electrical</u></b>
5	Does the scan tool display any DTCs which begin with "U"?	Go to <b><u>Scan Tool Does Not Communicate with Class 2 Device</u></b> in Data Link Communications	Go to <b>Step 6</b>
6	Does the scan tool display DTC B1000, or B1001?	Go to <b><u>Diagnostic Trouble Code (DTC) List</u></b> in Body Control System	Go to <b><u>Diagnostic Trouble Code (DTC) List</u></b>

## SCAN TOOL OUTPUT CONTROLS

### ECM

Scan Tool Output Control	Additional Menu Selection (s)	Description
Engine Output Controls	GEN L-Terminal	The engine control module (ECM) commands the generator OFF by removing the 5-volt reference signal from the L terminal of the voltage regulator when you select OFF. The generator will then stop generating an output voltage.

### IPC

Scan Tool Output Control	Additional Menu Selection(s)	Description
		The IPC illuminates the following indicators when you select ON:

Lamp and Gage Check	-	<ul style="list-style-type: none"> <li>• ABS</li> <li>• Air Bag</li> <li>• BRAKE</li> <li>• Charge</li> <li>• Fasten Safety Belt</li> <li>• High Beam</li> <li>• Low Oil Pressure</li> <li>• LOW TRAC</li> <li>• Upshift Indicator</li> </ul> <p>The IPC drives the following gages to maximum position when you select On:</p> <ul style="list-style-type: none"> <li>• Engine Coolant Temperature Gage</li> <li>• Fuel Gage</li> <li>• Speedometer</li> <li>• Tachometer</li> </ul> <p>The indicators should stay illuminated and all gages remain at maximum until commanded OFF. When commanded off, the indicators should turn off and all gages should remain at the minimum position until the test is exited or commanded ON.</p>
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## SCAN TOOL DATA LIST

### Body Control Module (BCM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
<b>Ignition ON/Engine OFF</b>			
Battery 1	Ignition	Volts	12.6 Volts

### Engine Control Module (ECM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
<b>Ignition ON/Engine OFF/Clutch Depressed or Transmission in Park or Neutral</b>			
Generator L-Terminal	General Info - Inputs	On/Off	Off
Ignition 1	General Info - Outputs	Volts	12.6 Volts

## SCAN TOOL DATA DEFINITIONS

### Battery 1

The scan tool displays 0-20 Volts. The scan tool displays the voltage as received on the battery positive voltage circuit of the BCM.

## Generator L-Terminal

The scan tool displays On/Off. The scan tool displays Off until the engine is running, then the ECM supplies then the percentage value varies depending on electrical loads

## Ignition 1

The scan tool displays 0-20 Volts. The scan tool displays the voltage as received on the Ignition 1 circuit to the ECM.

## DIAGNOSTIC TROUBLE CODE (DTC) LIST

### Diagnostic Trouble Code (DTC) List

DTC	Diagnostic Procedure	Modules
B1325	<u>DTC B1325</u>	BCM
B1327	<u>DTC B1327</u>	BCM, ONS
B1328	<u>DTC B1328</u>	BCM, ONS
P0562	<u>DTC P0562</u>	ECM
P0563	<u>DTC P0563</u>	ECM
P0621	<u>DTC P0621</u>	ECM
P0622	<u>DTC P0622</u>	ECM

## DTC B1325

### Circuit Description

The body control module (BCM) monitors the battery voltage through the VBATT1 circuit.

A type information accompanies the DTC. Refer to **DTC Symptom Description** in Vehicle DTC Information.

### Conditions for Running the DTC

The voltage supplied to the BCM is in the range of 7-26 volts.

### Conditions for Setting the DTC

- DTC B1325 Type 03:
  - The BCM detects a system voltage below 9.0 volts.
  - The above condition is present for at least 5 seconds.
- DTC B1325 Type 07:
  - The BCM detects a system voltage above 18.0 volts.

- The above condition is present for at least 5 seconds.

### Action Taken When the DTC Sets

- The BCM immediately disables all outputs when a high voltage condition was detected, with the exception of GMLAN and Run/Crank relay that are disabled after a 3 minute delay.
- The setting of other DTCs is inhibited.

### Conditions for Clearing the DTC

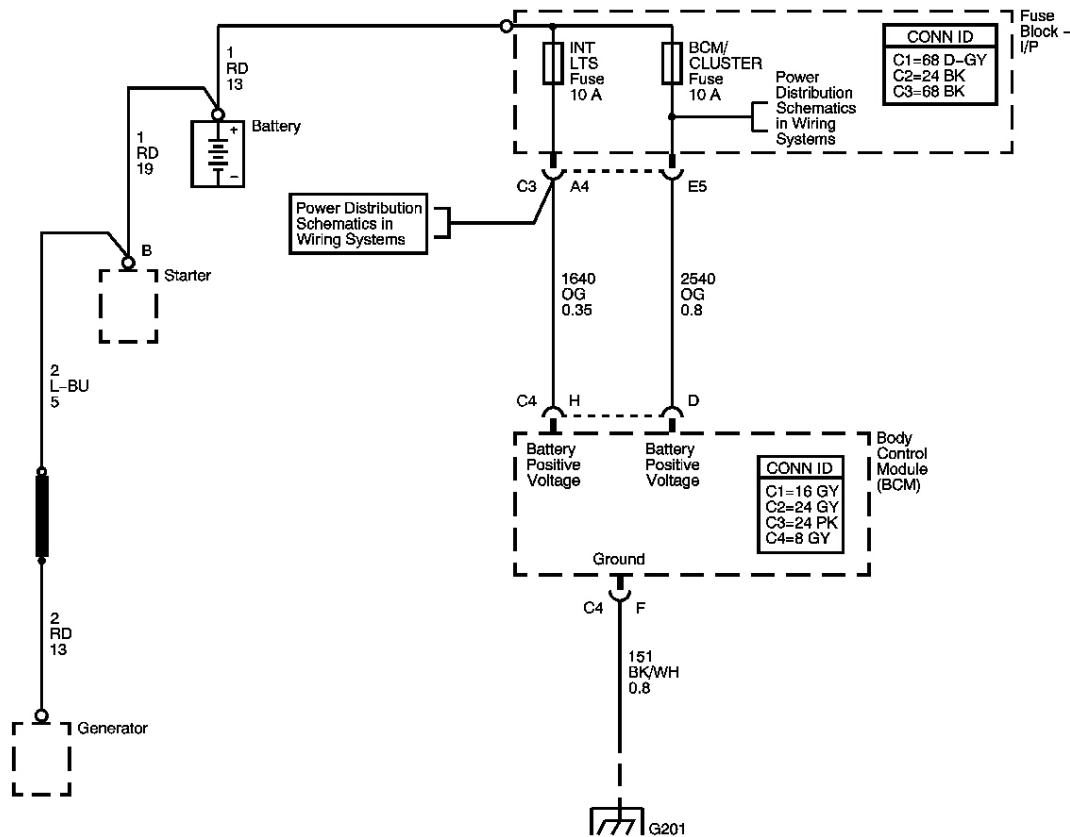
- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

### DTC B1325 Circuit

Step	Action	Values	Yes	No
<b>Schematic Reference:Body Control System Schematics</b> in Body Control System <b>Connector End View Reference:Body Control System Connector End Views</b> in Body Control System				
1	Did you perform the Diagnostic System Check for Engine Electrical?	-	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Engine Electrical</b>
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the Battery Voltage Input parameters in the BCM input data list.  Is the Battery Voltage Input parameter displayed in the specified range?	9.0-18.0 V	Go to <b>Step 3</b>	Go to <b>Step 4</b>
3	Is the DTC set as a current DTC?	-	Go to <b>Step 7</b>	Go to <b>Testing for Intermittent Conditions and Poor Connections</b> in Wiring Systems
4	1. Disconnect the BCM harness connectors. 2. Measure the voltage between the VBATT1 circuit at the BCM harness connector and a good ground. Refer to Circuit Description.  Is the measured value in the specified range?	9.0-18.0 V	Go to <b>Step 6</b>	Go to <b>Step 5</b>
5	Test the VBATT1 circuit for a short to ground or an open. Refer to Circuit Description. Did you find and correct the condition?	-	Go to	Go to <b>Battery Inspection/Test (Side Terminal Battery)Battery Inspection/Test (Top Post</b>

			<b>Step 9</b>	<b>Terminal Battery)</b>
6	Test the all of ground circuits of the BCM for an open or high resistance. Did you find and correct the condition?	-	Go to <b>Step 9</b>	Go to <b>Step 7</b>
7	Inspect for poor connections at the module harness connectors. Refer to <b>Testing for Intermittent Conditions and Poor Connections</b> and <b>Connector Repairs</b> in Wiring Systems. Did you find and correct the condition?	-	Go to <b>Step 9</b>	Go to <b>Step 8</b>
8	<b>IMPORTANT:</b> <b>Perform the module setup procedure if required.</b>  Replace the BCM. Refer to <b>Body Control Module Replacement</b> in Body Control System. Did you complete the replacement?	-	Go to <b>Step 9</b>	-
9	Operate the system in order to verify the repair. Did you find and correct the condition?	-	System OK	Go to <b>Step 2</b>

**DTC B1327**



**Fig. 5: DTC B1327 Circuit**  
 Courtesy of GENERAL MOTORS CORP.

### Circuit Description

The body control module (BCM) has an internal voltage sensor with a dedicated circuit that checks the battery positive voltage and battery negative circuit voltage to determine if it is above 8.7 volts.

### Conditions for Running the DTC

This DTC shall run only if the BCM has power, ground and the ignition is not in START mode. This DTC shall execute regardless of the battery voltage.

### Conditions for Setting the DTC

- This DTC shall be set as current when the voltage falls below 8.7 volts for 1,200 milliseconds.
- When the vehicle exits START the BCM shall delay checking the voltage for 2 seconds.

### Action Taken When the DTC Sets

- The ECM will not illuminate the charge indicator.
- A message shall be sent out on the class 2 lines to notify all other modules of low battery voltage.

### Conditions for Clearing the MIL/DTC

In order to clear the DTC from a current status the ignition must be cycled and the voltage shall be greater than 9.0 volts.

### Test Description

The number below refers to the step number on the diagnostic table.

**3:** Compares battery voltage with the voltage that the BCM calculates.

### DTC B1327 Circuit

Step	Action	Value (s)	Yes	No
<b>Connector End View Reference:</b> <u>Inline Harness Connector End Views</u> in Wiring Systems or <b>Body Control System Connector End Views</b> in Body Control System				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Engine Electrical</u></b>
2	<ol style="list-style-type: none"> <li>1. Install a scan tool.</li> <li>2. Turn ON the ignition, with the engine OFF.</li> <li>3. With a scan tool, observe the Battery 1 parameter in the Ignition data list of the body control module (BCM).</li> </ol> <p>Does the scan tool indicate the battery voltage is greater than the specified value?</p>	8.8 V	Go to <b>Step 5</b>	Go to <b>Step 3</b>
3	<ol style="list-style-type: none"> <li>1. Measure the voltage across the battery terminals.</li> <li>2. Compare the battery voltage with the Battery 1 parameter in the Ignition data list of the BCM.</li> </ol> <p>Are the voltages within the specified value?</p>	1.0 V	Go to <b><u>Battery Inspection/Test (Side Terminal Battery)</u></b> <b><u>Battery Inspection/Test (Top Post Terminal Battery)</u></b>	Go to <b>Step 5</b>
	Test the battery voltage and ground circuits of the BCM for a high resistance.			



4	Refer to <b>Circuit Testing</b> and <b>Wiring Repairs</b> in Wiring Systems. Did you find and correct the condition?	-	Go to <b>Step 7</b>	Go to <b>Step 5</b>
5	Inspect for poor connections at the harness connector of the BCM. Refer to <b>Testing for Intermittent Conditions and Poor Connections</b> and <b>Connector Repairs</b> in Wiring Systems. Did you find and correct the condition?	-	Go to <b>Step 7</b>	Go to <b>Step 6</b>
6	<b>IMPORTANT:</b> <b>Perform the setup procedure for the BCM.</b>  Replace the BCM. Refer to <b>Body Control Module Replacement</b> in Body Control Systems. Did you complete the replacement?	-	Go to <b>Step 7</b>	-
7	1. Use the scan tool in order to clear the DTC. 2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text.  Does the DTC reset?	-	Go to <b>Step 2</b>	System OK

## DTC B1328

### Circuit Description

The body control module (BCM) has an internal voltage sensor with a dedicated circuit that checks the battery positive voltage and battery negative circuit voltage to determine if it is below 18.0 volts.

### Conditions for Running the DTC

This DTC shall run only if the BCM has power, ground and the ignition is not in START mode. This DTC shall execute regardless of the battery voltage.

### Conditions for Setting the DTC

This DTC shall be set as current when the voltage raises above 18.0 volts for 1,200 milliseconds.

### Action Taken When the DTC Sets

- The ECM will not illuminate the charge indicator.
- This DTC shall be set as current when the voltage raises above 17.0 volts for 1,200 milliseconds.

A message shall be sent out on the class 2 lines to notify all other modules of low battery voltage.

### Conditions for Clearing the MIL/DTC

In order to clear the DTC from a current status the ignition must be cycled and the voltage shall be less than 17.0 volts.

### Test Description

The number below refers to the step number on the diagnostic table.

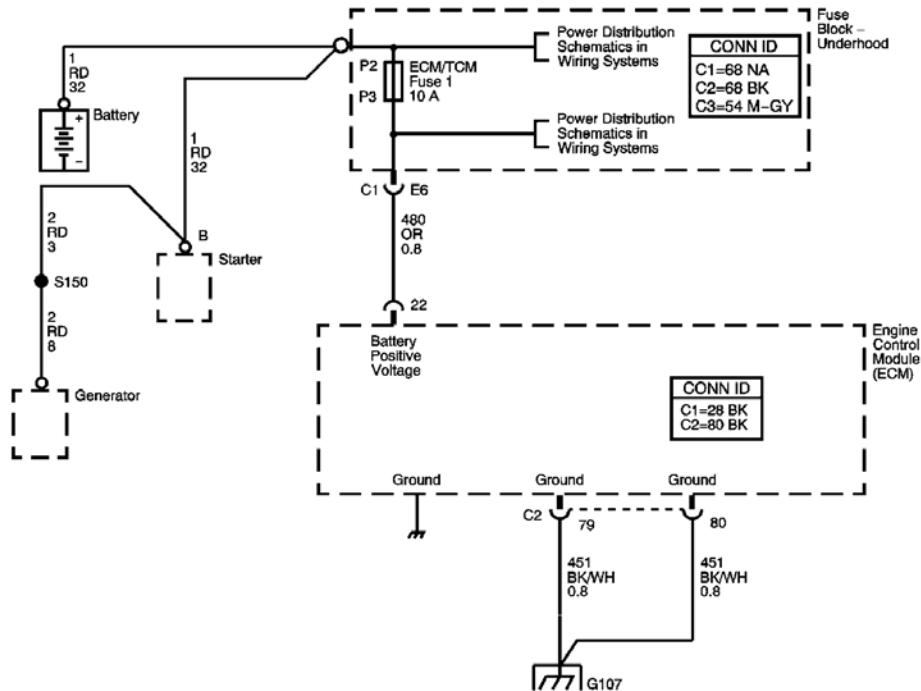
**3:** Compares battery voltage with the voltage that the BCM calculates.

### DTC B1328 Circuit

Step	Action	Value (s)	Yes	No
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Engine Electrical</b>
2	<ol style="list-style-type: none"> <li>1. Install a scan tool.</li> <li>2. Start the engine</li> <li>3. Increase engine speed to above 1,500 RPM.</li> <li>4. With a scan tool, observe the Battery 1 parameter in the Ignition data list of the BCM.</li> </ol> <p>Does the scan tool indicate the battery voltage is less than the specified value?</p>	17.0 V	Go to <b>Step 4</b>	Go to <b>Step 3</b>
3	<ol style="list-style-type: none"> <li>1. Measure the voltage across the battery terminals.</li> <li>2. Compare the battery voltage with the Battery 1 parameter in the Ignition data list of the BCM.</li> </ol> <p>Are the voltages within the specified value?</p>	1.0 V	Go to <b>Charging System Test</b>	Go to <b>Step 4</b>
4	<p>Inspect for poor connections at the harness connector of the BCM. Refer to <b>Testing for Intermittent Conditions and Poor Connections</b> and <b>Connector Repairs</b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to <b>Step 6</b>	Go to <b>Step 5</b>
5	<p><b>IMPORTANT:</b> <b>Perform the setup procedure for the BCM.</b></p> <p>Replace the BCM. Refer to <b>Body Control Module Replacement</b> in Body Control Systems. Did you complete the replacement?</p>	-	Go to <b>Step 6</b>	-

6	<ol style="list-style-type: none"> <li>1. Use the scan tool in order to clear the DTC.</li> <li>2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text.</li> </ol>	-	<p>Go to <b>Step 2</b></p> <p>System OK</p>
Does the DTC reset?			

## DTC P0562



**Fig. 6: DTC P0562 Circuit**

Courtesy of GENERAL MOTORS CORP.

### Circuit Description

The ECM checks the system voltage to make sure that the voltage stays within the proper range. Damage to components, and incorrect input can occur when the voltage is out of range. The ECM monitors the system voltage over an extended length of time. If the ECM detects an excessively low system voltage, DTC P0562 will set.

### Conditions for Running the DTC

System voltage between 9.5 and 18 volts.

### Conditions for Setting the DTC

- The ECM detects a system voltage below 10.5 Volts for 4 minutes.
- Engine speed above 1,300 RPM.

#### Action Taken When the DTC Sets

- The ECM will not illuminate the charge indicator.
- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store conditions which were present when the DTC set as Fail Records data only.

#### Conditions for Clearing the DTC

- The ECM will command the message OFF after one trip in which the diagnostic test has been run and passed.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using the scan tool Clear DTC Information function.

#### DTC P0562 Circuit

Step	Action	Value (s)	Yes	No
<b>Connector End View Reference: Engine Electrical Connector End Views , Engine Control Module (ECM) Connector End Views in Engine Controls - 2.2L (L61), or Powertrain Control Module (PCM) Connector End Views in Engine Controls - 3.5L (L66)</b>				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to <b>Step 3</b>	Go to <b><u>Diagnostic System Check - Engine Electrical</u></b>
2	<ol style="list-style-type: none"> <li>1. Install a scan tool.</li> <li>2. Operate the vehicle within the conditions for running the DTC as specified in the supporting text.</li> <li>3. Using the scan tool, observe the specific DTC Information for DTC P0562 until the test runs.</li> </ol> <p>Does the scan tool indicate that DTC P0562 has passed this ignition cycle?</p>	-	Go to <b><u>Testing for Intermittent Conditions and Poor Connections in Wiring Systems</u></b>	Go to <b>Step 3</b>
3	<ol style="list-style-type: none"> <li>1. Start the engine.</li> <li>2. Turn Off all accessories.</li> <li>3. With a scan tool, observe the Ignition 1 parameter in the ECM data list.</li> </ol> <p>Does the scan tool indicate that the Ignition 1</p>	10.5 V		

	parameter is greater than the specified range?		Go to <b>Step 7</b>	Go to <b>Step 4</b>
4	Measure the voltage at the battery terminals and compare it with the Ignition 1 parameter in the ECM data list. Are the battery voltage and ECM Ignition 1 readings different by more than the value specified?	0.5 V	Go to <b>Step 5</b>	Go to <b>Charging System Test</b>
5	Test the battery positive voltage circuit of the ECM for a high resistance. Refer to <b>Circuit Testing</b> and <b>Wiring Repairs</b> in Wiring Systems. Did you find and correct the condition?	-	Go to <b>Step 8</b>	Go to <b>Step 6</b>
6	Inspect for poor connections at the harness connector of the ECM. Refer to <b>Testing for Intermittent Conditions and Poor Connections</b> and <b>Connector Repairs</b> in Wiring Systems. Did you find and correct the condition?	-	Go to <b>Step 8</b>	Go to <b>Step 7</b>
7	<b>IMPORTANT:</b> <b>The replacement ECM must be programmed.</b>  Replace the ECM. Refer to <b>Engine Control Module (ECM) Replacement</b> in Engine Controls - 2.2L (L61) or <b>Powertrain Control Module (PCM) Replacement</b> in Engine Controls - 3.5L (L66) Did you complete the replacement?	-	Go to <b>Step 8</b>	-
8	1. Review and record the scan tool Fail Records data. 2. Use the scan tool in order to clear the DTC. 3. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. 4. Using the scan tool, observe the Specific DTC Information for DTC P0562 until the test runs.  Does the scan tool indicate that DTC P0562 failed this ignition?	-	Go to <b>Step 3</b>	System OK

## DTC P0563

### Circuit Description

The ECM checks the system voltage to make sure that the voltage stays within the proper range. Damage to

components, and incorrect input can occur when the voltage is out of range. The ECM monitors the system voltage over an extended length of time. If the ECM detects an excessively high system voltage, DTC P0563 will set.

### Conditions for Running the DTC

System voltage between 9.5 and 18 volts.

### Conditions for Setting the DTC

The ECM detects a system voltage above 18.0 volts for 5 seconds.

### Action Taken When the DTC Sets

- The ECM will not illuminate the charge indicator.
- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store conditions which were present when the DTC set as Fail Records data only.

### Conditions for Clearing the DTC

- The ECM will command the message OFF after one trip in which the diagnostic test has been run and passed.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using the scan tool Clear DTC Information function.

### DTC P0563 Circuit

Step	Action	Value (s)	Yes	No
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Engine Electrical</u></b>
2	<ol style="list-style-type: none"> <li>1. Install a scan tool.</li> <li>2. Operate the vehicle within the conditions for running the DTC as specified in the supporting text.</li> <li>3. Using the scan tool, observe the specific DTC Information for DTC P0563 until the test runs.</li> </ol> <p>Does the scan tool indicate that DTC P0563 has passed this ignition cycle?</p>	-	Go to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> in Wiring Systems	Go to <b>Step 3</b>
	<ol style="list-style-type: none"> <li>1. Start the engine.</li> </ol>			

3	<p>2. With a scan tool, observe the Ignition 1 parameter in the ECM data list.</p> <p>Does the scan tool indicate that the Ignition 1 Signal parameter is less than the specified range?</p>	17.5 V		Go to <b>Step 5</b>	Go to <b>Step 4</b>
4	<p>Measure the voltage at the battery terminals and compare it with the Ignition 1 parameter in the ECM data list</p> <p>Are the battery voltage and ECM Ignition 1 readings different by more than the value specified?</p>	0.5 V		Go to <b>Step 5</b>	Go to <b>Charging System Test</b>
5	<p><b>IMPORTANT:</b> <b>The replacement ECM must be programmed.</b></p> <p>Replace the ECM. Refer to <b>Engine Control Module (ECM) Replacement</b> in Engine Controls - 2.2L (L61) or <b>Powertrain Control Module (PCM) Replacement</b> in Engine Controls - 3.5L (L66) Did you complete the replacement?</p>	-		Go to <b>Step 6</b>	-
6	<ol style="list-style-type: none"> <li>1. Review and record the scan tool Fail Records data.</li> <li>2. Use the scan tool in order to clear the DTC.</li> <li>3. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text.</li> <li>4. Using the scan tool, observe the Specific DTC Information for DTC P0563 until the test runs.</li> </ol> <p>Does the scan tool indicate that DTC P0563 failed this ignition?</p>	-		Go to <b>Step 3</b>	System OK

## DTC P0621

### Circuit Description

The engine control module (ECM) uses the generator turn on signal circuit to control the load of the generator on the engine. A high side driver in the ECM applies a voltage to the voltage regulator. When the ECM turns ON the high side driver, the voltage regulator turns ON the field circuit. When the ECM turns OFF the high side driver, the voltage regulator turns OFF the field circuit.

The ECM monitors the state of the generator turn on signal circuit. With the engine running, the ECM should detect a high generator turn on signal circuit, or when the charging system malfunctions. If the ECM detects a

low generator turn on signal circuit DTC P0621 will set. When the DTC sets, the ECM will send a class 2 serial data message to the instrument panel cluster (IPC) to illuminate the charge indicator.

### Conditions for Running the DTC

#### Key ON Test

- The key is in the ON position for 5 seconds.
- The engine is OFF.

#### Engine Run Test

- The engine is running.
- The engine speed is less than 3,000 RPM.

### Conditions for Setting the DTC

During key ON test, the ECM detects a high signal voltage on the generator turn on signal circuit for at least 5 seconds.

During the RUN test, the ECM detects a low signal voltage on the generator turn on signal circuit for at least 10 seconds.

### Action Taken When the DTC Sets

- The ECM sends a class 2 message to the IPC to illuminate the charge indicator.
- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store the conditions present when the DTC set as Fail Records data only.
- The Service Vehicle Soon (SVS) light may be illuminated.

### Conditions for Clearing the MIL/DTC

- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using the scan tool Clear DTC Information function.

### DTC P0621 Circuit

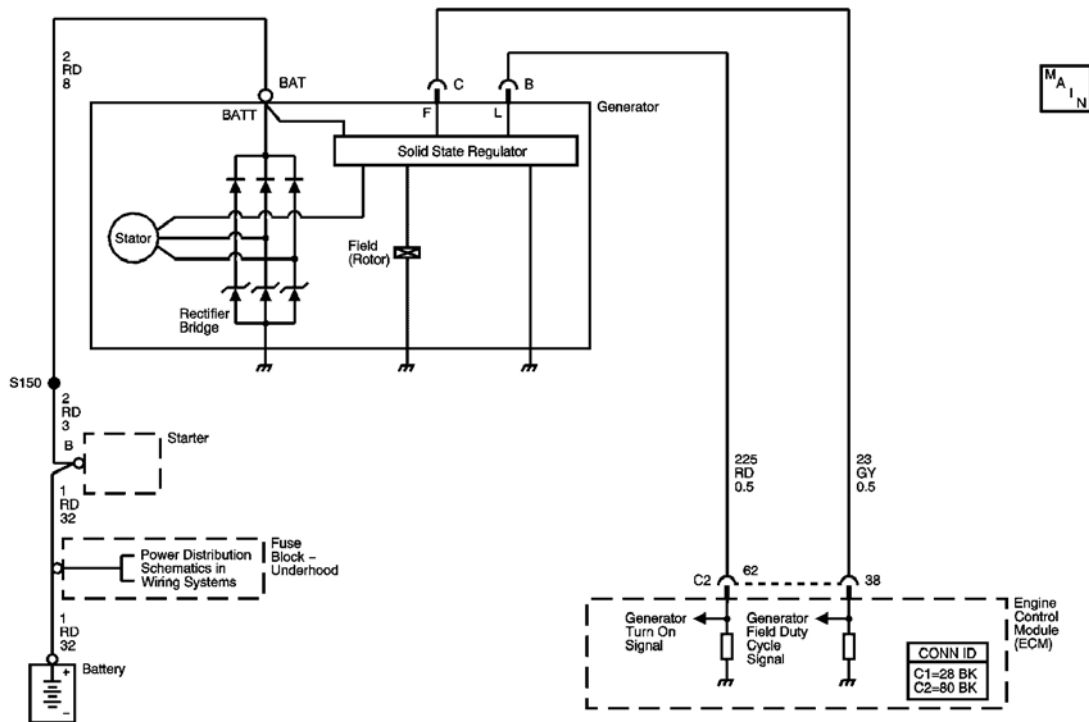
Step	Action	Values	Yes	No
<b>Connector End View Reference: Engine Electrical Connector End Views , Engine Control Module (ECM) Connector End Views in Engine Controls - 2.2L (L61), or Powertrain Control Module (PCM) Connector End Views in Engine Controls - 3.5L (L66)</b>				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Engine Electrical</b>



2	<ol style="list-style-type: none"> <li>1. Install a scan tool.</li> <li>2. Operate the vehicle within the conditions for running the DTC as specified in the supporting text.</li> <li>3. Using the scan tool, observe the specific DTC Information for DTC P0621 until the test runs.</li> </ol> <p>Does the scan tool indicate that DTC P0621 has passed this ignition cycle?</p>	-	<p>Go to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> in Wiring Systems</p>	Go to <b>Step 3</b>
3	<ol style="list-style-type: none"> <li>1. Start the engine.</li> <li>2. With a scan tool, while observing the Ignition 1 parameter in the engine controls data list, command the Generator L-Terminal Off for 5 seconds and then back on.</li> </ol> <p>Does the scan tool indicate a change in voltage each time the Generator L - Terminal is commanded Off and On?</p>	-	Go to <b>Step 6</b>	Go to <b>Step 4</b>
4	<ol style="list-style-type: none"> <li>1. Turn OFF the ignition.</li> <li>2. Disconnect the generator harness connector.</li> <li>3. Start the engine.</li> <li>4. Measure the voltage between the generator turn on signal circuit of the generator harness connector and a good ground.</li> </ol> <p>Is the voltage within the specified range.</p>	4.5-5.5 V	Go to <b>Step 7</b>	Go to <b>Step 5</b>
5	<p>Test the generator turn on signal circuit for a short, high resistance or open. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to <b>Step 10</b>	Go to <b>Step 8</b>
6	<p>Test the generator battery voltage output circuit for a high resistance or open. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to <b>Step 10</b>	Go to <b><u>Charging System Test</u></b>
7	<p>Inspect for poor connections at the harness connector of the generator. Refer to <b><u>Connector Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to <b>Step 10</b>	Go to <b><u>Charging System Test</u></b>

8	<p>Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to <b>Connector Repairs</b> in Wiring Systems. Did you find and correct the condition?</p>	-	Go to <b>Step 10</b>	Go to <b>Step 9</b>
9	<p><b>IMPORTANT:</b>  <b>The replacement ECM must be programmed.</b></p> <p>Replace the ECM. Refer to <b>Engine Control Module (ECM) Replacement</b> in Engine Controls - 2.2L (L61) or <b>Powertrain Control Module (PCM) Replacement</b> in Engine Controls - 3.5L (L66). Did you complete the replacement?</p>	-	Go to <b>Step 10</b>	-
10	<ol style="list-style-type: none"> <li>1. Review and record the scan tool Fail Records data.</li> <li>2. Use the scan tool in order to clear the DTC.</li> <li>3. Operate the vehicle within the Conditions for Running DTC P0621 as specified in the supporting text.</li> <li>4. Using the scan tool, observe the Specific DTC Information for DTC P0621 until the test runs.</li> </ol> <p>Does the scan tool indicate that DTC P0621 failed?</p>	-	Go to <b>Step 3</b>	System OK

## DTC P0622



**Fig. 7: DTC P0622 Circuit**

Courtesy of GENERAL MOTORS CORP.

### Circuit Description

The engine control module (ECM) uses the generator field duty cycle signal circuit to monitor the duty cycle of the generator. The generator field duty cycle signal circuit connects to the high side of the field winding in the generator. A pulse width modulated (PWM) high side driver in the voltage regulator turns the field winding 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 state of the generator field duty cycle signal circuit. When the key is in the RUN position and the engine is OFF, the ECM should detect a duty cycle near 0 percent. However, when the engine is running, the duty cycle should be between 5 percent and 100 percent. The ECM monitors the PWM signal, if the ECM detects an out of range PWM signal, DTC P0622 will set. When the DTC sets, the ECM will send a class 2 serial data message to the IPC to illuminate the charge indicator.

### Conditions for Running the DTC

#### Key ON Test

- No generator, CKP sensors, or CMP sensor DTCs are set.
- The key is in the RUN position.
- The engine is not running.

## Run Test

- No generator, CKP sensors, or CMP sensor DTCs are set.
- The engine speed is less than 3,000 RPM.

## Conditions for Setting the DTC

- During the key ON test, the ECM detects a PWM signal greater than 65 percent for at least 5 seconds.
- During the RUN test, the ECM detects a PWM signal less than 5 percent for at least 15 seconds.

## Action Taken When the DTC Sets

- The ECM sends a class 2 message to the IPC to illuminate the charge indicator.
- The ECM will not illuminate the malfunction indicator lamp (MIL).
- The ECM will store the conditions present when the DTC set as Fail Records data only.
- The Service Vehicle Soon (SVS) light may be illuminated.

## Conditions for Clearing the MIL/DTC

- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using the scan tool Clear DTC Information function.

## DTC P0622 Circuit

Step	Action	Value (s)	Yes	No
<b>Connector End View Reference: Engine Electrical Connector End Views , Engine Control Module (ECM) Connector End Views</b> in Engine Controls - 2.2L (L61), or <b>Powertrain Control Module (PCM) Connector End Views</b> in Engine Controls - 3.5L (L66)				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Engine Electrical</b>
2	1. Install a scan tool. 2. Start the engine. 3. With a scan tool, observe the GEN - F Terminal parameter in the engine control module (ECM) data list.  Does the scan tool indicate that the GEN - F Terminal parameter is within the specified range?	5-95%	Go to <b>Step 3</b>	Go to <b>Step 4</b>
3	With the scan tool command the generator OFF. Does the GEN - F Terminal signal parameter change?	-	Go to <b>Testing for Intermittent Conditions and Poor</b>	

			<u>Connections</u> in Wiring Systems	Go to <b>Step 4</b>
4	<ol style="list-style-type: none"> <li>1. Turn OFF the ignition.</li> <li>2. Disconnect the generator harness connector.</li> <li>3. Connect test lamp to battery positive voltage.</li> <li>4. Turn ON the ignition, with the engine OFF.</li> <li>5. Probe the F-Terminal in the generator connector.</li> <li>6. Observe the GEN - F Terminal Signal parameter in the ECM data list.</li> </ol> <p>Is the GEN - F Terminal Signal parameter near the specified value?</p>	100%	Go to <b>Charging System Test</b>	Go to <b>Step 5</b>
5	<p>Test the generator field duty cycle signal circuit for a short or open. Refer to <b>Circuit Testing</b> and <b>Wiring Repairs</b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to <b>Step 8</b>	Go to <b>Step 6</b>
6	<p>Inspect for poor connections at the harness connector of the ECM. Refer to <b>Connector Repairs</b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to <b>Step 8</b>	Go to <b>Step 7</b>
7	<p><b>IMPORTANT:</b> <b>The replacement ECM must be programmed.</b></p> <p>Replace the ECM. Refer to <b>Engine Control Module (ECM) Replacement</b> in Engine Controls - 2.2L (L61) or <b>Powertrain Control Module (PCM) Replacement</b> in Engine Controls - 3.5L (L66). Did you complete the replacement?</p>	-	Go to <b>Step 8</b>	-
8	<ol style="list-style-type: none"> <li>1. Review and record the scan tool Fail Records data.</li> <li>2. Clear any DTCs.</li> <li>3. Operate the vehicle within the Fail Records conditions as noted.</li> <li>4. Using a scan tool, monitor the Specific DTC info for this DTC.</li> </ol> <p>Does the scan tool indicate that this DTC failed this ignition?</p>	-	Go to <b>Step 2</b>	System OK

## SYMPTOMS - ENGINE ELECTRICAL

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

- Perform **Diagnostic System Check - Engine Electrical** 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**
  - **Starting System Description and Operation**
  - **Charging 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** in Wiring Systems.
- 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** in Wiring Systems.

### Symptom List

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

- **Starter Solenoid Does Not Click**
- **Starter Solenoid Clicks, Engine Does Not Crank**
- **Engine Cranks Slowly**
- **Charge Indicator Always On**
- **Charge Indicator Inoperative**
- **Battery Inspection/Test (Side Terminal Battery) or Battery Inspection/Test (Top Post Terminal Battery)**
- **Battery Electrical Drain/Parasitic Load Test**
- **Battery Common Causes of Failure**
- **Starter Motor Noise Diagnosis**
- **Charging System Test**
- **Generator Noise Diagnosis**

## BATTERY INSPECTION/TEST (SIDE TERMINAL BATTERY)

### Tools Required

**SA9154Z-A** Starting and Charging System Tester. See **Special Tools and Equipment** .

### Diagnostic Aids

#### **IMPORTANT:**

- **A dead battery is usually a symptom of another problem. Fix the problem, do not just charge or change the battery.**
- **Failure to properly understand the battery and its function could lead to a misdiagnosis and unneeded repairs. Refer to Battery Description and Operation and Battery Common Causes of Failure for more information.**

Follow these instructions in order to avoid an incorrect diagnosis because of connections:

- If testing the vehicle with the battery cables still connected, wiggle the **SA9154Z-A** clips on the terminal bolt. See **Special Tools and Equipment** . This may cut through any coating or through any oxidation that may be present on the bolt.

Even new bolts contain a protective coating that may insulate or cause a resistance in the test circuit.

- If correct connections to the battery terminal bolts in the vehicle are in doubt, perform the following steps:
  1. Disconnect the negative battery cable.
  2. Disconnect the positive battery cable.
  3. Install the test adapters on the terminals.
- If the tester displays a "Bad Battery" result for a battery tested in the vehicle with the battery cables connected, perform the following steps:
  1. Disconnect the negative battery cable.
  2. Disconnect the positive battery cable.
  3. Install the tester adapters.
  4. Replace the battery only if the Out-of-Vehicle test shows a "Bad Battery" result. This prevents battery replacements that are due only to faulty battery cable connections.
- Use the correct terminal adapters.

Do not use any common bolts or a combination of bolts, nuts, and or washers as adapters when testing the battery.

Use the test adapters that are provided with the **SA9154Z-A** or P/N 12303040 terminal adapters. See **Special Tools and Equipment** . If the adapters that are provided with the **SA9154Z-A** require replacement, use P/N 12303040. See **Special Tools and Equipment** . Any other adapter may not contact the correct areas of the battery terminal, causing a resistance that may result in an invalid battery test result.

**Battery Inspection/Test (Side Terminal Battery)**

Step	Action	Values	Yes	No
<b>CAUTION:</b> <b>Refer to Battery Disconnect Caution in Cautions and Notices.</b>				
1	Inspect the battery for a cracked, broken, or damaged case, which may be indicated by battery acid leakage. Is the battery OK?	-	Go to <b>Step 2</b>	Go to <b>Step 13</b>
2	Compare the cold cranking amperage (CCA), and reserve capacity (RC) and/or amp hour (AH) rating of the battery to the original battery or original equipment (OE) specification. Refer to <b>Battery Usage</b> . Does the battery meet or exceed the specifications?	-	Go to <b>Step 3</b>	Go to <b>Step 13</b>
3	1. Turn OFF the ignition. 2. Attempt to rotate the negative battery cable connector clockwise with light finger pressure.  Does the negative connector rotate?	-	Go to <b>Step 4</b>	Go to <b>Step 5</b>
4	Use a torque wrench in order to verify the torque to loosen the negative battery terminal bolt. Is the torque above the specified value?	10 N.m (88 lb in)	Go to <b>Step 9</b>	Go to <b>Step 8</b>
5	Attempt to rotate the positive battery cable connector clockwise with light finger pressure. Does the positive connector rotate?	-	Go to <b>Step 7</b>	Go to <b>Step 6</b>
6	<b>IMPORTANT:</b> <b>Ensure that all of the electrical loads are turned OFF.</b>  1. Install the <b>SA9154Z-A</b> Starting and Charging System Tester. See <b>Special Tools and Equipment</b> . 2. Follow the directions supplied with the tester. 3. Follow any directions displayed on the tester. 4. If the tester displays "Good, Low Charge" or "Charge and Retest", refer to <b>Battery Charging</b> .  Did the tester pass the battery?	-	Go to <b>Step 13</b>	Go to <b>Step 8</b>
7	Use a torque wrench in order to verify the torque to loosen the positive battery terminal bolt. Is the torque above the specified value?	10 N.m (88 lb in)	Go to <b>Step 10</b>	Go to <b>Step 8</b>
8	1. Disconnect the negative battery cable. 2. Disconnect the positive battery cable. 3. Clean and wire brush the lead face of both battery terminals and the metal contact rings in both cable connectors. 4. Remove the bolts from the cable connectors in order to provide access to the connector rings as needed.	-		



	<p>5. If either of the battery terminals or the cable rings are excessively damaged or corroded, replace as needed.</p> <p>Did you complete the repair?</p>		Go to <b>Step 11</b>	-
9	<p>1. Disconnect the negative battery cable.</p> <p>2. Inspect for the following conditions and repair as needed:</p> <ul style="list-style-type: none"> <li>• The cable bolt is too long or deformed at the end</li> <li>• There is foreign material present inside the nut in the battery terminal</li> <li>• Damage to the battery terminal face or cable connector ring</li> </ul> <p>Did you complete the repair?</p>		Go to <b>Step 10</b>	-
10	<p>1. Disconnect the positive battery cable.</p> <p>2. Inspect for the following conditions and repair as needed:</p> <ul style="list-style-type: none"> <li>• The cable bolt is too long or deformed</li> <li>• There is foreign material present inside the nut in the battery terminal</li> <li>• Damage to the battery terminal face or cable connector ring</li> </ul> <p>Did you complete the repair?</p>	-	Go to <b>Step 11</b>	-
11	<p><b>IMPORTANT:</b> Ensure that both battery cables are disconnected and proper adapters are installed in the battery terminals.</p> <p>1. Install the <b>SA9154Z-A</b> . See <b><u>Special Tools and Equipment</u></b> .</p> <p>2. Follow any directions displayed on the tester.</p> <p>3. If the tester calls for charging the battery, refer to <b><u>Battery Charging</u></b> .</p> <p>Did the tester pass the battery?</p>	-	Go to <b>Step 12</b>	Go to <b>Step 13</b>
12	<p>1. Connect the positive battery cable to the batteries positive terminal.</p> <p><b>NOTE:</b> <b>Refer to Fastener Notice in Cautions and Notices.</b></p> <p>2. Tighten the positive battery cable bolt to the specified value.</p> <p>3. Connect the negative battery cable to the battery negative terminal.</p>	17 N.m (13 lb ft)		

	4. Tighten the negative battery cable bolt to the specified value.		Battery OK	-
	Are the cable bolts properly tightened?		Battery OK	-
13	Replace the battery. Refer to <b>Battery Replacement</b> . Did you complete the replacement?	-	Battery OK	-

## BATTERY INSPECTION/TEST (TOP POST TERMINAL BATTERY)

### Tools Required

SA9154Z-A Starting and Charging System Tester. See **Special Tools and Equipment** .

### Diagnostic Aids

#### IMPORTANT:

- A dead battery is usually a symptom of another problem. Fix the problem, do not just charge or change the battery.
- Failure to properly understand the battery and its function could lead to a misdiagnosis and unneeded repairs. Refer to **Battery Description and Operation** and **Battery Common Causes of Failure** for more information.

Follow these instructions in order to avoid an incorrect diagnosis because of connections:

- If testing the vehicle with the battery cables still connected, wiggle the SA9154Z-A clips on the terminal. See **Special Tools and Equipment** . This may cut through any coating or through any oxidation that may be present on the terminal.

Even new terminals contain a protective coating that may insulate or cause a resistance in the test circuit.

- If correct connections to the battery terminals in the vehicle are in doubt, perform the following steps:
  1. Disconnect the negative battery cable.
  2. Disconnect the positive battery cable.
- If the tester displays a "Bad Battery" result for a battery tested in the vehicle with the battery cables connected, perform the following steps:
  1. Disconnect the negative battery cable.
  2. Disconnect the positive battery cable.

### Battery Inspection/Test (Top Post Terminal Battery)

Step	Action	Values	Yes	No
<b>CAUTION:</b> Refer to <b>Battery Disconnect Caution in Cautions and Notices.</b>				
1	Inspect the battery for a cracked, broken, or damaged case, which may be indicated by battery acid leakage. Is the battery OK?	-	Go to <b>Step 2</b>	Go to <b>Step 9</b>

2	<p>Compare the cold cranking amperage (CCA), and reserve capacity (RC) and/or amp hour (AH) rating of the battery to the original battery or original equipment (OE) specification. Refer to <b>Battery Usage</b> .</p> <p>Does the battery meet or exceed the specifications?</p>	-	Go to <b>Step 3</b>	Go to <b>Step 9</b>
3	<ol style="list-style-type: none"> <li>1. Turn OFF the ignition.</li> <li>2. Attempt to rotate the negative battery cable connector with light finger pressure.</li> </ol> <p>Does the negative connector rotate?</p>	-	Go to <b>Step 6</b>	Go to <b>Step 4</b>
4	<p>Attempt to rotate the positive battery cable connector clockwise with light finger pressure.</p> <p>Does the positive connector rotate?</p>	-	Go to <b>Step 6</b>	Go to <b>Step 5</b>
5	<p><b>IMPORTANT:</b> <b>Ensure that all of the electrical loads are turned OFF.</b></p> <ol style="list-style-type: none"> <li>1. Install the <b>SA9154Z-A</b> Starting and Charging System Tester. See <b>Special Tools and Equipment</b> .</li> <li>2. Follow the directions supplied with the tester.</li> <li>3. Follow any directions displayed on the tester.</li> <li>4. If the tester displays "Good, Low Charge" or "Charge and Retest", refer to <b>Battery Charging</b> .</li> </ol> <p>Did the tester pass the battery?</p>	-	Battery OK	Go to <b>Step 6</b>
6	<ol style="list-style-type: none"> <li>1. Disconnect the negative battery cable.</li> <li>2. Disconnect the positive battery cable.</li> <li>3. Clean and wire brush both battery post and the metal contact rings on both cable connectors.</li> <li>4. If either of the battery terminals or the contact rings are excessively damaged or corroded, replace as needed.</li> </ol> <p>Did you complete the repair?</p>	-	Go to <b>Step 7</b>	-
7	<p><b>IMPORTANT:</b> <b>Ensure that both battery cables are disconnected.</b></p> <ol style="list-style-type: none"> <li>1. Install the <b>SA9154Z-A</b> . See <b>Special Tools and Equipment</b> .</li> <li>2. Follow any directions displayed on the tester.</li> <li>3. If the tester calls for charging the battery, refer to <b>Battery Charging</b> .</li> </ol> <p>Did the tester pass the battery?</p>	-	Go to <b>Step 8</b>	Go to <b>Step 9</b>
	<ol style="list-style-type: none"> <li>1. Connect the positive battery cable to the batteries positive terminal.</li> </ol>			

	<p><b>NOTE:</b> Refer to <b>Fastener Notice in Cautions and Notices.</b></p>			
8	<p>2. Tighten the positive battery cable bolt to the specified value.</p> <p>3. Connect the negative battery cable to the battery negative terminal.</p> <p>4. Tighten the negative battery cable bolt to the specified value.</p>	6 N.m (53 lb in)		
	Are the cable bolts properly tightened?		Battery OK	-
9	Replace the battery. Refer to <b>Battery Replacement</b> . Did you complete the replacement?	-	Battery OK	-

## BATTERY CHARGING

### Tools Required

**SA9154Z-A** Starting and Charging System Tester. See **Special Tools and Equipment** .

- For best results, use an automatic taper-rate battery charger with a voltage capability of 16 volts.
- 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 **SA9154Z-A** before charging. See **Special Tools and Equipment** .

### Battery State of Charge

**IMPORTANT: Using voltage to determine the batteries state of charge (SOC) 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 SOC will only be an estimate.**

The maintenance free batteries SOC 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 SOC:

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.

**IMPORTANT: The table is accurate to +/-10 percent 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 SOC according to the estimated battery temperature:

### Battery Charging

Battery Voltage	% Charge at 0°C (32°F)	% Charge at 25°C (75°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 SOC information as follows:

- A battery with a SOC that is below 65 percent must always be recharged before returning it to service or continuing storage.
- A battery with a SOC that is 65 percent 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 percent, 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 SOC 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 volts, 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 manufacturers 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

**NOTE:** 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 PCM or other electronic components.

**NOTE:** Refer to Fastener Notice in Cautions and Notices.

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.

**Tighten:** Tighten the battery side terminal adapters to 15 N.m (11 lb ft).

Use the following procedure to charge the battery:

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 fuse block - underhood.

**NOTE:** 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.

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. If the negative battery cable is disconnected and a terminal adapter is being used, connect directly to the adapter.
5. Turn ON the charger and set to the highest setting for normal charging.
6. Inspect the battery every half hour after starting the battery charger.
  - Charge the battery until the taper-rate charger indicates that the battery is fully charged.
  - Estimate the battery temperature by feeling the side of the battery. If it feels hot to the touch or its temperature is over 45°C (125°F), discontinue charging and allow the battery to cool before resuming charging.
7. After charging, test the battery. Refer to **Battery Inspection/Test (Side Terminal Battery)** or **Battery Inspection/Test (Top Post Terminal Battery)** .

## **BATTERY ELECTRICAL DRAIN/PARASITIC LOAD TEST**

### **Tools Required**

J 38758 Parasitic Draw Test Switch

### **Diagnostic Aids**

- Be sure to rule out any possible obvious influences, such as customer error or aftermarket equipment.
- Customer driving habits, such as regular short trips. This does 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(R), and regulated voltage control (RVC), 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** in Body Control System for the system or modules description and operation.
- Remote keyless entry (RKE) will wake up due to an outside input. Refer to **Keyless Entry System Description and Operation** in Keyless Entry.

**IMPORTANT: The battery specification listed below is a generic specification. Refer to Battery Usage when testing the battery.**

- The battery run down time will vary depending on cold cranking amperage (CCA) and reserve capacity (RC). If the CCA and RC are higher, then the battery run down time would be longer. If the CCA and RC are lower, then the battery run down time would be shorter. The graph below indicates roughly how many days a 690 CCA battery with at 110 min. RC (60.5 AH) starting at 80 percent state of charge will last with a constant current draw until it reaches 50 percent state of charge. Differences in battery rating and temperature will affect the results.

#### **Battery Electrical Drain/Parasitic Load Test**

<b>Current Drain</b>	<b>Days</b>
25 mA	30.5
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

**CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.**

**NOTE: Do not turn the parasitic draw test switch to the OFF position with the engine running. Damage will occur to the vehicle's electrical system.**

**NOTE: The test switch must be in the ON position when removing the fuses in order to maintain continuity in the electrical system. This avoids damaging the digital**

**multimeter due to accidental overloading, such as a door being opened to change a fuse.**

**IMPORTANT: The switch knob (1) on the J 38758 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. Disconnect the battery negative cable from the battery negative terminal.
2. Install the male end of the J 38758 to the battery ground terminal.
3. Turn the J 38758 knob to the OFF position.
4. Install the battery negative cable to the female end of the J 38758 .
5. Connect a 10A fused jumper wire to the test switch tool terminals.
6. Turn the J 38758 knob to the ON position.
7. Road test the vehicle and activate ALL of the accessories, including the radio and air conditioning. This may take up to 30 minutes.
8. Park the vehicle. Turn the ignition switch to the OFF position and remove the ignition switch key.
9. Turn the J 38758 knob to the OFF position. The current now flows through the jumper wire.
10. Wait 1 minute. If the fuse blows, install an inductive ammeter and go to step 20.
11. Remove the fused jumper wire.
12. Set a digital multimeter to the 10A scale.
13. Connect the digital multimeter to the test switch tool terminals.
14. Turn the J 38758 knob to the OFF position. The current flows now through the digital multimeter.
15. Wait 1 minute. Check and record the current reading.
  1. When there is a current reading on 2A or less, turn the J 38758 knob to the ON position. The electrical current will now pass through the switch.
  2. Then switch the digital multimeter down to the 2A scale for a more accurate reading when the J 38758 knob is turned OFF.
16. Turn the J 38758 knob to the OFF position. Wait 15 minutes for most vehicles.
17. Check and record the current reading.
18. Note the battery reserve capacity, amp hour rating. Refer to **Battery Usage** .
  1. Divide the reserve capacity by 4, amp hour rating by 2.4.
  2. Compare this to the multimeter milliampere reading taken in the previous step. The parasitic current drain should not exceed this number. Example: If a battery has a reserve capacity of 100 minutes, (60 A/H) the current drain should not exceed 25 mA.
19. If excessive current drain is not found at this time and there are no other apparent causes, complete the following:
20. Using the MIN/MAX function of the digital multimeter, monitor the parasitic drain overnight or during the day. This will determine if something has been activated during that time frame.



**NOTE:** The test switch must be in the ON position when removing the fuses in order to maintain continuity in the electrical system. This avoids damaging the digital multimeter due to accidental overloading, such as a door being opened to change a fuse.

**IMPORTANT:** Removing fuses, relays, and connectors to determine the failure area may wake up modules. You must wait for these modules to go to sleep or use the sleep function on the scan tool.

21. When the vehicle has an unacceptable amount of parasitic current drain, remove each fuse one at a time until the current drain falls to an acceptable level. This will indicate which circuit is causing the drain. Refer to **Power Distribution Schematics** in Wiring Systems to diagnose exactly which part of the suspect circuit is causing the parasitic drain. In some cases a non-fused circuit or component, such as a relay, is the cause of excessive parasitic current drain.
22. Repeat the parasitic current drain test procedure after any repair has been completed to make sure that the parasitic current drain is at an acceptable level.
23. When the cause of the excessive current drain has been located and repaired, remove the J 38758 .
24. Connect the battery negative cable to the battery negative terminal.

## **BATTERY COMMON CAUSES OF FAILURE**

A battery is not designed to last forever. With proper care, however, the battery will provide years of good service. If the battery tests good but still fails to perform well, the following are some of the more common causes:

- A vehicle accessory was left on overnight.
- The driving speeds have been slow with frequent stops, stop-and-go driving, with many electrical accessories in use, particularly air conditioning, headlights, wipers, heated rear window, cellular telephone, etc.
- The electrical load has exceeded the generator output, particularly with the addition of aftermarket equipment.
- Existing conditions in the charging system, including the following possibilities:
  - A slipping belt
  - A bad generator
- The battery has not been properly maintained, including a loose battery hold down or missing battery insulator if used.
- There are mechanical conditions in the electrical system, such as a short or a pinched wire, attributing to power failure. Refer to **General Electrical Diagnosis Procedures** in Wiring Systems.

### **Electrolyte Freezing**

The freezing point of electrolyte depends on its specific gravity. A fully charged battery will not freeze until the ambient temperature gets below  $-54^{\circ}\text{C}$  ( $-65^{\circ}\text{F}$ ). However, a battery with a low state of charge may freeze at temperatures as high as  $-7^{\circ}\text{C}$  ( $20^{\circ}\text{F}$ ). Since freezing may ruin a battery, the battery should be protected against

freezing by keeping it properly charged above 80 percent state of charge, the freezing point of the battery will be somewhere below -32°C (-25°F).

### **Battery Protection During Vehicle Storage**

Certain devices on the vehicle maintain a small continuous current drain, parasitic load, on the battery. A battery that is not used for an extended period of time will discharge. Eventually permanent damage will result. Discharged batteries will also freeze in cold weather. Refer to **Battery Inspection/Test (Side Terminal Battery)** or **Battery Inspection/Test (Top Post Terminal Battery)** .

In order to maintain the battery state of charge while storing the vehicle for more than 30 days:

**CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.**

Disconnect the battery ground cable to protect the battery from discharge by parasitic current drains.

When the battery cannot be disconnected:

1. Maintain a high state of charge.
2. Establish a regular schedule for recharging the battery every 20-45 days.

A battery that has remained in a discharged state for a long period of time is difficult to recharge or may be permanently damaged.

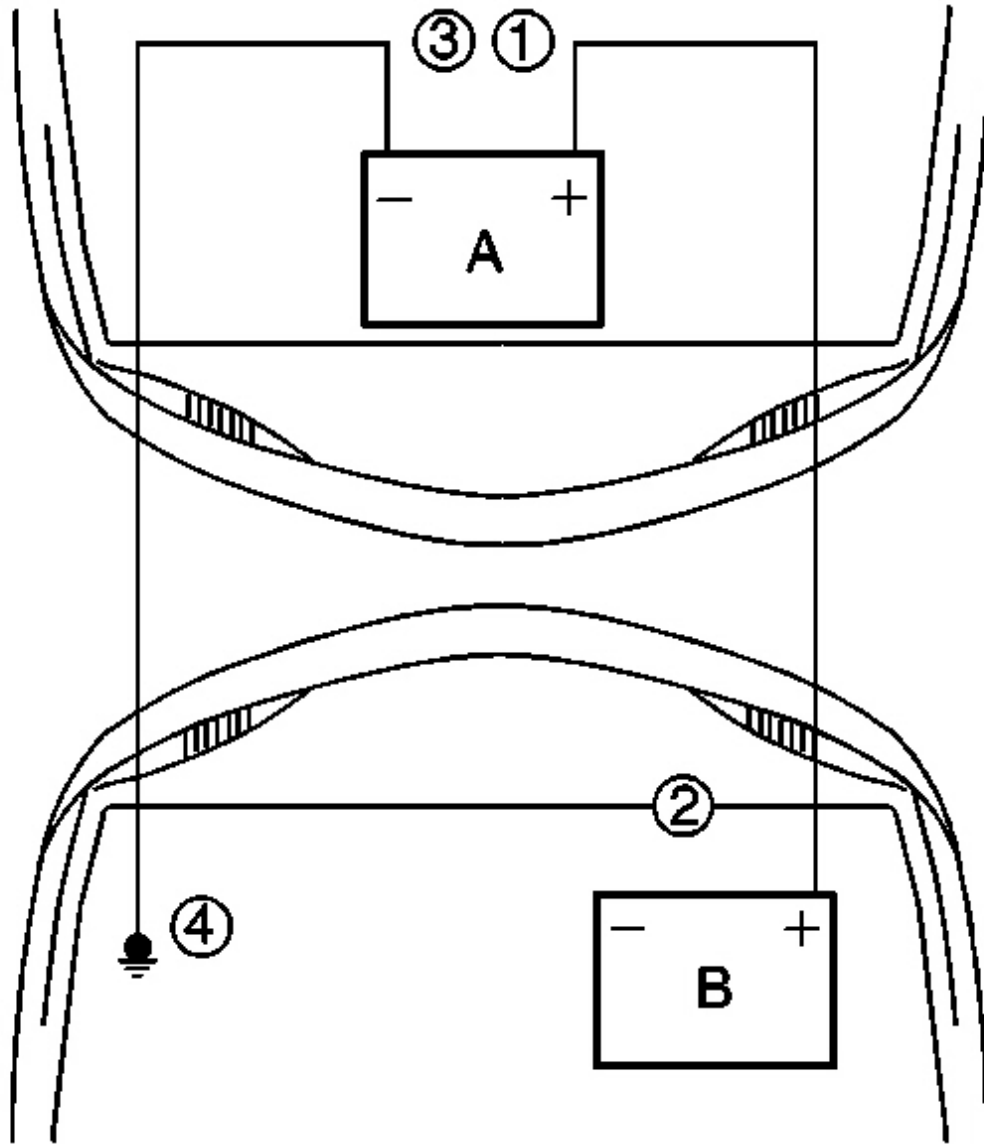
### **JUMP STARTING IN CASE OF EMERGENCY**

**CAUTION: Batteries produce explosive gases. Batteries contain corrosive acid. Batteries supply levels of electrical current high enough to cause burns. Therefore, in order to reduce the risk of personal injury while working near a battery, observe the following guidelines:**

- Always shield your eyes.
- Avoid leaning over the battery whenever possible.
- Do not expose the battery to open flames or sparks.
- Do not allow battery acid to contact the eyes or the skin.
  - Flush any contacted areas with water immediately and thoroughly.
  - Get medical help.

**NOTE:** This vehicle has a 12 volt, negative ground electrical system. Make sure the vehicle or equipment being used to jump start the engine is also 12 volt, negative ground. Use of any other type of system will damage the vehicle's electrical components.

1. Position the vehicle with the booster battery so that the jumper cables will reach.
  - Do not let the 2 vehicles touch.
  - Make sure that the jumper cables do not have loose ends, or missing insulation.
2. Place an automatic transmission in PARK. If equipped with a manual transmission, place in NEUTRAL and block the wheels.
3. Turn OFF all electrical loads on both vehicles that are not needed.
4. Turn OFF the ignition on both vehicles.



**Fig. 8: Connecting Battery Terminal Jumpers**  
 Courtesy of GENERAL MOTORS CORP.

5. Connect the red positive (+) cable to the battery positive (+) terminal (2) of the vehicle with the discharged battery.

Use a remote positive (+) terminal if the vehicle has one.

6. Connect the red positive (+) cable to the positive (+) terminal (1) of the booster battery.

Use a remote positive (+) terminal if the vehicle has one.

7. Connect the black negative (-) cable to the negative (-) terminal (3) of the booster battery.

**CAUTION: Do not connect a jumper cable directly to the negative terminal of a discharged battery to prevent sparking and possible explosion of battery gases.**

8. The final connection is made to a heavy, unpainted metal engine part (4) of the vehicle with the discharged battery.

This final attachment must be at least 46 cm (18 in) away from the dead battery.

9. Start the engine of the vehicle that is providing the boost.

**NOTE: Never operate the starter motor more than 15 seconds at a time without pausing in order to allow it to cool for at least 2 minutes. Overheating will damage the starter motor.**

10. Crank the engine of the vehicle with the discharged battery.

11. The black negative (-) cable must be first disconnected from the vehicle that was boosted (4).

12. Disconnect the black negative (-) cable from the negative (-) terminal (3) of the booster battery.

**NOTE: Do not let the cable end touch any metal. Damage to the battery and other components may result.**

13. Disconnect the red positive (+) cable from the positive (+) terminal (1) of the booster battery.

14. Disconnect the red positive (+) cable from the remote positive (+) terminal (2) of the vehicle with the discharged battery.

## CHARGING SYSTEM TEST

### Tools Required

SA9154Z-A Starting and Charging System Tester. See **Special Tools and Equipment** .

### Charging System Test

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check for Engine Electrical?	-	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Engine Electrical</b>
	Start the engine, observe the charge indicator			

2	on the instrument panel cluster (IPC) or message in the driver information center (DIC). Does the charge indicator illuminate or the DIC display a charging system message?	-	Go to <b>Step 3</b>	Go to <b>Testing for Intermittent Conditions and Poor Connections</b> in Wiring Systems
3	<ol style="list-style-type: none"> <li>1. Turn OFF the ignition.</li> <li>2. Connect the red lead of the <b>SA9154Z-A</b> to the battery positive terminal. See <b>Special Tools and Equipment</b> .</li> <li>3. Connect the grey lead of the <b>SA9154Z-A</b> to the output circuit of the generator. See <b>Special Tools and Equipment</b> .</li> <li>4. Start the engine.</li> <li>5. Turn On the <b>SA9154Z-A</b> . See <b>Special Tools and Equipment</b> .</li> <li>6. Turn Off all vehicle accessories Off.</li> <li>7. Follow the <b>SA9154Z-A</b> prompts. See <b>Special Tools and Equipment</b> .</li> <li>8. Press CHARGING SYSTEM TEST.</li> </ol> <p>Is the voltage displayed within the specified value?</p>	13.0 V - 15.5 V	Go to <b>Step 4</b>	Go to <b>Step 5</b>
4	Is the generator output current greater than or equal to the load test value given in <b>Generator Usage</b> ?	-	Go to <b>Step 6</b>	Go to <b>Step 5</b>
5	Replace the generator. Refer to <b>Generator Replacement (L61)Generator Replacement (L66)</b> . Did you complete the replacement?	-	Go to <b>Step 6</b>	-
6	Operate the vehicle in order to verify the repair. Did you correct the condition?	-	Generator OK	Go to <b>Step 2</b>

## CHARGE INDICATOR ALWAYS ON

### Charge Indicator Always On

Step	Action	Value (s)	Yes	No
<b>Connector End View Reference:Engine Electrical Connector End Views , Engine Control Module (ECM) Connector End Views</b> in Engine Controls - 2.2L (L61), or <b>Powertrain Control Module (PCM) Connector End Views</b> in Engine Controls - 3.5L (L66)				
1	Did you perform the Diagnostic System Check for Engine Electrical?	-	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Engine Electrical</b>

2	1. Start the engine. 2. Turn Off all accessories.  Does the battery charge indicator remain illuminated?	-	Go to <b>Step 3</b>	Go to <b>Testing for Intermittent Conditions and Poor Connections</b> in Wiring Systems
3	1. Install a scan tool 2. With a scan tool, observe the Battery 1 parameter in the body control module (BCM) data list.  Does the voltage measure within the normal operating range?	12.6-16.0 V	Go to <b>Step 4</b>	Go to <b>Charging System Test</b>
4	With a scan tool, observe the Battery 1 parameter in the powertrain control module (PCM) data list. Does the voltage measure within the normal operating range?	12.6-16.0 V	Go to <b>Step 5</b>	Go to <b>Charging System Test</b>
5	With a scan tool, command the lamp and gages On and Off. Does the charge indicator turn On and Off with each command?	-	Go to <b>Step 6</b>	Go to <b>Step 7</b>
6	<b>IMPORTANT:</b> <b>The replacement ECM must be programmed.</b>  Replace the ECM. Refer to <b>Engine Control Module (ECM) Replacement</b> in Engine Controls - 2.2L (L61) or <b>Powertrain Control Module (PCM) Replacement</b> in Engine Controls - 3.5L (L66) Did you complete the replacement?	-	Go to <b>Step 8</b>	-
7	Replace the instrument panel cluster. Refer to <b>Instrument Panel Cluster (IPC) Replacement</b> in Instrument Panel, Gages and Console. Did you complete the replacement?	-	Go to <b>Step 8</b>	-
8	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to <b>Step 2</b>

## CHARGE INDICATOR INOPERATIVE

### Charge Indicator Inoperative

Step	Action	Yes	No
<b>Connector End View Reference: Engine Electrical Connector End Views , Engine Control Module (ECM) Connector End Views</b> in Engine Controls - 2.2L (L61), or <b>Powertrain Control Module (PCM) Connector End Views</b> in Engine Controls - 3.5L (L66)			
1	Did you perform the Diagnostic System Check for Engine Electrical?	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Engine Electrical</b>

2	Turn ON the ignition, with the engine OFF. Does the battery charge indicator illuminate?	Go to <b>Step 4</b>	Go to <b>Step 3</b>
3	1. Install a scan tool. 2. With a scan tool, command the lamp and gages On and Off.  Does the charge indicator turn On and Off with each command?	Go to <b>Testing for Intermittent Conditions and Poor Connections</b> in Wiring Systems	Go to <b>Step 7</b>
4	Test the generator turn on signal circuit for an open. Refer to <b>Circuit Testing</b> and <b>Wiring Repairs</b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 8</b>	Go to <b>Step 5</b>
5	Inspect for poor connections at the harness connector of the ECM. Refer to <b>Connector Repairs</b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 8</b>	Go to <b>Step 6</b>
6	<b>IMPORTANT:</b> <b>The replacement ECM must be programmed.</b>  Replace the ECM. Refer to <b>Engine Control Module (ECM) Replacement</b> in Engine Controls - 2.2L (L61) or <b>Powertrain Control Module (PCM) Replacement</b> in Engine Controls - 3.5L (L66) Did you complete the replacement?	Go to <b>Step 8</b>	-
7	Replace the instrument panel cluster. Refer to <b>Instrument Panel Cluster (IPC) Replacement</b> in Instrument Panel, Gages and Console. Did you complete the replacement?	Go to <b>Step 8</b>	-
8	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 2</b>

## GENERATOR NOISE DIAGNOSIS

### 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.

### Generator Noise Diagnosis

Step	Action	Yes	No
1	Test the generator for proper operation using the Generator Tester. Refer to <b>Charging System Test</b> .	Go to	Go to <b>Step</b>



	Is the generator operating properly?	Step 2	11
2	<ol style="list-style-type: none"> <li>1. Start the engine. Verify that the noise can be heard.</li> <li>2. Turn OFF all accessories.</li> <li>3. Turn OFF the Ignition.</li> </ol> <p><b>CAUTION:</b>  <b>Make sure that the load is completely turned off before connecting or disconnecting a carbon pile load tester to the battery. Otherwise, sparking could ignite battery gasses which are extremely flammable and may explode violently.</b></p> <ol style="list-style-type: none"> <li>4. Connect a carbon pile tester to the vehicle.</li> <li>5. Connect an inductive ammeter probe to the output circuit of the generator.</li> <li>6. Start the engine.</li> <li>7. Increase engine speed to 1,500 RPM.</li> <li>8. Increase and decrease the amount of load placed upon the generator.</li> <li>9. Listen for the noise.</li> </ol> <p>Does the noise increase and decrease with the amount of load placed upon the generator by the carbonpile tester?</p>	Go to <b>Step 11</b>	Go to <b>Step 3</b>
3	<ol style="list-style-type: none"> <li>1. Turn OFF the engine.</li> <li>2. Remove the drive belt. Refer to <b>Drive Belt Replacement</b> in Engine Mechanical - 2.2L (L61) or <b>Drive Belt Replacement</b> in Engine Mechanical - 3.5L (L66).</li> <li>3. Spin the generator pulley by hand.</li> </ol> <p>Does the generator shaft spin smoothly and without any roughness or grinding noise?</p>	Go to <b>Step 4</b>	Go to <b>Step 11</b>
4	<p>Inspect the generator for a loose pulley and/or pulley nut.</p> <p>Is the generator pulley or pulley nut loose?</p>	Go to <b>Step 11</b>	Go to <b>Step 5</b>
5	<ol style="list-style-type: none"> <li>1. Loosen all of the generator mounting bolts.</li> <li>2. Tighten the generator mounting bolts to specifications and in the proper sequence, if necessary. Refer to <b>Generator Replacement (L61)Generator Replacement (L66)</b> .</li> <li>3. Install the drive belt. Refer to <b>Drive Belt Replacement</b> in Engine Mechanical - 2.2L (L61) or <b>Drive Belt Replacement</b> in Engine Mechanical - 3.5L (L66).</li> <li>4. Start the engine.</li> </ol> <p>Has the noise decreased or stopped?</p>	System OK	Go to <b>Step 6</b>
	Inspect the generator for the following conditions:		

6	<ul style="list-style-type: none"> <li>• Strained or stretched electrical connections.</li> <li>• Hoses or other vehicle equipment resting on the generator, which may cause the noise to be transmitted into the passenger compartment</li> </ul> <p>Are any electrical connections pulling on the generator or are any hoses, etc. resting on the generator?</p>	Go to <b>Step 7</b>	Go to <b>Step 8</b>
7	<ol style="list-style-type: none"> <li>1. Reroute the electrical connections to relieve the tension.</li> <li>2. Reroute the hoses, etc. away from the generator.</li> <li>3. Start the engine.</li> </ol> <p>Has the noise decreased or stopped?</p>	System OK	Go to <b>Step 8</b>
8	<p>Inspect the drive belt for proper tension. Refer to <b>Drive Belt Tensioner Diagnosis</b> in Engine Mechanical - 2.2L (L61) or <b>Drive Belt Tensioner Diagnosis</b> in Engine Mechanical - 3.5L (L66).</p> <p>Is the drive belt loose?</p>	Go to <b>Step 9</b>	Go to <b>Step 10</b>
9	<ol style="list-style-type: none"> <li>1. Replace the drive belt tensioner. Refer to <b>Drive Belt Tensioner Replacement</b> in Engine Mechanical - 2.2 L (L61) or <b>Drive Belt Tensioner Replacement</b> in Engine Mechanical - 3.5L (L66).</li> <li>2. Start the engine.</li> </ol> <p>Has the noise decreased or stopped?</p>	System OK	Go to <b>Step 11</b>
10	<p>Compare the vehicle with a known good vehicle.</p> <p>Do both vehicles make the same noise?</p>	System OK	Go to <b>Step 11</b>
11	<p><b>IMPORTANT:</b></p> <p><b>If no definite generator problems were found, be sure that all other possible sources of objectionable noise are eliminated before replacing the generator. Replacing the generator may not change the noise level if the noise is a normal characteristic of the generator or the generator mounting.</b></p> <p>Replace the generator. Refer to <b>Generator Replacement (L61)Generator Replacement (L66)</b> .Has the noise decreased or stopped?</p>	Go to <b>Step 12</b>	-
12	<p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>	System OK	Go to <b>Step 2</b>

## STARTER SOLENOID DOES NOT CLICK

### Starter Solenoid Does Not Click

Step	Action	Yes	No
<p><b>Schematic Reference: Starting and Charging Schematics</b></p> <p><b>Connector End View Reference:Master Electrical Component List</b> in Wiring Systems</p>			
1	Did you perform the Engine Electrical		Go to <b>Diagnostic System</b>

	Diagnostic System Check?	Go to <b>Step 2</b>	<u>Check - Engine Electrical</u>
2	Turn the ignition to the Start position. Is the Theft indicator flashing?	Go to <b><u>Diagnostic System Check - Theft Deterrent</u></b> in Theft Deterrent	Go to <b>Step 3</b>
3	Turn the ignition to the Start position. Does the starter solenoid click?	Go to <b><u>Starter Solenoid Clicks, Engine Does Not Crank</u></b>	Go to <b>Step 4</b>
4	Does the vehicle have an automatic transmission?	Go to <b>Step 5</b>	Go to <b>Step 8</b>
5	<ol style="list-style-type: none"> <li>1. Install a scan tool.</li> <li>2. Turn ON the ignition, with the engine OFF.</li> <li>3. Place the transmission in Park or Neutral.</li> <li>4. With a scan tool, observe the TR Sw. parameter in the transmission data list.</li> </ol> Does the scan tool display Park or Neutral?	Go to <b>Step 6</b>	Go to <b><u>Range Selector Displays Incorrect Range</u></b> in Automatic Transaxle -5AT or <b><u>Range Selector Displays Incorrect Range</u></b> in Automatic Transmission -VT25-E
6	<ol style="list-style-type: none"> <li>1. Disconnect the transmission range switch.</li> <li>2. Connect a test lamp between the crank voltage circuit of the transmission range switch harness connector and ground.</li> <li>3. Turn the ignition to the Start position.</li> </ol> Does the test lamp illuminate?	Go to <b>Step 7</b>	Go to <b>Step 10</b>
7	<p><b>IMPORTANT:</b> <b>You must use 10 AWG wire for the fused jumper. Any smaller wire will cause too high of a resistance and a misdiagnosis will occur.</b></p> <ol style="list-style-type: none"> <li>1. Connect a 15 A fused jumper wire between the crank voltage circuit of the transmission range switch and the starter solenoid crank voltage circuit of the transmission range switch.</li> <li>2. Turn the ignition to the Start position.</li> </ol> Does the engine Crank?	Go to <b>Step 13</b>	Go to <b>Step 11</b>

8	<p><b>IMPORTANT:</b> Place the transmission in neutral and set the parking brake.</p> <ol style="list-style-type: none"> <li>1. Disconnect the clutch pedal position (CCP) switch.</li> <li>2. Connect a test lamp between the crank voltage circuit of the CCP switch harness connector and ground.</li> <li>3. Turn the ignition to the Start position.</li> </ol> <p>Does the test lamp illuminate?</p>	Go to <b>Step 9</b>	Go to <b>Step 10</b>
9	<p><b>IMPORTANT:</b> You must use 10 AWG wire for the fused jumper. Any smaller wire will cause too high of a resistance and a misdiagnosis will occur.</p> <ol style="list-style-type: none"> <li>1. Connect a 15 A fused jumper wire between the crank voltage circuit of the CCP switch and the starter solenoid crank voltage circuit of the CCP switch.</li> <li>2. Turn the ignition to the Start position.</li> </ol> <p>Does the engine Crank?</p>	Go to <b>Step 14</b>	Go to <b>Step 11</b>
10	<p>Test the crank voltage circuit of the transmission range switch or CCP switch for a high resistance or an open. Refer to <b>Circuit Testing</b> and <b>Wiring Repairs</b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 20</b>	Go to <b>Step 12</b>
11	<p>Test the starter solenoid crank voltage circuit for a short, high resistance or an open. Refer to <b>Circuit Testing</b> and <b>Wiring Repairs</b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 20</b>	Go to <b>Step 15</b>
12	<p>Inspect for poor connections at the ignition switch. Refer to <b>Testing for Intermittent Conditions and Poor Connections</b> and <b>Connector Repairs</b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to <b>Step 20</b>	Go to <b>Step 16</b>
13	<p>Inspect for poor connections at the transmission range switch. Refer to <b>Testing for Intermittent Conditions and Poor</b></p>		

	<b>Connections</b> and <b>Connector Repairs</b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 20</b>	Go to <b>Step 17</b>
14	Inspect for poor connections at the CCP switch. Refer to <b>Testing for Intermittent Conditions and Poor Connections</b> and <b>Connector Repairs</b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 20</b>	Go to <b>Step 18</b>
15	Inspect for poor connections at the starter solenoid. Refer to <b>Testing for Intermittent Conditions and Poor Connections</b> and <b>Connector Repairs</b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 20</b>	Go to <b>Step 19</b>
16	Replace the Ignition Switch. Refer to <b>Ignition Switch Replacement</b> in Steering Wheel and Column. Did you complete the replacement?	Go to <b>Step 20</b>	-
17	Replace the transmission range switch. Refer to <b>Park/Neutral Position Switch Replacement</b> in Automatic Transaxle -5AT or <b>Park/Neutral Position Switch Replacement</b> in Automatic Transmission - VT25-E. Did you complete the replacement?	Go to <b>Step 20</b>	-
18	Replace the CCP switch. Refer to <b>Clutch Pedal Position Switch Replacement</b> in Clutch. Did you complete the replacement?	Go to <b>Step 20</b>	-
19	Replace the Starter Motor. Refer to <b>Starter Motor Replacement (L61)</b> <b>Starter Motor Replacement (L66)</b> . Did you complete the replacement?	Go to <b>Step 20</b>	-
20	Operate the system for which the symptom occurred. Is the symptom still present?	Go to <b>Step 2</b>	System OK

## STARTER SOLENOID CLICKS, ENGINE DOES NOT CRANK

### Starter Solenoid Clicks, Engine Does Not Crank

Step	Action	Yes	No
<b>Schematic Reference: Starting and Charging Schematics</b>			
<b>Connector End View Reference: Master Electrical Component List</b> in Wiring Systems			
1	Did you perform the Engine Electrical Diagnostic System Check?	Go to <b>Step 2</b>	Go to <b>Diagnostic System Check - Engine Electrical</b>
2	Turn the ignition to the START position.	Go to	Go to <b>Starter Solenoid Does Not</b>

	Did the starter solenoid click?	Step 3	Click
3	Inspect the engine and belt drive system for mechanical binding, seized engine, or seized generator. Does the engine move freely?	Go to <b>Step 4</b>	Go to <b>Engine Will Not Crank - Crankshaft Will Not Rotate</b> in Engine Mechanical - 2.2L
4	Test the battery positive cable between the battery and the starter solenoid for high resistance. Refer to <b>Circuit Testing</b> and <b>Wiring Repairs</b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 8</b>	Go to <b>Step 5</b>
5	Test the ground circuit between the battery and the starter motor for a high resistance. Refer to <b>Circuit Testing</b> and <b>Wiring Repairs</b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 8</b>	Go to <b>Step 6</b>
6	Inspect for poor connections at the starter. Refer to <b>Testing for Intermittent Conditions and Poor Connections</b> and <b>Connector Repairs</b> in Wiring Systems. Did you find and correct the condition?	Go to <b>Step 8</b>	Go to <b>Step 7</b>
7	Replace the starter. Refer to <b>Starter Motor Replacement (L61)</b> <b>Starter Motor Replacement (L66)</b> . Did you complete the replacement?	Go to <b>Step 8</b>	-
8	Operate the system for which the symptom occurred. Did you correct the condition?	System OK	Go to <b>Step 2</b>

## ENGINE CRANKS SLOWLY

Inspect the following items:

- Battery - Perform the Battery Inspection/Test. Refer to **Battery Inspection/Test (Side Terminal Battery)** or **Battery Inspection/Test (Top Post Terminal Battery)** .
- Wiring - Inspect the wiring for damage. Inspect all connections to the starter motor, the solenoid, the battery, and all ground connections. Refer to **Circuit Testing** or **Wiring Repairs** or **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.
- Engine - Verify that the engine is not seized.

If the battery, the wiring, and the engine are functioning properly, and the engine continues to crank slowly, replace the starter motor. Refer to **Starter Motor Replacement (L61)** or **Starter Motor Replacement (L66)** .

## STARTER MOTOR NOISE DIAGNOSIS

### Diagnostic Aids

- Inspect the flywheel ring gear for damage or unusual wear.

- Stuck relays or other electrical problems may also cause the starter drive to remain engaged.
- Shim the starter as required.
- In order to add pinion to ring gear clearance a full size shim must be used. Do not shim only one starter mounting bolt. There are 3 shims available in different shapes, for clearance, all are 1 mm (0.039 in) thick.

### Starter Motor Noise Diagnosis

Step	Action	Yes	No
1	Did you perform the Engine Electrical Diagnostic System Check?	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Engine Electrical</u></b>
2	Start the engine. Does the starter operate normally?	Go to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b>	Go to <b>Step 3</b>
3	Start the engine while listening to the starter motor turn. Is there a loud "whoop?" It may sound like a siren if the engine is revved while the starter is engaged, after the engine starts, but while the starter is still held in the engaged position.	Go to <b>Step 6</b>	Go to <b>Step 4</b>
4	Do you hear a "rumble", a "growl", or, in some cases, a "knock" as the starter is coasting down to a stop after starting the engine?	Go to <b>Step 7</b>	Go to <b>Step 5</b>
5	<b>IMPORTANT:</b> <b>This is often diagnosed as a starter drive gear hang-in or a weak solenoid. Refer to Diagnostic Aids.</b>  When the engine is cranked, do you hear a high-pitched whine after the engine cranks and starts normally?	Go to <b>Step 8</b>	Go to <b>Step 7</b>
6	Inspect the flywheel ring gear for the following: <ul style="list-style-type: none"> <li>• Chipped gear teeth</li> <li>• Missing gear teeth</li> <li>• Milled teeth</li> </ul> Is the flywheel bent, or does it have damaged teeth?	Go to <b>Step 9</b>	Go to <b>Step 10</b>
7	1. Remove the starter motor. Refer to <b><u>Starter Motor Replacement (L61)</u></b> <b><u>Starter Motor Replacement (L66)</u></b> 2. Inspect the starter motor bushings and clutch		

	gear. Does the clutch gear have chipped or milled teeth or worn bushings?	Go to <b>Step 10</b>	Go to <b>Step 9</b>
8	Shim the starter motor away from the flywheel by adding shims between the starter motor and the engine block one at a time. Flywheel runout may make this noise appear to be intermittent. Did you complete the repair?	Go to <b>Step 11</b>	-
9	Replace the flexplate. Refer to <b>Engine Flywheel Replacement</b> in Engine Mechanical - 2.2L (L61) or <b>Engine Flywheel Replacement</b> in Engine Mechanical - 3.5L (L66). Did you complete the replacement?	Go to <b>Step 11</b>	-
10	Replace the starter motor. Refer to <b>Starter Motor Replacement (L61)</b> <a href="#">Starter Motor Replacement (L66)</a> . Did you complete the replacement?	Go to <b>Step 11</b>	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

## REPAIR INSTRUCTIONS

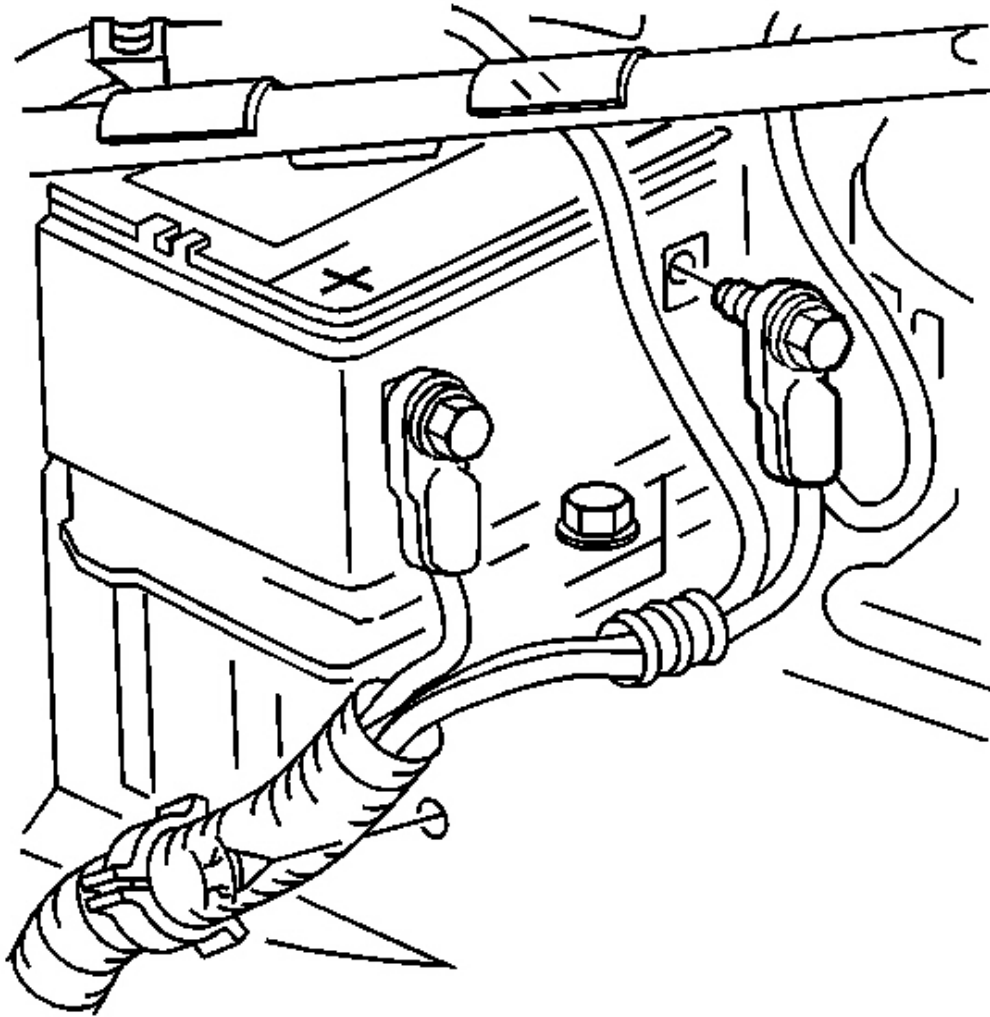
### BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE

#### Removal Procedure

**CAUTION:** Refer to **Battery Disconnect Caution** in Cautions and Notices.

1. Record all of the customer's radio station presets.
2. Turn off all the lamps and accessories.
3. Make sure the ignition switch is in the OFF position.

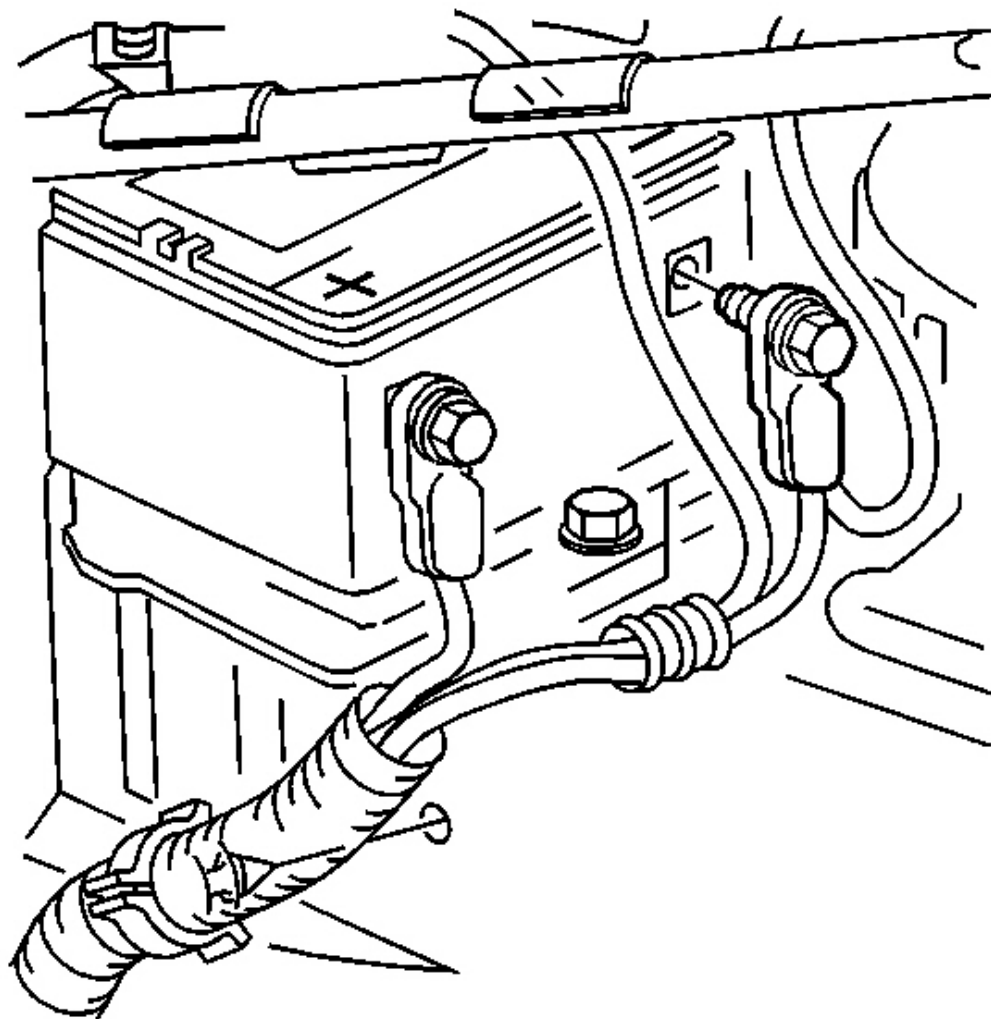




**Fig. 9: View Of Battery Ground (Negative) Cable & Bolt**  
Courtesy of GENERAL MOTORS CORP.

4. Remove the battery ground (negative) cable and bolt from the battery.

#### **Installation Procedure**



**Fig. 10: View Of Battery Ground (Negative) Cable & Bolt**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice in Cautions and Notices.

**IMPORTANT:** Clean any existing corrosion from the battery terminal bolt flange and the battery cable end.

1. Install the battery ground (negative) cable and bolt to the battery.

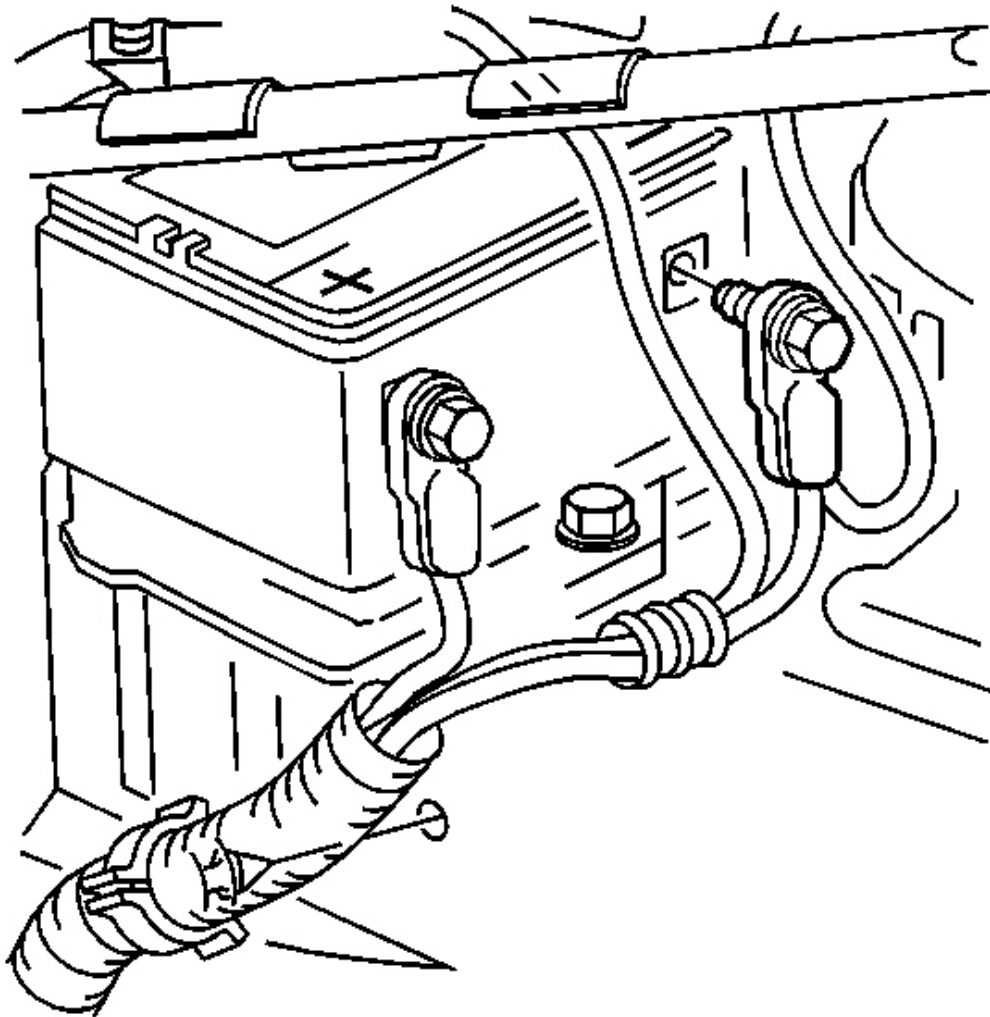
**Tighten:** Tighten the battery terminal bolt to 16 N.m (12 lb ft).

2. Program all of the customer's radio station presets and set the radio clock to the current time.

## **BATTERY NEGATIVE CABLE REPLACEMENT (L61)**

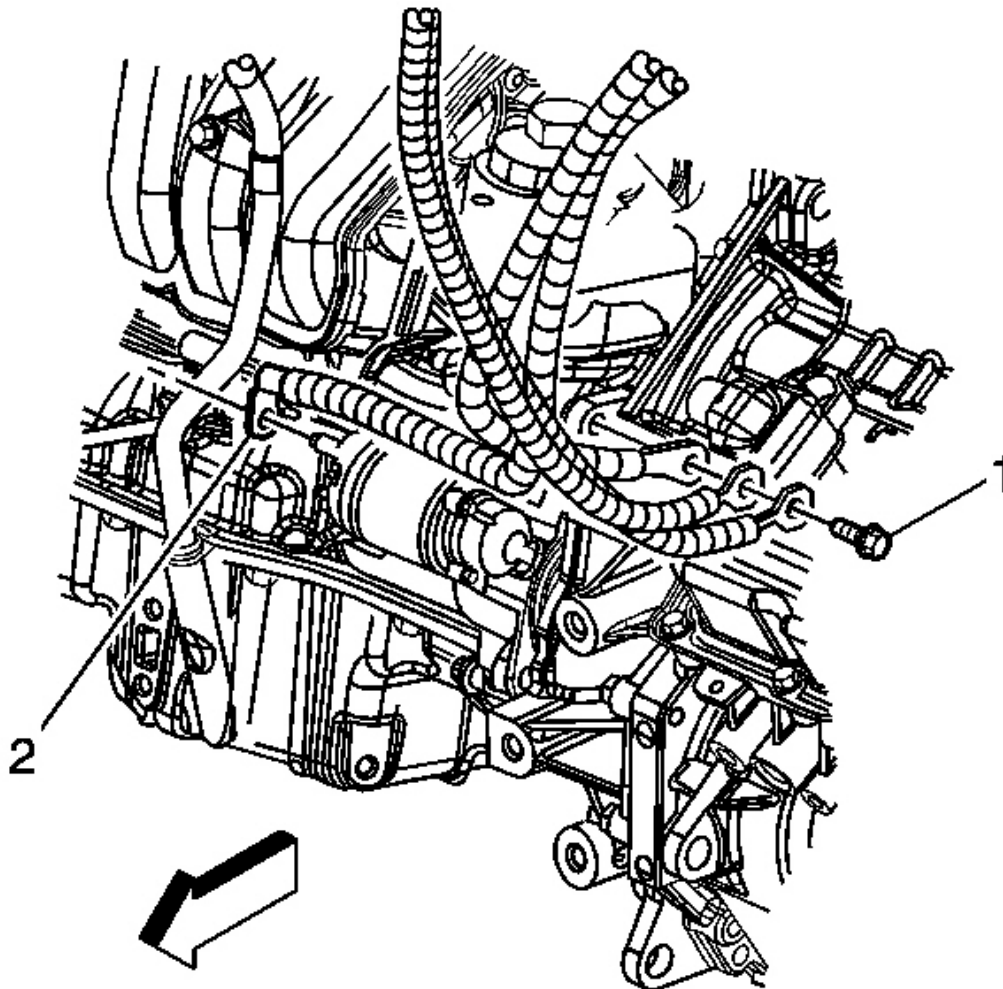
### **Removal Procedure**

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .



**Fig. 11: View Of Negative Battery Cable (L61)**  
Courtesy of GENERAL MOTORS CORP.

2. Remove the battery tray. Refer to **Battery Tray Replacement (L61)** or **Battery Tray Replacement (L66)**.
3. Remove the negative battery cable nut from the right frame rail.

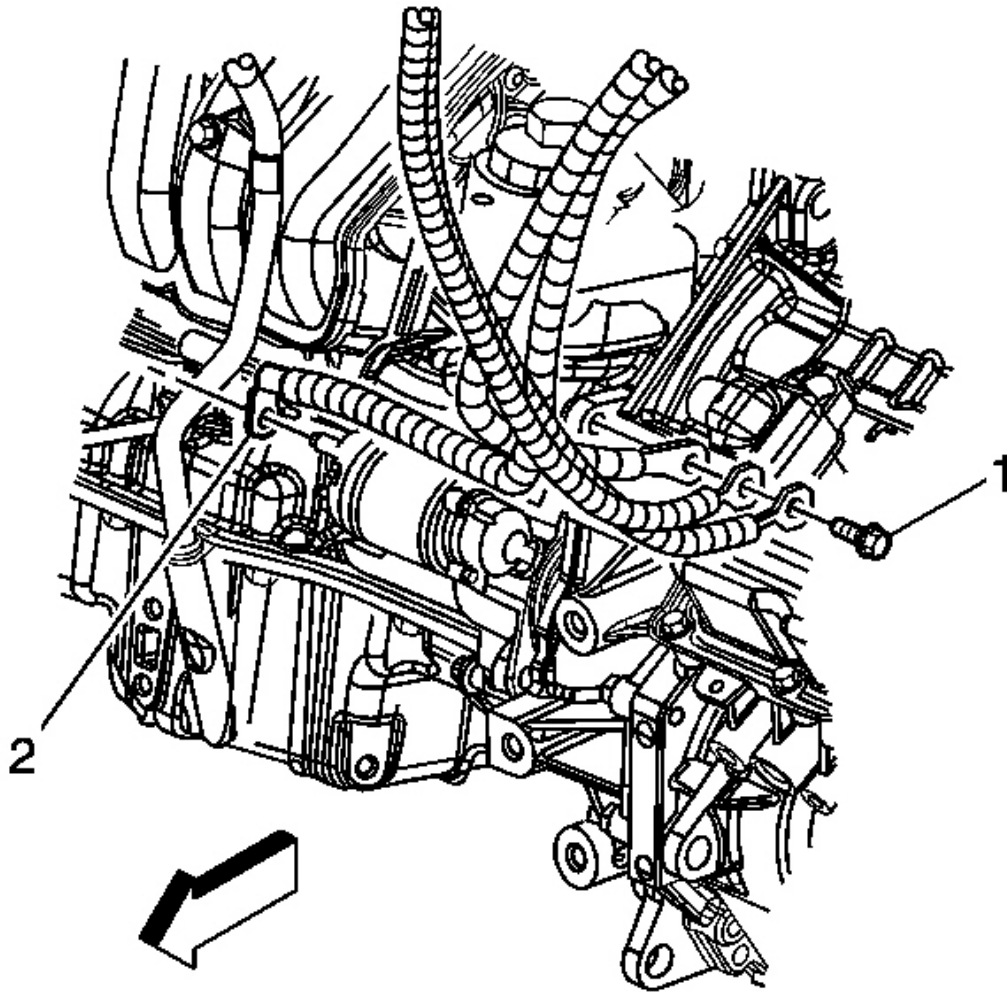


**Fig. 12: View Of Negative Battery Cable To The Transmission Bracket**  
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the negative battery cable from the transmission bracket (1).

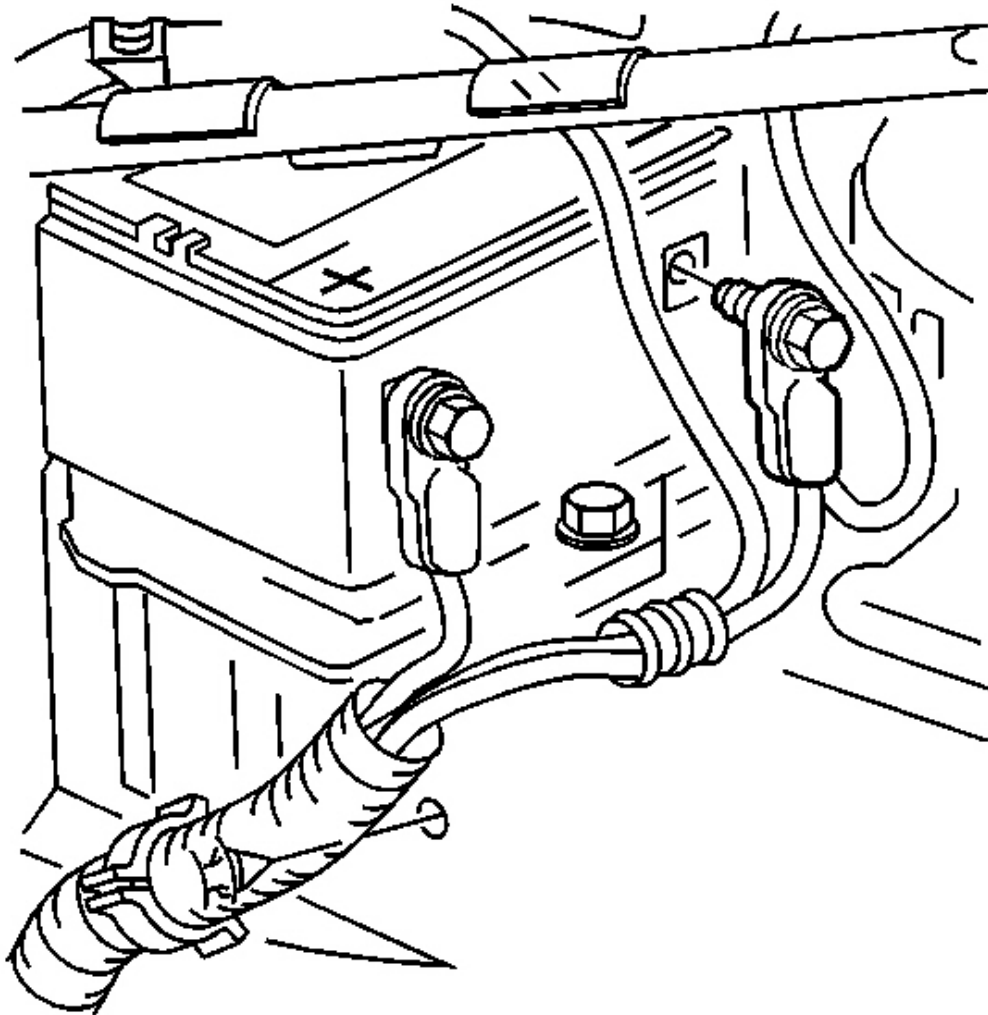
5. Disconnect the negative battery cable from the retainers.
6. Remove the negative battery cable.

### Installation Procedure



**Fig. 13: View Of Negative Battery Cable To The Transmission Bracket**  
Courtesy of GENERAL MOTORS CORP.

1. Install the negative battery cable into the retainers.
2. Connect the negative battery cable to the transmission bracket (1).



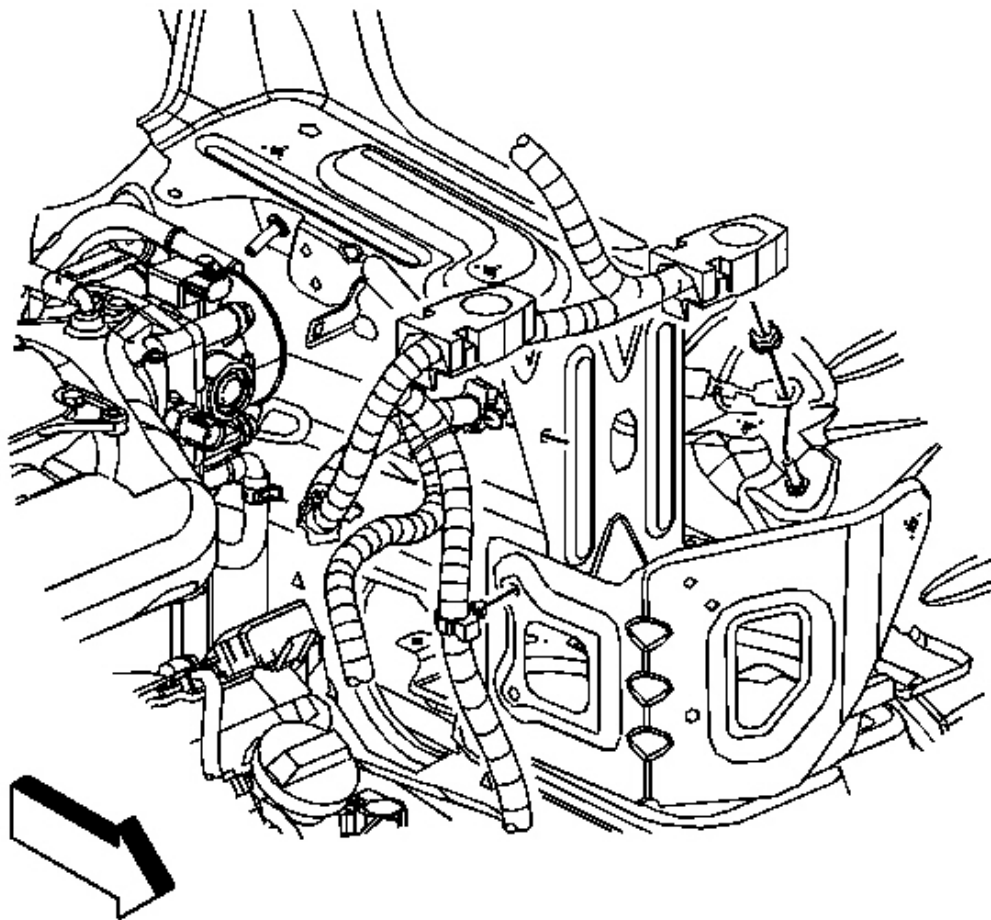
**Fig. 14: View Of Battery Ground (Negative) Cable & Bolt**  
Courtesy of GENERAL MOTORS CORP.

3. Install the negative battery cable to the right frame rail.
4. Install the battery tray. Refer to **Battery Tray Replacement (L61)** or **Battery Tray Replacement (L66)**.
5. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

#### **BATTERY NEGATIVE CABLE REPLACEMENT (L66)**

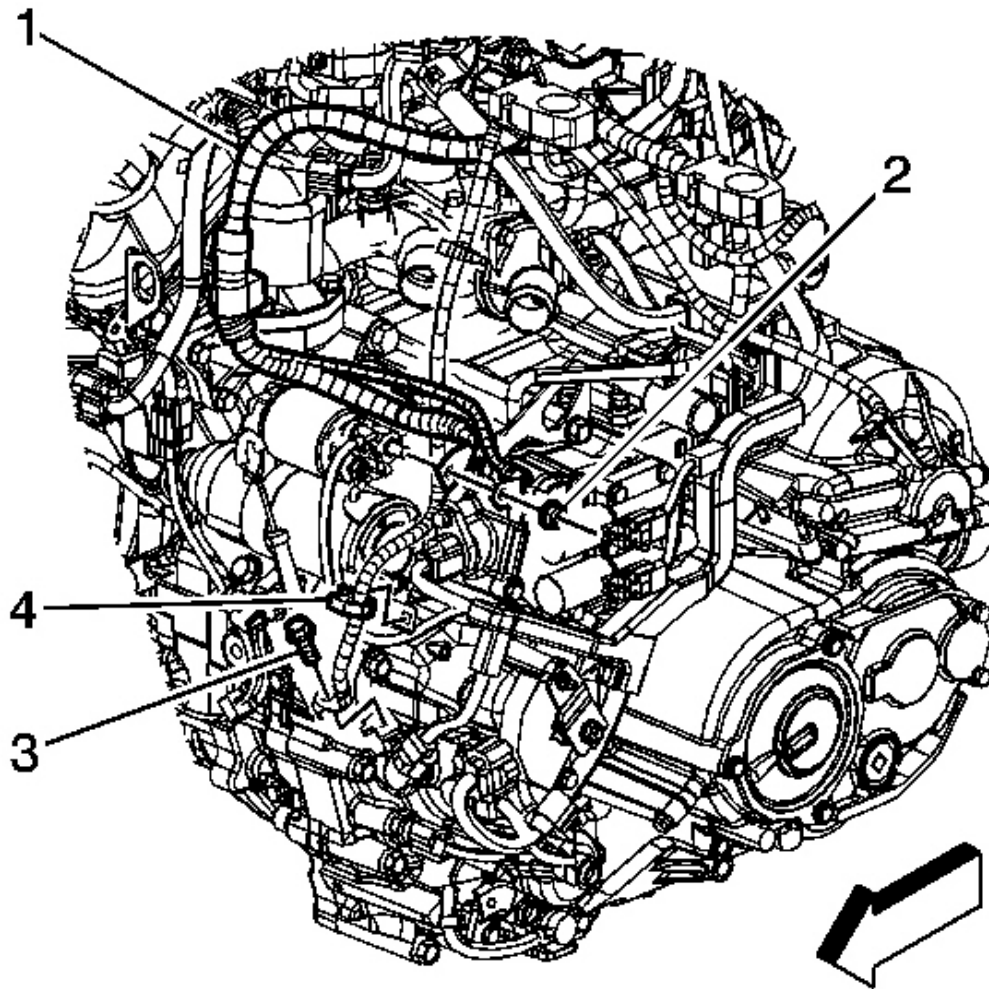
## Removal Procedure

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .



**Fig. 15: View Of Negative Battery Cable (L66)**  
Courtesy of GENERAL MOTORS CORP.

2. Remove the battery tray. Refer to **Battery Tray Replacement (L61)** or **Battery Tray Replacement (L66)** .
3. Remove the negative battery cable nut from the right frame rail.

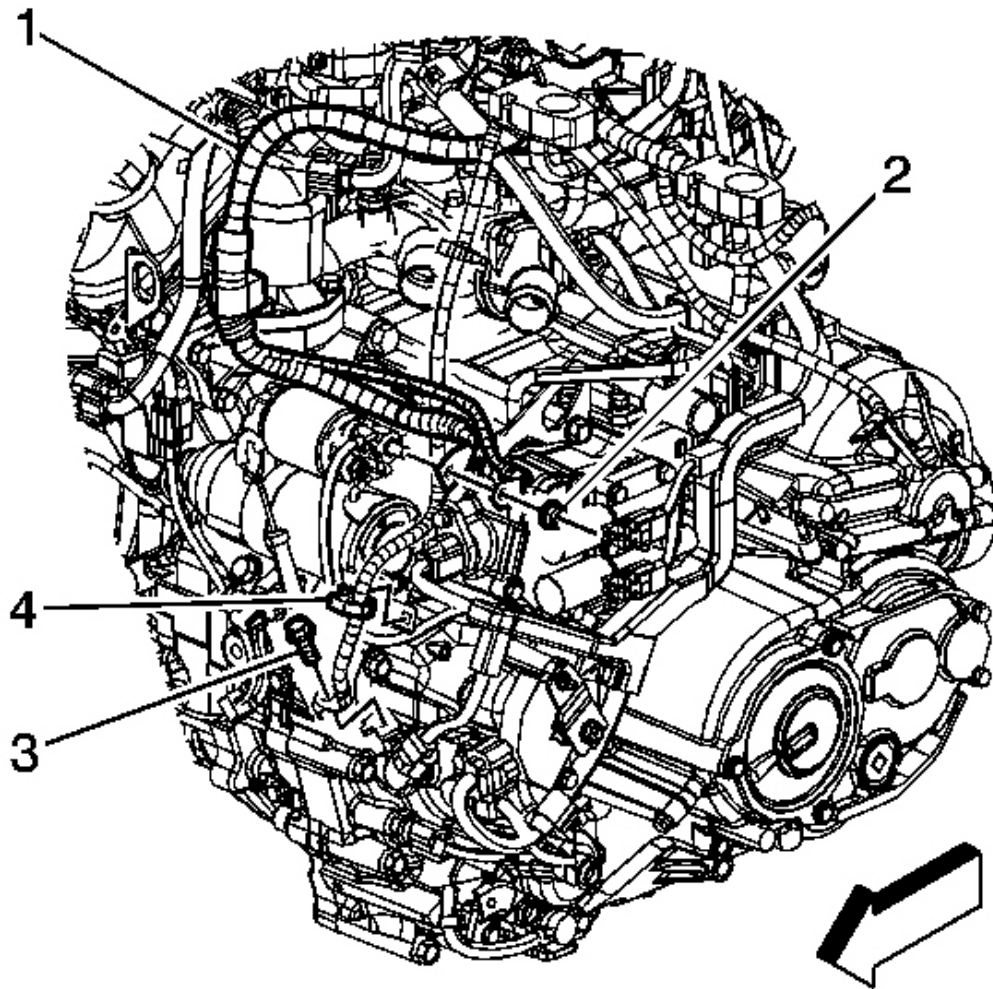


**Fig. 16: View Of Negative Battery Cable To The Transmission Bracket**  
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the negative battery cable from the transmission bracket (3).
5. Disconnect the negative battery cable from the retainers.
6. Remove the negative battery cable.

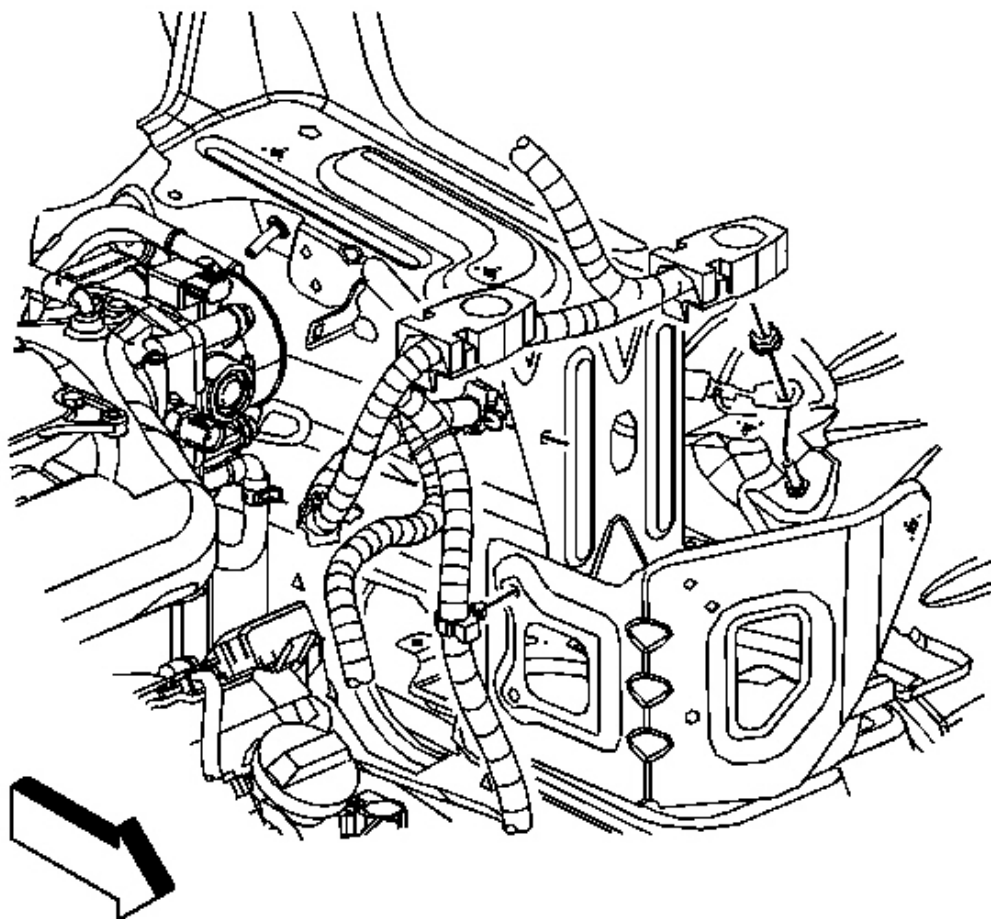
#### **Installation Procedure**





**Fig. 17: View Of Negative Battery Cable To The Transmission Bracket**  
Courtesy of GENERAL MOTORS CORP.

1. Install the negative battery cable into the retainers.
2. Connect the negative battery cable to the transmission bracket (3).



**Fig. 18: View Of Negative Battery Cable To The Right Frame Rail**  
Courtesy of GENERAL MOTORS CORP.

3. Install the negative battery cable to the right frame rail.
4. Install the battery tray. Refer to **Battery Tray Replacement (L61)** or **Battery Tray Replacement (L66)** .
5. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .

## **BATTERY POSITIVE CABLE REPLACEMENT (L61)**

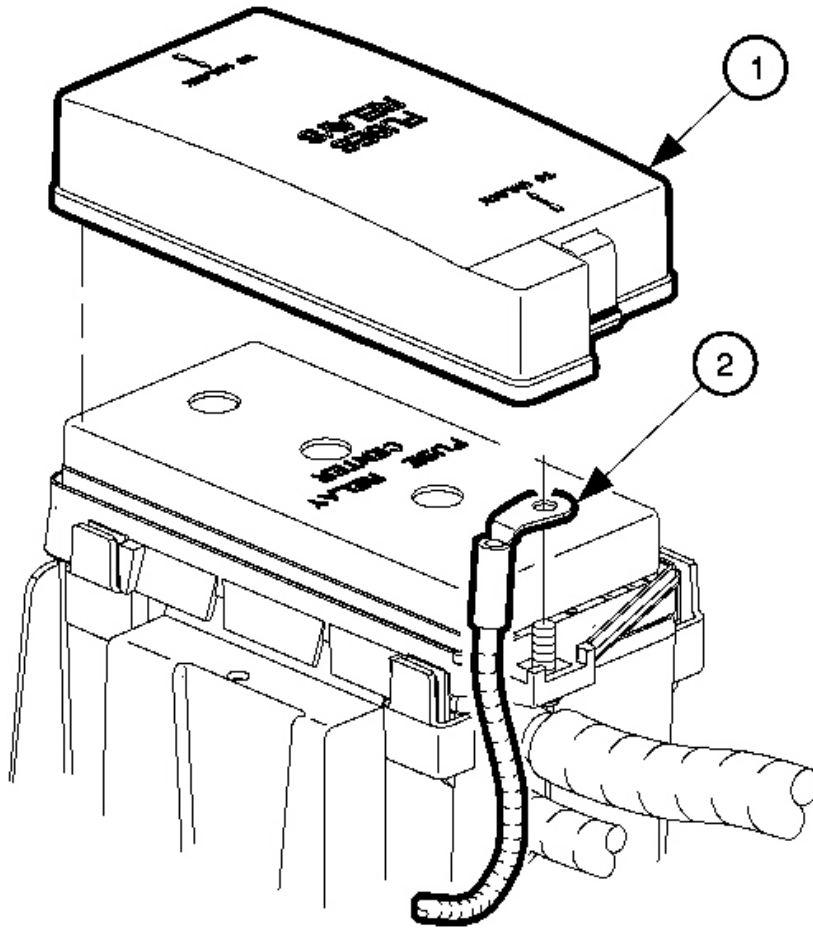
### **Removal Procedure**

**IMPORTANT:** • Always use replacement cables that are of the same type, diameter and

length of the cables that you are replacing.

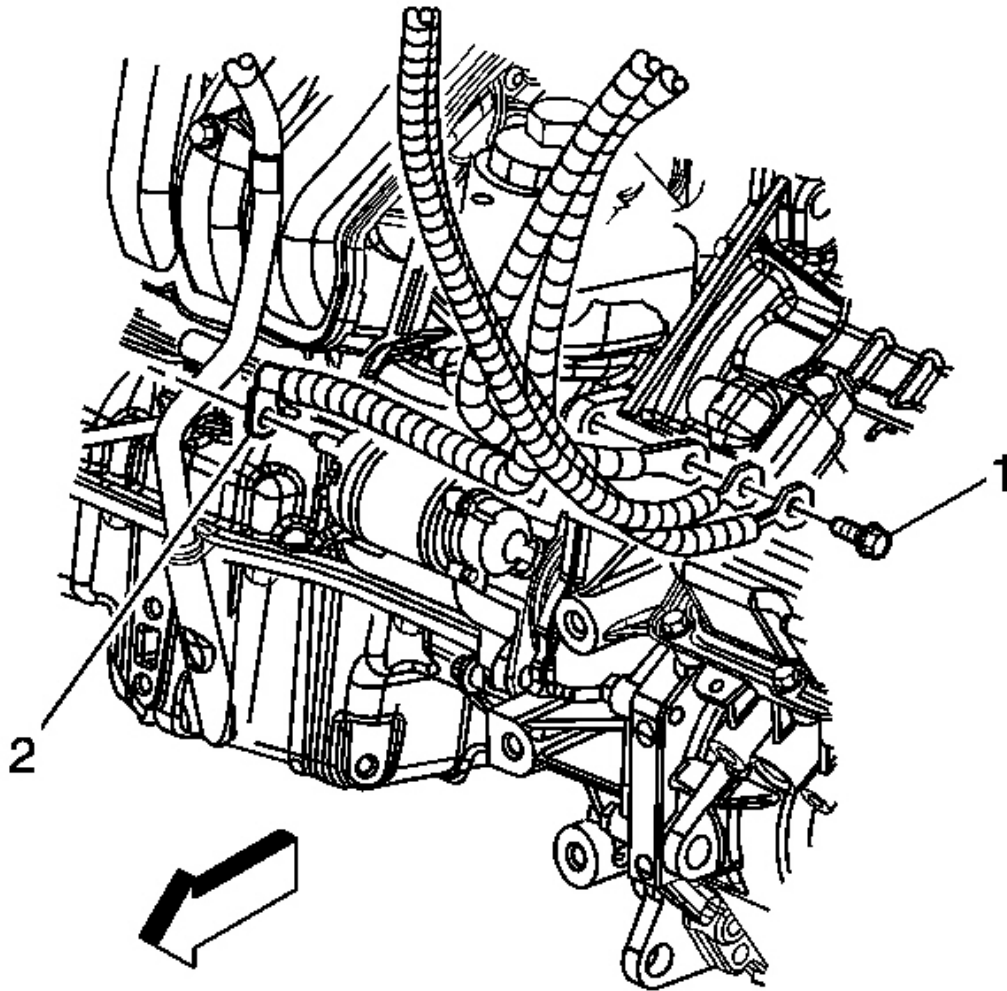
- Always route the replacement cable the same way as the original cable.

1. Disconnect the negative battery cable from the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .
2. Disconnect the positive battery cable from the battery.



**Fig. 19: View Of Positive Battery Cable (L66)**  
Courtesy of GENERAL MOTORS CORP.

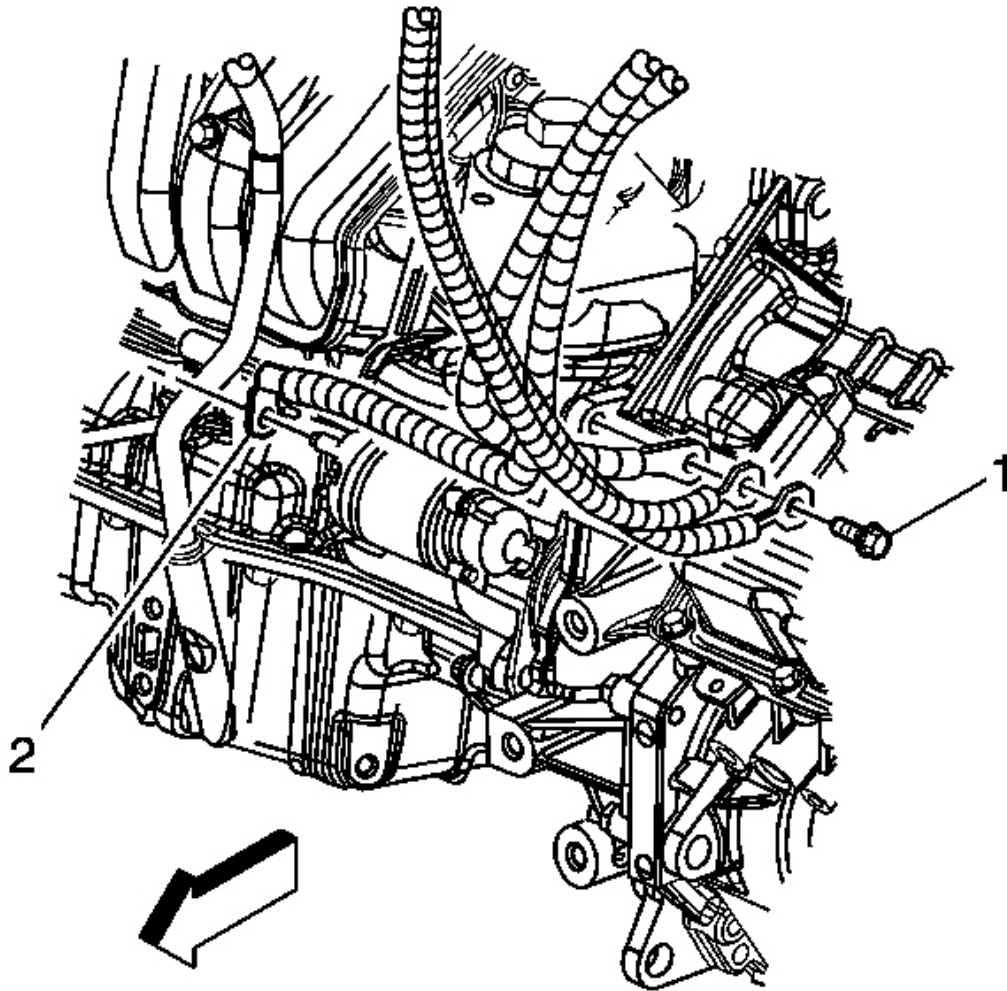
3. Remove the UHJB cover (1).
4. Disconnect the positive battery cable (2) from the UHJB.



**Fig. 20: View Of Negative Battery Cable To The Transmission Bracket**  
Courtesy of GENERAL MOTORS CORP.

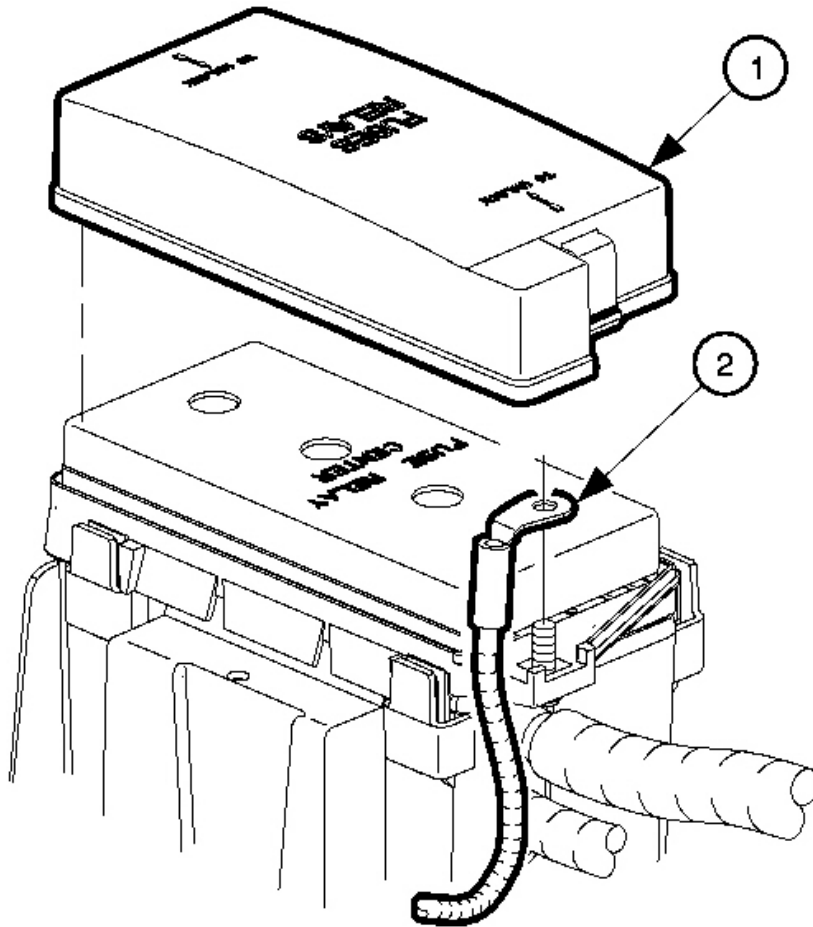
5. Disconnect the positive battery cable from the starter (2).
6. Disconnect the positive battery cable from the retainers.
7. Disconnect the positive battery cable from the generator.
8. Remove the positive battery cable from the vehicle.

#### **Installation Procedure**



**Fig. 21: View Of Negative Battery Cable To The Transmission Bracket**  
Courtesy of GENERAL MOTORS CORP.

1. Route the battery cable through the engine compartment and connect to the cable retainers.
2. Connect the positive battery cable to the generator.
3. Connect the positive battery cable to the starter (2).



**Fig. 22: View Of Positive Battery Cable (L66)**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice in Cautions and Notices.

4. Connect the positive battery cable to the UHJB (2).

**Tighten:** Tighten the positive cable to UHJB to 17 N.m (13 lb ft).

5. Install the UHJB cover (1).
6. Connect the positive battery cable to the battery.
7. Connect the negative battery cable. Refer to Battery Negative Cable Disconnect/Connect Procedure.

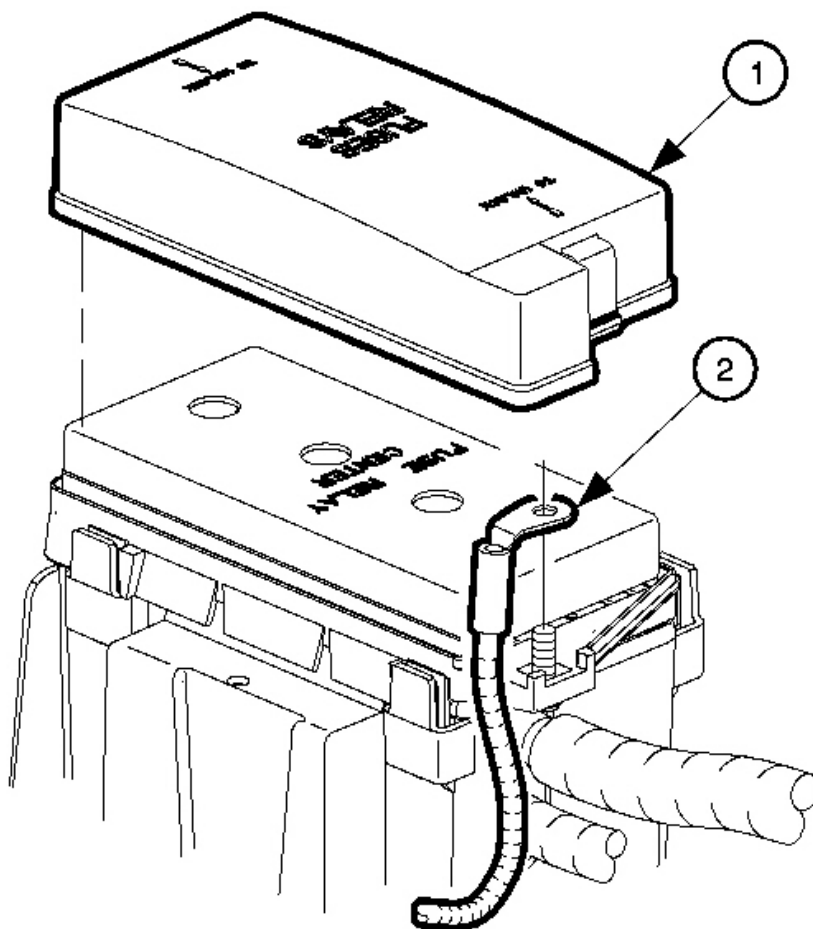
## BATTERY POSITIVE CABLE REPLACEMENT (L66)

### Removal Procedure

#### IMPORTANT:

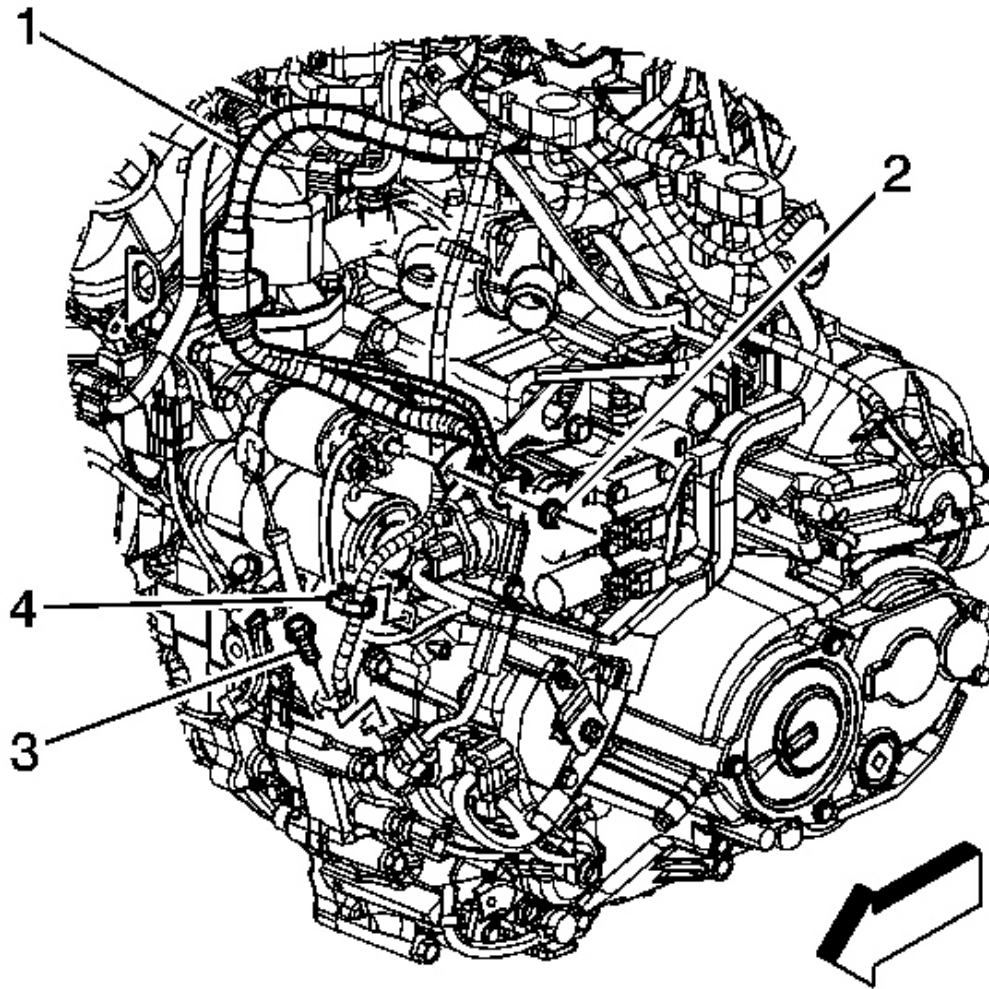
- Always use replacement cables that are of the same type, diameter and length of the cables that you are replacing.
- Always route the replacement cable the same way as the original cable.

1. Disconnect the negative battery cable from the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .
2. Disconnect the positive battery cable (2) from the battery.



**Fig. 23: View Of Positive Battery Cable (L66)**  
Courtesy of GENERAL MOTORS CORP.

3. Remove the UHJB cover (1).
4. Disconnect the positive battery cable (2) from the UHJB.



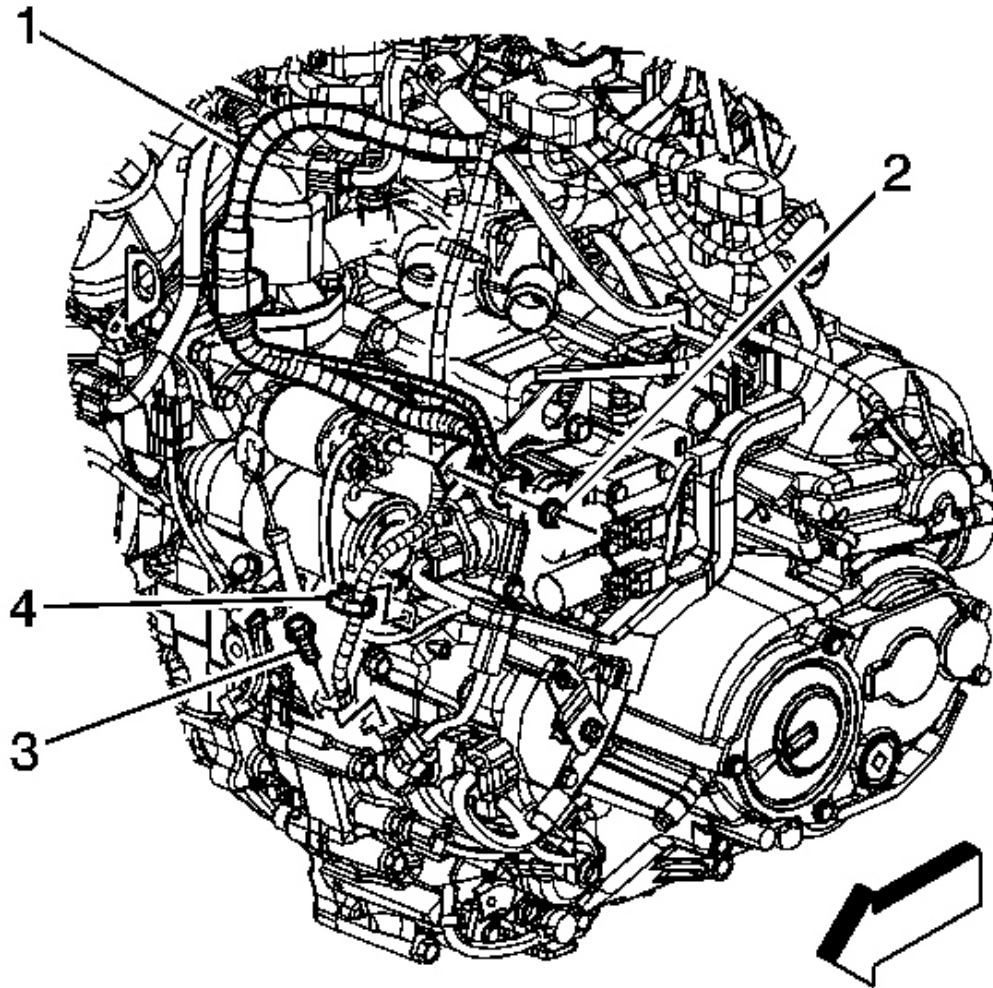
**Fig. 24: View Of Negative Battery Cable To The Transmission Bracket**  
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the positive battery cable from the starter (2).
6. Disconnect the positive battery cable from the retainers.



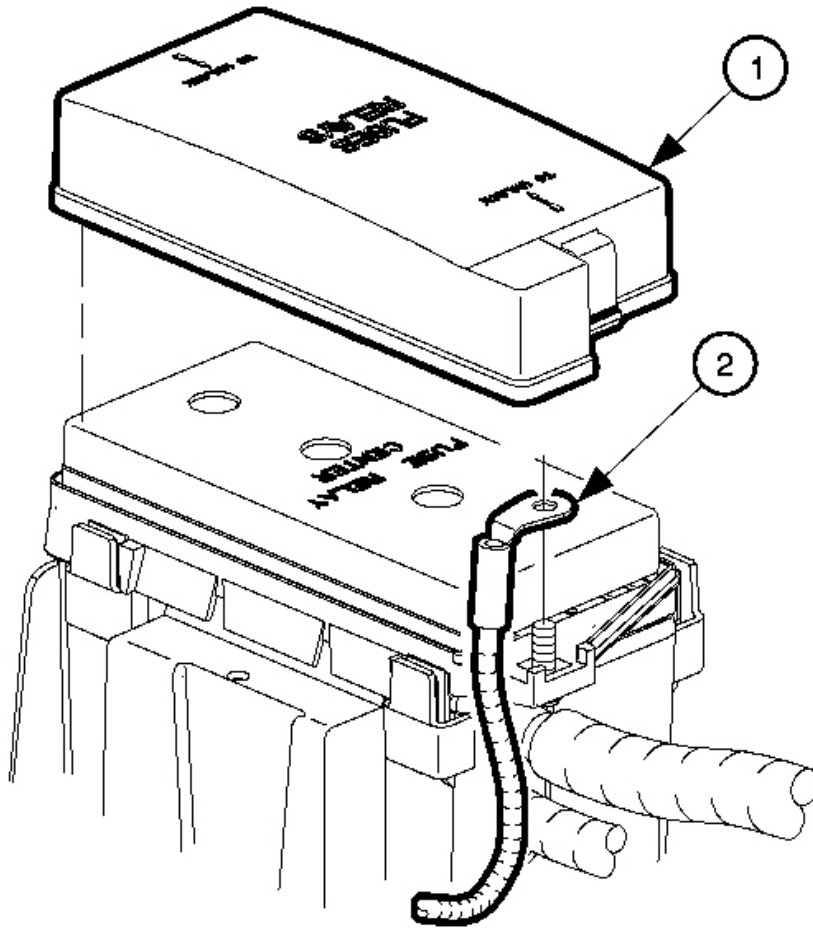
7. Disconnect the positive battery cable from the generator.
8. Remove the positive battery cable from the vehicle.

### Installation Procedure



**Fig. 25: View Of Negative Battery Cable To The Transmission Bracket**  
Courtesy of GENERAL MOTORS CORP.

1. Route the battery cable through the engine compartment and connect to the cable retainers.
2. Connect the positive battery cable to the generator.
3. Connect the positive battery cable to the starter (2).



**Fig. 26: View Of Positive Battery Cable (L66)**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice in Cautions and Notices.

4. Connect the positive battery cable to the UHJB (2).

**Tighten:** Tighten the positive cable to UHJB to 17 N.m (13 lb ft).

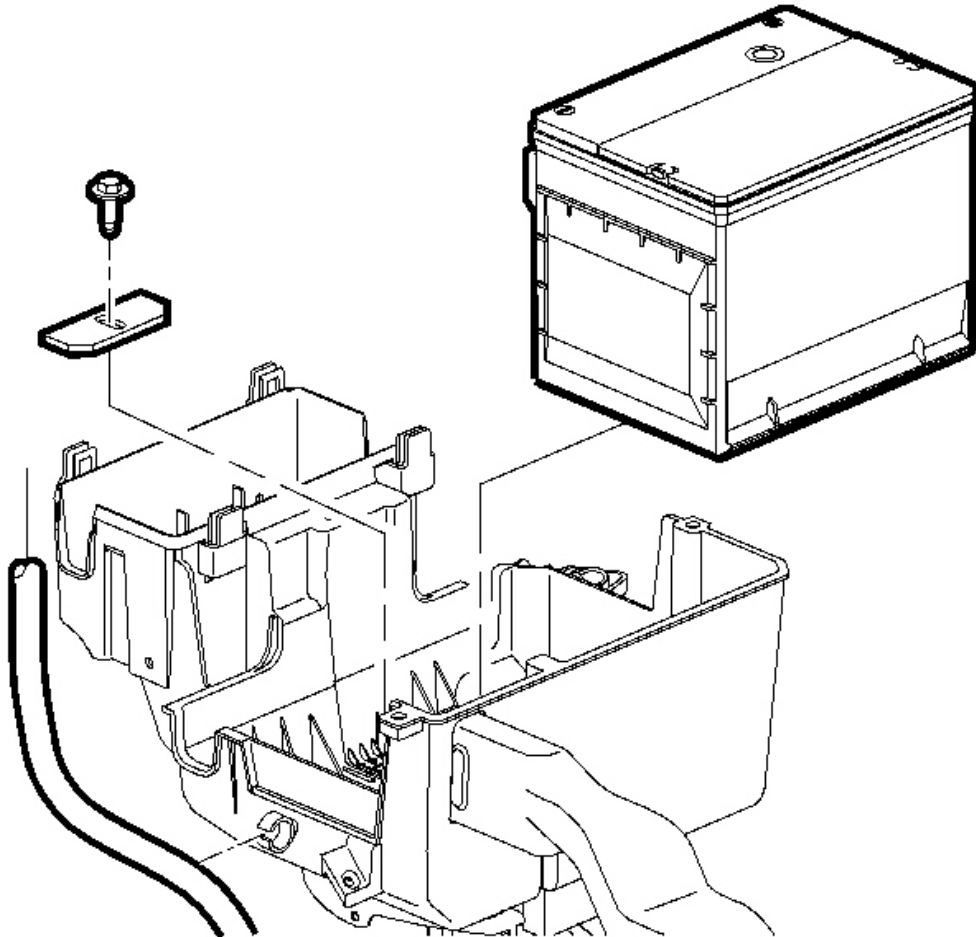
5. Install the UHJB cover (1).
6. Connect the positive battery cable to the battery.
7. Connect the negative battery cable. Refer to Battery Negative Cable Disconnect/Connect Procedure.

# BATTERY REPLACEMENT

## Removal Procedure

**IMPORTANT: Record all pre-set radio stations.**

1. Turn the ignition OFF.
2. For vehicles with L61 engine, remove the battery box. Refer to **Battery Box Replacement** .
3. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .
4. Disconnect the positive battery cable.



**Fig. 27: View Of Battery**

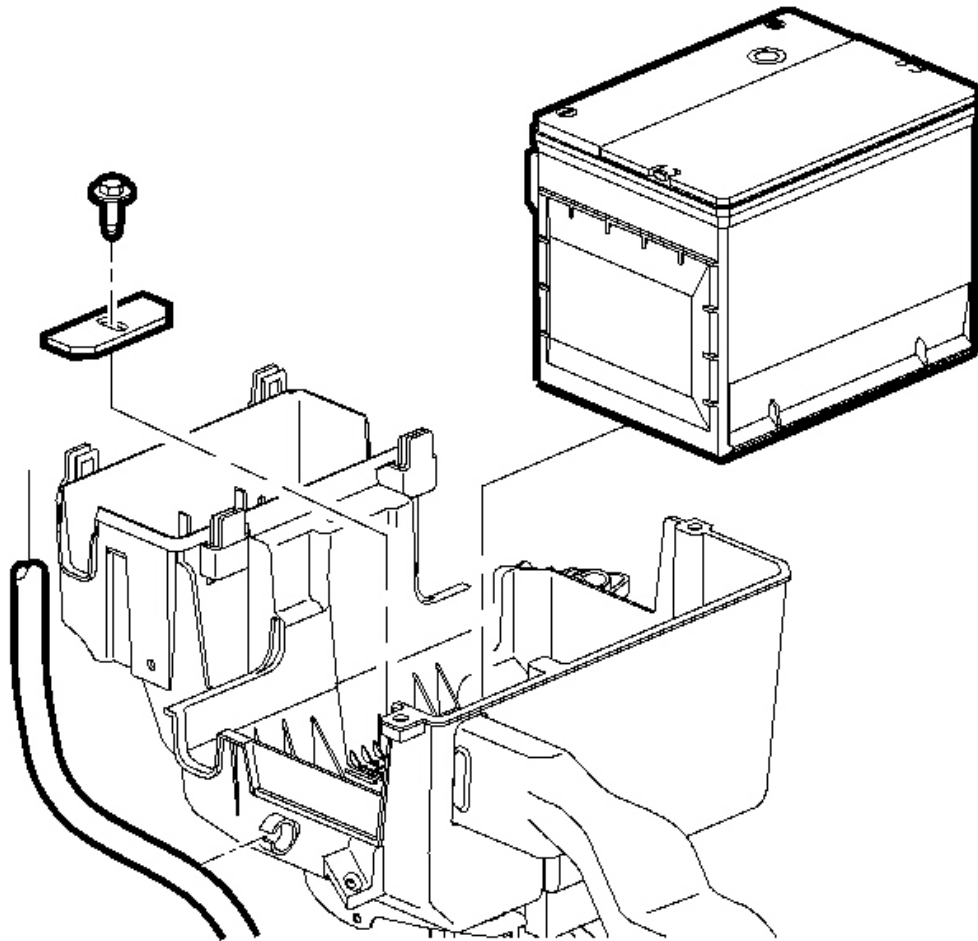
Courtesy of GENERAL MOTORS CORP.

**CAUTION: Do not tip the battery over a 45 degree angle or acid could spill causing serious personal injury.**

5. Loosen the battery hold down bolt and remove the battery.

**Installation Procedure**

**CAUTION: Do not tip the battery over a 45 degree angle or acid could spill causing serious personal injury.**



**Fig. 28: View Of Battery**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice in Cautions and Notices.

1. Install the battery and tighten the battery hold down bolt.

**Tighten:** Tighten the battery hold down bolt to 15 N.m (11 lb ft).

2. Connect the positive battery cable to the battery.

**Tighten:** Tighten the battery terminal bolts to 17 N.m (13 lb ft).

3. Connect the negative battery cable to the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .

**Tighten:** Tighten the battery terminal bolts to 17 N.m (13 lb ft).

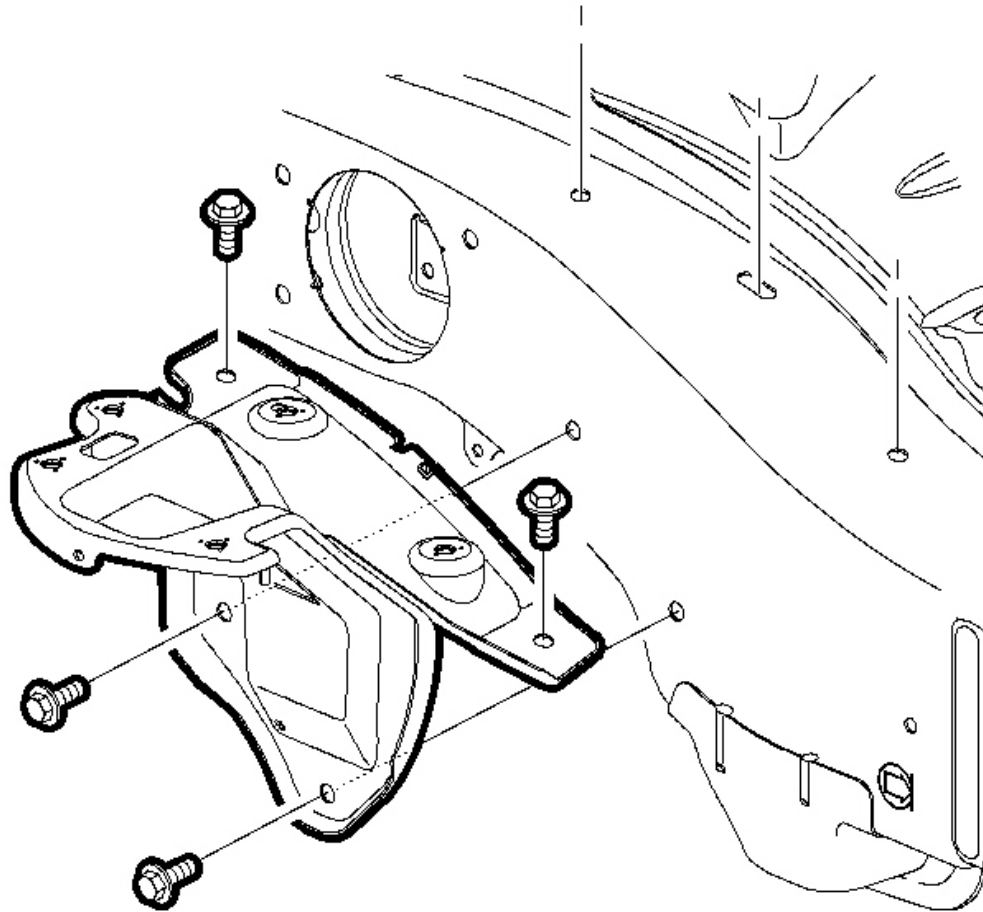
4. For vehicles with L61 engine, install the battery box. Refer to **Battery Box Replacement** .

**Tighten:** Tighten the battery cooling cover box screws to 2 N.m (18 lb in).

5. Reprogram the radio stations.

## **BATTERY TRAY REPLACEMENT (L61)**

### **Removal Procedure**



**Fig. 29: View Of Battery Tray Bracket Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the battery box. Refer to **Battery Box Replacement** .
2. Loosen the battery tray bracket bolts and remove the bracket.

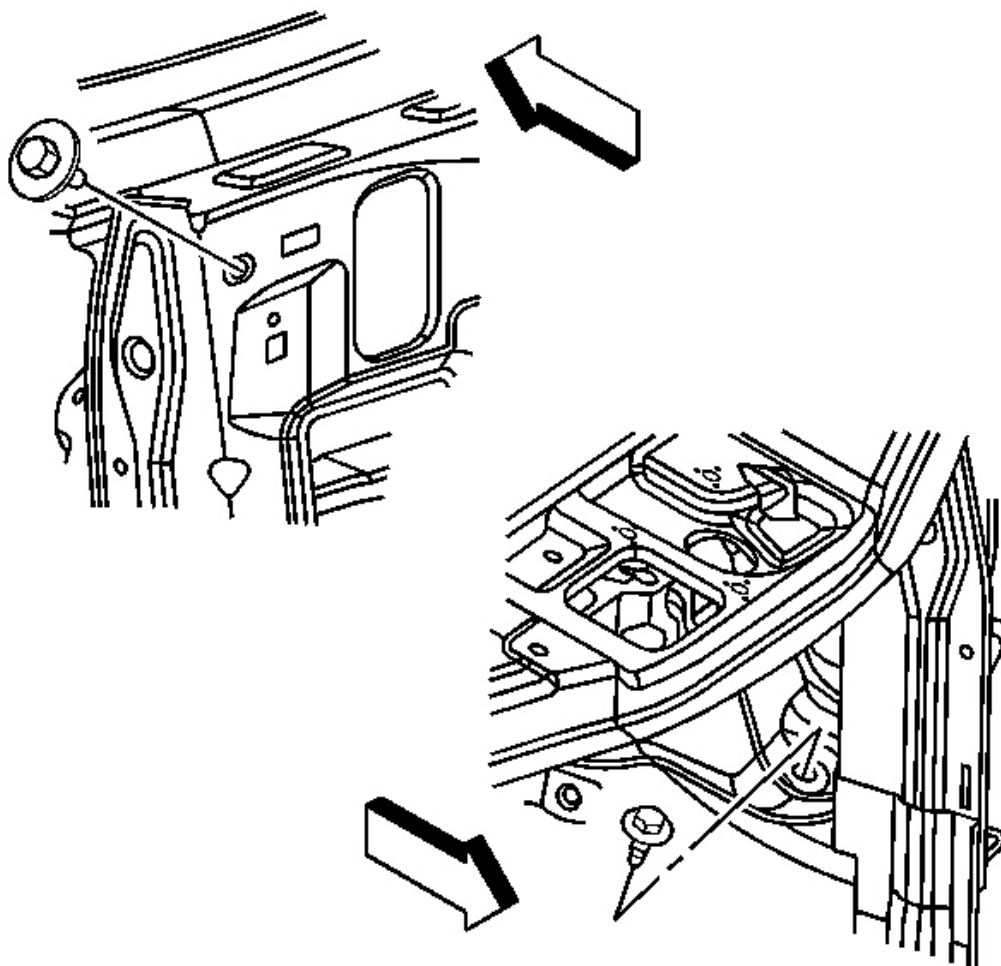
#### **Installation Procedure**





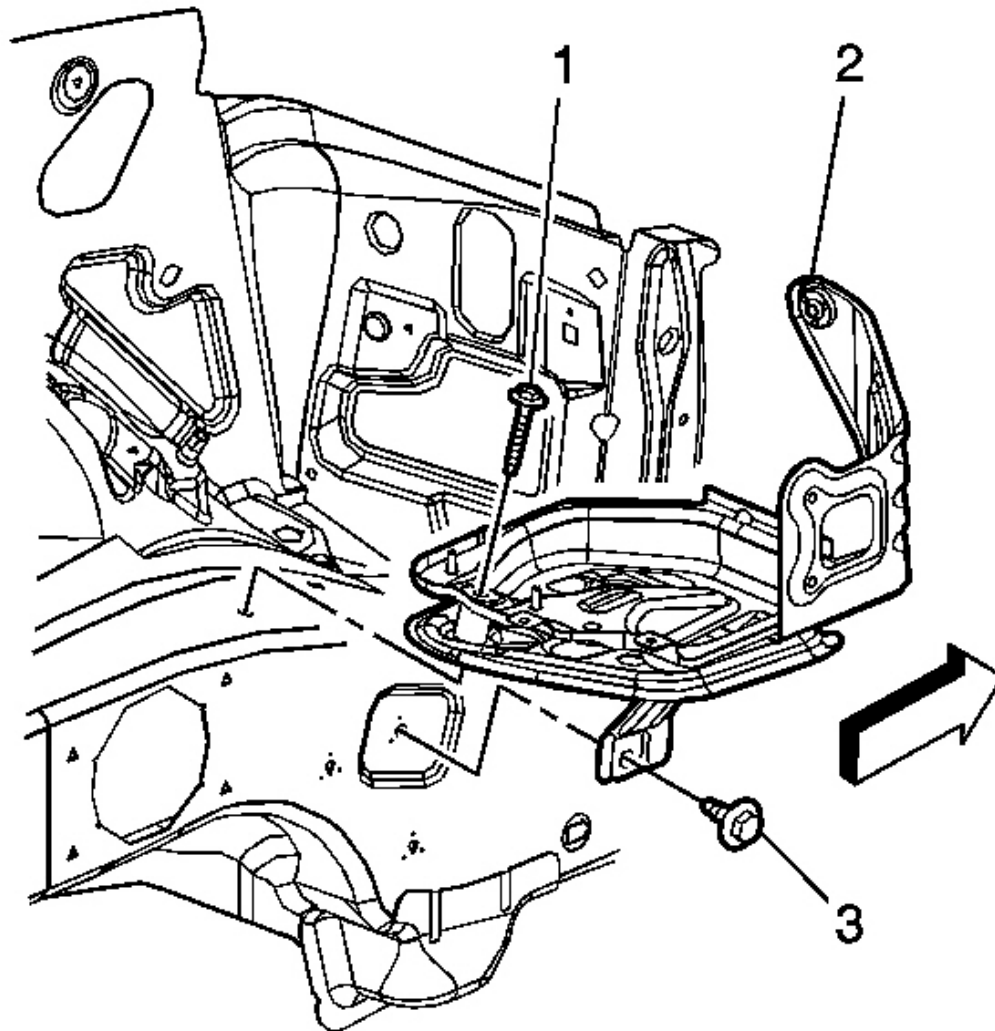
## Removal Procedure

1. Remove the battery. Refer to **Battery Replacement** .
2. Remove the 3 UHJB nuts and lift the UHJB from the battery tray.
3. Remove the left headlight. Refer to **Headlamp Assembly or Headlamp Bulb and/or Cornering, Sidemarker, Park, Turn Signal Bulb Replacement** in Lighting Systems.



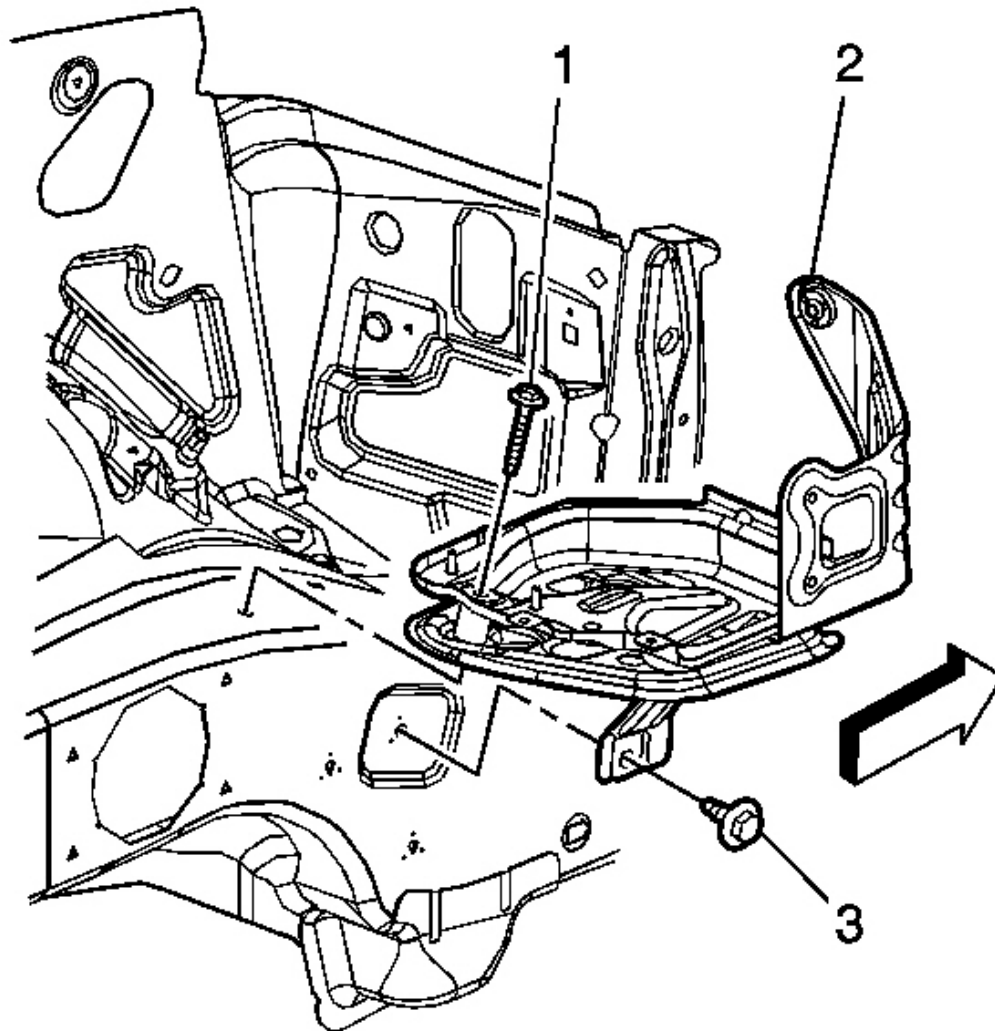
**Fig. 31: View Of Battery Tray (L66)**  
Courtesy of GENERAL MOTORS CORP.

4. Remove the battery tray bolt behind the headlight.



**Fig. 32: View Of Battery Tray Bolt On The Top Of The Side Rail**  
Courtesy of GENERAL MOTORS CORP.

5. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
6. Remove the lower battery tray bolt (3).
7. Lower the vehicle.
8. Remove the battery tray bolt on top of the side rail (1).
9. Remove the battery tray.



**Fig. 33: View Of Battery Tray Bolt On The Top Of The Side Rail**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to **Fastener Notice** in Cautions and Notices.

1. Position the battery tray bracket and install the bolt to the top of the side rail (1).

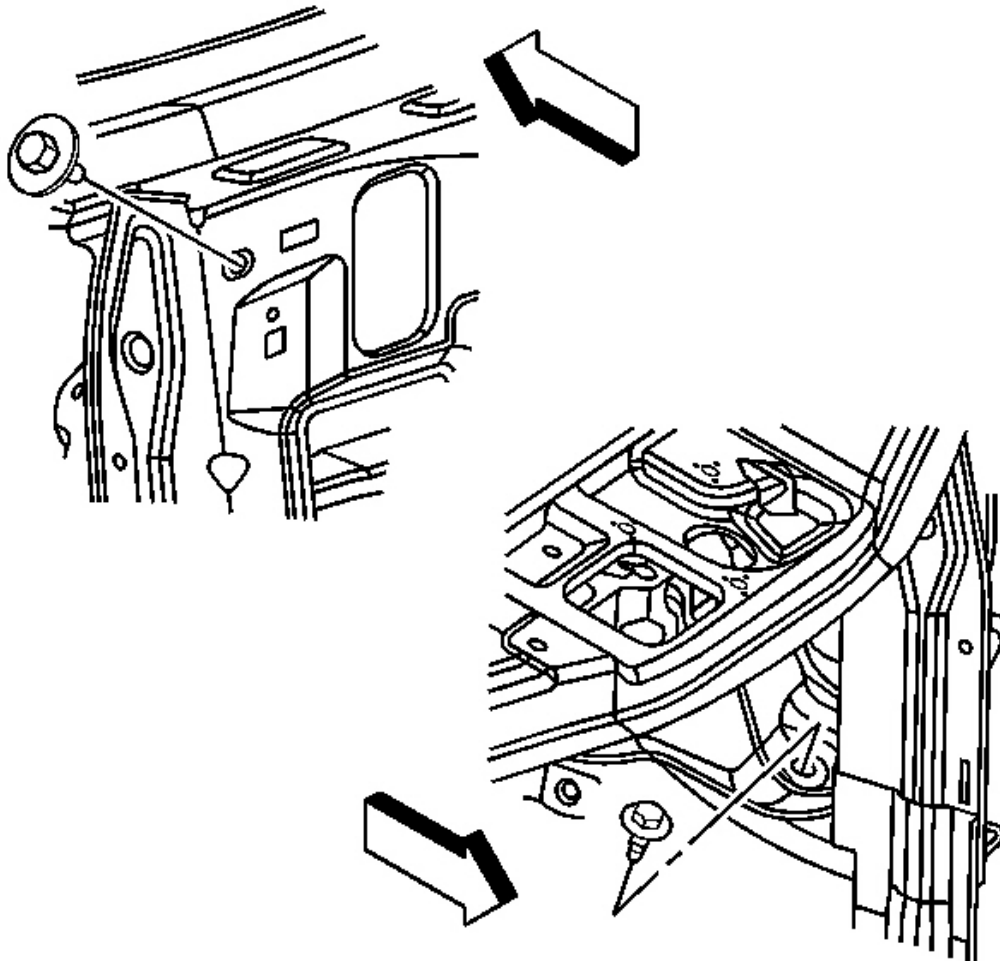
**Tighten:** Tighten the battery tray bracket bolts to 15 N.m (11 lb ft).

2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

3. Install the lower battery tray bolt (3).

**Tighten:** Tighten the battery tray bolt to 15 N.m (11 lb ft).

4. Lower the vehicle.



**Fig. 34: View Of Battery Tray Bolt Behind The Headlight**  
Courtesy of GENERAL MOTORS CORP.

5. Install the battery tray bolt behind the headlight.

**Tighten:** Tighten the bolt to 15 N.m (11 lb ft).

6. Install the left headlight. Refer to **Headlamp Assembly or Headlamp Bulb and/or Cornering, Sidemarker, Park, Turn Signal Bulb Replacement** in Lighting Systems.
7. Install the UHJB and nuts.

**Tighten:** Tighten the nuts to 12 N.m (106 lb in).

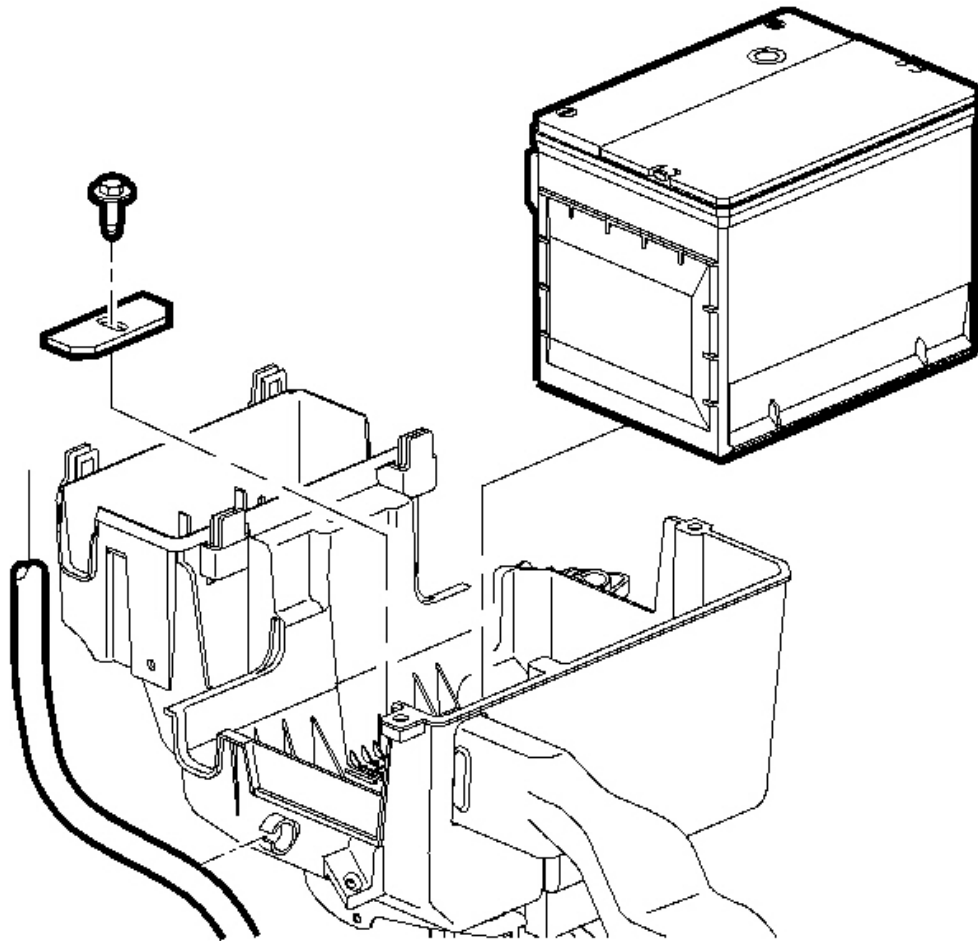
8. Install the battery. Refer to **Battery Replacement** .

## **BATTERY BOX REPLACEMENT**

### **Removal Procedure**

**IMPORTANT: Record all pre-set radio stations.**

1. Turn the ignition OFF.
2. Loosen the battery cover screws and remove the battery cover.
3. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .
4. Disconnect the positive battery cable.

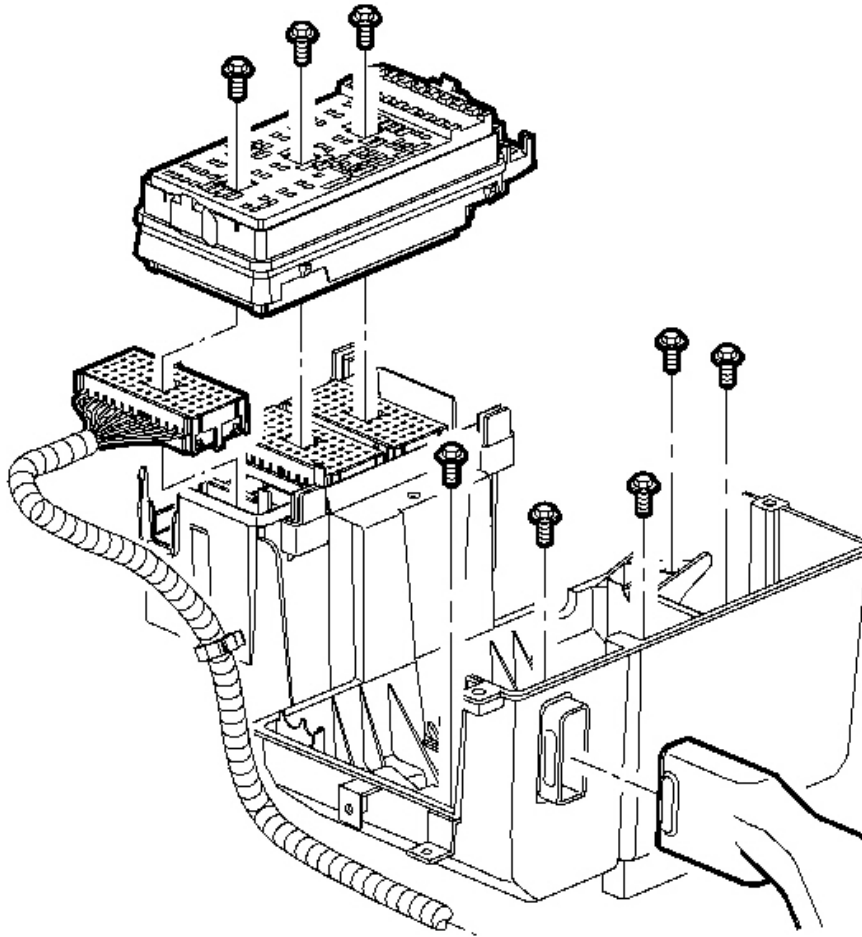


**Fig. 35: View Of Battery**  
Courtesy of GENERAL MOTORS CORP.

**CAUTION: Do not tip the battery over a 45 degree angle or acid could spill causing serious personal injury.**

5. Remove the battery hold down bolt and remove the battery.
6. Remove the underhood fuse block (UHFB) cover.
7. Remove the positive battery cable and electronic power steering (EPS) wire from B+ terminal at UHFB.
8. Open all retainer clips and remove all cables, lines and harnesses from the battery cooling box.
9. Remove the UHFB connector retaining bolts.

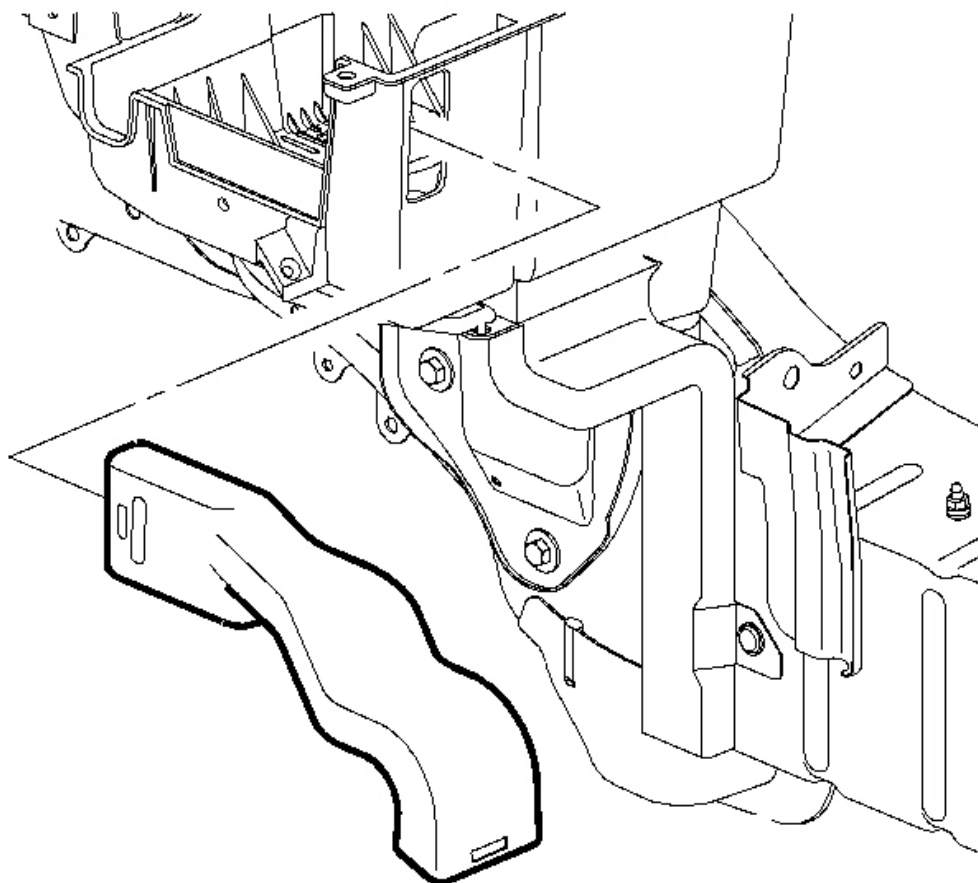
10. Unfasten the UHFB from its housing and disconnect the forward lamp harness.



**Fig. 36: View Of Battery Cooling Box Bolts**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT: Protect the disconnected harness from contamination during service.**

11. Remove the battery cooling box bolts.
12. Remove the battery cooling box side support bolt.

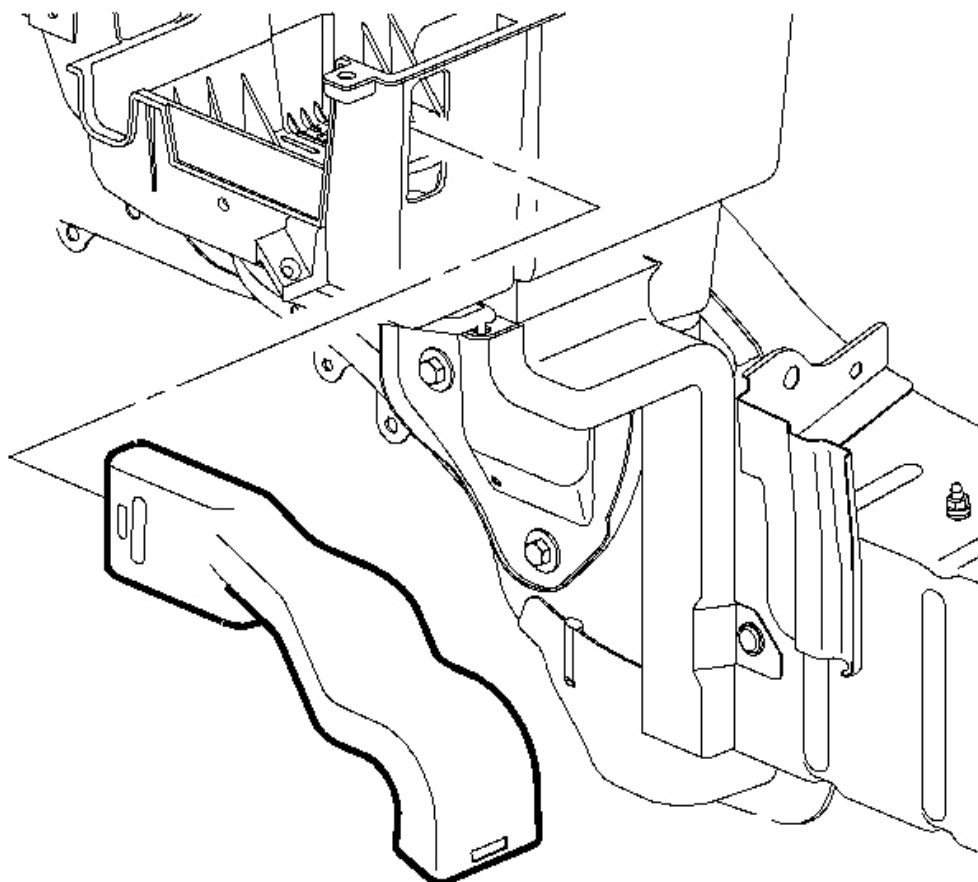


**Fig. 37: View Of Inlet & Outlet Ducts With The Battery Cooling Box**  
**Courtesy of GENERAL MOTORS CORP.**

13. Pull the inlet duct away from the battery cooling box.
14. Rotate the UHFB out of the way and remove the battery cooling box.

**Installation Procedure**





**Fig. 38: View Of Inlet & Outlet Ducts With The Battery Cooling Box**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** Alignment of inlet and outlet ducts with the battery cooling box is critical to ensure proper airflow to the battery.

1. Position the battery cooling box on the tray so that the inlet and outlet ducts are properly aligned.

**NOTE:** Refer to Fastener Notice in Cautions and Notices.

**IMPORTANT:** Over tightening the battery cooling box bolts will break/crack the plastic.

2. Install the battery cooling box bolts.

**Tighten:** Tighten the battery cooling box bolts to 15 N.m (11 lb ft).

3. Install the battery cooling box side support bolt.

**Tighten:** Tighten the battery cooling box side support bolt to 10 N.m (89 lb in).

4. Connect the forward lamp harness to the UHFB and attach the UHFB into the housing.
5. Tighten the UHFB connector retaining screws.

**Tighten:** Tighten the UHFB connector bolts to 4 N.m (35 lb in).

6. Secure all cables, lines and harnesses into retaining clips.
7. Attach the positive battery cable and EPS wire to the B+ terminal at the UHFB and tighten the nut.

**Tighten:** Tighten the UHFB B+ terminal nut to 10 N.m (89 lb in).

**CAUTION: Do not tip the battery over a 45 degree angle or acid could spill causing serious personal injury.**

8. Install the battery and tighten the battery hold down bolt.

**Tighten:** Tighten the battery hold down bolt to 15 N.m (11 lb ft).

9. Connect the positive battery cable to the battery.

**Tighten:** Tighten the battery terminal bolt to 17 N.m (13 lb ft).

10. Connect the negative battery cable to the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .
11. Install the UHFB cover.
12. Install the battery cooling box cover and tighten the screws.

**Tighten:** Tighten the battery cooling box cover screws to 2 N.m (18 lb in).

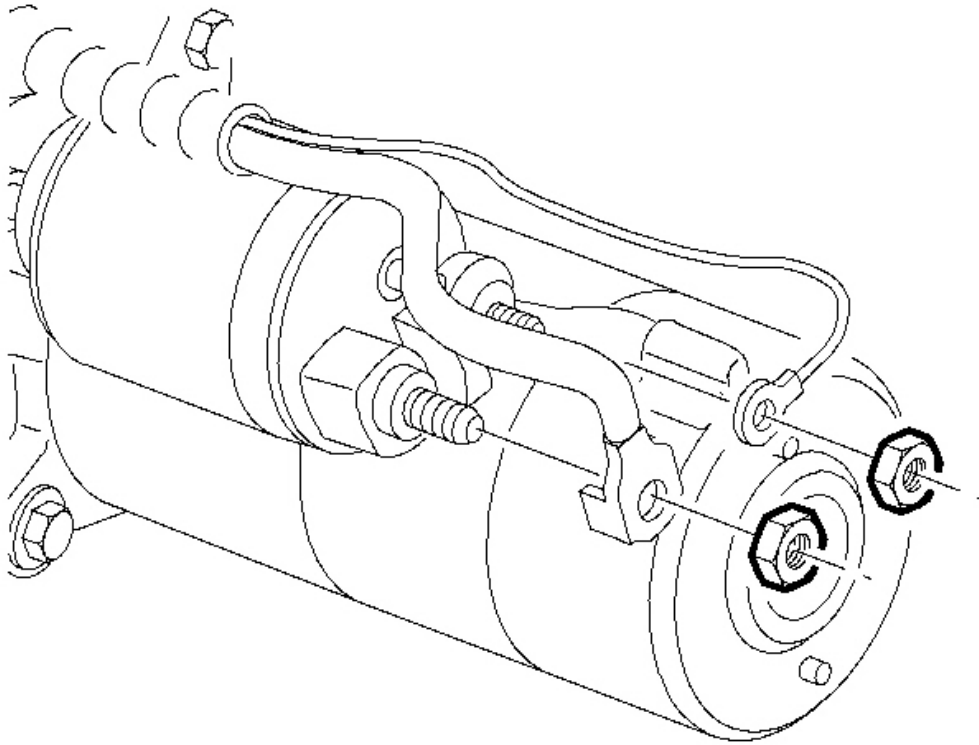
13. Reprogram the radio stations.

## **STARTER MOTOR REPLACEMENT (L61)**

### **Removal Procedure**

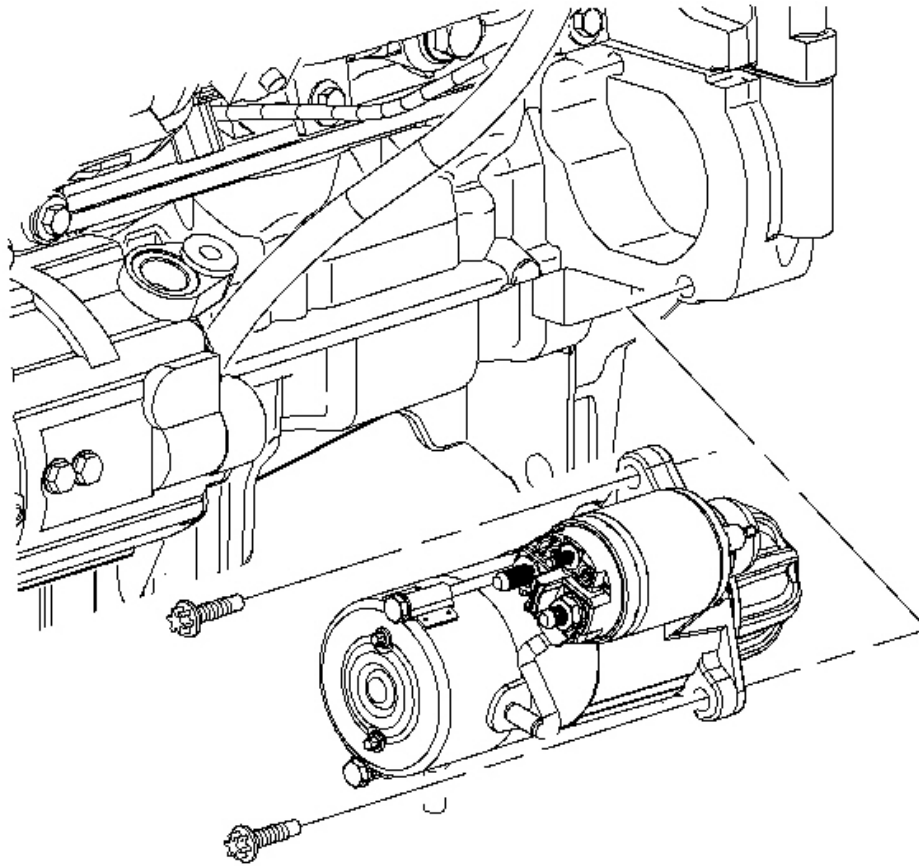
**IMPORTANT: Record all pre-set radio stations.**

1. Turn the ignition OFF.
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .



**Fig. 39: View Of Starter Motor**  
Courtesy of GENERAL MOTORS CORP.

3. Remove the B+ battery cable nut at starter.
4. Remove the S-terminal nut.
5. Remove the lower starter assembly to engine block bolt.
6. Remove the upper starter assembly to engine block bolt.
7. Move the starter right, clearing the engine block, then left and out of the engine block (flywheel housing).



**Fig. 40: View Of Starter Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

1. Guide the starter into the engine block (flywheel housing).

**NOTE:** Refer to **Fastener Notice** in **Cautions and Notices**.

2. Install the starter mounting bolts.

**Tighten:** Tighten the starter-to-engine bolts to 40 N.m (30 lb ft).

3. Install the B+ cable and nut.

**Tighten:** Tighten the B+ cable-to-starter nut to 10 N.m (89 lb in).

4. Install the S-terminal wire and nut.

**Tighten:** Tighten the S-terminal nut to 5 N.m (4 lb ft).

5. Connect the negative battery cable to the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .

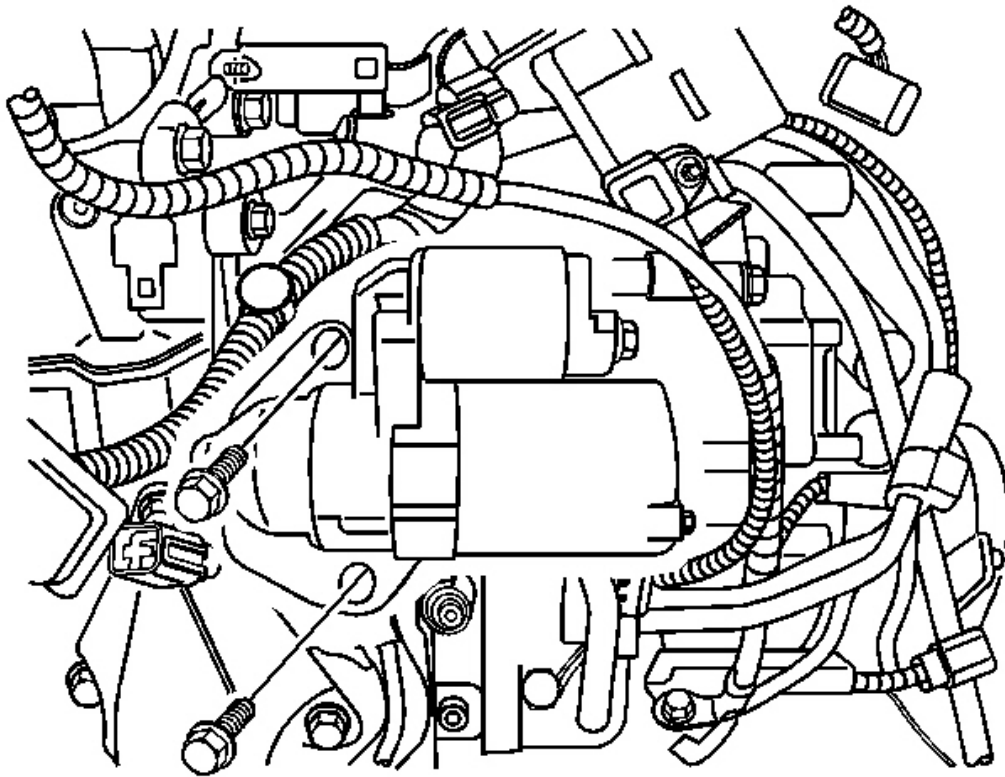
**Tighten:** Tighten the battery terminal bolts to 17 N.m (13 lb ft).

6. Reprogram the radio stations.

## **STARTER MOTOR REPLACEMENT (L66)**

### **Removal Procedure**

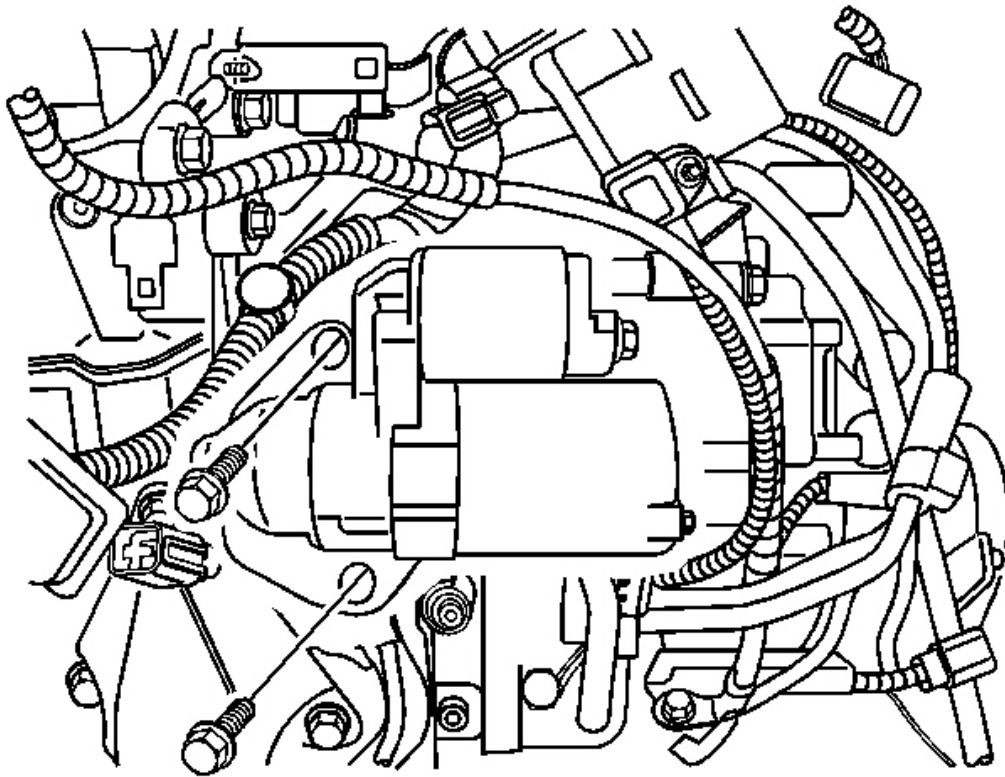
**IMPORTANT: Record all pre-set radio stations.**



**Fig. 41: Identifying Starter Motor (L66)**  
Courtesy of GENERAL MOTORS CORP.

1. Turn the ignition OFF.
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .
3. Remove the B+ battery cable nut at starter.
4. Remove the S-terminal connector.
5. Remove the lower starter assembly to transmission bolt and oxygen sensor connector bracket.
6. Remove the upper starter assembly to transmission bolt.
7. Remove the starter.

#### **Installation Procedure**



**Fig. 42: Identifying Starter Motor (L66)**  
Courtesy of GENERAL MOTORS CORP.

1. Install the starter to the transmission.

**NOTE:** Refer to **Fastener Notice** in Cautions and Notices.

2. Install the starter mounting bolts.

**Tighten:** Tighten the starter-to-transmission bolts to 44 N.m (33 lb ft).

3. Install the B+ cable and nut.

**Tighten:** Tighten the B+ cable-to-starter nut to 10 N.m (89 lb in).

4. Install the S-terminal wire.

5. Connect the negative battery cable to the battery. Refer to **Battery Negative Cable Disconnect/Connect**

**Procedure** .

**Tighten:** Tighten the battery terminal bolt to 17 N.m (13 lb ft).

6. Reprogram the radio stations.

**GENERATOR REPLACEMENT (L61)**

**Tools Required**

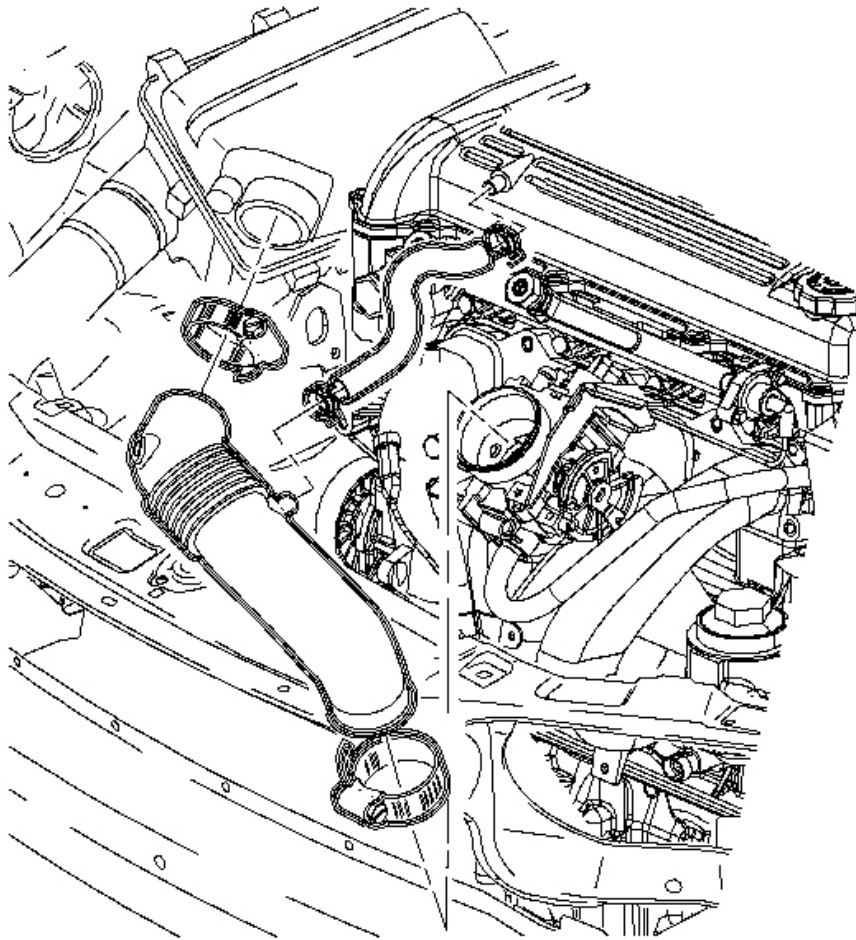
**J 44811** Accessory Belt Tensioner Unloader

**Removal Procedure**

**IMPORTANT: Record all pre-set radio stations.**

1. Turn the ignition OFF.
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .
3. Remove the throttle body air duct.

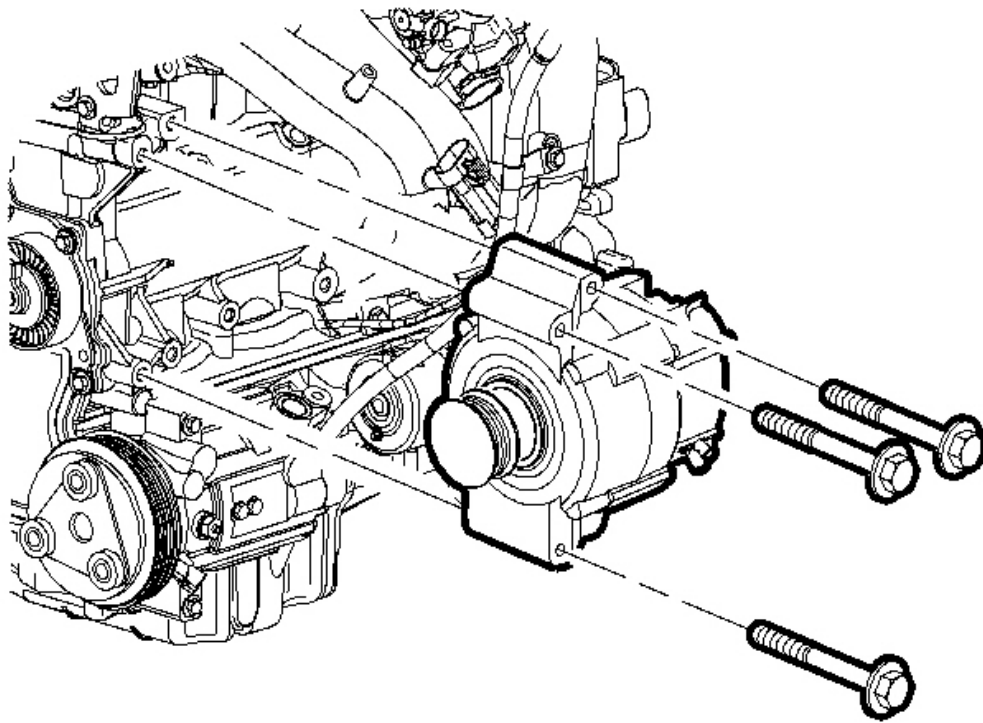




**Fig. 43: View Of Generator (L61)**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT: Use the required J 44811 .**

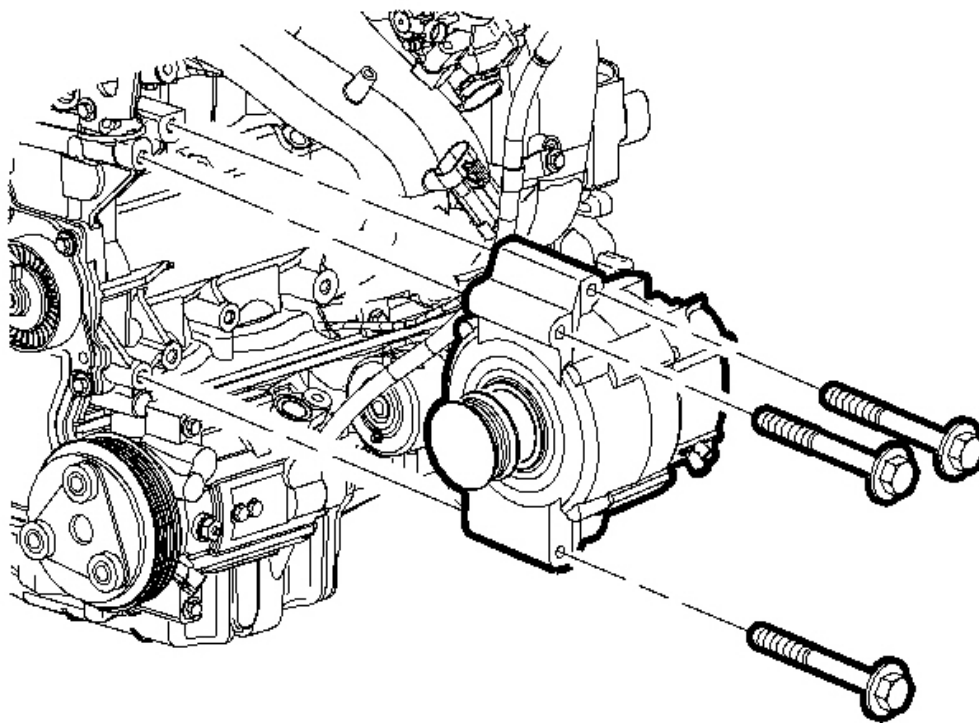
4. Remove the accessory drive belt. Refer to **Drive Belt Replacement** in Engine Mechanical - 2.2L (L61).
5. Disconnect the generator electrical connections.



**Fig. 44: View Of Generator To Engine Block Bolts**  
**Courtesy of GENERAL MOTORS CORP.**

6. Remove the generator to engine block bolts and the generator.

#### **Installation Procedure**



**Fig. 45: View Of Generator To Engine Block Bolts**  
Courtesy of GENERAL MOTORS CORP.

1. Position the generator and install the top bolts finger tight.

**NOTE:** Refer to **Fastener Notice** in Cautions and Notices.

2. Install the bottom bolts and tighten all the generator bolts.

**Tighten:** Tighten the generator-to-engine block bolts to 22 N.m (16 lb ft).

3. Connect the electrical connections.

**Tighten:** Tighten the B+ cable-to-generator nut to 20 N.m (15 lb ft).

**IMPORTANT: Use the required accessory drive belt removal tool number J 44811 .**

4. Install the accessory drive belt. Refer to **Drive Belt Replacement** in Engine Mechanical - 2.2L (L61).
5. Install the throttle body air duct. Refer to **Air Cleaner Intake Duct Replacement** in Engine Controls - 2.2L (L61).
6. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .

**Tighten:** Tighten the battery terminal bolt to 17 N.m (13 lb ft).

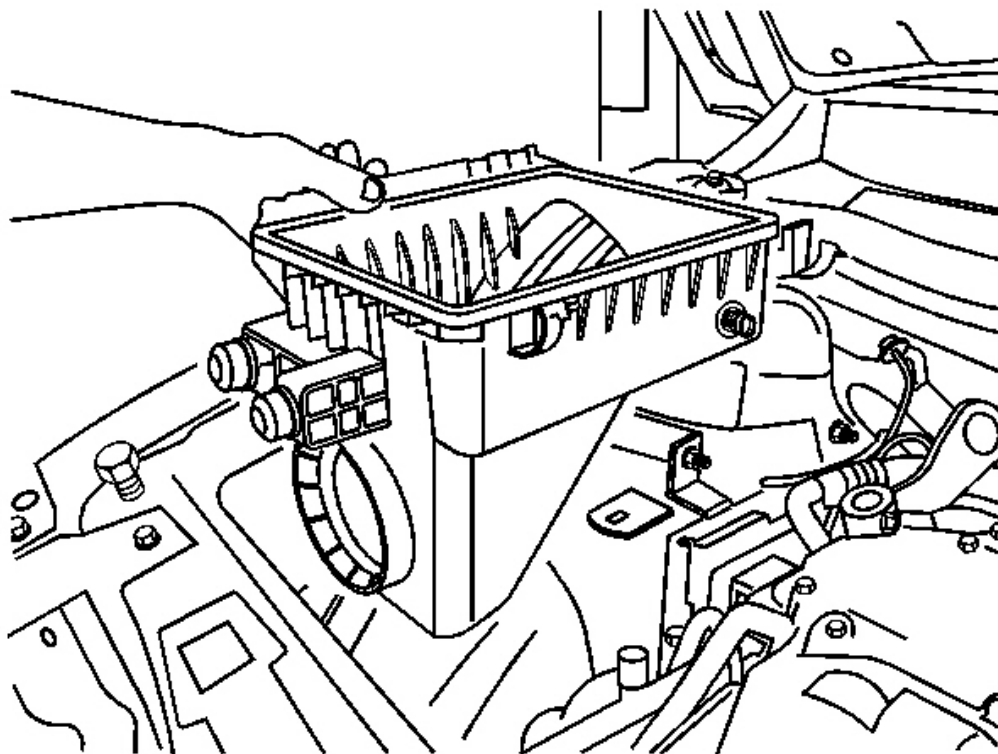
7. Reprogram the radio stations.

## **GENERATOR REPLACEMENT (L66)**

### **Removal Procedure**

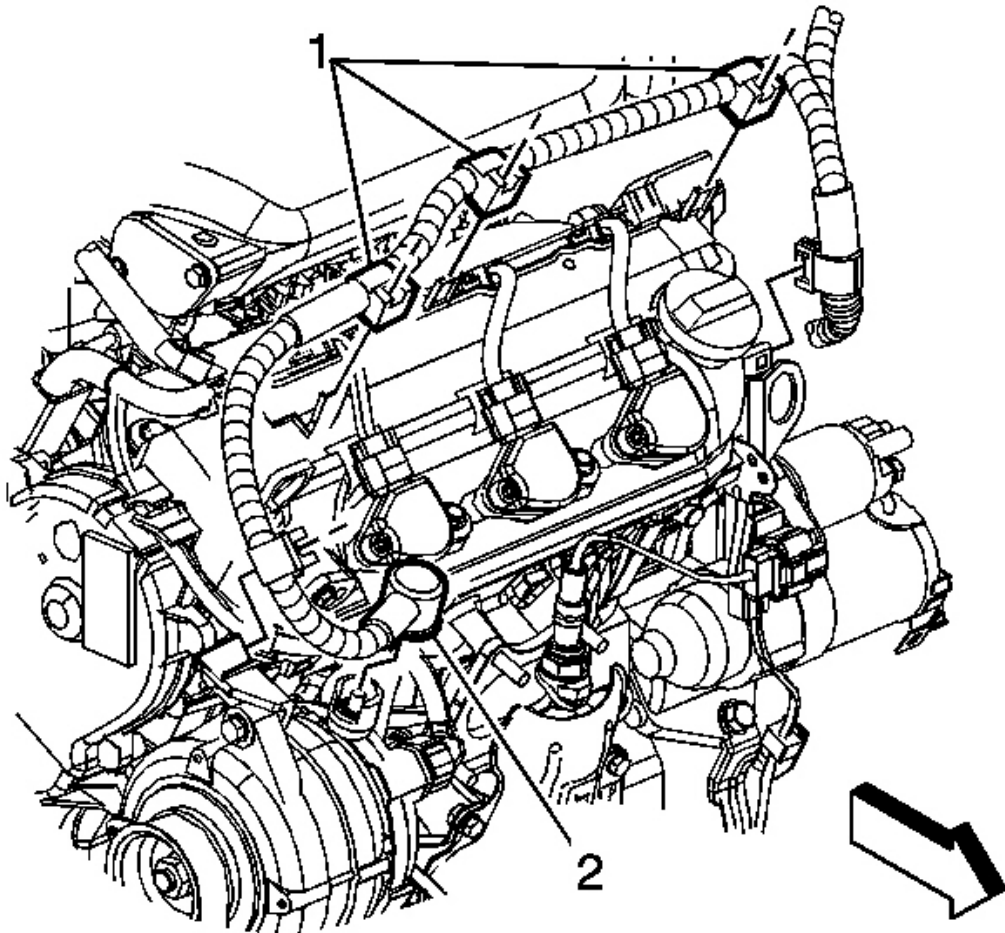
**IMPORTANT: Record all pre-set radio stations.**

1. Turn the ignition OFF.
2. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .



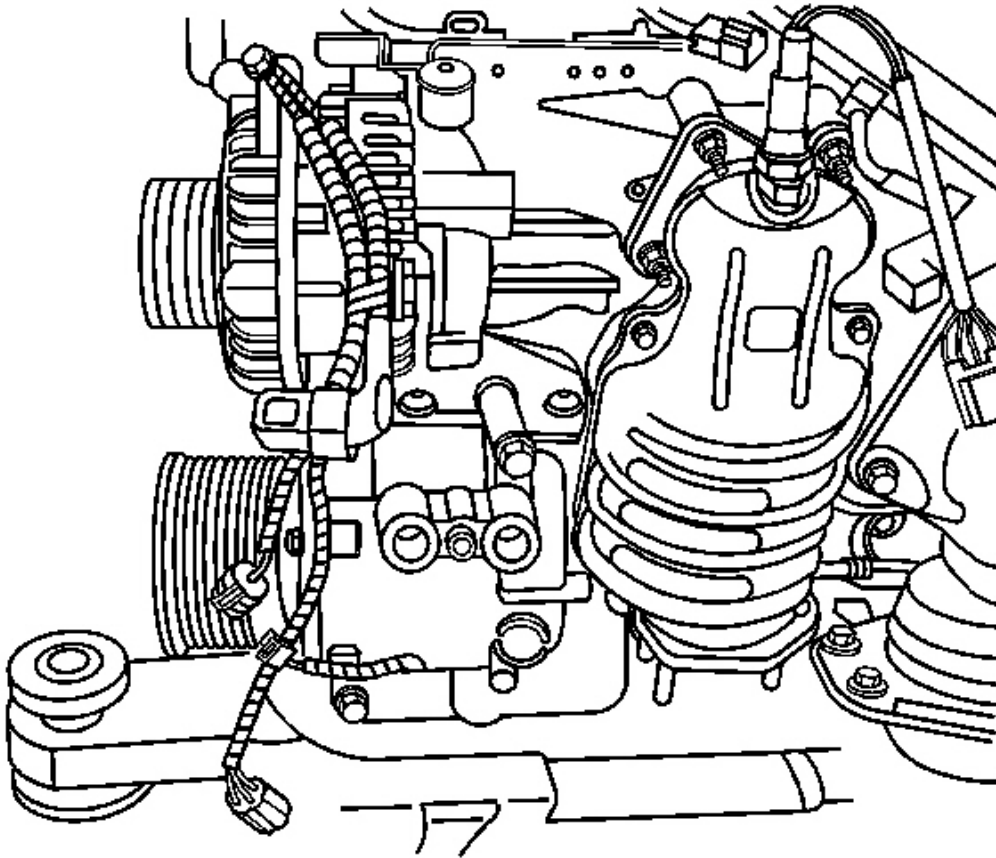
**Fig. 46: View Of Generator (L66)**  
Courtesy of GENERAL MOTORS CORP.

3. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls - 3.5L (L66).
4. Remove the accessory drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** in Engine Mechanical - 3.5L (L66).
5. Install the engine support fixture. Refer to **Engine Support Fixture** in Engine Mechanical - 3.5L (L66).
6. Remove the front of the engine mount through bolt and raise the engine for proper clearance.



**Fig. 47: View Of Generator Electrical Connectors**  
Courtesy of GENERAL MOTORS CORP.

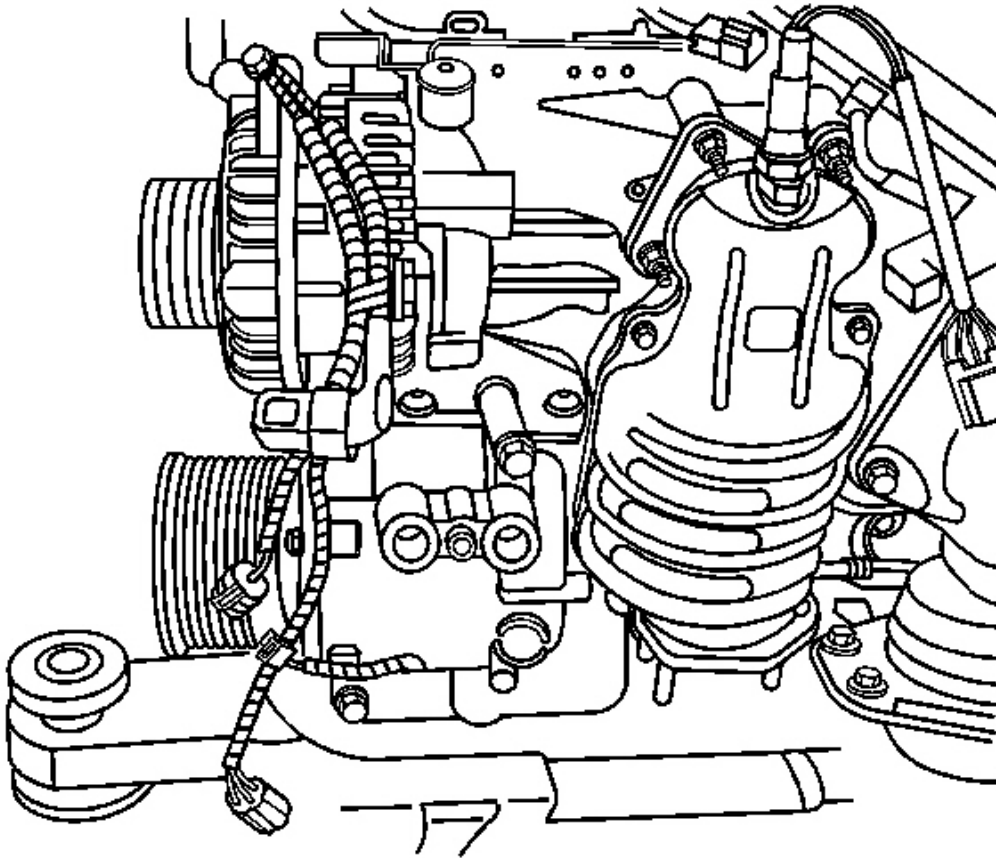
7. Disconnect the generator electrical connections.



**Fig. 48: View Of Generator & Install The Top Bolts**  
Courtesy of GENERAL MOTORS CORP.

8. Remove the generator to engine block bolts and the generator.

#### **Installation Procedure**



**Fig. 49: View Of Generator & Install The Top Bolts**  
Courtesy of GENERAL MOTORS CORP.

1. Position the generator and install the top bolts finger tight.

**NOTE:** Refer to Fastener Notice in Cautions and Notices.

2. Install the bottom bolts and tighten all the generator bolts.

**Tighten:** Tighten the generator-to-engine block bolts to 44 N.m (33 lb ft).

3. Connect the electrical connections.

**Tighten:** Tighten the B+ cable-to-generator nut to 12 N.m (106 lb in).



4. Lower the engine and tighten the engine mount through bolt.

**Tighten:** Tighten the bolts to 110 N.m (81 lb ft).

5. Remove the engine support fixture.

6. Install the accessory drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** in Engine Mechanical - 3.5L (L66).

7. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** in Engine Controls - 3.5L (L66).

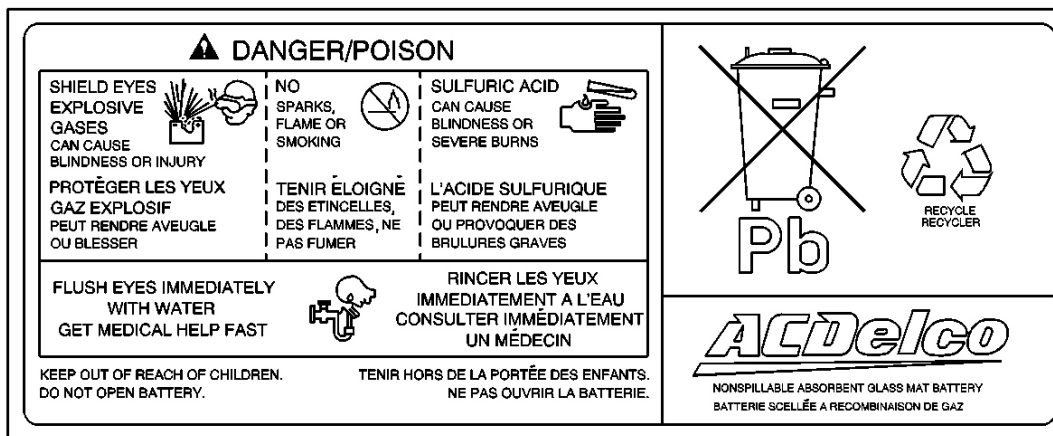
8. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

**Tighten:** Tighten the battery terminal bolt to 17 N.m (13 lb ft).

9. Reprogram the radio stations.

## DESCRIPTION AND OPERATION

### BATTERY DESCRIPTION AND OPERATION



**Fig. 50: Battery Label**

Courtesy of GENERAL MOTORS CORP.

**CAUTION:** 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.**

**IMPORTANT: Because of the materials used in the manufacture of automotive lead-acid batteries, dealers and service shops that handle them are subject to various regulations issued by OSHA, EPA, DOT, and various state or local agencies. Other regulations may also apply in other locations. Always know and follow these regulations when handling batteries.**

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

The battery specification label, example below, contains information about the following:

- The test ratings
- The original equipment catalog number
- The recommended replacement model number

CATALOG NO.

1819

CCA 770	LOAD TEST 380
REPLACEMENT MODEL 100 – 6YR	

**Fig. 51: Battery Specification Label**  
Courtesy of GENERAL MOTORS CORP.

#### **Battery Ratings**

A battery may have 3 ratings:

- Amp hour
- Reserve capacity
- Cold cranking amperage

When a battery is replaced, use a battery with similar ratings. Refer to the battery specification label on the original battery or refer to **Battery Usage** .

#### **Amp Hour**

The amp hour rating of a battery is the amount of time it takes a fully charged battery, being discharged at a constant rate of 1 amperes and a constant temperature of 27°C (80°F), to reach a terminal voltage of 10.5 volts. Refer to **Battery Usage** for the amp hour rating of the original equipment battery.

### **Reserve Capacity**

Reserve capacity is the amount of time in minutes it takes a fully charged battery, being discharged at a constant rate of 25 amperes and a constant temperature of 27°C (80°F), to reach a terminal voltage of 10.5 volts. Refer to **Battery Usage** for the reserve capacity rating of the original equipment battery.

### **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°C (0°F) while maintaining at least 7.2 volts. Refer to **Battery Usage** for the cold cranking amperage rating for this vehicle.

## **CHARGING SYSTEM DESCRIPTION AND OPERATION**

### **Generator**

The generator features the following major components:

- The delta stator
- The rectifier bridge
- The rotor with slip rings and brushes
- A conventional pulley
- The regulator

The pulley and the fan cool the slip ring and the frame.

The generator features permanently lubricated bearings. Service should only include tightening of mount components. Otherwise, replace the generator as a complete unit.

### **Regulator**

The voltage regulator controls the rotor field current in order to limit the system voltage. When the field current is on, the regulator switches the current on and off at a rate of 400 cycles per second in order to perform the following functions:

- Radio noise control
- Obtain the correct average current needed for proper system voltage control

At high speeds, the on-time may be 10 percent with the off-time at 90 percent. At low speeds, the on-time may be 90 percent and the off-time 10 percent.

## **Circuit Description**

The generator provides voltage to operate the vehicle's electrical system and to charge its battery. A magnetic field is created when current flows through the rotor. This field rotates as the rotor is driven by the engine, creating an AC voltage in the stator windings. The AC voltage is converted to DC by the rectifier bridge and is supplied to the electrical system at the battery terminal.

When the engine is running, the generator turn-on signal is sent to the generator from the PCM, 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 F terminal is connected internally to the voltage regulator and externally to the PCM. When the voltage regulator detects a charging system problem, it grounds this circuit to signal the PCM that a problem exists. The PCM monitors the generator field duty cycle signal circuit. The system voltage sense circuit receives B+ voltage that is Hot At All Times through the GEN BAT fuse in the underhood junction block. This voltage is used by the regulator as the reference for system voltage control.

## **STARTING SYSTEM DESCRIPTION AND OPERATION**

The PG-260D is a non-repairable starter motor. It has 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 through 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**

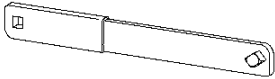
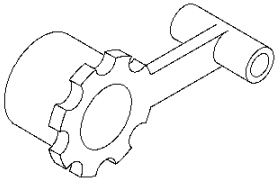
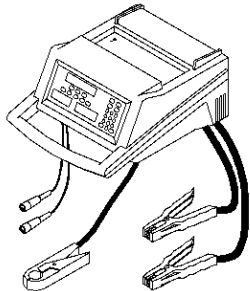
Moving the ignition switch to the START position signals the body control module (BCM) through discrete inputs from the ignition transducer that engine crank has been requested. The BCM verifies that theft is not

active and sends a serial data message to the ECM requesting engine start. The ECM receives a 12 volt signal from the park/neutral position switch or clutch pedal start switch notifying that it is safe to start the engine. There is a splice on this circuit in the fuse block - underhood that supplies power for the starter relay coil. The starter relay coil control circuit is then grounded by the ECM closing the switch in the starter relay supplying 12 volts to the S terminal of the starter. Ground is supplied through the engine block.

## SPECIAL TOOLS AND EQUIPMENT

### SPECIAL TOOLS

#### Special Tools

Illustration	Tool Number/Description
	J 44811 Accessory Belt Tensioner Unloader
	SA9130Z Parasitic Load Tester
	SA9154Z-A Starting and Charging System Tester