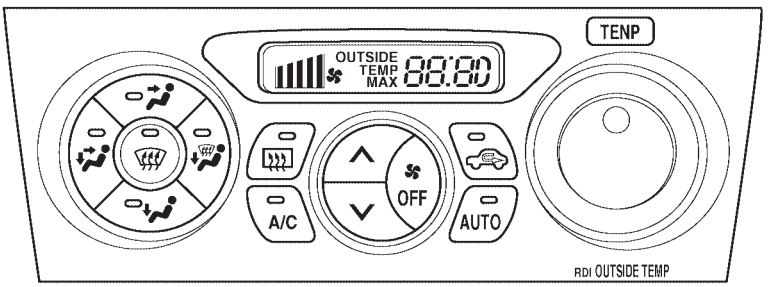
## ■ CONSTRUCTION AND OPERATION

### 1. Heater Control Panel

- 2 types of heater control panels are used; the rotary switch and lever type for the manual type air conditioner, and the push button type for the fully automatic controlled type air conditioner.
- The size and the position of the buttons and the switches are designed with the frequency of use and the order of operation controls is taken into account.
- The push button type heater control panel uses a larger LCD (Liquid Crystal Display) to display the set temperature, air outlet volume, etc., and improves its visibility.
- The set temperature display and the outside temperature display on the push button type heater control panel can be switched by the push of a button.


(When displaying outside temperature)




**Push Button Type**

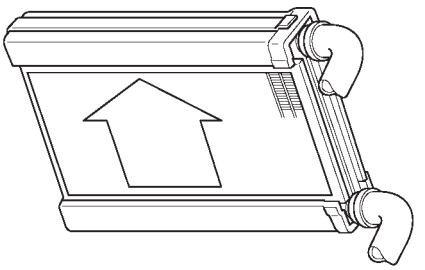
174BE03

### 2. Air Conditioner Unit

A semi-center location air conditioner unit, in which the evaporator and heater core are placed in the vehicle's longitudinal direction. As a result, the air conditioner unit has been made more compact and light weight.

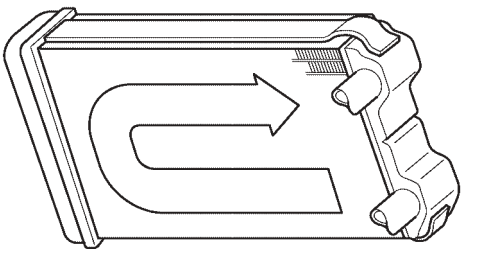
#### Heater Core

A compact, lightweight, and highly efficient straight flow (full-path flow) aluminum heater core has been adopted.



**New**

152BE21

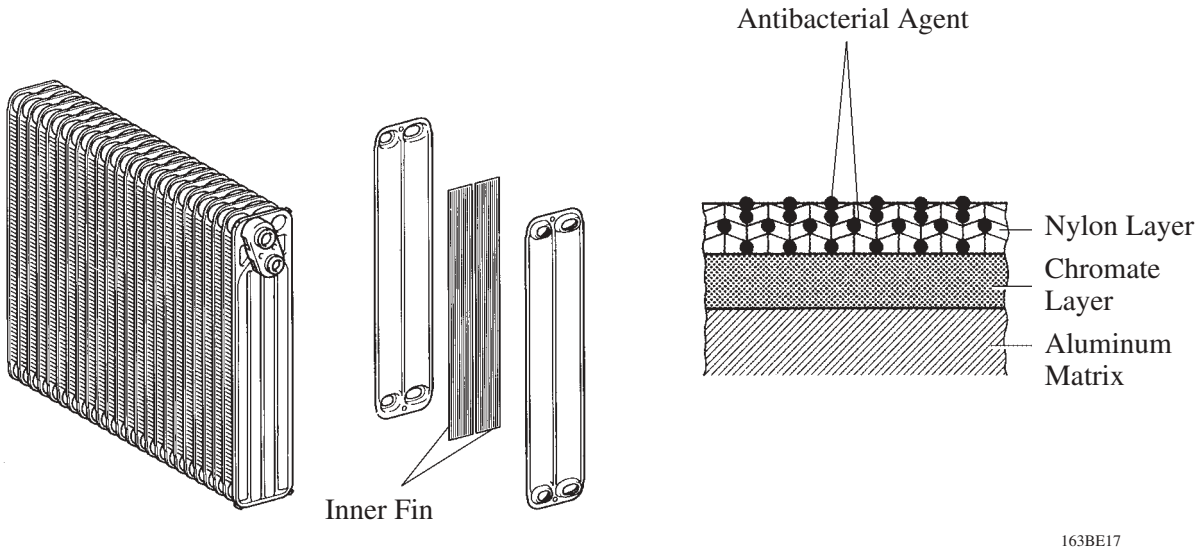


**Previous**

152BE22

## Evaporator

By placing the tanks at the top and the bottom of the evaporator unit and by adopting an inner fin construction, the heat exchanging efficiency has been improved and the evaporator unit's temperature distribution has been made more uniform. As a result, it has become possible to realize a thinner evaporator construction. Furthermore, the evaporator body has been coated with a type of resin that contains an antibacterial agent in order to minimize the source of foul odor and the propagation of bacteria.

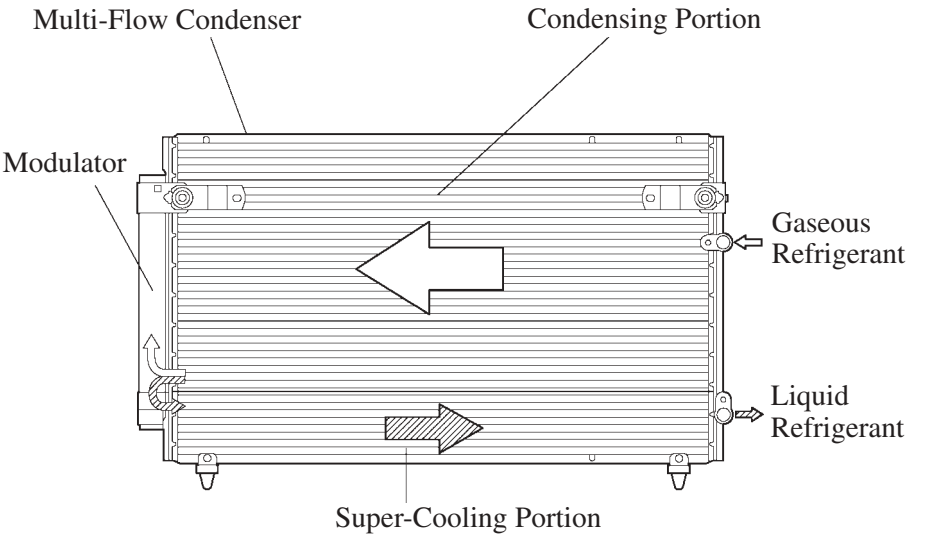


## 3. Condenser

The new CELICA has adopted a sub-cool condenser in which a multi-flow condenser (consisting of two cooling portions: a condensing portion and a super-cooling portion) and a gas-liquid separator (modulator) have been integrated. This condenser has adopted the sub-cool cycle for its cooling cycle system to improve the heat exchanging efficiency.

### Sub-Cool Cycle

In the sub-cool cycle of the sub-cool condenser that has been adopted, 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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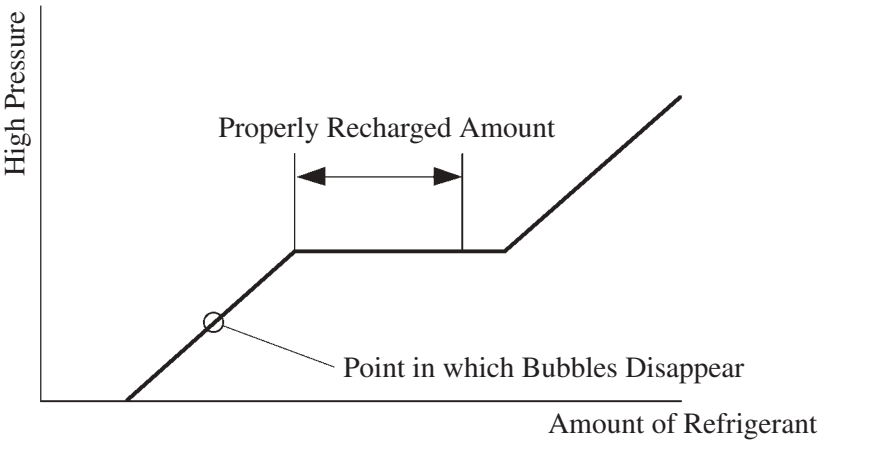
**NOTE:** The point at which the air bubbles disappear in the refrigerant of the sub-cool cycle is lower than the proper amount of refrigerant with which the system must be filled. Therefore, if the system is recharged with refrigerant based on the point at which the air bubbles disappear, the amount of refrigerant would be insufficient. As a result, the cooling performance of the system will be affected.

For the proper method of verifying the amount of the refrigerant and to recharge the system with refrigerant, see the CELICA Chassis & Body Repair Manual (Pub. No. RM743E)

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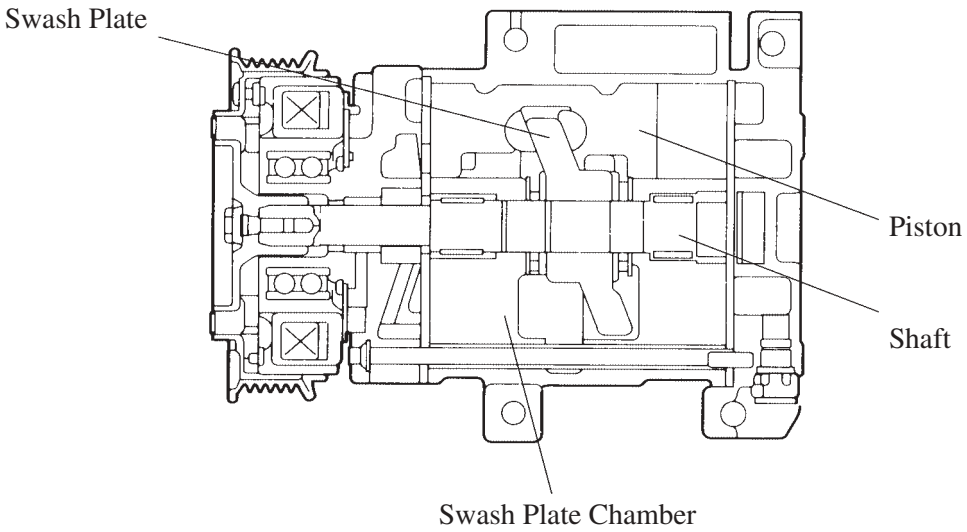
## 4. Compressor

A compact, lightweight, and low-noise swash plate type compressor has been adopted.

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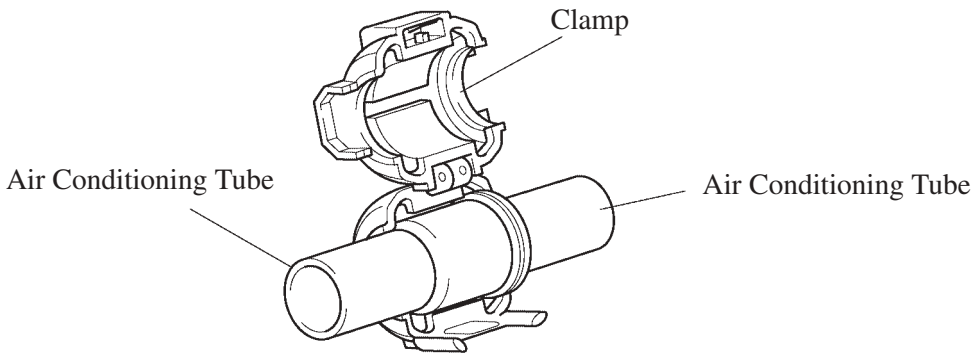
## 5. Quick Joint

The joint of the air conditioning tube, which passes through the dash panel, has been changed from the nut-and-union type that is used on the previous model to the clamp type quick joint. As a result, the ease of operation and service has been improved.






160CM04

## 6. Air Conditioner ECU (Fully Automatic Controlled Type Air Conditioner)

### General

- A fully automatic control type air conditioner has been adopted. This system uses an air conditioner ECU to perform the calculation of the required outlet air temperature control, temperature control, blower control, air inlet control, air outlet control, and compressor control.
- The self-diagnosis system used can be controlled and displayed on the heater control panel.

### Calculation of Required Outlet Air Temperature (TAO: Temperature Air Outlet)

After receiving the signals from the sensors and the temperature control switch setting, the air conditioner ECU uses the formula shown below to calculate the required outlet air temperature, to regulate the servomotors and blower motor. This is an outlet air temperature that is required in maintaining the set temperature in a stable manner.

$$TAO = K_{SET} \times TSET - Kr \times TR - K_{AM} \times TAMdisp - Ks \times TS + C - TC$$

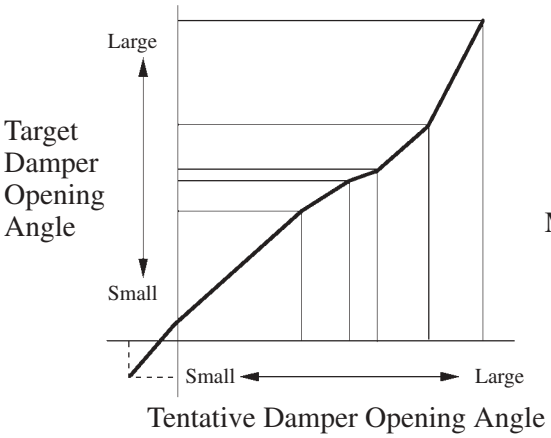
| | | | |
|---|---|---|---|
| $K_{SET}$ | = Setting Temperature Coefficient | TSET | = Setting Temperature |
| Kr | = Room Air Temperature Coefficient | TR | = Room Air Temperature |
| $K_{AM}$ | = Ambient Air Temperature Coefficient | TAMdisp | = Ambient Air Temperature |
| Ks | = Solar Radiation Coefficient | TS | = Solar Radiation |
| C | = Correct Constant | TC | = Compressor ON/OFF Correct Constant |

### Temperature Control System

#### 1) Air Mix Damper Control

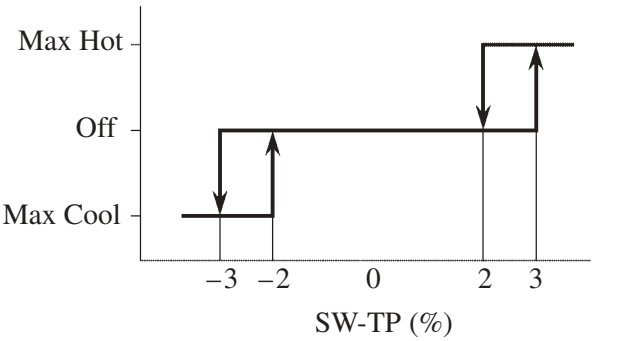
In response to the temperature control switch setting, the required outlet air temperature, evaporator temperature sensor, and water temperature sensor compensations are used by the air mix damper control to calculate a tentative damper opening angle, through an arithmetic circuit in the air mix damper, to arrive at a target damper opening angle. If the difference between the target damper opening angle and the actual damper opening angle is 3% or more, the air mix damper control regulates the servomotor to reduce that difference to 2% or less.

**▶ Calculating the Target Damper Opening ◀**




174BE04

**▶ Air Mix Servomotor Control ◀**




SW: Target Damper Opening Angle
TP: Actual Damper Opening Angle

174BE05

## Blower Control System

### 1) Blower Motor Startup Control

When the blower motor is started up, the blower voltage in the auto mode (low speed) is output to the blower controller for 3 seconds. This is designed to protect the blower controller from a sudden startup voltage surge.

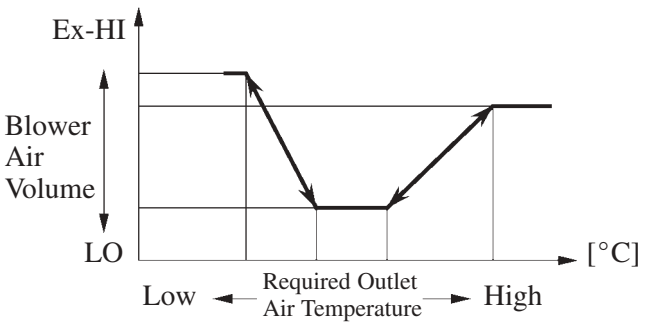
### 2) Manual Control

Sets the blower speed according to operation of the blower switch.

### 3) Automatic Control

#### a. Stepless Air Volume Control

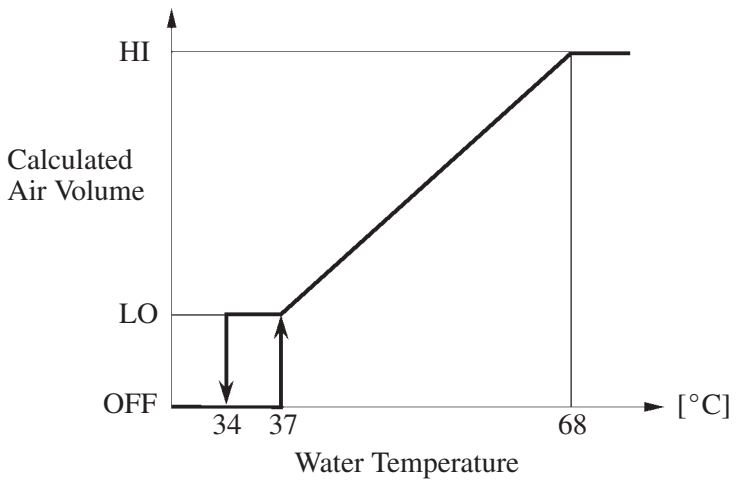
As shown on the right, when the AUTO switch on the heater control panel is pushed, the air conditioner ECU automatically regulates the voltage to the blower controller, in accordance with the required outlet air temperature, to deliver stepless air volume.




174BE06

#### b. Warm-Up Control

When the water temperature detected by the water temperature sensor is below a predetermined level and the air outlet is in the FOOT or BI-LEVEL mode, the blower does not operate. When the water temperature reaches 37°C, the blower motor operates at low speed. When the water temperature is between 37 to 68°C, the air flow calculation using the water temperature sensor signal, and, the air flow calculation using the required outlet air temperature are compared, and the lesser of the two is automatically selected as the air flow to be used. When the water temperature reaches 68°C or more, the blower motor runs at high speed. Moreover, when the water temperature is under 34°C, and the warm-up control is effected (blower motor off), the air outlet is switched to the DEF mode. Later, when the blower motor turns on, the air outlet changes from the DEF mode to the FOOT or BI-LEVEL mode.

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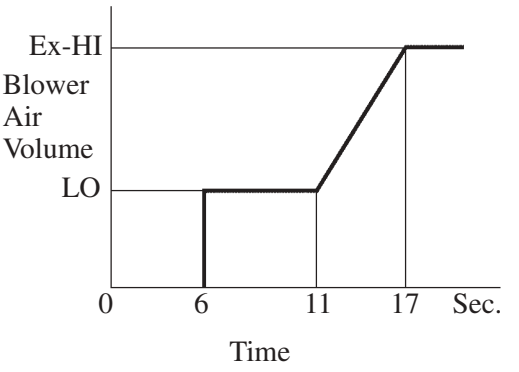
### c. Time-Lagged Air Flow Control

2 types of time-lagged air flow control (in accordance with the temperature detected by the evaporator temperature sensor) help prevent hot air from being emitted from FACE or BI-LEVEL vent.

#### i) Evaporator temperature sensor at 30°C or more

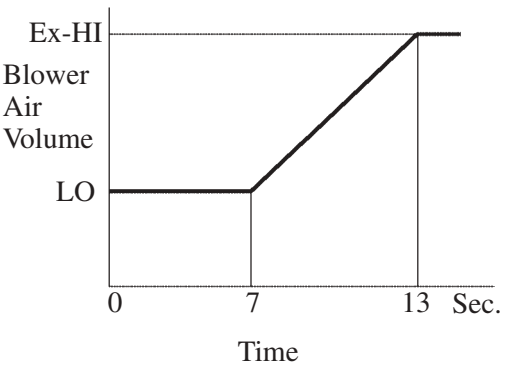
As shown in the diagram on the right, this control turns OFF the blower motor for approximately 6 seconds and turns ON the compressor to cool the air conditioner unit. After approximately 6 seconds have elapsed, the blower motor rotates in the manual LO mode, allowing the cooled air to be discharged from the vents. Thus, the discomfort that is associated with the discharge of warm air is prevented.
Between approximately 11 to 17 seconds, the airflow volume according to the time-lagged airflow control and the airflow volume of the blower control according to the calculation of the required outlet air temperature are compared. The airflow volume is then regulated at the smaller volume of the two.
After 17 seconds have elapsed, control is effected by the blower control according to the calculation of the required outlet air temperature.




174BE08

#### ii) Evaporator temperature sensor at 30°C or less

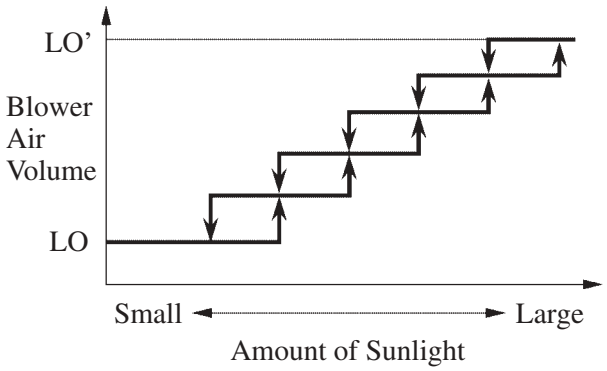
As shown in the diagram on the right, for approximately 17 seconds, the blower motor rotates in the manual LO mode.
Thereafter, up to approximately 13 seconds, the airflow volume according to the time-lagged airflow control and the airflow volume according to the blower control of the calculation of the required outlet air temperature are compared. The airflow volume is then regulated at the smaller volume of the two.
After 13 seconds have elapsed, control is effected based on the blower control according to the calculation of the required outlet air temperature.




174BE09

**d. Sanlight Air Flow Control**

Controls the blower speed in accordance with the intensity of the sunlight when the air outlet mode is at FACE or BI-LEVEL. The blower low speed can be adjusted up to 5 steps, in response to the sunlight signal received from the solar sensor.




174BE10

## Air Inlet Control System

**1) Manual Control**

Drives the air inlet servomotor according to the operation of the air inlet control switch and fixes the dampers in the FRESH or RECIRC. position.

## Air Outlet Control System

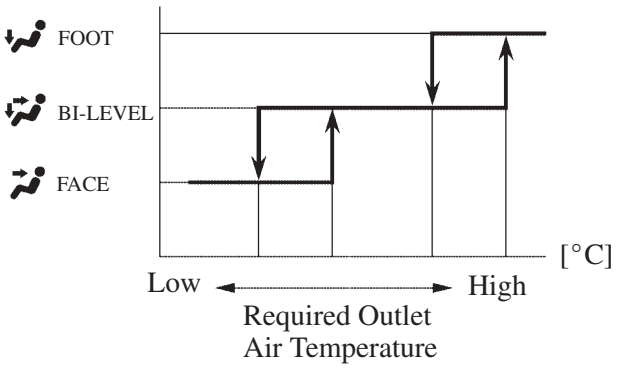
**1) Manual Control**

Changes the air outlet in accordance with the selected position of the mode select switch.

**2) Automatic Control**

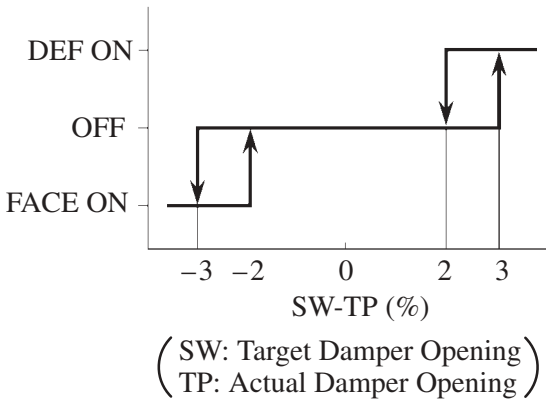
When the AUTO switch of the control panel has been turned ON, automatic control causes the air mix servomotor to rotate to a desired position in accordance with the target damper opening, which is based on the calculation of the required outlet air temperature.
Furthermore, under automatic control, the potentiometer in the air mix servomotor is used to detect the actual damper opening, as opposed to the calculated target damper opening, so that control can be effected to match the actual damper opening to the calculated target damper opening.

**▶ Calculating the Target Damper Opening ◀**




174BE11

**▶ Air Mix Servomotor Control ◀**

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## Compressor Control System

### 1) OFF Control

Turns OFF the magnetic clutch of the compressor when the conditions for turning the blower motor OFF during warm-up control have been met.

### 2) Refrigerant Pressure Malfunction Detection

By monitoring the pressure switch signal, this system can judge the refrigerant pressure to be abnormal, and turns off the compressor magnetic clutch relay, if the pressure switch remains off.

### 3) Evaporator Temperature Sensor Judgment

When the detected temperature of the evaporator temperature sensor is below 3 °C, the air conditioner ECU turns OFF the magnetic clutch of the compressor in order to prevent the evaporator from becoming frosted.

### 4) Defroster Linked Control

When the front defroster switch is turned on, the magnetic clutch relay is activated auto matically to engage the compressor. Also, when the blower is furned off, and the front defroster switch is turned on, the blower will turn on in the automatic control condition.

### 5) Forcible 60-Second Activation Control of Compressor

When the conditions listed below have been met, the air conditioner ECU forcibly turns ON the magnetic clutch for 60 seconds to prevent the windshield from becoming fogged.

- A/C switch = ON
- When the conditions for turning the blower motor OFF during warm-up control have been met.
- When the control conditions of the evaporator temperature sensor judgment have not been met.

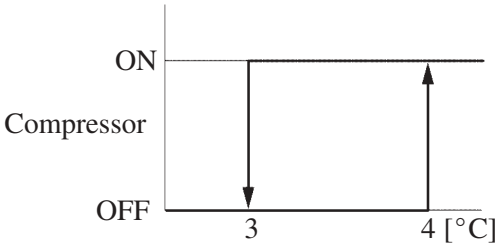
### 6) Automatic ECON (Economy) Control

#### a. General

Through the adoption of the automatic ECON control, cooling performance, dehumidifying performance, and fuel economy have been realized.

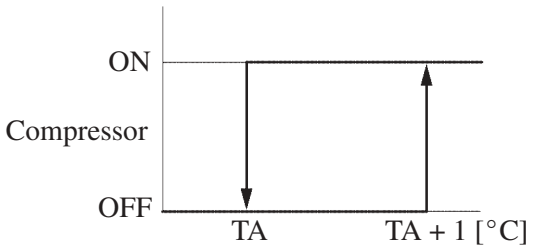
### b. Operation

When the air outlet is in a mode other than the defroster mode, the air conditioner system operates in the air conditioner control mode for 5 minutes after the air conditioning is turned ON (compressor ON). Thus, the air conditioner ECU controls the ON/OFF function of the compressor based on the temperature that is detected by the evaporator temperature sensor.
After 5 minutes have elapsed since the air conditioner was turned ON, the air conditioner ECU will make either of the lower temperature as a compressor control temperature when calculating the compressor control temperature from the detected temperature by the ambient temperature sensor and the required outlet air temperature.
For 5 to 8 minutes after the air conditioner was turned ON, the ECU controls the compressor by increasing the compressor control temperature gradually until the compressor control temperature reaches to this calculated temperature.
After 8 minutes have elapsed from the time the air conditioner was turned ON, the air conditioner system engages in the automatic ECON control mode, and the ECU controls the compressor according to the compressor control temperature that was calculated by the aforementioned formula.
Whenever the air outlet mode is in the defroster mode, the air conditioner system is engaged in the air conditioner control mode and the ECU controls the ON/OFF function of the compressor according to the temperature that is detected by the evaporator temperature sensor.
In addition, even if the air outlet mode is changed from the defroster mode to another mode, the system will continue to operate in the air conditioner control mode until the ignition switch is turned OFF.




Evaporator Temperature Sensor
Air Conditioner Control Mode

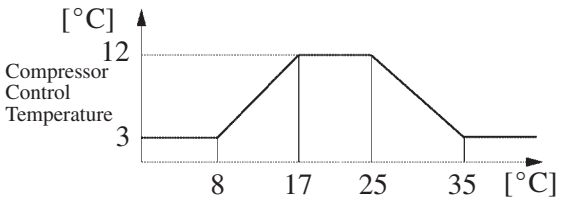
145BE59




Compressor Control Temperature
Automatic ECON Control Mode

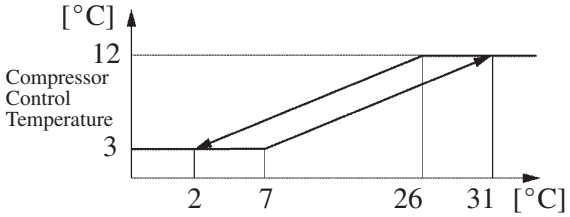
145BE60

**Compressor Control Temperature**




Ambient Temperature Calculation
Based on Ambient Temperature

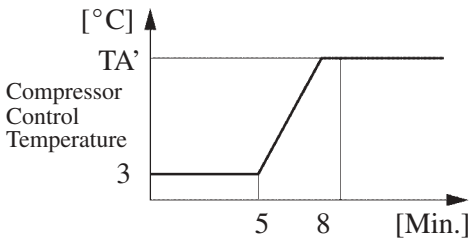
145BE61




Required Outlet Air Temperature Calculation
Based on Required Outlet Air Temperature

145BE62

**Method for Calculating Compressor Control Temperature**




TA': Initially Calculated
Compressor Control Temperature

145BE63

**Determining Compressor Control Temperature**

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## Self-Diagnosis

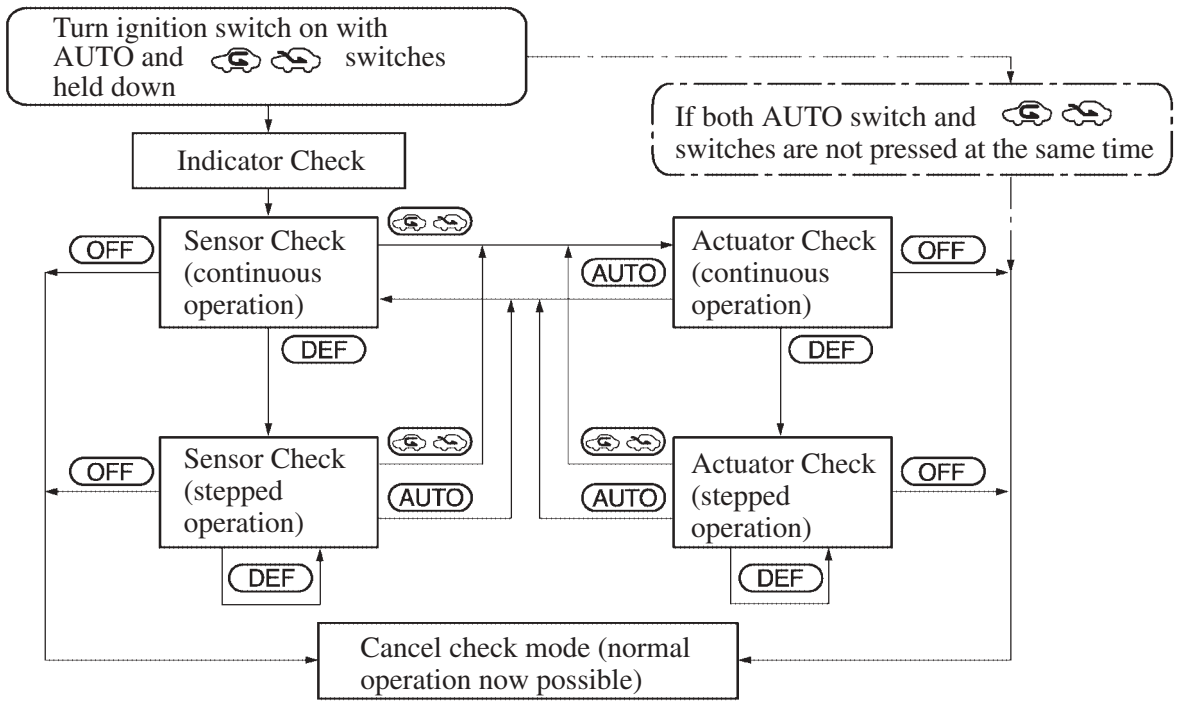
The air conditioner ECU has a self-diagnosis function. It stores any operation failures in the air conditioning system memory in the form of a malfunction code. By operating switches on the air conditioning control panel, the stored malfunction code will be indicated. Since diagnostic results are stored directly by electric power from the battery, they are not cleared even when the ignition switch is turned off.

### ▶ Functions ◀

| Function | Outline |
|---|---|
| Indicator Check | Checks indicator lights and temperature setting display. |
| Sensor Check | Checks the past and present malfunctions of the sensors, and clearing the past malfunction data. |
| Actuator Check | Checks against actuator check pattern if blower motor, servo motors and magnetic clutch are operating correctly according to signals from ECU. |

### 1) Indicator, Sensor and Actuator Checking Procedure

The check functions can be started by the following procedure shown below.

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For details on the indicator check, sensor check and actuator check functions of this system, refer to the CELICA Chassis & Body Repair Manual (Pub. No. RM743E).