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HVAC SYSTEM (HEATER, VENTILATOR, AND A/C)

HEATER SYSTEM

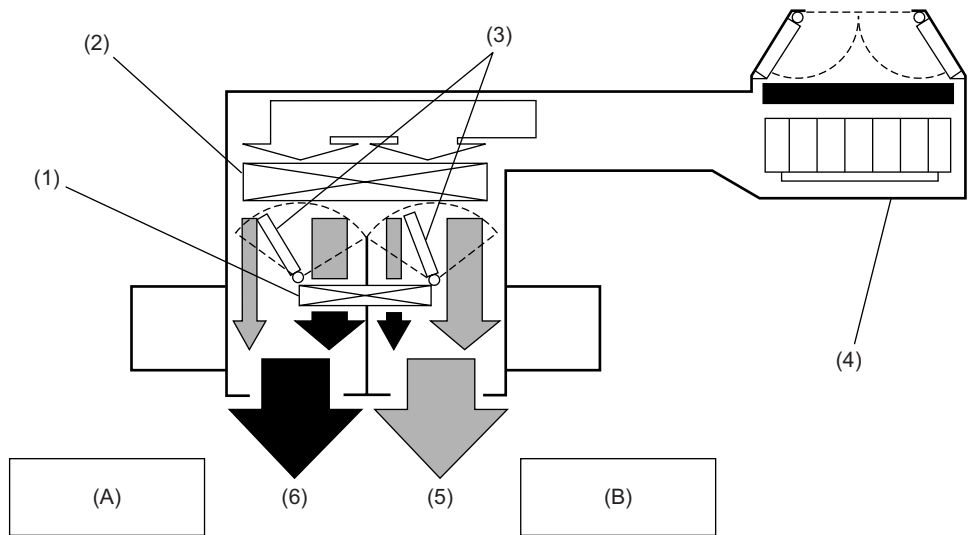
HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

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1. Heater System

A: GENERAL

- A semi-center type integrated air conditioning unit is used, where a high performance heater core and an evaporator core are placed in front and rear of the unit. While ensuring sufficient leg space at the front passenger's seat, resistance to air flow in the air passage is reduced, and the air conditioning system offers a low noise and comfortable environment in all seasons through its functions such as heating, air conditioning, ventilating and defrosting.
- On models with automatic air conditioning, a left/right independent temperature control system is introduced to enable the driver and passenger choose a desirable temperature setting individually.



AC-01171

- (A) Driver's seat
- (B) Passenger's seat
- (1) Heater core
- (2) Evaporator
- (3) Air mix door

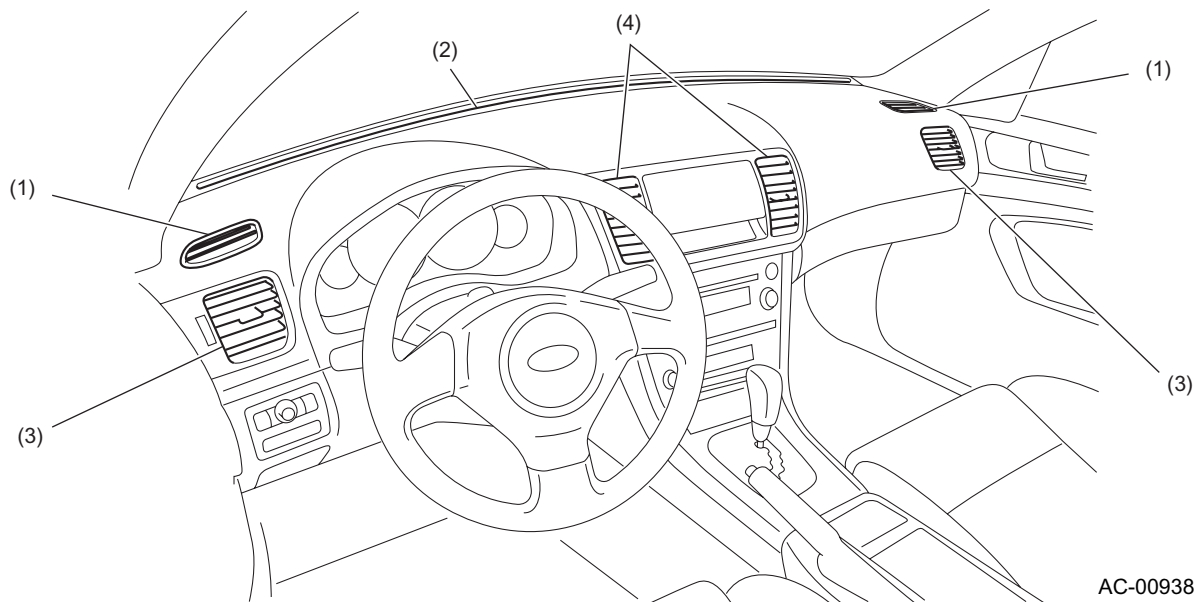
- (4) Blower unit
- (5) Cool air
- (6) Warm air

- There are four ventilation grilles in the dashboard; two large size grilles at the center and a side grille at each side. To improve the defrosting performance, air is always sent out from the side grilles.

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- (1) Side defroster
- (2) Front defroster

- (3) Side ventilation grille
- (4) Center ventilation grille

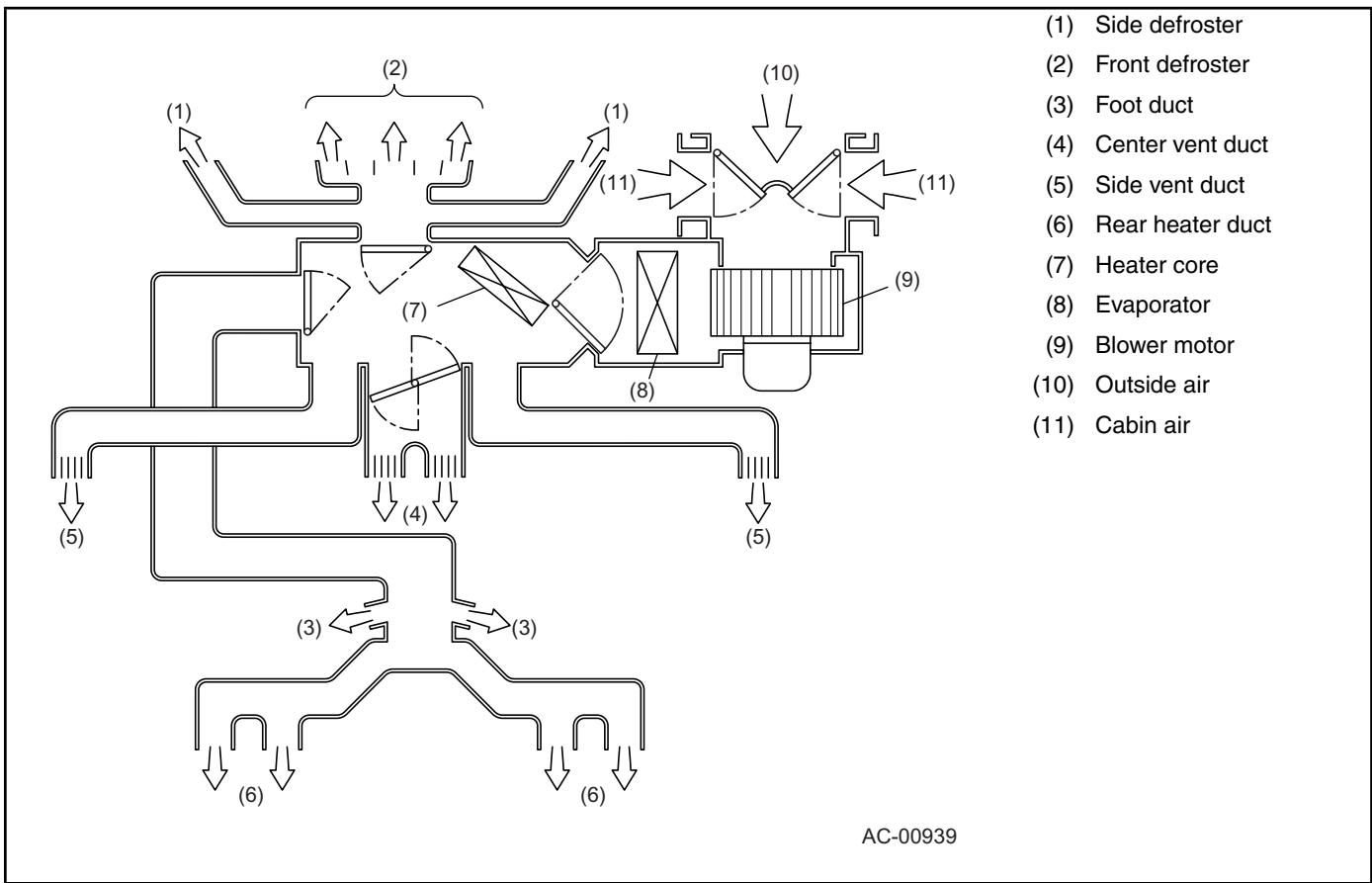
1. SPECIFICATIONS

Heating type	Heating performance (W)	Blower power consumption (W)	Maximum blower capacity (m ³ /h)		
			VENT	HEAT	DEF
Outside air mixing type ("full-air-mix" type)	5200	220 or less	460	320	300

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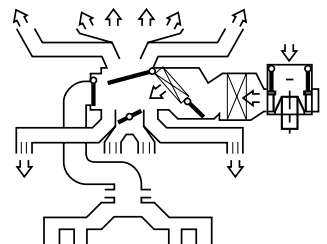

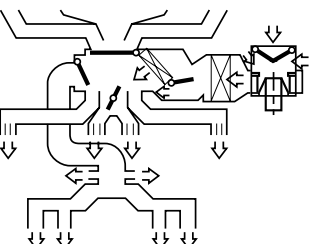

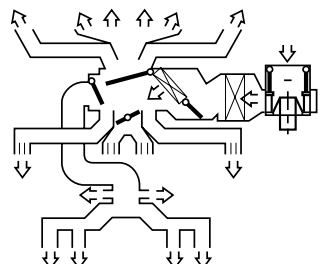

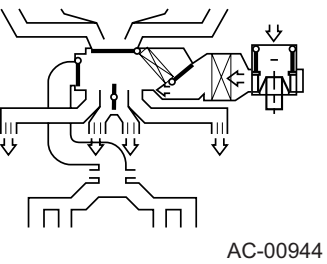

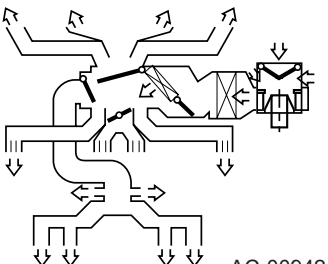

B: AIR FLOW MODES



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Switch position		Heater unit door operation		Switch position		Heater unit door operation	
Air flow control	 DEF AC-00119	 AC-00940	Air flow control	 BILEVEL AC-00122	 AC-00943		
	 DEF/FOOT AC-00837	 AC-00941		 FACE AC-00839	 AC-00944		
	 FOOT AC-00838	 AC-00942		FRESH/RECIRC switching  AC-00124	This switch allows selecting either of cabin-air-recirculation or fresh-air-introduction modes. FRESH/RECIRC is changed each time the switch is pressed. Indicator ON: cabin air recirculation Indicator OFF: fresh air introduction		

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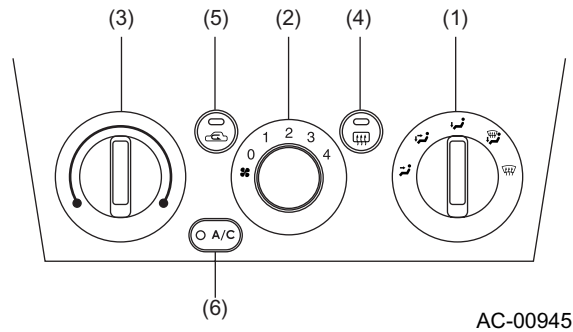
C: CONTROL PANEL

- The control panel is incorporated into the center panel. To improve the appearance of the interior, the panel is integrated with the audio panel except for models with some audio equipment variations.

- A rear window defogger switch is located in the control panel.

1. MODELS WITH MANUAL AIR CONDITIONING

- The control panel uses three large-diameter, dial type switches for easy operation and good visual recognition.



- (1) Air flow control dial:
This switch allows selecting any of the five air flow modes.



AC-00127

- (2) Fan speed control dial:
This switch allows turning on/off the blower and selecting any of the four blower speeds.

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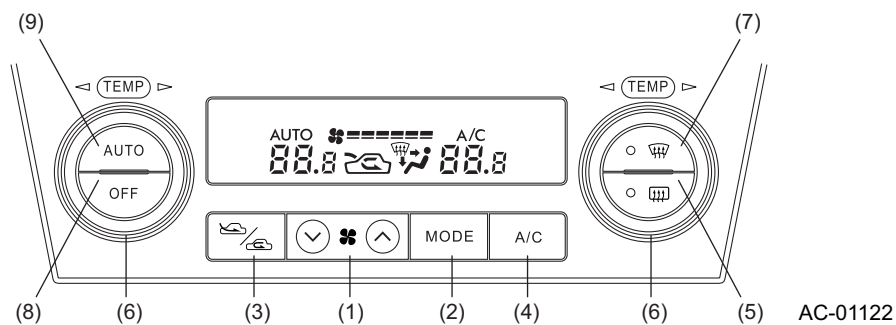
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AC-00126

- (3) Temperature control dial:
This switch allows step-less adjusting of the temperature of air delivered through ventilators.
- (4) Rear window defogger switch:
This switch activates the rear defogger. When the switch is left on, a timer keeps the defogger activated for 15 minutes and then turns it off automatically.
- (5) FRESH/RECIRC switch:
This switch allows selecting either cabin-air-recirculation or fresh-air-introduction.
- (6) Air conditioning switch:
This switch turns on or off the air conditioning compressor.

2. MODELS WITH AUTOMATIC AIR CONDITIONING

- A motor driven actuator is used for air outlet switching, driver and passenger side temperature control, and FRESH/RECIRC switching.
- A large sized LCD panel which excels in visibility is used for the control panel.
- To eliminate errors due to heat, the cabin temperature sensor is moved from the control panel to the console side panel.



- (1) Fan speed control switch:
In automatic air conditioning mode, the system controls the blower speed automatically in accordance with sensor signals.
In manual air conditioning mode, this switch allows selecting any of the six blower speeds.
- (2) Air flow control switch:
This switch allows selecting any of the four air flow modes.

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AC-00130

- (3) **FRESH/RECIRC switch:**
This switch allows selecting either cabin-air-recirculation or fresh-air-introduction.
- (4) **A/C switch:**
This switch turns on or off the air conditioning compressor.
- (5) **Rear window defogger switch:**
This switch activates the rear defogger. When the switch is left on, a timer keeps the defogger activated for 15 minutes and then turns it off automatically.
- (6) **Temperature control dial (left: driver's seat, right: passenger's seat):**
By turning the left or right dial the temperature of air delivered through ventilators can be adjusted individually at the driver's side and passenger's side. When the dial is turned clockwise the temperature setting rises, and when the dial is turned counterclockwise the setting becomes lower. Temperature setting can be changed in a range between 18 and 32°C in 0.5°C steps.
- (7) **Defroster switch:**
When this switch is turned ON the system enters the defroster mode.
- (8) **OFF switch:**
All functions are disabled.
- (9) **AUTO switch:**
When this switch is turned ON the system enters auto air conditioning mode and automatically controls the blower fan speed, air outlet, fresh/recirculation switching, and compressor operation.

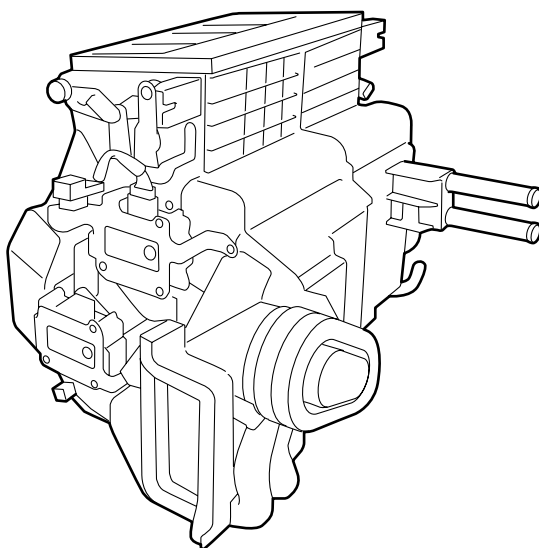
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D: HEATER AND COOLING UNIT

- Having an evaporator core at the front and a heater core at the rear, this single unit combines both heating and cooling functions.
- The heater and cooling unit incorporates mode doors for creating different air flow modes and an air mix door for mixing heated air and outside air.
- On models with automatic air conditioning, the inside of the heater and cooling unit is separated into left and right parts so that the driver and passenger can individually control the temperature.
- In models with an automatic air conditioning, the mode doors and air mixing door are moved by electric-motor-driven actuators.
In models with a manual air conditioning system, the air mix door is moved by a linkage cable.



AC-00947

1. SPECIFICATIONS

Heater core size	Heat output
264 × 110 × 27	5200 W

HEATER SYSTEM

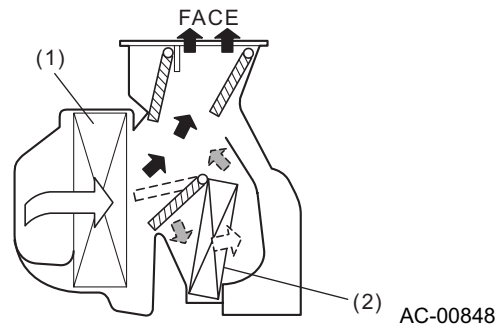
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2. DESIGN FEATURES FOR EACH AIR FLOW MODE

1) Ventilation (FACE) mode

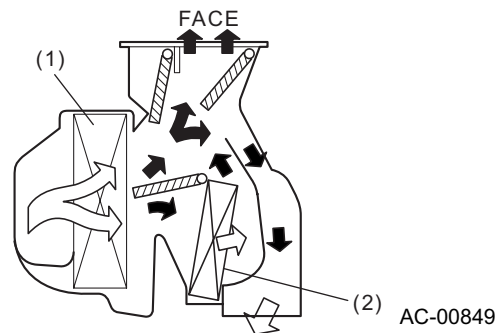
- The passage leading air from the evaporator to the ventilation duct is made straight to reduce air flow resistance.
- When the air temperature is necessary to be adjusted, heated air is blown at right angles against the flow of cool air from the evaporator. This allows the airs to mix thoroughly.



- (1) Evaporator
- (2) Heater core

2) Foot/face (BILEVEL) mode

- The air that has flown through the evaporator is divided into two directions. Part of this air flows through the heater core and becomes warm air. The rest of the air goes to the outlet as cool air, however, this is mixed with the warm air from the heater core. The mixed air then flows to the ventilation and heater ducts.



- (1) Evaporator
- (2) Heater core

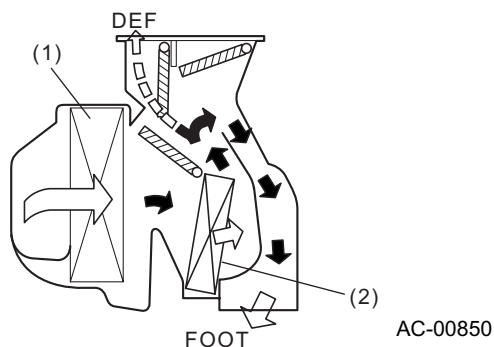
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3) Heating (FOOT) mode

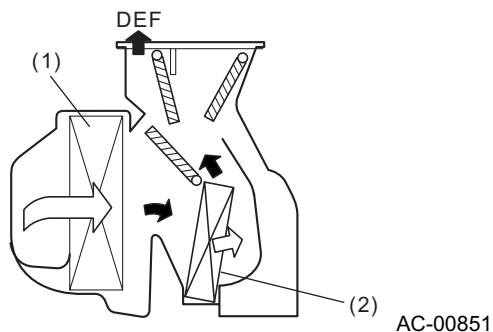
- The air that has flown through the evaporator is heated at the heater core and then flows to the heater ducts.
- To defog the windshield, the defroster door is slightly open and warm air is also sent to the defroster (DEF) duct.
- The side ventilation grills ventilate air always.



- (1) Evaporator
- (2) Heater core

4) Defroster (DEF) mode

- Air passages are designed in such a way that air flow resistance is minimized and defrosting performance is maximized.
- The air passages toward the defroster (DEF) outlet is long enough to ensure a same airflow rate at all defroster outlets.
- The side ventilation grills ventilate air always.



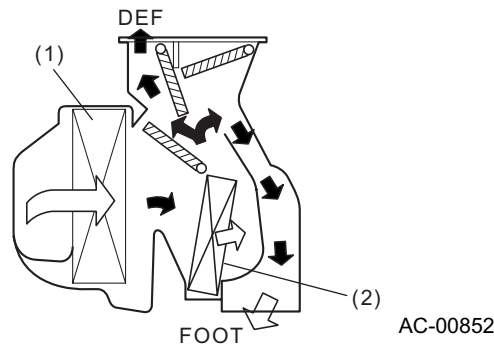
- (1) Evaporator
- (2) Heater core

HEATER SYSTEM

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5) Defroster (DEF) /Heating (FOOT) mode

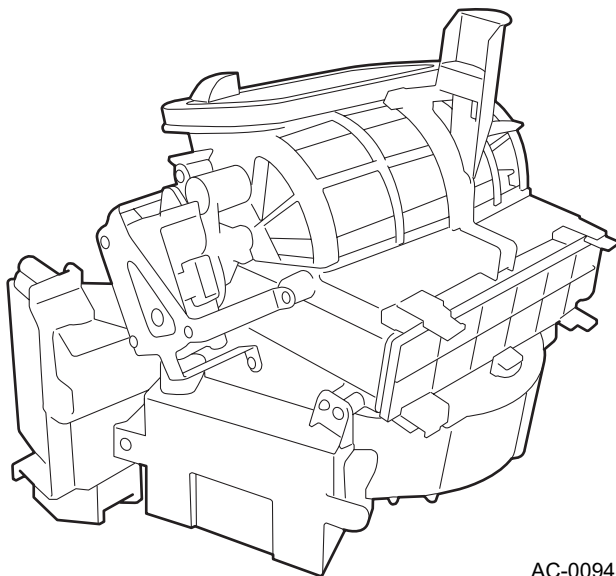
- The air from the evaporator flows through the heater core and the warmed air flows to the defroster (DEF) duct and foot duct to defog the windshield while sending warm air to the legs.
- The air directed to the defroster duct flows out from the front and side defroster ducts to defog the windows.
- The side ventilation grills ventilate air always.



- (1) Evaporator
- (2) Heater core

E: BLOWER UNIT

- The blower unit uses a low-noise-type motor.



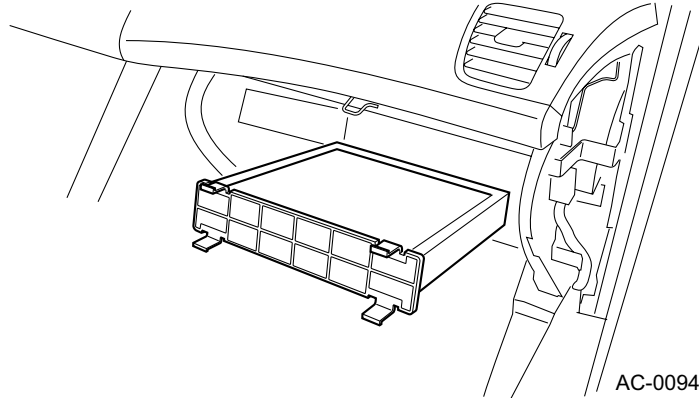
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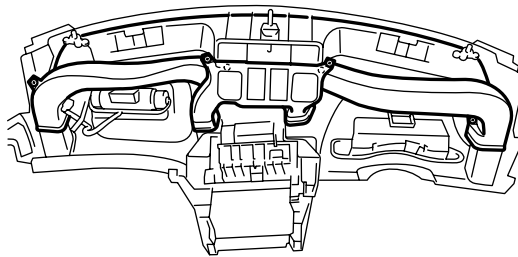
F: FILTER

- Clean air filters are available for all models as dealer option. They can remove dust, cigarette smoke particles and other similar impurities in the air.



G: DUCT

- The ventilation duct and defroster duct are located behind the instrument panel. Both the ducts have been modified in the shape to reduce air flow resistance.
- Defrosting air flow is divided at the center, so that air can flow out evenly through a wide center defroster as well as right and left side defrosters.



AC-00950

COOLING SYSTEM

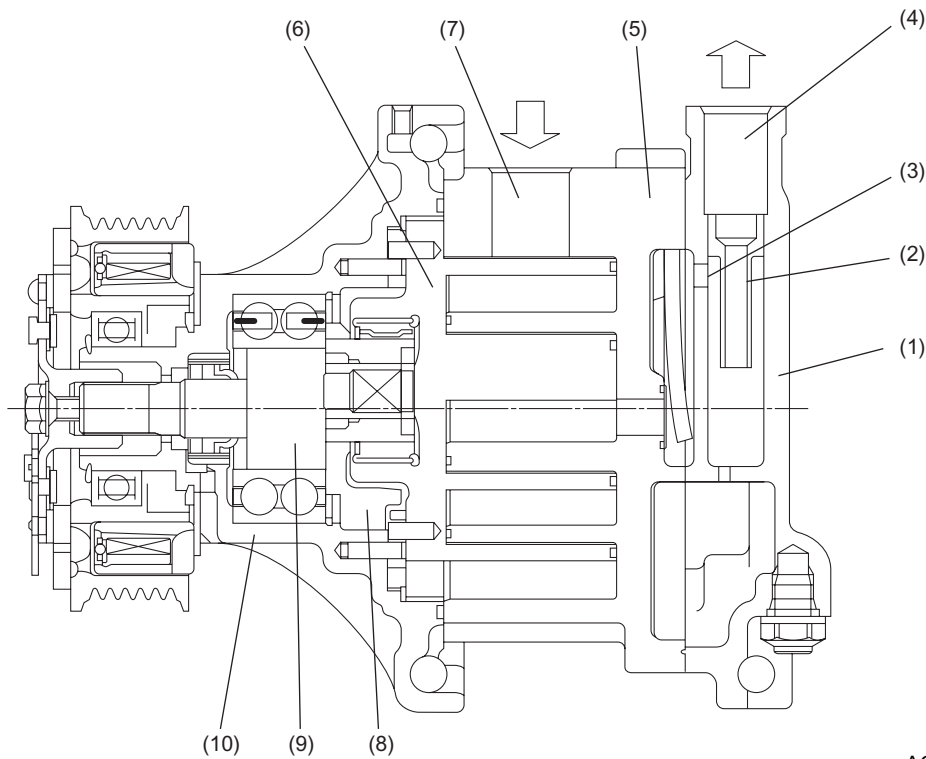
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2. Cooling System

A: COMPRESSOR

As two scrolls (one movable and other fixed) are engaged, a crescent chamber is formed between multiple contact points. The movable scroll cannot rotate on its own axis but orbits instead, so the operating chamber moves inwards while its capacity is reduced. Intake, compression and discharge take place simultaneously at multiple operation chambers, and compressed refrigerant is sent from the discharge hole at the center to the oil separator and then separated in to refrigerant gas and oil before it is output from the discharge port.



AC-00874

- | | |
|-------------------------|---------------------------|
| (1) Rear housing | (6) Rotor: movable scroll |
| (2) Oil separator | (7) Suction port |
| (3) Discharge hole | (8) Balancer |
| (4) Discharge port | (9) Shaft |
| (5) Shell: fixed scroll | (10) Front housing |

COOLING SYSTEM

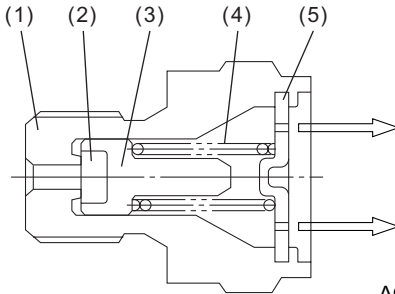
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1. PRESSURE RELIEF VALVE

This valve opens if the pressure of the high-pressure refrigerant gas rises to a dangerously high level to release part of refrigerant into the atmosphere, thus protecting the compressor. The valve is designed to limit the amount of released gas to the necessary minimum.

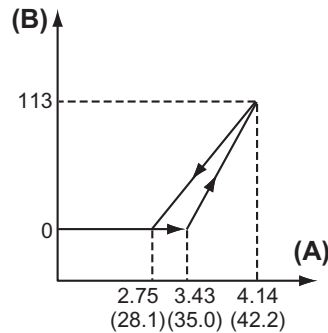
- Valve opening pressure: above 3.43 MPa (35.0 kgf/cm²)
- Valve closing pressure: above 2.75 MPa (28.1 kgf/cm²)
- Valve wide open pressure: below 4.14 MPa (42.2 kgf/cm²)



AC-00875

- | | |
|-------------|------------|
| (1) Housing | (4) Spring |
| (2) Valve | (5) Plate |
| (3) Holder | |

Operating characteristics



AC-00876

- (A) Pressure MPa (kgf/cm²)
(B) Leakage l/min

COOLING SYSTEM

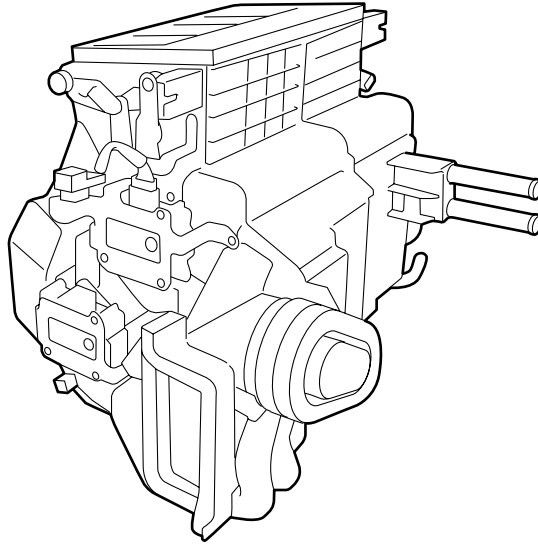
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B: COOLING UNIT

The heater unit and cooling unit are integrated into a single heater and cooling unit.

The cooling section components of this unit include an evaporator, expansion valve, and case.



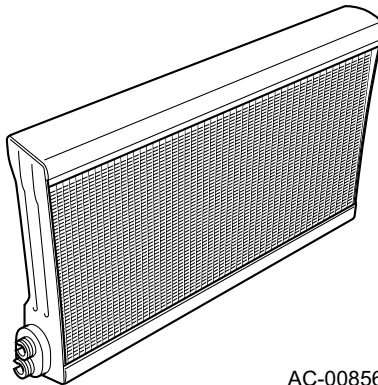
AC-00947

1. EVAPORATOR

The evaporator is a laminated type.

When a low-pressure, low-temperature refrigerant is sprayed by the expansion valve into the evaporator, it evaporates and cools the evaporator surfaces.

The cabin air is drawn by the blower and cooled down as it flows over the evaporator. The cooled air then flows passing through the heater unit and delivered into the cabin through vent outlets.



AC-00856

COOLING SYSTEM

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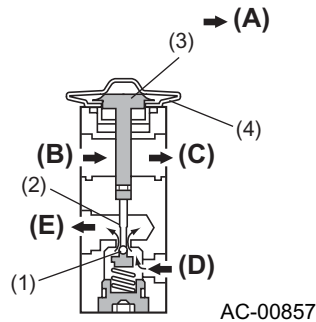
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2. EXPANSION VALVE

The expansion valve regulates the flow of refrigerant such that heat exchange takes place optimally.

The expansion valve performs two functions; it sprays the high-pressure refrigerant from the condenser using a throttle valve, and it regulates the amount of the spray by changing opening of the throttle valve.

The expansion valve consists of such main components as a heat sensing cylinder, diaphragm, ball valve, spring, and adjusting screw.



- | | |
|---------------------------|-----------------------------------------|
| (1) Ball valve | (A) Refrigerant flow |
| (2) Shaft | (B) From evaporator (low-pressure side) |
| (3) Heat sensing cylinder | (C) To compressor |
| (4) Diaphragm | (D) To liquid tank |
| | (E) To evaporator (high-pressure side) |

The heat (temperature) sensing cylinder is held in contact with the evaporator outlet pipe so that a pressure corresponding to the sensed temperature may be applied to the chamber above the diaphragm. There is a pressure equalizing hole which communicates with the chamber below the diaphragm to transmit changes in the refrigerant pressure to the chamber. The ball valve is linked with the diaphragm and moves according to changes in the balance between the force applied to the diaphragm and the tension of the spring.

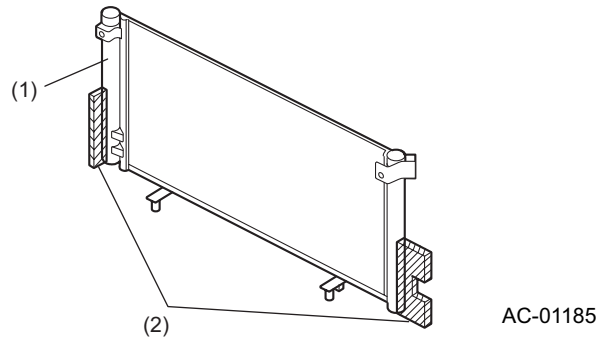
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C: CONDENSER

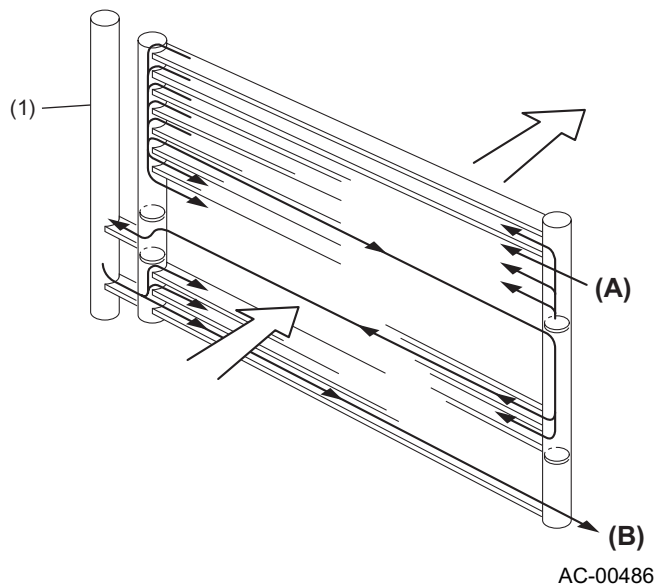
The condenser is a newly developed subcooling condenser that integrates a multi-flow type condenser and a modulator (gas-liquid separator) into a single unit. The condenser has a high heat-exchange efficiency.



- (1) Liquid tank
- (2) Urethane

1. SUBCOOLING CONDENSER

The new subcooling condenser has a subcooling section where part of the refrigerant that remains in gas form is cooled and reduced into liquid form. This enables almost 100% of the refrigerant to be re-liquefied.



- (1) Liquid tank
- (A) Suction
- (B) Discharge

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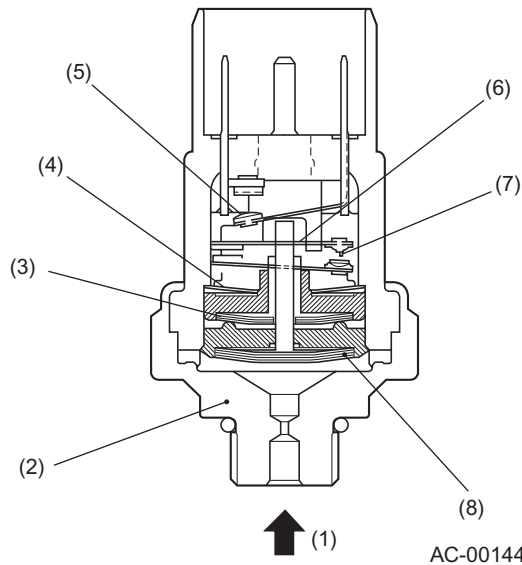
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D: PRESSURE SWITCH

The pressure switch is a high-pressure side component of the refrigeration cycle (cooling cycle). It consists of a diaphragm that receives refrigerant gas pressure, a snap plate, a rod, contacts that open both when the gas pressure is too low and when it is too high, and a switch that operates at mid-pressure.

The pressure switch plays the following roles:

- Prevents “no-gas” operation due to leakage (when gas pressure is too low)
- Protects the system against abnormally high refrigerant pressure (when gas pressure is too high)
- Detects compressor load (mid pressure contact: electric cooling fan output control)



(1) Pressure

(2) Housing

(3) Diaphragm (high pressure)

(4) Diaphragm (low pressure)

(5) Mid-pressure switch

(6) Lever (high-pressure)

(7) High and low pressure switch

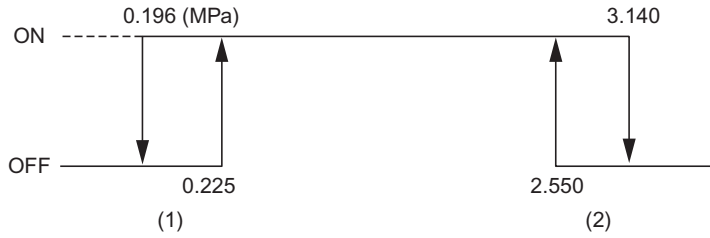
(8) Diaphragm (mid pressure)

COOLING SYSTEM

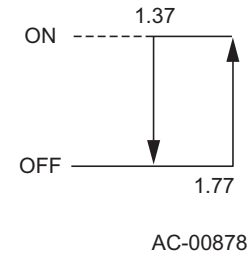
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ON-OFF pressures

(A)



(B)



AC-00878

(A) High and low pressure switch

(B) Mid-pressure switch

(1) Low pressure

(2) High pressure

1. SPECIFICATIONS

High/low pressure switch (compressor ON/OFF control)

Low pressure switch	ON→OFF	0.196 MPa (2.00 kgf/cm ²)
	OFF→ON	0.255 MPa (2.60 kgf/cm ²)
High pressure switch	ON→OFF	3.140 MPa (32.0 kgf/cm ²)
	OFF→ON	2.550 MPa (26.0 kgf/cm ²)

Mid pressure switch (electric cooling fan output control)

Compressor at low load	ON→OFF	1.37 MPa (13.9 kgf/cm ²)
Compressor at high load	OFF→ON	1.77 MPa (18.0 kgf/cm ²)

MANUAL AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

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3. Manual Air Conditioning

A: GENERAL

1. SPECIFICATIONS

Item	Specifications		Remarks	
Air conditioning	"Full-air-mix" type			
Cooling performance	Cooling capacity (W)	5300		
	Air flow rate (m ³ /h)	460		
Refrigerant quantity	HFC-134a (g)	400±30		
Compressor	Type	Scroll	Denso SCSA08C	
	Capacity (cm ³ /rev)	74.5		
	Maximum permissible speed (rpm)	9000		
	Lubricant (amount contained in compressor in g)	Denso oil 8 (70)		
Magnetic clutch	Type	Dry, single disc		
	Power consumption (W)	35		
	Pulley ratio	1:1.43 (crankshaft pulley diameter: 133 mm; compressor pulley diameter: 125 mm)		
	Belt	Polyurethane V-belt with four ribs		
Condenser	Type	Multi-flow type (with built-in liquid tank for subcooling)		
	Fan	Type		Electric-motor-driven axial flow fan
		Fan diameter		300 mm (7+5 blades)
		Power consumption (W)		90 × 2
Evaporator	Type	Laminated		
	Expansion valve	External pressure equalizing type		
	Temperature control	Thermo AMP (amplifier)		
Other controls	Fast idle control system	Engine control module (ECM)		
	High and low pressure limit control	Low pressure switch: Turns off compressor at a pressure lower than 0.196 MPa High-pressure switch: Turns off compressor at a pressure higher than 3.140 MPa		
	High-speed limit control	Performed by ECM		
	Radiator and condenser fan control	Performed by ECM		

2. CONTROL PANEL

<Ref. to AC-6, MODELS WITH MANUAL AIR CONDITIONING, CONTROL PANEL, Heater System.>

3. THERMO AMP (AMPLIFIER)

The thermo AMP detects the temperature at the evaporator outlet to turn off the magnetic clutch circuit when the evaporator temperature drops to a certain level in order to prevent frost from forming on the evaporator.

AUTOMATIC AIR CONDITIONING

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4. Automatic Air Conditioning

A: GENERAL

When the AUTO mode is selected, the automatic air conditioner controls the air temperature and air flow rate automatically.

AUTOMATIC AIR CONDITIONING

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1. SPECIFICATIONS

Item	Specifications		Remarks	
Air conditioning	"Full-air-mix" type			
Cooling performance	Cooling capacity (W)	5300		
	Air flow rate (m ³ /h)	460		
Refrigerant (g)	400±30			
Compressor	Type	Scroll	Denso SCSA08C	
	Capacity (cm ³ /rev)	74.5		
	Maximum permissible speed (rpm)	9000		
	Lubricant (amount contained in compressor in g)	Denso oil 8 (70)		
Magnetic clutch	Type	Dry, single disc		
	Power consumption (W)	35		
	Pulley ratio	1:1.43 (crankshaft pulley diameter: 133 mm; compressor pulley diameter: 125 mm)		
	Belt	Polyurethane V-belt with four ribs (H4) or six ribs (H6)		
Condenser	Type	Multi-flow type (with built-in liquid tank for subcooling)		
	Fan	Type		Electric-motor-driven axial flow fan
		Fan diameter		H4: 300 mm Turbo and H6: 320 mm (7+5 blades)
		Power consumption (W)		H4: 90 × 2, H6: 160 × 2, Turbo: 120 × 2
Evaporator	Type	Laminated		
	Expansion valve	External pressure equalizing type		
	Temperature control sensor	Thermistor		
Automatic control system	Temperature control	"Full-air-mix" system		
	Fan speed control	Automatic control: stepless Manual control: six steps		
	Air introduction selection	Manual (inside air recirculation/fresh air introduction)		
	Air outlet selection	Manual (ventilation, bi-level, heater, defroster and heater/defroster)		
Other controls	Fast idle control system	Engine control module (ECM)		
	High and low pressure limit control	Low-pressure switch: Turns off compressor at a pressure higher than 0.196 MPa High-pressure switch: Turns off compressor at a pressure higher than 3.140 MPa		
	High-speed limit control	Performed by ECM		
	Radiator and condenser fan control	Performed by ECM		
Diagnosis function	The auto A/C control module has a sensor and actuator diagnosis function.			
Other controls	Manual adjustment possible at maximum heating and maximum cooling positions			

AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

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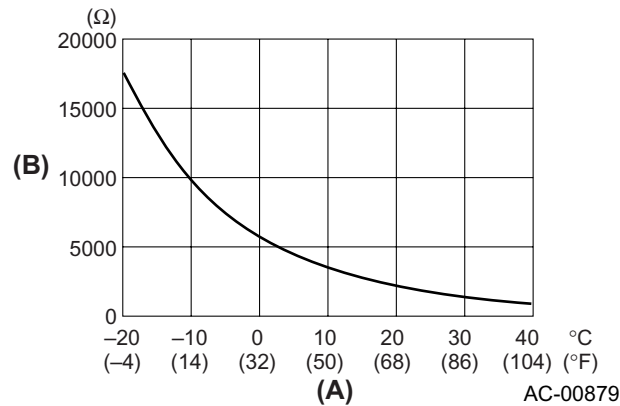
B: CONTROL PANEL

<Ref. to AC-7, MODELS WITH AUTOMATIC AIR CONDITIONING, CONTROL PANEL, Heater System.>

C: IN-VEHICLE SENSOR

The in-vehicle sensor detects the cabin temperature and sends an electric signal corresponding to the temperature to the A/C control module.

This sensor consists of an aspirator and a thermistor, the resistance of which changes in inverse proportion to the temperature. The aspirator operates by a vacuum generated in the heater unit (only when the blower unit is turned on).



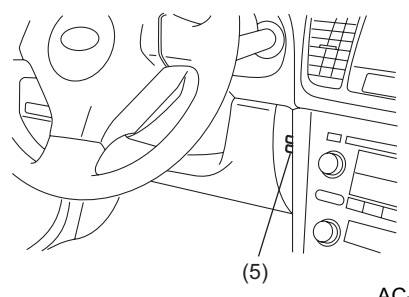
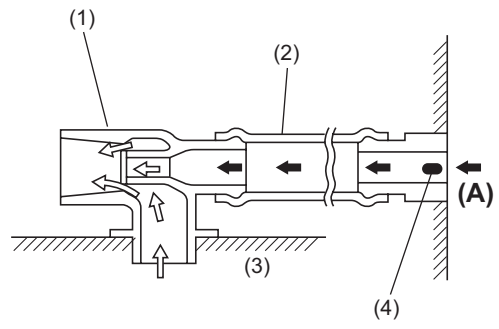
(A) Temperature

(B) Resistance

AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

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AC-01186

- (1) Aspirator
- (2) Aspirator duct
- (3) Heater unit
- (4) In-vehicle sensor
- (5) Cabin air inlet
- (A)** Cabin air

AUTOMATIC AIR CONDITIONING

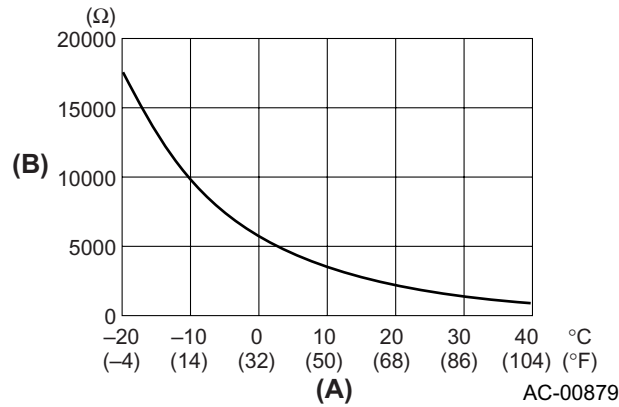
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D: AMBIENT SENSOR

The ambient sensor uses a thermistor to detect the ambient temperature and outputs a signal corresponding the detected temperature to the auto A/C control module.

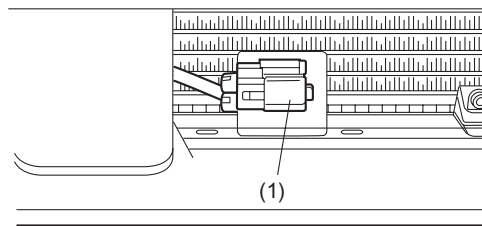
The thermistor is covered with a plastic molding to increase its thermal capacity, thus preventing it from being too sensitive to rapid changes in the temperature and enabling the sensor to output an average ambient temperature.



(A) Temperature

(B) Resistance

The ambient sensor is attached to the radiator lower panel at the portion where the radiator panel is located in such a way that it is exposed to outside air most efficiently.



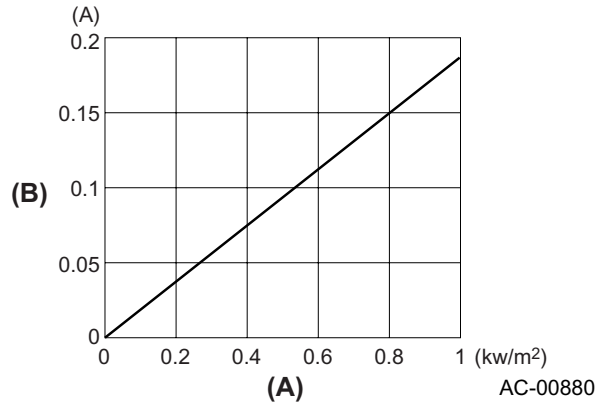
AC-00712

(1) Ambient sensor

E: SUN-LOAD SENSOR

The sun-load sensor uses a photodiode which can convert change in the intensity of solar radiation into change in the electric current. The output signal of the sensor is sent to the auto A/C control module.

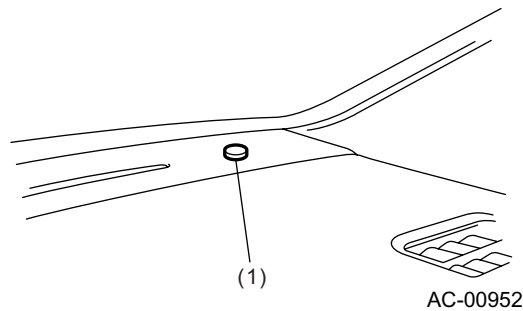
Sun-load sensor characteristic



(A) Solar radiation

(B) Photoelectric current

The sun-load sensor is attached to the front defroster grill.



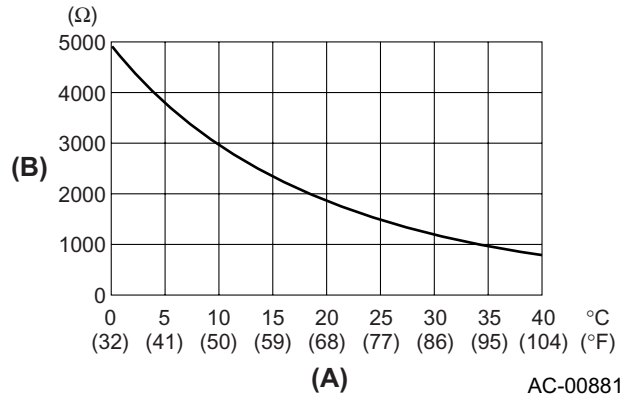
(1) Sun-load sensor

AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

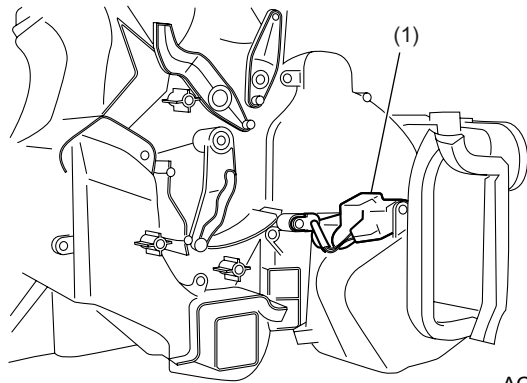
F: EVAPORATOR SENSOR

The evaporator sensor detects the temperature of the air that has passed over the evaporator and transmits a signal corresponding to the temperature to the auto A/C control module.



(A) Temperature

(B) Resistance



(1) Evaporator sensor connector

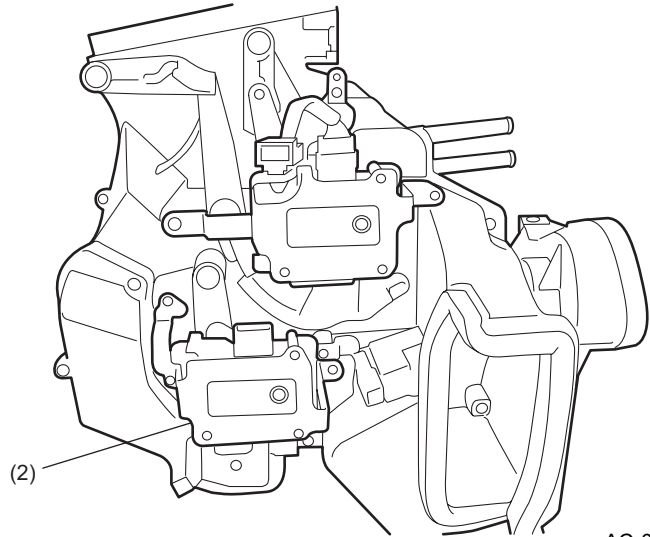
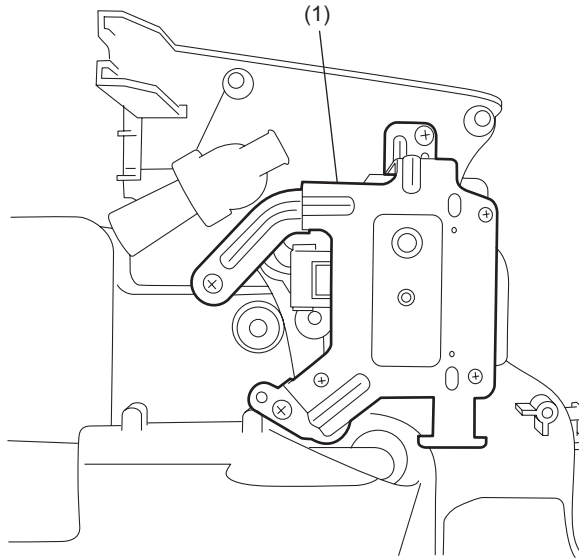
AUTOMATIC AIR CONDITIONING

HVAC SYSTEM (HEATER, VENTILATOR AND A/C)

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G: AIR MIX DOOR ACTUATOR

Air mix door actuators are installed at left and right of the heater and cooling unit, and they move the left and right air mix doors independently to the proper position in response to signals from the auto A/C control module. This enables the driver and passenger to control the temperature individually.



AC-01123

- (1) Air mix door actuator (driver's seat)
- (2) Air mix door actuator (passenger's seat)

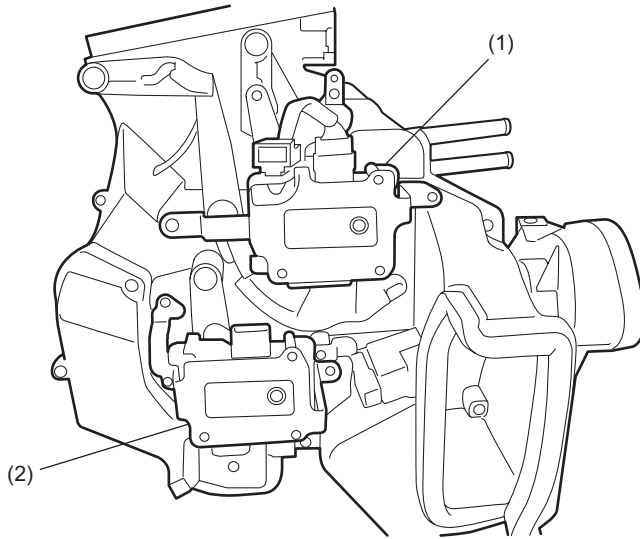
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H: MODE DOOR ACTUATOR

The mode door actuator incorporates an electric motor which turns in one or the other direction in response to signals from the auto A/C control module. The motion of the electric motor is transmitted to each mode door via a linkage and moves the door to the position appropriate for the selected air flow mode.



AC-00954

- (1) Mode door actuator
- (2) Air mix door actuator

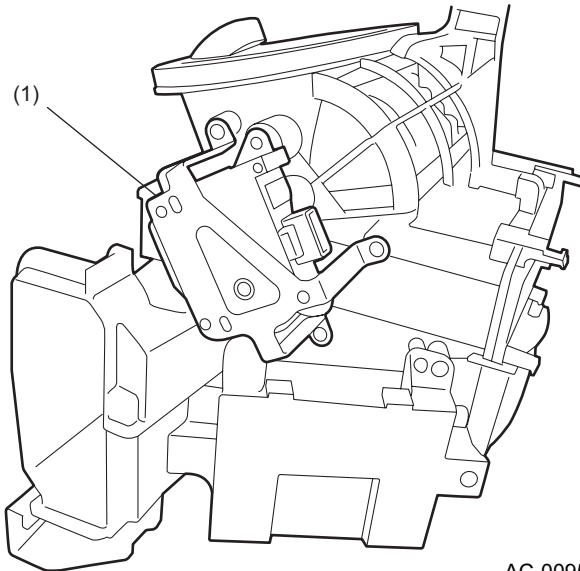
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I: FRESH/RECIRC DOOR ACTUATOR

The FRESH/RECIRC door actuator incorporates an electric motor which turns in one or the other direction in response to a signal from the auto A/C control module. The motion of the electric motor is transmitted to the FRESH/RECIRC door via a linkage to move the door to the outside-air introduction or cabin-air-recirculation position.



AC-00955

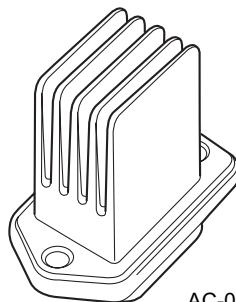
(1) FRESH/RECIRC door actuator

J: FAN CONTROL AMPLIFIER

The fan control amplifier uses a MOS* type field effect transistor. This amplifier steplessly regulates the blower motor voltage (in the range between approximately 3V and 12V) in response to gate voltage signals issued by the auto A/C control module.

Since this fan control amplifier features very small voltage drop, it can handle the maximum voltage for the maximum blower speed without need for a high-voltage relay.

*MOS = metal oxide semiconductor



AC-00720

AUTOMATIC AIR CONDITIONING

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