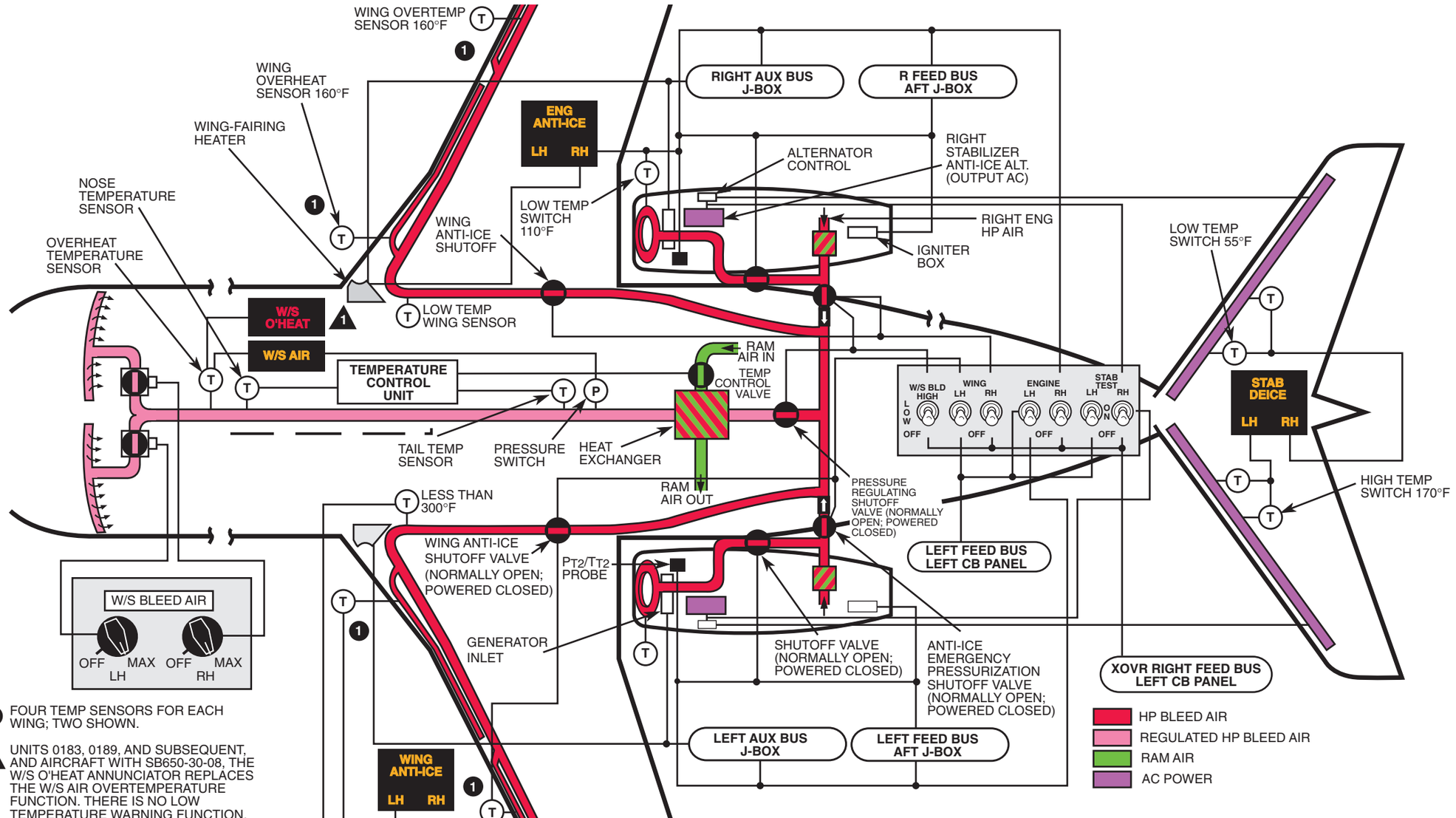
Anti-Ice Protection Systems

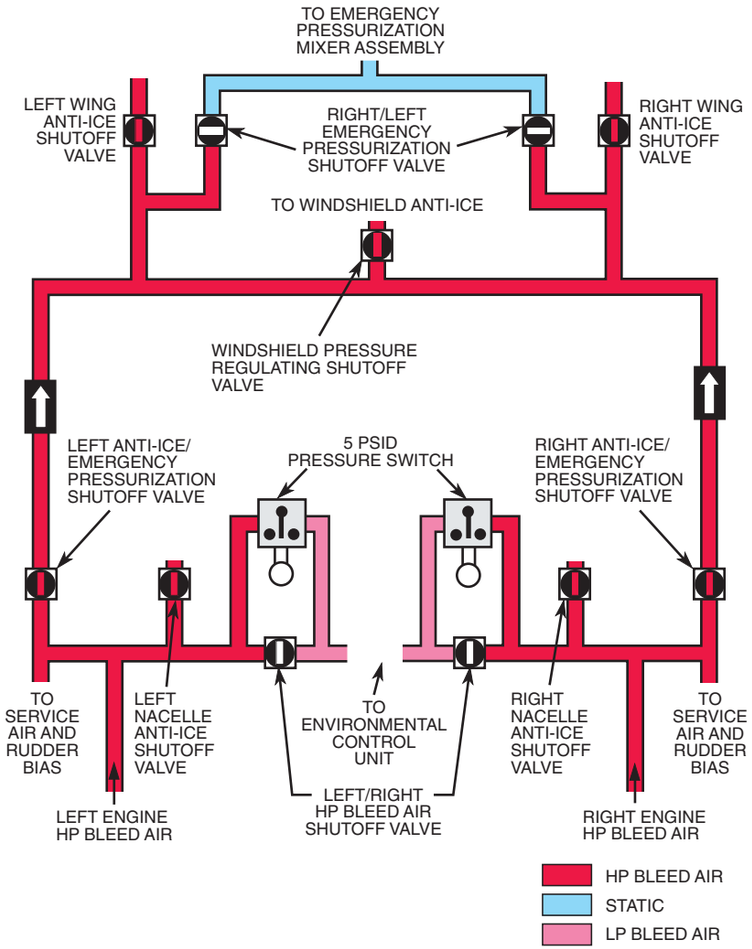


1 FOUR TEMP SENSORS FOR EACH WING; TWO SHOWN.

1 UNITS 0183, 0189, AND SUBSEQUENT, AND AIRCRAFT WITH SB650-30-08, THE W/S O'HEAT ANNUNCIATOR REPLACES THE W/S AIR OVERTEMPERATURE FUNCTION. THERE IS NO LOW TEMPERATURE WARNING FUNCTION.

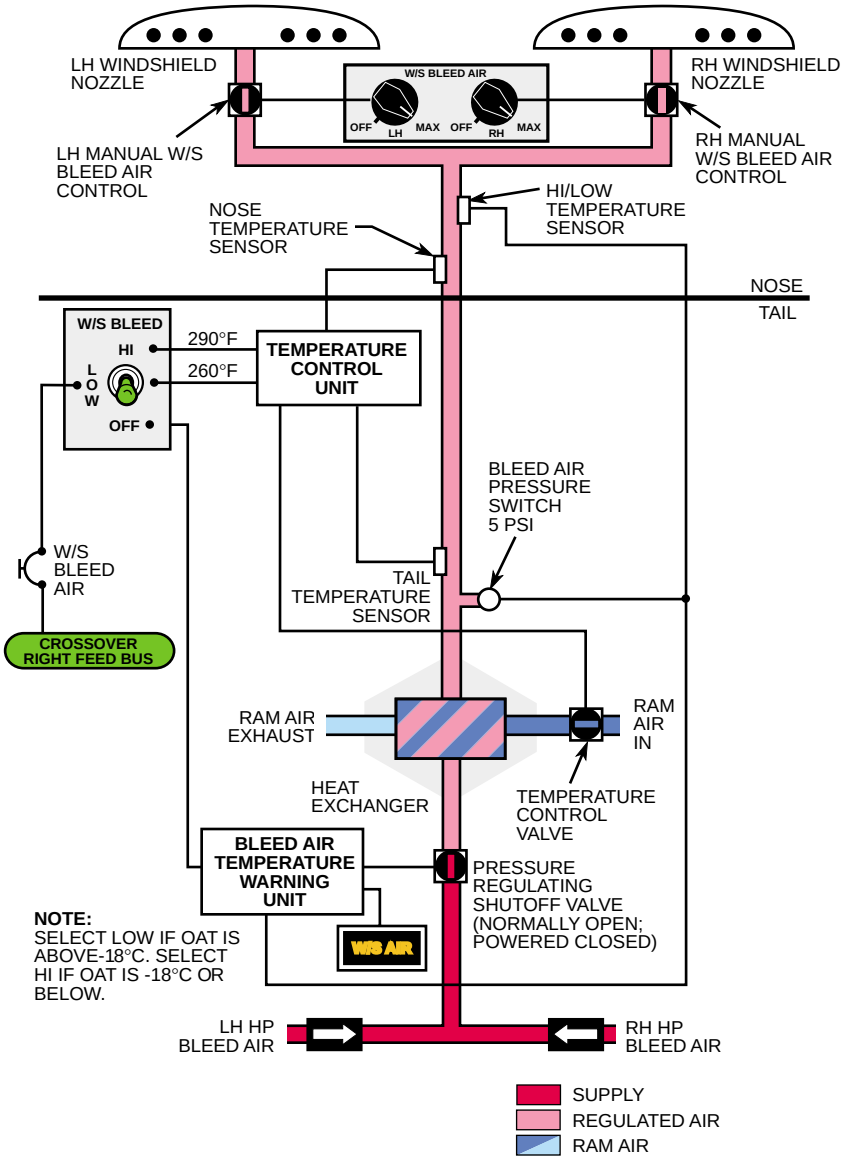
SimuFlite

Bleed Air Flow System



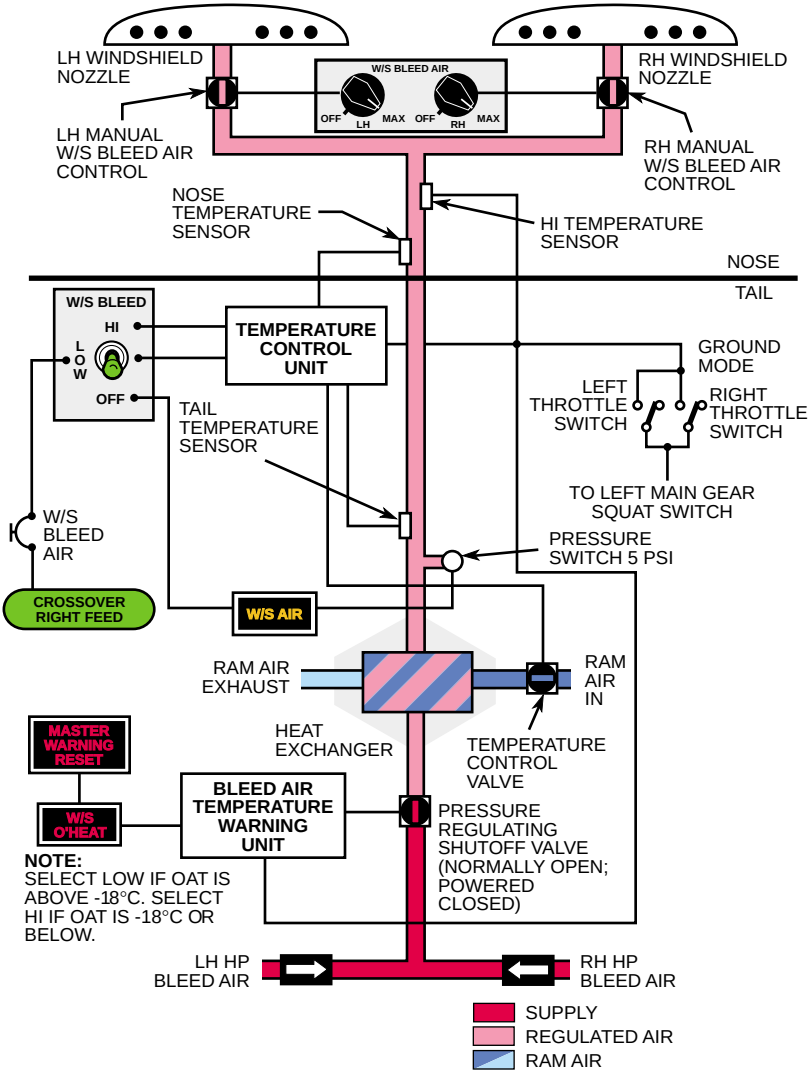
Windshield Bleed Air Flow System

Units 001 to 182, 184 to 188; units without SB650-30-08



Windshield Bleed Air Flow System

Units 183, 189 and subsequent; units with SB650-30-08



Ice Detection

At night with the DAY/NITE DIM switch in ON, a small red light on each side of the glareshield shines upward through the windshield. As ice begins to accumulate on the windshield edges, it reflects the red light back toward the crew and appears as small red circles on the inside of the windshield. During the day, placing the palm of your hand or a piece of white paper over the lights verifies normal operation.

With the RECOG/TAXI switch in the WING INSP position, 28V DC illuminates the left and right wing root ice inspection lights to light the wing leading edges.

Bleed Air Anti-Icing

Hot, high pressure engine bleed air heats the wing leading edges, windshield, and engine air inlets to prevent ice accumulation.

The high pressure (HP) bleed air supply from each engine splits and supplies each of the anti-icing systems through separate pressure regulating shutoff valves.

Engine Air Inlet

Turning the LH/RH ENGINE ANTI-ICE switches to ON removes power from the nacelle anti-ice pressure regulating valve and shutoff valve. A 5 PSIG or greater, bleed air opens the valve so air can flow at a maximum temperature of 500°F (260°C) to the engine air inlet lip piccolo. After heating the inlet, the bleed air exhausts overboard through four louvers.

Turning the ENGINE ANTI-ICE switches on also activates the wing root fairing heating system, engine P_{t2}/T_{t2} probe heater, generator air inlet heating, and engine ignition system.

Placing the ENGINE ANTI-ICE switches in OFF supplies 28V DC to close the nacelle anti-ice pressure regulating and shutoff valve.

If bleed air temperature is less than 110°F (43°C), a temperature sensor in the inlet illuminates the associated LH/RH ENG ANTI-ICE annunciator. The annunciator(s) also illuminates if wing root fairing temperature is above 130°F (54°C) or below 45°F (7°C), or the P_{t2}/T_{t2} probe heater fails.

Wing Leading Edge

With the LH/RH WING ANTI-ICE switches in ON, HP air flows from each engine through a normally open anti-ice/emergency pressurization shutoff valve and a check valve. The check valve prevents bleed air from an operating engine entering an inoperative engine. Each engine's HP air supply for the wing anti-icing system essentially combines so that loss of one engine does not render the system inoperative.

Before reaching each wing, a wing anti-ice pressure regulating shutoff valve, controlled by the LH/RH WING ANTI-ICE switches, regulates HP air pressure to 24 ±3 PSIG. From the shutoff valve, piccolo tubes distribute HP air into the narrow cavity between the wing leading edge skin and liner. After heating the leading edge, air exhausts overboard through a louver near the wing tip lower surface.

An anti-ice fail switch upstream of the first piccolo tube monitors HP air delivery temperature. At an HP air temperature below 300°F (149°C), the switch closes to illuminate the respective LH/RH WING ANTI-ICE annunciator.

Four overtemperature switches downstream of the anti-ice fail switch provide overtemperature protection. If HP air exceeds 160°F (71°C), one or more overtemperature switches close to illuminate the LH/RH WING ANTI-ICE annunciator and supply closing power to the wing anti-ice pressure regulating shutoff valve. When temperatures drop, the switch(es) open, the annunciator extinguishes, and the shutoff valve opens.

Windshield

Placing the W/S BLD switch in LOW or HIGH supplies power to the windshield temperature control unit that, in turn, removes power to the windshield anti-ice pressure regulating shutoff valve. The shutoff valve opens; bleed air flows through a heat exchanger before it reaches the manually operated shutoff valves.

Using three temperature sensors to monitor the air temperature in the ducting, the temperature control unit regulates the opening and closing of a temperature control valve. The temperature control valve opens to increase ram air flow and decrease windshield air temperature; it closes to decrease ram air flow and increase windshield air temperature.

Rotating the W/S BLEED AIR control knobs from the OFF position opens the manually operated shutoff valves and regulates windshield air flow.

The W/S AIR annunciator illuminates with:

- W/S BLD switch on and bleed air temperature below 233°F (112°C)
- W/S BLD switch in LOW or HIGH and bleed air temperature exceeds 294°F (146°C); system shuts down and cycles
- bleed air pressure less than 5 PSIG with W/S BLD switch on
- bleed air pressure greater than 5 PSIG with W/S BLD switch off
- power lost of the temperature control systems.

On **units 183, 189 and subsequent and earlier aircraft with SB650-30-08**, there is a W/S O'HT annunciator in addition to the W/S AIR annunciator. The W/S O'HT annunciator illuminates with:

- engine power less than 75% N_1 RPM and bleed air temperature exceeds 295°F (146°C)

- engine power greater than 75% N_1 RPM and bleed air temperature exceeds 233°F (112°C) for thirty seconds.

Windshield bleed air anti-icing also supplements the rain removal system by directing air across the windshield.

Turning the W/S ALC switch to ON pumps TT-I-735 specification isopropyl alcohol from a two-quart reservoir through a filter to the pilot's windshield spray tube.

Electrical Anti-Icing

Electrically powered heating elements warm the wing root, horizontal stabilizer leading edges, generator air inlet, rudder bias actuators, pitot tubes, static ports, angle-of-attack (AOA) probe, ram air temperature (RAT) probe, and drain masts.

Wing Root

To prevent ice accumulation on the wing root fairings and possible engine ice ingestion, each wing root fairing has an electrically powered thermal heating blanket. With the ENG ANTI-ICE switches on, 28V DC from the Left Feed and Crossover Right Feed buses powers the thermal blankets through a temperature control unit. With the system operating, the control unit maintains a wing root fairing temperature of 124 to 156°F (51 to 69°C).

If the fairing temperature drops below approximately 45°F (7°C) or exceeds approximately 170°F (77°C) the associated ENG ANTI-ICE LH/RH annunciator illuminates. During overheat conditions, the temperature controller cycles power to thermal blankets as they overheat and then cool.

Horizontal Stabilizer

AC-powered thermal blankets in the horizontal stabilizer leading edges protect them from ice accumulation. In the air with the LH/RH STAB switches on, 115V AC, 200 to 400 Hz power supplied by the engine-driven alternators flows through the stab heat control relay to the temperature controller. The controller then supplies power to the blanket's parting strip to maintain temperature at 130 to 150°F (54 to 66°C); it also cycles power to the blanket shedder areas. As the controller cycles, it supplies power to the inboard upper, inboard lower, outboard upper, then outboard lower shedder areas.

If the parting strip fails to reach 45°F (7°C) or reaches 170°F (77°C), the STAB DEICE annunciator illuminates. During an overheat condition, the controller cycles power off and on to the parting strip as it overheats and cools.

Normal system operation can be monitored through the left and right AC AMPS ammeters. As the system cycles, the amperage varies as the controller cycles power to the shedder areas.

Generator Air Inlet

Turning the ENG ANTI-ICE switches to ON energizes two relays to supply 28V DC through overheat switches to the generator air inlet heating elements. On **units 001 to 173**, the overheat switches open at 130°F (54°C) to cut power to the heating element. On **unit 174 and subsequent**, the overheat switches open at 325°F (163°C). During an overheat condition, the switches open and close as the heating element overheats and then cools.

Pitot/Static and Rudder Bias

With the LH/RH PITOT/STATIC ANTI-ICE switches on, 28V DC power from the Left Feed and Right Crossover buses flows to the pitot tube, instrument and pressurization system static port, and AOA transmitter probe heating elements. The RH PITOT/STATIC ANTI-ICE switch also supplies power to the rudder bias actuator heating blanket. Rudder bias heating can be monitored on the RUDDER BIAS HTR ammeter.

Current sensors monitor pitot tube and static port heating element operation. If a heating element fails or a switch is in OFF, the current sensors illuminate the associated LH/RH P/S HTR OFF annunciator.

RAT Probe

Turning the RAT ANTI-ICE switch to ON supplies 28V DC to the ram air temperature (RAT) probe heating element. Normal operation can be verified by a RAT rise with the switch in ON.

Drain Masts

Whenever the aircraft's electrical system is energized, 28V DC from the Left Feed bus powers the drain mast heating elements.

Engine Anti-Ice System

Power Source	Engine HP bleed air Left/Right Feed buses – 28V DC (left CB panel)
Distribution	Bleed air Nacelle inlet 28V DC Wing root fairing thermal blanket Generator inlet anti-ice P_{t2}/T_{t2} probe Engine ignition
Control	ENG ANTI ICE (L/R) switches
Monitor	ENG ANTI-ICE LH/RH annunciators
Protection	ENG LH/RH CBs (5A)

Wing Anti-Ice System

Power Source	HP bleed air manifold Left/Right Feed buses (left CB panel)
Distribution	Wing leading edges (L/R)
Control	Wing anti-ice switches (L/R)
Monitor	WING ANTI-ICE LH/RH annunciators
Protection	WING LH/RH CBs (5A)

Horizontal Stabilizer Anti-Ice System

Power Source	Crossover Right Feed bus (right stab anti-ice) Left Feed bus (left stab anti-ice) Alternators Two engine-driven, 5 kVA, 115 to 120V AC three-phase, 200 to 400 Hz
Distribution	Horizontal stabilizer (L/R) leading edges Repeating cycle: Upper/lower inboard Upper/lower outboard
Control	STAB LH/RH switches (tilt panel)
Monitor	STAB DEICE LH/RH annunciators LH/RH ALT voltmeter Alternator voltmeter (2A) Alternator ammeter (2A)
Protection	HORIZ STAB LH/RH CBs (5A)

Windshield Bleed Air Anti-Ice, Rain Removal, and Back-up Alcohol Deice Systems

Power Source	Crossover Right Feed bus Engine HP bleed air Manual rain doors Alcohol reservoir
Distribution	Windshields (L/R) Backup alcohol: left windshield only (15 minutes continuous operation)
Control	W/S BLD switch W/S BLEED AIR knobs (2) PULL RAIN manual handle W/S ALC switch
Monitor	W/S AIR annunciator W/S O'HEAT annunciator (**units 183, 189 and subsequent; units with SB650-30-08**)
Protection	Circuit breakers W/S ALCOHOL (5A) W/S BLEED AIR (5A) LH W/S HTR BLD (2A) RH W/S HTR BLD (7.5A) Temperature sensors

NOTE: If an electrical power loss occurs, a solenoid-operated, pressure-regulating shutoff valve fails to open. If the manual valves are open, this allows engine bleed air (not temperature-controlled) to flow to the windshields.