

2008 HVAC

HVAC - Manual - Ascender, Envoy & Trailblazer

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Actuator Retaining Screws, ALL	1.9 N.m	17 lb in
HVAC Control Module Retaining Screws	1.9 N.m	17 lb in

SCHEMATIC & ROUTING DIAGRAMS

HVAC SCHEMATICS

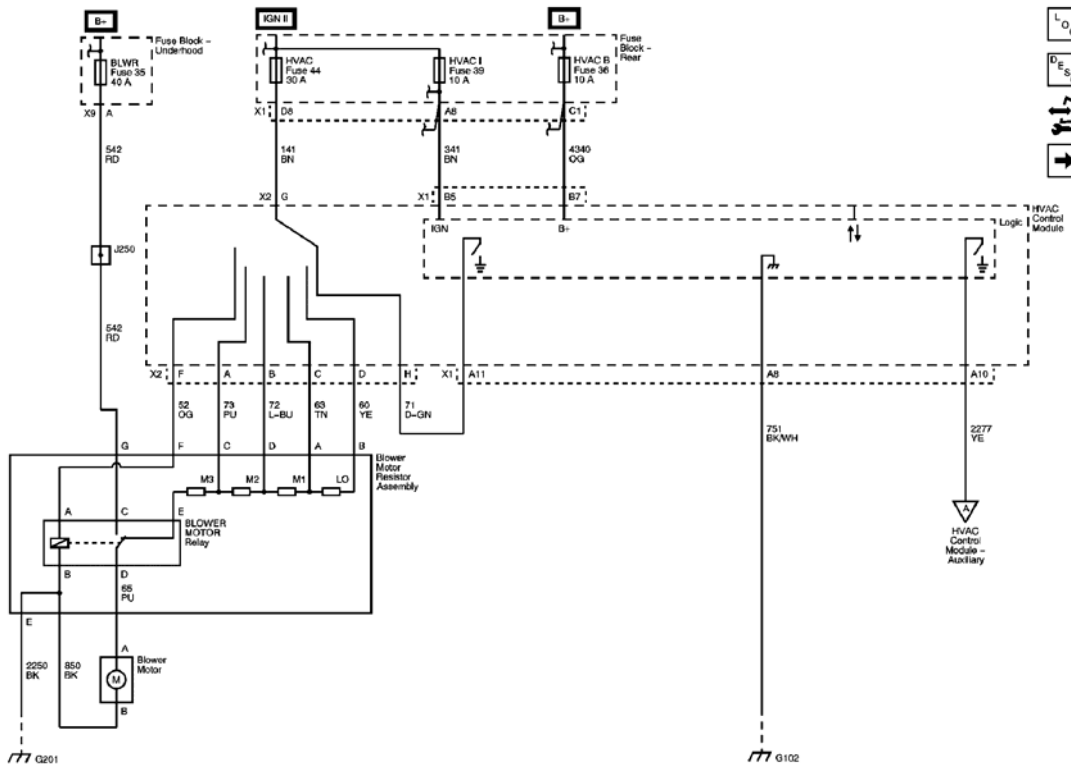


Fig. 1: Module Power, Ground, Serial Data & Blower Motor Schematic
 Courtesy of GENERAL MOTORS CORP.

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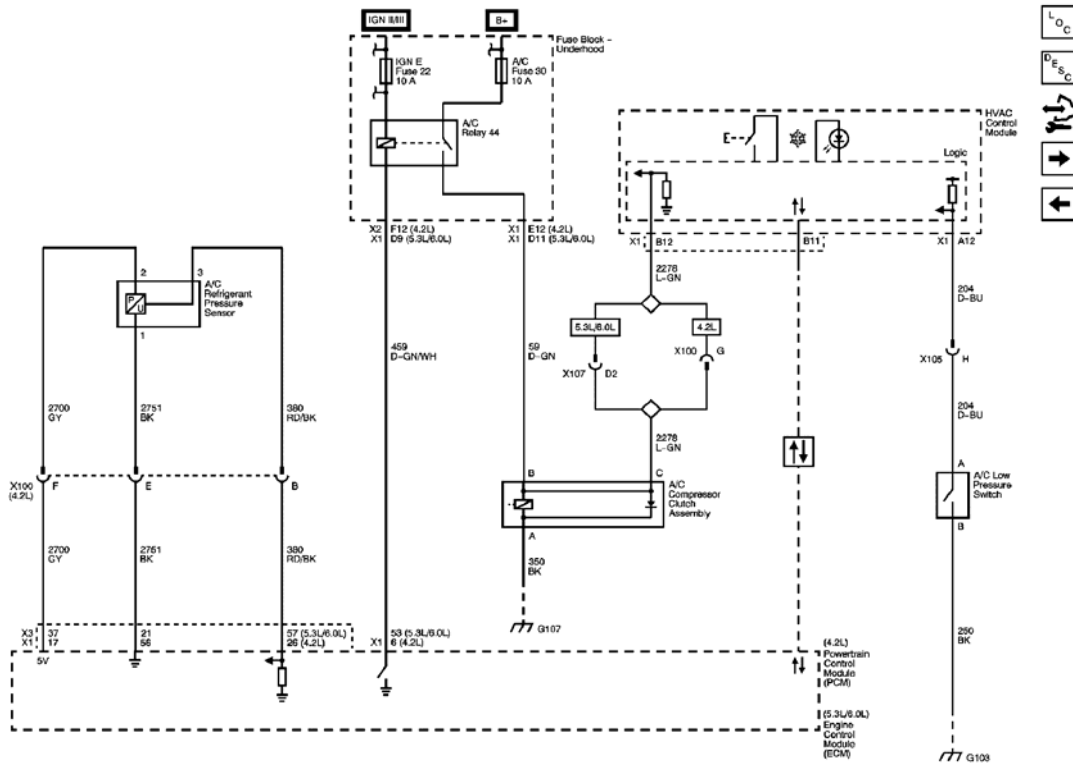


Fig. 2: Compressor Controls Schematic
Courtesy of GENERAL MOTORS CORP.

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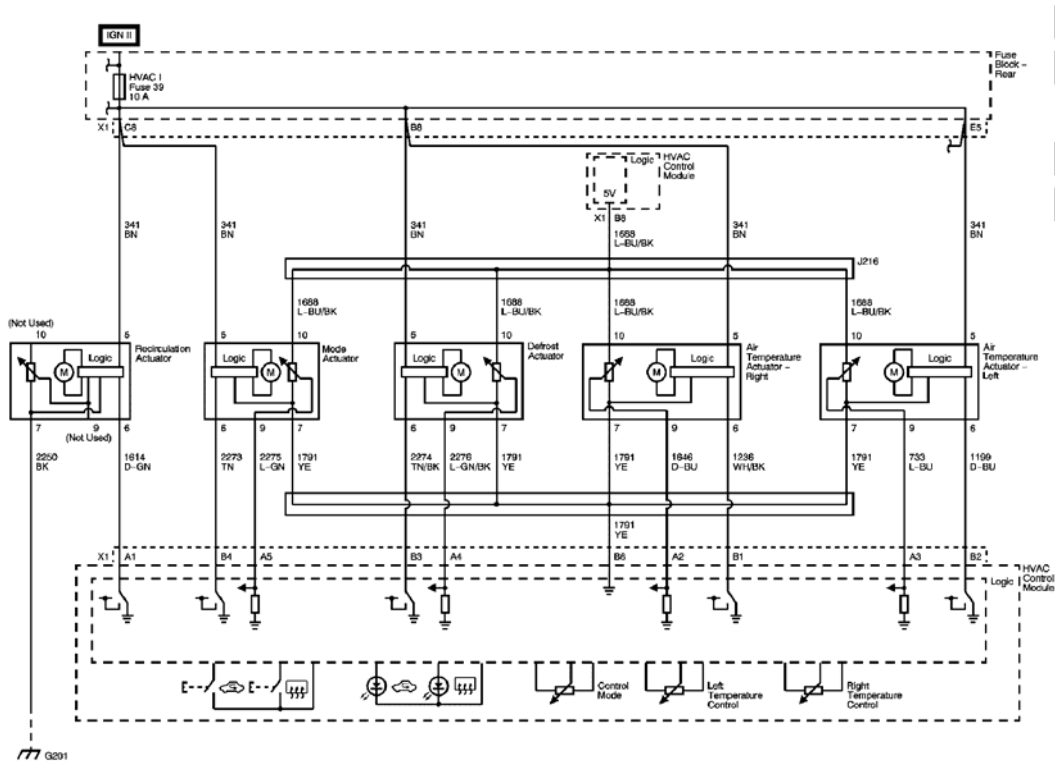


Fig. 3: Air Delivery/Temperature Actuators Schematic
Courtesy of GENERAL MOTORS CORP.

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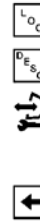
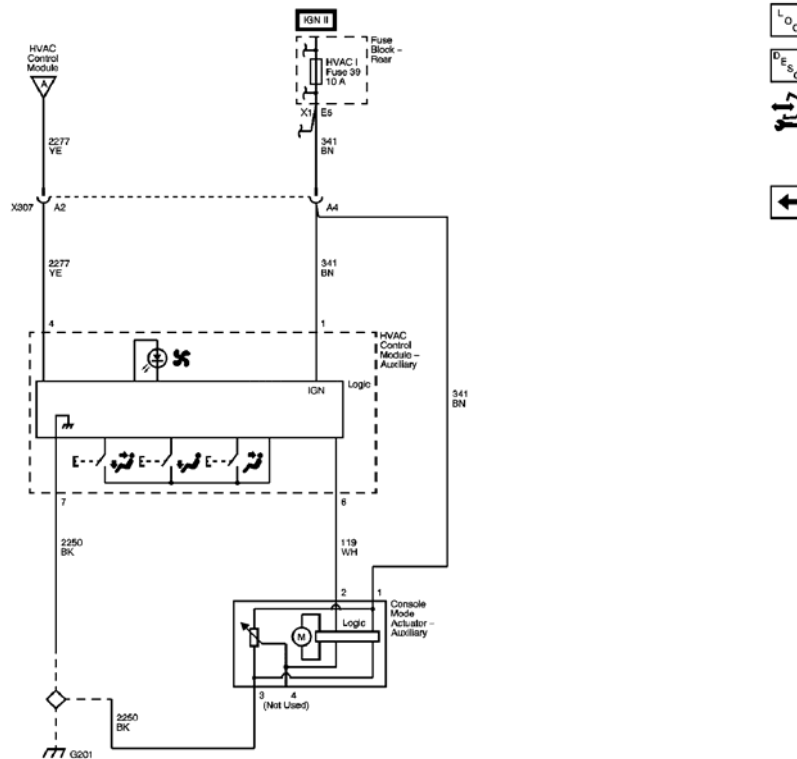


Fig. 4: Rear Mode Controls Schematic
 Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION & PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B0248, B0263, B0408, B0414, B0418, B0424, B3761, or B3770</u>	B0248: Air Flow Control 3 Circuit B0263: Air Flow Control 6 Circuit B0408: Temperature Control 1 Circuit B0414: Range/Performance Temperature Control 2 Feedback Circuit B0418: Temperature Control 2 Circuit B0424: Range/Performance B3761: Air Flow Control 3 Feedback Circuit B3770: Air Flow Control 6 Feedback Circuit
<u>DTC P0530</u>	P0530: Air Conditioning Refrigerant Pressure Sensor Circuit

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

Diagnostic Instructions

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- 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 Circuit

DTC B0263

Air Flow Control 6 Circuit

DTC B0408

Temperature Control 1 Circuit

DTC B0414

Range/Performance Temperature Control 2 Feedback Circuit

DTC B0418

Temperature Control 2 Circuit

DTC B0424

Range/Performance

DTC B3761

Air Flow Control 3 Feedback Circuit

DTC B3770

Air Flow Control 6 Feedback Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
	DTC B0229, DTC B0414, DTC B0424, DTC B3761,		DTC B0229, DTC B0414, DTC B0424, DTC B3761,	

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

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Mode Low Reference Circuit	-	B3770	-	-
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Circuit/System Description

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

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

The control circuit is deactivated for the appropriate actuator.

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

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

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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

Circuit/System Testing

1. Ignition OFF, disconnect the appropriate actuator and test for less than 1 ohm between the low reference circuit and ground.
 - If greater than 1 ohm, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the HVAC control module.
2. Ignition ON, test for 4.8-5.2 volts between the 5-volt reference circuit and ground.
 - If less than 4.8 volts, test the 5-volt reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the HVAC control module.
 - If greater than 5.2 volts, test the 5-volt reference circuit for a short to voltage. If the circuit tests normal, replace the HVAC control module.
3. Verify the appropriate scan tool parameter is less than 4 counts.
 - If greater than 4 counts, test the signal circuit for a short to ground. If the circuit tests normal, replace the HVAC control module.
4. Install a 3-amp fused jumper wire between the signal circuit and the low reference circuit terminal. Verify the appropriate scan tool parameter is greater than 250 counts.
 - If less than 250 counts, test the signal circuit for a short to voltage or an open/high resistance. If the

circuit tests normal, replace the HVAC control module.

5. Ignition ON, verify that a test lamp illuminates between the ignition 3 circuit and ground.
 - If the test lamp does not illuminate, test the ignition 3 circuit for a short to ground an open/high resistance.
6. Install a DMM between the actuator control circuit and ground. While monitoring the DMM use the scan tool to command the appropriate actuator from one direction to the other. If the voltage on the control circuit moves from 0 volts in one direction to 5 volts in the other direction and 2.5 volts in the at rest state.
 - If the voltage does not change, test the control circuit for an open, short to voltage or short to ground. If circuit tests normal replace the HVAC control module.
7. If all circuits test normal, replace the actuator.

Repair Procedures

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

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

DTC P0530

Diagnostic Instructions

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

DTC Descriptors

DTC P0530

Air Conditioning Refrigerant Pressure Sensor Circuit

Diagnostic Fault Information

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

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Low Reference Circuit	-	P0530	-	-
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Circuit/System Description

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Diagnostic Aids

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

Reference Information

Schematic Reference

HVAC Schematics

Description and Operation

- **Air Delivery Description and Operation**

- **Air Temperature Description and Operation**

Electrical Information Reference

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

Scan Tool Reference

Control Module References for Scan Tool Information

Circuit/System Verification

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

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the A/C pressure sensor.
2. Ignition OFF, test for less than 1 ohm of resistance between the low reference circuit terminal 1 and ground.
 - If greater than 1 ohm, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the ECM.
3. Ignition ON, test for 4.8-5.2 volts between the 5-volt reference circuit terminal 2 and ground.
 - If less than 4.8 volts, test the 5-volt reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the ECM.
 - If greater than 5.2 volts, test the 5-volt reference circuit for a short to voltage. If the circuit tests normal, replace the ECM.
4. Verify the scan tool A/C High Side Pressure Sensor parameter is less than 428 psi.
 - If greater than 428 psi, test the signal circuit terminal 3 for a short to voltage. If the circuit tests normal, replace the ECM.
5. Install a 3-amp fused jumper wire between the signal circuit terminal 3 and the 5-volt reference circuit terminal 2. Verify the scan tool A/C High Side Pressure Sensor parameter is greater than 428 psi.
 - If less than 428 psi, test the signal circuit for short to ground or an open/high resistance. If the circuit tests normal, replace the ECM.
6. If all circuits test normal, test or replace the A/C Pressure Sensor.

Repair Procedures

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

- **Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement**

- **Control Module References** for ECM replacement, setup, and programming

SYMPTOMS - HVAC SYSTEMS - MANUAL

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

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

Visual/Physical Inspection

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

Intermittent

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

Symptom List

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

- **Air Conditioning Compressor Malfunction**
- **Blower Motor Malfunction**
- **Leak Testing**

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- Noise Diagnosis - HVAC Module
- Noise Diagnosis - Blower Motor
- Odor Diagnosis

AIR CONDITIONING COMPRESSOR MALFUNCTION

Diagnostic Instructions

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

Diagnostic Fault Information

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

Circuit/System Description

When the A/C switch is pressed, the HVAC control module grounds the A/C request signal circuit. This input will request the ECM to ground the A/C compressor clutch relay control circuit, which will switch the A/C COMPRESSOR CLUTCH relay on. With the relay contacts closed, battery voltage is supplied to the A/C compressor clutch assembly.

Diagnostic Aids

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

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

- ECM does not detect insufficient idle quality
- The ambient temperature is above 1°C (34°F)

Reference Information**Schematic Reference****HVAC Schematics****Connector End View Reference****Component Connector End Views****Description and Operation**

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

Electrical Information Reference

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

Scan Tool Reference**Control Module References** for scan tool information**Circuit/System Verification**

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

Circuit/System Testing

1. Ignition OFF, disconnect the X2 harness connector at the HVAC control module.
2. Test for less than 1.0 ohm of resistance between the ground circuit terminal and ground.
 - If greater than the specified, test the ground circuit for an open/high resistance.
3. Remove the A/C compressor clutch relay.
4. Verify that a test lamp illuminates between the relay coil B+ circuit terminal 85 and ground.

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

Repair Procedures

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

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

BLOWER MOTOR MALFUNCTION

Diagnostic Instructions

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
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HVAC BLOWER HIGH Relay Control	1	1	2	-
Relay Controlled Output	1, 2	1	1, 2	-
Blower Motor Resistor Assembly Output	1	1	2	-
HVAC BLOWER HIGH Relay Ground	-	1	1	-
Blower Motor Ground	-	1	1	-
1. Blower Motor Inoperative 2. Blower Motor Always On				

Circuit/System Description

The HVAC control module applies voltage to the blower motor control circuit that corresponds to the selected blower speed. The resistors and the blower motor are in a series circuit. The following list represents the number of resistors in series with the blower motor per particular speed request:

- Low speed - 4 resistors
- Medium 1 speed - 3 resistors
- Medium 2 speed - 2 resistors
- Medium 3 speed - 1 resistor

When the operator requests High speed, the HVAC control module applies voltage to the blower motor relay through the high blower motor control circuit. The voltage energizes the blower motor relay, connecting the blower motor to battery positive voltage.

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

Listen to the function of the blower motor while commanding the blower motor speed from Off through to the High speed positions using the blower motor switch, the blower motor speed should increase and decrease speeds when changing between the speed positions.

- If the blower motor speed does not change, refer to Blower Motor Malfunction.

Circuit/System Testing

Blower Motor Malfunction

1. Ignition OFF, disconnect the harness connector at the blower motor resistor assembly.
2. While changing the fan speed switch between the Low, M1, M2, M3 and High positions, verify that a test lamp illuminates between ground and the appropriate blower motor control circuit terminals listed below:
 - Low terminal D
 - M1 terminal C
 - M2 terminal B
 - M3 terminal A
 - High terminal F
 - If the test lamp does not illuminate, test the appropriate control circuit for a short to ground or an open/high resistance.
3. Ignition OFF, connect the harness connector at the blower motor resistor assembly and disconnect the blower motor.
4. Ignition ON, connect a test lamp between the blower motor control circuit terminal A and the blower motor ground circuit terminal B.
5. Cycle the fan speed switch between the Low, M1, M2, M3 and High positions. 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 resistor assembly.
 - 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 resistor assembly.
6. If all circuits test normal, test or replace the blower motor.

Component Testing

Blower Motor Test

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

Relay Test

1. Ignition OFF, disconnect the HVAC BLOWER HIGH relay.
2. Test for 60-200 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 less than infinite resistance, replace the relay.
4. Test for less than 2 ohms between terminals 30 and 87A.
 - If greater than 2 ohms, replace the relay.
5. Install a 3-amp fused jumper wire between relay terminal 85 and 12 volts. Install a jumper wire between relay terminal 86 and ground. Measure for less than 2 ohms between terminals 30 and 87.
 - If greater than 2 ohms, replace the relay.

Repair Procedures

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

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

AIR RECIRCULATION 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

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Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Recirculation Actuator Ignition	1	1	-	-
Recirculation Actuator Control	1	1	1	-
Recirculation Actuator Ground	-	1	1	-

1. Recirculation Actuator Inoperative

Circuit/System Description

The recirculation actuator is a 3-wire bi-directional electric motor. Ignition 3 voltage, ground and control circuits enable the actuator to operate. The control circuit uses a 0-12 volts linear-ramped signal to command the actuator movement. The 0 and 12-volt control values represent the opposite limits of the actuator range of motion. The values in between 0 and 12 volts correspond to the positions between the limits.

When the HVAC control assembly sets a commanded, or targeted, value, the control signal is set to a value between 0-12 volts. The actuator shaft rotates until the commanded position is reached. The module will maintain the control value until a new commanded value is needed.

Diagnostic Aids

Inspect the recirculation door and the recirculation actuator for the following conditions:

- A misaligned recirculation actuator.
- Broken or binding linkages or recirculation door.
- An obstruction that prevents the recirculation door from operating within its full range of motion.
- Missing seals to the recirculation door.
- Misaligned seals to the recirculation door.

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, place the blower motor switch at the maximum speed position and the mode switch in the vent or panel position.
2. Press the recirculation control switch from the recirc position to the outside air position. The recirculation actuator should follow the commanded states of recirc to outside air.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the recirculation actuator.
2. Test for less than 1.0 ohm between the recirculation actuator ground circuit terminal 7 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 recirculation actuator ignition circuit terminal 5 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, replace the recirculation actuator.
4. Install a DMM between the control circuit terminal 6 and ground. Command the actuator in each direction. Voltage on the control circuit should change from 0 volts when commanding the actuator in one direction to 12 volts in the other direction.
 - If the voltage does not change as specified, replace the HVAC control module.
5. If all circuits test normal, test or replace the recirculation actuator.

Repair Procedures

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

- **Recirculation Door Replacement**
- **Control Module References** for HVAC replacement, setup, and programming

AMBIENT AIR TEMPERATURE DISPLAY UPDATING

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

ambient air temperature display on the HVAC control module, perform the following procedure:

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

ACTUATOR RECALIBRATION

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

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

1. Place the ignition switch to the OFF position.
2. Disconnect the scan tool.
3. Install the HVAC control module.
4. Connect all previously disconnected components.
5. Start the vehicle.
6. Wait 40 seconds for the HVAC control module to self-calibrate.
7. Verify that no DTCs have set as current DTCs.

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

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

Preferred Method (w/ Scan Tool)

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

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

result.

Alternate Method (w/o Scan Tool)

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

REPAIR INSTRUCTIONS

HVAC CONTROL MODULE REPLACEMENT

Removal Procedure

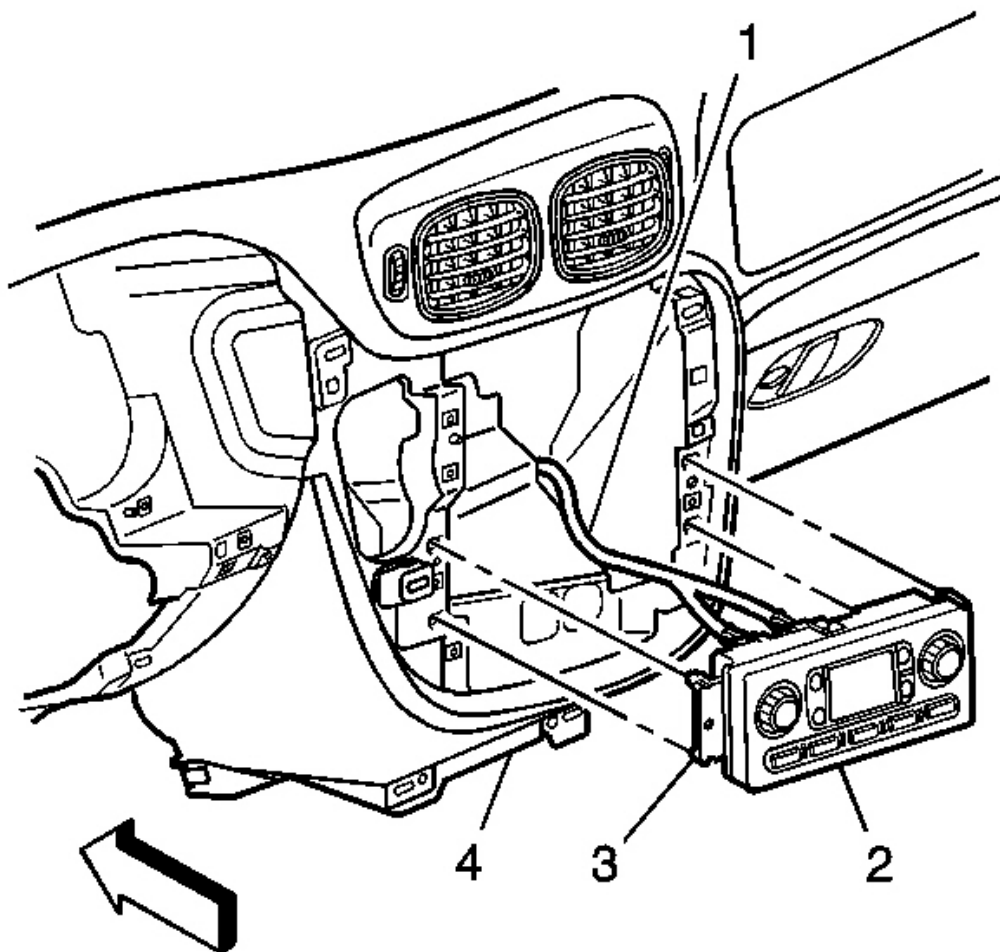


Fig. 5: View Of HVAC Control Module
Courtesy of GENERAL MOTORS CORP.

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

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

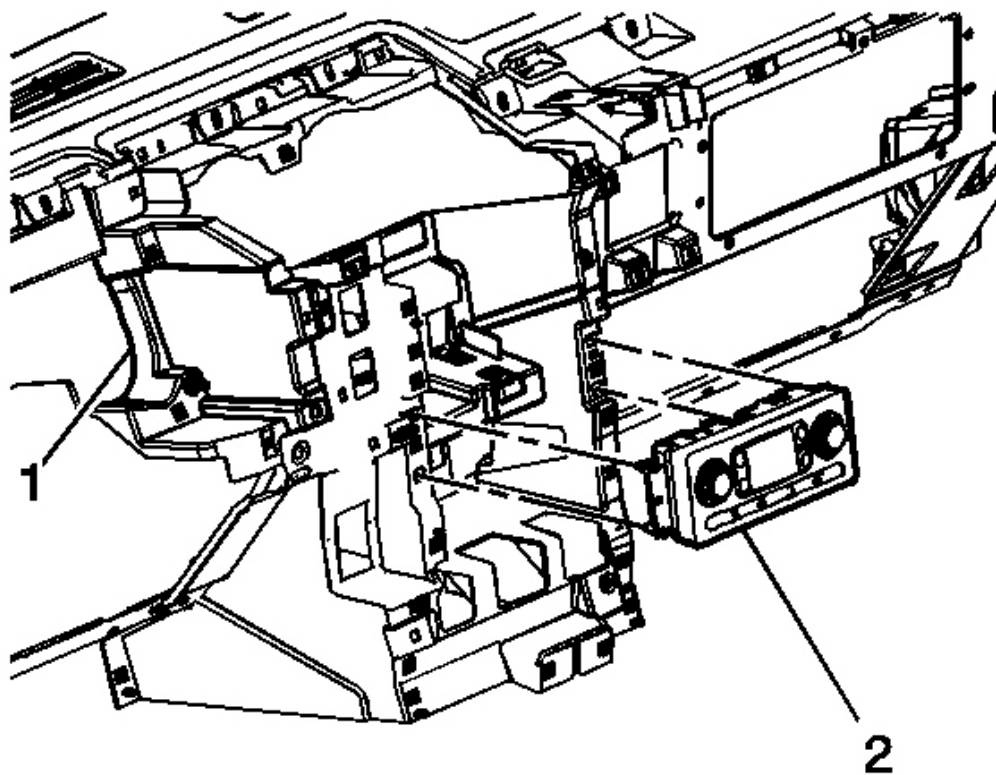


Fig. 6: View Of HVAC Control Module & I/P Panel
Courtesy of GENERAL MOTORS CORP.

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

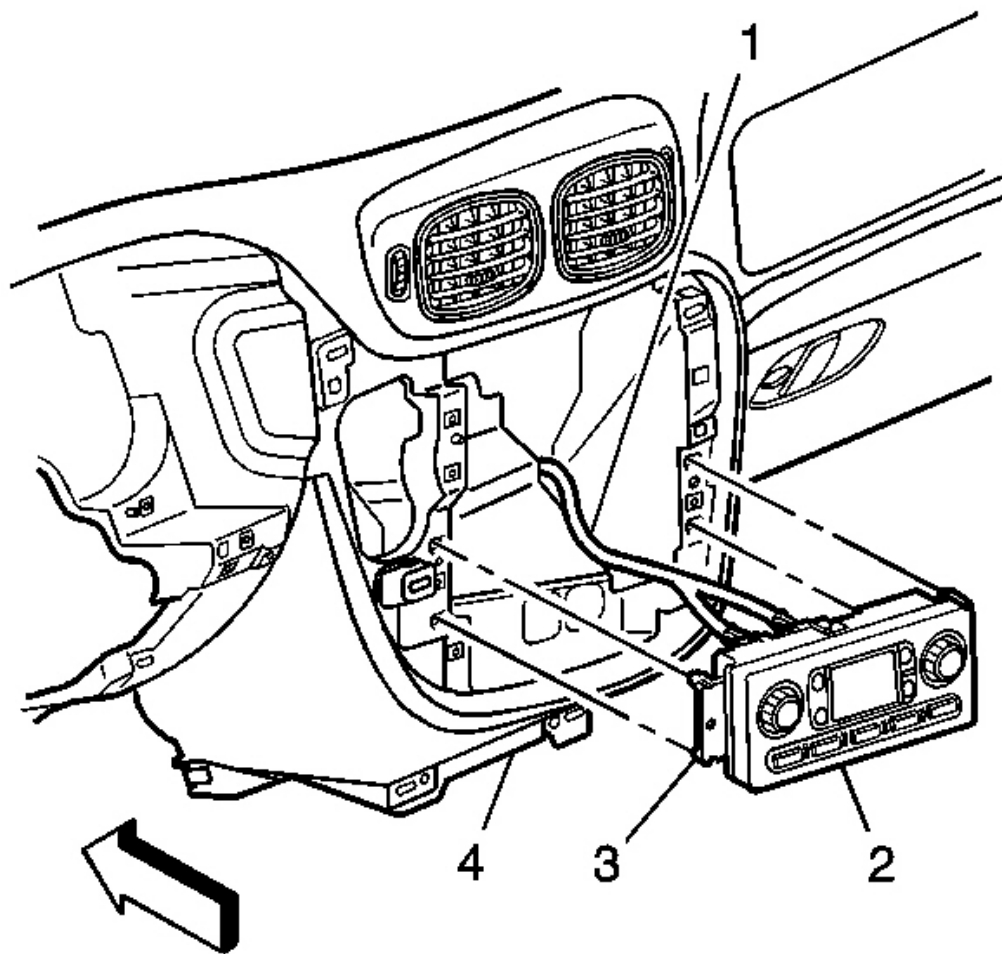


Fig. 7: View Of HVAC Control Module
Courtesy of GENERAL MOTORS CORP.

2. Install the HVAC control module (2) to the instrument panel (4), ensuring that the HVAC control module retaining tabs (3) lock into place.

NOTE: Refer to Fastener Notice .

3. Install the HVAC control module retaining screws.

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

4. Install the I/P accessory trim plate. Refer to Instrument Panel Accessory Trim Plate Replacement

(GMC) or Instrument Panel Cluster Trim Plate Bezel Replacement (Chevrolet) or Instrument Panel Cluster Trim Plate Bezel Replacement (GMC, Buick) .

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 let run for 1 minute.

AIR TEMPERATURE ACTUATOR REPLACEMENT - RIGHT SIDE

Removal Procedure

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

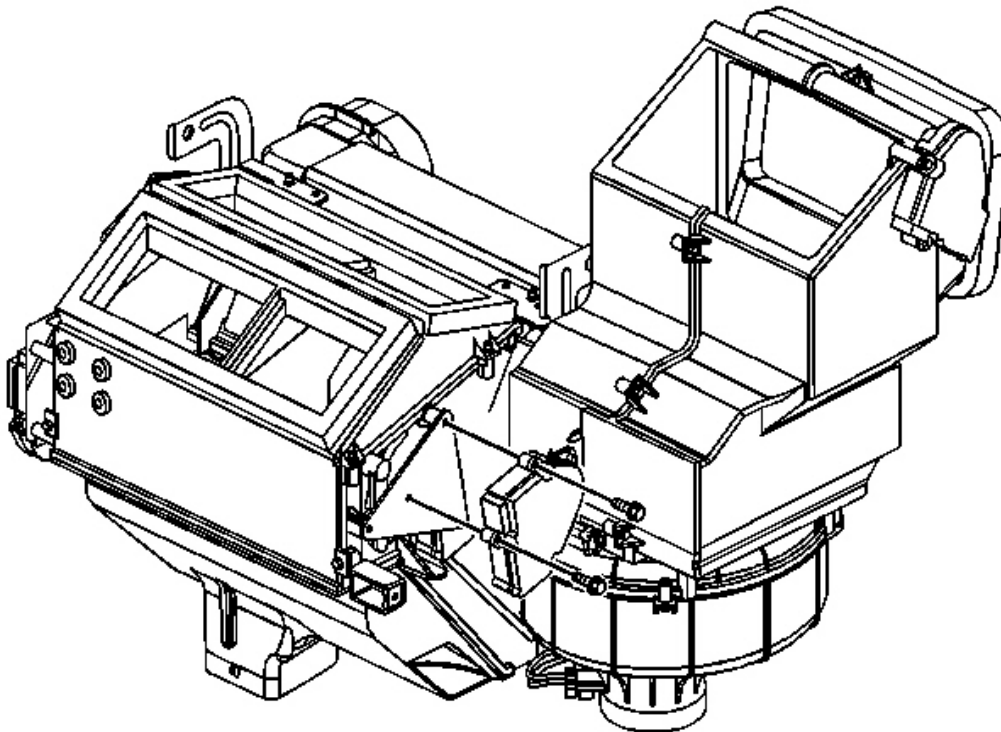


Fig. 8: View Of HVAC Module
Courtesy of GENERAL MOTORS CORP.

2. Remove the right side air temperature actuator retaining screws.

3. Disconnect the right side air temperature actuator electrical connector.
4. Remove the right side air temperature actuator.

Installation Procedure

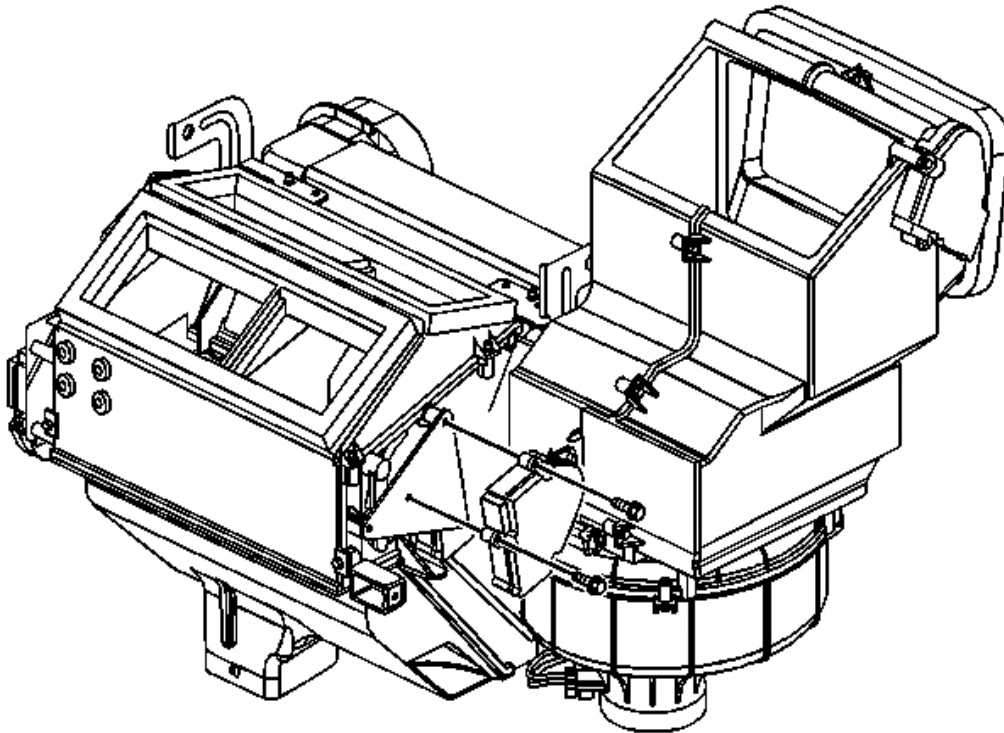


Fig. 9: View Of HVAC Module
Courtesy of GENERAL MOTORS CORP.

1. Install the right side air temperature actuator.

NOTE: Refer to Fastener Notice.

2. Install the right side air temperature actuator retaining screws.

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

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

5. Recalibrate the air temperature actuator on vehicles equipped with automatic climate control (C68). Refer to **Actuator Recalibration** .

AIR TEMPERATURE ACTUATOR REPLACEMENT - LEFT SIDE

Removal Procedure

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

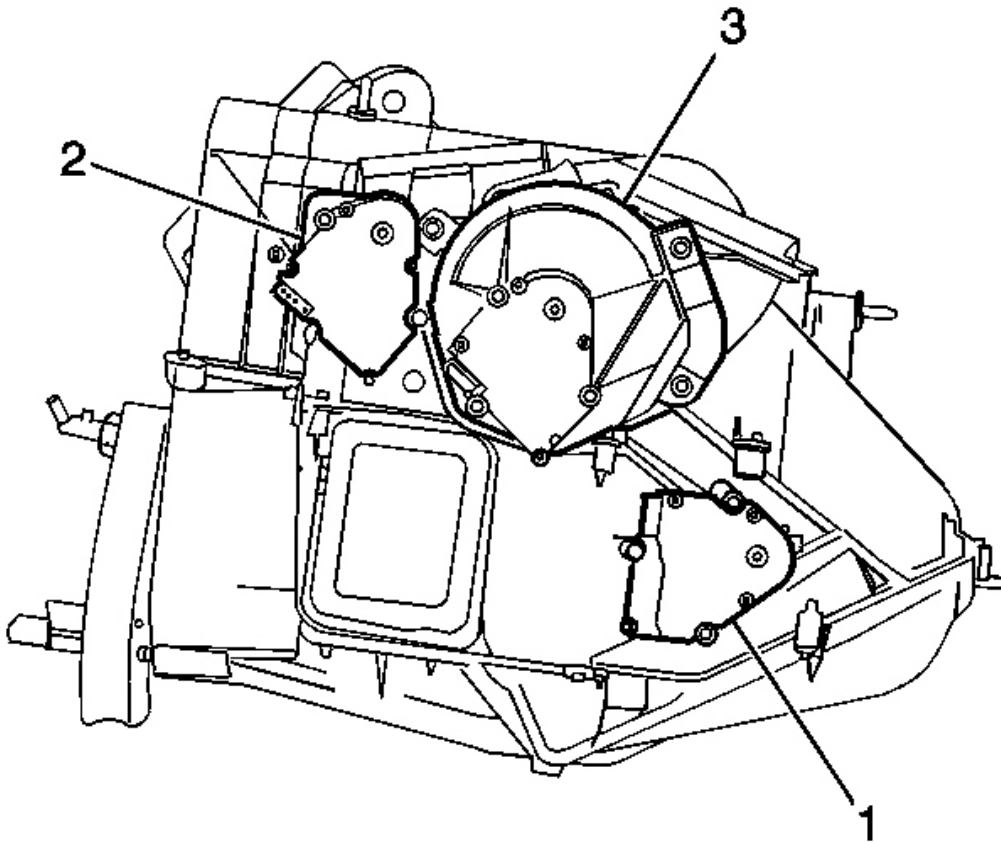


Fig. 10: Identifying Mode & Air Temperature Actuator
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

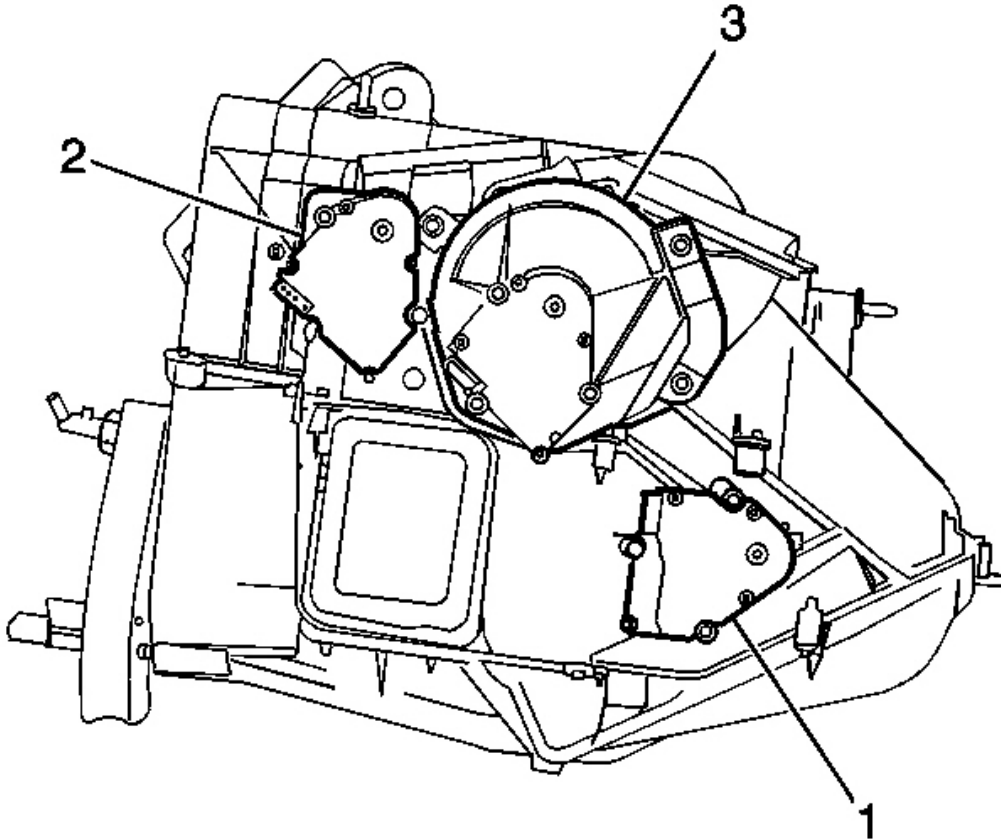


Fig. 11: Identifying Mode & Air Temperature Actuator
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Refer to Fastener Notice .

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

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

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

Actuator Recalibration .

DEFROSTER ACTUATOR REPLACEMENT

Removal Procedure

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

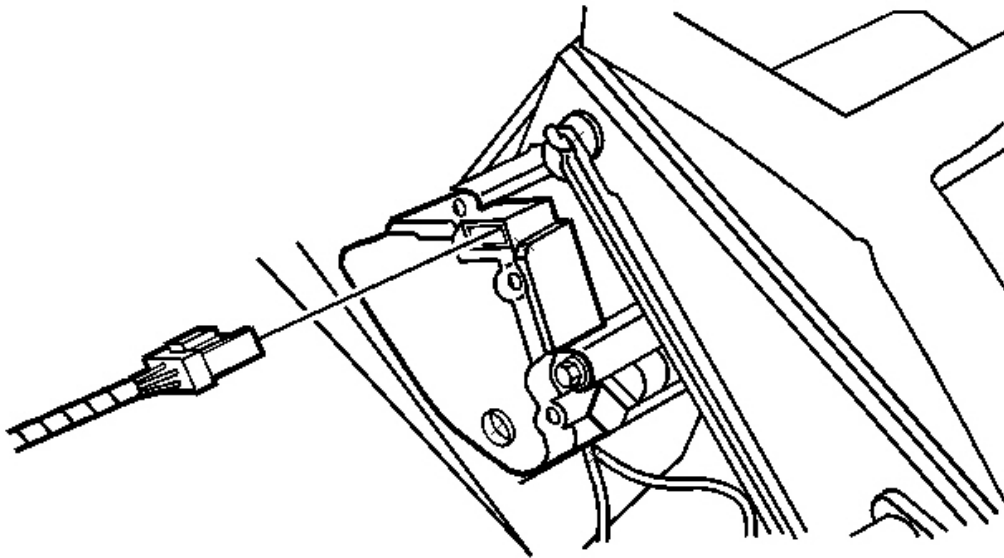


Fig. 12: Locating Actuator Connector
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

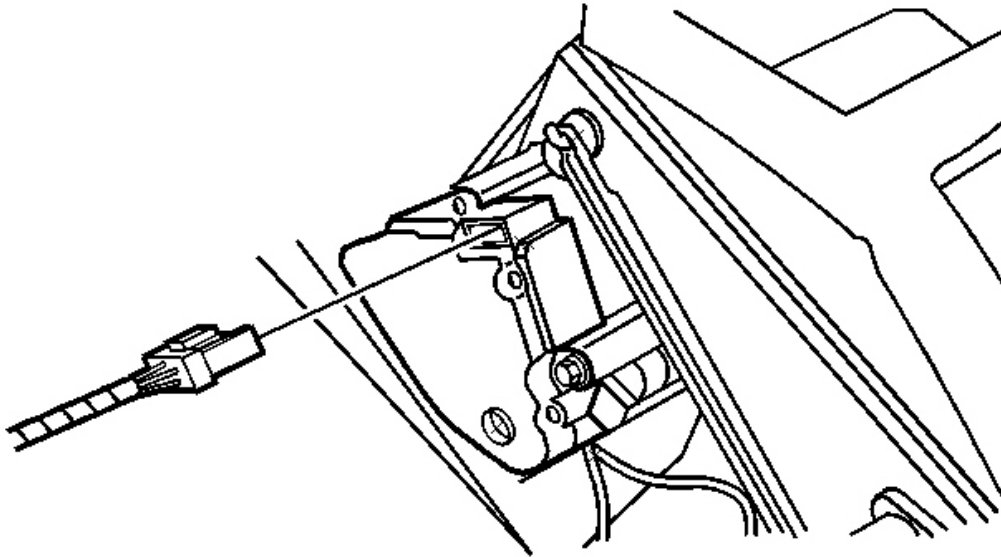


Fig. 13: Locating Actuator Connector
Courtesy of GENERAL MOTORS CORP.

1. Install the defroster actuator.

NOTE: Refer to Fastener Notice .

2. Install the defroster actuator screws.

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

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

MODE ACTUATOR REPLACEMENT

Removal Procedure

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

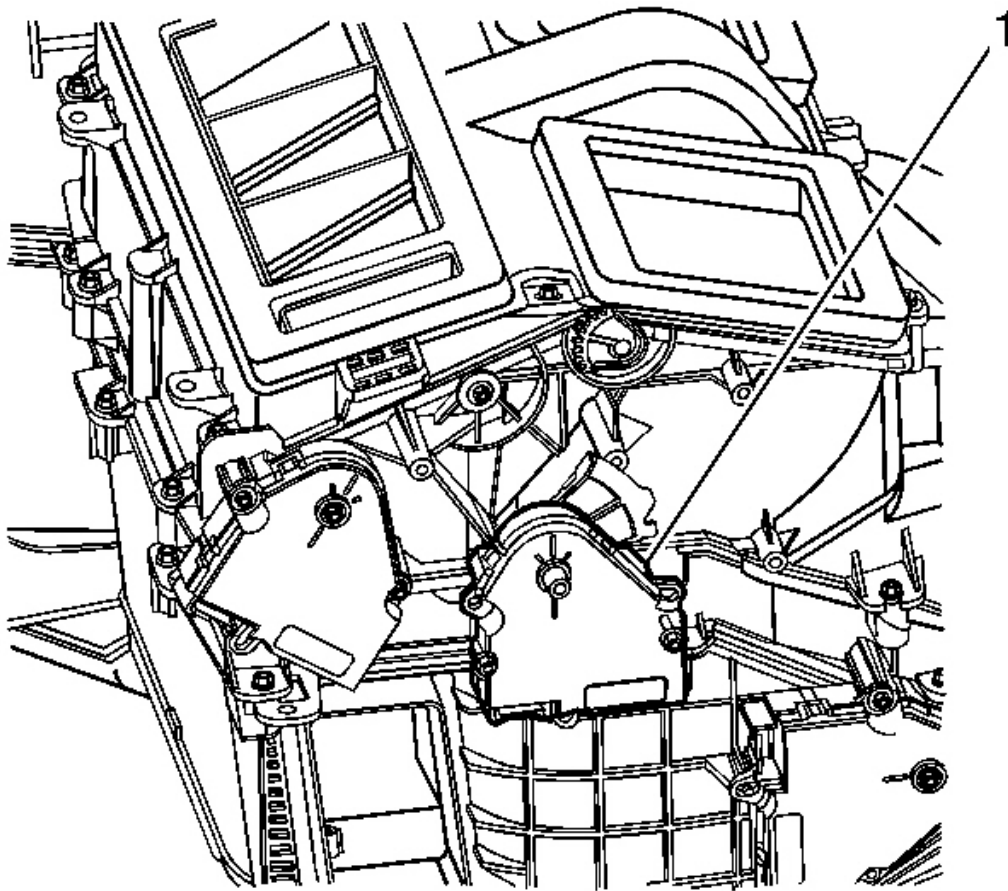


Fig. 14: Identifying Mode Actuator
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

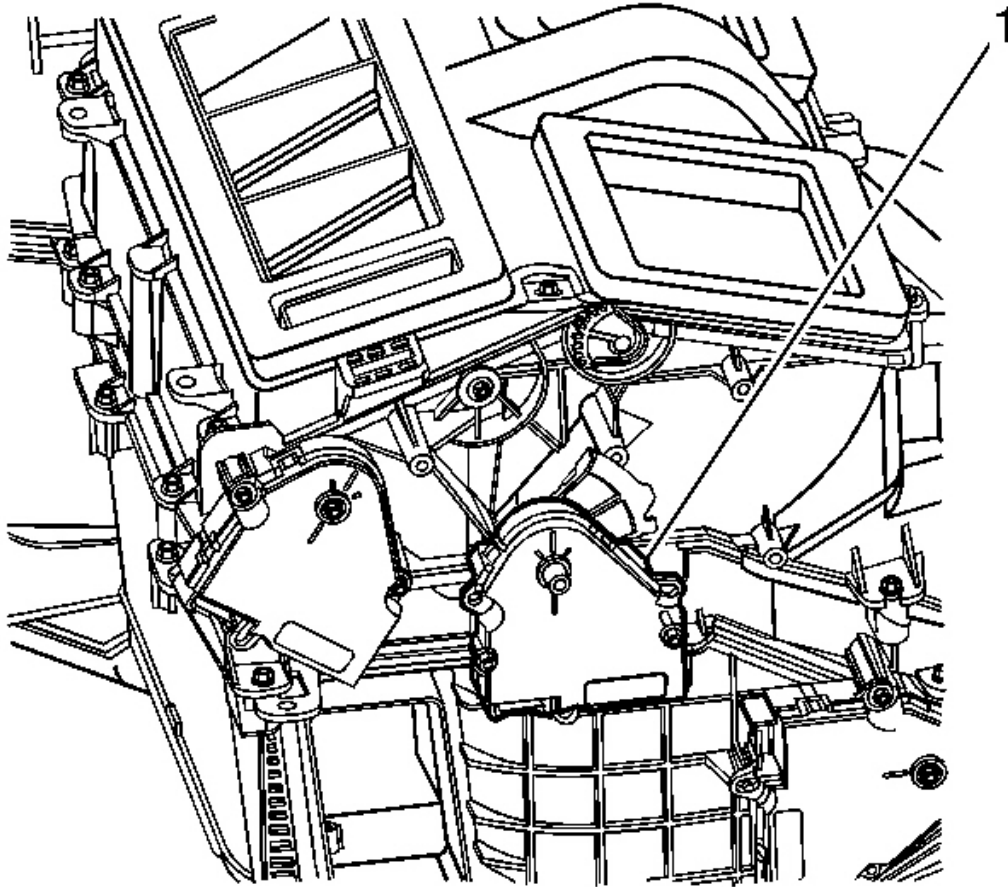


Fig. 15: Identifying Mode Actuator

Courtesy of GENERAL MOTORS CORP.

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

1. Install the mode actuator (1).

NOTE: Refer to Fastener Notice .

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

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

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

RECIRCULATION ACTUATOR REPLACEMENT

Removal Procedure

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

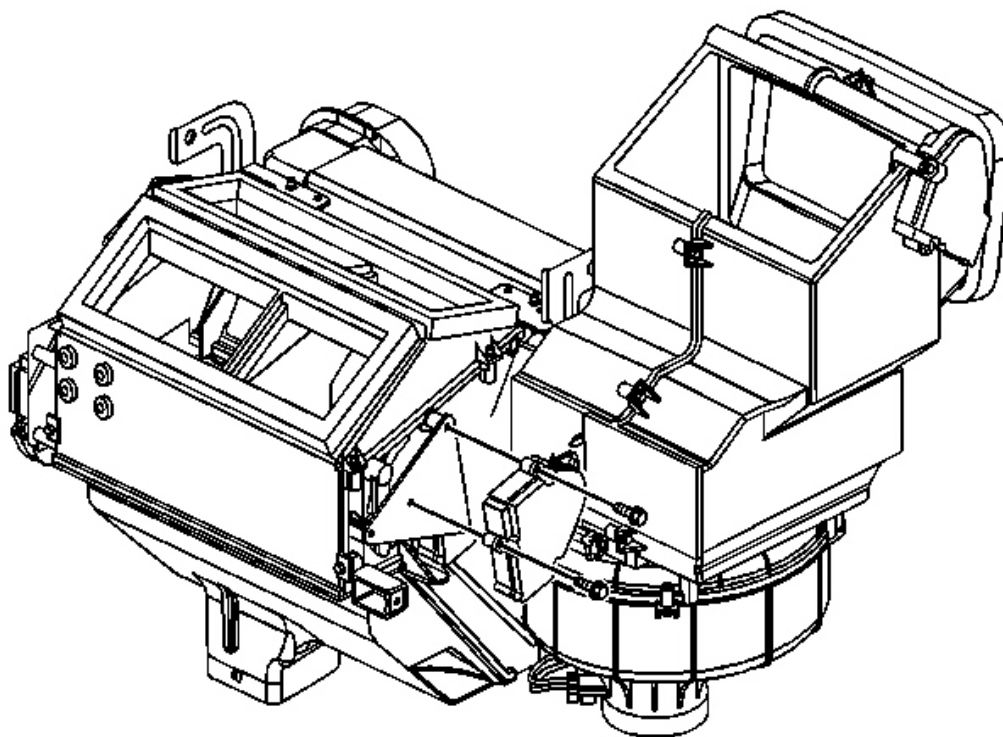


Fig. 16: View Of HVAC Module
Courtesy of GENERAL MOTORS CORP.

3. Remove the air inlet assembly.
4. Remove the recirculation actuator screws.
5. Remove the electrical connector from the recirculation actuator.

6. Remove the recirculation actuator.

Installation Procedure

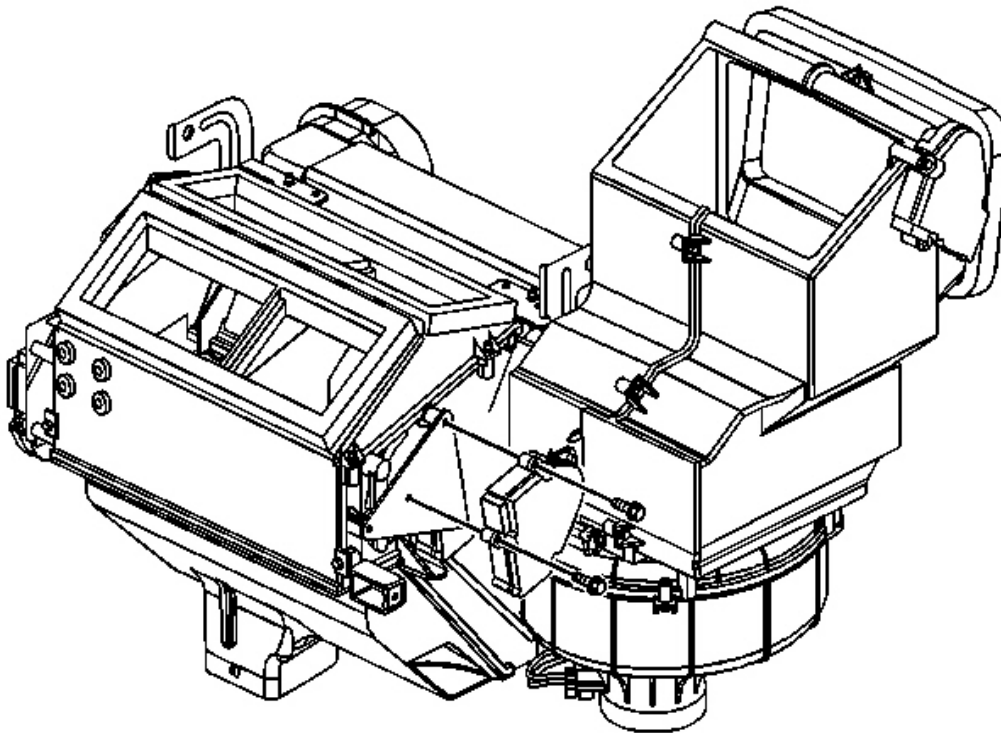


Fig. 17: View Of HVAC Module
Courtesy of GENERAL MOTORS CORP.

1. Install the recirculation actuator.

NOTE: Refer to Fastener Notice .

2. Install the screws to the recirculation actuator.

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

3. Install the air inlet assembly.
4. Install the air inlet assembly screws.

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

5. Connect the electrical connector to the recirculation actuator.
6. Install the HVAC module assembly. Refer to **HVAC Module Assembly Replacement** .
7. Recalibrate the recirculation actuator. Refer to **Actuator Recalibration**

AUXILIARY HEATER & AIR CONDITIONING CONTROL MODULE REPLACEMENT

Removal Procedure

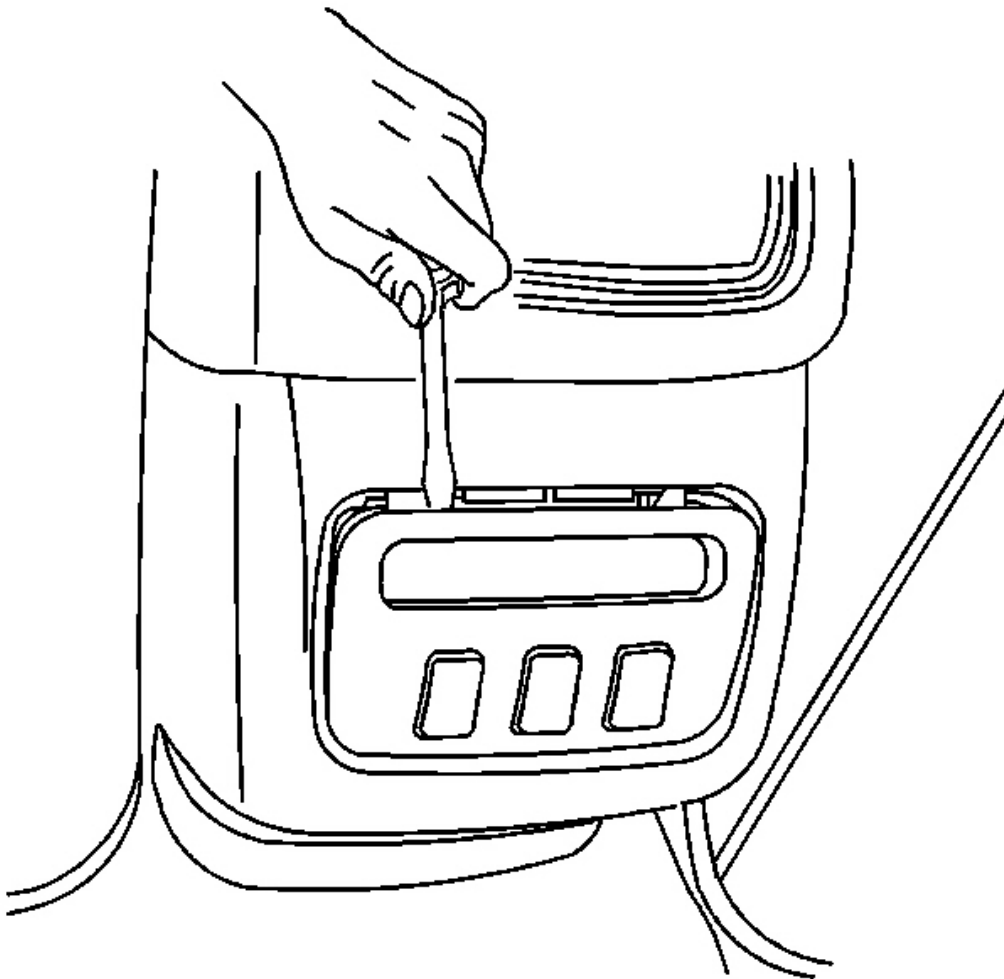


Fig. 18: View Of Flat Bladed Tool & Auxiliary HVAC Control Module
Courtesy of GENERAL MOTORS CORP.

1. Using a flat bladed tool, carefully pry out on the top of the HVAC control-auxiliary.

2. Remove the HVAC control-auxiliary from the center console/seat.

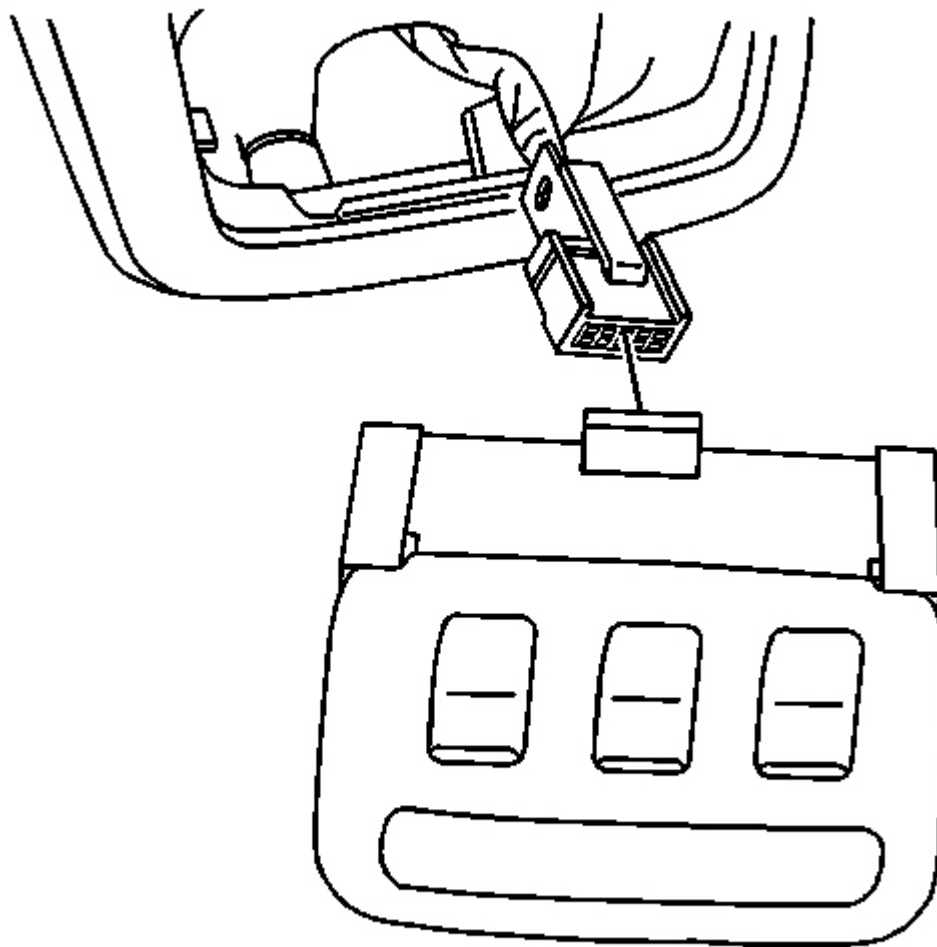


Fig. 19: View Of HVAC Control-Auxiliary Electrical Connector
Courtesy of GENERAL MOTORS CORP.

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

Installation Procedure

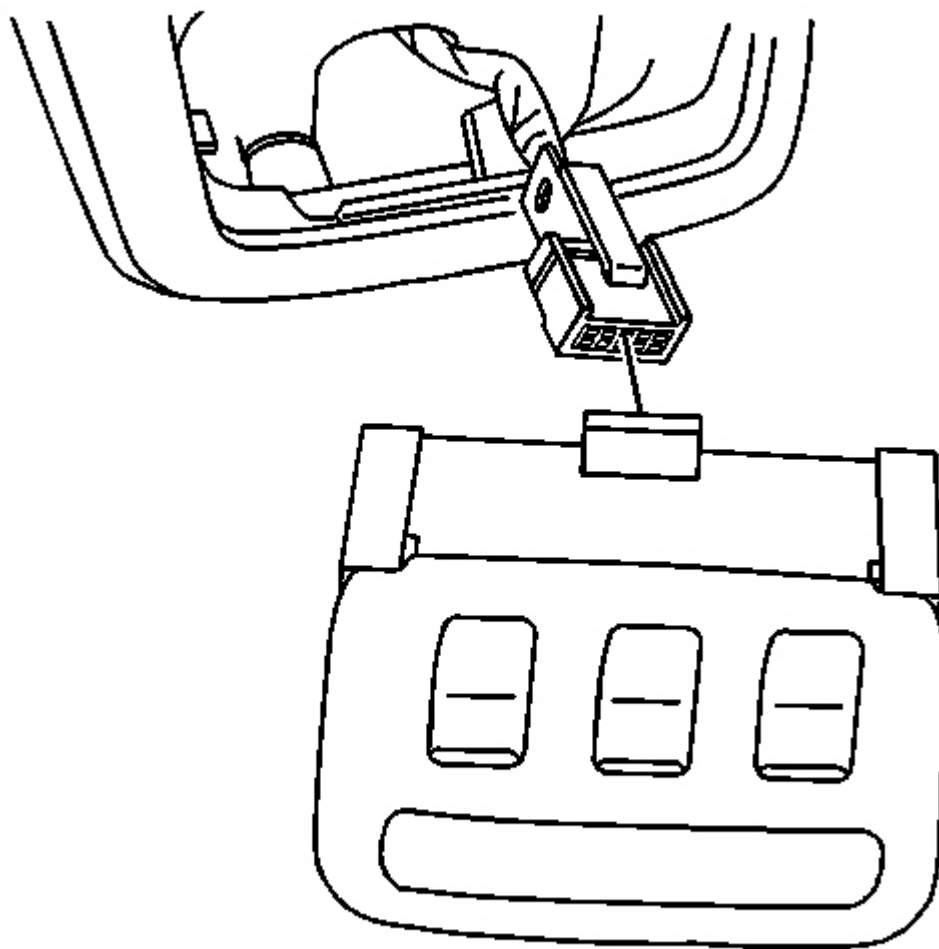


Fig. 20: View Of HVAC Control-Auxiliary Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Connect the rear HVAC control-auxiliary electrical connector.

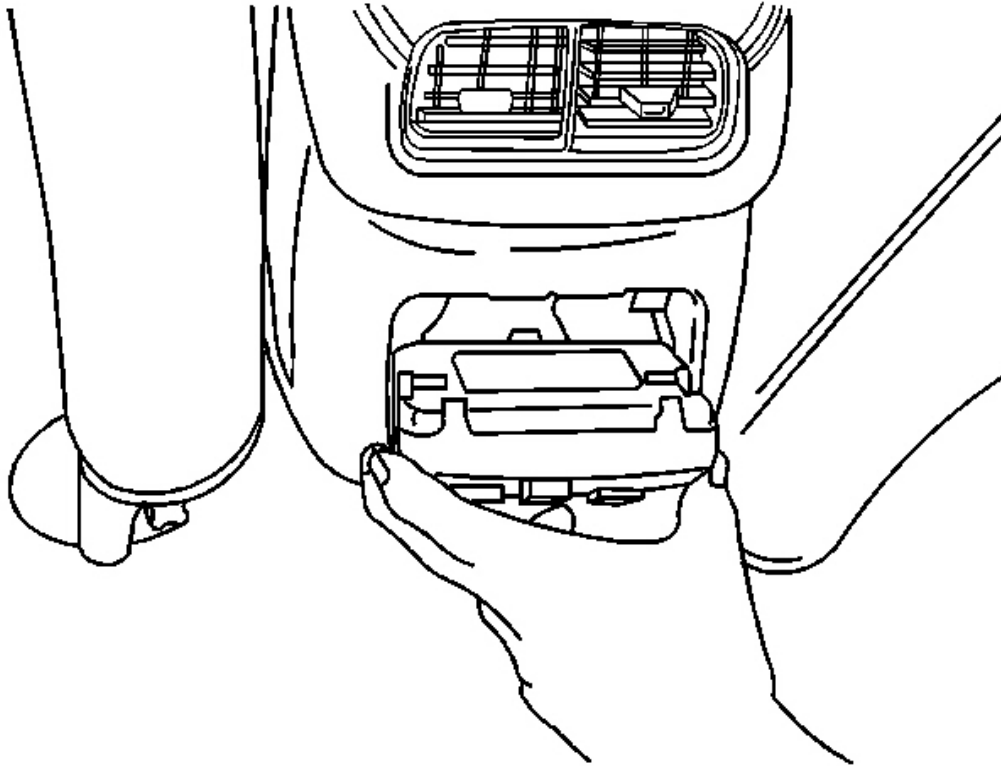


Fig. 21: Installing Control Bottom First
Courtesy of GENERAL MOTORS CORP.

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

MODE ACTUATOR REPLACEMENT - CONSOLE

Removal Procedure

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

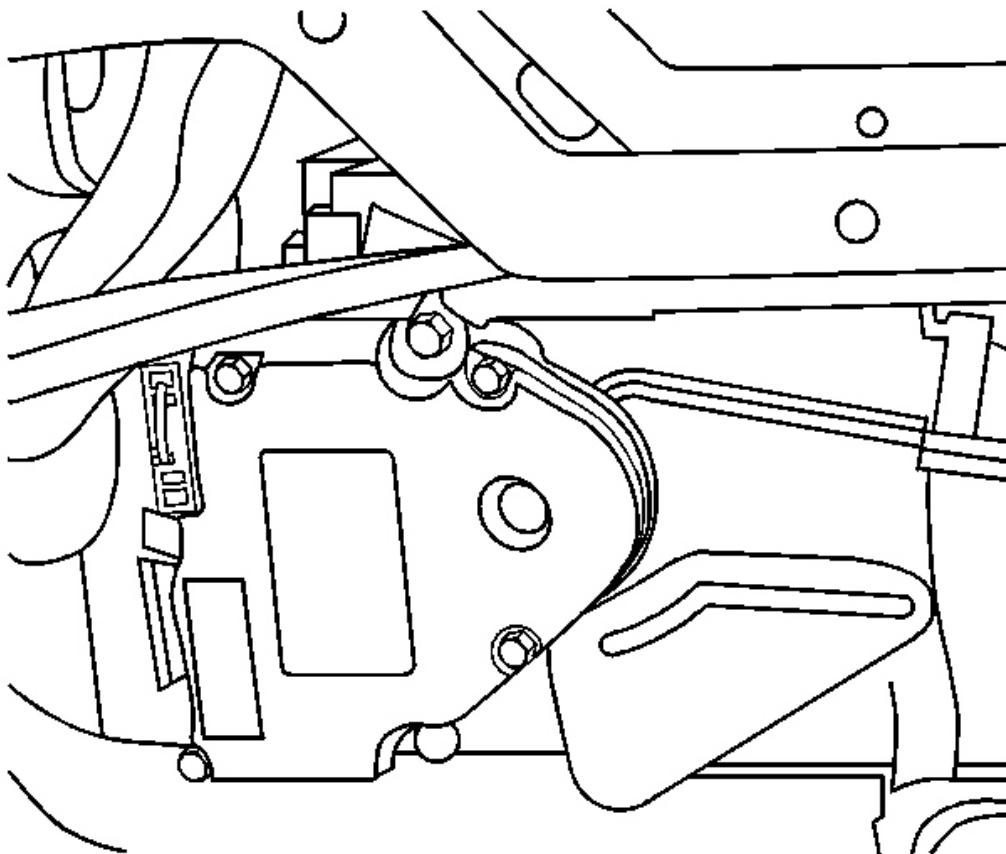


Fig. 22: View of Auxiliary Mode Actuator Screws
Courtesy of GENERAL MOTORS CORP.

5. Remove the rear mode actuator retaining screws.
6. Disconnect the electrical connector.

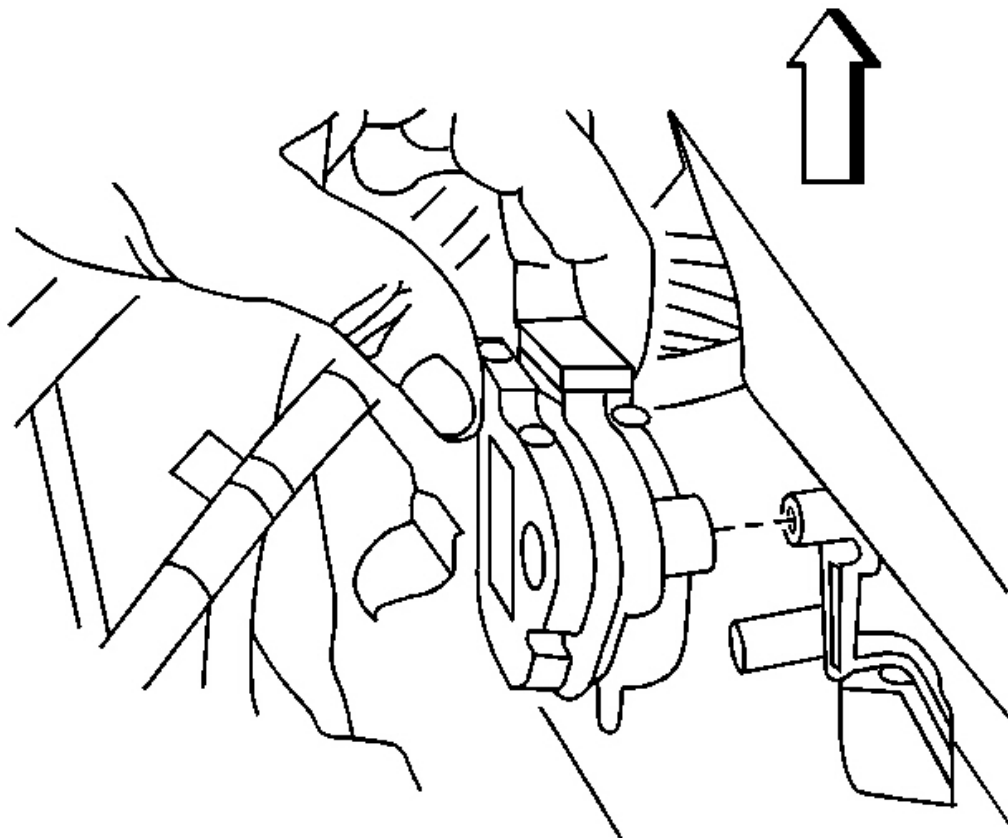


Fig. 23: View Of Actuator Assembly
Courtesy of GENERAL MOTORS CORP.

7. Remove the rear mode actuator.

Installation Procedure

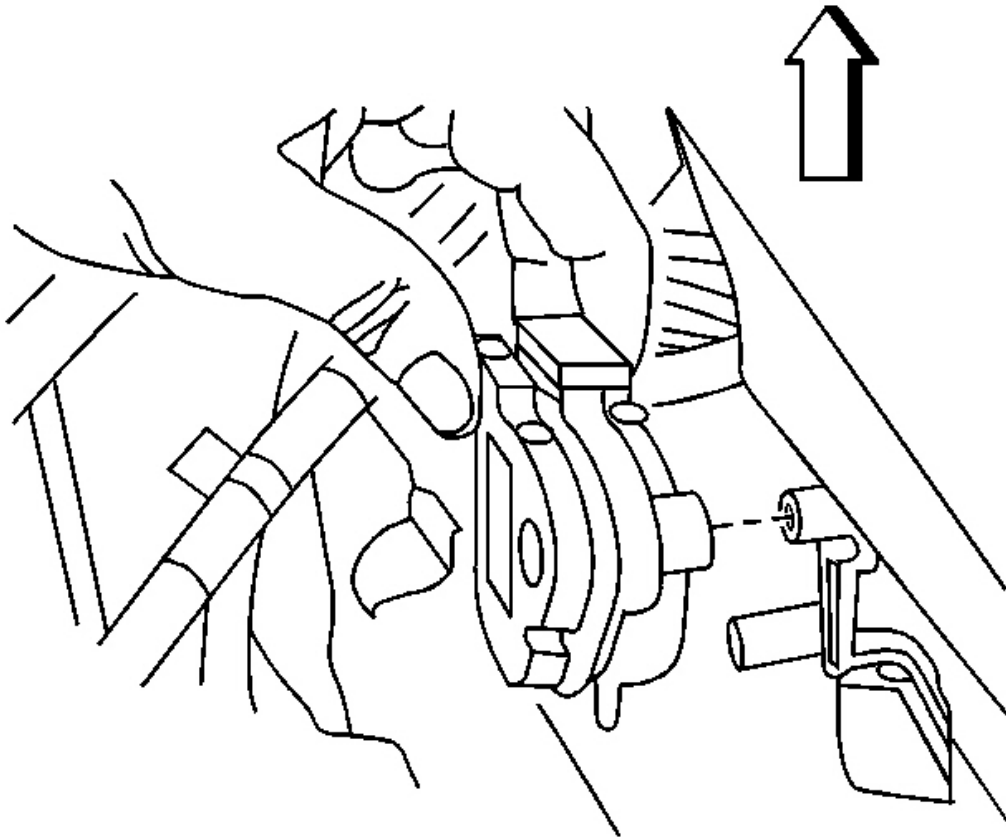


Fig. 24: View Of Actuator Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the mode actuator.
2. Connect the electrical connector.

NOTE: Refer to Fastener Notice .

3. Install the screws to the mode actuator.

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

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

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

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

DESCRIPTION & OPERATION

AIR DELIVERY DESCRIPTION & OPERATION

The air delivery description and operation is divided into 6 areas:

- HVAC Control Components
- Air Speed
- Auxiliary Air Speed
- Air Delivery
- Auxiliary Air Delivery
- 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 body control module (BCM), which is the vehicle mode master, provides a device on signal. The control module supports the following features:

Feature	Availability
Afterblow	No
Purge	No
Personalization	No
Actuator Calibration	Yes

Auxiliary HVAC Control Module

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

Defrost Actuator

The defrost actuator is a 5 wire bi-directional electric motor that incorporates a feedback potentiometer. Ignition 3 voltage, low reference, control, 5 volt reference and position signal circuits enable the actuator to operate. The

control circuit uses either a 0, 2.5 or 5 volt signal to command the actuator movement. When the actuator is at rest, the control circuit value is 2.5 volts. A 0 or 5 volt control signal commands the actuator movement in opposite directions. When the actuator shaft rotates, the potentiometer's adjustable contact changes the door position signal between 0-5 volts.

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

Mode Actuator

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

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

Auxiliary Mode Actuator

The auxiliary mode actuator is a 5 wire bi-directional electric motor that incorporates a feedback potentiometer. Low reference, 5 volt reference, position signal, and 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 auxiliary HVAC control module grounds one of the control circuits while providing the other with 12 volts. The control module reverses the polarity of the control circuits to move the actuator in the opposite direction. When the actuator shaft rotates, the potentiometer's adjustable contact changes the door position signal between 0-5 volts.

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

Auxiliary Console Mode Actuator

The auxiliary console mode actuator is a 5 wire bi-directional electric motor that incorporates a feedback potentiometer. Low reference, 5 volt reference, position signal, and 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 auxiliary

HVAC control module grounds one of the control circuits while providing the other with 12 volts. The control module reverses the polarity of the control circuits to move the actuator in the opposite direction. When the actuator shaft rotates, the potentiometer's adjustable contact changes the door position signal between 0-5 volts.

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

Air Speed - Front Control

The blower motor forces outside air into the vehicle's interior. The vehicle operator determines the blower motor's speed when the driver places the blower switch in one of 5 blower speeds. The blower motor will always operate in any switch 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. The blower motor OFF input is connected in series with the HVAC control module by the off blower motor control circuit.

Depending upon the selected speed, power is provided to the blower motor from either the ignition 3 voltage or battery positive voltage circuits from the fuse block. The battery positive voltage circuit only provides power when the High blower switch position is selected. Power and ground are provided to the HVAC control module by the ignition 3 voltage and the ground circuits.

Low Blower Speed

When the Low 1 blower speed is selected, the HVAC control module applies voltage to the blower motor resistor assembly through the low blower motor control circuit. Voltage is divided between 4 series resistors, a blower relay, and the blower motor to achieve the desired blower speed. The blower motor is grounded through the ground circuit.

Medium Blower Speeds

When the Medium 1 blower speed is selected, the HVAC control module applies voltage to the blower motor resistor assembly through the medium 1 blower motor control circuit. Voltage is divided between 3 series resistors, a blower relay, and the blower motor to achieve the desired blower speed. The blower motor is grounded through the ground circuit.

When the Medium 2 blower speed is selected, the HVAC control module applies voltage to the blower motor resistor assembly through the medium 2 blower motor control circuit. Voltage is divided between 2 series resistors, a blower relay, and the blower motor to achieve the desired blower speed. The blower motor is grounded through the ground circuit.

When the Medium 3 blower speed is selected, the HVAC control module applies voltage to the blower motor resistor assembly through the medium 3 blower motor control circuit. Voltage is divided between a series resistor, a blower relay, and the blower motor to achieve the desired blower speed. The blower motor is grounded through the ground circuit.

High Blower Speed

When the High blower speed is selected, the HVAC control module applies voltage to the blower motor resistor assembly through the high blower motor control circuit. The voltage energizes the blower relay, causing the blower motor to be connected directly to the battery positive voltage circuit. The blower motor and blower motor relay are grounded through the ground circuit.

Air Speed - Auxiliary

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

Air Distribution

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

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

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

Mode Actuator

The mode actuator is an electronic stepper motor with feedback potentiometers. The HVAC control module sends signals to the mode door actuator through the mode door control circuit. Zero volts drives the actuator in one direction while 5-volts moves the actuator in the opposite direction. When the actuator receives 2.5 volts, the actuator rotation stops. A 5-volt reference signal is sent out over the 5-volt reference circuit to the mode

actuator. When you select a desired mode setting, logic determines the value of the mode actuator signals. The HVAC control module's software uses this reference voltage in order to determine the position of the mode actuator through the mode door position signal circuit. The motor moves the mode door to the desired position.

Defrost Actuator

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

Front Defrost

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

Air Distribution - Auxiliary Control

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

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

Recirculation Operation

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

AIR TEMPERATURE DESCRIPTION & OPERATION

The air temperature controls are divided into 5 areas:

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- HVAC Control Components
- Heating and A/C Operation
- Auxiliary 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 body control module (BCM), which is the vehicle mode master, provides a device on signal. The control module supports the following features:

Feature	Availability
Afterblow	No
Purge	No
Personalization	No
Actuator Calibration	Yes

Auxiliary HVAC Control Module - VIN 6

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

Air Temperature Actuator

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

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

Auxiliary Air Temperature Actuator - VIN 6

The auxiliary air temperature actuator is a 5-wire bi-directional electric motor that incorporates a feedback potentiometer. Low reference, 5-volt reference, position signal, and 2 control circuits enable the actuator to operate. The control circuits use either a 0 or 12 volt value to co-ordinate the actuator movement. When the actuator is at rest, both control circuits have a value of 0 volts. In order to move the actuator, the auxiliary HVAC control module grounds 1 of the control circuits while providing the other with 12 volts. The control module reverses the polarity of the control circuits to move the actuator in the opposite direction. When the actuator shaft rotates, the potentiometer's adjustable contact changes the door position signal between 0-5 volts.

The auxiliary HVAC control module uses a range of 0-255 counts to index the actuator position. The door position signal voltage is converted to a 0-255 count range. When the module sets a commanded, or targeted value, 1 of the control circuits is grounded. As the actuator shaft rotates the changing position signal is sent to the module. Once the position signal and the commanded value are the same, the module grounds both control circuits.

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 PCM converts the voltage signal to a pressure value.

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

A/C Low Pressure Switch

The A/C low pressure switch protects the A/C system from a low pressure condition that could damage the A/C compressor or cause evaporator icing. The HVAC control module applies 5 volts to the A/C low pressure switch signal circuit. The switch will open when the A/C low side pressure reaches 124 kPa (18 psi). This prevents the A/C compressor from operating. The switch will then close when A/C low pressure side reaches 275 kPa (40 psi). This enables the A/C compressor to turn back ON.

Coolant Bypass Valve

The coolant bypass valve controls coolant flow to the auxiliary heater core. Integral to the coolant bypass valve is an electric solenoid that controls vacuum flow to open and close the valve. When the HVAC control module applies 12 volts to the integral solenoid, the solenoid applies vacuum to a diaphragm that closes the water valve. This action restricts coolant flow to the auxiliary heater core. The coolant bypass valve is normally open to allow coolant flow.

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

temperature:

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

The manual HVAC system is a dual temperature zone system. There are 2 separate air temperature levers. Moving the air temperature levers to the upward position diverts most of the airflow through the heater core, which increases the outlet air temperature. Moving the air temperature levers to the most downward position diverts most of the airflow around the heater core, which decreases the outlet air temperature. The right air temperature actuator controls the duct air temperature flowing through the center console to the second row seating passengers. The air temperature offset can be as much as 16.7°C (30°F).

Pressing the A/C button enables the HVAC control module to request A/C compressor engagement and turn ON the A/C button LED. The HVAC control module sends a class 2 message to the PCM for A/C compressor engagement. The PCM will provide a ground for the A/C compressor relay enabling it to close its internal contacts to send battery voltage to the A/C compressor clutch coil. The A/C compressor diode will prevent a voltage spike, resulting from the collapse of the magnetic field of the coil, from entering the vehicle electrical system when the compressor is disengaged. Defrost and Defog mode selections will request A/C operation but not turn ON the A/C LED.

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

- Ambient air temperature above 1°C (35°F).
- A/C low pressure switch signal circuit is grounded.
- A/C refrigerant pressure sensor parameter is less than 2413 kPa (350 psi).
- A/C compressor temperature switch contacts are closed.
- PCM receives an A/C request from the HVAC control module.
- Engine coolant temperature (ECT) is less than 123°C (253°F).
- The engine RPM is more than 550 RPM.
- The throttle position is less than 100 percent.

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

The PCM monitors the A/C refrigerant pressure sensor signal circuit. The voltage signal on this circuit is proportional to the refrigerant pressure inside the A/C high side pressure line. As the pressure inside the line increases, so does the voltage signal. If the pressure is above 2413 kPa (350 psi), the A/C compressor output is

disabled. When the pressure lowers to 1578 kPa (229 psi), the PCM enables the compressor to operate.

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

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

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

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

- Ambient air temperature is less than 1°C (35°F).
- A/C compressor temperature switch contacts are open.
- Throttle position is 100 percent.
- The A/C low pressure switch is open.
- A/C high side pressure is more than 2413 kPa (350 psi).
- A/C low side pressure is less than 151 kPa (22 psi).
- Engine coolant temperature (ECT) is more than 123°C (253°F).
- Engine speed is more than 5,500 RPM.
- Transmission shift
- PCM detects excessive torque load.
- PCM detects insufficient idle quality.
- PCM detects a hard launch condition.

Auxiliary Heating & A/C Operation

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

The auxiliary air temperature switch is a rotary knob switch. Turning the air temperature switch to the warmest position diverts most of the airflow through the heater core, which increases the outlet air temperature. Turning the air temperature switch to the coolest position diverts most of the airflow around the heater core, which

decreases the outlet air temperature.

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

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

Engine Coolant

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

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

A/C Cycle

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

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

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

The condenser is located in front of the radiator for maximum heat transfer. The condenser is made of aluminum tubing and aluminum cooling fins, which allows rapid heat transfer for the refrigerant. The semi-

cooled liquid refrigerant exits the condenser and flows through the liquid line, to the orifice tube.

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

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

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

A/C Cycle with Auxiliary

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

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

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

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

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

The condenser is located in front of the radiator for maximum heat transfer. The condenser is made of

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

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

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

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