2008 HVAC

HVAC - Manual - Cab & Chassis Sierra, Cab & Chassis Silverado, Sierra & Silverado

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Air Temperature Actuator Mounting Screw	1.6 N.m	14 lb in
Mode Actuator Mounting Screw	1.6 N.m	14 lb in
Overhead Console Screw	2 N.m	18 lb in
Recirculation Actuator Mounting Screw	1.6 N.m	14 lb in

SCHEMATIC AND ROUTING DIAGRAMS

HVAC SCHEMATICS

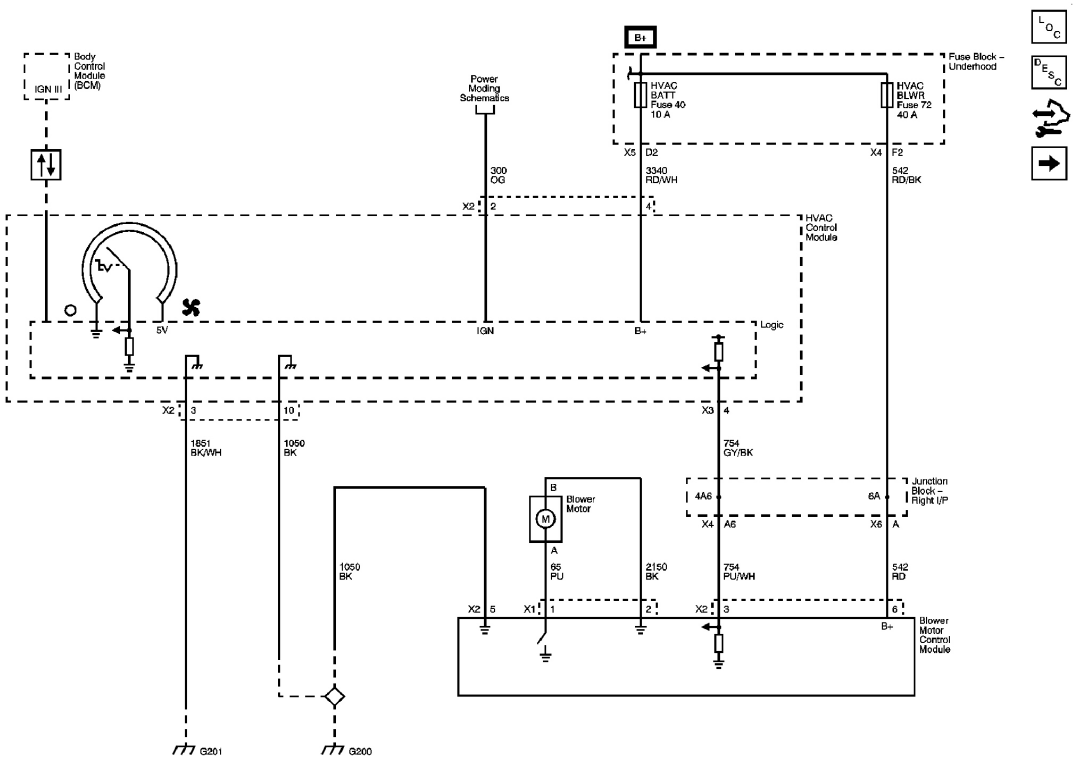


Fig. 1: Module Power, Ground, Serial Data and Blower Controls

Courtesy of GENERAL MOTORS CORP.

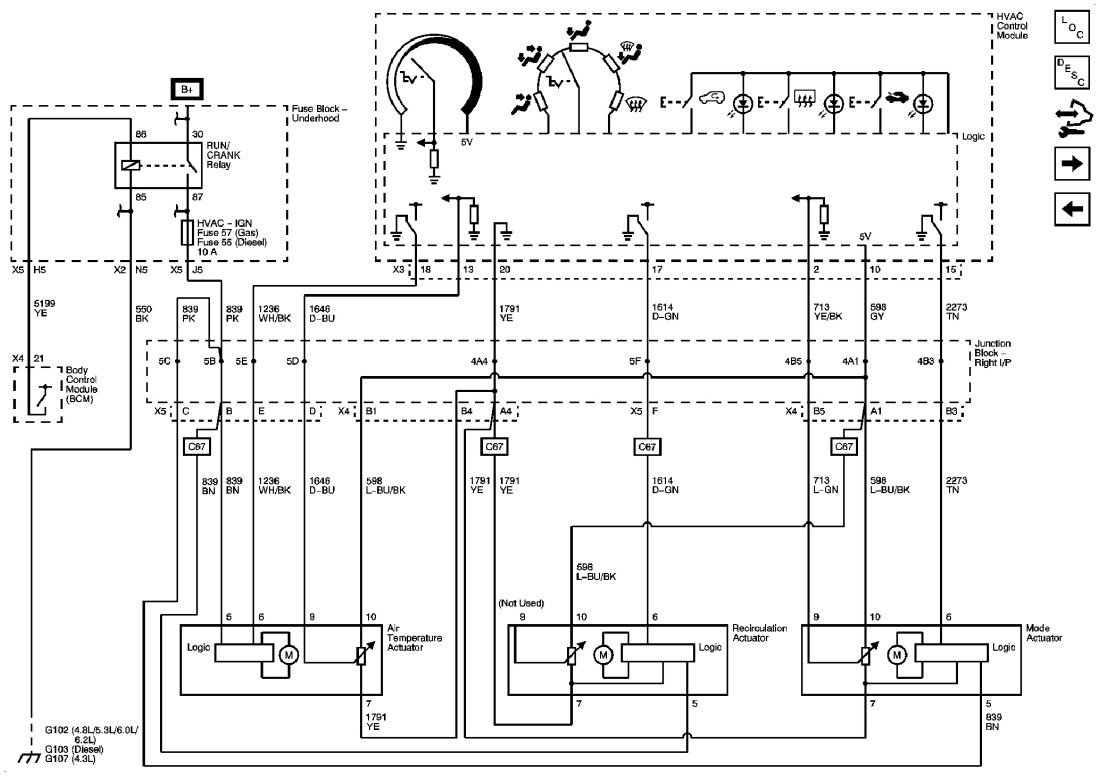


Fig. 2: Mode and Temperature Controls
Courtesy of GENERAL MOTORS CORP.

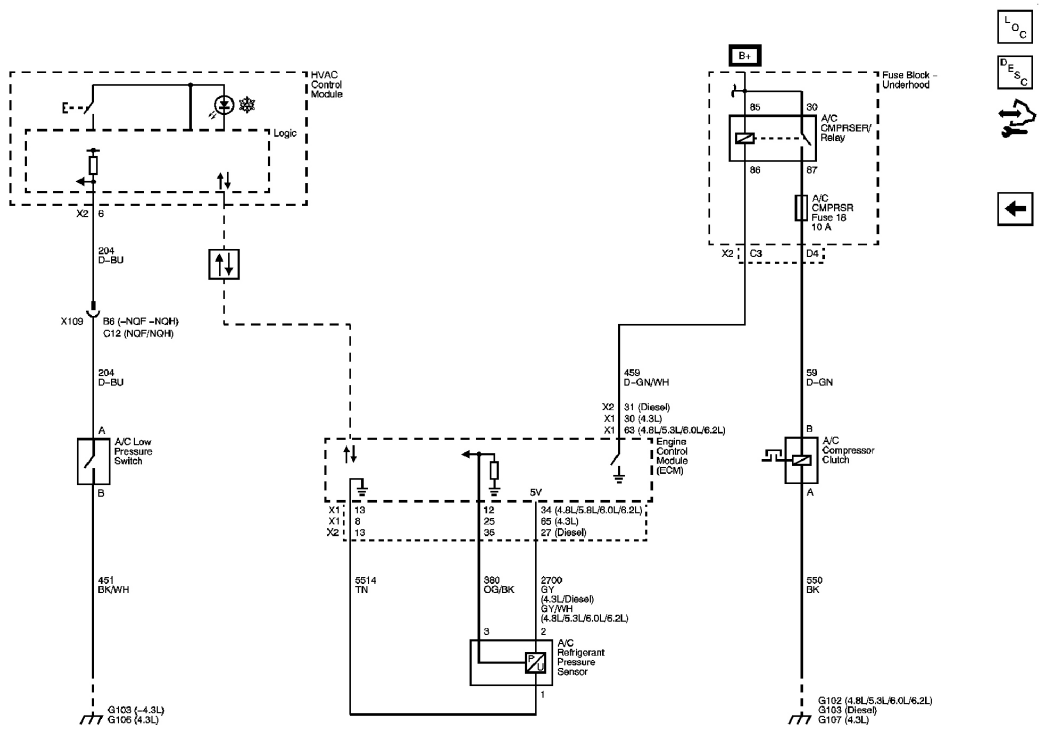


Fig. 3: A/C Compressor Controls C67
Courtesy of GENERAL MOTORS CORP.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B0228, B0413, B0423, or B3779	B0228 02: Recirculate Position Feedback Circuit Short to Ground B0228 05: Recirculate Position Feedback Circuit Short to Battery or Open B0228 61: Recirculate Position Circuit Actuator Stuck B0413 02: Temperature Control 1 Feedback Circuit Short to Ground B0413 05: Temperature Control 1 Feedback Circuit Short to Battery or Open B0413 61: Temperature Control 1 Feedback Circuit Actuator Stuck Open

	B0423 02: Temperature Control 2 Feedback Circuit Short to Ground B0423 05: Temperature Control 2 Feedback Circuit Short to Battery or Open B0423 61: Temperature Control 2 Circuit Actuator Stuck B3779 02: Air Flow Control 9 Feedback Circuit Short to Ground B3779 05: Air Flow Control 9 Feedback Circuit Short to Battery or Open B3779 61: Air Flow Control 9 Circuit Actuator Stuck
DTC P0532 or P0533	P0532: Air Conditioning A/C Refrigerant Pressure Sensor Circuit Low Voltage P0533: Air Conditioning A/C Refrigerant Pressure Sensor Circuit High Voltage
DTC P0645	P0645: A/C Clutch Relay Control Circuit
DTC P0646 or P0647	P0646: Air Conditioning (A/C) Clutch Relay Control Circuit Low Voltage P0647: Air Conditioning (A/C) Clutch Relay Control Circuit High Voltage

DTC B0228, B0413, B0423, OR B3779

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 B0228 02

Recirculate Position Feedback Circuit Short to Ground

DTC B0228 05

Recirculate Position Feedback Circuit Short to Battery or Open

DTC B0228 61

Recirculate Position Circuit Actuator Stuck

DTC B0413 02

Temperature Control 1 Feedback Circuit Short to Ground

DTC B0413 05

Temperature Control 1 Feedback Circuit Short to Battery or Open

DTC B0413 61

Temperature Control 1 Feedback Circuit Actuator Stuck Open

DTC B0423 02

Temperature Control 2 Feedback Circuit Short to Ground

DTC B0423 05

Temperature Control 2 Feedback Circuit Short to Battery or Open

DTC B0423 61

Temperature Control 2 Circuit Actuator Stuck

DTC B3779 02

Air Flow Control 9 Feedback Circuit Short to Ground

DTC B3779 05

Air Flow Control 9 Feedback Circuit Short to Battery or Open

DTC B3779 61

Air Flow Control 9 Circuit Actuator Stuck

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

Recirculation Door Ignition	B0228 02	B0228 05	B0228 05	B0228 61
Recirculation 5-Volt Reference	B0228 02, B0413 02, B0423 02 or B3779 02	B0228 05	B0228 02, B0413 02, B0423 02 or B3779 02	B0228 61
Recirculation Door Position Signal	B0228 02	B0228 05	B0228 05	B0228 61
Recirculation Door Control	B0228 02	B0228 05	B0228 05	B0228 61
Recirculation Low Reference	B0228 02	B0228 05	B0228 05	B0228 61
Driver Air Temperature Door Ignition	B0413 02	B0413 05	B0413 05	B0413 61
Driver Air Temperature 5-Volt Reference	B0228 02, B0413 02, B0423 02 or B3779 02	B0413 05	B0228 02, B0413 02, B0423 02 or B3779 02	B0413 61
Driver Air Temperature Door Position Signal	B0413 02	B0413 05	B0413 05	B0413 61
Driver Air Temperature Door Control	B0413 02	B0413 05	B0413 05	B0413 61
Driver Air Temperature Low Reference	B0413 02	B0413 05	B0413 05	B0413 61
Passenger Air Temperature Door Ignition	B0423 02	B0423 05	B0423 05	B0423 61
Passenger Air Temperature 5-Volt Reference	B0228 02, B0413 02, B0423 02 or B3779 02	B0423 05	B0228 02, B0413 02, B0423 02 or B3779 02	B0423 61
Passenger Air Temperature Door Position Signal	B0423 02	B0423 05	B0423 05	B0423 61
Passenger Air Temperature Door Control	B0423 02	B0423 05	B0423 05	B0423 61
Passenger Air Temperature Low Reference	B0423 02	B0423 05	B0423 05	B0423 61
Mode Door Ignition	B3779 02	B3779 05	B3779 05	B3779 61
Mode 5-Volt Reference	B0228 02, B0413 02,	B3779 05	B0228 02, B0413 02,	B3779 61

	B0423 02 or B3779 02		B0423 02 or B3779 02	
Mode Door Position Signal	B3779 02	B3779 05	B3779 05	B3779 61
Mode Door Control	B3779 02	B3779 05	B3779 05	B3779 61
Mode Low Reference	B3779 02	B3779 05	B3779 05	B3779 61

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.

- B0228 is for the recirculate actuator.
- B0413 is for the drivers air temperature actuator.
- B0423 is for the passenger air temperature actuator.
- B3779 is for the mode actuator.

Conditions for Running the DTC

- Ignition 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 100 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 harness connector at the appropriate actuator.
2. Test for less than 1 ohm between the low reference circuit terminal 7 and ground.
    - If greater than the specified range, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the HVAC control module.
3. Ignition ON, test for 4.8-5.2 volts between the 5-volt reference circuit terminal 10 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 HVAC control module.
- If greater than the specified range, test the 5-volt reference circuit for a short to voltage. If the circuit tests normal, replace the HVAC control module.

4. Verify the appropriate scan tool parameter is less than 4 counts.
   - If greater than the specified range, test the signal circuit terminal 9 for a short to ground. If the circuit tests normal, replace the HVAC control module.
5. Install a 3-amp fused jumper wire between the signal circuit terminal 9 and the low reference circuit terminal. Verify the appropriate scan tool parameter is greater than 250 counts.
   - If less than the specified range, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the HVAC control module.
6. Ignition ON, verify that a test lamp illuminates between the 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.
7. Install a DMM between the actuator control circuit terminal 6 and ground. While monitoring the DMM, use the scan tool to command the appropriate actuator from one direction to the other. The voltage on the control circuit should move 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.
8. If all circuits test normal, replace the actuator.

Repair Procedures

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

- **Air Temperature Actuator Replacement - Right Side**
- **Air Temperature Actuator Replacement - Left Side**
- **Mode Actuator Replacement**
- **Recirculation Actuator Replacement**

DTC 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 Descriptors

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	P0532	P0532	-	-
A/C Refrigerant Pressure Sensor Signal	P0532	P0532	P0533	-
Low Reference	-	P0533	-	-

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) sets DTC P0532.

- The ECM detects that the A/C pressure is more than 428 psi (4.92 volts) sets DTC P0533.

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 Pressure Sensor parameter. The reading should be between 0.1 volts (1 psi) and 4.90 volts (425 psi) and change with A/C refrigerant pressure changes.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the A/C refrigerant pressure sensor.
2. Ignition OFF, test for less than 10 ohms 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 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 0.1 volts (1 psi).
    - If greater than the specified range, test the signal circuit terminal 3 for a short to voltage. If the circuit tests normal, replace the ECM.
5. Install a 3A 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 (425 psi).
    - If less than the specified range, 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 refrigerant pressure sensor.

Repair Procedures

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

- **Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement (Non-HP2)**
- **Control Module References** for the ECM replacement, setup, and programming

DTC P0645

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

A/C Clutch Relay Control Circuit

Diagnostic Fault Information

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

Circuit System Description

Ignition voltage is supplied directly to the A/C compressor clutch relay. The engine control module (ECM) controls the relay by grounding the A/C clutch relay control circuit. When the ECM is commanding a component ON, the voltage of the control circuit should be near 0 volt. 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 11-18 volts.
- The engine speed is greater than 600 RPM.
- An A/C request is made.

Conditions for Setting the DTCs

The ECM detects an open on the control circuit of the A/C compressor clutch relay when commanded OFF with the engine in crank or run status.

Action Taken When the DTC Sets

The ECM will store conditions which were present when the DTC set as Failure Records data only. This information will not be stored as Freeze Frame data.

Conditions for Clearing the DTC

A history DTC clears after 40 consecutive warm-up cycles have occurred without a malfunction.

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 A/C Relay ON and OFF with a scan tool. Feel/listen for the A/C relay to click.

Circuit/System Testing

1. Ignition OFF, disconnect the A/C relay.
2. Ignition ON, verify that a test lamp does not illuminate between the control circuit terminal 86 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 85 and ground.
    - If the test lamp does not illuminate, test the ignition circuit for a short to ground or a open/high resistance. If the circuit tests normal and ignition circuit fuse is open, test all components connected to the ignition circuit and replace as necessary.
4. Verify that a test lamp illuminates between the relay B+ circuit terminal 30 and ground.
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or a open/high resistance. If the circuit tests normal and B+ circuit fuse is open, replace the A/C clutch relay.
5. Disconnect the harness connector at the A/C clutch coil.
6. Test for less than 1 ohm between the ground circuit terminal 2 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 clutch coil.
8. Connect a 10-amp fused jumper wire between the B+ circuit terminal 30 and control circuit terminal 87. Verify the A/C clutch is activated.
    - If the A/C clutch does not activate, test the control circuit for an open/high resistance. If the circuit tests normal, test or replace the A/C clutch.
9. Connect a test lamp between the ignition circuit terminal 85 and the control circuit terminal 86.
10. Command the A/C relay output function 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 clutch 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 ECM replacement, setup, and programming

DTC 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 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 B+	P0646	P0647	P0647	-
A/C Compressor Clutch Relay Control	P0646	P0647	P0647	-

Circuit/System Description

The engine control module (ECM)/powertrain control module (PCM) controls the A/C compressor clutch based on an A/C request serial data message from the HVAC control module. The ECM/PCM monitors the A/C refrigerant pressure sensor and if pressure is within a specified range, will engage the A/C compressor by grounding the A/C compressor clutch relay control circuit.

B+ is applied to the A/C relay in the RUN/START position and with the A/C compressor clutch relay control circuit grounded by the ECM/PCM, current flows through the coil side of the A/C relay. With current flowing through the coil side of the relay, a magnetic field is created which pulls the switch side of the relay closed, sending current to the A/C compressor clutch, allowing the A/C compressor to be engaged.

Conditions for Running the DTC

An A/C request is received from the HVAC module.

Conditions for Setting the DTC

A short to voltage, short to ground, or open/high resistance is seen on the A/C compressor clutch relay control circuit.

Action Taken When the DTC Sets

DTC P0646 and DTC P0647 are Type C DTCs

Conditions for Clearing the DTC

DTC P0646 and DTC P0647 are Type C DTCs

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Air Temperature Description and Operation

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

Engine running, command the A/C Relay On and OFF with a scan tool. The A/C compressor clutch should engage and disengage.

Circuit/System Testing

1. Ignition OFF, disconnect the A/C relay.
2. Ignition ON, verify a test lamp illuminates between the relay coil B+ circuit terminal and ground.
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance.
3. Connect a test lamp between the relay coil B+ circuit terminal and the A/C compressor clutch relay control circuit terminal.
4. Engine running, command the A/C relay ON and OFF. The test lamp should turn ON and OFF when changing between the commanded states.
    - If the test lamp is always ON, test the control circuit for a short to ground. If the

circuit tests normal, replace the ECM/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 ECM/PCM.
5. If all circuits test normal, test or replace the A/C relay.

Repair Procedures

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

Control Module References for ECM/PCM 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:

- **Blower Motor Malfunction**
- **Air Conditioning Compressor Malfunction**
- **Noise Diagnosis - Air Conditioning (A/C) System**
- **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+	1	1	-	-
A/C Relay Coil Side Supply Voltage	1	1	-	-
Ignition 1	1	1	-	-
A/C Low Pressure Switch Signal	1	1	1	-
A/C Compressor Clutch Relay Control	P0645	P0645	P0645	-
A/C Relay Coil Side Ground	-	1	-	-
A/C Low Pressure Switch	-	1	-	-

Ground				
1. A/C Compressor Inoperative				

Circuit/System Description

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

Diagnostic Aids

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

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

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

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

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine running, press the A/C request switch. The A/C compressor clutch should engage.
2. Place the mode switch in the defrost position. The A/C compressor clutch should engage.
    - If the clutch does not engage refer to

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the A/C low pressure switch.
2. Test for less than 5 ohms between the ground 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 scan tool Low Pressure Switch parameter is Open.
    - If not the specified value, test the signal circuit terminal A for a short to ground. If the circuit tests normal, replace the HVAC control module
4. Connect a 3-amp fused jumper wire between the signal circuit terminal A and ground. Verify the scan tool Low Pressure Switch parameter is Closed.
    - 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. Connect the harness connector at the A/C low pressure switch. Verify the scan tool Low Pressure Switch parameter is Closed.
    - If not the specified value, test or replace the A/C low pressure switch.
6. Ignition OFF, disconnect the A/C relay.
7. Ignition ON, verify that a test lamp does not illuminate between the control circuit terminal 86 and ground.
    - If the test lamp illuminates, test the control circuit for a short to voltage.
8. Verify that a test lamp illuminates between the ignition circuit terminal 85 and ground.

- If the test lamp does not illuminate, test the ignition circuit for a short to ground or a open/high resistance. If the circuit tests normal and ignition circuit fuse is open, test all components connected to the ignition circuit and replace as necessary.

9. Verify that a test lamp illuminates between the relay B+ circuit terminal 30 and ground.
   - If the test lamp does not illuminate, test the B+ circuit for a short to ground or a open/high resistance. If the circuit tests normal and B+ circuit fuse is open, replace the A/C clutch relay.
10. Disconnect the harness connector at the A/C clutch coil.
11. Test for less than 1 ohm between the ground circuit terminal 2 and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
12. Connect the harness connector at the A/C clutch coil.
13. Connect a 10-amp fused jumper wire between the B+ circuit terminal 30 and control circuit terminal 87. Verify the A/C clutch is activated.
    - If the A/C clutch does not activate, test the control circuit for an open/high resistance. If the circuit tests normal, test or replace the A/C clutch.
14. Connect a test lamp between the ignition circuit terminal 85 and the control circuit terminal 86.
15. Command the A/C relay output function 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.
16. If all circuits test normal, test or replace the A/C clutch relay.

Repair Procedures

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

- **Air Conditioning Compressor Replacement (LY2, LY5, LH6, L76, L92 and LMG)** or **Air Conditioning Compressor Replacement (LLY/LMM)** or **Air Conditioning Compressor Replacement (LU3)**
- **Compressor Clutch Plate/Hub Assembly Replacement (4.3L, 6.6L)** or **Compressor Clutch Plate/Hub Assembly Replacement (V8 - Gas)**
- **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
Blower Motor Control Module B+	1	1	-	-
Blower Motor B+	1	1	-	-
Blower Motor Speed Control	2	1	1	-
Blower Motor Control	2	1	1	-
Ground	-	1	-	-
1. Blower Motor Inoperative 2. Blower Motor Always On				

Circuit/System Description

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

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

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

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the X2 harness connector at the blower motor control module.
2. Test for less than 1.0 ohm between the ground circuit terminal 5 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 6 and ground.
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the B+ circuit fuse (HVAC BLWR 40-amp) in the underhood fuse block is open, test all components connected to the B+ circuit and replace as necessary.
4. Connect a DMM between the control circuit terminal 3 and ground.
5. Cycle the blower motor from OFF to HIGH. The voltage should increase while changing between the commanded states.
    - If voltage remains greater than 11.5 volts while changing between the commanded states, test the control circuit for a short to voltage. If the circuit test normal, replace the HVAC control module.
    - If voltage remains less than 1.0 volts while changing between the commanded states, test the control circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the HVAC control module.
    - If voltage is between 1.0-11.5 volts and does not increase when changing between the commanded states, replace the HVAC control module.

6. Ignition OFF, connect the X2 harness connector at the blower motor control module. Disconnect the harness connector at the blower motor.
7. Ignition ON, verify that a test lamp illuminates between the B+ circuit terminal A and ground.
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the blower motor control module.
8. Connect a test lamp between the control circuit terminal B and the B+ circuit terminal A.
9. Turn the blower motor on high speed then to low speed. The test lamp intensity should be bright when in high speed and very dim or off when the blower is on low speed.
    - If the test lamp intensity does not vary, test the control circuit for a short to voltage, short to ground, or an open/high resistance. If the circuit tests normal, replace the blower motor control module.
10. If all circuits test normal, test or 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 setup, replacement, 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

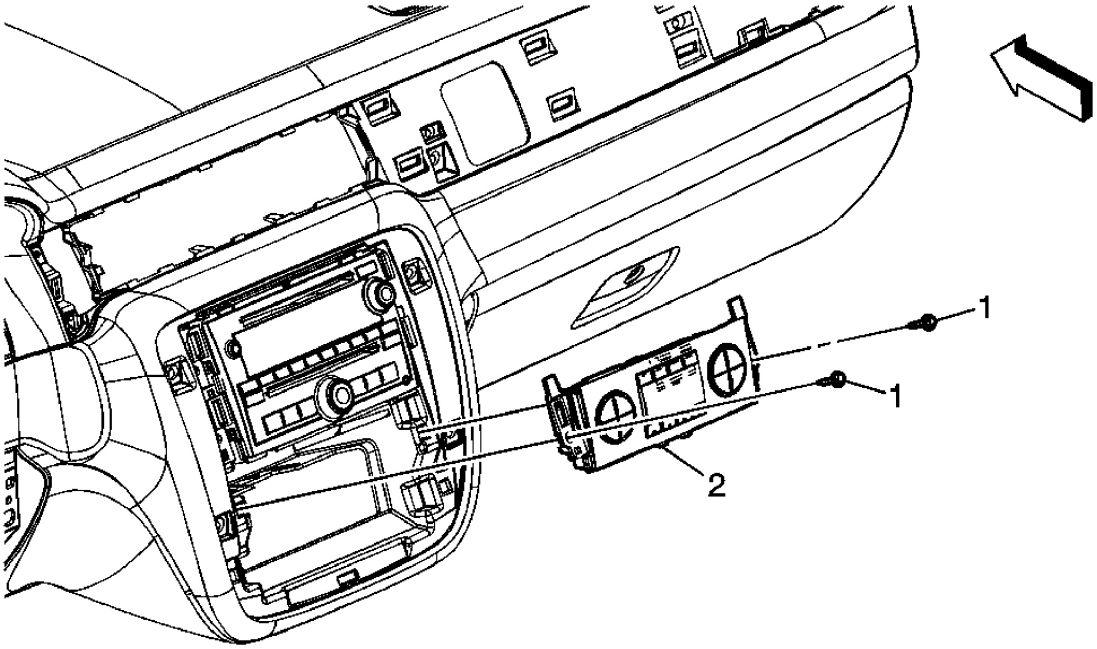


Fig. 4: View Of HVAC Control Assembly & Screws
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure 1. Remove the instrument panel accessory trim plate. Refer to **Instrument Panel Accessory Trim Plate Replacement (without RPO SLT)** or **Instrument Panel Accessory Trim Plate Replacement (with RPO SLT)** . 2. Remove the accessory switch assembly. Refer to **Accessory Switch Replacement (with RPO SLT)** or **Accessory Switch Replacement (without RPO SLT)** . 3. Disconnect the electrical connectors.	
	Screw, Control Assembly - Heater and Air Conditioning (Qty: 2) **NOTE:**

1	**Refer to Fastener Notice .** **Tighten:** 1.5 N.m (13 lb in)
2	Control Assembly, Heater and Air Conditioning **Tip:** HVAC Control Module must be reprogrammed. Refer to **Control Module References** .

AIR TEMPERATURE ACTUATOR REPLACEMENT - LEFT SIDE

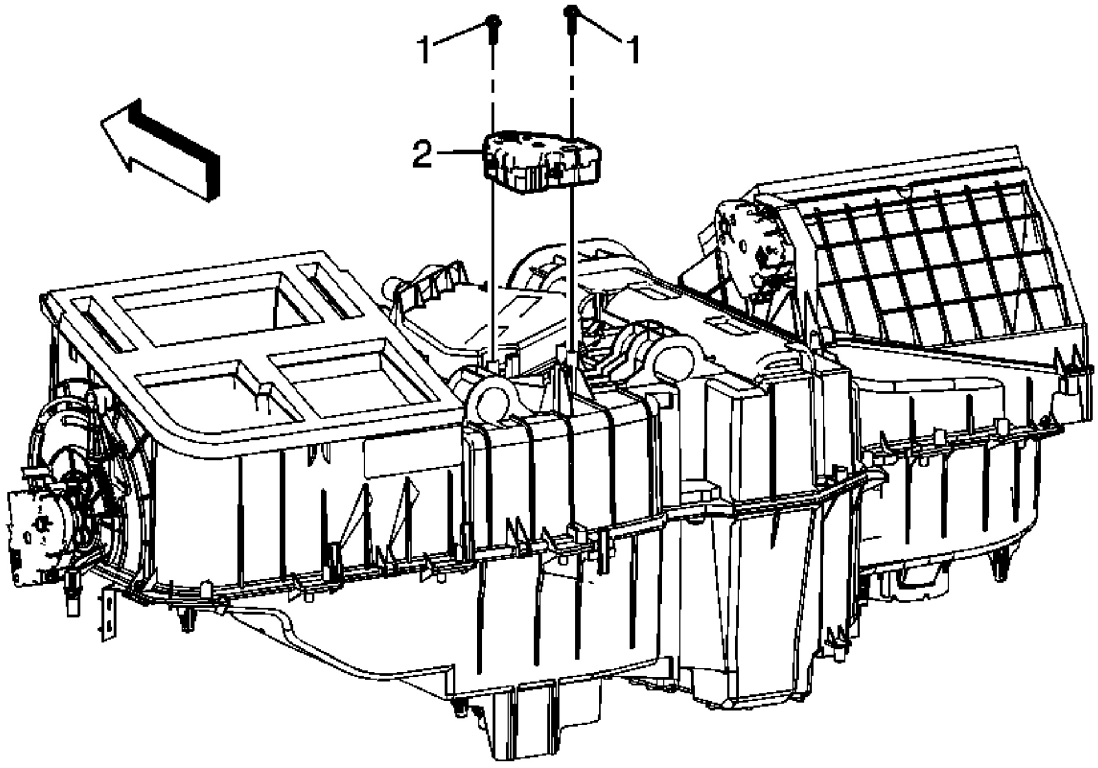


Fig. 5: View Of Air Temp Actuator & Screws
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name

NOTE:
In order to avoid actuator damage, DO NOT apply power to the actuator when it is not installed in the HVAC module.

Preliminary Procedure

1. Remove the instrument panel to the service position. Refer to **Instrument Panel**

	Service Positioning (Without SLT) or **Instrument Panel Service Positioning (With SLT)** . 2. Disconnect the electrical connector from the air temp actuator.
1	Air Temp Actuator Screw (Qty: 2) **NOTE:** **Refer to Fastener Notice .** **Tighten:** 1.6 N.m (14 lb in)
2	Air Temp Actuator **Procedure:** Re-calibrate the air temp actuator. Refer to **Actuator Recalibration**.

AIR TEMPERATURE ACTUATOR REPLACEMENT - RIGHT SIDE

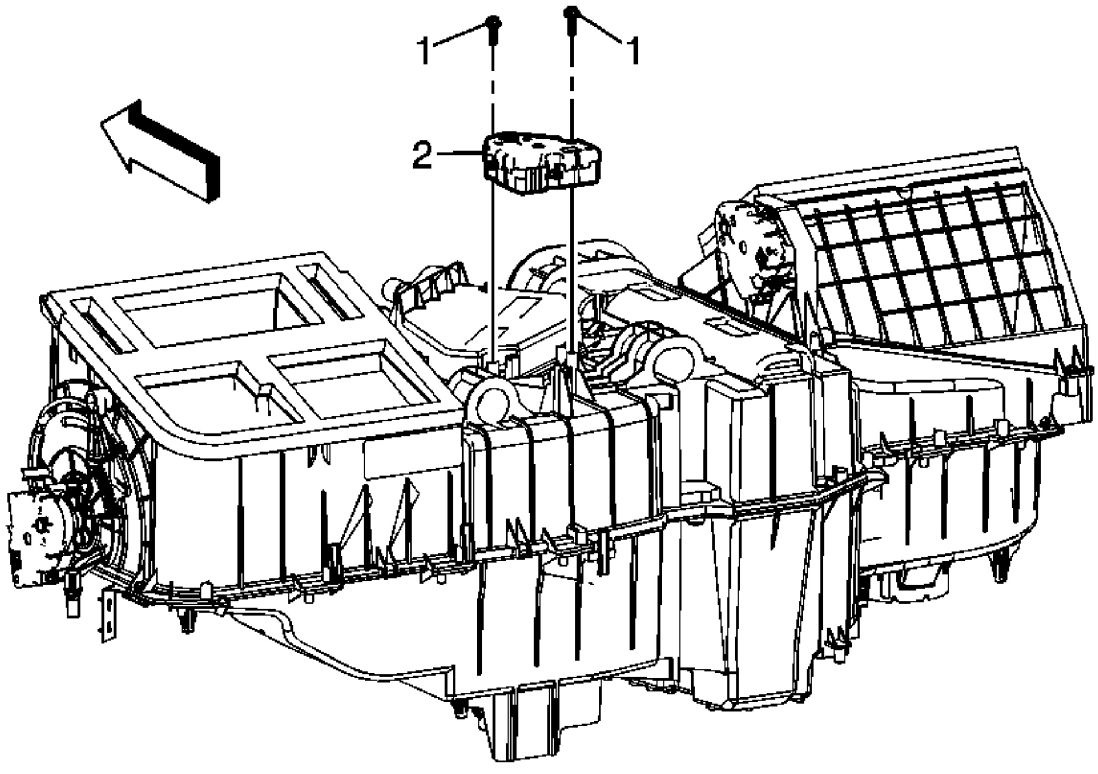


Fig. 6: View Of Air Temp Actuator & Screws
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name

NOTE:
In order to avoid actuator damage, DO NOT apply power to the actuator when it is not installed in the HVAC module.

Preliminary Procedure

1. Remove the instrument panel to the service position. Refer to **Instrument Panel Service Positioning (Without SLT)** or **Instrument Panel Service Positioning (With SLT)** .
2. Disconnect the electrical connector from the air temp actuator.

1	Air Temp Actuator Screw (Qty: 2) **NOTE:** **Refer to Fastener Notice .** **Tighten:** 1.6 N.m (14 lb in)
2	Air Temp Actuator **Procedure:** Re-calibrate the air temp actuator. Refer to **Actuator Recalibration**.

AIR TEMPERATURE ACTUATOR REPLACEMENT - LEFT SIDE

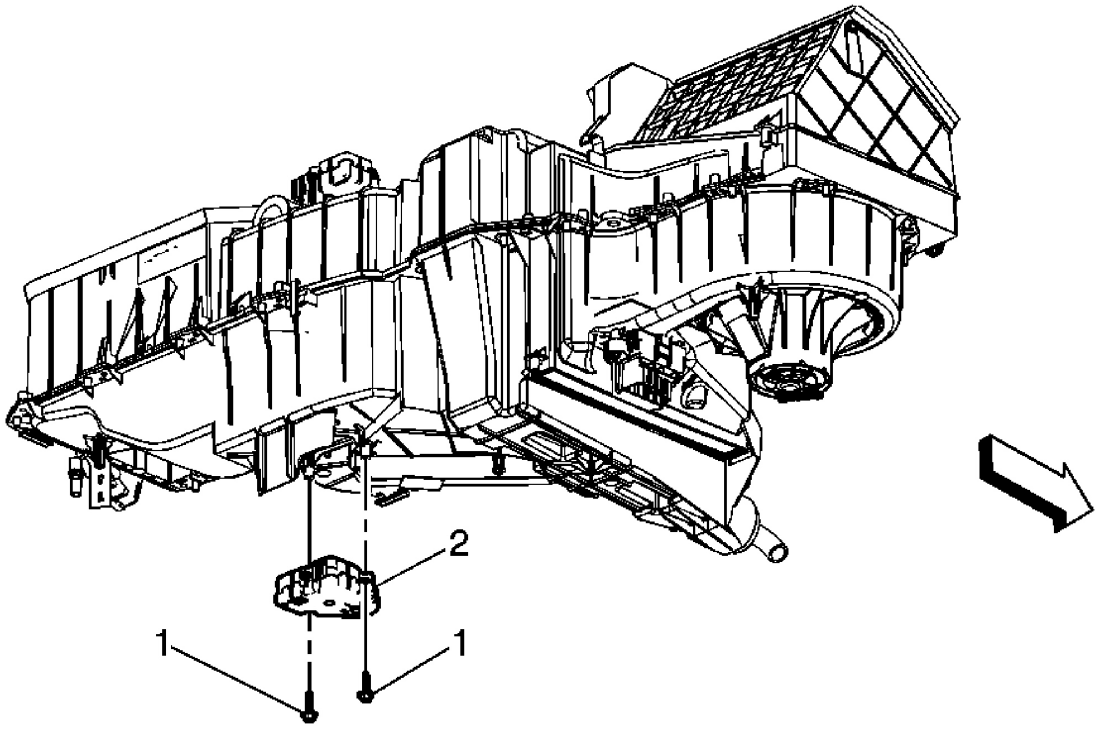


Fig. 7: Air Temperature Actuator Replacement
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
NOTE: **In order to avoid actuator damage, DO NOT apply power to the actuator when it is not installed in the HVAC module.** **Preliminary Procedure** 1. Remove the instrument panel insulator. Refer to **Instrument Panel Insulator Replacement (with RPO SLT)** or **Instrument Panel Insulator Replacement (without RPO SLT)** . 2. Disconnect the electrical connector from the air temp actuator.	
1	Air Temp Actuator Screw (Qty: 2) **NOTE:** **Refer to Fastener Notice .** **Tighten:** 1.6 N.m (14 lb in)

2	Air Temp Actuator **Procedure:** Re-calibrate the air temp actuator. Refer to **Actuator Recalibration** .

MODE ACTUATOR REPLACEMENT

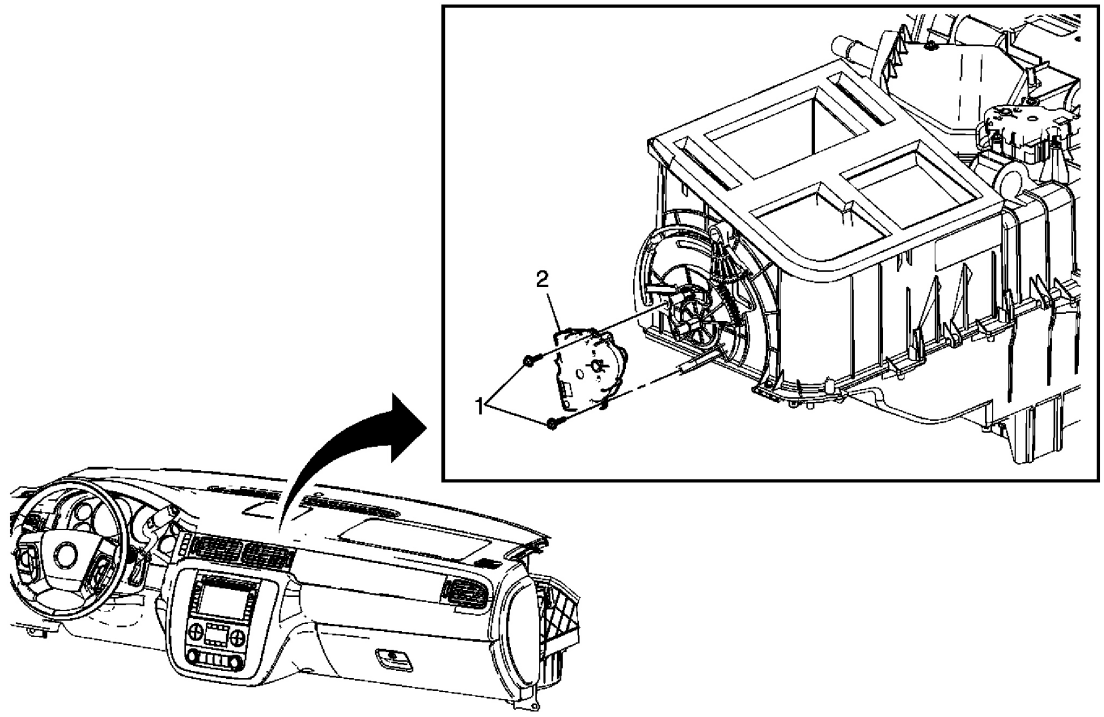


Fig. 8: View Of Mode Actuator & Screws
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name

NOTE:
In order to avoid actuator damage, DO NOT apply power to the actuator when it is not installed in the HVAC module.

Preliminary Procedure

1. Remove the knee bolster. Refer to **Knee Bolster Replacement (with RPO SLT)** or **Knee Bolster Replacement (without RPO SLT)** .
2. Remove the air outlet duct - floor LH. Refer to **Floor Air Outlet Duct Replacement - Left Side** .
3. Disconnect the electrical connector from the mode actuator.

1	Mode Actuator Screw (Qty: 2) **NOTE:** **Refer to Fastener Notice .** **Tighten:** 1.6 N.m (14 lb in)
2	Mode Actuator **Procedure:** Re-calibrate the mode actuator. Refer to **Actuator Recalibration**. **Tip:** Mode actuator cam is now accessible.

RECIRCULATION ACTUATOR REPLACEMENT

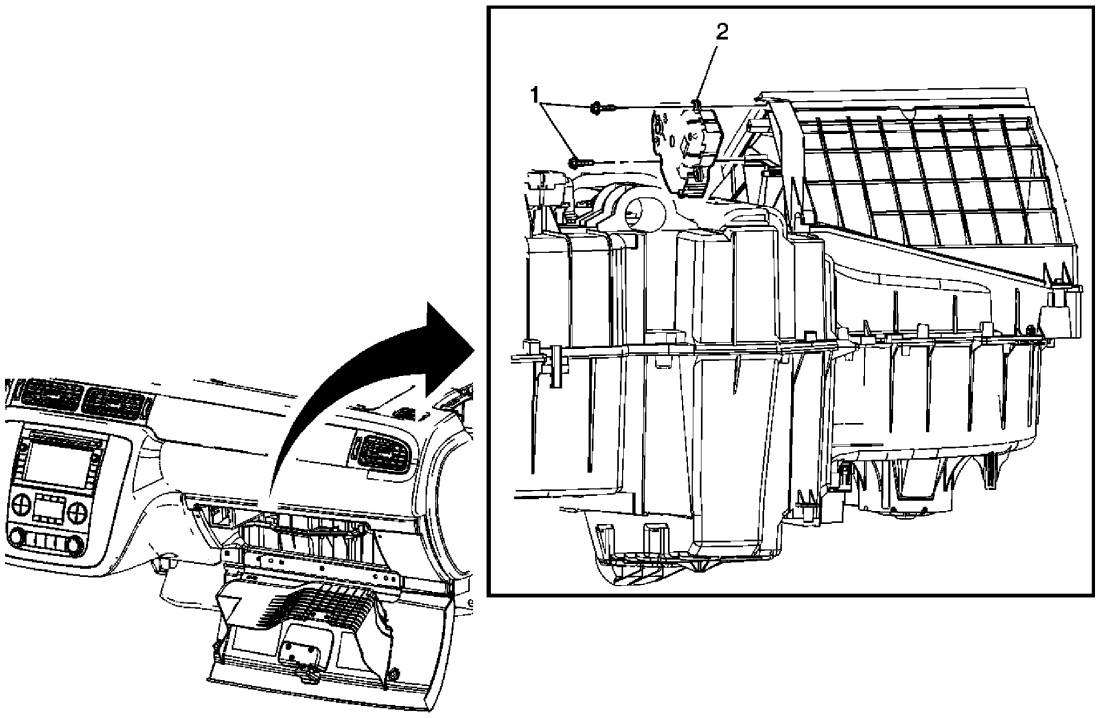


Fig. 9: View Of Recirculation Actuator & Screws
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
NOTE: **In order to avoid actuator damage, DO NOT apply power to the actuator when it is not installed in the HVAC module.**	

Preliminary Procedure

1. Remove the inflatable restraint I/P module. Refer to **Inflatable Restraint Instrument Panel Module Replacement**
2. Disconnect the electrical connector from the recirculation actuator.

1	Recirculation Actuator Screw (Qty: 2) **NOTE:** **Refer to Fastener Notice .** **Tighten:** 2 N.m (18 lb in)
2	Recirculation Actuator **Procedure:** Re-calibrate the recirculation actuator. Refer to **Actuator Recalibration**.

DESCRIPTION AND OPERATION

AIR DELIVERY DESCRIPTION AND OPERATION

The air delivery controls are divided into four areas.

- HVAC Control Components
- Air Speed
- 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

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.

Air Speed

The blower motor circulates air through 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.

Off

When the OFF position is selected, the HVAC control module applies voltage to the fan off input within the HVAC control module through the off blower motor control circuit. When the HVAC control module receives this input, any A/C request will be cancelled and the A/C request LED will turn off. Fresh air will still be brought in from the outside, but the LED indicator on the switch will not illuminate.

Recirculation Mode

When the recirculation switch is pressed, a signal is sent from the HVAC control module to the recirculation actuator through the recirculation door control circuit. When the logic receives the signal, the recirculation actuator moves into the recirculation mode. This brings air from inside the vehicle instead of fresh air from the outside. Power and ground are provided to the recirculation actuator by the ignition 3 voltage and ground circuit. Recirculation is not available when the HVAC control module is in the defrost position. The recirculation mode will stay on

and the LED will illuminate until a non-recirculation mode is selected.

Air Delivery

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 door is moved to the defrost position, the A/C compressor clutch engages and the recirculation actuator will be moved to the outside air position. Regardless of the mode setting, a small amount of air will be diverted to the defrost ducts to reduce windshield fogging.

Mode Actuator

The mode actuator is an electronic stepper motor with feedback potentiometers. The HVAC control module sends different 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.

Front Defrost

When you select defrost, 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 rear window defogger does not affect the HVAC system.

Recirculation Operation

Recirculation Actuator

The HVAC control module controls the air intake through the recirculation actuator. Recirculation is not available when the mode is in defrost. When the mode is in defog, Recirculation will only be available for 10 minutes. The operator must activate the blower for Recirculation operation. The A/C high-pressure recirculation switch can cause the HVAC system to recirculate air. 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. When the high side pressure reaches 2206-2620 Kpa (320-380 psi), the PCM will place the HVAC system in recirculation mode. The high side pressure is lowered when the inside air cools the refrigerant within the A/C evaporator. When the high-side pressure reaches 1447-1861 Kpa (210-270 psi), the PCM will place the HVAC system out of recirculation mode.

AIR TEMPERATURE DESCRIPTION AND OPERATION

The air temperature controls are divided into four 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 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

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.

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 2957 kPa (429 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 138-172 kPa (20-25 psi). This prevents the A/C compressor from operating. The switch will then close when A/C low pressure side reaches 275-317 kPa (40-46 psi). This enables the A/C compressor to turn back ON.

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

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 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:

- The ambient air temperature is above 4°C (40°F).
- The A/C low pressure switch signal circuit is grounded.
- The A/C refrigerant pressure sensor parameter is less than 2957 kPa (429 psi).
- The PCM receives an A/C request from the HVAC control module.
- The engine coolant temperature (ECT) is less than 121°C (250°F).
- The engine RPM is more than 550 RPM.
- The throttle position is less than 100%.

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 2957 kPa (429 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

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

- The ambient air temperature is less than 4°C (40°F).
- The throttle position is 100%.
- The A/C low pressure switch is open.
- The A/C high side pressure is more than 2957 kPa (429 psi).
- The A/C low side pressure is less than 151 kPa (22 psi).
- The engine coolant temperature (ECT) is more than 121°C (250°F).
- The engine speed is more than 5500 RPM.
- Transmission shift
- The PCM detects excessive torque load.
- The PCM detects insufficient idle quality.
- The PCM detects a hard launch condition.

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.

Auxiliary Coolant Pump (w/HP2)

The auxiliary coolant pump circulates coolant through the engine and heater core when HVAC requires heating and the engine is HOT and OFF. The HCM will turn on the auxiliary coolant pump when the HVAC control module commands it to do so by sending a class 2 signal to the HCM.

A/C Cycle

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

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

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

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

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

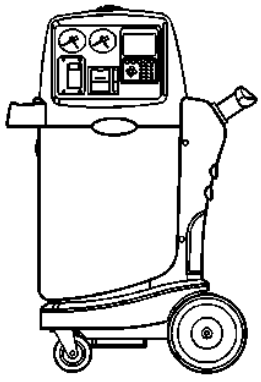
Refrigerant exiting the orifice tube flows into the evaporator core in a low pressure, liquid state. Ambient air is drawn through the HVAC module and passes through the evaporator core. Warm and moist air will cause the liquid refrigerant boil inside of the evaporator core. The boiling refrigerant absorbs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

The conditioned air is distributed through the HVAC module for passenger comfort. The heat and

moisture removed from the passenger compartment will also change form, or condense, and is discharged from the HVAC module as water.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

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