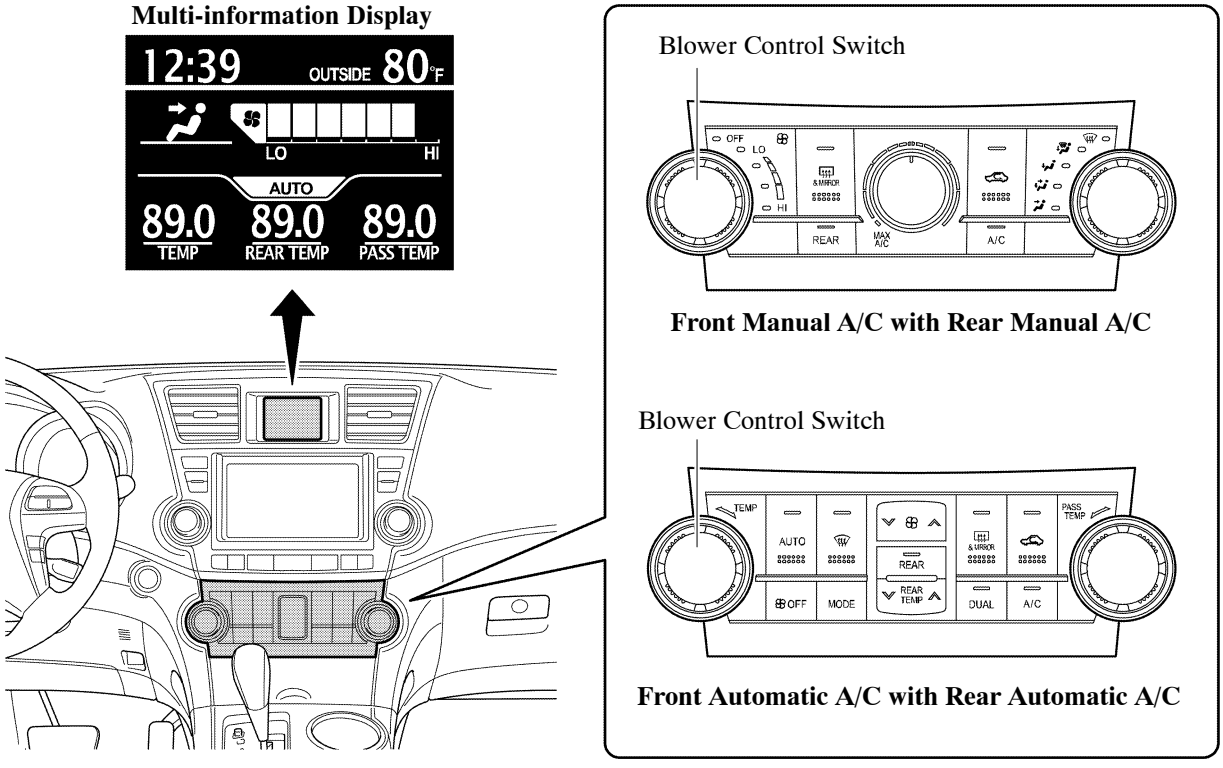
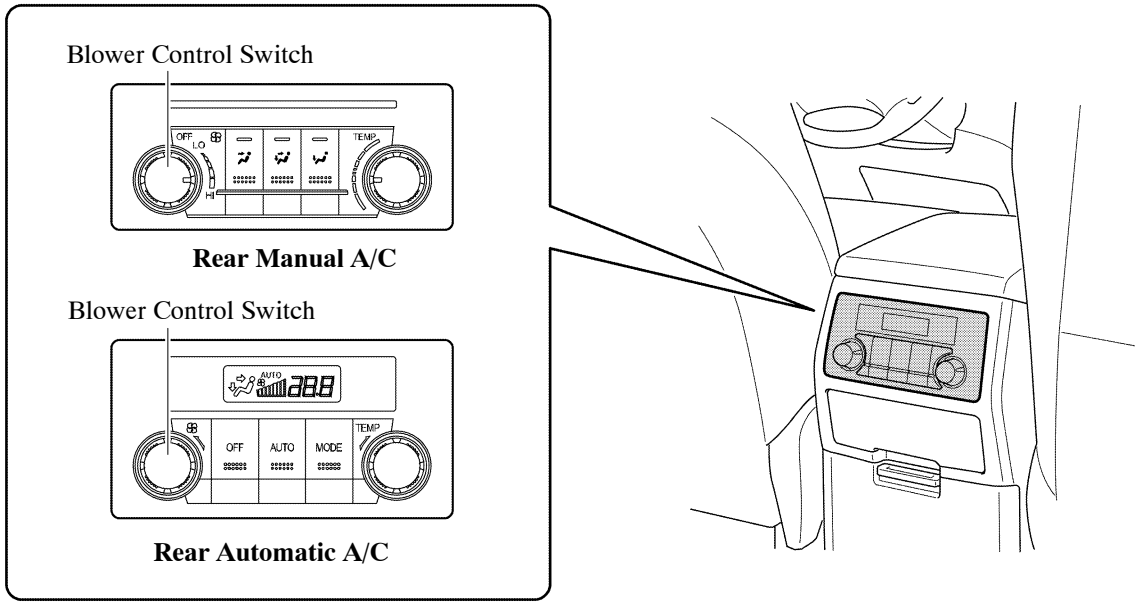
■CONSTRUCTION AND OPERATION

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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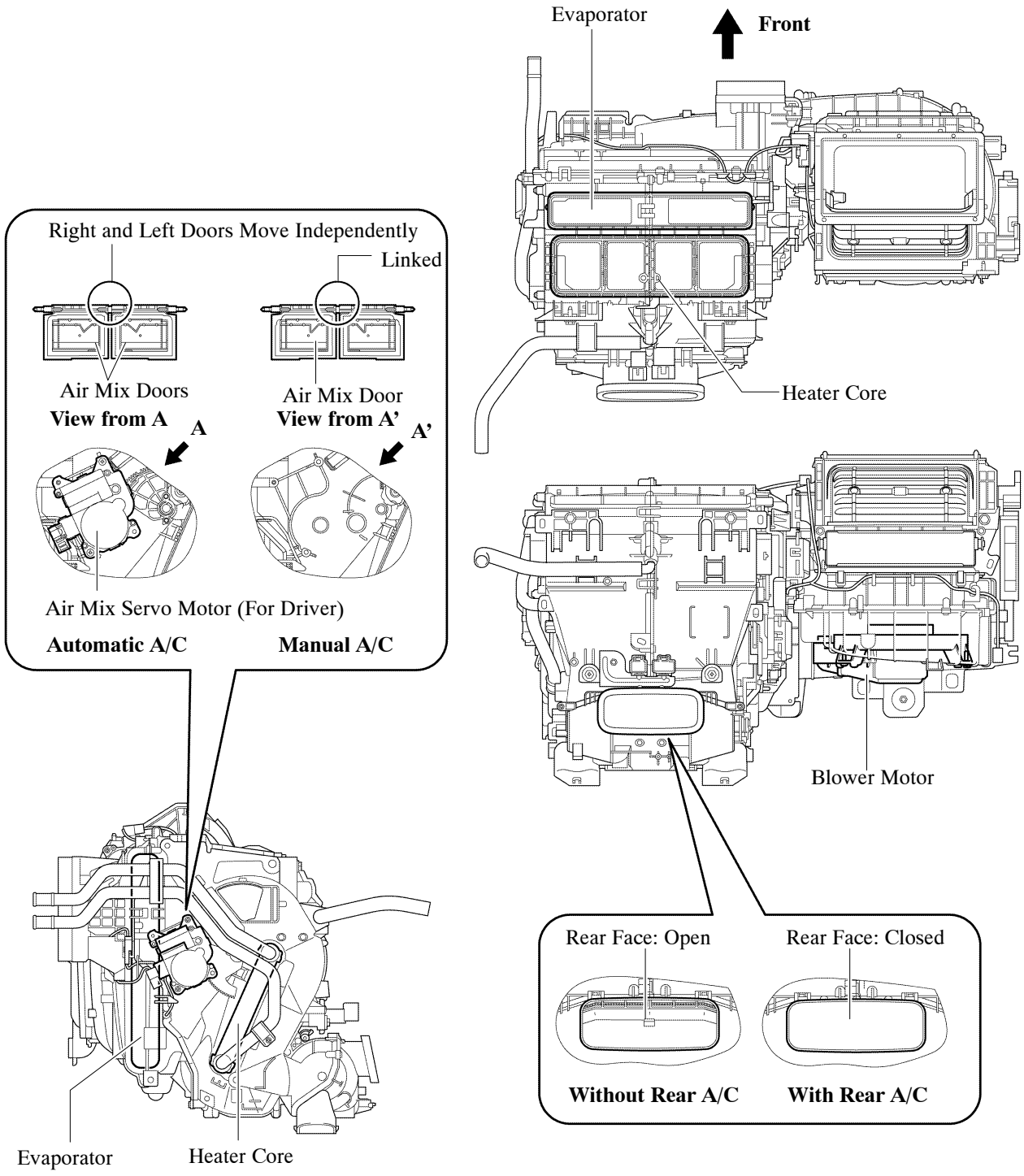
BE

2. Air Conditioning Unit

Front A/C Unit

The front air conditioning unit consists of the evaporator, heater core, servo motors, evaporator temperature sensor, 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.

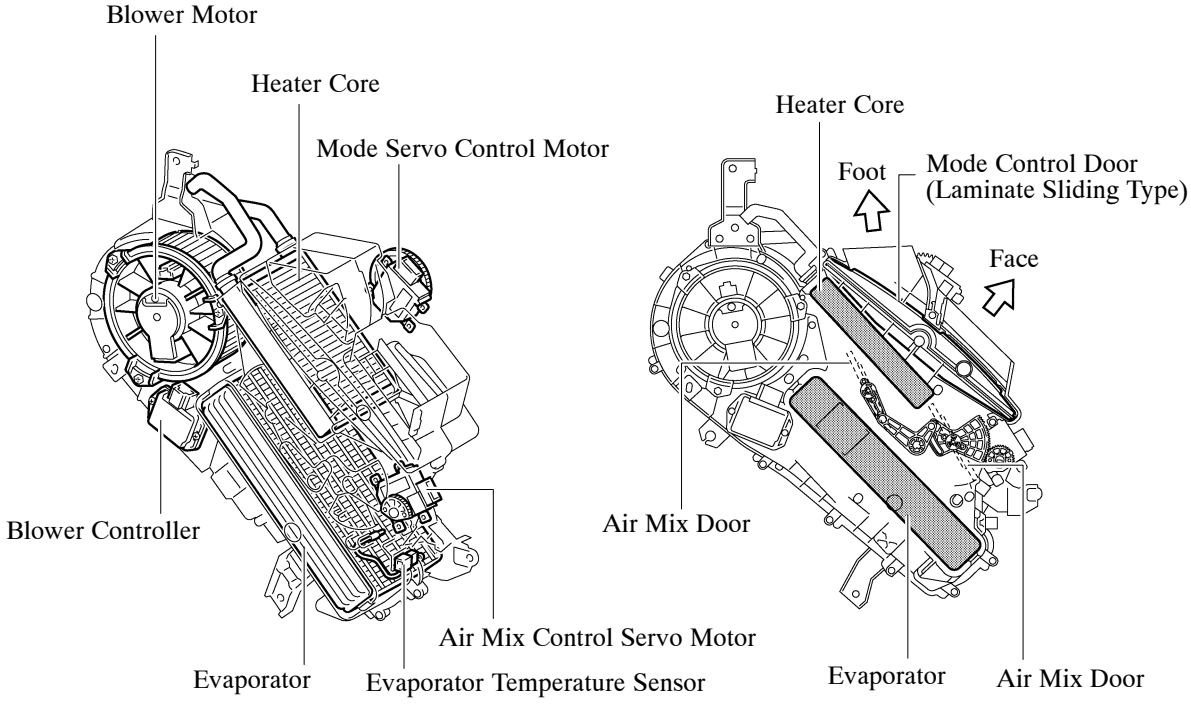


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Rear Air Conditioning Unit

The rear air conditioning 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.



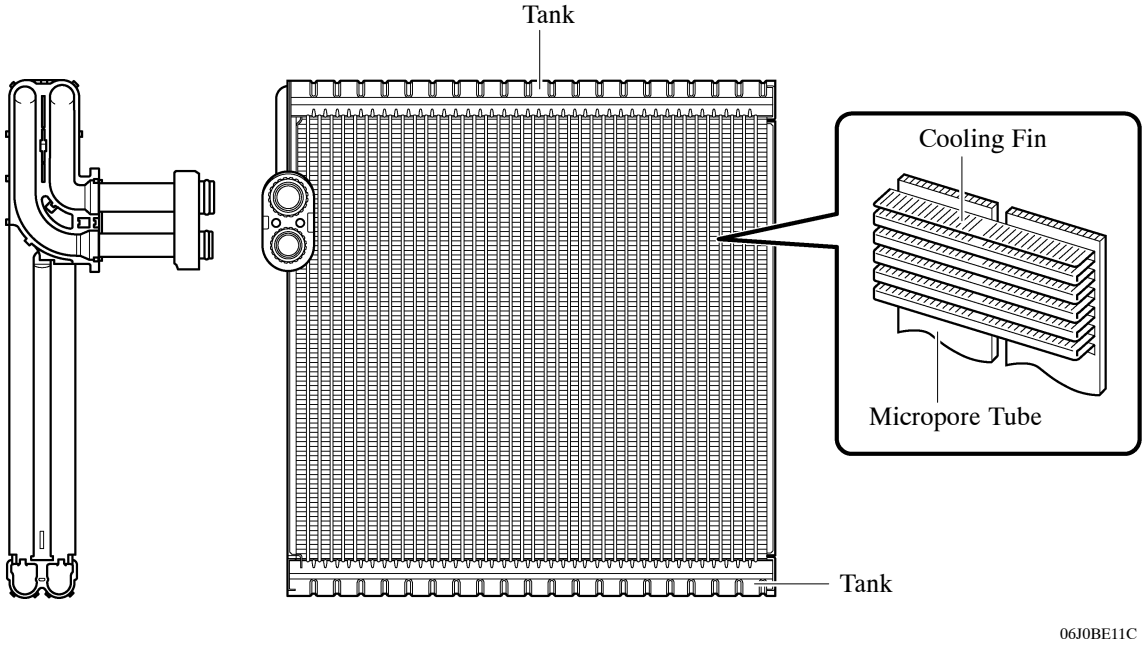
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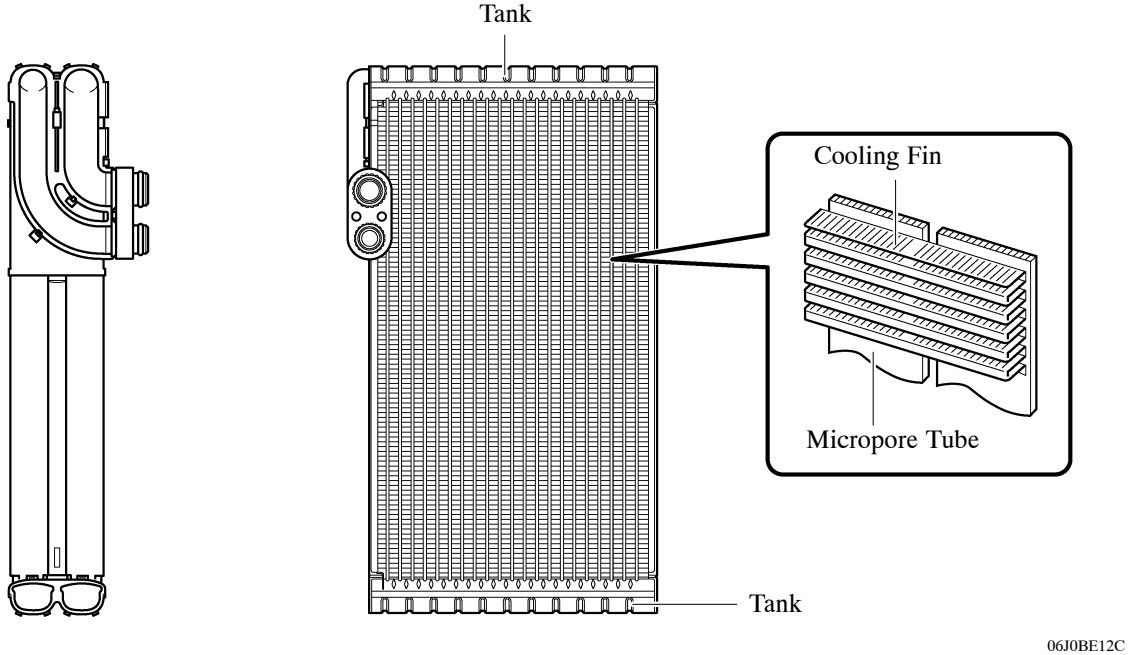
Evaporator

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)



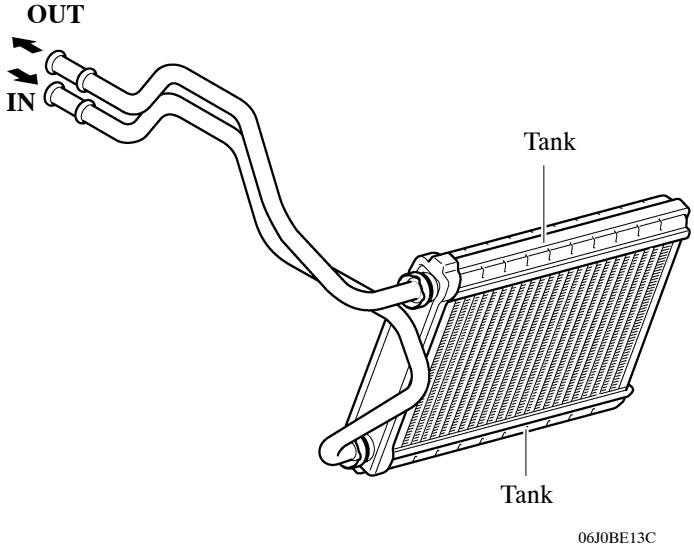
For Rear A/C (Manual and Automatic)

Evaporator Temperature Sensor

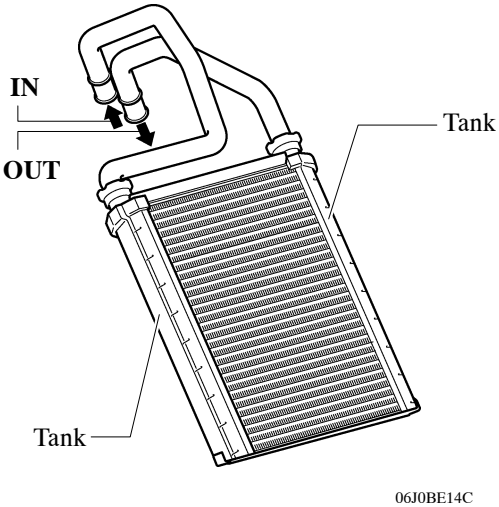
The evaporator temperature sensor detects the temperature of the cool air immediately past the evaporator in the form of resistance changes, and outputs it to the air conditioning amplifier.

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)

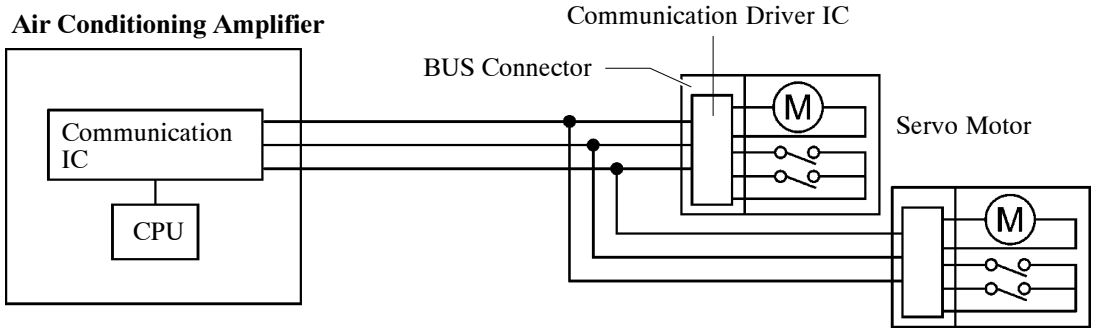
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Blower Motor

- 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.

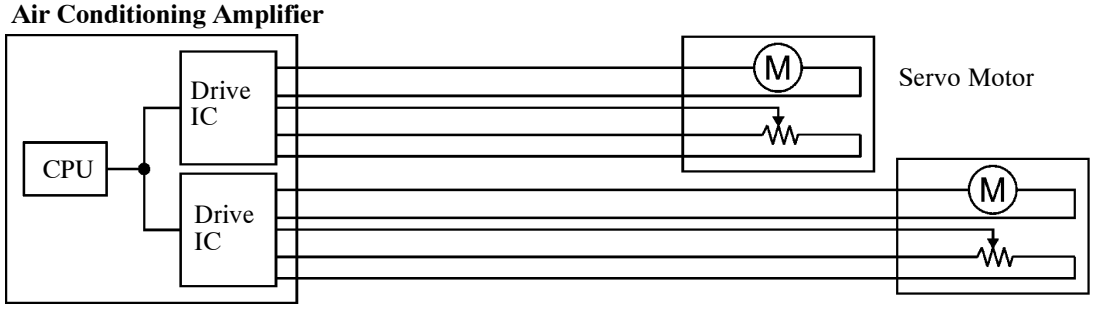
BUS Connector

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, a more lightweight construction and a reduced number of wires.



With BUS Connector

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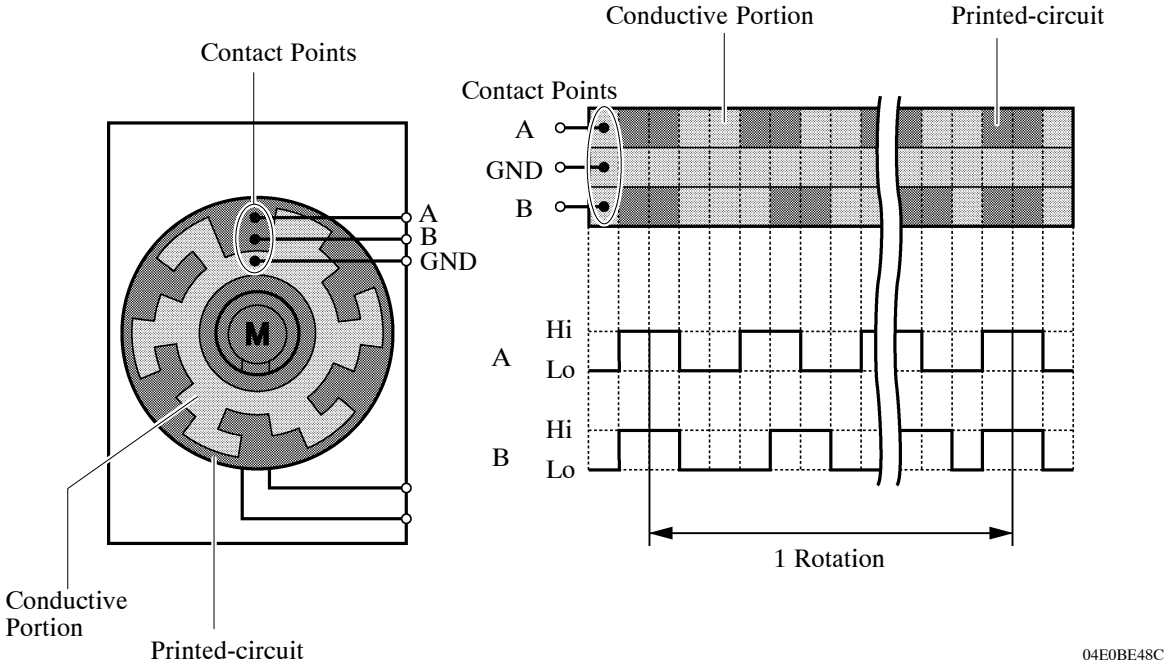


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Without BUS Connector

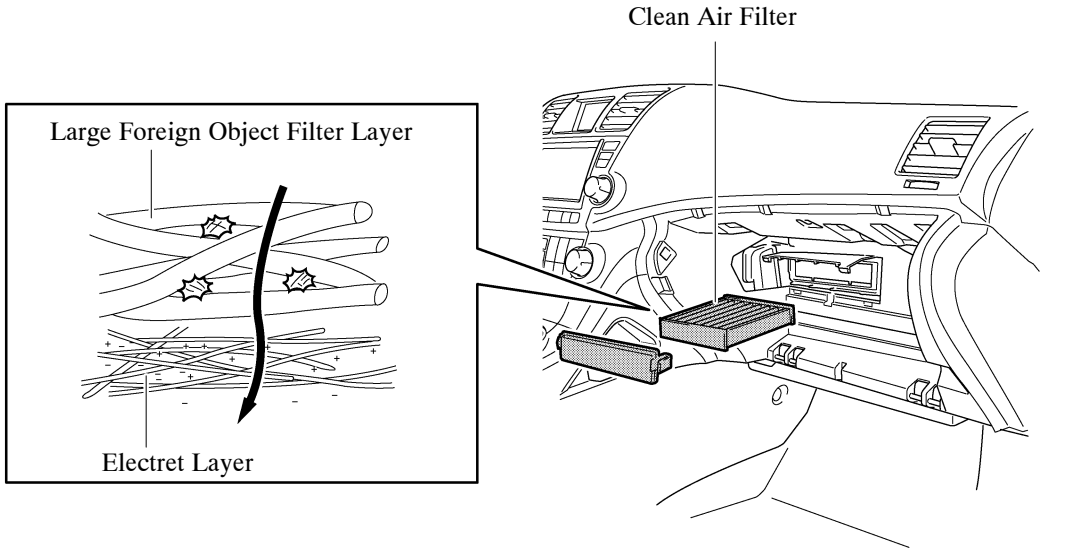
Servo Motor

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.



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

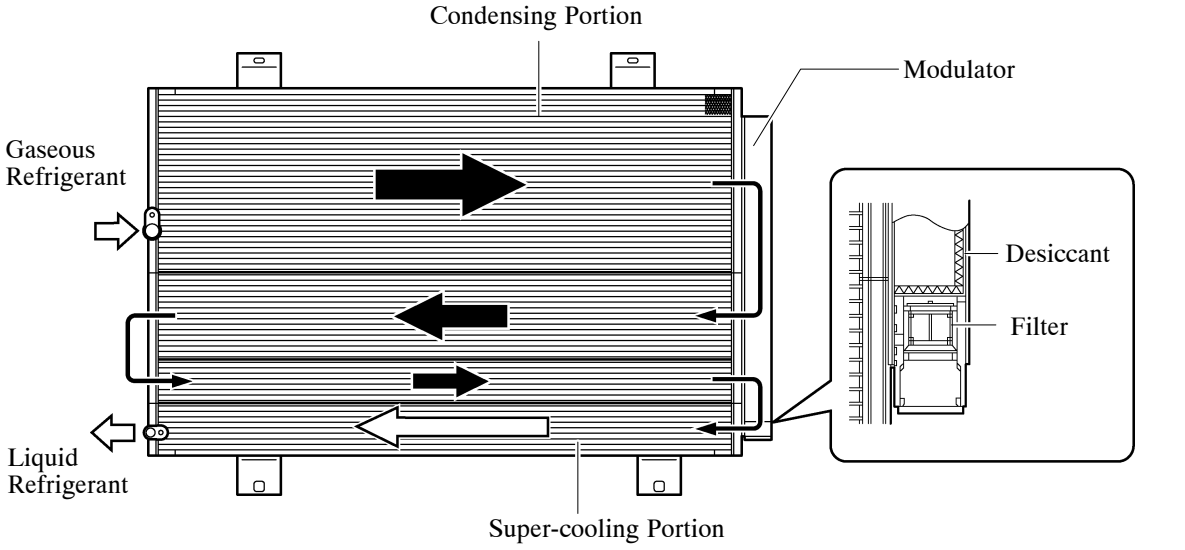
- The clean air filter on U.S.A. models should be changed at 30000 miles.
- The clean air filter on Canada models should be changed at 16000 km.

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 the gas-liquid separator (modulator) is 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.

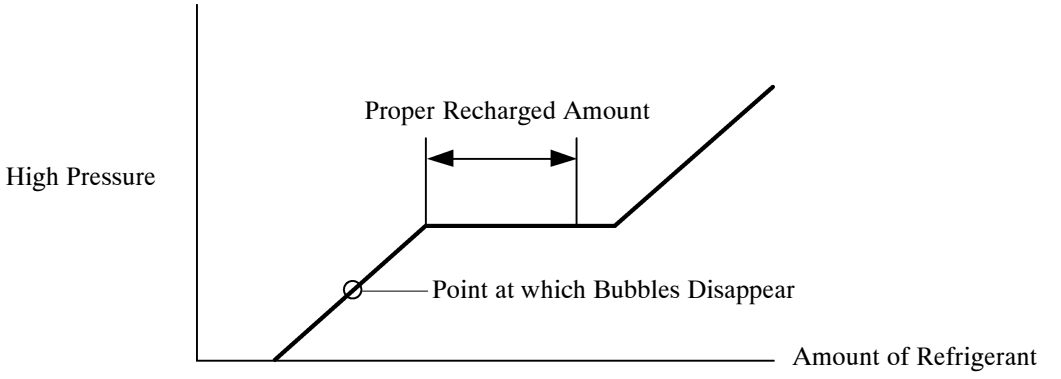


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Service Tip

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 HIGHLANDER HYBRID VEHICLE Repair Manual (Pub. No. RM07V0U).



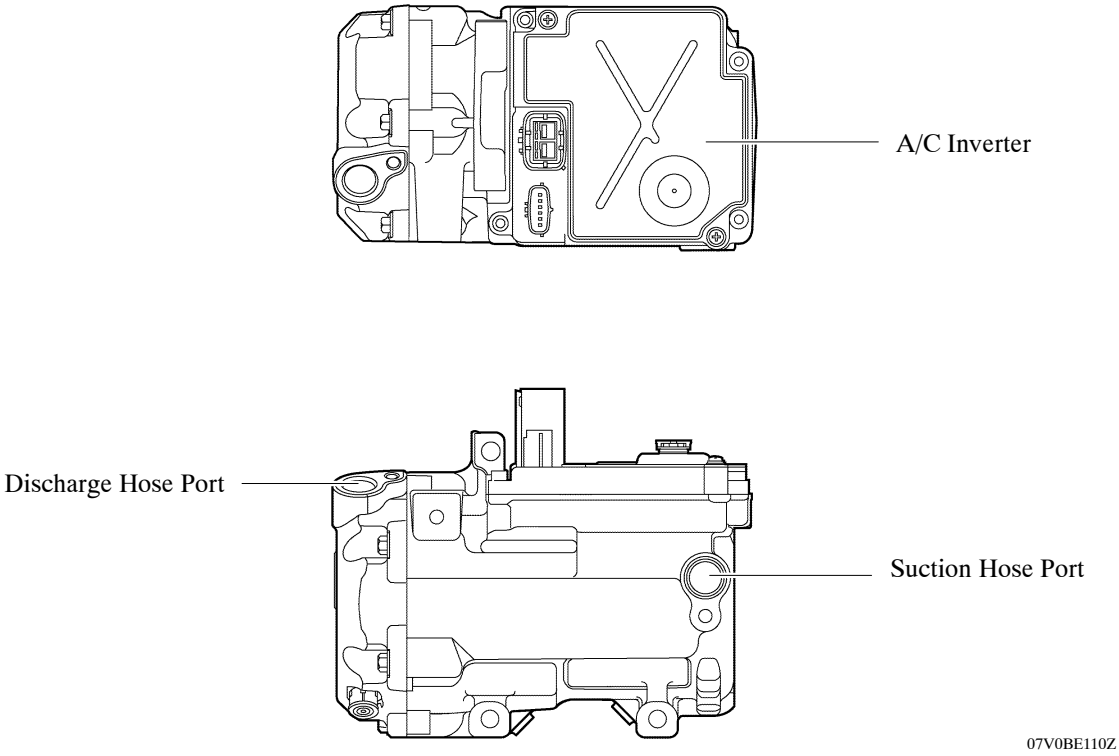
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4. Compressor with Motor Assembly

General

- An ES27 compressor with motor assembly that is driven by a motor is used. The basic construction and operation of this compressor are the same as the ordinary scroll compressor, except that it is driven by an electric motor.
- The A/C (Air Conditioning) inverter is integrated with the compressor.
- The electric motor is actuated by 3-phase alternating current (288 V) supplied by the A/C inverter. As a result, the air conditioning system is actuated without depending on the operation of the engine, thus realizing a comfortable air conditioning system and low fuel consumption.
- Due to the use of an electric motor to drive the compressor with motor assembly, the compressor speed can be controlled at the required speed calculated by the air conditioning amplifier. Thus, the cooling and dehumidification performance and power consumption are optimized.
- Low-moisture permeation hoses are used for the suction and discharge hoses at the compressor in order to minimize the entry of moisture into the refrigeration cycle.
- The compressor uses high-voltage alternating current. If a short or open circuit occurs in the compressor wiring harness, the hybrid vehicle control ECU will cut off the A/C inverter circuit in order to stop the power supply to the compressor motor.
- For details on the compressor with motor assembly control performed by the air conditioning amplifier, see page BE-77.

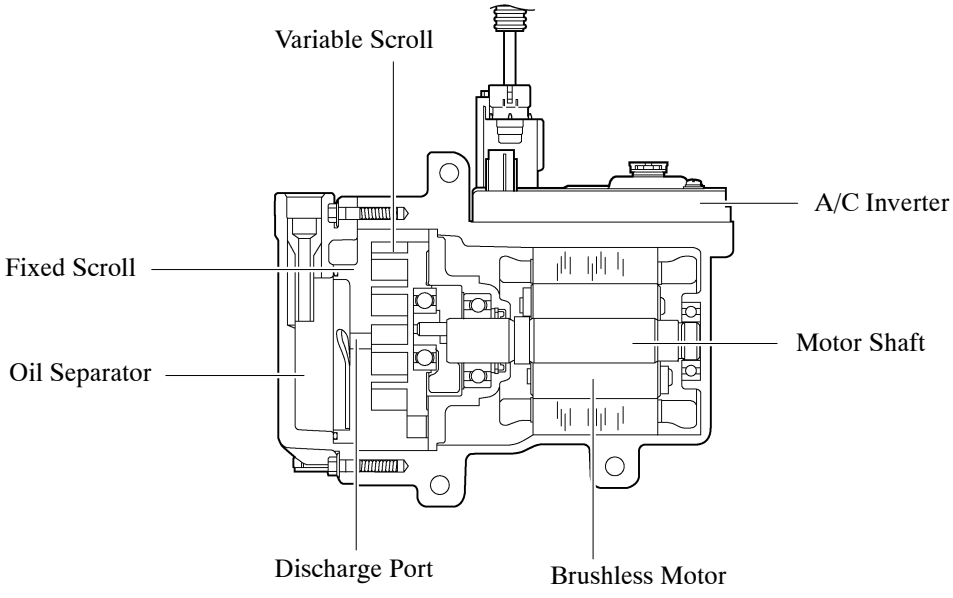


Service Tip

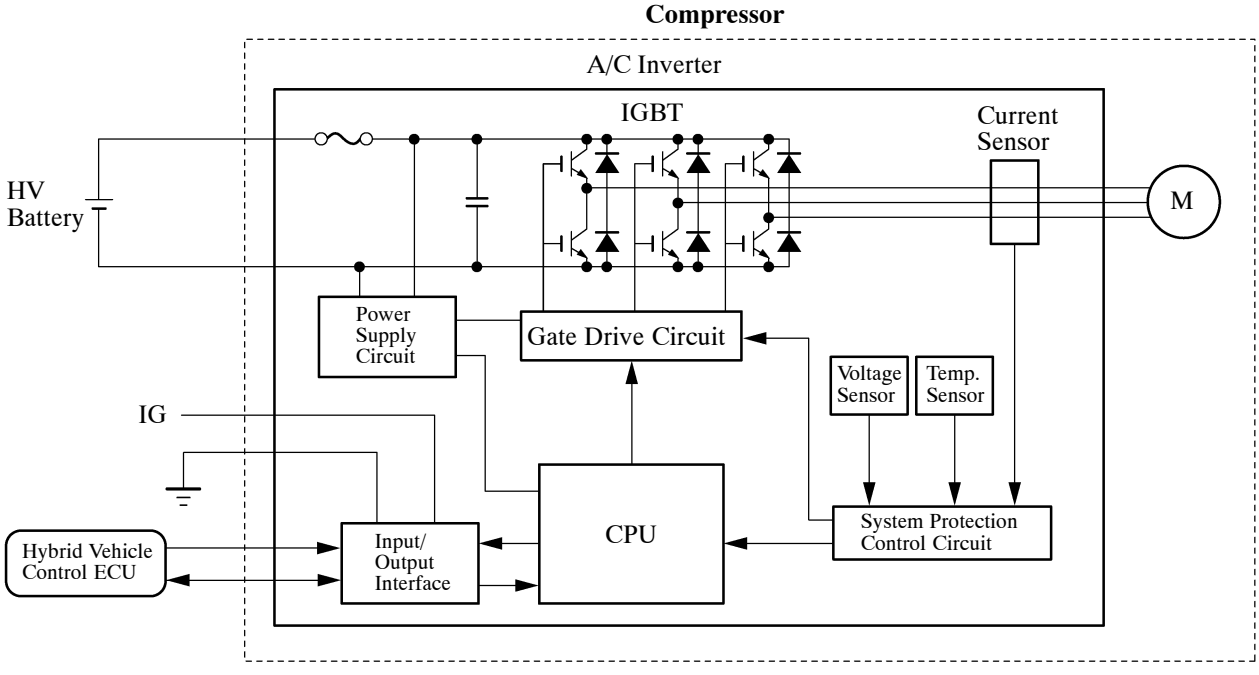
In order to ensure the proper insulation of the internal high-voltage portion of the compressor and the compressor housing, compressor oil (ND11) with a high level of insulation performance is used. Therefore, never use compressor oil other than the ND11 type compressor oil or a compressor oil having equivalent lubrication and electrical insulation properties.

Construction

- The compressor with motor assembly consists of a spirally wound fixed scroll and variable scroll that form a pair, a brushless motor, an oil separator, a motor shaft and A/C inverter.
- The fixed scroll is integrated with the housing. Because the rotation of the shaft causes the variable scroll to revolve while maintaining the same posture, the volume of the space that is partitioned by both scrolls varies to perform the suction, compression, and the discharge of the refrigerant gas.
- Locating the suction port directly above the scrolls enables direct suction, thus realizing improved suction efficiency.
- Containing a built-in oil separator, this compressor is able to separate the compressor oil that is intermixed with the refrigerant and circulates in the refrigeration cycle, thus realizing a reduction in the oil circulation rate.
- This inverter converts the HV battery's nominal voltage of DC 288V into AC 288V and supplies power to operate the compressor.



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Operation

1) Suction

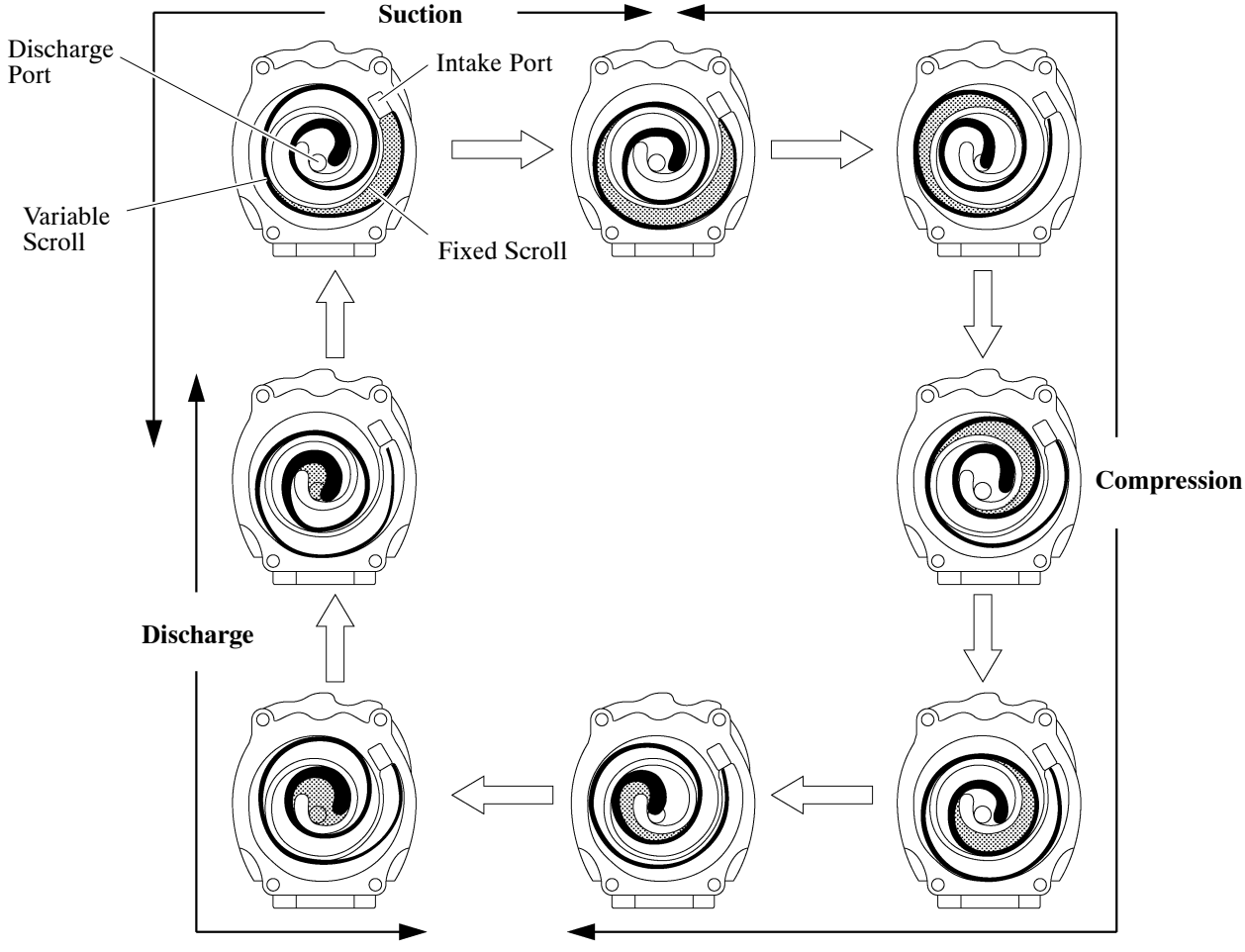
As the capacity of the compression chamber, which is created between the variable scroll and the fixed scroll, increases in accordance with the speed of the variable scroll, refrigerant gas is drawn in from the intake port.

2) Compression

From the state at which the suction process has been completed, as the revolution of the variable scroll advances further, the capacity of the compression chamber decreases gradually. Consequently, the refrigerant gas that has been drawn in becomes compressed gradually and is sent to the center of the fixed scroll. The compression of the refrigerant gas is completed when the variable scroll completes approximately 2 revolutions.

3) Discharge

When the compression of the refrigerant gas is completed and the refrigerant pressure becomes high, the refrigerant gas discharges through the discharge port located in the center of the fixed scroll by pushing the discharge valve.



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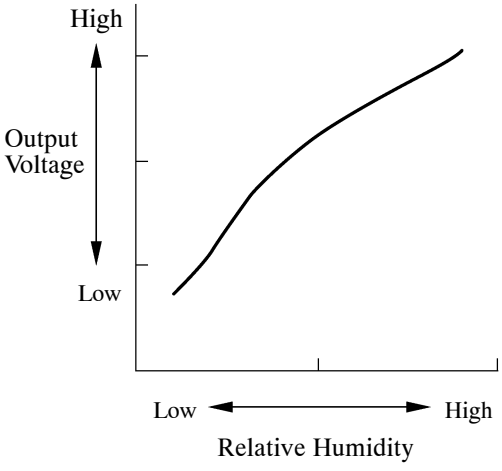
5. Room Temperature Sensor and Humidity Sensor

- The availability of the room temperature sensor and humidity sensor is as follows.

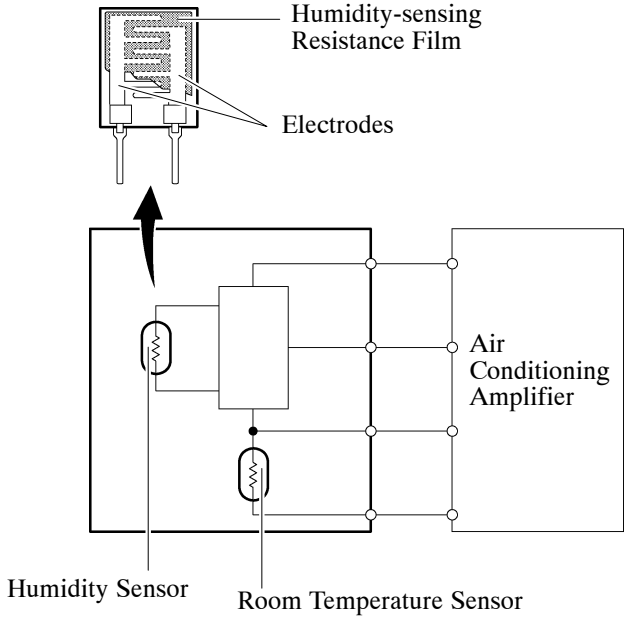
×: Standard -: Not Equipped

Item		Equipment	
		Room Temperature Sensor	Humidity Sensor
Front A/C	Manual	×	-
	Automatic	×	×
Rear A/C	Manual	-	-
	Automatic	×	-

- 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.
- A humidity sensor function is added to the room temperature sensor. By enabling the detection of humidity in the vehicle interior, this function optimizes the amount of dehumidification effort during the operation of the air conditioning system. As a result, the power consumption of the compressor has been reduced and a comfortable level of humidity has been realized in the vehicle interior.
- The humidity-sensing resistance film that is built into the humidity sensor absorbs and releases the humidity in the vehicle interior. During the absorption and releasing processes, the humidity-sensing resistance film expands (during the absorption of humidity) and contracts (during drying). The clearance between the carbon particles in the humidity-sensing resistance film expands and contracts during absorption and drying, thus changing the resistance between the electrodes. The air conditioning amplifier determines the humidity in the vehicle interior through the changes in the output voltage of the humidity sensor that are caused by the resistance between the electrodes.



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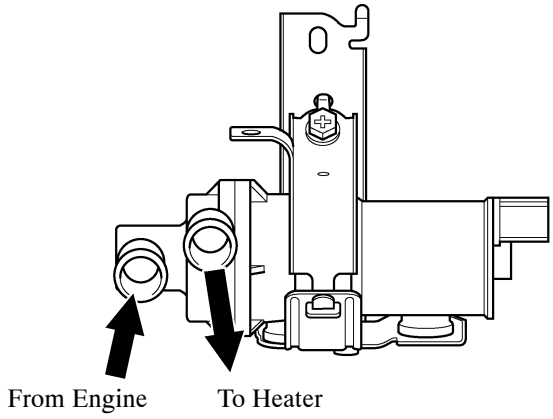
BE

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. Water Pump

- A water pump is used to circulate coolant for the heater core in the air conditioning system. This provides a stable heater performance even if the engine is stopped due to THS-II control.
- A water pump in which the water flow resistance has been reduced is used.

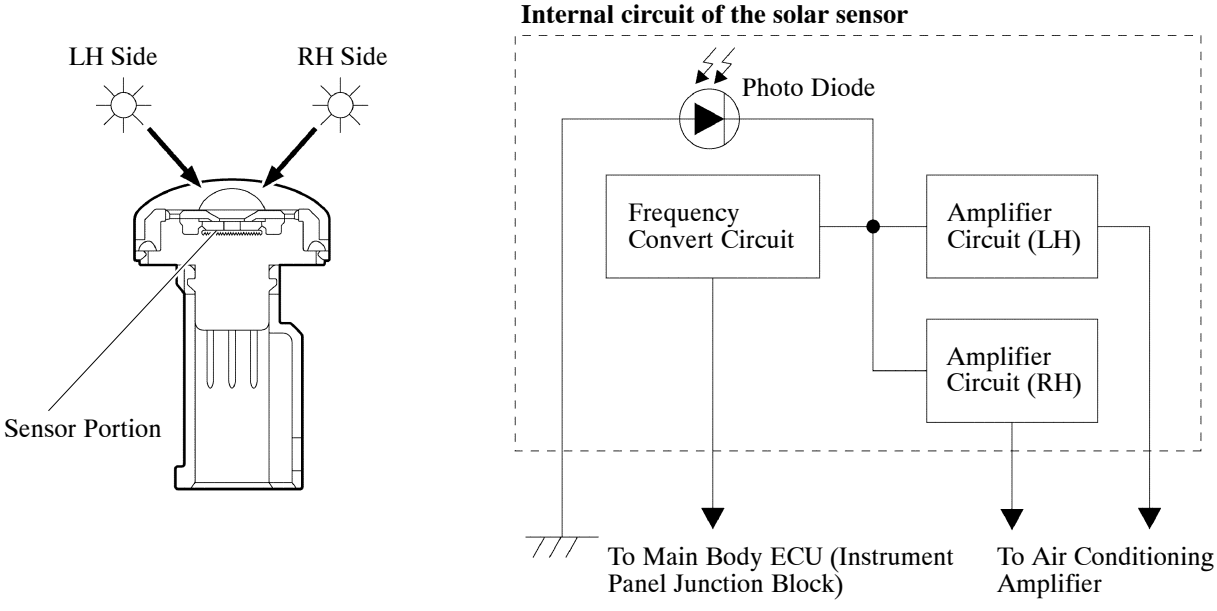


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8. Solar Sensor

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.



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