

2008 HVAC

HVAC - Manual - LaCrosse

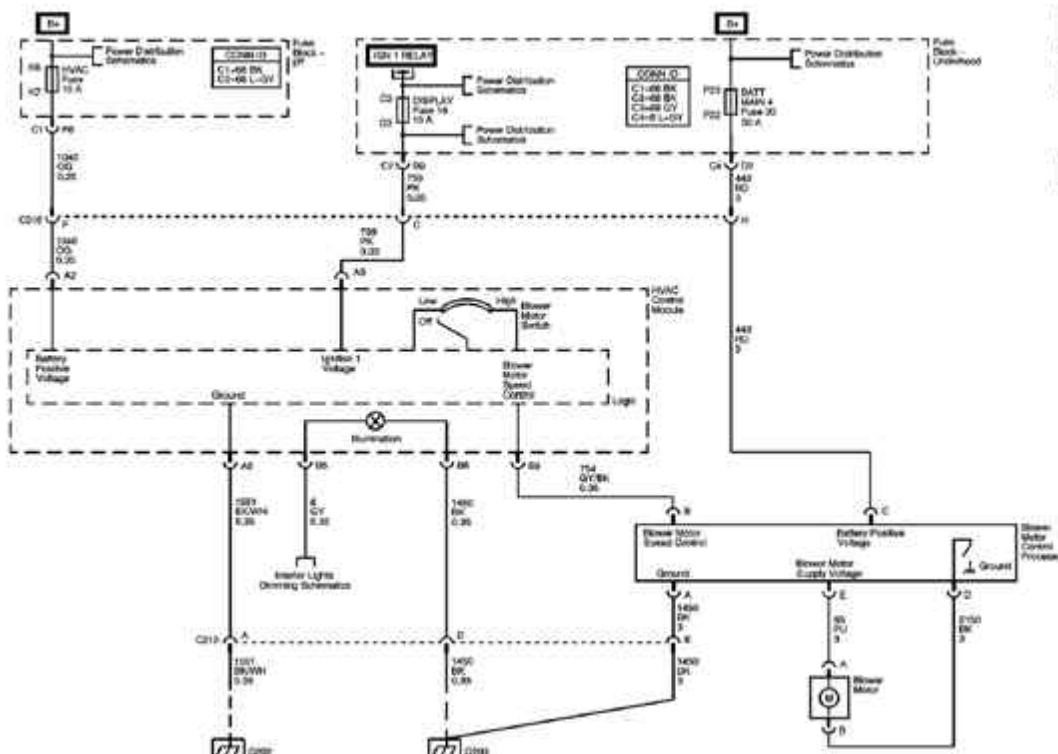
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Air Temperature Actuator Screw	1.5 N.m	13 lb in
HVAC Control Module Screw	2 N.m	18 lb in
Instrument Panel Compartment Screw	2 N.m	18 lb in
Mode Actuator Screw	1.5 N.m	13 lb in
Recirculation Actuator Screw	1.5 N.m	13 lb in

SCHEMATIC AND ROUTING DIAGRAMS

HVAC SCHEMATIC



2008 Buick LaCrosse CXL

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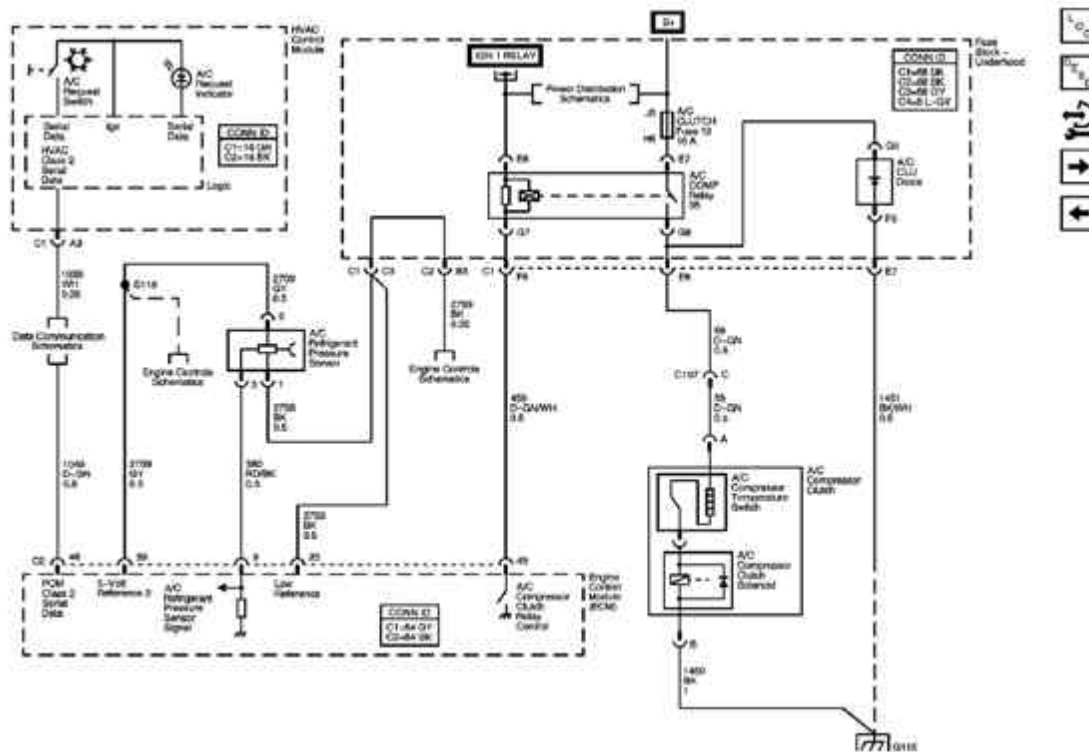


Fig. 3: Compressor Controls and Serial Data Schematic - LY7
Courtesy of GENERAL MOTORS CORP.

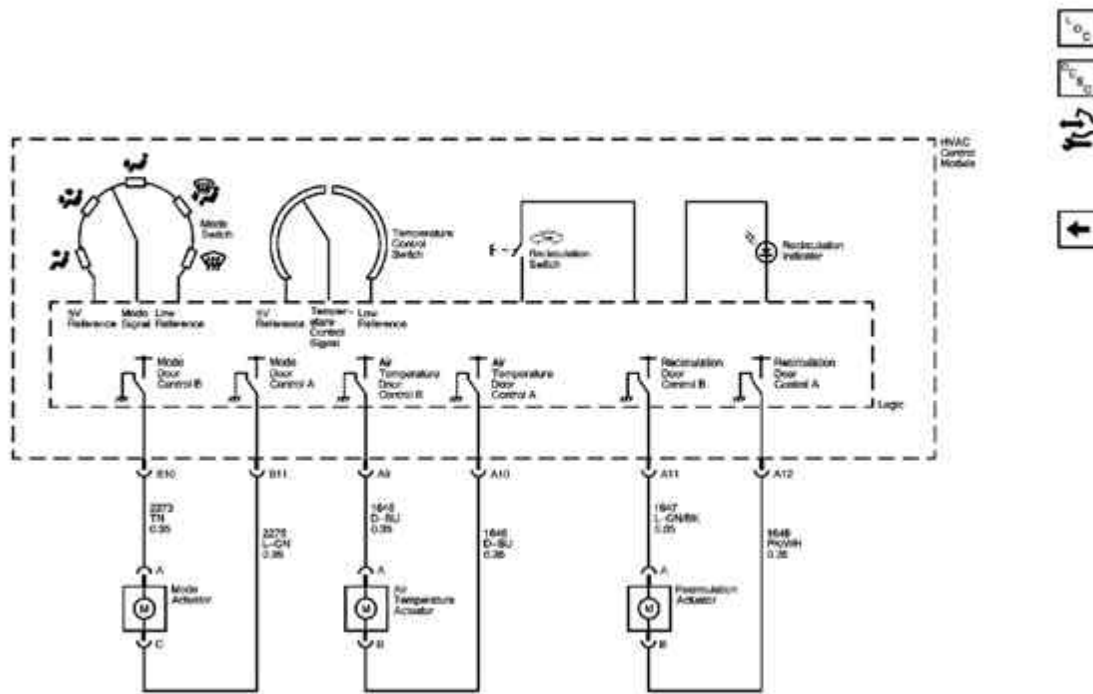


Fig. 4: Mode and Air Temperature Controls Schematic
 Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B0248, B0249, B0268, B0269, B0408, B0409, B0414, B0418, B0419, B0424, B3748 or B3749	B0248: Air Flow Control 3 Blend Defog and Floor Circuit B0249: Air Flow Control 3 Blend Defog and Floor Circuit Range/Performance B0268: Air Flow Control 7 Recirculate Circuit B0269: Air Flow Control 7 Recirculate Circuit Range/Performance B0408: Temperature Control 1 Circuit B0409: Temperature Control 1 Circuit Range/Performance B0414: Temperature Control 1 Feedback Circuit

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	Range/Performance B0418: Temperature Control 2 Circuit B0419: Temperature Control 2 Circuit Range/Performance B0424: Temperature Control 2 Feedback Circuit Range/Performance B3748: Air Flow Control 3 Blend Defog and Floor Feedback Circuit Range/Performance B3749: Air Flow Control 7 Recirculate Feedback Circuit Range/Performance
<u>DTC P0530, P0532, or P0533</u>	P0530: Air Conditioning A/C Refrigerant Pressure Sensor Circuit P0532: Air Conditioning A/C Refrigerant Pressure Sensor Circuit Low Voltage P0533: Air Conditioning A/C Refrigerant Pressure Sensor Circuit High Voltage
<u>DTC P0645, P0646, or P0647</u>	P0645: Air Conditioning (A/C) Clutch Relay Control Circuit P0646: Air Conditioning (A/C) Clutch Relay Control Circuit Low Voltage P0647: Air Conditioning (A/C) Clutch Relay Control Circuit High Voltage

DTC B0248, B0249, B0268, B0269, B0408, B0409, B0414, B0418, B0419, B0424, B3748 OR B3749**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 B0248**

Air Flow Control 3 Blend Defog and Floor Circuit

DTC B0249

Air Flow Control 3 Blend Defog and Floor Circuit Range/Performance

DTC B0268

Air Flow Control 7 Recirculate Circuit

DTC B0269

Air Flow Control 7 Recirculate Circuit Range/Performance

DTC B0408

Temperature Control 1 Circuit

DTC B0409

Temperature Control 1 Circuit Range/Performance

DTC B0414

Temperature Control 1 Feedback Circuit Range/Performance

DTC B0418

Temperature Control 2 Circuit

DTC B0419

Temperature Control 2 Circuit Range/Performance

DTC B0424

Temperature Control 2 Feedback Circuit Range/Performance

DTC B3748

Air Flow Control 3 Blend Defog and Floor Feedback Circuit Range/Performance

DTC B3749

Air Flow Control 7 Recirculate Feedback Circuit Range/Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Recirculation Door Control A	B0268, B0269, B3749	B0268, B0269, B3749	B0268, B0269, B3749	-
Recirculation Door Control B	B0268, B0269, B3749	B0268, B0269, B3749	B0268, B0269, B3749	-
Left Air Temperature Door Control A	B0408, B0409, B0414	B0408, B0409, B0414	B0408, B0409, B0414	-
Left Air Temperature Door Control B	B0408, B0409, B0414	B0408, B0409, B0414	B0408, B0409, B0414	-
Right Air Temperature Door Control A	B0418, B0419, B0424	B0418, B0419, B0424	B0418, B0419, B0424	-
Right Air Temperature Door Control B	B0418, B0419, B0424	B0418, B0419, B0424	B0418, B0419, B0424	-
Mode Door Control A	B0248, B0249, B3748	B0248, B0249, B3748	B0248, B0249, B3748	-
Mode Door Control B	B0248, B0249, B3748	B0248, B0249, B3748	B0248, B0249, B3748	-

Circuit/System Description

The actuator is an electronic stepper motor. The HVAC control module supplies power and ground to the actuator. The HVAC control module controls the direction of the actuator by changing the polarity of the control circuits. When the actuator reaches its desired position, both circuits are fixed to the same value 0 volts. The HVAC control module determines the door or mode film position by counting pulses, voltage fluctuations, caused by the brush to commutator action generated during normal motor operation. The HVAC control module monitors a voltage drop across an internal resistance to detect the pulses. The HVAC control module converts the pulses to counts with a range of 0-255 counts.

When a calibration or recalibration procedure is performed, the HVAC control module calculates the door or mode film travel range. The HVAC control module commands the actuator in one extreme position then counts pulses starting from 0 counts. The HVAC control module compares the total number of pulses to calibrated limits. If the total pulse count is less than or equal to the maximum calibrated limit and greater than or equal to the minimum calibrated limit, then the calibration is considered successful.

- Air flow control 3 circuit refers to the mode actuator.
- Air flow control 7 circuit refers to the recirculation actuator.
- Temperature control 1 circuit refers to the left air temperature.
- Temperature control 2 circuit refers to the right air temperature.

Conditions for Running the DTC

- The ignition is ON.
- Ignition voltage is between 9-16 volts.
- 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 7 counts or greater than 250 counts.

Action Taken When the DTC Sets

Driver A and driver B circuits are 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 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 Testing

1. Ignition OFF, disconnect the harness connector at the appropriate actuator.
2. Ignition ON, connect a test lamp between the control circuit terminal A and

control circuit terminal B or terminal C for the mode actuator. Command the actuator in each direction. The test lamp should briefly illuminate when commanding the actuator in one direction to the other direction.

- If the test lamp is always OFF, test the appropriate control circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the HVAC control module.
- If the test lamp continuously illuminates, test the appropriate control circuit for a short to B+. If the circuit tests normal, replace the HVAC control module.

3. If all circuits test normal, replace the appropriate actuator.

Component Testing

1. Install a 10-amp fused jumper wire between the control terminal A and 12 volts. Momentarily install a jumper wire between the control terminal B and ground. The appropriate actuator shaft should rotate.
 - If the function does not perform as specified, replace the appropriate actuator.
2. Reverse the jumper wires; the appropriate actuator shaft should rotate.
 - If the function does not perform as specified, replace the appropriate actuator.

Repair Procedures

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

- **Air Temperature Actuator Replacement**
- **Recirculation Actuator Replacement**
- **Mode Actuator Replacement**
- **Control Module References** for HVAC replacement, setup, and programming

DTC P0530, P0532, OR P0533

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 Descriptor

DTC P0530

Air Conditioning A/C Refrigerant Pressure Sensor Circuit

DTC P0532

Air Conditioning A/C Refrigerant Pressure Sensor Circuit Low Voltage

DTC P0533

Air Conditioning A/C Refrigerant Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5-Volt Reference	P0530, P0532	P0530, P0532	P0530, P0533	-
A/C Refrigerant Pressure Sensor Signal Circuit	P0530, P0532	P0530, P0532	P0530, P0533	-
Low Reference Circuit	-	P0530, P0532	P0530, P0533	-

Circuit/System Description

The powertrain control module (PCM) monitors the high side refrigerant pressure via the A/C refrigerant pressure sensor. The PCM applies a 5-volt reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the A/C refrigerant pressure sensor signal to the PCM 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 PCM commands the cooling fans on. When pressure is too high

or too low the PCM will not allow the A/C compressor clutch to engage. When the DTC is set, the PCM does not allow the A/C compressor clutch to engage. This is done to protect the compressor.

Conditions for Running the DTC

- The engine is running.
- The battery voltage is between 11-18 volts.

Conditions for Setting the DTC**P0530**

The A/C refrigerant pressure sensor signal voltage is less than 0.2 volt or more than 4.88 volts for more than 3 seconds.

P0532

The A/C refrigerant pressure sensor signal voltage is less than 0.2 volt for more than 3 seconds.

P0533

The A/C refrigerant pressure sensor signal voltage is more than 4.88 volts for more than 3 seconds.

Action Taken When the DTC Sets

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

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 scan tool A/C High Side Pressure parameter. The reading should be between 0.2 and 4.90 volts (9 and 453 psi), and change with pressure.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the A/C refrigerant pressure sensor.
2. Ignition OFF, test for less than 1.0 ohm of resistance between the low reference circuit terminal 1 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 PCM.
- 3. Ignition ON, test for 4.8-5.2 volts between the 5-volt reference circuit terminal 2 and ground.
 - If less than the specified range, test the 5-volt reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the PCM.
 - If greater than the specified range, test the 5-volt reference circuit for a short to voltage. If the circuit tests normal, replace the PCM.
- 4. Verify the scan tool A/C High Side Pressure Sensor parameter is less than 0.2 volts.
 - If greater than 0.2 volts, test the signal circuit for a short to voltage. If the circuit tests normal, replace the PCM.
- 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 4.90 volts.
 - If less than 4.90 volts, test the signal circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the PCM.
- 6. If all circuits test normal, replace the A/C refrigerant pressure sensor.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector at the A/C refrigerant pressure sensor.
2. Test for 0.721k ohms of resistance between the 5-volt reference terminal 2 and the low reference terminal 1.
 - If the resistance is not equal to or close to the specified value, replace the A/C refrigerant pressure sensor.
3. Test for 0.721k ohms of resistance between the signal terminal 3 and the low reference terminal 3.
 - If the resistance is not equal to or close to the specified value, replace the A/C refrigerant 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 PCM setup, replacement, and programming

DTC P0645, P0646, OR P0647

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 P0645**

Air Conditioning (A/C) Clutch Relay Control Circuit

DTC P0646

Air Conditioning (A/C) Clutch Relay Control Circuit Low Voltage

DTC P0647

Air Conditioning (A/C) Clutch Relay Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
A/C Relay Coil Ignition	2	2	-	-
A/C Relay Switch B+	2	2	-	-
	P0645,	P0645,	P0645,	

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A/C Relay Control	P0646	P0647	P0647	-
A/C Clutch Control	2	2	1	-
A/C Compressor Clutch Ground	-	2	2	-
1. A/C Clutch Always Engaged				
2. A/C Clutch Inoperative				

Circuit/System Description

Ignition voltage is supplied directly to the air conditioning (A/C) compressor clutch relay. The powertrain control module (PCM) controls the relay by grounding the A/C clutch relay control circuit via an internal solid state device called a driver. The primary function of the driver is to supply the ground for the component being controlled. The driver has a fault line which is monitored by the PCM. When the PCM is commanding a component ON, the voltage of the control circuit should be near 0 volts. When the PCM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be near battery voltage.

Conditions for Running the DTC

- The ignition voltage is between 9 and 18 volts.
- The engine speed is more than 80 RPM.
- The PCM A/C Compressor Clutch Relay Control transitions between ON to OFF or from OFF to ON.

Conditions for Setting the DTC

- A short to ground on the A/C compressor clutch relay control circuit.
- A short to voltage on the A/C compressor clutch relay control circuit.
- An open circuit on the A/C compressor clutch relay control circuit or relay.
- An internally shorted or excessively low resistance A/C clutch relay coil.

Action Taken When the DTC Sets

- The A/C clutch relay is commanded OFF.
- The conditions for which the DTC was set will be stored in the Failure Records data only. No information will be stored as Freeze Frame data.

Conditions for Clearing the DTC

The history DTC will clear after 40 fault-free ignition cycles.

Diagnostic Aids

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

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 Testing**

1. Ignition OFF, disconnect the A/C COMP relay.
2. Ignition ON, verify that a test lamp does not illuminate between the relay coil

control circuit terminal G7 and ground.

- If the test lamp illuminates, test the control circuit for a short to voltage.
- 3. Verify that a test lamp illuminates between the relay coil ignition circuit terminal E8 and ground.
 - If the test lamp does not illuminate, test the ignition circuit for a short to ground or an open/high resistance. If the circuit tests normal and ignition circuit fuse is open, test or replace the relay.
- 4. Connect a test lamp between the relay coil ignition circuit terminal E8 and the relay coil control circuit terminal G7.
- 5. Command the A/C relay ON and OFF with a scan tool. 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 PCM.
 - If the test lamp is always OFF, test the control circuit for a short to voltage, or an open/high resistance. If the circuit tests normal, replace the PCM.
- 6. If all circuits test normal, test or replace the A/C COMP relay.

Component Testing

1. Ignition OFF, disconnect the A/C COMP relay.
2. Test for 60-180 ohms between terminals 85 and 86.
 - If the resistance is not within the specified range, replace the relay.
3. Test for infinite resistance between the following terminals:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If not the specified value, replace the relay.
4. Install a 30-amp fused jumper wire between relay terminal 85 and 12 volts. Install a jumper wire between relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.
 - If greater than the specified range, replace the relay.

Repair Procedures

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

- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Control Module References** for PCM setup, replacement, and programming

SYMPTOMS - HVAC SYSTEMS - MANUAL

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

- **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 conditions may 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**
- **Defrosting Insufficient**
- **Noise Diagnosis - Blower Motor**
- **Noise Diagnosis - Air Conditioning (A/C) System**
- **Noise Diagnosis - HVAC Module**
- **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
A/C Relay Coil Ignition	2	2	-	-
A/C Relay Switch B+	2	2	-	-

A/C Relay Control	P0645, P0646	P0645, P0647	P0645, P0647	-
A/C Clutch Control	2	2	1	-
A/C Compressor Clutch Ground	-	2	2	-
1. A/C Clutch Always Engaged 2. A/C Clutch 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 engine control module (ECM) to ground the A/C compressor clutch relay control circuit, which will switch the A/C COMP relay. 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 less than 4,760 RPM
- Engine speed is more than 600 RPM
- A/C high side pressure is between 2929-269 kPa (425-39 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

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. Ignition ON, 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.

Circuit/System Testing

1. Ignition OFF, disconnect the A/C COMP relay.
2. Ignition ON, verify that a test lamp does not illuminate between the control circuit terminal G8 and ground.
 - If the test lamp illuminates, test the control circuit for a short to voltage.
3. Verify that a test lamp illuminates between the ignition circuit terminal E8 and ground.
 - If the test lamp does not illuminate, test the ignition circuit for a short to

ground or an open/high resistance. If the circuit tests normal and the ignition circuit fuse is open, test or replace the A/C COMP relay.

4. Verify that a test lamp illuminates between the B+ circuit terminal E7 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 is open, test the control circuit terminal for a short to ground.
5. Disconnect the harness connector at the A/C compressor clutch.
6. Test for less than 1.0 ohm between the A/C compressor clutch ground circuit terminal B and ground.
 - If greater than the specified range, test the ground circuit for an open/high resistance.
7. Connect the harness connector at the A/C compressor clutch.
8. Connect a 10A fused jumper wire between the B+ circuit terminal E7 and the control circuit terminal G8. Verify the A/C compressor clutch is activated.
 - 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 clutch.
9. Connect a test lamp between the ignition circuit terminal E8 and the control circuit terminal G7.
10. Command the A/C relay ON and OFF with a scan tool. 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 ECM.
 - If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the PCM.
11. If all circuits test normal, test or replace the A/C COMP relay.

Component Testing

Relay Test

1. Ignition OFF, disconnect the A/C COMP relay.
2. Test for 60-180 ohms between terminals 85 and 86.

- If the resistance is not within the specified range, replace the relay.
- 3. Test for infinite resistance between the following terminals:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
- If not the specified value, replace the relay.
- 4. Install a 30-amp fused jumper wire between relay terminal 85 and 12 volts. Install a jumper wire between relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.
 - If greater than the specified range, replace the relay.

Repair Procedures

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

Control Module References for PCM 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
Blower Motor Speed Control Circuit	1, 2	1	1, 2	-
Blower Motor Control				

Processor B+	1	1	-	-
Blower Motor Control Processor Ground	-	1	1	-
Blower Motor Low Reference Circuit	2	1	1	-
1. Blower Motor Inoperative 2. Blower Motor Always On				

Circuit/System Description

Blower Motor Control Processor

The blower motor control processor 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 processor to operate. The HVAC control module provides a pulse width modulation (PWM) signal to the blower motor speed control processor in order to command the blower motor speed. The processor supplies 12 volts to the blower motor through the blower motor voltage supply circuit. The control processor uses the blower motor ground as a low side control to adjust the blower motor speed.

Diagnostic Aids

Be sure the blower motor housing is not shorted to a grounded surface causing the blower motor to run continuously at high speed.

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. Ignition ON, command the blower motor ON and OFF with a scan tool. The blower motor should turn ON and OFF when changing between the commanded states.
2. Observe the scan tool Commanded Blower parameter while changing the blower motor switch from Off through to the High speed positions. The display should change from 0-100 percent.
 - If the display does not change, replace the HVAC control module.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the blower motor control processor.
2. Test for less than 1.0 ohm of resistance between the ground circuit terminal A 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 terminal C 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 is open, replace the blower motor control processor.

4. Ignition OFF, connect the harness connector at the blower motor control processor and disconnect the harness connector at the blower motor.
5. Connect a test lamp between the control circuit terminal B and B+.
6. Ignition ON, command the blower motor ON and OFF with a scan tool, the test lamp should turn ON and OFF when changing between the commanded states.
 - If the test lamp is always OFF, test the ground circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the blower motor control processor.
 - If the test lamp is always ON, test the ground circuit for a short to ground. If the circuit tests normal, replace the blower motor control processor.
7. Connect a test lamp between the control circuit terminal A and ground.
8. Turn the blower motor ON and cycle between low and high speeds. The test lamp should illuminate and change in intensity as the blower speed is varied.
 - If the test lamp is always OFF, test the control circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the blower motor control processor.
 - If the test lamp does not change intensity, test the control circuit for a short to voltage. If the circuit tests normal, replace the blower motor control processor.
9. If all circuits test normal, test or replace the blower motor.

Component Testing

1. Ignition OFF, disconnect the harness connector at the blower motor.
2. Install a 30-amp fused jumper wire between the control 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.

• **Blower Motor Control Module Replacement**

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

ACTUATOR RECALIBRATION

Calibration Procedure

Use the following steps to perform the calibration update:

1. Turn OFF the ignition.
2. Remove the battery positive voltage circuit fuse of the HVAC Control Module.

IMPORTANT: The module memory will not clear if the battery positive voltage circuit fuse is installed in less than 60 seconds.

3. Wait 60 seconds.
4. Install the fuse.

REPAIR INSTRUCTIONS

HEATER AND AIR CONDITIONING CONTROL REPLACEMENT

Removal Procedure

1. Remove the instrument panel lower trim plate. Refer to **Instrument Panel Lower Trim Plate Replacement** .

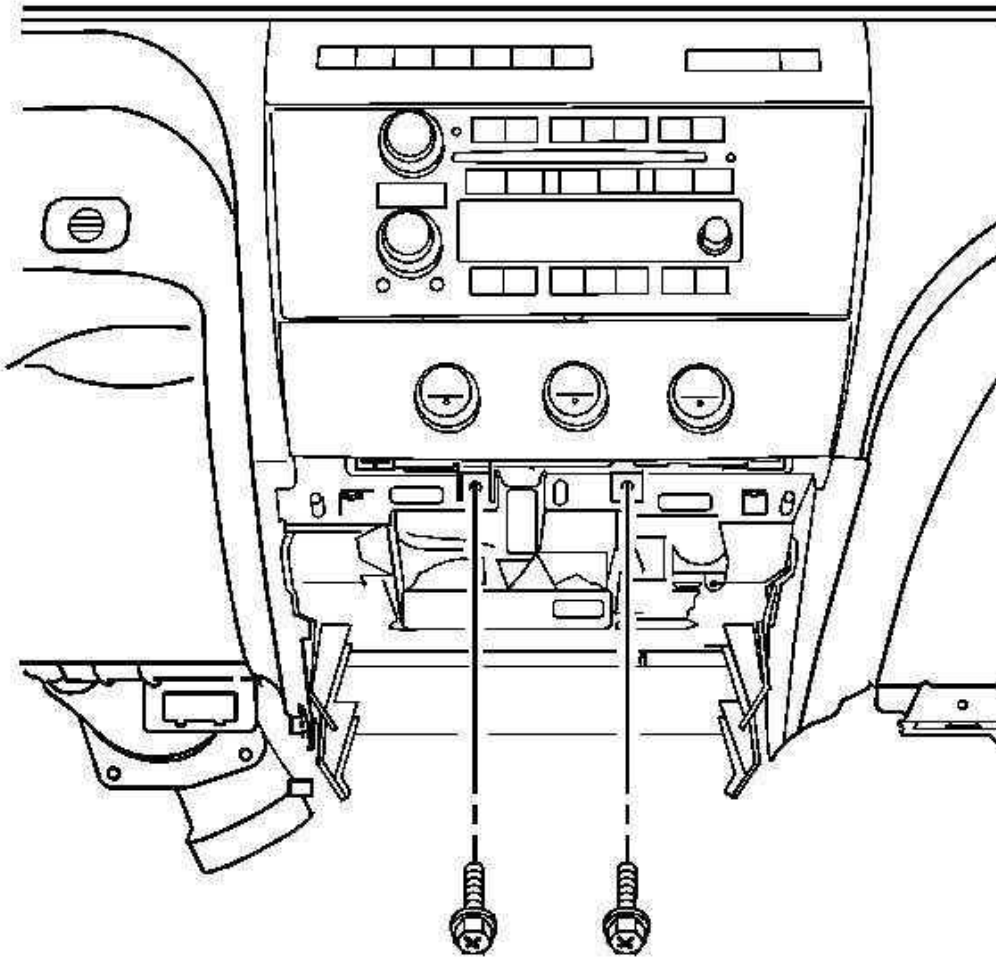


Fig. 5: Identifying HVAC Control Assembly Mounting Screws
Courtesy of GENERAL MOTORS CORP.

2. Remove the HVAC control assembly mounting screws (1).

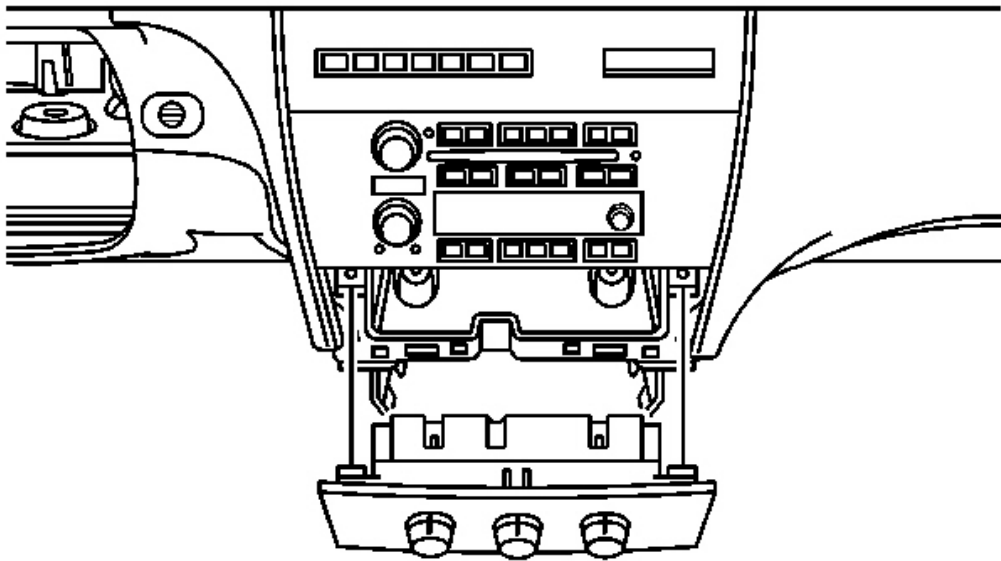


Fig. 6: Identifying HVAC Control Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Retaining clips hold the HVAC control assembly in place.

3. Pull the HVAC control assembly rearward from the instrument panel.
4. Disconnect the electrical connectors form the HVAC control assembly.
5. Remove the HVAC control assembly.

Installation Procedure

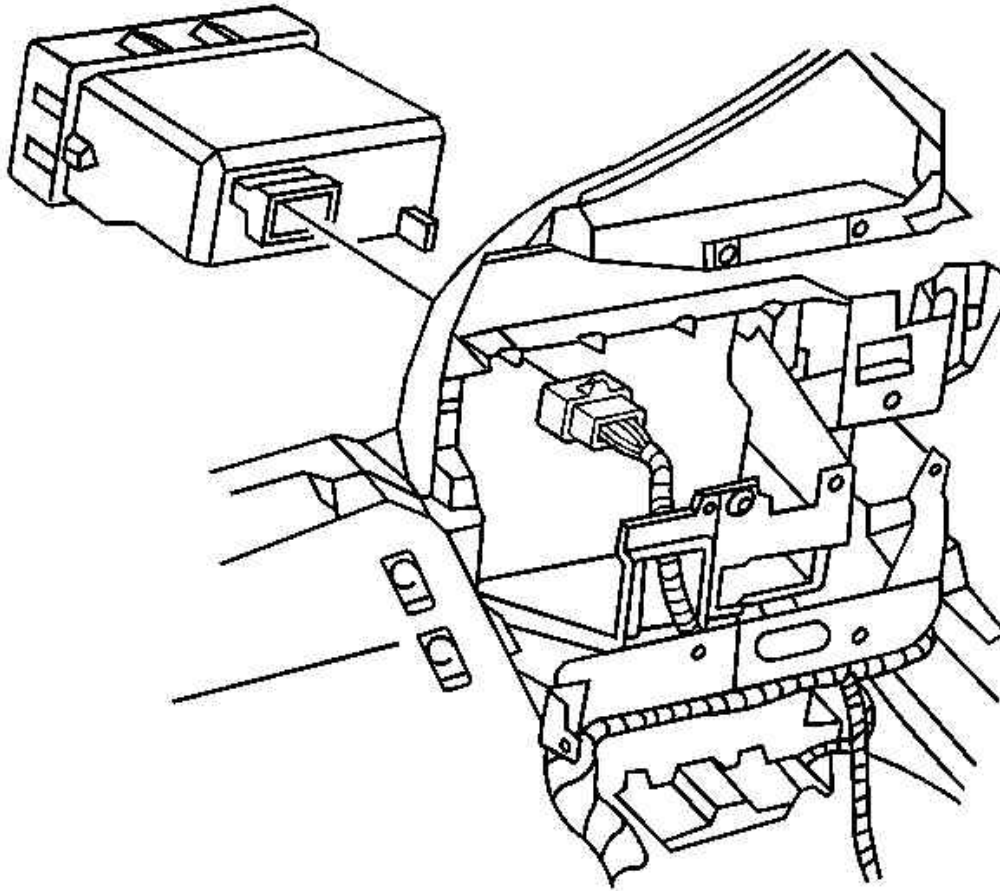


Fig. 7: Identifying HVAC Control Module Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The key should be in the off position when connecting the electrical connectors to ensure proper calibration.

1. Connect the electrical connectors to the HVAC control assembly.

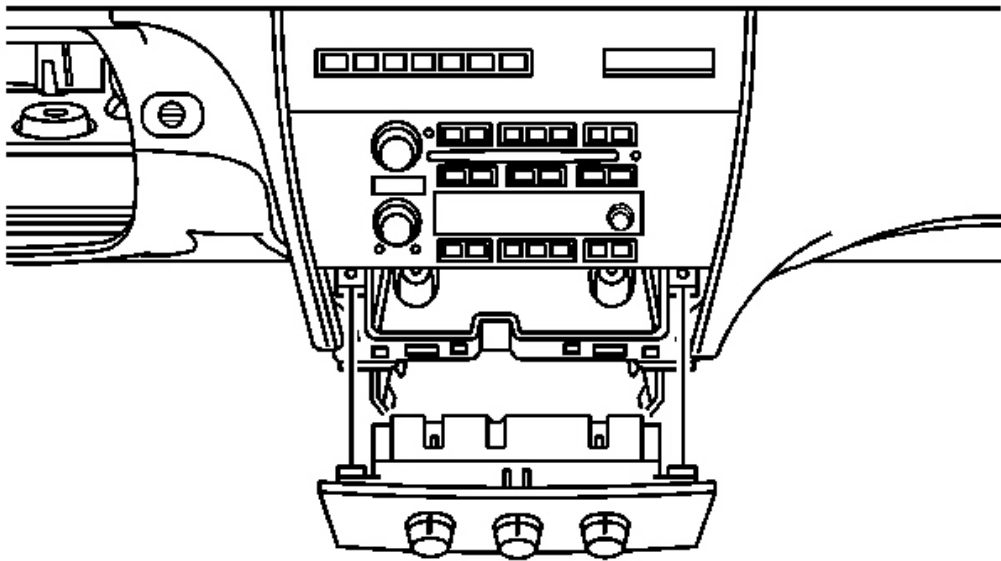


Fig. 8: Identifying HVAC Control Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install the HVAC control assembly.

NOTE: Refer to Fastener Notice .

3. Install the HVAC control assembly mounting screws.

Tighten: Tighten the screws to 2 N.m (18 lb in).

4. Install the instrument panel lower trim plate. Refer to Instrument Panel Lower Trim Plate Replacement .

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

5. Start the engine and run for 1 minute.

AIR TEMPERATURE ACTUATOR REPLACEMENT

Removal Procedure

1. Remove the right side instrument panel (I/P) insulator. Refer to **Instrument Panel Insulator Panel Replacement - Right Side** .
2. Remove the I/P compartment. Refer to **Instrument Panel Compartment Replacement** .

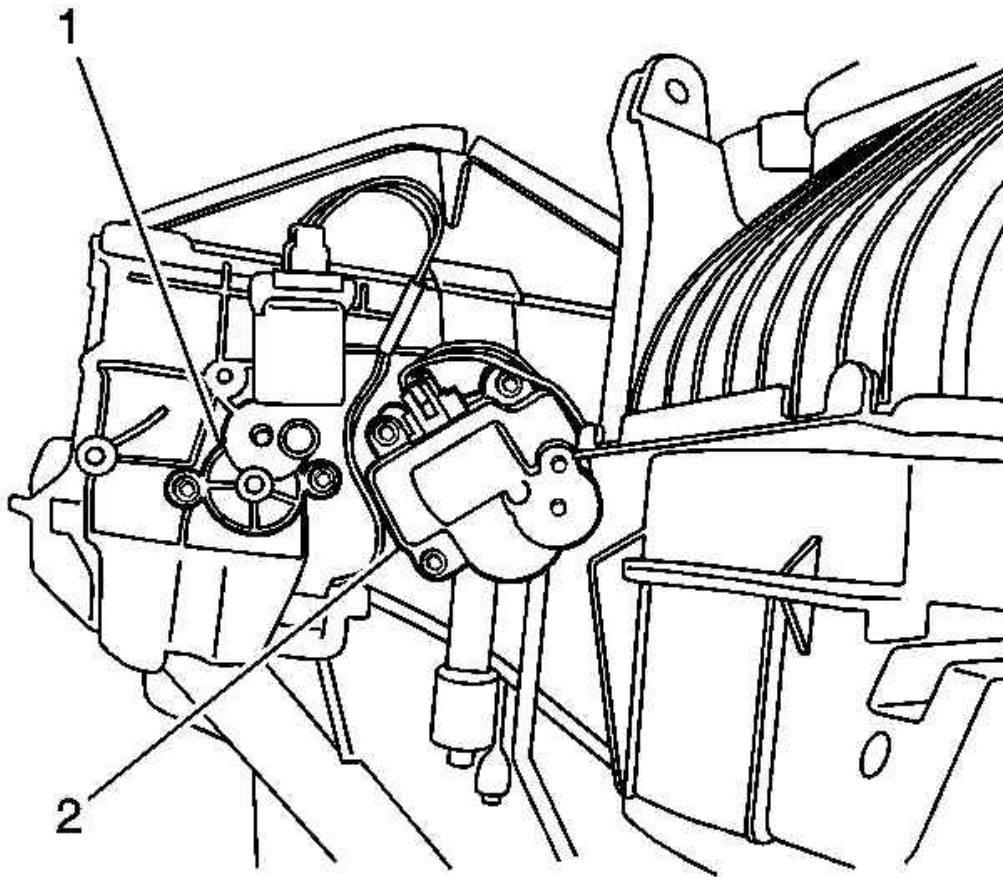


Fig. 9: View Of Right Air Temperature Actuator & Mode Actuator
Courtesy of GENERAL MOTORS CORP.

3. Remove the screws retaining the air temperature actuator (2).
4. Disconnect the electrical connector from the air temperature actuator.
5. Remove the air temperature actuator from the HVAC module assembly.

Installation Procedure

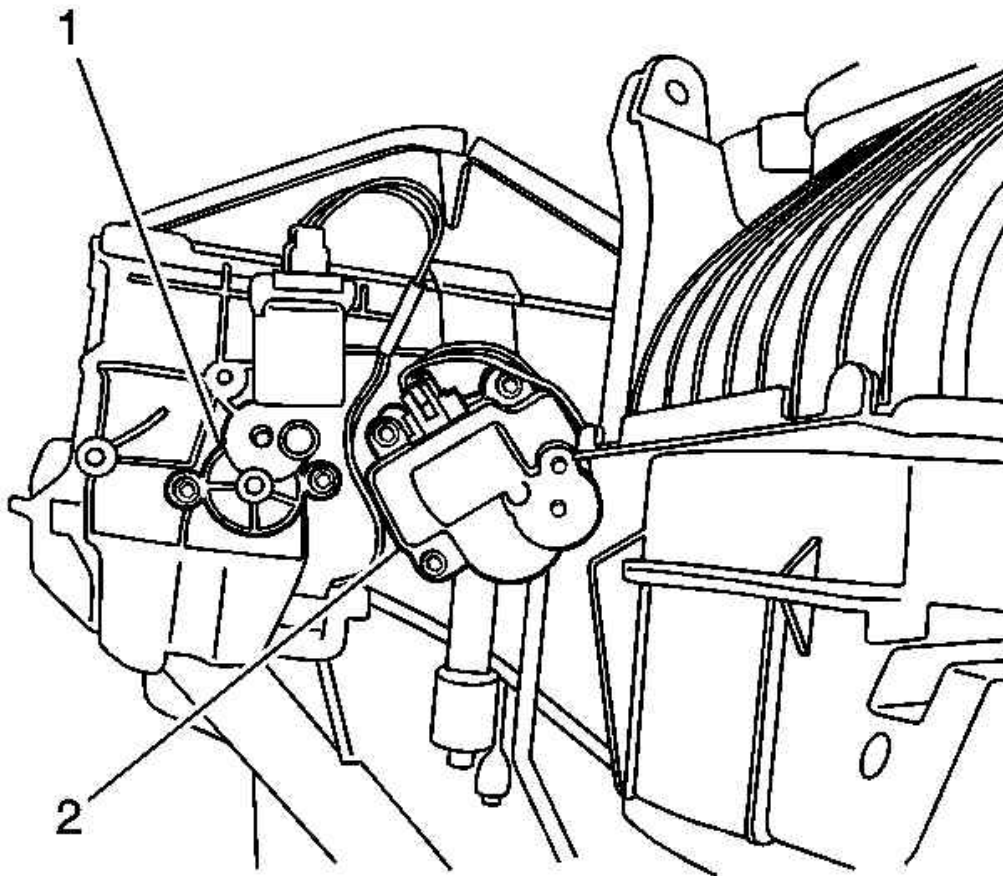


Fig. 10: View Of Right Air Temperature Actuator & Mode Actuator
Courtesy of GENERAL MOTORS CORP.

1. Position the air temperature actuator (2). Align the slots in the electric actuator driver to the flats on the shaft.
2. Align the locating hole to the alignment pin on the HVAC module case.

3. Slide the actuator driver on the shaft. The actuator driver should sit completely on the shaft and the mounting holes should be flush with the HVAC module case.

NOTE: Refer to Fastener Notice .

4. Install the screws to the air temperature actuator.

Tighten: Tighten the screw to 1.5 N.m (13 lb in).

5. Connect the electrical connector to the air temperature actuator.
6. Install the I/P compartment. Refer to Instrument Panel Compartment Replacement .
7. Install the right side I/P insulator. Refer to Instrument Panel Insulator Panel Replacement - Right Side .
8. Calibrate the actuator. Refer to Actuator Recalibration.

MODE ACTUATOR REPLACEMENT

Removal Procedure

1. Remove the right instrument panel (I/P) insulator. Refer to Instrument Panel Insulator Panel Replacement - Right Side .
2. Remove the I/P compartment. Refer to Instrument Panel Compartment Replacement .

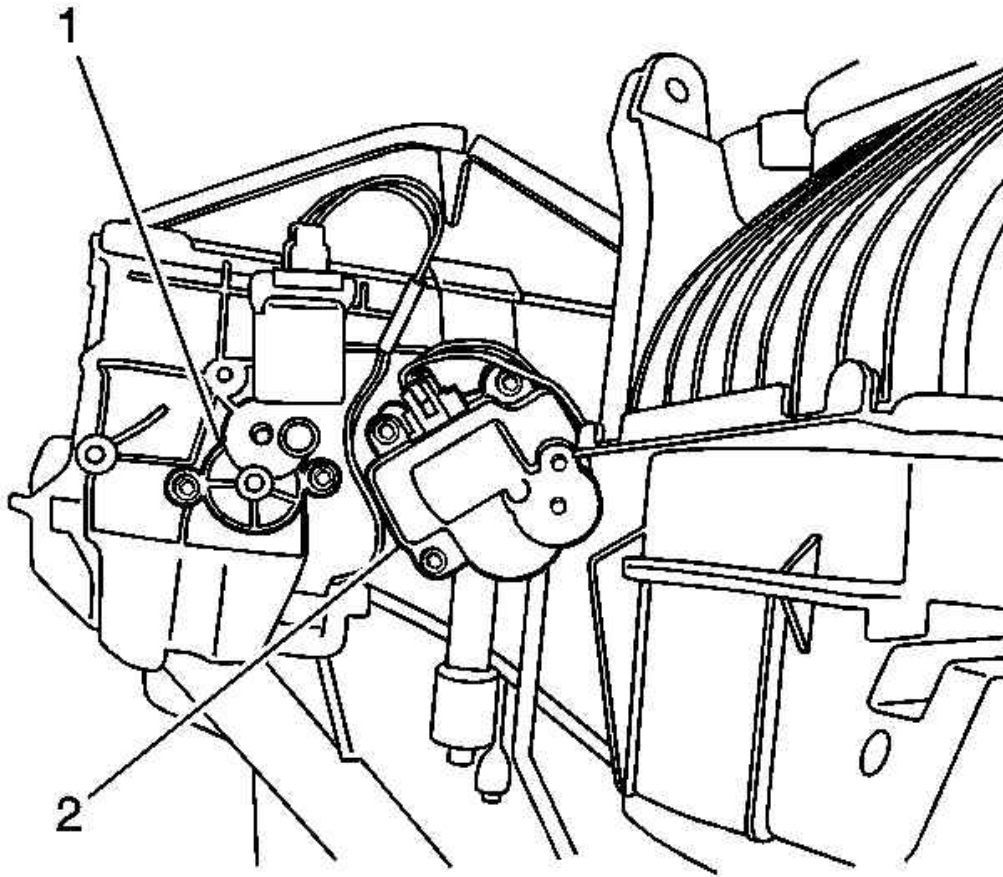


Fig. 11: View Of Right Air Temperature Actuator & Mode Actuator
Courtesy of GENERAL MOTORS CORP.

3. Remove the screws that secure the mode actuator (1) to the HVAC module assembly.
4. Remove the mode actuator from the HVAC module assembly.
5. Disconnect the electrical connector from the mode actuator.

Installation Procedure

1. Position the mode actuator, aligning the slots in the electric actuator drive to the flats on the shaft.

2. Align the locating hole to the alignment pin on the HVAC module assembly.
3. Slide the actuator drive completely onto the shaft, with the mounting holes flush with the mounting screw holes on the HVAC module assembly.

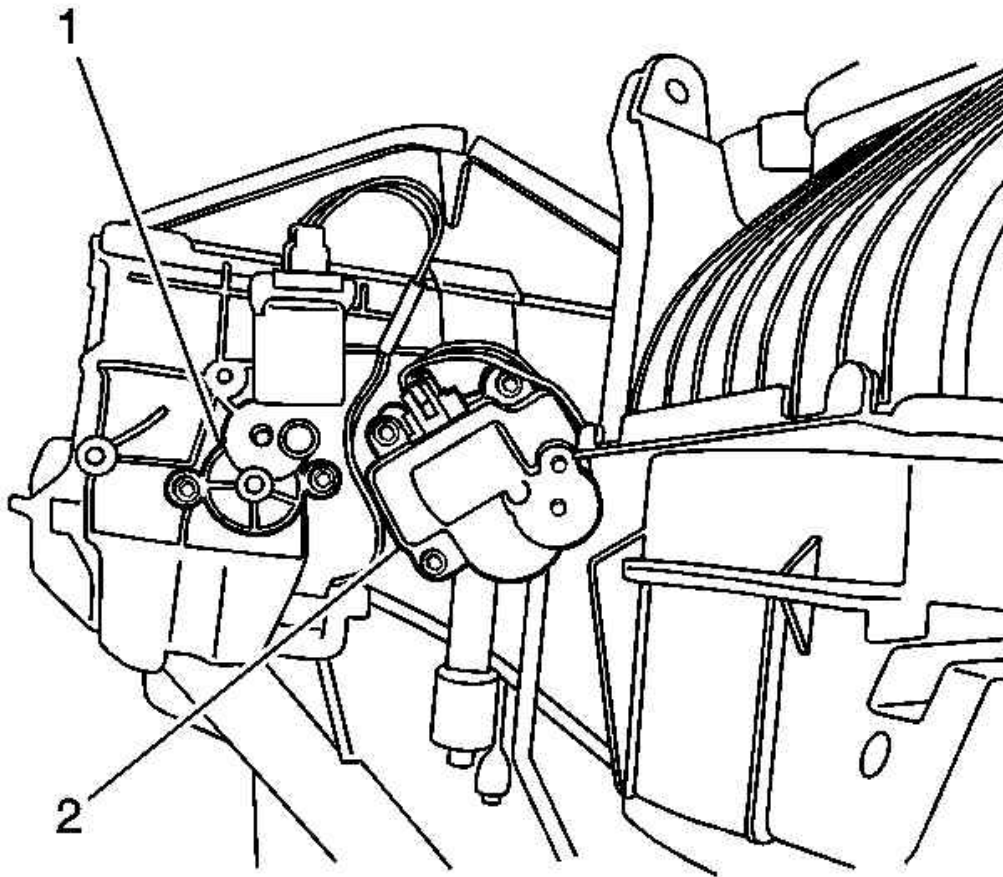


Fig. 12: View Of Right Air Temperature Actuator & Mode Actuator
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

Tighten: Tighten the screws to 1.5 N.m (13 lb in).

5. Connect the electrical connector to the mode actuator.
6. Install the I/P compartment. Refer to **Instrument Panel Compartment Replacement** .
7. Install the right I/P insulator. Refer to **Instrument Panel Insulator Panel Replacement - Right Side** .
8. Calibrate the actuator. Refer to **Actuator Recalibration**.

RECIRCULATION ACTUATOR REPLACEMENT

Removal Procedure

1. Remove the right instrument panel (I/P) insulator. Refer to **Instrument Panel Insulator Panel Replacement - Right Side** .
2. Remove the I/P compartment. Refer to **Instrument Panel Compartment Replacement** .

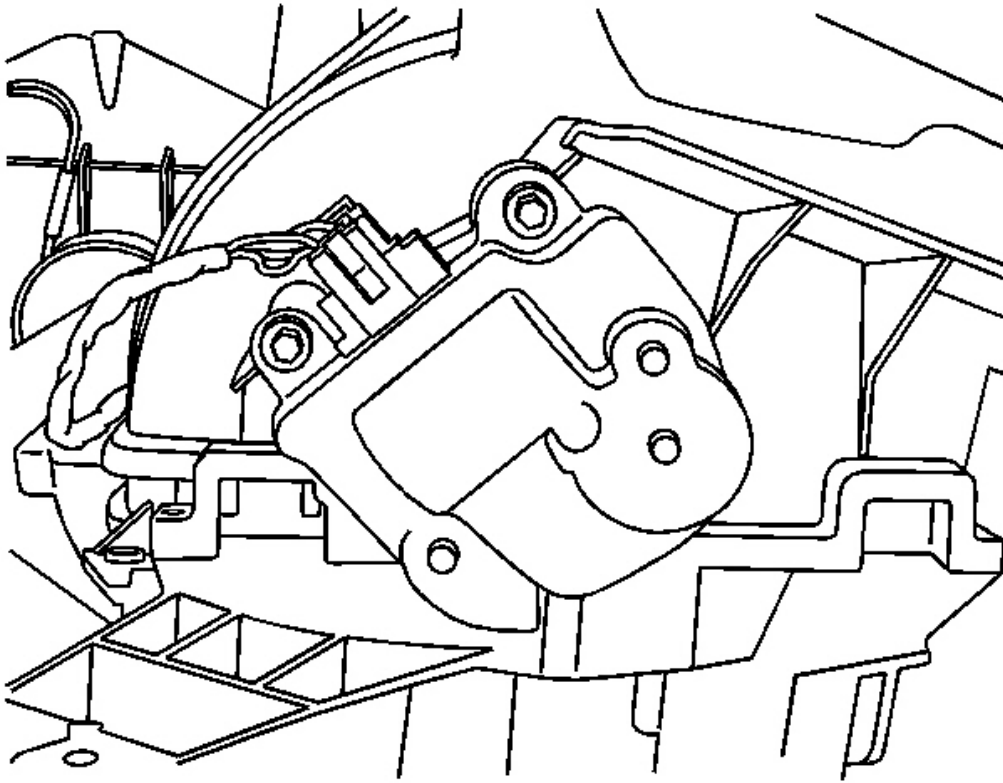


Fig. 13: View Of Recirculation Actuator
Courtesy of GENERAL MOTORS CORP.

3. Remove the screws that secure the recirculation actuator to the HVAC module assembly.
4. Remove the recirculation actuator from the HVAC module assembly.
5. Disconnect the electrical connector from the recirculation actuator.

Installation Procedure

1. Position the recirculation actuator, aligning the slots in the electric actuator drive to the flats on the shaft.
2. Align the locating hole to the alignment pin on the HVAC module assembly.
3. Slide the actuator drive completely onto the shaft, with the mounting holes

flush with the mounting screw holes on the HVAC module assembly.

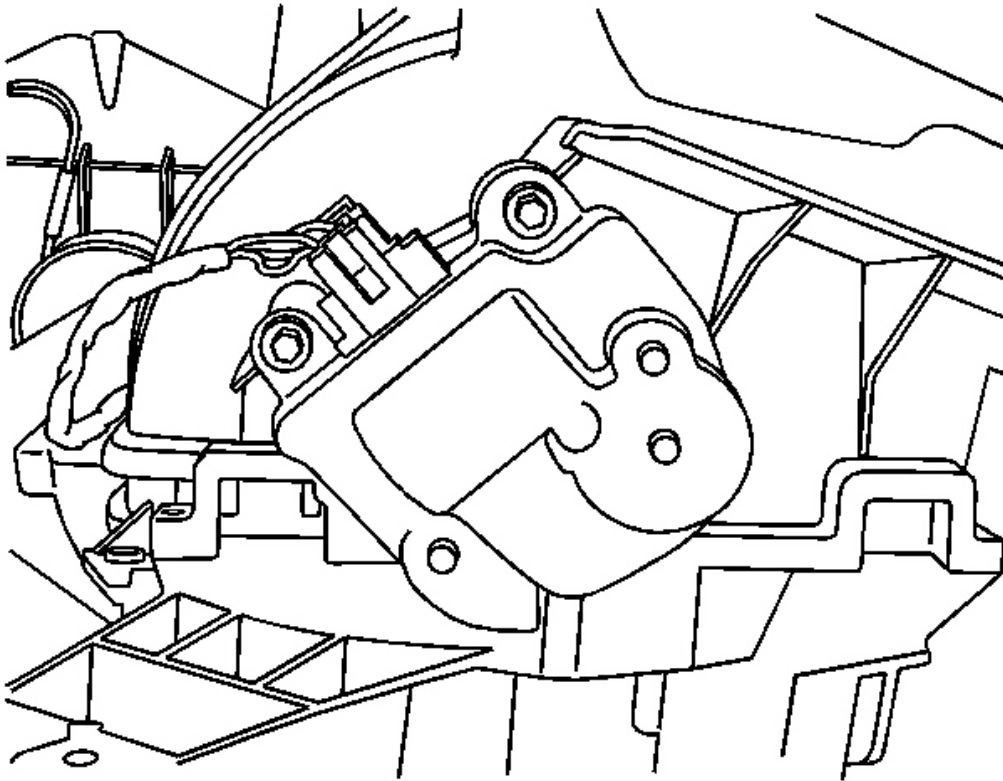


Fig. 14: View Of Recirculation Actuator
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

4. Install the screws to the recirculation actuator.

Tighten: Tighten the screws to 1.5 N.m (13 lb in).

5. Connect the electrical connector to the recirculation actuator.
6. Install the I/P compartment. Refer to Instrument Panel Compartment Replacement .

7. Install the right/I/P insulator. Refer to **Instrument Panel Insulator Panel Replacement - Right Side** .
8. Calibrate the actuator. Refer to **Actuator Recalibration**.

DESCRIPTION AND OPERATION

AIR DELIVERY DESCRIPTION AND OPERATION

The air delivery controls are divided into 4 areas:

- HVAC Control Components
- Air Speed
- Air Distribution
- Recirculation 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 control module supports the following features:

Feature	Availability
Afterblow	Optional
Purge	No
Personalization	No
Actuator Calibration	Yes

Mode/Recirculation Actuator

The mode/recirculation actuator is a 2 wire bi-directional electric motor. Two 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 HVAC control module grounds the appropriate control circuit for the commanded direction. The HVAC control module reverses the polarity of the control circuits to move the actuator in the opposite direction.

The HVAC control module determines the door position by counting motor pulses on one of the control circuits. These pulses are small voltage fluctuations that occur when the brush is shorted across 2 commutator contacts as the motor rotates. As the actuator shaft rotates, the HVAC control module monitors the voltage drop across an internal resistance to detect the pulses. The HVAC control module converts the pulses to counts with a range of 0 to 255 counts. The HVAC control module uses a range of 0-255 counts to index the actuator position.

Mode Valve Assembly

The film valve system has several operating characteristics:

- The cycle time for a mode change will vary based on the starting point of the film valve relative to the requested mode position.
- The maximum time to achieve a mode change occur when the film valve travels between vent and defrost.
- Mode change times may vary slightly based on variations in system airflow, temperature and voltage.
- The amount of air rush noise heard when a mode change is requested that causes the film valve to move through three or more primary modes is dependent on blower speed.
- Recalibration will typically occur when the engine is OFF. The actuator noise heard during recalibration may be more noticeable than during normal operation.

Blower Motor Control Processor

The blower motor control processor is an interface between the HVAC control module and the blower motor. The blower motor speed control, battery positive voltage and ground circuits enable the control processor to operate. The HVAC control module provides a PWM signal to the control processor in order to command the blower motor speed. The processor supplies 12 volts to the blower

motor through the blower motor voltage supply circuit. The control processor uses the blower motor ground as a low side control to adjust the blower motor speed.

Air Speed

The blower motor forces air to circulate within the vehicle's interior. The vehicle operator determines the blower motor's speed by placing the blower motor switch in a desired speed position. The blower motor will only operate if the blower motor switch is in any position other than OFF, and the ignition switch is in the RUN position, with the exception of afterblow.

Once a blower speed is selected, the blower speed remains constant until a new speed is selected.

As the requested blower speed increases, the following conditions occur:

- The HVAC control module increases the amount of time that the blower motor speed control circuit is modulated to ground.
- The voltage and duty cycle, measured between the blower motor speed control circuit and ground, decrease.

As the requested blower speed decreases, the following conditions occur:

- The HVAC control module decreases the amount of time that the blower motor speed control circuit is modulated to ground.
- The voltage and duty cycle, measured between the blower motor speed control circuit and ground, increase.

Afterblow

Afterblow is a feature that dries the evaporator core by operating the blower motor after the engine is turned off. This reduces the amount of microbial growth that can create undesirable odors. The vehicle does not come equipped with the afterblow feature turned on. If the afterblow feature is required due to an odor concern, it must be turned on by the scan tool.

The following conditions must be met for afterblow to operate:

- The A/C compressor operated for more than 10 seconds.
- The A/C compressor, after operating for more than 10 seconds has not been deactivated for more than 10 minutes.
- The system voltage is at least 11 volts to start and 10 volts to continue to run.
- The ignition has been in the OFF position for at least 20 minutes.

Once the above conditions have been met the following sequence of events will occur:

- The blower will run for 4 minutes at 59 percent blower speed.
- The recirculation door moves to outside air position.
- The mode valve moves to the floor position.

Air Distribution

The HVAC control module controls the mode actuator in order to distribute airflow to a desired outlet. The mode switch provides the vehicle operator with the ability to override the automatic setting. When the mode switch is moved to the heater through defrost positions, the A/C compressor clutch engages and the recirculation actuator will be moved to the outside air position. When VENT is pressed, the following will occur:

- The mode valve will be moved to the panel position.
- The recirculation actuator will follow user request if blower is ON and power mode is in Run.
- The A/C compressor will follow user request if blower is ON and power mode is in Run.

Recirculation Operation

The HVAC control module controls the air intake through the recirculation actuator. Recirculation is not available when the mode is in heater through defrost. The operator must activate the blower for Recirculation operation.

Remote Start

Remote Start Activation

The following describes the HVAC control head functionality upon receiving the remote start active serial data message and a power mode status is set to off a wake. intake air temperature (IAT) on manual systems, are utilized to determine the moding of the following features: Blower Mode (Bi-level, floor, Defrost, Recirc and rear Defrost. These features as determined by the IAT during activation sequence and are maintained for the duration of engine run time. Calibratable temperatures are utilized to provide low, mid and high temperature ranges for feature selectable. Blower and mode have the range to select any valid feature positions. When the remote start active serial data is received ignition-off loop HVAC algorithms will act the same as if a run power mode received (i.e. re-calibration, After blow, ignition-off motor positioning etc.) off timer and ignition on timer have the functionality as in Run mode.

Remote Start De-activation

When the remote start is exited (class 2 power mode = run mode or remote start engine), In the case of manual settings, displays will revert to actual state of operation of the features on the basis of their normal control algorithms.

AIR TEMPERATURE DESCRIPTION AND OPERATION

The air temperature controls are divided into 4 areas

- HVAC Control Components
- Heating and A/C Operation
- 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 control module supports the following features:

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Feature	Availability
Afterblow	Optional
Purge	No
Personalization	No
Actuator Calibration	Yes

Air Temperature Actuator

The air temperature actuator is a 2-wire bi-directional electric motor. Two control circuits enable the actuator to operate. The control circuits use either a 0-volt 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 HVAC control module grounds the appropriate control circuit for the commanded direction. The HVAC control module reverses the polarity of the control circuits to move the actuator in the opposite direction.

The HVAC control module determines the door position by counting motor pulses on one of the control circuits. These pulses are small voltage fluctuations that occur when the brush is shorted across 2 commutator contacts as the motor rotates. As the actuator shaft rotates, the HVAC control module monitors the voltage drop across an internal resistance to detect the pulses. The HVAC control module converts the pulses to counts with a range of 0-255 counts. The HVAC control module uses a range of 0-255 counts to index the actuator position.

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 A/C refrigerant pressure sensor protects the A/C system from operating when an excessively high or low pressure condition exists. The PCM disables the compressor clutch under the following conditions:

- A/C pressure is more than 3034 kPa (440 psi). The clutch will be enabled after

the pressure decreases to less than 2068 kPa (300 psi).

- A/C pressure is less than 241 kPa (35 psi). The clutch will be enabled after the pressure increases to more than 248 kPa (36 psi).

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. 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

The A/C system can be engaged by either pressing the A/C switch or by selecting the following modes:

- Max A/C
- Heater
- Mix-Blend
- Front Defrost

The A/C LED will not illuminate unless the driver presses the A/C request switch on the HVAC control module. Otherwise, the A/C system may be running without the A/C LED indicator illuminated. The following conditions must be met in order for the powertrain control module (PCM) to turn on the compressor clutch:

- The ambient air temperature is above 4°C (40°F).
- The engine coolant temperature (ECT) is less than 124°C (255°F).
- The A/C pressure is between 241-3034 kPa (35-440 psi).

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

- The throttle position is 100%.
- The A/C pressure is more than 3034 kPa (440 psi).
- The A/C pressure is less than 241 kPa (35 psi).
- The engine coolant temperature (ECT) is more than 124°C (255°F).
- The engine speed is more than 5480 RPMs for at least 409 seconds.
- A transmission shift has occurred.
- The PCM detects excessive torque load.
- The PCM detects insufficient idle quality.
- The PCM detects a hard launch condition.

When the compressor clutch disengages, the compressor clutch diode protects the electrical system from a voltage spike.

Remote Start

Remote Start Activation

The following describes the HVAC control head functionality upon receiving the remote start active serial data message and a power mode status is set to off a wake. intake air temperature (IAT) on manual systems, are utilized to determine the moding of the following features: Blower Mode (Bi-level, floor, Defrost, Recirc and rear Defrost. These features as determined by the IAT during activation sequence and are maintained for the duration of engine run time. Calibratable temperatures are utilized to provide low, mid and high temperature ranges for feature selectable. Blower and mode have the range to select any valid feature positions. When the remote start active serial data is received ignition-off loop HVAC algorithms will act the same as if a run power mode received (i.e. re-calibration, After blow, ignition-off motor positioning etc.) off timer and ignition on timer have the functionality as in Run mode.

Remote Start De-activation

When the remote start is exited (class 2 power mode = run mode or remote start

engine), In the case of manual settings, displays will revert to actual state of operation of the features on the basis of their normal control algorithms.

Engine Coolant

Engine coolant is the key element of the heating system. The thermostat controls 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 assembly. The heat of the coolant flowing through the heater core is absorbed by the ambient air drawn through the HVAC module assembly. Heated air is distributed to the passenger compartment through the HVAC module assembly for passenger comfort.

The amount of heat delivered to the passenger compartment is controlled by opening or closing the air temperature door. The coolant exits the heater core through the return heater hose and recirculates 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 a very low temperature gas that can transfer the undesirable heat and moisture from the passenger compartment to the outside air.

A Delphi model CVC7 piston type compressor is used on this model year vehicle. The A/C compressor is belt driven and operates when the magnetic clutch is engaged. The compressor builds pressure on the vapor refrigerant, which adds heat to the refrigerant. The refrigerant is discharged from the compressor through the discharge hose and is 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 high pressure switch were to fail or if the refrigerant system becomes restricted and refrigerant pressure continues 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 TXV.

The TXV is located at the evaporator inlet. The TXV is the dividing point for the high and the low pressure sides of the 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 TXV. 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 HVAC module and passes through the evaporator core. Warm and moist air causes the liquid refrigerant to 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 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 HVAC module for passenger comfort. The heat and moisture removed from the passenger compartment condenses and is discharged from the HVAC module as water.

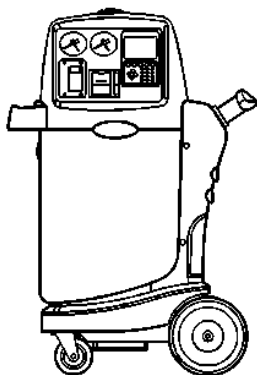
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description

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J 43600
ACR 2000 Air Conditioning Service
Center

2008 HVAC

HVAC - Automatic - LaCrosse

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Air Temperature Actuator Screw	1.5 N.m	13 lb in
HVAC Control Module Screw	2 N.m	18 lb in
Instrument Panel Compartment Screw	2 N.m	18 lb in
Mode Actuator Screw	1.5 N.m	13 lb in
Recirculation Actuator Screw	1.5 N.m	13 lb in

SENSOR RESISTANCE TABLE

Temperature	Inside Air Temperature Sensor Resistance	Ambient Air Temperature Sensor Resistance	Evaporator Temperature Sensor Resistance
-17°C (2°F)	13,790 ohms	13,790 ohms	12,235 ohms
-12°C (11°F)	10,434 ohms	10,434 ohms	9,251 ohms
-4°C (25°F)	6,806 ohms	6,806 ohms	6,017 ohms
-1°C (31°F)	5,831 ohms	5,831 ohms	5,147 ohms
1°C (31°F)	5,269 ohms	5,269 ohms	4,647 ohms
5°C (41°F)	4,317 ohms	4,317 ohms	3,804 ohms
10°C (50°F)	3,389 ohms	3,389 ohms	2,983 ohms
12°C (53°F)	3,083 ohms	3,083 ohms	2,712 ohms
15°C (59°F)	2,680 ohms	2,680 ohms	2,357 ohms
17°C (62°F)	2,445 ohms	2,445 ohms	2,148 ohms
21°C (69°F)	2,041 ohms	2,041 ohms	1,789 ohms
23°C (73°F)	1,868 ohms	1,868 ohms	1,636 ohms
25°C (77°F)	1,711 ohms	1,711 ohms	1,497 ohms
28°C (82°F)	1,503 ohms	1,503 ohms	1,313 ohms
31°C (87°F)	1,324 ohms	1,324 ohms	1,154 ohms
34°C (93°F)	1,168 ohms	1,168 ohms	1,017 ohms
38°C (100°F)	992 ohms	992 ohms	862 ohms
42°C (107°F)	846 ohms	846 ohms	733 ohms
49°C (120°F)	645 ohms	645 ohms	558 ohms

SCHEMATIC AND ROUTING DIAGRAMS

HVAC SCHEMATICS

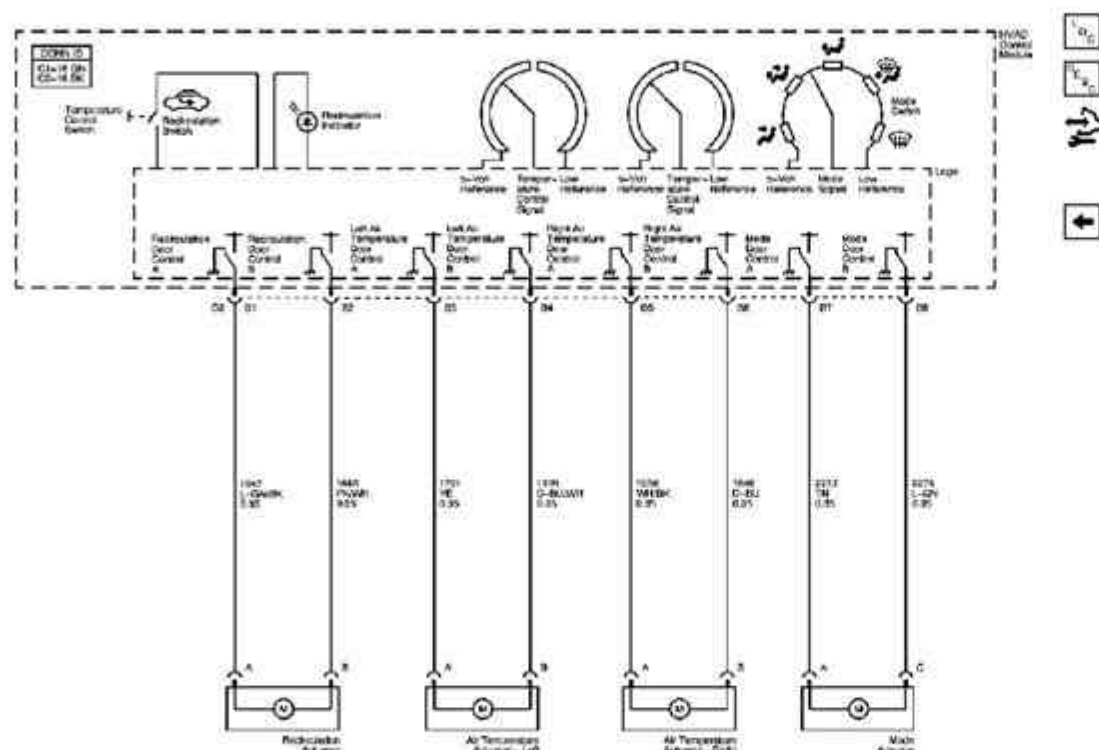


Fig. 5: Air Delivery/Temperature Controls Schematic
 Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B0160 or B0161	B0160: Outside Air Temperature Sensor Circuit Low B0161: Outside Air Temperature Sensor Circuit High
DTC B0164, B0174, B0179, B0510, or B0515	B0164: Passenger Compartment Temp Sensor Circuit Range/Performance B0174: Output Air Temperature Sensor 1 (upper left) Circuit Range/Performance B0179: Output Air Temperature Sensor 2 (lower left) Circuit Range/Performance B0510: Output Air Temperature Sensor 3 (upper right) Circuit Range/Performance B0515: Output Air Temperature Sensor 4 (lower right) Circuit Range/Performance
DTC B0184 or B0189	B0184: Solar Load Sensor 1 (left) Circuit Range/Performance B0189: Solar Load Sensor 2 (right) Circuit Range/Performance
DTC B0248, B0249, B0268, B0269, B0408, B0409, B0414, B0418, B0419, B0424, B3748 or B3749	B0248: Air Flow Control 3 Blend Defog and Floor Circuit B0249: Air Flow Control 3 Blend Defog and Floor Circuit Range/Performance B0268: Air Flow Control 7 Recirculate Circuit B0269: Air Flow Control 7 Recirculate Circuit Range/Performance B0408: Temperature Control 1 Circuit B0409: Temperature Control 1 Circuit Range/Performance B0414: Temperature Control 1 Feedback Circuit Range/Performance B0418: Temperature Control 2 Circuit B0419: Temperature Control 2 Circuit Range/Performance B0424: Temperature Control 2 Feedback Circuit Range/Performance

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	B3748: Air Flow Control 3 Blend Defog and Floor Feedback Circuit Range/Performance B3749: Air Flow Control 7 Recirculate Feedback Circuit Range/Performance
<u>DTC P0530, P0532, or P0533</u>	P0530: Air Conditioning A/C Refrigerant Pressure Sensor Circuit P0532: Air Conditioning A/C Refrigerant Pressure Sensor Circuit Low Voltage P0533: Air Conditioning A/C Refrigerant Pressure Sensor Circuit High Voltage
<u>DTC P0645, P0646, or P0647</u>	P0645: Air Conditioning (A/C) Clutch Relay Control Circuit P0646: Air Conditioning (A/C) Clutch Relay Control Circuit Low Voltage P0647: Air Conditioning (A/C) Clutch Relay Control Circuit High Voltage

DTC B0160 OR B0161**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 B0160**

Outside Air Temperature Sensor Circuit Low

DTC B0161

Outside Air Temperature Sensor Circuit High

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ambient Air Temperature Sensor Signal Circuit	B0160	B0161	B0161	-
Low Reference Circuit	-	B0161	B0161	-

Circuit/System Description

The instrument panel cluster (IPC) monitors the ambient air temperature sensor to display ambient air temperature. The temperature sensor is a 2-wire negative temperature co-efficient thermistor. The IPC applies 5 volts to an internal input resistor that is connected to the signal circuits of the ambient air temperature sensor. The IPC provides the ground to the ambient air temperature sensor through the low reference circuit. The IPC monitors the voltage drop across the ambient air temperature sensor and uses the input for automatic control calculations. When the ambient air temperatures are cold, the resistance of the sensor is high and the voltage signals are high. When the ambient air temperatures are hot, the resistance of the sensors is low and the voltage signals are low. The IPC converts the voltage value to a temperature value of Celsius and Fahrenheit that will be displayed by the IPC.

Conditions for Running the DTC

The ignition is turned ON.

Conditions for Setting the DTC

B0160

The IPC detects a short to ground in the sensor signal circuit.

B0161

The IPC detects a short to voltage or an open/high resistance in the sensor signal circuit or the low reference circuit.

Action Taken When the DTC Sets

- The default value of 3°C (38°F) will be substituted for the ambient air temperature sensor data by the IPC.
- The IPC will display the set temperature when ON.

Conditions for Clearing the DTC

- The DTC will become history if the BCM no longer detects a failure.
- The history DTC will clear after 40 fault-free ignition cycles.

Reference Information**Schematic Reference****Instrument Cluster 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 scan tool Ambient Air Temp Sensor parameter. The reading should be between 0.1-4.9 volts and change with temperature.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the ambient air temperature sensor.
2. Ignition OFF, test for less than 1.0 ohm of resistance 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 IPC.
- 3. Ignition ON, verify the scan tool Ambient Air Temp Sensor parameter is greater than 4.9 volts.
 - If less than the specified range, test the signal circuit for a short to ground. If the circuit tests normal, replace the IPC.
- 4. Install a 3-amp fused jumper wire between the signal circuit terminal A and the low reference circuit terminal B. Verify the scan tool Ambient Air Temp Sensor parameter is less than 0.1 volt.
 - If greater 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 IPC.
- 5. If all circuits test normal, replace the ambient air temperature sensor.

Component Testing

1. Test the ambient temperature sensor by observing the temperature sensor while also monitoring the sensor resistance.
2. Compare the readings with the temperature versus resistance table, verify that the resistance is within 5 percent of the specification.
 - If the resistance versus temperature reading is not within the specified range, replace the ambient air temperature sensor.

Repair Procedures

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

Ambient Air Temperature Sensor Replacement

DTC B0164, 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 B0164

Passenger Compartment Temp Sensor Circuit Range/Performance

DTC B0174

Output Air Temperature Sensor 1 (upper left) Circuit Range/Performance

DTC B0179

Output Air Temperature Sensor 2 (lower left) Circuit Range/Performance

DTC B0510

Output Air Temperature Sensor 3 (upper right) Circuit Range/Performance

DTC B0515

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Output Air Temperature Sensor 4 (lower right) Circuit Range/Performance**Diagnostic Fault Information**

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Inside Air Temperature Sensor Signal	B0164	B0164	B0164	-
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	-
Inside Air Temperature Sensor Low Reference	B0164	B0164	B0164	-
Upper Left Air Temperature Sensor Low Reference	B0174	B0174	B0174	-
Upper Right Air Temperature Sensor Low Reference	B0510	B0510	B0510	-
Lower Left Air Temperature Sensor Low Reference	B0179	B0179	B0179	-
Lower Right Air Temperature Sensor Low Reference	B0515	B0515	B0515	-

Circuit/System Description

The HVAC control module monitors air temperature through air temperature sensors. When the air is cold, the sensor resistance and signal voltage are high. When the air is warm, the sensor resistance and signal voltage are low. The HVAC control module requests A/C compressor clutch engagement and controls the appropriate mode and air temperature actuator door positions in order to maintain the selected air temperature on the HVAC control module.

The inside air temperature sensor is contained within the HVAC control module. The replacement of the inside air temperature sensor involves the replacement of the HVAC control module. The inside air temperature sensor provides the HVAC control module with the temperature of the air drawn through an aspirator from the passenger compartment across a sensor. A reference voltage is supplied to the sensor thermistor and the HVAC control module determines the voltage drop across that device which is proportional to temperature. As the air temperature increases, the resistance decreases and the voltage signal decreases. As the air temperature decreases, the resistance increases and the voltage signal increases.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The HVAC control module detects the air temperature sensor signal circuit is less than 2 counts or greater than 253 counts for 30 seconds.

Action Taken When the DTC Sets

A default value will be used for the sensor data by the HVAC control module.

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 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 Testing**

1. Ignition OFF, disconnect the harness connector at the appropriate temperature sensor.
2. Ignition OFF, test for less than 1.0 ohm of resistance between the appropriate low reference circuit terminal B and ground.
 - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Ignition ON, verify the appropriate scan tool temperature sensor parameter is greater than 250 counts.
 - If less than the specified range, test the appropriate signal circuit terminal for a short to ground. If the circuit tests normal, replace the HVAC control module.
4. Install a 3A fused jumper wire between the appropriate signal circuit terminal A and ground. Verify the appropriate scan tool temperature sensor parameter is less than 5 counts.
 - If greater 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 appropriate temperature sensor.

Repair Procedures

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

- **Control Module References** for HVAC control module replacement, setup, and programming
- **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](#)
- [Inside Air Temperature Sensor Replacement](#)

DTC B0184 OR B0189**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 B0184**

Solar Load Sensor 1 (left) Circuit Range/Performance

DTC B0189

Solar Load Sensor 2 (right) Circuit Range/Performance

Circuit/System 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. Low reference and signal circuits enable the sensor to operate. As the sunload increases, the sensor signal decreases. 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 passenger compartment.

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 0.09 volt (5 counts) or more than 4.90 volts (250 counts).

Action Taken When the DTC Sets

If the DTC sets due to a low voltage condition, the HVAC control module will operate the system as if a maximum sunload condition exists. If the DTC sets due to a high voltage condition, the HVAC control module will operate the system as if a minimum 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 Testing

1. Ignition OFF, disconnect the harness connector at the sunload sensor assembly.
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 the sunload sensor parameter is greater than 250 counts.
 - If not the specified value, test the appropriate signal circuit terminal A or B for a short to ground. If the circuit tests normal, replace the HVAC control module.
4. Install a 3A fused jumper wire between ground circuit terminal C and the appropriate signal circuit terminal of the sensor listed below. Verify the appropriate sunload sensor parameter is less than 5 counts.
 - Sunload sensor circuit terminal A.
 - Sunload sensor circuit terminal B.
 - If not the specified value, 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, replace the sunload sensor assembly.

Repair Procedures

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

- [Control Module References](#) for HVAC control module replacement, setup and programming
- [Sun Load Sensor Replacement](#)

DTC B0248, B0249, B0268, B0269, B0408, B0409, B0414, B0418, B0419, B0424, B3748 OR B3749

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.

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DTC Descriptors**DTC B0248**

Air Flow Control 3 Blend Defog and Floor Circuit

DTC B0249

Air Flow Control 3 Blend Defog and Floor Circuit Range/Performance

DTC B0268

Air Flow Control 7 Recirculate Circuit

DTC B0269

Air Flow Control 7 Recirculate Circuit Range/Performance

DTC B0408

Temperature Control 1 Circuit

DTC B0409

Temperature Control 1 Circuit Range/Performance

DTC B0414

Temperature Control 1 Feedback Circuit Range/Performance

DTC B0418

Temperature Control 2 Circuit

DTC B0419

Temperature Control 2 Circuit Range/Performance

DTC B0424

Temperature Control 2 Feedback Circuit Range/Performance

DTC B3748

Air Flow Control 3 Blend Defog and Floor Feedback Circuit Range/Performance

DTC B3749

Air Flow Control 7 Recirculate Feedback Circuit Range/Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Recirculation Door Control A	B0268, B0269, B3749	B0268, B0269, B3749	B0268, B0269, B3749	-

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Recirculation Door Control B	B0268, B0269, B3749	B0268, B0269, B3749	B0268, B0269, B3749	-
Left Air Temperature Door Control A	B0408, B0409, B0414	B0408, B0409, B0414	B0408, B0409, B0414	-
Left Air Temperature Door Control B	B0408, B0409, B0414	B0408, B0409, B0414	B0408, B0409, B0414	-
Right Air Temperature Door Control A	B0418, B0419, B0424	B0418, B0419, B0424	B0418, B0419, B0424	-
Right Air Temperature Door Control B	B0418, B0419, B0424	B0418, B0419, B0424	B0418, B0419, B0424	-
Mode Door Control A	B0248, B0249, B3748	B0248, B0249, B3748	B0248, B0249, B3748	-
Mode Door Control B	B0248, B0249, B3748	B0248, B0249, B3748	B0248, B0249, B3748	-

Circuit/System Description

The actuator is an electronic stepper motor. The HVAC control module supplies power and ground to the actuator. The HVAC control module controls the direction of the actuator by changing the polarity of the control circuits. When the actuator reaches its desired position, both circuits are fixed to the same value 0 volts. The HVAC control module determines the door or mode film position by counting pulses, voltage fluctuations, caused by the brush to commutator action generated during normal motor operation. The HVAC control module monitors a voltage drop across an internal resistance to detect the pulses. The HVAC control module converts the pulses to counts with a range of 0-255 counts.

When a calibration or recalibration procedure is performed, the HVAC control module calculates the door or mode film travel range. The HVAC control module commands the actuator in one extreme position then counts pulses starting from 0 counts. The HVAC control module compares the total number of pulses to calibrated limits. If the total pulse count is less than or equal to the maximum calibrated limit and greater than or equal to the minimum calibrated limit, then the calibration is considered successful.

- Air flow control 3 circuit refers to the mode actuator.
- Air flow control 7 circuit refers to the recirculation actuator.
- Temperature control 1 circuit refers to the left air temperature.
- Temperature control 2 circuit refers to the right air temperature.

Conditions for Running the DTC

- The ignition is ON.
- Ignition voltage is between 9-16 volts.
- 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 7 counts or greater than 250 counts.

Action Taken When the DTC Sets

Driver A and driver B circuits are 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 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 Testing**

1. Ignition OFF, disconnect the harness connector at the appropriate actuator.
2. Ignition ON, connect a test lamp between the control circuit terminal A and control circuit terminal B. Command the actuator in each direction. The test lamp should briefly illuminate when commanding the actuator in one direction to the other direction.
 - If the test lamp is always OFF, test the appropriate control circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the HVAC control module.
 - If the test lamp continuously illuminates, test the appropriate control circuit for a short to B+. If the circuit tests normal, replace the HVAC control module.
3. If all circuits test normal, replace the appropriate actuator.

Component Testing

1. Install a 10-amp fused jumper wire between the control terminal A and 12 volts. Momentarily install a jumper wire between the control terminal B and ground. The appropriate actuator shaft should rotate.
 - If the function does not perform as specified, replace the appropriate actuator.
2. Reverse the jumper wires; the appropriate actuator shaft should rotate.
 - If the function does not perform as specified, replace the appropriate actuator.

Repair Procedures

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

- **Air Temperature Actuator Replacement - Left Side**

- **Air Temperature Actuator Replacement - Right Side**
- **Recirculation Actuator Replacement**
- **Mode Actuator Replacement**
- **Control Module References** for HVAC replacement, setup, and programming

DTC P0530, P0532, OR P0533**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 Descriptor**DTC P0530**

Air Conditioning A/C Refrigerant Pressure Sensor Circuit

DTC P0532

Air Conditioning A/C Refrigerant Pressure Sensor Circuit Low Voltage

DTC P0533

Air Conditioning A/C Refrigerant Pressure Sensor Circuit High Voltage

Circuit/System Description

The engine control module (ECM) monitors the high side refrigerant pressure via the A/C refrigerant pressure sensor. The ECM applies a 5-volt reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the A/C refrigerant pressure 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. When the DTC is set, the ECM does not allow the A/C compressor clutch to engage. This is done to protect the compressor.

Conditions for Running the DTC

- The engine is running.
- The battery voltage is between 11-18 volts.

Conditions for Setting the DTC**P0530**

The A/C refrigerant pressure sensor signal voltage is less than 0.2 volt or more than 4.88 volts for more than 3 seconds.

P0532

The A/C refrigerant pressure sensor signal voltage is less than 0.2 volt for more than 3 seconds.

P0533

The A/C refrigerant pressure sensor signal voltage is more than 4.88 volts for more than 3 seconds.

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****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 scan tool A/C High Side Pressure parameter in the ECM. The reading should be between 0.2 and 4.90 volts (9 and 453 psi), and change with pressure.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the A/C refrigerant pressure sensor.
2. Ignition OFF, test for less than 1.0 ohm of resistance between the low reference circuit terminal 1 and ground.
 - If greater than the specified range, test the low reference circuit terminal 1 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 the specified range, 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 the specified range, 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 0.2 volts.
 - If greater than 0.2 volts, 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 4.90 volts.
 - If less than 4.90 volts, test the signal circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the ECM.
- 6. If all circuits test normal, replace the A/C refrigerant pressure sensor.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector at the A/C refrigerant pressure sensor.
2. Test for 0.721k ohms of resistance between the 5-volt reference terminal 2 and the low reference terminal 1.
 - If the resistance is not equal to or close to the specified value, replace the A/C refrigerant pressure sensor.
3. Test for 0.721k ohms of resistance between the signal terminal 3 and the low reference terminal 3.
 - If the resistance is not equal to or close to the specified value, replace the A/C refrigerant 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 setup, replacement, and programming

DTC P0645, P0646, OR P0647

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 Descriptor

DTC P0645

Air Conditioning (A/C) Clutch Relay Control Circuit

DTC P0646

Air Conditioning (A/C) Clutch Relay Control Circuit Low Voltage

DTC P0647

Air Conditioning (A/C) Clutch Relay Control Circuit High Voltage

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Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
A/C Relay Coil Ignition	2	2	-	-
A/C Relay Switch B+	2	2	-	-
A/C Relay Control	P0645, P0646	P0645, P0647	P0645, P0647	-
A/C Clutch Control	2	2	1	-
A/C Compressor Clutch Ground	-	2	2	-
1. A/C Clutch Always Engaged 2. A/C Clutch Inoperative				

Circuit/System Description

Ignition voltage is supplied directly to the air conditioning (A/C) compressor clutch relay. The engine control module (ECM) controls the relay by grounding the A/C clutch relay control circuit via an internal solid state device called a driver. The primary function of the driver is to supply the ground for the component being controlled. The driver has a fault line which is monitored by the ECM. When the ECM is commanding a component ON, the voltage of the control circuit should be near 0 volts. When the ECM is commanding the control circuit to a component OFF, the voltage potential of the circuit should be near battery voltage.

Conditions for Running the DTC

- The ignition voltage is between 9 and 18 volts.
- The engine speed is more than 80 RPM.
- The ECM A/C Compressor Clutch Relay Control transitions between ON to OFF or from OFF to ON.

Conditions for Setting the DTC

- A short to ground on the A/C compressor clutch relay control circuit.
- A short to voltage on the A/C compressor clutch relay control circuit.
- An open circuit on the A/C compressor clutch relay control circuit or relay.
- An internally shorted or excessively low resistance A/C clutch relay coil.

Action Taken When the DTC Sets

- The A/C clutch relay is commanded OFF.
- The conditions for which the DTC was set will be stored in the Failure Records data only. No information will be stored as Freeze Frame data.

Conditions for Clearing the DTC

The history DTC will clear after 40 fault-free ignition cycles.

Diagnostic Aids

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

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 Testing

1. Ignition OFF, disconnect the A/C COMP relay.
2. Ignition ON, verify that a test lamp does not illuminate between the relay coil control circuit terminal G7 and ground.
 - If the test lamp illuminates, test the control circuit for a short to voltage.
3. Verify that a test lamp illuminates between the relay coil ignition circuit terminal E8 and ground.
 - If the test lamp does not illuminate, test the ignition circuit for a short to ground or an open/high resistance. If the circuit tests normal and ignition circuit fuse is open, test or replace the relay.
4. Connect a test lamp between the relay coil ignition circuit terminal E8 and the relay coil control circuit terminal G7.
5. Command the A/C relay ON and OFF with a scan tool. 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 ECM.
 - If the test lamp is always OFF, test the control circuit for a short to voltage, 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 COMP relay.

Component Testing

1. Ignition OFF, disconnect the A/C COMP relay.
2. Test for 60-180 ohms between terminals 85 and 86.
 - If the resistance is not within the specified range, replace the relay.
3. Test for infinite resistance between the following terminals:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If not the specified value, replace the relay.
4. Install a 30-amp fused jumper wire between relay terminal 85 and 12 volts. Install a jumper wire between

relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.

- o If greater than the specified range, replace the relay.

Repair Procedures

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

- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Control Module References** for ECM setup, replacement, and programming

SYMPTOMS - HVAC SYSTEMS - AUTOMATIC

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

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

Visual/Physical Inspection

1. Inspect for aftermarket devices which could affect the operation of the HVAC System. Refer to **Checking Aftermarket Accessories** .
2. Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
3. Verify the A/C compressor clutch turns freely and is not seized.
4. Verify that the customer is using the correct key to enable personalization and is not inadvertently activating auxiliary HVAC controls.
5. The A/C compressor will not operate in cold outside air temperatures. Refer to **Air Temperature Description and Operation**.
6. The following conditions may 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
7. 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 - Blower Motor**
- **Noise Diagnosis - Air Conditioning (A/C) System**
- **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
A/C Relay Coil Ignition	2	2	-	-
A/C Relay Switch B+	2	2	-	-
A/C Relay Control	P0645, P0646	P0645, P0647	P0645, P0647	-
A/C Clutch Control	2	2	1	-
A/C Compressor Clutch Ground	-	2	2	-
1. A/C Clutch Always Engaged 2. A/C Clutch 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 engine control module (ECM) to ground the A/C compressor clutch relay control circuit, which will switch the A/C COMP relay. 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 less than 4,760 RPM
- Engine speed is more than 600 RPM
- A/C high side pressure is between 2929-269 kPa (425-39 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

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. Ignition ON, 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.

Circuit/System Testing

1. Ignition OFF, disconnect the A/C COMP relay.
2. Ignition ON, verify that a test lamp does not illuminate between the control circuit terminal G8 and ground.
 - o If the test lamp illuminates, test the control circuit for a short to voltage.
3. Verify that a test lamp illuminates between the ignition circuit terminal E8 and ground.
 - o If the test lamp does not illuminate, test the ignition circuit for a short to ground or an open/high resistance. If the circuit tests normal and the ignition circuit fuse is open, test or replace the A/C COMP relay.
4. Verify that a test lamp illuminates between the B+ circuit terminal E7 and ground.
 - o 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 is open, test the control circuit terminal for a short to ground.
5. Disconnect the harness connector at the A/C compressor clutch.
6. Test for less than 1.0 ohm between the A/C compressor clutch ground circuit terminal B and ground.
 - o If greater than the specified range, test the ground circuit for an open/high resistance.
7. Connect the harness connector at the A/C compressor clutch.
8. Connect a 10A fused jumper wire between the B+ circuit terminal E7 and the control circuit terminal G8. Verify the A/C compressor clutch is activated.

- 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 clutch.
- 9. Connect a test lamp between the ignition circuit terminal E8 and the control circuit terminal G7.
- 10. Command the A/C relay ON and OFF with a scan tool. 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 ECM.
 - If the test lamp is always OFF, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the ECM.
- 11. If all circuits test normal, test or replace the A/C COMP relay.

Component Testing

Relay Test

1. Ignition OFF, disconnect the A/C COMP relay.
2. Test for 60-180 ohms between terminals 85 and 86.
 - If the resistance is not within the specified range, replace the relay.
3. Test for infinite resistance between the following terminals:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If not the specified value, replace the relay.
4. Install a 30-amp fused jumper wire between relay terminal 85 and 12 volts. Install a jumper wire between relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.
 - If greater than the specified range, replace the relay.

Repair Procedures

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

Control Module References for ECM setup, replacement, 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
Blower Motor Speed Control Circuit	1, 2	1	1, 2	-
Blower Motor Control Processor B+	1	1	-	-
Blower Motor Control Processor				

2008 Buick LaCrosse CXL

2008 HVAC HVAC - Automatic - LaCrosse

Ground	-	1	1	-
Blower Motor Low Reference Circuit	2	1	1	-
1. Blower Motor Inoperative 2. Blower Motor Always On				

Circuit/System Description

Blower Motor Control Processor

The blower motor control processor 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 processor to operate. The HVAC control module provides a pulse width modulation (PWM) signal to the blower motor speed control processor in order to command the blower motor speed. The processor supplies 12 volts to the blower motor through the blower motor voltage supply circuit. The control processor uses the blower motor ground as a low side control to adjust the blower motor speed.

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. Ignition ON, command the blower motor ON and OFF with a scan tool. The blower motor should turn ON and OFF when changing between the commanded states.
2. Observe the scan tool Commanded Blower parameter while changing the blower motor switch from Off through to the High speed positions. The display should change from 0-100 percent.
 - o If the display does not change, replace the HVAC control module.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the blower motor control processor.

2. Test for less than 1.0 ohm of resistance between the ground circuit terminal A 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 terminal C 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 is open, replace the blower motor control processor.
4. Ignition OFF, connect the harness connector at the blower motor control processor and disconnect the harness connector at the blower motor.
5. Connect a test lamp between the control circuit terminal B and B+.
6. Ignition ON, command the blower motor ON and OFF with a scan tool, the test lamp should turn ON and OFF when changing between the commanded states.
 - If the test lamp is always OFF, test the ground circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the blower motor control processor.
 - If the test lamp is always ON, test the ground circuit for a short to ground. If the circuit tests normal, replace the blower motor control processor.
7. Connect a test lamp between the control circuit terminal A and ground.
8. Turn the blower motor ON and cycle between low and high speeds. The test lamp should illuminate and change in intensity as the blower speed is varied.
 - If the test lamp is always OFF, test the control circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the blower motor control processor.
 - If the test lamp does not change intensity, test the control circuit for a short to voltage. If the circuit tests normal, replace the blower motor control processor.
9. If all circuits test normal, test or replace the blower motor.

Component Testing

1. Ignition OFF, disconnect the harness connector at the blower motor.
2. Install a 30-amp fused jumper wire between the control 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.

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

AIR TEMPERATURE 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

2008 Buick LaCrosse CXL

2008 HVAC HVAC - Automatic - LaCrosse

Ambient Air Temperature Sensor Signal	B0158 03	B0158 03	B0158 07	B0158 03, 07
Inside Air Temperature Sensor Signal	B0163 06	B0163 06	B0163 06	B0163 06
Left Sunload Sensor Signal	B0183 06	B0183 06	B0183 06	-
Right Sunload Sensor Signal	B0188 06	B0188 06	B0188 06	-
Evaporator Temperature Sensor Signal	B3933 06	B3933 06	B3933 06	-
Low Reference	-	B3933 06, B0158 03, B0163 06	B3933 06, B0158 07, B0163 06	B0158 07, B0163 06
Sunload sensors Ground Circuit	-	B0183 06, B0188 06	B0183 06, B0188 06	-

Circuit Description**Inside and Ambient Air Temperature Sensors**

The HVAC control module supplies the inside and ambient air temperature sensors with a low reference circuit and 5-volt signal circuit. The inside air temperature sensor has a fan motor that operates using body ground and a 12 volt supply from the HVAC control module when the ignition and HVAC control module are ON. The HVAC control module determines the voltage drop across the sensors, 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.

Sunload Sensor Assembly

The sunload sensor is a 2-wire photo diode. Body ground and 5-volt signal circuits enable the sensor to operate. As the sunload increases, the sensor signal decreases. The sensor operates within an intensity range between completely dark and very bright. 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.

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. Ignition ON, cover the sunload sensor assembly with a shop towel or other suitable item. Verify the scan tool Right Sunload Sensor and Left Sunload Sensor parameters are within 3 counts of each other.
 - If not within the specified range, refer to Sunload Sensor Circuit Malfunction in **Circuit/System Testing**.
2. Remove the shop towel and shine a flashlight on the sunload sensor assembly. Verify the scan tool Right Sunload Sensor and Left Sunload Sensor parameters are within 3 counts of each other.
 - If not within the specified range, refer to Sunload Sensor Circuit Malfunction in **Circuit/System Testing**.
3. Measure actual outside air temperature using a thermometer. Compare this value to the scan tool Outside Air Temp. Raw parameter. The measured temperature should be within 5 degrees of parameter.
 - If not within the specified range, refer to Evaporator and Ambient Air Temperature Sensor Circuit Malfunction in **Circuit/System Testing**.
4. Measure actual inside air temperature using a thermometer. Compare this value to the scan tool Inside Air Temp. parameter. The measured temperature should be within 5 degrees of parameter.
 - If not within the specified range, refer to Inside Air Temperature Sensor Circuit Malfunction in **Circuit/System Testing**.

Circuit/System Testing

IMPORTANT: If any of the air temperature sensors or sunload sensors have an out of range condition caused by a short to voltage, short to ground, or an open/high resistance a diagnostic trouble code (DTC) will set. The following tests describe conditions that can cause inaccurate information to be processed in the HVAC control module and also operate between the minimum and maximum operating range without setting a DTC.

Ambient Air Temperature Sensor Circuit Malfunction

1. Ignition OFF, disconnect the harness connector at the appropriate temperature sensor.
2. Ignition OFF, test for less than 10 ohms of resistance between the appropriate low reference circuit terminal and ground.
 - Ambient air temperature sensor terminal B.
 - Evaporator temperature sensor terminal 2.
 - If greater than the specified range, test the low reference circuit for 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 B and the appropriate signal circuit terminal.
 - Ambient air temperature sensor terminal A.
 - Evaporator temperature sensor terminal 1.
 - If less than the specified range, test the signal circuit for high resistance. If the circuit tests normal, replace the HVAC control module.
4. If all circuits test normal, test or replace the appropriate temperature sensor.

Sunload Sensor Circuit Malfunction

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

Inside Air Temperature Sensor Circuit Malfunction

1. Ignition OFF, disconnect the harness connector at the inside air 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 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 high resistance. If the circuit tests normal, replace the HVAC control module.
4. If all circuits test normal, test or replace the inside air temperature sensor.

Component Testing

1. Test the appropriate air temperature sensor by varying the sensor temperature in water while monitoring the sensor resistance.
2. Compare the readings with the Temperature vs 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.

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

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/ECAS fuse for a minimum of 10 seconds.
6. Install the HVAC/ECAS 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**

1. Remove the instrument panel lower trim plate. Refer to **Instrument Panel Lower Trim Plate Replacement**.

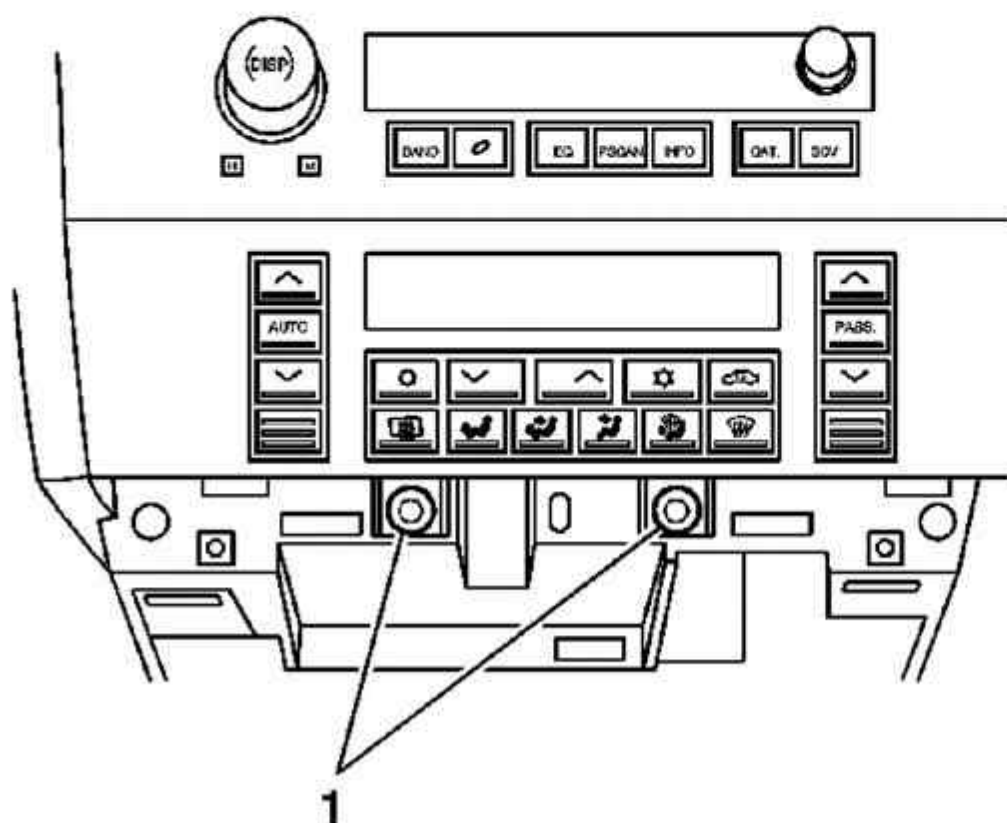


Fig. 6: Identifying HVAC Control Module Mounting Screws
 Courtesy of GENERAL MOTORS CORP.

2. Remove the HVAC control module mounting screws (1).

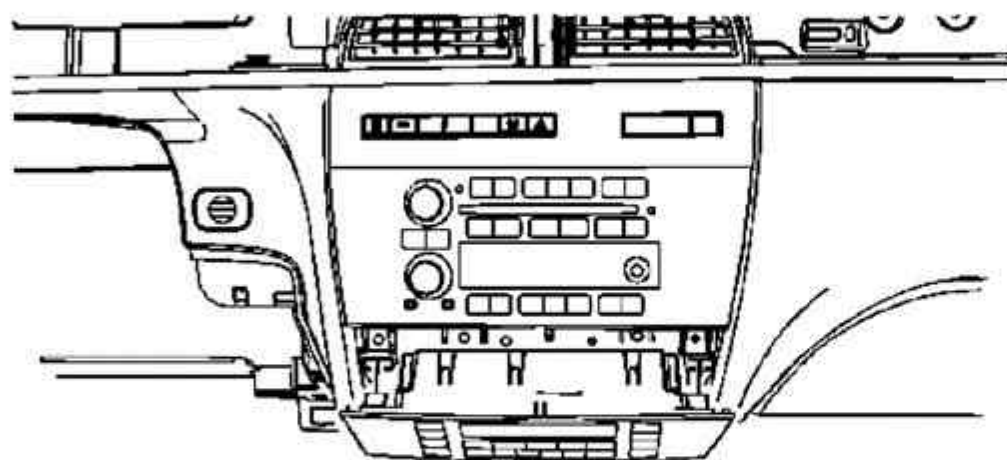


Fig. 7: View Of HVAC Control Module Mounting Clips
 Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Retaining clips hold the HVAC control module in place.

3. Pull the HVAC control module rearward from the instrument panel.
4. Disconnect the electrical connectors from the HVAC control module.
5. Remove the HVAC control module.

Installation Procedure

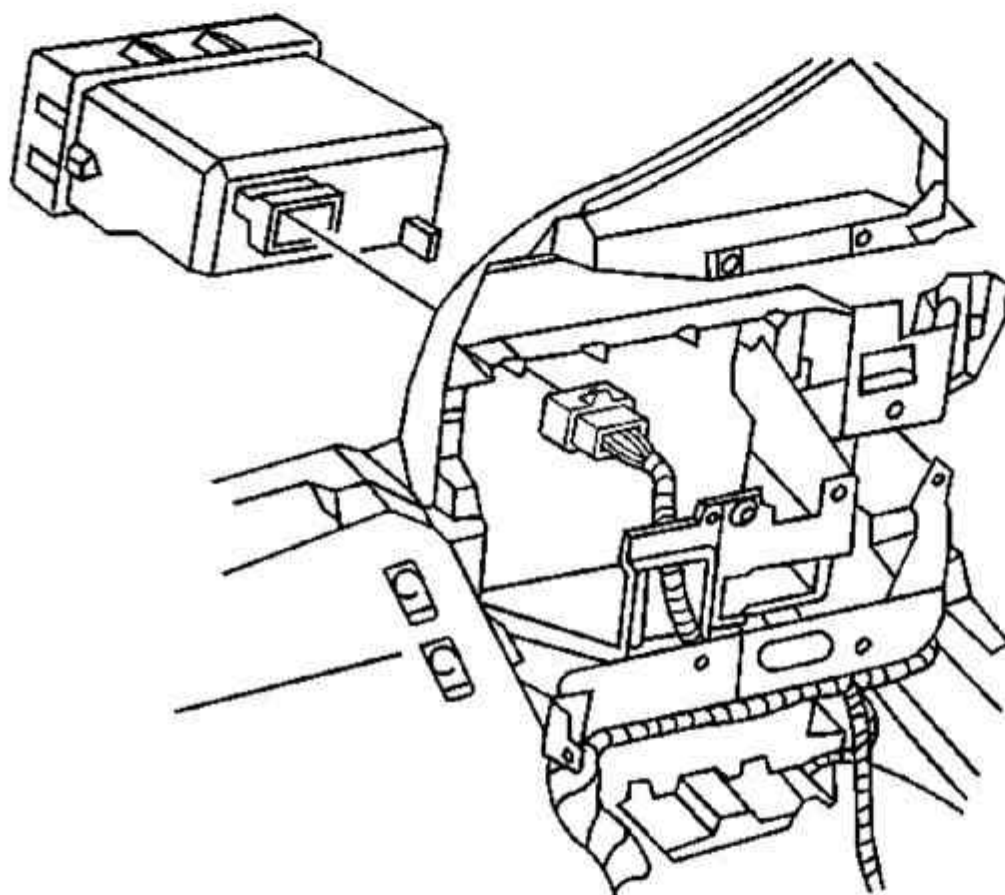


Fig. 8: Identifying HVAC Control Module Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The key should be in the off position when connecting the electrical connectors to ensure proper calibration.

1. Connect the electrical connectors to the HVAC control module.

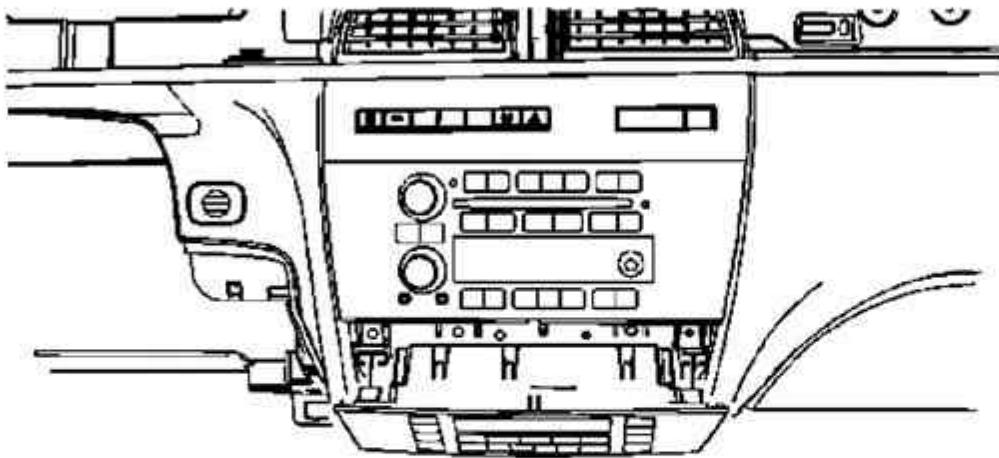


Fig. 9: View Of HVAC Control Module Mounting Clips
Courtesy of GENERAL MOTORS CORP.

2. Install the HVAC control module.

NOTE: Refer to Fastener Notice .

3. Install the HVAC control module mounting screws.

Tighten: Tighten the screws to 2 N.m (18 lb in).

4. Install the instrument panel lower trim plate. Refer to Instrument Panel Lower Trim Plate Replacement .

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

5. Start the engine and run for 1 minute. Refer to Control Module References for programming and setup information.

RECIRCULATION ACTUATOR REPLACEMENT

Removal Procedure

1. Remove the right instrument panel (I/P) insulator. Refer to Instrument Panel Insulator Panel Replacement - Right Side .
2. Remove the I/P compartment. Refer to Instrument Panel Compartment Replacement .

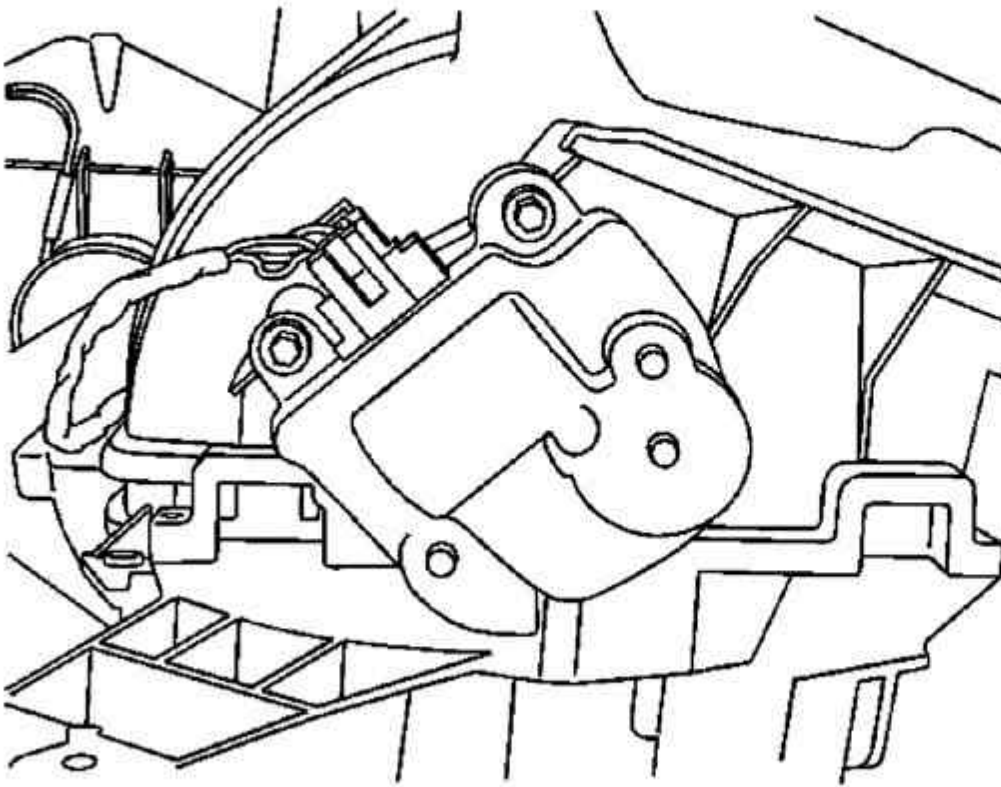


Fig. 10: View Of Recirculation Actuator
Courtesy of GENERAL MOTORS CORP.

3. Remove the screws that secure the recirculation actuator to the HVAC module assembly.
4. Remove the recirculation actuator from the HVAC module assembly.
5. Disconnect the electrical connector from the recirculation actuator.

Installation Procedure

1. Position the recirculation actuator, aligning the slots in the electric actuator drive to the flats on the shaft.
2. Align the locating hole to the alignment pin on the HVAC module assembly.
3. Slide the actuator drive completely onto the shaft, with the mounting holes flush with the mounting screw holes on the HVAC module assembly.

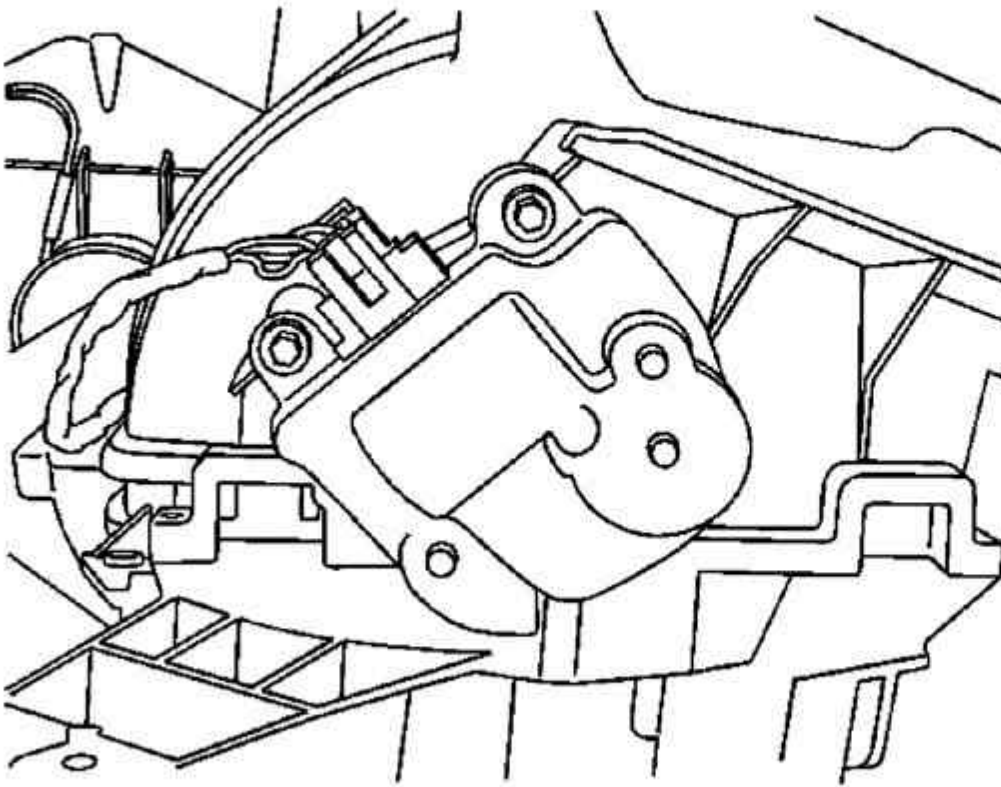


Fig. 11: View Of Recirculation Actuator
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

4. Install the screws to the recirculation actuator.

Tighten: Tighten the screws to 1.5 N.m (13 lb in).

5. Connect the electrical connector to the recirculation actuator.
6. Install the I/P compartment. Refer to Instrument Panel Compartment Replacement .
7. Install the right I/P insulator. Refer to Instrument Panel Insulator Panel Replacement - Right Side .
8. Calibrate the actuator. Refer to Actuator Recalibration .

MODE ACTUATOR REPLACEMENT

Removal Procedure

1. Remove the right instrument panel (I/P) insulator. Refer to Instrument Panel Insulator Panel Replacement - Right Side .
2. Remove the I/P compartment. Refer to Instrument Panel Compartment Replacement .

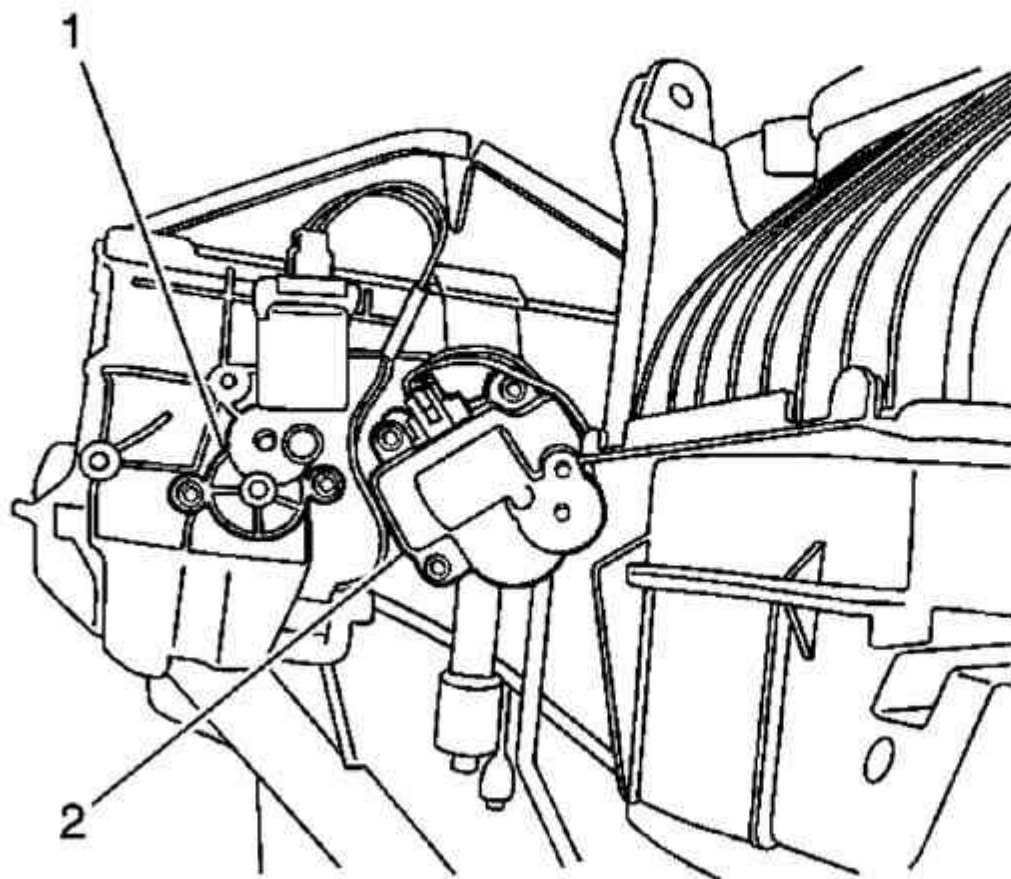


Fig. 12: View Of Right Air Temperature Actuator & Mode Actuator
Courtesy of GENERAL MOTORS CORP.

3. Remove the screws that secure the mode actuator (1) to the HVAC module assembly.
4. Remove the mode actuator from the HVAC module assembly.
5. Disconnect the electrical connector from the mode actuator.

Installation Procedure

1. Position the mode actuator, aligning the slots in the electric actuator drive to the flats on the shaft.
2. Align the locating hole to the alignment pin on the HVAC module assembly.
3. Slide the actuator drive completely onto the shaft, with the mounting holes flush with the mounting screw holes on the HVAC module assembly.

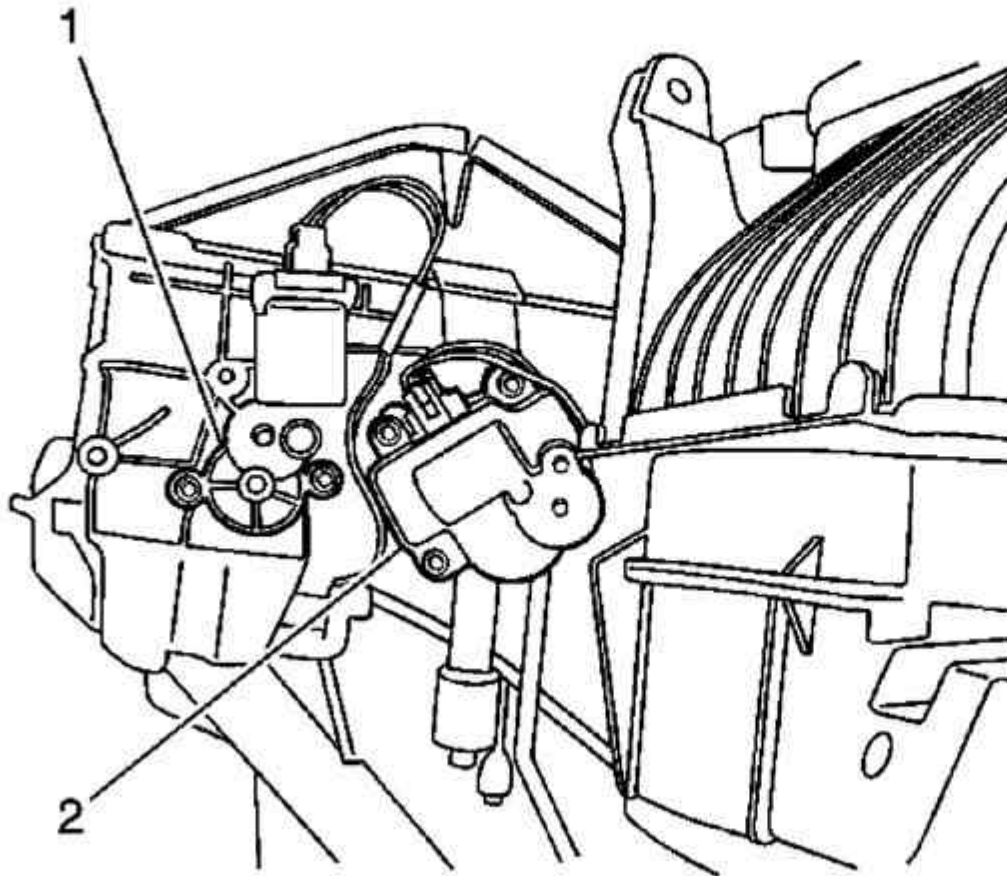


Fig. 13: View Of Right Air Temperature Actuator & Mode Actuator
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

Tighten: Tighten the screws to 1.5 N.m (13 lb in).

5. Connect the electrical connector to the mode actuator.
6. Install the I/P compartment. Refer to Instrument Panel Compartment Replacement .
7. Install the right I/P insulator. Refer to Instrument Panel Insulator Panel Replacement - Right Side .
8. Calibrate the actuator. Refer to Actuator Recalibration .

AIR TEMPERATURE ACTUATOR REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove the right side instrument panel (I/P) insulator. Refer to Instrument Panel Insulator Panel Replacement - Right Side .
2. Remove the I/P compartment. Refer to Instrument Panel Compartment Replacement .

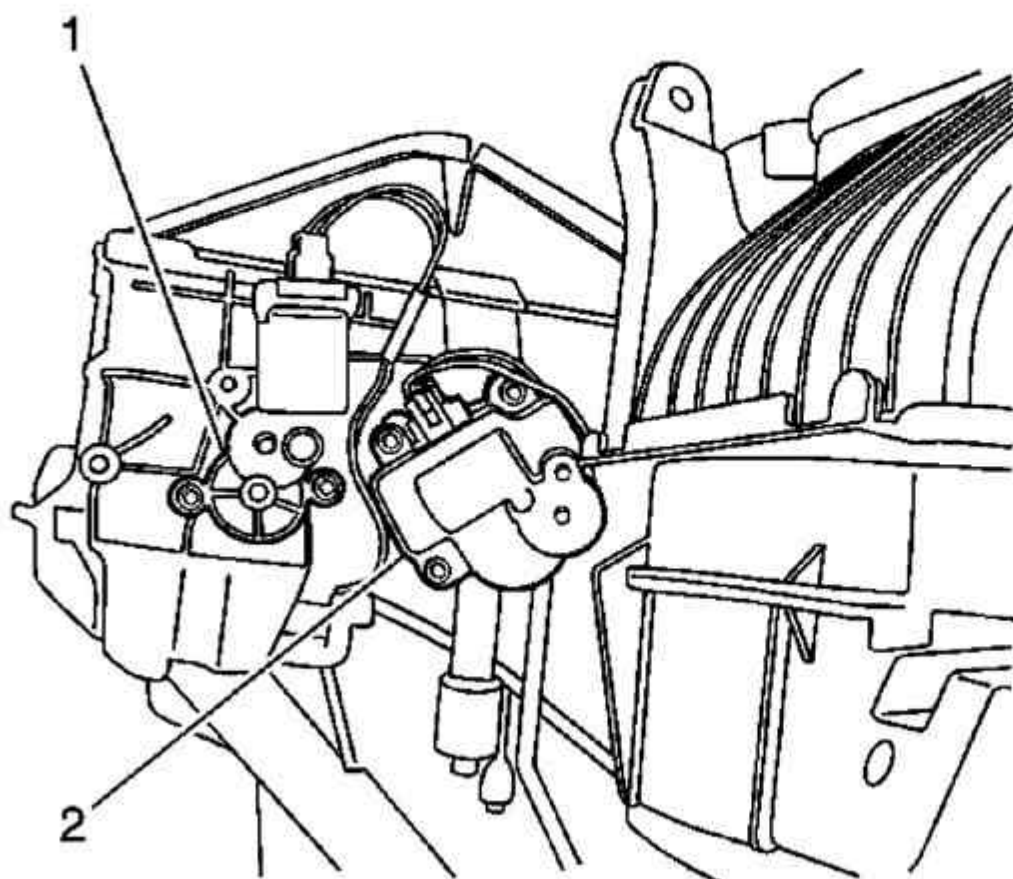


Fig. 14: View Of Right Air Temperature Actuator & Mode Actuator
Courtesy of GENERAL MOTORS CORP.

3. Remove the screws retaining the air temperature actuator (2).
4. Disconnect the electrical connector from the air temperature actuator.
5. Remove the air temperature actuator from the HVAC Module Assembly.

Installation Procedure

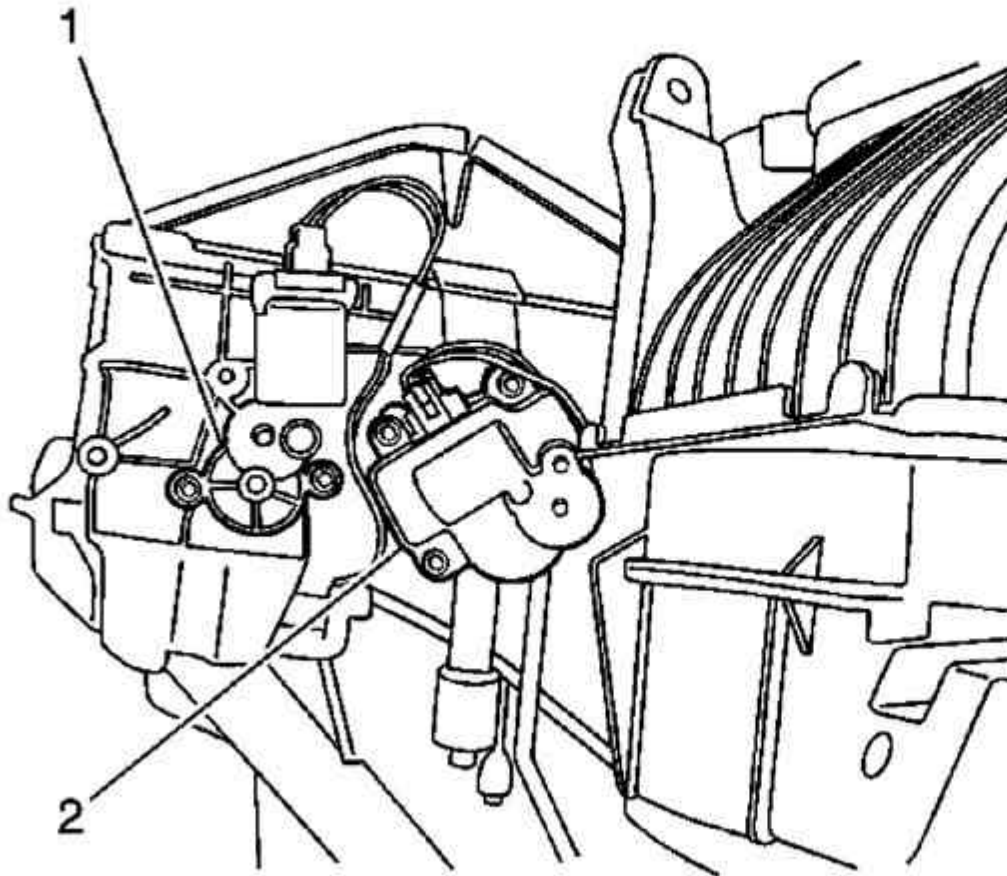


Fig. 15: View Of Right Air Temperature Actuator & Mode Actuator
Courtesy of GENERAL MOTORS CORP.

1. Position the air temperature actuator (2). Align the slots in the electric actuator driver to the flats on the shaft.
2. Align the locating hole to the alignment pin on the HVAC module case.
3. Slide the actuator driver on the shaft. The actuator driver should sit completely on the shaft and the mounting holes should be flush with the HVAC module case.

NOTE: Refer to Fastener Notice .

4. Install the screws to the air temperature actuator.

Tighten: Tighten the screw to 1.5 N.m (13 lb in).

5. Connect the electrical connector to the air temperature actuator.
6. Install the I/P compartment. Refer to Instrument Panel Compartment Replacement .
7. Install the right side I/P insulator. Refer to Instrument Panel Insulator Panel Replacement - Right Side .
8. Calibrate the actuator. Refer to Actuator Recalibration .

AIR TEMPERATURE ACTUATOR REPLACEMENT - LEFT SIDE

Removal Procedure

1. Remove the left closeout panel. Refer to Instrument Panel Insulator Panel Replacement - Left Side .
2. Disconnect the electrical connector from the left air temperature actuator.
3. Remove the mounting screws from the left air temperature actuator.

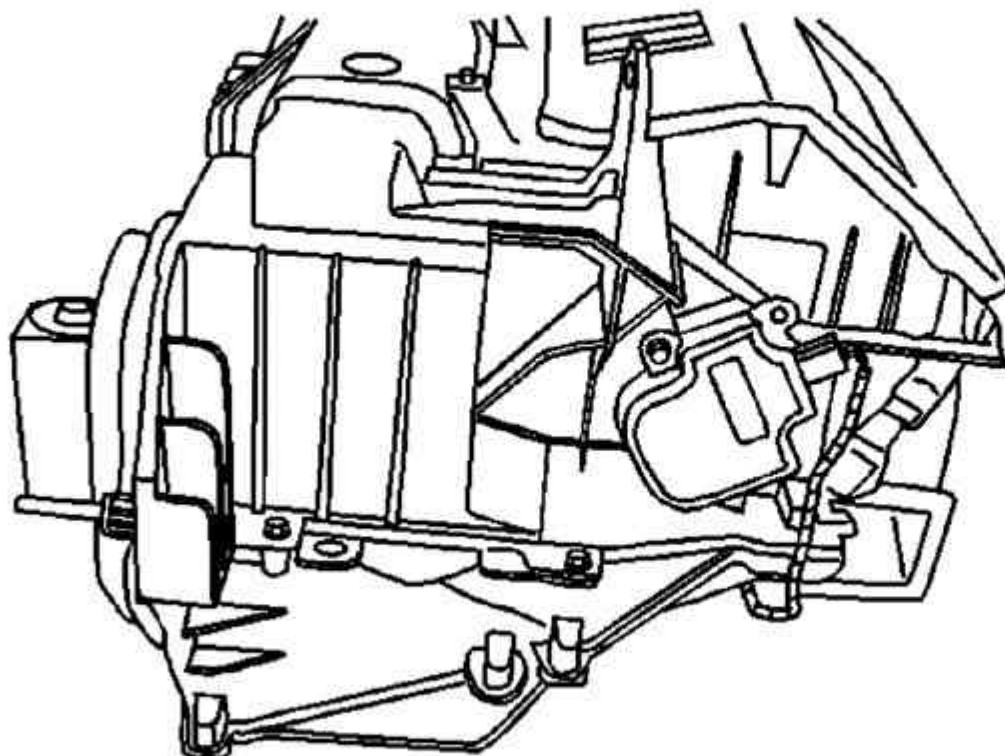


Fig. 16: Identifying Left Air Temperature Actuator
Courtesy of GENERAL MOTORS CORP.

4. Remove the left air temperature actuator.

Installation Procedure

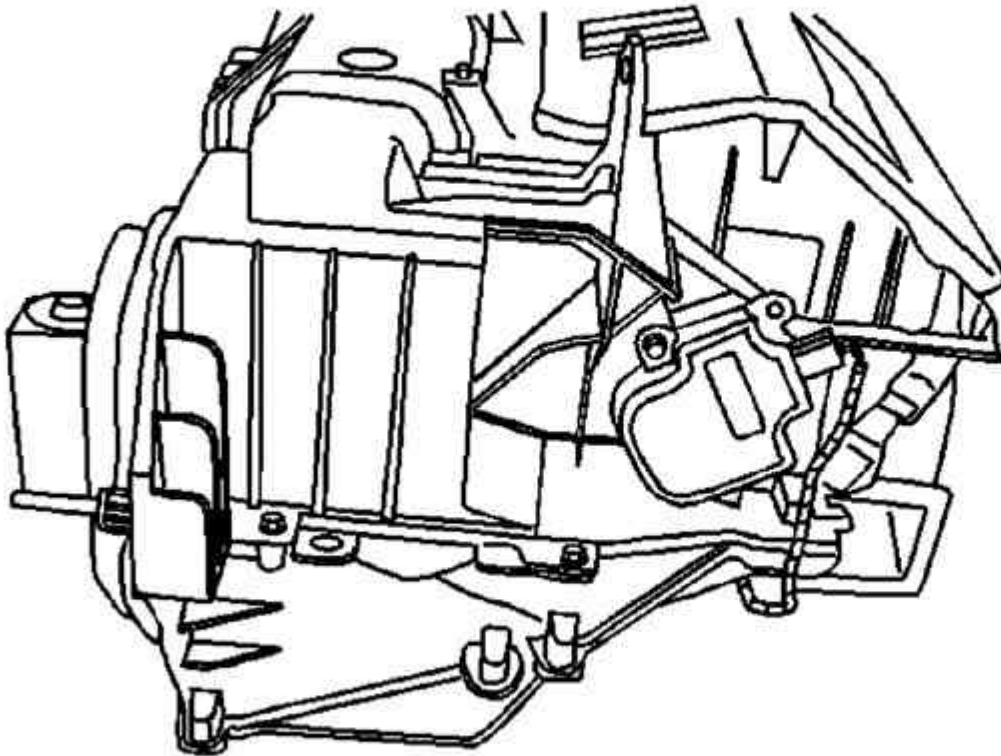


Fig. 17: Identifying Left Air Temperature Actuator
Courtesy of GENERAL MOTORS CORP.

1. Position the left air temperature actuator. Align the slots in the electric actuator driver to the flats on the shaft.
2. Align the locating hole to the alignment pin on the HVAC module case.
3. Slide the actuator on the shaft. The actuator driver should seat completely onto the shaft and the mounting holes should be flush with the mounting screws on the HVAC module case.

NOTE: Refer to Fastener Notice .

4. Install the mounting screws to the left air temperature actuator.

Tighten: Tighten the screws to 1.5 N.m (13 lb in).

5. Connect the electrical connector to the left air temperature actuator.
6. Install the left closeout panel. Refer to Instrument Panel Insulator Panel Replacement - Left Side .
7. Calibrate the actuator. Refer to Actuator Recalibration .

AIR TEMPERATURE SENSOR REPLACEMENT - UPPER RIGHT SIDE

Removal Procedure

1. Remove the radio. Refer to Radio Replacement .

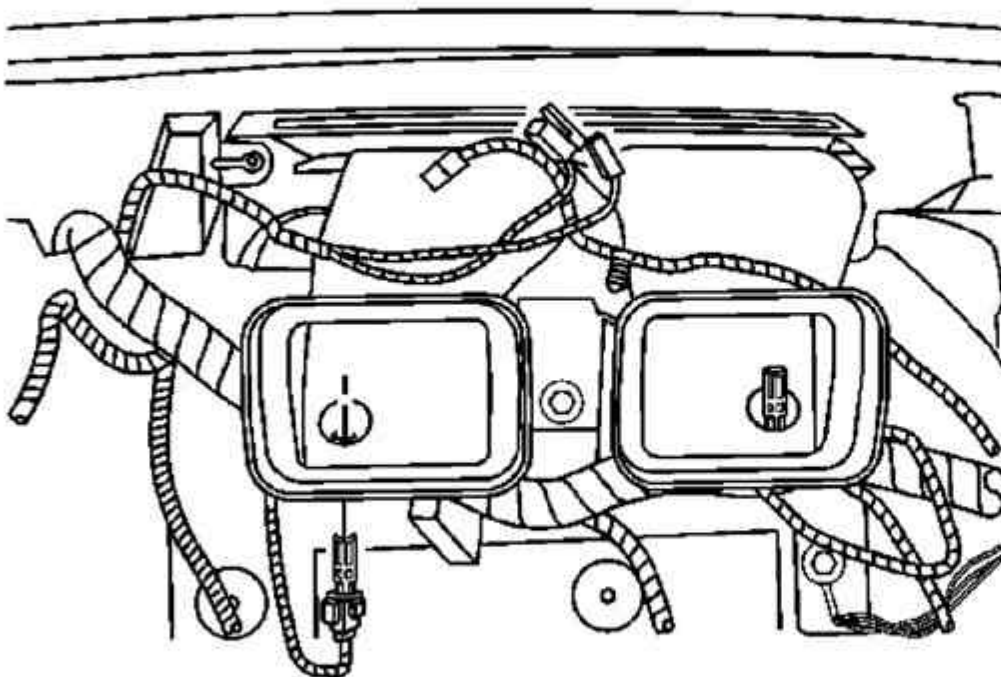


Fig. 18: Identifying Upper Air Temperature Sensor

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Rotate the upper air temperature sensor counterclockwise to disengage from the heater outlet cover.

2. Remove the upper right air temperature sensor from the center air duct.
3. Disconnect the electrical connector from the upper right air temperature sensor.

Installation Procedure

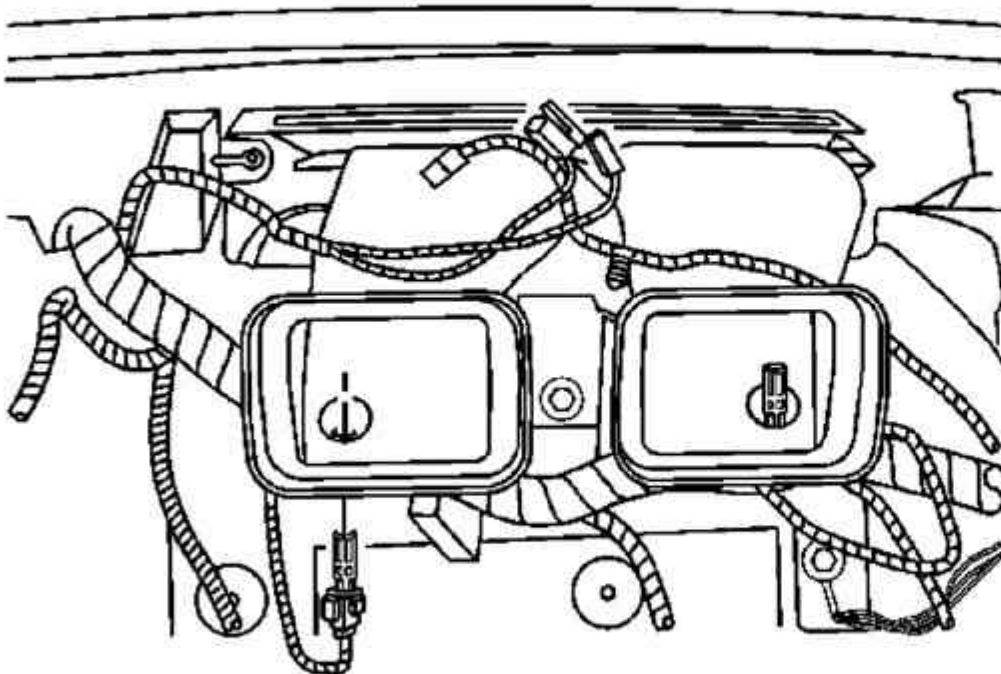


Fig. 19: Identifying Upper Air Temperature Sensor

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Rotate the upper air temperature sensor clockwise to engage the sensor to the heater outlet cover.

1. Install the upper right air temperature sensor to the center air duct.
2. Connect the upper right air temperature sensor electrical connector.
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**.

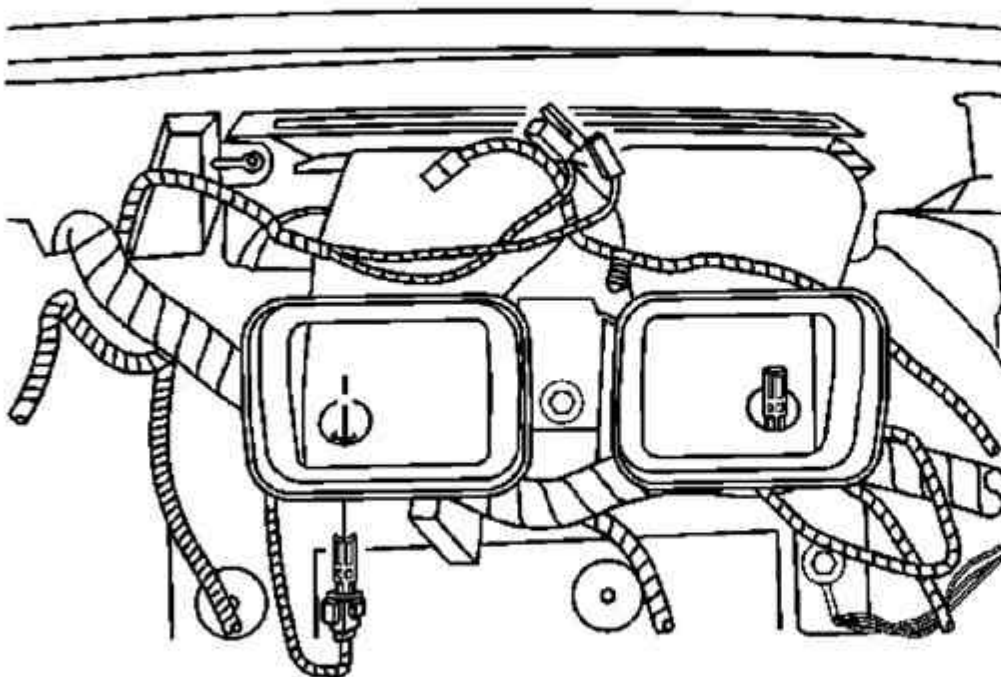


Fig. 20: Identifying Upper Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Rotate the upper air temperature sensor counter-clockwise to disengage from the heater outlet cover.

2. Remove the upper left air temperature sensor from the center air duct.
3. Disconnect the electrical connector from the upper left air temperature sensor.

Installation Procedure

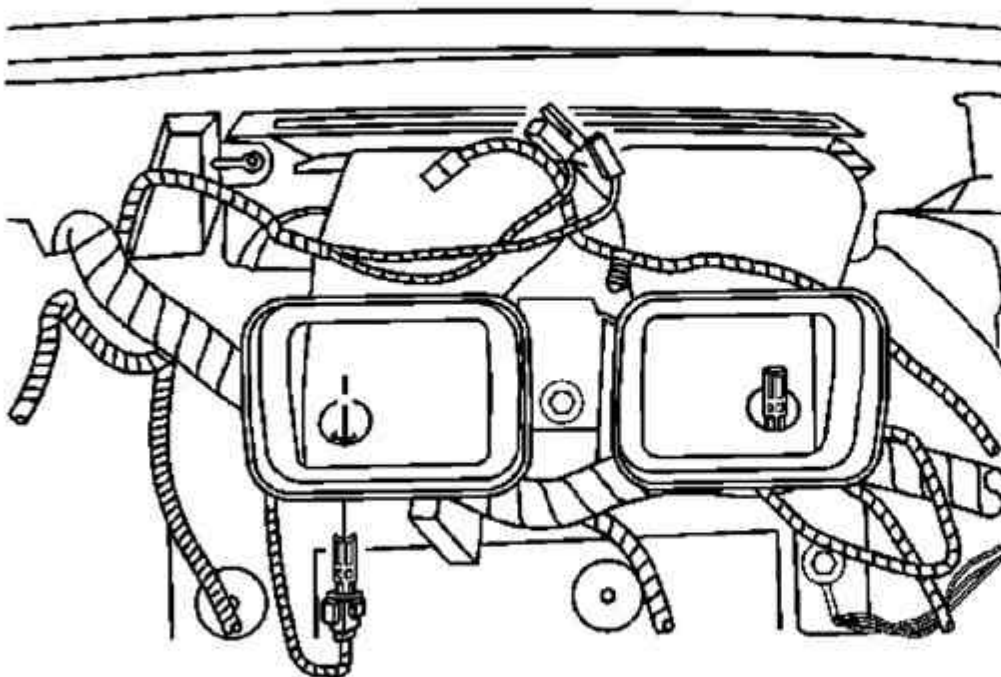


Fig. 21: Identifying Upper Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Rotate the upper air temperature sensor clockwise to engage the sensor to the heater outlet cover.

1. Install the upper left air temperature sensor to the center air duct.
2. Connect the upper left air temperature sensor electrical connector.
3. Install the radio. Refer to **Radio Replacement** .

AIR TEMPERATURE SENSOR REPLACEMENT - LOWER LEFT SIDE

Removal Procedure

1. Remove the left closeout panel. Refer to **Instrument Panel Insulator Panel Replacement - Left Side** .

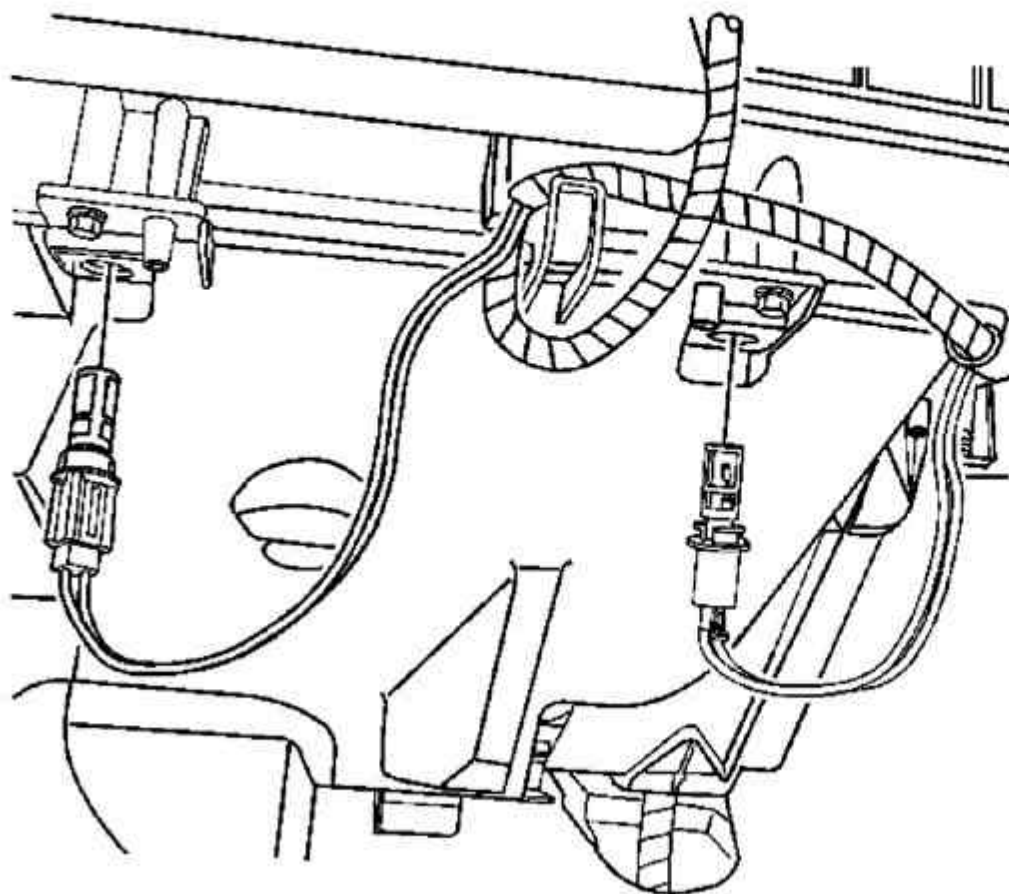


Fig. 22: Identifying Lower Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Rotate the lower air temperature sensor counterclockwise to disengage from the heater outlet cover.

2. Remove the lower left air temperature sensor from the heater outlet cover.
3. Disconnect the electrical connector from the lower left air temperature sensor.

Installation Procedure

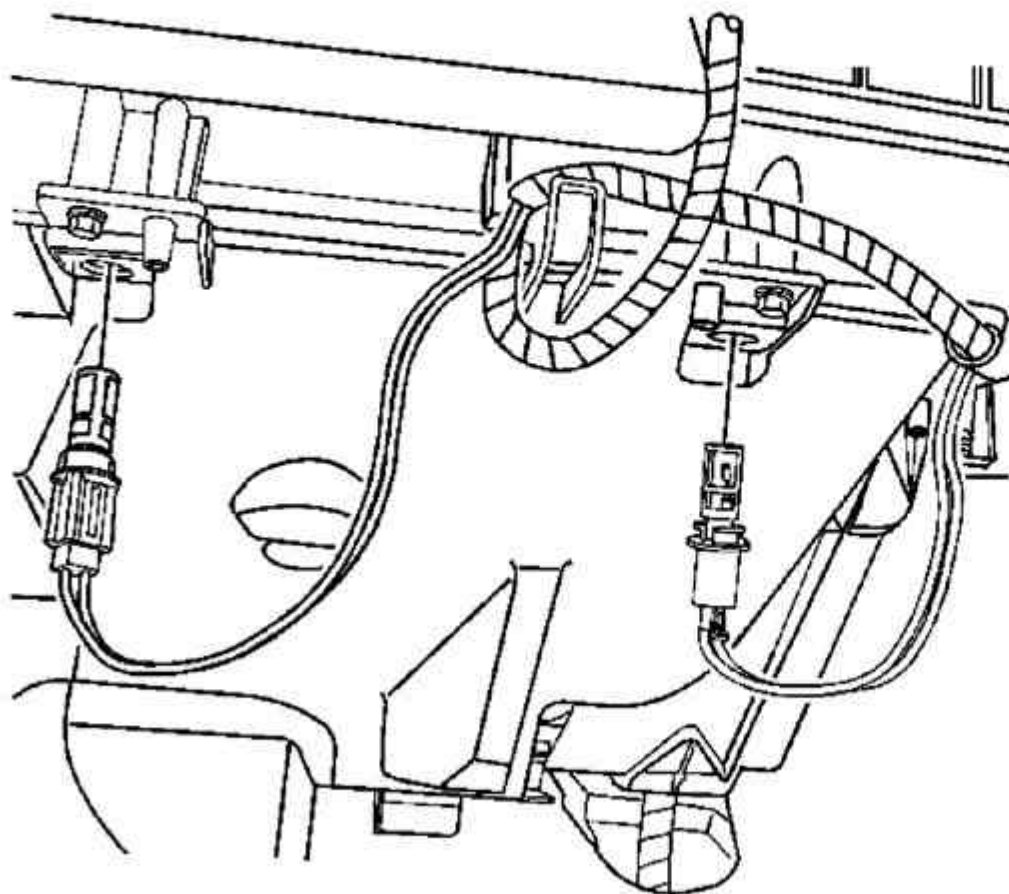


Fig. 23: Identifying Lower Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Rotate the lower air temperature sensor clockwise to engage the sensor to the heater outlet cover.

1. Install the lower left air temperature sensor to the heater outlet cover.
2. Connect the lower left air temperature sensor electrical connector.
3. Install the left closeout panel. Refer to **Instrument Panel Insulator Panel Replacement - Left Side**.

AIR TEMPERATURE SENSOR REPLACEMENT - LOWER RIGHT SIDE

Removal Procedure

1. Remove the right closeout panel. Refer to **Instrument Panel Insulator Panel Replacement - Right Side**.

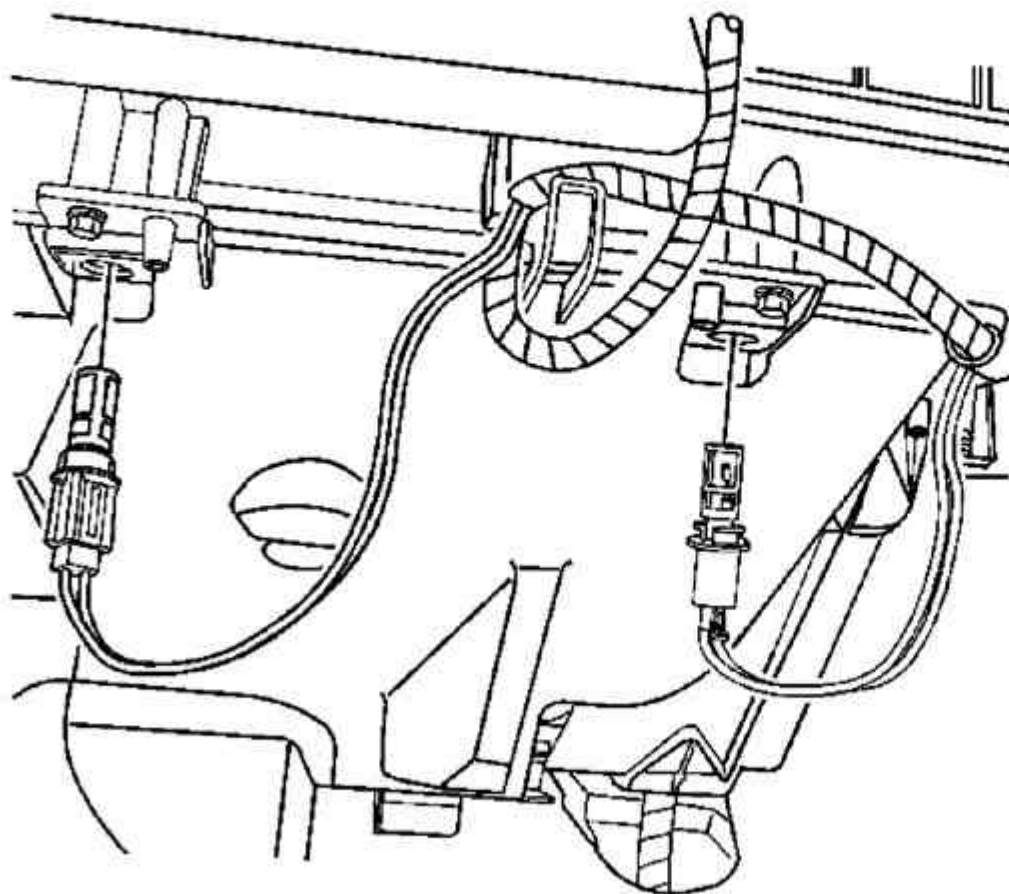


Fig. 24: Identifying Lower Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Rotate the lower air temperature sensor counterclockwise to disengage from the heater outlet cover.

2. Remove the lower right air temperature sensor from the heater outlet cover.
3. Disconnect the electrical connector from the lower right air temperature sensor.

Installation Procedure

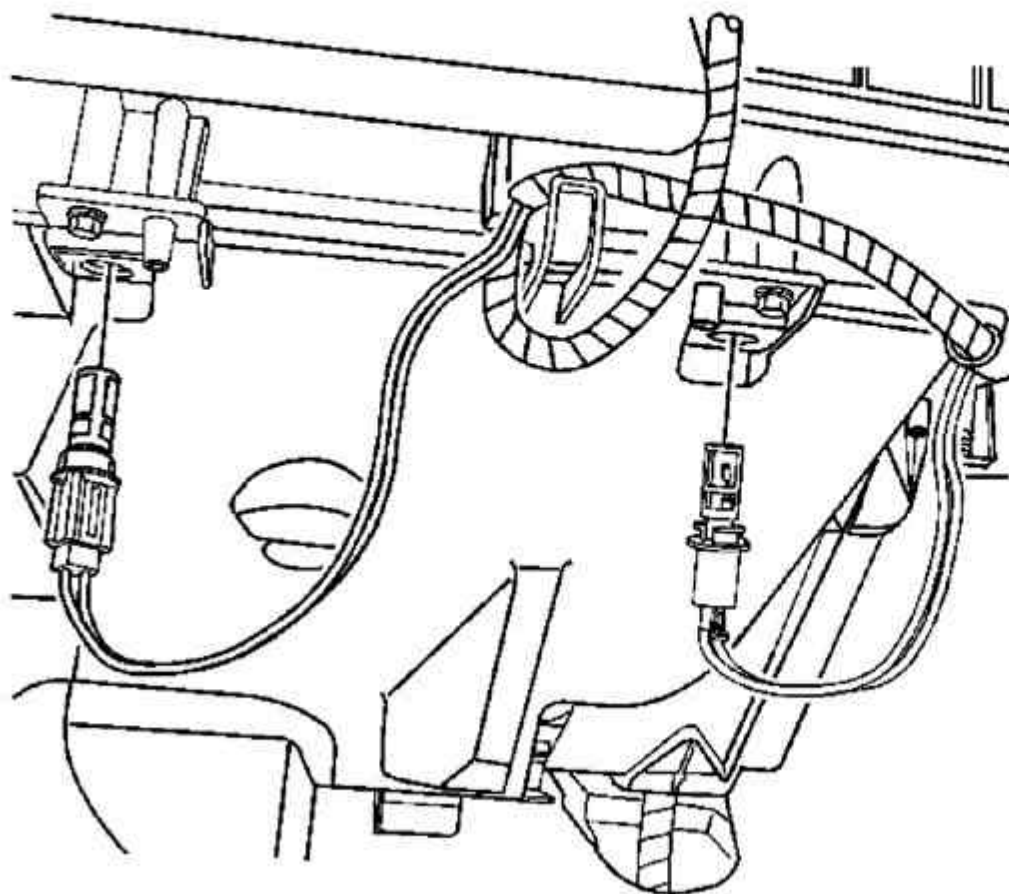


Fig. 25: Identifying Lower Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Rotate the lower air temperature sensor clockwise to engage the sensor to the heater outlet cover.

1. Install the lower right air temperature sensor to the heater outlet cover.
2. Connect the lower right air temperature sensor electrical connector.
3. Install the right closeout panel. Refer to **Instrument Panel Insulator Panel Replacement - Right Side**.

AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT

Removal Procedure

1. Remove the upper air deflector. Refer to **Radiator Air Upper Baffle and Deflector Replacement**.

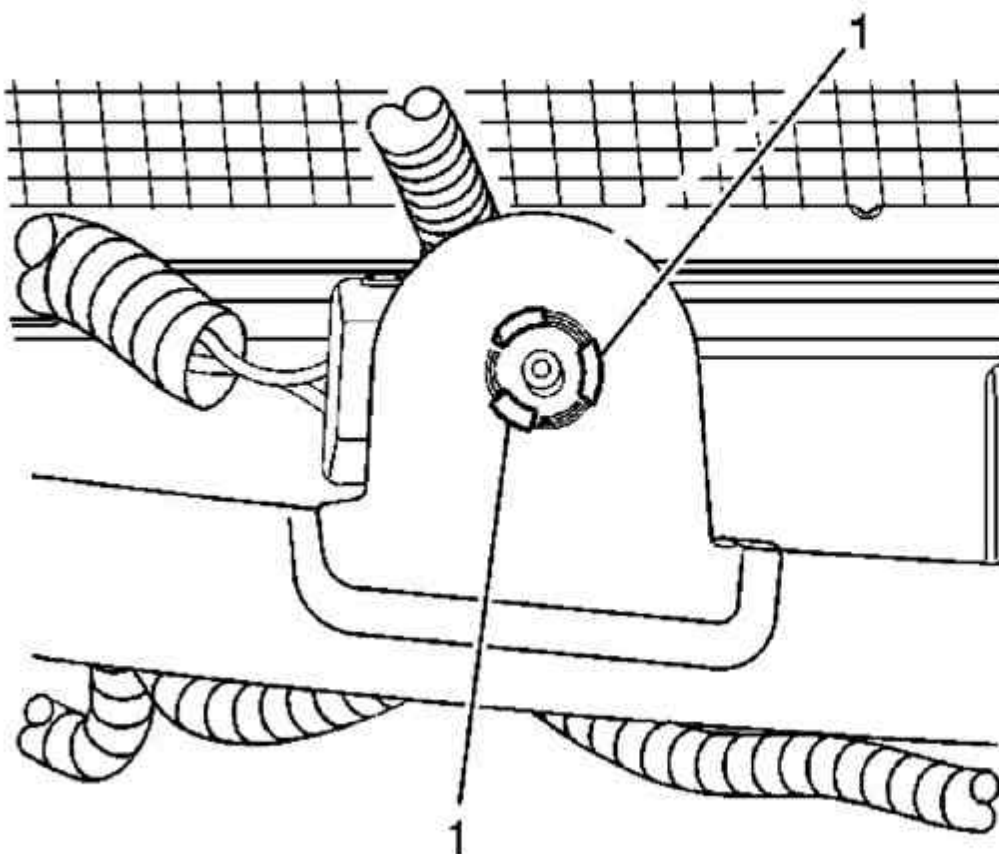


Fig. 26: Identifying Ambient Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

2. Push inward on the retaining tabs (1) to disengage the ambient air temperature sensor.
3. Disconnect the electrical connector from the ambient air temperature sensor.

Installation Procedure

1. Connect the ambient air temperature sensor electrical connector to the ambient air temperature sensor.

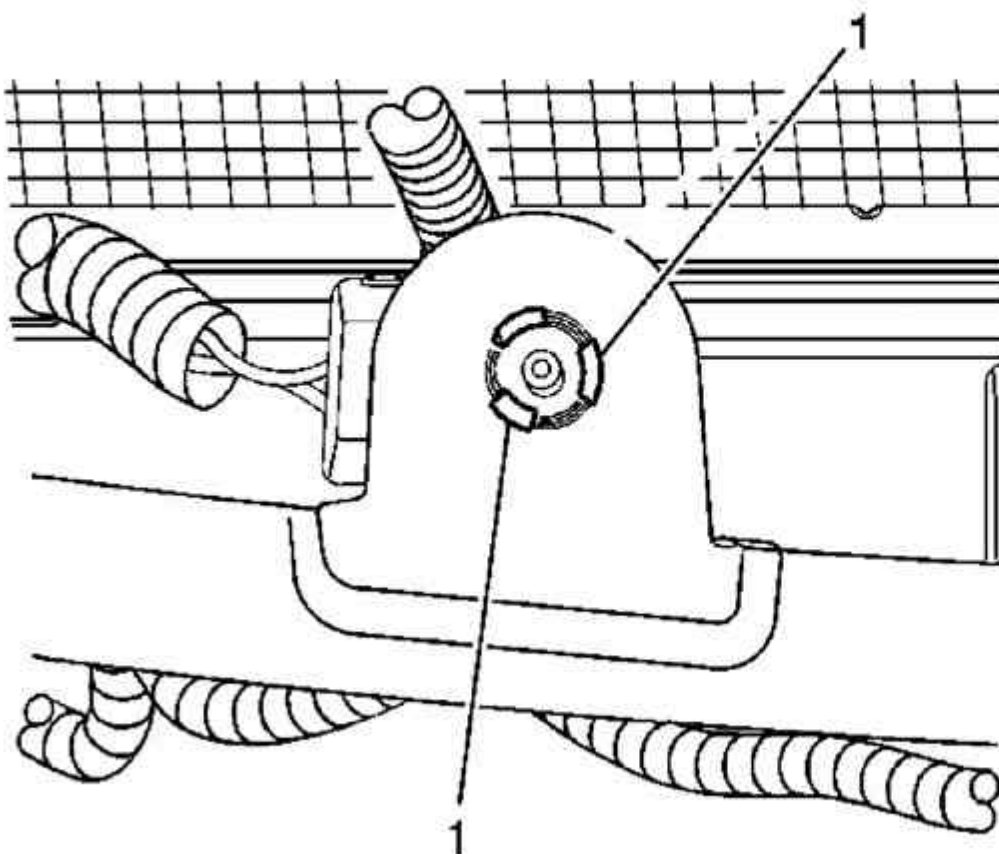


Fig. 27: Identifying Ambient Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

2. Align the retaining tabs (1) to the bottom side of the ambient air temperature sensor hole.
3. Push upwards to install the ambient air temperature sensor to the vehicle.
4. Install the upper air deflector. Refer to **Radiator Air Upper Baffle and Deflector Replacement**.

INSIDE AIR TEMPERATURE SENSOR REPLACEMENT

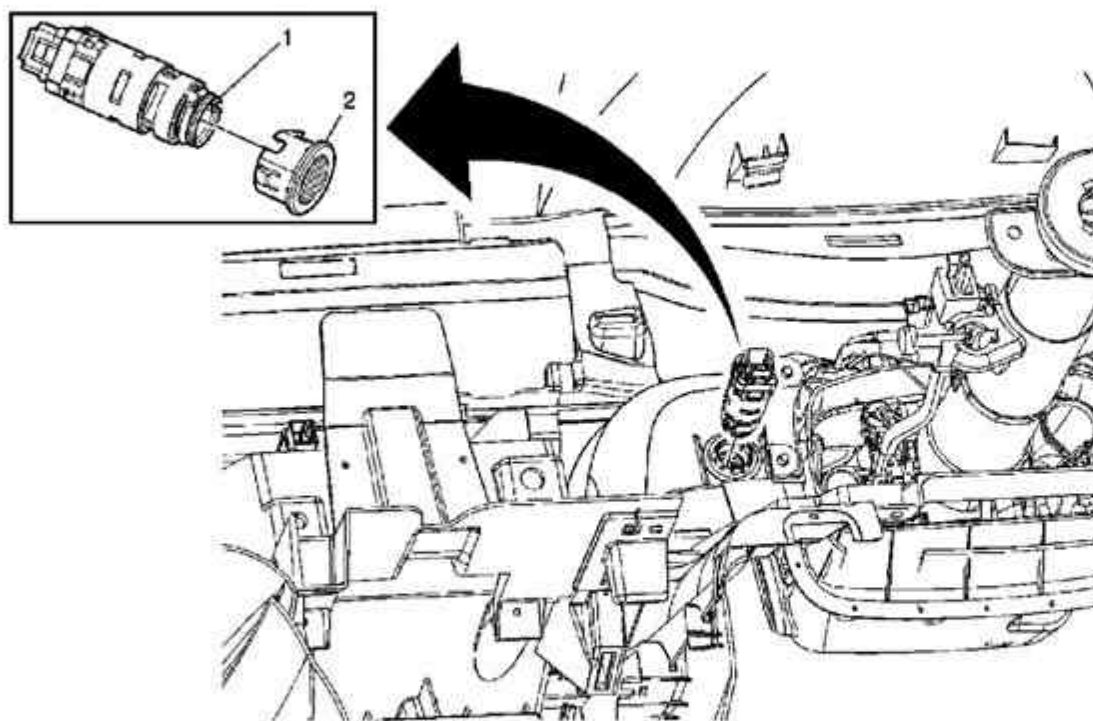


Fig. 28: View Of Inside Air Temperature Sensor
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u> .	
Preliminary Procedure: Remove the knee bolster. Refer to <u>Driver Knee Bolster Replacement</u> .	
1	Sensor, Inside Air Temperature Tip: Disconnect the electrical connector.
2	Bezel, Inside Air Temperature Sensor

SUN LOAD SENSOR REPLACEMENT

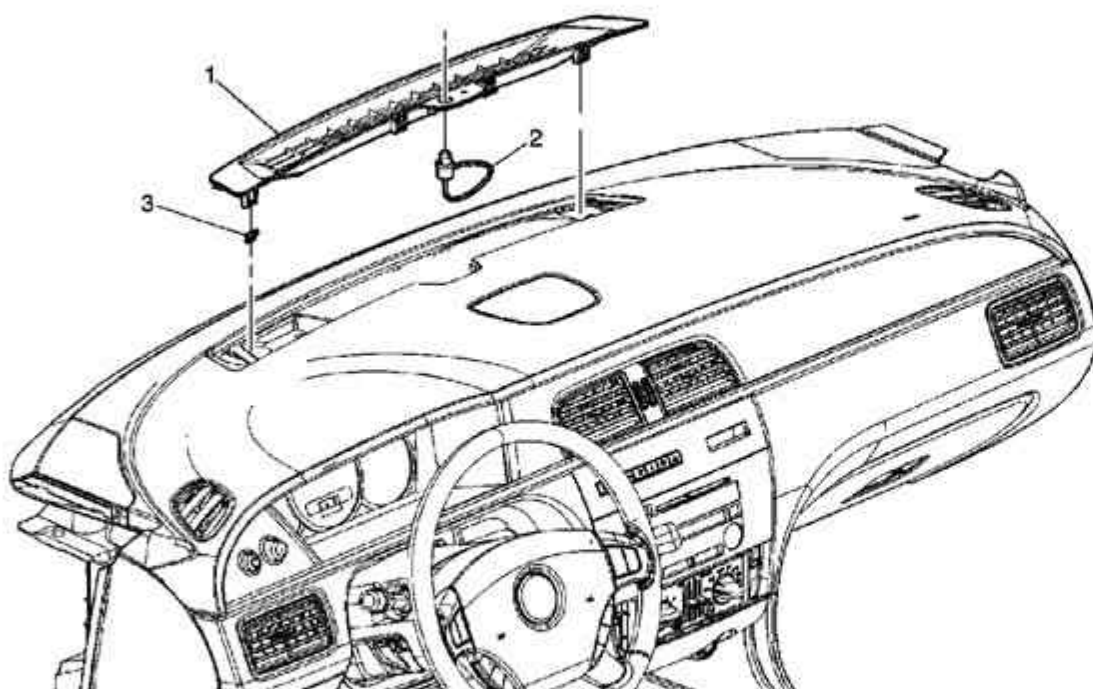


Fig. 29: Identifying Daytime Running Lamps (DRL) Ambient Light Sensor
 Courtesy of GENERAL MOTORS CORP.

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Callout	Component Name
1	Air Defroster Outlet
2	Sun Load Sensor Procedure: Disconnect the electrical connector.
3	Retaining Clip (Qty: 4)

DESCRIPTION AND OPERATION

AIR DELIVERY DESCRIPTION AND OPERATION

The air delivery controls are divided into 2 primary areas. The first, air speed, is dependent upon blower motor speed. The second, air distribution, is related to various single or multiple air outlets.

Air Speed

The blower motor forces air throughout the vehicles interior. The vehicle operator determines the blower motor's speed by toggling the blower motor switch manually or by using the automatic mode. The blower motor will always operate at some speed as long as the HVAC control module is in any position other than OFF, as long as the ignition switch is in the RUN position. The blower motor and mode switches are located within the HVAC control module.

Power is provided to the blower motor from the blower motor control processor through the blower motor supply voltage circuit. The blower motor control processor receives power from the under hood electrical center through the battery positive voltage circuit. Ground is provided by the blower motor control processor and ground circuit.

When any blower speed is selected, whether manual or automatic, the blower motor control processor will control blower motor speeds based on a 5-volt signal circuit that is pulse width modulated (PWM) signal by the HVAC control module. When a low blower speed is requested, the PWM signal is reduced. When a higher blower speed is requested, the PWM signal is increased. The blower motor control processor interprets the PWM signal and varies the ground on the blower motor control circuit internally. An open circuit, short to ground, or short to battery on the blower motor speed control circuit will disrupt the PWM signal and cause the blower motor to not operate. In automatic operation, the HVAC control module will determine what blower speed is necessary in order to achieve or maintain a desired temperature. Toggling the blower button manually also activates the liquid crystal display (LCD) display for the blower speed selected.

Off Mode

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 outlets. The HVAC control module attempts to match the inside air temperature and driver selected temperatures. Since the air conditioning (A/C) compressor is not running, the incoming air may be warmed but not cooled. Press the driver side air temperature switch to turn off the HVAC system. The ambient air temperature will show on the display.

Recirculation Mode

When the recirculation switch is pressed, the HVAC control module will apply a ground to one of the recirculation door control circuits in order to obtain the desired position. The recirculation actuator is a reverse polarity motor, each circuit provides both power and ground to the recirculation actuator. When the actuator is being held in a stationary position, both of the recirculation door control circuits have 12 volts applied to both sides of the actuator motor. This holds the actuator stationary. When a recirculate position is requested, one of the recirculation door control circuits will ground driving the recirculation actuator into the desired position. When an outside air position is requested, the other recirculation door control circuit will ground. This moves the recirculation actuator into an outside air position. This brings air from outside the vehicle instead of air from the inside.

The HVAC control module provides power and ground to the recirculation actuator. The HVAC control module receives power from the under hood electrical center through the ignition 3 voltage circuit. Ground is provided by the ground circuit.

The recirculation mode can be used in both automatic and manual operation. The only time recirculation is not available is when FRONT DEFROST and mix blend mode is selected. The RECIRC LED will flash to alert the driver that recirculation mode is not available. Pressing the recirculation switch, from the OFF position, will set the blower, mode and A/C compressor clutch into automatic mode.

When in automatic mode, recirculation will stay on until either the vehicle operator selects outside air, by pressing the RECIRCULATION switch, or the HVAC control module automatically moves the recirculation actuator. Automatic recirculation is only available when air temperatures are 21°C (70°F) or warmer. The recirculation actuator position will vary to obtain a cooler duct air temperature when cool air is selected. This will assist in cooling the vehicle quicker.

The HVAC control module will move the recirculation actuator to the outside air position at ignition off to bring fresh air to replace stale air that has accumulated in the HVAC module during shut down.

When requested the recirculation actuator will be able to move to the 100 percent recirculation position for a limited time, after that limited time the actuator will move to the 90 percent position. In the auto mode only, the recirculation actuator will move faster to the recirculation position when vehicle is at an idle compared to the normal speed of the actuator during normal operation.

If the recirculation actuator or related circuits has a failure the HVAC control module will attempt to drive the actuator to the outside air position regardless of mode selection. If there is a failure with one of the air temperature actuators the HVAC control module will allow the recirculation actuator to move to the outside air position.

Automatic Modes

The automatic HVAC system will warm up/cool down and maintain the interior temperature of the vehicle by controlling the A/C compressor clutch, blower motor, air temperature, mode and recirculation actuators to achieve the desired temperature. For fully automatic operation, both the blower and mode buttons must be in the AUTO position. Blower speeds will change automatically based on inputs to the HVAC control module. The HVAC control module will always come back to the last settings after an ignition cycle or, if equipped, to the last settings of the driver by pressing the UNLOCK button on the remote keyless entry fob and placing the ignition in RUN. Only RECIRCULATION will have to be reset after each ignition cycle.

Moisture tends to accumulate in the HVAC module assembly after the engine has been shut OFF. The HVAC control module will purge the HVAC module of stale air and moisture to prevent window fogging. The mode actuator will move to the floor mode and run the low speed blower for 10 seconds to purge out the air and moisture. The recirculation actuator will be in the outside air position. Purge mode can be bypassed if any manual modes are selected.

In cold temperatures, the automatic HVAC system will provide heat in the most efficient manner. On cold engine start-up, when temperatures are -1°C (30°F) or colder, low blower speeds will be selected and airflow will be directed on the windshield for 3 minutes. This is done to prevent windshield fogging. To warm the interior quickly, maximum heat mode is used where the blower is at maximum speed, floor mode, both air temperature actuators are in full hot position and outside air is being drawn in. The vehicle operator can select the extreme warm setting of 32°C (90°F), but the system will be out of automatic operation and not warm the vehicle any faster or regulate the blower speed. Once the desired temperature is reached, the blower motor, mode, recirculation and temperature will be adjusted automatically by the HVAC control module.

In warm temperatures, the automatic HVAC system will provide A/C in the most efficient manner. On vehicle start-up, the HVAC control module will monitor for conditions that indicate the possible presence of moisture in the HVAC module. To avoid blowing hot air and moisture out at the driver, the HVAC control module moves the

mode door toward the floor and runs the low speed blower for a 3 seconds. This purge mode can be bypassed if the vehicle is started with the blower switch in maximum speed position. To cool the interior quickly, maximum cool mode is used where the blower is at maximum speed, both air temperature actuators are in full cold position and the recirculation actuator is drawing air from inside the vehicle. The vehicle operator can select the extreme cool setting of 16°C (60°F), but the system will be out of automatic operation and not cool the vehicle any faster or regulate the blower speed. Once the desired temperature is reached, the blower motor, mode, recirculation and temperature will be adjusted automatically by the HVAC control module.

Air Distribution

When the mode switch is pressed, a ground is provided from the HVAC control module to the mode actuator through the mode door control circuits. When the mode actuator receives the signal, the mode actuator moves into the desired position.

The HVAC control module provides power and ground to the mode actuator. The HVAC control module receives power from the rear fuse block through the ignition 3 voltage circuit. Ground is provided by the ground circuit.

The mode actuator is a reverse polarity motor. Each circuit provides both power and ground to the mode actuator. When the mode actuator is being held in position, both of the mode door control circuits have 12 volts applied to both sides of the actuator motor. This holds the actuator stationary. When a mode is requested, one of the mode door control circuits will ground, driving the mode actuator into the desired mode.

Front Defrost Mode

The front defrost mode is the only setting that is not controlled by the automatic HVAC system. When defrost is selected, by the vehicle operator, the A/C compressor is activated and outside air is brought into the vehicle. The blower motor will be activated, regardless of coolant temperature and air will be directed toward the windshield, the side windows and some air flow to the floor. Recirculation mode is not available in front defrost. The recirculation LED will flash on their respective displays if any of those switches are pressed when in front defrost mode. This indicates that these modes are not available. The rear window defogger does not affect the HVAC system in any setting.

Mode Switch

Use the MODE switch in order to change the air delivery mode in the vehicle. Selection of the MODE switch when in AUTO mode will lock in the air flow mode that AUTO was controlling. The system will stay in that mode until the MODE or AUTO switch is pressed. Toggling the MODE button also activates the LCD display for the mode selected. If an airflow mode is currently displayed, pressing the MODE button selects the next air flow mode. The air flow direction will sequence through the following modes:

- MIX-BLEND-Air is directed through the floor, windshield, and side window outlets.
- BI-LEVEL-Cool air is delivered through the vent outlets while warm air is delivered through the floor outlets.
- FLOOR-Air is delivered through the floor, windshield and side window outlets.
- VENT-Air is delivered through the instrument panel outlets.

These are the only air flow modes available through the MODE button. When in AUTO mode, the HVAC control module will only operate in the following modes:

- BI-LEVEL
- VENT
- FLOOR

Dual Zone Control Switch

The passenger air temperature switch is provided to allow the passenger to set air discharge temperatures on the passenger side of the vehicle. Passenger temperatures can be set from 15-32°C (60-90°F). To activate the dual zone, the passenger air temperature switch to the desired offset. If the passenger air temperature switch has been turned on, it can be turned off by pressing the passenger switch. Greater sunload on one side of the vehicle may cause the discharge air temperatures to be different, even when the HVAC system is not operating in a dual zone mode.

The HVAC control module provides power and ground to the passenger air temperature actuator. The HVAC control module receives power from the under hood electrical center through the ignition 3 voltage circuit. Ground is provided by the ground circuit.

The passenger air temperature actuator is a reverse polarity motor. Each circuit provides both power and ground to the passenger air temperature actuator. When the passenger air temperature actuator is being held in position, both of the passenger air temperature door control circuits have 12 volts applied to both sides of the actuator motor. This holds the actuator stationary. When a temperature offset is requested, one of the passenger air temperature door control circuits will ground, driving the passenger air temperature actuator into the desired temperature offset.

Remote Start

Remote Start Activation

The following describes the HVAC control head functionality upon receiving the remote start active serial data message and a power mode status is set to off a wake. Outside ambient temperature sensor, OAT- on automatic systems or intake air temperature (IAT) on manual systems, are utilized to determine the moding of the following features: Blower Mode (Bi-level, floor, Defrost, Recirc and rear Defrost. These features as determined by the OAT/IAT during activation sequence are maintained for the duration of engine run time. Class 2 supplies the ambient temperature. Calibratable temperatures are utilized to provide low, mid and high temperature ranges for feature selectable. Blower and mode have the range to select any valid feature positions. When the remote start active serial data is received ignition-off loop HVAC algorithms will act the same as if a run power mode received (i.e. re-calibration, After blow, ignition-off motor positioning etc.) off timer and ignition on timer have the functionality as in Run mode.

Remote Start De-activation

When the remote start is exited (class 2 power mode = run mode or remote start engine), all displays will revert to that based on actual settings on the vehicle. In the case of manual settings, displays will revert to actual state of operation of the features on the basis of their normal control algorithms.

AIR TEMPERATURE DESCRIPTION AND OPERATION

The air temperature controls are divided into three primary areas:

- Automatic operation
- The heating and air conditioning system
- The air conditioning (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 power mode master, provides a device on signal. The control module supports the following features:

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Feature	Availability
Afterblow	Yes
Purge	No
Personalization	No
Actuator Calibration	Yes

Personalization

The HVAC control module will receive information that defines the current driver of the vehicle from the driver door module (DDM) through class 2 communication. The HVAC system will memorize the following system configurations for up to three unique drivers:

- Driver set temperature
- Passenger set temperature
- Mode
- Blower motor speed (auto, speed 1, 2, 3, 4, 5, 6)
- Air conditioning (A/C) compressor request, auto ON or A/C OFF

This information shall be stored inside the HVAC control module memory. When a different driver identification button is selected the HVAC control module will recall the appropriate driver settings. When the HVAC control module is first turned on, the last stored settings for the current driver will be activated except for the rear defrost and heated seat settings.

Air Temperature Actuators

The air temperature actuator is a 2-wire bi-directional electric motor. Two 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 12 volts. In order to move the actuator, the HVAC control module grounds the appropriate control circuit for the commanded direction. The HVAC control module reverses the polarity of the control circuits to move the actuator in the opposite direction.

The HVAC control module determines the door position by counting motor pulses on one of the control circuits. These pulses are small voltage fluctuations that occur when the brush is shorted across two commutator contacts as the motor rotates. As the actuator shaft rotates, the HVAC control module monitors the voltage drop across an internal resistance to detect the pulses. The HVAC control module converts the pulses to counts with a range of 0-255 counts. The HVAC control module uses a range of 0-255 counts to index the actuator position.

Air Temperature Sensors

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

- Outside
- Inside
- Upper right
- Upper left
- Lower right
- Lower left

The upper and lower duct sensors are divided into left and right zone operation. The left side upper and lower duct sensors will only effect the operation of the left air temperature actuator and the right side upper and lower duct sensors will only effect the operation of the right air temperature actuator. The duct sensors are used to measure the

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temperature of the air exiting the ducts. The sensors operate within a temperature range between -6.5 to +57.5°C (+20.3 to +135.5°F). When temperature increases the sensor signal decreases. The HVAC control module converts the 0-5 volt sensor signal to a range between 0-255 counts. If the HVAC control module detects that one of the duct temperatures must change, the HVAC control module will adjust the appropriate air temperature actuator. The following list shows the duct sensors that are monitored by the HVAC control module in each mode position:

Mode Position	Duct Sensor Monitored
Vent	Upper left duct sensor and upper right duct sensor
Bi-Level	Upper left duct sensor and upper right duct sensor
Defog	Lower left duct sensor and lower right duct sensor
Floor	Lower left duct sensor and lower right duct sensor
Front Defrost	Lower left duct sensor and lower right duct sensor

If the HVAC control module detects a malfunctioning sensor, the HVAC system will only malfunction when the sensor is monitored.

The inside temperature sensor operates within a temperature range between -6.5 to +57.5°C (+20.3 to +135.5°F). If the sensor is shorted to ground, an open, or shorted to voltage, the HVAC system will use a default value.

The outside temperature sensor operates within a temperature range between -30 to +51°C (-22 to +123.8°F). The OAT valve is received and displayed through the instrument panel cluster (IPC). If the IPC has determined that the outside temperature sensor has failed, the IPC shall display, 75, in place of the outside air temperature. If the sensor is shorted to ground, an open, or shorted voltage, the IPC will use a default value.

The IPC displays the outside air temperature value that it receives through a class 2 or GMLAN message. The scan tool has the ability to update the displayed ambient air temperature. The outside air temperature value is displayed or updated under the following conditions:

Condition	Display
At start up with the engine OFF more than 3 hours	Displays actual outside temperature
At start up with the engine OFF less than 3 hours	Displays last stored temperature
Vehicle moving above 16 km/h (10 mph) for 5 minutes	Updates temperature display at a slow filtered rate.
Vehicle moving at 51 km/h (32 mph) or greater for 2.5 minutes	Updates temperature display as rapidly as possible.
When the sensor reading is less than the displayed value.	Updates temperature display as rapidly as possible.
When the Front Defrost, Rear Defog and fan up buttons are pressed simultaneously.	Updates temperature display instantly.

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 along with the ambient light sensor. Low reference and signal circuits enable the sensor to operate. As the sunload increases, the sensor signal decreases. 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 sensor is open or shorted, no sunload condition occurs.

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 A/C refrigerant pressure sensor prevents the A/C system from operating when an excessively high or low pressure condition exists. The engine control module (ECM) disables the compressor clutch under the following conditions:

- A/C pressure is more than 2850 kPa (413 psi). The clutch will be enabled after the pressure decreases to less than 2100 kPa (254 psi).
- A/C pressure is less than 204 kPa (30 psi). The clutch will be enabled after the pressure increases to more than 220 kPa (32 psi).

If the ECM detects a failure in the A/C refrigerant pressure sensor or circuit, the class 2 message sent to the HVAC control module will be invalid. The HVAC control module will display A/C OFF on the module as long as the condition is present.

Heating and A/C Operation

The purpose of the heating and air conditioning (A/C) system is to provide the following:

- Heated air
- Cooled air
- Remove humidity from the interior of the vehicle
- Reduce windshield fogging

Regardless of the temperature setting, the following can effect the rate that the HVAC system can achieve a desired temperature:

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

The HVAC control module commands or monitors the following actions when an air temperature setting is selected.

WARMEST POSITION-The air temperature actuator door position directs maximum air flow through the heater core.

COLDEST POSITION-The air temperature actuator door position directs maximum air flow around the heater core.

BETWEEN THE WARMEST AND COLDEST POSITION-The following sensors are monitored to direct the appropriate amount of air through the heater core to achieve the desired temperature:

- Sunload

- Outside temperature
- Inside temperature
- Duct temperatures

The A/C system is engaged by selecting any switch on the HVAC control module except the, A/C OFF switch. The A/C switch will illuminate, A/C OFF, when the A/C switch is selected. The HVAC control module sends a class 2 A/C request message to the body control module (BCM) for A/C compressor clutch operation. The BCM must communicate with the engine control module (ECM) in order for the A/C clutch to be engaged. The HVAC system uses a compact variable swash plate compressor. The following conditions must be met in order for the ECM to turn ON the compressor clutch from the HVAC control module request:

- The BCM will allow A/C operation if the following limits are within normal operating range
 - A/C line pressure
 - A/C refrigerant low temperature
 - Ambient temperature
 - Engine coolant temperature
 - Battery voltage
- HVAC control module
 - OAT temperature more than 1.5°C (35°F)
 - Control module operating range 9-16 volts
- ECM
 - Engine coolant temperature (ECT) is less than 128°C (262°F).
 - Engine RPM is more than 0 RPM.
 - A/C pressure is between 2 850 kPa (413 psi) and 204 kPa (30 psi).

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

- Throttle position is 100 percent
- A/C pressure is more than 2 850 kPa (413 psi)
- A/C pressure is less than 204 kPa (30 psi)
- ECT is more than 128°C (262°F)

If there is a malfunction in the A/C system, the driver information center will read, SERVICE A/C SYSTEM, to alert the driver.

When the compressor clutch disengages, the compressor clutch diode protects the electrical system from a voltage spike.

Dual Zone Operation

The HVAC control module has temperature settings for the driver and the passenger. If the passenger setting is turned off then the driver setting controls both driver and passenger temperature actuators. The passenger setting can not be used without the driver setting also being ON. The passenger setting can be turned ON or OFF by pressing the temperature switch on the passenger side of the HVAC control module. When the passenger setting is ON, the passenger temperature can be adjusted independently from the driver setting and the passenger temperature is displayed on the passenger side of the control module. A different sunload or duct temperature on one side of the vehicle may cause different discharge air temperatures even when the passenger setting is not turned ON.

Automatic Operation

In automatic operation, the HVAC control module will maintain the comfort level inside of the vehicle by

controlling the air conditioning (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 blower motor switch must be in the AUTO position.
- The air temperature switch must be in any other position other than 60 or 90 degrees.
- The mode switch must be in the AUTO position.

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

- Regulate blower motor speed
- Position the air temperature actuator
- Position the mode actuator
- Position the recirculation actuator

When the warmest position is selected in automatic operation the blower speed, based on coolant temperature, will increase gradually until the vehicle reaches normal operating temperature. When normal operating temperature is reached the blower will stay on high speed and the air temperature actuators will stay in the full heat position. When the coldest position is selected in automatic operation the blower will stay on high and the air temperature actuators will stay in the full cold position.

In cold temperatures, the automatic HVAC system will provide heat in the most efficient manner. The vehicle operator can select an extreme temperature setting but the system will not warm the vehicle any faster. In warm temperatures, the automatic HVAC system will also provide air conditioning in the most efficient manner. Selecting an extreme cool temperature will not cool the vehicle any faster.

Remote Start

Remote Start Activation

The following describes the HVAC control head functionality upon receiving the remote start active serial data message and a power mode status is set to off a wake. Outside ambient temperature sensor, OAT- on automatic systems or intake air temperature (IAT) on manual systems, are utilized to determine the moding of the following features: Blower Mode (Bi-level, floor, Defrost, Recirc and rear Defrost. These features as determined by the OAT/IAT during activation sequence are maintained for the duration of engine run time. Class 2 supplies the ambient temperature. Calibratable temperatures are utilized to provide low, mid and high temperature ranges for feature selectable. Blower and mode have the range to select any valid feature positions. When the remote start active serial data is received ignition-off loop HVAC algorithms will act the same as if a run power mode received (i.e. re-calibration, after blow, ignition-off motor positioning etc.) off timer and ignition on timer have the functionality as in Run mode.

Remote Start De-activation

When the remote start is exited (class 2 power mode = run mode or remote start engine) all displays will revert to that based on actual settings on the vehicle. In the case of manual settings, displays will revert to actual state of operation of the features on the basis of their normal control algorithms.

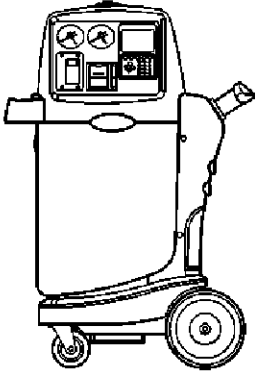
Engine Coolant

Engine coolant is the key element of the heating system. The engine thermostat controls the normal engine operating coolant temperature. Coolant pumped out of the engine enters the heater core through the inlet heater hose. The air flowing through the HVAC module absorbs the heat of the coolant flowing through the heater core.

The coolant then exits the heater core through the heater outlet hose and returns back to the engine block.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
	J 43600 ACR 2000 Air Conditioning Service Center

2008 Buick LaCrosse CXL
2008 HVAC HVAC - Automatic - LaCrosse

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