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| <b>Service Category:</b> Vehicle Interior  |                     | <b>Section:</b> Heating/Air Conditioning |
| <b>Model Year:</b> 2008  | <b>Model:</b> ES350 | <b>Doc ID:</b> RM000001O7U00VX           |
| <b>Title:</b> AIR CONDITIONING: AIR CONDITIONING SYSTEM: SYSTEM DESCRIPTION (2008 ES350) |                     |  |

## SYSTEM DESCRIPTION

### 1. GENERAL

The air conditioning system has the following controls:

| CONTROL                         | OUTLINE  |
|---------------------------------|--|
| Neural Network Control          | 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.  |
| Automatic Recirculation Control | Automatically changes the air inlet mode to fresh air or recirculation air mode in accordance with the level of harmful elements in the outside air, the cabin temperature, and the ambient temperature.   |
| Outlet Air Temp. Control        | Based on the temperature set at the temperature control switch, the neural network control calculates the outlet air temperature based on the input signals from various sensors.  |
|                                 | The temperature setting for the driver and front passenger are controlled independently in order to provide a separate vehicle interior temperatures for the right and left side of the cabin. Thus, air conditioning that accommodates the occupants' preferences has been realized.  |
| 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 achieve the calculated required outlet air temperature.   |
|                                 | Drives the servo motor (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              | Through the calculation of the target evaporator temperature based on various sensor signals, the A/C amplifier optimally controls the discharge capacity by regulating the opening extent of the A/C compressor solenoid valve.   |
|                                 | The A/C amplifier compares the A/C pulley speed signals, which are transmitted by the lock sensor located on the A/C compressor, with the engine speed signals, which are transmitted by the ECM (crankshaft position sensor). When the A/C amplifier determines that the A/C pulley is locked, it turns off the magnetic clutch.    |
| MAX A/C Control                 | When the temperature control switch is in the MAX A/C position, the A/C amplifier turns the compressor on and activates the servomotor (air inlet) to set the air inlet control damper to the RECIRC position, improving the cooling efficiency.   |
| Rear Window Defogger Control    | Switches the rear defogger and outside rear view mirror heaters on for 15 minutes when the rear defogger button is pressed. Switches them off if the button is pressed while they are operating.   |

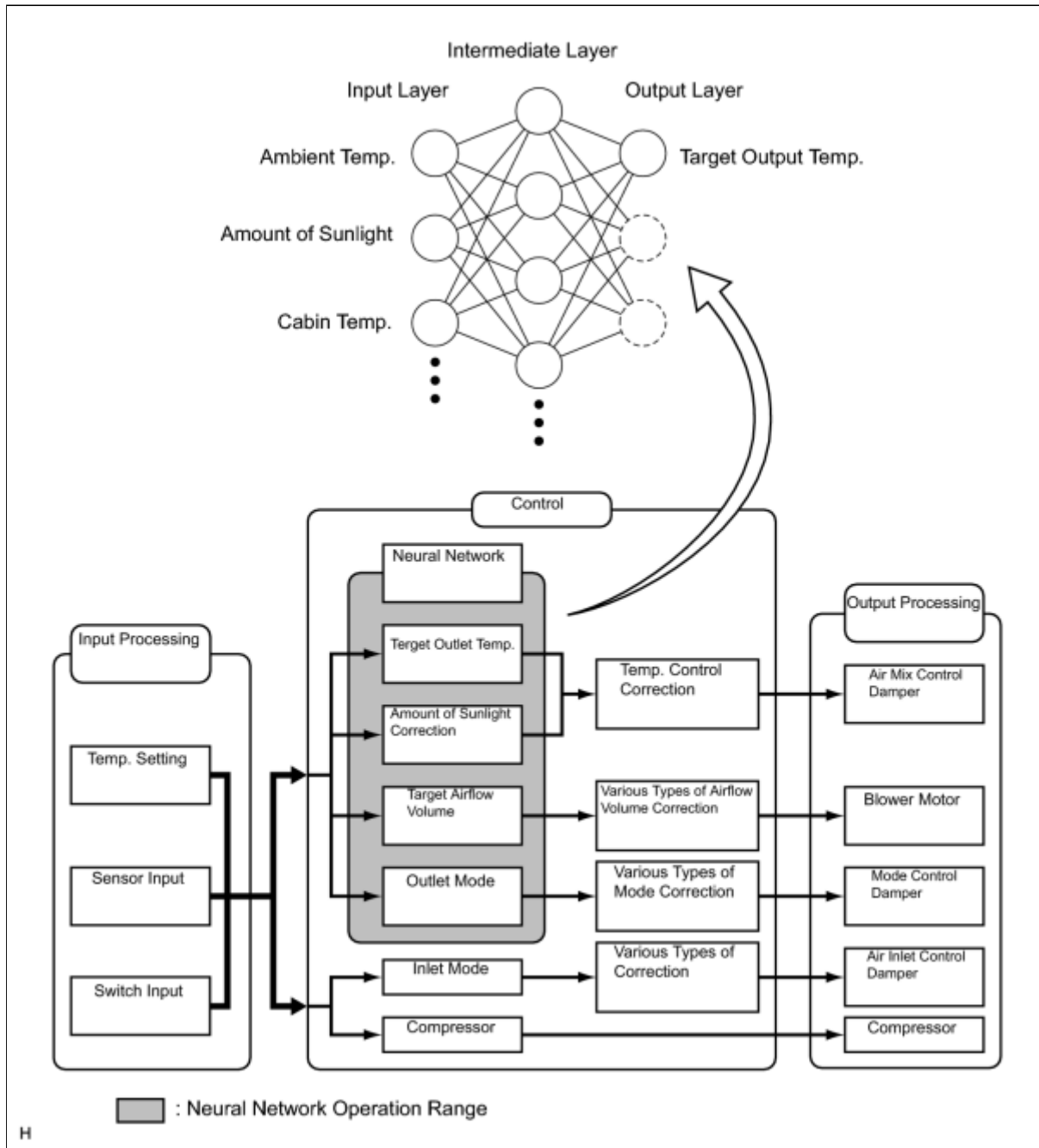
|  |   |
|--|---|
| Outside Temperature Indication Control | Calculates the outside temperature using signals transmitted by the outside temperature sensor. Calculated values are corrected by the A/C amplifier and then indicated on the multi-information display. |
| Self-Diagnosis                         | A DTC (Diagnostic Trouble Code) is stored in the memory when the A/C amplifier detects a problem with the air conditioning system.  |

## 2. NEURAL NETWORK CONTROL

- In previous automatic air conditioning systems, the A/C 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.

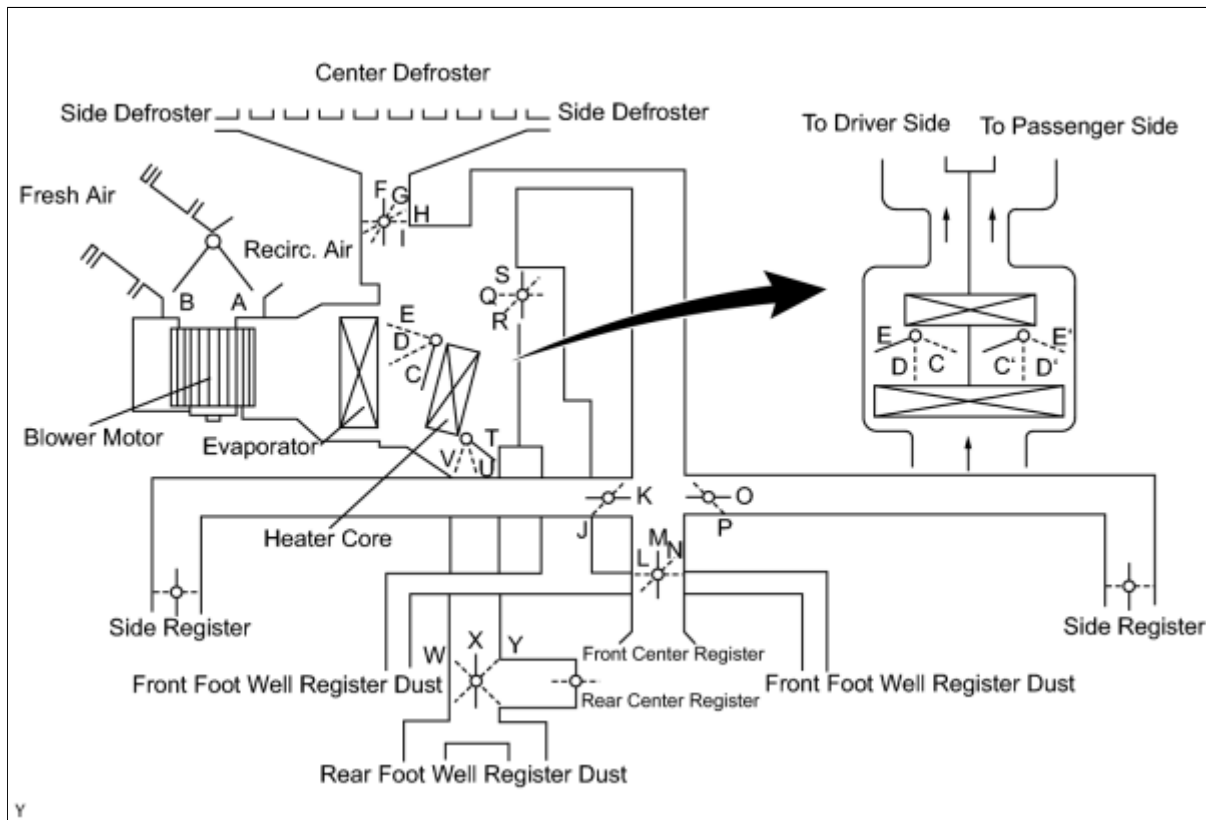
However, because the senses of a person are rather complex, a given temperature is sensed differently, depending on the environment in which the person is situated. For example, a given amount of solar radiation can feel comfortably warm in a cold climate, or extremely uncomfortable in a hot climate. Therefore, as a technique for effecting a higher level of control, a neural network has been adopted in the automatic air conditioning system. With this technique, the data that has been collected under varying environmental conditions is stored in the A/C amplifier. The A/C 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 A/C amplifier controls the servo motors and blower motor in accordance with the control volumes that have been calculated by the neural network control.








### 3. MODE POSITION AND DAMPER OPERATION






(a) Mode Position and Damper Operation



### Functions of Main Dampers:

| CONTROL DAMPER            | OPERATION POSITION  | DAMPER POSITION                          | OPERATION  |
|---------------------------|---|--|--|
| Air Inlet Control Damper  | FRESH   | A  | Brings in fresh air.   |
|                           | RECIRC  | B  | Recirculates internal air.   |
| Air Mix Control Damper    | MAX COLD to MAX HOT Temperature Setting   | C - D - E<br>(C' - D' - E')<br>T - U - V | Varies the mixture ratio of the fresh air and the recirculation air in order to regulate the temperature continuously from HOT to COLD.  |
| Air Outlet Control Damper | DEF<br>        | F, J, L, P, S, Y                         | Defrosts the windshield through the center defroster, side defroster, and side register.   |
|                           | FOOT / DEF<br> | G, J, L, P, Q, X                         | Defrosts the windshield through the center defroster, side defroster, side register, and rear center register, while air is also blown out from the front and rear foot well register ducts. |
|                           | FOOT<br>       | H, J, L, P, Q, X                         | Air blows out of the foot well register dust, and side register. In addition, air blows out slightly from the center defroster and side defroster.   |
|                           | BI-LEVEL<br>   | I, K, N, O, R, X                         | Air blows out of the front and rear center registers, side register and front and rear foot well register ducts.   |
|                           | FACE<br>       | I, K, M, O, S, W                         | Air blows out of the front and rear center registers, and side register.   |



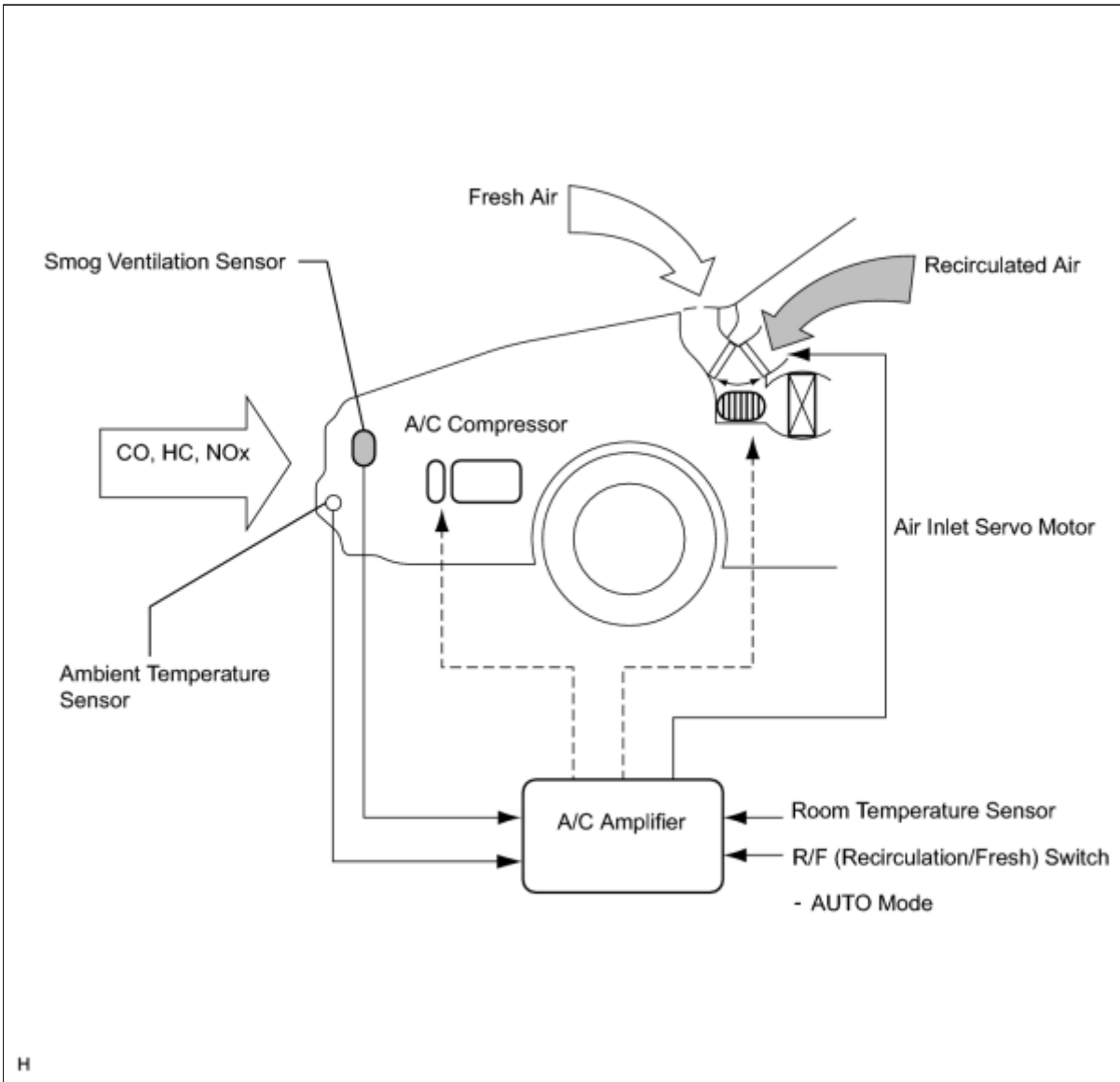
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|--|-------|---|---|---|---|---|---|---|
| <br>FOOT-F*3 | ○ / - | — | ○ | ○ | ○ | ○ | ○ | ○ |
| <br>FOOT-R*4 | ○ / ○ | — | ○ | ○ | ○ | ○ | ○ | ○ |
| <br>FOOT-D*5 | ○ / - | — | ○ | ○ | ○ | ○ | ○ | ○ |
| <br>F/D      | ○ / ○ | — | ○ | ○ | ○ | ○ | ○ | ○ |
| <br>DEF    | ○ / ○ | — | ○ | — | — | — | ○ | ○ |

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

- \*1: Greater airflow volume at the upper area
- \*2: Greater airflow volume at the lower area
- \*3: Greater airflow volume at the front
- \*4: Greater airflow volume at the rear
- \*5: Greater airflow volume at the defroster

## 5. AUTOMATIC RECIRCULATION CONTROL

- (a) When the automatic recirculation control is operating, the A/C amplifier automatically changes the air inlet mode to the fresh air or recirculation air mode based on signals from the smog ventilation sensor, ambient temperature, and room temperature sensors when the AUTO air inlet mode is selected.



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- (1) The A/C amplifier detects harmful elements (CO, HC, and NOx) based on smog ventilation sensor signals and automatically switches the air inlet mode to the recirculate air mode to prevent such harmful elements from entering the cabin.
- (2) The A/C amplifier detects cabin temperature based on a room temperature sensor signal and automatically switches the air inlet mode to the recirculate air mode to prevent the cabin temperature from becoming too high.
- (3) The A/C amplifier detects the outside temperature based on an ambient temperature sensor signal and automatically switches the air inlet mode to the fresh air mode to prevent the windshield from fogging up.

#### NOTICE:

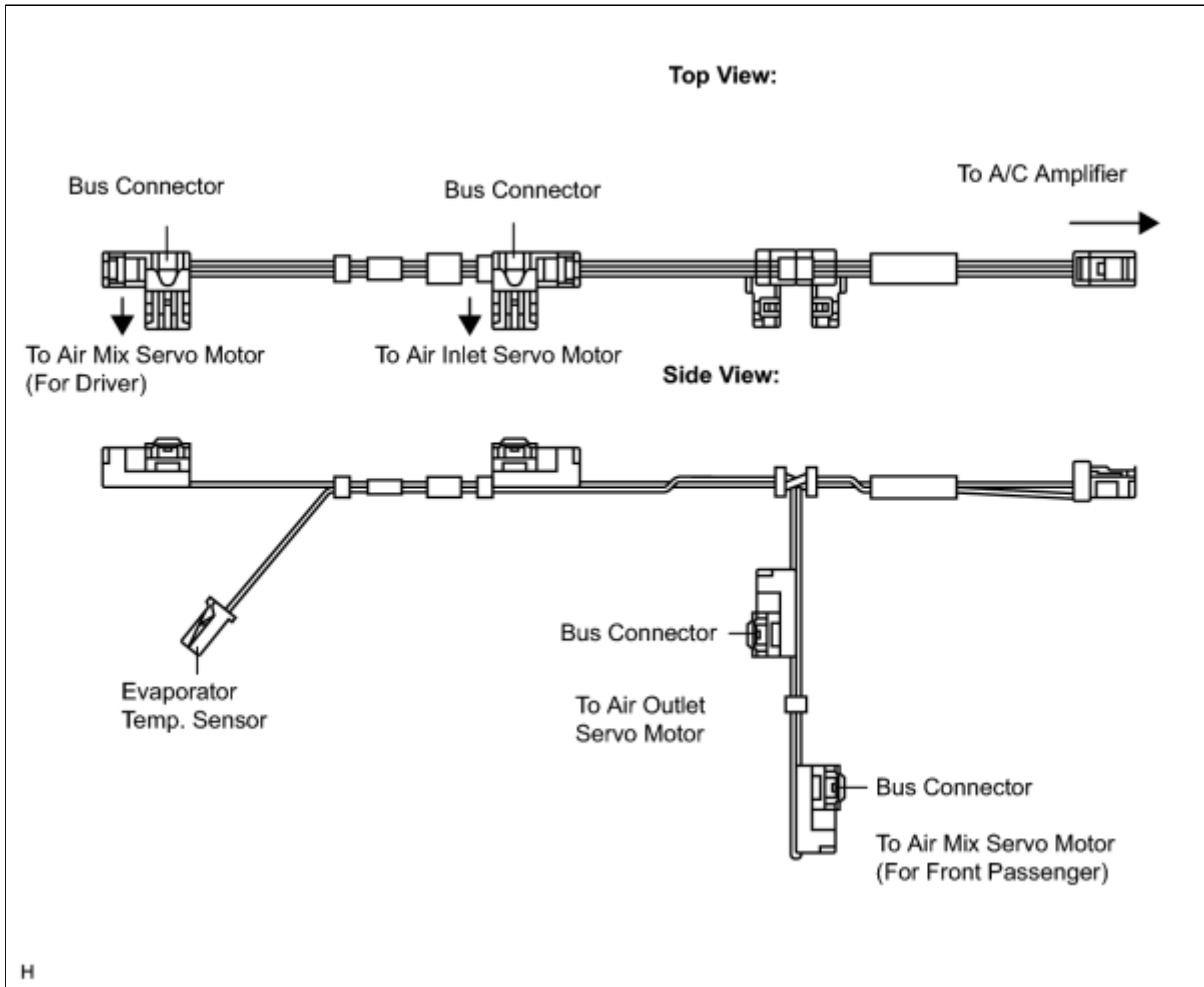
The smog ventilation sensor cannot detect elements such as the smoke from a bonfire or factory exhaust, foul or animal odors, and dirt or dust particles. Therefore, the air inlet modes are not switched in accordance with those elements.

## 6. BLOWER MOTOR

The blower motor has a built-in blower controller, and is controlled with duty control from the A/C amplifier.

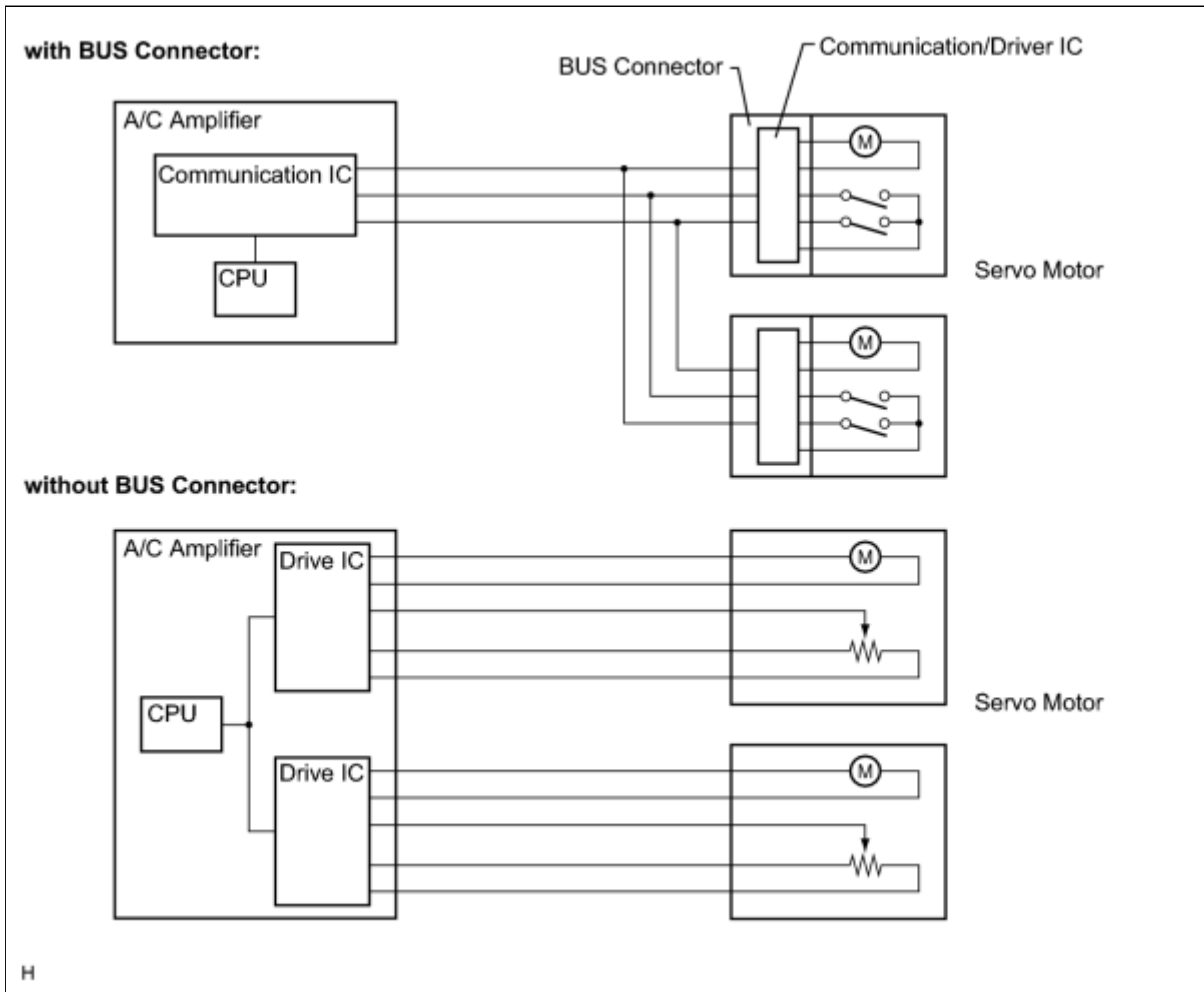
## 7. BUS CONNECTOR

- (a) A BUS connector is used in the wire harness connection that connects the servo motor from the A/C amplifier.



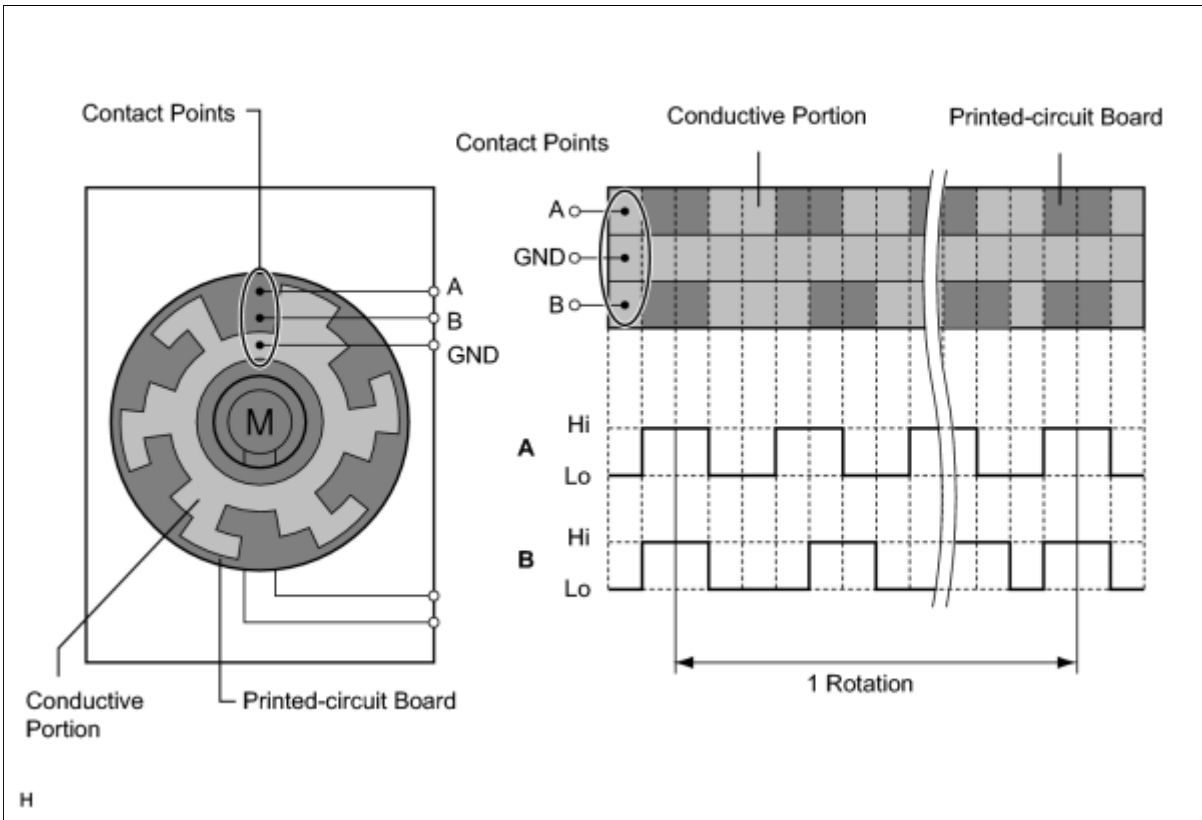
- (b) The BUS connector has a built-in communication/driver IC which communicates with each servo motor connector, actuates the servo motor, and has a position detection function. This enables bus communication for the servo motor wire harness, for a more lightweight construction and a reduced number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





## 8. SERVO MOTOR

- (a) The pulse pattern type servo motor consists of a printed circuit board and servo motor. The printed circuit board has three contact points, and transmits to the A/C amplifier two ON-OFF signals for the difference of the pulse phase. The BUS connector detects the damper position and movement direction with this signal.



## 9. A/C COMPRESSOR

### (a) General

- (1) The A/C compressor is a continuously variable capacity type in which its capacity can be varied in accordance with the cooling load of the air conditioning.
- (2) This compressor consists of the A/C pulley, shaft, lug plate, swash plate, piston, shoe, crank chamber, cylinder, and solenoid valve.
- (3) A solenoid valve that adjusts the suction pressure so that the compressor capacity can be controlled as desired is provided.

### (b) Solenoid Valve Operation

- (1) The crank chamber is connected to the discharge passage. A solenoid valve is provided between the discharge passage (LO pressure) and the discharge passage (HI pressure).
- (2) The solenoid valve operates under duty cycle control in accordance with the signals from A/C amplifier.
- (3) When the solenoid 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.
- (4) When the solenoid 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.

## 10. LOCK SENSOR

The lock sensor sends A/C pulley speed signals to the A/C amplifier. The A/C amplifier determines whether the magnetic clutch is locked or not by using those signals and engine speed signals.

## 11. ROOM TEMPERATURE SENSOR

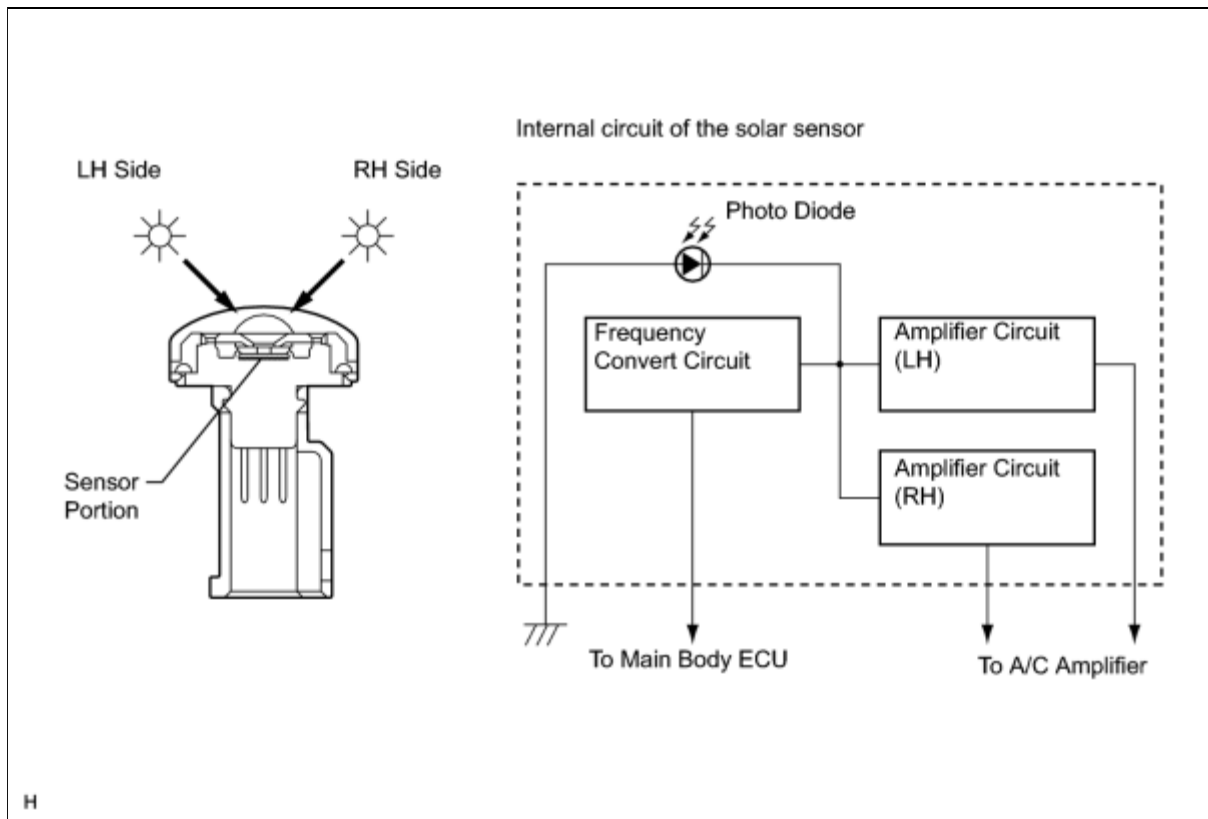
The room temperature sensor detects the cabin temperature based on changes in the resistance of its built-in thermistor and sends a signal to the A/C amplifier.

## 12. AMBIENT TEMPERATURE SENSOR

The ambient temperature sensor detects the outside temperature based on changes in the resistance of its built-in thermistor and sends a signal to the A/C amplifier.

## 13. SOLAR SENSOR

- (a) The solar sensor consists of a photo diode, two amplifier circuits for the solar sensor, and frequency converter circuit for the light control sensor.
- (b) A 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 the LH and RH sides (2 directions) and outputs these sunlight strength signals to the A/C amplifier.



## 14. 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 A/C amplifier.

## 15. A/C PRESSURE SENSOR

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

## 16. SMOG VENTILATION SENSOR

- (a) The smog ventilation sensor detects harmful elements such as CO, HC, and NOx, which are present in the air outside of the vehicle. The sensor outputs it to the A/C amplifier.

(b) The sensitivity of the smog ventilation sensor can be adjusted. Adjustment can be done using the heater control panel or multi-display.

