

2013 HVAC

HVAC - Manual - Malibu

SCHEMATIC WIRING DIAGRAMS

HVAC WIRING SCHEMATICS

Power, Ground, Serial Data, Blower Control and HVAC Controls Wiring Schematics

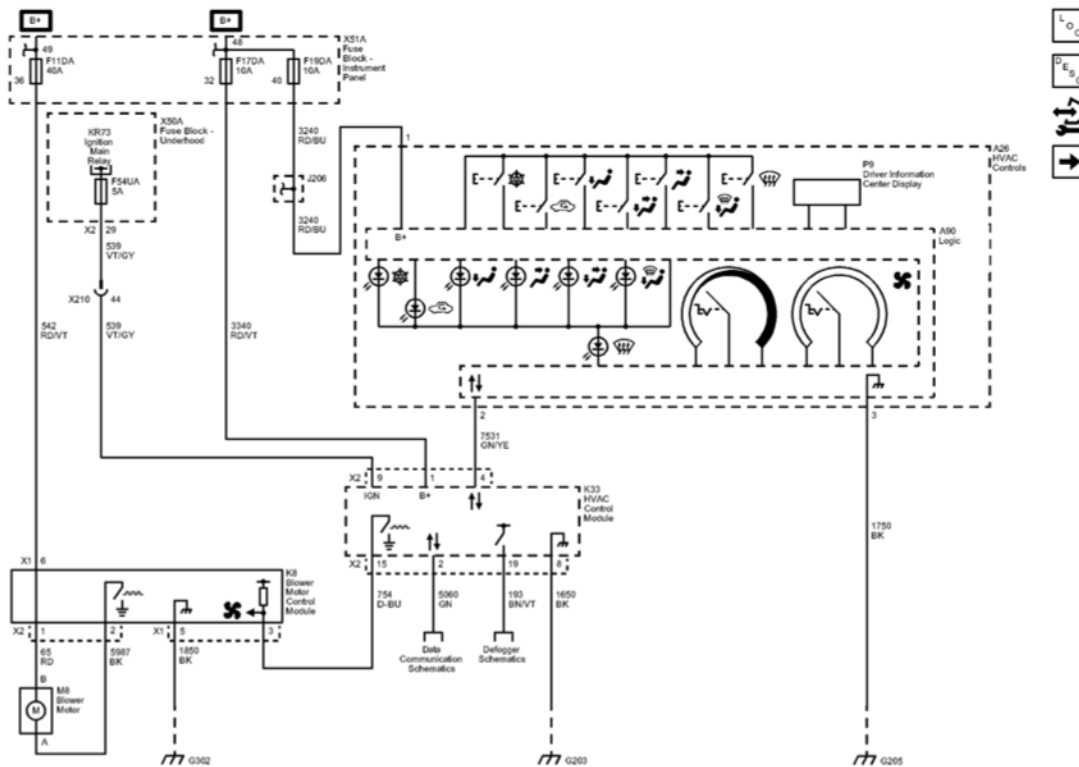


Fig. 1: Power, Ground, Serial Data, Blower Control and HVAC Controls Wiring Schematics
Courtesy of GENERAL MOTORS COMPANY

A/C Compressor Controls Wiring Schematics

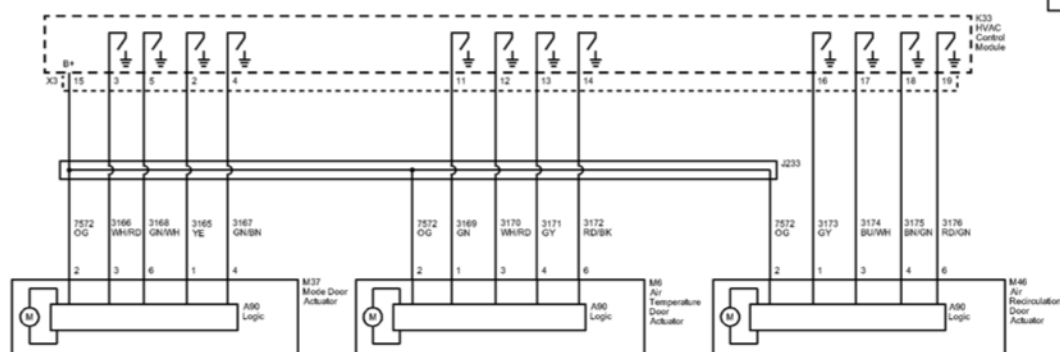
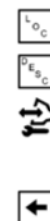


Fig. 3: Mode and Temperature Control Actuators Wiring Schematics
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

HVAC COMPONENT REPLACEMENT REFERENCE

HVAC Component Replacement Reference

Scan Tool Name	Component Code / Schematic Name	Service Name	Repair Instruction Name
Air Recirculation Door Actuator	M46 Air Recirculation Door Actuator	Air Recirculation Door Actuator	<u>Air Inlet Valve Actuator Replacement</u>
Left Temperature Door Actuator	M6 Air Temperature Door Actuator	Air Temperature Actuator	<u>Temperature Valve Actuator Replacement - Left Side</u>
Mode Door Actuator	M37 Mode Door Actuator	Mode Door Actuator	<u>Mode Control Cam Actuator Replacement</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 Evaporator Temperature Sensor	B39 A/C Evaporator Temperature Sensor	Air Conditioning Evaporator Temperature Sensor	<u>Air Conditioning Refrigerant Temperature Sensor Replacement</u>
A/C High Side Pressure Sensor	B1 A/C Refrigerant Pressure Sensor	A/C High Side Pressure Sensor	<u>Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement (LUK) , Air Conditioning (A/C) Refrigerant 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) , Air Conditioning Compressor Replacement (LCV) , 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) , Air Conditioning Compressor Replacement (LCV) , Air Conditioning Compressor Replacement (LTG)</u>
HVAC Controls	A26 HVAC Controls	HVAC Controls	<u>Heater and Air Conditioning Control Replacement (With RPO C60)</u>
Remote Heater and Air Conditioning Control Module	K33 HVAC Control Module	HVAC Control Module	<u>Heater and Air Conditioning Remote Control Replacement (Module)</u>

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<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, B0233, B023A, or B0408</u>	DTC B0223 01 Recirculate Position Command 1 Circuit Short to Battery DTC B0223 06 Recirculate Position Command 1 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
<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 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

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Description and Operation

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- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF 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 and connect a DMM between the control circuit terminal 3 and ground, ignition ON.
- 6. Verify the resistance value is between 500 ohms and 140K ohms and there is a noticeable change when moving between commanded fan speeds.
 - **If not within the specified range or there is no noticeable change**
 - 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 within the specified range and there is a noticeable change**
- 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 and progressively dimmer as the blower speed is decreased.
 - **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, B0233, B023A, OR B0408

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 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

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,	B0223 06, B0233 06, B0408 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
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, buttons, and dials on the HVAC controls, air temperature door position, mode door position, and recirculation door position can be selected. The selected values are passed to the HVAC control module via serial data. The HVAC control module supplies a switched 12 V control voltage to the stepper motors and energizes the 4 stepper motor coils with a pulsed ground signal. The stepper motors move the appropriate doors to the requested positions.

Conditions for Running the DTC

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

Conditions for Setting the DTC

B023A 02

The stepper motors supply output is shorted to ground.

B0223 01, B0233 01, B023A 01, or B0408 01

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

B0223 06, B0233 06, B0233 06, or B0408 06

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

Action Taken When the DTC Sets

B023A 02

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

- All stepper motors are deactivated.

B0223, B0233, B023A, or 0408

- 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

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- **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, or B0408.

- **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
 - M6 Air Temperature Door Actuator
2. Disconnect the harness connector at the K33 HVAC Control Module.
3. Test for infinite resistance between the K33 HVAC Control Module 12 V reference circuit terminal 15 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

4. Ignition ON.
5. Test for less than 1 V between the K33 HVAC Control Module 12 V reference circuit terminal 15 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

6. Connect the harness connector at the K33 HVAC Control Module, ignition ON.
7. Clear all DTCs.
8. Verify DTC B023A is not set.

- **If the DTC is set.**

Replace the K33 HVAC Control Module.

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

9. Verify DTC B023A does not set after connecting each of the components listed below one at a time and operating them through their full range.
 - M37 Mode Door Actuator
 - M46 Air Recirculation Door Actuator
 - M6 Air Temperature Door Actuator
- **If the DTC sets after connecting one of the components**

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

○ **If the DTC does not set**

10. All OK.

DTC B0223, B022A, B0233, or B0408

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 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 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 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
Electric Variable Displacement Control	B393B 04	B393B 04	B393B 0B	-
Electric Variable Displacement Supply	-	B393B 04	-	-

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.

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

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Connector End View Reference

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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 Q46 A/C Compressor Solenoid Valve. It may take up to 2 min for all vehicle systems to power down.
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 Q46 A/C Compressor Solenoid Valve.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector at the Q46 A/C Compressor Solenoid Valve.
2. Test for 7-15 ohms between B+ circuit terminal 2 and control circuit terminal 1.
 - **If less than 7 ohms or greater than 15 ohms**

Replace the Q46 A/C Compressor Solenoid Valve
 - **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 Q46 A/C Compressor Solenoid Valve
 - **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

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HVAC Schematics

Connector End View Reference

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- **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 ECM 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
B+	1	1	-	-
A/C Compressor Clutch Supply Voltage	1	1	1	-
Ignition	P0645	P0645	-	-
A/C Compressor Clutch Control	P0645	P0645	P0645	-
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

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- 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 - MANUAL

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 **Manual HVAC Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the HVAC System. Refer to **Checking Aftermarket Accessories**.
- 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

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

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

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

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

Refer to .

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

10. Engine ON, A/C system ON.
11. Verify cool air flows from the ducts with the temperature control in the coldest position.

- **If the air is not cool**

1. Verify the Q2 A/C Compressor Clutch is engaged.
 - If the Q2 A/C Compressor Clutch is not engaged, refer to **Air Conditioning Compressor Malfunction.**
 - If the Q2 A/C Compressor Clutch is engaged, refer to **Air Conditioning (A/C) System Performance Test** , and **DTC B393B.**

- **If the air is cool**

12. Verify warm air flows from the ducts with the temperature control in the warmest position.
 - **If the air is not warm**

Refer to **Heating Performance Diagnostic** .

- If the air is warm

13. 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

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- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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

1. Ignition ON, press and release the A/C Switch.
2. Verify the HVAC control module scan tool A/C Switch parameter changes between Active and Inactive.
 - **If the parameter does not change**
Replace the A26 HVAC Controls.
 - **If the parameter changes**
3. Set A/C system to coolest setting with blower ON.
4. Press and release the A/C switch several times.
5. Verify the ECM scan tool A/C Request Signal parameter changes between Active and Inactive.

- **If the parameter does not change**

Replace the K33 HVAC Control Module.

- **If the parameter changes**

6. Verify the A/C compressor clutch engages 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 running.

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

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 (WITH RPO C60)

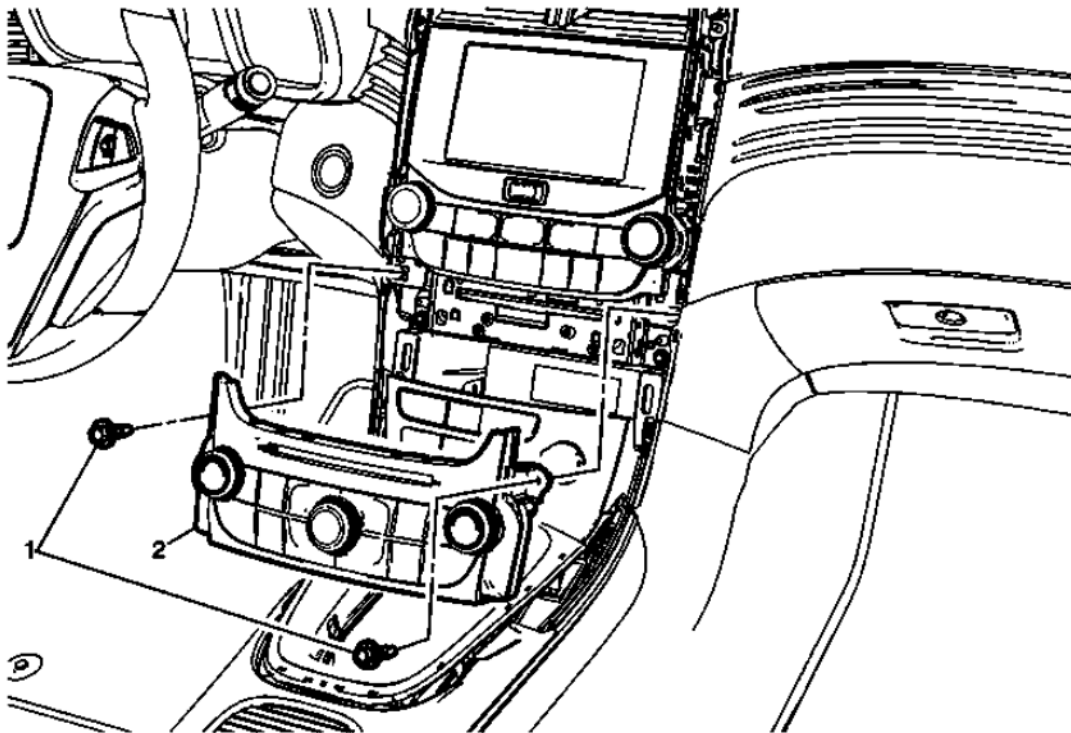


Fig. 4: Heater and Air Conditioning Control (With RPO C60)

Courtesy of GENERAL MOTORS COMPANY

Heater and Air Conditioning Control Replacement (With RPO C60)

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 (MODULE)

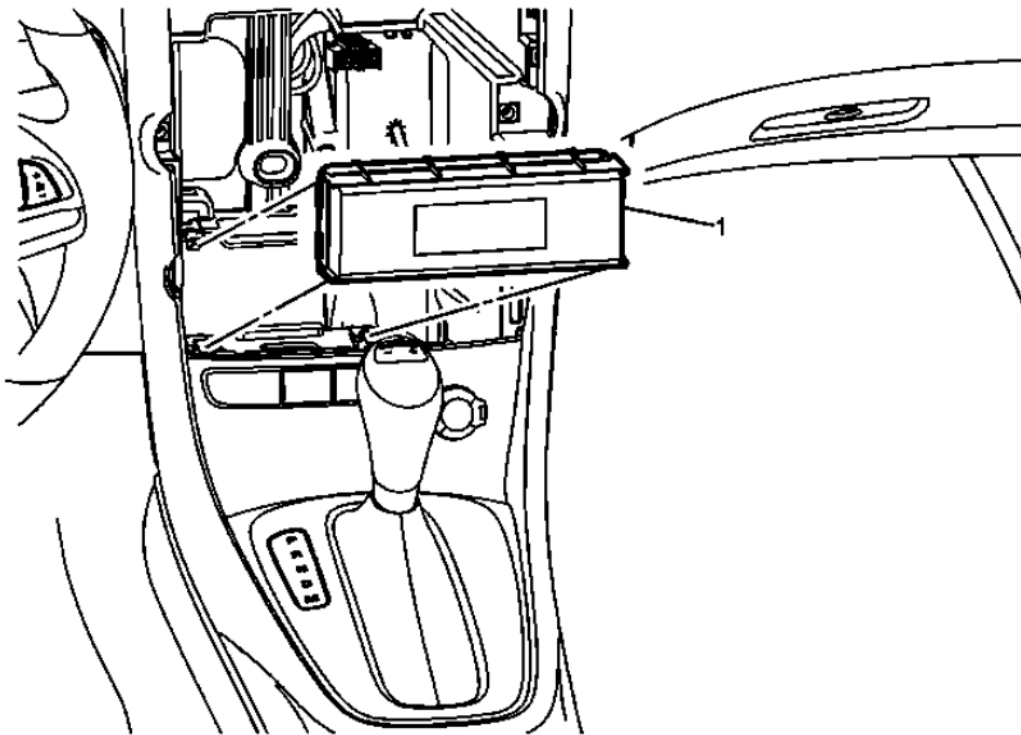


Fig. 5: Heater And Air Conditioning Remote Control
 Courtesy of GENERAL MOTORS COMPANY

Heater and Air Conditioning Remote Control Replacement (Module)

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

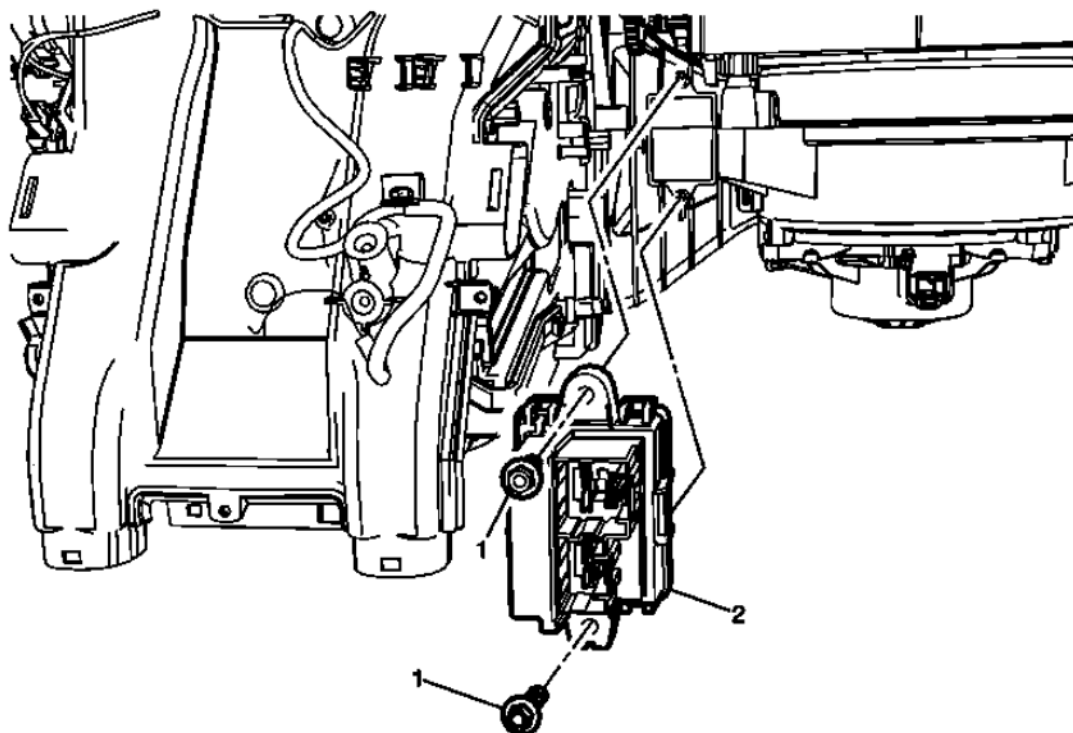


Fig. 6: Heater and Blower and Air Conditioning Control Module
 Courtesy of GENERAL MOTORS COMPANY

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

TEMPERATURE VALVE ACTUATOR REPLACEMENT - LEFT SIDE

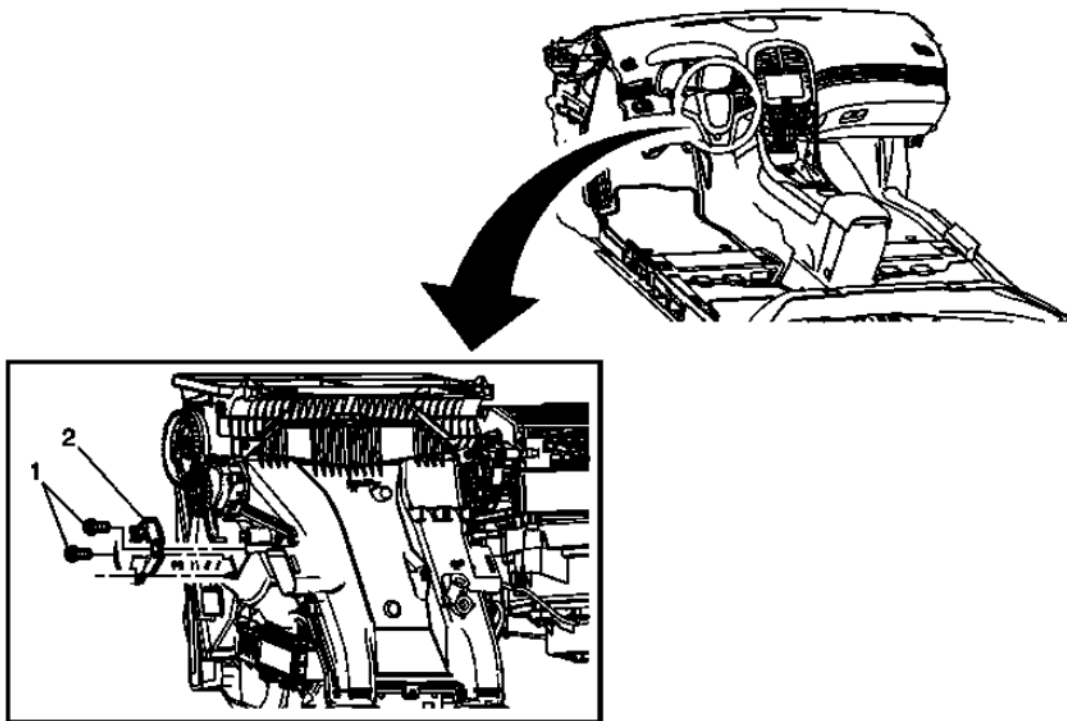


Fig. 7: Temperature Valve Actuator - Left Side
 Courtesy of GENERAL MOTORS COMPANY

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.

MODE VALVE LEVER REPLACEMENT

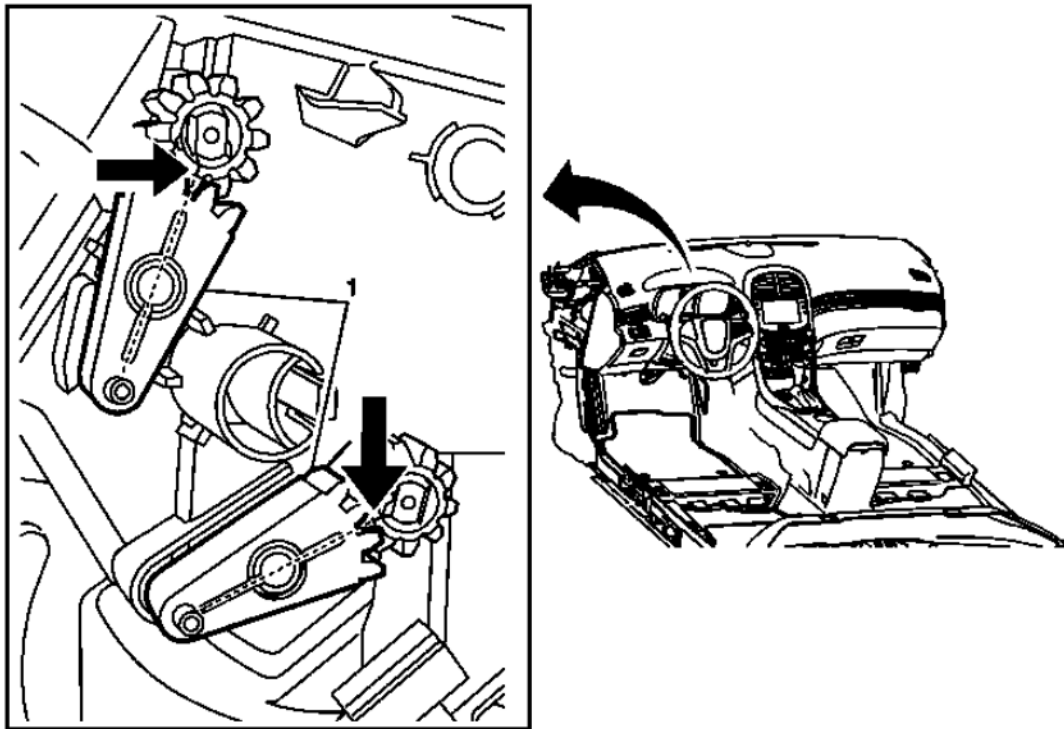


Fig. 8: Mode Valve Lever

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

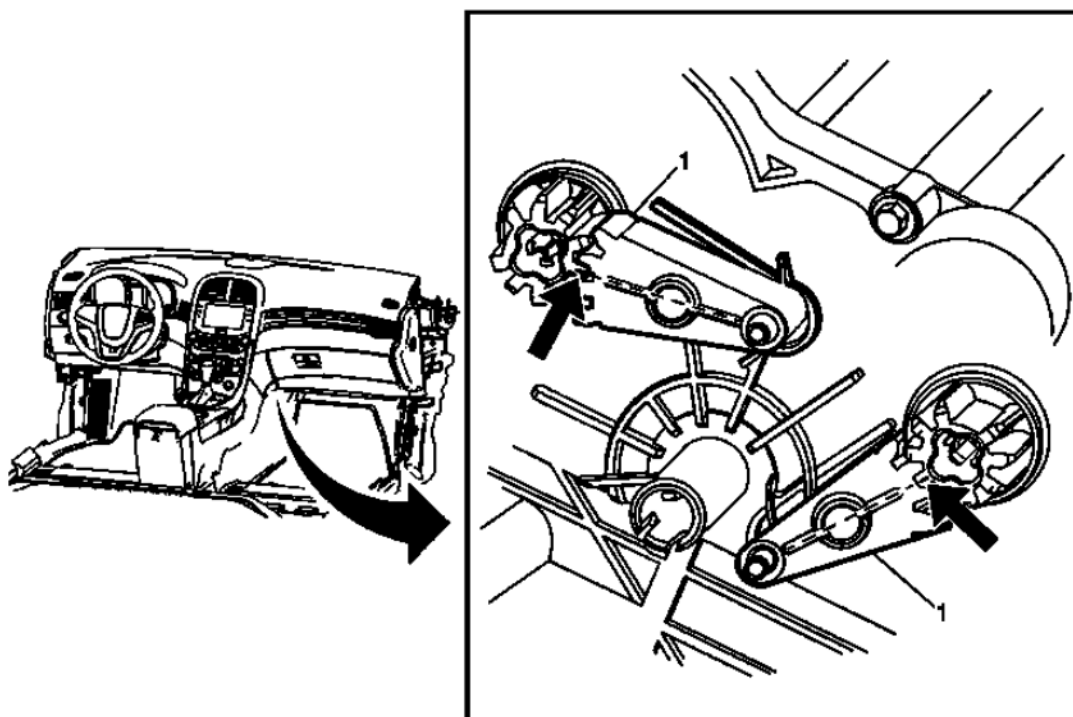


Fig. 9: Vent Valve Lever

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.

MODE VALVE ACTUATOR GEAR REPLACEMENT

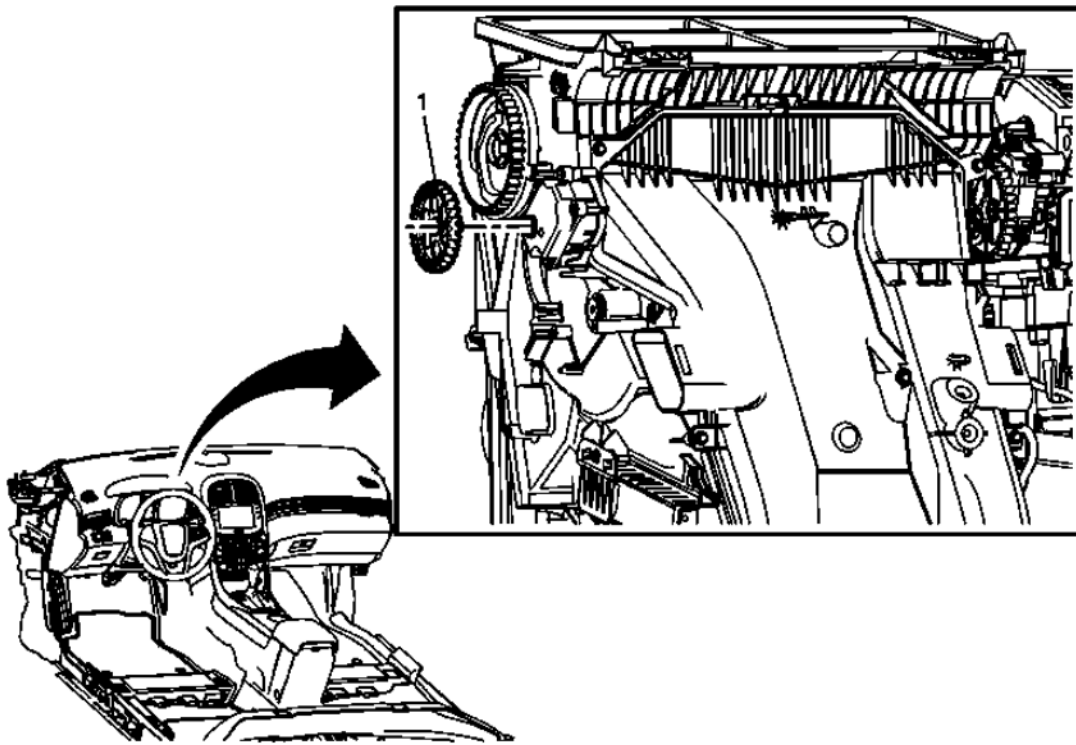


Fig. 10: Mode Valve Actuator Gear
 Courtesy of GENERAL MOTORS COMPANY

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

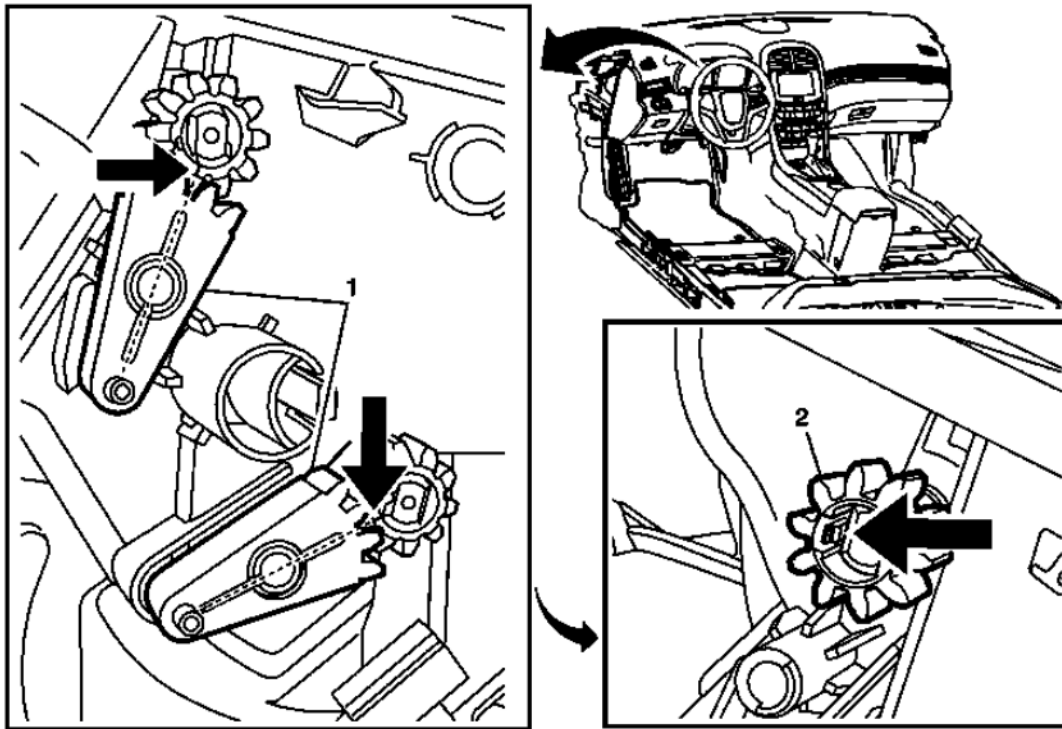


Fig. 11: Mode Valve Gear
Courtesy of GENERAL MOTORS COMPANY

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

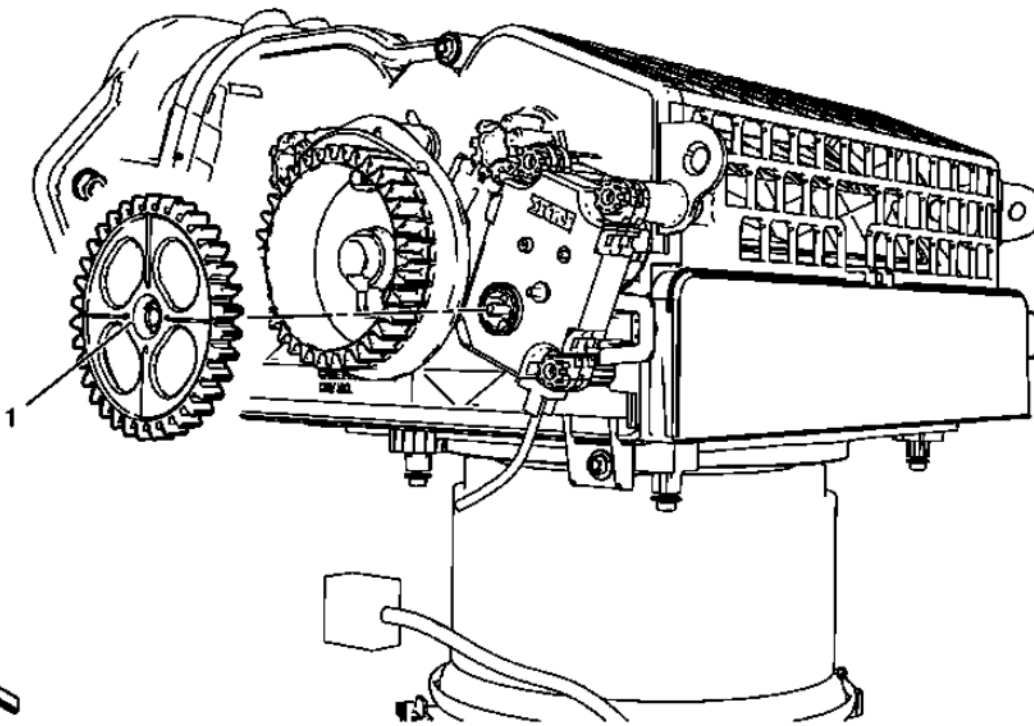


Fig. 12: Air Inlet Valve Actuator Gear (Left Hand Drive)
 Courtesy of GENERAL MOTORS COMPANY

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 ACTUATOR REPLACEMENT

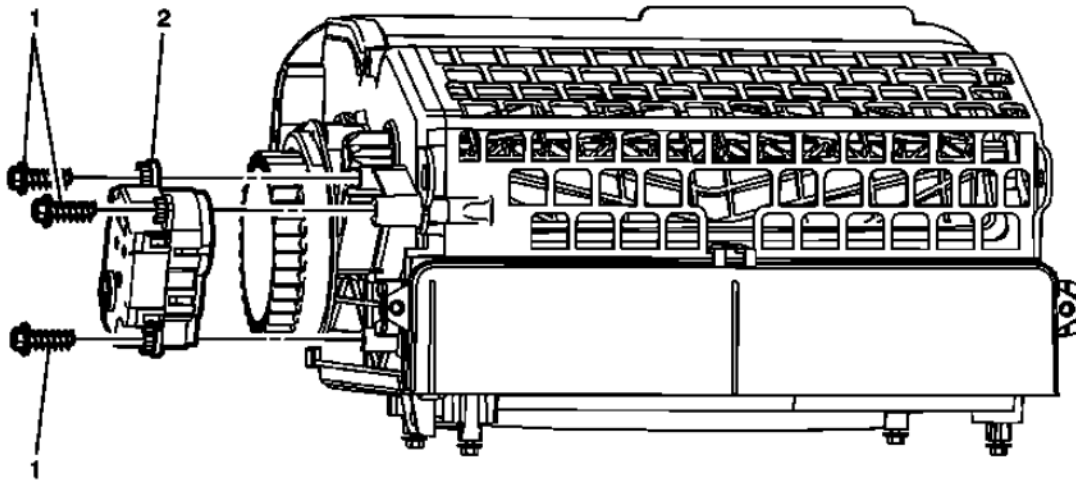


Fig. 13: Air Inlet Valve Actuator
 Courtesy of GENERAL MOTORS COMPANY

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.

AIR INLET VALVE AND INSIDE AIR VALVE CONTROL CAM REPLACEMENT

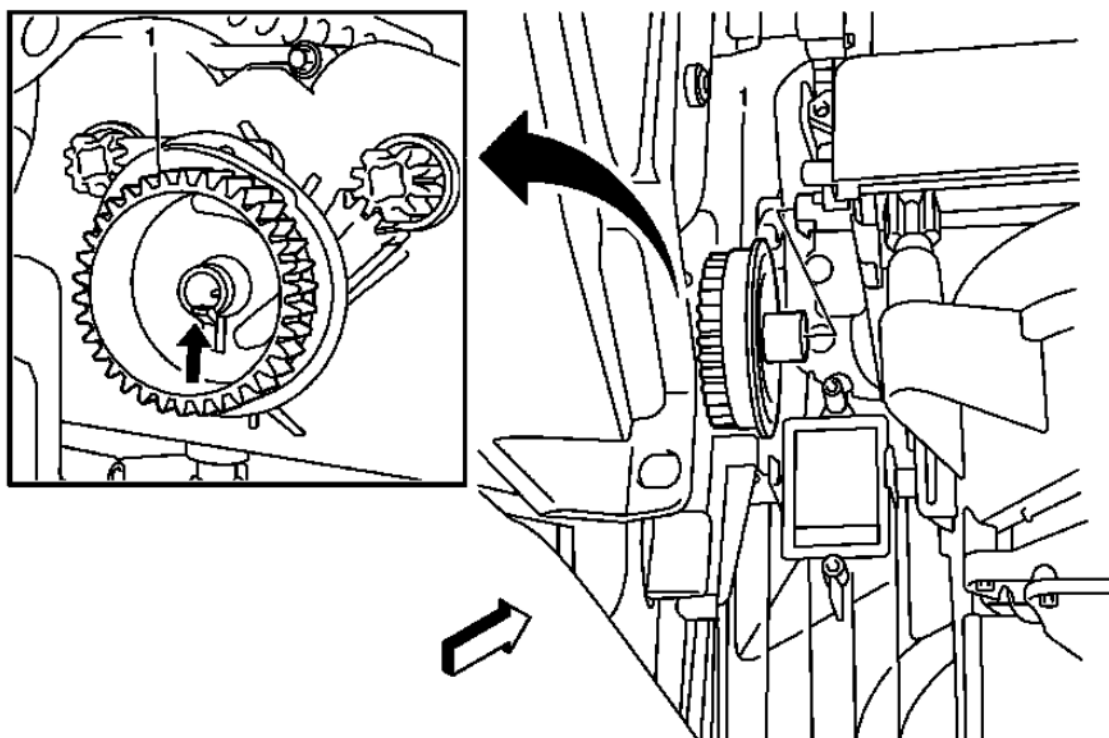


Fig. 14: Air Inlet Valve And Inside Air Valve Control Cam
 Courtesy of GENERAL MOTORS COMPANY

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 REPLACEMENT

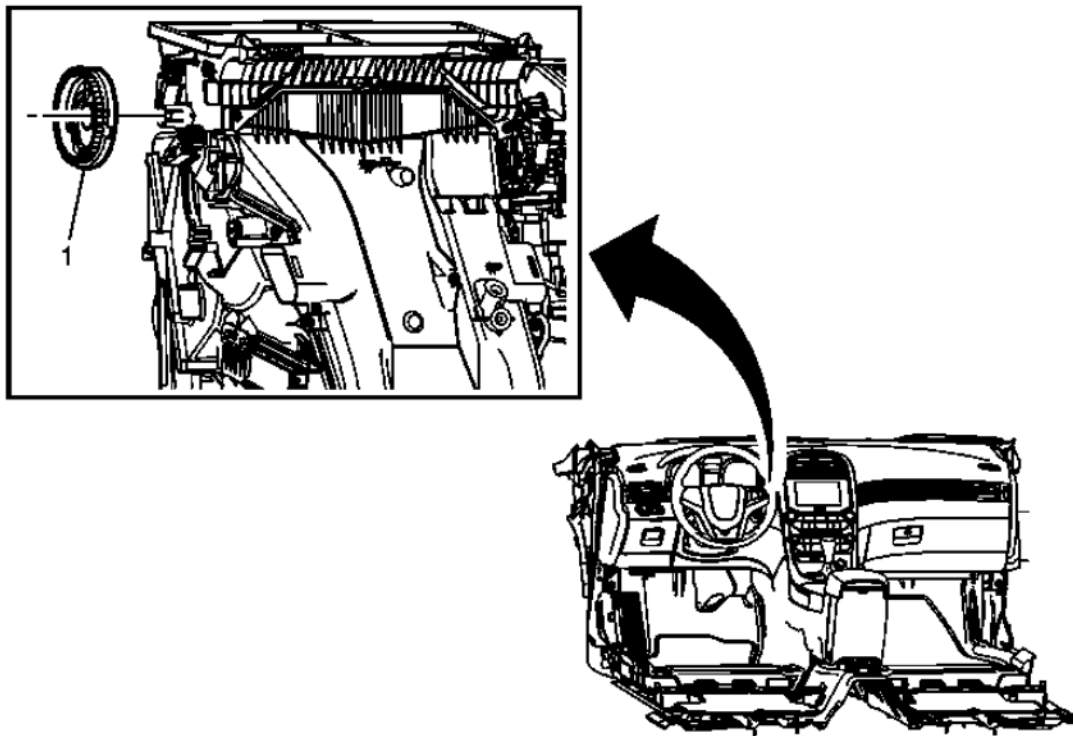


Fig. 15: Mode Control Cam
Courtesy of GENERAL MOTORS COMPANY

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

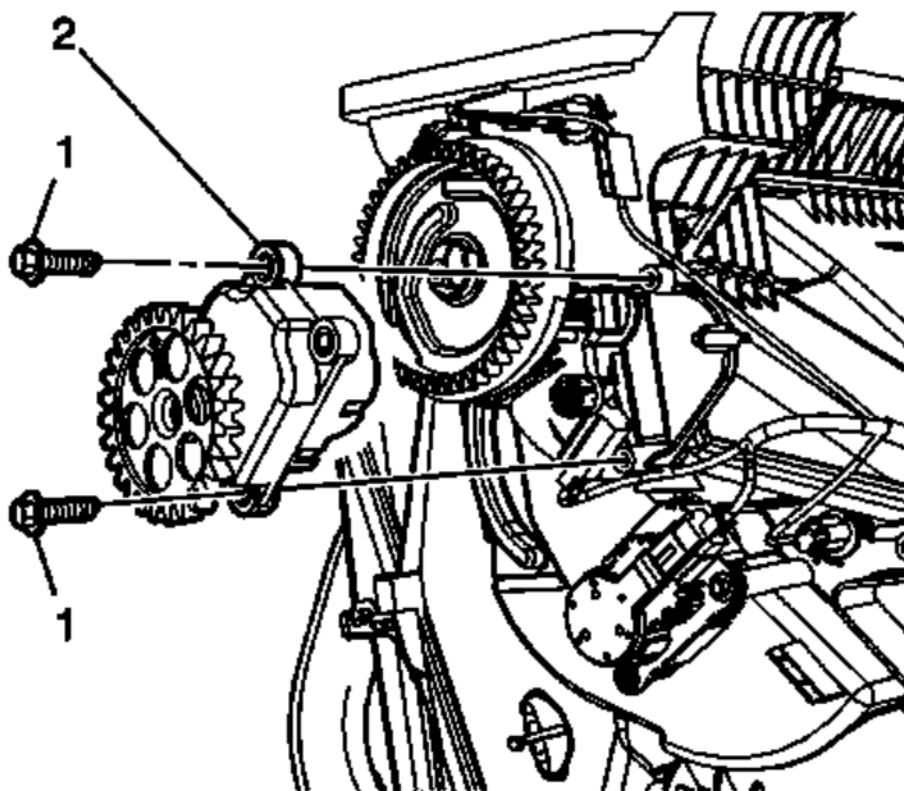


Fig. 16: View Of Mode Cam Gear Actuator, Screws & HVAC Module
Courtesy of GENERAL MOTORS COMPANY

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.

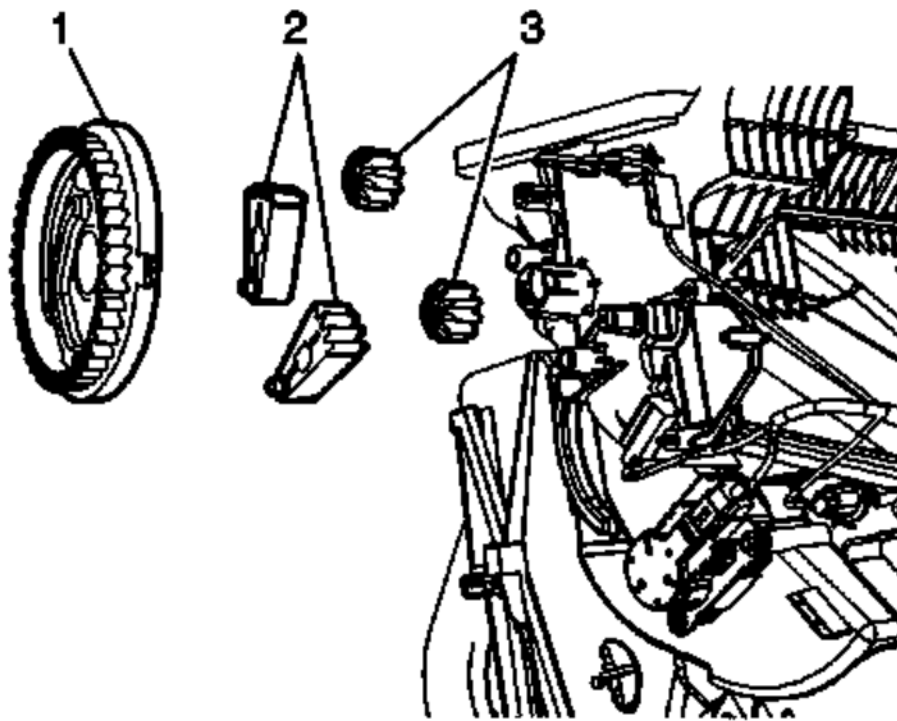


Fig. 17: View Of Mode Cam Gear
Courtesy of GENERAL MOTORS COMPANY

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.

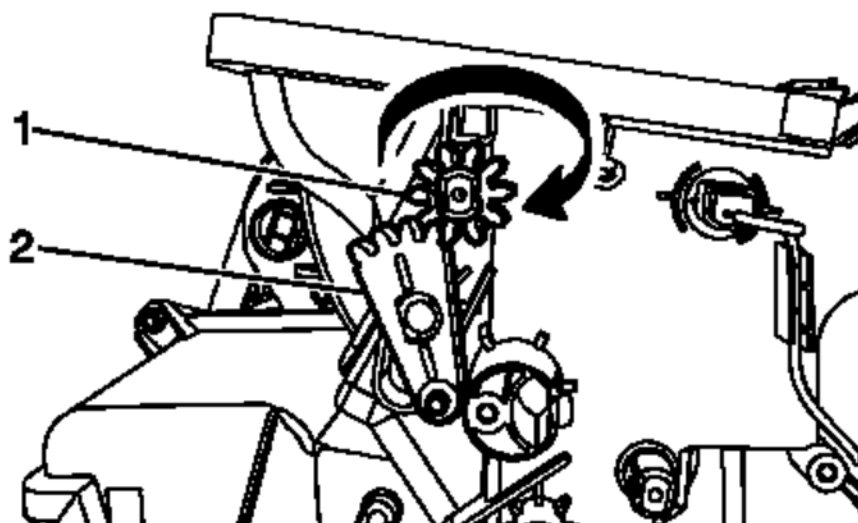


Fig. 18: Rotating defroster gear clockwise
Courtesy of GENERAL MOTORS COMPANY

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).

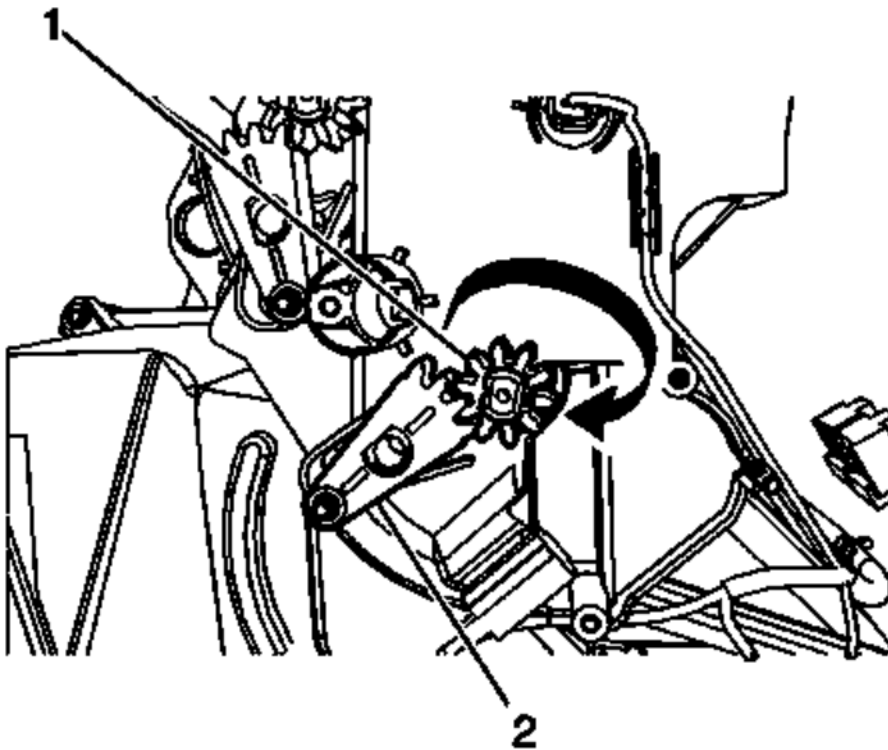


Fig. 19: Rotating Heater Door Gear
Courtesy of GENERAL MOTORS COMPANY

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).

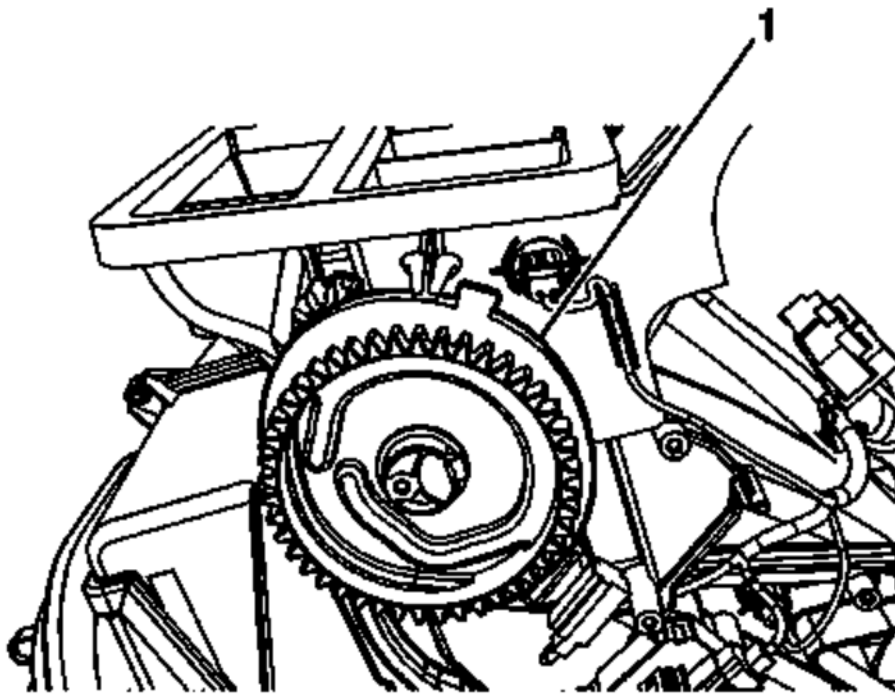


Fig. 20: View Of Mode Cam

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.

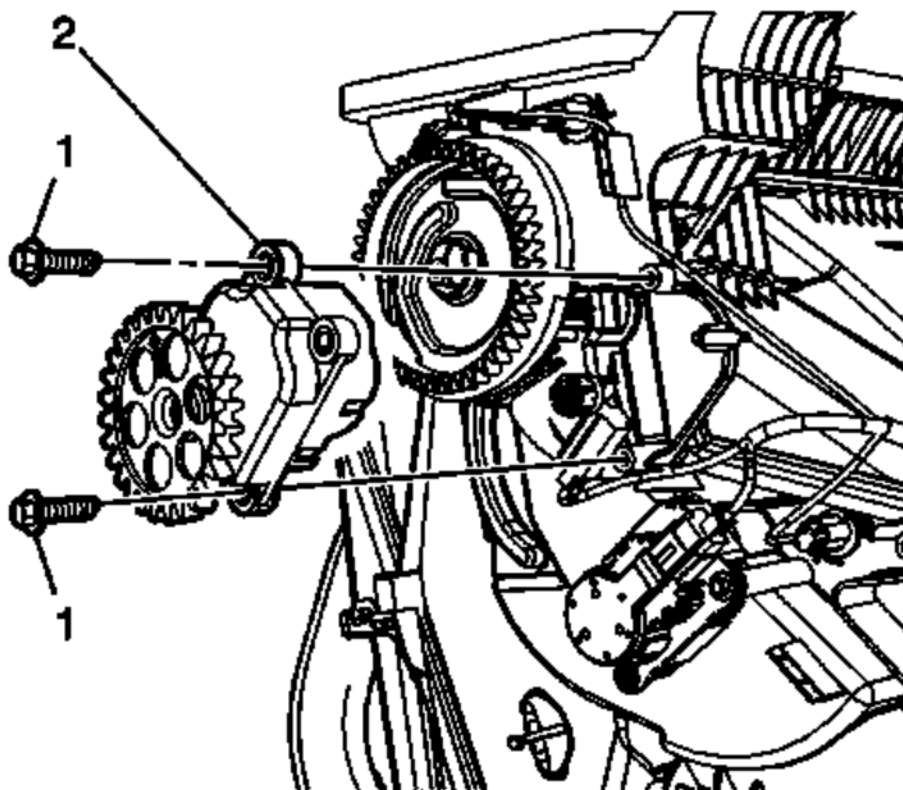


Fig. 21: View Of Mode Cam Gear Actuator, Screws & HVAC Module
Courtesy of GENERAL MOTORS COMPANY

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 .

MODE CONTROL CAM ACTUATOR REPLACEMENT

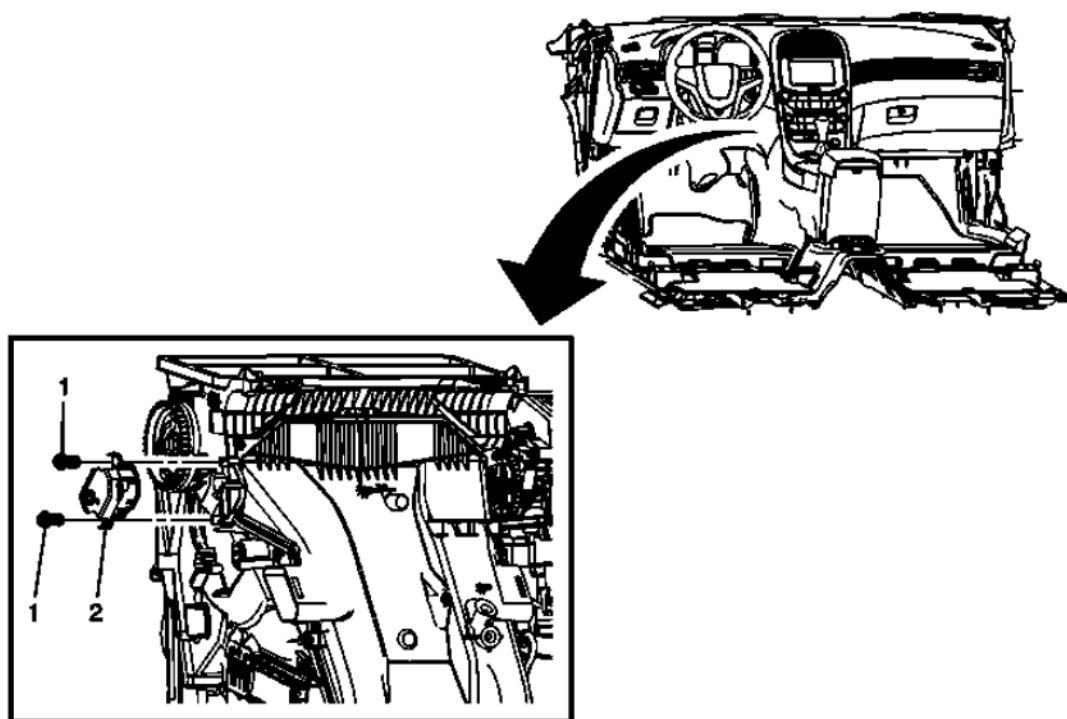


Fig. 22: Mode Control Cam Actuator
 Courtesy of GENERAL MOTORS COMPANY

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.

SUN LOAD TEMPERATURE SENSOR REPLACEMENT (AMBIENT LIGHT SENSOR)

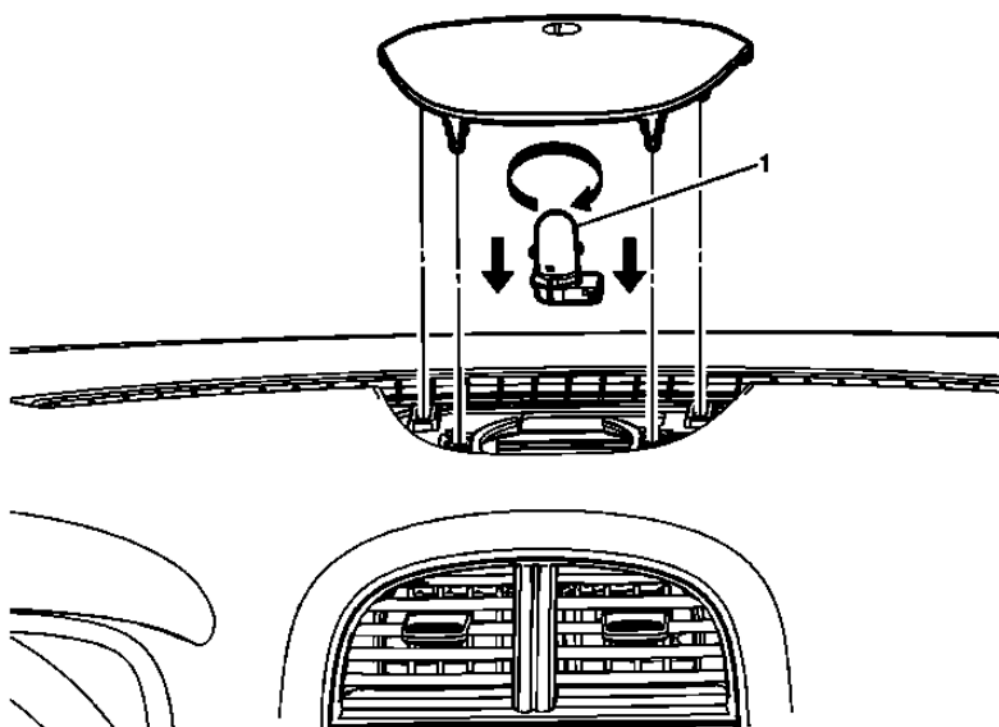


Fig. 23: Headlamp Automatic Control Ambient Light Sensor
 Courtesy of GENERAL MOTORS COMPANY

Sun Load Temperature Sensor Replacement (Ambient Light Sensor)

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.

AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT

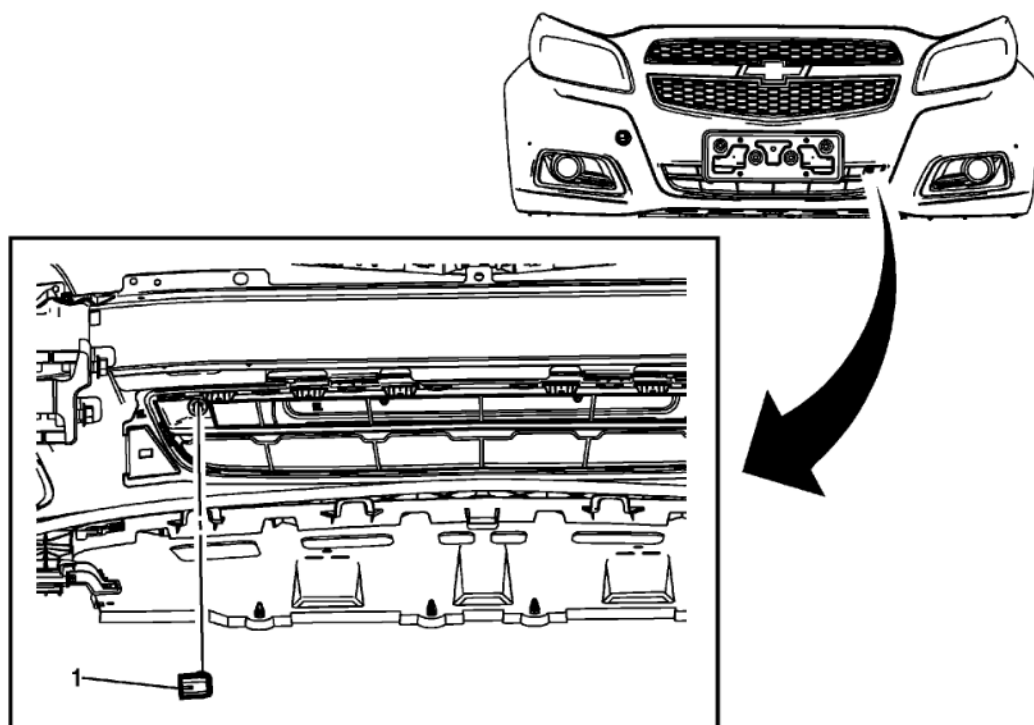


Fig. 24: Ambient Air Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

Ambient Air Temperature 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.

AIR CONDITIONING REFRIGERANT TEMPERATURE SENSOR REPLACEMENT

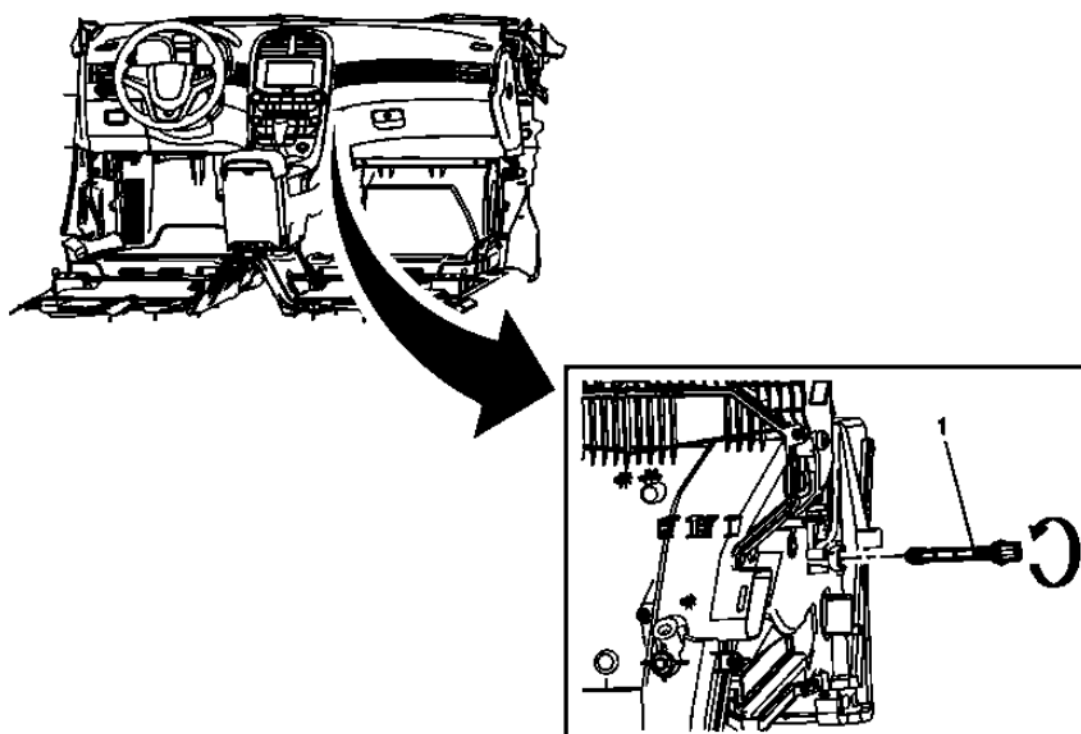


Fig. 25: Air Conditioning Refrigerant Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

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.

DESCRIPTION AND OPERATION

MANUAL HVAC DESCRIPTION AND OPERATION

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

- HVAC Control Components
- Air Speed

- Air Delivery
- Heating and A/C Operation
- Recirculation Operation
- Engine Coolant
- A/C Cycle

HVAC Control Components

HVAC Controls

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

HVAC Control Module

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

The HVAC control module supports the following features:

Feature	Availability
Afterblow	Available if reprogrammed by the technician
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

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 air temperature actuator puts the mixed air flap into the calculated position, in order to reach the selected temperature of the 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 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.

Blower Motor

The blower motor speed control signal from the HVAC Control Module, battery positive and ground circuits enable the blower motor to operate. The blower motor control circuitry is integrated within the blower motor assembly. The HVAC Control Module provides a pulse width modulation (PWM) signal to the blower motor to request a specific motor speed. The blower motor translates the PWM signal and drives the motor accordingly. As the requested blower speed increases, the HVAC control module increases the amount of time that the speed signal is modulated to ground. As the requested blower speed decreases, the HVAC control module decreases the amount of time that the signal is modulated to ground.

Evaporator Temperature Sensor

The evaporator temperature sensor is a 2-wire negative temperature 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. The 5 V reference voltage, low reference, and signal circuits enable the sensor to operate. The A/C pressure signal can be between 0.2-4.8 V. When the A/C refrigerant pressure is low, the signal value is near 0 V. When the A/C refrigerant pressure is high, the signal value is near 5 V. The engine control module (ECM) converts the voltage signal to a pressure value. When pressure is too high or too low, the ECM will not allow the A/C compressor clutch to engage.

A/C Compressor

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 a constant 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 valve using a (PWM) signal in order to determine the amount of compressor displacement. The performance of the A/C compressor is regulated according to adjusted interior temperature.

Air Speed

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

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

the desired blower motor speed.

Air Delivery

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

The rear window defogger does not affect the HVAC system.

Heating and A/C Operation

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

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

When the A/C switch is pressed, the HVAC controls sends a signal to the HVAC control module via LIN-Bus. The HVAC control module evaluates this signal and sends an A/C request signal to the ECM via CAN-Bus. The ECM checks all preconditions before releasing and if all conditions are met sends a release signal back to the HVAC control module.

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

- 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 A/C high side pressure sensor information is used by the ECM to determine the following:

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

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

Recirculation Operation

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

Engine Coolant

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

Coolant enters the heater core through the inlet heater hose, in a pressurized state. The heater core is located inside the HVAC module. The ambient air drawn through the HVAC module absorbs the heat of the coolant flowing through the heater core. Heated air is distributed to the passenger compartment, through the HVAC module, for passenger comfort. Opening or closing the air temperature 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 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 module for passenger comfort. The heat and moisture removed from the passenger compartment will also change form, or condense, and is discharged from the HVAC module as water.