

2004 ELECTRICAL
Engine Electrical - Ion

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Battery Brace Bolt	25 N.m	18 lb ft
Battery Hold Down Retaining Bolt	25 N.m	18 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
Generator Bolts	22 N.m	16 lb ft
Generator Terminal Nut	20 N.m	15 lb ft
Ground Cable to Side Rail Bolt	20 N.m	15 lb ft
Ground to Engine Block Nut	17 N.m	13 lb ft
Remote Battery Terminal Nut	17 N.m	13 lb ft
Starter Motor Bolts	40 N.m	30 lb ft
Starter Solenoid B Terminal Nut	17 N.m	13 lb ft
Starter Solenoid S Terminal Nut	3 N.m	27 lb in

BATTERY USAGE

Battery Usage

Application	Specification
	L61
Cold Cranking Amperage	600 A
Reserve Capacity Rating	90 Minutes
Replacement Battery Number	75V-6YR

STARTER MOTOR USAGE

Starter Motor Usage

Application	Model
L61	PG-260D

GENERATOR USAGE

Generator Usage

Application	Specification
	2.2L (L61)
Generator Model	Valeo SG10

Application	Specification
Rated Output	105 A
Load Test Output	73 A

SCHEMATIC AND ROUTING DIAGRAMS

STARTING AND CHARGING SCHEMATICS

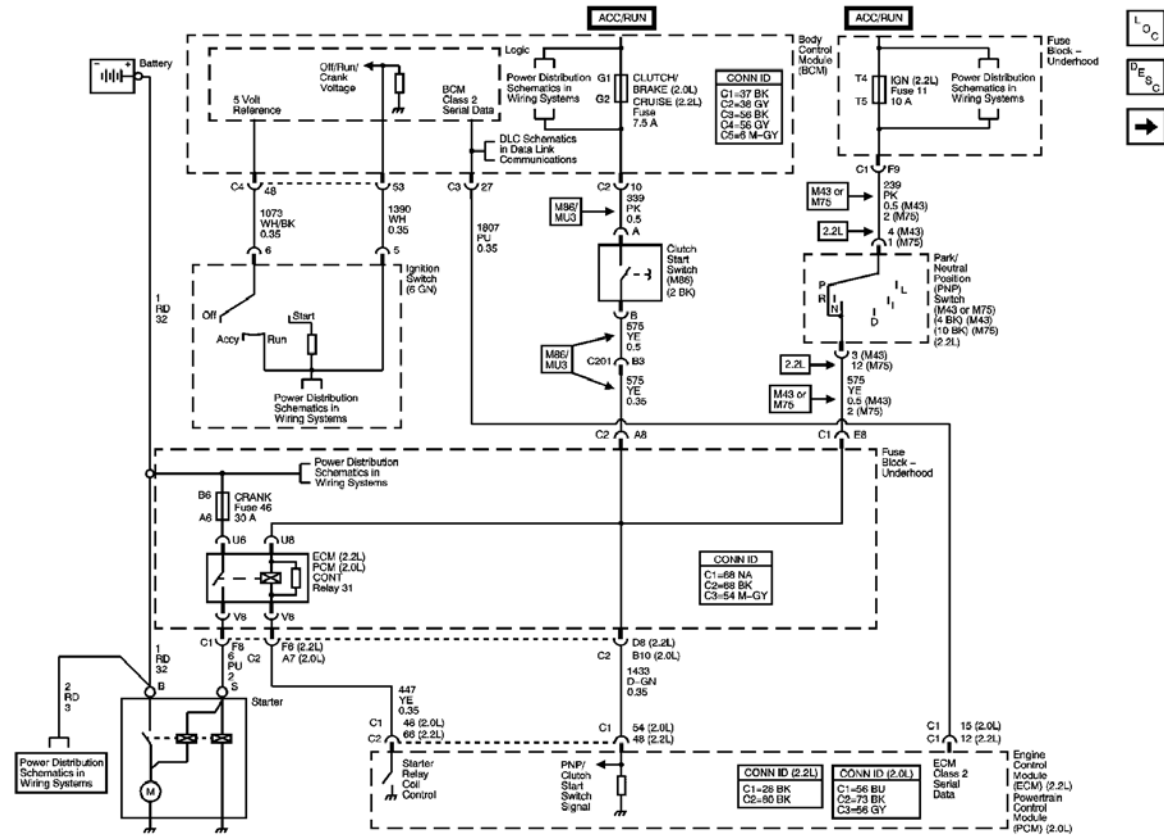


Fig. 1: Starting - Early Production
 Courtesy of GENERAL MOTORS CORP.

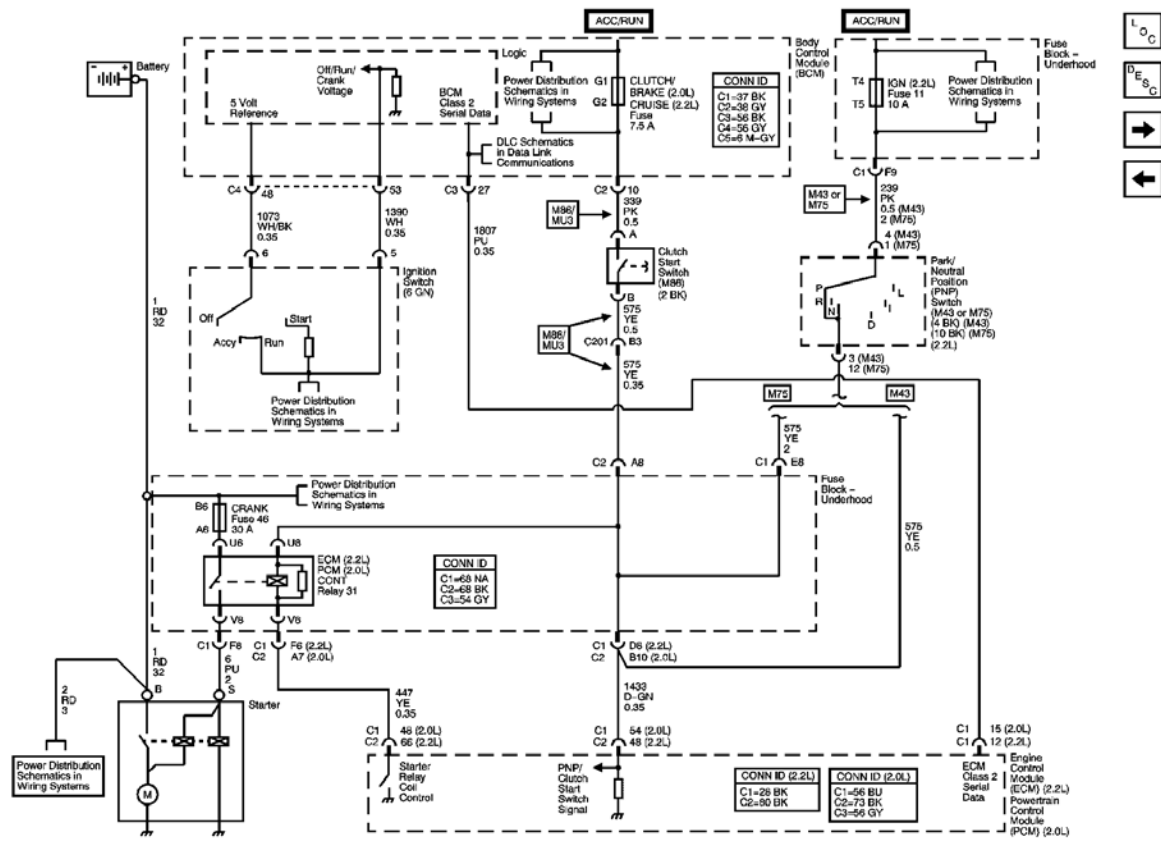


Fig. 2: Starting - Late Production
 Courtesy of GENERAL MOTORS CORP.

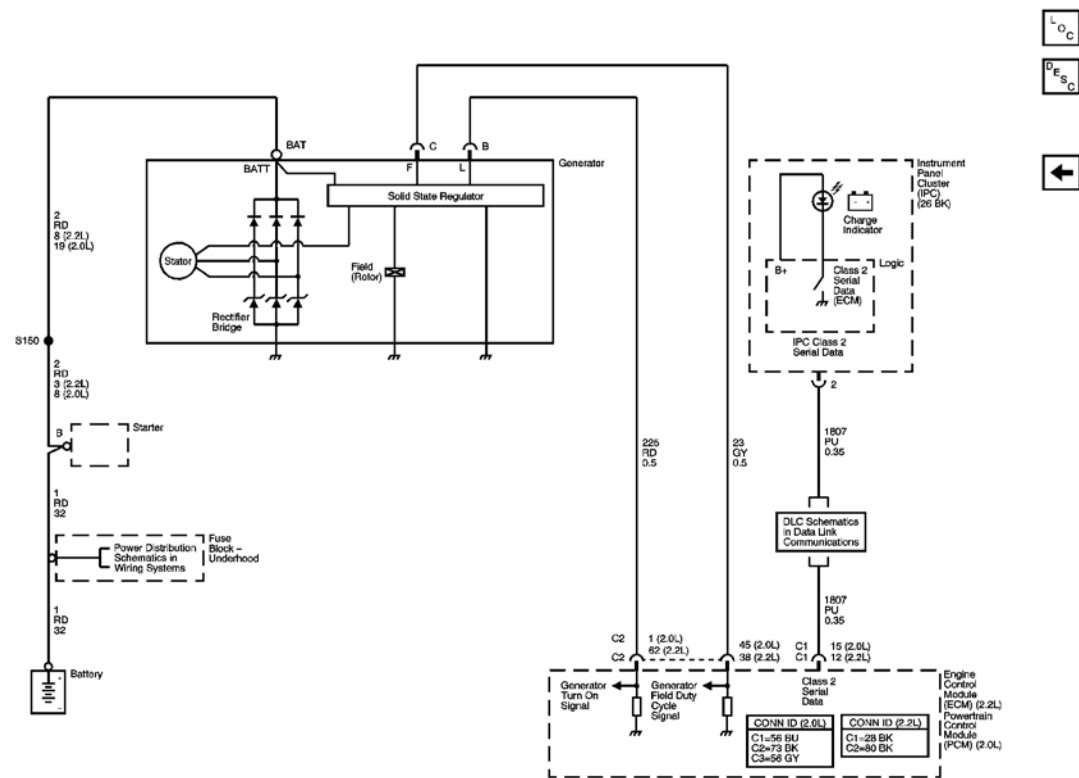


Fig. 3: Charging

Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

ENGINE ELECTRICAL COMPONENT VIEWS

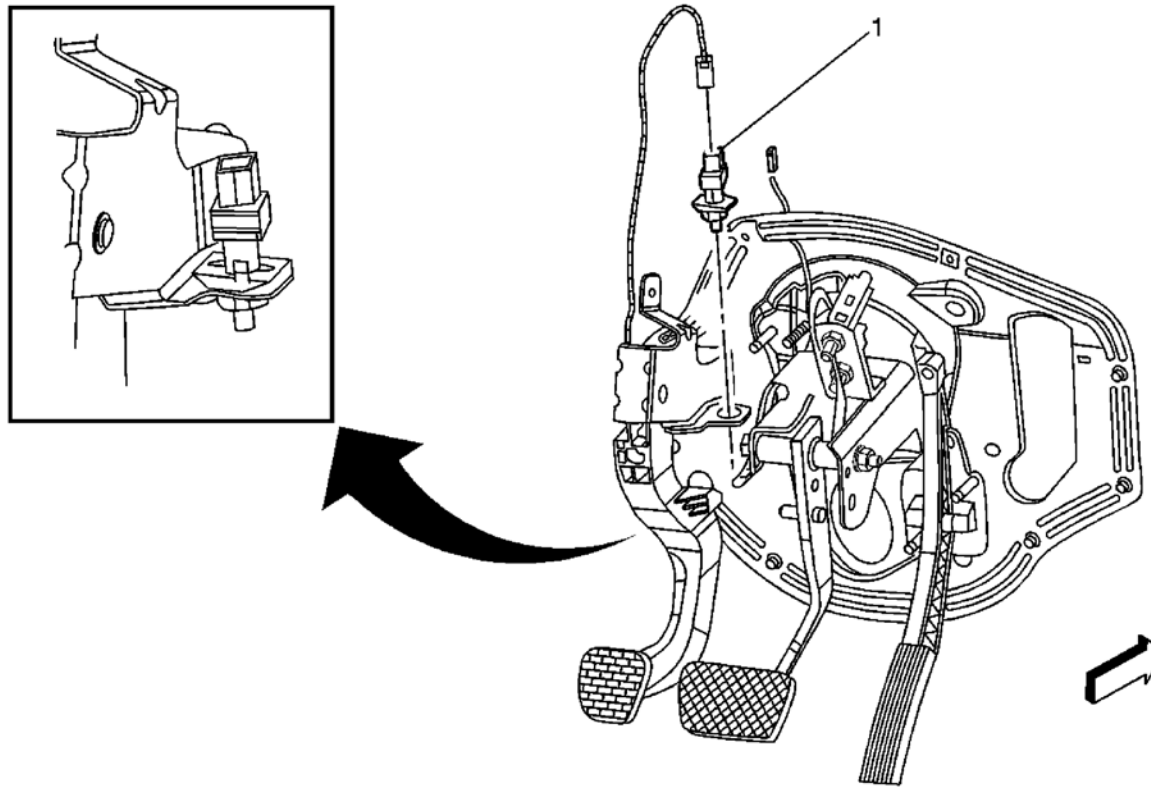


Fig. 4: Left Side Of I/P In Pedal Bracket (M86) Component View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	Clutch Start Switch

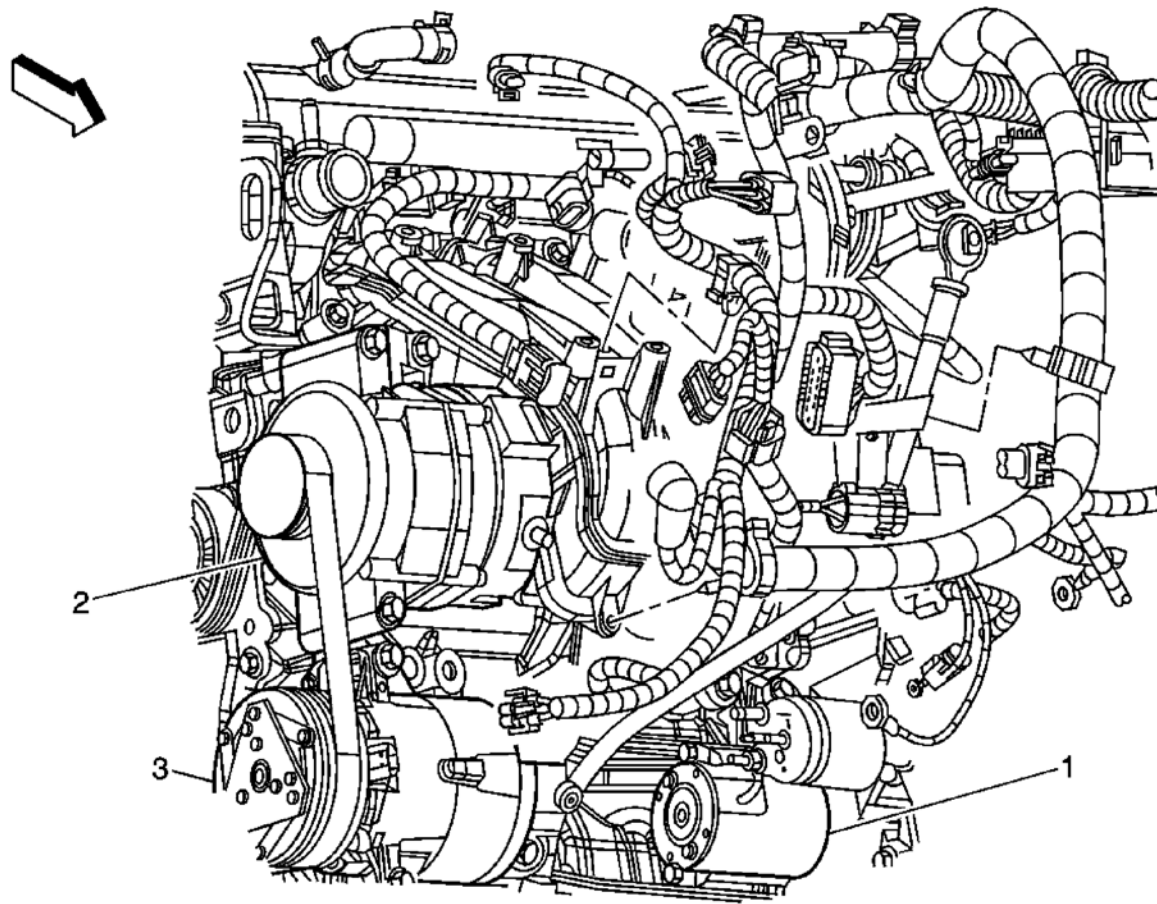


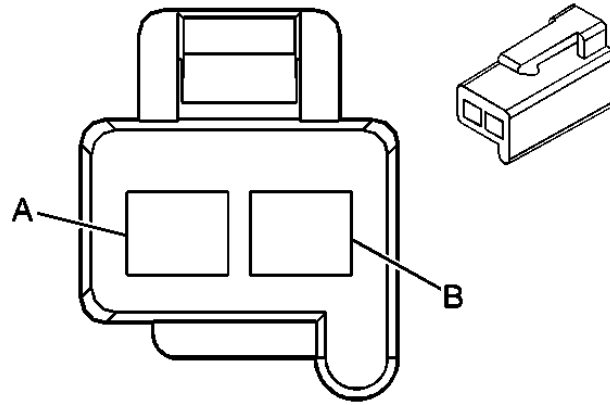
Fig. 5: Right Front Side Of Engine Component View
 Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
1	Starter
2	Generator
3	A/C Compressor Clutch

ENGINE ELECTRICAL CONNECTOR END VIEWS

Clutch Start Switch (M86/MU3) Terminal Identification

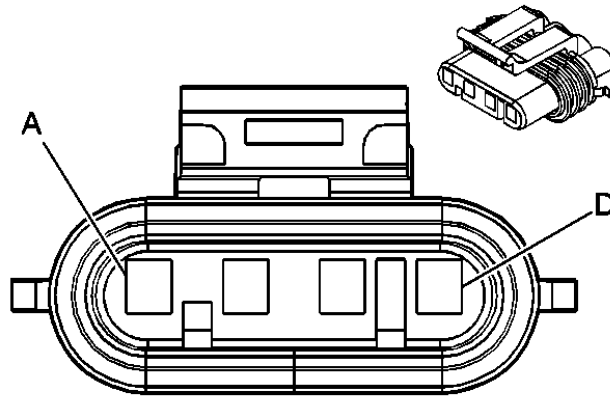


Connector Part Information

- 12041433
- 2-Way F Metri-Pack 280 Series (BK)

Pin	Wire Color	Circuit No.	Function
A	PK	339	Ignition 1 Voltage
B	YE	575	Clutch Start Switch Signal

Generator Terminal Identification (Early Production)

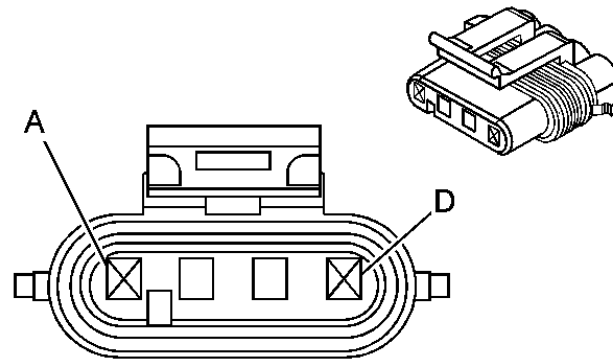


Connector Part Information

- 12186568
- 4-Way F Metri-Pack 150 Series (BK)

Pin	Wire Color	Circuit No.	Function
A	-	-	Not Used
B	RD	225	Generator Turn On Signal
C	GY	23	Generator Field Duty Cycle Signal
D	-	-	Not Used

Generator Terminal Identification (Late Production)



Connector Part Information

- 15355066
- 2-Way F Metri-Pack 150 Series (BG)

Pin	Wire Color	Circuit No.	Function
A	-	-	Not Available
B	RD	225	Generator Turn On Signal
C	GY	23	Generator Field Duty Cycle Signal
D	-	-	Not Available

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.

- 4:** Lack of communication may be due to a partial malfunction of the class 2 serial data circuit or GMLAN circuit or due to a total malfunction of the class 2 serial data circuit or GMLAN circuit. The specified procedure will determine the particular condition.
- 5:** Lack of communication may be due to a partial malfunction of the class 2 serial data circuit or GMLAN circuit or due to a total malfunction of the class 2 serial data circuit or GMLAN circuit. The specified procedure will determine the particular condition.
- 6:** The symptom list in Symptoms will determine the correct diagnostic procedure to use.
- 7:** 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.
- 8:** 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 Battery Inspection/Test . Does the battery pass the test?	Go to Step 2	-
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. Does the scan tool power up?	Go to Step 3	Go to Scan Tool Does Not Power Up in Data Link Communications
3	IMPORTANT: The engine may start during the following step. Turn OFF the engine as soon as you have observed the Crank power mode. 1. With a scan tool, observe the Power Mode parameter in the ignition data display of the body control module (BCM). 2. Rotate the ignition switch through all positions while observing the class 2 Power Mode parameter. Does the Ignition Switch parameter reading match the ignition switch position for all switch positions?	Go to Step 5	Go to Power Mode Mismatch in Body Control System
4	1. Turn ON the ignition, with the engine OFF. 2. Attempt to communicate with the engine control module (ECM). Does the scan tool communicate with the ECM?	Go to Step 5	Go to Data Link References in Data Link Communications
5	1. Turn ON the ignition, with the engine OFF. 2. Attempt to communicate with the BCM. Does the scan tool communicate with the BCM?	Go to Step 6	Go to Data Link References in Data Link Communications
6	1. Select the display DTCs function for the BCM and PCM. 2. Record all of the displayed DTCs, the DTC status, and the module which set the DTC. Does the scan tool display any DTCs?	Go to Step 7	Go to Symptoms - Engine Electrical
7	Does the scan tool display any ECM DTCs which begin with "U"?	Go to Data Link References in Data Link Communications	Go to Step 8
8	Does the scan tool display any BCM DTCs which begin with "U"?	Go to Data Link References in Data Link Communications	Go to Step 9
9	Does the scan tool display DTC B1000, B1001, B1004, B1007, or B1009?	Go to Diagnostic Trouble Code (DTC) List in Body Control System	Go to Diagnostic Trouble Code (DTC) List

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

Scan Tool Output Control	Additional Menu Selection(s)	Description
		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
Lamp and Gage Check	-	<p>The IPC illuminates the following indicators when you select ON:</p> <ul style="list-style-type: none"> • ABS • Air Bag • BRAKE • Charge • Fasten Safety Belt • High Beam • Low Oil Pressure • LOW TRAC • Upshift Indicator <p>The IPC drives the following gages to maximum position when you select On:</p> <ul style="list-style-type: none"> • Engine Coolant Temperature Gage • Fuel Gage • Speedometer • Tachometer <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>

SCAN TOOL DATA LIST

Body Control Module (BCM)

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

Engine Control Module (ECM)

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF/Clutch Depressed or Transmission in Park or Neutral			
GEN F-Terminal Signal	General Info - Outputs	%	0%
GEN L-Terminal Signal Command	General Info - Outputs	On/Off	Off
Ignition 1	General Info - Outputs	Volts	12.6 Volts
Starter Relay Command	Output Driver Status	On/Off	Off
Starter Relay - Low Volts	Output Driver Status	Test Pass/Test Fail/Test Not Run	Test Pass

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/Engine OFF/Clutch Depressed or Transmission in Park or Neutral			
Starter Relay - Open	Output Driver Status	Test Pass/Test Fail/Test Not Run	Test Pass
Starter Relay - High Volts	Output Driver Status	Test Pass/Test Fail/Test Not Run	Test Not Run

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.

GEN F-Terminal Signal

The scan tool displays 0%-100%. The scan tool displays 0%-10% until the engine is started and the PCM receives a signal from the generator then OK is displayed.

GEN L-Terminal Signal Command

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 Signal

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

Starter Relay Command

The scan tool displays On/Off. The scan tool displays Off until the ignition is placed into the START position then ON is displayed while the engine is cranking.

Starter Relay - High Volts

The scan tool displays Test Pass/Test Fail/Test Not Run. The scan tool displays the current status of the PCM CONT relay signal circuit.

Starter Relay - Low Volts

The scan tool displays Test Pass/Test Fail/Test Not Run. The scan tool displays the current status of the PCM CONT relay signal circuit.

Starter Relay - Open

The scan tool displays Test Pass/Test Fail/Test Not Run. The scan tool displays the current status of the PCM CONT relay signal circuit.

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
P0616	<u>DTC P0616</u>	ECM
P0617	<u>DTC P0617</u>	ECM

DTC	Diagnostic Procedure	Modules
P0621	DTC P0621	ECM
P0622	DTC P0622	ECM

DTC B1325

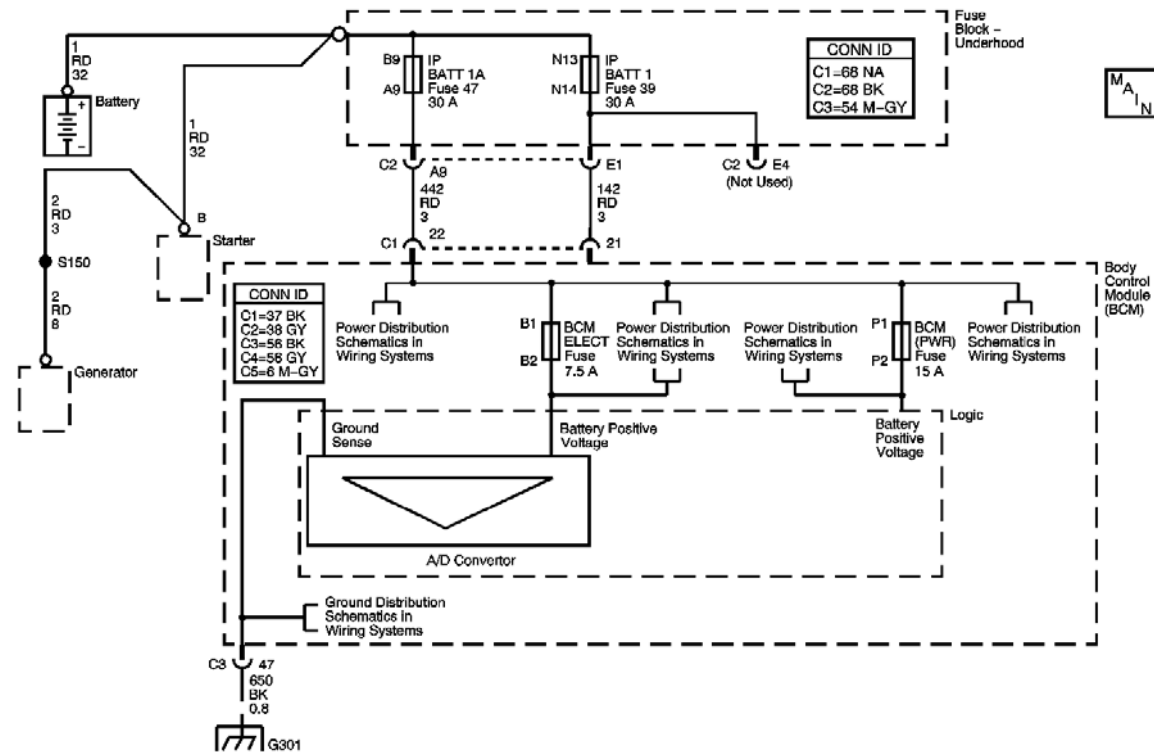


Fig. 6: VBATT1 Circuit Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

- The BCM detects a system voltage below 9 volts or above 18 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 the Run/Crank relay that is 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

Step	Action	Values	Yes	No
Schematic Reference: Body Control System Schematics in Body Control System Connector End View Reference: Body Control System Connector End Views in Body Control System				
1	Did you perform the Diagnostic System Check for Engine Electrical?	-	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
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?	9-18 V	Go to Step 3	Go to Step 4
3	Is the DTC set as a current DTC?	-	Go to Step 7	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems
4	1. Disconnect the body control module (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?	9-18 V	Go to Step 6	Go to Step 5
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 Step 9	Go to Battery Inspection/Test
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 Step 9	Go to Step 7
7	Inspect for poor connections at the module harness connectors. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 9	Go to Step 8
8	IMPORTANT: Perform the module setup procedure if required. Replace the BCM. Refer to Body Control Module Replacement in Body Control System. Did you complete the replacement?	-	Go to Step 9	-
9	Operate the system in order to verify the repair. Did you find and correct the condition?	-	System OK	Go to Step 2

DTC B1327

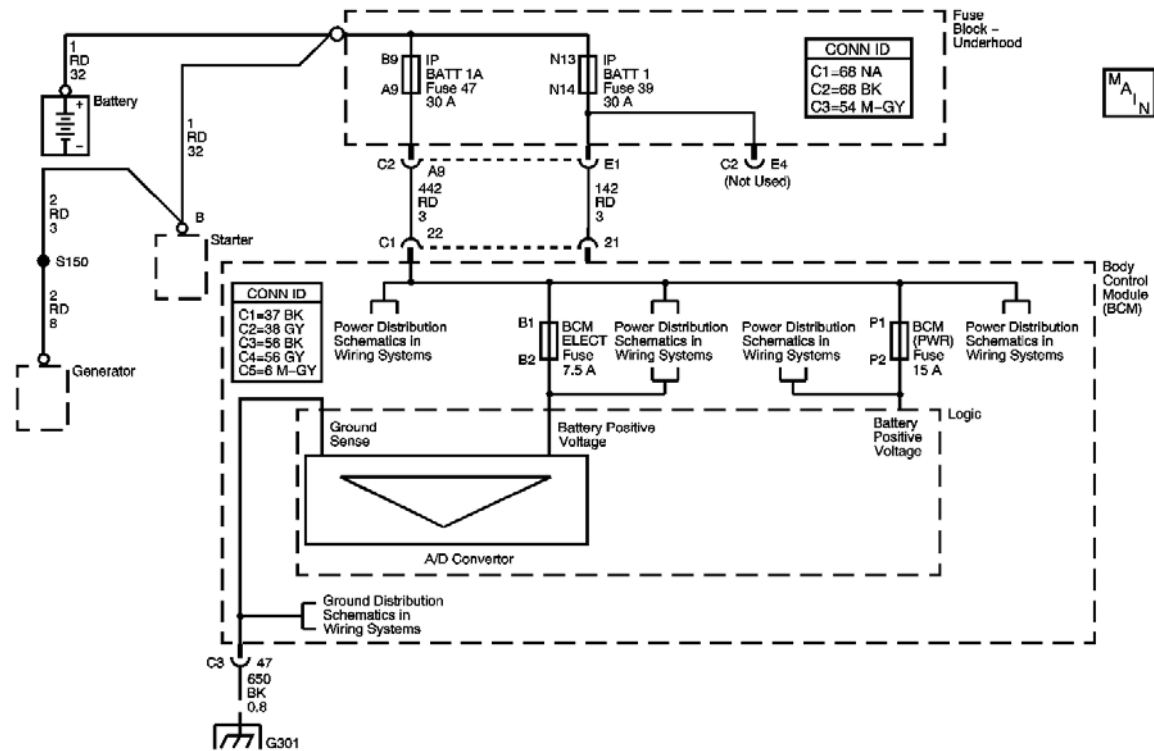


Fig. 7: VBATT1 Circuit

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 1200 milliseconds.
- When the vehicle exits START the BCM shall delay checking the voltage for 2 seconds.

Action Taken When the DTC Sets

- The engine control module (ECM) / powertrain control module (PCM) 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

Step	Action	Value(s)	Yes	No
Connector End View Reference: Inline Harness Connector End Views in Wiring Systems or Body Control System Connector End Views in Body Control System				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	<ol style="list-style-type: none"> 1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With a scan tool, observe the Battery 1 parameter in the Ignition data list of the body control module (BCM). Does the scan tool indicate the battery voltage is greater than the specified value?	8.8 V	Go to Step 5	Go to Step 3
3	<ol style="list-style-type: none"> 1. Measure the voltage across the battery terminals. 2. Compare the battery voltage with the Battery 1 parameter in the Ignition data list of the BCM. Are the voltages within the specified value?	1 V	Go to Battery Inspection/Test	Go to Step 4
4	Test the battery voltage and ground circuits of the BCM for a high resistance. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 7	Go to Step 5
5	Inspect for poor connections at the harness connector of the BCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 7	Go to Step 6
6	IMPORTANT: Perform the setup procedure for the BCM. Replace the BCM. Refer to Body Control Module Replacement .Did you complete the replacement?	-	Go to Step 7	-
7	<ol style="list-style-type: none"> 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 Step 2	System OK

DTC B1328

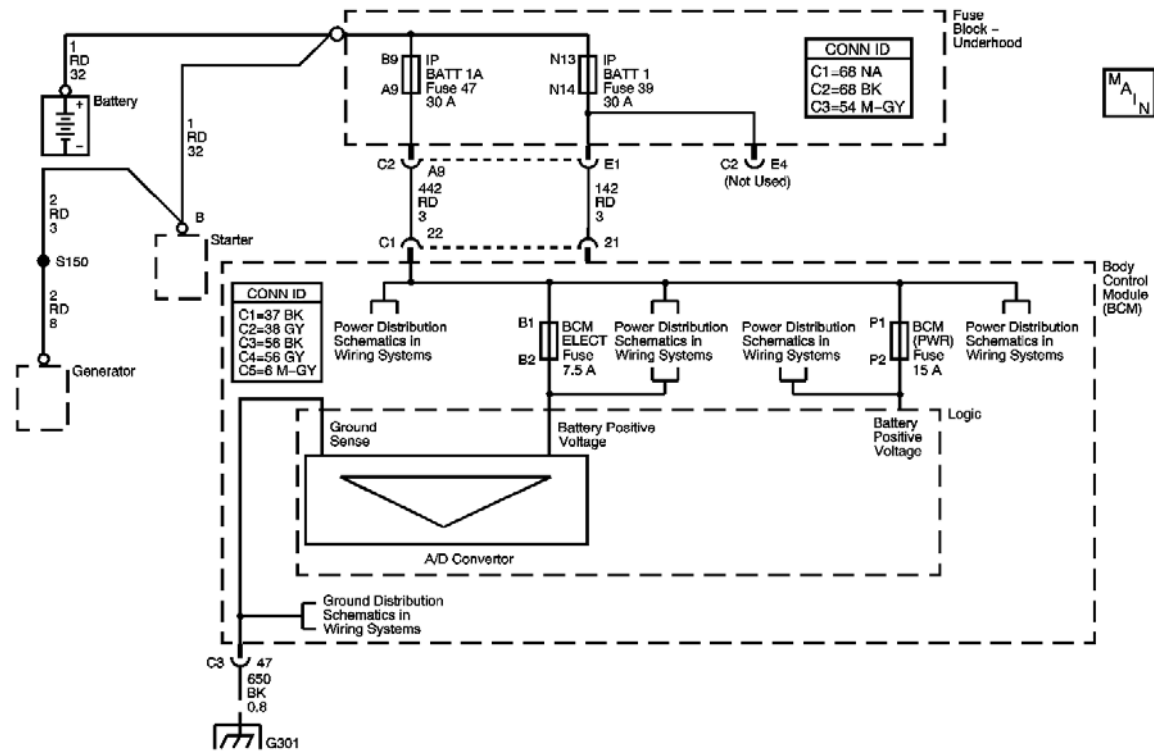


Fig. 8: VBATT1 Circuit

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 below 18 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 volts for 1200 milliseconds.

Action Taken When the DTC Sets

- The engine control module (ECM)/powertrain control module (PCM) will not illuminate the charge indicator.
- This DTC shall be set as current when the voltage raises above 18 volts for 1200 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 18 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

Step	Action	Value(s)	Yes	No
Connector End View Reference: Inline Harness Connector End Views in Wiring Systems or Body Control System Connector End Views in Body Control System				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	<ol style="list-style-type: none"> 1. Install a scan tool. 2. Start the engine 3. Increase engine speed to above 1,500 RPM. 4. With a scan tool, observe the Battery 1 parameter in the Ignition data list of the body control module (BCM). <p>Does the scan tool indicate the battery voltage is less than the specified value?</p>	18 V	Go to Step 4	Go to Step 3
3	<ol style="list-style-type: none"> 1. Measure the voltage across the battery terminals. 2. Compare the battery voltage with the Battery 1 parameter in the Ignition data list of the BCM. <p>Are the voltages within the specified value?</p>	1 V	Go to Charging System Test	Go to Step 4
4	<p>Inspect for poor connections at the harness connector of the BCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to Step 6	Go to Step 5
5	<p>IMPORTANT:</p> <p>Perform the setup procedure for the BCM.</p> <p>Replace the BCM. Refer to Body Control Module Replacement .Did you complete the replacement?</p>	-	Go to Step 6	-
6	<ol style="list-style-type: none"> 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. <p>Does the DTC reset?</p>	-	Go to Step 2	System OK

DTC P0562

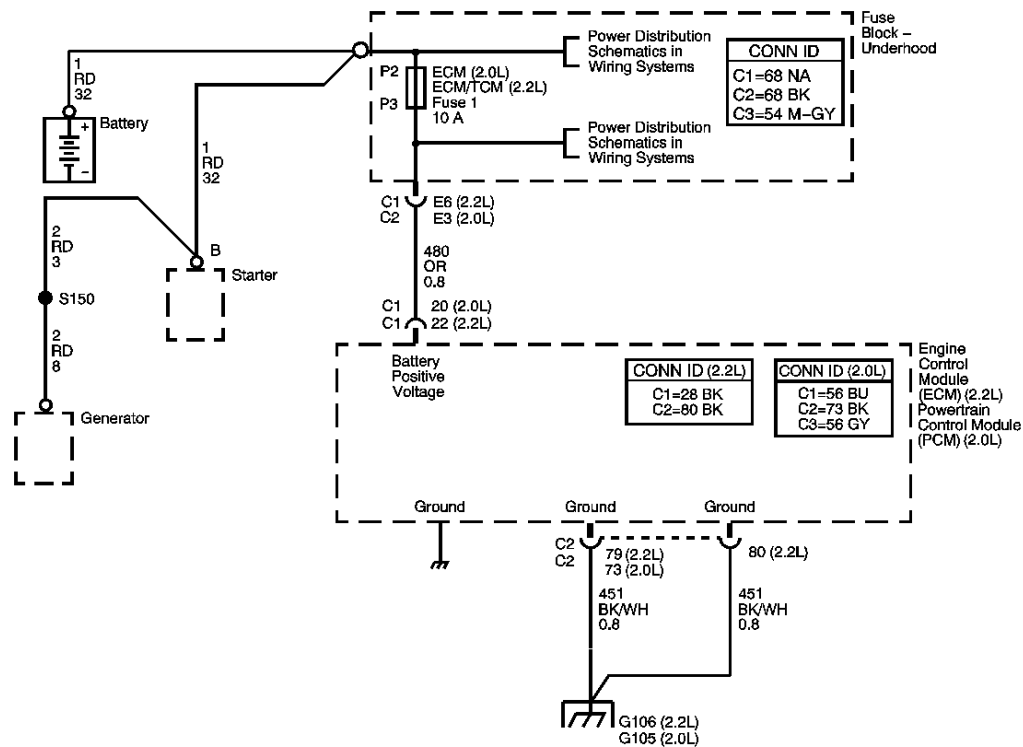


Fig. 9: View Of ECM/PCM Circuit
 Courtesy of GENERAL MOTORS CORP.

Circuit Description

The engine control module (ECM)/powertrain control module (PCM) 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/PCM monitors the system voltage over an extended length of time. If the ECM/PCM detects an excessively low system voltage, DTC P0562 will set.

Conditions for Running the DTC

System voltage between 9.5-18 volts.

Conditions for Setting the DTC

The ECM/PCM detects a system voltage below 10.5 volts for 10 seconds.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

- The ECM/PCM 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

Step	Action	Value(s)	Yes	No
Connector End View Reference: Inline Harness Connector End Views in Wiring Systems, Engine Control Module (ECM) Connector End Views in Engine Controls - 2.2L (L61) or Powertrain Control Module (PCM) Replacement in Engine Controls - 2.0L (LSJ)				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	<ol style="list-style-type: none"> 1. Install a scan tool. 2. Operate the vehicle within the conditions for running the DTC as specified in the supporting text. 3. Using the scan tool, observe the specific DTC Information for DTC P0562 until the test runs. Does the scan tool indicate that DTC P0562 has passed this ignition cycle?	-	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
3	<ol style="list-style-type: none"> 1. Start the engine. 2. Turn OFF all accessories. 3. With a scan tool, observe the Ignition 1 parameter in the engine controls data list. Does the scan tool indicate that the Ignition 1 parameter is greater than the specified range?	10.5 V	Go to Step 7	Go to Step 4
4	Measure the voltage at the battery terminals and compare it with the Ignition 1 parameter in the engine controls data list. Are the battery voltage and engine control module (ECM)/powertrain control module (PCM) Ignition 1 readings different by more than the value specified?	0.5 V	Go to Step 5	Go to Charging System Test
5	Test the battery positive voltage circuit of the ECM/PCM for a high resistance. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 8	Go to Step 6
6	Inspect for poor connections at the harness connector of the ECM/PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 8	Go to Step 7
7	IMPORTANT: The replacement ECM/PCM must be programmed. Replace the ECM/PCM. Refer to Engine Control Module (ECM) Replacement in Engine Controls - 2.2L (L61) or Powertrain Control Module (PCM) Replacement in Engine Controls - 2.0L (LSJ). Did you complete the replacement?	-	Go to Step 8	-
8	<ol style="list-style-type: none"> 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 	-	Go to Step 3	System OK

Step	Action	Value(s)	Yes	No
	P0562 until the test runs.			
	Does the scan tool indicate that DTC P0562 failed this ignition?			

DTC P0563

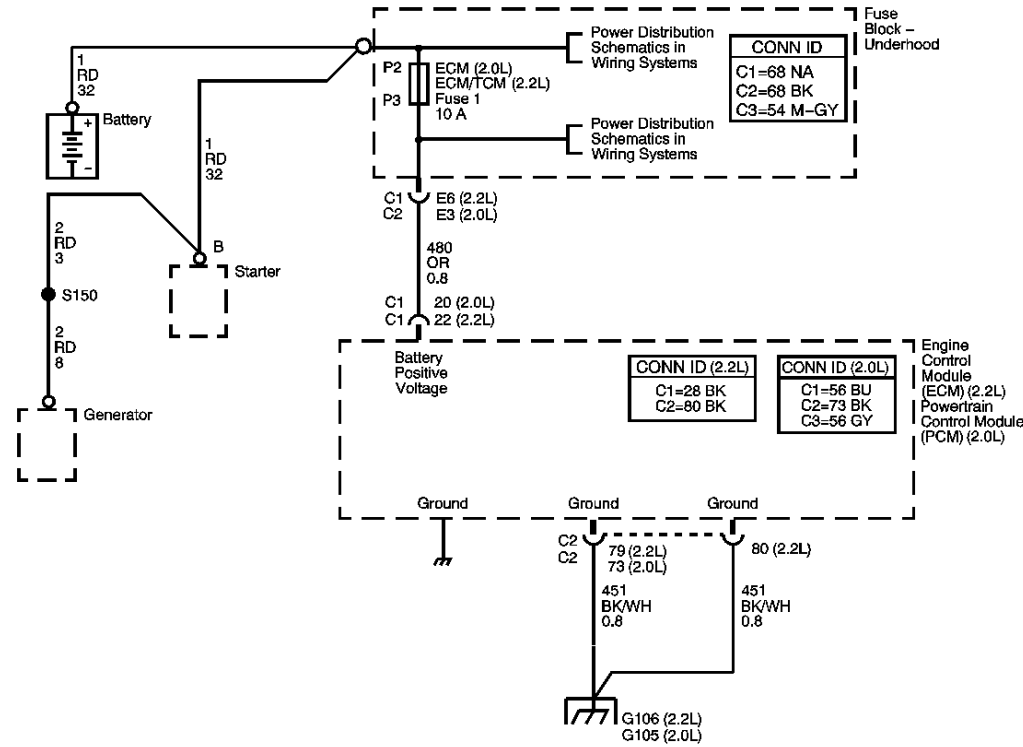


Fig. 10: View Of ECM/PCM Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The engine control module (ECM)/powertrain control module (PCM) 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/PCM monitors the system voltage over an extended length of time. If the ECM/PCM detects an excessively high system voltage, DTC P0563 will set.

Conditions for Running the DTC

System voltage between 9.5-18 volts.

Conditions for Setting the DTC

The ECM/PCM detects a system voltage above 17.5 volts for 10 seconds.

Action Taken When the DTC Sets

- The ECM/PCM will not illuminate the charge indicator.
- The ECM/PCM will not illuminate the malfunction indicator lamp (MIL).

- The ECM/PCM will store conditions which were present when the DTC set as Fail Records data only.

Conditions for Clearing the DTC

- The ECM/PCM 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

Step	Action	Value(s)	Yes	No
Connector End View Reference: Inline Harness Connector End Views in Wiring Systems, Engine Control Module (ECM) Connector End Views in Engine Controls - 2.2L (L61) or Powertrain Control Module (PCM) Replacement in Engine Controls - 2.0L (LSJ)				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	<ol style="list-style-type: none"> 1. Install a scan tool. 2. Operate the vehicle within the conditions for running the DTC as specified in the supporting text. 3. Using the scan tool, observe the specific DTC Information for DTC P0563 until the test runs. Does the scan tool indicate that DTC P0563 has passed this ignition cycle?	-	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
3	<ol style="list-style-type: none"> 1. Start the engine. 2. With a scan tool, observe the Ignition 1 parameter in the engine controls data list. Does the scan tool indicate that the Ignition 1 Signal parameter is less than the specified range?	17.5 V	Go to Step 5	Go to Step 4
4	Measure the voltage at the battery terminals and compare it with the Ignition 1 parameter in the engine controls data list. Are the battery voltage and engine control module (ECM)/powertrain control module (PCM) Ignition 1 readings different by more than the value specified?	0.5 V	Go to Step 5	Go to Charging System Test
5	IMPORTANT: The replacement ECM/PCM must be programmed. Replace the ECM/PCM. Refer to Engine Control Module (ECM) Replacement in Engine Controls - 2.2L (L61) or Powertrain Control Module (PCM) Replacement in Engine Controls - 2.0L (LSJ). Did you complete the replacement?	-	Go to Step 6	-
6	<ol style="list-style-type: none"> 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 P0563 until the test runs. Does the scan tool indicate that DTC P0563 failed this ignition?	-	Go to Step 3	System OK

DTC P0616

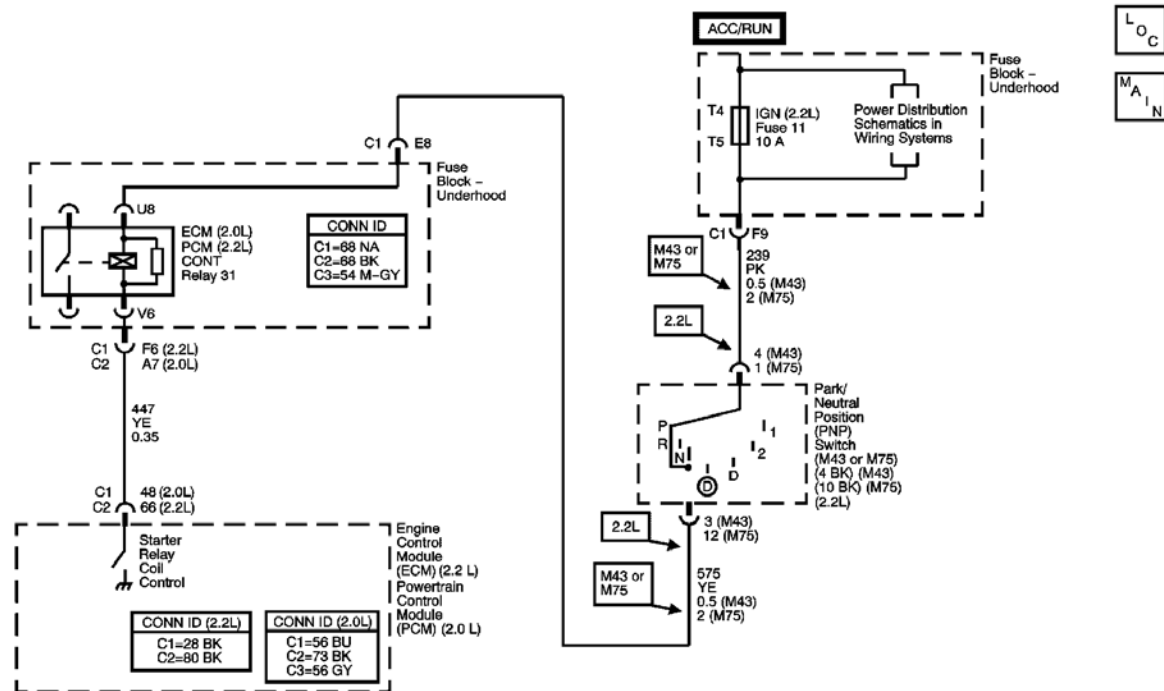


Fig. 11: ECM/PCM Starter Relay Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The engine control module (ECM)/powertrain control module (PCM) supplies a ground path for the starter relay when start enable has been requested. The ECM/PCM monitors this circuit for conditions that are incorrect for the commanded state. If the ECM/PCM detects an improper circuit condition, starter relay DTC P0616 will set.

Conditions for Running the DTC

- System voltage is between 8-16 volts.
- The ignition is in the CRANK position.

Conditions for Setting the DTC

- The ECM/PCM detects an improper voltage level on the output circuit that controls the starter relay.
- The condition exists for at least 2 seconds.

Action Taken When the DTC Sets

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

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 P0616

Step	Action	Yes	No
Connector End View Reference: Master Electrical Component List in Wiring Systems			
1	Did you perform the Engine Electrical Diagnostic System Check?	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	<ol style="list-style-type: none"> 1. Install a scan tool. 2. Operate the vehicle within the conditions for running the DTC as specified in the supporting text. 3. Using the scan tool, observe the specific DTC Information for DTC P0616 until the test runs. <p>Does the scan tool indicate that DTC P0616 has passed this ignition cycle?</p>	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
3	Test the control circuit of the engine control module (ECM) CONT/powertrain control module (PCM) CONT relay for a short to ground. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 6	Go to Step 4
4	Inspect for poor connections at the ECM/PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 6	Go to Step 5
5	<p>IMPORTANT: The replacement ECM/PCM must be programmed.</p> <p>Replace the ECM/PCM. Refer to Engine Control Module (ECM) Replacement in Engine Controls - 2.2L (L61) or Powertrain Control Module (PCM) Replacement in Engine Controls - 2.0L (LSJ). Did you complete the replacement?</p>	Go to Step 6	-
6	<ol style="list-style-type: none"> 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. 4. Using the scan tool, observe the Specific DTC Information for DTC P0616 until the test runs. <p>Does the scan tool indicate that DTC P0616 failed this ignition?</p>	Go to Step 2	System OK

DTC P0617

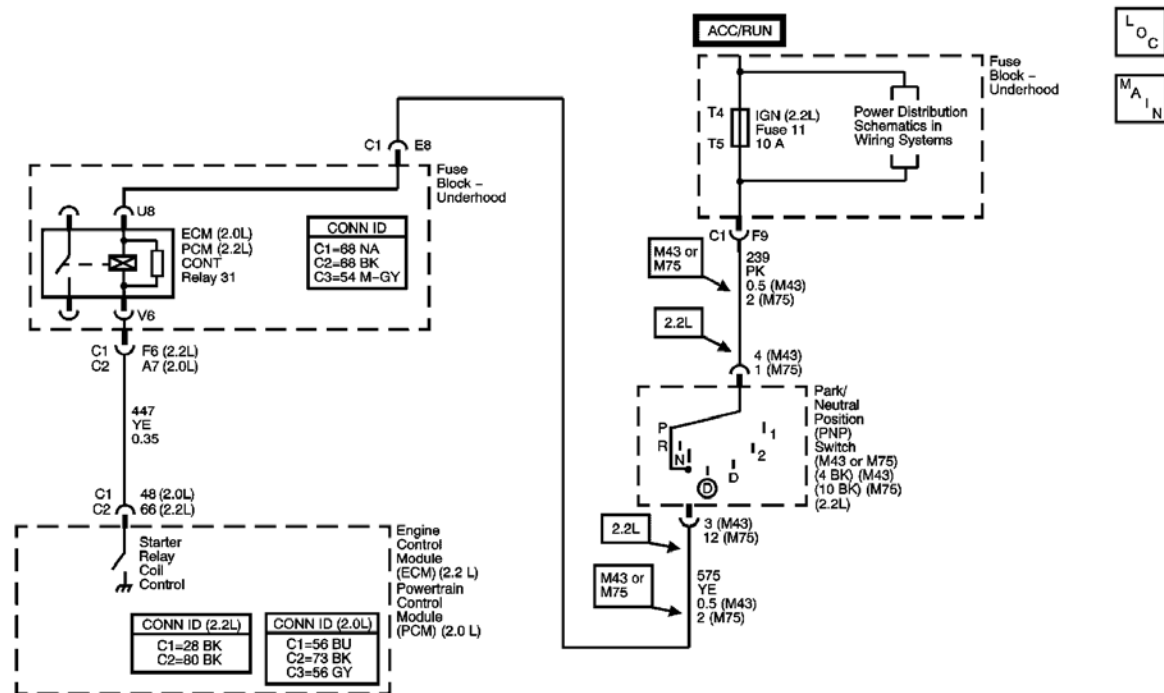


Fig. 12: ECM/PCM Starter Relay Circuit
 Courtesy of GENERAL MOTORS CORP.

Circuit Description

The engine control module (ECM)/powertrain control module (PCM) supplies a ground path for the starter relay when start enable has been requested. The ECM/PCM monitors this circuit for conditions that are incorrect for the commanded state. If the ECM/PCM detects an improper circuit condition, starter relay DTC P0617 will set.

Conditions for Running the DTC

- System voltage is between 8-16 volts.
- The ignition is in the CRANK position.

Conditions for Setting the DTC

- The ECM/PCM detects an improper voltage level on the output circuit that controls the starter relay.
- The condition exists for at least 2 seconds.

Action Taken When the DTC Sets

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

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 P0617

Step	Action	Yes	No
Connector End View Reference: Master Electrical Component List in Wiring Systems			
1	Did you perform the Engine Electrical Diagnostic System Check?	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	<ol style="list-style-type: none"> 1. Install a scan tool. 2. Operate the vehicle within the Conditions for Running the DTC. 3. Using the scan tool, observe the Specific DTC Information for DTC P0617 until the test runs. Does the scan tool indicate that DTC P0617 has passed this ignition cycle?	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
3	Test the control circuit of the starter relay for a short to battery. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 6	Go to Step 4
4	Inspect for poor connections at the engine control module (ECM)/powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 6	Go to Step 5
5	IMPORTANT: The replacement ECM/PCM must be programmed. Replace the ECM/PCM. Refer to Engine Control Module (ECM) Replacement in Engine Controls - 2.2L (L61) or Powertrain Control Module (PCM) Replacement in Engine Controls - 2.0L (LSJ). Did you complete the replacement?	Go to Step 6	-
6	<ol style="list-style-type: none"> 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 P0617 until the test runs. Does the scan tool indicate that DTC P0617 failed this ignition?	Go to Step 2	System OK

DTC P0621

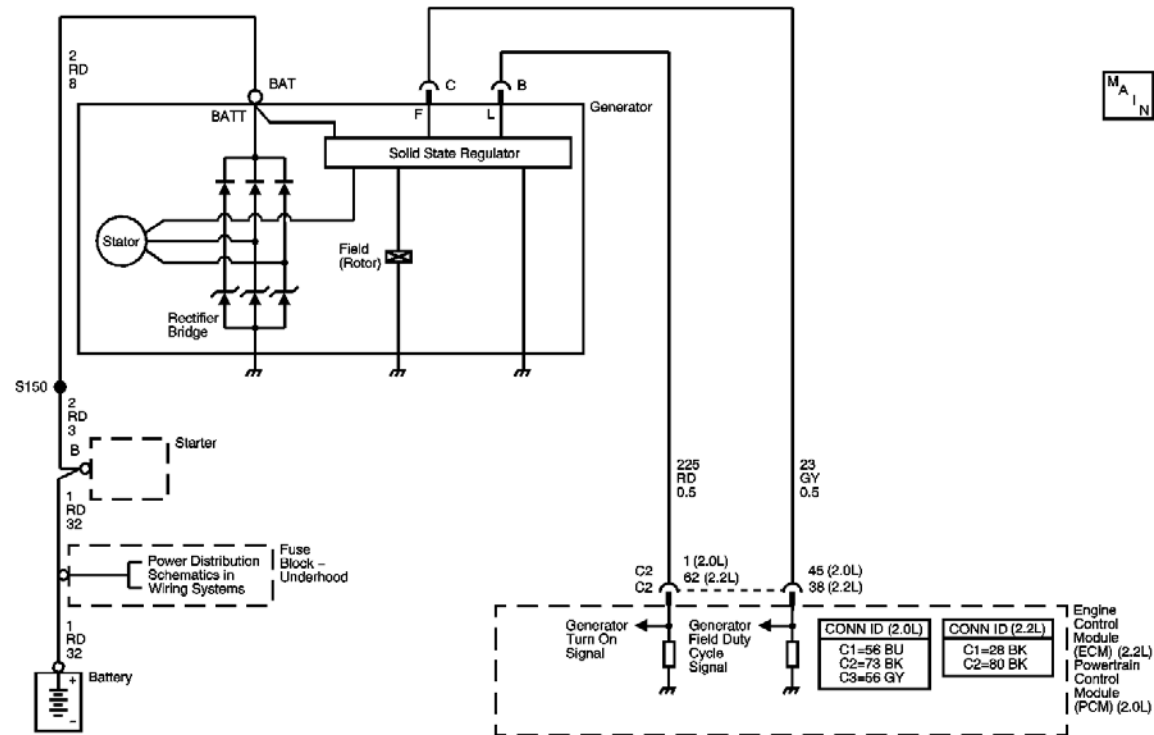


Fig. 13: Generator Turn ON Signal Circuit
 Courtesy of GENERAL MOTORS CORP.

Circuit Description

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

The ECM/PCM monitors the state of the generator turn ON signal circuit. With the engine running, the ECM/PCM should detect a high generator turn ON signal circuit, or when the charging system malfunctions. If the ECM/PCM detects a low generator turn ON signal circuit DTC P0621 will set. When the DTC sets, the ECM/PCM will send a class 2 serial data message to the instrument panel cluster (IPC) to illuminate the charge indicator.

Conditions for Running the DTC

- No generator, crankshaft position (CKP) sensors, or camshaft position (CMP) sensor DTCs are set.
- The engine is running.

Conditions for Setting the DTC

The ECM detects a low signal voltage on the generator turn on signal circuit for at least 5 seconds.

Action Taken When the DTC Sets

- The ECM/PCM sends a class 2 message to the IPC to illuminate the charge indicator.
- The ECM/PCM will not illuminate the malfunction indicator lamp (MIL).

- The ECM/PCM will store the conditions present when the DTC set as Failure Records data only.

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

Step	Action	Values	Yes	No
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 - 2.0 (LSJ)				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	<ol style="list-style-type: none"> 1. Install a scan tool. 2. Operate the vehicle within the conditions for running the DTC as specified in the supporting text. 3. Using the scan tool, observe the specific DTC Information for DTC P0621 until the test runs. Does the scan tool indicate that DTC P0621 has passed this ignition cycle?	-	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
3	<ol style="list-style-type: none"> 1. Start the engine. 2. With a scan tool, while observing the Ignition 1 parameter in the engine controls data list, command the Generator L-Terminal ON and OFF. Does the scan tool indicate a change in voltage each time the Generator L - Terminal is commanded ON and OFF?	-	Go to Step 6	Go to Step 4
4	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the generator harness connector. 3. Start the engine. 4. Measure the voltage between the generator turn ON signal circuit of the generator harness connector and a good ground. Is the voltage within the specified range?	4.5-5.5 V	Go to Step 7	Go to Step 5
5	Test the generator turn ON signal circuit for a short to ground or open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 10	Go to Step 8
6	Test the generator battery voltage output circuit for a high resistance or open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 10	Go to Charging System Test
7	Inspect for poor connections at the harness connector of the generator. Refer to Connector Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 10	Go to Charging System Test
8	Inspect for poor connections at the harness connector of the engine control module (ECM)/powertrain control module (PCM). Refer to Connector Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 10	Go to Step 9

Step	Action	Values	Yes	No
9	<p>IMPORTANT: The replacement ECM/PCM must be programmed.</p> <p>Replace the ECM/PCM. Refer to Engine Control Module (ECM) Replacement in Engine Controls - 2.2L (L61) or Powertrain Control Module (PCM) Replacement in Engine Controls - 2.0L (LSJ). Did you complete the replacement?</p>	-	Go to Step 10	-
10	<ol style="list-style-type: none"> Review and record the scan tool Fail Records data. Use the scan tool in order to clear the DTC. Operate the vehicle within the Conditions for Running DTC P0621 as specified in the supporting text. Using the scan tool, observe the Specific DTC Information for DTC P0621 until the test runs. <p>Does the scan tool indicate that DTC P0621 failed?</p>	-	Go to Step 3	System OK

DTC P0622

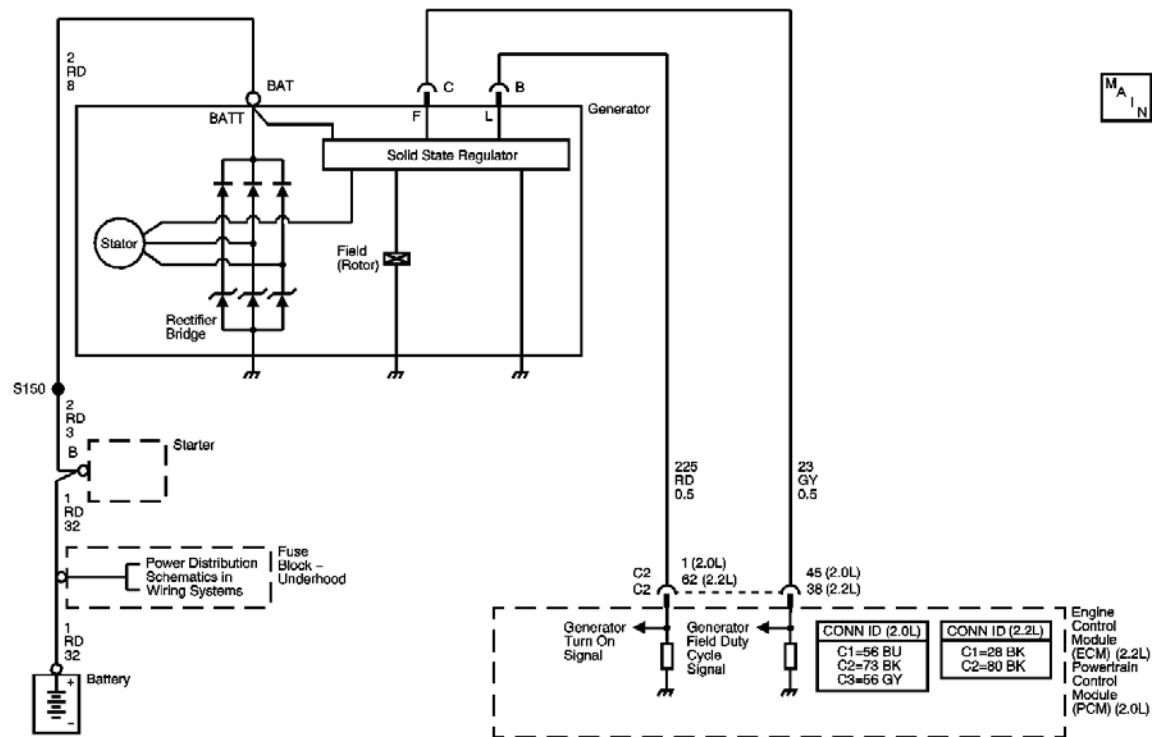


Fig. 14: Generator Turn ON Signal Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The engine control module (ECM)/powertrain control module (PCM) 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/PCM uses the PWM signal input to determine the generator load on the engine. This allows the ECM/PCM to adjust the idle speed to compensate for high electrical loads.

The ECM/PCM 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/PCM 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/PCM monitors the PWM signal, if the ECM/PCM detects an out of range PWM signal, DTC P0622 will set. When the DTC sets, the ECM/PCM 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, crankshaft position (CKP) sensors, or camshaft position (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 3000 RPM.

Conditions for Setting the DTC

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

OR

- During the RUN test, the ECM/PCM detects a PWM signal less than 5 percent for at least 15 seconds.

Action Taken When the DTC Sets

- The ECM/PCM sends a class 2 message to the IPC to illuminate the charge indicator.
- The ECM/PCM will not illuminate the malfunction indicator lamp (MIL).
- The ECM/PCM will store the conditions present when the DTC set as Fail Records data only.

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

Step	Action	Value(s)	Yes	No
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 - 2.0L (LSJ)				
1	Did you perform the Engine Electrical Diagnostic System Check?	-	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	1. Install a scan tool. 2. Start the engine. 3. With a scan tool, observe the GEN - F Terminal parameter in the	5-95%	Go to Step 3	Go to Step 4

Step	Action	Value(s)	Yes	No
	engine controls data list. Does the scan tool indicate that the GEN - F Terminal parameter is within the specified range?			
3	With the scan tool command the generator OFF. Does the GEN - F Terminal signal parameter change?	-	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the generator harness connector. 3. Connect test lamp to battery positive voltage. 4. Turn ON the ignition, with the engine OFF. 5. Probe the F-Terminal in the generator connector. 6. Observe the GEN - F Terminal Signal parameter in the engine controls data list. Is the GEN - F Terminal Signal parameter near the specified value?	100%	Go to Charging System Test	Go to Step 5
5	Test the generator field duty cycle signal circuit for a short or open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 8	Go to Step 6
6	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to Connector Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 8	Go to Step 7
7	IMPORTANT: The replacement ECM / powertrain control module (PCM) must be programmed. Replace the ECM/PCM. Refer to Engine Control Module (ECM) Replacement in Engine Controls - 2.2L (L61) or Powertrain Control Module (PCM) Replacement in Engine Controls - 2.0L (LSJ). Did you complete the replacement?	-	Go to Step 8	-
8	1. Review and record the scan tool Fail Records data. 2. Clear any DTCs. 3. Operate the vehicle within the Fail Records conditions as noted. 4. Using a scan tool, monitor the Specific DTC info for this DTC. Does the scan tool indicate that this DTC failed this ignition?	-	Go to Step 2	System OK

DTC P1633

Circuit Description

The powertrain control module (PCM) receives 2 ignition inputs from the ignition switch, ignition 1 signal and ignition accessory signal. The PCM receives the crank input from a serial data message from the BCM. The PCM determines the state of the ignition switch based on these 3 inputs. If the PCM detects an improper ignition accessory signal, DTC P1633 will set.

Conditions for Running the DTC

No Class 2 serial data circuit problem.

Conditions for Setting the DTC

The PCM detects an improper ignition accessory input voltage.

Action Taken When the DTC Sets

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

Conditions for Clearing the 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 P1633

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics in Engine Controls 2.0L (LSJ) Connector End View Reference: Powertrain Control Module (PCM) Connector End Views in Engine Controls 2.0L (LSJ)			
1	Did you perform the Diagnostic System Check - Engine Electrical?	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	1. Turn ON the ignition with the engine OFF. 2. With a scan tool observe the Ignition Accessory Signal parameter in the Engine Data list. Does the scan tool display ON?	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
3	1. Turn OFF the ignition 2. Disconnect the PCM. 3. Connect a test lamp between the accessory voltage circuit of the powertrain control module (PCM) and a good ground. 4. Turn the ignition switch to the accessory and ON positions. Does the test lamp illuminate with the ignition switch in both the accessory and ON positions?	Go to Step 5	Go to Step 4
4	Repair the accessory voltage circuit of the PCM for an open or for a high resistance. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 7	-
5	Inspect for poor connections at the harness connector of the powertrain control module. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 7	Go to Step 6
6	IMPORTANT: Program the PCM. Replace the PCM. Refer to Powertrain Control Module (PCM) Replacement .Did	Go to Step 7	-

Step	Action	Yes	No
7	you complete the replacement?		
	<ol style="list-style-type: none"> 1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. 		
	Does the DTC fail this ignition?	Go to Step 3	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](#)
- [Battery Electrical Drain/Parasitic Load Test](#)
- [Battery Common Causes of Failure](#)
- [Starter Motor Noise Diagnosis](#)

- [Charging System Test](#)
- [Generator Noise Diagnosis](#)

BATTERY INSPECTION/TEST

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

Step	Action	Values	Yes	No
CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.				
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 Step 2	Go to Step 9
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 Battery Usage . Does the battery meet or exceed the specifications?	-	Go to Step 3	Go to Step 9
3	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Attempt to rotate the negative battery cable connector with light finger pressure. Does the negative connector rotate?	-	Go to Step 6	Go to Step 4

Step	Action	Values	Yes	No
4	Attempt to rotate the positive battery cable connector clockwise with light finger pressure. Does the positive connector rotate?	-	Go to Step 6	Go to Step 5
5	<p>IMPORTANT: Ensure that all of the electrical loads are turned OFF.</p> <ol style="list-style-type: none"> 1. Install the SA9154Z-A Starting and Charging System Tester. See Special Tools and Equipment. 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 Battery Charging. <p>Did the tester pass the battery?</p>	-	Battery OK	Go to Step 6
6	<ol style="list-style-type: none"> 1. Disconnect the negative battery cable. 2. Disconnect the positive battery cable. 3. Clean and wire brush both battery post and the metal contact rings on both cable connectors. 4. If either of the battery terminals or the contact rings are excessively damaged or corroded, replace as needed. <p>Did you complete the repair?</p>	-	Go to Step 7	-
7	<p>IMPORTANT: Ensure that both battery cables are disconnected.</p> <ol style="list-style-type: none"> 1. Install the SA9154Z-A . See Special Tools and Equipment. 2. Follow any directions displayed on the tester. 3. If the tester calls for charging the battery, refer to Battery Charging. <p>Did the tester pass the battery?</p>	-	Go to Step 8	Go to Step 9
8	<ol style="list-style-type: none"> 1. Connect the positive battery cable to the batteries positive terminal. <p>NOTE: Refer to Fastener Notice in Cautions and Notices.</p> <ol style="list-style-type: none"> 2. Tighten the positive battery cable bolt to the specified value. 3. Connect the negative battery cable to the battery negative terminal. 4. Tighten the negative battery cable bolt to the specified value. <p>Are the cable bolts properly tightened?</p>	6 N.m (53 lb in)	Battery OK	-
9	Replace the battery. Refer to Battery Replacement . Did you complete the replacement?	-	Battery OK	-

BATTERY CHARGING

Tools Required

SA9154Z-A Starting and Charging System Tester. See [Special Tools and Equipment](#).

NOTE:

- 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](#).

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®, 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

Current Drain	Days
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.
 - A. 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.
 - B. 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](#).
 - A. Divide the reserve capacity by 4, amp hour rating by 2.4.
 - B. 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°C (-65°F). However, a battery with a low state of charge may freeze at temperatures as high as -7°C (20°F). Since freezing may ruin a battery, the battery should be protected against freezing by keeping it properly charged. As long as the green eye is visible in the hydrometer, 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](#).

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

1. Ensure that the green dot is visible in the built-in hydrometer.

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

2. 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.
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.

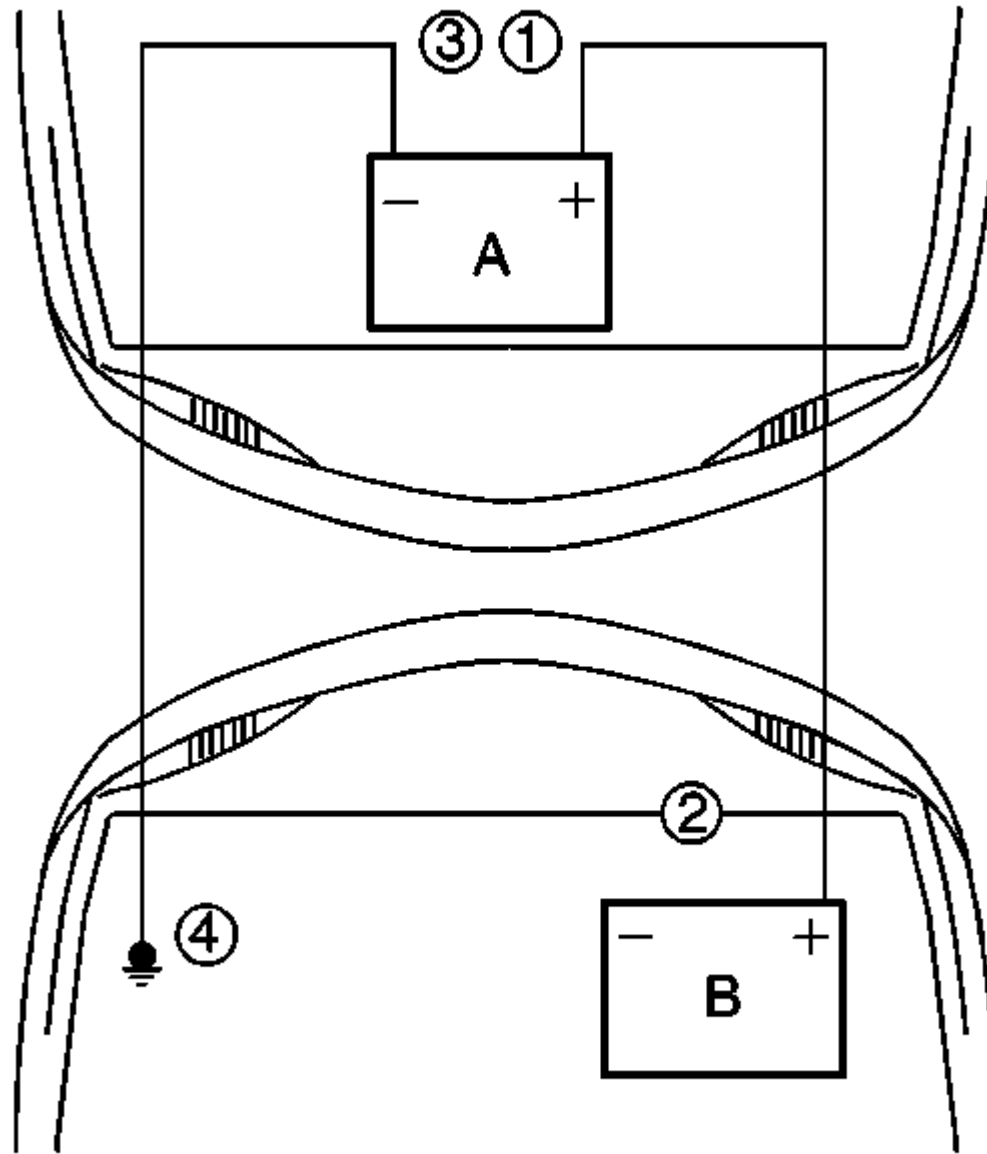


Fig. 15: Identifying Proper Jumper Cable Connection
Courtesy of GENERAL MOTORS CORP.

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

CHARGE INDICATOR ALWAYS ON

Charge Indicator Always On

Step	Action	Value(s)	Yes	No
Connector End View Reference: Engine Electrical Connector End Views or Engine Control Module (ECM) Connector End Views in Engine Controls - 2.2 L (L61) or Powertrain Control Module (PCM) Connector End Views in Engine Controls - 2.0 L (LSJ)				
1	Did you perform the Diagnostic System Check for Engine Electrical?	-	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	Start the engine. Does the battery charge indicator remain illuminated?	-	Go to Step 3	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems

Step	Action	Value(s)	Yes	No
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?	10.5-17.5 V	Go to Step 4	Go to Charging System Test
4	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 Step 5	Go to Step 6
5	IMPORTANT: The replacement engine control module (ECM)/powertrain control module (PCM) must be programmed. Replace the ECM/PCM. Refer to Engine Control Module (ECM) Replacement in Engine Controls - 2.2 L (L61) or Powertrain Control Module (PCM) Replacement in Engine Controls - 2.0 L (LSJ). Did you complete the replacement?	-	Go to Step 7	-
6	Replace the instrument panel cluster. Refer to Instrument Panel Cluster (IPC) Replacement in Instrument Panel, Gages and Console. Did you complete the replacement?	-	Go to Step 7	-
7	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to Step 2

CHARGE INDICATOR INOPERATIVE

Charge Indicator Inoperative

Step	Action	Yes	No
Connector End View Reference: Engine Electrical Connector End Views or Engine Control Module (ECM) Connector End Views in Engine Controls - 2.2 L (L61) or Powertrain Control Module (PCM) Connector End Views in Engine Controls - 2.0 L (LSJ)			
1	Did you perform the Diagnostic System Check for Engine Electrical?	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	Turn ON the ignition, with the engine OFF. Does the battery charge indicator illuminate?	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
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 Step 4	Go to Step 7
4	Test the generator turn on signal circuit for a short to ground or open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 8	Go to Step 5
5	Inspect for poor connections at the harness connector of the engine control module (ECM)/powertrain control module (PCM). Refer to Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 8	Go to Step 6

Step	Action	Yes	No
6	<p>IMPORTANT: The replacement ECM/PCM must be programmed.</p> <p>Replace the ECM/PCM. Refer to Engine Control Module (ECM) Replacement in Engine Controls - 2.2 L (L61) or Powertrain Control Module (PCM) Replacement in Engine Controls - 2.0 L (LSJ). Did you complete the replacement?</p>	Go to Step 8	-
7	<p>Replace the instrument panel cluster. Refer to Instrument Panel Cluster (IPC) Replacement in Instrument Panel, Gages and Console. Did you complete the replacement?</p>	Go to Step 8	-
8	<p>Operate the system in order to verify the repair. Did you correct the condition?</p>	System OK	Go to Step 2

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	<p>Test the generator for proper operation using the Generator Tester. Refer to Charging System Test. Is the generator operating properly?</p>	Go to Step 2	Go to Step 11
2	<ol style="list-style-type: none"> 1. Start the engine. Verify that the noise can be heard. 2. Turn OFF the engine. 3. Disconnect the 4-way connector from the generator. 4. Start the engine. 5. Listen for the noise. <p>Has the noise stopped?</p>	Go to Step 11	Go to Step 3
3	<ol style="list-style-type: none"> 1. Turn OFF the engine. 2. Remove the drive belt. Refer to Drive Belt Replacement in Engine Mechanical - 2.2L (L61) or Drive Belt Replacement in Engine Mechanical - 2.0L (LSJ). 3. Spin the generator pulley by hand. <p>Does the generator shaft spin smoothly and without any roughness or grinding noise?</p>	Go to Step 4	Go to Step 11
4	<p>Inspect the generator for a loose pulley and/or pulley nut. Is the generator pulley or pulley nut loose?</p>	Go to Step 11	Go to Step 5
5	<ol style="list-style-type: none"> 1. Loosen all of the generator mounting bolts. 2. Tighten the generator mounting bolts to specifications and in the proper sequence, if necessary. Refer to Generator Replacement (LSJ) or Generator Replacement (L61). 3. Install the drive belt. Refer to Drive Belt Replacement in Engine Mechanical - 	System OK	Go to Step 6

Step	Action	Yes	No
6	2.2L (L61) or Drive Belt Replacement in Engine Mechanical - 2.0L (LSJ). 4. Start the engine. Has the noise decreased or stopped?		
	Inspect the generator for the following conditions: <ul style="list-style-type: none"> • Strained or stretched electrical connections. • Hoses or other vehicle equipment resting on the generator, which may cause the noise to be transmitted into the passenger compartment Are any electrical connections pulling on the generator or are any hoses, etc. resting on the generator?		
7	1. Reroute the electrical connections to relieve the tension. 2. Reroute the hoses, etc. away from the generator. 3. Start the engine. Has the noise decreased or stopped?	System OK	Go to Step 8
8	Inspect the drive belt for proper tension. Refer to Drive Belt Tensioner Diagnosis in Engine Mechanical - 2.2L (L61) or Drive Belt Tensioner Diagnosis in Engine Mechanical - 2.0L (LSJ). Is the drive belt loose?	Go to Step 9	Go to Step 10
9	1. Replace the drive belt tensioner. Refer to Drive Belt Tensioner Replacement in Engine Mechanical - 2.2L (L61) or Drive Belt Tensioner Replacement - Supercharger in Engine Mechanical - 2.0L (LSJ). 2. Start the engine. Has the noise decreased or stopped?	System OK	Go to Step 11
10	Compare the vehicle with a known good vehicle. Do both vehicles make the same noise?	System OK	Go to Step 11
11	IMPORTANT: 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. Replace the generator. Refer to Generator Replacement (LSJ) or Generator Replacement (L61) . Has the noise decreased or stopped?	Go to Step 12	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

STARTER SOLENOID DOES NOT CLICK

Starter Solenoid Does Not Click

Step	Action	Yes	No
Schematic Reference: Starting and Charging Schematics			

Step	Action	Yes	No
Connector End View Reference: Master Electrical Component List in Wiring Systems			
1	Did you perform the Diagnostic System Check for Engine Electrical?	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	<ol style="list-style-type: none"> 1. Depress the clutch pedal or verify that the transmission is in Park or Neutral. 2. Turn the ignition switch to the START position. Does the engine crank?	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
3	Is the security indicator flashing?	Go to Diagnostic System Check - Theft Deterrent in Theft Deterrent	Go to Step 4
4	<ol style="list-style-type: none"> 1. Depress the clutch pedal or verify that the transmission is in Park or Neutral. 2. Cycle the ignition switch from the RUN to START position several times. Does the engine control module (ECM)/powertrain control module (PCM) CONT relay click each time the ignition is placed in the START position?	Go to Step 5	Go to Step 8
5	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the ECM/PCM CONT relay. 3. Connect a test lamp between the battery positive voltage circuit of the ECM/PCM CONT relay switch and a good ground. Does the test lamp illuminate?	Go to Step 6	Go to Step 24
6	<p>IMPORTANT: The engine may crank during this procedure.</p> <ol style="list-style-type: none"> 1. Depress the clutch pedal or verify that the transmission is in Park or Neutral. 2. Connect a 30-amp fused jumper between the battery positive voltage circuit of the ECM/PCM CONT relay switch and the starter solenoid crank voltage circuit. Does the engine crank?	Go to Step 18	Go to Step 7
7	Does the fuse in the jumper open?	Go to Step 25	Go to Step 16
8	<ol style="list-style-type: none"> 1. Turn OFF the ignition. 2. Disconnect the ECM/PCM CONT relay. 3. Turn On the ignition, with the engine Off. 4. Connect a test lamp between the PNP/Clutch Start Switch Signal circuit of the ECM/PCM CONT relay coil and a good ground. 5. Depress the clutch pedal or verify that the transmission is in Park or Neutral. 6. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	Go to Step 9	Go to Step 11

Step	Action	Yes	No
9	<ol style="list-style-type: none"> 1. Connect a test lamp between the PNP/Clutch Start Switch Signal circuit of the ECM/PCM CONT relay coil and the control circuit of the ECM/PCM CONT relay. 2. Depress the clutch pedal or verify that the transmission is in Park or Neutral. 3. Turn the ignition to the CRANK position. <p>Does the test lamp illuminate?</p>	Go to Step 18	Go to Step 10
10	<ol style="list-style-type: none"> 1. Install the ECM/PCM CONT relay. 2. With a scan tool, observe the Starter Relay-Low Volts parameter in the General Info-Outputs data list of the ECM/PCM. 3. Depress the clutch pedal or verify that the transmission is in Park or Neutral. 4. Turn the ignition to the CRANK position. <p>Does the scan tool display Test Fail?</p>	Go to Step 26	Go to Step 17
11	Does the vehicle have an automatic transmission?	Go to Step 12	Go to Step 14
12	<ol style="list-style-type: none"> 1. Disconnect the park/neutral position (PNP) switch. 2. Connect a test lamp between the ignition 1 voltage circuit of the PNP switch and a good ground. 3. Turn ON the ignition, with the engine OFF. <p>Does the test lamp illuminate?</p>	Go to Step 13	Go to Step 27
13	<ol style="list-style-type: none"> 1. Connect a 3-amp fused jumper between the PNP/Clutch Start Switch Signal circuit of the ECM/PCM CONT relay coil and the control circuit of the ECM/PCM CONT relay. 2. Connect a test lamp between the ignition 1 voltage circuit of the PNP switch and the PNP/Clutch Start Switch Signal circuit. 3. Turn ON the ignition, with the engine OFF. <p>Does the test lamp illuminate?</p>	Go to Step 20	Go to Step 28
14	<ol style="list-style-type: none"> 1. Disconnect the clutch start switch. 2. Connect a test lamp between the ignition 1 voltage circuit of the clutch start switch and a good ground. 3. Turn ON the ignition, with the engine OFF. <p>Does the test lamp illuminate?</p>	Go to Step 15	Go to Step 27
15	<ol style="list-style-type: none"> 1. Connect a 3-amp fused jumper between the ignition 1 voltage circuit of the ECM/PCM CONT relay coil and the control circuit of the ECM/PCM CONT relay. 2. Connect a test lamp between the ignition 1 voltage circuit of the clutch start switch and the PNP/Clutch Start Switch Signal circuit. 3. Turn ON the ignition, with the engine OFF. <p>Does the test lamp illuminate?</p>	Go to Step 22	Go to Step 28
16	<p>Test the starter solenoid crank voltage circuit for a high resistance or open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	Go to Step 34	Go to Step 19

Step	Action	Yes	No
17	Test the PNP/Clutch Start Switch Signal circuit for a high resistance or open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 34	Go to Step 23
18	Inspect for poor connections at the ECM/PCM CONT relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 34	Go to Step 29
19	Inspect for poor connections at the starter solenoid. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 34	Go to Step 30
20	Inspect the PNP switch for proper adjustment. Refer to Park/Neutral Position Switch Adjustment in Automatic Transmissions - AF23-5 or Park/Neutral Position Switch Adjustment in Automatic Transmissions - VT25-E. Did you find and correct the condition?	Go to Step 34	Go to Step 21
21	Inspect for poor connections at the harness connector of the PNP switch. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 34	Go to Step 31
22	Inspect for poor connections at the harness connector of the clutch start switch. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 34	Go to Step 32
23	Inspect for poor connections at the harness connector of the ECM/PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 34	Go to Step 33
24	Repair the open or high resistance in the battery positive voltage circuit of the ECM/PCM CONT relay switch circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 34	-
25	Repair the short to ground in the starter solenoid crank voltage circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 34	-
26	Repair the open or high resistance in the control circuit of the ECM/PCM CONT relay. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 34	-
27	Repair the open or high resistance in the ignition 1 voltage circuit of the PNP switch or clutch start switch. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 34	-
28	Repair the open or high resistance in the PNP/Clutch Start Switch Signal circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 34	-
29	Replace the ECM/PCM CONT relay. Did you complete the replacement?	Go to Step 34	-
30	Replace the starter motor. Refer to Starter Motor Replacement (2.2L (L61)) or Starter Motor Replacement (2.0L (LSJ)) . Did you complete the replacement?	Go to Step 34	-

Step	Action	Yes	No
31	Replace the PNP switch. Refer to Park/Neutral Position Switch Replacement in Automatic Transmissions - AF23-5 or Park/Neutral Position Switch Replacement in Automatic Transmissions - VT25-E. Did you complete the replacement?	Go to Step 34	-
32	Replace the clutch start switch. Refer to Clutch Pedal Position Switch Replacement in Clutch. Did you complete the replacement?	Go to Step 34	-
33	IMPORTANT: The replacement ECM/PCM must be programmed. Replace the ECM/PCM. Refer to Engine Control Module (ECM) Replacement in Engine Controls - 2.2 L (L61) or Powertrain Control Module (PCM) Replacement in Engine Controls - 2.0 L (LSJ). Did you complete the replacement?	Go to Step 34	-
34	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

STARTER SOLENOID CLICKS, ENGINE DOES NOT CRANK

Starter Solenoid Clicks, Engine Does Not Crank

Step	Action	Yes	No
Schematic Reference: Starting and Charging Schematics Connector End View Reference: Master Electrical Component List in Wiring Systems			
1	Did you perform the Engine Electrical Diagnostic System Check?	Go to Step 2	Go to Diagnostic System Check - Engine Electrical
2	Turn the ignition to the START position. Did the starter solenoid click?	Go to Step 3	Go to Starter Solenoid Does Not Click
3	Inspect the engine and belt drive system for mechanical binding, seized engine, or seized generator. Does the engine move freely?	Go to Step 4	Go to Engine Will Not Crank - Crankshaft Will Not Rotate in Engine Mechanical - 2.2 L (L61) or Engine Will Not Crank - Crankshaft Will Not Rotate in Engine Mechanical - 2.0 L (LSJ)
4	Test the battery positive cable between the battery and the starter solenoid for high resistance. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 8	Go to Step 5
5	Test the ground circuit between the battery and the starter motor for a high resistance. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 8	Go to Step 6
6	Inspect for poor connections at the starter. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 8	Go to Step 7
7	Replace the starter. Refer to Starter Motor Replacement (2.2L (L61)) or Starter Motor Replacement (2.0L (LSJ)) . Did you complete the replacement?	Go to Step 8	-

Step	Action	Yes	No
8	Operate the system for which the symptom occurred. Did you correct the condition?	System OK	Go to Step 2

ENGINE CRANKS SLOWLY

Inspect the following items:

- Battery - Perform the Battery Inspection/Test. Refer to [Battery Inspection/Test](#).
- 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](#) , [Wiring Repairs](#) , [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 \(2.2L \(L61\)\)](#) or [Starter Motor Replacement \(2.0L \(LSJ\)\)](#).

STARTER MOTOR NOISE DIAGNOSIS

Diagnostic Aids

Inspect the flywheel ring gear for damage or unusual wear.

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 Step 2	Go to Diagnostic System Check - Engine Electrical
2	Start the engine. Does the starter operate normally?	Go to Testing for Intermittent Conditions and Poor Connections in Wiring Systems	Go to Step 3
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 Step 6	Go to Step 4
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 Step 7	Go to Step 5
5	IMPORTANT: This is often diagnosed as a starter drive gear hang-in or a weak solenoid. When the engine is cranked, do you hear a high-pitched whine after the engine cranks and starts normally?	Go to Step 8	Go to Step 7
6	Inspect the flywheel ring gear for the following: <ul style="list-style-type: none"> • Chipped gear teeth 	Go to Step 9	Go to Step 10

Step	Action	Yes	No
7	<ul style="list-style-type: none"> • Missing gear teeth • Milled teeth <p>Is the flywheel bent, or does it have damaged teeth?</p>	Go to Step 10	Go to Step 9
	<ol style="list-style-type: none"> 1. Remove the starter motor. Refer to Starter Motor Replacement (2.2L (L61)) or Starter Motor Replacement (2.0L (LSJ)). 2. Inspect the starter motor bushings and clutch gear. <p>Does the clutch gear have chipped or milled teeth or worn bushings?</p>		
8	<p>Shim the starter motor away from the flywheel by adding shims between the starter motor and the engine block one at a time.</p> <p>Flywheel runout may make this noise appear to be intermittent.</p> <p>Did you complete the repair?</p>	Go to Step 11	-
9	<p>Replace the flywheel. Refer to Engine Flywheel Replacement in Engine Mechanical - 2.2L (L61) or Engine Flywheel Replacement in Engine Mechanical - 2.0L (LSJ).</p> <p>Did you complete the replacement?</p>	Go to Step 11	-
10	<p>Replace the starter motor. Refer to Starter Motor Replacement (2.2L (L61)) or Starter Motor Replacement (2.0L (LSJ)).</p> <p>Did you complete the replacement?</p>	Go to Step 11	-
11	<p>Operate the system in order to verify the repair.</p> <p>Did you correct the condition?</p>	System OK	Go to Step 3

REPAIR INSTRUCTIONS

BATTERY NEGATIVE CABLE DISCONNECT/CONNECT PROCEDURE

Removal Procedure

CAUTION: Refer to [SIR Caution](#) in Cautions and Notices.

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

1. Record all of the vehicle preset radio stations.
2. Turn OFF all the lamps and the accessories.
3. Make sure the ignition switch is in the OFF position.
4. Disconnect the battery negative cable from the battery (2).

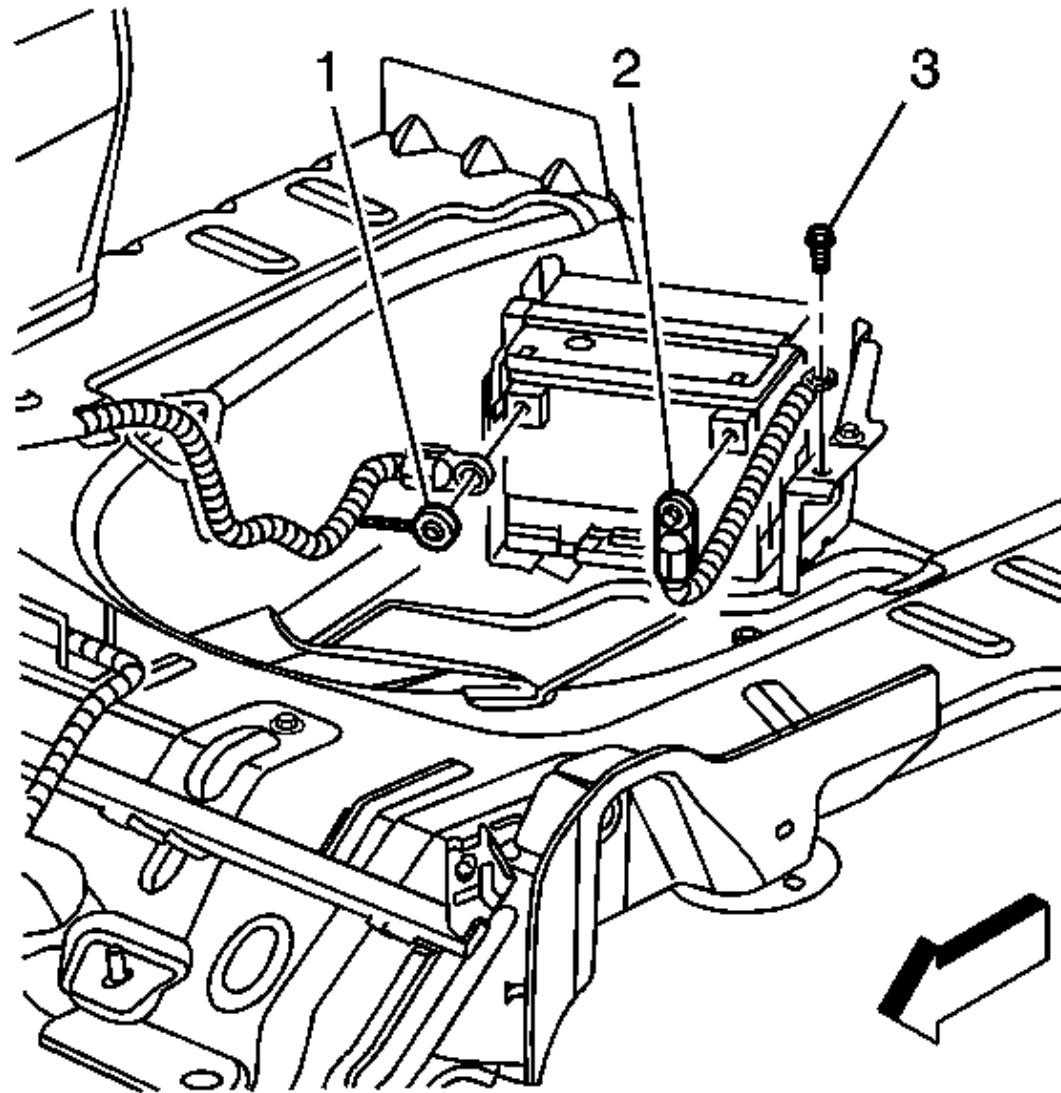


Fig. 16: View Of Battery & Battery Cables
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: Clean any existing oxidation from the contact face of the battery terminal and battery cable using a wire brush before installing the battery cable to the battery terminal.

1. Connect the battery negative cable to the battery (2).

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

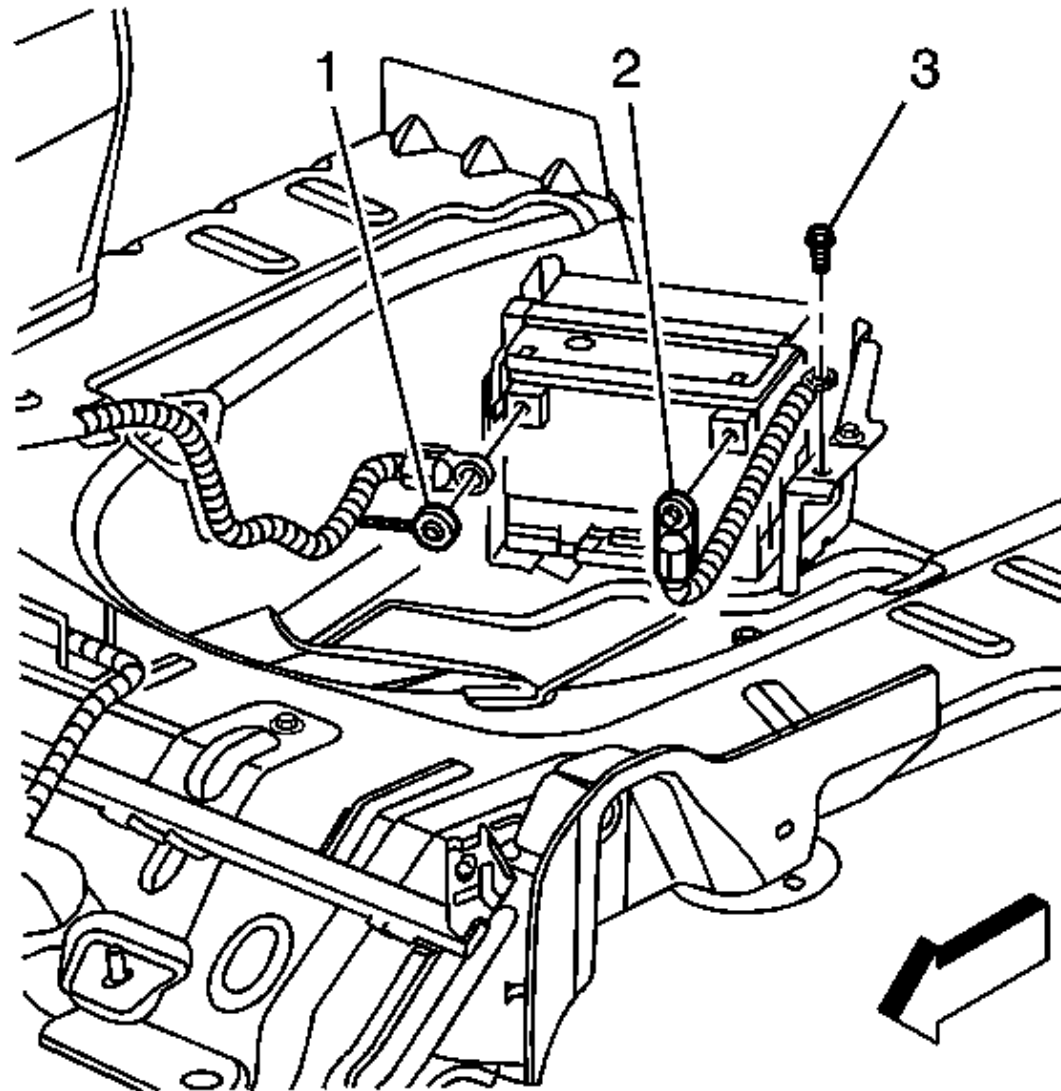


Fig. 17: View Of Battery & Battery Cables
Courtesy of GENERAL MOTORS CORP.

2. Reset the radio stations and the clock.

BATTERY NEGATIVE CABLE REPLACEMENT (ENGINE TO CHASSIS)

Removal Procedure

1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).
2. Remove the ground cable from the positive battery cable near the transmission.
3. Disconnect the ground cable at the rear of the engine (1).
4. Remove the bolt retaining the ground cable at the side rail (2).

5. Remove the ground cable from the vehicle, noting the routing for installation.

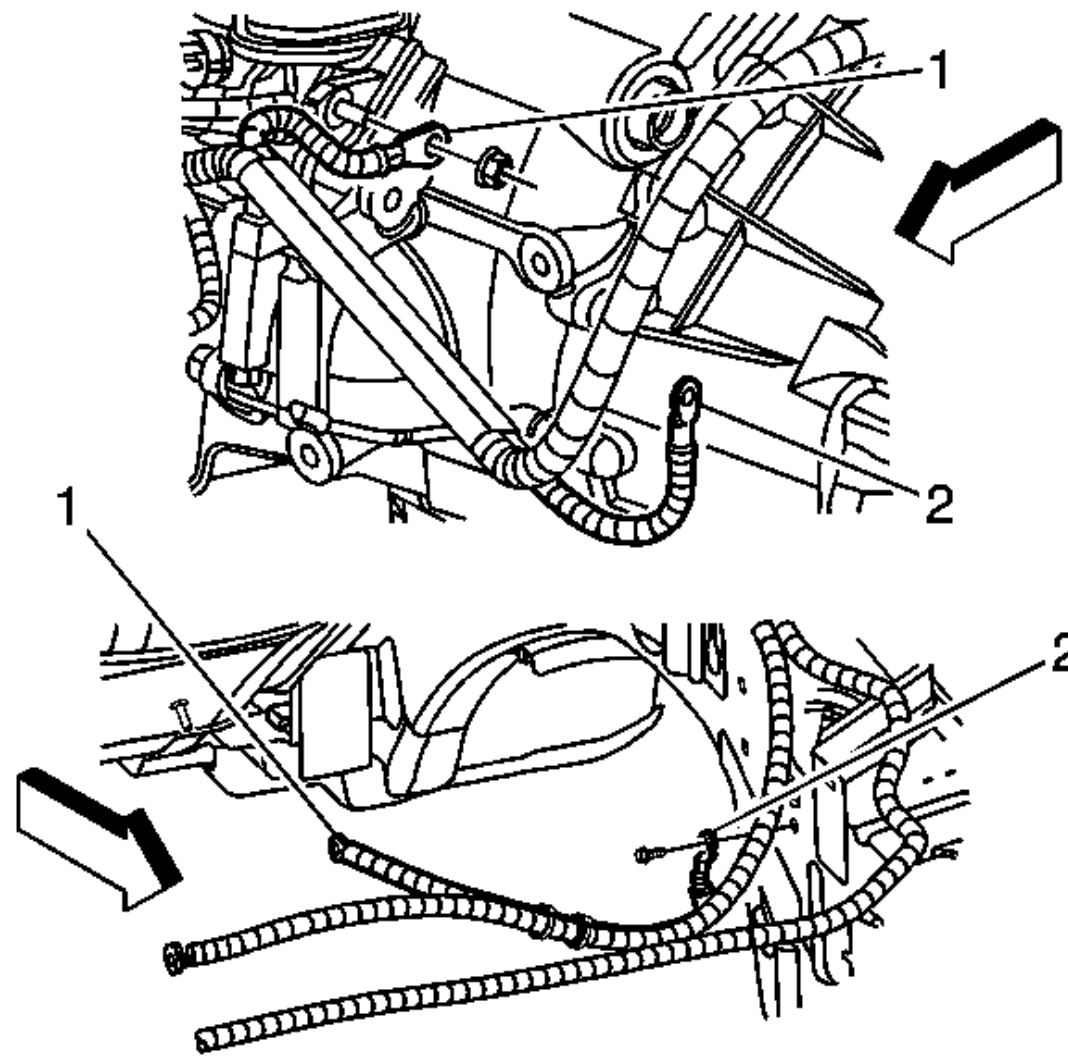


Fig. 18: View Of Ground Cable

Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Position the ground cable as noted during removal.

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

2. Install the ground cable to side rail bolt (2).

Tighten: Tighten the bolt to 20 N.m (15 lb ft).

3. Install the ground cable to the rear of the engine (1).

Tighten: Tighten the ground to engine block nut to 17 N.m (13 lb ft).

4. Tape the ground cable to the wiring harness near the transmission.

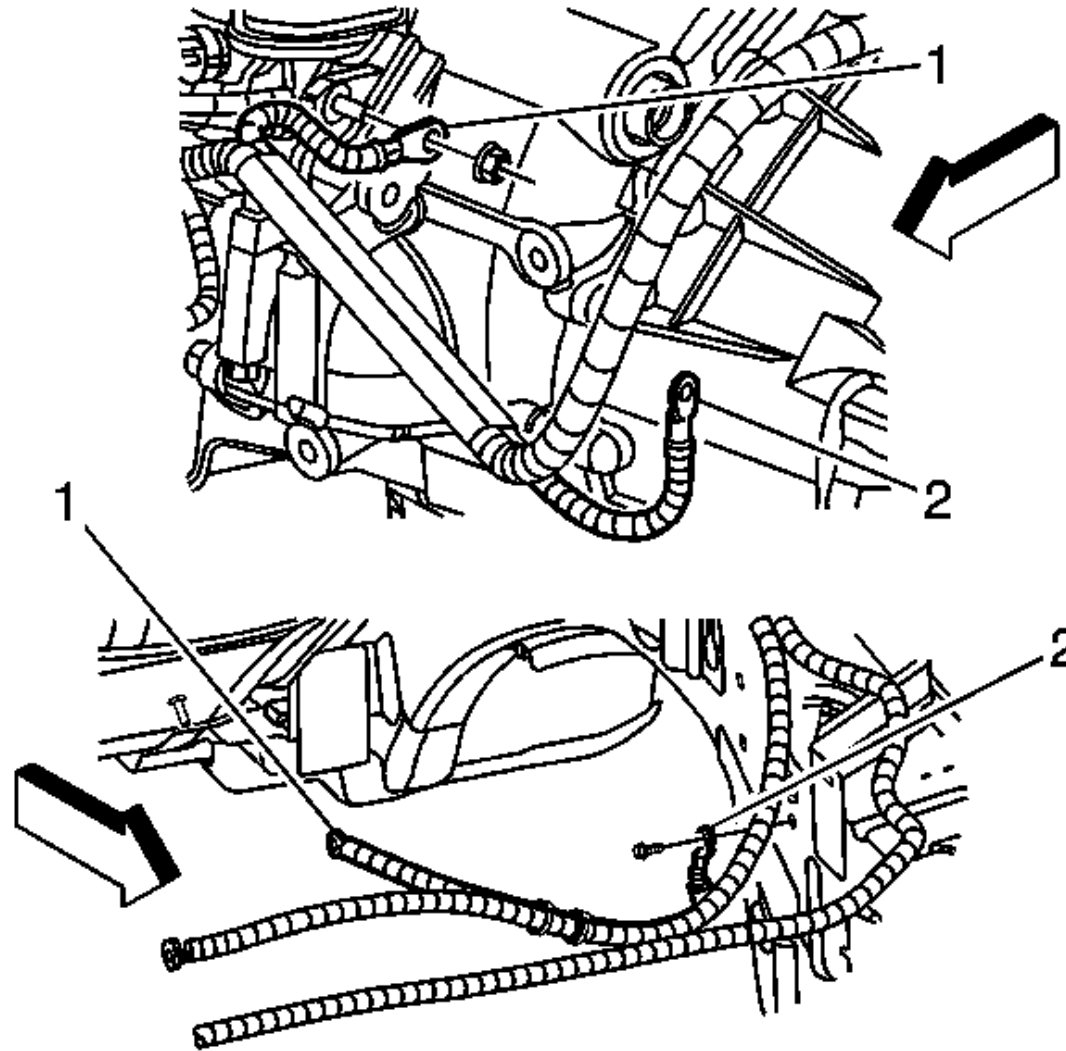


Fig. 19: View Of Ground Cable

Courtesy of GENERAL MOTORS CORP.

5. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).

BATTERY NEGATIVE CABLE REPLACEMENT (BATTERY TO BATTERY TRAY)

Removal Procedure

1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).

2. Disconnect the negative battery cable from the battery hold down bracket (3).
3. Remove the cable from the vehicle.

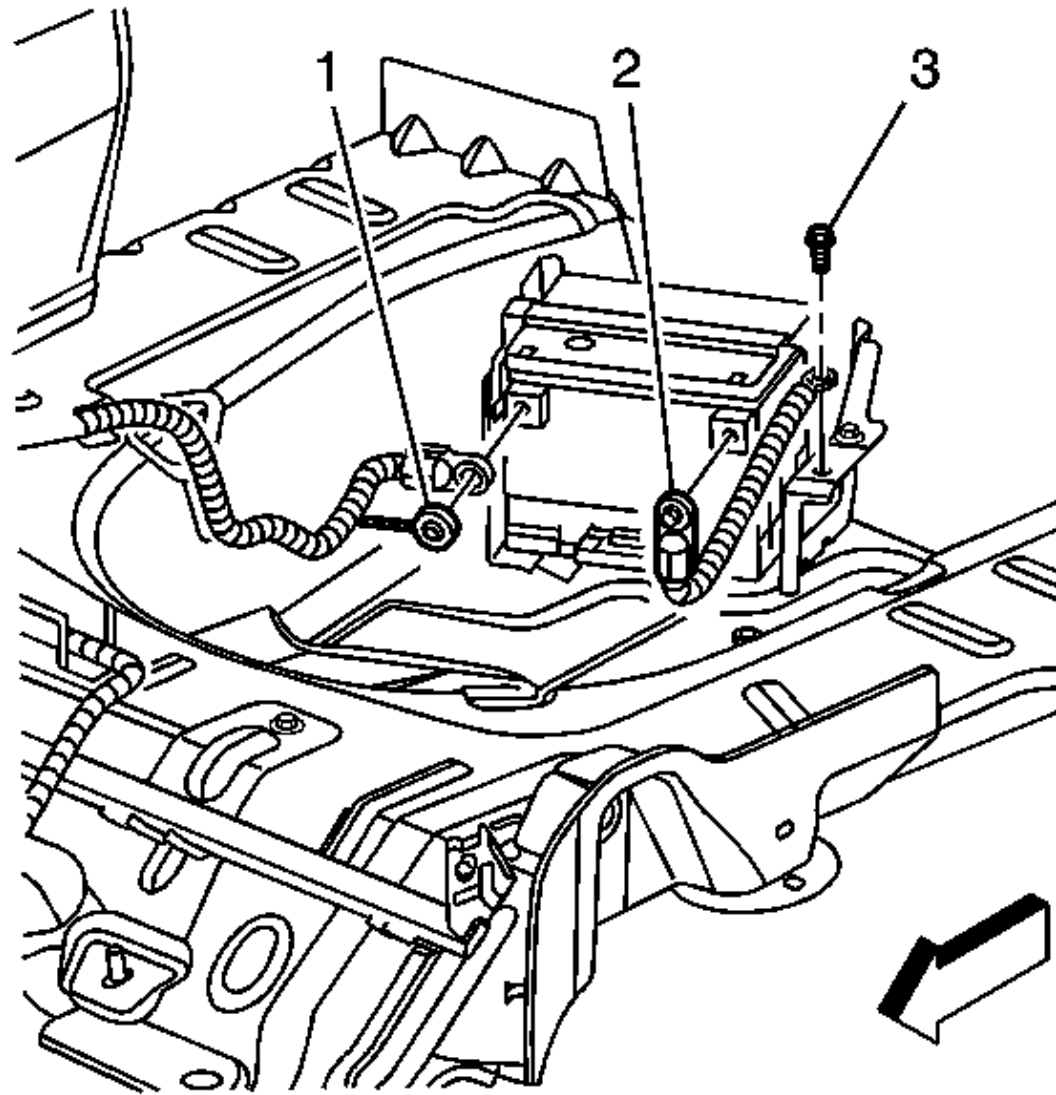


Fig. 20: View Of Battery & Battery Cables
Courtesy of GENERAL MOTORS CORP.

Installation Procedure

NOTE: Refer to [Fastener Notice](#) in Cautions and Notices.

1. Connect the negative battery cable from the battery hold down bracket (3).

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

2. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).

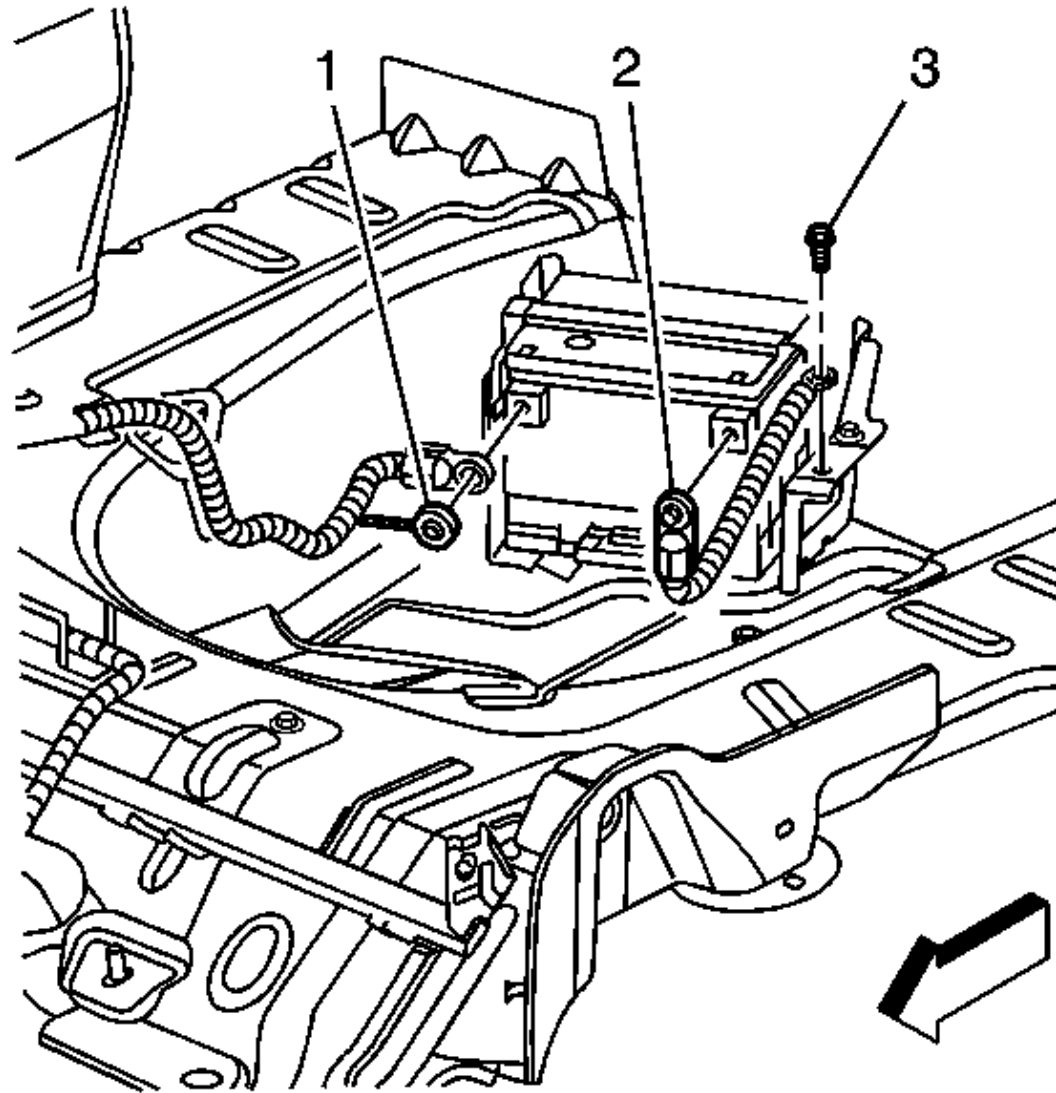


Fig. 21: View Of Battery & Battery Cables
Courtesy of GENERAL MOTORS CORP.

BATTERY POSITIVE CABLE REPLACEMENT (UNDERHOOD JUNCTION BLOCK TO STARTER)

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 (1) from the under hood junction block terminal.

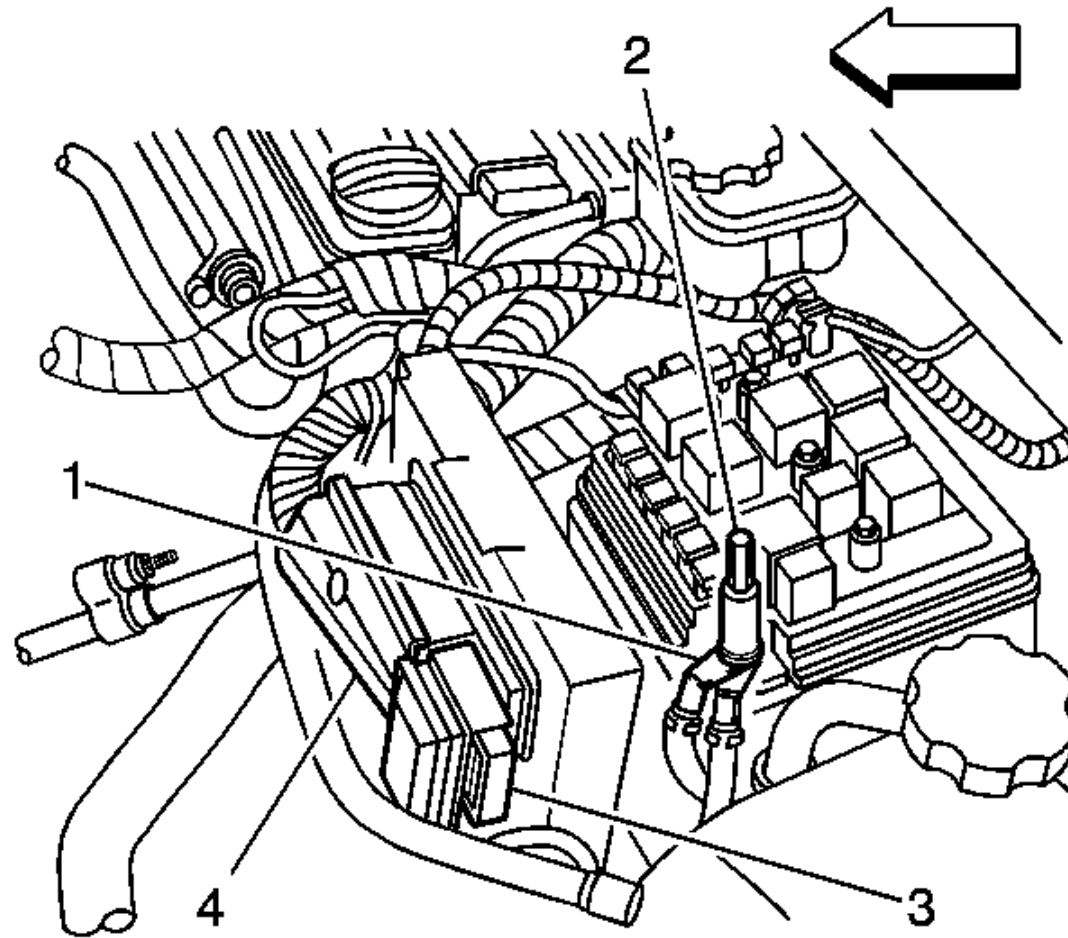


Fig. 22: View Of Engine Electrical Center
Courtesy of GENERAL MOTORS CORP.

3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) in General Information.
4. Disconnect the positive cable from the negative cable near the transmission.
5. Disconnect the positive battery cable (4) from the starter.

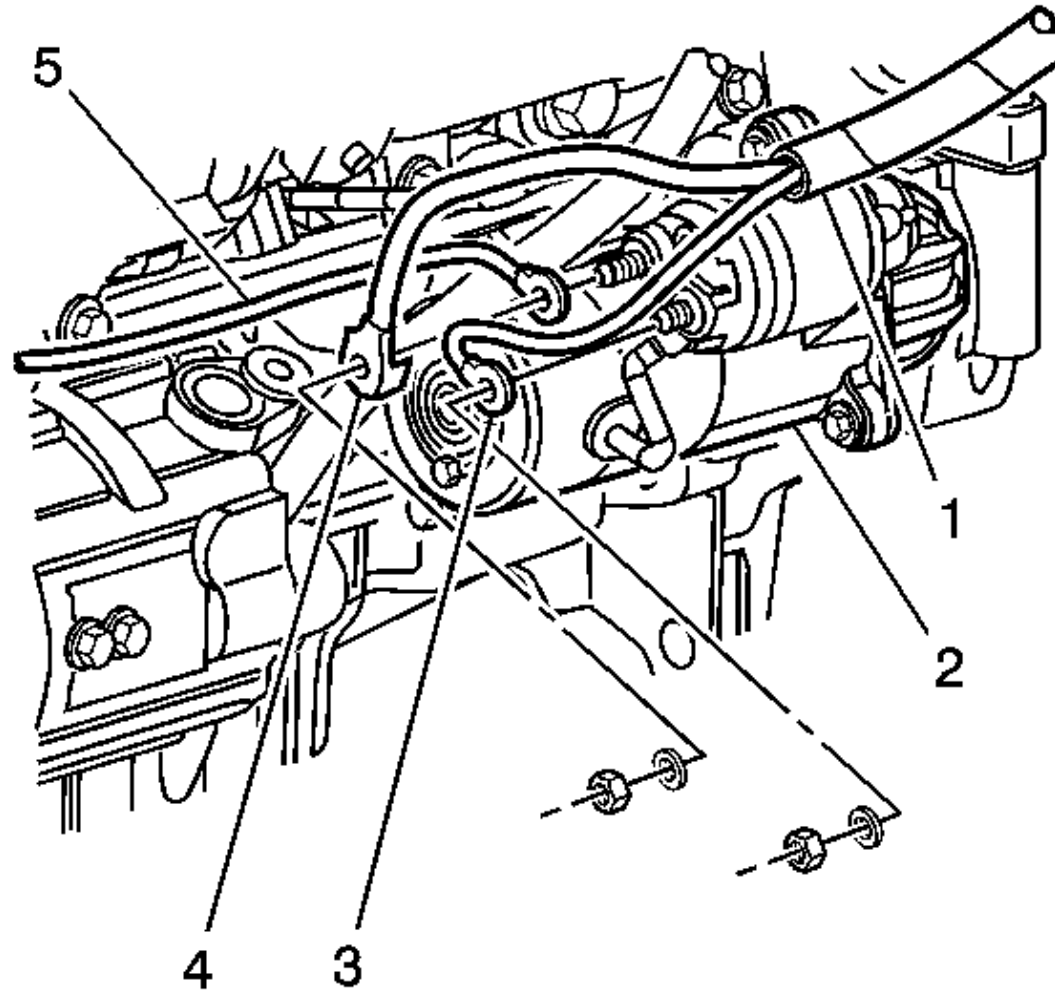


Fig. 23: Identifying Starter Electrical Connectors

Courtesy of GENERAL MOTORS CORP.

6. Remove the battery cable from the vehicle.

Installation Procedure

1. Place the battery cable in the vehicle using the original routing.

NOTE: Refer to [Fastener Notice](#) in Cautions and Notices.

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

Tighten: Tighten the starter terminal nut to 17 N.m (13 lb ft).

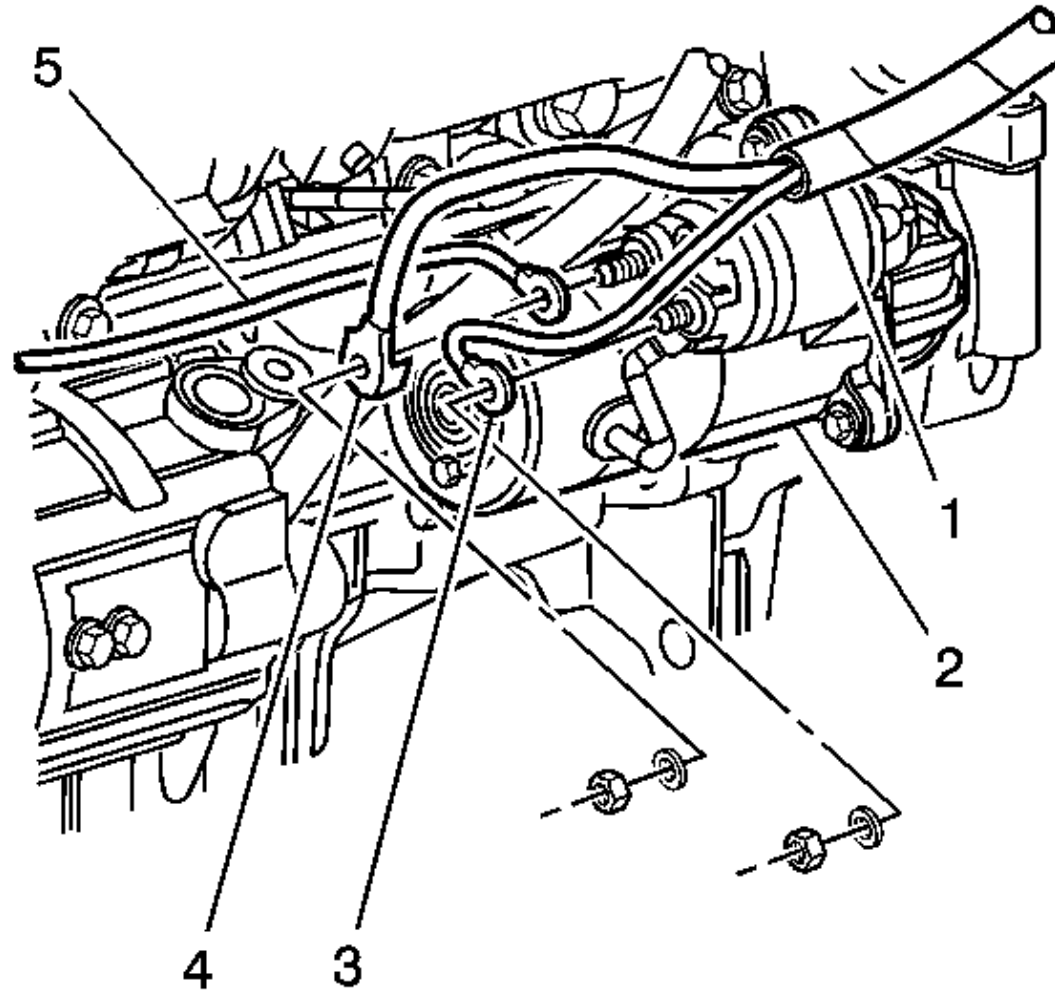


Fig. 24: Identifying Starter Electrical Connectors

Courtesy of GENERAL MOTORS CORP.

3. Tape the positive battery cable to the negative battery cable near the transmission.
4. Lower the vehicle.
5. Connect the positive battery cable (1) to the under hood junction block positive bolt (2).

Tighten: Tighten the bolt (2) to 17 N.m (13 lb ft).

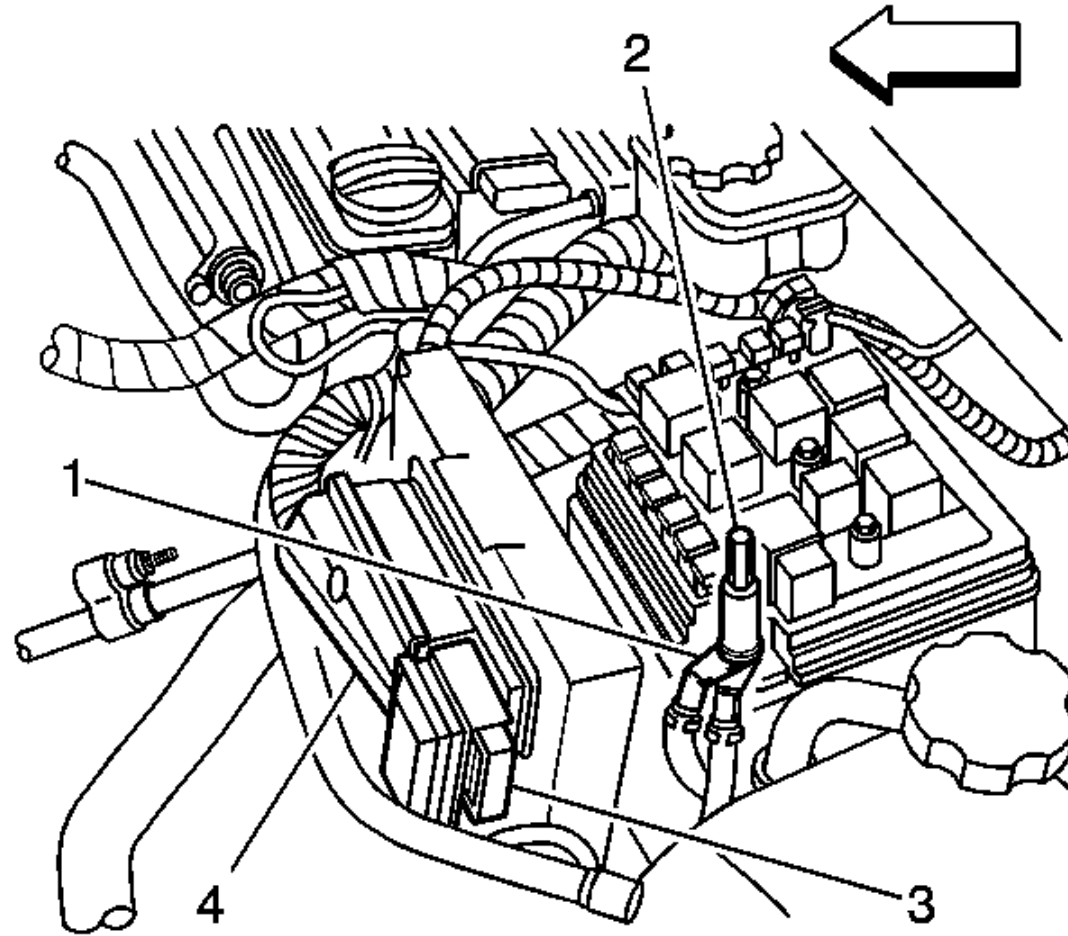


Fig. 25: View Of Engine Electrical Center
Courtesy of GENERAL MOTORS CORP.

6. Connect the negative battery cable to the battery. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).

BATTERY POSITIVE CABLE REPLACEMENT (BATTERY TO UNDER HOOD JUNCTION BLOCK)

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 (1) from the battery.

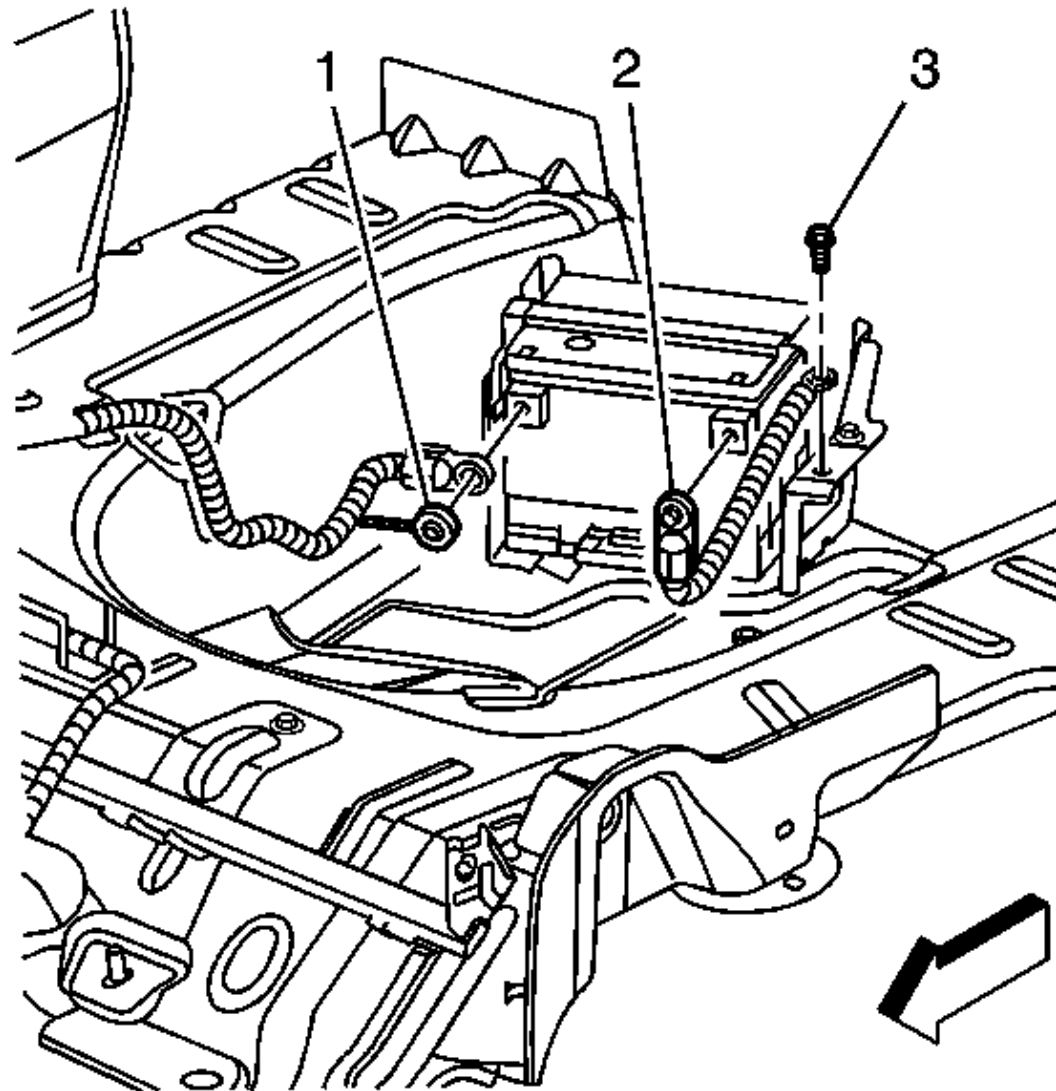


Fig. 26: View Of Battery & Battery Cables
Courtesy of GENERAL MOTORS CORP.

3. Remove the under hood junction block. Refer to [Underhood Electrical Center or Junction Block Bracket Replacement](#) in Wiring Systems.
4. Unseat the cable retainer from the under hood area near the LT shock tower.
5. Remove the rear seat cushion. Refer to [Seat Cushion Replacement - Rear \(Coupe\)](#) or [Seat Cushion Replacement - Rear \(Sedan\)](#) in Seats.
6. Remove the drivers seat assembly. Refer to [Seat Replacement - Front Bucket](#) in Seats.
7. Pull back the carpet and sound insulation padding in order to expose the battery positive cable. Refer to [Carpet Replacement](#) in Interior Trim.
8. Release the cable hold down clips in the interior and trunk area to the vehicle.

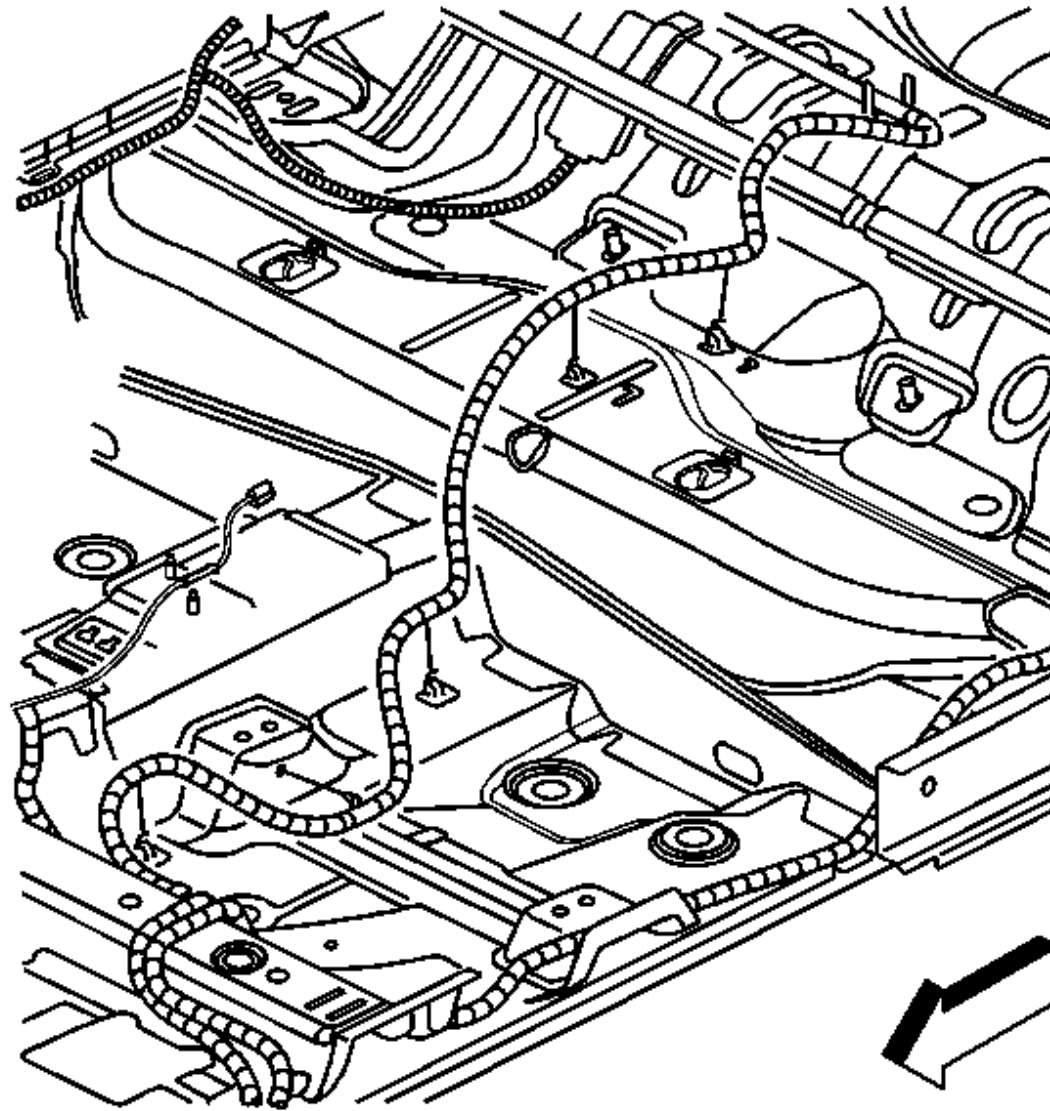


Fig. 27: Locating Cable Hold Down Clips
Courtesy of GENERAL MOTORS CORP.

9. Pull the interior to engine compartment grommet from the interior in order to release the cable.
10. Remove the positive cable from the vehicle.

Installation Procedure

1. Route the battery cable through the engine compartment pass through and up to the underhood junction block.
2. Seat the grommet from the vehicle interior area.
3. Route the battery positive cable along the floor pan of the interior and trunk area.
4. Secure the positive battery cable to the interior area and trunk compartment clips.

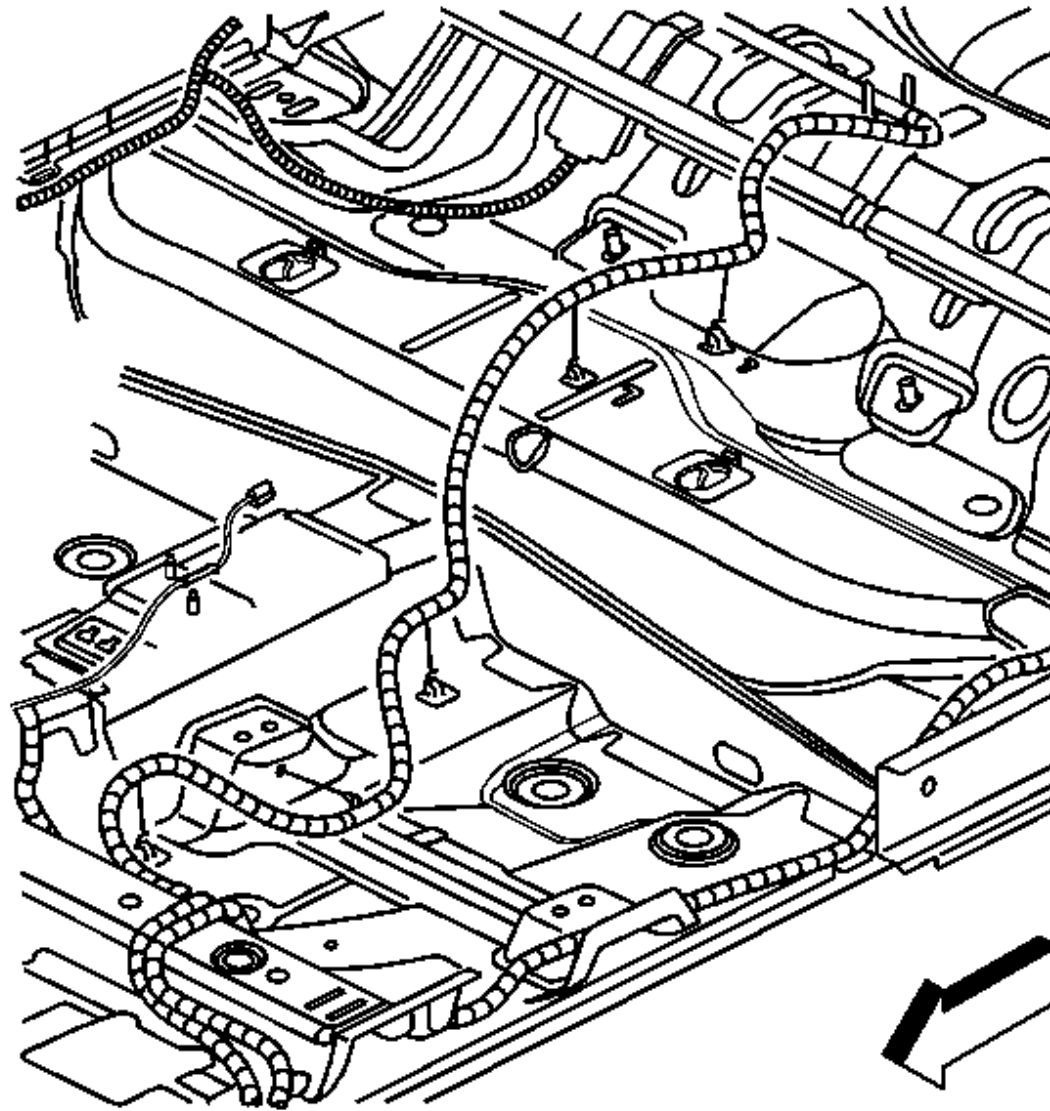


Fig. 28: Locating Cable Hold Down Clips
Courtesy of GENERAL MOTORS CORP.

5. Position the sound insulation and carpet to the interior. Refer to [Carpet Replacement](#) in Interior Trim.
6. Install the drivers seat assembly. Refer to [Seat Replacement - Front Bucket](#) in Seats.
7. Install the rear seat cushion. Refer to [Seat Cushion Replacement - Rear \(Coupe\)](#) or [Seat Cushion Replacement - Rear \(Sedan\)](#) in Seats.
8. Secure the cable retainer to the under hood area near the LT shock tower.
9. Install the under hood junction block. Refer to [Underhood Electrical Center or Junction Block Bracket Replacement](#) in Wiring Systems.

NOTE: Refer to [Fastener Notice](#) in Cautions and Notices.

10. Connect the positive battery cable to the battery.

Tighten: Tighten the positive battery terminal bolt (1) to 17 N.m (13 lb ft).

11. Connect the negative battery cable (2) to the battery. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).

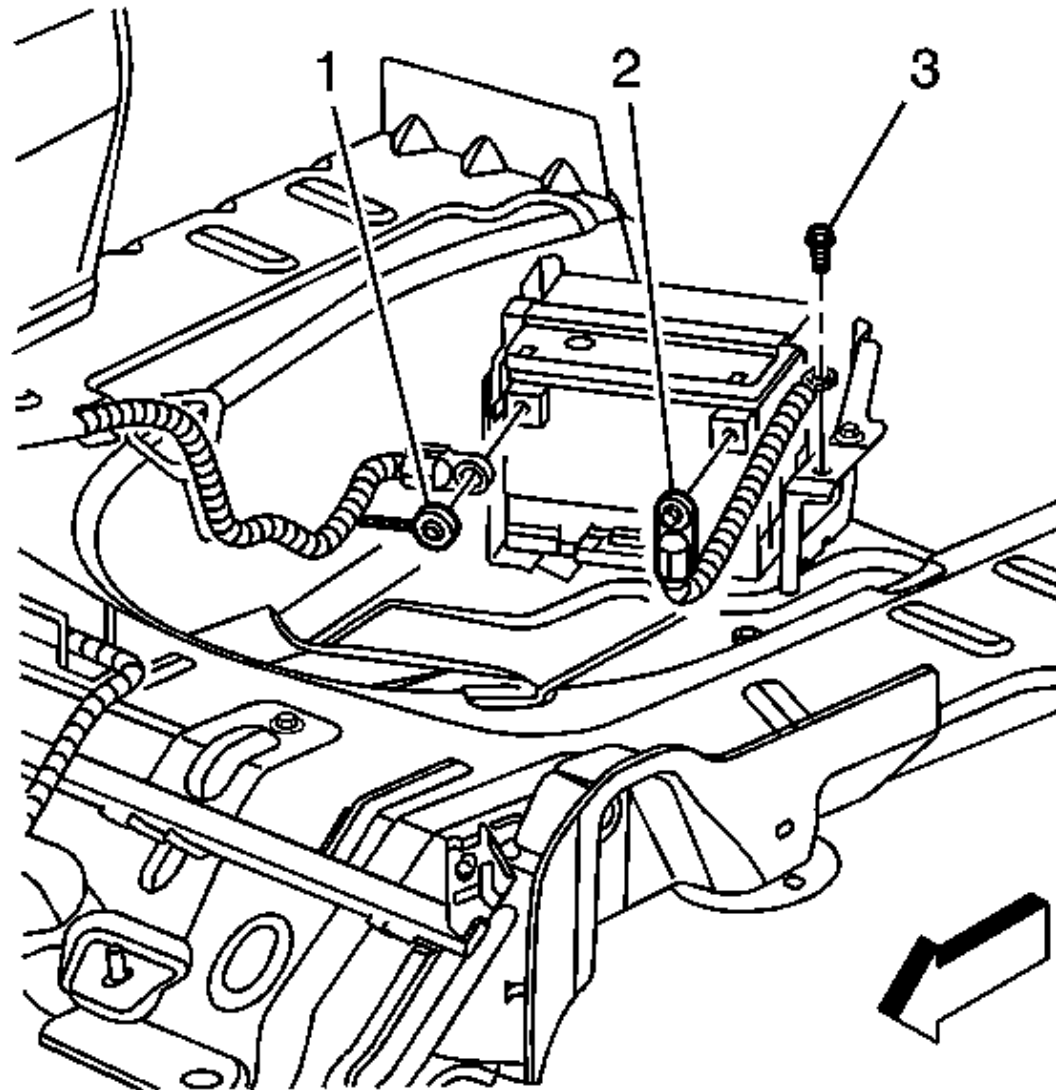


Fig. 29: View Of Battery & Battery Cables
Courtesy of GENERAL MOTORS CORP.

BATTERY REPLACEMENT

Removal Procedure

1. Disconnect the negative battery cable (2). Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).
2. Disconnect the positive battery cable (1).

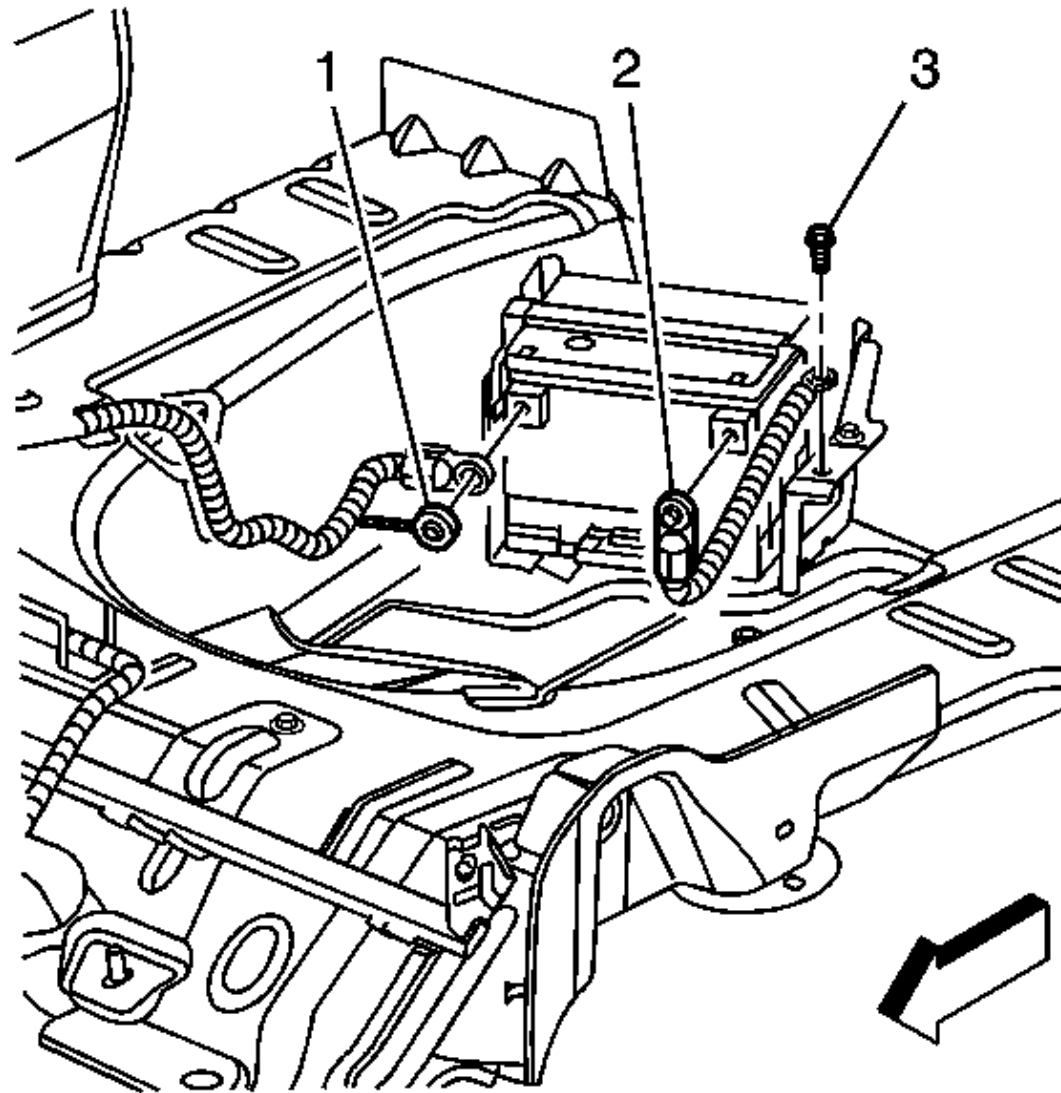


Fig. 30: View Of Battery & Battery Cables
Courtesy of GENERAL MOTORS CORP.

3. Remove the battery hold down retainer bolt and retainer (1).
4. Disconnect the battery vent assembly.
5. Remove the battery brace bolt and brace (2).

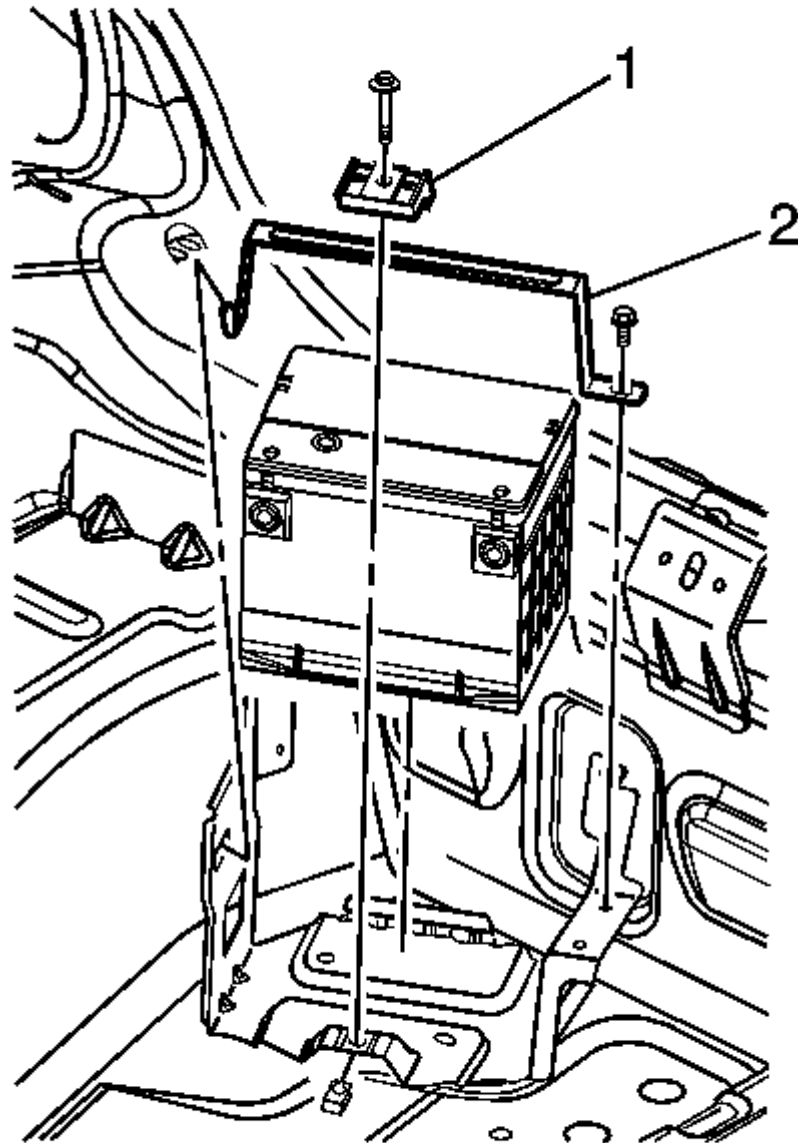


Fig. 31: View Of Battery Hold Down Retainer & Brace
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not tip the battery more than 40 degrees during removal.

6. Remove the battery.

Installation Procedure

IMPORTANT: Do not tip the battery more than 40 degrees during battery installation.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the battery to the battery tray.
2. Install the battery brace (2) and the brace bolt.

Tighten: Tighten the battery brace bolt to 25 N.m (18 lb ft).

3. Install the battery hold down retainer (1) and bolt.

Tighten: Tighten the battery hold down retainer bolt to 18 N.m (13 lb ft).

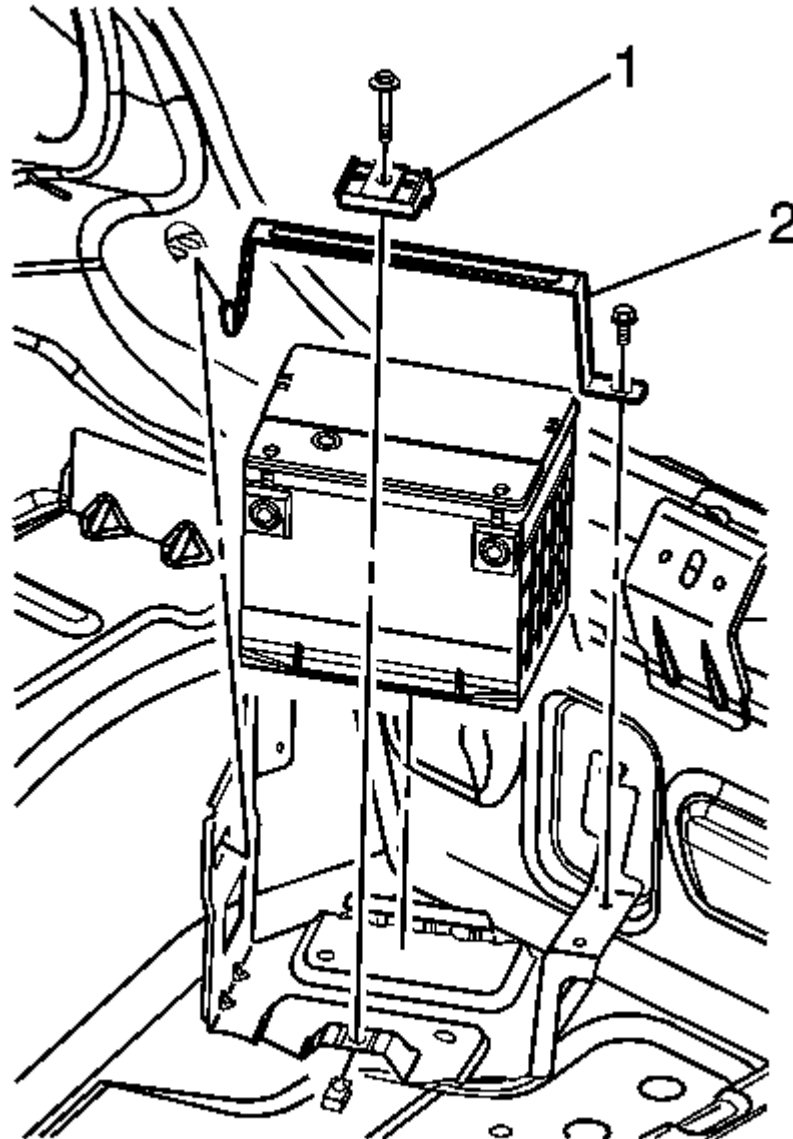


Fig. 32: View Of Battery Hold Down Retainer & Brace

Courtesy of GENERAL MOTORS CORP.

4. Connect the battery vent assembly.
5. Connect the positive battery cable bolt (1).

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

6. Connect the negative battery cable bolt (2). Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).

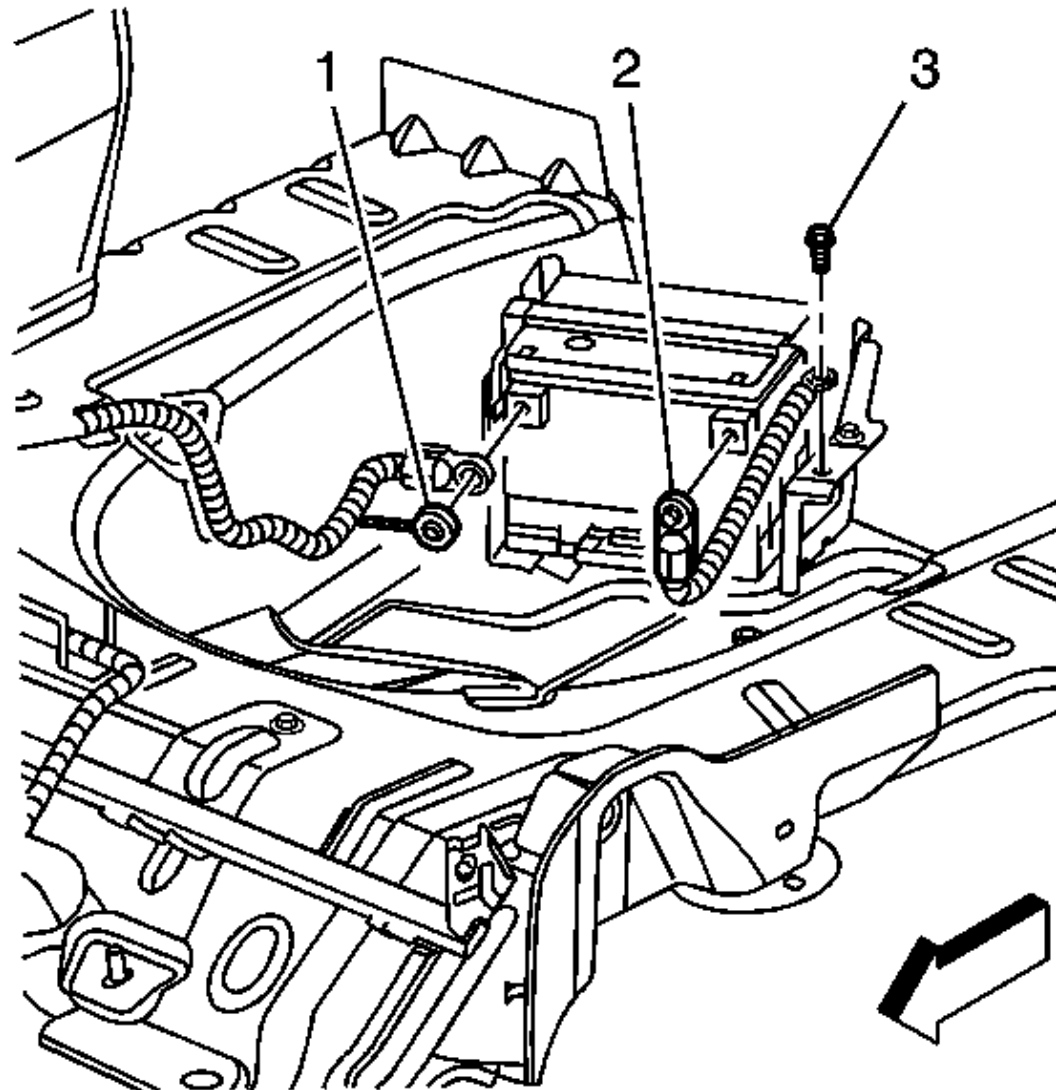


Fig. 33: View Of Battery & Battery Cables
Courtesy of GENERAL MOTORS CORP.

Removal Procedure

1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) in General Information.
3. Disconnect the electrical connectors (3,4,5) from the starter.

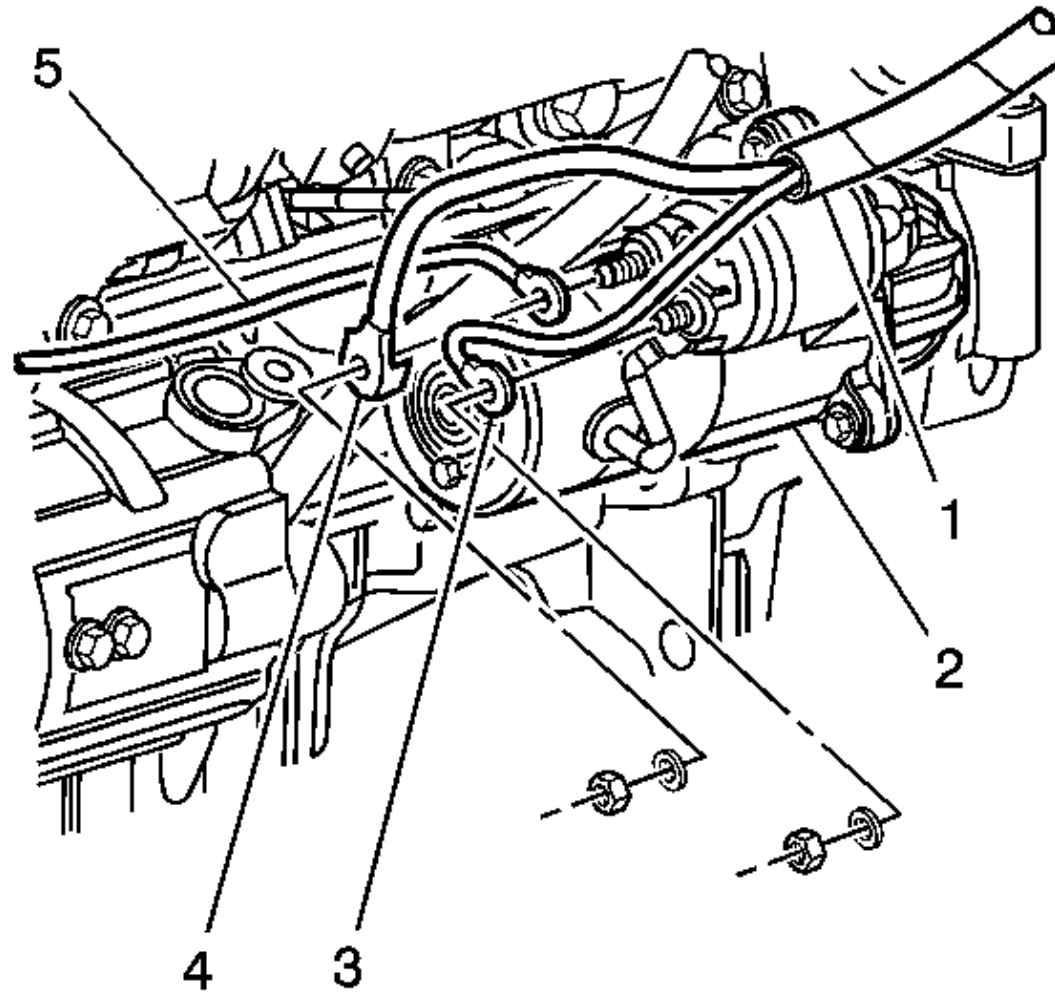


Fig. 34: Identifying Starter Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

4. Remove the starter bolts.
5. Remove the starter.

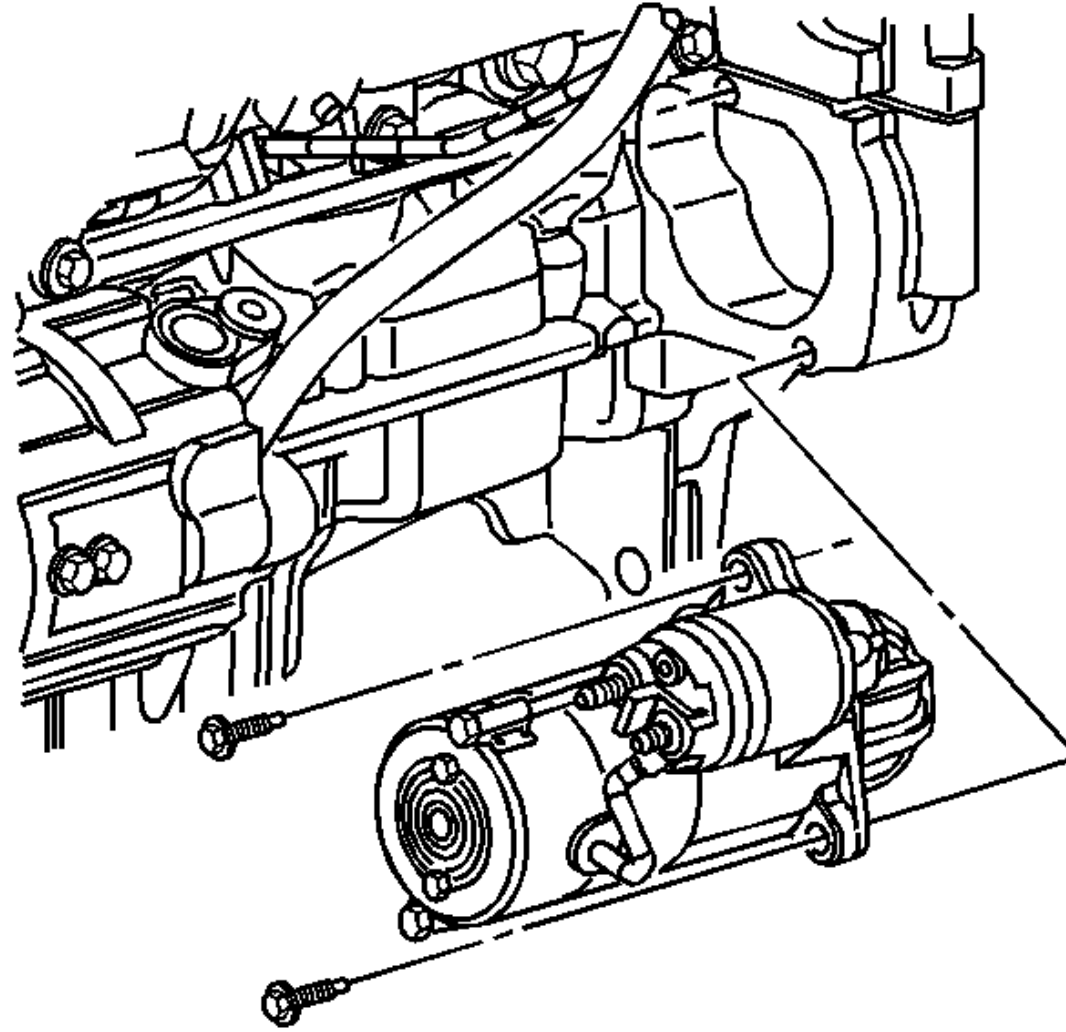


Fig. 35: View Of Starter

Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the starter.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the starter bolts.

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

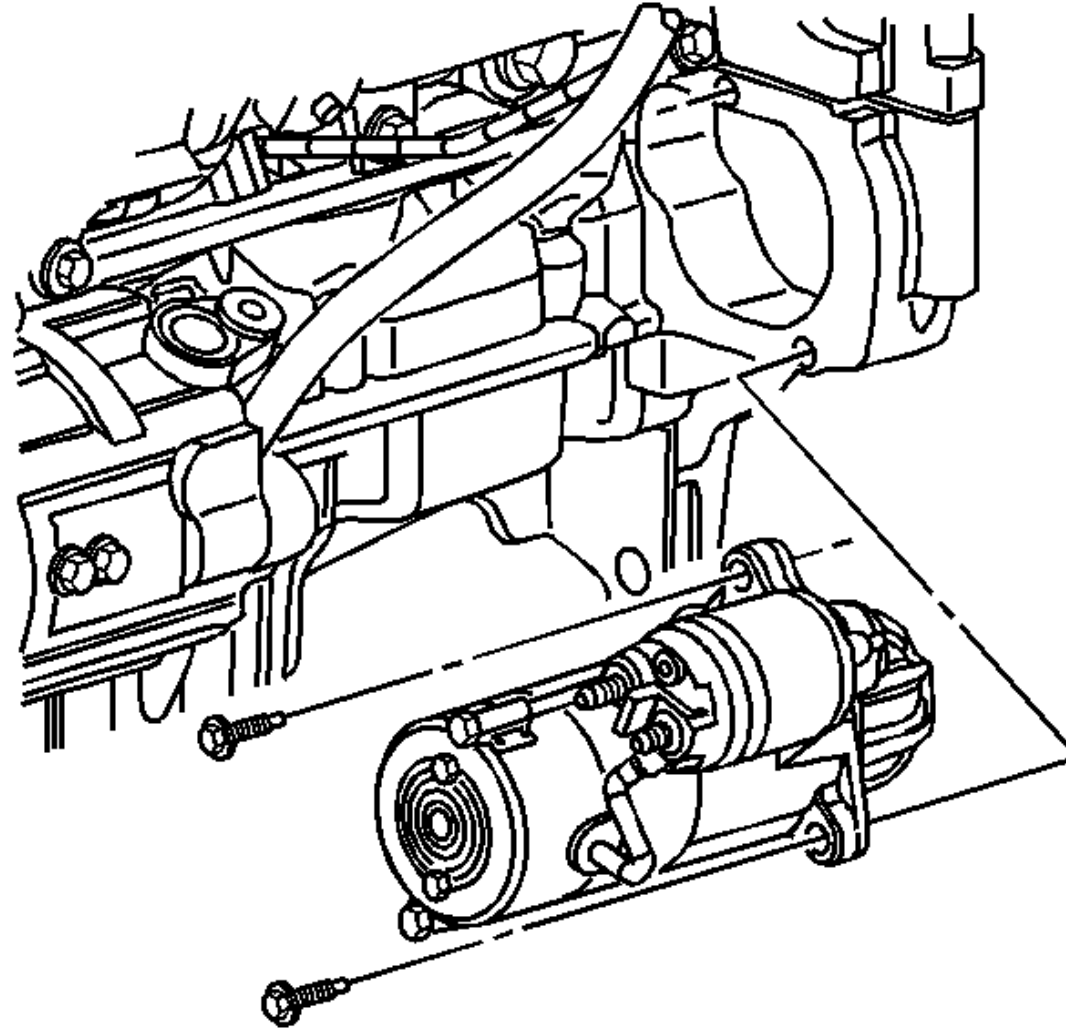


Fig. 36: View Of Starter

Courtesy of GENERAL MOTORS CORP.

3. Connect the electrical connectors (4,5) to the starter.

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

4. Connect the S terminal connector (3) to the starter.

Tighten: Tighten the battery terminal nut to 3 N.m (27 lb in).

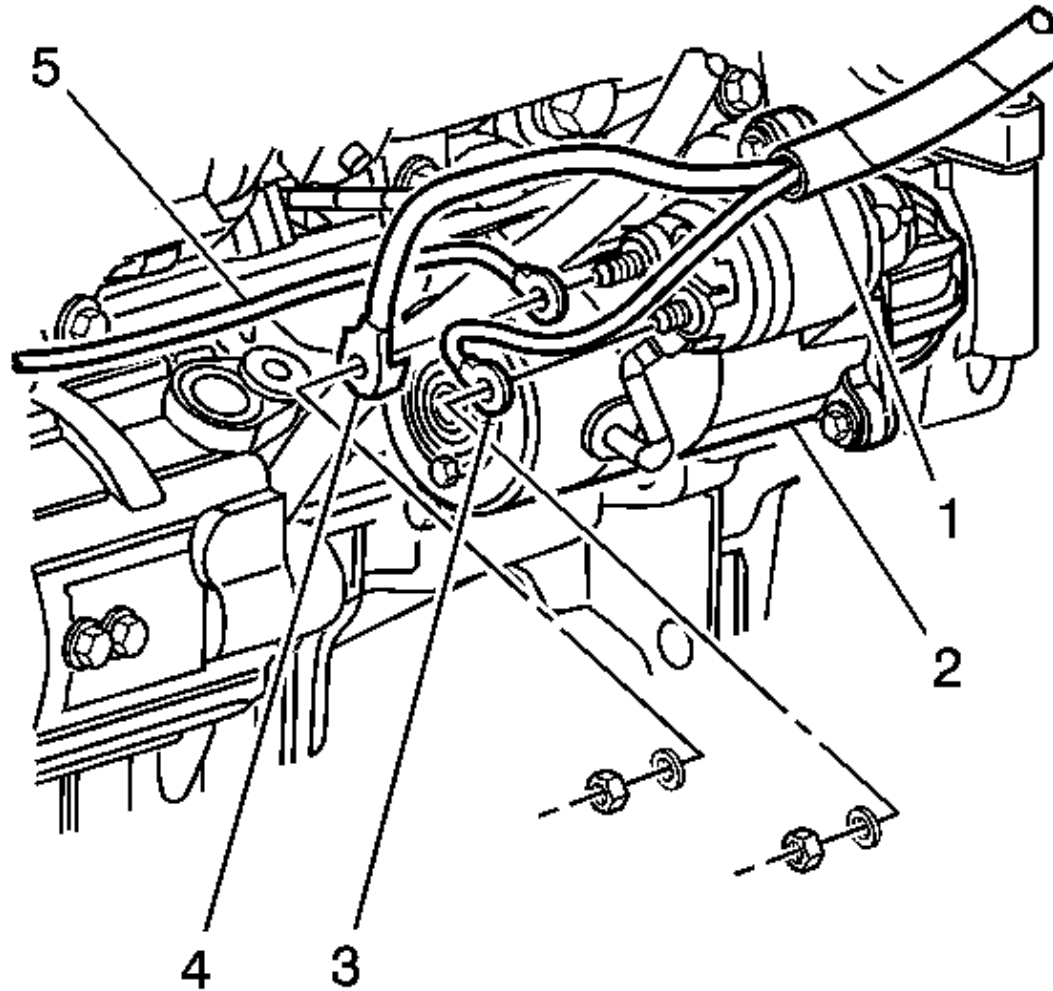


Fig. 37: Identifying Starter Electrical Connectors

Courtesy of GENERAL MOTORS CORP.

5. Lower the vehicle.
6. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).

STARTER MOTOR REPLACEMENT (2.0L (LSJ))

Removal Procedure

1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) in General Information.
3. Remove the intercooler pump outer bracket.
4. Disconnect the electrical connectors (3,4,5) from the starter.

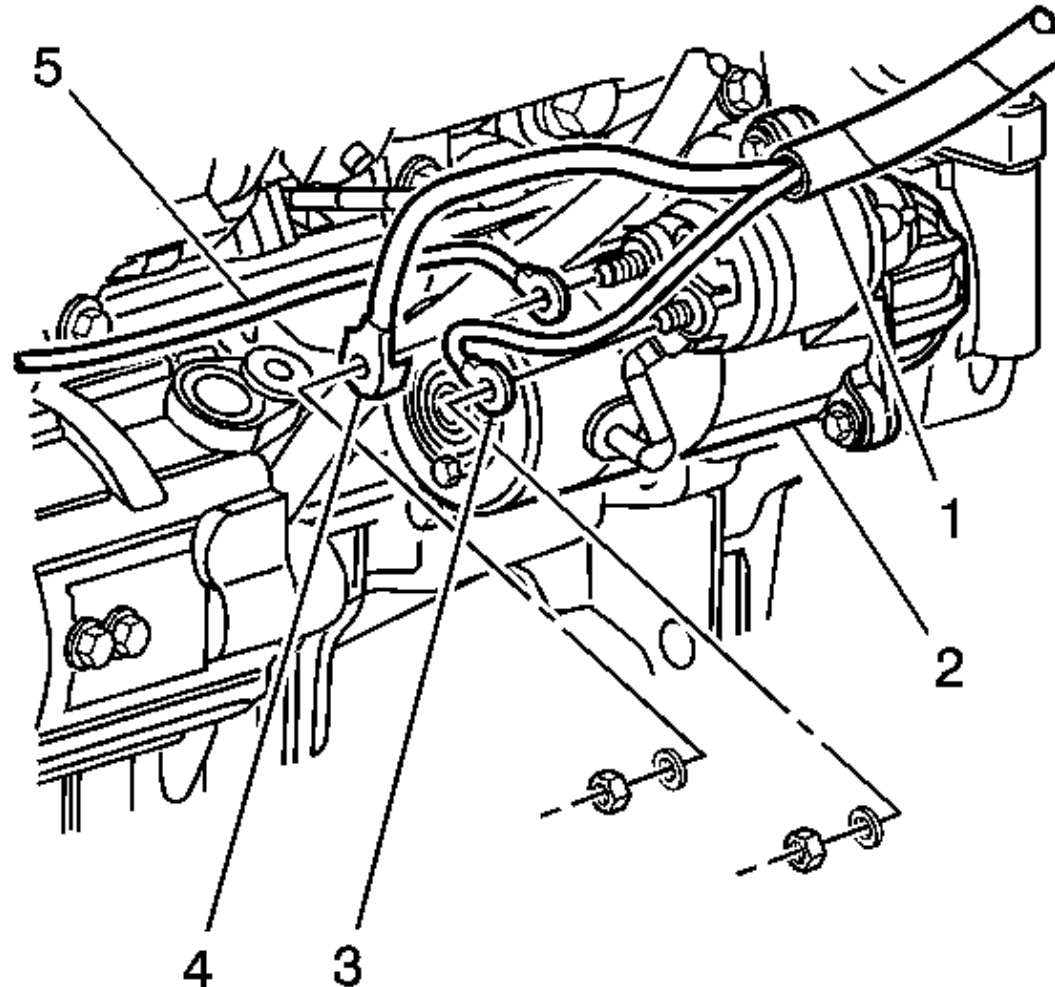


Fig. 38: Identifying Starter Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

5. Remove the starter bolts.
6. Remove the starter.

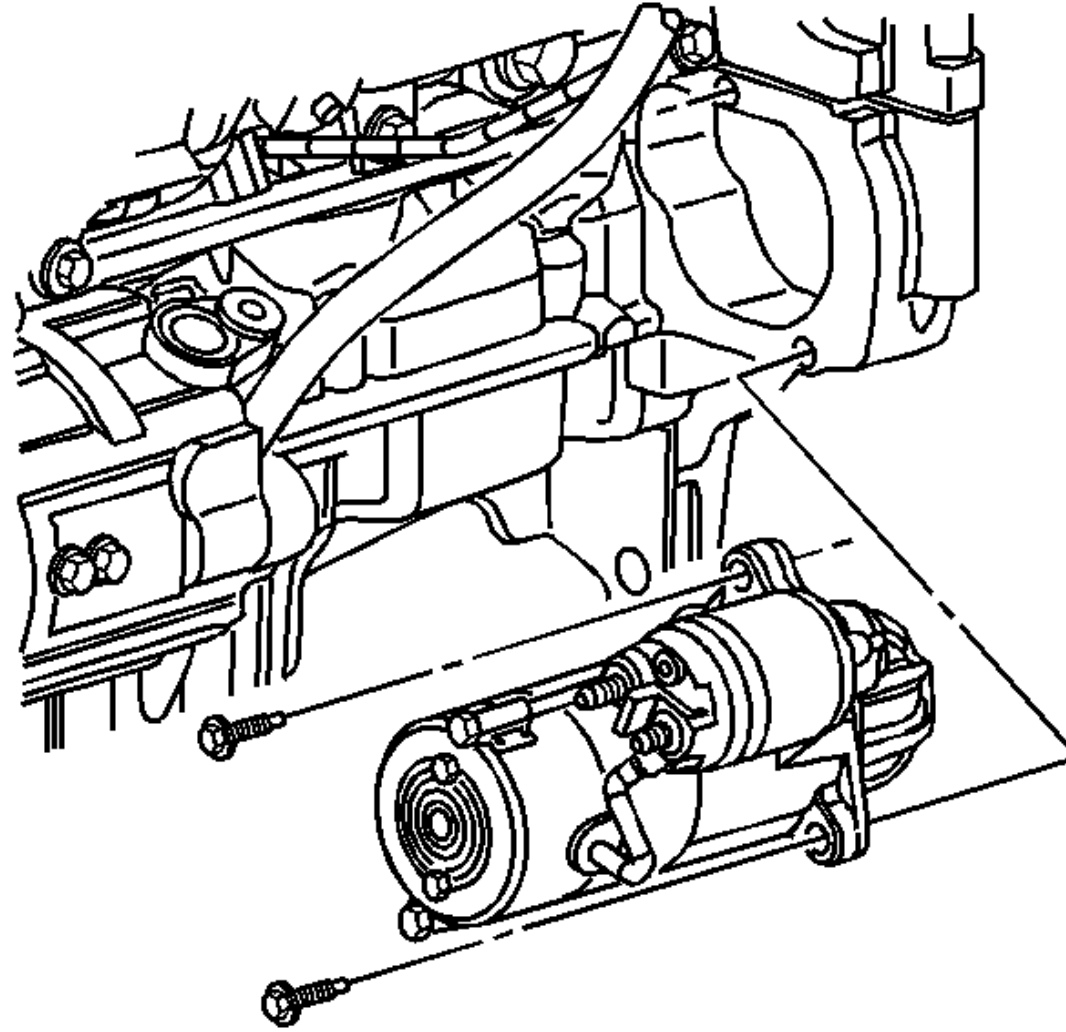


Fig. 39: View Of Starter

Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Install the starter.

NOTE: Refer to [Fastener Notice](#) in Cautions and Notices.

2. Install the starter bolts.

Tighten: Tighten the starter bolts to 50 N.m (37 lb ft).

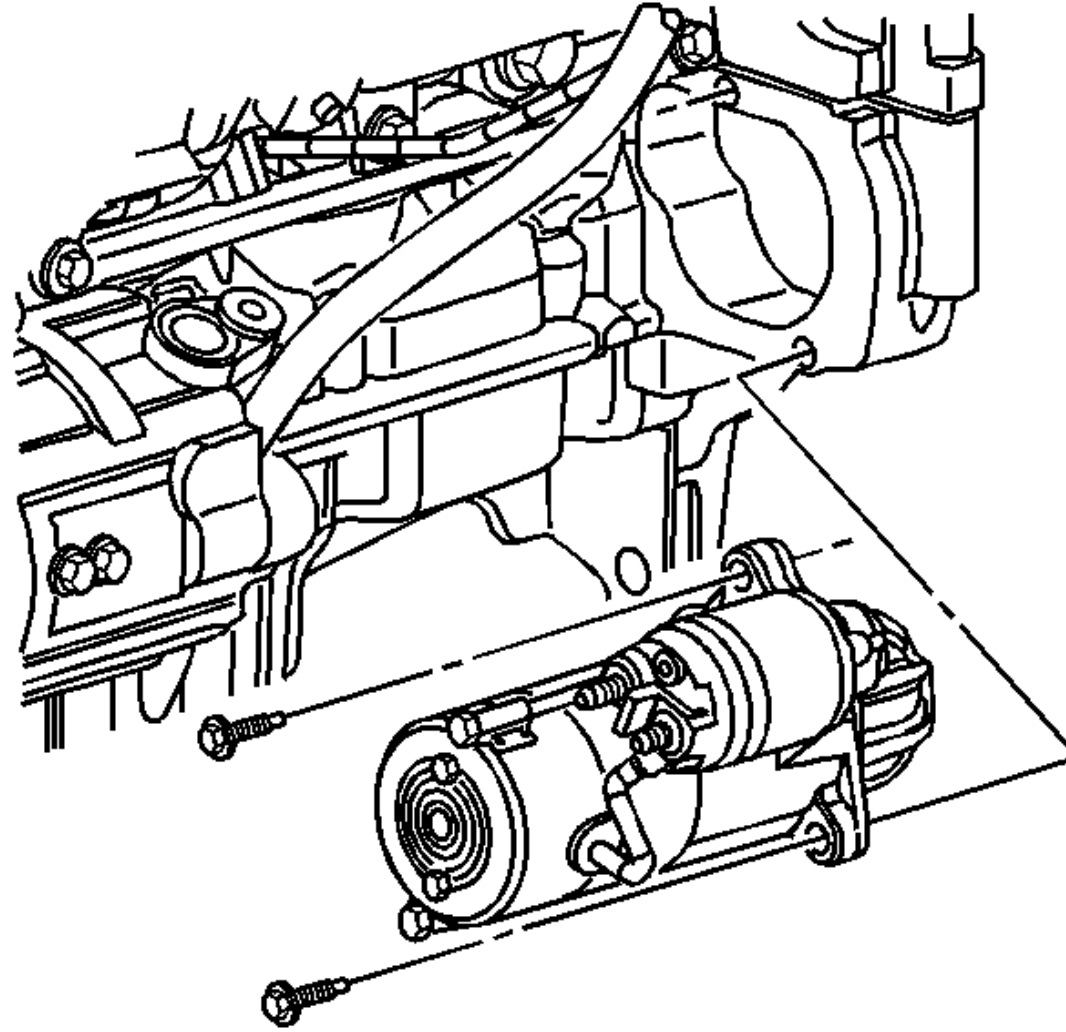


Fig. 40: View Of Starter

Courtesy of GENERAL MOTORS CORP.

3. Connect the electrical connectors (4,5) to the starter.

Tighten: Tighten the battery terminal nut to 11 N.m (97 lb in).

4. Connect the S terminal connector (3) to the starter.

Tighten: Tighten the battery terminal nut to 3 N.m (27 lb in).

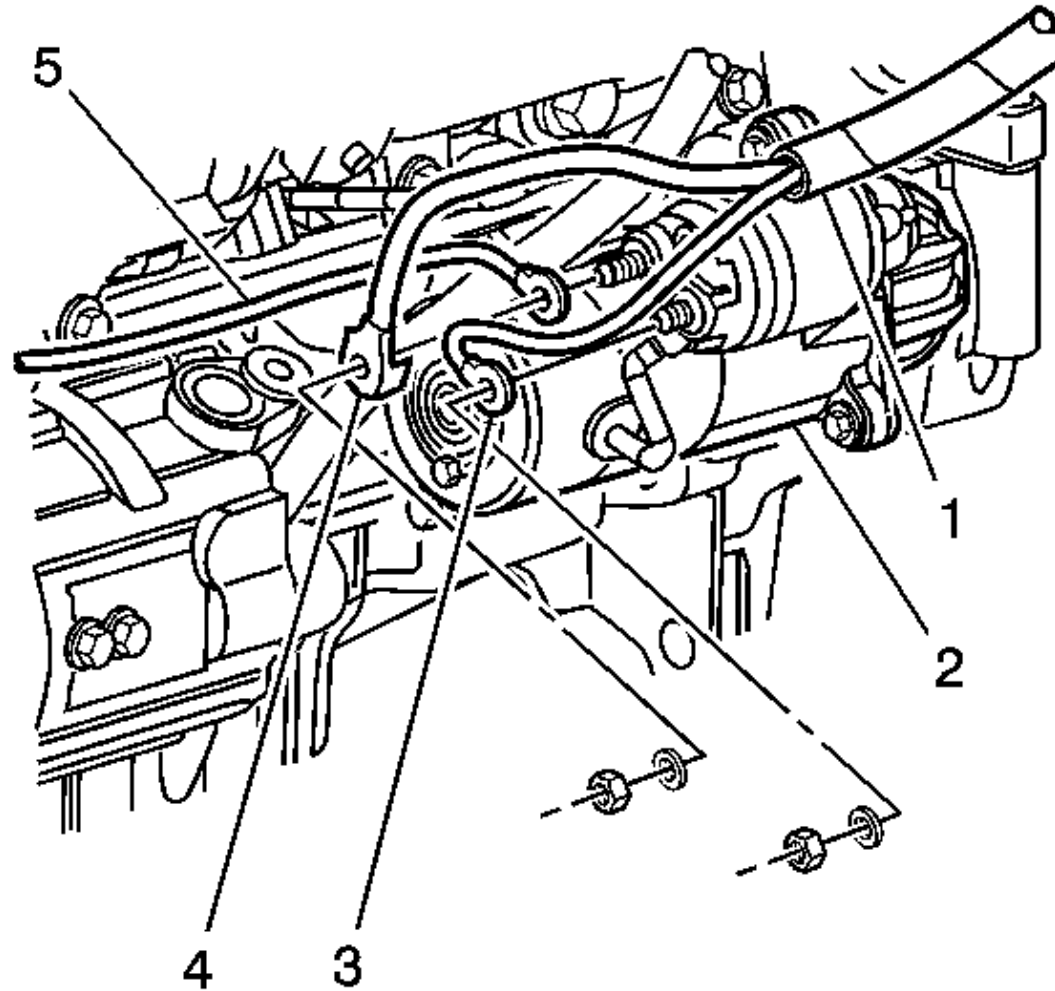


Fig. 41: Identifying Starter Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

5. Install the intercooler pump outer bracket.

Tighten: Tighten the bolts to 20 N.m (15 lb ft).

6. Lower the vehicle.

7. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).

GENERATOR REPLACEMENT (LSJ)

Removal Procedure

1. Disconnect negative battery cable. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).
2. Remove the drive belt. Refer to [Drive Belt Replacement](#) in Engine Mechanical - 2.0L (LSJ).

3. Remove the supercharger. Refer to [Supercharger Replacement](#) in Engine Mechanical - 2.0L (LSJ).
4. Disconnect the generator connectors.
5. Remove the generator bolts.
6. Remove the generator from the vehicle.

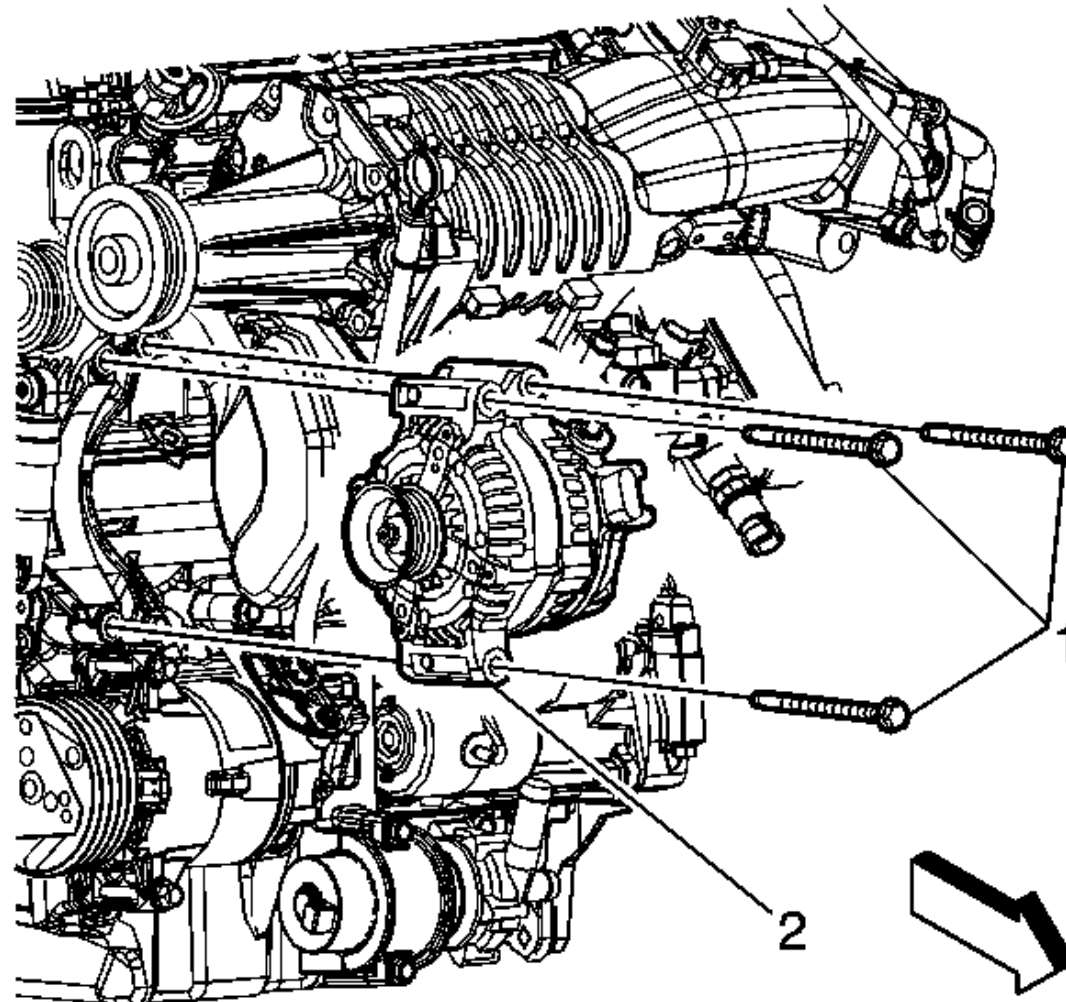


Fig. 42: View Of Generator

Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Position the generator on the engine.

NOTE: Refer to [Fastener Notice](#) in Cautions and Notices.

2. Install the generator bolts.

Tighten: Tighten the generator bolts to 25 N.m (18 lb ft).

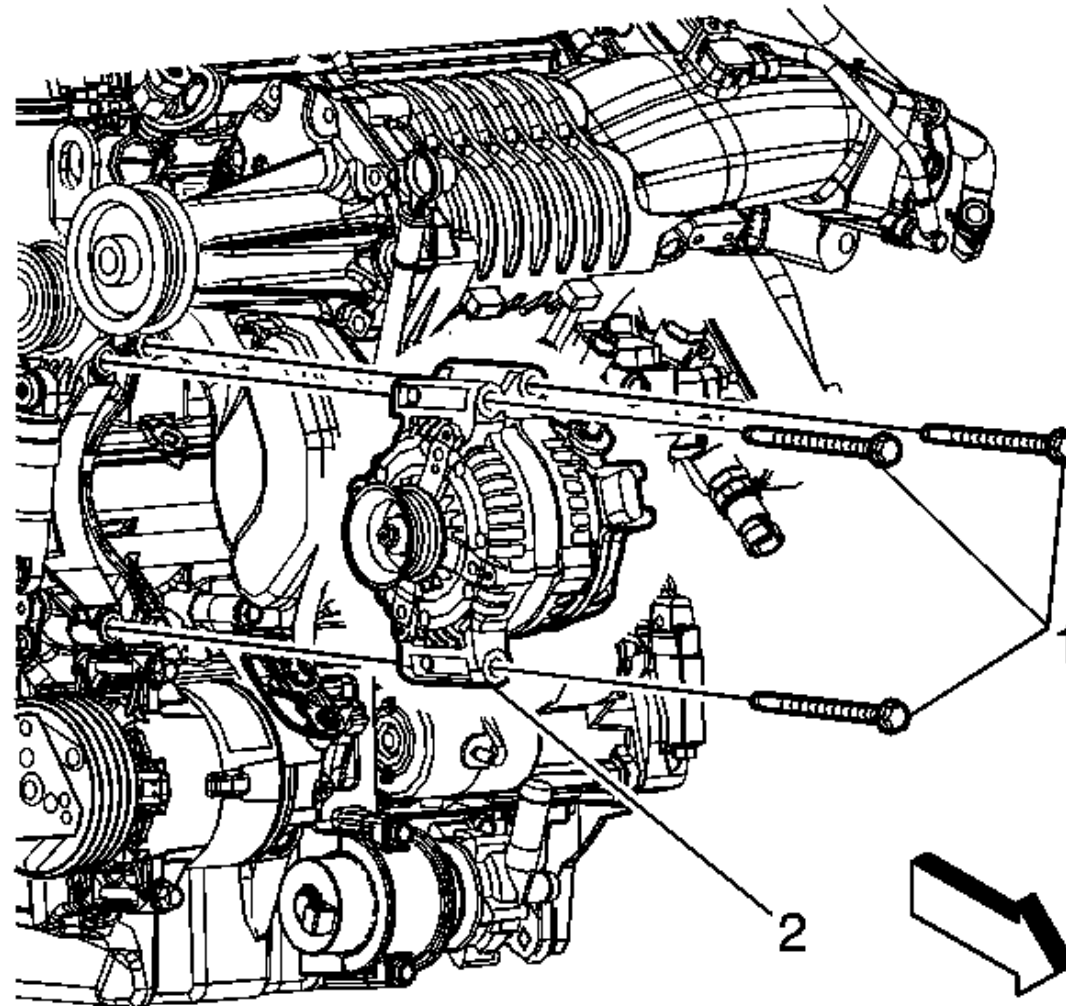


Fig. 43: View Of Generator

Courtesy of GENERAL MOTORS CORP.

3. Connect the positive battery harness to the generator battery terminal.

Tighten: Tighten the generator terminal nut to 20 N.m (15 lb ft).

4. Connect the generator harness connectors.
5. Install the supercharger. Refer to [Supercharger Replacement](#) in Engine Mechanical - 2.0L (LSJ).
6. Install the drive belt. Refer to [Drive Belt Replacement](#) in Engine Mechanical - 2.0L (LSJ).
7. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).

GENERATOR REPLACEMENT (L61)

Removal Procedure

1. Disconnect negative battery cable. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).
2. Remove the drive belt. Refer to [Drive Belt Replacement](#) in Engine Mechanical - 2.2L (L61).
3. Remove the air cleaner outlet resonator. Refer to [Air Cleaner Outlet Resonator Replacement](#) in Engine Controls - 2.2L (L61).
4. Disconnect the generator connectors.
5. Remove the generator bolts.
6. Remove the generator from the vehicle.

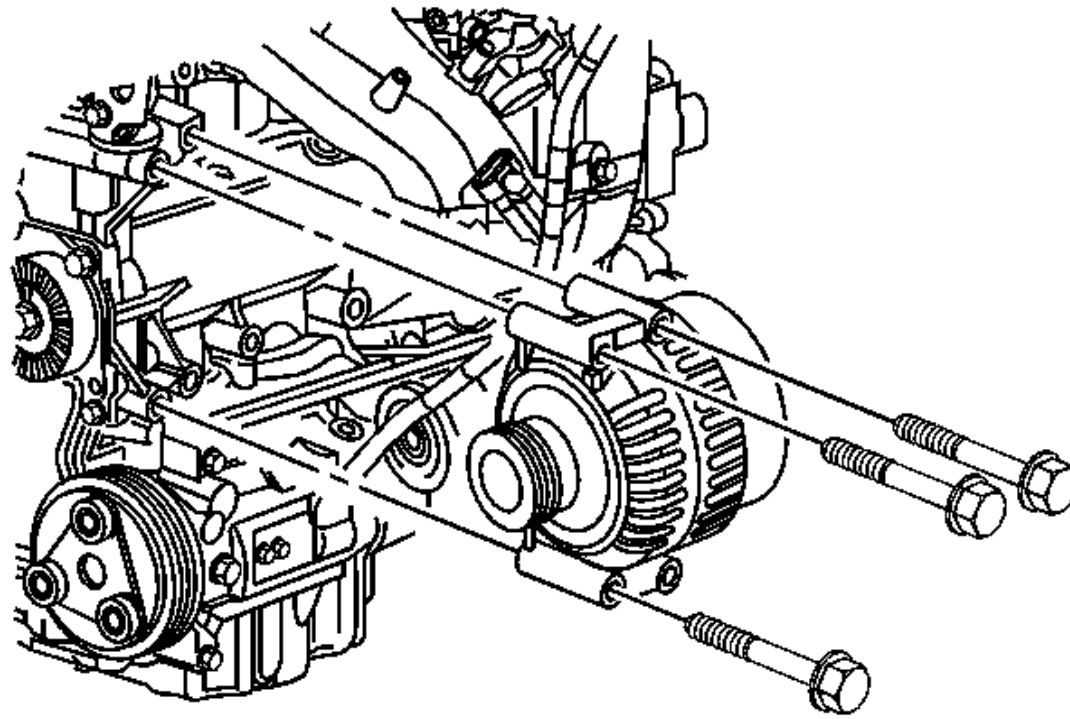


Fig. 44: Identifying Generator Bolts

Courtesy of GENERAL MOTORS CORP.

Installation Procedure

1. Position the generator on the engine.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the generator bolts.

Tighten: Tighten the generator bolts to 22 N.m (16 lb ft).

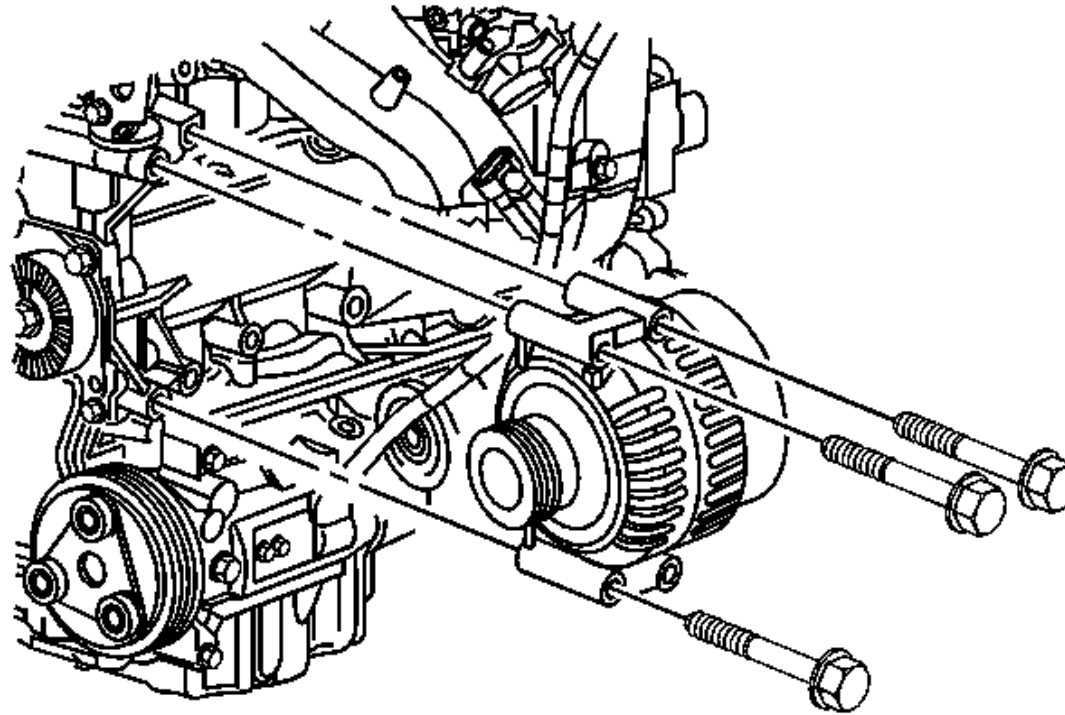


Fig. 45: Identifying Generator Bolts

Courtesy of GENERAL MOTORS CORP.

3. Connect the positive battery harness to the generator battery terminal.

Tighten: Tighten the generator terminal nut to 20 N.m (15 lb ft).

4. Connect the generator harness connectors.
5. Install the air cleaner outlet resonator. Refer to [Air Cleaner Outlet Resonator Replacement](#) in Engine Controls - 2.2L (L61).
6. Install the drive belt. Refer to [Drive Belt Replacement](#) in Engine Mechanical - 2.2L (L61).
7. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnect/Connect Procedure](#).

DESCRIPTION AND OPERATION

BATTERY DESCRIPTION AND OPERATION

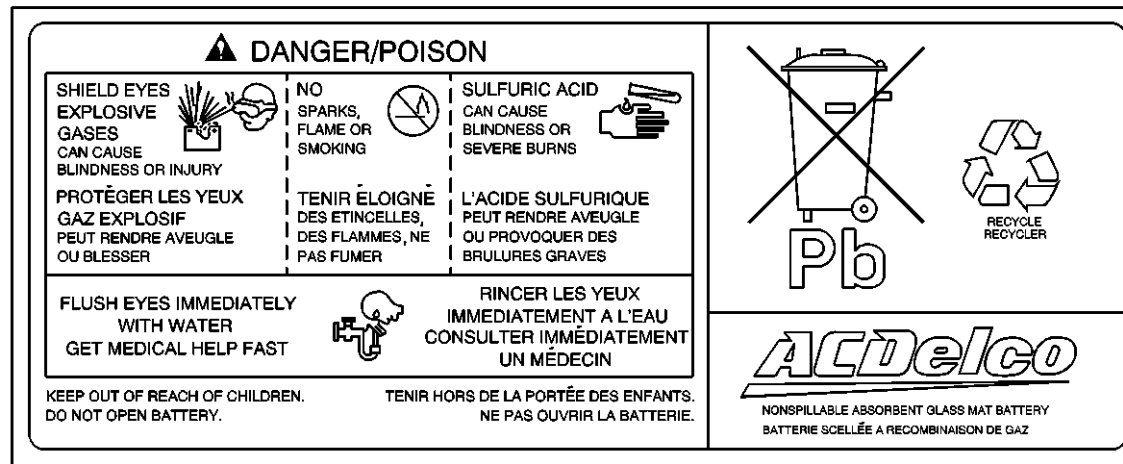


Fig. 46: Battery Warning Label

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.

Because of the materials used in the manufacture of automotive lead-acid batteries, dealers and service shops that handle them are subject to various **IMPORTANT:** 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. 47: View Of 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 engine control module (ECM)/powertrain control module (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 ECM/PCM. When the voltage regulator detects a charging system problem, it grounds this circuit to signal the ECM/PCM that a problem exists. The ECM/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 engine control module (ECM)/powertrain control module (PCM) requesting engine start. The ECM/PCM 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/PCM 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

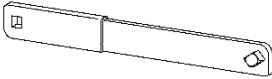
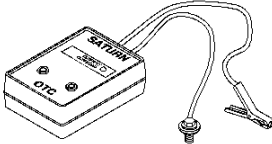
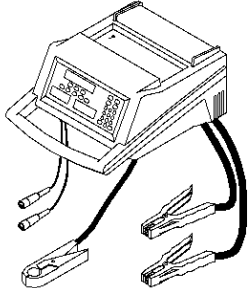
Illustration	Tool Number/Description
	J 44811 Accessory Belt Tensioner Unloader

Illustration	Tool Number/Description
	<p data-bbox="1536 253 1815 322">SA9130Z Parasitic Load Tester</p>
	<p data-bbox="1439 649 1916 719">SA9154Z-A Starting and Charging System Tester</p>