Reference to Figure 64 Landing Gear Extension/Retraction and Steering System Schematic

ATA 32 LANDING GEAR

32–30/51 EXTENSION/RETRACTION AND STEERING

SYSTEM DESCRIPTION

1 Landing Gear Control and Interface Unit

Two LGCIUs are continuously supplied with power, but only one LGCIU controls the extension/retraction sequence at a time. The control changes from one LGCIU to the other after each retraction/extension cycle(when the L/G control lever is moved away from the DOWN position) or when one LGCIU becomes unserviceable. The LGCIU gets position signals from the proximity sensors and the L/G control lever. It uses these position signals to set the L/G door and the L/G selector valves in the correct position.

2 Safety Valve

The L/G Isolation Safety Valve is a solenoid operated valve. It is de–energized closed if airspeed >264kts.

It is energized open if airspeed is < 260kts and the LG control lever is down or the A/C is on ground..

3 Selector Valves

The L/G Selector Valve and the L/G Door Selector Valve are solenoid operated valves in the hydraulic system. Signals from the LGCIUs control the operation of the selector valves.

4 Free Fall Extension System

A mechanical free fall system extends the L/G if the normal extension and retraction system is not serviceable.

When the extension handle is turned three times it operates the L/G components in the following sequence:

- the cut out valve closes to isolate the pressure supply and connect it to return
- the vent valves operate to bypass the normal L/G extension system
- the L/G door and the L/G uplocks release
- the L/G doors are opened by the L/G weight and aerodynamic force. Gravity extends the L/G, which is held and locked in the extended position. When the L/G is extended by the free fall system, the L/G doors stay open.

5 Ground Door Opening Handles

A ground opening handle for each landing gear mechanically activates a door ground opening bypass valve and releases an door uplock. The door bypass valve isolates the hydraulic supply and couples the two chambers of the Door Actuating Cylinder.

6 Gear and Door Uplocks

The MLG/NLG Gear and Door Uplocks are mechanical devices which automatically lock the MLGs and NLG in the retracted position. They are closed mechanically and opened hydraulically in the normal extension and retraction mode and can be opened mechanically in the free fall extension mode.

7 Lock Stay Actuator

During gear retraction the actuator overcomes the lock–spring tension, breaks the over– center lock and folds the lock– stay and side stay into position for retraction. During gear extension the lock stay actuator supports the over– centering movement of the lock–springs on the landing gear lock stay as soon as the door actuator is pressurized to close. On ground with hydraulic pressure available the lock stay actuator and the door actuator are pressurized.

8 Gear Actuator

The gear actuator moves the landing gear during extension and retraction. They include restrictor valves to dampen the movement at the end of travel. The piston shape also increases the damping effect. The MLG actuator retracts when the gear is extended and vice versa.

9 Steering Handwheel

The steering handwheel actuates a transmitter unit. The maximum wheel angle is +/– 75˚. Depending on a/c speed the orders to the wheels are limited linearly to 0˚ from 20kts to 70kts. The handwheel includes a pushbutton switch for the disconnection of the steering control input through the rudder pedals.

10 Rudder Pedal Steering Input

A position transmitter on the rudder pedals sends signals via the ELAC to the BSCU to give nose wheel steering inputs. The maximum wheel angle is +/– 6˚. Depending on a/c speed the orders to the wheels are limited linearly to 0˚ between 40kts and 130kts.

11 Landing Gear Control Lever

The LG control lever sends position signals to both LGCIU. The signal is also used for the safety valve activation logic. The lever has a LGCIU activated baulk solenoid which blocks the lever movement if all shock absorbers are compressed.

RUDDER PEDALS 10

LANDING-GEAR CONTROL LEVER

11

UP

DOWN

GRAVITY GEAR EXTENSION HANDLE

4

PROXIMITY SENSORS

WHEEL

UP LOCK

N/W STEER L/G CTL

UP LOCK

140 °C 140
=1= REL =2=
195 PSI 195

ANTI SKID
AUTO BRK
MED

155 °C 140
=3= REL =4=
195 PSI 195

TAT +15 °C
SAT +15 °C

GMT
12 H 00

G.W. 60 3 T
C.G. 28.1 %

ECAM WHEEL PAGE

FREE FALL EXTENSION SEQUENCE OF OPERATION

1 2 3 4 MECHANICAL INPUT

9 STEERING HANDWHEEL

LGCIU 1 2

1

NLG GEAR DOWN

RETURN MANIFOLD

HYDRAULIC GENERATION

2 SAFETY VALVE

1 FREE FALL CUTOUT VALVE

NOTE:
SHOWN POSITION IS
GEAR DOWN/DOORS CLOSED
(NORMAL GRD CONDITION)

8 GEAR ACTUATOR

GEAR UPLOCK

LOCK STAY ACTUATOR 7

6

DOOR UPLOCK

TOWING CONTROL LEVER

BSCU

ELECTRICAL BOX

GEARS

DOWN

DOORS

CLOSE

NLG DOOR OPEN

4

NLG DOOR CLOSE

UP

3

OPEN

SELECTOR VALVES

NLG POSITION

DOWN

UP

STEERING BLOCK

SWIVEL VALVE

DOOR ACTUATOR

DOOR GROUND OPENING BYPASS VALVE

FREE FALL VENT VALVE

2

RETURN MANIFOLD

GROUND DOOR OPENING HANDLE

5

NOTE:

THE HANDLE CAN ONLY BE MOVED FROM DOWN TO UP IF GREEN HYDRAULIC PRESSURE IS AVAILABLE BECAUSE OF AN MECHANICAL BLOCKAGE WITHIN THE BYPASS VALVE

NOTE: ON ENHANCED A/C THE NOSE WHEEL STEERING SYSTEM IS CONNECTED TO THE YELLOW HYDRAULIC SYSTEM

NLG GEAR UP

Figure 64 Landing Gear Extension/Retraction and Steering System Schematic

Reference to Figure 65 Wheels and Brakes System Schematic (Non-Enhanced Technology)

32–40 WHEELS AND BRAKES

SYSTEM DESCRIPTION (NON-ENHANCED TECHNOLOGY)

1 Brake and Steering Control Unit (BSCU)

The BSCU is made of two systems physically distinct but functionally identical (System 1and 2).

The main functions are:

- Braking control through the servo valves and the pressure transducers.
- Braking regulation by check and comparison of the speed of each braked wheel.
- Automatic braking control through the substitution of a programmed speed with a given acceleration rate to the anti skid reference speed.
- Nose wheel steering control through a hydraulic block and an actuating cylinder.
- Monitoring and memorization of failures.

2 Brake Pedal Transmitter Unit (BPTU)

One brake pedal transmitter unit is located underfloor on the First Officer side. It transforms the mechanical input from the left and right pedals into four identical electrical voltages per side. These voltages are sent to the BSCU.

3 Normal Brake Selector Valve

The selector valve isolates the normal braking system when normal brake is not selected or the pedals are released. It is solenoid controlled by the BSCU (de–energized closed).

4 Normal Brake Servo Valve

Four Servo Valves, one for each brake, controlled by the BSCU regulate the brake pressure in the normal brake system independently for each brake. The Brake Servo Valve supplies a pressure inversely proportional to the current it receives from the BSCU.

5 Parking Brake Electrical Control Valve

The control valve receives signals from the position of the PARK BRK control switch through an electrical linear transmitter. The linear transmitter operates an internal hydromechanical valve. This valve limits the parking brake pressure up to ~2100 psi.

This pressure causes:

- operation of the secondary slide valve of the brake automatic selector to isolate the return line of the alternate brake servo valve. This prevents leakage of fluid to the Yellow reservoir.
- operation of the parking brake operated valve.

6 Automatic Selector

The primary function of the automatic selector is to select the Normal Hydraulic System (Green) or the Alternate System (Yellow) for the supply of the brakes. The automatic selector includes a primary stage which selects the system. The primary stage includes a differential section piston which operates a slide valve, for Normal braking and a set of valves for Alternate Braking. Thus the two systems are isolated from each other. The automatic selector also includes a secondary stage. This secondary stage is used to cut off the return from the servo valves of the Alternate Brake System if the system is supplied by the Parking Brake or Accu only.

7 Master Cylinders

There are two master cylinders. Both are installed on the First Officer brake pedals. The master cylinders are used to control the distribution dual valve of the Alternate brake system by displacement of a volume of fluid and give artificial feel at the pedals by means of an internal spring and the load resulting from the pressure that increases in the control circuit.

8 Alternate Brake Distribution Dual Valve

The distribution dual valve includes two independent pressure reducing valves, one for each main gear. When the pedal is pushed in, the volume of fluid moved by the master cylinder causes the displacement of the pistons. The maximum pressure supplied is ~2500 psi.

9 Dual Shuttle Valve

The dual shuttle valve includes two valves, one for each main gear. Each valve is used to select either the Alternate system or the Parking system to supply the brake system of the corresponding gear.

10 Parking Brake Operated Valve

The parking brake operated valve shuts off supply to the Alternate brake system to prevent leakage through the distribution dual valve.

11 Alternate Brake Servo Valve

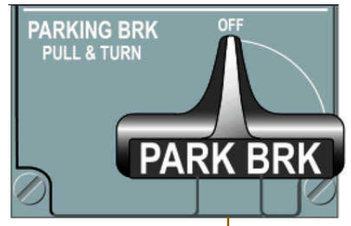
One servo valve supplies one brake only. The servo valves are supplied with pressure when the pedals are pushed in. When there is no anti skid regulation, the pressure applied to the brakes is equal to the pressure supplied to the servo valves. The anti skid system regulation decreases the pressure at the brake.

LANDING GEAR CONTROL PANEL

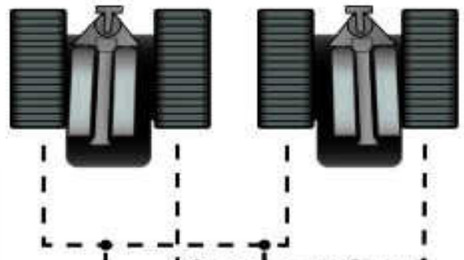
1 BSCU

SYS 1 | SYS 2

PARK BRAKE CONTROL HANDLE



BRAKE PEDALS



ACCUMULATOR

PRESS RELIEF VALVE

YELLOW RETURN MANIFOLD

YELLOW HP MANIFOLD

GREEN RETURN MANIFOLD

GREEN HP MANIFOLD

NORMAL BRAKE SELECTOR VALVE 3

PARK BRK ELEC CTRL VALVE 5

ELECTRICAL XMTR 2

HYDRAULIC LP RESERVOIR

MASTER CYLINDERS 7

BRAKE FAN P/B

8

DISTRIBUTION DUAL VALVE

DUAL SHUTTLE VALVE 9

FROM 3/4

TO 3/4

AUTOMATIC SELECTOR 6

FROM 3/4

4 NORM SV

NORM SV

PRESSURE TRANSDUCER

10

PARKING BRAKE OPERATED VALVE

PRESSURE TRANSDUCER

TO 3/4

WHEEL 1

WHEEL 2

BRAKE FAN

TACHO

TACHO

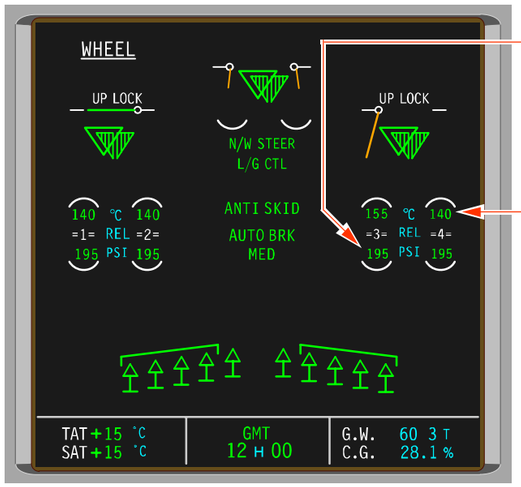
TIRE PRESSURE INDICATION SENSOR (OPTIONAL)

11

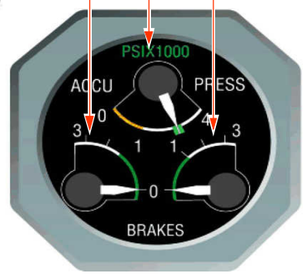
ALTN SV

ALTN SV

BRAKE TEMPERATURE SENSOR



ECAM WHEEL PAGE



TRIPLE PRESSURE INDICATOR

Figure 65 Wheels and Brakes System Schematic (Non-Enhanced Technology)

Reference to Figure 66 Wheels and Brakes Operational Schematic (Non-Enhanced Technology)

COMPONENT DESCRIPTION (NON-ENHANCED TECHNOLOGY)

1 Normal Brake Pressure Transducers

The Brake Pressure Transducers are installed on the manifold of the Normal Brake Servo Valve, one downstream of each Servo Valve.

They send pressure information to the BSCU.

2 Alternate Brake Pressure Transducer

Two pressure transmitters measure the pressure at the outlet of the dual shuttle valve, i.e. the pressure supplied either by the Alternate Brake Distribution Dual Valve or by the Parking Brake Electrical Control Valve.

The pressure transmitters send the information to an indicator (Brake Yellow Pressure Triple Indicator) in the cockpit.

The indicator also shows the pressure of the brake Yellow Pressure Accumulator.

3 Yellow Accumulator Pressure Transmitter

It is installed in the common supply line.

It transmits data of the hydraulic fluid pressure to the third input of the Brake Pressure Triple Indicator.

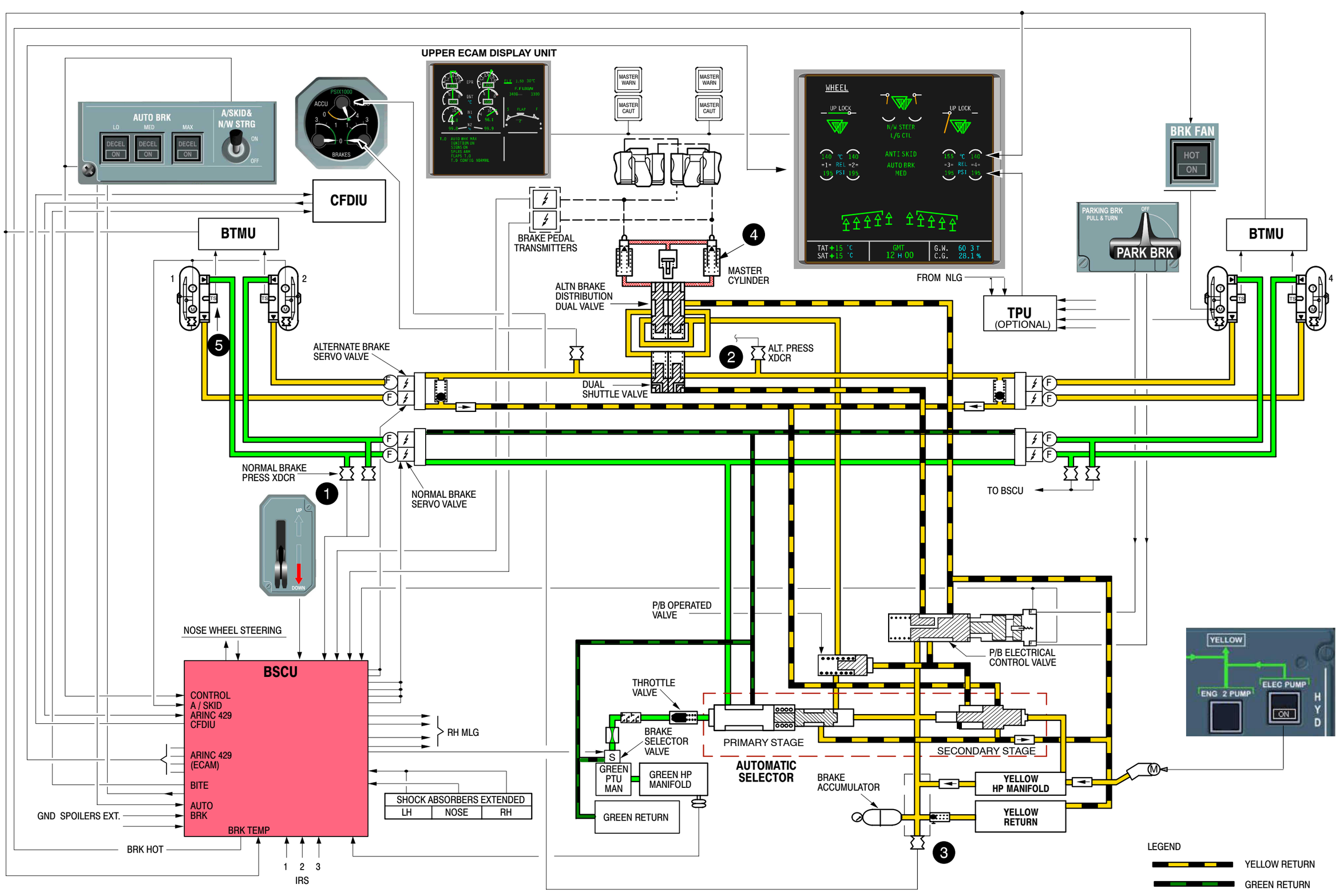
4 Pedal Artificial Feel

The artificial feel at the pedals is identical in the Normal and Alternate Braking modes.

The Master Cylinders of the Alternate system provide the artificial feel (master cylinder spring and pressure in the master cylinder).

5 Temperature Sensor and Brake Temperature Monitoring Unit (BTMU)

A chromel-alumel temperature sensor delivers a voltage proportional to the temperature of each brake unit to the BTMU. The BTMU processes these data and sends a signal to the BSCU.



NOTE: ALL PISTONS ARE SHOWN IN BASIC CONDITIONS

Figure 66 Wheels and Brakes Operational Schematic (Non-Enhanced Technology)

Reference to Figure 67 Wheels and Brakes System Schematic (Enhanced Technology)

SYSTEM DESCRIPTION (ENHANCED TECHNOLOGY)

DIFFERENCE TO CLASSIC SUMMARY

Since the Enhanced Brake System is equipped with an additional control unit, pressure sensor and alternate brake selector valve, the automatic selector and the LP hydraulic input from the pedals is no longer needed.

1 Brake And Steering Control Unit (BSCU)

Main functions are the same like on classic a/c. Additionally the BSCU provides information and communication to the ABCU.

2 Brake Pedal Transmitter Unit (BPTU)

Main functions are the same like on classic a/c.

3 Normal Brake Selector Valve

Main functions are the same like on classic a/c.

4 Normal Brake Servo Valves

Four Servo Valves, one for each brake, controlled by the BSCU regulate the brake pressure in the normal brake system independently for each brake. The Brake Servo Valve supplies a pressure proportional to the current it receives from the BSCU.

5 Park Brake Control Valve

Main functions are the same like on classic a/c.

6 Alternate Braking Control Unit (ABCU)

When ALTERNATE braking circuit is activated, braking control is provided by the ABCU.

Antiskid protection is still provided by the BSCU, which sends antiskid orders to the ABCU.

The ABCU is automatically activated if:

- the A/SKID & N/W STRG switch is selected to OFF position
- the BSCU is not serviceable (system 1 and 2 failures)
- the normal braking system has failed
- only the batteries supply the aircraft

The ABCU sends the braking orders, combined or not with antiskid control orders, to the alternate brake DDVs.

When alternate braking is activated but anti skid protection is not available the ABCU limits the brake pressure to ~1000PSI.

7 Alternate Brake Pedal Transmitter Unit (ALTN BPTU)

The alternate BPTU is installed at the captains position and transmits pedal deflection inputs to the ABCU.

Braking Operation during Towing:
A function in the ABCU allows to brake the aircraft during towing operation. The ABCU is able to switch from DC Essential Power Supply to the Hot Bus Power Supply when no electrical power supply is available and the pedals are depressed.
The ABCU is connected to a third set of potentiometers in the alternate BPTU and a connection to the Hot bus Power Supply is done.
Park Brake can be applied, as well without electricity on board (batteries only).

8 Alternate Brake Selector Valve

The alternate selector valve is the same as the normal selector valve but controlled by the ABCU.

9 Direct Drive Valve

The Direct Drive Valve receives an input current from the ABCU which corresponds to the required brake pressure. A torque motor controls a internal hydraulic stage which regulates the hydraulic pressure supply to the L/H or R/H brake pair.

10 Shuttle Valve

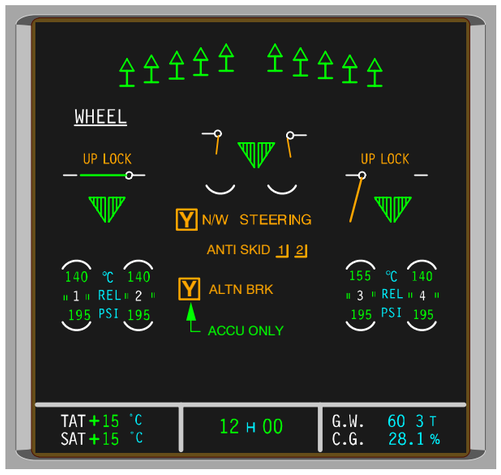
The shuttle valve isolates the parking brake supply from the alternate brake supply. When the parking brake is set, the parking brake hydraulic supply moves the valve against the spring. This lets the parking brake supply go through to the related brakes and isolates the alternate brake supply.

Since the Enhanced Brake System is equipped with an additional control unit, pressure sensor and alternate brake selector valve, the automatic selector and the LP hydraulic input from the pedals is no longer needed.

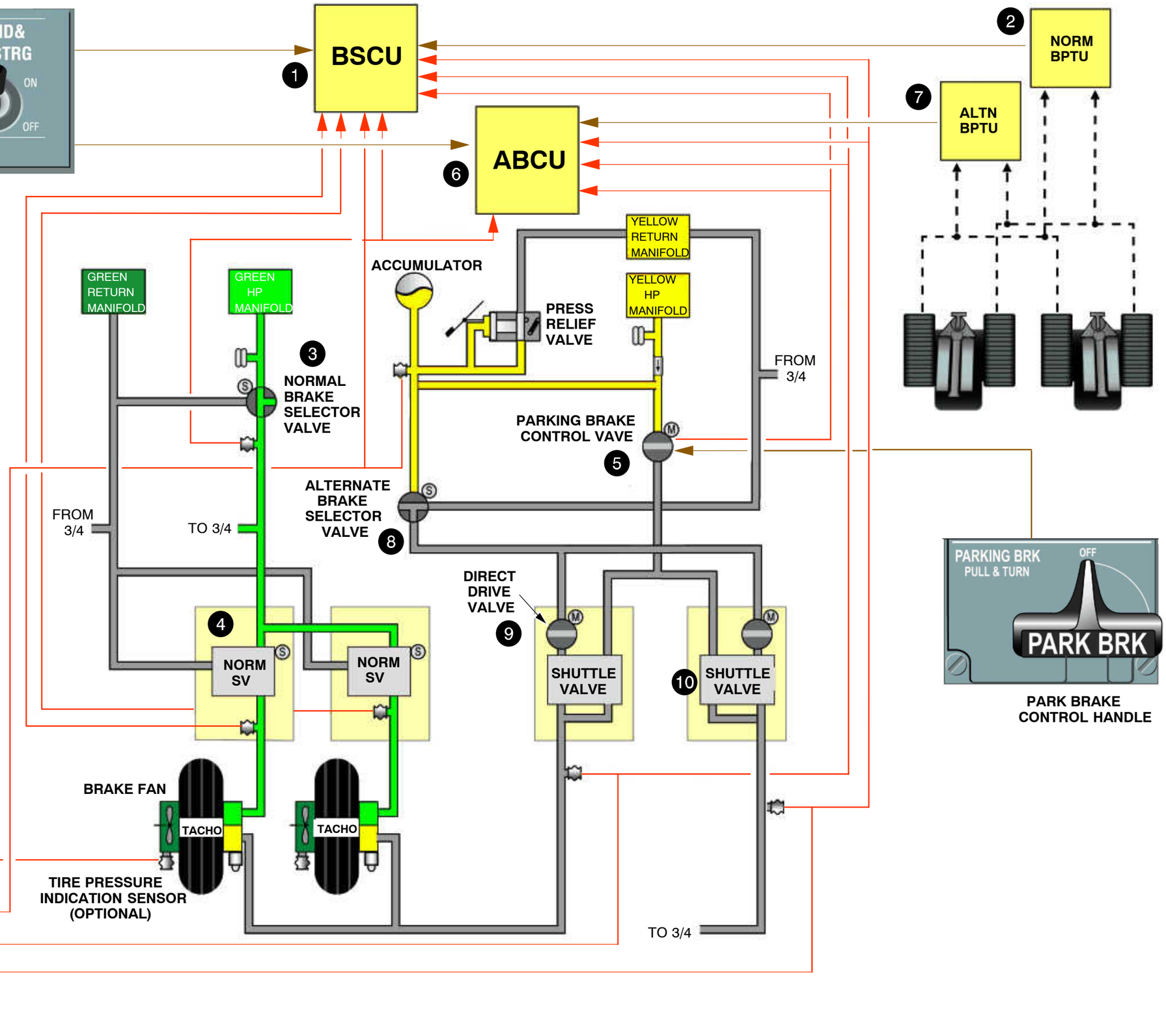
Also some of the related control valves have been deleted.

LANDING GEAR CONTROL PANEL

ECAM WHEEL PAGE



TRIPLE PRESSURE INDICATOR



PARK BRAKE CONTROL HANDLE

Figure 67 Wheels and Brakes System Schematic (Enhanced Technology)

Reference to Figure 68 A/BRK and ALTN Braking Schematic (Enhanced Technology)

COMPONENT DESCRIPTION (ENHANCED TECHNOLOGY)

1 Normal Brake Pressure Transducers

The Brake Pressure Transducers are installed on the manifold of the Normal Brake Servo Valve, one downstream of each Servo Valve.

They send pressure information to the BSCU.

2 Alternate Brake Pressure Transducers

The pressure transducers send data to the BSCU, ABCU and to the Triple Indicator (right & left side).

3 Yellow Accumulator Pressure Transmitter

It is installed in the common supply line. It transmits data of the hydraulic fluid pressure to the third input of the Brake Pressure Triple Indicator and to the ABCU.

4 Pedal Artificial Feel

A dedicated spring operated actuator (spring rod) gives a resistance when a force is put on the related pedal and put the pedal back to its initial position when the force is removed.

5 Temperature Sensor and Brake Temperature Monitoring Unit (BTMU)

A chromel-alumel temperature sensor delivers a voltage proportional to the temperature of each brake unit to the BTMU. The BTMU processes these data and sends a signal to the BSCU.

6 Green Brake System Pressure Transducer

This pressure transducer sends pressure information to the BSCU and ABCU.

If during brake inputs the pressure decreases below 1300 PSI the normal brake system is de–activated and the ABCU activates the altenate brake system.

If the Green hydraulic supply increases to more than ~2176 PSI after braking, the ABCU will give back the control to the BSCU (Normal Brake System), once the brake pedals have been fully released to prevent transient during a braking phase.

LANDING GEAR PANEL (402 VU)

LDG GEAR
UNLK
UNLK
UNLK
BRK FAN
HOT
ON
AUTO/BRK
LO
MED
MAX
DECEL
ON
DECEL
ON
DECEL
ON
A/SKID & N/W STRG
ON
OFF

BRAKING & STEERING CONTROL UNIT
BITE
AUTOBRAKE
ANTI-SKID

SECs
ADIRSs
LGCIUs
TO ABCU

L/G LEVER (400VU)
UP
DOWN

CFDIU
SDAC
FDIU
DMU

GREEN HP
SPRING ROD
4
A/S ON-OFF
NORM BRK SELECTOR VALVE
ALTN BPTU
NORM BPTU
BSCU IN USE
ABCU IN USE
FUNCTIONAL TESTS
A/S DDV RH & LH
FAULT MESSAGES
ALTERNATE BRAKING CONTROL UNIT
401PP ESS BUS 28 VDC
701PP HOT BUS 28 VDC
SDAC
6
3 & 4
2
NORMAL SERVO VALVE
F
NORM BRK SERVO MANIFOLD
1
TRIPLE PRESSURE INDICATOR
ACCU PRESS
BRAKES PSIx1000
WHEEL 1
BTMU
T
5
TO ABCU

BRAKE ACCU
YELLOW HP
ALTN HP MANIFOLD
TO BSCU & ABCU
3
RELIEF VALVE
ALTN BRK SEL VALVE
PARK BRK CTL VALVE
TO BSCU & ABCU
PARKING BRK HANDLE
PARKING BRK PULL & TURN
OFF
PARK BRK
ON
M
M
ALTN DDV
ALTN DDV
SHUTTLE VALVE
F
F
ALTN BRK MANIFOLD
ALTN BRK MANIFOLD
2
3
4
TO 2

Figure 68 A/BRK and ALTN Braking Schematic (Enhanced Technology)