

A330-200
TECHNICAL TRAINING MANUAL
MECHANICS / ELECTRICS & AVIONICS COURSE
32 LANDING GEAR
GE Metric

**This document must be used
for training purposes only.**

**Under no circumstances
should this document be used as a reference.**

All rights reserved.

No part of this manual may be reproduced in any form,
by photostat, microfilm, retrieval system, or any other means,
without the prior written permission of AIRBUS S.A.S.

■ FQW4200

TABLE OF CONTENTS

** System Presentation (1)	1
** System Control and Indicating (1)	9
LANDING GEAR AND DOORS	
● ** Landing Gear ECAM Presentation (1)	15
● ** MLG Presentation (2)	21
● ** MLG Doors Presentation (2)	25
● ** NLG Presentation (2).	29
● ** NLG Doors Presentation (2)	33
● ** Normal Operation (1)	37
● ** Normal Sequence D/O (3)	41
● ** Free Fall Extension (1)	49
● ** Free Fall Extension D/O (3)	53
● ** Doors Ground Opening (1)	57
● ** Doors Ground Opening D/O (3)	61

■ FQW4200

TABLE OF CONTENTS

● ** Landing Gear Warnings & Ops Limitations (3)	69
● ** MLG Components (3)	75
● ** MLG and Door Components (3).	83
● ** NLG Components (3).	95
● ** NLG and Door Components (3)	101
● ** MLG Extension/Retraction Components (3)	111
● ** NLG Extension/Retraction Components (3)	125
● ** Extension/Retraction Components (3)	137
● ** Free Fall Extension Components (3).	149
● ** LGCIU Interfaces (3)	163

WHEELS AND BRAKES

● ** Brake System Presentation (1)	187
● ** Normal Braking System Presentation (1)	191
● ** Normal Braking D/O (3)	195
● ** Alternate Braking System Presentation (1)	199

■ FQW4200

TABLE OF CONTENTS

● ** Alternate Braking D/O (3)	203
● ** Parking Brake System Presentation (1).	207
● ** Parking Brake D/O (3).	211
● ** In Flight Braking Presentation (1)	215
● ** Brake Cooling System Presentation (1).	221
● ** Brake System Temperature Presentation (1).	225
● ** Braking ECAM Presentation (1)	229
● ** Braking Warnings & Ops Limitations (3).	233
● ** Wheels & Brakes Components (3)	237
● ** Normal Braking Components (3)	249
● ** Alternate Braking Components (3)	263
● ** Parking Brake Components (3)	279
● ** Brake Cooling Components (3).	287
● ** Brake System Temperature Components (3).	293
● ** BSCU Interfaces (3).	299

■ FQW4200

TABLE OF CONTENTS

NOSE WHEEL STEERING

● ** Nose Wheel Steering Sys Presentation (1)	305
● ** Nose Wheel Steering D/O (3)	309
● ** N/WS ECAM Page Presentation (1)	317
● ** Nose Wheel Steering Warnings (3)	321
● ** Components (2)	325
● ** Components (3)	333
● ** BSCU Interfaces (3).	347

TPIS

● ** TPIS Presentation (1)	353
● ** Tire Pressure Indicating Warnings (3)	357
● ** Components (3)	361
● ** TPIS Interfaces (3)	369

■ FQW4200

TABLE OF CONTENTS

MAINTENANCE PRACTICES

• SPECIFIC PAGES

- ** CMS Specific Page Presentation (3) 375

• SERVICING

- ** Braking Servicing /2 (2) 387

THIS PAGE INTENTIONALLY LEFT BLANK

SYSTEM PRESENTATION

Gear
Extension/Retraction
Brakes
Steering

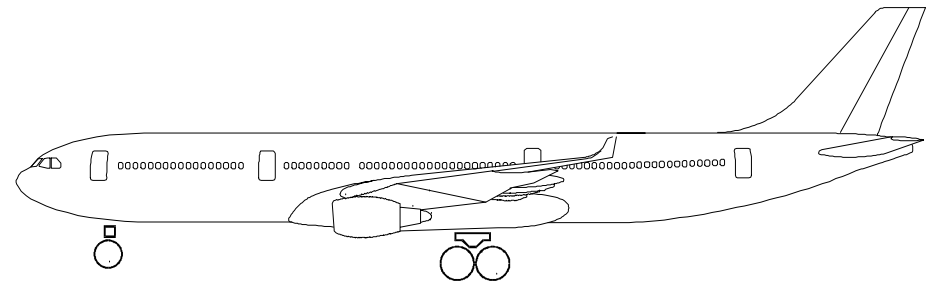
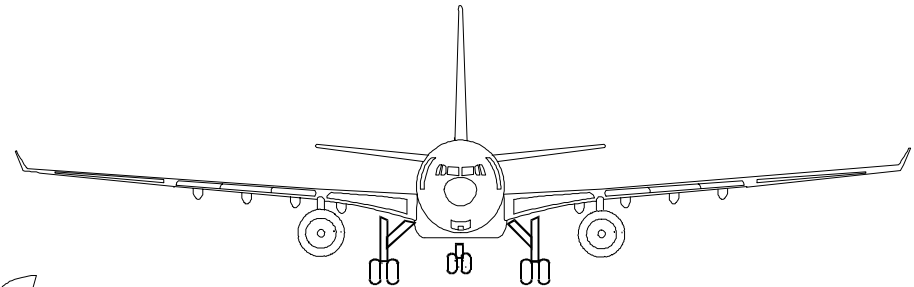
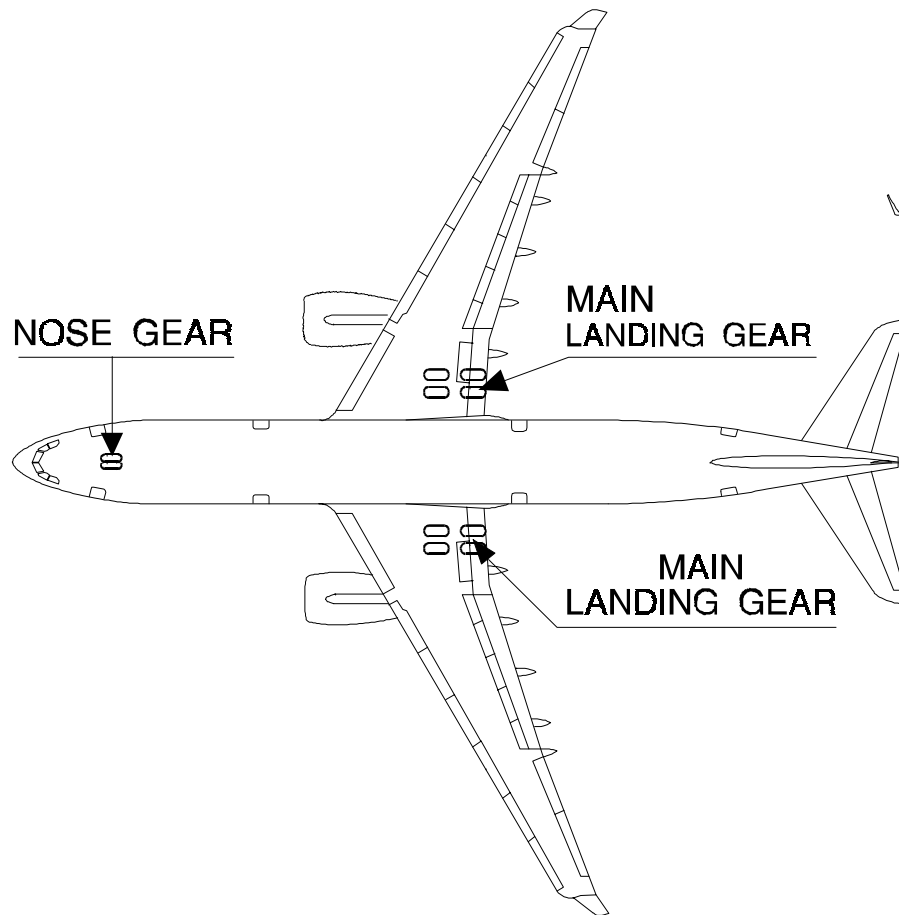
GEAR

The landing gear consists of a forward retracting nose gear and two inboard retracting main gear legs.

Each main gear has an oleopneumatic shock absorber and a rocking bogie beam equipped with four wheels.

Each main wheel is fitted with anti-skid wheel brakes.

The two-wheel nose gear comprises a two stage oleopneumatic shock absorber and a nose wheel steering system.



EXTENSION/RETRACTION

Gear and doors are electrically controlled and hydraulically operated by the green hydraulic system.

All gear doors open during landing gear transit.
The hydraulically operated doors close each time the landing gear is fully extended or retracted.

The doors which are fitted to the landing gear struts are mechanically operated by the gear and close at the end of gear retraction.

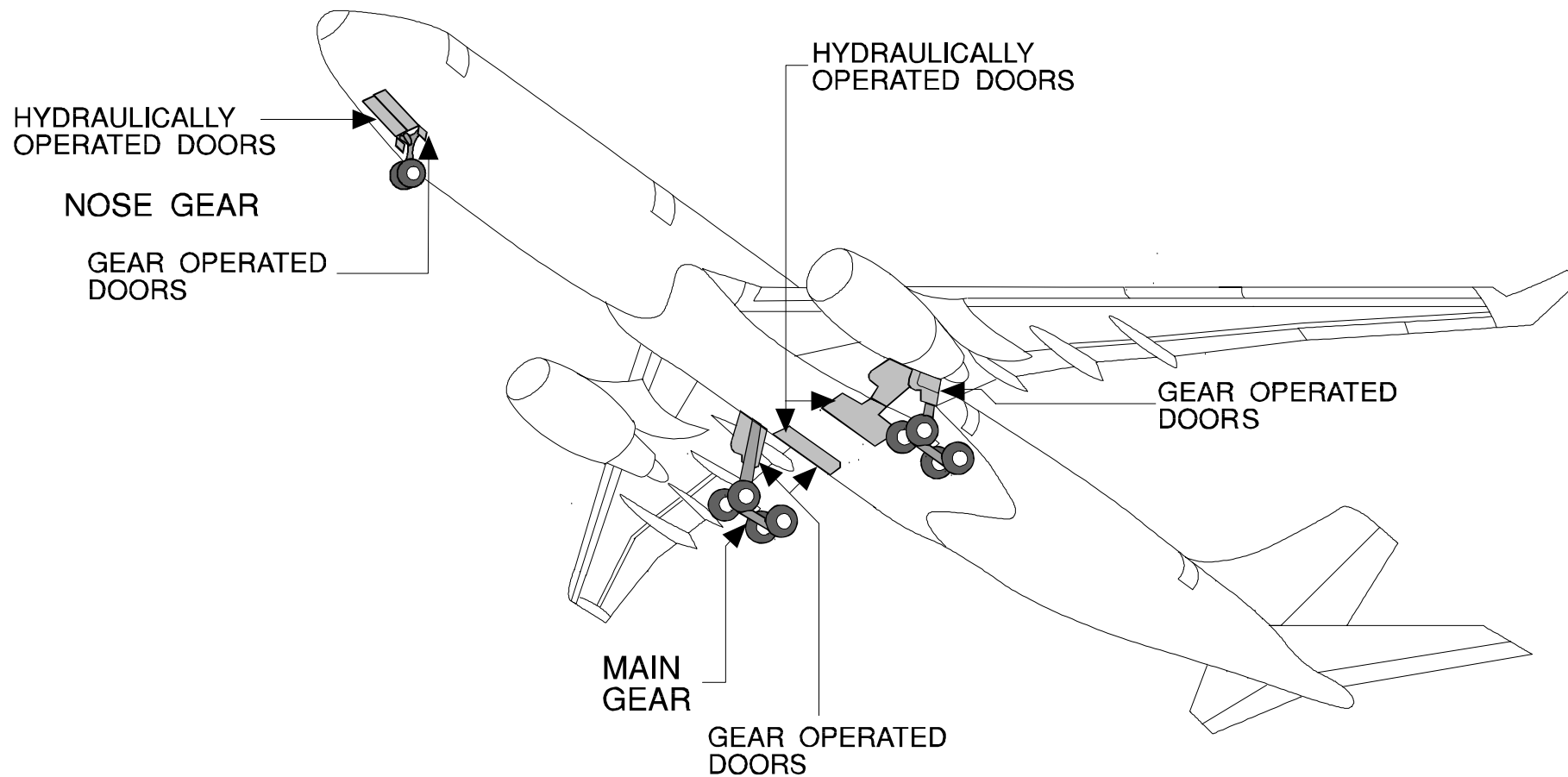
A hydraulically operated pitch trimmer on each bogie beam damps the movement and ensures return to normal position when the landing gear is free of the runway surface.

BRAKES

Carbon multidisc brakes are installed on main gear wheels only.

The rotation of the Nose wheels is stopped by friction pads after take off at the end of retraction cycle.

In case of brake overheating, fans provide cooling of all brakes (optional system).



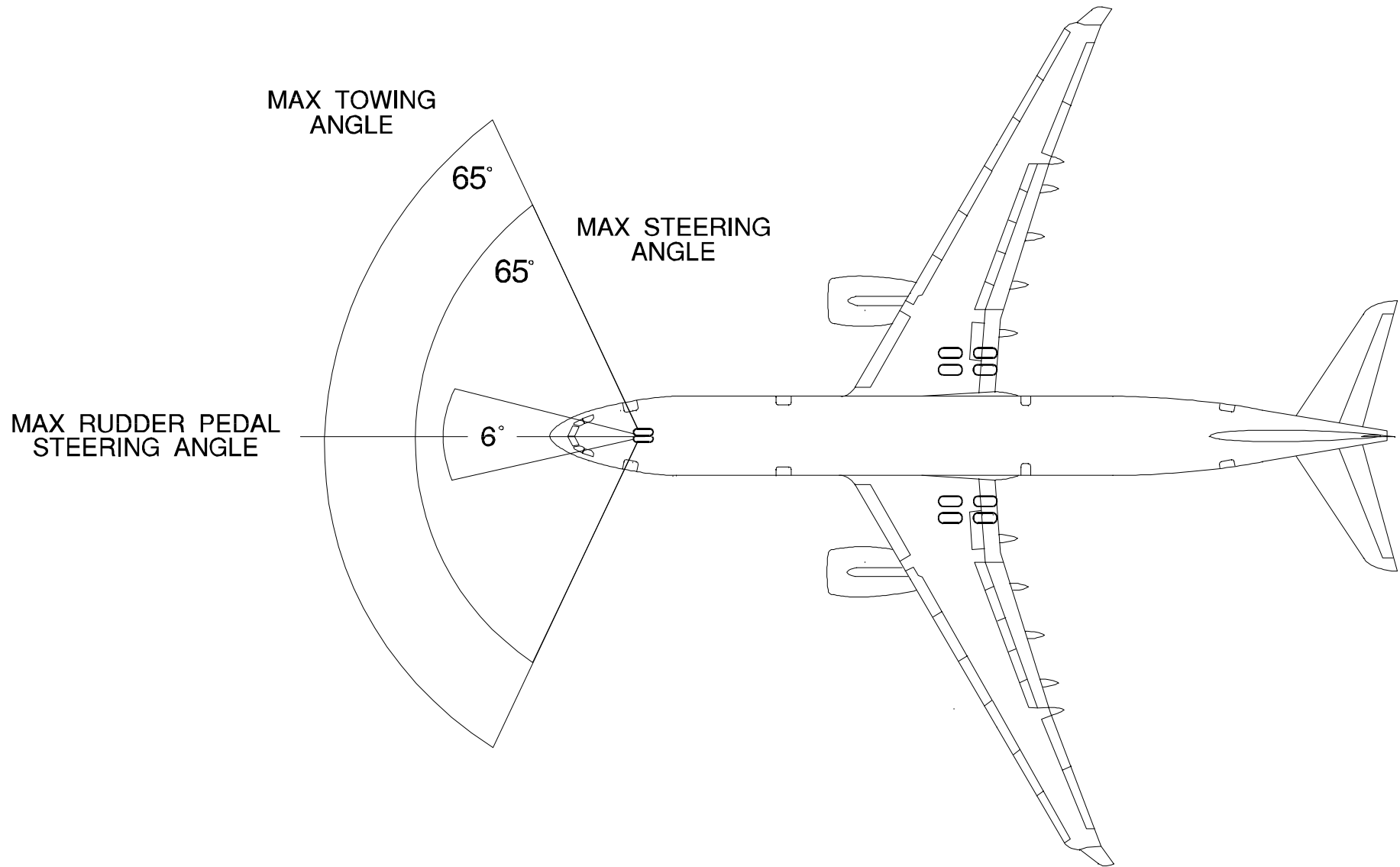
FQW4200 GE Metric

STEERING

The nose wheel steering system is electrically signalled and is powered by the green hydraulic system.

This enables an available powered steering over the range of 65° below 10 knots.

In addition, the aircraft can be towed or pushed back to a nose wheel angle of 65° from the aircraft centerline without any mechanical disconnection.



FQW4200 GE Metric

STUDENT NOTES:

FQW4200 GE Metric

SYSTEM CONTROL AND INDICATING

Landing Gear Panel
Automatic Braking
Anti Skid Switch
Triple Indicator
Control Lever
Free Fall Selectors
Parking Brake
ECAM System Display
Nose Wheel Steering Handwheel
Rudder Pedals
Brake Fan
Towing Warning Light

Except for the parking brake handle ; the rudder pedals and nosewheel steering handwheels, all landing gear and braking controls and indications are located on the main instrument panel.

LANDING GEAR PANEL

An "UNLOCK" light is provided for each gear. It comes on red when the corresponding gear is not locked in the selected position.

The green triangle comes on when the corresponding gear is locked down.

AUTOMATIC BRAKING

The auto brake pushbutton controls the arming of the required deceleration rate.

The "ON" light comes on blue to indicate positive arming when selected. The "DECEL" light comes on green when the correct deceleration is reached.

ANTI SKID SWITCH

An "ON/OFF" switch activates or deactivates the nosewheel steering and anti-skid functions.

TRIPLE INDICATOR

"ACCU PRESS" indicates the pressure in both blue brake accumulators.

"BRAKES" indicates a blue pressure delivered to left and right main gear brakes.

CONTROL LEVER

The lever must be pulled before selecting one of the two possible positions. When the landing gear is not downlocked in landing configuration, the red arrow of the control lever comes on.

FREE FALL SELECTORS

The two toggle selectors are linked together to operate as one control.

The selectors have three stable positions :

- center: OFF,
- down: DOWN,
- up: RESET.

PARKING BRAKE

Pull the handle and turn it clockwise to apply the brake.

CAUTION: as long as the handle is not in the "ON" position, the parking brake is not applied.

ECAM SYSTEM DISPLAY

The ECAM "WHEEL" page shows the landing gear, brake and steering controls and indications.

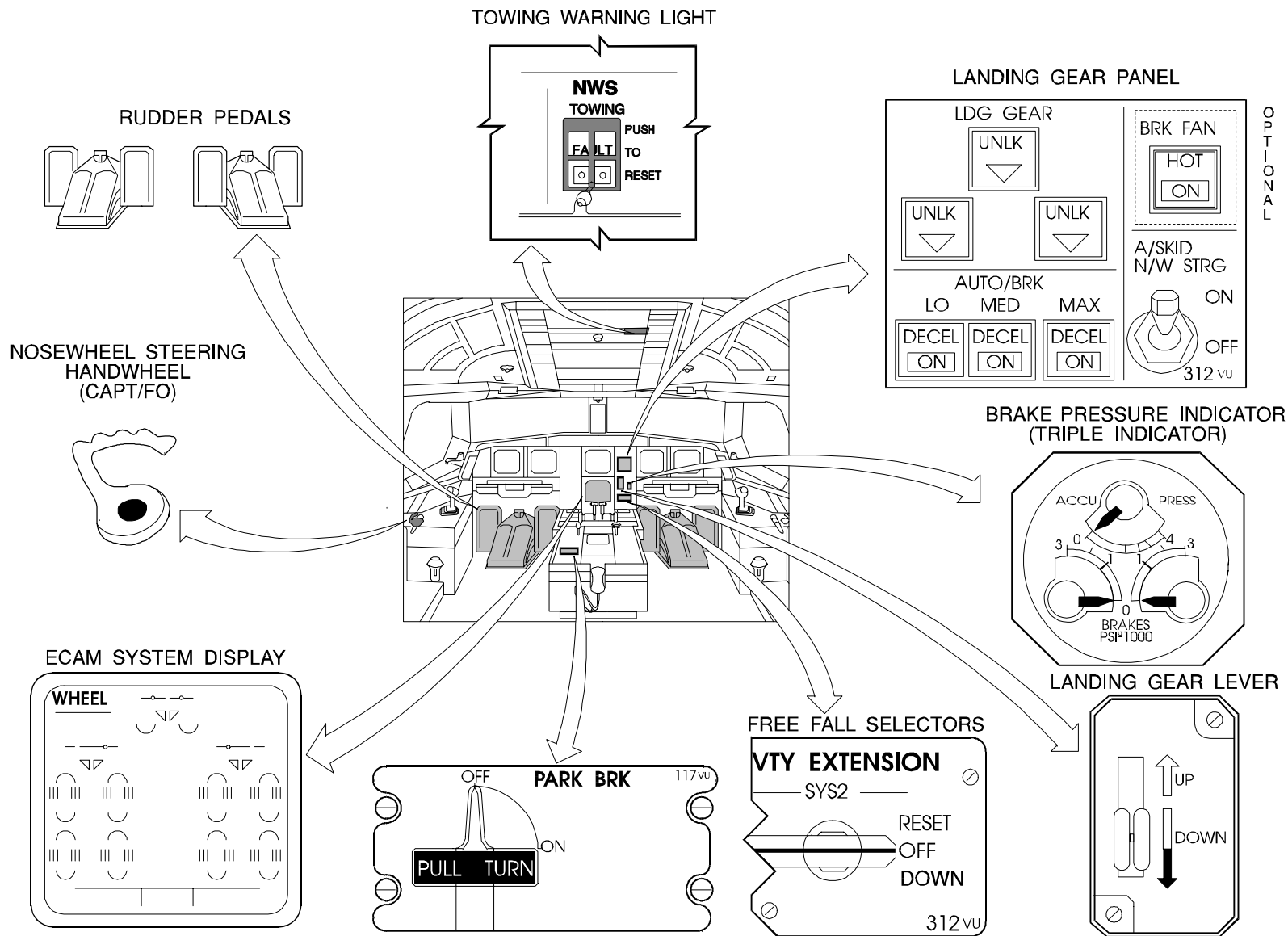
NOSE WHEEL STEERING HANDWHEEL

The steering handwheels control the nosewheel steering angle up to 65 degrees in either direction.

When the rudder pedal disconnect pushbutton is pressed, the nosewheel steering control by the pedals is disconnected.

RUDDER PEDALS

Manual braking is provided by the Captain and First Officer brake pedals.



FQW4200 GE Metric

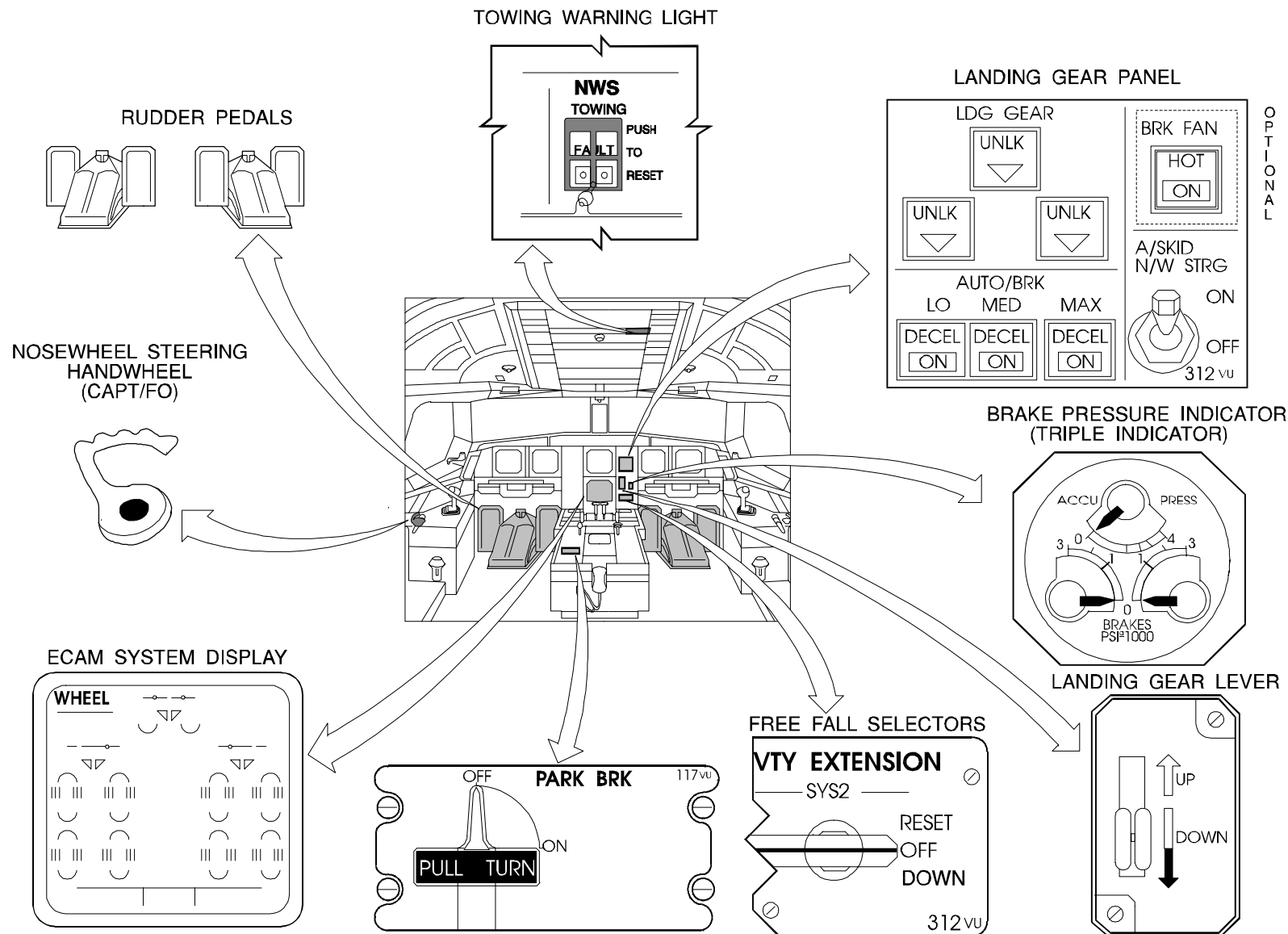
BRAKE FAN

If the Brake Fan System option is installed, the brake fan switch will be fitted on the panel.

The "HOT" light comes on amber to indicate a brake over-temperature. The blue "ON" light comes on when brake cooling fans are activated.

TOWING WARNING LIGHT

The FAULT light comes on red when the rotation angle limits of the Nose Landing Gear have been exceeded during towing operations.



FQW4200 GE Metric

STUDENT NOTES

FQW4200 GE Metric

LANDING GEAR ECAM PRESENTATION

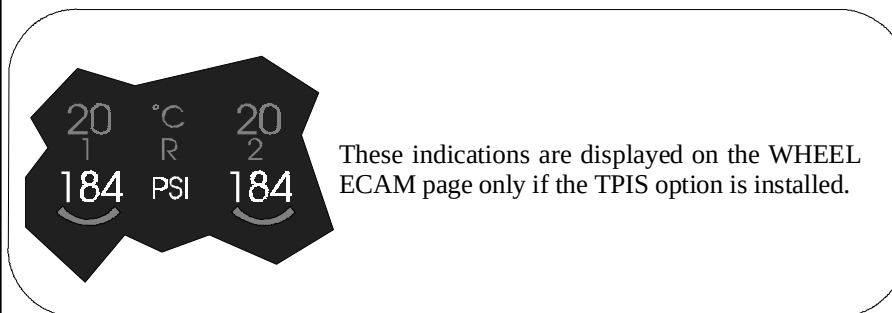
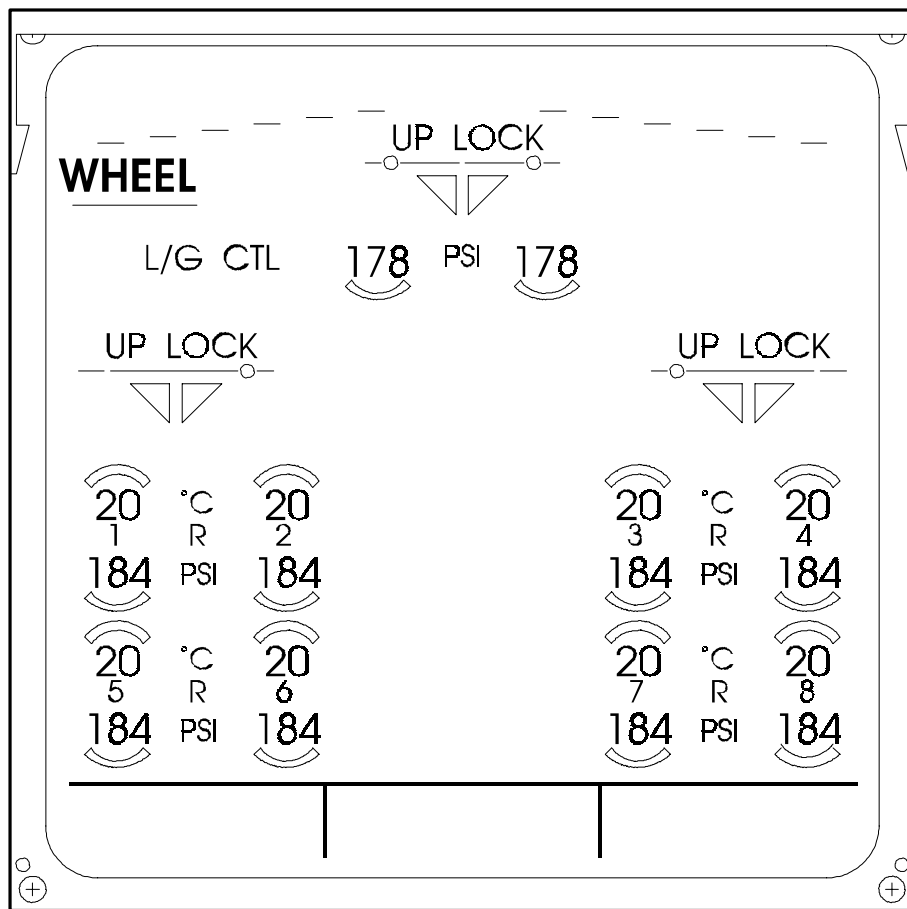
- General
- Landing Gear Position
- Landing Gear Door Position
- Uplock
- Landing Gear Control

GENERAL

The ECAM display provides visual indications of the position of the landing gear and doors.

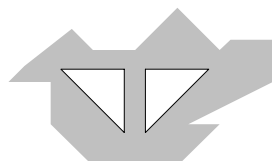
The WHEEL page is automatically displayed :

- On ground with engine running. It disappears when take-off power is applied.
- In flight when landing gear is selected "DOWN" or below 800 ft radio altitude. It disappears at engine shutdown.



LANDING GEAR POSITION

The position of each landing gear leg is indicated by a pair of triangles.
The left hand triangle is controlled by LGCIU 1, the right hand triangle by LGCIU 2.

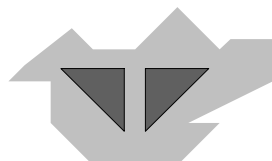


**BOTH
GREEN**

LGCIUs detect L/G downlocked.



No signal when LGCIUs detect L/G uplock.



**BOTH
RED**

LGCIUs detect L/G in transit.



LGCIUs failed.

AMBER



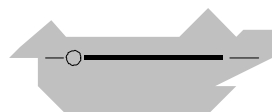
**ONE GREEN
ONE RED**

Indication discrepancy.
One green symbol is enough to confirm that a gear is downlocked.

LANDING GEAR DOOR POSITION

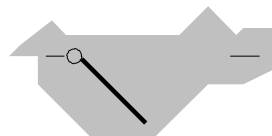
Three stable line indications are provided to show the landing gear door positions.

Here are the possible indications :



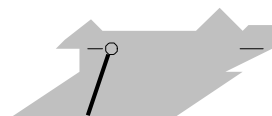
GREEN

Door locked up.



AMBER

Door in transit.



AMBER

Door fully open.

UNLOCK

The "UNLOCK" indication comes on when the landing gear is locked down and its unlock is closed.



AMBER

It appears amber associated with an ECAM caution, if any landing gear unlock is inadvertently engaged by maintenance people when the corresponding landing gear is downlocked.

LANDING GEAR CONTROL

The "LANDING GEAR CONTROL" indication comes on as soon as the landing gear position does not correspond to the control lever position.



AMBER

It appears amber associated with an ECAM caution, in case of disagreement between landing gear lever and landing gear position.
It also appears during extension and retraction sequence.

STUDENT NOTES

MAIN LANDING GEAR PRESENTATION

Leg Assembly
Shock Absorber
Side Stay Assembly
Lock Stay
Lock Springs
Torque Links
Shortening Mechanism
Actuator
Lock Stay Actuator
Uplock Assembly
Pitch Trimmer
Bogie Beam
Side Stay

LEG ASSEMBLY

The main landing gear leg is the primary part of the main landing gear.

The main landing gear leg has attachments for :

- the side stay,
- the main gear actuator,
- the bogie beam,
- the pitch trimmer,
- the torque links,
- the articulating links.

SHOCK ABSORBER

The shock absorber transmits the landing, take-off and taxiing loads to the wing and absorbs landing energy.

The shock absorber is a capsule that includes the sliding tube.
It is an inverted oleopneumatic unit that is installed in the main fitting.

SIDE STAY ASSEMBLY

A side stay assembly holds the main landing gear in the extended position.

The side stay assembly includes a side stay, a lock stay, a lock stay actuator and two pairs of lock springs.

LOCK STAY

The lock stay is the mechanical downlock for the main landing gear.
It is a two "H" section links that move around a central pin.

A forked end attaches the lock stay to the basic side stay and a cardan joint attaches it to the main fitting.

A ground-lock pin can be installed through the links of the lock stay when they are in the overcenter position.

LOCK SPRINGS

Tension springs are installed in the upper and lower channels of the upper side stay and are connected between the basic side stay and a lever on the lock stay.

During the extension cycle the lock springs move the lock stay to an overcenter position and keep it there.
For removal and installation, special tools are required.

TORQUE LINKS

The torque links are attached to the main landing gear leg and the sliding tube to prevent rotation of the bogie assembly.

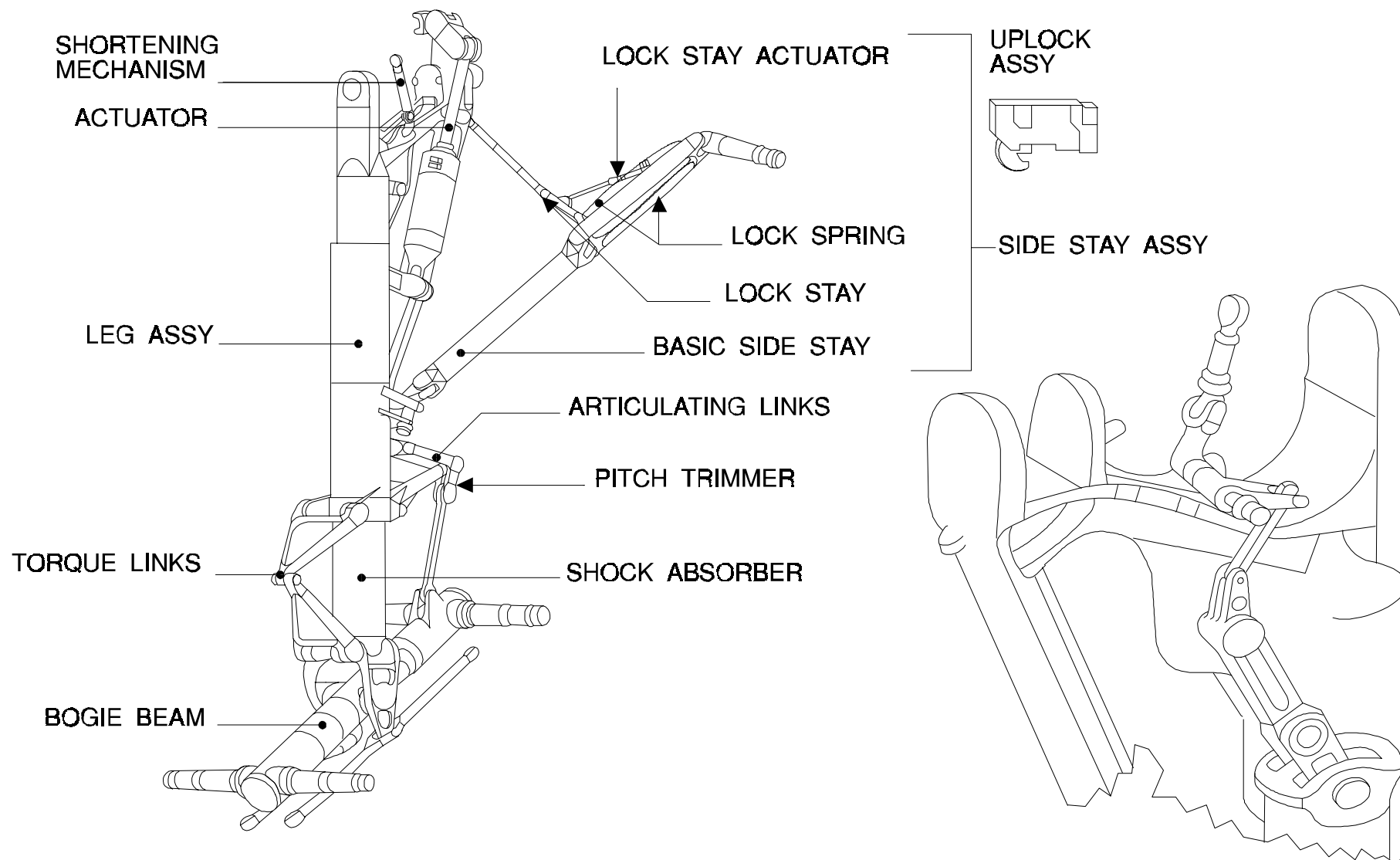
The upper torque link is attached to the main landing gear leg and the lower link to the sliding tube.

SHORTENING MECHANISM

The shortening mechanism, contained in the main fitting, is a mechanical linkage assembly in two parts:

- the drive links, that control the movement of the shock absorber,
- the main linkage, that moves the shock absorber capsule during extension and retraction.

During retraction of the main landing gear, with the over center lock released, the shortening mechanism pulls the lower main link (with the shock absorber) up, which sufficiently decreases the length of the main landing gear leg, so that it can go into the main gear bay.



FQW4200 GE Metric

ACTUATOR

The main landing gear retraction actuator is attached at the fixed end of the inboard side of the gear main fitting.

The retraction actuator is connected at one end to the main fitting and at the other end to a retraction bracket which pivots around the front pintle pin. The retraction bracket is connected to the rear spar by a fixed link.

LOCK STAY ACTUATOR

The main landing gear lock stay actuator is attached at the fixed end to the upper side stay link and to the lock stay links by the rod end.

The lock stay actuator is hydraulically powered to overcenter the lock stay, which prevents the side stay from folding.

UNLOCK ASSEMBLY

The main landing gear uplock is a mechanical device that automatically locks the main gear in the retracted position.

The uplock is closed mechanically and opened hydraulically in the normal extension and retraction sequence.

The uplock can also be opened mechanically in the free fall extension.

PITCH TRIMMER

The pitch trimmer is installed between the main fitting and the upper links.

A set of articulating links (two upper and one lower) connects the main fitting to the front of the bogie beam.

The green hydraulic system continuously supplies the pitch trimmer which maintains the required geometry of the links during retraction sequence, take off and landing phases.

BOGIE BEAM

A bogie beam is located at the lower end of the sliding member.

Each main landing gear has a four wheel bogie beam, which hinges around a pin near the bottom of the sliding tube.

It has two axles for the wheels and brakes.

SIDE STAY

The side stay assembly is installed between the rear spar of the wing and the main fitting of the main landing gear leg.

Universal cardan joints attach the side stay assembly at each position.

MAIN LANDING GEAR DOORS PRESENTATION

Main Door Assembly
Fairing Door Assembly
Door Actuator
Door Uplock Assembly

MAIN DOOR ASSEMBLY

The main landing gear doors are made of carbon fibre reinforced plastic with a nomex honeycomb core.

Each main door is hinged at the keel beam and closes outboard.

A ramp on the door ensures that the main gear does not get caught on the door during a free fall extension.

FAIRING DOOR ASSEMBLY

The leg fairing door is attached to the main landing gear leg and operates with it.

The hinged door is installed on a hinge on the lower wing surface.

An adjustable rod connects the hinged door to the MLG leg.

When the main gear operates, the rod operates the hinged door.

DOOR ACTUATOR

The main landing gear door actuator operates the main door during the extension and retraction sequences.

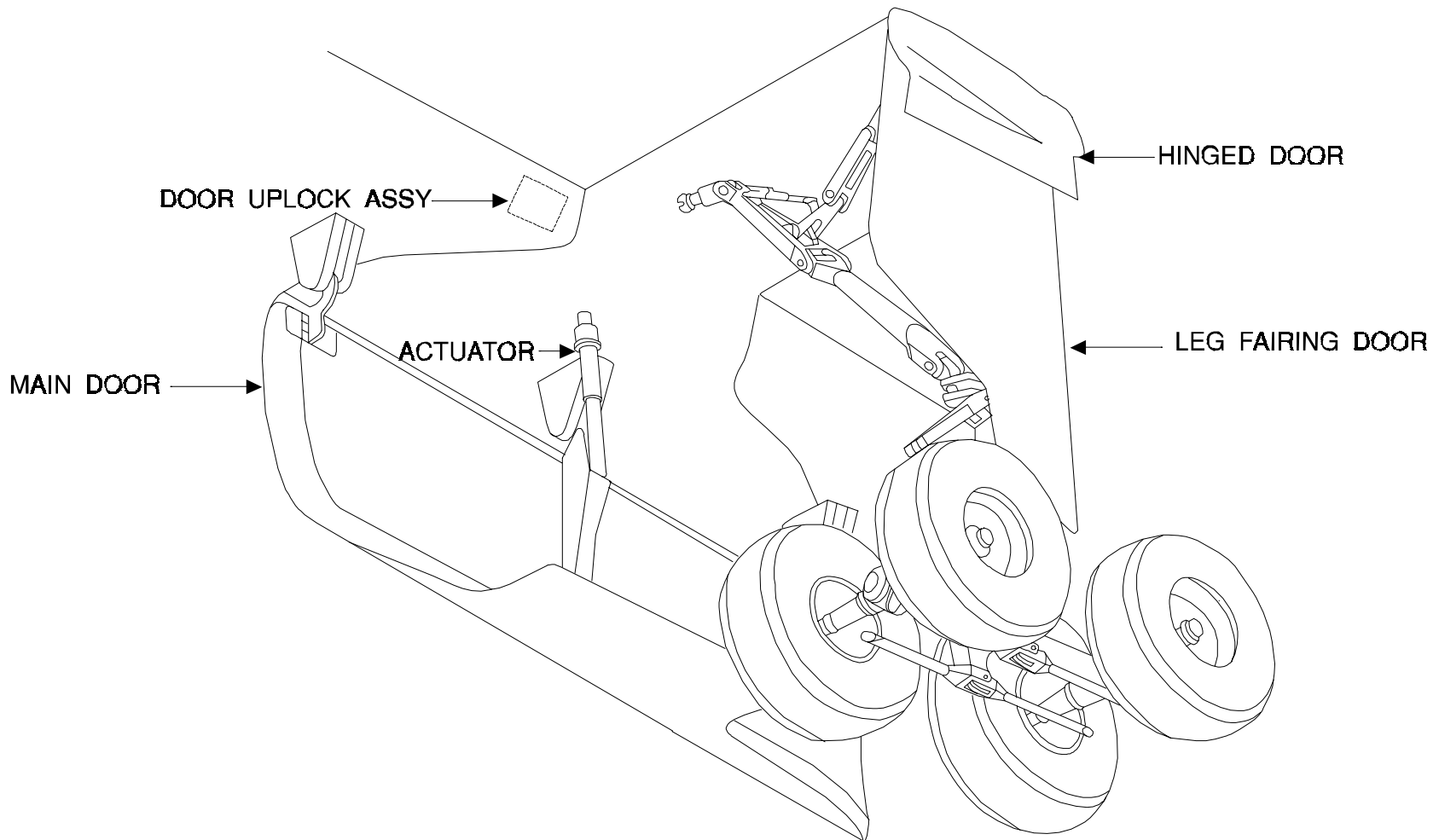
The door opens in sequence before movement of the main gear, but closes when the main gear is uplocked or downlocked.

DOOR UPLOCK ASSEMBLY

The main landing gear door uplock is a mechanical device that automatically locks the main landing gear doors in the closed position.

The uplock is closed mechanically and opened hydraulically in the normal extension and retraction modes.

The uplock can also be mechanically opened for free fall extension and ground door opening.



FQW4200 GE Metric

STUDENT NOTES

NOSE LANDING GEAR PRESENTATION

Leg Assembly
Shock Absorber
Drag Stay Assembly
Lock Stay
Lock Springs
Torque Links
Swivel Bearing Assembly
Retraction Actuator
Downlock Actuator
Uplock Assembly
Steering Actuators

The nose landing gear, with a twin wheel axle, is installed in the forward fuselage and retracts forward into the nose landing gear bay.

LEG ASSEMBLY

The landing gear leg consists of a main fitting with a sliding tube assembly that includes the axle and a shock absorber with a wheel steering assembly.

The main fitting comprises the following parts :

- a barrel,
- a cross member,
- two side stays,
- two aircraft attachment lugs.

SHOCK ABSORBER

The nose landing gear has a two stage oleo-pneumatic shock absorber that decreases the landing, take-off and taxiing loads that are transmitted to the aircraft structure.

The shock absorber comprises the main fitting (with a piston stop tube) and the sliding tube (which moves vertically in the main fitting).

DRAG STAY ASSEMBLY

A drag stay assembly is installed between the underfloor of the pressure bulkhead and the front of the main fitting.

The drag stay assembly keeps the nose landing gear leg rigid when it is in the extended position and includes a lock stay, a downlock actuator and a pair of downlock springs.

LOCK STAY

The lock stay is installed between the main fitting and the center pivot point of the drag stay. It has an upper link and a lower link.

The lock stay holds the drag stay in a straight configuration when the nose landing gear is extended.

A ground-lock pin can be installed in the center pivot of the lock stay when the nose landing gear is downlocked.

LOCK SPRINGS

A pair of lock springs is connected between the upper link of the lock stay to the front of the main fitting.

The lock springs keep the lock stay in its overcenter, locked position, when the nose landing gear is extended.

For removal and installation, special tools are required.

TORQUE LINKS

The torque links are designed to react to the torque along the vertical centerline in the event of unequal wheel loading or when turning the aircraft. The upper torque link is attached to the steering collar and the lower link to the sliding member.

SWIVEL BEARING ASSEMBLY

The two swivel bearings are mounted between a fixed and a moving assembly. They keep the pins aligned preventing any additional friction and possible bending.

RETRACTION ACTUATOR

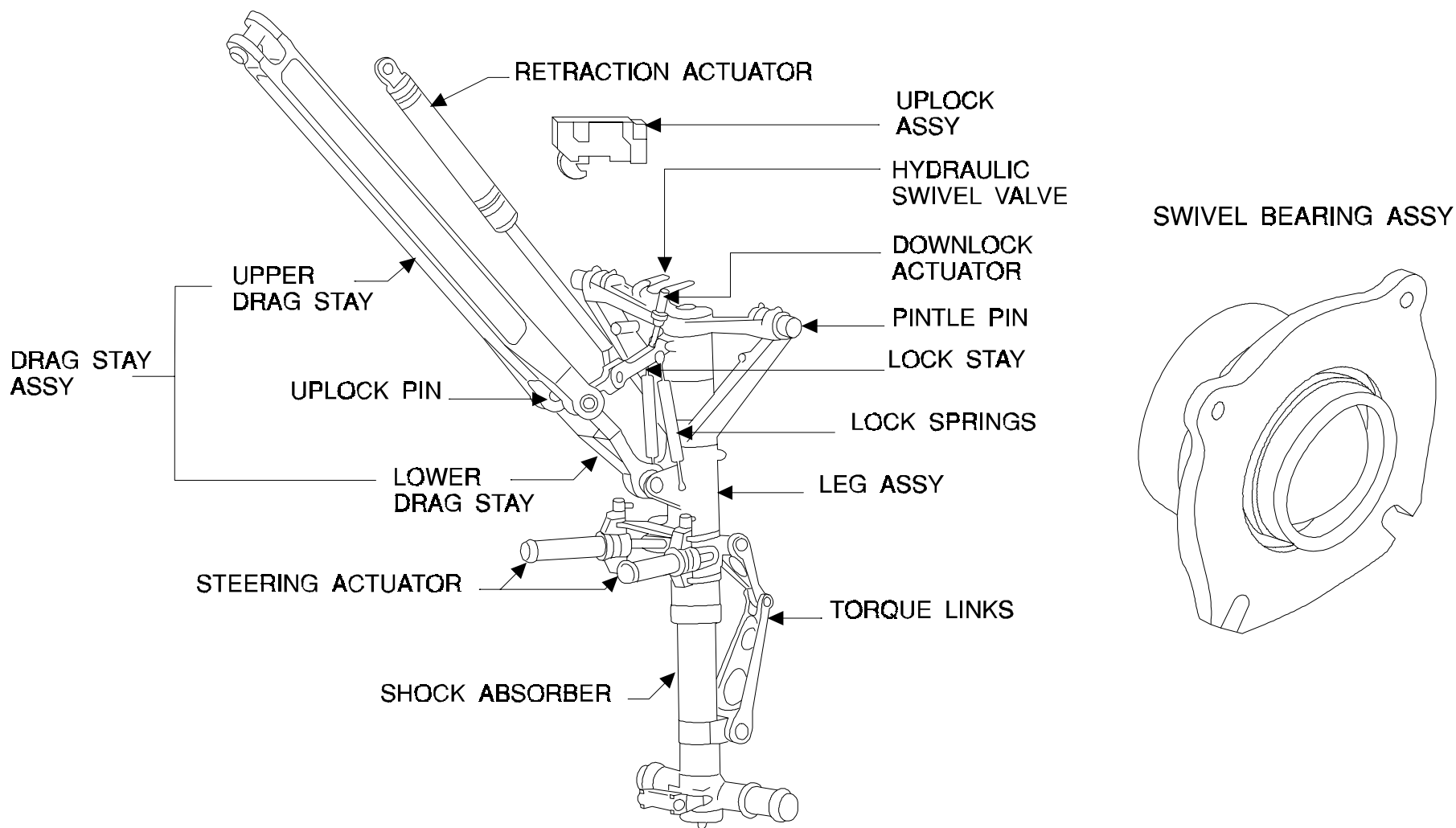
The nose landing gear retraction actuator is attached to the gear leg at the piston rod end and to the nose landing gear bay roof at the fixed end.

DOWNLOCK ACTUATOR

The nose landing gear is fitted with a downlock actuator to operate the lock links between the drag stay and the main fitting.

During retraction, the downlock actuator releases the overcenter lock of the lockstay.

During extension, the tension of the downlock springs and the hydraulic pressure of the downlock actuator unfold the lock stay and the drag stay until they reach their overcenter position.



UPLOCK ASSEMBLY

The nose landing gear uplock is a mechanical device that automatically locks the nose landing gear in the retracted position.

The uplock is closed mechanically and opened hydraulically in the normal extension and retraction sequence.

The uplock can also be opened mechanically for the free fall extension.

STEERING ACTUATOR

The nose wheels are steered by twin, double acting hydraulic actuators which pivot on attachments on the main fitting.

NOSE LANDING GEAR DOORS PRESENTATION

Main Door Assembly
AFT Door Assembly
Nose Leg Door
Door Uplock Assembly

The nose landing gear doors are made from carbon fibre reinforced plastic with nomex honeycomb core.

MAIN DOOR ASSEMBLY

Each forward door hinges at the forward side of the nose landing gear bay, to close inward to a dual-hooked uplock at the front of the bay.

A nose landing gear door actuator independently operates each forward door.

AFT DOOR ASSEMBLY

Each aft door has hinges at its outer edge. Adjustable rods connect the rear doors to the nose landing gear leg.

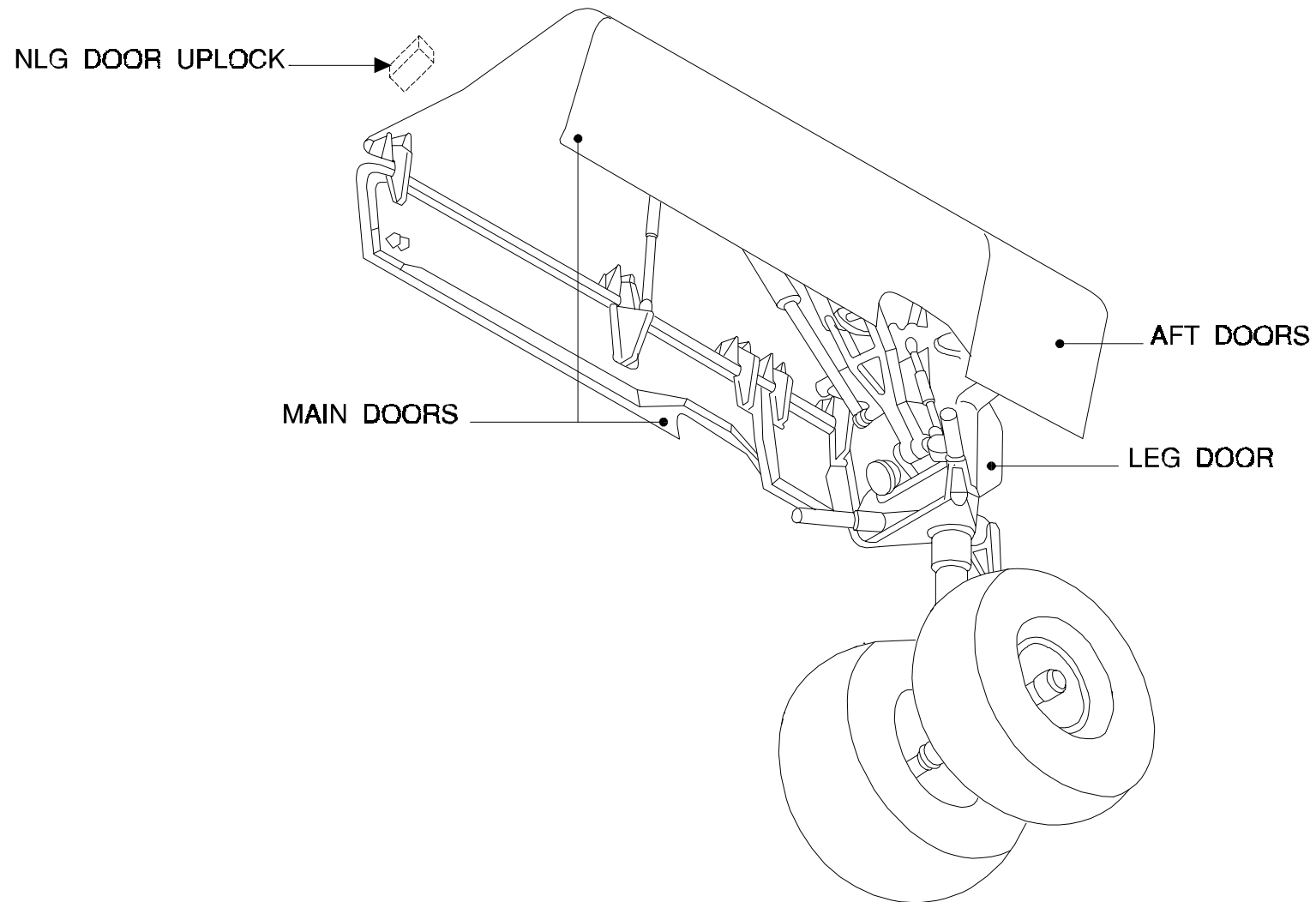
NOSE LEG DOOR

The fixed fairing, at the rear of the nose landing gear leg is the shape of the cut out in the two forward doors.

DOOR UPLOCK ASSEMBLY

The nose landing gear door uplock is a mechanical device that automatically locks the nose landing gear doors in the closed position.

The uplock can also be mechanically opened for free fall extension and ground door opening.



STUDENT NOTES

NORMAL OPERATION

Principle
Retraction
Extension

PRINCIPLE

Landing gear normal operation is controlled through a lever located on the main instrument panel.

The landing gear control lever has two positions only :

UP
DOWN

Gear and door sequencing is electrically controlled by Landing Gear Control and Interface Unit 1 or 2.

An interlock mechanism prevents unsafe retraction when landing gear is not in flight condition.

Each Landing Gear control and Interface Unit controls one complete cycle : one "UP" selection and one "DOWN" selection.

The LGCIUs switch over automatically at each landing gear retraction cycle, or in case of sequencing system failure.

The two systems are electrically segregated with different connections on the related selector valves.

Other aircraft systems are linked to the LGCIUs for "FLIGHT" / "GROUND" signals.

In normal operation, all gears and doors are hydraulically actuated by the green hydraulic system.

In case of failure, landing gear can be extended through an electro-mechanical system, using a pair of switches located in the cockpit.

Landing gear indicators are located on the main instrument panel.

The two LGCIUs process gear position, sequencing information and gear lever selection.

They also provide Landing gear warning information to the ECAM.

RETRACTION

At this stage of the operation, the landing gear is down and locked.

The aircraft is in flight condition.

Landing Gear Control and Interface Unit 1 is in command.

Landing Gear Control and Interface Unit 2 is in stand by.

At each gear UP selection, a changeover of control from the previous stand by Landing Gear Control and Interface Unit is performed.

Landing gear retraction sequence :

Doors open.
Gear retracts.
Doors close.

The hydraulic supply to the landing gear circuit is automatically cut off by a safety valve above 280 knots.

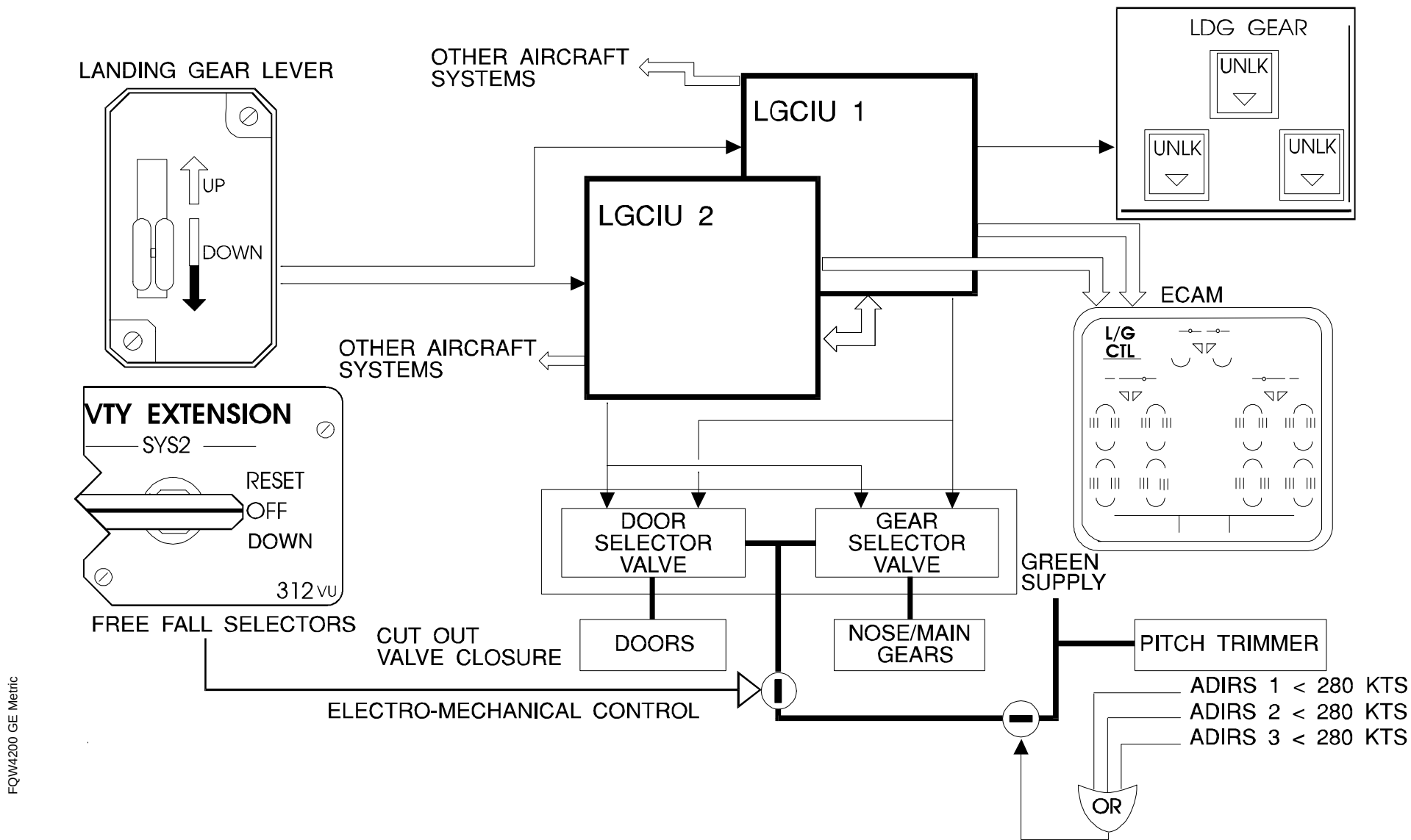
EXTENSION

All gears are retracted and uplocked , and all doors are closed and uplocked.

At each gear "DOWN" selection the LGCIU in command controls the extension sequence.

Landing gear extension sequence :

Doors open.
Gear extends.
Doors close.



FQW4200 GE Metric

STUDENT NOTES:

FQW4200 GE Metric

NORMAL SEQUENCE DESCRIPTION AND OPERATION

Description
Selection

RETRACTION

Doors Open
Gear Locked Up
Doors Closed

EXTENSION

Doors Open
Gear Locked Down
Doors Closed

DESCRIPTION

The landing gear and door actuation is electrically signalled by one of the two Landing Gear Control and Interface Units.

The electrical wirings to the Landing Gear Control and Interface Units are duplicated with segregated routings.

These computers also control the sequencing of the gear and doors during extension and retraction sequence.

Landing Gear Control and Interface Units receive position information from proximity sensors and command orders from the landing gear lever.

Both Landing Gear Control and Interface Units simultaneously send landing gear and door position to the ECAM wheel page.

The correct operation of the landing gear and doors is detected by proximity sensors and indicated to the ECAM and landing gear indicator panel.

NOTE: During retraction the main wheel bogie beam is repositioned from a trailing mode to a horizontal mode before entering the main landing gear bay.

The hydraulic supply is taken from the green system via the safety valve and the cut out valve.

The safety valve is operated by dual solenoids and is energized to open.

The safety valve is de-energized when the calibrated airspeed increases above 280 kts.

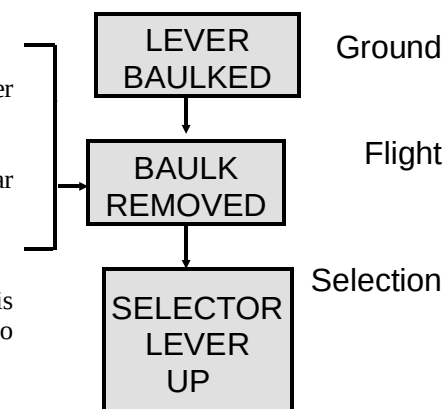
It is energized to open when the gear is selected down and speed is below 280 kts.

SELECTION

The gear is extended and downlocked; hydraulically operated doors are closed and uplocked.

- Nose gear shock absorber extended
- Nose wheel steering centered
- LH RH bogie trail angle with gear locked down

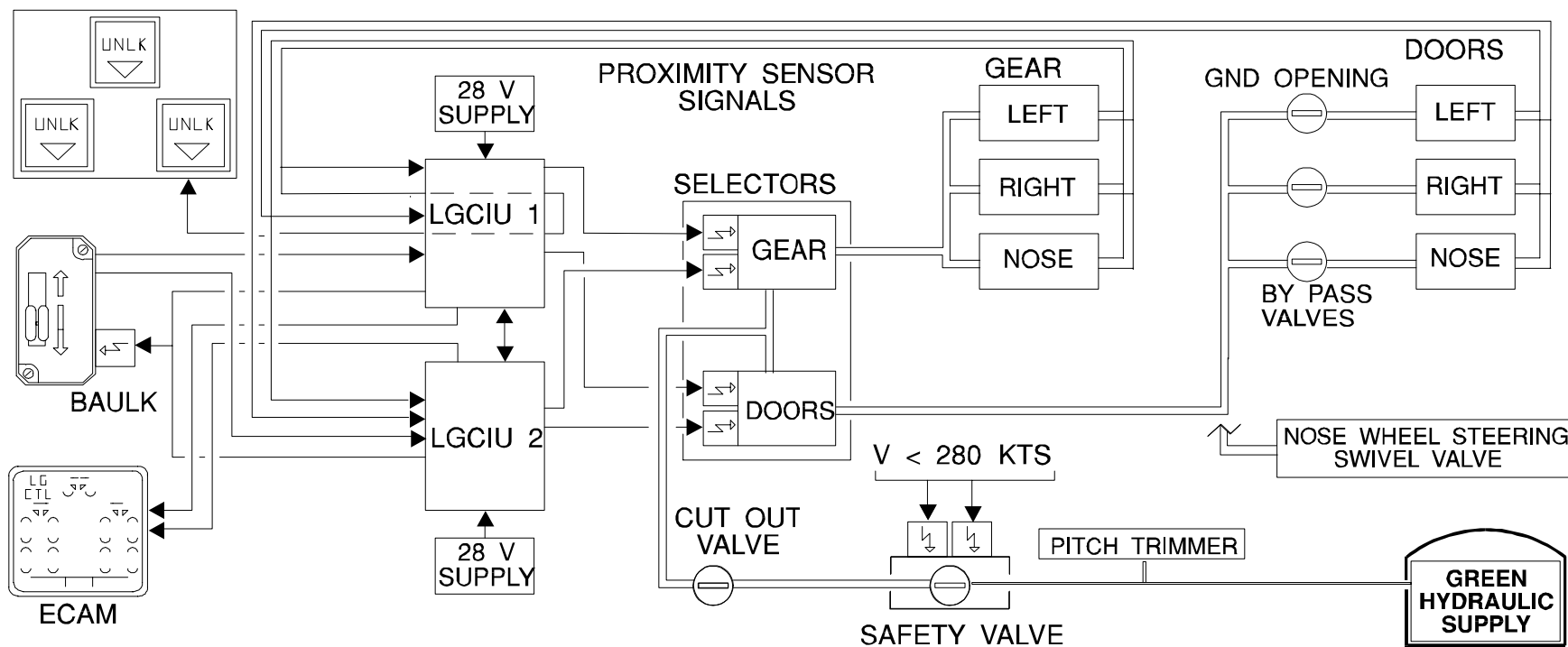
* At each gear UP selection there is a change over from LGCIU 1 to LGCIU 2 or vice versa.



On the landing gear downlock indicator lights panel, the landing gear position is given by independent proximity sensors from the extension retraction indicating system. They are connected to the indicator lights by an independent wired circuit through LGCIU 1.

Each light shows the landing gear position:

- the red UNLK legend when the landing gear is not in the selected position,
- the green triangle when the landing gear is in the downlocked position,
- no light when the landing gear is in the uplocked position.

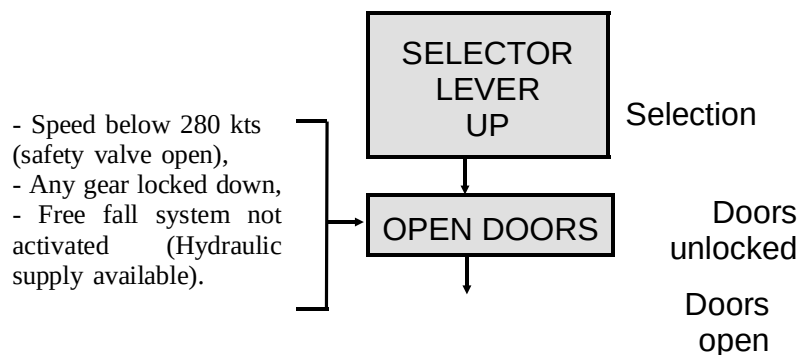


FQW4200 GE Metric

RETRACTION

DOORS OPEN

All hydraulically operated doors start to open and are held in the fully open position by the door actuators. Proximity sensors indicate that doors are in the fully open position.

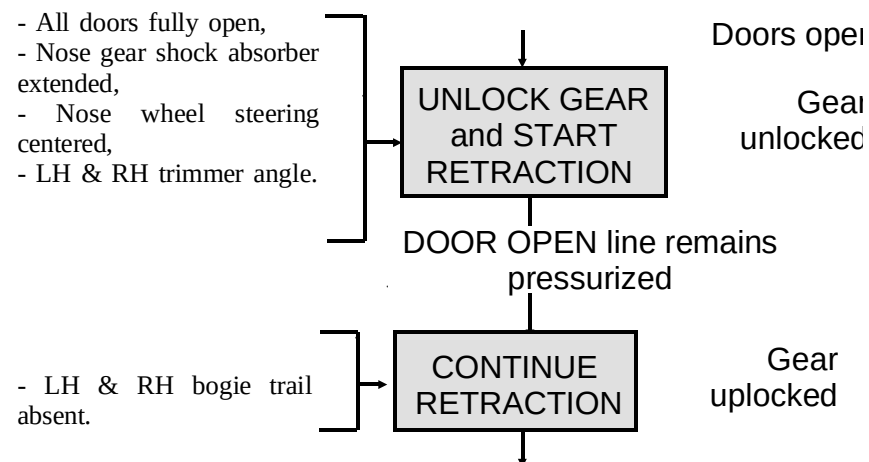


GEAR LOCKED UP

On retraction, the shortening mechanism moves the bogie beam and holds it in the horizontal position for entering the main gear bay.

Landing gear legs retract into their respective stowage bays and are uplocked.

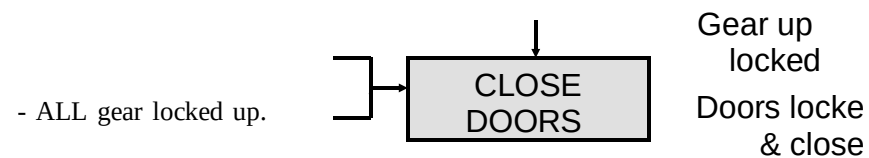
Proximity sensors indicate that the gear uplocks are locked.



DOORS CLOSED

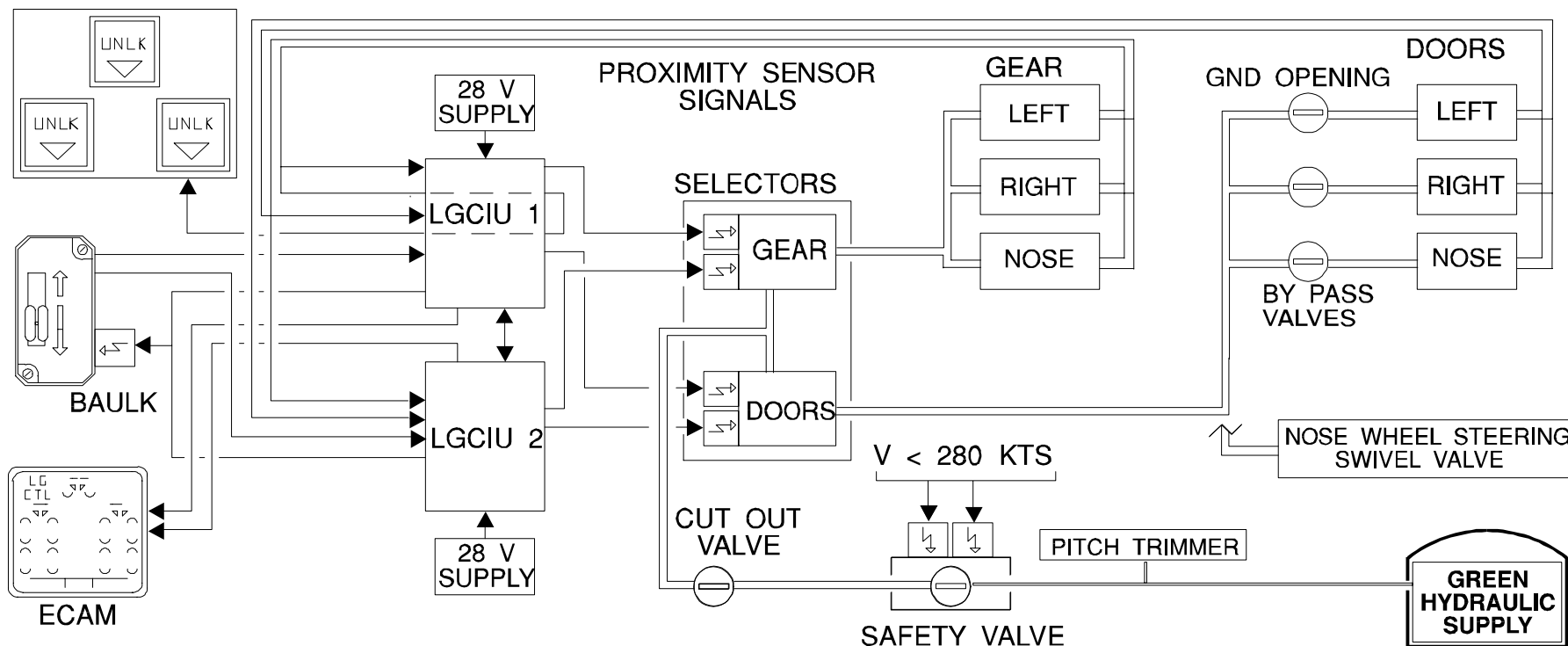
All hydraulically operated doors are closed and uplocked.

Proximity sensors indicate that the door uplocks are locked.



The safety valve is de-energized when the calibrated airspeed increases above 280 knots.

The complete landing gear hydraulic system is then depressurized.



FQW4200 GE Metric

EXTENSION

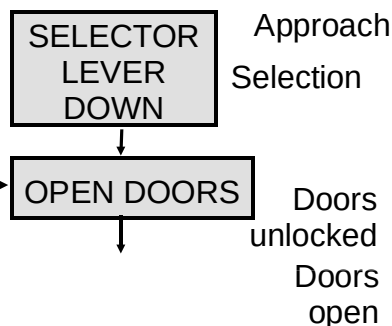
DOORS OPEN

Landing gear control lever is selected DOWN.

All hydraulically operated doors start to open and are held in the fully open position by the door actuators.
Proximity sensors indicate that the doors are in the fully open position.

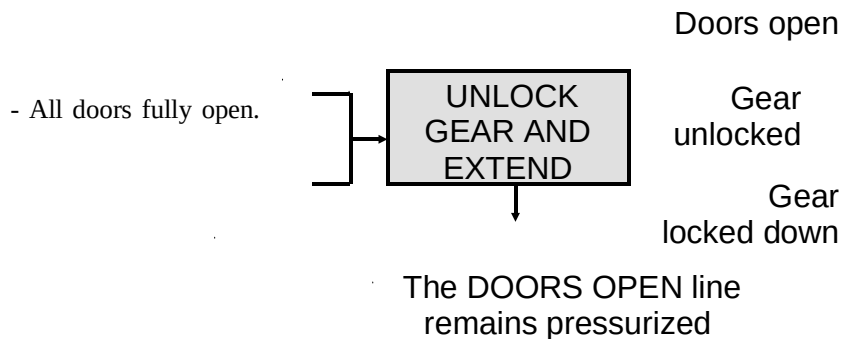
SYSTEM DEPRESSURIZED

- Speed below 280 kts (safety valve open),
- Any of nose or main gear locked up,
- Free fall system not activated (Hydraulic supply available).



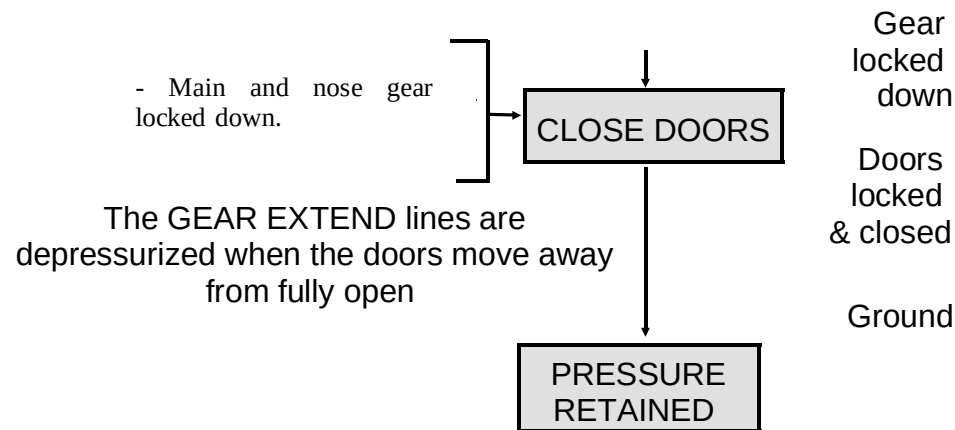
GEAR LOCKED DOWN

Landing gear is extended and downlocked.
Proximity sensors indicate the downlock condition of the gear.



DOORS CLOSED

All hydraulically operated gear doors are closed and uplocked.
Proximity sensors indicate that the door uplocks are locked.



STUDENT NOTES:

FQW4200 GE Metric

STUDENT NOTES

FREE FALL EXTENSION

Free Fall Selectors
Electric Actuators

FQW4200 GE Metric

FREE FALL SELECTORS

In case of normal extension failure, the landing gear can be extended by gravity through an electro-mechanical system.

The power supply is duplicated and is controlled by toggle selectors on the main instrument panel.

Two toggle selectors are mechanically linked to each other to operate as one control in flight conditions, but they may be separated and operated individually for test purposes.

The normal hydraulic system may be restored by setting the selectors in the "RESET" position.

When the gear is returned to the normal stowed position, the selectors may then be set to "OFF".

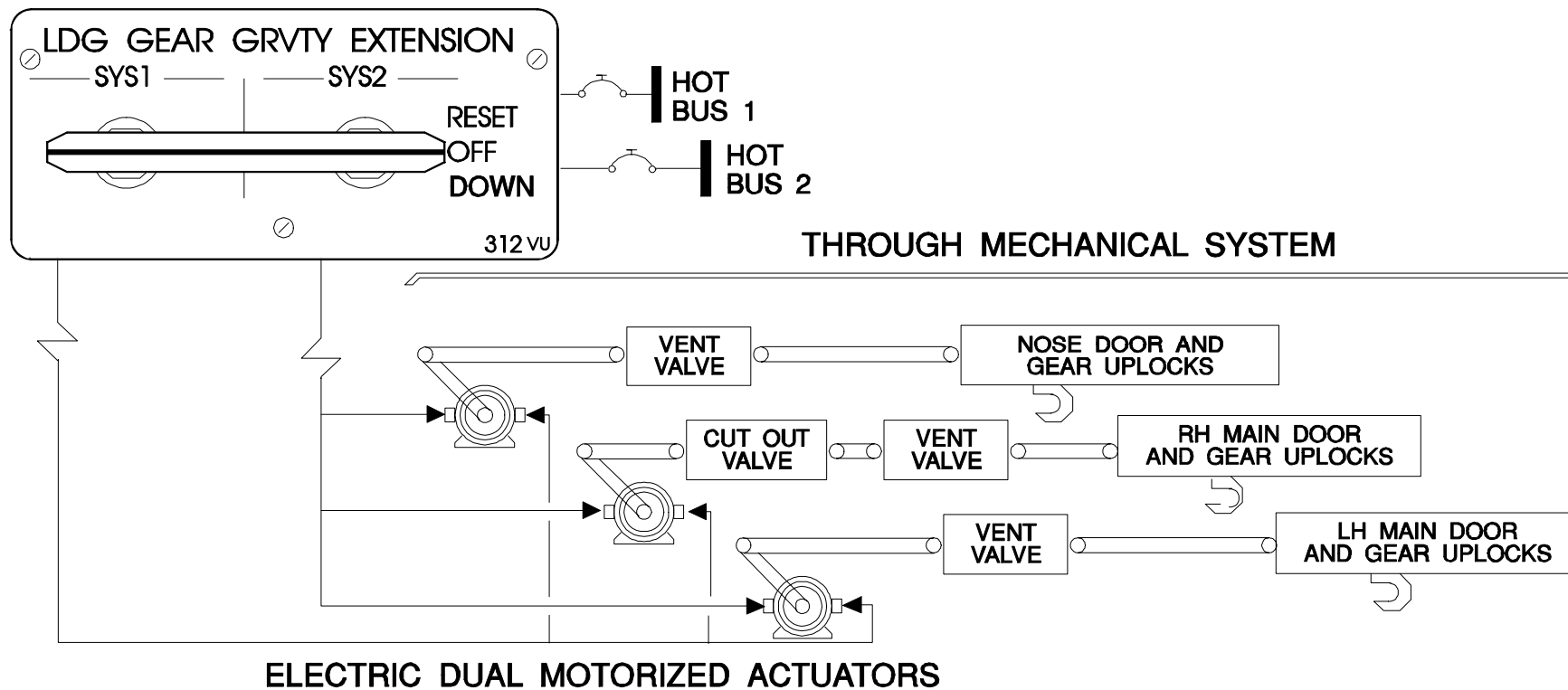
ELECTRIC ACTUATORS

Operation of the free fall system is achieved by electric motorised actuators, one for each main gear and one for nose landing gear.

When the toggle selectors are set to the "DOWN" position an electrical supply is connected to both motors in each actuator.

A mechanical linkage connects the motorized actuator to the vent valve, the door uplocks and the gear uplocks.

In addition there is a cut out valve which isolates the whole landing gear system from the green hydraulic supply when the the FREE FALL system is operated



FQW4200 GE Metric

STUDENT NOTES:

FREE FALL EXTENSION DESCRIPTION AND OPERATION

Description
Operation
Reset

FQW4200 GE Metric

DESCRIPTION

The Free Fall Extension system comprises electric dual motorized actuators:

- one for each main gear and,
- one for the nose landing gear.

In the nose and main landing gear bays, a mechanical linkage connects the motorized actuators to: VENT VALVES; DOOR UPLOCK and GEAR UPLOCK.

In addition, there is a CUT OUT VALVE in the right hand main landing gear bay.

OPERATION

CAUTION: The free Fall Extension system can be operated with aircraft not electrically powered (the electrical actuators are supplied by the hot busses). Normally both motors, in the electrical actuators, are energized together and the actuators reach full travel in approximately ten seconds.

The output of the electrical motor is in the form of a reduction gear box. If one motor or its power supply fails the other motor will drive the actuator to full travel in approximately 20 sec.

When the electrical actuators are energized the output shaft moves by 90 degrees to release the door and gear uplocks.

During the travel the control linkage is arranged to sequence the operation as follows:

- (1) - CUT OUT VALVE operates.
This isolates the whole landing gear system from the green hydraulic supply.
- (2) - VENT VALVES operate, connecting all gear and door actuators to the green hydraulic system return.
- (3) - DOOR UPLOCK boxes operate releasing the hook.
- (4) - GEAR UPLOCK boxes operate and gear falls down by gravity.

RESET

After a Free Fall Extension test, the normal landing gear hydraulic system may be restored as follows:

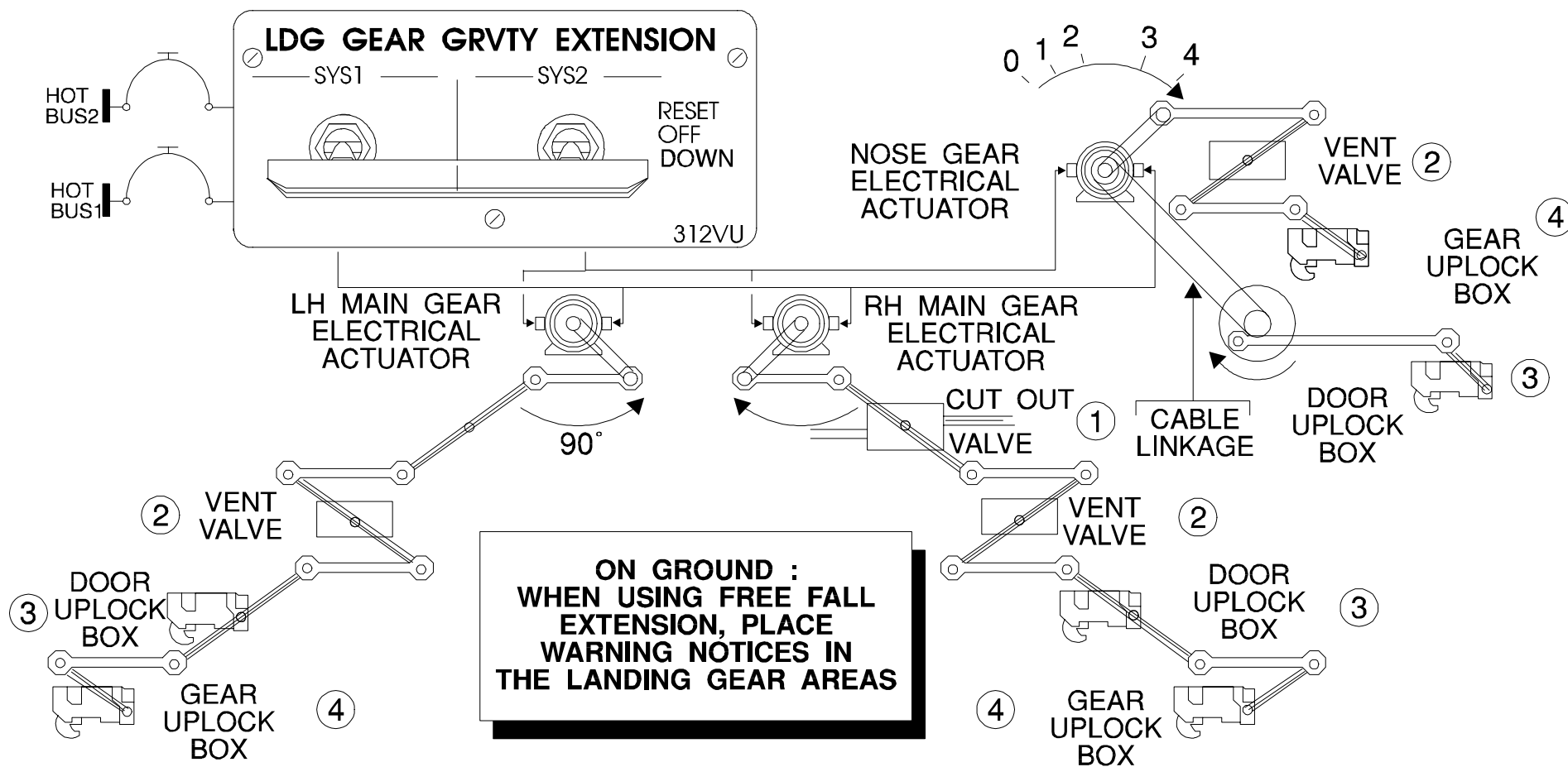
- with the landing gear control lever set to DOWN, reset the system by setting the toggle selectors to "RESET".

The actuator output shaft moves by 90° in reverse direction.

Upon completion of the reset, the hydraulic pressure is restored.

Doors are pressurized open while landing gear is retracted and then doors close.

The three electrical actuators are then de-energized by setting the toggle selectors to OFF.



FQW4200 GE Metric

STUDENT NOTES:

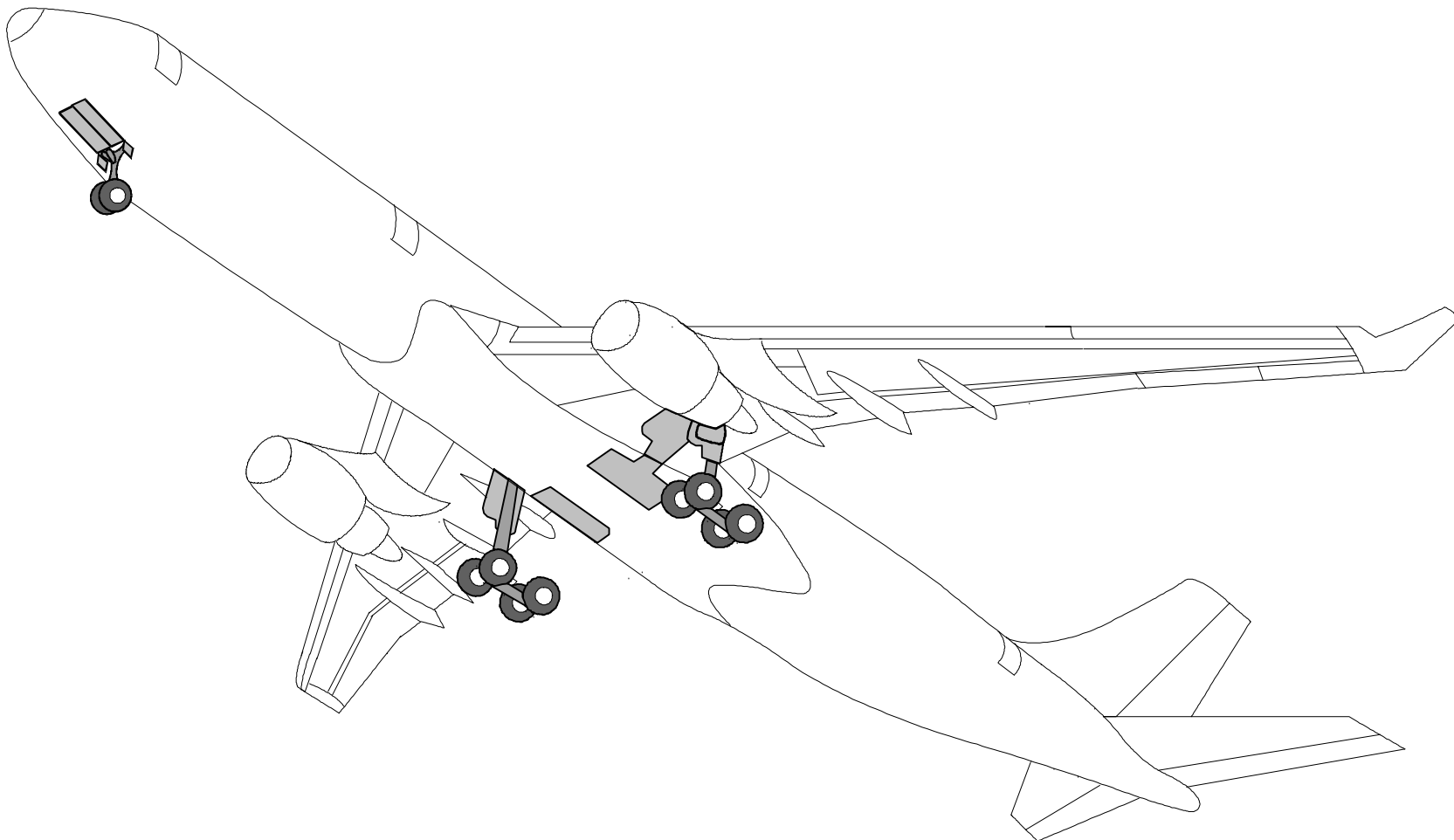
DOORS GROUND OPENING

Main Landing Gear Doors
Nose Landing Gear Doors

The system provides a means of opening and closing the hydraulically operated landing gear doors for maintenance purposes.

MAIN LANDING GEAR DOORS

NOSE LANDING GEAR DOORS



FQW4200 GE Metric

STUDENT NOTES

FQW4200 GE Metric

DOORS GROUND OPENING DESCRIPTION AND OPERATION

Main Door
Nose Door
Hydraulic Operation

MAIN DOOR

The Main Door has a ground door opening system that comprises these primary components :

- a ground door opening handle,
- a bi-stable mechanism,
- a bypass valve,
- a door uplock.

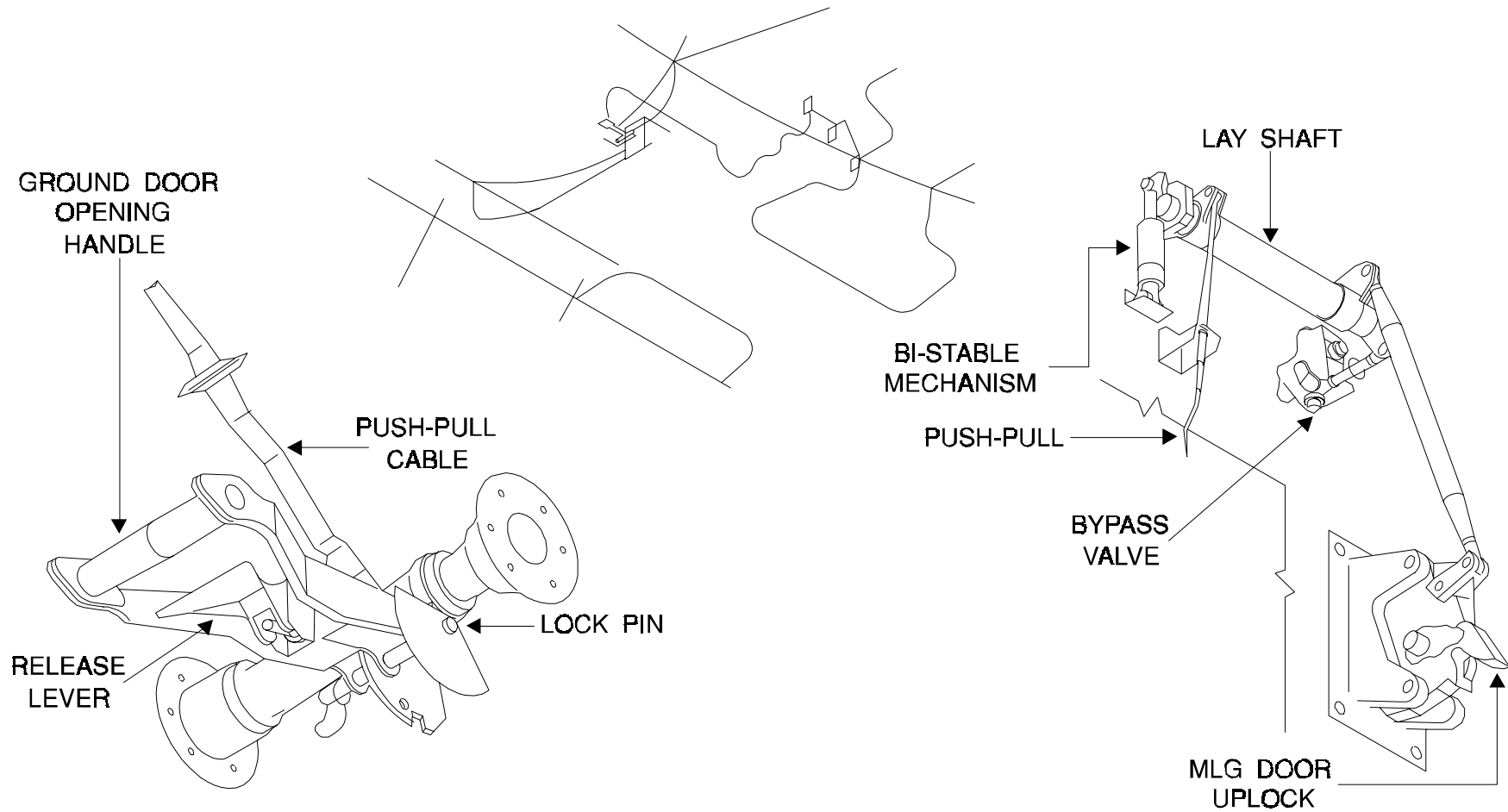
The ground door opening handle is located forward of the Main Landing Gear bay. This location places the operator in a safe position with a clear view of the door travel.

The handle is connected through a push-pull cable to a lay shaft at the outboard side of the Main Landing Gear bay.

The bi-stable mechanism is at the forward end of the lay-shaft. The rods for the bypass valve and main door uplock are at the rear.

The bi-stable mechanism makes sure that the bypass valve can only stay in the fully open or closed position.

The handle also makes the other rod on the layshaft turn a splined shaft on the door uplock, which releases the uplock hook and enables the Main Door to open by gravity.



FQW4200 GE Metric

NOSE DOOR

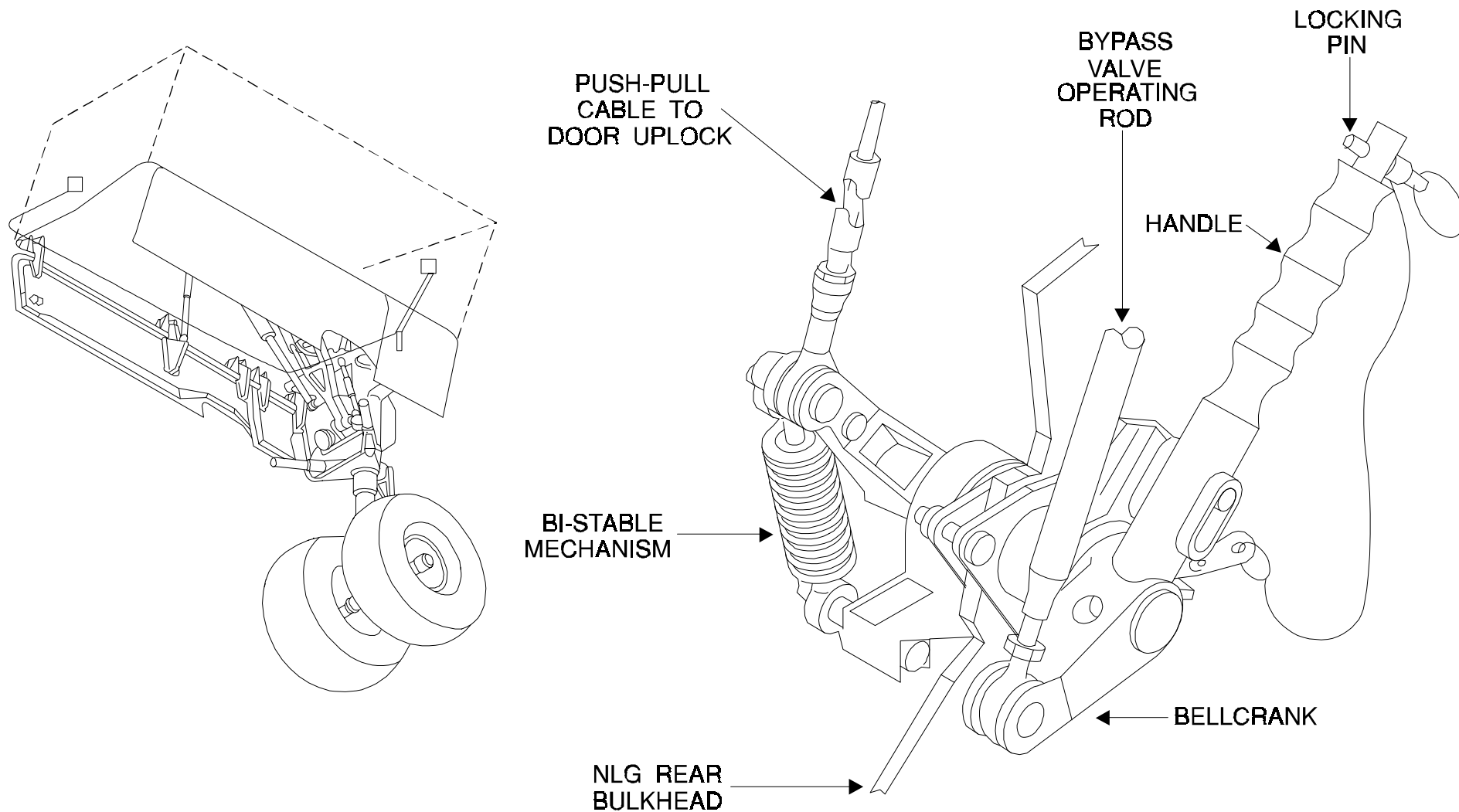
The forward doors of the Nose Landing Gear have a ground door opening system that comprises these primary components :

- a ground door opening handle,
- a bi-stable mechanism,
- a bypass valve,
- a door uplock.

The ground door opening handle is located in a housing in the aft bulkhead of the Nose Landing Gear bay. This location places the operator in a safe position with a clear view of the door travel.

The handle is connected through a spindle and a push-pull cable to the forward door uplock.

The bi-stable mechanism is connected to the spindle and makes sure that the bypass valve can only stay in the fully open or the fully closed position.



FQW4200 GE Metric

HYDRAULIC OPERATION

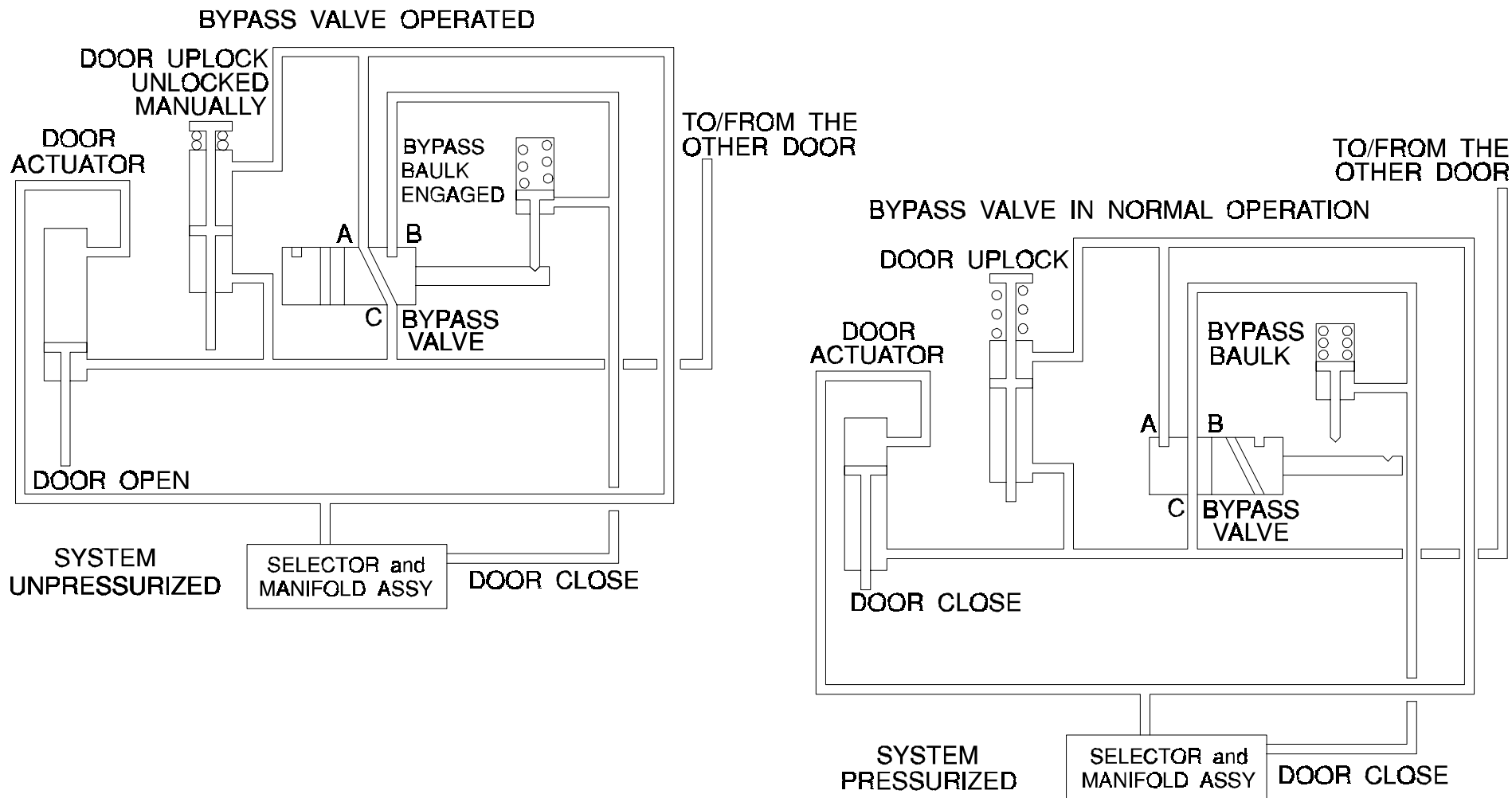
During operation of the normal extension and retraction system, hydraulic fluid goes through the bypass valve between ports B and C.

When the ground door opening handle is operated, port B is closed to stop the supply pressure.

Port C is connected to port A to let hydraulic fluid go freely between each side of the door actuator.

A baulk in the bypass valve locks the movement of the ground door opening handle in the "open" position until the green hydraulic system is pressurized.

This makes sure that the doors can only be closed when the handle can be moved to the "close" position.



STUDENT NOTES

FQW4200 GE Metric

LANDING GEAR WARNINGS AND OPERATING LIMITATIONS

- Gear Not Down
- Gear Not Downlocked
- Retraction Fault
- Doors Not Closed
- Gear Not Uplocked
- Gear Uplock Fault
- Lengthening Fault
- LGCIU 1(2) Fault
- System Disagree
- Operating Limitations

GEAR NOT DOWN

Note the red arrow on L/G selector.

This warning appears if:

- L/G is not downlocked,
 - Radio height is low (below 750 ft),
 - All operating engines are at low power,
- or
- L/G is not downlocked,
 - Radio height is low (below 750 ft),
 - Flaps are at "3" or "FULL",
- or
- L/G is not downlocked,
 - Flaps are at "FULL",
 - Both radio altimeters failed.

GEAR NOT DOWNLOCKED

Note the UNLK red light on the LDG GEAR indicator and the full red triangle symbols on the ECAM display. The right main landing gear is not downlocked at extension.

In this case, you should recycle the L/G, and, if unsuccessful, a gravity extension of the landing gear should be performed.

RETRACTION FAULT

An interlock mechanism prevents the landing gear lever selection to UP when the landing gear is not properly positionned for retraction.

In this case, the Landing gear is stuck down, and limit your speed to:

- Max speed 300/.72 (Gear down, doors closed).

DOORS NOT CLOSED

Note the DOOR NOT CLOSED amber symbol on the ECAM display.

The right main landing gear door is not closed at retraction.

If the L/G is downlocked, you should keep it down. In all cases, you should limit your speed to:

- Max speed 270/.65 (doors open).

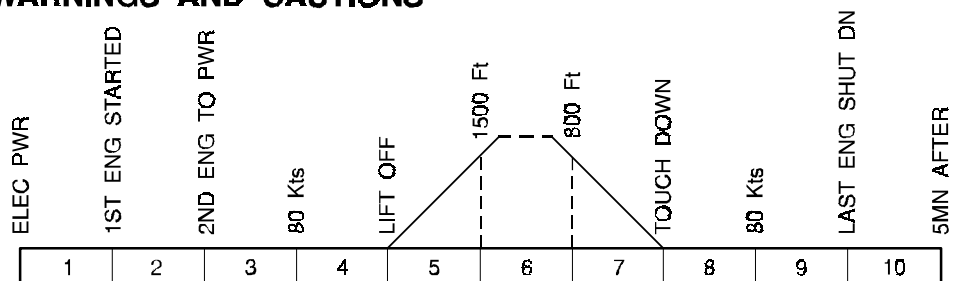
GEAR NOT UNLOCKED

Note the UNLK red light on the LDG GEAR indicator and the full red triangle symbols on the ECAM display. The left main landing gear is not unlocked at retraction.

In this case, you should recycle the landing gear. If it is unsuccessful keep it down and limit your speed:

- Max speed 300/.72 (Gear down, doors closed).

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
GEAR NOT DOWN 1) L/G not downlocked and radio height lower than 750 ft and all engine at approach idle. or 2) L/G not downlocked and radio height lower than 750 ft and flaps at "3" or FULL or 3) L/G not downlocked and flaps at "FULL" and both radio altimeters failed NOTE : In the cases 2 and 3 above, the aural warning can only be cancelled by the emer canc pb.	CRC	MASTER WARM	NIL	RED ARROW It on LDG GEAR panel	1 to 5 8 to 10
GEAR NOT DOWNLOCKED One gear not downlocked and L/G selected down			WHEEL	UNLK on LDG GEAR panel	3, 4, 5
RETRACTION FAULT	SINGLE CHIME	MASTER CAUT	NIL	NIL	1, 3, 4 7, 8
DOORS NOT CLOSED One gear door is not uplocked			WHEEL	NIL	1, 3, 4, 5, 8, 9, 10
GEAR NOT UNLOCKED One gear not uplocked and L/G not selected down				UNLK It on LDG GEAR panel	3, 4 7 to 10

FQW4200 GE Metric

GEAR UPLOCK FAULT

This caution is triggered when a gear uplock is inadvertently engaged on ground by maintenance personnel. Note the UNLK red light on the LDG GEAR indicator and the UP LOCK amber message on the ECAM display.

LENGTHENING FAULT

Note the UNLK red light on the LDG GEAR indicator and the full red triangle symbols on the ECAM display. The "shortening mechanism" did not work properly during extension.

In this case, you should NOT recycle the landing gear but keep it down, and limit your speed to:

- Max speed 300/.72 (Gear down, doors closed).

LGCIU 1 FAULT

Note the XX amber symbols on the ECAM display. The Landing Gear Control and Interface Unit (LGCIU) is faulty.

NOTE: The green triangle lights illuminate even in case of LGCIU 1 failure.

SYSTEM DISAGREE

Note the full green and red triangle symbols on the ECAM display. The right main landing gear is seen in transit by LGCIU 2 whereas it is seen downlocked by LGCIU 1.

Note the UNLK red light on the LDG GEAR indicator and the full red and green triangle symbols on the ECAM. In this second example, the right main landing gear is seen downlocked only by LGCIU 2.

In the both cases: the green triangle light and the full green and red triangle symbols or the UNLK red light and the full red and green triangle symbols, the landing gears are downlocked.

One green symbol or light is enough to confirm that a gear is downlocked.

OPERATING LIMITATIONS

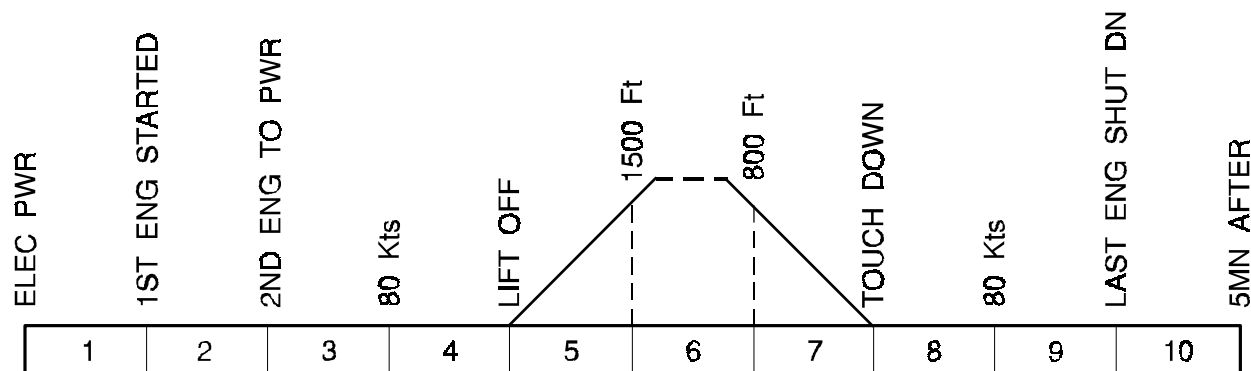
Maximum L/G operating speed:

VLO : 270/.65

Maximum L/G extended speed:

VLE : 300/.72

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
GEAR UPLOCK FAULT One gear uplock engaged with corresponding gear downlock	SINGLE CHIME	MASTER CAUT	WHEEL	UNLK It on LDG GEAR panel	4, 7, 8
LENGTHENING FAULT			NIL	NIL	3, 4, 8
LGCIU 1(2) FAULT	NIL	NIL	WHEEL	NIL	3, 4, 5 7, 8
SYS DISAGREE Disagree between L/G positions detected by the two LGCIU'S					

FQW4200 GE Metric

STUDENT NOTES

MAIN LANDING GEAR COMPONENTS

Shock Absorber
Bogie Beam
Pitch Trimmer

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is :

- hydraulic system depressurized
- ground lock pins and safety sleeves are in place
- wheel chocks are in place
- landing gear control lever is in "DOWN" POSITION and locked
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

SHOCK ABSORBER

FIN : 5018GM
5019GM

ZONE : 730 (LH)
740 (RH)

COMPONENT DESCRIPTION

The shock absorber is a self contained unit that includes the sliding tube.

It is a telescopic oleo pneumatic unit that operates in two directions. Fluid and gas are contained in the shock absorber without separation.

The primary components of the shock absorber are a piston and a cylinder (sliding tube).

The bleed valve, the top fill/charge valve and the levelling tube are installed at the top of the piston for maintenance.

SPECIAL DESIGN

To prevent external leakage at the piston cylinder interface, two gland seals are housed in tandem.

The second seal acts as back-up and is activated manually without any disassembly of the shock absorber unit.

In the normal operating mode, the first seal performs the sealing function while the second seal is de-energized as it has hydraulic pressure on both sides.

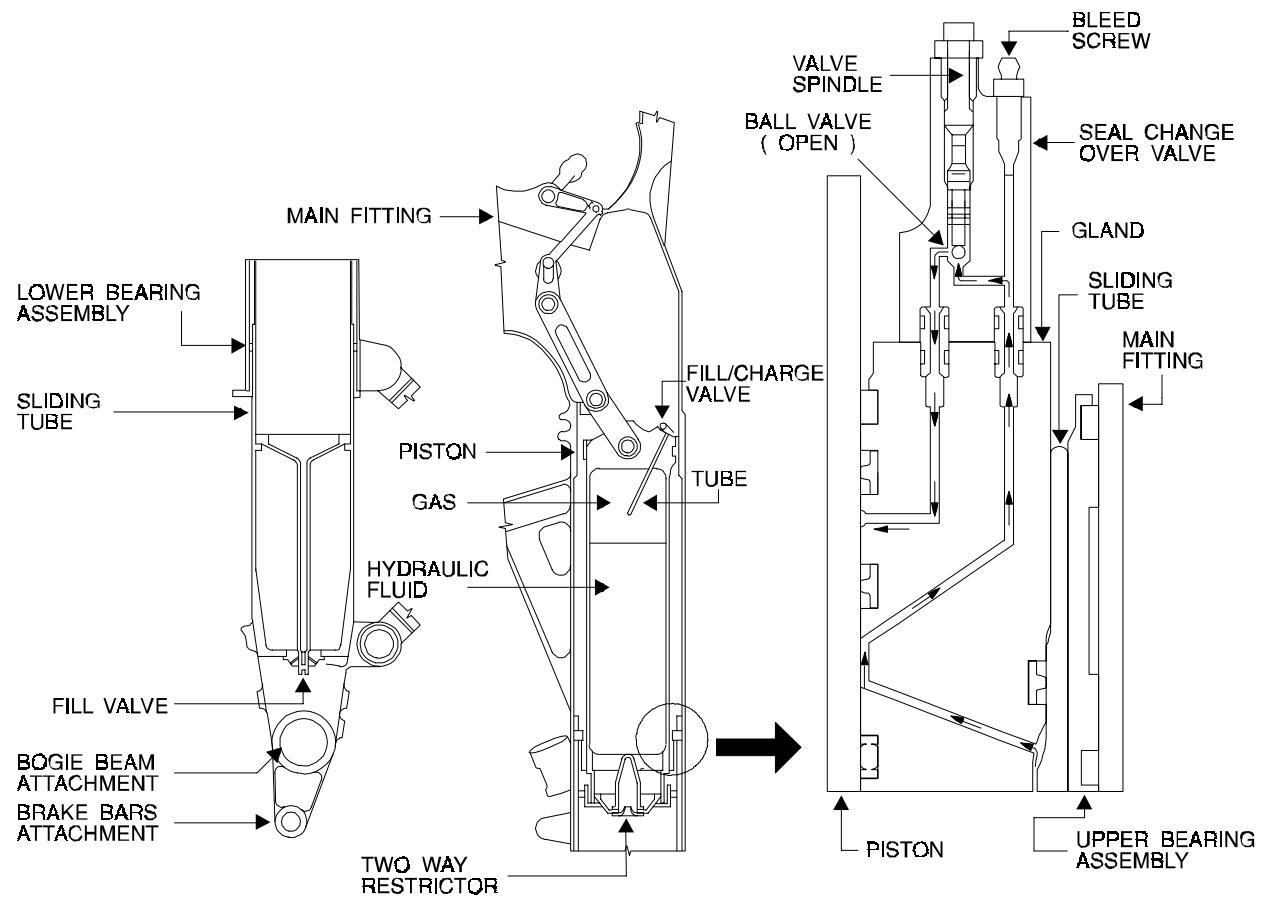
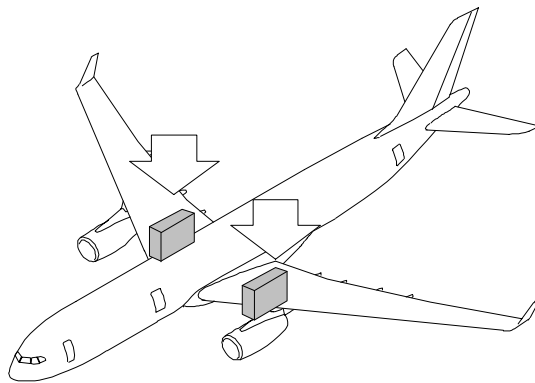
In the event of failure of the first seal, the second seal is energized by closing the change-over valve.

OIL SPECIFICATION

The change-over valve is accessible when shock absorber is in the fully compressed position.

The oil used is :

AIR 3520 (MIL-H-5606)



FQW4200 GE Metric

BOGIE BEAM

FIN : 5010GM (LH)
5011GM (RH)

ZONE : 730 (LH)
740 (RH)

COMPONENT DESCRIPTION

The bogie beam has lugs for the attachment of towing and debogging equipment and for the lower articulating link.
Axles are hollow and contain the brake control tachometers.
Tire pressure indication and brake cooling fans can also be fitted.

SPECIAL DESIGN

All dressings are mounted on the top of the bogie beam to ensure minimum vulnerability to damage and to provide optimum maintainability.

PITCH TRIMMER

FIN : 5008GM (LH)
5009GM (RH)

ZONE : 730 (LH)
740 (RH)

COMPONENT DESCRIPTION

The pitch trimmer is a hydraulically powered actuator.
It has a cylinder, a piston rod and a damping tube.
Two bleed screws are installed on the cylinder.
They permit the bore of the cylinder and the bore of the piston to be bled.

The piston has an end fitting at one end, that connects it to the upper articulating links, and a piston head at the other.

A set of holes in the piston rod permit the transmission of hydraulic fluid between the bore of the cylinder and the bore of the piston.

SPECIAL DESIGN

The pitch trimmer has three specific functions :

- At aircraft rotation on lift off, the shock absorbers extend and the pitch trimmer bottoms on its internal stop.

The shock absorber on full extension rotates the bogie beam to give the aircraft a greater rotation angle for take off.

When aircraft achieves weight off wheels, the pitch trimmer maintains the required articulation link geometry to align the bogie beam during the shortening and allow stowage of the gear in the bay.

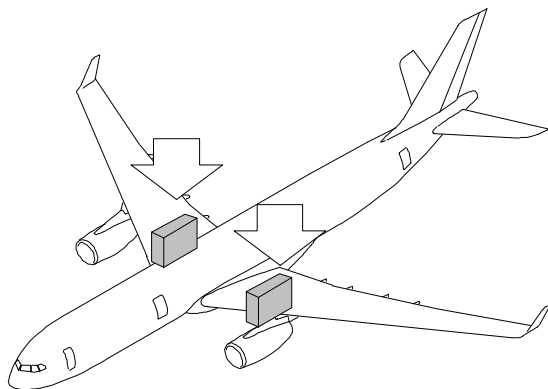
The pitch trimmer is also utilized to provide damping on the ground.

OPERATION

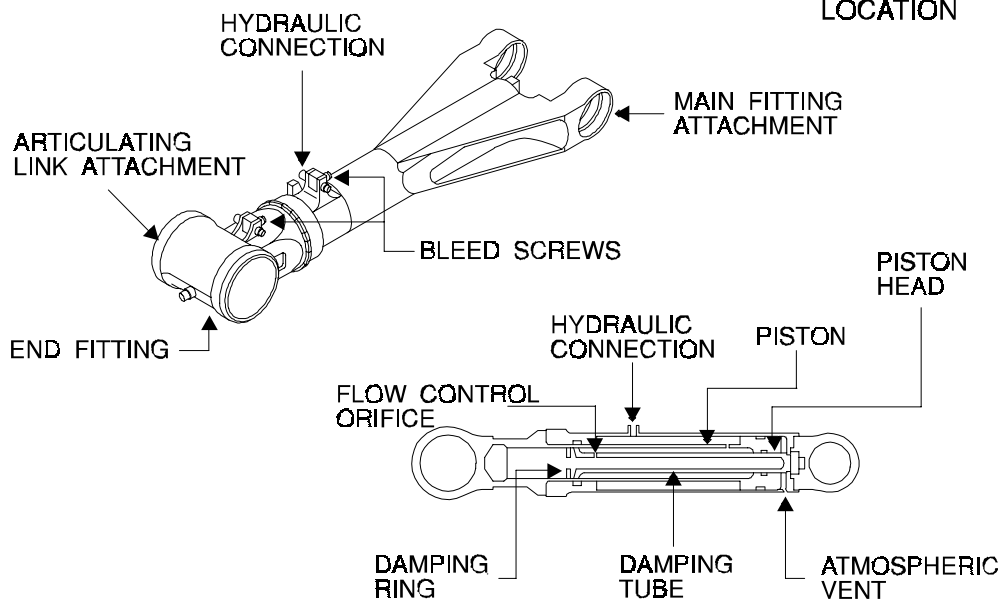
Pitch trimmer operation during landing phase.

- At touch down, rear tires start to take the LDG loads.
- Shock absorber starts to compress as load increases.
- The landing loads increase on the front tires .
- The shock absorber is at its static deflection.

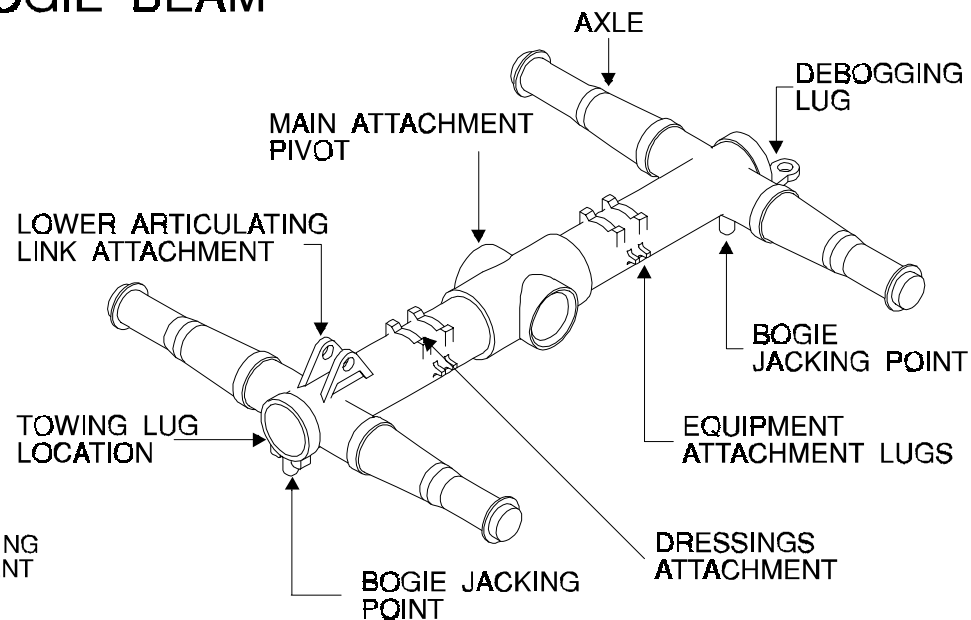
As the shock absorber is compressed the pitch trimmer is mechanically forced to extend. When the A/C taxies, the pitch trimmer damps the movement of the bogie beam around its pivot.



PITCH TRIMMER



BOGIE BEAM



STUDENT NOTES

FQW4200 GE Metric

MAIN LANDING GEAR AND DOOR COMPONENTS

- Leg Assembly
- Side Stay Assembly
- Side Stay
- Lock Stay
- Lock Springs
- Torque Links
- Main Landing Gear Doors
- Hinged Fairing
- Fixed Fairing
- Bogie Alignment
- Safety Valve
- Check Valve
- Relief Valve

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is :

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked,
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

FQW4200 GE Metric

LEG ASSEMBLY

FIN : 5018GM(LH)
5019GM(RH)

ZONE : 730(LH)
740(RH)

COMPONENT DESCRIPTION

The one piece forged main fitting consists of a main barrel and the drag stay.
It also has integral lugs and associated greased bushes for the attachment points.
The attachment lug has a spherical bearing which transmits vertical and drag loads to the wing.

SIDE STAY ASSEMBLY

FIN : 5012GM(LH)
5013GM(RH)

ZONE : 730(LH)
740(RH)

COMPONENT DESCRIPTION

The double linked folding side stay assembly is connected to the main fitting and the airframe by cardan joints.
The upper side stay link contains the attachment points for the lock stay, the lock springs and the lock stay actuator.

SIDE STAY

ZONE : 730(LH)
740(RH)

COMPONENT DESCRIPTION

The side stay is fitted with downlock springs to ensure the lock stay links are brought overcenter and are retained in the locked position during normal L/G extension and free fall.

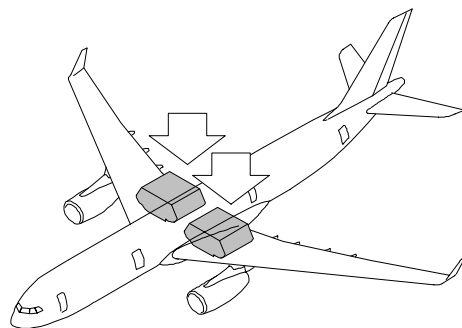
LOCK SPRINGS

FIN : 5234GA 5236GA
5235GA 5237GA

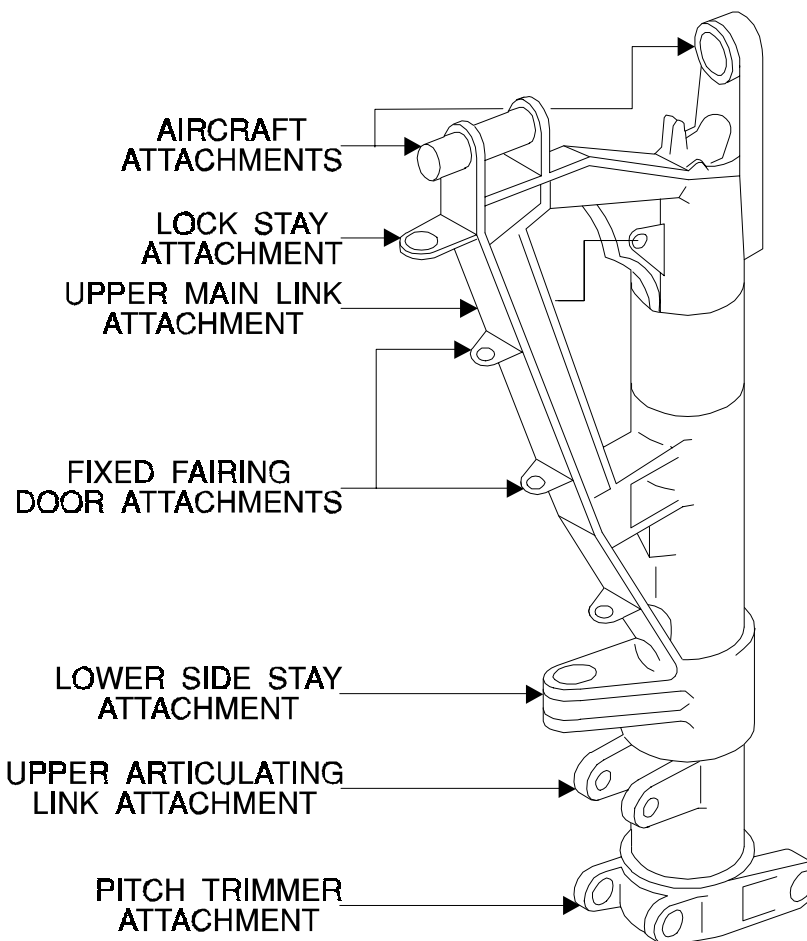
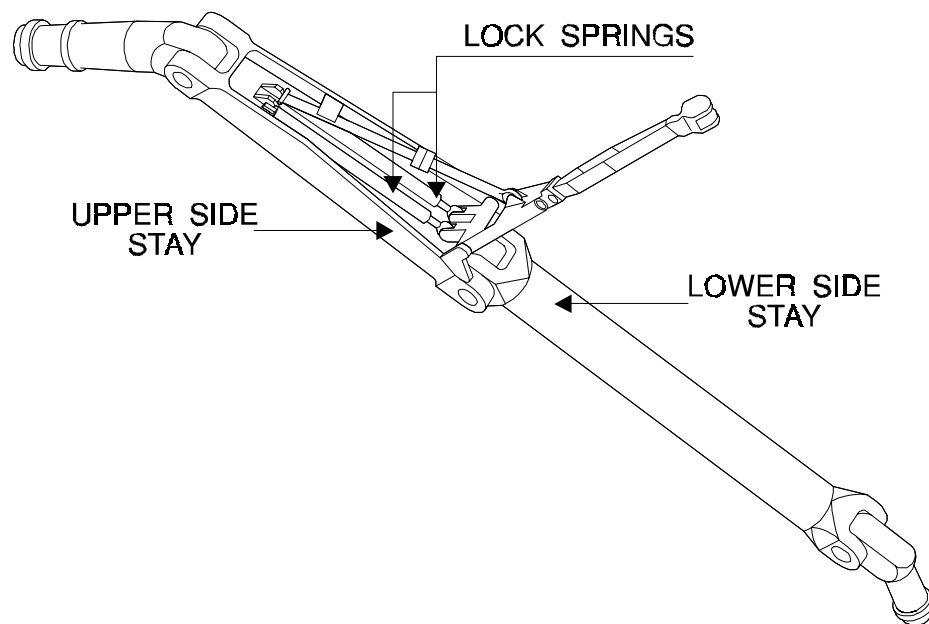
ZONE : 730(LH)
740(RH)

COMPONENT DESCRIPTION

Tension springs are installed in the top channel of the upper of the side stay.
They are connected between the upper end of the basic stay and the lugs of the lock stay.
The top eye-end is fixed and bonded in the helicoid of the spring.



SIDE STAY ASSEMBLY



FQW4200 GE Metric

LOCK STAY

ZONE : 730(LH)
740(RH)

COMPONENT DESCRIPTION

The double linked folding lock stay is located in the downlock position by the out stop of the lock stay actuator.

The links of the lock stay have over travel stops to maintain a safe downlocked condition in the event of the failure of the lock stay actuator.

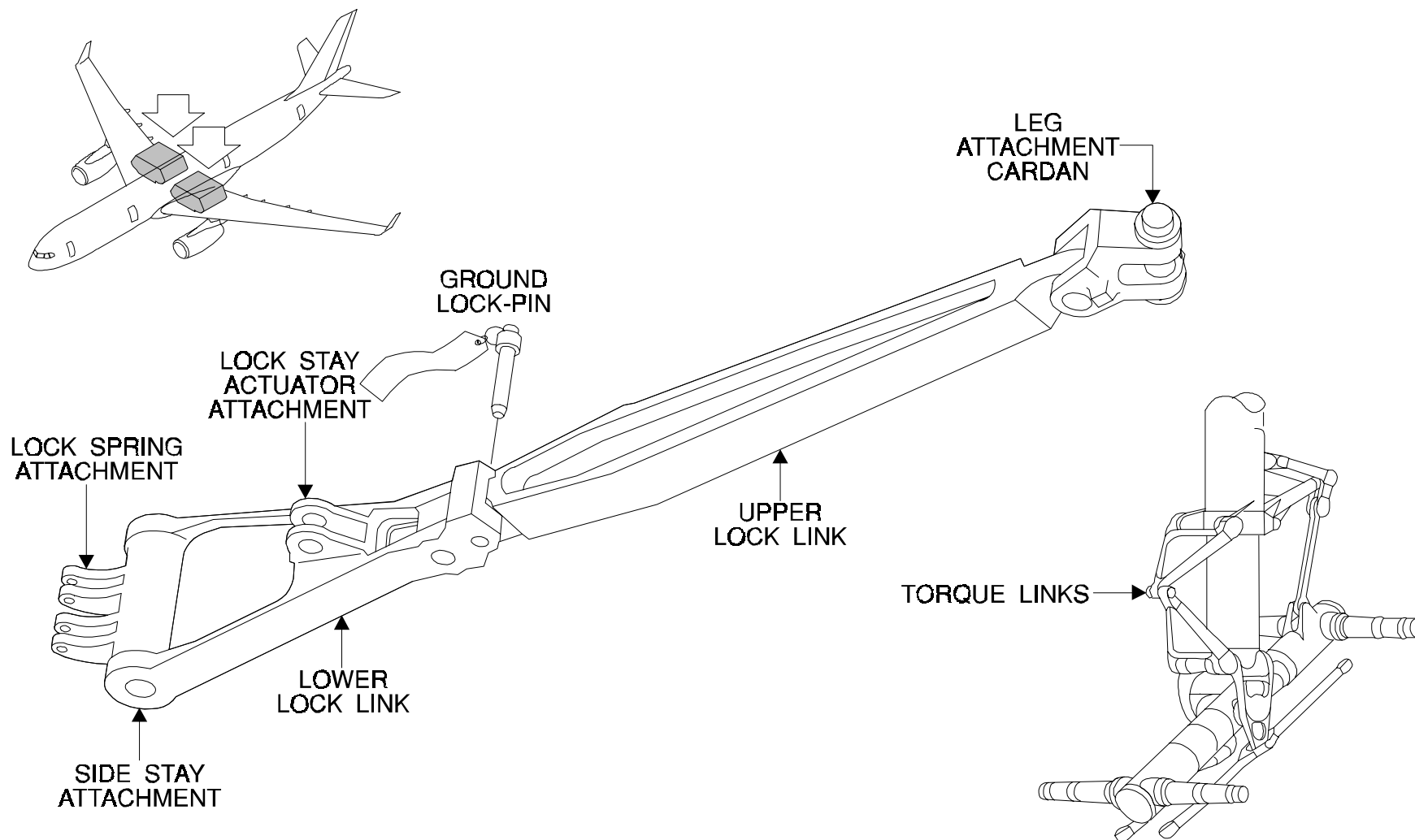
TORQUE LINKS

ZONE : 730(LH)
740(RH)

COMPONENT DESCRIPTION

The torque links are designed to react the torque about the vertical centerline in the event of unequal wheel loading or when turning the aircraft.

The torque is transmitted through the leg to the pintle.



FQW4200 GE Metric

MAIN LANDING GEAR DOORS

ZONE : 730(LH)
740(RH)

COMPONENT DESCRIPTION

The main landing gear door is attached to the fuselage by three hinges and is operated by a hydraulic actuator.
The door attachment point for the actuator is on the center hinge, an uplock roller fitted on the lower part of the door engages in an uplock assembly to keep the door up in the closed position.

HINGED FAIRING

ZONE : 730(LH)
740(RH)

COMPONENT DESCRIPTION

The hinged fairing is attached to the wing skin by two hinges and to the landing gear by an adjustable tie rod.
The tie rod causes the hinged fairing to follow the landing gear during extension and retraction.

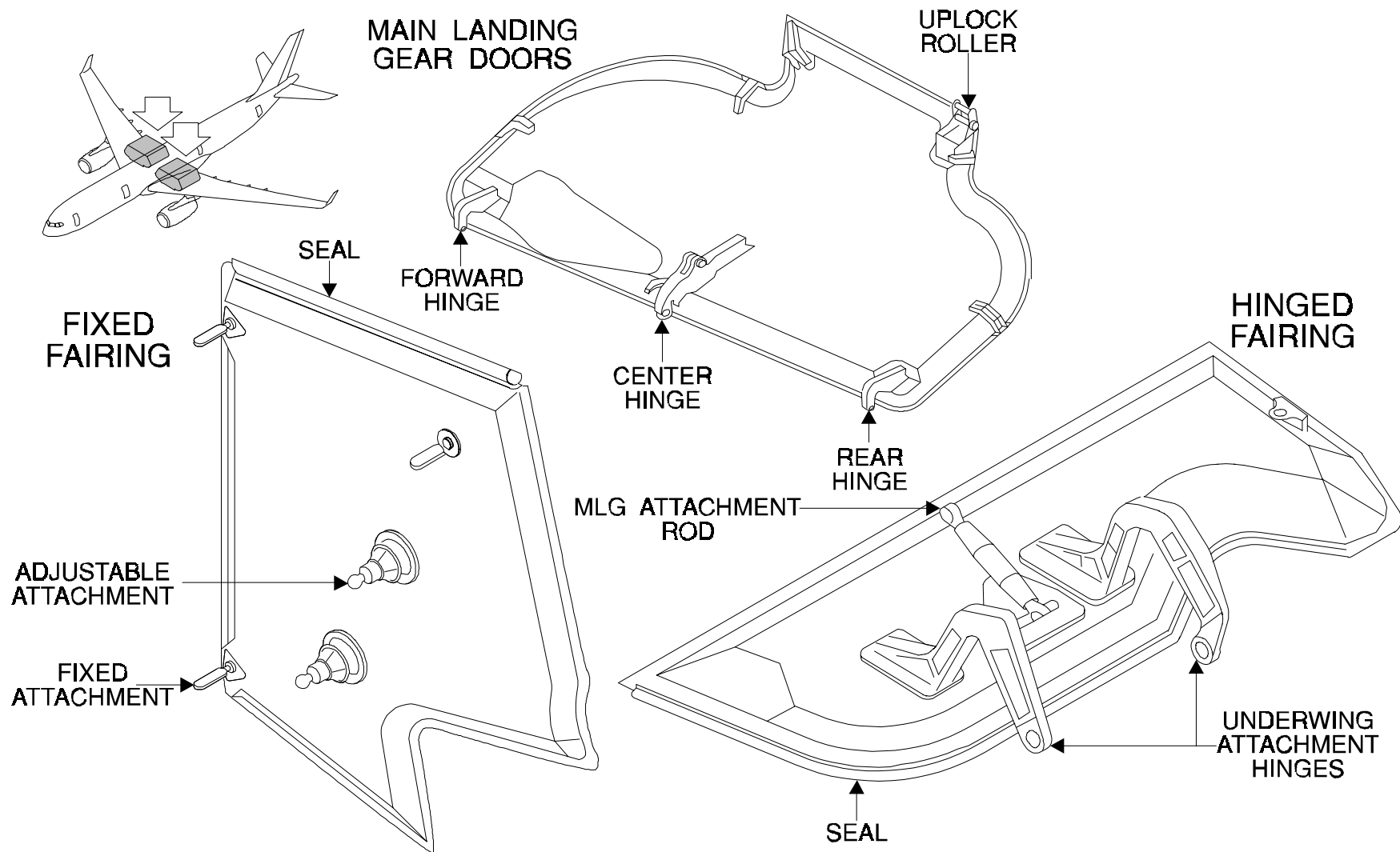
FIXED FAIRING

ZONE : 730(LH)
740(RH)

COMPONENT DESCRIPTION

The fixed fairing is attached to the outboard side of the landing gear main fitting by two types of attachments :

- two adjustable studs,
- three rod ends.



FQW4200 GE Metric

PITCH TRIMMER BOGIE ALIGNMENT

FIN : 5008GM(LH)
5009GM(RH)

ZONE : 730(LH)
740(RH)

COMPONENT DESCRIPTION

The bogie alignment manifold assembly is outboard on the shroud box at the rear of the MLG bay.
The assembly includes a safety valve, a check valve and a pressure relief valve.
The safety valve is installed externally but the other parts are internal components of the manifold.

PITCH TRIMMER SAFETY VALVE

FIN : 5004GM(LH)
5005GM(RH)

ZONE : 730(LH)
740(RH)

COMPONENT DESCRIPTION

It prevents the loss of hydraulic fluid from the hydraulic system, if a large leakage occurs in the pitch trimmer supply line.
If the flow rate, through the valve, increases to 60l/mn, the valve will automatically close.
When the hydraulic pressure decreases to 27.5psi, the valve will go back to its normal position.

PITCH TRIMMER CHECK VALVE

FIN : 5006GM(LH)
5007GM(RH)

ZONE : 730(LH)
740(RH)

COMPONENT DESCRIPTION

It prevents the transmission of high pressure to the green hydraulic system.
When the pitch trimmer is in retraction mode, the green hydraulic pressure keeps the check valve open.
When the external forces extend the pitch trimmer, an increase in the hydraulic pressure occurs which closes this valve.

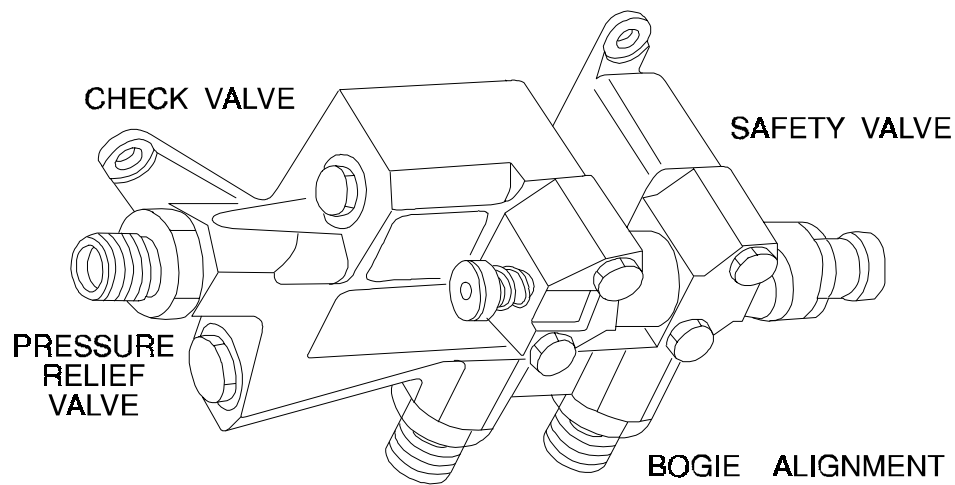
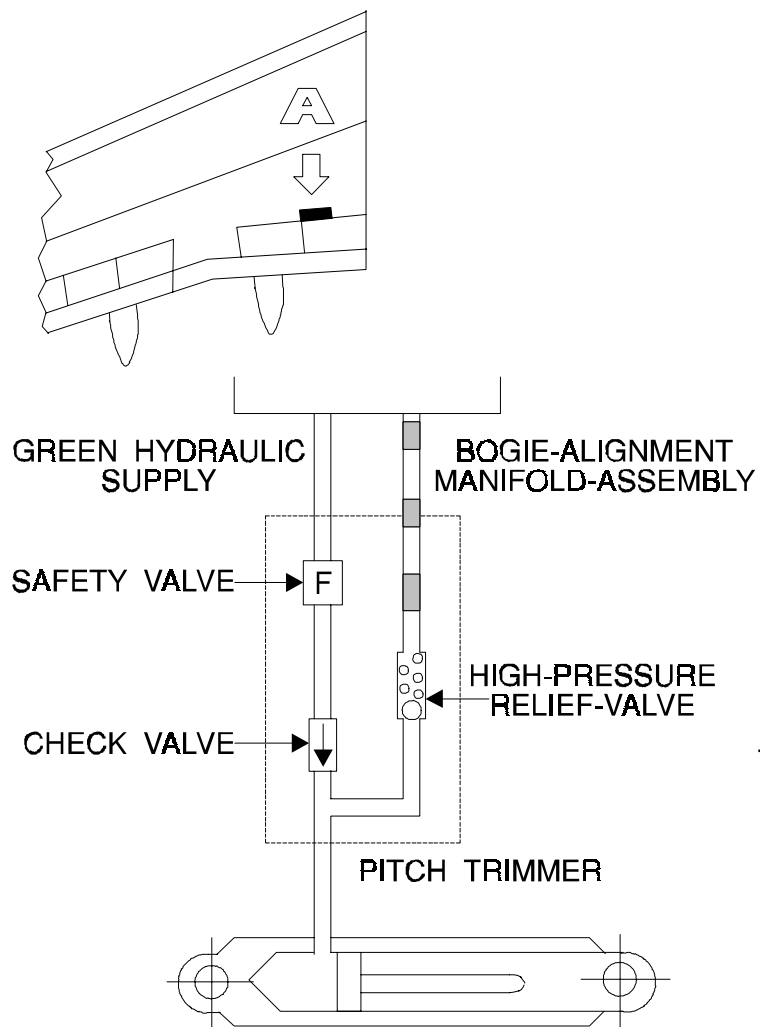
PITCH TRIMMER RELIEF VALVE

FIN : 5002GM(LH)
5003GM(RH)

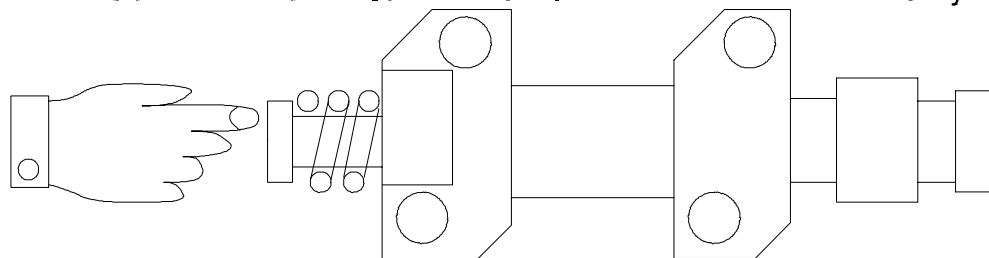
ZONE : 730(LH)
740(RH)

COMPONENT DESCRIPTION

It releases the high pressure generated in the pitch trimmer when it is mechanically extended.
When the reverse flow pressure exceeds a flow rate of 71l/mn, the pressure relief valve releases the hydraulic fluid to the return line.



The "PUSH TO RESET" button is used to reset the valve manually



STUDENT NOTES

NOSE LANDING GEAR COMPONENTS

Shock Absorber

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is :

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked,
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

SHOCK ABSORBER

FIN : 500GN

ZONE : 711

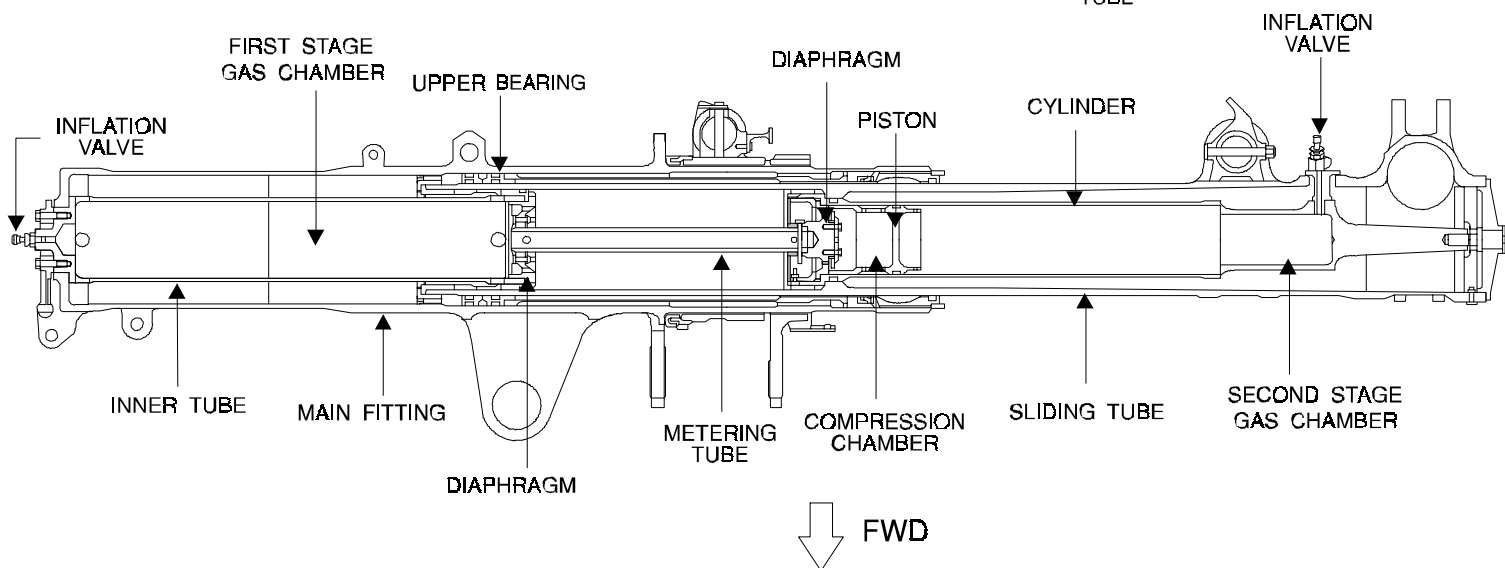
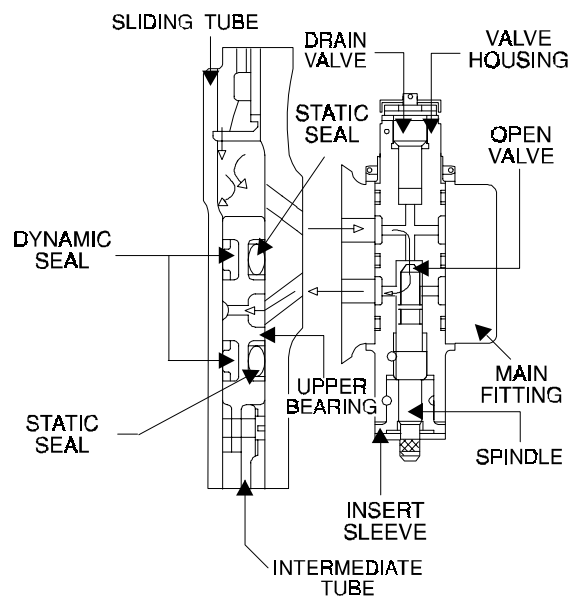
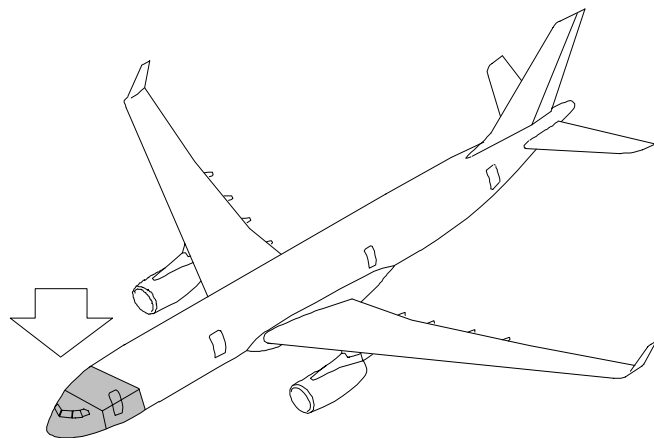
COMPONENT DESCRIPTION

The shock absorber is of the double stage oleopneumatic type. It is made from the main fitting and the sliding tube. It is a telescopic strut that operates in the two directions. The chambers contain gas and hydraulic fluid. The gas compresses to absorb the loads made during landing, taxing and take-off and the movement of the fluid between the chambers is controlled to decrease the speed at which the shock absorber operates. The shock absorber oil used is Air 3250 (MIL-H 5606).

SPARE SEAL DETAIL

Dynamic seals are located at the upper bearing in an area where shearing stresses and distortion are low.

If there is a leakage, the spare seal is energized by closing the valve which is built outside the main fitting in the by-pass valve housing. This operation is done without the need of deflating the shock absorber.



FQW4200 GE Metric

STUDENT NOTES

NOSE LANDING GEAR AND DOOR COMPONENTS

- Leg Assembly
- Drag Stay Assembly
- Lock Stay Assembly
- Lock Springs
- Bearing Assembly Swivel
- Torque Links
- Nose Landing Gear Main Door
- Nose Landing Gear AFT Door
- Nose Landing Gear Leg Door

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is :

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked,
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

FQW4200 GE Metric

LEG ASSEMBLY

FIN : 5002GN

ZONE : 711

COMPONENT DESCRIPTION

The main fitting is attached on the aircraft structure with two trunnions.

It carries lugs to mount the retraction actuator, the bottom link of the drag stay and the top link of the lock stay.

The steering assembly is also mounted on the fitting to react turning loads back to structure.

DRAG STAY ASSEMBLY

FIN : 5001GN

ZONE : 711

COMPONENT DESCRIPTION

The double linked folding drag stay assembly is connected to the main fitting and the forward section of the Nose Landing Gear bay roof.

A double-linked folding lock stay is located between the drag stay and the main fitting.

A secondary stop for the lock links is provided by bottoming of the lock stay actuator.

LOCK STAY ASSEMBLY

FIN : 5001GN

ZONE : 711

COMPONENT DESCRIPTION

The lock stay is fitted with two downlock springs that ensure the lockstay links are brought overcenter and are retained in the locked

position during normal extension and free-fall.

The assembly has been designed such that one spring is capable of downlocking the gear and keeping it in this condition.

During normal operation the lock stay actuator is pressurised, to assist the springs in making the downlock.

LOCK SPRINGS

FIN : 5001GN

ZONE : 711

COMPONENT DESCRIPTION

Two springs hold the overcenter folding lock stay in the downlocked position when the nose landing gear is extended.

TORQUE LINKS

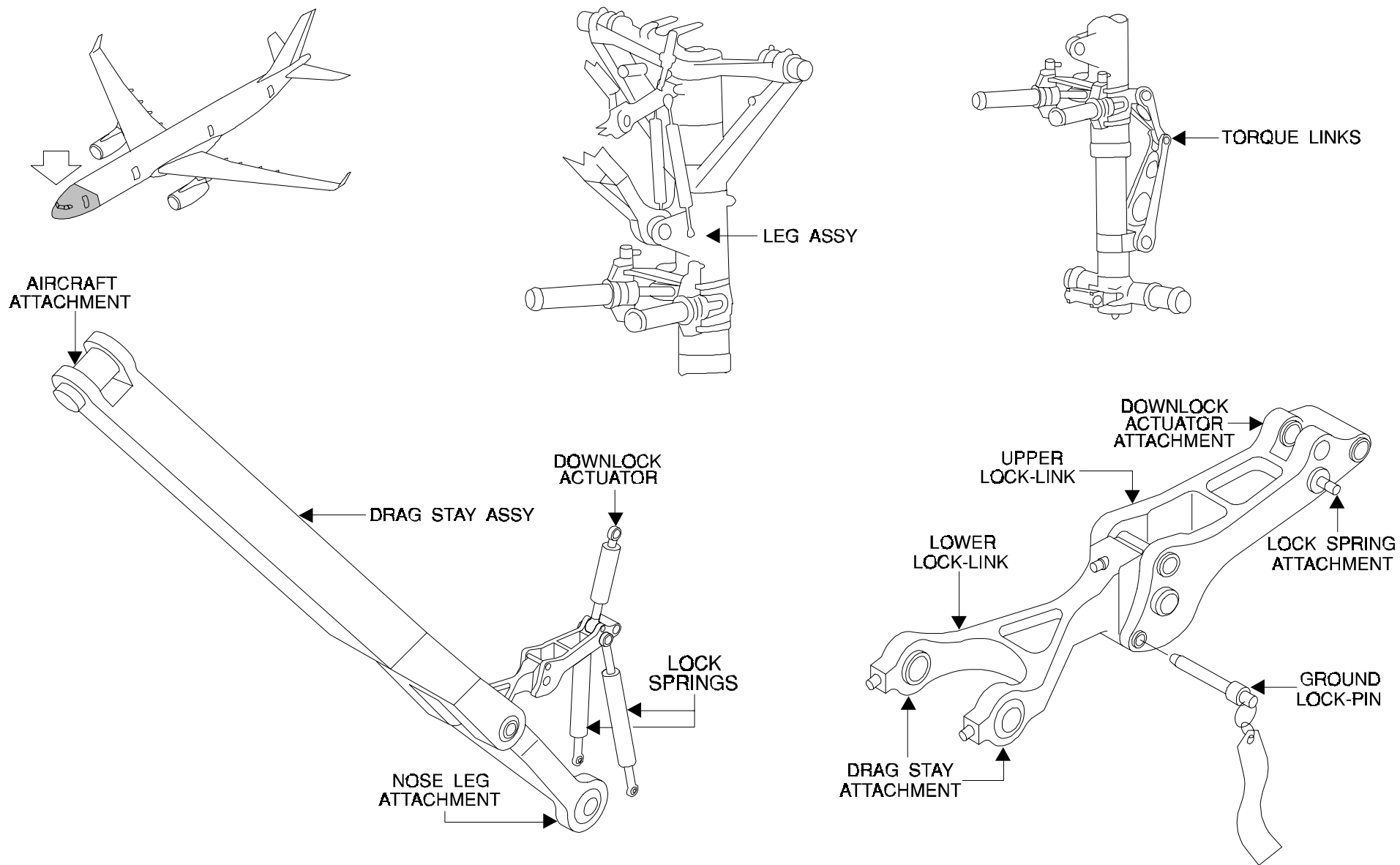
ZONE : 711

COMPONENT DESCRIPTION

The upper torque links are attached to the steering collar and the lower link to the sliding member.

The torque links are designed to react the torque about the vertical centerline in the event of unequal wheel loading when turning the aircraft.

The torque is transmitted to the steering mechanism back to the main fitting.



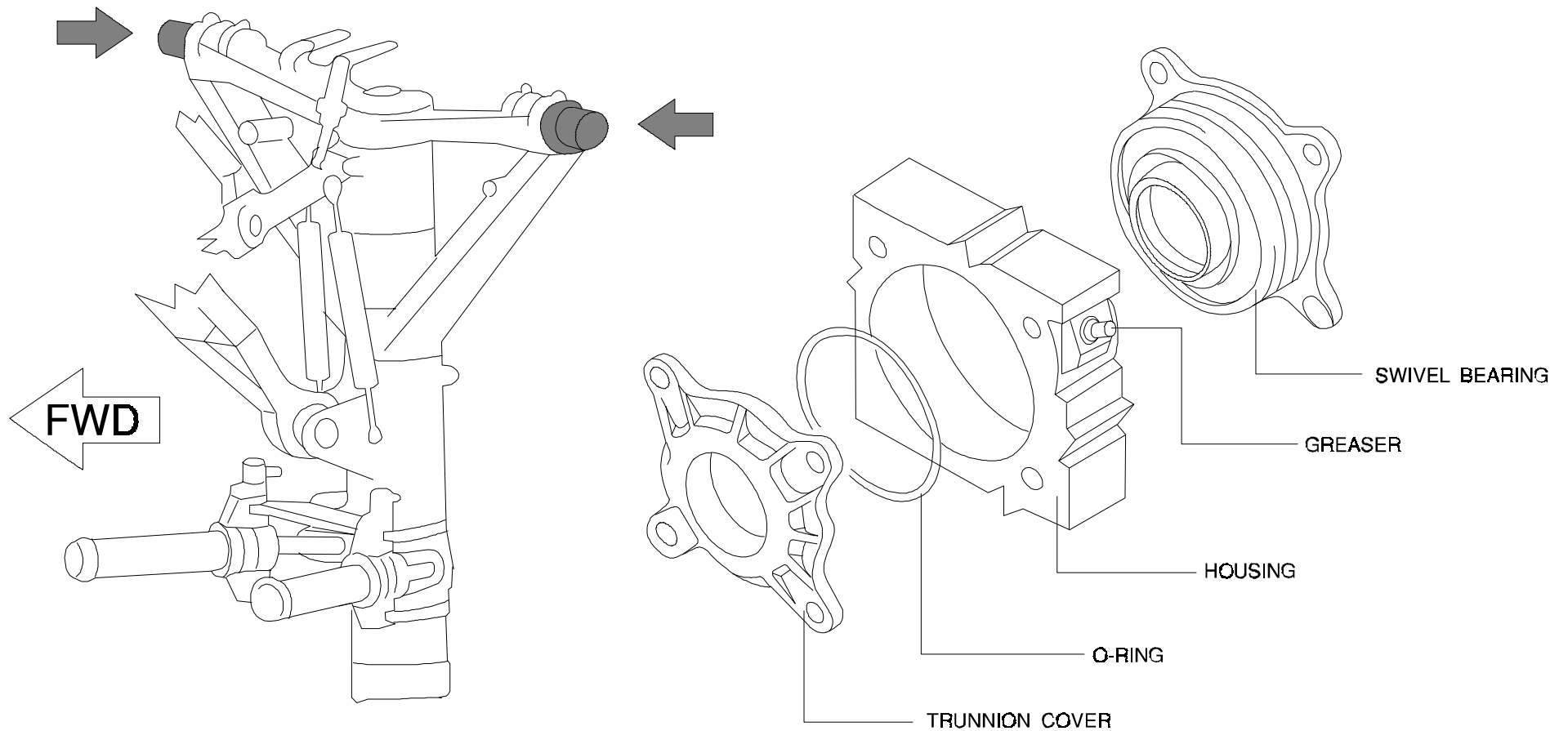
FQW4200 GE Metric

SWIVEL BEARING ASSEMBLY

ZONE : 711

COMPONENT DESCRIPTION

The swivel bearing assemblies provide the hinge points between the NLG main fitting and the aircraft structure. They transmit the vertical and horizontal loads to the aircraft structure.



FQW4200 GE Metric

NOSE LANDING GEAR MAIN DOOR

ZONE : 713 - 714

COMPONENT DESCRIPTION

Each forward door has three swan-neck hinges at the outboard edge.
A door-open groundlock pin can be installed in the center hinge of each forward door.
There is an uplock roller at the forward end.
A cut-out at the inboard rear side of each forward door permits the location of the nose landing gear drag stay, when the gear is extended.

NOSE LANDING GEAR LEG DOOR

ZONE : 712

COMPONENT DESCRIPTION

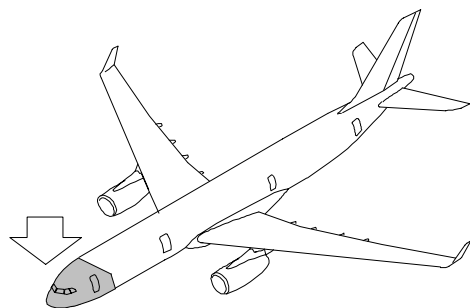
This door is attached to the rear part of the gear leg.
When the gear is retracted, this door closes off the area through which the drag stay passes when the gear is extended.

NOSE LANDING GEAR AFT DOOR

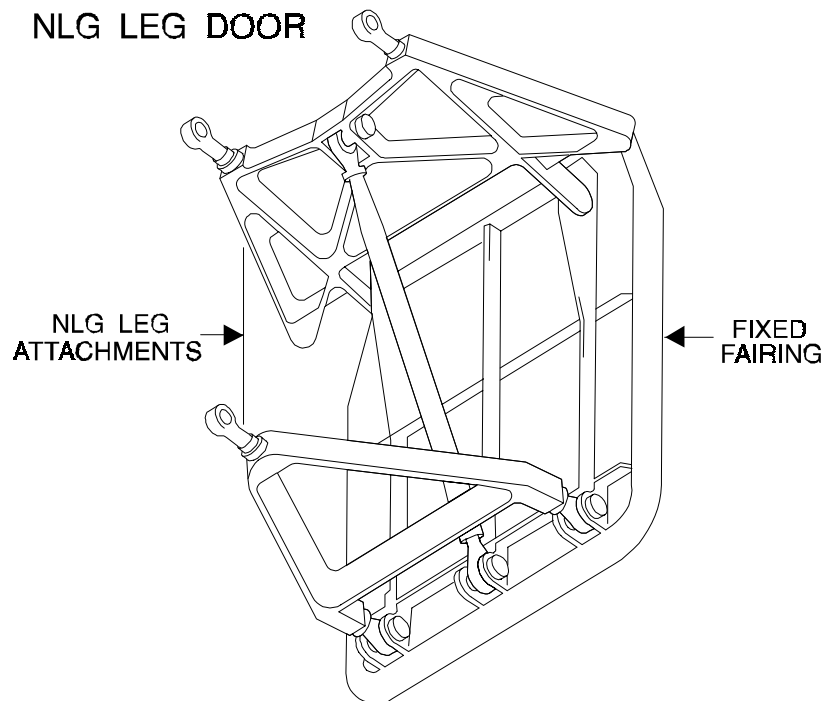
ZONE : 715 - 716

COMPONENT DESCRIPTION

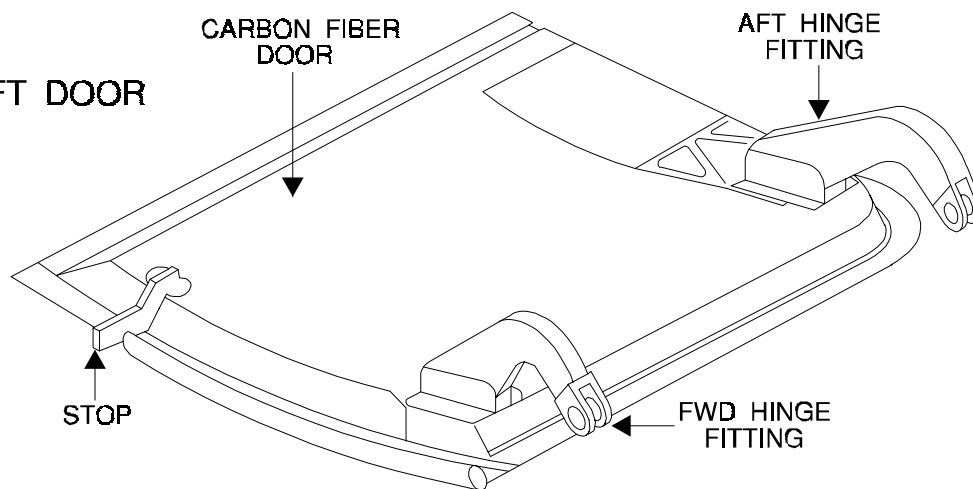
The two aft doors are symmetrical and are both attached to the structure at two points.
These two doors are also connected by adjustable rods to the gear, and close the aft part of the bay when the gear is retracted.
When the gear is extended, the doors remain open.



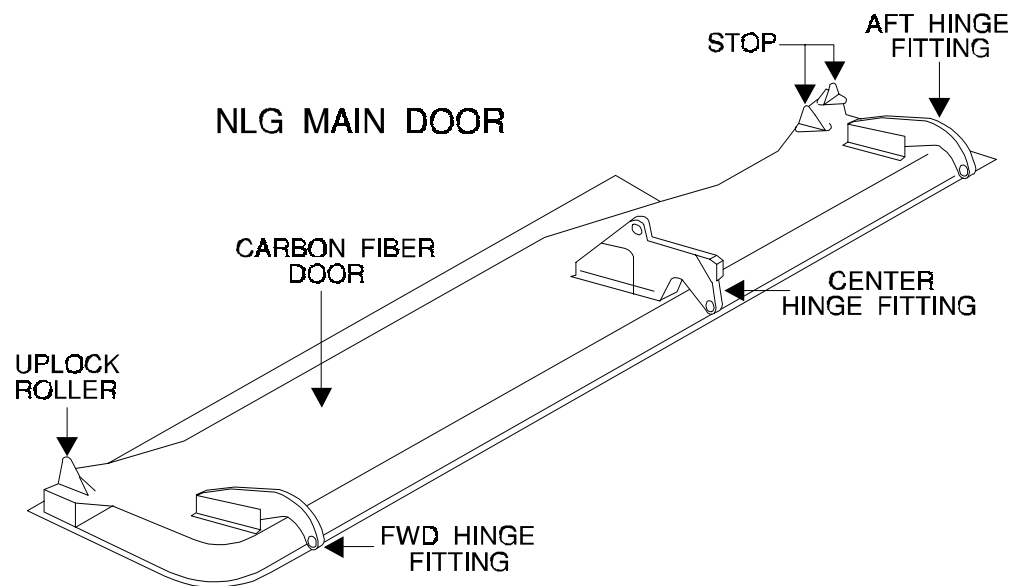
NLG LEG DOOR



NLG AFT DOOR



NLG MAIN DOOR



STUDENT NOTES

FQW4200 GE Metric

MAIN LANDING GEAR EXTENSION/RETRACTION COMPONENTS

Door Bypass Valve
MLG Door Uplock
MLG Uplock
MLG Actuator
MLG Door Actuator
MLG Downlock Actuator
Restrictor Valve
Delay Valve

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is:

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked,
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

DOOR BYPASS VALVE

FIN : 5205GA(NLG) 5228GA(LH)
5265GA(CLG) 5229GA(RH)

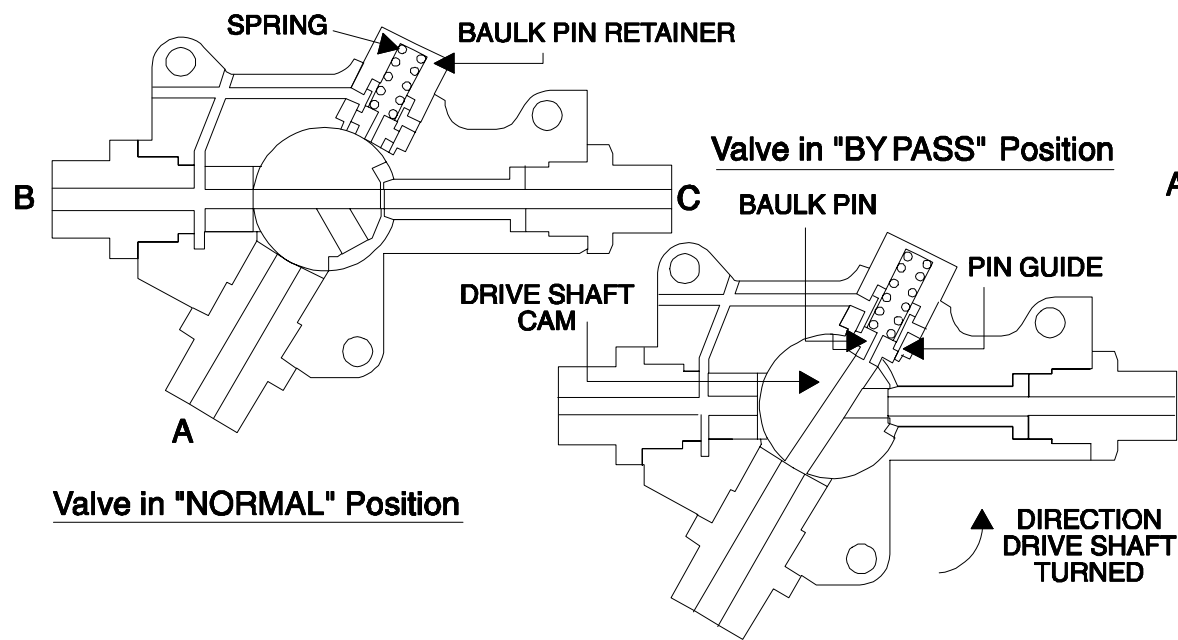
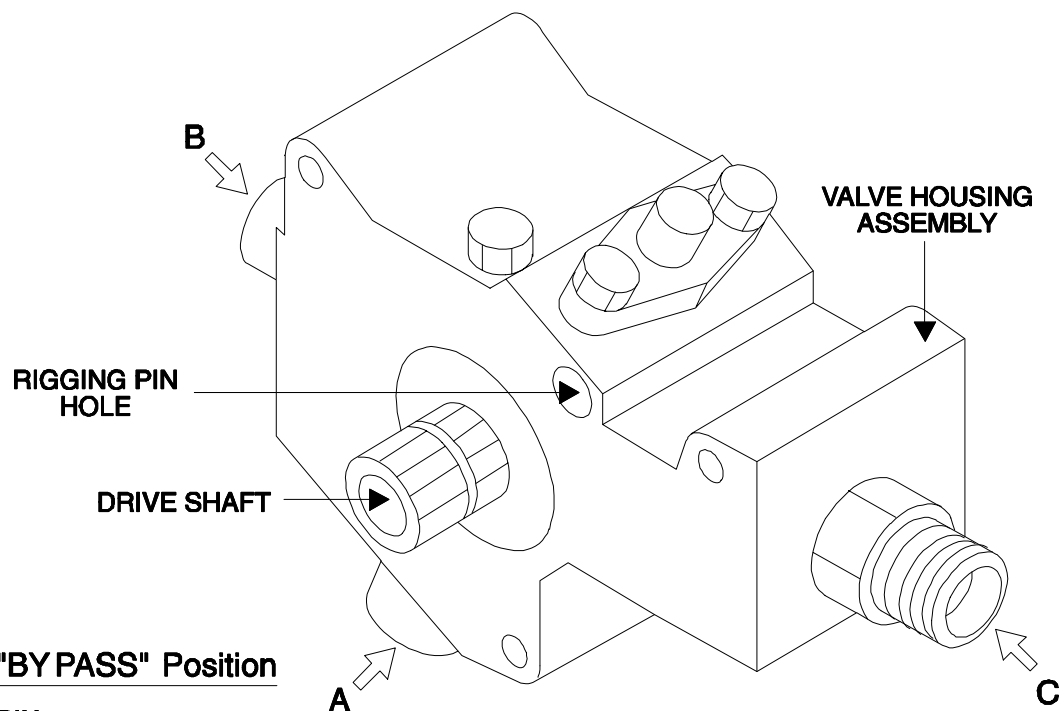
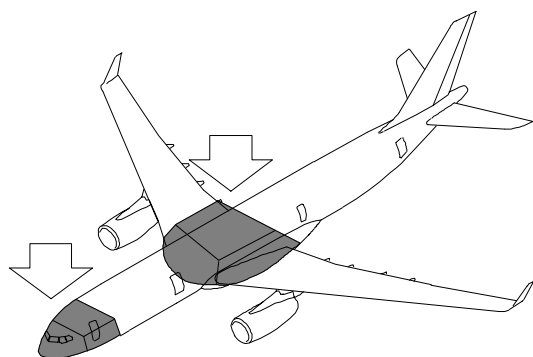
ZONE : 121 - 147 - 148

COMPONENT DESCRIPTION

The door BYPASS valve is inserted in the doors close hydraulic supply line. When operated, it disconnects the door actuator from the supply and connects the extend and retract parts of the actuator together.

The valve incorporates a baulk mechanism which responds to pressure in the doors close line.

The baulk mechanism prevents from selecting the UP position of the ground door opening handles if the hydraulic circuit is not pressurized.



FQW4200 GE Metric

MLG DOOR UPLOCK

FIN : 5224GA(LH)
5225GA(RH)

ZONE : 147 - 148

COMPONENT DESCRIPTION

The casing is in two halves attached together with bolts.
The hydraulic actuator is attached to the casing and contains a piston.
A spring keeps the piston retracted when there is no hydraulic pressure. The casing has two holes for rigging pins.
The holes are positioned for these functions:

- C : proximity sensors rigging,
- D : free fall mechanism rigging,
- E : ground door opening system rigging.

UPLOCK DETAIL

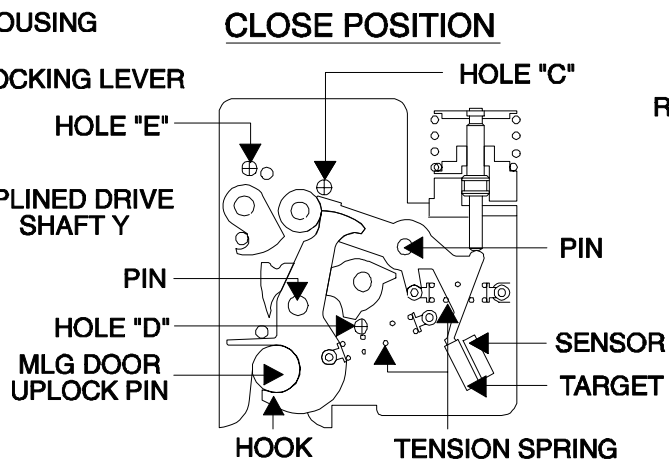
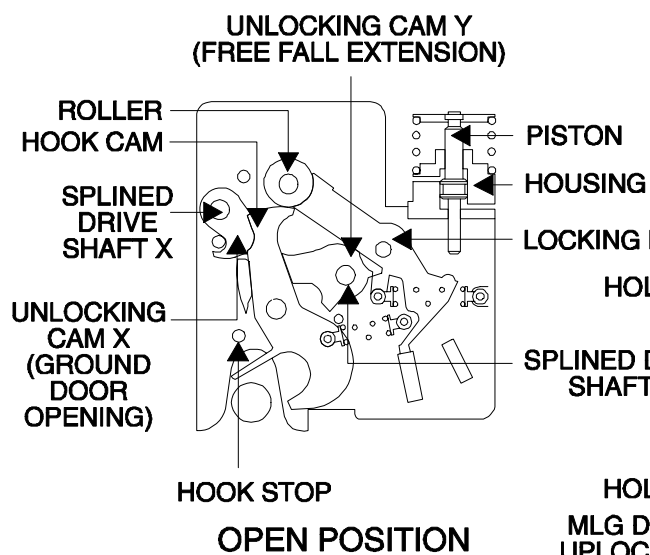
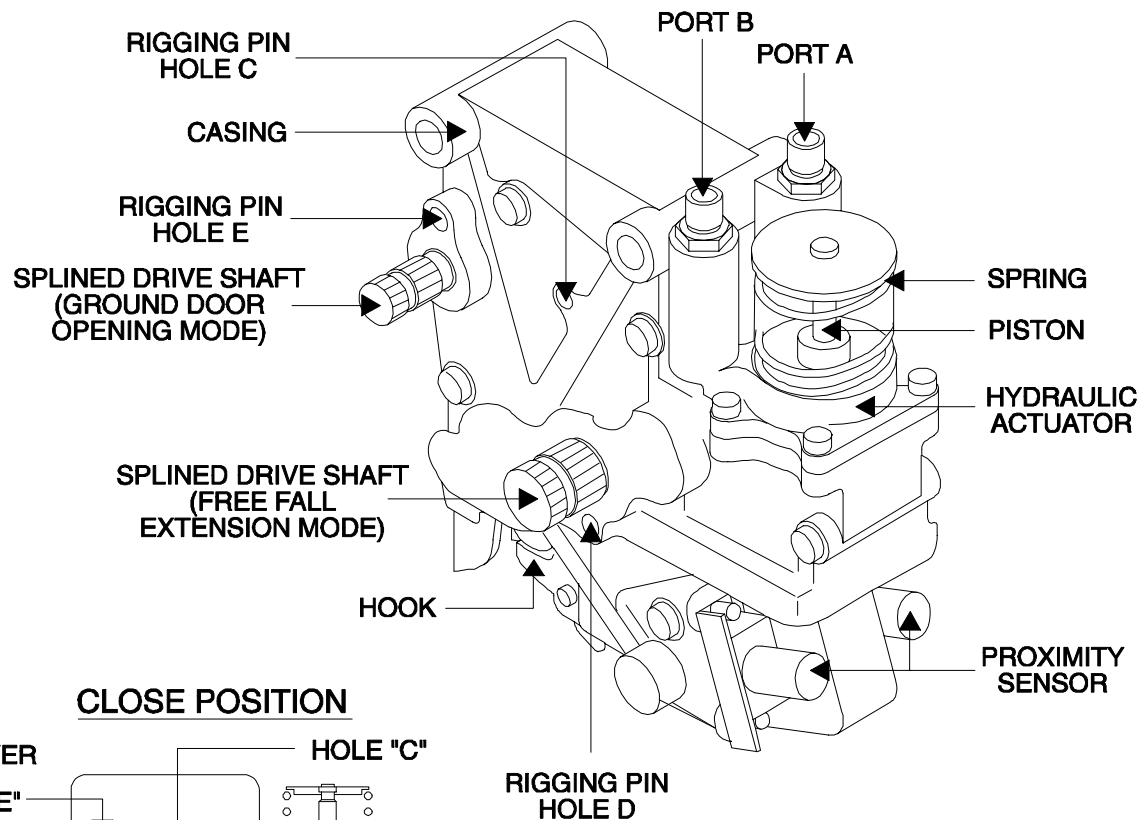
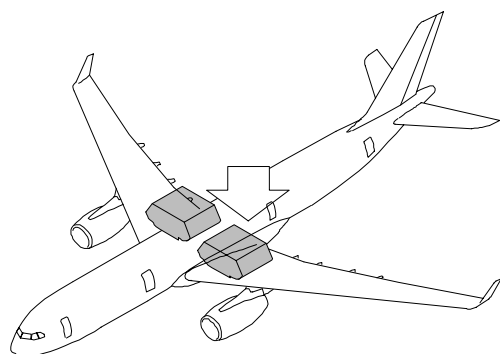
To open the hook, the hydraulic actuator extends the piston which pushes against the locking lever.
The locking lever turns and the roller moves to the top face of the hook cam.
The force on the MLG door uplock pin and the tension in the spring turns the hook to the open position.
The targets move away from the proximity sensors and give an uplock "open" signal.

GROUND OPENING

When the Ground door opening system is operated, the splined drive shaft "X" turns the unlocking cam "X".
The unlocking cam "X" pushes against the roller and turns the locking lever to open position.

FREE-FALL OPERATION

When the free fall extension is operated, the splined drive shaft "Y" turns the unlocking cam "Y".
The unlocking cam "Y" pushes against the roller and turns the locking lever to the open position.



FQW4200 GE Metric

MLG UPLOCK

FIN : 5220GA(LH)
5221GA(RH)

ZONE : 147 - 148

COMPONENT DESCRIPTION

The casing is in two halves attached together with bolts.
The hydraulic actuator is attached to the casing and contains a piston.
A spring keeps the piston retracted when there is no hydraulic pressure. The casing has three holes for rigging pins.
The holes are positioned for these functions:

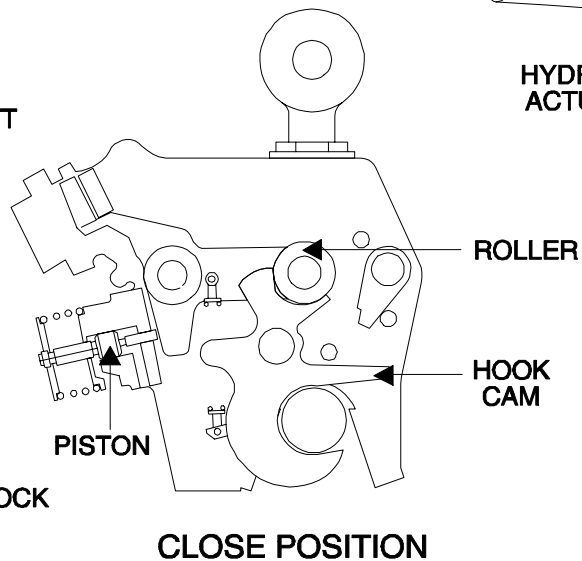
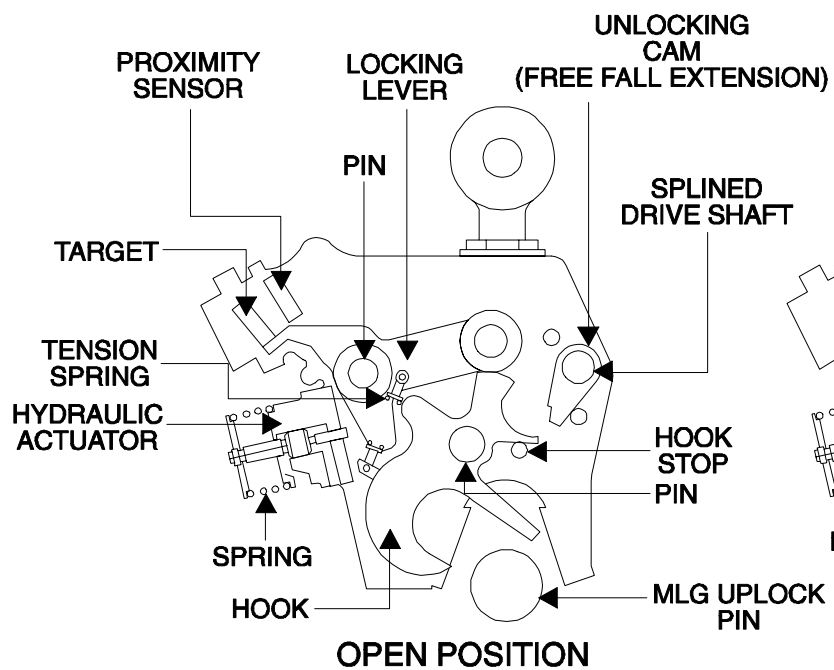
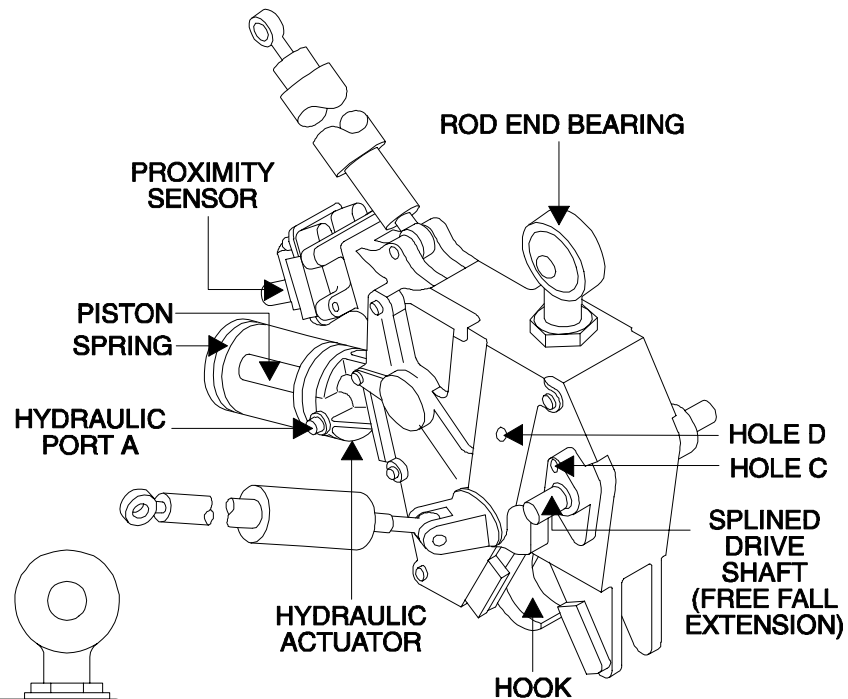
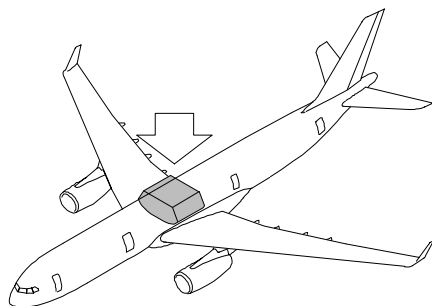
- D : proximity sensors rigging,
- C : free fall mechanism rigging.

UPLOCK DETAIL

To close the uplock, the MLG uplock pin comes against the upper face of the hook.
The hook turns to lock the MLG uplock pin in position.
As it turns the tension springs turns the locking lever until the roller moves against the side face of the hook cam.
The roller held against the side face of the cam keeps the hooks in position.
The targets are near the proximity sensors and give an uplock "closed" signal.

FREE FALL

When the free fall extension is operated, the splined drive shaft turns the unlocking cam.
The unlocking cam pushes against the roller and turns the locking lever to the open position.



FQW4200 GE Metric

MLG ACTUATOR

FIN : 5222GA(LH)
5223GA(RH)

ZONE : 731 - 741

COMPONENT DESCRIPTION

The actuator is a hydraulic powered unit with rate control devices.
The piston rod is contained in the cylinder.
Each valve housing is attached to the cylinder and contains a restrictor and a restrictor valve.
The restrictor decreases the flow of fluid in each direction and a restrictor valve decreases the flow of fluid out of the cylinder.

SPECIAL DESIGN

Pressure is simultaneously supplied to both sides of the actuator to extend the actuator to lower the gear.
To retract the gear, pressure is applied to the annular area of the actuator.

MLG DOOR ACTUATOR

FIN : 5226GA(LH)
5227GA(RH)

ZONE : 734 - 744

COMPONENT DESCRIPTION

The door actuator is a hydraulic actuator with rate devices.
The piston and piston rod are contained in a cylinder.
A damping piston, on each side goes into a damping bore at the end of the extend and retract stroke.

MLG DOWNLOCK ACTUATOR

FIN : 5254GA(LH)
5255GA(RH)

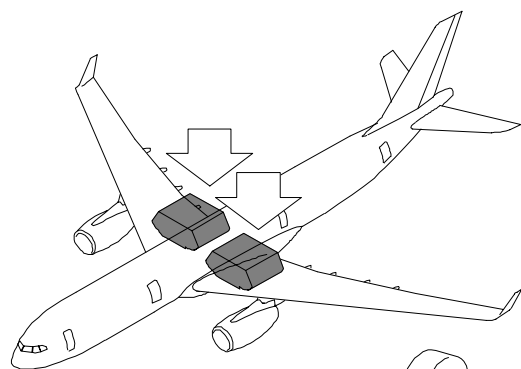
ZONE : 731 - 741

COMPONENT DESCRIPTION

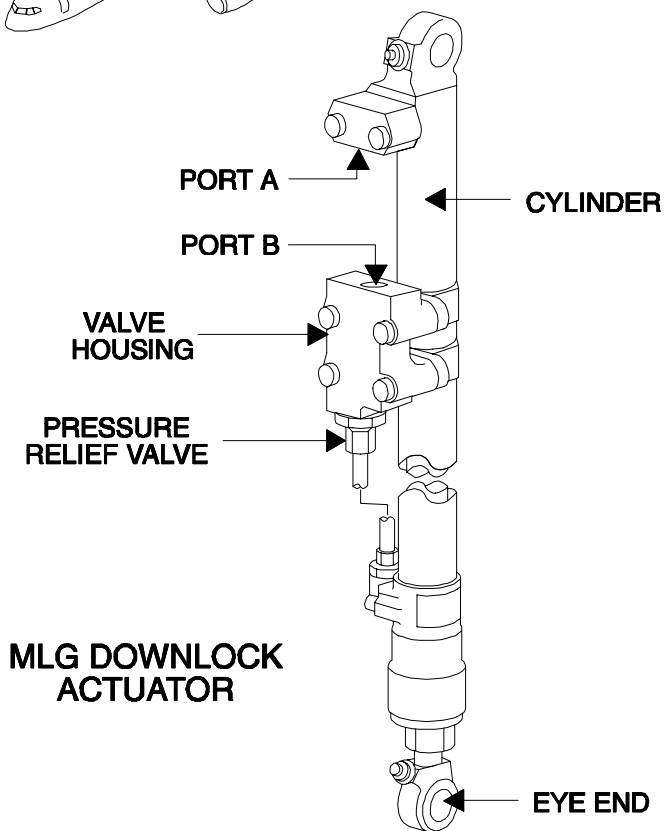
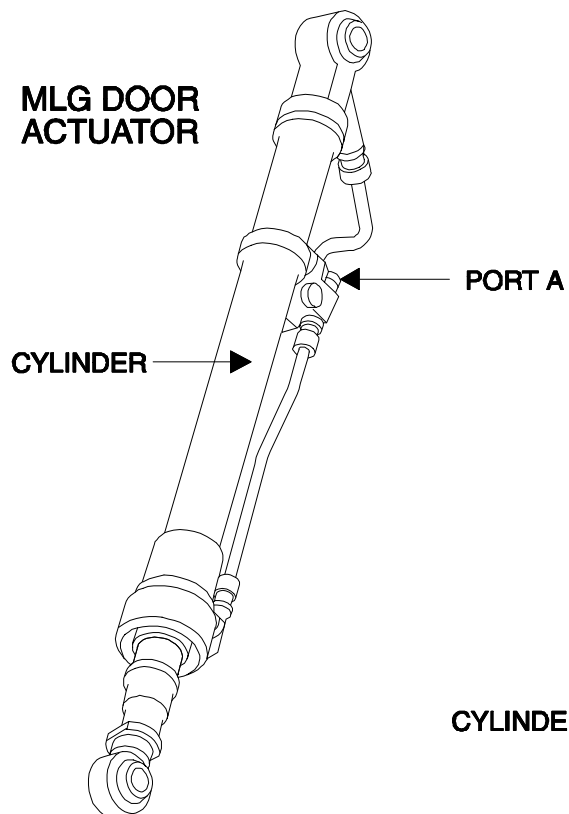
The downlock actuator is a hydraulic unit with a rate control device.
The piston moves in the cylinder.
Bolts attach the housing and body onto the cylinder.
The end fitting contains a poppet type restrictor valve (port A).
The body contains a poppet type restrictor valve and a pressure relief valve (port B).

SPECIAL DESIGN

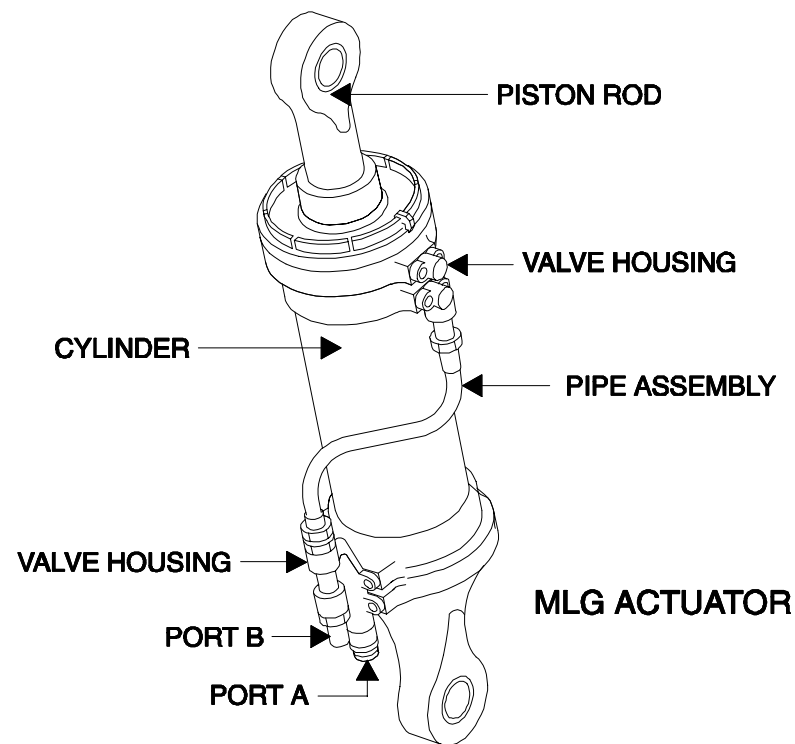
The actuator is simultaneously pressurized on the full and annular area during gear extension.
During retraction, the annular area of the actuator is pressurized to retract the actuator.



MLG DOOR ACTUATOR



MLG DOWNLOCK ACTUATOR



MLG ACTUATOR

FQW4200 GE Metric

RESTRICTOR VALVE

FIN : 5287GA(LH)
5288GA(RH)

ZONE : 147 - 148

COMPONENT DESCRIPTION

The restrictor valve is a spring loaded poppet valve.
It restricts the hydraulic flow during extension to control the rate of operation.

DELAY VALVE

FIN : 5358GA(LH)
5359GA(RH)

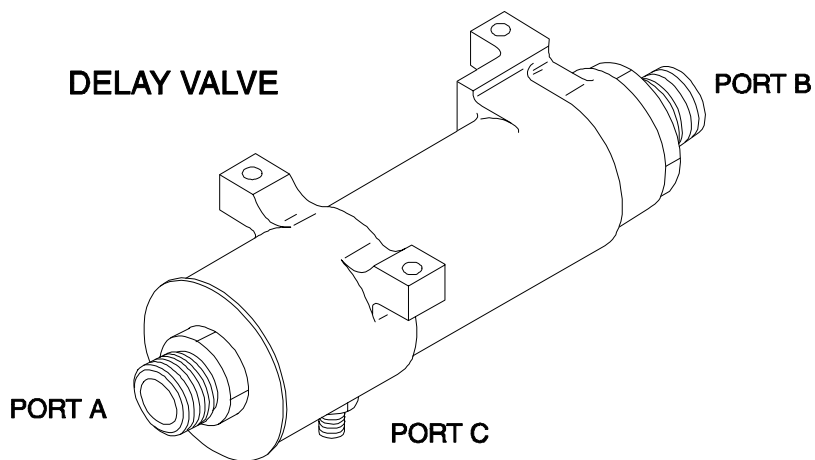
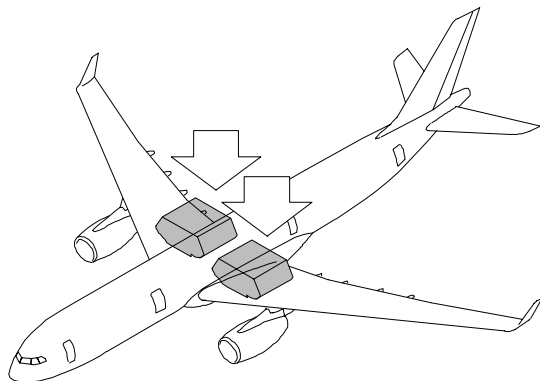
ZONE : 147 - 148

COMPONENT DESCRIPTION

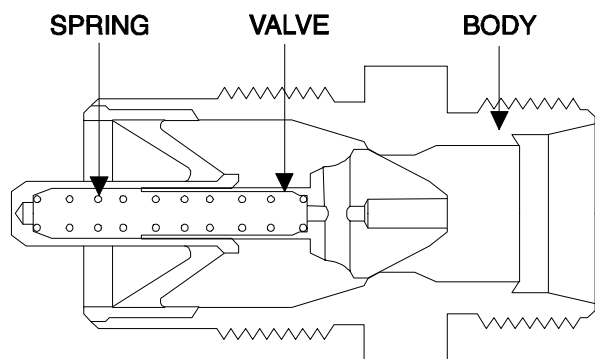
A delay valve in each MLG retract line makes sure that when hydraulic pressure is sent to retract the MLG, priority is given first to downlock actuator which starts to fold the Lock Stay Assembly and the Side Stay Assembly. After delay valve opening, hydraulic fluid pressurizes the retraction side of the MLG actuator. This reduces the loads on the MLG and the structure during retraction.

SPECIAL DESIGN

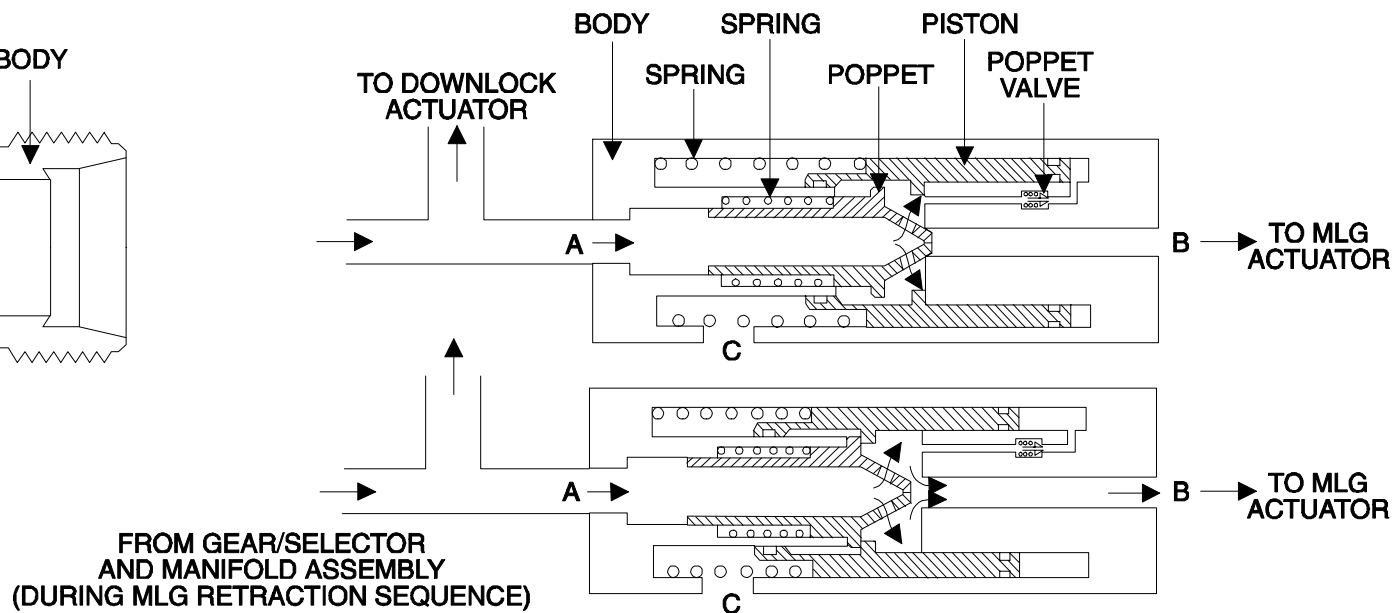
When port A is pressurized, there is no initial flow from port B. Fluid flows through the poppet and through the oneway restrictor to the end of the piston. The pressure pushes the piston against the spring tension and moves it along the body. When the piston touches the poppet, it moves the poppet off the face and opens the port A to port B. This lets pressurized fluid now flow from port A to port B. Hydraulic fluid can flow freely in the opposite direction, port B to port A.



RESTRICTOR VALVE



DELAY VALVE - SCHEMATIC



FQW4200 GE Metric

STUDENT NOTES

FQW4200 GE Metric

NOSE LANDING EXTENSION/RETRACTION COMPONENTS

NLG Door Actuator
NLG Safety Valve
NLG Uplock
NLG Retraction Actuator
NLG Downlock Actuator
NLG Changeover Valve

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is:

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked,
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

FQW4200 GE Metric

NLG DOOR ACTUATOR

FIN : 5203GA(LH)
5204GA(RH)

ZONE : 123 - 124

COMPONENT DESCRIPTION

The actuators are fitted with restrictors at both ends to control the rate of operation of the door.
End of stroke damping at each end of travel is also provided to reduce structural loads.

NLG RETRACTION ACTUATOR

FIN : 5201GA

ZONE : 711

COMPONENT DESCRIPTION

The ports are both fitted with restrictors to control the operating rate of the leg.
End of stroke damping is incorporated in both directions to reduce structural loads as the gear locks up or down.

SPECIAL DESIGN

Hydraulic pressure is supplied to the annulus area of the actuator to raise the landing gear.
To extend the gear, pressure is supplied to both sides of the actuator.

NLG DOWNLOCK ACTUATOR

FIN : 5214GA

ZONE : 711

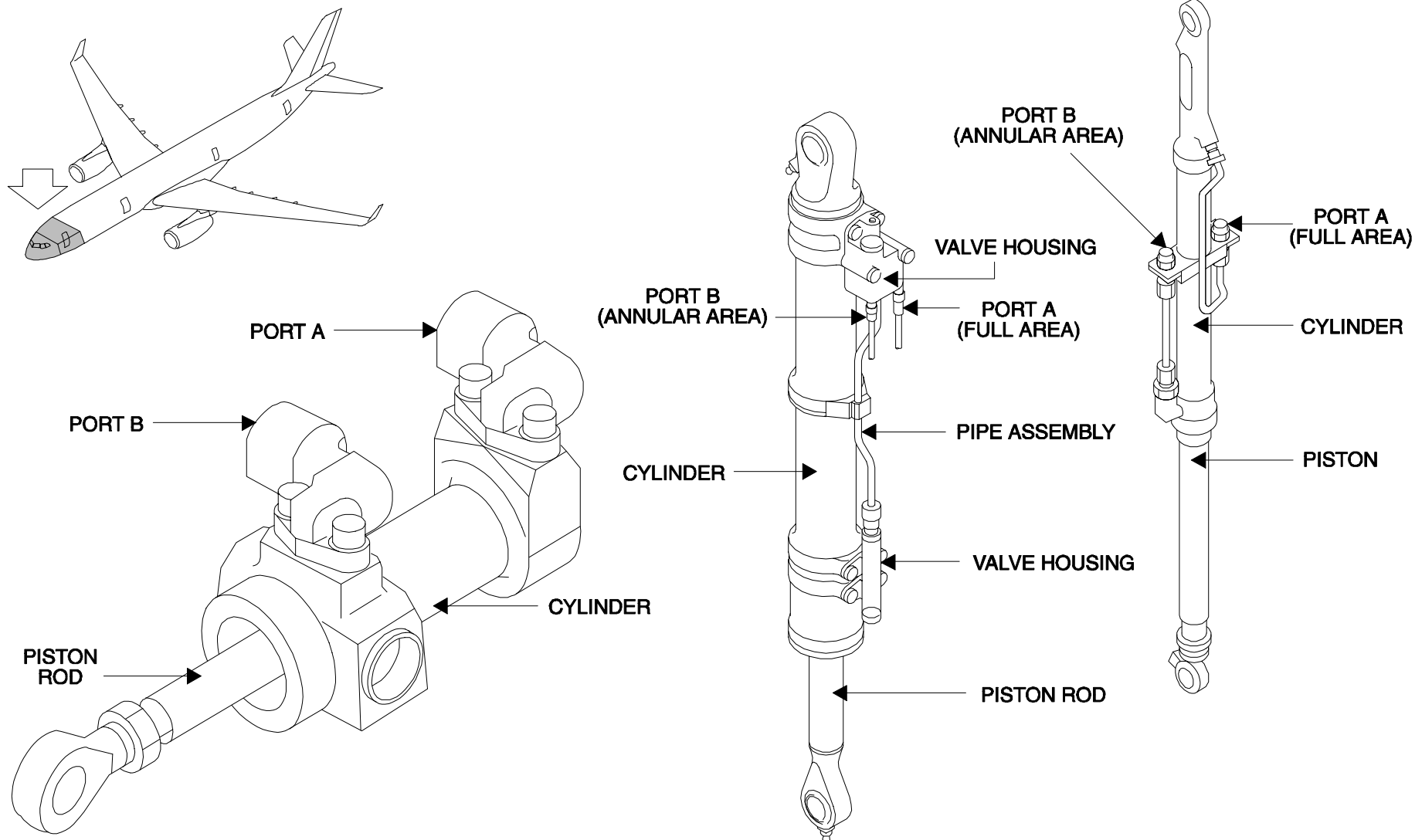
COMPONENT DESCRIPTION

The actuator is fitted with restrictors to control its rate of operation.
End of stroke damping takes place in the locking position to reduce the loads in the downlock mechanism.

SPECIAL DESIGN

When the main door is pressurized to close, the full area side of the downlock actuator is simultaneously pressurized.
During retraction of the landing gear, the annulus of the lock stay actuator is pressurized to retract the actuator.

NLG DOOR ACTUATOR



FQW4200 GE Metric

NLG DOWNLOCK ACTUATOR

NLG RETRACTION ACTUATOR

NLG SAFETY VALVE

FIN : 5281GA(OPEN)
5282GA(CLOSE)

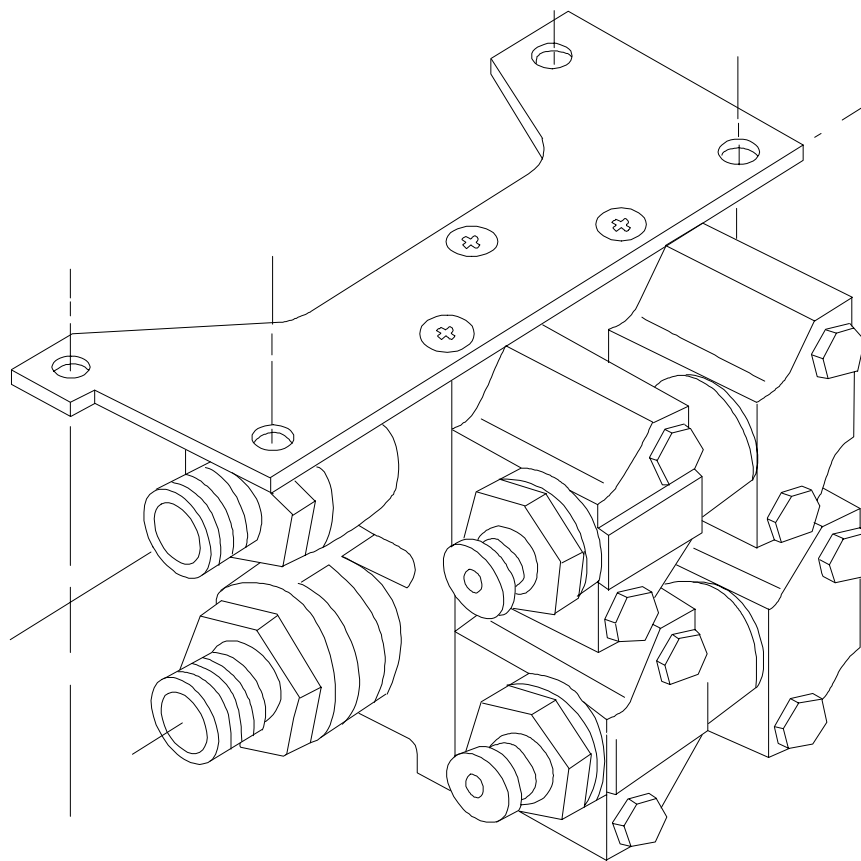
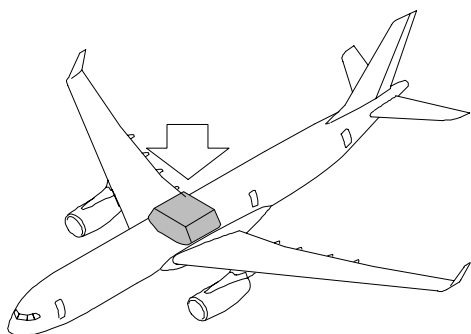
ZONE : 147

COMPONENT DESCRIPTION

The door open/close lines are under pressure for a longer time than the gear extend/retract lines hence the probability of fluid loss is increased by the higher risk time, so they are fitted with volumetric type fuses.

SPECIAL DESIGN

The fuses are similar in design to the MLG pitch trimmer fuses.
At the valves nominal flow rate of 34 litres/minute, pressure difference between chamber (1) and (2) produces a load that is resisted by the spring force.
If the flow rate exceeds 53 litres/minute, the poppet valve will close.



FQW4200 GE Metric

NLG UPLOCK

FIN : 5200GA

ZONE : 123

COMPONENT DESCRIPTION

The casing is in two halves attached together with bolts.

The hydraulic actuator is attached to the casing and contains a piston.

A spring keeps the piston retracted when there is no hydraulic pressure. The actuator has two hydraulic ports A and B.

The casing has a hole C.

When a pin is installed in hole C, it locks the unit in the closed position. The proximity sensors are attached to the casing.

UPLOCK DETAIL

To open the uplock, a hydraulic pressure at port A of the hydraulic actuator extends the piston which pushes against the locking lever.

The locking lever turns and roller "Y" moves to the side face of the hook cam.

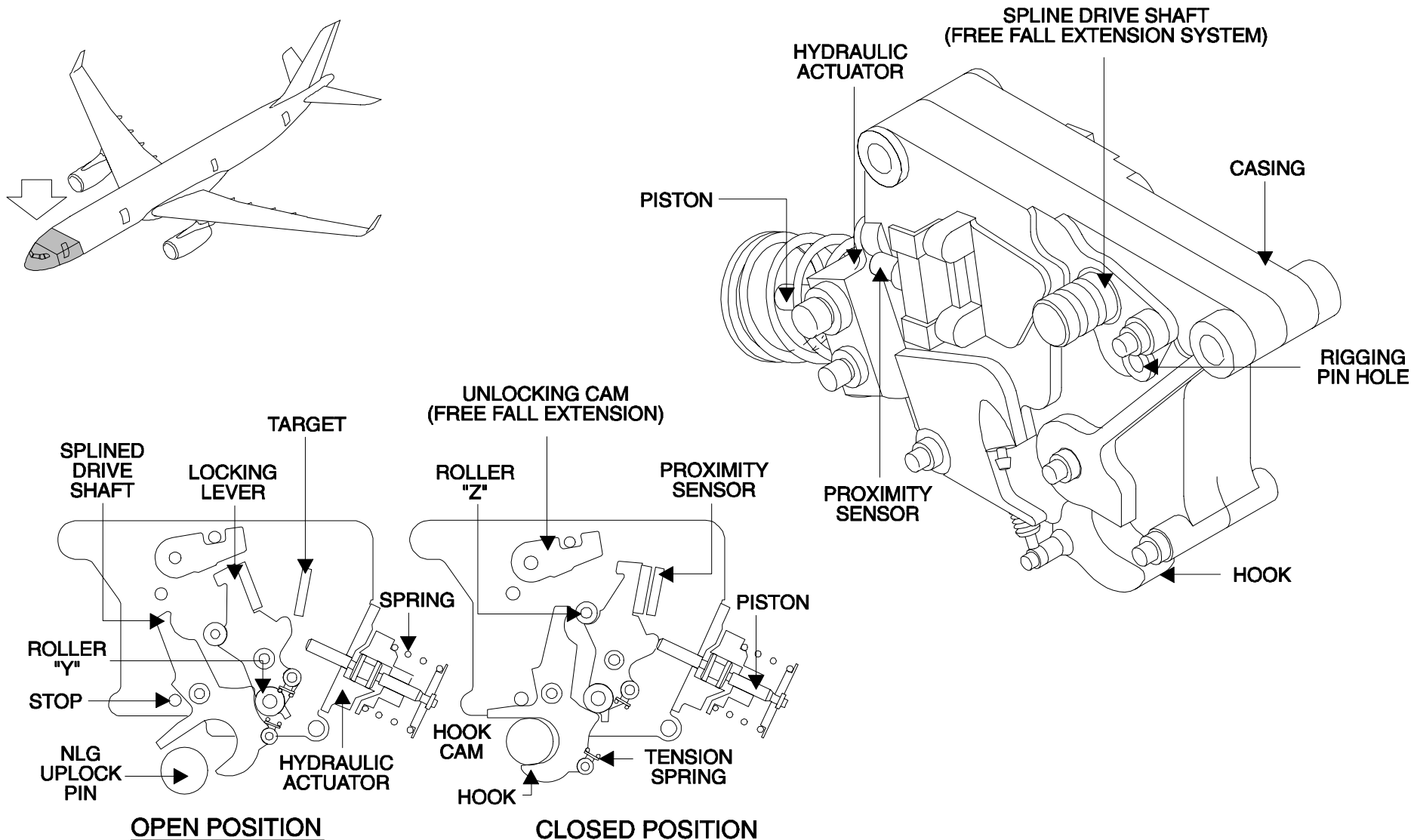
The force on the NLG uplock pin and the tension in the spring turns the hook to the open position.

The target moves away from the proximity sensors to give an uplock "OPEN" signal.

FREE-FALL OPERATION

When the free fall extension is operated, the splined drive shaft turns the unlocking cam.

The unlocking cam pushes against the roller and turns the locking lever to the open position.



FQW4200 GE Metric

NLG CHANGEOVER VALVE

FIN : 5215GA

ZONE : 123

COMPONENT DESCRIPTION

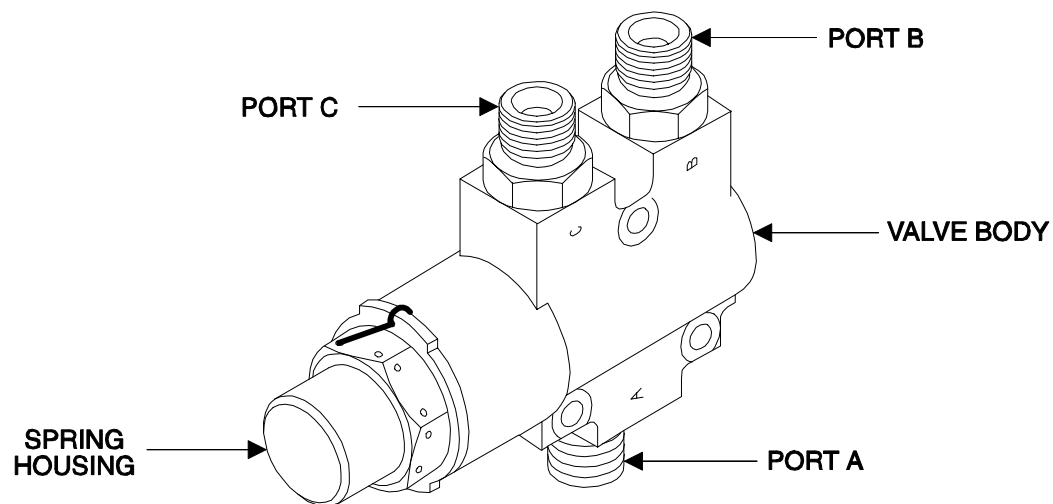
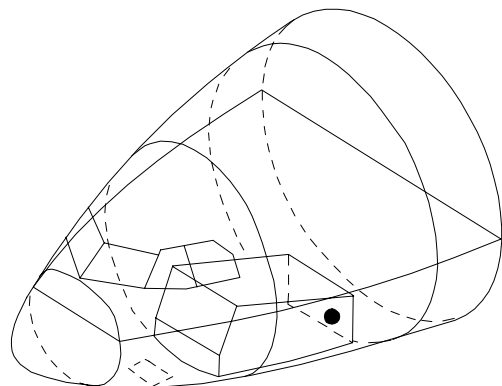
The NLG retraction valve which is installed in the NLG retraction line, is a spool-type valve. During retraction, the return line of the Nose Wheel Steering system is used instead of the normal return line to prevent retardation in the speed of the NLG retraction. The return line of the Nose Wheel Steering system has a larger diameter than the normal return line and so has less pressure drop and thus no fluid restriction.

NLG EXTENSION

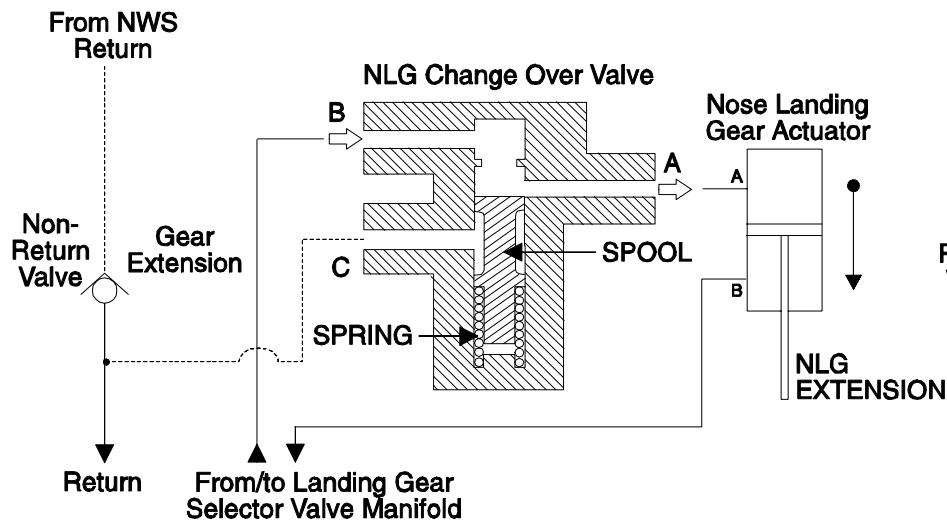
Schema n° 1

NLG RETRACTION

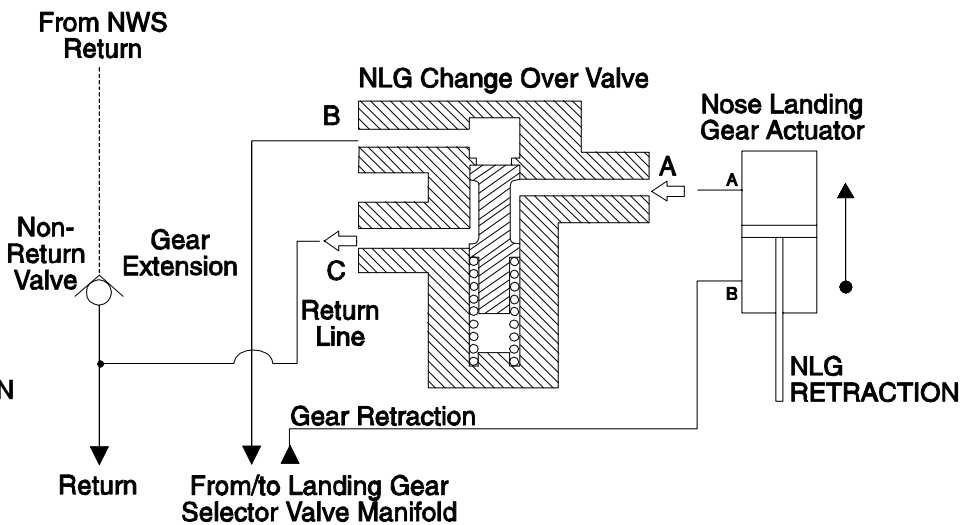
Schema n° 2



SCHEMA No 1



SCHEMA No 2



FQW4200 GE Metric

STUDENT NOTES

EXTENSION/RETRACTION COMPONENTS

Control Lever
Selector Valve and Manifold Assy
Selector Valve
LGCIU
Safety Valve
Proximity Sensor

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is :

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked,
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

FQW4200 GE Metric

CONTROL LEVER

FIN : 6GA

ZONE : 210

COMPONENT DESCRIPTION

The control lever has a knurled wheel on the end of an arm.

The arm moves in a slot in the face of the unit.

Internal locks in the unit keep the arm in the fully UP or DOWN position. The arm moves switches inside the unit, which supply electrical signals to the LGCIUs.

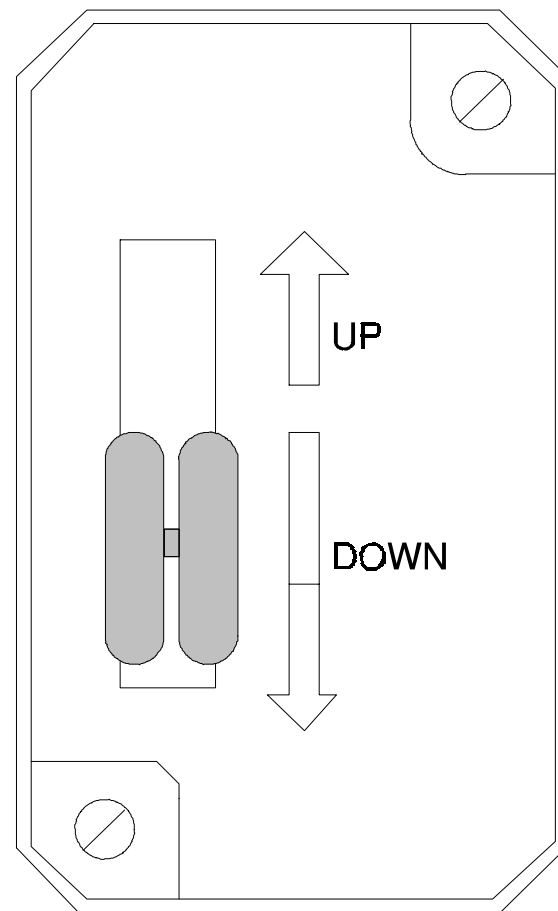
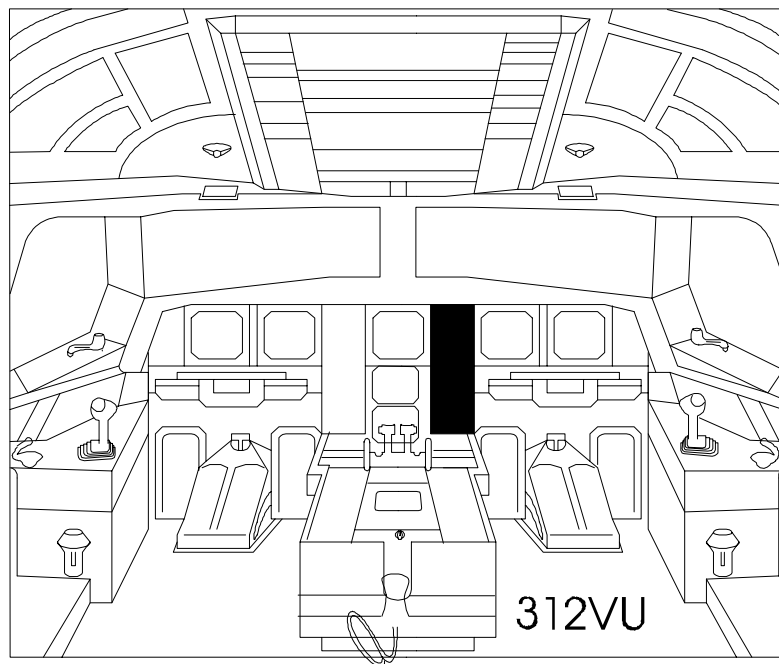
SPECIAL DESIGN

To operate the L/G control lever, the control lever is pulled away from the face then moved to the UP or DOWN position.

The lower part of the DOWN arrow shows red (with internal red lighting) when the aircraft is in a landing configuration but the L/G is not locked down.

SAFETY PRECAUTION

A solenoid-operated baulk mechanism prevents an UP selection if the L/G shock absorbers are not fully extended.



SELECTOR VALVE AND MANIFOLD ASSY

FIN : 5280GA

ZONE : 147

COMPONENT DESCRIPTION

The landing gear selector valves and manifold assembly consist of two electro-hydraulic selector valves and an associated manifold.

These control the normal operation of the aircraft landing gear and the associated doors.

The manifold has two faces on which the selector valves are installed. It includes two restrictor valves installed in the port supplies and one check valve in the supply drilling to the door selector valve.

SELECTOR VALVE

FIN : 5280GA

ZONE : 147

COMPONENT DESCRIPTION

The main components of each selector valve are two solenoids, two pilot valves and a spool valve.

Each selector valve is a four way, three position valve controlled by 2 solenoids, each solenoid having duplicated winding.

With the solenoids de-energized the valve is positively centered and held in a neutral position.

Energizing one of the solenoids will operate the valve to the selected position.

The selectors are designed to minimize the risk of inadvertent selection.

SAFETY VALVE

FIN : 5281GA

5282GA

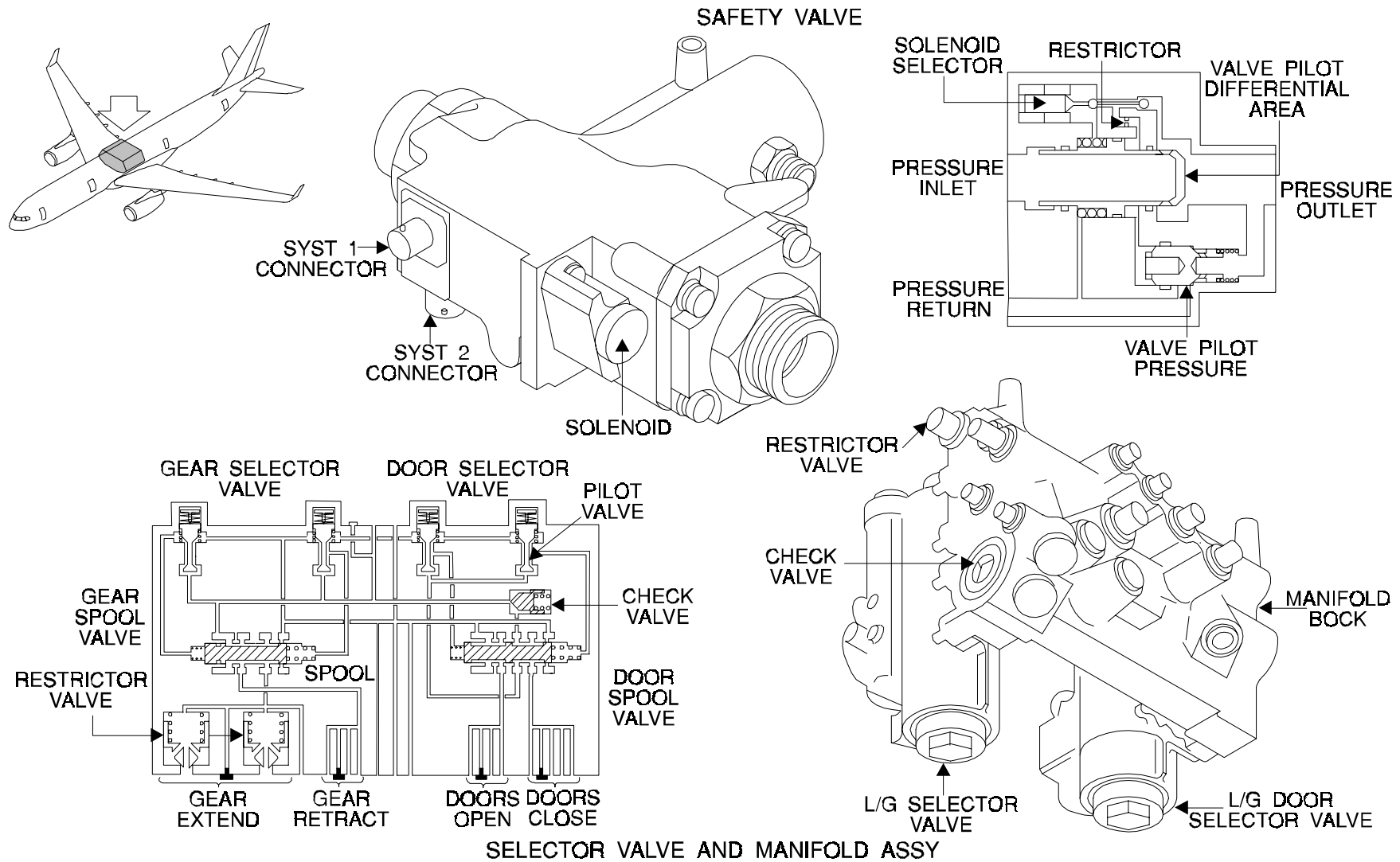
ZONE : 147

COMPONENT DESCRIPTION

The single safety valve is line mounted immediately downstream of the green system priority valve.

The valve is solenoid operated with two coils that are separately energized. In normal operation both coils are energized, but the valve will operate with one coil energized.

When the calculated airspeed exceeds 280 kts, the solenoid is de-energized.



FQW4200 GE Metric

LGCIU

FIN : 5GA1
5GA2

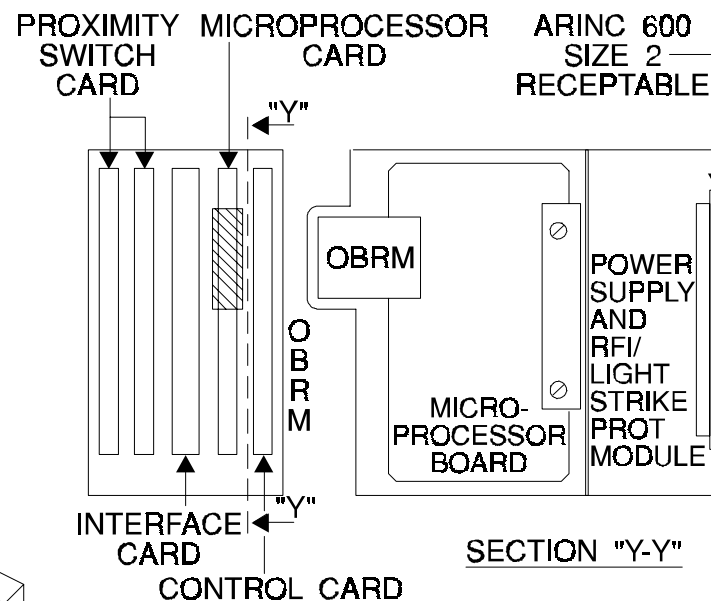
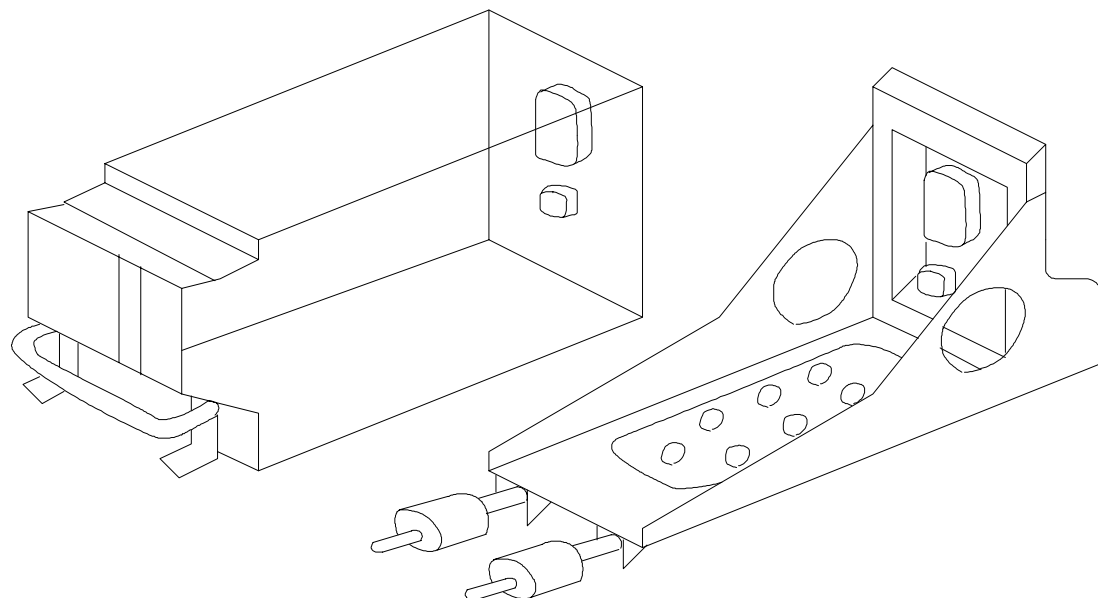
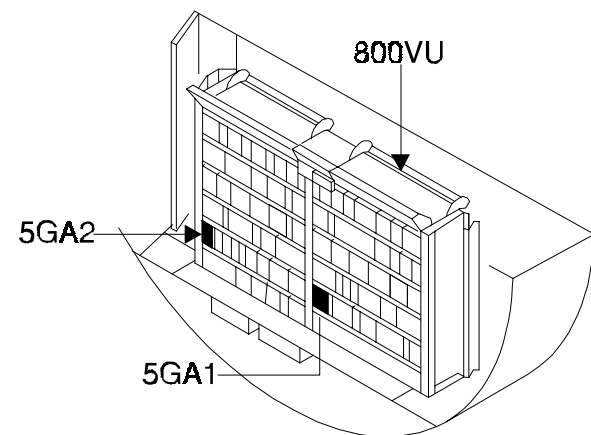
ZONE : 121
122

COMPONENT DESCRIPTION

The LGCIUs are located in the avionics bay, on rack 800VU.

A lightning protection card prevents damage to the LGCIU's components. An On Board Replaceable memory Module is attached to the front of the LGCIU.

It contains the program, in erasable programmed read only memory, that controls the operation of the LGCIU.



PROXIMITY SENSOR

COMPONENT DESCRIPTION

Each proximity sensor consists of a rectangular stainless steel unit, which contains the sensor coil.

On one side of the unit is a sensor area, which detects the presence of the sensor target.

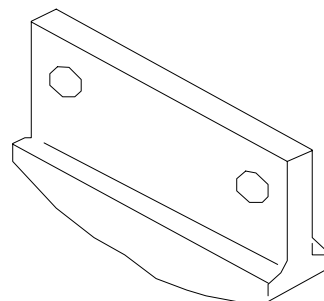
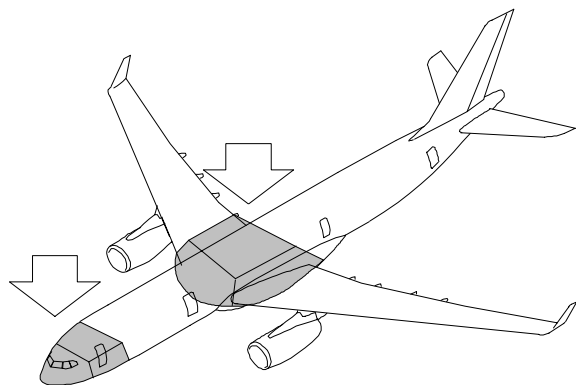
The proximity sensor works on the principle of variable reluctance, governed by the movement of the sensor.

MLG SENSOR

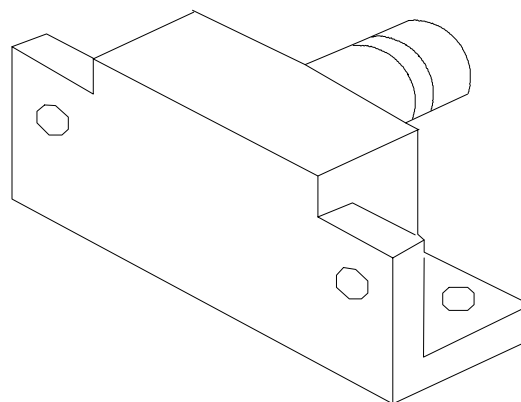
FIN	TITLE	ZONE	FIN	TITLE	ZONE
10GA1	UPLOCK(LH)	147	28GA1	S/MECH(RH)	741
11CA1	UPLOCK(RH)	148	29CA1	BOGIE TRAIL(RH)	741
15GA1	DOWNLOCK(LH)	731	30GA1	PITC TRIM(LH)	731
16GA1	DOWNLOCK(RH)	741	31GA1	PITC TRIM(RH)	741
26GA1	S/MECH DK(LH)	731	33GA1	UPLOCK(LH)	147
27GA1	BOGIE TRAIL(LH)		34CA1	UPLOCK(RH)	148
	LGCIU1 SHOWN		39GA1	DOOR OPEN(LH)	734
	LGCIU1 SIMILAR		40GA1	DOOR OPEN(RH)	744
			7GB	DOWNLOCK IN(LH)	731
			8GB	DOWNLOCK IN(RH)	741

NLG SENSOR

FIN	TITLE	ZONE	FIN	TITLE	ZONE
13CA1	UPLOCK	123	44GA1	DOOR OPEN(RH)	124
20GA1	DOWNLOCK	711			
24GA1	SHOCK ABSORB	711		LGCIU1 SHOWN	
37GA1	DOOR UPLOCK(LH)	123		LGCIU2 SIMILAR	
38GA1	DOOR UPLOCK(RH)	124			
43GA1	DOOR OPEN(LH)	123			
9GB	DOWNLOCK IN	711			



SENSOR TARGET



PROXIMITY SENSOR

FQW4200 GE Metric

STUDENT NOTES

FQW4200 GE Metric

FREE FALL EXTENSION COMPONENTS

Cutout Valve
Vent Valve
Gravity Extension
Actuator
Linkage

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is :

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked,
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

FQW4200 GE Metric

CUTOUT VALVE

FIN : 5285GA

ZONE : 148

COMPONENT DESCRIPTION

The cutout valve is a mechanically operated hydraulic unit.

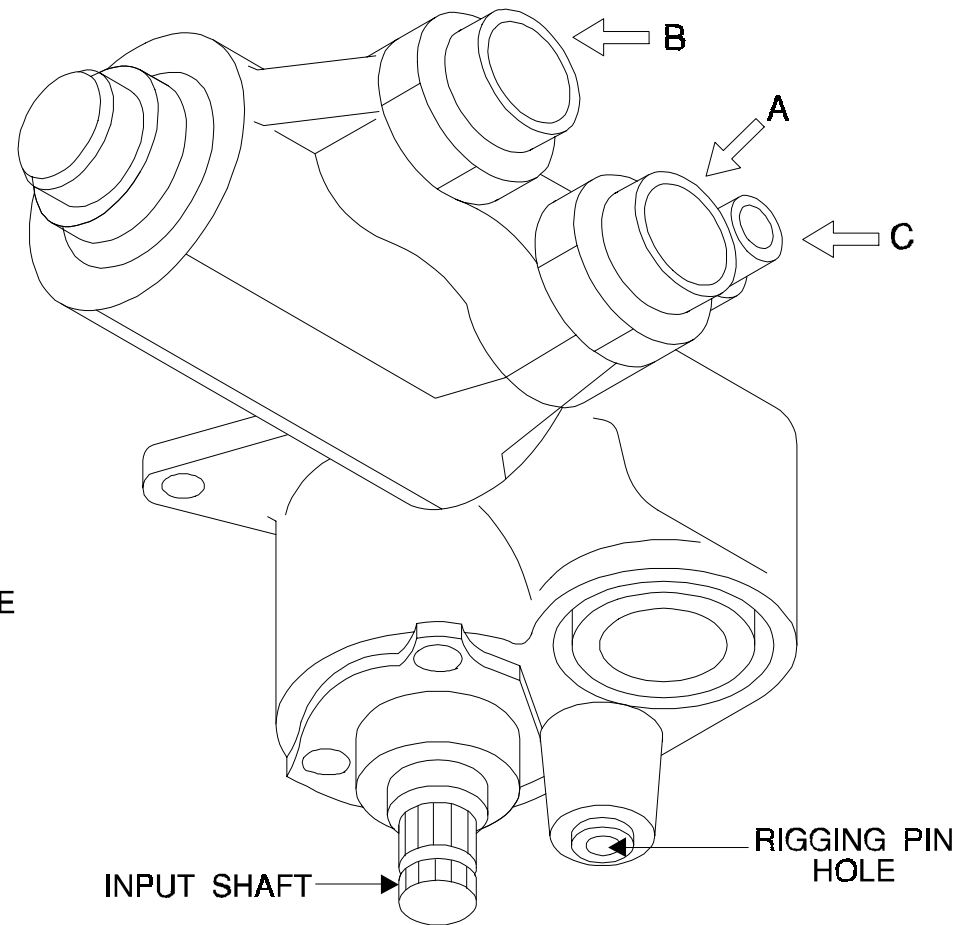
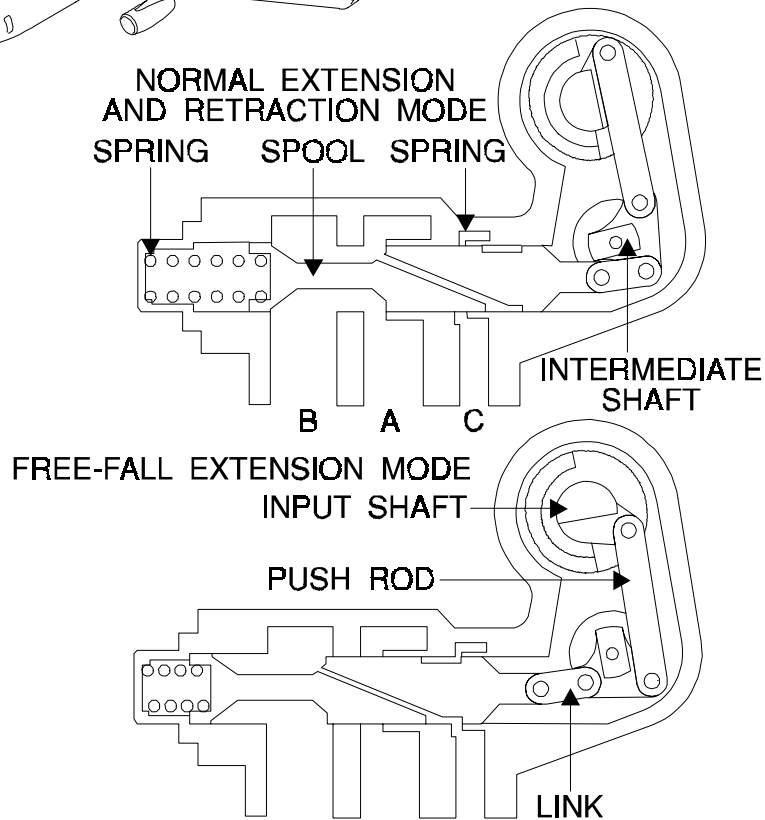
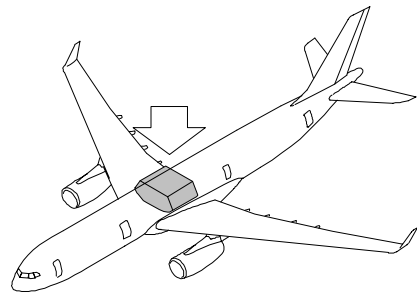
It has a casing that contains a sealed lining in which a sealed spool moves to open or close the ports A, B or C.

In the normal extension and retraction mode, port A is open to port B and port C is closed.

When the input shaft turns, it moves the spool in the lining.

At 28 degrees, port A closes to port B.

At 30 degrees port B opens to port C.



FQW4200 GE Metric

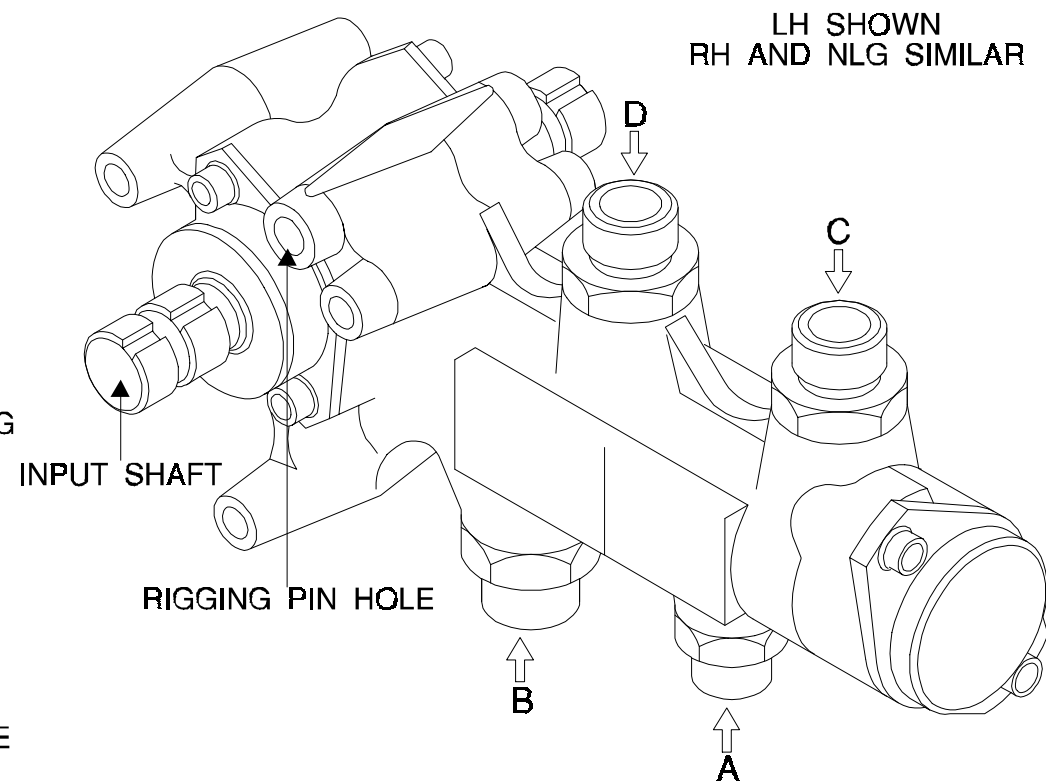
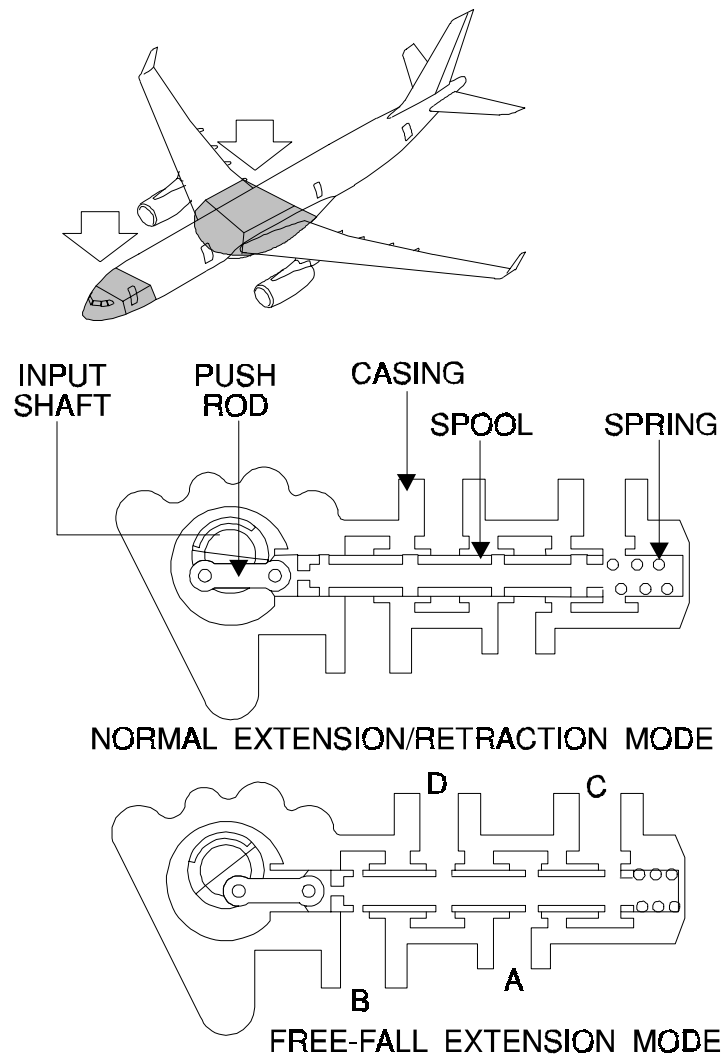
VENT VALVE

FIN : 5206GA(NLG)
5230GA(LH)
5231GA(RH)

ZONE : 123(NLG)
147(LH)
148(RH)

COMPONENT DESCRIPTION

The vent valve is a mechanically operated hydraulic unit.
It has a casing that contains a sealed lining in which a sealed spool moves to open or close the ports A, B, C or D.
In the normal extension and retraction mode, ports A, B and D are closed and port C is open to the system return.
When the shaft turns, it moves the spool in the lining.
In the 30 to 50 degrees sector of movement, ports A, B, C and D open.



GRAVITY EXTENSION SWITCH

FIN : 8GF1
8GF2

ZONE : 210

COMPONENT DESCRIPTION

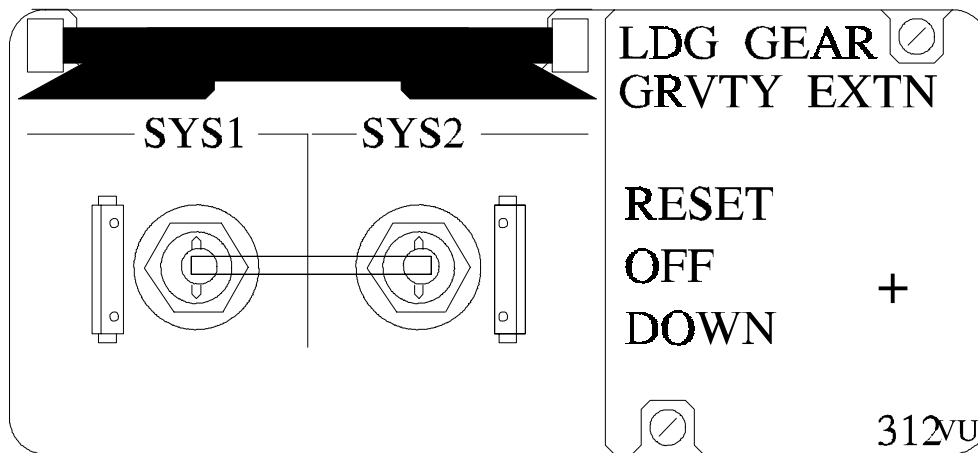
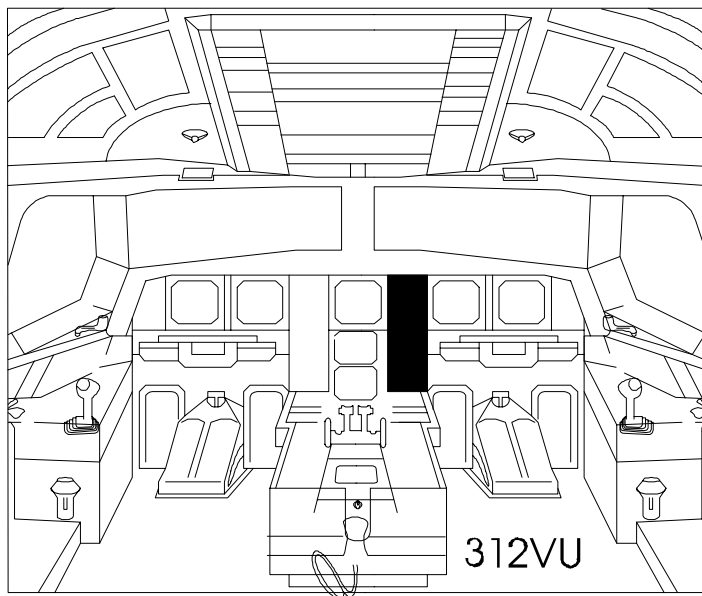
The gravity extension system is an electromechanical system controlled through two switches located on the center instrument panel.

It permits the main and nose landing gear extension in case of normal extension system failure.

SPECIAL DESIGN

The L/G gravity extension selectors are locked toggle type switches. They are connected together with a link so that both are operated at the same time.

When the link is disconnected each selector can be operated independently. After a free fall extension, it is possible to restore normal operation provided the green hydraulic pressure is available.



FQW4200 GE Metric

ACTUATOR

FIN : 7GF(NLG)
5GF(LH)
6GF(RH)

ZONE : 121(NLG)
145(LH)
146(RH)

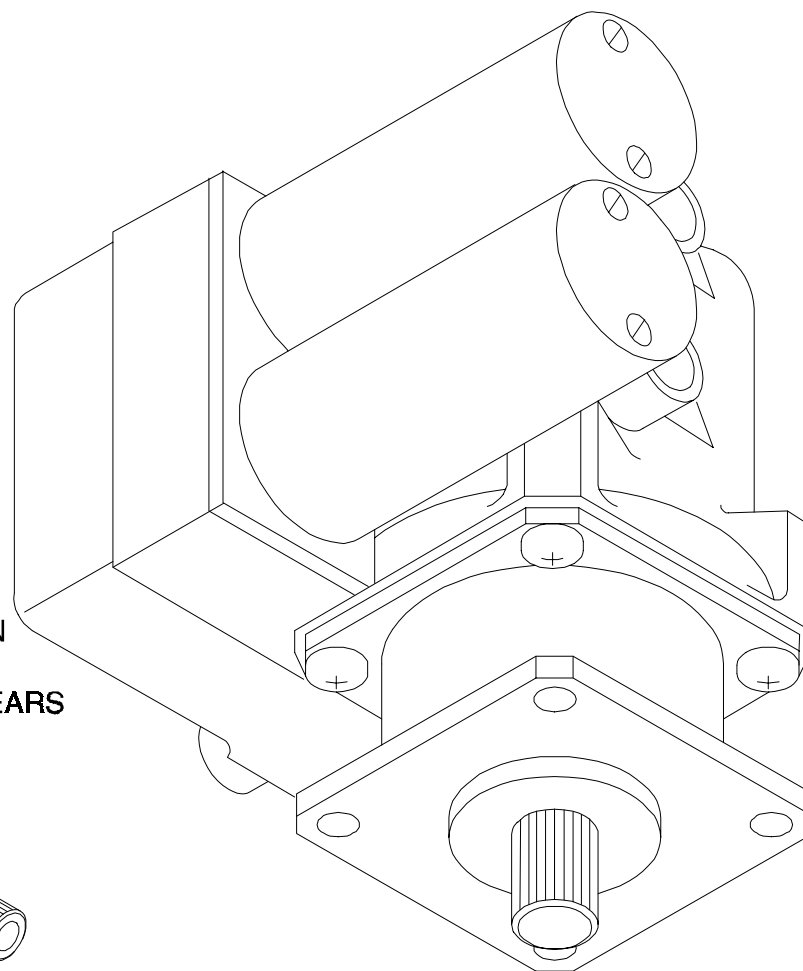
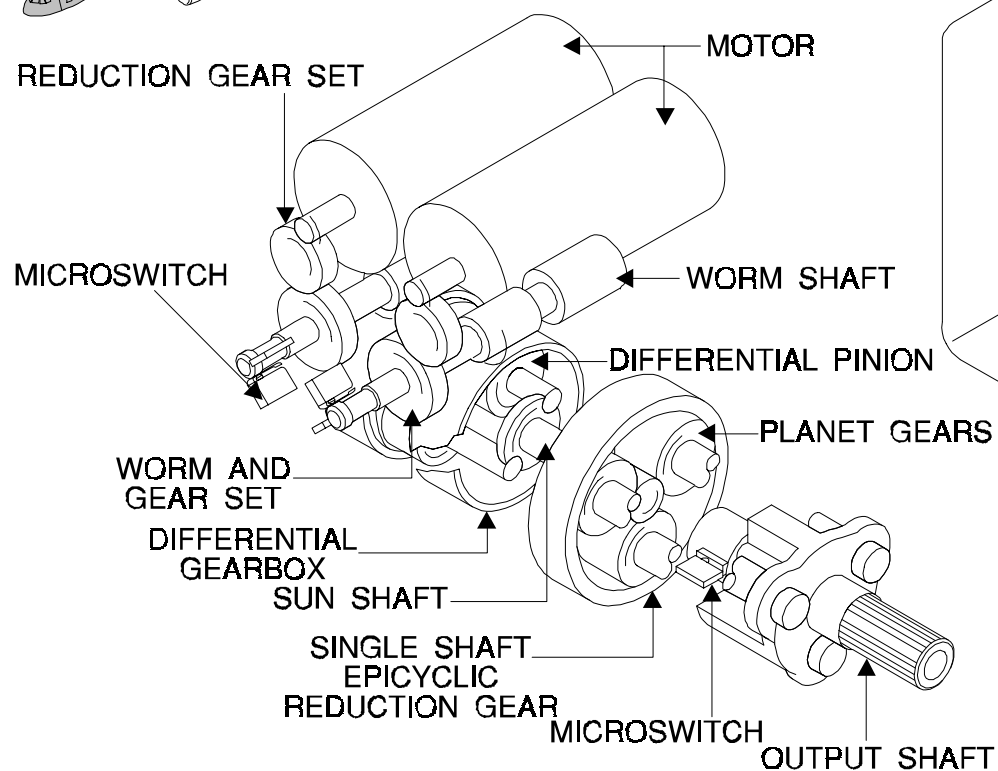
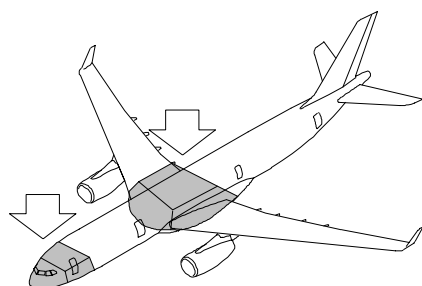
COMPONENT DESCRIPTION

Two completely independent electrical systems are used, each connected to a "hot" bus bar from an aircraft battery.

The actuators contain two 28 volt DC permanent magnet motors.

Each motor drives one branch of a differential gear, through a worm and wheel gear input.

The actuator incorporates a torque limiting device which permits a maximum output shaft torque of 200 Nm to be transmitted in both directions of rotation.



FQW4200 GE Metric

LINKAGE

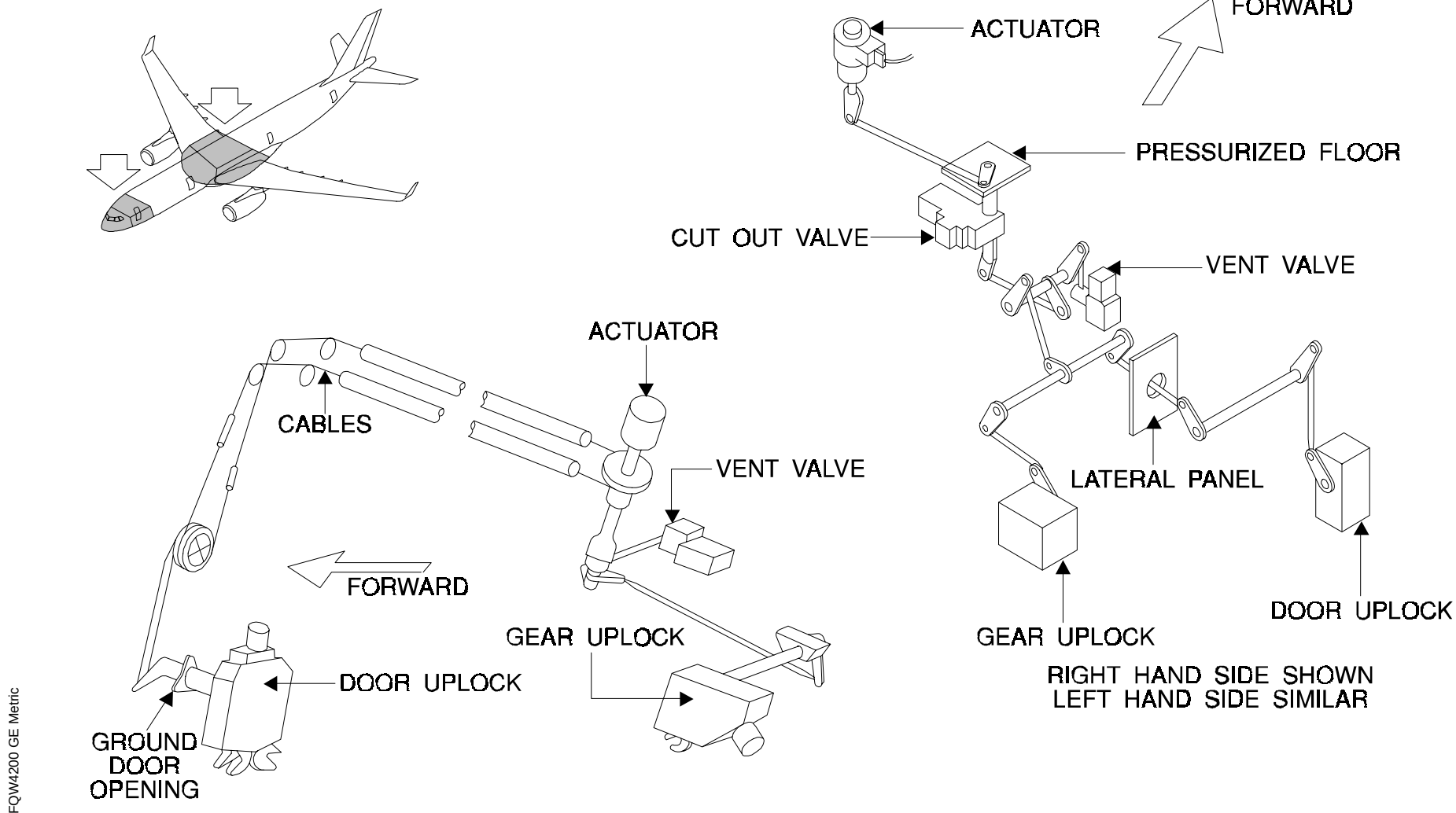
FIN : TBD

ZONE : TBD

COMPONENT DESCRIPTION

In each main landing gear bay and the nose landing gear bay, a mechanical linkage connects the motorized actuator to a vent valve, the door uplock and gear uplock.

The right hand main landing gear system also operates a cut-out valve which disconnects the landing gear circuit from the green hydraulic supply.



STUDENT NOTES

LANDING GEAR CONTROL AND INTERFACE UNIT (LGCIU) INTERFACES

General

ATA 21 - AIR CONDITIONING
ATA 22 - AUTOFLIGHT
ATA 23 - COMMUNICATION
ATA 24 - ELECTRICAL POWER
ATA 26 - FIRE PROTECTION
ATA 27 - FLIGHT CONTROLS
ATA 28 - FUEL
ATA 29 - HYDRAULIC POWER
ATA 30 - ICE AND RAIN PROTECTION
ATA 31 - INDICATING/RECORDING
ATA 32 - LANDING GEAR
ATA 33 - LIGHTS
ATA 34 - NAVIGATION
ATA 38 - WATER AND WASTE
ATA 45 - ON BOARD MAINTENANCE
ATA 49 - AUXILIARY POWER UNIT
ATA 52 - DOORS
ATA 73 - ENGINES

GENERAL

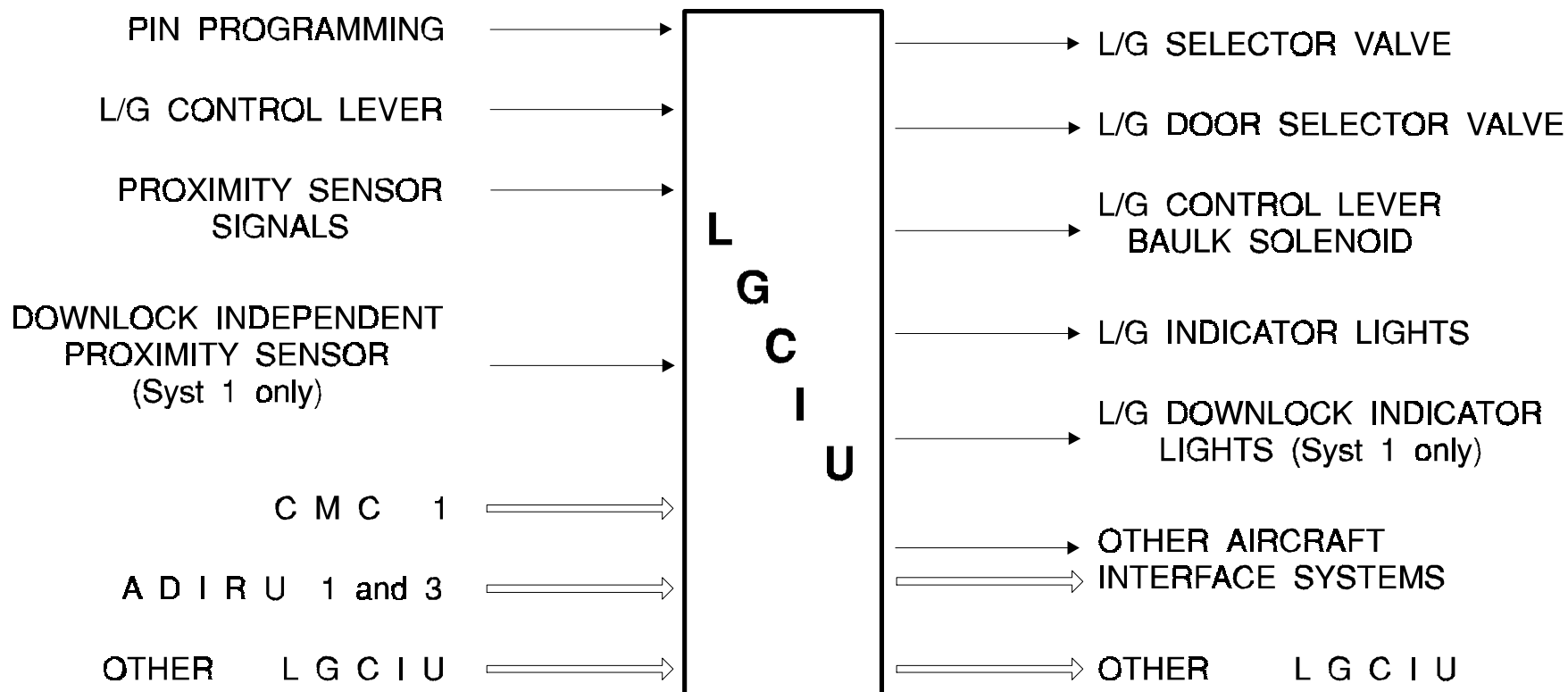
The Landing Gear Control and Interface system is composed of two electrically segregated systems :

- system one Landing Gear Control and Interface Unit 1 (LGCIU1) is energized from the essential bus bar,
- system two (LGCIU2) is energized from the normal bus bar.

Each system has its own set of proximity switches to monitor the landing gear position.

Proximity switch data is interpreted by LGCIUs and is used for :

- controlling the landing gear,
- indicating the landing gear position,
- generating landing gear position information to be used by other aircraft systems.



The different positions of the landing gear, used by other aircraft systems are displayed in the table.

The first part of the table indicates which landing gear control and interface unit is concerned and which gear position is used.

"*" indicates which gear position is used :

- M : Left Hand and Right Hand landing gear.
- LH : Left Hand landing gear.
- RH : Right Hand landing gear.
- N : Nose landing gear.

The second area gives the signal type used by other aircraft systems.

- TYPE 1 :

The different parameters are transmitted in digital format on an ARINC 429 data bus.

- TYPE 3 :

Transistor conducting to earth potential for ON with 1 Amp load capability switching 8x100 mA maximum loads.
Each load is isolated by a diode.

- TYPE 4 :

Latching relay provides contacts used as type 3 signals conducting to earth potential for ON.

The third area gives :

- The electrical code circuitry.
- The corresponding ATA chapter, and the relevant system.
- Electrical Code circuitry : "EC".
- Corresponding ATA chapter : "ATA".
- Relevant system : "FUNCTION".

If the electrical supplies to a unit are turned off or lost :

- There is no ARINC 429 transmission.
- All transistors switch to high impedance.
- All latching relay contacts remain in the position which they were in immediately before loss of power.

LGCIU : LANDING GEAR CONTROL AND INTERFACE UNIT .

M : LEFT AND RIGHT MAIN GEAR

LH : LEFT MAIN GEAR

RH : RIGHT MAIN GEAR

N : NOSE GEAR

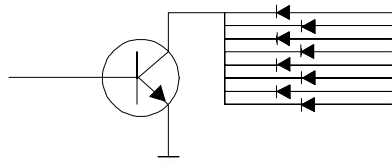
L G C I U 1					L G C I U 2					GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N	T	M	LH	RH	N	T	SIG	EC	ATA	FUNCTION
*	*				*	*				3	WD	2612	ENG. FIRE DET.
1										2	3		

SIG : SIGNAL TYPE

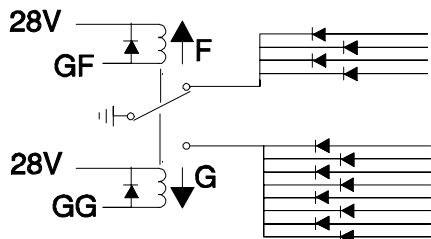
TYPE 1 : LABEL 020/030



**TYPE 3 : 1 AMP TRANSISTOR
8x100 mA LOADS**



TYPE 4 : LATCHING RELAY



GF : GEAR IN FLIGHT LH/RH/N
GG : GEAR ON GROUND LH/RH/N

ATA 21 - AIR CONDITIONING

L G C I U 1					L G C I U 2					GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
		*					*			3	HR	2125	AIR COND
		*				*	*			3	HQ	2126	AEVC
						*	*			3	HL	2131	CABIN PRESS CONT
						*	*			3	HH	2153	PACK CON IND
							*			3	HK	2163	ZONE CONT

L G C I U 1					L G C I U 2					GEAR IN FLIGHT (NOT COMPRESSED)			
M	LH	RH	N		M	LH	RH	N	C	SIG	EC	ATA	FUNCTION
	*						*			4	HR	2125	AIR COND COMP VENT
										3	HN	2128	VENT CONT

FQW4200 GE Metric

ATA 22 - AUTOFLIGHT

L G C I U 1					L G C I U 2					GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
	*	*	*			*	*	*		3 1	CB CC	2285 2286	FMGES FMGES

L G C I U 1					L G C I U 2					GEAR LOCKED DOWN			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
	*	*				*	*			1	CC	2286	FMGES

ATA 23 - COMMUNICATION

L G C I U 1				L G C I U 2				GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
			*					3	RK	2371	CVR
L G C I U 1				L G C I U 2				GEAR ON GROUND OR GND PWR CONNECTED			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
			*				*	3	RH	2373	CIDS
L G C I U 1				L G C I U 2				GEAR LOCKED DOWN			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
			*				*	3	RH	2373	CIDS
L G C I U 1				L G C I U 2				GEAR IN FLIGHT (NOT COMPRESSED)			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
	*					*		3	RE	2311	HF 1
	*					*		3	RE	2311	HF 2
	*					*		3	RC	2312	VHF 1
	*					*		3	RC	2312	VHF 2
	*				*	*		3	RC	2312	VHF 3
	*					*		3	RV	2328	SAT COMM 1
	*					*		3	RV	2328	SAT COMM 2
	*					*		3	RN	2351	AMU
	*		*			*		3	RK	2371	CVR
	*					*		3	RG	2381	RMP 1
	*					*		3	RG	2381	RMP 2
	*				*	*		3	RG	2381	RMP 3
	*		*		*			4	WC	2342	GROUND WARNING

(OPTIONAL)

(OPTIONAL)

ATA 24 - ELECTRICAL POWER

L G C I U 1					L G C I U 2					GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
			*							3	XM	2429	ECMU
			*							4	PC	2435	DC ESS DIST
			*							3	PB	2438	BATT DC GEN
			*							3	XG	2441	AC EXT POWER
			*							3	XD	2453	C/B MONITORING

L G C I U 1					L G C I U 2					GEAR IN FLIGHT (NOT COMPRESSED)			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
			*							4	XE	2424	AC EMERG GEN

ATA 26 - FIRE PROTECTION

L G C I U 1					L G C I U 2					GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
	*	*				*	*			3	WD	2612	ENG FIRE DETECT
*					*					3	WG	2613	APU FIRE/OVHEAT
*										3	WF	2622	APU FIRE EXT

L G C I U 1					L G C I U 2					GEAR ON GROUND OR GND PWR CONNECTED			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
			*					*		3	WH	2616	SMOKE DETECT

ATA 27 - FLIGHT CONTROLS

L G C I U 1				L G C I U 2				GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
			*				*	1	CE	2793	FCPC 1/2/3
	*	*			*	*		1	CE	2793	FCPC 1
	*	*			*	*		1	CE	2793	FCPC 2
	*	*			*	*		1	CE	2793	FCPC 3
*				*				3	CV	2751	FLAPS EL CTL/MONG
*				*				3	CW	2781	SLATS EL CTL/MONG
			*					4	CD	2797	FCDC 1
							*	4	CD	2797	FCDC 2

L G C I U 1				L G C I U 2				GEAR LOCKED DOWN			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
			*				*	1	CE	2793	FCPC 1/2/3
	*	*			*	*		1	CE	2793	FCPC 1
	*	*			*	*		1	CE	2793	FCPC 2
	*	*			*	*		1	CE	2793	FCPC 3
	*	*			*	*		3	CS	2798	FCSC 2
	*	*			*	*		3	CS	2798	FCSC 1

L G C I U 1				L G C I U 2				GEAR IN FLIGHT (NOT COMPRESSED)			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
		*				*		4	CS	2798	FCSC 1/2

ATA 28 - FUEL

L G C I U 1					L G C I U 2					GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
*			*					*		3 4	QC QM	2822 2851	APU FUEL FCMS

L G C I U 1					L G C I U 2					GEAR LOCKED DOWN			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
	*					*				3	QM	2851	FCMS

FQW4200 GE Metric

ATA 29 - HYDRAULIC POWER

[illegible]

ATA 30 - ICE AND RAIN PROTECTION

L G C I U 1					L G C I U 2					GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
	*	*			*	*	*			3	DG	3040	WHC
										3	DW	3073	WATER FREEZ PROT

L G C I U 1					L G C I U 2					GEAR ON GROUND OR GND PWR CONNECTED			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
	*	*	*			*	*	*		3	DA	3031	PROBES ICE PROT

L G C I U 1					L G C I U 2					GEAR IN FLIGHT (NOT COMPRESSED)			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
*					*					3	DL	3011	WING ANTI ICE

FQW4200 GE Metric

ATA 31 - INDICATING/RECORDING

L G C I U 1				L G C I U 2				GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
				*	*	*	*	1	TU	3133	DFDRS
				*	*	*	*	1	TV	3136	ACMS
*	*	*	*	*	*	*	*	1	GT	3144	WEIGHT/BALANCE
*	*	*	*	*	*	*	*	1	WW	3152	FWS/CMS
	*			*				1	WW	3152	WHS
*				*				3	WW	3152	FWC SDAC
				*				3	WT	3162	DMC 1/3
				*				3	WT	3162	DMC 2

(OPTIONAL)
(OPTIONAL)

L G C I U 1				L G C I U 2				GEAR LOCKED DOWN			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
				*	*	*	*	1	TU	3133	DFDRS
				*	*	*	*	1	TV	3136	ACMS
*	*	*	*	*	*	*	*	1	GT	3144	WEIGHT/BALANCE
*	*	*	*	*	*	*	*	1	NW	3152	FWS/CMS
*	*	*	*	*	*	*	*	3	WW	3152	FWC

(OPTIONAL)
(OPTIONAL)

L G C I U 1				L G C I U 2				DOOR FULLY OPEN			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
				*	*	*	*	1	TU	3133	DFDRS
				*	*	*	*	1	TV	3136	ACMS
*	*	*	*	*	*	*	*	1	GT	3144	WEIGHT/BALANCE
*	*	*	*	*	*	*	*	1	WW	3152	FWS/CMS

(OPTIONAL)
(OPTIONAL)

L G C I U 1				L G C I U 2				DOOR NOT LOCKED UP			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
				*	*	*	*	1	TU	3133	DFDRS
				*	*	*	*	1	TV	3136	ACMS
*	*	*	*	*	*	*	*	1	GT	3144	WEIGHT/BALANCE
*	*	*	*	*	*	*	*	1	WW	3152	FWS/CMS

(OPTIONAL)
(OPTIONAL)

ATA 32 - LANDING GEAR

L G C I U 1				L G C I U 2				GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
	*	*	*			*		3	GG	3242	BSCU

L G C I U 1				L G C I U 2				GEAR ON GROUND OR GND PWR CONNECTED			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
		*				*		3	GA	3231	L/G SAFETY VALVE

L G C I U 1				L G C I U 2				GEAR LOCKED DOWN			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
		*	*		*		*	3	GG	3242	BSCU
					*			3	GD	3242	BRK FANS

(OPTIONAL)

ATA 33 - LIGHTS

L G C I U 1					L G C I U 2					GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
					*					3	LY	3347	LOGO LIGHTS
					*					3	LV	3348	ANTICOL STROBE

L G C I U 1					L G C I U 2					GEAR LOCKED DOWN			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
			*					*		3	LC	3343	RWY/TURN OFF LIGHT
			*					*		3	LR	3346	TAXI/T.O LIGHT

FQW4200 GE Metric

ATA 34 - NAVIGATION

L G C I U 1				L G C I U 2				GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
	*		*					4	FP	3411	ADIRS
	*							3	SG	3443	TCAS
			*					3	WZ	3448	GPWS
	*							3	SH	3452	ATC 1
						*		3	SH	3452	ATC 2
	*							3	FN	3457	STBY ALT
L G C I U 1				L G C I U 2				GEAR LOCKED DOWN			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
	*							3	SG	3443	TCAS
	*							3	WZ	3448	GPWS
L G C I U 1				L G C I U 2				GEAR IN FLIGHT (NOT COMPRESSED)			
M	LH	RH	N	M	LH	RH	N	SIG	EC	ATA	FUNCTION
	*					*		3	RT	3436	ILS 1
								3	RT	3436	ILS 2
						*		3	SQ	3441	RADAR 1
	*					*		3	SQ	3441	RADAR 2
						*		3	SA	3442	RADIO ALT 1
	*					*		3	SA	3442	RADIO ALT 2
						*		3	SD	3451	DME 1
	*					*		3	SD	3451	DME 2
						*		3	RP	3453	ADF 1
	*					*		3	RP	3453	ADF 2
						*		3	RS	3455	VOR 1
	*					*		3	RS	3455	VOR 2
				*	*			3	SN	3458	GPS 2

(OPTIONAL)

(OPTIONAL)

(OPTIONAL)

(OPTIONAL)

(OPTIONAL)

(OPTIONAL)

ATA 38 - WATER AND WASTE

L G C I U 1					L G C I U 2					GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
								*		4	MG	3831	VACUUM TOILET

ATA 45 - ON BOARD MAINTENANCE

L G C I U 1					L G C I U 2					GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
		*								3	TD	4522	MDDU

(OPTIONAL)

L G C I U 1					L G C I U 2					GEAR ON GROUND OR GND PWR CONNECTED			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
			*							3	TM	4512	CMC 1/2

ATA 49 - AUXILIARY POWER UNIT

L G C I U 1					L G C I U 2					GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
	*									3	KD	4961	APU CONTROL

ATA 52 - DOORS

L G C I U 1					L G C I U 2					GEAR ON GROUND OR GND PWR CONNECTED			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
			*					*		3	MJ	5235	DOORS AND ESCAPE SLIDE CTL SYSTEM

ATA 73 - ENGINES

L G C I U 1					L G C I U 2					GEAR ON GROUND (COMPRESSED)			
M	LH	RH	N		M	LH	RH	N		SIG	EC	ATA	FUNCTION
	*	*	*			*	*	*		3	KS	7325	EIVMU

STUDENT NOTES

FQW4200 GE Metric

BRAKE SYSTEM PRESENTATION

Normal Braking
Alternate Braking
In Flight Braking
Parking Brake

NORMAL BRAKING

The normal braking system is powered by the green hydraulic system.

ALTERNATE BRAKING

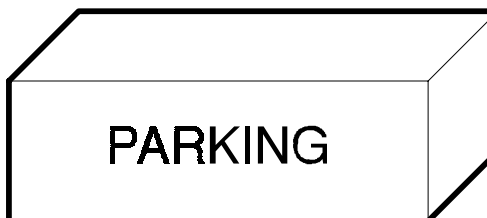
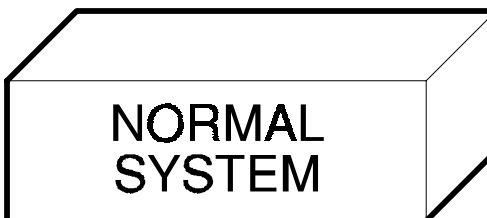
The alternate braking system is powered by the blue hydraulic system.

IN FLIGHT BRAKING

In flight braking is supplied by the normal system for the main wheels. The other wheels are stopped by friction pads.

PARKING BRAKE

The parking brake is actuated and supplied by blue hydraulic pressure, or by two accumulators.



STUDENT NOTES

FQW4200 GE Metric

NORMAL BRAKING SYSTEM PRESENTATION

Braking and Steering Control Unit (B.S.C.U)
Automatic
Manual

Braking is normal when:

- Green High Pressure is available,
- ANTI/SKID switch is "ON",
- PARK BRAKE is not "ON",
- ANTISKID is operative.

The control is electrical and achieved through the B.S.C.U either automatically or via the pedals.

No brake pressure indication is provided.

B.S.C.U

The Braking and Steering Control Unit controls the operations of the electro-hydraulic valves in the system.

It has the following primary functions:

- Normal braking with automatic and manual inputs,
- Anti-skid function to give maximum braking efficiency and,
- Automatic braking of main wheels during landing gear retraction.

The braking system is electrically controlled by the B.S.C.U which comprises two independent channels.

A changeover takes place each time the landing gear is set to "DOWN".

AUTOMATIC

Before landing the AUTOBRAKE should be set as required.

When the medium pushbutton deceleration rate is selected, the "ON" light comes on BLUE, to indicate a positive arming of the system.

Braking will begin with the ground spoilers deployment order.

When the aircraft is on ground, the Braking and Steering Control Unit sends an opening order to the normal selector valve.

The automatic selector valve, which is now powered by the green hydraulic pressure, operates and cuts the blue hydraulic pressure.

The Braking and Steering Control Unit regulates green pressure by progressive closure of the normal servovalve.

Wheel rotation speed, braking pressure values and ADIRU data are supplied to the Braking and Steering Control Unit for braking and antiskid computation.

When aircraft deceleration reaches the given value, the "DECEL" light comes on GREEN.

MANUAL

After landing the brake pedals should be pressed as required.

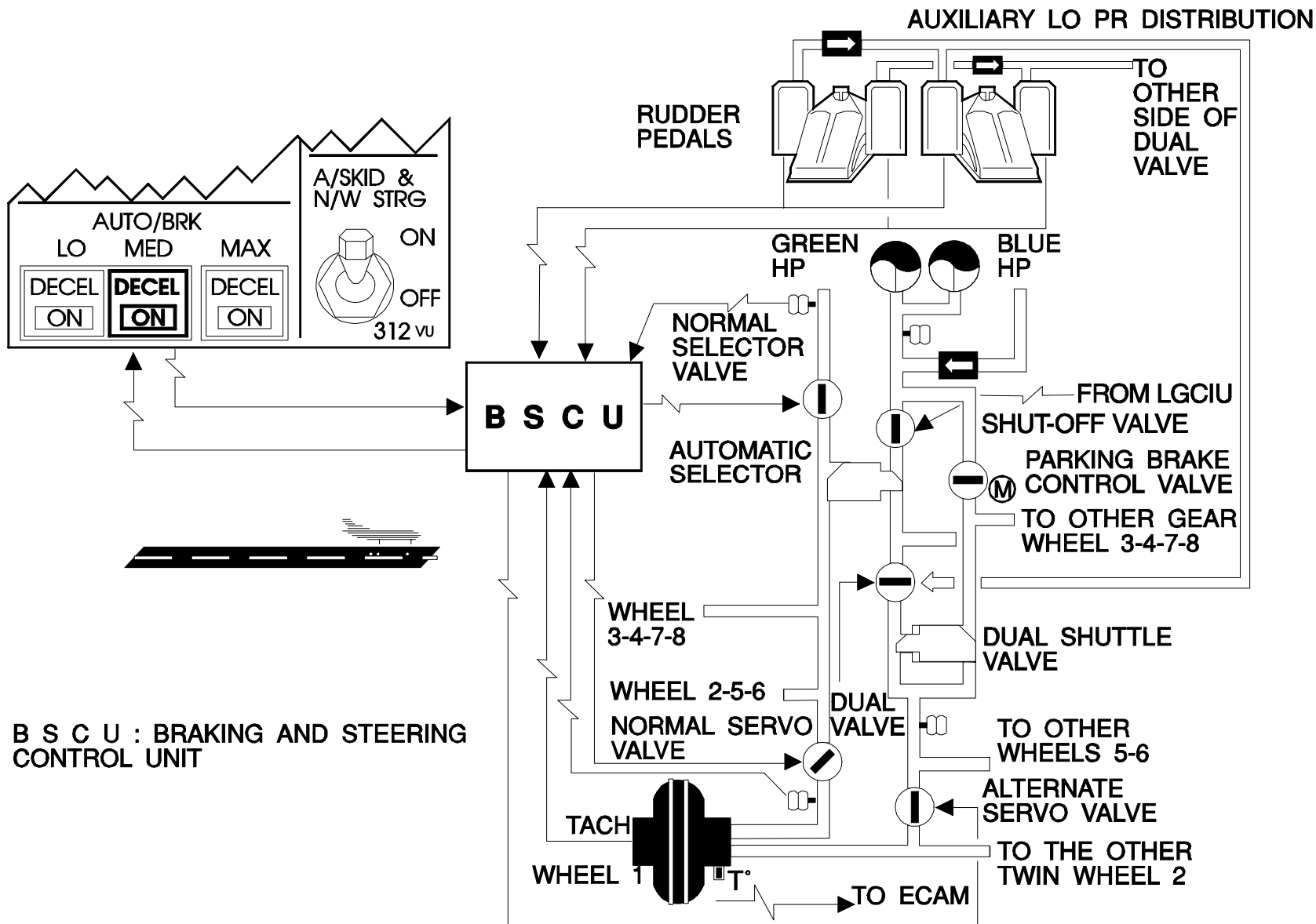
Electrical braking orders are sent by the pedals to the Braking and Steering Control unit.

At this time, the Braking and Steering Control Unit sends an opening order to the normal selector valve.

Now powered by the green hydraulic pressure, the automatic selector valve operates and cuts the blue hydraulic pressure.

The Braking and Steering Control Unit regulates green pressure by progressive closure of the normal servovalve.

Wheel rotation speed, braking pressure values and ADIRU data are supplied to the Braking and Steering Control Unit for braking and antiskid computation.



STUDENT NOTES:

NORMAL BRAKING DESCRIPTION AND OPERATION

Operation

OPERATION

Two different braking modes are available depending on the selection of the automatic braking mode or the manual braking mode.

The Braking and Steering Control Unit energizes the normal selector valve, when all normal braking conditions are available.

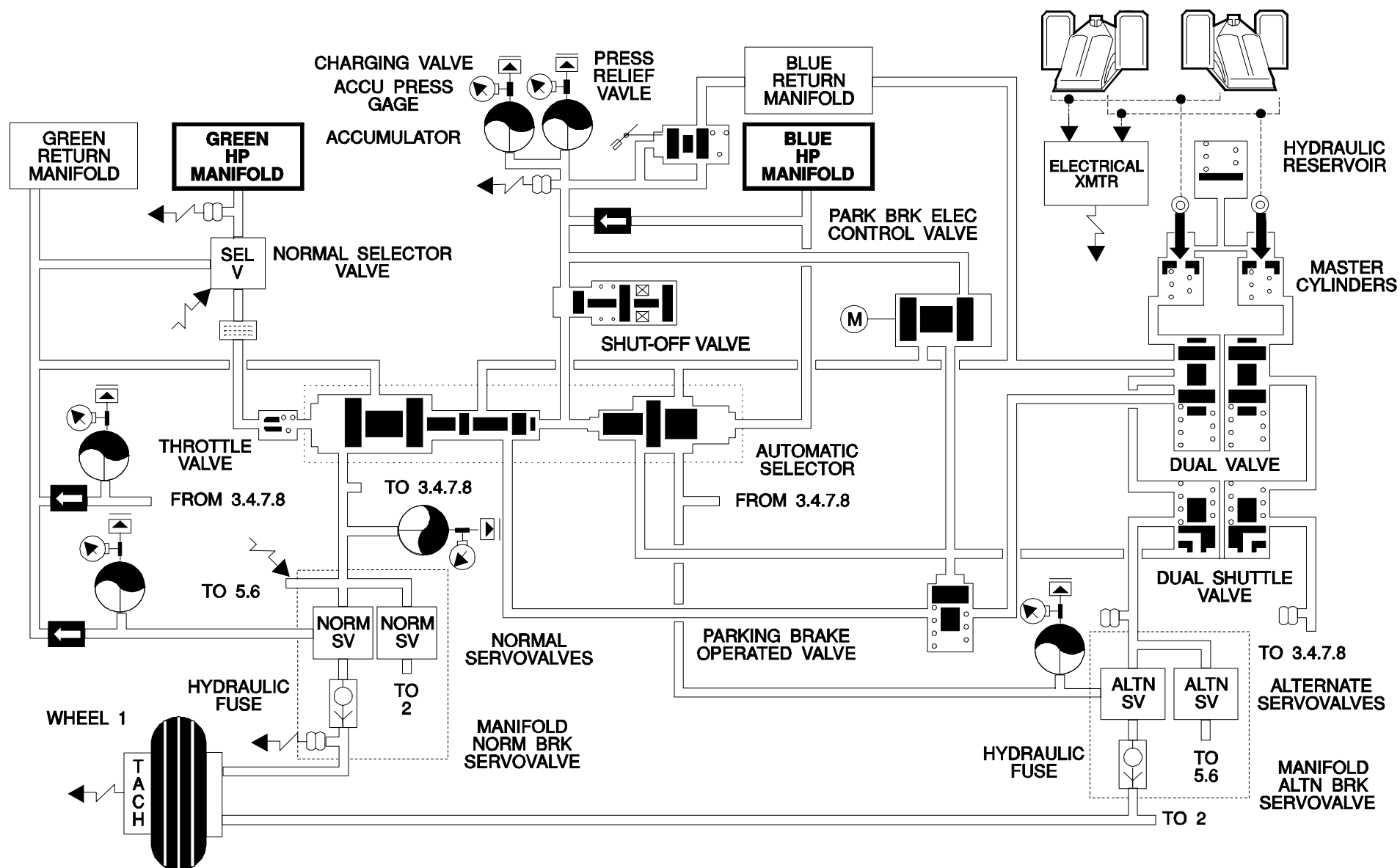
The brake selector valve connects the green hydraulic pressure to the automatic selector valve through the throttle valve.

At the same time the automatic selector valve isolates the blue hydraulic pressure from the alternate braking system.

The Braking and Steering Control Unit energizes the servovalves to supply the specified amount of green system pressure to the brakes.

The fluid goes through a hydraulic fuse to the pistons of the brakes which are then applied.

The hydraulic fuse stops the flow in the line if there is a leakage downstream of the servovalves.



FQW4200 GE Metric

STUDENT NOTES:

FQW4200 GE Metric

ALTERNATE BRAKING SYSTEM PRESENTATION

With Antiskid
Without Antiskid

FQW4200 GE Metric

Braking is alternate when :

- Green High Pressure is not available,
- Specified failure occurs in the Normal Braking System,
- Anti/Skid switch is OFF,

The switching between the green and blue systems is achieved by the automatic reversible hydraulic selector valve.
LH/RH brake pressure and blue accumulator pressure indications are provided.

WITH ANTISKID

Let's start the alternate braking system from a normal braking sequence. At this stage of the operation, the aircraft has landed and braked manually on the green system.

Green pressure is lost. The Braking and Steering Control Unit de-energizes the normal selector valve.

The autobrake is lost. Alternate braking with antiskid is now available.

The automatic selector valve operates and allows blue system pressure into the alternate braking system.

Control of the alternate braking system is achieved by the pedals only, through the auxiliary low pressure distribution control system.

Blue braking pressure is regulated via the dual valve.

The Braking and Steering Control Unit sends antiskid closing signals to the alternate servo valve.

The pressure delivered to the Left Hand and Right Hand brakes as well as the blue accumulator pressure are indicated on the blue pressure triple indicator.

WITHOUT ANTISKID

Let's start the alternate braking system from a normal braking sequence. At this stage of the operation, the aircraft has landed and braked manually on the green system.

The Braking and Steering Control Unit becomes inoperative.
Normal braking and antiskid are lost.

Alternate braking without antiskid is now available.

The automatic selector valve operates and allows blue system pressure into the alternate braking system.

Control of the alternate braking system is achieved by the pedals only, through the auxiliary low pressure distribution control system.

Blue braking pressure is regulated via the dual valve.

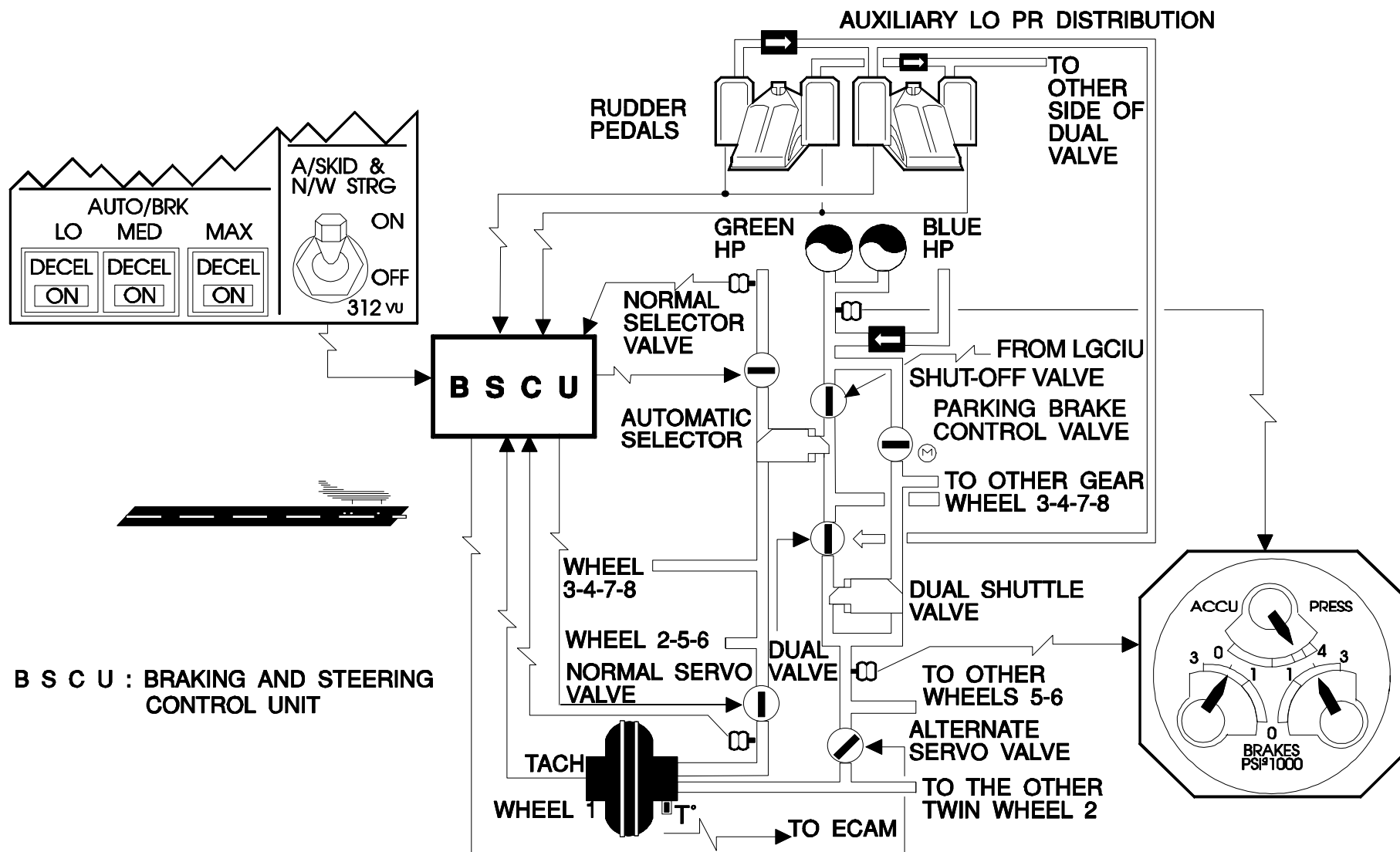
The alternate servovalve remains fully open as it receives no antiskid signals from the Braking and Steering Control Unit.

The brake pressure has to be limited by the pilot to avoid wheel locking.

The pressure delivered to the Left Hand and Right Hand brakes as well as the blue accumulator pressure are indicated on the blue pressure triple indicator.

When all other braking modes have failed, you can use the emergency braking.

At least 7 full brake applications are possible.



FQW4200 GE Metric

STUDENT NOTES:

FQW4200 GE Metric

ALTERNATE BRAKING DESCRIPTION AND OPERATION

Operation

FQW4200 GE Metric

OPERATION

An electrically operated shut-off valve is energized during specified flight phases to isolate the alternate brake accumulators during flight. This prevents leakage of the accumulators.

When the Braking and Steering Control Unit has cut off the green hydraulic system via the normal selector valve, the automatic selector valve operates to connect the blue hydraulic pressure to the braking system.

When the brake pedals operate through the auxiliary low pressure system, the master cylinders are compressed in proportion to the pedal angle to control the distribution dual valve.

The dual valve allows the demanded blue pressure to go to the alternate servovalves through the dual shuttle valve.

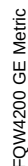
The master cylinders give "ARTIFICIAL FEEL" in proportion to the pedal angle.

Pressure is supplied to the brake piston through the servovalves which are controlled by the Braking and Steering Control Unit if the antiskid system is available.

The servovalves remain open if the alternate braking system operates without antiskid protection.

In the event of loss of the blue hydraulic system pressure, accumulators installed within the brake system maintain a limited supply of alternate system pressure.

The triple pressure indicator shows the supply pressure and the pressure delivered to the brakes.



STUDENT NOTES:

FQW4200 GE Metric

PARKING BRAKE SYSTEM PRESENTATION

On
Off

Operating the "PARKING BRAKE" control handle deactivates the other braking modes and the antiskid.

The return lines are shut off to maintain the parking pressure for at least 12 hours.

It is not necessary to press the pedals when the "PARK BRK" is set to "ON".

ON

Let's start the parking brake system from a normal braking sequence. At this stage of the operation, the aircraft has reached its gate and is braked manually using the pedals and the green system.

When the "PARKING BRAKE" is set to "ON", the parking brake control valve is activated and a signal is sent to the Braking and Steering Control Unit.

The Braking and Steering Control Unit depressurizes the normal braking system by closing the normal selector valve and de-energizing the servovalves.

Blue hydraulic pressure passes through the parking control valve and reaches the dual shuttle valve.

The dual shuttle valve moves back and allows the alternate system circuit to be pressurized by the "PARKING BRAKE" system.

Brakes are now supplied with the blue high pressure, or accumulator pressure, through fully open alternate servovalves.

Full parking brake pressure is applied to all brakes.

The pressures, delivered to the Left Hand and Right Hand brakes as well as the blue accumulator pressure, are indicated on the blue pressure triple indicator.

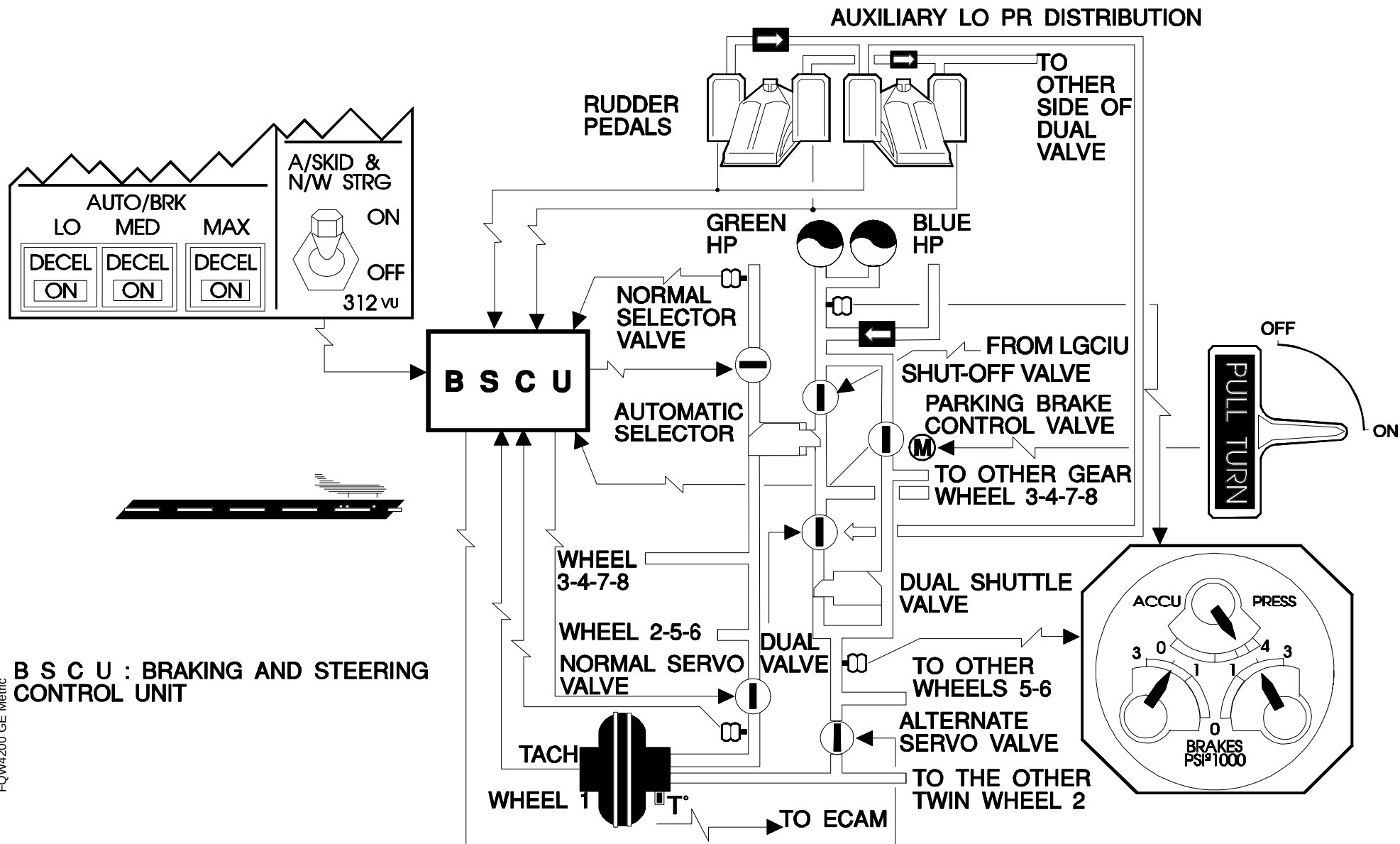
OFF

The parking brake system can also be used as emergency braking when all other braking modes have failed.

At least 7 full brake applications are possible.

When the "PARKING BRAKE" is reset, the braking mode is restored.

The blue accumulator can be pressurized by pressing the blue electrical pump pushbutton switch.



FQW4200 GE Metric

STUDENT NOTES:

PARKING BRAKE DESCRIPTION AND OPERATION

Operation

OPERATION

When the parking brake selector switch, in the cockpit, is set to ON, the motors in the parking brake control valve are energized.

Pressure is supplied to the automatic selector valve which closes the return lines from the alternate brake servovalves.

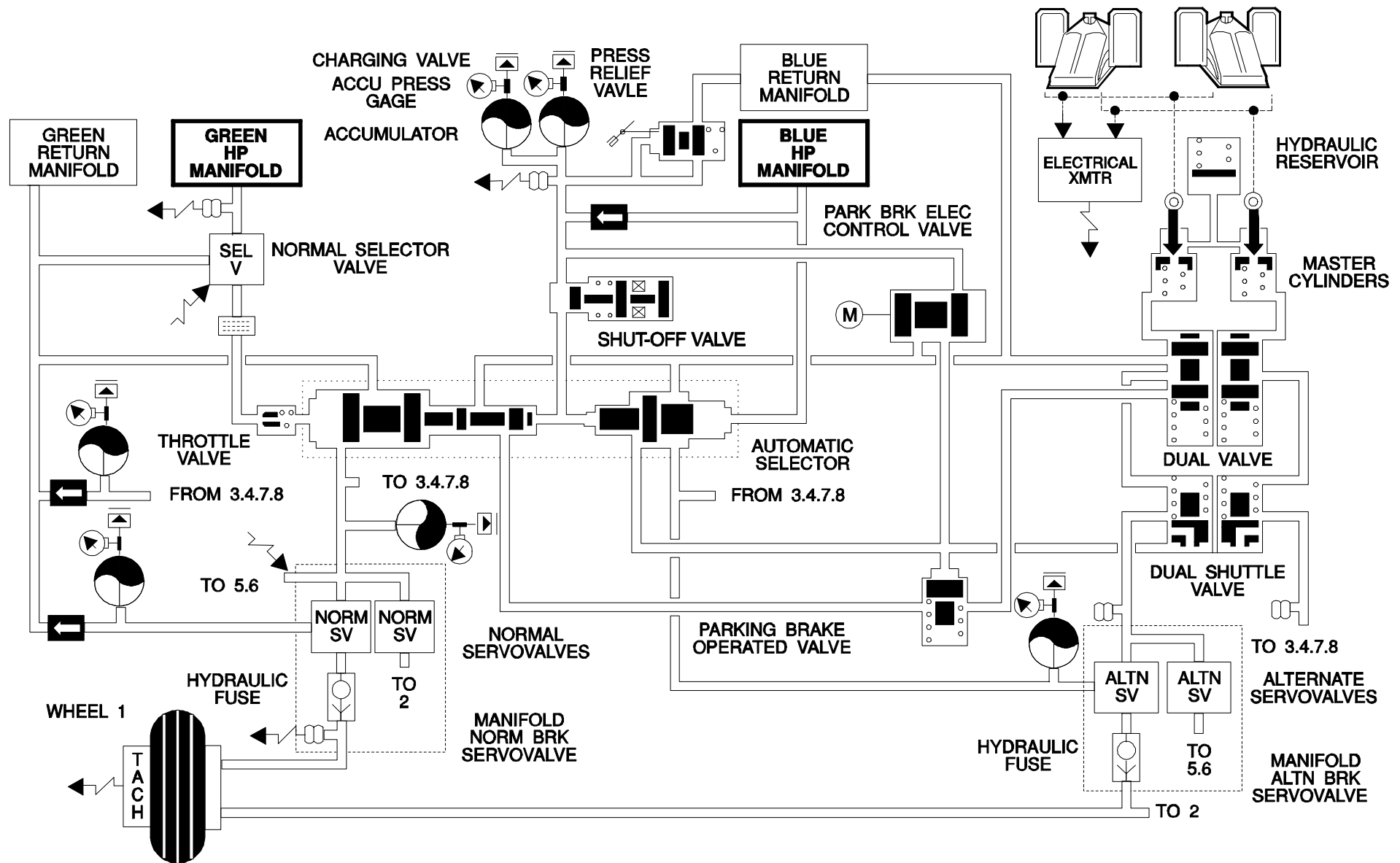
Pressure is supplied to the parking brake operated valve which isolates the dual valve from the parking brake system.

The dual shuttle valve connects the pressurized fluid to the brakes.

Accumulator replenishment is automatic by means of the blue electric pump.

The pressure in the brakes is required to be maintained for a duration of 12 hours at 175 bars (2540 psi).

When the parking brake selector switch is set to OFF, the motors are energized to release the applied pressure and to open the hydraulic line to the blue return manifold.



FQW4200 GE Metric

STUDENT NOTES:

FQW4200 GE Metric

IN FLIGHT BRAKING PRESENTATION

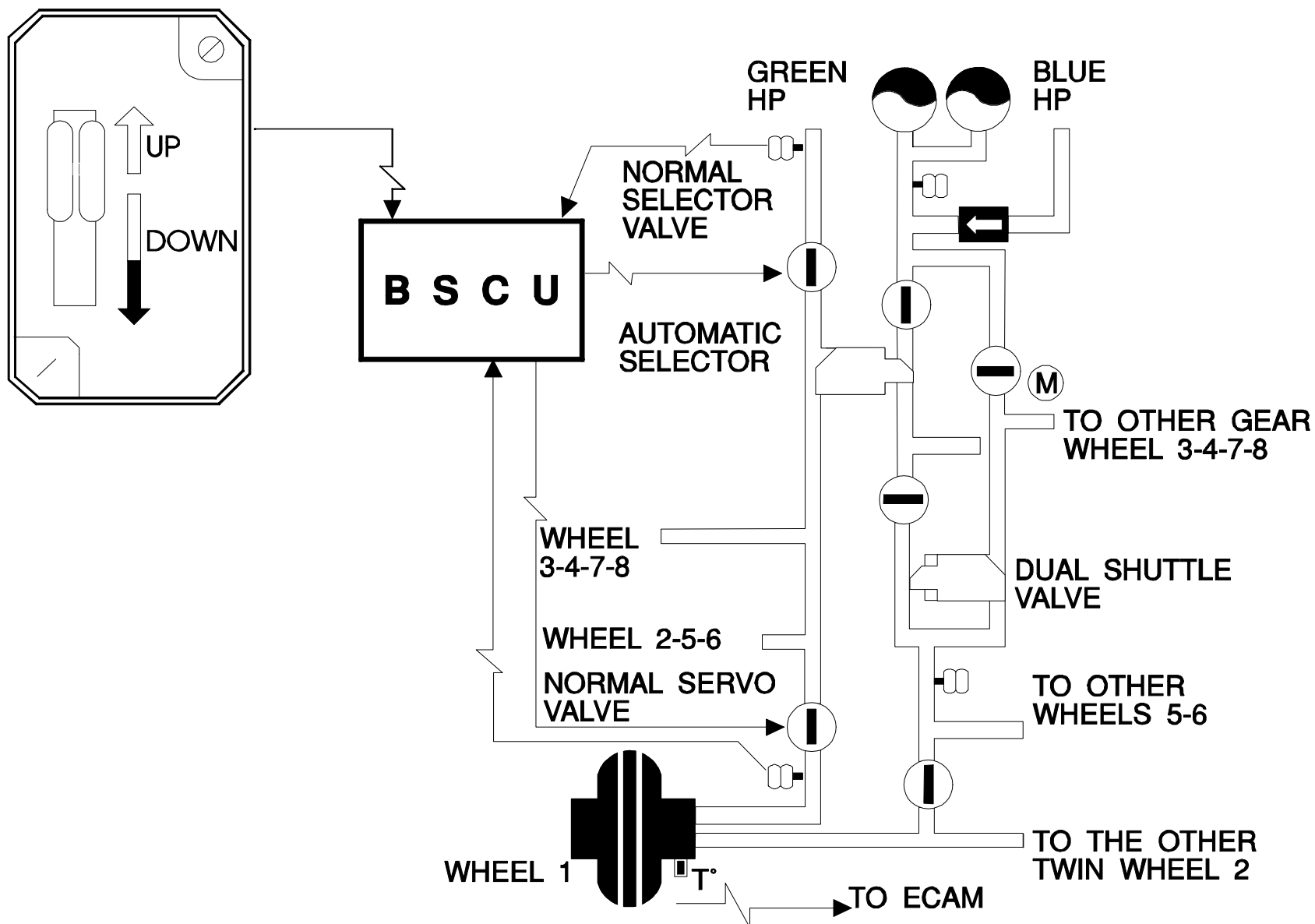
Main Landing Gear
Nose Landing Gear

MAIN LANDING GEAR

Before entry into the landing gear bay, the main landing gear wheels are stopped using normal braking system.

During landing gear retraction, braking occurs automatically for a specified time. The anti-skid system is inhibited during in flight braking.

When the selector lever is put in the "UP" position, the normal selector valve operates to connect the green hydraulic power supply to the normal braking system.



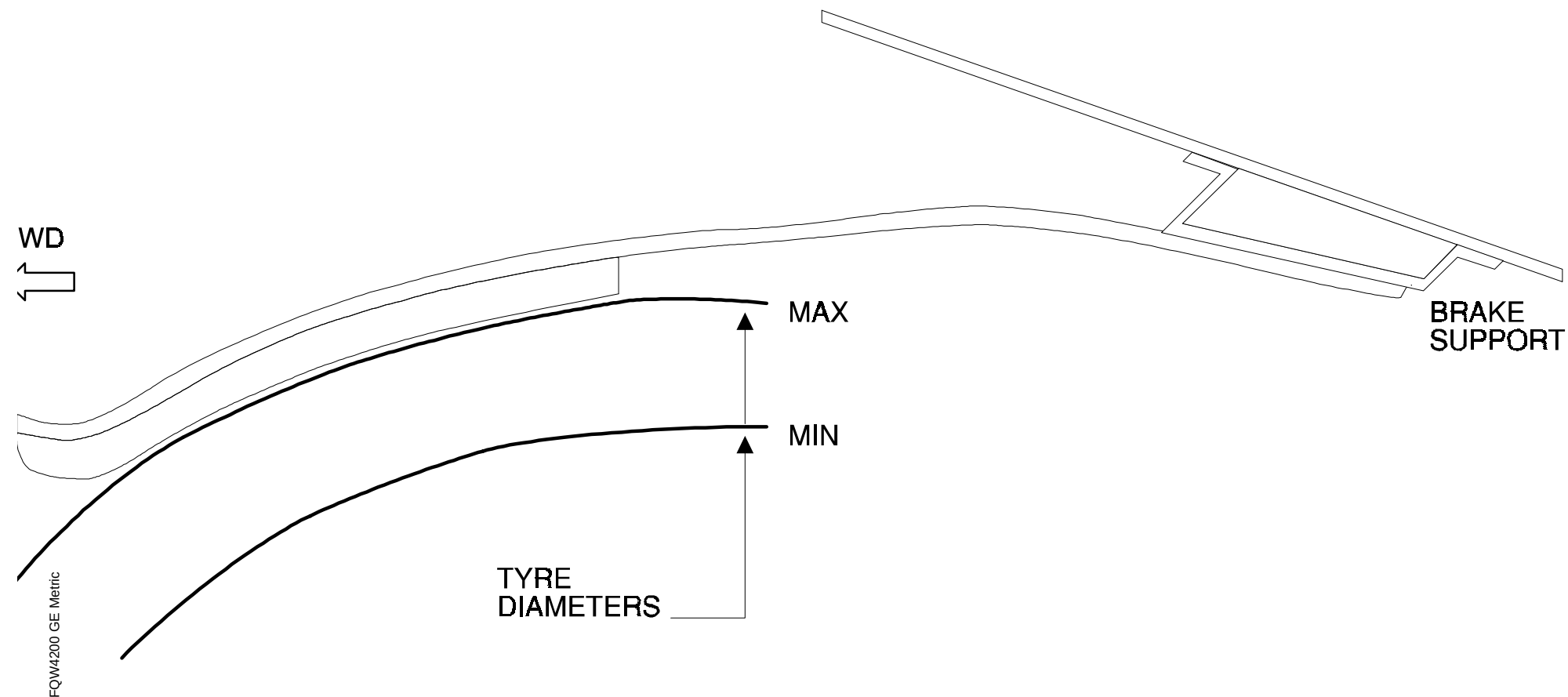
FQW4200 GE Metric

NOSE LANDING GEAR

The nose landing gear wheel rotation is stopped by friction pads.

At the end of landing gear retraction, the nose landing gear wheel rotation is stopped by mechanically operated braking pads.

(2 BRAKES, 1 ON EACH WHEEL)



STUDENT NOTES

BRAKE COOLING SYSTEM PRESENTATION

Brake Cooling System Presentation

FQW4200 GE Metric

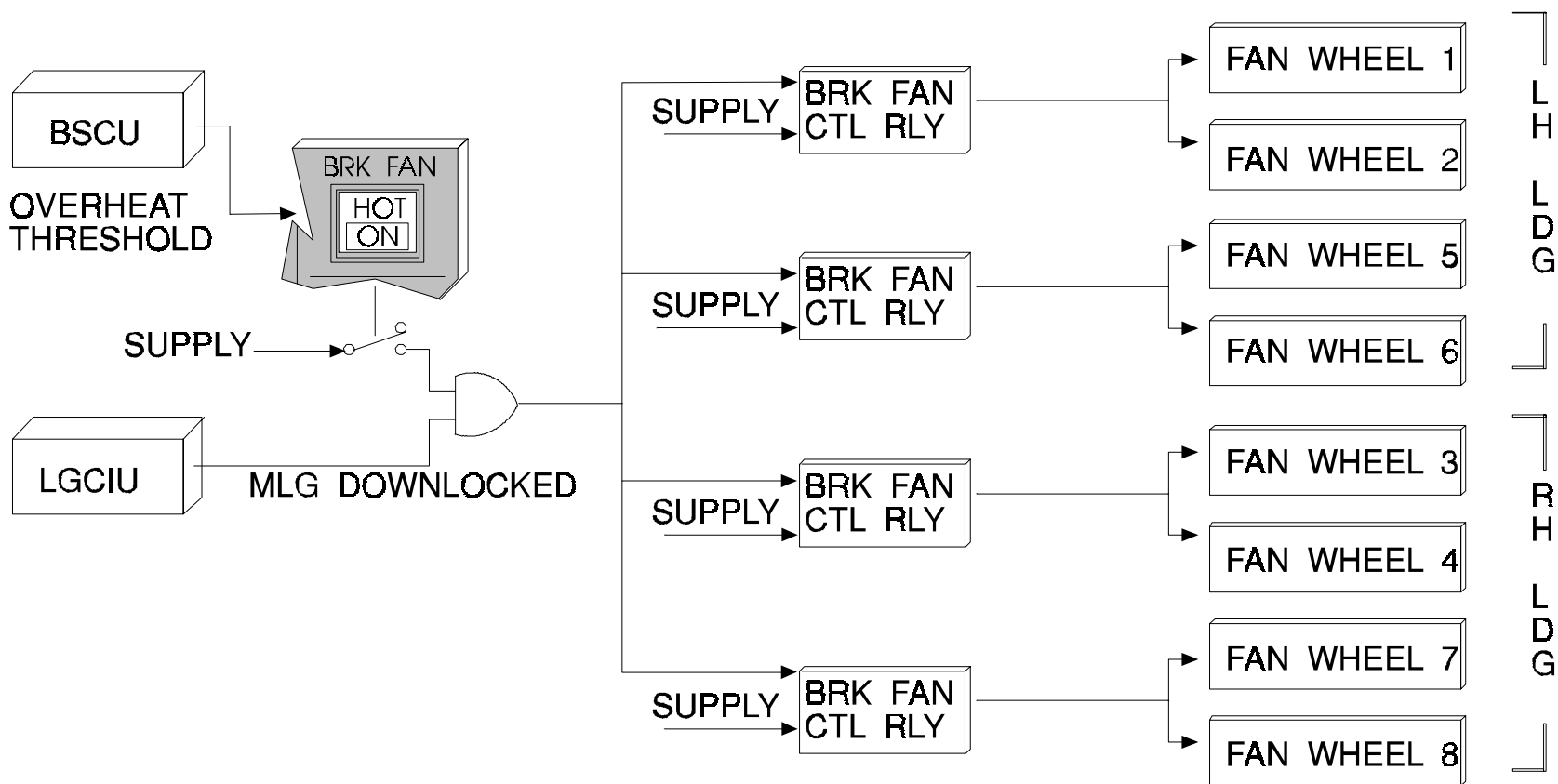
BRAKE COOLING SYSTEM PRESENTATION

The brake cooling system permits high speed cooling of the brakes.

When a brake is hot, the "HOT" legend of the pushbutton comes on amber.

The BRK FAN pushbutton operates the fans when the landing gear is down and locked.

Each fan has a three-phase type motor.



BSCU : BRAKING and STEERING CONTROL UNIT.

LGCIU : LANDING GEAR CONTROL and INTERFACE UNIT.

STUDENT NOTES

BRAKE SYSTEM TEMPERATURE PRESENTATION

Principle
Temperature Sensor
Brake Temperature Monitoring Units (BTMU)
Braking and Steering Control Unit (BSCU)

An easily accessible chromel alumel thermocouple temperature sensor is installed in each brake for the purpose of monitoring the brake heat pack temperature.

PRINCIPLE

Each brake temperature monitoring unit receives the voltage from two temperature sensors.

After processing, the electric circuits deliver a voltage proportional to the temperature of each brake heat sink.

TEMPERATURE SENSOR

The chromel-alumel temperature sensor delivers a voltage proportional to the temperature difference between the cold junction and the hot junction.

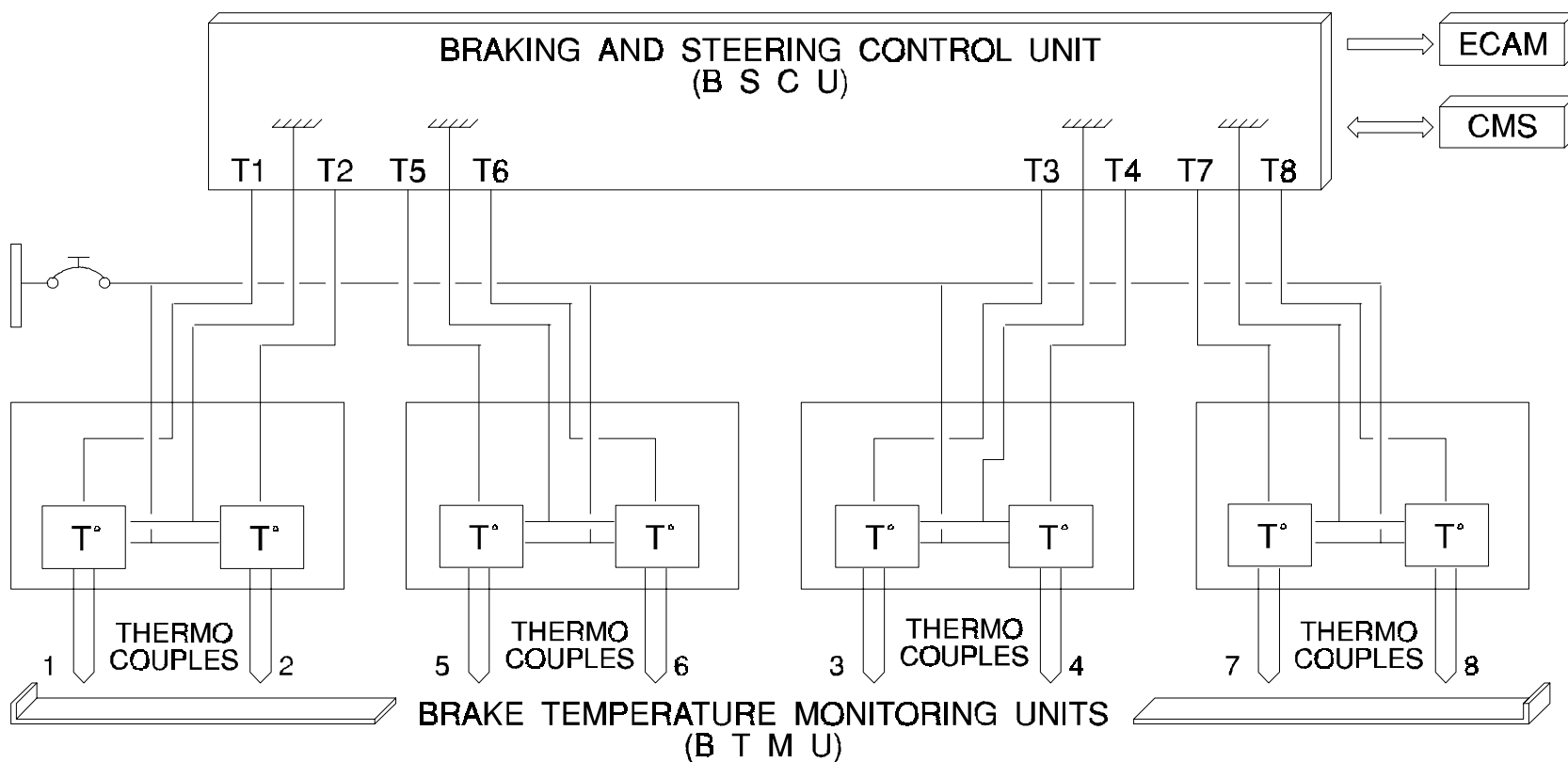
BRAKE TEMPERATURE MONITORING UNITS (BTMU)

The brake temperature monitoring unit :

- processes the data from the temperature sensor and compensates the thermocouple cold junction.

BRAKING AND STEERING CONTROL UNIT (BSCU)

The function of the braking and steering control unit is to change the electrical signals to a temperature indication on the ECAM display.



FQW4200 GE Metric

STUDENT NOTES

FQW4200 GE Metric

BRAKING ECAM PRESENTATION

Normal Braking
Anti Skid
Automatic Braking
Release Indications
Brake Temperature

NORMAL BRAKING

The normal braking indication appears if normal braking is inoperative.



No indication when normal braking system is available.



Amber if braking system is in alternate mode.

AUTOMATIC BRAKING

The autobrake indication appears in green when automatic braking is selected and armed.



Green when AUTO BRAKE is armed.

MAX, MED or LOW indicates the selected rate (green).



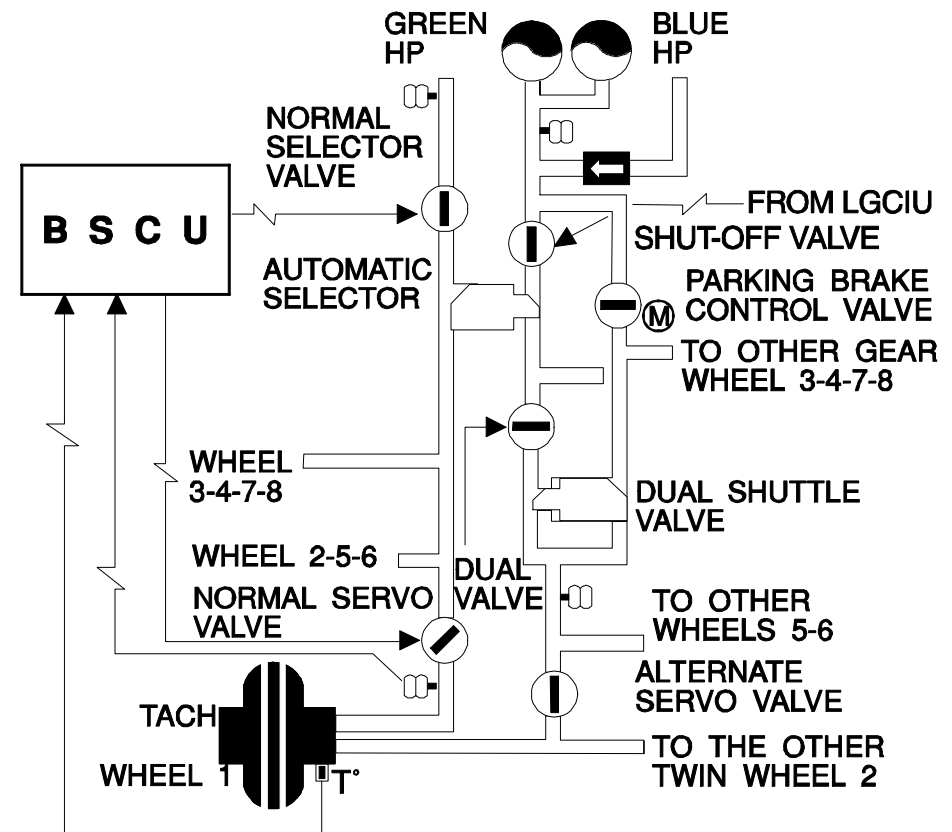
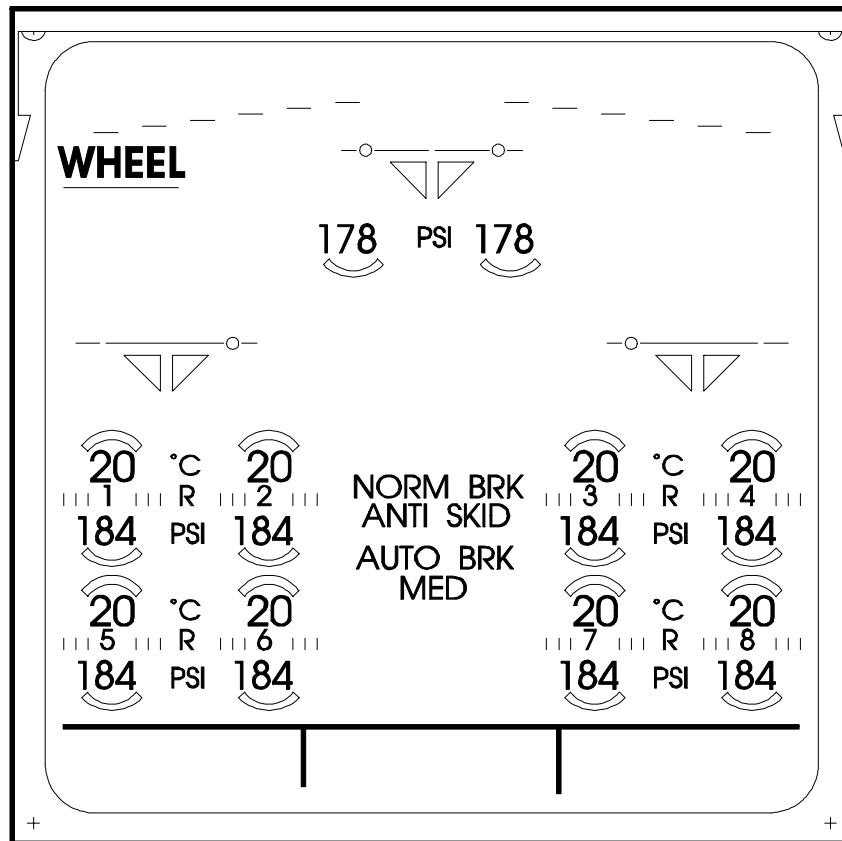
Amber associated with an ECAM caution in case of system failure.

ANTI-SKID

The Anti skid indication appears if anti skid is inoperative or selected off.



Appears amber associated with an ECAM caution in case of total BSCU failure, or when the A/SKID and N/W STRG switch is OFF, or in case of ANTI SKID failure detected by the BSCU.



These indications are displayed on the WHEEL ECAM page only if the TPIS option is installed.

RELEASE INDICATIONS

Vertical bars are provided to indicate the release order to the brakes.



Comes on green in flight when L/G is extended provided ANTI SKID is valid.

Disappears and reappears on ground after touch down depending on release order to the brakes.



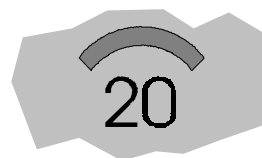
Becomes amber in case of residual brake pressure.



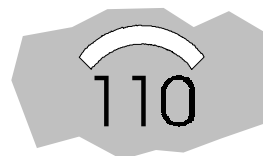
R "RELEASE" indication is always displayed white.

BRAKE TEMPERATURE

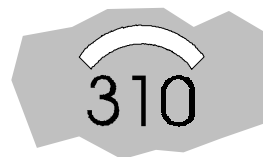
Brake temperature indications are given in degrees celsius.



Indication is normally green.



Green arc appears on the hottest wheel when one brake temperature exceeds 100°C.



Indication becomes amber associated with an ECAM caution when the corresponding brake temperature exceeds 300°C.

In addition, the arc becomes amber on the hottest wheel.

BRAKING WARNINGS AND OPERATING LIMITATIONS

- Park BRK On
- Brakes Hot
- Anti Skid Fault
- Auto BRK Fault
- Release Fault
- Anti Skid Off
- Operating Limitations

PARK BRK ON

This warning is triggered when parking brake is ON and :
- Thrust levers are set to takeoff position (TOGA or FLX-TO)
You should not exceed 75% (TBC) of N1 with brakes ON.

BRAKES HOT

Note the 305 amber symbol on the ECAM display and HOT amber light on the Landing Gear Indicating panel. This caution is triggered when the temperature of a wheel brake is higher than 300.C.
In this case, you should delay your takeoff until the warning disappears. or cool the brakes using the brake fan.

A/SKID FAULT

Note the ANTI SKID amber message on the ECAM display. This caution is triggered when both Braking and Steering Control Unit (BSCU) channels have failed. You are on alternate braking, no nose wheel steering.
In this case, you should limit braking pressure to 1000PSI and expect an increased landing distance.

AUTO BRK FAULT

Notice the AUTO BRK amber message on the ECAM display. This caution is triggered if the auto braking system fails when armed.

RELEASE FAULT

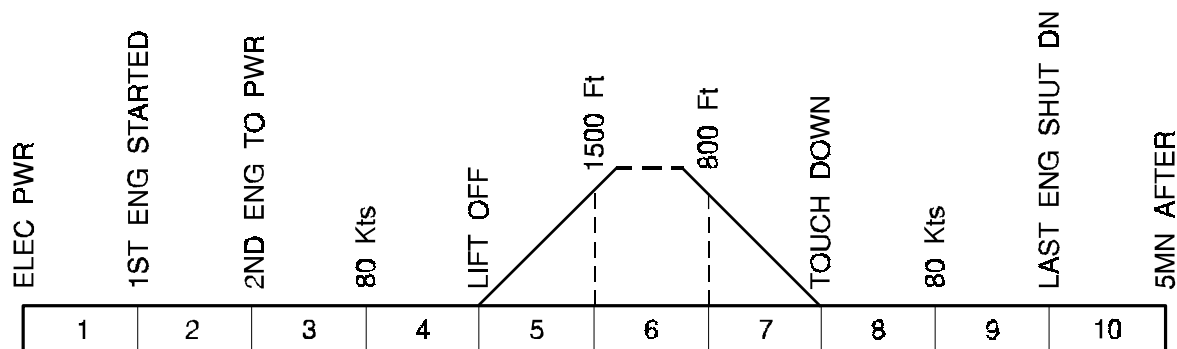
Notice that the released brake symbol of wheel #8 is missing on the ECAM display. This caution is triggered when the release signal of a wheel brake is not present and the gears are downlocked.
In this case, you should expect an increased landing distance.

A/SKID OFF

Note the ANTI SKID amber message on the ECAM display. This caution is triggered when the anti skid switch is set to OFF position.
You should restore A/SKID. If unsuccessful, you should limit braking pressure to 1000PSI and expect an increased landing distance.

OPERATING LIMITATIONS

Maximum wheel brake temperature for takeoff : 300.C



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
CONFIG PARK BRK ON parking brake is ON when thrust levers are set at T.O or FLX T.O. power position	CRC	MASTER WARN	NIL	NIL	1, 2, 5 to 10
BRAKES HOT one brake temperature higher than 300°C	SINGLE CHIME	MASTER CAUT	WHEEL	BRK FAN It	4, 8
A / SKID NWS FAULT				NIL	3, 4, 5
AUTO BRK FAULT failure of autobrake when armed					
RELEASE FAULT one release signal not present when in flight with L/G down locked					

STUDENT NOTES

FQW4200 GE Metric

WHEELS AND BRAKES COMPONENTS

MLG Wheel
NLG Wheel
Brake Assembly
Tachometer
Park Brake Accumulator

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is :

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked,
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

MLG WHEEL

FIN	ZONE	FIN	ZONE
6500GG	730	6504GG	730
6501GG	730	6505GG	730
6502GG	740	6506GG	740
6503GG	740	6507GG	740

Tire Dimension :

radial 1400*530 R23

bias 54*21-23

COMPONENT DESCRIPTION

The MLG wheel consists of two forged half wheels made from aluminium alloy.

They are held together by high tensile steel tie bolts and locking nuts. A pressure seal is created between the two half wheels by an "O-ring".

SPECIAL DESIGN

Main wheels are equipped with fusible plugs which are designed to melt and hence deflate the tire when the hottest part of the wheel reaches 205°C.

Main wheels are installed onto the axle with a steel axle sleeve.

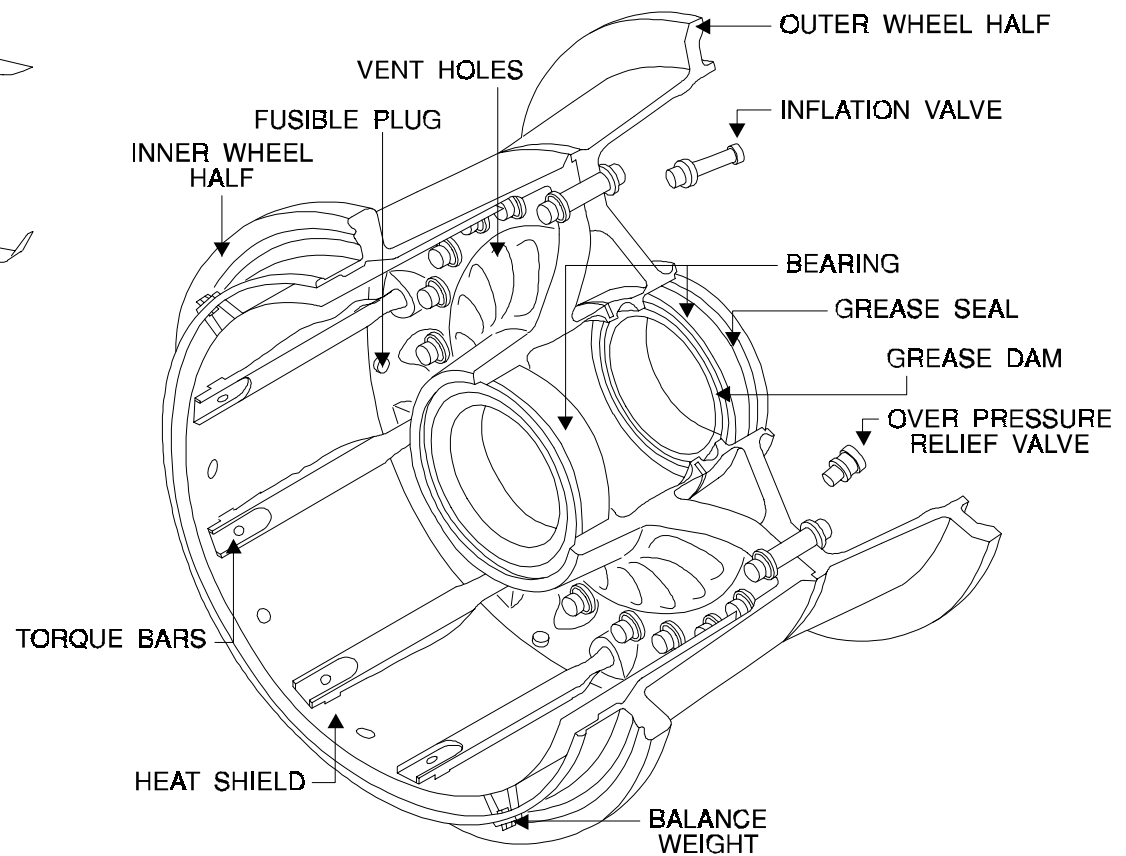
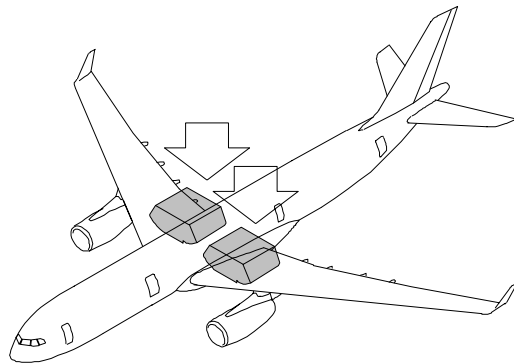
To prevent rotation of the axle sleeve, four splines on the axle sleeve engage on corresponding slots on the end of the axle.

TIRE REQUIREMENT

MLG Tire Pressure :

12.8 bars (186 psi) unloaded

13.3 bars (194 psi) loaded



NLG WHEEL

FIN : 6510GG(LH)
6511GG(RH)

ZONE : 710

COMPONENT DESCRIPTION

The NLG wheel consists of two forged half wheels made from aluminium alloy.

A pressure seal is created between the two half wheels by an "O-ring".

SPECIAL DESIGN

Nose wheels are equipped with :

- a high flow type tire inflation valve,
- an over pressure relief valve,
- TPIS transducer.

The axle sleeve is made from aluminium alloy with anti-rotation provided by two pins secured onto the axle.

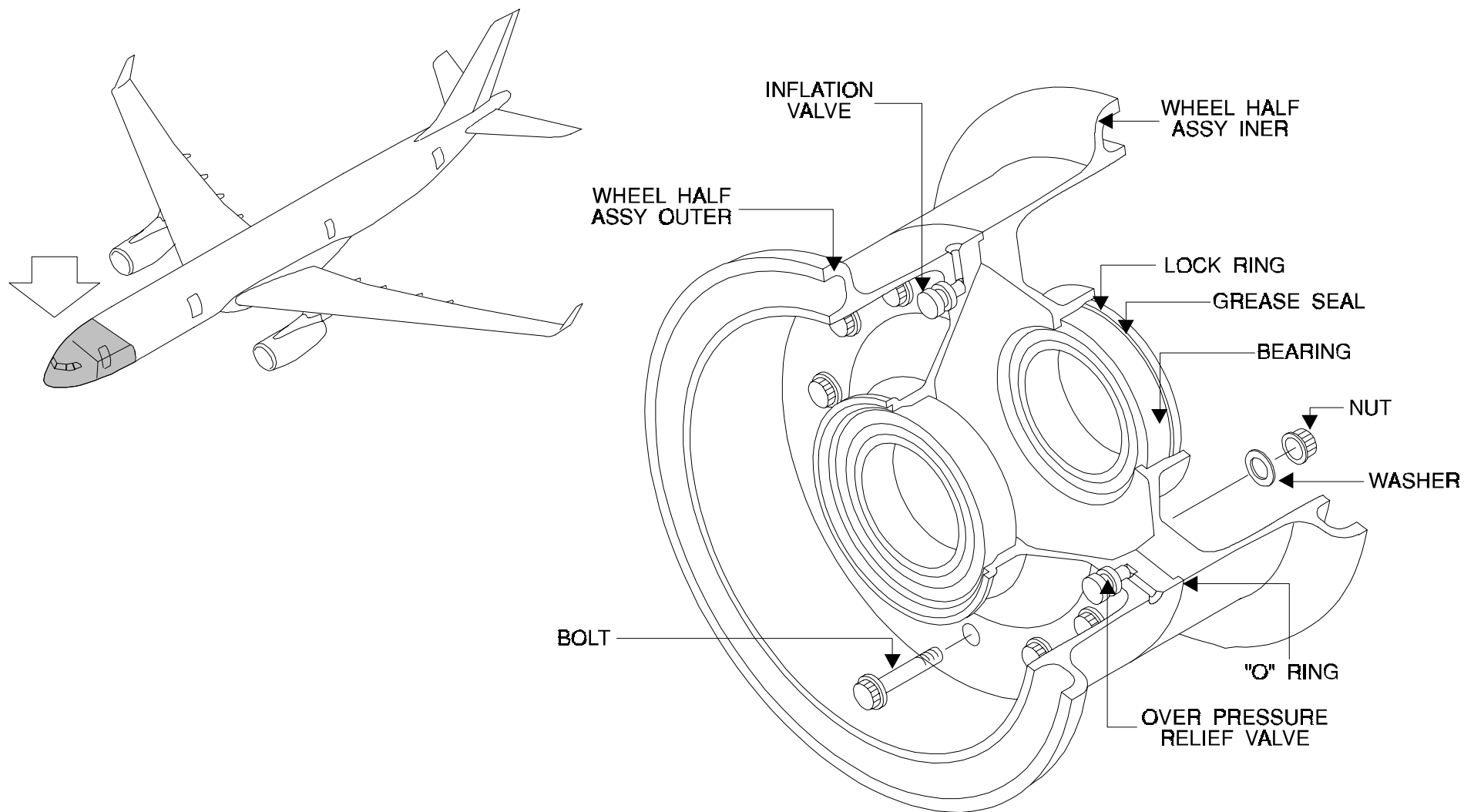
TIRE REQUIREMENT

NLG Tire Pressure :

10.5 bars (152 psi) unloaded
10.9 bars (158 psi) loaded

Tire Dimension :

radial 1050*395 R16
bias 40.5*15.5-16



FQW4200 GE Metric

BRAKE ASSEMBLY

FIN	ZONE	FIN	ZONE
5240GG	730	5242GG	730
5241GG	730	5243GG	730
5244GG	740	5246GG	740
5245GG	740	5247GG	740

COMPONENT DESCRIPTION

Each brake assembly comprises :

- a piston housing (7 pistons normal brake, 7 alternate),
- a torque tube,
- carbon heat pack,
- temperature sensor,
- two wear indicators.

TACHOMETER

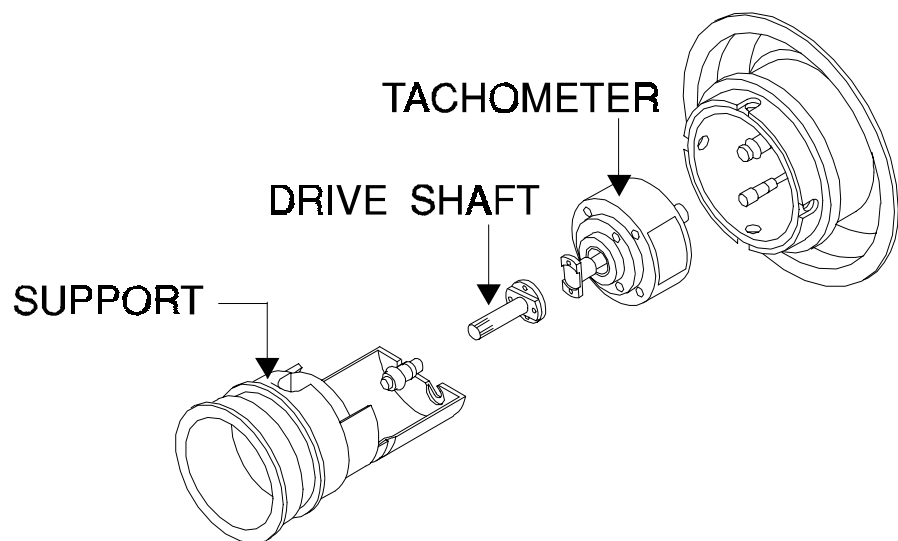
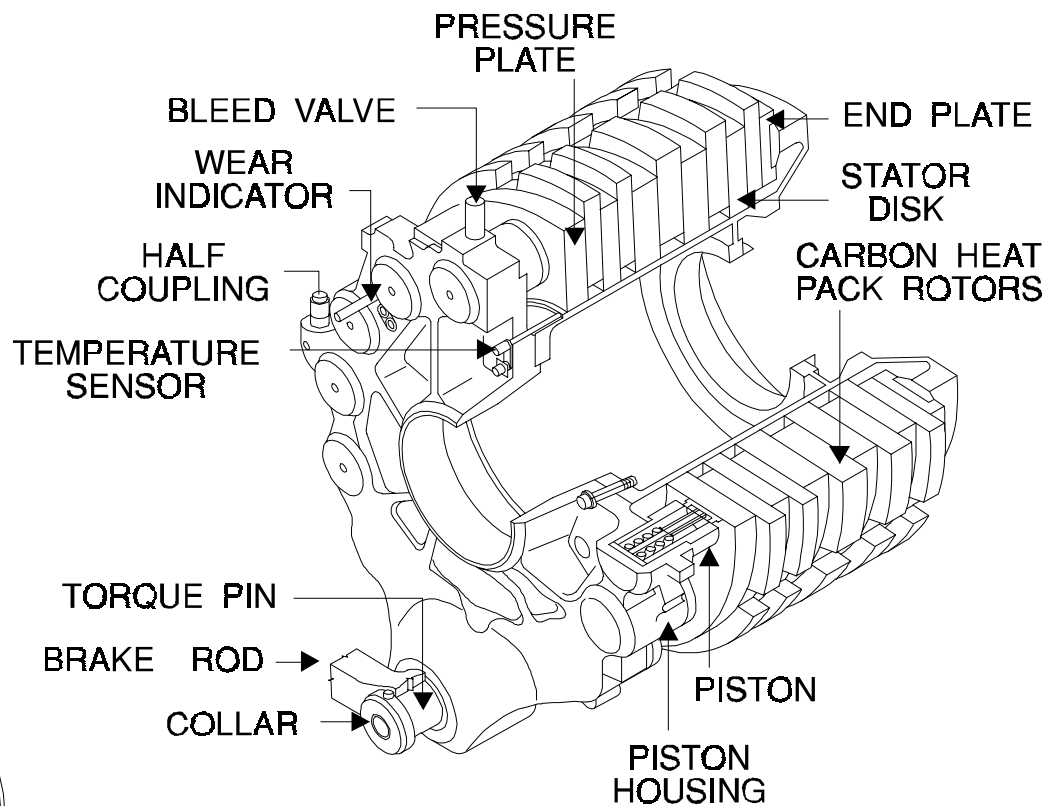
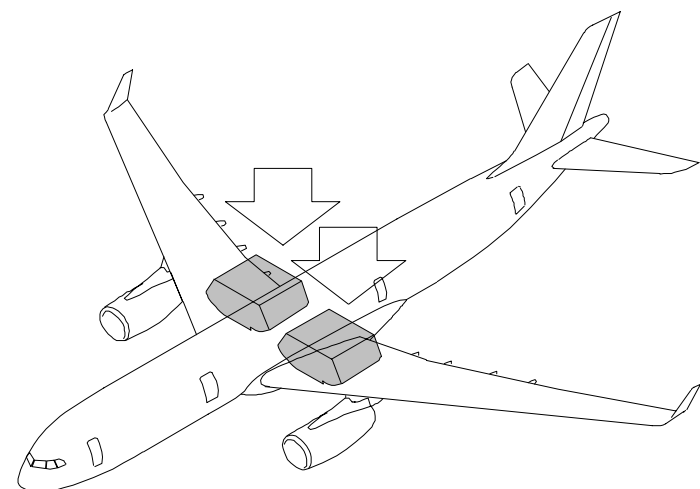
FIN : 13GG1(LH) 13GG2(RH)
14GG1(LH) 14GG2(RH)
15GG1(LH) 15GG2(RH)
16GG1(LH) 16GG2(RH)

ZONE : 730 - 740

COMPONENT DESCRIPTION

A tachometer is installed in each axle of the MLG bogies, a special carrier holds the tachometer.

The tachometer supplies a signal in proportion to the speed it turns.



FQW4200 GE Metric

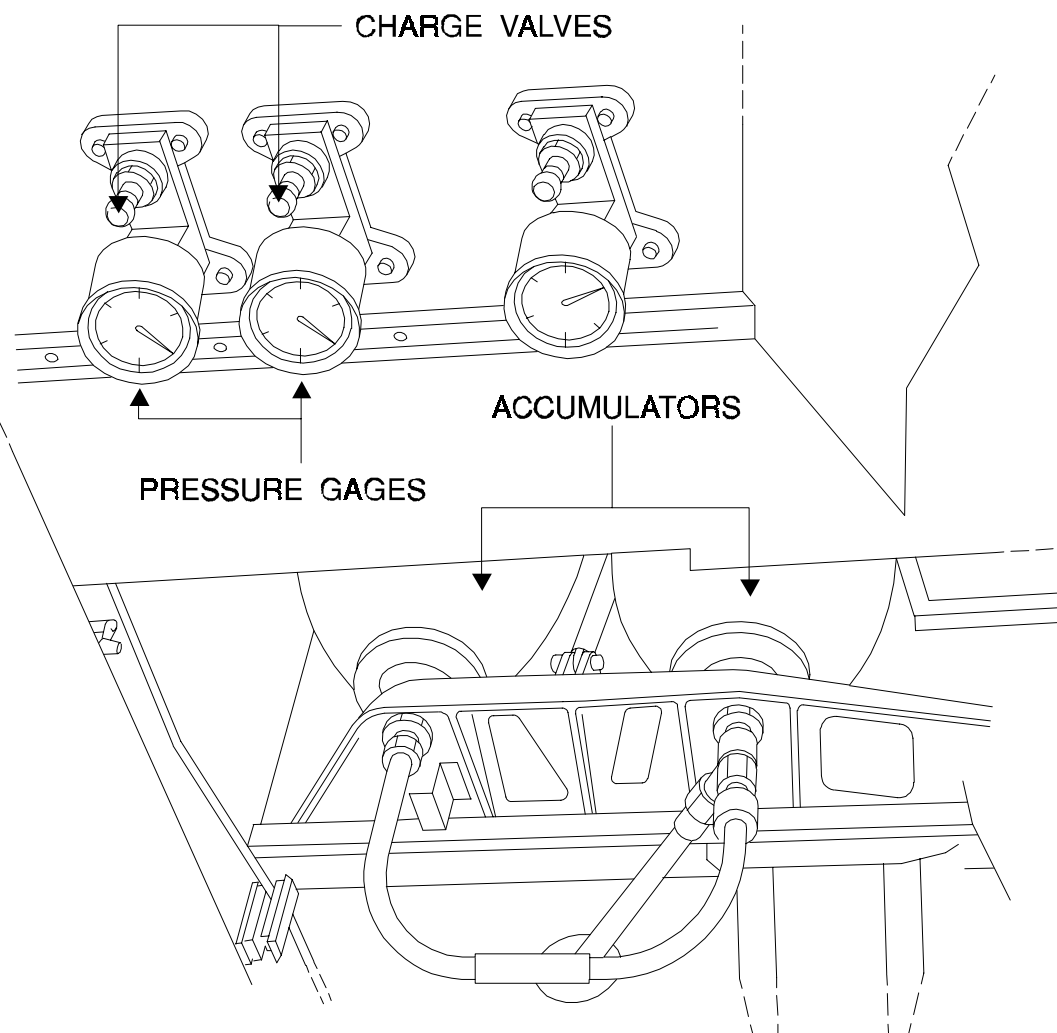
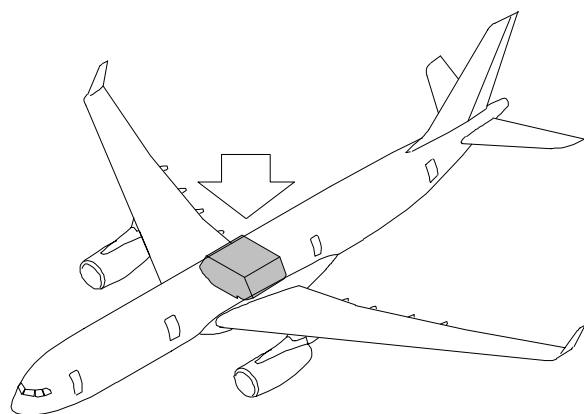
PARK BRAKE ACCUMULATOR

FIN : 5426GG
5427GG

ZONE : 195

COMPONENT DESCRIPTION

The two accumulators are oleo-pneumatic units that keep a specified nitrogen volume. They are charged to 100 bars (1450psi) each. They have the capacity to maintain the park brake pressure of 175 bars (2540psi) for a minimum of 12 hours within the range of -40°C to +60°C.



STUDENTS NOTE

FQW4200 GE Metric

NORMAL BRAKING COMPONENTS

- Normal Brake Selector Valve
- Automatic Selector Valve
- Normal Brake Manifold
- Braking And Steering Control Unit
- Safety Valve
- Brake Accumulator
- Pedal Transmitter
- Normal Servo- Valve
- Tachometers
- Pressure Transducers

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is :

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked,
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

FQW4200 GE Metric

NORMAL BRAKE SELECTOR VALVE

FIN : 4GG

ZONE : 150

COMPONENT DESCRIPTION

The normal brake selector valve is a solenoid operated valve located on the brake manifold.

The normal brake selector valve has a spring loaded shuttle valve and a restrictor valve.

SPECIAL DESIGN

The valve is energized open, green hydraulic pressure moves the shuttle valve against the spring and pressurizes the normal supply line. When the valve is de-energized closed, the spring closes the shuttle valve and the restrictor controls the valve closing speed.

AUTOMATIC SELECTOR VALVE

FIN : 5202GG

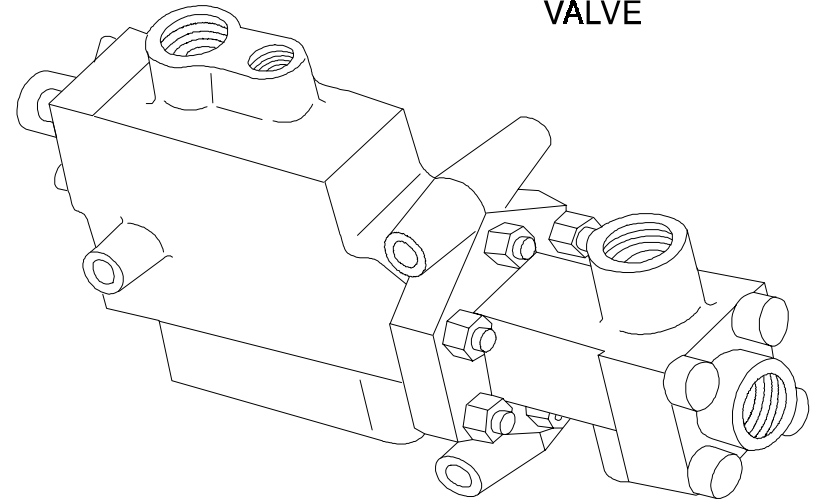
ZONE : 150

COMPONENT DESCRIPTION

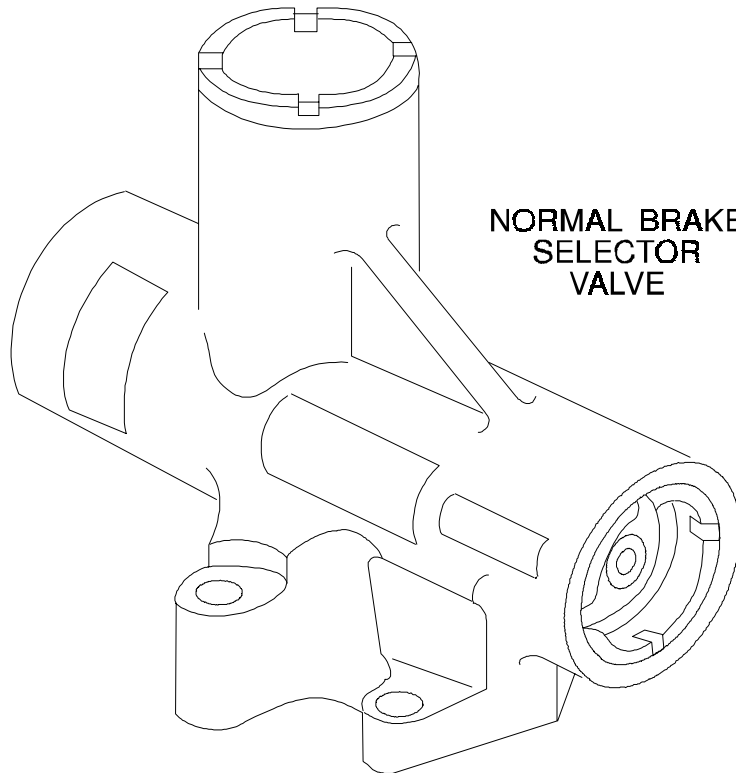
The automatic selector valve is a hydraulically operated two stage valve. Its function is to pressurize the normal brake system or the blue alternate system.

The valve contains a throttle valve to give normal flow for opening and restricted flow to control the valve closing rate.

**AUTOMATIC
SELECTOR
VALVE**



**NORMAL BRAKE
SELECTOR
VALVE**



NORMAL BRAKE MANIFOLD

FIN : 5206GG(LH)
5207GG(RH)

ZONE : 741 - 731

COMPONENT DESCRIPTION

The normal brake manifold is located on the main landing gear drag stay. It provides a mounting for the normal servo valves, the safety valves and pressure transducers.

SAFETY VALVE

FIN : 5250GG(LH) 5254GG(RH)
5251GG(LH) 5255GG(RH)
5252GG(LH) 5256GG(RH)
5253GG(LH) 5257GG(RH)

ZONE : 741 - 731

COMPONENT DESCRIPTION

The safety valves are hydraulic and automatically closed when the flow through the valve is above a specified limit.

The valve body is held in position by equal pressure in the two chambers.

When a high flow occurs in the outlet port, the pressure becomes unequal, the valve body moves towards the valve seat and then closes off the outflow.

BRAKE ACCUMULATOR

FIN : 5216GG(LH)
5217GG(RH)

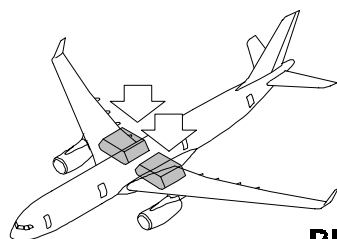
ZONE : 741 - 731

COMPONENT DESCRIPTION

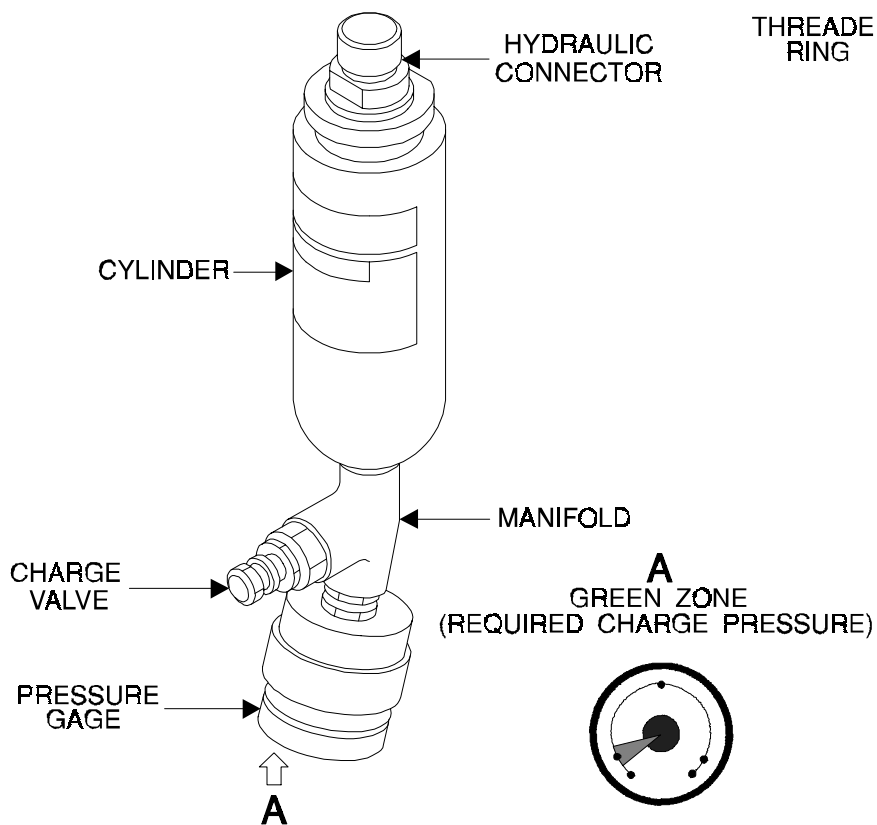
One normal return accumulator is installed on each main landing gear leg. They are of hydraulic nitrogen accumulator type.

A pressure gage is fitted at the nitrogen end of the accumulator.

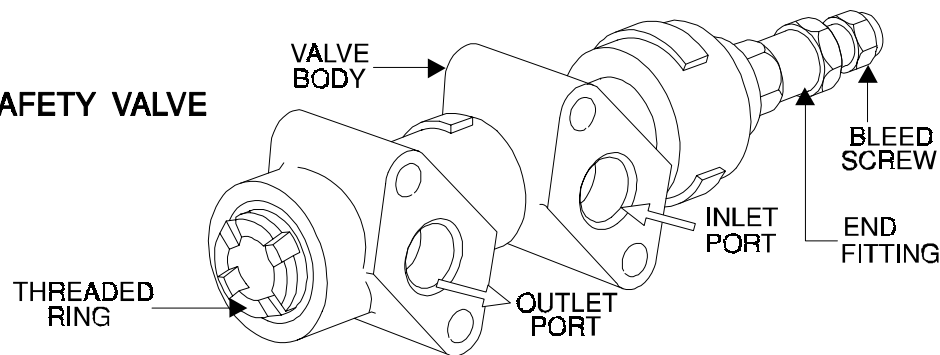
The accumulator provides a constant pressure to the four brake lines.



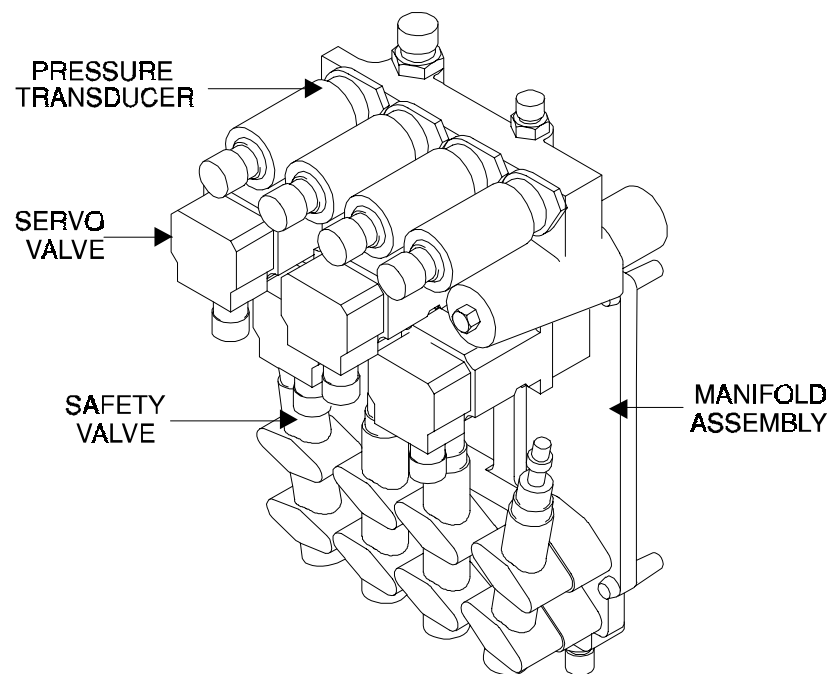
BRAKE ACCUMULATOR



SAFETY VALVE



NORMAL BRAKE MANIFOLD



FQW4200 GE Metric

BRAKING AND STEERING CONTROL UNIT

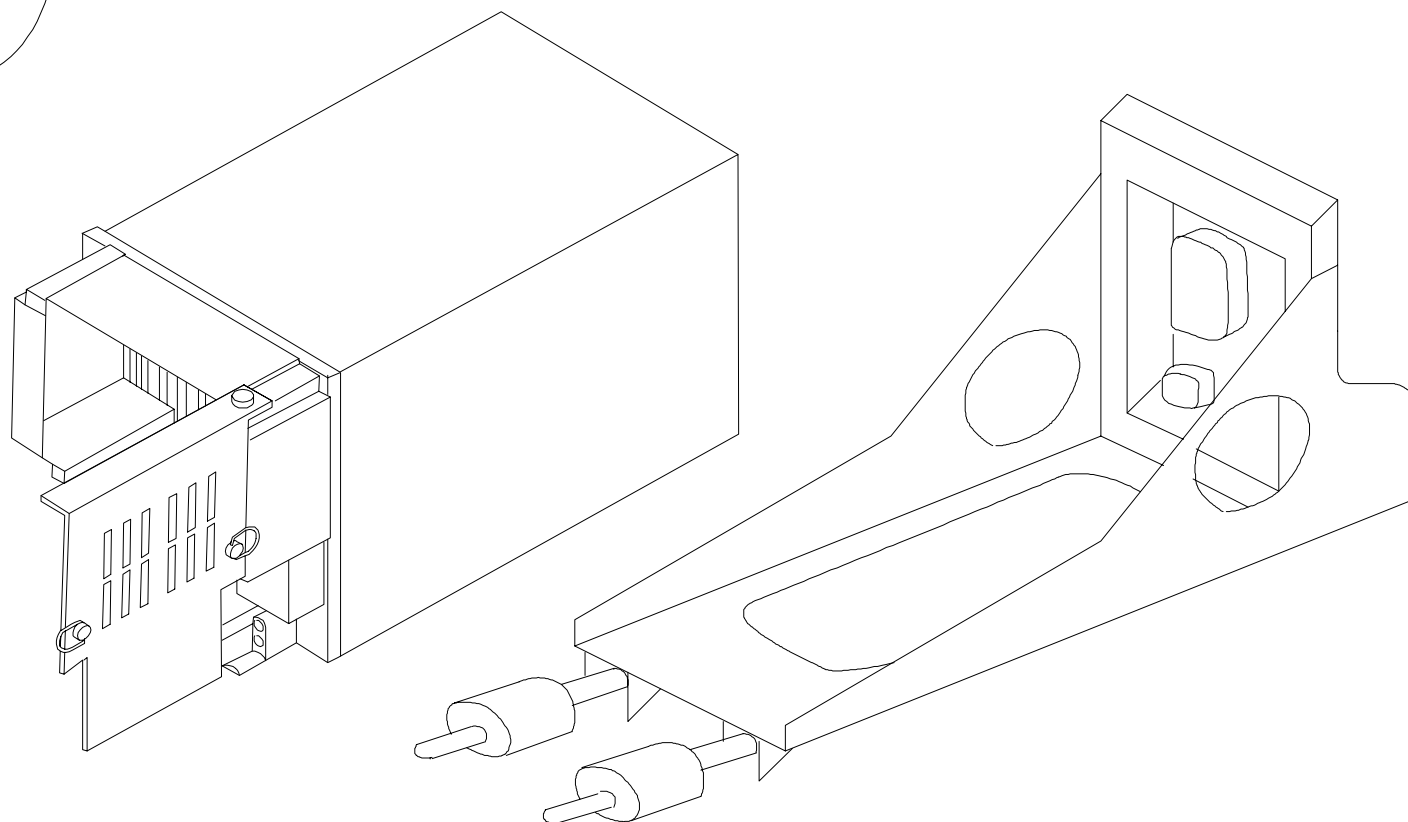
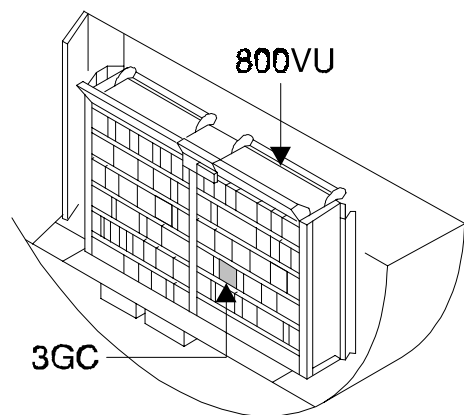
FIN : 3GG

ZONE : 120

COMPONENT DESCRIPTION

The BSCU is a dual function (steering and braking) duplex digital computer contained in a 6MCU size case located on the avionics rack 800VU.

It controls the normal brake pressure and the antiskid function, automatic braking (on ground and in flight) and the steering system. It converts data for display and warnings, performs various tests and supplies information for the CMS.



FQW4200 GE Metric

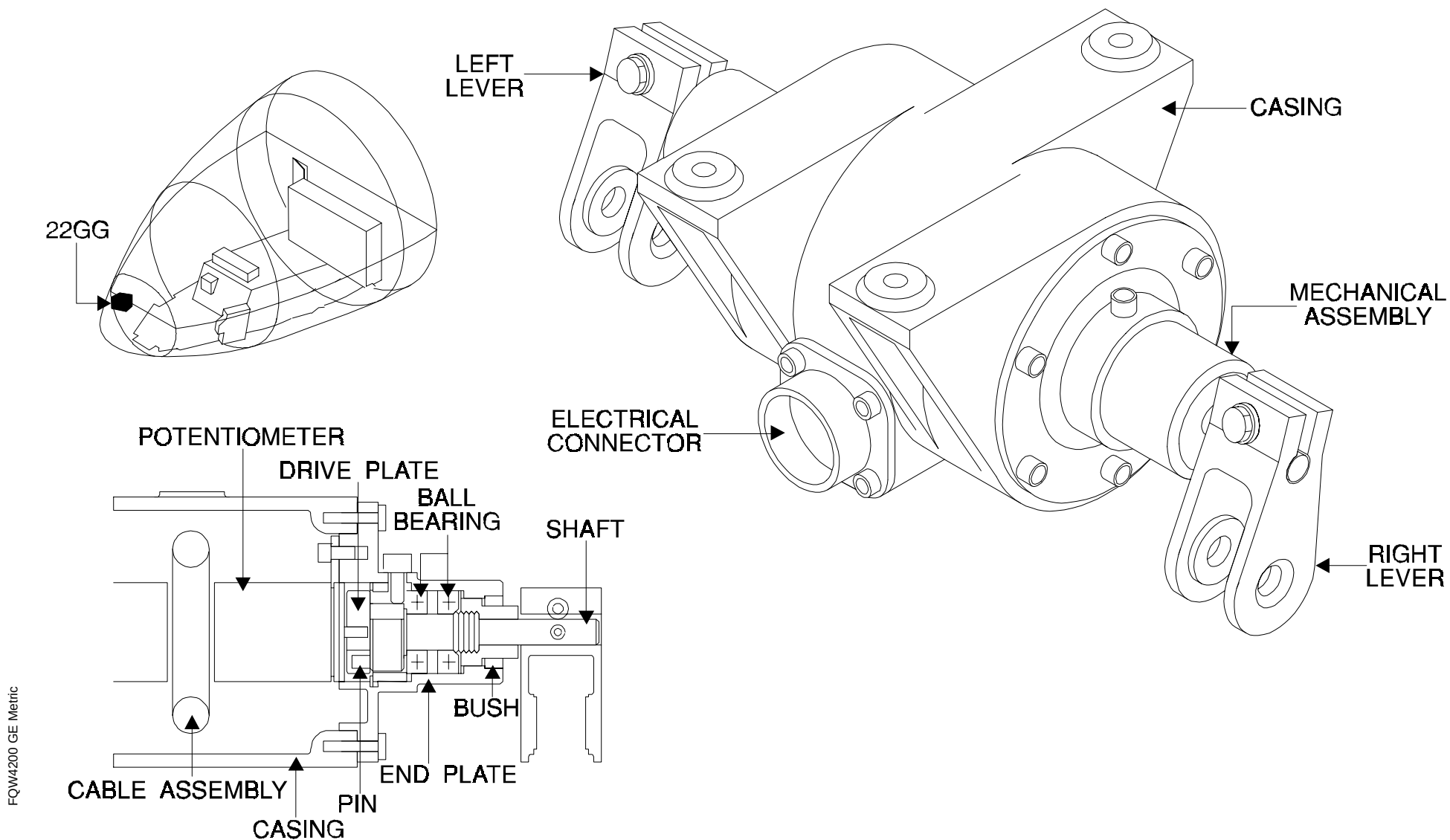
PEDAL TRANSMITTER

FIN : 22GG

ZONE : 120

COMPONENT DESCRIPTION

It has two input levers, one for the left and one for the right pedals.
It changes the mechanical inputs into four identical electrical voltages per side, using plastic track potentiometers.
These voltages are sent to the BSCU which will energize the normal brake selector valve.



FQW4200 GE Metric

NORMAL SERVO-VALVE

FIN : 9GG1(LH) 9GG2(RH)
10GG1(LH) 10GG2(RH)
11GG1(LH) 11GG2(RH)
12GG1(LH) 12GG2(RH)

ZONE : 741 - 731

COMPONENT DESCRIPTION

The normal servo valves are electro-hydraulic valves controlled by the BSCU to provide the correct hydraulic pressure to the brake units and to provide the release of that pressure at the correct time to give the optimum braking efficiency with anti-skid control.

TACHOMETERS

FIN : 13GG1(LH) 13GG2(RH)
14GG1(LH) 14GG2(RH)
15GG1(LH) 15GG2(RH)
16GG1(LH) 16GG2(RH)

ZONE : 741 - 731

COMPONENT DESCRIPTION

The tachometer is installed in each wheel axle of the main landing gear, it supplies a signal in proportion to the speed it turns. It has an electrical connector at one end plate and the drive shaft on the other end.
As the wheel turns, the rotor gives an alternating current. The frequency of this current is proportional to the wheel speed.
The signal is sent to the BSCU.

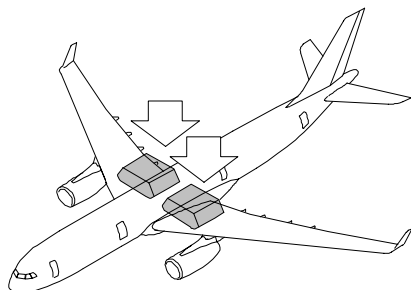
PRESSURE TRANSDUCERS

FIN : 5GG1(LH) 5GG2(RH)
6GG1(LH) 6GG2(RH)
7GG1(LH) 7GG2(RH)
8GG1(LH) 8GG2(RH)

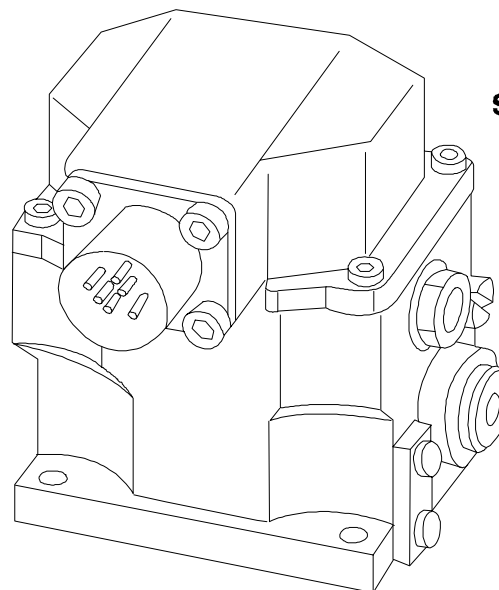
ZONE : 150

COMPONENT DESCRIPTION

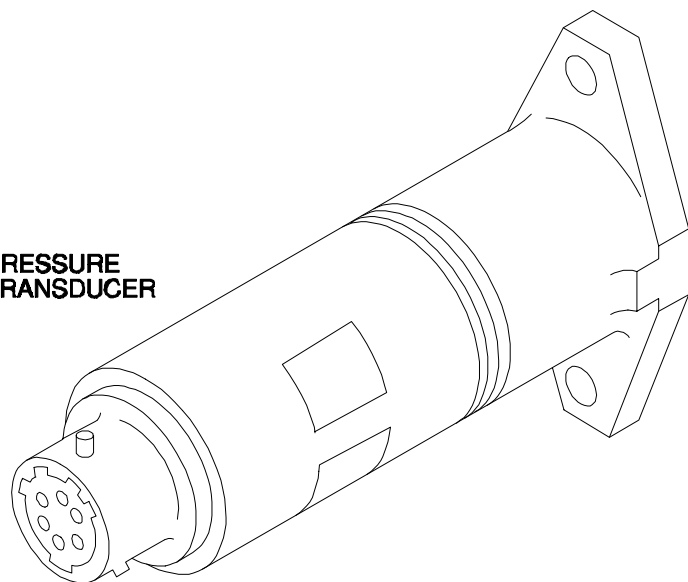
The transducers are made of an electronic bridge type circuit for measuring the hydraulic pressure in the brake lines.
This provides a feedback to the BSCU for correct operation of the brake system.



**NORMAL
SERVO-VALVE**



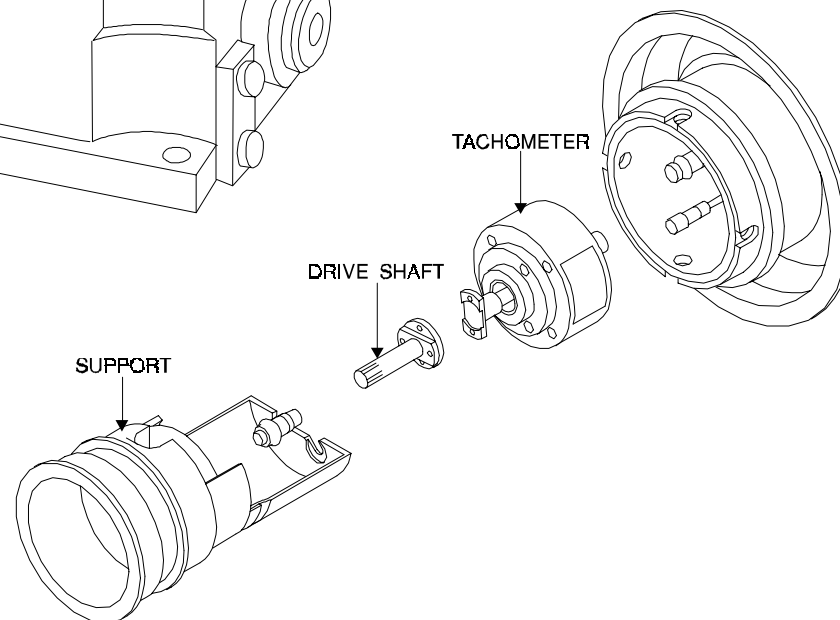
**PRESSURE
TRANSDUCER**



TACHOMETER

DRIVE SHAFT

SUPPORT



FQW4200 GE Metric

STUDENT NOTES

ALTERNATE BRAKING COMPONENTS

Reservoir
Master Cylinder
Dual Valve
Safety Valve
Shut-Off Valve
Return Accumulator
Servo Valve
Manifold
Park Brake Accumulators
Pressure Transducers
Triple Indicator

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is:

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked,
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

RESERVOIR

FIN : 5424GG

ZONE : 120

COMPONENT DESCRIPTION

The alternate brake reservoir is located in the avionics bay. The reservoir provides sufficient quantity of pressurized hydraulic fluid to keep the master cylinders full. A transparent indicator with a red and green line indicates the low and correct fluid level in the reservoir.

MASTER CYLINDER

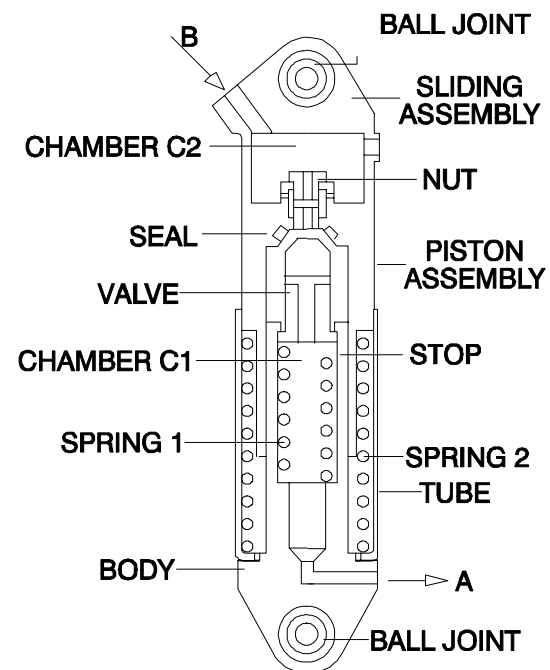
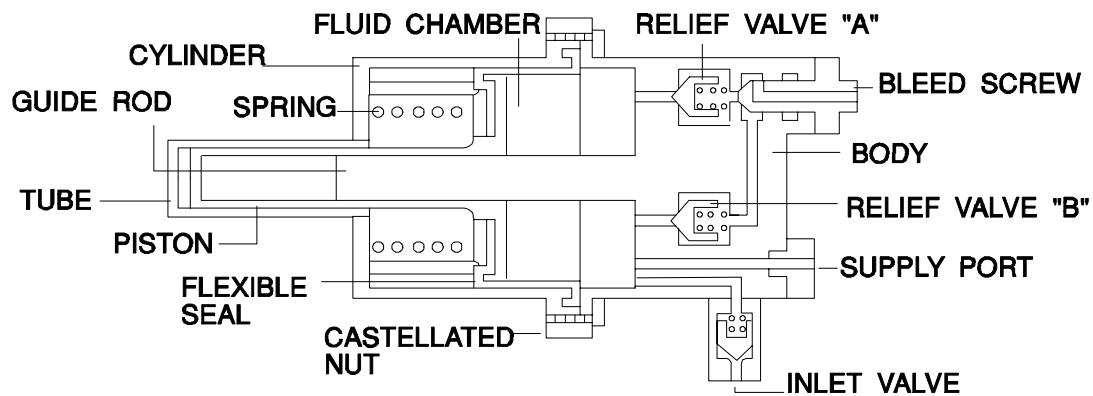
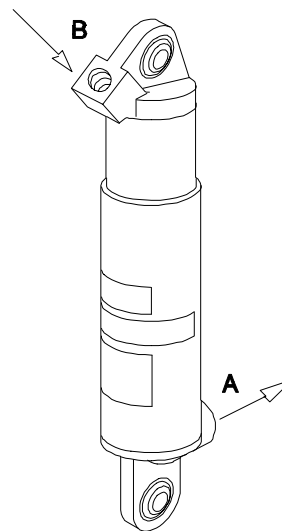
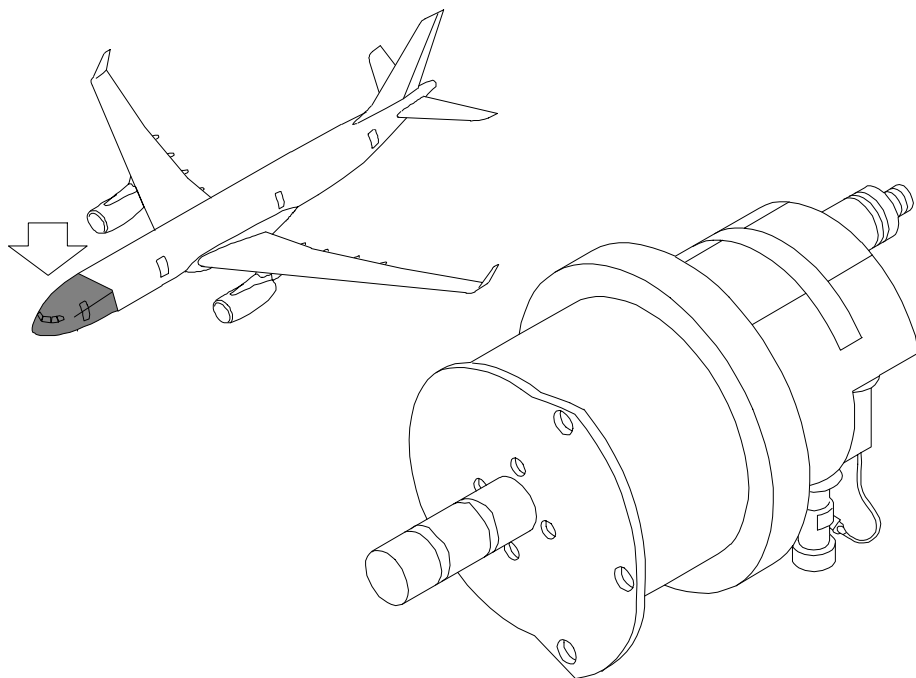
FIN : 5422GG(RH)- 5423GG(LH)

ZONE : 120

COMPONENT DESCRIPTION

Master cylinders are located below the cockpit floor on the First Officer pedal controls. They provide a related feel force during brake pedal operation. They change the mechanical input into an hydraulic pressure to operate the dual valve.

Pedal pressure moves the spring and supplies pressure to the dual valve. With no pressure on the pedals, the spring and hydraulic pressure return the sliding assy to its original position.



FQW4200 GE Metric

DUAL VALVE

FIN : 5403GG

ZONE : 147

COMPONENT DESCRIPTION

The dual valve controls the quantity of hydraulic pressure passing to the brakes. This is a hydro-mechanical valve containing two identical assemblies. Each control valve assembly operates in proportion to the pressure from its related pedal/master cylinders. This provides independent braking for the left and right main wheel assemblies.

SAFETY VALVE

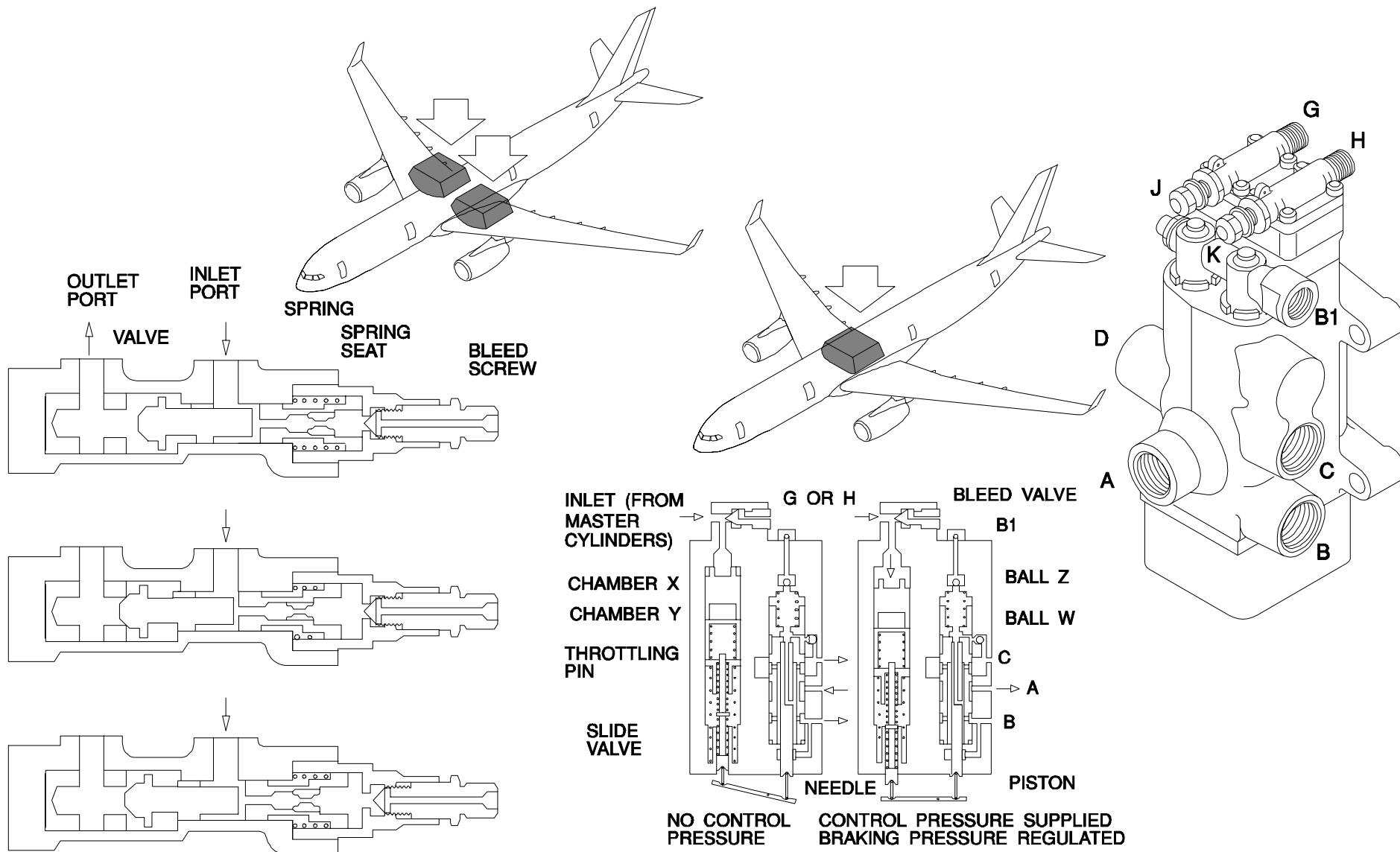
FIN : 5409HGG - 5409GG

ZONE : 741 - 731

COMPONENT DESCRIPTION

Safety valves are located downstream of the servo valves. They are normally spring loaded open valves with up(X) and downstream(Y) chambers controlling valve position. With a leak downstream, the downstream chamber will lose pressure and the valve forced closed on its seat.

FQW4200 GE Metric



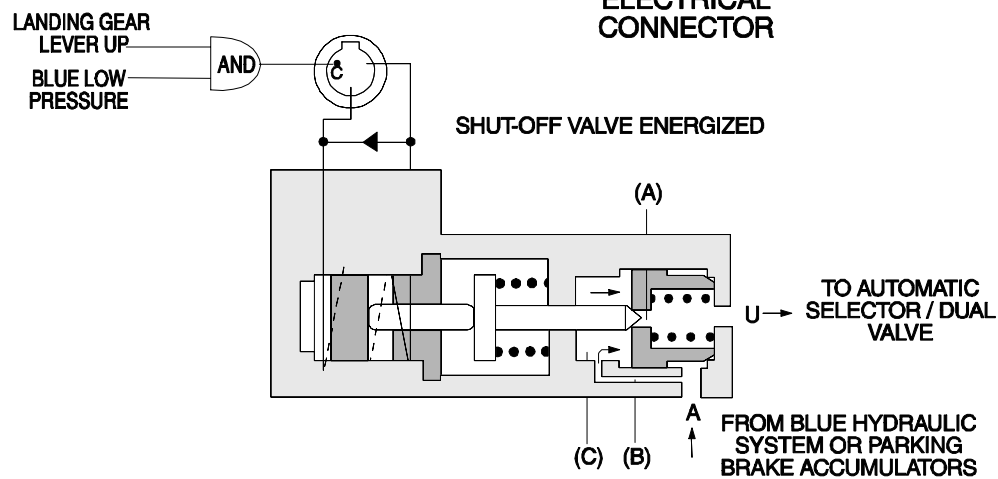
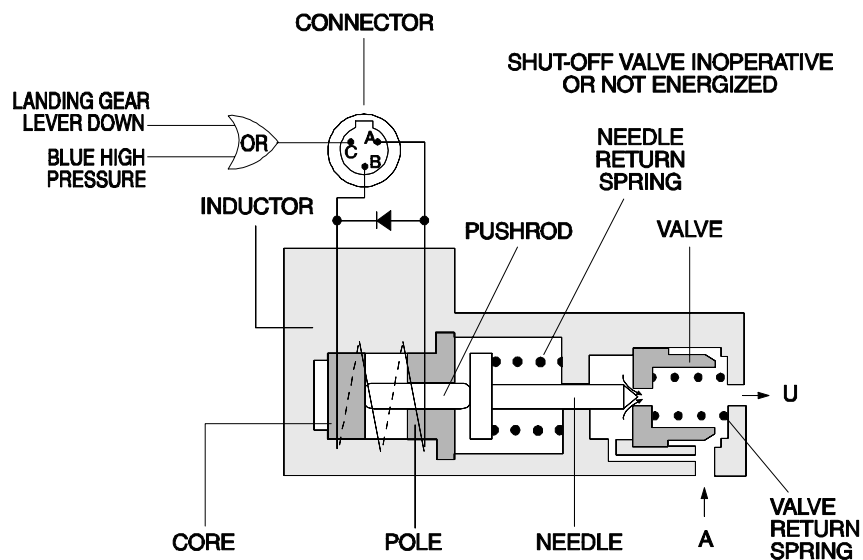
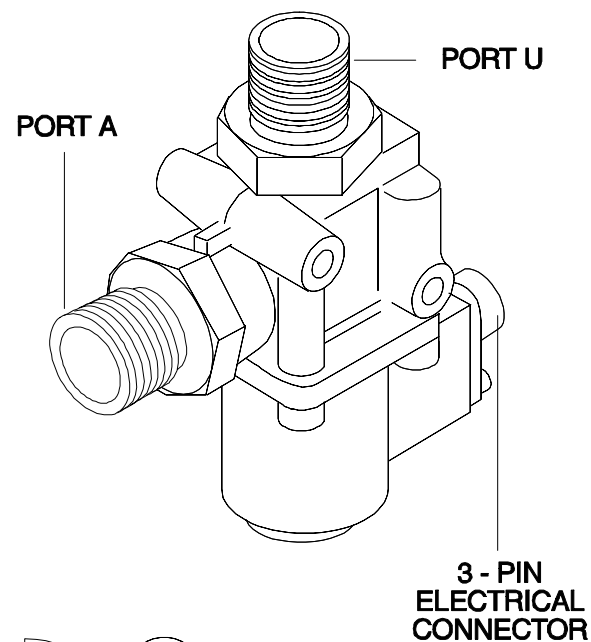
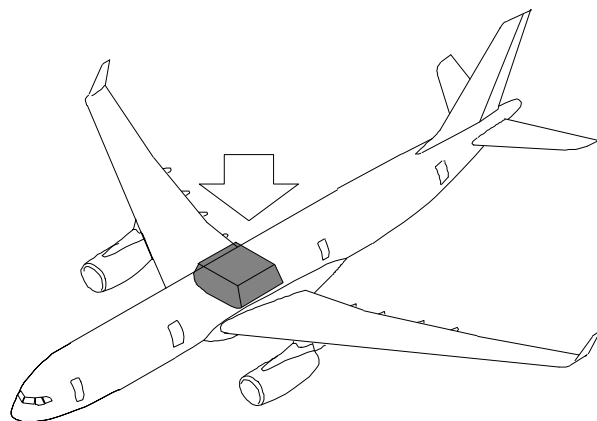
SHUT-OFF VALVE

FIN : 9GZ

ZONE : 147

COMPONENT DESCRIPTION

To ensure that alternate braking remains effective following green system failure during a long flight, the shut-off valve, installed in the alternate braking system, prevents depressurization of the parking brake accumulators. The valve is energized to close if the blue system pressure falls. This stops the internal leakage through the dual valve, thus maintaining accumulator pressure. This valve de-energizes to open at landing gear selection.



FQW4200 GE Metric

RETURN ACCUMULATOR

FIN : 5412GG - 5413GG

ZONE : 741 -731

COMPONENT DESCRIPTION

The return accumulators are bladder type accumulators. They are identical to the normal brake accumulators with a nitrogen charging point. Their function is to make sure the brakes release smoothly. Each one is fitted with a pressure gage for correct quantity of charging.

SERVO VALVE

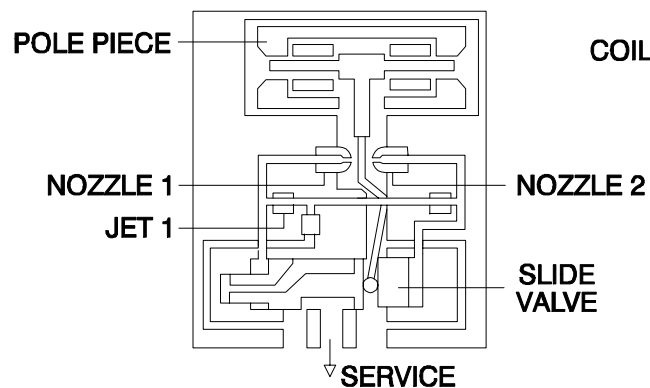
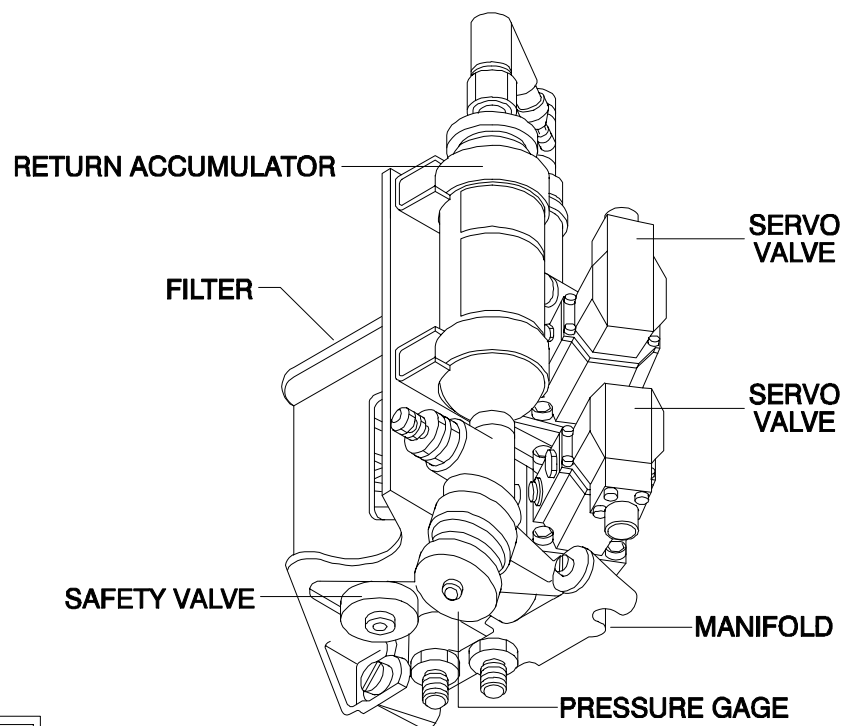
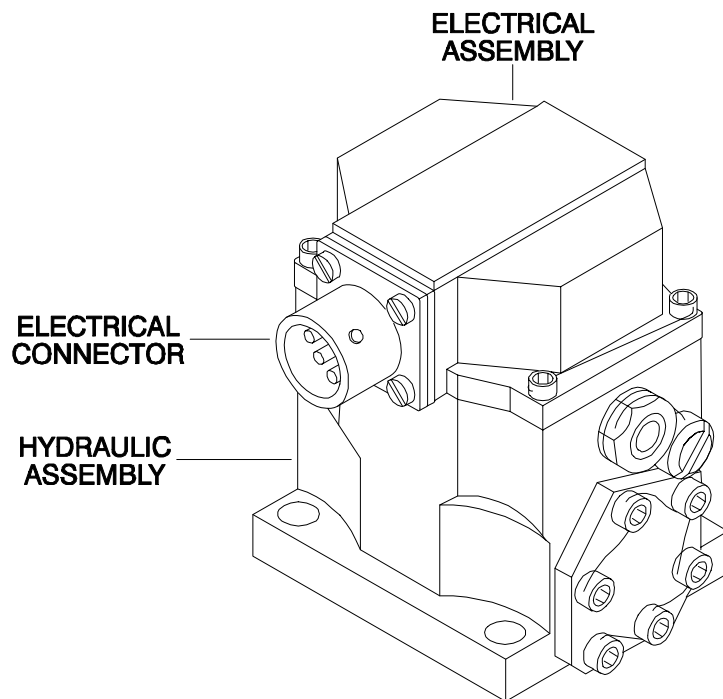
FIN : 1GY1 -1GY2
2GY1 -2GY2

ZONE : 741 -731

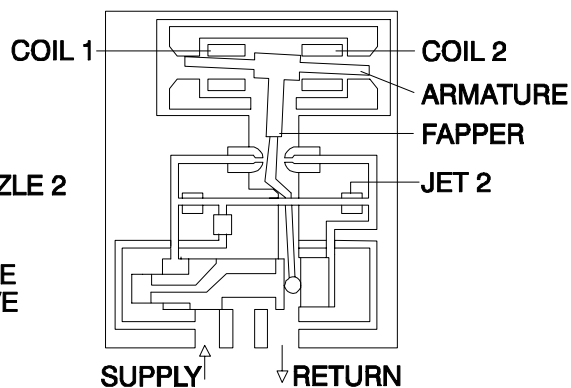
COMPONENT DESCRIPTION

The alternate servo valves are identical to the normal servo valves. The electrical control is different:

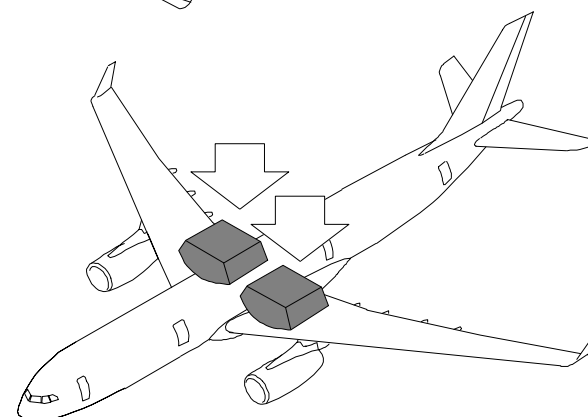
- only one coil is connected to the electrical connector,
- the coil is only energized to release the pressure in the brakes.



MINIMUM CONTROL CURRENT
AT THE COIL



MAXIMUM CONTROL CURRENT
AT THE COIL



MANIFOLD

FIN : 5406GG - 5407GG

ZONE : 741 - 731

COMPONENT DESCRIPTION

The manifold alternate brake provides a mounting for:

- Return accumulator,
- Two servo valves,
- Two safety valves.

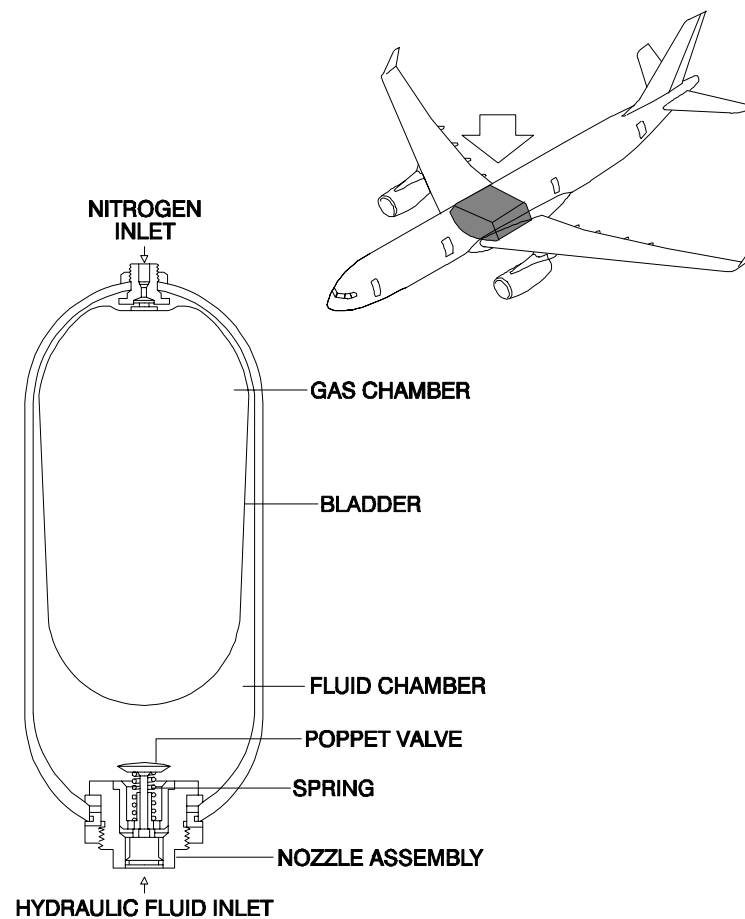
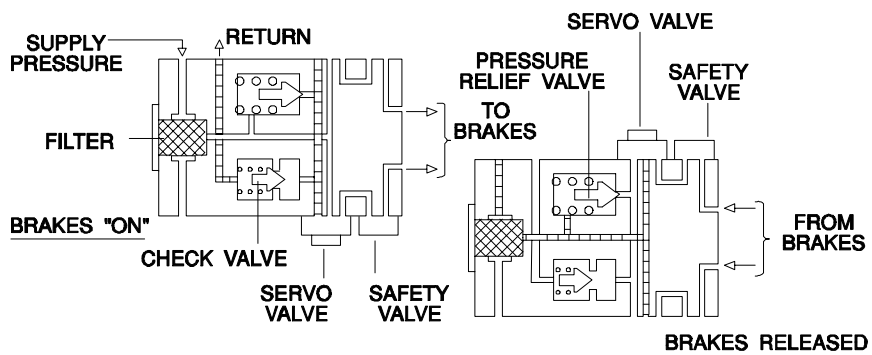
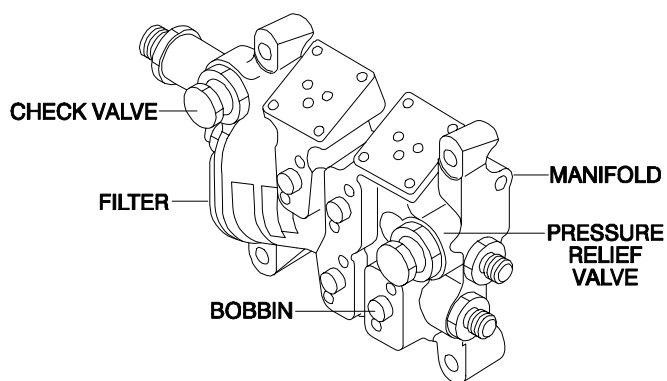
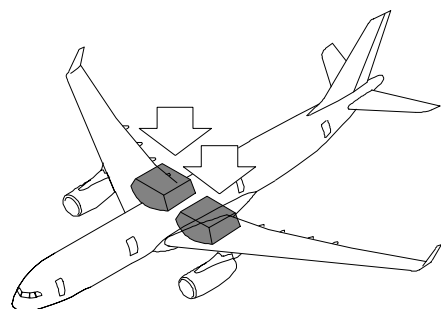
PARK BRAKE ACCUMULATORS

FIN : 5426GG - 5427GG

ZONE : 147

COMPONENT DESCRIPTION

Parking brake accumulators are located forward of the main landing gear bay in the belly fairing. They are of the bladder type and are serviced from the blue hydraulic ground service panel. They are able to provide seven applications of the brakes with no system pressure available. Two pressure gages are provided on the blue ground service panel for the correct servicing of the accumulators.



FQW4200 GE Metric

PRESSURE TRANSDUCERS

FIN : 3GK1 - 3GK2 - 4GK

ZONE : 147

COMPONENT DESCRIPTION

Pressure transducers measure pressure in the left and right alternate brake supply lines. The third one measures the blue accumulators pressure for alternate braking.

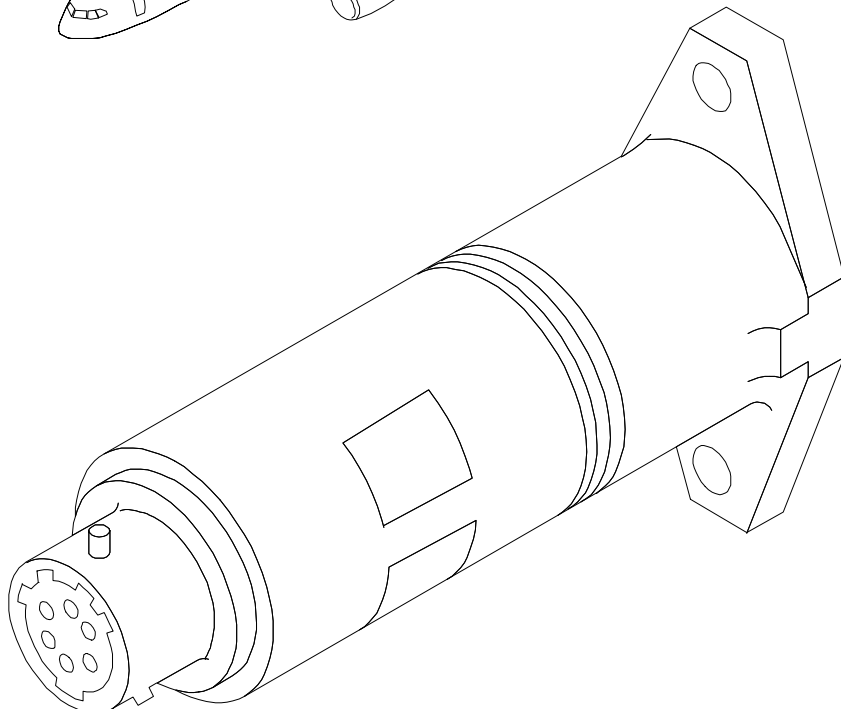
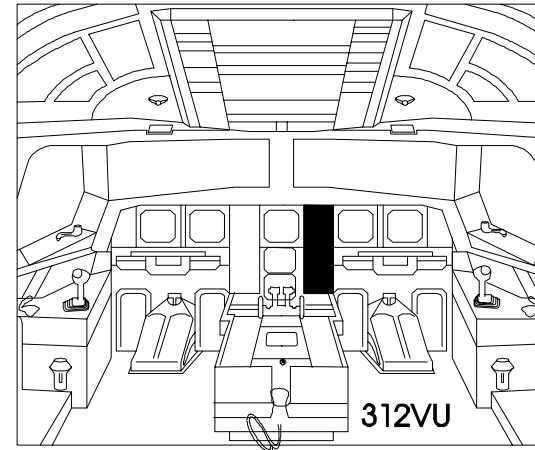
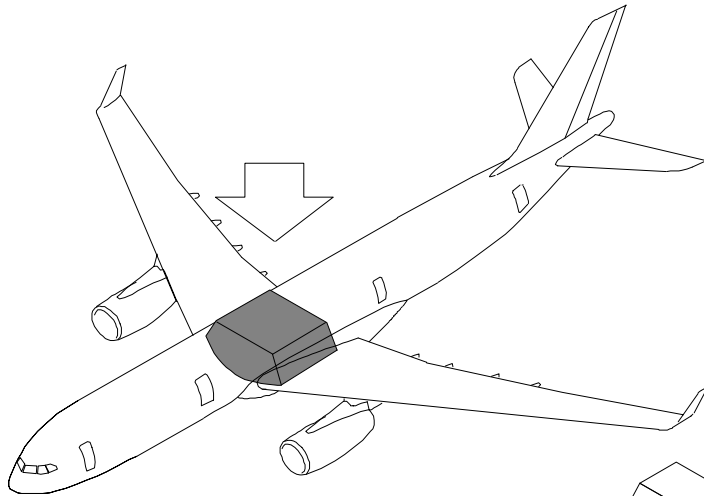
TRIPLE INDICATOR

FIN : 2GK

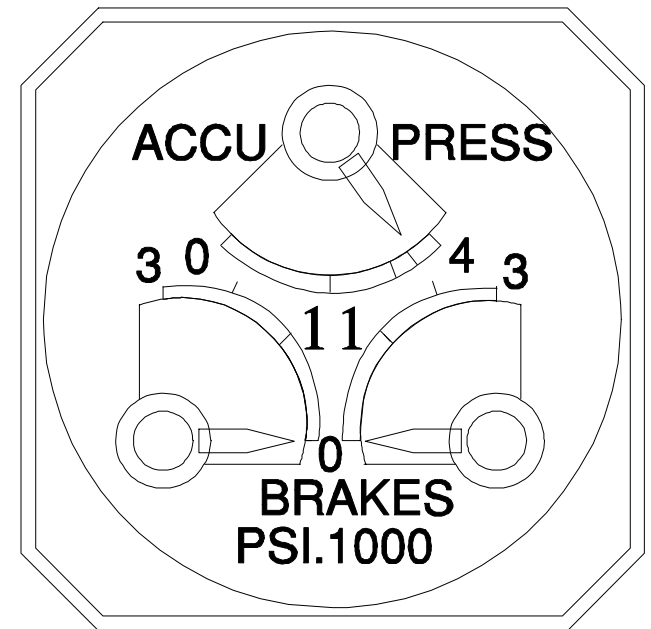
ZONE : 210

COMPONENT DESCRIPTION

The triple pressure indicator provides the pressure indication of the alternate brake system plus accumulators pressure. An indicator band from 0 to 1000 psi is provided on the left and right brake pressure indicators for alternate braking without anti skid.



FQW4200 GE Metric



STUDENT NOTE

PARKING BRAKE COMPONENTS

Park brake operated valve
Dual shuttle valve
Park brake manifold
Park brake control valve

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is:

- hydraulic system depressurized
- ground lock pins and safety sleeves are in place
- wheel chocks are in place
- landing gear control lever is in "DOWN" position and locked
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

FQW4200 GE Metric

PARK BRAKE OPERATED VALVE

FIN : 5801GG

ZONE : 147

COMPONENT DESCRIPTION

Parking brake operated valve is located in the main landing gear bay. It is a mechanical valve containing one spring loaded shuttle valve. When the parking brake is selected "ON", the supply pressure from the parking brake control valve moves the shuttle valve on to its seat to isolate the supply from the automatic selector valve.

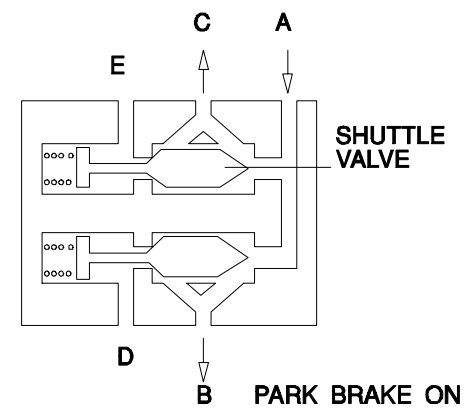
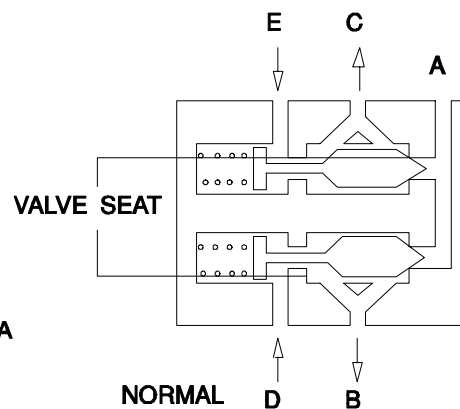
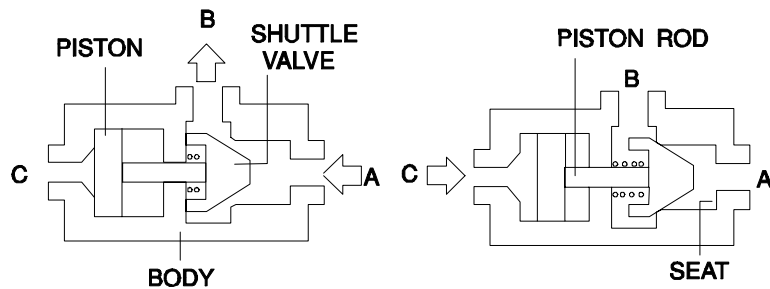
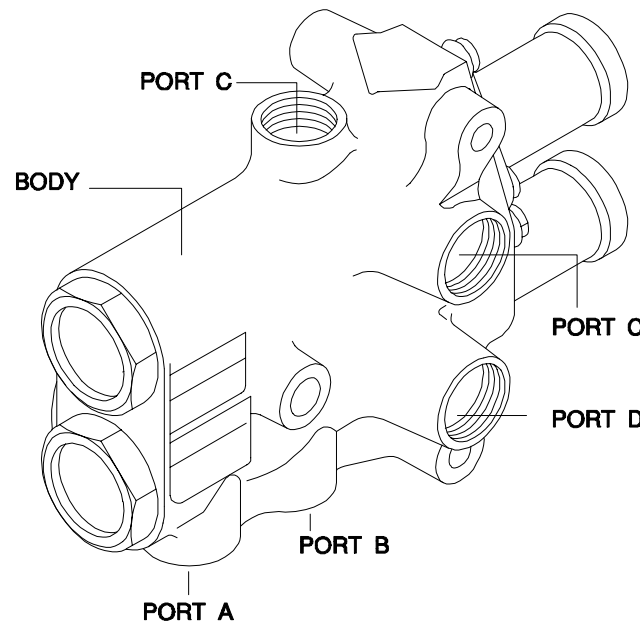
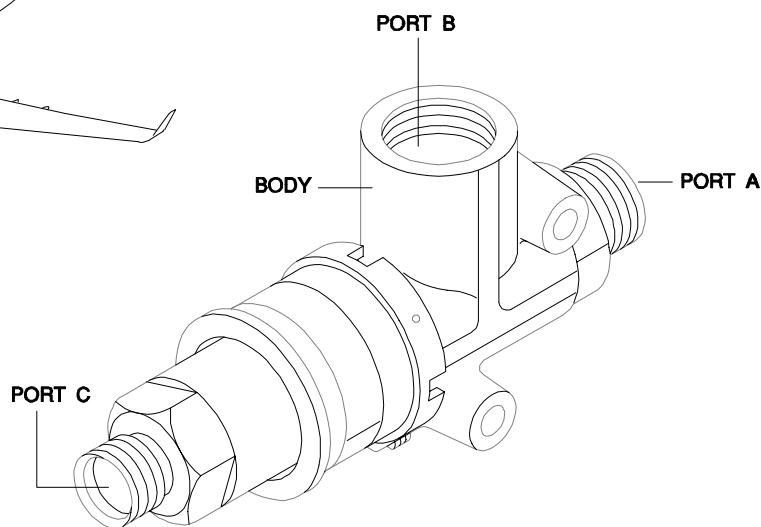
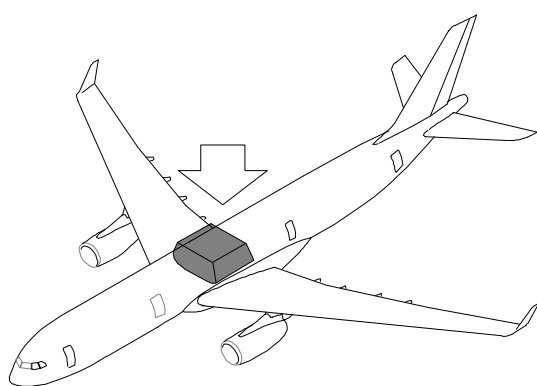
DUAL SHUTTLE VALVE

FIN : 5404GG

ZONE : 147

DUAL SHUTTLE VALVE

Dual shuttle valve is located in landing gear bay. It contains two spring loaded shuttle valves. When the parking brake is selected "ON", the dual shuttle valve closes the supply to the dual valve and opens the supply to the alternate servo valves.



PARK BRAKE MANIFOLD

FIN : 5401GG

ZONE : 147

COMPONENT DESCRIPTION

Parking brake manifold is located in the main landing gear bay. The manifold receives the blue hydraulic system supply and the two brake accumulators pressure. These are separated by the check valve. The manifold contains the pressure transducer and the pressure relief valve. The pressure relief valve operates to return at 265 bars (3843 psi). A manual lever can be operated to open the pressure relief valve.

PARK BRAKE CONTROL VAVE

FIN : 4GZ

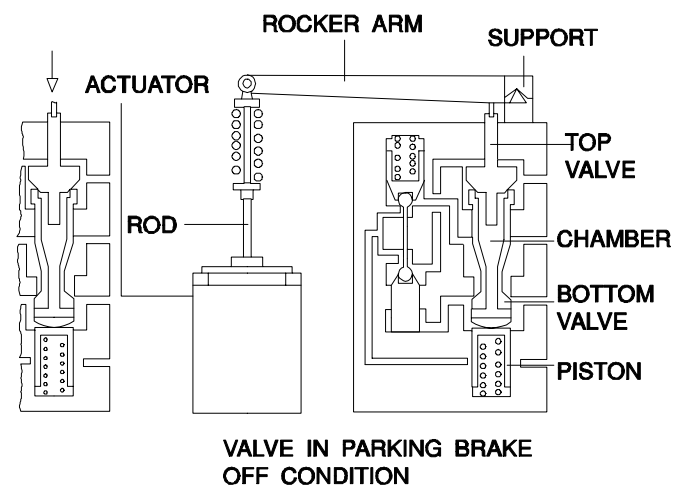
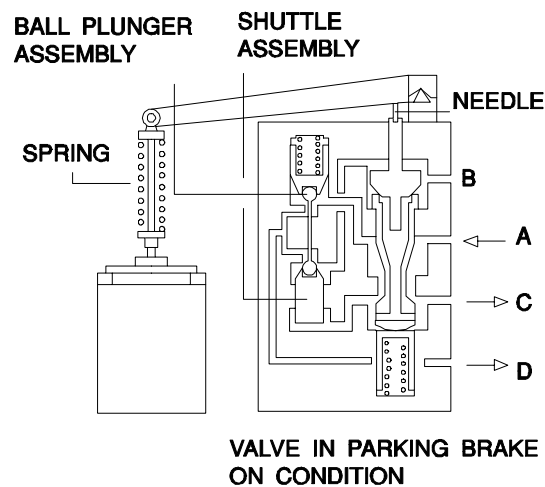
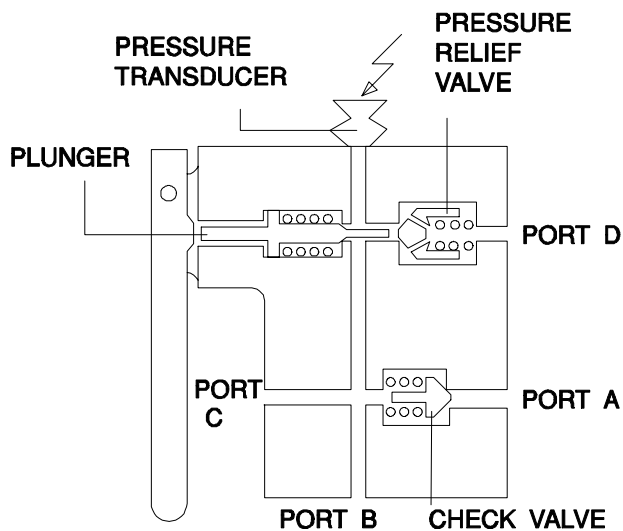
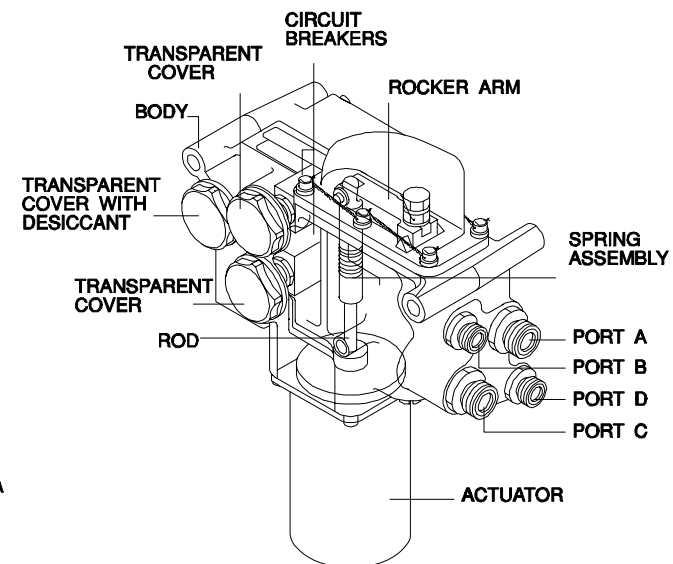
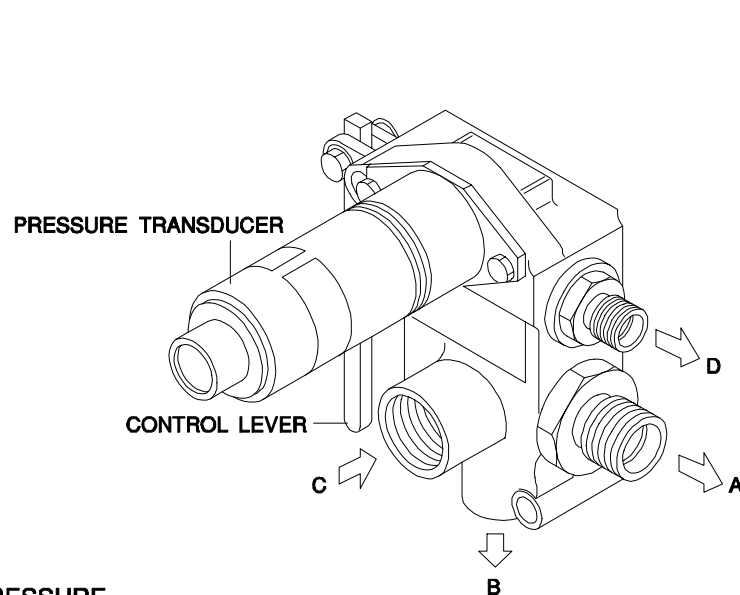
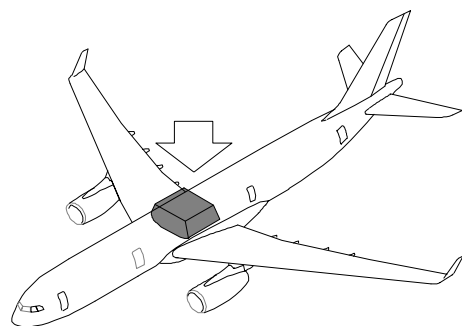
ZONE : 147

COMPONENT DESCRIPTION

Parking brake control valve is located in the main landing gear bay. The valve contains a pressure reducing valve and a selector valve. The pressure reducing valve limits the operating pressure to 175 bars (2538psi) to the alternate servo valves.

COMPONENT OPERATION

The selector valve provides the correct positioning of the main valve to supply the pressure to the alternate servo valves and close the automatic selector valve return lines. Two electrical motors move the actuator when the parking brake selector is set to "ON" or "OFF" position.



FQW4200 GE Metric

STUDENT NOTE

BRAKE COOLING COMPONENTS

Motor Assembly

FQW4200 GE Metric

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is :

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked,
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

FQW4200 GE Metric

MOTOR ASSEMBLY

FIN : 9GD1(LH) 9GD2(RH)
10GD1(LH) 10GD2(RH)
11GD1(LH) 11GD2(RH)
12GD1(LH) 12GD2(RH)

ZONE : 730 - 740

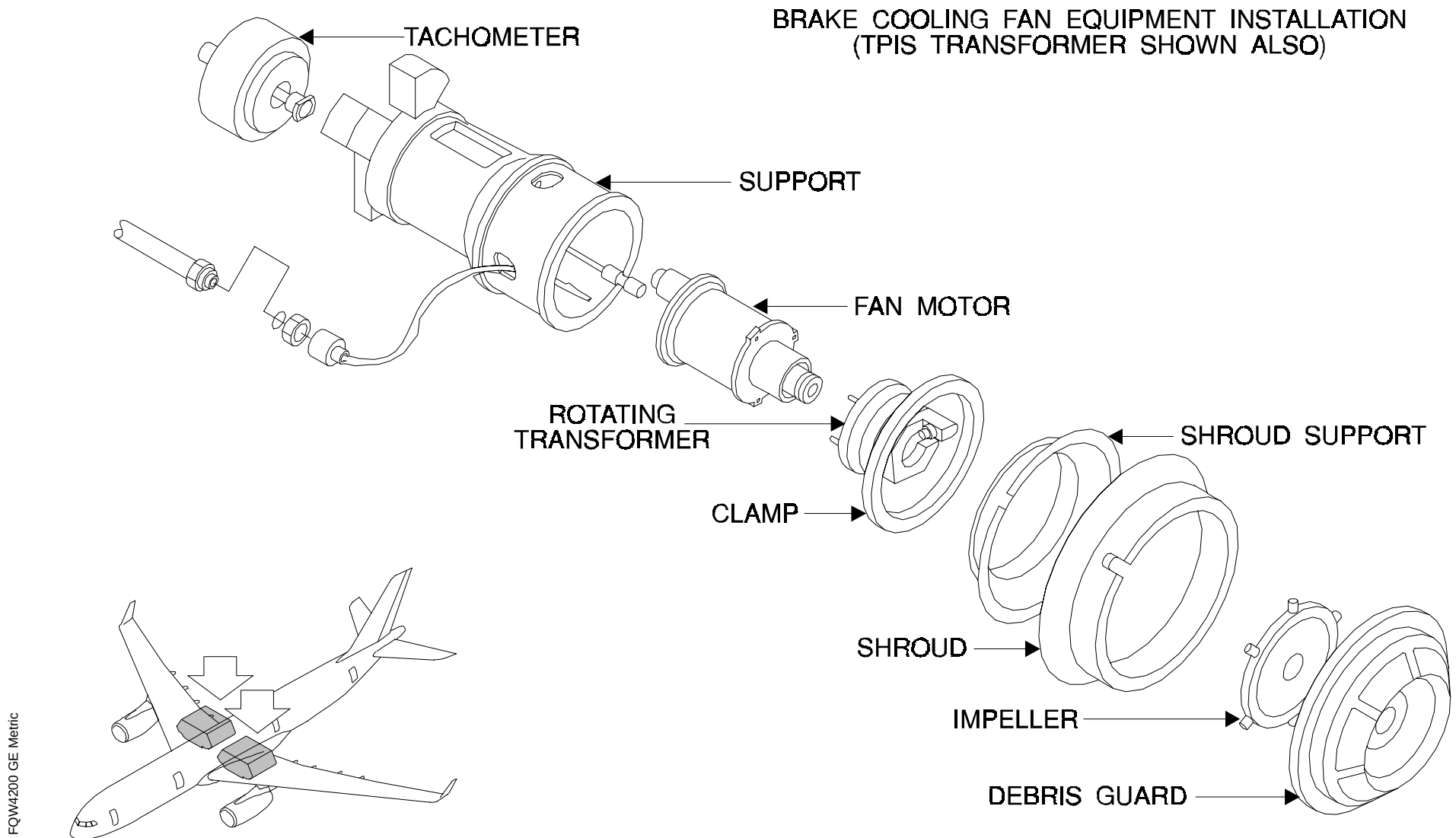
MOTOR DESCRIPTION

The electric motor and the fan assembly are installed in each main landing gear axle.

The electric motor is attached to a carrier and the motor drive shaft connects the motor to the fan assembly.

A nut attaches the fan assembly to the motor drive shaft which has a central bore.

The motor is a 3 phase 200V, 400hz motor with an electrical connector. The fan assembly includes a five bladed impeller.



STUDENT NOTES

BRAKE SYSTEM TEMPERATURE COMPONENTS

Brake Temperature Monitoring Unit
Temperature Sensor

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is :

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked,
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

BTMU (BRAKE TEMPERATURE MONITORING UNIT)

FIN : 3GW1(LH) 3GW2(RH)
 4GW1(LH) 4GW2(RH)

ZONE : 730 - 740

COMPONENT DESCRIPTION

Two BTMUs are installed on the bogie beam of each main landing gear. The system transmits data to the Brake and Steering Control Unit.

The BTMU is a sealed unit which has two cable assemblies ; there are two identical electronic circuits in the BTMU.

SPECIAL DESIGN

Each circuit :

- compensates the thermocouple junction and amplifies the input voltage from the temperature sensor.
- monitors the temperature sensor circuit for open and short circuit conditions.
- calculates and supplies an output voltage 1V --> 9V in proportion to the temperature of the related brake.

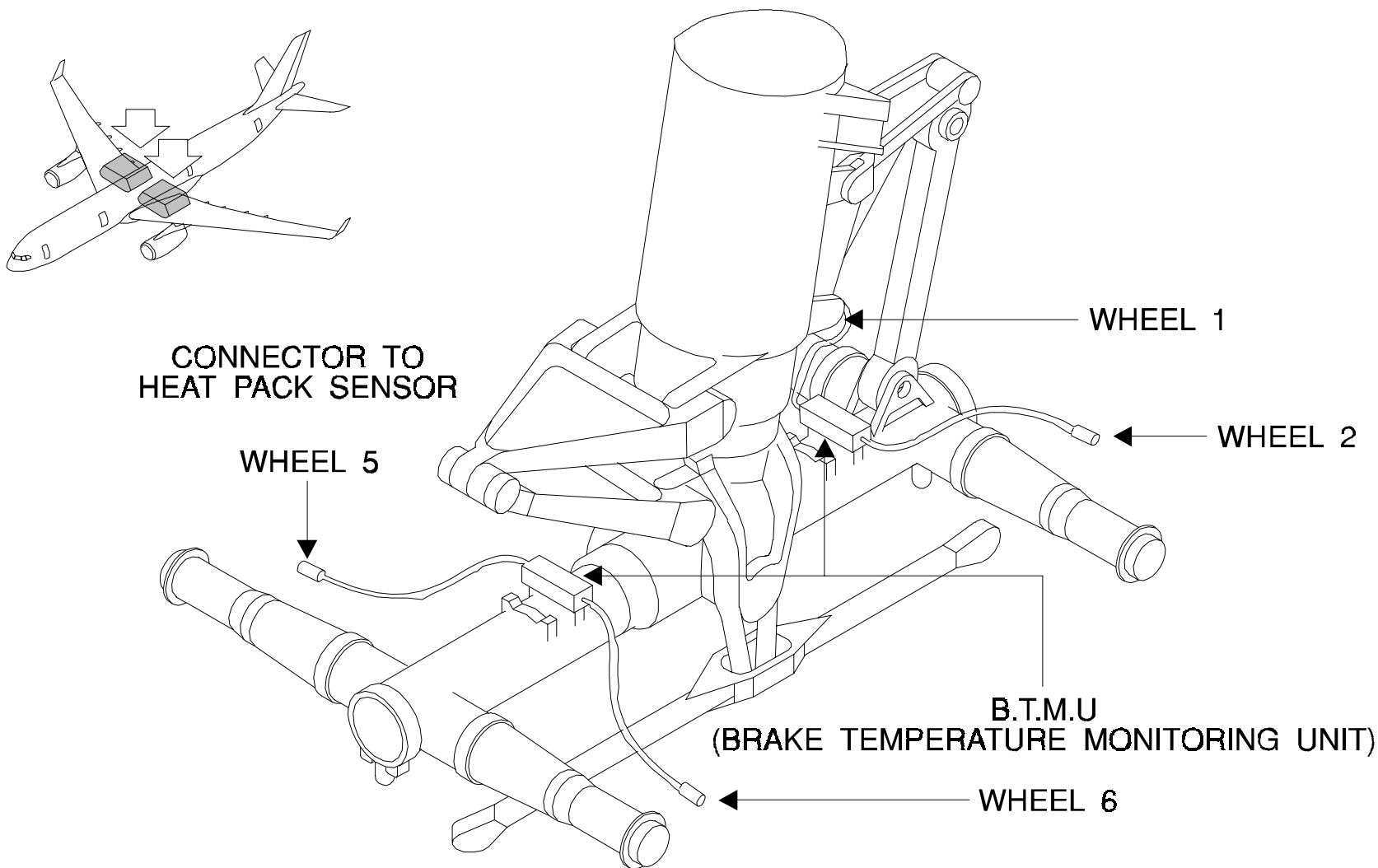
TEMPERATURE SENSOR

FIN : 5GW1(LH) 5GW2(RH)
 6GW1(LH) 6GW2(RH)
 7GW1(LH) 7GW2(RH)
 8GW1(LH) 8GW2(RH)

ZONE : 730 - 740

COMPONENT DESCRIPTION

It is a chromel alumel thermocouple. It supplies an output voltage in proportion to the temperature difference between the ambient temperature and the temperature at the thermocouple.



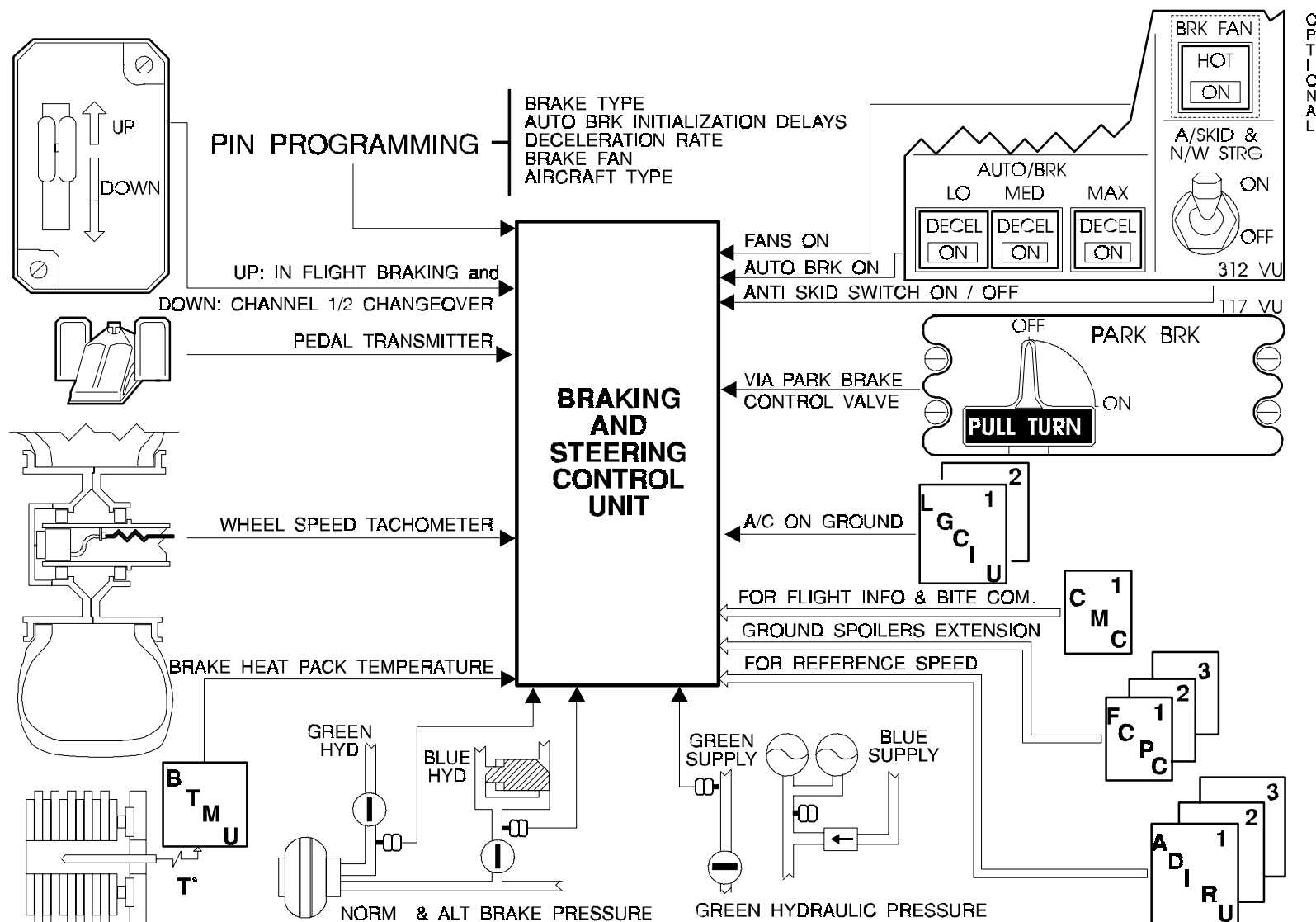
STUDENT NOTES

BRAKING AND STEERING CONTROL UNIT (BSCU) INTERFACES

Inputs
Outputs

INPUTS

The Braking and Steering Control Unit receives different signals in discrete analog or ARINC form.

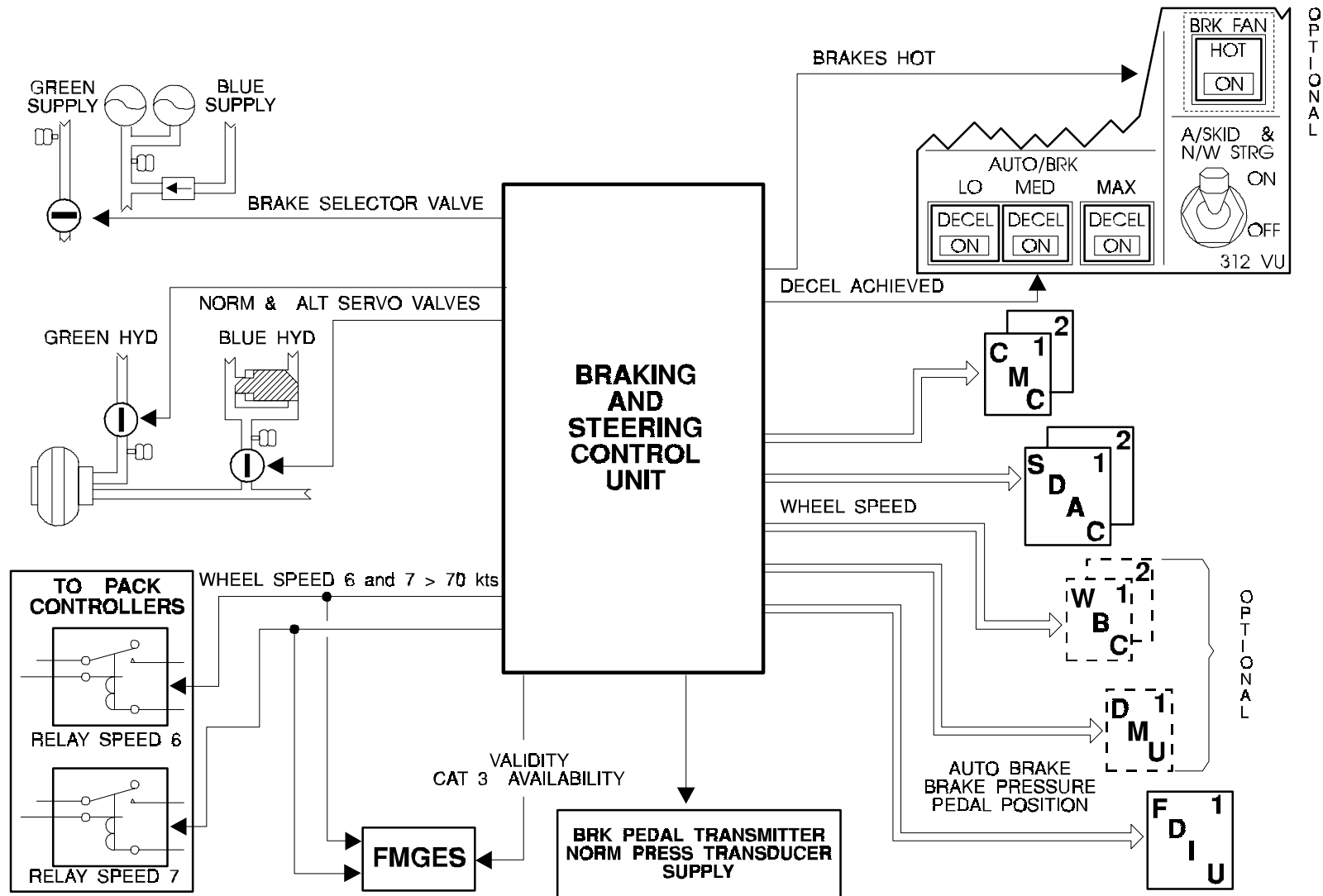


FQW4200 GE Metric

OUTPUTS

The Braking and Steering Control Unit produces Output signals to control the braking and to provide indications, warnings and maintenance information to other aircraft systems.

These signals are in discrete analog or ARINC form.



FQW4200 GE Metric

STUDENT NOTES

NOSE WHEEL STEERING SYSTEM PRESENTATION

- Control
- Pedals
- Disconnect Pushbutton
- B.S.C.U
- Activation
- Towing Control Lever
- Steering Angle Protection

Nose wheel steering is provided by a servomechanism, electrically controlled from the cockpit via the Braking and Steering Control Unit.

An internal cam mechanism returns the nose wheel to the centered position after take off.

CONTROL

Steering is controlled by the two handwheels and the rudder pedals. Signals are algebraically added if the controls are operated simultaneously.

Maximum nose wheel steering angle is:

- * 65° in either direction using the handwheel.
- * 6° in either direction depending on A/C speed using the pedals or under autopilot control.

PEDALS

Steering orders from the rudder pedals are sent to the Braking and Steering Control Unit, via the Flight Control Primary Computer which also receives autopilot steering signals.

The resulting signal is algebraically added to the handwheel signals.

DISCONNECT PUSHBUTTON

When a rudder pedal disconnect pushbutton is pressed in, the nose wheel steering by the pedals is disconnected.

The disconnect pushbuttons are also used during rudder ground check.

B.S.C.U

The Anti Skid switch enables the Braking and Steering Control Unit, which computes the steering orders, to be electrically powered.

B.S.C.U: Braking and Steering Control Unit

ACTIVATION

The steering servovalve is powered by the green hydraulic system pressure tapped from the nose landing gear door closing circuit.

The green pressure supplies the steering servovalve when:

- The aircraft speed is below 100 kts,
- One engine is running,
- The towing lever is in normal position,
- The shock absorbers are compressed.

NOTE : Steering is lost after gear gravity extension as the doors remain open.

TOWING CONTROL LEVER

A lever on the towing electrical box enables the steering system to be deactivated for towing.

With the lever in towing position:

- The maximum towing angle is plus or minus 65°.
- The ECAM MEMO DISPLAY shows NOSE WHEEL STEERING DISC in green, which changes to amber if one engine is running.

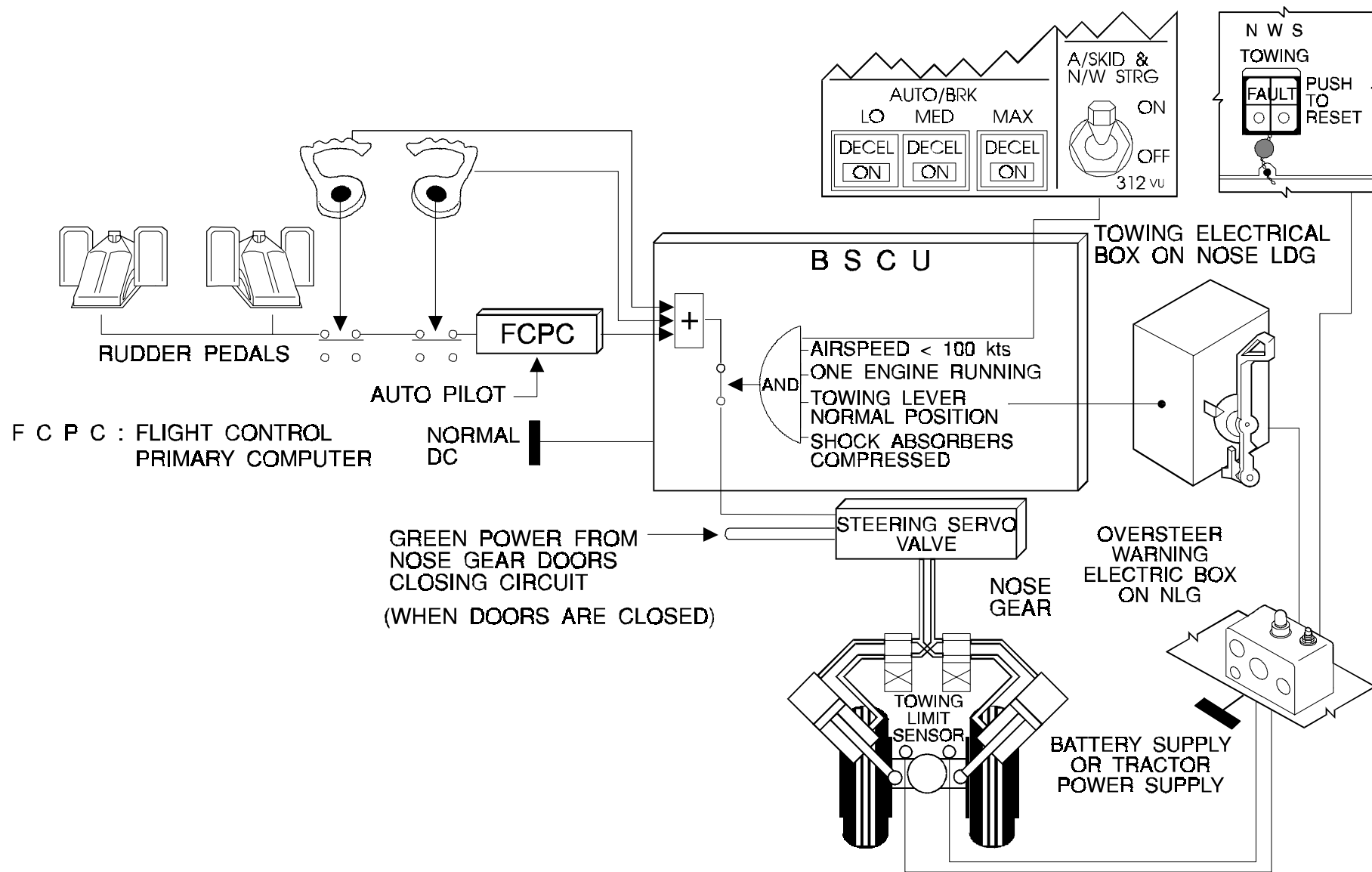
STEERING ANGLE PROTECTION

The towing warning is triggered by the towing limit sensors which energize, through the oversteer warning electric box, the pushbutton switch located in the cockpit.

The pushbutton switch is fitted with a guard which is sealed by a sealed lockwire to prevent an unauthorized reset of the system.

When the towing angle limits are exceeded, you have to:

- reset the system (the pushbutton switch must be pushed in).
- do the inspection/check required in the documentation.



STUDENT NOTES:

FQW4200 GE Metric

NOSE WHEEL STEERING DESCRIPTION AND OPERATION

Principle
Braking and Steering Control Unit (BSCU)
Hydraulic Operation
Castoring Mode

PRINCIPLE

The Braking and Steering Control Unit controls and monitors the operation of the steering system.

Two handwheel transmitters can send a maximum steering angle of 65 degrees to the Braking and Steering Control Unit when the ground speed is less than 10 knots.

The steering angle decreases in proportion to the increase of the aircraft speed.

The rudder pedals and the Flight Management and Guidance Envelope Computers supply secondary steering inputs to the Braking and Steering Control Unit through the flight control primary computers. These inputs can give a maximum of 6 degrees of steering angle.

When the aircraft ground speed is more than 40 kts, the available steering angle decreases and this continues in proportion to the increase of the aircraft speed.

The Braking and Steering Control Unit uses the steering inputs from the feedback sensors to calculate the necessary steering angle, the rate of the movement and the direction of the turn.

The Braking and Steering Control Unit sends outputs to the electro-hydraulic components to operate the steering mechanism.

BRAKING AND STEERING CONTROL UNIT (BSCU)

The steering function is controlled by the Braking and Steering Control Unit which controls the steering position via an electrically signalled servovalve in response to electrical signals from the steering angle inputs.

System 1 and 2 have independent power supplies.

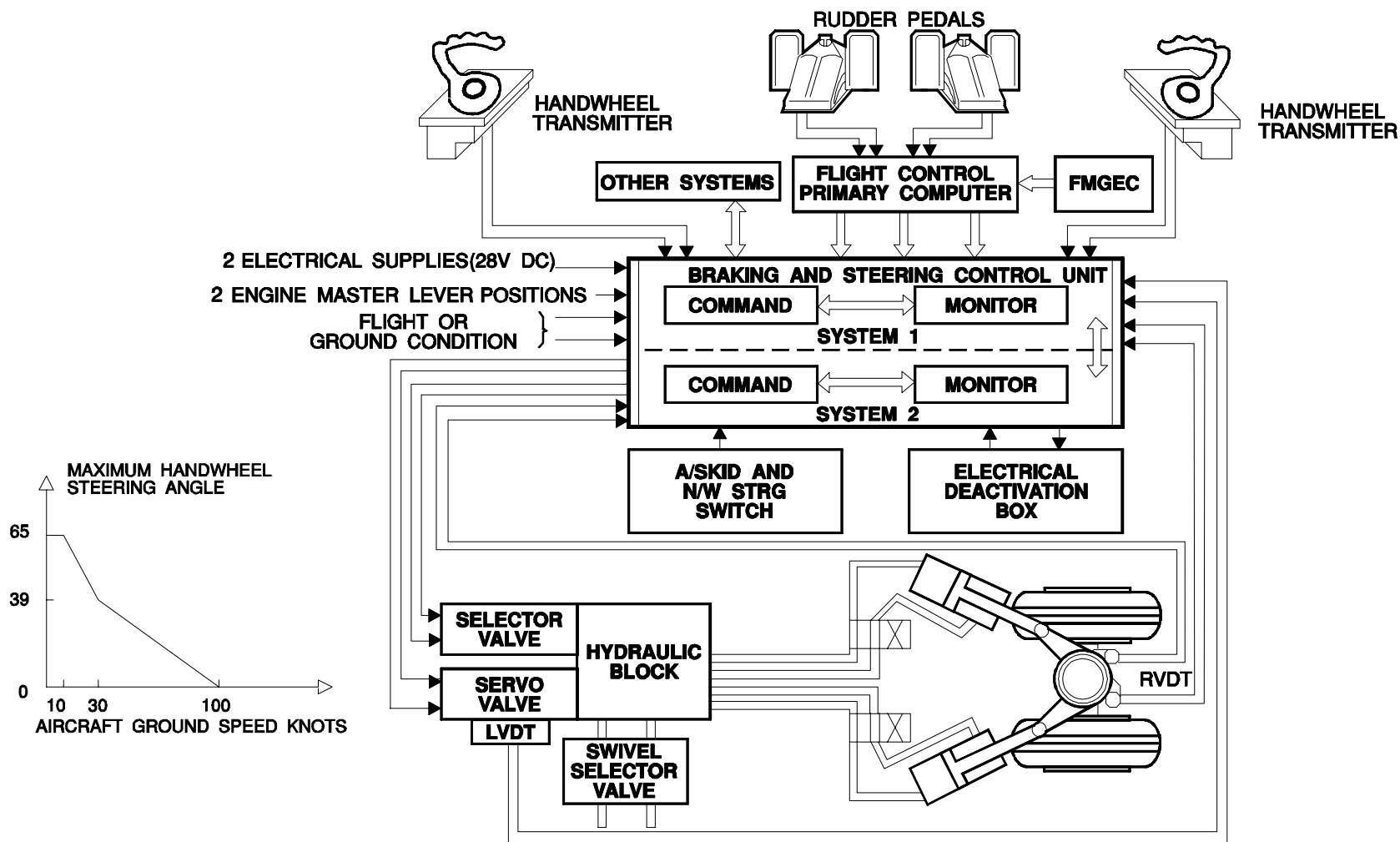
Each system is divided into two channels, a monitoring channel and a command channel.

The command channel calculates and generates the command signals while the monitoring channel checks if the command channel is operating correctly.

If the two systems are supplied simultaneously, system 1 has priority and system 2 is in standby.

In order to maintain maximum steering system availability, the Braking and Steering Control Unit and most of its electrical peripherals are duplicated and segregated into system 1 and system 2.

The two systems switch over automatically at each landing gear extension cycle or in case of sequencing system failure.



FQW4200 GE Metric

HYDRAULIC OPERATION

When all conditions are available, the Green Hydraulic Pressure is applied to the system through the swivel selector valve.

The swivel selector valve isolates the green hydraulic pressure from the system and connects it to the green return lines, when the nose landing gear is retracted.

Pressure is sent to the shut-off valve through the check valve.

The check valve helps the pressure maintaining valve to keep a pressure in the system when the hydraulic power is not available.

The Braking and Steering Control Unit energizes the selector valve which releases the control pressure at the shut-off valve.

When the selector valve is de-energized, the control pressure is held at the shut-off valve and the supply line is connected to return.

When the shut-off valve opens, a control pressure goes through to the bypass valve, that operates to isolate the steering actuator service lines from each other.

The servovalve supplies the hydraulic pressure to the steering actuator in proportion to an electrical signal from the Braking and Steering Control Unit. This valve includes two coils, a jet pipe and a spool.

A Linear Variable Differential Transducer (LVDT) sends the data to the monitor channel of the BSCU providing the correct position of the servovalve.

The supply pressure is routed to the correct end of each steering actuator through the refilling valve, an anti-shimmy valve and the rotating selector valves.

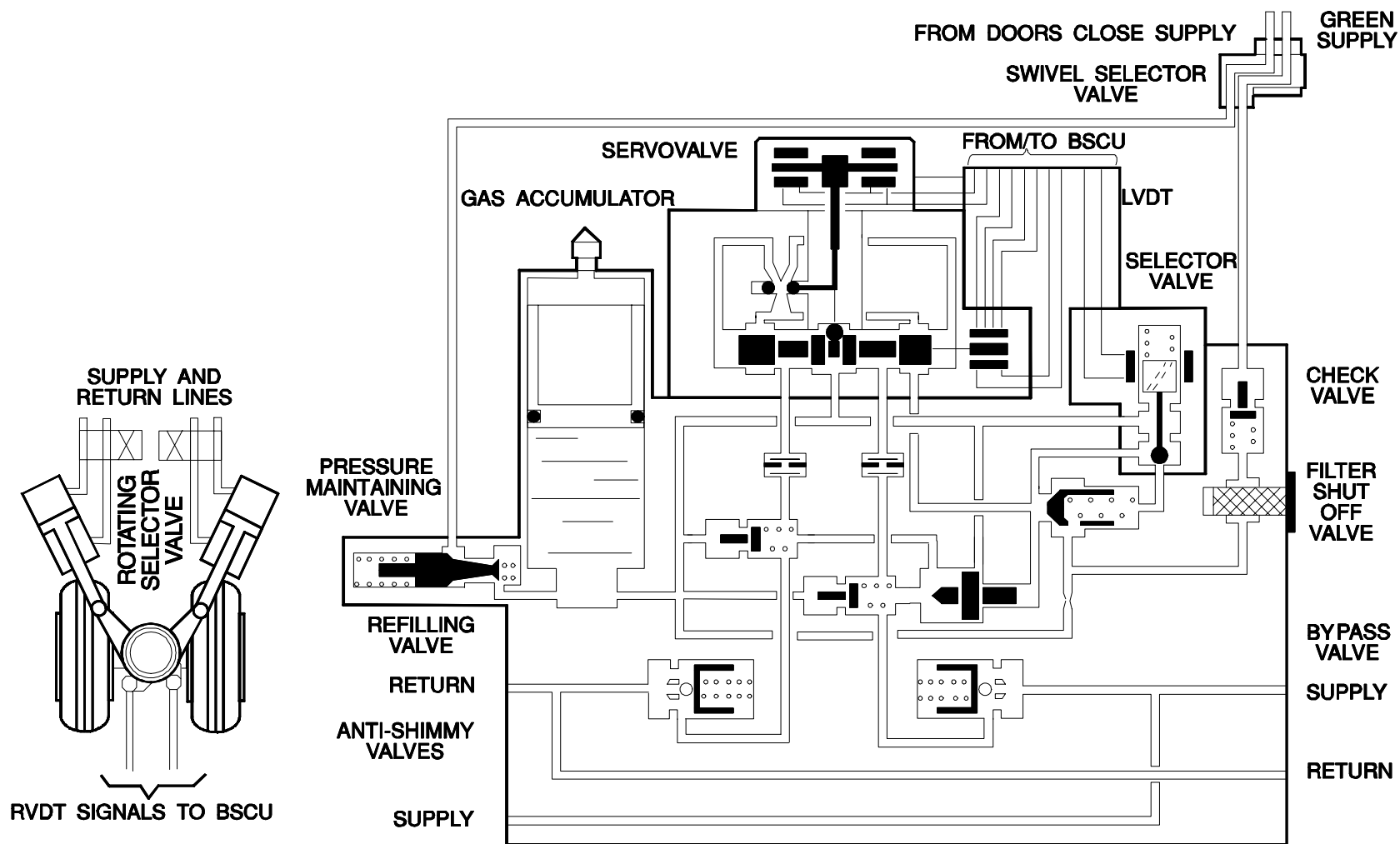
The refilling valve prevents cavitation of the steering actuator.

The anti-shimmy valve controls the flow of Hydraulic Fluid through each line and modulates the return flow.

The mechanically controlled rotating selector valves connect two service lines to their related steering actuator. Each service line is used either as a supply or return line, or is connected to the full bore or annulus end of the actuator as necessary.

The configuration of the valve changes when the nose wheel moves past a certain angle. Thus the service lines are always connected to the correct end of the actuator.

The Rotary Variable Differential Transducer (RVDT) monitors the correct angular position of the nose wheels and sends data to the command and monitor channels of the Braking and Steering Control Unit.



FQW4200 GE Metric

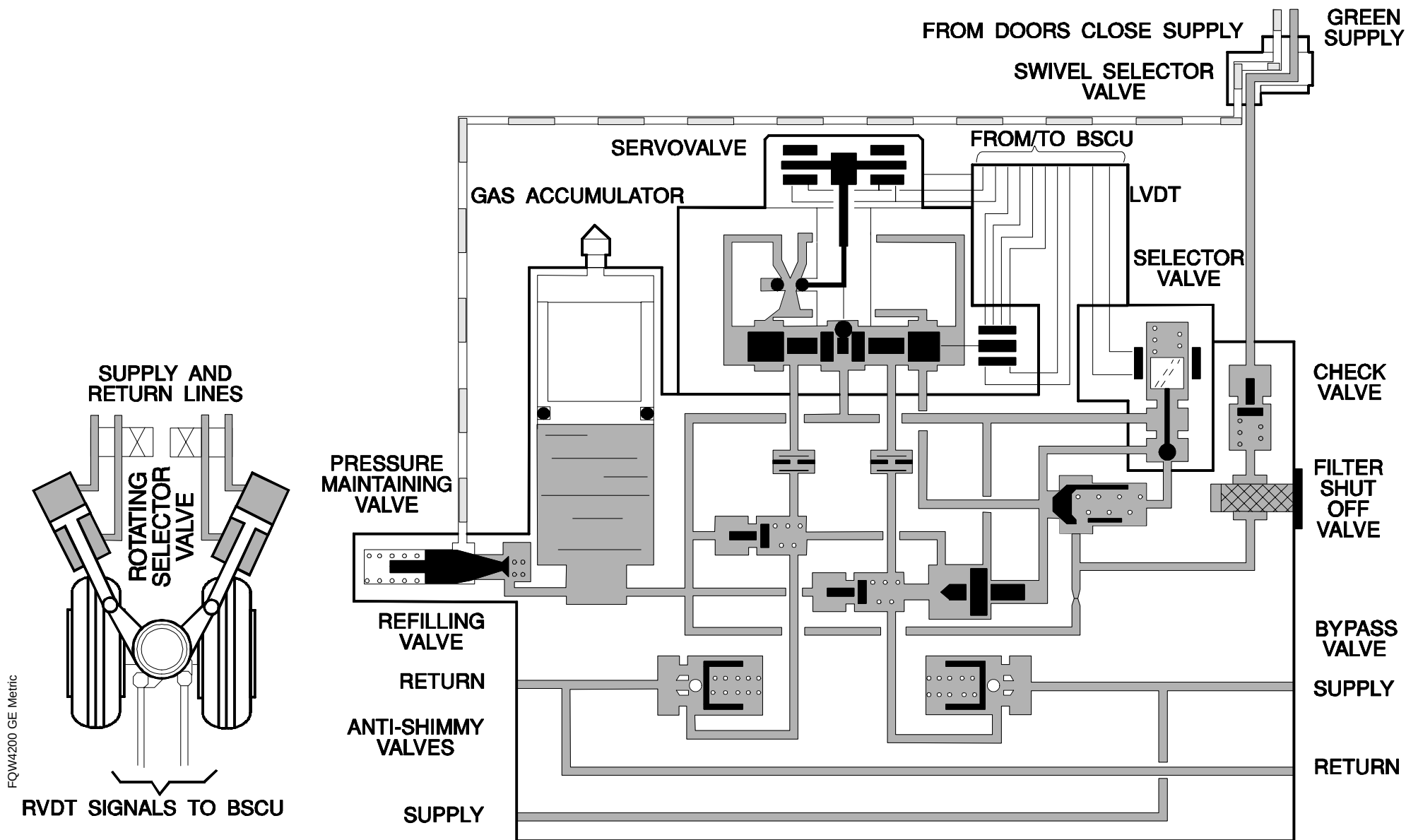
CASTORING MODE

When the anti-skid and nose wheel steering switch is set to OFF or specific BSCU failure has occurred, the steering mechanism can castor.

During castoring the hydraulic fluid in the actuators can move from one actuator to the other through the anti-shimmy and bypass valves. The valves operate to power the steering mode and to reduce the pressure.

The same pressure from the gas accumulator is sent to each side of both actuators through the hydraulic block.

The function of the accumulator is to prevent cavitation in the actuator chamber when green hydraulic pressure is lost.



FQW4200 GE Metric

STUDENT NOTES:

NOSE WHEEL STEERING ECAM PAGE PRESENTATION

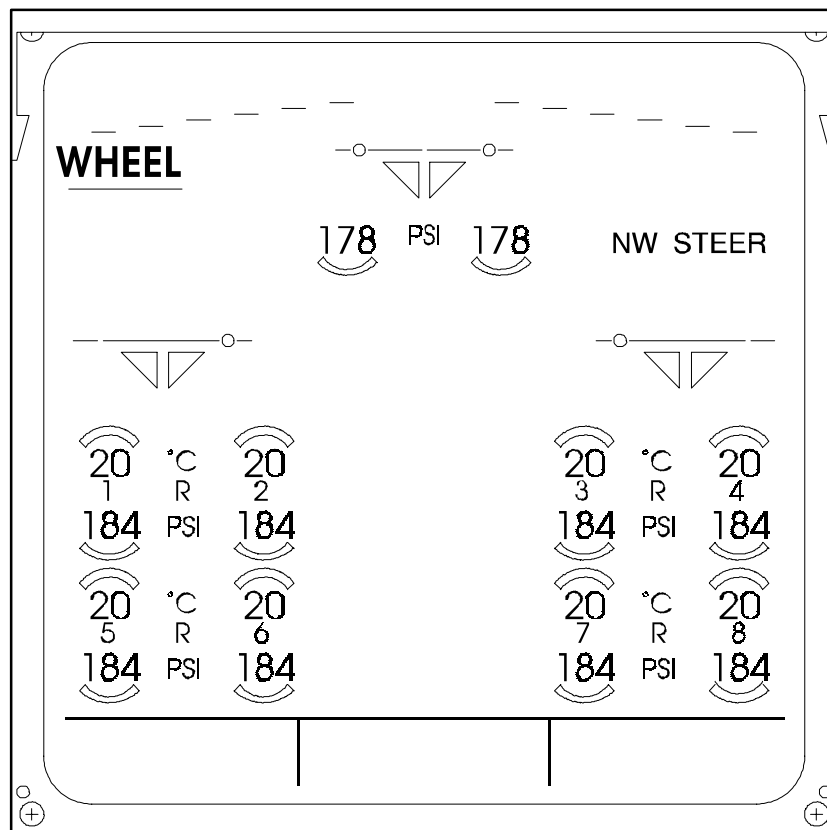
Nose Wheel Steering

NOSE WHEEL STEERING

Nose wheel steering indication appears if nose wheel steering is inoperative.



NW STEER appears amber associated with an ECAM caution in case of nose wheel steering failure detected by the BSCU (and during ground towing or when A/SKID and N/W STRG switch is OFF).



These indications are displayed on the WHEEL ECAM page only if the TPIS option is installed.

STUDENT NOTES

FQW4200 GE Metric

NOSE WHEEL STEERING WARNINGS

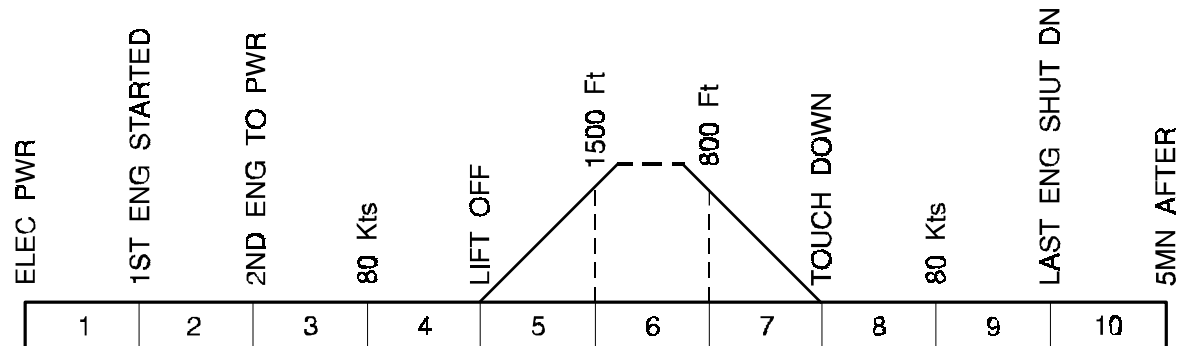
NW Steer Fault

N.W .STEER FAULT

Note the "NW STEER" amber message on the ECAM display. This caution is triggered when a nose wheel steering fault is detected by the Braking and Steering Control Unit (BSCU).

On ground, you should stop the aircraft, then recycle the nose wheel steering.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
NW STEER FAULT detected by BSCU	SINGLE CHIME	MASTER CAUT	WHEEL	NIL	3, 4, 5, 8

FQW4200 GE Metric

STUDENT NOTES

NOSE WHEEL STEERING COMPONENTS

Electrical box
Oversteer Warning Electric Box
Proximity Sensors

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is :

- hydraulic system depressurized
- ground lock pins and safety sleeves are in place
- wheel chocks are in place
- landing gear control lever is in "DOWN" position and locked
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

ELECTRICAL BOX

FIN : 5GC

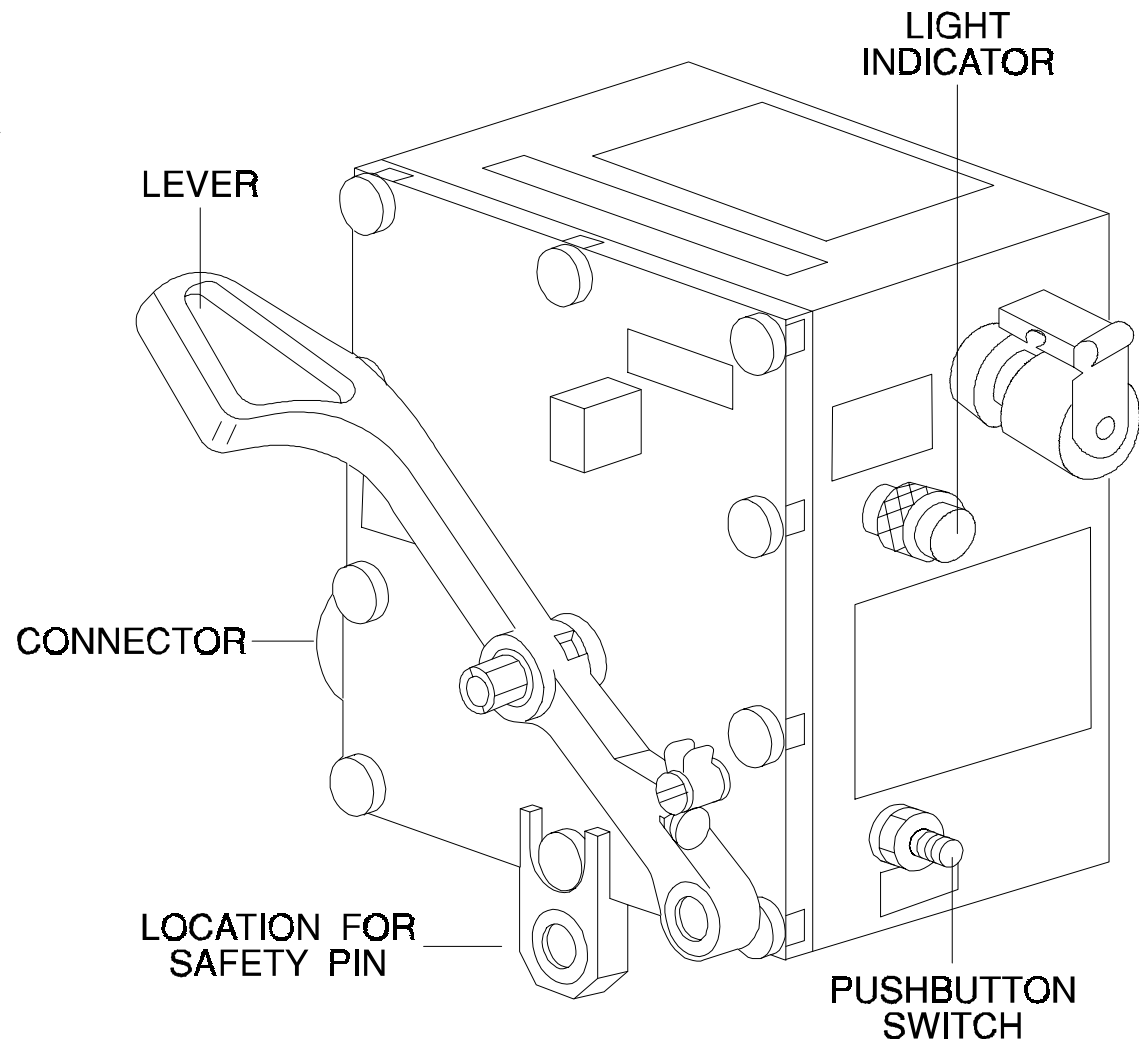
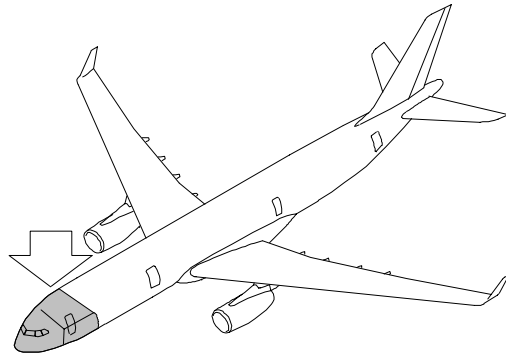
ZONE : 711

COMPONENT DESCRIPTION

The electrical de-activation box is located on the nose landing gear leg. It provides a by pass of the nose wheel steering system. The lever is normally in the steering position. When the lever is moved and pinned to the towing position, a switch closes and isolates the steering control. The light indicates when the parking brake is in the "ON" position.

DE-ACTIVATION

The pushbutton allows to test the indicator light. When the lever on the side of the electrical box is moved against the spring and safety pinned in the towing position, all electrical steering commands are isolated. The nose gear can be towed.



OVERSTEER WARNING ELECTRIC BOX

FIN : 8GH

ZONE : 711

COMPONENT DESCRIPTION

The electric box is an enclosure of the NLG steering angle protection system. It is installed on the NLG. It acts as an interface between the aircraft and tractor power supplies. It includes a press-to-test pushbutton switch for its warning light. The NLG steering angle protection system is energized from one of these sources :

- the aircraft busbars 105PP (BUS1) and 701PP (HOT BUS)
- the towing tractor.

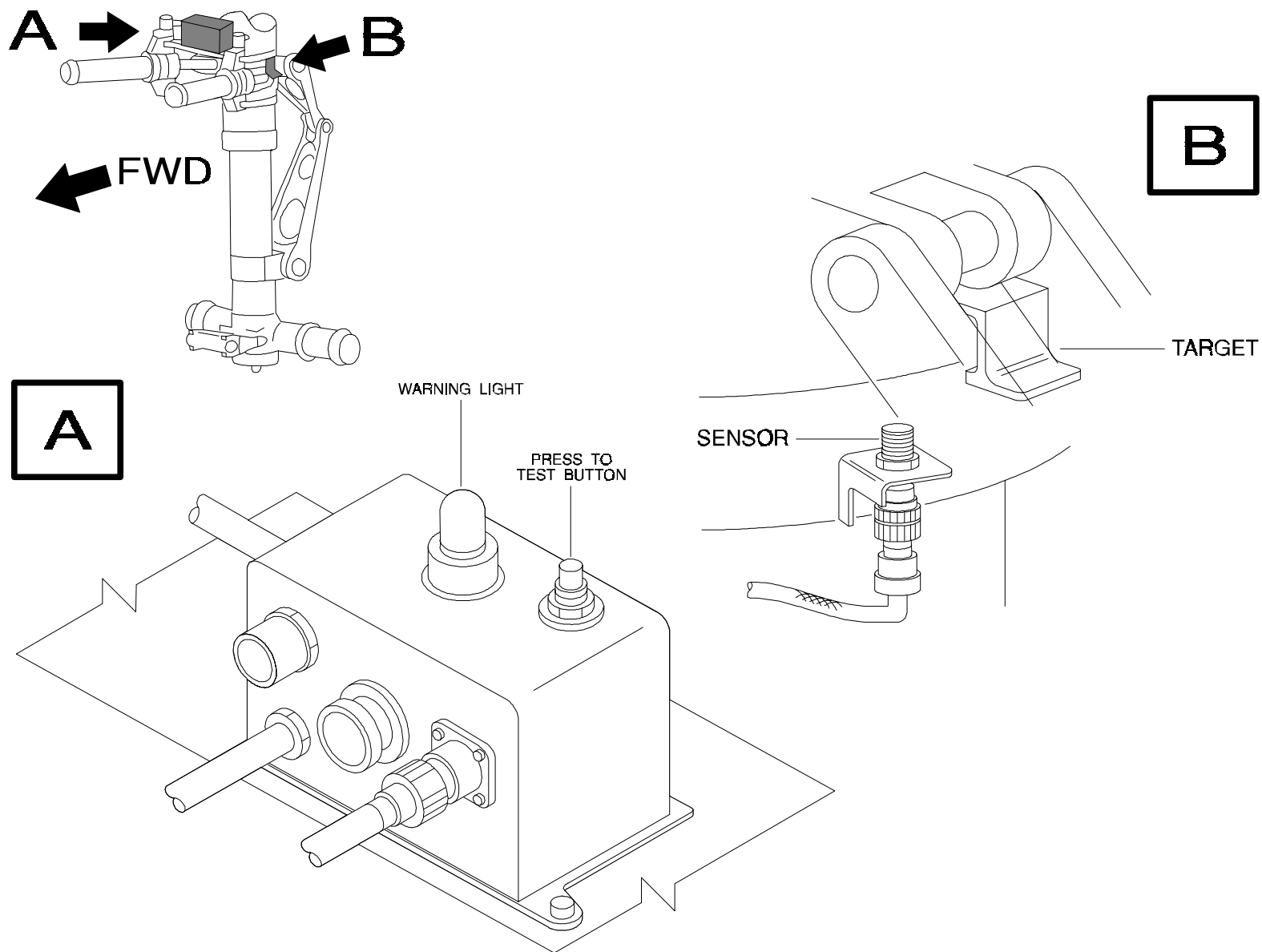
PROXIMITY SENSORS

FIN : 1GH-2GH

ZONE : 711

COMPONENT DESCRIPTION

The two hermetically sealed proximity sensors are installed on each side of the NLG which operate with a single target. The target is installed on the lug of the upper torque link. As the NLG turns, the target moves closer to the left or the right proximity sensors which stay in the same position. The sensors operate when the active surface detects a target within given distances.



FQW4200 GE Metric

STUDENT NOTES

NOSE WHEEL STEERING COMPONENTS

Nose Wheel Steering Handwheel Transmitter
Swivel Selector Valve
Rotating Selector Valve
Feedback Sensor
Nose Wheel Steering Actuator
Hydraulic Block
Gearbox
Servo Valve

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken , that is:

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked,
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

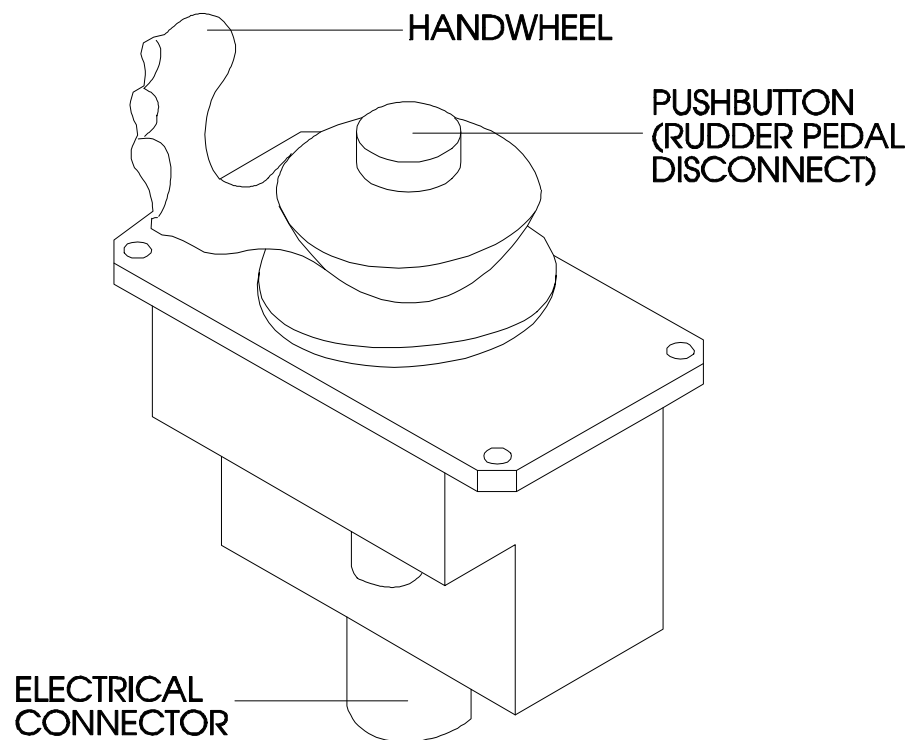
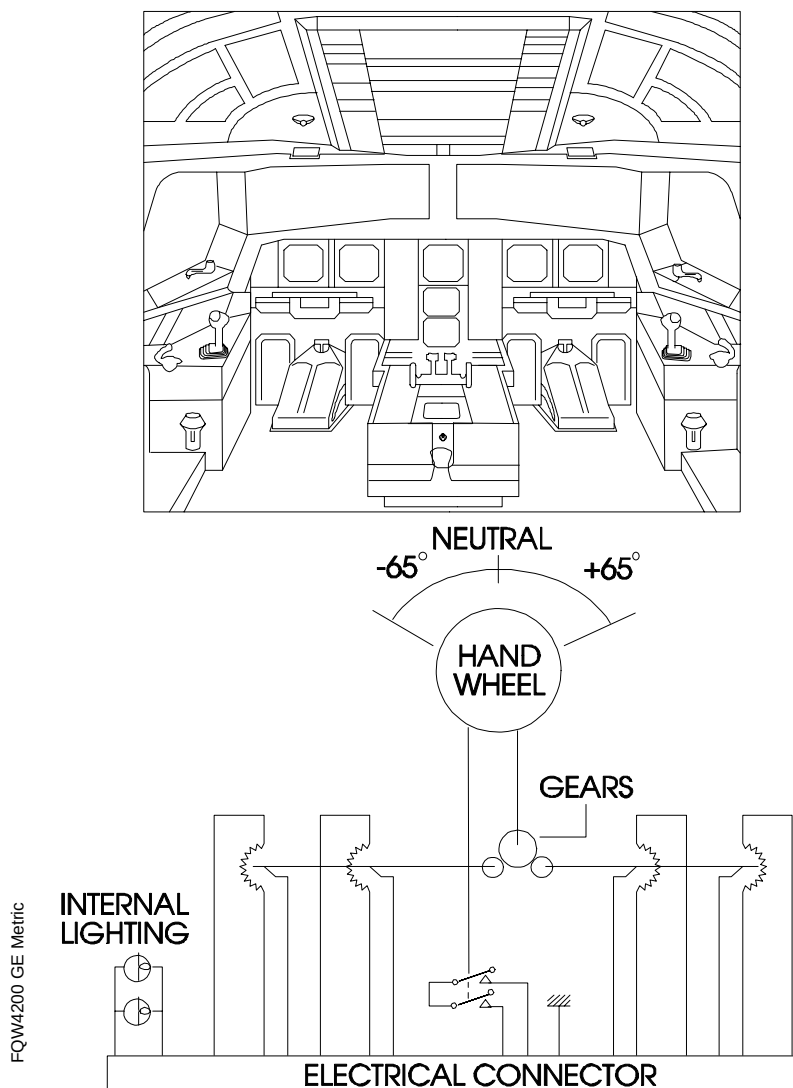
NOSE WHEEL STEERING HANDWHEEL TRANSMITTER

FIN : 1GC - 2GC

ZONE : 211 - 212

COMPONENT DESCRIPTION

Handwheels are connected by a gear to two pairs of potentiometers. Movement of the handwheels is transmitted through gears to the potentiometers which signal the control data to the BSCU. Two potentiometers are used for the control channels and two are used for the monitor channels in the BSCU.



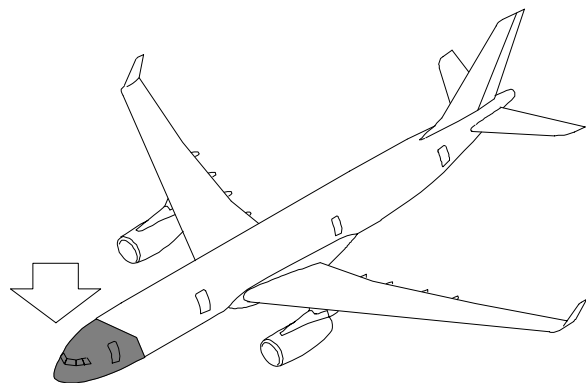
SWIVEL SELECTOR VALVE

FIN : 5100GC

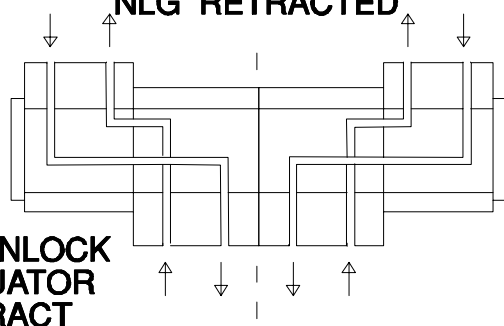
ZONE : 711

COMPONENT DESCRIPTION

When the NLG rotates during retraction, the swivel selector valve moves to close the pressure and the return ports and isolates the nose wheel steering system. When the the NLG extends and locks in the down position, the swivel valve aligns the nose wheel steering to the green hydraulic system.

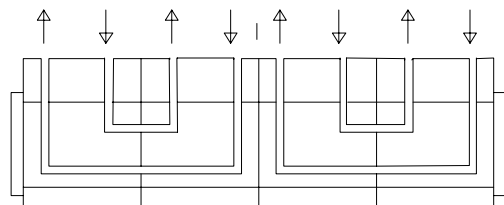


NLG RETRACTED

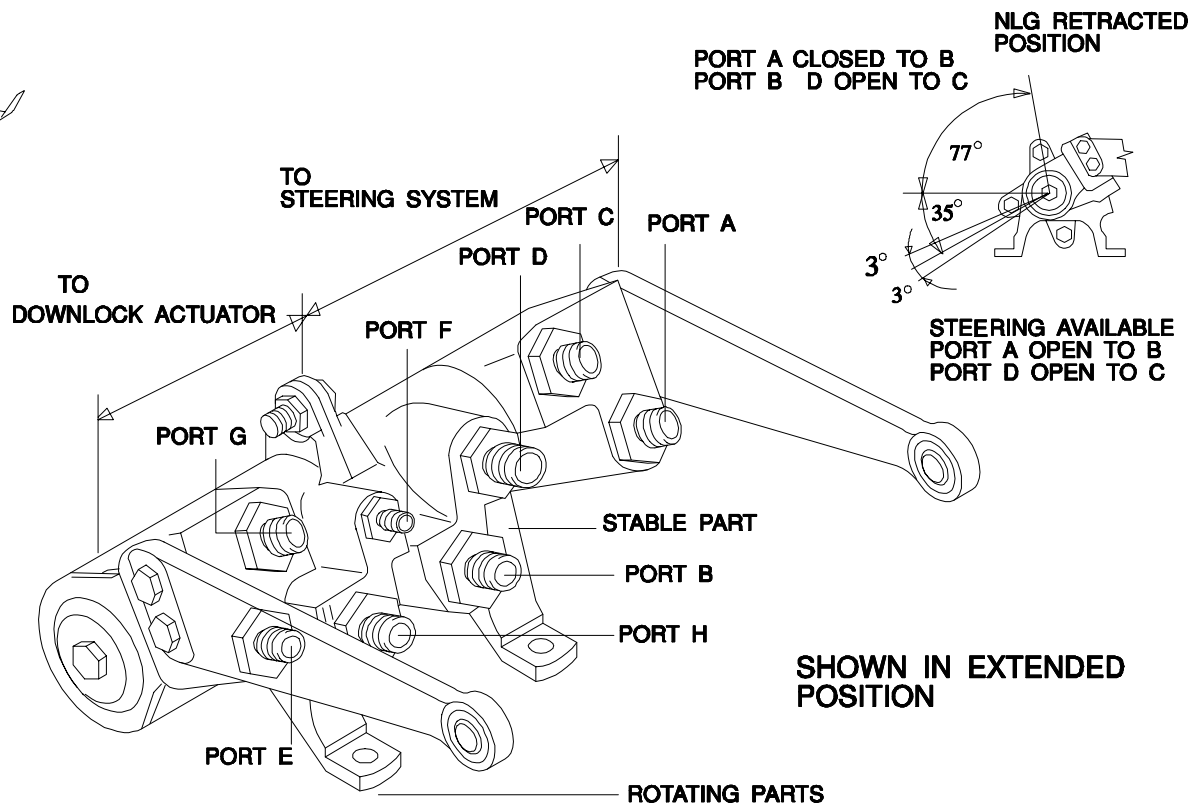


**DOWNLOCK ACTUATOR
RETRACT**

NLG EXTENDED



**DOWNLOCK ACTUATOR STEERING AVAILABLE
EXTENDED**



FQW4200 GE Metric

ROTATING SELECTOR VALVE

FIN : 5108GC - 5109GC

ZONE : 711

COMPONENT DESCRIPTION

It is located on the forward face of the Nose Landing Gear and attached to the steering collar. Its function is to supply the hydraulic pressure to the correct end of the steering actuator during steering operations.

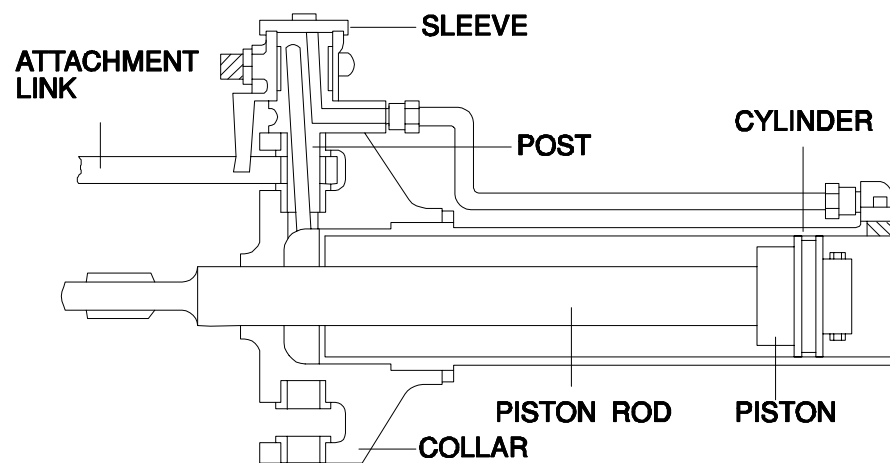
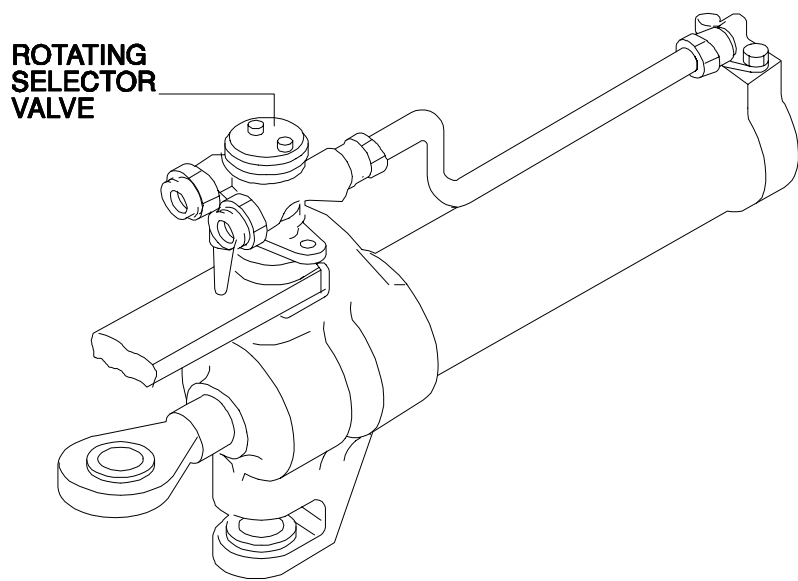
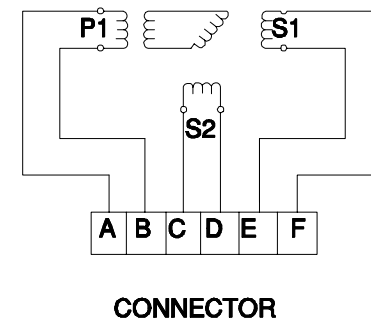
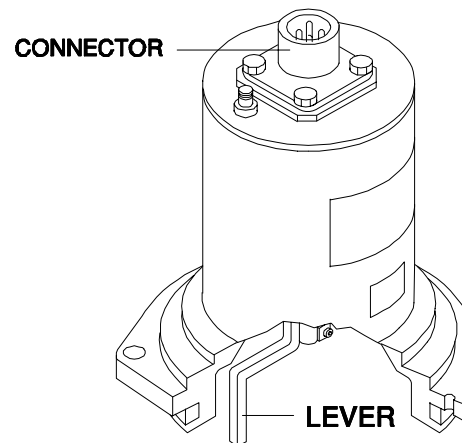
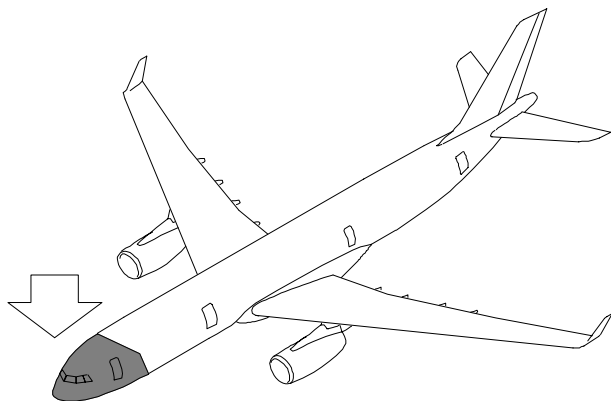
FEEDBACK SENSOR

FIN : 3GC - 4GC

ZONE : 711

COMPONENT DESCRIPTION

These two Rotary Variable Differential Transducers (RVDT) monitor the steering angle of the nose wheels. One sensor sends the output to the command channel, the second sensor sends its output to the monitor channel of the BSCU.



FQW4200 GE Metric

NOSE WHEEL STEERING ACTUATOR

FIN : 5106GC - 5107GC

ZONE : 711

COMPONENT DESCRIPTION

The two actuators are attached by a collar to the Nose Landing Gear. The actuators, when pressurized and signalled to move, start to turn the sliding inner tube of the nose gear through the steering collar. The hydraulic block controls the supply of the green system pressure for this operation.

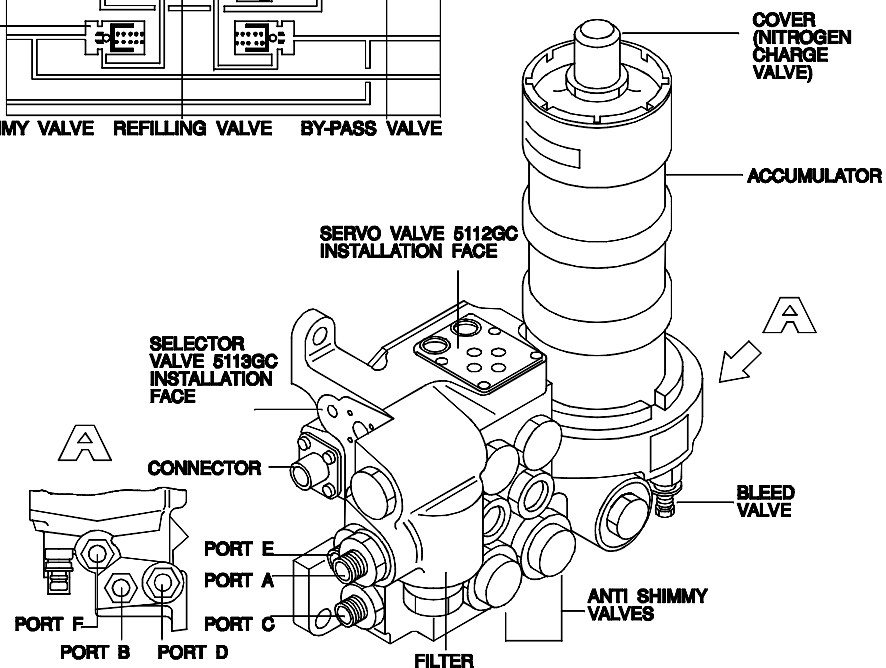
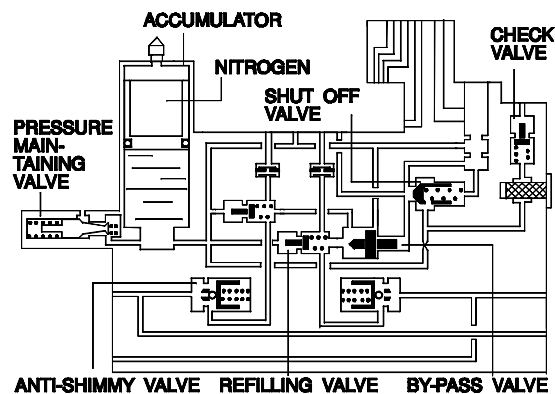
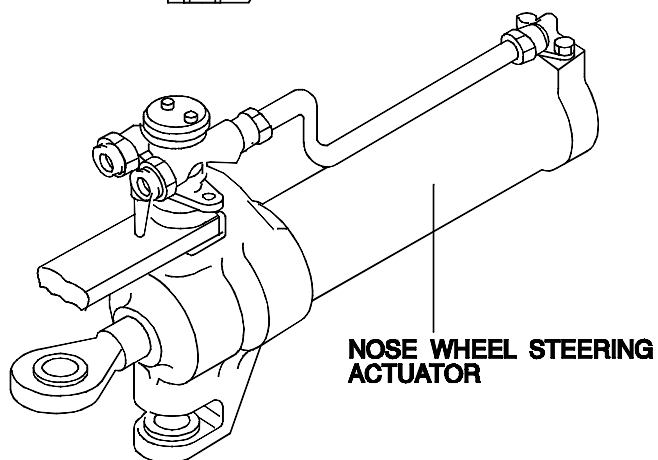
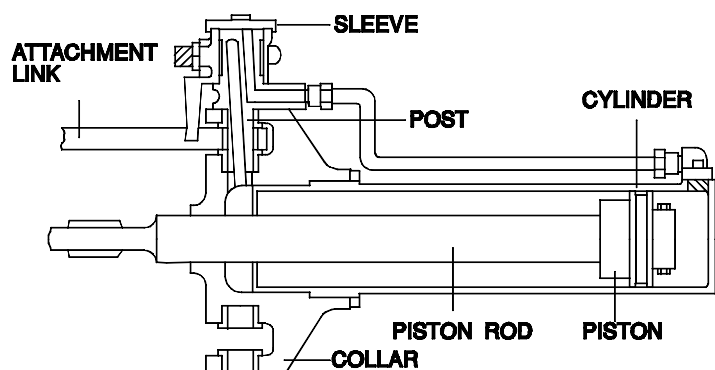
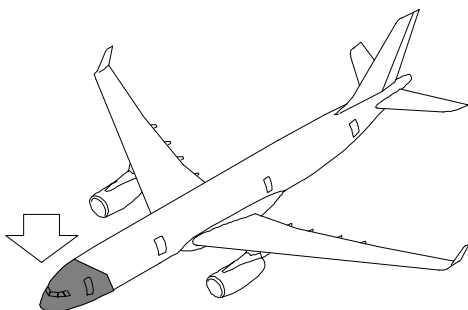
HYDRAULIC BLOCK

FIN : 6GC

ZONE : 711

COMPONENT DESCRIPTION

It is located on the nose gear strut. It controls the supply of the hydraulic pressure and the return from the steering actuators. It provides a mounting for the Nose Wheel Steering components.



GEARBOX

FIN : 5104GC - 5105GC

ZONE : 711

COMPONENT DESCRIPTION

Two gearboxes provide the interfaces between the feedback sensors (RVDT) and the Nose Landing Gear. The gearbox engages with the gear teeth inside the top of the sliding inner tube of the Nose Gear.

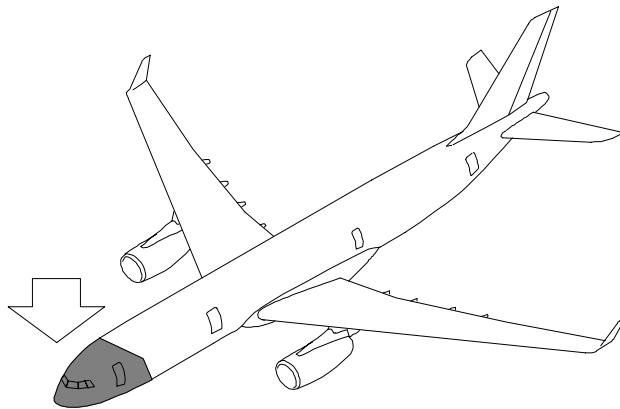
SERVO VALVE

FIN : 5112GC

ZONE : 711

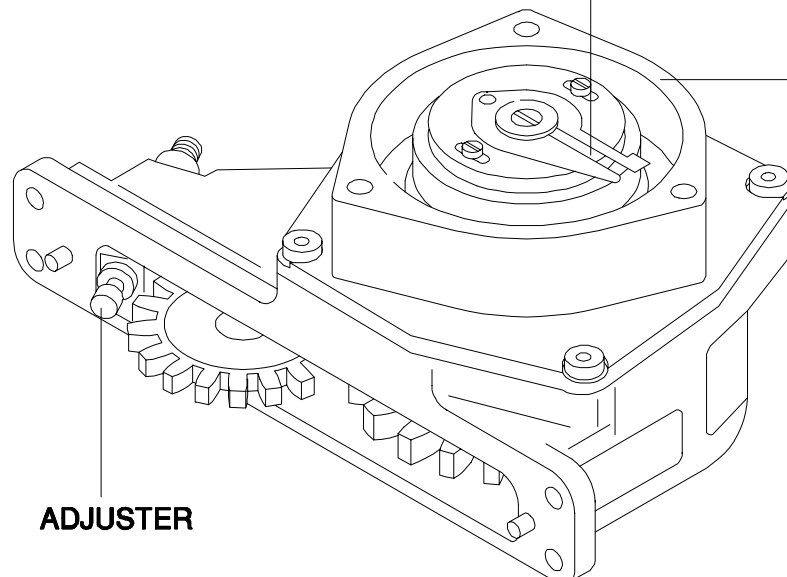
COMPONENT DESCRIPTION

It is an electro-hydraulic valve that supplies hydraulic pressure to the steering actuators in proportion to the electrical input. The servo valve includes a linear variable differential transducer (LVDT) for valve position feedback to the BSCU.



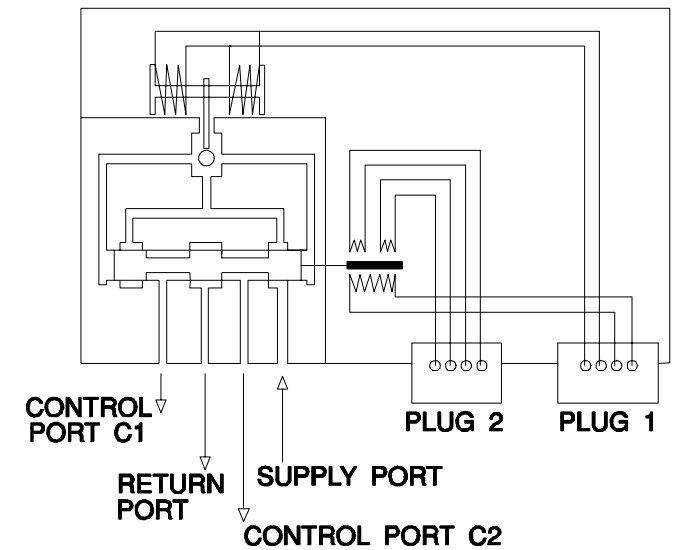
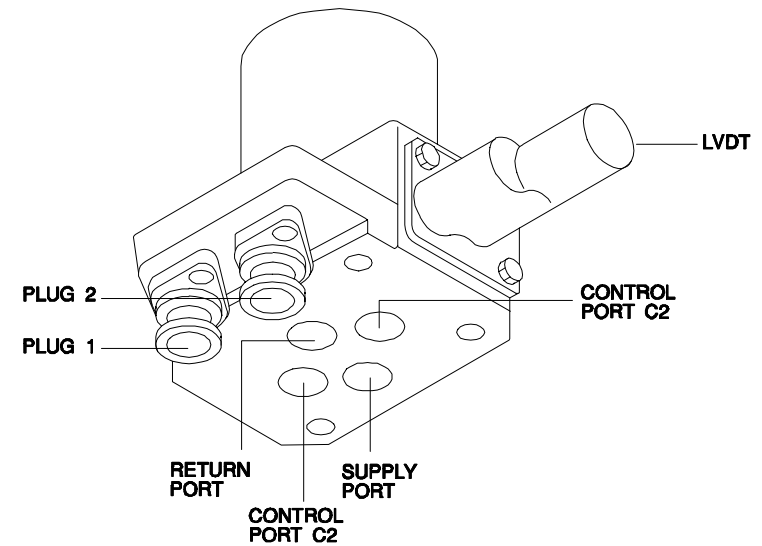
SLOT FOR PIN OF RVDT

FEEDBACK
SENSOR (RVDT)
ATTACHMENT
FACE



ADJUSTER

FQW4200 GE Metric



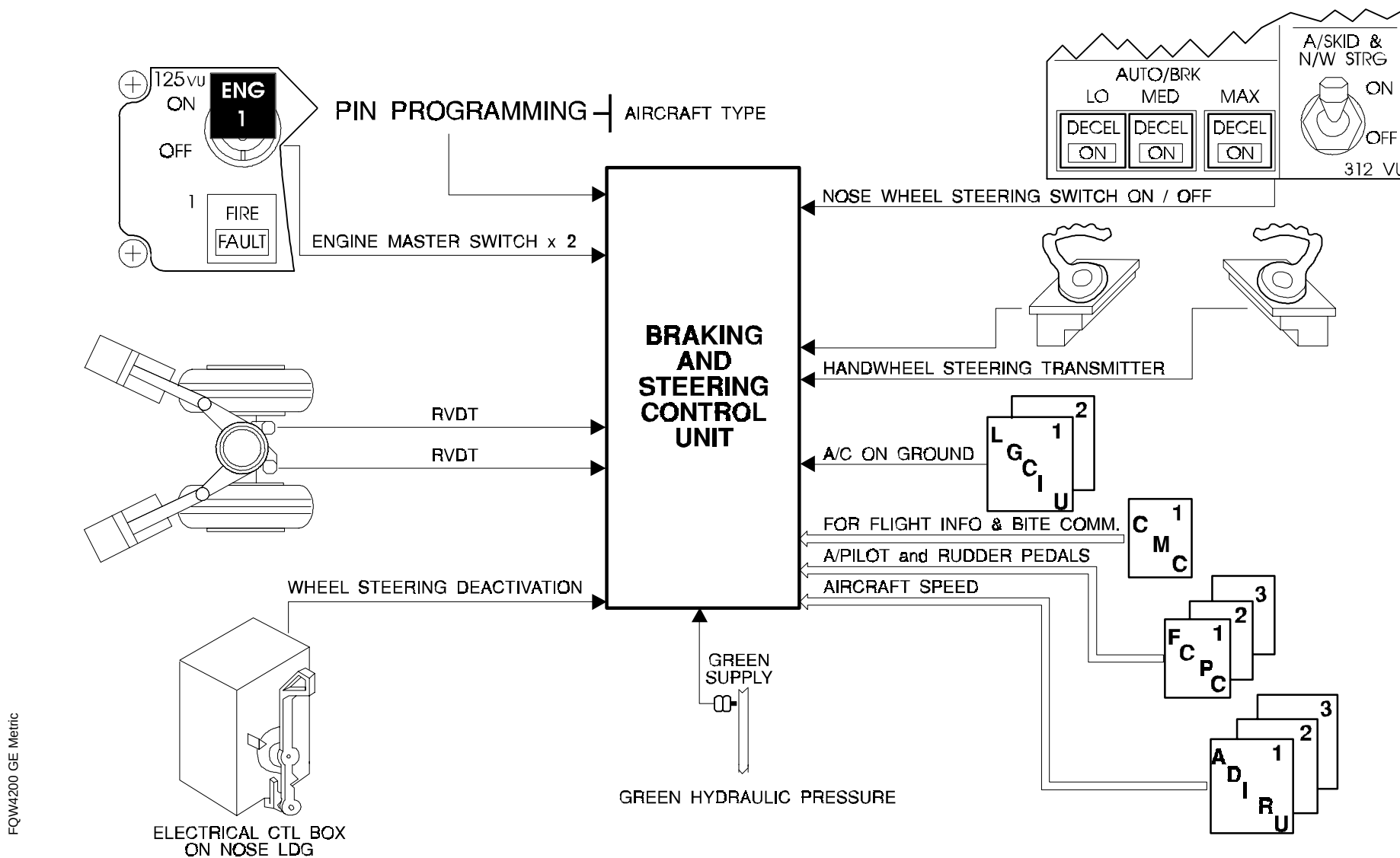
STUDENT NOTES

BRAKING AND STEERING CONTROL UNIT (BSCU) INTERFACES

Inputs
Outputs

INPUTS

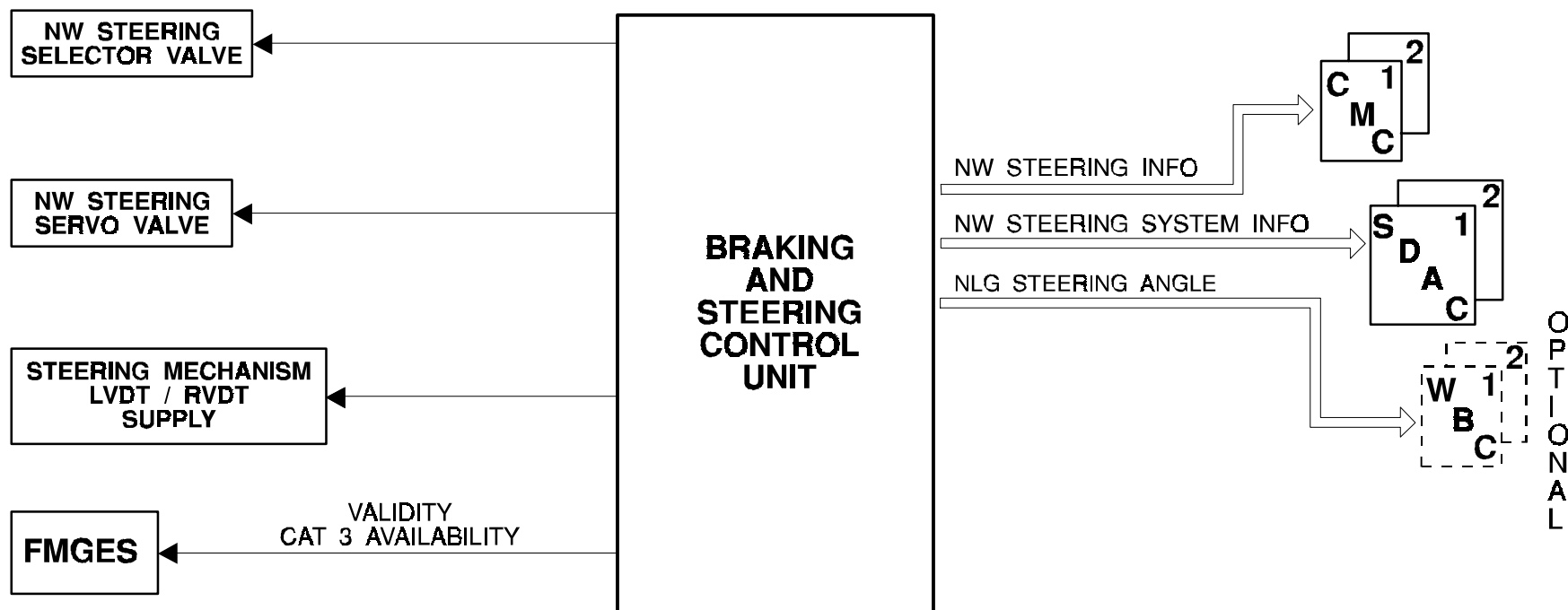
The Braking and Steering Control Unit receives different signals for the Nose Wheel Steering System Control.
These signals are in discrete, analog or ARINC form.



FQW4200 GE Metric

OUTPUTS

The Braking and Steering Control Unit sends different signals to the Nose Wheel Steering System and other Aircraft Systems.
These signals are in discrete, analog or ARINC form.



FQW4200 GE Metric

STUDENT NOTES

TIRE PRESSURE INDICATING SYSTEM PRESENTATION

Function
Description

FQW4200 GE Metric

FUNCTION

The function of the Tire Pressure Indicating System (TPIS) is to supply :

- pressure information, for each tire, to be displayed on the ECAM, and warnings when pressure in one or more tires does not agree with the specified pressure.

The warning functions of the system are as follows :

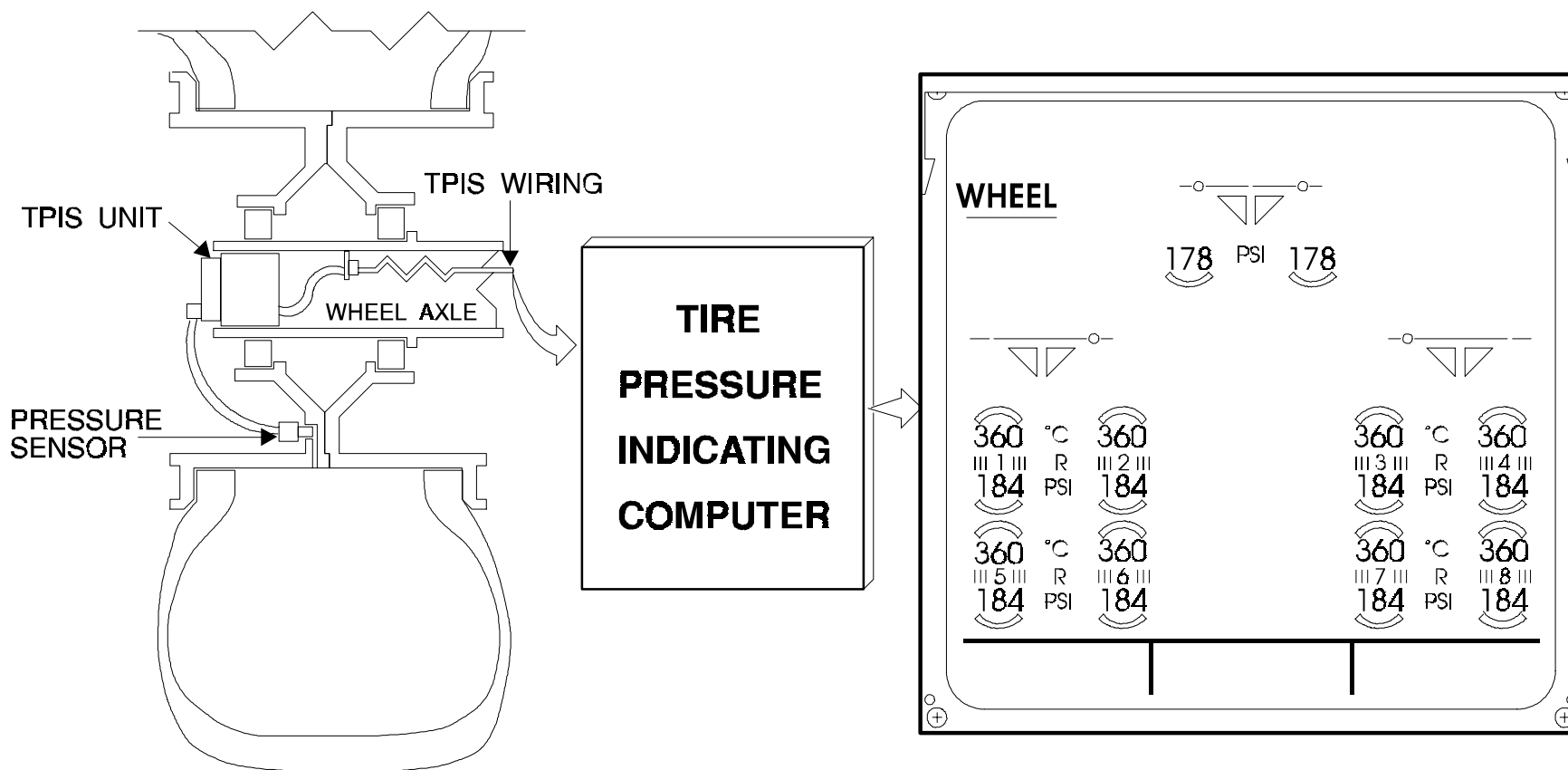
- It shows that the absolute pressure of any tire is lower than a given value.
- It tells the flight crew when the pressure difference between 2 tires installed on the same wheel axle is above a given value.
- The indication becomes amber in case of abnormal pressure.

DESCRIPTION

The Tire Pressure Indicating System has a sensor and a transmitter for each wheel, and includes a computer : the Tire Pressure Indicating Computer (TPIC).

The system includes :

- A sensor which measures the pressure of each tire.
- A transmission unit which transmits the electrical pressure signal from the wheel to the wheel axle. It includes a rotating transformer and an integrated electronic module.
- A computer : TPIC (Tire Pressure Indicating Computer).



FQW4200 GE Metric

STUDENT NOTES:

FQW4200 GE Metric

TIRE PRESSURE INDICATING WARNINGS

Tire Pressure Indicating System Fault

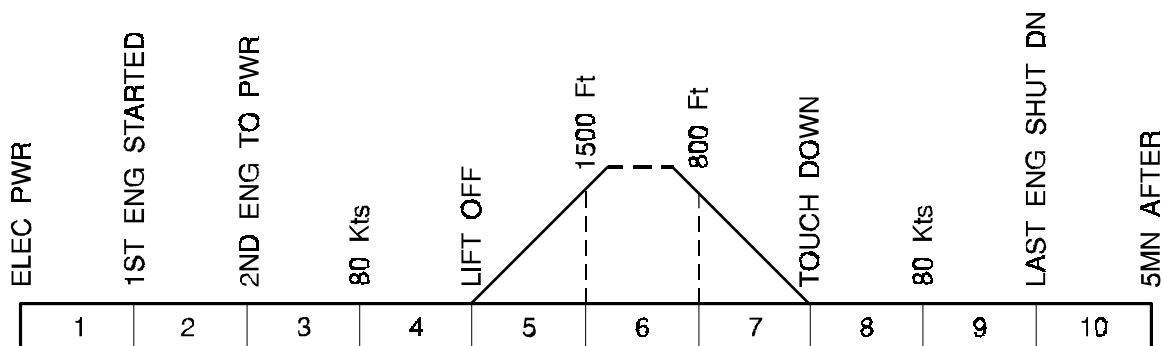
TIRE PRESSURE INDICATING SYSTEM FAULT

Note the "173" amber symbol on the ECAM page.

This caution is triggered when :

- One tire pressure is lower than the specified percentage of the maximal pressure
- or
- The difference of pressure between two wheels on the same axle is too high.

WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
TIRE LO PR One tire pressure is lower than : 74% of nominal pressure from lift off to the engines shut down 89% of nominal pressure in other cases or difference of pressure between two wheels on the same axle is higher than: 21% of nominal pressure from lift off to engines shut down 15% of nominal pressure in the other cases.	SINGLE CHIME	MASTER CAUT	WHEEL	NIL	4, 5, 8

STUDENT NOTES

FQW4200 GE Metric

TIRE PRESSURE INDICATING SYSTEM COMPONENTS

Tire Pressure Indicating System Sensor
Tire Pressure Indicating System Transmitter
Tire Pressure Indicating Computer

SAFETY PRECAUTIONS

Before working in the Landing Gear area, make sure that all safety measures have been taken, that is :

- hydraulic system depressurized,
- ground lock pins and safety sleeves are in place,
- wheel chocks are in place,
- landing gear control lever is in "DOWN" position and locked
- free fall extension selector is in "OFF" position and locked.

STUDENT NOTES

TIRE PRESSURE INDICATING SYSTEM SENSOR

FIN	TITLE	ZONE	FIN	TITLE	ZONE
4GV1	NLG(LH)	711	8GV2	MLG(4)	741
4VG2	NLG(RH)	711	10GV1	MLG(5)	731
6GV1	MLG(1)	731	10GV2	MLG(7)	741
6GV2	MLG(3)	741	12GV1	MLG(6)	731
8GV1	MLG(2)	731	12GV2	MLG(8)	741

COMPONENT DESCRIPTION

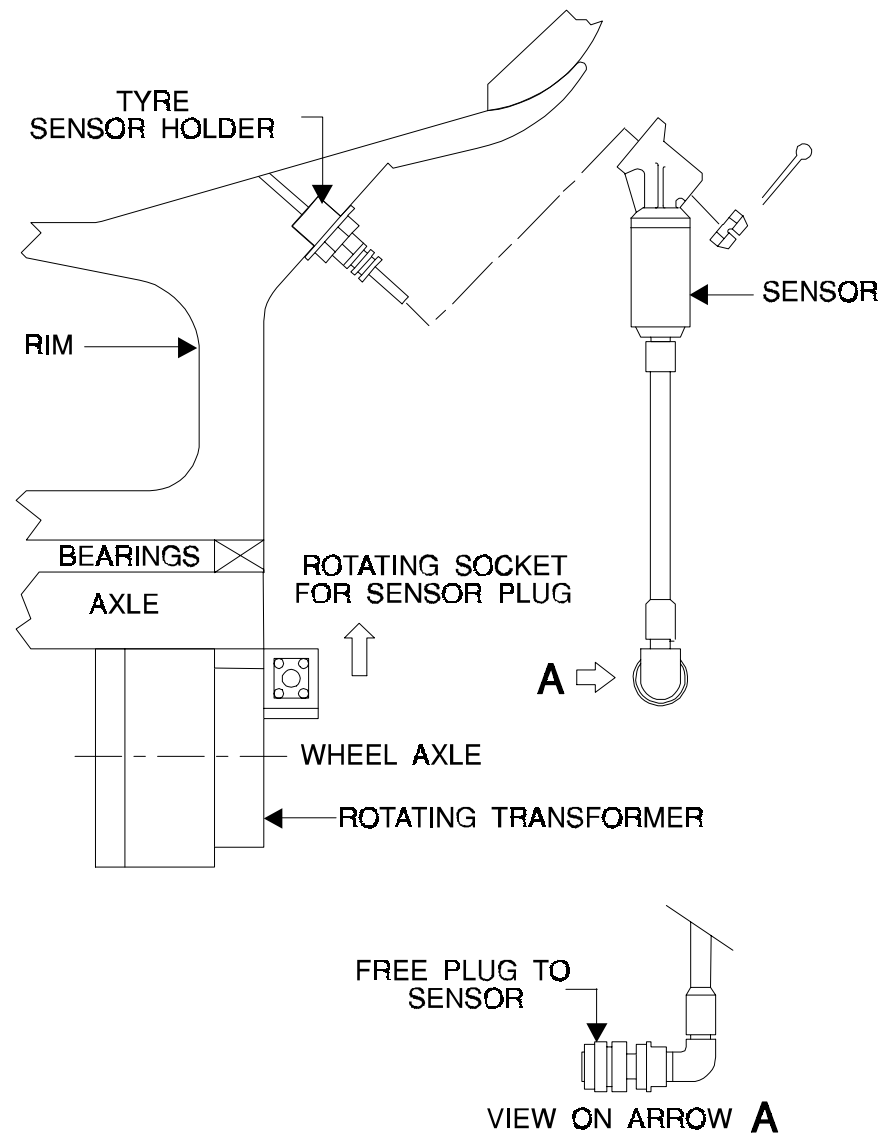
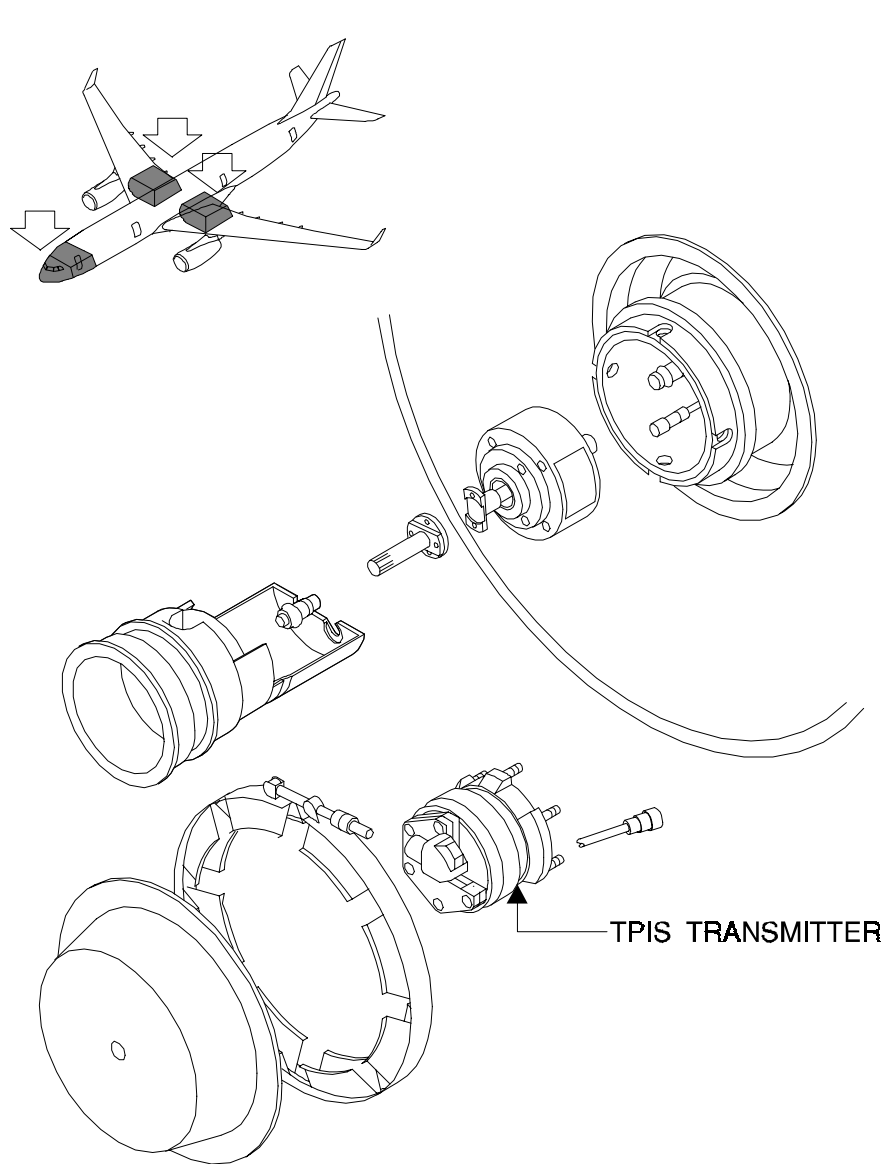
The sensor is contained in a stainless steel housing and is made up of a pressure cell and a miniaturized electronic circuit.
A flying lead and connector are attached to the housing.
The pressure cell is a strain gage type with a piezo-resistive bridge connected to the electronic circuit.
The sensor is located on each wheel and measures the tire pressure and changes the value into a digital signal.

TIRE PRESSURE INDICATING SYSTEM TRANSMITTER

FIN	TITLE	ZONE	FIN	TITLE	ZONE
3GV1	NLG(LH)	711	7GV2	MLG(4)	741
3VG2	NLG(RH)	711	9GV1	MLG(5)	731
5GV1	MLG(1)	731	9GV2	MLG(7)	741
5GV2	MLG(3)	741	11GV1	MLG(6)	731
7GV1	MLG(2)	731	11GV2	MLG(8)	741

COMPONENT DESCRIPTION

The transmitter is made up of a stator and a rotor.
The stator (primary windings) is attached to the carrier in the axle and is electrically connected to the TPIC.
The rotor (secondary windings) turns in the stator and is connected to the sensor flying lead.



FQW4200 GE Metric

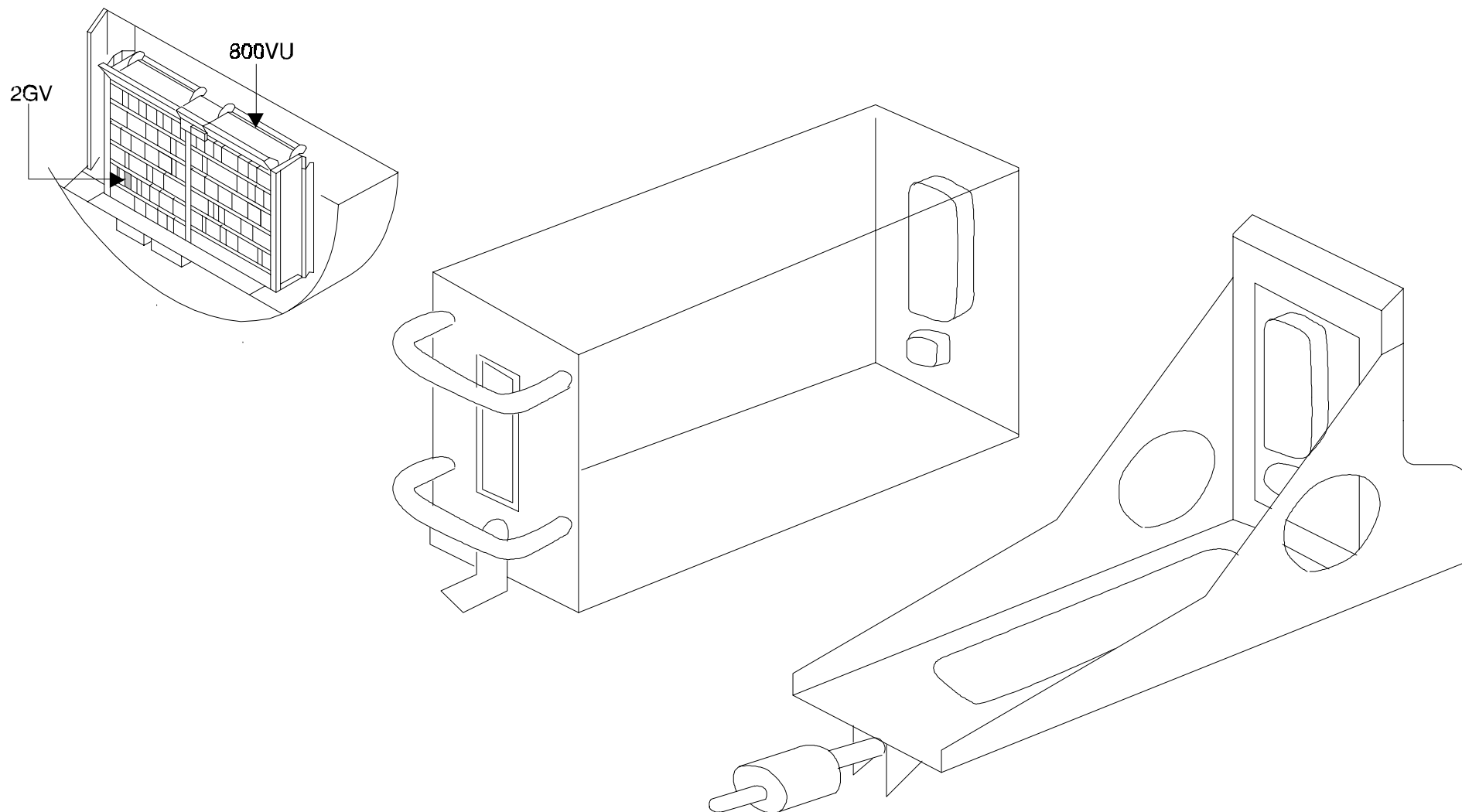
TIRE PRESSURE INDICATING COMPUTER

FIN : 2GV

ZONE : TBD

COMPONENT DESCRIPTION

The TPIC is microprocessor controlled with an ARINC 600 connector.
It has an OBRM attached to the front casing.
The OBRM contains the program (in erasable programmed read only memory) that controls the operation of the TPIC.
The OBRM also contains 16 sets of pressure data.
The computer is supplied with 28V DC and is located on rack 800 VU in the avionics compartment.



FQW4200 GE Metric

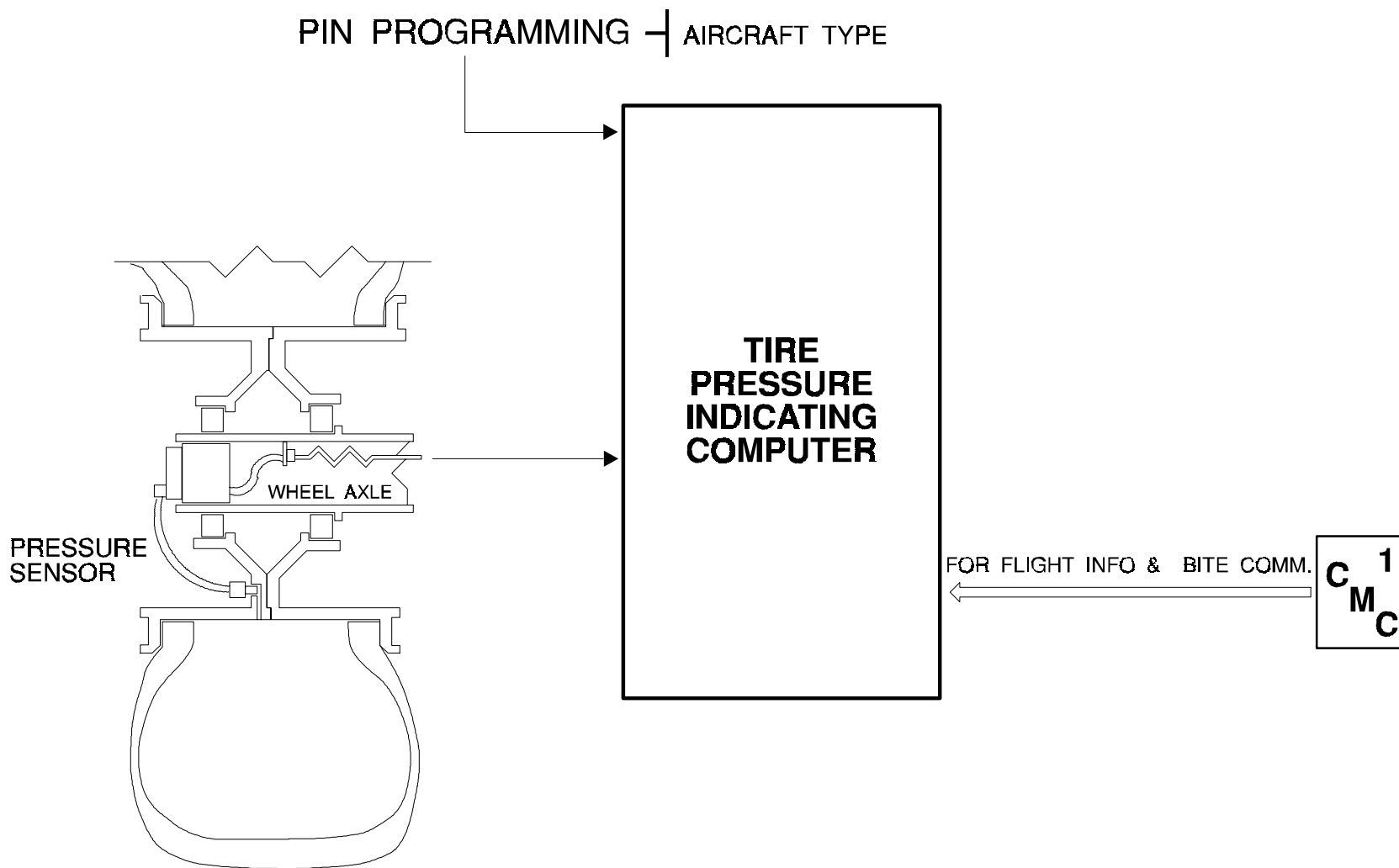
STUDENT NOTES

TIRE PRESSURE INDICATING SYSTEM INTERFACES

Inputs
Outputs

INPUTS

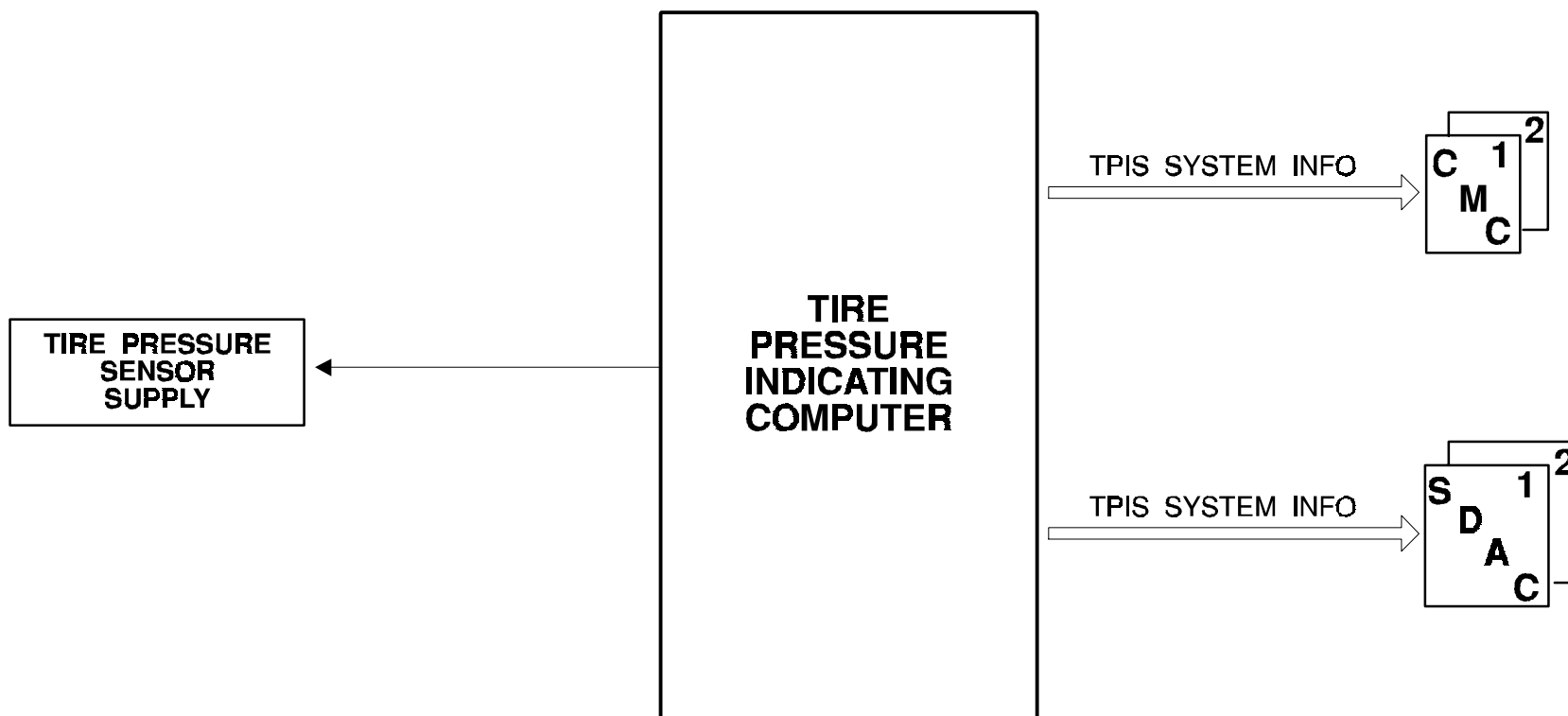
The Tire Pressure Indicating Computer receives different signals in discrete, analog or ARINC form.



FQW4200 GE Metric

OUTPUTS

The Tire Pressure Indicating Computer produces ARINC signals to provide indications, warnings and maintenance information.
An analog signal is produced to supply the sensor.



FQW4200 GE Metric

STUDENT NOTES

FQW4200 GE Metric

SPECIFIC CMS PAGE PRESENTATION

Steering
Tyre press (optional)
Extn/Retrn
Braking

STEERING

Selecting STEERING enables access to the BRAKING and STEERING main menu.

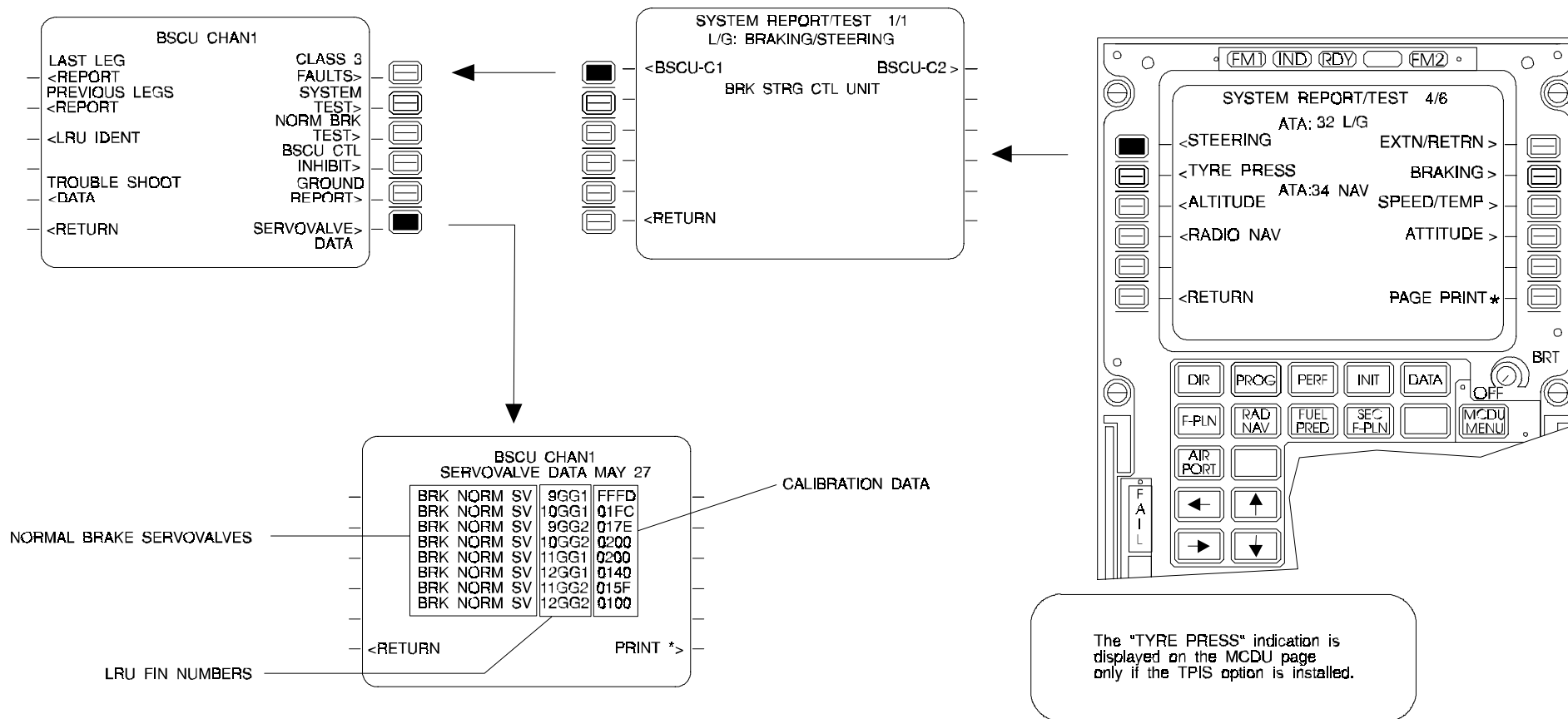
All BSCU channel main menus are identical.

As well as the standard CMS functions, the BSCU menu includes specific data.

This display shows the calibration data for each of the servovalves in the normal braking system. The data shows the relation between the electrical power input and the hydraulic pressure supplied.

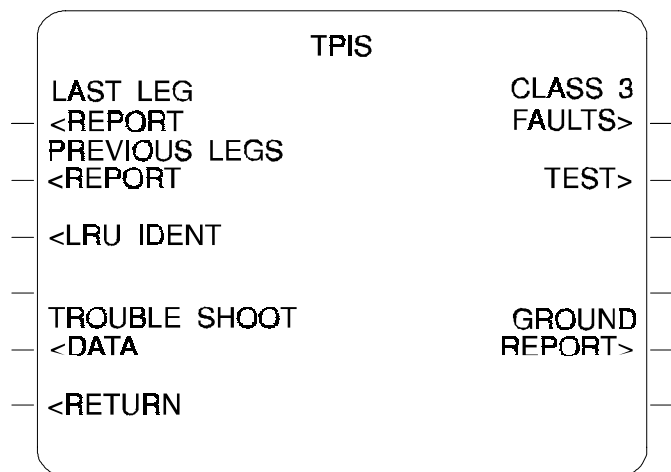
The servovalve data page displays the servovalve static correction value in hexadecimal. To obtain a physical value in bars, this number requires converting to decimal and dividing by 128.

A static value is always displayed and limited to ± 20 bars.

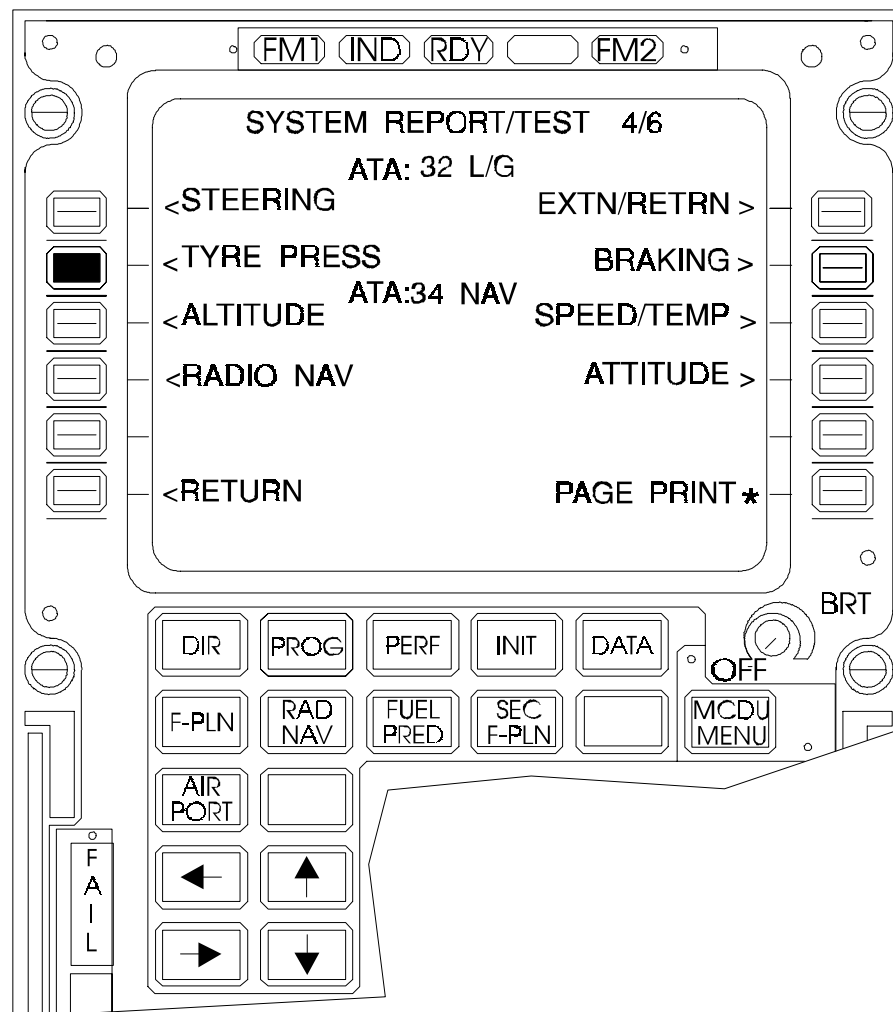


TYRE PRESS (OPTIONAL)

All items of this menu are standard.



The "TYRE PRESS" indication is displayed on the MCDU page only if the TPIS option is installed.



EXTN/RETRN

Selecting EXTN/RETRN enables direct access to the EXTENSION/RETRACTION main menu.
All LGCIU main menus are identical.

As well as the standard CMS functions, the LGCIU menu includes a specific page.
The LGCIU SIMULATION function is displayed on the second MCDU screen which is accessible through the scrolling keys.

Using the first left key enables access to the LANDING GEAR SIMULATION.

Using the second left key enables the LANDING GEAR SIMULATION to be confirmed.

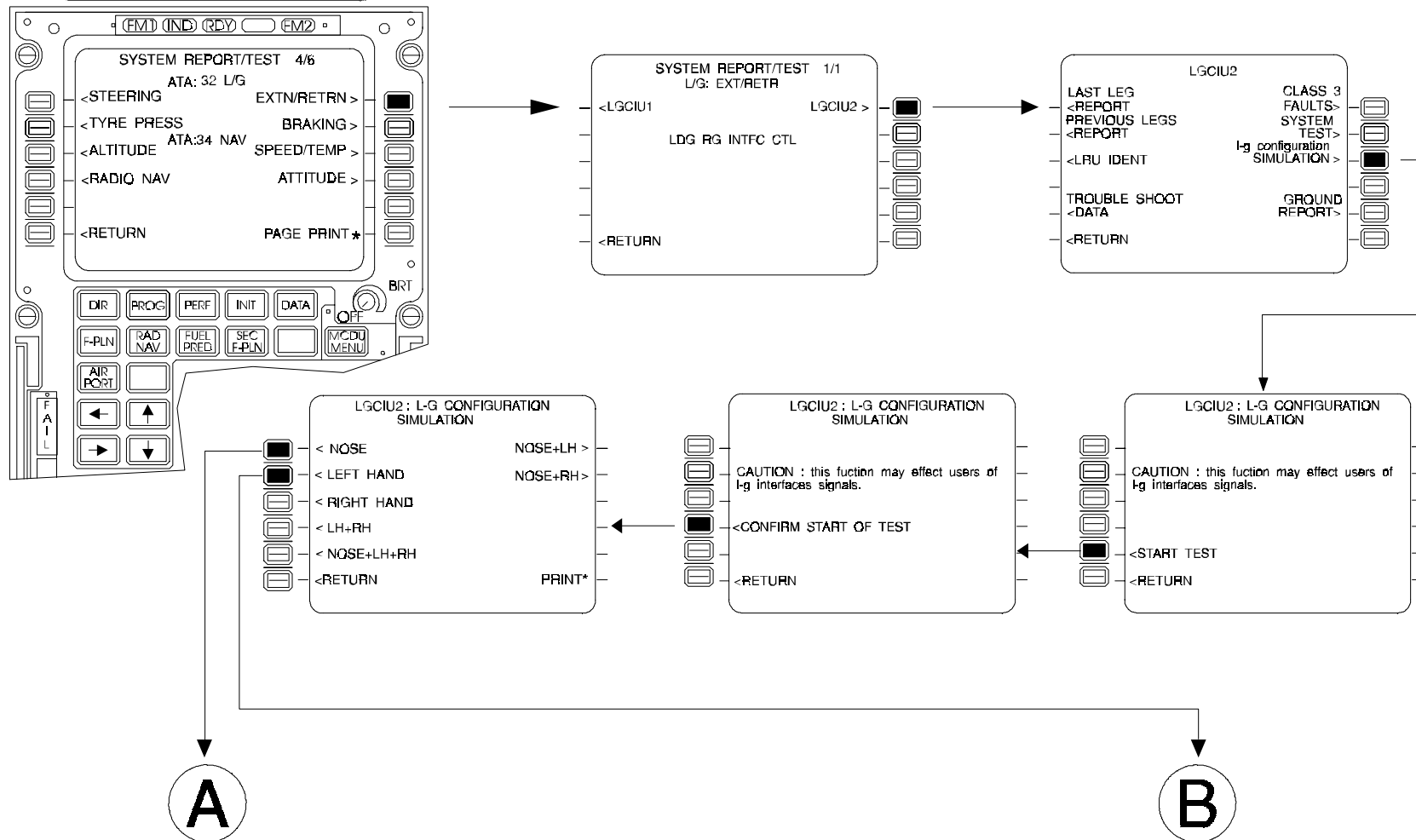
The display shows the available alternative configuration. A selection of the related MCDU key starts the simulation sequence.

During the L/G simulation, the selected LGCIU :

- disables its outputs to the L/G and door selector valves.
- continues to output the correct data for the L/G not selected.

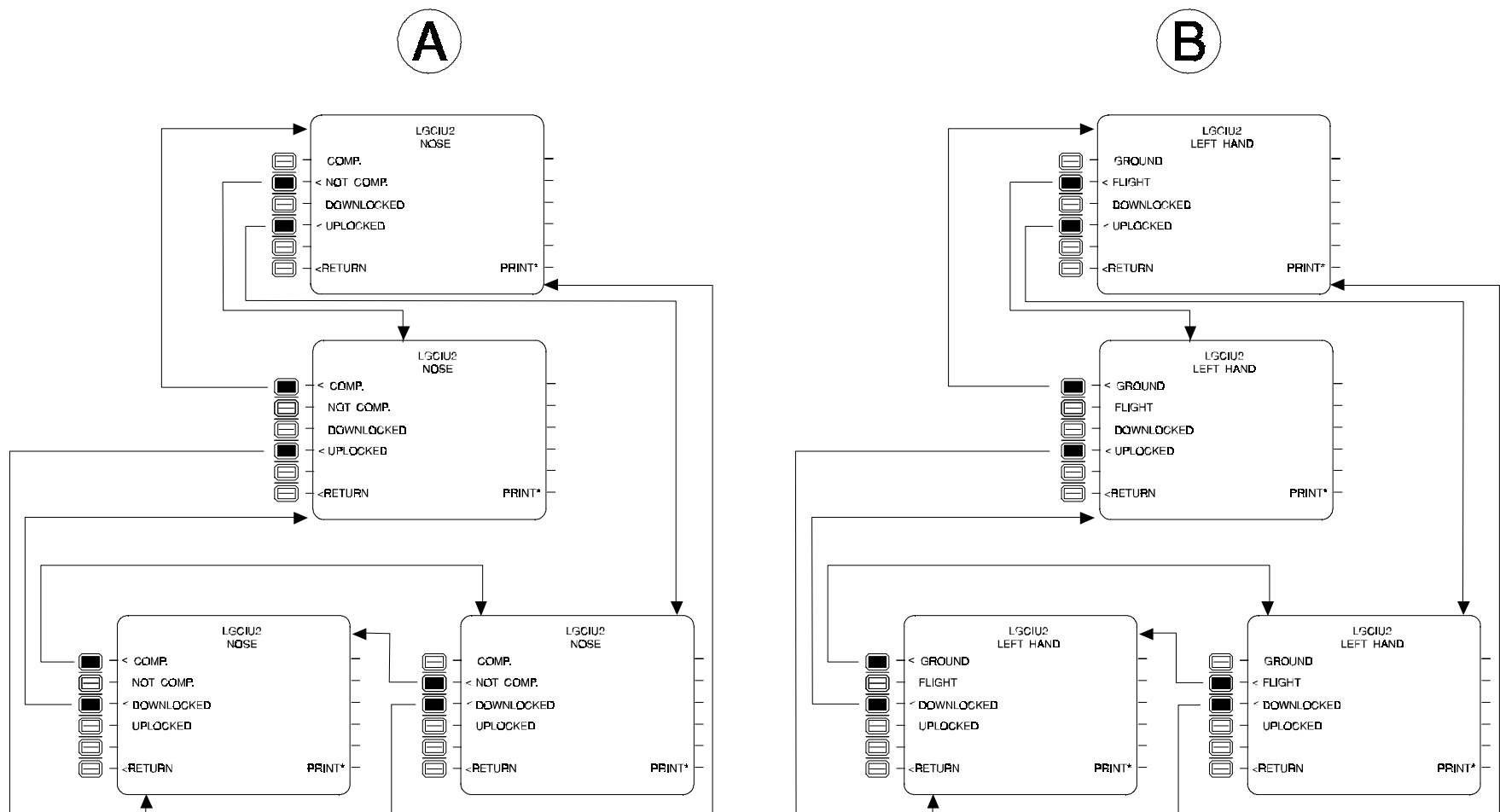
This function lets the LGCIU BITE circuits send specific output signals. These output signals relate to the flight or ground configuration and to the uplocked or downlocked configuration of each landing gear.

The "TYRE PRESS" indication is displayed on the MCDU page only if the TPIS option is installed.



FQW4200 GE Metric

The line key symbol "<" shows the configuration that can be set. When there is no symbol "<", this shows the configuration that is set.
The initial configuration always shows the ground configuration.



FQW4200 GE Metric

BRAKING

Selecting STEERING enables access to the BRAKING and STEERING main menu.

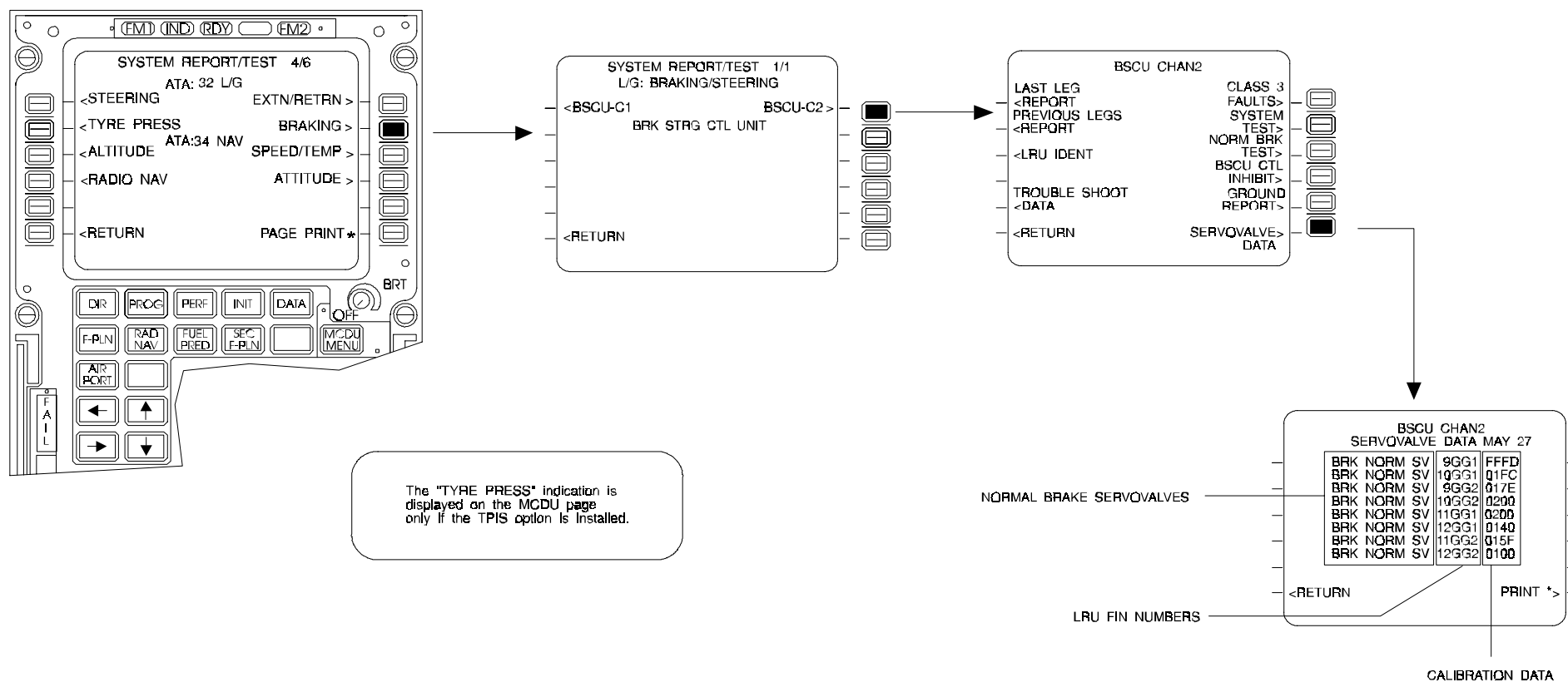
All BSCU channel main menus are identical.

As well as the standard CMS functions, the BSCU menu includes specific data.

This display shows the calibration data for each of the servovalves in the normal braking system. The data shows the relation between the electrical power input and the hydraulic pressure supplied.

The servovalve data page displays the servovalve static correction value in hexadecimal. To obtain a physical value in bars, this number requires converting to decimal and dividing by 128.

A static value is always displayed and limited to ± 20 bars.



STUDENT NOTES

BRAKING SERVICING (2)

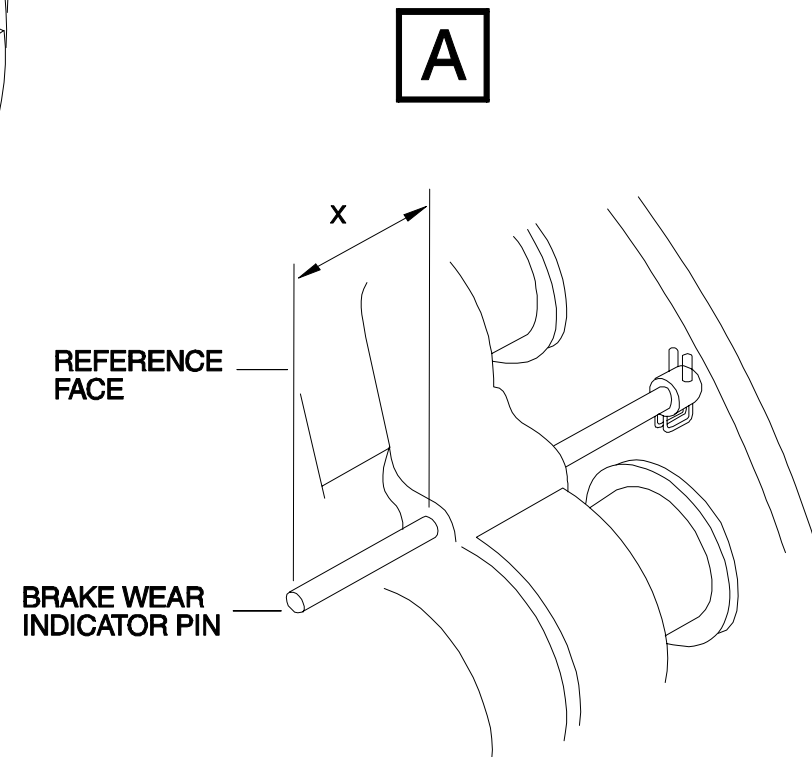
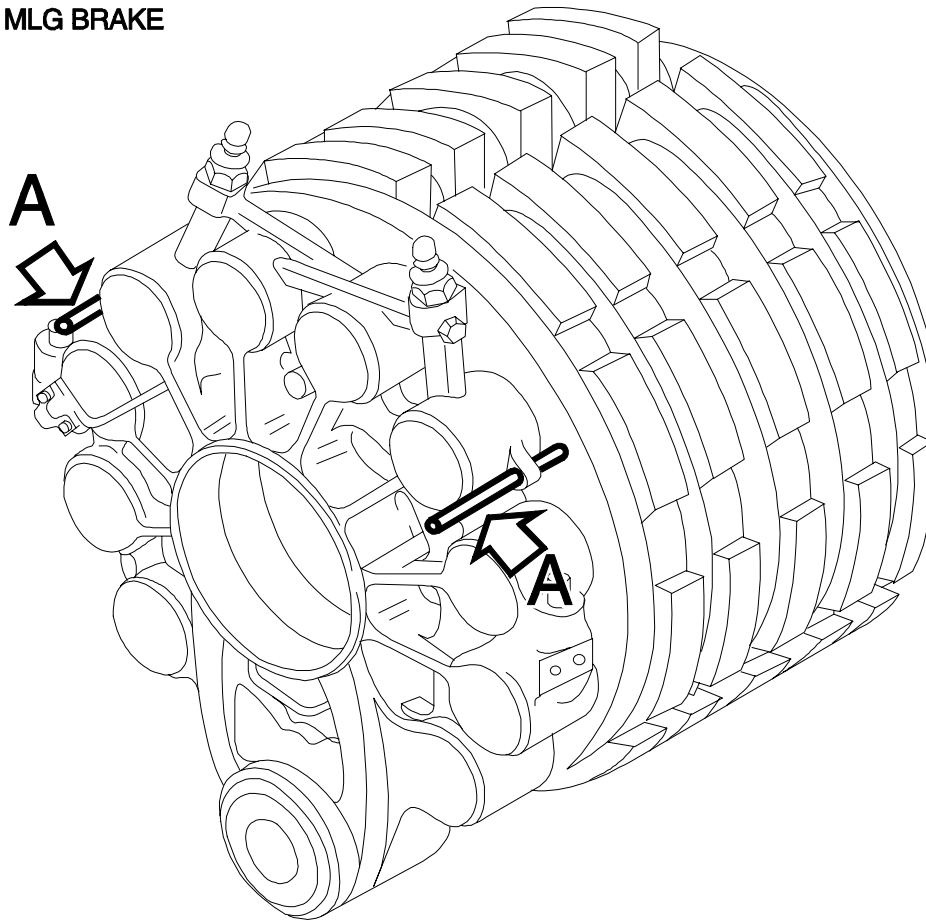
Brake Wear Limits
Tire Condition Checks

BRAKE WEAR LIMITS

WARNING: Make sure that the parking brake is applied.

The brake must be replaced, when the ends of the brake wear indicator pins are level with the brake housing bracket ($X = 0$).

MLG BRAKE



FQW4200 GE Metric

TIRE CONDITION CHECKS

GENERAL

WARNING: Make sure that the safety devices and the warning notices are in position before you start a task on or near:

- the flight controls
- the flight control surfaces
- the landing gear and the related doors
- components that move.

PRECAUTION: Put a warning notice in the cockpit to tell persons not to operate the landing gear or brakes.

LIMITATIONS OF DAMAGE

Nose wheel tires:

The CL (Cut Limit) value is 9mm (0.34in).

The LL (Length Limit) value is 50mm (2.0in).

Main wheel tires:

The CL (Cut Limit) value is 11mm (0.44in).

The LL (Length Limit) value is 60mm (2.4in).

TREAD WEAR CRITERIA

The table shows the defects for which the wheel must be replaced.

Tread wear	The groove depth is less than 1mm (0.04in) at any point on the tread surface
	The steel protector shows at any point on the tread surface
Flat spot on the tread surface	The protector shows at the flat spot
Tread wear that is not symmetrical	The tire is out of the wear limit or will be in a short time

TREAD INSPECTION

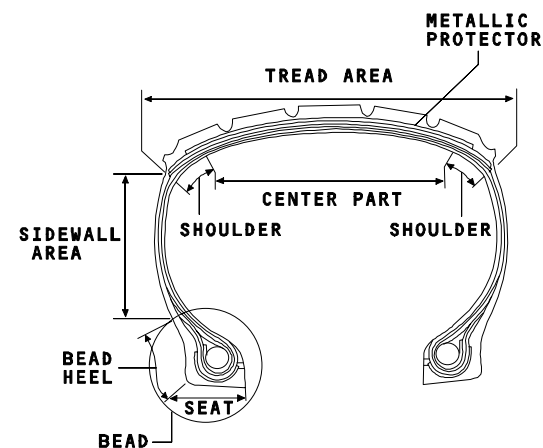
The table shows the defects for which the wheel must be replaced.

Cuts	The metallic protector is damaged
	The estimated depth (started from the bottom of the nearest groove) of the cut is more than the CL
	The estimated depth (started from the bottom of the nearest groove) of the cut is less than or the same as the CL and the largest length of the cut is more than the LL.
The tread broken away	The void area is more than 6sq cm (1sq in)
	The metallic protector is damaged
Open tread joint	The opening is seen
Groove cracking	The length of the crack is more than the LL
Rib under-cutting	The depth of the undercut is more than 6mm (0.25in)

SIDEWALL INSPECTION

The table shows the defects for which the wheel must be replaced.

Radical cuts, cracks or splits (at an angle of less than 30 deg from the radial direction)	The depth is more than 2mm (0.08in) or touches the carcass
Cuts, cracks or splits (at an angle of more than 30 deg from the radial direction)	The carcass is touched
Tire damage in the sidewall	Always (no tolerances)
Blisters or bulges	Always (no tolerances) The tire must be inspected



BEAD INSPECTION

The table shows the defects for which the wheel must be replaced.

Bead wires can be seen	Always (no tolerances)
Damaged beads or bead wires	Always (no tolerances)
Cracks in the upper part of the bead zone	The depth of the crack is more than 1mm (0.04in)
The bead zone that touches the upper part of the flange is worn	The depth of the worn area is more than 1mm (0.04in)
Blisters in the upper part of the bead zone above the rim flange	The length or diameter of the blister is more than 10mm (0.40in)

TREAD WEAR CRITERIA (BIAS PLY)

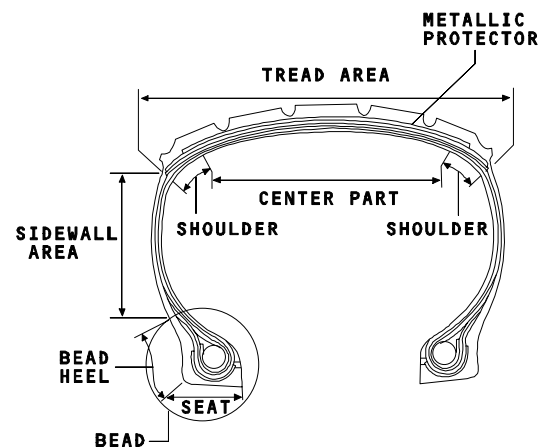
The table shows the defects for which the wheel must be replaced.

Tread wear	The tread is worn to the bottom of a groove at one position on the tire
	The fabric shows in one position in the tread area
Tread wear is not symmetrical	The tire is in the wear limits and the fabric does not show In this case, the tire can be turned on the wheel thru 180 degrees on the vertical axis to be used again

TREAD INSPECTION

The table shows the defects for which the wheel must be replaced.

Cuts	The cut goes into the fabric	
	The cut is across more than 50% of the rib and the depth of the cut is more than the limit of depth of the remaining tread:	
	Depth of remaining tread	maximum depth of cut
	12.7 - 10.3 mm (0.50 - 0.41 in)	6.4 mm (0.25 in)
	9.5 - 7.1 mm (0.37 - 0.28 in)	4.8 mm (0.19 in)
	6.4 - 4.0 mm (0.25 - 0.16 in)	3.2 mm (0.13 in)
	3.2 - 0.0 mm (0.13 - 0.00 in)	1.6 mm (0.06 in)
Bulge	A bulge in the tire tread, sidewall or bead area (Make a mark on the bulge with a crayon)	
Crack in groove	Fabric shows through the cracks in the grooves	
	The crack undercuts the tread ribs	
Flat spots	The fabric can be seen at the flat spot	



STUDENT NOTES