

HVAC

HVAC - Automatic - Canyon, Colorado

SPECIFICATIONS

FASTENER SPECIFICATIONS

Application	Specification	
	Metric	English
Air Inlet Valve Actuator Fastener	9.0 N.m	80 lb in
Mode Valve Link Fastener	9.0 N.m	80 lb in
Temperature Valve Actuator Fastener	9.0 N.m	80 lb in

SCHEMATIC WIRING DIAGRAMS

HVAC WIRING SCHEMATICS

Power, Ground, Serial Data, HVAC and Blower Controls

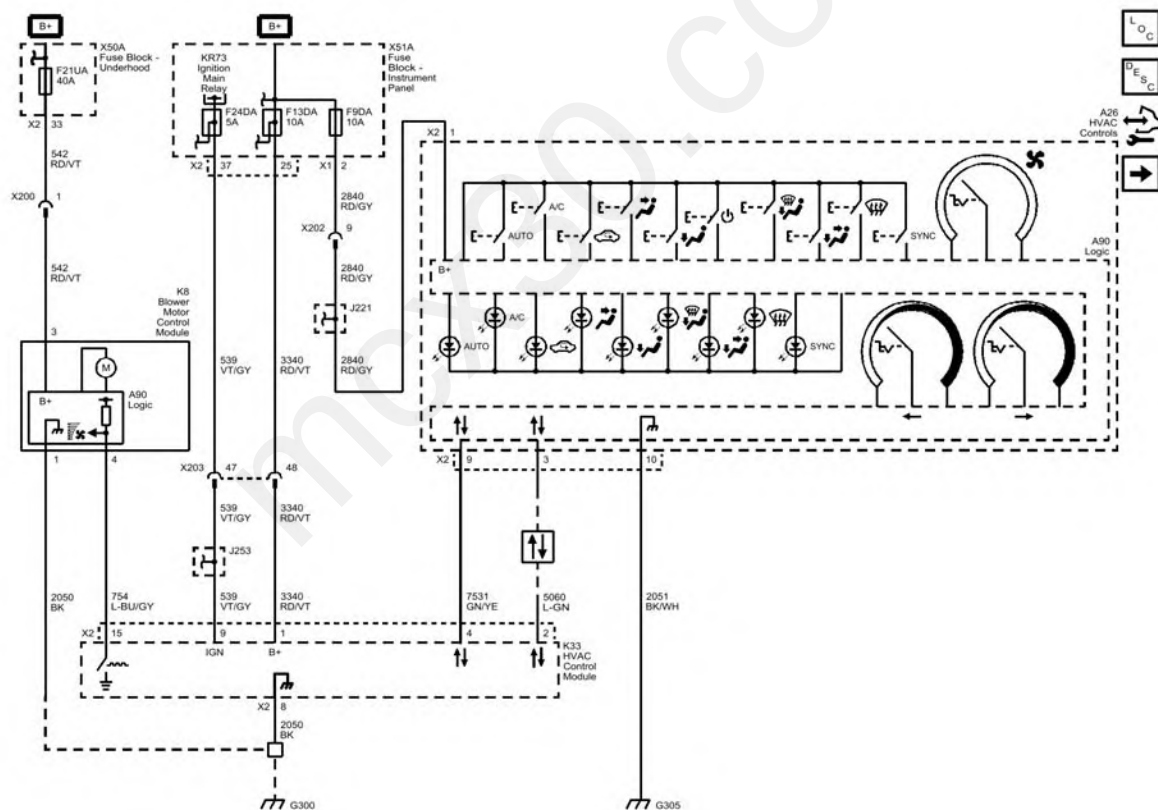


Fig. 1: Power, Ground, Serial Data, HVAC and Blower Controls
 Courtesy of GENERAL MOTORS COMPANY

Moisture, Sunload, and Temperature Sensors

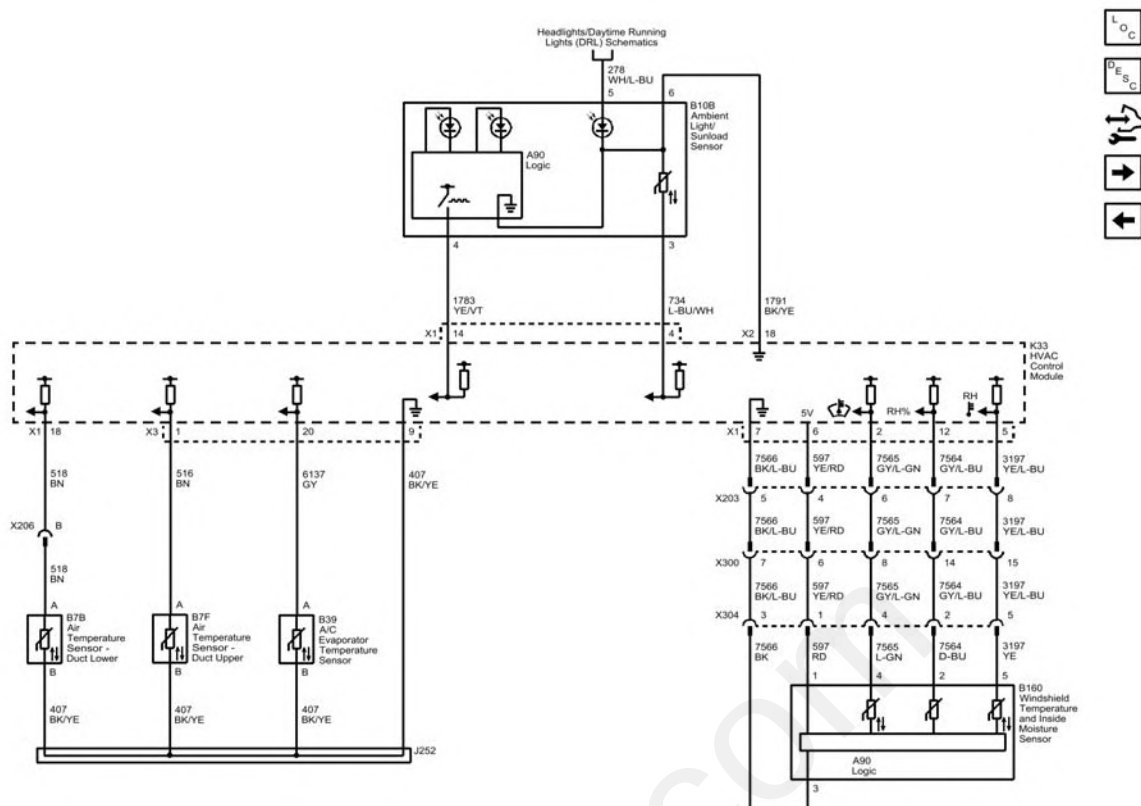


Fig. 2: Moisture, Sunload, and Temperature Sensors

Courtesy of GENERAL MOTORS COMPANY

Mode and Temperature Control Actuators

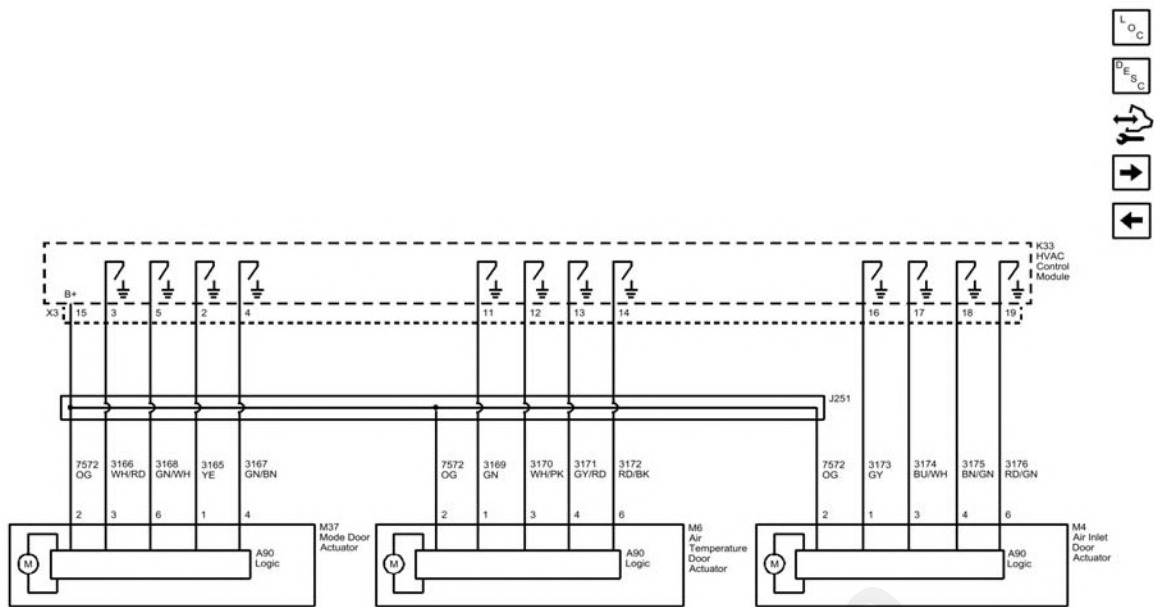


Fig. 3: Mode and Temperature Control Actuators
 Courtesy of GENERAL MOTORS COMPANY

A/C Compressor Controls



Courtesy of GENERAL MOTORS COMPANY

Auxiliary Heater (LWN)

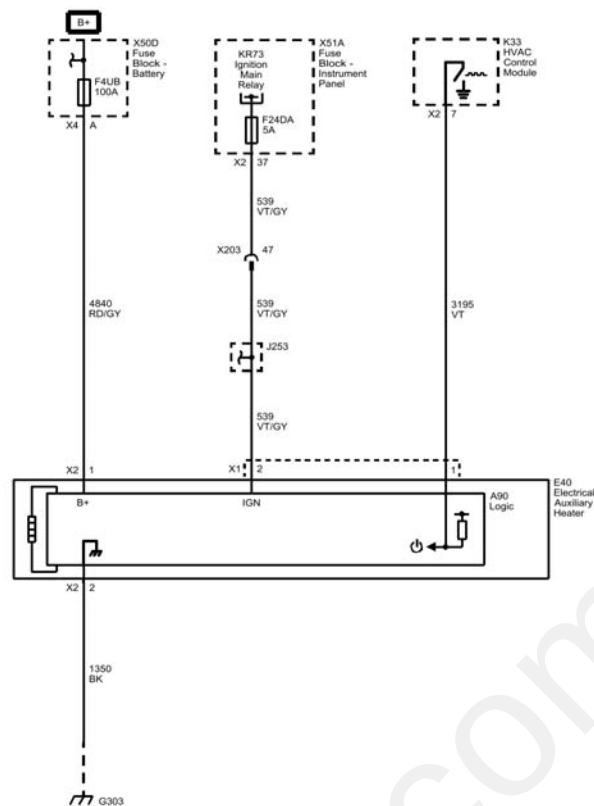


Fig. 5: Auxiliary Heater (LWN)

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

HVAC COMPONENT REPLACEMENT REFERENCE

Component	Repair Instruction
A26 HVAC Controls	Heater and Air Conditioning Control Replacement
B1 A/C Refrigerant Pressure Sensor	Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement (LFX) Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement (LCV)
B10B Ambient Light/Sunload Sensor	Sun Load Temperature and Headlamp Automatic Control Ambient Light Sensor Replacement
B160 Windshield Temperature and Inside Moisture Sensor	Inside Air Moisture and Windshield Temperature Sensor Replacement
B39 A/C Evaporator Temperature Sensor	Evaporator Air Temperature Sensor Replacement
B7B Air Temperature Sensor - Duct Lower	Duct Air Temperature Sensor Replacement - Lower
B7F Air Temperature Sensor - Duct Upper	Duct Air Temperature Sensor Replacement - Upper
E40 Electrical Auxiliary Heater	Heater Core Replacement Heater Core Replacement (Auxiliary C32 LWN)

Component	Short to	Open/High Resistance	Signal
Circuit	Ground	Replacement (Voltage)	Performance
G1 A/C Compressor	Compressor Replacement (LCV) Air Conditioning Compressor Replacement (LWN)		
K33 HVAC Control Module	Heater and Air Conditioning Remote Control Replacement		
K8 Blower Motor Control Module	Blower Motor Replacement		
M37 Mode Door Actuator	Mode Valve Actuator Replacement (RHD)		
M4 Air Inlet Door Actuator	Air Inlet Valve Actuator Replacement		
M6 Air Temperature Door Actuator	Temperature Valve Actuator Replacement		
Q2 A/C Compressor Clutch	Air Conditioning Compressor Replacement (LFX) Air Conditioning Compressor Replacement (LCV) Air Conditioning Compressor Replacement (LWN)		
Q46 A/C Compressor Solenoid Valve	Air Conditioning Compressor Replacement (LFX) Air Conditioning Compressor Replacement (LCV) Air Conditioning Compressor Replacement (LWN)		

DTC B0163, B0183, OR B1405: PASSENGER COMPARTMENT TEMPERATURE SENSOR/SOLAR LOAD SENSOR/CONTROL MODULE VOLTAGE REFERENCE OUTPUT 2

Diagnostic Instructions

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

DTC Descriptors

DTC B0163

Passenger Compartment Temperature Sensor Circuit

DTC B0183

Solar Load Sensor Circuit

DTC B1405

Control Module Voltage Reference Output 2 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
Temperature Signal	B0163 02	B0163 05	B0163 05	1
Sunload Signal	B0183 02	B0183 05	B0183 05	1
Clock Signal	B1405 02	B1405 05	B1405 05	1

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Reference	-	B0163 05, B0183 05	-	-
1. HVAC Malfunction				

Circuit/System Description

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

The solar sensor uses 4 unique circuits as detailed below:

- Low reference circuit - This is a common ground for the ambient light/sunload sensor assembly.
- Temperature signal circuit - This is the signal circuit for the temperature sensor.
- Clock signal circuit - This has 2 functions, via a high side PWM signal, the HVAC control module supplies power to the sensor as well as a clock input for the sensor microprocessor.
- Sunload signal circuit - This is used as an output from the solar sensor to the HVAC control module to transmit sun heat (IR) intensity, elevation, and azimuth data.

The passenger compartment temperature sensor is a negative temperature coefficient thermistor. 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 automatic 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 input signal is out of range. The HVAC control module detects voltage less than 0.1 V on the temperature signal circuit.

B0163 05

The input signal is out of range. The HVAC control module detects voltage greater than 4.9 V on the temperature signal circuit.

B0183 02

The input signal is out of range. The HVAC control module detects voltage less than 0.1 V on the solar sensor signal circuit.

B0183 05

The input signal is out of range. The HVAC control module detects voltage greater than 4.9 V on the solar sensor signal circuit.

B1405 02

ial is out of range. The HVAC control module detects voltage less than 10 V on the clock/power supply circuit.

B1405 05

The input signal is out of range. The HVAC control module detects a short to voltage or an open the clock/power supply circuit.

Action Taken When the DTC Sets

B0163 02, B0163 05, B0183 02, B0183 05

The system will use the last valid values as a default.

B1405 02, B1405 05

If no value is read at the time of fault, the HVAC control module uses 0 W/m² as intensity.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - 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

1. Verify DTCs B0163, B0183, or B1405 are not set.

- **If any of the DTCs are set**

Refer to Circuit System Testing.

- **If none of the DTCs are set**

he actual inside air temperature, using a thermometer, is less than a 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 Circuit System Testing.

- **If less than a 3Â°C (5Â°F) difference**

3. Verify the scan tool Sunload parameter changes while covering the B10B Ambient Light/Sunload Sensor with a shop towel and changes when shining a bright light on it

- **If the Sunload parameter does not change**

Refer to Circuit System Testing.

- **If the Sunload parameter changes**

4. All OK.

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 Ω between the low reference circuit terminal 6 and ground.

- **If 10 Ω or greater**

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

2. Test for less than 2 Ω in the low reference circuit end to end.

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

- **If less than 10 Ω**

3. Ignition ON, test for 4.8-5.2 V between the signal circuit terminal 3 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 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , 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**

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 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 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , 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

5. Verify a test lamp does not illuminate between the signal circuit terminal 2 and ground.

• If the test lamp illuminates

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 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 the test lamp does not illuminate

6. Test for greater than 10 V between signal circuit terminal 2 and ground.

• If less than 10 V

1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
2. Test for infinite resistance between signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC Control Module.

7. Test or replace the B10B Ambient Light/Sunload Sensor.

Repair Instructions

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

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

DTC B0173, B0178, OR B3933: AIR TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

Diagnostic Procedure Instructions provides an overview of each diagnostic category.

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

DTC B0173 02

Upper Left Duct Air Temperature Sensor Circuit Short to Ground

DTC B0173 05

Upper Left Duct Air Temperature Sensor Circuit High Voltage/Open

DTC B0178 02

Lower Left Duct Air Temperature Sensor Circuit Short to Ground

DTC B0178 05

Lower Left Duct Air Temperature Sensor Circuit High Voltage/Open

DTC B3933 02

Air Conditioning Evaporator Temperature Sensor Circuit Short to Ground

DTC B3933 05

Air Conditioning Evaporator Temperature Sensor Circuit High Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Upper Left Duct Air Temperature Sensor Signal	B0173 02	B0173 05	B0173 05	-
Lower Left Duct Air Temperature Sensor Signal	B0178 02	B0178 05	B0178 05	-
Air Conditioning Evaporator Temperature Sensor Signal	B3933 02	B3933 05	B3933 05	-
Low Reference	-	B0173 05, B0178 05, B3933 05	B0173 05, B0178 05, 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
- 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 is capable of reading temperatures ranging from -40 to +80Â°C (-40 to +176Â°F), with a signal voltage between 0-5 V. If the HVAC control module detects a malfunctioning

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

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

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**

he 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 10 Ω between the low reference circuit terminal B and ground.

- **If 10 Ω or greater**

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

2. Test for less than 2 Ω in the low reference circuit end to end.

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

- **If less than 10 Ω**

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 connector 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 -37 $^{\circ}$ C (-35 $^{\circ}$ F) or less**

5. 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 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 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , 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**
6. Install a 3 A fused jumper wire between the signal circuit terminal A and the low reference circuit terminal B.
 7. Verify the scan tool temperature sensor parameter is greater than 77°C (170°F).
 - **If less than 77°C (170°F)**
 1. Ignition OFF, remove the jumper wire and 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
 3. Ignition OFF
 4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω, replace the K33 HVAC Control Module.
 - **If 77°C (170°F) or greater**
 8. 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 10 Ω between the low reference circuit terminal B and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω, replace the K33 HVAC Control Module.
 - **If less than 10 Ω**
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 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 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω, replace the K33 HVAC Control Module.
 - **If greater than 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.

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
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- If between 4.8-5.2 V

- Test or replace the temperature sensor.
- 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.
- Verify the DTC does not set.

- If the DTC sets

Replace the K33 HVAC Control Module.

- If the DTC does not set

- All OK

Repair Instructions

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

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

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

Diagnostic Instructions

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

DTC Descriptors

DTC 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
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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, B048C 05, B048F 05, B1395 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

ntrol 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

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 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 Ω between the low reference circuit terminal 3 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC Control Module.
 - **If less than 10 Ω**
3. Ignition ON.

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 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , 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 $^{\circ}\text{C}$ (-35 $^{\circ}\text{F}$).

- Windshield Temperature
- Passenger Compartment Humidity Sensor Temperature

- **If -37 $^{\circ}\text{C}$ (-35 $^{\circ}\text{F}$) 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 -37 $^{\circ}\text{C}$ (-35 $^{\circ}\text{F}$)**

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 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , 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.

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 114°C (238°F).
 - Windshield Temperature
 - Passenger Compartment Humidity Sensor Temperature
 - **If 114°C (238°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 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω, replace the K33 HVAC Control Module.
 - **If greater than 114°C (238°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 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω, 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**

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
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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 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , 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.

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

DTC B0193: FRONT BLOWER MOTOR SPEED

Diagnostic Instructions

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

DTC Descriptors

DTC B0193 01

Front Blower Motor Speed Circuit Short to Battery

DTC B0193 06

Front Blower Motor Speed Circuit Low Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B0193 06	B0193 06	-	-
Control	B0193 06	B0193 06	B0193 01	-
Ground	-	B0193 06	-	-

Circuit/System Description

otor 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 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

Connector End View Reference

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Description and Operation

Automatic HVAC Description and Operation

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

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 Ω between the ground circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Verify a test lamp illuminates between the B+ circuit terminal 3 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 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , 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**
4. Remove the test lamp.
5. Ignition ON. Test for less than 1 V between the control circuit terminal 4 and ground.
 - **If 1 V or greater**
 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, replace the K33 HVAC Control Module
 - **If less than 1 V**
6. Ignition OFF. It may take up to 2 min for all vehicle systems to power down.
7. Test for infinite resistance between the control circuit terminal 4 and ground.
 - **If less than infinite resistance**
 1. Disconnect the X2 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 infinite resistance**

OFF, connect the harness connector at the M8 Blower Motor. Ignition ON.

9. While backprobing terminal 4 at the M8 Blower Motor, test for greater than 1 V between control circuit and ground.

- **If less than 1 V**

Replace the M8 Blower Motor.

- **If 1 V or greater**

10. Verify the voltage decreases and increases while using the controls to change the blower speed selection.

- **If the voltage does not decrease and increase as the blower speed selection is changed**

1. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module.

2. Test for less than 2 Ω in the control circuit end to end.

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

- **If the voltage decreases and increases as the blower speed selection is changed**

11. Replace the M8 Blower Motor.

Repair Instructions

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

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

DTC B0223, B0233, B023A, OR B0408: RECIRCULATE POSITION COMMAND /AIR FLOW CONTROL/HVAC ACTUATORS SUPPLY VOLTAGE/MAIN TEMPERATURE CONTROL

Diagnostic Instructions

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

DTC Descriptor

DTC B0223

Recirculate Position Command 1 Circuit

DTC B0233

Air Flow Control Circuit

DTC B023A

HVAC Actuators Supply Voltage

DTC B0408

Main Temperature Control Circuit

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

It Information Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Stepper Motors 12 V Reference	B023A 02, B0223 06, B0233 06, B0408 06,	B0223 06, B0233 06, B0408 06,	-	-
Recirculation Actuator Control Circuits	B0223 06	B0223 06	B0223 01	1
Air Temperature Actuator Control Circuits	B0408 06	B0408 06	B0408 01	1
Mode Actuator Control Circuits	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, buttons, 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 switched 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 to the requested 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, B0233 01, or B0408 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, B0233 06, or B0408 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 02

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

B0223, B0233, or B0408

ected 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.

Diagnostic Aids

During diagnosis, it is important to verify that the air control door and any associated components (linkage, cams, gears, etc.) operate properly. Inspect for any conditions that may limit or prevent the air control door from moving smoothly or moving through its full range of travel. Any mechanical issues should be corrected first, before proceeding with electrical diagnosis.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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- 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. 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, B0233, or B0408.
 - **If the concern or DTC has been corrected**
3. All OK.

Circuit/System Testing

DTC B023A

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
- M4 Air Inlet Door Actuator
- M6 Air Temperature Door Actuator

2. Disconnect the X3 harness connector at the K33 HVAC Control Module.

3. Test for infinite resistance between the 12 V reference circuit terminal 15 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 12 V reference circuit terminal 15 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

6. Connect the harness connector 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
- M4 Air Inlet Door Actuator
- M6 Air Temperature Door Actuator
- **If the DTC sets after connecting one of the components**

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

- **If the DTC does not set**

10. All OK.

DTC B0223, B0233, or B0408

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

NOTE: If more than one actuator is affected, test the B+ circuit at each actuator.

2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.

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

1. Disconnect the X3 harness connector at the K33 HVAC Control Module.

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 less than 2 Ω in the B+ circuit end to end.

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

- **If the test lamp illuminates**

3. Ignition OFF, disconnect the X3 harness connector at the K33 HVAC Control Module, ignition ON.

4. Test for less than 1 V between ground and the actuator control circuits listed below:

- Control Circuit - terminal 1
- Control Circuit - terminal 3
- Control Circuit - terminal 4
- Control Circuit - terminal 6
- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

5. Ignition OFF.

6. Test for infinite resistance between ground and the actuator control circuits listed below:

- Control Circuit - terminal 1
- Control Circuit - terminal 3
- Control Circuit - terminal 4
- Control Circuit - terminal 6
- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

7. Test for less than 2 Ω end to end in the circuits listed below:

- Control Circuit - terminal 1
- Control Circuit - terminal 3
- Control Circuit - terminal 4
- Control Circuit - terminal 6
- B+ Circuit - terminal 2
- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

NOTE: Before replacing an actuator, verify that there are no mechanical issues with the air control door and any associated components.

8. Test or replace the actuator.

9. Verify the symptom or DTC was corrected.

- **If the symptom or DTC was not corrected**

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
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- If the symptom or DTC was corrected

10. All OK.

Repair Instructions

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

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

DTC B048D OR B048E: AUXILIARY HEATER SYSTEM

Diagnostic Instructions

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

DTC Descriptors

DTC B048D 01

Auxiliary Heater Temperature Command Circuit Short to Battery

DTC B048D 06

Auxiliary Heater Temperature Command Circuit Low Voltage/Open

DTC B048E 00

Auxiliary Heater System Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Electrical Auxiliary Heater Control	B048D 06	B048D 06	B048D 01	-
Electrical Auxiliary Heater Signal	B048E 00	B048E 00	B048E 00	-

Circuit/System Description

The HVAC control module sends a low side pulse width modulation (PWM) signal to request electrical auxiliary heater operation if the interior temperature is too low and additional heat is required. The request signal from the HVAC control module, battery positive, ignition and ground circuits enable the electrical auxiliary heater to operate.

Conditions for Running the DTC

- Ignition ON
- The HVAC control module is ON.
- The electrical auxiliary heater is ON.

Setting the DTC

B048D 01

The voltage at the HVAC control module output to the electrical auxiliary heater is always high.

B048D 06

The voltage at the HVAC control module output to the electrical auxiliary heater is always low or floating.

B048E 00

The feedback signal of the electrical auxiliary heater does not correspond with the requested PWM signal.

Action Taken When the DTC Sets

The electrical auxiliary heater is inoperative.

Conditions for Clearing the DTC

The feedback signal of the electrical auxiliary heater corresponds with the requested PWM signal.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

Electrical Auxiliary Heater Control Circuit Malfunction

1. Ignition OFF, disconnect the X2 harness connector at the E40 Electrical Auxiliary Heater. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
 - If 10 Ω or greater

gnition OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

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

- **If less than 10 Ω**

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 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , 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 terminal 1 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the E40 Electrical Auxiliary Heater.

- **If the test lamp illuminates**

5. Ignition OFF, remove the test lamp and disconnect the X1 harness connector at the E40 Electrical Auxiliary Heater, ignition ON.

6. Verify a test lamp illuminates between the ignition circuit terminal 2 X1 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 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , 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 ignition circuit terminal 2 X1 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the E40 Electrical Auxiliary Heater.

- **If the test lamp illuminates**

7. Ignition OFF, remove the test lamp and disconnect the X2 harness connector at the K33 HVAC Control Module, ignition ON.

8. Test for less than 1 V between the control circuit terminal 7 X2 at the K33 HVAC Control Module harness connector and ground.

- **If greater than 1 V**

Repair the short to voltage on the circuit.

- **If less than 1 V**

9. Ignition OFF.

10. Test for infinite resistance between the control circuit terminal 7 X2 at the K33 HVAC Control Module harness connector and ground.

Less than infinite resistance to Ground	Open/High Resistance	Short to Voltage	Signal Performance
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Repair the short to ground on the circuit.

- **If infinite resistance**

11. Test for less than $2\ \Omega$ between the K33 HVAC Control Module control circuit terminal 7 X2 and control circuit terminal 1 X1 at the E40 Electrical Auxiliary Heater harness connector.

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

Repair the open/high resistance in the circuit.

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

12. Replace the E40 Electrical Auxiliary Heater and verify the DTC does not reset.

- **If DTC resets**

Replace the K33 HVAC Control Module.

- **If DTC does not reset**

13. All OK.

Repair Instructions

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

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for 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.
- [Diagnostic Procedure Instructions](#) provides 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+	B393B 0B	B393B 04	-	-
Control	B393B 04	B393B 04	B393B 0B	-

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

The module provides both switched 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 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

Connector End View Reference

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- Wiring Repairs

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 Ω 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 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , 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 Ω between B+ terminal 2 and control terminal 1.
 - **If less than 7 Ω or greater than 15 Ω**

Replace the G1 A/C Compressor.
 - **If between 7-15 Ω**
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.

infinite resistance	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
4. All OK				

Repair Instructions

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

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

DTC P0532 OR P0533: AIR CONDITIONING (A/C) REFRIGERANT PRESSURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of 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

ects 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

HVAC Schematics

Connector End View Reference

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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 Ω between the low reference circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 10 Ω**
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 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , 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.

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
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- If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
- If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , 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.

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

DTC P0645, P0646, OR P0647: AIR CONDITIONING (A/C) COMPRESSOR

Diagnostic Instructions

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

DTC Descriptors

DTC P0645

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

DTC P0646

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

DTC P0647

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

Diagnostic Fault Information

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

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

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 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , 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 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , 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 Ω between the ground circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
- 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 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , 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 Ω between terminals 85 and 86.
 - **If not between 60-180 Ω**

Replace the KR29 A/C Compressor Clutch Relay.
 - **If between 60-180 Ω**
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 Ω between terminals 30 and 87.

- **If 2 Ω or greater**

Replace the KR29 A/C Compressor Clutch Relay.

- **If less than 2 Ω**

6. All OK.

Repair Instructions

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

- [HVAC Component Replacement Reference](#)
- [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.

owing 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Aids

Check the following mechanical fault sources:

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

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Scan Tool Reference

Control Module References for scan tool information

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 in each speed position**
Refer to DTC B0193.
 - **If the blower motor operates properly in each speed position**
4. Verify all HVAC doors move when pressing the appropriate switch.
 - **If any HVAC door does not move**
Refer to DTC B0223, B0233, B023A, or B0408.
 - **If all HVAC doors move**
5. Install the appropriate ACR Air Conditioning Recharge 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
 - A/C Evaporator Temperature Sensor
 - **If not within 10% of ambient temperature**

refer to [DTC B0173, B0178, 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, B048E, 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 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 B0163, B0183, or B1405.](#)

- **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, B0183, or B1405.](#)

- **If less than a 3Â°C (5Â°F) difference**

16. Verify the Auxiliary Electric Heater (if equipped) is operating properly.

- **If the Auxiliary Electric Heater is not operating properly**

Refer to [DTC B048D or B048E](#)

- If the Auxiliary Electric Heater is operating properly.

17. All OK.

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

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for 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.
- [Diagnostic Procedure Instructions](#) provides 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 is above 1Â°C (34Â°F).
- Blower motor is ON.

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[HVAC Schematics](#)

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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 Request Signal parameter changes between Active and Inactive.
 - **If the parameter does not change**
Replace the A20 Radio/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 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**
Refer to DTC P0645, P0646, or P0647
 - **If the A/C compressor clutch engages**
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**

Repair Instructions

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

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

HVAC Control Module Replacement

When replacing or disconnecting the HVAC control module, it will be necessary to perform a recalibration process. When installing or reconnecting the HVAC control module, be sure to perform the following:

Preferred Method (with Scan Tool)

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

OFF.

2. Disconnect the scan tool.
3. Install/connect the HVAC control module.
4. Connect all previously disconnected components.
5. Start the vehicle.
6. With the scan tool, initiate the HVAC Actuators Learn feature of the HVAC control module Special Functions menu.
7. Operate system and verify that no DTCs have set as current DTCs.
8. 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 adjust any controls on the HVAC control module while the HVAC control module is self-calibrating. If interrupted, improper HVAC performance will result.

1. Clear all DTCs.
2. Ignition OFF.
3. Install/connect the HVAC control module.
4. Connect all previously disconnected components.
5. Remove the HVAC control module fuse for a minimum of 10 s.
6. Install the HVAC control module fuse.
7. Start the vehicle.
8. Wait 40 s for the HVAC control module to self-calibrate.

Actuator Replacement

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

Preferred Method (with Scan Tool)

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

1. Clear all DTCs.
2. Ignition OFF.
3. Install the HVAC actuator.
4. Connect all previously disconnected components.
5. Start the vehicle.
6. With the scan tool, initiate the HVAC Actuators Relearn feature of the HVAC control module Special Functions menu.

system and verify that no DTCs have set as current DTCs.

8. 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 adjust any controls on the HVAC control module while the HVAC control module is self-calibrating. If interrupted, improper HVAC performance will result.

1. Clear all DTCs.
2. Ignition OFF.
3. Install the HVAC actuator.
4. Connect all previously disconnected components.
5. Remove the HVAC control module fuse for a minimum of 10 s.
6. Install the HVAC control module fuse.
7. Start the vehicle.
8. 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.

The DuraSeal splice sleeves have the following 2 critical features:

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	

- 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 ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19300089	Red (1) or Red/Green (1)	Red (2)	0.22-0.8/(18-26)
Blue 19168447	Blue (2)	Blue (3)	1.0-2.0/(14-16)
Yellow 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.

Use 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.

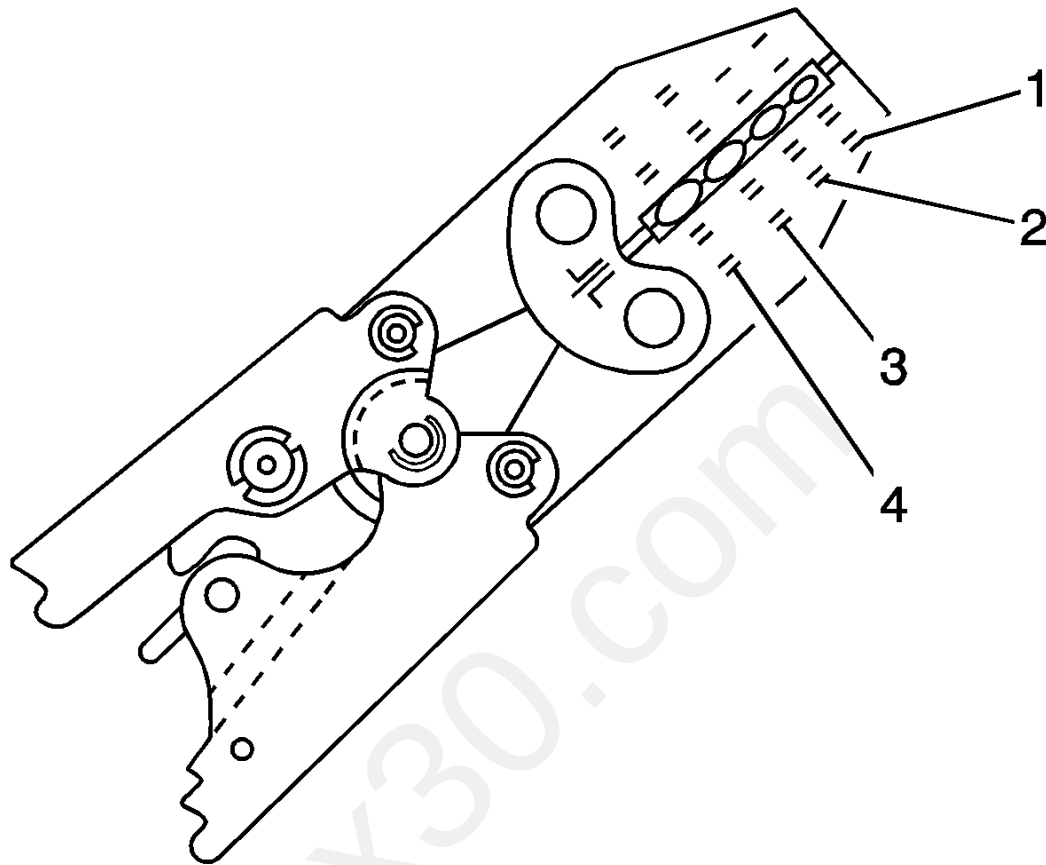


Fig. 6: Crimping Tool

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.

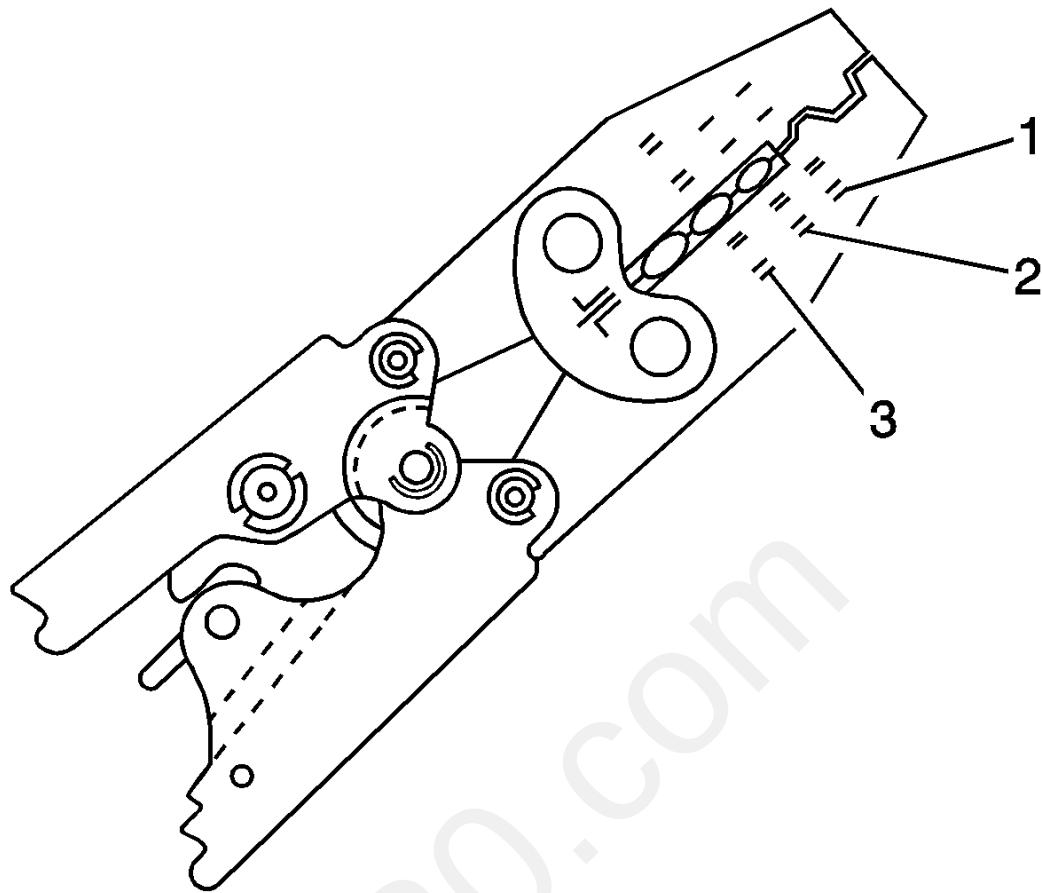


Fig. 7: Identifying Splice Crimp Tool Nests Terminal Identification
 Courtesy of GENERAL MOTORS COMPANY

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).

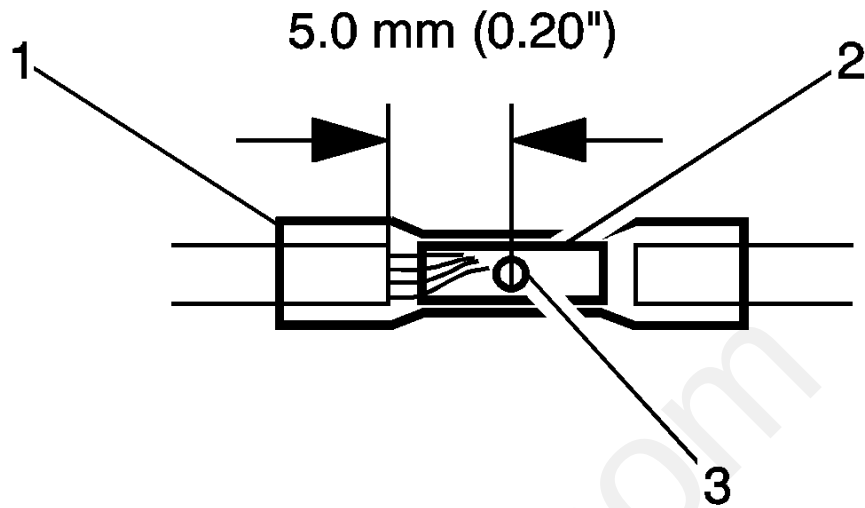


Fig. 8: Identifying Duraseal Splice Sleeve

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. 9: 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. 10: Crimped Duraseal 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.

ie 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.

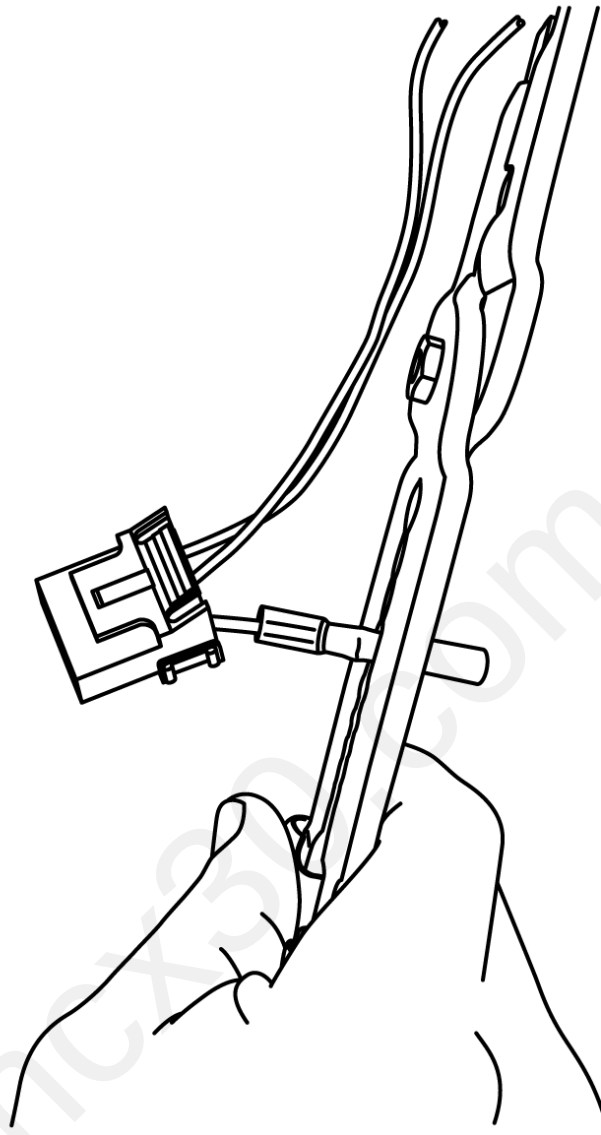


Fig. 11: Tightly Close Handles Of Crimp Tool
Courtesy of GENERAL MOTORS COMPANY

- 2.
3. 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.

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

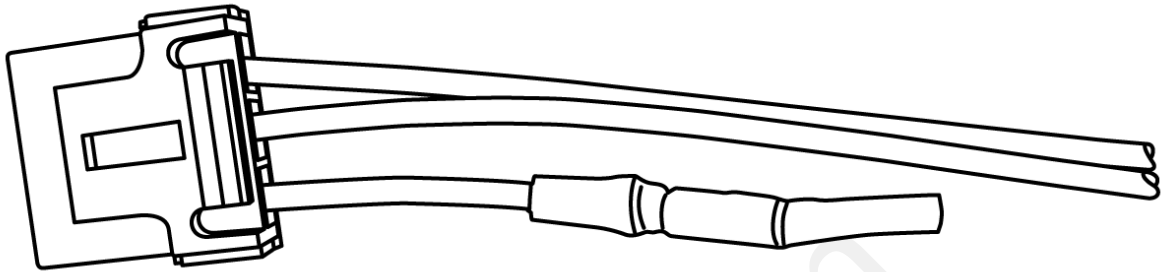


Fig. 12: Applying Heat To Crimped Area Of Barrel
Courtesy of GENERAL MOTORS COMPANY

5. 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.

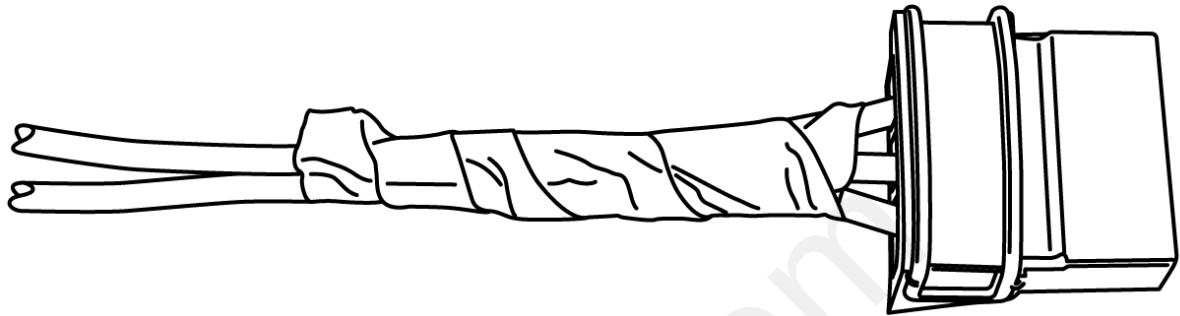


Fig. 13: Taping Extra Terminated Leads Back Into Harness
Courtesy of GENERAL MOTORS COMPANY

6. 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

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:

- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- 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.

1 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. Inspect the connections at the component and

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.

: **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

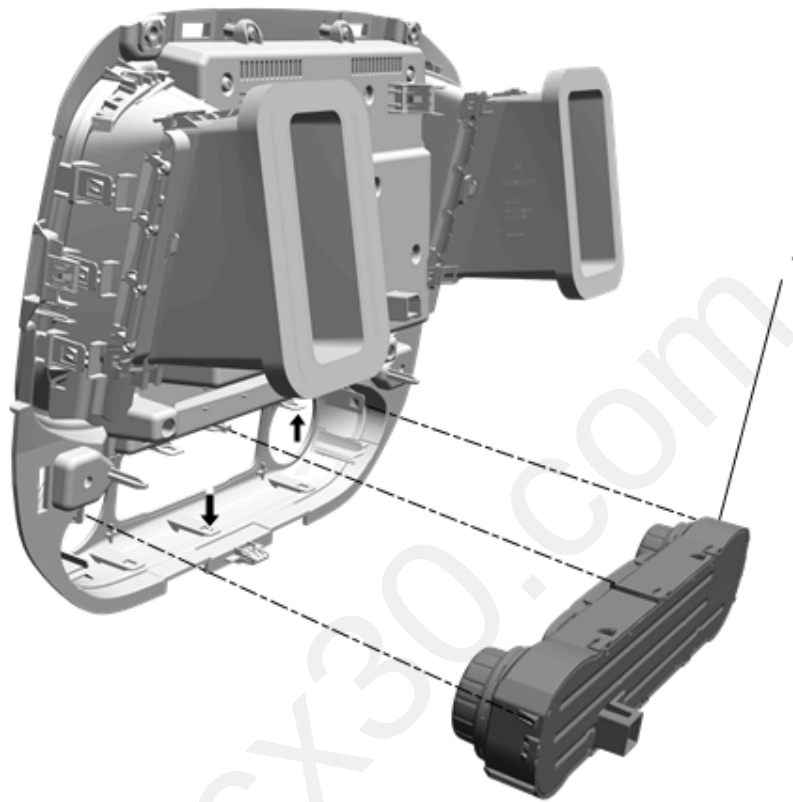


Fig. 14: Heater and Air Conditioning Control
Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure Remove the radio control assembly. Refer to Radio Control Assembly Replacement .	
1	Heater and Air Conditioning Control Procedure Using a suitable tool release the detent's to remove heater and air conditioning control.

HEATER AND AIR CONDITIONING REMOTE CONTROL REPLACEMENT



Fig. 15: Heater and Air Conditioning Remote Control
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Instrument Panel Accessory Bezel Replacement</u> NOTE: 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	Heater and Air Conditioning Remote Control Procedures 1. Disconnect the heater and air conditioning remote control module connectors. 2. Perform the necessary programming and setup procedure: <u>Control Module References</u> 3. Perform the actuator calibration procedure. <u>Actuator Recalibration</u>

AIR INLET VALVE ACTUATOR REPLACEMENT

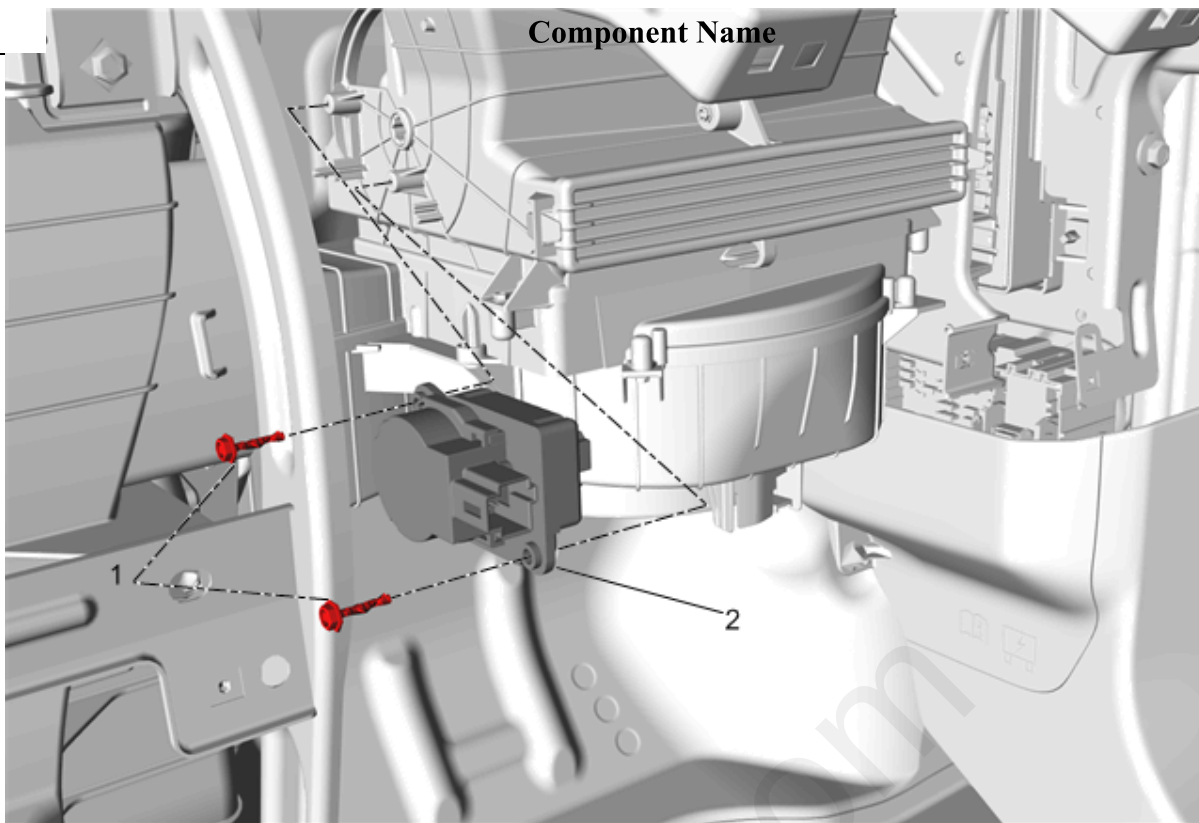


Fig. 16: Air Inlet Valve Actuator
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Instrument Panel Compartment Door Replacement</u>	
1	Air Inlet Valve Actuator Fastener (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.3 N.m (12 lb in)
3	Air Inlet Valve Actuator Procedures 1. Disconnect the electrical connector. 2. Perform the actuator calibration procedure. <u>Actuator Recalibration</u>

MODE VALVE ACTUATOR REPLACEMENT

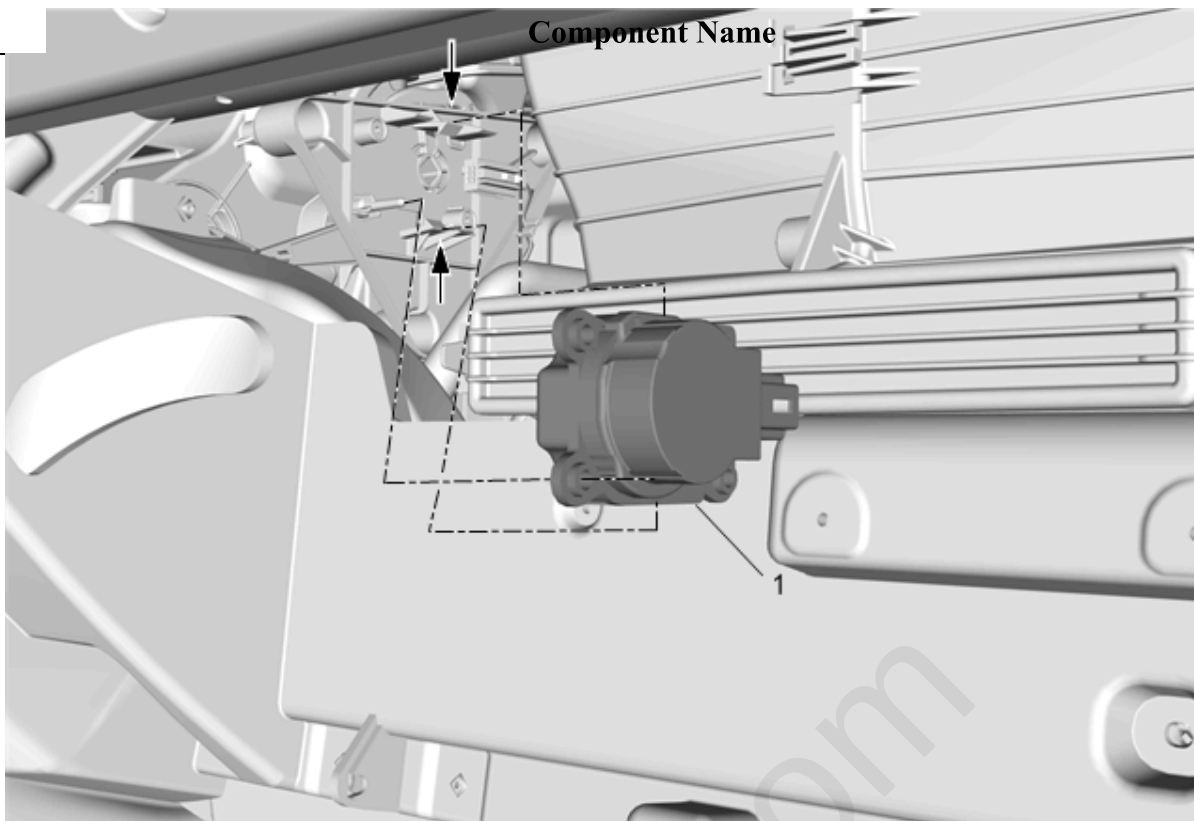


Fig. 17: Mode Valve Actuator

Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure <u>Instrument Panel Compartment Door Replacement</u>	
1	Mode Valve Actuator Procedures 1. Disconnect the mode valve actuator electrical connector. 2. Un-clip the mode valve actuator from heater and air conditioning control bracket. 3. Perform the actuator re-calibration procedure. Refer to <u>Actuator Recalibration</u>.

MODE VALVE ACTUATOR REPLACEMENT (RHD)

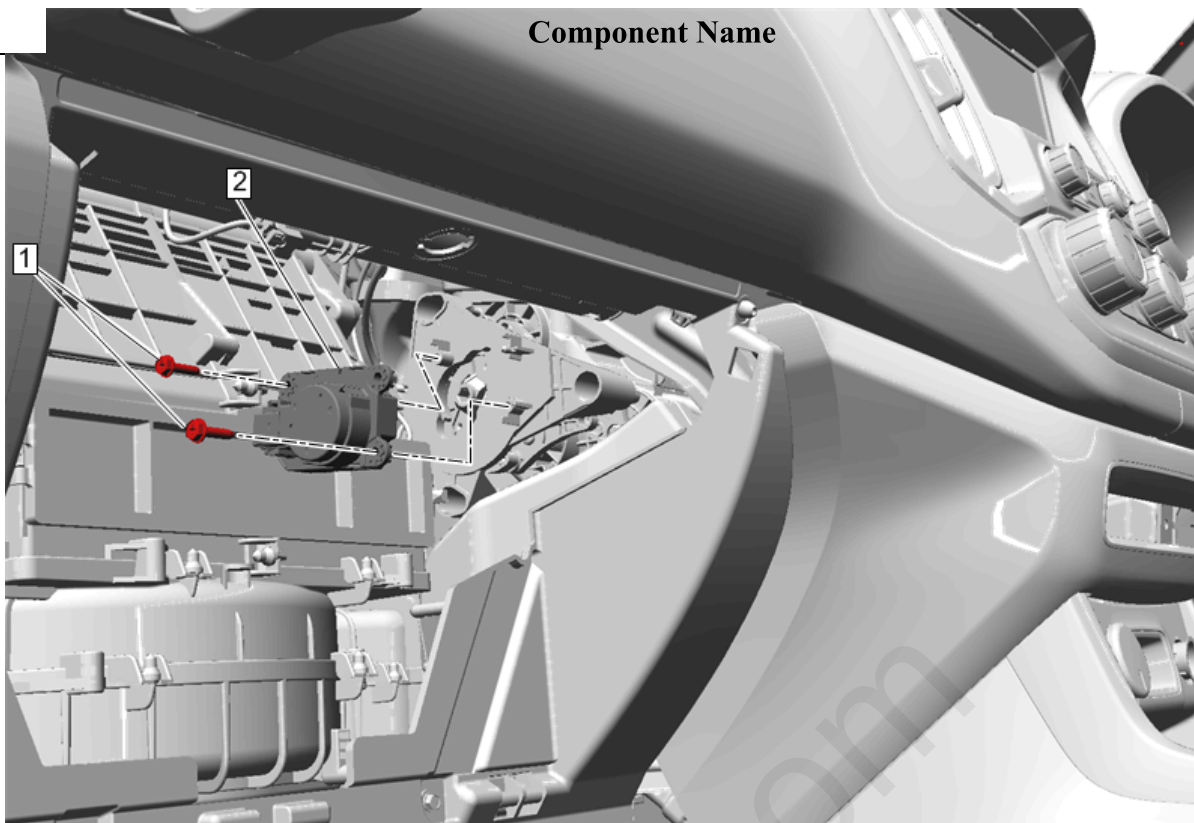


Fig. 18: Mode Valve Actuator (RHD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Instrument Panel Compartment Door Replacement</u>	
1	Mode Valve Actuator Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1.3 N.m (12 lb in)
2	Mode Valve Actuator Procedure 1. Disconnect the electrical connector. 2. Clear the DTCs from the heater and air conditioning remote control module. 3. Perform the actuator calibration procedure. <u>Actuator Recalibration</u>

MODE CONTROL CAM REPLACEMENT

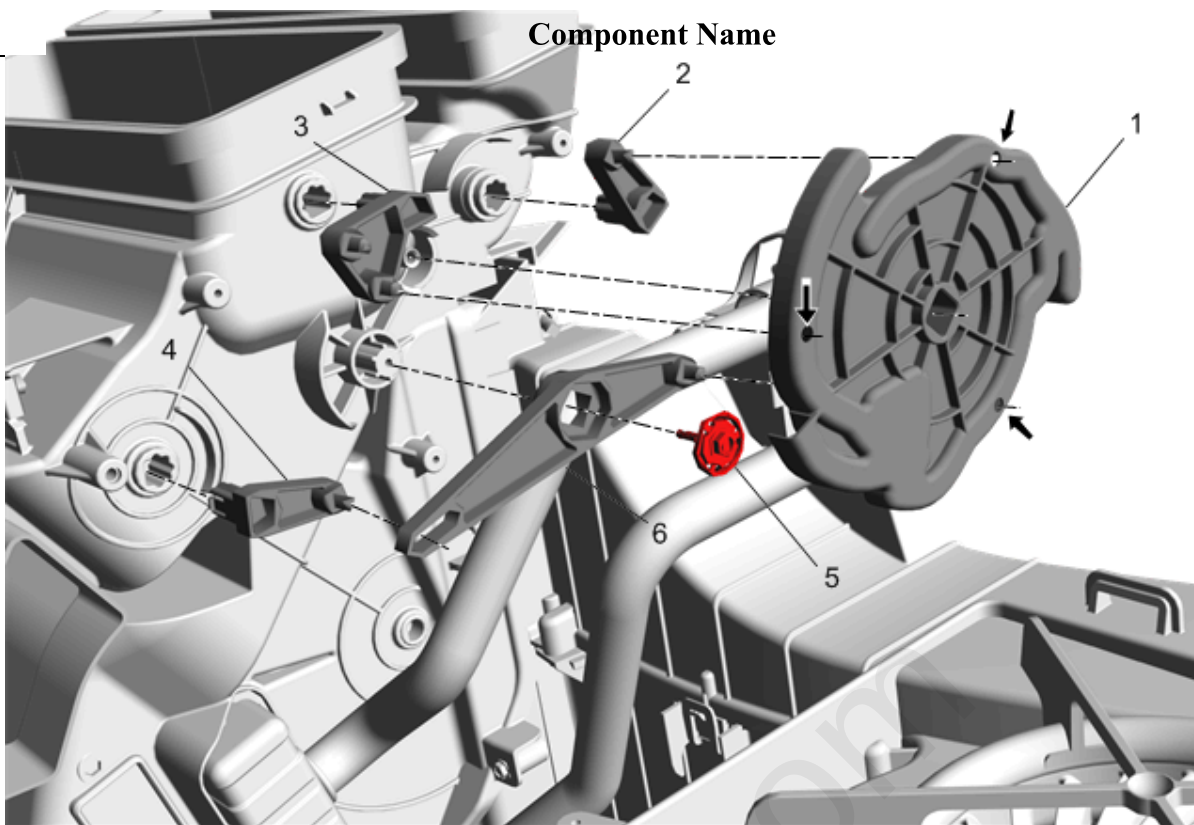


Fig. 19: Mode Control Cam

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Heater and Air Conditioning Control Bracket Replacement</u>	
1	Mode Control Cam Procedures 1. Inspect the mode control cam and replace as necessary. 2. Reassemble the cam, levers and links and position as shown above. 3. For proper alignment of the mode control cam, the levers and the link studs should align with the round windows on the cam indicated by the arrows.
2	Defroster Valve Lever Procedure Inspect the defroster valve lever and replace as necessary.
3	Vent Valve Lever Procedure Inspect the vent valve lever and replace as necessary.
4	Floor Valve lever Procedure Inspect the floor valve lever and replace as necessary.

Component Name	
5	Mode Valve Link Fastener CAUTION: Refer to Fastener Caution . Tighten 1.5 N.m (13 lb in)
6	Mode Valve Link Procedure Inspect the mode valve link and replace as necessary.

TEMPERATURE VALVE ACTUATOR REPLACEMENT

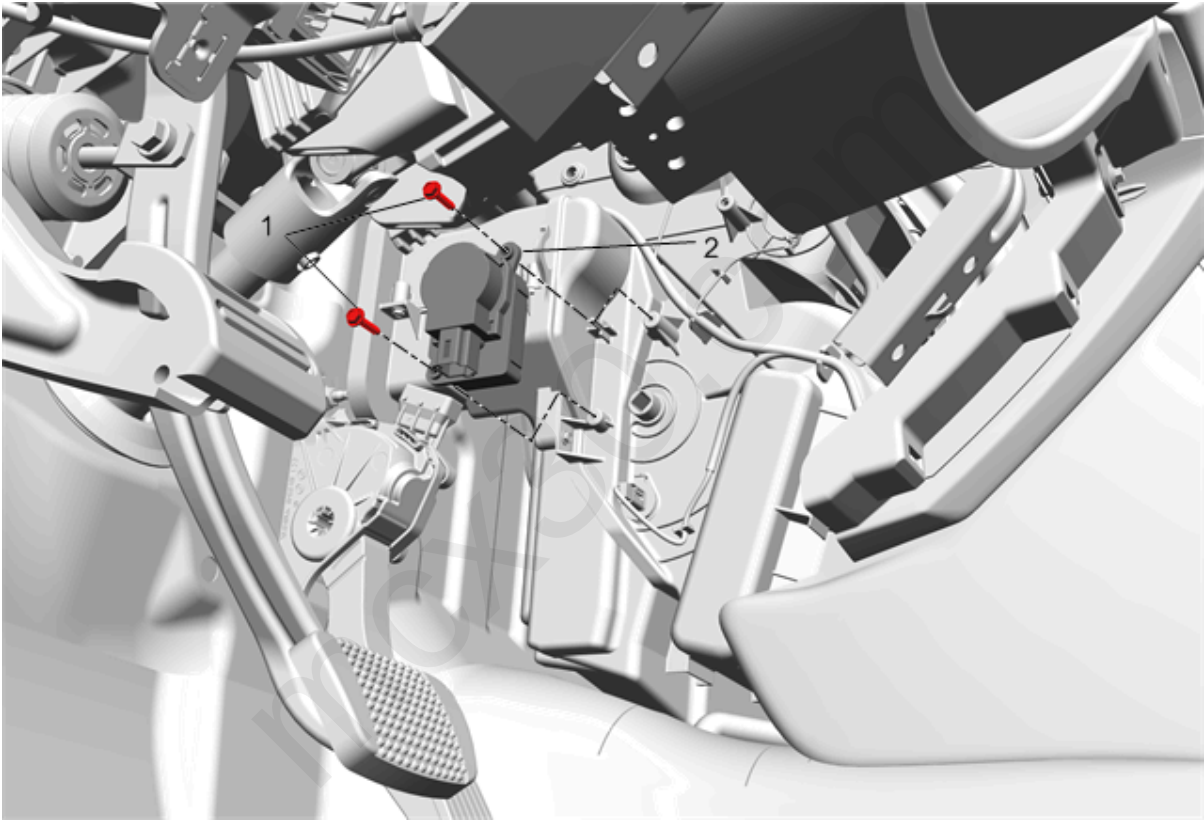


Fig. 20: Temperature Valve Actuator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Floor Front Air Outlet Duct Replacement - Left Side	
1	Temperature Valve Actuator Fastener (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 1.3 N.m (12 lb in)

Component Name	
2	Temperature Valve Actuator Preliminary Procedures 1. Disconnect the electrical connector. 2. Perform the actuator calibration procedure. Actuator Recalibration

DUCT AIR TEMPERATURE SENSOR REPLACEMENT - UPPER

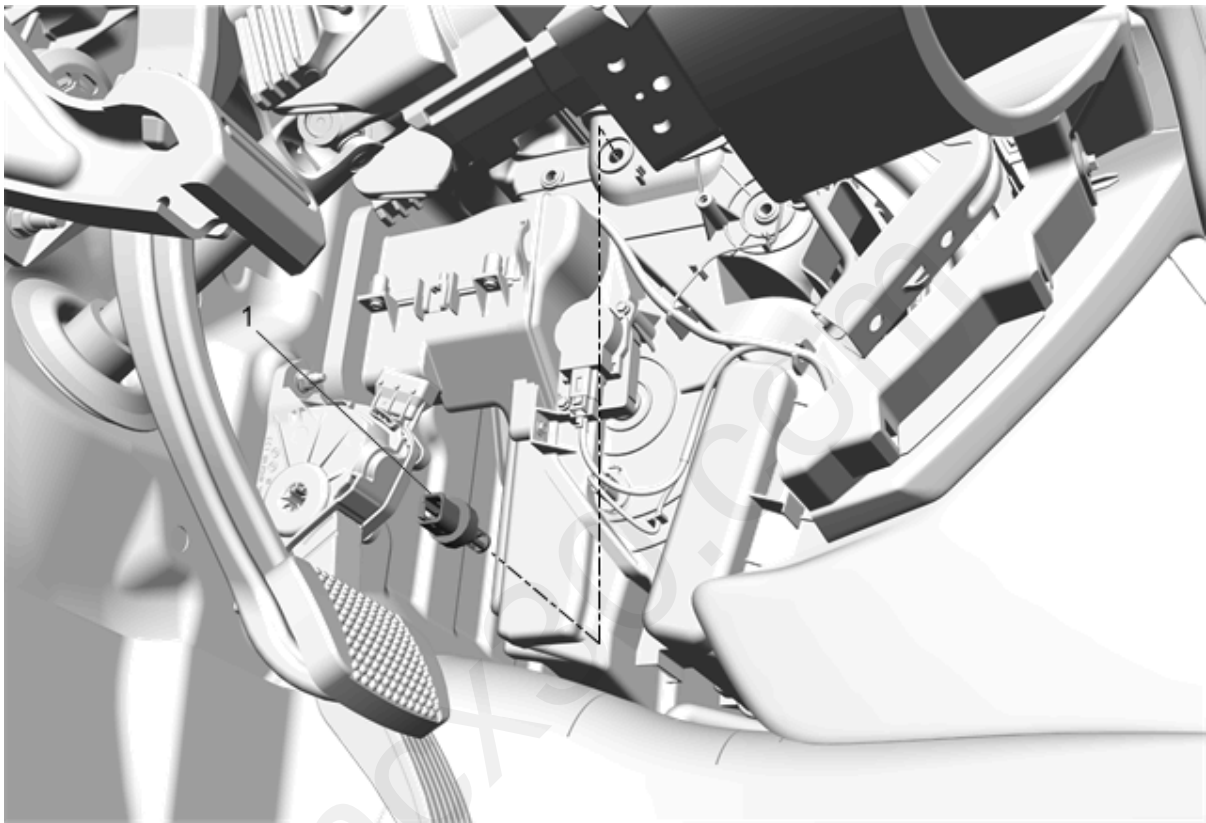


Fig. 21: Duct Air Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure Remove the left floor front air outlet duct. Refer to Floor Front Air Outlet Duct Replacement - Left Side .	
1	Duct Air Temperature Sensor - Upper Left Side Procedures 1. Disconnect the left upper duct air temperature sensor electrical connector. 2. To remove the left upper duct air temperature sensor, pull the left upper duct air temperature sensor out of the heater case.

DUCT AIR TEMPERATURE SENSOR REPLACEMENT - LOWER

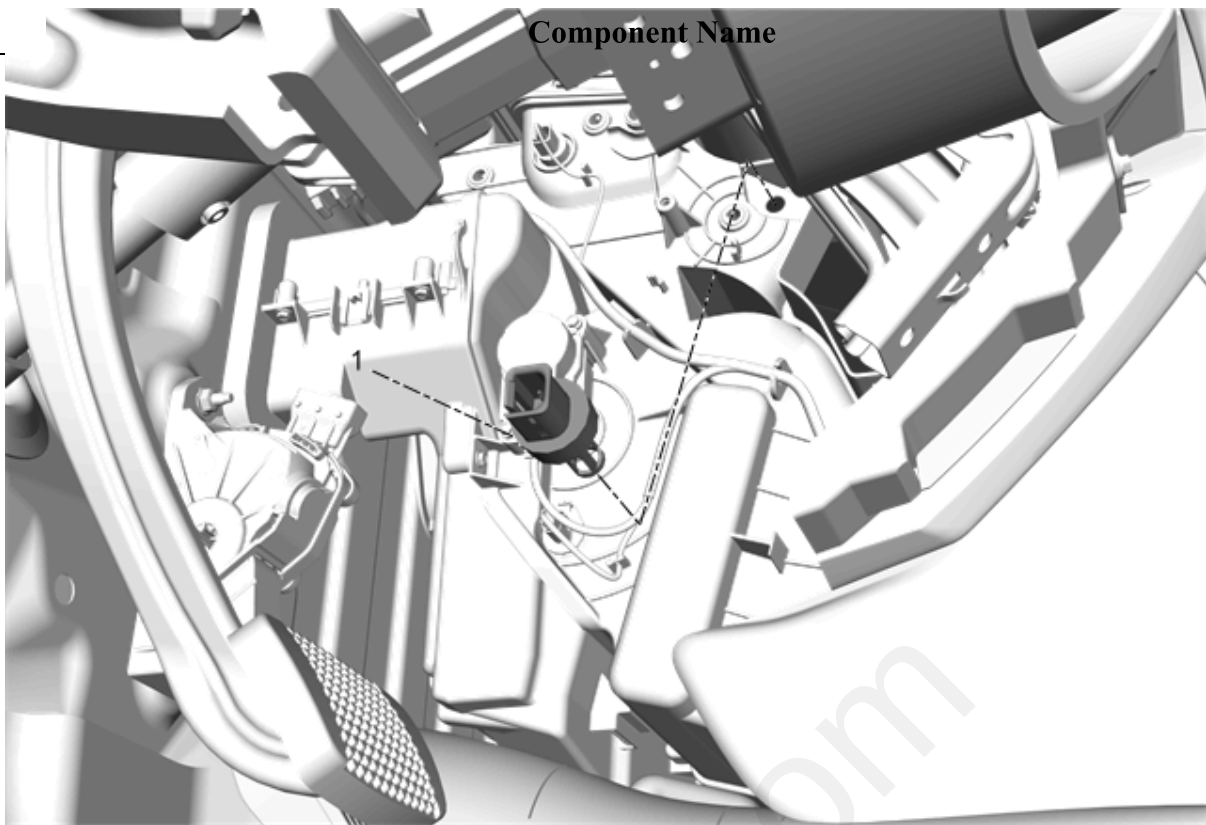


Fig. 22: Duct Air Temperature Sensor - Lower
 Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure Remove the left floor front air outlet duct. Refer to Floor Front Air Outlet Duct Replacement - Left Side .	
1	Duct Air Temperature Sensor - Lower Left Side Procedures 1. Disconnect the left lower duct air temperature sensor electrical connector. 2. To remove the left lower duct air temperature sensor, pull the left lower duct air temperature sensor out of the heater case.

EVAPORATOR AIR TEMPERATURE SENSOR REPLACEMENT

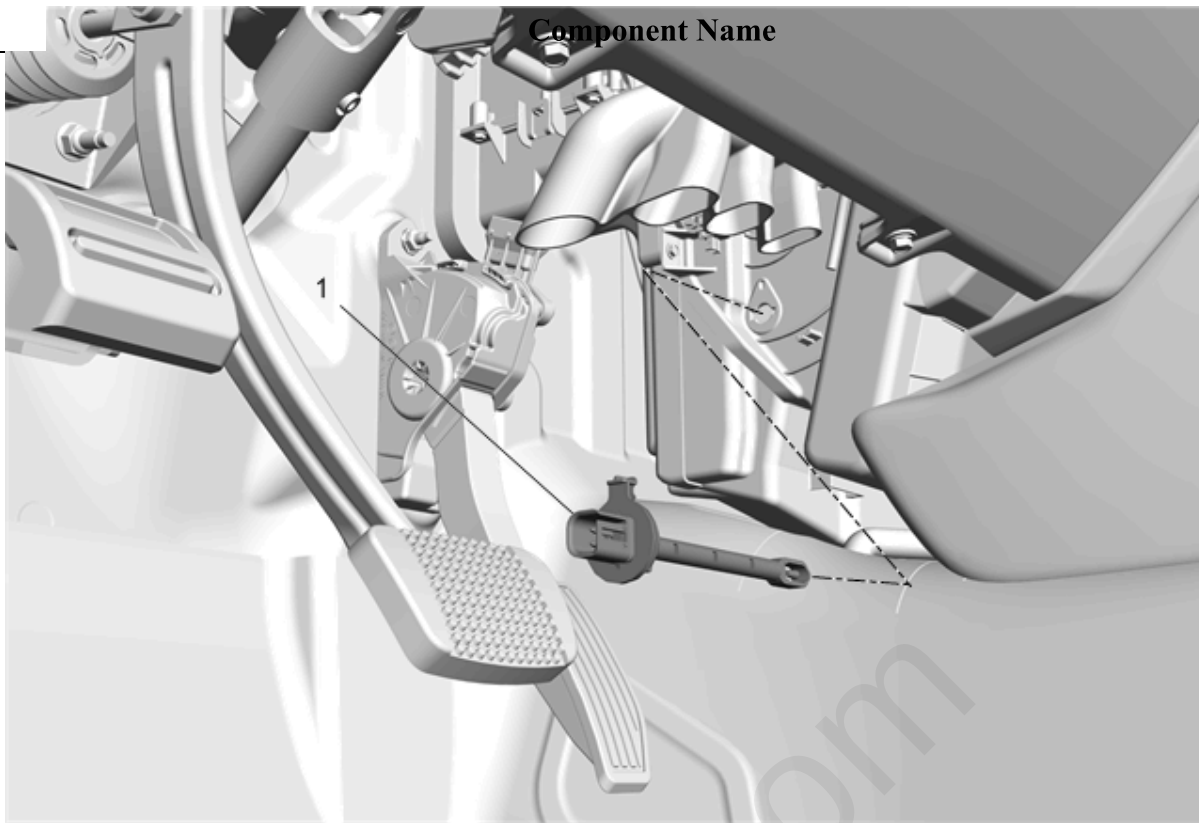


Fig. 23: Evaporator Air Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
1	Air Conditioning Evaporator Air Temperature Sensor Procedures 1. Disconnect the air conditioning evaporator air temperature sensor electrical connector. 2. Using light pressure pull back the locking tab and rotate air conditioning evaporator air temperature sensor quarter of a turn counter clock wise to remove the sensor from the heater case.

INSIDE AIR MOISTURE AND WINDSHIELD TEMPERATURE SENSOR REPLACEMENT

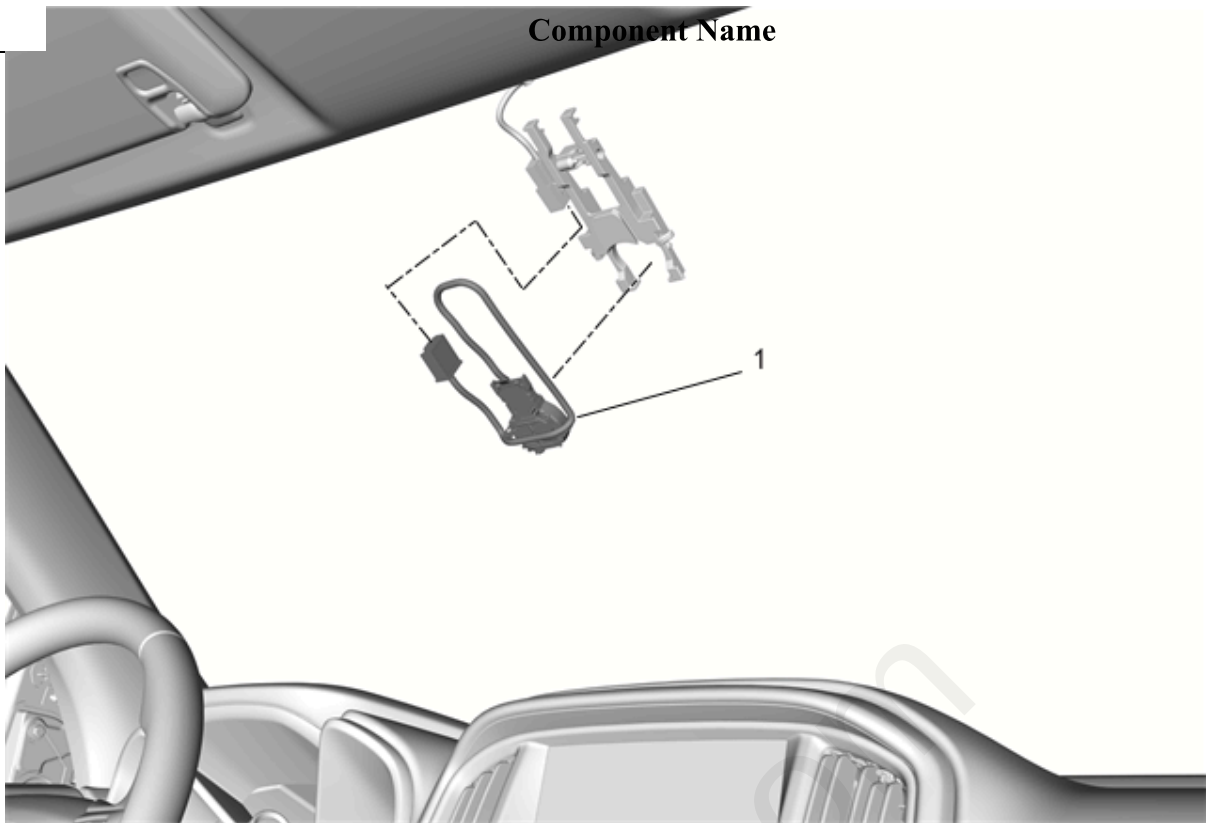


Fig. 24: Inside Air Moisture and Windshield Temperature Sensor

Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure Remove the inside rearview mirror assembly. Refer to Inside Rearview Mirror Replacement (With UE1) Inside Rearview Mirror Replacement (Without UE1) .	
1	Inside Air Moisture and Windshield Temperature Sensor Procedures 1. Unlatch the inside air moisture and windshield temperature sensor, from the inside rear view mirror support bracket. 2. Disconnect the inside air moisture and windshield temperature sensor connector.

SUN LOAD TEMPERATURE AND HEADLAMP AUTOMATIC CONTROL AMBIENT LIGHT SENSOR REPLACEMENT

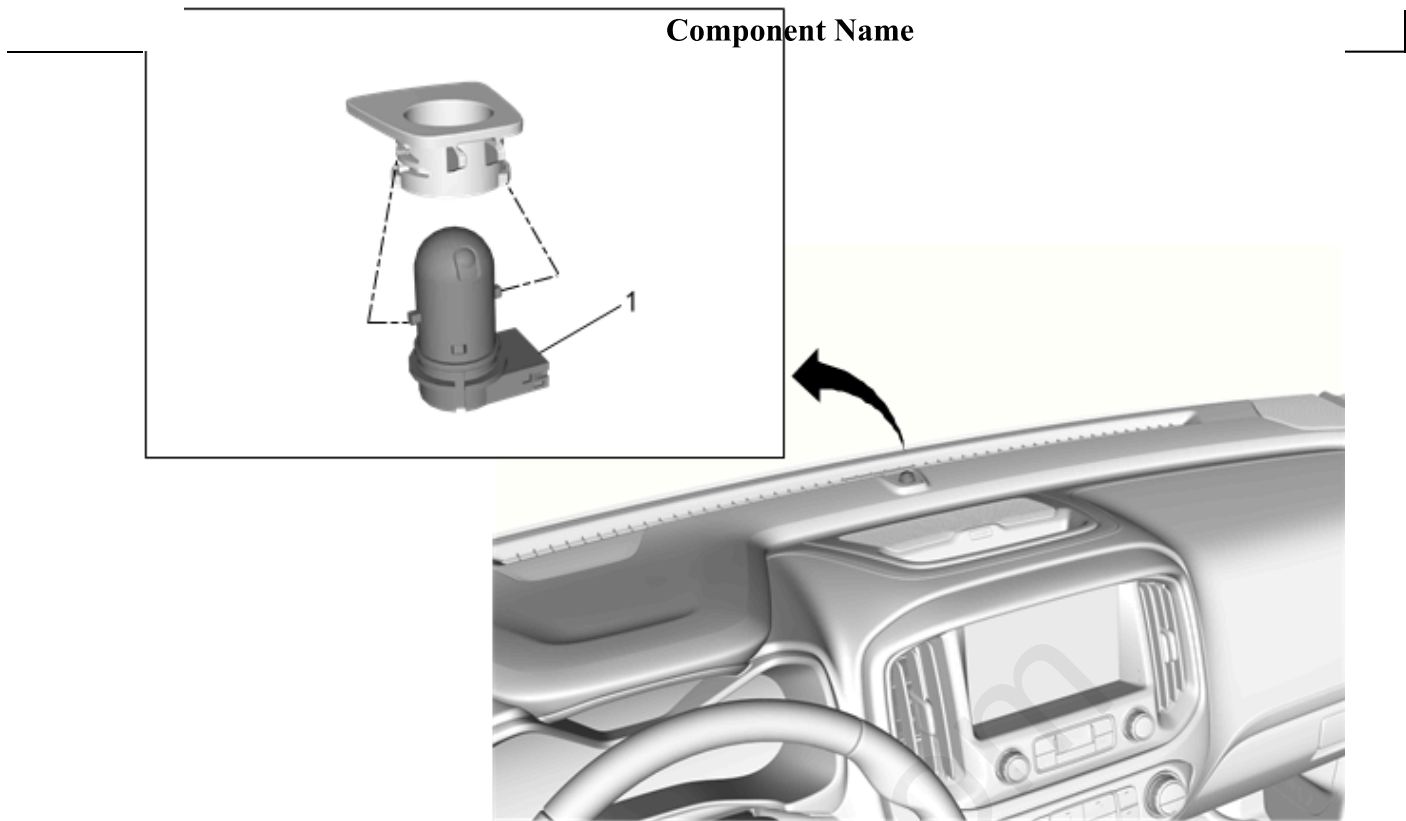


Fig. 25: Headlamp Automatic Control Ambient Light Sensor
 Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure Remove the daytime running lamp ambient light bezel. Refer to Daytime Running Lamp Ambient Light Bezel Replacement .	
1	Sun Load Temperature and Headlamp Automatic Control Ambient Light Sensor Procedure Turn the sun load temperature and headlamp automatic control ambient light sensor a quarter of a turn counter clock wise to remove the daytime running lamp ambient light bezel.

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
- Auxiliary Electric Heater
- Engine Coolant and A/C System Refrigerant

HVAC Control Components

ol	Feature	Availability
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The HVAC controls contains all buttons, switches, and dials which are required to control the functions of the HVAC system 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

Actuators

Doors in the HVAC case assembly are used to control air flow. The HVAC control module operates the doors through the use of actuators, with one actuator being used for each door. The system has the following air control doors and associated actuators: mode, temperature, and recirculation.

Each actuator used in the system 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 associated air control door 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 door.

Blower Motor

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 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. 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.

Evaporator Temperature Sensor

The evaporator temperature sensor is a 2-wire negative temperature coefficient 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°C (38°F), the compressor will be switched off in order to prevent a frozen evaporator.

Duct Temperature Sensors

ature sensors are 2-wire negative temperature coefficient thermistors. The sensors operate within a temperature range of -40 to +85Â°C (-40 to +185Â°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 desired Air temperature door position.

A/C Refrigerant Pressure Sensor

The A/C refrigerant pressure sensor is a 3-wire piezoelectric pressure transducer. The 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 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.

Windshield Temperature and Inside Moisture Sensor

The windshield temperature and inside moisture 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.

Air Speed

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

The HVAC control module provides a PWM signal to the blower motor in order to command the desired blower motor speed.

Afterblow

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 21Â°C (70Â°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 blower motor will perform the following sequence up to 5 times. This could last up to an hour:

1. The blower motor will be OFF for 7-11 minutes.
2. The blower motor will RUN for 25-30 seconds.

Air Delivery

The desired air distribution mode can be selected with the air distribution switches at the HVAC controls. The HVAC controls 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

This vehicle may be equipped with a low voltage positive temperature coefficient cabin air heater. This is an electrical grid heater located in the HVAC case consisting of three 330 W stages used to heat the passenger compartment under cold conditions. When max temperature is selected and the engine coolant has not yet reached a sufficient temperature, the cabin air heater will be cycled on by the HVAC control module. The HVAC control module will monitor conditions in order to determine when to reduce or turn off the electrical cabin air heater.

When the A/C switch is pressed, the HVAC controls 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 following conditions must be met in order to activate the A/C compressor:

voltage is between 9-18 V

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

The A/C high side pressure 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 determine the path of the incoming air. 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

The recirculation switch is integrated into the HVAC controls. 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.

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

- Upper left air temperature sensor
- Windshield temperature and inside moisture sensor
- Ambient light/sunload sensor
- Air quality sensor
- Regulate blower motor speed
- Position the air temperature actuator
- Position the mode actuator
- Position the recirculation actuator
- Request A/C operation

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

Auxiliary Electric Heater (Diesel ONLY)

Models equipped with a diesel engine are also equipped with an auxiliary electric heater grid to provide faster cabin warm-ups in cold climates. The auxiliary heater grid is mounted in the low-center of the HVAC module, where heat is transferred from the grid to air which is directed to the floor outlet ducts.

The auxiliary heater is enabled only when the cabin temperature is set to MAX, the engine coolant temperature is less than 80°C (176°F), and the outside air temperature is below 12°C (54°F). When engine coolant temperature rises above 80°C (176°F), the temperature control is moved away from the MAX position, or the outside air temperature is above 12°C (54°F), the auxiliary electric heater is disabled, and cabin heat is managed only by the coolant-based heater core and temperature door position. If the auxiliary electric heater is activated and then turns off, it can actuate once again if the engine coolant temperature drops below 75°C (167°F), or the outside air temperature drops below 8°C (46°F).

The actual amount of heat output from the auxiliary electric heater can vary and is dependant upon internal overheating protection, battery state of charge, and other vehicle electrical load requirements.

Engine Coolant and A/C System Refrigerant

For information on engine coolant, coolant flow, A/C refrigerant, and the A/C refrigerant cycle, refer to [**Heating and Air Conditioning System Description and Operation**](#).

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