2008 HVAC

HVAC - Automatic - Ascender, Envoy & Trailblazer

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Actuator Retaining Screw, ALL	1.9 N.m	17 lb in
Blower Motor Control Processor Mounting Screw	1.9 N.m	17 lb in
Blower Motor Resistor Mounting Screw	1.9 N.m	17 lb in
HVAC Control Module Screw	1.9 N.m	17 lb in

SENSOR RESISTANCE TABLE

Temperature		Outside Resistance		Inside Resistance	
°C	°F	Minimum Resistance K Ohms	Maximum Resistance K Ohms	Minimum Resistance K Ohms	Maximum Resistance K Ohms
-40	-40	332.4	334.7	95.80	105.6
-35	-31	240.3	241.8	69.09	75.81
-30	-22	175.6	176.6	50.34	55.00
-25	-13	129.6	130.3	37.04	40.29
-20	-4	96.55	97.07	27.51	29.80
-15	5	72.63	72.99	20.61	22.24
-10	14	55.12	55.38	15.57	16.74
-5	23	42.20	42.38	11.86	12.70
0	32	32.62	32.75	9.108	9.712
5	41	25.34	25.44	7.047	7.492
10	50	19.86	19.94	5.494	5.825
15	59	15.68	15.74	4.326	4.574
20	68	12.46	12.51	3.417	3.602
25	77	9.98	10.02	2.73	2.870
30	86	8.043	8.076	2.185	2.295
35	95	6.517	6.543	1.757	1.843
40	104	5.309	5.33	1.425	1.494

SCHEMATIC & ROUTING DIAGRAMS

HVAC SCHEMATICS

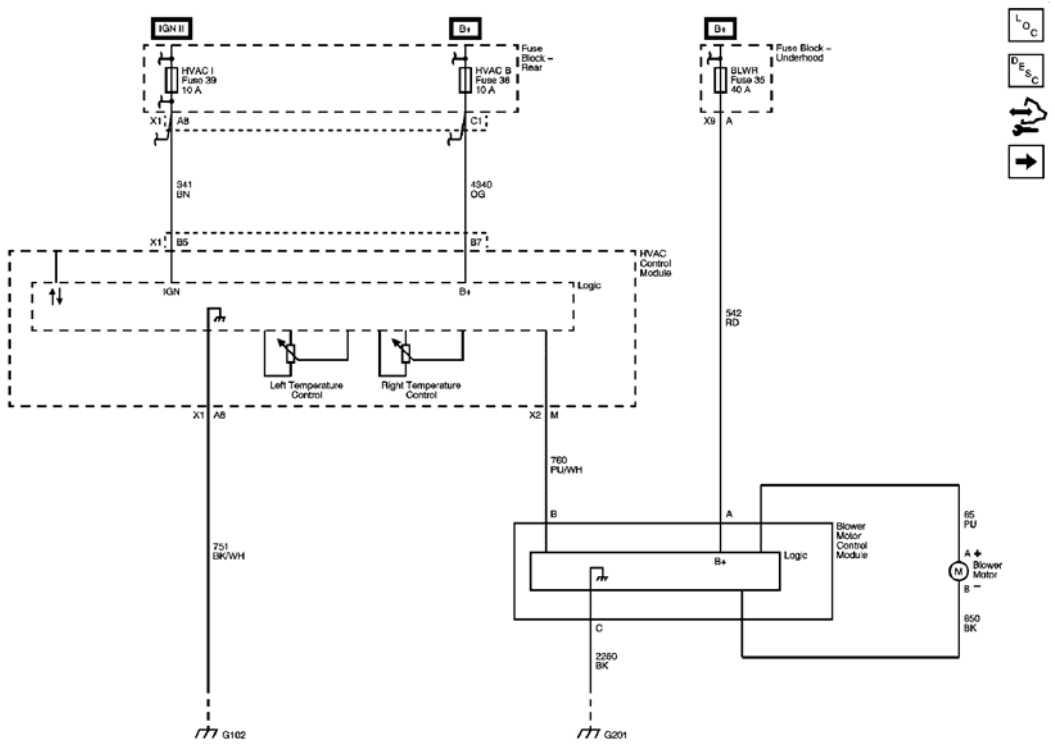

Fig. 1: Module Power, Ground, Serial Data & Blower Motor Schematic
Courtesy of GENERAL MOTORS CORP.

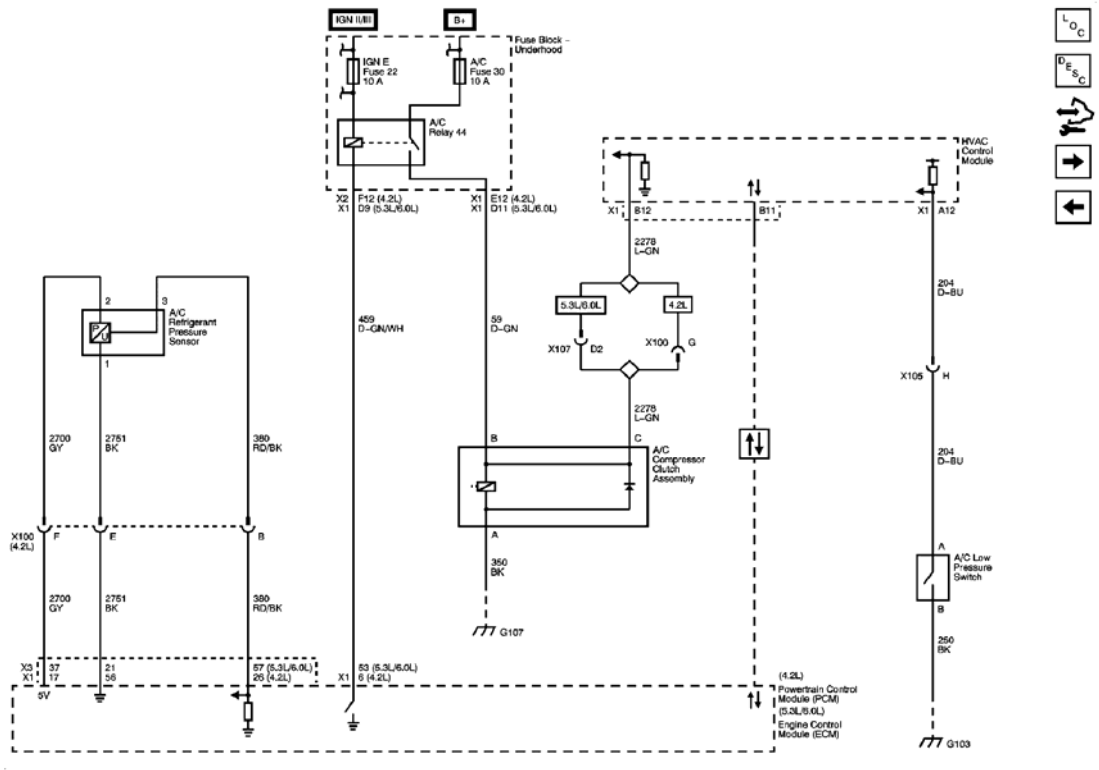

Fig. 2: Compressor Controls Schematic
Courtesy of GENERAL MOTORS CORP.

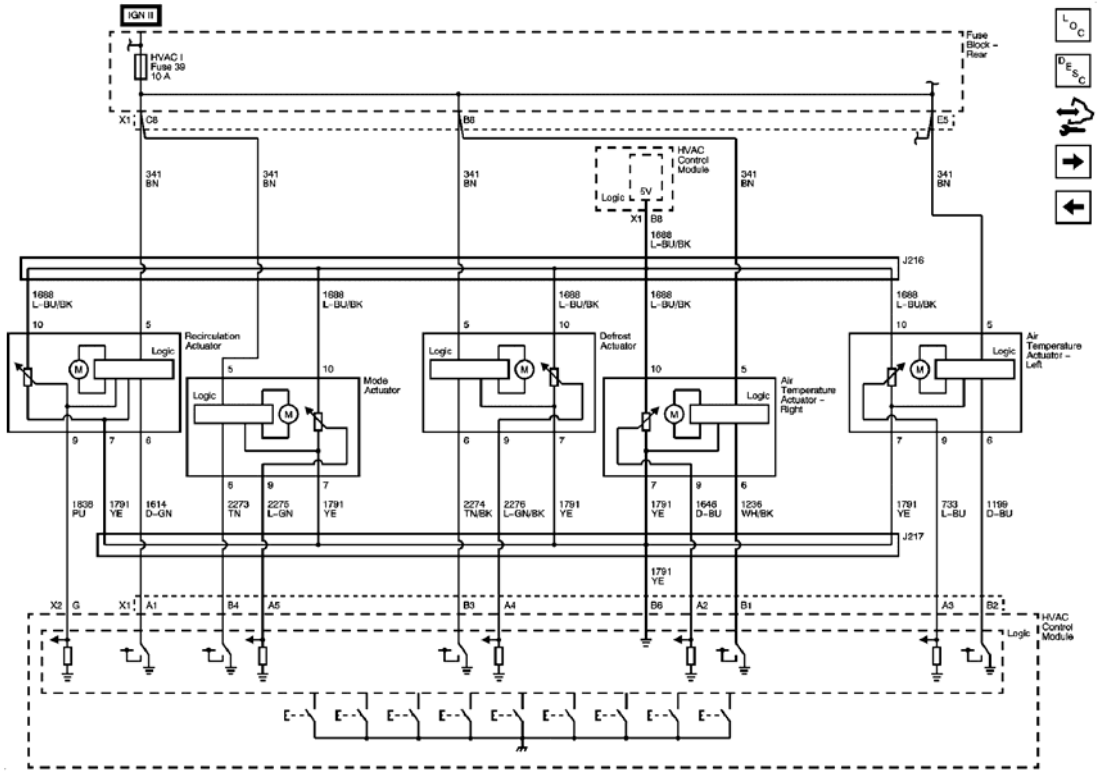

Fig. 3: Air Delivery/Temperature Actuators Schematic
Courtesy of GENERAL MOTORS CORP.

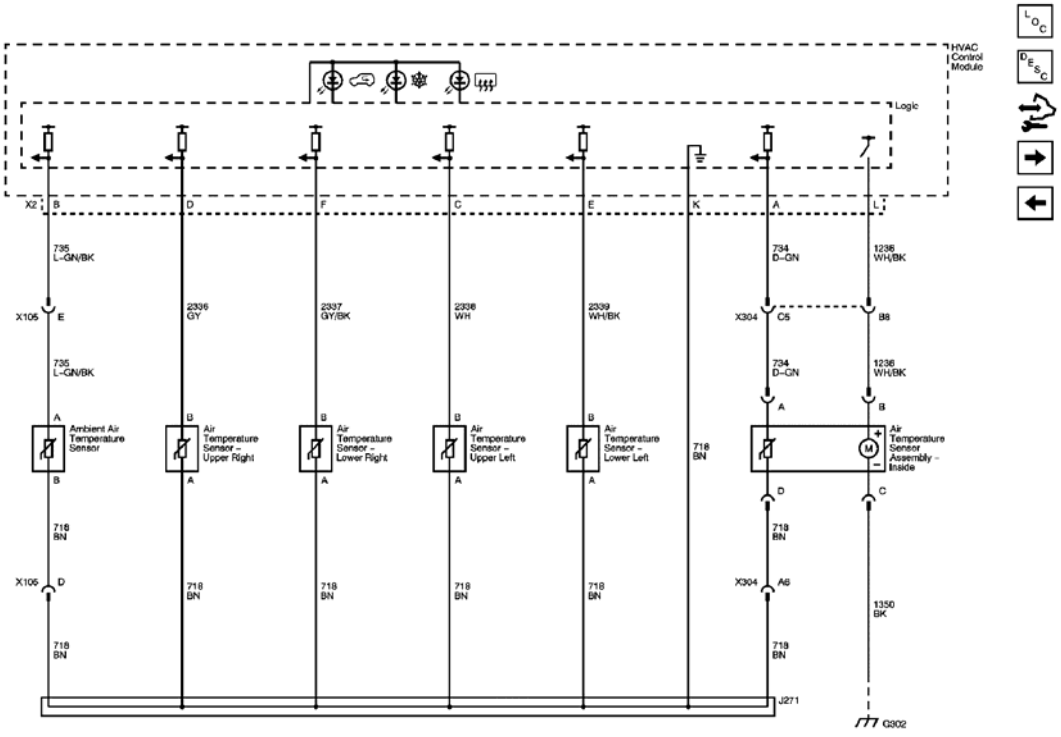

Fig. 4: Air Temperature Sensors Schematic
Courtesy of GENERAL MOTORS CORP.

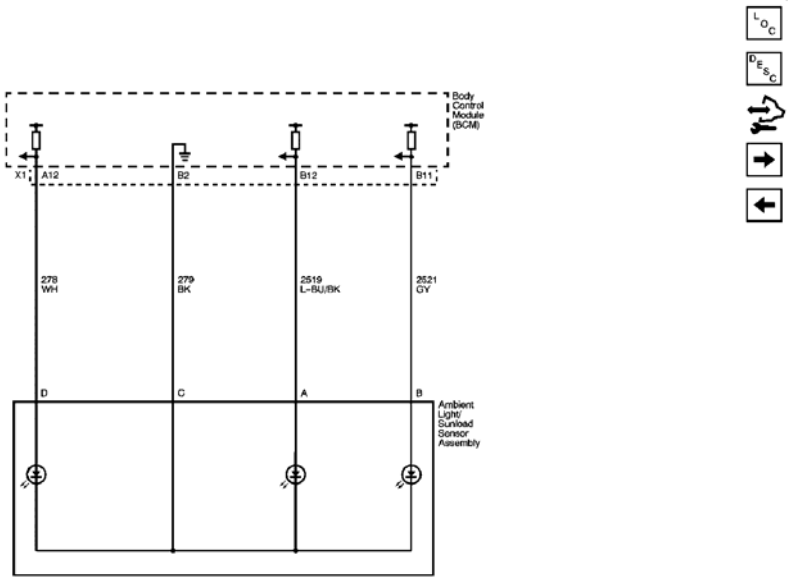

Fig. 5: Ambient Light/Sunload Sensors Schematic
Courtesy of GENERAL MOTORS CORP.

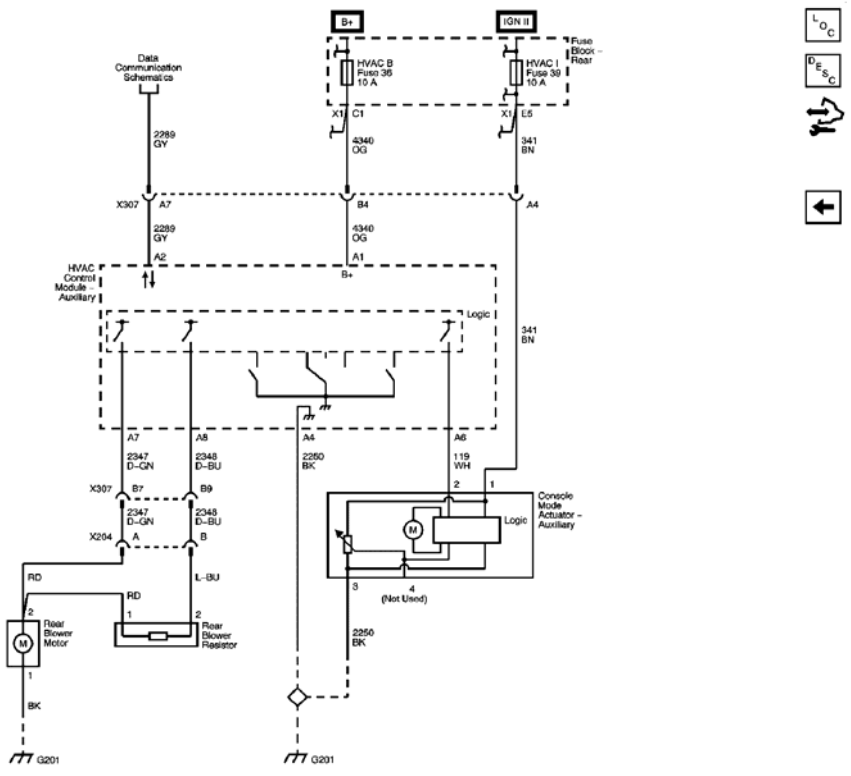

Fig. 6: Rear Auxiliary Controls Schematic
Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION & PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B0159 or B0164	B0159: Range/Performance Passenger Compartment Temp Sensor B0164: Circuit Range/Performance Output Air Temperature Sensor 1 Circuit
DTC B0174, B0179, B0510, or B0515	B0174: Range/Performance Output Air Temperature Sensor 2 Circuit B0179: Range/Performance Output Air Temperature Sensor 3 Circuit B0510: Range/Performance Output Air Temperature Sensor 4 Circuit B0515: Range/Performance
DTC B0183 or B0188	B0183: Solar Load Sensor 1 Circuit B0188: Solar Load Sensor 2 Circuit
DTC B0229, B0248, B0263, B0268, B0408, B0414, B0418, B0424, B3761, or B3770	B0229: Range/Performance Temperature Control 1 Feedback Circuit B0414: Range/Performance Temperature Control 2 Feedback Circuit B0424: Range/Performance B3761: Air Flow Control 3 Feedback Circuit

	B3770: Air Flow Control 6 Feedback Circuit B0248: Air Flow Control 3 Circuit B0263: Air Flow Control 6 Circuit B0268: Air Flow Control 7 Circuit B0408: Temperature Control 1 Circuit B0418: Temperature Control 2 Circuit
DTC P0530	P0530: Air Conditioning Refrigerant Pressure Sensor Circuit

DTC B0159 OR B0164

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0159

Range/Performance Passenger Compartment Temp Sensor

DTC B0164

Circuit Range/Performance Output Air Temperature Sensor 1 Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ambient Air Temperature Sensor Signal	B0159	B0159	B0159	-
Inside Air Temperature Sensor	B0164	B0164	B0164	-
Low Reference	-	B0159, B0164	B0159, B0164	-

Circuit/System Description

The ambient air temperature sensor allows the HVAC control module to monitor the temperature of the air surrounding the front of the vehicle. The inside air temperature sensor assembly allows the HVAC control module to monitor the temperature of the air inside the passenger compartment. The module applies 5 volts to internal input resistors that are connected to the signal circuits of the air temperature sensors. The module provides ground to the air temperature sensors through the low reference circuits. The HVAC control module monitors the voltage drops across the air temperature sensors and uses the inputs for automatic control calculations. The HVAC control module also uses the ambient air temperature input to calculate the value of the ambient air temperature display. When the air temperatures are cold, the resistances of the sensors are high and the voltage signals are high. When the air temperatures are hot, the resistances of the sensors are low and the

voltage signals are low.

Conditions for Running the DTC

The ignition is turned ON.

Conditions for Setting the DTC

- The HVAC control module detects the sensor signal circuit is less than -35°C (-39°F).
- The HVAC control module detects the sensor signal circuit is more than 85°C (185°F).

Action Taken When the DTC Sets

The HVAC control module uses a default air temperature value for further automatic control calculations. The default values are not displayed on the scan tool.

Conditions for Clearing the DTC

- The DTC will become history if the HVAC control module no longer detects a failure.
- The history DTC will clear after 100 fault-free ignition cycles.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

- **Air Temperature Description and Operation**
- **Air Delivery Description and Operation**

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Ignition ON, observe the Air Temp. Sensor parameter. The reading should be between -35°C (-39°F) and 85°C (185°F) and change with ambient air temperature changes.

Circuit/System Testing

IMPORTANT: An instant OAT update must be performed by pressing the A/C and Recirc buttons at the same time before and after the system has been serviced to update the filtered ambient air temperature sensor.

1. Ignition OFF, disconnect the harness connector at the air temp sensor.
2. Ignition OFF, test for less than 10 ohms between the low reference circuit terminal B and ground.
    - If greater than the specified range, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the HVAC control module.
3. Ignition ON, verify the scan tool Air Temp Sensor parameter is less than -35°C (-39°F).
    - If greater than the specified range, test the signal circuit terminal A for a short to ground. If the circuit tests normal, replace the HVAC control module.
4. Install a 3A fused jumper wire between the signal circuit terminal A and the low reference circuit terminal B. Verify the scan tool Air Temp Sensor Raw parameter is greater than 85°C (185°F).
    - If less than the specified range, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the HVAC control module.
5. If all circuits test normal, test or replace the air temp sensor.

Component Testing

1. Test the air temperature sensor by varying the sensor temperature while monitoring the sensor resistance.
2. Compare the readings with the Temperature VS Resistance table **Sensor Resistance Table** and verify that the resistance is within 5 percent of the specification.
    - If not within the specified range, replace the sensor.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Inside Air Temperature Sensor Replacement**
- **Ambient Air Temperature Sensor Replacement**
- **Control Module References** for HVAC control module replacement, setup, and programming

DTC B0174, B0179, B0510, OR B0515

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0174

Range/Performance Output Air Temperature Sensor 2 Circuit

DTC B0179

Range/Performance Output Air Temperature Sensor 3 Circuit

DTC B0510

Range/Performance Output Air Temperature Sensor 4 Circuit

DTC B0515

Range/Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Upper Left Air Temperature Sensor Signal	B0174	B0174	B0174	-
Upper Right Air Temperature Sensor Signal	B0510	B0510	B0510	-
Lower Left Air Temperature Sensor Signal	B0179	B0179	B0179	-
Lower Right Air Temperature Sensor Signal	B0515	B0515	B0515	-
Low Reference	-	B0174, B0510, B0179, B0515,	B0174, B0510, B0179, B0515,	-

Circuit/System Description

The HVAC control module supplies the air duct temperature sensors with a low reference circuit and 5-volt signal circuit. The HVAC control module determines the voltage drop across the sensor, which is proportional to temperature. As the air temperature increases, the sensor resistance decreases and the voltage signal decreases. As the air temperature decreases, the sensor resistance increases and the voltage signal increases.

- Output Air Temperature Sensor 1 refers to the upper left air duct temperature sensor
- Output Air Temperature Sensor 2 refers to the lower left air duct temperature sensor

- Output Air Temperature Sensor 3 refers to the upper right air duct temperature sensor
- Output Air Temperature Sensor 4 refers to the lower right air duct temperature sensor

Conditions for Running the DTC

The ignition is turned ON.

Conditions for Setting the DTC

The HVAC control module detects the inside air temperature sensor signal circuit is less than -36°C (-38°F) or greater than 215°C (419°F) for greater than 15 seconds.

Action Taken When the DTC Sets

The system operates using a default value.

Conditions for Clearing the DTC

- The DTC will become history if the HVAC control module no longer detects the condition that set the DTC.
- The history DTC will clear after 50 fault-free ignition cycles.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Air Temperature Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for Scan Tool Information

Circuit/System Verification

Ignition ON, observe the appropriate scan tool air duct temperature sensor. The reading should be between -35° C (-39°F) and 98°C (208°F) and change with duct air temperature changes.

Circuit/System Testing

IMPORTANT: If an air duct temperature sensor has an out of range condition caused by a short to voltage, short to ground, or an open/high resistance, the scan tool will display the same value: 39°F (4°C).

1. Ignition OFF, disconnect the harness connector at the appropriate air duct temperature sensor.
2. Ignition OFF, test for less than 10 ohms of resistance between the low reference circuit terminal 2 and ground.
    - If greater than the specified range, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the HVAC control module.
3. Ignition ON, test for 4.8-5.2 volts between the low reference circuit terminal 2 and the signal circuit terminal 1.
    - If less than the specified range, test the signal circuit for a short to ground or open/high resistance. If the circuit tests normal, replace the HVAC control module.
    - If greater than the specified range, test the signal circuit for a short to voltage. If the circuit tests normal, replace the HVAC control module.
4. If all circuits test normal, test or replace the air duct temperature sensor.

Component Testing

1. Test the air duct temperature sensor by varying the sensor temperature while monitoring the sensor resistance.
2. Compare the readings with the Temperature VS Resistance table **Sensor Resistance Table** and verify that the resistance is within 5 percent of the specification.
    - If not within the specified range, replace the sensor.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Air Temperature Sensor Replacement - Upper Right Side**
- **Air Temperature Sensor Replacement - Upper Left Side**
- **Air Temperature Sensor Replacement - Lower Left Side**
- **Air Temperature Sensor Replacement - Lower Right Side**
- **Control Module References** for HVAC control module replacement, setup and programming

DTC B0183 OR B0188

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0183

Solar Load Sensor 1 Circuit

DTC B0188

Solar Load Sensor 2 Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Sunload Sensor Signal	B0183	B0183	B0183	-
Right Sunload Sensor Signal	B0188	B0188	B0188	-
Sunload sensors Ground Circuit	-	B0183, B0188	B0183, B0188	-

Circuit Description

The sunload sensor is a 2-wire photo diode. The vehicle uses left and right sunload sensors. The two sensors are integrated into the sunload sensor assembly along with the ambient light sensor. Ground and signal circuits enable the sensors to operate. As the sunload increases, the sensor signal decreases. The sensor signal varies between 0 and 5 volts. The HVAC control module converts the signal to a range between 0 and 255 counts. The sunload sensor provides the HVAC control module with a measurement of the amount of light shining on the vehicle. Bright or high intensity light causes the vehicles interior temperature to increase. The HVAC system compensates for the increased temperature by diverting additional cool air into the vehicle.

The following DTCs are for the left and right sunload sensors.

- B0183 is for the left sunload sensor.
- B0188 is for the right sunload sensor.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The HVAC control module detects the signal circuit is less than 5 counts or greater than 250 counts.

Action Taken When the DTC Sets

- The driver information center (DIC) will display SERVICE A/C SYSTEM.
- The system will operate as if no sunload condition exists.

Conditions for Clearing the DTC

- The DTC will become history if the HVAC control module no longer detects the condition that set the DTC.
- The history DTC will clear after 50 fault-free ignition cycles.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

- **Air Temperature Description and Operation**
- **Air Delivery Description and Operation**

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Ignition ON, observe the appropriate scan tool Sunload Sensor Parameter. The reading should be between 5 and 250 counts and change with sunlight intensity.

Circuit/System Testing

IMPORTANT: If a solar load sensor has an out of range condition caused by a short to

voltage, short to ground, or an open/high resistance, the scan tool will display the same value: 225 counts.

1. Ignition OFF, disconnect the harness connector at the sunload sensor.
2. Test for less than 10 ohms of resistance between the ground circuit terminal C and ground.
   - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, test for 4.8-5.2 volts between the ground circuit terminal C and the appropriate signal circuit terminal.
   - Left solar load sensor circuit terminal A.
   - Right solar load sensor circuit terminal B.
   - If less than the specified range, test the signal circuit for a short to ground or open/high resistance. If the circuit tests normal, replace the HVAC control module.
   - If greater than the specified range, test the signal circuit for a short to voltage. If the circuit tests normal, replace the HVAC control module.
4. If all circuits test normal, test or replace the sunload sensor.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Sun Load Sensor Replacement**
- **Control Module References** for HVAC control module replacement, setup, and programming

DTC B0229, B0248, B0263, B0268, B0408, B0414, B0418, B0424, B3761, OR B3770

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0229

Range/Performance Temperature Control 1 Feedback Circuit

DTC B0414

Range/Performance Temperature Control 2 Feedback Circuit

DTC B0424

Range/Performance

DTC B3761

Air Flow Control 3 Feedback Circuit

DTC B3770

Air Flow Control 6 Feedback Circuit

DTC B0248

Air Flow Control 3 Circuit

DTC B0263

Air Flow Control 6 Circuit

DTC B0268

Air Flow Control 7 Circuit

DTC B0408

Temperature Control 1 Circuit

DTC B0418

Temperature Control 2 Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Recirculation 5-Volt Reference Circuit	DTC B0229, DTC B0414, DTC B0424, DTC B3761, DTC B3770, DTC B0248, DTC B0263, DTC B0268, DTC B0408 or DTC B0418	B0229	DTC B0229, DTC B0414, DTC B0424, DTC B3761, DTC B3770, DTC B0248, DTC B0263, DTC B0268, DTC B0408 or DTC B0418	B0229
Recirculation Door Position Signal	B0229	B0229	B0229	B0229
Recirculation Door Control Circuit	B0229	B0229	B0229	B0229

Voltage Supply Circuit	-	B0229	-	B0229
Recirculation Low Reference Circuit	-	B0229	-	B0229
Driver Air Temperature 5-Volt Reference Circuit	DTC B0229, DTC B0414, DTC B0424, DTC B3761, DTC B3770, DTC B0248, DTC B0263, DTC B0268, DTC B0408 or DTC B0418	B0414	DTC B0229, DTC B0414, DTC B0424, DTC B3761, DTC B3770, DTC B0248, DTC B0263, DTC B0268, DTC B0408 or DTC B0418	B0414
Driver Air Temperature Door Position Signal	B0414	B0414	B0414	B0414
Driver Air Temperature Door Control Circuit	B0414	B0414	B0414	-
Driver Air Temperature Door Voltage Supply Circuit	-	B0414	-	-
Driver Air Temperature Low Reference Circuit	-	B0413 05	-	-
Passenger Air Temperature 5-Volt Reference Circuit	DTC B0229, DTC B0414, DTC B0424, DTC B3761, DTC B3770, DTC B0248, DTC B0263, DTC B0268, DTC B0408 or DTC B0418	B0424	DTC B0229, DTC B0414, DTC B0424, DTC B3761, DTC B3770, DTC B0248, DTC B0263, DTC B0268, DTC B0408 or DTC B0418	B0424
Passenger Air Temperature Door Position Signal	B0424	B0424	B0424	B0424
Passenger Air Temperature Door Control Circuit	B0424	B0424	B0424	B0424
Passenger Air Temperature Door Voltage Supply Circuit	-	B0424	-	-
Passenger Air Temperature Low Reference Circuit	-	B0424	-	-
	DTC B0229, DTC B0414, DTC B0424, DTC B3761, DTC		DTC B0229, DTC B0414, DTC B0424, DTC B3761,	

Mode 5-Volt Reference Circuit	B3770, DTC B0248, DTC B0263, DTC B0268, DTC B0408 or DTC B0418	B3770	DTC B3770, DTC B0248, DTC B0263, DTC B0268, DTC B0408 or DTC B0418	B3770
Mode Door Position Signal	B3770	B3770	B3770	B3770
Mode Door Control Circuit	B3770	B3770	B3770	B3770
Mode Door Supply Voltage Circuit	-	B3770	-	-
Mode Low Reference Circuit	-	B3770	-	-

Circuit/System Description

The HVAC control module controls the HVAC door actuators to regulate the airflow through the HVAC system. Each actuator consists of an electric motor and a potentiometer. The module supplies a low reference and 5-volt reference source voltage to the potentiometer. The HVAC control module monitors the voltage drop across the potentiometer on the door position signal circuit. When the actuator shaft rotates, the voltage on the door position signal circuit changes. The control circuit uses either a 0, 2.5 or 5-volt signal to command the actuator movement. When the actuator is at rest, the control circuit value is 2.5 volts. A 0 or 5-volt control signal commands the actuator movement in opposite directions.

- B0229 is for the recirculation actuator.
- B0414 is for the left air temperature actuator.
- B0424 is for the right air temperature actuator.
- B3761 is for the defrost actuator.
- B3770 is for the mode actuator.
- B0248 is for the defrost actuator.
- B0263 is for the mode actuator.
- B0268 is for the recirculation actuator.
- B0408 is for the left air temperature actuator.
- B0418 is for the right air temperature actuator.

Conditions for Running the DTC

- The ignition is ON.
- The HVAC module is ON.

Conditions for Setting the DTC

The actual door position differs from the commanded door position by more than 4 counts or the HVAC control module detects the door position signal circuit is less than 3 counts or greater than 253 counts.

Action Taken When the DTC Sets

The control circuit is deactivated for the appropriate actuator.

Conditions for Clearing the DTC

- The DTC becomes history when the HVAC control module no longer detects the condition that set the DTC.
- The history DTC will clear after 50 fault-free ignition cycles.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

- **Air Delivery Description and Operation**
- **Air Temperature Description and Operation**

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Ignition ON, command the appropriate actuator in both directions with a scan tool. The scan tool door position parameter reading should be between 3 and 253 counts.

Circuit/System Testing

1. Ignition OFF, disconnect the appropriate actuator and test for less than 1 ohm between the low reference circuit and ground.
    - If greater than 1 ohm, test the low reference circuit for an open/high resistance. If the circuit tests

normal, replace the HVAC control module.

2. Ignition ON, test for 4.8-5.2 volts between the 5-volt reference circuit and ground.
    - If less than 4.8 volts, test the 5-volt reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the HVAC control module.
    - If greater than 5.2 volts, test the 5-volt reference circuit for a short to voltage. If the circuit tests normal, replace the HVAC control module.
3. Verify the appropriate scan tool parameter is less than 4 counts.
    - If greater than 4 counts, test the signal circuit for a short to ground. If the circuit tests normal, replace the HVAC control module.
4. Install a 3-amp fused jumper wire between the signal circuit and the low reference circuit terminal. Verify the appropriate scan tool parameter is greater than 250 counts.
    - If less than 250 counts, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the HVAC control module.
5. Ignition ON, verify that a test lamp illuminates between the ignition 3 circuit and ground.
    - If the test lamp does not illuminate, test the ignition 3 circuit for a short to ground an open/high resistance.
6. Install a DMM between the actuator control circuit and ground. While monitoring the DMM use the scan tool to command the appropriate actuator from one direction to the other. If the voltage on the control circuit moves from 0 volts in one direction to 5 volts in the other direction and 2.5 volts in the at rest state.
    - If the voltage does not change, test the control circuit for an open, short to voltage or short to ground. If circuit tests normal replace the HVAC control module.
7. If all circuits test normal, replace the actuator.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Recirculation Actuator Replacement**
- **Mode Actuator Replacement**
- **Air Temperature Actuator Replacement - Left Side**
- **Air Temperature Actuator Replacement - Right Side**
- **Defroster Actuator Replacement**
- **Control Module References** for HVAC control module and HVAC Auxiliary control module or rear seat audio (RSA) replacement, setup, and programming

DTC P0530

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0530

Air Conditioning Refrigerant Pressure Sensor Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5-Volt Reference Circuit	P0530	P0530	-	-
A/C Refrigerant Pressure Sensor Signal Circuit	P0530	P0530	P0530	-
Low Reference Circuit	-	P0530	-	-

Circuit/System Description

The engine control module (ECM) monitors the high side refrigerant pressure through the A/C refrigerant pressure sensor. The ECM supplies a 5-volt reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the sensor signal to the ECM to vary. When the pressure is high, the signal voltage is high. When the pressure is low, the signal voltage is low. When pressure is high, the ECM commands the cooling fans on. When pressure is too high or too low, the ECM will not allow the A/C compressor clutch to engage.

Conditions for Running the DTC

- Engine is running.
- Any of the conditions for setting the DTC are met for 15 seconds.
- Battery voltage is between 11-18 volts.

Conditions for Setting the DTC

- The ECM detects that the A/C pressure is less than 1 psi (0.01 volt).
- The ECM detects that the A/C pressure is more than 428 psi (4.92 volts).

Action Taken When the DTC Sets

- The ECM will not illuminate the malfunction indicator lamp (MIL)
- The ECM stores the Failure Records.
- The A/C compressor clutch is disabled.

Conditions for Clearing the DTC

- The history DTC will clear after 40 consecutive ignition cycles have occurred without a malfunction.
- The DTC will become history if the ECM no longer detects a failure.

Diagnostic Aids

A malfunction within the refrigerant system causing high pressure can cause this DTC to set.

Reference Information

Schematic Reference

HVAC Schematics

Description and Operation

- **Air Delivery Description and Operation**
- **Air Temperature Description and Operation**

Electrical Information Reference

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

Scan Tool Reference

Control Module References for Scan Tool Information

Circuit/System Verification

Ignition ON, observe the scan tool A/C High Side Pressure Sensor parameter. The reading should be between 1 psi and 428 psi.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the A/C pressure sensor.
2. Ignition OFF, test for less than 1 ohm of resistance between the low reference circuit terminal 1 and ground.
    - If greater than 1 ohm, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the ECM.
3. Ignition ON, test for 4.8-5.2 volts between the 5-volt reference circuit terminal 2 and ground.
    - If less than 4.8 volts, test the 5-volt reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the ECM.

- If greater than 5.2 volts, test the 5-volt reference circuit for a short to voltage. If the circuit tests normal, replace the ECM.

4. Verify the scan tool A/C High Side Pressure Sensor parameter is less than 428 psi.
   - If greater than 428 psi, test the signal circuit terminal 3 for a short to voltage. If the circuit tests normal, replace the ECM.
5. Install a 3-amp fused jumper wire between the signal circuit terminal 3 and the 5-volt reference circuit terminal 2. Verify the scan tool A/C High Side Pressure Sensor parameter is greater than 428 psi.
   - If less than 428 psi, test the signal circuit for short to ground or an open/high resistance. If the circuit tests normal, replace the ECM.
6. If all circuits test normal, test or replace the A/C Pressure Sensor.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement**
- **Control Module References** for ECM replacement, setup, and programming

SYMPTOMS - HVAC SYSTEMS - AUTOMATIC

IMPORTANT: Review the system operation in order to familiarize yourself with the system functions. Refer to the following procedures:

- **Air Delivery Description and Operation**
- **Air Temperature Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the HVAC System. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Verify the A/C compressor clutch turns freely and is not seized.
- The A/C compressor will not operate in cold outside air temperatures. Refer to **Air Temperature Description and Operation**.
- The following could cause window fogging:
  - Wet carpet or mats
  - High humidity
  - Interior water leak
  - Blocked A/C evaporator drain tube
  - Maximum passenger capacity
  - Blocked body pressure relief valves

- Inspect the air distribution system for causes of reduced air flow:
  - Obstructed or dirty passenger compartment air filter, if equipped
  - Blocked or damaged air inlet or outlet vents

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:

- **Air Conditioning Compressor Malfunction**
- **Blower Motor Malfunction**
- **Leak Testing**
- **Noise Diagnosis - HVAC Module**
- **Noise Diagnosis - Blower Motor**
- **Odor Diagnosis**

AIR CONDITIONING COMPRESSOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Circuit	1	1	-	-
A/C Relay Coil Side Supply Voltage Circuit	1	1	-	-
Ignition 1 Circuit	1	1	-	-
A/C Compressor Clutch Relay Control	P0645	P0645	P0645	-
A/C Relay Coil Side Ground Circuit	-	1	-	-
1. A/C Compressor Inoperative				

Circuit/System Description

When the A/C switch is pressed, the HVAC control module grounds the A/C request signal circuit. This input will request the ECM to ground the A/C compressor clutch relay control circuit, which will switch the A/C

CMPRSR CLUTCH relay on. With the relay contacts closed, battery voltage is supplied to the A/C compressor clutch assembly.

Diagnostic Aids

The following conditions must be met in order for the ECM to turn on the compressor clutch:

- Battery voltage is between 9-18 volts
- Engine coolant temperature (ECT) is less than 123°C (253°F)
- Engine speed is greater than 600 RPM
- Engine speed is less than 4,760 RPM
- A/C high side pressure is between 2929-269 kPa (39-425 psi)
- Throttle position is less than 100 percent
- Evaporator temperature is greater than 0°C (32°F)
- ECM does not detect excessive torque load
- ECM does not detect insufficient idle quality
- The ambient temperature is above 1°C (34°F)

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

- **Air Temperature Description and Operation**
- **Air Delivery Description and Operation**

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine running
2. Press the A/C request switch. The A/C compressor clutch should engage.
3. Place the mode switch in the defrost position. The A/C compressor clutch should engage.
    - If the clutch does not engage refer to **Air Conditioning (A/C) System Performance Test**

Circuit/System Testing

1. Ignition OFF, disconnect the X2 harness connector at the HVAC control module.
2. Test for less than 1.0 ohm of resistance between the ground circuit terminal and ground.
    - If greater than the specified, test the ground circuit for an open/high resistance.
3. Remove the A/C compressor clutch relay.
4. Verify that a test lamp illuminates between the relay coil B+ circuit terminal 85 and ground.
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance.
5. Verify that a test lamp illuminates between the relay switch B+ circuit terminal 30 and ground.
    - If the test lamp does not illuminate, test the relay switch B+ circuit for an open/high resistance. If the A/C clutch fuse is open, test the relay switch control circuit for a short to ground. If all circuits test normal, test or replace the A/C compressor clutch.
6. Disconnect the harness connector at the A/C compressor clutch terminal 1.
7. Ignition OFF test for less than 1.0 ohm of resistance between the A/C compressor ground circuit terminal 2 and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
8. Connect the harness connector at the A/C compressor clutch.
9. Connect a 10-amp fused jumper wire between the relay switch B+ circuit terminal 30 and the relay switch control circuit terminal 87. Verify the A/C compressor clutch engages.
    - If the A/C compressor clutch does not activate, test the control circuit for an open/high resistance. If the circuit tests normal, test or replace the A/C compressor.
10. Connect a test lamp between the relay control circuit terminal 86 and the relay coil B+ circuit terminal 85.
11. Using a scan tool, command the A/C relay output ON and OFF. The test lamp should turn ON and OFF when changing between the commanded states.
    - If the test lamp remains ON all the time, test for a short to ground on the control circuit connector X1 terminal 53. If the circuit tests normal, replace the ECM.
    - If the test lamp remains OFF all the time, test for a short to voltage or an open/high resistance on the control circuit. If the circuit tests normal, replace the ECM.
12. If all circuits test normal, test or replace the A/C compressor.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Compressor Replacement (LL8)** or **Compressor Replacement (LH6, LS2)**
- **Control Module References** for HVAC control module and ECM replacement, setup, and programming

BLOWER MOTOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Battery Positive Voltage Circuit at the Blower Motor Control module	-	1	-	-
Blower Motor Speed Control Circuit at the Blower Motor Control module	2	1	1	-
Blower Motor Low Reference Circuit (between motor and control module)	-	1	-	-
Ground Circuit of the Blower Motor Control module	-	1	-	-
1. Blower Motor Inoperative 2. Blower Motor Always On				

Circuit/System Description

Blower Motor Control Module

The blower motor control module is an interface between the HVAC control module and the blower motor. The blower motor speed control, battery positive and ground circuits enable the control module to operate. The HVAC control module provides a pulse width modulation (PWM) signal to the blower motor speed control module in order to command the blower motor speed. The module supplies 12 volts to the blower motor through the blower motor voltage supply circuit.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

- **Air Delivery Description and Operation**
- **Air Temperature Description and Operation**

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the blower motor control module connector.
2. Test for less than 1.0 ohm of resistance between the ground circuit terminal C and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify that a test lamp illuminates between the B+ circuit of the blower motor speed control module supply voltage terminal, terminal A and ground.
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the B+ circuit fuse (HVAC 15-amp) in the instrument panel (IP) BEC is open, test all components connected to the B+ circuit and replace as necessary.
4. Connect a test lamp between the blower motor speed control circuit terminal B and the blower motor supply voltage circuit terminal A of the blower motor control module.
5. Turn the blower motor ON and then OFF. The test lamp should turn ON and OFF when changing between the commanded states.
    - If the test lamp is always ON, test the control circuit for a short to ground. If the circuit tests normal, replace the HVAC control module.
    - If the test lamp is always OFF, test the speed control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the HVAC control module.
6. Ignition OFF, connect the harness connector at the blower motor control module.
7. Disconnect the harness connector at the blower motor.
8. Ignition ON, verify that a test lamp illuminates between the blower motor supply voltage circuit terminal A at the blower motor and ground.
    - If the test lamp does not illuminate, test the blower motor supply voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the blower motor control module.
9. Connect a test lamp between the blower motor supply voltage circuit terminal A and the blower motor ground circuit terminal B of the blower motor.

10. Turn the blower motor ON high speed then to low speed. The test lamp intensity should be bright when ON high speed and very dim or out when the blower is on low speed.
    - If the test lamp intensity is not correct, test the blower motor ground circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the blower motor control module.
11. If all circuits test normal, replace the blower motor.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Blower Motor Control Processor Replacement**
- **Blower Motor Replacement**
- **Control Module References** for ECM, and HVAC control module setup, replacement, and programming

AUXILIARY BLOWER MOTOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Blower Motor Relay Switch B+	2	2	-	-
Blower Motor Relay Coil Ignition	2	2	-	-
Blower Motor Resistor Control	1	1	1	-
Relay Controlled Output Circuit	2	2	-	-
Blower Motor Control	2	2	-	-
Blower Motor Relay Coil Ground	-	2	2	-
Blower Motor Switch Ground	-	2	2	-
1. Blower Motor Malfunction 2. Blower Motor Inoperative				

Circuit/System Description

Low speed is air flowing through the center console ducts being pushed by the front blower motor. Medium speed is controlled by the auxiliary HVAC control module using 1 resistor in series with the blower motor. High speed is also controlled by the auxiliary HVAC control module it applies battery voltage straight to the auxiliary blower motor.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

- **Air Temperature Description and Operation**
- **Air Delivery Description and Operation**

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Ignition ON, mode selector set to Vent, command the blower motor from MED to HIGH by changing the blower motor switch positions, the blower motor should activate and operate from medium to high when changing between the commanded states.

Circuit/System Testing

Blower Motor Malfunction

1. Ignition OFF, disconnect the harness connector at the auxiliary HVAC control module.
2. Ignition OFF, test for less than 1.0 ohm between the ground circuit terminal A4 and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, place the auxiliary blower motor in each speed position. Verify that a test lamp does illuminate between each control circuit terminal for the proper switch position and ground.
    - If the test lamp does not illuminate, test the appropriate control circuit for a short to ground, open or high resistance.
4. Ignition ON, place the auxiliary blower in the high speed position. Connect a test lamp between the control circuit terminal 2 and the ground circuit terminal 1 at the blower motor.
    - If the test lamp is OFF, test the ground circuit for an open/high resistance. If the circuit tests

normal, replace the blower motor.

Component Testing

Blower Motor

1. Ignition OFF, disconnect the harness connector at the blower motor.
2. Install a 30-amp fused jumper wire between the relay controlled output circuit terminal A and 12 volts. Install a jumper wire between the control circuit terminal B and ground. Verify the blower motor activates.
    - If the blower motor does not activate, replace the blower motor.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Auxiliary Blower Motor Replacement**
- **Blower Motor Resistor Assembly Replacement**
- **Control Module References**

AMBIENT AIR TEMPERATURE DISPLAY UPDATING

The HVAC control module will not request compressor clutch engagement when the ambient air temperature display is less than 5°C (40°F). In order to inspect compressor clutch operation during cold weather conditions, the vehicle must be brought inside and the ambient air temperature display must be updated. To update the ambient air temperature display on the HVAC control module, perform the following procedure:

1. Turn ON the ignition.
2. Simultaneously press the MODE, FRONT DEFROST and REAR DEFROST switches.

ACTUATOR RECALIBRATION

When replacing the HVAC control module it will be necessary to allow the HVAC control module to perform a calibration process. When installing the HVAC control module be sure to perform the following:

IMPORTANT: Do not adjust any controls on the HVAC control module while the HVAC control module is self-calibrating. If interrupted, improper HVAC performance will result.

1. Place the ignition switch to the OFF position.
2. Disconnect the scan tool.
3. Install the HVAC control module.
4. Connect all previously disconnected components.
5. Start the vehicle.

6. Wait 40 seconds for the HVAC control module to self-calibrate.
7. Verify that no DTCs have set as current DTCs.

When replacing the HVAC actuator it will be necessary to allow the HVAC control module to perform a calibration process. When installing the HVAC actuator be sure to perform one of the following:

IMPORTANT: Do not adjust any controls on the HVAC control module while the HVAC control module is self-calibrating. If interrupted improper HVAC performance will result.

Preferred Method (w/ Scan Tool)

1. Clear all DTCs.
2. Place the ignition switch in the OFF position.
3. Install the HVAC actuator.
4. Connect all previously disconnected components.
5. Start the vehicle.
6. With the scan tool, initiate the Motor Re-calibration feature of the Heating and Air Conditioning Special Functions menu.
7. Verify that no DTCs have set as current DTCs.

IMPORTANT: Do not adjust any controls on the HVAC control module while the HVAC control module is self-calibrating. If interrupted, improper HVAC performance will result.

Alternate Method (w/o Scan Tool)

1. Clear all DTCs.
2. Place the ignition switch to the OFF position.
3. Install the HVAC actuator.
4. Connect all previously disconnected components.
5. Remove the HVAC B fuse for a minimum of 10 seconds.
6. Install the HVAC B fuse.
7. Start the vehicle.
8. Wait 40 seconds for the HVAC control module to self-calibrate.
9. Verify that no DTCs have set as current DTCs.

REPAIR INSTRUCTIONS

HVAC CONTROL MODULE REPLACEMENT

Removal Procedure

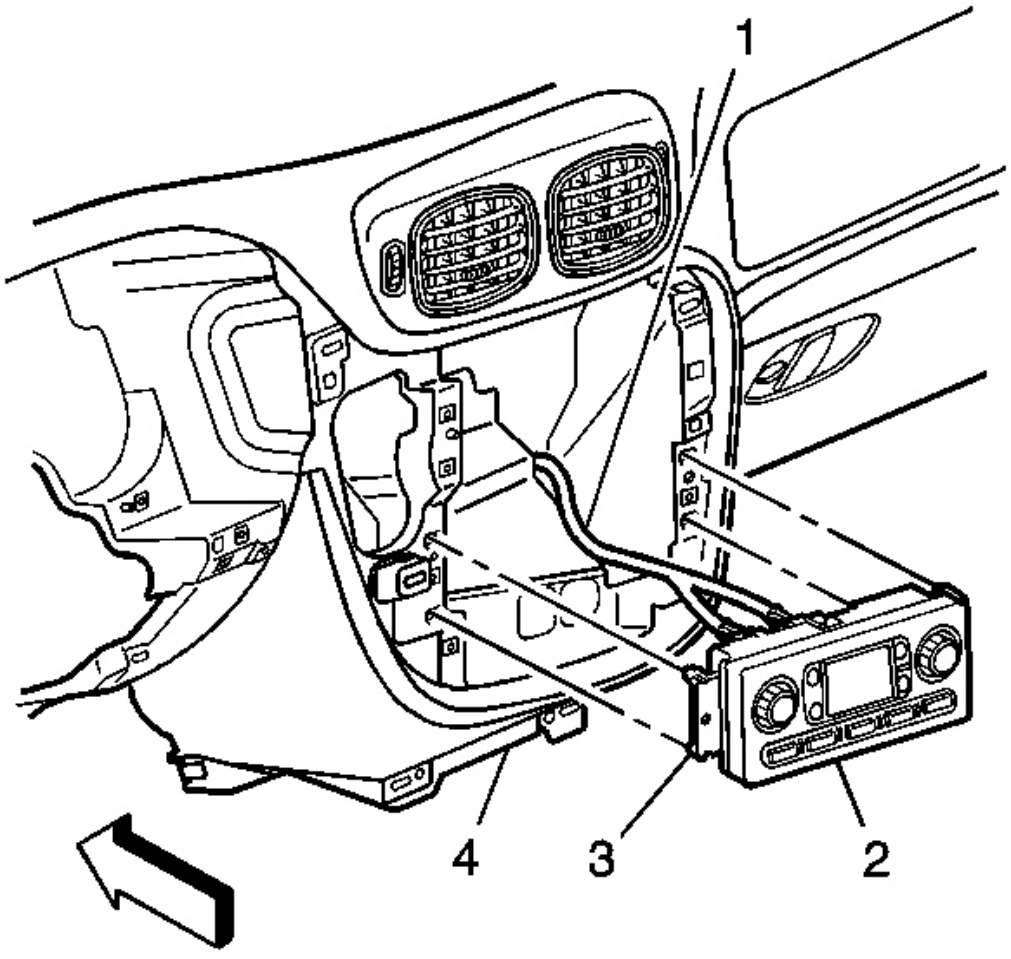

Fig. 7: View Of HVAC Control Module
Courtesy of GENERAL MOTORS CORP.

1. Remove the I/P accessory trim plate. Refer to **Instrument Panel Accessory Trim Plate Replacement (GMC)** or **Instrument Panel Cluster Trim Plate Bezel Replacement (Chevrolet)** or **Instrument Panel Cluster Trim Plate Bezel Replacement (GMC, Buick)** .
2. Remove the HVAC control module screws.
3. Depress the HVAC control module tabs (3) and remove the HVAC control module (2) from the I/P (4).
4. Disconnect the electrical connectors (1) from the HVAC control module (2).

Installation Procedure

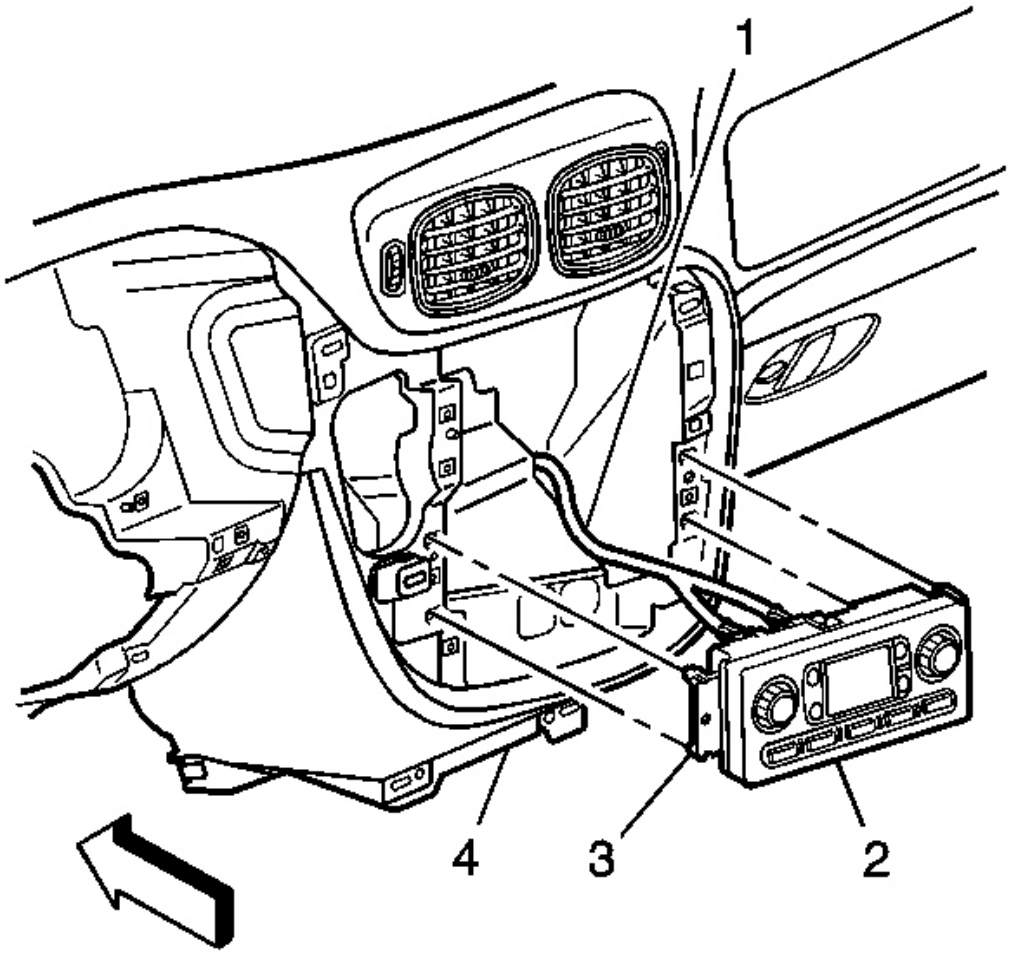

Fig. 8: View Of HVAC Control Module
Courtesy of GENERAL MOTORS CORP.

1. Connect the electrical connectors (1) to the HVAC control module (2).

IMPORTANT: Ensure that the HVAC control module tabs (3) lock into place.

2. Install the HVAC control module (2) into the I/P (4).

NOTE: Refer to Fastener Notice .

3. Install the HVAC control module screws.

Tighten: Tighten the screws to 1.9 N.m (17 lb in).

4. Install the I/P accessory trim plate. Refer to **Instrument Panel Accessory Trim Plate Replacement (GMC)** or**Instrument Panel Cluster Trim Plate Bezel Replacement (Chevrolet)** or **Instrument Panel Cluster Trim Plate Bezel Replacement (GMC, Buick)** .

AUXILIARY HEATER & AIR CONDITIONING CONTROL MODULE REPLACEMENT

Removal Procedure

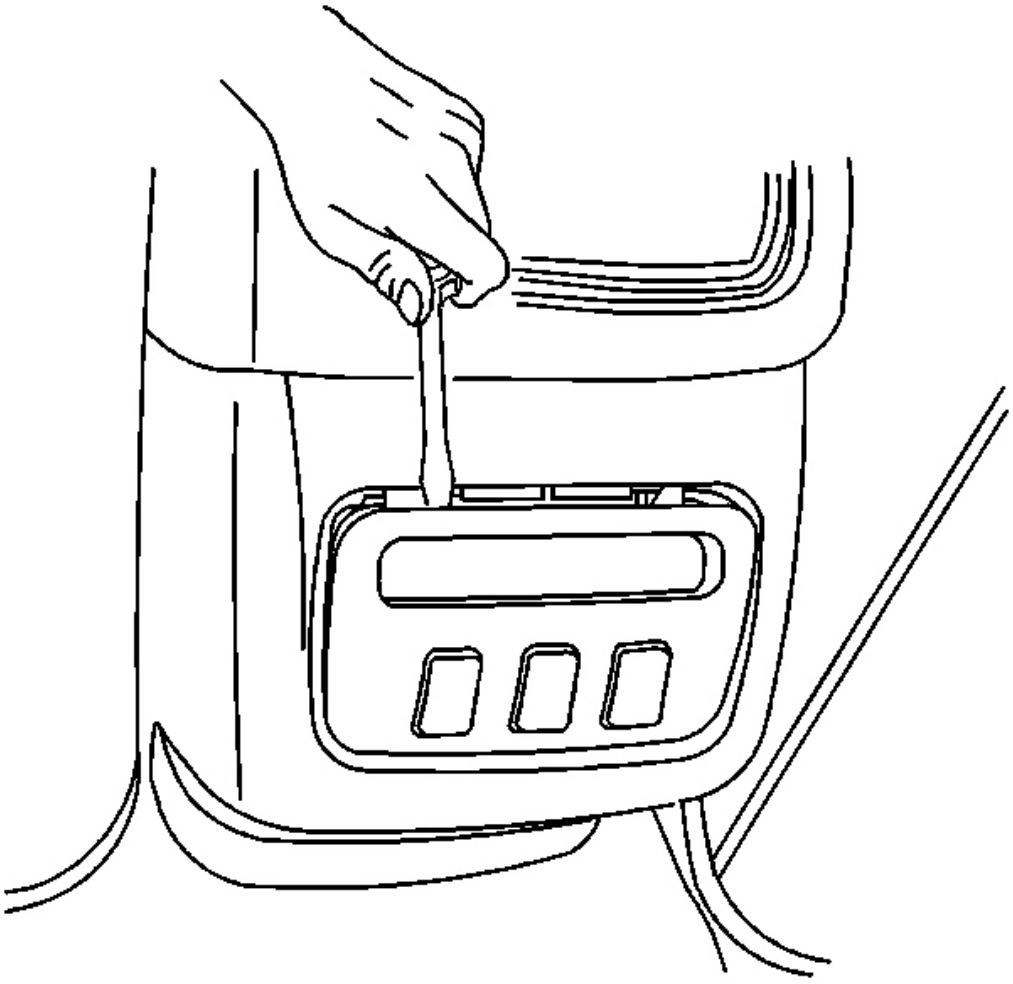

Fig. 9: Removing Auxiliary HVAC Control Module
Courtesy of GENERAL MOTORS CORP.

1. Using a flat bladed tool, carefully pry out on the top of the HVAC control-auxiliary.
2. Remove the HVAC control-auxiliary from the center console/seat.

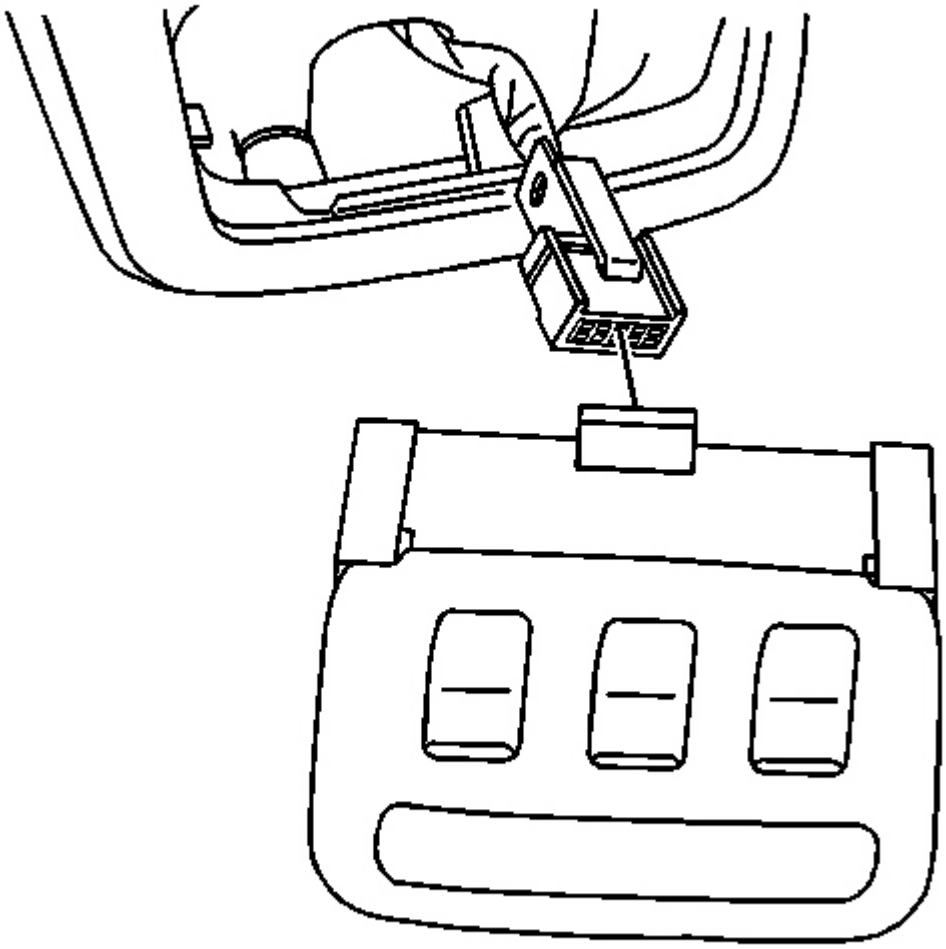

Fig. 10: View Of HVAC Control-Auxiliary Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the electrical connector.
4. Remove the HVAC control-auxiliary.

Installation Procedure

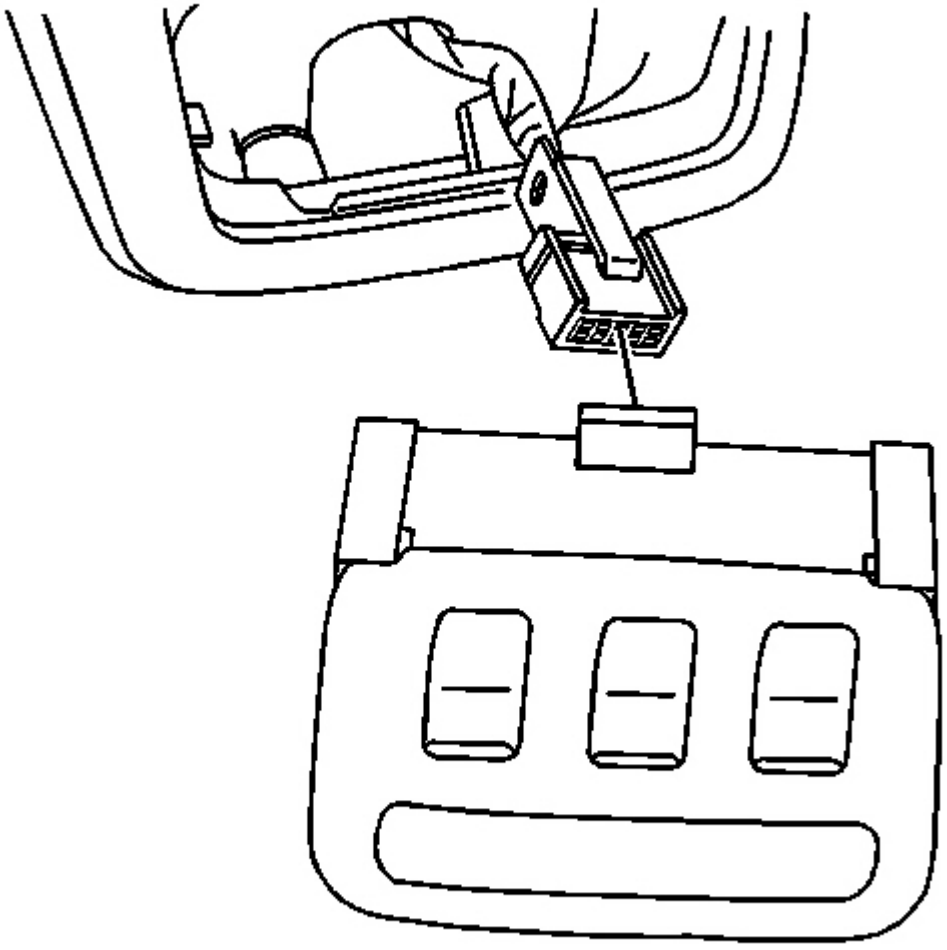

Fig. 11: View Of HVAC Control-Auxiliary Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Connect the HVAC control-auxiliary electrical connector.

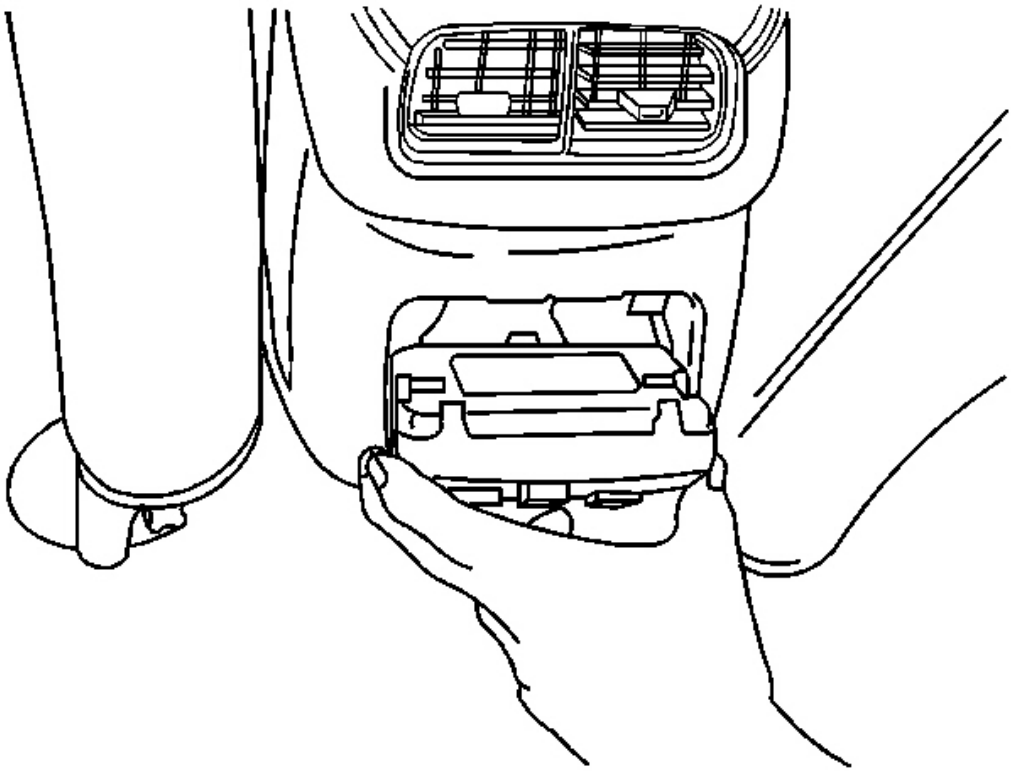

Fig. 12: View Of Auxiliary HVAC Control Module
Courtesy of GENERAL MOTORS CORP.

2. Install the HVAC control-auxiliary in the console bottom first.
3. Push in at the top of the HVAC control-auxiliary in order to engage the HVAC control-auxiliary in the console/seat.

BLOWER MOTOR CONTROL PROCESSOR REPLACEMENT

Removal Procedure

1. Remove the right closeout panel. Refer to **Instrument Panel Insulator Panel Replacement - Right Side** .
2. Disconnect the electrical connector from the blower motor.

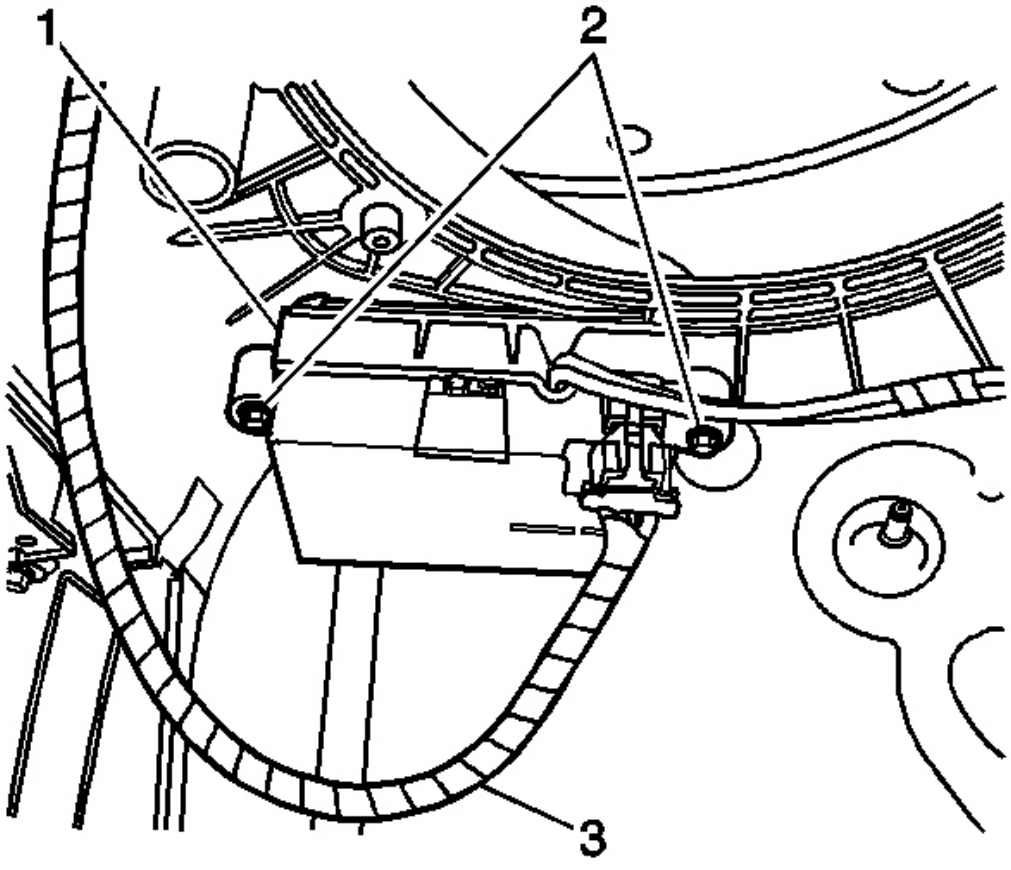

Fig. 13: View Of Electrical Connector, Blower Motor Control Processor & Mounting Screws
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the electrical connector (3) from the blower motor control processor (1).
4. Remove the blower motor control processor mounting screws (2).
5. Remove the blower motor control processor (1).

Installation Procedure

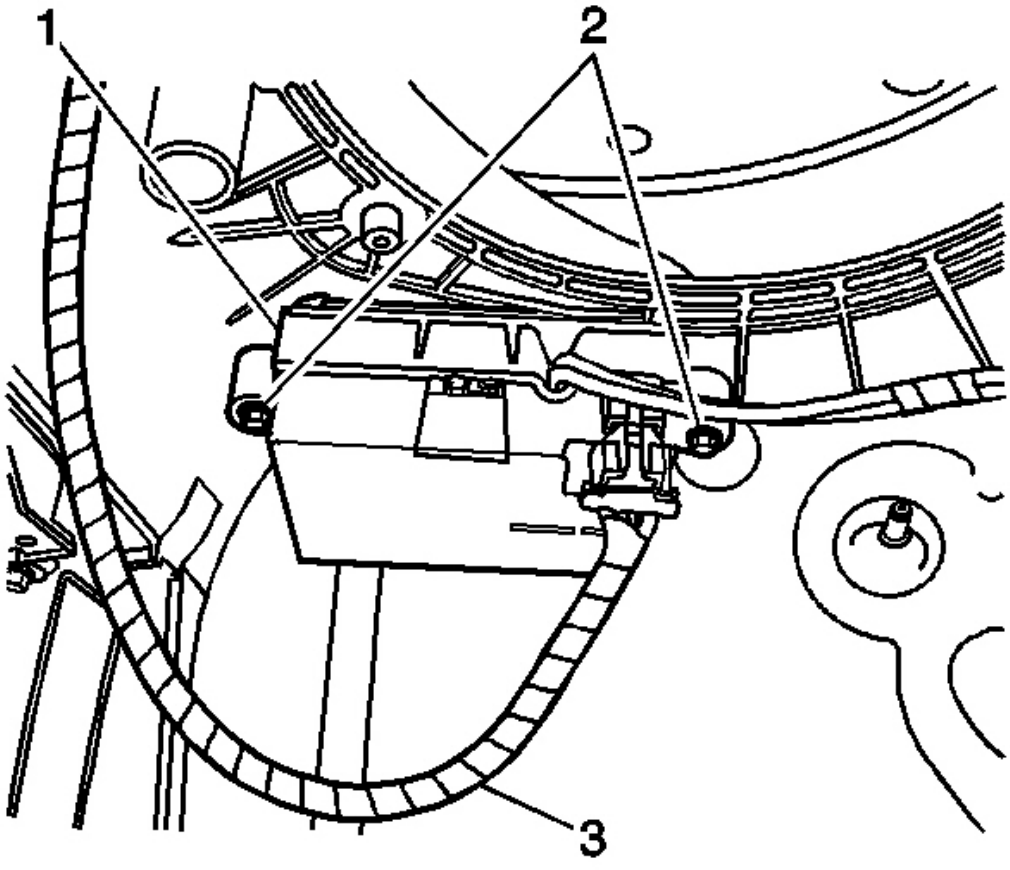

Fig. 14: View Of Electrical Connector, Blower Motor Control Processor & Mounting Screws
Courtesy of GENERAL MOTORS CORP.

1. Install the blower motor control processor (1).

   NOTE: Refer to Fastener Notice .

2. Install the blower motor control processor mounting screws (2).

   Tighten: Tighten the screws to 1.9 N.m (17 lb in).

3. Connect the electrical connector (3) to the blower motor control processor (1).
4. Connect the electrical connector to the blower motor.
5. Install the right closeout panel. Refer to **Instrument Panel Insulator Panel Replacement - Right Side** .

RECIRCULATION ACTUATOR REPLACEMENT

Removal Procedure

1. Remove the HVAC module assembly. Refer to **HVAC Module Assembly Replacement** .
2. Remove the screws from the air inlet assembly.
3. Remove the air inlet assembly.

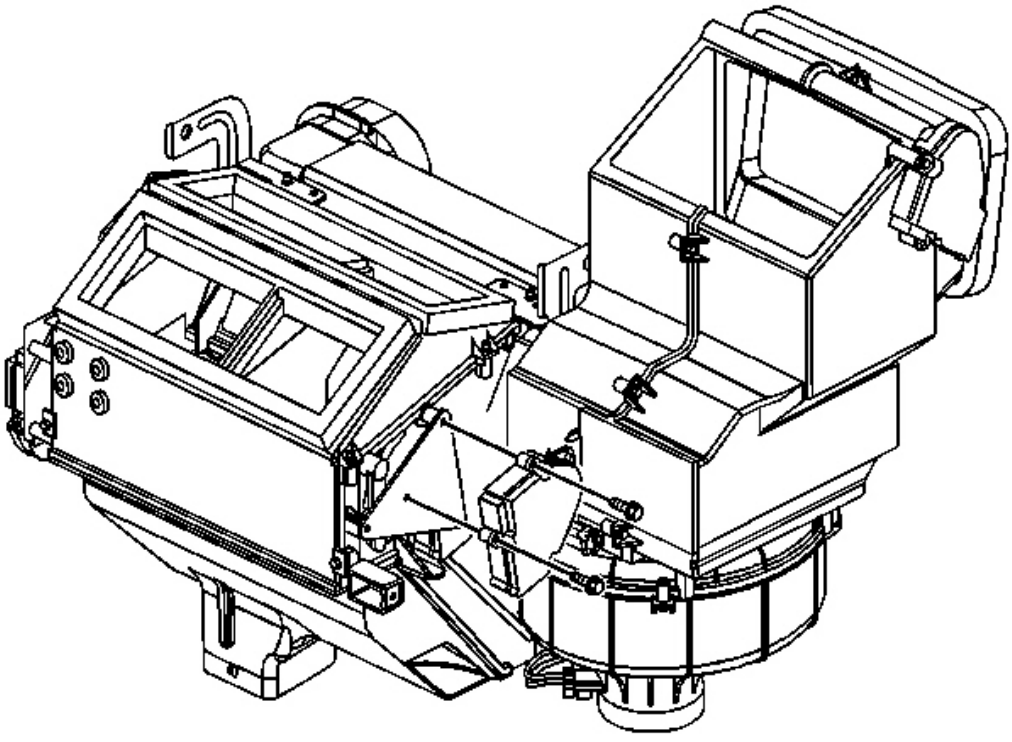

Fig. 15: View Of HVAC Module
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the recirculation actuator electrical connector
5. Remove the recirculation actuator screws.
6. Remove the recirculation actuator.

Installation Procedure

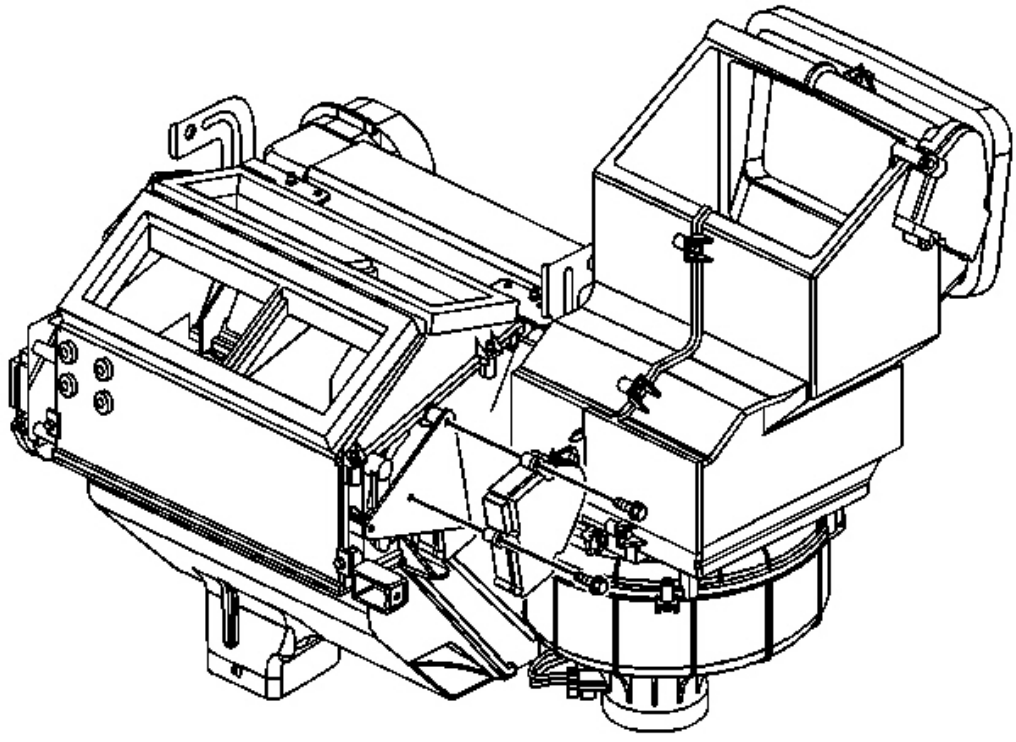

Fig. 16: View Of HVAC Module
Courtesy of GENERAL MOTORS CORP.

1. Install the recirculation actuator.
2. Install the air inlet assembly.

NOTE: **Refer to Fastener Notice .**

3. Install the recirculation actuator screws.

   Tighten: Tighten the screws to 1.9 N.m (17 lb in).

4. Connect the recirculation actuator electrical connector.
5. Install the HVAC module assembly. Refer to **HVAC Module Assembly Replacement** .
6. Recalibrate the recirculation actuator on vehicles equipped with automatic climate control (C68). Refer to **Actuator Recalibration**.

MODE ACTUATOR REPLACEMENT

Removal Procedure

1. Remove the left side sound insulator screws.
2. Remove the left hand floor duct. Refer to **Floor Air Outlet Duct Replacement - Left Side (with JF4)** or **Floor Air Outlet Duct Replacement - Left Side (without JF4)** .

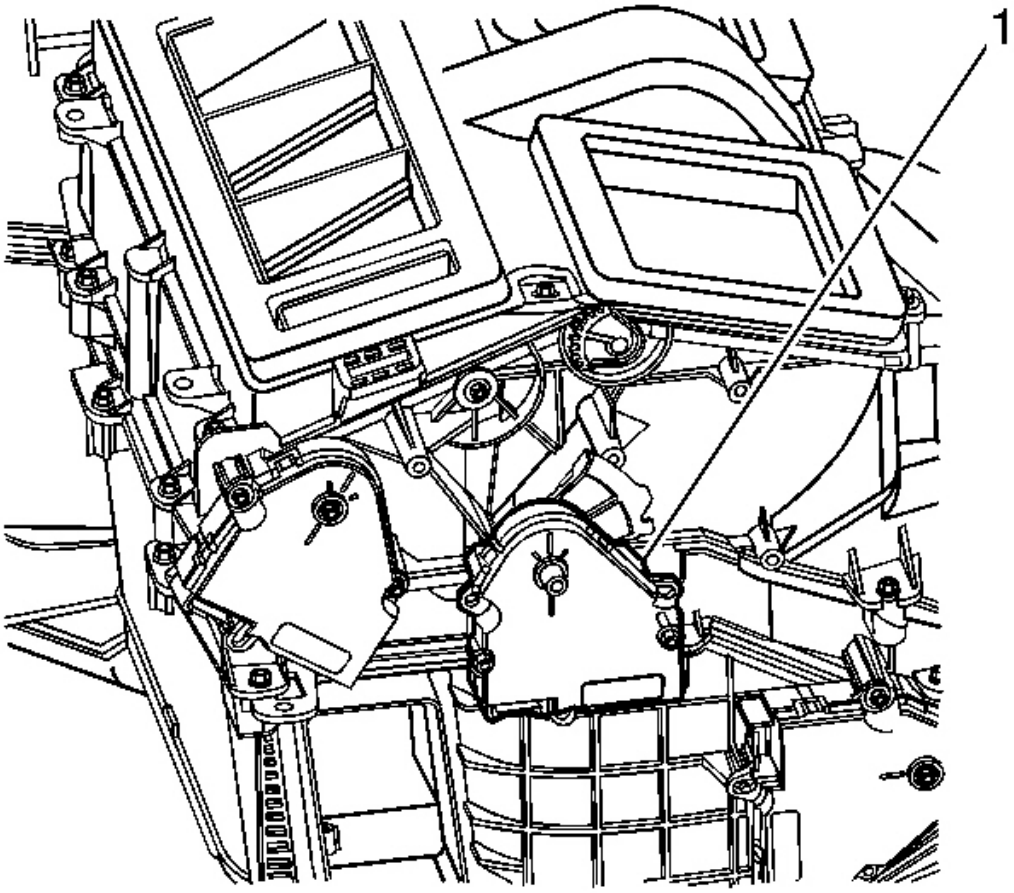

Fig. 17: Identifying Mode Actuator
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the electrical connector from the mode actuator.
4. Remove the screws from the mode actuator (1).
5. Remove the mode actuator.

Installation Procedure

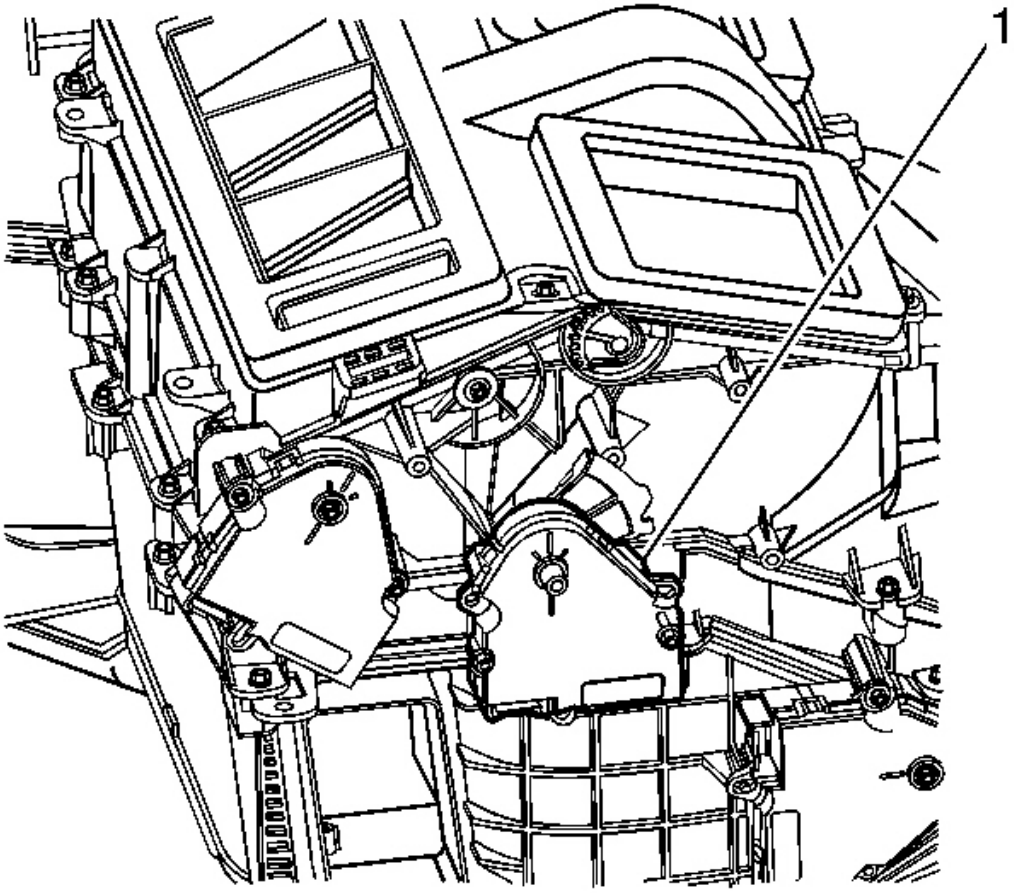

Fig. 18: Identifying Mode Actuator
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The new actuator is in Bi-Level mode. Place the door in the middle of the travel position before you install the actuator.

1. Install the mode actuator (1).

   NOTE: Refer to Fastener Notice .

2. Install the screws to the mode actuator (1).

   Tighten: Tighten the screws to 1.9 N.m (18 lb in).

3. Install the left hand floor duct. Refer to **Floor Air Outlet Duct Replacement - Left Side (with JF4)** or **Floor Air Outlet Duct Replacement - Left Side (without JF4)** .
4. Install the left side sound insulator screws.
5. Recalibrate the mode actuator. Refer to **Actuator Recalibration**

DEFROSTER ACTUATOR REPLACEMENT

Removal Procedure

1. Remove the I/P carrier. Refer to **Instrument Panel Carrier Replacement** .

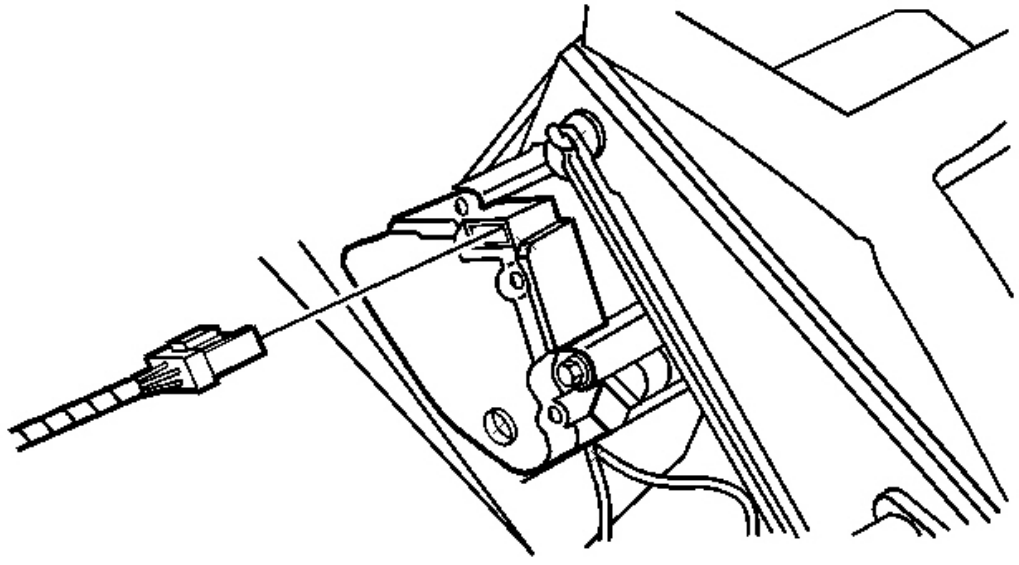

Fig. 19: Locating Actuator Connector
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the electrical connector from the defroster actuator.
3. Remove the screws from the defroster actuator.
4. Remove the defroster actuator.

Installation Procedure

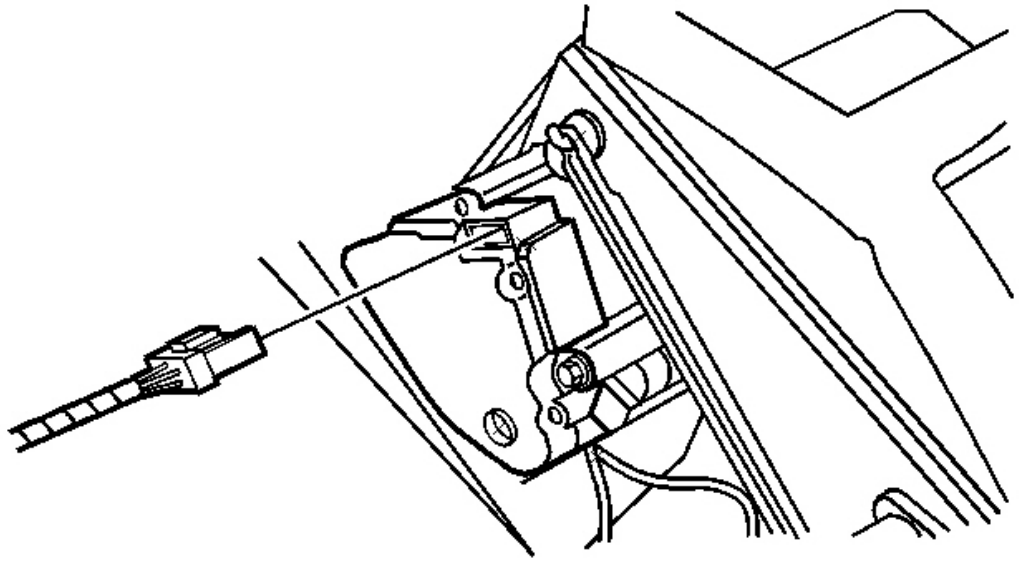

Fig. 20: Locating Actuator Connector
Courtesy of GENERAL MOTORS CORP.

1. Install the defroster actuator.

NOTE: Refer to Fastener Notice .

2. Install the defroster actuator screws.

Tighten: Tighten the screws to 1.9 N.m (17 lb in).

3. Connect the electrical connector to the defroster actuator.
4. Install the I/P carrier. Refer to **Instrument Panel Carrier Replacement** .

AIR TEMPERATURE ACTUATOR REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the I/P carrier. Refer to **Instrument Panel Carrier Replacement** .

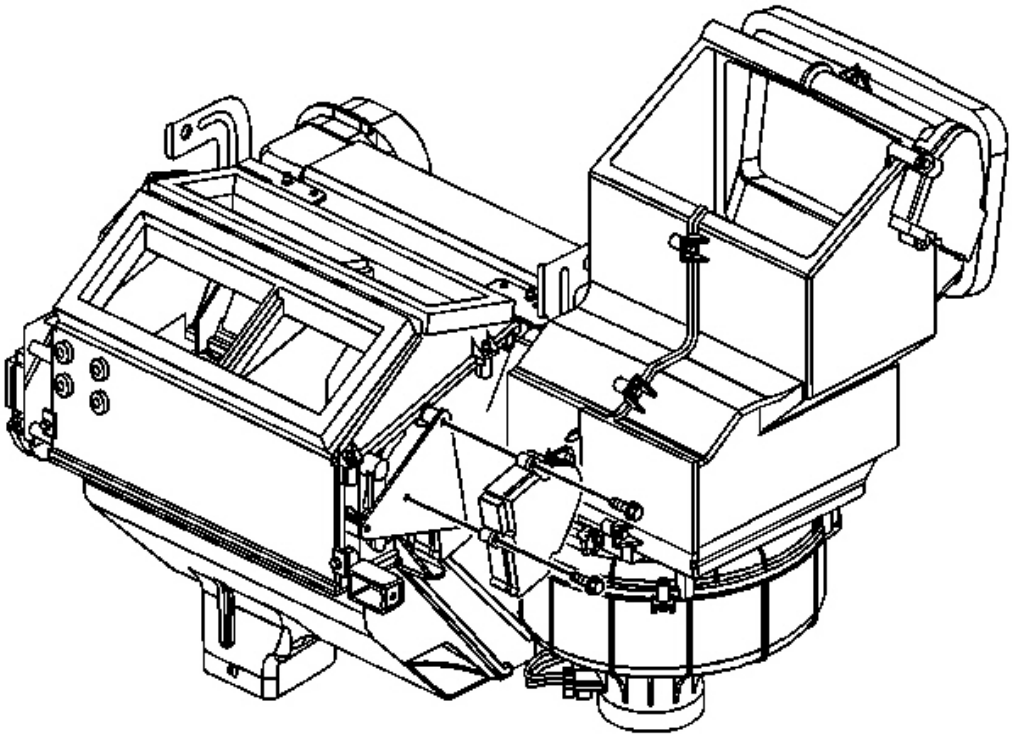

Fig. 21: View Of HVAC Module, Air Temperature Actuator & Retaining Screws
Courtesy of GENERAL MOTORS CORP.

2. Remove the air temperature actuator-right retaining screws.
3. Disconnect the air temperature actuator-right electrical connector.
4. Remove the air temperature actuator-right.

Installation Procedure

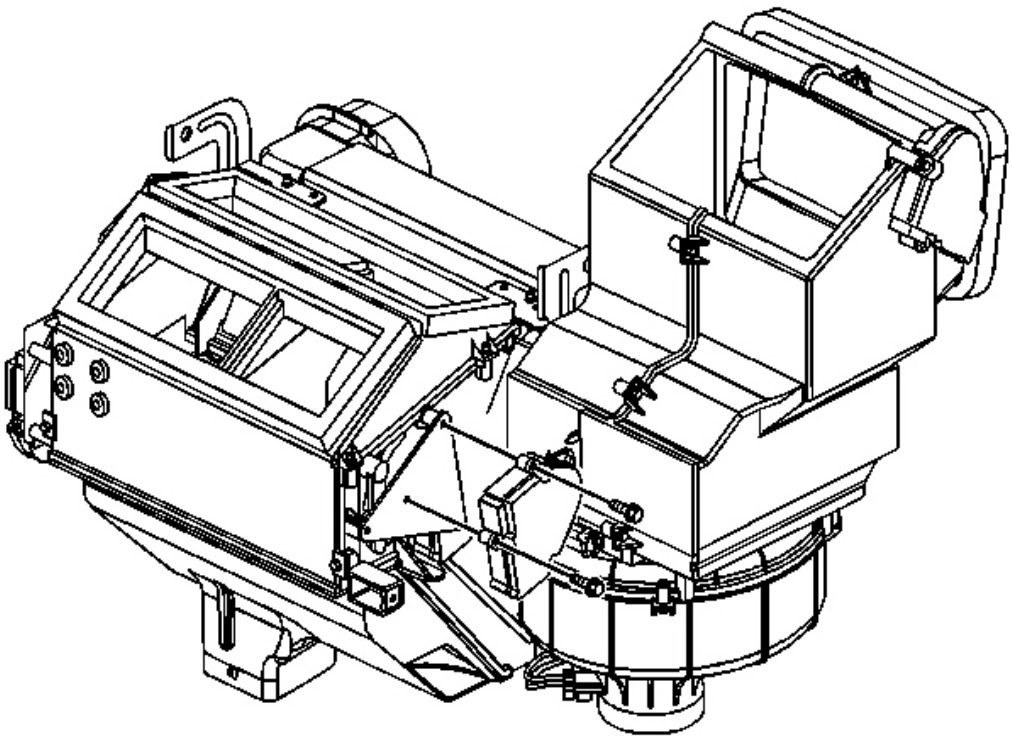

Fig. 22: View Of HVAC Module, Air Temperature Actuator & Retaining Screws
Courtesy of GENERAL MOTORS CORP.

1. Install the air temperature actuator-right.

   NOTE: Refer to Fastener Notice .

2. Tighten the air temperature actuator-right retaining screws.

   Tighten: Tighten the screws to 1.9 N.m (17 lb in).

3. Install the air temperature actuator-right electrical connector.
4. Install the I/P carrier. Refer to **Instrument Panel Carrier Replacement** .
5. Recalibrate the air temperature actuator on vehicles equipped with automatic climate control (C68). Refer to **Actuator Recalibration**.

AIR TEMPERATURE ACTUATOR REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the I/P carrier. Refer to **Instrument Panel Carrier Replacement** .

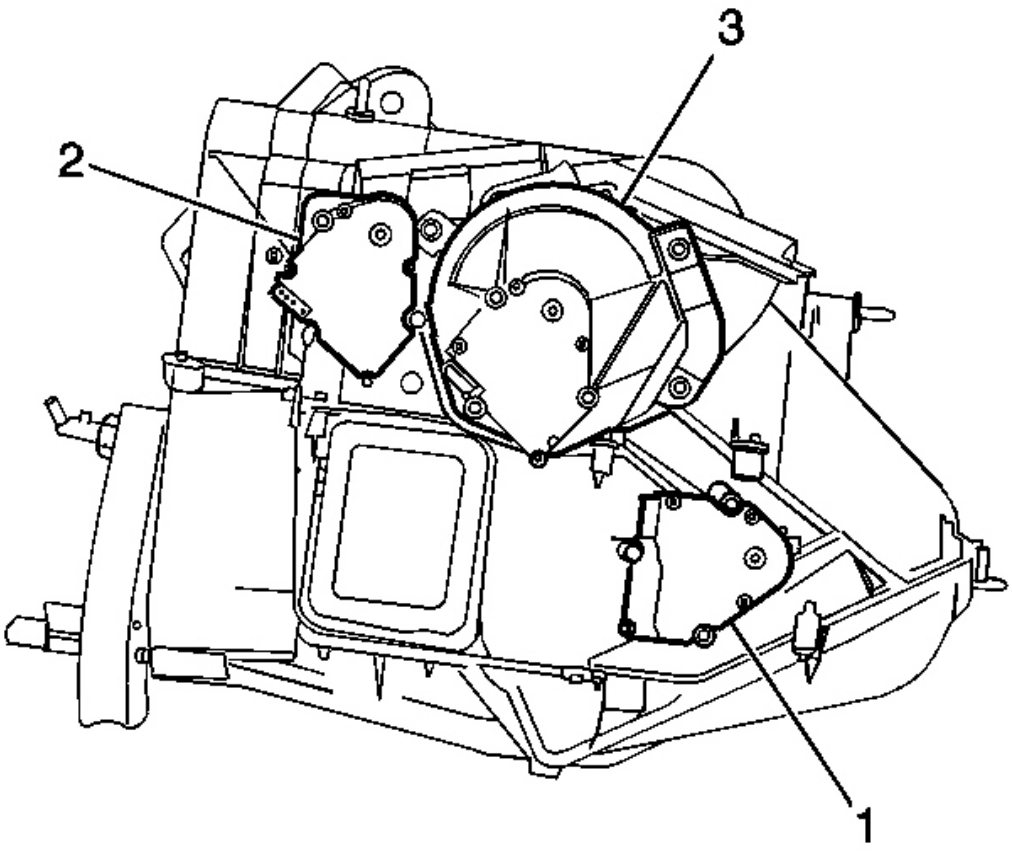

Fig. 23: Identifying Mode & Air Temperature Actuator
Courtesy of GENERAL MOTORS CORP.

2. Remove the air temperature actuator-left (1) retaining screws.
3. Disconnect the air temperature actuator-left electrical connector.
4. Remove the air temperature actuator-left.

Installation Procedure

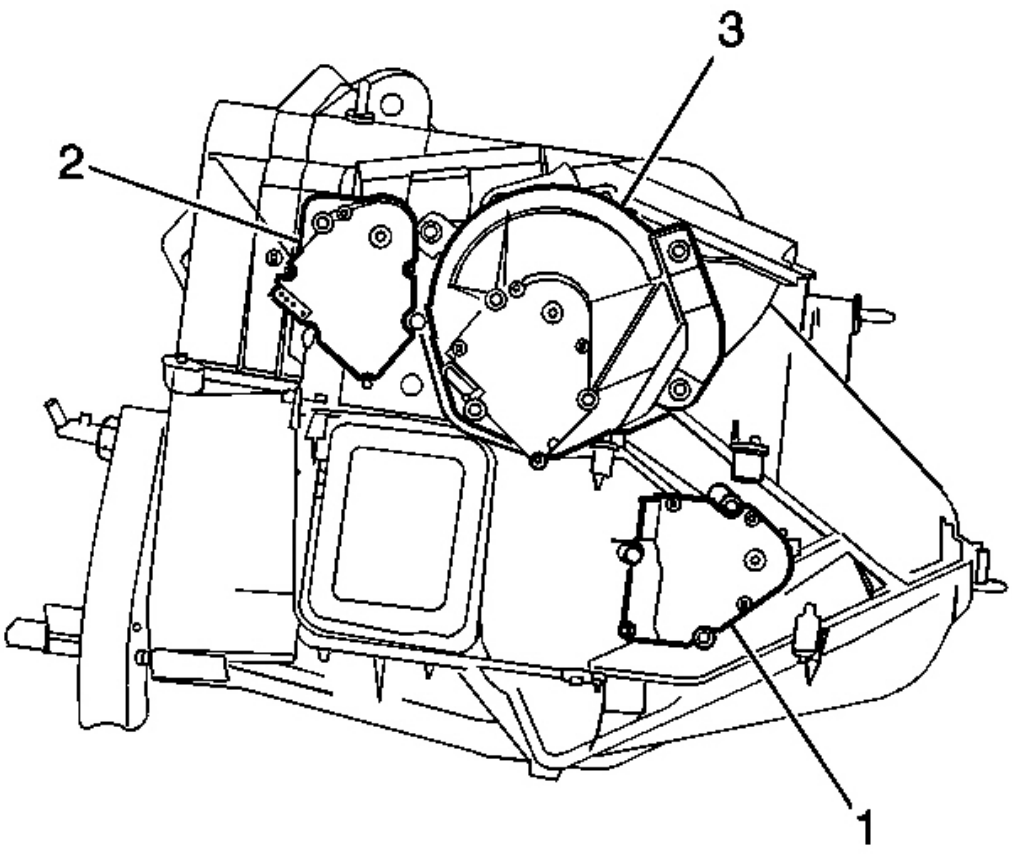

Fig. 24: Identifying Mode & Air Temperature Actuator
Courtesy of GENERAL MOTORS CORP.

1. Install the air temperature actuator-left (1).

   NOTE: Refer to Fastener Notice .

2. Install the air temperature actuator-left retaining screws.

   Tighten: Tighten the screws to 1.9 N.m (17 lb in).

3. Connect the air temperature actuator-left electrical connector.
4. Install the I/P carrier. Refer to **Instrument Panel Carrier Replacement** .
5. Recalibrate the air temperature actuator on vehicles equipped with automatic climate control (C68). Refer to **Actuator Recalibration**.

MODE ACTUATOR REPLACEMENT - CONSOLE

Removal Procedure

1. Remove the console. Refer to **Console Replacement** .
2. Remove the screw from the air outlet duct.
3. Remove the air outlet duct from the console.

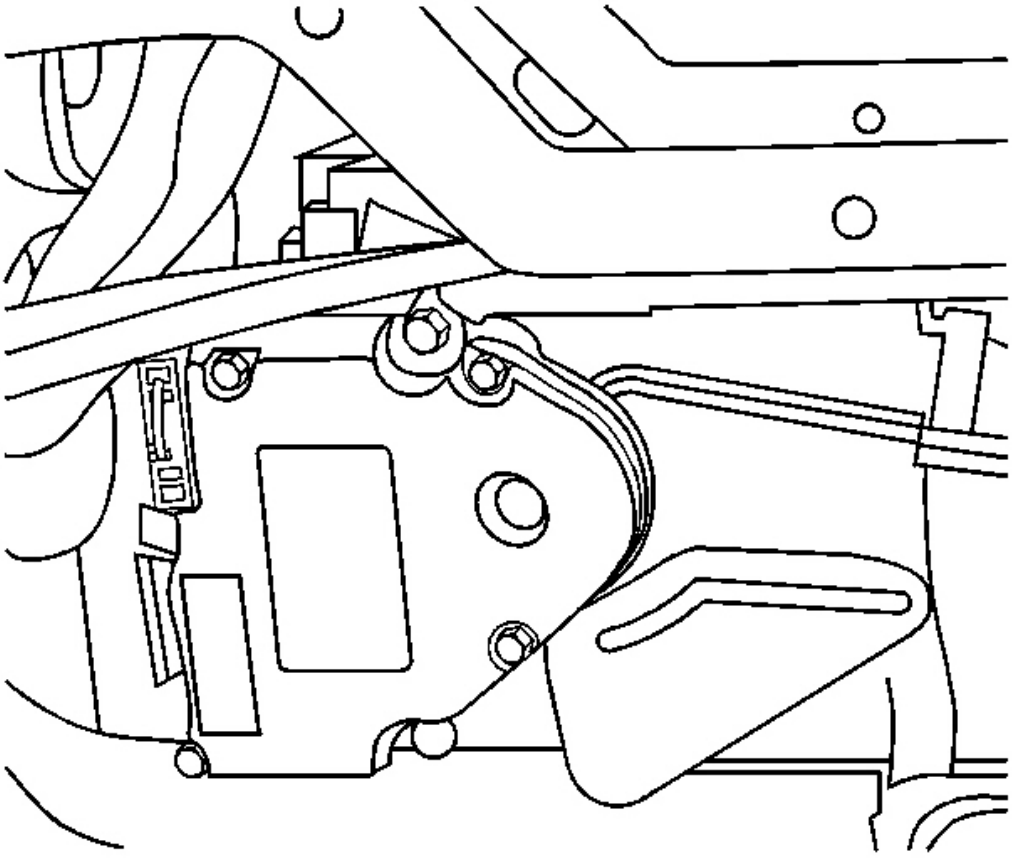

Fig. 25: View of Auxiliary Mode Actuator Screws
Courtesy of GENERAL MOTORS CORP.

4. Remove the rear mode actuator retaining screws.

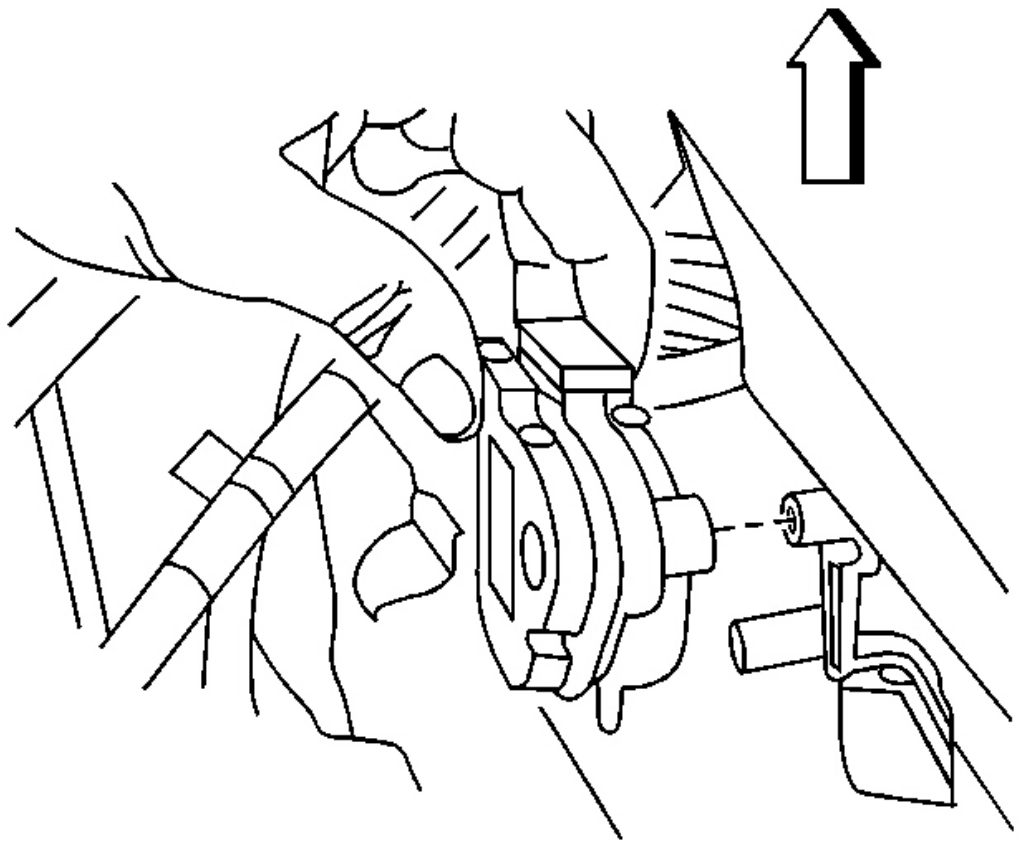

Fig. 26: Removing Actuator Assembly
Courtesy of GENERAL MOTORS CORP.

5. Remove the rear mode actuator.

Installation Procedure

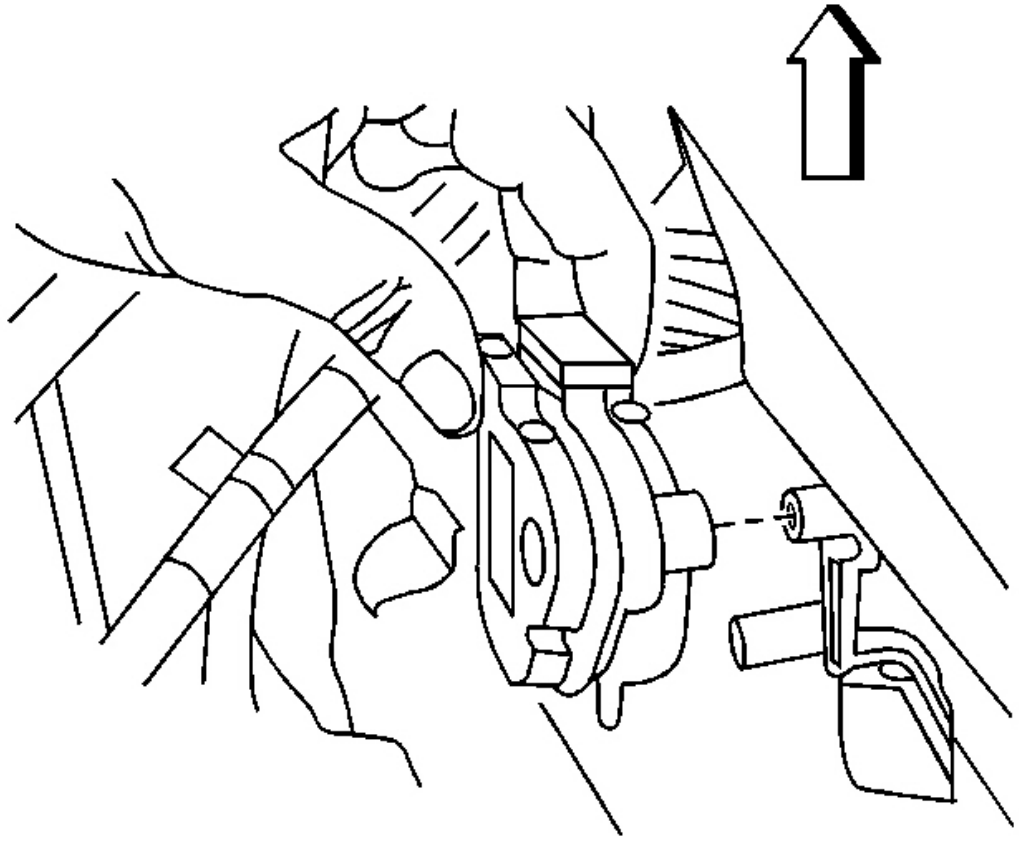

Fig. 27: Installing Actuator Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the mode actuator.

NOTE: **Refer to Fastener Notice .**

2. Install the screws to the mode actuator.

Tighten: Tighten the screws to 1.9 N.m (17 lb in).

3. Install the air outlet duct to the console.
4. Install the screw to the air outlet duct.

Tighten: Tighten the screw to 1.9 N.m (17 lb in).

5. Install the console. Refer to **Console Replacement** .

AIR TEMPERATURE SENSOR REPLACEMENT - UPPER RIGHT SIDE

Removal Procedure

1. Remove the radio. Refer to **Radio Replacement** .

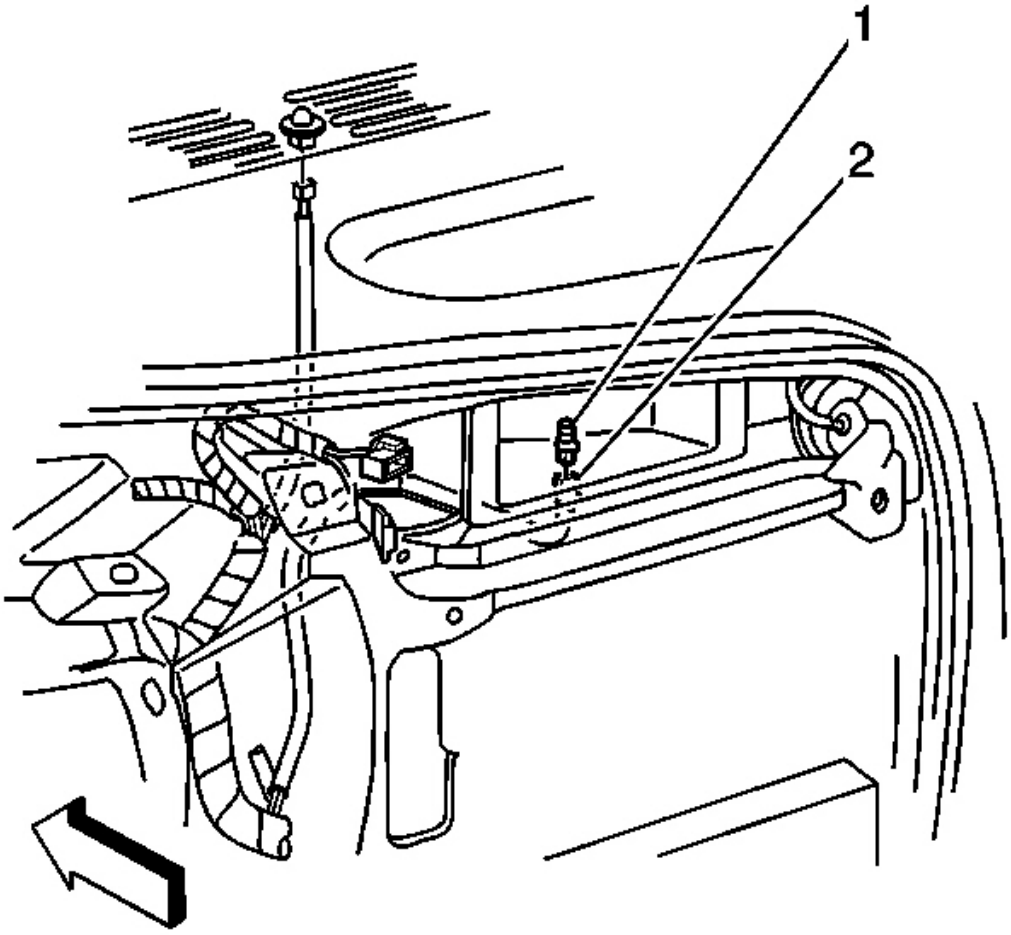

Fig. 28: Identifying Upper Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the electrical connector (2) from the air temperature sensor - upper right (1).
3. Remove the air temperature sensor - upper right (1) by turning the sensor clockwise and pulling out.

Installation Procedure

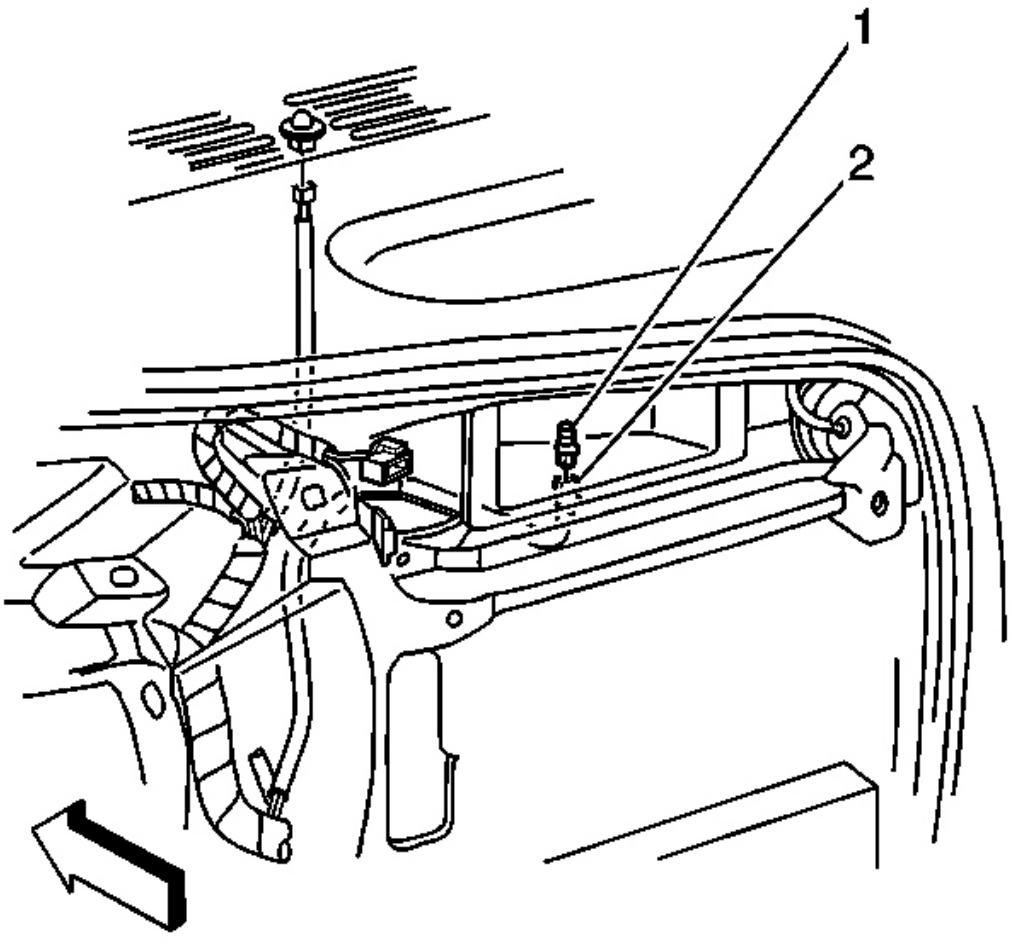

Fig. 29: Identifying Upper Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

1. Install the air temperature sensor - upper right (1).
2. Connect the electrical connector (2) to the air temperature sensor - upper right (1).
3. Install the radio. Refer to **Radio Replacement** .

AIR TEMPERATURE SENSOR REPLACEMENT - UPPER LEFT SIDE

Removal Procedure

1. Remove the radio. Refer to **Radio Replacement** .

2. Remove the HVAC control module. Refer to **HVAC Control Module Replacement**.

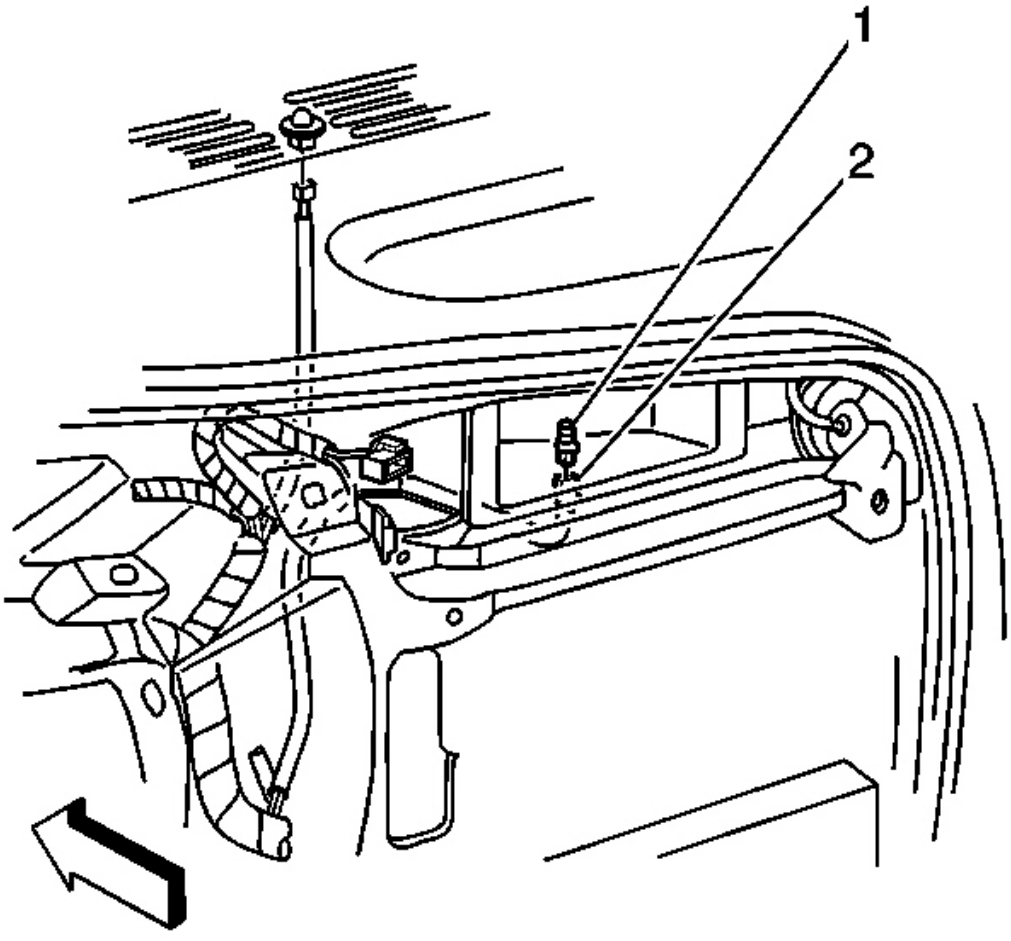

Fig. 30: Identifying Upper Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

3. Remove the air temperature sensor.
4. Disconnect the electrical connector (2) from the upper air temperature sensor (1).

Installation Procedure

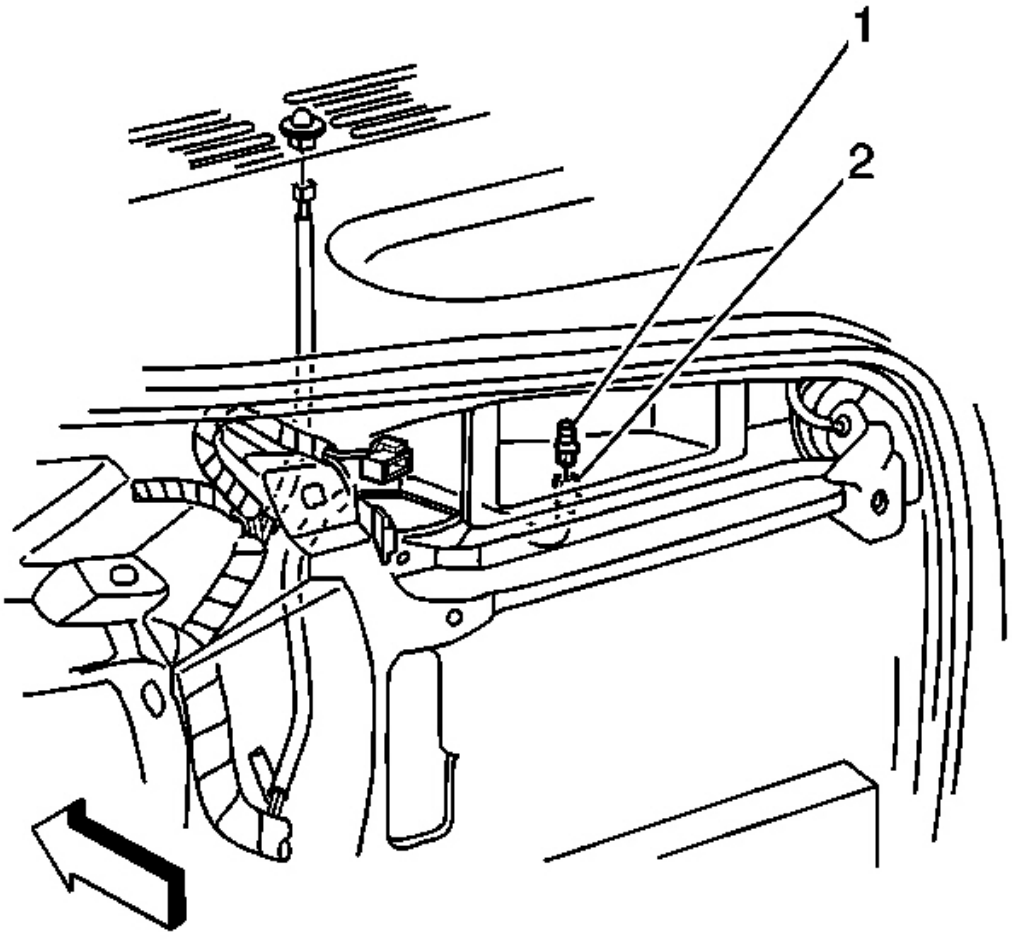

Fig. 31: Identifying Upper Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

1. Install the upper air temperature sensor.
2. Connect the electrical connector (2) to the upper air temperature sensor (1).
3. Install the upper air temperature sensor.
4. Install the HVAC control module. Refer to **HVAC Control Module Replacement**.
5. Install the radio. Refer to **Radio Replacement** .

AIR TEMPERATURE SENSOR REPLACEMENT - LOWER LEFT SIDE

Removal Procedure

1. Remove the I/P assembly. Refer to **Instrument Panel Assembly Replacement** .

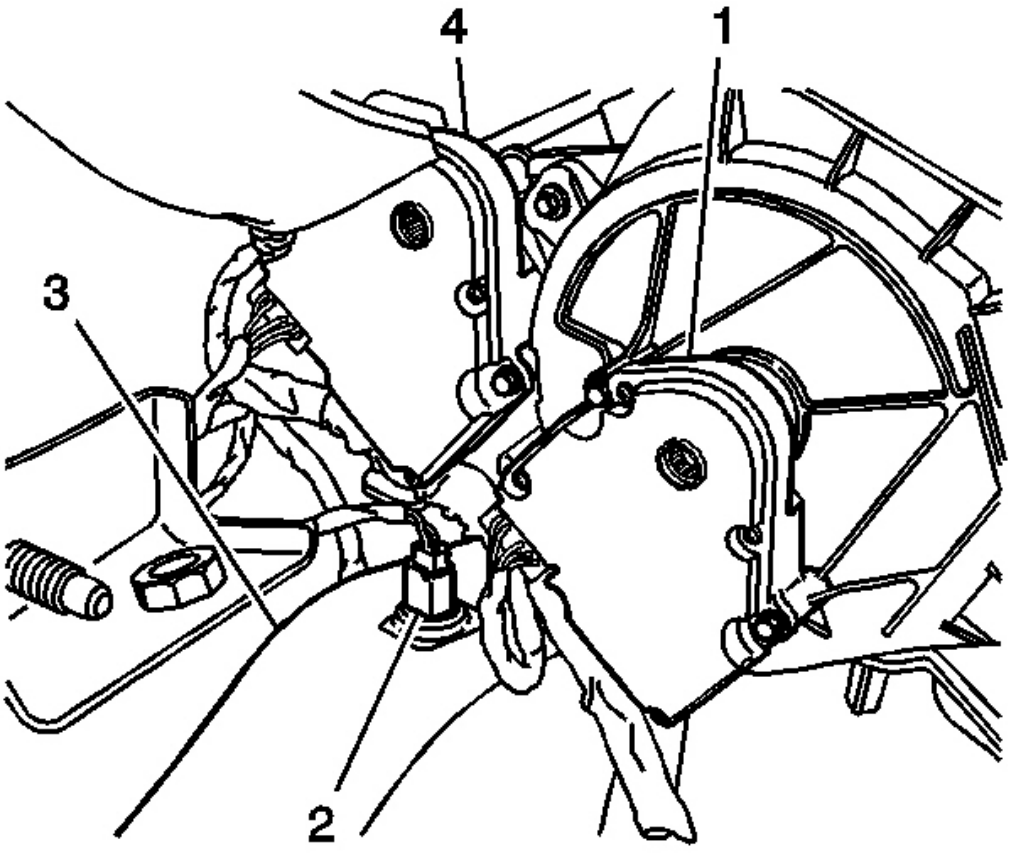

Fig. 32: Identifying Lower Left Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the electrical connector from the air temperature sensor-lower left (2).
3. Remove the air temperature sensor-lower left.

Installation Procedure

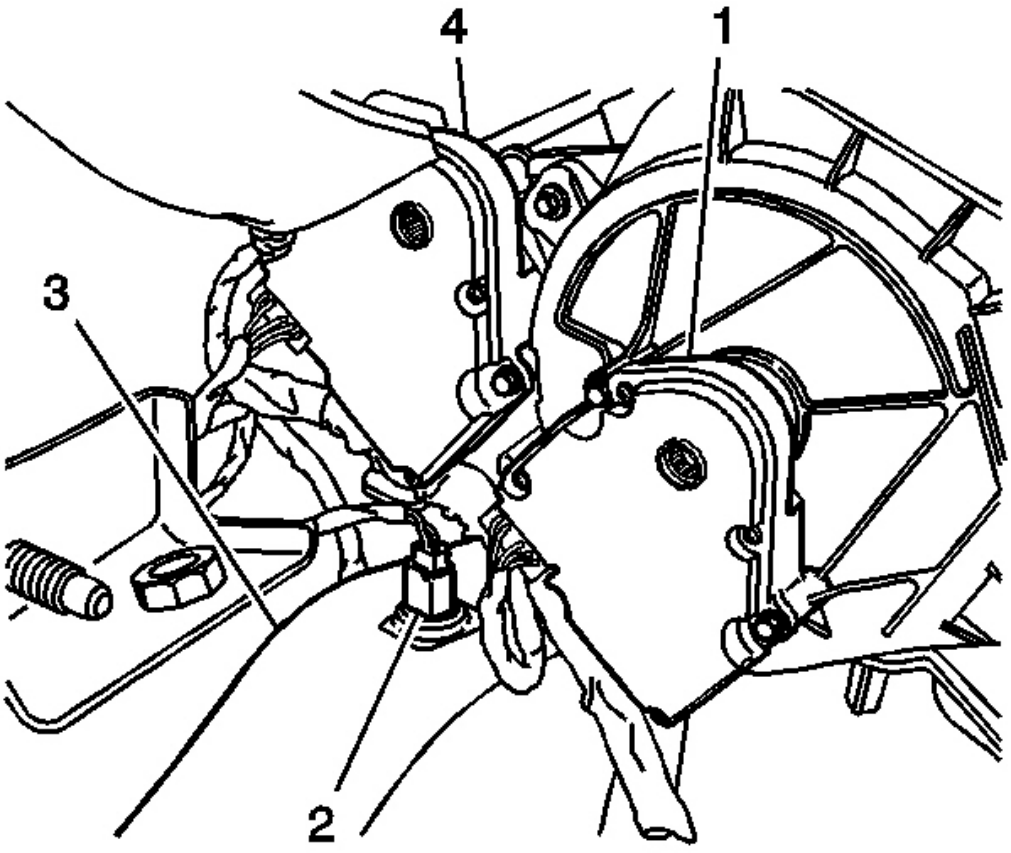

Fig. 33: Identifying Lower Left Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

1. Install the air temperature sensor-lower left (2).
2. Connect the electrical connector to the air temperature sensor-lower left.
3. Install the I/P assembly. Refer to **Instrument Panel Assembly Replacement** .

AIR TEMPERATURE SENSOR REPLACEMENT - LOWER RIGHT SIDE

Removal Procedure

1. Remove the passenger side closeout panel. Refer to **Instrument Panel Insulator Panel Replacement - Right Side** .
2. Remove the I/P lower closeout panel. Refer to **Instrument Panel Insulator Panel Replacement (GMC/Chevrolet)** .

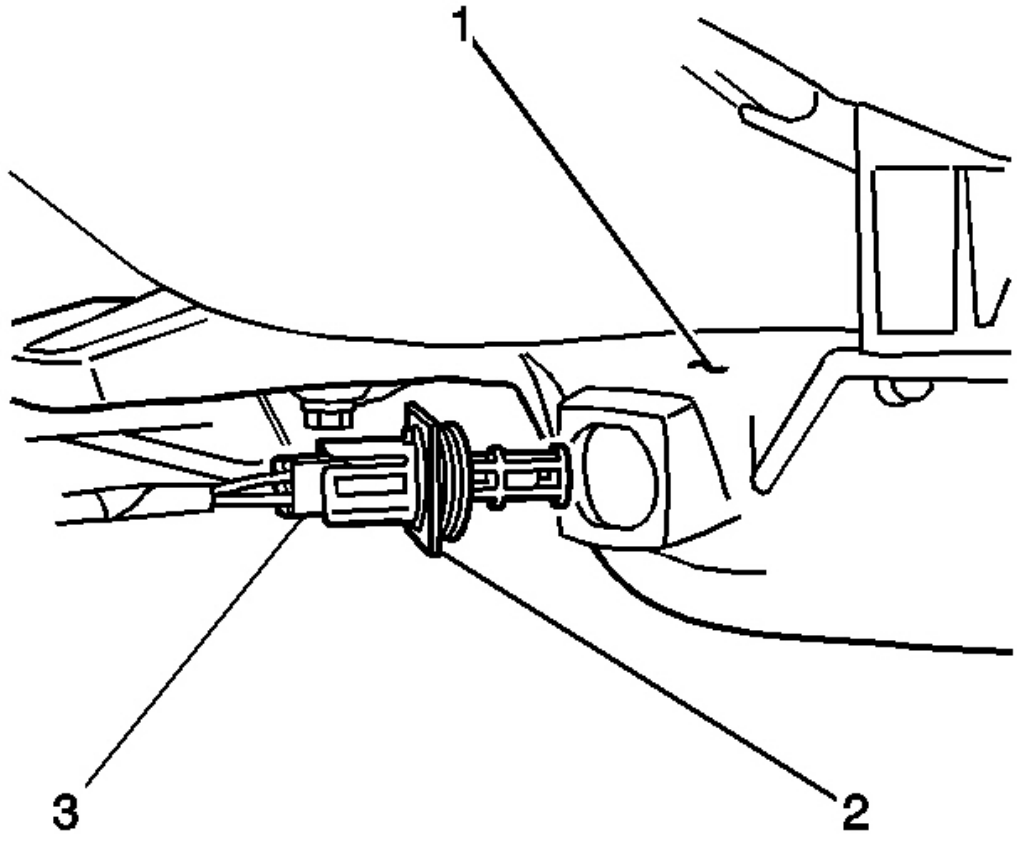

Fig. 34: Identifying Lower Right Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the electrical connector (3) from the air temperature sensor-lower right (2).
4. Remove the air temperature sensor-lower right (2).

Installation Procedure

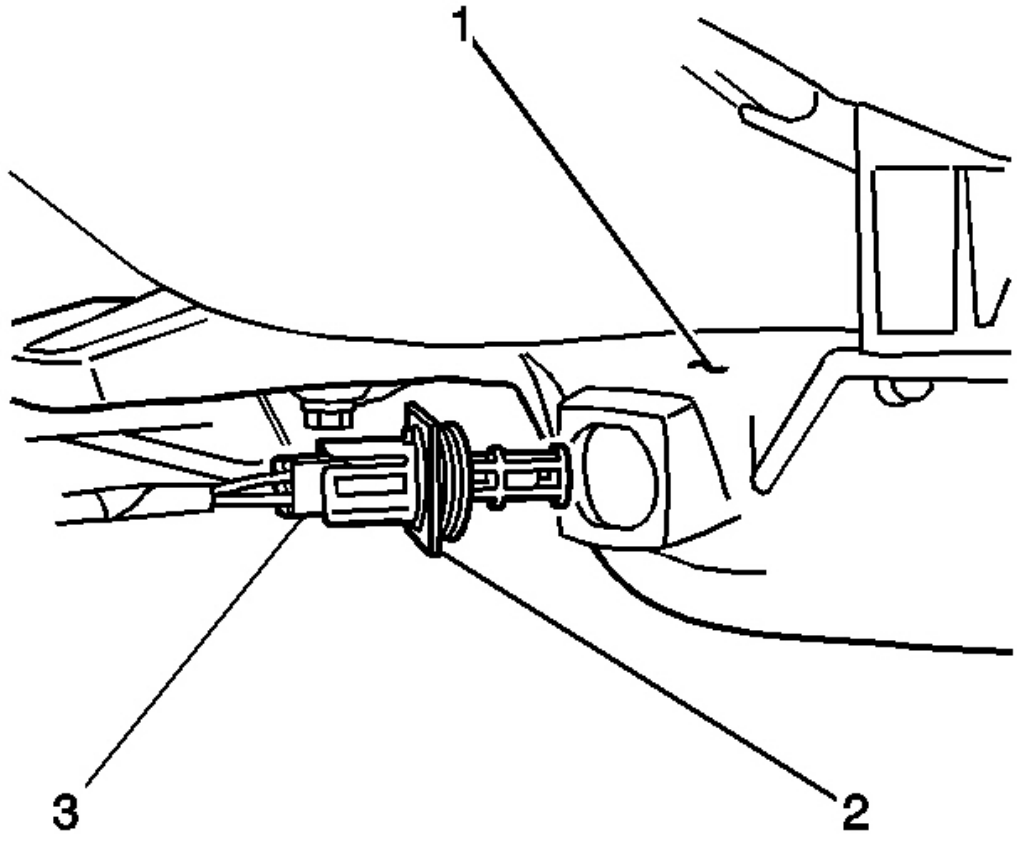

Fig. 35: Identifying Lower Right Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

1. Install the air temperature sensor-lower right (2).
2. Connect the electrical connector (3) to the air temperature sensor-lower right (2).
3. Install the I/P lower closeout panel. Refer to **Instrument Panel Insulator Panel Replacement (GMC/Chevrolet)** .
4. Install the passenger side closeout panel. Refer to **Instrument Panel Insulator Panel Replacement - Right Side** .

INSIDE AIR TEMPERATURE SENSOR REPLACEMENT

Removal Procedure

IMPORTANT: Recline the driver seat rearward to access the left center trim pillar.

1. Remove the upper portion of the left center trim pillar.

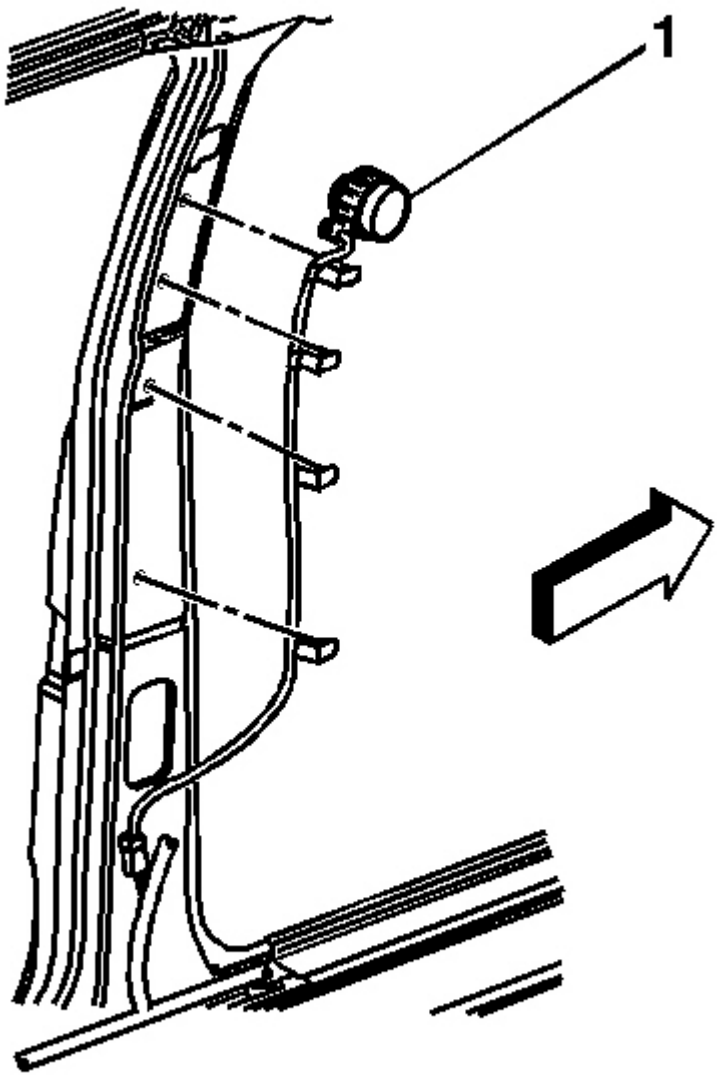

Fig. 36: Identifying Inside Air Temperature Sensor Assembly
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the electrical connector.
3. Remove the retaining clips from the B pillar.
4. Remove the inside air temperature sensor assembly (1) from the B pillar.

Installation Procedure

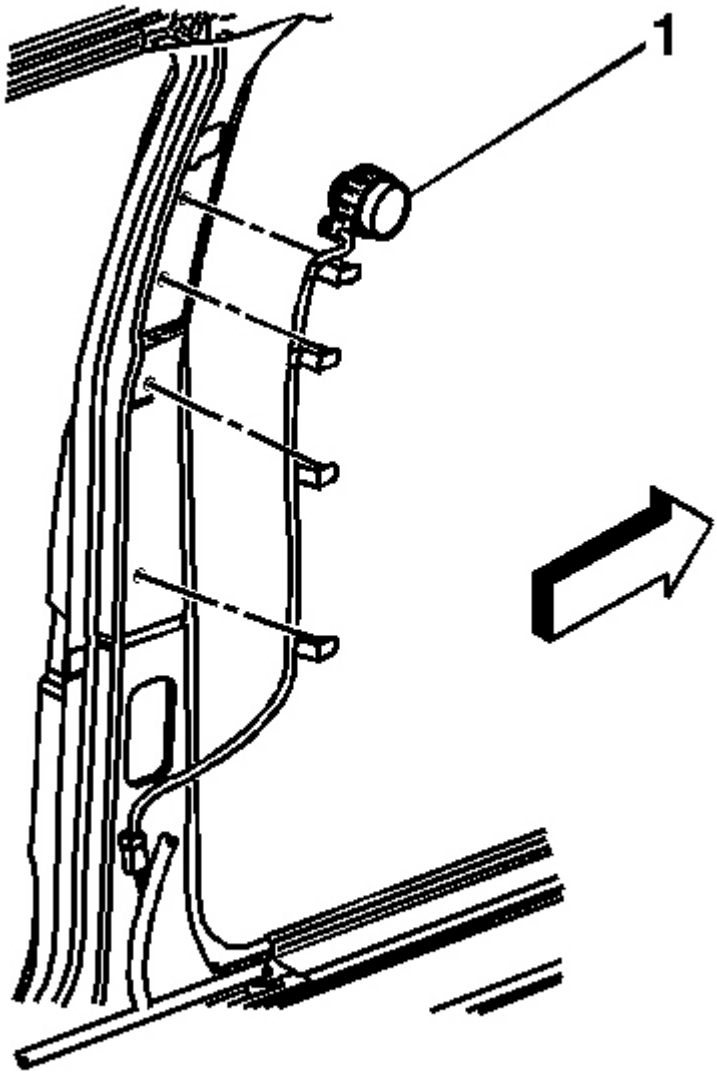

Fig. 37: Identifying Inside Air Temperature Sensor Assembly
Courtesy of GENERAL MOTORS CORP.

1. Connect the electrical connector to the inside air temperature sensor assembly (1).
2. Install the inside air temperature sensor assembly (1) to the B pillar.
3. Install the retaining clips to the B pillar.

4. Install the upper portion of the left center trim pillar.

SUN LOAD SENSOR REPLACEMENT

Removal Procedure

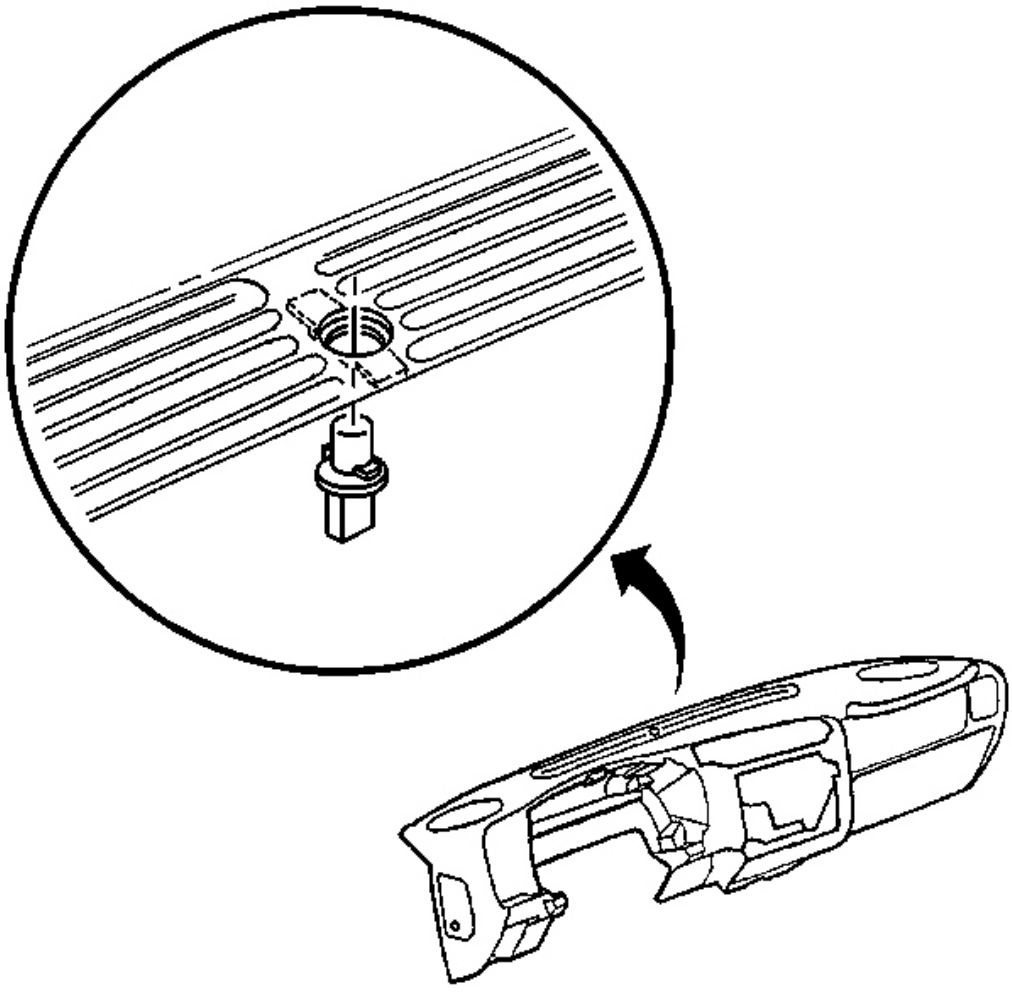

Fig. 38: View Of Sun Load Sensor
Courtesy of GENERAL MOTORS CORP.

1. Remove the I/P upper trim pad. Refer to **Instrument Panel Upper Trim Pad Replacement** .
2. Remove the sun load sensor from the I/P upper trim pad by turning counter clockwise.
3. Disconnect the electrical connector from the sun load sensor.

Installation Procedure

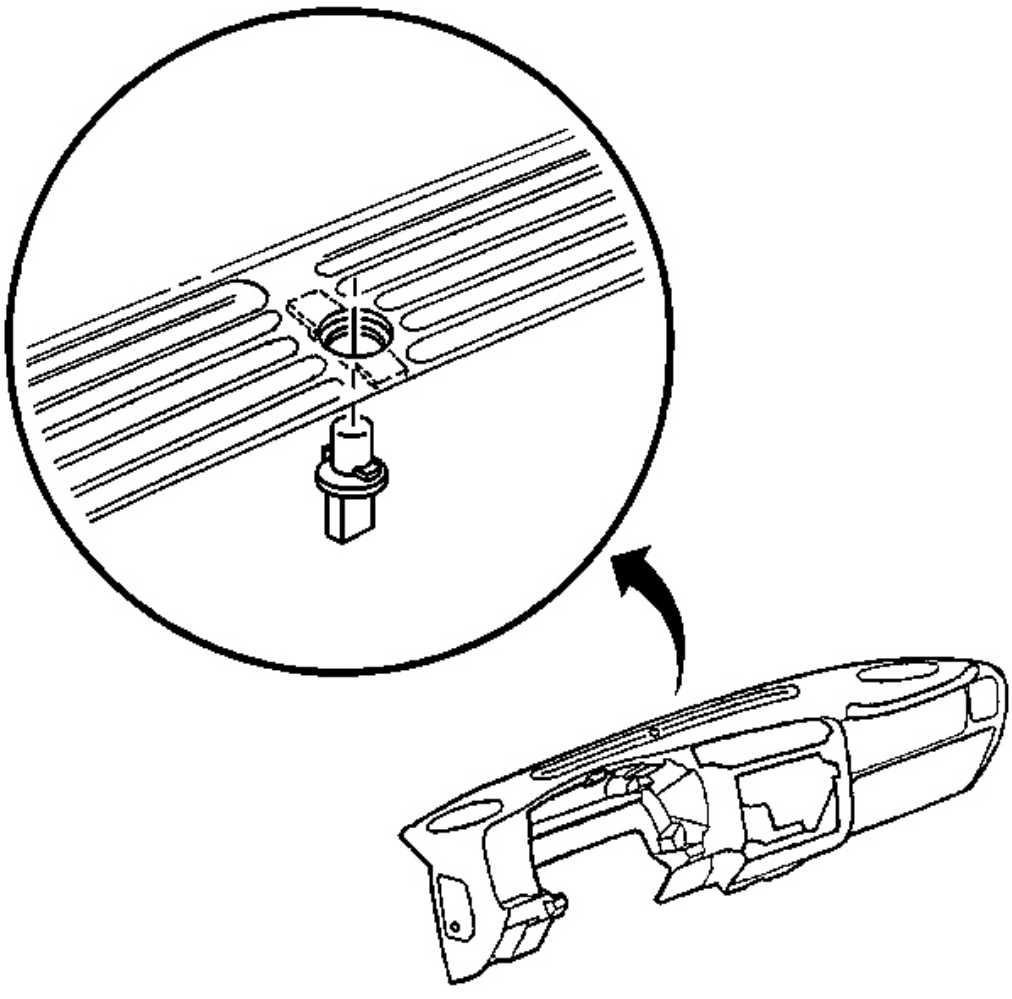

Fig. 39: View Of Sun Load Sensor
Courtesy of GENERAL MOTORS CORP.

1. Connect the electrical connector to the sun load sensor.
2. Install the sun load sensor to the I/P upper trim pad by turning clockwise.
3. Install the I/P upper trim pad. Refer to **Instrument Panel Upper Trim Pad Replacement** .

DESCRIPTION & OPERATION

AIR DELIVERY DESCRIPTION & OPERATION

The air delivery description and operation is divided into 7 areas:

- HVAC Control Components
- Air Speed
- Auxiliary Air Speed
- Air Delivery
- Auxiliary Air Delivery
- Recirculation Operation
- Automatic Operation

HVAC Control Components

HVAC Control Module

The HVAC control module is a class 2 device that interfaces between the operator and the HVAC system to maintain air temperature and distribution settings. The battery positive voltage circuit provides power that the control module uses for keep alive memory (KAM). If the battery positive voltage circuit loses power, all HVAC DTCs and settings will be erased from KAM. The body control module (BCM), which is the vehicle mode master, provides a device on signal. The control module supports the following features:

Feature	Availability
Afterblow	No
Purge	No
Personalization	Yes
Actuator Calibration	Yes

Auxiliary HVAC Control Module - VIN 6

The auxiliary HVAC control module is a class 2 device that interfaces between the rear seat occupants and the auxiliary HVAC system to maintain auxiliary air temperature and auxiliary air distribution settings. The battery positive voltage circuit provides power that the control module uses for KAM. If the battery positive voltage circuit loses power, all auxiliary HVAC DTCs and settings will be erased from KAM. The auxiliary HVAC control module will perform a recalibration of the electric actuators when commanded with a scan tool or if KAM is lost. This will ensure the actuators are moving with in the calibrated range. During this calbration process the auxiliary blower motor will be disabled for up to 3 minutes.

Defrost Actuator

The defrost actuator is a 5-wire bi-directional electric motor that incorporates a feedback potentiometer. Ignition 3 voltage, low reference, control, 5-volt reference and position signal circuits enable the actuator to operate. The control circuit uses either a 0, 2.5 or 5-volt signal to command the actuator movement. When the actuator is at rest, the control circuit value is 2.5 volts. A 0 or 5-volt control signal commands the actuator movement in opposite directions. When the actuator shaft rotates, the potentiometer's adjustable contact changes the door position signal between 0-5 volts.

The HVAC control module uses a range of 0-255 counts to index the actuator position. The door position signal voltage is converted to a 0-255 count range. When the module sets a commanded, or targeted, value, the control signal is changed to either 0 or 5 volts depending upon the direction that the actuator needs to rotate to reach the commanded value. As the actuator shaft rotates the changing position signal is sent to the module. Once the position signal and the commanded value are the same, the module changes the control signal to 2.5 volts.

Mode Actuator

The mode actuator is a 5-wire bi-directional electric motor that incorporates a feedback potentiometer. Ignition 3 voltage, low reference, control, 5-volt reference and position signal circuits enable the actuator to operate. The control circuit uses either a 0, 2.5 or 5-volt signal to command the actuator movement. When the actuator is at rest, the control circuit value is 2.5 volts. A 0 or 5-volt control signal commands the actuator movement in opposite directions. When the actuator shaft rotates, the potentiometer's adjustable contact changes the door position signal between 0-5 volts.

The HVAC control module uses a range of 0-255 counts to index the actuator position. The door position signal voltage is converted to a 0-255 count range. When the module sets a commanded, or targeted, value, the control signal is changed to either 0 or 5 volts depending upon the direction that the actuator needs to rotate to reach the commanded value. As the actuator shaft rotates the changing position signal is sent to the module. Once the position signal and the commanded value are the same, the module changes the control signal to 2.5 volts.

Auxiliary Mode Actuator - VIN 6

The auxiliary mode actuator is a 5-wire bi-directional electric motor that incorporates a feedback potentiometer. Low reference, 5-volt reference, position signal, and 2 control circuits enable the actuator to operate. The control circuits use either a 0 or 12 volt value to coordinate the actuator movement. When the actuator is at rest, both control circuits have a value of 0 volts. In order to move the actuator, the auxiliary HVAC control module grounds one of the control circuits while providing the other with 12 volts. The control module reverses the polarity of the control circuits to move the actuator in the opposite direction. When the actuator shaft rotates, the potentiometer's adjustable contact changes the door position signal between 0-5 volts.

The auxiliary HVAC control module uses a range of 0-255 counts to index the actuator position. The door position signal voltage is converted to a 0-255 count range. When the module sets a commanded, or targeted, value, one of the control circuits is grounded. As the actuator shaft rotates the changing position signal is sent to the module. Once the position signal and the commanded value are the same, the module grounds both control circuits.

Auxiliary Console Mode Actuator

The auxiliary console mode actuator is a 5-wire bi-directional electric motor that incorporates a feedback potentiometer. Low reference, 5-volt reference, position signal, and 2 control circuits enable the actuator to operate. The control circuits use either a 0 or 12 volt value to co-ordinate the actuator movement. When the actuator is at rest, both control circuits have a value of 0 volts. In order to move the actuator, the auxiliary HVAC control module grounds one of the control circuits while providing the other with 12 volts. The control module reverses the polarity of the control circuits to move the actuator in the opposite direction. When the actuator shaft rotates, the potentiometer's adjustable contact changes the door position signal between 0-5 volts.

The auxiliary HVAC control module uses a range of 0-255 counts to index the actuator position. The door

position signal voltage is converted to a 0-255 count range. When the module sets a commanded, or targeted, value, one of the control circuits is grounded. As the actuator shaft rotates the changing position signal is sent to the module. Once the position signal and the commanded value are the same, the module grounds both control circuits.

Blower Motor Control Processor

The blower motor control processor controls the speed of the blower motor by increasing or decreasing the voltage drop on the ground side of the blower motor. The HVAC control module provides a low side pulse width modulated signal to the blower motor control processor over the blower motor speed control circuit. As the requested blower speed increases, the HVAC control module increases the amount of time that the speed signal is modulated to ground. As the requested blower speed decreases, the HVAC control module decreases the amount of time that the signal is modulated to ground.

Air Speed - Front Control

The blower control switch is integrated into the HVAC control module. The 2 rocker type switches provide the vehicle operator the ability to select several blower speeds. The HVAC control module uses a bar graph type display to indicate the selected blower speed. The HVAC control module provides a pulse width modulated (PWM) signal to the blower motor through the blower motor speed control circuit. The blower motor changes speed based on the received PWM signal from the HVAC control module. Power and ground are provided to the blower motor through the battery positive voltage and ground circuits. When the HVAC control module is operating in AUTO mode, the system automatically controls the blower speed. Power and ground are provided to the HVAC control module by the ignition 3 voltage and the ground circuits.

Air Speed - Auxiliary - VIN 6

There are 2 separate controls for the auxiliary HVAC system. There is the front auxiliary blower motor switch and the auxiliary HVAC control module. If the front auxiliary blower motor switch is in any other position than OFF or REAR, then the auxiliary air temperature actuator mimics the set passenger temperature. The auxiliary mode will mimic the primary mode. If the front auxiliary blower motor switch is in the REAR position, then the system will only function with inputs to the auxiliary HVAC control module. If the front auxiliary blower motor switch is in the OFF position, then the auxiliary HVAC control module does not respond to input. The auxiliary HVAC control module can not request A/C operation from the PCM. The 2 rocker type switches on the auxiliary HVAC control module provide the operator the ability to select several blower speeds. The auxiliary HVAC control module uses a bar graph type display to indicate the selected blower speed. The auxiliary HVAC control module provides a pulse width modulated (PWM) signal to the auxiliary blower motor through the auxiliary blower motor speed control circuit. The auxiliary blower motor changes speed based on the received PWM signal from the auxiliary HVAC control module. Power and ground are provided to the auxiliary blower motor through the battery positive voltage and ground circuits. Power and ground are provided to the auxiliary HVAC control module by the ignition 3 voltage and the ground circuits.

Air Speed - Auxiliary - VIN 3

The auxiliary HVAC system uses an LED display for air speed. When one LED is illuminated on the auxiliary HVAC control module the air flow through the center console to the rear is provided by the primary blower motor. The air speed will vary depending on the front blower motor setting. When 2 LED's are illuminated the auxiliary blower motor is set to medium speed. When 3 LED's are illuminated the auxiliary blower motor is set

to high speed. When the operator selects medium blower speed, power is delivered to the auxiliary blower motor through the auxiliary blower motor medium speed control circuit. When the operator selects high blower speed, power is delivered to the auxiliary blower motor through the auxiliary blower motor high speed control circuit. Ground is provided to the blower motor through the ground circuit. Power and ground are provided to the auxiliary HVAC control module through the ignition 3 voltage and ground circuits.

OFF Mode

Press the OFF switch to turn off the HVAC control module. When the vehicle is moving, air flowing over the vehicle increases the air pressure just ahead of the windshield. This forces air into the outside air inlet, into the HVAC module and out through the floor and windshield outlets. Since the A/C compressor is not running, the incoming air may be warmed but not cooled.

Air Distribution

The HVAC control module controls the distribution of air by the use of a defrost actuator and a mode actuator. The modes that may be selected are:

- Defrost
- Defog
- Panel
- Bi-Level
- Floor

The mode and defrost actuators are connected to the mode and defrost doors by a cam type linkage system. Depending on the position of the door, air is directed through the HVAC module and distributed through various ducts leading to the outlets in the dash. If the HVAC control module detects a fault with the mode or defrost doors the HVAC control module will try to drive the actuator for a predetermined amount of time, to defrost, which is the defaulted position for the mode and defrost door actuators. When the mode switch is placed in the defrost or defog positions the A/C is commanded on and the recirculation door is moved to the outside air position to help reduce window fogging. A/C is available in all modes and recirculation is only available in the panel and bi-level modes.

Mode Actuator

The mode actuator is an electronic stepper motor with feedback potentiometers. The HVAC control module sends signals to the mode door actuator through the mode door control circuit. Zero volts drives the actuator in one direction while 5 volts moves the actuator in the opposite direction. When the actuator receives 2.5 volts, the actuator rotation stops. A 5-volt reference signal is sent out over the 5-volt reference circuit to the mode actuator. When you select a desired mode setting, logic determines the value of the mode actuator signals. The HVAC control module's software uses this reference voltage in order to determine the position of the mode actuator through the mode door position signal circuit. The motor moves the mode door to the desired position.

Defrost Actuator

The defrost actuator operates the same as the mode actuator. The HVAC control module sends signals to the mode door actuator through the defrost door control circuit. Zero volts drives the actuator in one direction while

5 volts moves the actuator in the opposite direction. When the actuator receives 2.5 volts, the actuator rotation stops. A 5-volt reference signal is sent out over the 5-volt reference circuit to the defrost actuator. When you select a defrost setting, logic determines the value of the defrost actuator signals. The HVAC control module's software uses this reference voltage in order to determine the position of the mode actuator through the defrost door position signal circuit. The motor moves the defrost door to the desired position.

Front Defrost

When defrost is selected, the A/C compressor is activated. The A/C compressor clutch will engage when ambient temperatures are above 3°C (38°F). The blower motor will be activated, regardless of the coolant temperature. The HVAC control module will override the auxiliary HVAC control module so a high volume of air is delivered to the front defrost vents. The rear window defogger does not affect the HVAC system.

Air Distribution - Auxiliary Control VIN 3

The auxiliary HVAC system provides ventilation for the rear seat occupants. The rear seat occupants will exercise control of the auxiliary air delivery modes and air speed, while the HVAC control module will maintain control of the air temperature setting. The HVAC control module's blower motor must be ON in order for the auxiliary HVAC system to receive heated or cooled air. The HVAC control module will have the authority to override the auxiliary HVAC system and place it in the OFF mode when the primary HVAC system is placed in the front window DEFROST position. To override the auxiliary HVAC control module, a signal is delivered from the HVAC control module through the class 2 serial data circuit, to the auxiliary HVAC control module. This pause in operation will be indicated by the flashing the text OFF.

When the auxiliary mode switch is toggled, a signal is sent to the auxiliary mode actuator through the auxiliary mode door control circuit. Power and ground are supplied to the auxiliary mode actuator through the ignition 3 voltage and ground circuits.

When the HVAC control module is ON, the air that is delivered to the auxiliary HVAC system is the low auxiliary blower speed. When the operator selects medium blower speed, power is delivered to the auxiliary blower motor through the auxiliary blower motor medium speed control circuit. When the operator selects high blower speed, power is delivered to the auxiliary blower motor through the auxiliary blower motor high speed control circuit. Ground is provided to the blower motor through the ground circuit. Power and ground are provided to the auxiliary HVAC control module through the ignition 3 voltage and ground circuits.

Air Distribution - Auxiliary Control VIN 6

The auxiliary HVAC system provides ventilation for the rear seat occupants.

The auxiliary mode actuator shares a control circuit with the auxiliary air temperature actuator. If change of position is required for both actuators, then the module positions the auxiliary air temperature actuator first. All control circuits for the auxiliary actuators are at a low voltage potential until a change of position is required. The module then applies a high voltage potential to the appropriate control circuit, which will rotate the actuator.

Recirculation Operation

The HVAC control module controls the air intake through the recirculation actuator. The recirculation switch

closes the recirculation door in order to circulate the air within the vehicle. The outside air switch opens the recirculation door in order to route outside air into the vehicle. Regardless of the blower motor switch position, recirculation is available only in the panel and bi-level mode switch positions. Including the OFF position. The mode switch must be placed in either the panel or bi-level position before the blower motor switch is placed in the OFF position. In order to reduce windshield fogging, outside air is circulated when the mode switch is in the defrost or defog positions. If the recirculation switch is pressed into the ON position when the mode switch is in an unavailable mode position, then the recirculation switch LED will flash 3 times. If the HVAC control module detects a fault with the recirc door the HVAC control module will try to drive the actuator for a predetermined amount of time, to outside air, which is the defaulted position for the recirculation actuator.

Automatic Operation

In automatic operation, the HVAC control module will maintain the comfort level inside of the vehicle by controlling the A/C compressor clutch, the blower motor, the air temperature actuators, mode actuator and recirculation.

To place the HVAC system in Automatic mode, the following is required:

- The Auto switch must be activated
- The air temperature switch must be in any other position other than full hot or full cold position

Once the desired temperature is reached, the blower motor, mode, recirculation and temperature actuators will automatically be adjusted to maintain the temperature selected. The HVAC control module performs the following functions to maintain the desired air temperature:

- Monitor the following sensors:
  - Inside air temperature sensor
  - Ambient Air Temperature Sensor
  - Lower Left Air Temperature Sensor
  - Lower Right Air Temperature Sensor
  - Upper Left Air Temperature Sensor
  - Upper Right Air Temperature Sensor
- Regulate blower motor speed
- Position the air temperature actuator
- Position the mode actuator
- Position the recirculation actuator
- Request A/C operation

AIR TEMPERATURE DESCRIPTION & OPERATION

The air temperature controls are divided into 7 areas:

- HVAC Control Components
- Heating and A/C Operation

- Auxiliary Heating and A/C Operation
- Automatic Operation
- Steering Wheel Controls
- Engine Coolant
- A/C Cycle

HVAC Control Components

HVAC Control Module

The HVAC control module is a class 2 device that interfaces between the operator and the HVAC system to maintain air temperature and distribution settings. The battery positive voltage circuit provides power that the control module uses for keep alive memory (KAM). If the battery positive voltage circuit loses power, all HVAC DTCs and settings will be erased from KAM. The body control module (BCM), which is the vehicle mode master, provides a device on signal. The control module supports the following features:

Feature	Availability
Afterblow	No
Purge	No
Personalization	Yes
Actuator Calibration	Yes

Auxiliary HVAC Control Module - VIN 6

The auxiliary HVAC control module is a class 2 device that interfaces between the rear seat occupants and the auxiliary HVAC system to maintain auxiliary air temperature and auxiliary air distribution settings. The battery positive voltage circuit provides power that the control module uses for KAM. If the battery positive voltage circuit loses power, all auxiliary HVAC DTCs and settings will be erased from KAM. The auxiliary HVAC control module will perform a recalibration of the electric actuators when commanded with a scan tool or if KAM is lost. This will ensure the actuators are moving with in the calibrated range.

Air Temperature Actuator

The air temperature actuators are a 5-wire bi-directional electric motor that incorporates a feedback potentiometer. Ignition 3 voltage, low reference, control, 5-volt reference, and position signal circuits enable the actuator to operate. The control circuit uses either a 0, 2.5, or 5-volt signal to command the actuator movement. When the actuator is at rest, the control circuit value is 2.5 volts. A 0 or 5-volt control signal commands the actuator movement in opposite directions. When the actuator shaft rotates, the potentiometer's adjustable contact changes the door position signal between 0-5 volts.

The HVAC control module uses a range of 0-255 counts to index the actuator position. The door position signal voltage is converted to a 0-255 count range. When the module sets a commanded, or targeted, value, the control signal is changed to either 0 or 5 volts depending upon the direction that the actuator needs to rotate to reach the commanded value. As the actuator shaft rotates, the changing position signal is sent to the module. Once the position signal and the commanded value are the same, the module changes the control signal to 2.5 volts.

Auxiliary Air Temperature Actuator - VIN 6

The auxiliary air temperature actuator is a 5-wire bi-directional electric motor that incorporates a feedback potentiometer. Low reference, 5-volt reference, position signal, and 2 control circuits enable the actuator to operate. The control circuits use either a 0 or 12-volt value to coordinate the actuator movement. When the actuator is at rest, both control circuits have a value of 0 volts. In order to move the actuator, the auxiliary HVAC control module grounds one of the control circuits while providing the other with 12 volts. The control module reverses the polarity of the control circuits to move the actuator in the opposite direction. When the actuator shaft rotates, the potentiometers adjustable contact changes the door position signal between 0-5 volts.

The auxiliary HVAC control module uses a range of 0-255 counts to index the actuator position. The door position signal voltage is converted to a 0-255 count range. When the module sets a commanded, or targeted, value, one of the control circuits is grounded. As the actuator shaft rotates, the changing position signal is sent to the module. Once the position signal and the commanded value are the same, the module grounds both control circuits.

Air Temperature Sensors

The air temperature sensors are a 2-wire negative temperature co-efficient thermistor. The vehicle uses the following air temperature sensors:

- Ambient air temperature sensor
- Inside air temperature sensor assembly
- Upper left air temperature sensor
- Upper right air temperature sensor
- Lower left air temperature sensor
- Lower right air temperature sensor

A signal and low reference circuit enables the sensor to operate. As the air temperature surrounding the sensor increases, the sensor resistance decreases. The sensor signal voltage decreases as the resistance decreases. The sensor operates within a temperature range between -40 to +101°C (-40 to +215°F). The sensor signal varies between 0-5 volts.

The input of the duct air temperature sensors are different from the ambient and inside sensors. The HVAC control module converts the signal to a range between 0-255 counts. As the air temperature increases the count value will decrease.

If the HVAC control module detects a malfunctioning sensor, then the control module software will use a defaulted air temperature value. The default value for the ambient and inside air temperature sensors will be displayed on the scan tool. The default value for the duct air temperature sensors will not be displayed on the scan tool. The scan tool parameter for the duct air temperature sensors are the actual state of the signal circuit. The default action ensures that the HVAC system can adjust the inside air temperature near the desired temperature until the condition is corrected.

The ambient air temperature sensor mounts underhood and can be affected by city traffic, by idling, and by restarting a hot engine. Therefore, the HVAC control module filters the value of the ambient air temperature

sensor for temperature display. The ambient air temperature value is updated under the following conditions:

A new outside temperature reading will be displayed if the vehicle has been off for more than three hours. If the vehicle has been off for less than three hours, the old temperature reading may be displayed because underhood heat is affecting the true outside temperature. Since underhood heat can also affect the outside temperature while the engine is running, it may take several minutes of driving before the display updates to the actual outside temperature.

Condition	Display
At start up with the engine off less than 2 hours	Displays last stored temperature
At start up with the engine off more than 2 hours	Displays real-time temperature
Engine coolant temperature is less than 28°C (50°F) above the ambient air temperature	Displays real-time temperature
Vehicle speed above 32 km/h (20 mph) for a minimum of 80 seconds	Displays real-time temperature
Sensor reading is less than the last displayed value	Displays real-time temperature

The scan tool has the ability to update the displayed ambient air temperature. To update the ambient air temperature display on the HVAC control module, perform the following procedure: Simultaneously press the MODE, FRONT DEFROST, and REAR DEFROST switches.

1. Turn ON the ignition.
2. Simultaneously press the MODE, FRONT DEFROST, and REAR DEFROST switches.

Sunload Sensor

The sunload sensor is a 2-wire photo diode. The vehicle uses left and right sunload sensors. The 2 sensors are integrated into the sunload sensor assembly. Low reference and signal circuits enable the sensor to operate. As the light shining upon the sensor gets brighter, the sensor resistance increases. The sensor signal decreases as the resistance increases. The sensor operates within an intensity range between completely dark and bright. The sensor signal varies between 0-5 volts. The HVAC control module converts the signal to a range between 0-255 counts.

The sunload sensor provides the HVAC control module a measurement of the amount of light shining on the vehicle. Bright, or high intensity, light causes the vehicles inside temperature to increase. The HVAC system compensates for the increased temperature by diverting additional cool air into the vehicle.

If the HVAC control module detects a malfunctioning sensor, then the control module software will use a defaulted sunload value. This value will not be displayed on the scan tool. The default action ensures that the HVAC system can adjust the inside air temperature near the desired temperature until the condition is fixed. The scan tool parameter for the sunload sensor is the actual state of the signal circuit.

A/C Refrigerant Pressure Sensor

The A/C refrigerant pressure sensor is a 3-wire piezoelectric pressure transducer. A 5-volt reference, low reference, and signal circuits enable the sensor to operate. The A/C pressure signal can be between 0-5 volts.

When the A/C refrigerant pressure is low, the signal value is near 0 volts. When the A/C refrigerant pressure is high, the signal value is near 5 volts. The powertrain control module (PCM) converts the voltage signal to a pressure value.

The A/C refrigerant pressure sensor protects the A/C system from operating when an excessively high pressure condition exists. The PCM disables the compressor clutch if the A/C pressure is more than 2413 kPa (350 psi). The clutch will be enabled after the pressure decreases to less than 1578 kPa (229 psi).

A/C Low Pressure Switch

The A/C low pressure switch protects the A/C system from a low pressure condition that could damage the A/C compressor or cause evaporator icing. The HVAC control module applies 5 volts to the A/C low pressure switch signal circuit. The switch will open when the A/C low side pressure reaches 137-165 kPa (20-24 psi). This prevents the A/C compressor from operating. The switch will then close when A/C low pressure side reaches 275-310 kPa (40-45 psi). This enables the A/C compressor to turn back ON.

The low pressure switch uses refrigerant pressure to open and close a set of electrical contacts. When A/C request is authorized, the switch is closed and shows normal status. During this state, the switch will show 0 volts on the A/C low pressure sensor signal circuit. When A/C request is denied due to a low pressure condition, the switch will be open. During this state, the switch will show 5 volts on the A/C low pressure sensor signal circuit.

Coolant Bypass Valve

The coolant bypass valve controls coolant flow to the auxiliary heater core. Integral to the coolant bypass valve is an electric solenoid that controls vacuum flow to open and close the valve. When the HVAC control module applies 12 volts to the integral solenoid, the solenoid applies vacuum to a diaphragm that closes the water valve. This action restricts coolant flow to the auxiliary heater core. The coolant bypass valve is a normally open valve. If there is a concern with control of the valve or with its vacuum source the valve will still be able to supply heated coolant to the auxiliary heater core.

Heating and A/C Operation

The purpose of the heating and A/C system is to provide heated and cooled air to the interior of the vehicle. The A/C system will also remove humidity from the interior and reduce windshield fogging. The vehicle operator can determine the passenger compartment temperature by adjusting the air temperature switch. The vehicle passenger can offset the passenger temperature as much as 16.7°C (30°F). Regardless of the temperature setting, the following can effect the rate that the HVAC system can achieve the desired temperature:

- Recirculation actuator setting
- Difference between inside and desired temperature
- Difference between ambient and desired temperature
- Blower motor speed setting
- Mode setting
- Auxiliary HVAC settings

The control module makes the following actions when automatic operation is not selected, and an air temperature setting is selected:

- When the air temperature switch is placed in the warmest position, the control module commands the air temperature door to divert maximum air past the heater core.
- When the air temperature switch is placed in the coldest position, the control module commands the air temperature door to direct air to bypass the heater core.
- When the air temperature switch is placed between the warmest and coldest positions, the control module monitors the following sensor inputs to determine the air temperature door position that diverts the appropriate amount of air past the heater core in order to achieve the desired temperature:
  - Sunload
  - Duct temperatures
  - Ambient temperature
  - Inside temperature

The A/C system can be engaged by either pressing the A/C switch or during automatic operation. The HVAC control module sends a class 2 message to the powertrain control module (PCM) for A/C compressor engagement. The PCM will provide a ground for the A/C compressor relay enabling it to close its internal contacts to send battery voltage to the A/C compressor clutch coil. The A/C compressor diode will prevent a voltage spike, resulting from the collapse of the magnetic field of the coil, from entering the vehicle electrical system when the compressor is disengaged.

The following conditions must be met in order for the A/C compressor clutch to turn ON:

- The ambient air temperature is above 1°C (35°F).
- The A/C low pressure switch signal circuit is grounded.
- The A/C refrigerant pressure sensor parameter is less than 2 413 kPa (350 psi).
- The A/C compressor temperature switch contacts are closed.
- The PCM receives an A/C request from the HVAC control module.
- The engine coolant temperature (ECT) is less than 123°C (253°F).
- The engine RPM is more than 550 RPM.
- The throttle position is less than 100 percent.

The HVAC control module monitors the A/C low pressure switch signal circuit. If the voltage signal on this circuit has no voltage drop, the module will interpret this condition as a low pressure, disabling the A/C request. The A/C low pressure switch will open its internal contacts at 151 kPa (22 psi). Then close the contacts at 275 kPa (40 psi) to resume A/C operation. This switch assists in cycling the A/C compressor and prevents A/C compressor operation if system has a low refrigerant level.

The PCM monitors the A/C refrigerant pressure sensor signal circuit. The voltage signal on this circuit is proportional to the refrigerant pressure inside the A/C high side pressure line. As the pressure inside the line increases, so does the voltage signal. If the pressure is above 2 413 kPa (350 psi), the A/C compressor output is disabled. When the pressure lowers to 1 578 kPa (229 psi), the PCM enables the compressor to operate.

The sensor information is used by the PCM to determine the following:

- The A/C high side pressure
- An A/C system load on the engine
- An excessive A/C high side pressure
- The heat load at the A/C condenser

The A/C compressor has an A/C compressor temperature switch. This switch protects the compressor from over heating. The switch interrupts power to the compressor clutch coil. When the compressor core temperature rises above 135°C (275°F), the switch opens, disabling the compressor clutch coil. When the temperature lowers to 120°C (248°F), the switch closes, enabling the compressor clutch coil. This switch is not a serviceable part, it is integral to the A/C compressor.

Once engaged, the compressor clutch will be disengaged for the following conditions:

- The ambient air temperature is less than 1°C (35°F).
- The A/C compressor temperature switch contacts are open.
- The throttle position is 100 percent.
- The A/C low pressure switch is open.
- The A/C high side pressure is more than 2 413 kPa (350 psi).
- The A/C low side pressure is less than 151 kPa (22 psi).
- The engine coolant temperature (ECT) is more than 123°C (253°F).
- The engine speed is more than 5,500 RPM.
- Transmission shift
- The PCM detects excessive torque load.
- The PCM detects insufficient idle quality.
- The PCM detects a hard launch condition.

Auxiliary Heating & A/C Operation

There are 2 separate controls for the auxiliary HVAC system. There is the front auxiliary blower motor switch and the auxiliary HVAC control module. If the front auxiliary blower motor switch is in any other position than OFF or REAR, then the auxiliary air temperature actuator mimics the set passenger temperature. The auxiliary mode will mimic the primary mode. If the front auxiliary blower motor switch is in the REAR position, then the system will only function with inputs to the auxiliary HVAC control module. If the front auxiliary blower motor switch is in the OFF position, then the auxiliary HVAC control module does not respond to input. The auxiliary HVAC control module can not request A/C operation from the powertrain control module (PCM).

Pressing the UP air temperature switch to the warmest position diverts most of the airflow through the heater core, which increases the outlet air temperature. Pressing the DOWN air temperature switch to the coolest position diverts most of the airflow around the heater core, which decreases the outlet air temperature.

The auxiliary air temperature actuator shares a control circuit with the auxiliary mode actuator. If change of

position is required for both actuators, then the module positions the auxiliary air temperature actuator first. All control circuits for the auxiliary actuators are at a low voltage potential until a change of position is required. The module then applies a high voltage potential to the appropriate control circuit, which will rotate the actuator.

The coolant bypass valve controls coolant flow to the auxiliary heater core. If a cool air temperature is selected, the auxiliary HVAC control module sends a class 2 message to the HVAC control module to close the valve. When the HVAC control module applies 12 volts to the coolant bypass solenoid control circuit, the solenoid opens. When the solenoid is open, a diaphragm closes the water valve when vacuum is applied. This action restricts coolant flow to the auxiliary heater core. The coolant bypass valve is a normally open valve.

Automatic Operation

In automatic operation, the HVAC control module will maintain the comfort level inside of the vehicle by controlling the A/C compressor clutch, the blower motor, the air temperature actuators, mode actuator, and recirculation.

To place the HVAC system in Automatic mode, the following is required:

- The Auto switch must be activated.
- The air temperature switch must be in any other position other than full hot or full cold position.

Once the desired temperature is reached, the blower motor, mode, recirculation, and temperature actuators will automatically be adjusted to maintain the temperature selected. The HVAC control module performs the following functions to maintain the desired air temperature:

- Monitor the following sensors:
  - Inside air temperature sensor
  - Ambient air temperature sensor
  - Lower left air temperature sensor
  - Lower right air temperature sensor
  - Upper left air temperature sensor
  - Upper right air temperature sensor
- Regulate blower motor speed
- Position the air temperature actuator
- Position the mode actuator
- Position the recirculation actuator
- Request A/C operation

Steering Wheel Controls

The steering wheel controls for the HVAC system include air temperature and blower motor speed adjustments. Pressing the up arrow on the air temperature switch increases the outlet air temperature. Pressing the down arrow on the air temperature switch decreases the outlet air temperature. The body control module (BCM)

receives the input from the steering wheel controls. Pressing one of the steering wheel switches enables an in line resistor to drop voltage on the remote radio control signal circuit. The BCM then interprets this voltage signal and sends a class 2 message to the HVAC control module for the desired change.

Engine Coolant

Engine coolant is the essential element of the heating system. The thermostat controls the normal engine operating coolant temperature. The thermostat also creates a restriction for the cooling system that promotes a positive coolant flow and helps prevent cavitation.

Coolant enters the heater core through the inlet heater hose, in a pressurized state. The heater core is located inside the HVAC module. The ambient air drawn through the HVAC module absorbs the heat of the coolant flowing through the heater core. Heated air is distributed to the passenger compartment, through the HVAC module, for passenger comfort. Opening or closing the air temperature door controls the amount of heat delivered to the passenger compartment. The coolant exits the heater core through the return heater hose and recirculated back through the engine cooling system.

A/C Cycle

Refrigerant is the key element in an air conditioning system. R-134a is presently the only EPA approved refrigerant for automotive use. R-134a is an very low temperature gas that can transfer the undesirable heat and moisture from the passenger compartment to the outside air.

The A/C compressor is belt driven and operates when the magnetic clutch is engaged. The compressor builds pressure on the vapor refrigerant. Compressing the refrigerant also adds heat to the refrigerant. The refrigerant is discharged from the compressor, through the discharge hose, and forced to flow to the condenser and then through the balance of the A/C system. The A/C system is mechanically protected with the use of a high pressure relief valve. If the A/C refrigerant pressure sensor were to fail or if the refrigerant system becomes restricted and refrigerant pressure continued to rise, the high pressure relief will pop open and release refrigerant from the system.

Compressed refrigerant enters the condenser in a high temperature, high pressure vapor state. As the refrigerant flows through the condenser, the heat of the refrigerant is transferred to the ambient air passing through the condenser. Cooling the refrigerant causes the refrigerant to condense and change from a vapor to a liquid state.

The condenser is located in front of the radiator for maximum heat transfer. The condenser is made of aluminum tubing and aluminum cooling fins, which allows rapid heat transfer for the refrigerant. The semi-cooled liquid refrigerant exits the condenser and flows through the liquid line, to the orifice tube.

The orifice tube is located in the liquid line between the condenser and the evaporator. The orifice tube is the dividing point for the high and the low pressure sides of the A/C system. As the refrigerant passes through the orifice tube, the pressure on the refrigerant is lowered. Due to the pressure differential on the liquid refrigerant, the refrigerant will begin to vaporize at the orifice tube. The orifice tube also meters the amount of liquid refrigerant that can flow into the evaporator.

Refrigerant exiting the orifice tube flows into the evaporator core in a low pressure, liquid state. Ambient air is drawn through the HVAC module and passes through the evaporator core. Warm and moist air will cause the

liquid refrigerant boil inside of the evaporator core. The boiling refrigerant absorbs heat from the ambient air and draws moisture onto the evaporator. The refrigerant exits the evaporator through the suction line and back to the compressor, in a vapor state, and completing the A/C cycle of heat removal. At the compressor, the refrigerant is compressed again and the cycle of heat removal is repeated.

The conditioned air is distributed through the HVAC module for passenger comfort. The heat and moisture removed from the passenger compartment will also change form, or condense, and is discharged from the HVAC module as water.

A/C Cycle with Auxiliary

The auxiliary A/C system operates from the vehicles primary A/C system. The front or primary A/C system must be ON to allow the rear A/C system to function.

Refrigerant is the key element in an air conditioning system. R-134a is presently the only EPA approved refrigerant for automotive use. R-134a is an very low temperature gas that can transfer the undesirable heat and moisture from the passenger compartment to the outside air.

The A/C system used on this vehicle is a non cycling system. Non cycling A/C systems use a high pressure switch to protect the A/C system from excessive pressure. The high pressure switch will OPEN the electrical signal, to the compressor clutch, in the event that the refrigerant pressure becomes excessive. After the high and low side of the A/C system pressure equalize, the high pressure switch will CLOSE. Closing the high pressure switch will complete the electrical circuit to the compressor clutch. The A/C system is also mechanically protected with the use of a high pressure relief valve. If the high pressure switch were to fail or if the refrigerant system becomes restricted and refrigerant pressure continued to rise, the high pressure relief will pop open and release refrigerant from the system.

The A/C compressor is belt driven and operates when the magnetic clutch is engaged. The compressor builds pressure on the vapor refrigerant. Compressing the refrigerant also adds heat to the refrigerant. The refrigerant is discharged from the compressor, through the discharge hose, and forced to flow to the condenser and then through the balance of the A/C system.

Compressed refrigerant enters the condenser in a high temperature, high pressure vapor state. As the refrigerant flows through the condenser, the heat of the refrigerant is transferred to the ambient air passing through the condenser. Cooling the refrigerant causes the refrigerant to condense and change from a vapor to a liquid state.

The condenser is located in front of the radiator for maximum heat transfer. The condenser is made of aluminum tubing and aluminum cooling fins, which allows rapid heat transfer for the refrigerant. The semi-cooled liquid refrigerant exits the condenser and flows through the liquid line. The liquid line flow is split and the liquid refrigerant flows to both the front or primary A/C system, and to the liquid line for the rear A/C system.

The liquid refrigerant, flowing to the rear A/C system, flows into the rear thermal expansion valve (TXV). The rear TXV is located at the rear evaporator inlet. The TXV is the dividing point for the high and the low pressure sides of the rear A/C system. As the refrigerant passes through the TXV, the pressure on the refrigerant is lowered. Due to the pressure differential on the liquid refrigerant, the refrigerant will begin to boil at the expansion device. The TXV also meters the amount of liquid refrigerant that can flow into the evaporator.

Refrigerant exiting the TXV flows into the evaporator core in a low pressure, liquid state. Ambient air is drawn through the rear A/C module and passes through the evaporator core. Warm and moist air will cause the liquid refrigerant boil inside of the evaporator core. The boiling refrigerant absorbs heat from the ambient air and draws moisture onto the evaporator. The refrigerant exits the evaporator through the suction line and back to the primary A/C systems suction line. Refrigerant in the primary A/C system suction line flows back to the compressor, in a vapor state, and completes the A/C cycle of heat removal. At the compressor, the refrigerant is compressed again and the cycle of heat removal is repeated.

The conditioned air is distributed through the rear A/C module for passenger comfort. The heat and moisture removed from the rear passenger compartment will also change form, or condense, and is discharged from the rear A/C module as water.