power from the DC emergency bus and can be anti-iced by battery power, in case of electrical failure, by placing the battery switch to EMER. Ground operation of the pitot-static heat should be limited to less than two minutes to avoid damage to the pitot-static system and the AOA vane heater. Electrical power is from 7.5 ampere circuit breakers marked L PITOT-STATIC and R PITOT-STATIC, on the left circuit breaker panel. The angle-of-attack circuit protection is 5 amperes and is marked AOA HTR.

ENVIRONMENTAL

The pressurization and air conditioning systems utilize engine bleed air to pressurize and air condition the cabin and defog the cabin and cockpit windows. During normal operation, most functions are automatic. The only manual adjustments required are for individual comfort, such as fan selection and temperature. When additional cooling is required a Freon air conditioning system is used to further cool and circulate the cabin air, which has already been conditioned by the pylon mounted precoolers and the cabin air heat exchanger. Fresh air for cabin ventilation is available, when the pressurization system is not in use, by selecting FRESH AIR on the air source selector.

PRESSURIZATION

Two elements are required to provide cabin pressurization. One is a constant source of air. The other is a method of controlling the flow of air out of the airplane to achieve the desired differential pressure and resultant cabin altitude. In the CitationJet, the inflow of air to the cabin is constant (through a wide range of engine power settings) and the outflow of air is controlled by the two outflow valves located in the aft pressure bulkhead.

The major components of the pressurization control system are: the pressurization controller, the primary and secondary outflow valves, the manual toggle valve, and the cabin dump switch. Also, the following units are mounted on the primary outflow valve and affect operation of the outflow valves; the vacuum ejector and the climb and dive solenoids. Both outflow valves contain maximum differential safety valves, and maximum altitude safety valves. The safety valves will always override the controller activated solenoids and the manual toggle valve, as a safeguard against developing a cabin overpressure or underpressure condition.

Outflow Valves

The outflow valves have three modes: ground taxi, pre-pressurization, and flight. In the ground taxi mode the airplane is on the ground with either engine operating below 85% N_2 RPM. Both outflow valves are kept fully open. In pre-pressurization mode when both engines are set to greater than 85% N_2 RPM, both outflow valves will slowly close to bring the cabin altitude to a differential pressure of 200 feet below the field pressure altitude during the takeoff roll. At liftoff the squat switch will put the airplane pressurization system into flight mode. In flight mode the cabin is pressurized by a constant 8 pounds-per-minute of temperature controlled air.

The primary and secondary outflow valves are identical to each other with the exception that the primary valve also has the vacuum ejector, and the cabin altitude climb and dive solenoids mounted on it. These units can function through the secondary outflow valve, if necessary, through connecting ports between the two valves.

The flow rate of the exhausted cabin air is controlled by the modulated position of the diaphragm in the primary and secondary outflow valves. Air can be added to or removed from the control chamber of the valves by the climb and dive solenoids, which respond to commands from the pressurization controller. An increase of pressure in the outflow valve chamber will cause the cabin altitude to decrease; an increase of negative pressure in the control chamber will cause the cabin altitude to climb. If the pressure in each side of the chamber is balanced the cabin pressure will remain static.

In the event that control vacuum should exceed limits due to a malfunction, the cabin altitude limit valves are provided to prevent cabin altitude from exceeding 13,000 feet, +1500 or -1500 feet. If the control vacuum exceeds the barometric reference in the cabin altitude limit valve, it will open and release cabin air into the outflow valve control chamber. This will cause the outflow valves to move toward the closed position and re-establish cabin pressure. The cabin dump switch, located on pressurization-environmental control panel, may be actuated to reduce cabin pressure. The switch disables the electrical controls and activates the primary outflow climb solenoid to pull air out of both outflow valve control chambers and dump cabin pressure to the limits of the cabin altitude limit valves.

Cabin altitudes above 14,500 feet will be prevented. In the event of a vacuum system failure, select pressurization source to MANUAL and control the cabin altitude with the MANUAL UP/DOWN switch.

The maximum differential pressure valve on each outflow valve has an independent pressure relief function which constantly compares cabin pressure to the outside ambient pressure. If it senses a differential pressure greater than 8.6 psi it will vent outflow valve control chamber air to the outside air, allowing the outflow valve to open and prevent excessive cabin pressurization.

Pressurization Controller

The pressurization controller is comprised of two digital windows marked SET ALT and RATE, an FL button, an EXER button and a SET ALT knob. The controller is normally operated in the AUTO mode, which is selected by positioning the MANUAL/AUTO switch on the pressurization-environmental control panel to AUTO. In AUTO mode the operator normally selects the landing field pressure altitude before takeoff by setting the information into the upper window with the SET ALT knob. Then, in flight the controller will continuously generate an auto-schedule based on the departure field elevation, the maximum altitude in flight sensed by the air data sensor, and any later operator changes of the landing field pressure altitude. The controller determines the pressure rate of change and the cabin pressure altitude based on the auto-schedule and the air data computer indicated altitude. The auto-schedule will depressurize the cabin at the set landing altitude before landing. Cabin rate-of-change is an automatic function of the system and is not directly selectable.

If the air data computer information is interrupted, or other system failure should cause the AUTO mode to fail, the controller will switch the system to isobaric mode of control. A yellow warning indicator on the display face will illuminate to advise of the change. The landing field altitude on the controller display will then switch to the selected flight level, which will allow the operator to set the desired airplane cruising flight level in order to continue to cause automatic control of the cabin pressure rate of change and the cabin altitude. A near maximum cabin differential pressure will be maintained.

In isobaric control the operator may recall the selected landing field altitude by pressing the FL (flight level) button on the controller, and the selected flight level on the controller display will be replaced by landing field altitude annunciated as CA (cabin altitude). Further pushes of the FL button will cycle the display between flight level (FL) and cabin altitude (CA). Cabin altitude function can be selected to set cabin altitude prior to landing. If air data computer information is restored the controller will automatically switch back to AUTO mode and the yellow warning indication will be extinguished.

Neither AUTO or ISOBARIC modes are available in case of DC electrical power failure since the controller does not receive power from the emergency bus. The manual control system functions without electrical power and is used to directly control the outflow valves in case of electrical failure or failure of the automatic controller.

The EXER button on the face of the controller provides two sets of built-in test features - a ground test function and built in maintenance tests. The test is initiated by pressing the EXER button and holding it for approximately two minutes. If the engines are running the cabin will gradually pressurize to 200 feet below field elevation. Releasing the button terminates the test, conducts a display test, and gradually depressurizes the cabin.

The maintenance tests are initiated by pressing a hidden button between the FL and EXER buttons. It requires a slender tool for depression. The airplane must be on the ground to enable the maintenance mode, and once in the mode a yellow warning indicator on the display will continually flash.

Manual Control

Manual control is selected by placing the MANUAL/AUTO switch to MANUAL. When manual mode is selected the cabin altitude is manually controlled by pushing UP or DOWN on the manual toggle valve - electrical power is not required. This manually changes the control chamber pressure in the outflow valves and therefore controls the cabin altitude. Up will increase cabin altitude (decrease cabin pressure) and down will decrease cabin altitude (increase cabin pressure). The rate-of-change in this mode is fixed by orifices. Air from the manual pressurization valve on the tilt panel is passed through a tube to just forward of the aft pressure bulkhead and fed into a tube between the two outflow valves. The two safety valves cannot be overridden in manual mode and will still be effective in preventing overpressurization because of excessive absolute or differential pressure.

Cabin Altimeter

The cabin altimeter is located on the tilt panel adjacent to the pressurization controller. The cabin altimeter presents existing cabin altitude on the outer scale, and pressure differential on the inner scale. The pressure differential needle will indicate a malfunction of the outflow valves whenever a pressure differential in excess of 8.9 PSI is shown on the gage. The rate at which change of cabin altitude is effected is built into the controller and is not selectable by the operator.

Pressurization Source

Engine bleed air (compressor discharge) is used as the source of high pressure air to provide cabin pressurization. Each engine has two ports from which bleed air is extracted. The bleed air from the engine passes through a pylon mounted air-to-air heat exchanger immediately after leaving the engine, for cooling. At the pylon heat exchanger the air temperature is cooled to a range of between approximately 420°F to 500°F. It then passes through a check valve and a shutoff valve before entering a wye connection where air from both engines is joined. It then passes through dual mass flow valves and through the cabin air-to-air heat exchanger in the tail cone, before entering the cabin through the cabin floor and arm rest ducts. The amount of ambient ram cooling air passed through the tail cone mounted cabin air-to-air heat exchanger is controlled by a ram air modulating valve which is linked to the cabin temperature control system.

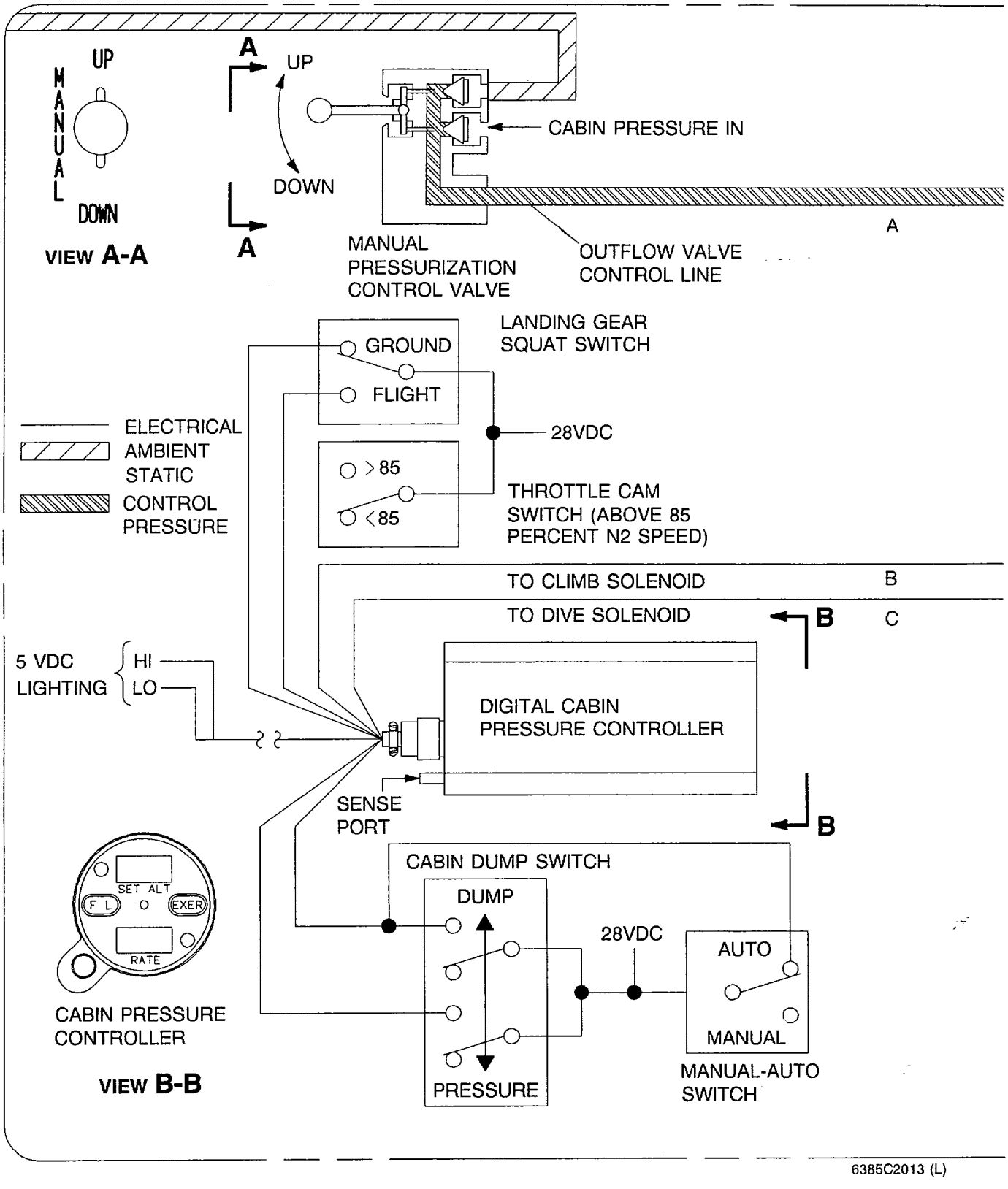

Figure 2-21. Pressurization Control System Schematic (Sheet 1 of 2)

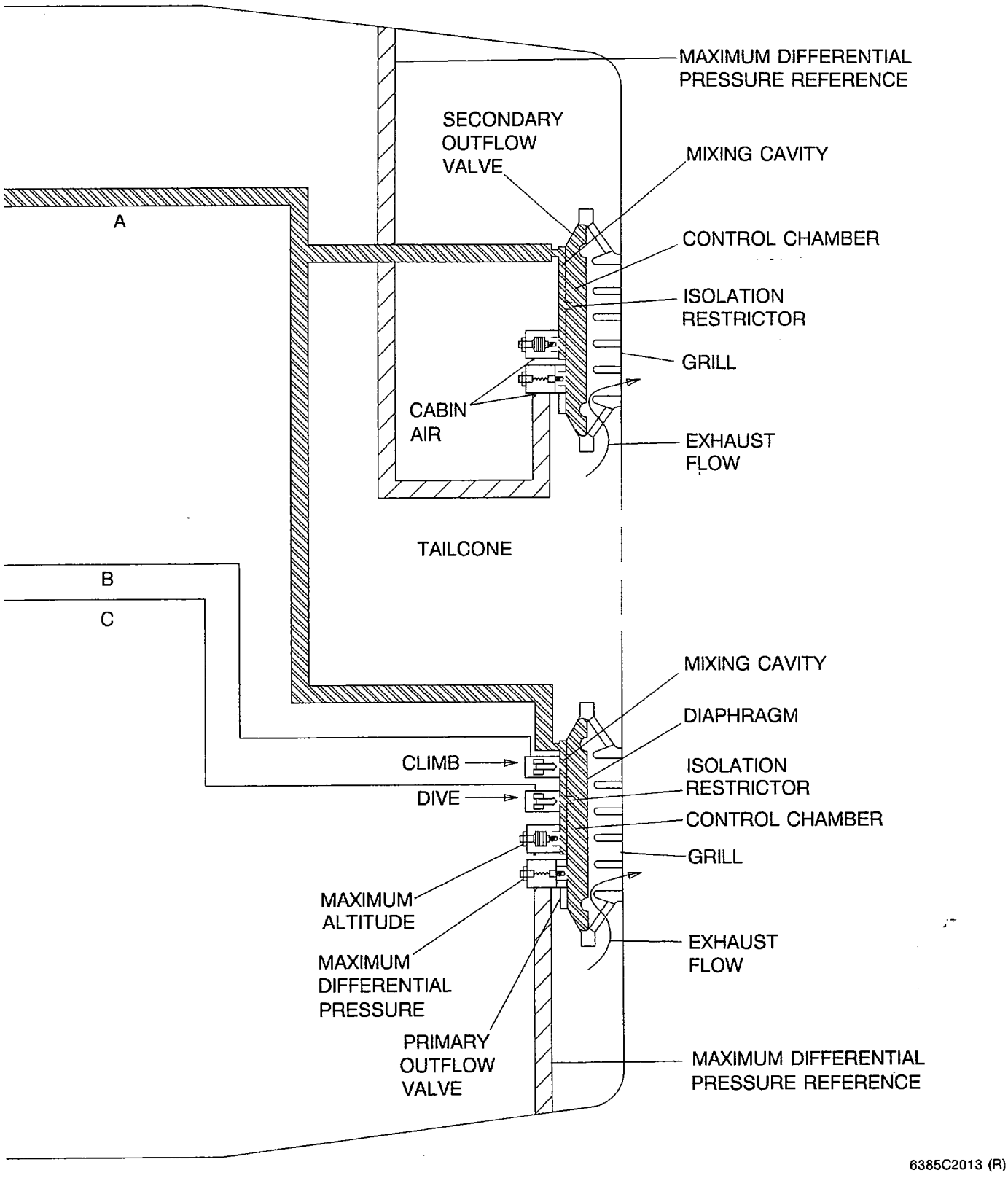

Figure 2-21. Pressurization Control System Schematic (Sheet 2)

The source of cabin pressurization air is controlled by the air source selector (AIR SOURCE SELECT) switch (knob) on the tilt panel. The source selector is a six-position switch labeled OFF, FRESH AIR, L, BOTH, R, and EMER. In the OFF position, both bleed air control valves are closed allowing no bleed air to enter the cabin, but allowing ram air flow to the airplane. In the FRESH AIR position ram air is selected and the airplane cannot be pressurized. A fresh air fan operates in the FRESH AIR position to assist ram air flow and to provide flow on the ground. The FRESH AIR position is intended for ground and low altitude operation only. When FRESH AIR is selected the amber FRESH AIR annunciator on the annunciator panel will illuminate to remind the pilot that a pressurization mode is not selected. In the L position, the left engine shutoff valve will open, allowing the left engine bleed air to enter the cabin. In the R position, the right engine shutoff valve will open, allowing right engine bleed air to enter the cabin. In the BOTH position, the left and right pressure regulating shutoff valves will open, allowing both left and right engine bleed air to enter the cabin. The pressure regulating shutoff valves are designed to fail safe, in that when electrical power is removed from the valves they revert to the open position. They are powered closed. The air from one engine or both engines is regulated to a maximum flow rate of eight pounds-per-minute by dual pressurization flow control and shutoff valve.

In EMER position the emergency pressurization mode is selected. In the emergency mode, pressurization air is provided directly from the windshield anti-ice line through the emergency pressurization shutoff valve. The windshield manual valves must be closed for the emergency pressurization to operate. The emergency pressurization shutoff valve is located under the cockpit floor and connects the windshield bleed air with the cockpit footwarmer and windshield defog ducts. Emergency pressurization air temperature is reduced by the windshield heat exchanger and cannot be regulated by the temperature controls. Under normal conditions at medium to high altitudes a normal cabin temperature will be maintained. When emergency pressurization is selected the amber EMERG PRESS ON annunciator on the annunciator panel and the MASTER CAUTION will illuminate. Emergency pressurization is not intended for extended use.

Cabin Temperature Control

The first stage of cooling of the cabin pressurization bleed air is accomplished by routing engine bleed air through a precooler in each engine pylon and the second stage is accomplished by passing the air through the cabin air heat exchanger. Cabin armrest and underfloor ducting is used to distribute the cooled bleed air to the cabin and cockpit. Cabin temperature control can be controlled manually or automatically. Automatic (AUTO) control is accomplished through positioning the AUTO temperature select knob on the tilt panel to a desired position between COLD and HOT. The selectable temperature represented is approximately from 65°F to 85°F. The automatic temperature sensor is located in the inlet of the aft fan which is located in the dropped isle at the bottom of the aft pressure bulkhead. Do not block the aft fan inlet with baggage, coats, etc. If the inlet is blocked, the sensor will sense under-floor temperature and cabin temperature will not be properly regulated. If the temperature sensed is more or less than the temperature selected on the controller, the controller will command a ram air modulating valve at the cabin air heat exchanger to move, changing the heat exchanger cross flow and thereby changing the temperature of the bleed air entering the cabin.

The controller will also cause the pylon mounted bleed air precooler doors to move to full open or full closed position in order to provide more or less ambient crossflow air to cool the incoming cabin air, if anti-ice is not selected. The precooler doors are activated by 23 PSI regulated service air which is created by sending engine bleed air through the service air pressure regulator.

When the wing anti-ice is not on and the temperature controller drives the ram air modulating valve to a position of more than 50% open, a limit switch in the ram air modulating valve will send a signal to a bypass solenoid on the precooler pneumatic actuator which will

drive the precooler control valves to the full open position. If the wing anti-ice is on, system logic prevents the position of the ram air modulating valve from affecting the position of the precooler doors, because of the temperature requirements of the wing anti-ice system.

In order to maintain a comfortable temperature in the cockpit, a flow divider is installed to allow the crew to proportion, to a certain extent, the amount of cooled bleed air provided to the cockpit versus the cabin. The flow divider is controlled by a four position selector mounted on the tilt panel labeled COCKPIT AIR DIST. The COCKPIT AIR DIST selector does not select a cockpit temperature; it only proportions bleed air to the cockpit and cabin. The NORM position on the selector proportions an equal amount of bleed air to the cabin and cockpit. The MAX position results in a cockpit bias which proportions approximately 90% of the bleed air to the cockpit and the remaining air to the cabin. The intermediate positions may be selected as required to maintain cockpit comfort.

In case of a significant difference between selected and actual cabin temperature in AUTO mode, selecting full HOT or full COLD will not increase the cabin temperature rate-of-change, but will most likely result in a cabin temperature overshoot. A constant setting or making changes in smaller increments will provide most satisfactory operation.

When the temperature selector is in the auto range on the ground and the throttles are set at less than 85% N_2 and the controller is demanding cooling, pressurization bleed air will be shut off by the cabin flow control and shutoff valve. Flood cooling mode is useful in this condition. Bleed air will be supplied to enable heating if cabin temperature is below 65°F.

In order to enable the temperature control system to operate more efficiently a temperature anticipator sensor is located in the cabin air duct downstream of the cabin air heat exchanger, in order to sense air temperature changes which occur due to external conditions. The sensor "anticipates" the requirement for a temperature change reaction and acts to position the ram air modulating valve, which will regulate the air temperature before it is sensed by the cabin automatic temperature control. This improves the system's ability to smoothly maintain an even temperature.

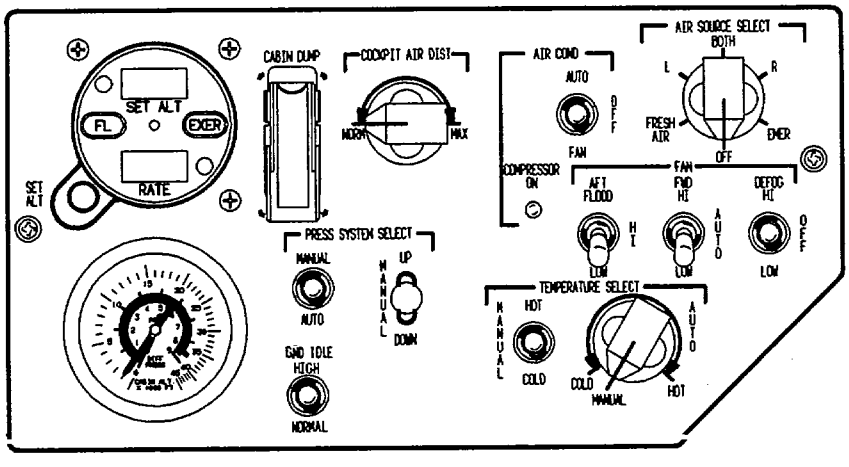

Figure 2-22. Pressurization - Environmental Control Panel (Typical)

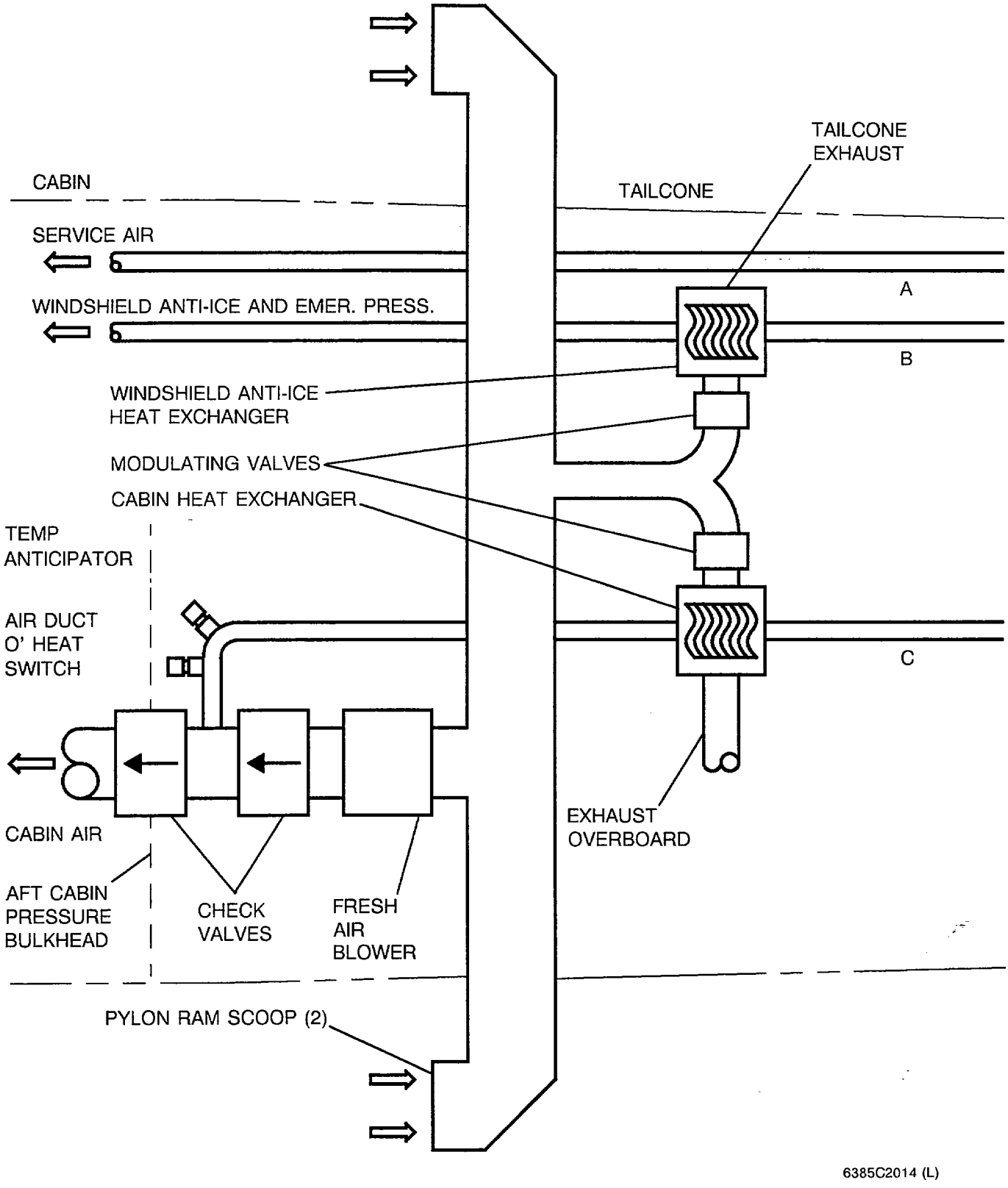

Figure 2-23. Bleed Air Schematic (Sheet 1 of 2)

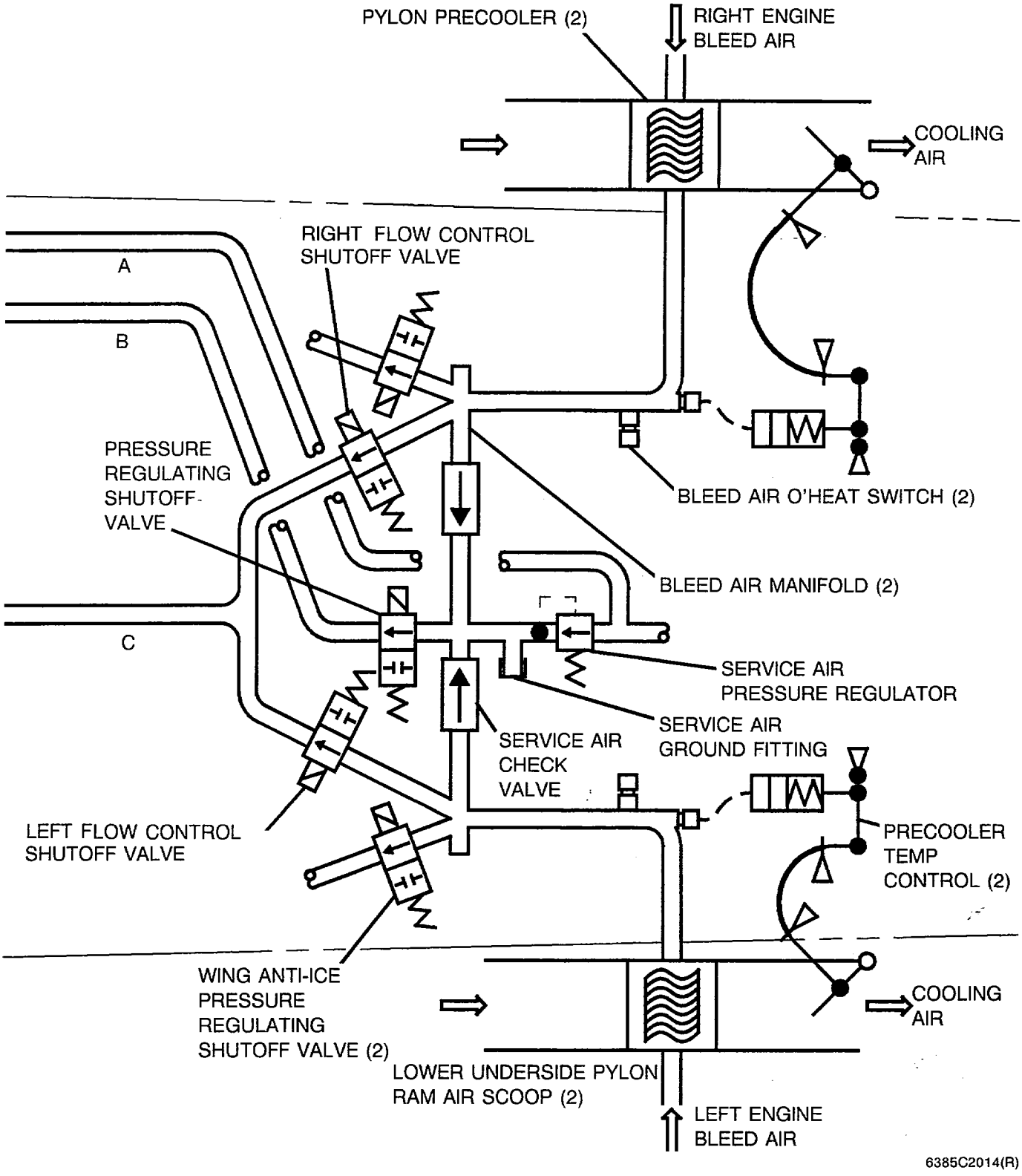

Figure 2-23. Bleed Air Schematic (Sheet 2)

Turning the TEMPERATURE SELECT knob fully counterclockwise into the MANUAL position enables the MANUAL HOT/COLD switch for manual control of the cabin temperature. The manual switch takes about 15 seconds to drive the ram air modulating valve from one extreme to the other. Manual control of cabin temperature can be effected by holding the switch in the desired position for a few seconds at a time and gauging the temperature change after a reasonable delay. The MANUAL HOT/COLD switch does not select temperature; it only positions the ram air modulator valve. Therefore excessive use of the switch will likely result in temperature fluctuations and overshoots.

VAPOR CYCLE AIR CONDITIONING

At lower altitudes, in the traffic pattern and on the ground, the cooling provided by the bleed air system is not sufficient and further cooling is required. This cooling is accomplished by the vapor cycle air conditioning system which cools and recirculates cabin air that has already been delivered to the cabin by the bleed air system. This air is discharged through the overhead wemac outlets or flood cooling in the cabin and a floor vent in the cockpit. The system uses R134 refrigerant as a medium for cooling.

The Citation 525A vapor cycle air conditioning system is a conventional system powered by a DC electric motor. It consists of a compressor, a condenser, a receiver dryer which includes a binary pressure (safety) switch, two evaporators, and the required tubing, wiring, and ducting. The air conditioning motor is mounted on a pallet in the tailcone as a separate unit to the compressor, condenser, and the receiver dryer. The forward evaporator is located just aft of the side facing seat and the rear evaporator is mounted under the hump cover at the aft end of the dropped isle. Care should be taken not to block the forward evaporator inlet on the aft side of the evaporator cabinet. Blocking the inlet could result in an overpressure shutdown of the Freon system.

The rear evaporator is connected to the cabin overhead distribution duct as well as to a flood cooling duct located on the rear bulkhead. The forward evaporator is located aft of the pilot's seat and supplies cockpit overhead and defog airflow.

The cabin overhead/wemac air is circulated by the aft evaporator fan which can be operated with or without the air conditioner being in operation.

Controls for the vapor cycle air conditioning system are located on the right side of the tilt panel. The master switch for the system is the AIR COND AUTO/OFF/FAN switch. In the OFF position the vapor cycle air conditioning system does not operate, and the cabin bleed air temperature control system is also not operative. In the FAN position the air conditioner does not operate but the fan controls are energized. In AUTO position the vapor cycle system is automatically controlled by the ram air modulating valve. When the ram air modulating valve is driven 100% open, either automatically by the cabin temperature control or manually, the air conditioner compressor will cycle on. A secondary switch for the air conditioning system.is the DEFOG switch. The DEFOG switch will power the air conditioner regardless of the AIR COND switch position. Operation of the DEFOG switch is addressed in the FAN Controls section. A green COMPRESSOR ON light Located to the left of the row of fan switches will illuminate any time the vapor cycle air conditioner compressor is in operation.

In flight with the AIR COND switch in the AUTO position, power is applied to the cabin bleed air ram air modulating valve limit switches which control the compressor. In hot conditions the ram air valve will drive towards full open, demanding maximum bleed air cooling, and will trip the limit switch at the 100% open point and cycle the compressor on. The cabin is then provided with vapor cycle cooling while the ram air valve controls the temperature of bleed air delivered to the cabin. When the ram air valve drives to approximately 50% closed, a second limit switch will cause the compressor to shut off. This switch is bypassed when the defog system is in operation, and the compressor will still run.

NOTE

At temperatures below 50°F (10°C) the compressor may not operate due to low refrigerant pressure. This is a normal condition and the compressor will resume operation when the refrigerant warms sufficiently.

When the airplane is on the ground no ram air is available, so the ram air valve will drive to full open any time the cabin temperature is above the point at which the temperature control calls for cooling and will engage the compressor. Any time the cabin temperature is below the temperature control point, power is removed from the compressor when the ram air valve drives towards closed. This provides effective vapor cycle air conditioning on the ground.

Fan Controls

If the AIR COND switch is in the FAN or AUTO position the forward and aft evaporator fans will run continuously at the speed selected on those fan switches. The aft fan runs at the speed selected on the switch, or runs at HI speed if FLOOD is selected; FLOOD selection opens the flood cooling door, causes the fan to run at HI speed, and closes the overhead wemacs. Flood cooling provides the quickest and most effective cooling of the airplane. The forward fan switch has HI/AUTO/LOW positions and will run at the speed selected if it is HI or LOW. AUTO position causes the forward fan to run only at low speed when the air conditioning compressor is running; it will otherwise be off.

The cabin temperature sensor is located in the inlet duct to the aft fan. Therefore the AIR COND switch must be in AUTO or FAN to enable the aft fan to operate in LOW, HI, or FLOOD, and for the automatic cabin temperature control system to function properly. Care must be taken not to block the aft fan inlet, at the rear of the dropped isle, with baggage. Blocking the fan inlet will result in erratic cabin temperature control.

A switch labeled DEFOG/HI/FAN/LOW is located on the tilt panel. As part of the defog system, the DEFOG switch is the secondary switch for the operation of the air conditioner. When the defog system is operating, power is supplied to the air conditioner regardless of the position of the AIR COND/AUTO/OFF/FAN switch. When in the HI or LOW position, the defog switch activates the defog fan, the forward evaporator fan, and the forward evaporator diffuser diverter door.

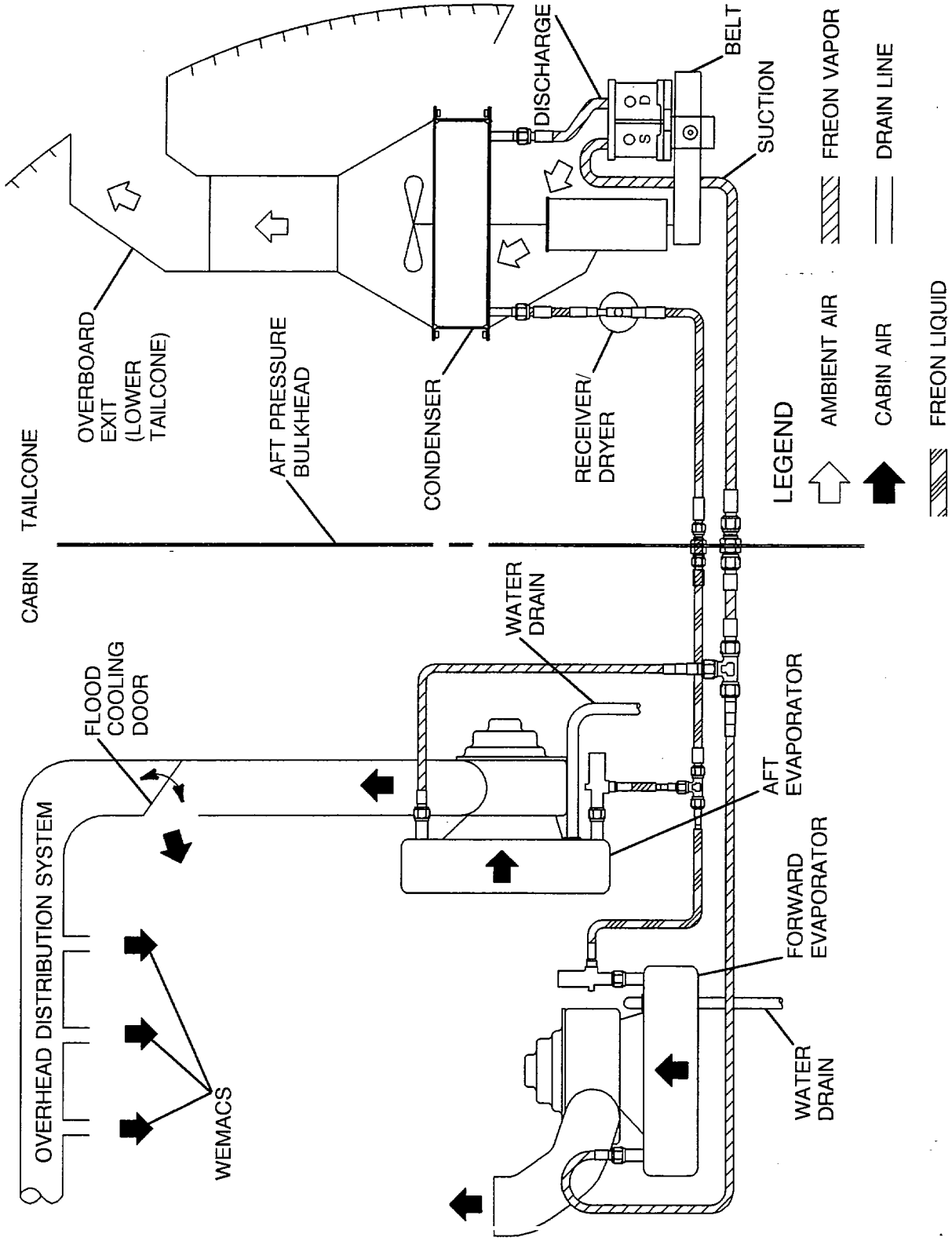

Figure 2-24. Freon Air Conditioning System Schematic