

Section C Supplement

Heating, Ventilation and Air Conditioning (HVAC)

This Section Refers to the

20000-Series Cars and Onwards

1987 to 2000

With Microprocessor Controlled Climate Control



Air conditioning system

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Precautions

Danger – Exhaust gases

To ensure adequate ventilation, always open garage doors fully before starting the car in a garage, or any confined space.

The exhaust gases contain carbon monoxide (CO), which is odourless and invisible, but very poisonous.

Operating the air conditioning system increases the danger of these gases entering the car.

General precautions

Before commencing work on the electrical system it is recommended that either the battery master switch be turned to the OFF position or that the battery is disconnected.

If the master switch has to be left in the ON position or if the battery is left connected, the gear range selector lever must be placed in the park position and the gearchange isolating fuse (fuse A6) removed from fuseboard F2 at the main fuseboard. Then remove the ignition key.

Never disconnect the battery or switch off the battery master switch when the engine is running.

Always ensure correct polarity when making cable connections.

It is recommended that when carrying out tests on the car wiring, a good quality multi-meter is used. Never use generator type meters.

Do not use a test lamp on circuitry that contains electronic components, such as the air conditioning system.

When working on or in the vicinity of the air conditioning micro-processor, anti-static precautions, in particular the wearing of an anti-static wristband connected to a good earth, must be observed.

Special precautions

The refrigerant used in the air conditioning system is dichlorodifluoromethane (Refrigerant 12). It is supplied to the service network in disposable containers or metal drums.

When correctly handled the refrigerant is perfectly safe, however, incorrect handling could result in injury or accident.

The following precautions must always be observed.

1. Do not smoke in the vicinity of refrigerant or a refrigeration system.
2. Always wear safety glasses when working on a refrigeration system.
3. Store refrigerant containers upright and away from direct sunlight.
4. When transporting refrigerant, ensure that the containers are secured, remain upright and away from direct sunlight.
5. Ensure that caps are fitted to drums not in use.

6. Refrigerant containers must not be overfilled, increased pressure could cause an explosion.
7. To heat the drum when charging a system, immerse in warm water at a maximum temperature of 51°C (124°F).

Never place the drum on a hot surface or attempt to heat the drum by means of a blowlamp, etc.

8. Do not discharge refrigerant in confined spaces or near to exposed flames. Contact with exposed flames can produce a toxic gas.

Always keep refrigerant clear of engine air intakes.

9. Excessive heat applied to any part of the refrigeration system will create high pressures within the system. Therefore, welding, soldering, or brazing should not be carried out on the system, or to any adjacent part of the car.

First aid – Refrigerant burns

If the skin comes into contact with refrigerant, it should be bathed with clean cold water and medical attention sought immediately. Do not apply localized heat, hot dressings, etc.

If an eye should become affected by refrigerant, it must be immediately washed with clean cold water. The eye must not be rubbed as this will aggravate the injury.

After administering this emergency treatment a doctor should be consulted as soon as possible.



Electrical test and fault diagnosis

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Electrical test and fault diagnosis

Introduction

If an electrical fault is suspected on the air conditioning system it will be necessary to determine whether the fault is in the wiring of the air conditioning system or on the micro-processor board.

If it is determined that the fault is on the micro-processor board, the board must be replaced as it is a non-serviceable item.

The wiring can be tested using the air conditioning test box RH 9884. Alternatively, test the wiring using a good quality multi-meter capable of measuring continuity, resistance, and direct current voltage.

If using the test box it is recommended that the test procedures be carried out in full, noting any malfunction. On completion of the test box procedures, correct any malfunction by selecting the appropriate sub-heading under Test procedures using a multi-meter. Carry out that particular procedure before retesting the system with the test box.

When correcting a malfunction or carrying out the test procedures using a multi-meter, identification of cable routes and connections, also components, can be made using the wiring diagrams and component locations contained within this section.

When working on or in the vicinity of the air conditioning micro-processor, anti-static precautions, in particular, the wearing of an anti-static wristband connected to a good earth, must be observed.

To avoid damage to the mating surfaces of plug or socket connections it is recommended that meter probes, etc., are applied from the rear, cable entry side. It may be necessary to release the locking bar of the plug or socket to achieve this.

Where it is necessary to start the car engine, all normal workshop safety precautions must be observed.

Before commencing the test procedures always ensure that the battery is in a fully charged condition.


Test procedures using test box RH 9884

Initial procedure

1. Remove fuse A1 at fuseboard F1.
2. Disconnect both the left-hand and right-hand 18-way plugs at the micro-processor. To avoid damage to the board it will be necessary to hold the opposite end of the board when removing a plug.
3. With all switches on the test box in the up position, connect the test box as follows.
 - a. Connect the lead from the test box marked LEFT to the left-hand 18-way plug from the micro-processor.
 - b. Connect the lead from the test box marked RIGHT to the right-hand 18-way plug from the micro-processor.

- c. Ensure that the termination on the single red cable from the test box is insulated and free from any earth potential.
- d. Connect the single purple cable from the test box to a known, fused, 12 volts positive supply.
4. Select ON position at the POWER switch on the test box noting that.
 - a. Dependent on the position of the air conditioning function switch on the facia, the corresponding lamp on the test box will be illuminated.
 - b. When testing with a cold engine [engine coolant temperature below 44°C (111°F)] the 44°C lamp on the test box will be illuminated.
 - c. The ALT (alternator) lamp on the test box will only be illuminated when the engine is running.

Air conditioning function switch – To test

1. Select OFF position at the air conditioning function switch on the facia. The OFF lamp at the test box should illuminate.
2. Rotate the function switch from OFF through each position to the  (defrost) position. At each switch position the corresponding lamp on the test box should illuminate.

Fans control circuit – To test

1. Move the left-hand FAN CONTROL switch on the test box to the down (ON) position. The fans should operate at minimum speed.
2. From left to right select the down position on the four remaining FAN CONTROL switches noting that as each switch is operated the speed of the fans increases.
3. Switch OFF the left-hand FAN CONTROL switch. Both fans should stop.

Mode change actuator – To test

1. Move the MODE switch on the test box to the down position. The mode change actuator should operate, directing air to the facia position.
2. Move the MODE switch on the test box to the SCREEN (up) position. The mode change actuator should operate, directing air to the screen position.
3. Ensure that the mode change flap seals effectively, especially in the screen position.

Left-hand recirculation actuator – To test

1. Move the L.H. switch on the test box to the down position. The left-hand recirculation actuator should operate, directing air to the fresh air position.
2. Move the L.H. switch on the test box to the RECIRC (up) position. The actuator should operate, directing air to the recirculation position.
3. Ensure that the flap seals effectively, especially in the recirculation position.

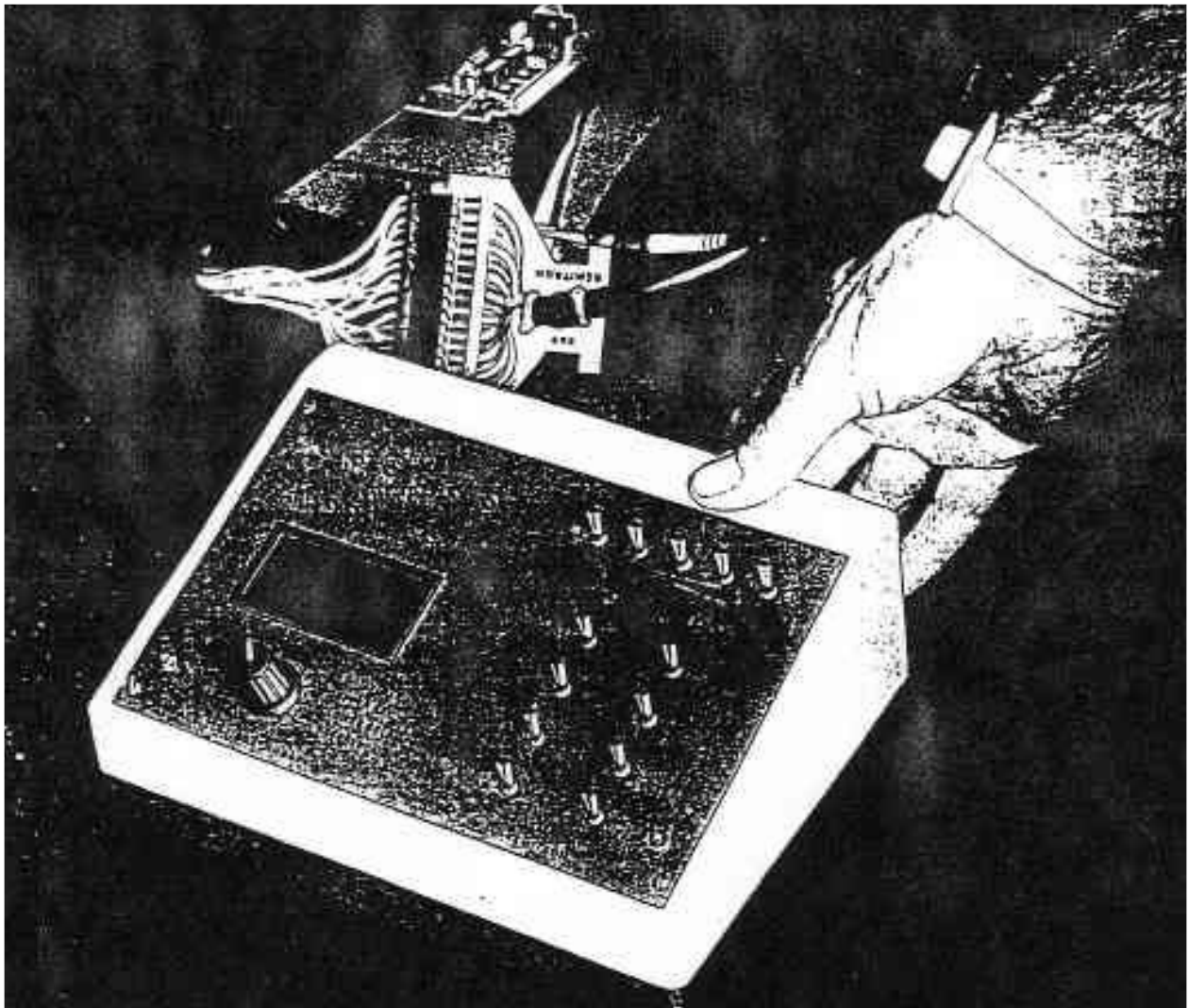


Fig. C4-1 Air conditioning system test box RH 9884

Right-hand recirculation actuator – To test

1. Move the R.H. switch on the test box to the down position. The right-hand recirculation actuator should operate, directing air to the fresh air position.
2. Move the R.H. switch on the test box to the RECIRC (up) position. The actuator should operate, directing air to the recirculation position.
3. Ensure that the flap seals effectively, especially in the recirculation position.

Lower quantity actuator – To test

1. Move the LOWER FLAP switch on the test box to the down position. The lower quantity actuator should operate, directing air to the lower outlets.
2. Move the LOWER FLAP switch on the test box to the SHUT (up) position. The lower quantity actuator should operate, closing off air from the lower outlets.
3. Ensure that the flap seals effectively, especially in the closed position.

Air conditioning temperature sensors – To test

1. Rotate the selector switch on the test box to the AMBIENT position. Read off the voltage.

Compare the voltage reading with the Temperature sensor voltage response graph and table given in figure C4-2. If the reading is within a $\pm 5\%$ tolerance the sensor is functioning correctly.

2. Repeat procedure 1 with the selector switch in the LOWER position.
3. Repeat procedure 1 with the selector switch in the TOP ROLL (solar) position.
4. Repeat procedure 1 with the selector switch in the UPPER position.

Screen-facia/recirc switch – To test

1. Press and hold the SCREEN-FACIA/RECIRC switch on the facia to the SCREEN/FACIA position. The SCREEN FACIA lamp on the test box should illuminate.

It should be noted that when carrying out this operation on certain 1987 model year cars the RECIRC lamp on the test box also illuminates but at a slightly lower intensity. If illumination of the lamp does occur, before continuing with the test procedure, the pink cables connected between the SCREEN-FACIA/RECIRC switch and the inner switch panel plug and socket 6-way must be disconnected and permanently removed.

2. Select the RECIRC position at the SCREEN-FACIA/RECIRC switch. The RECIRC lamp on the test box should illuminate.
3. Return the SCREEN-FACIA/RECIRC switch to the central position. The RECIRC lamp will be restored to its original condition, i.e. not necessarily extinguished.

Temperature selector controls test procedure

1. Rotate the selector switch on the test box to the REFERENCE position. Read off the voltage (approximately 2.5 volts).
2. Rotate the upper temperature selector on the facia to the mid-position and the selector switch on the test box to the UPPER SEL position. Read off the voltage. This output voltage should be within ± 0.5 volt of the reference voltage.
3. Rotate the lower temperature selector on the facia to the mid-position and the selector switch on the test box to the LOWER SEL position. Read off the voltage. This output voltage should be within ± 0.5 volt of the reference voltage.

Rear window demister and mirror heaters, compressor clutch, and water tap test procedure

1. Rotate the selector switch on the test box to the BAT. VOLTS position.
2. Move the H.R.W. switch to the down position. The voltage reading on the test box should decrease.
3. Move the H.R.W. switch to the up (off) position.
4. Move the COMP. CLUTCH switch to the down position. The compressor clutch in the engine compartment should be heard to operate.
5. Move the COMP. CLUTCH switch to the up (off) position.
6. Move the WATER TAP switch to the down position. The water tap situated in the engine compartment should operate.
7. Move the WATER TAP switch to the up (off) position.

Air conditioning coolant temperature switch – To test
This test must be carried out with a cold engine [i.e. engine coolant temperature below 44°C (111°F)].

1. The 44°C lamp on the test box will be illuminated.
2. Disconnect the coolant temperature switch on the thermostat housing. The 44°C lamp on the test box should extinguish.
3. Re-connect the coolant temperature switch.

Test procedures conclusion

1. Having verified the car wiring.
 - a. Disconnect the 12 volts positive supply to the test box.

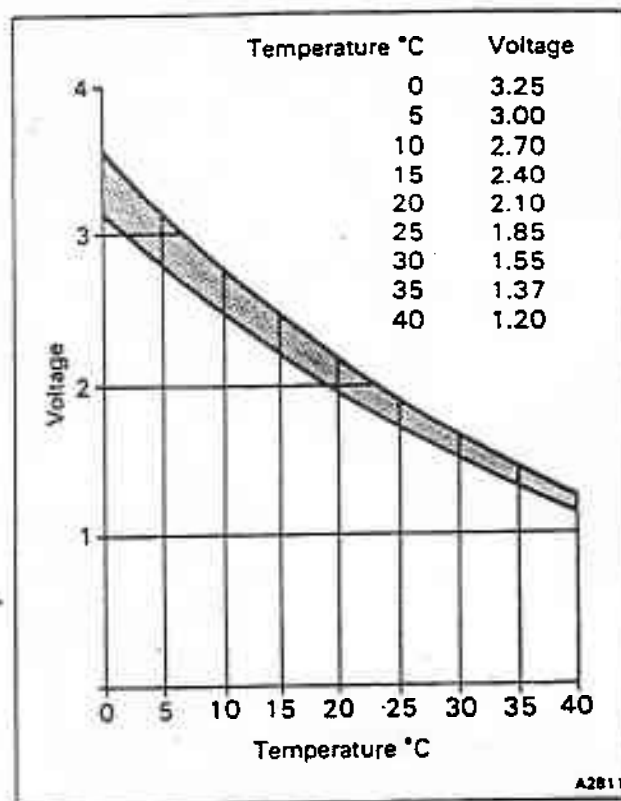


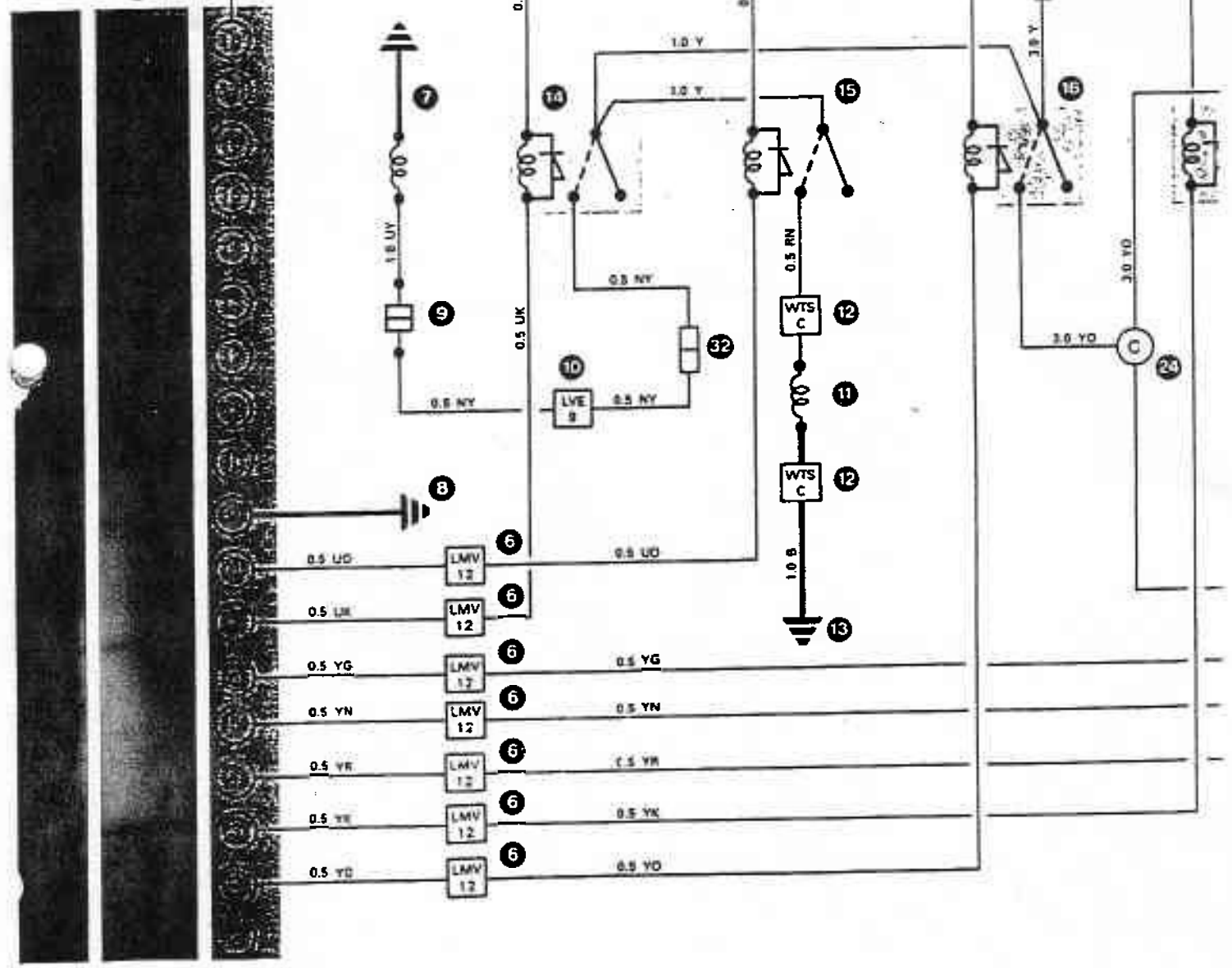
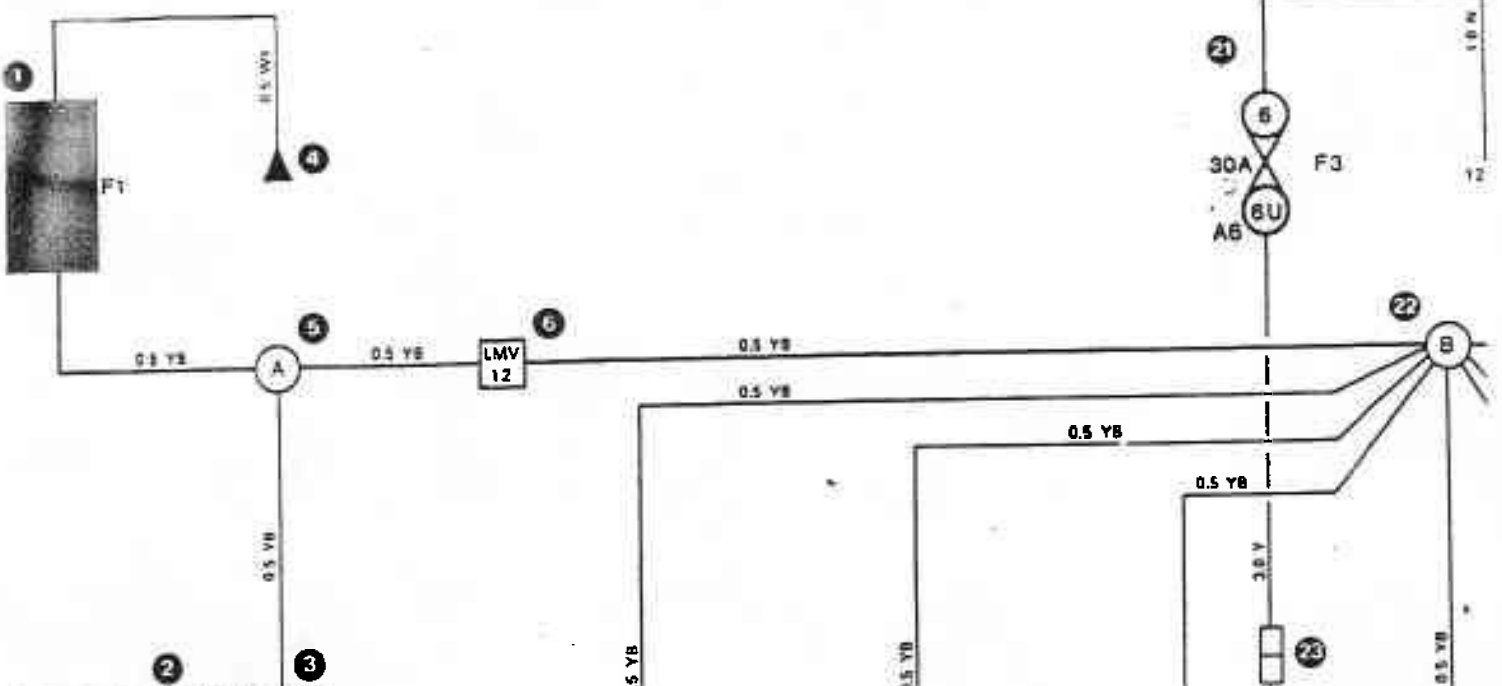
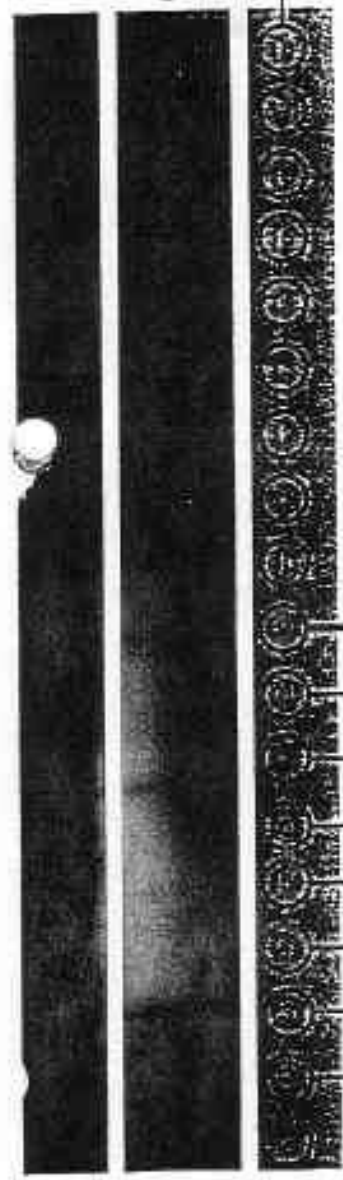
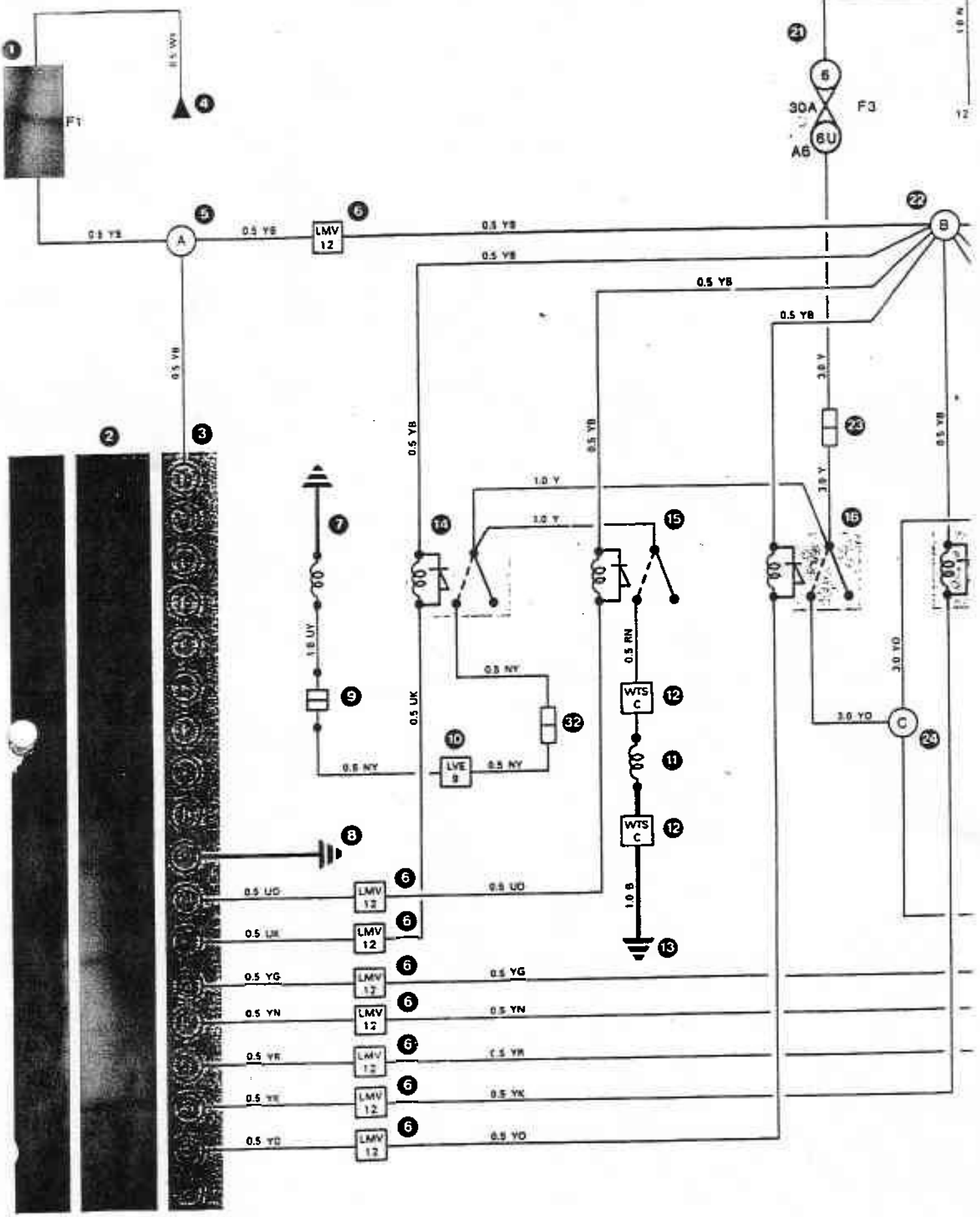
Fig. C4-2 Temperature sensor voltage response graph and table

- b. Disconnect the test box.
 - c. Re-connect the 18-way plugs to the micro-processor.
 - d. Replace fuse A1 at fuseboard F1.
2. Test the air conditioning system. If a malfunction is still apparent carry out the Micro-processor initializing procedure given under the heading Air conditioning micro-processor board.
 - If correct operation of the upper and lower blend flap actuators is verified by the initializing procedure the fault will be on the micro-processor board. Therefore, fit a new board.
 - If the correct operation of the upper and lower blend flap actuators cannot be verified by the initializing procedure, first substitute the actuator(s) to determine whether the fault is with the actuator(s) or on the micro-processor board. Renew as necessary.

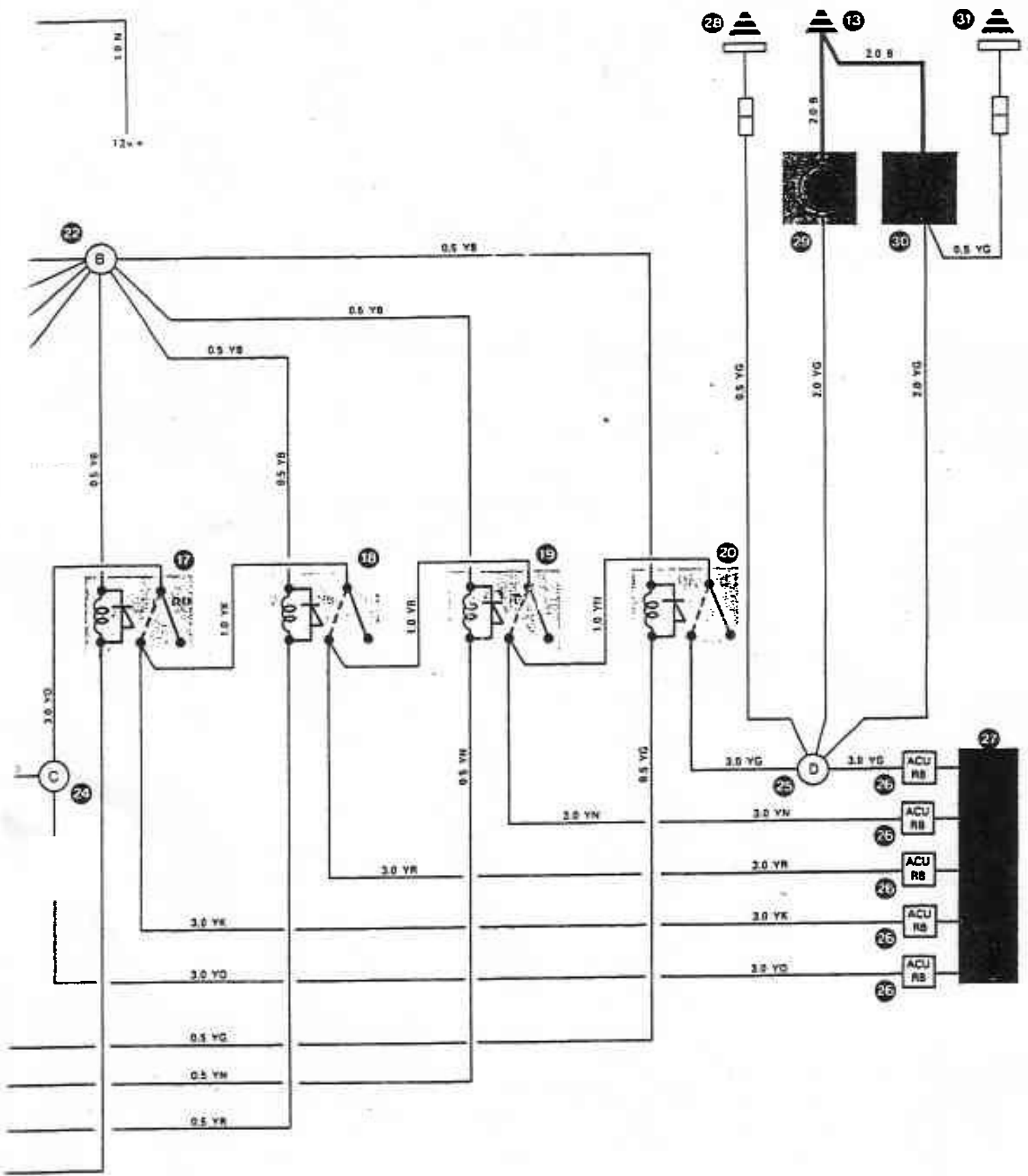


Fan control circuit

Wiring diagram and component location

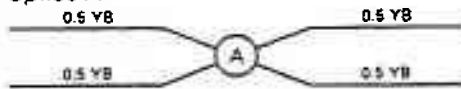


1.0 N
12x4

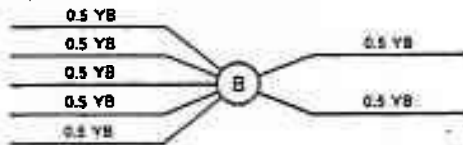




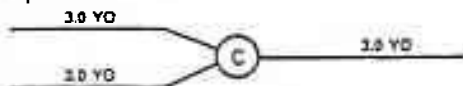
- 1 Fuseboard F1, fuse A1, 10 Amp
- 2 Air conditioning unit micro-processor
- 3 Air conditioning unit micro-processor plug 18-way
-right-hand
- 4 12 volts positive supply when engine is running
- 5 Splice A



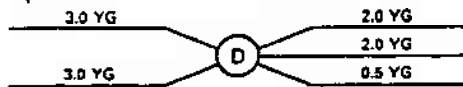
- 6 Left-hand main to valance loom plug and socket
12-way
- 7 Compressor clutch solenoid
- 8 Transmission tunnel earth point
- 9 Compressor ambient thermostat
- 10 Left-hand valance to engine loom plug and
socket 9-way
- 11 Water tap solenoid
- 12 Water tap solenoid connection
- 13 Front valance earth point
- 14 Compressor clutch relay
- 15 Water tap relay
- 16 Fans control relay
- 17 Fan speed relay 4
- 18 Fan speed relay 3
- 19 Fan speed relay 2
- 20 Fan speed relay 1
- 21 Fuseboard F3, fuse A6, 30 Amp
- 22 Splice B



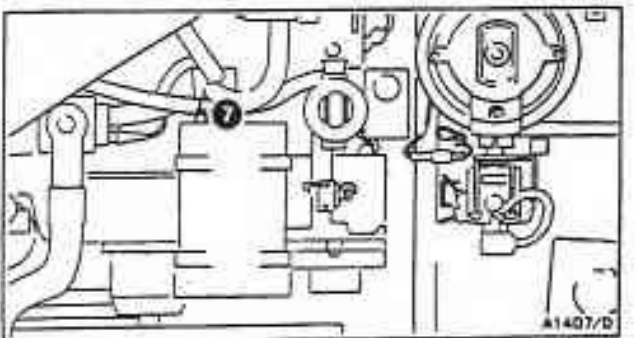
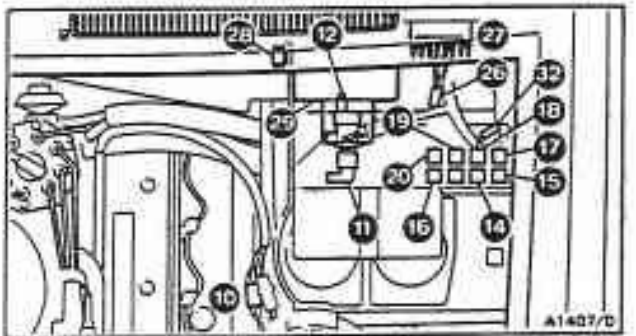
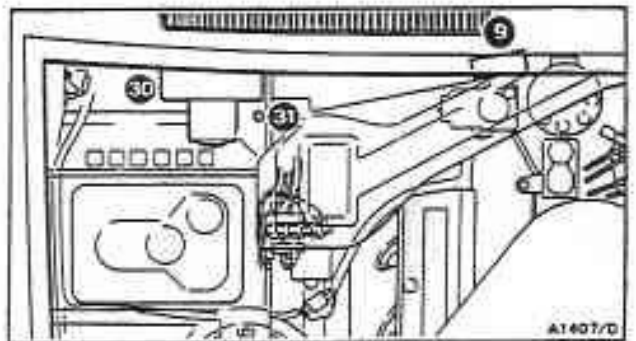
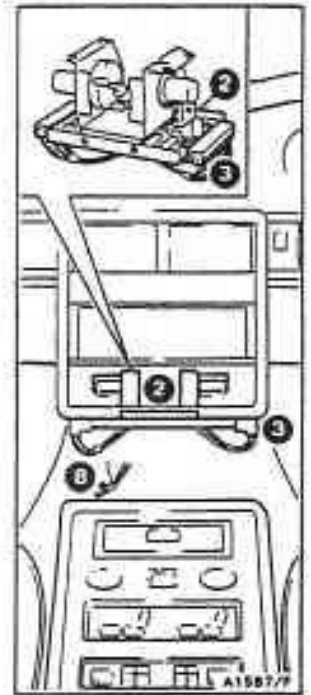
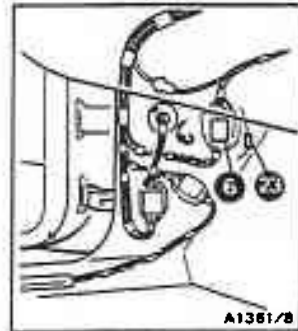
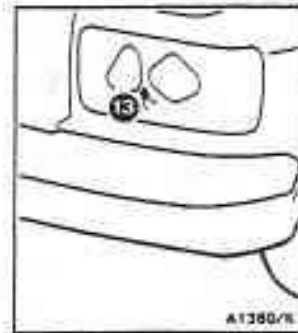
- 23 Left-hand main to valance loom connection
- 24 Splice C



- 25 Splice D



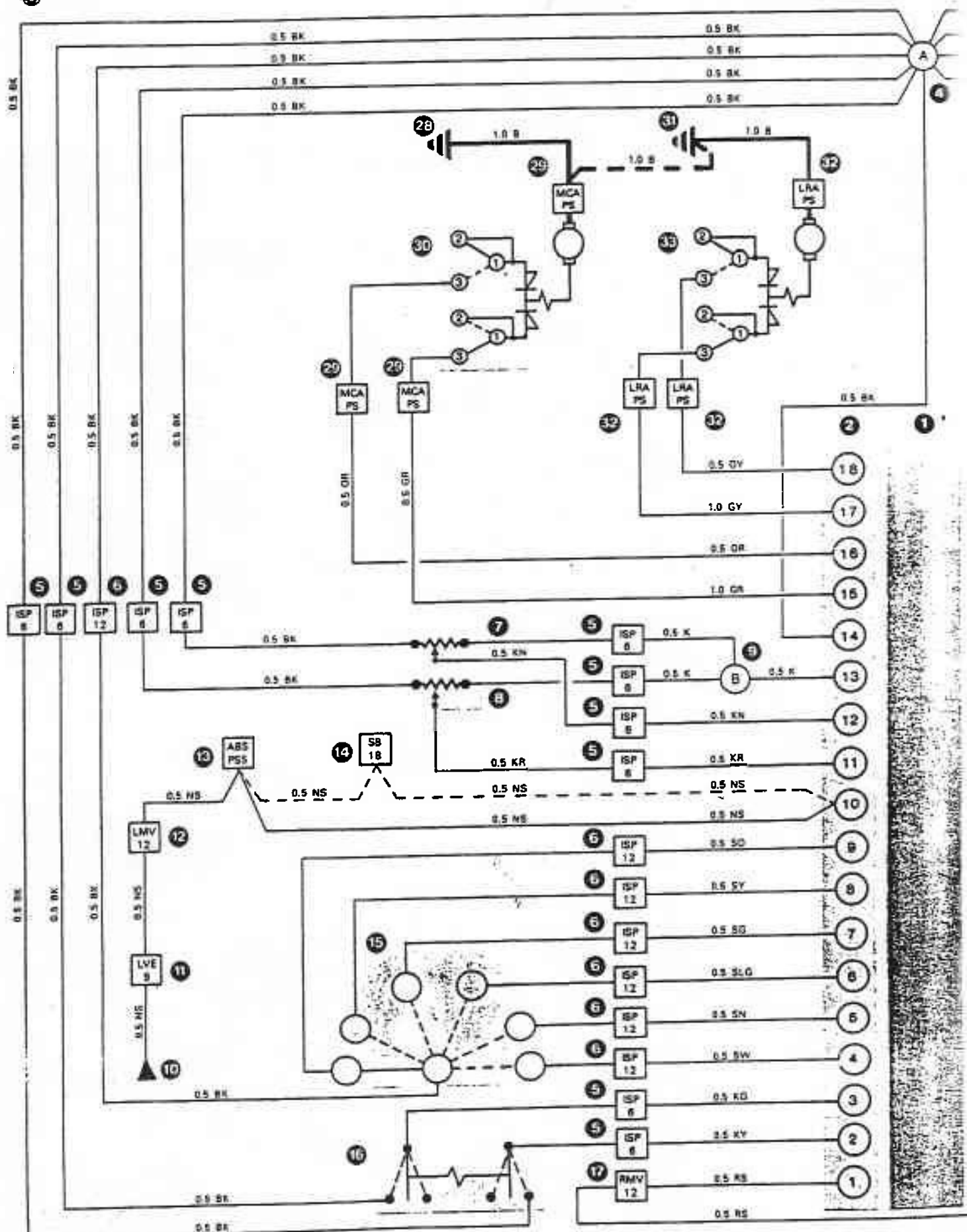
- 26 Air conditioning unit resistor block plug and
socket
- 27 Air conditioning unit resistor block
- 28 Air conditioning fan suppressor - left-hand
- 29 Air conditioning fan - left-hand
- 30 Air conditioning fan - right-hand
- 31 Air conditioning fan suppressor - right-hand
- 32 Air conditioning loom to left-hand valance loom
connection

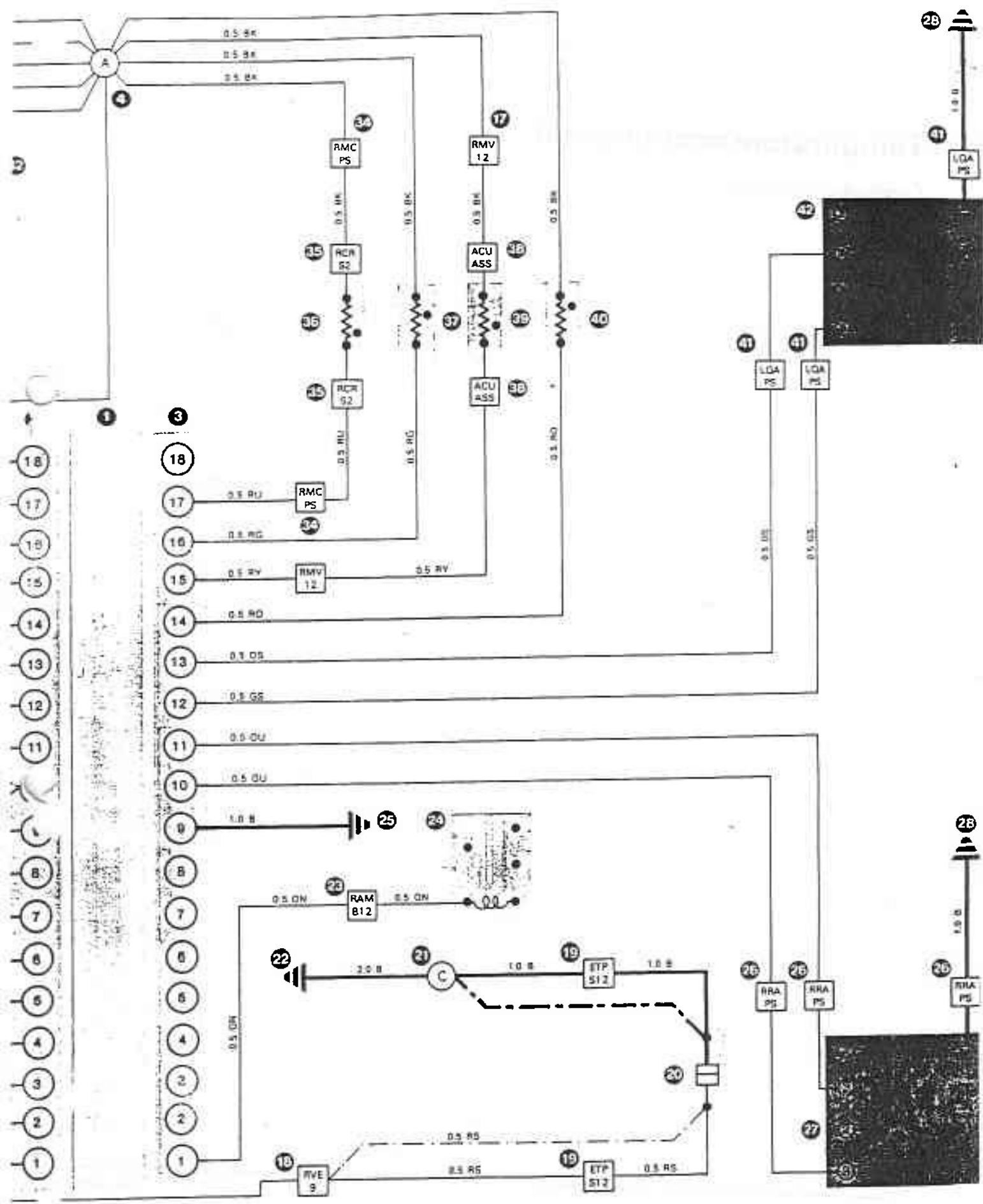




Temperature control circuit

Wiring diagram

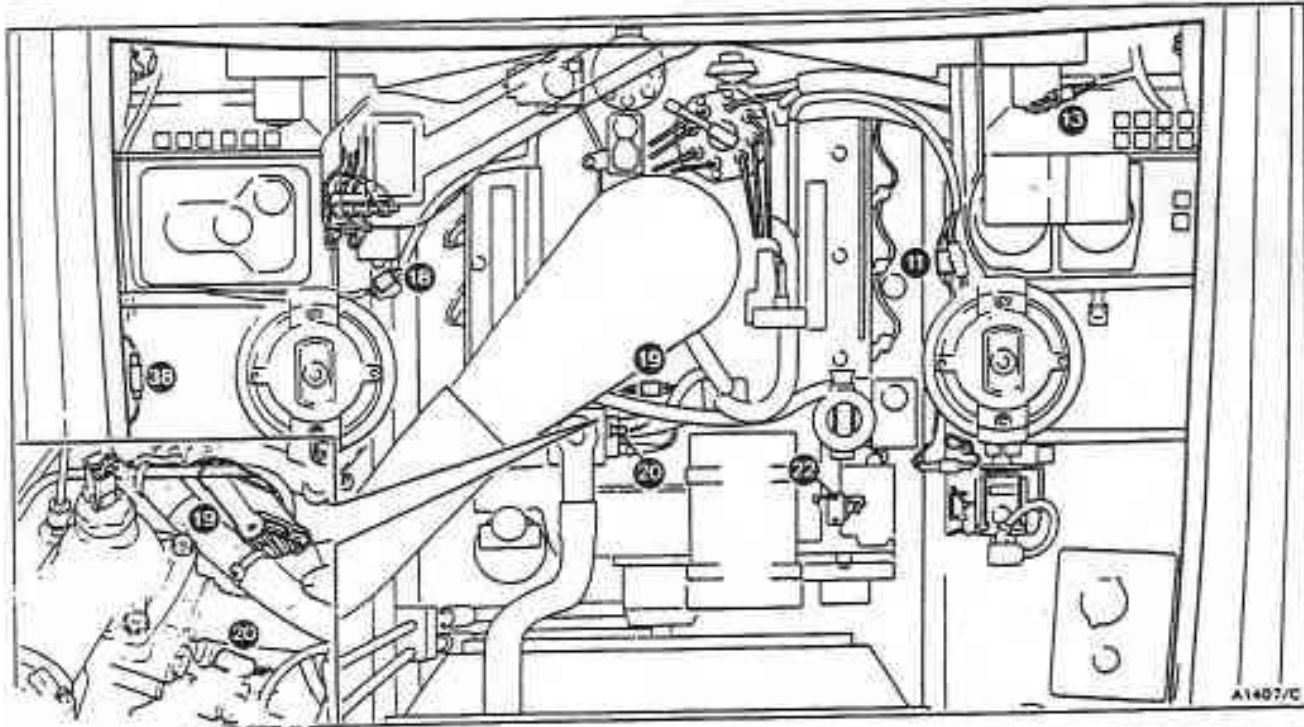
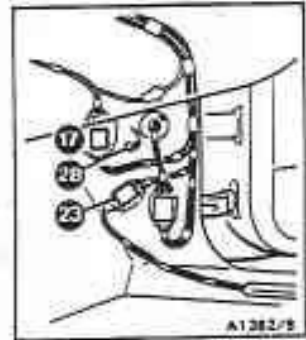
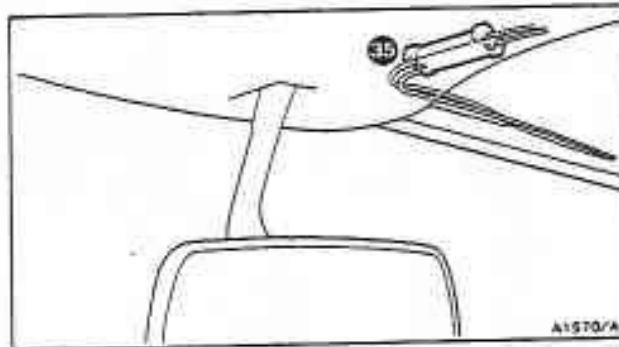
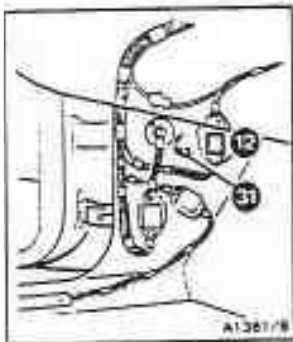
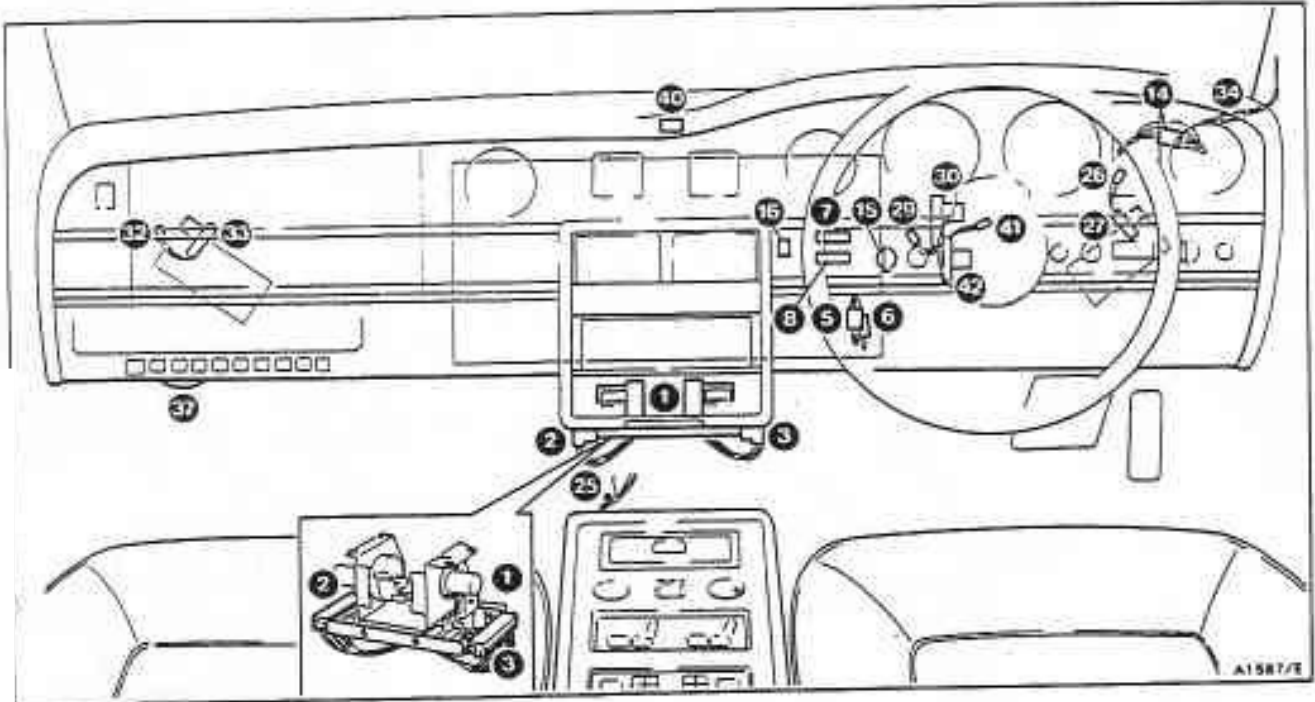






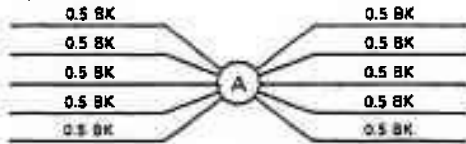
Temperature control circuit

Component location

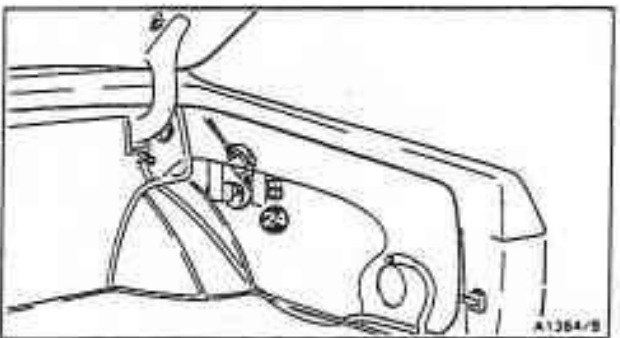
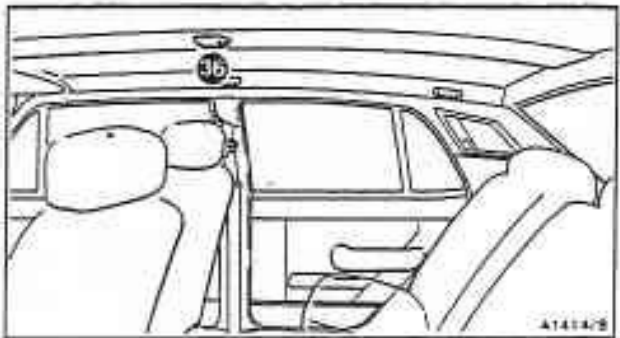
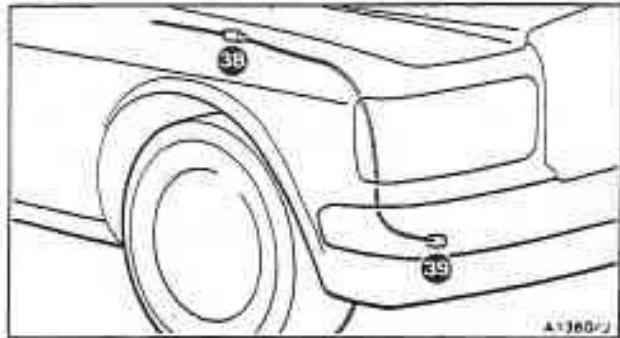
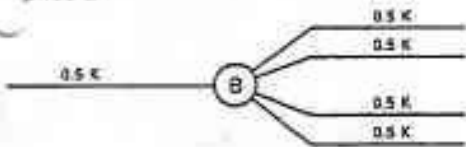


- 1 Air conditioning unit micro-processor
- 2 Air conditioning unit micro-processor plug 18-way – left-hand
- 3 Air conditioning unit micro-processor plug 18-way – right-hand

4 Splice A



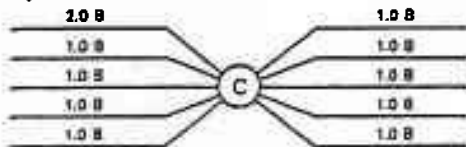
- 5 Inner switch panel plug and socket 6-way
- 6 Inner switch panel plug and socket 12-way
- 7 Upper temperature selector
- 8 Lower temperature selector
- 9 Splice B



- 10 Monitor supply from alternator (14 volts positive with engine running) to allow rear window and door mirror demisting
- 11 Left-hand valance to engine loom plug and socket 9-way
- 12 Left-hand main to valance loom plug and socket 12-way
- 13 Anti-lock braking system plug and socket 5-way
- 14 Switchbox plug and socket 18-way
- 15 Air conditioning control switch
- 16 Screen-facia/recirc switch
- 17 Right-hand main to valance loom plug and socket 12-way
- 18 Right-hand valance to engine loom plug and socket 9-way

- 19 Engine thermostat loom plug and socket 12-way
- 20 Coolant temperature switch

21 Splice C



- 22 Engine earth point
- 23 Right-hand 'A' post main to body loom plug and socket 12-way
- 24 Rear window demister relay – for details of the rear window demister and mirror heaters circuit refer to TSD 4701 Workshop Manual – Electrical, Section 16
- 25 Transmission tunnel earth point
- 26 Right-hand recirculation actuator plug and socket
- 27 Right-hand recirculation actuator
- 28 Right-hand 'A' post earth point
- 29 Mode change actuator plug and socket
- 30 Mode change actuator
- 31 Left-hand 'A' post earth point

- 32 Left-hand recirculation actuator plug and socket
 - 33 Left-hand recirculation actuator
 - 34 Right-hand main to cantrail loom plug and socket 6-way
 - 35 Right-hand cantrail to sensor loom plug and socket 2-way
 - 36 Cantrail sensor
 - 37 Knee roll sensor
 - 38 Air conditioning unit ambient sensor plug and socket
 - 39 Ambient sensor
 - 40 Top roll (solar) sensor
 - 41 Lower quantity actuator plug and socket
 - 42 Lower quantity actuator
- — — — — Denotes alternative cable route on Turbocharged cars

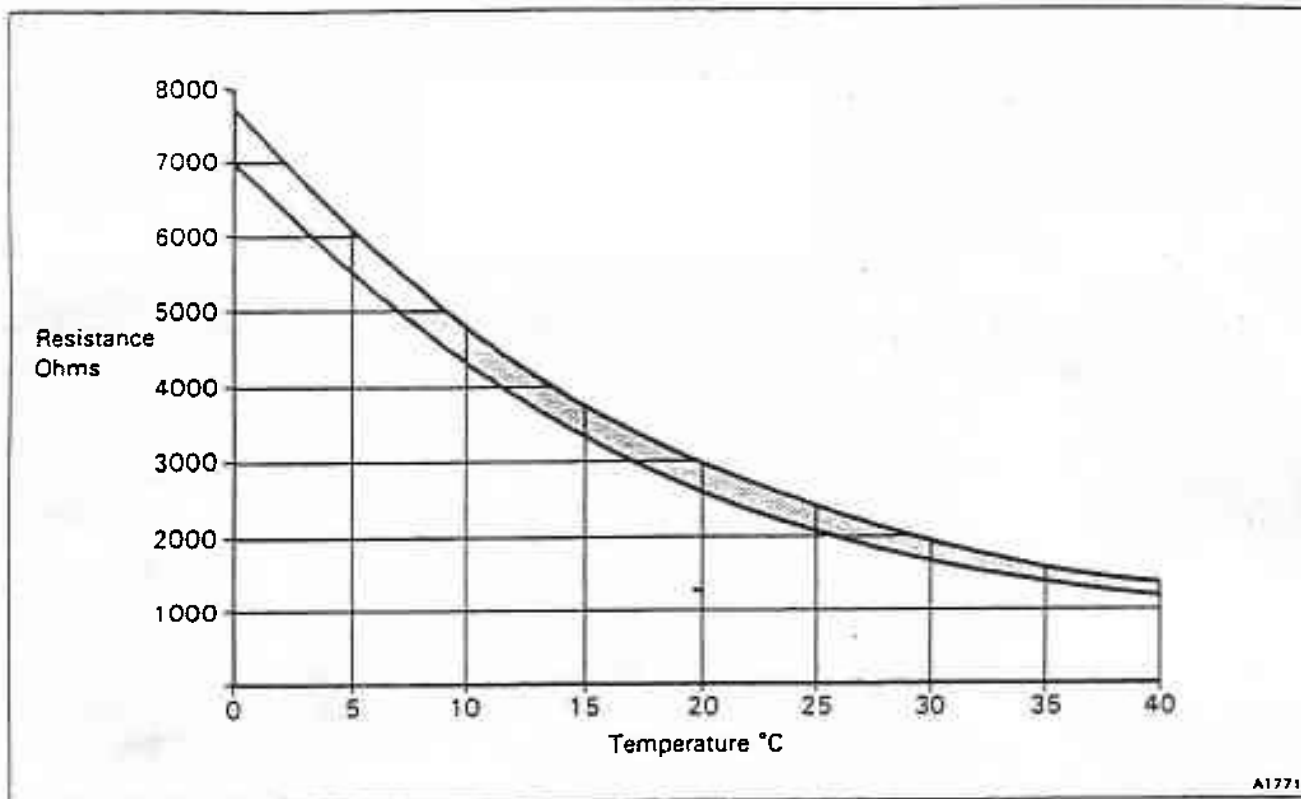


Fig. C4-3 Temperature sensor resistance graph

Lower quantity actuator – To test

Test procedure carried out at the right-hand 18-way plug.

1. Apply a known 12 volts positive supply to the green/slate cable at pin 12. The actuator should move the flap to the closed position.
 - Should the actuator fail to move.
 - a. Ensure that there is a good earth connection to the actuator.
 - b. Disconnect the 12 volts positive supply before checking the continuity of the green/slate cable to the actuator.
2. Apply a known 12 volts positive supply to the orange/slate cable at pin 13. The actuator should move the flap to the open position.
 - Should the actuator fail to move, disconnect the 12 volts positive supply before checking the continuity of the orange/slate cable to the actuator.
3. If no fault is found renew the actuator.

Air conditioning temperature sensors – To test

Test procedure carried out at the right-hand 18-way plug.

1. Disconnect the battery.
2. With the multi-meter set to ohms range.
 - a. Measure the resistance of each sensor between its connection at the plug (see item f) and a known earth point.
 - b. Compare the resistance measurement with the temperature/resistance graph shown in figure C4-3

- c. If the resistance falls to within $\pm 5\%$ of the graph reading, the sensor is operating correctly.
- d. If the graph reading is significantly outside the $\pm 5\%$ tolerance, renew the sensor.
- e. If a measurement cannot be obtained, check the continuity of the sensor wiring.
- f. Sensor connections.
 - Red/orange cable at pin 14 – Solar (top roll) sensor.
 - Red/yellow cable at pin 15 – Ambient sensor.
 - Red/green cable at pin 16 – Lower air (knee roll) sensor.
 - Red/blue cable at pin 17 – Upper air (roof) sensor.
3. Re-connect the battery.

Screen-facia/recirc switch – To test

Test procedure carried out at the left-hand 18-way plug.

1. Ensure the continuity of the pink/yellow cable at pin 2 to the black/pink cable at pin 14 when the SCREEN-FACIA/RECIRC switch is in the SCREEN-FACIA position.
2. Ensure the continuity of the pink/green cable at pin 3 to the black/pink cable at pin 14 when the SCREEN-FACIA/RECIRC switch is in the RECIRC position.

Temperature selector controls test procedure

Test procedure carried out at the left-hand 18-way plug.

1. Disconnect the battery.

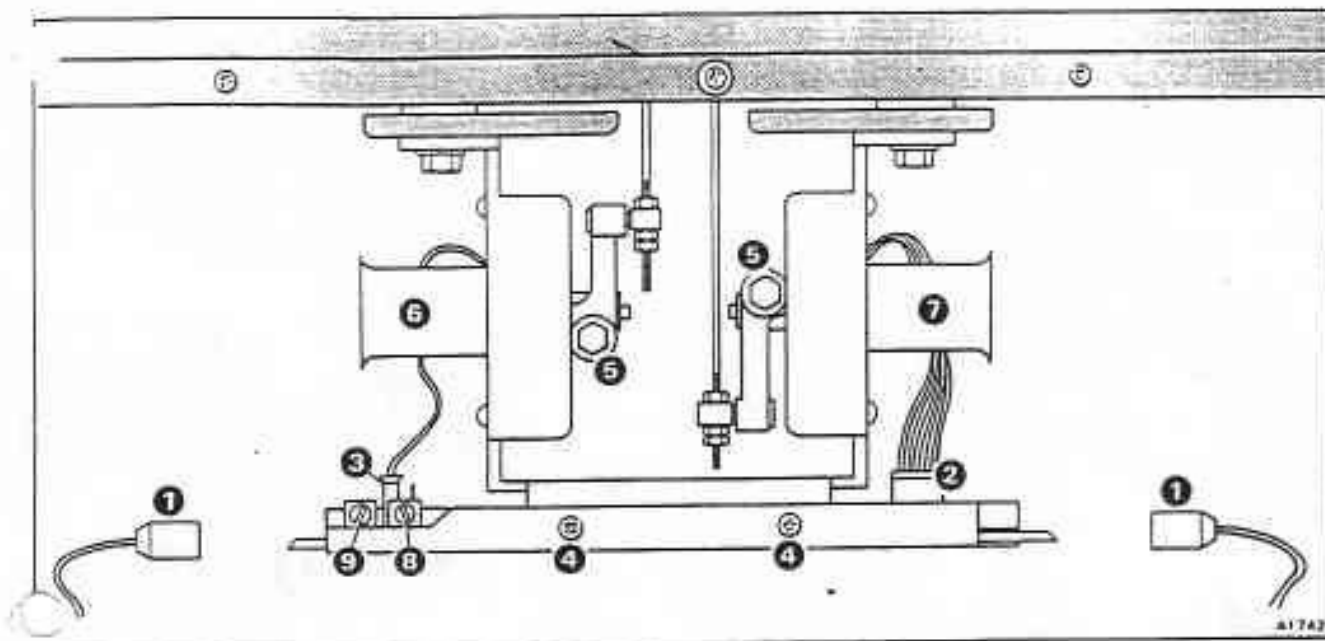


Fig. C4-4 Micro-processor and blend flap actuators assembly

2. With the multi-meter set to ohms range, measure the resistance from the pink cable at pin 13 to the black/pink cable at pin 14. The reading should be 500Ω.

If a reading of 1000Ω is recorded, one of the selector potentiometers is open circuit and must be replaced.

3. Rotate the lower temperature selector to the mid-position. Measure the resistance between the pink/red cable at pin 11 and the black/pink cable at pin 14. The reading should be 500Ω.

Rotate the lower temperature selector ensuring that a lower reading is measured as the red section is exposed, and a higher resistance is measured as the blue section is exposed.

Rotate the upper temperature selector to the mid-position. Measure the resistance between the pink/brown cable at pin 11 and the black/pink cable at pin 14. The reading should be 500Ω.

Rotate the upper temperature selector ensuring that a lower resistance is measured as the red section is exposed, and a higher resistance is measured as the blue section is exposed.

5. Re-connect the battery.

Rear window demister and mirror heaters, compressor clutch, and water tap test procedure
Test procedure carried out at the right-hand 18-way plug.

1. Remove fuse A1 at fuseboard F1.
2. Apply a known 12 volts positive supply to the yellow/black cable connection at terminal 1 of the fuseboard.
3. Apply a known earth to the following cables ensuring in each case that the appropriate relay energizes.

Orange/brown cable at pin 1 – rear window demister relay.

Blue/pink cable at pin 7 – compressor relay.

Blue/orange cable at pin 8 – water tap relay.

4. Should a relay not energize, first replace the relay and repeat the appropriate test.

If the relay still does not energize, disconnect the 12 volts positive supply before checking the continuity of the yellow/black cable from the fuse to the relay. If necessary, check the continuity of the appropriate cable to the other side of the relay coil (from the 18-way plug).

5. If all relays energize in procedure 3, and a fault is still suspected, refer to the appropriate wiring diagram for further details.

Note The wiring diagram for the compressor clutch and the water tap are contained within this section. However, the wiring diagram for the Rear window demister and mirror heaters circuit is contained in TSD 4701 Workshop Manual – Electrical, Section 16.

Air conditioning coolant temperature switch – To test
This test must be carried out with a cold engine [i.e. engine coolant temperature below 44°C (111°F)].

1. Check the continuity of the red/slate cable at pin 1 of the left-hand 18-way plug to a known earth point.
2. Disconnect the air conditioning coolant temperature switch and ensure that the red/slate cable now reads open circuit. Re-connect the switch.

Test procedures conclusion

1. Having verified the car wiring.
 - a. Ensure that all connections are remade.
 - b. If a fault has been found, retest the air conditioning system.

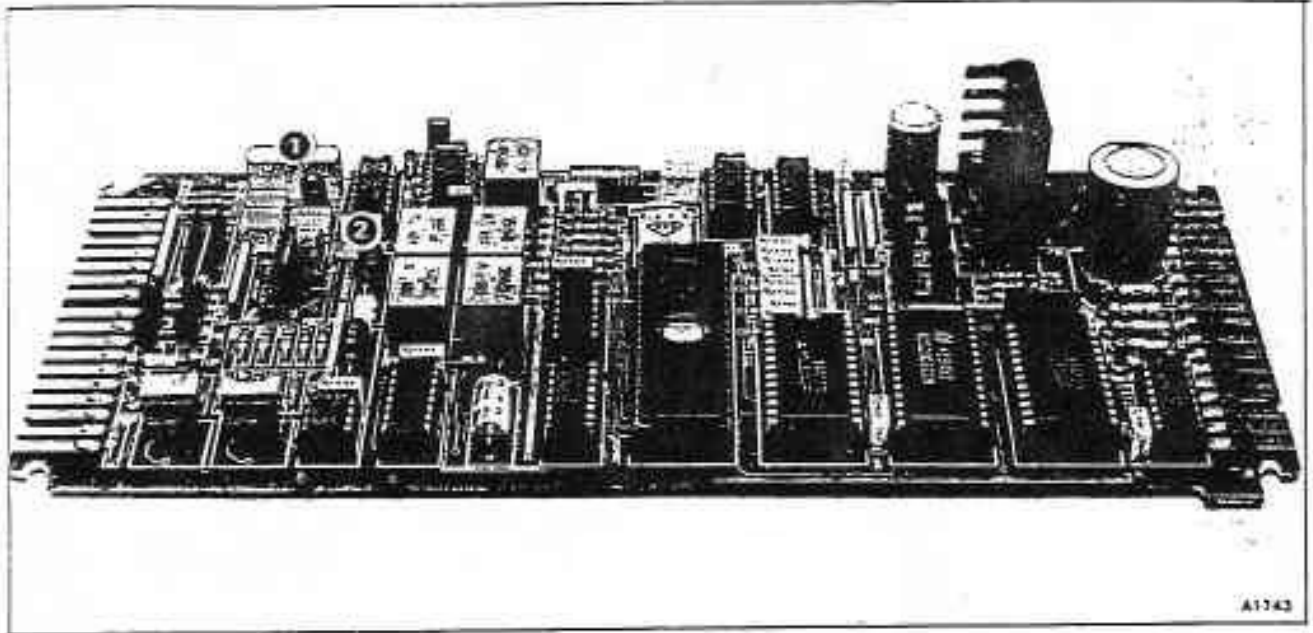


Fig. C4-5 Air conditioning micro-processor board

2. If no fault has been found and the air conditioning system circuitry is still faulty, replace the micro-processor board.

Air conditioning micro-processor board Handling precautions

The micro-processor board and connectors are durable if handled correctly. However, they are vulnerable to stray voltages, wrong polarity and especially static electricity. Therefore anti-static precautions, in particular the wearing of an anti-static wristband connected to a good earth, must be observed at all times.

The board is particularly vulnerable before the edge connectors are fitted (i.e. before it is earthed). Handling should therefore be kept to a minimum.

Boards must be stored in anti-static containers and kept dry and free from grease.

Micro-processor board – To remove (see fig. C4-4)

1. Remove fuse A1 at fuseboard F1.
2. To avoid damage when disconnecting or re-connecting a micro-processor board 18-way plug, it will be necessary to hold the opposite end of the board.

Disconnect both the left-hand and right-hand 18-way plugs from the micro-processor board (see item 1).

3. Disconnect the upper and lower blend flap actuator plugs from the micro-processor board (see items 2 and 3).
4. Remove the two setscrews securing the micro-processor board front retaining channel (see item 4). Remove the channel.
5. Lower the front edge of the micro-processor board and carefully withdraw.

Micro-processor board – To fit

Reverse Operations 2 to 5 inclusive of Micro-processor board – To remove. Then, carry out the Micro-processor initializing procedure.


Micro-processor initializing procedure (refer to figs. C4-4 and C4-5).

To carry out this procedure it may be necessary on some cars to remove the centre console. Refer to Chapter S of this manual for details.

1. Ensure that fuse A1 at fuseboard F1 is removed.
2. Ensure that the SCREEN-FACIA/RECIRC switch is set to the mid position.
3. Fit the micro-processor board test pins link RH 9884 DET 2 or bridge the test pins (see fig. C4-5 item 2).
4. Slacken the actuator arm securing bolts at the upper and lower blend flap actuators (see fig. C4-4 item 5).
5. Apply a known, fused, 12 volts positive supply to the yellow/black cable connection at the fuseboard.
If using test box RH 9884 with the purple cable connected to a 12 volts positive supply, the red cable from the test box can be connected to the yellow/black cable at the fuseboard. It should be noted that the large cables marked LEFT and RIGHT from the test box are not connected during this procedure.
6. Select OFF position at the air conditioning function switch on the facia. The lower blend flap actuator (see fig. C4-4 item 6) will operate and continue to operate during procedure 7.
7. Rotate the lower blend flap potentiometer (see fig. C4-4 item 8) throughout the full range of its travel, noting the portion of travel for which the LED (light emitting diode) on the micro-processor board (see fig. C4-5 item 1) illuminates.



Adjust the potentiometer to the centre of the illuminated portion of travel.

8. Select the  (defrost) position at the air conditioning switch on the fascia. The upper blend flap actuator will operate and continue to operate during procedure 9.

9. Rotate the upper blend flap potentiometer (see fig. C4-4 item 9) throughout the full range of its travel, noting the portion of travel for which the LED on the micro-processor board illuminates.

Adjust the potentiometer to the centre of the illuminated portion of travel.

10. Remove the test pins link RH 9884 DET 2 or remove the bridge from the test pins.

11. Tighten the actuator arm securing bolts at the upper and lower blend flap actuators (see fig. C4-4 item 5).

12. Disconnect the 12 volts positive supply from fuse A1 yellow/black cable connection.

13. Replace fuse A1 at fuseboard F1.

14. Test the air conditioning system.