

AIR CONDITIONING

■ DESCRIPTION

- The automatic air conditioning using multi-zone automatic climate control and neural network control is standard equipment.
- A multi-zone automatic climate control independently regulates the outlet air temperatures for the following four zones: the driver seat, the front passenger seat, the right side of the rear No. 1 and No. 2 seats, and the left side of the rear No. 1 and No. 2 seats. This offers comfortable space for all occupants.
- For further comfort enhancement for rear passengers, the rear air conditioning unit is provided.
- The air conditioning system has the following features:

Item	Features
High Performance	<ul style="list-style-type: none"> ● Neural network control is used so passengers can control the air conditioning accurately for maximum comfort. ● The up/down independent temperature control is used to achieve further comfort. The up/down independent temperature control adjusts the difference in temperature of the air blown over the upper body and lower body based on signals from the solar sensor. ● Automatic FOOT/DEF mode control is used to improve defroster performance. ● The sub-cool accelerator system has been provided. This system consists of inner and outer pipes, and is capable of improving the cooling performance because of its effective heat exchanging design. ● A pollen removal type, which has a pollen removal effect, is used as the clean air filter. ● The blower control has 9 steps to allow precise control.
Lightweight	A BUS connector with a built-in IC is used in a lightweight wire harness design to allow a reduced number of wires. The use of this connector means that pulse pattern type servomotors are used.
Others	<p>The following parts are used to ensure high cooling performance while realizing a compact and lightweight construction.</p> <ul style="list-style-type: none"> ● Semi-center location air conditioning unit ● RS (Revolutionary super-slim Structure) evaporator ● SFA (Straight Flow Aluminum)-II heater radiator ● MF (Multi-Flow)-IV sub-cool condenser

■ PERFORMANCE AND SPECIFICATION

1. Performance

► Front Air Conditioning Unit ◀

Heater	Heater Output	W	5400
	Air Flow Volume	m ³ /h	330
	Power Consumption	W	220
Air Conditioning	Cooling Capacity	W	6200
	Air Flow Volume	m ³ /h	570
	Power Consumption	W	300

► Rear Air Conditioning Unit ◀

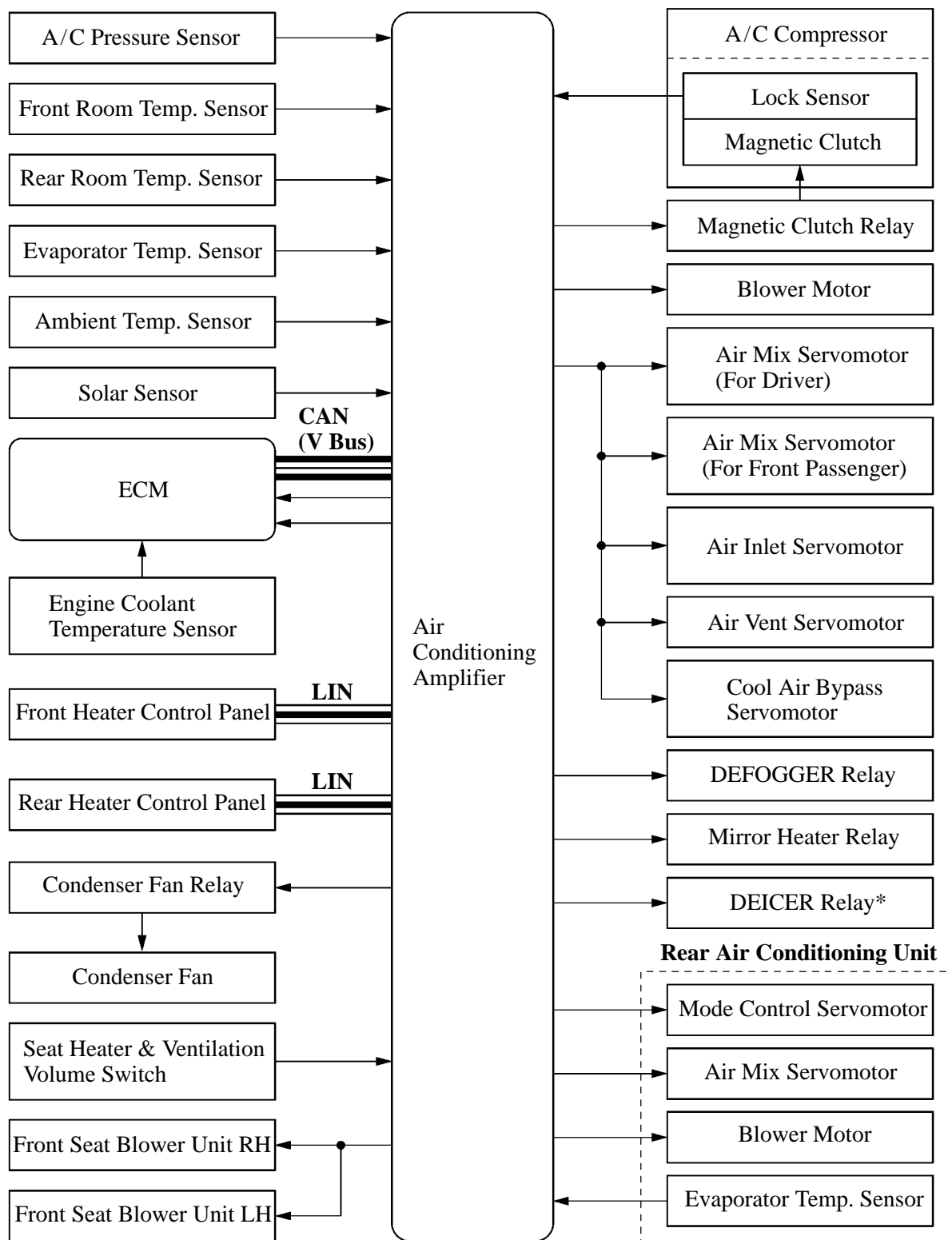
Heater	Heat Output	W	4000
	Air Flow Volume	m ³ /h	260
	Power Consumption	W	200
Air Conditioning	Cooling Capacity	W	3600
	Air Flow Volume	m ³ /h	360
	Power Consumption	W	200

2. Specification

Ventilation and Heater Radiator	Heater Radiator	Front	Type	SFA (Straight Flow Aluminum)-II
			Size W × H × L mm (in.)	263.9 × 100 × 27 (10.4 × 3.9 × 1.06)
			Fin Pitch mm (in.)	1.5 (0.06)
		Rear	Type	SFA (Straight Flow Aluminum)-II
			Size W × H × L mm (in.)	191.1 × 130 × 21 (7.5 × 5.1 × 0.8)
			Fin Pitch mm (in.)	1.8 (0.07)
	Blower	Front	Fan Type	Semi Sirocco
			Fan Size Dia. × H mm (in.)	165 × 70 (6.5 × 2.8)
		Rear	Fan Type	High Pressure Drop Type
			Fan Size Dia. × H mm (in.)	140 × 70 (5.5 × 2.8)

Air Conditioning	Condenser		Type	MF (Multi-Flow)-IV
			Size W × H × L mm (in.)	640 × 511 × 16 (25.2 × 20.1 × 0.6)
			Fin Pitch mm (in.)	3.15 (0.12)
	Evaporator	Front	Type	RS (Revolutionary super-slim Structure)
			Size W × H × L mm (in.)	293.1 × 215 × 50 (11.5 × 8.5 × 2.0)
			Fin Pitch mm (in.)	3.0 (0.12)
		Rear	Type	RS (Revolutionary super-slim Structure)
			Size W × H × L mm (in.)	145.7 × 255 × 50 (5.7 × 10 × 2.0)
			Fin Pitch mm (in.)	3.4 (0.13)
	A/C Compressor		Type	10SR19C
			Pulley	Steel with Magnetic Clutch
	Refrigerant		Type	HFC 134a
			Charge Volume g	890 ± 30

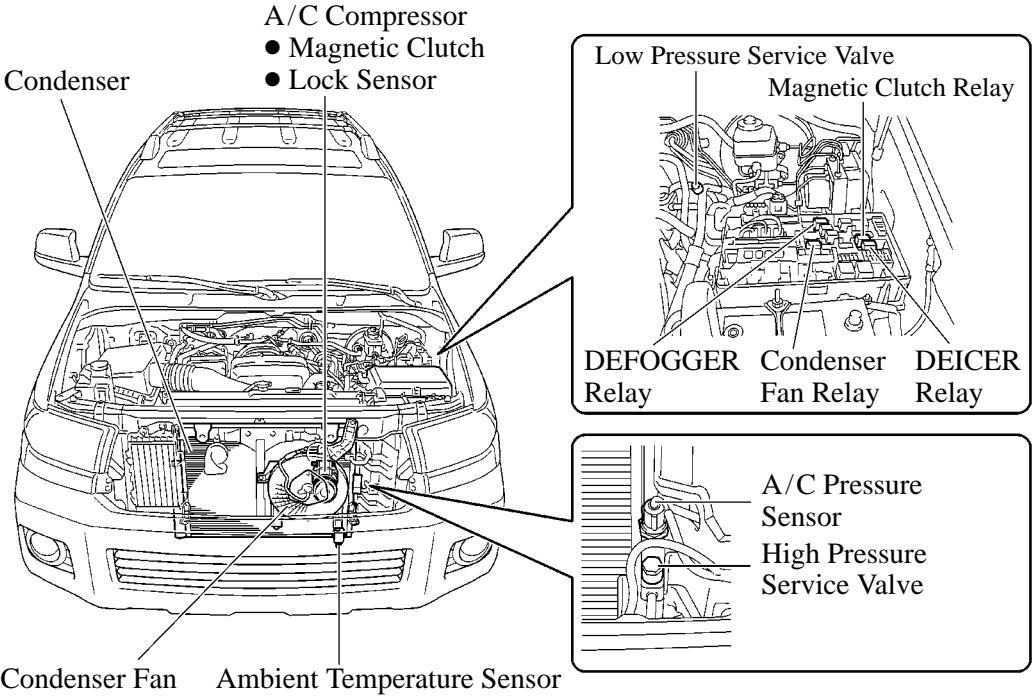
SYSTEM DIAGRAM



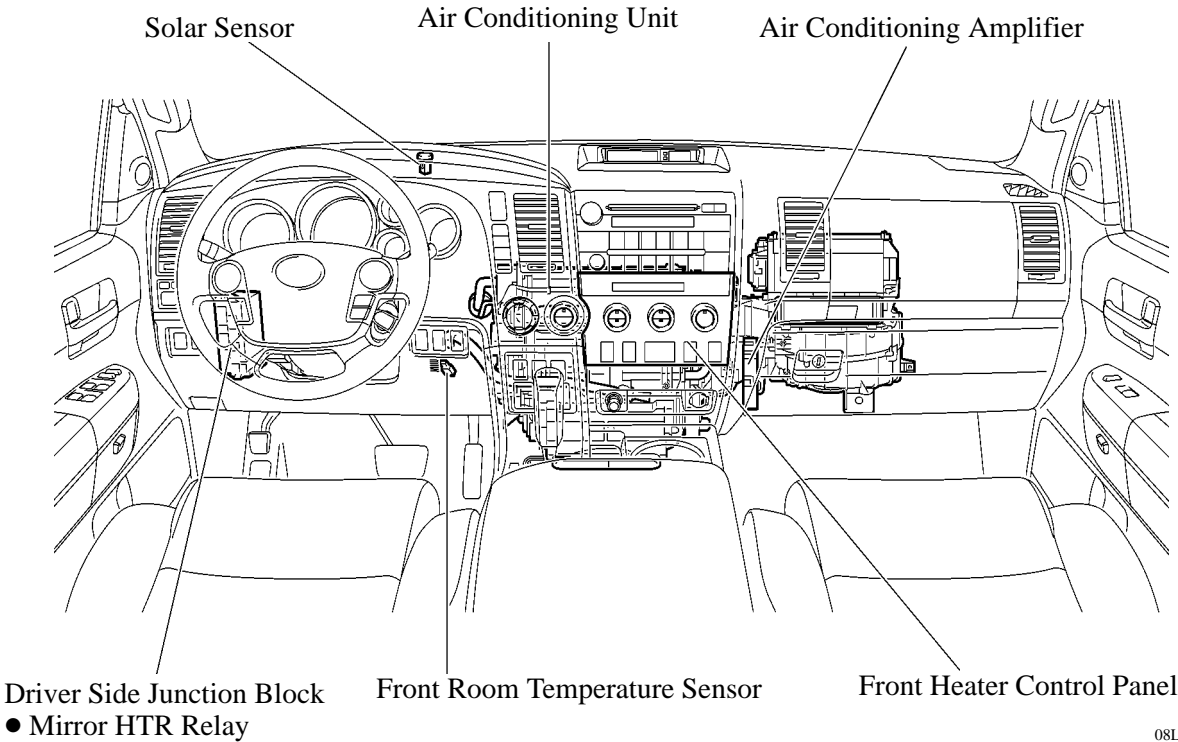
*: Optional Equipment

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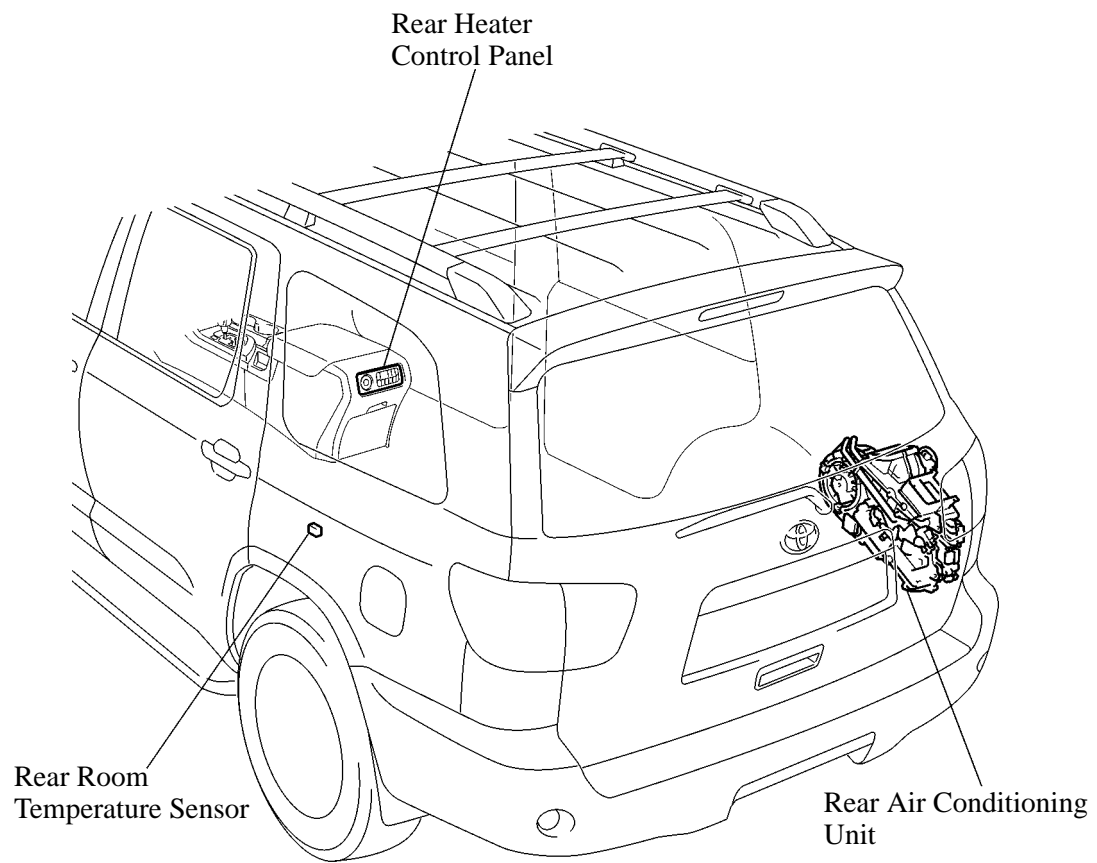
■ LAYOUT OF MAIN COMPONENTS



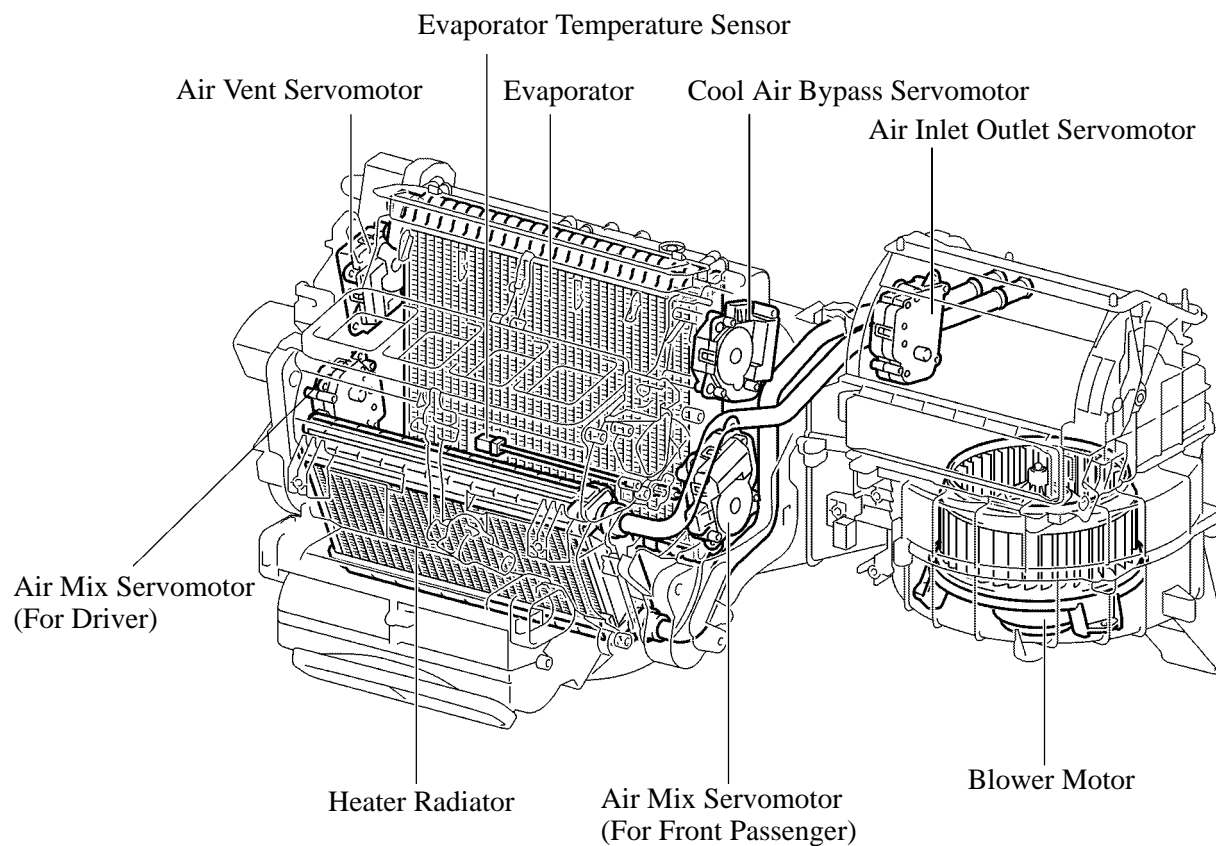
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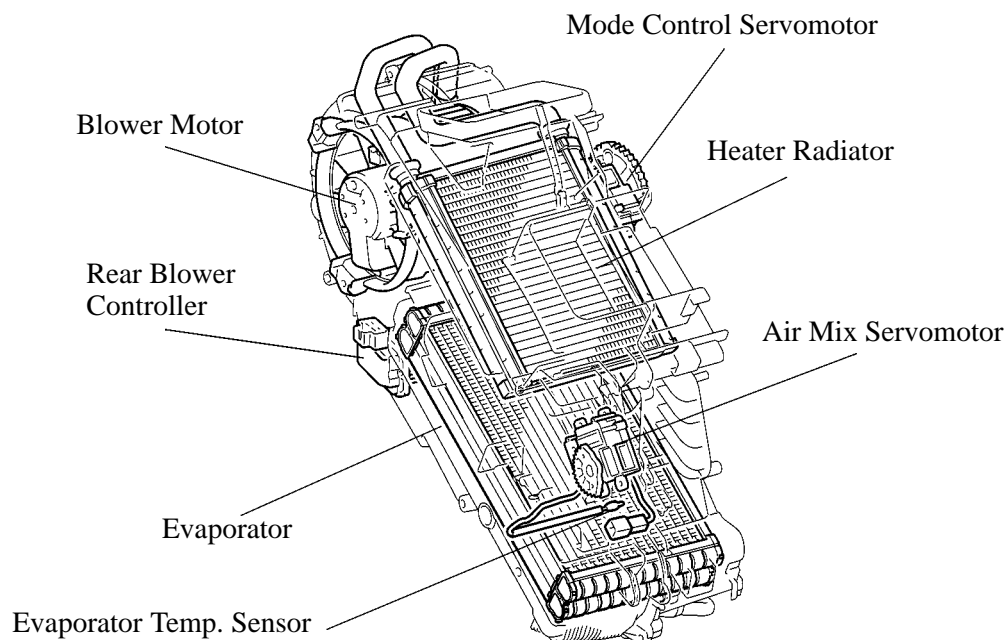
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**Front Air Conditioning Unit**

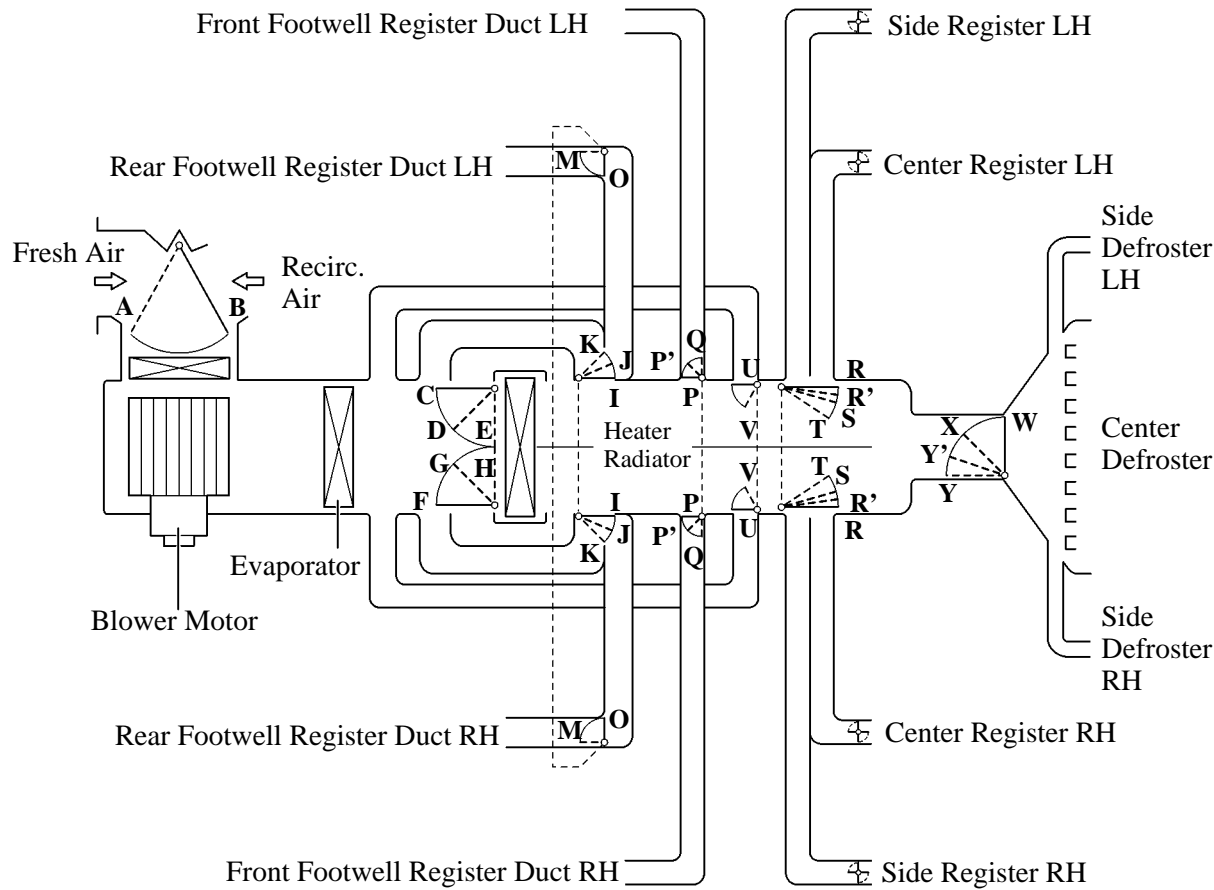
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**Rear Air Conditioning Unit**

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■ MODE POSITION AND DOOR OPERATION






► Front Air Conditioning ◀



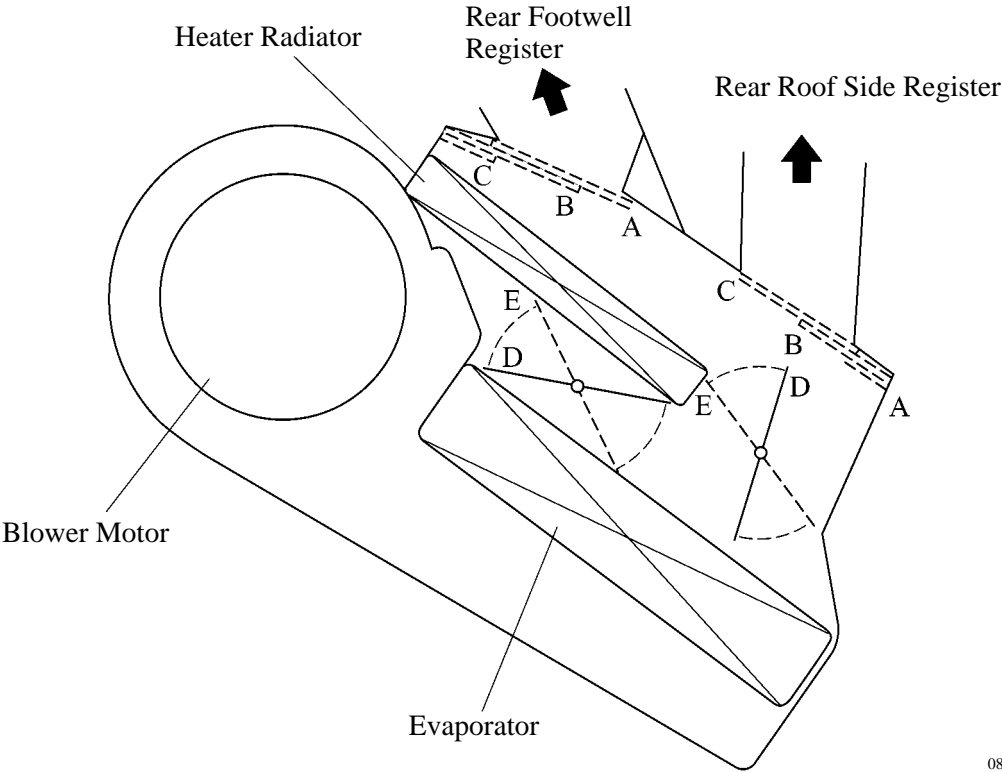
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-----: For ease of understanding, some of the overlapped parts are connected by this line.

► Function of Main Damper ◀




Control Damper	Operation Position	Damper Position	Operation
Air Inlet Control Damper	FRESH	B	Brings in fresh air.
	RECIRC	A	Recirculates internal air.
Air Mix Control Damper	MAX COLD to MAX HOT Temperature Setting	C – E, F – H, I – K	Varies the mixture ratio of the fresh air and recirculation air in order to regulate the temperature continuously between HOT and COLD.
Cool-air Bypass Damper	MAX COLD to MAX HOT Temperature Setting	U, V	Cool air blows out of the center register and side registers in order to adjust the temperature around the head of the occupant during cooling or warming.
Air Vent Control Damper	 FACE 187BE24	O, P, T, W	Air blows out of the center register, side registers, and footwell register ducts.
	 BI-LEVEL 187BE25	M, P', S, W	Air mainly blows out of the center register, side register, and footwell register ducts.
	 FOOT 187BE26	M, Q, R', X	Air mainly blows out of the front and rear footwell register ducts. In addition, air blows out slightly from the front and side defrosters, center register and side register.
	 FOOT/DEF 187BE27	M, P', R', Y'	Air mainly blows out of the front and side defrosters to defrost the windshield; air also blows out from the front and rear footwell register ducts, center register and side register.
	 DEF 187BE28	O, P, R, Y	Air blows out of the front and side defrosters and side registers to defrost the windshield.

► Rear Air Conditioning ◀



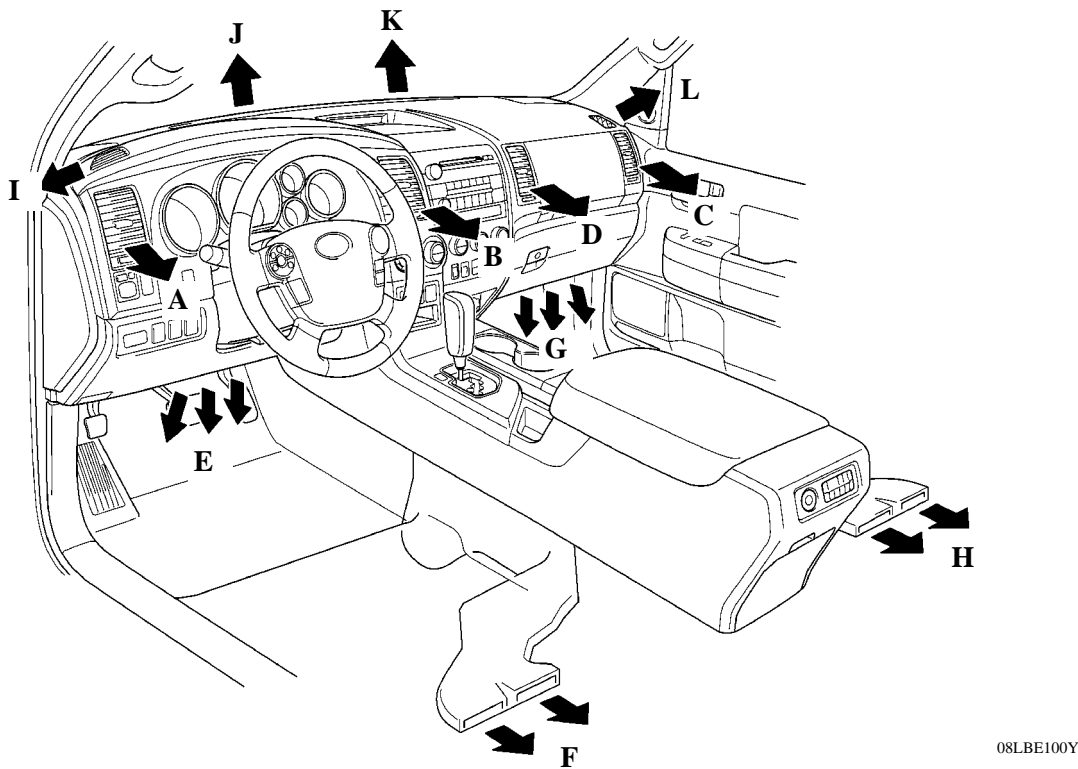
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
► Function of Main Damper ◀

Control Damper	Operation Position	Damper Position	Operation
Mode Control Damper	 187BE24 FACE	A	Air blows out of the rear roof side register.
	 187BE25 BI-LEVEL	B	Air blows out of the rear roof side register and the rear footwell register.
	 187BE26 FOOT	C	Air blows out of the rear footwell register.
Air Mix Control Damper	MAX COLD to MAX HOT Temp. Setting	D-E	Varies the mixture ratio of the cold air and the hot air in order to regulate the temperature continuously from HOT to COLD.

■ AIR OUTLETS AND AIRFLOW VOLUME

1. Front Registers



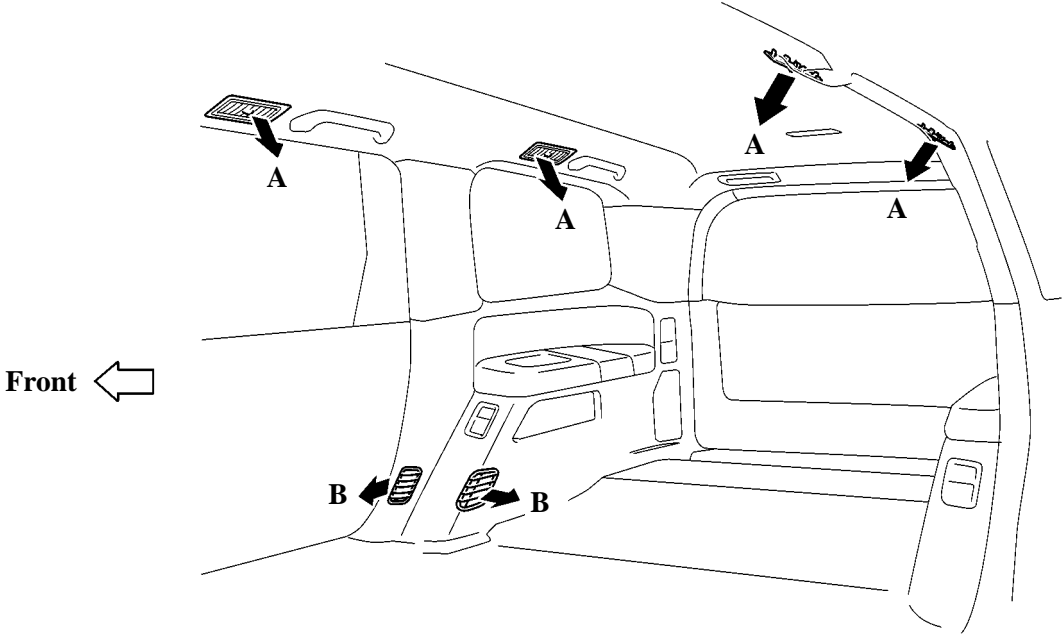
MODE		Selection	FACE				FOOT				DEF			
			Driver		Passenger		Driver		Passenger		Driver		Passenger	
			Side	Center	Side	Center	Front	Rear	Front	Rear	Side	Front	Front	Side
		Auto	A	B	C	D	E	F	G	H	I	J	K	L
	FACE1	○	◯	◯	◯	◯	—	—	—	—	—	—	—	—
	FACE2	○	◯	◯	◯	◯	◦	◦	◦	◦	—	—	—	—
	B/L	○	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
	FOOT-D*1	○	◦	◦	◦	◦	◯	◯	◯	◯	◦	◦	◦	◦
	FOOT-R*2	○	◦	◦	◦	◦	◯	◯	◯	◯	◦	◦	◦	◦
	FOOT-F	○	◦	◦	◦	◦	◯	◯	◯	◯	◦	◦	◦	◦
	F/D	○	◦	◦	◦	◦	◯	◦	◯	◦	◦	◯	◯	◦
	DEF	○	—	—	—	—	—	—	—	—	◯	◯	◯	◯

The size of the circle ○ indicates the proportion of airflow volume.

*1: DEF airflow volume has increased and window anti-fogging performance has enhanced.

*2: Heating for the rear seats during cold season has improved.

2. Rear Registers



INDICATION	MODE	A	B
	FACE	○	—
	BI-LEVEL	○	○
	FOOT	—	○

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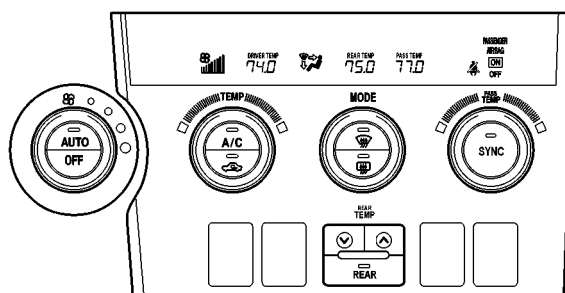
The size of the circle ○ indicates the proportion of airflow volume.

■ CONSTRUCTION AND OPERATION

1. Heater Control Panel

Front Heater Control Panel

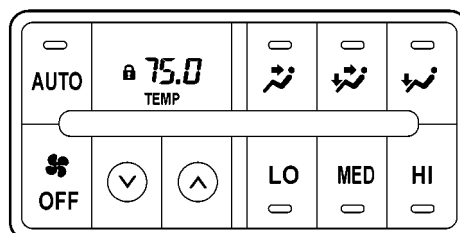
- An electric heater control panel is used.
- The front heater control panel has large switches and knobs, improving ease of use and visibility.



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Rear Heater Control Panel

- The set temperature for rear seats and the operation mode for the rear air conditioning can be adjusted by individually operating the switches arranged on the rear heater control panel located behind the center console.
- The set temperature for the rear air conditioning zone is displayed on the LCD (Liquid Crystal Display) of the rear heater control panel.

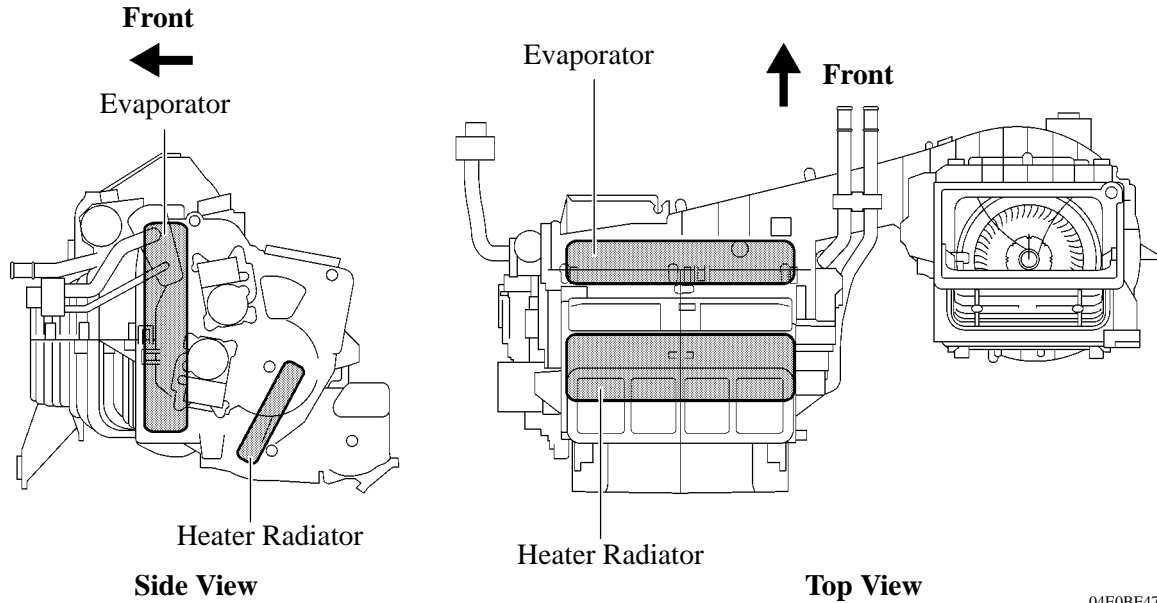


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2. Front Air Conditioning Unit

General

A semi-centrally located air conditioning unit, in which the evaporator and heater radiator are mounted transversely, is used. As a result, the air conditioning unit is made compact and lightweight.

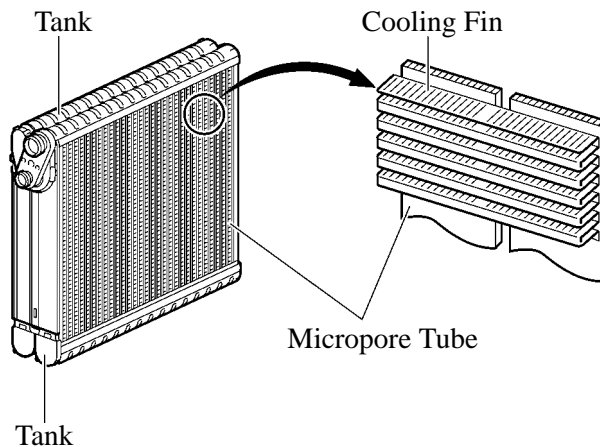


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Evaporator

An RS (Revolutionary super-slim Structure) type evaporator is used. Placing the tanks at the top and the bottom of the evaporator and adopting a micropore tube construction have realized the following effects:

- The heat exchange efficiency is improved.
- The temperature distribution is made more uniform.
- The evaporator is made thinner. 90 mm (3.5 in.) → 50 mm (2.0 in.)



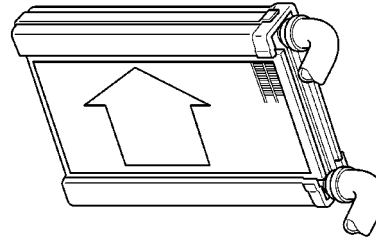
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Evaporator Temperature Sensor

The evaporator temperature sensor detects the temperature of the cool air immediately past the evaporator in the form of resistance changes, and outputs it to the air conditioning amplifier.

Heater Radiator

A compact, lightweight, and highly efficient SFA (Straight Flow Aluminum)-II type heater radiator is used.



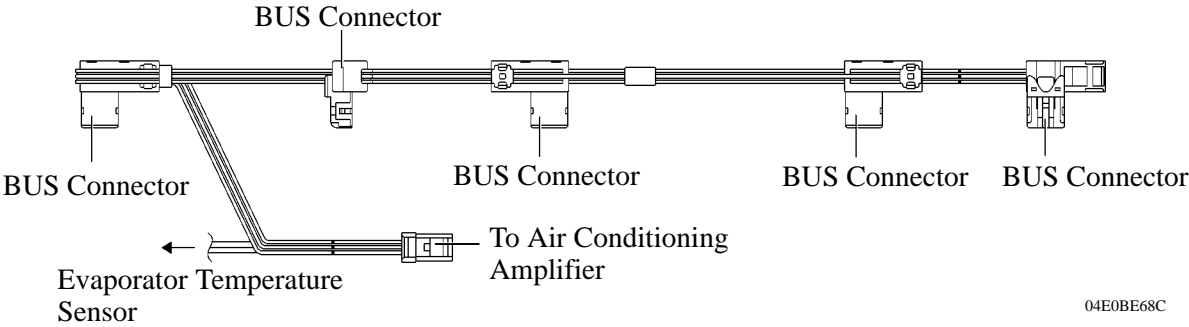
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Blower Motor

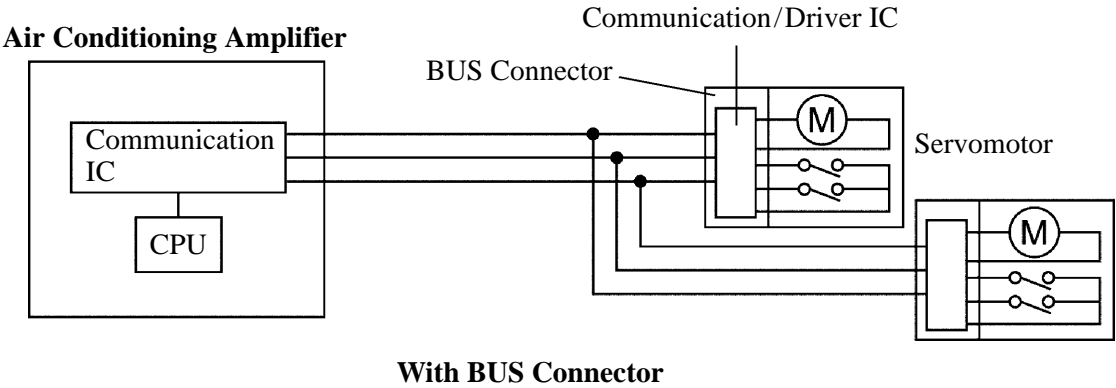
The blower motor has a built-in blower controller, and is controlled using duty control performed by the air conditioning amplifier.

BUS Connector

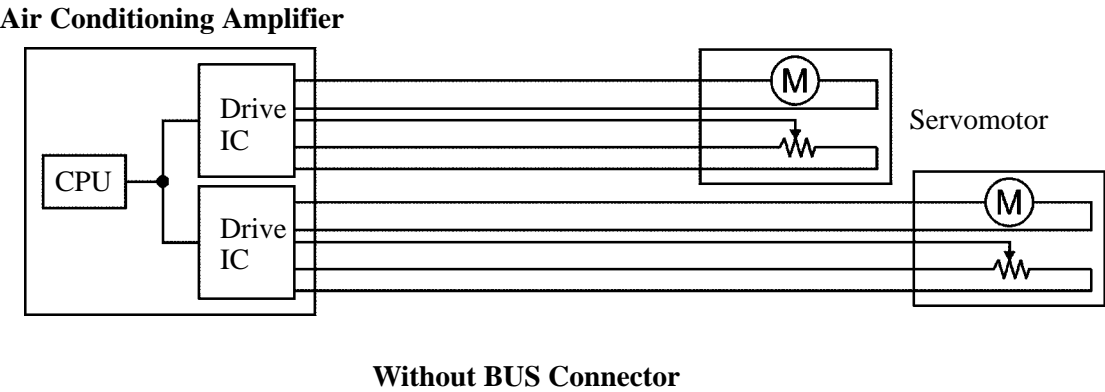
A BUS connector is used in the wire harness connection that connects the servomotor from the air conditioning amplifier.



The BUS connector has a built-in communication/driver IC which communicates with each servomotor connector, actuates the servomotor, and has a position detection function. This enables bus communication for the servomotor wire harness to realize a more lightweight construction and a reduced number of wires.



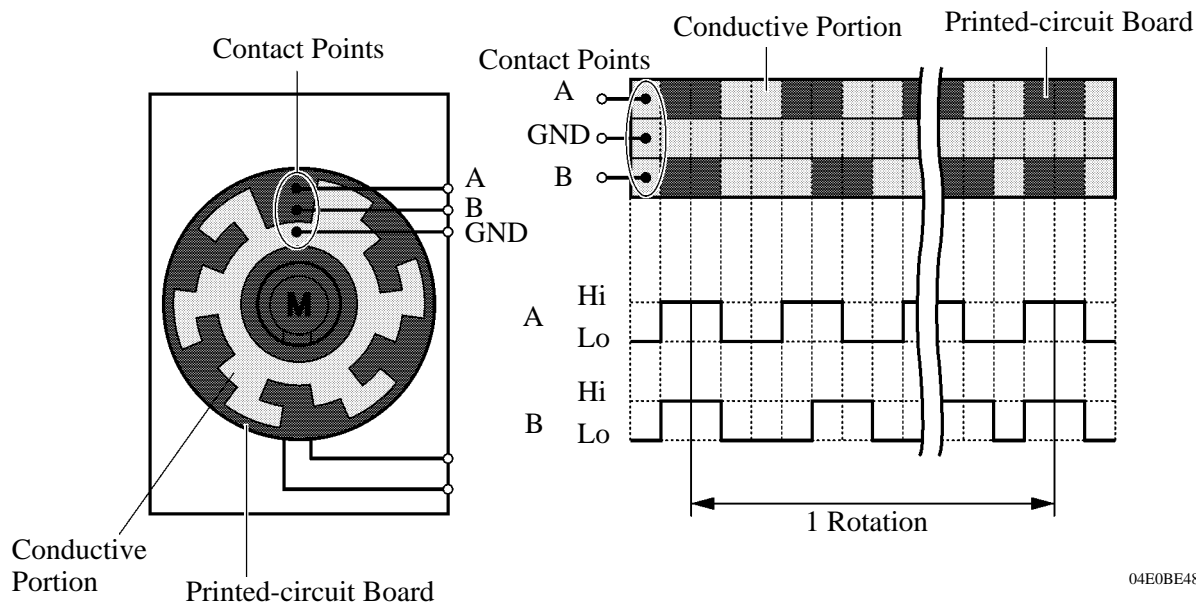
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Servomotor

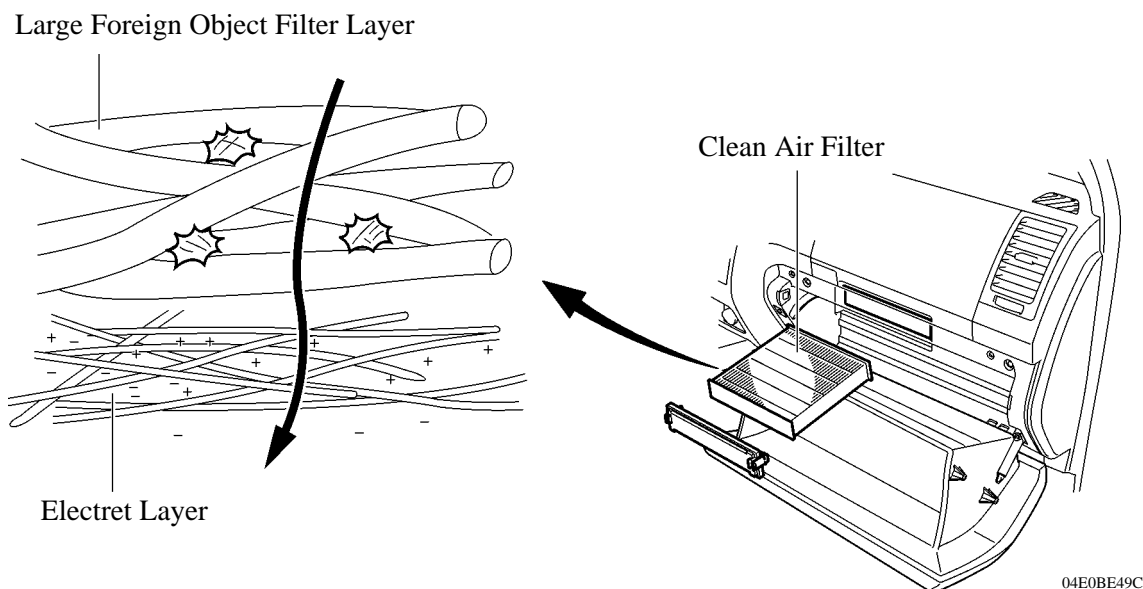
The pulse pattern type servomotor consists of a printed circuit board and a servomotor. The printed circuit board has three contact points, and can transmit two ON-OFF signals to the air conditioning amplifier based on the difference of the pulse phases. The BUS connector can detect the damper position and movement direction with this signal.



Clean Air Filter

A high efficiency type clean air filter is used. This filter excels in the removal of dust and pollen. The filter is made of polyester.

Because the filter is made of polyester, it can be disposed of easily as a non-hazardous combustible material, which is a feature that is provided in consideration of the environment.

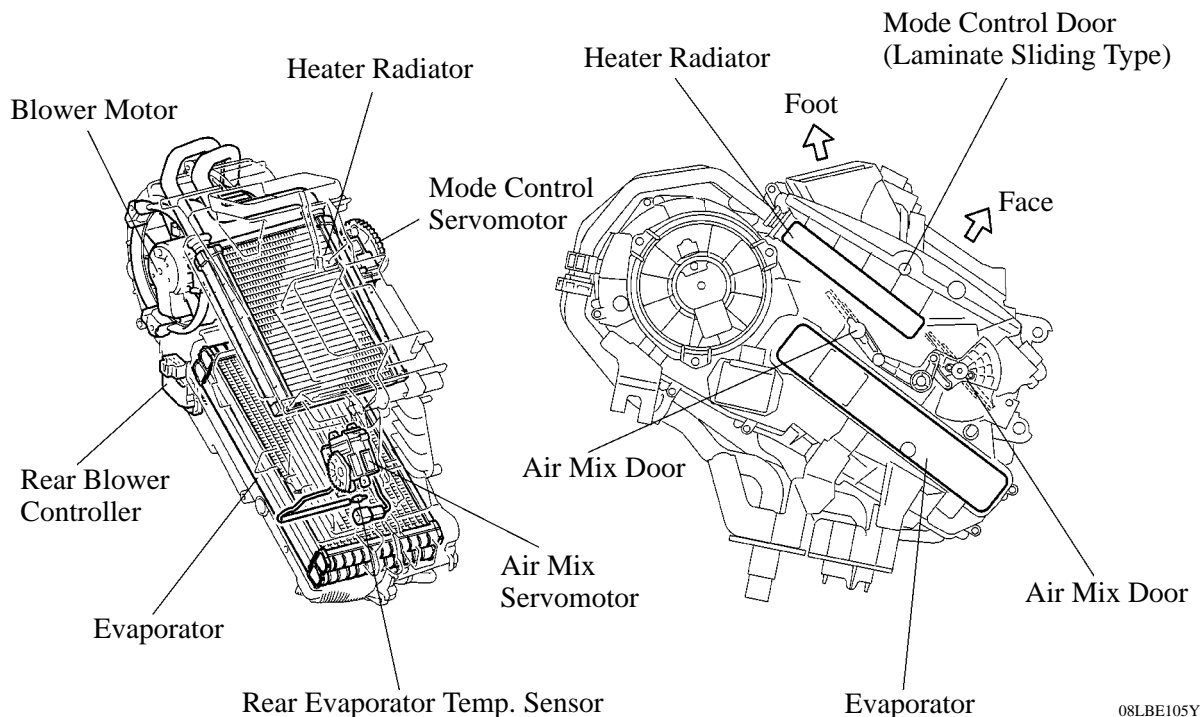


Service Tip

The replacement interval for the clean air filter is 50000 km/h (30000 miles). However, observation of these guidelines should depend on the usage conditions (or environment).

3. Rear Air Conditioning Unit

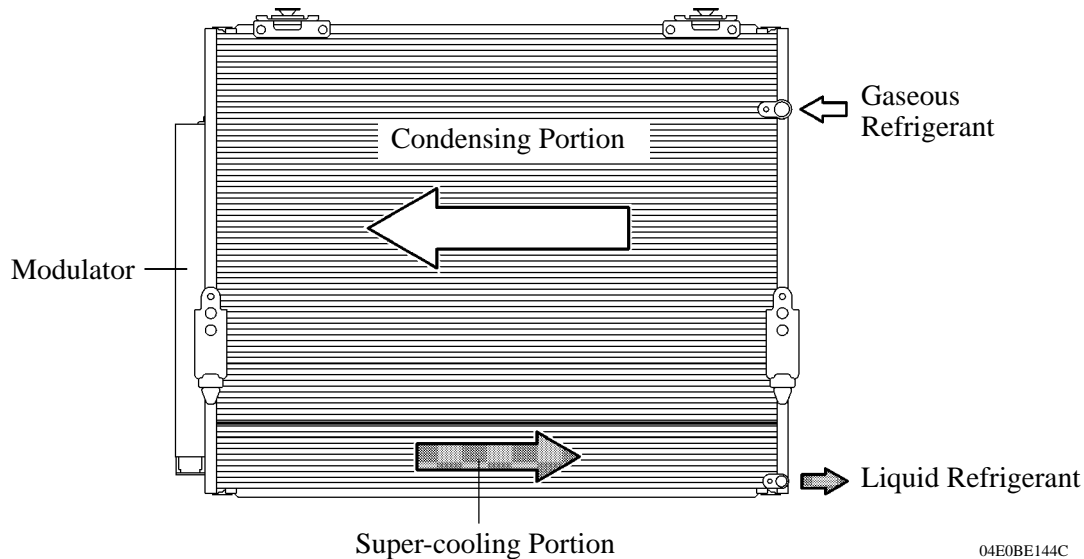
- The rear air conditioning unit is located in the right quarter trim.
- The rear air conditioning unit consists of the evaporator, heater radiator, air mix servomotor, mode control servomotor, evaporator temperature sensor, rear blower controller and rear blower motor.
- The evaporator and heater radiator are arranged horizontally to allow the airflow to be directed smoothly upward.
- The mode control servomotor operates the laminate sliding type mode control door, and the air mix servomotor controls the full air mix type air mix doors.
- The evaporator has the same RS (Revolutionary super-slim Structure) as the front evaporator. For details regarding the evaporator, see page BE-57.
- The heater radiator has the same SFA (Straight Flow Aluminum)-II type as the front heater radiator. For details regarding the heater radiator, see page BE-58.
- The evaporator temperature sensor detects the temperature of the cool air immediately past the evaporator in the form of resistance changes, and outputs it to the air conditioning amplifier.
- As in the front air conditioning unit, the servomotor fitted to the rear air conditioning unit is connected to the air conditioning amplifier with the BUS connector due to the lightweight construction and a reduced number of wires. For details regarding the BUS connector, see page BE-59.
Furthermore, the pulse pattern type is used for both the front and rear air conditioning units. For details regarding the servomotor, see page BE-60.
- The porous duct excellent in sound absorption property is provided in the air inlet duct to improve quietness in the cabin. The cross section of the porous duct consists of three layers. The inner polyethyleneterephthalate layer absorbs noises produced by the air conditioning unit, the central layer prevents the leakage of odor in the cabin, and the outer felt holds the duct shape.



4. Condenser

An MF (Multi-Flow) type condenser is used. The condenser consists of three portions: a condensing portion, a super-cooling portion, and a gas-liquid separator (modulator) are integrated together. This condenser uses a sub-cool cycle that offers excellent heat-exchange performance.

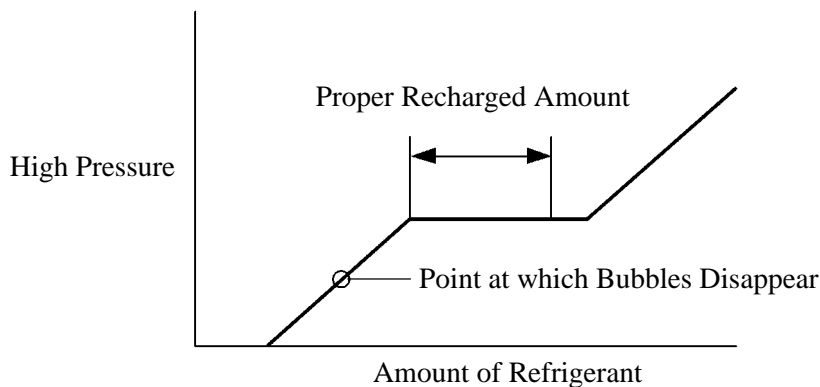
- In the sub-cool cycle, after the refrigerant passes through the condensing portion of the condenser, both the liquid refrigerant and the gaseous refrigerant that could not be liquefied are cooled again in the super-cooling portion. Thus, the refrigerant is sent to the evaporator in an almost completely liquefied state.



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Service Tip

The point at which the air bubbles disappear in the refrigerant of the sub-cool cycle is lower than the proper amount of refrigerant with which the system must be filled. Therefore, if the system is recharged with refrigerant based on the point at which the air bubbles disappear, the amount of refrigerant would be insufficient. As a result, the cooling performance of the system would be affected. If the system is overcharged with refrigerant, this will also lead to reduced performance. For the proper method of verifying the amount of the refrigerant and for instructions on how to recharge the system with refrigerant, see the 2008 Sequoia Repair Manual (Pub. No. RM08L0U).



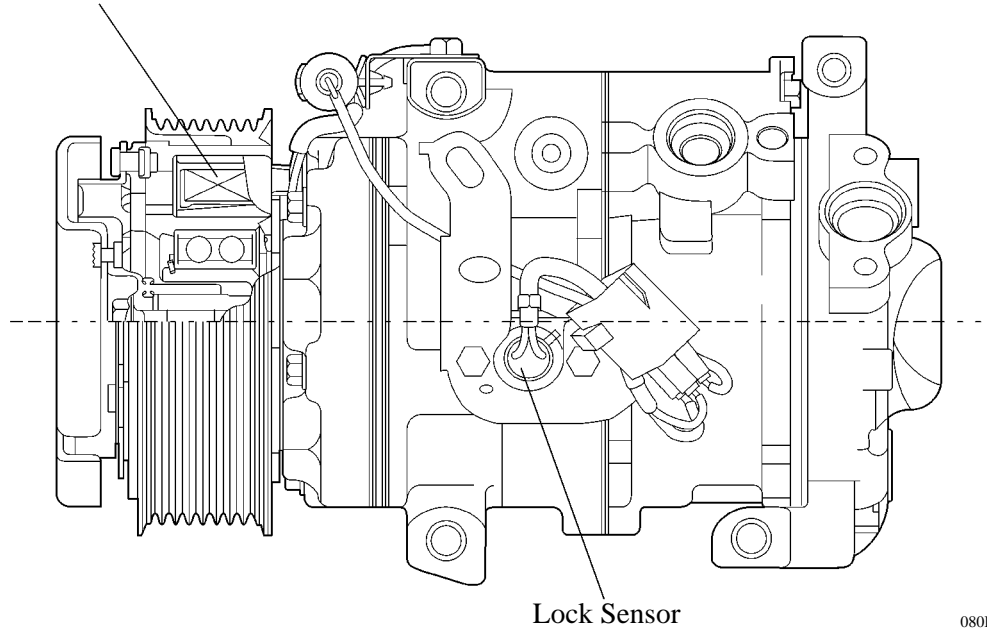
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5. A/C Compressor

General

- A 10SR19C A/C compressor has been provided, which features a compact, lightweight and low-noise swash plate design.
- The A/C compressor consists of the A/C pulley, shaft, lug plate, swash plate, piston, shoe, crank chamber, cylinder, and lock sensor.
- The lock sensor sends an A/C compressor speed signal to the ECM. The ECM compares this signal with an engine speed signal sent from the crankshaft position sensor. If the ECM determines that the A/C pulley has locked, the ECM turns the magnetic clutch off.
- A rotary valve capable of directing suction refrigerant into the cylinder has been provided.

Pulley with Magnetic Clutch

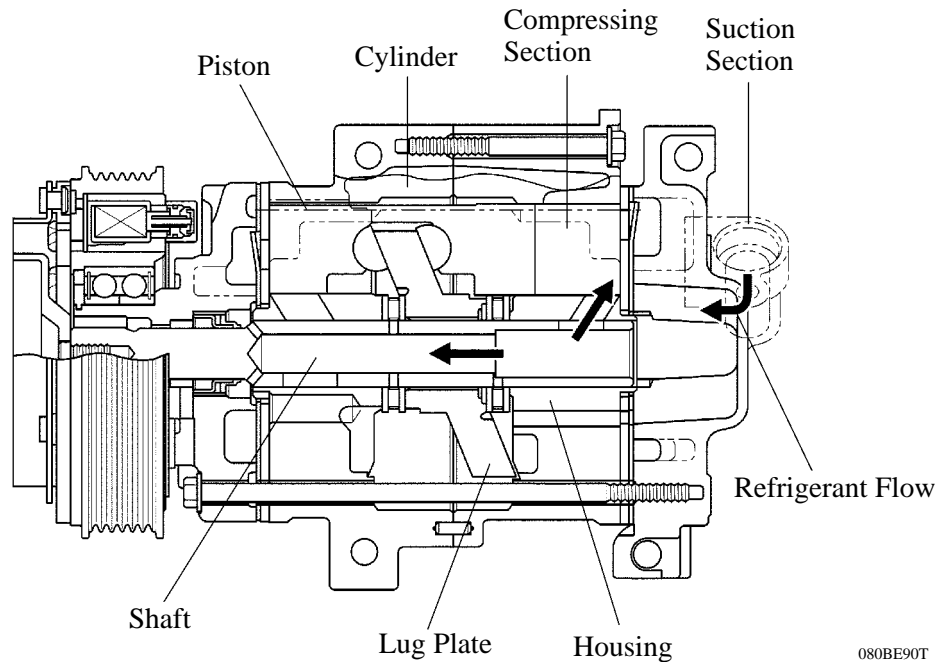


Lock Sensor

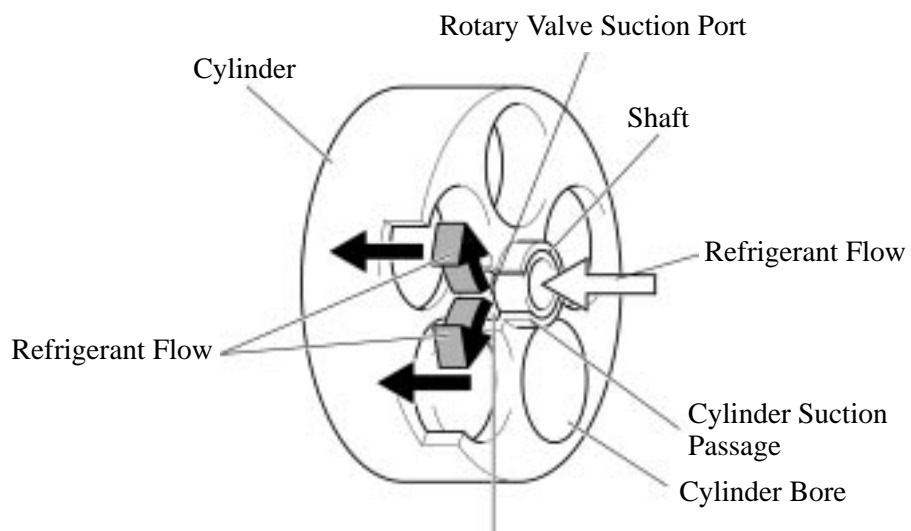
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Rotary Valve

- In order to eliminate suction loss, the rotary valve has been replaced with a conventional suction valve.
- A hollow shaft is used in the valve so as to allow refrigerant to be sucked into the compressing section of the cylinder through the hollow section. Holes individually arranged on the shaft and cylinder are designed to align during the rotation of the shaft. When the holes are aligned, refrigerant is sucked into the compressing section.



► Image of Valve Operational Behavior During Suction ◀



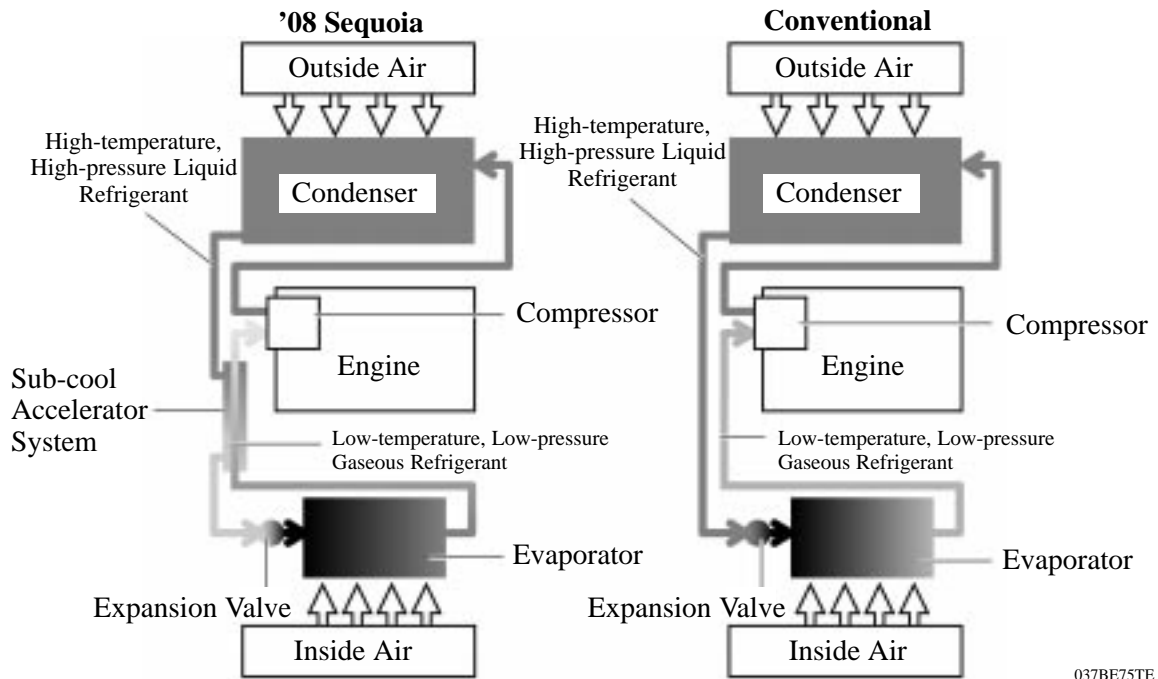
The position where the rotary valve suction port and cylinder suction passage become aligned

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6. Sub-cool Accelerator (Double-pipe Internal Heat Exchanger) System

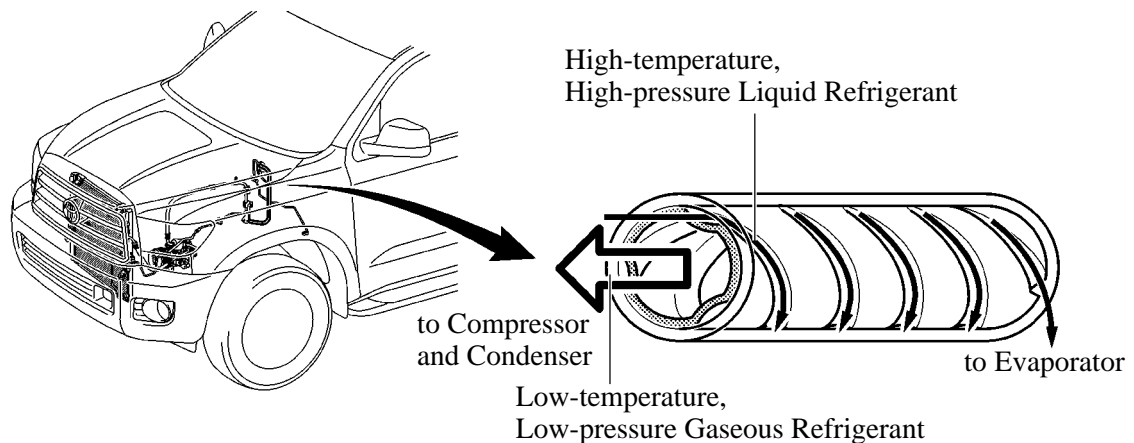
General

- A sub-cool accelerator (double-pipe internal heat exchanger) system has been provided. This system consists of an inner pipe and an outer pipe which are changed from the conventional refrigerant pipes (liquid and gaseous refrigerant pipes).
- The cooling performance can be enhanced by occurring heat exchange by utilizing temperature difference of refrigerant in a refrigeration cycle and further cooling the refrigerant discharged from the condenser.



Refrigerant Pipe

The refrigerant pipe consists of inner and outer pipes, and thus heat exchange can occur by utilizing the temperature difference between low-temperature, low-pressure gaseous refrigerant flowing inside the inner pipe and high-temperature, high-pressure liquid refrigerant flowing between the inner and outer pipes. Furthermore, a spiral groove is formed in the pipe in order to attain further effective heat exchange.



7. A/C Pressure Sensor

The A/C pressure sensor detects the refrigerant pressure and outputs it to the air conditioning amplifier in the form of voltage changes.

8. Room Temperature Sensor

The room temperature sensor detects the room temperature based on changes in the resistance of its built-in thermistor. This signal is used by the air conditioning amplifier.

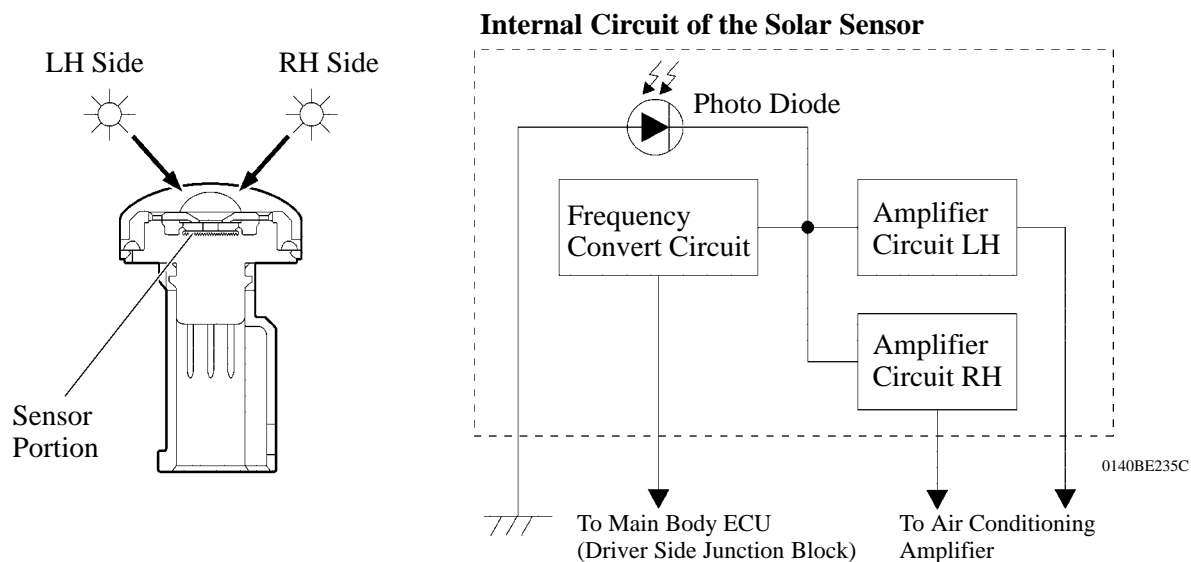
9. Ambient Temperature Sensor

The ambient temperature sensor detects the outside temperature based on changes in the resistance of its built-in thermistor. This signal is used by the air conditioning amplifier.

10. Solar Sensor

The solar sensor consists of a photo diode, two amplifier circuits for the solar sensor, and a frequency converter circuit for the light control sensor.

- The solar sensor detects (in the form of changes in the current that flows through the built-in photo diode) the changes in the amount of sunlight from its LH and RH sides (2 directions) and outputs these sunlight strength signals to the air conditioning amplifier.



■ SYSTEM CONTROL

1. General

The air conditioning system has the following controls.

Control	Outline
Neural Network Control [See page BE-68]	This control is capable of effecting complex control by artificially simulating the information processing method of the nervous system of living organisms in order to establish a complex input/output relationship that is similar to a human brain.
Outlet Air Temp. Control	Based on the temperature set at the temperature control dial, the neural network control calculates the outlet air temperature based on the input signals from various sensors.
Right/Left Independent Control	The temperature setting for the driver and front passenger is controlled independently in order to provide a separate vehicle interior temperature for the right and left side of the vehicle. Thus, air conditioning that accommodates the occupants' preferences has been realized.
Up/Down Independent Control	Adjusts the temperature of the air blown over the upper body and lower body separately based on signals from the solar sensor.
Blower Control	Controls the blower motor in accordance with the airflow volume that has been calculated by the neural network control based on the input signals from various sensors.
Air Outlet Control	Automatically switches the air outlets in accordance with the outlet mode that has been calculated by the neural network control based on the input signals from various sensors. In accordance with the engine coolant temperature, outside air temperature, amount of sunlight, required blower, outlet temperature, and vehicle speed conditions, this control automatically switches the blower outlet to the FOOT/DEF mode to prevent the windows from becoming fogged when the outside air temperature is low.
Air Inlet Control	Automatically controls the air inlet control damper to help achieve the calculated outlet air temperature that is required. Drives the servomotor (for air inlet) according to the operation of the air inlet control switch and moves the dampers to the FRESH or RECIRC position.
Compressor Control	This control turns OFF the magnetic clutch of the A/C compressor when the blower motor is turned OFF in case that the engine coolant temperature is below a predetermined value, an abnormal refrigerant pressure has been detected, or the discharge temperature of the evaporator is below a predetermined value (evaporator too cold). The air conditioning amplifier turns the compressor off if the engine coolant temperature becomes abnormally hot (120°C [248°F] or above) when driving under a high load.
Rear Window Defogger & Mirror Heater Control*	Switches the rear window defogger and outside rear view mirror heaters ON for 15 minutes when the rear window defogger button is pressed. Switches them OFF if the button is pressed again while they are operating.

*: Standard equipment for the Limited and Platinum grades and optional equipment for the SR5 grade.

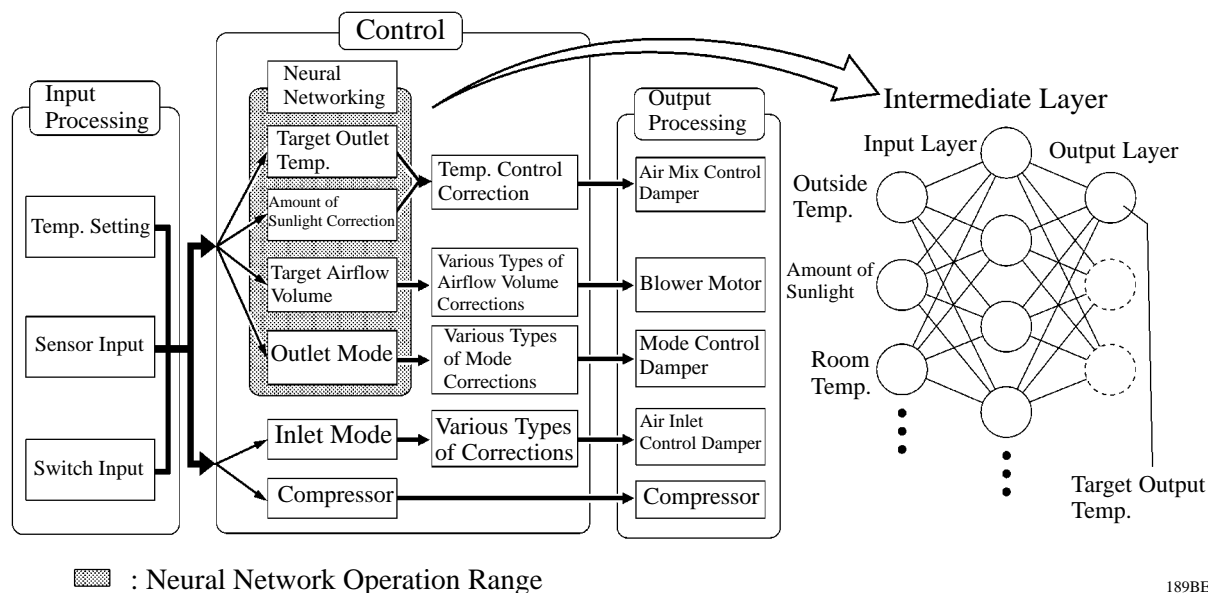
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Control	Outline
Front Wiper Deicer, Mirror Heater & Rear Window Defogger Control*	Switches the front wiper deicer, outside rear view mirror heaters and rear window defogger on for approx. 15 minutes when the front wiper deicer button is pressed.
Outside Temperature Indication Control	Based on the signal from the Ambient temperature sensor, this control calculates the outside temperature, and this value is then corrected in the air conditioning amplifier, and shown on the accessory meter.
Self-Diagnosis [See page BE-69]	A DTC (Diagnostic Trouble Code) is stored in the memory when the air conditioning amplifier detects a problem with the air conditioning system.

*: Optional Equipment

2. Neural Network Control

- Previously, in automatic air conditioning systems without neural network control, the air conditioning amplifier determined the required outlet air temperature and blower air volume in accordance with the calculation formula that has been obtained based on information received from the sensors. However, because the senses of a person are rather complex, a given temperature is sensed differently, depending on the environment in which the person is situated. For example, a given amount of solar radiation can feel comfortably warm in a cold climate, or extremely uncomfortable in a hot climate. Therefore, as a technique for effecting a higher level of control, a neural network is used in the automatic air conditioning system. With this technique, the data that has been collected under varying environmental conditions is stored in the air conditioning amplifier. The air conditioning amplifier can then effect control to provide enhanced air conditioning comfort.
- The neural network control consists of neurons in the input layer, intermediate layer, and output layer. The input layer neurons process the input data of the outside temperature, the amount of sunlight, and the room temperature based on the outputs of the switches and sensors, and output them to the intermediate layer neurons. Based on this data, the intermediate layer neurons adjust the strength of the links among the neurons. The sum of these is then calculated by the output layer neurons in the form of the required outlet temperature, solar correction, target airflow volume, and outlet mode control volume. Accordingly, the air conditioning amplifier controls the servomotors and blower motor in accordance with the control volumes that have been calculated by the neural network control.



3. Self-Diagnosis

The air conditioning amplifier has a self-diagnosis function. It stores a record of any air conditioning system failures in memory in the form of DTCs (Diagnostic Trouble Codes).

- There are two methods for reading DTCs. One is to use the Techstream, and the other is to read the DTCs using the heater control panel display.

For details, see the 2008 Sequoia Repair Manual (Pub. No. RM08L0U).