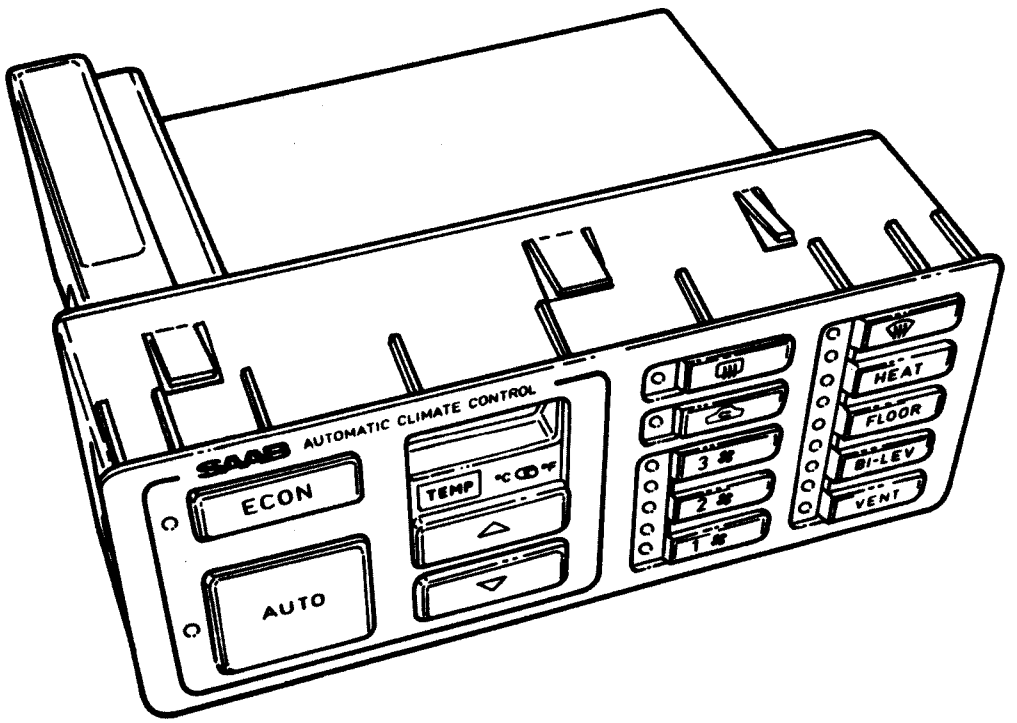
Automatic Climate Control

Introduction To ACC



Saab 9000 models sold in the United States have used two basic climate control systems. For identification purposes in this book we will refer to them as ACC 1 (1986-1989) and ACC 2 (1990 onward).

The basic construction and principles of operation for the two systems are very similar but there are some significant differences, particularly in the area of diagnostics. We will highlight these differences on the following pages.

Both systems measure:

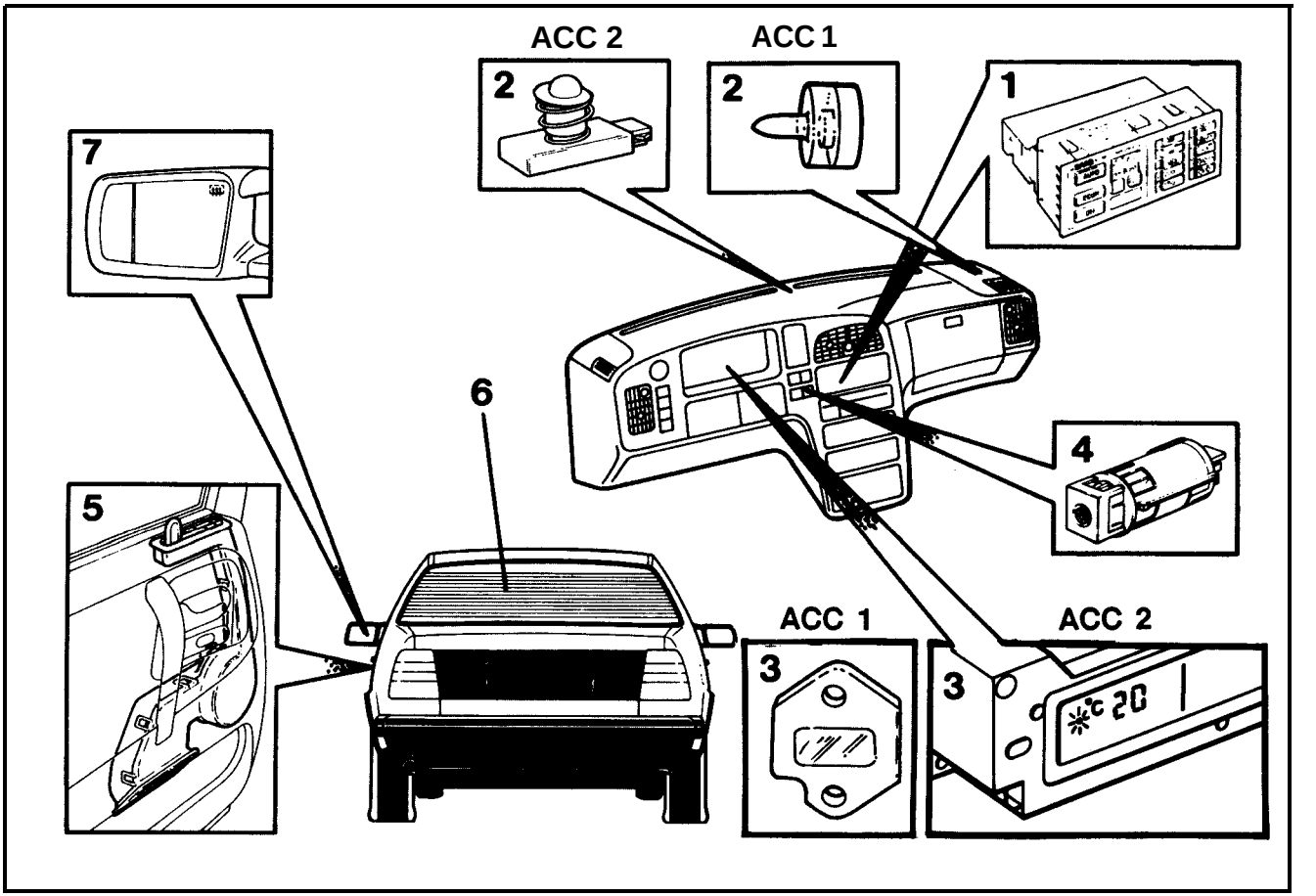
- **Outside (ambient) temperature**
- **Inside air temperature**
- **Mixed air temperature after the heater core**
- **Sun intensity**

This information is combined with input from the driver and used by the ACC microprocessor to control:

- **The AC compressor**
- **Cabin fan speed**
- **Air distribution**
- **Mixed air temperature**
- **The A.C. air recirculation flap**
- **Rear window and mirror defrosters**
- **Rear side window fans (ACC 2 only)**

Automatic Climate Control

ACC Unit And Associated Components



1. Automatic climate control unit
2. Solar sensor
3. Outside temperature indication
   - ACC I - Sensor located on blower motor housing
   - ACC II - Temperature signal received from EDU
4. Indoor temperature sensor
5. Rear door fans
6. Rear window heater
7. Outside mirror heaters

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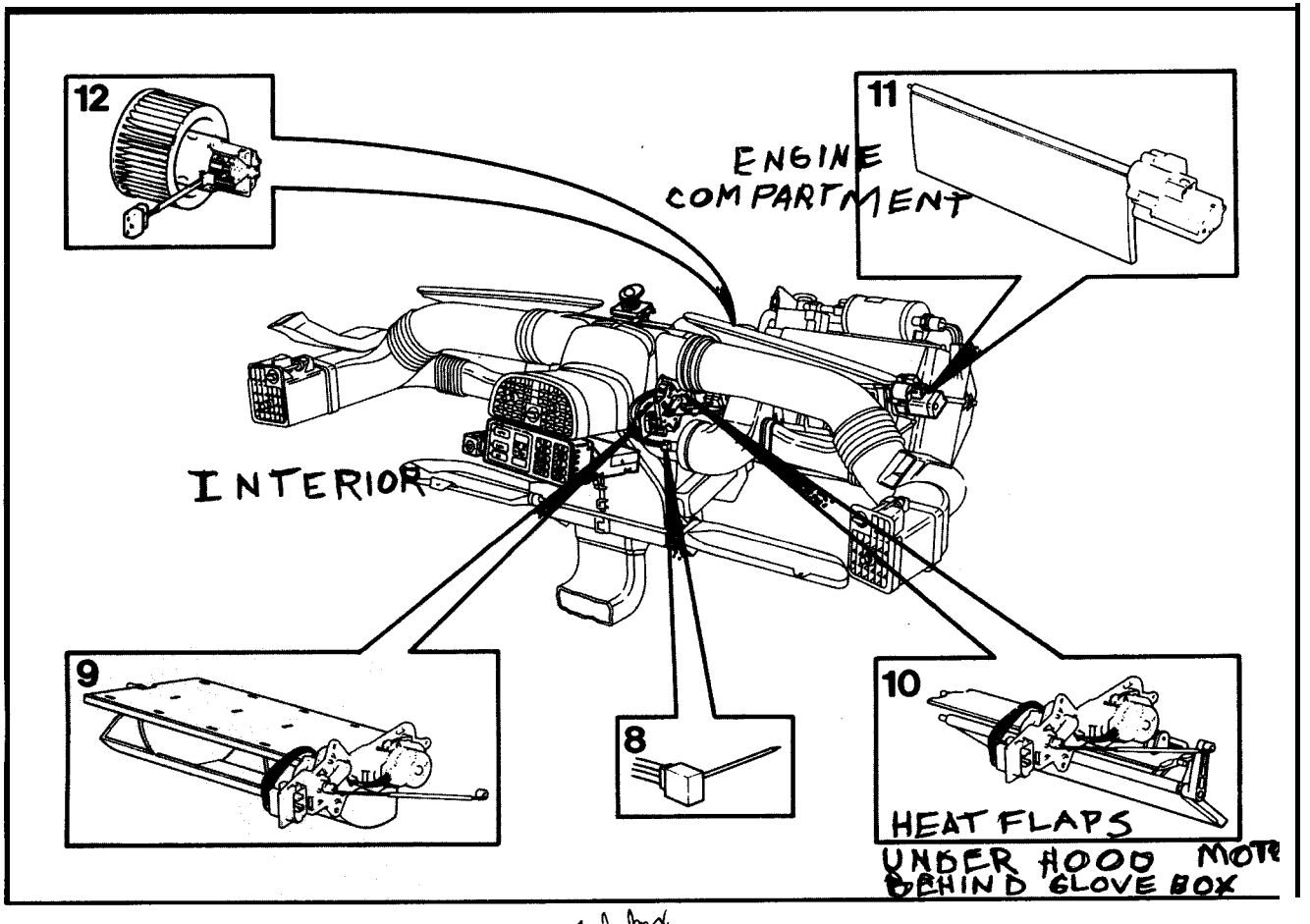
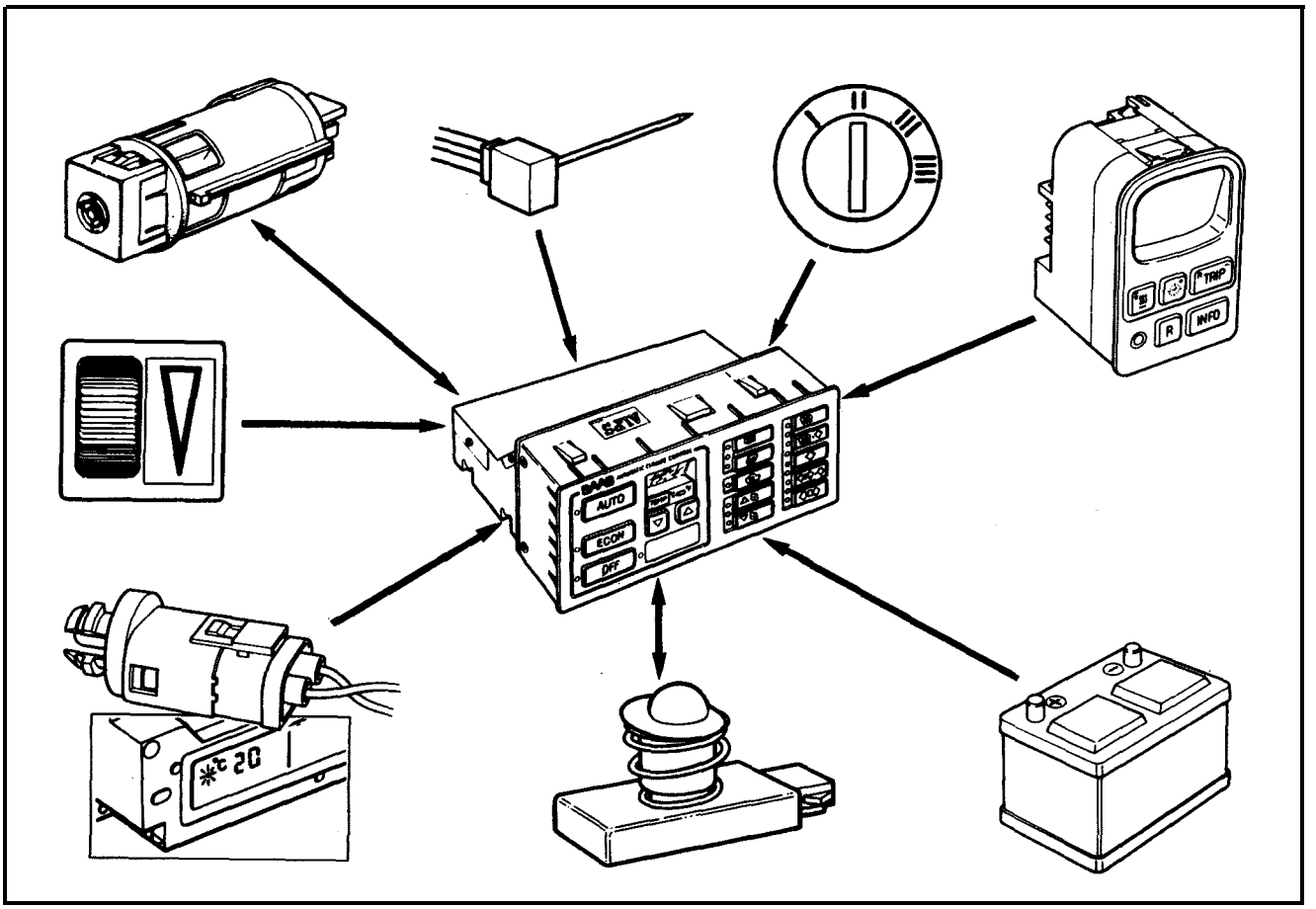
ACC Unit And Associated Components



8. Mixed air temperature sensor
9. Air distribution motor
10. Temperature control motor
11. Recirculation motor
12. Ventilation fan motor

Automatic Climate Control

Inputs



The temperature indication signals from the indoor and mixed air temperature sensors are DC signals proportional to temperature. Power is sent to the indoor temperature sensor for a small fan which moves air through the sensor.

On ACC II, the solar sensor input is also an output since it is a serial data link providing 2-way communication between the microprocessors used in the solar sensor and ACC unit.

The battery +30 supply provides the main power for the unit and the +54 ignition supply is used to switch on the unit.

On ACC I the outside temperature signal is calculated via voltage drop across a PTC resistor mounted on the main blower motor housing.

On ACC 2 the EDU processes a signal from the sensor mounted below the front bumper, converts it to digital pulses and transmits it to the ACC.

The rheostat supply is used for the push button lamps and during darker conditions also supplies the LED indicators.

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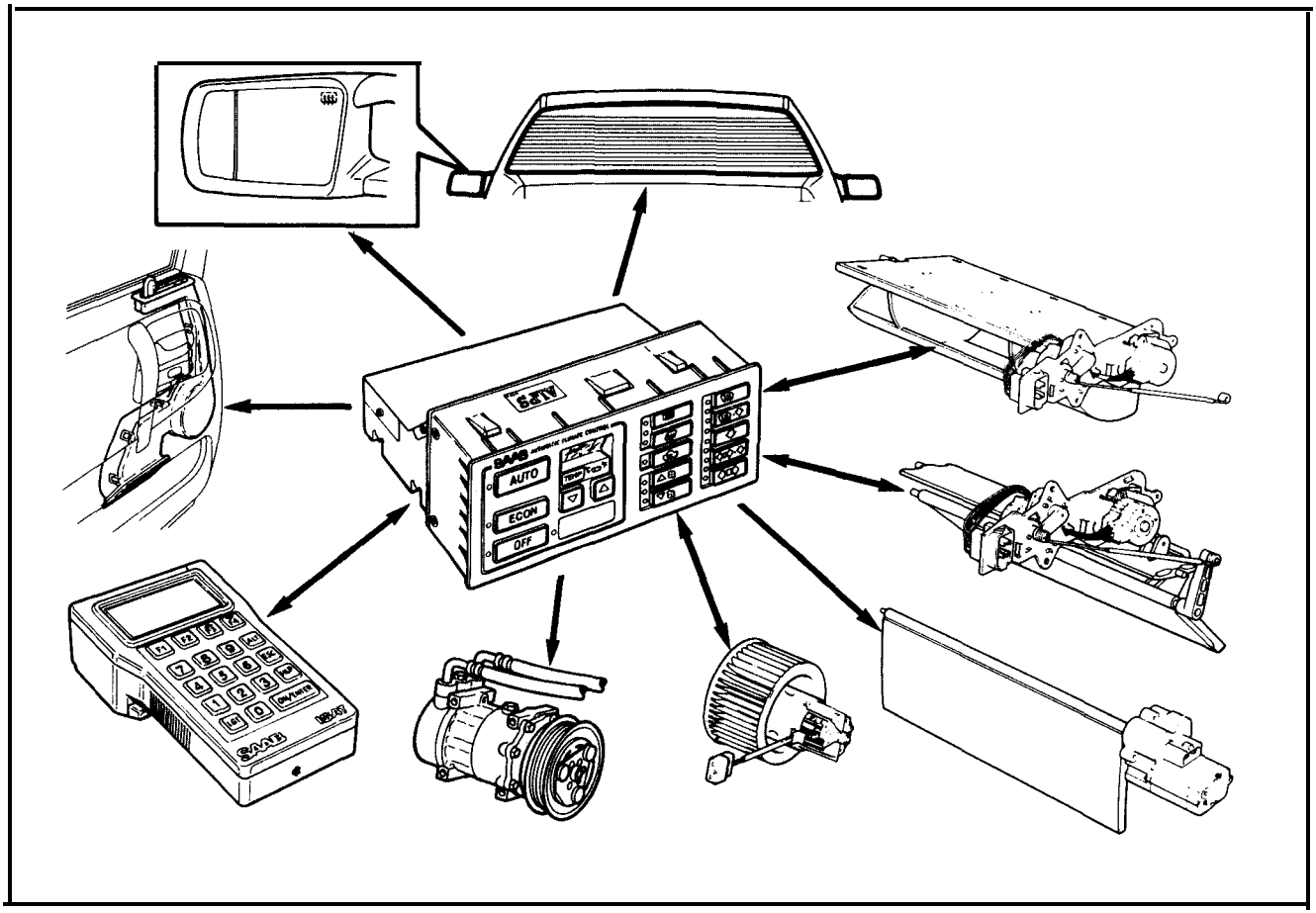
Outputs



The AC output and the output to the rear window and mirror heater are 12V signals to operate relays.

On ACC II, the ISAT output and input provides the communication between the ACC and ISAT microprocessors.

The remaining outputs are all motor drives as follows:

Ventilation fan: Variable 0 to 5V DC signal to the fan speed controller. The fan feedback signal is a 1 to 12V DC signal proportional to the speed of the fan.

Air recirculation flap: Reversible constant speed DC drive.

Temperature control flap

ACC 1 - Reversible DC motor with a built in variable resistor to feedback door position information to the ECU

ACC 2 - A pulsed power signal to operate the stepper motors. By counting the number of pulses the ECU can determine flap position.

Air distribution flap

ACC 1 Reversible DC motor with a built in variable resistor to feedback door position information to the ECU

ACC 2 A pulsed power signal to operate the stepper motors. By counting the number of pulses the ECU can determine flap position.

Rear door fans

ACC 2 - Variable voltage supply from 7-11 VDC proportional to cabin blower speed

ACC 1 - Not controlled by ACC, two speed rocker switch on the console.

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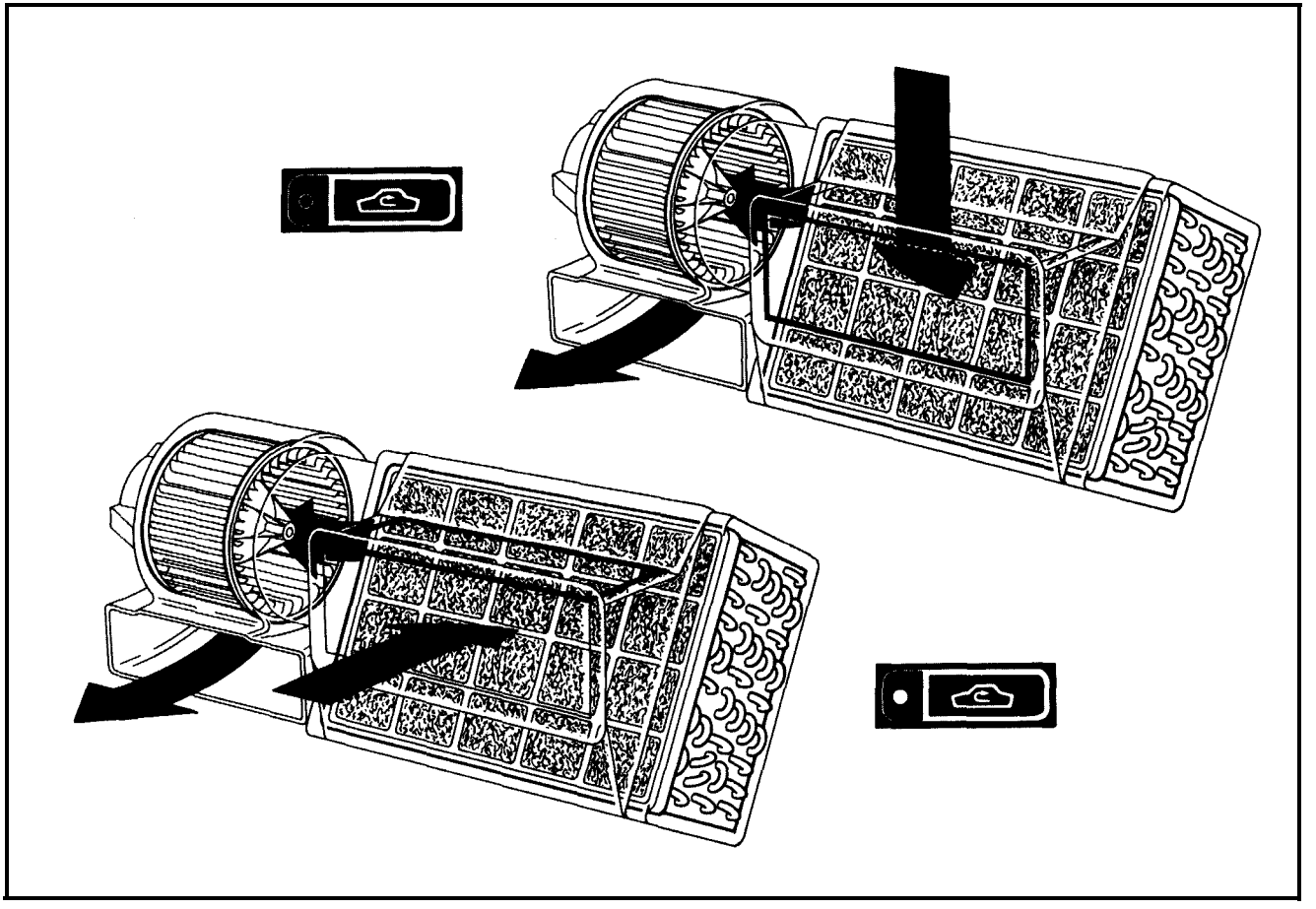
Recirculation Flap And AC Unit



Depending on the position of the recirculation flap, ventilation air from the passenger compartment is either recirculated or fresh air is drawn in from outside, providing outside conditions permit.

After the recirulation flap the air passes through the evaporator to the cabin fan.

Auto mode

For the first 60 seconds after staring, the recirculation flap remains in the fresh air position.

With an outside temperature of 81° F (27° C) or more the flap is in the recirculation position.

With an outside temperature of 79" F (26° C) or less the flap is in the fresh air position.

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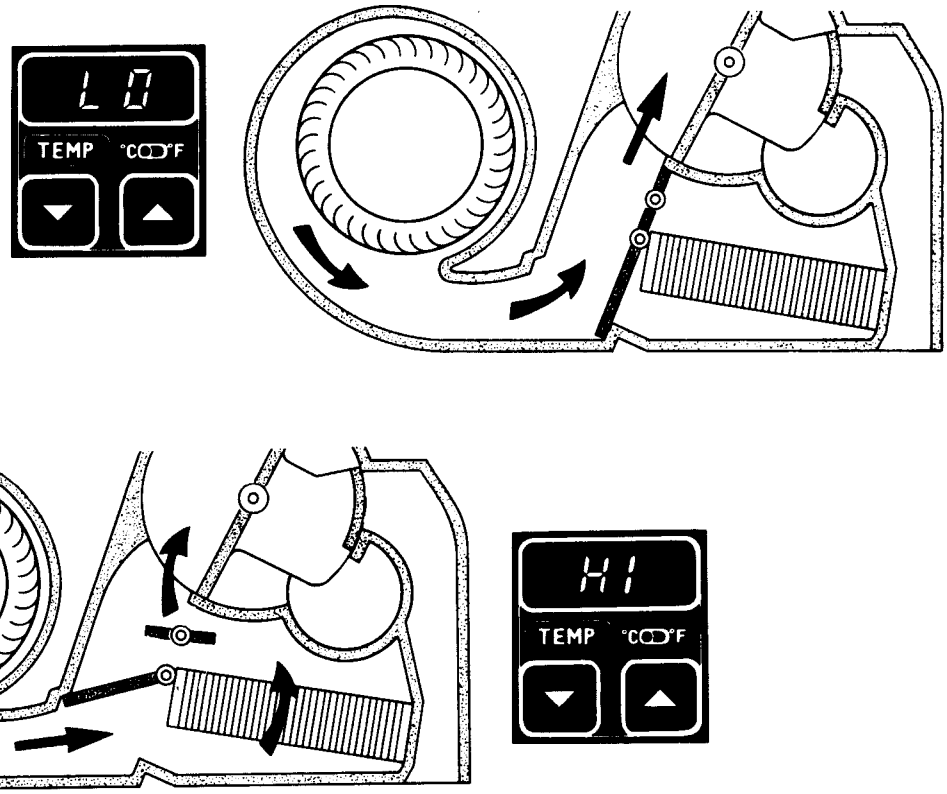
Ventilation Fan, Temp. Control & Air Dist. Flaps



The fan is located after the evaporator and blows air to the temperature control flap which determines the amount of air that passes over the heater; in the 0% flap position no air flows over the heater and in the 100% position all the air is heated.

The air distribution flap is at the end of the air flow path and routes the air to the required areas of the car. The positions of this flap can be selected either manually or automatically.

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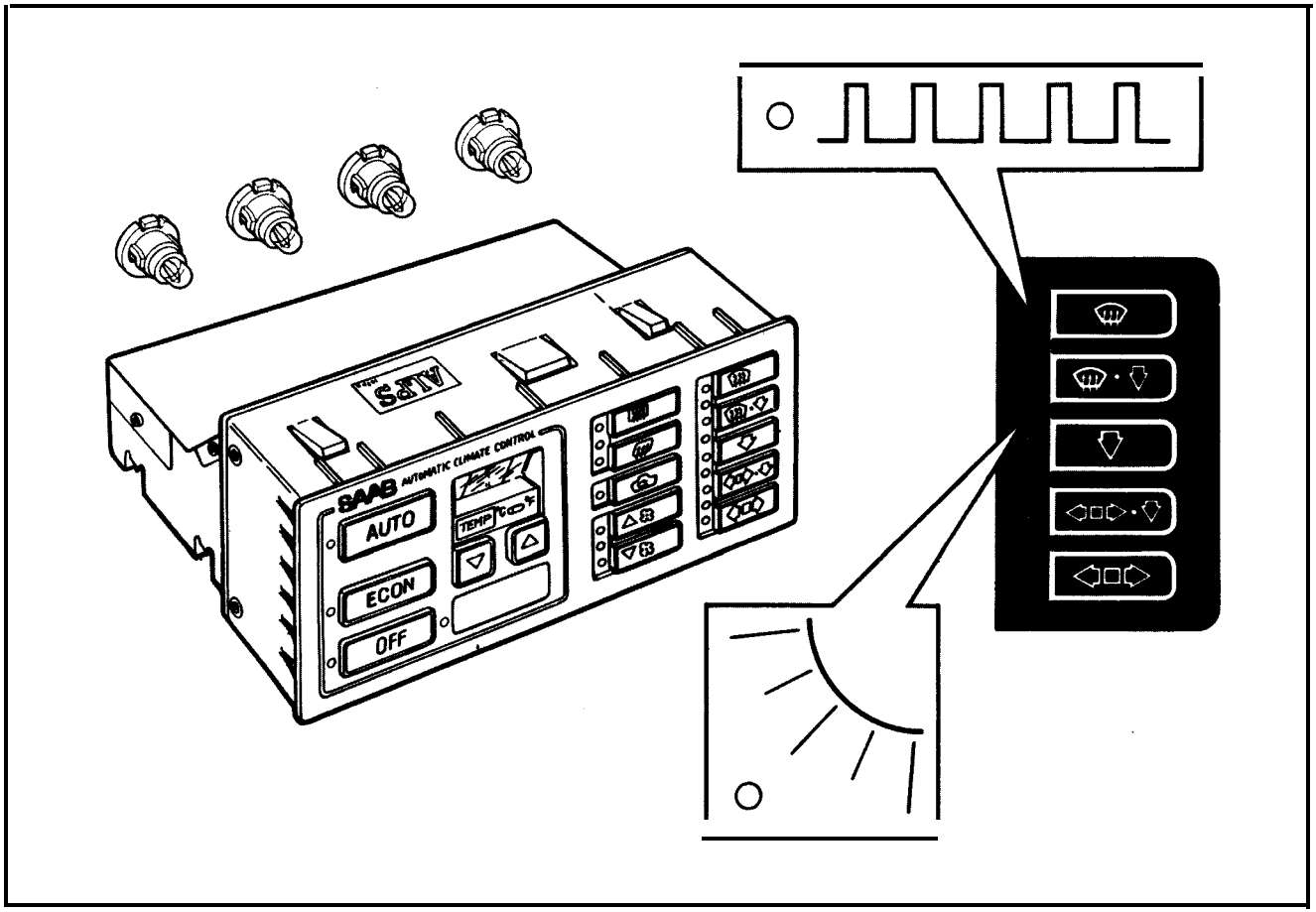
ACC Unit And Power Supplies



The unit is powered from the +54 and +30 circuits.

Indicators on the unit consist of a 2-digit display of the selected temperature and LEDs to indicate AUTO and/or the current manual selections. The 2-digit display is also used to indicate the number of faults, if any, which may be detected by the self test program. On ACC II units, the number of faults will be automatically shown on the display for approximately 10 seconds after starting.

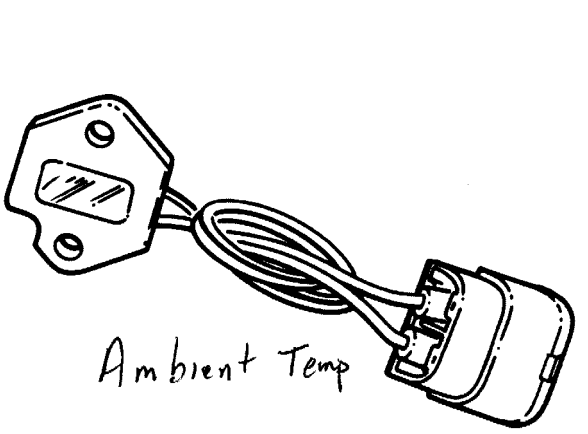
On ACC II, the LEDs and display are powered by a pulsed supply. In dark conditions the illumination level is controlled by the rheostat and in bright conditions by the ACC unit. The illumination is measured by a photo-transistor on the ACC panel.

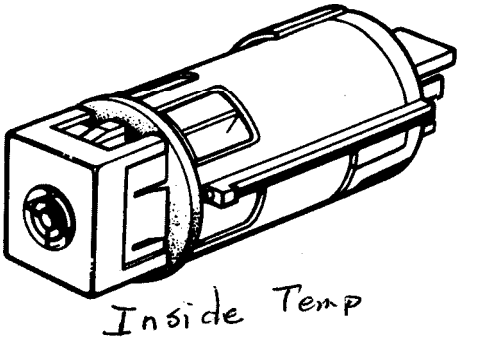
On ACC I, backlighting for the push buttons is provided by 3 bulbs powered by the rheostat.

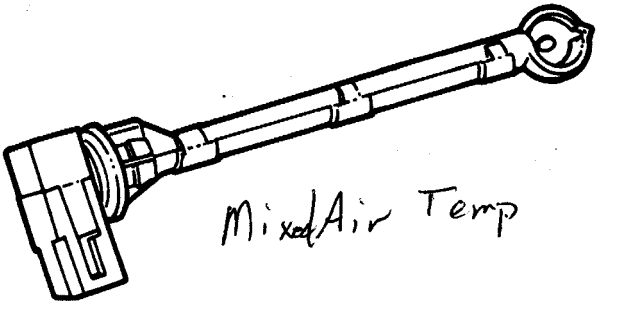
On ACC II, backlighting for the push buttons is from four bulbs powered by the rheostat. To gain access to the lamps, remove the front cover.

Automatic Climate Control

Temperature Sensors - ACC 1





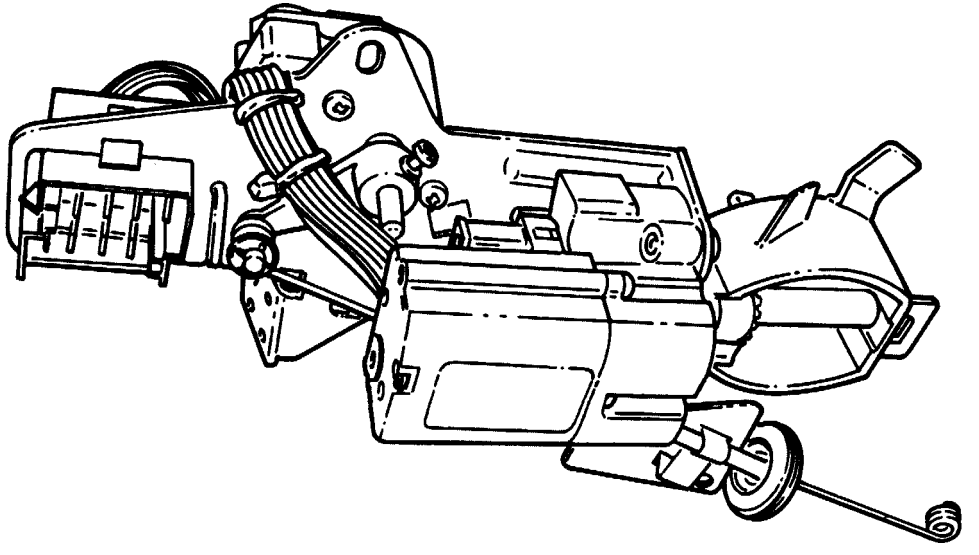


The ACC system needs three different temperature inputs to operate. This data is provided by the following solid state resistors:

- **Inside Temperature - A small fan draws air through the small vent to the right of the instrument cluster, ensuring an accurate sampling of cabin temperature.**
- **Mixed Air Temperature - This NTC measures air temperature downstream of the evaporator and heater core before it enters the distribution ducts.**
- **Ambient Temperature - Outside (ambient) air temperature is measured by a PTC (Positive Temperature Coefficient) sensor mounted on the outside of the cabin blower fan housing. In this position it samples the air being drawn into the evaporator housing.**

Automatic Climate Control

Flap Position Motors – ACC 1



The temperature control and air distribution flaps for the ACC I system are controlled by a sealed drive unit consisting of the following components:

- A reversible high speed DC motor
- A multistage gear reduction
- A variable resistor allowing the ACC ECU to sense output shaft position.

The variable resistor is preset during assembly but may become out of sync if proper procedures are not followed when servicing the dash. Erratic operation of the ACC, normally accompanied by a fault code on the diagnostic display will be the result.

There is no easy way to reset the resistor, the recommended repair is to replace the unit.

To avoid damage always follow these guidelines:

- Never power up an unmounted motor. The mounting hardware limits shaft rotation preventing you from overrunning the stops on the variable resistor.
- Before removing the drive assembly select HI on the temperature display.
- Allow the system to operate briefly until the flaps have locked in position, then turn the car off and remove the negative battery cable.

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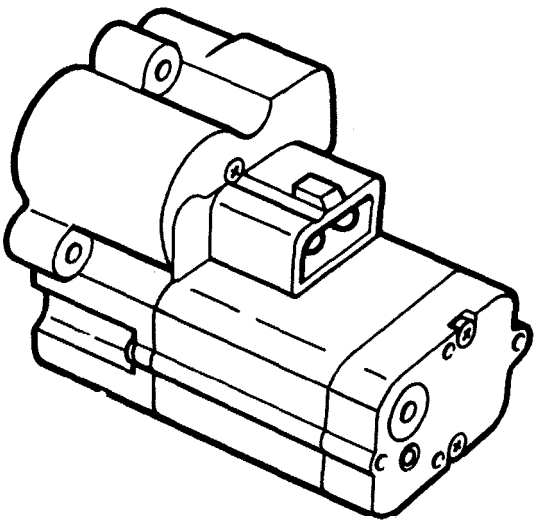
Recirculation Flap Motor



This is a fixed speed DC motor which runs in forward or reverse to move the flap between the fresh air and recirculation positions under control of the ACC unit. After approximately 15 seconds, the motor will switch off automatically.

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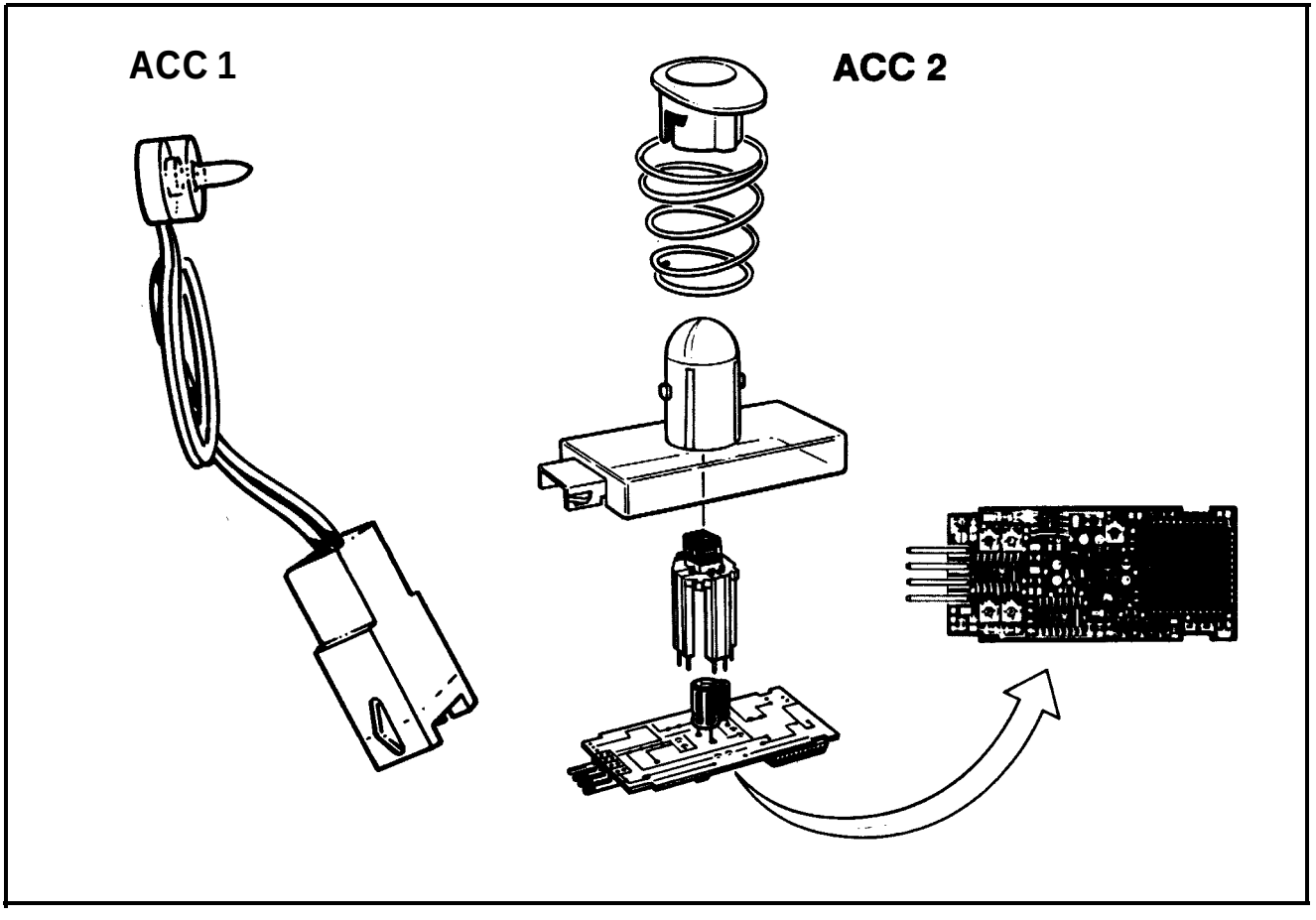
Solar Sensors



The solar sensor on cars equipped with ACC I is a photo cell which reacts to changes in the intensity of the sun. This information allows the ECU to modify cabin fan speed as a means of compensating for the affects of sun loading, This can be a significant factor considering the large areas of glass common in todays cars.

In the ACC II system the solar sensor is a microprocessor based unit fitted above the dash to sense the solar energy through the windshield. It consists of five solar cells and a microprocessor. The microprocessor transmits digital signals to indicate the intensity, angle of elevation and bearing of the sun.

The sensor is enclosed in a scratch-proof cover constructed of extremely tough epoxy-coated plastic. The top of the cover also acts as a filter, allowing only infra-red radiation to penetrate. The sensor is soldered into the printed circuit board which in turn is fitted in a plastic box and filled with silicone.

The message indicating the three measurements, unit is transmitted to the ACC unit in serial form at l-second intervals.

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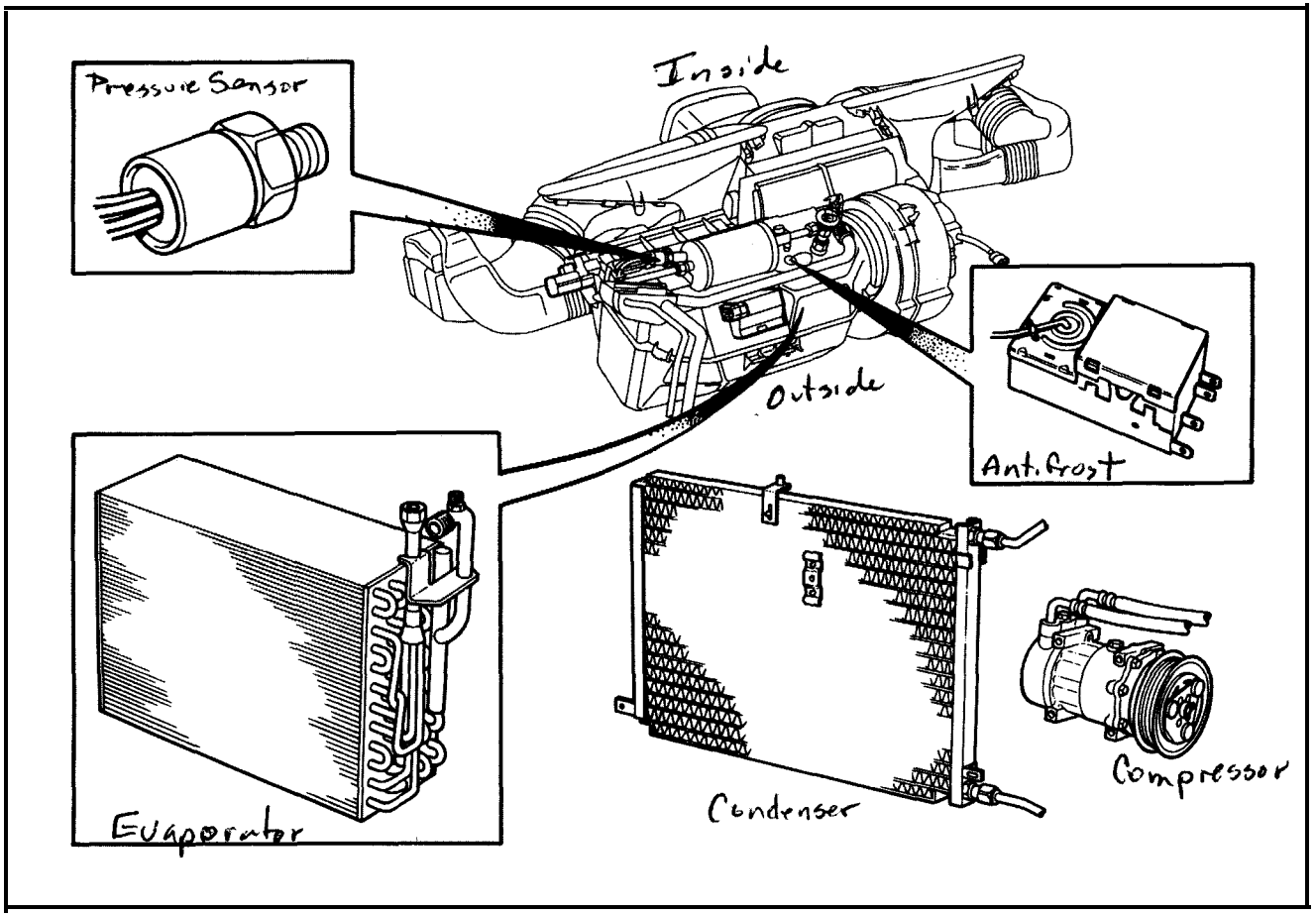
Air Conditioning Unit



The air conditioning system consists of a compressor, evaporator and condenser. An anti-frost switch is fitted on the evaporator and high and low pressure limit switches are fitted on the receiver dryer which is mounted on top of the evaporator.

Temperature control is achieved by blending cold air from the evaporator with hot air from the heater core.

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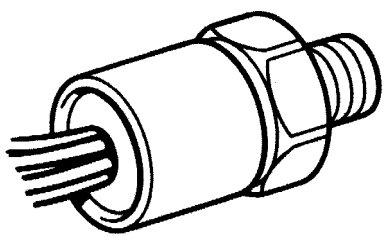
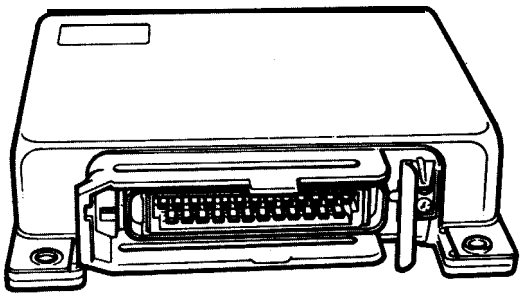
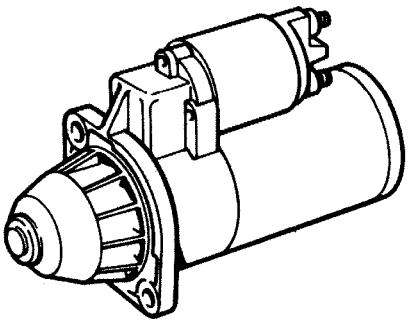
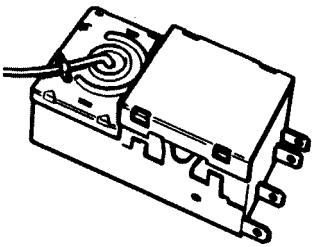
Air Conditioning Unit Control









To prevent the AC operating when ECON is selected the 12V control signal from the ACC unit is removed.

Other conditions which must be satisfied for the AC unit to operate are:

- When the contacts of both the high and low pressure switches, located on the receiver dryer are closed.
- The anti-frost thermostat fitted to the evaporator is in the closed position.
- The starter motor is not running.
- The engine has been running for at least 10 seconds after start.
- The engine is not running at full throttle.

To achieve the 10 second delay on earlier models, a timing relay is used. Beginning with LH 2.4.1 all interlocks which are dependent on the fuel injection system are incorporated in the LH ECU and an ordinary double or nothing relay is used.

To increase condenser cooling if the pressure of the refrigeration gas starts to rise, a pressure switch applies a signal to start the radiator fan.

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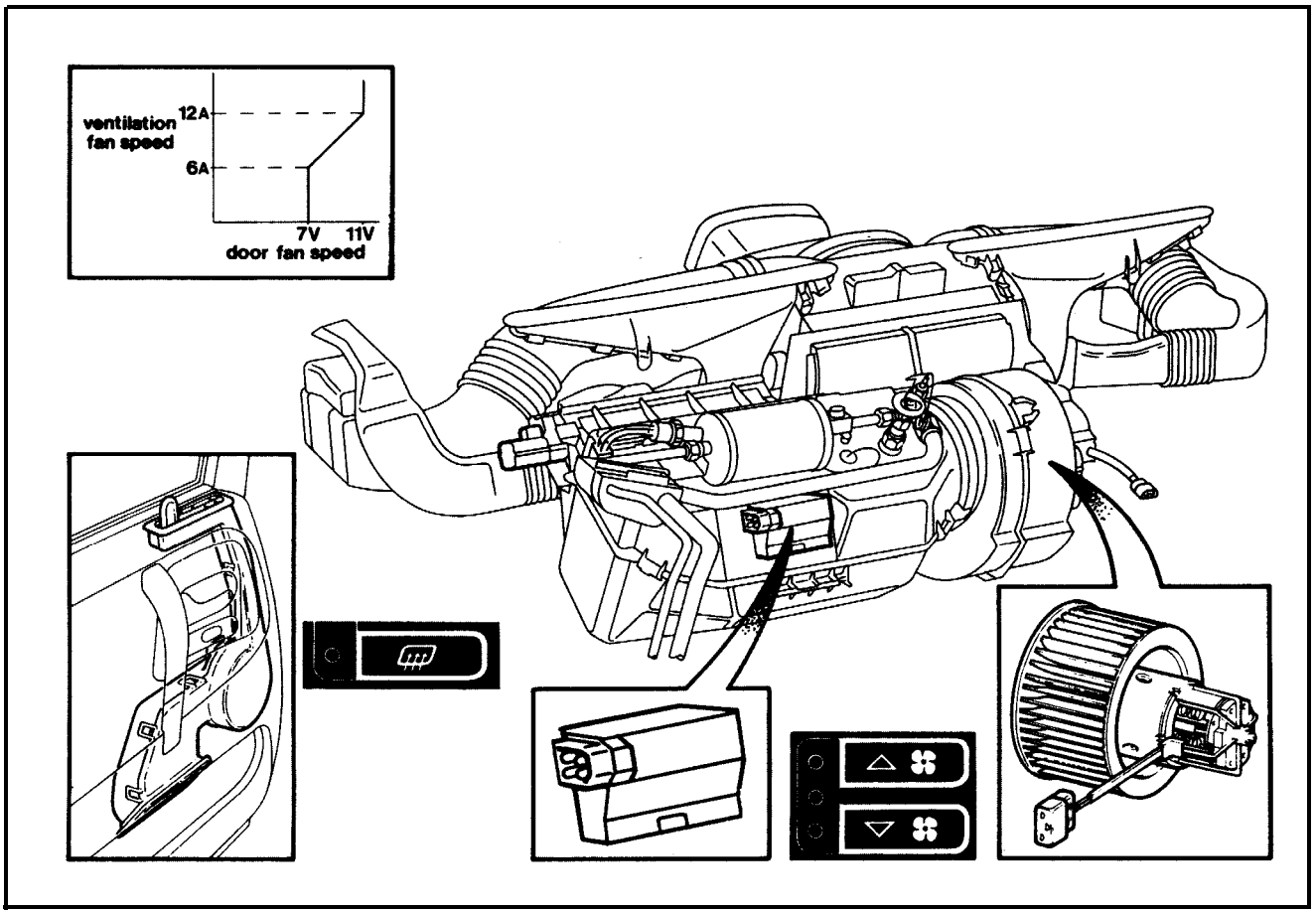
Ventilation And Rear Door Fans



The ventilation fan is driven by a variable speed DC motor. The speed is selected automatically in the AUTO mode and under control of the fan speed push buttons in the manual mode. To control the speed the ACC unit applies a control signal to a fan control unit which in turn varies the motor current. The rate of change of current is approximately 1 A per second. The current at maximum speed is approximately 16 A.

When HI or LO is selected on the temperature indicator the motor runs at maximum speed continuously.

On ACC I models (and early M90 ACC II models), a feedback signal from the negative terminal on the ventilation fan motor enables the ACC unit to monitor the speed of the ventilation fan motor.

The rear door fans on ACC I cars are controlled by a console mounted switch with **HI,** LO and **OFF** positions. Fan speed is controlled by a round ceramic resistor mounted under the drivers seat.

The rear door fans on cars with ACC II are also driven by variable speed DC motors. They have a preset minimum speed, increase in step with the ventilation fan in the middle of the range, and run at maximum speed at the top of the range. When the rear window heater is switched on, the door fans run at maximum speed.

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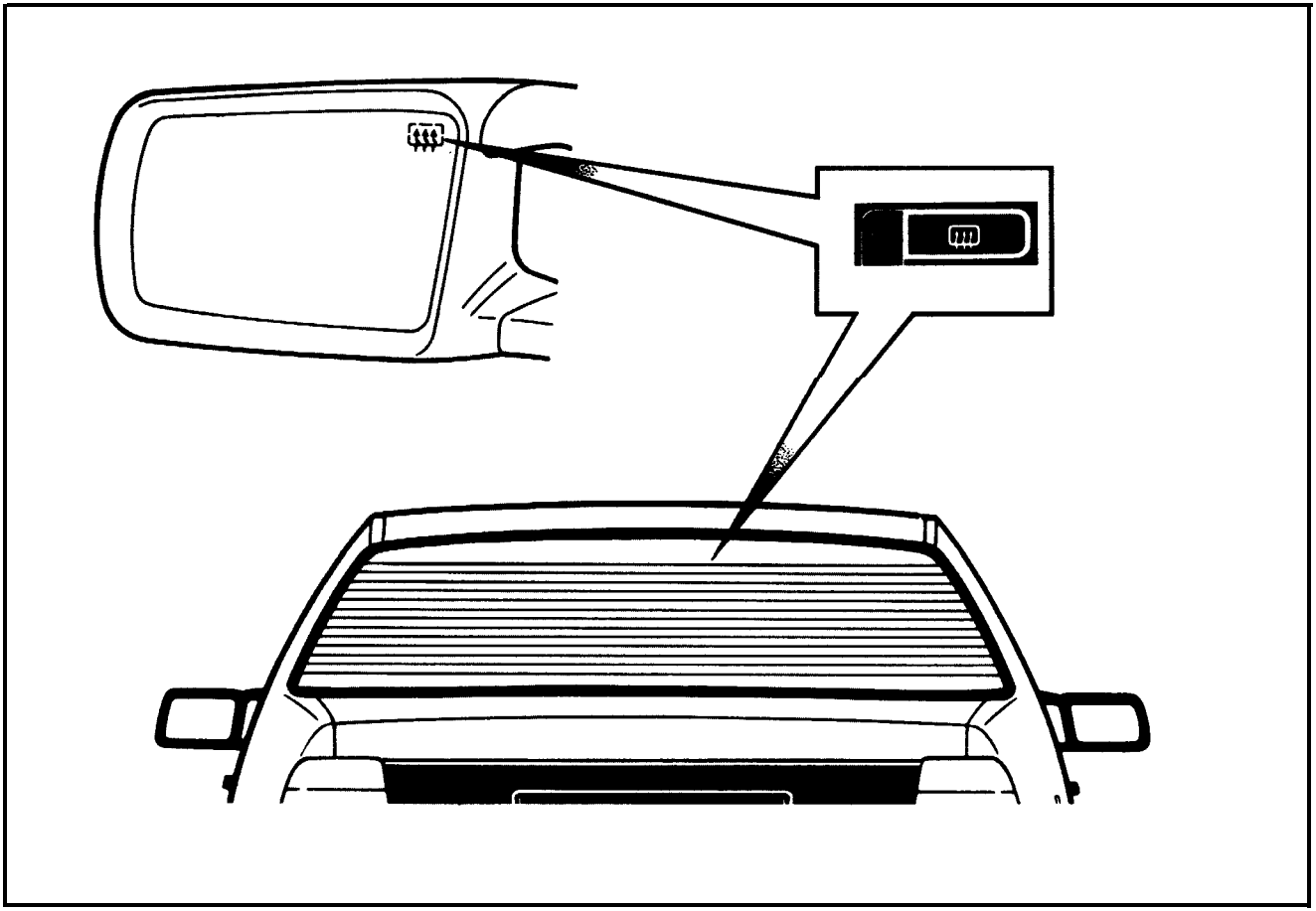
Rear Window And External Mirror Heaters



The +30 supply to the rear window and the external mirror heaters is switched on via a relay controlled by the ACC unit thereby enabling these functions to be controlled automatically when required.

On ACC II, when the indoor temperature is less than 50°F (+10°C) at ignition on, the supply is switched on automatically for approximately 10 minutes but can be manually switched off before this period has expired. Switch off after 10 minutes also occurs when the heater is switched on manually.

On ACC I, the 10 minute timing function is identical. The only difference is that the heaters are switched on when the outdoor temperature is less than 10°C at ignition "on".

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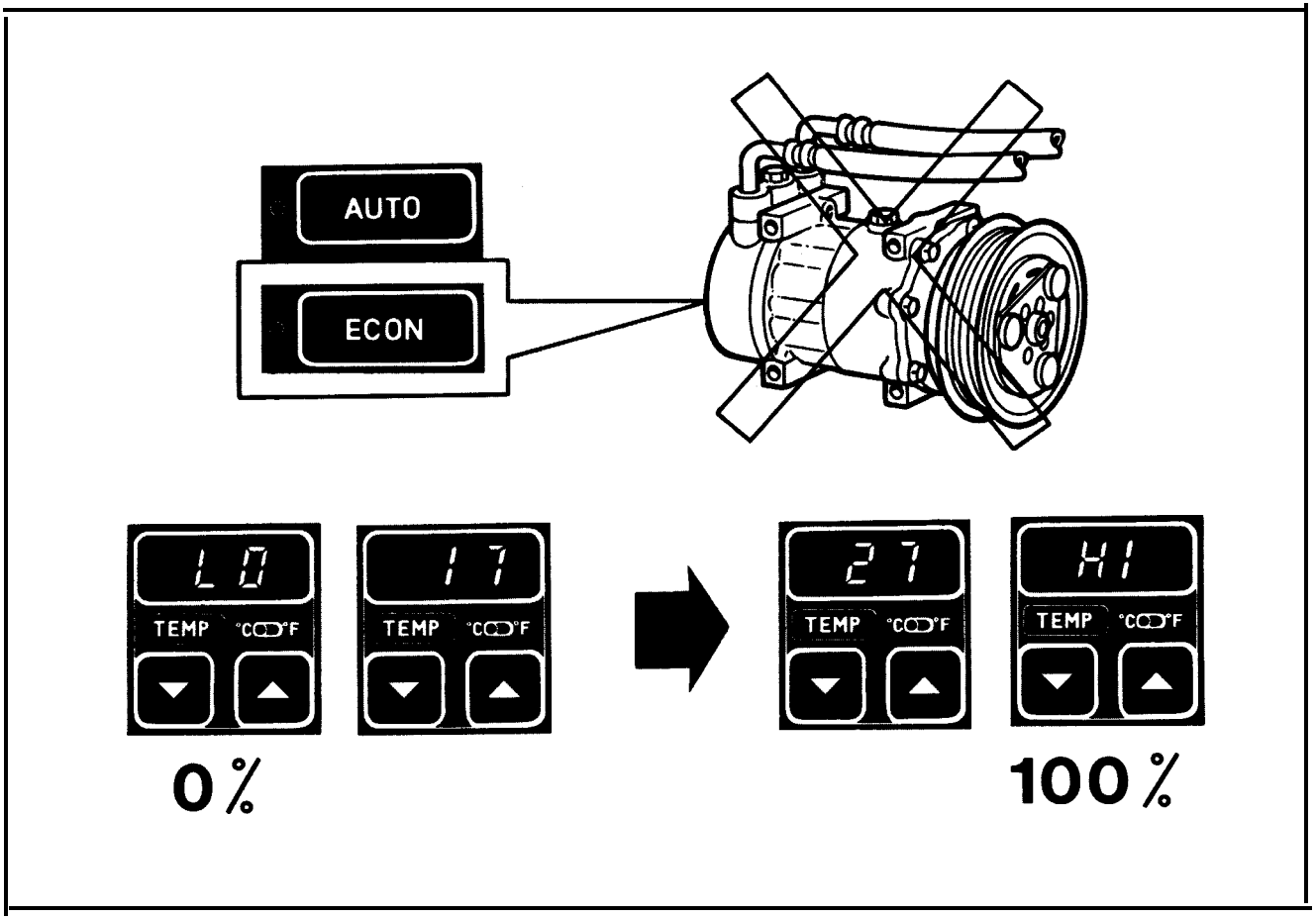
Automatic And Economy Modes



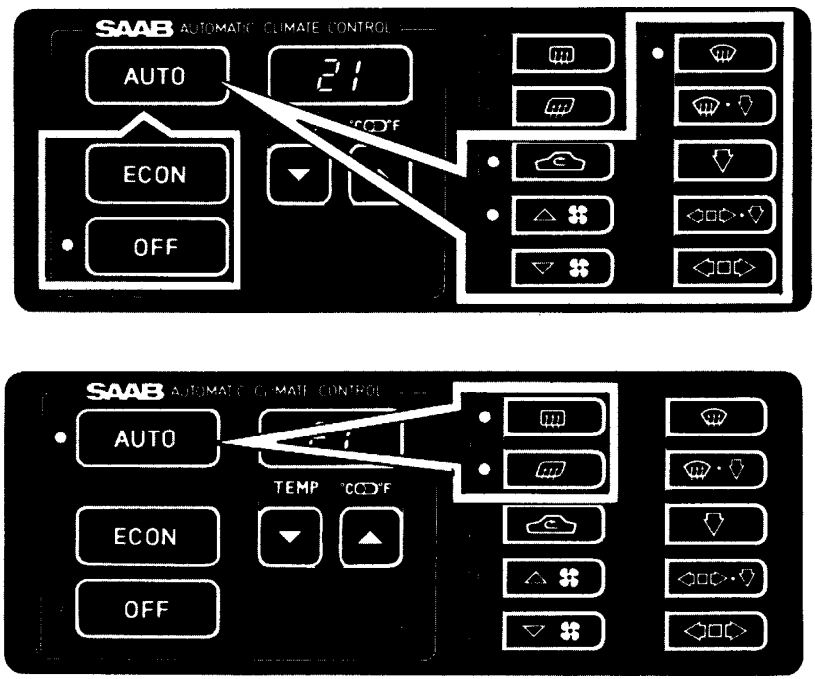
In the AUTO and ECON modes the system works to maintain the temperature at the selected value by controlling the positions of the various air flaps and the speed of the ventilation fan. The temperature selection range is 62-82°F (17-27° C).

With LO selected the temperature control flap is set to the 0% (bypass heater) position and the air distribution flap is set to VENT (flap angle 45 degrees). No temperature control occurs and the ventilation fan runs at maximum speed.

With HI selected, the temperature control flap is set to the 100% position (maximum heating) and the air distribution flap set to the (DEF-HEAT) position. No temperature control occurs and the ventilation fan runs at maximum speed.

Automatic Climate Control

Manual Mode



Manual selection of any of the following conditions causes the AUTO indicator to extinguish.

- Air recirculation
- Ventilation fan speed
- Air distribution
- Off mode (ACC II only)
- Economy mode

if for example an air distribution button (already lit) is pressed, air distribution begins to operate manually while air recirculation and ventilation fan speed continue to function automatically. The same applies to air recirculation and ventilation fan speed. Auto selection reverts everything to auto mode.

When rear window heater "on" or "off" is selected manually, the corresponding indicator lights or extinguishes but the AUTO indicator remains lit. Similarly, manual selection of rear door fans "off" (ACC II only) causes the indicator to extinguish but does not affect the AUTO indicator.

When the position of any of the control mechanisms is selected manually, the others continue to operate in the automatic mode to maintain the temperature constant.