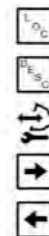
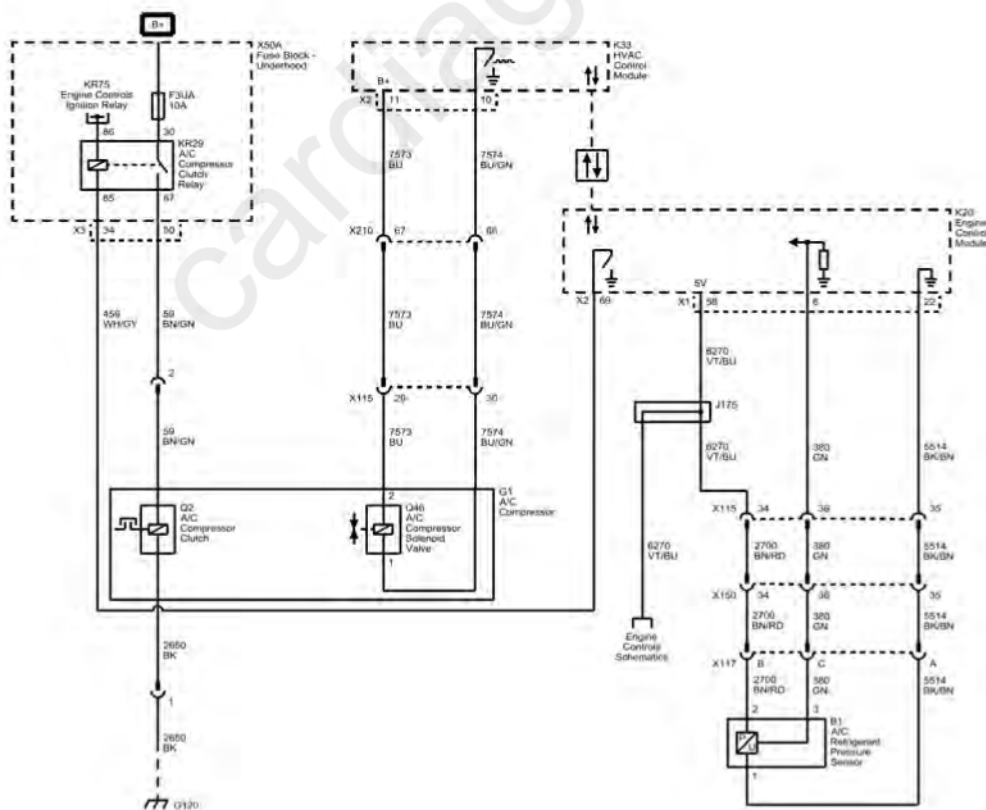


**Fig. 2: Blower Motor**

Courtesy of GENERAL MOTORS COMPANY

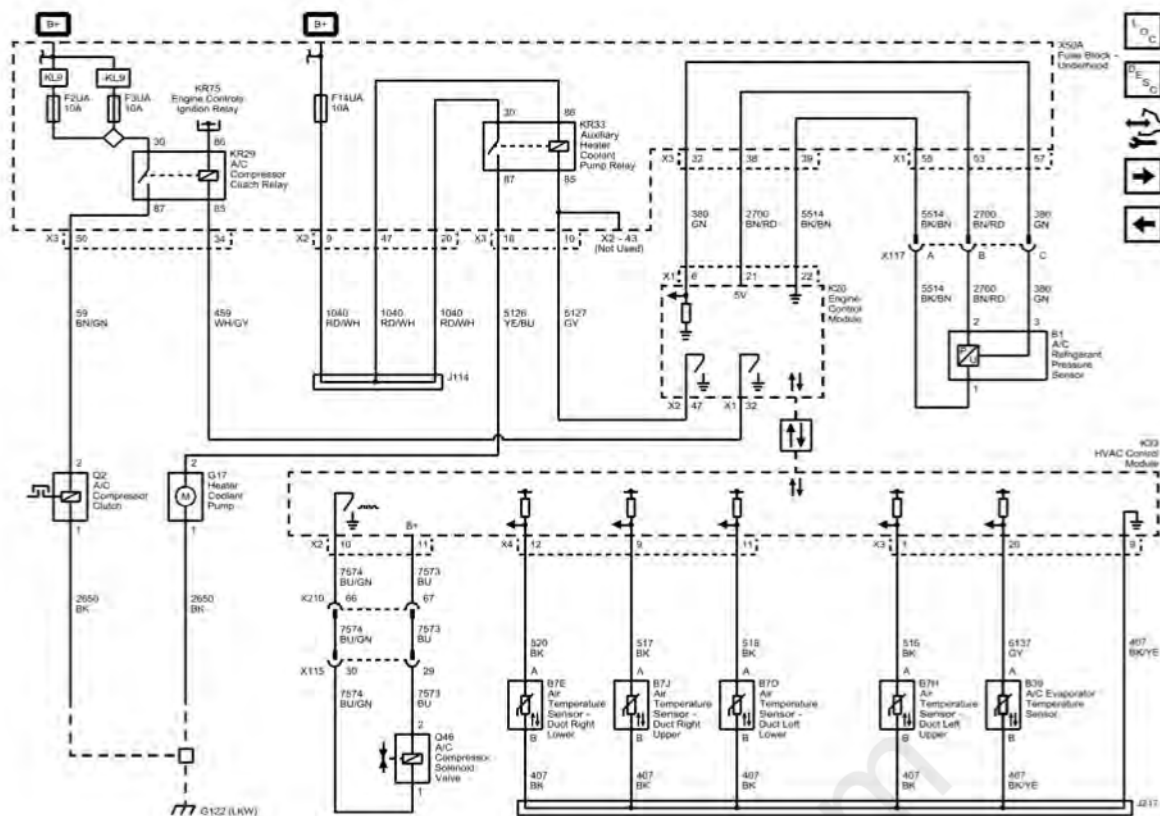
### A/C Compressor Controls



**Fig. 3: A/C Compressor Controls**

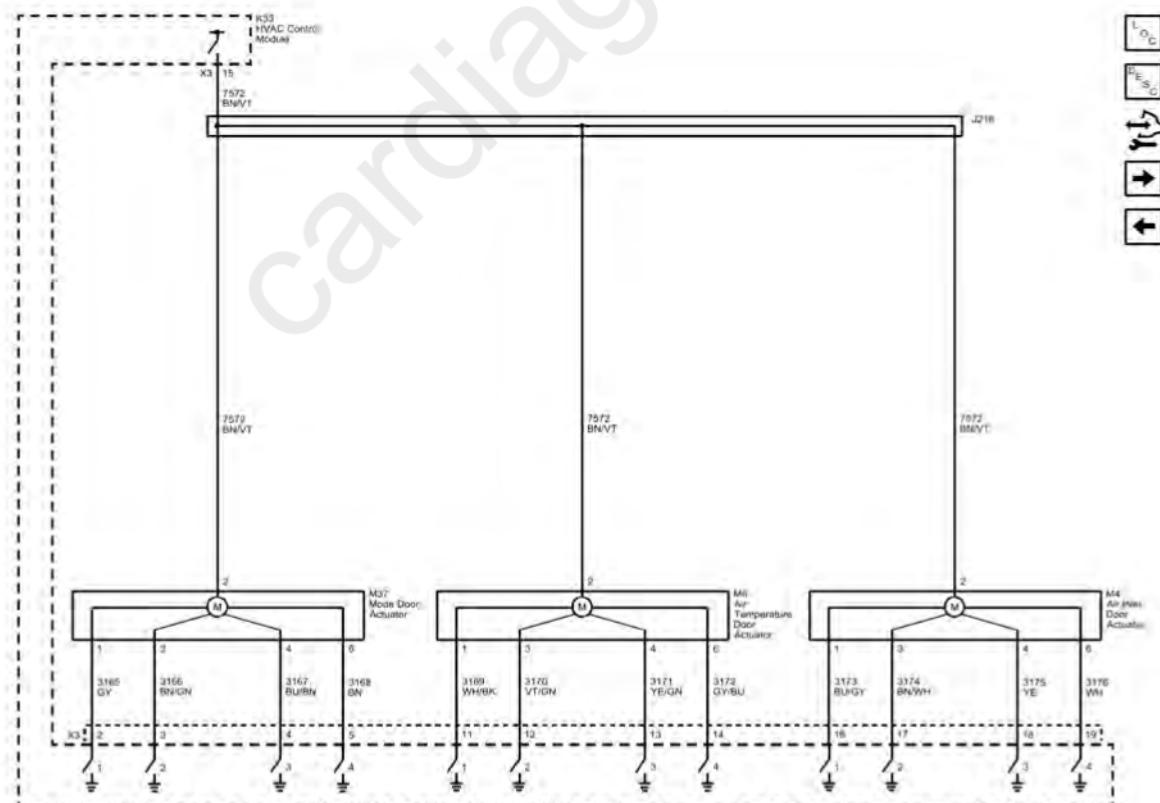
Courtesy of GENERAL MOTORS COMPANY

### Heater Coolant Pump (KL9)



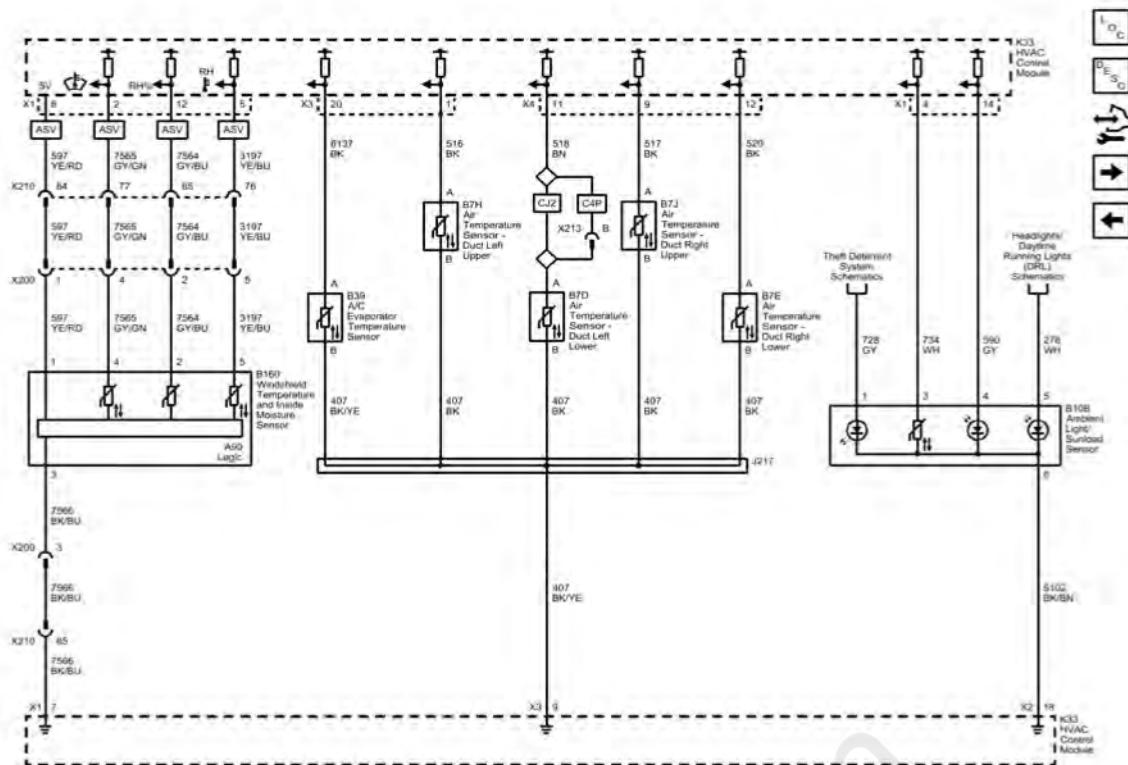
**Fig. 4: Heater Coolant Pump (KL9)**  
Courtesy of GENERAL MOTORS COMPANY

#### Mode and Temperature Control Actuators (C4P)



**Fig. 5: Mode and Temperature Control Actuators (C4P)**  
Courtesy of GENERAL MOTORS COMPANY

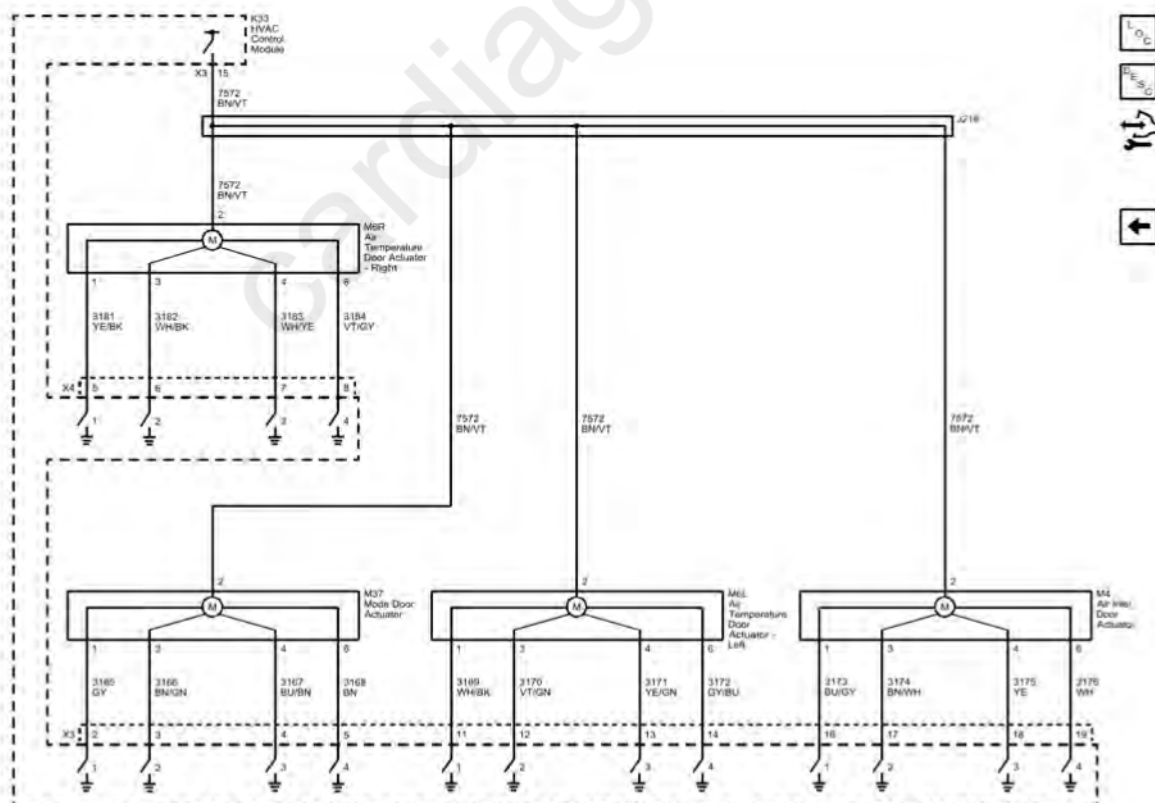
#### Sensors



**Fig. 6: Sensors**

Courtesy of GENERAL MOTORS COMPANY

### Mode and Temperature Control Actuators (CJ2)



**Fig. 7: Mode and Temperature Control Actuators (CJ2)**

Courtesy of GENERAL MOTORS COMPANY

## DIAGNOSTIC INFORMATION AND PROCEDURES



## HVAC COMPONENT REPLACEMENT REFERENCE

| Component                                              | Repair Instruction                                                                                                          |
|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| A26 HVAC Controls                                      | <a href="#">Heater and Air Conditioning Control Replacement</a>                                                             |
| B1 A/C Refrigerant Pressure Sensor                     | <a href="#">Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement</a>                                              |
| B10B Ambient Light/Sunload Sensor                      | <a href="#">Sun Load Temperature and Headlamp Automatic Control Ambient Light Sensor Replacement</a>                        |
| B160 Windshield Temperature and Inside Moisture Sensor | <a href="#">Inside Air Moisture and Windshield Temperature Sensor Replacement</a>                                           |
| B39 A/C Evaporator Temperature Sensor                  | <a href="#">Inside Air Temperature Sensor Replacement - Evaporator Core</a>                                                 |
| B7D Air Temperature Sensor - Duct Left Lower           | <a href="#">Inside Air Temperature Sensor Replacement - Left Side Lower</a>                                                 |
| B7E Air Temperature Sensor - Duct Right Lower          | <a href="#">Inside Air Temperature Sensor Replacement - Right Side Lower</a>                                                |
| B7H Air Temperature Sensor - Duct Left Upper           | <a href="#">Inside Air Temperature Sensor Replacement - Left Side Upper</a>                                                 |
| B7J Air Temperature Sensor - Duct Right Upper          | <a href="#">Inside Air Temperature Sensor Replacement - Right Side Upper</a>                                                |
| G17 Heater Coolant Pump                                | <a href="#">Auxiliary Water Pump Replacement (LCV)</a>                                                                      |
| K33 HVAC Control Module                                | <a href="#">Heater and Air Conditioning Remote Control Replacement</a>                                                      |
| M37 Mode Door Actuator                                 | <a href="#">Mode Control Cam Actuator Replacement</a>                                                                       |
| M46 Air Recirculation Door Actuator                    | <a href="#">Air Inlet Valve Actuator Replacement</a>                                                                        |
| M6L Air Temperature Door Actuator - Left               | <a href="#">Temperature Valve Actuator Replacement - Left Side</a>                                                          |
| M6R Air Temperature Door Actuator - Right              | <a href="#">Temperature Valve Actuator Replacement - Right Side (Upper)</a>                                                 |
| M8 Blower Motor                                        | <a href="#">Blower Motor Replacement</a>                                                                                    |
| Q2 A/C Compressor Clutch                               | <a href="#">Air Conditioning Compressor Replacement (LFX)</a> <a href="#">Air Conditioning Compressor Replacement (LCV)</a> |
| Q46 A/C Compressor Solenoid Valve                      | <a href="#">Air Conditioning Compressor Replacement (LFX)</a> <a href="#">Air Conditioning Compressor Replacement (LCV)</a> |

## DTC B0163: PASSENGER COMPARTMENT TEMPERATURE SENSOR CIRCUIT

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC B0163

Passenger Compartment Temperature Sensor Circuit

For symptom byte information, refer to [Symptom Byte List](#) .

### Diagnostic Fault Information

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

| Circuit       | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------|-----------------|----------------------|------------------|--------------------|
| Signal        | B0163 02        | B0163 05             | B0163 05         | -                  |
| Low Reference | -               | B0163 05, B0183 05   | -                | -                  |

### Circuit/System Description

The ambient light/sunload sensor integrates the sunload sensor and passenger compartment temperature sensor into a single assembly.

The solar sensor is connected to a low reference and a 5 V biased (pull up) signal circuit voltage from the HVAC control module. As the sunload increases, the sensor signal voltage decreases. The signal varies between 0.1 - 4.9 V and is provided to the HVAC control module.

The passenger compartment temperature sensor is a negative temperature coefficient thermistor. A signal and low reference circuit enable 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 vehicle 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

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.

#### B0163 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.

### 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 (C4P/CJ2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX

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 and all vehicle systems OFF, disconnect the harness connector at the B10B Ambient Light/Sunload Sensor. It may take up to 10 min for all vehicle systems to power down.

**NOTE:** The scan tool must be disconnected from the vehicle before performing the next test.

2. Test for less than 10  $\Omega$  between the low reference circuit terminal 6 and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K33 HVAC Control Module.
  - **If less than 10  $\Omega$**
3. Ignition ON.
4. Verify the scan tool Passenger Compartment Air Temperature (Unfiltered) parameter is less than -37 $^{\circ}$ C (-35 $^{\circ}$ F).
  - **If -37 $^{\circ}$ C (-35 $^{\circ}$ F) or greater**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module.
    2. Test for infinite resistance between the signal circuit terminal 3 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K33 HVAC Control Module.
  - **If less than -37 $^{\circ}$ C (-35 $^{\circ}$ F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the low reference circuit terminal 6.
6. Verify the scan tool Passenger Compartment Air Temperature (Unfiltered) parameter is greater than 113 $^{\circ}$ C (235 $^{\circ}$ F).
  - **If 113 $^{\circ}$ C (235 $^{\circ}$ F) or less**
    1. Ignition OFF, remove the jumper wire and disconnect the harness connectors at the K33 HVAC Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
  - 3. Ignition OFF.
  - 4. Test for less than 2  $\Omega$  in the signal circuit end to end.
    - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
    - If less than 2  $\Omega$ , replace the K33 HVAC Control Module.
  - **If greater than 113 $^{\circ}$ C (235 $^{\circ}$ F)**
7. Test or replace the B10B Ambient Light/Sunload Sensor.
8. Verify DTC B0163 does not set or the symptom does not occur while operating the vehicle within the Conditions for Running the DTC.
  - **If the DTC or symptom is not corrected.**

Replace the K33 HVAC Control Module.

- If the DTC or symptom is corrected.

9. All OK.

### Repair Instructions

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

- Refer to [HVAC Component Replacement Reference](#)
- Refer to [Control Module References](#) for HVAC control module replacement, programming and setup

## **DTC B0173, B0178, B0509, B0514 OR B3933: DUCT AIR TEMPERATURE SENSOR CIRCUITS/AIR CONDITIONING EVAPORATOR TEMPERATURE SENSOR CIRCUIT**

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide 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 B0509 02**

Upper Right Duct Air Temperature Sensor Circuit Short to Ground

#### **DTC B0509 05**

Upper Right Duct Air Temperature Sensor Circuit High Voltage/Open

#### **DTC B0514 02**

Lower Right Duct Air Temperature Sensor Circuit Short to Ground

#### **DTC B0514 05**

Lower Right 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



| <b>Circuit</b>                                        | <b>Short to Ground</b> | <b>Open/High Resistance</b>                                  | <b>Short to Voltage</b>                                      | <b>Signal Performance</b> |
|-------------------------------------------------------|------------------------|--------------------------------------------------------------|--------------------------------------------------------------|---------------------------|
| Upper Left Duct Air Temperature Sensor Signal         | B0173 02               | B0173 05                                                     | B0173 05                                                     | -                         |
| Lower Left Duct Air Temperature Sensor Signal         | B0178 02               | B0178 05                                                     | B0178 05                                                     | -                         |
| Upper Right Duct Air Temperature Sensor Signal        | B0509 02               | B0509 05                                                     | B0509 05                                                     | -                         |
| Lower Right Duct Air Temperature Sensor Signal        | B0514 02               | B0514 05                                                     | B0514 05                                                     | -                         |
| Air Conditioning Evaporator Temperature Sensor Signal | B3933 02               | B3933 05                                                     | B3933 05                                                     | -                         |
| Low Reference                                         | -                      | B0173 05,<br>B0178 05,<br>B0509 05,<br>B0514 05,<br>B3933 05 | B0173 05,<br>B0178 05,<br>B0509 05,<br>B0514 05,<br>B3933 05 | -                         |

### Circuit/System Description

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

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

This sensor operates using signal and low reference circuits. As the air temperature surrounding the sensor increases, the sensor resistance decreases. The sensor sends a signal voltage between 0 - 5 V. If the HVAC control module detects a malfunctioning sensor the software uses 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 (C4P/CJ2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX



## 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.
2. Verify DTC B3933 is not set.
  - **If DTC B3933 is set**  
  
Refer to Circuit/System Testing - Without Scan Tool Support.
  - **If DTC B3933 is not set**
3. Verify the appropriate temperature sensor has a parameter displayed in HVAC scan tool information.
  - **If there is no scan tool parameter**  
  
Refer to Circuit/System Testing - Without Scan Tool Support.
  - **If there is a scan tool parameter**
4. Refer to Circuit/System Testing - With Scan Tool Support

### Circuit/System Testing

#### **With Scan Tool Support**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate temperature sensor. It may take up to 10 min for all vehicle systems to power down.

**NOTE:**        **The scan tool must be disconnected from the vehicle before performing the next test.**

2. Test for less than 50  $\Omega$  between the low reference circuit terminal B and ground.
  - **If 50  $\Omega$  or greater**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K33 HVAC Control Module.
  - **If less than 50  $\Omega$**
3. Ignition ON.
4. Verify the appropriate scan tool temperature sensor parameter is less than -37 $^{\circ}$ C (-35 $^{\circ}$ F)
  - **If greater than -37 $^{\circ}$ C (-35 $^{\circ}$ F)**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module.
    2. Test for infinite resistance between the signal circuit terminal A and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K33 HVAC Control Module.

- **If -37Â°C (-35Â°F) or less**
5. Install a 3 A fused jumper wire between the signal circuit terminal A and the low reference circuit terminal B.
  6. Verify the scan tool temperature sensor parameter is greater than 77Â°C (170Â°F).
    - **If less than 77Â°C (170Â°F)**
      1. Ignition OFF, remove the jumper wire and disconnect the harness connectors at the K33 HVAC Control Module, ignition ON.
      2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
      3. Ignition OFF
      4. Test for less than 2  $\Omega$  in the signal circuit end to end.
        - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
        - If less than 2  $\Omega$ , replace the K33 HVAC Control Module.
    - **If 77Â°C (170Â°F) or greater**
  7. Test or replace the temperature sensor.

### Without Scan Tool Support

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate temperature sensor. It may take up to 10 min for all vehicle systems to power down.

**NOTE:** The scan tool must be disconnected from the vehicle before performing the next test.

2. Test for less than 50  $\Omega$  between the low reference circuit terminal B and ground.
  - **If 50  $\Omega$  or greater**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K33 HVAC Control Module.
  - **If less than 50  $\Omega$**
3. Test for 4.8 - 5.2 V between the signal circuit terminal A and ground.
  - **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K33 HVAC Control Module.
  - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K33 HVAC Control Module.
  - **If between 4.8 - 5.2 V**
4. Test or replace the temperature sensor.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.

- If the DTC sets

Replace the K33 HVAC Control Module.

- If the DTC does not set

7. All OK

### Repair Instructions

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

- Refer to [HVAC Component Replacement Reference](#)
- Refer to [Control Module References](#) for HVAC control module replacement, programming and setup

## DTC B018A, B048C, B048F, OR B1395: WINDSHIELD TEMPERATURE SENSOR/HUMIDITY SENSOR/CONTROL MODULE VOLTAGE REFERENCE OUTPUT CIRCUIT

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC B018A

Windshield Temperature Sensor Circuit

#### DTC B048C

Humidity Sensor Humidity Circuit

#### DTC B048F

Humidity Sensor Temperature Circuit

#### DTC B1395

Control Module Voltage Reference Output Circuit

For symptom byte information, refer to [Symptom Byte List](#).

### Diagnostic Fault Information

| Circuit               | Short to Ground | Open/High Resistance                            | Short to Voltage | Signal Performance |
|-----------------------|-----------------|-------------------------------------------------|------------------|--------------------|
| 5 V Reference         | B1395 03        | 1                                               | B1395 07         | -                  |
| Signal Terminal 2     | B048C 02        | B048C 05                                        | B048C 05         | -                  |
| Signal Terminal 4     | B018A 02        | B018A 05                                        | B018A 05         | -                  |
| Signal Terminal 5     | B048F 02        | B048F 05                                        | B048F 05         | -                  |
| Low Reference         | -               | B018A 05,<br>B048C 05,<br>B048F 05, B1395<br>03 | -                | -                  |
| 1. Sensor Malfunction |                 |                                                 |                  |                    |

### Circuit/System Description

The windshield temperature and inside moisture sensor includes the relative humidity sensor, windshield temperature sensor and humidity sensing element temperature sensor all in one assembly.

This sensor assembly provides information about:

- Relative humidity level at the windshield inside the vehicle
- Temperature of the windshield inside the vehicle
- Temperature of the humidity sensor element

The relative humidity sensor measures the relative humidity of the compartment side of the windshield. It also detects the temperature of the windshield surface on the compartment side. Both values are used as control inputs for the HVAC control module application to calculate the fog risk on windshield compartment side and ability to reduce fuel consumption by decreasing A/C compressor usage to a minimum without causing any fog. The sensor will also enable partial recirculation mode in order to improve heat-up performance of the passenger compartment under cold ambient temperature conditions without the risk of mist build-up on the windshield. The humidity sensor element temperature sensor supplies the temperature of the humidity sensor element. It is only needed if the thermal contact between the humidity sensing element and the inside windshield surface is not sufficient.

#### Conditions for Running the DTC

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

#### Conditions for Setting the DTC

##### **B018A 02, B048C 02, or B048F 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.

##### **B018A 05, B048C 05, B048F 05 or B1395 07**

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 5 V reference voltage out of range. The 5 V reference voltage is less than 4.5 V for more than 50 ms.

##### **B1395 07**

The HVAC control module detects the 5 V reference voltage out of range. The 5 V reference voltage is greater than 5.5 V for more than 50 ms.

#### 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 60% for humidity.

#### Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

#### Reference Information

Schematic Reference

#### HVAC Schematics (C4P/CJ2)

Connector End View Reference

#### COMPONENT CONNECTOR END VIEWS - INDEX

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 and all vehicle systems OFF, disconnect the harness connector at the B160 Windshield Temperature and Inside Moisture Sensor. It may take up to 10 min for all vehicle systems to power down.

**NOTE:** The scan tool must be disconnected from the vehicle before performing the next test.

2. Test for less than 10  $\Omega$  between the low reference circuit terminal 3 and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K33 HVAC Control Module.
  - **If less than 10  $\Omega$**
3. Ignition ON.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
  - **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the 5 V reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K33 HVAC Control Module.
  - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module, ignition ON.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K33 HVAC Control Module.
  - **If between 4.8 - 5.2 V**
5. Verify the scan tool parameters listed below are less than -37 $^{\circ}$ C (-35 $^{\circ}$ F).
  - Windshield Temperature
  - Passenger Compartment Humidity Sensor Temperature
  - **If -37 $^{\circ}$ C (-35 $^{\circ}$ F) or greater**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module.
    2. Test for infinite resistance between the signal circuit terminals listed below and ground:
      - Windshield temperature sensor signal terminal 4



- Passenger compartment humidity sensor temperature signal terminal 5
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the K33 HVAC Control Module.
  - **If less than -37Â°C (-35Â°F)**
6. Test for 4.8 - 5.2 V between the signal circuit terminals listed below and ground.
- Windshield temperature sensor signal terminal 4
  - Passenger compartment humidity sensor temperature signal terminal 5
  - **If less than 4.8 V**
1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
  2. Test for infinite resistance between the signal circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance
  3. Test for less than 2  $\Omega$  in the signal circuit end to end.
    - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
    - If less than 2  $\Omega$ , replace the K33 HVAC Control Module.
  - **If greater than for 5.2 V**
1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module, ignition ON.
  2. Test for less than 1 V between the signal circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K33 HVAC Control Module.
  - **If between 4.8 - 5.2 V**
7. Install a 3 A fused jumper wire between the low reference circuit terminal 3 and each signal circuit terminal listed below:
- Windshield temperature sensor signal terminal 4
  - Passenger compartment humidity sensor temperature signal terminal 5
8. Verify the appropriate scan tool parameter listed below is greater than 114Â°C (238Â°F).
- Windshield Temperature
  - Passenger Compartment Humidity Sensor Temperature
  - **If 114Â°C (238Â°F) or less**
1. Ignition OFF, remove the jumper wire and disconnect the harness connectors at the K33 HVAC Control Module, ignition ON.
  2. Test for less than 1 V between the signal circuit terminals listed below and ground:
    - Windshield temperature sensor signal terminal 4
    - Passenger compartment humidity sensor temperature signal terminal 5
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V
  3. Test for less than 2  $\Omega$  in the signal circuit end to end.
    - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
    - If less than 2  $\Omega$ , replace the K33 HVAC Control Module.
  - **If greater than 114Â°C (238Â°F)**
9. Remove the jumper wire.
10. Verify the scan tool Passenger Compartment Humidity parameter is greater than 95%.
- **If 95% or less**
1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module, ignition ON.
  2. Test for infinite resistance between the signal circuit terminal 2 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the K33 HVAC Control Module.

- **If greater than 95%**

11. Test for 4.8 - 5.2 V between the signal circuit terminal 2 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2  $\Omega$  in the signal circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K33 HVAC Control Module.

- **If greater than for 5.2 V**

1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K33 HVAC Control Module.

- **If between 4.8 - 5.2 V**

12. Install a 3 A fused jumper wire between the passenger compartment humidity signal circuit terminal 2 and the low reference circuit terminal 3.

13. Verify the scan tool Passenger Compartment Humidity Sensor parameter is less than 5%.

- **If 5% or greater**

1. Ignition OFF, remove the jumper wire and disconnect the harness connectors at the K33 HVAC Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit terminal 2 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2  $\Omega$  in the signal circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K33 HVAC Control Module.

- **If less than 5%**

14. Test or replace the B160 Windshield Temperature and Inside Moisture Sensor.

## Repair Instructions

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

- Refer to [HVAC Component Replacement Reference](#)
- Refer to [Control Module References](#) for HVAC control module replacement, programming and setup

## DTC B0183: SOLAR LOAD SENSOR CIRCUIT

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC B0183

Solar Load Sensor Circuit

For symptom byte information, refer to [Symptom Byte List](#) .

## Diagnostic Fault Information

| Circuit       | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------|-----------------|----------------------|------------------|--------------------|
| Signal        | B0183 02        | B0183 05             | B0183 05         | -                  |
| Low Reference | -               | B0163 05, B0183 05   | -                | -                  |

### Circuit/System Description

The ambient light/sunload sensor integrates the sunload sensor and passenger compartment temperature sensor into a single assembly.

The solar sensor is connected to a low reference and a 5 V biased (pull up) signal circuit voltage from the HVAC control module. As the sunload increases, the sensor signal voltage decreases. The signal varies between 0.1 - 4.9 V and is provided to the HVAC control module.

The passenger compartment temperature sensor is a negative temperature coefficient thermistor. A signal and low reference circuit enable 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 vehicle 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

#### 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.

### Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

### Reference Information

Schematic Reference

### HVAC Schematics (C4P/CJ2)

Connector End View Reference

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- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

### Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B10B Ambient Light/Sunload Sensor. It may take up to 10 min for all vehicle systems to power down.

**NOTE:** The scan tool must be disconnected from the vehicle before performing the next test.

2. Test for less than 10  $\Omega$  between the low reference circuit terminal 6 and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K33 HVAC Control Module.
  - **If less than 10  $\Omega$**
3. Ignition ON.
4. Test for 4.8 - 5.2 V between the signal circuit terminal 4 and ground.
  - **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K33 HVAC Control Module.
  - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K33 HVAC Control Module.
  - **If between 4.8 - 5.2 V**
5. Test or replace the B10B Ambient Light/Sunload Sensor.
6. Verify DTC B0183 does not set or the symptom does not occur while operating the vehicle within the Conditions for Running the DTC.
  - **If the DTC or symptom is not corrected.**

Replace the K33 HVAC Control Module.
  - **If the DTC or symptom is corrected.**
7. All OK.

### Repair Instructions

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

- Refer to [HVAC Component Replacement Reference](#)



- Refer to [Control Module References](#) for HVAC control module replacement, programming and setup

## **DTC B0193: FRONT BLOWER MOTOR SPEED CIRCUIT**

### **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.
- Refer to [Diagnostic Procedure Instructions](#) to provide 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 |
|---------------------|-----------------|----------------------|------------------|--------------------|
| B+                  | B0193 06        | B0193 06             | -                | -                  |
| Control             | B0193 06        | B0193 06             | B0193 01         | 1                  |
| Ground              | -               | B0193 06             | -                | -                  |
| 1. HVAC Malfunction |                 |                      |                  |                    |

### **Circuit/System Description**

The blower motor speed control signal from the HVAC control module, battery positive and ground circuits enable the blower motor to operate. The blower motor control circuitry is integrated within the blower motor assembly. The HVAC control module provides a ground pulse width modulation (PWM) signal to the blower motor to request a specific motor speed. The blower motor translates the PWM signal and drives the motor accordingly.

### **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 fluctuating.

### **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.

### **Diagnostic Aids**

The current design of this motor does not allow for bench testing. The motor will not operate by simply applying power and ground.

Inspect the motor shaft for rust or other foreign material which may prohibit proper motor operation.

Check for Preliminary Information or Technical Service Bulletins.

## **Reference Information**

Schematic Reference

## **HVAC Schematics (C4P/CJ2)**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

**Control Module References** for scan tool information

## **Circuit/System Testing**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the M8 Blower Motor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10  $\Omega$  between the ground circuit terminal 6 and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the ground circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.
  - **If less than 10  $\Omega$**
3. Ignition ON.
4. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the M8 Blower Motor.
  - **If the test lamp illuminates**
5. Remove the test lamp, ignition ON.

6. Verify the resistance between the control circuit terminal 2 and ground varies from 12K  $\Omega$  to 130K  $\Omega$  while changing blower speeds.
- **If the resistance does not change from 12K  $\Omega$  to 130K  $\Omega$** 
    1. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
    3. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance.
    4. Test for less than 2  $\Omega$  in the control circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$  replace the K33 HVAC Control Module.
  - **If the resistance does change from 12K  $\Omega$  to 130K  $\Omega$**
7. Test or replace the M8 Blower Motor.

### Repair Instructions

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

- Refer to [HVAC Component Replacement Reference](#)
- Refer to [Control Module References](#) for HVAC control module replacement, programming and setup

## **DTC B0223, B022A, B0233, B023A, B0408, OR B0418: RECIRCULATE POSITION COMMAND 1-2 CIRCUITS/AIR FLOW CONTROL CIRCUIT/HVAC ACTUATORS SUPPLY VOLTAGE/MAIN TEMPERATURE CONTROL CIRCUIT/RIGHT TEMPERATURE CONTROL CIRCUIT**

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

#### **DTC B0223 01**

Recirculate Position Command 1 Circuit Short to Battery

#### **DTC B0223 06**

Recirculate Position Command 1 Circuit Low Voltage/Open

#### **DTC B022A 01**

Recirculate Position Command 2 Circuit Short to Battery

#### **DTC B022A 06**

Recirculate Position Command 2 Circuit Low Voltage/Open

#### **DTC B0233 01**

Air Flow Control Circuit Short to Battery

#### **DTC B0233 06**

**DTC B023A 02**

HVAC Actuators Supply Voltage Short to Ground

**DTC B0408 01**

Main Temperature Control Circuit Short to Battery

**DTC B0408 06**

Main Temperature Control Circuit Low Voltage/Open

**DTC B0418 01**

Right Temperature Control Circuit Short to Battery

**DTC B0418 06**

Right Temperature Control Circuit Low Voltage/Open

**Diagnostic Fault Information**

| Circuit                                      | Short to Ground                                              | Open/High Resistance                            | Short to Voltage | Signal Performance |
|----------------------------------------------|--------------------------------------------------------------|-------------------------------------------------|------------------|--------------------|
| Stepper Motors 12 V Reference                | B023A 02,<br>B0223 06,<br>B0233 06,<br>B0408 06,<br>B0418 06 | B0223 06,<br>B0233 06,<br>B0408 06,<br>B0418 06 | -                | -                  |
| Recirculation Actuator Control 1             | B0223 06                                                     | B0223 06                                        | B0223 01         | 1                  |
| Recirculation Actuator Control 2             | B0223 06                                                     | B0223 06                                        | B0223 01         | 1                  |
| Recirculation Actuator Control 3             | B0223 06                                                     | B0223 06                                        | B0223 01         | 1                  |
| Recirculation Actuator Control 4             | B0223 06                                                     | B0223 06                                        | B0223 01         | 1                  |
| Air Temperature Actuator Control 1           | B0408 06                                                     | B0408 06                                        | B0408 01         | 1                  |
| Air Temperature Actuator Control 2           | B0408 06                                                     | B0408 06                                        | B0408 01         | 1                  |
| Air Temperature Actuator Control 3           | B0408 06                                                     | B0408 06                                        | B0408 01         | 1                  |
| Air Temperature Actuator Control 4           | B0408 06                                                     | B0408 06                                        | B0408 01         | 1                  |
| Passenger Air Temperature Actuator Control 1 | B0418 06                                                     | B0418 06                                        | B0418 01         | 1                  |
| Passenger Air Temperature Actuator Control 2 | B0418 06                                                     | B0418 06                                        | B0418 01         | 1                  |
| Passenger Air Temperature Actuator Control 3 | B0418 06                                                     | B0418 06                                        | B0418 01         | 1                  |
| Passenger Air Temperature Actuator Control 4 | B0418 06                                                     | B0418 06                                        | B0418 01         | 1                  |
| Mode Actuator Control 1                      | B0233 06                                                     | B0233 06                                        | B0233 01         | 1                  |
| Mode Actuator Control 2                      | B0233 06                                                     | B0233 06                                        | B0233 01         | 1                  |
| Mode Actuator Control 3                      | B0233 06                                                     | B0233 06                                        | B0233 01         | 1                  |
| Mode Actuator Control 4                      | B0233 06                                                     | B0233 06                                        | B0233 01         | 1                  |
| 1. HVAC Malfunction                          |                                                              |                                                 |                  |                    |

### **Circuit/System Description**

Stepper motors are used for temperature regulation, air distribution control and recirculation door control.

With the switches and dials on the HVAC controls, air temperature door position, mode door position and recirculation door position can be selected. The selected values are passed to the HVAC control module via serial data. The HVAC control module supplies a 12 V control voltage to the stepper motors and energizes the 4 stepper motor coils with a pulsed ground signal. The stepper motors move the appropriate doors into the calculated positions, in order to reach the desired positions.

### **Conditions for Running the DTC**

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

### **Conditions for Setting the DTC**

#### **B023A 02**

The stepper motors supply output is shorted to ground.

#### **B0223 01, B022A 01, B0233 01, B023A 01, B0408 01 or B0418 01**

At least one control circuits of the appropriate stepper motor is shorted to voltage when motor starts moving. Faults are not detected when motor is already running or target position is already reached.

#### **B0223 06, B022A 06, B0233 06, B0233 06, B0408 06 or B0418 06**

At least one control circuits of the appropriate stepper motor is shorted to ground or open when motor starts moving. Faults are not detected when motor is already running or target position is already reached.

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

#### **B023A**

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

#### **B0223, B022A, B0233, B0408 or B0418**

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

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

The condition for setting the DTC is no longer present.

### **Reference Information**

Schematic Reference

### **HVAC Schematics (C4P/CJ2)**

Connector End View Reference

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Scan Tool Reference

[Control Module References](#) for scan tool information

### Circuit/System Verification

1. Perform the [Actuator Recalibration](#) procedure.
2. Verify the concern or DTC has been corrected.
  - **If the concern or DTC has not been corrected**
    1. Verify DTC B023A is not set.
      - If DTC B023A is set  
Refer to Circuit/System Testing - DTC B023A.
      - If DTC B023A is not set  
Refer to Circuit/System Testing - DTC B0223, B022A, B0233, B0408 or B0418.
  - **If the concern or DTC has been corrected**
3. All OK.

### Circuit/System Testing

#### DTC B023A

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the components listed below. It may take up to 2 min for all vehicle systems to power down.
  - M37 Mode Door Actuator
  - M46 Air Recirculation Door Actuator
  - M6L Air Temperature Door Actuator - Left
  - M6R Air Temperature Door Actuator - Right
2. Disconnect the X3 and X4 harness connectors at the K33 HVAC Control Module.
3. Test for infinite resistance between the K33 HVAC Control Module 12 V reference circuit terminal 15 X3 and ground.
  - **If less than infinite resistance**  
Repair the short to ground on the circuit.
  - **If infinite resistance**
4. Ignition ON.
5. Test for less than 1 V between the K33 HVAC Control Module 12 V reference circuit terminal 15 X3 and ground.
  - **If 1 V or greater**  
Repair the short to voltage on the circuit.
  - **If less than 1 V**
6. Connect the X3 and X4 harness connectors at the K33 HVAC Control Module, ignition ON.
7. Clear all DTCs.
8. Verify DTC B023A is not set.
  - **If the DTC is set.**  
Replace the K33 HVAC Control Module.

- **If the DTC is not set.**

9. Verify DTC B023A does not set after connecting each of the components listed below one at a time and operating them through their full range.

- M37 Mode Door Actuator
- M46 Air Recirculation Door Actuator
- M6L Air Temperature Door Actuator - Left
- M6R Air Temperature Door Actuator - Right
- **If the DTC sets**

Replace the component that was connected immediately before the DTC set.

- **If the DTC does not set**

10. All OK.

### **DTC B0223, B022A, B0233, B0408 or B0418**

1. Ignition OFF, disconnect the harness connector at the appropriate door actuator, ignition ON.

2. Verify a test lamp flashes when connected between the 12 V reference circuit terminal 2 and ground.

- **If the test lamp does not flash**

1. Ignition OFF, remove the test lamp and disconnect the harness connector at the K33 HVAC Control Module.

2. Test for less than 2  $\Omega$  in the 12 V control circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K33 HVAC Control Module.

- **If the test lamp flashes**

3. Connect a test lamp between each control circuit listed below and B+.

- Control Circuit - terminal 1
- Control Circuit - terminal 3
- Control Circuit - terminal 4
- Control Circuit - terminal 6

4. Command the appropriate door actuator in both directions.

5. Verify the test lamp turns ON and then OFF during at least one of the directional commands.

- **If the test lamp is always ON**

1. Ignition OFF, remove the test lamp and disconnect the harness connector at the K33 HVAC Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K33 HVAC Control Module.

- **If the test lamp is always OFF**

1. Ignition OFF, remove the test lamp and disconnect the harness connector at the K33 HVAC Control Module, ignition ON.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Ignition OFF

4. Test for less than 2  $\Omega$  in the control circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K33 HVAC Control Module.

- **If the test lamp turns ON and then OFF**

6. Replace the door actuator.

## Repair Instructions

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

- Refer to [HVAC Component Replacement Reference](#)
- Refer to [Control Module References](#) for HVAC control module replacement, programming and setup

## DTC B269A, B269C, OR B269D: HEATER COOLANT PUMP CONTROL CIRCUIT

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

#### DTC B269A

Heater Coolant Pump Control Circuit Open

#### DTC B269C

Heater Coolant Pump Control Circuit Low

#### DTC B269D

Heater Coolant Pump Control Circuit High

### Diagnostic Fault Information

| Circuit            | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|--------------------|-----------------|----------------------|------------------|--------------------|
| Relay Coil Control | B269C           | B269A                | B269D            | -                  |

### Circuit/System Description

The primary purpose of the heater core coolant pump is to circulate engine coolant through the HVAC heater core when heat is required in the cabin for comfort. This normally happens when the vehicle is in an Auto Stop and the mechanical pump is not spinning. If the HVAC control module has determined heat is needed for the cabin, a request is sent via serial data to the engine control module to turn the pump ON. The engine control module controls the auxiliary coolant pump relay via the heater core coolant pump relay control circuit. The heater core coolant pump relay supplies voltage to the heater core coolant pump.

### Conditions for Running the DTC

- The 12 V battery voltage is greater than or equal to 9 V.
- The auxiliary heater coolant pump enable is commanded.

### Conditions for Setting the DTC

The engine control module detects the auxiliary heater coolant pump relay enable circuit is open, shorted to voltage or shorted to ground.

### Action Taken When the DTC Sets

DTCs B269A, B269C, and B269D are type B DTCs.

### Conditions for Clearing the DTC

DTCs B269A, B269C, and B269D are type B DTCs.

Schematic Reference

**HVAC Schematics (C4P/CJ2)**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

**Control Module References** for scan tool information

**Circuit/System Testing**

1. Ignition OFF, disconnect the KR33 Auxiliary Heater Coolant Pump Relay, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance,
    3. Test for greater than 5  $\Omega$  between the control circuit terminal 87 and ground.
      - If less than 5  $\Omega$ , repair the short to ground on the circuit.
      - If greater than 5  $\Omega$ , test or replace the KR33 Auxiliary Heater Coolant Pump Relay.
3. Verify a test lamp illuminates between the B+ circuit terminal 86 and ground.
  - **If the test lamp does not illuminate**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - **If the test lamp illuminates**
4. Connect a test lamp between the B+ circuit terminal 86 and the control circuit terminal 85.
5. Verify the test lamp turns ON and OFF when commanding the Engine Control Module Heater Coolant Pump On and Off with a scan tool.
  - **If the test lamp is always OFF**
    1. Ignition OFF, remove the test lamp, disconnect the X2 harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Ignition OFF

4. Test for less than 2  $\Omega$  in the control circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the K20 Engine Control Module.

• **If the test lamp is always ON**

1. Ignition OFF, remove the test lamp, disconnect the X2 harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

• **If the test lamp turns ON and OFF**

6. Verify a test lamp does not illuminate between the control circuit terminal 87 and ground.

• **If the test lamp illuminates**

Repair the short to voltage on the circuit.

• **If the test lamp does not illuminate**

7. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the G17 Heater Coolant Pump. It may take up to 2 min for all systems to power down.

8. Test for less than 10  $\Omega$  between the G17 Heater Coolant Pump ground circuit terminal 1 and ground.

• **If 10  $\Omega$  or greater**

1. Ignition OFF.

2. Test for less than 2  $\Omega$  in the ground circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.

• **If less than 10  $\Omega$**

9. Connect the harness connector at the G17 Heater Coolant Pump.

10. Ignition ON, connect a 5 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.

11. Verify the G17 Heater Coolant Pump is activated.

• **If the G17 Heater Coolant Pump does not activate**

1. Ignition OFF, remove the jumper wire.

2. Test for less than 2  $\Omega$  in the control circuit terminal 87 end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , test or replace the G17 Heater Coolant Pump.

• **If the G17 Heater Coolant Pump activates**

12. Test or replace the KR33 Auxiliary Heater Coolant Pump Relay.

## Component Testing

### Relay Test

1. Ignition OFF, disconnect the KR33 Auxiliary Heater Coolant Pump Relay.

2. Test for 60 - 180  $\Omega$  between terminals 85 and 86.

• **If less than 60  $\Omega$  or greater than 180  $\Omega$**

Replace the KR33 Auxiliary Heater Coolant Pump Relay.

• **If between 60 - 180  $\Omega$**



3. Test for infinite resistance between the terminals listed below:

- 30 and 86
- 30 and 87
- 30 and 85
- 85 and 87
- **If less than infinite resistance**

Replace the KR33 Auxiliary Heater Coolant Pump Relay.

- **If infinite resistance**

4. Install a 10 A fused jumper wire between relay terminal 86 and 12 V. Install a jumper wire between relay terminal 85 and ground.

5. Test for less than 2  $\Omega$  between terminals 30 and 87.

- **If 2  $\Omega$  or greater**

Replace the KR33 Auxiliary Heater Coolant Pump Relay.

- **If less than 2  $\Omega$**

6. All OK.

### Repair Instructions

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

- Refer to [HVAC Component Replacement Reference](#)
- Refer to [Control Module References](#) for HVAC control module replacement, programming and setup

## DTC B393B: AIR CONDITIONING COMPRESSOR VALVE CONTROL CIRCUIT

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

#### DTC B393B

Air Conditioning Compressor Valve Control Circuit

For symptom byte information, refer to [Symptom Byte List](#).

### Diagnostic Fault Information

| Circuit                       | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|-------------------------------|-----------------|----------------------|------------------|--------------------|
| B+                            | 1               | B393B 04             | -                | -                  |
| Control                       | B393B 04        | B393B 04             | B393B 0B         | -                  |
| 1. Solenoid Valve Malfunction |                 |                      |                  |                    |

### Circuit/System Description

This A/C system uses a conventional clutch to engage and mechanically turn the compressor and a variable displacement solenoid valve to alter the amount of displacement created by the turning of the compressor. The HVAC control module provides both battery voltage and a pulse width modulated ground to the variable displacement solenoid valve. When the A/C switch is pressed, the HVAC control module grounds the variable displacement solenoid using a low side (PWM) signal in order to command

the amount of compressor displacement. The performance of the A/C compressor is based on adjusted interior temperature and engine load.

### Conditions for Running the DTC

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

### Conditions for Setting the DTC

#### **B393B 04**

A PWM greater than 10% is sent but no current is read back.

#### **B393B 0B**

Measured current is above threshold of 815 mA.

### Action Taken When the DTC Sets

#### **B393B 04**

The A/C compressor is disabled.

#### **B393B 0B**

- The A/C compressor is disabled.
- Output will be switched off for hardware protection.

### Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

### Reference Information

Schematic Reference

### HVAC Schematics (C4P/CJ2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX

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- [Circuit Testing](#)
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- [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 Q46 A/C Compressor Solenoid Valve. Connect a test light between terminals 1 and 2 of the harness connector. Ignition ON.
2. Verify the test light turns on and off when commanding the Q46 A/C Compressor Solenoid Valve ON and OFF with the scan tool.

- **If the test light does not turn ON and OFF**

1. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module, ignition ON.
2. Test for less than 1 V between ground and each control circuit terminal listed below:
  - terminal 10
  - terminal 11
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V
3. Ignition OFF.
4. Test for infinite resistance between ground and each control circuit terminal listed below:
  - terminal 10
  - terminal 11
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance
5. Test for less than 2  $\Omega$  in each of the control circuits end to end listed below:
  - Q46 A/C Compressor Solenoid Valve terminal 1 and K33 HVAC Control Module terminal 10
  - Q46 A/C Compressor Solenoid Valve terminal 2 and K33 HVAC Control Module terminal 11
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K33 HVAC Control Module.

- **If the test light turns ON and OFF**

3. Test the Q46 A/C Compressor Solenoid Valve or replace the G1 A/C Compressor.

## Component Testing

### A/C Compressor Solenoid Valve Test

1. Ignition OFF, disconnect the harness connector at the Q46 A/C Compressor Solenoid Valve.
2. Test for 7 - 15  $\Omega$  between B+ terminal 2 and control terminal 1.
  - **If less than 7  $\Omega$  or greater than 15  $\Omega$**   
Replace the G1 A/C Compressor.
  - **If between 7 - 15  $\Omega$**
3. Test for infinite resistance between each terminal and the Q46 A/C Compressor Solenoid Valve housing/case.
  - **If less than infinite resistance**  
Replace the G1 A/C Compressor.
  - **If infinite resistance**
4. All OK.

## Repair Instructions

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

- Refer to [HVAC Component Replacement Reference](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup

## DTC P0532 OR P0533: AIR CONDITIONING (A/C) REFRIGERANT PRESSURE SENSOR CIRCUIT LOW/HIGH VOLTAGE

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of the diagnostic category.

## DTC Descriptors

### DTC P0532

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

### DTC P0533

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

## Diagnostic Fault Information

| Circuit       | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------|-----------------|----------------------|------------------|--------------------|
| 5 V Reference | P0532, P0641    | P0532                | P0533            | -                  |
| Signal        | P0532           | P0532                | P0533            | -                  |
| Low Reference | -               | P0533                | -                | -                  |

## Circuit/System Description

The engine control module (ECM) monitors the high side refrigerant pressure through the A/C refrigerant pressure sensor. The ECM supplies a 5 V 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. The ECM may use this information to turn the cooling fans on as well as to monitor clutch engagement. The HVAC module will receive the A/C refrigerant pressure information from the ECM via serial data.

## Conditions for Running the DTC

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

## Conditions for Setting the DTC

### P0532

The ECM detects that the A/C pressure is less than 1 psi (0.25 V).

### P0533

The ECM detects that the A/C pressure is more than 428 psi (4.92 V).

## Action Taken When the DTC Sets

- DTCs P0532 and P0533 are Type B DTCs
- 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.

## Diagnostic Aids

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

## Reference Information

Schematic Reference

**COMPONENT CONNECTOR END VIEWS - INDEX**

**Automatic HVAC Description and Operation**

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

**Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

**Control Module References** for scan tool information

**Circuit/System Verification**

1. Ignition ON
2. Verify the scan tool engine control module A/C High Side Pressure Sensor parameter is between 6.8 kPa (1 psi) and 2950 kPa (428 psi).
  - **If not between 6.8 kPa (1 psi) and 2950 kPa (428 psi)**  
Refer to Circuit/System Testing
  - **If between 6.8 kPa (1 psi) and 2950 kPa (428 psi)**
3. All OK

**Circuit/System Testing**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B1 A/C Refrigerant Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10  $\Omega$  between the low reference circuit terminal 1 and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If less than 10  $\Omega$**
3. Ignition ON.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 2 and ground.
  - **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the 5 V reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.



- If less than 2  $\Omega$ , replace the K20 Engine Control Module.
- **If greater than 5.2 V**
  1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
  2. Test for less than 1 V between the 5 V reference circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K20 Engine Control Module.
- **If between 4.8 - 5.2 V**
- 5. Verify the scan tool A/C High Side Pressure Sensor parameter is less than .25 V.
  - **If .25 V or greater**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit terminal 3 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 Engine Control Module.
  - **If less than .25 V**
- 6. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 2.
- 7. Verify the scan tool A/C High Side Pressure Sensor parameter is greater than 4.8 V.
  - **If 4.8 V or less**
    1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal 3 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If greater than 4.8 V**
- 8. Test or replace the B1 A/C Refrigerant Pressure Sensor.

### Repair Instructions

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

- Refer to [HVAC Component Replacement Reference](#)
- Refer to [Control Module References](#) for engine control module replacement, programming and setup

## DTC P0645, P0646, OR P0647: AIR CONDITIONING (A/C) COMPRESSOR CLUTCH RELAY CONTROL CIRCUIT

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC P0645

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

#### DTC P0646

**DTC P0647**

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

**Diagnostic Fault Information**

| <b>Circuit</b>                | <b>Short to Ground</b> | <b>Open/High Resistance</b> | <b>Short to Voltage</b> | <b>Signal Performance</b> |
|-------------------------------|------------------------|-----------------------------|-------------------------|---------------------------|
| Relay Coil Ignition           | P0645                  | P0645                       | -                       | -                         |
| Relay Switch B+               | 1                      | 1                           | -                       | -                         |
| Relay Coil Control            | P0646                  | P0645                       | P0647                   | -                         |
| Relay Switch Control          | 1                      | 1                           | 1                       | -                         |
| Ground                        | -                      | 1                           | -                       | -                         |
| 1. 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 serial data. The ECM then grounds the A/C compressor clutch relay coil control circuit, closing the relay contacts. The closed relay contacts provide voltage to the compressor clutch causing it to engage.

**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 or P0646**

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

**P0647**

The ECM detects a short to voltage at the A/C compressor clutch relay control circuit.

**Action Taken When the DTC Sets****P0645 or P0646**

The A/C compressor is inoperative or always active. The A/C compressor solenoid is commanded to 0% displacement. This causes warm air from the ducts, even with unwanted clutch engagement.

**P0647**

The A/C compressor is inoperative.

**Conditions for Clearing the DTC**

The condition for setting the DTC is no longer present.

**Reference Information**

Schematic Reference

**HVAC Schematics (C4P/CJ2)**

Connector End View Reference

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## Automatic HVAC Description and Operation

### Electrical Information Reference

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- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

### DTC Type Reference

## Powertrain Diagnostic Trouble Code (DTC) Type Definitions

### Scan Tool Reference

## Control Module References for scan tool information

### Circuit/System Testing

1. Ignition OFF, disconnect the KR29 A/C Compressor Clutch Relay, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Disconnect the harness connector at the Q2 A/C Compressor Clutch.
    4. Test for infinite resistance between the control circuit terminal 87 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, test or replace the Q2 A/C Compressor Clutch.
  - **If the test lamp illuminates**
3. Ignition ON.
4. Verify a test lamp illuminates between the ignition circuit terminal 86 and ground.
  - **If the test lamp does not illuminate**

Refer to [Power Mode Mismatch](#) .
  - **If the test lamp illuminates**
5. Connect a test lamp between the ignition circuit terminal 86 and the control circuit terminal 85.
6. Verify the test lamp turns ON and OFF when commanding the ECM A/C Compressor Clutch Relay On and Off with a scan tool.
  - **If the test lamp is always OFF**
    1. Ignition OFF, remove the test lamp and disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
    3. Ignition OFF.

4. Test for less than 2  $\Omega$  in the control circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
- **If the test lamp is always ON**
  1. Ignition OFF, remove the test lamp and disconnect the harness connector at the K20 Engine Control Module.
  2. Test for infinite resistance between the control circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the K20 Engine Control Module.
- **If the test lamp turns ON and OFF**
7. Verify a test lamp does not illuminate between the control circuit terminal 87 and ground.
  - **If the test lamp illuminates**

Repair the short to voltage on the circuit.
  - **If the test lamp does not illuminate**
8. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the Q2 A/C Compressor Clutch. It may take up to 2 min for all vehicle systems to power down.
9. Test for less than 10  $\Omega$  between the ground circuit terminal 1 and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the ground circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.
  - **If less than 10  $\Omega$**
10. Connect the harness connector at the Q2 A/C Compressor Clutch.
11. Ignition ON, connect a 10 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.
12. Verify the Q2 A/C Compressor Clutch is engaged.
  - **If the Q2 A/C Compressor Clutch does not engage**
    1. Ignition OFF, disconnect the harness connector at the Q2 A/C Compressor Clutch.
    2. Test for less than 2  $\Omega$  in the control circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , test or replace the Q2 A/C Compressor Clutch.
  - **If the Q2 A/C Compressor Clutch is engaged**
13. Test or replace the KR29 A/C Compressor Clutch Relay.

### Component Testing

1. Ignition OFF, disconnect the KR29 A/C Compressor Clutch Relay.
2. Test for 60 - 180  $\Omega$  between terminals 85 and 86.
  - **If not between 60 - 180  $\Omega$** 

Replace the KR29 A/C Compressor Clutch Relay.
  - **If between 60 - 180  $\Omega$**
3. Test for infinite resistance between the terminals listed below:
  - 30 and 86
  - 30 and 87
  - 30 and 85
  - 85 and 87
  - **If less than infinite resistance**



Replace the KR29 A/C Compressor Clutch Relay.

- **If infinite resistance**

4. Install a 15 A fused jumper wire between terminal 86 and 12 V. Install a jumper wire between terminal 85 and ground.

5. Test for less than 2  $\Omega$  between terminals 30 and 87.

- **If 2  $\Omega$  or greater**

Replace the KR29 A/C Compressor Clutch Relay.

- **If less than 2  $\Omega$**

6. All OK.

### Repair Instructions

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

- Refer to [HVAC Component Replacement Reference](#)
- Refer to [Control Module References](#) for engine control module replacement, programming and setup

### SYMPTOMS - HVAC SYSTEMS - AUTOMATIC

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

1. Perform the [Diagnostic System Check - Vehicle](#) before using the HVAC System Malfunction procedure 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](#).

### Visual/Physical Inspection

**NOTE:** Shutting one or more outlets may adversely affect the Automatic HVAC system by producing erroneous duct air temperature sensor readings in the duct connecting to the closed outlet. Where possible, always operate the Automatic HVAC system with all outlets open.

- Inspect for aftermarket devices which may affect the operation of the HVAC System. Refer to [Checking Aftermarket Accessories](#).
- Inspect the easily accessible or visible system components for obvious damage or conditions which 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](#) .

### Symptom List

Refer to [HVAC System Malfunction](#) in order to diagnose the symptom.

## HVAC SYSTEM 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### Diagnostic Aids

Check the following mechanical fault sources:

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

### Reference Information

Schematic Reference

### [HVAC Schematics \(C4P/CJ2\)](#)

Connector End View Reference

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- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

**J43600** ACR Air Conditioning Service Center

### Circuit/System Verification

**NOTE:** Check for bulletins before proceeding.

1. Ignition ON.
2. Verify every applicable scan tool Switch parameter changes when pressing the appropriate switch on the A26 HVAC Controls.
  - **If any parameter does not change**

Replace the A26 HVAC Controls.

- **If all parameters change**

3. Verify the blower motor operates properly with the blower motor switch in each speed position.

- **If the blower motor does not operate properly in each speed position**

Refer to [DTC B0193](#).

- **If the blower motor operates properly in each speed position**

4. Verify the HVAC doors listed below move when pressing the appropriate switch.

- Driver Temperature
- Passenger Temperature
- Mode
- Recirculation
- **If any HVAC door does not move**

Refer to [DTC B0223, B022A, B0233, B023A, B0408, or B0418](#).

- **If all HVAC doors move**

5. Install the J43600 ACR Air Conditioning Service Center.

6. Verify the high side pressure reading on the Air Conditioning Service Center is within 10% of the scan tool A/C High Side Pressure Sensor parameter.

- **If the reading is not within 10%**

Refer to [DTC P0532 or P0533](#).

- **If the reading is within 10%**

7. Verify the A/C High Side Pressure Sensor parameter is between 269-2929 kPa (39-425 PSI).

- **If the reading is not between 269-2929 kPa (39-425 PSI)**

Refer to [Air Conditioning \(A/C\) System Performance Test](#)

- **If the reading is between 269-2929 kPa (39-425 PSI)**

8. Verify the scan tool parameters listed below are within 10% of ambient temperature.

- Lower Left Duct Air Temperature Sensor
- Upper Left Duct Air Temperature Sensor
- Lower Right Duct Air Temperature Sensor
- Upper Right Duct Air Temperature Sensor
- A/C Evaporator Temperature Sensor
- **If not within 10% of ambient temperature**

Refer to [DTC B0173, B0178, B0509, B0514 or B3933](#).

- **If within 10% of ambient temperature**

9. Verify the scan tool parameters listed below are within 10% of actual conditions.

- Passenger Compartment Humidity
- Passenger Compartment Humidity Sensor Temperature
- Passenger Compartment Windshield Temperature
- **If not within 10% of actual conditions**

Refer to [DTC B018A, B048C, B048F, or B1395](#).

- **If within 10% of actual conditions**

10. Engine ON, A/C system ON.

11. Verify cool air flows from the ducts with the temperature control in the coldest position.

- **If the air is not cool**

1. Verify the Q2 A/C Compressor Clutch is engaged.
  - If the Q2 A/C Compressor Clutch is not engaged, refer to [Air Conditioning Compressor Malfunction](#).
  - If the Q2 A/C Compressor Clutch is engaged, refer to [Air Conditioning \(A/C\) System Performance Test](#) , and [DTC B393B](#).
- **If the air is cool**
12. Verify warm air flows from the ducts with the temperature control in the warmest position.
  - **If the air is not warm**  
  
Refer to [Heating Performance Diagnostic](#) .
  - **If the air is warm**
13. Engine OFF, ignition ON.
14. Verify the scan tool Sunload parameter changes while covering the B10B Ambient Light/Sunload Sensor with a shop towel or other suitable item.
  - **If the Sunload parameter does not change**  
  
Refer to [DTC B0183](#).
  - **If the Sunload parameter changes**
15. Verify the actual inside air temperature, using a thermometer, is less than 3Â°C (5Â°F) difference from the scan tool Inside Passenger Compartment Air Temp. Sensor parameter.
  - **If greater than a 3Â°C (5Â°F) difference**  
  
Refer to [DTC B0163](#).
  - **If less than a 3Â°C (5Â°F) difference**
16. Verify the vehicle is equipped with RPO code HP6.
  - **If the vehicle is not equipped with RPO code HP6.**  
  
Refer to step 18.
  - **If the vehicle is equipped with RPO code HP6.**
17. Verify the G17 Heater Coolant Pump turns On and Off when commanded with a scan tool.
  - **If the G17 Heater Coolant Pump does not turn On and Off**  
  
Refer to [DTC B269A, B269C, or B269D](#).
  - **If the G17 Heater Coolant Pump does turn On and Off**
18. All OK.

### Repair Instructions

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

- Refer to [HVAC Component Replacement Reference](#)
- Refer to [Control Module References](#) for HVAC control module replacement, programming and setup

## 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### Circuit/System Description

The A/C compressor uses a conventional belt driven magnetic clutch to engage and mechanically turn the compressor. When the A/C switch is pressed, the HVAC control module sends an A/C request message to the ECM via serial data. If specific criteria is met, the ECM then 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 permanently grounded A/C compressor clutch. The A/C compressor clutch will then be activated.

This A/C system utilizes a variable displacement solenoid valve to alter the amount of displacement created by the turning of the compressor. The HVAC control module provides both battery voltage and a pulse width modulated ground to the variable displacement solenoid valve. When the A/C switch is pressed, the HVAC control module grounds the variable displacement solenoid using a (PWM) signal in order to determine the amount of compressor displacement. The performance of the A/C compressor is regulated based on the adjusted interior temperature.

### **Diagnostic Aids**

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

- Battery voltage is between 9 - 18 V.
- Engine coolant temperature is less than 124Â°C (255Â°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 3Â°C (38Â°F).
- ECM does not detect excessive torque load.
- ECM does not detect insufficient idle quality.
- The ambient temperature sensor senses above 1Â°C (34Â°F).
- Blower motor is ON.

### **Reference Information**

Schematic Reference

#### **HVAC Schematics (C4P/CJ2)**

Connector End View Reference

#### **COMPONENT CONNECTOR END VIEWS - INDEX**

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**

**NOTE:** Refer to **HVAC System Malfunction** before performing this procedure.

1. Ignition ON, press and release the A/C Switch.



2. Verify the HVAC control module scan tool A/C Switch parameter changes between Active and Inactive.

- **If the parameter does not change**

Replace the A26 HVAC Controls.

- **If the parameter changes**

3. Set A/C system to coolest setting with blower ON.

4. Press and release the A/C switch several times.

5. Verify the ECM scan tool A/C Request Signal parameter changes between Active and Inactive.

- **If the parameter does not change**

Replace the K33 HVAC Control Module.

- **If the parameter changes**

6. Verify the A/C compressor clutch engages and disengages when commanding the ECM A/C Relay output function On and Off with a scan tool.

- **If the A/C compressor clutch does not engage or disengage as commanded**

Refer to [DTC P0645, P0646, or P0647](#)

- **If the A/C compressor clutch engages and disengages as commanded**

7. Engine ON.

8. Verify the HVAC control module scan tool A/C Compressor Refrigerant Solenoid Valve Command parameter changes with varying cooling loads.

- **If the parameter does not change**

Refer to [DTC B393B](#)

- **If the parameter does change**

9. All OK.

### Repair Instructions

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

- Refer to [HVAC Component Replacement Reference](#)
- Refer to [Control Module References](#) for HVAC control module replacement, programming and setup

### AFTERBLOW ENABLING

Afterblow is a feature that dries the evaporator core by operating the blower motor after the engine is turned off. This aids in reducing microbial growth that can create undesirable odors.

The vehicle does not come equipped with the afterblow feature turned on. If the afterblow feature is required due to an odor concern, it must be enabled by using the scan tool via the HVAC special functions menu.

Use the following procedure to enable the afterblow feature:

1. Connect the Scan Tool.
2. Turn ON the ignition, with the engine OFF.
3. Build the vehicle with the scan tool.
4. Select Module Diagnosis.
5. Select Remote Heater and Air Conditioning Control Module.
6. Select Configuration/Reset Functions.
7. Select HVAC Afterblow Configuration.



When afterblow has been enabled, the following conditions must be met for the HVAC control module to operate afterblow:

- The engine must be turned OFF.
- The outside air temperature must be at least 11Â°C (52Â°F) when the compressor was last operating before the engine was turned OFF.
- The A/C compressor must have operated for more than 2 minutes before the engine was turned OFF.
- The system voltage must be above 12 V.

Once the above conditions have been met, the blower motor will operate at a low blower speed, following the sequence below up to 5 times:

1. The blower motor will be OFF for 7 - 11 minutes.
2. The blower motor will operate for 20 - 60 seconds.

## ACTUATOR RECALIBRATION

Preferred Method (with Scan Tool)

**NOTE:** Do not operate any HVAC controls while the HVAC control module is calibrating as this may interrupt the process. If interrupted, improper HVAC performance will result.

1. Using a scan tool, perform the HVAC Actuators Learn in the HVAC Control Module.
2. Follow the scan tool directions to complete the procedure.
3. Operate the system and verify that no DTCs have set as current DTCs.
4. If DTC B101E 4B is set after attempting the actuator recalibration procedure, perform the following:
  1. Verify which actuator does not have a scan tool learn status parameter status of complete.
  2. Verify the unlearned actuator is physically rotating - A common cause of DTC B101E 4B is an actuator that is electrically OK but fails to physically rotate (e.g. stripped gears).
  3. If the unlearned actuator is not physically rotating, replace the actuator, otherwise replace the HVAC control module.

Alternate Method (without Scan Tool)

**NOTE:** Do not operate any HVAC controls while the HVAC control module is calibrating as this may interrupt the process. If interrupted, improper HVAC performance will result.

1. Ignition OFF/Vehicle OFF.
2. Remove the HVAC control module fuse for a minimum of 10 s.
3. Install the HVAC control module fuse.
4. Start the vehicle.
5. Wait 40 s for the HVAC control module to self-calibrate.

## REPAIR INSTRUCTIONS

### WIRE TO WIRE REPAIR - HVAC

#### Special Tools

- EL-38125-10 Splice Sleeve Crimping Tool (non GMNA)
- J-38125-5A Ultra Torch Special Tool
- J-38125-8 Splice Sleeve Crimping Tool (GMNA)

For equivalent regional tools, refer to [Special Tools](#) .

**WARNING:** In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

**NOTE:** If the wiring harness internal to the transmission is damaged, the wiring harness must be replaced. The use of splice sleeves in an attempt to repair the internal transmission wires, connectors, or terminals could result in performance issues.

**NOTE:** Do not splice wires in Door Harness Grommets.

**NOTE:** The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.

Use only DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

#### Splice Sleeve Selection

| Splice Sleeve Color              | Crimp Tool Nest Color    |               | Wire Gauge mm <sup>2</sup> / (AWG) |
|----------------------------------|--------------------------|---------------|------------------------------------|
|                                  | 3 Crimp Nests            | 4 Crimp Nests |                                    |
| Salmon (Yellow-Pink)<br>19300089 | Red (1) or Red/Green (1) | Red (2)       | 0.22 - 0.8/(18 - 26)               |
| Blue<br>19168447                 | Blue (2)                 | Blue (3)      | 1.0 - 2.0/(14 - 16)                |
| Yellow<br>19168448               | Yellow (3)               | Yellow (4)    | 3.0 - 5.0/(10 - 12)                |

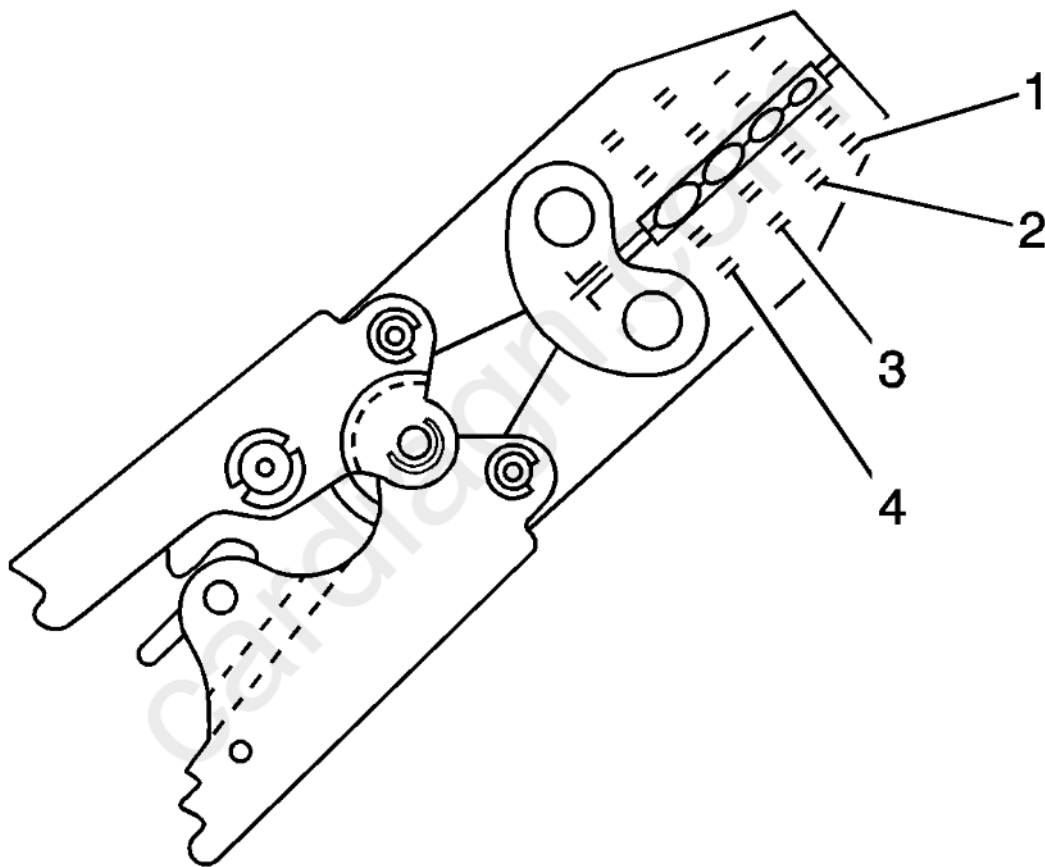
**NOTE:** You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:
  - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
  - Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
  - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

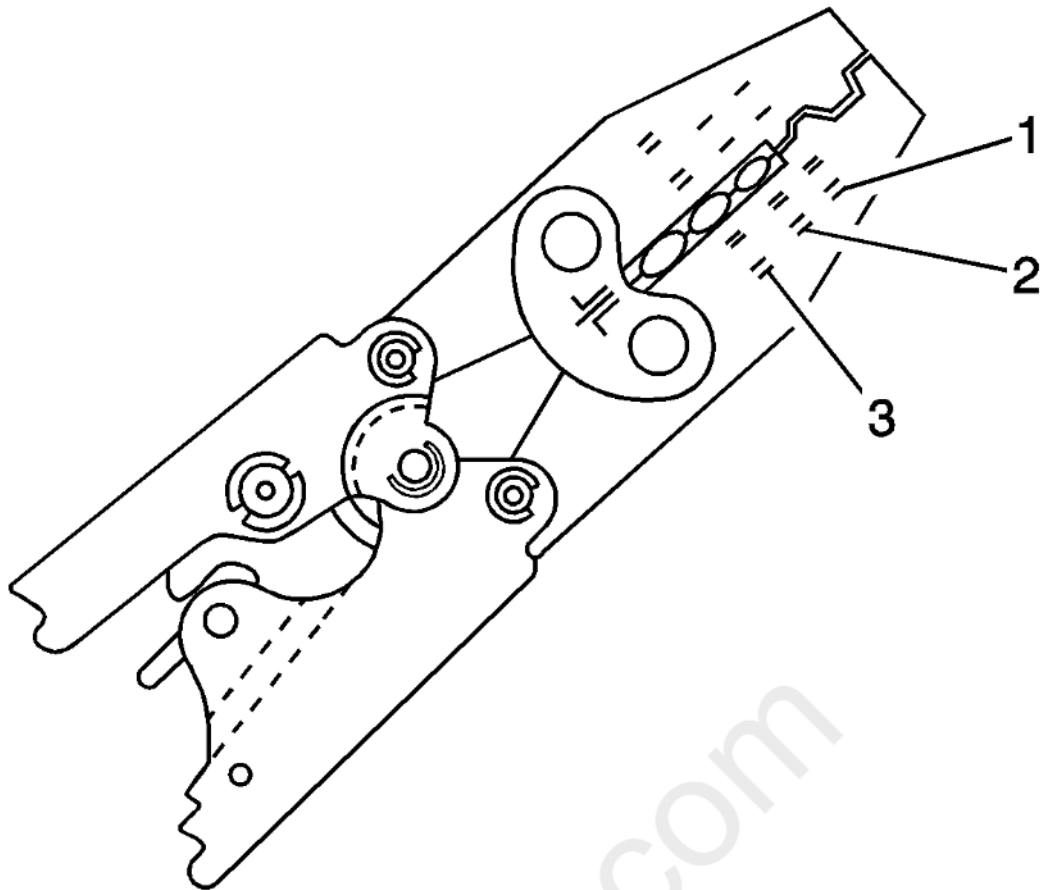
3. Strip the insulation:
  - When adding a length of wire to the existing harness, use the same size wire as the original wire.

- Perform one of the following items in order to find the correct wire size:
    - Find the wire on the schematic and convert to regional wiring gauge size.
    - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
  - Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
  - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
  - If the wire is damaged, repeat this procedure after removing the damaged section.
4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.
  5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.



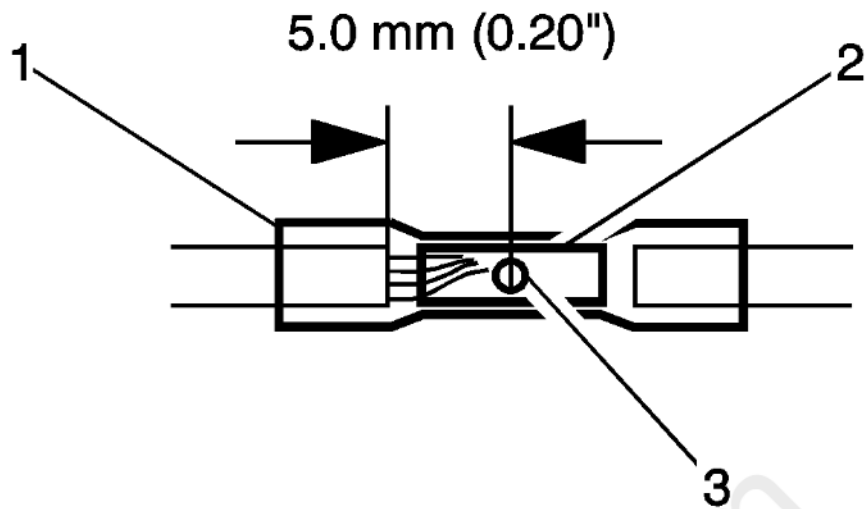
**Fig. 8: Splice Sleeve Crimping Tool With 4 Crimp Nests**  
 Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.



**Fig. 9: Splice Sleeve Crimping Tool With 3 Crimp Nests**  
**Courtesy of GENERAL MOTORS COMPANY**

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under crimp tool nest color).



**Fig. 10: Identifying DuraSeal Splice Sleeve**  
**Courtesy of GENERAL MOTORS COMPANY**

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.





**Fig. 11: Crimped DuraSeal Splice Sleeve**

**Courtesy of GENERAL MOTORS COMPANY**

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.



**Fig. 12: Heated Splice Sleeve**

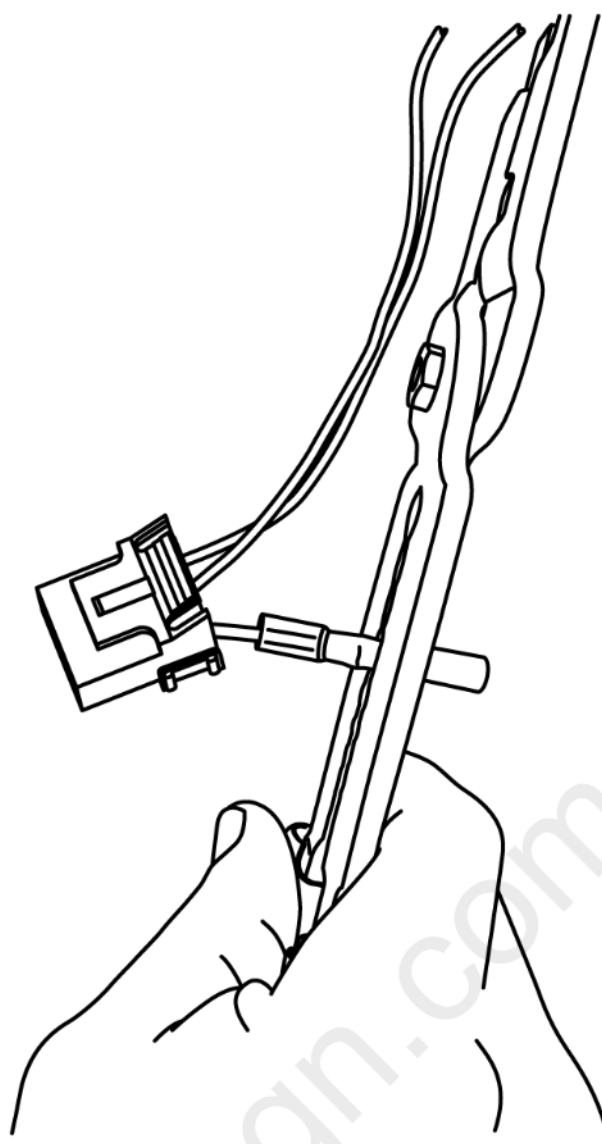
Courtesy of GENERAL MOTORS COMPANY

12. Using the heat torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
  - The tubing will shrink completely as the heat is moved along the insulation.
  - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

#### **Weatherpack™ Wiring Repair**

**NOTE:** Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.



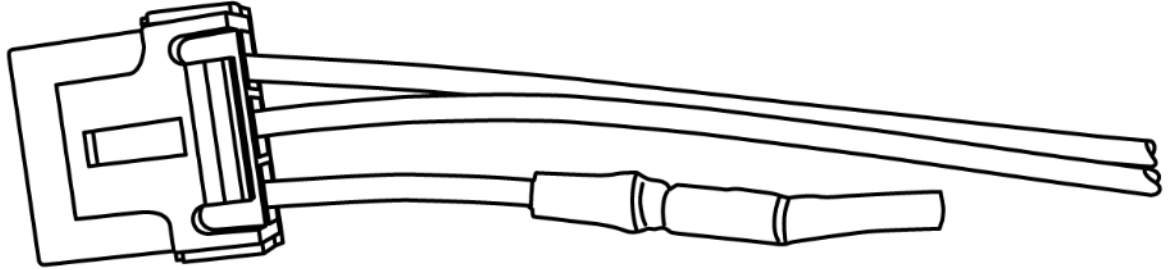
**Fig. 13: Tightly Close Handles Of Crimp Tool**

**Courtesy of GENERAL MOTORS COMPANY**

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSeal with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.



**Fig. 14: Heat To Crimped Area Of Barrel**

**Courtesy of GENERAL MOTORS COMPANY**

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
  - The tubing will shrink completely as the heat is moved along the insulation.
  - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.



**Fig. 15: Taping Extra Terminated Leads Back Into Harness**  
Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

### High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the heat torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
  - The tubing will shrink completely as the heat is moved along the insulation.
  - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

## CONNECTOR RECONNECTION - HVAC

### Special Tools

**EL-35616** Terminal Test Probe Kit

For equivalent regional tools, refer to **Special Tools** .

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.



Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Loose, corroded, or painted terminal stud/fastener
- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- A terminal not seated all the way into the connector body
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [\*\*Inducing Intermittent Fault Conditions\*\*](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [\*\*Testing for Electrical Intermittents\*\*](#) for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to [\*\*Scan Tool Snapshot Procedure\*\*](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

### Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

### Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

### Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use the **EL-35616** kit to test for proper terminal contact. Failure to use the **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

## **Flat Wire Connectors**

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter into the flat wire harness connector in order to test the circuit in question.

## **Control Module/Component Voltage and Grounds**

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Power Distribution Schematics](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Ground Distribution Schematics](#) .

## **Temperature Sensitivity**

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
  - High ambient temperatures
  - Underhood/engine generated heat
  - Circuit generated heat due to a poor connection, or high electrical load

- Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
  - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
  - The condition only occurs on a cold start.
  - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

### Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.
- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#).
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

### Incorrect Control Module

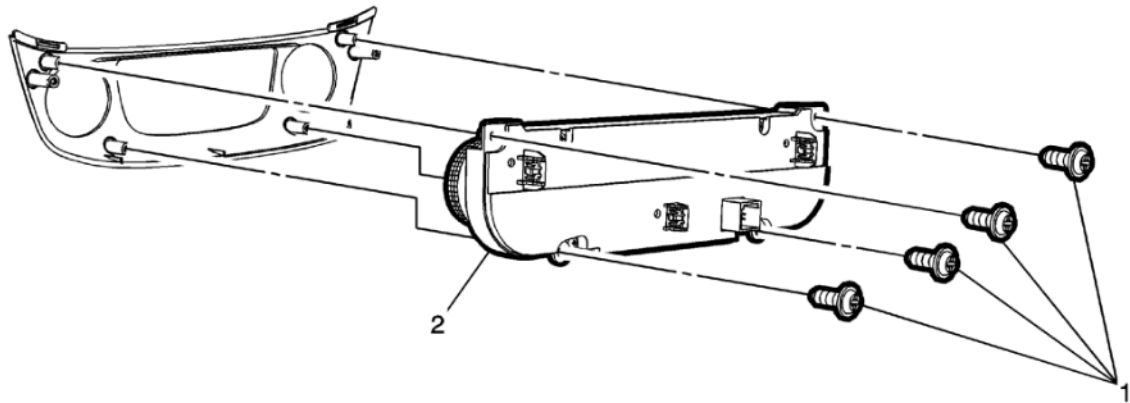
- There are only a few situations where reprogramming a control module is appropriate:
  - A new service control module is installed.
  - A control module from another vehicle is installed.
  - Revised software/calibration files have been released for this vehicle.

**NOTE:**      **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

## HEATER AND AIR CONDITIONING CONTROL REPLACEMENT

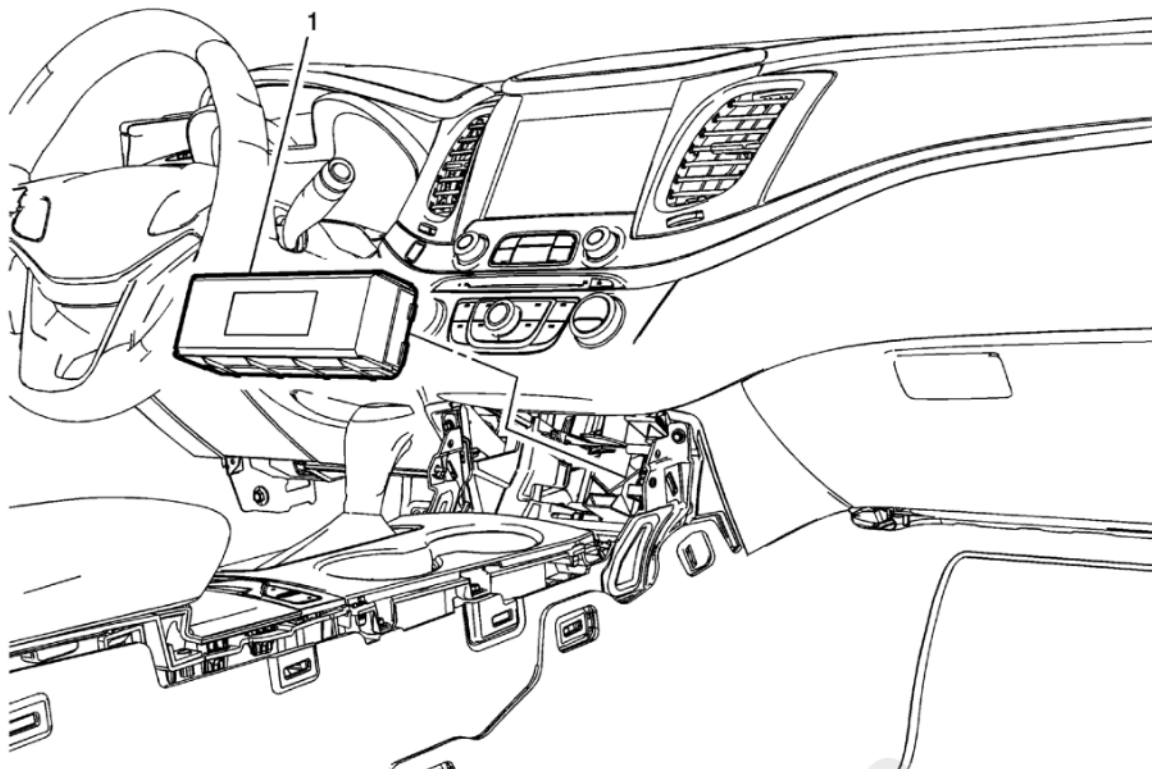




**Fig. 16: Heater & Air Conditioning Control**  
 Courtesy of GENERAL MOTORS COMPANY

| Call out                                                                                                                                                                                                                                                                                                                                  | Component Name                                                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b> <ol style="list-style-type: none"> <li>1. Disconnect the negative battery cable. Refer to <a href="#">Battery Negative Cable Disconnection and Connection</a> .</li> <li>2. Remove the instrument panel accessory bezel. Refer to <a href="#">Instrument Panel Accessory Bezel Replacement</a> .</li> </ol> |                                                                                                                             |
| 1                                                                                                                                                                                                                                                                                                                                         | Heater and Air Conditioning Control Fastener (Qty: 4)<br><br><b>CAUTION:</b><br>Refer to <a href="#">Fastener Caution</a> . |
| 2                                                                                                                                                                                                                                                                                                                                         | Heater and Air Conditioning Control                                                                                         |

## HEATER AND AIR CONDITIONING REMOTE CONTROL REPLACEMENT



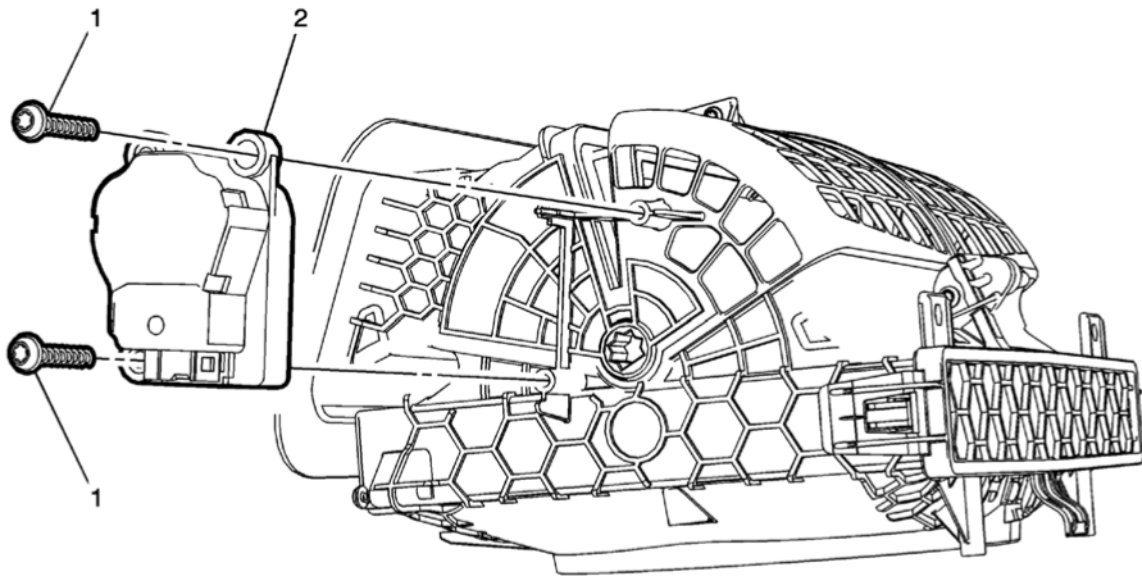
**Fig. 17: Heater and Air Conditioning Remote Control Module**

Courtesy of GENERAL MOTORS COMPANY

| Callout                                                                                                                                                                                                                                             | Component Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br>Remove Front Floor Console Front Compartment. Refer to <a href="#">Front Floor Console Front Compartment Replacement (Without K4C)</a> <a href="#">Front Floor Console Front Compartment Replacement (With K4C)</a> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                                                                                                                                                                                                                                     | Heater And Air Conditioning Remote Control Module<br><br><b>NOTE:</b><br>If the vehicle battery has NOT been disconnected, and the HVAC remote module is disconnected, when reinstalling or reconnecting the modules electrical connectors, the BROWN J2 electrical connector must be connected last. Once the vehicle has been reassembled, check and clear all DTCs in the HVAC module.                                                                                                                                                                                                                       |
| 1                                                                                                                                                                                                                                                   | <b>Procedures</b> <ol style="list-style-type: none"> <li>1. Unlatch the heater and air conditioning remote control module from the instrument panel carrier assembly.</li> <li>2. Disconnect the heater and air conditioning remote control module connectors.</li> <li>3. Perform the HVAC system control module programming and setup procedure. Refer to <a href="#">Control Module References</a></li> <li>4. Clear the DTCs from the heater and air conditioning remote control module.</li> <li>5. Perform the actuator calibration procedure. Refer to <a href="#">Actuator Recalibration</a></li> </ol> |

## AIR INLET VALVE ACTUATOR REPLACEMENT

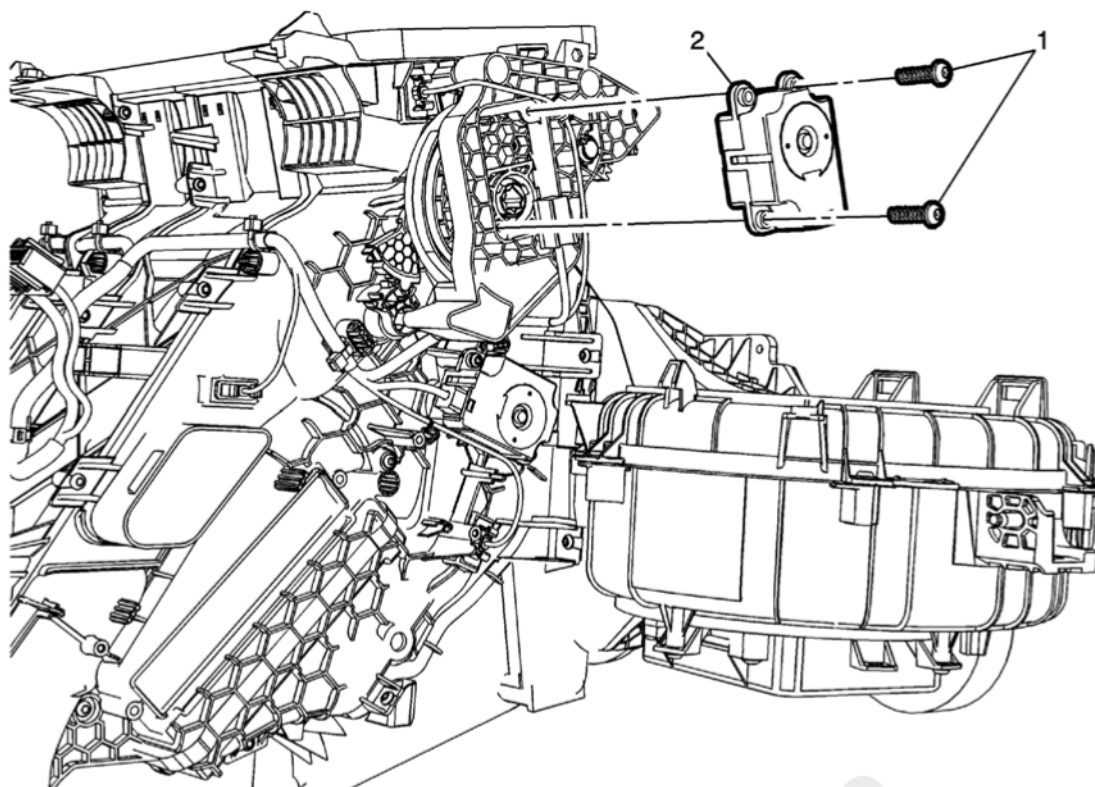




**Fig. 18: Air Inlet Valve Actuator & Fasteners**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout                                                                                                                                                                                                                                                                                                                                                                                                       | Component Name                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b> <ol style="list-style-type: none"> <li>1. Remove Heater and Air Conditioning Evaporator and Blower Module. Refer to <a href="#">Heater and Air Conditioning Evaporator and Blower Module Removal and Installation</a></li> <li>2. Remove Air Inlet Housing. Refer to <a href="#">Air Inlet Housing Replacement</a></li> <li>3. Disconnect the electrical connectors.</li> </ol> |                                                                                                                                                                                                                                                     |
| 1                                                                                                                                                                                                                                                                                                                                                                                                             | Air Inlet Valve Actuator Bolt (Qty: 2)<br><br><b>CAUTION:</b><br>Refer to <a href="#">Fastener Caution</a> .<br><br><b>Tighten</b><br>1.2 N.m (11 lb in)                                                                                            |
| 2                                                                                                                                                                                                                                                                                                                                                                                                             | Air Inlet Valve Actuator<br><br><b>Procedures</b> <ol style="list-style-type: none"> <li>1. Disconnect the electrical connector.</li> <li>2. Perform the actuator calibration procedure. Refer to <a href="#">Actuator Recalibration</a></li> </ol> |

## MODE CONTROL CAM ACTUATOR REPLACEMENT

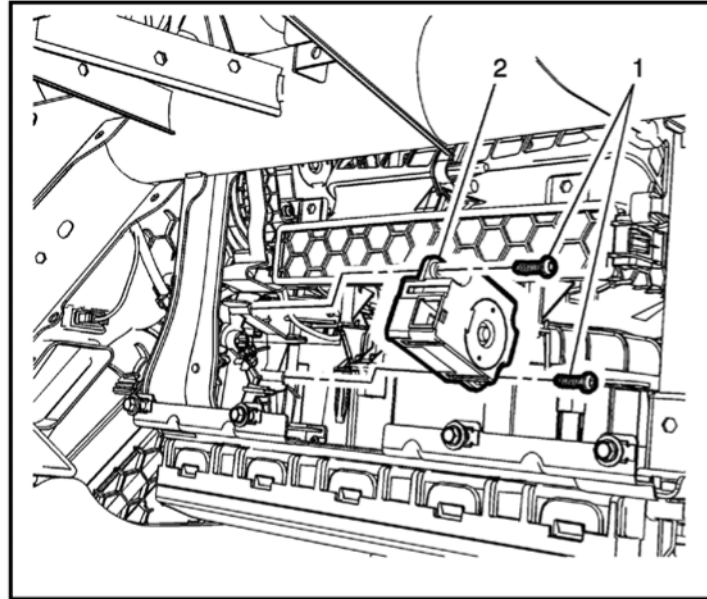
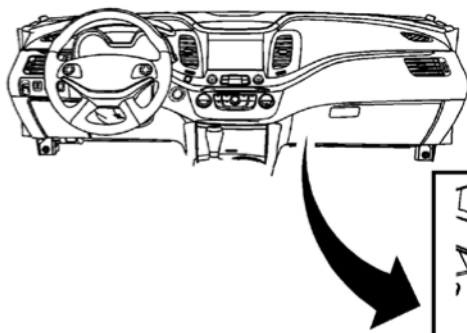


**Fig. 19: Mode Control Cam Actuator & Fasteners**

Courtesy of GENERAL MOTORS COMPANY

| Callout                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Component Name                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b> <ol style="list-style-type: none"> <li>1. Remove Heater and Air Conditioning Evaporator and Blower Module. Refer to <a href="#">Heater and Air Conditioning Evaporator and Blower Module Removal and Installation</a></li> <li>2. Remove Air Inlet Housing. Refer to <a href="#">Air Inlet Housing Replacement</a></li> <li>3. Disconnect the electrical connectors.</li> <li>4. Note the correct location of the electrical connectors.</li> </ol> |                                                                                                                                                                                                                                                      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Mode Control Cam Actuator Bolt (Qty: 2)<br><br><b>CAUTION:</b><br>Refer to <a href="#">Fastener Caution</a> .<br><br><b>Tighten</b><br>1.2 N.m (11 lb in)                                                                                            |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Mode Control Cam Actuator<br><br><b>Procedures</b> <ol style="list-style-type: none"> <li>1. Disconnect the electrical connector.</li> <li>2. Perform the actuator calibration procedure. Refer to <a href="#">Actuator Recalibration</a></li> </ol> |

## TEMPERATURE VALVE ACTUATOR REPLACEMENT - RIGHT SIDE (UPPER)

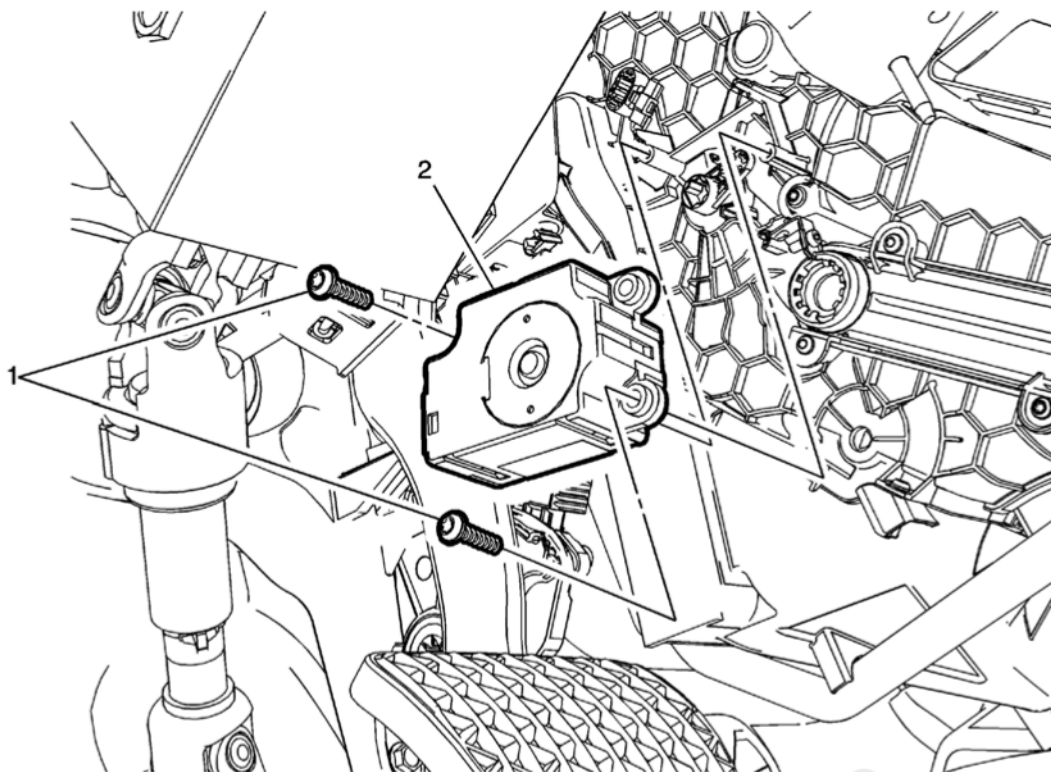


**Fig. 20: Temperature Valve Actuator - Right Side (Upper)**

Courtesy of GENERAL MOTORS COMPANY

| Call out                                                                                                                                                                                                                                                                                                                                                | Component Name                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b> <ol style="list-style-type: none"> <li>1. Remove the instrument panel compartment assembly. Refer to <a href="#">Instrument Panel Compartment Replacement</a> .</li> <li>2. Remove the right side floor front air outlet duct. Refer to <a href="#">Floor Front Air Outlet Duct Replacement - Right Side</a> .</li> </ol> |                                                                                                                                                                                                                                                                                                |
| 1                                                                                                                                                                                                                                                                                                                                                       | Right Side Temperature Valve Actuator Fastener (Qty: 2)<br><br><b>CAUTION:</b><br>Refer to <a href="#">Fastener Caution</a> .                                                                                                                                                                  |
| 2                                                                                                                                                                                                                                                                                                                                                       | Temperature Valve Actuator - Right Side<br><br><b>Procedures</b> <ol style="list-style-type: none"> <li>1. Disconnect the right side temperature valve actuator connector.</li> <li>2. Perform the actuator calibration procedure. Refer to <a href="#">Actuator Recalibration</a>.</li> </ol> |

## TEMPERATURE VALVE ACTUATOR REPLACEMENT - LEFT SIDE



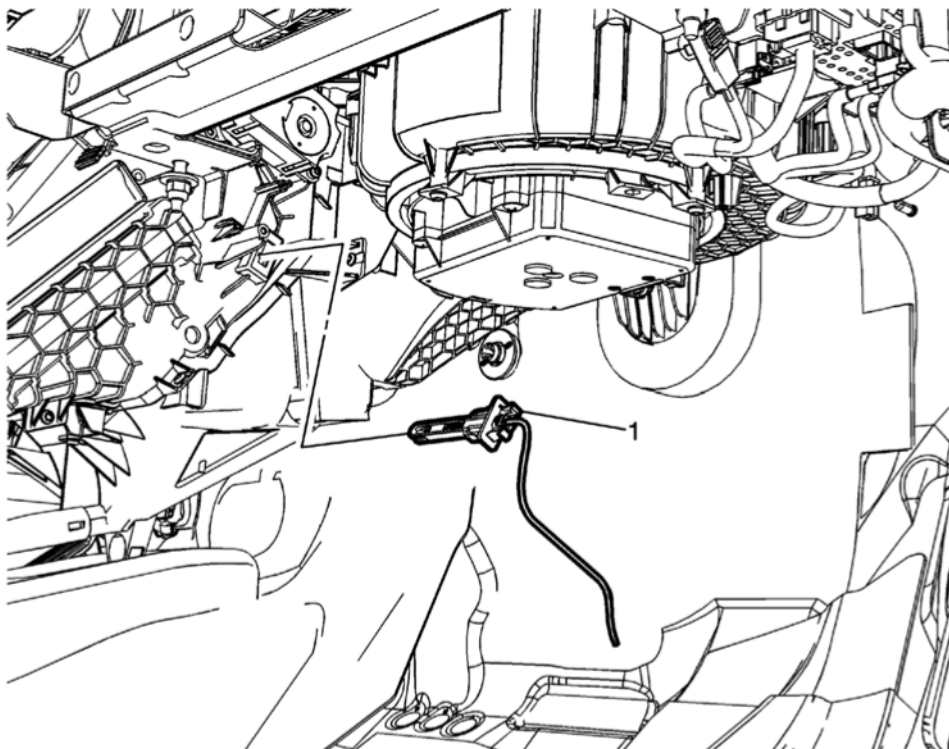
**Fig. 21: Temperature Valve Actuator & Fasteners - Left Side**

Courtesy of GENERAL MOTORS COMPANY

| Call out                                                                                                                                                                                                                                                                                                                                                                           | Component Name                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedures</b> <ol style="list-style-type: none"> <li>1. Remove the left side floor front air outlet duct. Refer to <a href="#">Floor Front Air Outlet Duct Replacement - Left Side</a> .</li> <li>2. Remove the drivers side instrument panel lower airbag assembly. Refer to <a href="#">Instrument Panel Lower Airbag Replacement - Driver Side</a> .</li> </ol> |                                                                                                                                                                                                                                                                                          |
| 1                                                                                                                                                                                                                                                                                                                                                                                  | Temperature Valve Actuator Fastener (Qty: 2)<br><b>CAUTION:</b><br>Refer to <a href="#">Fastener Caution</a> .                                                                                                                                                                           |
| 2                                                                                                                                                                                                                                                                                                                                                                                  | Temperature Valve Actuator - Left Side<br><b>Procedures</b> <ol style="list-style-type: none"> <li>1. Disconnect the left side temperature valve actuator connector.</li> <li>2. Perform the actuator calibration procedure. Refer to <a href="#">Actuator Recalibration</a>.</li> </ol> |

## INSIDE AIR TEMPERATURE SENSOR REPLACEMENT (EVAPORATOR CORE)





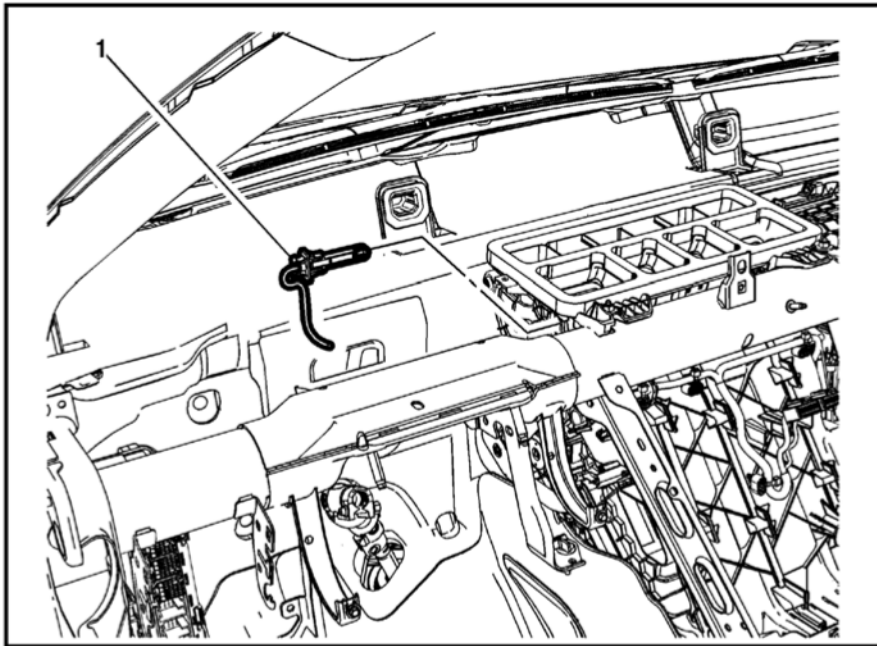
**Fig. 22: Inside Air Temperature Sensor (Evaporator Core)**

Courtesy of GENERAL MOTORS COMPANY

| Callout                                                                                                                                                            | Component Name                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br>Remove the right side front floor air outlet duct. Refer to <a href="#">Floor Front Air Outlet Duct Replacement - Right Side</a> . |                                                                                                                                                                         |
| 1                                                                                                                                                                  | Inside Air Temperature Sensor<br><br><b>NOTE:</b><br>The Inside air temperature sensor kit comes with a partial harness. Refer to <a href="#">Wire to Wire Repair</a> . |

**INSIDE AIR TEMPERATURE SENSOR REPLACEMENT - LEFT SIDE UPPER**



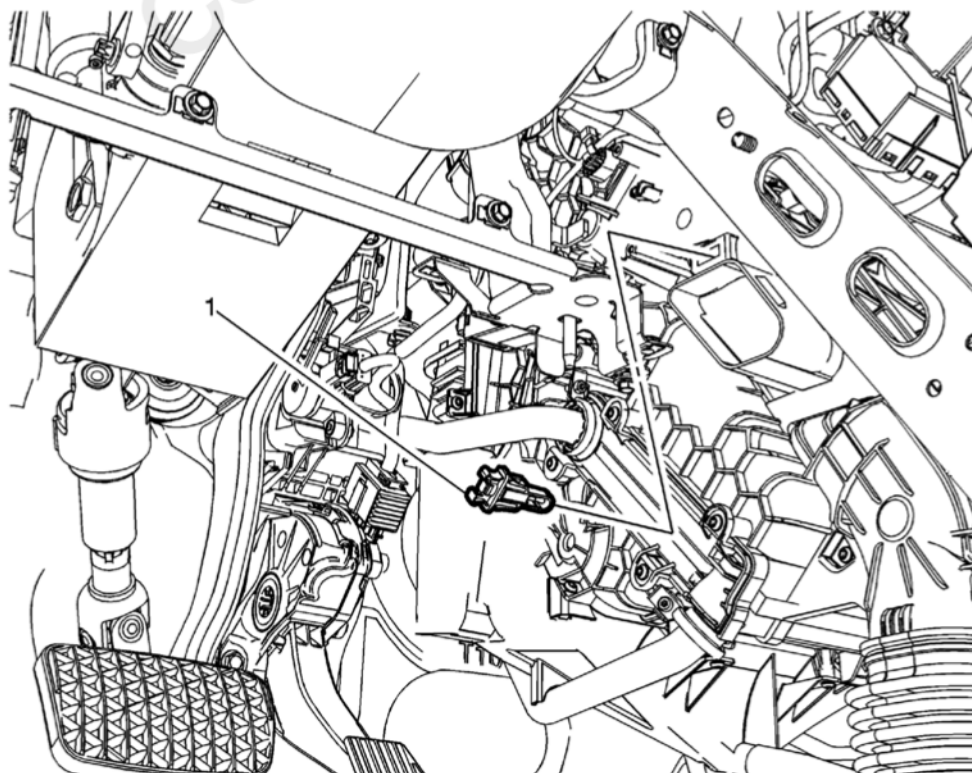


**Fig. 23: Inside Air Temperature Sensor - Left Side Upper**

Courtesy of GENERAL MOTORS COMPANY

| Call out                                                                                                                               | Component Name                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br>Remove the instrument panel assembly. Refer to <a href="#">Instrument Panel Assembly Replacement</a> . |                                                                                                                                                                                               |
| 1                                                                                                                                      | Inside Air Temperature Sensor - Upper Left Side<br><br><b>NOTE:</b><br>The lower duct air temperature sensor kit comes with a partial harness. Refer to <a href="#">Wire to Wire Repair</a> . |

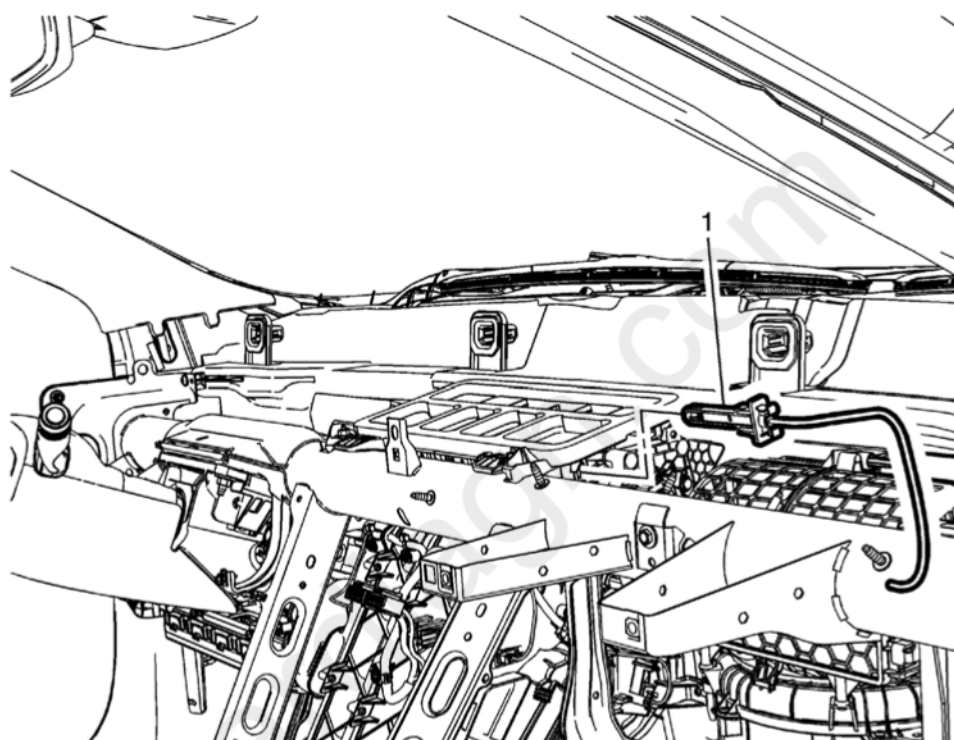
## INSIDE AIR TEMPERATURE SENSOR REPLACEMENT - LEFT SIDE LOWER



**Fig. 24: Inside Air Temperature Sensor - Left Side Lower**  
 Courtesy of GENERAL MOTORS COMPANY

| Call out                                                                                                                                                           | Component Name                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br>Remove the driver side front floor air outlet duct. Refer to <a href="#">Floor Front Air Outlet Duct Replacement - Left Side</a> . |                                                                                                                                                                                             |
| 1                                                                                                                                                                  | Duct Air Temperature Sensor - Lower Left Side<br><br><b>NOTE:</b><br>The lower duct air temperature sensor kit comes with a partial harness. Refer to <a href="#">Wire to Wire Repair</a> . |

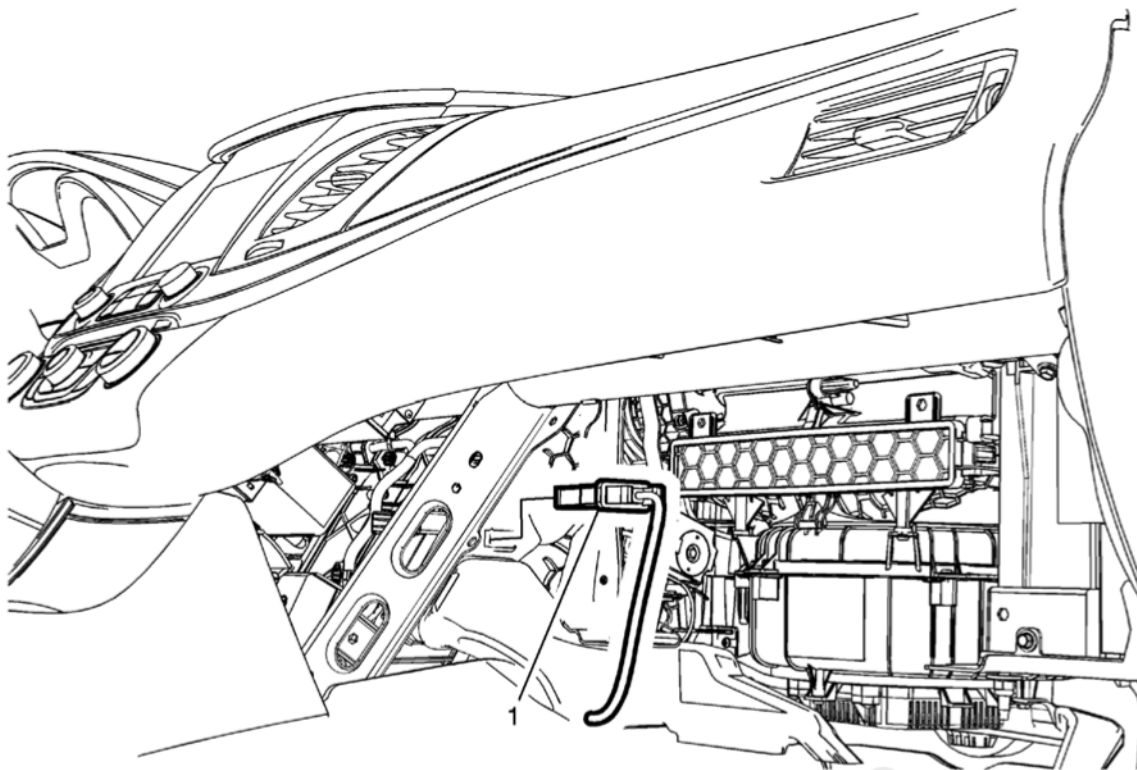
**INSIDE AIR TEMPERATURE SENSOR REPLACEMENT - RIGHT SIDE UPPER**



**Fig. 25: Inside Air Temperature Sensor - Right Side Upper**  
 Courtesy of GENERAL MOTORS COMPANY

| Callout                                                                                                                                | Component Name                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br>Remove the instrument panel assembly. Refer to <a href="#">Instrument Panel Assembly Replacement</a> . |                                                                                                                                                                                                |
| 1                                                                                                                                      | Inside Air Temperature Sensor - Upper Right Side<br><br><b>NOTE:</b><br>The lower duct air temperature sensor kit comes with a partial harness. Refer to <a href="#">Wire to Wire Repair</a> . |

**INSIDE AIR TEMPERATURE SENSOR REPLACEMENT - RIGHT SIDE LOWER**

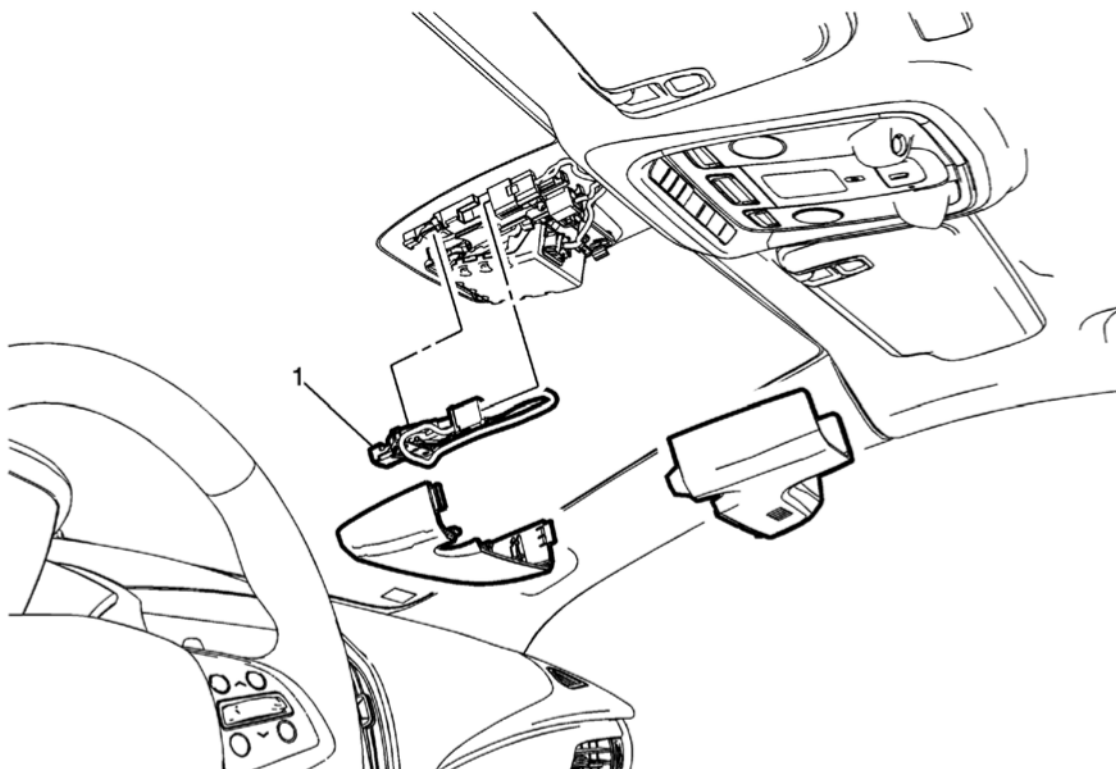


**Fig. 26: Inside Air Temperature Sensor - Right Side Lower**

Courtesy of GENERAL MOTORS COMPANY

| Call out                                                                                                                                     | Component Name                                                                                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br>Remove the instrument panel compartment. Refer to <a href="#">Instrument Panel Compartment Replacement</a> . |                                                                                                                                                                                              |
| 1                                                                                                                                            | Duct Air Temperature Sensor - Lower Right Side<br><br><b>NOTE:</b><br>The lower duct air temperature sensor kit comes with a partial harness. Refer to <a href="#">Wire to Wire Repair</a> . |

## INSIDE AIR MOISTURE AND WINDSHIELD TEMPERATURE SENSOR REPLACEMENT



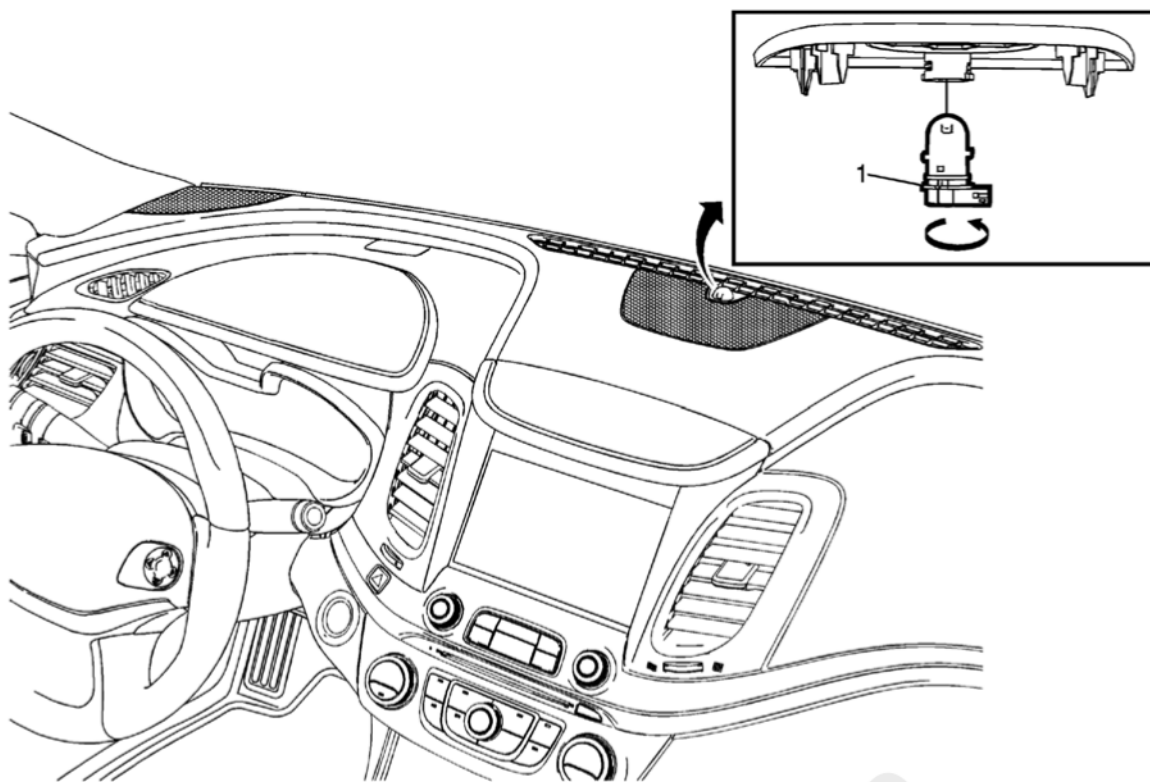
**Fig. 27: Inside Air Moisture and Windshield Temperature Sensor**

Courtesy of GENERAL MOTORS COMPANY

| Callout                                                                                          | Component Name                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b>                                                                     |                                                                                                                                                                                                                                                                                                                                                      |
| Remove the inside rearview mirror. Refer to <a href="#">Inside Rearview Mirror Replacement</a> . |                                                                                                                                                                                                                                                                                                                                                      |
| 1                                                                                                | Inside Air Moisture and Windshield Temperature Sensor<br><br><b>Procedures</b> <ol style="list-style-type: none"> <li>1. Unlatch the inside air moisture and windshield temperature sensor, from the inside rear view mirror support bracket.</li> <li>2. Disconnect the inside air moisture and windshield temperature sensor connector.</li> </ol> |

## **SUN LOAD TEMPERATURE AND HEADLAMP AUTOMATIC CONTROL AMBIENT LIGHT SENSOR REPLACEMENT**





**Fig. 28: Sun Load Temperature & Headlamp Automatic Control Ambient Light Sensor**  
 Courtesy of GENERAL MOTORS COMPANY

| Call out                                                                                                                                               | Component Name                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br>Remove the radio front center speaker grille. Refer to <a href="#">Radio Front Center Speaker Grille Replacement</a> . |                                                                                                                                                                                                                                 |
| 1                                                                                                                                                      | <b>Sun Load Temperature and Headlamp Automatic Control Ambient Light Sensor Procedure</b><br>Turn the sun load temperature and headlamp automatic control ambient light sensor a quarter of a turn counter clockwise to remove. |

## DESCRIPTION AND OPERATION

### AUTOMATIC HVAC DESCRIPTION AND OPERATION

The air temperature and the air delivery description and operation are divided into eight 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

##### HVAC Control

The HVAC control contains all switches, buttons, and dials which are required to control the functions of HVAC and serve as an 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 mode actuator is a 5-wire stepper motor. The HVAC control module supplies a 12 V reference voltage to the stepper motor and energizes the 4 stepper motor coils with a pulsed ground signal. The stepper motor puts the mode flap into the calculated position in order to reach the selected position. The null point of the stepper motor will be calibrated, if the stepper motor is new. When the stepper motor is calibrated, the HVAC control module can drive the applicable coil to reach exactly the desired position of the flap.

### Air Temperature Actuator (only C68)

The air temperature actuator is a 5-wire stepper motor. The HVAC control module supplies a 12 V reference voltage to the stepper motor and energizes the 4 stepper motor coils with a pulsed ground signal. The stepper motor puts the mixed air flap into the calculated position, in order to reach the selected temperature. The null point of the stepper motor will be calibrated, if the stepper motor is new. When the stepper motor is calibrated, the HVAC control module can drive the applicable coil to reach exactly the desired position of the flap.

### Air Temperature Actuators (only CJ2)

The interior temperature can be selected separately for the driver and passenger. For this purpose, two stepper motors are used that regulates two mixed air flaps independently of each other. The air temperature actuators are 5-wire stepper motors. The HVAC control module supplies a 12 V reference voltage to each stepper motor and energizes the 4 stepper motor coils with a pulsed ground signal. The left air temperature actuator moves the left mixed air flap into the calculated position, in order to reach the selected temperature of the left temperature switch. The right air temperature actuator puts the right mixed air flap into the calculated position, in order to reach the selected temperature of the right temperature switch. The null point of the stepper motor will be calibrated, if the stepper motor is new. When the stepper motor is calibrated, the HVAC control module can drive the applicable coil to reach exactly the desired position of the flap.

### Recirculation Actuator

The recirculation actuator is a 5-wire stepper motor. The HVAC control module supplies a 12 V reference voltage to the stepper motor and energizes the 4 stepper motor coils with a pulsed ground signal. The stepper motor puts the recirculation flap into the calculated position in order to reach the desired position. The null point of the stepper motor will be calibrated, if the stepper motor is new. When the stepper motor is calibrated, the HVAC control module can drive the applicable coil to reach exactly the desired position of the flap.

### Air Inlet Actuator (only CJ2)

The air inlet actuator is a 5-wire stepper motor. The HVAC control module supplies a 12 V reference voltage to the stepper motor and energizes the 4 stepper motor coils with a pulsed ground signal. The stepper motor moves the air inlet flap into the calculated position, in order to reach the selected position. The null point of the stepper motor will be calibrated, if the stepper motor is new. When the stepper

motor is calibrated, the HVAC control module can drive the applicable coil to reach exactly the desired position of the flap.

### **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  $+85^{\circ}\text{C}$  ( $-40$  to  $+185^{\circ}\text{F}$ ). 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  $+85^{\circ}\text{C}$  ( $-40$  to  $+185^{\circ}\text{F}$ ). The sensor is installed at the evaporator and measures its temperature. If the temperature drops under  $3^{\circ}\text{C}$  ( $38^{\circ}\text{F}$ ), 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 constantly belt driven. The performance of the A/C compressor is regulated per a lifting magnet in the A/C compressor. The HVAC control module supplies battery voltage to the A/C compressor. When the A/C switch is pressed, the HVAC control module provides a pulse width modulation (PWM) signal to the A/C compressor in order to command the performance of the A/C compressor. The performance of the A/C compressor is regulated according to adjusted interior temperature on the basis of characteristic lines. Therefore the HVAC control module grounds the A/C compressor with the PWM signal.

The windshield temperature and inside moisture sensor includes the relative humidity sensor, windshield temperature sensor and humidity sensing element temperature sensor.

This sensor assembly provides information about:

- Relative humidity level at windshield (compartment side)
- Temperature of the windshield inside (compartment side)
- Temperature of the humidity sensor element

The relative humidity sensor measures the relative humidity of the compartment side of the windshield. It also detects the temperature of the windshield surface on the passenger compartment side. Both values are used as control inputs for the HVAC control module application to calculate the fog risk on windshield compartment side and ability to reduce fuel consumption by decreasing A/C compressor power to a minimum without causing any fog. The sensor will also enable partial recirculation mode in order to improve heat-up performance of the passenger compartment under cold ambient temperature conditions without the risk of mist build-up on the windshield. The humidity sensor element temperature sensor supplies the temperature of the humidity sensor element. It is only needed if the thermal contact between the humidity sensing element and the inside windshield surface is not sufficient.

### **Ambient Light/Sunload Sensor (only C68)**

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.

### **Ambient Light/Sunload Sensor (only CJ2)**

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

This sensor assembly provides information about:

- Sun heat intensity
- Elevation
- Azimuth
- Passenger compartment temperature

The sunload sensor is connected to ground and to a 12 V clocked power supply through the HVAC control module. This clocked power supply is to power the sensor electronics and to work as a clock generator to the sunload sensor micro controller. The sensor uses a pulse signal for data identification and transferring the sun intensity measurement. At each positive transition from the clocked supply input, the sunload sensor micro controller will shift channels enabling new intensity measurement on the signal output to the HVAC control module. The signal voltage varies between 0 - 4 V.

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 motor speed is controlled by the HVAC Control Module using a low side PWM signal circuit. Using internal logic the blower motor interprets the PWM signal to operate at the desired speed command chosen by the user.

### **Afterblow**

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

After the HVAC control module has been programmed for afterblow, the following conditions must be met for afterblow to operate:

- The engine has been turned OFF for at least 30 minutes.
- The ambient air temperature is at least 21°C (70°F).
- The A/C compressor operated for more than 2 minutes before shut down.
- The system voltage is at least 12 volts.

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

1. The blower motor will RUN for 20 seconds.
2. The blower motor will be OFF for 10 minutes.
3. The blower motor will RUN for an additional 20 seconds.

### 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 HVAC control. The 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

When the A/C switch or the AUTO switch is pressed, the HVAC control sends a signal to the HVAC control module via LIN-Bus. The HVAC control module evaluates this signal and sends an A/C request signal to the ECM via CAN-Bus. The ECM checks all preconditions before releasing and if all conditions are met sends a release signal back to the HVAC control module. The A/C compressor is activated by the HVAC control module. The HVAC control module supplies battery voltage to the A/C compressor. When the A/C switch is pressed, the HVAC control module provides a pulse width modulation (PWM) signal to the A/C compressor in order to command the performance of the A/C compressor. The performance of the A/C compressor is regulated according to adjusted interior temperature on the basis of characteristic lines. Therefore the HVAC control module grounds the A/C compressor with the PWM signal.

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 3Â°C (38Â°F)
- ECM does not detect immoderate torque load
- ECM does not detect insufficient idle quality
- The ambient temperature is above 1Â°C (34Â°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 (only C68)**

The recirculation switch is part of the 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.

In automatic mode the values of the windshield temperature and inside moisture sensor are used as control inputs for the HVAC control module application to calculate the fog risk on the passenger compartment side of the windshield. The A/C compressor and the defrost mode are activated to prevent or remove fog on the passenger compartment side of the windshield.

### **Recirculation Operation (only CJ2)**

The recirculation switch is integrated into the 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 air inlet actuator and recirculation actuator. In the recirculation mode the air inlet flap closes and the recirculation flap opens in order to circulate the air within the vehicle. In fresh air mode the air inlet flap opens and the recirculation flap is closed 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 the air inlet actuator opens the air inlet flap and outside air is circulated to the windshield to reduce fogging.

In automatic mode the values of the windshield temperature and inside moisture sensor are used as control inputs for the HVAC control module application to calculate the fog risk on passenger compartment side of the windshield compartment side. The A/C compressor and the defrost mode are activated to prevent or remove fog on the passenger compartment side of the windshield.

### **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.

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
  - Lower right air temperature sensor
  - Upper left air temperature sensor
  - Upper right air temperature sensor
  - Windshield temperature and inside moisture sensor
  - Ambient light/sunload sensor
- Regulate blower motor speed
- Position the air temperature actuator (only C68)
- Position the air temperature actuators (only CJ2)
- Position the mode actuator
- Position the recirculation actuator
- Position the air inlet actuator (only CJ2)
- Request A/C operation
- Control of the A/C compressor

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.

In automatic mode the values of the windshield temperature and inside moisture sensor are used as control inputs for the HVAC control module application to calculate the fog risk on the passenger compartment side of the windshield and ability to reduce fuel consumption by decreasing A/C compressor power to a minimum without causing any fog. The A/C compressor and the defrost mode are activated to prevent or remove fog on the passenger compartment side of the windshield. The sensor will also enable partial recirculation mode in order to improve heat-up performance of the passenger compartment under cold ambient temperature conditions without the risk of mist build-up on the windshield.

### **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.

## Heater Coolant Pump

The primary purpose of the heater coolant pump is to circulate engine coolant through the HVAC heater core when heat is required in the cabin for comfort. This normally happens when the vehicle is in an Auto Stop and the mechanical pump is not operating. If the HVAC control module has determined heat is needed for the cabin, a request is sent via serial data to the engine control module to turn the pump ON. The engine control module controls the auxiliary coolant pump relay via the heater core coolant pump relay control circuit. The heater core coolant pump relay supplies voltage to the heater core coolant pump.

## 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.

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