

# **LANDING GEAR SYSTEM**

## **GENERAL**

The landing gear is tricycle type with two wheels on each gear strut. Each unit retracts into its own well and is fully covered by doors, mechanically connected to the landing gear.

Landing gear extension and retraction time is  $9 \pm 1$  seconds. In emergency, landing gear may be extended by compressed nitrogen.

## **MAIN LANDING GEAR (MLG)**

Each MLG wheels are mounted on a trailing beam pivoted on the MLG strut. Its shock absorber is pin-connected at both ends, absorbing the beam energy and transmitting the ground loads to the upper portion of the MLG structure.

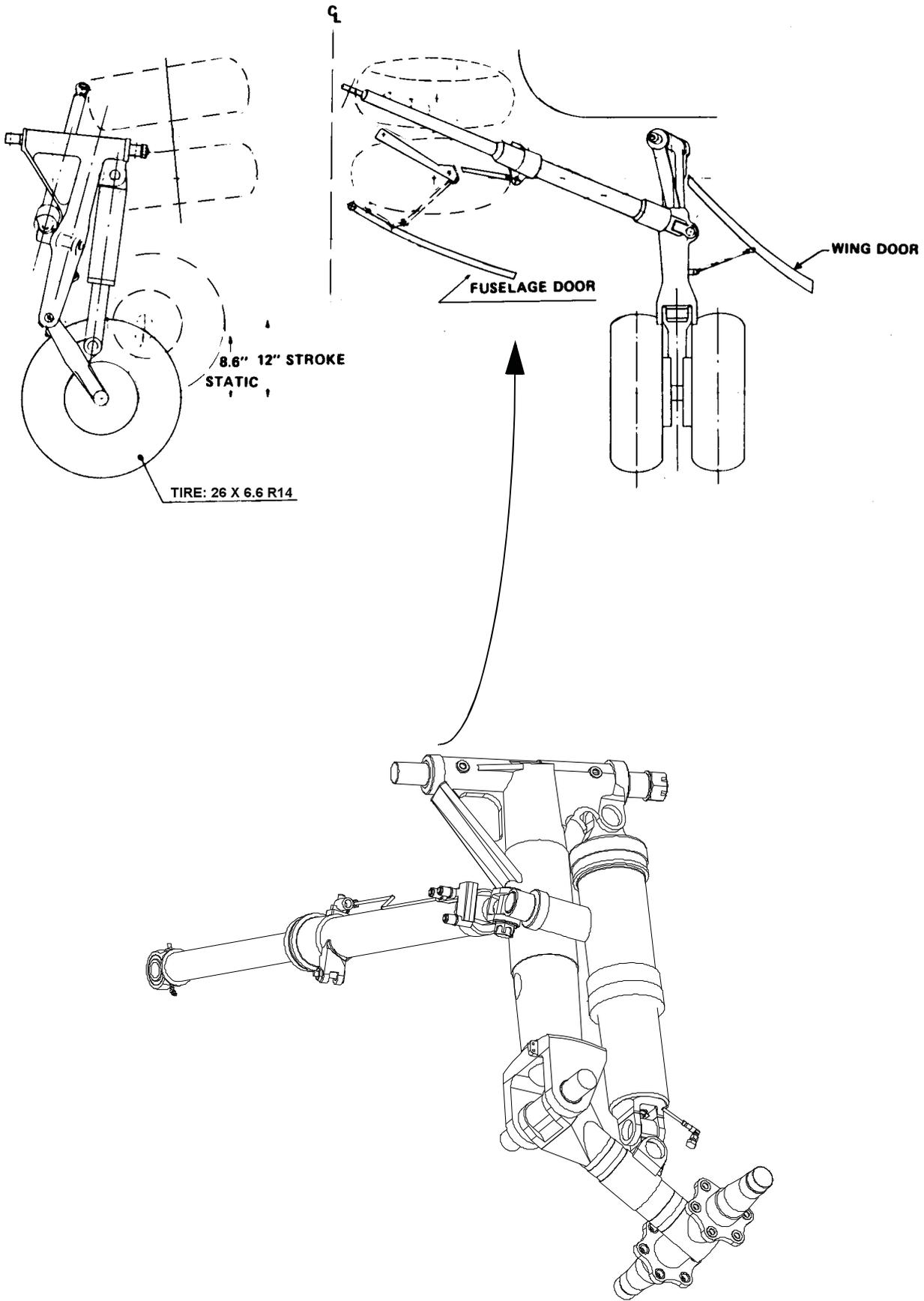
The ground loads are reacted by the wing structure by the journal bearings mounted coaxially in the wing, cordwise direction, and by the bracing actuator attached to the MLG strut.

The MLG retracts inwards into the fuselage wheel well. Each MLG has two doors, The outboard door is rigidly attached at the strut. The inboard door operates by mechanical linkage to the strut and is held in up position by two uplock cylinders. This uplock is released when landing gear lever is placed in down position by hydraulic pressure, or by nitrogen pressure in emergency. The MLG is held, while airborne, in retracted position by hydraulic pressure in the actuator and by the inboard door mechanical uplock if pressure drops.

As the gear is extended, an internal lock in the actuator automatically locks it in fully extended positions.

The MLG actuator also serves as the gear brace. The downlock is released when landing gear lever is placed in UP position by hydraulic pressure.

# Gulfstream G200 - Landing Gear System



**Figure 5-12. Main Landing Gear - Schematic**

## **NOSE LANDING GEAR (NLG)**

The NLG strut is cantilevered, sliding telescopically in a rotating tube. The rotating tube is positioned by a rack and pinion steering system. The steering movement is transmitted to the wheel axle by torque links. The steering angle is  $\pm 60^\circ$ , permitting runway width of 15 meters. Towing angle is  $\pm 100^\circ$  without disconnecting the torque links. A towing adapter is mounted on the strut with an integral safety shear pin.

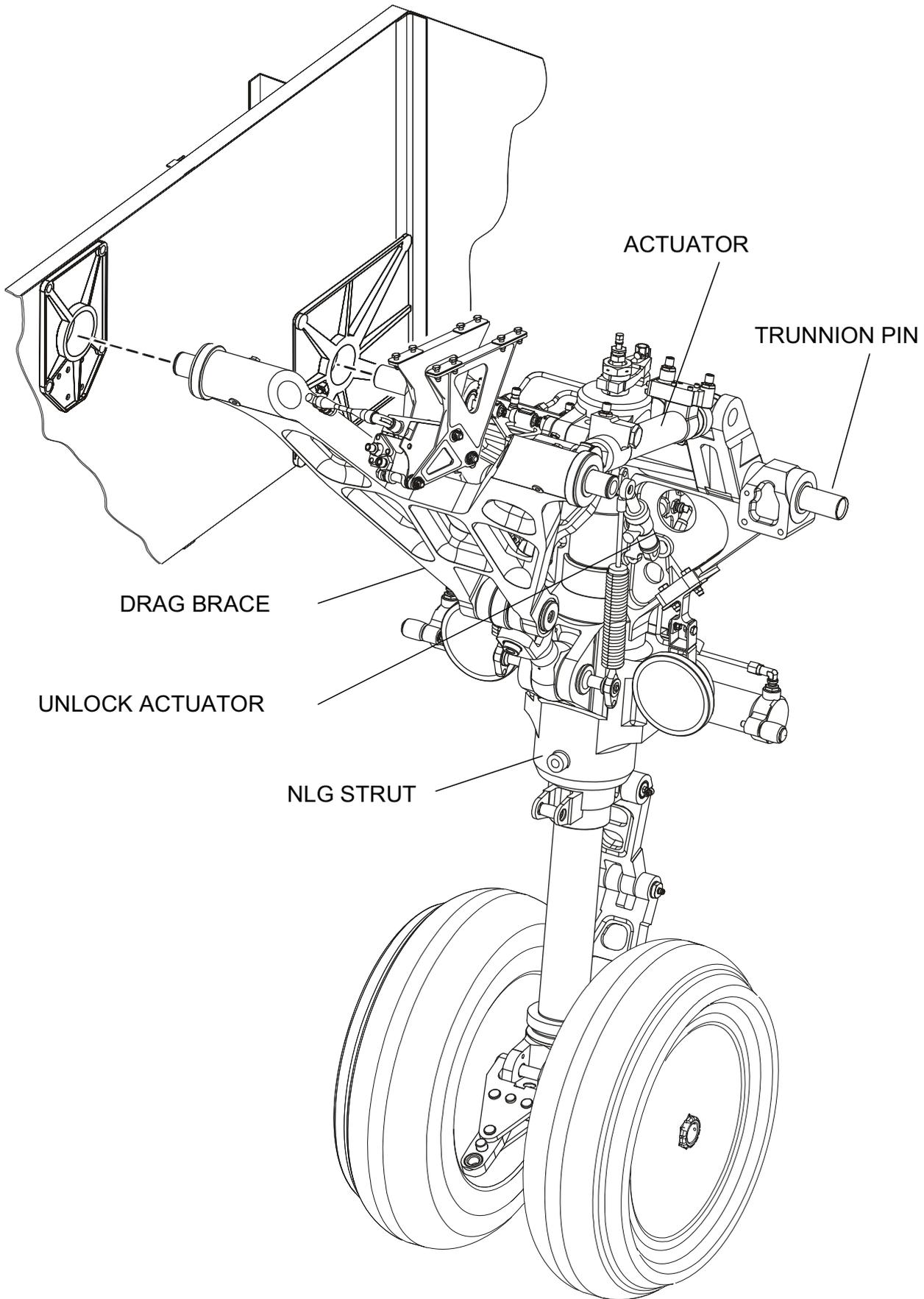
Ground loads are applied to the fuselage structure by means of two bearings and a drag brace. The drag brace is locked automatically in fully extended position by jury brace; it is unlocked by a hydraulic unlock actuator.

The NLG retracts forwards and locks up by spring-loaded mechanical lock. It is unlocked by hydraulic pressure. The hydraulic retracting actuator is sized to retract and extend the landing gear and doors.

When the nosewheel is off the ground, the NLG is centered by internal cams in the sliding tube, while the hydraulic supply is cut off from the steering system.

The NLG bay three doors are actuated mechanically by a system of bellcranks and rods connected to the levers on the NLG strut trunnion. The two side doors open and close during NLG extension and the rear door is opened backwards and remains open while the NLG is down.

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**Figure 5-13. Nose Landing Gear - Schematic**

## **EMERGENCY GEAR EXTENSION**

Emergency extension of the landing gear requires actuating the emergency gear DOWN handle (on left side of the pedestal), releasing compressed nitrogen to drive the landing gear into down & locked position, and opening a valve to direct the upward hydraulic pressure to the return line; this enables landing gear extension even if landing gear lever is stuck in UP position.

Once the gear Emergency DOWN handle is pulled, landing gear must not be retracted again.

## **LANDING GEAR SYSTEM CONTROLS AND INDICATORS**

Landing gear lever - Located on landing gear control panel on the front pedestal.

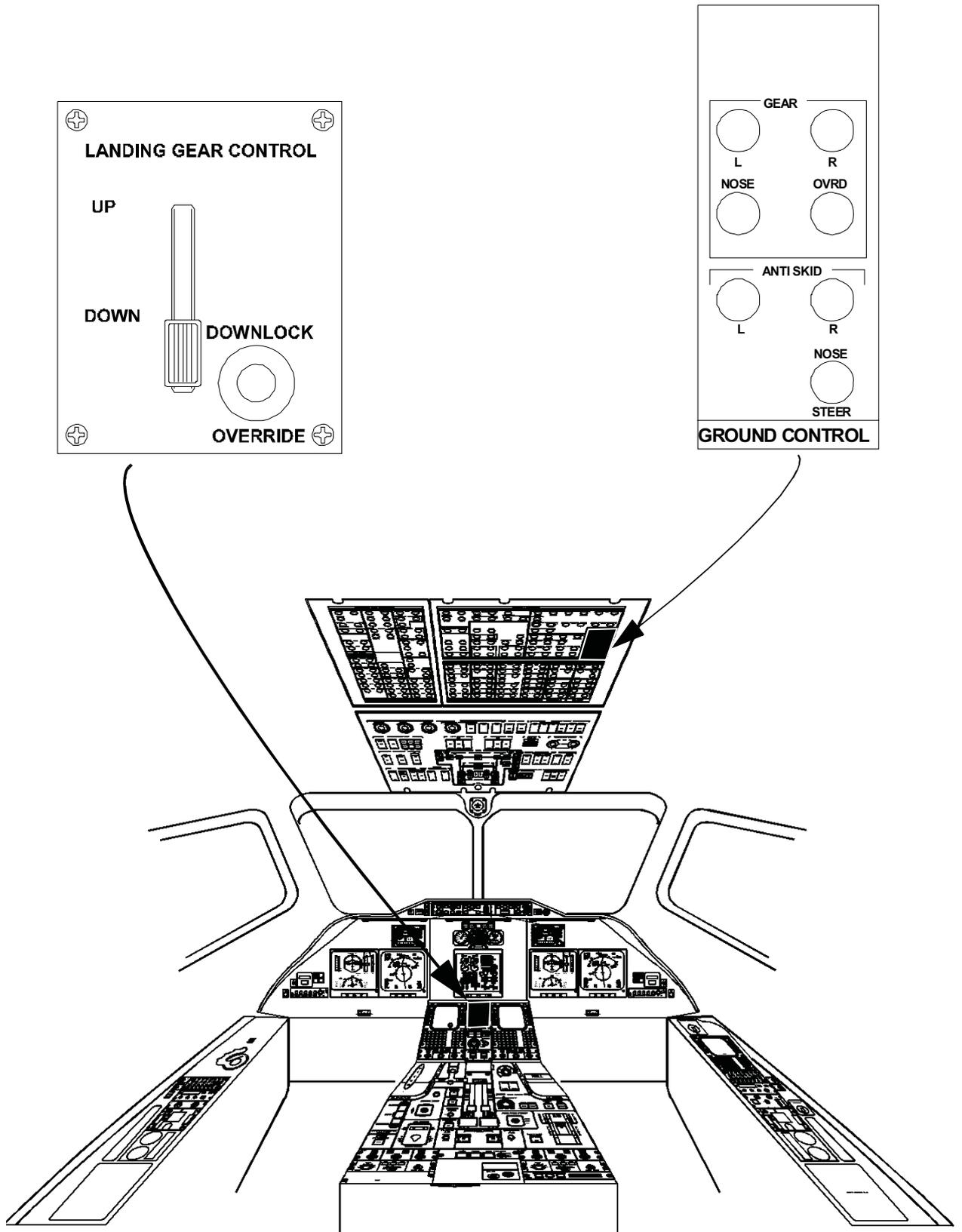
It retracts and extends landing gear. Two positions: UP and DOWN

DOWNLOCK OVERRIDE button - Energizes solenoid of downlock plunger if ground contact switch fails

### **Warning Messages**

**GEAR NOT DOWN** - Landing gear is not down and locked with radar altitude less than 800 ft (400 ft with MOD 7222) and one thrust lever at or below max cruise detent or flaps position more than 25°

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**Figure 5-14. Landing Gear System Controls**

## **WHEEL BRAKES SYSTEM**

Normal and emergency hydraulic wheel brake systems are controlled by conventional, dual, “tip-toe” brake pedals which actuate multi-disk self-adjusting brake units on each of the four MLG wheels. Normal operation of the brakes on each MLG strut is controlled by an anti-skid valve.

### **Normal Operation**

The normal and emergency wheel brake systems are controlled by mechanical inputs from brake pedals, with the pilots and co-pilots commands mechanically interconnected. When the pedals are pressed, proportional pressure from the right hydraulic system is metered by the power brake valve to the anti-skid control valves, and then through fuse and shuttle valves, into two split brakes on each main wheel, separately. Under normal operation, hydraulic pressure is directed to the brakes; pressure to the brakes is governed by pilots metered pressure and modulated by anti-skid to minimize wheel skid.

If any of the brake lines leading to the inboard wheels is broken, the hydraulic fuse on that side prevents loss of excessive amount of fluid and shuts off flow to the affected brake. The residual braking effect is 3/4 of normal.

### **Emergency Operation**

Emergency braking is used when the right hydraulic system fails. To obtain emergency braking, the PARK/EMERG lever is placed in EMERG position. The left hydraulic system pressure is used with half of the normal braking capacity. If both hydraulic systems fail, accumulator pressure is sufficient for six applications of emergency brakes for a total of 50 seconds (or one T/R deployment). Anti-skid system is inoperative.

## **Parking**

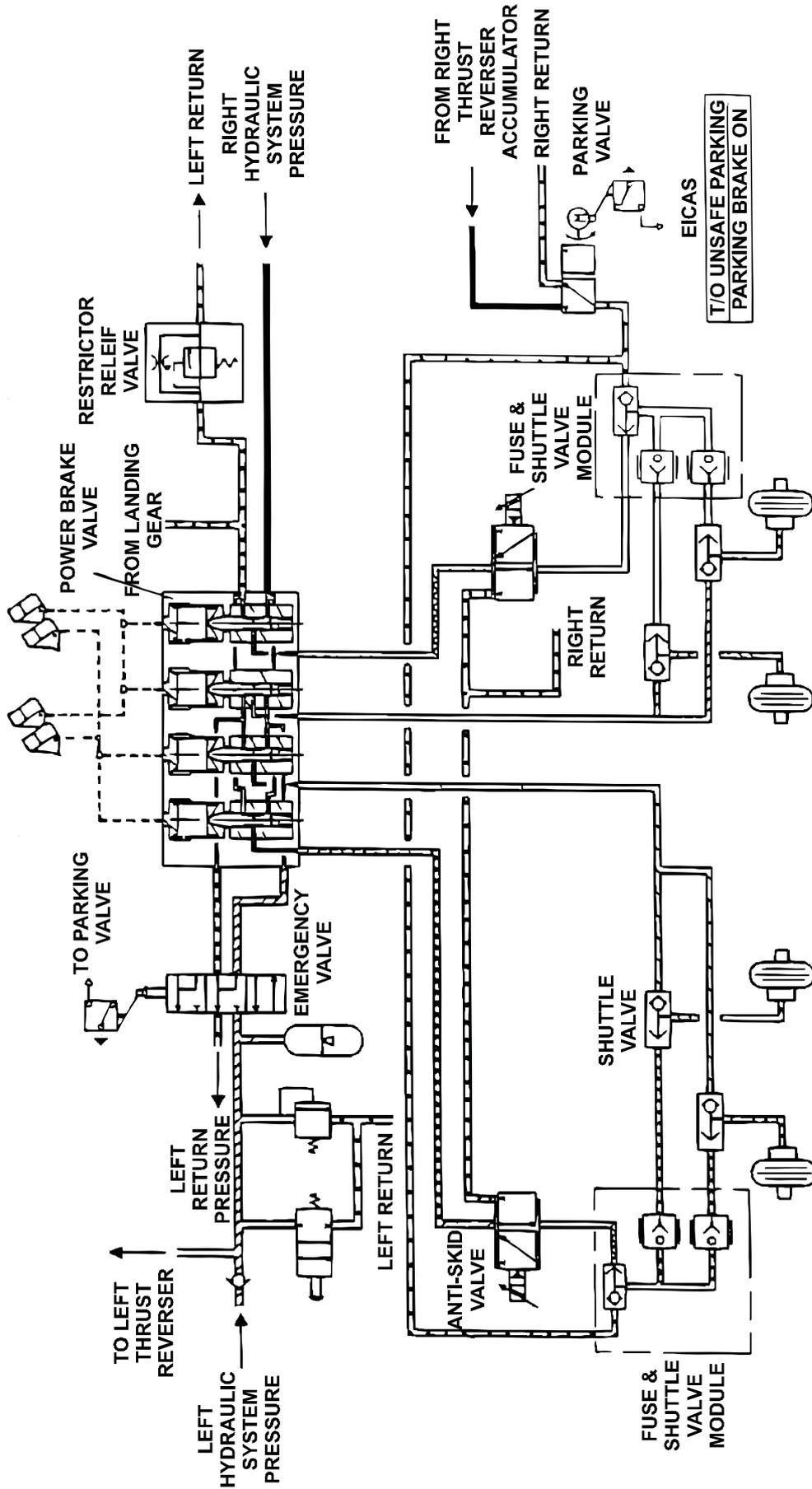
Parking is obtained when the PARK/EMERG lever is placed in PARK position.

The lever closes a switch which energizes the parking valve and connects the right hydraulic system pressure and the right T/R accumulator pressure to the normal brake lines through shuttle valves.

## **Anti Rotation**

The anti rotation function stops main wheels rotation after take-off during landing gear retraction before the main landing gear enters the wheel wells.

Back-pressure, developed in the return line during landing gear retraction, is directed into the power brake valve through the return port, which directs pressure through the (inoperative) anti-skid valve into the brakes (the anti-skid disengages when the landing gear goes out of down and locked position).



**Figure 5-15. Wheel Brake System - Schematic**

## **ANTI-SKID SYSTEM**

Anti-skid system prevents wheel skidding by limiting application of main hydraulic system pressure to brakes, thereby permitting shorter landing roll and minimizing tire wear. Maximum braking efficiency is obtained when all wheels are at maximum rate of deceleration short of a skidding wheel. Wheel speed detectors transmit electrical signals to system control box which sends corresponding signals to anti-skid control valves, causing the control valves to continuously vary brake pressure as required. In flight, and if wheel contact with ground is not firmly stabilized, brake system is rendered inoperative.

The anti-skid system consists of the following components:

- Electronic control unit
- Anti-skid control valves (2)
- Wheel speed sensors (4)
- Drive caps (4).

### **Operation**

The control unit receives wheel velocity signals from the wheel speed sensors of both wheels on one strut.

The signals are converted to voltage and filtered to attenuate the natural frequency of the strut.

The filters include a passive anti-skid drop out circuit to remove anti-skid control for wheel speeds below 10 knots.

Each wheel speed signal is applied to a skid detector which compares the wheel deceleration (derived from the wheel speed) to a preset reference level. Whenever an incipient skid is detected the skid detector send a proportional signal to the anti-skid servo valve which reduces the brake pressure.

In addition to that, after each incipient skid a modulator signal brings brake pressure to a value slightly below the incipient skid threshold, and then allows pressure to increase at a controlled rate.

The servo valve input circuit receives also a lead signal from a lead network which provides compensation for system lags.

The combination of skid detector, lead and modulator signals provide a highly adaptive and efficient skid control which achieves the greatest attainable deceleration while minimizing any tendency for deep skids.

Locked wheel protection is provided to each wheel by a detector and an wheel arming circuit.

When armed, the detector removes brake pressure on both paired wheel whenever the wheel speed on one or both of the wheels drops below 30 percent of the aircraft groundspeed.

The locked wheel arming circuit is armed to groundspeeds above 30 knots or when both left and right weight-on-wheel switches indicate an airborne condition.

Groundspeed is defined as the greater of the two wheel speeds.

Touchdown protection prevents any pressure at the brakes prior to the wheel spin-up because locked-wheels conditions are detected (arming circuit armed in flight and wheels not rotating).

After touchdown, brake pressure can be applied only at wheel spin-up above 35 knots or 2.5 to 3.5 seconds after transition of one weight-on-wheel switch, whichever occurs first. For speeds under 35 knots, the touchdown protection is lost if one weight-on-wheel switch fails in GROUND mode, but brakes pressure loss occurs only after a double failure in the AIR position.

(Continued)

The control unit provides continuous monitoring of system components and signals the **ANTI SKID OFF** light of the corresponding system if one or more of the following conditions exist:

- Opened or shorted wheel speed transducer or interface,
- Opened or shorted anti-skid control valve coil or interface,
- Loss of anti-skid control valve drive current from the control box,
- Loss of power or failure to control power on box power on, or loss of regulated power supply,
- Anti-skid control valve full dump command longer than 1 second with the weight-on-wheel switch in ground position.

If the fault is removed, the light goes out automatically.

After a tire burst at speeds higher than 30 knots a locked wheel condition is detected when the burst wheel speed decreases under 30% of the aircraft groundspeed and braking is lost on both wheels (**ANTI SKID OFF** light comes on).

The anti-skid system is to be switched off and braking continues.

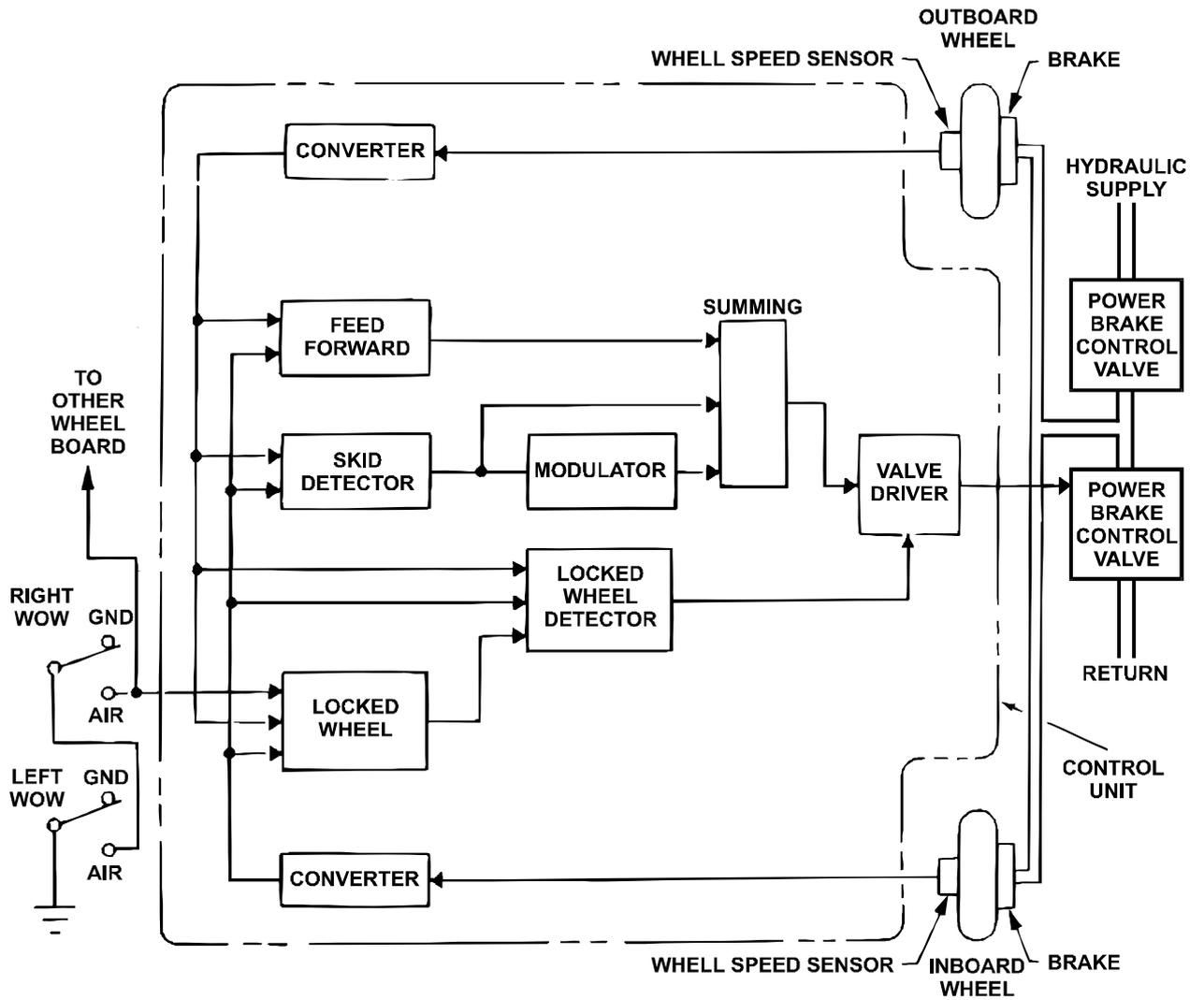
## **ANTI-SKID SYSTEM CONTROLS AND INDICATORS**

ANTI-SKID Pushbutton - Located on pilot glareshield. It has two positions as follows: Pressed off - Anti-skid system is off. (**ANTI-SKID** and the **OFF** lights are on).

Pressed **ON** - Anti-skid system is energized on ground. Switch is left in ON position during flight. Main gear downlock switch removes power from anti-skid system after take-off.

**OFF** Caution Light - Lights come on when main gear is down and locked and:

1. ANTI-SKID pushbutton is pressed off.
2. Electrical failure exists in control system.
3. Control system produces full brake release signal for more than one second.
4. Fault exists which may cause lock-up of one main wheel during deceleration.



**Figure 5-16. Anti-Skid Control System - Schematic**

## **NOSE WHEEL STEERING SYSTEM**

The NWS (Nose Wheel Steering) system includes a rack and pinion steering mechanism actuated by two coaxial hydraulic actuators, controlled and monitored by an electro-hydraulic servo system, which include's hydraulic control valve manifold and the ECU (Electronic Control Unit).

The NWS system provides: active steering angle of  $\pm 60^\circ$  and towing angle of  $\pm 100^\circ$  without need to manually disconnect the nose gear torque-links. The pilot controls the steering system by pedals, over an angle of  $\pm 3^\circ$  or by a handwheel, located on the pilot console, over an angle of  $\pm 60^\circ$ . The ON-OFF, NWS switch allows activation the NWS system, or to switch it off and remain with the NLG in a free-swivel mode, which provides shimmy damping.

PEDAL DISC pushbutton on the handwheel allows disconnection of nosewheel steering by the pedals (such as for flight controls check).

The NWS modes of operation are:

Active steering - normal mode on ground

Actively centered mode - the system is actively maintaining the nosewheel in a centered position during approach and take-off when both NLG weight-on-wheel switches are in air-position

By-pass mode - the two actuators are hydraulically interconnected by the bypass valve if NWS switch is OFF, or as a result of a hydraulic pressure failure. The bypass mode is the normal mode after NLG retraction.

Any single failure in the NWS system is detected by the monitoring channel which switches the system to the bypass mode (fail-passive).

In this case the aircraft directional control is achieved differential braking and/or rudder control.

### **Caution Messages**

**NWS INOP** - Nosewheel is down and locked and nosewheel steering system is off

## **AIR BRAKES**

Four control surfaces on each wing, rotating upwards by hydraulic power for activation, serve as air brakes. The surfaces have a deployed angle of  $45^\circ$ . The inboard pair is fed from the right hydraulic system and the outboard pair is fed from the left hydraulic system. The

actuators have mechanical lock for stowed position.

Ground operation includes all four surfaces and is achieved by GROUND A/B switch with ON/OFF positions. When deployed, the air brakes dump excess lift from the wing when aborting take-off or on landing. The ground air brakes differs from flight air brakes operation by faster rate of extension and the fact that they pop out only after the aircraft touches the ground.

To prevent erratic extension and retraction of the ground air brakes during bouncy landing, self holding relay bypasses the landing gear ground contact switch and holds the air brakes extended.

Placing GROUND A/B switch in ON position causes all surfaces to extend, if aircraft is on ground and thrust lever position is below MAX CRUISE; **FLIGHT** and **GROUND AIRBRAKES** messages come on. Moving thrust lever beyond MAX CRUISE (such as for go-around) causes all surface to retract.

Flight operation is achieved by FLIGHT A/B RETRACT / EXTEND switch. The switch is spring-loaded to OFF position. Asymmetry protection is operative once the switch is released and permits extension only if all four surfaces (inboard two surfaces of each wing) are out of retracted position. They may be extended, in flight, to increase drag at any airspeed.

**FLIGHT AIRBRAKES** message comes on whenever the flight air brakes are out of retracted position.

### Advisory Messages

**FLIGHT AIRBRAKES** - Flight (inboard) airbrakes extended.

**GROUND AIRBRAKES** - Ground (outboard) airbrakes extended