

## 2010 HVAC

### HVAC - Automatic - Equinox & Terrain

## SPECIFICATIONS

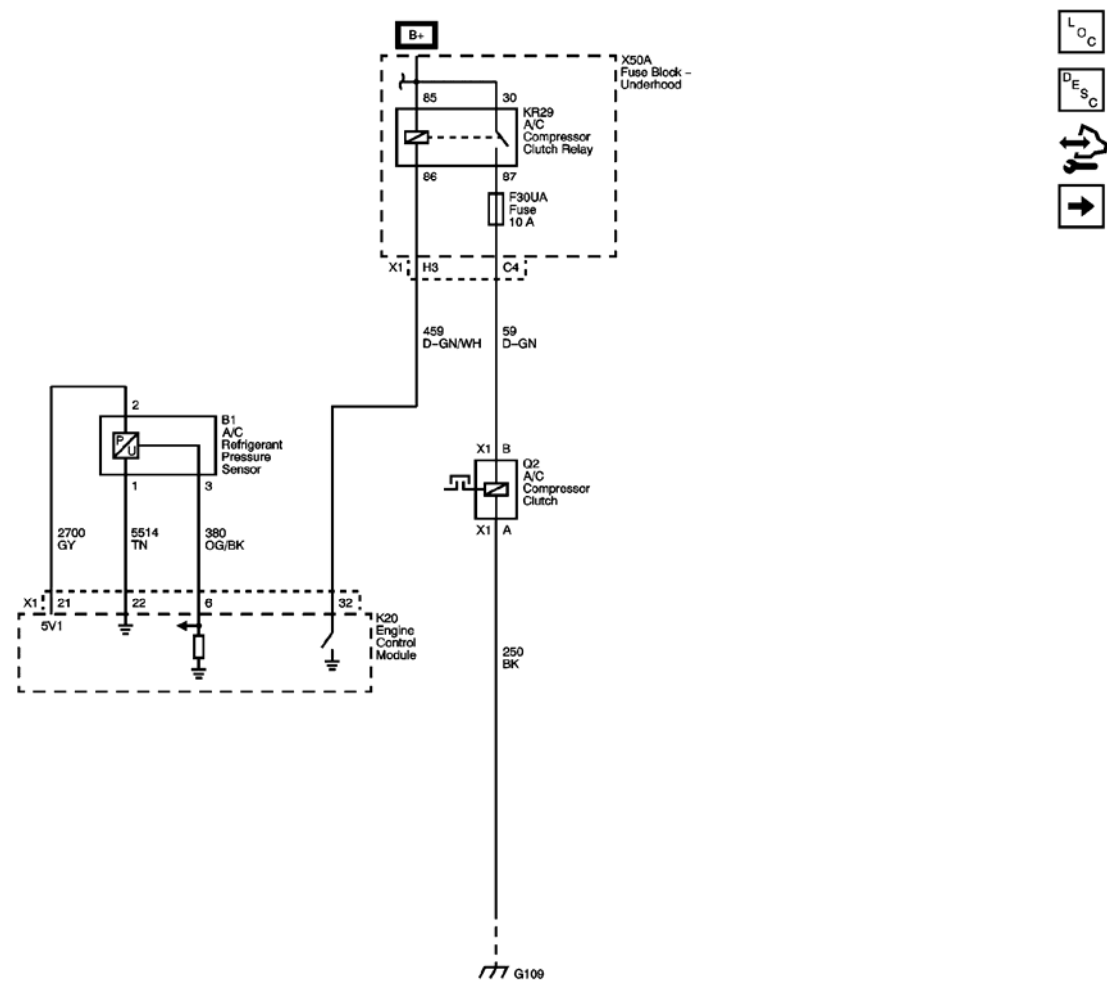
### FASTENER TIGHTENING SPECIFICATIONS

| Application                                                     | Specifications |          |
|-----------------------------------------------------------------|----------------|----------|
|                                                                 | Metric         | English  |
| Air Inlet Assembly Screws                                       | 1.5 N.m        | 13 lb in |
| Air Outlet Duct Screws                                          | 1.5 N.m        | 13 lb in |
| Battery Box to Body Bolts                                       | 15 N.m         | 11 lb ft |
| Blower Case Assembly Screws                                     | 1.5 N.m        | 13 lb in |
| Blower Motor Control Module Screws                              | 1.5 N.m        | 13 lb in |
| Blower Motor Screws                                             | 1.5 N.m        | 13 lb in |
| Compressor Clutch Bolt                                          | 21 N.m         | 16 lb ft |
| Compressor Clutch Coil Connector Bracket Screw                  | 4.3 N.m        | 38 lb in |
| Compressor Clutch Coil Screws                                   | 4.9 N.m        | 43 lb in |
| Compressor Hose Assembly to Battery Box Nut                     | 9 N.m          | 80 lb in |
| Compressor Hose Assembly to Compressor Nut                      | 20 N.m         | 15 lb ft |
| Compressor Hose Assembly to Condenser Nut                       | 20 N.m         | 15 lb ft |
| Compressor Pressure Relief Valve                                | 8.8 N.m        | 78 lb in |
| Compressor to Engine Bolts                                      | 50 N.m         | 37 lb ft |
| Condenser to Radiator Bolts                                     | 9 N.m          | 80 lb in |
| CRFM Bracket Bolts                                              | 20 N.m         | 15 lb ft |
| Evaporator Case Assembly Screws                                 | 1.5 N.m        | 13 lb in |
| Evaporator Outlet Hose and Liquid Line Clamp Bracket Nut to TXV | 20 N.m         | 15 lb ft |
| Evaporator Outlet Hose to Compressor Hose Nut                   | 20 N.m         | 15 lb ft |
| Front of Dash to HVAC Module Seal Nuts                          | 9 N.m          | 80 lb in |
| Heater Core Cover Screws                                        | 1.5 N.m        | 13 lb in |
| HVAC Module to Cross Car Beam Nuts and Bolts                    | 8 N.m          | 71 lb in |
| Intermediate Duct Fasteners                                     | 2.5 N.m        | 22 lb in |
| Liquid Line to Condenser Nut                                    | 20 N.m         | 15 lb ft |
| Liquid Line to Strut Tower Nut                                  | 9 N.m          | 80 lb in |
| Mode Actuator to Evaporator Case Screws                         | 1.5 N.m        | 13 lb in |
| Mode Cam Bracket to Evaporator Case Screws                      | 1.5 N.m        | 13 lb in |
| Passenger Compartment Air Filter Housing Nuts                   | 9 N.m          | 80 lb in |
| Receiver Dehydrator to Condenser Bolt                           | 4.2 N.m        | 37 lb in |
| Receiver Dehydrator Upper Clamp Bolt to Condenser               | 6.5 N.m        | 58 lb in |
| Refrigerant Pressure Sensor to Compressor Hose Assembly         | 4 N.m          | 35 lb in |

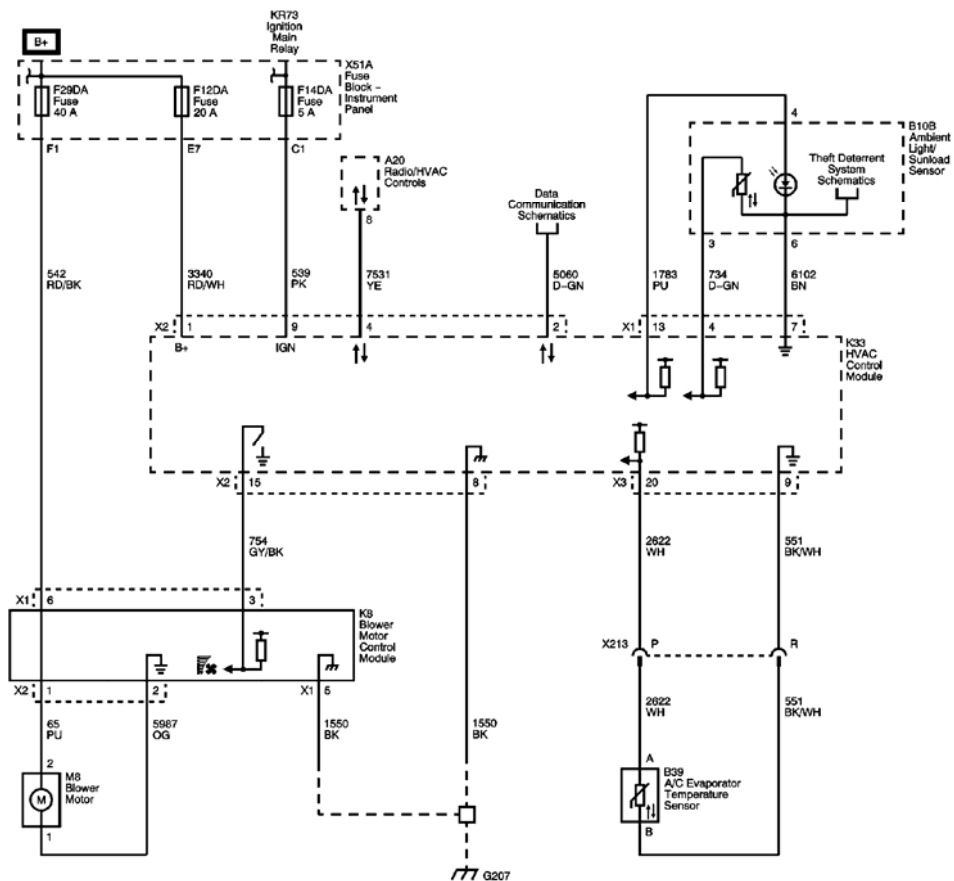
|                          |         |          |
|--------------------------|---------|----------|
| Surge Tank to Body Bolts | 9 N.m   | 80 lb in |
| TXV Backing Plate Bolts  | 3.5 N.m | 31 lb in |

SCHEMATIC AND ROUTING DIAGRAMS

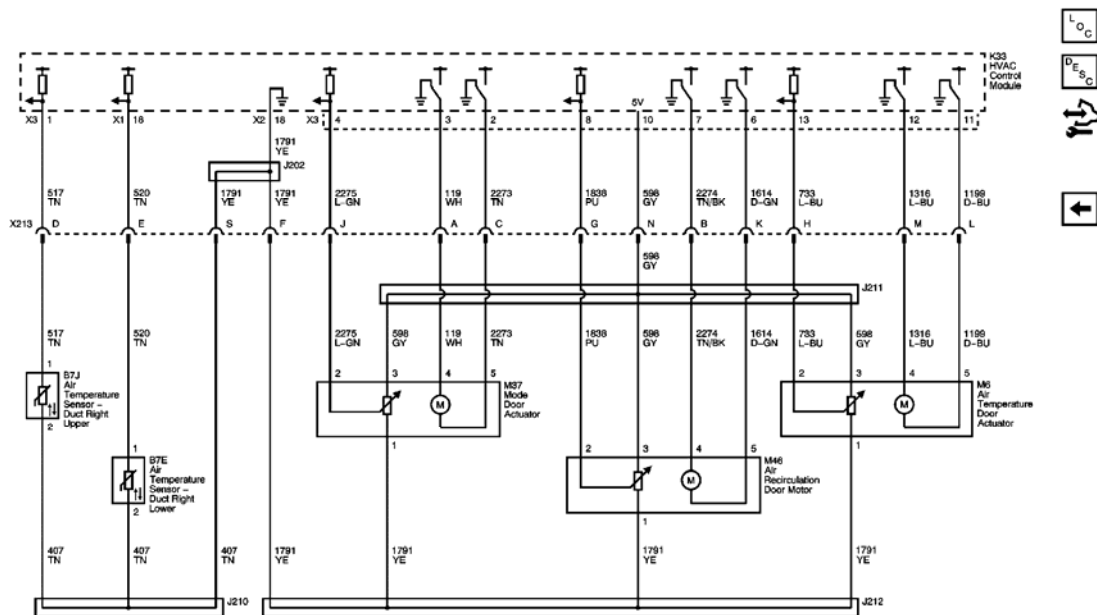
HVAC SCHEMATICS



**Fig. 1: A/C Compressor Controls (C68)**  
Courtesy of GENERAL MOTORS CORP.



**Fig. 2: Sensors and Blower Motor (C68)**  
 Courtesy of GENERAL MOTORS CORP.



**Fig. 3: Actuators (C68)**  
 Courtesy of GENERAL MOTORS CORP.

## DIAGNOSTIC INFORMATION AND PROCEDURES

### DIAGNOSTIC CODE INDEX

### DIAGNOSTIC CODE INDEX

| DTC                                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b><u>DTC B0163 or B0183</u></b>         | B0163 02: Passenger Compartment Temperature Sensor Circuit Short to Ground<br>B0163 05: Passenger Compartment Temperature Sensor Circuit High Voltage/Open<br>B0183 02: Solar Load Sensor Circuit Short to Ground<br>B0183 05: Solar Load Sensor Circuit High Voltage/Open                                                                                                                                                                                                                 |
| <b><u>DTC B0173, B0178, or B3933</u></b> | B0173 02: Upper Left Duct Air Temperature Sensor Circuit Short to Ground<br>B0173 05: Upper Left Duct Air Temperature Sensor Circuit High Voltage/Open<br>B0178 02: Lower Left Duct Air Temperature Sensor Circuit Short to Ground<br>B0178 05: Lower Left Duct Air Temperature Sensor Circuit High Voltage/Open<br>B3933 02: Air Conditioning Evaporator Temperature Sensor Circuit Short to Ground<br>B3933 05: Air Conditioning Evaporator Temperature Sensor Circuit High Voltage/Open |

|                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b><u>DTC B0193</u></b>                         | B0193 01: Front Blower Motor Speed Circuit Short to Battery<br>B0193 06: Front Blower Motor Speed Circuit Low Voltage/Open                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b><u>DTC B0228, B0413, B1395, or B374A</u></b> | B0228 02: Left Recirculate Position Feedback Circuit Short to Ground<br>B0228 05: Left Recirculate Position Feedback Circuit High Voltage/Open<br>B0413 02: Main Temperature Control Feedback Circuit Short to Ground<br>B0413 05: Main Temperature Control Feedback Circuit High Voltage/Open<br>B1395 03: Control Module Voltage Reference Output Circuit Low Voltage<br>B1395 07: Control Module Voltage Reference Output Circuit High Voltage<br>B374A 02: Air Flow Control Feedback Circuit Short to Ground<br>B374A 05: Air Flow Control Feedback Circuit High Voltage/Open |
| <b><u>DTC P0532 or P0533</u></b>                | P0532 00: Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit Low Voltage<br>P0533 00: Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit High Voltage                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b><u>DTC P0645</u></b>                         | P0645: Air Conditioning (A/C) Compressor Clutch Relay Control Circuit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

**DTC B0163 OR B0183**

**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 B0163 02**

Passenger Compartment Temperature Sensor Circuit Short to Ground

**DTC B0163 05**

Passenger Compartment Temperature Sensor Circuit High Voltage/Open

**DTC B0183 02**

Solar Load Sensor Circuit Short to Ground

**DTC B0183 05**

Solar Load Sensor Circuit High Voltage/Open

**Diagnostic Fault Information**

| Circuit                                         | Short to Ground | Open/High Resistance   | Short to Voltage | Signal Performance |
|-------------------------------------------------|-----------------|------------------------|------------------|--------------------|
| Passenger Compartment Temperature Sensor Signal | B0163 02        | B0163 05               | B0163 05         | 1                  |
| Sunload Sensor Signal                           | B0183 02        | B0183 05               | B0183 05         | 1                  |
| Ambient Light/Sunload Sensor Ground             | -               | B0163 05,<br>B0183 05, | -                | -                  |
| 1. Air Temperature Malfunction                  |                 |                        |                  |                    |

**Circuit/System Description**

The ambient light/sunload sensor includes the sunload sensor and passenger compartment temperature sensor.

This sensor assembly provides information about:

- Sun heat intensity
- Passenger compartment temperature

The solar sensor is connected to ground and to the 5 V stabilized voltage supply through the HVAC control module. As the sunload increases, the sensor signal voltage also increases and vice versa. The signal varies between 1.4-4.5 V and is provided to the HVAC control module.

The passenger compartment temperature sensor is a negative temperature co-efficient thermistor. A signal and low reference circuit enables the sensor to operate. As the air temperature increases, the sensor resistance decreases. The sensor signal varies between 0-5 V.

Bright or high intensity light causes the vehicles interior temperature to increase. The HVAC system compensates for the increased temperature by diverting additional cool air into the vehicle.

**Conditions for Running the DTC**

- Ignition ON.
- The HVAC control module is ON.

**Conditions for Setting the DTC**

**B0163 02 or B0163 05**

The HVAC control module detects the sensor signal out of range. The signal voltage is less than 0.1 V or greater than 4.9 V for more than 50 ms.

**B0183 02**

The input signal is out of range. The voltage is less than 0.1 V.

**B0183 05**

The input signal is out of range. The voltage is greater than 4.9 V.

#### **Action Taken When the DTC Sets**

- The system will use the last valid values as default.
- If no value is read at the time of fault, the HVAC control module uses 0 W/m<sup>2</sup> as intensity.

#### **Conditions for Clearing the DTC**

The condition for setting the DTC is no longer present.

#### **Reference Information**

#### **Schematic Reference**

#### **HVAC Schematics**

#### **Connector End View Reference**

#### **Component Connector End Views**

#### **Description and Operation**

#### **Automatic HVAC 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. Verify that DTC B0163 02 or B0163 05 is not set.
  - If DTC is present, refer to Passenger Compartment Temperature Sensor Circuit Malfunction.
2. Verify that DTC B0183 02 or B0183 05 is not set.
  - If DTC is present, refer to Sunload Sensor Circuit Malfunction.
3. Measure actual inside air temperature using a thermometer. Compare this value to the scan tool Passenger Compartment Air Temperature parameter. The measured temperature should be within 5°C (9°F) difference of parameter value.

- If not within the specified range, replace the B10B Ambient Light/Sunload Sensor.

## Circuit/System Testing

### Passenger Compartment Temperature Sensor Circuit Malfunction

1. Ignition OFF, disconnect the harness connector at the B10B Ambient Light/Sunload Sensor.
2. Test for less than 5 ohms between the ground circuit terminal 6 and ground.
  - If greater than the specified value, test the ground circuit for an open/high resistance.
3. Ignition ON, test for 4.8-5.2 V between the ground circuit terminal 6 and the signal circuit terminal 3.
  - If less than the specified range, test the signal circuit terminal for a short to ground or open/high resistance. If the circuit tests normal, replace the K33 HVAC Control Module.
  - If greater than the specified range, test the signal circuit terminal for a short to voltage. If the circuit tests normal, replace the K33 HVAC Control Module.
4. If all circuits test normal, replace the B10B Ambient Light/Sunload Sensor and verify the DTC does not reset.
  - If the DTC resets, replace the K33 HVAC Control Module.

### Sunload Sensor Circuit Malfunction

1. Ignition OFF, disconnect the harness connector at the B10B Ambient Light/Sunload Sensor.
2. Ignition ON, test for 4.8-5.2 V between the ground circuit terminal 6 and the signal circuit terminal 4.
  - If less than the specified range, test the signal circuit for a short to ground or open/high resistance. If the circuit tests normal, replace the K33 HVAC Control Module.
  - If greater than the specified range, test the signal circuit for a short to voltage. If the circuit tests normal, replace the K33 HVAC Control Module.
3. If all circuits test normal, replace the B10B Ambient Light/Sunload Sensor and verify the DTC does not reset.
  - If the DTC resets, replace the K33 HVAC Control Module.

## Repair Procedures

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

- **Headlamp Automatic Control Ambient Light Sensor Replacement**
- **Control Module References** for HVAC control module replacement, setup, and programming

## DTC B0173, B0178, OR B3933

### 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 B0173 02**

Upper Left Duct Air Temperature Sensor Circuit Short to Ground

**DTC B0173 05**

Upper Left Duct Air Temperature Sensor Circuit High Voltage/Open

**DTC B0178 02**

Lower Left Duct Air Temperature Sensor Circuit Short to Ground

**DTC B0178 05**

Lower Left Duct Air Temperature Sensor Circuit High Voltage/Open

**DTC B3933 02**

Air Conditioning Evaporator Temperature Sensor Circuit Short to Ground

**DTC B3933 05**

Air Conditioning Evaporator Temperature Sensor Circuit High Voltage/Open

**Diagnostic Fault Information**

| Circuit                                              | Short to Ground | Open/High Resistance | Short to Voltage                   | Signal Performance |
|------------------------------------------------------|-----------------|----------------------|------------------------------------|--------------------|
| Upper Left Duct Air Temperature Sensor Signal        | B0173 02        | B0173 05             | B0173 05                           | 1                  |
| Lower Left Duct Air Temperature Sensor Signal        | B0178 02        | B0178 05             | B0178 05                           | 1                  |
| A/C Evaporator Temperature Sensor Signal             | B3933 02        | B3933 05             | B3933 05                           | 1                  |
| Upper Left Duct Air Temperature Low Reference        | -               | B0173 05             | B0173 05,<br>B0178 05,<br>B3933 05 | -                  |
| Lower Left Duct Air Temperature Sensor Low Reference | -               | B0178 05             | B0173 05,<br>B0178 05,<br>B3933 05 | -                  |
| A/C Evaporator Temperature Sensor Low Reference      | -               | B3933 05             | B0173 05,<br>B0178 05,<br>B3933 05 | -                  |
| 1. Air Temperature Malfunction                       |                 |                      |                                    |                    |

## **Circuit/System Description**

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

- Air temperature sensor - left upper
- Air temperature sensor - left lower
- A/C evaporator temperature sensor

A signal and low reference circuit enables the sensor to operate. As the air temperature surrounding the sensor increases, the sensor resistance decreases. The sensor signal voltage decreases as the resistance decreases. The sensor operates within a temperature range between -40 to +85°C (-40 to +185°F). The sensor signal varies between 0-5 V. The HVAC control module converts the signal to a range between 0-255 counts. As the air temperature increases the count value will decrease. If the HVAC control module detects a malfunctioning sensor, then the control module software will use a default air temperature value. The default action ensures that the HVAC system can adjust the inside air temperature near the desired temperature until the condition is corrected.

## **Conditions for Running the DTC**

- Ignition ON.
- The HVAC control module is ON.

## **Conditions for Setting the DTC**

The HVAC control module detects the sensor signal out of range. The signal voltage is less than 0.1 V or greater than 4.9 V for more than 50 ms.

## **Action Taken When the DTC Sets**

The system operates using a default value.

## **Conditions for Clearing the DTC**

The sensor signal is within specified range between 0.1-4.9 V.

## **Reference Information**

## **Schematic Reference**

## **HVAC Schematics**

## **Connector End View Reference**

## **Component Connector End Views**

## **Description and Operation**

## **Automatic HVAC 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. Verify that DTC B0173 or B0178 is not set.
  - If a DTC is set, refer to Duct Temperature Sensor Circuit Malfunction.
2. Verify that DTC B3933 is not set.
  - If a DTC is set, refer to A/C Evaporator Temperature Sensor Circuit Malfunction.
3. Measure actual temperature using a thermometer at each of the duct temperature sensors. Compare this value to the appropriate scan tool Duct Actual parameter. The measured temperature should be within 5°C (9°F) difference of appropriate Duct Actual parameter value.
  - If not within the specified range, replace the appropriate duct temperature sensor.
4. Measure actual evaporator temperature using a thermometer. Compare this value to the scan tool A/C Evaporator Temperature Sensor parameter. The measured temperature should be within 5°C (9°F) difference of parameter value.
  - If not within the specified range, replace the B39 A/C Evaporator Temperature Sensor.

### **Circuit/System Testing**

#### **Duct Temperature Sensor Circuit Malfunction**

1. Ignition OFF, disconnect the harness connector at the appropriate temperature sensor.
2. Test for less than 5 ohms between the temperature sensor ground circuit terminal 2 and ground.
  - If greater than the specified value, test the ground circuit for an open/high resistance.
3. Ignition ON, test for 4.8-5.2 V between the signal circuit terminal 1 and ground.
  - If less than the specified range, test the signal circuit for a short to ground or open/high resistance. If the circuit tests normal, replace the K33 HVAC Control Module.
  - If greater than the specified range, test the signal circuit for a short to voltage. If the circuit tests normal, replace the K33 HVAC Control Module.
4. If all circuits test normal, replace the temperature sensor and verify the DTC does not reset.
  - If the DTC resets, replace the K33 HVAC Control Module.

A/C Evaporator Temperature Sensor Circuit Malfunction

1. Ignition OFF, disconnect the harness connector at the B39 A/C Evaporator Temperature Sensor.
2. Test for less than 5 ohms between the temperature sensor ground circuit terminal B and ground.
  - o If greater than the specified value, test the ground circuit for an open/high resistance.
3. Ignition ON, test for 4.8-5.2 V between the signal circuit terminal A and ground.
  - o If less than the specified range, test the signal circuit for a short to ground or open/high resistance. If the circuit tests normal, replace the K33 HVAC Control Module.
  - o If greater than the specified range, test the signal circuit for a short to voltage. If the circuit tests normal, replace the K33 HVAC Control Module.
4. If all circuits test normal, replace the B39 A/C Evaporator Temperature Sensor and verify the DTC does not reset.
  - o If the DTC resets, replace the K33 HVAC Control Module.

Repair Procedures

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

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

DTC B0193

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 B0193 01

Front Blower Motor Speed Circuit Short to Battery

DTC B0193 06

Front Blower Motor Speed Circuit Low Voltage/Open

Diagnostic Fault Information

| Circuit                        | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|--------------------------------|-----------------|----------------------|------------------|--------------------|
| Blower Motor Control Module B+ | B0193 06        | B0193 06             | -                | -                  |
| Blower Motor B+                | 1               | 1                    | -                | -                  |

|                                                          |          |          |          |   |
|----------------------------------------------------------|----------|----------|----------|---|
| Blower Motor Control Module Control                      | B0193 06 | B0193 06 | B0193 01 | - |
| Blower Motor Control                                     | 2        | 1        | 1        | - |
| Blower Motor Control Module Ground                       | -        | 1        | -        | - |
| 1. Blower Motor Inoperative<br>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 from the HVAC control module, battery positive and ground circuits enable the blower motor control module to operate. The HVAC control module provides a pulse width modulation (PWM) signal to the blower motor control module in order to command the blower motor speed. The blower motor control module transfers the PWM signal into a corresponding blower motor voltage. The voltage resides between 2-13 V and changes linear to the height of the PWM signal.

### Conditions for Running the DTC

- Ignition ON.
- The HVAC control module is ON.

### Conditions for Setting the DTC

#### B0193 01

The voltage at the HVAC control module output to the blower motor control module is always high.

#### B0193 06

The voltage at the HVAC control module output to the blower motor control module is always low or floating.

### Action Taken When the DTC Sets

The blower motor is inoperative.

### Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

### Reference Information

### Schematic Reference

### HVAC Schematics

### Connector End View Reference

## **Component Connector End Views**

### **Description and Operation**

## **Automatic HVAC 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 X1 harness connector at the K8 Blower Motor Control Module.
2. Test for less than 5 ohms between the ground circuit terminal 5 X1 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 X1 at the K8 Blower Motor Control Module harness connector and ground.
  - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance.
4. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module.
5. Ignition ON, test for less than 0.3 V between the control circuit terminal 3 X1 at the K8 Blower Motor Control Module harness connector and ground.
  - If greater than the specified range, test the control circuit for a short to voltage.
6. Ignition OFF, test for infinite resistance between the control circuit terminal 3 X1 at the K8 Blower Motor Control Module harness connector and ground.
  - If less than the specified range, test the control circuit for a short to ground.
7. Test for less than 5 ohms between the K33 HVAC Control Module control circuit terminal 15 X2 and control circuit terminal 3 X1 at the K8 Blower Motor Control Module harness connector.
  - If greater than the specified value, test the control circuit for an open/high resistance.
8. If all circuits test normal, replace the K8 Blower Motor Control Module.

### **Repair Procedures**

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

- **Blower Motor Control Module Replacement**

- **Control Module References** for HVAC control module replacement, setup, and programming

**DTC B0228, B0413, B1395, OR B374A**

**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 B0228 02**

Left Recirculate Position Feedback Circuit Short to Ground

**DTC B0228 05**

Left Recirculate Position Feedback Circuit High Voltage/Open

**DTC B0413 02**

Main Temperature Control Feedback Circuit Short to Ground

**DTC B0413 05**

Main Temperature Control Feedback Circuit High Voltage/Open

**DTC B1395 03**

Control Module Voltage Reference Output Circuit Low Voltage

**DTC B1395 07**

Control Module Voltage Reference Output Circuit High Voltage

**DTC B374A 02**

Air Flow Control Feedback Circuit Short to Ground

**DTC B374A 05**

Air Flow Control Feedback Circuit High Voltage/Open

**Diagnostic Fault Information**

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

| Circuit                                                                                               | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|-------------------------------------------------------------------------------------------------------|-----------------|----------------------|------------------|--------------------|
| Recirculation Actuator 5V Reference                                                                   | B1395 03        | B1395 07             | B1395 07         | -                  |
| Air Temperature Actuator 5V Reference                                                                 | B1395 03        | B1395 07             | B1395 07         | -                  |
| Mode Actuator 5V Reference                                                                            | B1395 03        | B1395 07             | B1395 07         | -                  |
| Recirculation Actuator Signal                                                                         | B0228 02        | B0228 05             | B0228 05         | 1                  |
| Air Temperature Actuator Signal                                                                       | B0413 02        | B0413 05             | B0413 05         | 2                  |
| Mode Actuator Signal                                                                                  | B374A 02        | B374A 05             | B374A 05         | 3                  |
| Recirculation Actuator Control 1                                                                      | 1               | 1                    | 1                | 1                  |
| Recirculation Actuator Control 2                                                                      | 1               | 1                    | 1                | 1                  |
| Air Temperature Actuator Control 1                                                                    | 2               | 2                    | 2                | 2                  |
| Air Temperature Actuator Control 2                                                                    | 2               | 2                    | 2                | 2                  |
| Mode Actuator Control 1                                                                               | 3               | 3                    | 3                | 3                  |
| Mode Actuator Control 2                                                                               | 3               | 3                    | 3                | 3                  |
| Recirculation Actuator Low Reference                                                                  | -               | B0228 05             | B0228 05         | -                  |
| Air Temperature Actuator Low Reference                                                                | -               | B0413 05             | B0413 05         | -                  |
| Mode Actuator Low Reference                                                                           | -               | B374A 05             | B374A 05         | -                  |
| 1. Air Recirculation Malfunction<br>2. Air Temperature Malfunction<br>3. Air Distribution Malfunction |                 |                      |                  |                    |

### Circuit/System Description

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

### Conditions for Running the DTC

- Ignition ON.
- The HVAC control module is ON.

## Conditions for Setting the DTC

### **B0228 02, B0413 02 or B374A 02**

The HVAC control module detects the sensor signal out of range. The signal voltage is less than 0.1 V for more than 50 ms.

### **B0228 05, B0413 05 or B374A 05**

The HVAC control module detects the sensor signal out of range. The signal voltage is greater than 4.9 V for more than 50 ms.

### **B1395 03**

The HVAC control module detects the sensor reference voltage out of range. The reference voltage is less than 0.1 V for more than 50 ms.

### **B1395 07**

The HVAC control module detects the sensor reference voltage out of range. The reference voltage is greater than 4.9 V for more than 50 ms.

## Action Taken When the DTC Sets

### **B1395**

- The affected output will be switched off for hardware protection.
- All actuators are deactivated.

### **B0228, B0413, or B374A**

- The affected output will be switched off for hardware protection.
- The affected actuator is deactivated.

## Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

## Reference Information

## Schematic Reference

### HVAC Schematics

## Connector End View Reference

### Component Connector End Views

## Description and Operation

### Automatic HVAC 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 5-250 counts.

#### Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the appropriate actuator.
2. Ignition OFF, test for less than 5 ohms between the low reference circuit terminal 1 and ground.
  - If greater than the specified value, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the K33 HVAC Control Module.
3. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.
  - If less than the specified range, test the 5 V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K33 HVAC Control Module.
  - If greater than the specified range, test the 5 V reference circuit for a short to voltage. If the circuit tests normal, replace the K33 HVAC Control Module.
4. Verify the appropriate scan tool Door Position parameter is greater than 250 counts.
  - If less than the specified value, test the signal circuit terminal 2 for a short to ground. If the circuit tests normal, replace the K33 HVAC Control Module.
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the low reference circuit terminal 1. Verify the appropriate scan tool Door Position parameter is less than 5 counts.
  - If greater than the specified value, test the signal circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K33 HVAC Control Module.
6. If all circuits test normal, replace the appropriate actuator and verify the DTC does not reset.
  - If the DTC resets, replace the K33 HVAC Control Module.

#### Repair Procedures

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Temperature Valve Actuator Replacement**
- **Air Inlet Valve Actuator Replacement**
- **Mode Valve Actuator Replacement**
- **Control Module References** for HVAC control module replacement, setup, and programming

**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 00**

Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit Low Voltage

**DTC P0533 00**

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 |
|------------------------------------|-----------------|----------------------|------------------|--------------------|
| 5V Reference                       | P0532 00        | P0532 00             | -                | -                  |
| Refrigerant Pressure Sensor Signal | P0532 00        | P0532 00             | P0533 00         | -                  |
| Low Reference                      | -               | P0532 00             | -                | -                  |

**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 5V 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 activation of the A/C compressor.

**Conditions for Running the DTC**

Engine is running.

**Conditions for Setting the DTC**

## **P0532 00**

The ECM detects a short to ground or open at the A/C pressure sensor signal circuit.

## **P0533 00**

The ECM detects a short to voltage at the A/C pressure sensor signal circuit.

### **Action Taken When the DTC Sets**

- The A/C compressor is disabled.
- The ECM will illuminate the malfunction indicator lamp (MIL).

### **Conditions for Clearing the DTC**

The condition for setting the DTC is no longer present.

### **Reference Information**

#### **Schematic Reference**

#### **HVAC Schematics**

#### **Connector End View Reference**

#### **Component Connector End Views**

#### **Description and Operation**

#### **Automatic HVAC Description and Operation**

#### **Electrical Information Reference**

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

#### **Scan Tool Reference**

#### **Control Module References** for scan tool information

#### **Circuit/System Testing**

1. Ignition OFF, disconnect the harness connector at the B1 A/C Refrigerant Pressure Sensor.
2. Ignition ON, test for 4.8-5.2 V between the 5V reference circuit terminal 2 and ground.

- If less than the specified range, test the 5V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace K20 Engine Control Module.
  - If greater than the specified range, test the 5V reference circuit for a short to voltage. If the circuit tests normal, replace the K20 Engine Control Module.
3. Test for 4.8-5.2 V between the 5V reference circuit terminal 2 and the low reference circuit terminal 1.
    - If less than the specified range, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace K20 Engine Control Module.
    - If greater than the specified range, test the low reference circuit for a short to voltage. If the circuit tests normal, replace the K20 Engine Control Module.
  4. Verify the scan tool A/C High Side Pressure Sensor parameter is less than 0.3 V.
    - If greater than the specified range, test the signal circuit for a short to voltage. If the circuit tests normal, replace the K20 Engine Control Module.
  5. Install a 3A fused jumper wire between the following signal circuit terminal 3 and the 5V reference circuit terminal 2. Verify the scan tool A/C high side pressure sensor parameter is greater than 4.8 V.
    - If less than the specified range, test the signal circuit for a short to ground or open/high resistance. If the circuit tests normal, replace the K20 Engine Control Module.
  6. If all circuits test normal, replace the B1 A/C Refrigerant Pressure Sensor.

**Repair Procedures**

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

- **Air Conditioning Refrigerant Pressure Sensor Valve Replacement (LAF)** or **Air Conditioning Refrigerant Pressure Sensor Valve Replacement (LF1)**
- **Control Module References** for HVAC Control Module 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**

Air Conditioning (A/C) Compressor Clutch Relay Control Circuit

**Diagnostic Fault Information**

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

|                                                                                               |       |       |       |   |
|-----------------------------------------------------------------------------------------------|-------|-------|-------|---|
| A/C Compressor Clutch Relay Coil Ignition                                                     | P0645 | P0645 | -     | - |
| A/C Compressor Clutch Relay Switch B+                                                         | 1     | 1     | -     | - |
| A/C Compressor Clutch Relay Coil Control                                                      | P0645 | P0645 | P0645 | 3 |
| A/C Compressor Control                                                                        | 1     | 1     | 2     | - |
| A/C Compressor Ground                                                                         | 1     | 1     | -     | - |
| 1. A/C Compressor Inoperative<br>2. A/C Compressor Always ON<br>3. A/C Compressor Malfunction |       |       |       |   |

### Circuit/System Description

When the A/C switch is pressed, the HVAC control module sends an A/C request message to the engine control module (ECM) via CAN-Bus. Therefore, the ECM grounds the A/C compressor clutch relay control circuit, which will switch the A/C compressor clutch relay. With the relay contacts closed, battery voltage is supplied to the A/C compressor clutch. The A/C compressor clutch will be activated.

### Conditions for Running the DTC

- Engine is running.
- The HVAC control module is ON.
- The A/C switch is active.

### Conditions for Setting the DTC

#### P0645

The ECM detects a short to ground or an open at the A/C compressor clutch relay control circuit.

### Action Taken When the DTC Sets

The A/C compressor is inoperative or always active.

### Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

### Reference Information

### Schematic Reference

### HVAC Schematics

### Connector End View Reference

## **Component Connector End Views**

### **Description and Operation**

## **Automatic HVAC 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, remove the KR29 A/C Compressor Clutch Relay.
2. Ignition ON, test for greater than 11 V between the ignition circuit terminal 86 at the KR29 A/C Compressor Clutch Relay and ground.
  - If less than the specified value, test the ignition circuit for a short to ground or an open/high resistance.
3. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
4. Ignition ON, test for less than 0.3 V between the control circuit terminal 85 at the KR29 A/C Compressor Clutch Relay and ground.
  - If greater than the specified value, test the control circuit for a short to voltage.
5. Ignition OFF, test for infinite resistance between the control circuit terminal 85 at the KR29 A/C Compressor Clutch Relay and ground.
  - If less than the specified value, test the control circuit for a short to ground.
6. Test for less than 5 ohms between the KR29 A/C Compressor Clutch Relay control circuit terminal 85 and the control circuit terminal 32 X1 at the K20 Engine Control Module.
  - If greater than the specified value, test the control circuit for an open/high resistance.
7. If all circuits test normal, test or replace the KR29 A/C Compressor Clutch Relay and verify the DTC does not reset.
  - If the DTC resets, replace the K20 Engine Control Module.

### **Component Testing**

#### **Static Test**

1. Ignition OFF, disconnect the KR29 A/C Compressor Clutch Relay.
2. Test for 60-180 ohms between the B+ terminal 85 and the control terminal 86 of the KR29 A/C

Compressor Clutch Relay.

- If not within the specified range, replace the KR29 A/C Compressor Clutch Relay.

3. Test for the resistance between the following terminals:

- 30 and 86
- 30 and 87
- 30 and 85
- 85 and 87

- If not the specified value, replace the KR29 A/C Compressor Clutch Relay.

### Repair Procedures

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

**Control Module References** for engine control module replacement, setup, and programming

### SYMPTOMS - HVAC SYSTEMS - AUTOMATIC

**NOTE:**        **The following steps must be completed before using the symptom tables:**

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

### Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the HVAC System. Refer to **Checking Aftermarket Accessories** Checking Aftermarket Accessories.
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.
- Verify the A/C compressor turns freely and is not seized.
- Verify that the customer is using the correct key to enable personalization and is not inadvertently activating auxiliary HVAC controls.
- The A/C compressor will not operate in cold outside air temperatures.
- The following conditions may cause window fogging:
  - Wet carpet or mats
  - High humidity
  - Interior water leak
  - Blocked A/C evaporator drain tube

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

### Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** 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**Air Conditioning Compressor Malfunction
- **Blower Motor Malfunction**Blower Motor Malfunction
- **Air Temperature Malfunction**Air Temperature Malfunction
- **Air Delivery Improper**
- **Air Recirculation Malfunction**

## AIR CONDITIONING COMPRESSOR MALFUNCTION

### Diagnostic Instructions

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

### Diagnostic Fault Information

| Circuit                                                                                       | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|-----------------------------------------------------------------------------------------------|-----------------|----------------------|------------------|--------------------|
| A/C Compressor Clutch Relay Coil Ignition                                                     | P0645           | P0645                | -                | -                  |
| A/C Compressor Clutch Relay Switch B+                                                         | 1               | 1                    | -                | -                  |
| A/C Compressor Clutch Relay Coil Control                                                      | P0645           | P0645                | P0645            | 3                  |
| A/C Compressor Control                                                                        | 1               | 1                    | 2                | -                  |
| A/C Compressor Ground                                                                         | 1               | 1                    | -                | -                  |
| 1. A/C Compressor Inoperative<br>2. A/C Compressor Always ON<br>3. A/C Compressor Malfunction |                 |                      |                  |                    |

## **Circuit/System Description**

When the A/C switch is pressed, the HVAC control module sends an A/C request message to the engine control module (ECM) via CAN-Bus. Therefore the ECM grounds the A/C compressor clutch relay control circuit, which will switch the A/C compressor clutch relay. With the relay contacts closed, battery voltage is supplied to the A/C compressor clutch. The A/C compressor clutch will be activated.

## **Diagnostic Aids**

The following conditions must be met in order for the HVAC control module to turn on the A/C compressor:

- Battery voltage is between 9-18 V
- Engine coolant temperature is less than 124°C (255°F)
- Engine speed is greater than 600 RPM
- Engine speed is less than 5 500 RPM
- A/C high side pressure is between 269-2 929 kPa (39-425 PSI)
- Throttle position is less than 100%
- Evaporator temperature is greater than 3°C (38°F)
- ECM does not detect immoderate 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**

#### **Automatic HVAC 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**

**NOTE:**        **Before executing Circuit/System Testing, all conditions shown in Diagnostic Aids must be met.**

1. Ignition ON, activate and deactivate the A/C switch. Verify the scan tool A/C Switch parameter changes between Active and Inactive.
  - If not the specified value, replace the A20 Radio/HVAC Control.
2. Activate and deactivate the A/C switch. Verify the engine control module (ECM) scan tool A/C Request Signal parameter changes between Active and Inactive.
  - If not the specified value, replace the K33 HVAC Control Module.
3. Ignition OFF, remove the KR29 A/C Compressor Clutch Relay.
4. Ignition ON, verify that a test lamp illuminates between the B+ circuit terminal 30 and ground.
  - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance.
5. Verify that a test lamp does not illuminate between the control circuit terminal 87 and ground.
  - If the test lamp illuminates, test the control circuit for a short to voltage.
6. Ignition OFF, disconnect the harness connector at the Q2 A/C Compressor Clutch.
7. Test for less than 5 ohms between the Q2 A/C Compressor Clutch ground circuit terminal A and ground.
  - If greater than the specified value, test the ground circuit for an open/high resistance.
8. Connect the harness connector at the Q2 A/C Compressor Clutch.
9. Ignition ON, connect a 10 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87. Verify the Q2 A/C Compressor Clutch is activated.
  - If the Q2 A/C Compressor Clutch does not activate, test the control circuit for an open/high resistance. If the circuit test normal, replace the Q2 A/C Compressor Clutch.
10. Connect a test lamp between the ignition circuit terminal 85 and the control circuit terminal 86.
11. Command the engine control module (ECM) A/C Relay output function ON and OFF with the scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
  - If the test lamp always illuminates or always does not illuminate, replace the K20 Engine Control Module.
12. If all circuits test normal, replace the KR29 A/C Compressor Clutch Relay.

### **Repair Procedures**

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

- **Air Conditioning Compressor Replacement (LAF)** or **Air Conditioning Compressor Replacement (LF1)**
- **Radio Control Assembly Replacement**
- **Control Module References** for HVAC Control Module 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+                           | B0193 06        | B0193 06             | -                | -                  |
| Blower Motor B+                                          | 1               | 1                    | -                | -                  |
| Blower Motor Control Module Control                      | B0193 06        | B0193 06             | B0193 01         | -                  |
| Blower Motor Control                                     | 2               | 1                    | 1                | -                  |
| Blower Motor Control Module Ground                       | -               | 1                    | -                | -                  |
| 1. Blower Motor Inoperative<br>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 from the HVAC control module, battery positive and ground circuits enable the blower motor control module to operate. The HVAC control module provides a pulse width modulation (PWM) signal to the blower motor control module in order to command the blower motor speed. The blower motor control module transfers the PWM signal into a corresponding blower motor voltage. The voltage amounts to between 2-13 V and changes linear to the reading of the PWM signal.

## Diagnostic Aids

Check the following mechanical fault sources:

- Air distribution box
- Air distribution hoses/air distribution ducts

## Reference Information

## Schematic Reference

## HVAC Schematics

## Connector End View Reference

## **Component Connector End Views**

### **Description and Operation**

## **Automatic HVAC 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, press and release the POWER switch. Verify the scan tool Front HVAC System Status parameter changes between Off and On.
  - If not the specified value, replace the A20 Radio/HVAC Controls.
2. Turn the blower motor knob on high speed then to low speed. Verify the scan tool Blower Motor Switch parameter. The reading should correspond to the selected blower step.
  - If not the specified value, replace the A20 Radio/HVAC Controls.
3. Press and release the AUTO Switch. Verify the scan tool Auto HVAC Button parameter changes between Active and Inactive.
  - If not the specified value, replace the A20 Radio/HVAC Controls.

### **Circuit/System Testing**

1. Ignition OFF, disconnect the X1 harness connector at the K8 Blower Motor Control Module.
2. Test for less than 5 ohms between the ground circuit terminal 5 X1 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 X1 and ground.
  - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance.
4. Connect a DMM between the control circuit terminal 3 X1 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 V while changing between the commanded states, test the control circuit for a short to voltage. If the circuit test normal, replace the K33 HVAC Control Module.

- If voltage remains less than 1.0 V 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 K33 HVAC Control Module.
  - If voltage is between 1.0-11.5 V and does not increase when changing between the commanded states, replace the K33 HVAC Control Module.
6. Ignition OFF, connect the X1 harness connector at the K8 Blower Motor Control Module and disconnect the harness connector at the M8 Blower Motor.
7. Ignition ON, verify that a test lamp illuminates between the B+ circuit terminal 2 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 K8 Blower Motor Control Module.
8. Connect a test lamp between the B+ circuit terminal 2 and the control circuit terminal 1.
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 K8 Blower Motor Control Module.
10. If all circuits test normal, replace the M8 Blower Motor.

**Repair Procedures**

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

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

**AIR TEMPERATURE MALFUNCTION**

**Diagnostic Instructions**

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

**Diagnostic Fault Information**

| Circuit                               | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------------------------------|-----------------|----------------------|------------------|--------------------|
| Air Temperature Actuator 5V Reference | B1395 03        | B1395 07             | B1395 07         | -                  |
| Air Temperature Actuator Control 1    | 1               | 1                    | 1                | 1                  |
| Air Temperature Actuator Control 2    | 1               | 1                    | 1                | 1                  |
|                                       |                 |                      |                  |                    |

|                                        |          |          |          |   |
|----------------------------------------|----------|----------|----------|---|
| Air Temperature Actuator Signal        | B0413 02 | B0413 05 | B0413 05 | 1 |
| Air Temperature Actuator Low Reference | -        | B0413 05 | B0413 05 | - |
| 1. Air Temperature Malfunction         |          |          |          |   |

### Circuit/System Description

With the temperature switch at the Radio/HVAC control, the desired air temperature flap position can be put in. The selected value is sent to the HVAC control module via the LIN-Bus.

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

### Diagnostic Aids

Check the following mechanical fault sources:

- Air distribution box
- Air distribution hoses/air distribution ducts

### Reference Information

### Schematic Reference

### HVAC Schematics

### Connector End View Reference

### Component Connector End Views

### Description and Operation

### Automatic HVAC 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**

### **Circuit/System Verification**

1. Ignition ON, press and release the POWER switch. Verify the scan tool Front HVAC System Status parameter changes between Off and On.
  - If not the specified value, replace the A20 Radio/HVAC Control.
2. Ignition ON, turn the temperature knob in all positions. Verify the scan tool Left Temperature Knob Position parameter. The reading should be between -5 to +5 and change with the knob position. At the left end position the reading should be 18 and at the right end position -18.
  - If not the specified value, replace the A20 Radio/HVAC Control.
3. Command the air temperature actuator in both directions with a scan tool. The scan tool Left Temperature Door Position parameter reading should be between 5-250 counts and change during the movement.
  - If not the within specified range, refer to Circuit/System Testing.
4. Measure actual inside air temperature using a thermometer. Compare this value to the scan tool Passenger Compartment Air Temperature parameter. The measured temperature should be within 5°C (9°F) difference of parameter value.
  - If not within the specified range, refer to **DTC B0163 or B0183**
5. Measure actual temperature using a thermometer at each of the duct temperature sensors. Compare this value to the appropriate scan tool Duct Actual parameter. The measured temperature should be within 5°C (9°F) difference of appropriate Duct Actual parameter value.
  - If not within the specified range, refer to **DTC B0173, B0178, or B3933**
6. Measure actual evaporator temperature using a thermometer. Compare this value to the scan tool A/C Evaporator Temperature Sensor parameter. The measured temperature should be within 5°C (9°F) difference of parameter value.
  - If not within the specified range, refer to **DTC B0173, B0178, or B3933**
7. Observe the scan tool Sunload parameter. The reading should be between 50-150 W/m<sup>2</sup> and change with sunlight intensity.
  - If not within the specified range or not change, refer to **DTC B0163 or B0183**
8. Engine is running, activate and deactivate the A/C switch. Verify the A/C compressor can be activated and deactivated.
  - If the A/C compressor cannot be activated or deactivated, refer to **Air Conditioning Compressor Malfunction**
9. Verify the engine reaches its operating temperature.
10. If all tests normal, replace the K33 HVAC Control Module.

### **Circuit/System Testing**

1. Ignition OFF, disconnect the harness connector at the M6 Air Temperature Door Actuator.
2. Test for less than 5 ohms between the control circuit terminal 4 and ground.
  - o If greater than the specified range, test the control circuit for a short to voltage or an open/high resistance. If circuit tests normal, replace the K33 HVAC Control Module.
3. Test for less than 5 ohms between the control circuit terminal 5 and ground.
  - o If greater than the specified range, test the control circuit for a short to voltage or an open/high resistance. If circuit tests normal, replace the K33 HVAC Control Module.
4. Connect a test lamp between control circuit terminal 5 and control circuit terminal 4.
5. Command the M6 Air Temperature Door Actuator in both directions with a scan tool. The test lamp should turn ON and OFF when commanded in both directions.
  - o If the test lamp remains OFF during either of the commands, test for a short to ground on either control circuit. If the circuits test normal, replace the K33 HVAC Control Module.
6. If both circuits test normal, replace the M6 Air Temperature Door Actuator

**Repair Procedures**

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

- **Temperature Valve Actuator Replacement**
- **Radio Control Assembly Replacement**
- **Control Module References**

**AIR DELIVERY IMPROPER**

**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 |
|---------------------------------|-----------------|----------------------|------------------|--------------------|
| Mode Actuator 5V Reference      | B1395 03        | B1395 07             | B1395 07         | -                  |
| Mode Actuator Control 1         | 1               | 1                    | 1                | 1                  |
| Mode Actuator Control 2         | 1               | 1                    | 1                | 1                  |
| Mode Actuator Signal            | B374A 02        | B374A 05             | B374A 05         | 1                  |
| Mode Actuator Low Reference     | -               | B374A 05             | B374A 05         | -                  |
| 1. Air Distribution Malfunction |                 |                      |                  |                    |

**Circuit/System Description**

With the MODE switches at the Radio/HVAC control, the wished air distribution flap position can be put in. The selected value is sent to the HVAC control module via the LIN-Bus.

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

### **Diagnostic Aids**

Check the following mechanical fault sources:

- Air distribution box
- Air distribution hoses/air distributing ducts

### **Reference Information**

#### **Schematic Reference**

#### **HVAC Schematics**

#### **Connector End View Reference**

#### **Component Connector End Views**

#### **Description and Operation**

#### **Automatic HVAC 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**

## Circuit/System Verification

1. Ignition ON, press and release the POWER switch. Verify the scan tool Front HVAC System Status parameter changes between Off and On.
  - If not the specified value, replace the A20 Radio/HVAC Control.
2. Press and release the MODE Up switch. Verify the scan tool Mode Switch parameter changes between Up and Inactive.
  - If not the specified value, replace the A20 Radio/HVAC Control.
3. Press and release the MODE Down switch. Verify the scan tool Mode Switch parameter changes between Down and Inactive.
  - If not the specified value, replace the A20 Radio/HVAC Control.
4. Press and release the defrost switch. Verify the scan tool Enhanced Defrost Switch parameter changes between Active and Inactive.
  - If not the specified value, replace the A20 Radio/HVAC Control.
5. Press and release the AUTO Switch. Verify the scan tool Auto HVAC Button parameter changes between Active and Inactive.
  - If not the specified value, replace the A20 Radio/HVAC Control.
6. Command the mode door actuator in both directions with a scan tool. The scan tool Left Mode Door Motor Direction parameter should change between Increase and Decrease during the movement.
  - If not the specified value, refer to Circuit/System Testing.
7. If all tests normal, replace the K33 HVAC Control Module.

## Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the M37 Mode Door Actuator.
2. Test for less than 5 ohms between the control circuit terminal 4 and ground.
  - If greater than the specified range, test the control circuit for a short to voltage or an open/high resistance. If circuit tests normal, replace the K33 HVAC Control Module.
3. Test for less than 5 ohms between the control circuit terminal 5 and ground.
  - If greater than the specified range, test the control circuit for a short to voltage or an open/high resistance. If circuit tests normal, replace the K33 HVAC Control Module.
4. Connect a test lamp between control circuit terminal 5 and control circuit terminal 4.
5. Command the M37 Mode Door Actuator in both directions with a scan tool. The test lamp should turn ON and OFF when commanded in both directions.
  - If the test lamp remains OFF during either of the commands, test for a short to ground on either control circuit. If the circuits test normal, replace the K33 HVAC Control Module.
6. If both circuits test normal, replace the M37 Mode Door Actuator.

## Repair Procedures

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

### ● **Mode Valve Actuator Replacement**

- **Radio Control Assembly Replacement**
- **Control Module References**

## 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

| Circuit                              | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|--------------------------------------|-----------------|----------------------|------------------|--------------------|
| Recirculation Actuator 5V Reference  | B1395 03        | B1395 07             | B1395 07         | -                  |
| Recirculation Actuator Control 1     | 1               | 1                    | 1                | 1                  |
| Recirculation Actuator Control 2     | 1               | 1                    | 1                | 1                  |
| Recirculation Actuator Signal        | B0228 02        | B0228 05             | B0228 05         | 1                  |
| Recirculation Actuator Low Reference | -               | B0228 05             | B0228 05         | -                  |
| 1. Air Recirculation Malfunction     |                 |                      |                  |                    |

### Circuit/System Description

For vehicles with heated seats the desired position of the recirculation flap can be set with the recirculation switch at the Radio/HVAC control. For vehicles without heated seats the desired position of the recirculation flap can be set with the recirculation and fresh air switch. The selected value is sent to the HVAC control module via the LIN-Bus.

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

### Diagnostic Aids

Check the following mechanical fault sources:

- Air distribution box
- Air distribution hoses/air distribution ducts

## **Reference Information**

## **Schematic Reference**

### **HVAC Schematics**

## **Connector End View Reference**

### **Component Connector End Views**

## **Description and Operation**

### **Automatic HVAC 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**

## **Circuit/System Verification**

1. Ignition ON, press and release the defrost switch. Verify the scan tool Enhanced Defrost Switch parameter changes between Active and Inactive.
  - If not the specified value, replace the A20 Radio/HVAC Control.
2. Press and release the recirculation switch. Verify the scan tool Air Recirculation Mode Switch parameter changes between Active and Inactive.
  - If not the specified value, replace the A20 Radio/HVAC Control.
3. Without heated seats: Press and release the fresh air switch. Verify the scan tool Fresh Air Switch parameter changes between On and Off.
  - If not the specified value, replace the A20 Radio/HVAC Control.
4. Command the recirculation door actuator in both directions with a scan tool. The scan tool Air Recirculation Door Position parameter reading should be between 5-250 counts and change during the movement.
  - If not the within specified range, refer to Circuit/System Testing.
5. If all tests normal, replace the K33 HVAC Control Module.

## Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the M46 Recirculation Door Motor.
2. Test for less than 5 ohms between the control circuit terminal 4 and ground.
  - If greater than the specified range, test the control circuit for a short to voltage or an open/high resistance. If circuit tests normal, replace the K33 HVAC Control Module.
3. Test for less than 5 ohms between the control circuit terminal 5 and ground.
  - If greater than the specified range, test the control circuit for a short to voltage or an open/high resistance. If circuit tests normal, replace the K33 HVAC Control Module.
4. Connect a test lamp between control circuit terminal 5 and control circuit terminal 4.
5. Command the M46 Recirculation Door Motor in both directions with a scan tool. The test lamp should turn ON and OFF when commanded in both directions.
  - If the test lamp remains OFF during either of the commands, test for a short to ground on either control circuit. If the circuits test normal, replace the K33 HVAC Control Module.
6. If both circuits test normal, replace the M46 Recirculation Door Motor.

## Repair Procedures

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

- **Air Inlet Valve Actuator Replacement**
- **Radio Control Assembly Replacement**
- **Control Module References**

## ACTUATOR RECALIBRATION

**NOTE:** 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.

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:

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. Ignition ON.
6. Wait 40 s 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:

## Preferred Method (with Scan Tool)

**NOTE:** 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. 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 HVAC Actuators re-calibration feature of the Remote Heater and Air Conditioning Control Module Special Functions menu.
7. Verify that no DTCs have set as current DTCs.

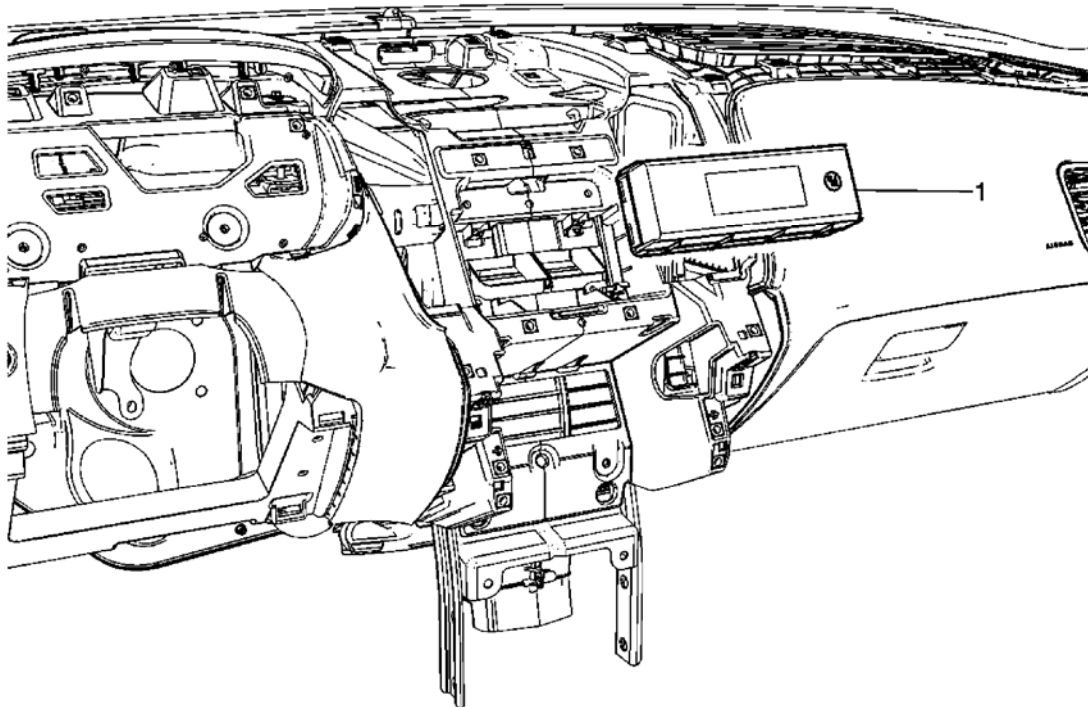
## Alternate Method (without Scan Tool)

**NOTE:** 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. 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 control module fuse for a minimum of 10 s.
6. Install the HVAC control module fuse.
7. Ignition ON.
8. Wait 40 s for the HVAC control module to self-calibrate.
9. Verify that no DTCs have set as current DTCs.

## REPAIR INSTRUCTIONS

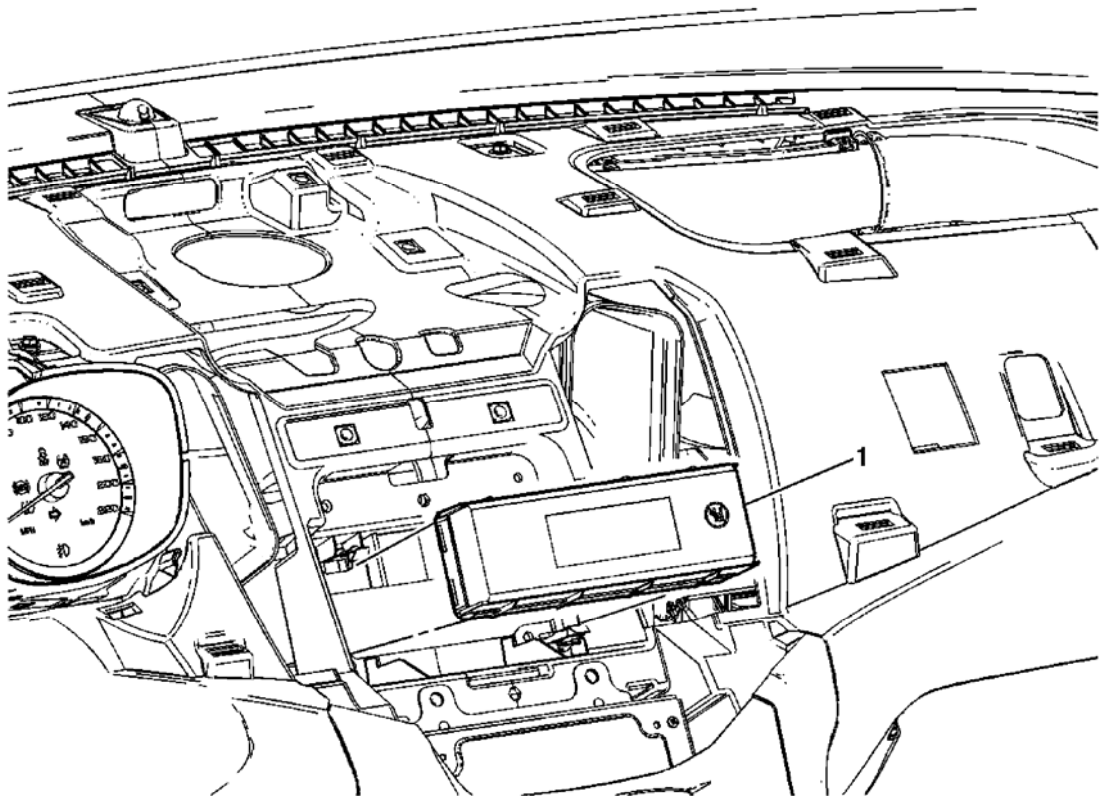
### HEATER AND AIR CONDITIONING CONTROL REPLACEMENT (EQUINOX)



**Fig. 4: Heater & Air Conditioning Control (Equinox)**  
Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                                                              | Component Name                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures:</b><br>Remove instrument panel upper trim. Refer to Instrument Panel Assembly Replacement. <b><u>Instrument Panel Upper Trim Panel Replacement (Equinox)</u></b> or <b><u>Instrument Panel Upper Trim Panel Replacement (Terrain)</u></b> |                                                                                                                                                                                                                                                       |
| 1                                                                                                                                                                                                                                                                    | Heater and Air Conditioning Control<br><br><b>Procedure</b><br><br>1. Disconnect the heater and air conditioning control harness connector.<br>2. Program the heater and air conditioning control. Refer to <b><u>Control Module References</u></b> . |

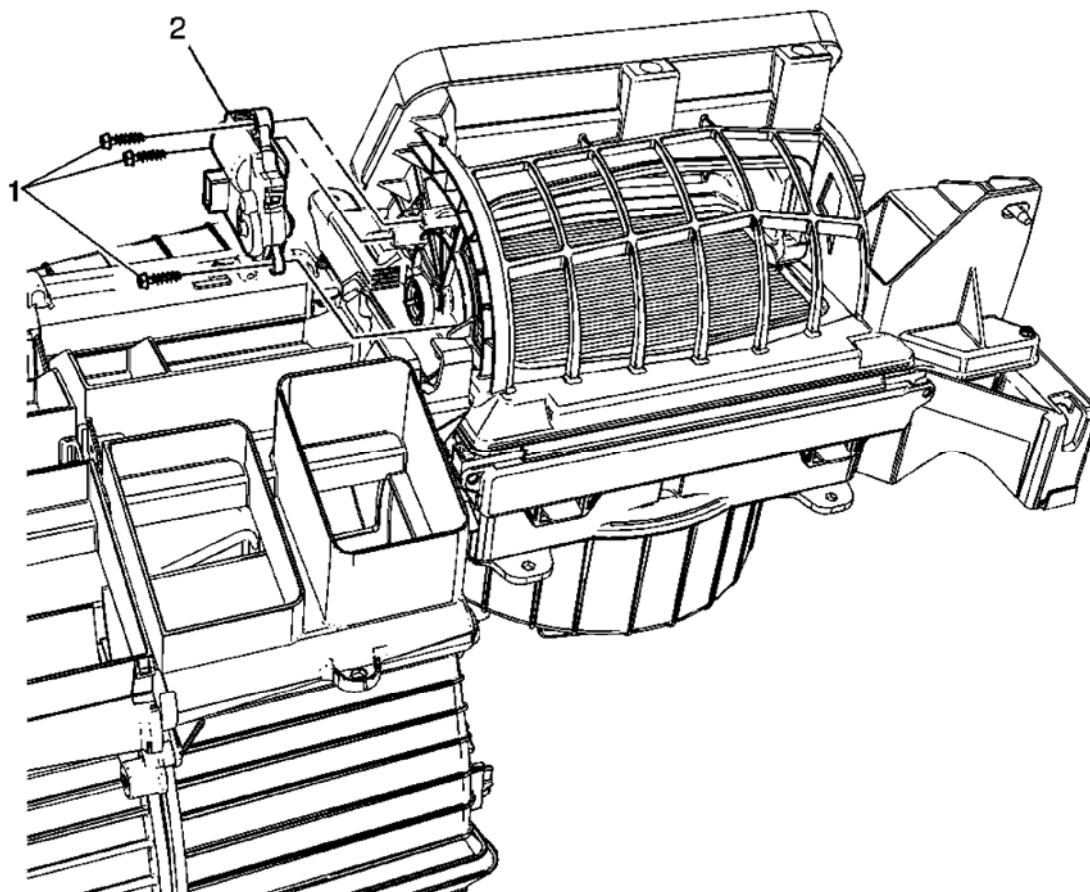
**HEATER AND AIR CONDITIONING CONTROL REPLACEMENT (TERRAIN)**



**Fig. 5: Heater & Air Conditioning Control (Terrain)**  
Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                                                              | Component Name                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures:</b><br>Remove instrument panel upper trim. Refer to Instrument Panel Assembly Replacement. <u><b>Instrument Panel Upper Trim Panel Replacement (Equinox)</b></u> or <u><b>Instrument Panel Upper Trim Panel Replacement (Terrain)</b></u> |                                                                                                                                                                                                                                                                   |
| 1                                                                                                                                                                                                                                                                    | Heater and Air Condition Remote Control.<br><br><b>Procedure</b><br><br>1. Disconnect the heater and air conditioning control harness connector.<br>2. Program the heater and air conditioning remote control. Refer to <u><b>Control Module References</b></u> . |

**AIR INLET VALVE ACTUATOR REPLACEMENT**

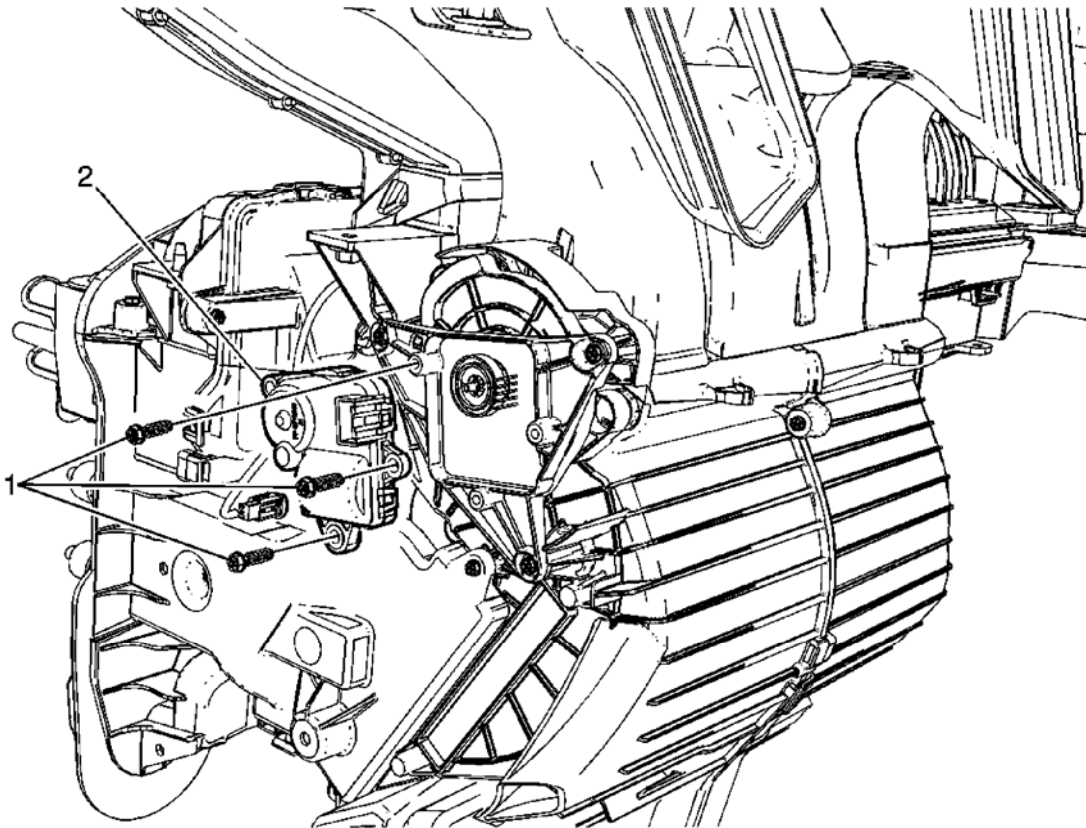


**Fig. 6: Air Inlet Valve Actuator**  
 Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                                                                        | Component Name                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b> <ol style="list-style-type: none"> <li>1. Remove the windshield defroster duct. Refer to <b><u>Windshield Defroster Duct Replacement</u></b> .</li> <li>2. Reposition any wiring or hoses to gain access to air inlet valve actuator.</li> </ol> |                                                                                                                                                       |
| 1                                                                                                                                                                                                                                                                              | Air Inlet Valve Actuator Screw (Qty: 3)<br><br><b>CAUTION:</b><br><b>Refer to <u>Fastener Caution</u> .</b><br><br><b>Tighten:</b> 1.5 N.m (13 lb in) |
| 2                                                                                                                                                                                                                                                                              | Air Inlet Valve Actuator<br><br><b>Procedure</b> <ol style="list-style-type: none"> <li>1. Disconnect wiring connector at actuator</li> </ol>         |

2. Calibrate the air inlet valve actuator. Refer to **Actuator Recalibration** .

## MODE VALVE ACTUATOR REPLACEMENT

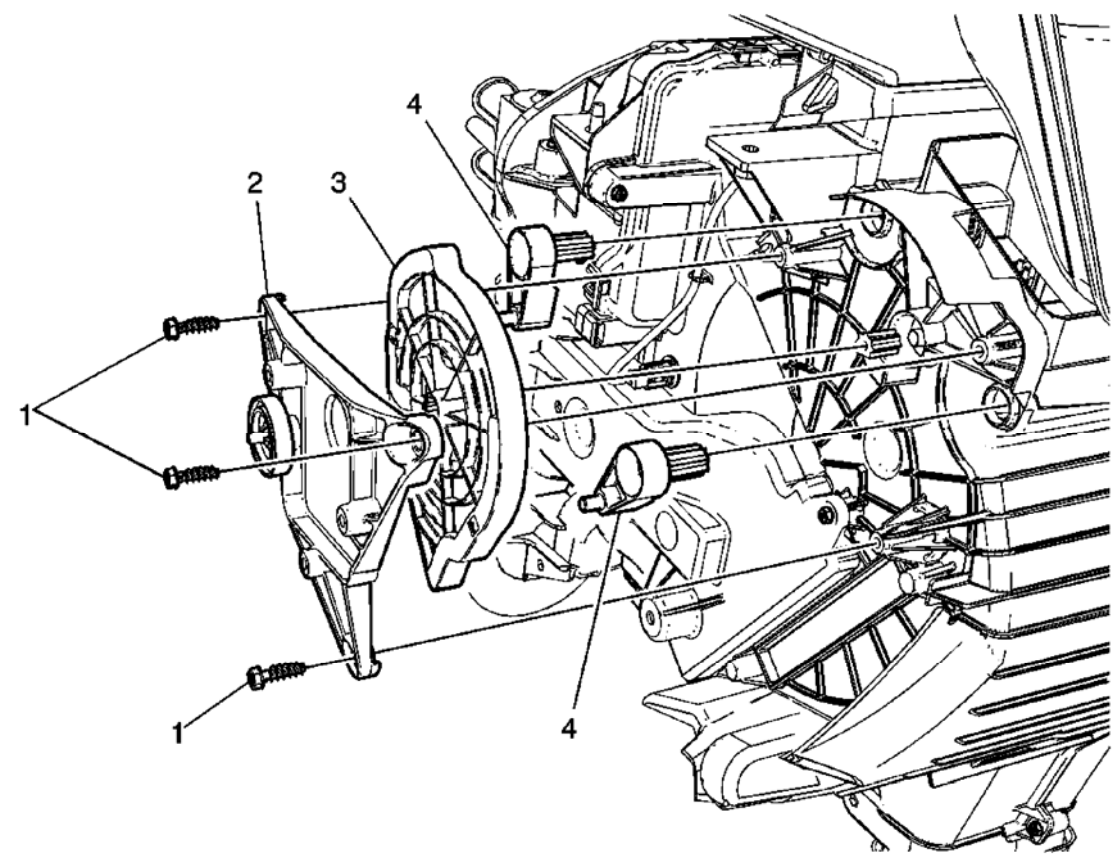


**Fig. 7: Mode Valve Actuator**  
Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Component Name                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                              |
| <ol style="list-style-type: none"><li>1. Remove instrument panel insulator panel - left side. Refer to <b><u>Instrument Panel Insulator Panel Replacement - Left Side (Equinox)</u></b> or <b><u>Instrument Panel Insulator Panel Replacement - Left Side (Terrain)</u></b> .</li><li>2. Remove the communication interface module. Refer to <b><u>Communication Interface Module Replacement</u></b> .</li><li>3. Reposition any wiring or hoses to gain access to mode control cam actuator.</li></ol> |                                                                                                              |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Mode Control Cam Actuator Screw (Qty: 3)<br><br><b>CAUTION:</b><br>Refer to <b><u>Fastener Caution</u></b> . |

|   |                                                                                                                                                                                                                                                   |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <b>Tighten:</b> 2.0 N.m (18 lb in)                                                                                                                                                                                                                |
| 2 | Mode Control Cam Actuator<br><br><b>Procedure</b><br><br><ol style="list-style-type: none"><li>1. Disconnect wiring connector at actuator.</li><li>2. Calibrate the mode control cam actuator. Refer to <u>Actuator Recalibration</u> .</li></ol> |

MODE CONTROL CAM REPLACEMENT

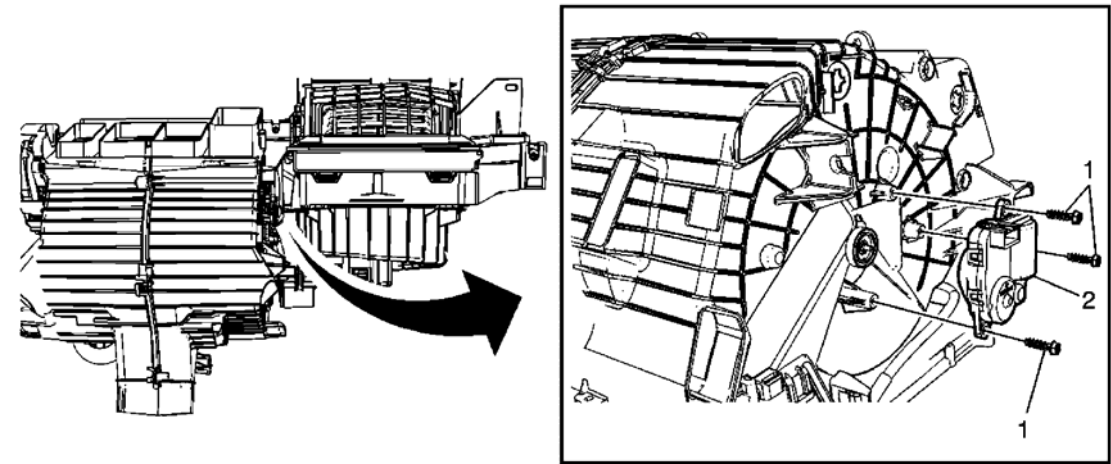


**Fig. 8: Mode Control Cam**  
Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                                                                                                                                                                           | Component Name |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                                                                                                                                                     |                |
| <ol style="list-style-type: none"><li>1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> .</li><li>2. Remove instrument Panel - left side. Refer to <u>Instrument Panel Insulator Panel Replacement - Left Side (Equinox)</u> or <u>Instrument Panel Insulator Panel Replacement - Left Side (Terrain)</u> .</li></ol> |                |

|                                                                              |                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3. Remove mode valve actuator. <b><u>Mode Valve Actuator Replacement</u></b> |                                                                                                                                                                                                                                              |
| 1                                                                            | <p>Mode Cam Actuator Cover Screw (Qty: 3)</p> <p><b>CAUTION:</b><br/>Refer to <b><u>Fastener Caution</u></b> .</p> <p><b>Procedure:</b><br/>Disconnect the mode actuator electrical connector.</p> <p><b>Tighten:</b> 1.5 N.m (13 lb in)</p> |
| 2                                                                            | Mode Cam Actuator Cover.                                                                                                                                                                                                                     |
| 3                                                                            | Mode Cam Actuator Gears                                                                                                                                                                                                                      |
| 4                                                                            | Mode Cam Actuator Arms (Qty: 2)                                                                                                                                                                                                              |

TEMPERATURE VALVE ACTUATOR REPLACEMENT

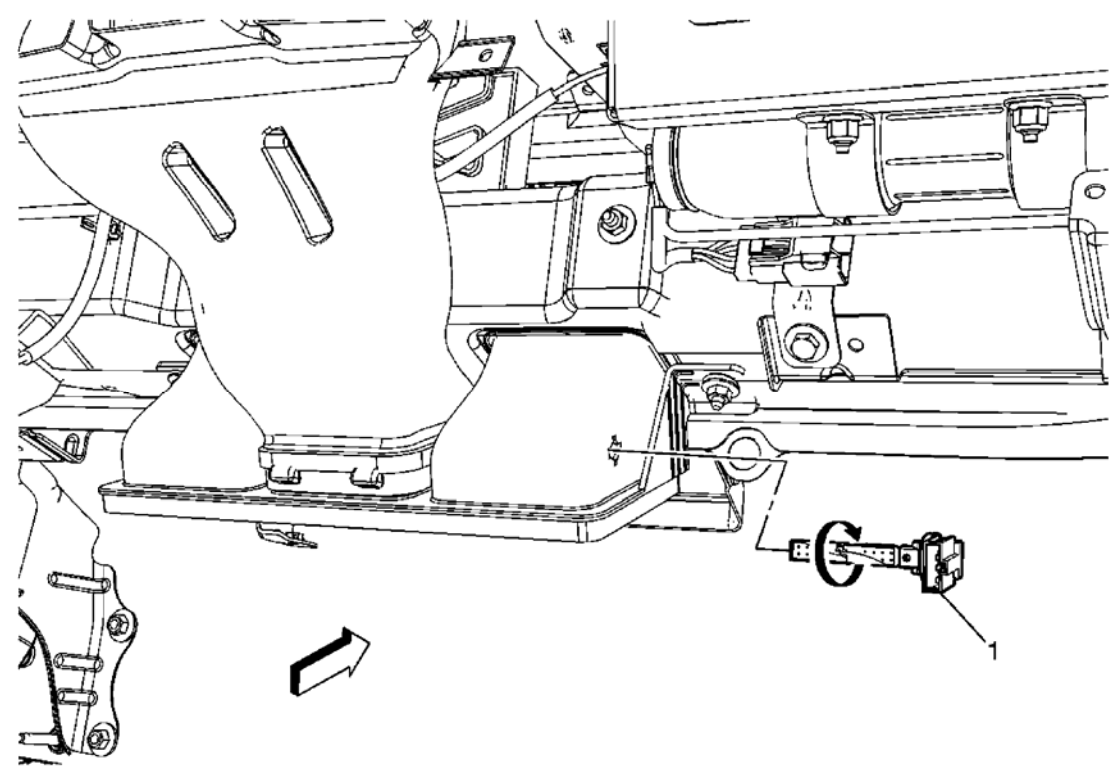


**Fig. 9: Temperature Valve Actuator**  
 Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                                                                                                                                                 | Component Name                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                                                                                                                           |                                           |
| 1. Disconnect the negative battery cable. Refer to <b><u>Battery Negative Cable Disconnection and Connection</u></b> .<br>2. Remove the insulator panel - right side. Refer to <b><u>Instrument Panel Insulator Panel Replacement - Right Side (Equinox)</u></b> or <b><u>Instrument Panel Insulator Panel Replacement - Right Side (Terrain)</u></b> . |                                           |
|                                                                                                                                                                                                                                                                                                                                                         | Temperature Valve Actuator Screw (Qty: 3) |

|   |                                                                                                                                                                                                                                                                        |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <p><b>CAUTION:</b><br/>Refer to <u>Fastener Caution</u> .</p> <p><b>Tighten:</b> 1.5 N.m (13 lb in)</p>                                                                                                                                                                |
| 2 | <p>Temperature Valve Actuator</p> <p><b>Procedure</b></p> <ol style="list-style-type: none"><li>1. Disconnect the temperature actuator electrical connector.</li><li>2. Recalibrate the temperature valve actuator. Refer to <u>Actuator Recalibration</u> .</li></ol> |

**DUCT AIR TEMPERATURE SENSOR REPLACEMENT - UPPER**



**Fig. 10: Duct Air Temperature Sensor - Upper**  
Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                                                                           | Component Name |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Preliminary Procedure</b>                                                                                                                                                                                                                                                      |                |
| <ol style="list-style-type: none"><li>1. Remove the I/P compartment door. Refer to <u>Instrument Panel Compartment Door Replacement (Equinox)</u> or <u>Instrument Panel Compartment Door Replacement (Terrain)</u> .</li><li>2. Disconnect the electrical connections.</li></ol> |                |

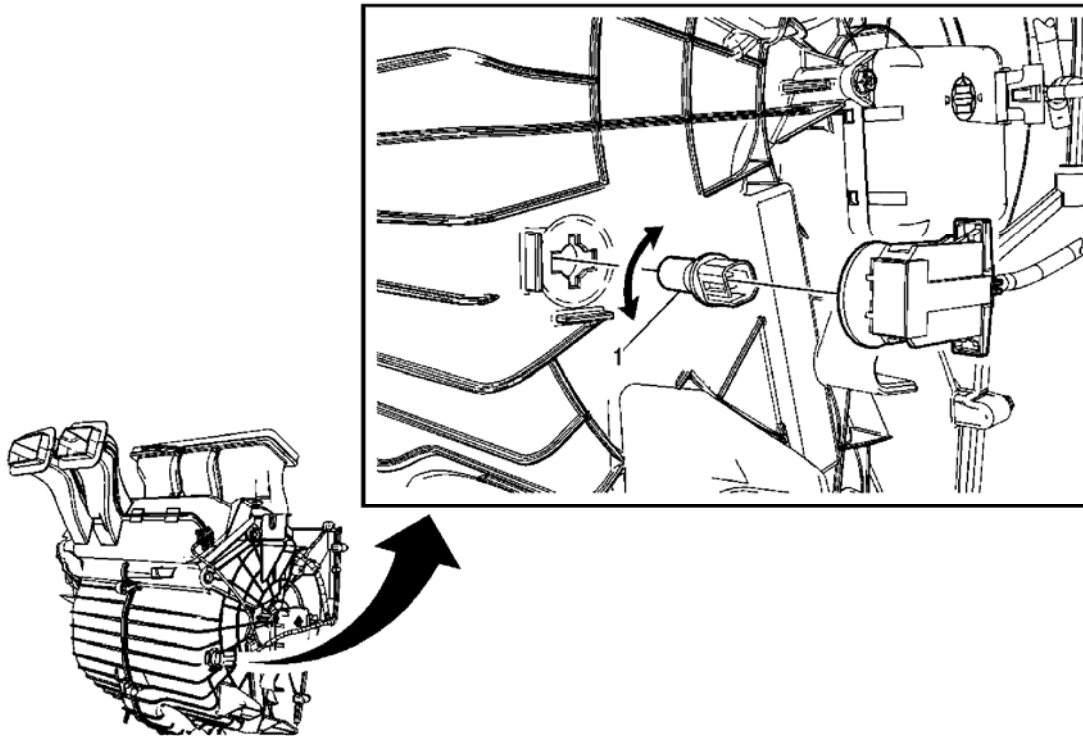
1

Air Temperature Sensor - Upper

**Procedure:**

Rotate sensor 1/4 turn to remove.

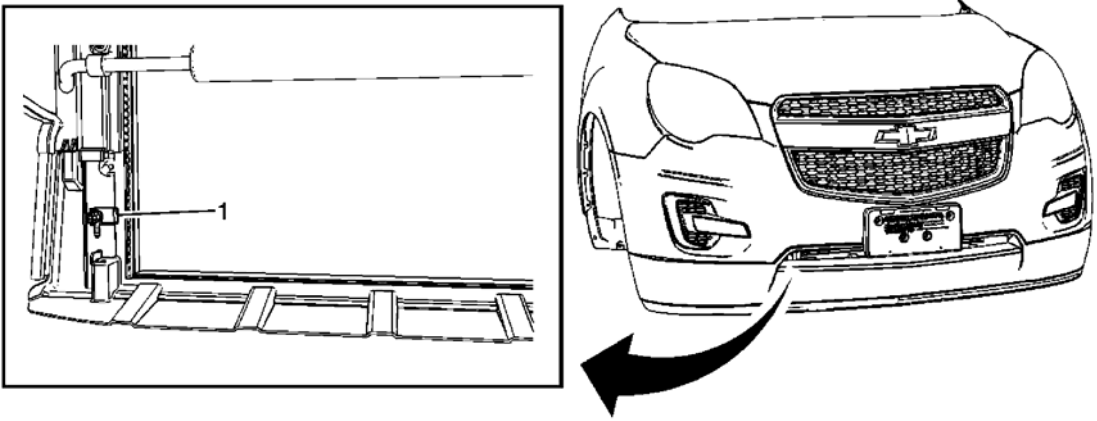
## DUCT AIR TEMPERATURE SENSOR REPLACEMENT - LOWER



**Fig. 11: Duct Air Temperature Sensor - Lower**  
Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                 | Component Name                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b>                                                                                                                                                            |                                                                                |
| 1. Remove I/P Compartment door. Refer to <b><u>Instrument Panel Compartment Door Replacement (Equinox)</u></b> or <b><u>Instrument Panel Compartment Door Replacement (Terrain)</u></b> |                                                                                |
| 2. Disconnect electrical connections.                                                                                                                                                   |                                                                                |
| 1                                                                                                                                                                                       | Air Temperature Sensor - Lower<br><b>Tip:</b> Rotate sensor 1/4 turn to remove |

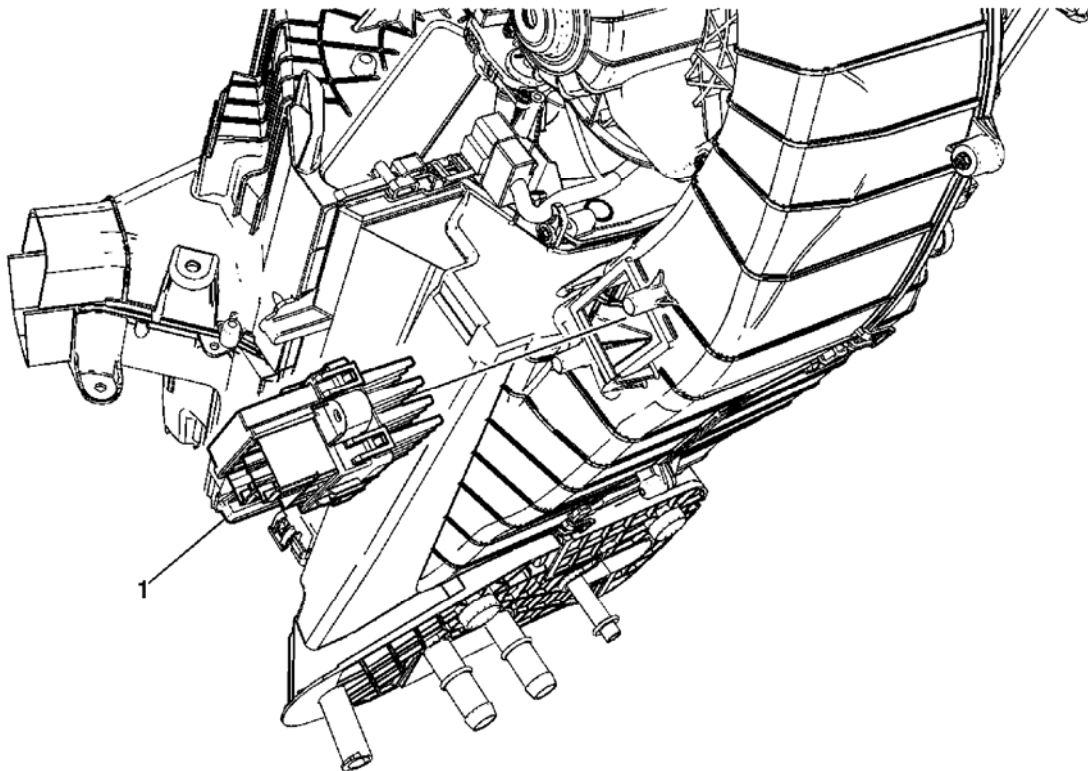
## AMBIENT AIR QUALITY SENSOR REPLACEMENT



**Fig. 12: Ambient Air Quality Sensor**  
**Courtesy of GENERAL MOTORS CORP.**

| Callout | Component Name                                                                                                                                                                                                                                                                              |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <div>Ambient Air Quality Sensor</div> <div><b>Procedures</b><div><div>1. Unsnap the ambient air quality sensor.</div><div>2. Disconnect the electrical connector.</div></div><div><b>Tip:</b> The sensor can be accesed through the fascia opening without removing the fascia.</div></div> |

**BLOWER MOTOR CONTROL MODULE REPLACEMENT**



**Fig. 13: Blower Motor Control Module**  
Courtesy of GENERAL MOTORS CORP.

| Callout                                                                                                                                                                                                                                      | Component Name                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| <b>Preliminary Procedures</b>                                                                                                                                                                                                                |                                                        |
| 1. Remove the instrument panel insulator panel right side. Refer to <u><b>Instrument Panel Insulator Panel Replacement - Right Side (Equinox)</b></u> or <u><b>Instrument Panel Insulator Panel Replacement - Right Side (Terrain)</b></u> . |                                                        |
| 2. Disconnect the heater and blower and air conditioning control module electrical connectors.                                                                                                                                               |                                                        |
| 1                                                                                                                                                                                                                                            | Heater and Blower and Air Conditioning Control Module. |

**DESCRIPTION AND OPERATION**

**AUTOMATIC HVAC DESCRIPTION AND OPERATION**

The air temperature and the air delivery description and operation are divided into 8 areas:

- HVAC Control Components
- Air Speed
- Air Delivery
- Heating and A/C Operation

- Recirculation Operation
- Automatic Operation
- Engine Coolant
- A/C Cycle

**HVAC Control Components**

**Radio/HVAC Control**

The Radio/HVAC control contains all switches, which are required to control the functions of HVAC and serve as interface between the operator and the HVAC control module. The selected values are passed to the HVAC control module via LIN-Bus.

**HVAC Control Module**

The HVAC control module is a GMLAN device that interfaces between the operator and the HVAC system to maintain and control desired air temperature and air distribution settings. The battery positive voltage circuit provides power that the HVAC control module uses for keep alive memory. If the battery positive voltage circuit loses power, all HVAC DTCs and settings will be erased from keep alive memory. The body control module (BCM), which is the vehicle mode master, provides a device ON-Signal. The HVAC control module provides blower, air delivery mode and air temperature settings.

The HVAC control module supports the following features:

| Feature              | Availability                                |
|----------------------|---------------------------------------------|
| Afterblow            | Available if reprogrammed by the technician |
| Purge                | Yes                                         |
| Personalization      | Yes                                         |
| Actuator Calibration | Yes                                         |

**Mode Actuator**

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

**Air Temperature Actuator**

The actuator is a 5-wire bi-directional electric motor that incorporates a feedback potentiometer. Low reference, 5V reference, position signal, and 2 control circuits enable the actuator to operate. The control circuits use either a 0 or 12 V value to coordinate the actuator movement. When the actuator is at rest, both control circuits have a value of 0 V. In order to move the actuator, the HVAC control module grounds one of the control circuits while providing the other with 12 V. The HVAC 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 V. 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, 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 removes power and ground from the control circuits.

### **Recirculation Actuator**

The actuator is a 5-wire bi-directional electric motor that incorporates a feedback potentiometer. Low reference, 5V reference, position signal, and 2 control circuits enable the actuator to operate. The control circuits use either a 0 or 12 V value to coordinate the actuator movement. When the actuator is at rest, both control circuits have a value of 0 V. In order to move the actuator, the HVAC control module grounds one of the control circuits while providing the other with 12 V. The HVAC 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 V. 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, 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 removes power and ground from the control circuits.

### **Blower Motor Control Processor**

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

### **Duct Temperature Sensors**

The air temperature sensors are 2-wire negative temperature co-efficient thermistors. The sensors operate within a temperature range of -40 to +85°C (-40 to +185°F). The sensors are installed in the air distribution ducts and measure the temperature of the air that streams from the ducts. The HVAC control module uses these values to calculate the mixed air flap position.

### **Evaporator Temperature Sensor**

The evaporator temperature sensor is a 2-wire negative temperature co-efficient thermistor. The sensor operates within a temperature range of -40 to +85°C (-40 to +185°F). The sensor is installed at the evaporator and measures its temperature. If the temperature drops under 3°C (38°F), the compressor will be switched off in order to prevent a frozen evaporator.

### **A/C Refrigerant Pressure Sensor**

The A/C refrigerant pressure sensor is a 3-wire piezoelectric pressure transducer. A 5 V reference voltage, low reference, and signal circuits enable the sensor to operate. The A/C pressure signal can be between 0.2-4.8 V. When the A/C refrigerant pressure is low, the signal value is near 0 V. When the A/C refrigerant pressure is high, the signal value is near 5 V. The engine control module (ECM) converts the voltage signal to a pressure value. When pressure is too high or too low, the ECM will not allow the A/C compressor clutch to engage.

### **A/C Compressor**

The A/C compressor is belt driven and operates when the magnetic clutch is engaged. When the A/C switch is pressed, the HVAC control module sends an A/C request message to the ECM via CAN-Bus. Therefore the ECM grounds the A/C compressor clutch relay control circuit, which will switch the A/C compressor clutch relay. With the relay contacts closed, battery voltage is supplied to the A/C compressor clutch. The A/C compressor clutch will be activated.

### **Ambient Light/Sunload Sensor**

The ambient light/sunload sensor includes the sunload sensor and passenger compartment temperature sensor.

This sensor assembly provides information about:

- Sun heat intensity
- Passenger compartment temperature

The solar sensor is connected to ground and to a 5 V stabilized voltage supply through the HVAC control module. As the sunload increases, the sensor signal voltage also increases and vice versa. The signal varies between 1.4-4.5 V and is provided to the HVAC control module.

The passenger compartment temperature sensor is a negative temperature co-efficient thermistor. A signal and low reference circuit enables the sensor to operate. As the air temperature increases, the sensor resistance decreases. The sensor signal varies between 0-5 V.

Bright or high intensity light causes the vehicles interior temperature to increase. The HVAC system compensates for the increased temperature by diverting additional cool air into the vehicle.

### **Air Speed**

The blower control switch is part of the Radio/HVAC control. The selected value of the blower switch position is sent to the HVAC control module via LIN-Bus.

The blower motor control module is an interface between HVAC control module and blower motor. The blower motor control module regulates supply voltage and ground circuits to blower motor. The HVAC control module provides a PWM signal to the blower motor control module in order to command the desired blower motor speed. The blower motor control module supplies battery voltage to the blower motor and uses the blower motor ground as a low side control to adjust the blower motor speed. The voltage amounts between 2-13 V and changes linear to the height of the PWM signal.

## Air Delivery

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

- Defrost
- Defog
- Panel
- Floor

The desired air distribution mode can be selected with the air distribution switches at the Radio/HVAC control. The Radio/HVAC control delivers the values to the HVAC control module via LIN-Bus. The HVAC control module controls the air distribution actuator so that it drives the flap to the calculated position. Depending on the position of the flap, air is distributed through various ducts leading to the outlets in the dash. Turning the mode flap to the defrost position, the HVAC control module will move the recirculation actuator to outside air, reducing window fogging. When defrost is selected, the blower motor will be activated, regardless of the coolant temperature. The HVAC control module enables a high volume of air delivered to the front defrost vents. A/C is available in all modes.

The rear window defogger does not affect the HVAC system.

## 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 affect the rate that the HVAC system can achieve the desired temperature:

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

Pressing the A/C switch or AUTO switch enables the HVAC control module to request A/C compressor engagement and turn ON the A/C switch LED respectively the AUTO switch LED if the AUTO switch is pressed. The setting of the A/C Mode can be adjusted to be set to On, Off, or kept to the Last Setting when the vehicle was last shut off. This setting is made in the Configuration Settings Menu and will determine what mode the A/C will be in when the vehicle is started. The HVAC control module sends a message to the engine control module (ECM) for A/C compressor engagement. The ECM 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 peak, resulting from the collapse of the magnetic field of the coil, from entering the vehicle electrical system when the compressor is disengaged.

The following conditions must be met in order to activate the A/C compressor:

- Battery voltage is between 9-18 V.

- Engine coolant temperature is less than 124°C (255°F).
- Engine speed is greater than 600 RPM.
- Engine speed is less than 5 500 RPM.
- A/C high side pressure is between 269-2 929 kPa (39-425 PSI).
- Throttle position is less than 100%.
- Evaporator temperature is greater than 3°C (38°F).
- ECM does not detect immoderate torque load.
- ECM does not detect insufficient idle quality.
- The ambient temperature is above 1°C (34°F).

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

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

The air streams into the passenger compartment through the heater core and the evaporator core. The air temperature actuator drives the mixed air flap to induce the airflow. If the interior temperature should be increased, the mixed air flap is put into the position in which more air streams through the heater core. If the interior temperature should be decreased, the mixed air flap is put into the position in which more air streams through the evaporator core.

#### **Recirculation Operation - without Heated Seats**

The recirculation switch and the fresh air switch are part of the Radio/HVAC control. The selected switch position is sent to the HVAC control module via LIN-Bus. The HVAC control module controls the air intake through the recirculation actuator. The recirculation switch closes the recirculation flap in order to circulate the air within the vehicle. Through selection of the fresh air switch, the recirculation flap is opened again in order to route outside air into the vehicle.

Recirculation is only available if the defrost mode is not active. When the defrost mode is active, the recirculation actuator opens the recirculation flap and outside air is circulated to the windshield to reduce fogging.

#### **Recirculation Operation - with Heated Seats**

The recirculation switch is part of the Radio/HVAC control. The selected recirculation switch position is sent to the HVAC control module via LIN-Bus. The HVAC control module controls the air intake through the recirculation actuator. The recirculation switch closes the recirculation flap in order to circulate the air within the vehicle. Through renewed selection of the recirculation switch, the recirculation flap is opened again in order to route outside air into the vehicle.

Recirculation is only available if the defrost mode is not active. When the defrost mode is active, the recirculation actuator opens the recirculation flap and outside air is circulated to the windshield to reduce

fogging.

## Automatic Operation

In automatic operation, the HVAC control module maintains the comfort level inside of the vehicle by controlling the A/C compressor clutch, the blower motor, the air temperature actuators, mode actuator and recirculation actuator. Personalized settings for auto fan speed, air conditioning mode, and remote start auto heat seats are available in the Configuration Settings Menu.

To put the HVAC system in automatic mode, the following is required:

1. The auto switch must be activated.
2. The air temperature switch must be in any other position than full hot or full cold position.

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

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

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

When the coldest position is selected in automatic operation the blower stays on high and the air temperature actuators stay in full cold position. The mode actuator remains in the panel position and the recirculation actuator will remain in the recirculation position.

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

**NOTE:** The "High" blower setting cannot raise the blower setting past 12, and the "Low" blower preference cannot drop the blower setting below 1, but the blower setting in Auto can be in-between blower settings.

Personalized Auto Fan Speed settings of "High", "Low", and "Normal" can be selected. The factory setting is "Normal", and will control the fan speed automatically from 1 to 12 according to the vehicle air temperature sensors and preprogrammed logic. A "High" personal fan setting can increase the fan speed up to 1 blower setting. A "Low" personal fan setting can decrease the fan speed 1 blower setting across a range of vehicle conditions.

### **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 control module. The ambient air drawn through the HVAC control module absorbs the heat of the coolant flowing through the heater core. Heated air is distributed to the passenger compartment, through the HVAC control module, for passenger comfort. Opening or closing the air temperature flap controls the amount of heat delivered to the passenger compartment. The coolant exits the heater core through the return heater hose and recirculates back to the engine cooling system.

### **A/C Cycle**

Refrigerant is the key element in an air conditioning system. R-134a is presently the only Environmental Protection Agency 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 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 fails 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 to the Receiver/Dehydrator (R/D).

The R/D contains desiccant that absorbs moisture that may be in the refrigerant system. The R/D also acts as a storage vessel to ensure that a steady flow of liquid reaches the thermal expansion valve. The refrigerant exits the R/D and flows through the liquid line to the thermal expansion valve.

The thermal expansion valve is located at the front of dash and attaches to the evaporator inlet and outlet pipes. The thermal expansion valve is the dividing point for the high and the low pressure sides of the A/C system. As the refrigerant passes through the thermal expansion valve, the pressure on the refrigerant is lowered. The thermal expansion valve also meters the amount of liquid refrigerant that can flow into the evaporator.

Refrigerant exiting the thermal expansion valve flows into the evaporator core in a low pressure, liquid state. Ambient air is drawn through the HVAC control 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 A/C compressor, in a vapor state, and completing the A/C cycle of heat removal. At the A/C compressor, the refrigerant is compressed again and the cycle of heat removal is repeated.

The conditioned air is distributed through the HVAC control 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 control module as water.