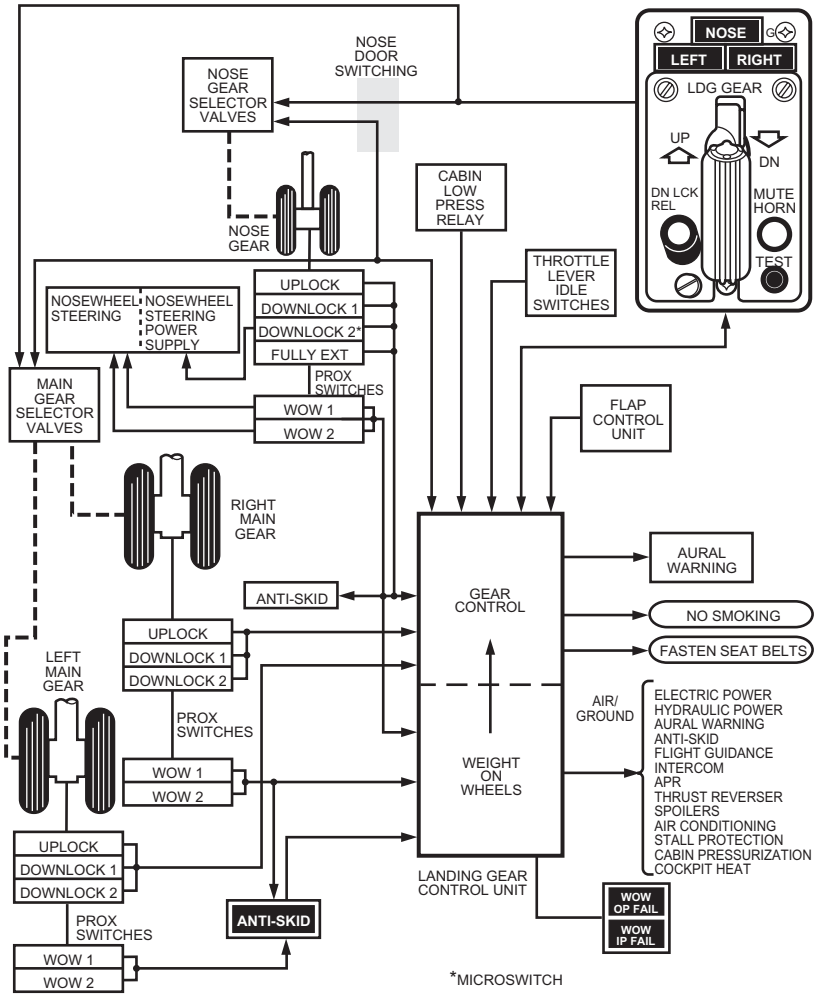
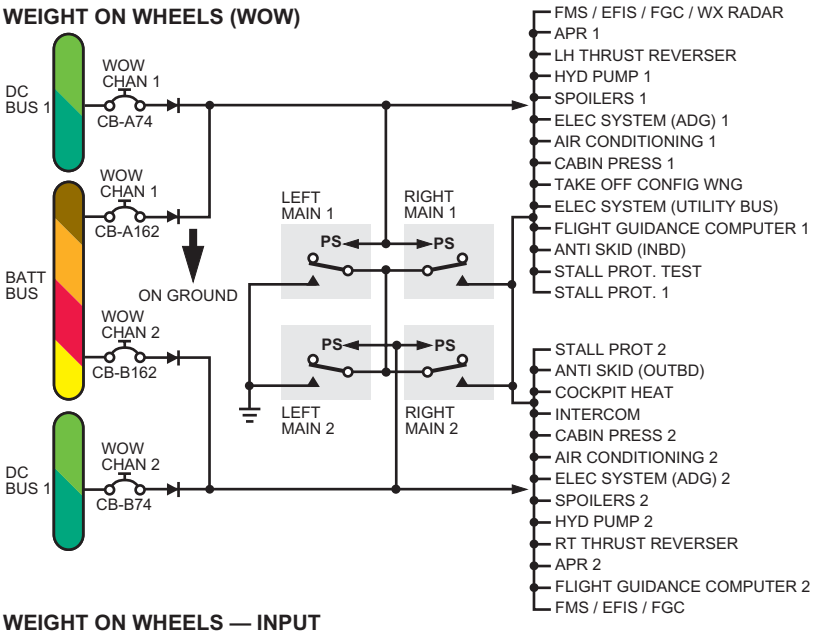
Landing Gear Control and Indication

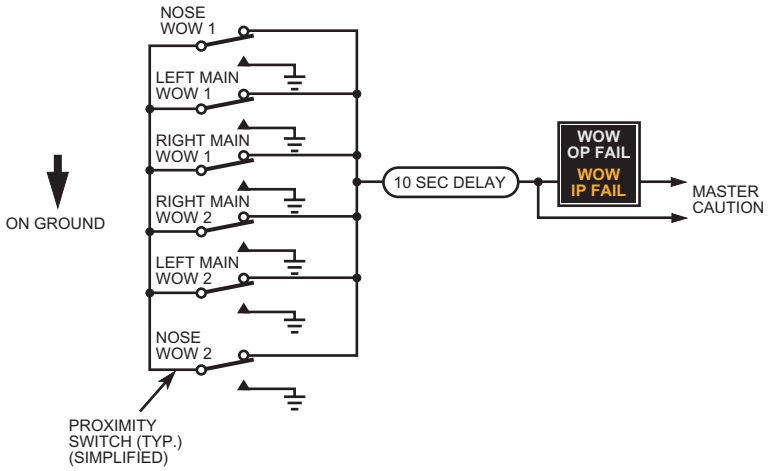


Weight-on-Wheels System

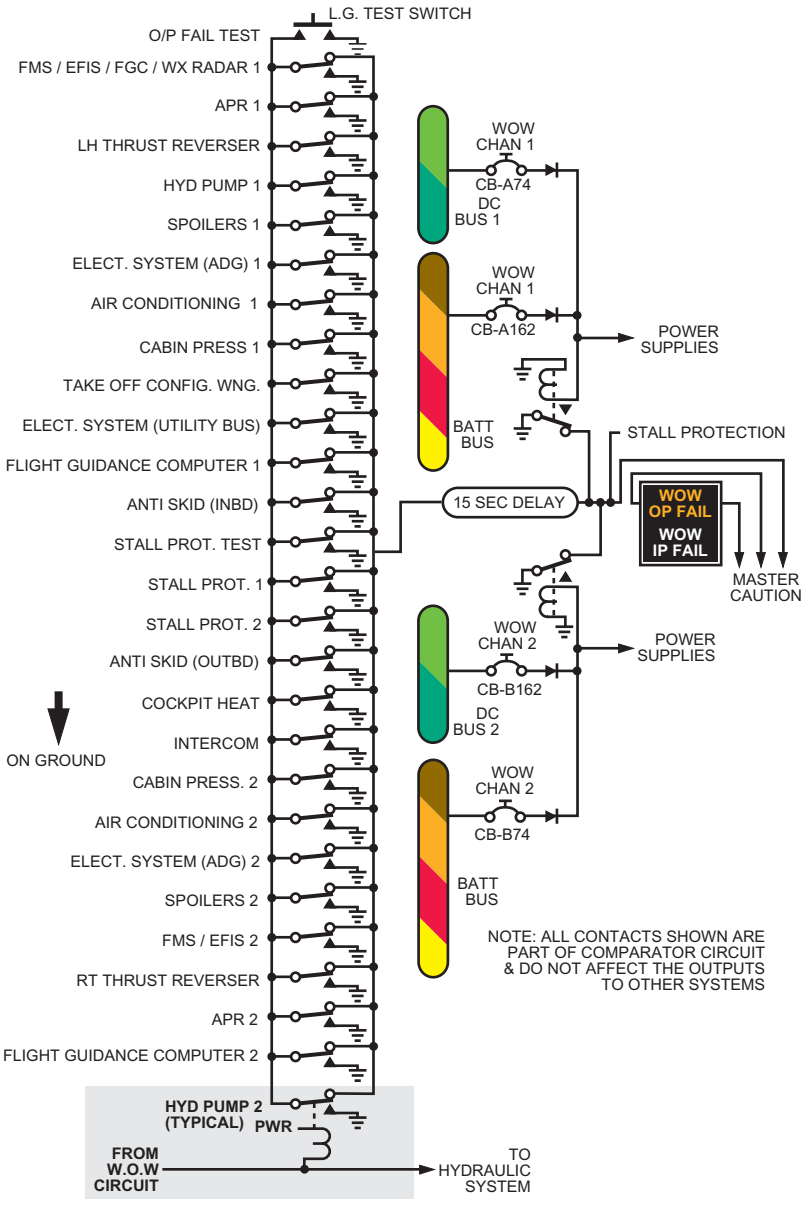
WEIGHT ON WHEELS (WOW)



WEIGHT ON WHEELS — INPUT



Landing Gear Control Unit



Landing Gear and Brakes

The landing gear system consists of trailing link main landing gear and a conventional nose landing gear. All gear have nitrogen-charged shock absorber struts with dual wheels and tires.

Normally, No. 3 hydraulic system pressure retracts and extends the gear. If an electrical, mechanical, or No. 3 hydraulic system fault occurs, a manually actuated emergency extension system mechanically releases the uplock actuators, dumps hydraulic pressure, and allows the gear to free fall by gravity. A down and locked condition is assisted by a combination of airflow and spring pressure on the nose gear and downlock assist actuator on each main gear, powered by the No. 2 hydraulic system.

Each main gear wheel has mechanically operated and hydraulically powered carbon composite brakes with anti-skid protection. Normally, No. 3 hydraulic system supplies the inboard brakes while the No. 2 hydraulic system supplies the outboard brakes. If the normal braking system fails (i.e., loss of hydraulic system pressure), a braking accumulator stores sufficient pressure for approximately six braking applications.

An electronically controlled (steer by wire), hydraulically operated nosewheel steering system positions the nose gear during ground operations in response to rudder pedal or pilot's handwheel movement.

Weight-on-Wheels System

The landing gear control unit consists of a gear control and No. 1 and No. 2 weight-on-wheel channel. The unit receives inputs from:

- nose and main gear downlocks
- nose gear oleo switch
- nose and main gear uplocks
- main gear proximity switches (two per landing gear leg)
- nose gear proximity switch and microswitch.

The gear control channel, depending on the position of the landing gear, then supplies outputs for the:

- nose and main gear retract and extend solenoids
- landing gear safe indicators
- landing gear unsafe indicator
- landing gear handle downlock solenoid
- horn mute indicator
- aural warning system
- fasten seat belts and no smoking signs
- nosewheel steering system.

The No. 1 and 2 WOW channels operate independently but are interconnected to prevent false gear indications from a single channel affecting an aircraft system. The two channels, in turn, control the operation of various aircraft systems (**see Table 4-M**).

If a landing gear proximity switch malfunctions and provides a different indication from the others, the landing gear control unit illuminates the WOW I/P (input) FAIL light after a 10-second delay. If a WOW channel output differs from the rest, the WOW O/P (output) FAIL light illuminates after a 10-second delay. The WOW O/P FAIL light also illuminates the WOW light on the 8-channel annunciator panel and the MASTER CAUTION lights.

No. 1 WOW System	No. 2 WOW System
Air conditioning	Air conditioning
Air-driven generator	Air-driven generator
Aural warning	Automatic power reserve
Automatic power reserve	Cabin pressurization
Autopilot	Cockpit heating
Cabin pressurization	Intercom
Cockpit heating	No. 2 Stall warning system
Ground spoilers	No. 2B pump interlock
Inboard anti-skid	Outboard anti-skid
Left thrust reverser	Right thrust reverser
No. 1 stall warning system	Spoilers
No. 1B pump interlock	

Table 4-M; Weight-on-Wheels System

Retraction

When the landing gear struts extend after takeoff, the WOW system proximity switches indicate an in-air condition. With these inputs, the landing gear control unit releases the control handle solenoid lock.

Moving the handle to the UP position with a weight-on-wheels signal not present begins the landing gear retraction sequence. The nose landing gear door selector valve shifts to the open position while the main landing gear selector valve shifts to the retract position. No. 3 hydraulic system pressure then flows through the priority and selector valves to the nose gear door and main gear uplock actuators. The nose gear doors begin opening and the main gear uplocks move to the unlocked position. The NOSE DOOR OPEN light illuminates, the NOSE, LEFT, and RIGHT lights extinguish, and the gear unsafe light flashes.

When the nose gear doors completely open, the nose gear selector valve shifts to the retract position, the downlock actuator releases, and the nose gear drag brace unlocks.

Hydraulic pressure to the retract side of the nose and main gear actuators unlocks the main gear downlock actuators and drives the landing gear into their wheel wells.

As the gear reaches the up and locked position, the uplocks mechanically latch to hold the gear in the retracted position. Operation of the uplocks then provides a gear retracted and locked indication to the nose gear door selector valve and the landing gear control unit. The door selector valve then directs pressure to close the nose gear doors. At the end of the retraction sequence, the nose gear, nose gear door, and main gear selector valves shift to the neutral position. The NOSE DOOR OPEN and gear unsafe lights then extinguish.

Extension

Moving the landing gear control handle to the DN position begins the extension sequence by energizing the nose gear door and main gear selector valves. The nose gear doors open. The nose gear selector valve shifts to the extended position; the uplocks release. Hydraulic pressure then flows to the extend side of the landing gear actuators. The NOSE DOOR OPEN light illuminates and the red gear unsafe light flashes.

Hydraulic pressure to the extend side of the landing gear actuators drive the gear legs to the extended position. When gear reaches the fully extended position, the mechanical nose gear drag brace and main gear actuator downlocks engage.

The NOSE, LEFT, and RIGHT lights illuminate and the gear unsafe light extinguishes. The nose gear door selector valve shifts to close the nose gear doors. The NOSE DOOR OPEN light extinguishes.

Emergency Extension

If the normal landing gear extension system fails (i.e., hydraulic system fails, electrical fault, etc.), pulling the L.G. PULL handle up unlocks the nose gear doors, releases the nose gear uplocks, and operates the nose gear dump valves. The nose gear begins extending under its own weight assisted by springs.

Further movement of the handle releases the main gear uplocks and operates the gear dump and main gear assist selector valves. The landing gear extends under its own weight assisted by actuators powered by the No. 2 hydraulic system.

Gear Warning

Retarding the throttles to idle with one of the landing gear not down and locked sounds the landing gear warning horn. Pressing the MUTE HORN pushbutton silences the horn and illuminates the button's amber light. Advancing a throttle above idle extinguishes the light.

Extending the flaps past 30° without the gear being extended also sounds the landing gear warning horn. The horn cannot be silenced by pressing the MUTE HORN button with the flaps past 30°.

Brakes

All main landing gear wheels have carbon composite, multiple disc brakes operated hydraulically by two separate hydraulic systems. No. 2 hydraulic system pressure supplies the outboard brakes while No. 3 system pressure supplies the inboard brakes.

Normal Braking

Pressing on a pair of toe brakes mechanically actuates the dual brake control valve spools. The spools shift to meter hydraulic fluid proportional to pedal effort through the anti-skid control valves and hydraulic fuses to the brake assemblies. The brake assembly pistons extend under pressure to force a pressure plate against the rotating and stationary discs.

With release of braking pressure, the brake control valves shift to direct hydraulic pressure to the system's return line.

Anti-Skid

With the ANTI-SKID switch in the ARM position, the parking brake off, and the nose gear down and locked, the anti-skid system arms and begins monitoring wheel speed for an incipient skid.

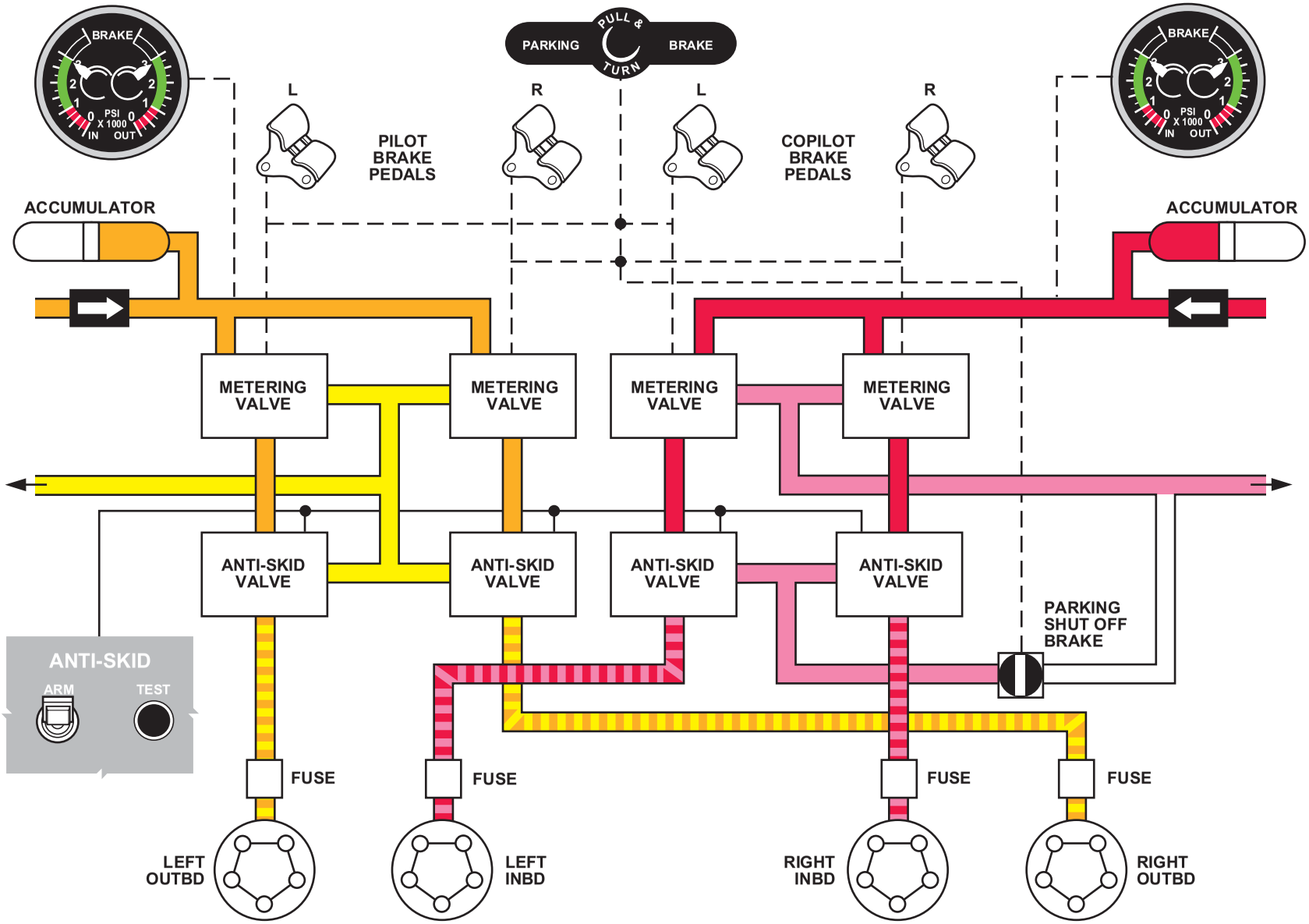
When the aircraft is airborne (wheel-off-wheels), the system's locked wheel detector circuit arms. Because the wheels are not spinning, the system sees a locked wheel condition and dumps all braking pressure through the anti-skid control valves. This feature prevents landing with the brakes applied.

At touchdown the WOW switches actuate to provide an on-ground indication to the skid control unit. Wheel spin-up above 35 kts then overrides the WOW switch signal to provide immediate braking and anti-skid protection.

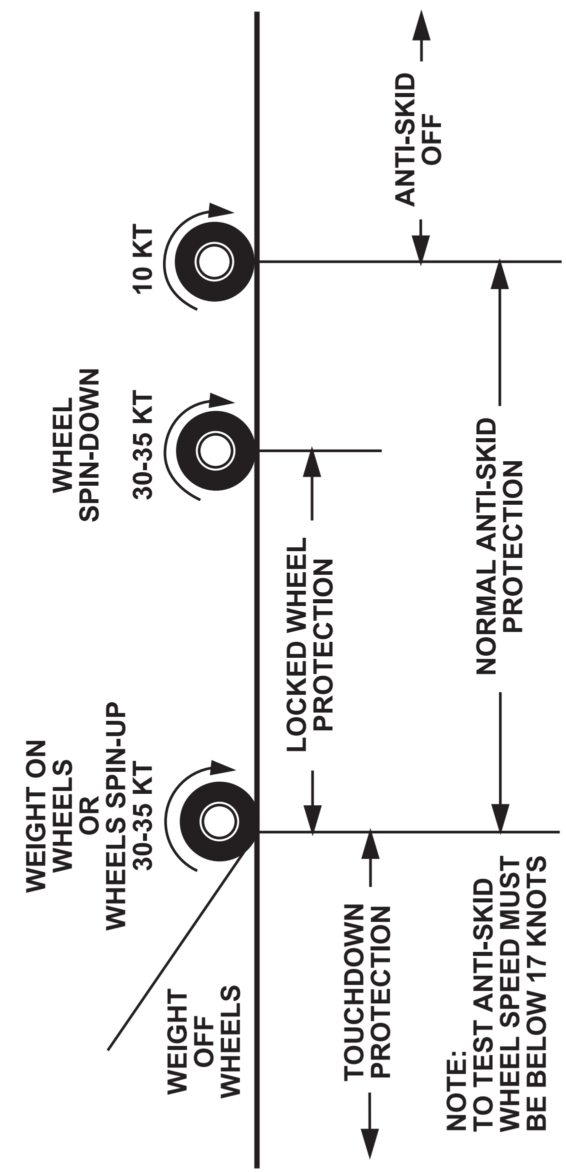
During the landing roll and taxi above 10 kts, the skid control system monitors main wheel deceleration and compares it to a reference signal. If a wheel's deceleration exceeds the reference signal, indicating an incipient skid, the skid control unit signals the skidding wheel's anti-skid control valve to momentarily reduce braking pressure and prevent a wheel skid.

The reduced braking pressure allows wheel spin up until it matches the others. After an incipient skid, the skid control unit modulates braking pressure to all wheels below the skid level.

Brake System



Anti-Skid Profile



Above 30 kts groundspeed, the anti-skid system's locked wheel protection also provides basic anti-skid protection if a skid occurs. As groundspeed drops below 10 kts, the system de-activates.

Pressing the anti-skid TEST button for two to four seconds with the aircraft below 17 kts groundspeed enables a complete test of the anti-skid system. Illumination of the INBD FAIL and OUTBD FAIL lights during testing indicates normal system operation. If a system component fails with the TEST button pressed, the associated light fails to illuminate. After releasing the button, illumination of the INBD FAIL or OUTBD FAIL light indicates a system malfunction. Releasing the anti-skid TEST button prematurely may result in a false failure indication.

Parking Brake

After applying both toe brakes, pulling the PARKING BRAKE handle out and rotating it 90° applies the parking brake by mechanically operating the brake control valves. The control valve's spools shift and trap hydraulic pressure in the inboard braking system supply lines.

Pulling the PARKING BRAKE handle also illuminates the parking brake ON light, closes the parking brake shutoff valve, and de-energizes the anti-skid system relays.

Applying the toe brakes and rotating the PARKING BRAKE handle 90° releases the parking brakes by mechanically unlocking the brake control valves. After unlocking the parking brake, stow the handle, then release the toe brakes. The ON light extinguishes.

The parking brake should be set from the pilot's seat. Although the system allows either set of brake pedals to set the parking brake, it may not be physically possible to depress the pedals sufficiently to set the brake and reach across the center pedestal to set the handle.

Nosewheel Steering

Placing the N/W STEER switch in the ARMED position with the landing gear down and locked and weight-off-wheels initiates the nosewheel steering system self-test. If the system detects an electrical or component fault, the NW STEER FAIL light illuminates; the system reverts to a free castoring mode that provides nosewheel shimmy dampening.

With weight-on-wheels and the N/W STEER switch in the ARMED position, the nosewheel steering system electronic control module (ECM) opens the steering selector valve. Deflecting the rudder pedals and/or handwheel from neutral actuates potentiometers connected to the ECM. The ECM, in response to these steering signals, generates the necessary commands to operate the steering control valve. The valve, in turn, directs No. 3 hydraulic system pressure to the appropriate side of the steering actuator. The actuator then mechanically positions the nosewheel in the appropriate direction through a pair of torque links that transfer steering action from the steering cuff to the nose wheels.

During towing, the torque links should not be disconnected; this prevents damage to the nosewheel steering system. Nose wheel steering must be selected OFF for towing.

When the nosewheel reaches the desired angle, its position sensor provides a feedback signal to the ECM. The ECM then commands the steering control valve to close both sides of the steering actuator. This holds the nosewheel at the desired angle.

Landing Gear

Power Source	No. 3 hydraulic system (normal) No. 2 hydraulic system (assist) Battery bus DC Bus 1 and DC Bus 2
Control	Landing gear control handle Gear control unit Weight-on-wheels system Downlock and uplock switches L.G. PULL handle (emergency extension)
Monitor	Gear handle unsafe light LEFT, NOSE, and RIGHT lights NOSE DOOR OPEN light Landing gear warning horn
Protection	Circuit breakers Weight-on-wheels system

Brakes and Anti-Skid System

Power Source	No. 2 hydraulic system (inboard) No. 2 hydraulic system (outboard) Essential DC bus DC Bus 1 and DC Bus 2
Control	Toe brake pedals Brake control valves Anti-skid system Anti-skid TEST button PARKING BRAKE handle
Monitor	Brake pressure gage INBD FAIL and OUTBD FAIL lights Parking brake ON light
Protection	Hydraulic fuses Anti-skid system

Nosewheel Steering

Power Source	No. 3 hydraulic system DC Bus 1 and DC Bus 2
Control	Handwheel (±55°) Rudder pedals (±7°) N/W STEER switch Electronic control module
Monitor	N/W STEER FAIL light
Protection	Weight-on-wheels system Landing gear downlock switches