

LANDING GEAR  
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CHAPTER 15

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## GENERAL

The landing gear system is a retractable tricycle type consisting of two main landing gear assemblies and a steerable nose landing gear assembly. Each assembly is equipped with a conventional oleo-pneumatic shock strut. On the ground, all three landing gear assemblies are secured with gear locking pins. The landing gear bays fully enclose the gears when retracted.

Normal extension and retraction is electrically controlled by the Landing Gear Electronic Control Unit (LGECU) and hydraulically operated by systems 2 and 3.

Emergency extension of the landing gear system is enabled through a manual release handle located in the flight compartment.

Each landing gear assembly has twin wheels and tires. The main wheels have hydraulically powered and electrically actuated carbon brakes controlled through a brake-by-wire system. Main landing gear overheat detection is available. Anti-skid protection and automatic braking is provided.

The main and nose landing gear assemblies use proximity sensors to provide air and ground sensing. This is accomplished by two sensors (referred to as Weight-On-Wheels or WOW) on each assembly.

All hydraulically actuated doors, uplocks, downlocks and nose shock strut (centering) use sensors to determine their position for gear operation.

Landing gear status and position is visually displayed on EICAS and aurally annunciated in the flight compartment. The anti-skid, nosewheel steering indication and status are also displayed on EICAS and interface with the central aircraft maintenance information system or CAIMS for failure detection and isolation. Brake temperature monitoring is displayed on the EICAS status display.

## MAIN LANDING GEAR ASSEMBLY

Each main landing gear assembly consists of:

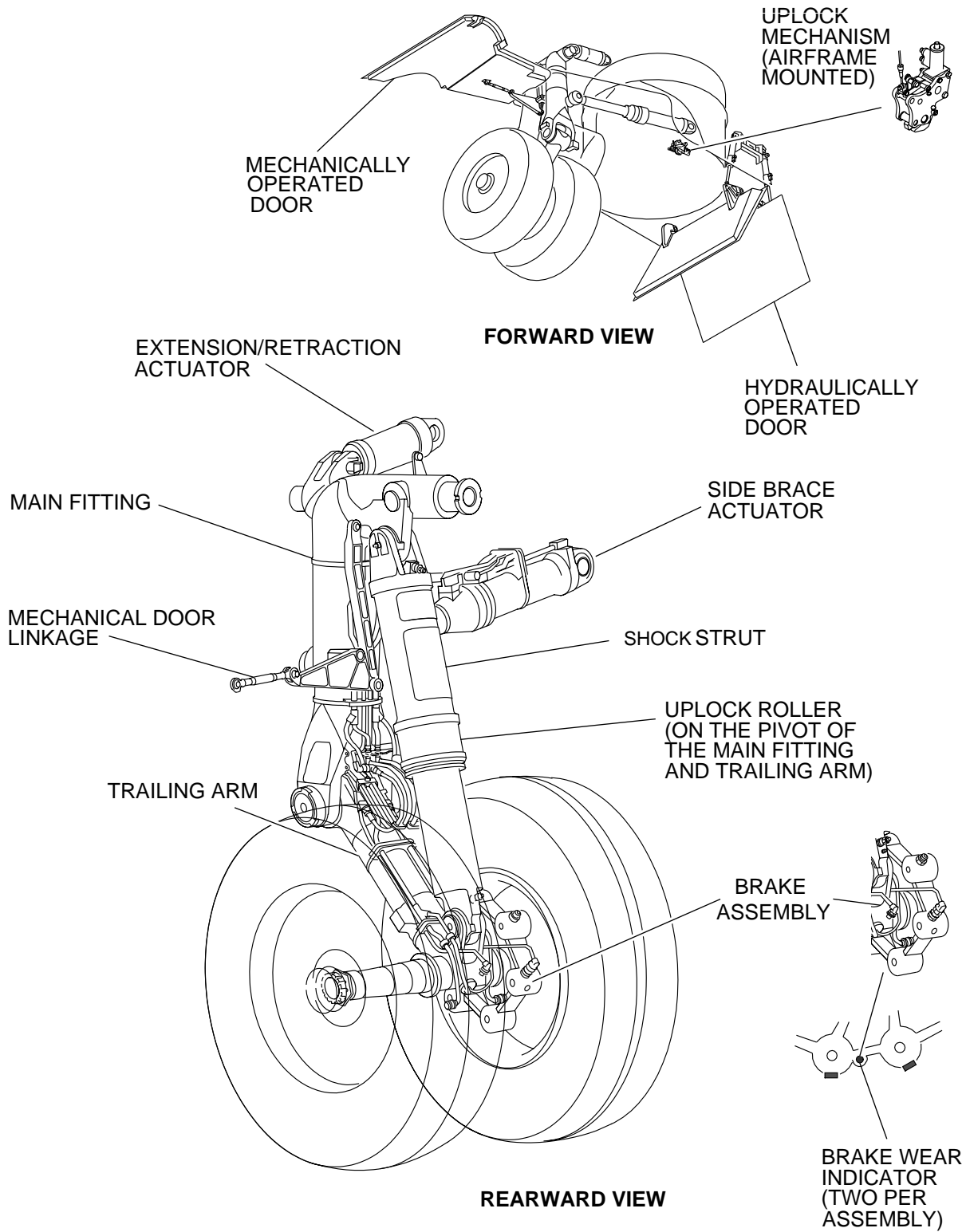
- Main fitting.
- Trailing arm.
- Side brace actuator.
- Extension/retraction actuator.
- Uplock mechanism.
- Oleo-pneumatic shock strut.
- Door linkages.

Each main gear retracts inward and up into the main landing gear bay and is mechanically held in the retracted position by an uplock mechanism. The gears are mechanically locked in the extended position by internal locking side brace actuators. During normal operation, the uplock and downlock mechanisms are hydraulically actuated to release the main gears.

Hydraulic System 3 is maintained to the side brace actuators while the gear is extended. This serves as a secondary safety feature.

# LANDING GEAR

## MAIN LANDING GEAR SCHEMATIC



GF1510\_001

**MAIN LANDING GEAR SCHEMATIC (CONT'D)**

The main landing gear is completely enclosed by four doors. Two outboard doors (one for each main) hinged to the belly fairing are mechanically linked outboard on each main gear assembly and positioned to the open and closed position with each main gear operation. Two inboard doors (one for each main) are hinged to the keel (centre) beam of the airplane. The inboard doors are hydraulically operated to open on selection of gear retraction or extension and to close when the gear is fully up or down. The inboard doors are manually deployed by the manual release system and can be opened for ground maintenance operation when required.

Hydraulic system No. 3 is used to release all gear and door uplocks, downlocks, nose gear actuator, (extension and retraction) and main gear side brace actuators during normal extension. The main gear extension/retraction actuators (used to raise and lower the main gear) are powered by hydraulic system No. 2 and will also assist gear extension for manual gear operation. A manual extension of the gear can be achieved by pulling the landing gear manual release handle located on the pedestal in the flight compartment. For operation, refer to MANUAL LANDING GEAR EXTENSION in this Chapter.

The main gear hydraulically-actuated doors, sequencing and position sensing, are controlled and continuously monitored by the LGECU. Any fault or position deviation detected is displayed on EICAS.

**Wheel Assemblies**

The airplane has four (carbon type) braked main wheels, two per main gear and two free rolling nose wheels. The main and nose wheels are fitted with tubeless tires. Four heat sensitive fusible plugs are installed in each main wheel to release excessive air pressure caused by heat build-up in the wheel/tire assembly.

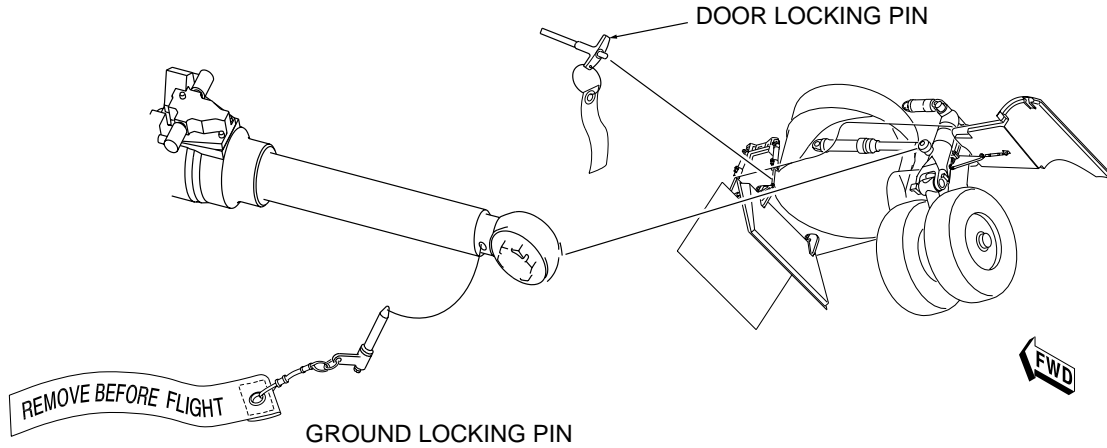
Two brake wear indicator pins are installed on each brake assembly to provide a visual indication of brake wear remaining in the disc stack. When the end of the wear indicator pin is flush with the top of the indicator housing, the brake must be serviced.

**NOTE**

The brake wear indicator pins must be checked with the parking brake applied and No. 2 and No. 3 hydraulic systems pressurized. It can also be checked with both systems 2 and 3 pressurized and normal brakes applied. However, this second method requires two people to do the check.

### MAIN GEAR/DOOR DOWNLOCK SAFETY PINS

A downlock safety pin is installed at the end of the side brace assembly to secure the main landing gear in position while on ground. A door locking pin is installed on the inboard door actuator assembly, if required during maintenance operations.



### MAIN LANDING GEAR OVERHEAT DETECTION

The main landing gear overhear detection system consists of single loop heat sensing elements, installed in both main landing gear bays. The overhear detection system continuously monitors the heat sensing elements in the main landing gear area. Any overhear condition or system fault detected by the monitoring system is annunciated on EICAS in the form of a main landing gear bay overhear warning message or main landing gear overhear fail caution message. Refer to FIRE PROTECTION Chapter 9 for additional information on main landing gear bay overhear fault and fail messages.

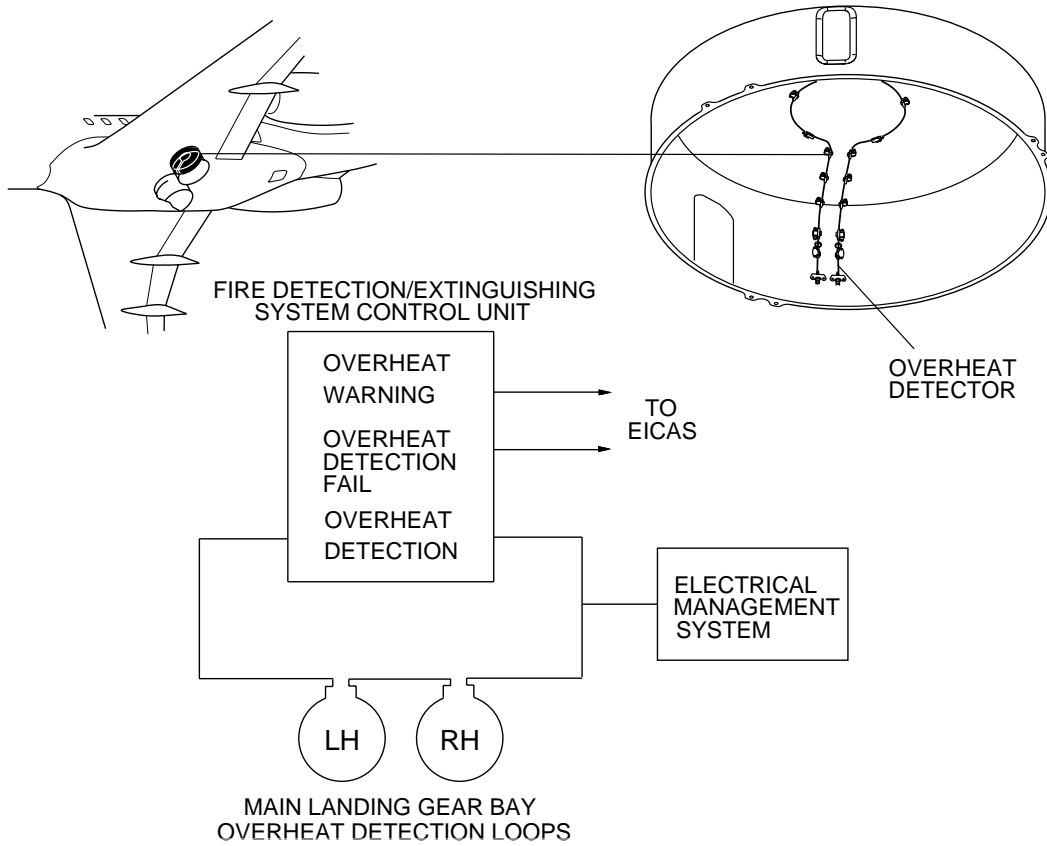
If the main landing gear system detects an overhear condition, it will be accompanied by a warning voice advisory as follows:



"GEAR BAY OVERHEAT"

The main landing gear overhear detection system and fault conditions may be tested through the Electrical Management System (EMS) in the flight compartment (refer to AURAL/VISUAL WARNING SYSTEM Chapter). Test result messages are displayed on EICAS.

LANDING GEAR BAY OVERHEAT SCHEMATIC



GF1510\_004

## NOSE LANDING GEAR ASSEMBLY

The nose gear assembly consists of:

- Oleo-pneumatic shock strut (main fitting).
- Hydraulic extension/retraction actuator.
- Uplock mechanism.
- Drag brace including a downlock mechanism.
- Set of nose gear doors and linkages.

The nose gear bay is completely enclosed by an aft door mechanically linked to the nose gear and by two forward doors hydraulically actuated by a mechanism located in the nose landing gear bay area. During normal operation the forward doors open only during gear retraction and extension (transit) operation. The forward doors are manually deployed by the manual release system and can be opened for ground maintenance operation when required. The aft door is mechanically linked to the nose gear and positioned to the open and closed position with each main gear operation.

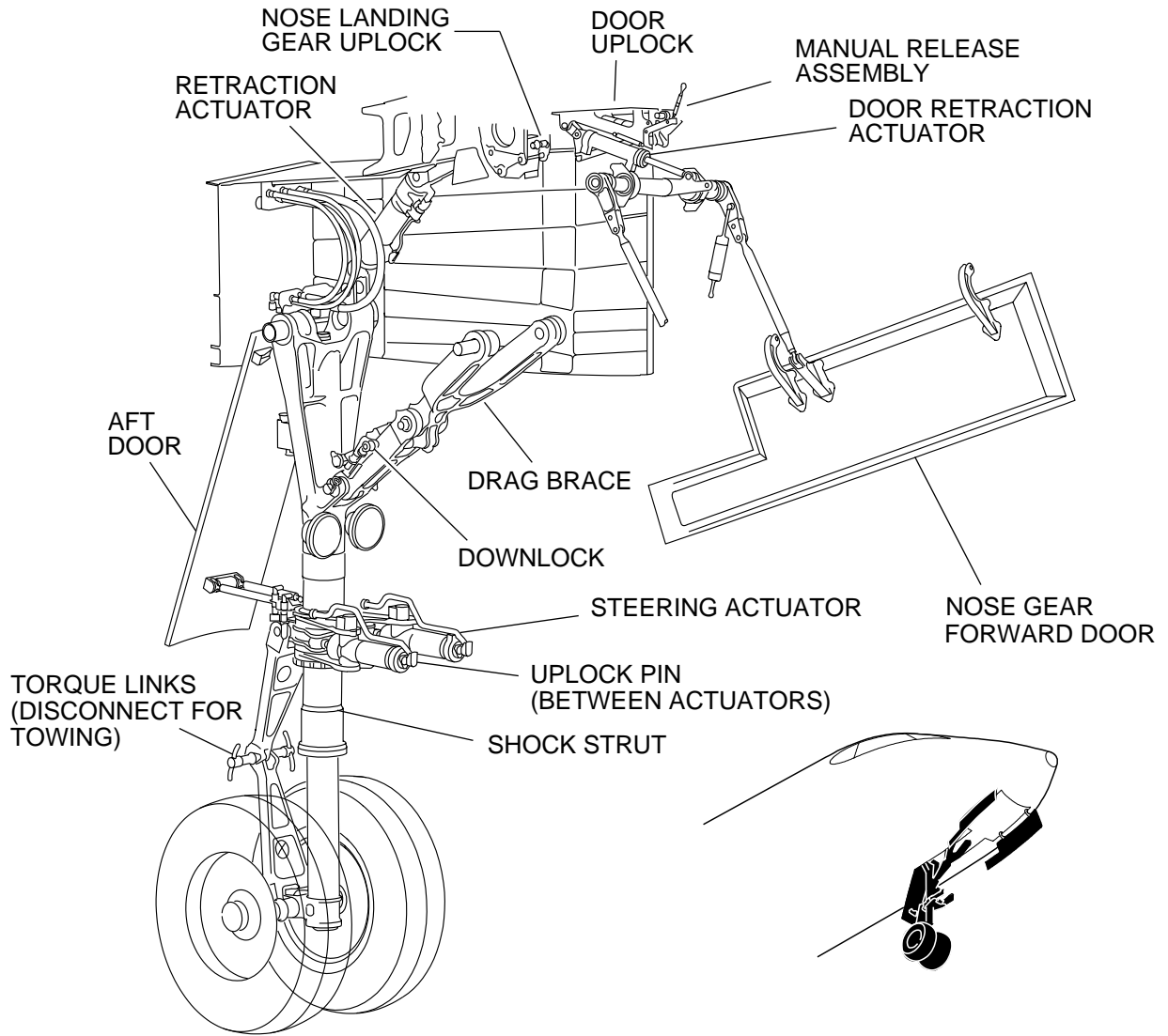
The nose gear retracts forward into the nose bay area and is held in the retracted position by an uplock mechanism. During normal operation, a downlock actuator and assist springs within the drag brace ensures downlock when the gear is extended. The nose gear is actuated by hydraulic system No. 3 to operate the uplocks (gear and door), downlocks and actuators.

In the event of an hydraulic system failure, a dedicated operating system provides a means to manually extend (freefall) the gear. As with the main gear, emergency extension of the nose gear is achieved by pulling the same landing gear manual release handle located on the pedestal in the flight compartment. Downlock of the nose gear is achieved through a mechanical locking device. Two downlock assist springs mounted on the drag brace assist nose gear extension. System No. 3 hydraulic pressure to the nose gear is maintained while in extended position.

The nose hydraulically actuated doors, gear sequencing and position sensing are controlled and continuously monitored by the LGECU. Any fault or position deviation detected is annunciated on EICAS.



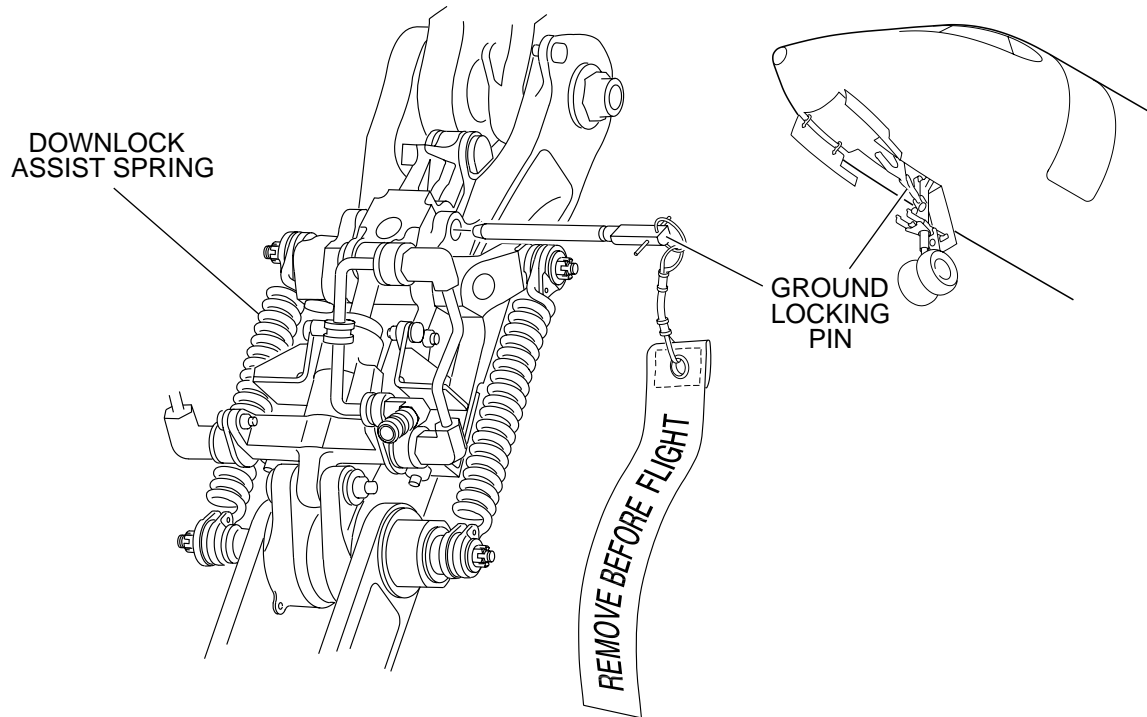
NOSE LANDING GEAR SCHEMATIC



GF1510\_005

**NOSE GEAR DOWNLOCK SAFETY PIN**

A downlock safety pin is installed within the drag brace assembly to secure the nose landing gear in position while on ground.



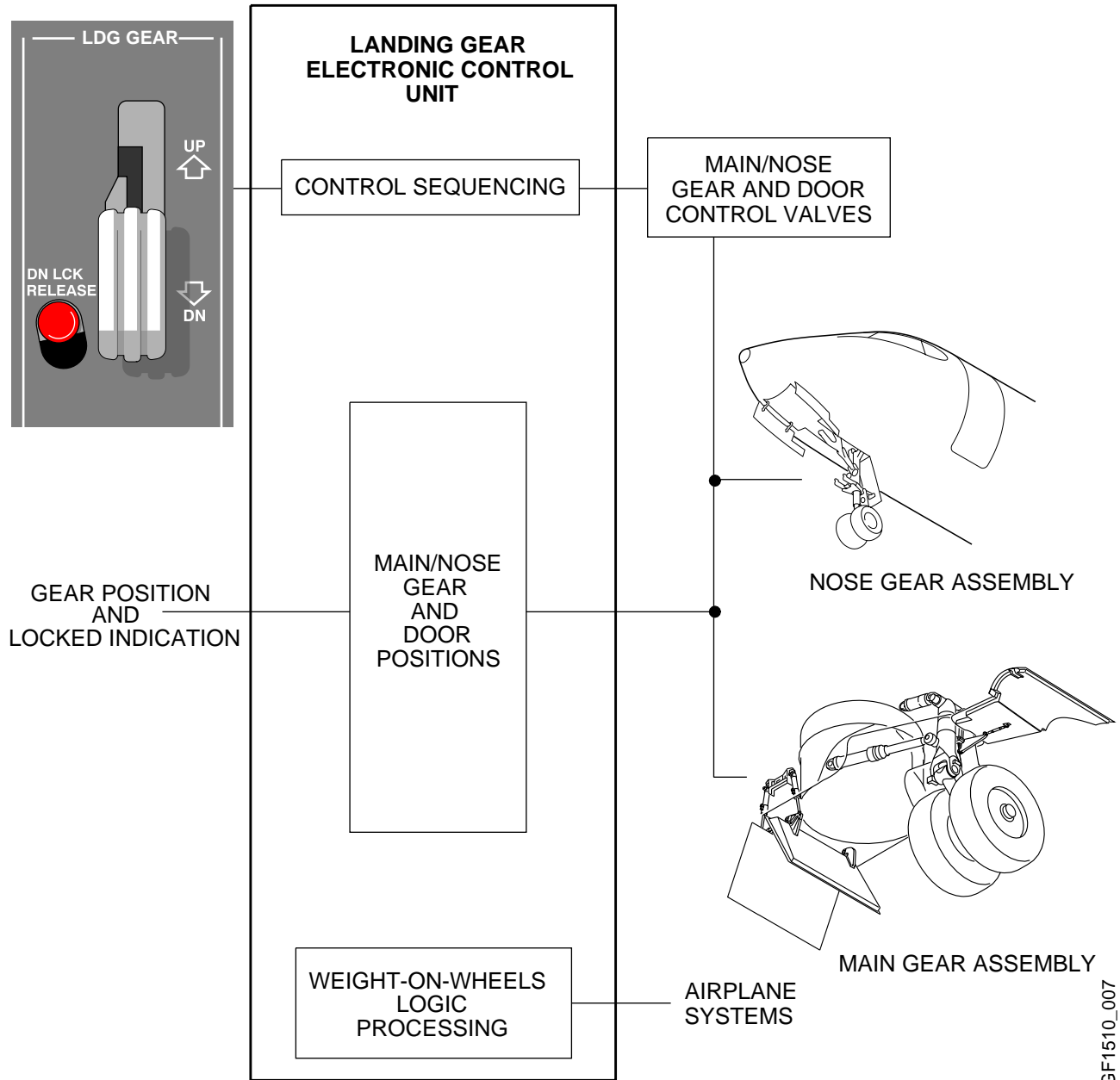
GF1510\_006

**LANDING GEAR ELECTRONIC CONTROL UNIT (LGECU)**

The Landing Gear Electronic Control Unit (LGECU) consists of two sub-systems which perform:

- All landing gear control and indication, including WOW.
- Landing gear and landing gear door operations.
- Control, indication and fuselage door status functions (refer to AIRPLANE GENERAL Chapter 1 for fuselage door indications).

**LGECU SYSTEM SCHEMATIC**



GF1510\_007

## LGECU CONTROL

The LGECU receives gear position commands (current or new) from the landing gear control handle in the flight compartment. The handle is compared with actual gear position and WOW for each landing gear assembly. The landing gear system includes proximity sensors for gear and door positioning and locked position monitoring.

The EICAS monitors the information received from the LGECU and generates status and warning messages when certain conditions are met.

The landing gear door, control and indications system provides three basic functions:

- Landing gear sequencing control – The system performs logic on handle position, landing gear and door positions, WOW and gear lock inputs. It provides the signals that command the landing gear, landing gear door and lock actuators that change the position of the landing gear based on this input logic.
- Landing gear, door and fuselage door position indication – The system monitors door position inputs, landing gear door inputs, landing gear position inputs and provides indication of the position status of airplane doors and landing gear.
- Weight-On-Wheels indication – The system monitors landing gear strut compression (sensor input) and provides indication of the air or ground status of the airplane. Weight-On-Wheel sensors on each landing gear assembly report to the LGECU and are divided into two classifications, WOW 1 and WOW 2 inputs. In addition, the system monitors its own circuitry and provides fault information to the central airplane information maintenance system or CAIMS and/or EICAS system.

The LGECU is divided into two sub-systems which provide control and indication to the landing gear system.

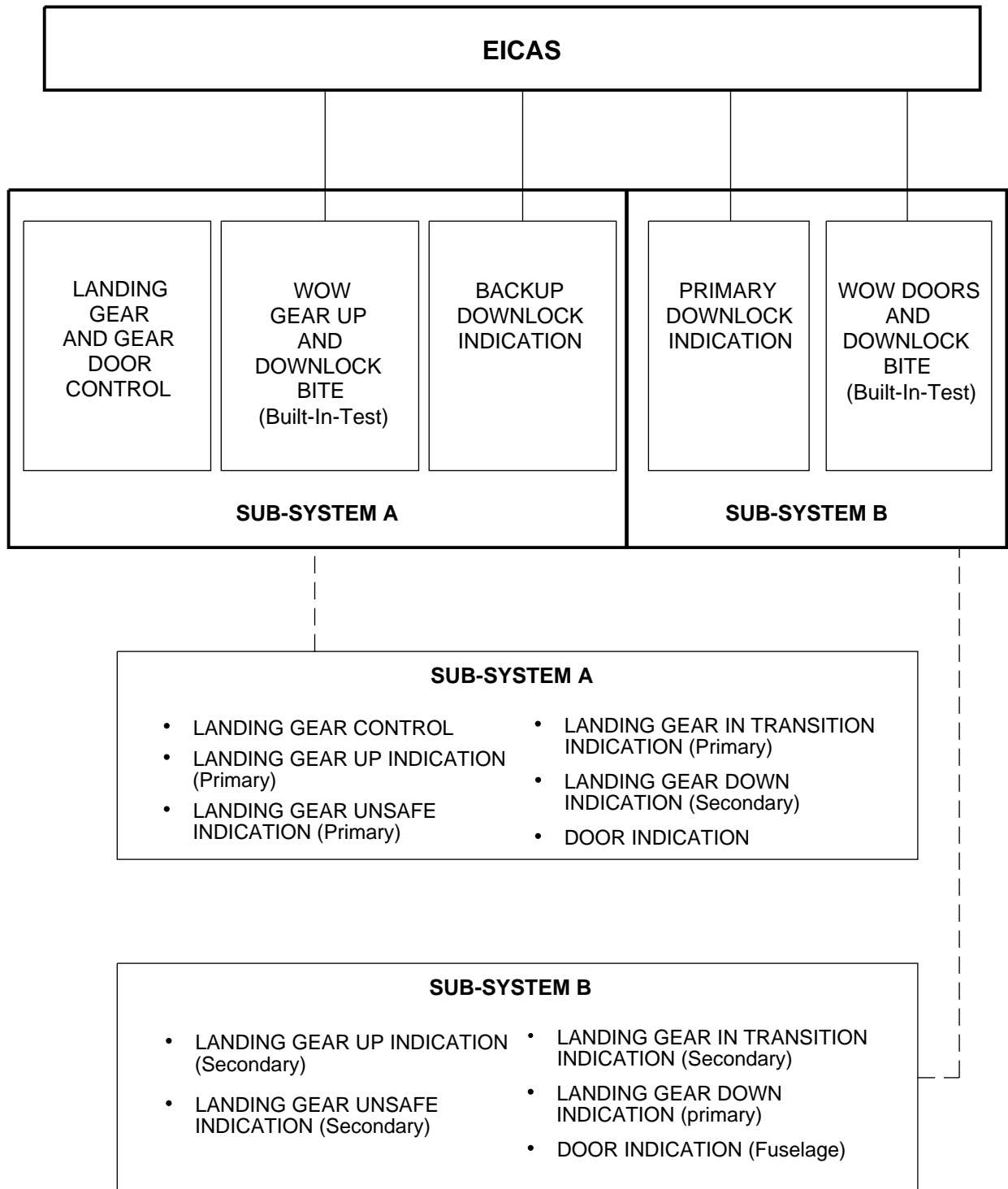
Sub-system A functions include:

- WOW #1 (WOW sensor input logic).
- Landing gear control and secondary position indication.
- Landing gear door control.

Sub-system B functions include:

- WOW #2 (WOW sensor input logic).
- Landing gear primary position indication.
- Landing gear door indication.
- Fuselage door Status.

**LGECU CONTROL SCHEMATIC**



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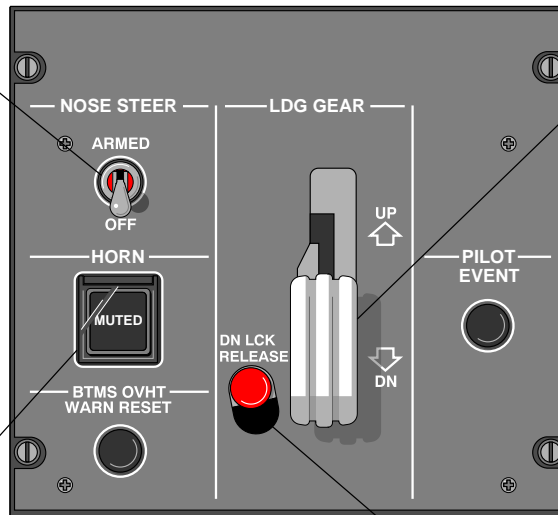
**LANDING GEAR CONTROL SYSTEM**

The landing gear control panel is located on the centre pedestal. The landing gear control handle is located in the centre of the control panel and is equipped with a solenoid lock which prevents inadvertent up selection with the airplane on the ground (WOW) signal. In the event of a solenoid lock malfunction (in flight), a downlock release switch (DN LCK REL) on the landing gear control panel permits up selection of the handle by overriding the solenoid lock.

**LANDING GEAR CONTROL PANEL**

**NOSE WHEEL STEERING Switch**

- ARMED – Circuit is set up for a command input on the ground.
- OFF – Nose wheel steering will revert to the free-caster mode of operation.



**LANDING GEAR Handle**

Controls retraction and extension of the landing gear by sending the command signal to the LGECU.

- UP– Handle must be pulled out to be moved to the UP position to retract the landing gear.
- DN – Handle must be pulled out to be moved to the DN position to extend the landing gear.

**HORN MUTED Switch**

Mutes the landing gear warning horn for certain airplane configurations. The "MUTED" white legend will display when the switch is selected.

**DOWN LOCK RELEASE**

(Spring loaded, solenoid activated)  
Select and hold in the down position to manually override the control lever solenoid locking mechanism.

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**LANDING GEAR INDICATION**

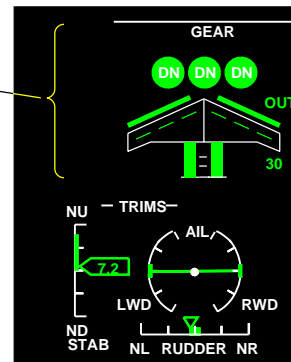
In flight, the landing gear position indication (pop up display) is removed from EICAS 30 seconds after all landing gear and slats/flaps indicate up and lock, and no system faults (example: gear, spoilers, brakes, slat/flap) exist.

**Gear Position (Flight Controls) Pop-Up**

Up, down and in transit indication is displayed on the EICAS primary page.

The pop-up display will appear when the airplane is configured to any of the following:

- Gear selected down.
- Slat/flap selection.
- Flight spoilers extended.



GF1510\_010

**LANDING GEAR POSITION AND WARNING SYSTEM**

The status of the landing gears and landing gear bay doors is determined by the LGECU using inputs from various proximity sensors. The resulting output is sent to EICAS which monitors the condition and position display of each system.

The position of each of the three landing gears is pictorially indicated by three symbols on the EICAS display primary page. The gear up symbol for each gear is "UP" in white letters enclosed by a white outlined box. The gear in transit symbol for each gear is amber cross hatching enclosed by an amber outlined box. The gear down symbol for each gear is "DN" in white letters enclosed by a solid green circle.

A "GEAR DISAGREE" caution message is posted on the primary page if any of the following conditions occur:

- Any one gear remains in transit for more than 28 seconds, the respective rectangle remains amber.
- The position of at least one gear does not agree with landing gear control lever except during normal transit.
- The landing gear control lever is left in the up position during manual extension.

An amber "NOSE DOOR" or "L-R MAIN GEAR DOOR" caution message will be posted on the primary page if one of the following conditions exist:

- Any door indicates not closed for longer than 30 seconds during extension or retraction.
- Any door indicates not closed for more than one second at any other time.

If any one gear remains in transit for more than 28 seconds, the respective rectangle remains amber and "GEAR DISAGREE" is posted on the primary page as a caution. The gear down, in transit and disagree conditions are displayed as long as the condition exists. The gear "UP" display is removed from the primary page 30 seconds after the flaps are retracted and brake temperatures are normal.

During normal extension and retraction, the landing gear will display an amber "GEAR DISAGREE" message, if the gear does not indicate a locked position within 30 seconds of selection.

A continuous "GEAR" voice warning is sounded in the event a landing is attempted with any of the landing gears not down and locked and the airplane is below 16,500 feet. For details on the aural "GEAR" warning refer to page 03-10-25 LANDING CONFIGURATION WARNING.

**LANDING GEAR POSITION AND WARNING SYSTEM (CONT'D)**

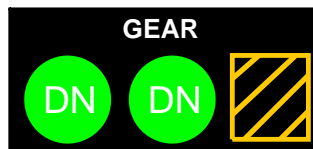
The LGECU of the landing gear system monitors all gear functions. Any deviation from the selected gear configuration or failure of the uplocks or downlocks is annunciated on EICAS in the form of visual and aural messages. The following are examples of the landing gear indicating that it is not in its commanded state:



**NOSE GEAR CAUTION**

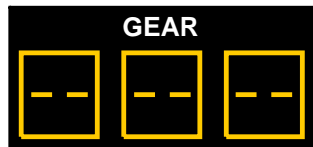
**GEAR WARNING INDICATION**

Indicates that landing gear does not agree with landing gear selector lever position. It will be accompanied by a voice advisory and a "GEAR DISAGREE" caution message.



**RIGHT MAIN GEAR CAUTION**

Each landing gear symbol will display dash marks when the gear information is unreliable.



**GEAR INVALID DATA**

**GEAR INVALID Indication (Dashes)**

Indicates that landing gear position is not valid and may or may not, be accompanied by a voice advisory and a "GEAR DISAGREE" caution message.

**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.



"Too Low Gear"

**Gear Warning**

The gear warning 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 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 is either inhibited, mutable or not mutable. The following tables detail the general logic behind gear warning operation.

GF1510\_011

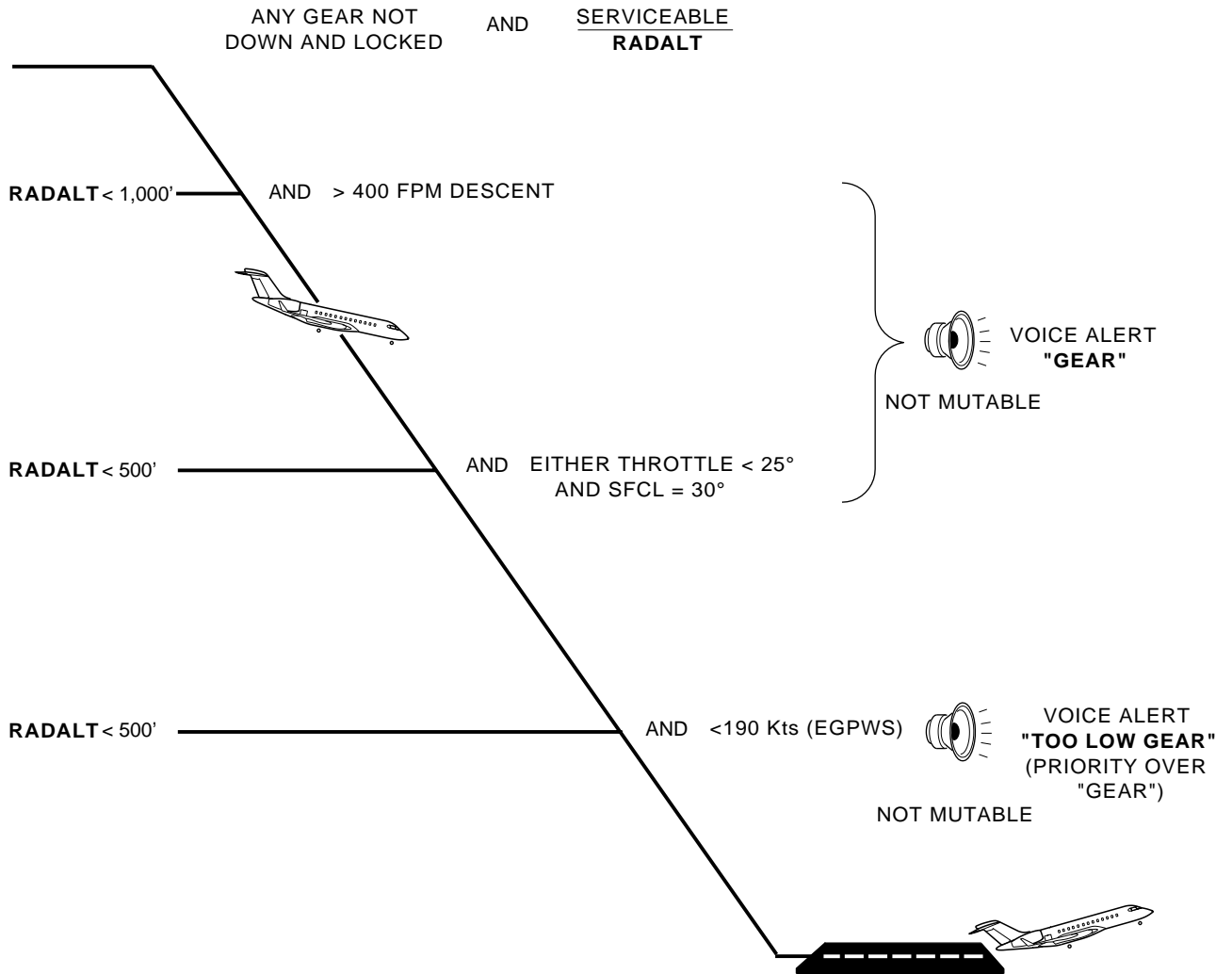
GF1510\_012



LANDING GEAR POSITION AND WARNING SYSTEM (CONT'D)

Landing Gear Warning Logic

Primary Mode

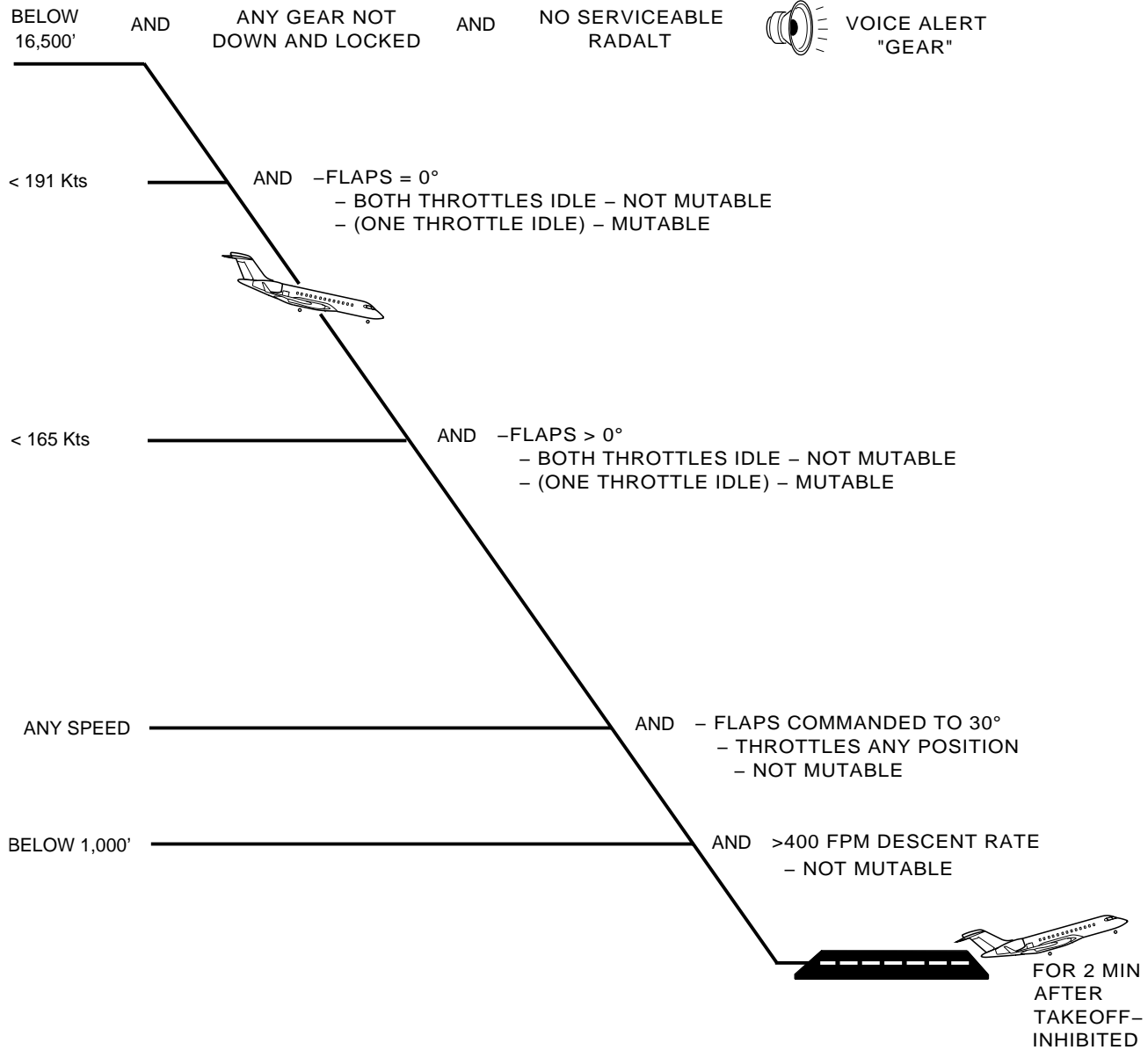


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LANDING GEAR POSITION AND WARNING SYSTEM (CONT'D)

Landing Gear Warning Logic (Cont'd)

Secondary Mode

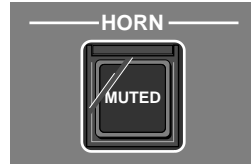


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## LANDING GEAR POSITION AND WARNING SYSTEM (CONT'D)

### 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.



GF1510\_014

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°.

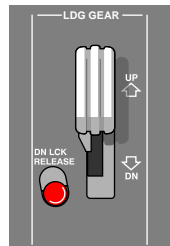
**RETRACTION AND EXTENSION SYSTEM**

Normal retraction and 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 No. 2 and No. 3 hydraulic system pressures.

**Landing Gear Retraction**

For landing gear retraction, once the airplane is airborne (example: weight-off-wheels, nose wheel 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.



**IN TRANSIT**

GF1510\_015

- The door selector valve is energized and No. 3 hydraulic system powers all door uplocks and door actuators.
- When the doors indicate open, the nose landing gear and main landing gear selector valves are energized.
- No. 3 hydraulic system releases the respective downlocks and completely retracts the nose landing gear (extension/retraction actuator). No. 2 hydraulic system will power the main 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 take-off) to pressurize the brakes and stop 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.



**UP AND LOCKED**

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**RETRACTION AND EXTENSION SYSTEM (CONT'D)**

**Landing Gear Extension**

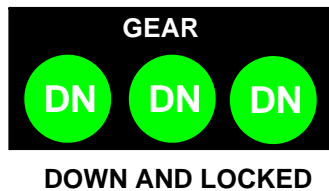
For landing gear extension, the LGECU commands and monitors the following events:

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



GF1510\_017

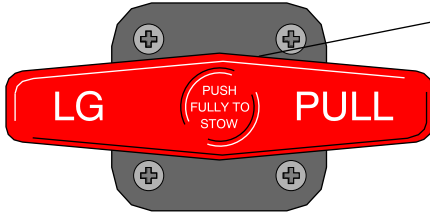
- The door selector valve is energized and No. 3 hydraulic system powers all door uplocks and door actuators.
- When the doors indicate open, the nose landing gear and main landing gear selector valves are energized.
- No. 3 hydraulic system releases the respective uplocks and extends the nose landing gear (extension/retraction actuator). No. 2 hydraulic system will power the main extension/retraction actuators (used to raise and lower the main gear) 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 retract 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.



GF1510\_018

## LANDING GEAR MANUAL RELEASE HANDLE

The following schematic represents the operation of the landing gear release handle in the extended and stowed positions.



### 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. Guide the handle to its stow position.

GF1510\_019

## 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 in the centre pedestal of 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 operation of the manual landing gear extension procedures, refer to the non-normal procedures, MANUAL LANDING GEAR EXTENSION in the Airplane Flight Manual.

### NOTE

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.

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 full stowed position.

**MANUAL LANDING GEAR EXTENSION (CONT'D)**

**Manual Release Sequence**

The following is a sequence of events which occur during manual landing gear extension.

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



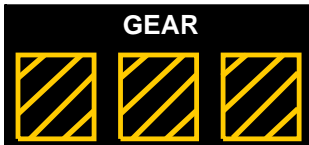
**MAIN GEAR IN TRANSIT**

GF1510\_020

- Both main landing gear retract/extend actuators are pressurized by hydraulic system No. 2 (through the action of the system #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.



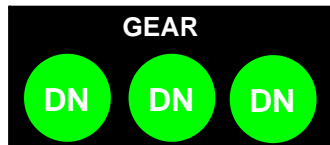
**ALL GEAR IN TRANSIT**

GF1510\_021

- 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 remain open. A “L–R MAIN GEAR DOOR” and “NOSE DOOR” caution message will be displayed.



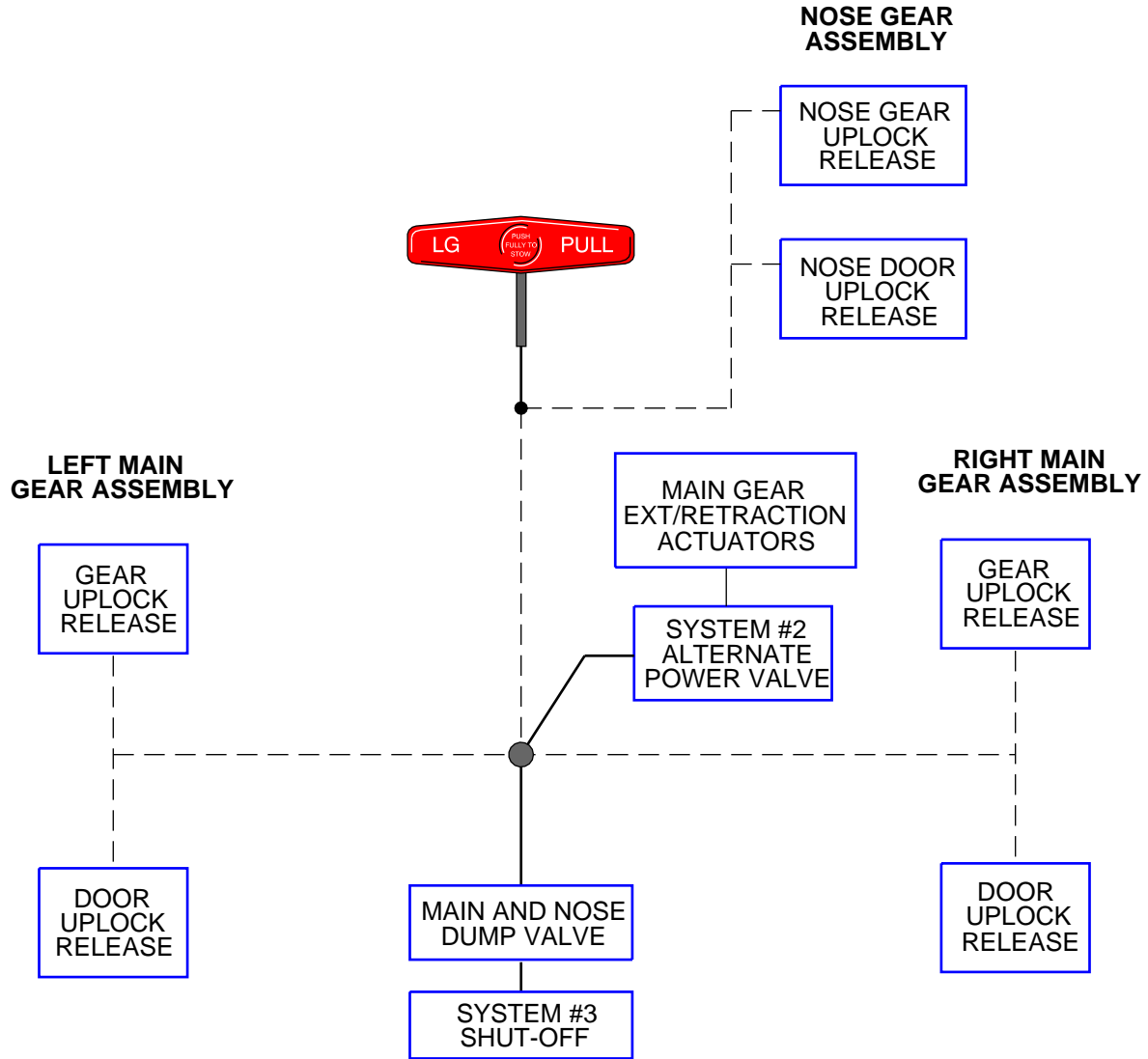
**DOWN AND LOCKED**

GF1510\_022

- 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 extension system.



LEGEND

Cable Circuit - - - - -  
Control Linkage —————

GF1510\_023



## BRAKE CONTROL SYSTEM

The main wheels have carbon disk brakes. They are controlled by the Brake Control Unit (BCU) using an anti-skid system, with auto-braking capability.

Refer to BRAKE CONTROL SCHEMATIC in this Chapter to support the information that follows.

The brake control system provides hydraulic services to the outboard brakes (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. The system 3 accumulator is also monitored to provide flight compartment indication of available parking/emergency accumulator pressure. 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/anti-skid or parking/emergency brake) to the brake.

Pilot and/or copilot brake input is provided by four brake pedal transducers. The signal is processed by the BCU and commands appropriate brake pressure. If a failure or unreliable signal is present, a pilot/copilot 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 anti-skid control valve operation. The brake and anti-skid 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 take-off).
- Inhibiting normal gear braking in flight.
- Independent wheel anti-skid.
- 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 cancelled 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 (example: locked wheel).

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.

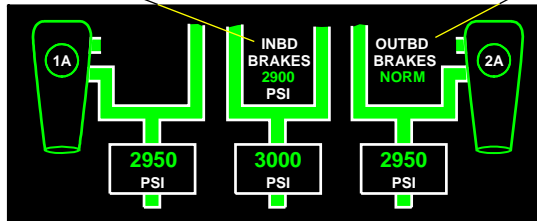
## BRAKE CONTROL SYSTEM (CONT'D)

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. The signal for brake pressure indication (systems 2 and 3) is derived from four electrically redundant brake pressure transducers positioned prior to each shuttle valve. One pressure transducer is linked to BCU channel A, the other to channel B for each system.

### INBOARD BRAKE PRESSURE READOUT

Displays in increments of 50 psi, pressure in the inboard brake system.

- Green – >1800 psi.
- Amber – ≤1800 psi.
- White – ≥3200 psi.



### OUTBOARD BRAKE PRESSURE READOUT

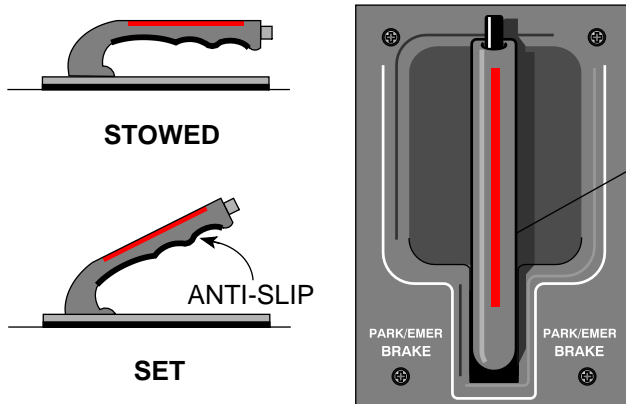
Displays pressure in the outboard brake system.

- Green – NORM will appear when pressure is increasing between 1400 – 1750 and above.
- Amber – LO PRESS ≤ 1400 psi.
- White – ≥ 3,200 psi

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## Park/Emergency Brake

Selection of the PARK/EMER BRAKE handle mounted on the centre pedestal will allow 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 transducer will provide a parking brake applied signal to the BCU and a message 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 anti-skid protection is available when proportional 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 accumulator pressure (Hydraulic synoptic page), provides indication for normal brake pressure, parking brake, No. 3 hydraulic failure or emergency brake application.



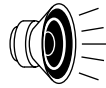
"NORMAL BRAKE FAIL"

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

**BRAKE CONTROL SYSTEM (CONT'D)**

**Park/Emergency Brake Take-off Configuration**

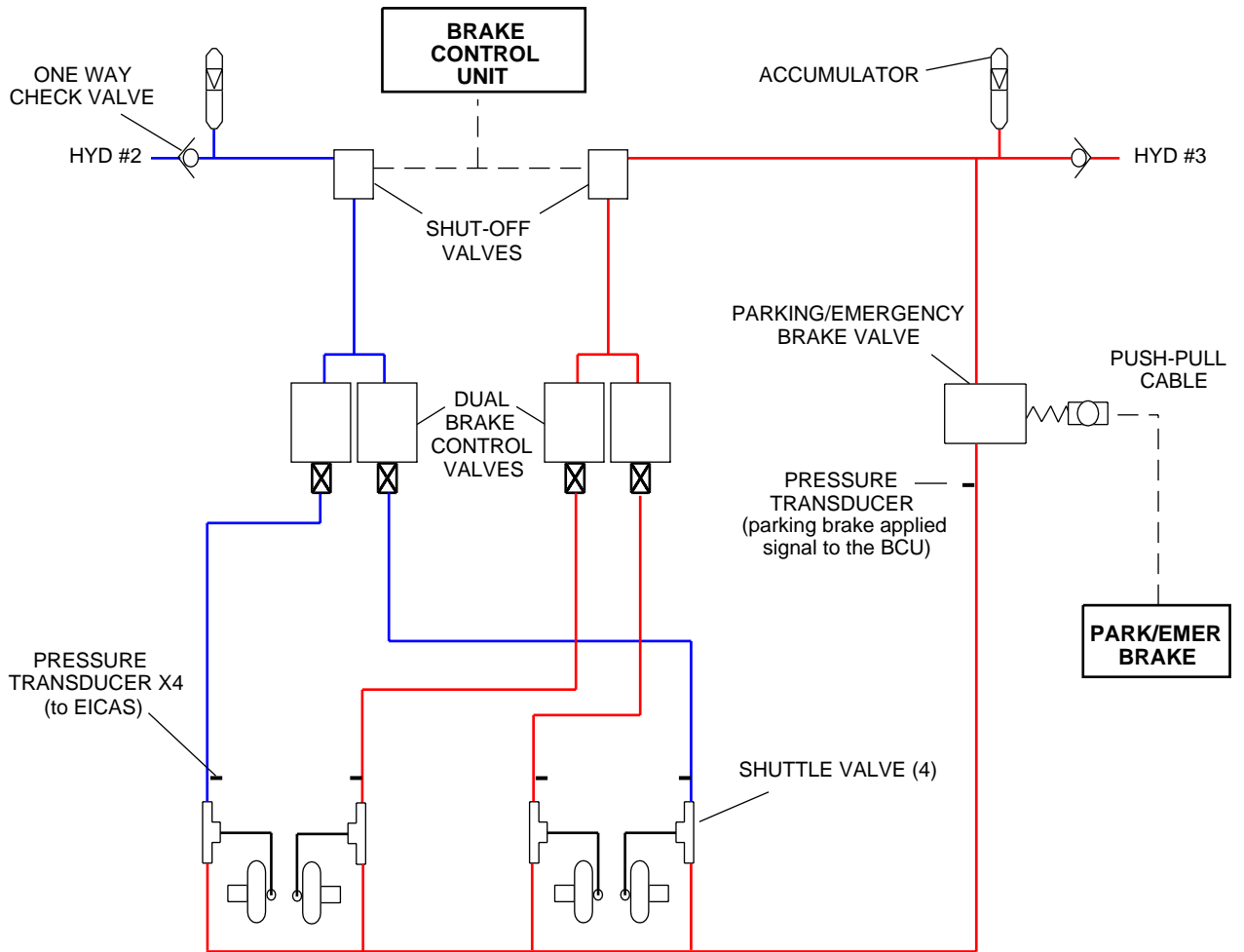
A take-off configuration warning in the form of a voice advisory "NO TAKE-OFF" and a red EICAS message "PARK BRAKE ON" will be annunciated if the PARK/EMER BRAKE handle is set and the airplane is in take-off parameters.



"NO TAKE-OFF"

**BRAKE CONTROL SCHEMATIC**

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

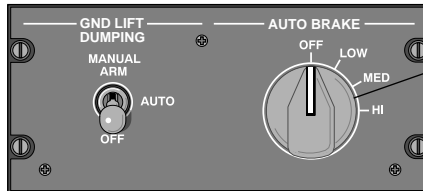


**NOTE**  
The return system is not shown in this schematic.

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**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 H (4,8 and 13 ft sec<sup>2</sup>).

**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 (example: WOW indicating air).
- No deploy command for the ground spoilers.
- Brake pedal application less than 20% travel .
- Wheel speed at zero velocity.
- No autobrake or brake control faults.

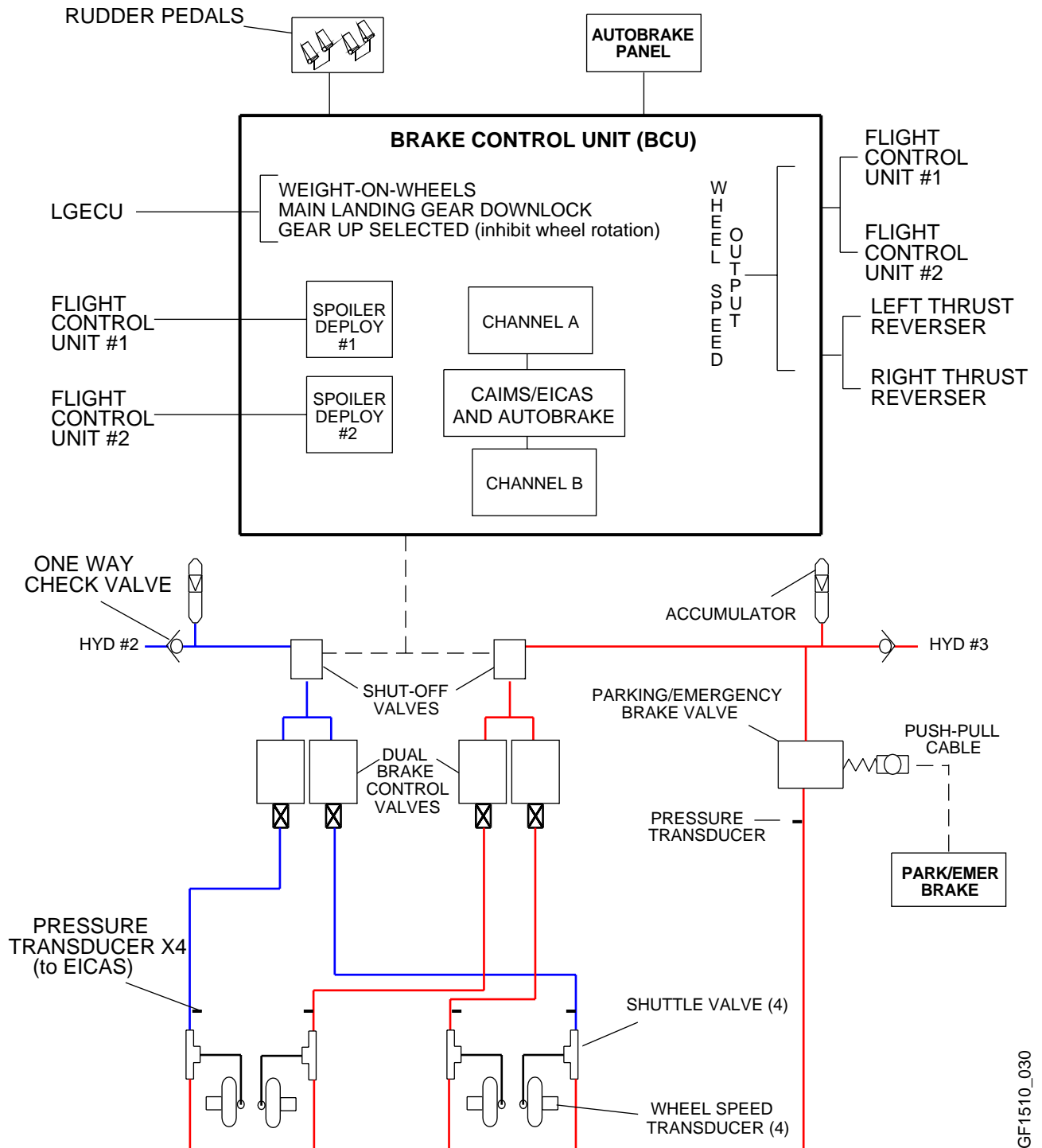
The autobrake will apply when all of the following conditions are met:

- Autobrake switch selected to either LO, 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 (determined by a comparison of channel A and B of the BCU).
- Ground spoilers stowed after having been deployed.

BCU INTERFACE SCHEMATIC

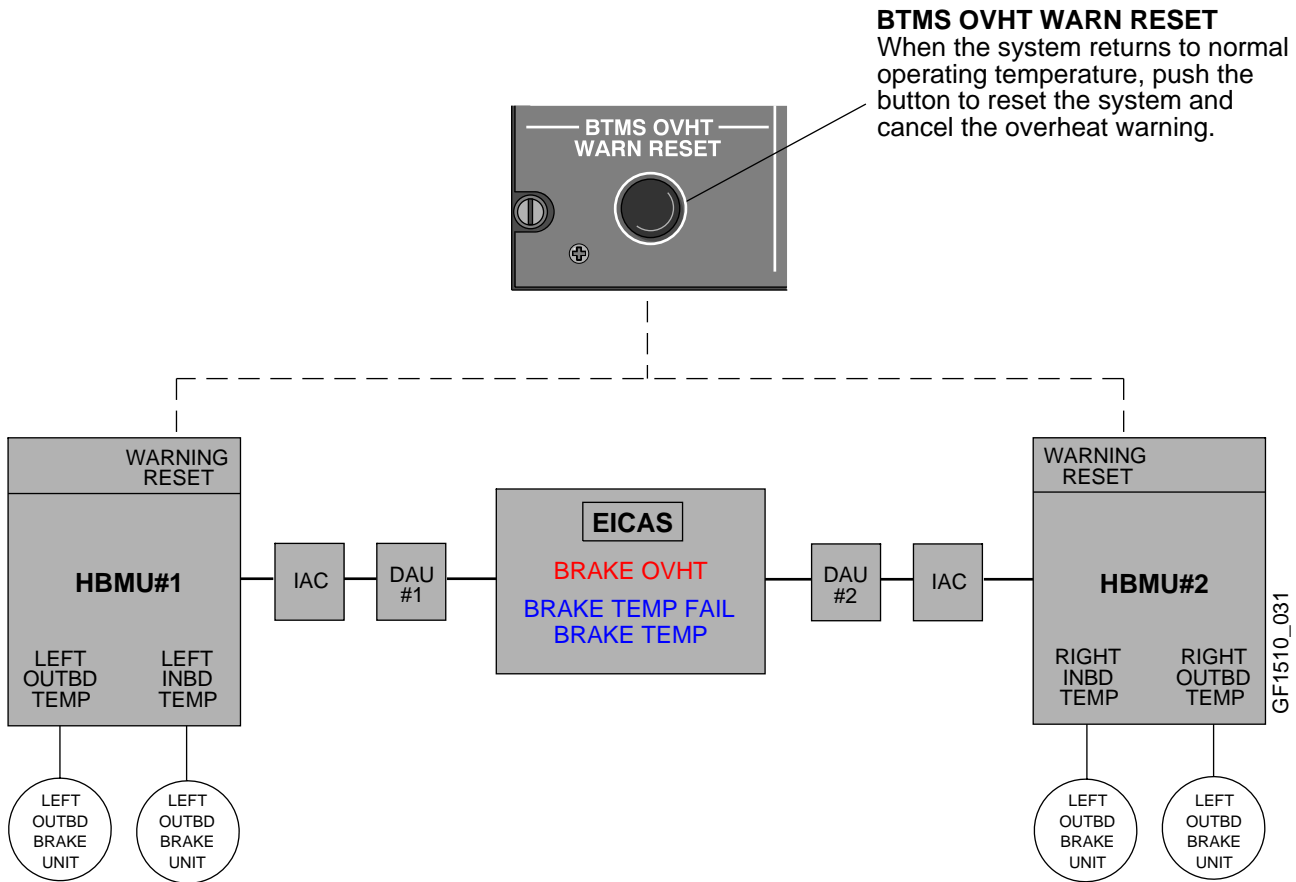


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**BRAKE TEMPERATURE MONITORING SYSTEM**

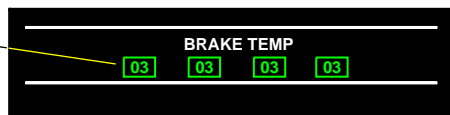
The Brake Temperature Monitoring System (BTMS) consists of four sensors each mounted in a brake housing and the Heater current/Brake temperature Monitor Unit (HBMU). Brake temperature is indicated in the flight compartment on the EICAS status display when the landing gear is selected down. A “BTMS OVHT 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**



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.

**BRAKE TEMPERATURE INDICATORS**



- Green range: 00-05
- White range: 06-16
- Red range: 17 and greater

A red EICAS message and a resettable warning will accompany the overheat condition. Resetting the system (when the condition no longer exists) will cancel the warning and display the numerical color values according to their sensors actual temperature.

## NOSE WHEEL STEERING SYSTEM

The steering control system is electrically controlled and hydraulically actuated.

The nose wheel 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 Electronic Control Unit ( ECU) 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 ECU will sum these inputs to a maximum of  $\pm 75^\circ$ .

Nose wheel position feedback is provided to the SCU by 2 transducers mounted on the steering actuators. The Steering Control Unit (SCU) controls an electro-hydraulic servo-valve 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.

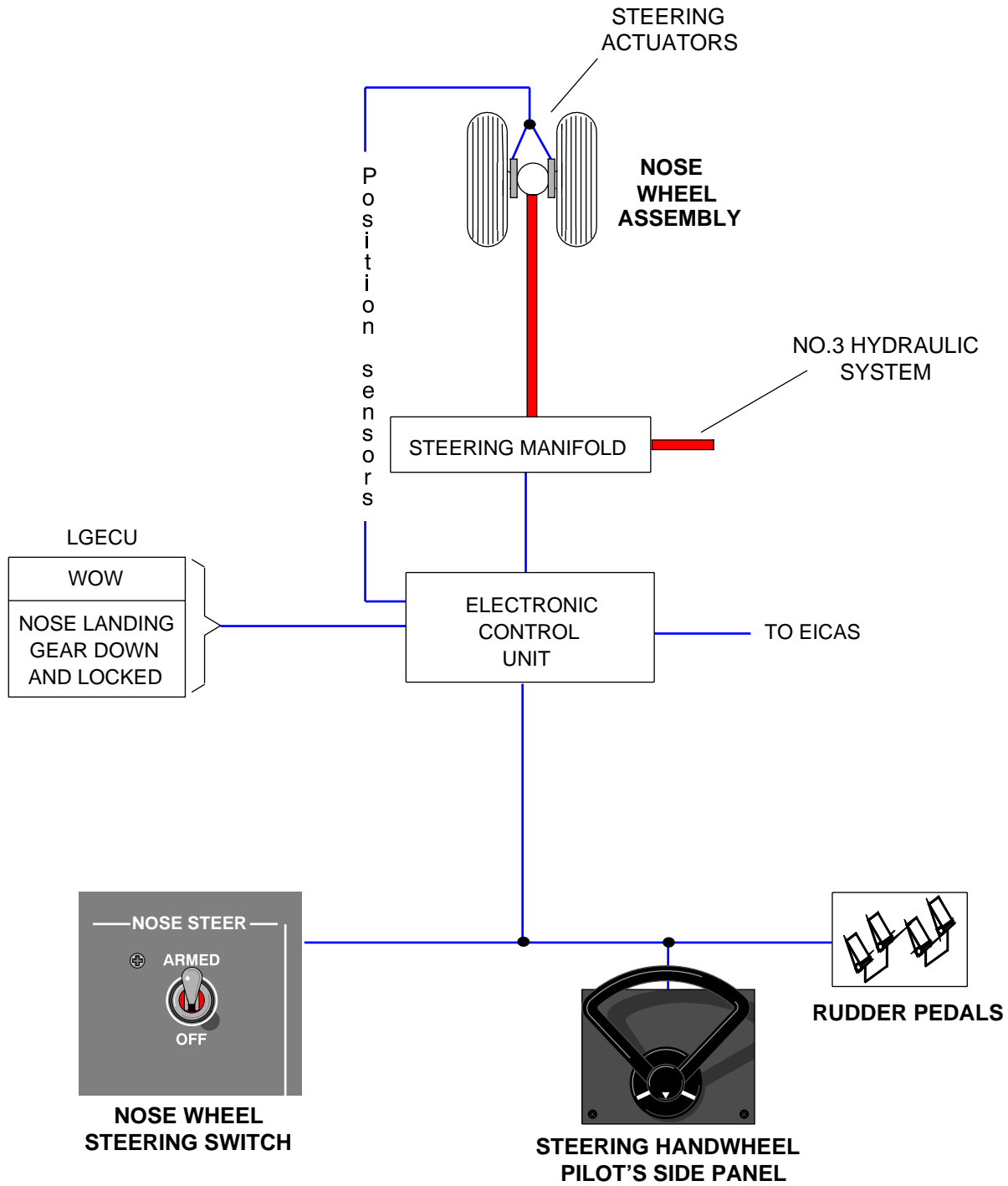
The steering commands are processed by the SCU and No. 3 hydraulic system pressure is routed through the system, when the landing gear is selected down.

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 nose wheel steering will revert to free caster and shimmy damping to ensure stability within the nose wheel circuit. In the free caster mode of operation, steering is accomplished only through differential braking and differential thrust.

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

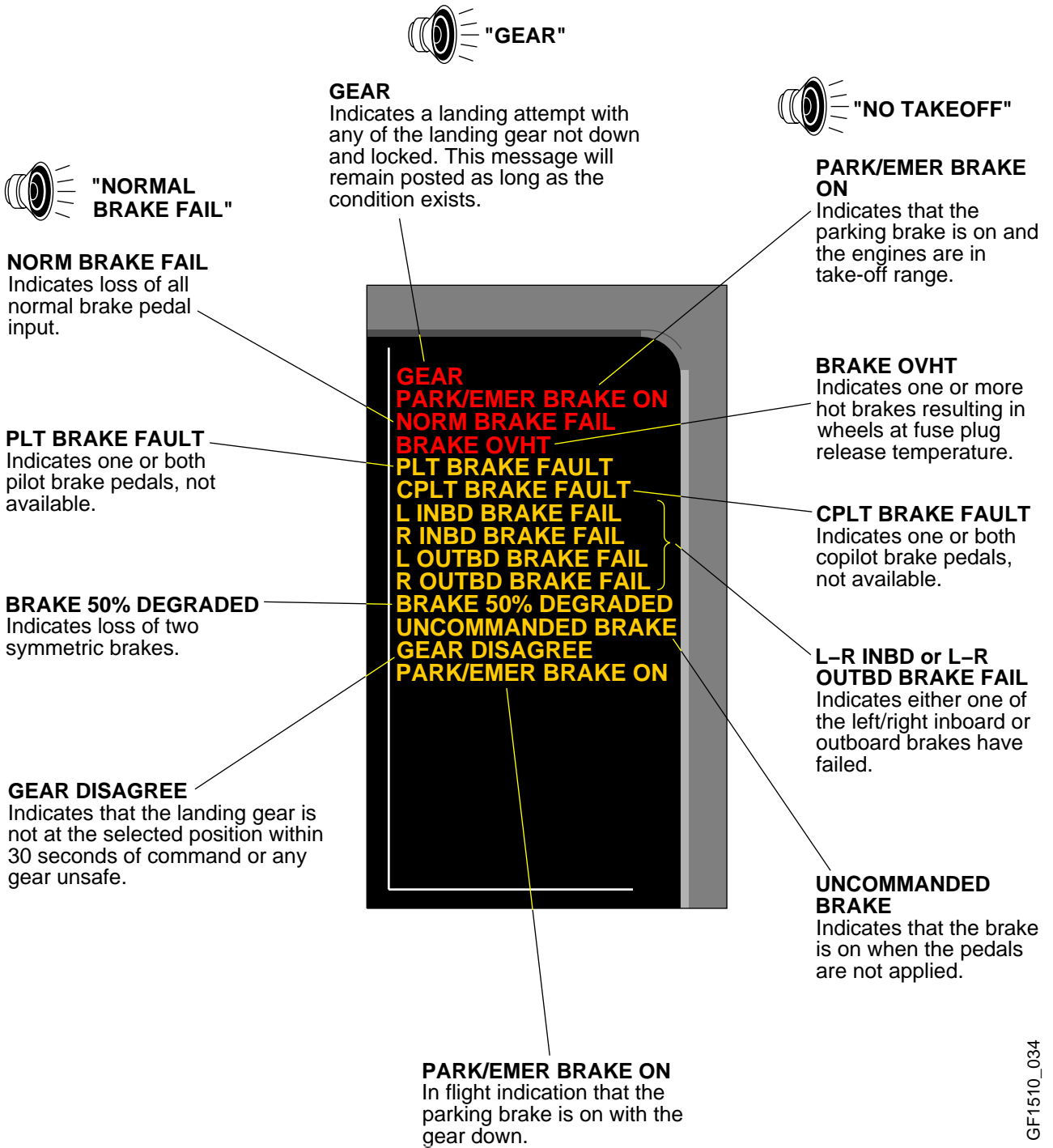
NOSE WHEEL STEERING SCHEMATIC



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EICAS MESSAGES



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EICAS MESSAGES (CONT'D)

**INBD (OUTBD) BRK LO PRESS**  
Indicates either the inboard or outboard brake supply is depleted.

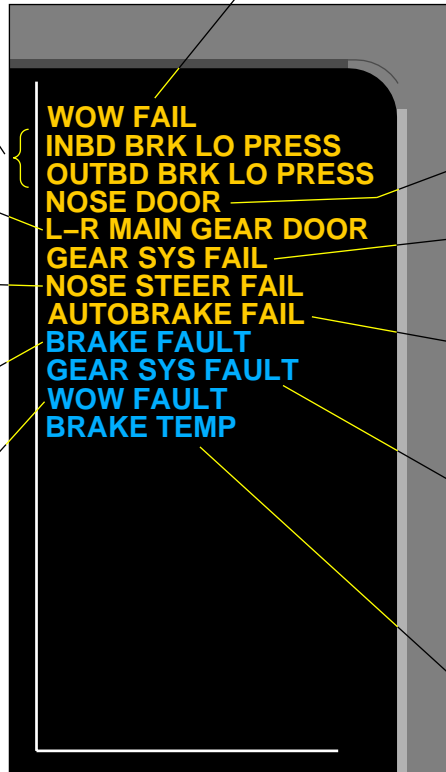
**WOW FAIL**  
Indicates loss of WOW function.

**L - R MAIN GEAR DOOR**  
Indicates that the left or right main gear door on the affected side is not closed.

**NOSE STEER FAIL**  
Indicates loss of nose wheel steering operation: nose wheel free-casters.

**BRAKE FAULT**  
Indicates loss of redundancy in the brake control system.

**WOW FAULT**  
Indicates a fault within the LGECU.



**NOSE DOOR**  
Indicates nose door in the not closed position.

**GEAR SYS FAIL**  
Indicates that the normal gear operation is not available.

**AUTOBRAKE FAIL**  
Indicates that the auto braking system is not available.

**GEAR SYS FAULT**  
Indicates loss of redundancy for downlock indications or EICAS communication.

**BRAKE TEMP**  
Indicates that one or more brake temperature indicators are in the white range.

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EICAS MESSAGES (CONT'D)

**AUTOBRAKE LOW**

Indicates that the autobrake is armed for low deceleration braking.

**PARK/EMER BRAKE ON**

Indicates that the parking brake is on with the airplane stopped.

**AUTOBRAKE HI**

Indicates that the autobrake is armed for high deceleration braking.



PARK/EMER BRAKE ON  
AUTOBRAKE LOW  
AUTOBRAKE MED  
AUTOBRAKE HI  
GEAR HORN MUTED  
NOSE STEER OFF

**AUTOBRAKE MED**

Indicates that the autobrake is armed for medium deceleration braking.

**NOSE STEER OFF**

Indicates that the NOSE STEER switch is in the OFF position.

**GEAR HORN MUTED**

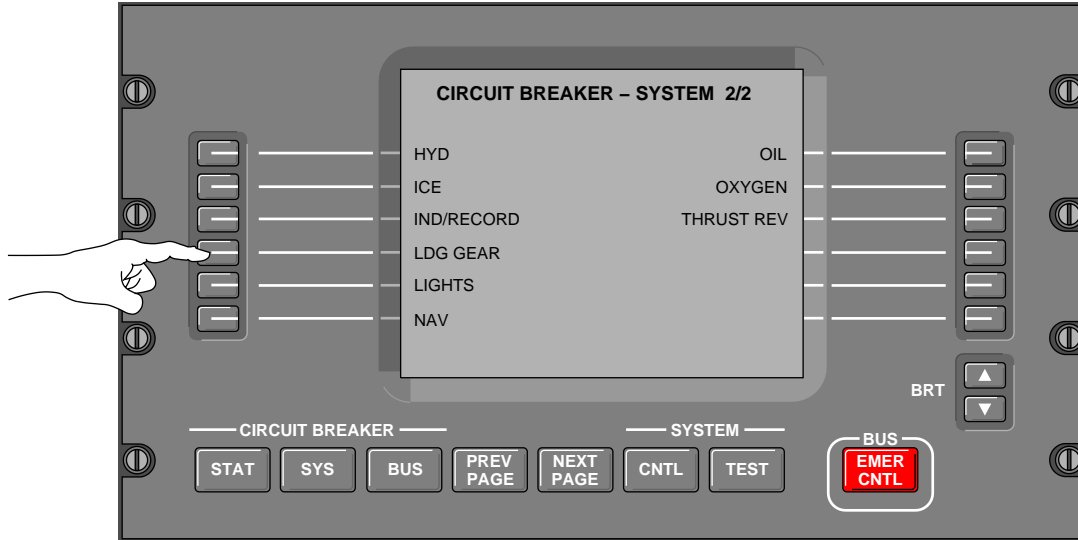
Indicates that the gear horn has been activated and the mute switch is selected.

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# LANDING GEAR EMS CIRCUIT PROTECTION

## CB - LDG GEAR SYSTEM



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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**LANDING GEAR  
EMS CIRCUIT PROTECTION**

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