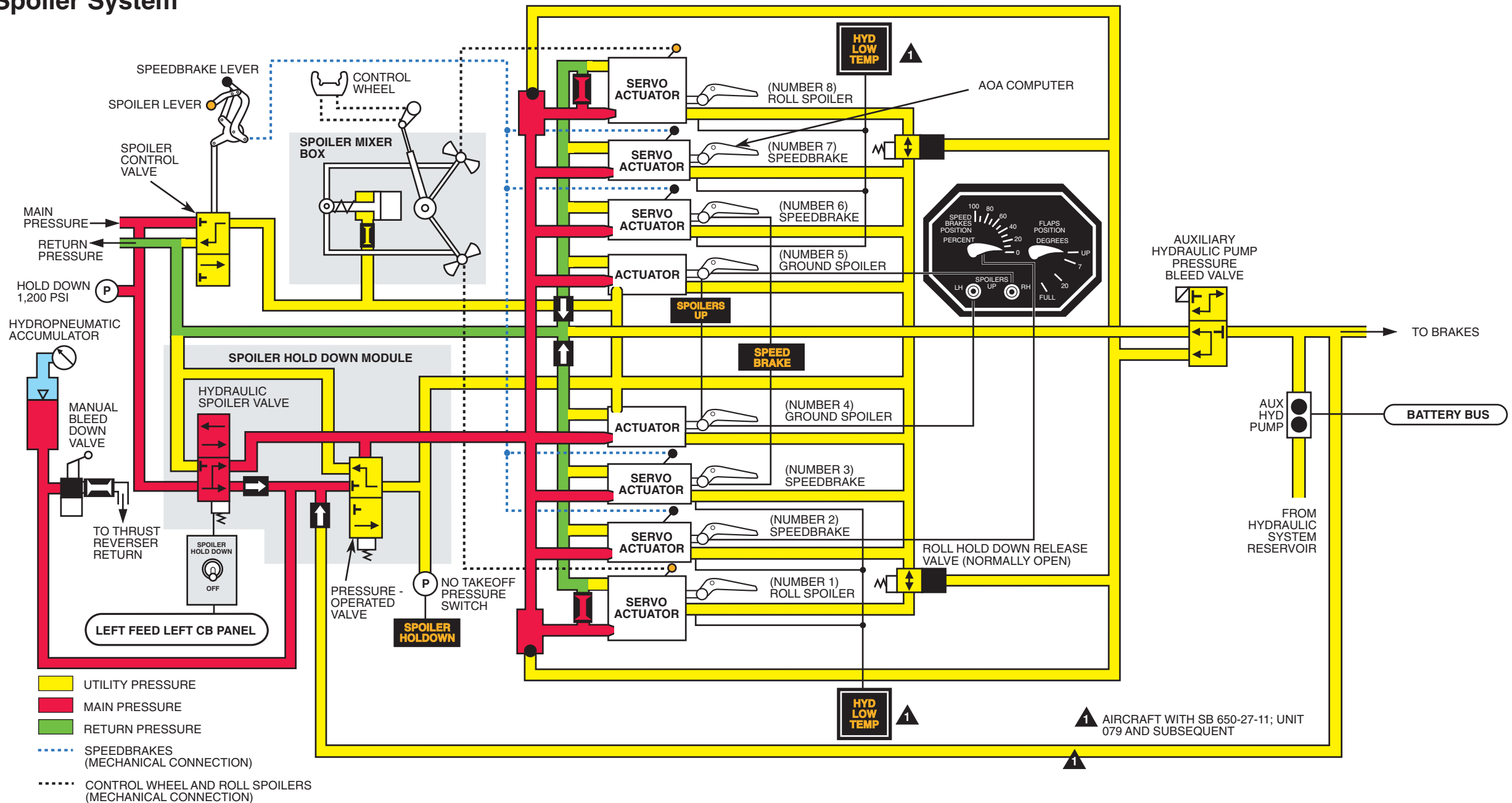
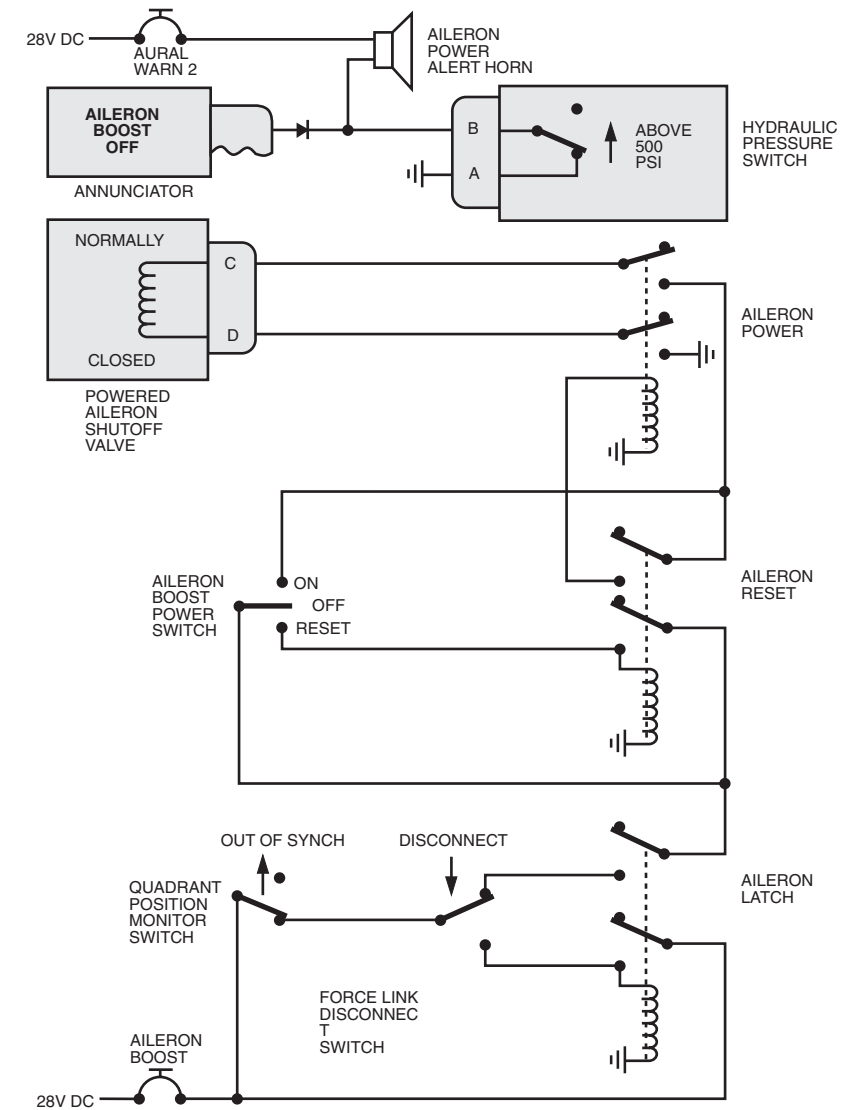


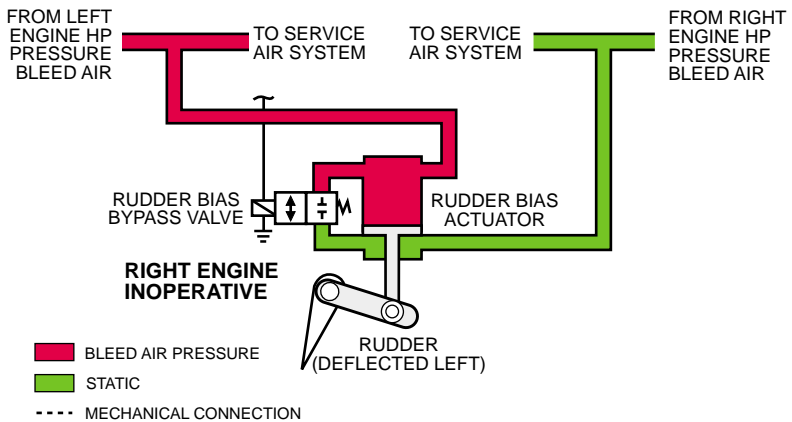
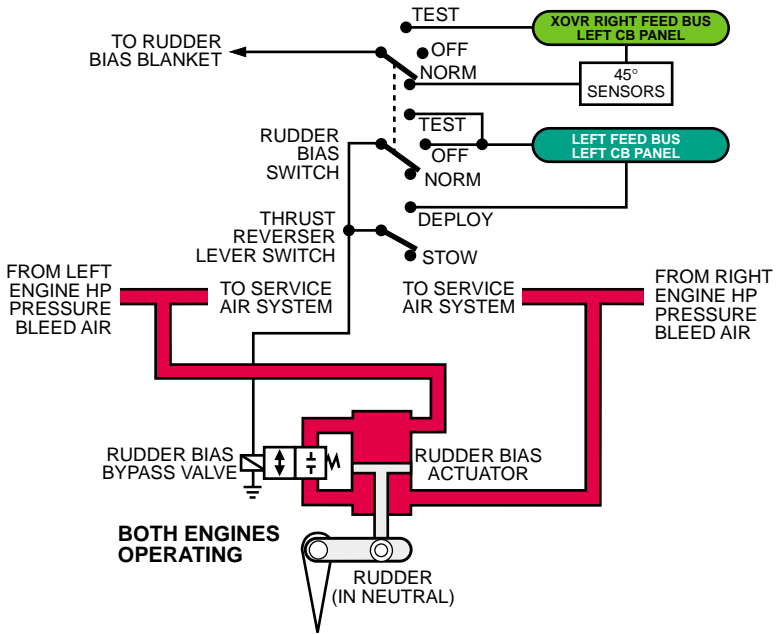
Spoiler System



Aileron Boost System



Rudder Bias System



Primary Flight Controls

The mechanically controlled primary flight controls include:

- hydraulically boosted ailerons
- hydraulically powered roll spoilers
- elevators
- rudder.

Pilot or autopilot inputs to the primary flight controls command the aircraft through the roll, pitch, and yaw axes.

Ailerons and Roll Spoilers

Movement of the control wheels left or right from neutral transmits control inputs through cables to the aileron crossover quadrant (CQA). The CQA, consisting of pilot's and copilot's quadrants, positions the ailerons through lockclad cables and the left and right aileron quadrants and the roll spoilers through cables. The ailerons and powerboost actuator connect to the pilot's quadrant. The roll spoilers and autopilot roll servo connect to the copilot's quadrant.

Total aileron movement, stop to stop, is 12.5° up or down. The roll spoilers assist the ailerons by moving up with the up aileron. Total roll spoiler extension is 47 +3/-0°.

With the aileron-spoiler interconnect/disconnect assembly engaged, movement of either control wheel controls the ailerons and roll spoilers. Pulling the AILERON SPOILER DISCONNECT handle disengages the disconnect assembly to give aileron control to the pilot and roll spoiler control to the copilot. The ailerons and roll spoilers cannot be reconnected in flight.

Normally, 28V DC from the Left Feed bus powers the aileron shutoff valve open. Force link disconnect and quadrant position monitor switches control power to the aileron shutoff valve. Excessive control forces de-actuate the force link disconnect switch and the shutoff valve closes. A force link or actuator component failure de-actuates the quadrant position monitor switch and the shutoff valve closes. When the valve closes the ailerons revert to manual control.

If the aileron boost system loses hydraulic pressure or the force link disconnect switch activates, the AIL BOOST OFF annunciator illuminates. Placing the AILERON BOOST switch in RESET and then ON resets the system.

Aileron Feel-Trim

Rotating the aileron trim wheel left or right from neutral mechanically trims the ailerons through the crossover quadrant assembly's pilot quadrant. There are no aileron trim tabs. A feel cartridge in the roll trim system provides an artificial control resistance through the pilot's quadrant.

Elevators

Moving control columns forward or aft from neutral move the elevators through a sector assembly, flexible and lockclad cables, aft quadrant, torque tubes, pushrods, and idler arm assembly for pitch control. Total elevator movement is $15.5 \pm 0.0/-0.5^\circ$ up and $15.0 \pm 1.0^\circ$ down. The autopilot elevator servo connects to the elevator cables in the vertical stabilizer.

Pitch Trim

The horizontal stabilizer moves to provide 2° nose down to 12° nose up pitch trim in response to the primary or secondary pitch trim system or the autopilot.

Momentarily pressing both halves of a control wheel split trim switch UP or DN arms the primary pitch trim system. The system now responds to inputs from the pilot or copilot trim switches or the autopilot. With the system armed, 26V AC supplied by the actuator control unit engages the actuator clutch. Stopping action by the motor shaft brake prevents actuator movement until the system receives an up or down input. Moving a split trim switch to UP or DN supplies the appropriate command to the actuator. The brake then releases, and the actuator ram drives the horizontal stabilizer in the appropriate direction.

Lifting the guard on the SECONDARY TRIM switch and placing it in the ON position disables the primary pitch trim system, autopilot; it also engages the secondary pitch trim actuator clutch. Moving the split trim switches next to the SECONDARY TRIM switch to the NOSE DOWN or NOSE UP position moves the horizontal stabilizer through relays and the secondary actuator.

A horizontal trim position indicator on the center pedestal driven by the primary actuator potentiometer shows horizontal stabilizer position from 2° nose down to 12° nose up. Operation of either pitch trim system for more than one second sounds a clacker audible through the cockpit loudspeakers and headsets.

If the primary pitch trim system fails, the PRI TRIM FAIL annunciator illuminates. Failure of the secondary pitch trim system illuminates the SEC TRIM FAULT annunciator.

Rudder

The rudder moves left or right 25° from neutral in response to rudder pedal and autopilot inputs to provide yaw control. Movement of the rudder pedals moves the rudder through cables and a bellcrank.

Rudder Trim

Rotating the rudder trim wheel left or right from neutral mechanically positions the servo-type rudder trim tab to reduce pedal forces. An indicator shows trim tab position NOSE L or NOSE R from neutral.

The rudder trim tab also functions as a servo tab in that it moves in the opposite direction of rudder deflection.

Rudder Bias

A pneumatically powered rudder bias system automatically positions the rudder to counteract an asymmetrical thrust condition.

With the RUD BIAS switch in NORM, the rudder bias bypass valve closes and HP bleed air from the left and right engines flows to the rudder bias actuator. With both engines producing equal thrust, pressure on each side of the actuator is equal and no rudder movement occurs. If one engine produces more power than the other, greater pressure on one side of the actuator forces the rudder in the direction of the engine producing more power to counteract asymmetrical thrust.

Placing the RUD BIAS switch in OFF supplies 28V DC from the Left Feed bus to the rudder bias bypass valve. The valve opens to equalize pressure on both sides of the actuator and disable the system. With the system off the RUDDER BIAS annunciator illuminates. During thrust reverser deployment the rudder bias system is inactive when the thrust reverser levers are in the idle reverse detent.

Placing the RUD BIAS switch in the momentary TEST position supplies 28V DC from the Crossover Right Feed bus to bypass temperature sensors and test the rudder bias heating blankets (see Ice and Rain Protection). Normally, the RH PITOT/STATIC switch controls power to the heating blankets.

Control Lock

Pulling the CONTROL LOCK T-handle out and rotating it 45° clockwise locks the ailerons, elevator, and rudder in the neutral position. It also limits throttle lever movement to approximately 1.25 inches forward of the idle thrust position. With the control lock engaged, the GUST LOCK and NO TAKEOFF annunciators illuminate.

Rotating the CONTROL LOCK T-handle counterclockwise and then pushing it in releases the control lock.

No Takeoff System

The no takeoff system illuminates the NO TAKEOFF annunciator and sounds an aural warning on the ground if:

- control lock engaged
- flaps extended less than 7° or more than 20°
- spoiler hold down system active
- horizontal stabilizer trim not set for takeoff
- speedbrakes or spoilers extended
- APU operating (ground units only).

Secondary Flight Controls

Secondary flight controls include:

- electrically controlled and mechanically operated flaps
- mechanically controlled and hydraulically operated speed-brakes/spoilers
- hydraulically controlled and operated ground spoilers.

Flaps

Each three-section fowler-type flap extends partially to increase lift and extends fully to increase lift and drag. The FLAP handle has detents for the UP (0°), 7°, 20° and FULL (37°) positions but can be selected for any intermediate setting within that travel range. On **aircraft with SB650-27-37, 650-27-39, or 650-27-41 (DC flap system)**, the flaps can be set to UP, 7°, 20°, or FULL position. No intermediate flap positions are possible.

After moving the FLAP handle from one position to the next, the flap controller operating on 28V DC from the Left Feed bus compares FLAP handle position to the current flap position provided by a position sensor on the outboard flap actuators.

If the controller senses no faults (i.e., asymmetrical flaps), it commands the power drive unit to extend or retract the flaps. Supplied with 28V DC from the Crossfeed bus, the drive unit motor turns and drives the eight actuators (four per side) through two angle gearboxes and flexible driveshafts. Each actuator then converts rotary motion into linear motion with a ballscrew.

During flap movement, the controller monitors flap speed, direction, and current. It also provides these signals to the angle-of-attack system, no takeoff system, and flap position indicator. When flaps reach the selected position, the flap controller commands the flap drive unit to stop.

If the flap controller senses an asymmetrical flap condition, it disables the drive motor unit power circuit to stop flap movement, illuminates the FLAP INOP annunciator, and locks the flaps in their current position with electrically powered asymmetry brakes. The controller also monitors the flap system for improper/incorrect flap commands, uncommanded flap movement, and overtemperature/overcurrent conditions.

If the flap controller overheats because of excessive flap cycling, the O'HEAT light and FLAPS INOP annunciator illuminate. After the controller cools the O'HEAT light extinguishes and the flap system and FLAPS INOP light can be reset.

On **aircraft with the DC flap system**, after moving the FLAP handle from one position to another, the flap controller engages the appropriate directional relay and the power relay to extend or retract the flaps. During the initial 0.5 seconds of flap movement, DC power flows through a soft start relay that increases flap operating voltage from 20 to 100 percent to the power drive unit. After another 0.5 seconds, a high speed relay removes the soft start relay from the power circuit.

As the flaps reach their commanded position, the flap controller removes the high speed relay from the circuit and enables the soft start relay. The soft start relay then reduces operating voltage to 50% to slow flap movement. When the flaps reach their commanded position, the left and right position sensors signal the flap controller and the flap controller disengages the power and directional relays and engages the brake relay to stop flap movement. After 0.4 seconds, the brake relay disengages.

Spoiler/Speedbrakes

Eight mechanically controlled and hydraulically operated spoiler panels, numbered left to right from 1 to 8, function as:

- roll spoilers to assist the ailerons
- speedbrakes to increase drag
- ground spoilers to destroy lift and slow the aircraft during the landing roll.

Roll Spoilers

With the aileron-spoiler interconnect/disconnect assembly engaged, control wheel movement operates the roll spoiler servo-actuator through the aileron crossover quadrant and spoiler mixer assembly. Hydraulic pressure then extends the roll spoiler to follow aileron movement. At full aileron up deflection, the roll spoiler extends to 47°.

Speedbrakes

Movement of the speedbrake level aft mechanically controls the servo-actuators for spoiler panels 2, 3, 6, and 7 through the speedbrake center quadrant, pushrods, and bellcranks. Hydraulic pressure then extends the spoiler-panels until they reach the position selected through the speedbrake lever. Depending on speedbrake lever position, the speedbrakes extend from 0 to 47°.

As the speedbrakes move, a position transmitter on panels 2 and 7 drives the speedbrakes position indicator on the center pedestal. The SPEEDBRAKE annunciator also illuminates during speedbrake extension.

Ground Spoilers

Full aft movement of the speedbrake lever unlocks the spoiler lever. Pulling the spoiler lever aft mechanically shifts the spoiler control valve to supply hydraulic pressure to the ground spoiler actuators (panels 4 and 5) and the spoiler mixer actuator. Panels 4 and 5 extend to 30° and panels 1 and 8 extend to 47°. During ground spoiler actuation all eight panels extend.

During ground spoiler extension, proximity switches illuminate the SPOILERS UP lights on the speedbrake position indicator and the SPOILERS UP annunciator.

Spoiler Hold Down

The spoiler hold down system prevent inadvertent spoiler and speedbrake extension in flight. The system operates automatically if main hydraulic system pressure drops or manually through the SPOILER HOLD DOWN switch.

If main hydraulic system pressure drops below 1,200 PSI with the AUX HYD PWR switch in NORM, the auxiliary hydraulic pump operates to supply hold down pressure to the retract side of spoiler panels 2 through 7. The roll spoilers (panels 1 and 8) continue to operate normally. If the AUX HYD PWR switch is in OFF, pressure from the spoiler/speedbrake hold down accumulator prevents speedbrake/spoiler extension.

Placing the SPOILER HOLD DOWN switch in the up position with the AUX HYD PWR switch in NORM performs the same function as the automatic hold down feature.

With the spoiler hold down system active, the SPOILER HOLD-DOWN annunciator illuminates.

Angle-of-Attack

Power Source	Crossover Right Feed bus (left CB panel)
Monitor	STALL WARN light FLAPS/SPOILER/SP/AOA probe warning light AOA indicator ADI (L/R)

Stall Warning System

Power Source	Angle-of-attack system
Control	AOA computer AOA CB
Monitor	AOA indicator Stick shaker

Trim Systems

Power Source	Battery bus – elevator Manual – aileron/rudder
Control	Yoke trim switches Manual knobs Autopilot servos
Monitor	Indicators Clacker No takeoff horn Annunciators NO TAKEOFF PRI TRIM FAIL SEC TRIM FAIL
Protection	Circuit breakers PITCH PWR (0.5A) PITCH CONTROL (0.5 OR 2A) SEC PITCH (7.5A)

Rudder Bias System

Power Source	HP bleed air Left Feed bus Crossover Right Feed bus (heaters)
Monitor	Rudder bias test Heater gage RUDDER BIAS light

Yaw Damper

Power Source	Autopilot Crossover Left Feed bus (right CB panel) Right Feed bus (right CB panel)
Monitor	AP ENGAGE light YD ENGAGE light

Speedbrakes/Spoilers

<p>Power Source</p>	<p>Aircraft hydraulic system, hold down hydraulic accumulator, or auxiliary hydraulic pump (units 079 and subsequent and aircraft with SB650-27-11) Speedbrake/spoiler hold down system Left Feed bus SPOILER HOLD DOWN switch Battery bus Auxiliary hydraulic pump Auxiliary hydraulic pump Roll control spoilers: panels 1, 8 Aircraft hydraulic system Speedbrakes: panels 2, 3, 6, 7 Ground spoilers: panels 4, 5 (or with panels 1, 8)</p>
<p>Control</p>	<p>Speedbrake lever Spoiler lever SPOILER HOLD DOWN switch AUX HYD PUMP switch</p>
<p>Monitor</p>	<p>Annunciators NO TAKEOFF SPEEDBRAKE SPOILERS UP SPOILER HOLDDOWN No takeoff horn Speedbrake position indicator Spoiler lights on speedbrake position indicator</p>

NOTE: With the battery switch in EMER position, the auxiliary hydraulic pump does not power roll spoilers on **units 001 to 089 without SB650-27-17.**

NOTE: To operate panels 1 and 8 simultaneously as spoilers for emergency descent or as ground spoilers with panels 4 and 5, main system hydraulic pressure must be present at the spoiler mixer box actuator.

Flaps

Power Source	Crossfeed bus – flap power Left Feed bus – flap control
Control	Flap control handle
Monitor	Flap position indicator Annunciator FLAPS INOP/O'HEAT FLAP O'SPEED (units 169 and subsequent with SB650-27-24) NO TAKEOFF No takeoff horn
Protection	Asymmetry sensing/protection Circuit breakers FLAP PWR (0.5A) FLAP CONTROL (3A)