Climate Control

This publication is intended for instructional purposes only. Always refer to the appropriate Jaguar Service publication for specific details and procedures.

⚠ WARNING: WHILE SERVICING AND TESTING VEHICLES AND VEHICLE SYSTEMS, TAKE ALL NECESSARY SAFETY PRECAUTIONS TO PREVENT THE POSSIBILITY OF BODILY INJURY OR DEATH.

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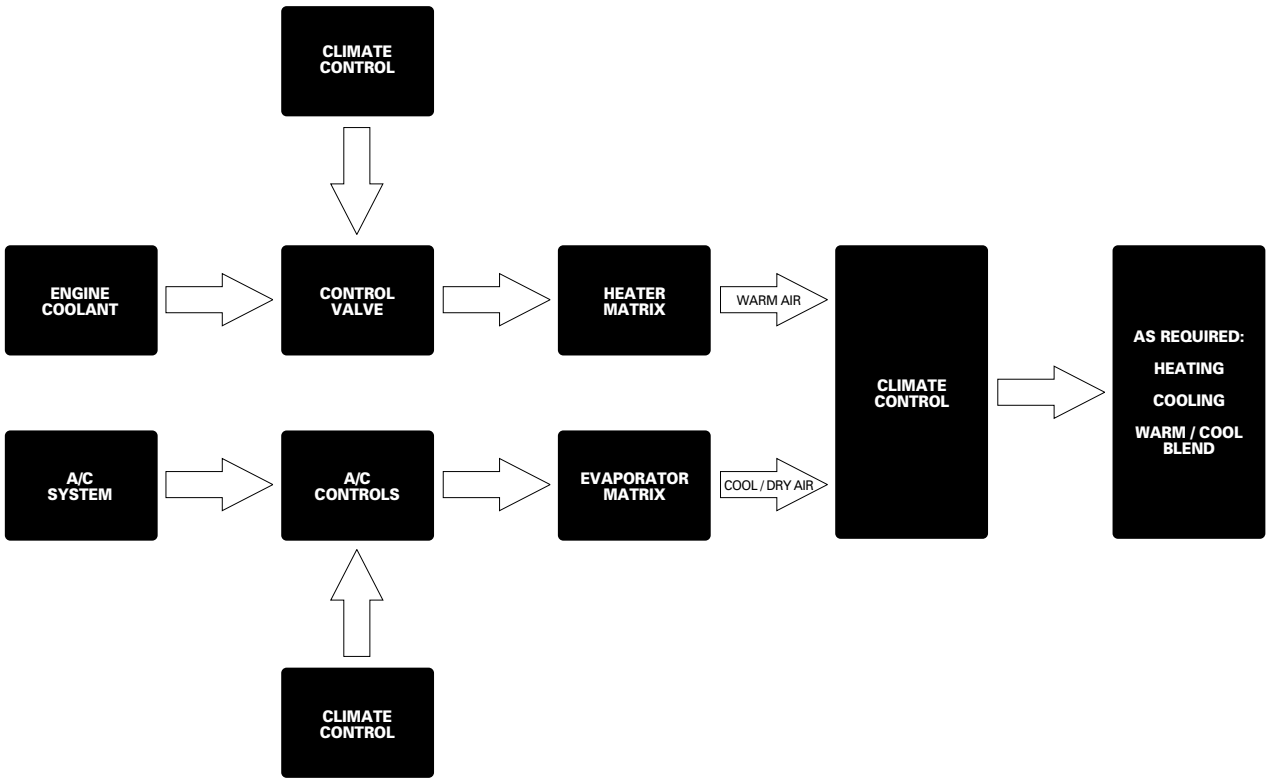
Introduction

Jaguar Climate Control Systems provide vehicle occupants with year-round automatic temperature and humidity control as selected on the control panel. The vehicle heating and air-conditioning systems are the foundation for providing the warm, cool or combined warm/cool air necessary to meet the desired conditions. Using advanced electronic components and a microprocessor-based control module, the Climate Control Systems produce a continuously comfortable environment over a wide range of ambient conditions.

CLIMATE CONTROL SYSTEMS INTEGRATION



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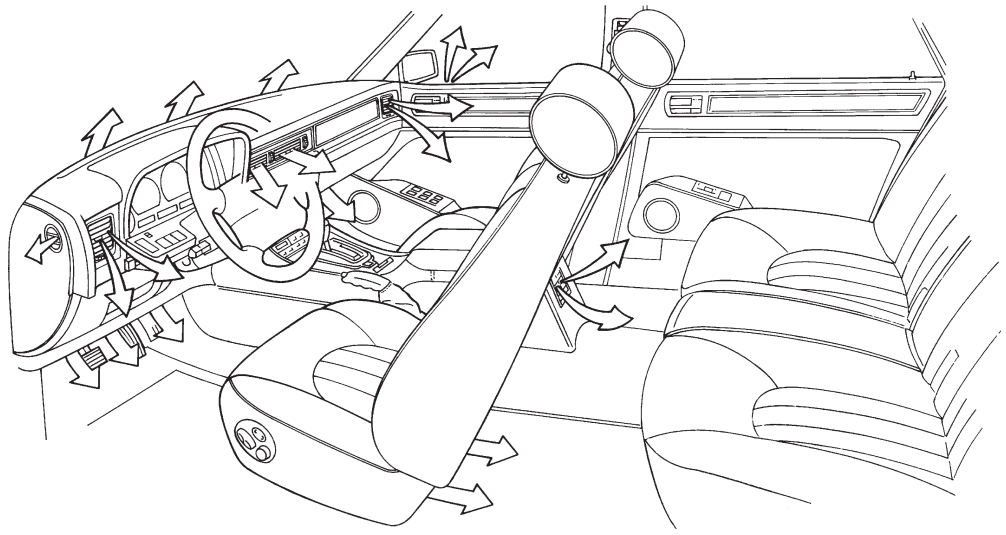
Contents

Overview

The Jaguar Denso Climate Control System, introduced in the 1995 Model Year Sedan Range, is standard equipment in all current production Jaguars. The system is controlled through a microprocessor-based electronic control module and a microprocessor-based control panel. The system produces the driver selected comfort level by controlling air flow volume and distribution using cooling from the air conditioning system and heat from the engine cooling system. To control cabin temperature, the system uses a heater valve to regulate the heater matrix temperature. The Denso system differs from previous Jaguar systems that controlled cabin temperature with flaps in the air conditioning heater unit to blend cooled air with the heated air from an unregulated heater matrix. The windshield, rear window, and mirror heater circuits are integral with the Denso climate control system.

SEDAN RANGE CLIMATE CONTROL AIR FLOW (1997 MY SHOWN)



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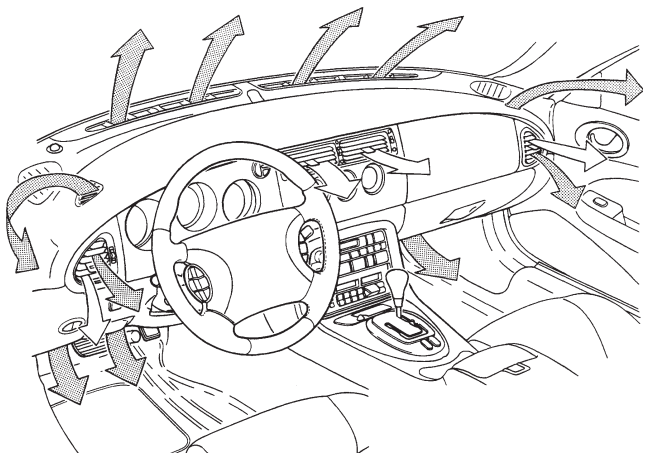
Diagnostic trouble codes (DTCs) and a panel display warn of system faults. In the case of most faults, a default value is substituted for the faulty signal allowing the climate control system to continue to function. Both the DTC and the panel display fault code information is supplied in this textbook with the description of each applicable component. A summary of DTCs and possible causes can be found on pages 61 – 64.

The climate control systems fitted to AJ16, V12 and AJV8 engine Sedan Range and XK8 vehicles operate in a similar fashion and share most components. Important differences between the systems are outlined in this book.

XK8 CLIMATE CONTROL AIR FLOW



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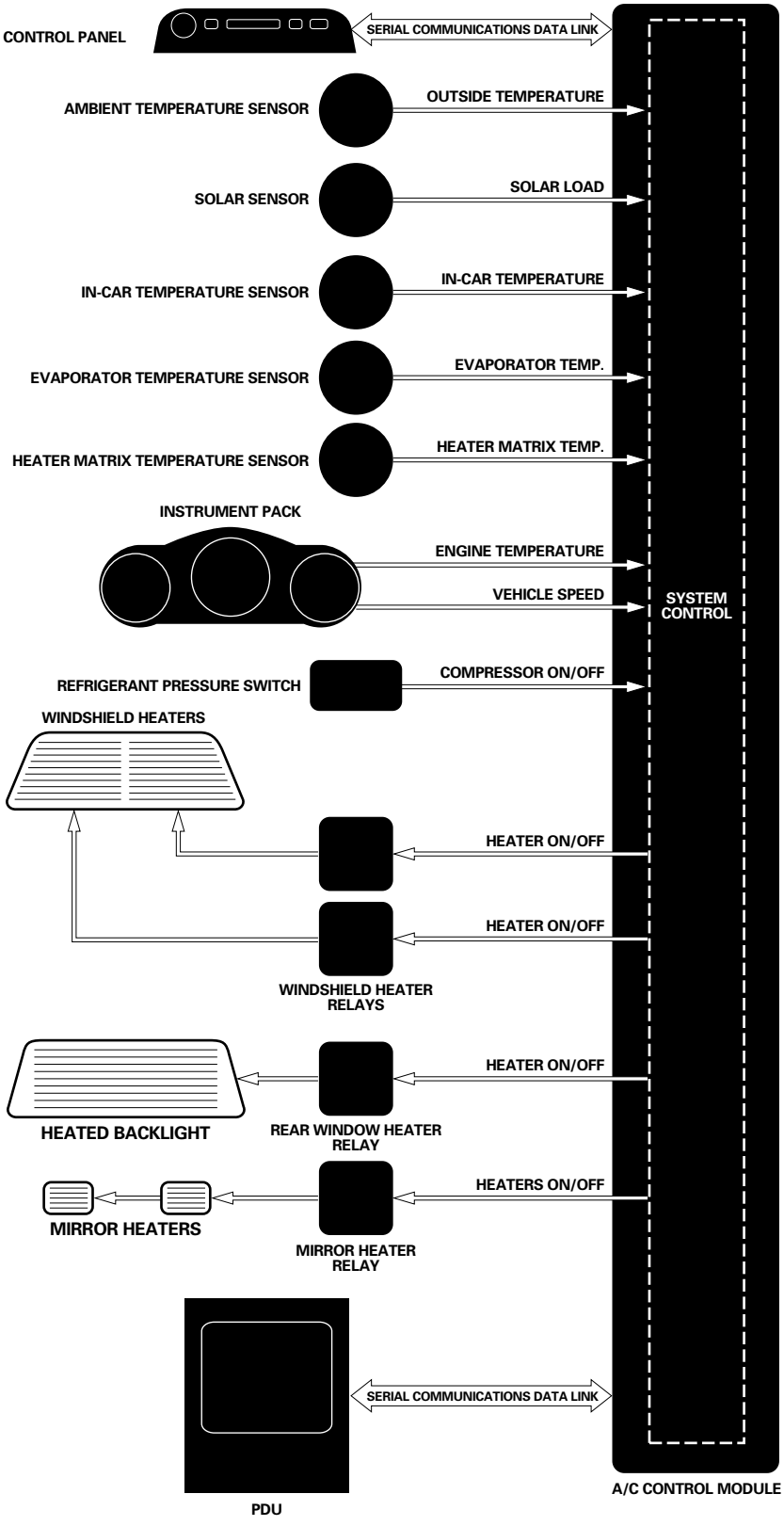
PLEASE NOTE: FOR AID IN UNDERSTANDING THE CLIMATE CONTROL SYSTEM, REFER TO THE APPLICABLE JAGUAR ELECTRICAL GUIDE FOR ELECTRICAL CIRCUIT DETAILS, COMPONENT INFORMATION, AND PIN-OUT DATA.

System Logic

AJ16 AND V12 CONTROL MODULE INPUTS / OUTPUTS



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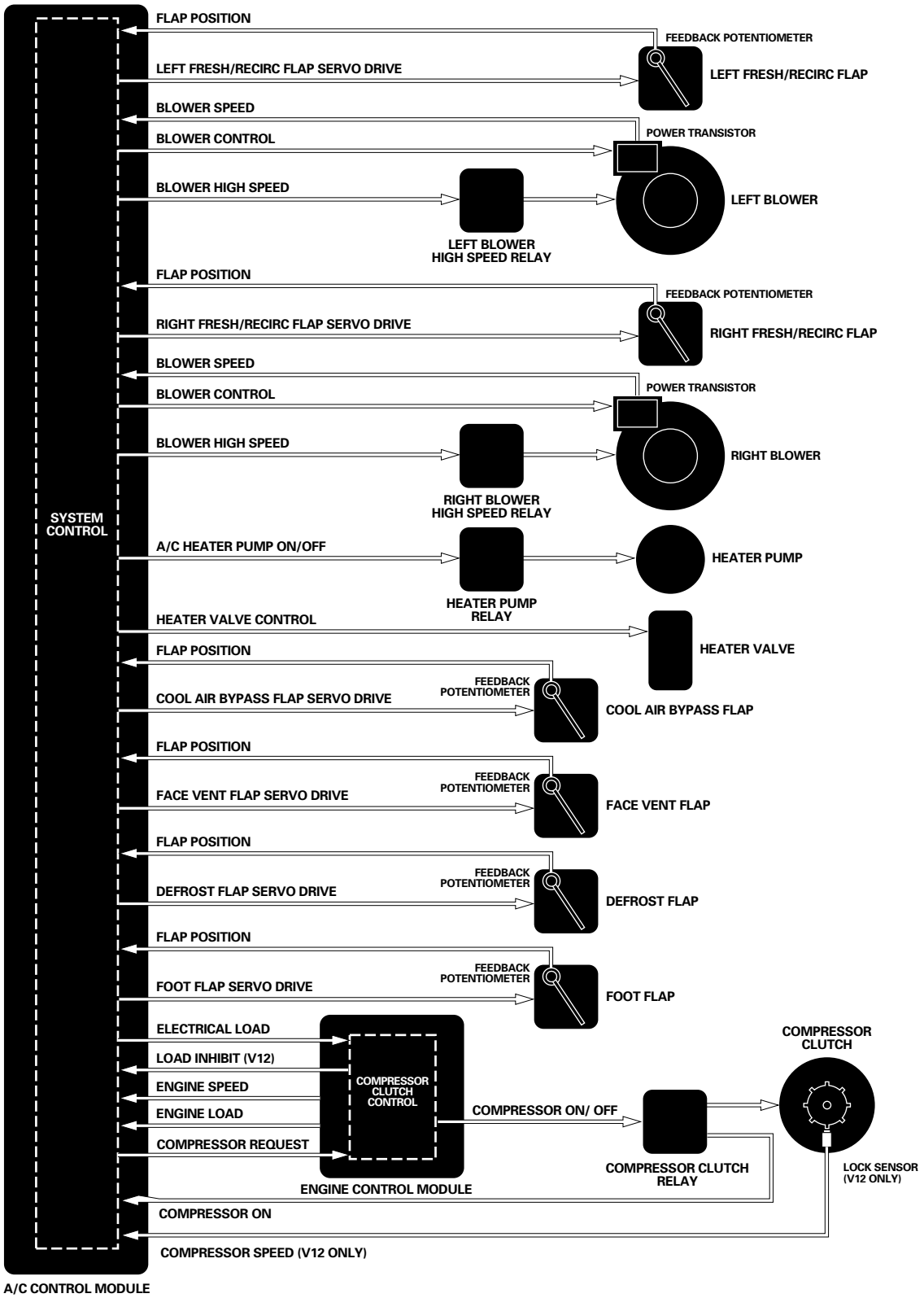
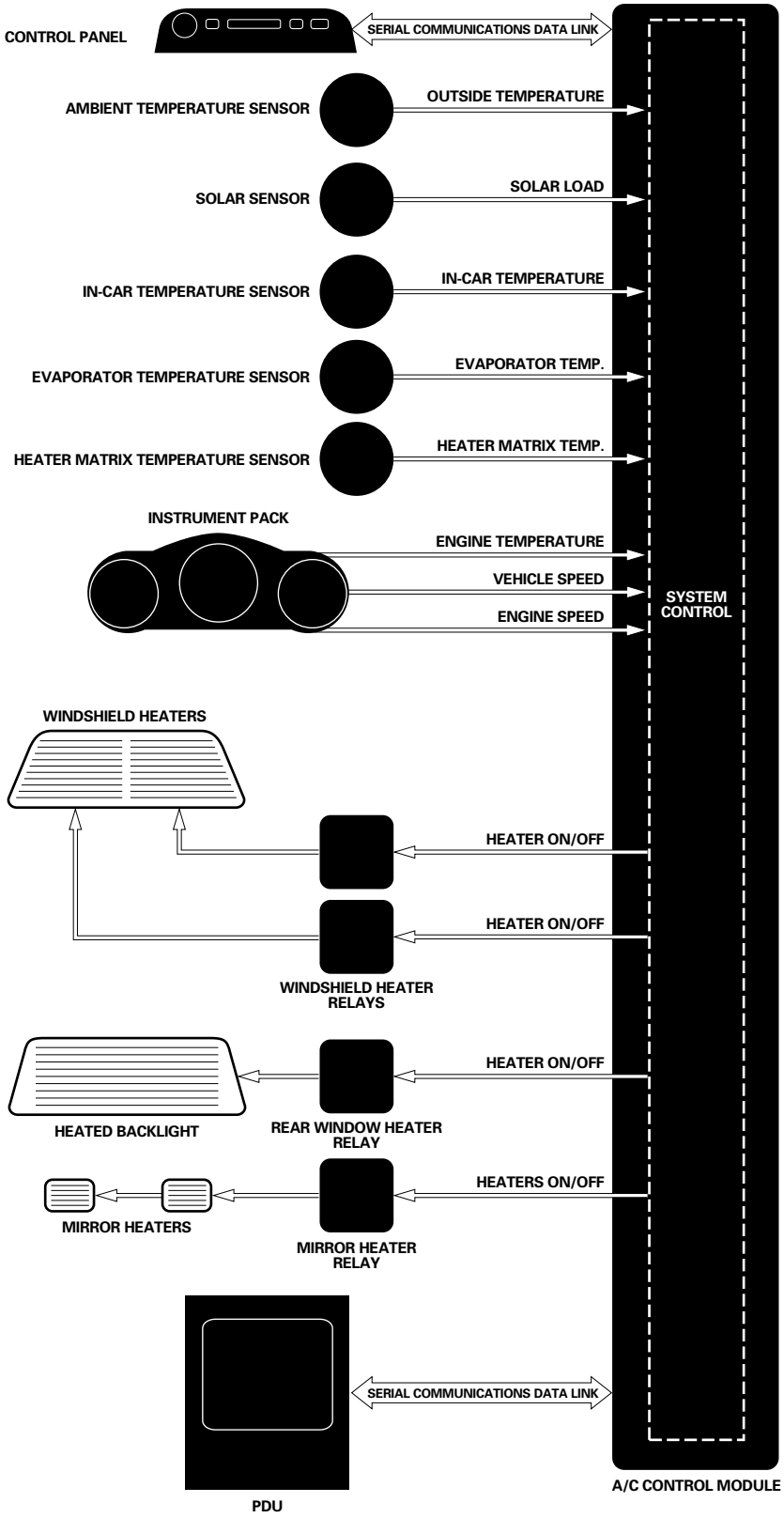

FLAP POSITION
FEEDBACK POTENTIOMETER
LEFT FRESH/RECIRC FLAP SERVO DRIVE
LEFT FRESH/RECIRC FLAP
BLOWER SPEED
POWER TRANSISTOR
BLOWER CONTROL
BLOWER HIGH SPEED
LEFT BLOWER
LEFT BLOWER HIGH SPEED RELAY
FLAP POSITION
FEEDBACK POTENTIOMETER
RIGHT FRESH/RECIRC FLAP SERVO DRIVE
RIGHT FRESH/RECIRC FLAP
BLOWER SPEED
POWER TRANSISTOR
BLOWER CONTROL
BLOWER HIGH SPEED
RIGHT BLOWER
RIGHT BLOWER HIGH SPEED RELAY
SYSTEM CONTROL
A/C HEATER PUMP ON/OFF
HEATER PUMP
HEATER PUMP RELAY
HEATER VALVE CONTROL
HEATER VALVE
FLAP POSITION
FEEDBACK POTENTIOMETER
COOL AIR BYPASS FLAP SERVO DRIVE
COOL AIR BYPASS FLAP
FLAP POSITION
FEEDBACK POTENTIOMETER
FACE VENT FLAP SERVO DRIVE
FACE VENT FLAP
FLAP POSITION
FEEDBACK POTENTIOMETER
DEFROST FLAP SERVO DRIVE
DEFROST FLAP
FLAP POSITION
FEEDBACK POTENTIOMETER
FOOT FLAP SERVO DRIVE
FOOT FLAP
ELECTRICAL LOAD
LOAD INHIBIT (V12)
ENGINE SPEED
ENGINE LOAD
COMPRESSOR REQUEST
COMPRESSOR CLUTCH CONTROL
ENGINE CONTROL MODULE
COMPRESSOR ON/ OFF
COMPRESSOR CLUTCH
COMPRESSOR CLUTCH RELAY
LOCK SENSOR (V12 ONLY)
COMPRESSOR ON
COMPRESSOR SPEED (V12 ONLY)
A/C CONTROL MODULE

T701/4.03B

System Logic

AJV8 CONTROL MODULE INPUTS / OUTPUTS



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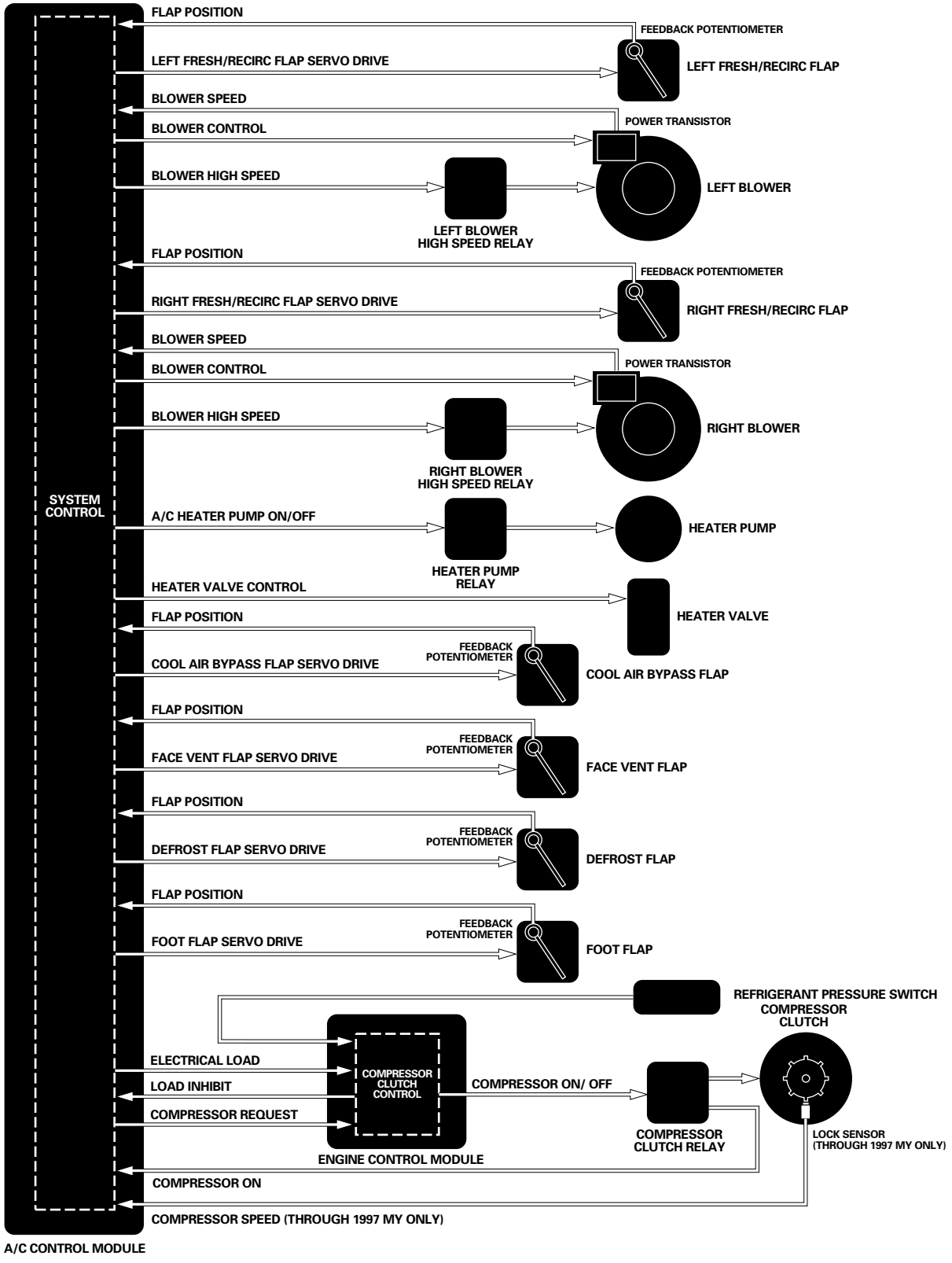
FLAP POSITION
FEEDBACK POTENTIOMETER
LEFT FRESH/RECIRC FLAP SERVO DRIVE
LEFT FRESH/RECIRC FLAP
BLOWER SPEED
POWER TRANSISTOR
BLOWER CONTROL
BLOWER HIGH SPEED
LEFT BLOWER
LEFT BLOWER HIGH SPEED RELAY
FLAP POSITION
FEEDBACK POTENTIOMETER
RIGHT FRESH/RECIRC FLAP SERVO DRIVE
RIGHT FRESH/RECIRC FLAP
BLOWER SPEED
POWER TRANSISTOR
BLOWER CONTROL
BLOWER HIGH SPEED
RIGHT BLOWER
RIGHT BLOWER HIGH SPEED RELAY
SYSTEM CONTROL
A/C HEATER PUMP ON/OFF
HEATER PUMP
HEATER PUMP RELAY
HEATER VALVE CONTROL
HEATER VALVE
FLAP POSITION
FEEDBACK POTENTIOMETER
COOL AIR BYPASS FLAP SERVO DRIVE
COOL AIR BYPASS FLAP
FLAP POSITION
FEEDBACK POTENTIOMETER
FACE VENT FLAP SERVO DRIVE
FACE VENT FLAP
FLAP POSITION
FEEDBACK POTENTIOMETER
DEFROST FLAP SERVO DRIVE
DEFROST FLAP
FLAP POSITION
FEEDBACK POTENTIOMETER
FOOT FLAP SERVO DRIVE
FOOT FLAP
REFRIGERANT PRESSURE SWITCH
COMPRESSOR CLUTCH
ELECTRICAL LOAD
LOAD INHIBIT
COMPRESSOR REQUEST
COMPRESSOR CLUTCH CONTROL
COMPRESSOR ON/ OFF
COMPRESSOR CLUTCH RELAY
LOCK SENSOR (THROUGH 1997 MY ONLY)
ENGINE CONTROL MODULE
COMPRESSOR ON
COMPRESSOR SPEED (THROUGH 1997 MY ONLY)
A/C CONTROL MODULE

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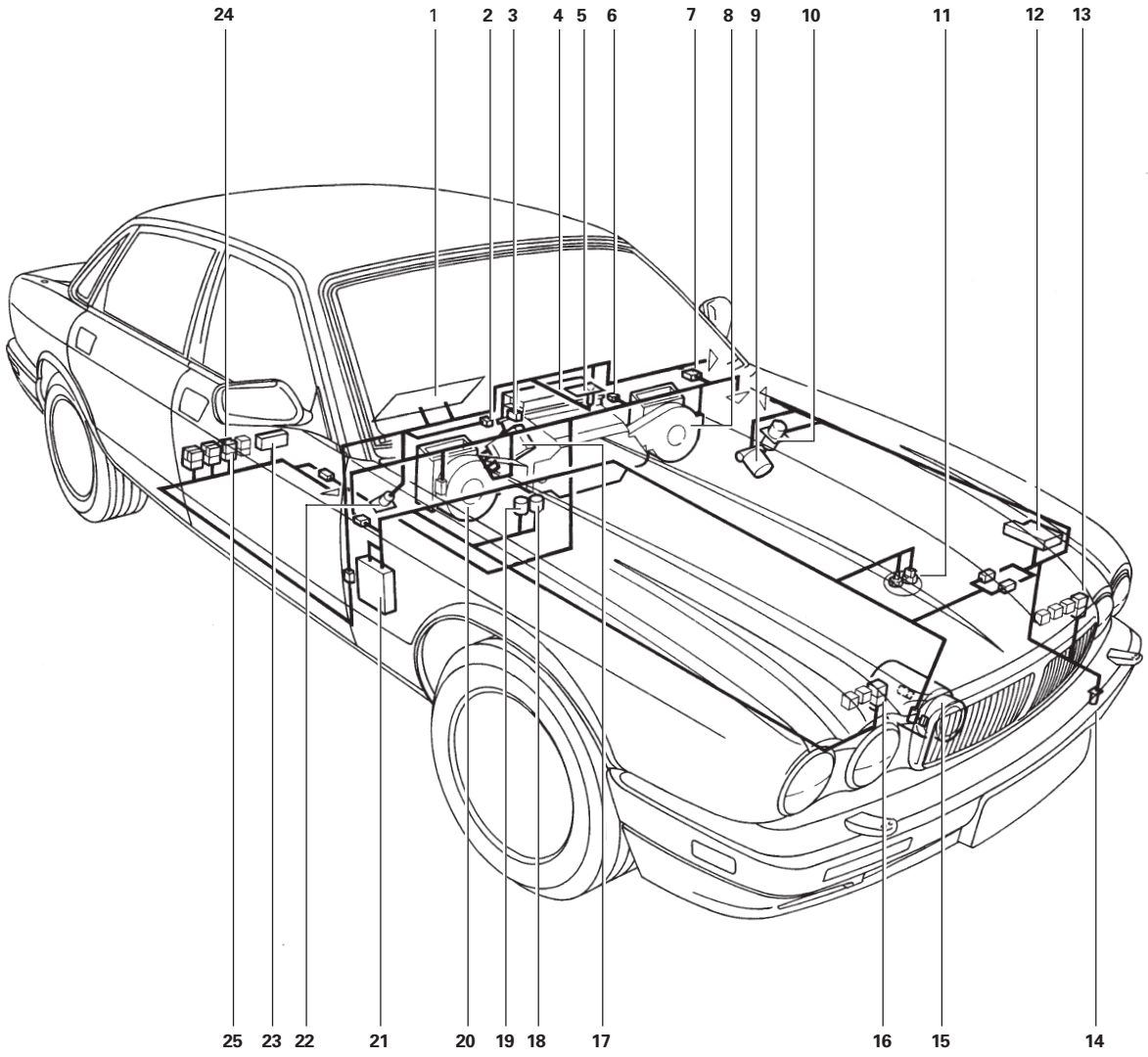
Component Location

AJ16 AND V12 SEDAN RANGE CLIMATE CONTROL COMPONENTS (RIGHT-HAND DRIVE SHOWN)



1 INSTRUMENT PACK
2 FASCIA SWITCH PACK CONNECTOR
3 DEFROST SERVO
4 AIR DISTRIBUTION BOX
5 SOLAR SENSOR
6 CONTROL PANEL CONNECTOR
7 CENTER CONSOLE CONNECTOR
8 LEFT SIDE BLOWER
9 HEATER PUMP
10 HEATER VALVE
11 COOLANT TEMPERATURE SENSOR
12 LEFT SIDE FRONT FUSE BOX
13 HEATER PUMP RELAY
14 AMBIENT TEMPERATURE SENSOR
15 COMPRESSOR
16 COMPRESSOR CLUTCH RELAY
17 AIR CONDITIONING CONTROL MODULE
18 TRIPLE PRESSURE SWITCH (AJ16)
DUAL PRESSURE SWITCH (V12)
19 SINGLE PRESSURE SWITCH (AJ16)
20 RIGHT SIDE BLOWER
21 ENGINE CONTROL MODULE
22 ASPIRATOR AND IN-CAR TEMP. SENSOR
23 A/C ISOLATE RELAY
24 LEFT SIDE BLOWER RELAY
25 RIGHT SIDE BLOWER RELAY

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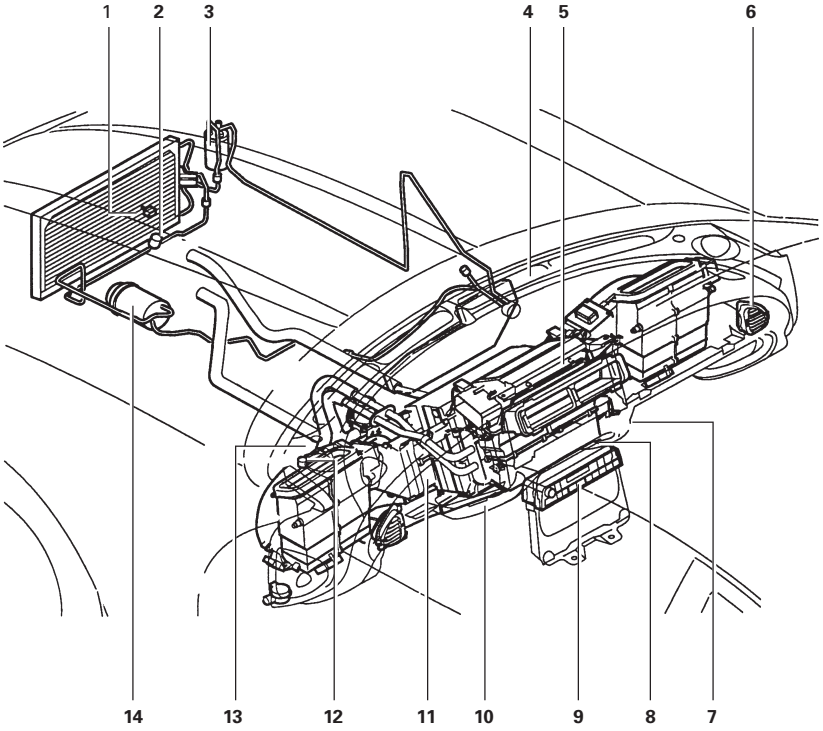
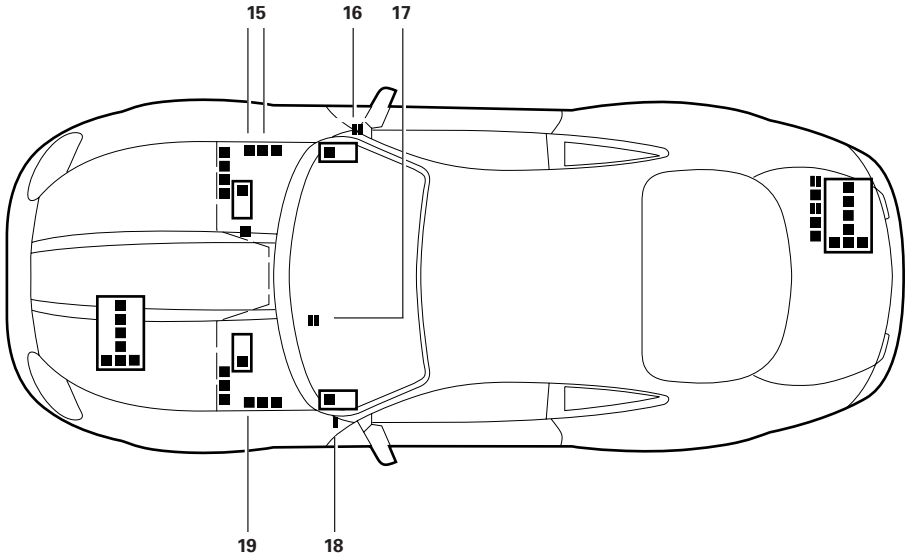
XK8 CLIMATE CONTROL COMPONENTS





1 AMBIENT TEMPERATURE SENSOR
2 REFRIGERANT 4-WAY PRESSURE SWITCH
3 RECEIVER / DRIER
4 PLENUM
5 AIR CONDITIONING / HEATER UNIT
6 FASCIA DUCTS
7 RIGHT SIDE BLOWER
8 AIR CONDITIONING CONTROL MODULE
9 CONTROL PANEL
10 LEFT SIDE BLOWER
11 ASPIRATOR ASSEMBLY
12 SOLAR SENSOR
13 HEATER VALVE AND PUMP
14 COMPRESSOR
15 WINDSHIELD HEATER RELAYS
16 AIR CONDITIONING ISOLATE RELAY
17 BLOWER MOTOR RELAYS
18 DOOR MIRROR HEATER RELAY
19 COMPRESSOR CLUTCH RELAY

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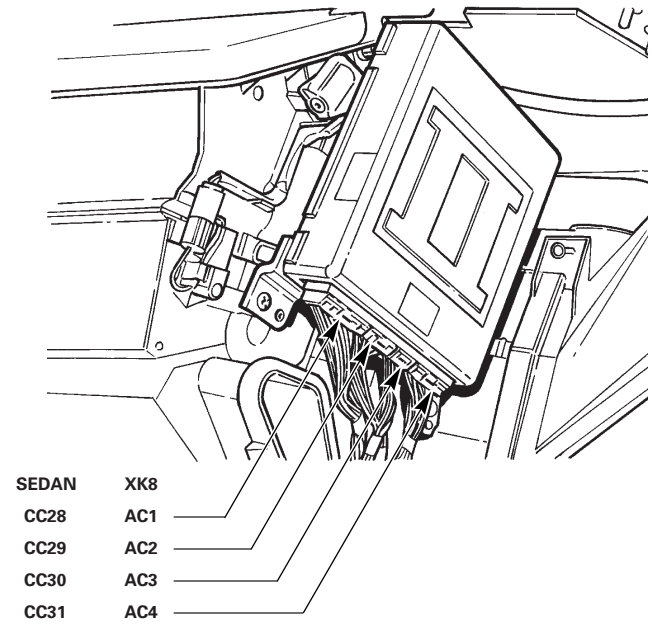
Control Module

The air conditioning control module (A/CCM), located on the right side of the air conditioning / heater unit, controls all system sensing and drive functions.

CLIMATE CONTROL MODULE (A/CCM)



The A/CCM has two microprocessors: one 8-bit and one 4-bit. The 8-bit microprocessor controls the overall system strategy and stores input / output information. The 4-bit microprocessor "conditions" the system signals and processes information.

The A/CCM uses discrete components plus analog-to-digital circuits to interface between the microprocessors, input sensors and output devices. Software programmed into an EPROM is used for control, data and diagnostics.

Ignition switched power activates the A/CCM when the ignition is switched to position II. Quiescent current from a battery power supply is used to keep the A/CCM random access memory (RAM) active so that diagnostic information is maintained.

The A/CCM contains four connector sockets. A rough guide to the connector function grouping is as follows:

Connector			
Sedan	**XK8**	**Description**	**Function**
CC28	AC1	26-way	system component drives; compressor clutch status
CC29	AC2	16-way	sensor inputs; feedback inputs; vehicle interface
CC30	AC3	12-way	sensor inputs; control panel communication; grounds; vehicle interface
CC31	AC4	22-way	power supplies; grounds; signal grounds; vehicle interface

Isolate relay

The A/C isolate relay remains energized by the A/CCM for 30 seconds after the ignition is switched off to provide battery power for the A/CCM to "park" the system servos.

NOTES

System Sensors and Potentiometers: Power Supply and Signal Ground

The climate control system uses multiple sensors to measure and report temperatures and on XJ12 and 1997 MY XK8 only, compressor rotation. Feedback potentiometers are used to report the position of air flow flaps and the desired face level differential position (through 1997 MY only). All of the sensors and potentiometers use a common five volt power supply (reference voltage) from the A/CCM and a common signal ground at the A/CCM.

Sensor and potentiometer power supply and signal ground diagnostic monitoring

The A/CCM monitors the sensor 5 volt power supply circuit for open circuit, high resistance and short circuit conditions. The signal ground circuit is monitored for open circuit conditions. If a fault is present, a DTC will be flagged.

DTCs:	PDU	Panel
	B1297	none
	B1298	none
	B1299	none
	B1863	none

Refer to the DTC Summary, pages 61 – 64.

NOTES

Control Module

System Diagnostics

The A/CCM continuously monitors the climate control system for faults. If a fault is detected the A/CCM flags a diagnostic trouble code (DTC) corresponding to the fault. All DTCs can be retrieved using PDU. In addition, some fault codes can be displayed on the control panel screen. The PDU DTCs consist of 5 characters; the codes displayed on the control panel are two digit numbers. PDU and panel display fault code information is supplied with the description of the applicable component in this textbook and in the DTC Summary on pages 61 – 64.

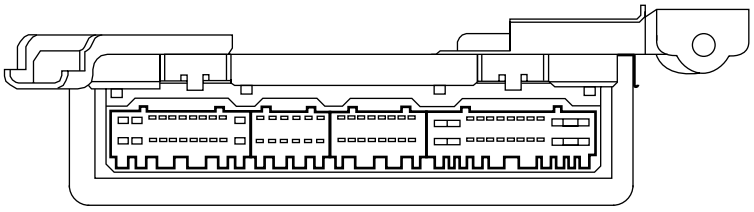
A/CCM power supplies and auxiliary ground diagnostic monitoring

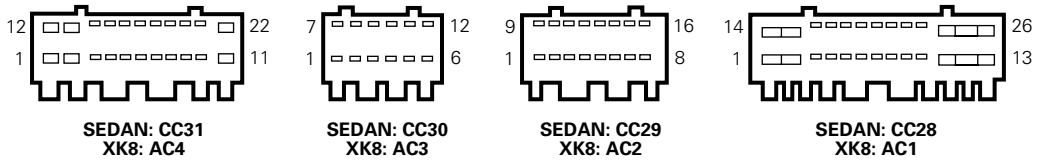
The A/CCM monitors the system power supplies for open circuit, high resistance, and short circuit conditions. The ignition switched ground input signal is monitored for open circuit or high resistance conditions. If a fault is present, a DTC will be flagged.

DTCs:	PDU	Panel
	B1292	none
	B1294	none
	B1355	none
	B1857	none

Refer to the DTC Summary, pages 61 – 64.

AIR CONDITIONING CONTROL MODULE (A/CCM)





SEDAN: CC31
XK8: AC4

SEDAN: CC30
XK8: AC3

SEDAN: CC29
XK8: AC2

SEDAN: CC28
XK8: AC1

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NOTES

Control Module Pin Out Information

I = Input O = Output SG = Signal ground D = Serial and encoded communications

I/O	Sedan	XK8	Description
I	CC28-1	AC1-1	Compressor clutch status
O	CC28-2	AC1-2	Heater valve active
O	CC28-3	AC1-3	RH blower motor relay
O	CC28-4	AC1-4	LH and RH windshield heater relays
O	CC28-5	AC1-5	Door mirror heater relay
O	CC28-6	AC1-6	Defrost vent servo motor
O	CC28-7	AC1-7	Center vent servo motor
O	CC28-8	AC1-8	LH fresh / recirculation vent servo motor
O	CC28-9	AC1-9	RH fresh / recirculation vent servo motor
O	CC28-12	AC1-12	Footwell vent servo motor
O	CC28-13	AC1-13	Cool air bypass vent servo motor
O	CC28-14	Not used	RH high speed blower relay
O	CC28-15	Not used	LH high speed blower relay
O	CC28-16	AC1-16	LH blower motor relay
O	CC28-17	AC1-17	Heater pump relay
O	CC28-18	AC1-18	Heated backlight relay
O	CC28-19	AC1-19	Defrost vent servo motor
O	CC28-20	AC1-20	Center vent servo motor
O	CC28-21	AC1-21	LH fresh / recirculation vent servo motor
O	CC28-22	AC1-22	RH fresh / recirculation vent servo motor
O	CC28-25	AC1-25	Footwell vent servo motor
O	CC28-26	AC1-26	Cool air bypass vent servo motor
I	CC29-1	AC2-1	Solar sensor feedback
I	CC29-2	AC2-2	Center vent potentiometer feedback
I	CC29-3	AC2-3	RH recirculation potentiometer feedback
I	CC29-5	AC2-5	Cool air bypass potentiometer feedback
I	CC29-6	AC2-6	Engine coolant temperature
I	CC29-7	AC2-7	RH blower speed feedback
O	CC29-8	AC2-8	RH blower speed control drive signal
I	CC29-9	AC2-9	Face vent differential temperature potentiometer (through 1997 MY)
I	CC29-10	AC2-10	Defrost vent potentiometer feedback
I	CC29-11	AC2-11	LH recirculation potentiometer feedback
I	CC29-13	AC2-13	Footwell vent recirculation potentiometer feedback
I	CC29-15	AC2-15	LH blower speed feedback
O	CC29-16	AC2-16	LH blower speed control drive signal

I/O	Sedan	XK8	Description
O	CC30-1	AC3-1	Air conditioning electrical load signal
O	CC30-2	AC3-2	Clock
D	CC30-3	AC3-3	Serial data output to control panel
I	CC30-4	AC3-4	Compressor lock signal (V12 and 1997 MY XK8 only)
I	CC30-5	AC3-5	Ambient temperature sensor feedback
I	CC30-6	AC3-6	Heater matrix air temp. sensor feedback
D	CC30-7	AC3-7	Serial data input from control panel
O	CC30-8	AC3-8	Start
	CC30-10	—	Ground
	—	AC3-10	Ignition switched power supply (momentary)
I	CC30-11	AC3-11	In-car temperature sensor
I	CC30-12	AC3-12	Evaporator temperature sensor
	CC31-1	AC4-1	Ignition switched B+ power supply
	CC31-2	AC4-2	B+ power supply (via A/C isolate relay)
I	CC31-3	AC4-3	Ignition switched ground (POS I)
O	CC31-4	AC4-4	Control panel battery power supply
	CC31-5	AC4-5	B+ power supply (A/CCM memory)
I	CC31-6	AC4-6	Engine speed signal
I	CC31-7	AC4-7	Load inhibit (V12 and 1997 MY XK8 only)
O	CC31-8	AC4-8	Servo potentiometer common reference voltage
O	CC31-9	AC4-9	Compressor clutch on request
D	CC31-10	AC4-10	Serial communication input
O	CC31-12	AC4-12	Control panel battery power supply
I	CC31-13	AC4-13	Ground
O	CC31-14	AC4-14	Control panel ground supply
O	CC31-15	AC4-15	Isolate relay active
I	CC31-16	AC4-16	Vehicle speed signal
I	CC31-17	—	Refrigerant dual pressure switch
I	—	AC4-17	Refrigerant 4-way pressure switch
O	CC31-18	AC4-18	Aspirator motor power supply
SG	CC31-19	AC4-19	Potentiometer common reference ground
I	CC31-20	AC4-20	Ground
D	CC31-21	AC4-21	Serial communication output

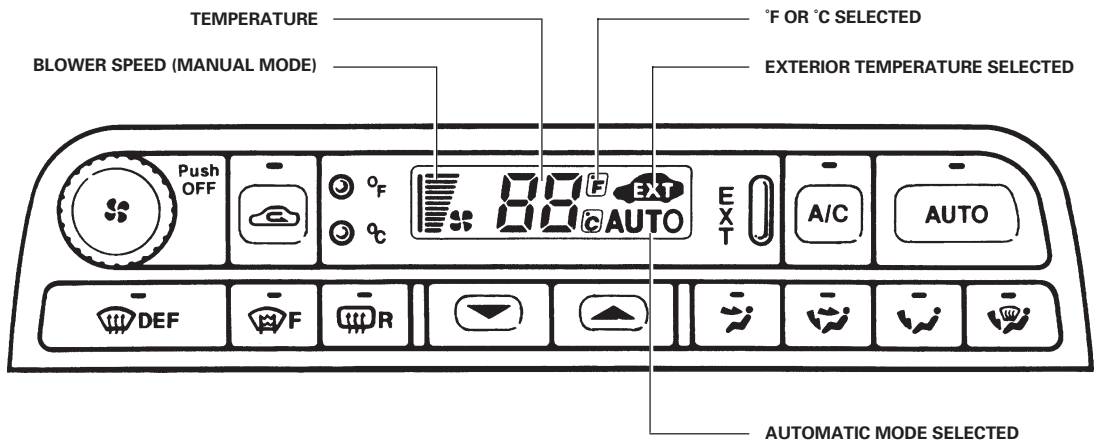
NOTES

Climate Control Panel

The control panel is the interface between the driver and the air conditioning control module (A/CCM). It has a 4-bit microprocessor that processes information and converts the selected switch positions and settings into digital data that is communicated to the A/CCM over a serial data link.

Data transfer between the control panel and the A/CCM occurs in cycles when the "START" signal is received from the A/CCM. The total communication contains 29 "CLOCK" pulses. In order to avoid errors, the A/CCM must receive two identical data transfers before any action is taken. Power supply to the control panel is provided via the A/CCM when the ignition switch is in position I (auxiliary) or II (ignition).

CLIMATE CONTROL PANEL DISPLAY



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Control Panel Display

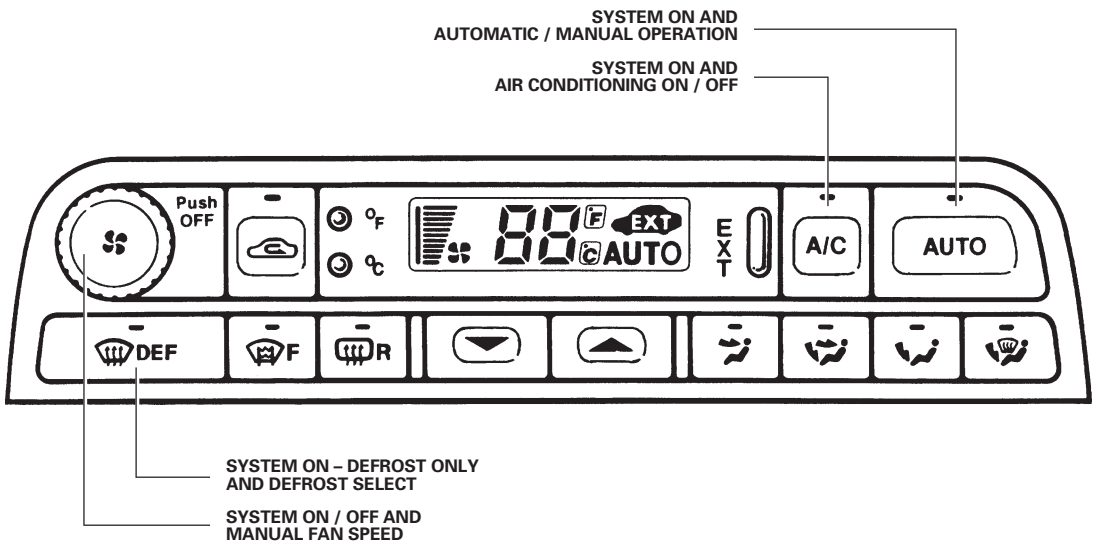
The display gives the driver a visual presentation of the system's current selections and operation:

Blower speed	A bar graph displays the blower speed during manual control.
Temperature	The interior or exterior temperature is displayed numerically. Exterior temperature is selected by pressing the EXT button: Momentary press (one beep) – four second display Long duration press (two beeps) – continuous display
Temperature scale	°F (Fahrenheit) or °C (Celsius) is displayed by pressing the °F or °C button.
Exterior temp. option	EXT is displayed when the exterior temperature is selected. The exterior temperature will continue to be displayed if the system is switched off.
Automatic mode	AUTO is displayed when the system is in automatic mode. Any manual overrides will switch off the AUTO indicator.
Displayed exterior temperature	To compensate for heat soak conditions, the displayed exterior temperature is stored in memory for one hour after the ignition is switched OFF.

If the ignition is switched ON before one hour has elapsed, and the ambient temperature has risen, the stored temperature is displayed; if the ambient temperature has dropped, the lower temperature is displayed. When the ignition is switched ON after one hour, the current ambient temperature is displayed.

Climate Control System ON / OFF

CLIMATE CONTROL PANEL ON / OFF FUNCTIONS



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The climate control panel is switched ON by pressing one of the following panel controls:

AUTO AUTO switches the system ON in the automatic mode; AUTO appears on the panel display. Temperature, blower speed and air distribution are automatically controlled. If heat is required, the blowers will not operate until the engine temperature has risen above 30 °C (87 °F), unless defrost is selected. The blowers operate any time cooling is required. Except in recirculation mode, blower speed is linked to vehicle speed to adjust for the ram air effect at higher vehicle speeds.

A/C A/C switches the system ON in air conditioning mode only. The system uses the air condition settings in effect the last time air conditioning was used.

DEF DEF switches the system ON in the defrost mode only. Air is directed to the windshield only. The blowers operate at maximum speed. Temperature is automatically controlled by the A/CCM.

Push OFF Push OFF switches the system ON in the AUTO mode. AUTO appears on the panel display.

The climate control system is switched OFF as follows:

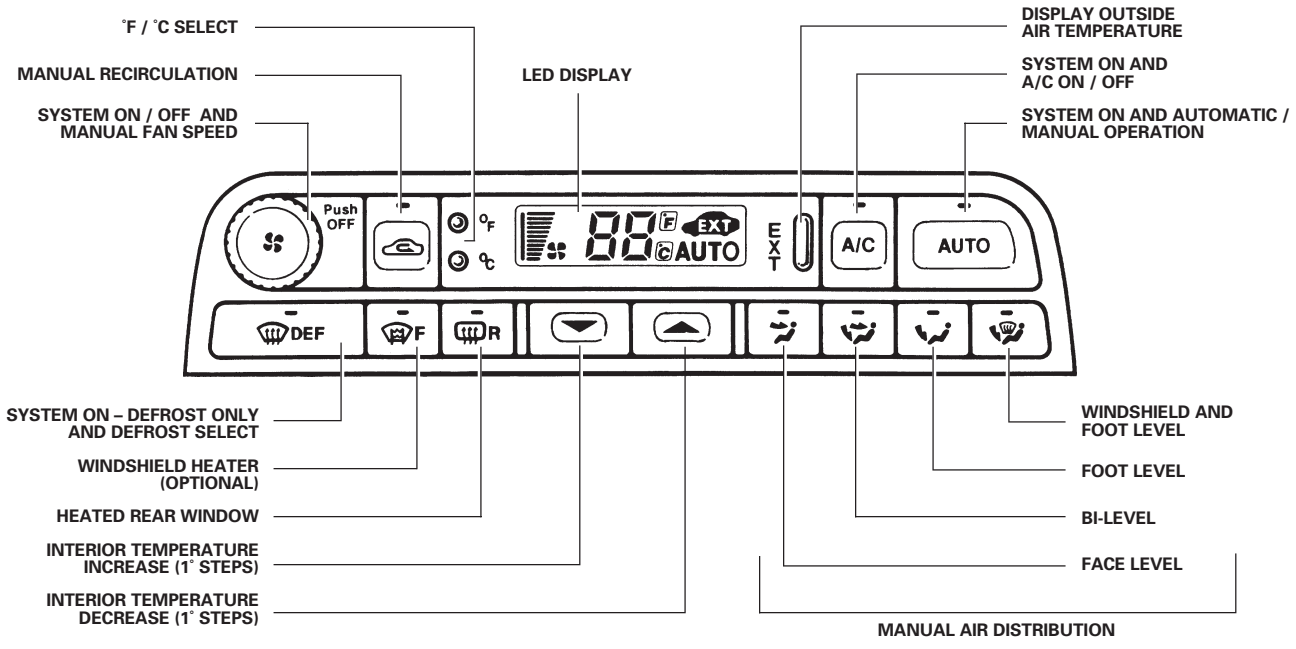
Push OFF Push OFF is the only method for switching the system OFF. When push OFF is pressed, the system is switched off and the fresh air or recirculation blower flaps are set to recirculation, shutting off outside air intake.

NOTES

Climate Control Panel

Climate Control Panel Switch Functions

CLIMATE CONTROL PANEL ON / OFF FUNCTIONS



Push OFF This switch is a combination switch for manual blower speed control and system ON / OFF. Pushing the rotary switch provides system ON or OFF. Turning the switch provides manual blower control and overrides the AUTO control blower speed functions.

Recirculation Pressing this switch closes off the outside air intake and recirculates cabin air. The LED indicates the status.

Momentary press (one beep) – five minute operation

Long duration press (two beeps) – continuous operation

A/C This switch signals the A/CCM to request air conditioning compressor operation from the engine control module. The LED indicates when compressor operation is requested.

AUTO When AUTO is selected (LED on), control of air distribution, blower speed, and interior temperature is fully automatic. Manual overrides, such as pressing one of the air distribution buttons, turning the blower speed control, or selecting A/C, will disengage the automatic function. The AUTO LED will go out to indicate that a manual override has been selected. When AUTO is pressed again, manual overrides are canceled and full automatic system control is restored.

DEF This switch selects defrost. Maximum blower speed occurs and all air is directed to the windshield. Blower speed can be reduced by turning the blower speed control rotary switch. Temperature is controlled by the A/CCM; however, the temperature can be adjusted by using the temperature select UP / DOWN switches. The optional heated windshield will also be switched on for six minutes. If DEF is switched off or the system is switched off before the six minutes has elapsed, the heated windshield will remain on for the six minute timed period. The LED indicates the status.

Heated windshield This switch selects the optional windshield electric heater. The heater will operate for six minutes, then time-out. The LED indicates the status. The windshield heater operates only when the engine is running.

Heated backlight This switch selects the backlight and door mirror heaters. The backlight will operate for 20 minutes and the door mirror heaters will operate for 11 minutes, then time-out. The LED indicates the status. The heated backlight and mirror heaters operate only when the engine is running.

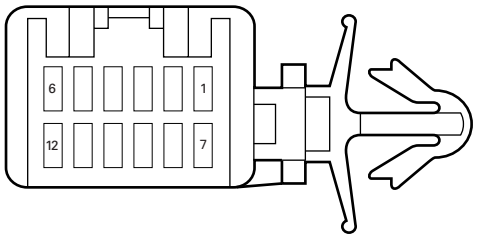
Interior temperature The temperature select buttons increase or decrease the desired interior temperature in 1° increments, °C or °F, as selected.

Manual air Four air distribution manual override buttons are used to override the automatic function and distribution override distribute air as the driver selects: FACE, FACE AND FEET (bi-level), FEET ONLY and WINDSHIELD AND FEET. The LED indicates the status.

Climate Control Panel Pin Out Information

I/O	Sedan	XK8	Description
I	CC2-1	FC43-1	Clock
I	CC2-2	FC43-2	Start
O	CC2-3	FC43-3	Serial data to AC/CM
I	CC2-4	FC43-4	Serial data from AC/CM
I	CC2-5	FC43-5	Battery power supply
I	CC2-6	FC43-6	Battery power supply
I	CC2-7	FC43-7	Ground supply
I	CC2-8	FC43-8	Locate illumination power supply
I	CC2-9	FC43-9	Dimmer override power supply

CLIMATE CONTROL PANEL CONNECTOR



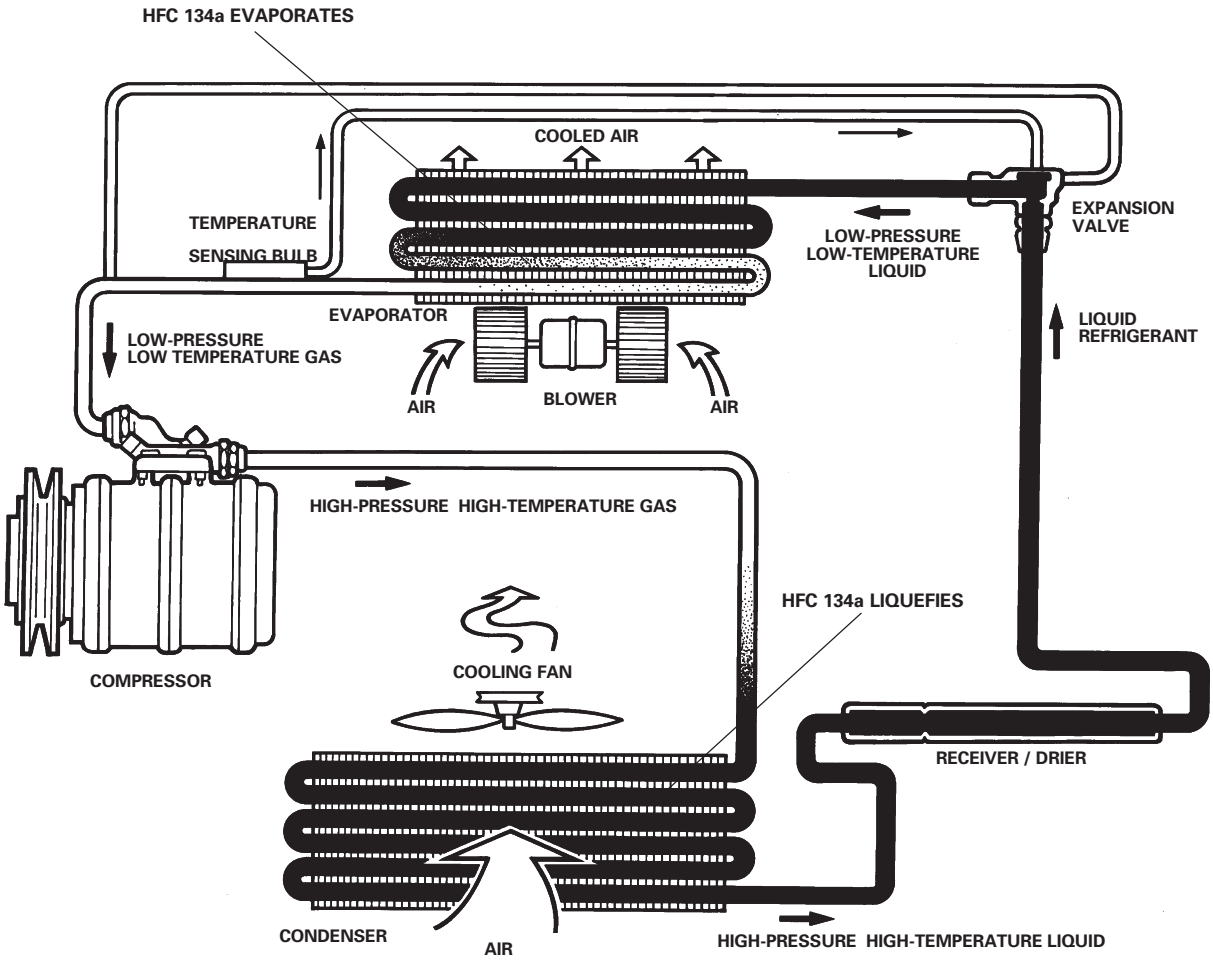
T701/4.10

NOTES

Air Conditioning / Refrigeration System

The Jaguar air conditioning system employs environmentally friendly R134a refrigerant. The layout of the system is conventional; however, there are minor differences between the Sedan and XK8 installations.

BASIC AIR CONDITIONING SYSTEM

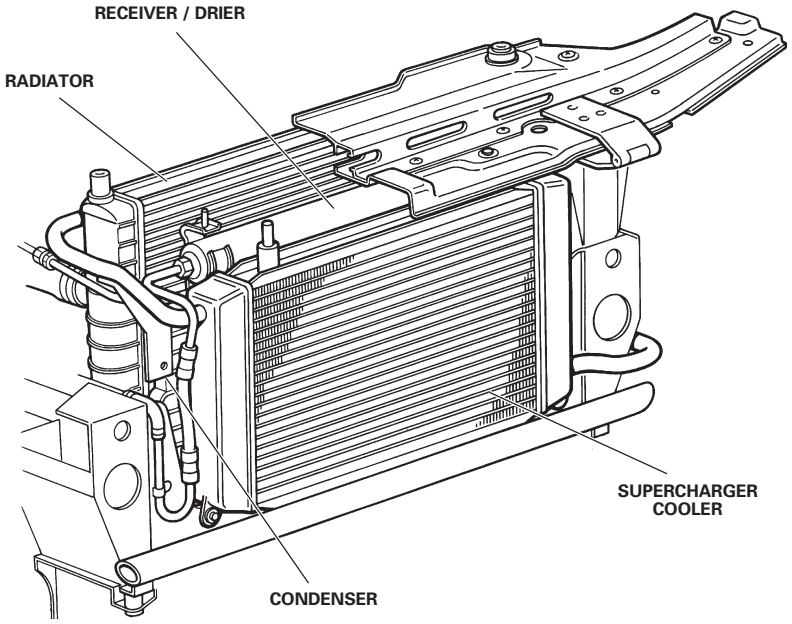


NOTES

Condenser

The condenser is part of the vehicle cooling pack. Located in front of the radiator, the condenser is the system high-side heat exchanger. In the condenser, the high temperature / high pressure refrigerant (in vapor form) condenses into a high pressure liquid. The condenser is constructed as a tube and fin unit similar to the radiator. Refrigerant flow through the condenser differs between the AJ16 and the V12, AJV8 condensers.

AJ16 SC COOLING PACK



T701/4.12

NOTES

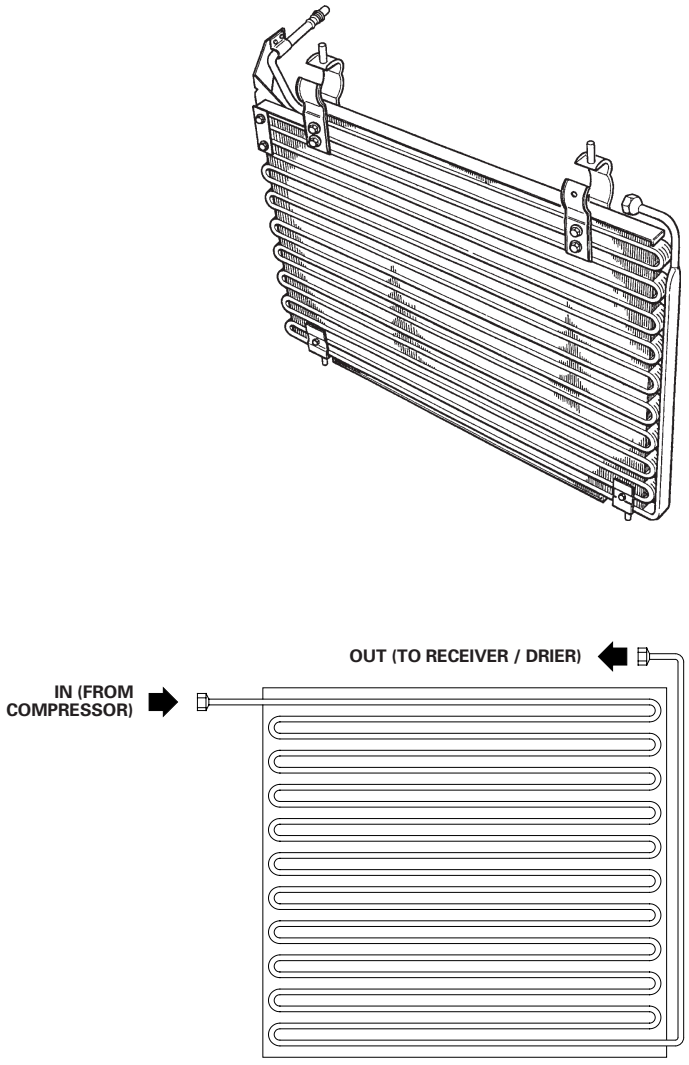
Air Conditioning / Refrigeration System

Condenser (continued)

AJ16 condenser (single path)

Refrigerant flows through the condenser in a single path from top to bottom.

SINGLE PATH CONDENSER



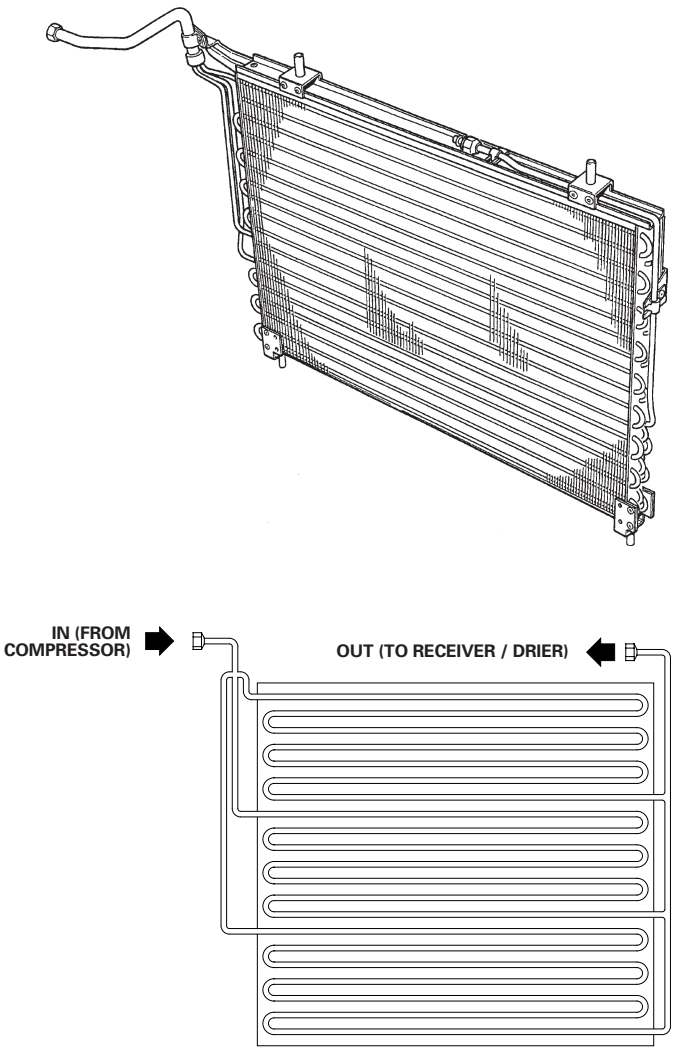
T701/4.13A & B

NOTES

V12 and AJV8 condensers (multi path)

Refrigerant flows through the condenser in separate paths starting at one side and exiting at the other.

MULTI-PATH CONDENSER (V12 SHOWN)

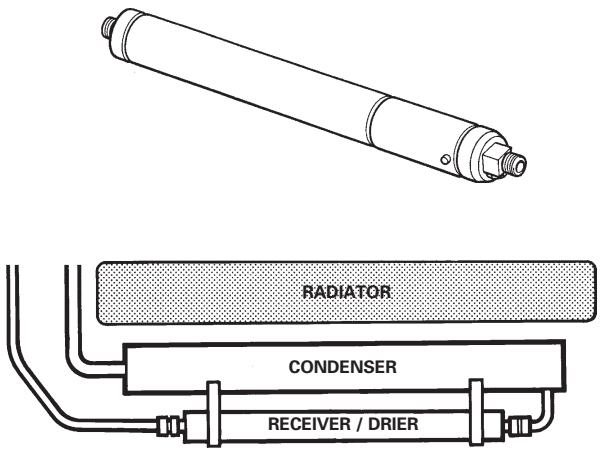


T701/4.14A & B

NOTES

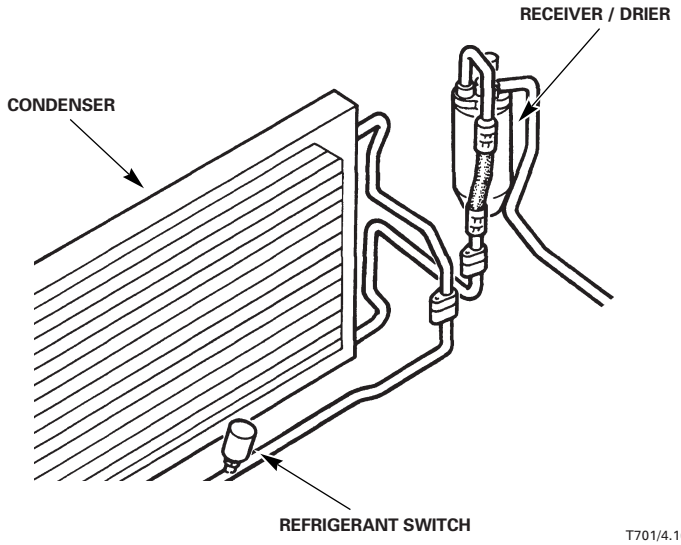
Air Conditioning / Refrigeration System

AJ16 AND V12 RECEIVER / DRIER LOCATION



T701/4.15A & B

AJV8 RECEIVER / DRIER LOCATION



T701/4.16

Receiver / Drier

The receiver / drier stores liquid refrigerant to allow for changes in evaporator demand. In addition, it filters the refrigerant and removes moisture. Due to the characteristics of R134a, no sight glass is provided.

On AJ16 an V12 installations the receiver / drier is horizontally mounted at the top of the condenser. The vertically mounted receiver / drier for AJV8 installations is located near the radiator on the right side of the engine compartment. The high side charge port is on top of the receiver / drier.

NOTES

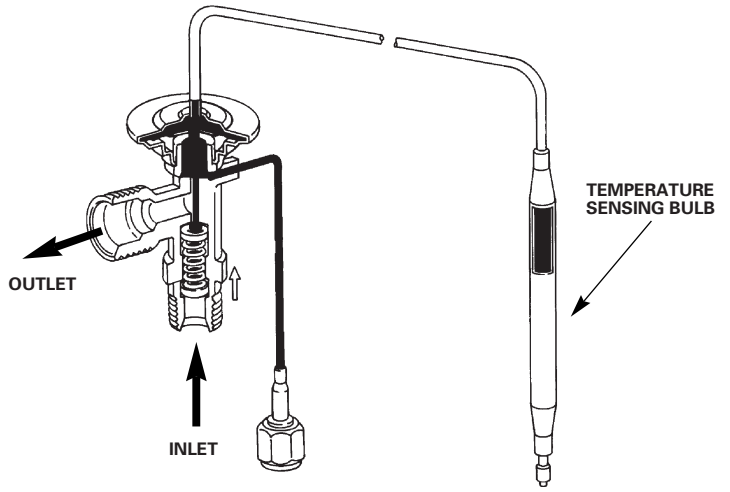
Expansion Valve

The expansion valve is located within the air conditioning / heater unit on the evaporator inlet. The expansion valve meters the refrigerant flow into the evaporator in proportion to the evaporator outlet temperature and refrigerant pressure.

Evaporator

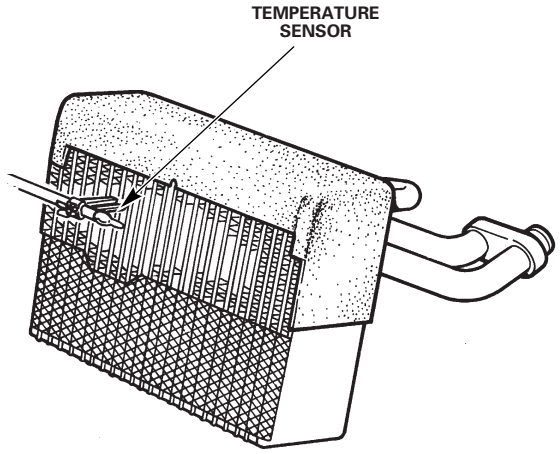
The evaporator is located within the air conditioning / heater unit behind the center console. It is the system low side heat exchanger. As the refrigerant is metered into the low pressure of the evaporator (compressor suction) it absorbs heat from the cabin air via the evaporator fins and changes to a vapor.

TYPICAL EXTERNAL EQUALIZING EXPANSION VALVE



T701/4.17

EVAPORATOR



T701/4.18

NOTES

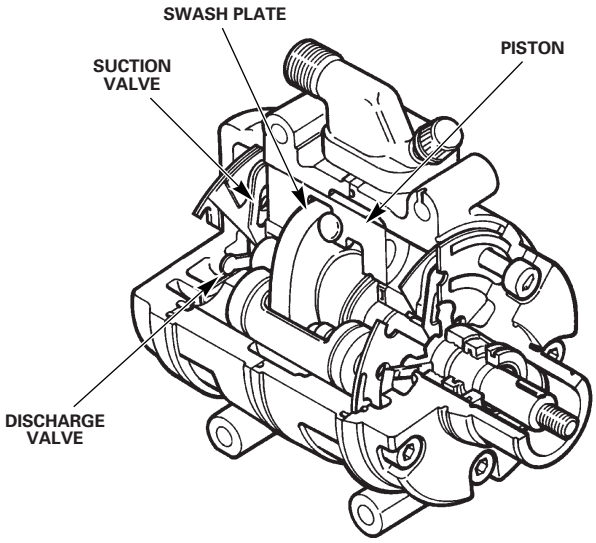
Air Conditioning / Refrigeration System

Compressor

The refrigerant is compressed and circulated by a ten-cylinder swash-plate type compressor. The compressor drive shaft connects to a swash plate that operates five double-ended pistons. This compressor design allows one end of each piston to be on the suction stroke while the other end is on the compression stroke, resulting in smooth, quiet operation.

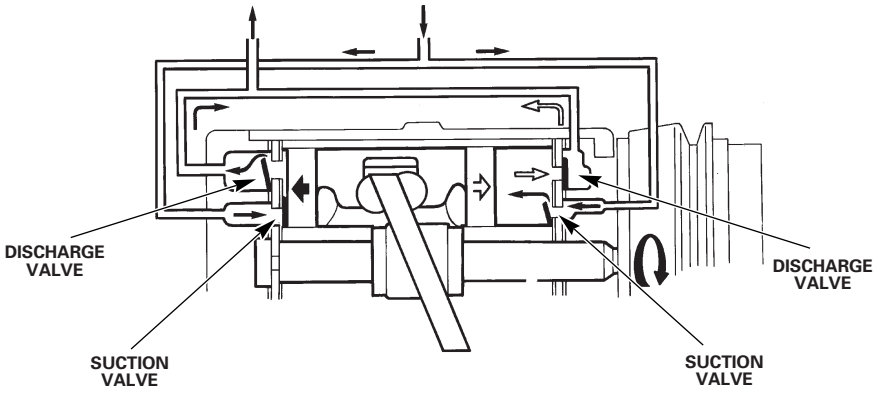
As a safety feature, a pressure relief valve in the compressor vents refrigerant at 41 bar (594 psi) and resets at approximately 28 bar (406 psi).

COMPRESSOR



T701/4.19

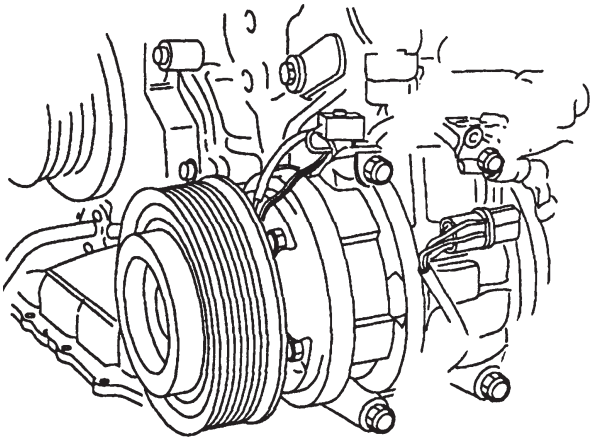
COMPRESSOR OPERATION



T701/4.20

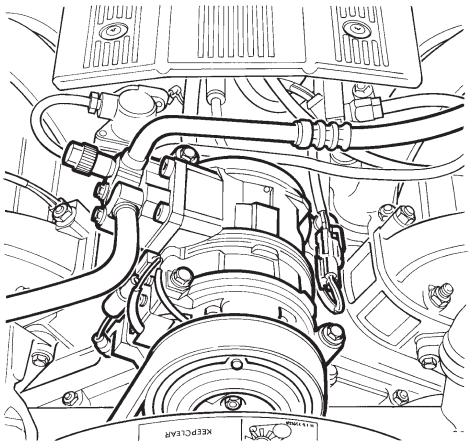
NOTES

AJV8 COMPRESSOR LOCATION



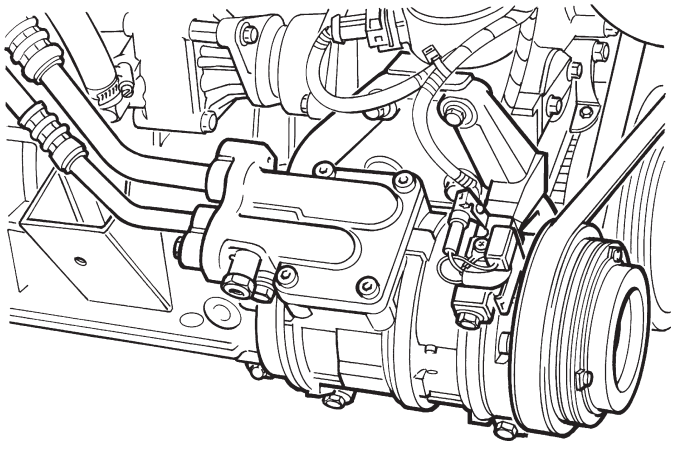
T701/4.21

AJ16 COMPRESSOR LOCATION



T701/4.22

V12 COMPRESSOR LOCATION



T701/4.23

Air Conditioning / Refrigeration System

Compressor (continued)

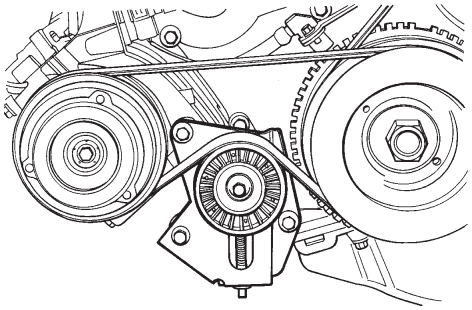
Compressor drive belt adjustment

AJ16 and V12 Both AJ16 and V12 engine drive belts use adjustable idler pulleys for belt tensioning. The AJ16 tensioner operates in a slotted bracket. The V12 tensioner operates on a pivoting bracket.

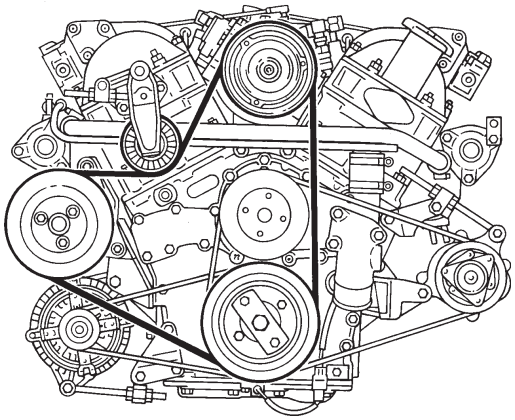
AJV8 AJV8 engine applications use a multi-ribbed serpentine belt with an automatic belt tensioner. A belt wear indicator on the tensioner indicates the need for belt replacement. Refer to the Service Manual for inspection and belt replacement procedures.

COMPRESSOR DRIVES

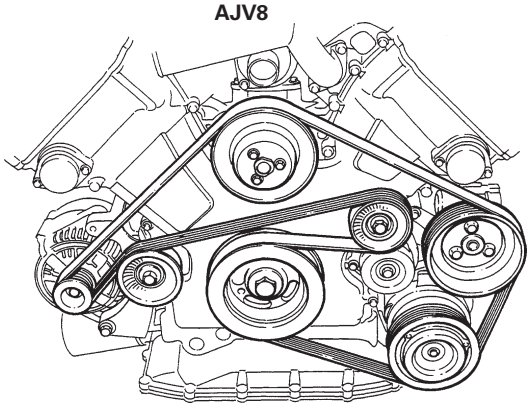
AJ16



V12



AJV8



T701/4.24, 4.25, 4.26

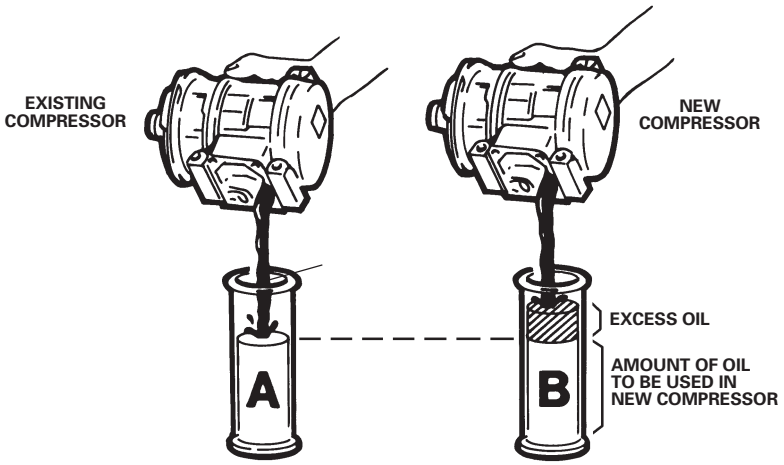
NOTES

Compressor lubricating oil

The compressor requires a special PAG lubricating oil. Refer to the Service Manual and / or Technical Bulletins for the correct part number and capacities.

⚠ CAUTION: Replacement compressors are supplied filled with the amount of lubricating oil specified for the entire air conditioning system. When replacing a compressor, completely drain and measure the oil from the existing compressor. Then, completely drain the oil from the replacement compressor. Refill the replacement compressor with an amount of fresh oil equal to that removed from the existing compressor.

FILLING REPLACEMENT COMPRESSOR



A = OIL DRAINED FROM EXISTING COMPRESSOR; B = AMOUNT OF FRESH OIL TO BE USED IN NEW COMPRESSOR

T701/4.27

NOTES

Air Conditioning / Refrigeration System

Compressor Clutch Control

The compressor is switched on or off depending on the evaporator temperature and the operating demands of the climate control system and the engine. When the climate control system is switched on, the A/CCM "requests" that the engine control module (ECM) switch on the compressor clutch. If engine operating parameters are within an acceptable range, the ECM applies a ground to the compressor clutch relay coil to switch on the compressor.

AJ16
The ECM may delay compressor clutch engagement for four seconds depending on engine operating temperature.

V12
The ECM inhibits compressor operation under the following conditions:

- Engine coolant temperature above 120 °C (248 °F).
- Engine speed below 500 rpm – the compressor is switched on again 20 seconds after the engine speed reaches 566 rpm.
- Full throttle operation – the compressor is switched off for 15 seconds. It is switched on again after 15 seconds or when the ECM no longer "sees" full throttle.

AJV8
The ECM inhibits compressor operation under the following conditions:

- Engine coolant temperatures above 119 ºC (246 ºF)
- At idle speed the compressor is momentarily inhibited (50 ms) to allow the ECM to increase the idle speed to compensate for the compressor load.
- At high engine load (WOT), the compressor is inhibited.

If the compressor clutch is engaged and one of the above conditions occurs, the ECM disengages the clutch until the inhibiting condition is corrected.

Compressor clutch diagnostic monitoring

The A/CCM uses the B+ "compressor on" input to monitor the integrity of the compressor clutch drive circuit. If all compressor operating conditions are met and a request signal has been sent to the ECM, the A/CCM should receive the B+ signal. If the B+ signal is not received, a fault condition is assumed and a DTC will be flagged, however; the A/CCM will continue to request the ECM for compressor operation.

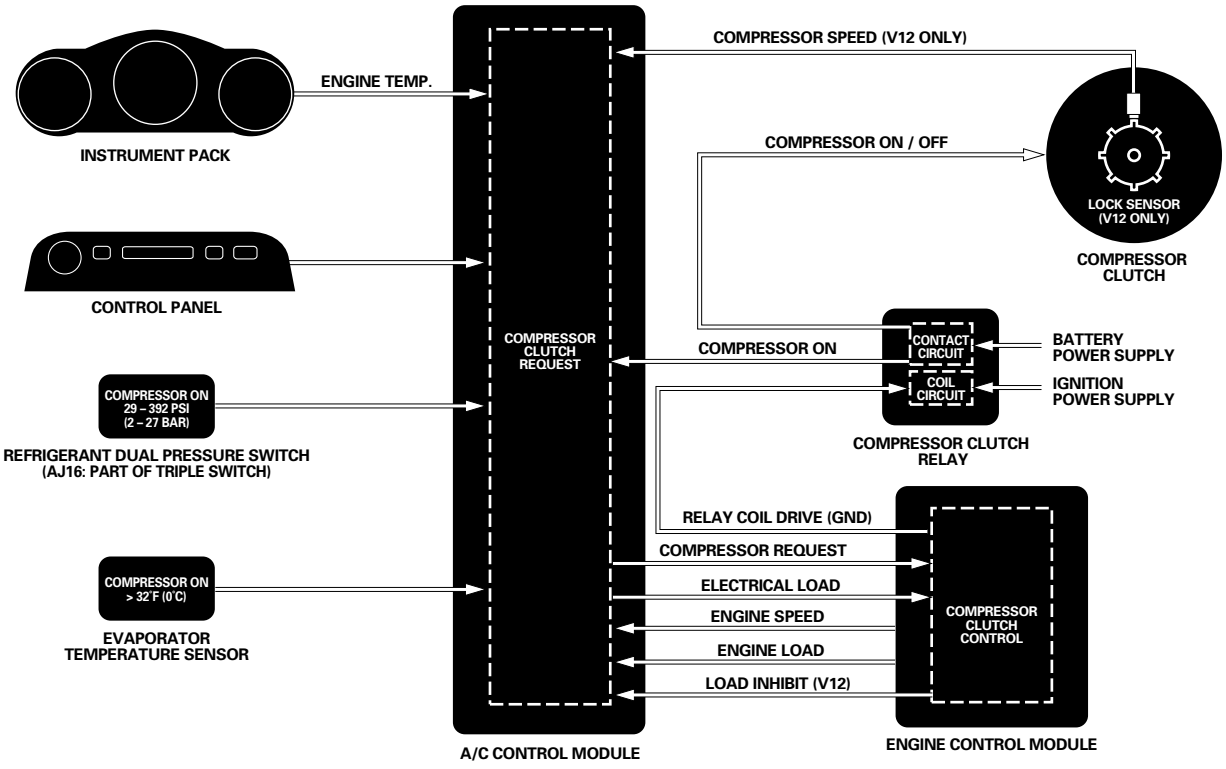
In V12 and AJV8 systems through the 1997 MY, the A/CCM monitors for compressor lock conditions when the B+ signal is present. No default value is used for this signal. There is no compressor lock sensor in AJ16 systems.

DTCs:	PDU	Panel
	B1969	none

Refer to the DTC Summary, pages 61 – 64.

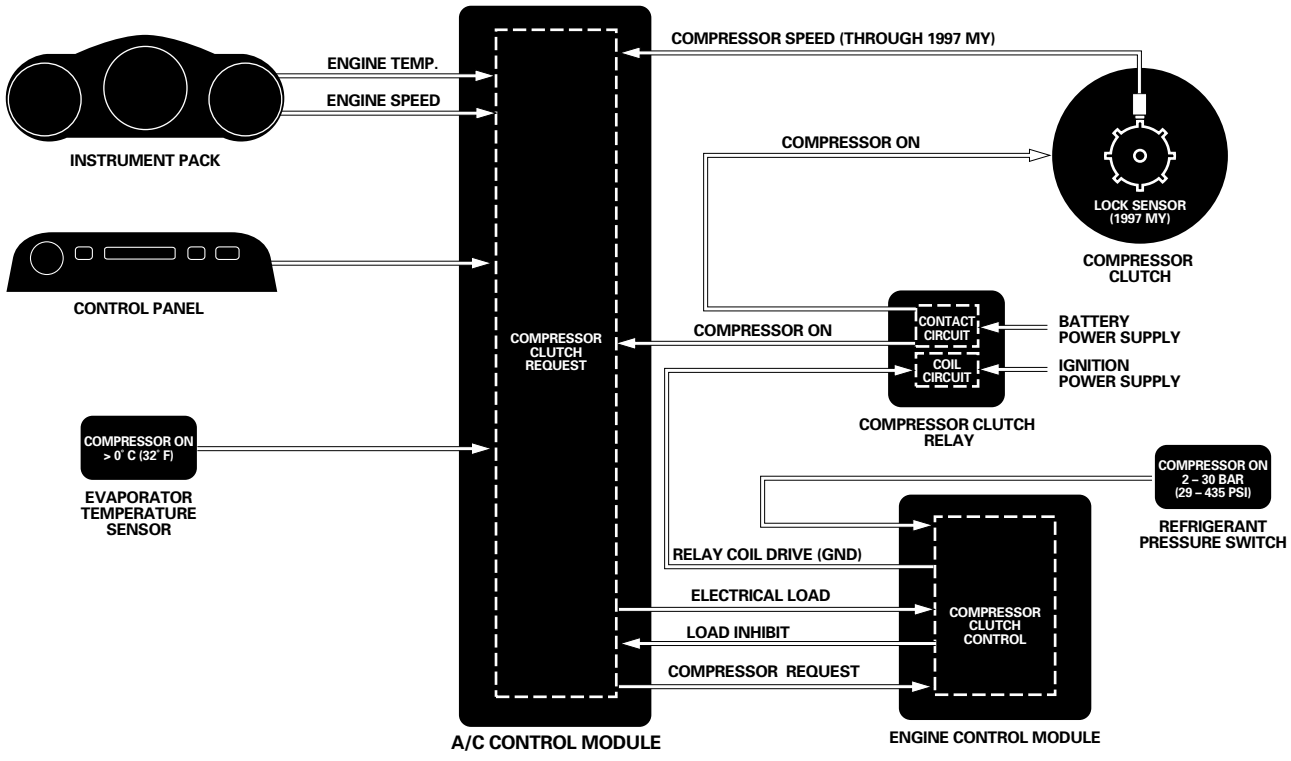
NOTES

AJ16, AND V12 COMPRESSOR CLUTCH CONTROL



T701/4.28

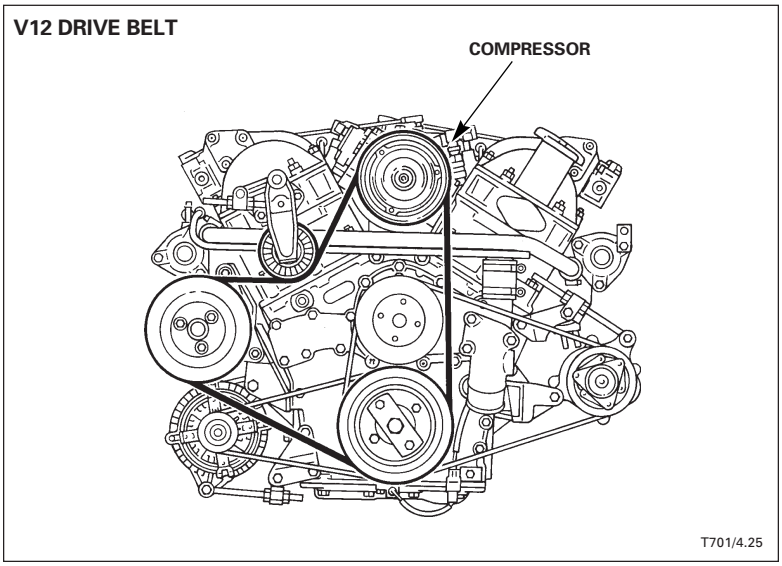
AJV8 COMPRESSOR CLUTCH CONTROL



T701/4.29

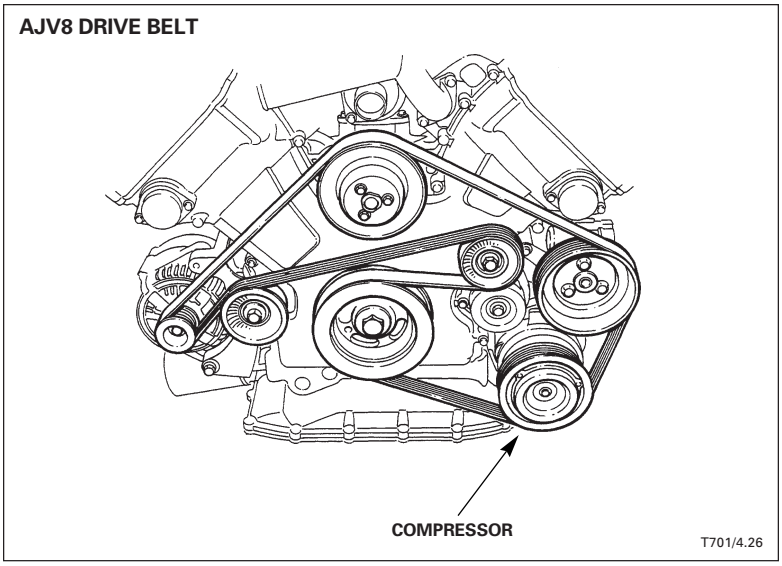
Air Conditioning / Refrigeration System

Compressor Lock Sensor (V12 and AJV8 through 1997 MY Only)



Because the power steering pump and air conditioning compressor are driven by the same belt on the V12 and the AJV8, a compressor lock sensor is installed to provide the A/CCM with an input to verify correct operation. The compressor lock sensor, similar to an ABS wheel speed sensor, provides a pulsed signal indicating compressor pulley speed. The A/CCM compares the pulley speed to the engine speed input received from the ECM. If the pulley speed indicates belt slippage, the A/CCM cancels the A/C request to the ECM to protect against drive belt failure. The A/CCM also flashes the control panel A/C switch LED as an immediate warning and flags DTC B1862.

The compressor lock sensor is deleted on AJV8 applications after the 1997 MY.



Compressor lock sensor diagnostic monitoring

The A/CCM monitors the compressor lock sensing circuit for open circuit and short circuit conditions. If a fault is present, a DTC will be flagged. No default value is used for this signal.

DTCs:	PDU	Panel
	B1862	22

Refer to the DTC Summary, pages 61 – 64.

NOTES

Refrigerant Pressure Switches

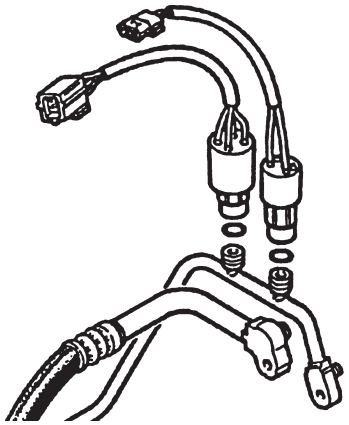
AJ16 and V12

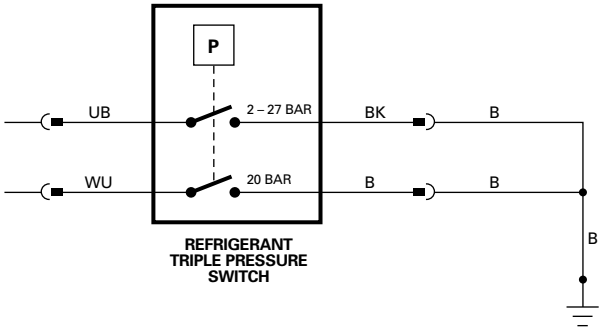
If the refrigerant pressure is low or high, the refrigerant dual pressure switch contacts will open to signal the A/CCM to switch the compressor off. Low pressure can result from a system leak or low ambient temperature. High pressure can be cause by poor system performance, system blockage, or high ambient temperature.

On AJ16, the pressure switch is part of the triple pressure switch. Refrigerant pressure must be between 2 – 27 bar (29 – 392 psi) for the switch contacts to remain closed and provide a ground signal to the A/CCM. The radiator cooling fans are switched from low to high speed by the other set of contacts in the triple pressure switch. Refer to AJ16 Cooling Fan Control, page 34.

The refrigerant pressure switch(es) are located close to the engine bulkhead on the right side.

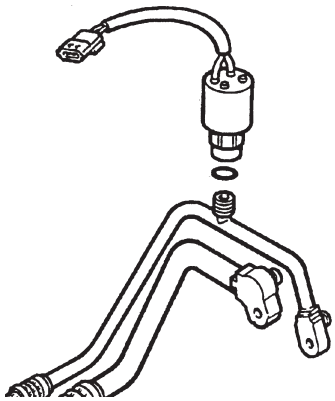
AJ16 REFRIGERANT PRESSURE SWITCHES

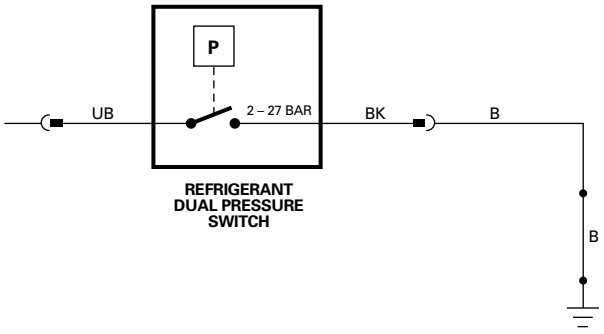




T701/4.30A & B

V12 REFRIGERANT PRESSURE SWITCH





T701/4.31A & B

Air Conditioning / Refrigeration System

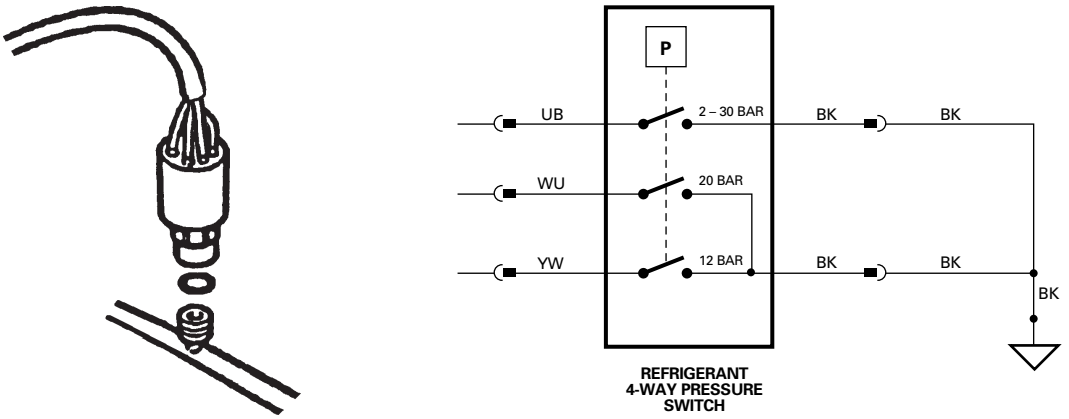
Refrigerant Pressure Switches (continued)

AJV8

A single 4-way pressure switch is located on the high pressure line between the compressor and condenser to monitor refrigerant pressure. The three contact sets in the switch work with the A/CCM and ECM to control compressor clutch engagement and radiator cooling fan speed. Refer to AJV8 Cooling Fan Control, page 36.

The refrigerant pressure must be between 2 – 30 bar (29 – 435 psi) for the switch contacts to remain closed and provide a signal to the A/CCM allowing the A/C request signal to the ECM.

AJV8 REFRIGERANT PRESSURE SWITCH



T701/4.32A & B

Refrigerant pressure switch diagnostic monitoring

The A/CCM monitors pressure switch operation by comparing the ambient temperature to the switch contact position. During normal ambient temperature conditions the switch contacts should be closed. If the switch circuit is open during normal conditions, DTC B1858 is flagged.

At ambient temperatures below -10 °C (14 °F), refrigerant pressure should drop below 2 bar (29 psi) and open the switch contacts. If the contacts are closed or there is a short circuit to ground, DTC B1861 is flagged. No default value is used for this signal.

DTCs:	PDU	Panel	Condition
	B1858	23	Open circuit
	B1861	23	Closed circuit

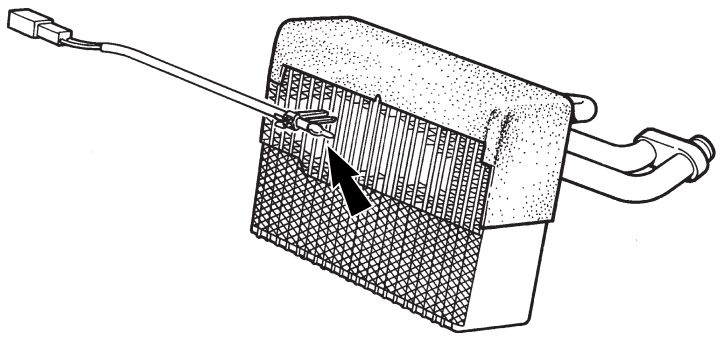
Refer to the DTC Summary, pages 61 – 64.

NOTES

Evaporator Temperature Sensor

The evaporator temperature sensor, located on the left side of the evaporator, is an NTC (negative temperature coefficient) sensor that provides a voltage signal to the A/CCM. If the evaporator temperature falls to 0 °C (32 °F), the A/CCM will cancel the A/C request to the ECM and switch off the compressor to prevent the evaporator matrix from freezing. When the evaporator temperature rises to approximately 3 °C (37.5 °F), the A/CCM will again request A/C from the ECM.

EVAPORATOR TEMPERATURE SENSOR



T701/4.33

Approximate temperature versus voltage

Temperature °C	Temperature °F	Voltage
32 – 37	90 – 100	1.50
26 – 31	79 – 89	1.75
21 – 25	70 – 78	2.00
17 – 21	63 – 70	2.25
13 – 18	56 – 65	2.50
08 – 13	47 – 56	2.75
05 – 09	42 – 49	3.00
01 – 04	35 – 40	3.25
- 05 – 0	23 – 32	3.50

Evaporator temperature sensor diagnostic monitoring

The A/CCM monitors the evaporator temperature sensing circuit for open circuit, high resistance, and short circuit conditions. If a fault is present, a DTC will be flagged.

A default value of 0 °C (32 °F) is substituted by the A/CCM if an evaporator temperature sensor fault is present. The compressor will not run when an evaporator temperature sensor fault is flagged.

DTCs:	PDU	Panel
	B1946	13
	B1947	13

Refer to the DTC Summary, pages 61 – 64.

NOTES

Cooling Fan Control

Cooling Fan Control – AJ16

The radiator and condenser cooling fans are controlled by both radiator coolant temperature and air conditioning refrigerant pressure. Fan operation depends on the cooling air flow requirement. At lower coolant temperature / refrigerant pressure, both fans operate at low speed (in series); at high coolant temperature / refrigerant pressure, both fans operate at high speed (in parallel). The refrigerant triple pressure switch contains a pressure contact set for high speed fan drive. A separate refrigerant single pressure switch is used for low speed fan drive. Fan speed switching is accomplished through a fan control relay module. For engine coolant temperature, a radiator thermostatic switch with two sets of contacts – one for slow speed fan drive and one for high speed fan drive is used.

Low speed fan operation
Both fans run at low speed (in series) when the radiator coolant temperature reaches 86 °C (187 °F) and / or the refrigerant pressure reaches 12 bar (174 psi).

High speed fan operation
Both fans run at high speed (in parallel) when the radiator coolant temperature reaches 100 °C (212 °F) and / or the refrigerant pressure reaches 20 bar (290 psi).

Beginning with VIN 761570, the refrigerant single pressure switch has been deleted from AJ16 engine vehicles. The cooling fans run continuously when the ignition is switched to position II.

Cooling Fan Control – V12

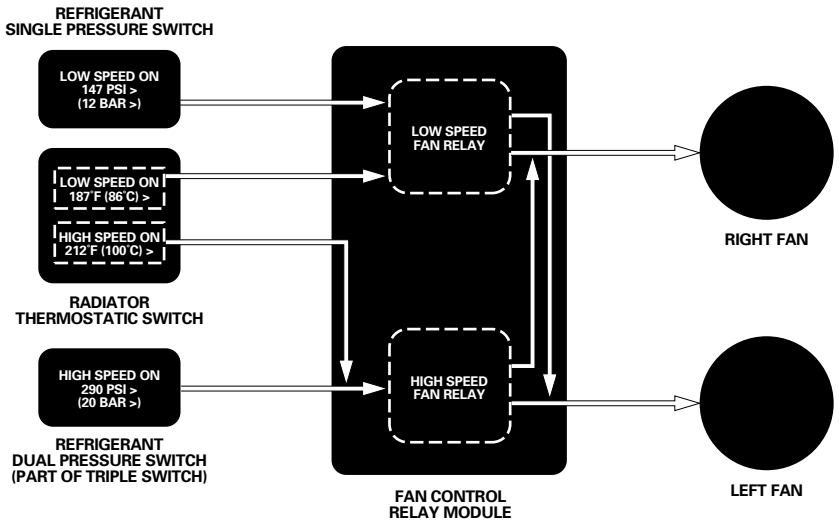
The radiator and condenser cooling fans are controlled by radiator coolant temperature. The V12 uses the same dual temperature radiator thermostatic switch and fan control relay module as the AJ16.

Low speed fan operation
Both fans run at low speed when the radiator coolant temperature reaches 86 °C (187 °F).

High speed fan operation
Both fans run at high speed when the radiator coolant temperature reaches 100 °C (212 °F).

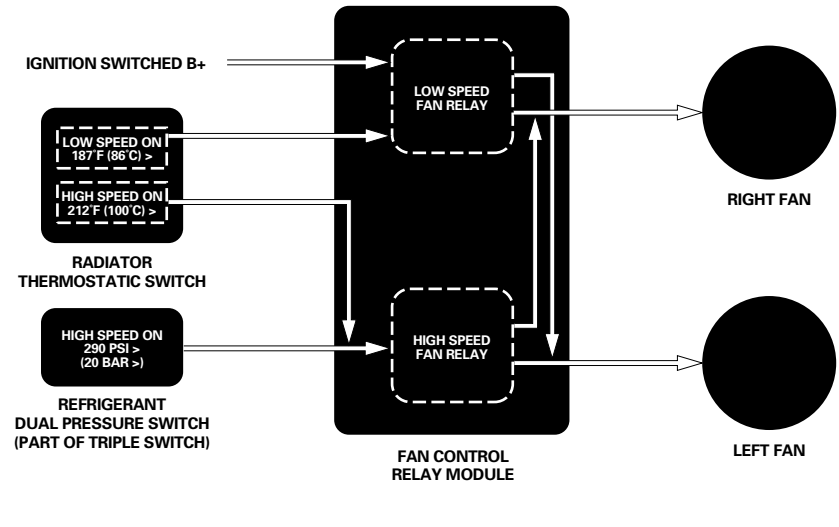
NOTES

AJ16 COOLING FAN CONTROL UP TO VIN 761569



T701/4.34

AJ16 COOLING FAN CONTROL FROM VIN 761570



T701/4.35

Cooling Fan Control

Cooling Fan Control – AJV8

The radiator / condenser cooling fans are controlled by the ECM via the fan control relay module using inputs from the engine coolant temperature sensor (ECT) and the 4-way refrigerant pressure switch 12 bar (174 psi) and 20 bar (290 psi) switch elements. At lower coolant temperatures / refrigerant pressures the fans operate at low speed (series). At high coolant temperatures / refrigerant pressures the fans operate at high speed (parallel). As the ECM switches the fan speeds, an overlap between switch on / switch off points prevents "hunting" between the fan modes

XK8 radiator fan switching points

Fan Speed	Engine coolant temperature		Refrigerant pressure	
	ON	OFF	ON	OFF
Low	90 °C (194 °F)	86 °C (187 °F)	12 bar (174 psi)	8 bar (116 psi)
Fast	97.5 °C (207.5 °F)	93.5 °C (200.5 °F)	20 bar (290 psi)	17.5 bar (254 psi)

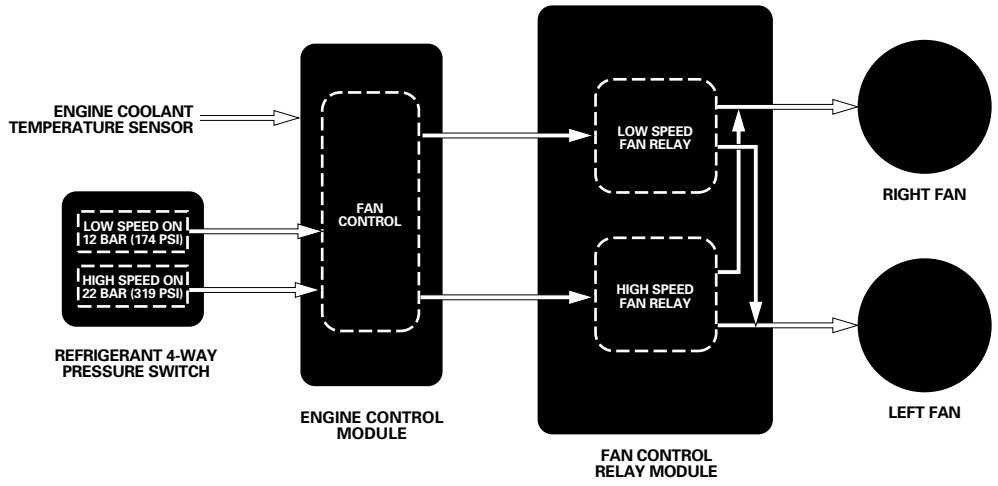
XJ8 radiator fan switching points

Fan Speed	Engine coolant temperature		Refrigerant pressure	
	ON	OFF	ON	OFF
Low	90 °C (194 °F)	86 °C (187 °F)	12 bar (174 psi)	8 bar (116 psi)
Fast	97.5 °C (207.5 °F)	93.5 °C (200.5 °F)	22 bar (319 psi)	17.5 bar (254 psi)

On all vehicles, when the engine is switched off, the ECM remains powered up for a few seconds to complete EMS adaptions. If the fans are operating when the engine is switched off, the ECM continues to drive the fans for 5 minutes or until the coolant temperature decreases to a preset value. If the fans are off when the engine is switched off and the coolant temperature rises to the switch-on point during the time the ECM is still powered, it will switch the fans on. The fans will operate for five minutes or until the coolant temperature decreases to a preset value.

NOTES

AJV8 COOLING FAN CONTROL

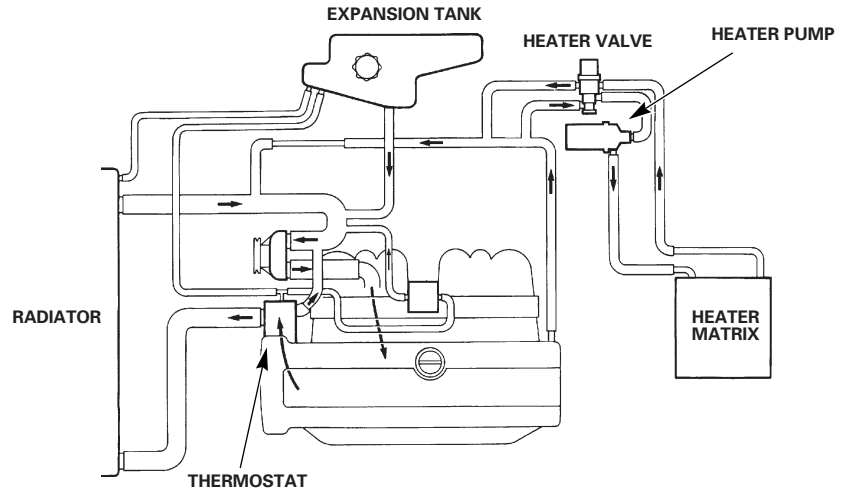


T701/4.36

Heating System

The Jaguar Climate Control System employs engine coolant to provide cabin heat. An electric pump constantly circulates engine coolant through the heater matrix when the engine is running. An A/CCM controlled heater valve maintains the heater matrix at the optimum temperature required to achieve the selected cabin temperature.

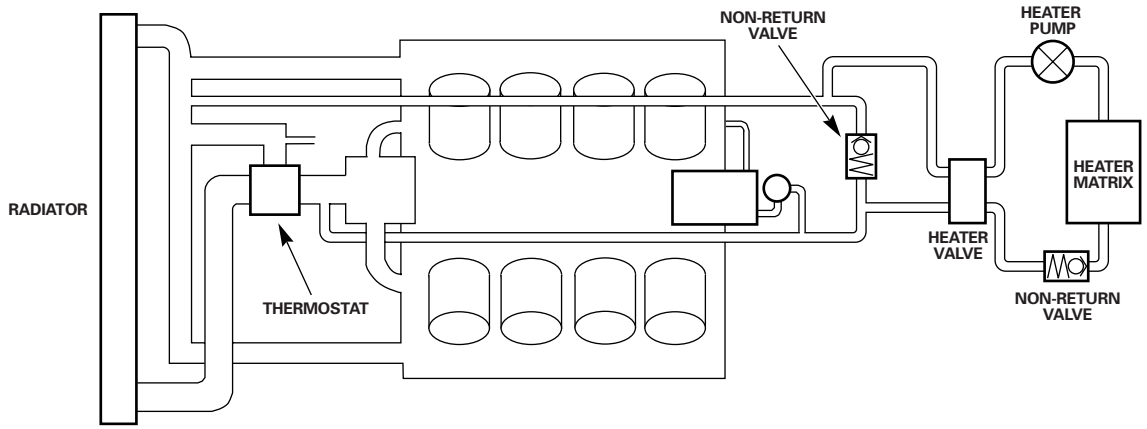
AJ16 NA COOLING SYSTEM



T701/4.37

The AJV8 heating system functions similarly to the AJ16 and V12 heating systems. The AJV8 low volume cooling system design requires two non-return valves to maintain correct coolant flow under all engine operating conditions. At low engine speeds, engine coolant flow pressure is less than heater pump pressure. The non-return valve in the engine cooling system prevents the heater pump from re-circulating coolant against the normal flow of engine coolant. The heater circuit non-return valve prevents hot engine coolant from flowing back into the heater matrix after the engine is switched off.

AJV8 NA COOLING SYSTEM



T701/4.38

Heater Pump

The pump is operated continuously by the A/CCM when the A/CCM receives an engine speed signal and the engine coolant temperature is above 30 °C (86 °F) ± 10 °C (18 °F). The A/CCM grounds the heater pump relay coil circuit to activate the pump. If the ignition is switched on and the engine is not running, the pump is switched off.

Heater pump diagnostic monitoring

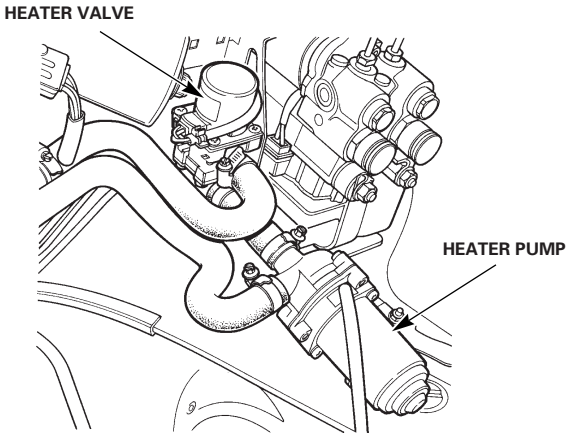
Heater pump diagnostic monitoring occurs only on 1995 MY vehicles up to VIN 739425. These vehicles use a high current draw motor with the ground circuit completed through the A/CCM. By monitoring the ground voltage, the A/CCM can detect when a pump motor failure has occurred (pump locked or ground circuit open). Vehicles from VIN 739426 use a lower current draw motor and no A/CCM diagnostic monitoring. The pump motor ground circuit is completed directly to ground.

DTCs:	PDU	Panel
	B1968	none

Refer to the DTC Summary, pages 61 – 64.

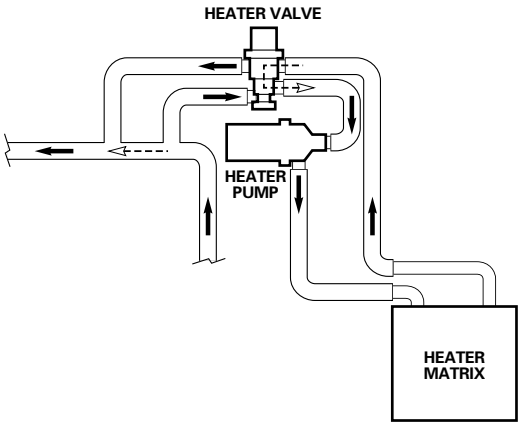
NOTES

HEATER PUMP AND VALVE (AJ16, V12 SHOWN)



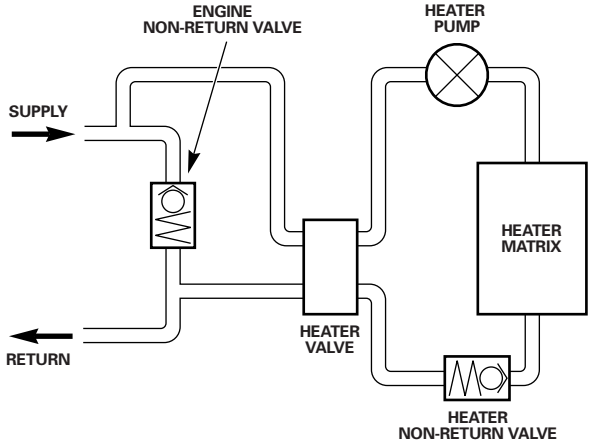
T701/4.39

AJ16 AND V12 HEATER COOLANT FLOW



T701/4.40

AJV8 HEATER COOLANT FLOW



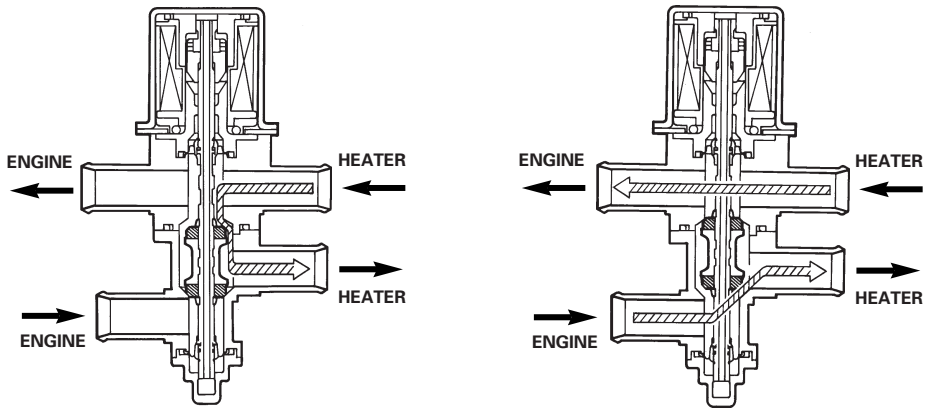
T701/4.41

Heating System

Heater Valve

Coolant circulation to the heater matrix is controlled through a variable duty cycle valve. The A/CCM drives the valve to fully open or closed to control the heater matrix temperature.

HEATER VALVE

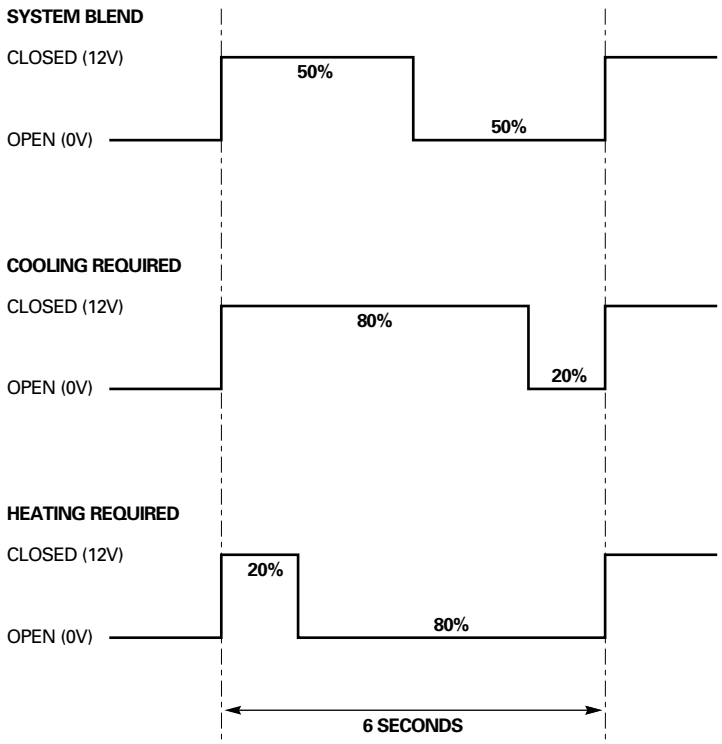


COLD: NO COOLANT FLOWS TO THE HEATER

HOT: ENGINE COOLANT FLOWS THROUGH THE VALVE TO THE HEATER

T701/4.42A & B

HEATER VALVE DRIVE SIGNALS



T701/4.43

The A/CCM drives the valve with a 12 volt, six second duty cycle signal. The A/CCM increases or decreases the length of the 12 volt signal within the duty cycle to achieve the required heater matrix temperature. If the drive circuit fails (open circuit), the valve defaults to the open position to allow full engine coolant flow to the heater matrix.

The A/CCM uses the control panel settings and the heater matrix temperature sensor input signals to achieve the optimum heater matrix temperature. To prevent the circulation of cool engine coolant through the heater matrix, the heater valve is driven closed during the following conditions:

Engine coolant temperature below 86 °F (30 °C) ± 18 °F (10 °C)

No engine speed signal present

The A/CCM does not monitor the heater valve circuit for diagnostics.

NOTES

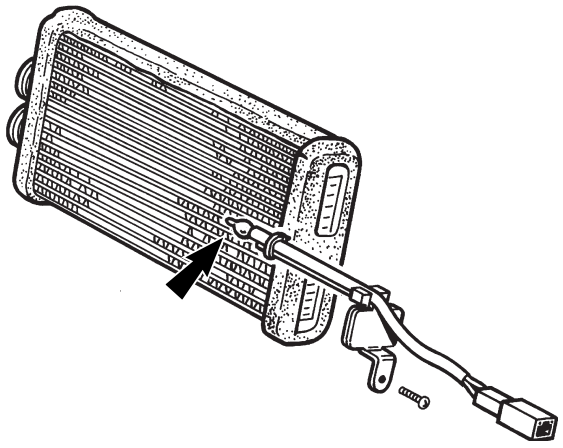
Heater matrix sensor

The NTC (negative temperature coefficient) heater matrix sensor, located on the right side of the heater matrix in the air conditioning / heater unit, provides the A/CCM with a voltage signal representing the heater matrix outlet air temperature. The heater matrix air temperature is one of the inputs used by the A/CCM to control the operation of the heater valve.

Approximate air temperature versus voltage:

Temperature °C	Temperature °F	Voltage
67 – 73	152 – 163	0.75
57 – 64	136 – 147	1.00
50 – 56	123 – 133	1.25
43 – 48	109 – 118	1.50
37 – 42	98 – 108	1.75
32 – 36	89 – 97	2.00
27 – 31	81 – 88	2.25
23 – 26	74 – 79	2.50
18 – 22	66 – 72	2.75
14 – 17	57 – 64	3.00
10 – 13	50 – 56	3.25

HEATER MATRIX SENSOR



T701/4.44

Heater matrix sensor diagnostic monitoring

The A/CCM monitors the heater matrix sensing circuit for open circuit, high resistance, and short circuit conditions. If a fault is present, a DTC will be flagged.

A default value of 45 °C (113 °F) is substituted by the A/CCM if a heater matrix air temperature sensor fault is present.

DTCs:	PDU	Panel
	B1966	15
	B1967	15

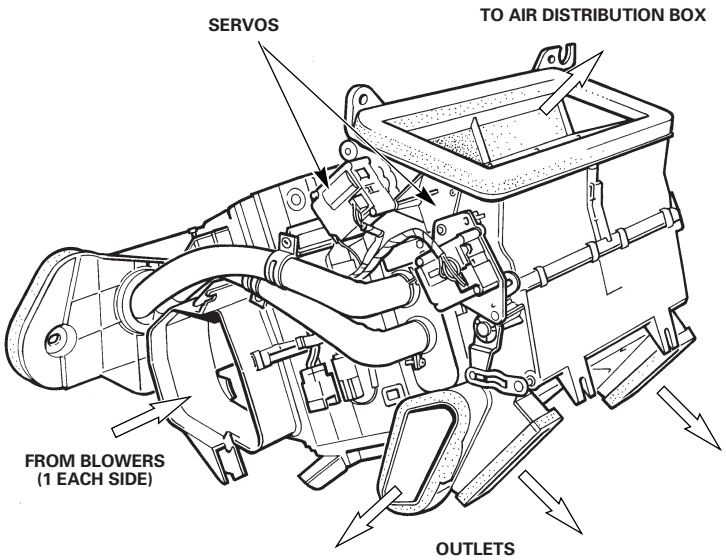
Refer to the DTC Summary, pages 61 – 64.

NOTES

Air Conditioning / Heater Unit

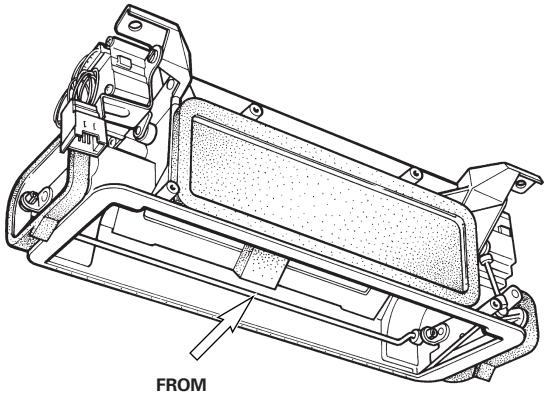
The air conditioning / heater unit is located behind the fascia and is connected by ducts to the right and left blowers. The unit directs air into the cabin at the desired temperature via a series of servo motor operated flaps. The position of the flaps is fed back to the A/CCM by non adjustable potentiometers integrated with the servo motors. The air conditioning / heater unit directs outlet air to the various cabin vents. The air distribution box, located on top of the air conditioning / heater unit, directs air to the windshield, side vents and face vents.

AIR CONDITIONING / HEATER UNIT



T701/4.45

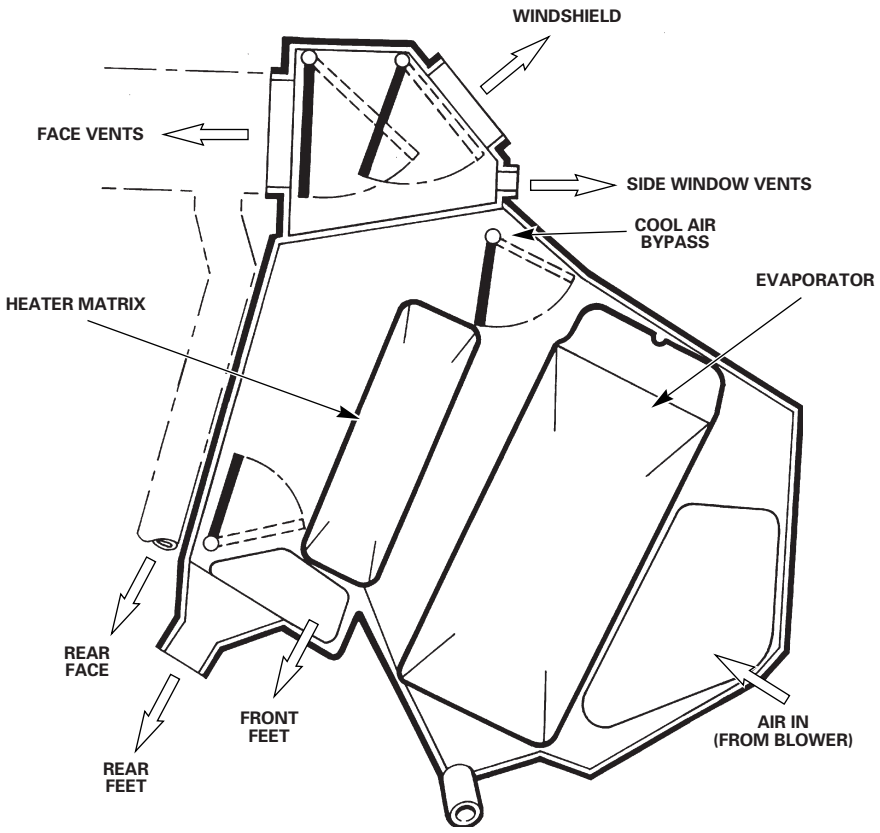
AIR DISTRIBUTION BOX



T701/4.46

NOTES

OUTLET AIR TEMPERATURE AND FLOW



T701/4.47

NOTES

Air Conditioning / Heater Unit

Blowers

The blower assemblies each contain a motor, fan, servo and fresh air / recirculation flap. They connect to either side of the air conditioning / heater unit with ducts. Each blower incorporates a power transistor assembly to regulate air flow output volume. The A/CCM varies the voltage applied to the base of the power transistor to vary the blower motor speed and thus the air flow output volume. During normal operation, power is supplied to the blower motors via the blower motor relay. The motor ground is completed by the power transistor circuit to provide varying blower motor speed. When maximum blower output is required, the A/CCM activates the high speed relay, which switches the blower motor ground circuit directly to ground and the motor runs at maximum speed.

In AUTO mode, blower motor variable speed is controlled automatically by the A/CCM. In manual control, 11 speed steps are available. Through the 1997 MY, to compensate for the effect of ram air on the air intakes, the A/CCM adjusts blower speed at vehicle speed above 25 mph (40 km/h). Blower speed compensation is canceled during the following conditions:

- Maximum blower speed required
- Fresh / recirc flaps positioned to recirculation
- DEFROST selected
- AUTO – full cooling required (fresh / recirc flaps positioned to recirculation)

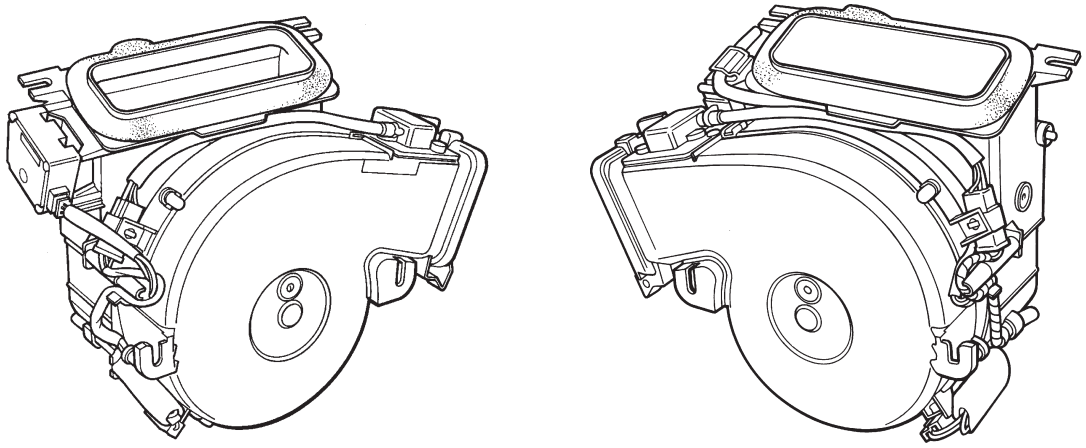
In the heating mode, blower operation is canceled by the A/CCM until the engine coolant temperature reaches 30 °C (86 °F) to prevent cold air distribution. The blowers operate at all times in the cooling and defrost modes.

The A/CCM does not monitor the blower motor circuits for diagnostics, however; the A/CCM receives a feedback signal from the power transistor circuit that indicates blower motor speed. This signal is used to adjust blower speed. If a fault occurs in the blower speed feedback circuit, the A/CCM uses a default speed that depends on the speed selected when the fault occurred. If the equivalent speed was above 7/8 bar segments, the A/CCM drives the blower motors at maximum speed; if the equivalent speed was below 7/8 bar segments, the blower motors are switched off.

The electrical load placed on the vehicle charging system by high speed blower operation is compensated for by the ECM (engine control module). Refer to Climate Control Electrical Load, page 56.

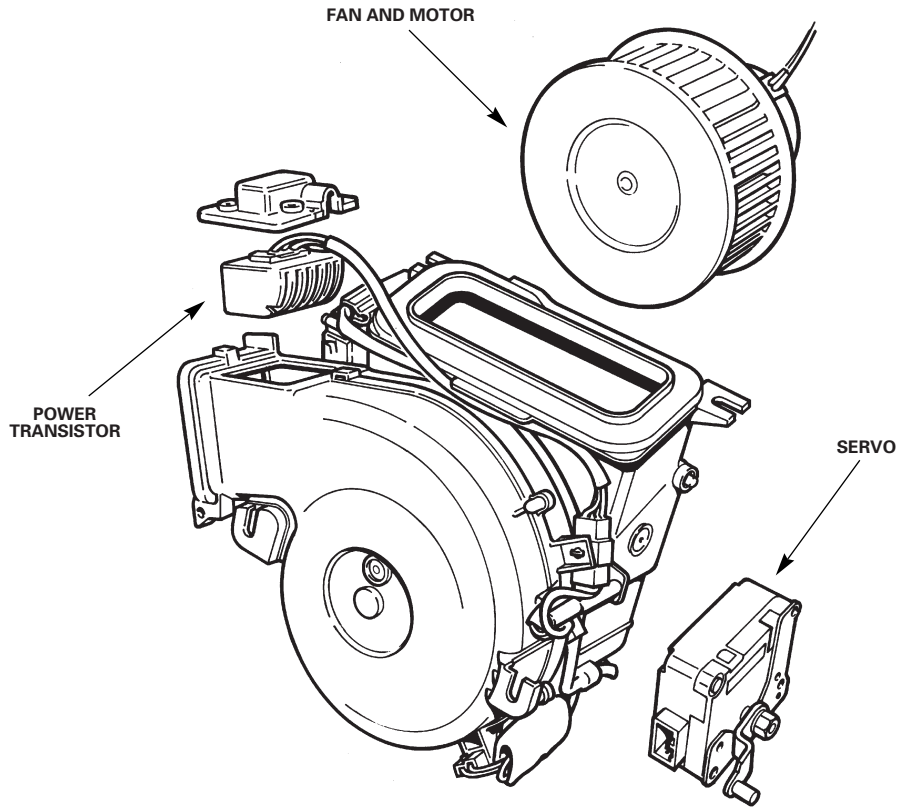
NOTES

BLOWERS



T701/4.48A & B

BLOWER COMPONENTS



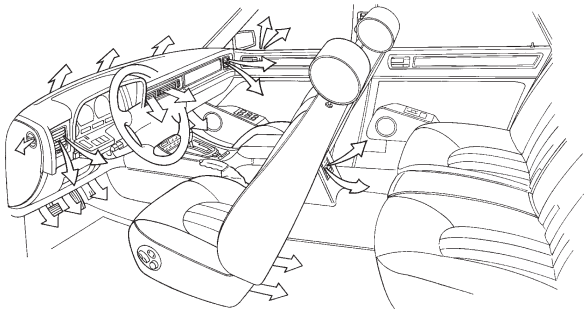
T401/4.49

Air Conditioning / Heater Unit

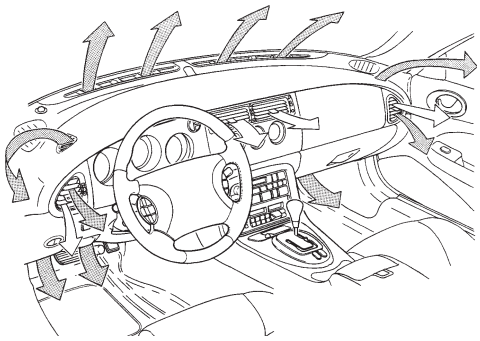
Cabin Air Distribution

Air is distributed to the cabin from multiple vents located at the face level, foot level, windshield, side windows, rear foot wells and rear center console.

AIR DISTRIBUTION



SEDAN RANGE



XK8

T701/4.50A & B

Face Vent Differential Temperature Control (through 1997 MY Only)

The face vent differential control is a potentiometer that provides the A/CCM with a feedback voltage to indicate the face level differential air temperature selected by the driver. The A/CCM adjusts the position of the upper cool air bypass flap to meet the desired selection. The resistance range of the potentiometer is nominally 2 – 8 kΩ:

Minimum differential (RED) 8 kΩ ± 10% = 1 volt (wiper feedback voltage)

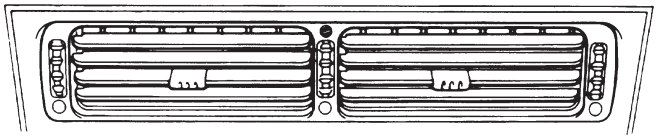
Maximum differential (BLUE) 2 kΩ ± 10% = 4 volt (wiper feedback voltage)

Face vent differential temperature control diagnostic monitoring

The A/CCM monitors the face vent differential temperature control circuit for open circuit, high resistance, and short circuit conditions. If a fault is present, a DTC will be flagged.

No default value is used for face vent differential control circuit failure.

FACE VENT DIFFERENTIAL TEMPERATURE CONTROL (THROUGH 1997 MY)



T701/4.51

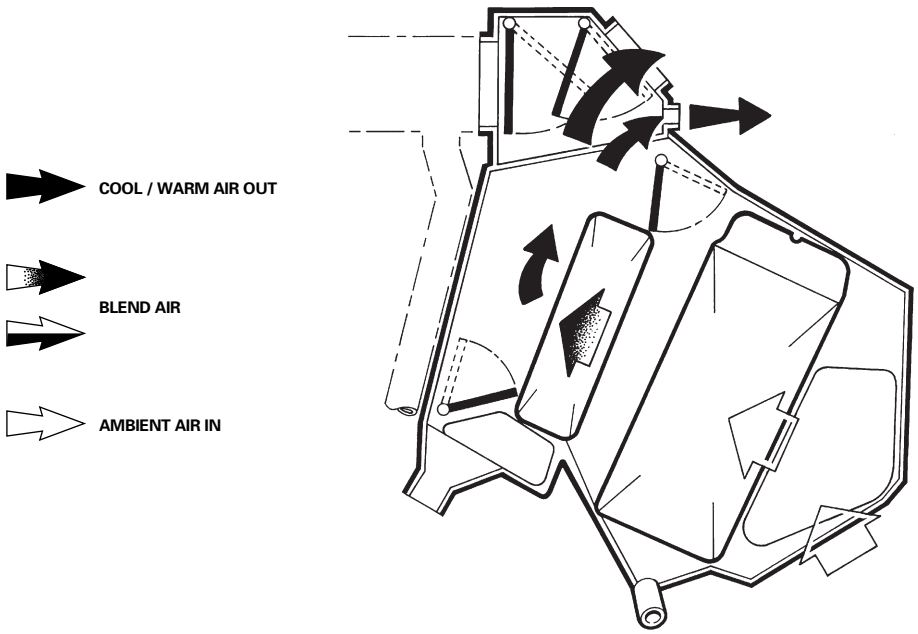
DTCs:	PDU	Panel
	B1849	24
	B1852	24

Refer to the DTC Summary, pages 61 – 64.

NOTES

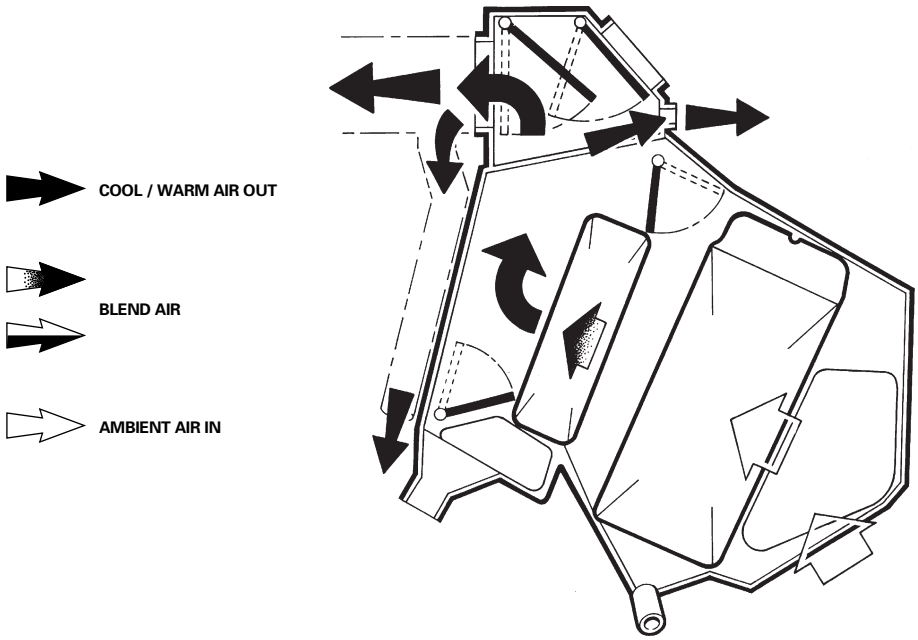
Air Distribution

DEFROST SELECTED



T701/4.52

FACE SELECTED

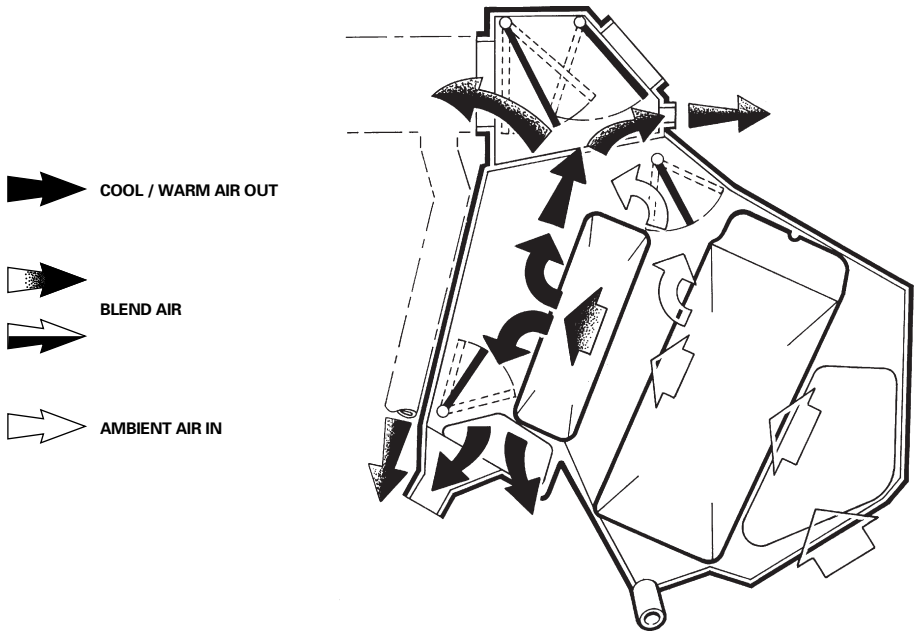


T701/4.53

Air Conditioning / Heater Unit

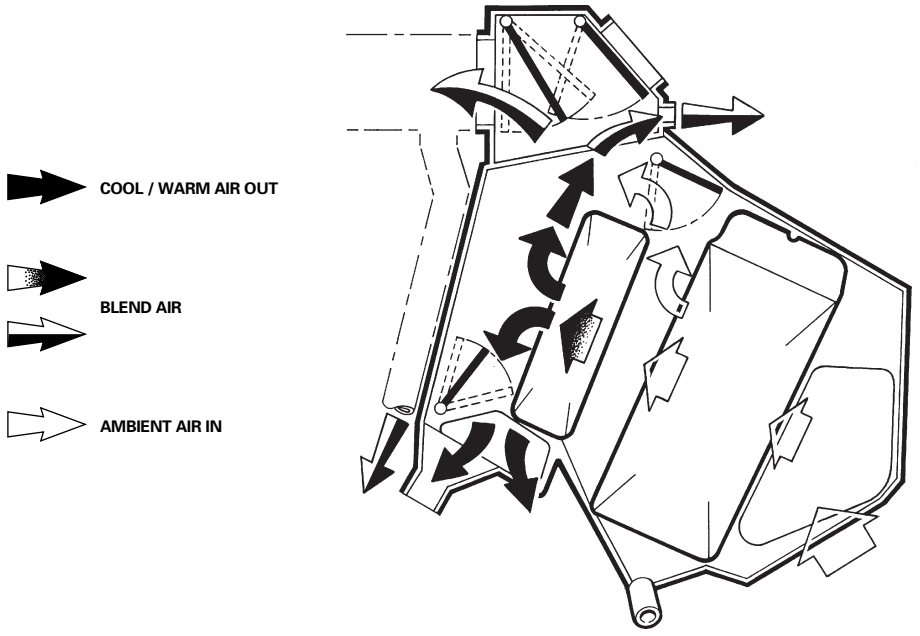
Air Distribution (continued)

FACE / FEET SELECTED (BI-LEVEL): MINIMUM TEMPERATURE DIFFERENTIAL (THROUGH 1997 MY ONLY)



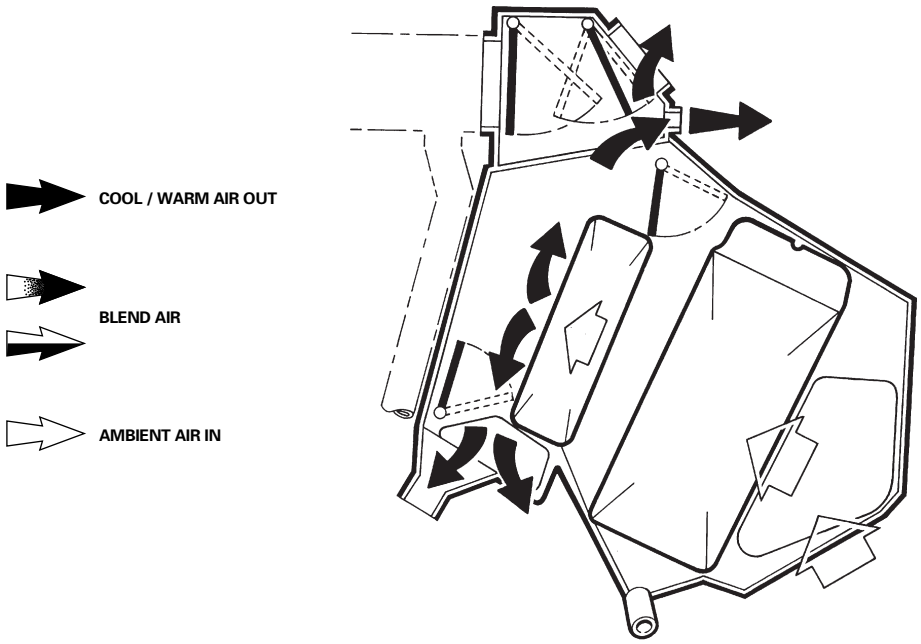
T701/4.54

FACE / FEET SELECTED (BI-LEVEL): MAXIMUM TEMPERATURE DIFFERENTIAL (THROUGH 1997 MY ONLY)



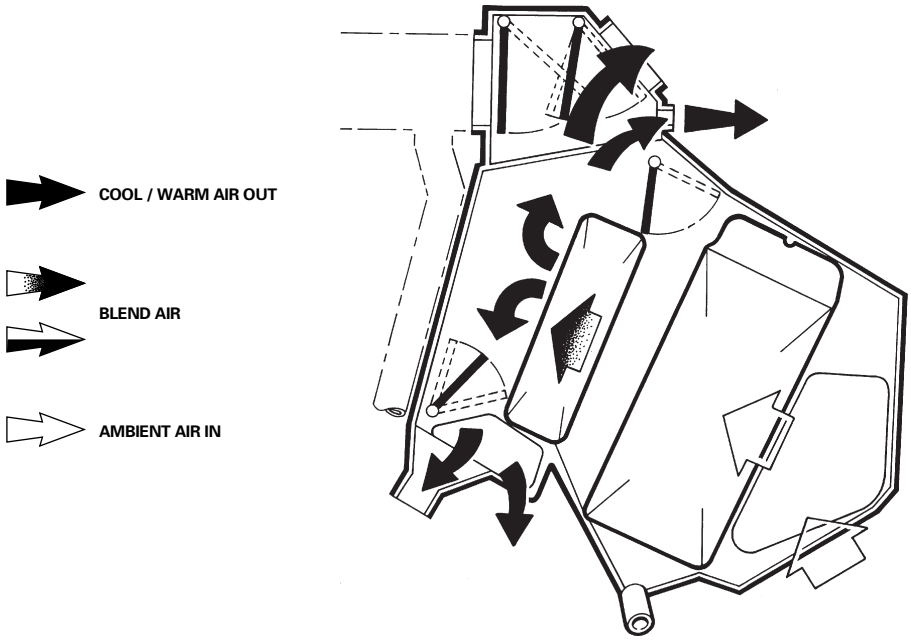
T701/4.55

FEET SELECTED



T701/4.56

DEMIST SELECTED

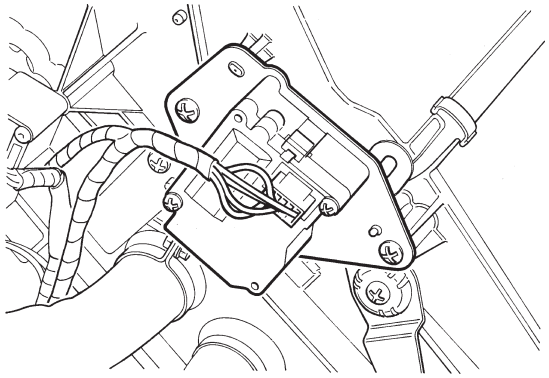


T701/4.57

Air Conditioning / Heater Unit

Servos and Feedback Potentiometers

SERVO ASSEMBLY



T701/4.58

Six air flow control flap servo assemblies are used in the system:

- Defrost vent
- Center vent
- Left fresh / recirc flap (blower intake)
- Right fresh / recirc flap (blower intake)
- Cool air bypass
- Footwell vent

Each servo incorporates a feedback potentiometer that provides the A/CCM with a feedback voltage that indicates the position of the air flow flap. The resistance range of the potentiometers is nominally 2 – 5 kΩ:

Flap closed 5 kΩ ± 10% = 1 volt (wiper feedback voltage)

Flap open 2 kΩ ± 10% = 4 volt (wiper feedback voltage)

Servos and feedback potentiometers diagnostic monitoring

The A/CCM monitors the feedback potentiometer sensing (wiper) circuits for open circuit, high resistance and short circuit conditions. If a fault is present, a DTC will be flagged. In addition, the A/CCM monitors the time required for each servo to position its flap. If the flap does not reach the required position within 30 seconds, a DTC is flagged.

No default values are used for servo / potentiometer circuit failures.

DTCs:	PDU	Panel	Component
	B1262	44	Defrost vent position
	B1268	34	Defrost feedback potentiometer
	B1271	34	Defrost feedback potentiometer
	B1263	45	Center vent position
	B1272	35	Center feedback potentiometer
	B1275	35	Center feedback potentiometer
	B1264	46	Footwell vent position
	B1276	36	Footwell feedback potentiometer
	B1279	36	Footwell feedback potentiometer
	B1265	43	Cool air bypass position
	B1280	33	Cool air bypass feedback potentiometer
	B1283	33	Cool air bypass feedback potentiometer
	B1266	41	Left fresh / recirculation position
	B1287	31	Left fresh / recirculation feedback potentiometer
	B1287	31	Left fresh / recirculation feedback potentiometer
	B1267	42	Right fresh / recirculation position
	B1288	32	Right fresh / recirculation feedback potentiometer
	B1291	32	Right fresh / recirculation feedback potentiometer

Refer to the DTC Summary, pages 61 – 64.

Temperature Control Sensors

The A/CCM uses the temperature control sensor inputs to determine the temperature and volume of air required to maintain the selected interior temperature of the passenger compartment

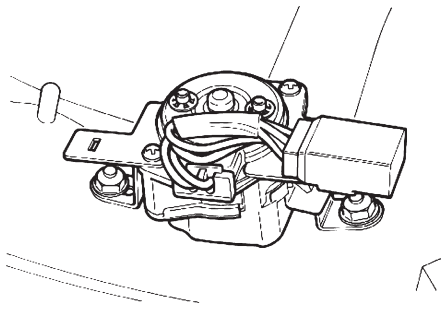
In-Car Temperature Sensor

The NTC (negative temperature coefficient) in-car temperature sensor is part of the aspirator assembly, located on the driver's side dash liner. The sensor provides the A/CCM with a voltage signal representing the average in-car air temperature. The A/CCM uses the signal to correct the outlet air temperature and distribution to reach the target in-car temperature selected by the driver.

Approximate in-car temperature versus voltage:

Temperature °C	Temperature °F	Voltage
33 – 37	92 – 99	2.00
28 – 32	84 – 90	2.25
24 – 27	75 – 81	2.50
19 – 22	67 – 72	2.75
15 – 18	59 – 66	3.00
11 – 14	52 – 57	3.25
6 – 10	43 – 50	3.50

ASPIRATOR / IN-CAR TEMPERATURE SENSOR



T701/4.59

In-car temperature diagnostic monitoring

The A/CCM monitors the in-car temperature sensing circuit for open circuit, high resistance and short circuit conditions. If a fault is present, a DTC will be flagged.

A default value of 25 °C (77 °F) is substituted by the A/CCM if an in-car temperature sensor fault is present.

DTCs:	PDU	Panel
	B1250	11
	B1253	11

Refer to the DTC Summary, pages 61 – 64.

Aspirator Motor

The motorized aspirator provides a constant flow of interior air over the in-car temperature sensor. The motor operates only when the control panel is switched ON. Operation is momentarily stopped when the ignition is turned to position III.

Aspirator motor diagnostic monitoring

The A/CCM monitors the aspirator motor circuit for open circuit, high resistance and short circuit conditions. If a fault is present, a DTC will be flagged.

No default value is used for aspirator motor failure. The in-car temperature sensor will continue to be used by the A/CCM, but temperature stability will be lost.

DTCs:	PDU	Panel
	B1853	none
	B1856	none

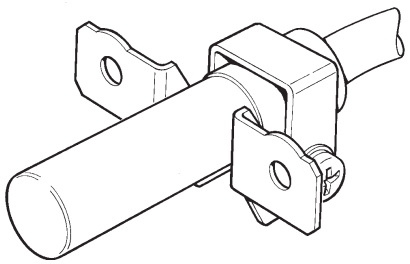
Refer to the DTC Summary, pages 61 – 64.

Temperature Control Sensors

Ambient Temperature Sensor

The NTC (negative temperature coefficient) ambient temperature sensor, located in the left hand front brake air cooling duct (AJ6 and V12 Sedans), lower left radiator mount (XJ8) or the right side horn bracket behind the front bumper (XK8), provides the A/CCM with a voltage signal representing the ambient air temperature. The A/CCM uses the signal to compensate for ambient air temperature conditions and for the exterior air temperature panel display. To prevent an incorrect temperature signal during "heat soak" conditions (stationary vehicle with the engine running), a rising temperature signal is ignored by the A/CCM at vehicle speeds below 9 mph (15 km/h). Falling temperature signals are always used by the A/CCM.

AMBIENT TEMPERATURE SENSOR



T701/4.60

Approx. ambient temperature versus voltage:

Temperature °C	Temperature °F	Voltage
44 – 49	111 – 121	1.25
38 – 42	101 – 108	1.50
32 – 36	90 – 97	1.75
27 – 31	81 – 88	2.00
23 – 26	74 – 79	2.25
18 – 22	65 – 71	2.50
13 – 17	56 – 63	2.75
9 – 12	48 – 54	3.00
5 – 8	41 – 47	3.25
0 – 4	32 – 39	3.50
5 – 1	24 – 30	3.75

Ambient temperature diagnostic monitoring

The A/CCM monitors the ambient temperature sensing circuit for open circuit, high resistance and short circuit conditions. If a fault is present, a DTC will be flagged.

A default value of 50 °F (10 °C) is substituted by the A/CCM if an ambient temperature sensor fault is present.

DTCs:	PDU	Panel
	B1254	12
	B1257	12

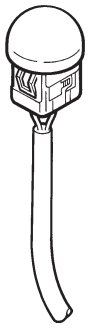
Refer to the DTC Summary, pages 61 – 64.

NOTES

Solar Sensor

The light sensitive solar sensor, located at the top of the fascia panel, provides the A/CCM with a voltage signal representing the "solar (sun) load" being placed on the vehicle. The sensor uses a light sensitive diode so that as the brightness of the sun brightness increases, the sensor voltage signal to the A/CCM increases. The range of the sensor is 0.75 – 4.75 volts.

SOLAR SENSOR



T701/4.61

Solar load diagnostic monitoring

The A/CCM monitors the solar sensor circuit for open circuit, high resistance, and short circuit conditions. If a fault is present, a DTC will be flagged.

A default value of 0 kW/m is substituted by the A/CCM if a solar sensor fault is present.

DTCs:	PDU	Panel
	B1258	21
	B1260	21

Refer to the DTC Summary, pages 61 – 64.

NOTES

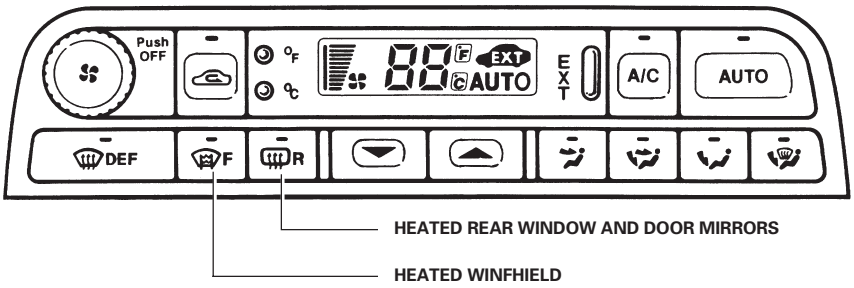
Vehicle Systems Interfaces

Windshield, Rear Window and Mirror Heaters

Control of the windshield, rear window and mirror heaters is integrated with the climate control system. The engine must be running for the heaters to operate. Refer to Engine Speed, page 56. Additionally, in V12 systems, no heater operation occurs during high engine load. Refer to Engine Load, page 56.

The A/CCM will not switch on the heaters until it receives an engine speed signal from the ECM. In V12 systems, the A/CCM will not switch on the heaters if it receives an engine load signal from the ECM. To compensate for the electrical load placed on the vehicle charging system when the heaters operate, the ECM acts to maintain the target idle speed. Refer to Climate Control Electrical Load, page 56.

CLIMATE CONTROL PANEL



T701/4.62

The heated rear window and door mirrors are activated by pressing the "R" button on the climate control panel. The heated windshield can be activated manually by pressing the panel "F" button.

When the heaters are requested, the A/CCM signals the ECM for permission to switch ON the heaters via the electrical load request hard wire circuit. Depending on the engine operating condition, the ECM inhibits heater operation by outputting a load inhibit signal to the A/CCM via the load inhibit hard wire circuit.

Engine conditions for heaters ON:

- Engine not at idle *
- Engine coolant temperature below 119 °C (246 °F)
- Throttle valve less than full load (WOT)

Engine conditions for heaters inhibited:

- Engine coolant temperature above 119 °C (246 °F)
- Throttle valve at full load (WOT)

* Engine at idle – Heaters inhibited for (approximately 50 ms) as the ECM adjusts the idle speed to compensate for the increased electrical load.

The heaters are timed as follows:

Heated rear window	20 ± 1 minutes
Heated door mirrors	11 ± 1 minutes
Heated windshield	6 ± 1 minutes

Heated Windshield

If a heated windshield is fitted, it can be activated manually or automatically. The heated windshield is inhibited by the ECM as described on the previous page.

Automatic activation

The heated windshield and door mirror heaters can activate automatically during certain driving conditions. No LEDs illuminate when the heaters are activated automatically, therefore the driver cannot easily tell when they switch on or off.

The windshield and door mirror heaters activate independently depending on ambient temperature and vehicle speed. Automatic activation points vary slightly depending on the A/CCM software. Activation occurs when all of the following conditions are met.

Automatic heated windshield activation:
Ambient temperature below approximately -10 – 0 °C (14 – 32 °F) and vehicle speed greater than 30 – 40 mph (48 – 64 km/h) for longer than 2 minutes. The windshield switches off immediately when the conditions are no longer valid.

Automatic door mirror activation:
Ambient temperature below 0 – 10 °C (32 – 50 °F) and vehicle speed greater than 30 mph (48 km/h). The mirrors switch off immediately if the temperature rises above the switch on point or after 2 minutes if the vehicle speed drops to below 30 mph (48 km/h).

The A/CCM does not monitor the window and mirror circuits for diagnostics.

NOTES

Vehicle Systems Interfaces

Climate Control Electrical Load

When the blowers operate at high speed and / or the window and mirror heaters operate, additional electrical load is placed on the vehicle charging system. When one or more of these components operate, the A/CCM provides the ECM with a B+ voltage signal. The ECM adjusts the engine idle speed to compensate for the increased load.

The A/CCM does not monitor the electrical load circuit for diagnostics.

Engine Load (V12 only)

The ECM outputs an engine load ground signal to the A/CCM if it a detects fluctuation in the idle speed or a high engine load. In response, the A/CCM inhibits operation of blower motor high speed and / or window and mirror heaters for a maximum of 15 seconds.

The A/CCM does not monitor the engine load circuit for diagnostics.

Engine Speed

The A/CCM receives an engine speed signal from the ECM (AJ16 and V12) or the instrument pack (AJV8). The A/CCM uses the engine speed signal for the following functions:

- Heater pump control
- Heater valve control
- Windshield, backlight and mirror heaters operation
- Compressor lock sensing (V12 and AJV8 through 1997 MY only)
- Diagnostics

Engine speed diagnostic monitoring

The A/CCM compares engine speed to vehicle speed. If the engine speed is 0 and the vehicle speed is above 50 mph (81 km/h), a DTC is flagged.

No default value is used for engine speed circuit failure.

DTCs:	PDU	Panel
	P0335	none

Refer to the DTC Summary, pages 61 – 64.

Engine Cranking

During engine cranking, the ignition switched ground signal is removed from the A/CCM (ignition switch position III) to signal the A/CCM to momentarily inhibit the operation of current consuming components.

The A/CCM does not monitor the engine cranking circuit for diagnostics.

NOTES

Engine Coolant Temperature

The A/CCM receives an engine coolant temperature voltage signal from the instrument pack.

Heating mode
When the system is in the heating mode and the engine coolant temperature is below 30 °C (86 °F), the A/CCM inhibits operation of the heater valve, heater pump, and the blowers. Once the coolant temperature has risen above this temperature, the heater pump and valve operation returns to normal; the blower speed will be lower than selected until the coolant temperature reaches 60 °C (140 °F).

Coolant Temperature Diagnostic Monitoring

The A/CCM monitors the engine coolant temperature circuit (between the instrument pack and the A/CCM) for open circuit, high resistance and short circuit conditions. If a fault is present, a DTC will be flagged.

If a circuit fault occurs between the coolant temperature sensor and the instrument pack, the instrument pack output will default to a voltage equal to 20 °C (68 °F). The A/CCM will not detect this fault.

If a circuit fault occurs between the instrument pack and the A/CCM, the A/CCM will substitute a default value of 76 °C (169 °F).

DTCs:	PDU	Panel
	B1948	14
	B1949	14

Refer to the DTC Summary, pages 61 – 64.

Vehicle Speed

The A/CCM receives a pulsed signal from the instrument pack to indicate vehicle speed. The instrument pack receives its signal from the ABS control module. The A/CCM uses the vehicle speed signal for the following functions:

- Blower speed control
- Ambient temperature signal recognition
- Diagnostics

The A/CCM does not monitor the vehicle speed circuit for diagnostics.

NOTES

Control Panel Diagnostics

System Self-Test

Some system generated fault codes can be displayed on the control panel screen. When a fault is flagged, an audible "beep" will sound and the message "Er" will be displayed for five seconds, after the ignition is switched to position II. To display stored "panel fault codes", follow this procedure:

- Switch off the ignition

  Press and hold the AUTO and FRESH / RECIRC buttons simultaneously while switching the ignition to position II.

  All of the panel LEDs and all LCD segments will flash ON and OFF. Any function LED indicator or LCD segment that does not flash suggests a fault condition within that area of the panel, or with the LED or LCD.

- Press AUTO

  The control panel display will flash and scroll through the list of flagged fault codes. A maximum of five codes will be stored and displayed. If 0 is displayed, no fault codes are flagged.

- Press FACE to manually scroll through the fault codes

  When a fault code is displayed, an accompanying beep will indicate if the fault is present. If the code is not accompanied by a beep, the fault occurred previously.

  NOTE: Faults that are present can not be cleared until the cause of the fault is repaired.

  To clear fault codes, press HRW and FACE simultaneously. Wait 30 seconds for the A/CCM to retest the system and reflag any current faults.

- Press PUSH OFF to return the system to normal operation (default panel settings)

Panel Communication Check

The data link, power, and lighting circuits between the A/CCM and the control panel can be checked by simultaneously holding AUTO and FAN while the ignition is switched to position II. Panel control LEDs will illuminate to indicate that each circuit is OK, as follows:

Circuit	LED
Ignition switched power supply (pos. II) circuit	Defrost button LED
Ignition switched power supply (pos. I, Aux.) circuit	Face button LED
Clock circuit	Bi-level button LED
Start circuit	Foot button LED
Data circuits	Defrost / foot button LED
Panel lighting	Recirc. button LED

NOTES

Actuator Check

The control panel, system actuators and certain components can be checked by simultaneously holding AUTO and FRESH / RECIRC while the ignition is switched to position II.

Control panel

All of the panel control LEDs and LCD segments will flash on and off to indicate that each panel circuit is OK. If a LED does not flash, a fault condition in that area of the panel is indicated, or the LED has failed. If a LCD segment does not flash, a fault condition in that area of the panel is indicated, or the LCD segment has failed.

Actuators and components

Check the actuators by selecting AUTO, then FRESH / RECIRC. Select FACE to cycle through the actuator mode conditions 20 – 27 as shown in the following table. After the check is complete, select PUSH OFF to restore normal system operation.

Actuator check chart

Code	Blower level	Face	Outlet: Foot	Defrost	Cool Air bypass	Fresh / recirc	Compressor	Heater valve	Heater
20	0	open	closed	closed	closed	fresh	OFF	closed	OFF
21	1	open	closed	closed	closed	fresh	OFF	closed	ON
22	10	open	closed	closed	open	1/2 open	A/C ON	closed	ON
23	17	bleed	1/2 open	closed	1/2 open	1/2 open	A/C ON	6 sec. pulse*	ON
24	17	bleed	1/2 open	closed	closed	recirc	A/C ON	6 sec. pulse*	ON
25	23	closed	open	bleed	closed	recirc	A/C ON	open	ON
26	23	closed	1/2 open	1/2 open	closed	recirc	A/C ON	open	ON
27	31	closed	closed	open	closed	open	A/C ON	open	ON

*The heater valve operates on a 6 second pulse (3 seconds ON, 3 seconds OFF)

Control panel diagnostic monitoring

The A/CCM can determine incorrect data by the absence of a minimum number of "high" and "low" bits in each data "block" received or sent. The A/CCM continuously checks the data flow between the A/CCM and the control panel. If consistent incorrect data is detected, a DTC is flagged.

DTCs:	PDU	Panel
	U1263	none
	U1264	none

Refer to the DTC Summary, pages 61 – 64.

NOTES

DTC Summary
Denso Climate Control System

PDU DIAGNOSTIC TROUBLE CODES (DTCs)

Use Toolbox to access the 5-character PDU DTCs.

PANEL FAULT CODES

Use the System Self-Test as described on page 58 to access the 2-digit Panel Fault Codes.

NOTES: PDU DTCs are more definitive than Panel Fault Codes. Use PDU when diagnosing System Faults.
Not all PDU DTCs have equivalent Panel Fault Codes.

PDU	PANEL	CIRCUIT	FAULT DESCRIPTION	POSSIBLE CAUSES
P0335	—	Engine speed input	Vehicle speed input > 50 mph; engine speed = 0	Vehicle speed input circuit between ECM and A/CCM: open circuit, short circuit or high resistance
B1250	11	In-car temperature sensor	In-car temperature sensing circuit fault	In-car temperature sensing circuit: open circuit, high resistance or short circuit to B+ voltage
B1253	11	In-car temperature sensor	In-car temperature sensing circuit fault	In-car temperature sensing circuit: short circuit to ground
B1254	12	Ambient temperature sensor	Ambient temperature sensing circuit fault	Ambient temperature sensing circuit: open circuit, high resistance or short circuit to B+ voltage
B1257	12	Ambient temperature sensor	Ambient temperature sensing circuit fault	Ambient temperature sensing circuit: short circuit to ground
B1258	21	Solar sensor	Solar sensing circuit fault	Solar sensing circuit: open circuit, high resistance or short circuit to B+ voltage
B1260	21	Solar sensor	Solar sensing circuit fault	Solar sensing circuit: short circuit to ground
B1262	44	Defrost servo	Defrost vent position not reached within 30 seconds	Defrost vent servo drive circuit: open circuit, high resistance or short circuit Defrost vent servo failure
B1263	45	Center vent servo	Center vent position not reached within 30 seconds	Center vent servo drive circuit: open circuit, high resistance or short circuit Center vent servo failure
B1264	46	Foot vent servo	Foot vent position not reached within 30 seconds	Foot vent servo drive circuit: open circuit, high resistance or short circuit Foot vent servo failure
B1265	43	Cool air bypass servo	Cool air bypass position not reached within 30 seconds	Cool air bypass servo drive circuit: open circuit, high resistance or short circuit Cool air bypass servo failure
B1266	41	Left fresh / recirc servo	Left fresh / recirc position not reached within 30 seconds	Left fresh / recirc servo drive circuit: open circuit, high resistance or short circuit Left fresh / recirc servo failure
B1267	42	Right fresh / recirc servo	Right fresh / recirc position not reached within 30 seconds	Right fresh / recirc servo drive circuit: open circuit, high resistance or short circuit Right fresh / recirc servo failure
B1268	34	Defrost feedback potentiometer	Defrost feedback potentiometer sensing (wiper) circuit fault	Defrost feedback potentiometer sensing circuit: open circuit, high resistance or short circuit to B+ voltage
B1271	34	Defrost feedback potentiometer	Defrost feedback potentiometer sensing (wiper) circuit fault	Defrost feedback potentiometer sensing circuit: short circuit to ground
B1272	35	Center vent feedback potentiometer	Center vent potentiometer sensing (wiper) circuit fault	Center vent potentiometer sensing circuit: open circuit, high resistance or short circuit to B+ voltage
B1275	35	Center vent feedback potentiometer	Center vent potentiometer sensing (wiper) circuit fault	Center vent feedback potentiometer sensing circuit: short circuit to ground

PDU	PANEL	CIRCUIT	FAULT DESCRIPTION	POSSIBLE CAUSES
B1276	36	Foot vent feedback potentiometer	Foot vent potentiometer sensing (wiper) circuit fault	Foot vent potentiometer sensing circuit: open circuit, high resistance or short circuit to B+ voltage
B1279	36	Foot vent feedback potentiometer	Foot vent potentiometer sensing (wiper) circuit fault	Foot vent potentiometer sensing circuit: short circuit to ground
B1280	33	Cool air bypass feedback potentiometer	Cool air bypass potentiometer sensing (wiper) circuit fault	Cool air bypass potentiometer sensing circuit: open circuit, high resistance or short circuit to B+ voltage
B1283	33	Cool air bypass feedback potentiometer	Cool air bypass potentiometer sensing (wiper) circuit fault	Cool air bypass potentiometer sensing circuit: short circuit to ground
B1284	31	Left fresh / recirc feedback potentiometer	Left fresh / recirc potentiometer sensing (wiper) circuit fault	Left fresh / recirc potentiometer sensing circuit: open circuit, high resistance or short circuit to B+ voltage
B1287	31	Left fresh / recirc feedback potentiometer	Left fresh / recirc potentiometer sensing (wiper) circuit fault	Left fresh / recirc potentiometer sensing circuit: short circuit to ground
B1288	32	Right fresh / recirc feedback potentiometer	Right fresh / recirc potentiometer sensing (wiper) circuit fault	Right fresh / recirc potentiometer sensing circuit: open circuit, high resistance or short circuit to B+ voltage
B1291	32	Right fresh / recirc feedback potentiometer	Right fresh / recirc potentiometer sensing (wiper) circuit fault	Right fresh / recirc potentiometer sensing circuit: short circuit to ground
B1292	—	B+ power supply (via A/C Isolate relay)	B+ power supply circuit fault between A/C Isolate relay and A/CCM	B+ circuit between A/C Isolate relay and A/CCM: open circuit or high resistance
B1294	—	B+ power supply (via A/C Isolate relay)	B+ power supply circuit fault between A/C Isolate relay and A/CCM	B+ circuit between A/C Isolate relay and A/CCM: short circuit to ground
B1297	—	Sensor 5 volt reference voltage	Sensor 5 volt reference voltage circuit fault	Sensor 5 volt reference voltage circuit: open circuit or short circuit to B+ voltage
B1298	—	Sensor 5 volt reference voltage	Sensor 5 volt reference voltage circuit fault	Sensor 5 volt reference voltage circuit: short circuit to ground
B1299	—	Sensor 5 volt reference voltage	Sensor 5 volt reference voltage circuit fault	Sensor 5 volt reference voltage circuit: high resistance
B1355	—	B+ power supply	B+ power supply circuit fault	B+ power supply circuit: open circuit or short circuit to ground
B1849	24	Face vent differential temperature control	Face vent differential temperature control potentiometer circuit fault	Face vent differential temperature potentiometer circuit: open circuit, high resistance or short circuit to B+ voltage
B1852	24	Face vent differential temperature control	Face vent differential temperature control potentiometer circuit fault	Face vent differential temperature potentiometer circuit: short circuit to ground
B1853	—	Aspirator motor	Aspirator motor circuit fault	Aspirator motor circuit: open circuit or high resistance Aspirator motor failure
B1856	—	Aspirator motor	Aspirator motor circuit fault	Aspirator motor circuit short circuit to ground
B1857	—	Ignition switched (Pos I, Aux) ground signal	Ignition switched ground signal circuit fault	Ignition switched ground signal circuit open circuit or high resistance
B1858	23	Refrigerant dual pressure switch	Refrigerant dual pressure switch circuit fault	Refrigerant charge low Refrigerant dual pressure switch circuit: open circuit, high resistance or short circuit to B+ voltage High engine temperature in high ambient temperature

PDU	PANEL	CIRCUIT	FAULT DESCRIPTION	POSSIBLE CAUSES
B1861	23	Refrigerant dual pressure switch	Refrigerant dual pressure switch circuit fault	Refrigerant dual pressure switch circuit: short circuit to ground
B1862	22	Compressor lock sensor	Compressor lock; Compressor lock sensing circuit fault	Slipping compressor drive belt Compressor lock Compressor lock sensing circuit: open circuit or short circuit to ground or B+ voltage
B1863	—	Sensor signal ground	Sensor signal ground circuit fault	Sensor signal ground circuit open circuit
B1946	13	Evaporator temperature sensor	Evaporator temperature sensing circuit fault	Evaporator temperature sensing circuit: open circuit, high resistance or short circuit to B+ voltage
B1947	13	Evaporator temperature sensor	Evaporator temperature sensing circuit fault	Evaporator temperature sensing circuit: short circuit to ground
B1948	14	Coolant temperature signal	Coolant temperature signal circuit fault between instrument pack and A/CCM	Signal circuit between instrument pack and A/CCM: open circuit, high resistance or short circuit to B+ voltage
B1949	14	Coolant temperature signal	Coolant temperature signal circuit fault between instrument pack and A/CCM	Signal circuit between instrument pack and A/CCM: short circuit to ground
B1966	15	Heater matrix air temperature sensor	Heater matrix air temperature sensing circuit fault	Heater matrix air temperature sensing circuit: open circuit, high resistance or short circuit to B+ voltage
B1967	15	Heater matrix air temperature sensor	Heater matrix air temperature sensing circuit fault	Heater matrix air temperature sensing circuit: short circuit to ground
B1968	—	Heater pump	Heater pump motor ground circuit fault	Heater pump motor ground circuit: open circuit Heater pump motor locked
B1969	—	Compressor clutch feedback	Compressor clutch circuit fault	Compressor clutch feedback circuit: open circuit o short circuit to ground Compressor clutch request circuit between A/CCM and ECM: open circuit or short circuit to ground Compressor clutch relay drive circuit between ECM and relay: open circuit or short circuit to ground Compressor clutch activate circuit between relay and clutch: open circuit or short circuit to ground Compressor clutch relay failure Compressor clutch failure
U1263	—	Control panel serial communication	Control panel serial communication circuit fault	Control panel to A/CCM circuit (data input CC30-7, clock, start): open circuit or short circuit Control panel failure A/CCM failure
U1264	—	Control panel serial communication	Control panel serial communication circuit fault	Control panel to A/CCM circuit (data output CC30-3): open circuit or short circuit Control panel failure A/CCM failure