

2013 HVAC

HVAC - Manual - Cruze

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Conditioning Control Module Bolt	2.5 N.m	22 lb in
Air Inlet Housing Bolt	2.5 N.m	22 lb in
Air Inlet Valve Actuator Bolt	2.5 N.m	22 lb in
Heater and Air Conditioning Evaporator Case Bolt	2.5 N.m	22 lb in
Instrument Panel Tie Bar Bolts	22 N.m	16 lb ft
Instrument Panel Tie Bar Nuts	9 N.m	80 lb in
Mode Control Cam Actuator Screw	2.5 N.m	22 lb in
Mode Valve Actuator Bolt	2.5 N.m	22 lb in
Temperature Valve Actuator Bolt	2.5 N.m	22 lb in

WIRING SCHEMATIC DIAGRAMS

HVAC WIRING SCHEMATICS

Module Power and Ground, Blower Control, and Serial Data Wiring Schematics

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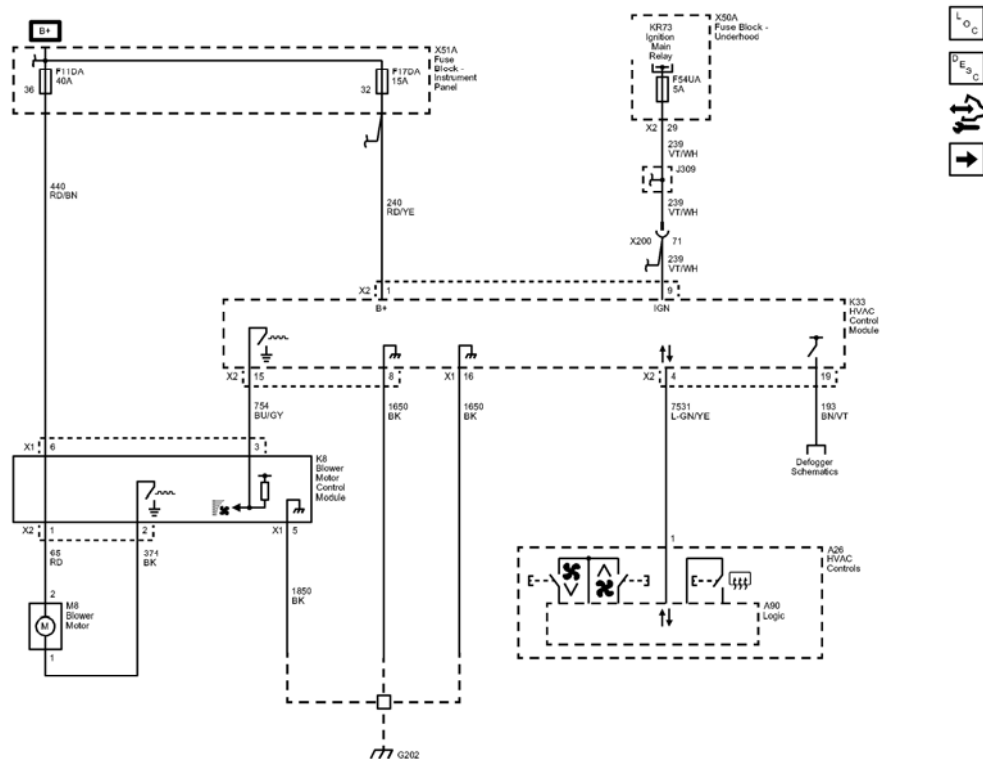


Fig. 1: Module Power and Ground, Blower Control, and Serial Data Wiring Schematics
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
440	Battery Positive Voltage
440 RD/BN	440 RD/BN
CAV_6	6
CONN_X1	X1
240	Battery Positive Voltage
240 RD/YE	240 RD/YE
CAV_1	1
CONN_X2	X2
239	Run/Crank Ignition 1 Voltage
239_VT/WH	239 VT/WH
CAV_9	9
CAV_29	29
CONN_X2	X2
193	Rear Defog Relay Control
193_BN/VT	193 BN/VT
CAV_19	19
7531	Linear Interconnect Network Bus 9

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7531_L-GN/YE	7531 L-GN/YE
CAV_1	1
CAV_4	4
CONN_X2	X2
1650	Ground
1650_BK	1650 BK
CAV_16	16
CONN_X1	X1
1650_BK	1650 BK
CAV_8	8
754	Blower Motor Speed Control
754_BU/GY	754 BU/GY
CAV_3	3
CAV_15	15
CONN_X2	X2
65	Blower Motor Supply Voltage
65_RD	65 RD
CAV_2	2
CAV_1	1
CONN_X2	X2
374	Blower Motor Fan Control
374_BK	374 BK
CAV_1	1
CAV_2	2
1850	Ground
1850_BK	1850 BK
CAV_5	5
CONN_X1	X1
CAV_71	71
239_VT/WH	239 VT/WH
239_VT/WH	239 VT/WH
CAV_36	36
CAV_32	32
G202	G202
F54UA	F54UA 5A
F17DA	F17DA 15A
F11DA	F11DA 40A
X200	X200
M8	
K8	
A90	Logic

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X51A	
KR73	
X50A	
Defogger_Schematics_REF	Defogger Schematics
A26	

Air Delivery and Temperature Controls Wiring Schematics

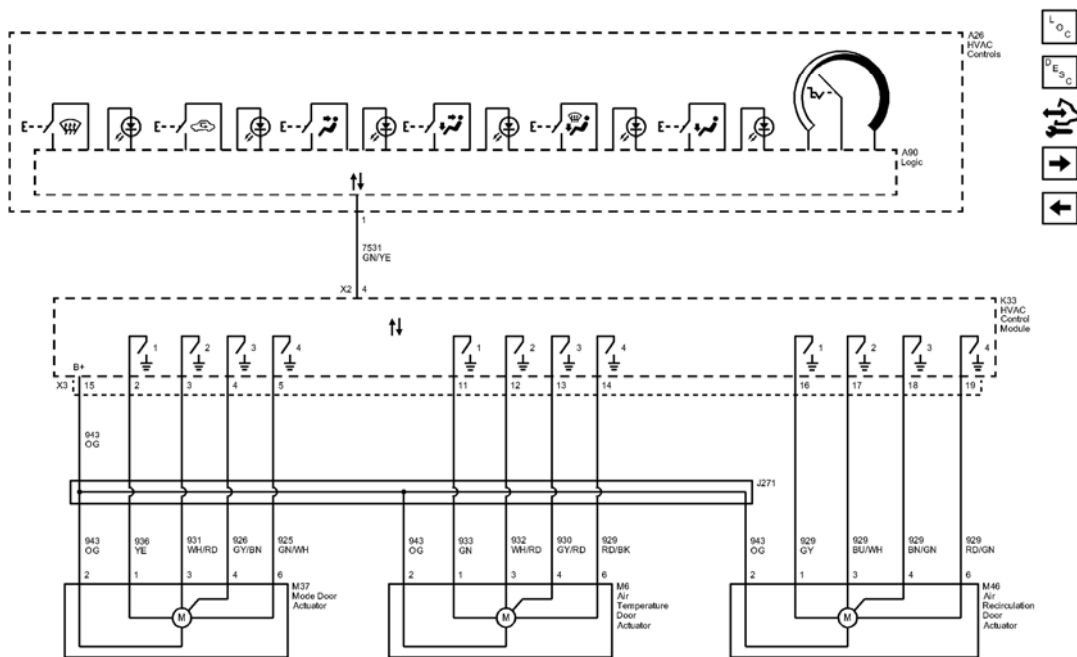


Fig. 2: Air Delivery and Temperature Controls Wiring Schematics
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
7531	Linear Interconnect Network Bus 9
7531 GN/YE	7531 GN/YE
CAV_4	4
CONN_X2	X2
CAV_1	1
943_OG	943 OG
CAV_2	2
CAV_15	15

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CONN_X3	X3
936_YE	936 YE
CAV_1	1
CAV_2	2
931_WH/RD	931 WH/RD
CAV_3	3
CAV_3	3
926_GY/BN	926 GY/BN
CAV_4	4
CAV_4	4
925_GN/WH	925 GN/WH
CAV_6	6
CAV_5	5
943_OG	943 OG
CAV_2	2
933_GN	933 GN
CAV_1	1
CAV_11	11
932_WH/RD	932 WH/RD
CAV_3	3
CAV_12	12
930_GY/RD	930 GY/RD
CAV_4	4
CAV_13	13
929_RD/BK	929 RD/BK
CAV_6	6
CAV_14	14
943_OG	943 OG
CAV_2	2
929_GY	929 GY
CAV_1	1
CAV_16	16
929_BU/WH	929 BU/WH
CAV_3	3
CAV_17	17
929_BN/GN	929 BN/GN
CAV_4	4
CAV_18	18
929_RD/GN	929 RD/GN
CAV_6	6
CAV_19	19

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	943 OG
J271	J271
A90	Logic
K33	
M37	
M6	
M46	
A26	

Evaporator Temperature Sensor and Compressor Controls (C67) Wiring Schematics

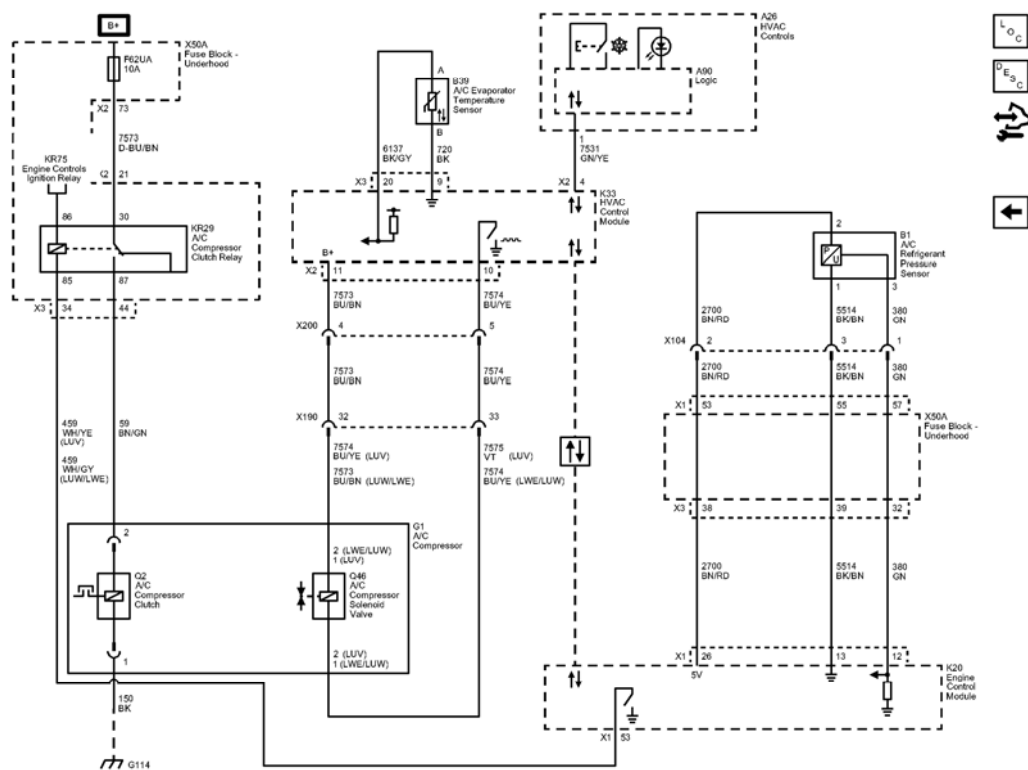


Fig. 3: Evaporator Temperature Sensor and Compressor Controls (C67) Wiring Schematics
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
7573	Electric Variable Displacement Supply
7573_D-BU/BN	7573 D-BU/BN
CAV_73	73
CONN_X2	X2
CAV 21	21

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CONN_X2	X2
59	A/C Compressor Clutch Supply Voltage
59 BN/GN	59 BN/GN
CAV_44	44
459	A/C Compressor Clutch Relay Control
459_WH/YE	459 WH/YE
CAV_53	53
CONN_X1	X1
CAV_34	34
CONN_X3	X3
459_WH/GY	459 WH/GY
LUV	ENGINE-GAS, 4 CYL, 1.4L, MFI, DOHC, TURBO, VVT, ALUM, GME, E85 MAX
LUW	ENGINE-GAS, 4 CYL, 1.8L, MFI, 103KW, DOHC, E85 MAX
LWE	ENGINE-GAS, 4 CYL, 1.8L, MFI, DOHC, VVT, 103 KW, GME
CAV_85	85
CAV_87	87
CAV_30	30
CAV_86	86
150	Ground
150_BK	150 BK
CAV_1	1
CAV_2	2
6137	EVAP Core Temperature Sensor Signal
6137_BK/GY	6137 BK/GY
CAV_20	20
CONN_X3	X3
CAV_A	A
720	Sensor Low Reference
720_BK	720 BK
CAV_9	9
CAV_B	B
7573_BU/BN	7573 BU/BN
CAV_11	11

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CONN_X2	X2
7573_BU/BN	7573 BU/BN
7574_BU/YE	7574 BU/YE
7573_BU/BN	7573 BU/BN
LUV	ENGINE-GAS, 4 CYL, 1.4L, MFI, DOHC, TURBO, VVT, ALUM, GME, E85 MAX
CAV_1	1
CAV_2	2
LWE	ENGINE-GAS, 4 CYL, 1.8L, MFI, DOHC, VVT, 103 KW, GME
LUW	ENGINE-GAS, 4 CYL, 1.8L, MFI, 103KW, DOHC, E85 MAX
LUV	ENGINE-GAS, 4 CYL, 1.4L, MFI, DOHC, TURBO, VVT, ALUM, GME, E85 MAX
7574	Electric Variable Displacement Control
7574_BU/YE	7574 BU/YE
CAV_10	10
7574_BU/YE	7574 BU/YE
CAV_1	1
CAV_2	2
LUV	ENGINE-GAS, 4 CYL, 1.4L, MFI, DOHC, TURBO, VVT, ALUM, GME, E85 MAX
LWE	ENGINE-GAS, 4 CYL, 1.8L, MFI, DOHC, VVT, 103 KW, GME
LUW	ENGINE-GAS, 4 CYL, 1.8L, MFI, 103KW, DOHC, E85 MAX
7575 VT	7575 VT
7574_BU/YE	7574 BU/YE
LUV	ENGINE-GAS, 4 CYL, 1.4L, MFI, DOHC, TURBO, VVT, ALUM, GME, E85 MAX
LWE	ENGINE-GAS, 4 CYL, 1.8L, MFI, DOHC, VVT, 103 KW, GME
LUW	ENGINE-GAS, 4 CYL, 1.8L, MFI, 103KW, DOHC, E85

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	MAX
SD	Serial Data
Data_Communication_Schematics_REF	Data Communication Schematics
7531	Linear Interconnect Network Bus 9
7531_GN/YE	7531 GN/YE
CAV_4	4
CONN_X2	X2
CAV_1	1
2700	A/C Pressure Sensor 5 Volt Reference
2700_BN/RD	2700 BN/RD
CAV_53	53
CONN_X1	X1
CAV_2	2
2700_BN/RD	2700 BN/RD
5514	A/C Refrigerant Pressure Sensor Low Reference
5514_BK/BN	5514 BK/BN
CAV_55	55
CAV_1	1
5514_BK/BN	5514 BK/BN
380	A/C Refrigerant Pressure Sensor Signal
380_GN	380 GN
CAV_57	57
CAV_3	3
380_GN	380 GN
2700_BN/RD	2700 BN/RD
CAV_26	26
CONN_X1	X1
CAV_38	38
CONN_X3	X3
5514_BK/BN	5514 BK/BN
CAV_13	13
CAV_39	39
380 GN	380 GN
CAV_12	12
CAV_32	32
LUW	ENGINE-GAS, 4 CYL, 1.8L, MFI, 103KW, DOHC, E85

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	MAX
LWE	ENGINE-GAS, 4 CYL, 1.8L, MFI, DOHC, VVT, 103 KW, GME
X200	X200
CAV_4	4
CAV_5	5
X190	X190
CAV_32	32
CAV_33	33
X104	X104
CAV_2	2
CAV_3	3
CAV_1	1
G114	G114
F62UA	F62UA 10A
X200	X200
X190	X190
X104	X104
B1	
K20	
A90	Logic
K33	
X50A	
B39	
Q46	
Q2	
G1	
KR75	
KR29	
X50A	
A26	

DIAGNOSTIC INFORMATION AND PROCEDURES**HVAC COMPONENT REPLACEMENT REFERENCE****HVAC Component Replacement Reference**

Scan Tool Name	Component Code / Schematic Name	Service Name	Repair Instruction Name
Air Recirculation Door Actuator	M46 Air Recirculation Door Actuator	Air Recirculation Door Actuator	<u>Air Inlet Valve Actuator Replacement</u>

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Left Temperature Door Actuator	M6 Air Temperature Actuator	Air Temperature Actuator	
Mode Door Actuator	M37 Mode Door Actuator	Mode Door Actuator	<u>Mode Control Cam Replacement</u>
A/C High Side Pressure Sensor	B1 A/C Refrigerant Pressure Sensor	A/C Refrigerant Pressure Sensor	<u>Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement</u>
Blower Motor	M8 Blower Motor	Blower Motor	<u>Blower Motor Replacement</u>
A/C Compressor Clutch	Q2 A/C Compressor Clutch	A/C Compressor Clutch	<u>Air Conditioning Compressor Replacement (1.8L LUW and LWE) , Air Conditioning Compressor Replacement (1.4L LUV)</u>
Blower Motor Control Module	K8 Blower Motor Control Module	Blower Motor Control Module	
Radio/HVAC Control	A20 Radio/HVAC Control	Radio/HVAC Control	<u>Heater and Air Conditioning Control Replacement</u>
Remote Heater and Air Conditioning Control Module	K33 HVAC Control Module	HVAC Control Module	

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B0193</u>	DTC B0193 01 Front Blower Motor Speed Circuit Short to Battery DTC B0193 06 Front Blower Motor Speed Circuit Low Voltage/Open
<u>DTC B0223, B0233, B023A, or B0408</u>	DTC B0223 01 Recirculate Position Command 1 Circuit Short to Battery DTC B0223 06 Recirculate Position Command 1 Circuit Low Voltage/Open DTC B0233 01 Air Flow Control Circuit Short to Battery DTC B0233 06 Air Flow Control Circuit Low Voltage/Open DTC B023A 02 HVAC Actuators Supply Voltage Short to Ground DTC B0408 01 Main Temperature Control Circuit Short to Battery

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	DTC B0408 06 Main Temperature Control Circuit Low Voltage/Open
<u>DTC B3933</u>	DTC B3933 02 Air Conditioning Evaporator Temperature Sensor Circuit Short to Ground DTC B3933 05 Air Conditioning Evaporator Temperature Sensor Circuit High Voltage/Open DTC B3933 13 Air Conditioning Evaporator Temperature Sensor Circuit High Temperature
<u>DTC B393B</u>	DTC B393B 04 Air Conditioning Compressor Valve Control Circuit Open DTC B393B 0B Air Conditioning Compressor Valve Control Circuit High Current
<u>DTC P0532 or P0533</u>	DTC P0532 00 Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit Low Voltage DTC P0533 00 Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit High Voltage
<u>DTC P0645, P0646, or P0647</u>	DTC P0645 Air Conditioning (A/C) Compressor Clutch Relay Control Circuit DTC P0646 Air Conditioning (A/C) Compressor Clutch Relay Control Circuit Low Voltage DTC P0647 Air Conditioning (A/C) Compressor Clutch Relay Control Circuit High Voltage

DTC B0193

Diagnostic Instructions

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

DTC Descriptors

DTC B0193 01

Front Blower Motor Speed Circuit Short to Battery

DTC B0193 06

Front Blower Motor Speed Circuit Low Voltage/Open

Diagnostic Fault Information

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

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Control	B0193 06	B0193 06	B0193 01	-
Ground	-	B0193 06	-	-

Circuit/System Description

The blower motor control module is an interface between the HVAC control module and the blower motor. The blower motor speed control from the HVAC control module, battery positive and ground circuits enable the blower motor control module to operate. The HVAC control module provides a pulse width modulation (PWM) signal to the blower motor control module in order to command the blower motor speed. The blower motor control module transfers the PWM signal into a corresponding blower motor voltage. The voltage resides between 2-13 V and changes linear to the height of the PWM signal.

Conditions for Running the DTC

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

Conditions for Setting the DTC

B0193 01

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

B0193 06

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

Action Taken When the DTC Sets

The blower motor is inoperative.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

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

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

If the motor operates properly please reinstall it, check for PIs or TSBs, and refer to Testing for Intermittent Conditions and Poor Connections in the Electrical Information Reference information of this document.

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 X1 harness connector at the K8 Blower Motor Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the ground circuit terminal 5 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify a test lamp illuminates between the B+ circuit terminal 6 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit terminal 6 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K8 Blower Motor Control Module.
- **If the test lamp illuminates**
- 5. Connect a DMM between the control circuit terminal 3 and ground.
- 6. Verify the resistance value is between 500 ohms and 140K ohms and there is a noticeable change when moving between commanded fan speeds.
 - **If not within the specified range or there is no noticeable change**
 1. Ignition OFF, disconnect the X2 harness connector at the K33 HVAC Control Module.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 4. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms replace the K33 HVAC Control Module.
 - **If within the specified range and there is a noticeable change**
 - 7. Ignition OFF, connect the X1 harness connector at the K8 Blower Motor Control Module, and disconnect the harness connector at the M8 Blower Motor, Ignition ON and blower ON.
 - 8. Verify a test lamp illuminates between the control circuit terminal B and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the X2 harness connector at the K8 Blower Motor Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms replace the K8 Blower Motor Control Module.
 - **If the test lamp illuminates**
 - 9. Connect a test lamp between control circuit terminal A and control circuit terminal B.
 - 10. Verify the test lamp becomes progressively brighter as the blower speed is increased and progressively dimmer as the blower speed is decreased.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the X2 harness connector at the K8 Blower Motor Control Module.
 2. Test for less than 1 V between the control circuit terminal A and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V

3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms replace the K8 Blower Motor Control Module.
 - **If the test lamp illuminates, but does not change in brightness**
1. Ignition OFF, disconnect the X2 harness connector at the K8 Blower Motor Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K8 Blower Motor Control Module.
 - **If the test lamp changes in brightness as the blower speed is changed**
11. Test or replace the M8 Blower Motor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

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

DTC B0223, B0233, B023A, OR B0408**Diagnostic Instructions**

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

DTC Descriptor**DTC B0223 01**

Recirculate Position Command 1 Circuit Short to Battery

DTC B0223 06

Recirculate Position Command 1 Circuit Low Voltage/Open

DTC B0233 01

Air Flow Control Circuit Short to Battery

DTC B0233 06

Air Flow Control Circuit Low Voltage/Open

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DTC B023A 02

HVAC Actuators Supply Voltage Short to Ground

DTC B0408 01

Main Temperature Control Circuit Short to Battery

DTC B0408 06

Main Temperature Control Circuit Low Voltage/Open

Diagnostic Fault Information

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

Circuit/System Description

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

With the appropriate switches at the Radio/HVAC control, the desired air temperature flap position, air distribution flap position and recirculation flap position can be put in. The selected values are passed to the HVAC control module via the LIN-Bus. The HVAC control module supplies a 12 V reference voltage to the stepper motors and energizes the 4 stepper motor coils with a pulsed ground signal. The stepper motors put the appropriate flap into the calculated position, in order to reach the put in temperature/position.

Conditions for Running the DTC

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

Conditions for Setting the DTC**B023A 02**

The stepper motors supply output is shorted to ground.

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

At least one control output (of four possible outputs) of the appropriate stepper motor is shorted to voltage when motor starts moving. Faults are not detected when motor is already running or target position is already reached.

B0223 06, B0233 06, B023A 06, or B0408 06

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

Action Taken When the DTC Sets**B023A 02**

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

B0223, B0233, B023A, or B0408,

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

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

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, disconnect the harness connector at the appropriate door actuator, ignition ON.
2. Connect a test lamp between the B+ circuit terminal 2 and ground.
3. Verify the test lamp turns ON and OFF repeatedly when commanding the actuator ON but not OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the harness connector at the K33 HVAC control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC control module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the harness connector at the K33 HVAC control module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K33 HVAC control module.

- **If the test lamp turns ON and OFF**
- 4. Connect a test lamp between each actuator harness connector terminal listed below one at a time and B+.
- Control Circuit - terminal 1
 - Control Circuit - terminal 3
 - Control Circuit - terminal 4
 - Control Circuit - terminal 6
- 5. Verify the test lamp turns ON and OFF repeatedly when commanding the actuator ON but not OFF with a scan tool.
- **If the test lamp is always OFF**
- 1. Ignition OFF, disconnect the harness connector at the K33 HVAC control module, Ignition ON.
- 2. Test for less than 1 V between the control circuit and ground.
- If less 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
- 3. Ignition OFF
- 4. Test for less than 2 ohms in the control circuit end to end.
- If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC control module.
- **If the test lamp is always ON**
- 1. Ignition OFF, disconnect the harness connector at the K33 HVAC control module.
- 2. Test for infinite resistance between the control circuit and ground.
- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC control module.
- **If the test lamp turns ON and OFF**
- 6. Replace the appropriate HVAC door actuator.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

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

DTC B3933

Diagnostic Instructions

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

DTC Descriptors

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DTC B3933 02

Air Conditioning Evaporator Temperature Sensor Circuit Short to Ground

DTC B3933 05

Air Conditioning Evaporator Temperature Sensor Circuit High Voltage/Open

DTC B3933 13

Air Conditioning Evaporator Temperature Sensor Circuit High Temperature

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B3933 02	B3933 05	B3933 05	1
Low Reference	-	B3933 05	B3933 05	-
1. Air Temperature Malfunction				

Circuit/System Description

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

A signal and low reference circuit enables the sensor to operate. As the air temperature surrounding the sensor increases, the sensor resistance decreases. The sensor signal voltage decreases as the resistance decreases. The sensor operates within a temperature range between -40 to +85°C (-40 to +185°F). The sensor signal varies between 0-5 V. The HVAC control module uses this information to keep the evaporator as close to the desired temperature without evaporator icing. If the HVAC control module detects a malfunctioning sensor, then the control module software will use a default air temperature value. The default action ensures that the HVAC system can adjust the inside air temperature near the desired temperature until the condition is corrected.

Conditions for Running the DTC

- Ignition ON
- The HVAC control module is ON.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

The system operates using a default value.

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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Manual HVAC Description and Operation

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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 Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B39 A/C Evaporator Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal B and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the A/C Evaporator Temperature scan tool parameter is more than 4.9 V.
 - **If less than 4.9 V**
 1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for infinite resistance between the signal circuit terminal A and ground.

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- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module.
 - **If 4.9 V or greater**
5. Install a 3 A fused jumper wire between the signal circuit terminal A and the low reference circuit terminal B.
 6. Verify the A/C Evaporator Temperature Sensor scan tool parameter is less than 0.1 V.
 - **If 0.1 V or greater**
 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
 3. Ignition OFF
 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If less than 0.1 V**
 7. Test or replace the B39 A/C Evaporator Temperature Sensor.

Repair Instructions

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

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

DTC B393B

Diagnostic Instructions

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

DTC Descriptors

DTC B393B 04

Air Conditioning Compressor Valve Control Circuit Open

DTC B393B 0B

Air Conditioning Compressor Valve Control Circuit High Current

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Diagnostic Fault Information

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

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 supplies battery voltage to the variable displacement solenoid valve. When the A/C switch is pressed, the HVAC control module provides a pulse width modulated (PWM) signal to the variable displacement solenoid valve in order to determine the amount of compressor displacement. The performance of the A/C compressor is regulated according to adjusted interior temperature on the basis of characteristic lines. Therefore the HVAC control module grounds the A/C compressor with the PWM signal.

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 variable displacement solenoid valve is disabled and defaults to the position of lowest possible compressor displacement. The compressor clutch is not disengaged.

B393B 0B

- The variable displacement solenoid valve is disabled and defaults to the position of lowest possible compressor displacement. The compressor clutch is not disengaged.
- 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 and all vehicle systems OFF, disconnect the harness connector at the Q46 A/C Compressor Solenoid Valve. It may take up to 2 minutes for all vehicle systems to power down.
2. Verify a test lamp illuminates between the B+ circuit terminal A and ground.
 - **If the test lamp does not illuminate**
 1. 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.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.
 - **If the test lamp illuminates**
3. Ignition ON, connect a test lamp between the control circuit terminal B and the B+ circuit terminal A.
4. Verify the test lamp turns ON and OFF when commanding the A/C Compressor Refrigerant Solenoid

Valve ON and OFF with a scan tool.

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

1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module, ignition ON.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Ignition OFF.
4. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K33 HVAC Control Module.

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

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

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

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

Component Testing

Static Test

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

Replace the Q46 A/C Compressor Solenoid Valve

- **If between 7-15 ohms**

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

Replace the Q46 A/C Compressor Solenoid Valve

- **If infinite resistance**

4. All OK

Repair Instructions

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

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

DTC P0532 OR P0533

Diagnostic Instructions

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

DTC Descriptors

DTC P0532 00

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

DTC P0533 00

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0532 00 P0641 00	P0532 00	P0641 00	-
Signal	P0532 00	P0532 00	P0533 00	-
Low Reference	-	P0533 00	-	-

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. When pressure is high, the ECM commands the cooling fans on. When pressure is too high or too low, the ECM will not allow the activation of the A/C compressor.

Conditions for Running the DTC

Engine is running.

Conditions for Setting the DTC

P0532 00

The ECM detects a short to ground or open at the A/C pressure sensor signal circuit.

P0533 00

The ECM detects a short to voltage at the A/C pressure sensor signal circuit.

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.

Reference Information

Schematic Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B1 A/C refrigerant pressure sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the low reference circuit terminal 1 and ground.
 - **If 5 ohms or greater**

1. Ignition OFF, disconnect the harness connector at the K20 ECM.
2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 ECM.
 - **If less than 5 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 2 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connector at the K20 ECM control module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 ECM.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the harness connector at the K20 ECM 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 ECM.
 - **If between 4.8-5.2 V**
5. Verify the scan tool A/C High Side Pressure Sensor parameter is less than .02 V.
 - **If .02 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 ECM, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 ECM.
 - **If less than .02 V**
6. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 2.
7. Verify the scan tool A/C High Side Pressure Sensor parameter is greater than 4.8 V.
 - **If 4.8 V or less**
 1. Ignition OFF, disconnect the harness connector at the K20 ECM.
 2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

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- If less than 2 ohms, replace the K20 ECM.
 - **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 (ECM) replacement, programming, and setup

DTC P0645, P0646, OR P0647

Diagnostic Instructions

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

DTC Descriptors

DTC P0645

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

DTC P0646

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

DTC P0647

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

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	1	1	-	-
A/C Compressor Clutch Supply Voltage	1	1	1	-
Ignition	P0645	P0645	-	-
A/C Compressor Clutch Control	P0645	P0645	P0645	-
Ground	-	1	-	-
1. A/C Compressor Malfunction				

Circuit/System Description

When the A/C switch is pressed, the HVAC control module sends an A/C request message to the engine control module (ECM) via serial data. The ECM then grounds the A/C compressor clutch relay coil control circuit, closing the relay contacts. The closed relay contacts provide voltage to the compressor clutch causing it to engage.

Conditions for Running the DTC

- Engine is running.
- The HVAC control module is ON.
- The A/C switch is active.

Conditions for Setting the DTC**P0645 or P0646**

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

P0647

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

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

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

P0647

The A/C compressor is inoperative.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

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HVAC Schematics

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

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

Refer to **Power Mode Mismatch** .

○ **If the test lamp illuminates**

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

○ **If the test lamp is always OFF**

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

○ **If the test lamp is always ON**

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

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

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

○ **If the test lamp illuminates**

Repair the short to voltage on the circuit.

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

8. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the Q2 A/C Compressor Clutch. It may take up to 2 min for all vehicle systems to power down.
9. Test for less than 10 ohms between the ground circuit terminal 1 and ground.

○ **If 10 ohms or greater**

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

○ **If less than 10 ohms**

10. Connect the harness connector at the Q2 A/C Compressor Clutch.
11. Ignition ON, connect a 10 A fused jumper wire between the B+ circuit terminal 30 and the control circuit

terminal 87.

12. Verify the Q2 A/C Compressor Clutch is engaged.

- **If the Q2 A/C Compressor Clutch does not engage**

1. Ignition OFF, disconnect the harness connector at the Q2 A/C Compressor Clutch.

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

- If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, test or replace the Q2 A/C Compressor Clutch.

- **If the Q2 A/C Compressor Clutch is engaged**

13. Test or replace the KR29 A/C Compressor Clutch Relay.

Component Testing

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

2. Test for 60-180 ohms between terminals 85 and 86.

- **If not between 60-180 ohms**

Replace the KR29 A/C Compressor Clutch Relay.

- **If between 60-180 ohms**

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

- 30 and 86

- 30 and 87

- 30 and 85

- 85 and 87

- **If less than infinite resistance**

Replace the KR29 A/C Compressor Clutch Relay.

- **If infinite resistance**

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

5. Test for less than 2 ohms between terminals 30 and 87.

- **If 2 ohms or greater**

Replace the KR29 A/C Compressor Clutch Relay.

- **If less than 2 ohms**

6. All OK.

Repair Instructions

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

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

SYMPTOMS - HVAC SYSTEMS - MANUAL

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

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Manual HVAC Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the HVAC System. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.
- Verify the A/C compressor turns freely and is not seized.
- Verify that the customer is using the correct key to enable personalization and is not inadvertently activating auxiliary HVAC controls.
- The A/C compressor will not operate in cold outside air temperatures.
- The following conditions may cause window fogging:
 - Wet carpet or mats
 - High humidity
 - Interior water leak
 - Blocked A/C evaporator drain tube
 - Maximum passenger capacity
 - Blocked body pressure relief valves
- Inspect the air distribution system for causes of reduced air flow:
 - Obstructed or dirty passenger compartment air filter, if equipped
 - Blocked or damaged air inlet or outlet vents

Intermittent

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

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **HVAC System Malfunction**

-

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

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Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

NOTE: Check for bulletins before proceeding.

1. Ignition ON, place the blower motor switch in each speed position. Verify that the blower motor operates properly in each position.
 - If the blower motor does not operate properly in all speeds, refer to **DTC B0193**.
2. Using the scan tool observe the mode, temperature, air inlet and recirculation door positions. Verify the actual and commanded door positions are within 4 counts of each other.
 - If not within the specified range, refer to Circuit/System Testing **DTC B0223, B0233, B023A, or B0408**.
3. Engine ON, A/C ON, place the temperature control in the coldest position. Verify that cool air flows from the ducts in the vehicle.
 - If the air is not cool, refer to **Air Conditioning (A/C) System Performance Test**.
4. Turn the A/C OFF and place the temperature control in the warmest position.
 - If the air is insufficiently heated refer to **Heating Performance Diagnostic**.
5. Ignition ON, observe the scan tool A/C Evaporator Temperature Sensor parameter. The reading should be between -39°F and 185°F and change with evaporator air temperature changes.
 - If not within the specified range, refer to Circuit/System Testing **DTC B3933**.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

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

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.

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

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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
A/C Compressor Clutch Relay Coil Ignition	P0646	P0645, P0646	-	-
A/C Compressor Clutch Relay Coil Control	P0646	P0645, P0646	P0647	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 CAN-Bus. Therefore, the ECM 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 A/C compressor clutch. The A/C compressor clutch will be activated.

Conditions for Running the DTC

- Engine is running.
- The HVAC control module is ON.
- The A/C switch is active.

Conditions for Setting the DTC

P0645 or P0646

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

P0647

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

Action Taken When the DTC Sets

P0645 or P0646

The A/C compressor is inoperative or always active.

P0647

The A/C compressor is inoperative.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, remove the KR29 A/C Compressor Clutch Relay.
2. Ignition ON, test for greater than 11 V between the ignition circuit terminal 86 at the KR29 A/C Compressor Clutch Relay and ground.
 - If less than the specified value, test the ignition circuit for a short to ground or an open/high resistance.
3. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module.
4. Ignition ON, test for less than 0.3 V between the control circuit terminal 85 at the KR29 A/C Compressor Clutch Relay and ground.
 - If greater than the specified value, test the control circuit for a short to voltage.
5. Ignition OFF, test for infinite resistance between the control circuit terminal 85 at the KR29 A/C Compressor Clutch Relay and ground.
 - If less than the specified value, test the control circuit for a short to ground.
6. Test for less than 5 ohms between the KR29 A/C Compressor Clutch Relay control circuit terminal 85 and the appropriate control circuit terminal at the K20 Engine Control Module harness connector listed below:

- Terminal 91 X2 with LXV
 - Terminal 51 X2 with LXT
 - Terminal 91 X2 with 2H0
 - Terminal 29 X2 with LLW
 - If greater than the specified value, test the control circuit for an open/high resistance.
7. If all circuits test normal, test or replace the KR29 A/C Compressor Clutch Relay.

Component Testing

Static Test

1. Ignition OFF, disconnect the KR29 A/C Compressor Clutch Relay.
2. Test for 60-180 ohms between the B+ terminal 85 and the control terminal 86 of the KR29 A/C Compressor Clutch Relay.
 - If not within the specified range, replace the KR29 A/C Compressor Clutch Relay.
3. Test for the resistance between the following terminals:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If not the specified value, replace the KR29 A/C Compressor Clutch Relay.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Control Module References for engine control module replacement, setup, and programming

AFTERBLOW ENABLING

The afterblow mode can be enabled using the scan tool. The afterblow mode allows the blower motor to operate after the engine has been turned off. This operation of the blower motor dries the evaporator core, which reduces the amount of microbial growth which can create undesirable odors.

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

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

7. Select HVAC Afterblow Configuration.

When afterblow has been enabled by the scan tool the blower motor will operate at 68% blower speed, following the sequence below up to 5 times. This could last up to an hour:

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

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

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

ACTUATOR RECALIBRATION

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

When replacing the HVAC control module it will be necessary to allow the HVAC control module to perform a calibration process. When installing the HVAC control module be sure to perform the following:

1. Place the ignition switch to the OFF position.
2. Disconnect the scan tool.
3. Install the HVAC control module.
4. Connect all previously disconnected components.
5. Ignition ON.
6. Wait 40 s for the HVAC control module to self-calibrate.
7. Verify that no DTCs have set as current DTCs.

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

Preferred Method (with Scan Tool)

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

1. Clear all DTCs.
2. Place the ignition switch in the OFF position.

3. Install the HVAC actuator.
4. Connect all previously disconnected components.
5. Start the vehicle.
6. With the scan tool, initiate the HVAC Actuators re-calibration feature of the Remote Heater and Air Conditioning Control Module Special Functions menu.
7. Verify that no DTCs have set as current DTCs.

Alternate Method (without Scan Tool)

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

1. Clear all DTCs.
2. Place the ignition switch to the OFF position.
3. Install the HVAC actuator.
4. Connect all previously disconnected components.
5. Remove the HVAC control module fuse for a minimum of 10 s.
6. Install the HVAC control module fuse.
7. Ignition ON.
8. Wait 40 s for the HVAC control module to self-calibrate.
9. Verify that no DTCs have set as current DTCs.

REPAIR INSTRUCTIONS**HEATER AND AIR CONDITIONING CONTROL REPLACEMENT**

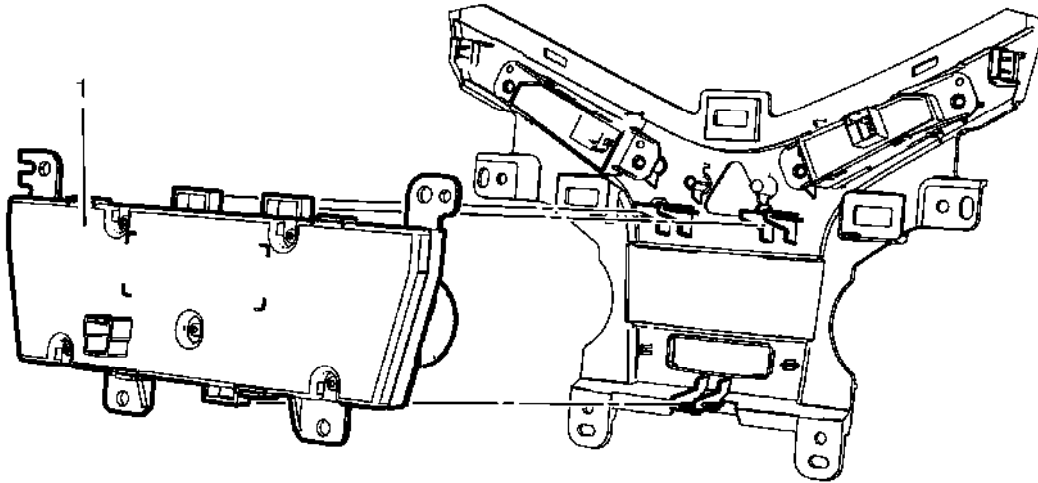


Fig. 4: Heater And Air Conditioning Control
Courtesy of GENERAL MOTORS COMPANY

Heater and Air Conditioning Control Replacement

Callout	Component Name
Preliminary Procedures Remove instrument panel accessory bezel. Refer to <u>Instrument Panel Accessory Bezel Replacement</u> .	
1	Heater and Air Conditioning Control
	Procedure 1. Unclip the retainer tabs. 2. For programming and set up information, refer to <u>Control Module References</u>

HEATER AND BLOWER AND AIR CONDITIONING CONTROL MODULE REPLACEMENT

Removal Procedure

1. Remove instrument panel compartment. Refer to **Instrument Panel Compartment Replacement** .
2. Remove floor air outlet duct right side. Refer to **Floor Air Outlet Duct Replacement - Right Side** .

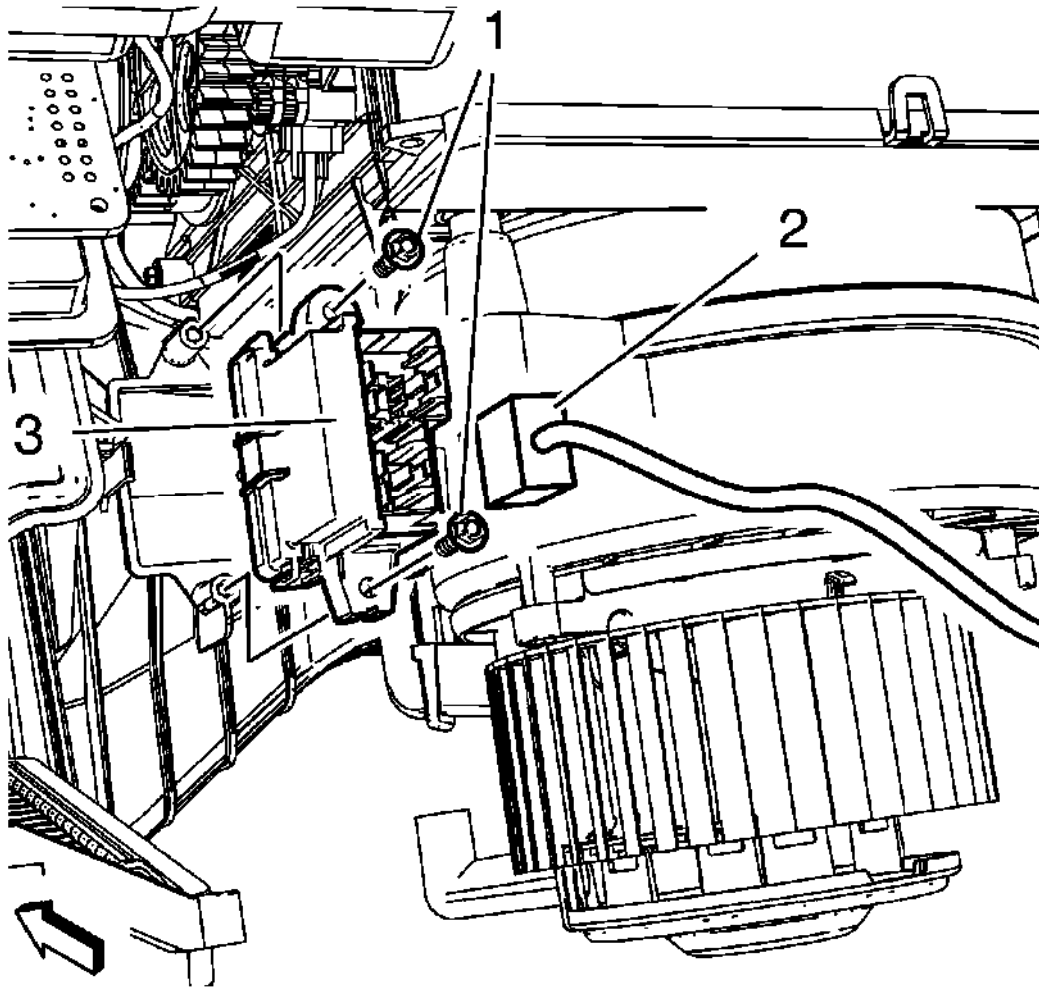


Fig. 5: Heater And Blower Control Module, Wiring Harness Plug And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the 2 heater and blower and air conditioning control module bolts (1) and the heater and blower and air conditioning control module wiring harness plug (2).
4. Remove heater and blower control module (3).

Installation Procedure

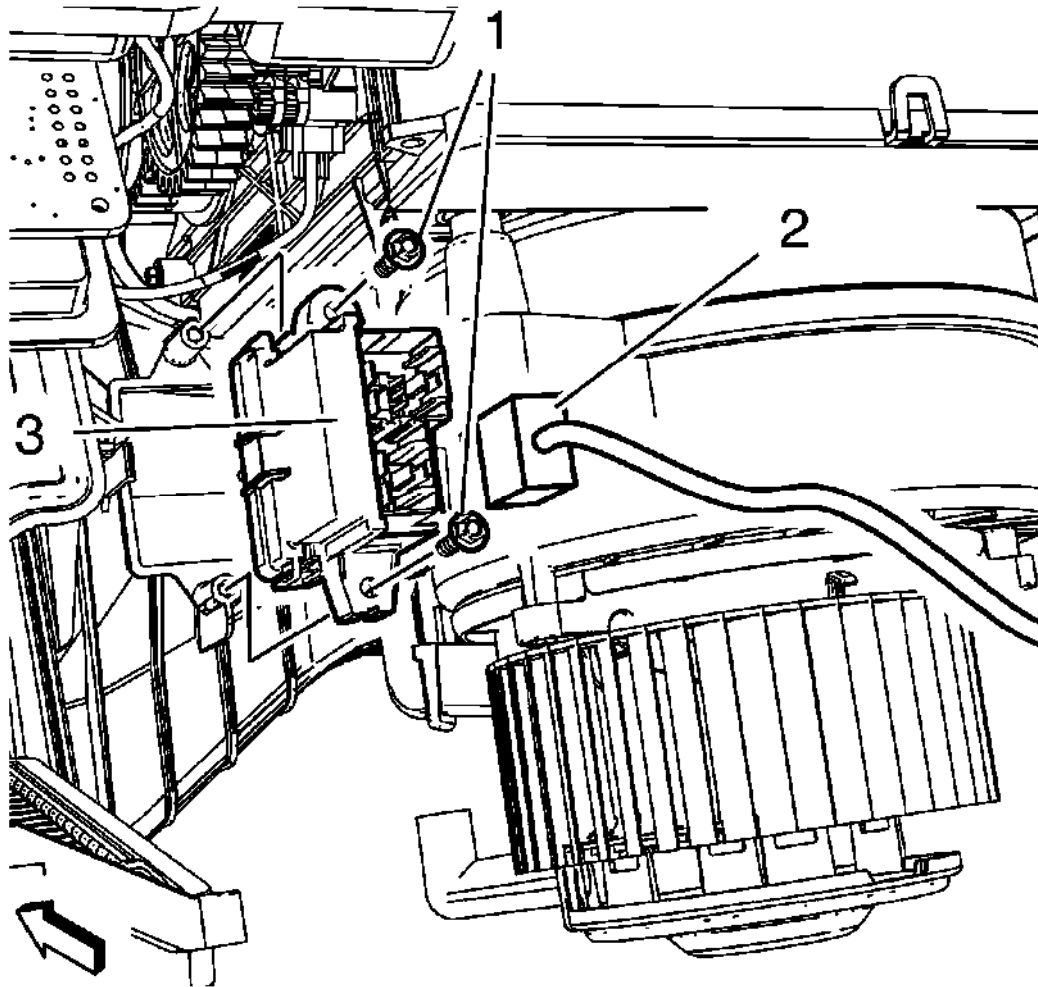


Fig. 6: Heater And Blower Control Module, Wiring Harness Plug And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install heater and blower control module (3).

CAUTION: Refer to Fastener Caution .

2. Install the heater and blower and air conditioning control module wiring harness plug (2) and the 2 heater and blower and air conditioning control module bolts (1). Tighten to 2.5 N.m (22 lb in).
3. Install floor air outlet duct right side. Refer to Floor Air Outlet Duct Replacement - Right Side .
4. Install instrument panel compartment. Refer to Instrument Panel Compartment Replacement .

TEMPERATURE VALVE ACTUATOR REPLACEMENT

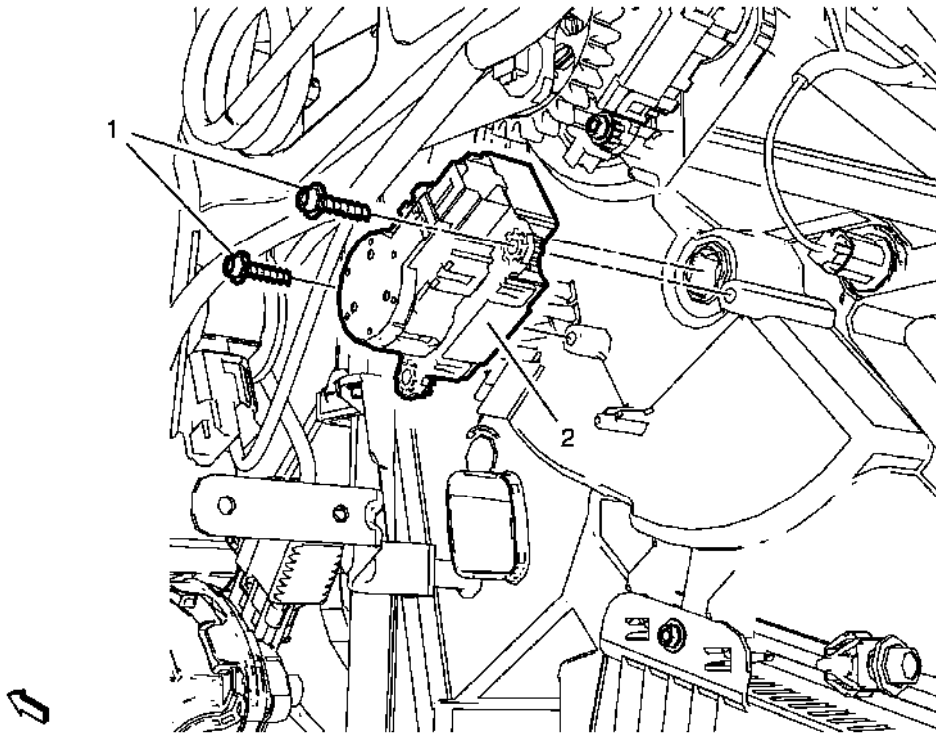


Fig. 7: Temperature Valve Actuator And Bolts
Courtesy of GENERAL MOTORS COMPANY

Temperature Valve Actuator Replacement

Callout	Component Name
Preliminary Procedures	
1. Remove instrument outer trim cover - left side. Refer to <u>Instrument Panel Outer Trim Cover Replacement - Left Side</u> .	
2. Remove instrument panel lower trim pad cover - left side. Refer to <u>Instrument Panel Lower Trim Panel Replacement - Left Side</u> .	
3. Remove floor air outlet duct - left side. Refer to <u>Floor Air Outlet Duct Replacement - Left Side</u> .	
1	Temperature Valve Actuator Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> .
2	Temperature Valve Actuator Procedure 1. Disconnect electrical connector. 2. Recalibrate the temperature valve actuator. Refer to <u>Actuator Recalibration</u> .

MODE VALVE LEVER REPLACEMENT

Removal Procedure

1. Remove instrument panel assembly. Refer to **Instrument Panel Assembly Replacement** .

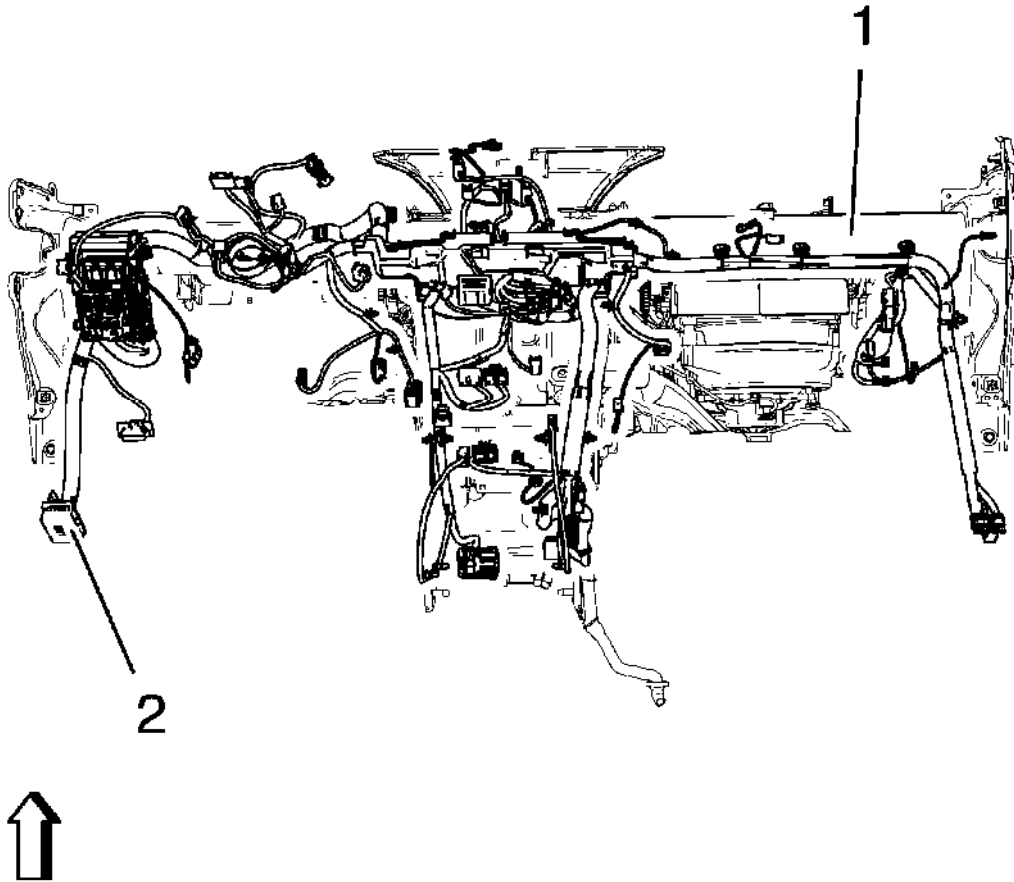


Fig. 8: Instrument Panel Wiring Harness And Instrument Panel Tie Bar
Courtesy of GENERAL MOTORS COMPANY

2. Remove instrument panel wiring harness (2) from instrument panel tie bar (1).

Disconnect electrical connectors.

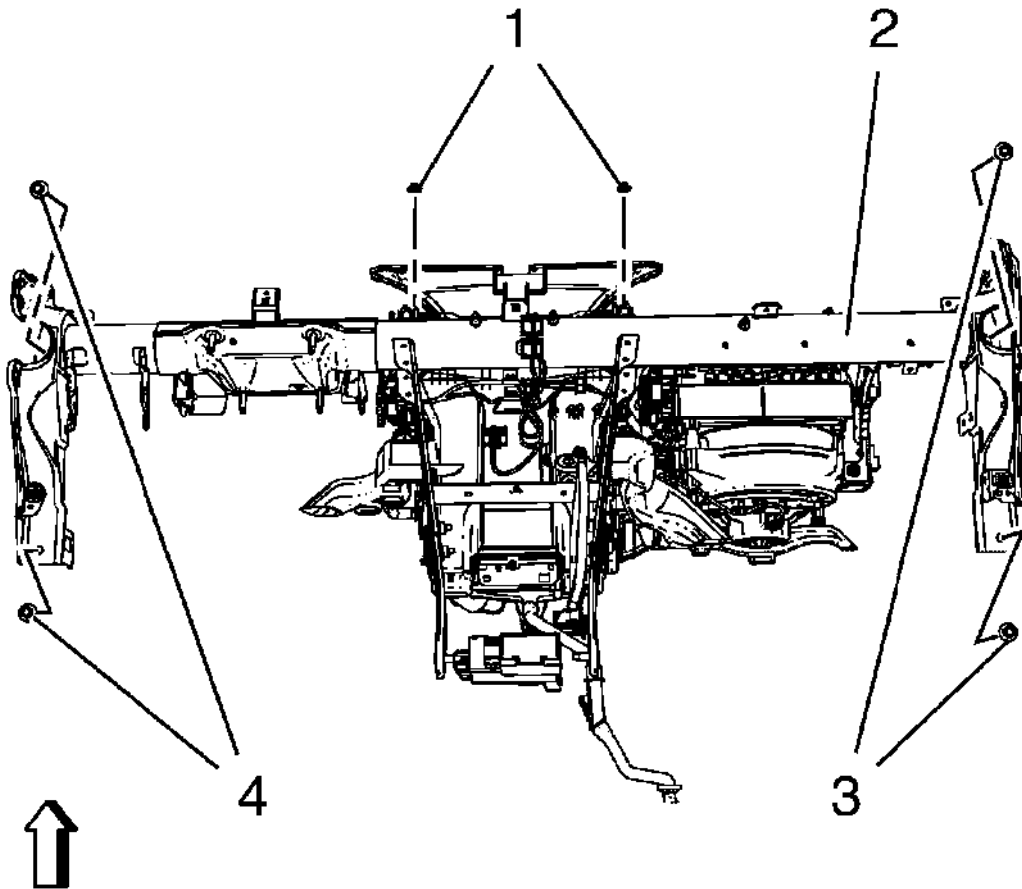


Fig. 9: Instrument Panel Tie Bar, Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

3. Remove instrument panel tie bar (2).
 - Remove 4 instrument panel tie bar bolts (3, 4).
 - Remove 2 instrument panel tie bar nuts (1).

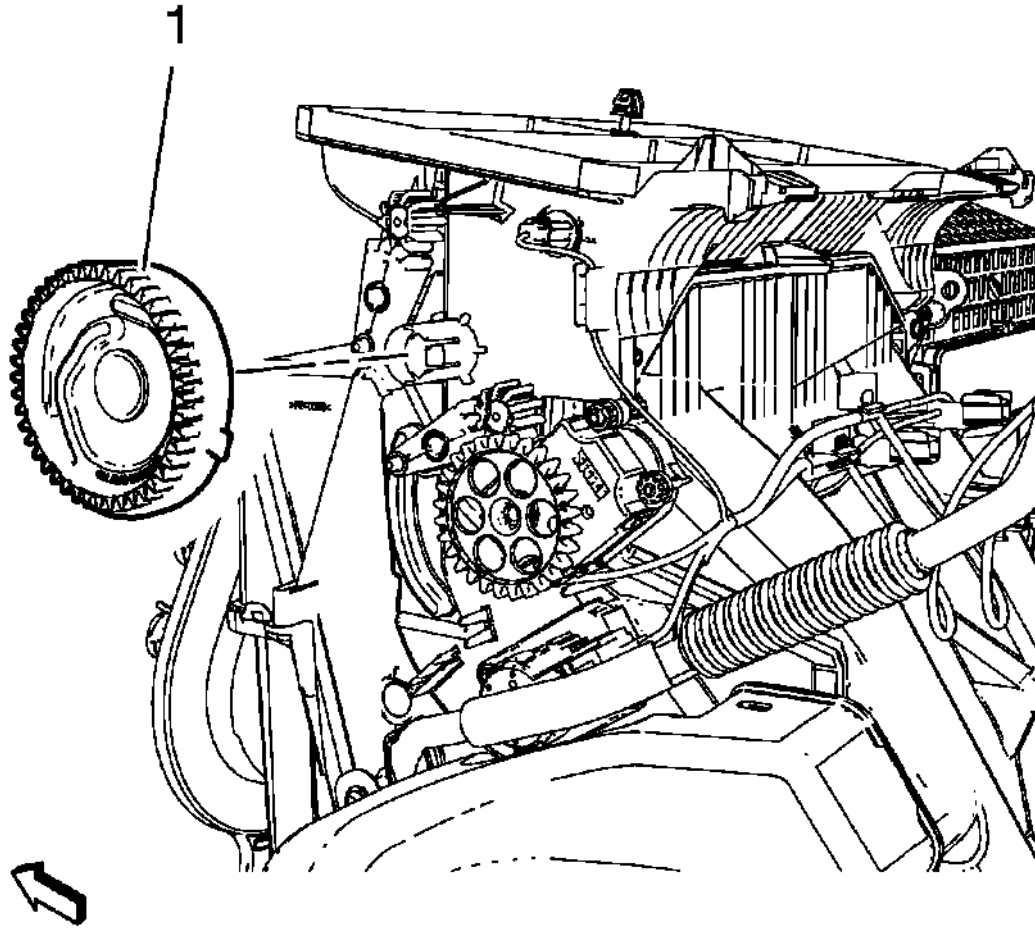


Fig. 10: Mode Control Cam

Courtesy of GENERAL MOTORS COMPANY

4. Remove mode control cam (1).

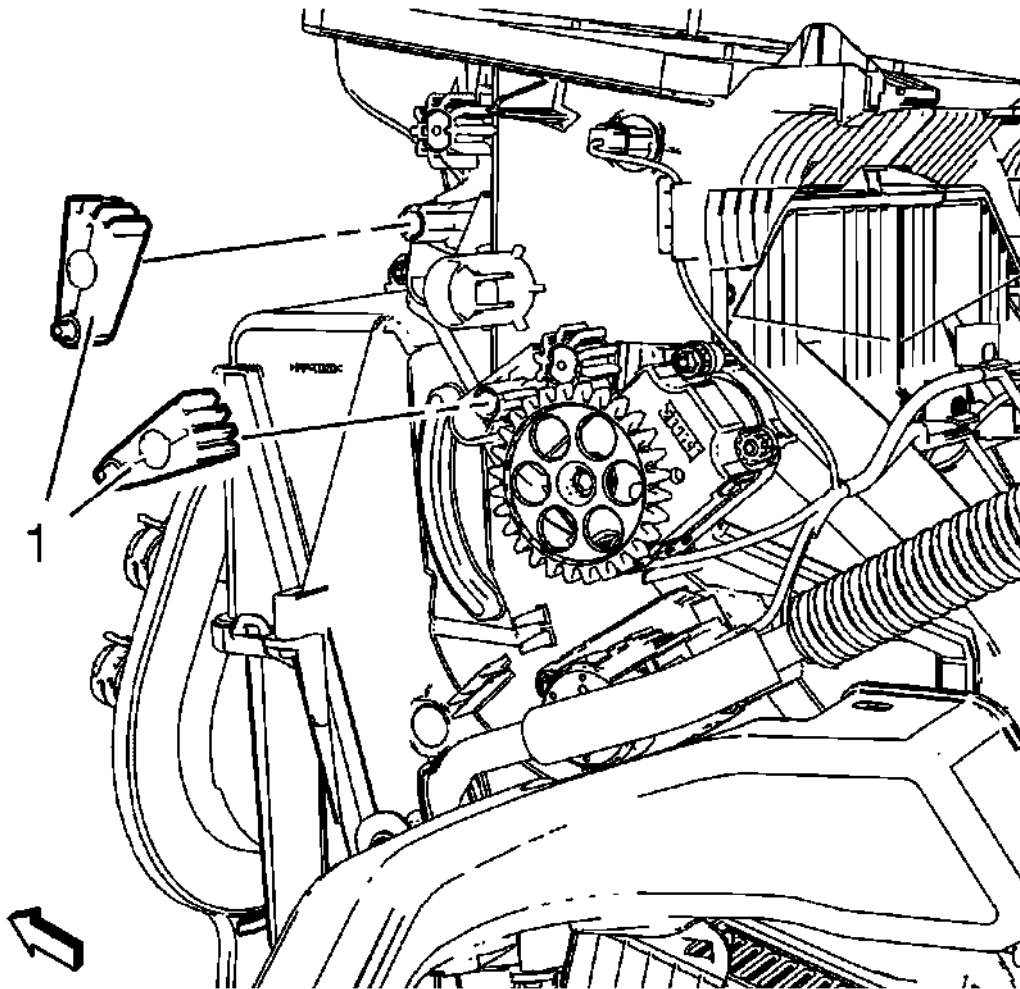


Fig. 11: Mode Valve Lever

Courtesy of GENERAL MOTORS COMPANY

5. Remove 2 mode valve lever (1).

Installation Procedure

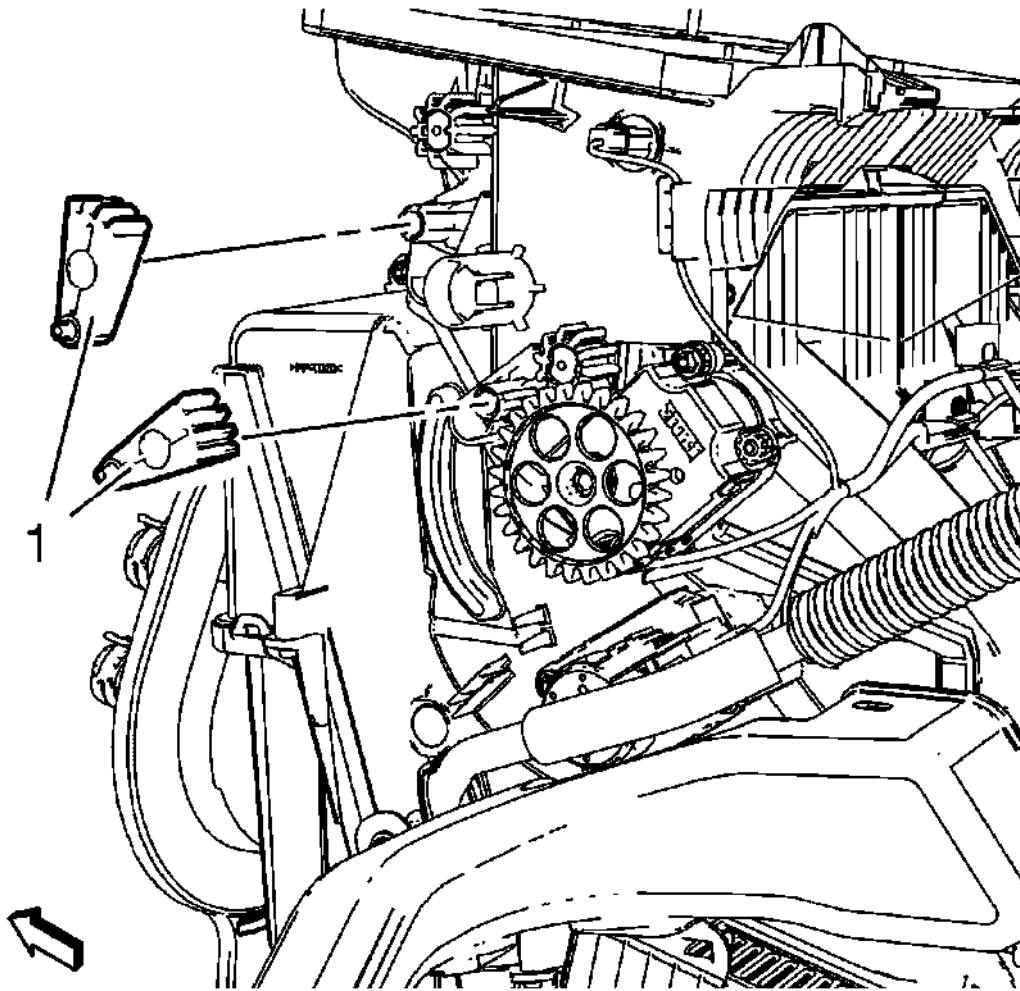


Fig. 12: Mode Valve Lever

Courtesy of GENERAL MOTORS COMPANY

1. Remove 2 mode valve lever (1).

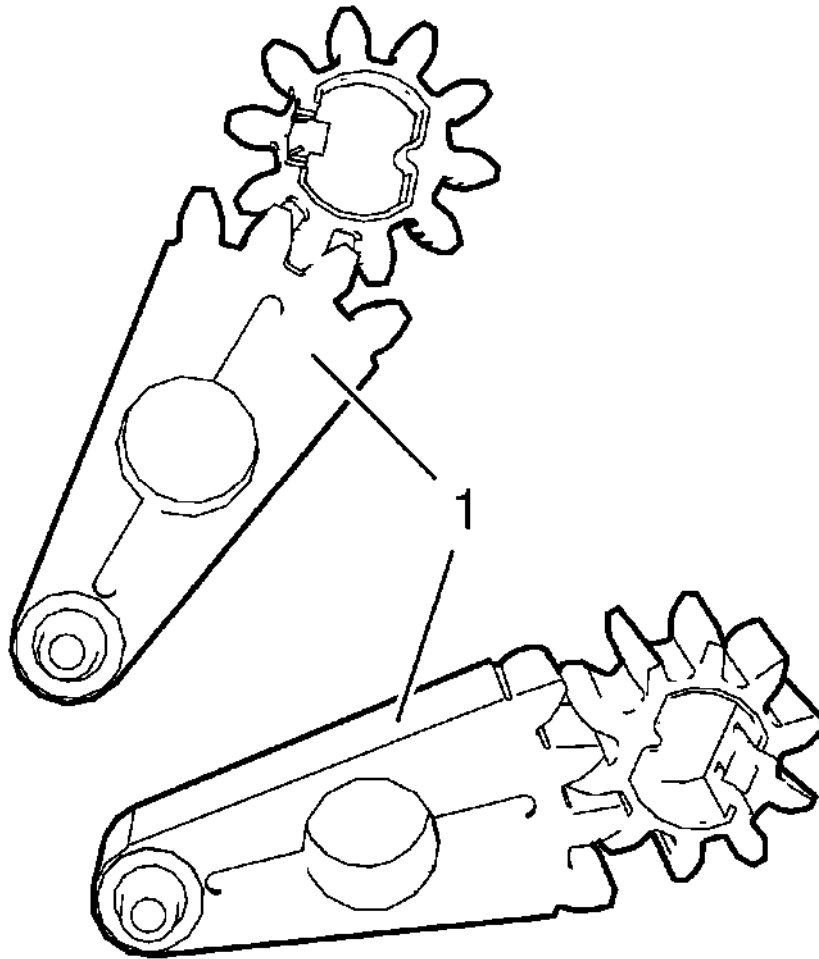


Fig. 13: Mode Valve Levers

Courtesy of GENERAL MOTORS COMPANY

NOTE: The mode valve levers have to be fitted to the according mode valve gears in figured position. The ventilation dampers have to be in middle position.

2. Make sure that mode valve gears of mode valve levers (1) are fitted as shown in graphic above.

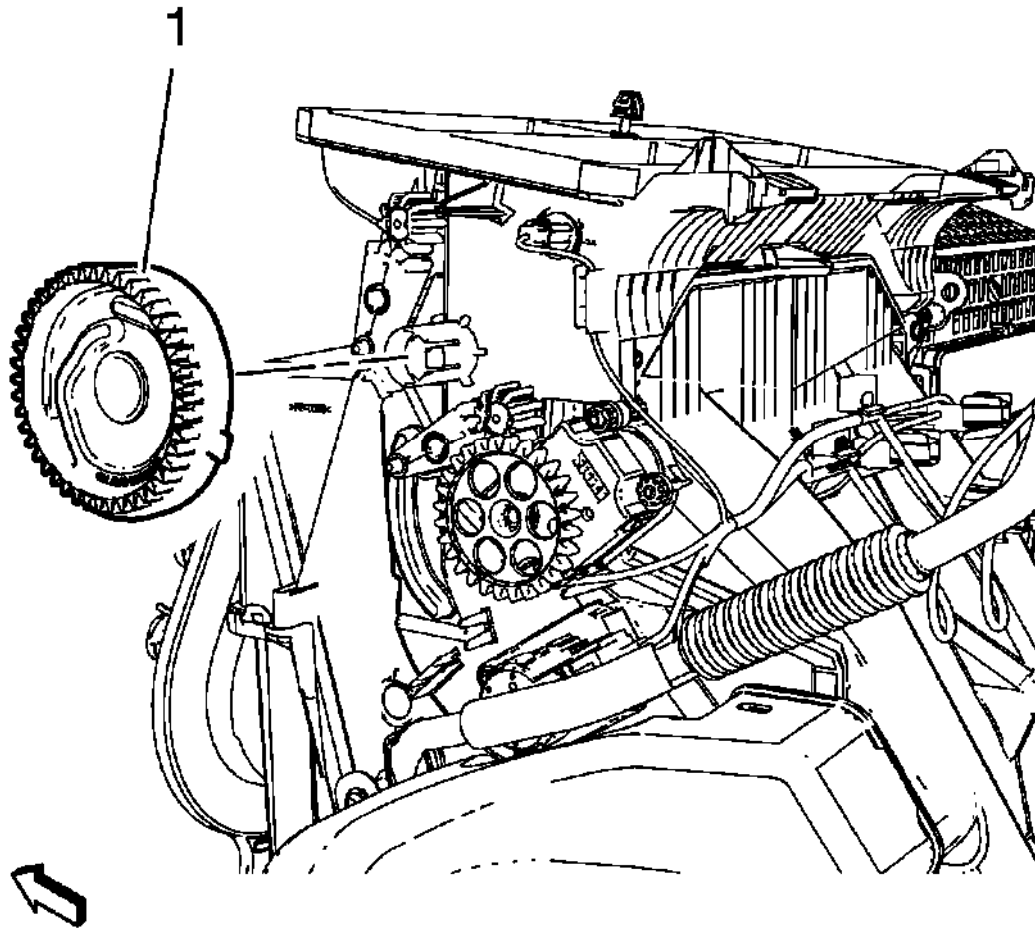


Fig. 14: Mode Control Cam

Courtesy of GENERAL MOTORS COMPANY

NOTE: The mode control cam can only be fitted in one position.

3. Install mode control cam (1).

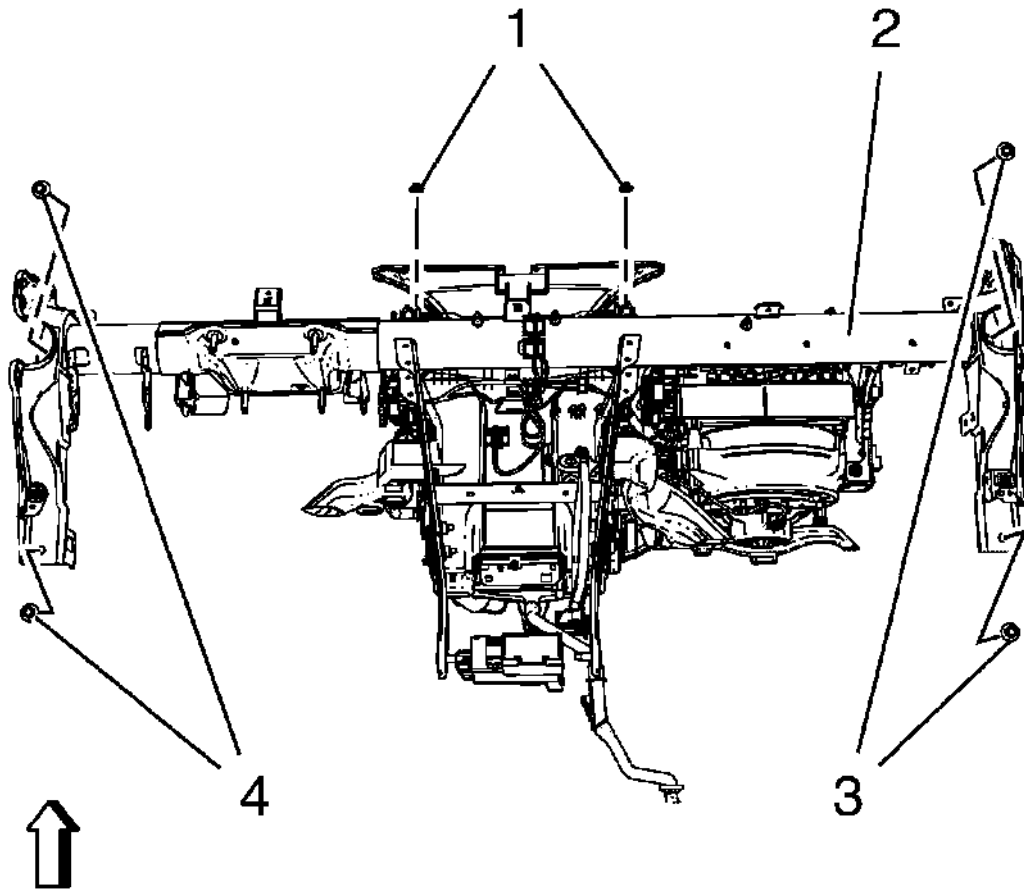


Fig. 15: Instrument Panel Tie Bar, Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Install instrument panel tie bar (2).
 - Install 4 instrument panel tie bar bolts (3, 4) and tighten to 22 N.m (17 lb ft).
 - Install 2 instrument panel tie bar nuts (1) and tighten to 9 N.m (80 lb in).

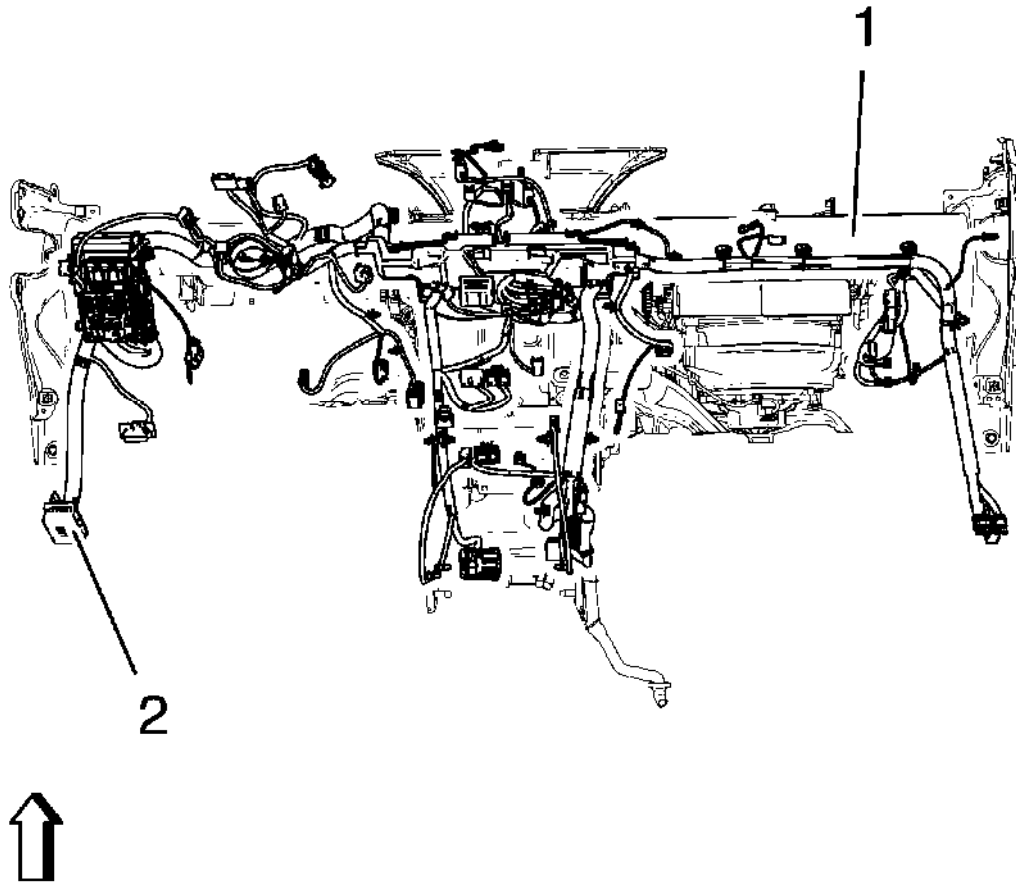


Fig. 16: Instrument Panel Wiring Harness And Instrument Panel Tie Bar
Courtesy of GENERAL MOTORS COMPANY

5. Install instrument panel wiring harness (2) from instrument panel tie bar (1).
Connect electrical connectors.
6. Install instrument panel assembly. Refer to **Instrument Panel Assembly Replacement** .

VENT VALVE LEVER REPLACEMENT

Removal Procedure

1. Remove instrument panel assembly. Refer to **Instrument Panel Assembly Replacement** .

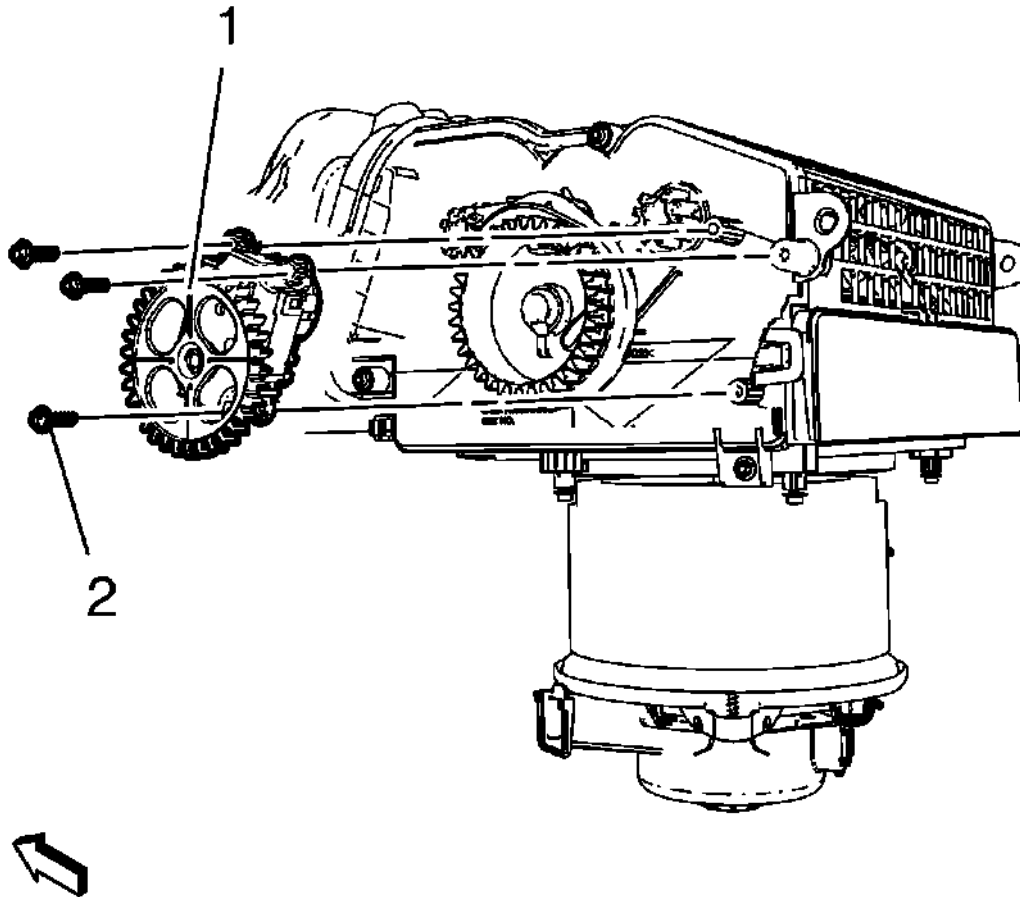


Fig. 17: Mode Control Cam Actuator

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect electrical connector and remove 3 mode control cam actuator screws (2) and remove mode control cam actuator (1).

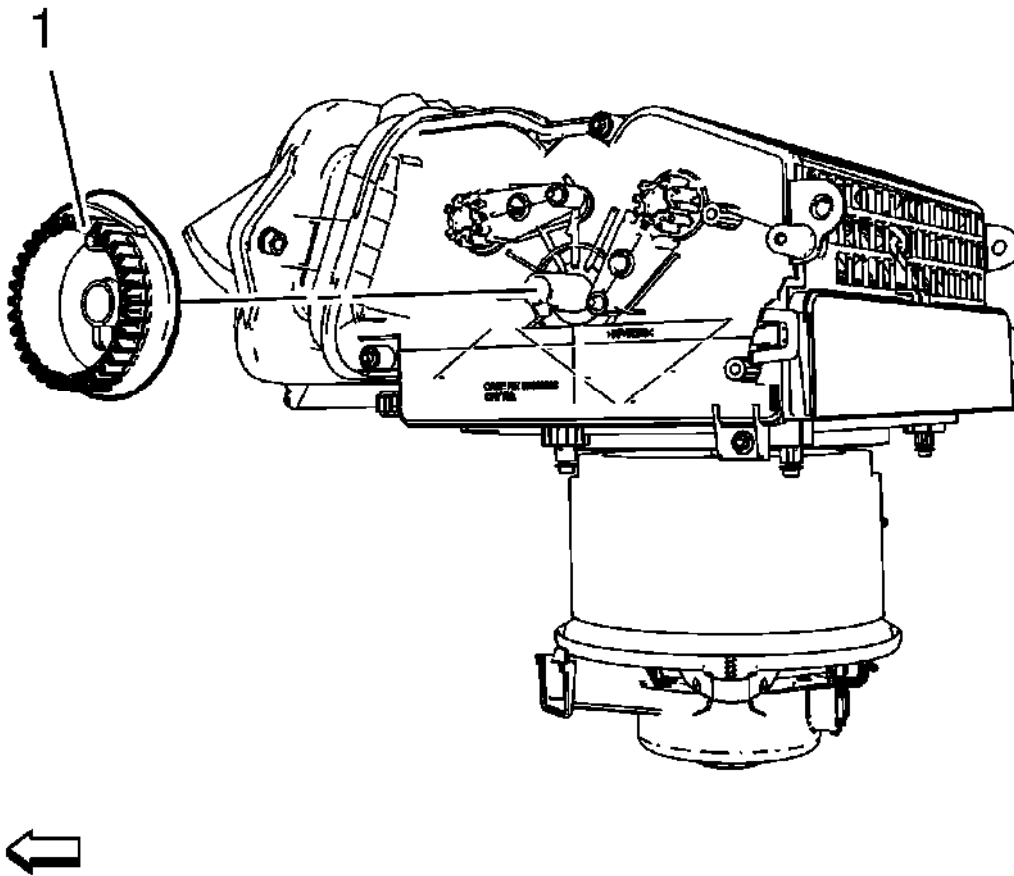


Fig. 18: Inside Air Valve Control Cam
Courtesy of GENERAL MOTORS COMPANY

NOTE: The graphic shows air inlet housing without attaching parts for better clarity.

3. Remove air inlet valve and inside air valve control cam (1).

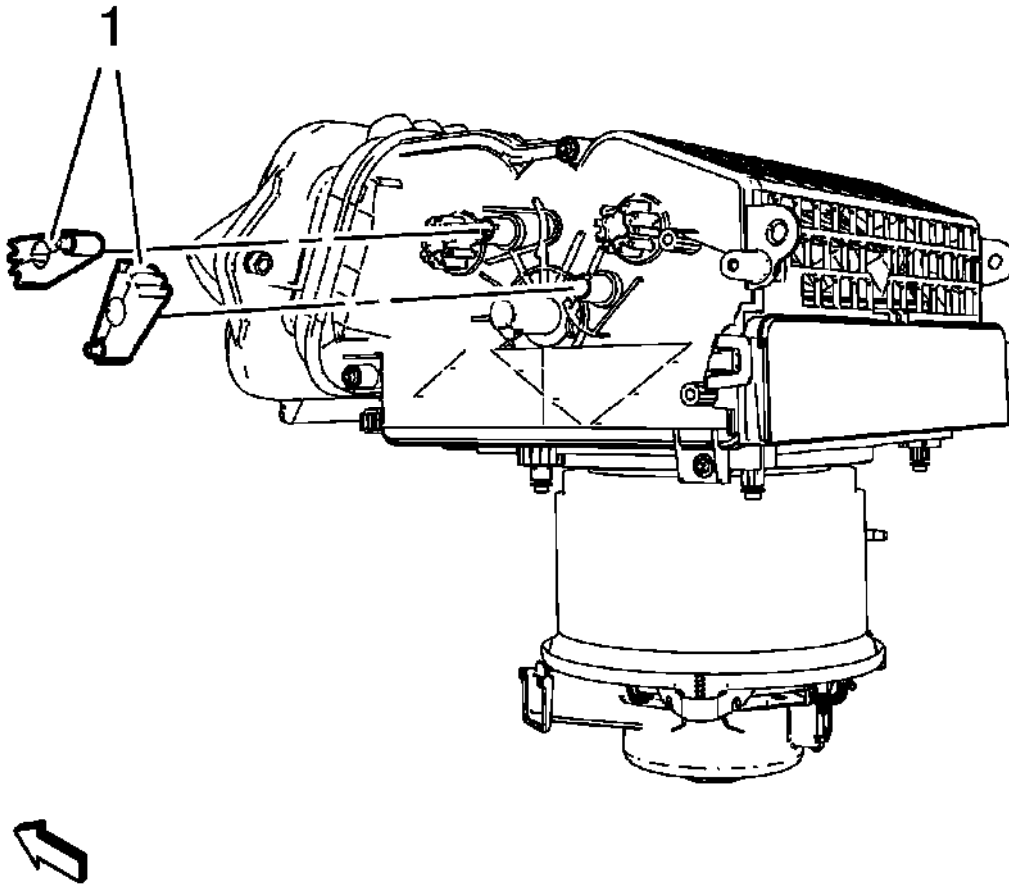


Fig. 19: Vent Valve Levers

Courtesy of GENERAL MOTORS COMPANY

4. Remove 2 vent valve levers (1).

Installation Procedure

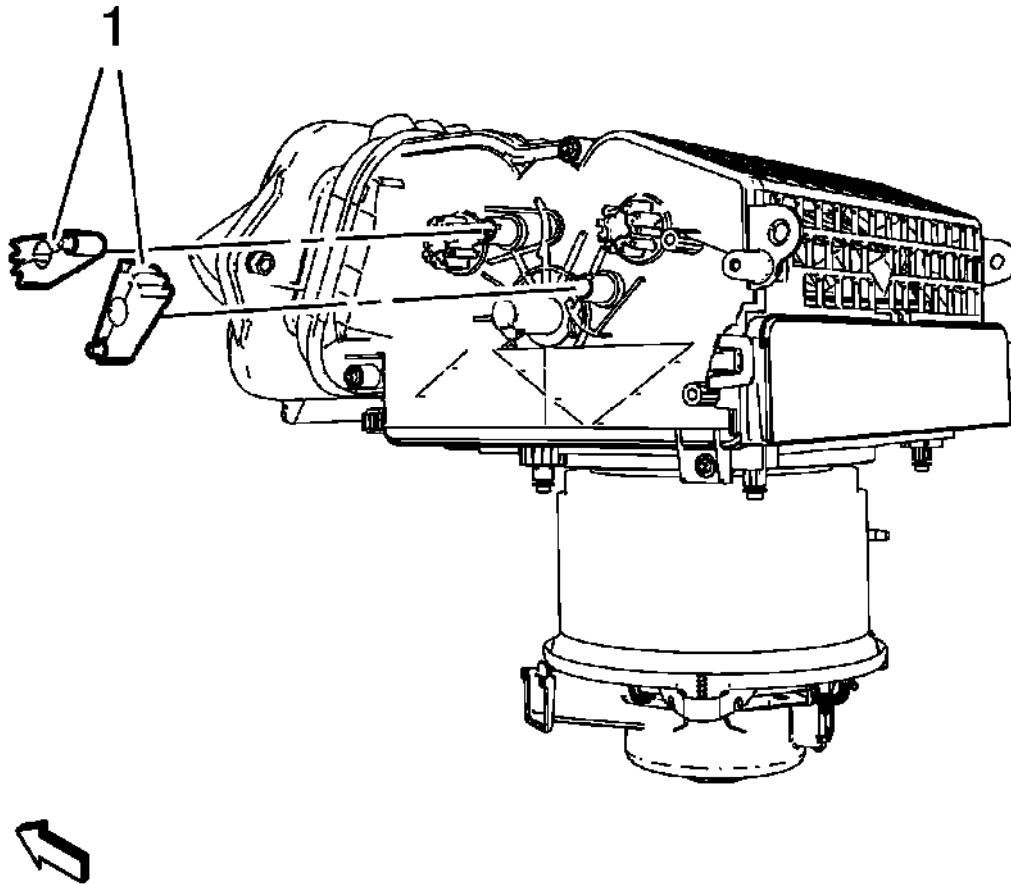


Fig. 20: Vent Valve Levers

Courtesy of GENERAL MOTORS COMPANY

1. Install 2 vent valve levers (1).

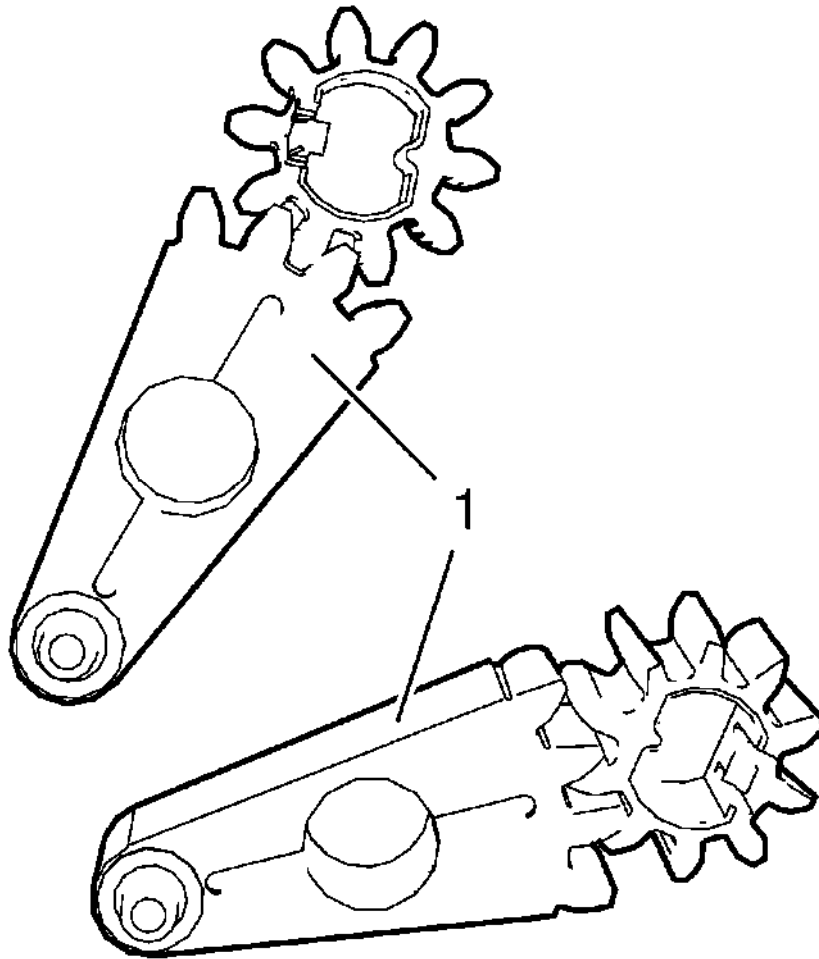


Fig. 21: Mode Valve Levers

Courtesy of GENERAL MOTORS COMPANY

NOTE: The vent valve levers have to be fitted to the according vent valve gears in figured position. The air circulation dampers have to be in middle position.

2. Make sure that mode valve gears of vent valve levers (1) are fitted as shown in graphic above.

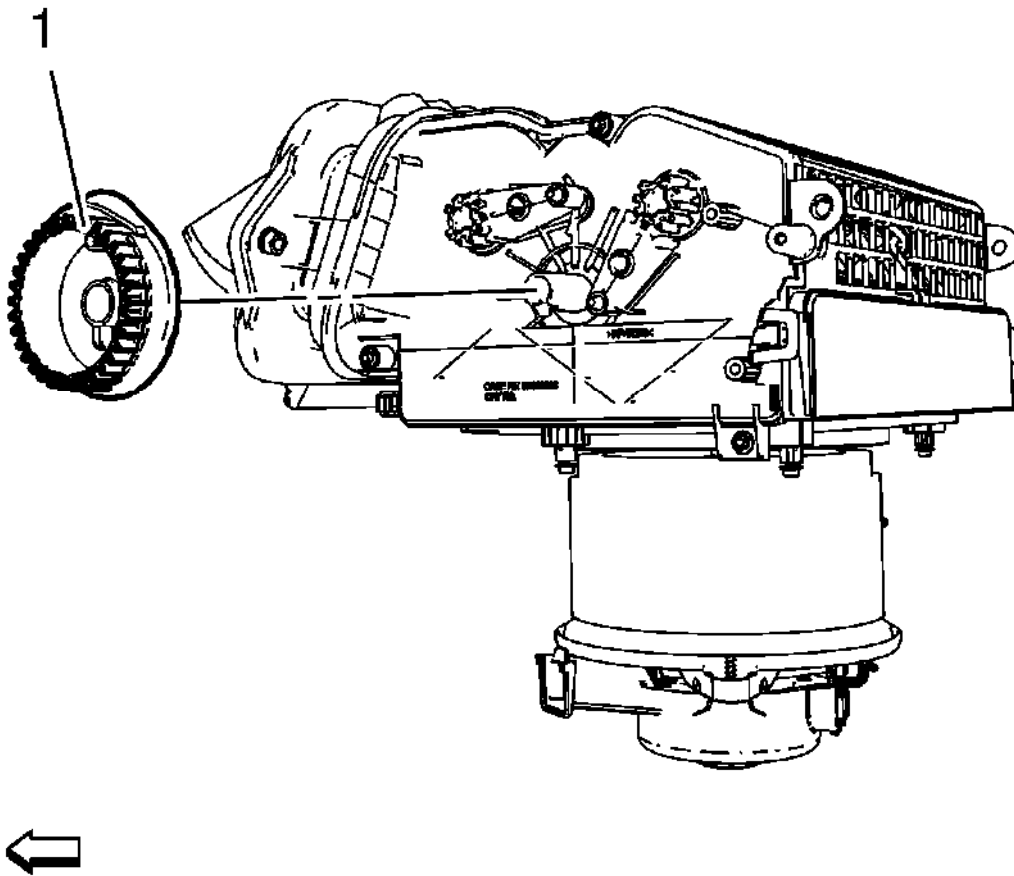


Fig. 22: Inside Air Valve Control Cam
Courtesy of GENERAL MOTORS COMPANY

NOTE: The air inlet valve and inside air valve control cam can only be fitted in one position.

3. Install air inlet valve and inside air valve control cam (1).

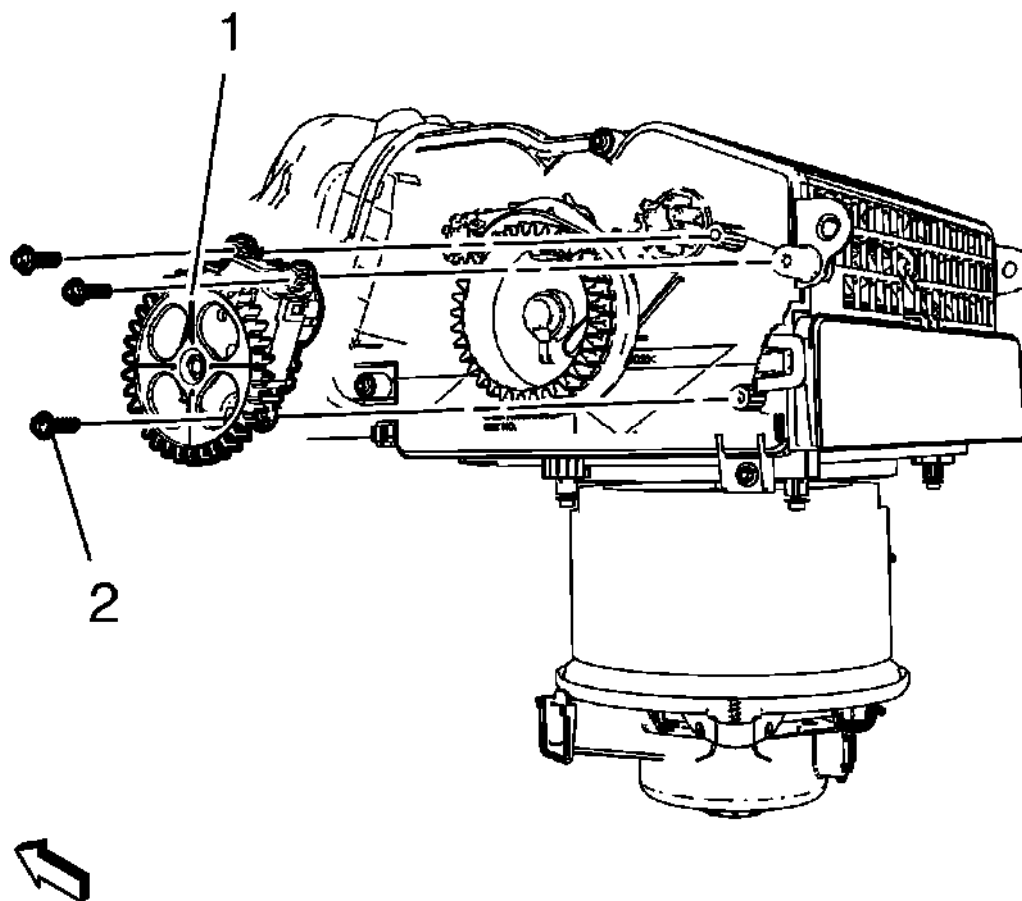


Fig. 23: Mode Control Cam Actuator

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Install mode control cam actuator (1) and Install 3 mode control cam actuator screws (2) and connect electrical connector.

Tighten

2.5 N.m (23 lb in)

5. Install instrument panel assembly. Refer to Instrument Panel Assembly Replacement .

MODE VALVE GEAR REPLACEMENT

Removal Procedure

1. Remove instrument panel assembly. Refer to **Instrument Panel Assembly Replacement** .

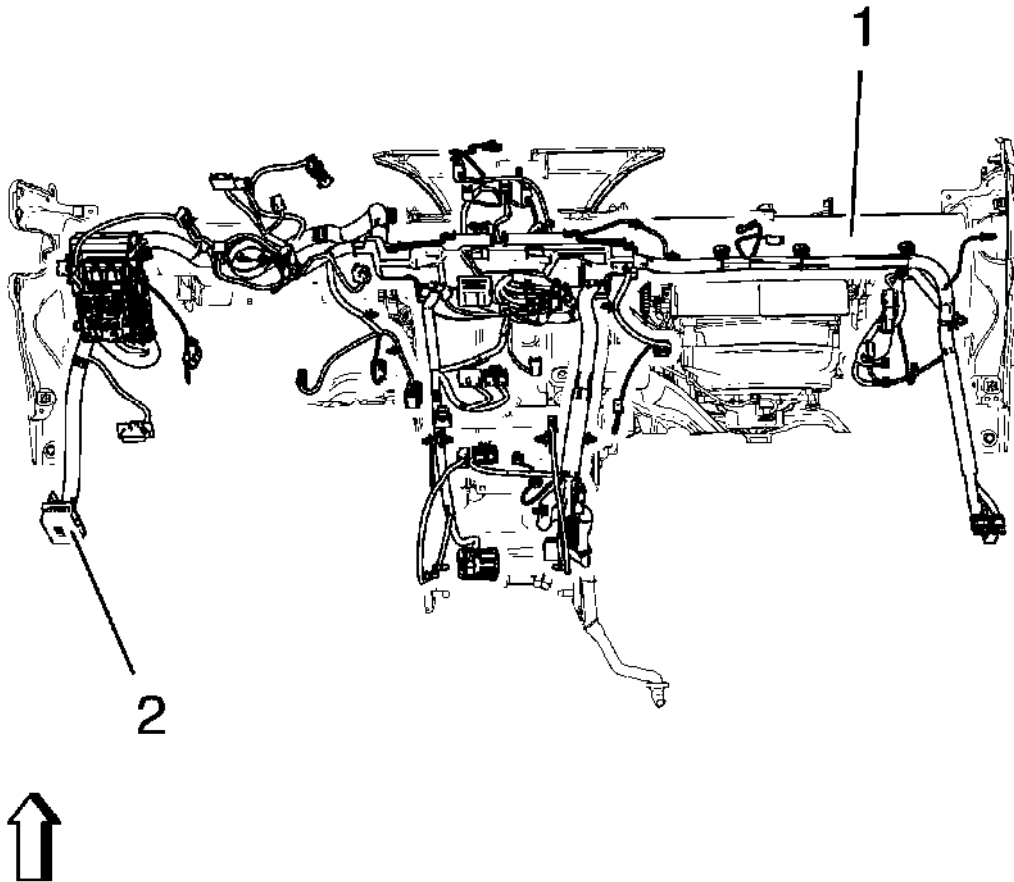


Fig. 24: Instrument Panel Wiring Harness And Instrument Panel Tie Bar
Courtesy of GENERAL MOTORS COMPANY

2. Remove instrument panel wiring harness (2) from instrument panel tie bar (1).

Disconnect electrical connectors.

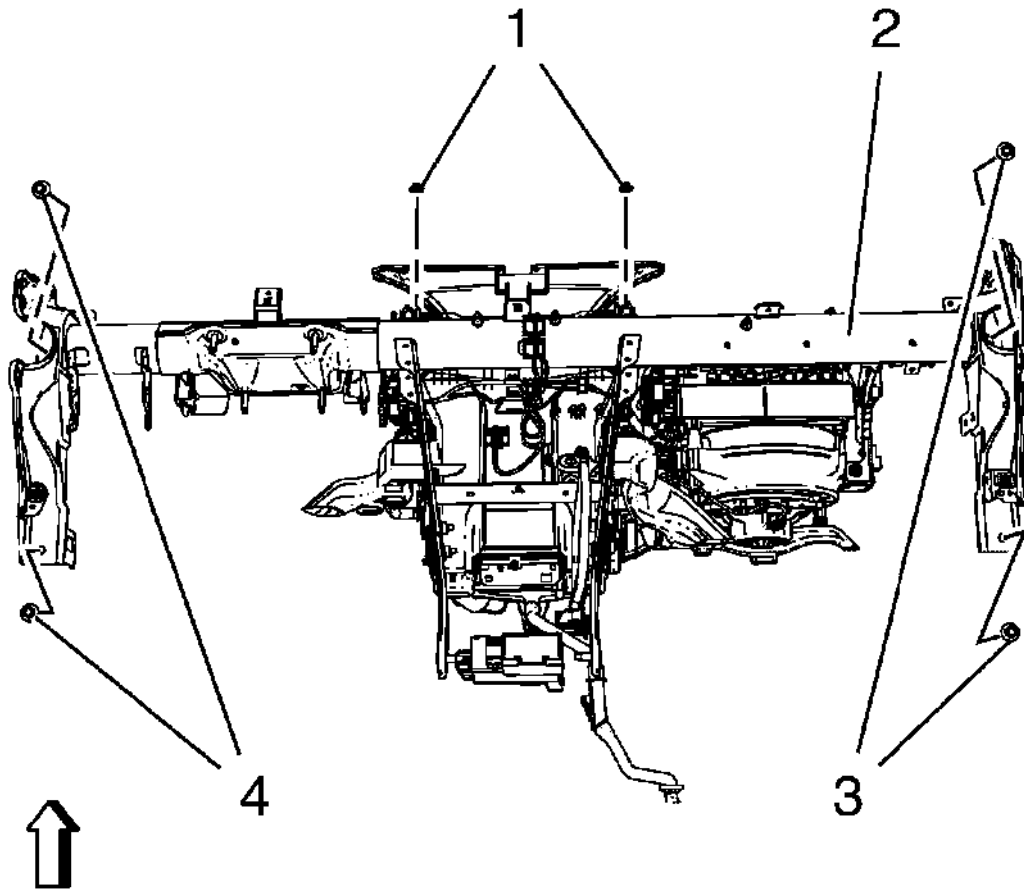


Fig. 25: Instrument Panel Tie Bar, Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

3. Remove instrument panel tie bar (2).
 - Remove 4 instrument panel tie bar bolts (3, 4).
 - Remove 2 instrument panel tie bar nuts (1).

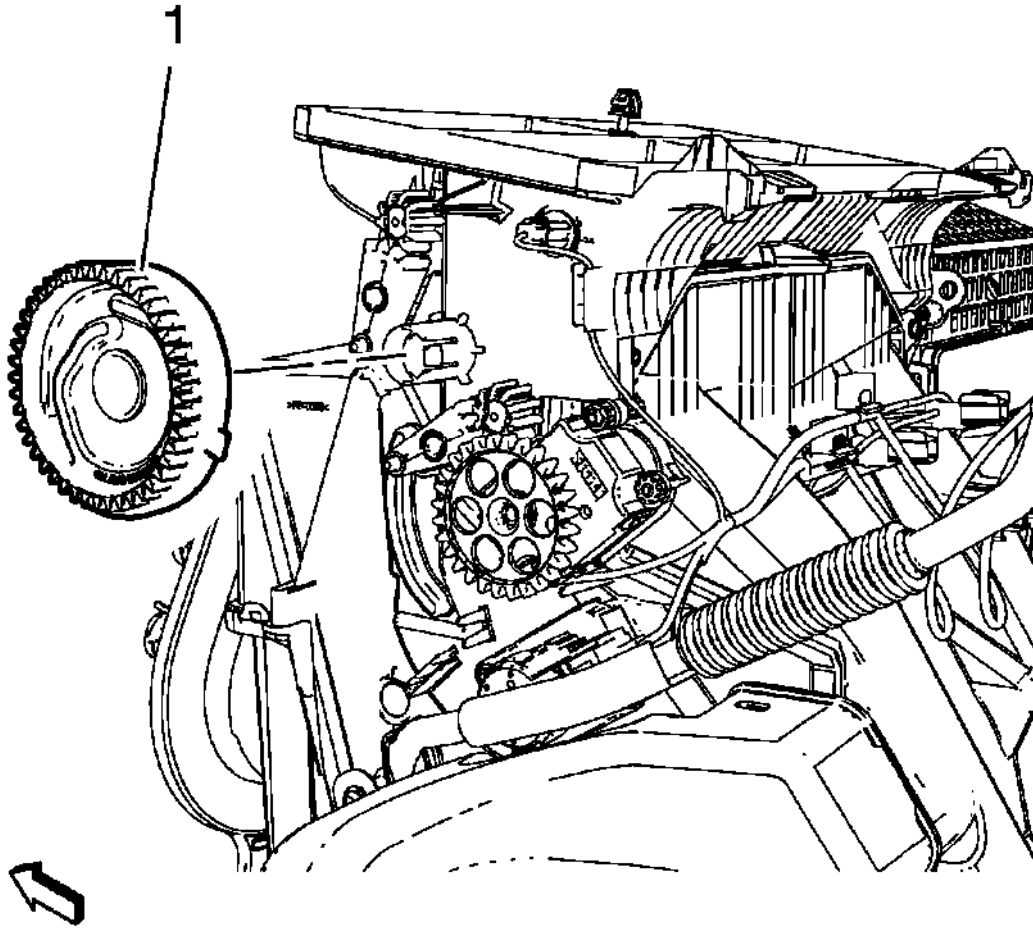


Fig. 26: Mode Control Cam

Courtesy of GENERAL MOTORS COMPANY

4. Remove mode control cam (1).

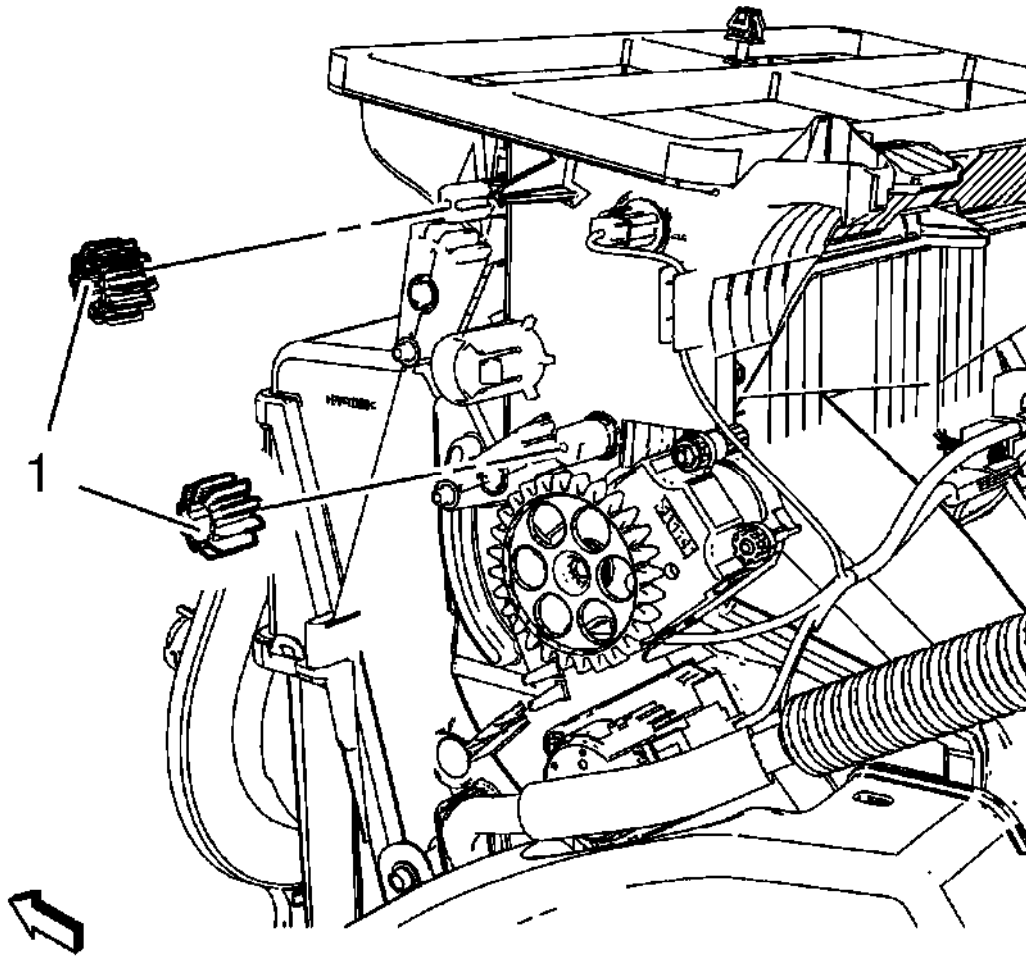


Fig. 27: Mode Valve Gear

Courtesy of GENERAL MOTORS COMPANY

5. Remove 2 mode valve gear (1).

Installation Procedure

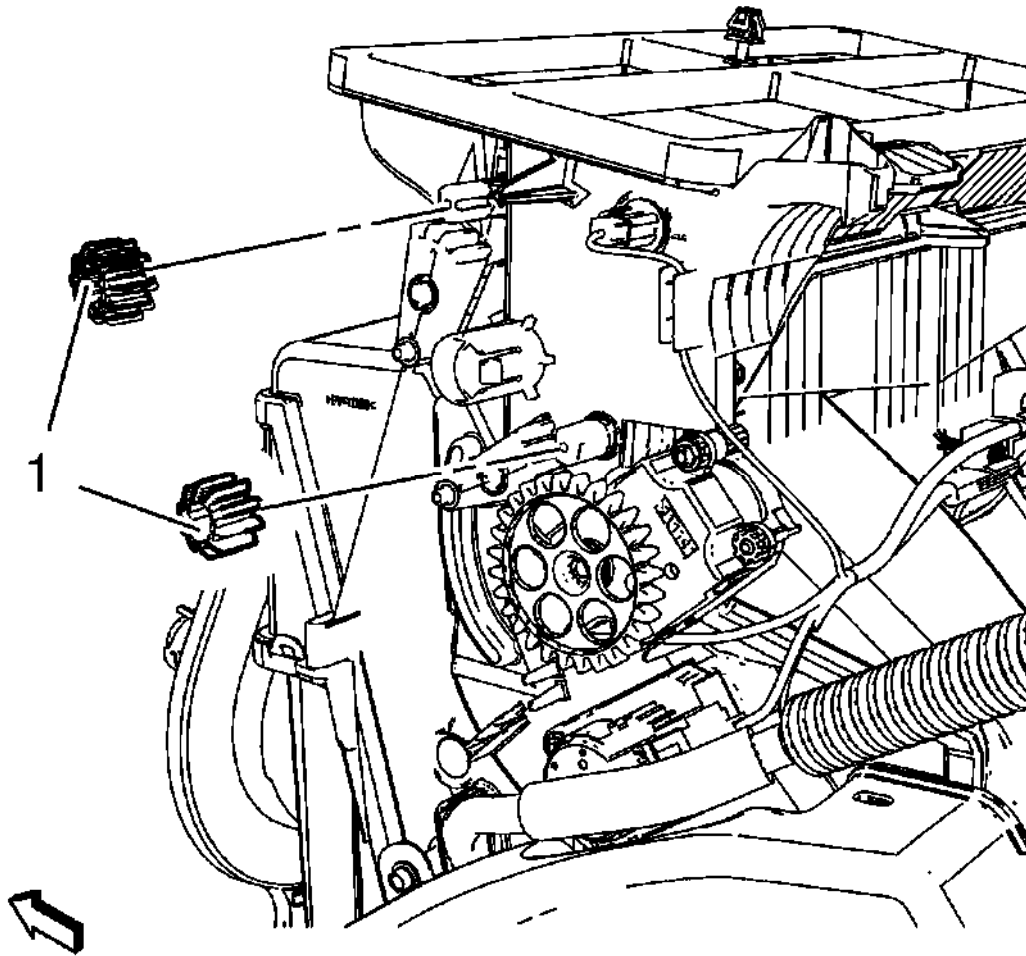


Fig. 28: Mode Valve Gear

Courtesy of GENERAL MOTORS COMPANY

1. Install 2 mode valve gear (1).

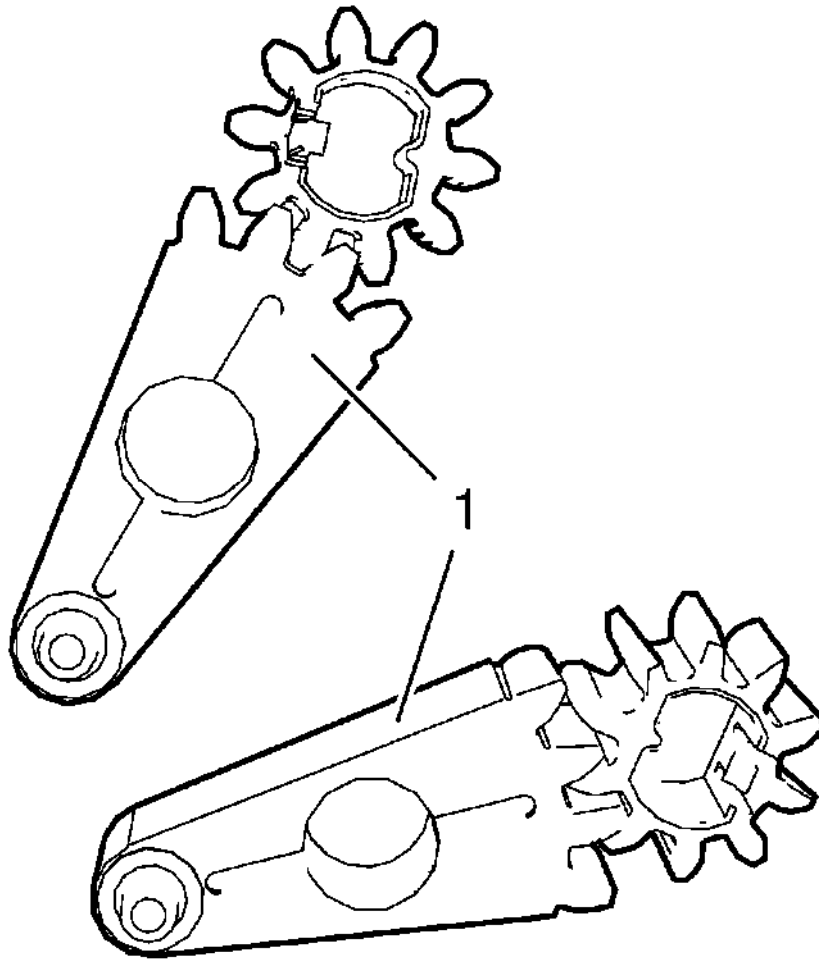


Fig. 29: Mode Valve Levers

Courtesy of GENERAL MOTORS COMPANY

NOTE: The mode valve gear can only be fitted in one position. The mode valve gears have to be fitted to the according mode valve levers in figured position. The ventilation dampers have to be in middle position.

2. Make sure that mode valve gears of mode valve levers (1) are fitted as shown in graphic above.

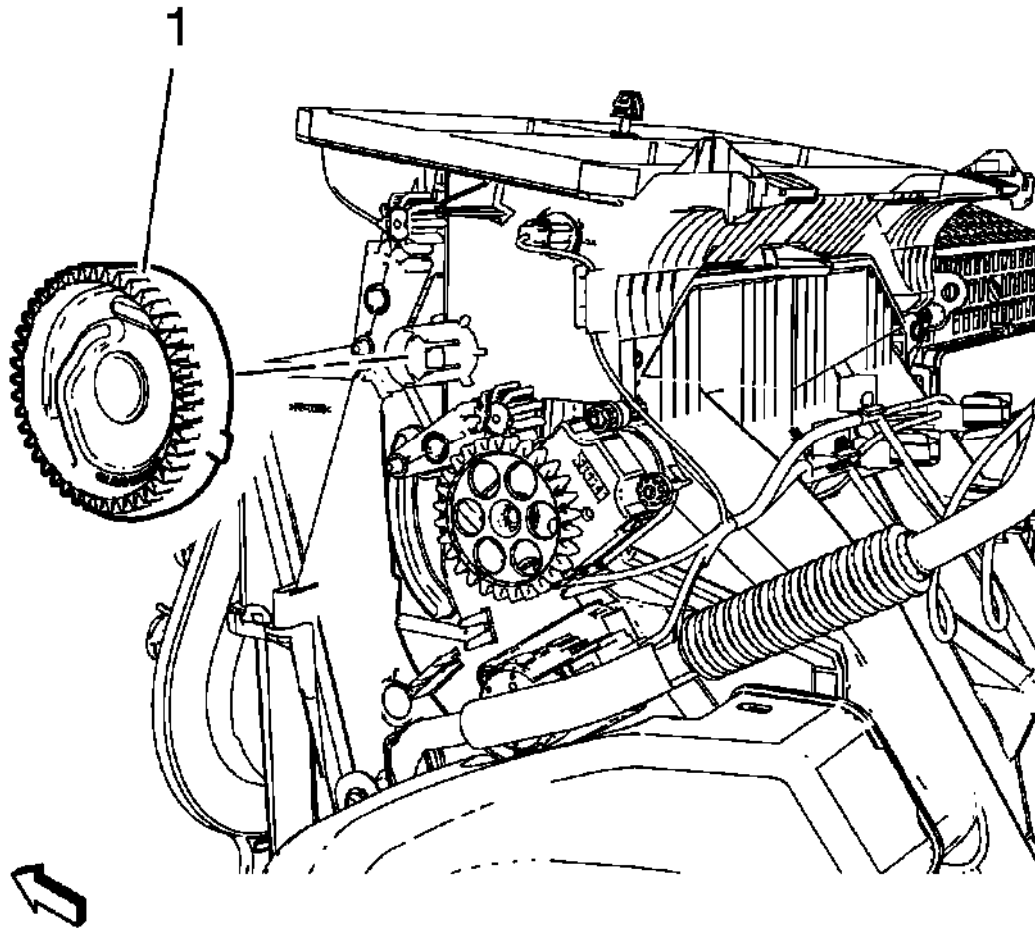


Fig. 30: Mode Control Cam

Courtesy of GENERAL MOTORS COMPANY

NOTE: The mode control cam can only be fitted in one position.

3. Install mode control cam (1).

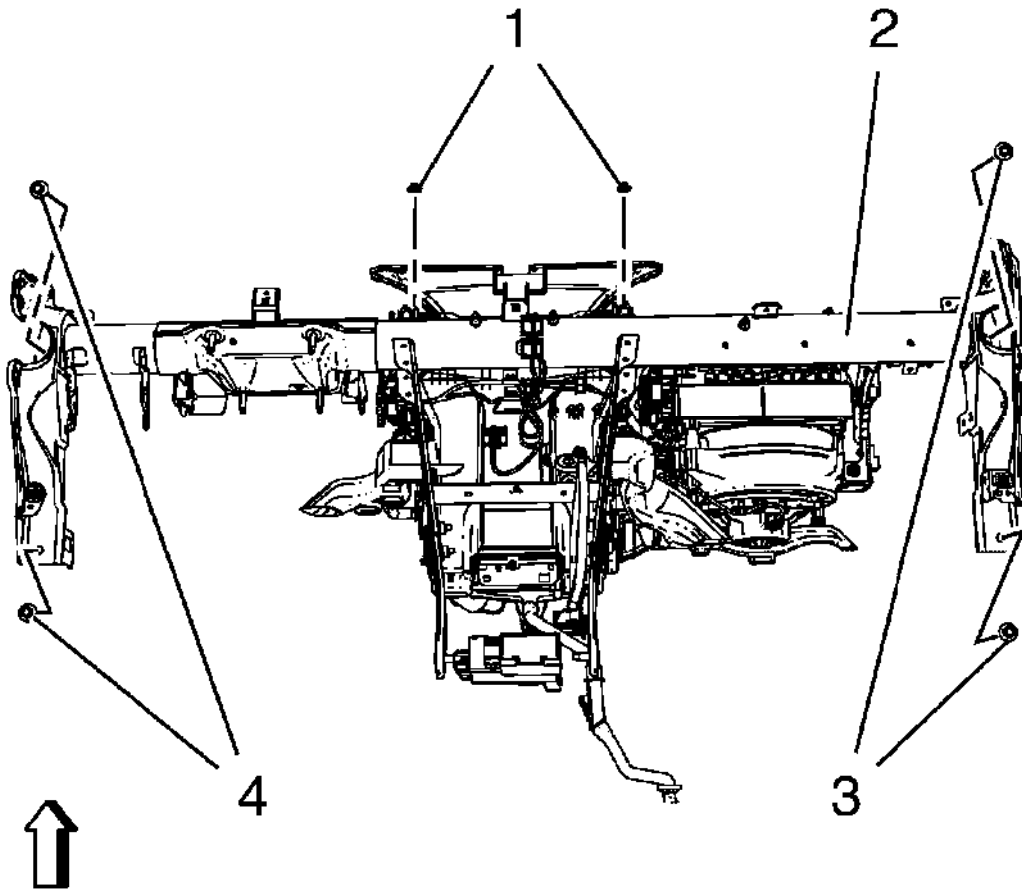


Fig. 31: Instrument Panel Tie Bar, Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

4. Install instrument panel tie bar (2).
 - Install 4 instrument panel tie bar bolts (3, 4) and tighten to 22 N.m (17 lb ft).
 - Install 2 instrument panel tie bar nuts (1) and tighten to 9 N.m (80 lb in).

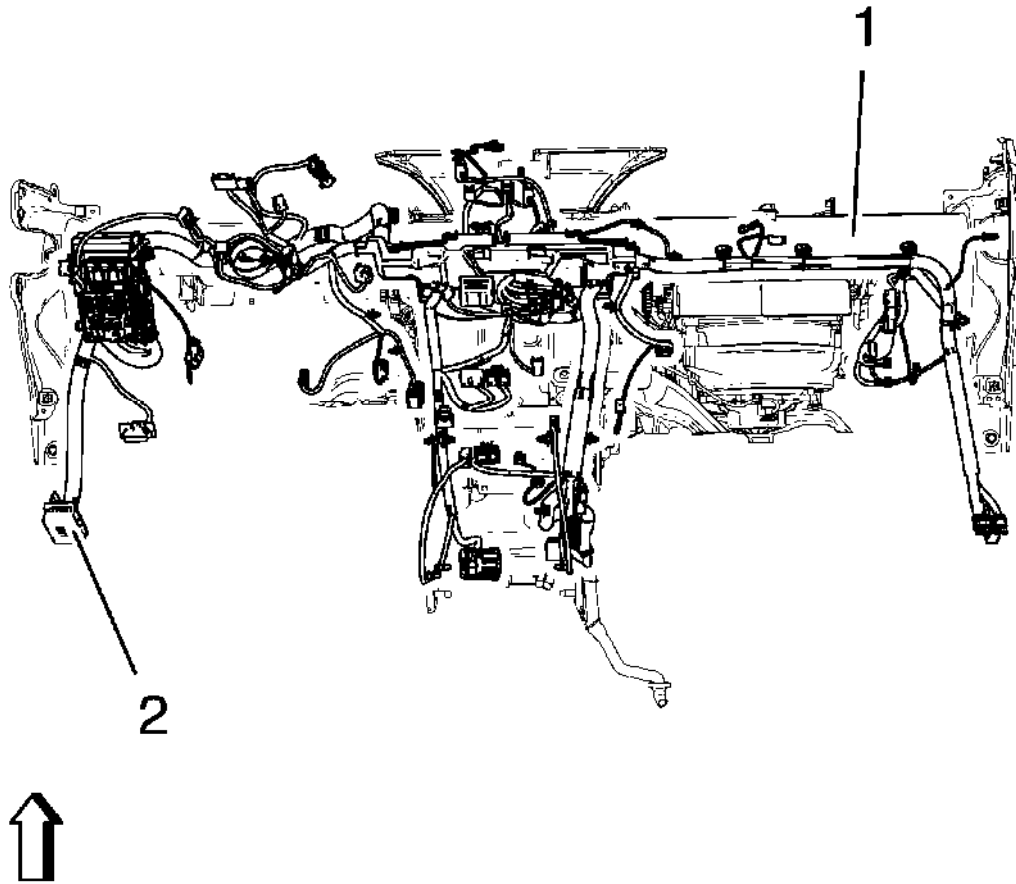


Fig. 32: Instrument Panel Wiring Harness And Instrument Panel Tie Bar
Courtesy of GENERAL MOTORS COMPANY

5. Install instrument panel wiring harness (2) from instrument panel tie bar (1).
Connect electrical connectors.
6. Install instrument panel assembly. Refer to **Instrument Panel Assembly Replacement** .

AIR INLET VALVE ACTUATOR GEAR REPLACEMENT

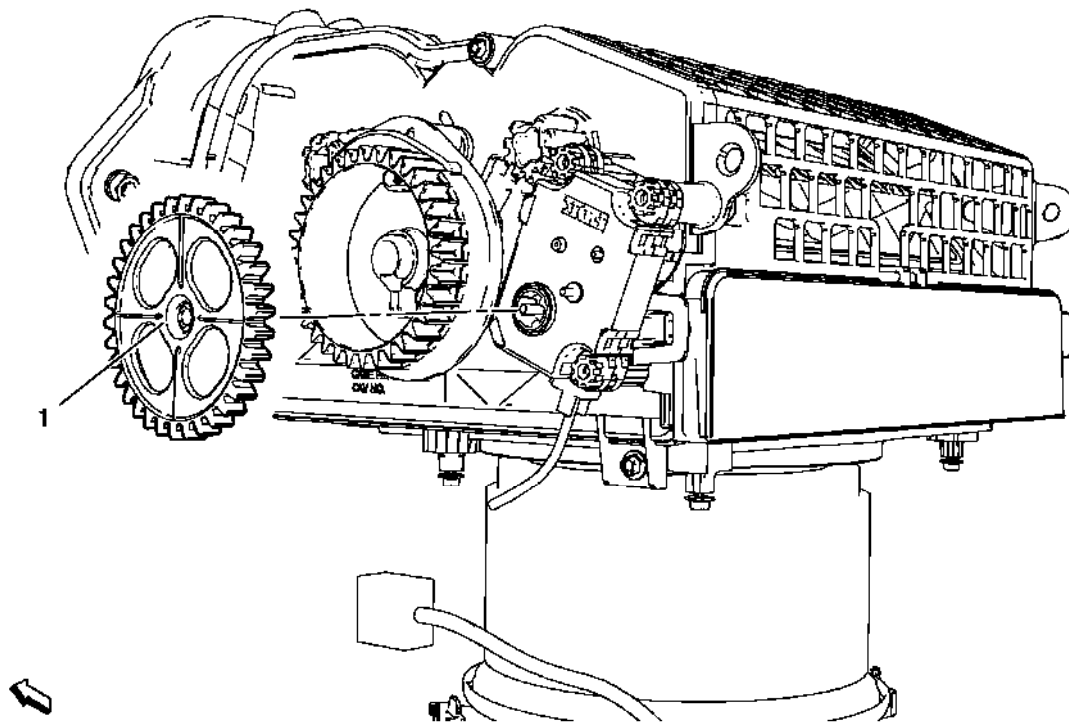


Fig. 33: Air Inlet Valve Actuator Gear (Left Hand Drive)

Courtesy of GENERAL MOTORS COMPANY

Air Inlet Valve Actuator Gear Replacement

Callout	Component Name
Preliminary Procedure Remove instrument panel compartment assembly. Refer to <u>Instrument Panel Compartment Replacement</u> .	
1	Air Inlet Valve Actuator Gear Procedure Pull air inlet valve actuator gear from air inlet valve actuator.

AIR INLET VALVE ACTUATOR REPLACEMENT

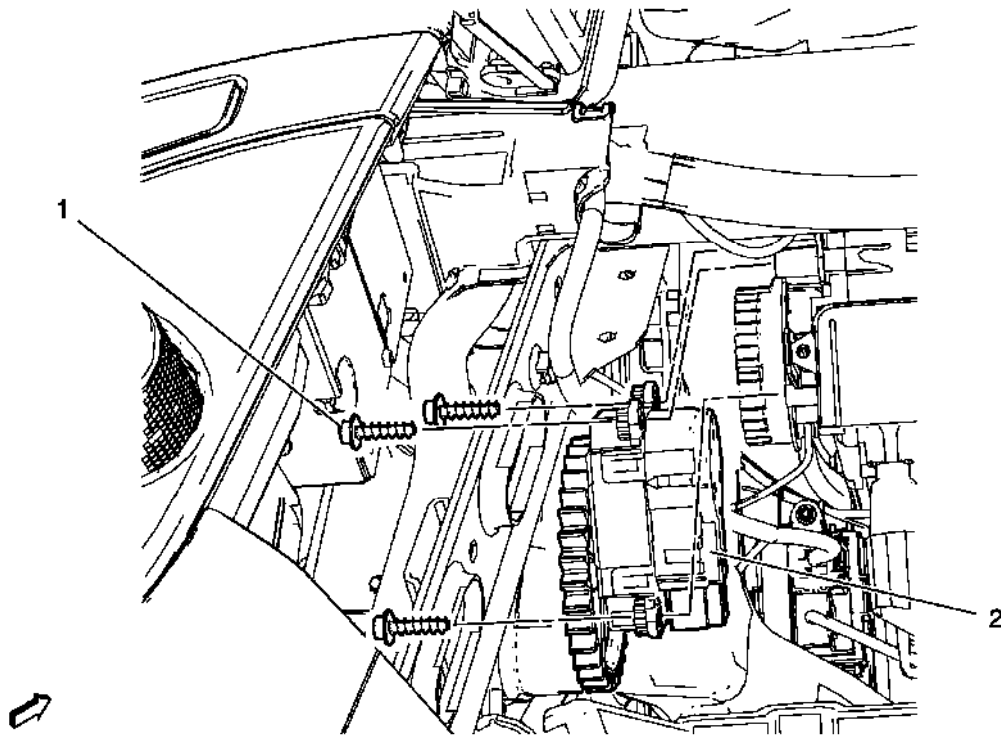


Fig. 34: Air Inlet Valve Actuator And Bolts
Courtesy of GENERAL MOTORS COMPANY

Air Inlet Valve Actuator Replacement

Callout	Component Name
Preliminary Procedures Remove the instrument panel compartment. Refer to <u>Instrument Panel Compartment Replacement</u> .	
1	Air Inlet Valve Actuator Bolt (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> .
2	Air Inlet Valve Actuator Procedure 1. Disconnect electrical connector. 2. Recalibrate the air inlet valve actuator. Refer to <u>Actuator Recalibration</u> .

AIR INLET VALVE AND INSIDE AIR VALVE CONTROL CAM REPLACEMENT

Removal Procedure

1. Remove instrument panel compartment assembly. Refer to **Instrument Panel Compartment Replacement** .

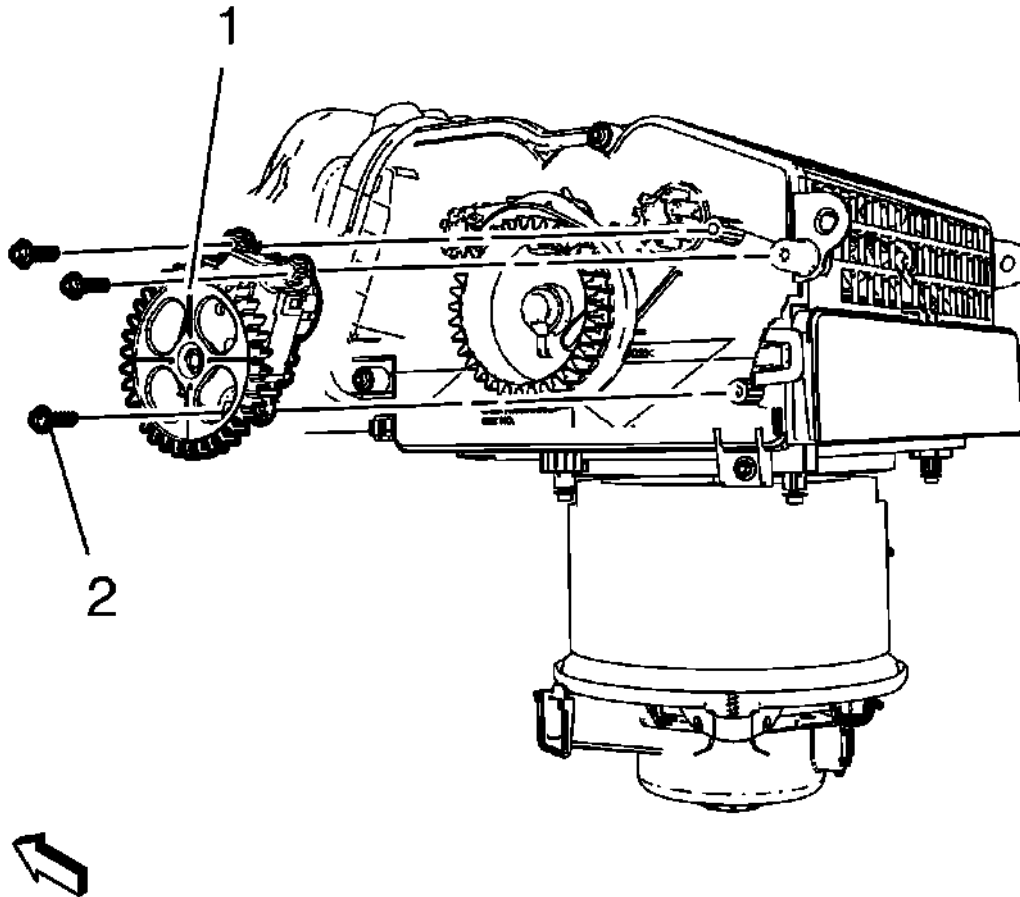


Fig. 35: Mode Control Cam Actuator

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect electrical connector and remove 3 mode control cam actuator screws (2) and remove mode control cam actuator (1).

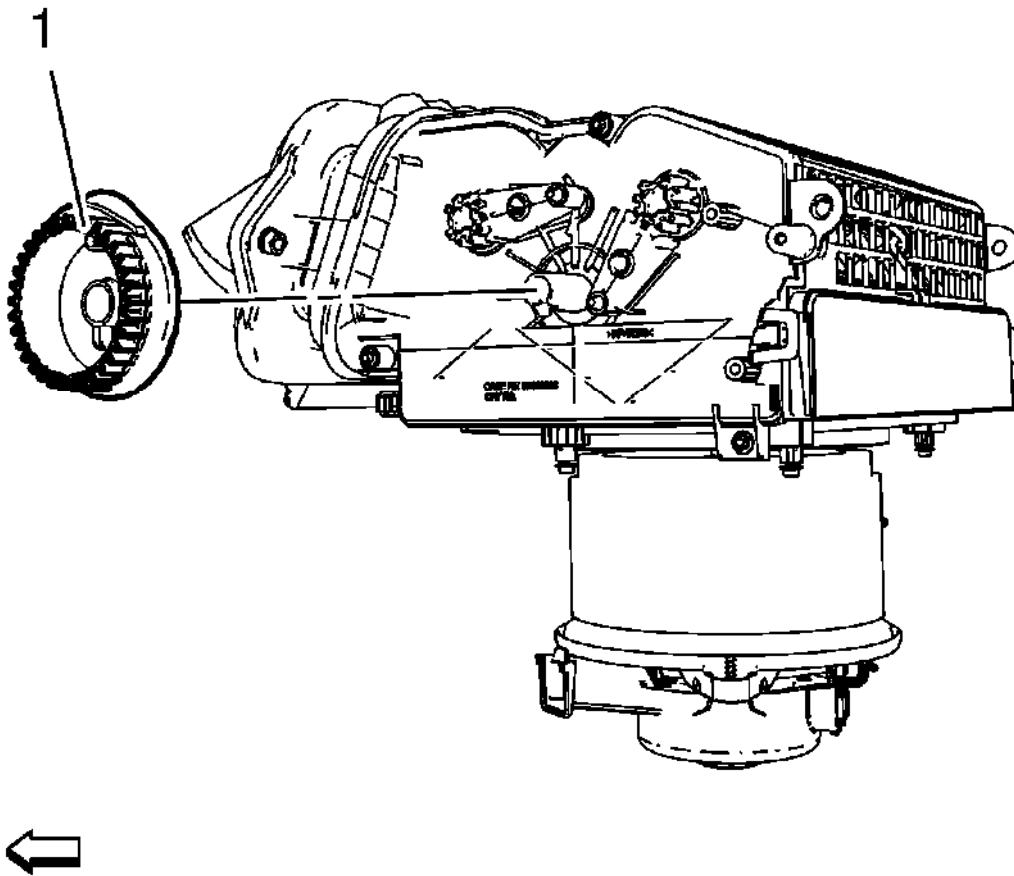


Fig. 36: Inside Air Valve Control Cam
Courtesy of GENERAL MOTORS COMPANY

NOTE: The graphic shows Air Inlet Housing without attaching parts for better clarity.

3. Remove air inlet valve and inside air valve control cam (1).

Installation Procedure

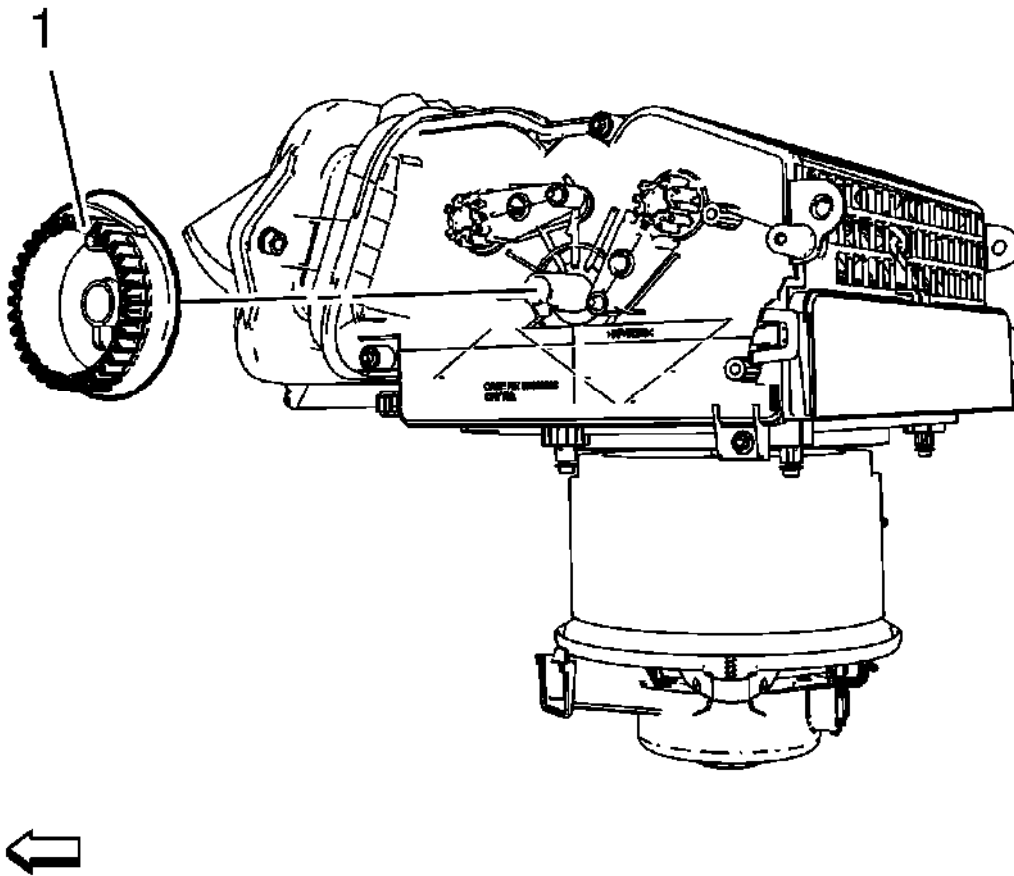


Fig. 37: Inside Air Valve Control Cam
Courtesy of GENERAL MOTORS COMPANY

NOTE: The air inlet valve and inside air valve control cam can only be fitted in one position.

1. Install air inlet valve and inside air valve control cam (1).

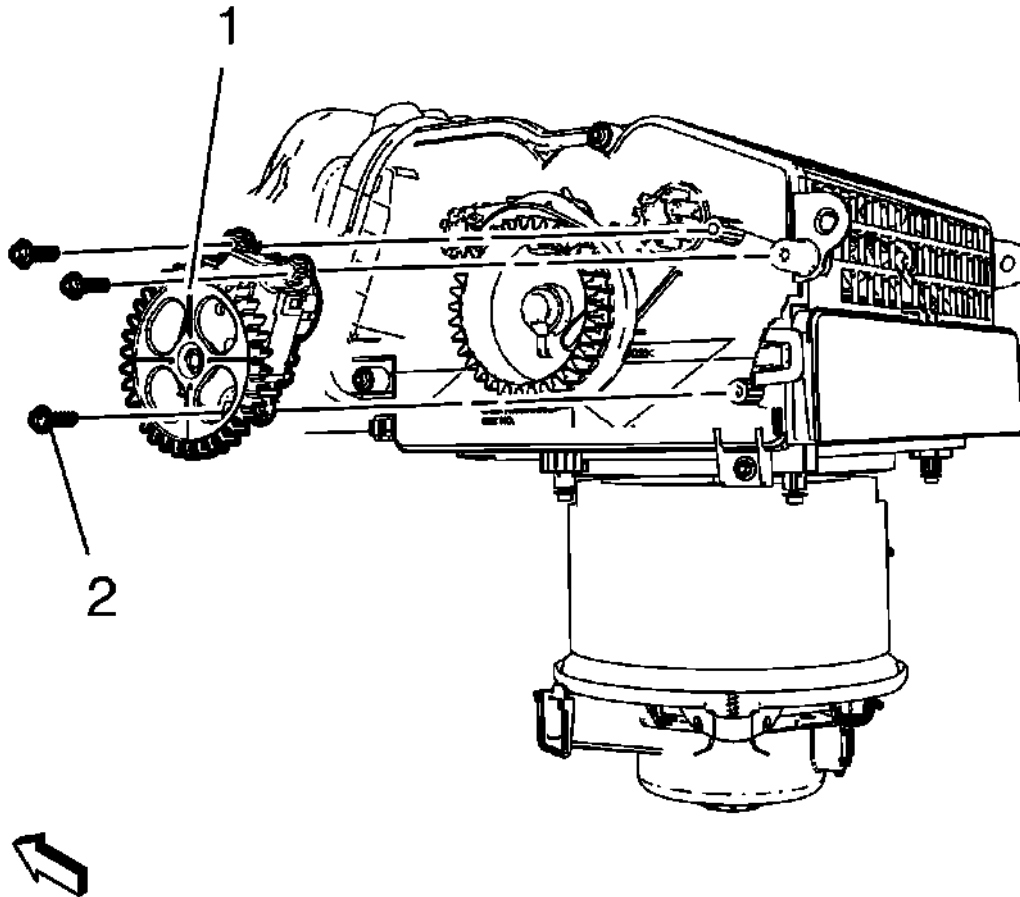


Fig. 38: Mode Control Cam Actuator
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install mode control cam actuator (1) and install 3 mode control cam actuator screws (2) and connect electrical connector. Tighten to 2.5 N.m (23 lb in).
3. Install instrument panel compartment assembly. Refer to Instrument Panel Compartment Replacement .

MODE CONTROL CAM REPLACEMENT

Removal Procedure

1. Remove the instrument panel assembly. Refer to Instrument Panel Assembly Replacement

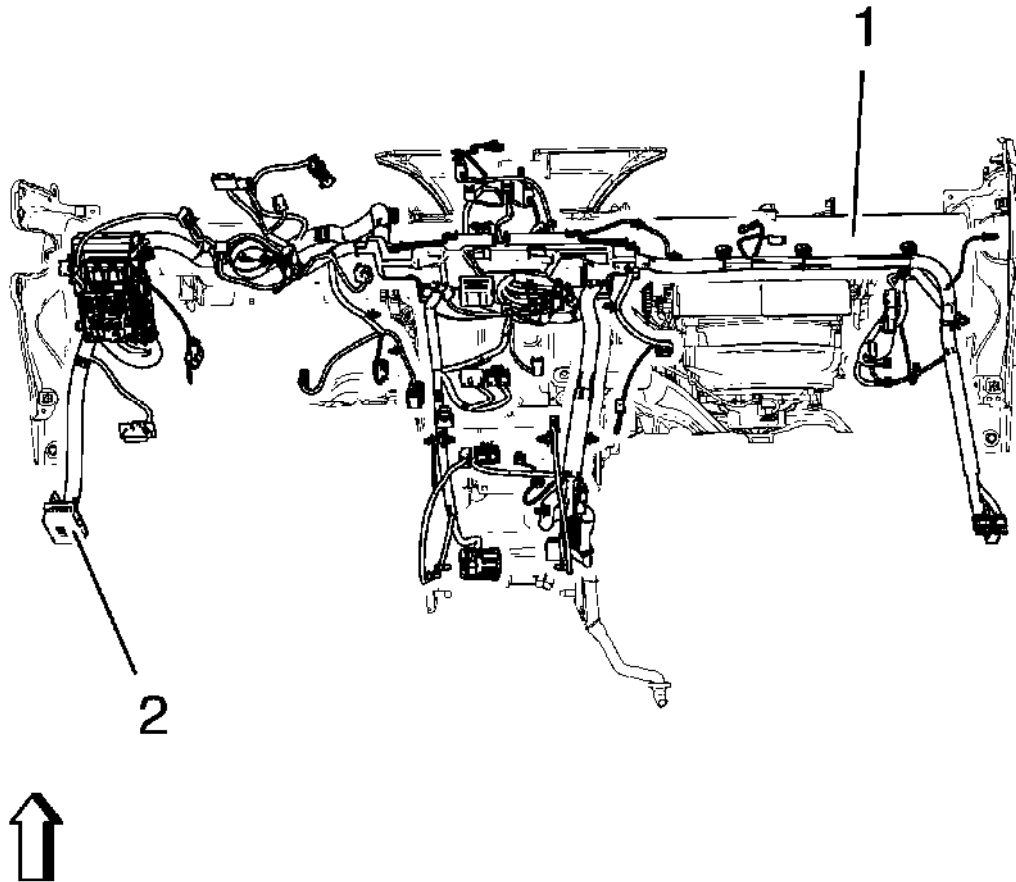


Fig. 39: Instrument Panel Wiring Harness And Instrument Panel Tie Bar
Courtesy of GENERAL MOTORS COMPANY

2. Remove the instrument panel wiring harness (2) from the instrument panel tie bar (1).
Disconnect the electrical connectors.

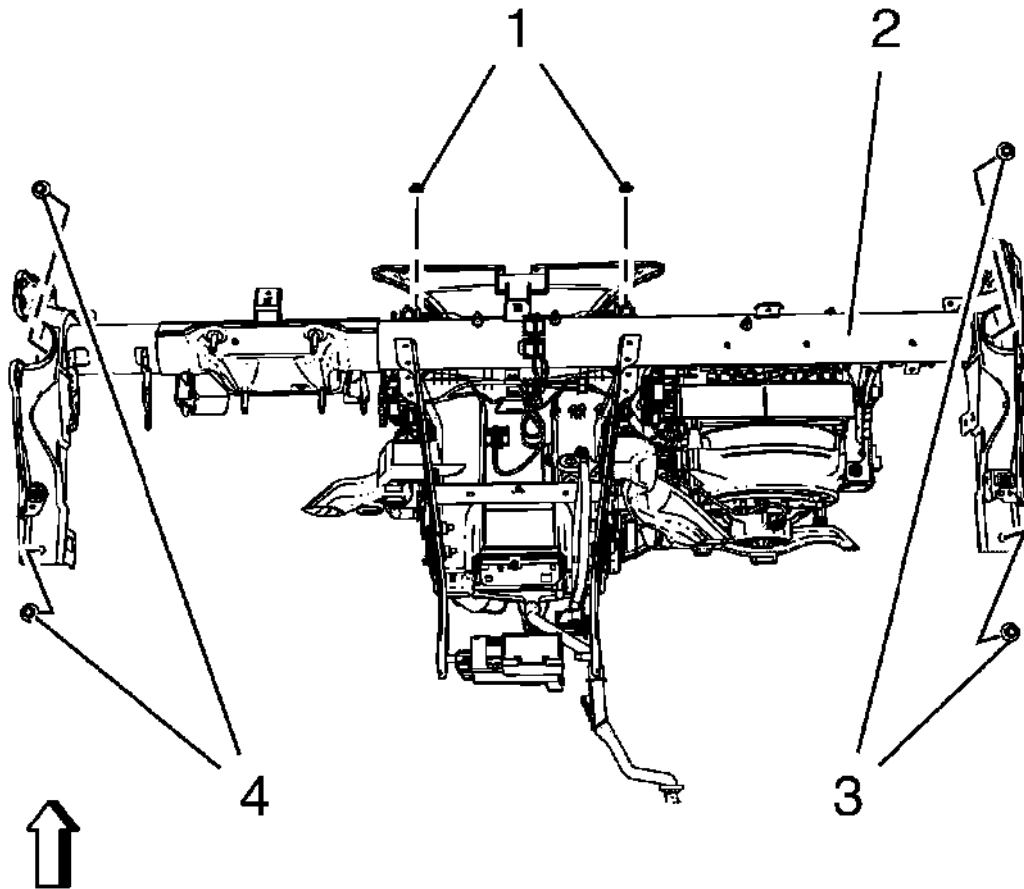


Fig. 40: Instrument Panel Tie Bar, Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the instrument panel tie bar (2).
 - Remove the 4 instrument panel tie bar bolts (3, 4).
 - Remove the 2 instrument panel tie bar nuts (1).

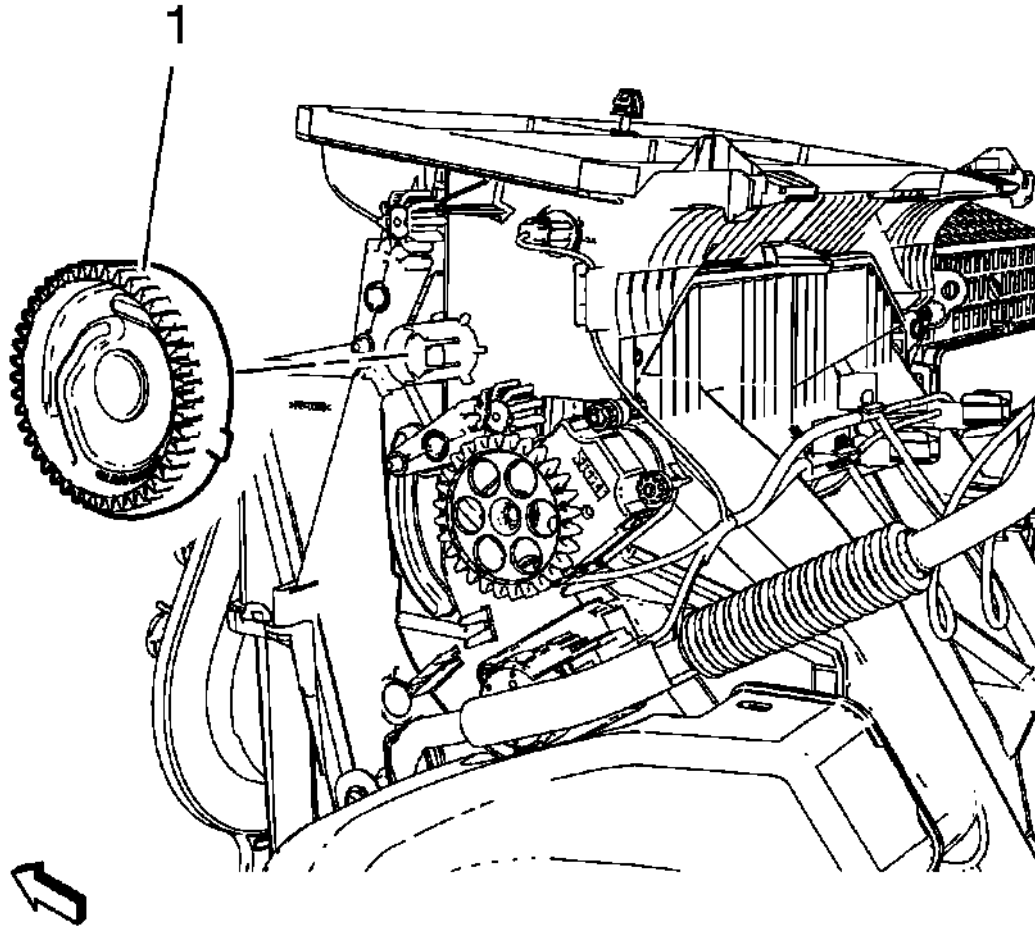


Fig. 41: Mode Control Cam

Courtesy of GENERAL MOTORS COMPANY

4. Remove the mode control cam (1).

Installation Procedure

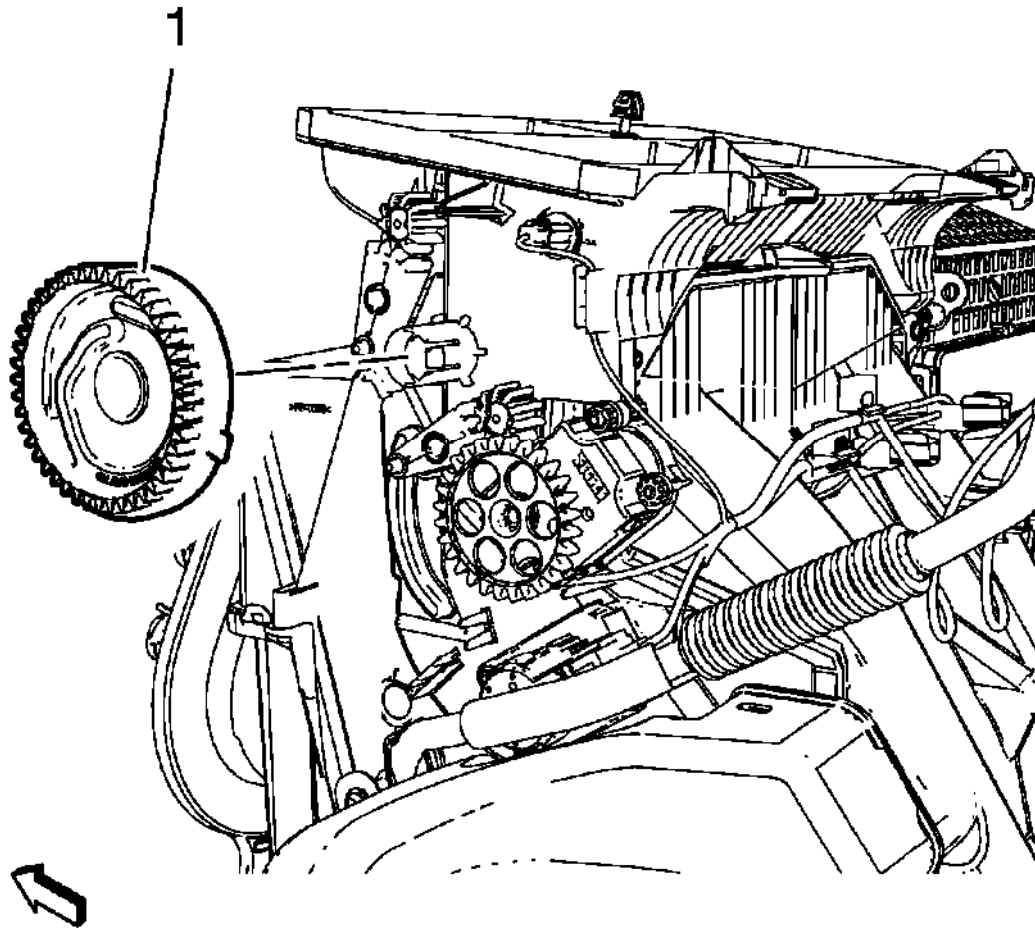


Fig. 42: Mode Control Cam

Courtesy of GENERAL MOTORS COMPANY

NOTE: The mode control cam can only be fitted in one position.

1. Install the mode control cam (1).

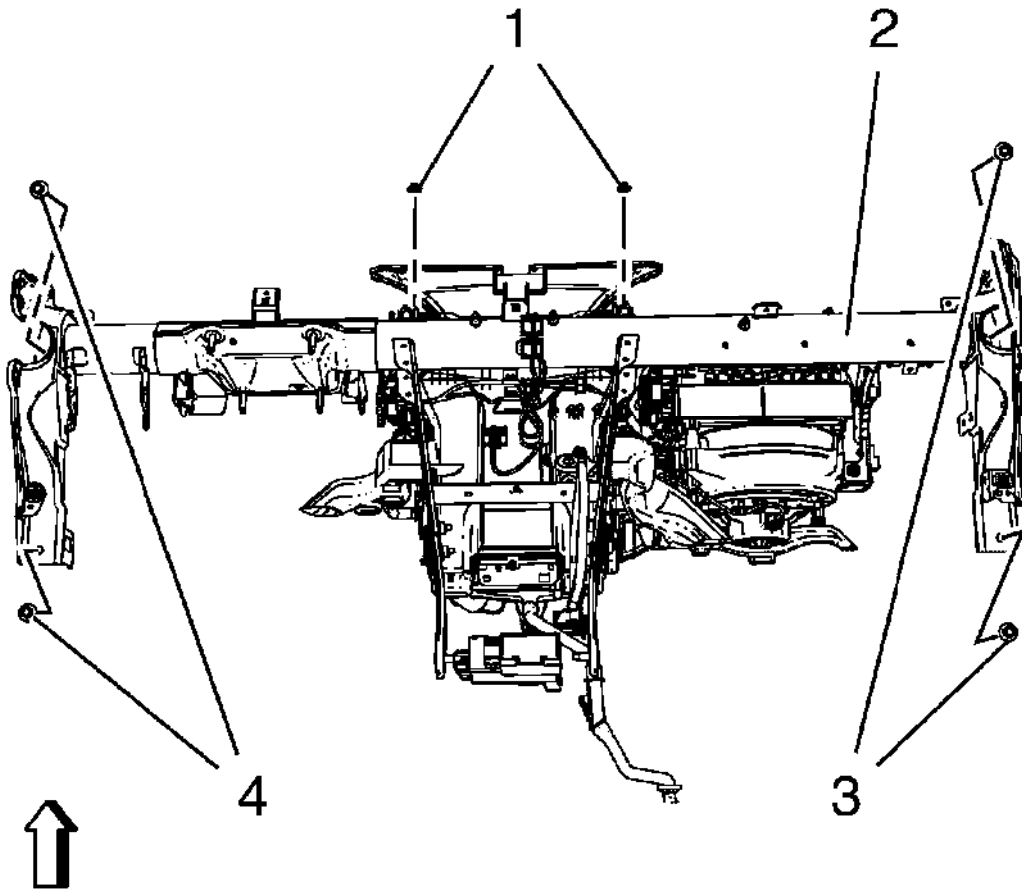


Fig. 43: Instrument Panel Tie Bar, Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution

2. Install the instrument panel tie bar (2).
 - Install the 4 instrument panel tie bar bolts (3, 4) and tighten to 19 N.m(17 lb ft).
 - Install the 2 instrument panel tie bar nuts (1) and tighten to 9 N.m(80 lb in).

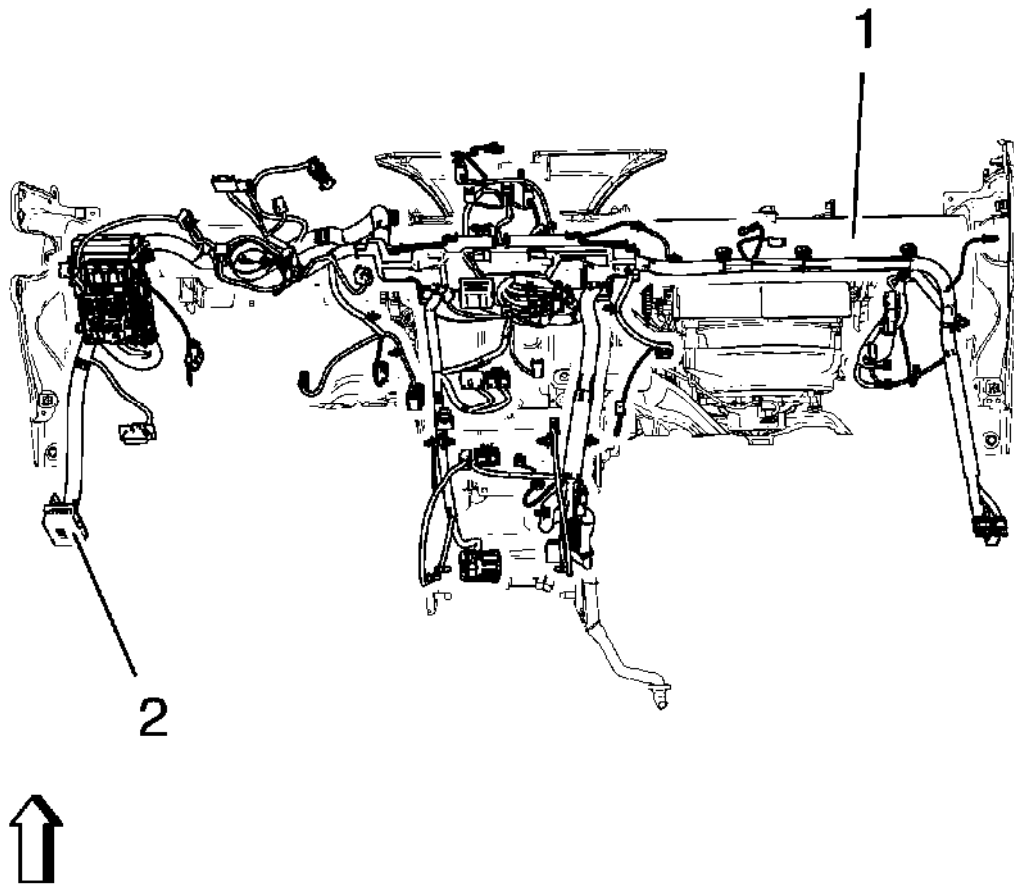


Fig. 44: Instrument Panel Wiring Harness And Instrument Panel Tie Bar
Courtesy of GENERAL MOTORS COMPANY

3. Install the instrument panel wiring harness (2) from the instrument panel tie bar (1).
Connect the electrical connectors.
4. Install the instrument panel assembly. Refer to **Instrument Panel Assembly Replacement** .

AIR CONDITIONING REFRIGERANT TEMPERATURE SENSOR REPLACEMENT - RIGHT SIDE

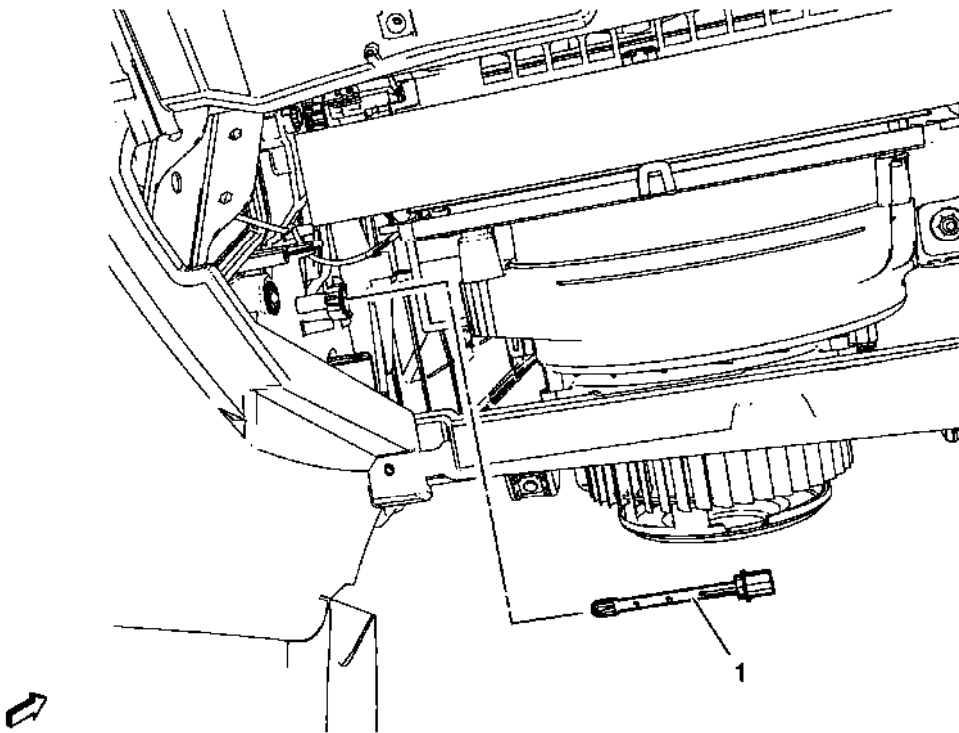


Fig. 45: Air Conditioning Refrigerant Temperature Sensor - Right Side (Left Hand Drive)
Courtesy of GENERAL MOTORS COMPANY

Air Conditioning Refrigerant Temperature Sensor Replacement - Right Side

Callout	Component Name
Preliminary Procedures Remove the heater and the blower and the air conditioning control module. Refer to <u>Heater and Blower and Air Conditioning Control Module Replacement</u> .	
1	Air Conditioning Refrigerant Temperature Sensor - Right Side. Procedure Disconnect the electrical connector.

DESCRIPTION AND OPERATION

MANUAL HVAC DESCRIPTION AND OPERATION

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

- HVAC Control Components
- Air Speed
- Air Delivery
- Heating and A/C Operation
- Recirculation Operation
- Engine Coolant

- A/C Cycle

HVAC Control Components

HVAC Control

The HVAC control 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 the 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.

There are some manual HVAC outputs that are controlled by the module without any customer input. Refer to Recirculation Operation for examples.

The HVAC control module supports the following features:

Feature	Availability
Purge	Yes
Personalization	Yes
Actuator Calibration	Yes

Mode Actuator

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

Air Temperature Actuator

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

Recirculation Actuator

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

Blower Motor Control Processor

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

Evaporator Temperature Sensor

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

A/C Refrigerant Pressure Sensor

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

A/C Compressor

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

Air Speed

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

The blower motor control module is an interface between HVAC control module and blower motor. The blower motor control module regulates supply voltage and ground circuits to blower motor. The HVAC control module provides a PWM signal to the blower motor control module in order to command the desired blower motor speed. The blower motor control module supplies battery voltage to the blower motor and uses the blower

motor ground as a low side control to adjust the blower motor speed. The voltage amounts between 2-13 V and changes linear to the height of the PWM signal.

Air Delivery

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

- Defrost
- Defog
- Panel
- Floor

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

The rear window defogger does not affect the HVAC system.

Recirculation Operation

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

Below are examples of manual HVAC outputs that are controlled by the module without any customer input.

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

When the temperature is set to full cold, the air inlet door will be forced to the recirculation position. The system will relieve the accumulation of CO₂ in the cabin after 30 minutes of recirculation, by moving to the actuator to intake fresh air.

Engine Coolant

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

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

A/C Cycle

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

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

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

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

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

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

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

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