2017 HVAC

HVAC - Manual - Sierra, Silverado

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Mode Control Cam Actuator Mounting Plate Bolt	2.5 N.m (22 lb in)

SCHEMATIC WIRING DIAGRAMS

HVAC WIRING SCHEMATICS

Ambient Light/Sunload Sensor and Mode Doors

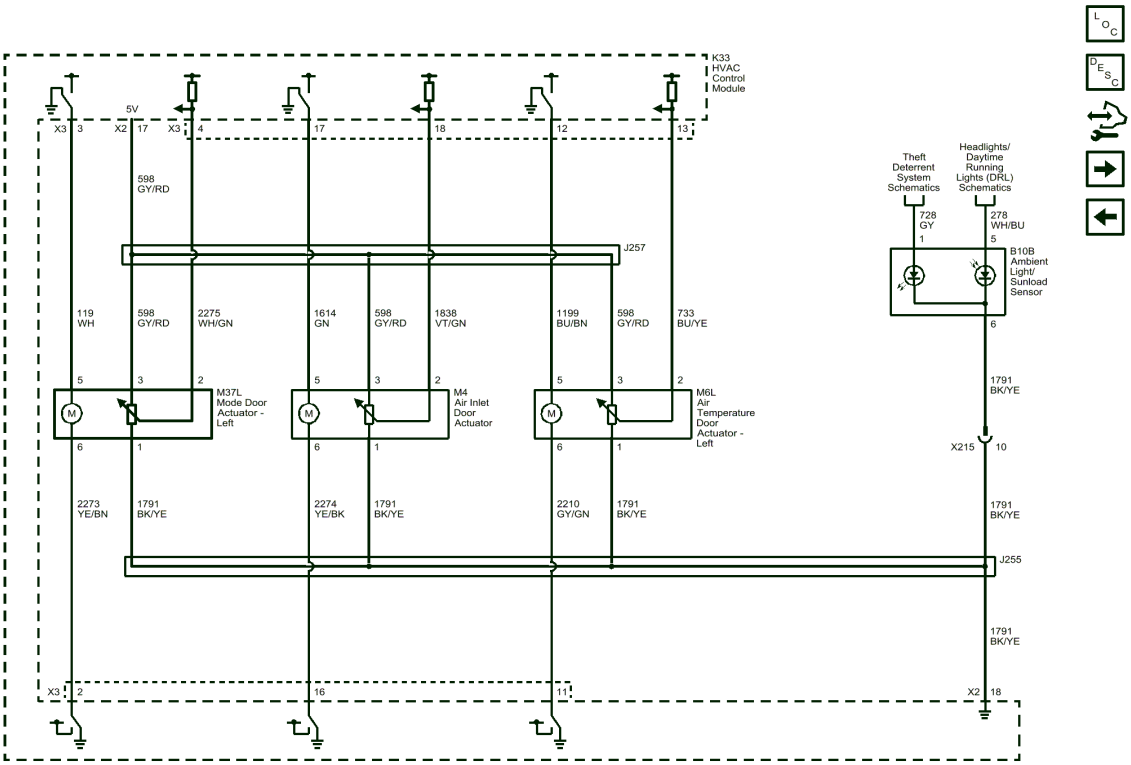

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Fig. 1: Ambient Light/Sunload Sensor and Mode Doors
Courtesy of GENERAL MOTORS COMPANY

A/C Compressor Controls

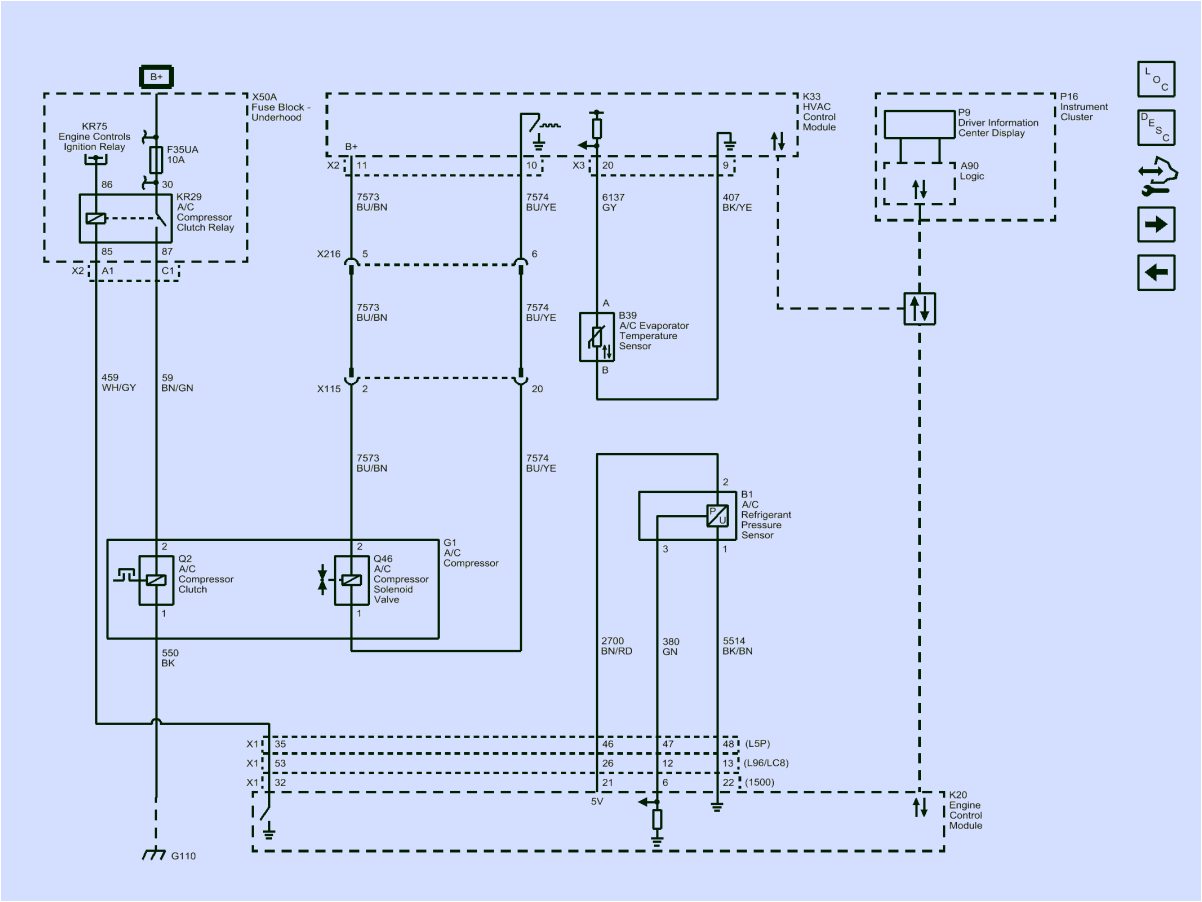

Fig. 2: A/C Compressor Controls
Courtesy of GENERAL MOTORS COMPANY

Power, Ground, Serial Data and Controls

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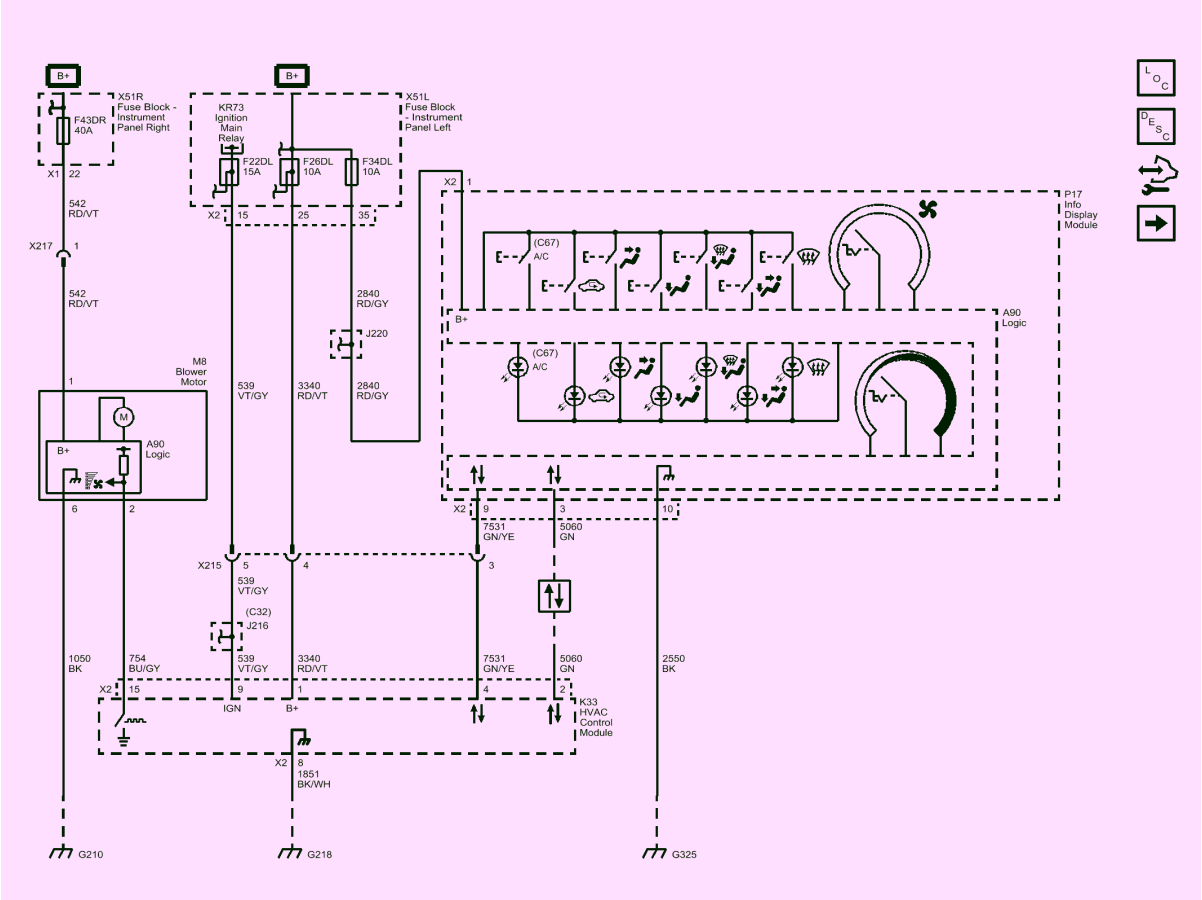

Fig. 3: Power, Ground, Serial Data and Controls
Courtesy of GENERAL MOTORS COMPANY

Auxiliary Heater (C32) and Temperature Sensors

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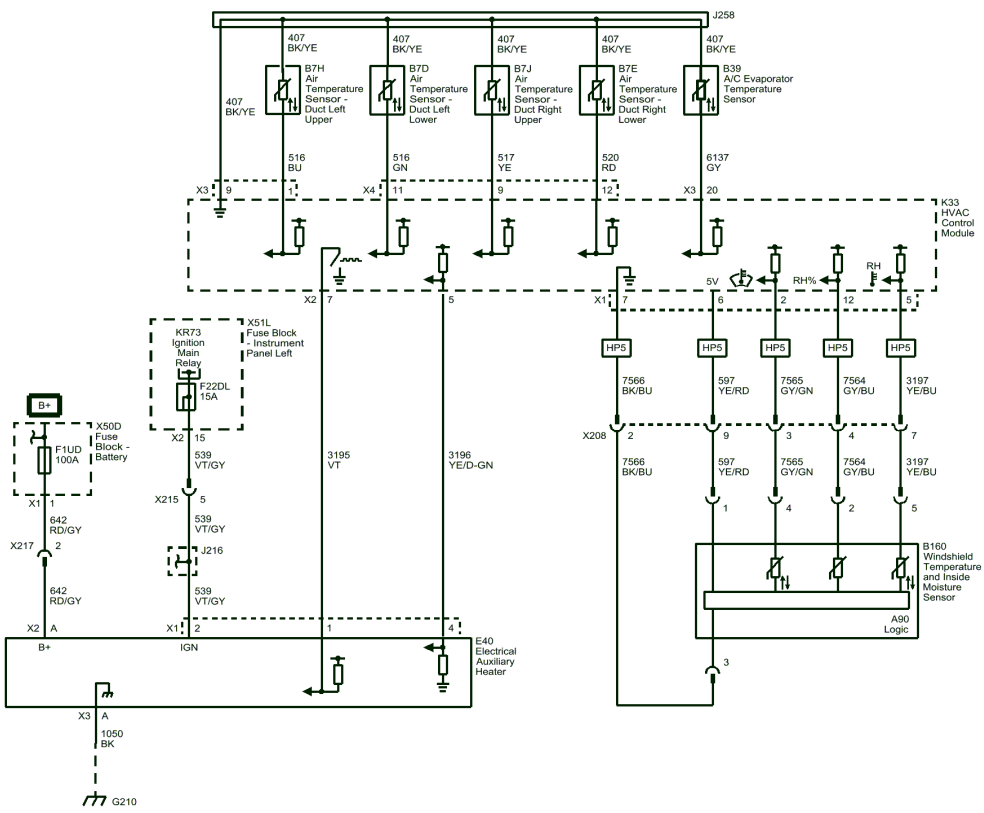

Fig. 4: Auxiliary Heater (C32) and Temperature Sensors
Courtesy of GENERAL MOTORS COMPANY

Heater Coolant Pump (HP5)

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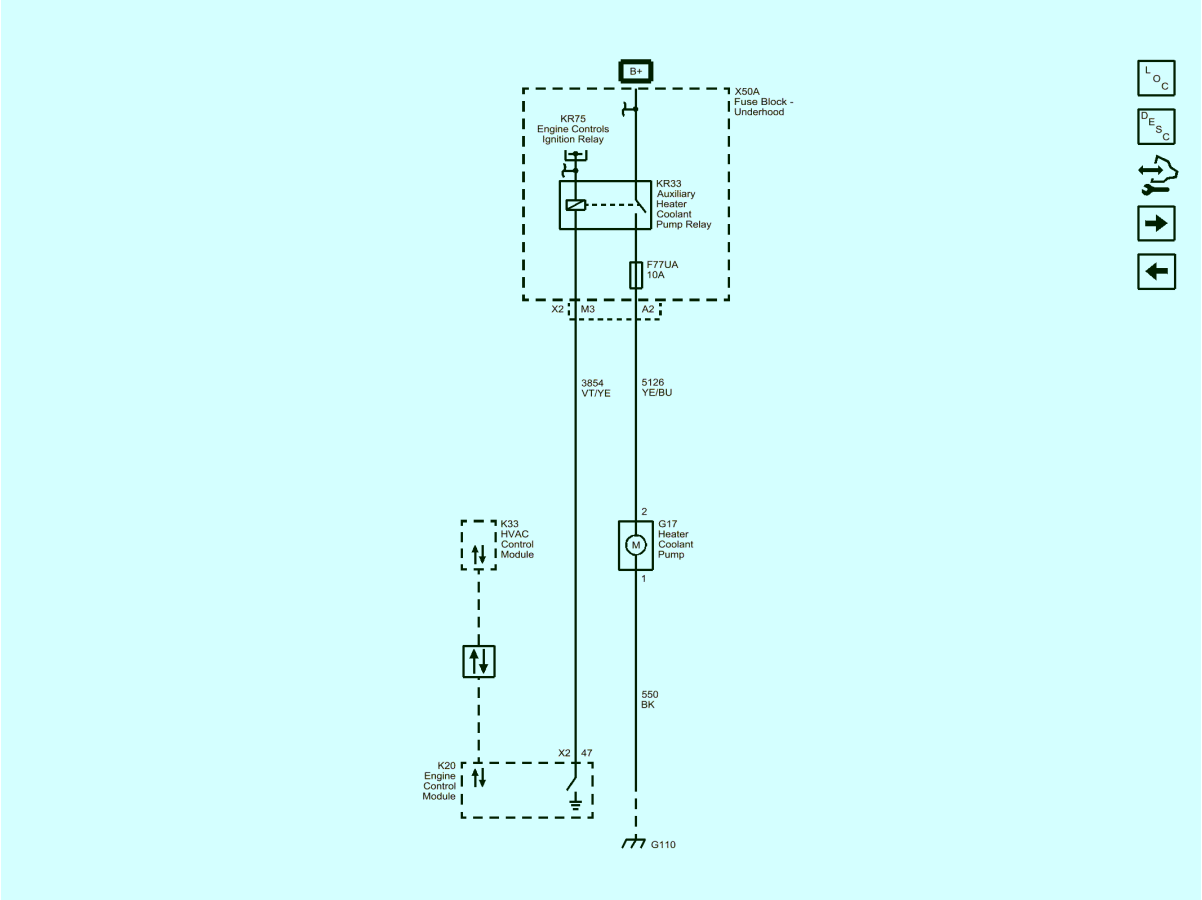

Fig. 5: Heater Coolant Pump (HP5)
Courtesy of GENERAL MOTORS COMPANY

Heater Coolant Pump (L5P)

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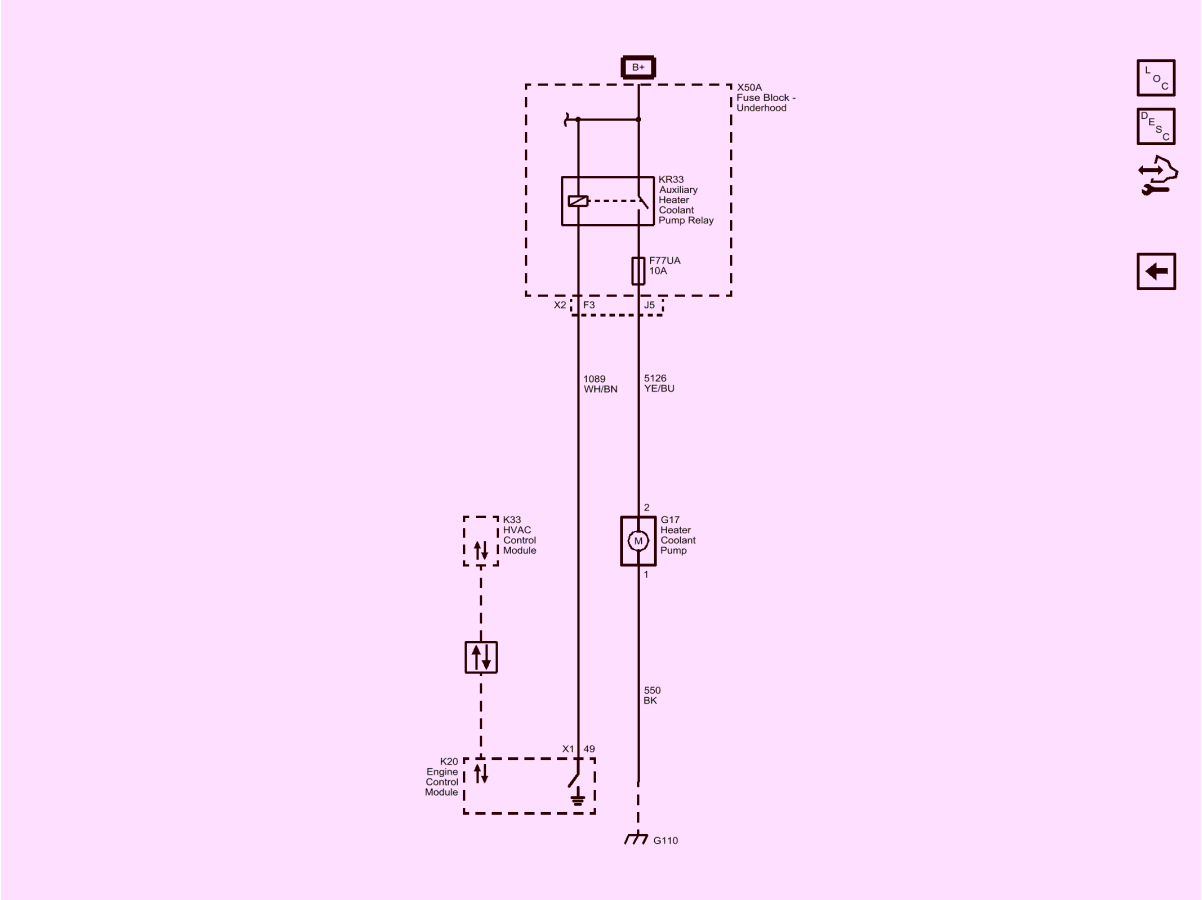

Fig. 6: Heater Coolant Pump (L5P)
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

HVAC COMPONENT REPLACEMENT REFERENCE

Component	Repair Instruction
A26 HVAC Controls	Heater and Air Conditioning Control Replacement
B1 A/C Refrigerant Pressure Sensor	Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement (L83, L96, LV3) Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement (L8B)
B39 A/C Evaporator Temperature Sensor	Evaporator Air Temperature Sensor Replacement
K33 HVAC Control Module	Heater and Air Conditioning Remote Control Replacement
M37 Mode Door Actuator	Mode Valve Actuator Replacement
M46 Air Recirculation Door Actuator	Air Inlet Valve Actuator Replacement
M6 Air Temperature Door Actuator	Temperature Valve Actuator Replacement
M8 Blower Motor	Blower Assembly Replacement
Q2 A/C Compressor Clutch	Air Conditioning Clutch Assembly Replacement (LV3) Air Conditioning Clutch Assembly Replacement (L83, L86) Air Conditioning Clutch Assembly Replacement (L96, LC8)

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Component	Repair Instruction
Q46 A/C Compressor Solenoid Valve	Air Conditioning Compressor Replacement (LV3) Air Conditioning Compressor Replacement (L83, L86) Air Conditioning Compressor Replacement (L96, LC8) Air Conditioning Compressor Replacement (L8B) Air Conditioning Compressor Replacement (L5P)

DTC B0193: FRONT BLOWER MOTOR

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	1
Ground	-	B0193 01	-	-
1. HVAC Malfunction				

Circuit/System Description

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

B0193 01

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

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B0193 06

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

Action Taken When the DTC Sets

The blower motor is inoperative.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

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

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

Check for Preliminary Information or Technical Service Bulletins.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Manual 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 M8 Blower Motor. It may take up to 10 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 6 and ground.
    - **If 10 Ω or greater**

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1. Ignition OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF, remove the test lamp.
2. Test for less than 2 Ω in the B+ circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF, remove the test lamp.
2. Test for infinite resistance between the B+ circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the M8 Blower Motor.

- **If the test lamp illuminates**

4. Remove the test lamp.
5. Ignition ON. Test for less than 1 V between the control circuit terminal 2 and ground.

- **If 1 V or greater**

1. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module. Ignition ON.
2. Test for less than 1 V between the control circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K33 HVAC Control Module

- **If less than 1 V**

6. Ignition OFF. It may take up to 10 min for all vehicle systems to power down.
7. Test for infinite resistance between the control circuit terminal 2 and ground.

- **If less than infinite resistance**

1. Disconnect the X2 harness connector at the K33 HVAC Control Module.
2. Test for infinite resistance between the control circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the K33 HVAC Control Module

- **If infinite resistance**

NOTE: **Verify the ignition is OFF before connecting the blower motor or incorrect test results may occur.**

8. Ignition OFF, connect the harness connector at the M8 Blower Motor. Ignition ON.
9. While backprobing terminal 2 at the M8 Blower Motor, test for greater than 1 V between control circuit and ground.

- **If less than 1 V**

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Replace the M8 Blower Motor.

- **If 1 V or greater**

10. Verify the voltage decreases and increases while using the controls to change the blower speed selection.
    - **If the voltage does not decrease and increase as the blower speed selection is changed**
    1. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module.
    2. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K33 HVAC Control Module.
    - **If the voltage decreases and increases as the blower speed selection is changed**
11. Replace the M8 Blower Motor.

Repair Instructions

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

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

DTC B0223, B0228, B0233, B0408, B0413, B1395, OR B374A: RECIRCULATE POSITION

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 B0223

Recirculate Position Command 1 Circuit

DTC B0228

Left Recirculate Position Feedback Circuit

DTC B0233

Air Flow Control Circuit

DTC B0408

Main Temperature Control Circuit

DTC B0413

Main Temperature Control Feedback Circuit

DTC B1395

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Control Module Voltage Reference Output Circuit

DTC B374A

Air Flow Control Feedback Circuit

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5V Reference	B1395 03	B1395 07	B1395 07	-
Recirculation Actuator Signal	B0228 02	B0228 05	B0228 05	1
Main Temperature Actuator Signal	B0413 02	B0413 05	B0413 05	2
Mode Actuator Signal	B374A 02	B374A 05	B374A 05	3
Recirculation Actuator Control 1	B0223 02	B0223 04	B0223 01	1
Recirculation Actuator Control 2	B0223 02	B0223 04	B0223 01	1
Main Temperature Actuator Control 1	B0408 02	B0408 04	B0408 01	2
Main Temperature Actuator Control 2	B0408 02	B0408 04	B0408 01	2
Mode Actuator Control 1	B0233 02	B0233 04	B0233 01	3
Mode Actuator Control 2	B0233 02	B0233 04	B0233 01	3
Low Reference	-	B0228 05	-	-

1. Air Recirculation Malfunction
2. Main Temperature Malfunction
3. Air Distribution Malfunction

Circuit/System Description

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

Each actuator used in the system is a 5-wire bi-directional electric motor that incorporate a feedback potentiometer. The five circuits are, low reference, 5 V reference, actuator position signal, and two control circuits. The control circuits use either a ground or 12 V value to coordinate the actuator movement. In order to move the actuator, the HVAC control module grounds one of the control circuits while providing the other with 12 V. The HVAC control module reverses the polarity of the control circuits to move the actuator in the opposite direction.

When the actuator shaft rotates, the potentiometer's sliding contact changes the door position signal between 0-5 V. The HVAC control module converts the voltage signal to counts. The total range of the counts is 0-1024, with an operating range between 20-1000. The actual operating range of an actuator is determined during calibration. During calibration, the actuator is moved though its full range of travel and the module stores the minimum and maximum value. Based on the desired system operation, the module sets a commanded, or targeted, value for the actuators. The control circuits are operated to move the door to the required position, and

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the changing position signal is sent to the module. Once the actual position signal and the commanded value are the same, the module ceases operating the control circuits and the actuator (and door) remain in the desired position.

Conditions for Running the DTC

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

Conditions for Setting the DTC

B0223, B0233, B0408

The HVAC control module detects a short to ground, short to voltage, or an open on one of the control circuits.

B0228 02, B0413 02, or B374A 02

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

B0228 05, B0413 05, or B374A 05

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

B0228 61, B0413 61, or B374A 61

The HVAC control module has commanded the actuator to move, and the sensor signal is not changing or has not moved to the commanded position.

B1395 03

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

B1395 07

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

Action Taken When the DTC Sets

B1395

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

B0223, B0228, B0233, B0408, B0413, or B374A

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

Conditions for Clearing the DTC

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The condition for setting the DTC is no longer present.

Diagnostic Aids

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

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

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- **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 B1395 is not set.
        - If DTC B1395 is set, refer to Circuit/System Testing - DTC B1395.
        - If DTC B1395 is not set, refer to Circuit/System Testing - DTC B0223, B0228, B0233, B0408, B0413, or B374A.
    - **If the concern or DTC has been corrected**
3. All OK.

Circuit/System Testing

DTC B1395

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the components listed

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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

2. Disconnect the X2 and X3 harness connectors at the K33 HVAC Control Module.
3. Test for infinite resistance between the K33 HVAC Control Module 5 V reference circuit terminal 17 X2 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 5 V reference terminal 17 X2 and ground.
   - **If 1 V or greater**

     Repair the short to voltage on the circuit.

   - **If less than 1 V**
6. Clear all DTCs.
7. Ignition OFF, connect the X2 and X3 harness connectors at the K33 HVAC Control Module, ignition ON.
8. Verify DTC B1395 is not set.
   - **If the DTC is set.**

     Replace the K33 HVAC Control Module.

   - **If the DTC is not set.**
9. Verify DTC B1395 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
   - **If the DTC sets after connecting one of the components**

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

   - **If the DTC does not set**
10. All OK.

DTC B0223, B0228, B0233, B0408, B0413, or B374A

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate door actuator. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module.

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2. Test for less than 2 Ω in the low reference circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K33 HVAC Control Module.
- **If less than 10 Ω**

3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF, disconnect the X2 and X3 harness connectors at the K33 HVAC Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 5 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K33 HVAC Control Module.
    - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the X2 and X3 harness connectors at the K33 HVAC Control Module, ignition ON.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K33 HVAC Control Module.
    - **If between 4.8-5.2 V**
5. Test for 4.8-5.2 V between the signal circuit terminal 2 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K33 HVAC Control Module.
    - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K33 HVAC Control Module.
    - **If between 4.8-5.2 V**
6. Ignition OFF, disconnect the harness connectors at the K33 HVAC Control Module, ignition ON.
7. Test for less than 1 V between each control circuit listed below and ground:
    - Actuator terminal 5
    - Actuator terminal 6

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- **If 1 V or greater**

  Repair the short to voltage on the circuit.

- **If less than 1 V**

8. Ignition OFF.
9. Test for infinite resistance between each control circuit listed below and ground:
   - Actuator terminal 5
   - Actuator terminal 6
   - **If less than infinite resistance**

     Repair the short to ground on the circuit.

   - **If infinite resistance**
10. Test for less than 2 Ω in each control circuit end to end.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**

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

11. Test or replace the actuator.
12. Verify the DTC does not set or the symptom does not occur while operating the vehicle within the Conditions for Running the DTC.
    - **If the DTC or symptom is not corrected**

      Replace the K33 HVAC Control Module.

    - **If the DTC or symptom is corrected**
13. All OK.

Repair Instructions

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

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

DTC B048D OR B048E: AUXILIARY HEATER

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

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DTC B048D

Auxiliary Heater Temperature Command Circuit

DTC B048E

Auxiliary Heater System Malfunction

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ground	B048E 00	B048E 00	B048E 00	-
B+	B048E 00	B048E 00	B048E 00	-
Ignition	B048E 00	B048E 00	B048E 00	-
Control	B048D 06	B048D 06	B048D 01	-
Signal	B048E 00	B048E 00	B048E 00	-

Circuit/System Description

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

B048D 01

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

B048D 06

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

B048E 00

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

Action Taken When the DTC Sets

The electrical auxiliary heater is inoperative.

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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Description and Operation

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC B048D 01 or B048D 06 is not set.
   - **If DTC B048D is present**

     Refer to Electrical Auxiliary Heater Control Circuit Malfunction - Circuit System Testing.

   - **If DTC B048D is not present**
2. Verify that DTC B048E is not set.
   - **If DTC B048E is present**

     Refer to Electrical Auxiliary Heater Signal Circuit Malfunction - Circuit System Testing.

   - **If DTC B048E is not present**
3. Verify the electrical auxiliary heater operates when commanded on by the HVAC module.
   - **If the electrical auxiliary heater does not operate**

     Refer to Electrical Auxiliary Heater Control Circuit Malfunction.

   - **If the electrical auxiliary heater does operate**
4. All OK.

Circuit/System Testing

Electrical Auxiliary Heater Control Circuit Malfunction

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1. Ignition OFF, disconnect the X3 harness connector at the E40 Electrical Auxiliary Heater. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal A and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Disconnect the X2 harness connector at the E40 Electrical Auxiliary Heater, ignition ON.
4. Verify a test lamp illuminates between the B+ circuit terminal A X2 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit terminal and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the E40 Electrical Auxiliary Heater.
    - **If the test lamp illuminates**
5. Ignition OFF, remove the test lamp and disconnect the X1 harness connector at the E40 Electrical Auxiliary Heater, ignition ON.
6. Verify a test lamp illuminates between the ignition circuit terminal 2 X1 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit terminal 2 X1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the E40 Electrical Auxiliary Heater.
    - **If the test lamp illuminates**
7. Ignition OFF, remove the test lamp and disconnect the X2 harness connector at the K33 HVAC Control Module, ignition ON.
8. Test for less than 0.3 V between the control circuit terminal 7 X2 at the K33 HVAC Control Module harness connector and ground.
    - **If greater than 0.3 V**

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Repair the short to voltage on the circuit.

- **If less than 0.3 V**

9. Ignition OFF.
10. Test for infinite resistance between the K33 HVAC Control Module control circuit terminal 7 X2 and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
11. Test for less than 5 Ω between the K33 HVAC Control Module control circuit terminal 7 X2 and the E40 Electrical Auxiliary Heater control circuit terminal 1 X1.
    - **If greater than 5 Ω**

      Repair the open/high resistance in the circuit.

    - **If less than 5 Ω**
12. Replace the E40 Electrical Auxiliary Heater.
13. Ignition ON.
14. Verify heater related DTCs are not set.
    - **If DTCs are set**

      Replace the K33 HVAC Control Module.

    - **If DTCs are not set**
15. All OK.

Electrical Auxiliary Heater Signal Circuit Malfunction

1. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module and disconnect the X1 harness connector at the E40 Electrical Auxiliary Heater, ignition ON.
2. Test for less than 0.3 V between the K33 HVAC Control Module signal circuit terminal 5 X2 and ground.
    - **If greater than 0.3 V**

      Repair the short to voltage on the circuit.

    - **If less than 0.3 V**
3. Ignition OFF.
4. Test for infinite resistance between the K33 HVAC Control Modules signal circuit terminal 5 X2 and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
5. Test for less than 5 Ω between the K33 HVAC Control Module control circuit terminal 5 X2 and the E40 Electrical Auxiliary Heater control circuit terminal 4 X1.

o

- **If greater than 5 Ω**

  Repair the open/high resistance in the circuit.

- **If less than 5 Ω**

6. Replace the E40 Electrical Auxiliary Heater.
7. Ignition ON.
8. Verify heater related DTCs are not set.
   - **If DTCs are set**

     Replace the K33 HVAC Control Module.

   - **If DTCs are not set**
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

DTC B1020: AUXILIARY ELECTRONIC CONTROL UNIT

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 B1020

Auxiliary Electronic Control Unit (ECU) Performance

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The HVAC module communicates with the HVAC controls via serial data. This DTC indicates a fault in the HVAC controls. The HVAC controls may continue to respond normally to faceplate functions when this DTC is set.

Conditions for Running the DTC

- Ignition is ON or in the ACC position.
- The system voltage is at least 9.5 V and no more than 15.5 V.
- All the above conditions are present for greater than 10 s.

Conditions for Setting the DTC

o

The HVAC module receives an improper status response indicating an internal ECU fault in the HVAC controls.

Action Taken when the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- A current DTC clears when the HVAC module receives a proper status response message back from the HVAC controls assembly.
- A history DTC clears after 50 malfunction-free ignition cycles.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the HVAC controls.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the HVAC controls.
- If this DTC is retrieved as both a current and history DTC, replace the HVAC controls.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B1020 is not set.
    - **If DTC B1020 is set**

      Replace the A26 HVAC Controls.

    - **If DTC B1020 is not set**

o

3. All OK.

Repair Instructions

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

Control Module References for HVAC controls replacement, programming, and setup

DTC B269A, B269C, OR B269D: HEATER COOLANT PUMP

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

DTC B269C

Heater Coolant Pump Control Circuit Low Voltage

DTC B269D

Heater Coolant Pump Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Coolant Pump Relay Coil Control	B269C, 2	B269A, 1	B269D, 1	-
Coolant Pump Relay Controlled Output	B3844 06, 1	1	2	-
Coolant Pump Ground	-	1	-	-
1. Coolant Pump inoperative 2. Coolant pump always on				

Circuit/System Description

The coolant heater pump is controlled by a relay. When operating conditions exist that requires coolant flow when the engine is not operating, the HVAC control module turns ON the heater coolant pump by applying ground to the relay control circuit which energizes the heater coolant pump relay.

Reference Information

Schematic Reference

HVAC Schematics

o

Connector End View Reference

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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 Verification

1. Vehicle in Service Mode.
2. Verify the G17 Heater Coolant Pump operates when commanding the Auxiliary Coolant Pump Relay On and Off with a scan tool.
   - **If the G17 Heater Coolant Pump does not operate**

     Refer to Circuit/System Testing

   - **If the G17 Heater Coolant Pump operates**
3. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block- Underhood.
2. Connect a test lamp between the control circuit terminal M3 and B+, ignition ON.
3. Verify the test lamp turns ON and OFF when commanding the G17 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 harness connector at the K20 Engine Control Module, ignition ON.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Ignition OFF.
   4. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If the test lamp is always ON**

o

1. Ignition OFF, remove the test lamp, 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**

4. Ignition OFF and all vehicle systems OFF, connect the harness connector at the X50A Fuse Block- Underhood. Disconnect the harness connector at the G17 Heater Coolant Pump. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 10 Ω between the ground circuit terminal 1 and ground.

- **If 10 Ω or greater**

1. Ignition OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

6. Connect a test lamp between the control circuit terminal 2 and ground.
7. Verify the test lamp turns ON and OFF when commanding the G17 Heater Coolant Pump ON and OFF with a scan tool.

- **If the test lamp is always OFF and the circuit fuse is good**

1. Ignition OFF, remove the test lamp, disconnect the X2 harness connector at the X50A Fuse Block- Underhood.
2. Test for less than 2 Ω in the control circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the X50A Fuse Block- Underhood.

- **If the test lamp is always OFF and the circuit fuse is open**

1. Ignition OFF, remove the test lamp.
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, test or replace the G17 Heater Coolant Pump.

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

1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block- Underhood, ignition ON.
2. Test for less than 1 V between the control circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the X50A Fuse Block- Underhood.

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

8. Test or replace the G17 Heater Coolant Pump.

Repair Instructions

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

o

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

DTC B3933: AIR CONDITIONING EVAPORATOR TEMPERATURE SENSOR

Diagnostic Instructions

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

DTC Descriptors

DTC B3933

Air Conditioning Evaporator Temperature Sensor Circuit

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Air Conditioning Evaporator Temperature Sensor Signal	B3933 02	B3933 05	B3933 05	-
Low Reference	-	B3933 05	B3933 05	-

Circuit/System Description

The evaporator temperature sensor is a 2-wire negative temperature coefficient thermistor.

The sensor operates using signal and low reference circuits. As the air temperature surrounding the sensor increases, the sensor resistance decreases. The sensor sends a signal voltage between 0-5 V. If the HVAC control module detects a malfunctioning sensor the software uses a default air temperature value. The default action ensures that the HVAC system can adjust the inside air temperature near the desired temperature until the condition is corrected.

Conditions for Running the DTC

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

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

The system operates using a default value.

Conditions for Clearing the DTC

o

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

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 Testing

1. Ignition OFF, cut both temperature sensor wires approximately 8 cm (3 in) from the B39 A/C Evaporator Temperature Sensor. It may take up to 10 min for all vehicle systems to power down.

NOTE:

- **Use the appropriate schematic to determine which wire to test.**
- **All testing is done at the K33 HVAC Control Module harness side of the wire.**
- **The scan tool must be disconnected from the vehicle before performing the next test.**

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

o

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

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
    - 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 B39 A/C Evaporator 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 control module replacement, programming and setup

DTC B393B: AIR CONDITIONING COMPRESSOR VALVE

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

o

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Electric Variable Displacement B+	B393B 0B	B393B 04	-	-
Electric Variable Displacement Control	B393B 04	B393B 04	B393B 0B	-

Circuit/System Description

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

Conditions for Running the DTC

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

Conditions for Setting the DTC

B393B 04

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

B393B 0B

Measured current is above threshold of 815 mA.

Action Taken When the DTC Sets

B393B 04

The A/C compressor is disabled.

B393B 0B

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

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the Q46 A/C Compressor Solenoid Valve. Connect a test light between terminals 1 and 2 of the harness connector. Ignition ON.
2. Verify the test light turns on and off when commanding the Q46 A/C Compressor Solenoid Valve ON and OFF with the scan tool.
    - **If the test light does not turn ON and OFF**
    1. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module, ignition ON.
    2. Test for less than 1 V between ground and each control circuit terminal listed below:
        - terminal 10
        - terminal 11
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Ignition OFF.
    4. Test for infinite resistance between ground and each control circuit terminal listed below:
        - terminal 10
        - terminal 11
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    5. Test for less than 2 Ω in each of the control circuits end to end listed below:
        - Q46 A/C Compressor Solenoid Valve terminal 1 and K33 HVAC Control Module terminal 10
        - Q46 A/C Compressor Solenoid Valve terminal 2 and K33 HVAC Control Module terminal 11
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K33 HVAC Control Module.

o

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

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

Component Testing

A/C Compressor Solenoid Valve Test

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

     Replace the G1 A/C Compressor.

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

     Replace the G1 A/C Compressor.

   - **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 control module replacement, programming and setup

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

Diagnostic Instructions

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

DTC Descriptors

DTC P0532

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

DTC P0533

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

Diagnostic Fault Information

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

o

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.

Conditions for Running the DTC

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

Conditions for Setting the DTC

P0532

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

P0533

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

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

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

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON
2. Verify the scan tool 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

   - **If between 6.8 kPa (1 psi) and 2950 kPa (428 psi)**
3. All OK

Circuit/System Testing

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

o

- If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the 5 V reference circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K20 Engine Control Module.

- **If between 4.8-5.2 V**

5. Verify the scan tool 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 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 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance

    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.

    - **If greater than 4.8 V**

8. Test or replace the B1 A/C Refrigerant Pressure Sensor.

Repair Instructions

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

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

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

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

o

- 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 Switch B+	1	1	-	-
Relay Coil Ignition	P0645	P0645	-	-
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

o

P0645 or P0646

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

P0647

The A/C compressor is inoperative.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

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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 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

o

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF, remove the test lamp.
2. Test for infinite resistance between the B+ circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance
3. Disconnect the harness connector at the Q2 A/C Compressor Clutch.
4. Test for infinite resistance between the control circuit terminal 87 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, test or replace the Q2 A/C Compressor Clutch.

- **If the test lamp illuminates**

3. Ignition ON.
4. Verify a test lamp illuminates between the ignition circuit terminal 86 and ground.
    - **If the test lamp does not illuminate**

      Refer to **Power Mode Mismatch** .

    - **If the test lamp illuminates**
5. Connect a test lamp between the ignition circuit terminal 86 and the control circuit terminal 85.
6. Verify the test lamp turns ON and OFF when commanding the ECM A/C Compressor Clutch Relay On and Off with a scan tool.
    - **If the test lamp is always OFF**

    1. Ignition OFF, remove the test lamp and disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Ignition OFF.
    4. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.

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

    1. Ignition OFF, remove the test lamp and disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K20 Engine Control Module.

    - **If the test lamp turns ON and OFF**
7. Verify a test lamp does not illuminate between the control circuit terminal 87 and ground.
    - **If the test lamp illuminates**

      Repair the short to voltage on the circuit.

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

o

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

Component Testing

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

      Replace the KR29 A/C Compressor Clutch Relay.

    - **If between 60-180 Ω**
3. Test for infinite resistance between the terminals listed below:
    - 30 and 86
    - 30 and 87
    - 30 and 85
    - 85 and 87
    - **If less than infinite resistance**

      Replace the KR29 A/C Compressor Clutch Relay.

    - **If infinite resistance**
4. Install a 15 A fused jumper wire between terminal 86 and 12 V. Install a jumper wire between terminal 85 and ground.
5. Test for less than 2 Ω between terminals 30 and 87.
    - **If 2 Ω or greater**

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Replace the KR29 A/C Compressor Clutch Relay.

- **If less than 2 Ω**

6. All OK.

Repair Instructions

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

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

SYMPTOMS - HVAC SYSTEMS - 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**

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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

Manual 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.**

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

     Replace the A26 HVAC Controls.

   - **If all parameters change**
3. Verify the blower motor operates properly with the blower motor switch in each speed position.
   - **If the blower motor does not operate in each speed position**

     Refer to **DTC B0193**.

   - **If the blower motor operates properly in each speed position**
4. Verify 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, B0228, B0233, B0408, B0413, B1395, or B374A**.

   - **If all HVAC doors move**
5. Install the J43600 ACR Air Conditioning Service Center.
6. Verify the high side pressure reading on the Air Conditioning Service Center is within 10% of the scan tool A/C High Side Pressure Sensor parameter.
   - **If the reading is not within 10%**

     Refer to **DTC P0532 or P0533**.

   - **If the reading is within 10%**
7. Verify the scan too lA/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 (R-134a)** **Air Conditioning (A/C) System Performance Test (R-1234yf)**

   - **If the reading is between 269-2929 kPa (39-425 PSI)**
8. Verify the scan tool A/C Evaporator Temperature Sensor parameter is within 10% of ambient temperature.
   - **If not within 10% of ambient temperature**

     Refer to **DTC B3933**.

   - **If within 10% of ambient temperature**
9. Engine ON, A/C system ON.
10. Verify cool air flows from the ducts with the temperature control in the coldest position.
    - **If the air is not cool**

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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 (R-134a)** **Air Conditioning (A/C) System Performance Test (R-1234yf)** , and **DTC B393B**.
- **If the air is cool**

11. 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**
12. Verify the Auxiliary Electric Heater (if equipped) is operating properly.
    - **If the Auxiliary Electric Heater is not operating properly**

      Refer to **DTC B048D or B048E**

    - If the Auxiliary Electric Heater is operating properly.
13. All OK.

Repair Instructions

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

- **HVAC Component Replacement Reference**

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.

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Diagnostic Aids

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

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

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Manual 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 Malfunctionbefore 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**

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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

Preferred Method (with Scan Tool)

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

1. Using a scan tool, perform the HVAC Actuators Learn in the HVAC Control Module.
2. Follow the scan tool directions to complete the procedure.
3. Operate the system and verify that no DTCs have set as current DTCs.
4. If DTC B101E 4B is set after attempting the actuator recalibration procedure, perform the following:
    1. Verify which actuator does not have a scan tool learn status parameter status of complete.

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2. Verify the unlearned actuator is physically rotating - A common cause of DTC B101E 4B is an actuator that is electrically OK but fails to physically rotate (e.g. stripped gears).
3. If the unlearned actuator is not physically rotating, replace the actuator, otherwise replace the HVAC control module.

Alternate Method (without Scan Tool)

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

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

REPAIR INSTRUCTIONS

WIRE TO WIRE REPAIR - HVAC

Special Tools

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

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

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

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

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

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

- **A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.**

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- **A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.**

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

Splice Sleeve Selection

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

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

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

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

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

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nests.

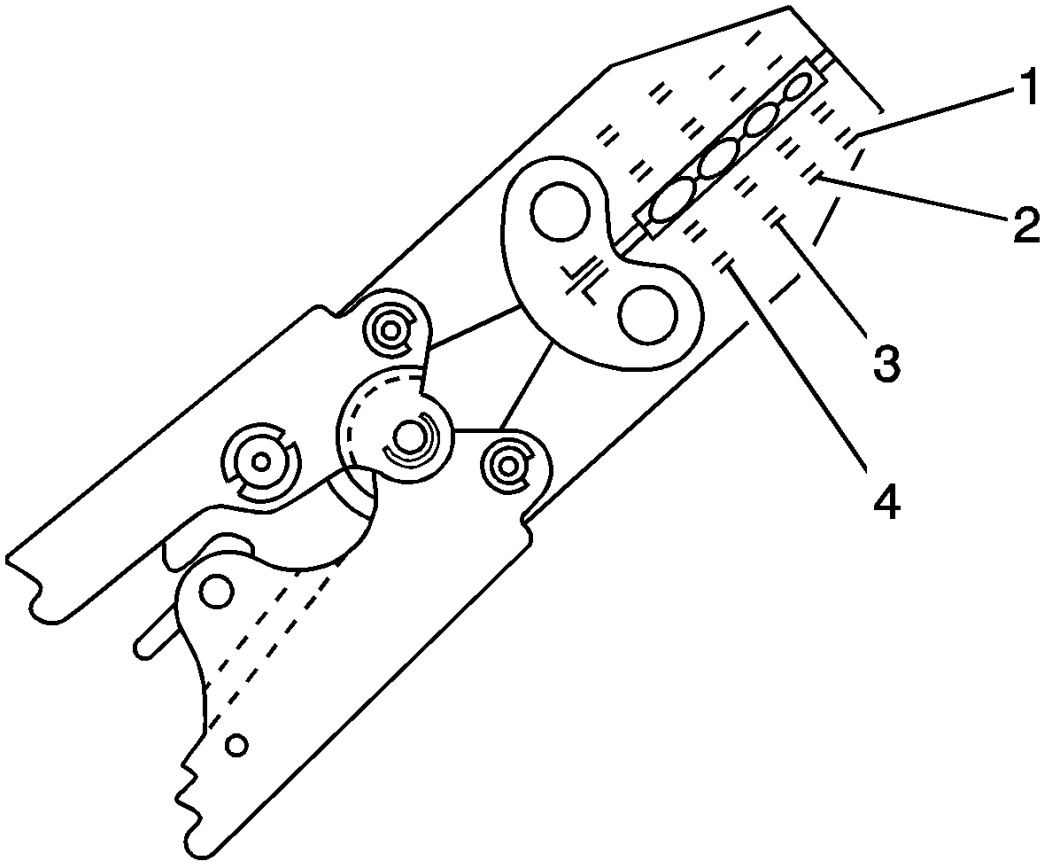

Fig. 7: Crimping Tool
Courtesy of GENERAL MOTORS COMPANY

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

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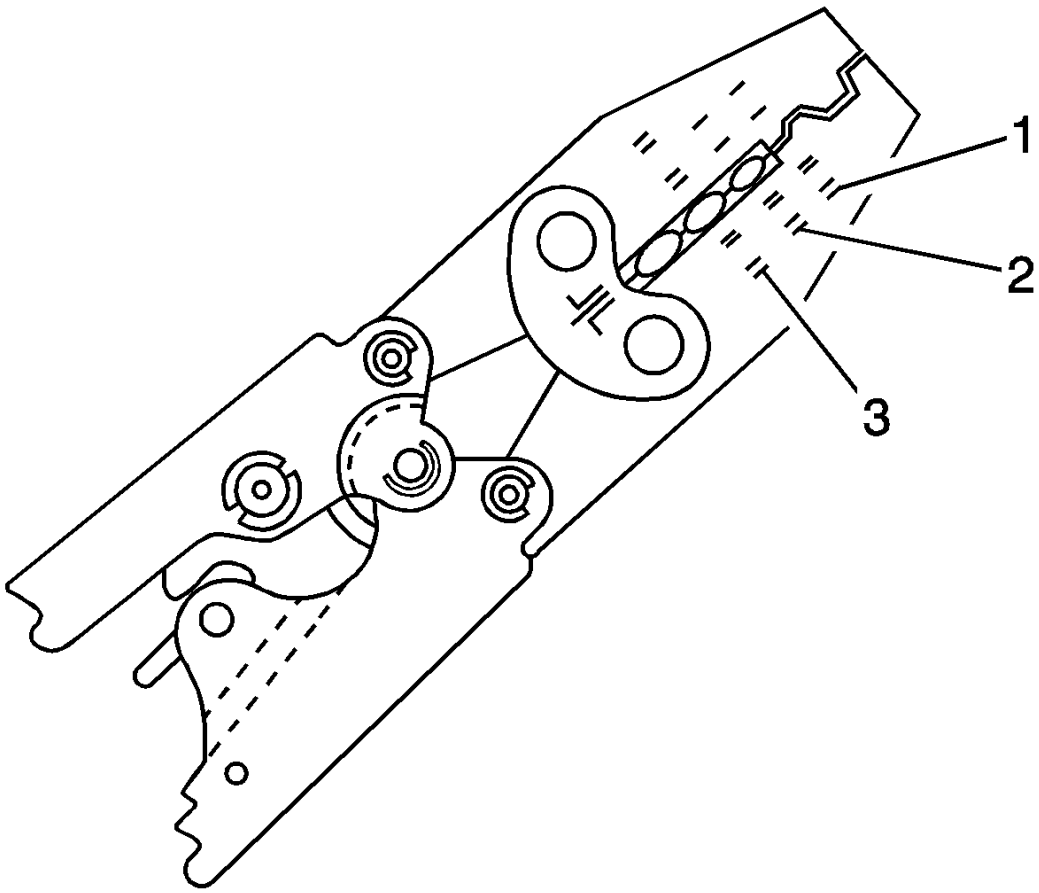

Fig. 8: Identifying Splice Crimp Tool Nests Terminal Identification
Courtesy of GENERAL MOTORS COMPANY

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

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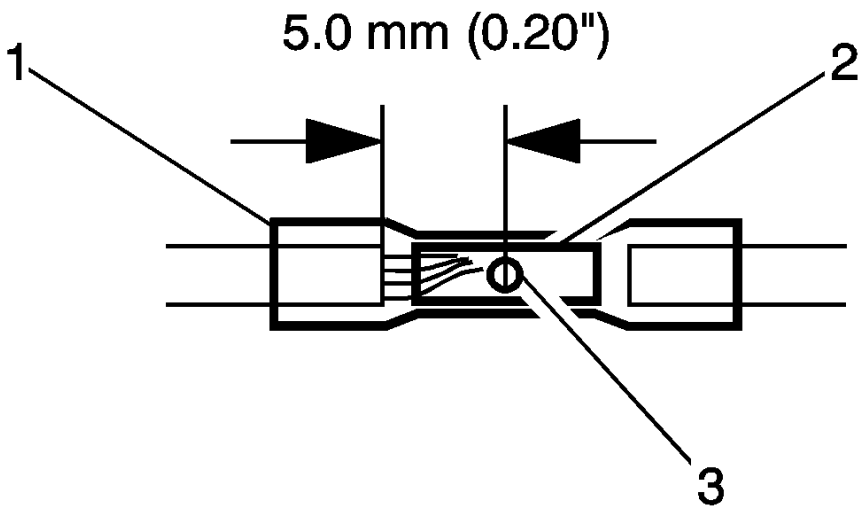

Fig. 9: Identifying Duraseal Splice Sleeve
Courtesy of GENERAL MOTORS COMPANY

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

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Fig. 10: Crimped Duraseal Splice Sleeve
Courtesy of GENERAL MOTORS COMPANY

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

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

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Fig. 11: Crimped Duraseal Splice Sleeve
Courtesy of GENERAL MOTORS COMPANY

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

Weatherpack™ Wiring Repair

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

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

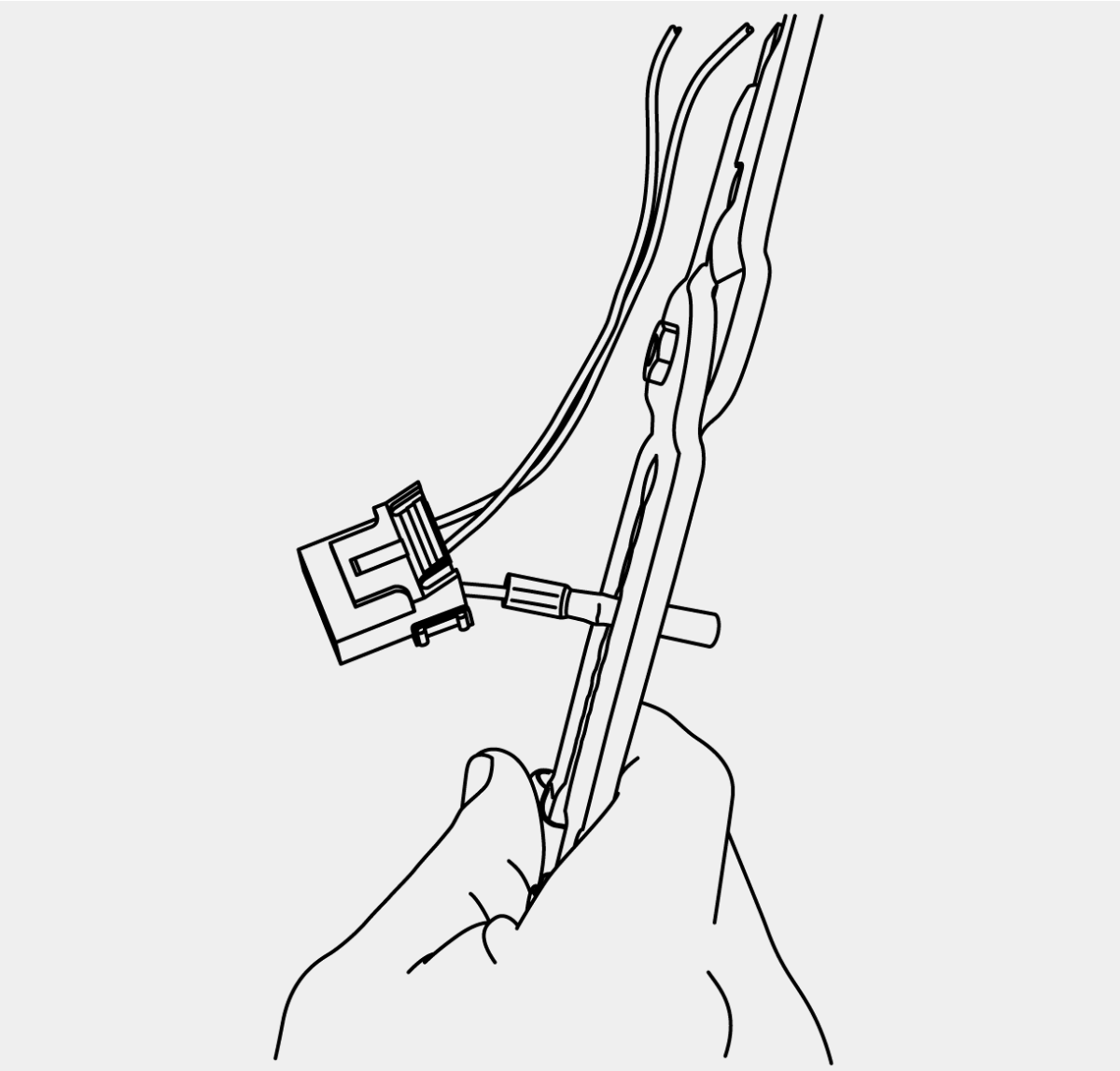

Fig. 12: Tightly Close Handles Of Crimp Tool
Courtesy of GENERAL MOTORS COMPANY

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

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

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

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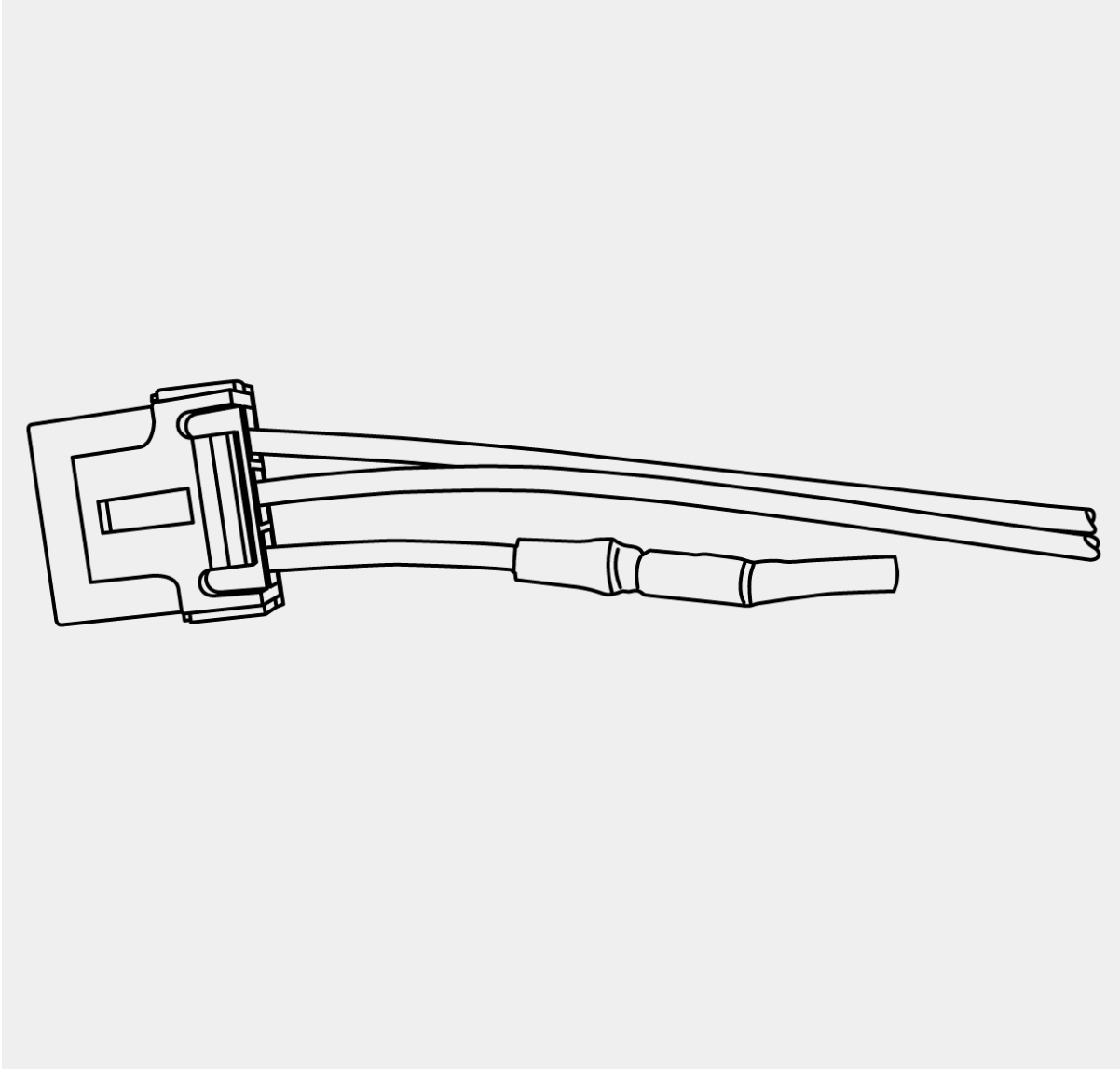

Fig. 13: Heat To Crimped Area Of Barrel
Courtesy of GENERAL MOTORS COMPANY

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

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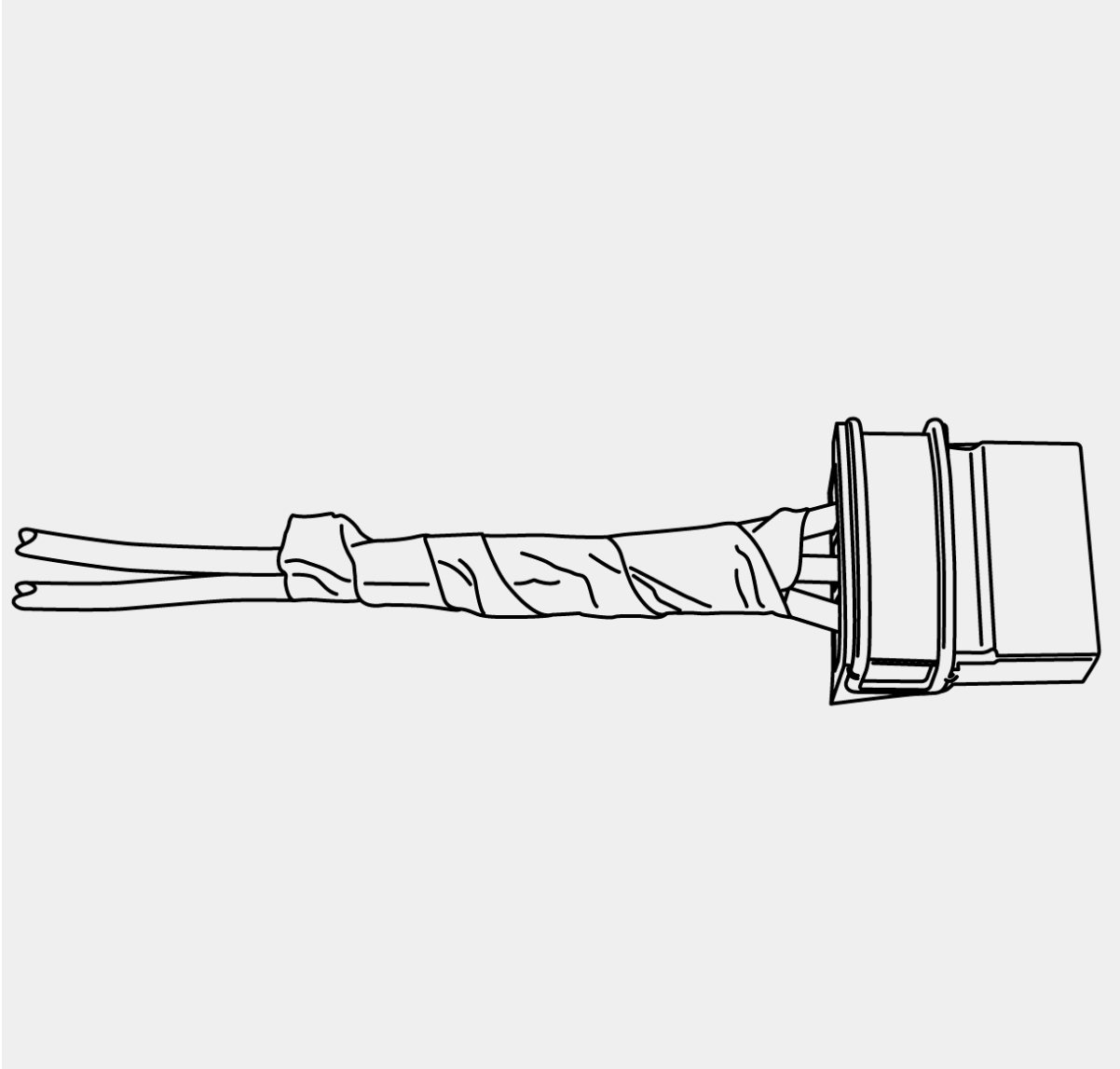

Fig. 14: Taping Extra Terminated Leads Back Into Harness
Courtesy of GENERAL MOTORS COMPANY

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

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

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

CONNECTOR RECONNECTION - HVAC

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Special Tools

EL-35616 Terminal Test Probe Kit

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

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

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

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

Testing for Terminal Fretting

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

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

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Testing for Proper Terminal Contact

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

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

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

Testing for Proper Terminal Contact in Bussed Electrical Centers

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

Follow the procedure below in order to test terminal contact:

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

Flat Wire Connectors

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

Follow the procedure below in order to test terminal contact:

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

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may

also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to **Circuit Testing** , and **Power Distribution Schematics (1500)** **Power Distribution Schematics ((2500/3500))** .

- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to **Circuit Testing** , and **Ground Distribution Schematics (1500)** **Ground Distribution Schematics ((2500/3500))** .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
  - High ambient temperatures
  - Underhood/engine generated heat
  - Circuit generated heat due to a poor connection, or high electrical load
  - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
  - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
  - The condition only occurs on a cold start.
  - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to **Inducing Intermittent Fault Conditions** in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

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

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.
- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is

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not operating. Refer to **Checking Aftermarket Accessories** .

- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

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

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

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

HEATER AND AIR CONDITIONING CONTROL REPLACEMENT

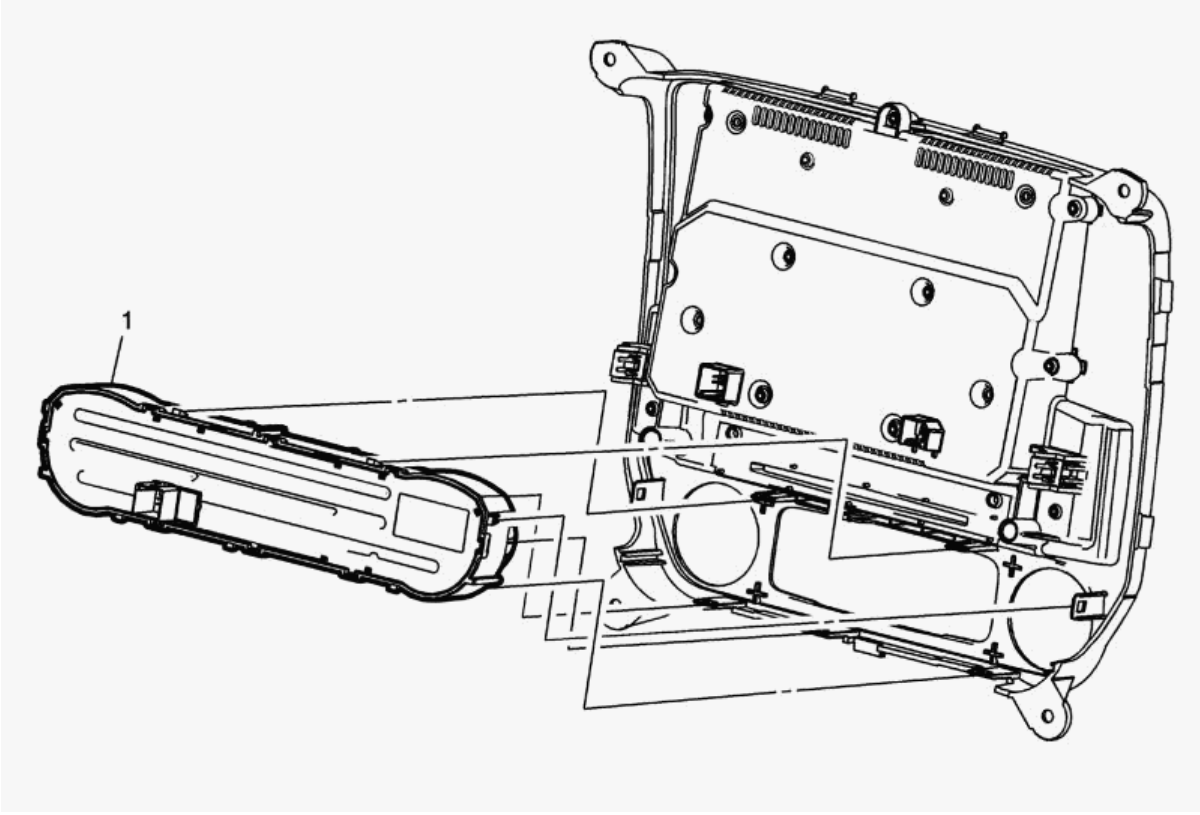

Fig. 15: Heater and Air Conditioning Control
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	

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Callout	Component Name
Remove the radio control assembly. Refer to **Radio Control Assembly Replacement** .	
1	Heater and Air Conditioning Control Assembly **Procedure** Disconnect the heater and air conditioning control assembly electrical connector.

HEATER AND AIR CONDITIONING REMOTE CONTROL REPLACEMENT

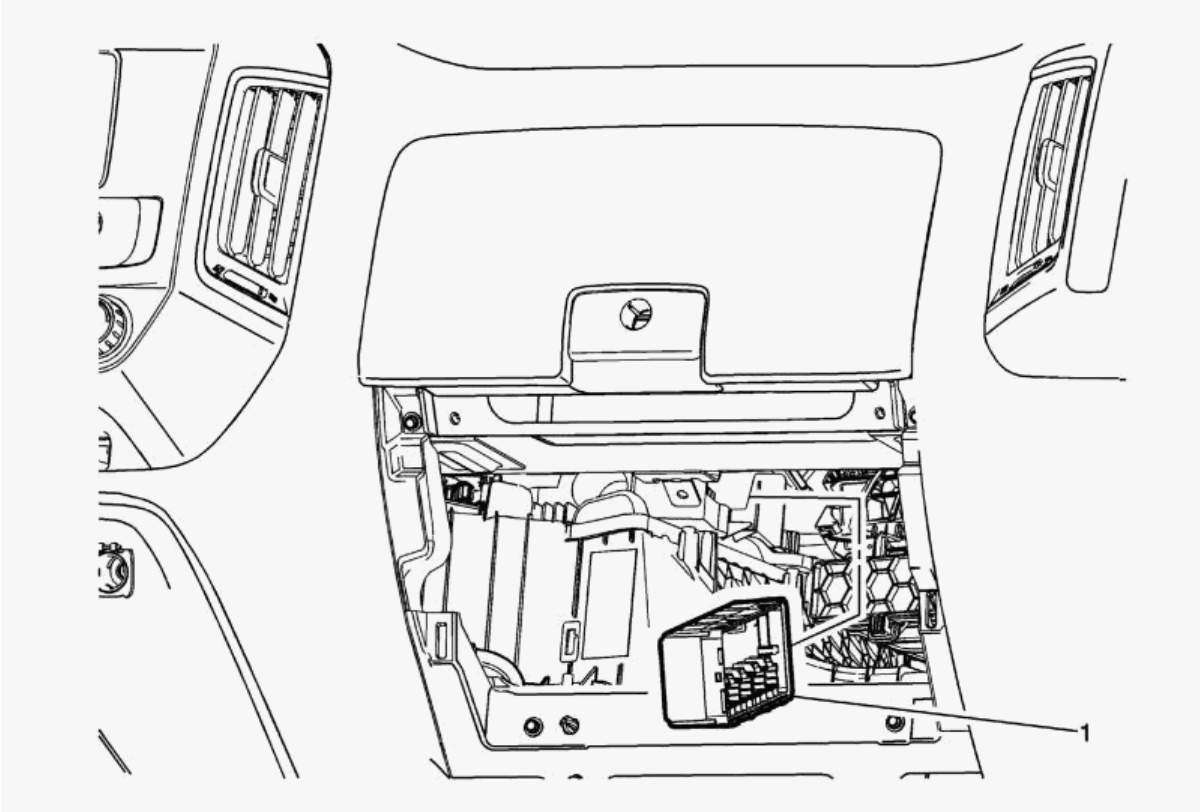

Fig. 16: Heater and Air Conditioning Remote Control
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Human Machine Interface Control Module Bracket Replacement** **NOTE:** **If the vehicle battery has NOT been disconnected, when reinstalling, replacing or reconnecting the HVAC remote control**	

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Callout	Component Name
module, the BROWN J2 connector must be connected last. Once all the parts are all in place, check and clear all DTCs in the HVAC module.	
1	Heater and Air Conditioning Remote Control **Procedures** 1. Unclip the heater and air conditioning remote control retainer from the heater cover. 2. Maneuver the heater and air conditioning remote control out and down from behind the instrument panel assembly. 3. Disconnect the heater and air conditioning remote control electrical connectors. 4. Perform the HVAC system control module programming and setup procedure. **Control Module References** 5. Perform the actuator calibration procedure. **Actuator Recalibration** 6. Clear all DTC in the heater and air conditioning remote control module.

TEMPERATURE VALVE ACTUATOR REPLACEMENT

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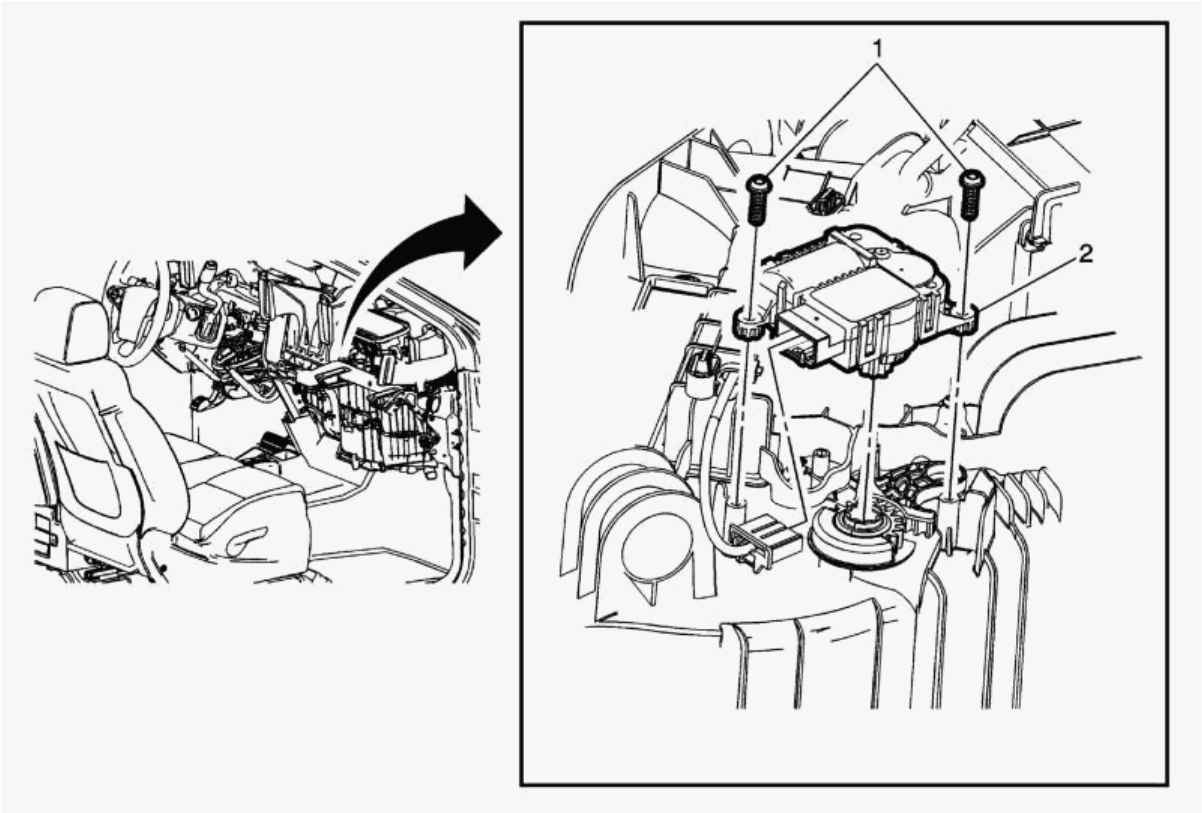

Fig. 17: Temperature Valve Actuator - Right Side
Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
CAUTION: **In order to avoid actuator damage, DO NOT apply power to the actuator when it is not installed in the HVAC module.** **Preliminary Procedure** Instrument Panel Assembly Removal	
1	Temperature Valve Actuator Fastener **CAUTION:** **Refer to Fastener Caution .**
2	Temperature Valve Actuator **Procedures**

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Call out	Component Name
	1. Disconnect the temperature valve actuator electrical connector. 2. Actuator Recalibration

MODE VALVE ACTUATOR REPLACEMENT

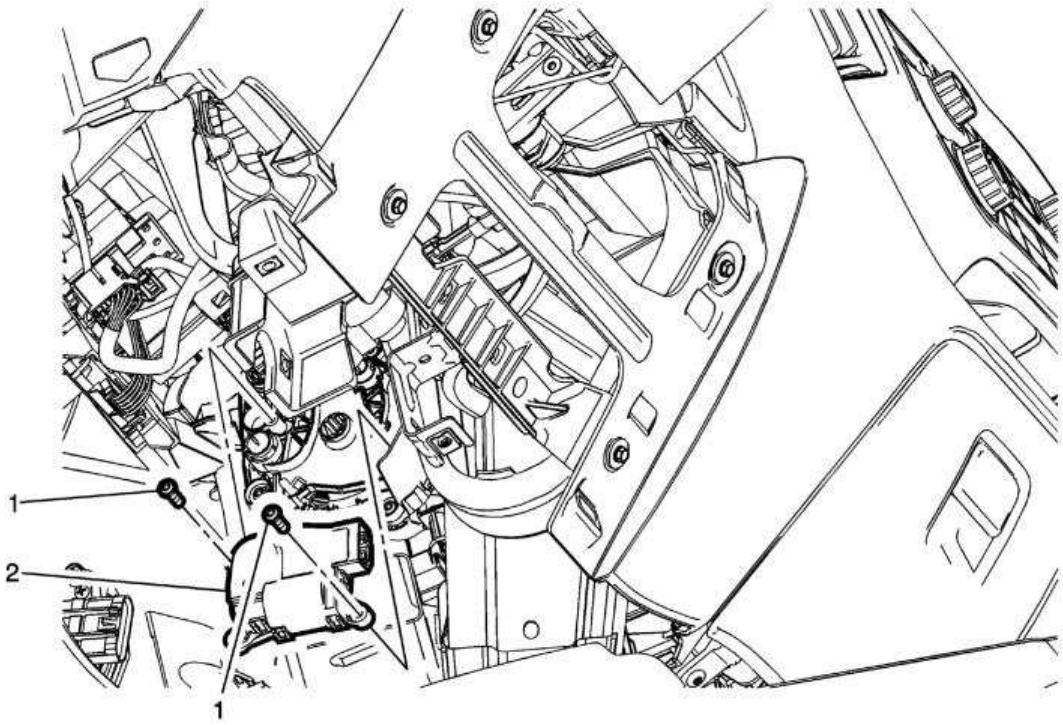

Fig. 18: Mode Valve Actuator
Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
	CAUTION: **In order to avoid actuator damage, DO NOT apply power to the actuator when it is not installed in the HVAC module.** **Preliminary Procedures** 1. Floor Front Air Outlet Duct Replacement - Left Side

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Call out	Component Name
2. Accessory AC and DC Power Control Module Replacement	
1	Mode Valve Actuator Motor Fastener **CAUTION:** **Refer to Fastener Caution .**
2	Mode Valve Actuator **Procedures** 1. Disconnect the mode valve actuator electrical connector. 2. Actuator Recalibration

MODE CONTROL CAM REPLACEMENT (C67)

Removal Procedure

1. With the ignition key in the on position, select the heater and air conditioning control to the vent mode position.
2. Turn the ignition key to the off position.

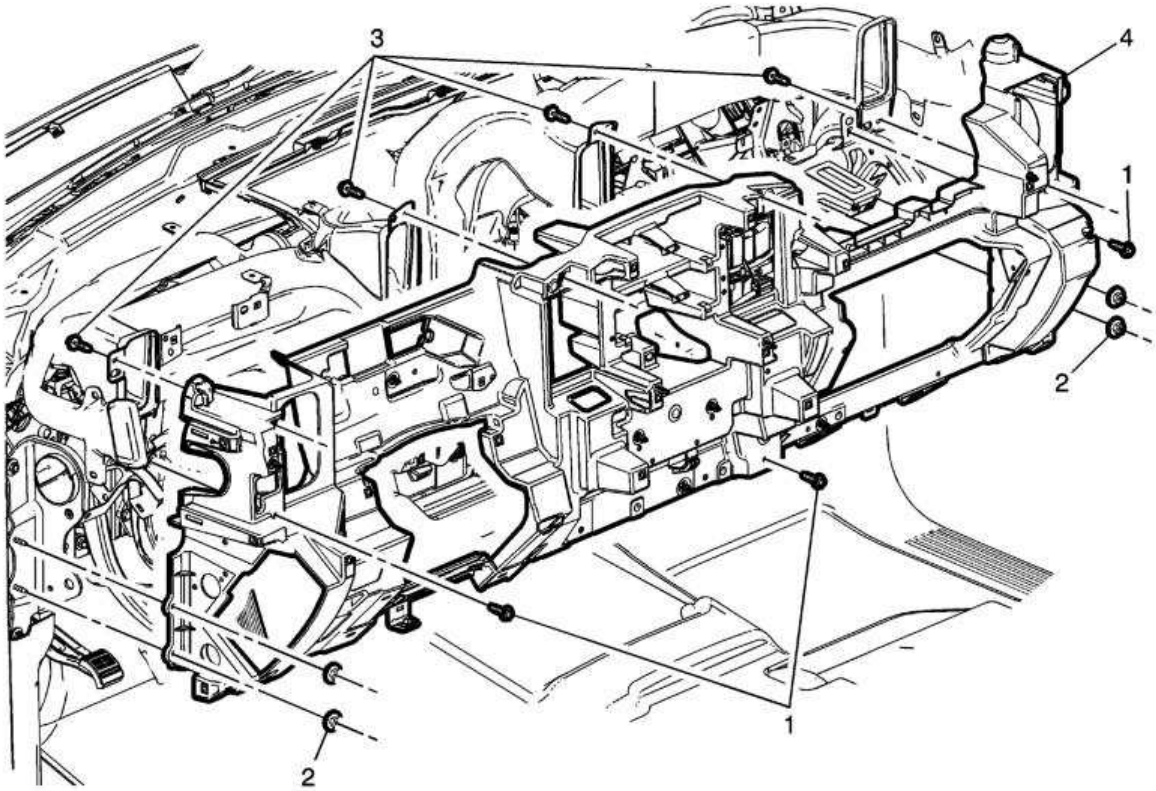

Fig. 19: Instrument Carrier
Courtesy of GENERAL MOTORS COMPANY

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3. Instrument Panel Carrier 4 - Remove - **Instrument Carrier Replacement**
4. Mode Valve Actuator - Remove - **Mode Valve Actuator Replacement**

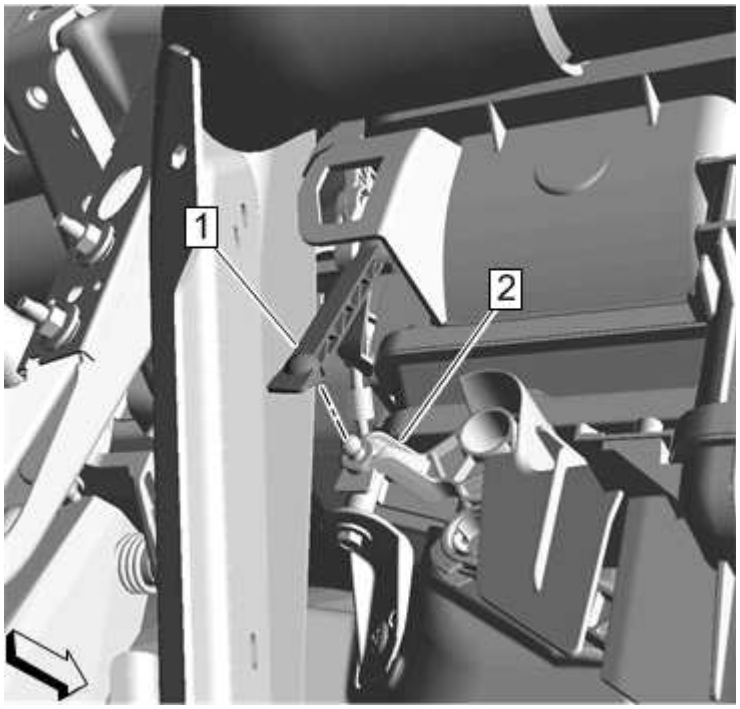

Fig. 20: Vent Valve Link And Floor Air Valve Lever
Courtesy of GENERAL MOTORS COMPANY

5. Un-snap the vent valve link (1) from the floor air valve lever (2).

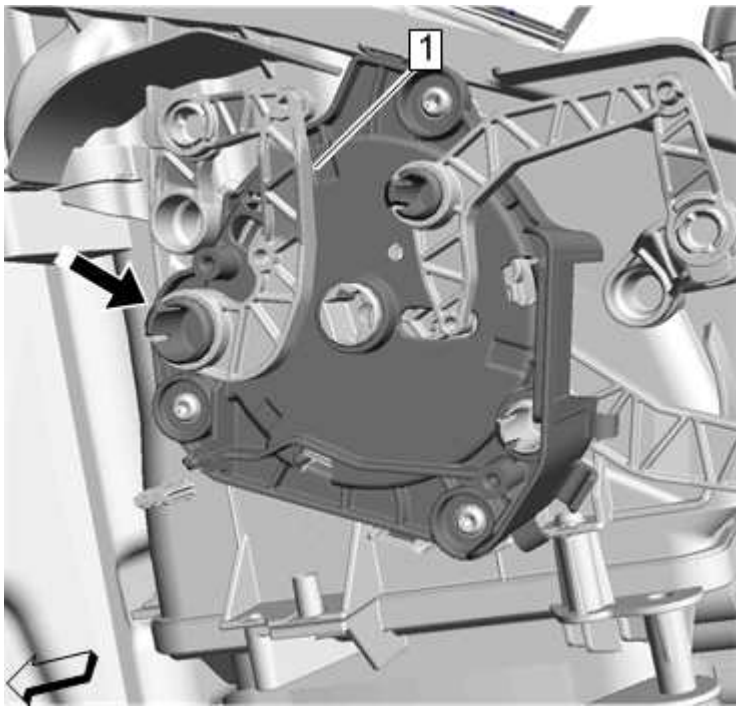

Fig. 21: Defroster Control Lever
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The instrument tie bar has been removed for clarity.**

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6. Depress the de-tent indicated by the arrow, and remove the heater and defroster control lever (1) from the mode control cam actuator mounting plate.

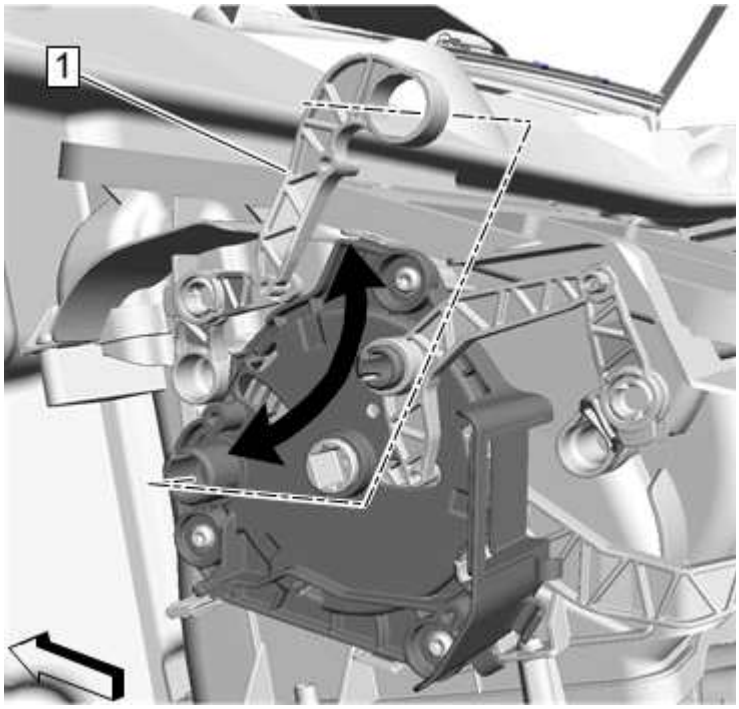

Fig. 22: Defroster Control Lever
Courtesy of GENERAL MOTORS COMPANY

7. Rotate the heater and defroster control lever (1) up and out of the way.

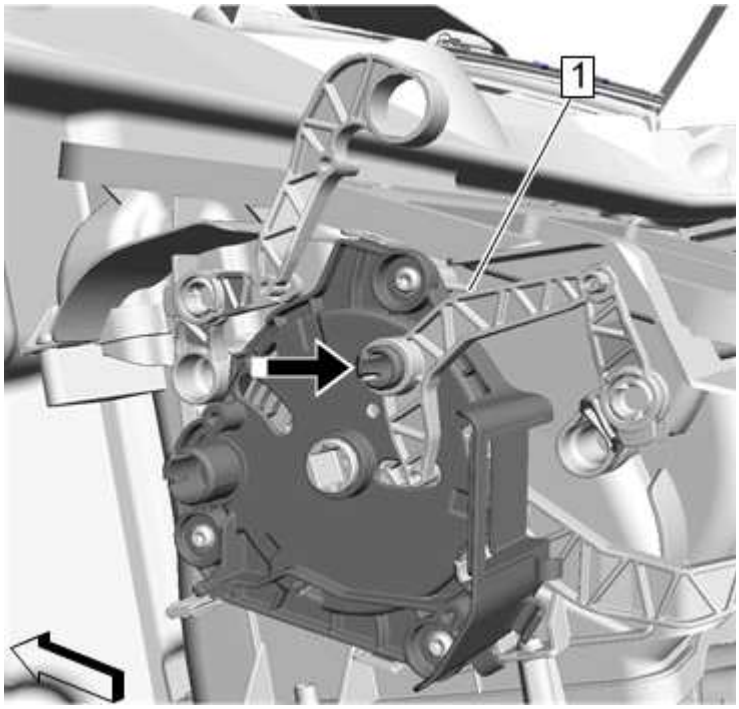

Fig. 23: Vent Valve Lever
Courtesy of GENERAL MOTORS COMPANY

8. Depress the de-tent indicated by the arrow, and remove the vent valve lever (1) from the mode control

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cam actuator mounting plate.

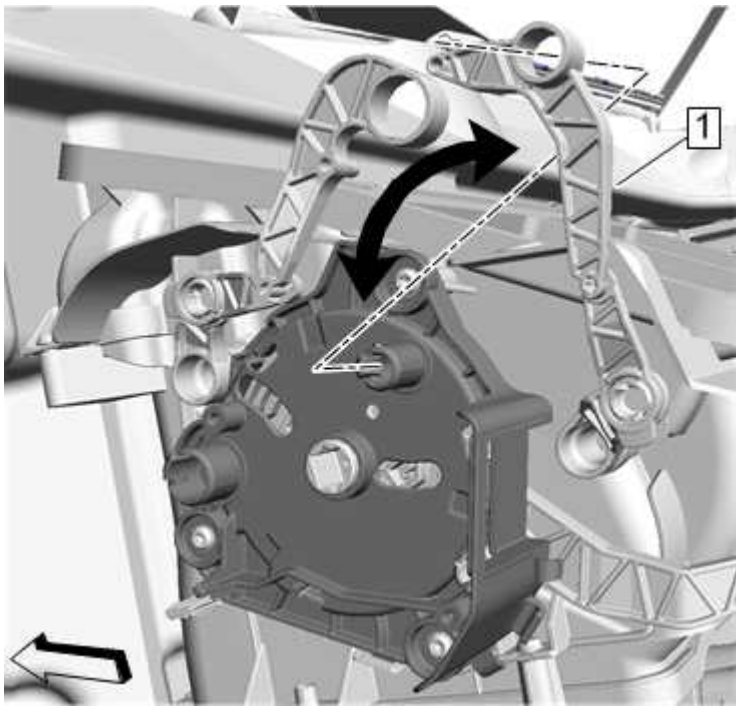

Fig. 24: Vent Valve Lever
Courtesy of GENERAL MOTORS COMPANY

9. Rotate the vent valve lever (1) up and out of the way.

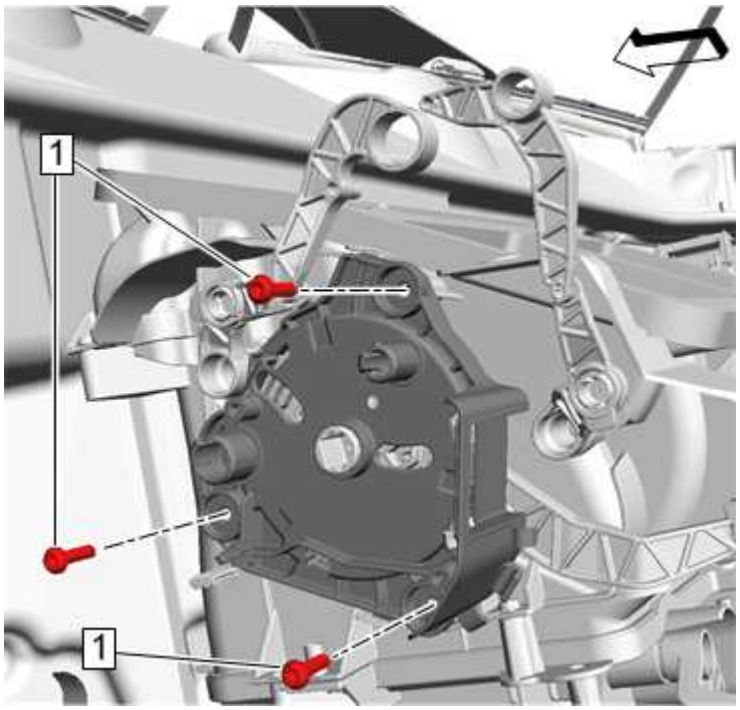

Fig. 25: Mode Control Cam Actuator Mounting Plate Bolt
Courtesy of GENERAL MOTORS COMPANY

10. Mode Control Cam Actuator Mounting Plate Bolt 1 @Mode Control Cam Actuator Mounting Plate - Remove

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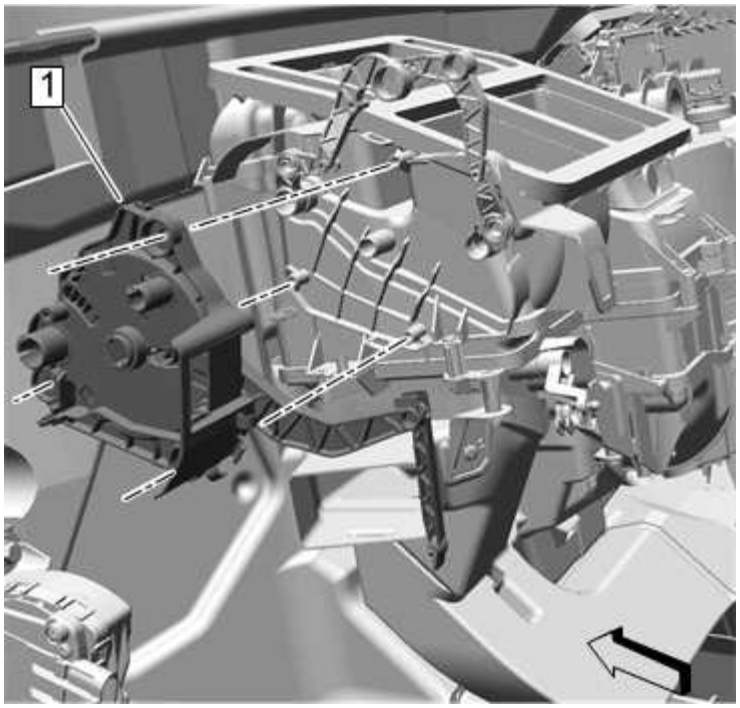

Fig. 26: Mode Control Cam
Courtesy of GENERAL MOTORS COMPANY

11. Mode Control Cam 1 - Remove

Installation Procedure

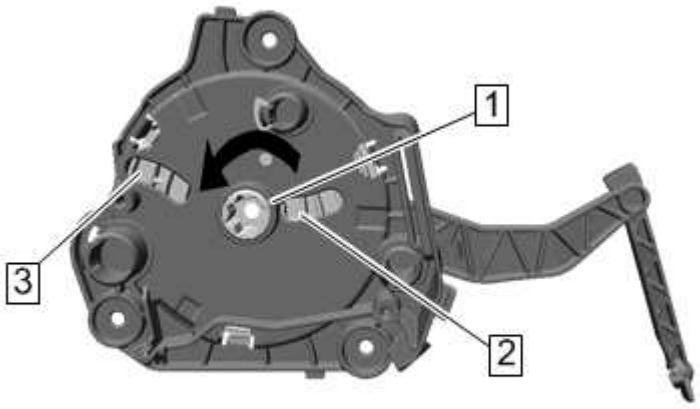

Fig. 27: Mode Control Cam Channel
Courtesy of GENERAL MOTORS COMPANY

1. Remove the vent valve lever and heater and defroster control lever from the replacement mode control cam assembly.

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2. Insert a 3/8 allen wrench into the actuator mode control cam interface drive gear (1), and rotate the mode control cam to the maximum counter clockwise travel position to set to the vent mode.

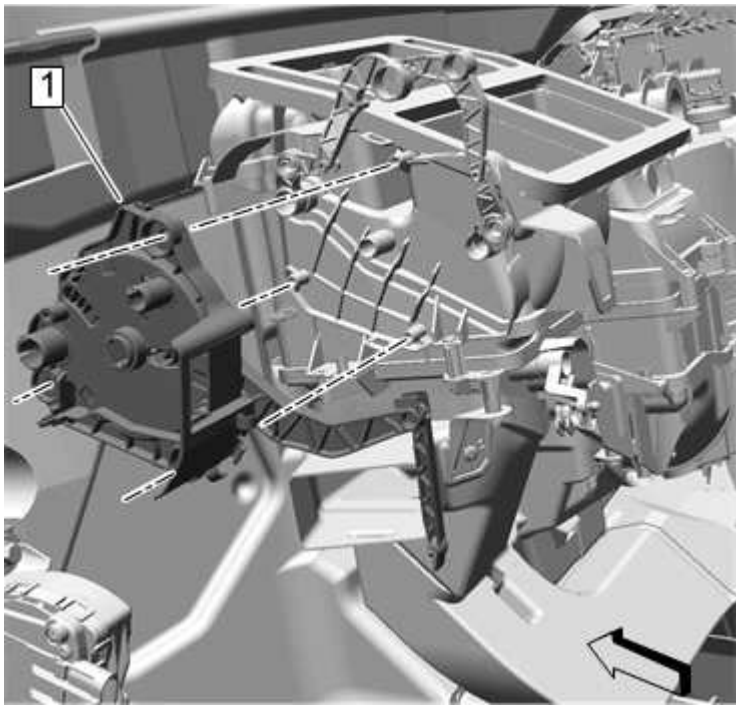

Fig. 28: Mode Control Cam
Courtesy of GENERAL MOTORS COMPANY

3. Mode Control Cam 1 - Install

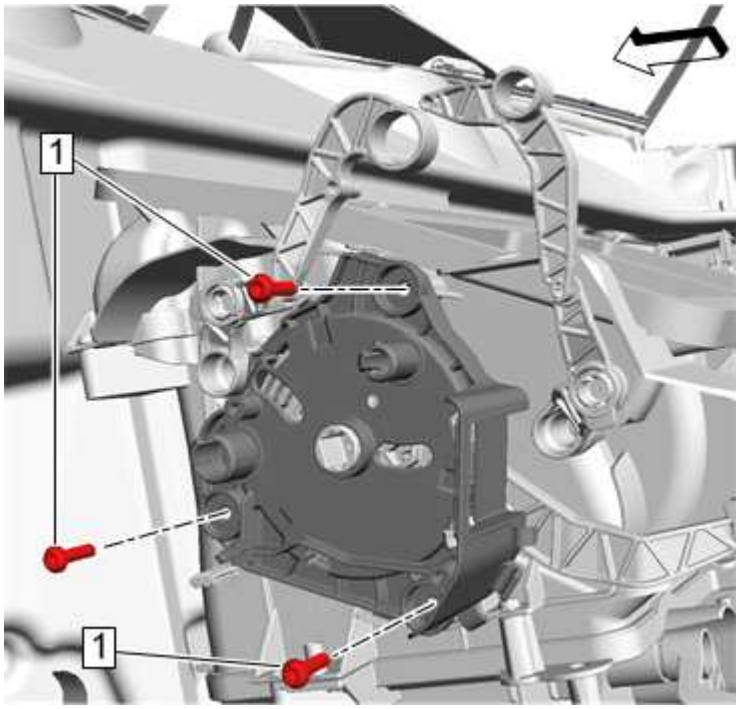

Fig. 29: Mode Control Cam Actuator Mounting Plate Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

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4. Mode Control Cam Actuator Mounting Plate Bolt 1 @Mode Control Cam Actuator Mounting Plate - Install and tighten 2.5 N.m (22 lb in)

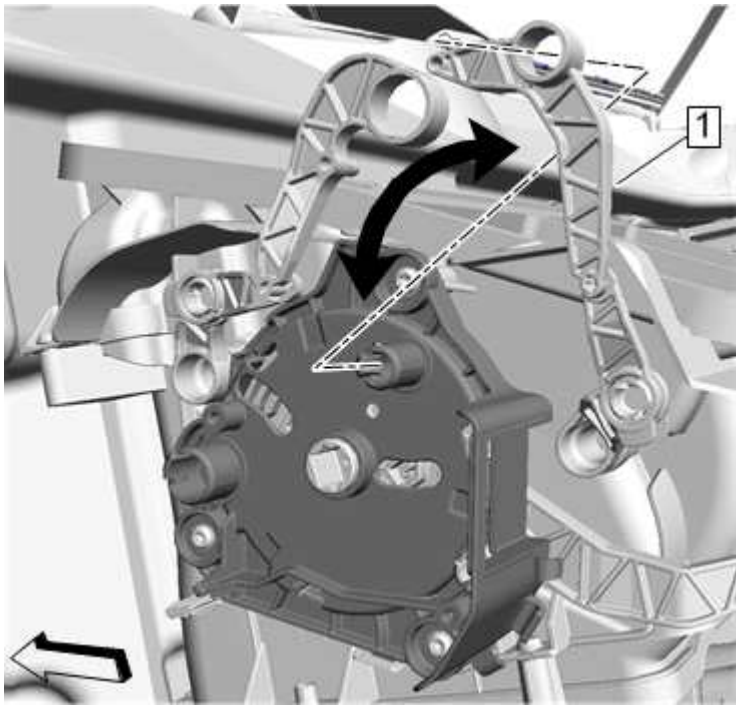

Fig. 30: Vent Valve Lever
Courtesy of GENERAL MOTORS COMPANY

5. Rotate the vent valve lever (1) back to vent valve lever proper position.

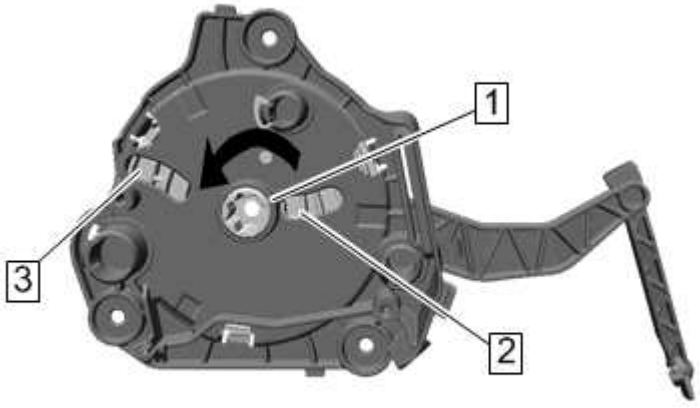

Fig. 31: Mode Control Cam Channel
Courtesy of GENERAL MOTORS COMPANY

6. Upon installation of the vent valve lever, insert the vent valve lever pin into mode control cam channel

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(2).

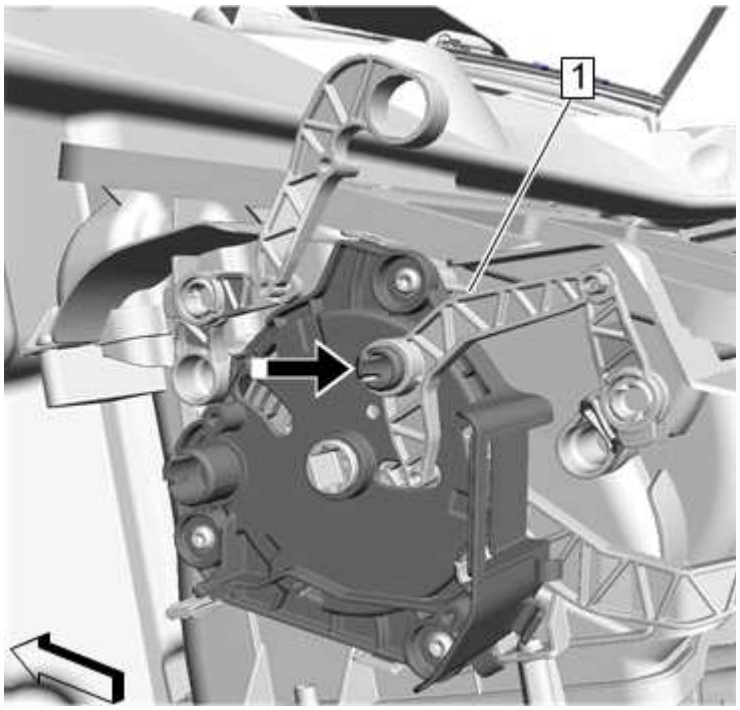

Fig. 32: Vent Valve Lever
Courtesy of GENERAL MOTORS COMPANY

7. Install the vent valve lever (1) onto the mode control cam actuator mounting plate.

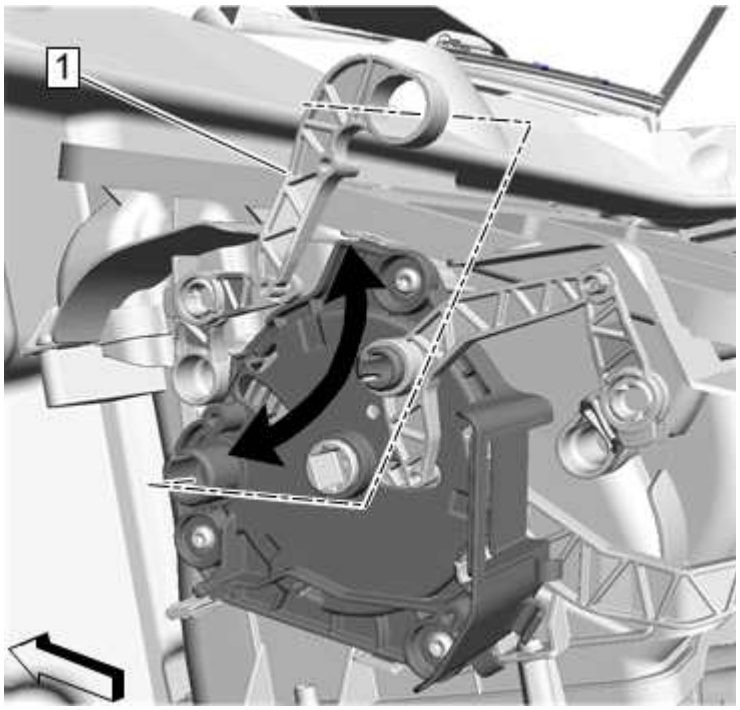

Fig. 33: Defroster Control Lever
Courtesy of GENERAL MOTORS COMPANY

8. Rotate the heater and defroster control lever (1) back to heater and defroster control lever proper position.

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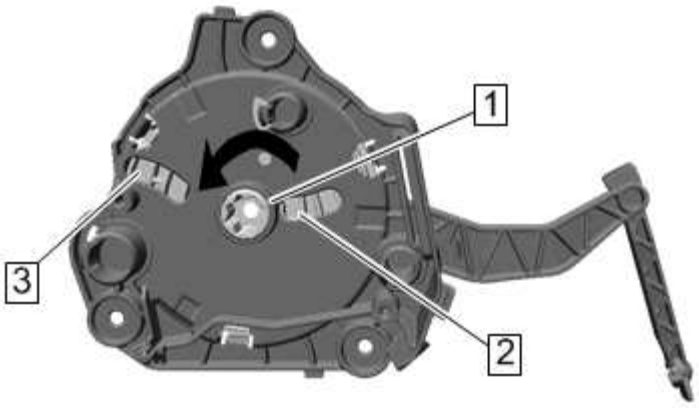

Fig. 34: Mode Control Cam Channel
Courtesy of GENERAL MOTORS COMPANY

9. Upon installation of the heater and defroster control lever, insert the heater and defroster control lever pin into mode control cam channel (3).

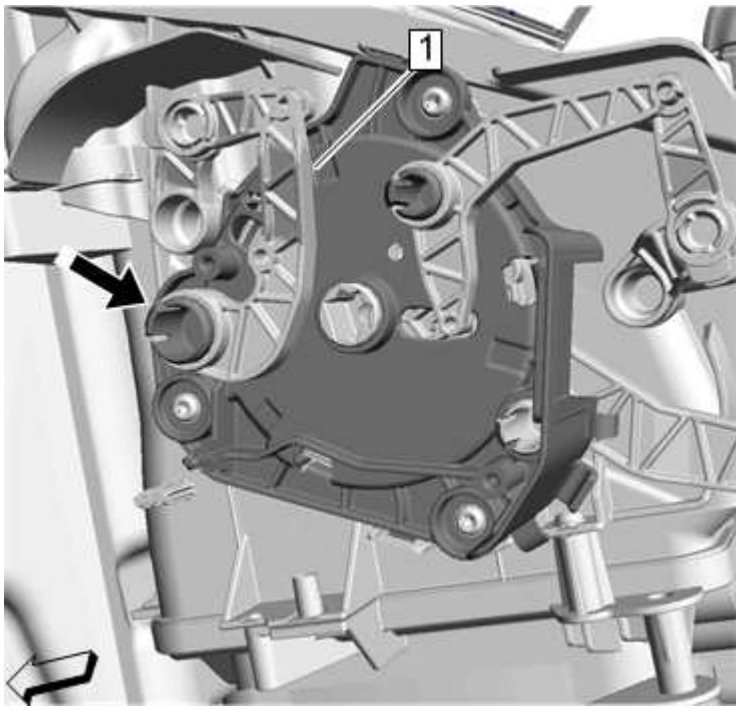

Fig. 35: Defroster Control Lever
Courtesy of GENERAL MOTORS COMPANY

10. Install the heater and defroster control lever (1) onto the mode control cam actuator mounting plate.

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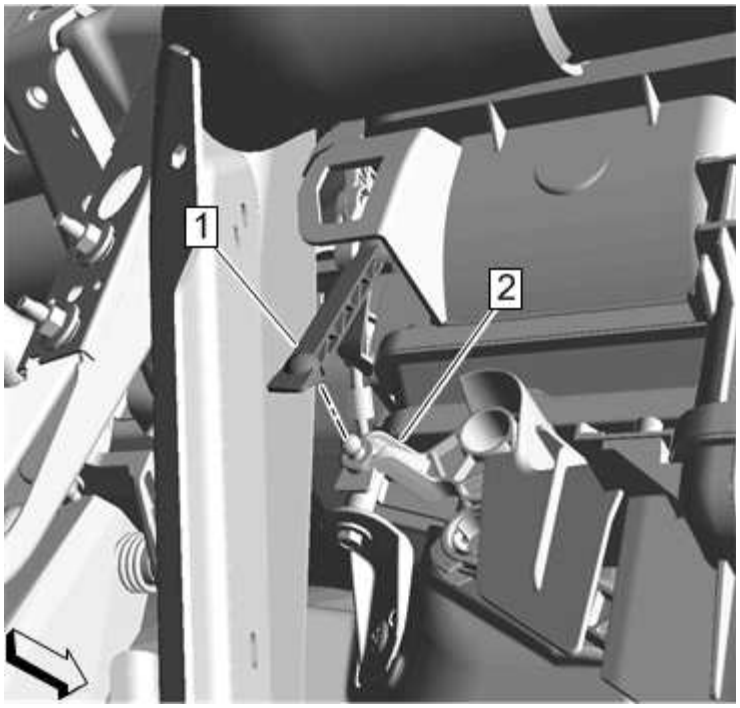

Fig. 36: Vent Valve Link And Floor Air Valve Lever
Courtesy of GENERAL MOTORS COMPANY

11. Snap the vent valve link (1) onto the floor air valve lever (2).
12. Mode Valve Actuator - Install - **Mode Valve Actuator Replacement**

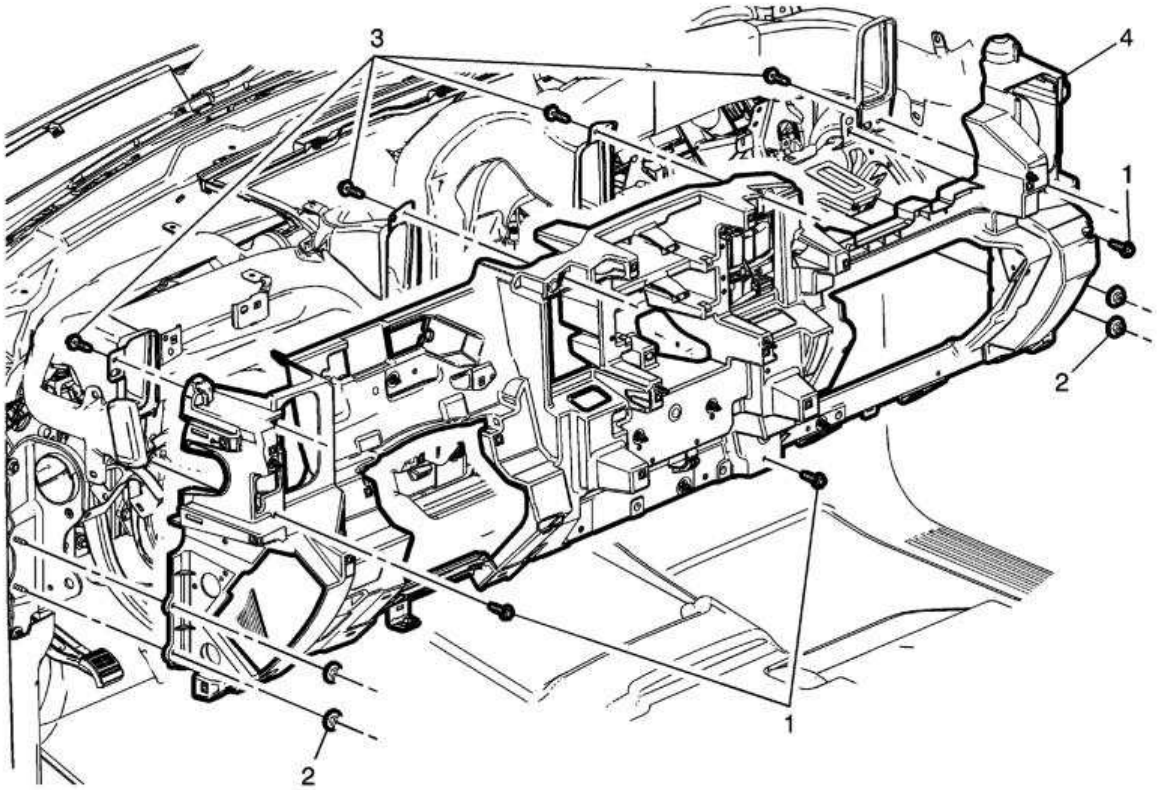

Fig. 37: Instrument Carrier
Courtesy of GENERAL MOTORS COMPANY

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13. Instrument Panel Carrier 4 - Install - **Instrument Carrier Replacement**
14. Clear the DTCs from the heater and air conditioning remote control module.
15. Perform the actuator calibration procedure. **Actuator Recalibration**

AIR INLET VALVE ACTUATOR REPLACEMENT

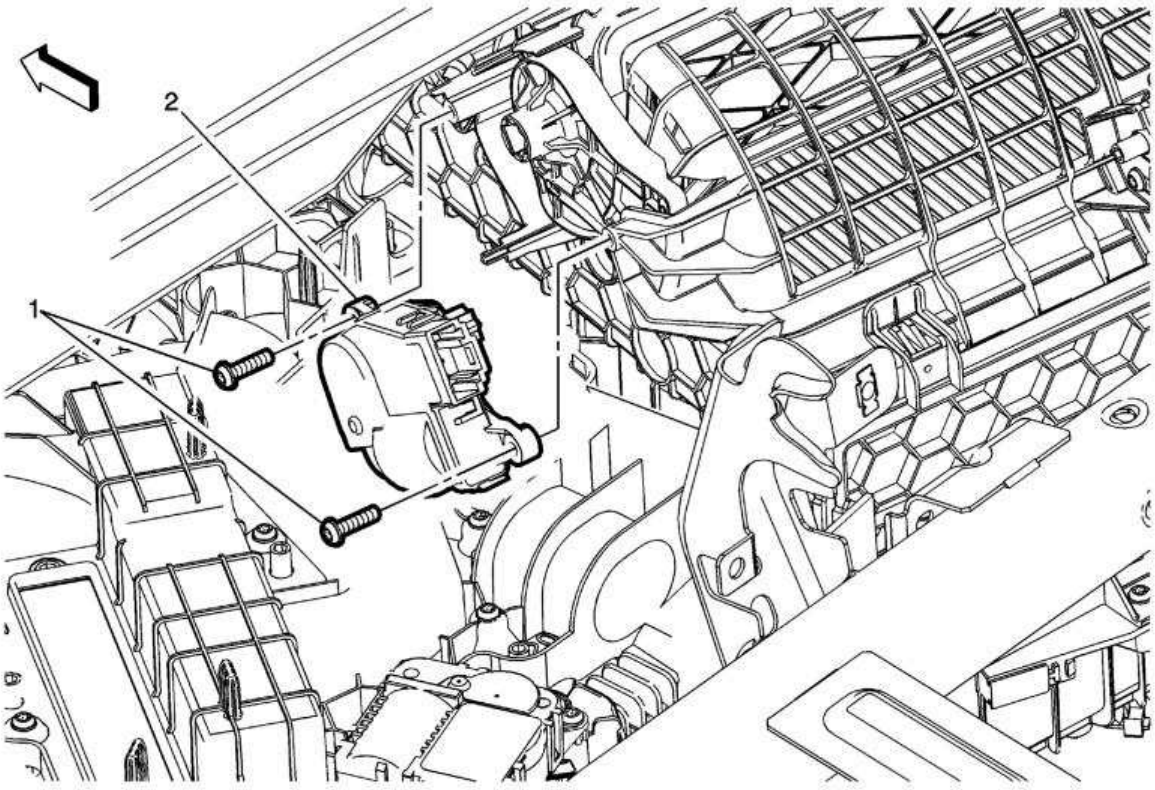

Fig. 38: Air Inlet Valve Actuator
Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
CAUTION: **In order to avoid actuator damage, DO NOT apply power to the actuator when it is not installed in the HVAC module.**	

Preliminary Procedures

1. **Instrument Panel Assembly Removal**
2. **Human Machine Interface Control Module Bracket Replacement**

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Call out	Component Name
3. Reposition the heater and air conditioning remote control out of the way. Refer to **Heater and Air Conditioning Remote Control Replacement** .	
1	Air Inlet Valve Actuator Fastener **CAUTION:** **Refer to** **Fastener Caution** .
2	Air Inlet Valve Actuator **Procedures** 1. Disconnect the air inlet valve actuator electrical connector. 2. **Actuator Recalibration**

EVAPORATOR AIR TEMPERATURE SENSOR REPLACEMENT

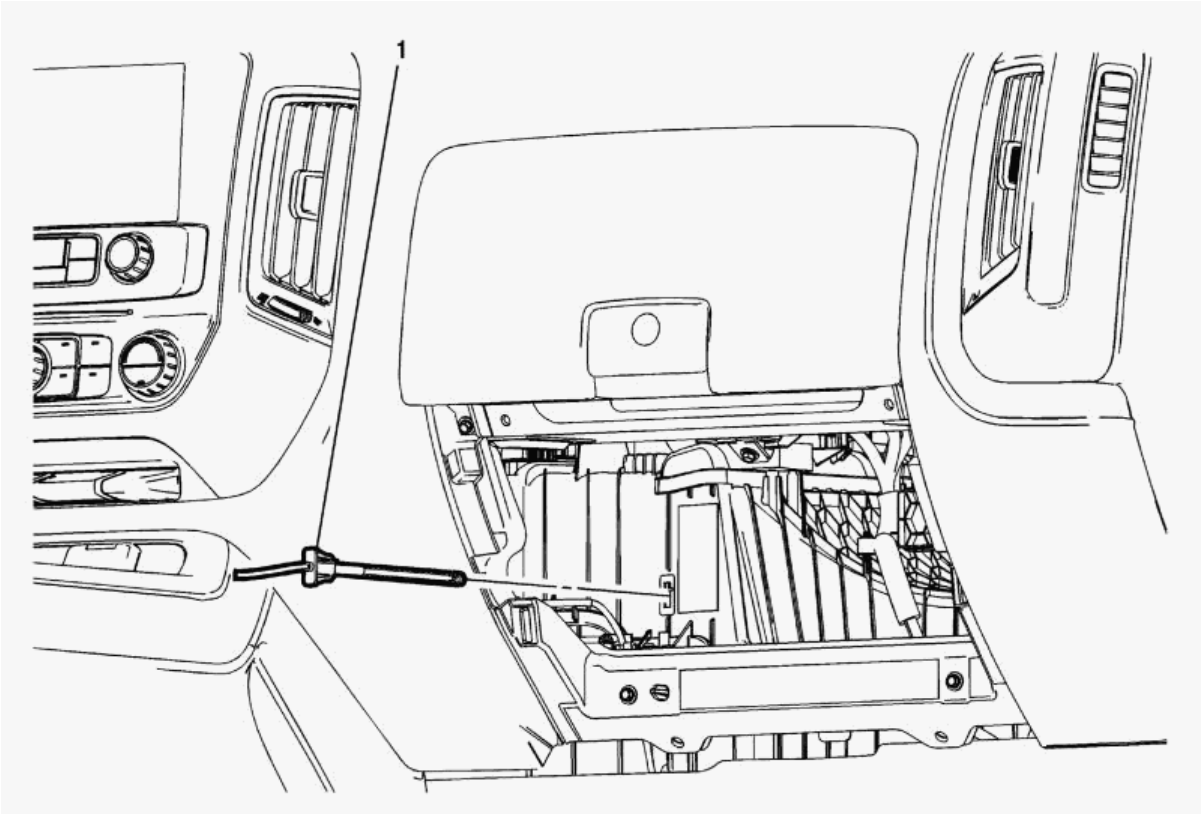

Fig. 39: Evaporator Air Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Procedure Remove the instrument panel compartment assembly. Refer to **Instrument Panel Compartment Replacement** .	

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Callout	Component Name
1	Air Conditioning Evaporator Air Temperature Sensor **NOTE:** **The evaporator air temperature sensor kit comes with a partial harness. Refer to Wire to Wire Repair .**

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

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Feature	Availability
Afterblow	Yes
Personalization	Yes
Actuator Calibration	Yes

Actuators

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

Each actuator used in the system is a 5-wire bi-directional electric motor that incorporate a feedback potentiometer. The five circuits are, low reference, 5 V reference, actuator position signal, and two control circuits. The control circuits use either a ground or 12 V value to coordinate the actuator movement. In order to move the actuator, the HVAC control module grounds one of the control circuits while providing the other with 12 V. The HVAC control module reverses the polarity of the control circuits to move the actuator in the opposite direction.

When the actuator shaft rotates, the potentiometer's sliding contact changes the door position signal between 0-5 V. The HVAC control module converts the voltage signal to counts. The total range of the counts is 0-1024, with an operating range between 20-1000. The actual operating range of an actuator is determined during calibration. During calibration, the actuator is moved though its full range of travel and the module stores the minimum and maximum value. Based on the desired system operation, the module sets a commanded, or targeted, value for the actuators. The control circuits are operated to move the door to the required position, and the changing position signal is sent to the module. Once the actual position signal and the commanded value are the same, the module ceases operating the control circuits and the actuator (and door) remain in the desired position.

Blower Motor Assembly

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 low side 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.

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 +85Â°C (-40 to +185Â°F). The sensor is installed at the evaporator and measures its temperature. If the temperature drops under 3Â°C (38Â°F), the compressor will be switched off in order to prevent evaporator icing.

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

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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 cooling load.

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 blower motor control circuitry is integrated within the blower motor assembly. The HVAC control module provides a low side 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.

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 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

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- 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 ECM will provide a ground for the A/C compressor relay enabling it to close its internal contacts to send battery voltage to the A/C compressor clutch coil. The A/C compressor clutch will be activated. The performance of the A/C compressor is regulated via a variable A/C compressor solenoid valve. 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 solenoid valve in order to command the performance of the A/C compressor.

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

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

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

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

Recirculation Operation

The recirculation switch is part of 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 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

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fogging.

Electric Auxiliary Heater

Some models are equipped with an auxiliary electric heater to assist in warming the passenger compartment when the engine coolant has not sufficiently warmed to operating temperature. The heater is a 12 V positive temperature coefficient heating element located in the HVAC case just downstream of the traditional heater core. The HVAC control module will activate it when the outside temperature is less than approximately 8Â°C (46Â°F), the engine coolant temperature is less than approximately 75Â°C (167Â°F), and the temperature blend door is commanded to the full hot position.

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.

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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.

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