

LANDING CONFIGURATION WARNING

The “Too low gear” aural warning through Enhanced Ground Proximity Warning System (EGPWS) is heard if:

- Any landing gear is not down and locked
- Radio altitude less than 500 feet above ground level, and the indicated airspeed less than 190 knots

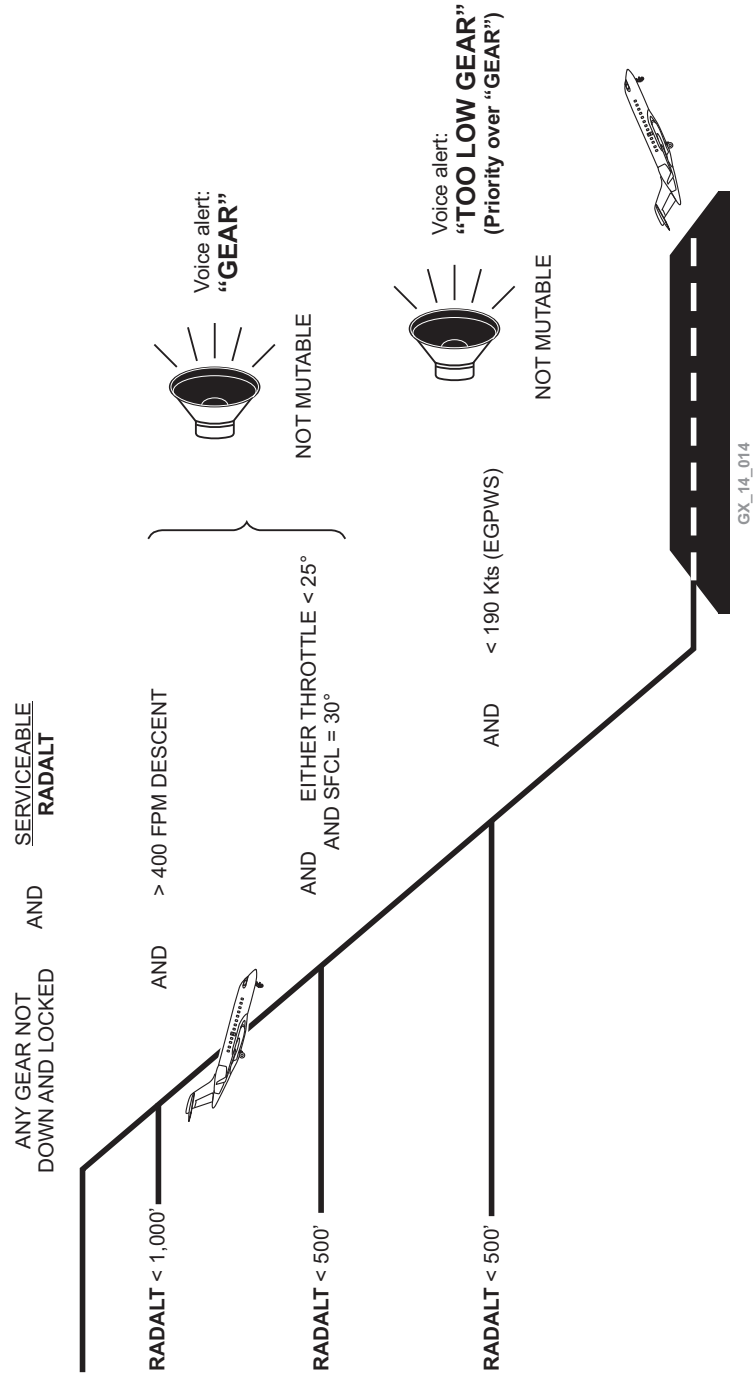


Gear Warning Horn

The gear warning horn has been designed with a logic circuit that maximizes protection against a possible gear up landing while minimizing nuisance warnings. On approach, a gear warning horn will normally sound if any gear is not down and locked. Various speed, altitude and configuration conditions govern whether or not the normal gear warning horn is either inhibited, mutable or not mutable. The following tables detail the general logic behind gear horn operation.

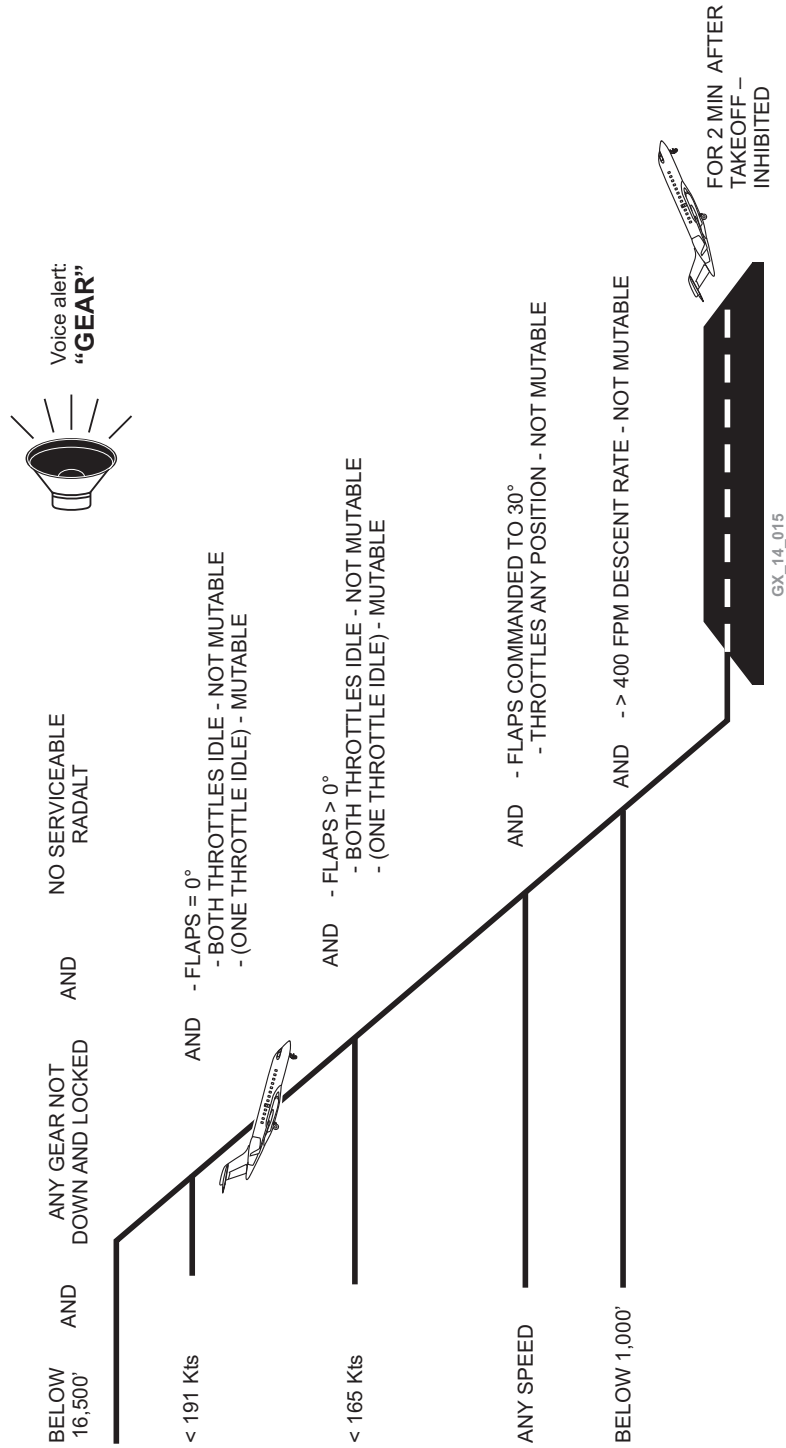
LANDING GEAR HORN WARNING LOGIC

Primary Mode



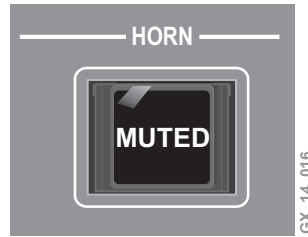
LANDING GEAR HORN WARNING LOGIC

Secondary Mode



GEAR WARNING HORN “MUTED” SWITCH

A “MUTED” switch is located on the landing gear control panel. It is used to disable the gear warning horn under certain airplane configurations with both radio altimeters inoperative. The “MUTED” switch is inoperative with at least one radio altimeter valid.



The gear warning horn is not mutable under any of the following conditions:

- When activated by flap position
- Both throttles at idle
- Radio altimeter(s) valid

The landing gear warning horn function is restored after it has been muted if any of the following conditions are met:

- Both throttles are advanced above idle
- All the landing gears are down and locked
- Flaps are commanded to 30°

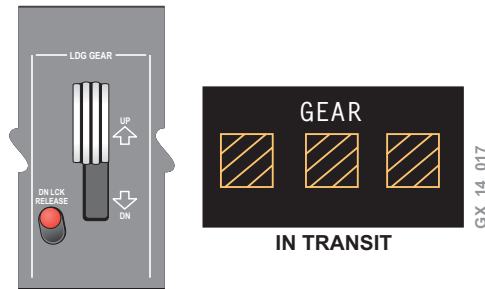
RETRACTION AND EXTENSION SYSTEM

Normal retraction or extension of the landing gear is initiated by landing gear control lever selection. The retraction or extension signal is sent to the LGECU which monitors various landing gear proximity sensing inputs and weight-on-wheels (WOW) inputs. If the correct parameters are met, the LGECU sequentially energizes the appropriate selector valves to retract or extend the landing gear using hydraulic pressures No. 2 and No. 3.

LANDING GEAR RETRACTION

For landing gear retraction, once the airplane is airborne (i.e.: weight-off-wheels, nosewheel centered), the LGECU commands and monitors the following events:

- Landing gear control lever solenoid downlock releases to permit up selection of the landing gear control lever



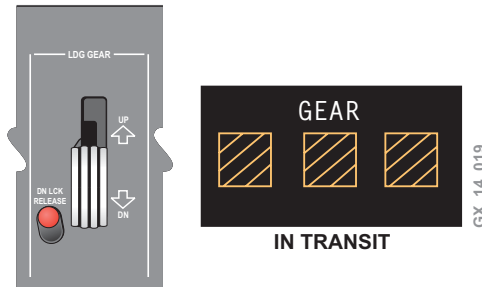
- The door selector valve is energized and hydraulic system No. 3 powers all door uplocks and door actuators
- When the doors indicate open, the nose landing gear and main landing gear selector valves are energized
- Hydraulic system No. 3 releases the respective downlocks and completely retracts the nose landing gear (extension/retraction actuator). Hydraulic system No. 2 will power the main gear extension/retraction actuators and completely retracts the main landing gear assemblies. The side brace actuator is energized only to disengage the internal downlocks during retraction
- The Brake Control Unit will command the brake control valves (for approximately 4 seconds after takeoff) to pressurize the brakes and stop main wheel rotation
- Uplocks of the nose landing gear and the main landing gear are engaged to secure the landing gears in the retracted position
- When uplock is achieved, the nose and main landing gear doors selector valves are energized to close the nose and main landing gear doors. The gear selector valves are de-energized when the gear is up and locked



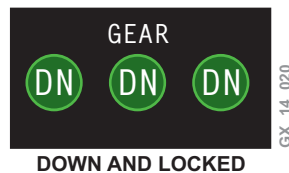
LANDING GEAR EXTENSION

For landing gear extension, the LGECU commands and monitors the following events:

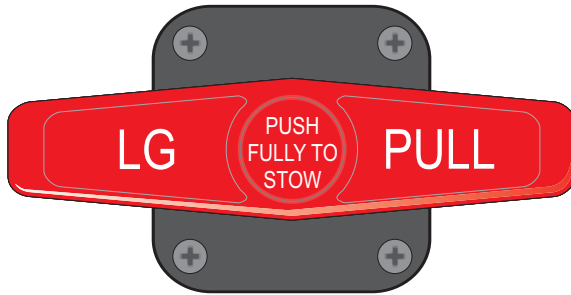
- Landing gear control lever is manually selected to the DN position



- The door selector valve is energized and hydraulic system No. 3 powers all door uplocks and door actuators
- When the doors indicate open, the nose landing gear and main landing gear selector valves are energized
- Hydraulic system No. 3 releases the respective uplocks and extends the nose landing gear (extension/retraction actuator). Hydraulic system No. 2 will power the main extension/retraction actuator to extend the main landing gear and at this time the side brace actuator remains de-energized
- When the main landing gear is almost down (sensed by proximity) the extension/retraction actuator powered by hydraulic system No. 2 is de-energized. At the same time, the main landing gear (side brace actuator) is energized, using hydraulic system No. 3 to power the gear to the downlock position
- Downlocks of the nose landing gear and the main landing gear are engaged to secure the landing gears in the extended position
- When downlock is achieved, the nose and main landing gear doors selector valves are energized to close the nose and main landing gear doors. The nose and main gear selector valves remain energized to keep a positive pressure on the downlock mechanisms



Landing Gear Manual Release Handle



LG Manual Release Handle

- To manually extend the landing gear: Pull the handle through all detent positions until the handle locks in the full extended position.
- To reset the manual release system: Keep a slight pressure on the handle to prevent the handle from rapidly returning to stow while pushing in the "PUSH FULLY TO STOW" button.

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MANUAL LANDING GEAR EXTENSION

Should a failure occur in the normal actuation system, landing gear extension is possible by pulling the landing gear manual release handle located on the center pedestal in the flight compartment. The design configuration allows the system to be restowed to its initial position under any conditions by simply reversing the manual release handle movement.

NOTE

Manual landing gear extension is carried out with the landing gear control lever in the down position.

For manual extension procedures, refer to the non-normal procedures, MANUAL LANDING GEAR EXTENSION in the Airplane Flight Manual CSP 700-1.

NOTE

- 1) The landing gear manual release handle will ratchet from the stow to the extend position upon selection. The handle will lock in a given detent position if released during extension only.
- 2) When the handle is selected to stow following a full extension, the handle will not ratchet (lock) if released. When the PUSH FULLY TO STOW button is pushed, care should be taken to guide the handle (under spring tension) to its fully stowed position.

Manual Release Sequence

The following is the sequence of events which occur during manual landing gear extension:

- Landing gear manual release handle PULL to full extension
- System No. 3 shutoff valve blocks pressure to all hydraulically operated gear door uplocks and the landing gear uplocks
- Dump valve opens, transferring hydraulic system No. 3 pressure from all gear and door actuators to return
- The main gear doors and uplocks are mechanically released



- Both main landing gear extension/retraction actuators are pressurized by hydraulic system No. 2 (through the action of the system No. 2 alternate power valve) to assist main gear downlock

Within approximately one to two seconds following full extension of the manual release handle:

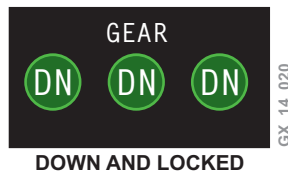
- The nose landing gear door and gear uplocks are mechanically released



- The nose landing gear is permitted to free-fall and is assisted by springs within the drag brace to achieve downlock

NOTE

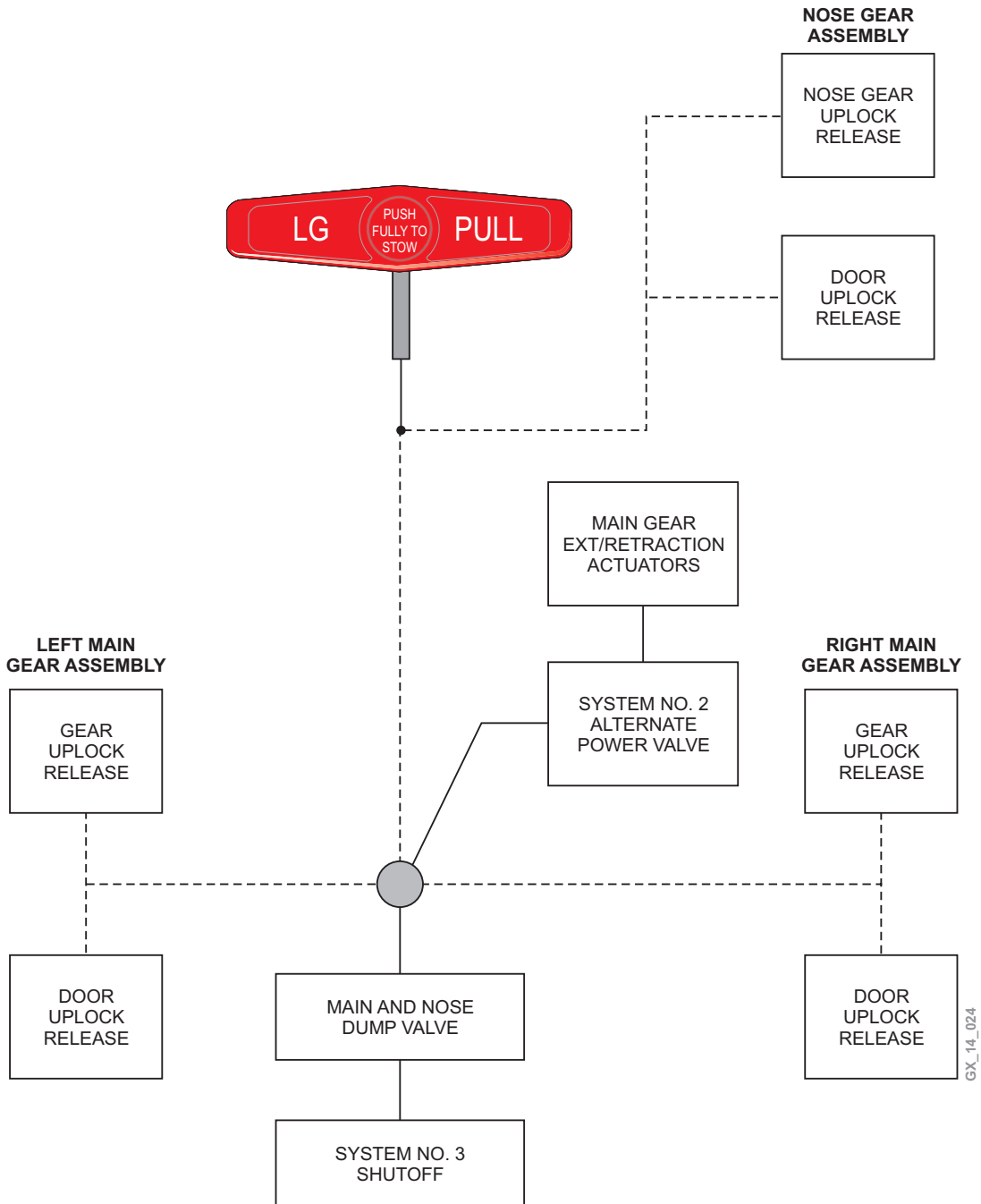
With all gear indicating down and locked, the left and right main and nose gear doors, and nose door remain open. L-R MAIN GEAR DOOR and NOSE DOOR caution message will be displayed.



- Upon successful completion of manual gear extension, the manual release handle is to remain fully extended

Landing Gear Manual Release Schematic

The following schematic is an overview of the manual gear lowering system.



NOSEWHEEL STEERING SYSTEM

The steering control system is electrically controlled and hydraulically actuated.

The nosewheel steering system is armed from a switch on the landing gear control panel in the flight compartment. It is activated once the WOW signal and nose landing gear down-and-locked signals are present. Steering commands are input to the Steering Control Unit (SCU) through the pilot's hand wheel (full authority $\pm 75^\circ$) and/or the rudder pedals (limited authority $\pm 7.5^\circ$).

NOTE

If handwheel and rudder pedal input commands are received at the same time, the SCU will sum these inputs to a maximum of $\pm 75^\circ$.

Nosewheel position feedback is provided to the SCU by two transducers mounted on the steering actuators. The SCU controls an electrohydraulic servovalve in the hydraulic manifold (mounted on the nose gear assembly), which ports hydraulic pressure to each of the steering actuators as required. The steering actuators (mounted on the main fitting of the nose gear) operate in a push/pull manner to rotate the steering collar. Mechanical torque links are provided to transmit the movement of the steering collar to the nose wheels.

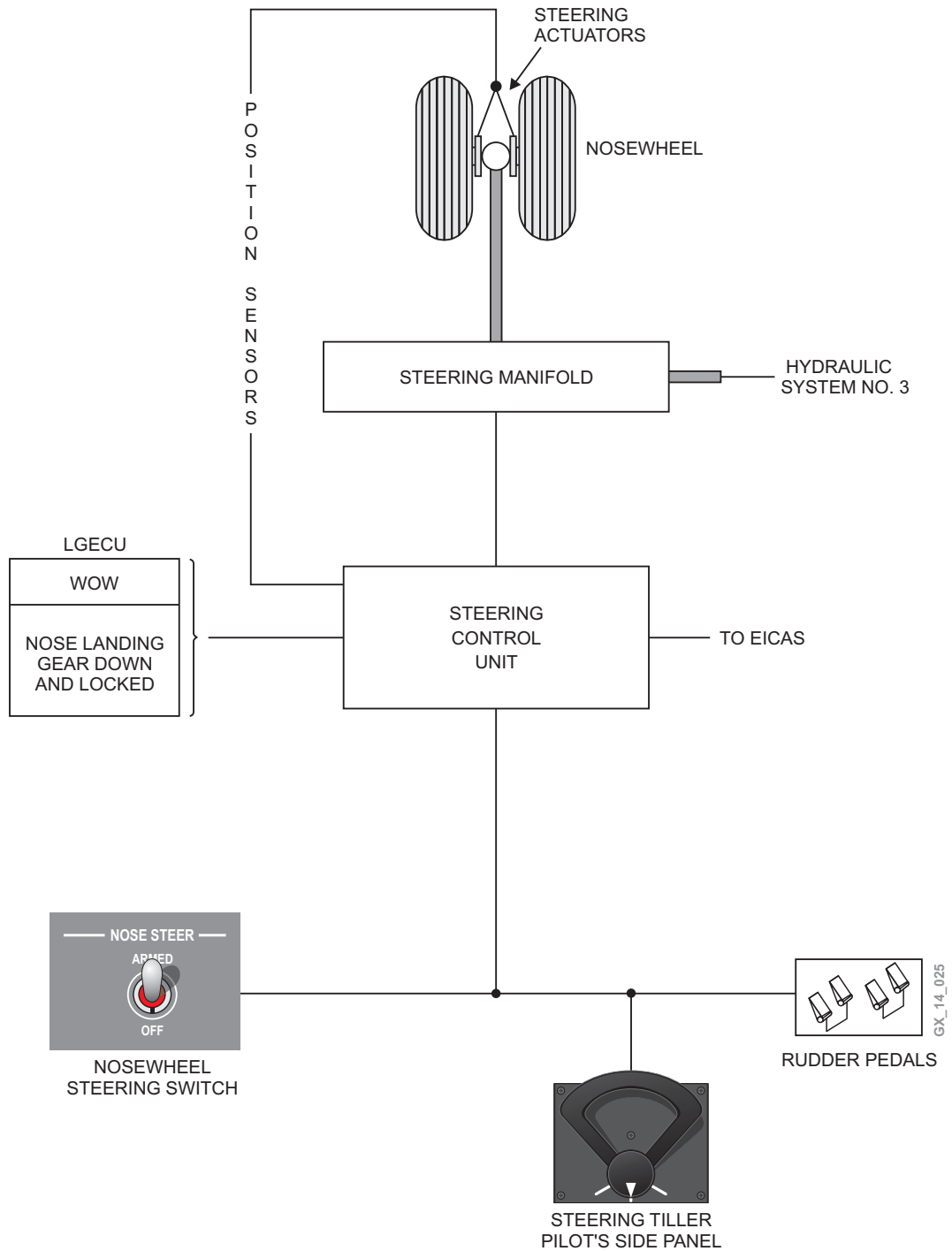
The steering commands are processed by the SCU and hydraulic system No. 3 pressure is routed through the system when the landing gear is selected down.

In the air mode, the nose wheel is centered electrically by the SCU and mechanically by centering cams as the shock strut extends under its own weight.

When the steering system is disarmed or with no WOW signal, the nosewheel steering will revert to free caster and shimmy damping to ensure stability within the nosewheel circuit. In the free caster mode of operation, steering is accomplished only through differential braking and differential thrust.

The SCU continuously monitors the nosewheel steering system and any fault within the system will be displayed as a caution message. Fault detection will result in nosewheel steering system shutdown and the system will then operate in free caster mode of operation.

NOSEWHEEL STEERING SCHEMATIC



BRAKE CONTROL SYSTEM

The main wheels have carbon disk brakes. They are controlled by the Brake Control Unit (BCU) using an antiskid system with autobraking capability.

Refer to BRAKE CONTROL SCHEMATIC of this chapter to support the information that follows.

The brake control system provides hydraulic services to the outboard (hydraulic system 2) and the inboard braking systems (hydraulic system 3). Hydraulic system 3 will also provide pressure to all brakes via shuttle valves for parking/ emergency brake application. Brake systems 2 and 3 have an accumulator (backup) for emergency operation in case of hydraulic system failure. Hydraulic volumetric fuses are installed at each brake supply line to provide system protection against line rupture.

Two brake shutoff valves control the inlet pressure to the brake control valves and are used to:

- Turn off hydraulic power to the brake control valves during flight
- Shut off pressure in the event of uncommanded braking

The hydraulic inlet porting of the brakes has a shuttle valve. Brake shuttle valves are used to isolate brake control function from park/emergency brake function. Four shuttle valves are used, one for each brake. The shuttle valve provides the higher of the two input pressures (either brake control/antiskid or parking/emergency brake) to the brake.

Pilot and/or co-pilot brake input is provided by four brake pedal transducers. The signal is processed by the electronic Brake Control Unit (BCU) and commands appropriate brake pressure. If a failure or unreliable signal is present, a pilot/co-pilot brake fault message will display on EICAS. Wheel speed is monitored by four transducers installed in each main wheel axle and these signals are used for antiskid control valve operation. The brake and antiskid control system interfaces with the BCU for autobrake capability.

The BCU provides the brake control system with built-in-test equipment (BITE) and the following protections:

- Gear retract braking (stops wheel rotation, after takeoff)
- Inhibiting normal gear braking in flight
- Independent wheel antiskid
- Locked wheel, and touchdown protection

In the air mode (no WOW signal) the BCU configures the airplane to a full brake dump to prevent wheel lock-up on touchdown. The touchdown protection system is canceled to allow modulated braking once a predetermined wheel spin-up signal is present or airplane WOW is detected. The BCU will cancel hydraulic power to any wheel which is sensed to be at an abnormal deceleration rate (i.e. locked wheel).

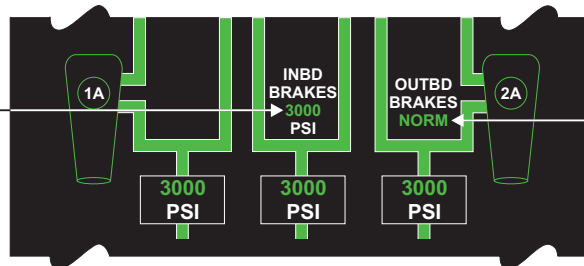
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The dual brake control system independently controls the braking of each main wheel by modulating the pressure outputs of the appropriate brake control valve. This modulation is controlled by the BCU which monitors individual wheel speed and deceleration through the wheel speed transducers.

Available inboard and outboard brake pressure supply is continuously monitored and displayed on the EICAS hydraulic synoptic page, and any abnormal brake pressure detected is displayed on EICAS in the form of a message.

INBOARD BRAKE PRESSURE Readout
Displays in increments of 50 psi, pressure in the inboard brake system.

- **Green** – between 1,800 and 3,200 psi.
- **Amber** – \leq 1,800 psi.
- **White** – $>$ 3,200 psi.



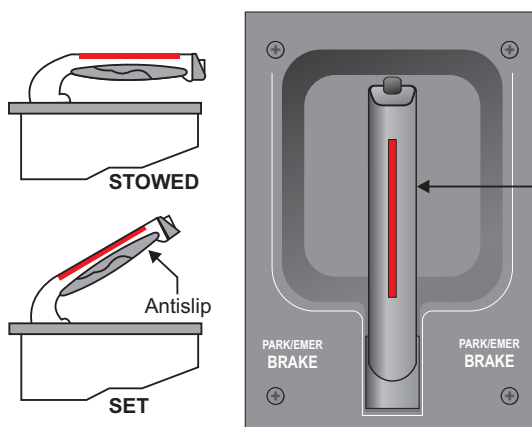
OUTBOARD BRAKE PRESSURE Readout
Displays pressure in the outboard brake system.

- **NORM**
Green – $>$ 1400 psi
- **LO PRESS**
Amber – \leq 1400 psi

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PARK/EMERGENCY BRAKE

Selection of the PARK/EMER BRAKE handle mounted on the center pedestal will allow the flow of hydraulic system No. 3 pressure to the shuttle valves of all brake assemblies and apply the brakes. Mechanical linkages, connected by a push/pull cable, transfer manual inputs from the parking brake lever to the parking brake valve. For parking brake application extend the handle to its full extended (lock) position. A pressure switch provides a parking brake applied signal to the BCU and messages to the EICAS.



PARK/EMER BRAKE Handle

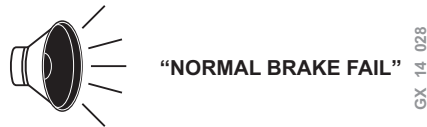
- Direct pull to full up position will lock the handle (in the extend position) for parking. The handle must be pulled up prior to pressing the parking brake button to disengage the locking mechanism.
- Gradual pull will provide mechanical proportional braking in an emergency condition to stop the airplane if required.

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Emergency proportional braking can also be commanded through the same handle. No antiskid protection is available when emergency braking is selected. Emergency brake application is based on the amount of travel selected by the pilot. A slow steady pull is recommended for best results.

Flight Compartment indication of hydraulic No. 3 pressure (Hydraulic synoptic page), provides indication for normal brake pressure, parking brake, hydraulic No. 3 failure, or emergency brake application.



If the normal brake system fails, it will be accompanied by a warning voice advisory and a warning NORM BRAKE FAIL message.

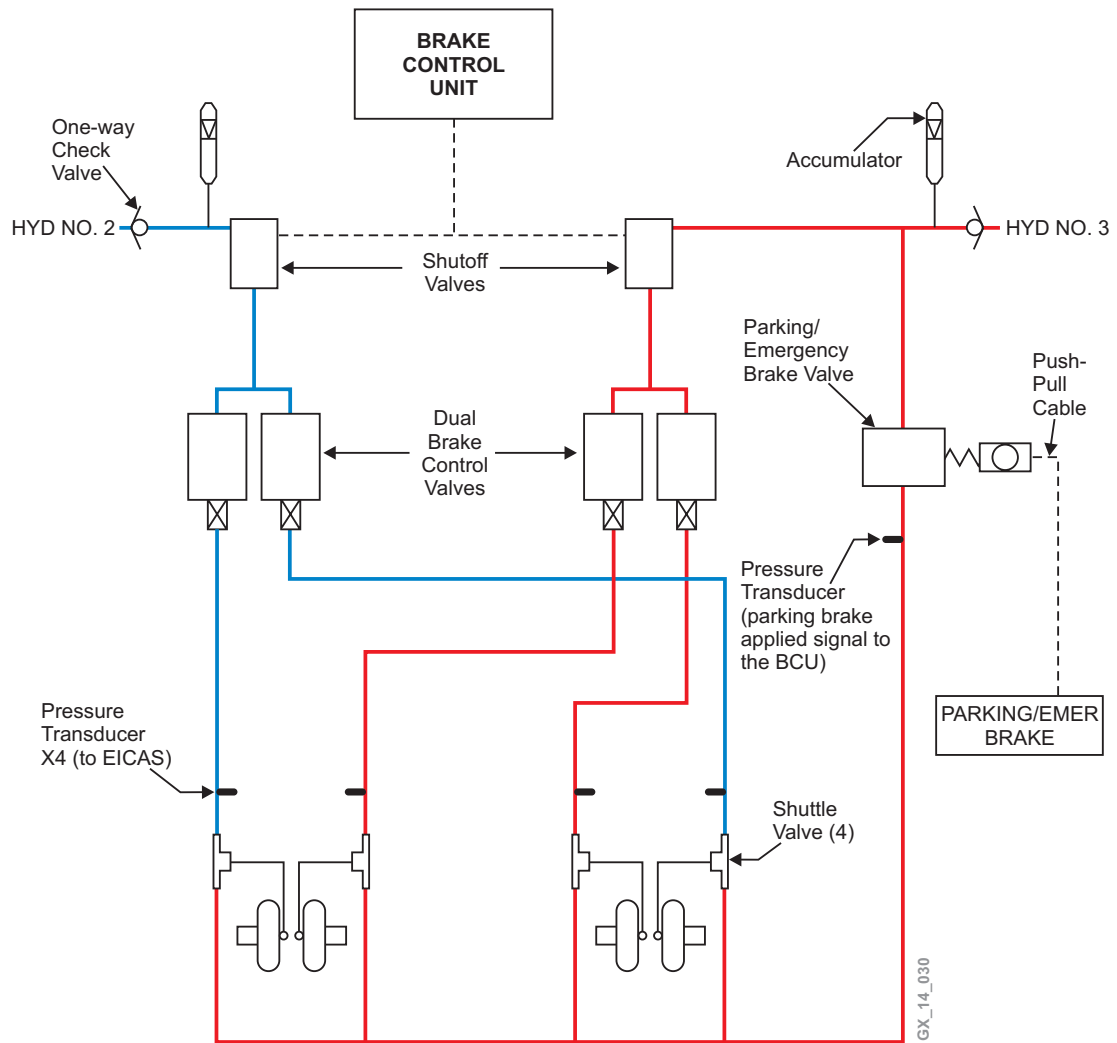
Park/Emergency Brake Takeoff Configuration

A takeoff configuration warning in the form of a voice advisory NO TAKEOFF and a red EICAS message PARK BRAKE ON will be annunciated if the PARK/EMER BRAKE handle is set and the throttles advanced for takeoff.



BRAKE CONTROL SCHEMATIC

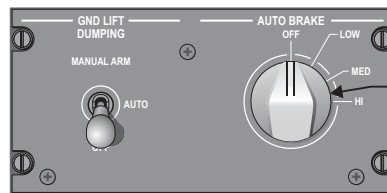
The following schematic is an overview of the components contained within the brake control system.



AUTOBRAKE SYSTEM

Autobrake function is provided for landing only. A flight compartment mounted AUTOBRAKE switch provides selection of three deceleration levels and an OFF position. The switch is spring loaded to the OFF position when not activated or disabled. The three deceleration levels are indicated as LO, MED, and HI (4, 8 and 13ft sec²).

AUTOBRAKE PANEL



AUTOBRAKE Switch

- **OFF** – Inhibits the autobrake function.
- **LO, MED and HI** – Provides a controlled rate of deceleration based upon selection.

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Deceleration rates are calculated from the reference wheel speed. If the rate difference is more than a predetermined rate of knots, it will cancel the autobrake function and the switch will return to the OFF position automatically.

All of the following conditions must be met to “arm” the autobrake and hold the switch in the selected position:

- Switch selected to either LO, MED, or HI
- Airplane in the flight mode of operation (i.e.: WOW indicating air)
- No deploy command for the ground lift dump spoilers
- Brake pedal command for application travel less than 20%
- Wheel speed at zero velocity
- No autobrake or brake control faults

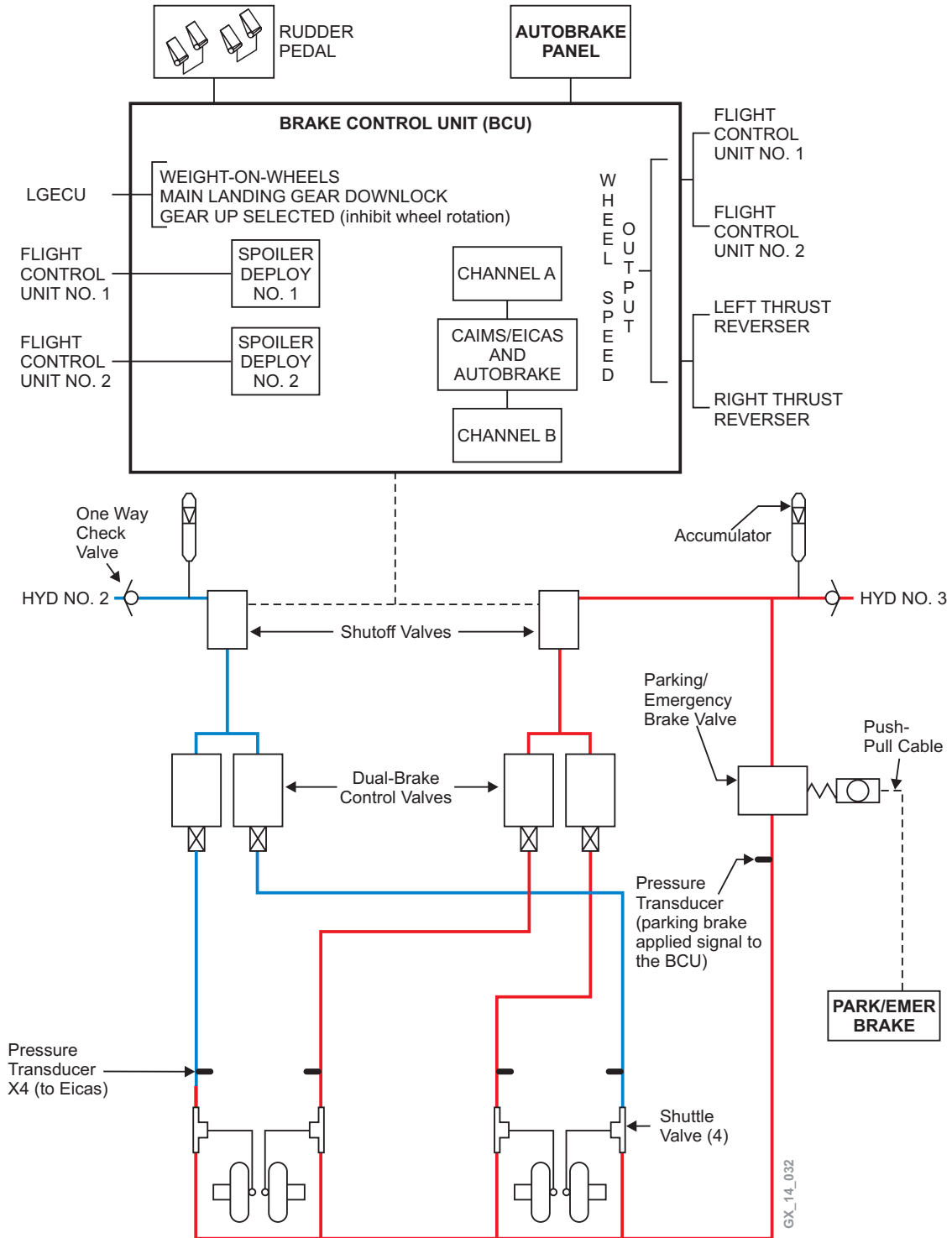
The autobrake will apply when all of the following conditions are met:

- Autobrake switch selected to either LOW, MED, or HI
- Both MLG weight on wheels for greater than 5 seconds or wheels spin-up greater than 50 knots
- Ground spoilers commanded to deploy

The autobrake will “disarm” (release the deceleration control and command the AUTOBRAKE switch to rotate to the OFF position) under any of the following conditions:

- Autobrake switch selected to OFF at any time
- Brake pedal application of greater than 20% travel
- Any autobrake or brake control fault during autobrake operation
- Wheel speed signal invalid (comparison of channel A and B of the BCU)
- Ground spoilers stowed after having been deployed

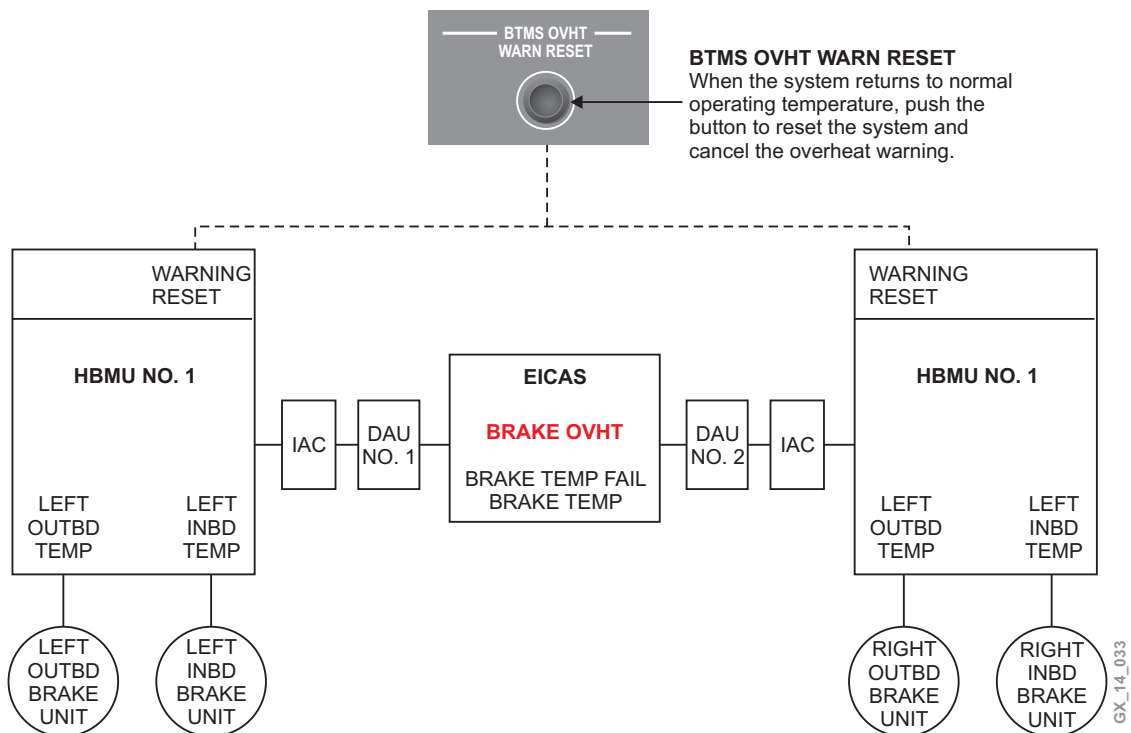
BCU INTERFACE SCHEMATIC



BRAKE TEMPERATURE MONITORING UNIT

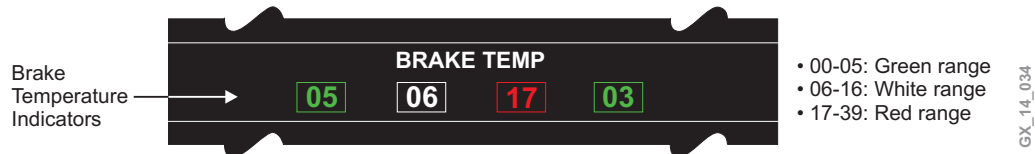
The Brake Temperature Monitoring System (BTMS) consists of four sensors each mounted in a brake housing and the Heater current/Brake temperature Monitor unit (HBMU). Brake temperature is indicated in the flight compartment on the EICAS status display when the landing gear is selected down. A BTMS OVHT WARN RESET button is located on the landing gear control panel and is used to reset the system when the condition no longer exists. Brake cooling charts will determine the safe range of operation. Refer to brake cooling chart in the Airplane Flight Manual CSP 700-1.

BRAKE TEMPERATURE MONITORING SCHEMATIC



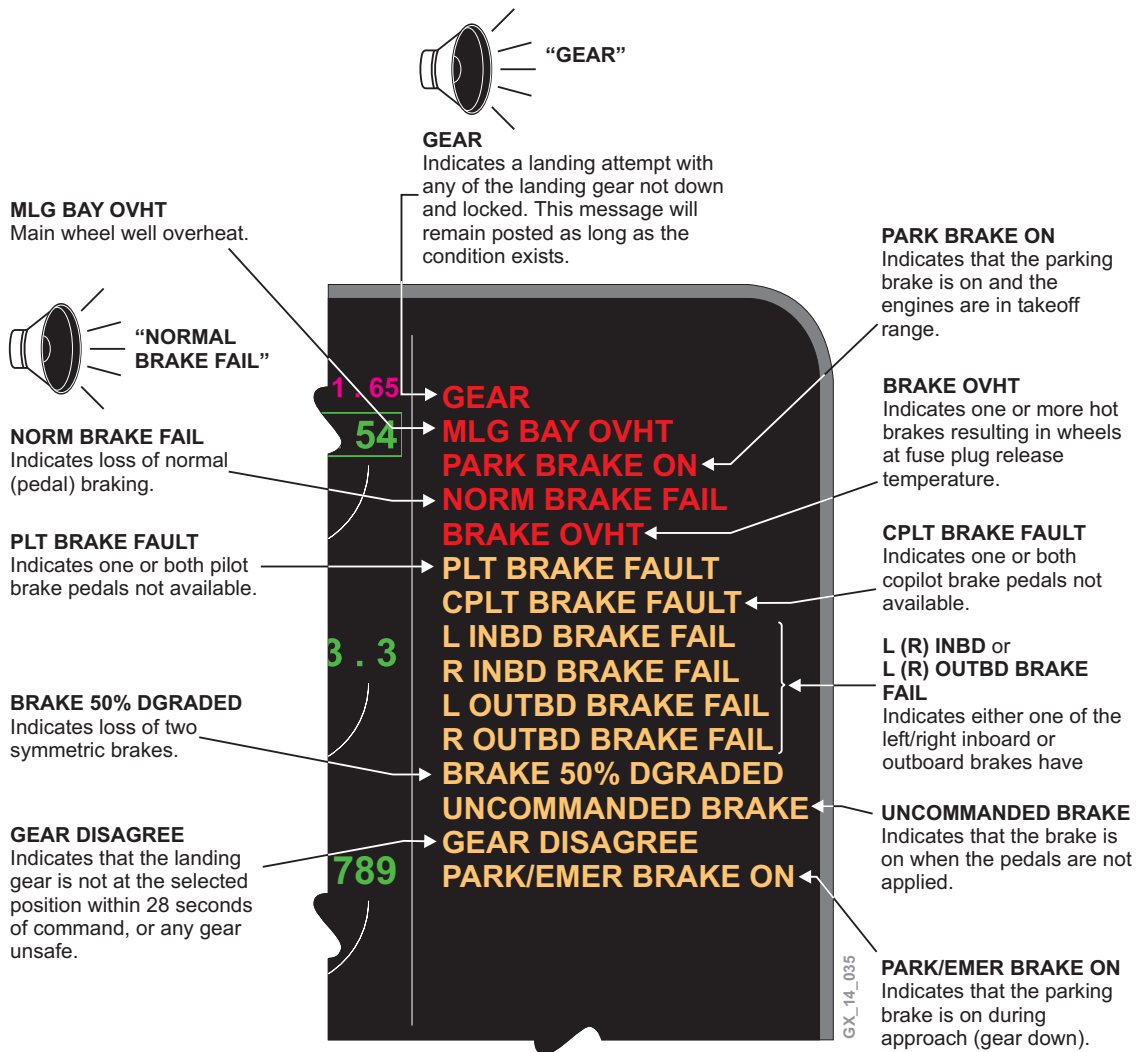
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The BTMU turns the corresponding display (on the EICAS status page) red when a brake overheat condition exists, and when the wheels are approaching the fuse plug release temperature. If fuse plug release occurs, the wheel assembly will release the tire pressure to atmosphere.

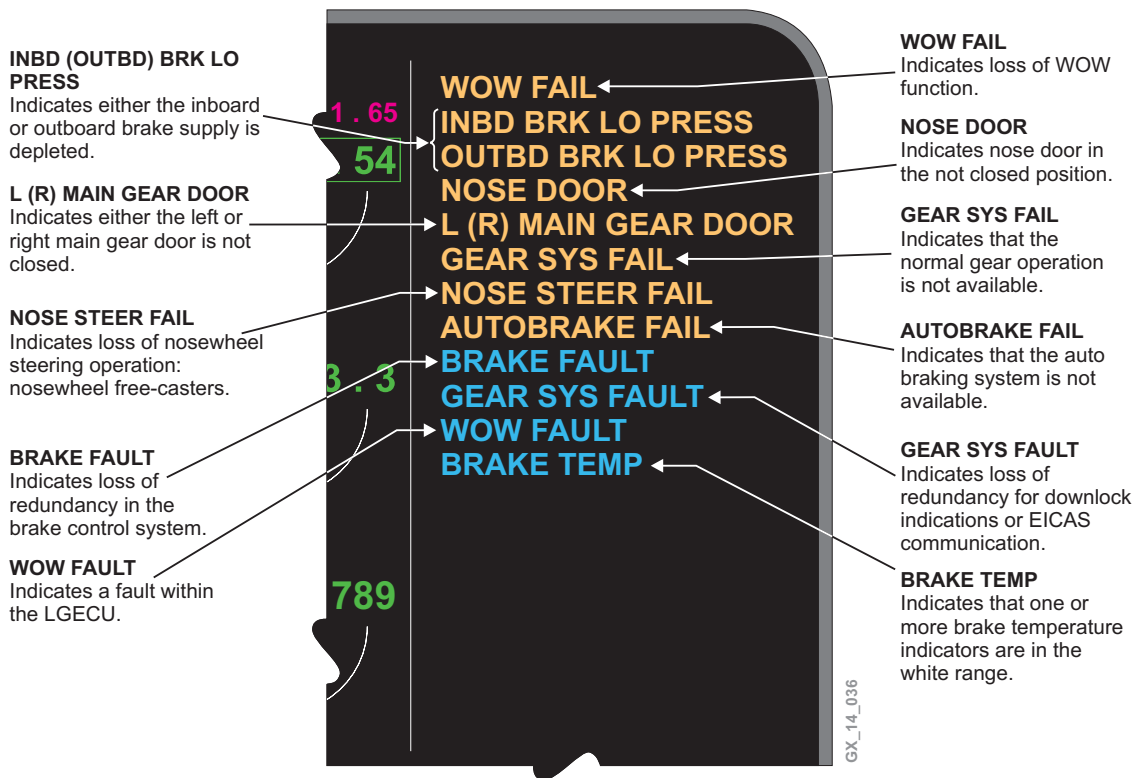


A red Warning EICAS message (BRAKE OVHT) accompanies the overheat condition. The spring-loaded BTMS OVHT WARNING RESET button is mounted to the left of the landing gear control handle. Once an overheat warning has been triggered, momentarily pressing the reset, removes the warning, provided the condition no longer exists (indicators showing below the red range).

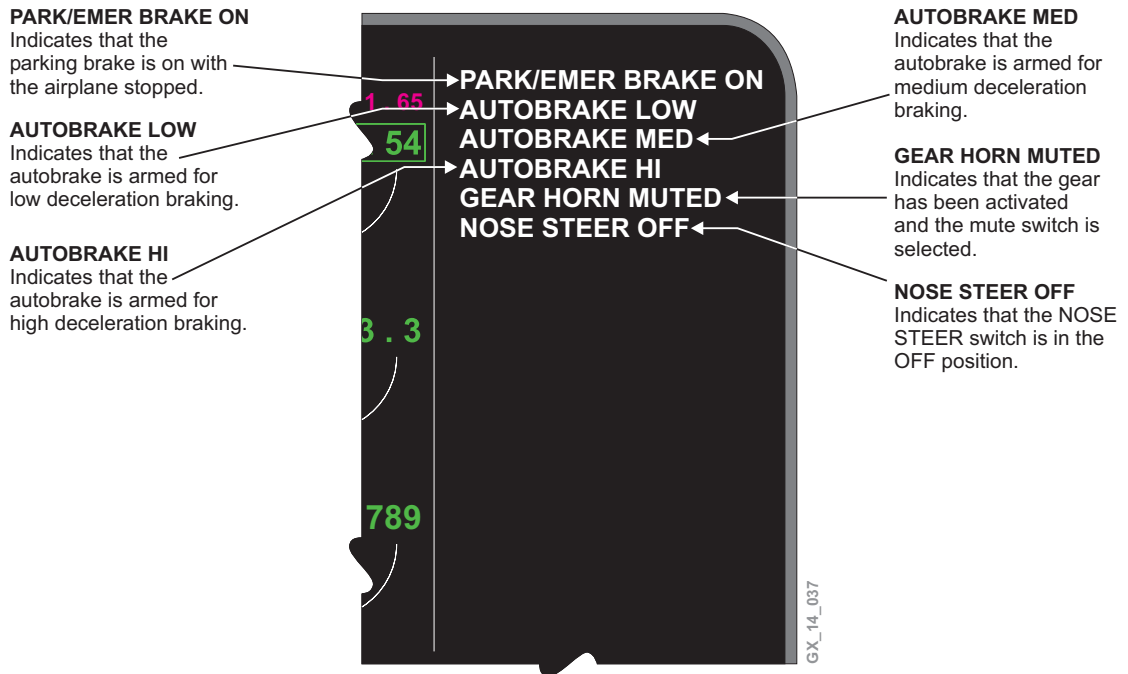
EICAS MESSAGES



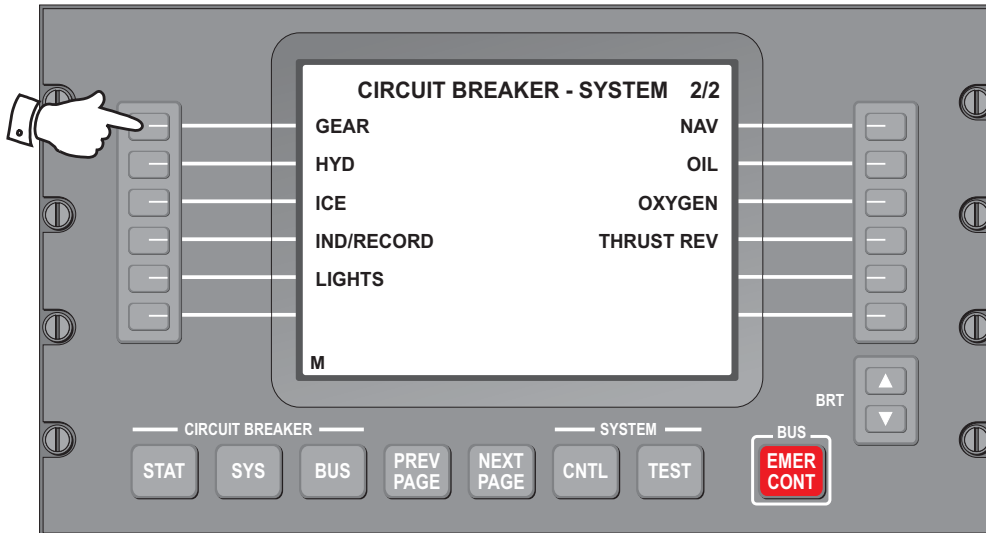
EICAS MESSAGES (Cont)



EICAS MESSAGES (Cont)



EMS CIRCUIT PROTECTION



CB - LDG GEAR SYSTEM 1/2		
BRAKE CTL CH A	DC 1	IN
BRAKE CTL CH B	BATT	IN
GEAR CTL A PWR 1	DC 1	IN
GEAR CTL A PWR 2	BATT	IN
GEAR CTL B PWR 1	DC 2	IN
GEAR CTL B PWR 2	BATT	IN

CB - LDG GEAR SYSTEM 2/2		
NOSE STEER PWR 1	DC 1	IN
NOSE STEER PWR 2	DC 2	IN

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