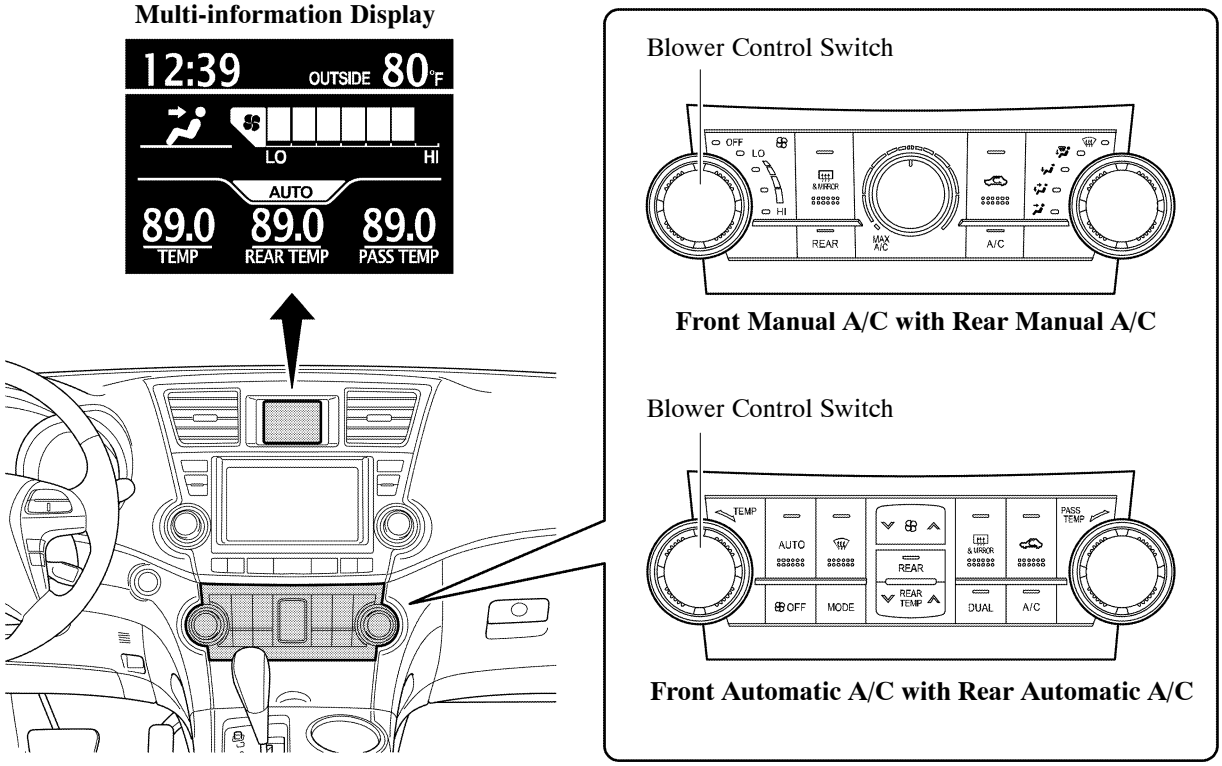
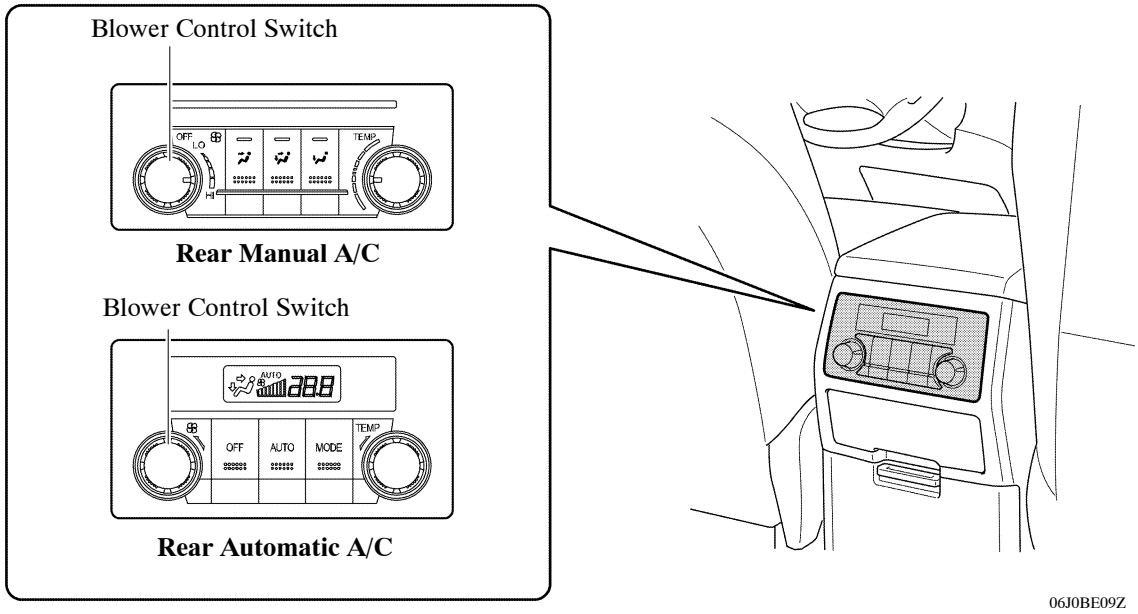
■CONSTRUCTION AND OPERATION

1. Heater Control Panel

- For both the front and rear manual and automatic A/C, the heater control panel blower control switches are steplessly adjustable, using a pulse type control to achieve further comfort.
- The multi-information display is used as the automatic A/C display, thus the heater control panel can be made more compact.



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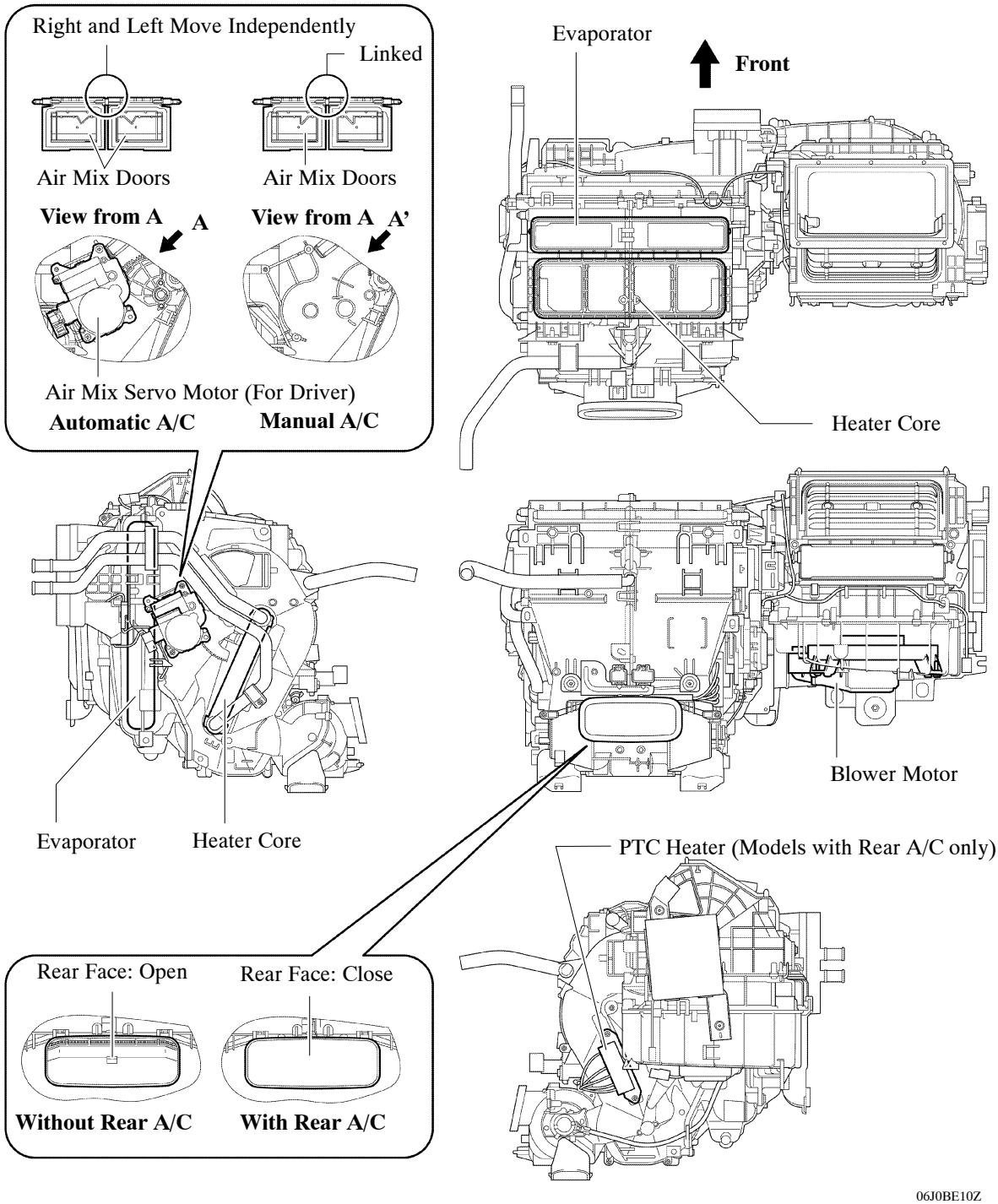
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2. Air Conditioning Unit

Front A/C Unit

The front air conditioner unit consists of the evaporator, heater core, servo motors, evaporator temperature sensor, PTC (Positive Temperature Coefficient) heater and blower motor.

- The evaporator and heater core are mounted transversely to achieve a compact and lightweight form.
- A BUS connector is used in the wire harness connection that connects the servo motor from the Air Conditioning Amplifier.

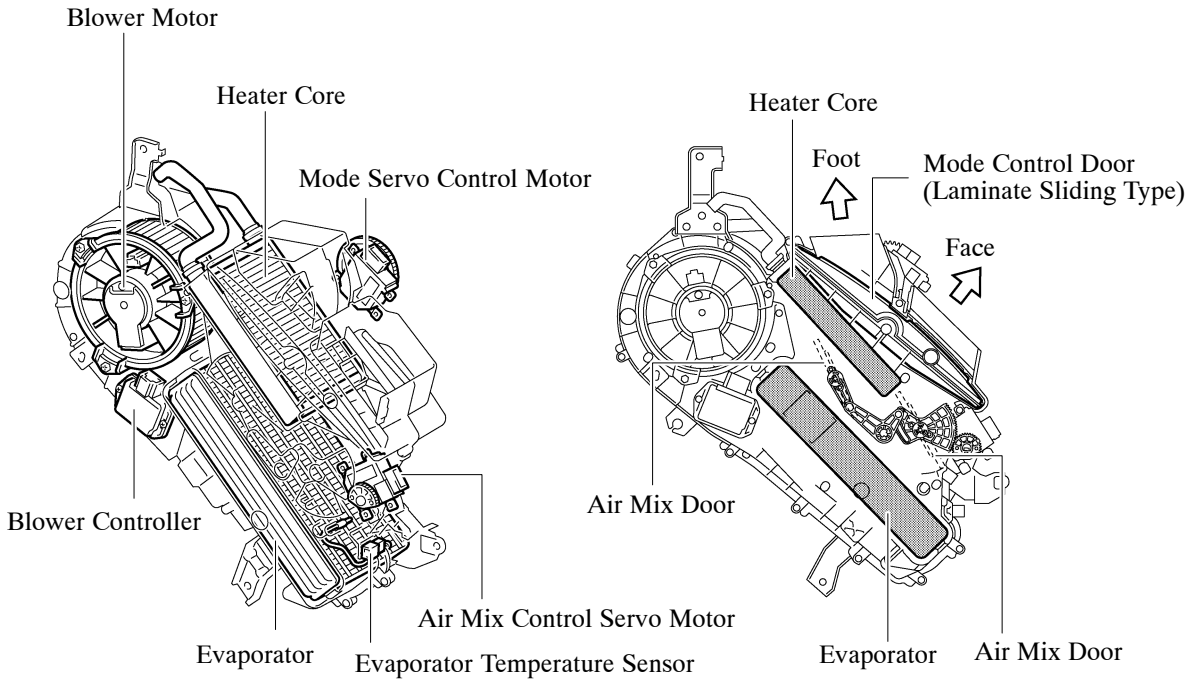


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Rear Air Conditioning Unit

The rear air conditioner unit consists of the evaporator, heater core, air mix control servo motor, mode control servo motor, evaporator temperature sensor, and rear blower motor.

- The evaporator and heater core are arranged horizontally to allow the airflow to be directed smoothly upward.
- The mode control servo motor operates the laminate sliding type mode control door, and the air mix control servo motor controls the full air mix type air mix doors.
- A BUS connector is used in the wire harness connection that connects the servo motor from the Air Conditioning Amplifier.

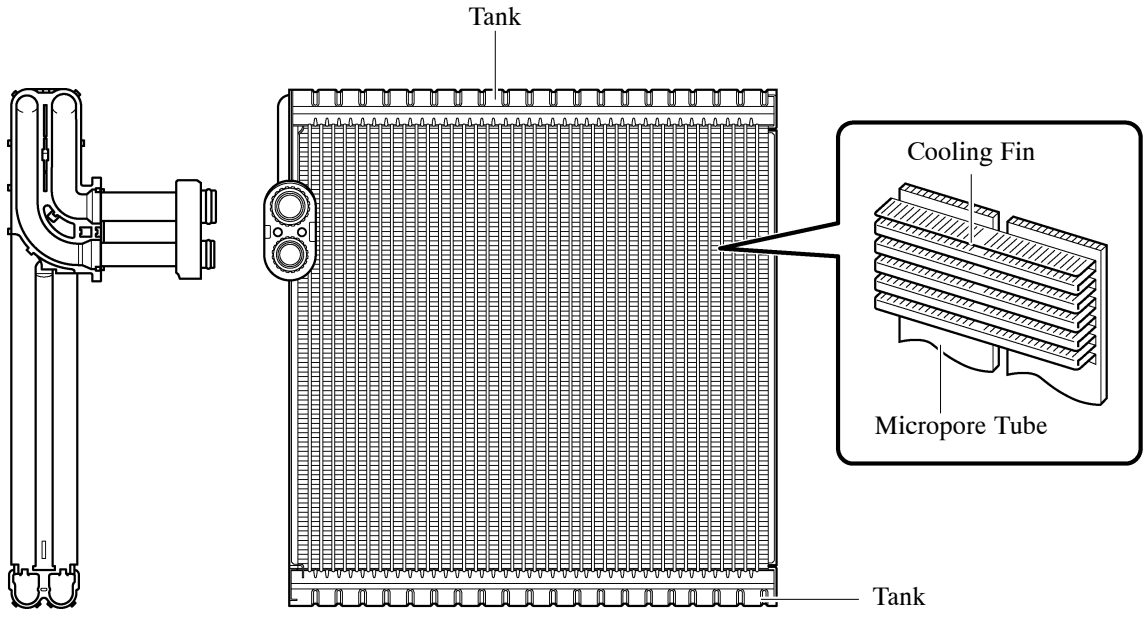


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Evaporator

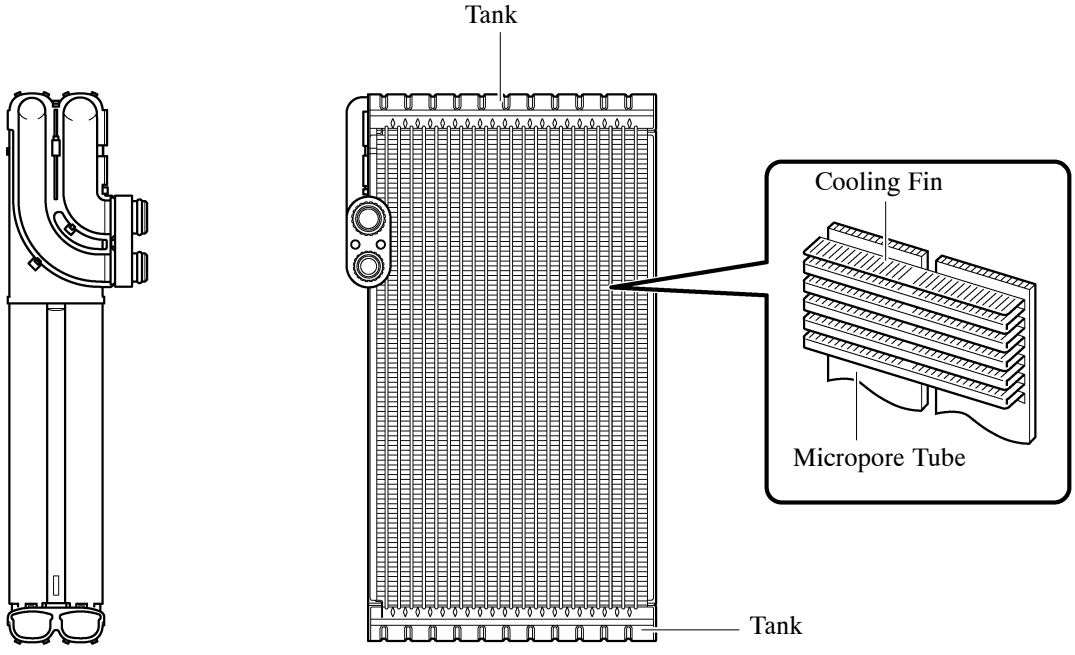
The evaporator placing the tanks at the top and the bottom and adopting a micropore tube construction have realized the following effects:

- The heat exchange efficiency is improved.
- The temperature distribution is made more uniform.
- The evaporator is made thinner.



For Front A/C (Manual and Automatic)

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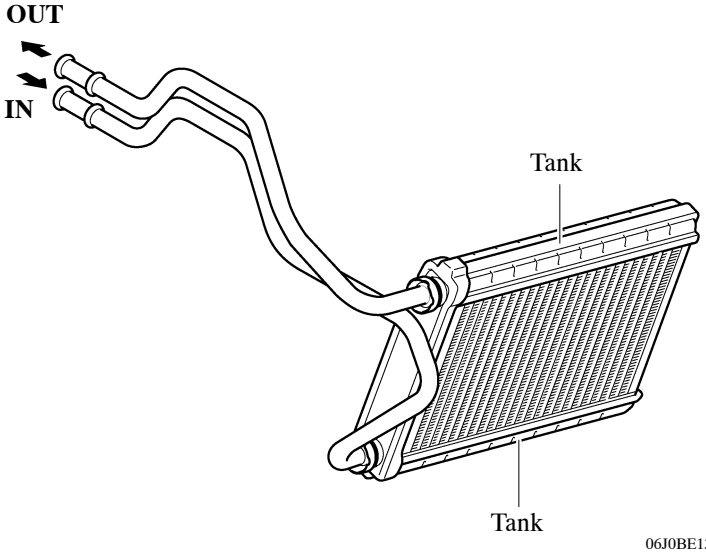
For Rear A/C (Manual and Automatic)

Evaporator Temperature Sensor

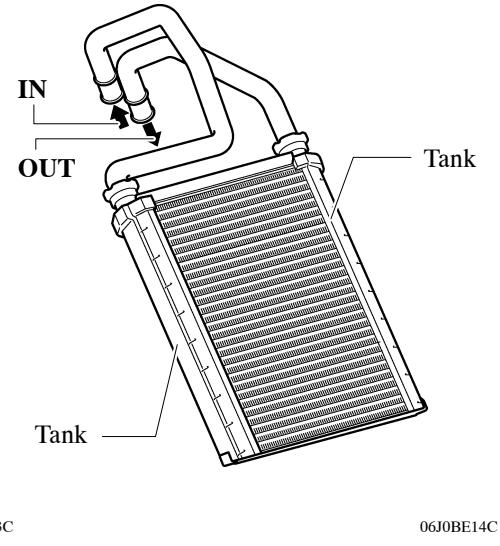
The evaporator temperature sensor detects the temperature of the cool air immediately past the evaporator in the form of resistance changes, and outputs it to the Air Conditioning Amplifier.

Heater Core

The compact, lightweight, and highly efficient SFA (Straight Flow Aluminum)-II type heater core is used for the front air conditioning and the rear air conditioning.



For Front A/C (Manual and Automatic)



For Rear A/C (Manual and Automatic)

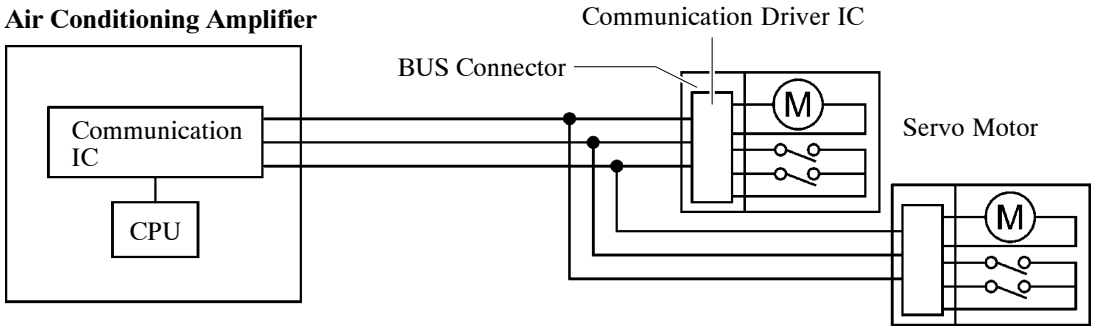
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Blower Motor

- The blower motor (for front air conditioning) has a built-in blower controller, and is controlled using duty control performed by the Air Conditioning Amplifier.
- The blower motor (for rear air conditioning) is controlled using duty control performed by the Air Conditioning Amplifier.

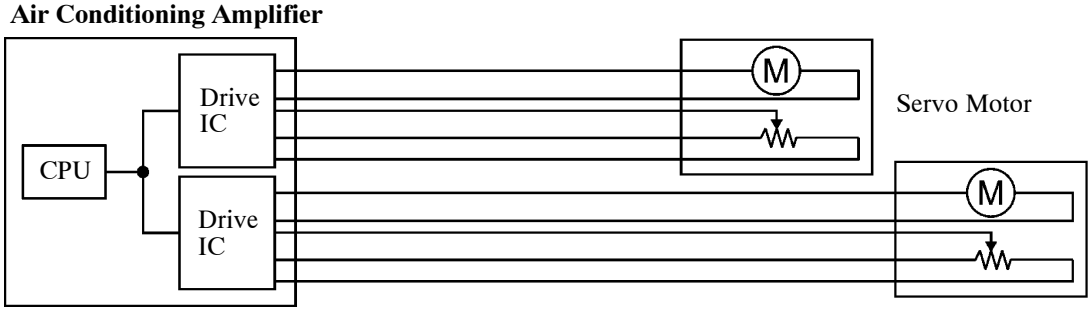
BUS Connector

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



With BUS Connector

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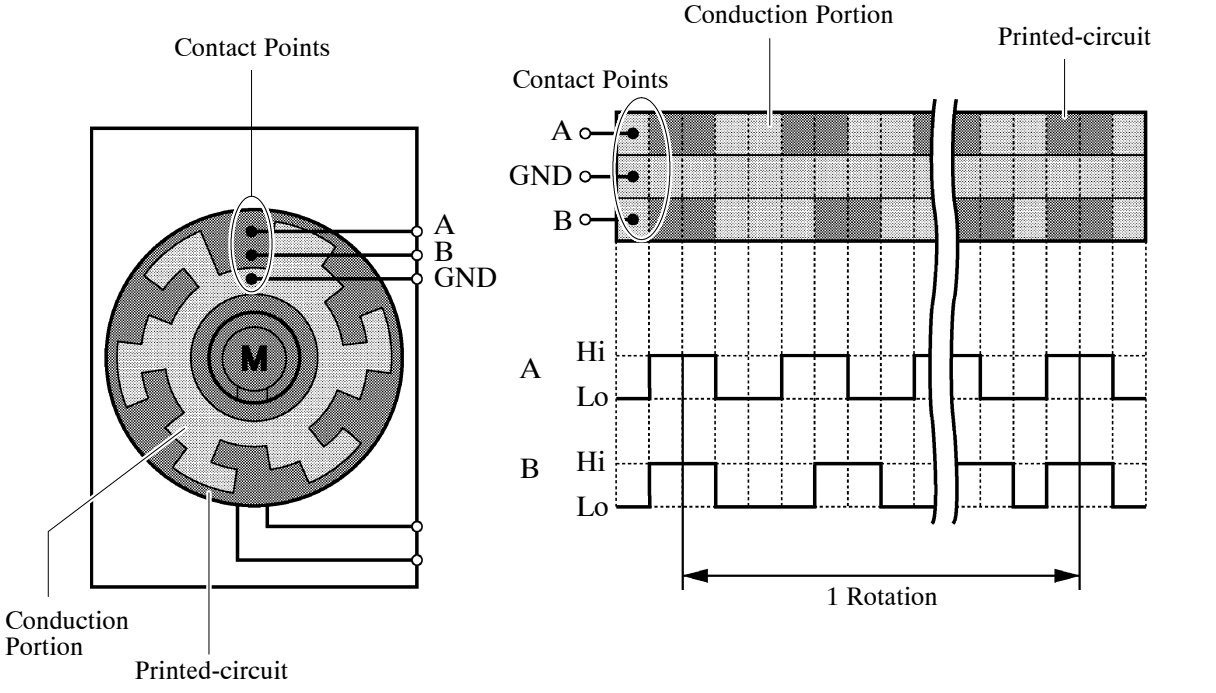


Without BUS Connector

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Servo Motor

The pulse pattern type servo motor consists of a printed circuit board and a servo motor. 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.



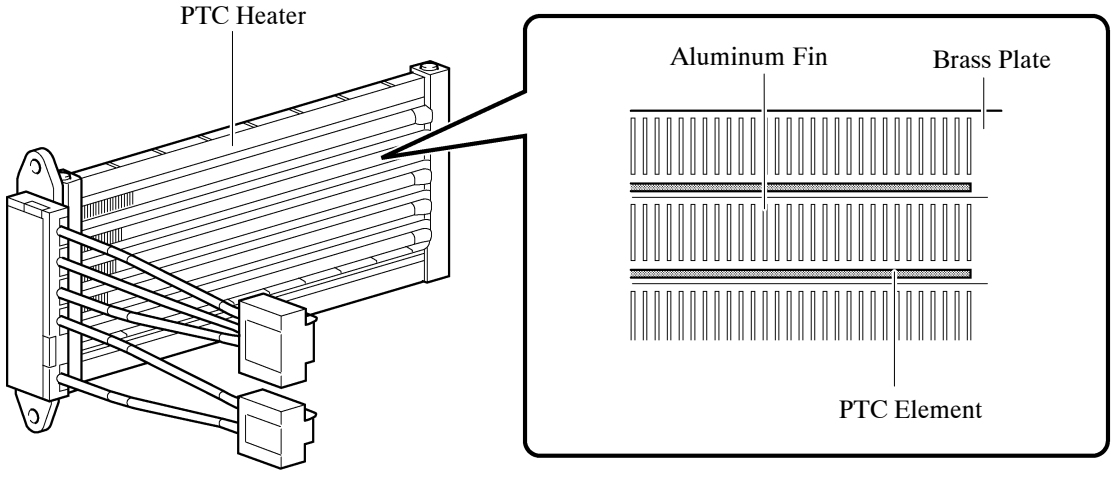
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PTC Heater

1) General

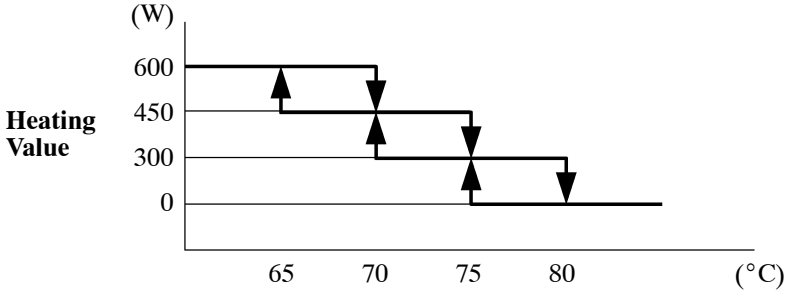
The PTC (Positive Temperature Coefficient) heater consists of a PTC element, aluminum fin, and brass plate. When current is applied to the PTC element, it generates heat to warm the air that passes through the unit.



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2) PTC Heater Operating Condition

The PTC heater is controlled by the Air Conditioning Amplifier in accordance with the engine coolant temperature, engine speed, air mix setting, ambient temperature and electrical load (generator power ratio). For example, the number of the operating PTC heaters varies with engine coolant temperature as in the graph below.

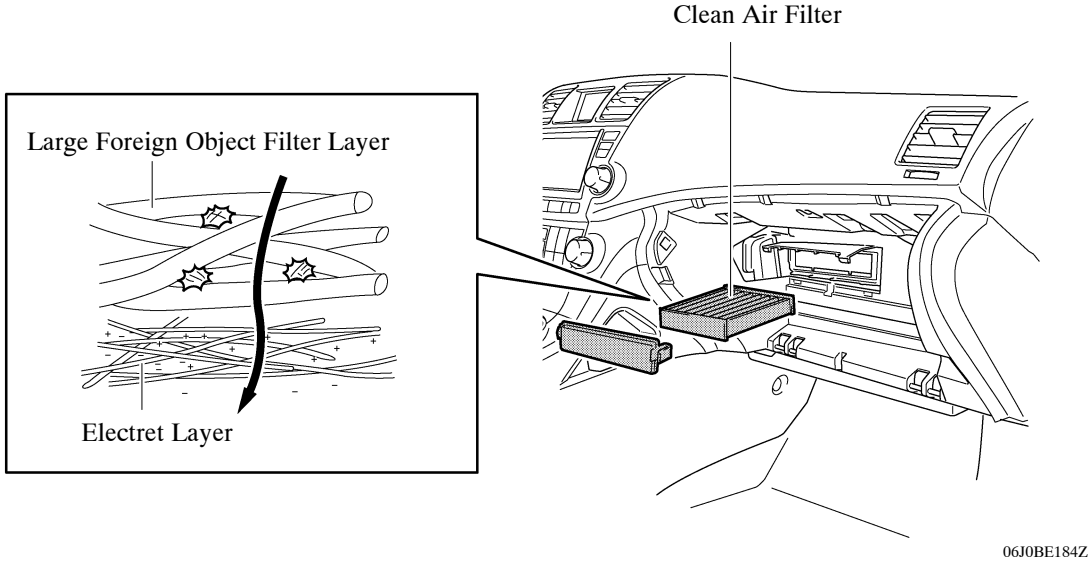


Engine Coolant Temperature

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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, a feature that is provided in consideration of the environment.



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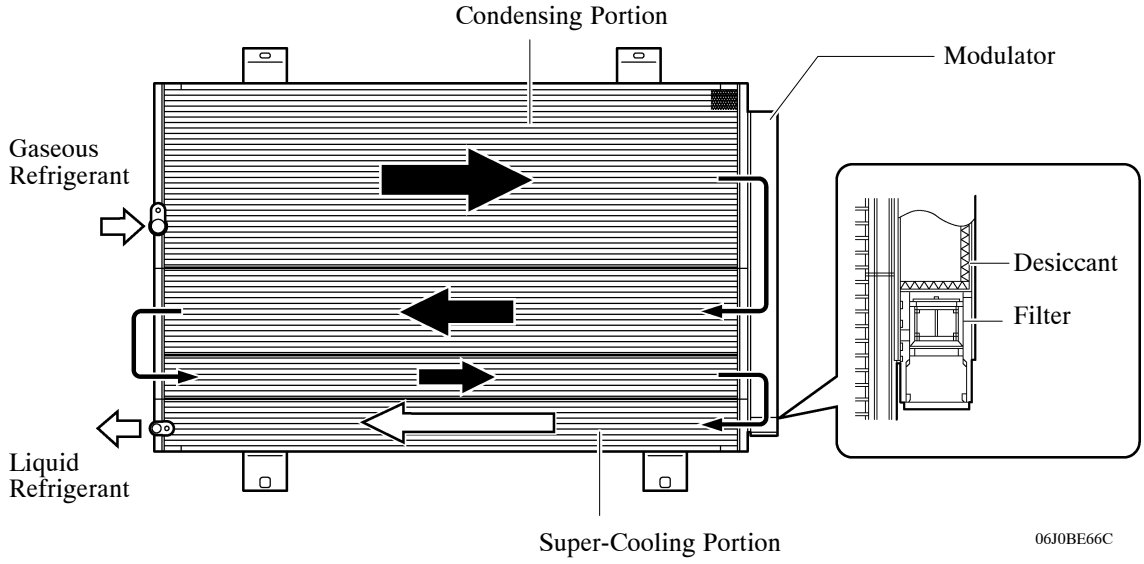
Service Tip

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

3. Condenser

The condenser consists of two cooling portions: a condensing portion and a super-cooling portion, and gas-liquid separator (modulator) are integrated together. This condenser uses a sub-cool cycle that offers excellent heat-exchange performance.

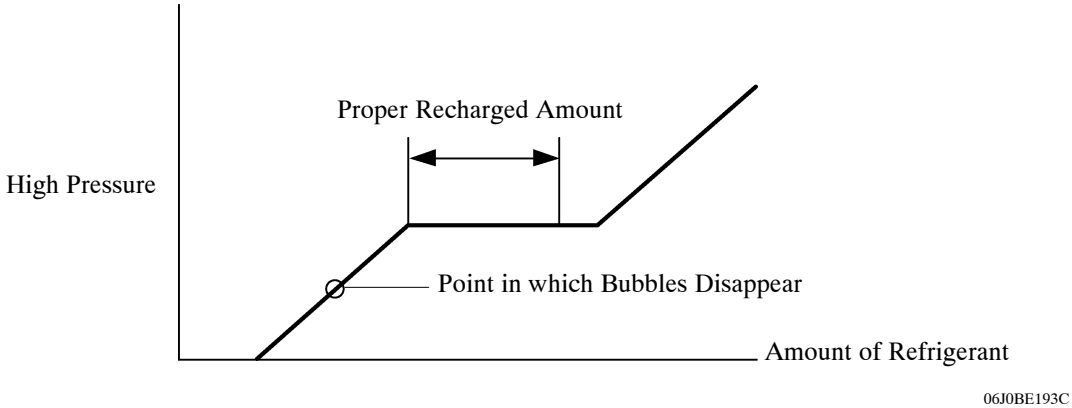
- In the sub-cool cycle, after the refrigerant passes through the condensing portion of the condenser, both the liquid refrigerant and the gaseous refrigerant that could not be liquefied are cooled again in the super-cooling portion. Thus, the refrigerant is sent to the evaporator in an almost completely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



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 HIGHLANDER Repair Manual (Pub. No. RM06J0U).

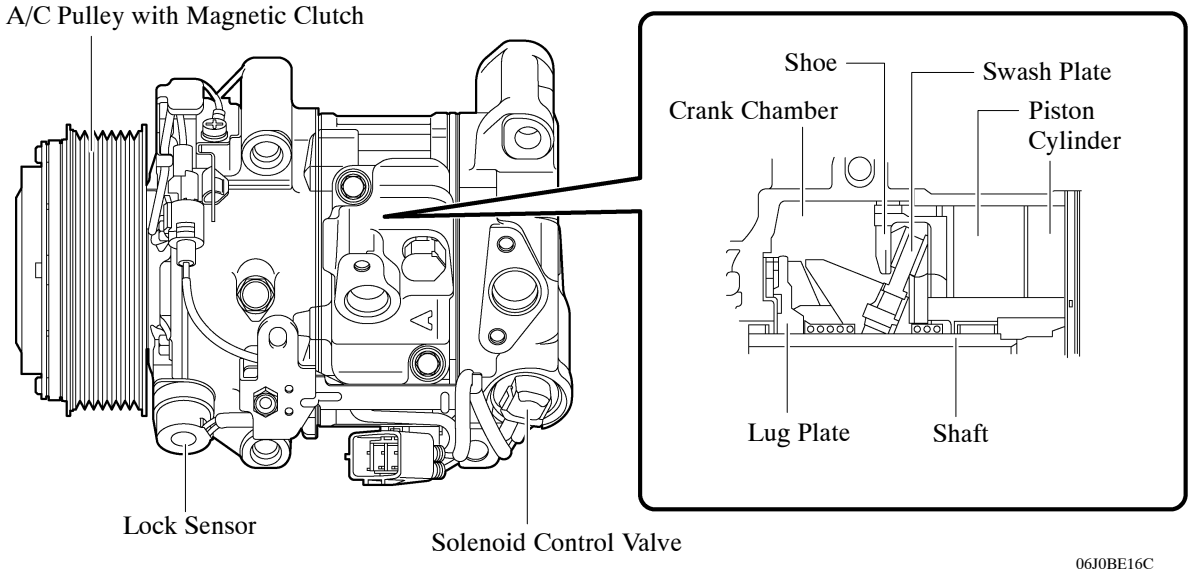


4. Compressor and Pulley

General

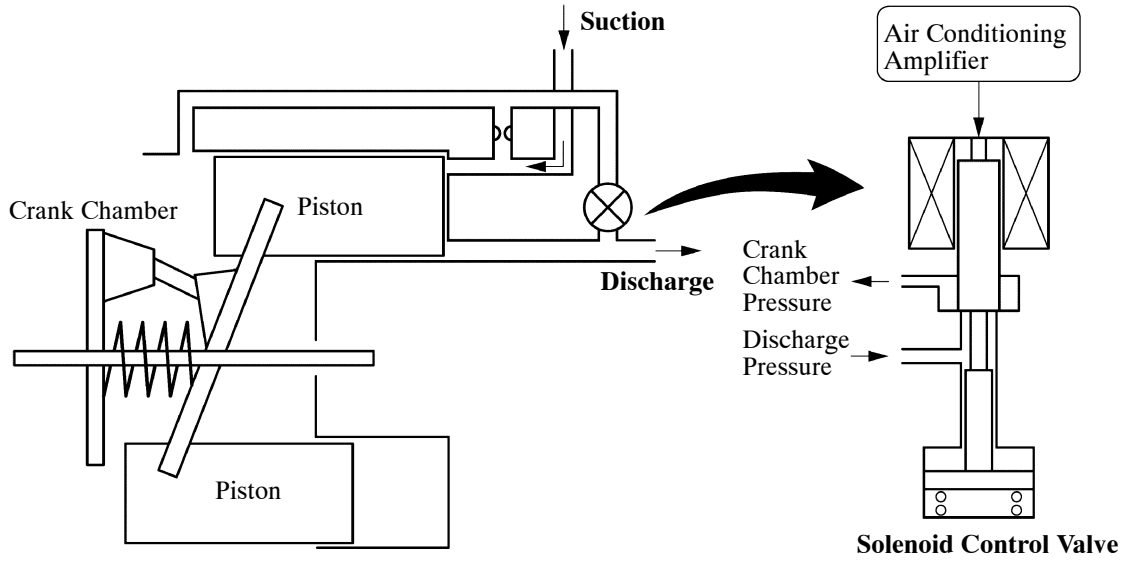
The compressor and pulley is continuously variable capacity type in which its capacity can be varied in accordance with the cooling load of the air conditioning.

- The compressor and pulley consists of the A/C pulley, shaft, lug plate, swash plate, piston, shoe, crank chamber, cylinder, lock sensor and solenoid control valve.
- The ECM sends an engine speed signal to the Air Conditioning Amplifier. The Air Conditioning Amplifier compares this signal with an A/C compressor lock signal sent from the lock sensor. If the ECM determines that the A/C pulley has locked, the Air Conditioning Amplifier turns the magnetic clutch off.
- A solenoid control valve that adjusts the suction pressure so that the compressor capacity can be controlled as desired is provided.



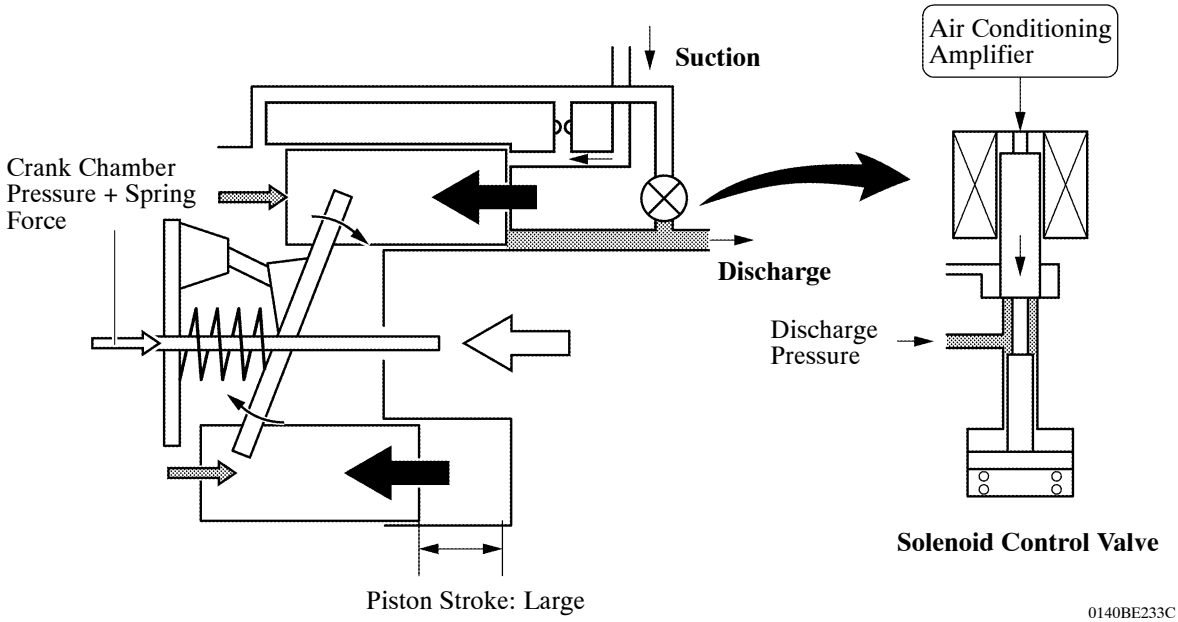
Variable Capacity Operation

- The crank chamber is connected to the suction passage. A solenoid valve is provided between the suction passage (LO pressure) and the discharge passage (HI pressure).
- The solenoid control valve operates under duty cycle control in accordance with the signals from Air Conditioning Amplifier.



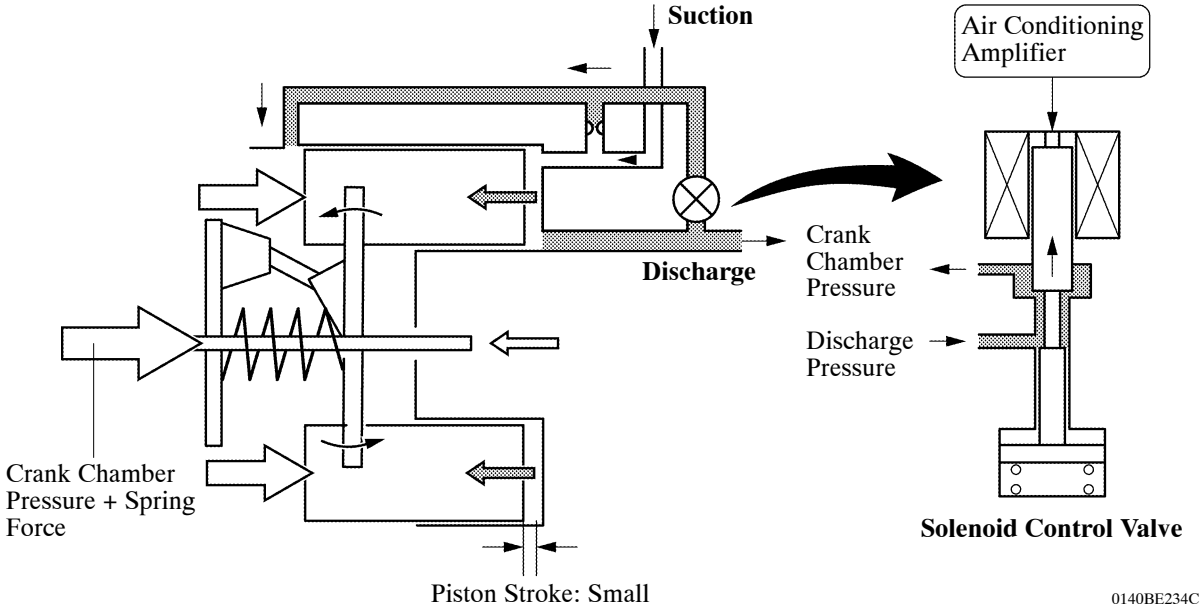
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- When the solenoid control valve closes (solenoid coil is energized), a difference in pressure is created and the pressure in the crank chamber decreases. Then, the pressure that is applied to the right side of the piston becomes greater than the pressure that is applied to the left side of the piston. This compresses the spring and tilts the swash plate. As a result, the piston stroke increases and the discharge capacity increases.



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- When the solenoid control valve opens (solenoid coil is not energized), the difference in pressure disappears. Then, the pressure that is applied to the left side of the piston becomes the same as the pressure that is applied to the right side of the piston. Thus, the spring elongates and eliminates the tilt of the swash plate. As a result, there is no piston stroke and the discharge capacity is reduced.



5. Room Temperature Sensor (Front and Rear)

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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.

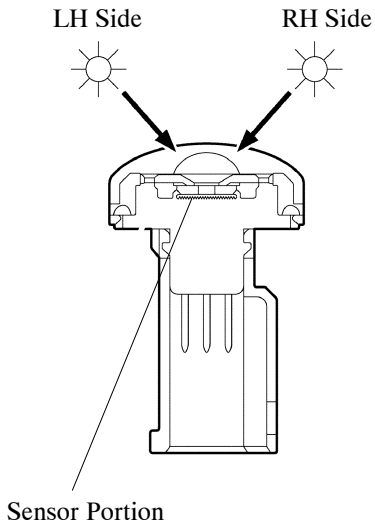
6. Ambient Temperature Sensor

The ambient temperature sensor detects the ambient temperature based on changes in the resistance of its built-in thermistor. This signal is used by the Air Conditioning Amplifier.

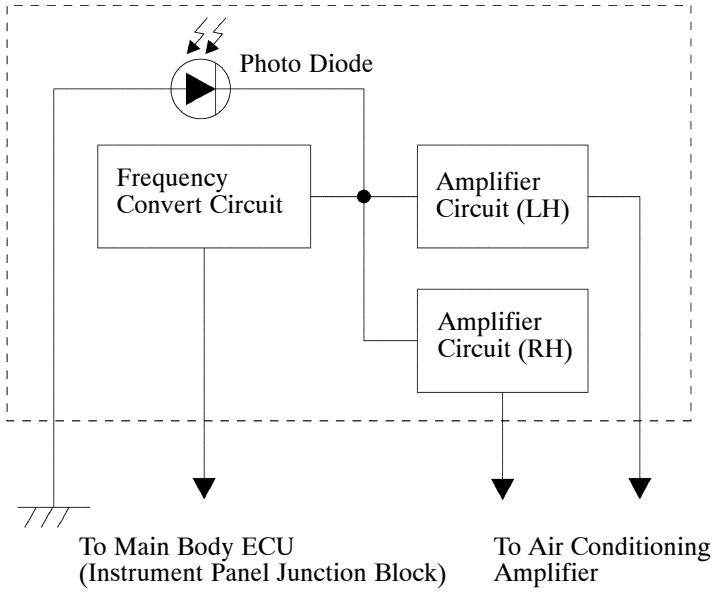
7. Solar Sensor

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.



Internal circuit of the solar sensor



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