

2006 Chevrolet Impala LS

2006 BRAKES Antilock Brake System - Impala

2006 BRAKES

Antilock Brake System - Impala

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Brake Pipe Fittings at Brake Pressure Modulator Valve (BPMV) and Master Cylinder	24 N.m	18 lb ft
Brake Pressure Modulator Valve (BPMV) and Electronic Brake Control Module (EBCM) Assembly to Mounting Bracket	10 N.m	89 lb in
Electronic Brake Control Module (EBCM) to Brake Pressure Modulator Valve (BPMV)	5 N.m	44 lb in
I/P Cluster Trim Plate Screws	2 N.m	18 lb in
Mounting Bracket Nut/Bolt Assembly to Shock Tower	10 N.m	89 lb in
Mounting Bracket Nut Assembly to Shock Tower	3 N.m	27 lb in

SCHEMATIC AND ROUTING DIAGRAMS

ABS SCHEMATIC ICONS

ABS Schematic Icons

Icon	Icon Definition
	IMPORTANT: Twisted-pair wires provide an effective shield that helps protect sensitive electronic components from electrical interference. If the wires were covered with shielding, install new shielding. In order to prevent electrical interference from degrading the performance of the connected components, you must maintain the proper specification when making any repairs to the twisted-pair wires shown : • The wires must be twisted a minimum of 9 turns per 31 cm (12 in) as measured anywhere along the length of the wires.

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- The outside diameter of the twisted wires must not exceed 6.0 mm (0.25 in).

ABS SCHEMATICS

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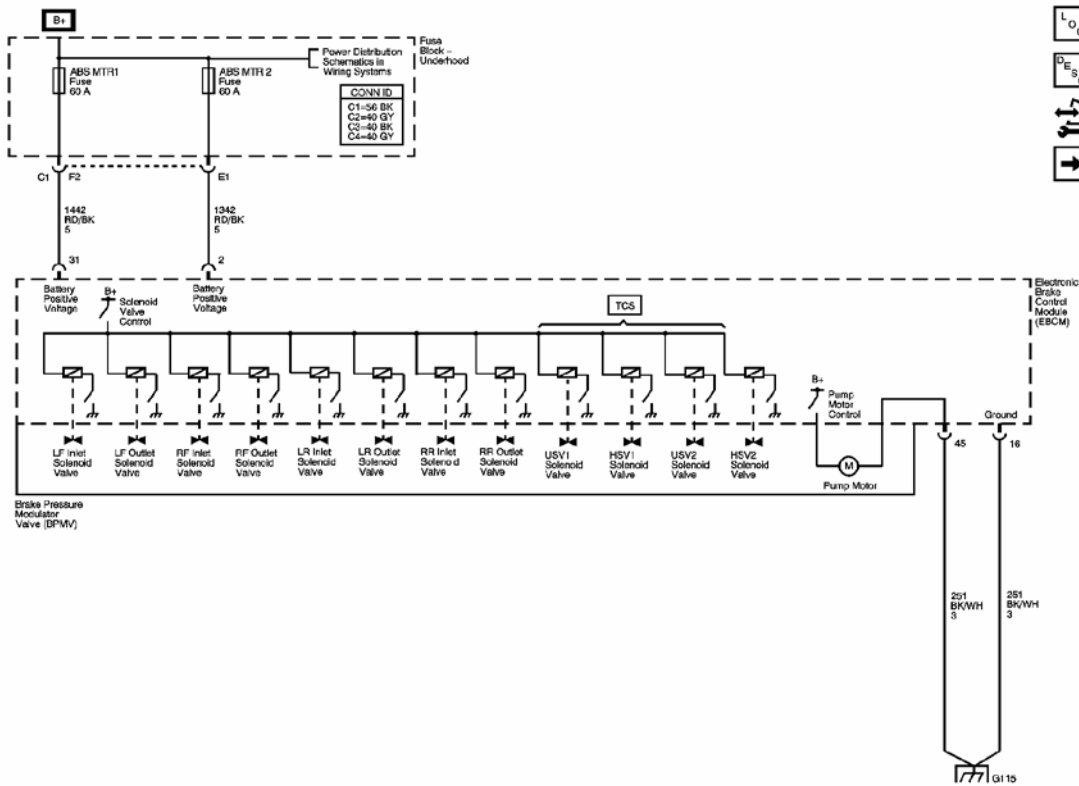


Fig. 1: Power, Ground, and Brake Pressure Modulator Valves - Wiring Diagram
 Courtesy of GENERAL MOTORS CORP.

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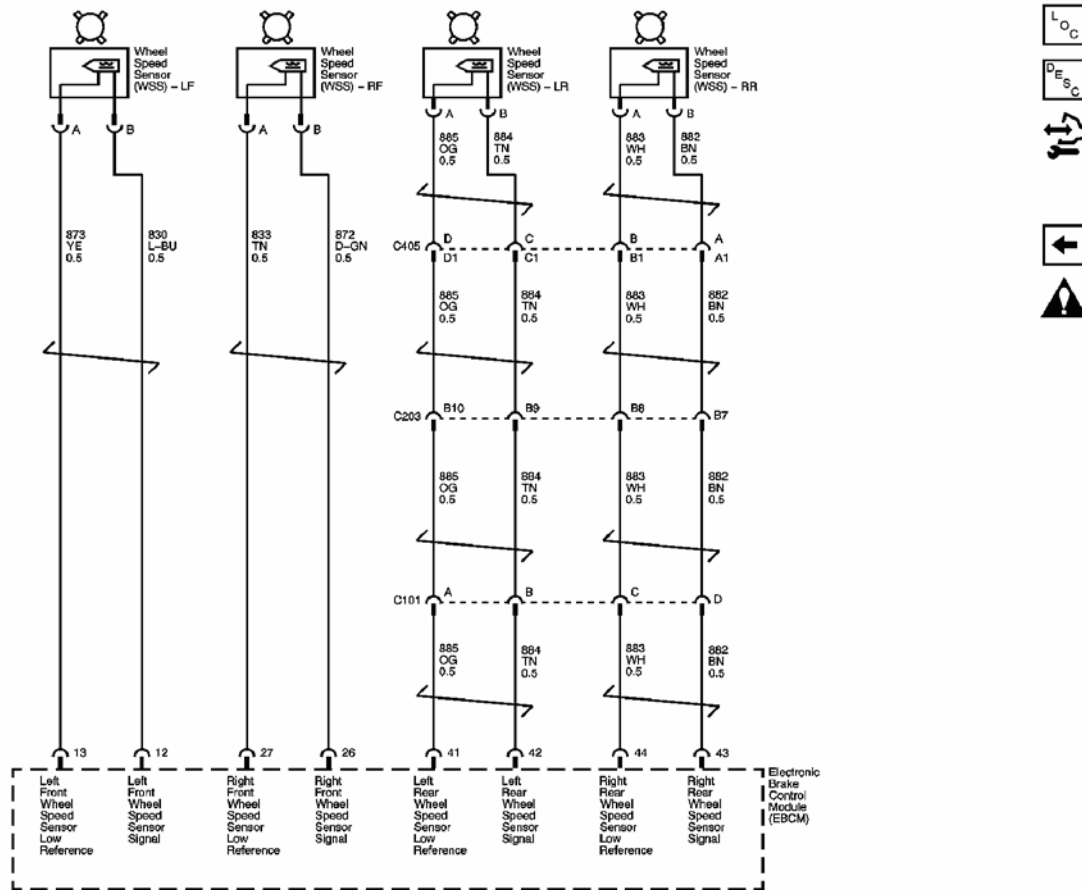


Fig. 3: Wheel Speed Sensors - Wiring Diagram
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

ABS COMPONENT VIEWS

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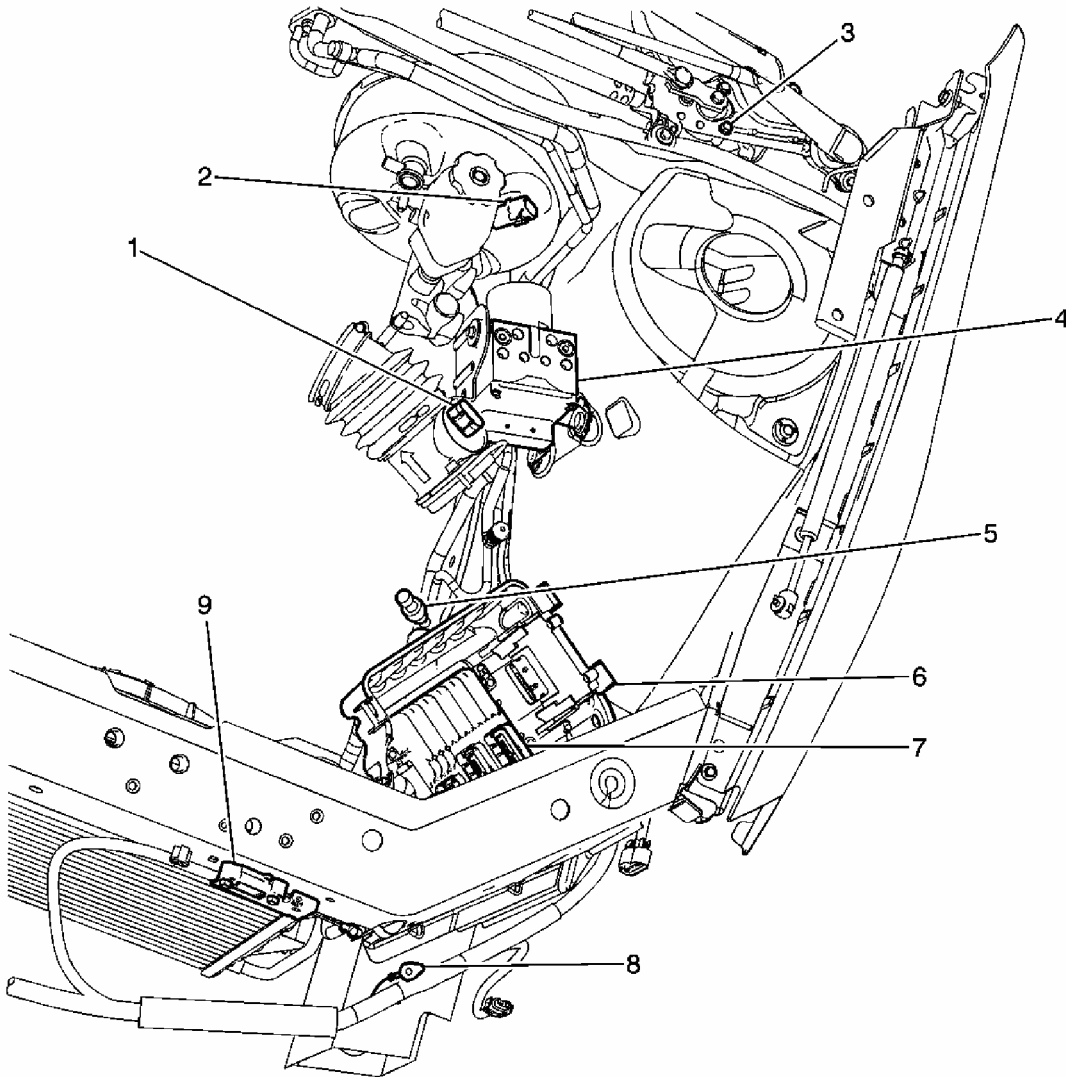


Fig. 4: LF of the Engine Compartment
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 4

Callout	Component Name
1	Mass Air Flow (MAF) / Intake Air Temperature (IAT) Sensor
2	Brake Fluid Level Switch
3	Windshield Wiper Motor
4	Electronic Brake Control Module (EBCM)
5	A/C Refrigerant Pressure Sensor
6	Transmission Control Module (TCM)
7	Engine Control Module (ECM)
8	G101

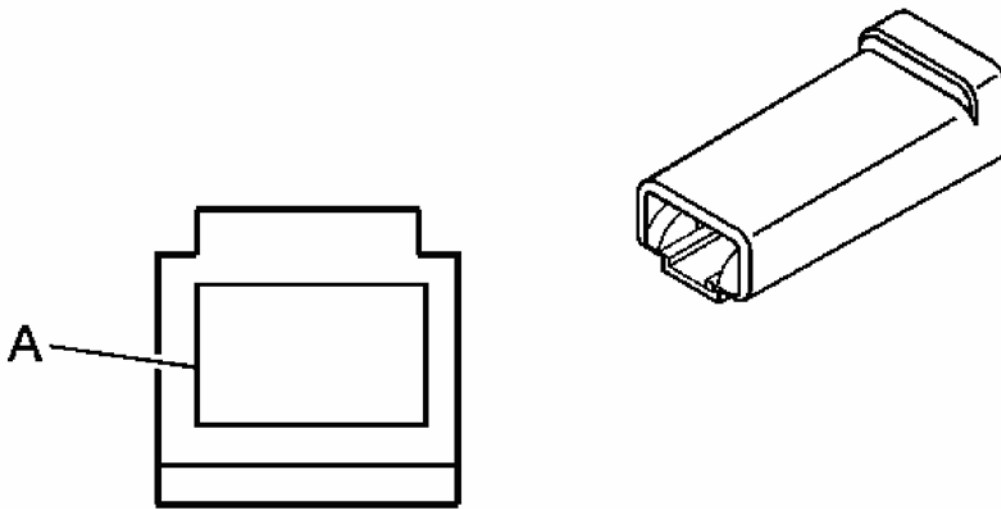
ABS CONNECTOR END VIEWS**Electronic Brake Control Module (EBCM)**

Fig. 5: Electronic Brake Control Module Connector End View
Courtesy of GENERAL MOTORS CORP.

ABS Connector End Views**Connector Part Information**

- OEM: 15492334
- Service: See Catalog
- Description: 46-Way F Receptacle 0.64 6.3 Sealed

Terminal Part Information

- Pins: 2, 31
- Terminal/Tray: 7116-4142-02/10
- Core/Insulation Crimp: D/3
- Release Tool/Test Probe: 12094430/J-35616-42 (RD)
- Pins: 16, 45
- Terminal/Tray: 7116-4141-02/10

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- Core/Insulation Crimp: See Terminal Repair Kit
- Release Tool/Test Probe: 12094430/J-35616-42 (RD)
- Pins: 3, 4, 18, 19, 32, 12, 13, 21, 26, 27, 41, 42, 43, 44
- Terminal/Tray: 638551-1/16
- Core/Insulation Crimp: Pins 3, 4, 18, 19, 32 - J/J
- Core/Insulation Crimp: Pins 12, 13, 21, 26, 27, 41, 42, 43, 44 - K/K
- Release Tool/Test Probe: 15315247/J-35616-64A (L-BU)

Electronic Brake Control Module (EBCM)

Pin	Wire Color	Circuit No.	Function
1	-	-	Not Used
2	RD/BK	1342	Battery Positive Voltage
3	TN/BK	2500	High Speed GMLAN Serial Data Bus+
4	TN/BK	2500	High Speed GMLAN Serial Data Bus+
5-11	-	-	Not Used
12	L-BU	830	Left Front Wheel Speed Sensor Signal
13	YE	873	Left Front Wheel Speed Sensor Low Reference
14-15	-	-	Not Used
16	BK/WH	251	Ground
17	-	-	Not Used
18	TN	2501	High Speed GMLAN Serial Data Bus-
19	TN	2501	High Speed GMLAN Serial Data Bus-
20	-	-	Not Used
21	BN	818	Vehicle Speed Signal
22-25	-	-	Not Used
26	D-GN	872	Right Front Wheel Speed Sensor Signal
27	TN	833	Right Front Wheel Speed Sensor Low Reference
28-30	-	-	Not Used
31	RD/BK	1442	Battery Positive Voltage
32	L-BU	5986	TBD

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33-40	-	-	Not Used
41	OG	885	Left Rear Wheel Speed Sensor Low Reference
42	TN	884	Left Rear Wheel Speed Sensor Signal
43	BN	882	Right Rear Wheel Speed Sensor Signal
44	WH	883	Right Rear Wheel Speed Sensor Low Reference
45	BK/WH	251	Ground
46	-	-	Not Used

Wheel Speed Sensor (WSS) - LF

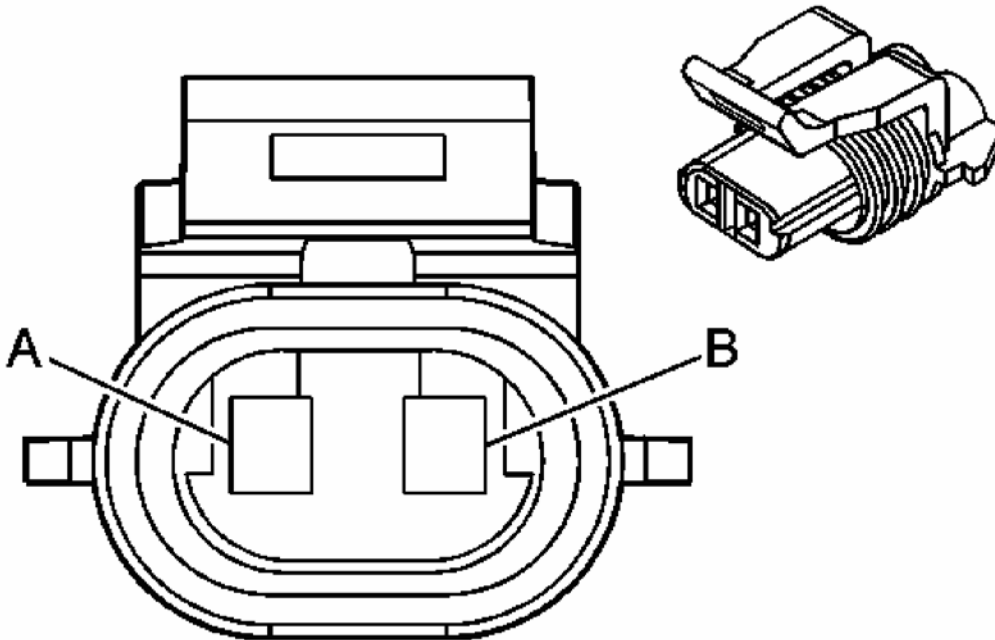


Fig. 6: Connector End Views

Courtesy of GENERAL MOTORS CORP.

ABS Connector End Views

Connector Part Information

- OEM: 12052644

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- Service: See Catalog
- Description: 2-Way F Metri-Pack 150 Sealed (L-GY)

Terminal Part Information

- Terminal/Tray: 12048074/2
- Core/Insulation Crimp: E/1
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Wheel Speed Sensor (WSS) - LF

Pin	Wire Color	Circuit No.	Function
A	YE	873	Left Front Wheel Speed Sensor Low Reference
B	L-BU	830	Left Front Wheel Speed Sensor Signal

Wheel Speed Sensor (WSS) - RF

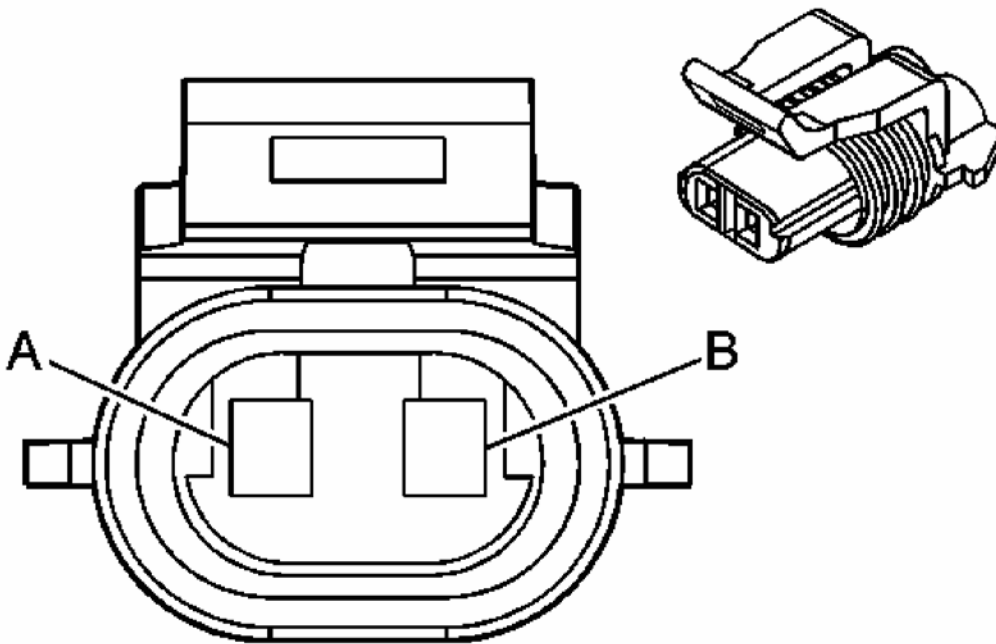


Fig. 7: Connector End Views

Courtesy of GENERAL MOTORS CORP.

ABS Connector End Views

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Connector Part Information

- OEM: 12052644
- Service: See Catalog
- Description: 2-Way F Metri-Pack 150 Sealed (L-GY)

Terminal Part Information

- Terminal/Tray: 12048074/2
- Core/Insulation Crimp: E/1
- Release Tool/Test Probe: 12094429/J-35616-2A (GY)

Wheel Speed Sensor (WSS) - RF

Pin	Wire Color	Circuit No.	Function
A	TN	833	Right Front Wheel Speed Sensor Low Reference
B	D-GN	872	Right Front Wheel Speed Sensor Signal

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC C0035-C0050</u>	MULTIPLE VALUES refer to reference in column to the left
<u>DTCs C0110 04, C0110 61</u>	Pump Motor Circuit Open Circuit, Pump Motor Circuit Actuator Stuck
<u>DTC C0161</u>	TCS Brake Switch Circuit
<u>DTC C0179</u>	System Thermal High
<u>DTC C0201</u>	Antilock Brake System (ABS) Enable Relay Contact Circuit
<u>DTC C0245</u>	As the wheel spins, the wheel speed sensor produces an AC signal. The electronic brake control module (EBCM) uses the frequency of the AC signal to calculate the wheel speed.
<u>DTC C0550</u>	Electronic Control Unit (ECU) Performance
<u>DTC C0899</u>	Device Voltage Low
<u>DTC C0900</u>	Device Voltage High

DIAGNOSTIC STARTING POINT - ANTILOCK BRAKE SYSTEM

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Begin the system diagnosis with **Diagnostic System Check - Vehicle** in Vehicle DTC Information. 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.

SCAN TOOL OUTPUT CONTROLS

Electronic Brake Control Module (EBCM)

Scan Tool Output Control	Additional Menu Selection(s)	Description
ABS Relay	-	Commands the ABS relay ON and OFF.
Automated Bleed	-	Used in order to bleed the ABS hydraulics. Refer to ABS Automated Bleed Procedure .
Automated Test	-	Cycles each solenoid valve and the pump motor in order to verify component operation. This test is identical to the Initialization Sequence. If a malfunction is detected, the EBCM will set the appropriate DTCs. The DTCs will be displayed upon completion of the test.
LF Inlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
LF Outlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
LR Inlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
LR Outlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
RF Inlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
RF Outlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
RR Inlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
RR Outlet Solenoid	Solenoid Test	Commands the solenoid ON and OFF.
TIM Reset	-	Used in order to reset the tire inflation monitor.

SCAN TOOL DATA LIST

Electronic Brake Control Module (EBCM)

Ignition is ON, engine OFF, and vehicle is stationary.			

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Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
ABS Active	ABS Data	Yes/No	No
ABS Failed	ABS Data	Yes/No	No
Battery Voltage Signal	ABS/TCS Data	Volts	Varies
BPP Signal	ABS Data	Released/Applied	Released
Brake Fluid Level Status	ABS Data	OK/Low	OK
Delivered Torque	TCS Data	%	Varies
DRP Active	ABS Data	Yes/No	No
DRP Disabled	ABS Data	Yes/No	No
Engine Drag Control Failed	ABS Data	Yes/No	No
Left Front Wheel Speed	ABS/TCS Data	km/h or mph	0
Left Rear Wheel Speed	ABS/TCS Data	km/h or mph	0
LF Inlet Valve Solenoid	ABS Data	On/Off	Off
LF Outlet Valve Solenoid	ABS Data	On/Off	Off
LR Inlet Valve Solenoid	ABS Data	On/Off	Off
LR Outlet Valve Solenoid	ABS Data	On/Off	Off
Panic Brake Assist Failed	ABS Data	No/Yes	No
Pump Motor Commanded Voltage	ABS/TCS Data	Volts	Varies
Requested Torque	TCS Data	%	Varies
Right Front Wheel Speed	ABS/TCS Data	km/h or mph	0
Right Rear Wheel Speed	ABS/TCS Data	km/h or mph	0
RF Inlet Valve Solenoid	ABS Data	On/Off	Off
RF Outlet Valve Solenoid	ABS Data	On/Off	Off
RR Inlet Valve	ABS Data	Active/Inactive	Off

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Solenoid			
RR Outlet Valve Solenoid	ABS Data	On/Off	Off
TCS Active	TCS Data	Yes/No	No
TCS Failed	TCS Data	Yes/No	No

SCAN TOOL DATA DEFINITIONS

The Antilock Brake System (ABS) scan tool data definitions contain a brief description of all ABS related parameters available on the scan tool. The parameters available on the scan tool are listed below in alphanumeric order.

ABS Active

The scan tool displays if the ABS system is performing antilock braking.

ABS Failed

The scan tool displays the working state of the ABS system.

ABS Pump Motor

The scan tool displays On/Off. The scan tool displays On when the ABS pump motor is commanded on.

Battery Voltage Signal

The scan tool displays the approximate voltage supplied by the battery and charging system.

BPP Signal:

The scan tool displays the applied state of the brake pedal position sensor.

Brake Fluid Level Status

The scan tool displays if the brake fluid is Low or OK.

Delivered Torque

The scan tool displays between 11% and 90%. The powertrain control module (PCM) provides the percentage of engine torque that is currently applied to the wheels. The lower the percentage the less torque applied to the wheels.

DRP Active

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The scan tool displays if the electronic brake control module (EBCM) is performing dynamic rear proportioning.

DRP Disabled

The scan tool displays if the EBCM is no longer able to perform dynamic rear proportioning.

Engine Drag Control Failed:

The scan tool displays if the EBCM is no longer able to perform engine drag control.

Left Front Wheel Speed

The scan tool displays the actual speed of the left front wheel.

Left Rear Wheel Speed

The scan tool displays the actual speed of the left rear wheel.

LF Inlet Valve Command

The scan tool displays the commanded state of the left front inlet valve solenoid.

LF Outlet Valve Command

The scan tool displays the commanded state of the left front outlet valve solenoid.

LR Inlet Valve Command

The scan tool displays the commanded state of the left rear inlet valve solenoid.

LR Outlet Valve Command

The scan tool displays the commanded state of the left front outlet valve solenoid.

Pump Motor Commanded Voltage

The scan tool displays the voltage applied to the ABS pump motor

Requested Torque

The scan tool displays between 11% and 90%. The PCM provides the percentage of engine torque that is currently applied to the wheels. The lower the percentage the less torque applied to the wheels.

Right Front Wheel Speed

The scan tool displays the actual speed of the left front wheel.

Right Rear Wheel Speed

The scan tool displays the actual speed of the left rear wheel.

RF Inlet Valve Command

The scan tool displays the commanded state of the left front inlet valve solenoid.

RF outlet Valve Command

The scan tool displays On/Off. The scan tool displays On when the right front outlet valve solenoid is commanded on.

RR Inlet Valve Command

The scan tool displays the commanded state of the left rear inlet valve solenoid.

RR Outlet Valve Command

The scan tool displays the commanded state of the left front outlet valve solenoid.

TCS Active

The scan tool displays if the EBCM is requesting torque reduction from the PCM.

TCS Failed

The scan tool displays if the EBCM is no longer able to perform traction control.

ENHANCED DIAGNOSTICS**History Data**

Enhanced diagnostic information is found in the History Data function of the scan tool. Enhanced diagnostic information provides the service technician with specific malfunction occurrence information.

The scan tool will display the last 3 DTCs to occur, one at a time. The DTC with the most recent occurrence will be displayed first. Each DTC will include the following:

- The number of drive cycles since the DTC last occurred.
- The number of occurrences for the DTC since the scan tool DTC information was last

cleared.

The most recent DTC will also display various data parameters with values from the time of the DTC occurrence.

Diagnostic Strategy

In difficult diagnostic situations use the above information to identify malfunction occurrence trends. Ask question such as the following:

- Did the malfunction only occur once over a large number of drive cycles, indicating an unusual condition present when it occurred?
- Does the malfunction occur infrequently over a large number of drive cycles, indicating that special diagnostic techniques may be required to identify the source of the malfunction?

A malfunction that occurs more frequently increases the odds of finding the cause of the malfunction.

Use the information in order to determine if a DTC is intermittent. Use the information in order to determine if the DTC has not set for long periods of time due to weather changes or a repair prior to this visit.

DTC C0035-C0050**DTC Descriptor****DTC C0035 00**

Left Front Wheel Speed Sensor Circuit No Additional Information

DTC C0035 0F

Left Front Wheel Speed Sensor Circuit Erratic Signal

DTC C0035 18

Left Front Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

DTC C0040 00

Right Front Wheel Speed Sensor Circuit No Additional Information

DTC C0040 0F

Right Front Wheel Speed Sensor Circuit Erratic Signal

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DTC C0040 18

Right Front Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

DTC C0045 00

Left Rear Wheel Speed Sensor Circuit No Additional Information

DTC C0045 0F

Left Rear Wheel Speed Sensor Circuit Erratic Signal

DTC C0045 18

Left Rear Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

DTC C0050 00

Right Rear Wheel Speed Sensor Circuit No Additional Information

DTC C0050 0F

Right Rear Wheel Speed Sensor Circuit Erratic Signal

DTC C0050 18

Right Rear Wheel Speed Sensor Circuit Signal Amplitude Less Than Minimum

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC C0035-C0050

Circuit	Short to Ground	Open or High Resistance	Short to Voltage	Signal Performance
Left Front Sensor Signal	C0035 00	C0035 00	C0035 00	C0035 0F C0035 18
Left Front Sensor Low Reference	C0035 00	C0035 00	C0035 00	C0035 0F C0035 18
Right Front Sensor Signal	C0040 00	C0040 00	C0040 00	C0040 0F C0040 18
Right Front Sensor Low Reference	C0040 00	C0040 00	C0040 00	C0040 0F C0040 18

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Left Rear Sensor Signal	C0045 00	C0045 00	C0045 00	C0045 0F ¹ C0045 18
Left Rear Sensor Low Reference	C0045 00	C0045 00	C0045 00	C0045 0F ¹ C0045 18
Right Rear Sensor Signal	C0050 00	C0050 00	C0050 00	C0050 0F ¹ C0050 18
Right Rear Sensor Low Reference	C0050 00	C0050 00	C0050 00	C0050 0F ¹ C0050 18
¹ Damaged rear Wheel Speed Sensor Ring can cause code to set.				

Circuit/System Description

As the wheel spins, the wheel speed sensor produces an AC signal. The electronic brake control module (EBCM) uses the frequency of the AC signal to calculate the wheel speed.

Conditions for Running the DTC

C0035 00 - C0050 00

- The ignition is ON.
- Ignition voltage is greater than 8 volts.

C0035 0F - C0050 0F

- The ignition is ON.
- Ignition voltage is greater than 8 volts.
- The brake pedal is not pressed.
- A DTC is not set for the other wheel speed circuit on the same axle.

C0035 18 - C0050 18

- The ignition is ON.
- Ignition voltage is greater than 8 volts.
- The brake pedal is not pressed.
- No other wheel speed circuit DTCs are set.
- At least 2 other wheel speeds are not 0 km/h (0 mph).

Conditions for Setting the DTC

C0035 00 - C0050 00

- An open is detected on the wheel speed sensor signal circuit.

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- A short to ground is detected on the wheel speed sensor signal circuit.
- A short to voltage is detected on the wheel speed sensor signal circuit.

C0035 0F - C0050 0F

The EBCM detects a rapid variation in the wheel speed. The wheel speed changes by 20 km/h (12 mph) or more in 0.01 second. The change must occur 3 times with no more than 0.2 second between occurrences.

C0035 18 - C0050 18

- One wheel speed is 0 km/h (0 mph).
- The remaining wheel speeds are greater than 8 km/h (5 mph).
- The difference between the remaining wheel speeds is less than 11 km/h (7 mph) from each other.

OR

- The 2 wheel speed sensor inputs are 0 and DTCs are set.
- The 2 suspect wheel speeds equal zero for 6 seconds.
- The other wheel speeds are greater than 16 km/h (10 mph).
- The other wheel speeds are within 11 km/h (7 mph) of each other.

Action Taken When the DTC Sets

- Dynamic rear proportion (DRP) is degraded.
- Multiple wheel speed faults on same axle will disable DRP and turn ON the brake warning lamp.
- ABS indicator turns ON.
- Traction Control indicator turns ON.
- Driver information center (DIC) displays the SERVICE BRAKE SYSTEM message.

Conditions for Clearing the MIL/DTC

- The condition for setting the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

- A damaged rear wheel speed sensor ring can cause failure type byte 04 (Erratic Signal) to set.

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- If 2 or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.

C0035 18, 0F, 00 - C0050 18, 0F, 00

If the customer comments that the ABS indicator is ON only during moist environmental conditions; rain, snow, vehicle wash, etc., inspect the wheel speed sensor wiring for signs of water intrusion. If the DTC is not current, clear all DTCs and simulate the effects of water intrusion by using the following procedure:

1. Spray the suspected area with a 5 percent saltwater solution. To create a 5 percent saltwater solution, add 2 teaspoons of salt to 8 fl oz of water (10 g of salt to 200 ml of water).
2. Test drive the vehicle over various road surfaces: bumps, turns, etc., above 40 km/h (25 mph) for at least 30 seconds.
3. Rinse the area thoroughly when completed.

Reference Information

Schematic Reference

ABS Schematics

Connector End View Reference

ABS Connector End Views

Electrical Information Reference

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

Scan Tool Reference

Scan Tool Data List for EBCM

Circuit/System Verification

With scan tool installed, drive the vehicle in a straight line at a speed greater than 8 km/h (5 mph). All wheel speed sensors should display the same speed.

Circuit/System Testing

Note: It is recommend that component testing is performed before circuit testing when

diagnosing wheel speed sensors.

1. With the ignition OFF, disconnect the EBCM connector.
2. With the ignition ON, measure for 0 volt between the sensor signal circuit or the low reference circuit and ground at the EBCM connector.
 - If over 0 volt, repair the short to voltage in the sensor signal circuit or the low reference circuit.
3. With the ignition OFF, measure for infinite ohms of resistance between the wheel speed sensor signal or the low reference circuit and ground at the EBCM connector.
 - If less than infinite ohms, repair the short to ground in the sensor signal or the low reference circuit.
4. Measure for 850-1350 ohms of resistance between the wheel speed sensor signal and low reference circuits at the EBCM connector.
 - If greater than 1350 ohms, test for an open/high resistance in the circuit or faulty wheel speed sensor.
 - If less than 850 ohms, test for a short between the circuits or faulty wheel speed sensor.
5. If all circuits test normal, replace the EBCM.

Component Testing

1. Disconnect the wheel speed sensor connector.
2. With the ignition OFF, measure for 850-1350 ohms of resistance across the wheel speed sensor.
 - If the resistance is not between 850-1350 ohms, replace the faulty wheel speed sensor.
3. Spin the wheel, measure across the wheel speed sensor for 100 mv AC or greater.
 - If the AC voltage is less than 100 mv, replace the wheel speed sensor.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Wheel Bearing/Hub Replacement - Front**
- **Wheel Speed Sensor Replacement - Rear**
- **Control Module References** for EBCM replacement, setup, and programming

DTC C0110

DTC Descriptor

DTC C0110 04

Pump Motor Circuit Open Circuit

DTC C0110 61

Pump Motor Circuit Actuator Stuck

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The electronic brake control module (EBCM) supplies ground to activate the Antilock Brake System (ABS) pump motor. An internal system relay in the EBCM supplies battery positive voltage to the pump motor when the ignition is turned ON. The EBCM monitors pump motor feedback voltage after activation to detect a stalled or binding pump motor.

Conditions for Running the DTC**C0110 04**

- System and ignition voltage is above 10.5 volts.
- The system enable relay is ON.
- The pump motor has been commanded OFF for 2.5 seconds.

C0110 61

- The ignition is ON.
- The system enable relay is ON.
- The pump motor has been commanded ON, OFF, and ON again.

Conditions for Setting the DTC**C0110 04**

The EBCM detects an open in the pump motor circuit when the feedback voltage remains greater than 0.75 volt for more than 50 msec.

C00110 61

The pump motor continues to rotate briefly after activation creating a feedback voltage. The EBCM sets the code if the measured feedback voltage indicates a binding or stalled pump motor.

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Action Taken When the DTC Sets

- The EBCM disables the ABS/Traction Control System (TCS) for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The Traction Control indicator turns ON.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

The pump motor is integral to the brake pressure modulator valve (BPMV). The pump motor is not serviceable.

Reference Information

Schematic Reference

ABS Schematics

Connector End View Reference

ABS Connector End Views

Electrical Information Reference

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

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. Ignition OFF, disconnect the EBCM harness connector and connect a test lamp between the battery positive voltage circuit terminal and chassis ground.
2. Verify that the test lamp illuminates.
 - If the test lamp does not illuminate, repair the open or high resistance in the battery positive voltage circuit.

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3. Connect a test lamp between the battery positive voltage circuit and pump motor ground circuit at the EBCM connector. Verify that the test lamp illuminates.
 - If the test lamp does not illuminate, repair the open or high resistance in the pump motor ground circuit.
4. Ignition OFF, remove the EBCM from the BPMV.
5. Inspect the EBCM to BPMV connector for conditions such as damage, corrosion, or presence of brake fluid.
 - If connector corrosion or damage is evident, replace BPMV and/or EBCM as necessary.
 - If brake fluid is present, replace both BPMV and EBCM.
6. Connect the EBCM harness to the EBCM with the BPMV still separated.
7. Connect a test lamp between the pump motor circuits, internal EBCM side.
8. Ignition ON, use the scan tool to perform the Pump Motor Test.
 - If test lamp illuminates, replace the BPMV.
 - If test lamp does not illuminate, replace the EBCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Brake Pressure Modulator Valve (BPMV) Replacement**
- **Control Module References** for EBCM replacement, setup, and programming

DTC C0161

DTC Descriptor

DTC C0161

TCS Brake Switch Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The brake pedal position (BPP) sensor is an input to the body control module (BCM). The BCM activates the brake lamps when the BPP is in an applied state. The BCM then sends a brake pedal applied state status via serial data messages to the electronic brake control module (EBCM) and other electronic control modules. The BPP sensor is a potentiometer

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type sensor with a 5-volt reference circuit and a low reference circuit. The BCM supplies the 5-volt reference to the BPP.

Conditions for Running the DTC

The Ignition is ON.

Conditions for Setting the DTC

- Brake pedal is sensed as applied during moderate to high vehicle acceleration.
- Brake pedal state is observed as applied for 144 consecutive seconds.

Action Taken When the DTC Sets

- EBCM disables the traction control system (TCS) for the duration of the ignition cycle.
- The Traction Control indicator turns ON.
- Driver information center (DIC) displays the SERVICE TRACTION message.

Conditions for Clearing the MIL/DTC

- The condition for the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles

Diagnostic Aids

The DTC C0161 can be set if the vehicle has been driven with the brake applied during acceleration.

Reference Information

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

1. With the scan tool, check the vehicle for brake pedal position (BPP) related DTCs.
 - If DTC C0277 or C0297 are present, diagnose BPP DTCs.
2. Lightly apply and release the brake pedal. The stop lamps should illuminate and then turn OFF.
 - If the stop lamps do not operate properly, refer to **Symptoms - Lighting Systems**.
3. If no Lighting System problems can be found, refer to **Diagnostic Aids**.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for BCM and EBCM replacement, setup, and programming

DTC C0179

DTC Descriptor

DTC C0179 00

System Thermal High

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The electronic brake control module (EBCM) monitors Traction Control System (TCS) activation in order to calculate an estimate of the electronic brake control module (EBCM) solenoid valve temperatures. In most cases high solenoid valve temperatures are caused by extended TCS activation. If the EBCM calculates that the solenoid valve temperatures are too high, the EBCM will temporarily suspend the TCS function until the solenoid valves cool.

Conditions for Running the DTC

- The ignition is ON.
- Ignition voltage is greater than 8 volts.

Conditions for Setting the DTC

The estimated solenoid coil temperature reaches 220 degrees Celsius.

Action Taken When the DTC Sets

- EBCM disables the TCS for the duration of the ignition cycle.
- Traction control warning lamp illuminates.
- Driver information center (DIC) displays the SERVICE TRACTION CONTROL message.

Conditions for Clearing the DTC

- After the solenoid valves have cooled the EBCM automatically re-enables TCS

function.

- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

Most occurrences of this DTC are caused by excessive TCS activation or braking.

Reference Information

Schematic Reference

ABS Schematics

Connector End View Reference

ABS Connector End Views

Electrical Information Reference

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

Scan Tool Reference

Scan Tool Data List for EBCM

Circuit/System Testing

Note: Allow brakes to cool down before performing test.

1. With scan tool clear the DTC.
2. With scan tool connected test drive the vehicle under normal braking conditions and without causing TCS or ABS activation. Verify DTC C0179 resets.
 - If the DTC resets replace the EBCM.
3. Refer to Diagnostic Aids.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

DTC Descriptor**DTC C0201**

Antilock Brake System (ABS) Enable Relay Contact Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The solenoid relay, located within the electronic brake control module (EBCM), supplies battery voltage to all of the valve solenoids.

Conditions for Running the DTC

- Ignition voltage is greater than 9.5 volts.
- The solenoid relay is commanded ON.

Conditions for Setting the DTC

One or more of the following conditions exists:

- The EBCM detects an open in the battery positive voltage circuit to the solenoid valve relay.
- The EBCM detects a stuck open solenoid valve relay or an open circuit between the solenoid valve relay and solenoid valves.

Action Taken When the DTC Sets

- The EBCM disables the ABS/TCS/DRP for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The Traction Control indicator turns ON.
- The red brake warning indicator turns ON.
- The driver information center (DIC) displays the SERVICE BRAKE SYSTEM/TRACTION SYSTEM message.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Reference Information**Schematic Reference****ABS Schematics****Connector End View Reference****ABS Connector End Views****Electrical Information Reference**

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

Scan Tool Reference**Scan Tool Data List****Circuit/System Verification**

With the scan tool, access the ABS special functions menu and perform the ABS Motor test. The pump motor should function and no DTCs should be set.

Circuit/System Testing

Test for an open or a short to ground in the solenoid valve battery positive voltage circuit.

- If battery positive voltage circuit tests normal, replace the EBCM/BPMV assembly.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for EBCM replacement, setup, and programming

DTC C0245**DTC Descriptor****DTC C0245 Mismatched Tire****Circuit/System Description**

As the wheel spins, the wheel speed sensor produces an AC signal. The electronic brake

control module (EBCM) uses the frequency of the AC signal to calculate the wheel speed.

Conditions for Running the DTC

- The ignition is ON.
- Vehicle speed is greater than 14 km/h (9 mph)
- Ignition voltage is greater than 8 volts.
- The vehicle is traveling in a strait path
- Brake pedal is not applied
- Traction control is not active

Conditions for Setting the DTC

Wheel speed differences between one wheel and the others is greater than 25 percent.

Action Taken When the DTC Sets

- The EBCM disables the Antilock Brake System (ABS)
- The ABS indicator turns ON
- The EBCM disables Traction Control System (TCS)

Diagnostic Aids

Inspect tires for improper air pressure or improper size.

DTC C0550**DTC Descriptor****DTC C0550**

Electronic Control Unit (ECU) Performance

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The electronic brake control module (EBCM) detects an internal malfunction.

Conditions for Running the DTC

The ignition switch is in the ON position.

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Conditions for Setting the DTC

An internal EBCM malfunction exists.

Action Taken When the DTC Sets

- The EBCM disables the ABS/TCS/DRP for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The Traction Control indicator turns ON.
- The red brake warning indicator turns ON.
- The driver information center (DIC) displays the SERVICE BRAKE SYSTEM/TRACTION SYSTEM message.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Circuit/System Testing

DTC C0550 will set as result of internal (EBCM) circuit failure.

- Replace the EBCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for EBCM replacement, setup, and programming

DTC C0899

DTC Descriptor

DTC C0899

Device Voltage Low

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

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The electronic brake control module (EBCM) monitors the ignition voltage level available for system operation. A low voltage condition prevents the system from operating properly.

Conditions for Running the DTC

Ignition is ON.

Conditions for Setting the DTC

This fault will be set if the ignition voltage to EBCM is less than 9 volts for 100 msec.

Action Taken When the DTC Sets

- Traction Control System (TCS) and Vehicle Stability Enhancement System (VSES) for the duration of the ignition cycle.
- The TC indicator turns ON.
- The driver information center (DIC) displays the Service Stability System message.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Reference Information

Schematic Reference

ABS Schematics

Connector End View Reference

ABS Connector End Views

Electrical Information Reference

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

Scan Tool Reference

Scan Tool Data List

Circuit/System Testing

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1. Measure the voltage at the battery terminals.
2. With scan tool read the ignition voltage in the EBCM data list. Verify that battery terminal voltage and ignition voltage readings do not differ more than 1 volt.
 - o If more than 1 volt test the ground circuit of the EBCM for high resistance or replace the EBCM.
3. Go to **Charging System Test** .

DTC C0900

DTC Descriptor

DTC C0900

Device Voltage High

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The electronic brake control module (EBCM) monitors the ignition voltage. If the voltage level is too high, damage may result in the system. When a high voltage condition is detected, the EBCM turns OFF the system relay which removes battery voltage from the solenoid valves and pump motor.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The system voltage is greater than 16 volts for 100 msec.

Action Taken When the DTC Sets

- The EBCM disables the ABS/TCS/DRP for the duration of the ignition cycle.
- The ABS indicator turns ON.
- The Traction Control indicator turns ON.
- The red brake warning indicator turns ON.
- The driver information center (DIC) displays the SERVICE BRAKE SYSTEM/TRACTION SYSTEM message.

Conditions for Clearing the DTC

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- The condition for the DTC is no longer present and the DTC is cleared with a scan tool.
- The EBCM automatically clears the history DTC when a current DTC is not detected in 100 consecutive drive cycles.

Diagnostic Aids

Test the charging system. Refer to **Charging System Test** .

SYMPTOMS - ANTILOCK BRAKE SYSTEM

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

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **ABS Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the antilock brake system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the master cylinder reservoir for the proper brake fluid level.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

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

- **ABS Indicator Inoperative**
- **ABS Indicator Always On**

ABS INDICATOR ALWAYS ON

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The instrument panel cluster (IPC) illuminates the Antilock Brake System (ABS) indicator by supplying ground to the lamp. The electronic brake control module (EBCM) sends a serial data messages to the IPC, in order to command the indicator ON or OFF.

Reference Information

Schematic Reference

ABS Schematics

Connector End View Reference

- ABS Connector End Views
- INSTRUMENT PANEL, GAGES, AND CONSOLE CONNECTOR END VIEWS

Electrical Information Reference

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

Scan Tool Reference

Scan Tool Data List for EBCM

Circuit/System Testing

Note: Diagnose all vehicle DTCs before using this diagnostic.

With the scan tool, select instrument panel special functions Lamp Test. Command the instrument panel warning lamps OFF.

- If the ABS warning lamp does not turn OFF, replace the IPC.
- If the ABS lamp turns OFF and there are no DTCs stored in any vehicle systems, replace the EBCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after

completing the diagnostic procedure.

Control Module References for EBCM or IPC replacement, setup, and programming

ABS INDICATOR INOPERATIVE**Diagnostic Fault Information**

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The instrument panel cluster (IPC) illuminates the Antilock Brake System (ABS) indicator by supplying ground to the lamp. The electronic brake control module (EBCM) sends a serial data messages to the IPC, in order to command the indicator ON or OFF.

Reference Information**Schematic Reference****ABS Schematics****Connector End View Reference**

- **ABS Connector End Views**
- **INSTRUMENT PANEL, GAGES, AND CONSOLE CONNECTOR END VIEWS**

Electrical Information Reference

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

Scan Tool Reference**Scan Tool Data List for EBCM****Circuit/System Testing**

1. With the scan tool, select instrument panel special functions Lamp Test. Command the instrument panel lamps ON. Verify ABS lamp illuminates.
 - If the ABS lamp does not illuminate, replace the IPC.
2. Replace the EBCM.

Repair Procedures

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for EBCM and IPC replacement, setup, and programming

TRACTION OFF INDICATOR ALWAYS ON

Circuit Description

The Low Traction indicator is controlled by the instrument cluster via serial data messages from the EBCM. When the ABS or TCS is active for 0.5 seconds, the EBCM commands the instrument cluster to turn ON the Low Traction indicator.

The Low Traction indicator will also turn ON during the instrument cluster bulb check. When the ignition switch is turned to ON, the Low Traction indicator will turn ON for approximately 3 seconds and then turn OFF.

Diagnostic Aids

The malfunction must be present during diagnosis in order to prevent unnecessary parts replacement. Always begin diagnosis with Diagnostic System Check - Vehicle.

Test Description

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

3: This step tests if the instrument panel cluster (IPC) is able to turn OFF the Traction Off indicator.

Traction Off Indicator Always On

Step	Action	Yes	No
Schematic Reference: <u>ABS Schematics</u> Connector End View Reference: <u>ABS Connector End Views</u> or <u>Instrument Panel, Gages, and Console Connector End Views</u> in Instrument Panel, Gages, and Console			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	1. Turn OFF the ignition for 5 seconds. 2. Turn ON the ignition while observing the Traction Off indicator.		

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	Does the Traction Off indicator illuminate for 2 seconds and then turn OFF?	Go to Diagnostic Aids	Go to Step 3
3	1. Install a scan tool. 2. Select the Instrument Panel Cluster (IPC) Special Functions menu on the scan tool. 3. Command the IPC lamps OFF. Does the Traction Off indicator turn OFF?	Go to Step 5	Go to Step 4
4	Replace the IPC. Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to Step 6	-
5	Replace the electronic brake control module (EBCM). Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to Step 6	-
6	1. Turn OFF the ignition for 5 seconds. 2. Turn ON the ignition while observing the Traction Off indicator. Does the Traction Off indicator illuminate for 2 seconds and then turn OFF?	System OK	Go to Step 3

TRACTION OFF INDICATOR INOPERATIVE**Circuit Description**

The Low Traction indicator is controlled by the instrument cluster via serial data messages from the EBCM. When the ABS or TCS is active for 0.5 seconds, the EBCM commands the instrument cluster to turn ON the Low Traction indicator.

The Low Traction indicator will also turn ON during the instrument cluster bulb check. When the ignition switch is turned to ON, the Low Traction indicator will turn ON for approximately 3 seconds and then turn OFF.

Diagnostic Aids

The malfunction must be present during diagnosis in order to prevent unnecessary parts replacement. Always begin diagnosis with **Diagnostic System Check - Vehicle**.

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Test Description

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

3: This step tests if the instrument panel cluster (IPC) is able to turn ON the Traction Off indicator.

Traction Off Indicator Inoperative

Step	Action	Yes	No
Schematic Reference: <u>ABS Schematics</u> Connector End View Reference: <u>ABS Connector End Views</u> or <u>Instrument Panel, Gages, and Console Connector End Views</u> in Instrument Panel, Gages, and Console			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information
2	1. Turn OFF the ignition for 5 seconds. 2. Turn ON the ignition while observing the Traction Off indicator. Does the Traction Off indicator illuminate for 2 seconds and then turn OFF?	Go to Diagnostic Aids	Go to Step 3
3	1. Install a scan tool. 2. Select the Instrument Panel Cluster (IPC) Special Functions menu on the scan tool. 3. Command the IPC lamps ON. Does the Traction Off indicator turn ON?	Go to Step 5	Go to Step 4
4	Replace the IPC. Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to Step 6	-
5	Replace the electronic brake control module (EBCM). Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to Step 6	-

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6	1. Turn OFF the ignition for 5 seconds. 2. Turn ON the ignition while observing the Traction Off indicator.		
	Does the Traction Off indicator illuminate for 2 seconds and then turn OFF?	System OK	Go to Step 3

REPAIR INSTRUCTIONS

ABS AUTOMATED BLEED PROCEDURE

Bleeding the ABS System

CAUTION: Refer to Brake Fluid Irritant Caution in Cautions and Notices.

NOTE: Refer to Brake Fluid Effects on Paint and Electrical Components Notice in Cautions and Notices.

Perform a manual or pressure bleeding procedure. Refer to Hydraulic Brake System Bleeding (Manual) or Hydraulic Brake System Bleeding (Pressure) in Hydraulic Brakes. If the desired brake pedal height results are not achieved, perform the Automated Bleed Procedure.

The procedure cycles the system valves and runs the pump in order to purge the air from the secondary circuits normally closed off during normal base brake operation and bleeding. The automated bleed procedure is recommended when air ingestion is suspected in the secondary circuits, or when the brake pressure modulator valve (BPMV) has been replaced.

Automated Bleed Procedure

NOTE: The Auto Bleed Procedure may be terminated at any time during the process by pressing the EXIT button. No further Scan Tool prompts pertaining to the Auto Bleed procedure will be given. After exiting the bleed procedure, relieve bleed pressure and disconnect bleed equipment per manufacturers instructions. Failure to properly relieve pressure may result in spilled brake fluid causing damage to components and painted surfaces.

1. Raise the vehicle on a suitable support. Refer to Lifting and Jacking the Vehicle in General Information.
2. Remove all 4 tire and wheel assemblies. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.

3. Inspect the brake system for leaks and visual damage. Refer to **Brake Fluid Loss or Symptoms - Hydraulic Brakes** in Hydraulic Brakes. Repair or replace as needed.
4. Inspect the battery state of charge. Refer to **Battery Inspection/Test** in Engine Electrical.
5. Install a scan tool.
6. Turn ON the ignition, with the engine OFF.
7. With the scan tool, establish communications with the electronic brake control module (EBCM). Select Special Functions. Select Automated Bleed from the Special Functions menu.
8. Bleed the base brake system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** in Hydraulic Brakes.
9. Follow the scan tool directions until the desired brake pedal height is achieved.
10. If the bleed procedure is aborted, a malfunction exists. Perform the following steps before resuming the bleed procedure:
 - If a DTC is detected, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** and diagnose the appropriate DTC.
 - If the brake pedal feels spongy, perform the conventional brake bleed procedure again. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** in Hydraulic Brakes.
11. When the desired pedal height is achieved, press the brake pedal in order to inspect for firmness.
12. Remove the scan tool.
13. Install the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
14. Inspect the brake fluid level. Refer to **Master Cylinder Reservoir Filling** in Hydraulic Brakes.
15. Road test the vehicle while inspecting that the pedal remains high and firm.

ELECTRONIC BRAKE CONTROL MODULE REPLACEMENT

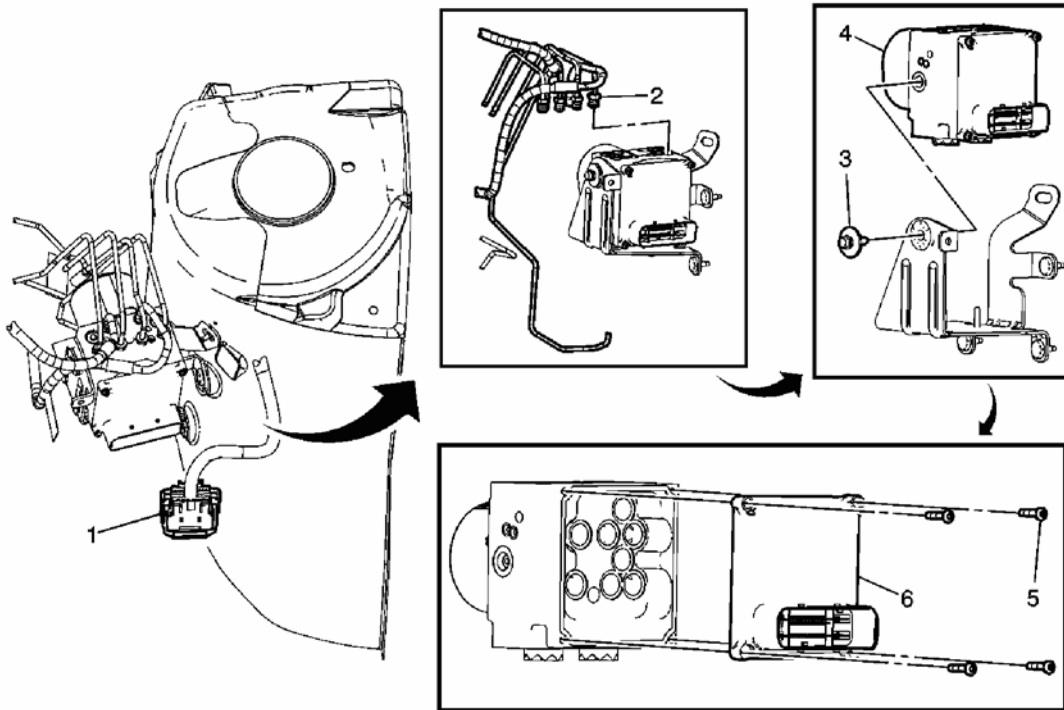


Fig. 8: Replacing Electronic Brake Control Module
Courtesy of GENERAL MOTORS CORP.

Electronic Brake Control Module Replacement

Callout	Component Name
CAUTION: Refer to <u>Brake Fluid Irritant Caution</u> . CAUTION: Refer to <u>Brake Fluid Effects on Paint and Electrical Components Notice</u> . NOTE: Refer to <u>Fastener Notice</u> . Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u>. Preliminary Procedure 1. Remove the air cleaner assembly for the 3.5L, refer to <u>Air Cleaner Assembly Replacement</u> . 2. Remove the air cleaner assembly for the 3.9L, refer to <u>Air Cleaner Assembly</u>	

Replacement

3. Remove the air cleaner assembly for the 5.3L, refer to **Air Cleaner Assembly Replacement**

1	Electrical Connector
2	Brake Pipe Fittings Tip: Cap or plug the brake pipes so as not to allow the brake system to become contaminated and brake fluid from leaking. Tightening Specifications: Tighten to 24 N.m (18 lb ft).
3	Mounting Bolt Tightening Specifications: Tighten to 10 N.m (89 lb in).
4	ABS Module
5	EBCM Screw Tightening Specifications: Tighten to 5 N.m (44 lb in).
6	Electronic Brake Control Module (EBCM) Tip: • If the EBCM is to be removed to service the ABS system, cover the unit so has not allow it to become contaminated. • Clean the sealing surface of the EBCM with denatured alcohol and a lint free towel. • Bleed the ABS System. Refer to <u>ABS Automated Bleed Procedure</u>.

BRAKE PRESSURE MODULATOR VALVE (BPMV) REPLACEMENT

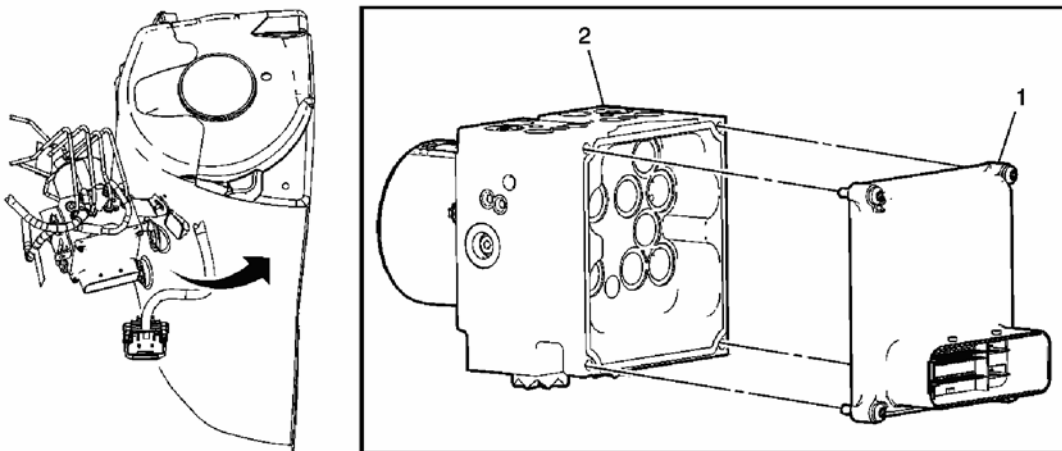
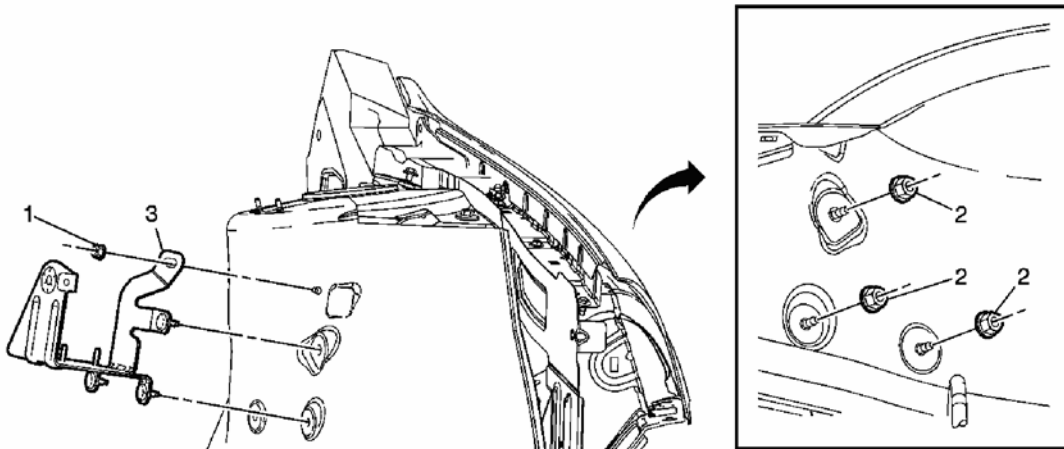


Fig. 9: Replacing Brake Pressure Modulator Valve (BPMV)
 Courtesy of GENERAL MOTORS CORP.

Brake Pressure Modulator Valve (BPMV) Replacement

Callout	Component Name
CAUTION: Refer to <u>Brake Fluid Irritant Caution</u> .	
CAUTION: Refer to <u>Brake Fluid Effects on Paint and Electrical Components Notice</u> .	
NOTE: Refer to <u>Fastener Tightening Specifications</u> .	
Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u> . Preliminary Procedure: Remove the Electronic Brake Control Module (EBCM). Refer to <u>Electronic Brake Control Module Replacement</u> .	
1	EBCM
2	Brake Pressure Control Module (BPMV) Tip: • If the BPMV is to be removed to service the ABS system, cover the unit so has not allow it to become contaminated. • Clean the sealing surface of the BPMV with denatured alcohol and a lint free towel. • Bleed the ABS System. Refer to <u>ABS Automated Bleed Procedure</u>.

BRAKE PRESSURE MODULATOR VALVE (BPMV) BRACKET REPLACEMENT**Fig. 10: Replacing Brake Pressure Modulator Valve Bracket**

Courtesy of GENERAL MOTORS CORP.

Brake Pressure Modulator Valve (BPMV) Bracket Replacement

Callout	Component Name
CAUTION: Refer to <u>Brake Fluid Irritant Caution</u> .	
CAUTION: Refer to <u>Brake Fluid Effects on Paint and Electrical Components Notice</u> .	
NOTE: Refer to <u>Fastener Notice</u> .	
Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u> . Preliminary Procedure: Remove the Electronic Brake Control Module (EBCM). Refer to <u>Brake Pressure Modulator Valve (BPMV) Replacement</u> .	
1	Retaining Nut Tightening Specification: Tighten to 3 N.m (27 lb in).
2	Retaining Nut Tightening Specification: Tighten to 10 N.m (89 lb in).
3	Mounting Bracket

FRONT WHEEL SPEED SENSOR REPLACEMENT

Removal Procedure

IMPORTANT: The front wheel speed sensors and rings are integral with the hub and bearing assemblies.

If a speed sensor or a ring needs replacement, replace the entire hub and bearing assembly. Do not service the harness pigtail individually because the harness pigtail is part of the sensor. Refer to Wheel Bearing/Hub Replacement - Front in Front Suspension.

1. Raise and support the vehicle on a suitable hoist. Refer to Lifting and Jacking the Vehicle in General Information.
2. Remove the front tire and wheel assembly. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.

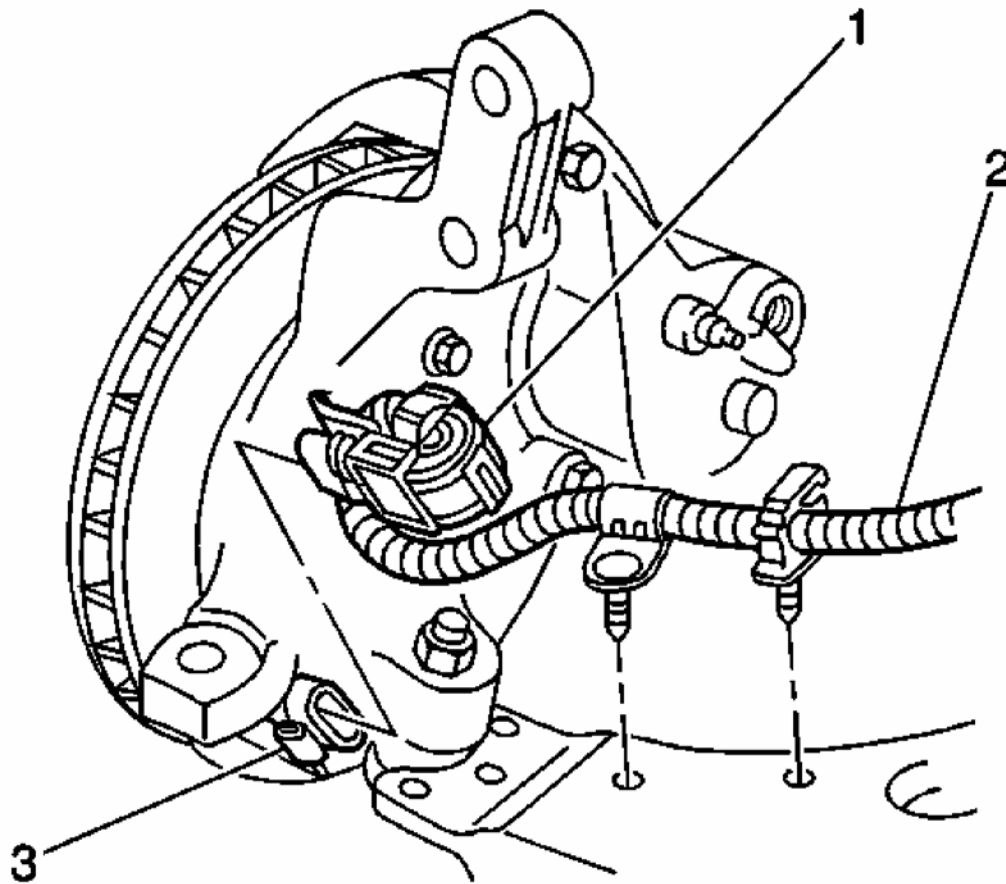


Fig. 11: Front Wheel Speed Sensor Jumper Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the front wheel speed sensor jumper harness electrical connector (1).

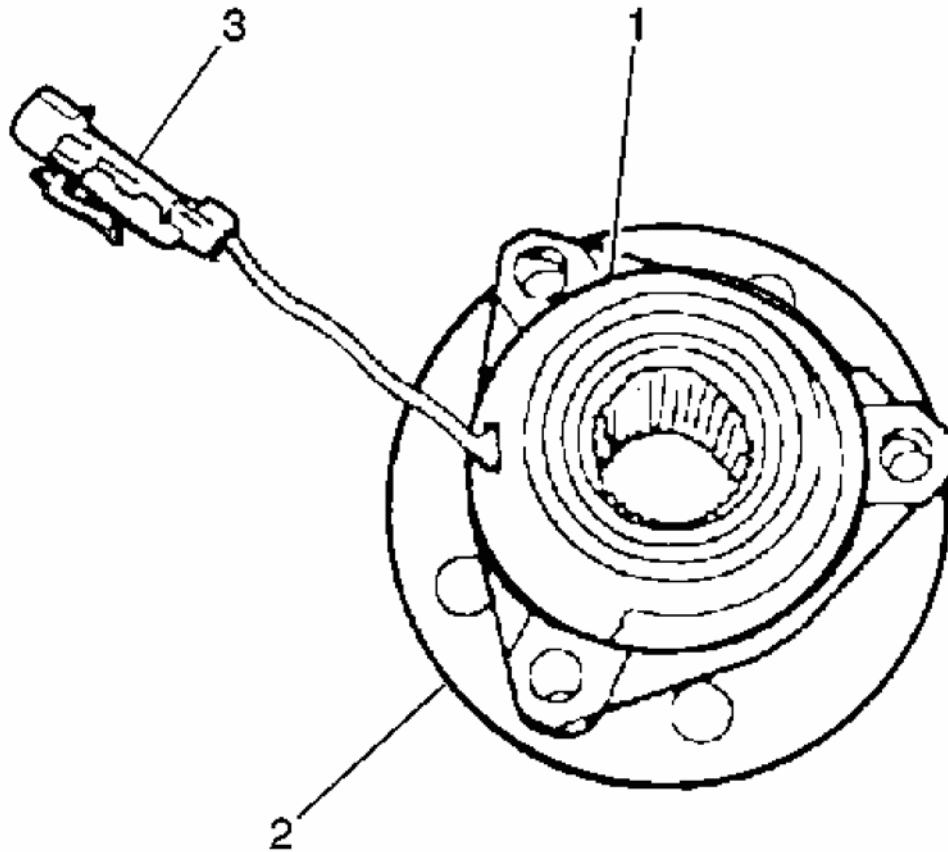


Fig. 12: Hub & Bearing Assembly - Front
Courtesy of GENERAL MOTORS CORP.

4. Remove the hub and bearing assembly (2). Refer to **Wheel Bearing/Hub Replacement - Front** in Front Suspension.

Installation Procedure

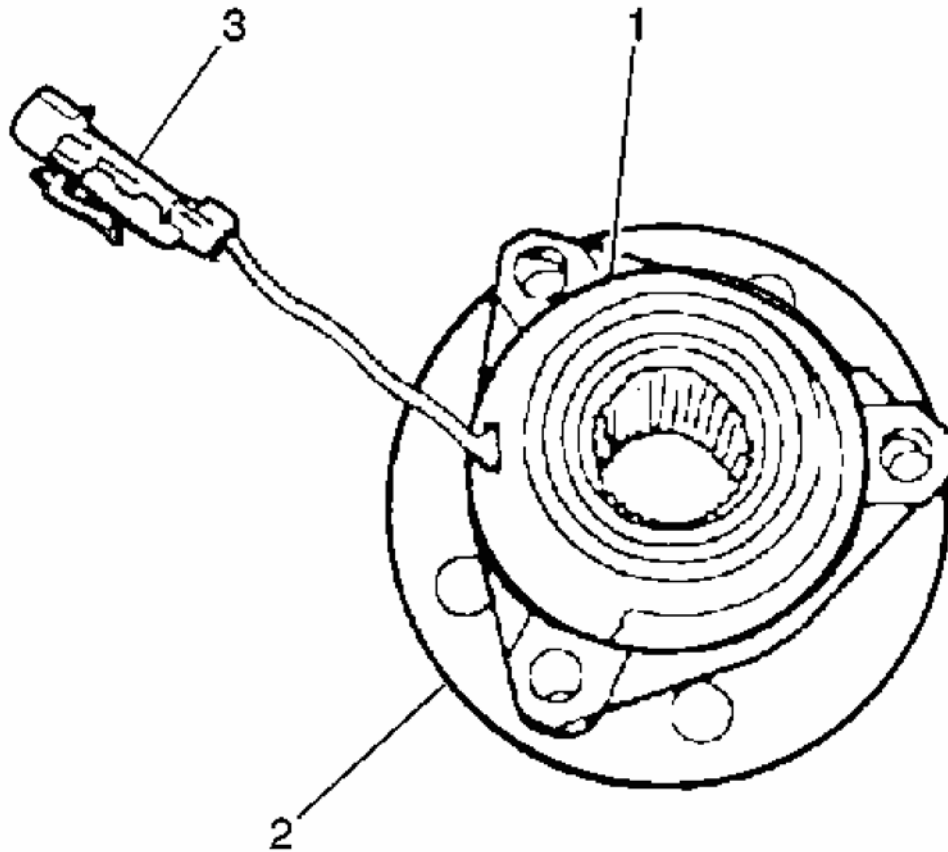


Fig. 13: Hub & Bearing Assembly - Front
Courtesy of GENERAL MOTORS CORP.

1. Install the hub and bearing assembly (2) to the vehicle. Refer to **Wheel Bearing/Hub Replacement - Front** in Front Suspension.

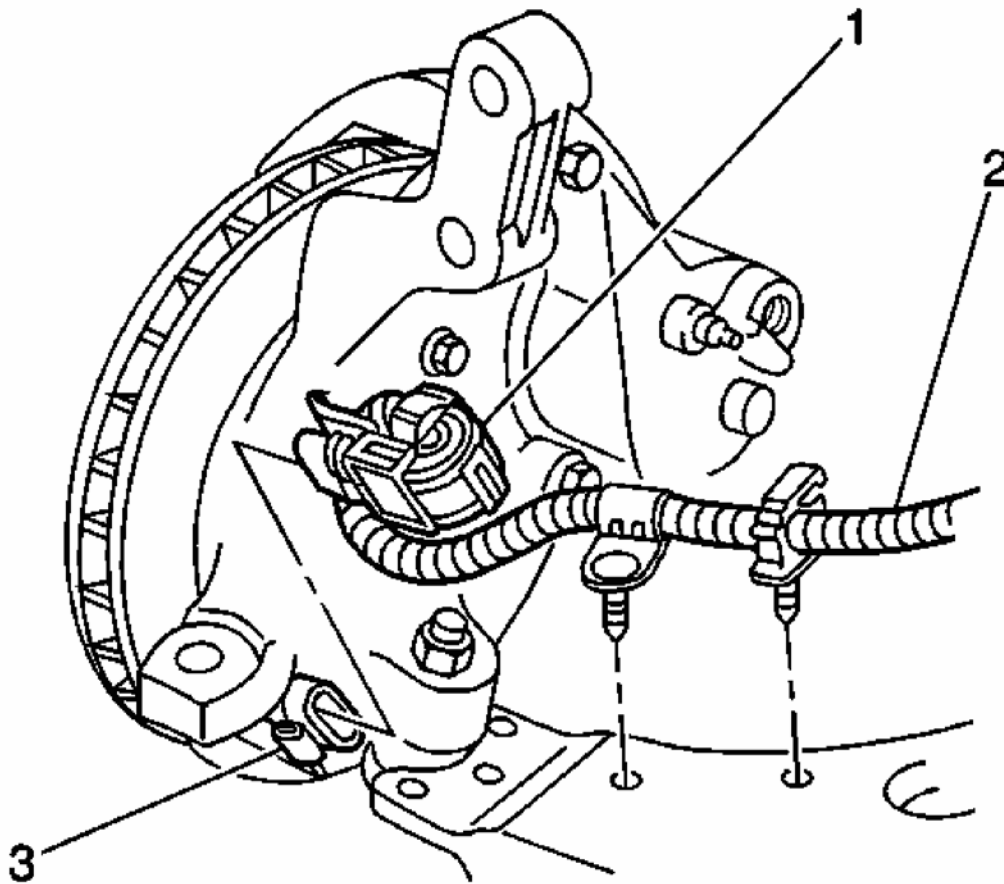


Fig. 14: Front Wheel Speed Sensor Jumper Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Install the front wheel speed sensor jumper harness electrical connector (1).
3. Install the wheel and tire assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
4. Lower the vehicle.
5. Turn the ignition switch to the ON position with the engine OFF.
6. Perform the **Diagnostic System Check - Vehicle** in Vehicle DTC Information.

REAR WHEEL SPEED SENSOR REPLACEMENT

Removal Procedure

IMPORTANT: The rear wheel speed sensors and rings are integral with the hub and bearing assemblies.

If a speed sensor or a ring needs replacement, replace the entire hub and bearing assembly. Refer to Wheel Bearing/Hub Replacement - Rear in Rear Suspension.

1. Raise and support the vehicle on a suitable hoist. Refer to Lifting and Jacking the Vehicle in General Information.
2. Remove the rear tire and wheel assembly. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.

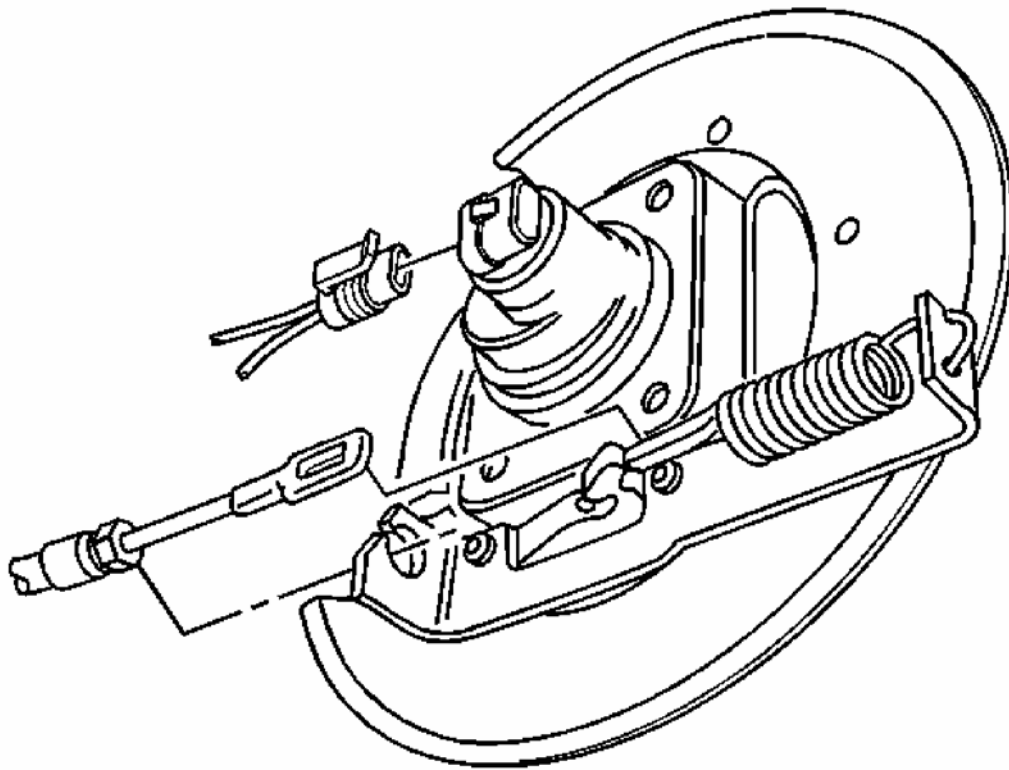


Fig. 15: View Of Rear Park Brake Cable & Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the electrical connector from the rear wheel speed sensor.

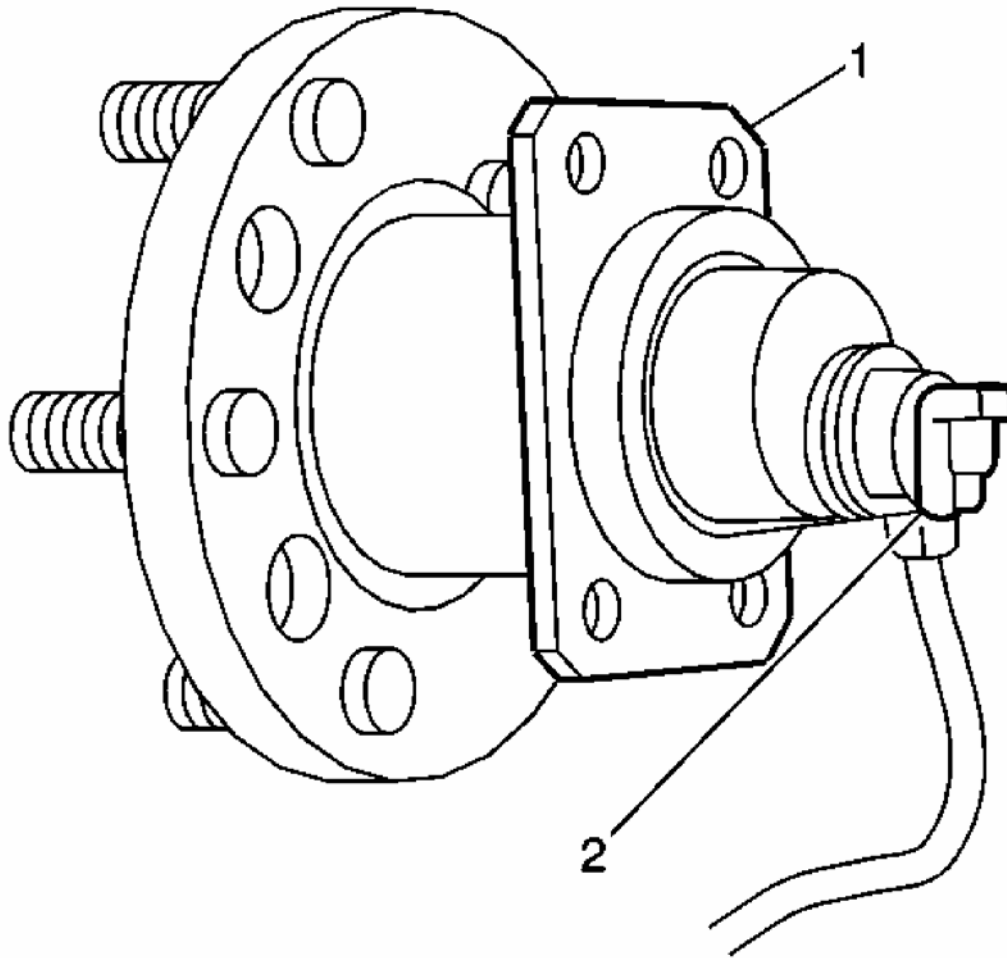


Fig. 16: Installing Hub & Bearing Assembly - Rear
Courtesy of GENERAL MOTORS CORP.

4. Remove the hub and bearing assembly (1). Refer to **Wheel Bearing/Hub Replacement - Rear** in Rear Suspension.

Installation Procedure

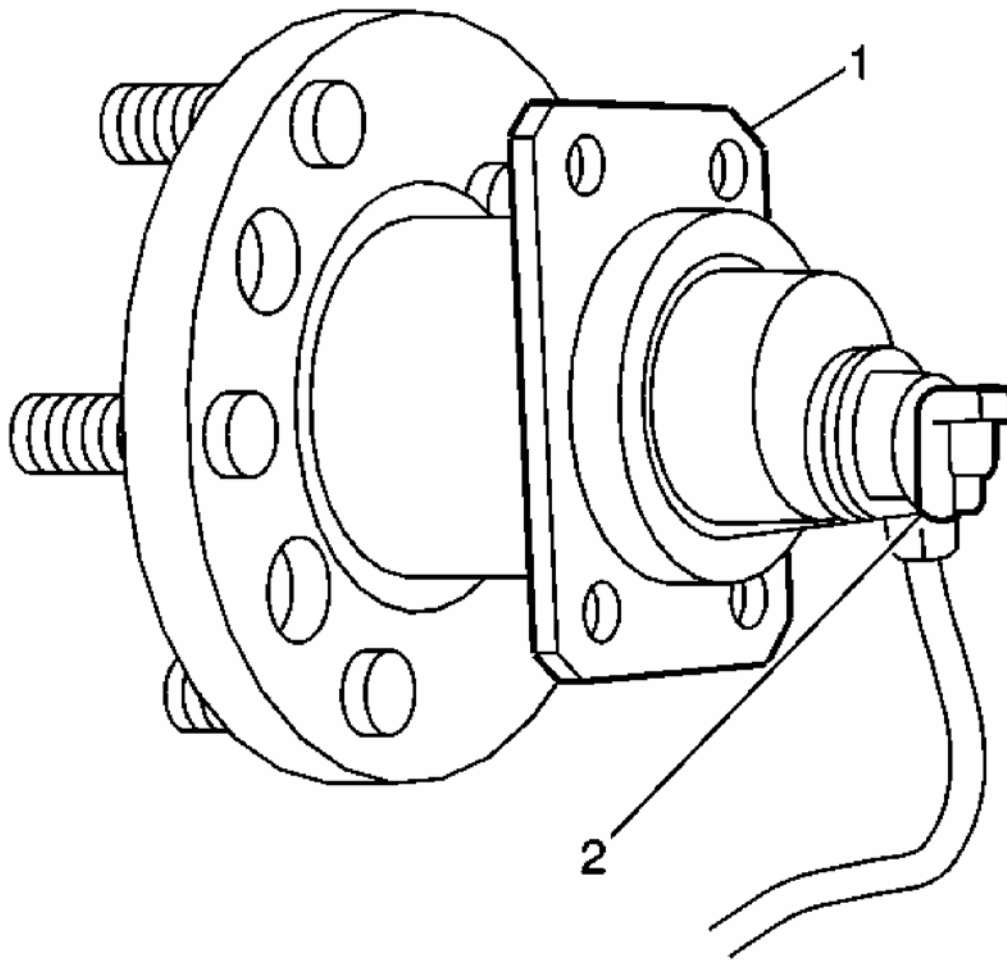


Fig. 17: Installing Hub & Bearing Assembly - Rear
Courtesy of GENERAL MOTORS CORP.

1. Install the hub and bearing assembly (1) to the vehicle. Refer to **Wheel Bearing/Hub Replacement - Rear** in Rear Suspension.

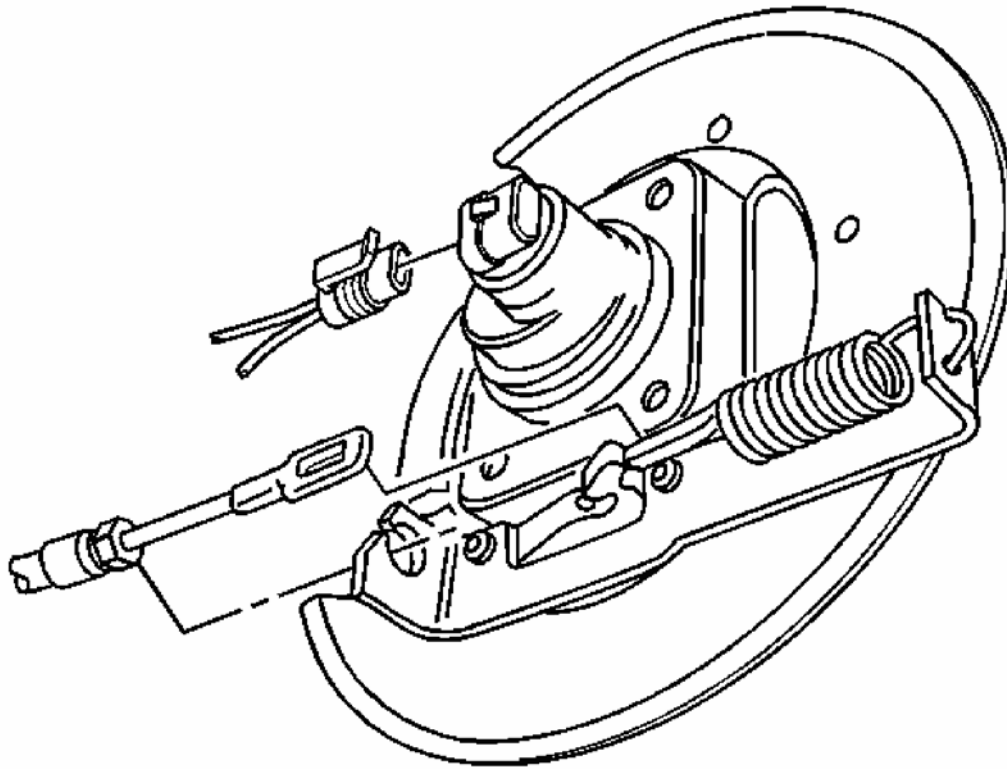


Fig. 18: View Of Rear Park Brake Cable & Wheel Speed Sensor Electrical Connector

Courtesy of GENERAL MOTORS CORP.

2. Connect the electrical connector to the rear wheel speed sensor.
3. Install the wheel and tire assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
4. Lower the vehicle.
5. Turn the ignition switch to the ON position, with the engine OFF.
6. Perform the **Diagnostic System Check - Vehicle** in Vehicle DTC Information.

TRACTION CONTROL SWITCH REPLACEMENT (IMPALA)

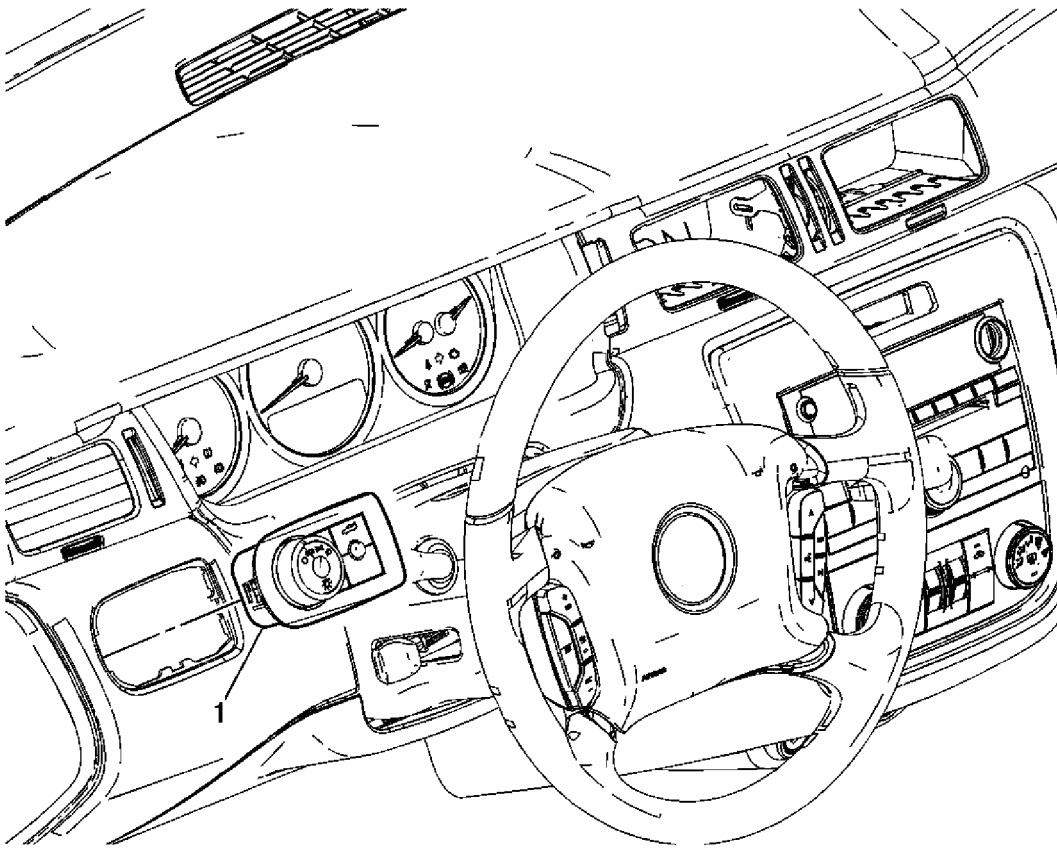


Fig. 19: Replacing Traction Control Switch
Courtesy of GENERAL MOTORS CORP.

Traction Control Switch Replacement (Impala)

Callout	Component Name
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications .	
1	Switch Assembly, Headlamp Instrument Panel Dimmer Tip: • The traction control switch is part of the headlamp switch and must be serviced as an assembly. • Disconnect the electrical connector.

DESCRIPTION AND OPERATION

ABS DESCRIPTION AND OPERATION

This vehicle is equipped with an TRW 440 brake master cylinder assembly. The electronic brake control module (EBCM) and the brake pressure modulator valve (BPMV) can be serviced separately. The BPMV uses a 4-circuit configuration to control hydraulic pressure

to each wheel independently.

The following vehicle performance enhancement systems are provided.

- Antilock Brake System (ABS)
- Dynamic Rear Proportioning (DRP)
- Traction Control System (TCS) (w/NW7)

The following components are involved in the operation of the above systems:

- Brake pressure modulator valve (BPMV)-The BPMV contains the hydraulic valves and pump motor that are controlled electrically by the EBCM. The BPMV uses a 4-circuit configuration with a diagonal split. The BPMV directs fluid from the reservoir of the master cylinder to the left front and right rear wheels and fluid from the other reservoir to the right front and left rear wheels. The diagonal circuits are hydraulically isolated so that a leak or malfunction in one circuit will allow continued braking ability on the other.
- Master cylinder pressure sensor-The master cylinder pressure sensor is located within the BPMV. The master cylinder pressure sensor uses a 5-volt reference and generates an output signal proportionate to the hydraulic fluid pressure which is present in the hydraulic brake circuit at the master cylinder.
- Solenoids-The solenoids are commanded ON and OFF by the EBCM to operate the appropriate valves in the BPMV.
- System relay-There are 2 system relays internal to the EBCM. The system relays are energized when the ignition is ON. The system relays supply battery positive voltage to the valve solenoids and to the ABS pump motor. This voltage is referred to as system voltage
- Traction control switch (w/NW7 and w/JL4)-TCS and vehicle stability enhancement system (VSES) is manually disabled or enabled using the traction control switch.
- Wheel speed sensors (WSS)-EBCM sends a 12-volt reference voltage signal to each wheel speed sensor. As the wheel spins, the wheel speed sensor produces a square wave DC signal voltage. The wheel speed sensor increases the signal frequency as the wheel speed increases, but does not increase the signal amplitude.
- Brake pedal position (BPP) sensor-The EBCM receives a serial data message from the body control module (BCM) to indicate that the brake pedal is applied.

Initialization Sequence

The electronic brake control module (EBCM) performs 1 initialization test each ignition cycle. The initialization of the EBCM occurs when 1 set of the following conditions occur:

- The EBCM detects that there is a minimum of 500 RPM from the powertrain control module (PCM) via a serial data message.

- The brake pedal is not applied.

OR

- The vehicle speed is greater than 16 km/h (10 mph).
- The brake pedal is applied.

Antilock Brake System (ABS) Operation

When wheel slip is detected during a brake application, an ABS event occurs. During antilock braking, hydraulic pressure in the individual wheel circuits is controlled to prevent any wheel from slipping. A separate hydraulic line and specific solenoid valves are provided for each wheel. The ABS can decrease, hold, or increase hydraulic pressure to each wheel. The ABS does not, however, increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During antilock braking, a series of rapid pulsations is felt in the brake pedal. These pulsations are caused by the rapid changes in position of the individual solenoid valves as the electronic brake control module (EBCM) responds to wheel speed sensor inputs and attempts to prevent wheel slip. These pedal pulsations are present only during antilock braking and stop when normal braking is resumed or when the vehicle comes to a stop. A ticking or popping noise may also be heard as the solenoid valves cycle rapidly. During antilock braking on dry pavement, intermittent chirping noises may be heard as the tires approach slipping. These noises and pedal pulsations are considered normal during antilock operation.

Vehicles equipped with ABS may be stopped by applying normal force to the brake pedal. Brake pedal operation during normal braking is no different than that of previous non-ABS systems. Maintaining a constant force on the brake pedal provides the shortest stopping distance while maintaining vehicle stability. The typical ABS activation sequence is as follows:

Pressure Hold

The EBCM closes the isolation valve and keeps the dump valve closed in order to isolate the slipping wheel when wheel slip occurs. This holds the pressure steady on the brake so that the hydraulic pressure does not increase or decrease.

Pressure Decrease

If a pressure hold does not correct the wheel slip condition, a pressure decrease occurs. The isolation valve remains closed and the dump valve is opened. This allows a small amount of brake fluid to escape from the hydraulic circuit into the reservoir.

Pressure Increase

After the wheel slip is corrected, a pressure increase occurs. The isolation and dump valves are returned to their off states and brake pressure in the hydraulic circuit is once again dependent on the amount of force applied to the brake pedal by the driver. If the driver applies too much pressure causing wheel slip, the ABS activation sequence reoccurs.

Dynamic Rear Proportioning (DRP) Operation

The dynamic rear proportioning (DRP) is a control system that enhances the hydraulic proportioning function of the mechanical proportioning valve in the base brake system. The DRP control system is part of the operation software in the electronic brake control module (EBCM). The DRP uses active control with existing ABS in order to regulate the vehicle's rear brake pressure.

Traction Control System (TCS)

When drive wheel slip is noted while the brake is not applied, the electronic brake control module (EBCM) will enter traction control mode. The traction control system (TCS) controls vehicle traction by applying brakes and limiting engine torque to the drive wheels. The EBCM performs the following TCS operations:

- The EBCM requests the powertrain control module (PCM) to reduce the amount of torque to the drive wheels via serial data messages.
- The PCM reduces torque to the drive wheels by retarding spark timing and throttle actuator control (TAC).
- The PCM reports the amount torque delivered to the drive wheels via serial data messages.
- The EBCM applies brake pressure to the slipping wheel in order to transfer torque to the gripping wheel.

Power-Up Self-Test

The electronic brake control module (EBCM) is able to detect many malfunctions whenever the ignition is ON. However, certain failures cannot be detected unless active diagnostic tests are performed on the components. Shorted solenoid coil or motor windings, for example, cannot be detected until the components are commanded ON by the EBCM. Therefore, a power-up self-test is required at the beginning of each ignition cycle to verify correct operation of components before the various control systems can be enabled. The EBCM performs the power-up self-test when the vehicle achieves a speed greater than 10 km/h (7 mph). The system relay, solenoids, and the ABS pump motor are commanded ON and OFF to verify proper operation and the EBCM verifies the ability to return the system to base braking in the event of a failure. The power-up self-test may sometimes be heard by the driver or passengers of the vehicle.

Driver Information Indicators and Messages

The following indicators are used to inform the driver of several different conditions:

Brake System Warning Indicator

The instrument panel cluster (IPC) illuminates the brake warning indicator when any of the following instances occur.

- The body control module (BCM) detects that the park brake is engaged. The BCM sends a serial data message to the IPC requesting illumination.
- The electronic brake control module (EBCM) detects a low brake fluid condition. The EBCM sends a serial data message to the IPC requesting illumination.
- The IPC performs the bulb check.
- The IPC detects a loss of serial data communication with the EBCM.
- The EBCM detects an ABS-disabling malfunction which also disables dynamic rear proportioning (DRP). The EBCM sends a serial data message to the IPC requesting illumination.

ABS Indicator

The IPC illuminates the ABS indicator when any of the following instances occur.

- The EBCM detects an ABS-disabling malfunction. The EBCM sends a serial data message to the IPC requesting illumination.
- The IPC performs the bulb check.
- The IPC detects a loss of serial data communication with the EBCM.

SERVICE BRAKE SYSTEM Message

The IPC displays the message whenever the ABS indicator is illuminated due to an ABS fault.

BRAKE SYSTEM Fault Message

The IPC displays the message whenever the red brake warning indicator is illuminated due to a base brake or DRP fault.

SERVICE TRACTION fault Message

The IPC displays the traction fault message when either of the following instances occur:

- The EBCM detects a malfunction that requires traction control to be disabled. The EBCM sends a serial data message to the IPC requesting that the message be displayed.
- The IPC detects a loss of serial data communication with the EBCM.