

HVAC - Automatic - Malibu

HVAC WIRING SCHEMATICS

Ambient Light/Sunload, and Windshield Sensors (CJ2) Wiring Schematics

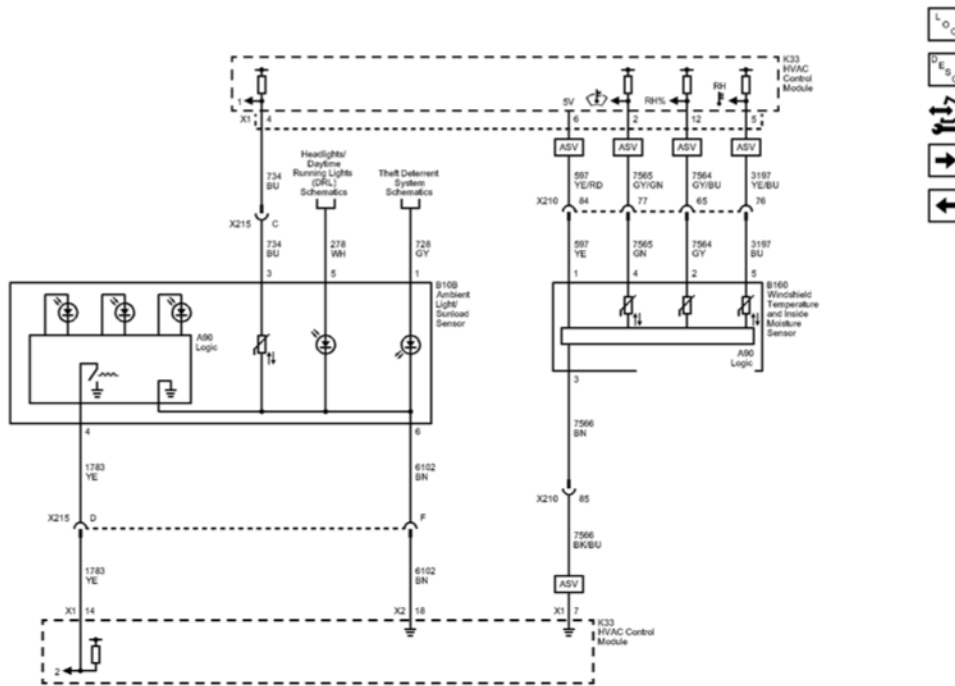


Fig. 2: Ambient Light/Sunload, and Windshield Sensors (CJ2) Wiring Schematics
 Courtesy of GENERAL MOTORS COMPANY

Temperature Sensors, Compressor Controls and Heater Coolant Pump Wiring Schematics

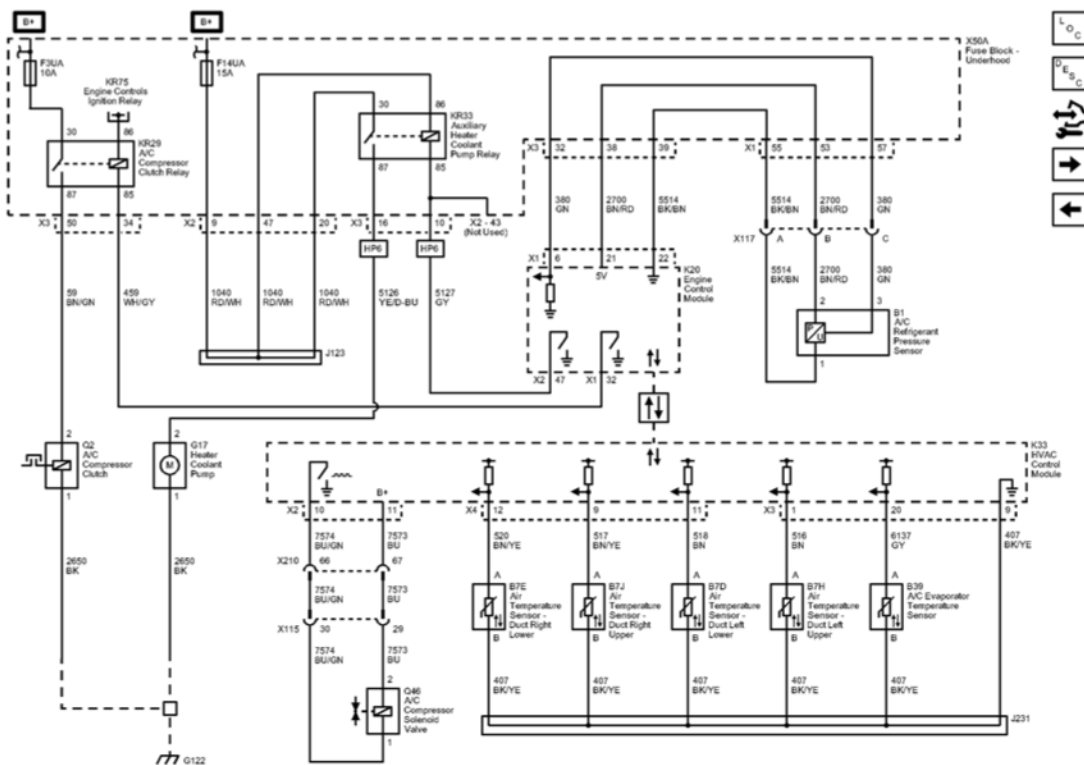


Fig. 3: Temperature Sensors, Compressor Controls and Heater Coolant Pump Wiring Schematics
 Courtesy of GENERAL MOTORS COMPANY

Mode and Temperature Control Actuators Wiring Schematics

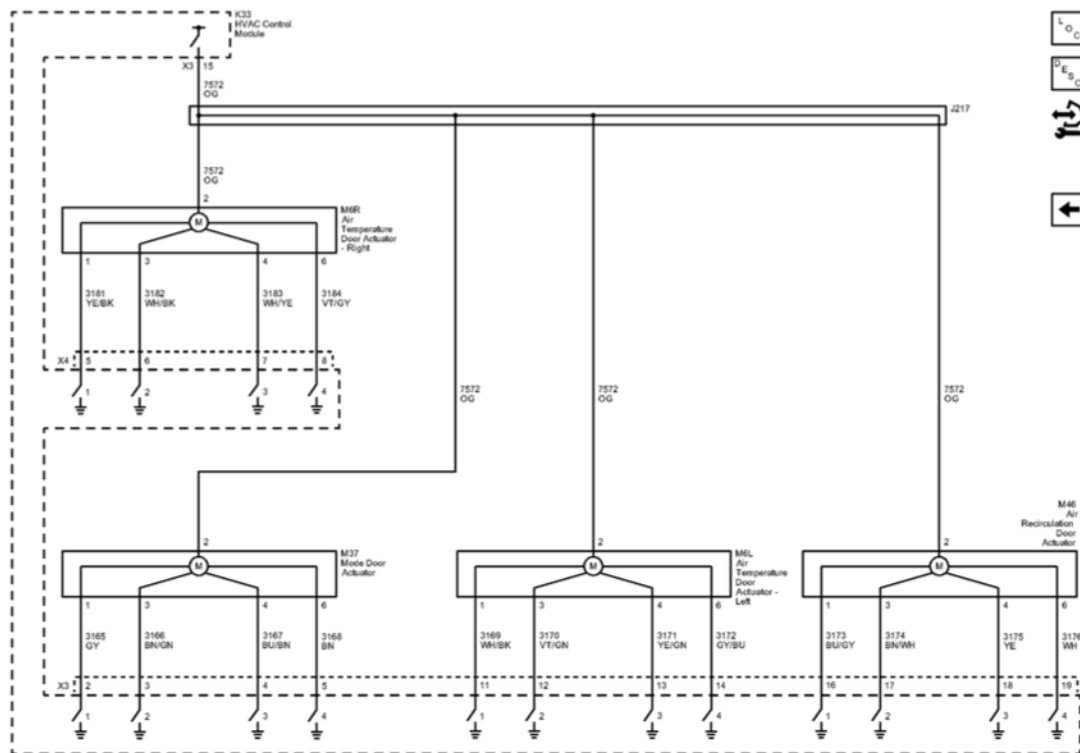


Fig. 4: Mode and Temperature Control Actuators Wiring Schematics
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

HVAC COMPONENT REPLACEMENT REFERENCE

HVAC Component Replacement Reference

Scan Tool Name	Component Code / Schematic Name	Service Name	Repair Instruction Name
Passenger Compartment Humidity, Passenger Compartment Humidity Sensor Temperature, Windshield Temperature	B160 Windshield Temperature and Inside Moisture Sensor	Humidity/Windshield Temperature Sensor	<u>Inside Air Moisture and Windshield Temperature Sensor Replacement</u>
Air Recirculation Door	M46 Air Recirculation Door Actuator	Air Recirculation Door Actuator	<u>Air Inlet Valve Actuator Replacement</u>
Right Temperature	M6R Air Temperature	Right Air Temperature Door	<u>Temperature Valve Actuator</u>

Door	Door Actuator - Right	Actuator	<u>Replacement - Right Side</u>
Left Temperature Door	M6L Air Temperature Door Actuator - Left	Left Air Temperature Door Actuator	<u>Temperature Valve Actuator Replacement - Left Side</u>
Mode Door	M37 Mode Door Actuator	Mode Door Actuator	<u>Mode Control Cam Actuator Replacement</u>
Upper Left Duct Air Temperature Sensor	B7H Air Temperature Sensor - Duct Left Upper	Duct Air Temperature Sensor- Upper Left	<u>Duct Air Temperature Sensor Replacement - Upper Left Side</u>
Lower Left Duct Air Temperature Sensor	B7D Air Temperature Sensor - Duct Left Lower	Duct Air Temperature Sensor- Lower Left	<u>Duct Air Temperature Sensor Replacement - Lower Left Side</u>
Upper Right Duct Air Temperature Sensor	B7J Air Temperature Sensor - Duct Right Upper	Duct Air Temperature Sensor- Upper Right	<u>Duct Air Temperature Sensor Replacement - Upper Right Side</u>
Lower Right Duct Air Temperature Sensor	B7E Air Temperature Sensor - Duct Right Lower	Duct Air Temperature Sensor- Lower Right	<u>Duct Air Temperature Sensor Replacement - Lower Right Side</u>
A/C Evaporator Temperature Sensor	B39 A/C Evaporator Temperature Sensor	Evaporator Temperature Sensor	<u>Air Conditioning Refrigerant Temperature Sensor Replacement</u>
Passenger Compartment Air Temperature Sensor and Sunload Sensor	B10B Ambient Light/Sunload Sensor	Inside Air Temperature, Ambient Light and Sun Load sensor	<u>Sun Load Temperature Sensor Replacement (Ambient Light Sensor)</u>
Blower Motor	M8 Blower Motor	Blower Motor	<u>Blower Motor Replacement</u>
Blower Motor Control Module	K8 Blower Motor Control Module	Blower Motor Control Module	<u>Heater and Blower and Air Conditioning Control Module Replacement</u>
A/C High Side Pressure Sensor	B1 A/C Refrigerant Pressure Sensor	A/C Refrigerant Pressure Sensor	<u>Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement (LUK) , Air Conditioning (A/C) Refrigerant</u>

			<u>Pressure Sensor Replacement (LCV, LTG)</u>
A/C Compressor Clutch	Q2 A/C Compressor Clutch	A/C Compressor Clutch	<u>Air Conditioning Compressor Replacement (LUK) ,</u> <u>Air Conditioning Compressor Replacement (LCV) ,</u> <u>Air Conditioning Compressor Replacement (LTG)</u>
A/C Compressor Solenoid Valve	Q46 A/C Compressor Solenoid Valve	A/C Compressor Solenoid Valve	<u>Air Conditioning Compressor Replacement (LUK) ,</u> <u>Air Conditioning Compressor Replacement (LCV) ,</u> <u>Air Conditioning Compressor Replacement (LTG)</u>
Heater Coolant Pump	G17 Heater Coolant Pump	Heater Coolant Pump	<u>Auxiliary Water Pump Replacement</u>
HVAC Controls	A26 HVAC Controls	HVAC Controls	<u>Heater and Air Conditioning Control Replacement</u>
Remote Heater and Air Conditioning Control Module	K33 HVAC Control Module	HVAC Control Module	<u>Heater and Air Conditioning Remote Control Replacement</u>

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B0163</u>	DTC B0163 02 Passenger Compartment Temperature Sensor Circuit Short to Ground DTC B0163 05 Passenger Compartment Temperature Sensor Circuit High Voltage/Open
	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

<u>DTC B0173, B0178, B0509, B0514 or B3933</u>	DTC B0509 02 Upper Right Duct Air Temperature Sensor Circuit Short to Ground DTC B0509 05 Upper Right Duct Air Temperature Sensor Circuit High Voltage/Open DTC B0514 02 Lower Right Duct Air Temperature Sensor Circuit Short to Ground DTC B0514 05 Lower Right Duct Air Temperature Sensor Circuit High Voltage/Open DTC B3933 02 Air Conditioning Evaporator Temperature Sensor Circuit Short to Ground DTC B3933 05 Air Conditioning Evaporator Temperature Sensor Circuit High Voltage/Open
<u>DTC B018A, B048C, B048F, or B1395</u>	DTC B018A 02 Windshield Temperature Sensor Circuit Short to Ground DTC B018A 05 Windshield Temperature Sensor Circuit High Voltage/Open DTC B048C 02 Humidity Sensor Humidity Circuit Short to Ground DTC B048C 05 Humidity Sensor Humidity Circuit High Voltage/Open DTC B048F 02 Humidity Sensor Temperature Circuit Short to Ground DTC B048F 05 Humidity Sensor Temperature Circuit High Voltage/Open DTC B1395 03 Control Module Voltage Reference Output Circuit Low Voltage DTC B1395 07 Control Module Voltage Reference Output Circuit High Voltage
<u>DTC B0183</u>	DTC B0183 02 Solar Load Sensor Circuit Short to Ground DTC B0183 05 Solar Load Sensor Circuit High Voltage/Open
<u>DTC B0193</u>	DTC B0193 01 Front Blower Motor Speed Circuit Short to Battery DTC B0193 06 Front Blower Motor Speed Circuit Low Voltage/Open
<u>DTC B0223, B022A, B0233, B023A, B0408, or</u>	DTC B0223 01 Recirculate Position Command 1 Circuit Short to Battery DTC B0223 06 Recirculate Position Command 1 Circuit Low Voltage/Open DTC B022A 01 Recirculate Position Command 2 Circuit Short to Battery DTC B022A 06 Recirculate Position Command 2 Circuit Low Voltage/Open DTC B0233 01 Air Flow Control Circuit Short to Battery DTC B0233 06 Air Flow Control Circuit Low

<u>B0418</u>	Voltage/Open DTC B023A 02 HVAC Actuators Supply Voltage Short to Ground DTC B0408 01 Main Temperature Control Circuit Short to Battery DTC B0408 06 Main Temperature Control Circuit Low Voltage/Open DTC B0418 01 Right Temperature Control Circuit Short to Battery DTC B0418 06 Right Temperature Control Circuit Low Voltage/Open
<u>DTC B269A, B269C, or B269D</u>	DTC B269A Heater Coolant Pump Control Circuit Open DTC B269C Heater Coolant Pump Control Circuit Low DTC B269D Heater Coolant Pump Control Circuit High
<u>DTC B393B</u>	DTC B393B 04 Air Conditioning Compressor Valve Control Circuit Open DTC B393B 0B Air Conditioning Compressor Valve Control Circuit High Current
<u>DTC P0532 or P0533</u>	DTC P0532 Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit Low Voltage DTC P0533 Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit High Voltage
<u>DTC P0645, P0646, or P0647</u>	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

DTC B0163

Diagnostic Instructions

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

DTC Descriptors

DTC B0163 02

Passenger Compartment Temperature Sensor Circuit Short to Ground

DTC B0163 05

Passenger Compartment Temperature Sensor Circuit High Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B0163 02	B0163 05	B0163 05	1
Low Reference	-	B0163 05, B0183 05	-	-
1. HVAC Malfunction				

Circuit/System Description

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

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

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

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

Conditions for Running the DTC

- Ignition ON
- The HVAC control module is ON.

Conditions for Setting the DTC

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 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 ohms between the low reference circuit terminal 6 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Passenger Compartment Air Temperature (Unfiltered) parameter is less than -37°C (-35°F).
 - **If -37°C (-35°F) or greater**
 1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K33 HVAC Control Module.
- **If less than -37°C (-35°F)**
- 5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the low reference circuit terminal 6.
- 6. Verify the scan tool parameter Passenger Compartment Air Temperature (Unfiltered) parameter is greater than 113°C (235°F).
 - **If 113°C (235°F) or less**
 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 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If greater than 113°C (235°F)**
- 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 HVAC control module replacement, programming and setup

DTC B0173, B0178, B0509, B0514 OR B3933

Diagnostic Instructions

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

DTC Descriptors

DTC B0173 02

Upper Left Duct Air Temperature Sensor Circuit Short to Ground

DTC B0173 05

Upper Left Duct Air Temperature Sensor Circuit High Voltage/Open

DTC B0178 02

Lower Left Duct Air Temperature Sensor Circuit Short to Ground

DTC B0178 05

Lower Left Duct Air Temperature Sensor Circuit High Voltage/Open

DTC B0509 02

Upper Right Duct Air Temperature Sensor Circuit Short to Ground

DTC B0509 05

Upper Right Duct Air Temperature Sensor Circuit High Voltage/Open

DTC B0514 02

Lower Right Duct Air Temperature Sensor Circuit Short to Ground

DTC B0514 05

Lower Right Duct Air Temperature Sensor Circuit High Voltage/Open

DTC B3933 02

Air Conditioning Evaporator Temperature Sensor Circuit Short to Ground

DTC B3933 05

Air Conditioning Evaporator Temperature Sensor Circuit High Voltage/Open

Diagnostic Fault Information

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	-
Upper Right Duct Air Temperature Sensor Signal	B0509 02	B0509 05	B0509 05	-
Lower Right Duct Air Temperature Sensor Signal	B0514 02	B0514 05	B0514 05	-
Air Conditioning Evaporator Temperature	B3933 02	B3933 05	B3933 05	-

Sensor Signal				
Low Reference	-	B0173 05, B0178 05, B0509 05, B0514 05, B3933 05	B0173 05, B0178 05, B0509 05, B0514 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
- Air temperature sensor - right upper
- Air temperature sensor - right lower
- A/C evaporator temperature sensor

This sensor operates using signal and low reference circuits. As the air temperature surrounding the sensor increases, the sensor resistance decreases. The sensor is capable of reading temperatures ranging from -40 to +115°C (-40 to +240°F), with a signal voltage between 0-5 V. If the HVAC control module detects a malfunctioning sensor the software uses a default air temperature value. The default action ensures that the HVAC system can adjust the inside air temperature near the desired temperature until the condition is corrected.

Conditions for Running the DTC

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

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

The system operates using a default value.

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

HVAC Schematics

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 the appropriate temperature sensor has a parameter displayed in HVAC scan tool information.
 - o **If there is no scan tool parameter**

Refer to Circuit/System Testing below - Without Scan Tool Support.

- o **If there is a scan tool parameter**

3. Refer to Circuit/System Testing below- 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.
2. Test for less than 10 ohms between the low reference circuit terminal B and ground.
 - o **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - o If 2 ohms or greater, repair the open/high resistance in the circuit.
 - o If less than 2 ohms, replace the K33 HVAC Control Module.

- **If less than 10 ohms**
- 3. Ignition ON.
- 4. Verify the appropriate scan tool temperature sensor parameter is less than -37°C (-35°F)
 - **If greater than -37°C (-35°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°C (-35°F) or less**
- 5. Install a 3 A fused jumper wire between the signal circuit terminal A and the low reference circuit terminal B.
- 6. Verify the scan tool temperature sensor parameter is greater than 110°C (230°F).
 - **If less than 110°C (230°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 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If 110°C (230°F) or greater**
- 7. Test or replace the temperature sensor.

Without Scan Tool Support

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate temperature sensor. It may take up to 10 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal B and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If less than 10 ohms**
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 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, 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.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K33 HVAC Control Module.

- **If between 4.8-5.2 V**

4. Test or replace the temperature sensor.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
 - **If the DTC sets**

Replace the K33 HVAC Control Module.

- **If the DTC does not set**

7. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

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

DTC B018A, B048C, B048F, OR B1395

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 02

Windshield Temperature Sensor Circuit Short to Ground

DTC B018A 05

Windshield Temperature Sensor Circuit High Voltage/Open

DTC B048C 02

Humidity Sensor Humidity Circuit Short to Ground

DTC B048C 05

Humidity Sensor Humidity Circuit High Voltage/Open

DTC B048F 02

Humidity Sensor Temperature Circuit Short to Ground

DTC B048F 05

Humidity Sensor Temperature Circuit High Voltage/Open

DTC B1395 03

Control Module Voltage Reference Output Circuit Low Voltage

DTC B1395 07

Control Module Voltage Reference Output Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	B1395 03	B1395 03	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	-	-

Circuit/System Description

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

This sensor assembly provides information about:

- Relative humidity level at windshield inside
- Temperature of the windshield inside
- 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 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.

Conditions for Running the DTC

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

Conditions for Setting the DTC

B018A 02, B048C 02, B048F 02 or B1395 03

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.

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 ohms between the low reference circuit terminal 3 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connector 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 ohms in the 5 V reference circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
- If less than 2 ohms, 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 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°C (-35°F).
 - Windshield Temperature
 - Passenger Compartment Humidity Sensor Temperature
- **If -37°C (-35°F) or greater**
- 1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
- 2. Test for infinite resistance between ground and the signal circuit terminals listed below:
 - 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°C (-35°F)**
- 6. 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
- 7. 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 connector 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 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
- **If greater than 114°C (238°F)**

8. Remove the jumper wire.
9. Verify the scan tool Passenger Compartment Humidity parameter is greater than 95%.
 - **If 95% or less**
 1. Ignition OFF, disconnect the harness connector 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%**
10. Install a 3 A fused jumper wire between the passenger compartment humidity sensor signal circuit terminal 2 and the low reference circuit terminal 3.
11. 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 connector 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 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If less than 5%**
12. 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 B0183

Diagnostic Instructions

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

DTC Descriptors

DTC B0183 02

Solar Load Sensor Circuit Short to Ground

DTC B0183 05

Solar Load Sensor Circuit High Voltage/Open

Diagnostic Fault Information

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

Circuit/System Description

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

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

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

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

Conditions for Running the DTC

- Ignition ON
- The HVAC Control Module is ON.

Conditions for Setting the DTC

B0183 02

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

B0183 05

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

Action Taken When the DTC Sets

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

- If no value is read at the time of fault, the HVAC control module uses 0 W/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 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 ohms between the low reference circuit terminal 6 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.

- **If less than 10 ohms**
- 3. Ignition ON.
- 4. Test for 4.8-5.2 V between the signal circuit terminal 4 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness 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 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, 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.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K33 HVAC Control Module.
 - **If between 4.8-5.2 V**
- 5. Test or replace the B10B Ambient Light/Sunload Sensor.
- 6. Verify DTC B0183 did not reset.
 - **If DTC B0183 did reset**

Replace the K33 HVAC Control Module.
 - **If DTC B0183 did not reset**
- 7. 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 B0193

Diagnostic Instructions

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

DTC Descriptors

DTC B0193 01

Front Blower Motor Speed Circuit Short to Battery

DTC B0193 06

Front Blower Motor Speed Circuit Low Voltage/Open

Diagnostic Fault Information

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

Circuit/System Description

The blower motor control module is an interface between the HVAC control module and the blower motor. The blower motor control module has 4 circuits: a B+ input, a signal input from the HVAC module, a B+ output to the blower motor, and a low side pulse width modulation (PWM) output. The HVAC control module provides a low side (PWM) signal to the blower motor control module in order to request the blower motor speed. The blower motor control module grounds the blower motor using a low side PWM signal in order to vary the blower motor speed.

Conditions for Running the DTC

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

Conditions for Setting the DTC

B0193 01

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

B0193 06

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

Action Taken When the DTC Sets

The blower motor is inoperative.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

Prior to motor replacement connect a direct independent B+ and ground to verify operation.

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

If the motor operates properly please reinstall it and check for Preliminary Information or Technical Service Bulletins

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 X1 harness connector at the K8 Blower Motor Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 5 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, repair the open/high resistance in the ground connection.
- **If less than 10 ohms**
- 3. Ignition ON.
- 4. Verify a test lamp illuminates between the B+ circuit terminal 6 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 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, 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 6 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Disconnect the X2 harness connector at the K8 Blower Motor Control Module and disconnect the harness connector at the M8 Blower Motor.
 4. Test for infinite resistance between the M8 Blower Motor control circuit terminal B and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test or replace the M8 Blower Motor.
 - **If the test lamp illuminates**
- 5. Remove the test lamp, ignition ON.
- 6. Test for 2.8-3.2 V between control circuit terminal 3 and ground.
 - **If not between 2.8-3.2 V**
 1. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF.
 4. 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.
 5. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms replace the K33 HVAC Control Module.
 - **If between 2.8-3.2 V**
- 7. Ignition OFF, connect the X1 harness connector at the K8 Blower Motor Control Module, and disconnect the harness connector at the M8 Blower Motor, ignition ON and blower ON.

8. Verify a test lamp illuminates between the control circuit terminal B and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp and disconnect the X2 harness connector at the K8 Blower Motor Control Module.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms replace the K8 Blower Motor Control Module.
 - **If the test lamp illuminates**
9. Connect a test lamp between control circuit terminal A and control circuit terminal B.
10. Verify the test lamp becomes progressively brighter as the blower speed is increased.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp and disconnect the X2 harness connector at the K8 Blower Motor Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit terminal A 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 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms replace the K8 Blower Motor Control Module.
 - **If the test lamp illuminates, but does not change in brightness**
 1. Ignition OFF, remove the test lamp and disconnect the X2 harness connector at the K8 Blower Motor 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 K8 Blower Motor Control Module.
 - **If the test lamp changes in brightness as the blower speed is changed**
 - 11. Test or replace the M8 Blower Motor.

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 B0223, B022A, B0233, B023A, B0408, OR B0418

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 01

Recirculate Position Command 1 Circuit Short to Battery

DTC B0223 06

Recirculate Position Command 1 Circuit Low Voltage/Open

DTC B022A 01

Recirculate Position Command 2 Circuit Short to Battery

DTC B022A 06

Recirculate Position Command 2 Circuit Low Voltage/Open

DTC B0233 01

Air Flow Control Circuit Short to Battery

DTC B0233 06

Air Flow Control Circuit Low Voltage/Open

DTC B023A 02

HVAC Actuators Supply Voltage Short to Ground

DTC B0408 01

Main Temperature Control Circuit Short to Battery

DTC B0408 06

Main Temperature Control Circuit Low Voltage/Open

DTC B0418 01

Right Temperature Control Circuit Short to Battery

DTC B0418 06

Right Temperature Control Circuit Low Voltage/Open

Diagnostic Fault Information

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

Circuit/System Description

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

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

B023A 02

The stepper motors supply output is shorted to ground.

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

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

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

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

Action Taken When the DTC Sets

B023A

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

B0223, B022A, B0233, B0408 or B0418,

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

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

HVAC Schematics

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. 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 below- DTC B023A.

- If DTC B023A is not set

Refer to Circuit/System Testing below- DTC B0223, B022A, B0233, B0408 or B0418.

- **If the concern or DTC has been corrected**

3. All OK.

Circuit/System Testing

DTC B023A

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the components listed below. It may take up to 2 min for all vehicle systems to power down.
 - M37 Mode Door Actuator

- M46 Air Recirculation Door Actuator
 - M6L Air Temperature Door Actuator - Left
 - M6R Air Temperature Door Actuator - Right
2. Disconnect the X3 and X4 harness connectors at the K33 HVAC Control Module.
 3. Test for infinite resistance between the K33 HVAC Control Module 12 V reference circuit terminal 15 X3 and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
 4. Ignition ON.
 5. Test for less than 1 V between the K33 HVAC Control Module 12 V reference circuit terminal 15 X3 and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
 6. Connect the X3 and X4 harness connectors at the K33 HVAC Control Module, ignition ON.
 7. Clear all DTCs.
 8. Verify DTC B023A is not set.
 - **If the DTC is set.**

Replace the K33 HVAC Control Module.
 - **If the DTC is not set.**
 9. Verify DTC B023A does not set after connecting each of the components listed below one at a time and operating them through their full range.
 - M37 Mode Door Actuator
 - M46 Air Recirculation Door Actuator
 - M6L Air Temperature Door Actuator - Left
 - M6R Air Temperature Door Actuator - Right
 - **If the DTC sets**

Replace the component that was connected immediately before the DTC set.
 - **If the DTC does not set**
 10. All OK.

DTC B0223, B022A, B0233, B0408 or B0418

1. Ignition OFF, disconnect the harness connector at the appropriate door actuator, ignition ON.
2. Verify a test lamp flashes when connected between the 12 V reference circuit terminal 2 and ground.
 - **If the test lamp does not flash**
 1. Ignition OFF, remove the test lamp and disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for less than 2 ohms in the 12 V control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If the test lamp flashes**
3. Connect a test lamp between each control circuit listed below and B+.
 - Control Circuit - terminal 1
 - Control Circuit - terminal 3
 - Control Circuit - terminal 4
 - Control Circuit - terminal 6
4. Command the appropriate door actuator in both directions.
5. Verify the test lamp turns ON and then OFF during at least one of the directional commands.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp and disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module.
 - **If the test lamp is always OFF**
 1. Ignition OFF, remove the test lamp and disconnect the harness connector at the K33 HVAC Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF
 4. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If the test lamp turns ON and then OFF**
6. Replace the door actuator.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

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

DTC B269A, B269C, OR B269D

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 B269A

Heater Coolant Pump Control Circuit Open

DTC B269C

Heater Coolant Pump Control Circuit Low

DTC B269D

Heater Coolant Pump Control Circuit High

Diagnostic Fault Information

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

Circuit/System Description

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

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, disconnect the KR33 Auxiliary Heater Coolant Pump Relay, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.

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

Repair the short to voltage on the circuit.

- **If the test lamp does not illuminate**
- 7. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the G17 Heater Coolant Pump. It may take up to 2 min for all systems to power down.
- 8. Test for less than 10 ohms between the G17 Heater Coolant Pump ground circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
- 9. Connect the harness connector at the G17 Heater Coolant Pump.
- 10. Ignition ON, connect a 5 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.
- 11. Verify the G17 Heater Coolant Pump is activated.
 - **If the G17 Heater Coolant Pump does not activate**
 1. Ignition OFF, remove the jumper wire.
 2. Test for less than 2 ohms in the control circuit terminal 87 end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the G17 Heater Coolant Pump.
 - **If the G17 Heater Coolant Pump activates**
- 12. Test or replace the KR33 Auxiliary Heater Coolant Pump Relay.

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 B393B

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 04

Air Conditioning Compressor Valve Control Circuit Open

DTC B393B 0B

Air Conditioning Compressor Valve Control Circuit High Current

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B393B 0B	B393B 04	-	-
Control Circuit	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 HVAC control module provides both battery voltage and a pulse width modulated ground to the variable displacement solenoid valve. When the A/C switch is pressed, the HVAC control module grounds the variable displacement solenoid using a low side (PWM) signal in order to 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

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, disconnect the harness connector at the Q46 A/C Compressor Solenoid Valve, ignition ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp and disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for infinite resistance between the 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 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If the test lamp illuminates**
3. Ignition ON, connect a test lamp between the control circuit terminal 1 and the B+ circuit terminal 2.

4. Verify the test lamp turns ON and OFF when commanding the A/C Compressor Refrigerant Solenoid Valve 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 K33 HVAC Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF.
 4. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp and disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module.
 - **If the test lamp turns ON and OFF**
5. Test 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 ohms between B+ terminal 2 and control terminal 1.
 - **If less than 7 ohms or greater than 15 ohms**

Replace the G1 A/C Compressor.
 - **If between 7-15 ohms**
3. Test for infinite resistance between each terminal and the Q46 A/C Compressor Solenoid Valve housing/case.
 - **If less than infinite resistance**

Replace the G1 A/C Compressor.
 - **If infinite resistance**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

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

DTC P0532 OR P0533

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of 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 seconds.
- Battery voltage is between 11-18 V.

Conditions for Setting the DTC

P0532

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

P0533

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

Action Taken When the DTC Sets

- 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

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

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 below

- **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 ohms between the low reference circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 10 ohms**
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 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, 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 ECM 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 ECM A/C High Side Pressure Sensor parameter is greater than 4.8 V.
 - **If 4.8 V or less**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, 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

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.

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the KR29 A/C Compressor Clutch Relay, ignition ON.

2. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, 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 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, 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 ohms between the ground circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
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 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, 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 ohms between terminals 85 and 86.
 - **If not between 60-180 ohms**

Replace the KR29 A/C Compressor Clutch Relay.
 - **If between 60-180 ohms**

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 ohms between terminals 30 and 87.

- **If 2 ohms or greater**

Replace the KR29 A/C Compressor Clutch Relay.

- **If less than 2 ohms**

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.
- The following conditions may cause window fogging:
 - Wet carpet or mats
 - High humidity
 - Interior water leak
 - Blocked A/C evaporator drain tube
 - Maximum passenger capacity
 - Blocked body pressure relief valves
- Inspect the air distribution system for causes of reduced air flow:
 - Obstructed or dirty passenger compartment air filter, if equipped
 - Blocked or damaged air inlet or outlet vents

Intermittent

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

Symptom List

Refer to **HVAC System Malfunction** in order to diagnose the symptom.

HVAC SYSTEM MALFUNCTION

Diagnostic Instructions

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

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

Special Tools

J43600 ACR Air Conditioning Service Center

Circuit/System Verification

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

1. Ignition ON.
2. Verify the scan tool Blower Motor Switch parameter changes when rotating the blower switch through each speed position.
 - **If the parameter does not change for each speed position**
 Replace the A26 HVAC Controls.
 - **If the parameter changes for each speed position**
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 the scan tool parameters listed below change when pressing the appropriate switch.

- Driver Temp. Dr. Motor Command
- Psgr. Temp. Dr. Motor Command
- Recirculation Dr. Motor Command
- Mode Dr. Motor Command

○ **If any parameter does not change**

Replace the A26 HVAC Controls

○ **If all parameters change**

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

- Driver Temperature
- Passenger Temperature
- Mode
- Recirculation

○ **If any HVAC door does not move**

Refer to **DTC B0223, B022A, B0233, B023A, B0408, or B0418**.

○ **If all HVAC doors move**

6. Install the J43600 ACR Air Conditioning Service Center.

7. 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%**

8. 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)**

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

- Lower Left Duct Air Temperature Sensor
- Upper Left Duct Air Temperature Sensor
- Lower Right Duct Air Temperature Sensor
- Upper Right Duct Air Temperature Sensor

- A/C Evaporator Temperature Sensor
- **If not within 10% of ambient temperature**

Refer to **DTC B0173, B0178, B0509, B0514 or B3933.**

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

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

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

Refer to **DTC B018A, B048C, B048F, or B1395.**

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

11. Engine ON, A/C system ON

12. 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**

13. 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**

14. Engine OFF, ignition ON.

15. Verify the scan tool Sunload parameter changes while covering the B10B Ambient Light/Sunload Sensor with a shop towel or other suitable item.

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

Refer to **DTC B0183.**

- **If the Sunload parameter changes**

16. Verify the actual inside air temperature, using a thermometer, is less than 3°C (5°F) difference from the scan tool Inside Passenger Compartment Air Temp. Sensor parameter.

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

Refer to **DTC B0163**.

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

17. Verify the vehicle is equipped with RPO code HP6.

- **If the vehicle is not equipped with RPO code HP6.**

Refer to step 19.

- **If the vehicle is equipped with RPO code HP6.**

18. Verify the G17 Heater Coolant Pump turns On and Off when commanded with a scan tool.

- **If the G17 Heater Coolant Pump does not turn On and Off**

Refer to **DTC B269A, B269C, or B269D**.

- **If the G17 Heater Coolant Pump does turn On and Off**

19. 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

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 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).
- Blower motor is ON.

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

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

1. Ignition ON, press and release the A/C Switch.
2. Verify the HVAC control module scan tool A/C Switch parameter changes between Active and Inactive.
 - **If the parameter does not change**

Replace the 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**
9. 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

AFTERBLOW ENABLING

The afterblow mode can be enabled using the scan tool. The afterblow mode allows the blower motor to operate

after the engine has been turned off. This operation of the blower motor dries the evaporator core, which reduces the amount of microbial growth which can create undesirable odors.

Use the following procedure in order to enable the afterblow mode:

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 by the scan tool the blower motor will operate at 68% blower speed, following the sequence below 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.

The following conditions must be met for the HVAC module to operate the afterblow:

- The engine must be turned off for at least 30 min.
- The outside air temperature must be at least 21°C (70°F).
- The A/C compressor must have operated for more than 2 minutes before shut down during the latest key cycle.
- The system voltage must be at least 12 V.

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.

1. Ignition 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.
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 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

HEATER AND AIR CONDITIONING CONTROL REPLACEMENT

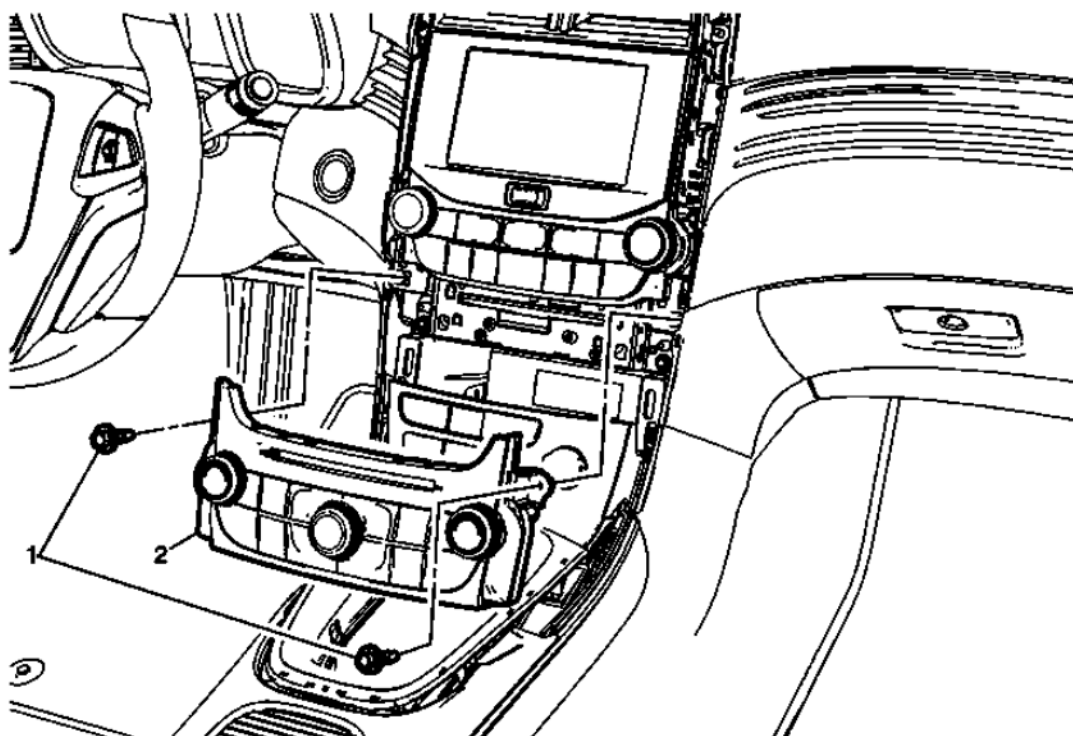


Fig. 5: Heater and Air Conditioning Control
 Courtesy of GENERAL MOTORS COMPANY

Heater and Air Conditioning Control Replacement

Callout	Component Name
Preliminary Procedure Remove the instrument panel accessory bezel. Refer to <u>Instrument Panel Accessory Bezel Replacement</u> .	
1	Heater and Air Conditioning Control Fasteners (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> .
2	Heater and Air Conditioning Control Procedure Disconnect the heater and air conditioning control connections.

HEATER AND AIR CONDITIONING REMOTE CONTROL REPLACEMENT

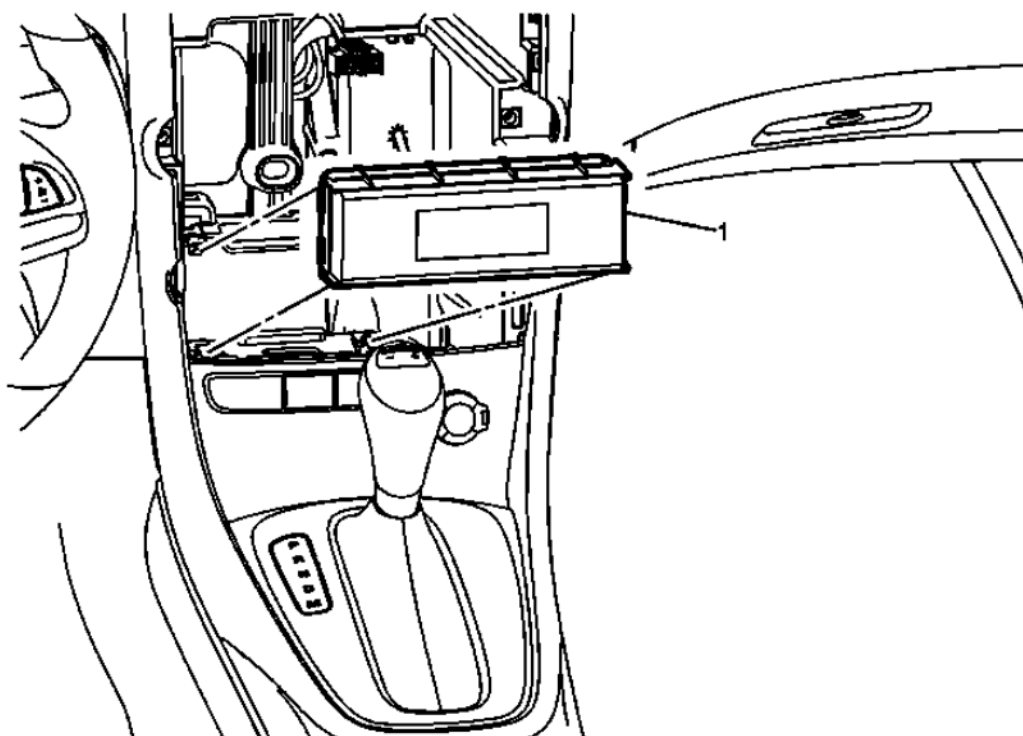


Fig. 6: Heater And Air Conditioning Remote Control
 Courtesy of GENERAL MOTORS COMPANY

Heater and Air Conditioning Remote Control Replacement

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the heater and air conditioning control. Refer to <u>Heater and Air Conditioning Control Replacement</u>. 3. Remove the instrument Panel trim plate. Refer to <u>Instrument Panel Trim Plate Replacement</u> .	
1	Heater and Air Conditioning Remote Control Procedure 1. Disconnect the heater and air conditioning remote control connector. 2. For programming and set up information, refer to <u>Control Module References</u> .

HEATER AND BLOWER AND AIR CONDITIONING CONTROL MODULE REPLACEMENT

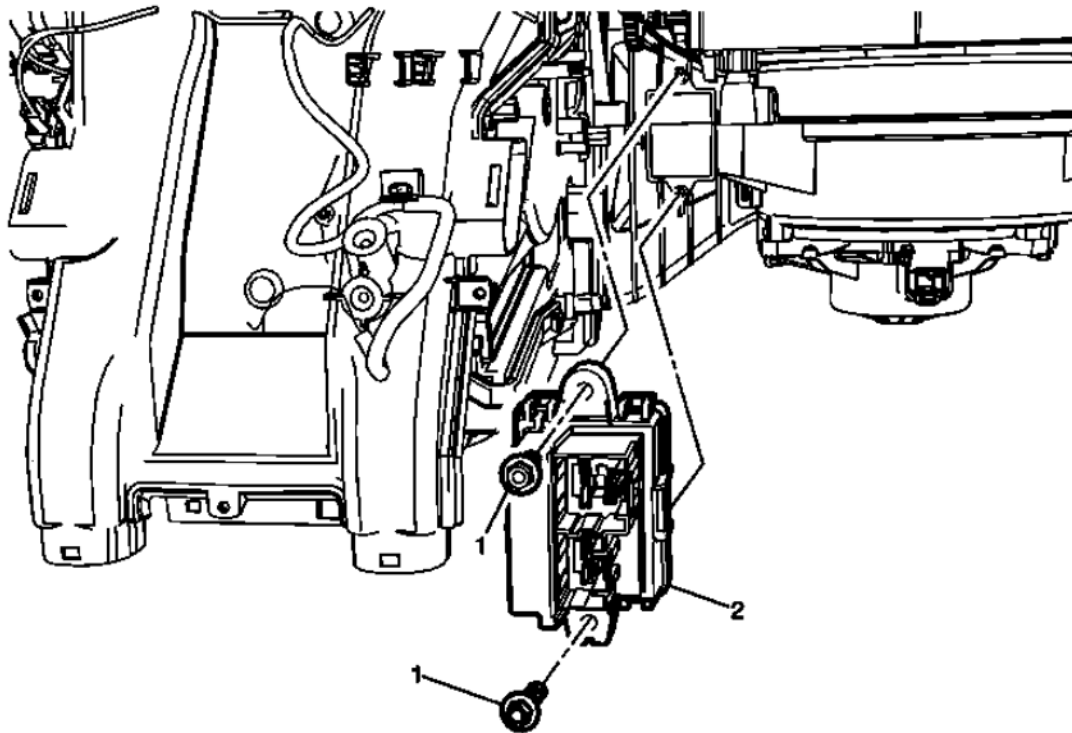


Fig. 7: Heater and Blower and Air Conditioning Control Module
 Courtesy of GENERAL MOTORS COMPANY

Heater and Blower and Air Conditioning Control Module Replacement

Callout	Component Name
Preliminary Procedure	
1. Remove the floor air outlet duct. Refer to Floor Air Outlet Duct Replacement - Right Side .	
2. Disconnect the heater and blower and air conditioning control module electrical connectors.	
1	Heater and Blower and Air Conditioning Control Module Fastener (Qty: 2)
2	Heater and Blower and Air Conditioning Control Module

MODE VALVE LEVER REPLACEMENT

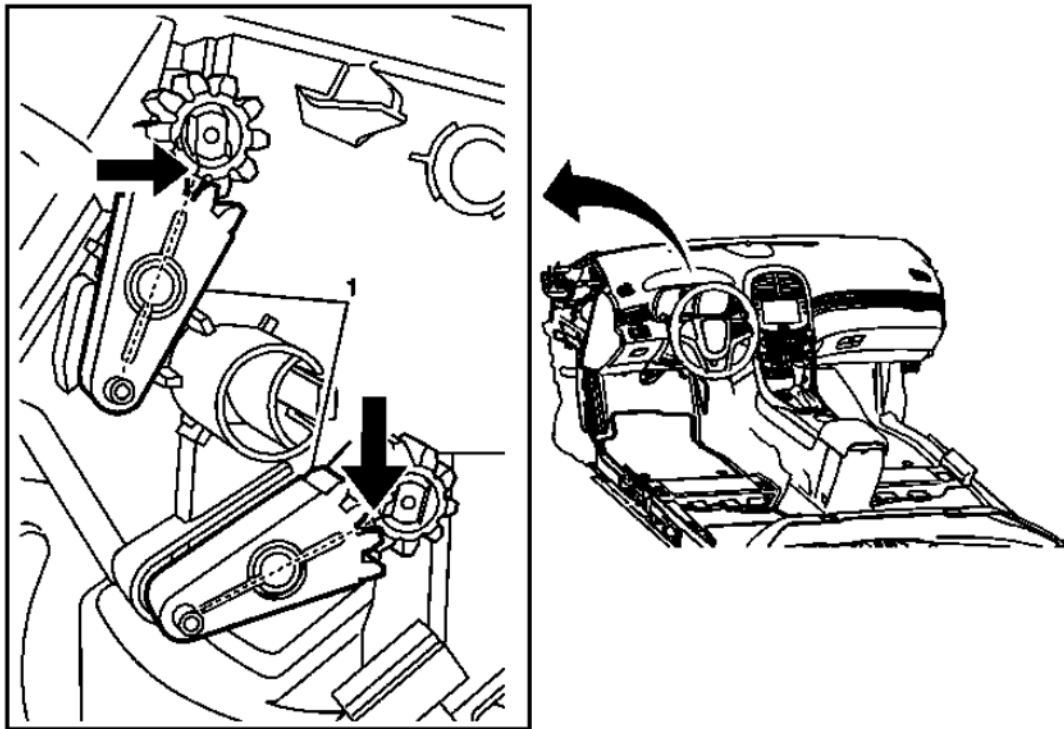


Fig. 8: Mode Valve Lever

Courtesy of GENERAL MOTORS COMPANY

Mode Valve Lever Replacement

Callout	Component Name
Preliminary Procedure Remove the mode control cam. Refer to Mode Control Cam Replacement .	
1	Mode Valve Lever Procedure 1. Move the valve to the middle position and mark the position of the mode valve lever notch to the mode valve gear. 2. Remove the mode valve lever. TIP: Use the indentation for the correct positioning of the lever arms.

VENT VALVE LEVER REPLACEMENT

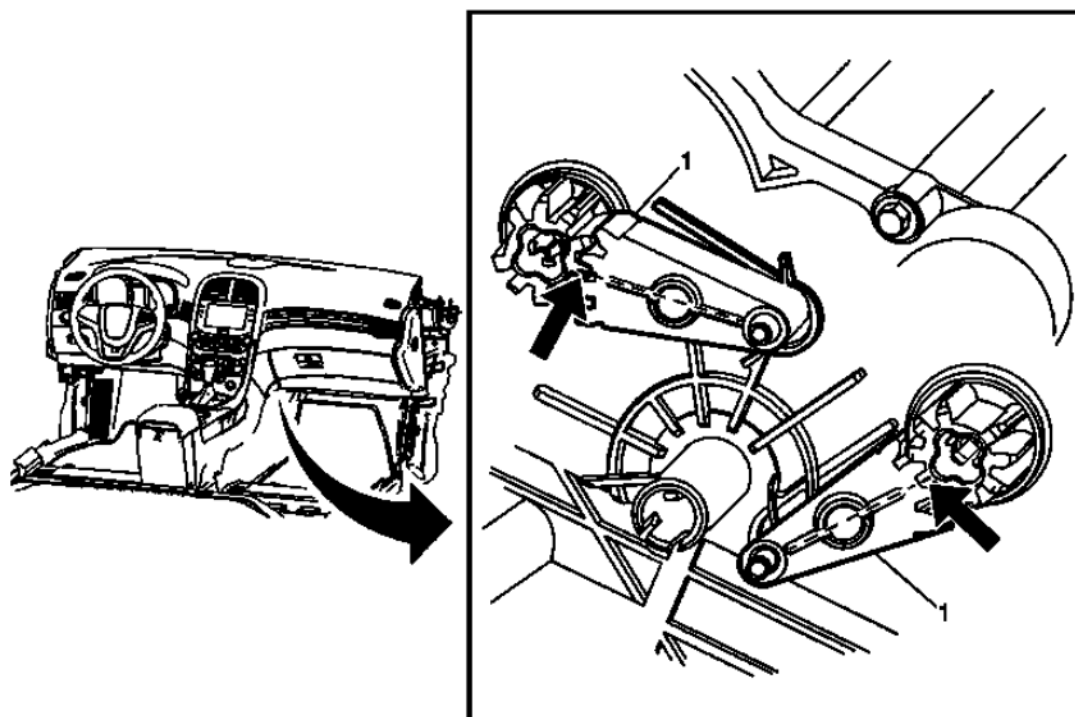


Fig. 9: Vent Valve Lever

Courtesy of GENERAL MOTORS COMPANY

Vent Valve Lever Replacement

Callout	Component Name
Preliminary Procedure Remove the air inlet valve and inside air valve control cam. Refer to <u>Air Inlet Valve and Inside Air Valve Control Cam Replacement</u> .	
1	Vent Valve Lever Procedure 1. Move the valve to the middle position and mark the position of the vent valve lever notch to the vent valve gear. 2. Remove the vent valve lever. TIP: Use the indentation for the correct positioning of the lever arms.

AIR INLET VALVE ACTUATOR REPLACEMENT

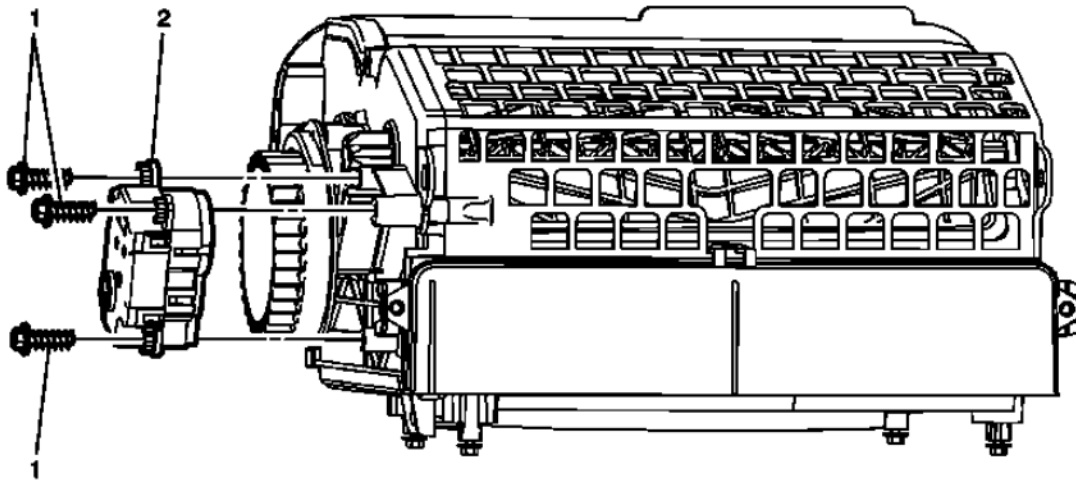


Fig. 10: Air Inlet Valve Actuator
 Courtesy of GENERAL MOTORS COMPANY

Air Inlet Valve Actuator Replacement

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the air inlet assembly. Refer to <u>Air Inlet Assembly Replacement</u> . 3. Remove the air inlet valve actuator gear. Refer to <u>Air Inlet Valve Actuator Gear Replacement</u>.	
1	Air Inlet Valve Actuator Screw (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> .
2	Air Inlet Valve Actuator Procedure Disconnect the air inlet valve actuator electrical connector. TIP: Actuator is self-calibrating when connecting the battery.

MODE VALVE ACTUATOR GEAR REPLACEMENT

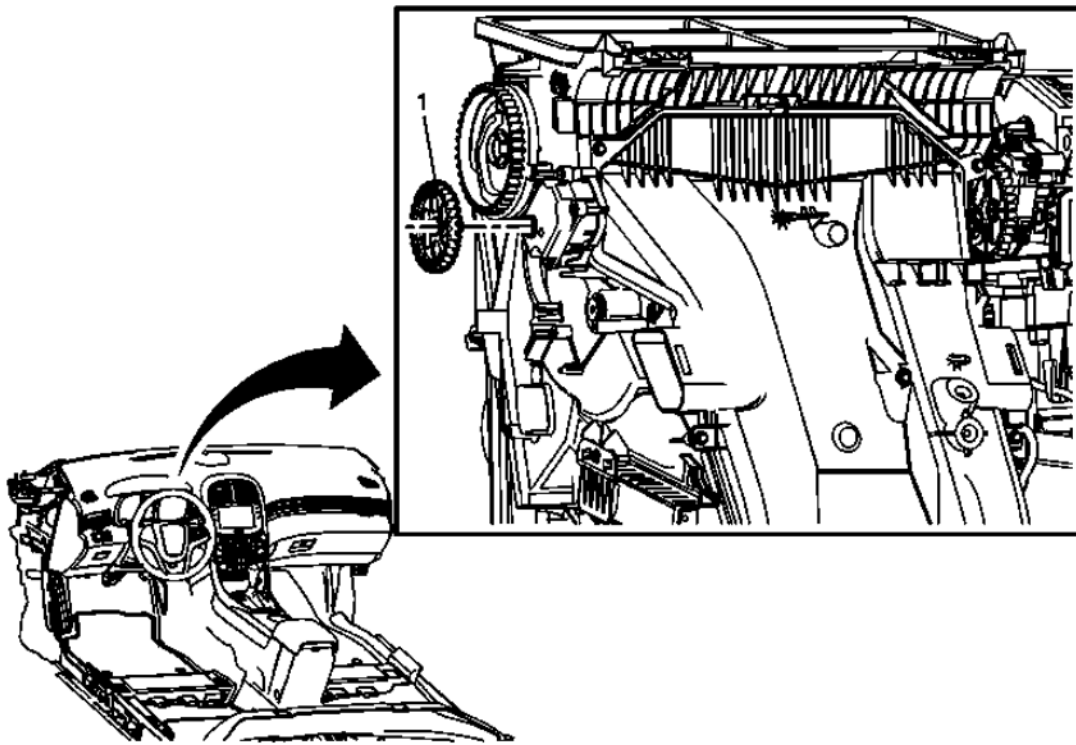


Fig. 11: Mode Valve Actuator Gear
 Courtesy of GENERAL MOTORS COMPANY

Mode Valve Actuator Gear Replacement

Callout	Component Name
Preliminary Procedure Remove the floor air outlet duct. Refer to Floor Air Outlet Duct Replacement - Left Side .	
1	Mode Valve Actuator Gear Procedure Pull off the actuator gear.

MODE VALVE GEAR REPLACEMENT

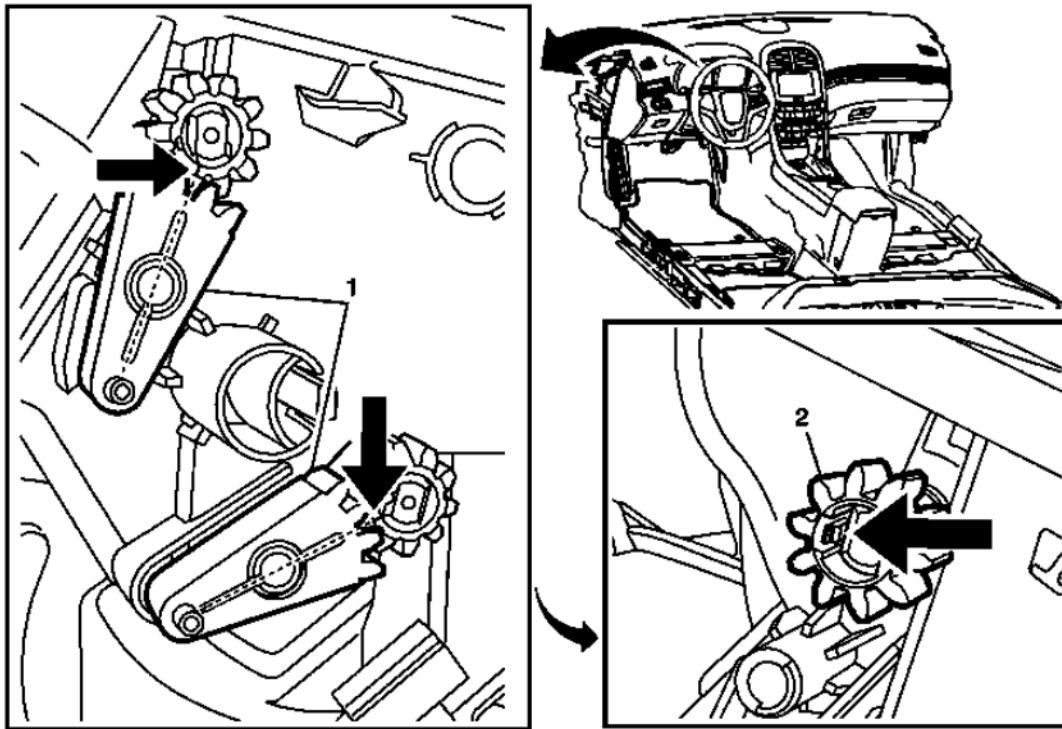


Fig. 12: Mode Valve Gear
Courtesy of GENERAL MOTORS COMPANY

Mode Valve Gear Replacement

Callout	Component Name
Preliminary Procedure Remove the mode control cam Refer to Mode Control Cam Replacement .	
1	Mode Valve Lever Procedure 1. Move the valve to the middle position and mark the position of the mode valve lever notch to the mode valve gear. 2. Remove the mode valve lever.
2	Mode Valve Gear Procedure Release and remove the mode valve gear. 1. When replacing the valve gear, transfer the mark to the new part. 2. The mode valve gear can only be fitted in one position. 3. Use the indentation for the correct positioning of the lever arms.

AIR INLET VALVE ACTUATOR GEAR REPLACEMENT

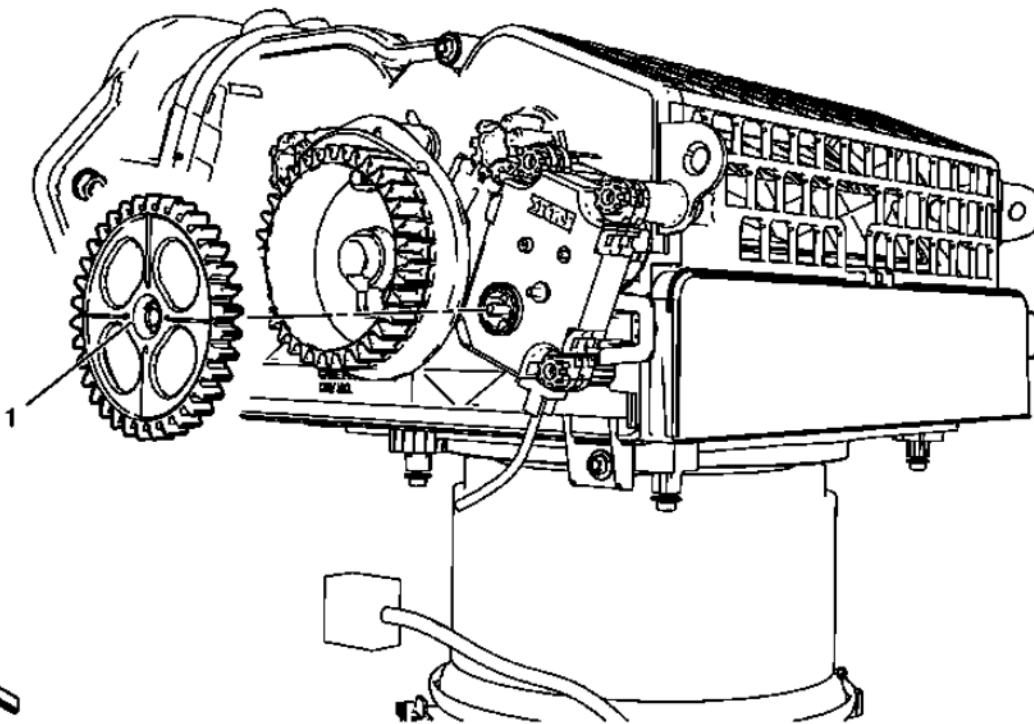


Fig. 13: Air Inlet Valve Actuator Gear (Left Hand Drive)
 Courtesy of GENERAL MOTORS COMPANY

Air Inlet Valve Actuator Gear Replacement

Callout	Component Name
Preliminary Procedure Remove Air Inlet Assembly. Refer to Air Inlet Assembly Replacement .	
1	Air Inlet Valve Actuator Gear Procedure Pull off the actuator gear.

AIR INLET VALVE AND INSIDE AIR VALVE CONTROL CAM REPLACEMENT

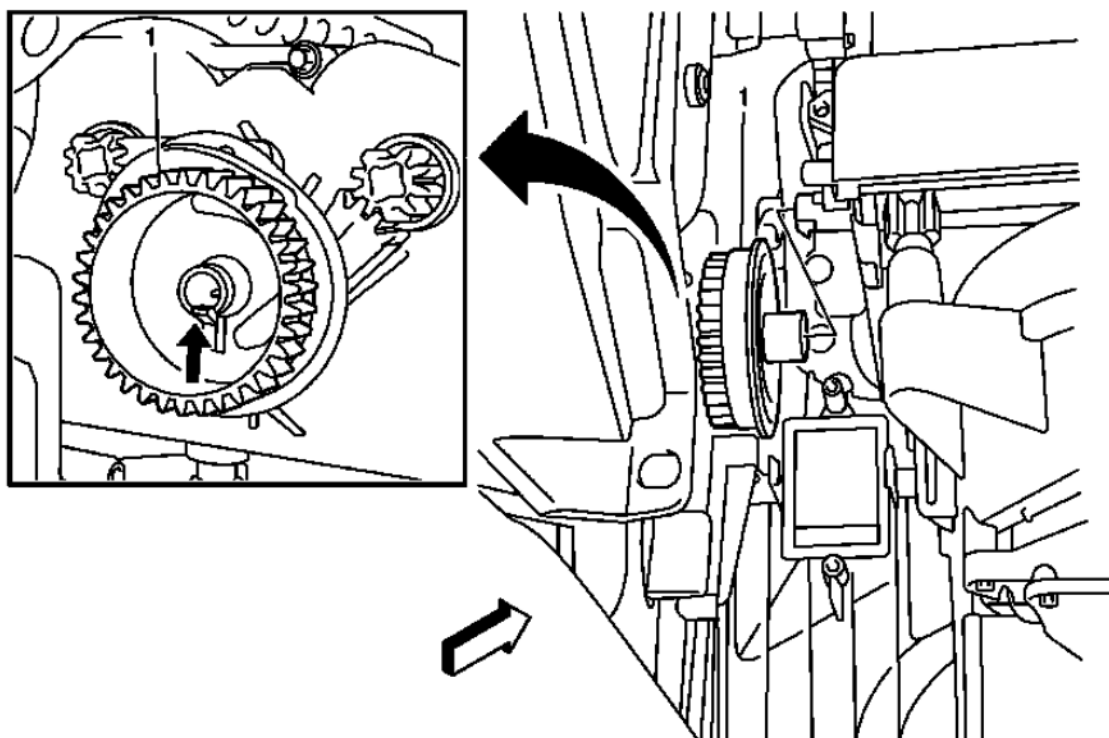


Fig. 14: Air Inlet Valve And Inside Air Valve Control Cam
 Courtesy of GENERAL MOTORS COMPANY

Air Inlet Valve and Inside Air Valve Control Cam Replacement

Callout	Component Name
Preliminary Procedure Remove the air inlet valve actuator. Refer to Air Inlet Valve Actuator Replacement .	
1	Air Inlet Valve and Inside Air Valve Control Cam Procedure Release the center tab and pull off the control cam. NOTE: The air inlet valve and inside air valve control cam can only be fitted in one position.

MODE CONTROL CAM ACTUATOR REPLACEMENT

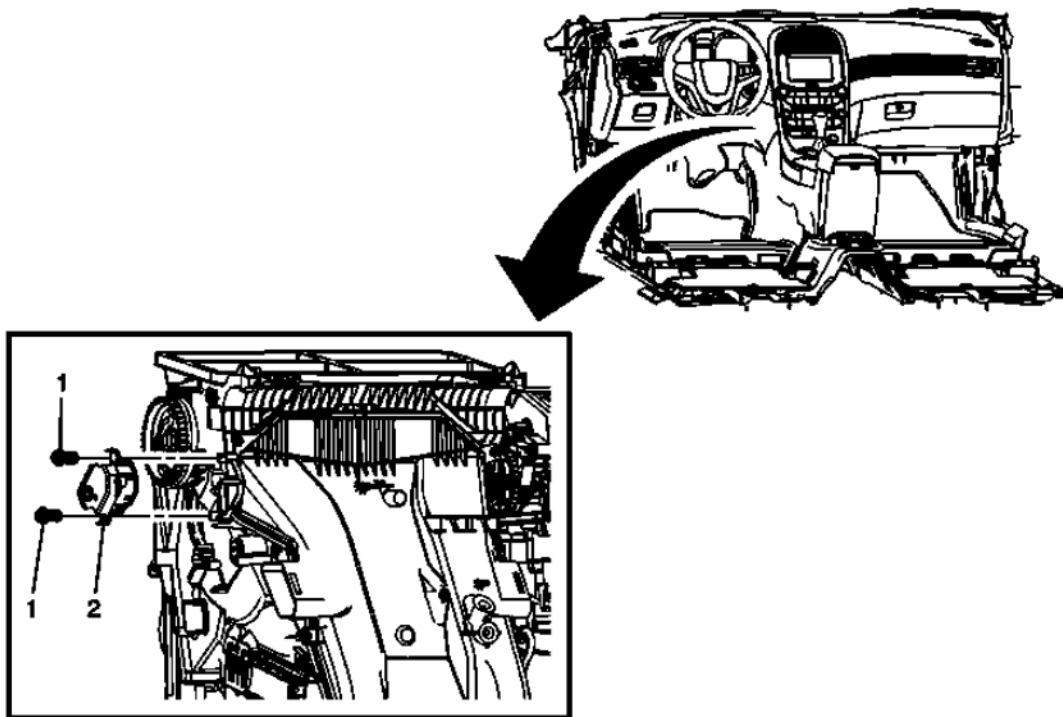


Fig. 15: Mode Control Cam Actuator
 Courtesy of GENERAL MOTORS COMPANY

Mode Control Cam Actuator Replacement

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the floor air outlet duct - left side. Refer to <u>Floor Air Outlet Duct Replacement - Left Side</u> .	
1	Mode Actuator Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> .
2	Mode Actuator Procedure Disconnect the mode actuator electrical connector. NOTE: Actuator is self-calibrating when connecting the battery.

MODE CONTROL CAM REPLACEMENT

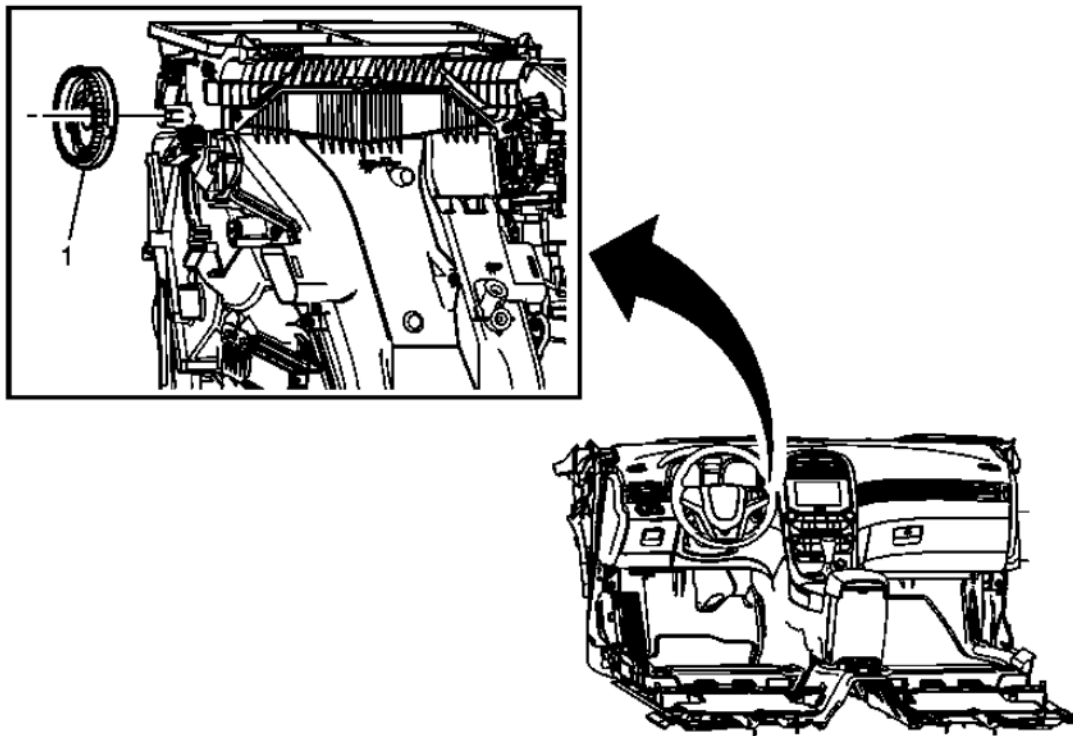


Fig. 16: Mode Control Cam
Courtesy of GENERAL MOTORS COMPANY

Mode Control Cam Replacement

Callout	Component Name
Preliminary Procedures	
1. Remove the instrument panel tie bar assembly. Refer to <u>Instrument Panel Tie Bar Replacement</u> . 2. Remove the mode valve actuator gear. Refer to <u>Mode Valve Actuator Gear Replacement</u> .	
1	Mode Control Cam Procedure Release the tab in the center and pull off the control cam. NOTE: The mode control cam can only be fitted in one position.

MODE CONTROL CAM ALIGNMENT

Removal Procedure

NOTE: The HVAC module must be removed to accurately set the cam gear timing. Failure to do so may result in poor HVAC performance and/or damage to the HVAC module.

1. Remove the HVAC module from the vehicle. Refer to Heater and Air Conditioning Evaporator and

Blower Module Removal and Installation

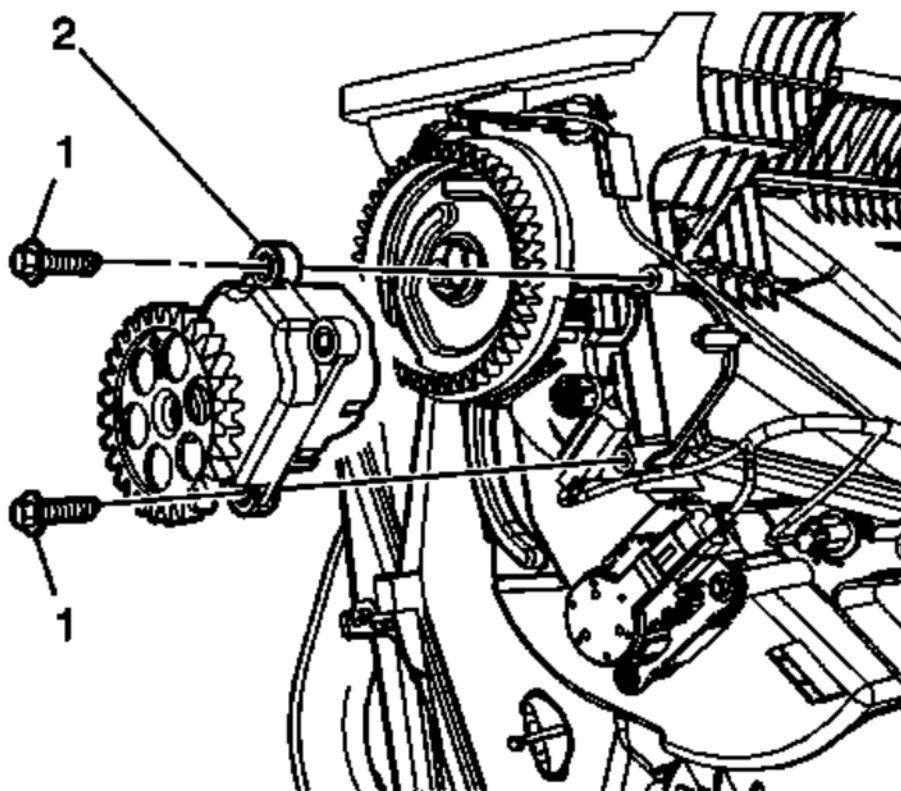


Fig. 17: View Of Mode Cam Gear Actuator, Screws & HVAC Module
Courtesy of GENERAL MOTORS COMPANY

2. Remove the mode cam gear actuator screws (1) and separate the actuator (2) from the HVAC module.
3. Disconnect the mode cam gear actuator electrical connector.

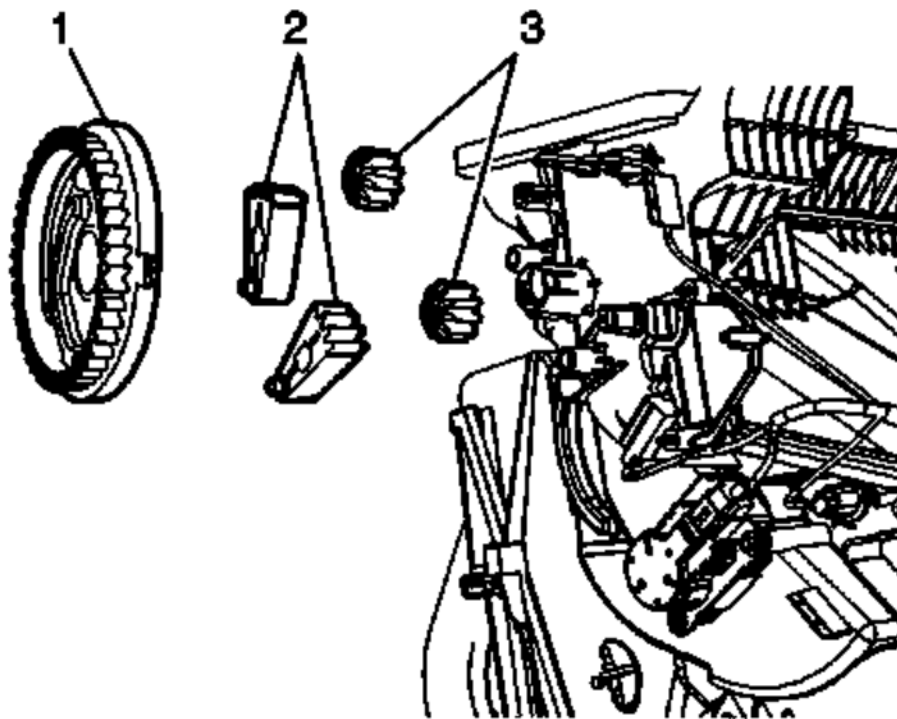


Fig. 18: View Of Mode Cam Gear
Courtesy of GENERAL MOTORS COMPANY

4. Remove the mode cam gear (1) from the HVAC module.
5. For alignment purposes, remove both cam gear levers (2).
6. If the valve gears (3) are damaged, remove them from the HVAC module and discard.

Installation Procedure

NOTE: Do not use casting marks behind the cam gear levers for aligning the cam levers to the cam gear. Doing so may result in poor HVAC performance and/or damage to the HVAC module.

1. If the valve gears were removed or replaced, install them onto the HVAC module.

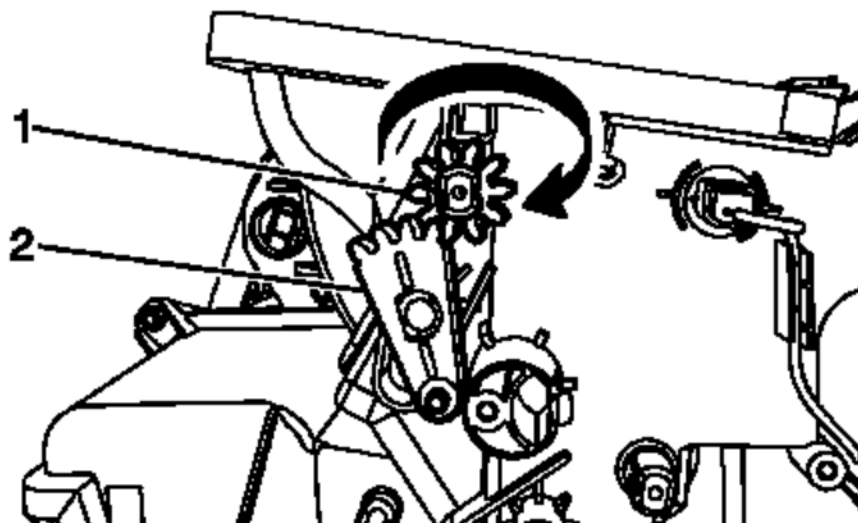


Fig. 19: Rotating defroster gear clockwise
Courtesy of GENERAL MOTORS COMPANY

2. Rotate the defroster gear clockwise (1) as far as it will go, and install the lever by engaging a gear tooth into the right most lever gap (2).

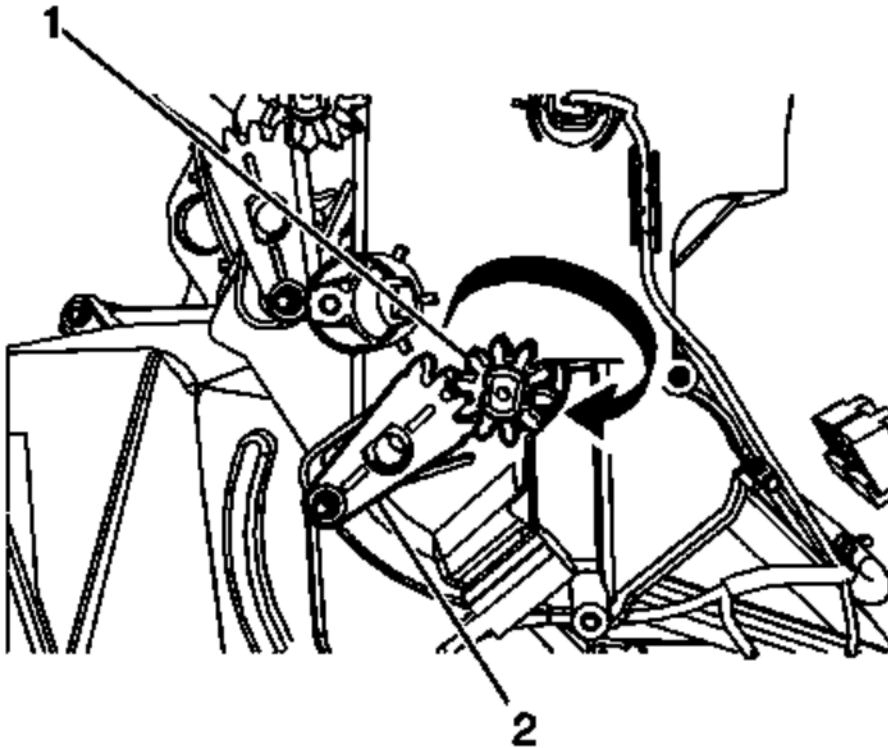


Fig. 20: Rotating Heater Door Gear
Courtesy of GENERAL MOTORS COMPANY

3. Rotate the heater door gear clockwise (1) as far as it will go, and install the lever by engaging a gear tooth into the right most lever gap (2).

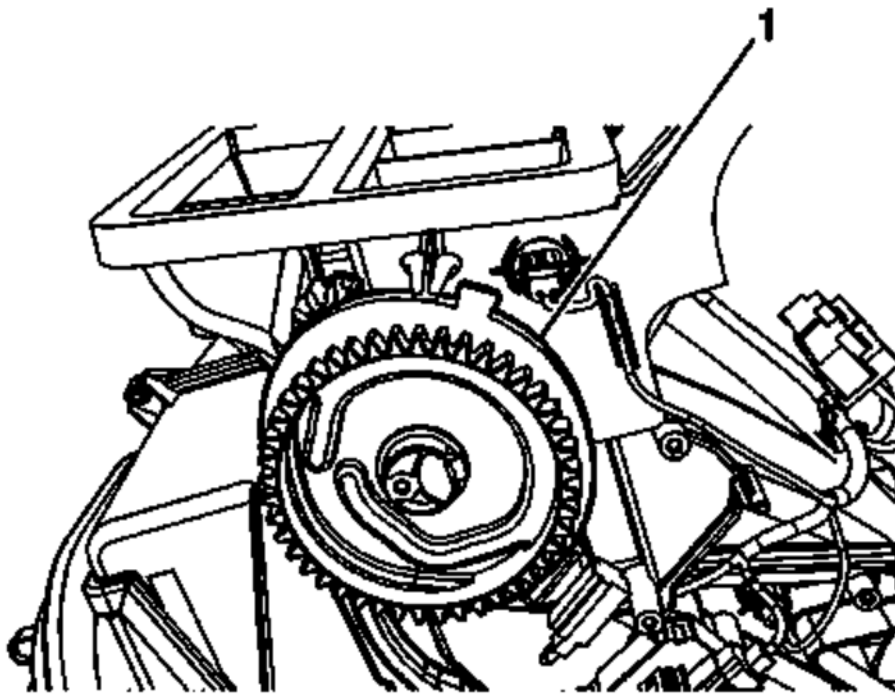


Fig. 21: View Of Mode Cam

Courtesy of GENERAL MOTORS COMPANY

4. Install the mode cam into position on the levers.
5. Continue to push the mode cam onto the case and rotate left and/or right until an audible click is heard locking the mode cam in place.
6. Rotate the mode cam (1) from stop to stop. It should rotate completely without binding. If the mode cam does not rotate from stop to stop, then remove the mode cam and levers and repeat steps 2-6.

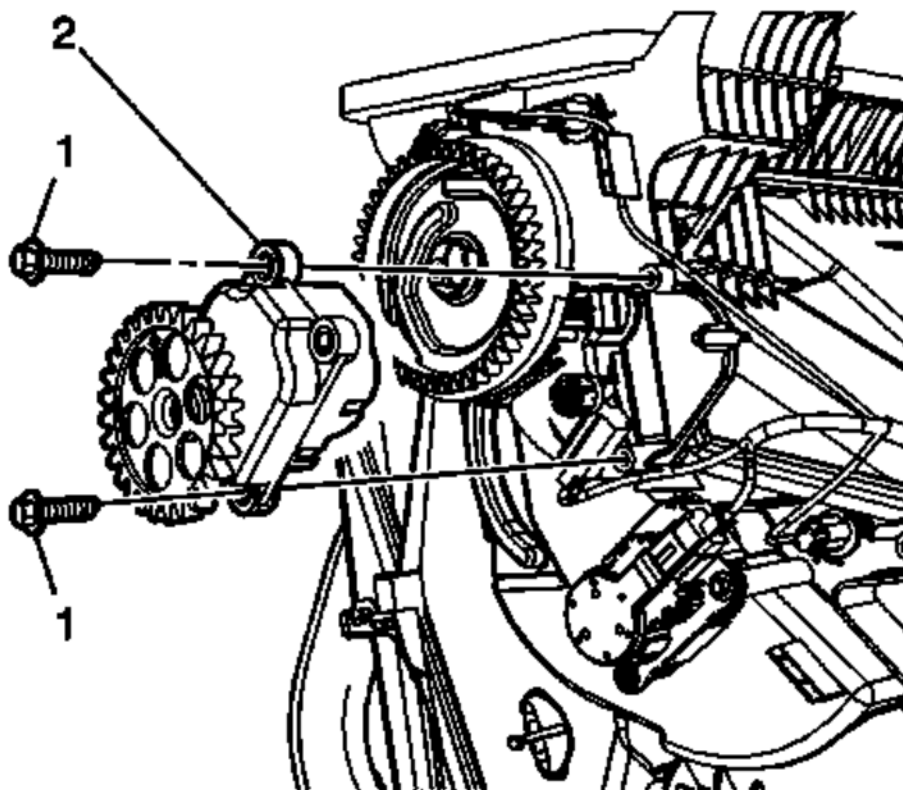


Fig. 22: View Of Mode Cam Gear Actuator, Screws & HVAC Module
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

7. Place the mode cam actuator and gear assembly (2) on the HVAC module and install the screws (1).
8. Connect the mode cam actuator electrical connector.
9. Install the HVAC module. Refer to Heater and Air Conditioning Evaporator and Blower Module Removal and Installation .

TEMPERATURE VALVE ACTUATOR REPLACEMENT - RIGHT SIDE

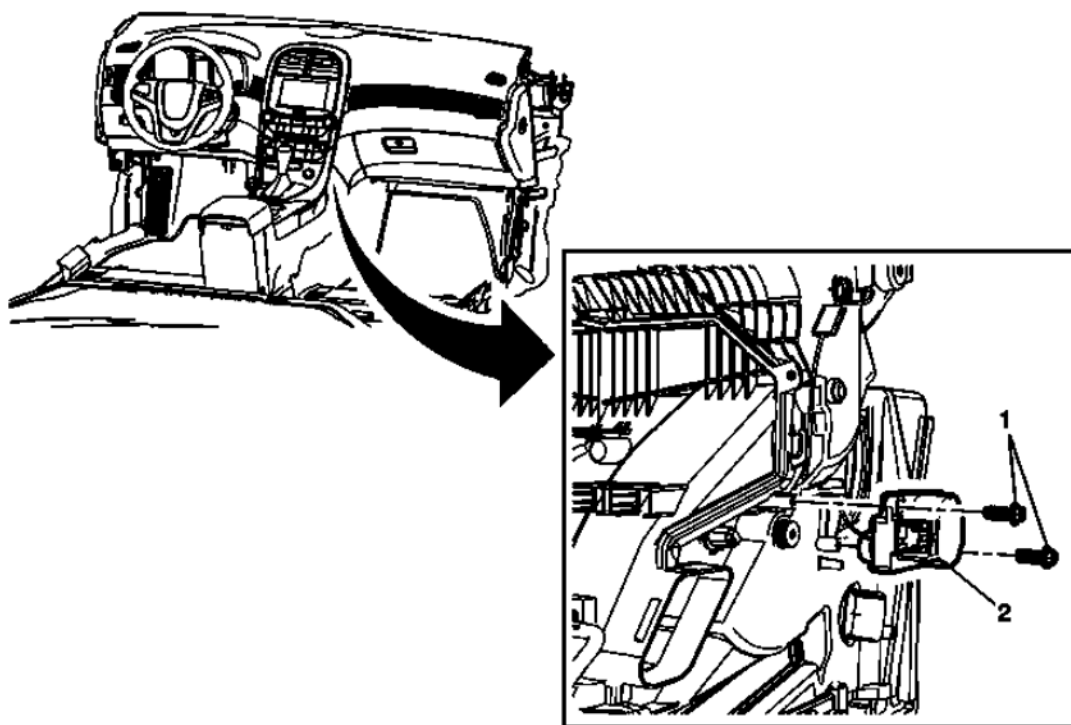


Fig. 23: Temperature Valve Actuator - Right Side
 Courtesy of GENERAL MOTORS COMPANY

Temperature Valve Actuator Replacement - Right Side

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the floor air outlet duct - right side. Refer to <u>Floor Air Outlet Duct Replacement - Right Side</u> .	
1	Temperature Valve Actuator Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> .
2	Temperature Valve Actuator Procedure Disconnect the temperature actuator electrical connector. NOTE: Actuator is self-calibrating when connecting the battery.

TEMPERATURE VALVE ACTUATOR REPLACEMENT - LEFT SIDE

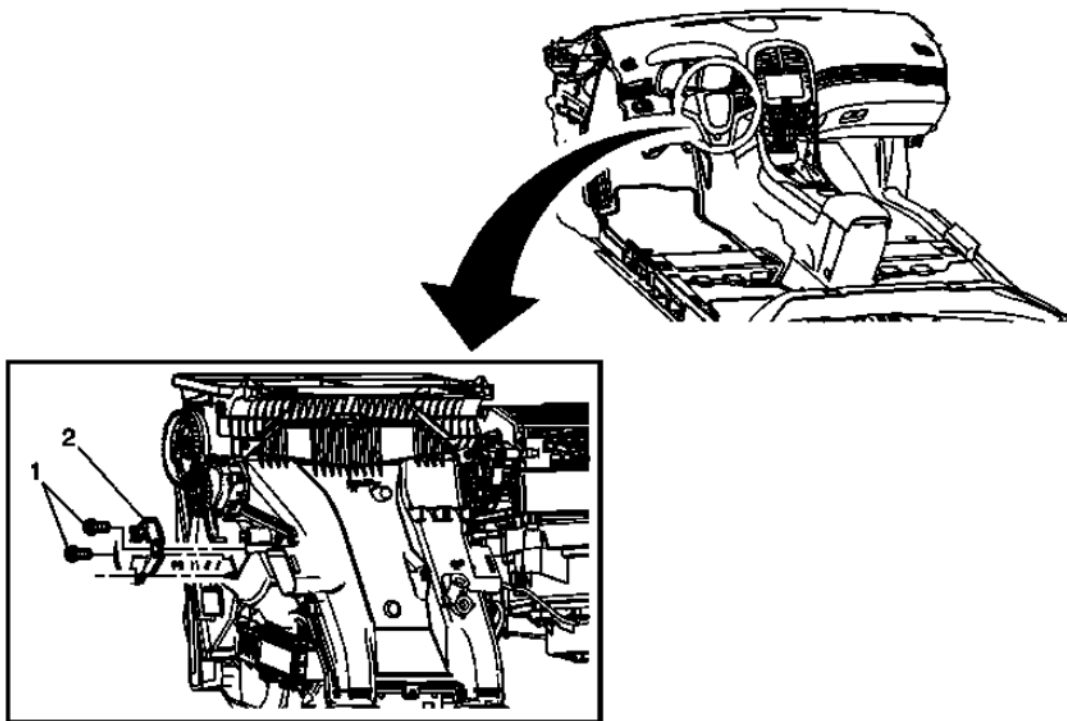


Fig. 24: Temperature Valve Actuator - Left Side
 Courtesy of GENERAL MOTORS COMPANY

Temperature Valve Actuator Replacement - Left Side

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the floor air outlet duct - left side. Refer to <u>Floor Air Outlet Duct Replacement - Left Side</u> .	
1	Temperature Valve Actuator Screw (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> .
2	Temperature Valve Actuator Procedure Disconnect the temperature actuator electrical connector. NOTE: Actuator is self-calibrating when connecting the battery.

AIR CONDITIONING REFRIGERANT TEMPERATURE SENSOR REPLACEMENT

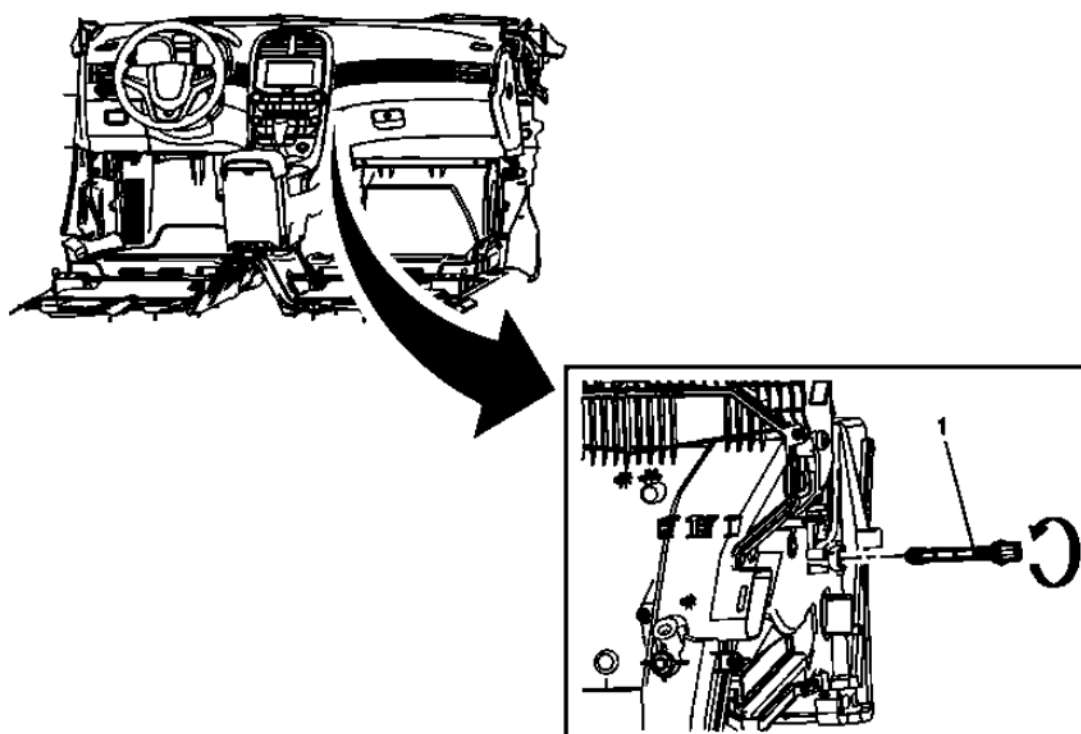


Fig. 25: Air Conditioning Refrigerant Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

Air Conditioning Refrigerant Temperature Sensor Replacement

Callout	Component Name
Preliminary Procedure Remove the heater and blower and air conditioning control module. Refer to <u>Heater and Blower and Air Conditioning Control Module Replacement</u> .	
1	Air Conditioning Refrigerant Temperature Sensor Procedure 1. Disconnect the refrigerant temperature sensor electrical connector. 2. Twist and pull the refrigerant temperature sensor from the HVAC module assembly.

DUCT AIR TEMPERATURE SENSOR REPLACEMENT - UPPER RIGHT SIDE

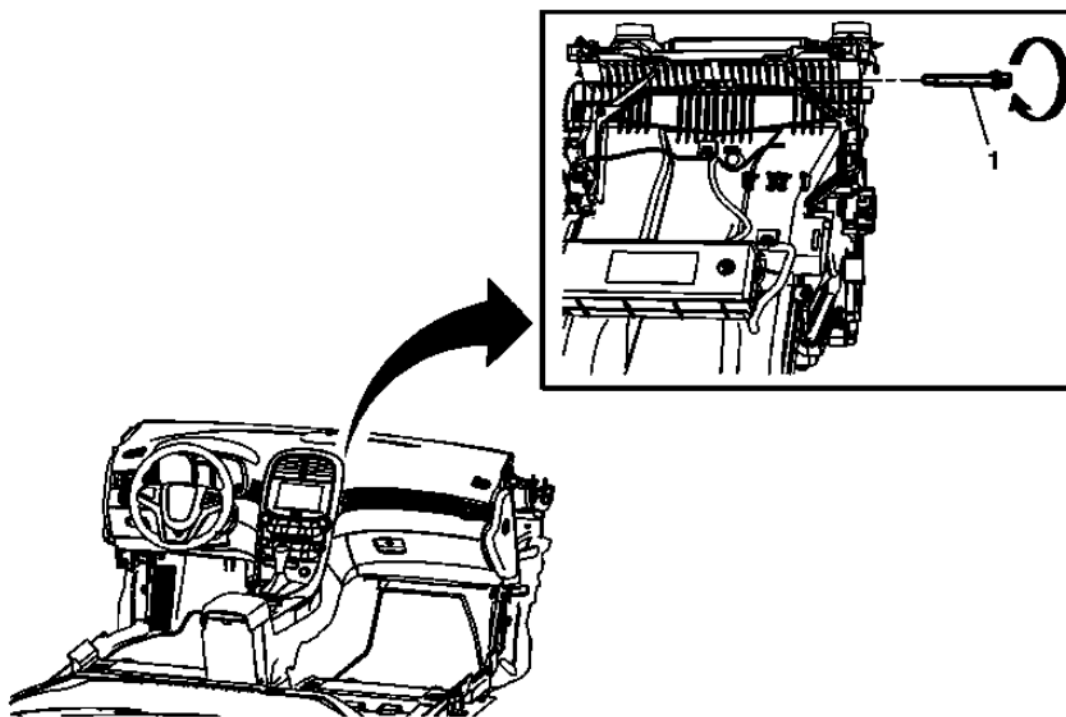


Fig. 26: Duct Air Temperature Sensor - Upper Right Side
 Courtesy of GENERAL MOTORS COMPANY

Duct Air Temperature Sensor Replacement - Upper Right Side

Callout	Component Name
Preliminary Procedures	
1. Disconnect the negative battery cable. Refer to <u>Battery Negative Cable Disconnection and Connection</u> . 2. Remove the instrument panel assembly. Refer to <u>Instrument Panel Assembly Replacement</u> .	
1	Duct Air Temperature Sensor- Upper Right Side Procedure 1. Disconnect the air temperature sensor electrical connector. 2. Twist and pull the upper air temperature sensor from the HVAC module assembly.

DUCT AIR TEMPERATURE SENSOR REPLACEMENT - UPPER LEFT SIDE

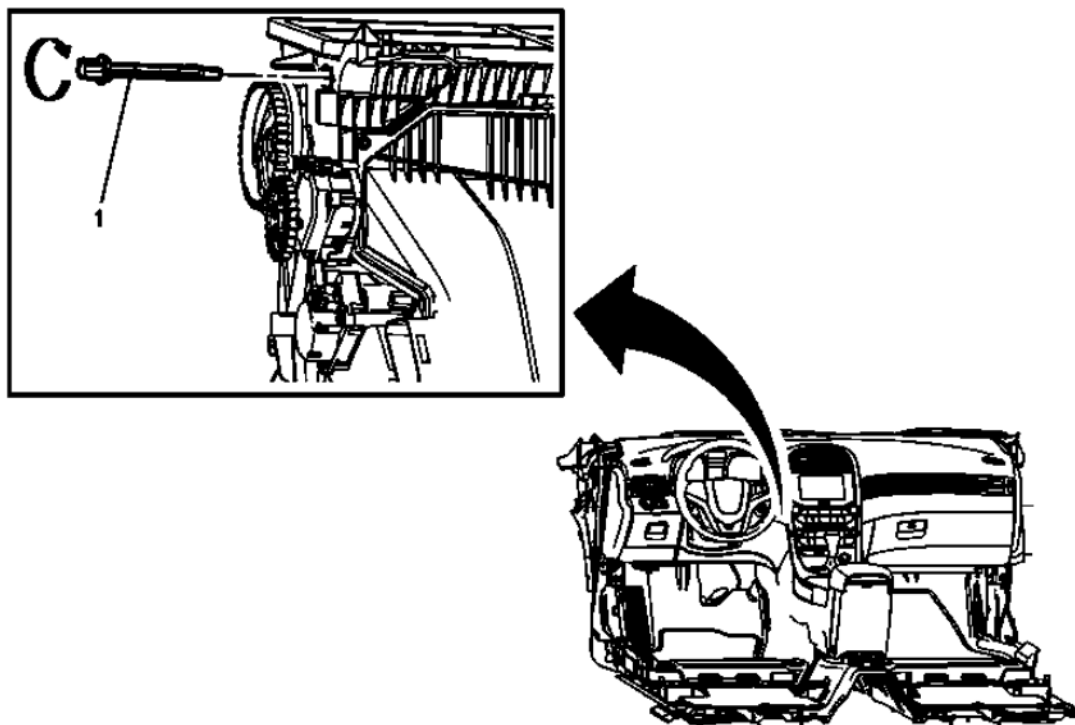


Fig. 27: Duct Air Temperature Sensor - Upper Left Side
 Courtesy of GENERAL MOTORS COMPANY

Duct Air Temperature Sensor Replacement - Upper Left Side

Callout	Component Name
Preliminary Procedure Remove the instrument panel assembly. Refer to <u>Instrument Panel Assembly Replacement</u> .	
1	Duct Air Temperature Sensor Replacement- Upper Left Side Procedure 1. Disconnect the air temperature sensor electrical connector. 2. Twist and pull the lower air temperature sensor from the HVAC module assembly.

DUCT AIR TEMPERATURE SENSOR REPLACEMENT - LOWER LEFT SIDE

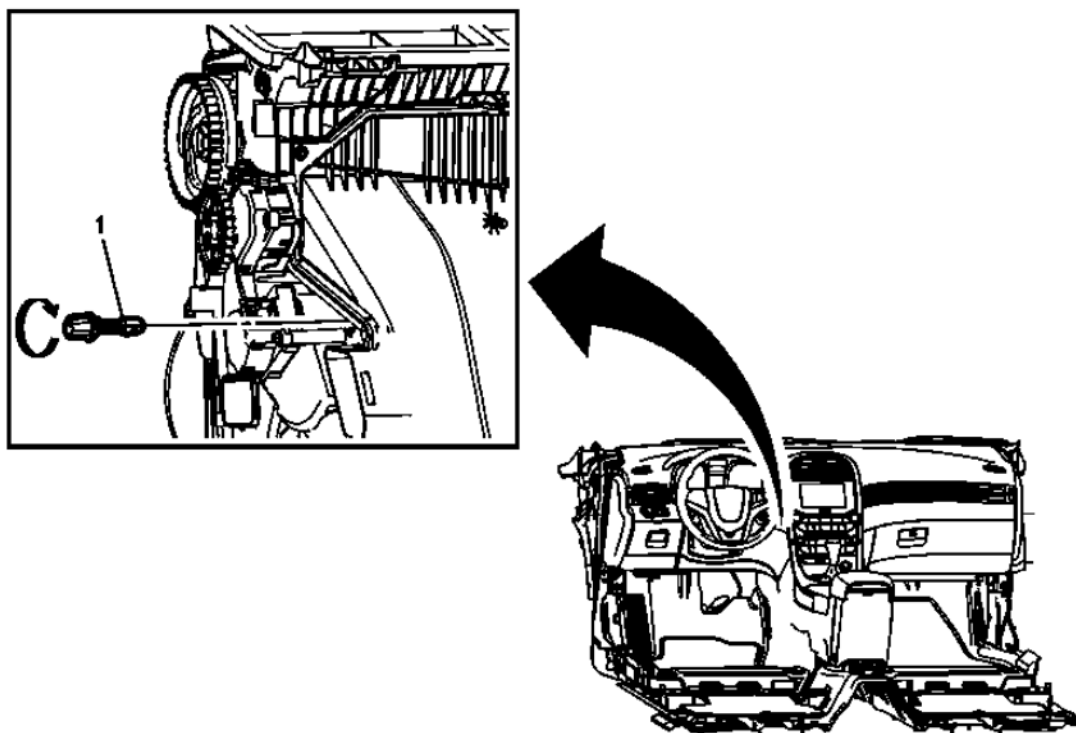


Fig. 28: Duct Air Temperature Sensor - Lower Left Side
 Courtesy of GENERAL MOTORS COMPANY

Duct Air Temperature Sensor Replacement - Lower Left Side

Callout	Component Name
Preliminary Procedure Remove the floor air outlet duct- left side. Refer to Floor Air Outlet Duct Replacement - Left Side .	
1	Duct Air Temperature Sensor- Lower Left Side Procedure 1. Disconnect the air temperature sensor electrical connector. 2. Twist and pull the lower duct air temperature sensor from the HVAC module assembly.

DUCT AIR TEMPERATURE SENSOR REPLACEMENT - LOWER RIGHT SIDE

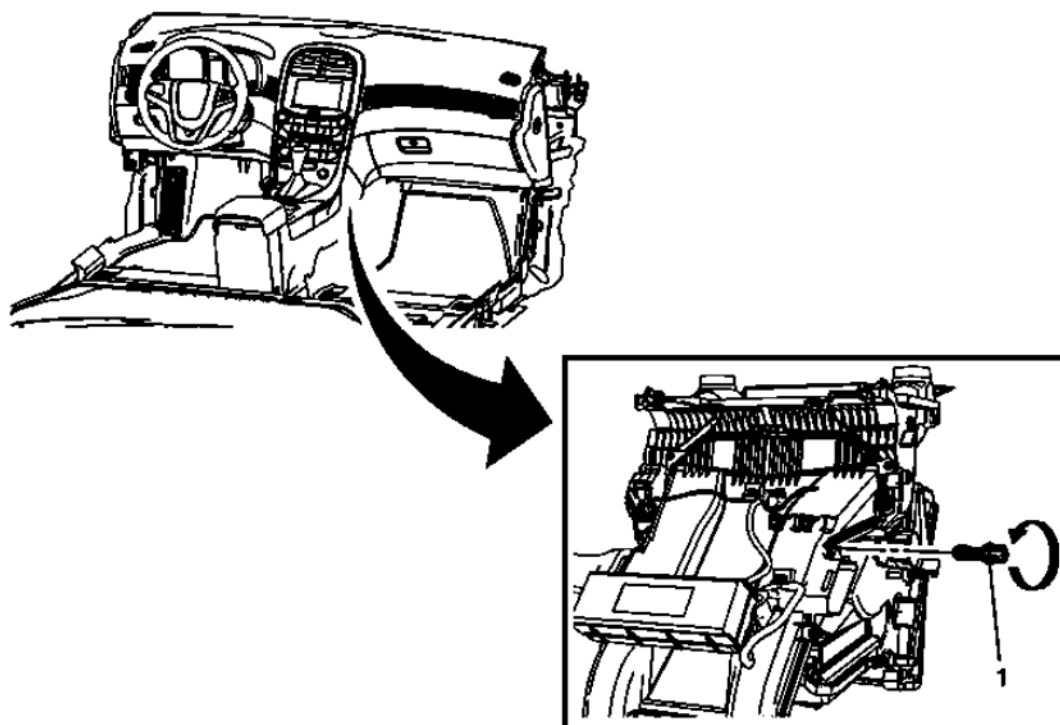


Fig. 29: Duct Air Temperature Sensor - Lower Right Side
 Courtesy of GENERAL MOTORS COMPANY

Duct Air Temperature Sensor Replacement - Lower Right Side

Callout	Component Name
Preliminary Procedure Remove the right floor air outlet duct. Refer to Floor Air Outlet Duct Replacement - Right Side .	
1	Duct Air Temperature Sensor- Lower Right Side Procedure 1. Disconnect the air temperature sensor electrical connector. 2. Twist and pull the lower duct air temperature sensor from the HVAC module assembly.

AMBIENT AIR QUALITY SENSOR REPLACEMENT

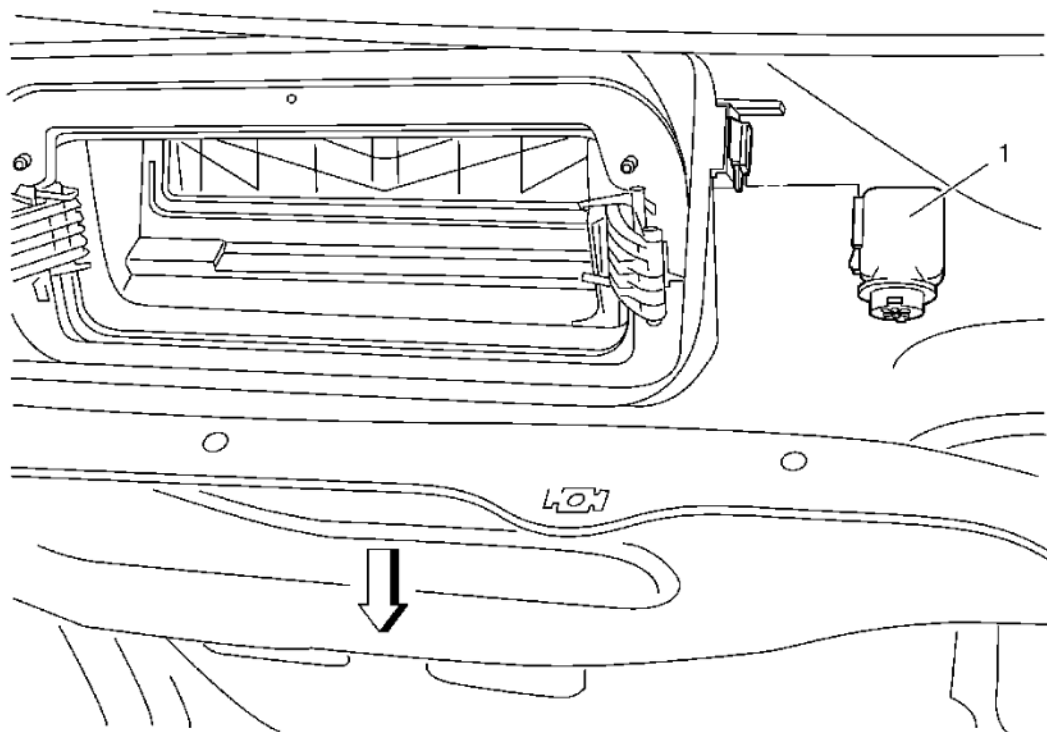


Fig. 30: Ambient Air Quality Sensor
 Courtesy of GENERAL MOTORS COMPANY

Ambient Air Quality Sensor Replacement

Callout	Component Name
Preliminary Procedure Remove the air inlet grille panel water deflector. Refer to <u>Air Inlet Grille Panel Water Deflector Replacement</u> .	
1	Ambient Air Quality Sensor Procedures 1. Unsnap the ambient air quality sensor and move it forward. 2. Disconnect the electrical connector.

AMBIENT AIR TEMPERATURE GAUGE SENSOR REPLACEMENT

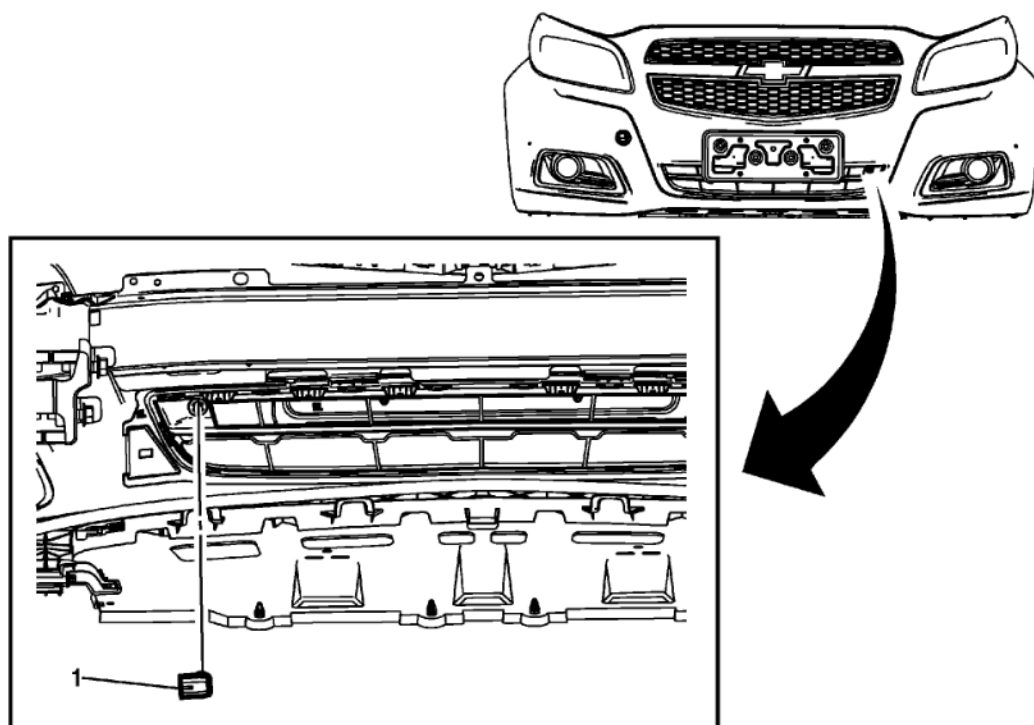


Fig. 31: Ambient Air Temperature Gauge Sensor
 Courtesy of GENERAL MOTORS COMPANY

Ambient Air Temperature Gauge Sensor Replacement

Callout	Component Name
Preliminary Procedure Remove the radiator lower grille assembly. Refer to Front Lower Grille Replacement .	
1	Ambient Air Temperature Sensor Procedure 1. Disconnect the ambient air temperature sensor connector. 2. Unsnap the temperature sensor.

INSIDE AIR MOISTURE AND WINDSHIELD TEMPERATURE SENSOR REPLACEMENT

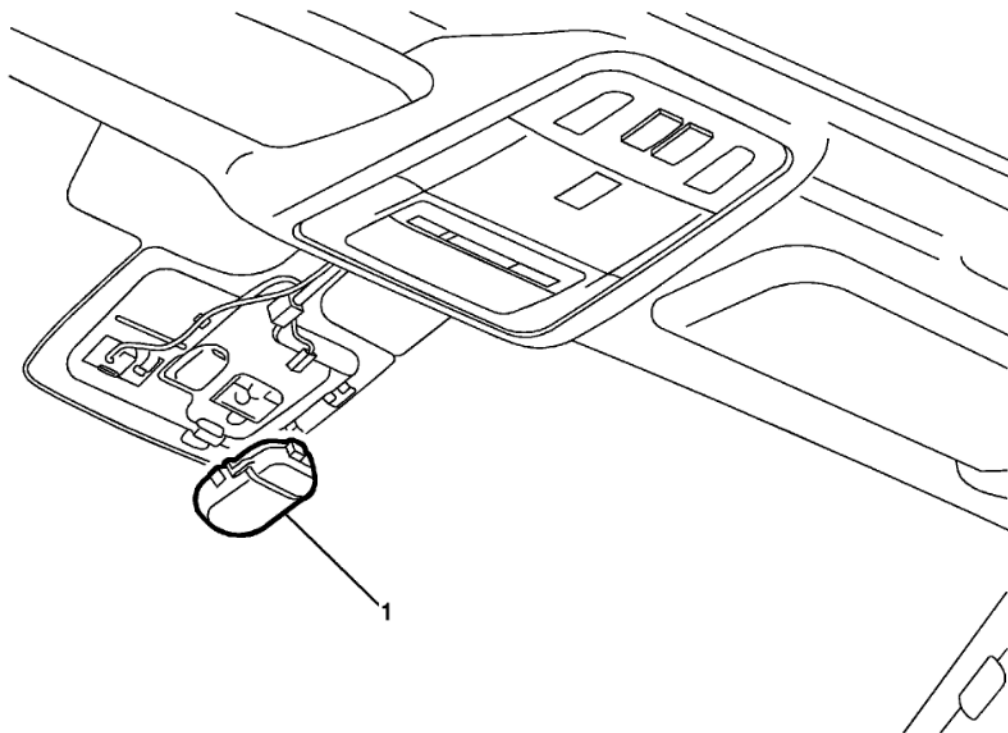


Fig. 32: Inside Air Moisture and Windshield Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

Inside Air Moisture and Windshield Temperature Sensor Replacement

Callout	Component Name
1	Cell Title: Inside Air Moisture and Windshield Temperature Sensor Procedure 1. Remove the inside rearview mirror mounting plate cover. 2. Release the retainers on each side of the sensor and remove the sensor from the mounting plate. 3. Disconnect the electrical connector.

SUN LOAD TEMPERATURE SENSOR REPLACEMENT

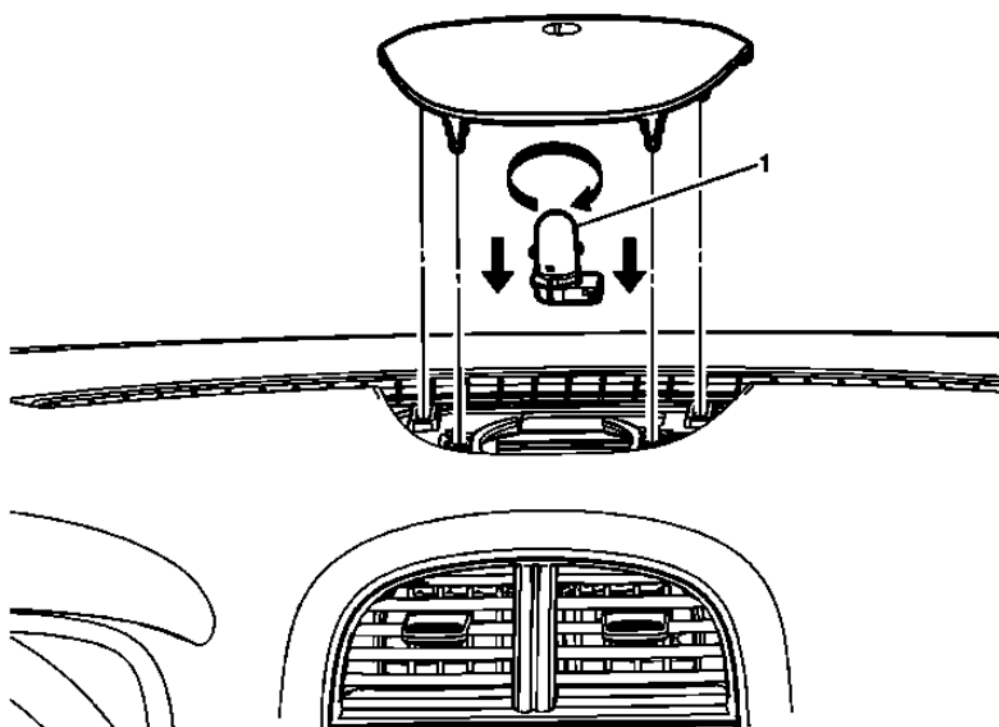


Fig. 33: Headlamp Automatic Control Ambient Light Sensor
 Courtesy of GENERAL MOTORS COMPANY

Sun Load Temperature Sensor Replacement

Callout	Component Name
Preliminary Procedure Remove the front radio speaker grille. Refer to Radio Front Speaker Grille Replacement .	
1	Sun Load Temperature and Headlamp Automatic Control Ambient Light Sensor Procedure 1. Disconnect the electrical connector. 2. Twist the sensor counterclockwise to remove.

DESCRIPTION AND OPERATION

AUTOMATIC HVAC DESCRIPTION AND OPERATION

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

- HVAC Control Components
- Air Speed
- Air Delivery

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

HVAC Control Components

HVAC Control

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

HVAC Control Module

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

The HVAC control module supports the following features:

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

Mode Actuator

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

Air Temperature Actuator (only C68)

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

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

Air Temperature Actuators (only CJ2)

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

Recirculation Actuator

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

Air Inlet Actuator (only CJ2)

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

Blower Motor Control Processor

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

Duct Temperature Sensors

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

Evaporator Temperature Sensor

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

A/C Refrigerant Pressure Sensor

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

A/C Compressor

The A/C compressor is constantly belt driven. The performance of the A/C compressor is regulated per a lifting magnet in the A/C compressor. The HVAC control module supplies battery voltage to the A/C compressor. When the A/C switch is pressed, the HVAC control module provides a pulse width modulation (PWM) signal to the A/C compressor in order to command the performance of the A/C compressor. The performance of the A/C compressor is regulated according to adjusted interior temperature on the basis of characteristic lines. Therefore the HVAC control module grounds the A/C compressor with the PWM signal.

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

This sensor assembly provides information about:

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

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

Ambient Light/Sunload Sensor (only C68)

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

This sensor assembly provides information about:

- Sun heat intensity
- Passenger compartment temperature

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

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

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

Ambient Light/Sunload Sensor (only CJ2)

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

This sensor assembly provides information about:

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

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

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

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

Air Speed

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

Afterblow

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

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

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

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

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

Air Delivery

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

- Defrost
- Defog
- Panel
- Floor

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

The rear window defogger does not affect the HVAC system.

Heating and A/C Operation

The purpose of the heating and A/C system is to provide heated and cooled air to the interior of the vehicle. The A/C system will also remove humidity from the interior and reduce windshield fogging. Regardless of the temperature setting, the following can affect the rate that the HVAC system can achieve the desired temperature:

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

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

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

- Battery voltage is between 9-18 V
- Engine coolant temperature is less than 124°C (255°F)
- Engine speed is greater than 600 RPM
- Engine speed is less than 5 500 RPM
- A/C high side pressure is between 269-2 929 kPa (39-425 PSI)
- Throttle position is less than 100%
- Evaporator temperature is greater than 3°C (38°F)
- ECM does not detect immoderate torque load
- ECM does not detect insufficient idle quality
- The ambient temperature is above 1°C (34°F)

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

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

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

Recirculation Operation (only C68)

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

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

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

Recirculation Operation (only CJ2)

The recirculation switch is integrated into the HVAC control. The selected recirculation switch position is sent to the HVAC control module via LIN-Bus. The HVAC control module controls the air intake through the air inlet actuator and recirculation actuator. In the recirculation mode the air inlet flap closes and the recirculation flap opens in order to circulate the air within the vehicle. In fresh air mode the air inlet flap opens and the recirculation flap is closed again in order to route outside air into the vehicle. Recirculation is only available if the defrost mode is not active. When the defrost mode is active, the recirculation actuator opens the recirculation flap and the air inlet actuator opens the air inlet flap and outside air is circulated to the windshield to reduce fogging.

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

Automatic Operation

In automatic operation, the HVAC control module maintains the comfort level inside of the vehicle by controlling the A/C compressor clutch, the blower motor, the air temperature actuators, mode actuator and recirculation actuator.

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

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

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

- Monitors the following sensors:

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

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

Engine Coolant

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

Coolant enters the heater core through the inlet heater hose, in a pressurized state. The heater core is located

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

A/C Cycle

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

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

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

The condenser is located in front of the radiator for maximum heat transfer. The condenser is made of aluminum tubing and aluminum cooling fins, which allows rapid heat transfer for the refrigerant. The semi-cooled liquid refrigerant exits the condenser and flows to the Receiver/Dehydrator(R/D).

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

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

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

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