TECHSAVIATION
Training Center

Este material em hipótese alguma substituirá os manuais do fabricante para qualquer ação de manutenção. Consulte os manuais correspondentes. **EDUCATIONAL PURPOSE ONLY**

LANDING GEAR - ATA 32-00

Landing Gear

General Description

Introduction

The 787 has the standard tricycle-type landing gear. There is a nose landing gear and two main landing gears.

The components for the main landing gear do these functions:

- Raise and lower the gear
- Control the tilt angle of the wheel truck
- Support and lock the gear in both the extend and retract positions
- Shock absorption to the airframe.

Retract and Extend

Control of the landing gear retract and extend is from hosted applications in the common core system. The center hydraulic system retracts the landing gear.

Alternate Extend

The landing gear can extend without normal control available.


32-00 Landing Gear
787 DREAM LINER

Main Landing Gear and Doors

These are the main landing gear components:

- Shock strut
- Side brace assembly
- Drag brace assembly.

The shock strut is an inner and outer shock strut. The torsion links keep the inner and outer shock struts together. The outer shock strut has the trunnion assembly. The trunnion assembly connects to wing structure. The inner shock strut connects to the truck assembly.

The truck assembly with the four wheels and tires connects to the inner shock strut. These assemblies support most of the weight of the airplane on the ground. The truck assemblies have tow fittings at each end.

There are five doors for each landing gear:

- Body door
- Shock strut door
- Lower shock strut door
- Drag brace door
- Trunnion door.

Description

The trunnion is the pivot point for the landing gear retract and extend movements. The landing gear actuator connects the landing gear outer shock strut to wing structure.

The shock strut absorbs the shock of contact with the runway when landing.

The side brace transfers inboard landing gear loads to the airplane structure during taxi, and provides one of the main landing gear downlock functions.

The drag brace assembly transfers forward and aft landing gear movement to the airplane structure during taxi, and provides a main landing gear downlock function.

The truck positioner actuator puts the truck to the correct position for gear retraction or gear extension.

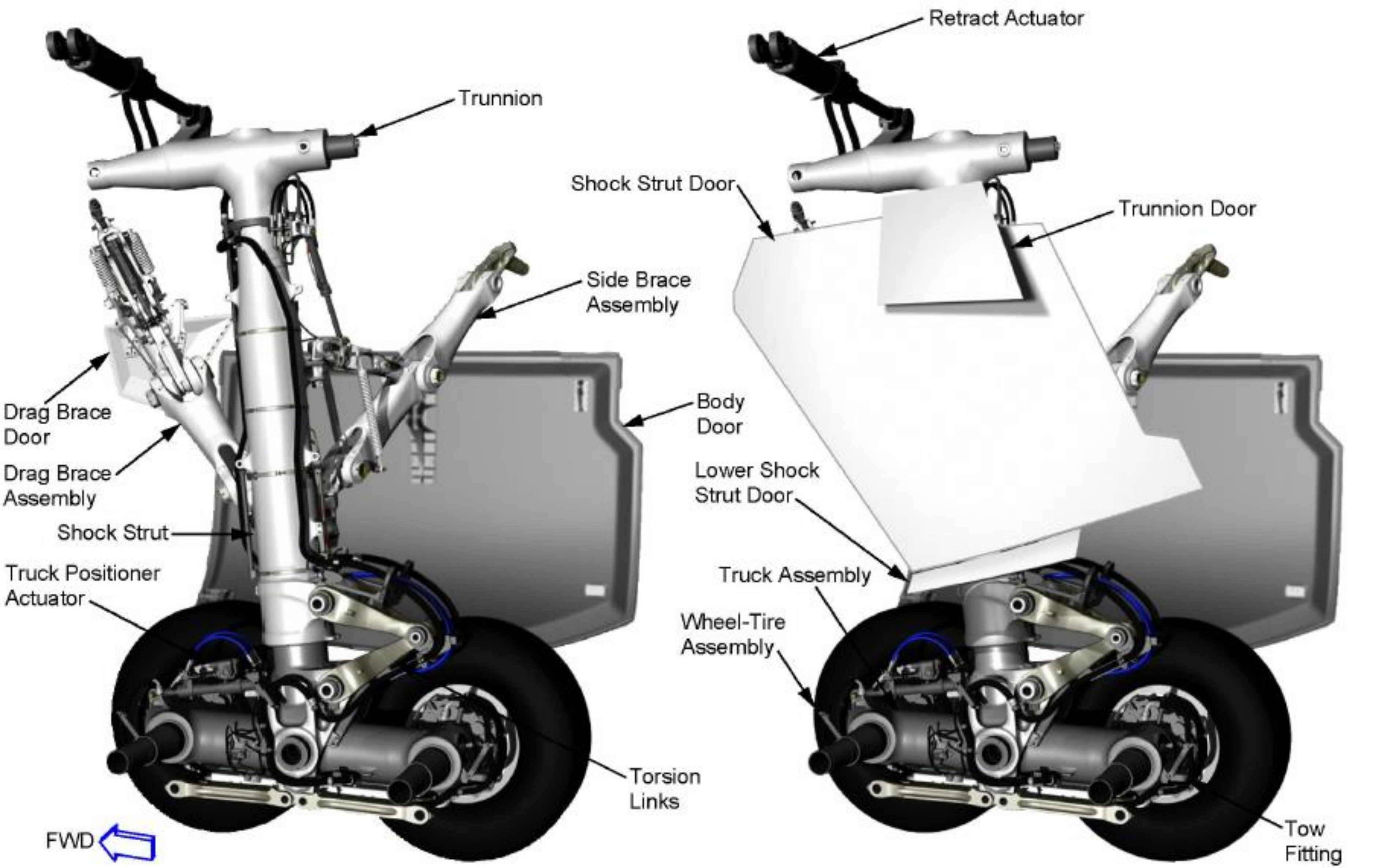
These doors provide an aerodynamic fairing when the landing gear is retracted:

- Shock strut door
- Lower shock strut door
- Drag brace door
- Trunnion door.

The body doors protect the wheels and give an aerodynamic fairing when the gear is extended and retracted.

The 787-9/10 body doors are different from the 787-8, to accommodate the wider truck and larger wheels and tires.

The 787-10 has a modified strut door to provide space for the Semi- Levered Gear (SLG) actuator as the gear retracts.

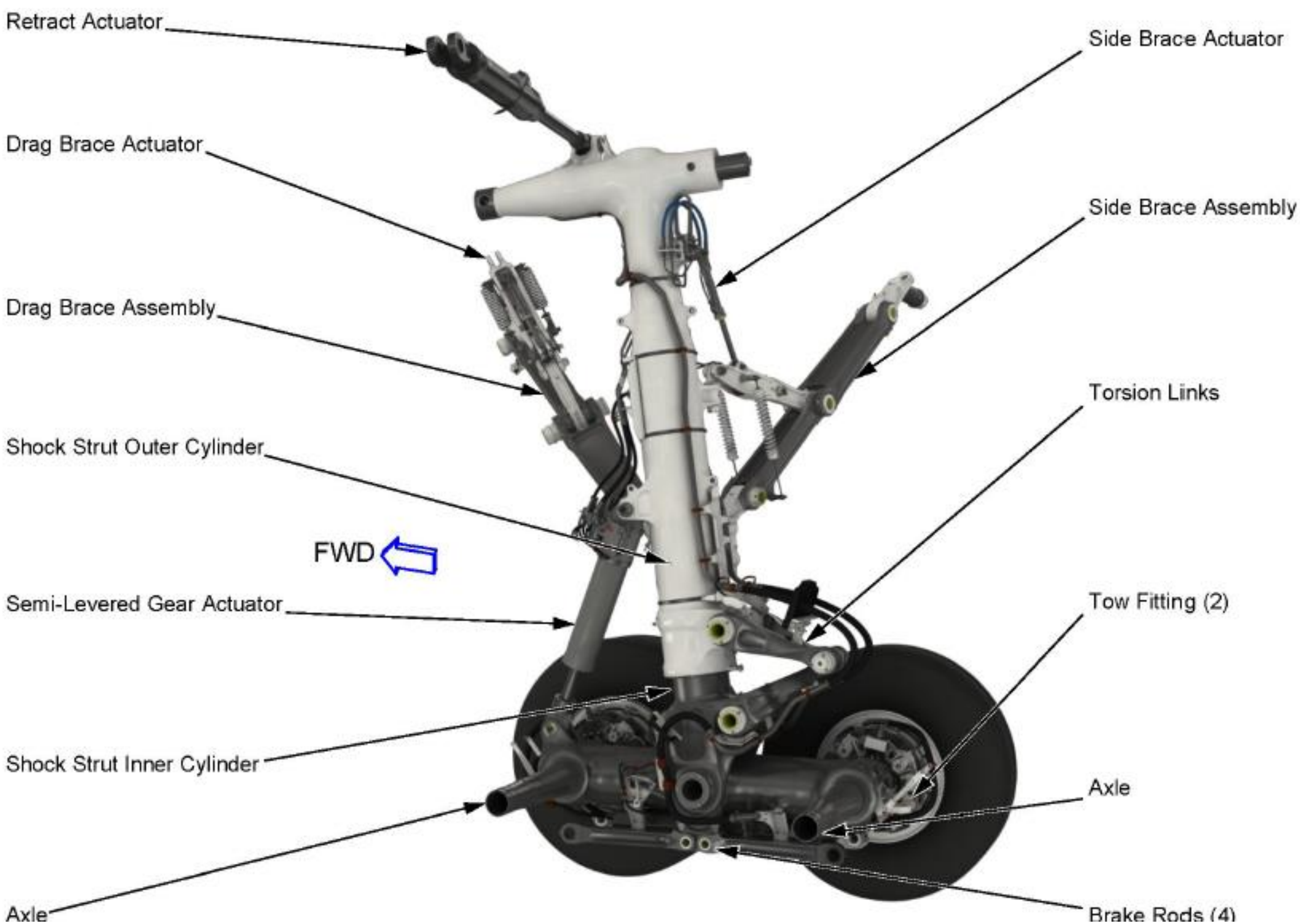

Trunnion
Drag Brace Door
Drag Brace Assembly
Shock Strut
Truck Positioner Actuator
FWD
Side Brace Assembly
Body Door
Torsion Links
Retract Actuator
Shock Strut Door
Trunnion Door
Lower Shock Strut Door
Truck Assembly
Wheel-Tire Assembly
Tow Fitting

787-10 Main Landing Gear

The 787-10 landing gear operates similar to the 787-8 and 787-9. The main difference is that the truck tilt actuator on the 787-8/9 has been replaced by the Semi-Levered Gear (SLG) actuator.

The SLG actuator improves takeoff performance by increasing the height of the landing gear during airplane liftoff. The SLG hydraulic strut locks and acts as stiff springs between the outer shock strut cylinder and the forward end of the MLG trucks.

The tilt position is about 22 degrees toes up and the stow position is about 12 degrees toes down.


Retract Actuator
Drag Brace Actuator
Drag Brace Assembly
Shock Strut Outer Cylinder
FWD
Semi-Levered Gear Actuator
Shock Strut Inner Cylinder
Axle
Side Brace Actuator
Side Brace Assembly
Torsion Links
Tow Fitting (2)
Axle
Brake Rods (4)

Nose Landing Gear

The Nose Landing Gear (NLG) is supported by these components:

- Shock strut
- Upper drag brace
- Lower drag brace.

The shock strut is in two parts, an inner shock strut and an outer shock strut. The torsion links keep the inner and outer shock struts together. The upper torque link connects to the nose wheel steering collar, around the outer shock strut. The lower torque link connects to the inner shock strut.

One end of a lock link connects at the pivot point of the upper and lower drag braces. The other end of the lock link connects to aft bulkhead structure of the nose wheel well.

The lock link goes over-center to lock the landing gear, both up and down.

The tow fitting is on the inner shock strut. This tow fitting is used for most of the airplane towing operations.

There are four doors for the NLG:

- Right forward door
- Left forward door
- Right aft door
- Left aft door.

There are two sets of trunnion fittings for the NLG. One set is for the upper drag brace. The other set is for the shock strut.

DESCRIPTION

The shock strut absorbs the shock of contact with the runway during taxi and landing.

The inner shock strut, operated by nose wheel steering, provides directional control during taxi, takeoff, and landing.

The upper drag brace trunnion provides a pivot point for the upper drag brace during NLG retract and extend.

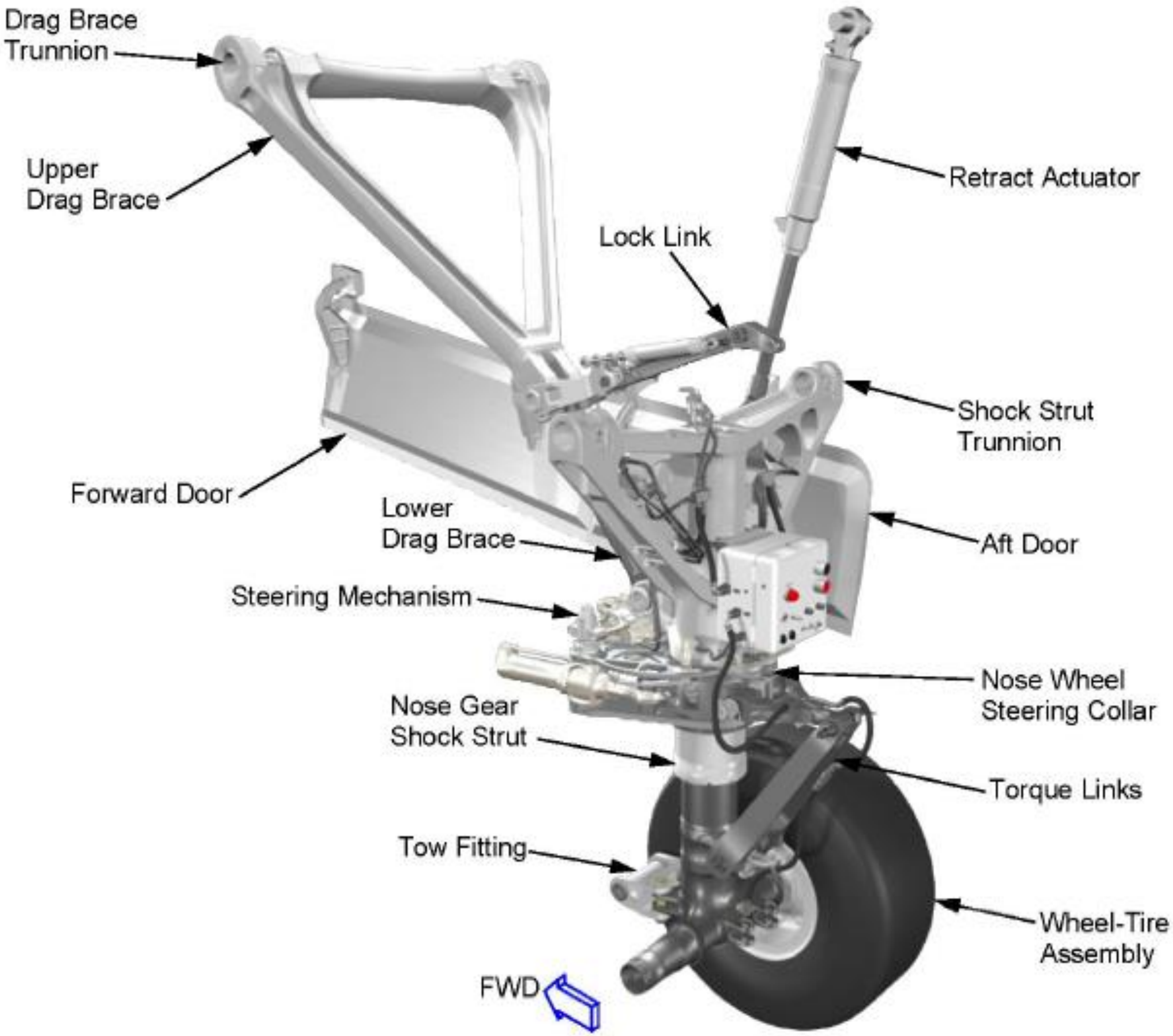
The shock strut trunnion provides a pivot point for the shock strut during NLG retract and extend.

The upper and lower drag braces help to keep the NLG locked in both the extend and retract positions.

The drag braces also transfer NLG longitudinal forces during landing and taxi to the airplane structure.

The two forward doors provide aerodynamic fairing with the NLG extended and retracted. The two aft doors provide aerodynamic fairing when the NLG is retracted.

The lock link holds the upper and lower drag braces to lock the NLG in the extend position. The lock link holds the upper drag brace up to lock the NLG in the retract position.


Drag Brace Trunnion
Upper Drag Brace
Retract Actuator
Lock Link
Shock Strut Trunnion
Forward Door
Lower Drag Brace
Aft Door
Steering Mechanism
Nose Wheel Steering Collar
Nose Gear Shock Strut
Torque Links
Tow Fitting
Wheel-Tire Assembly
FWD

Proximity Sensor System

The proximity sensor system uses proximity sensors for these indications:

- Nose Landing Gear (NLG) up and locked
- NLG down and locked
- NLG door position
- Main Landing Gear (MLG) up and locked
- MLG down and locked
- MLG body door position
- Airplane in air mode
- Airplane fast on ground
- Airplane slow on ground.

The proximity sensor system uses micro switches and lights to show whether the NLG and MLG doors are safe or unsafe.

The system also monitors two electrical circuit wires in the tail strike module. The proximity sensor system uses the module to alert the flight crew if the airplane tail has come too close to the ground during takeoff or landing.

Hosted functions in the Common Core System (CCS) send the proximity data to the Display Crew Alerting System (DCAS). DCAS shows this data on these Head- Down Displays (HDD):

- EICAS display
- Landing gear synoptic display
- Landing gear maintenance pages.

Description

For redundancy, there are two proximity sensor channels for the NLG and MLG indication.

These are the indication proximity sensors for the NLG indication:

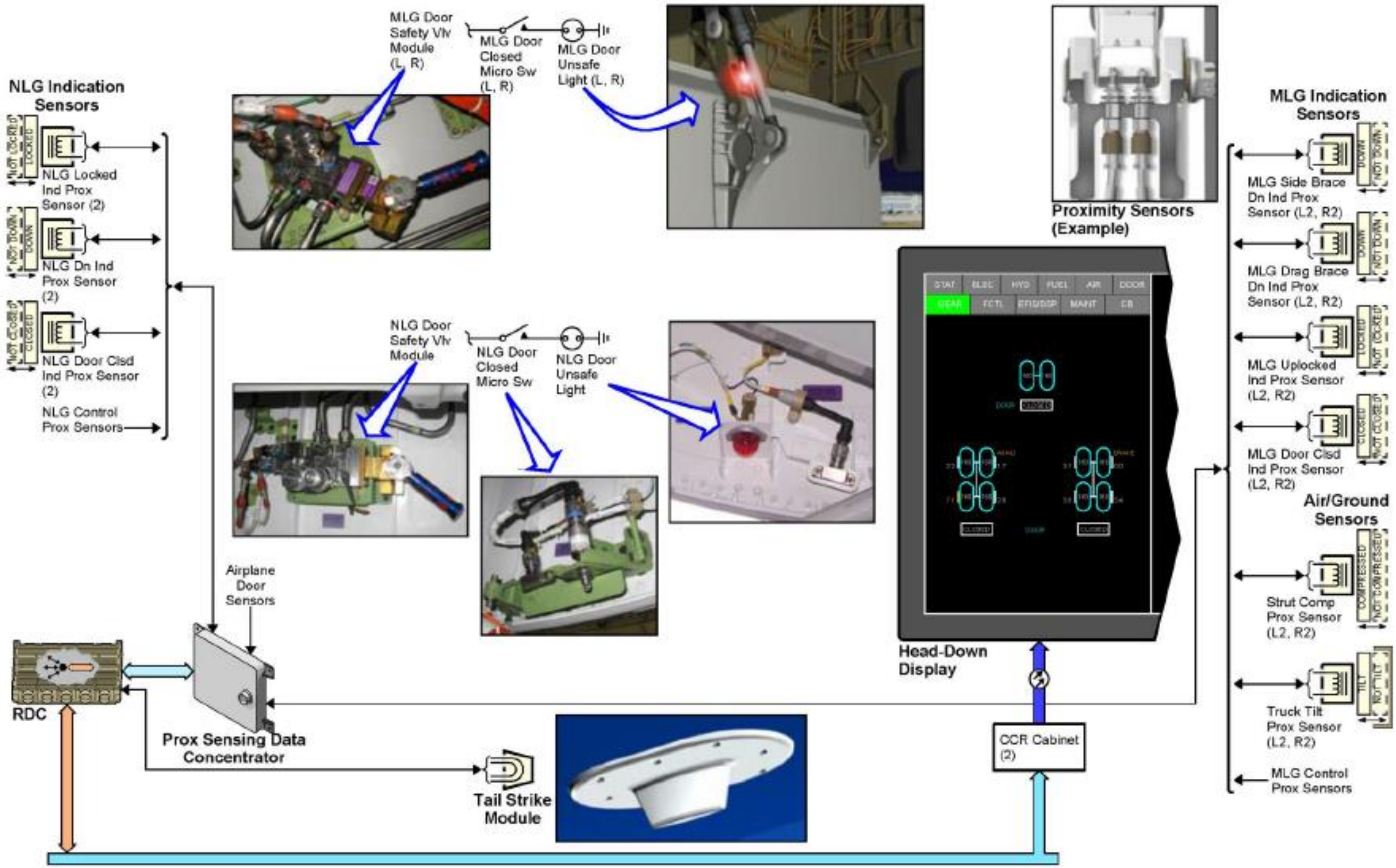
- NLG locked indication sensors
- NLG strut down sensors
- NLG door closed sensors.

These are the indication proximity sensors for the left and right MLG indications:

- MLG side brace down sensors
- MLG drag brace down sensors
- MLG uplock indication sensors
- MLG body door closed sensors.

The CCS uses these sensors for airplane-on-ground sensing:

- Landing gear truck tilt sensor, not tilt – fast on ground
- Strut compressed sensors, not compressed – slow on ground.


MLG Door Safety Vlv Module (L, R)
MLG Door Closed Micro Sw (L, R)
MLG Door Unsafe Light (L, R)
NLG Indication Sensors
NLG Locked Ind Prox Sensor (2)
NLG Dn Ind Prox Sensor (2)
NLG Door Clsd Ind Prox Sensor (2)
NLG Control Prox Sensors
NLG Door Safety Vlv Module
NLG Door Closed Micro Sw
NLG Door Unsafe Light
Proximity Sensors (Example)
MLG Indication Sensors
MLG Side Brace Dn Ind Prox Sensor (L2, R2)
MLG Drag Brace Dn Ind Prox Sensor (L2, R2)
MLG Uplocked Ind Prox Sensor (L2, R2)
MLG Door Clsd Ind Prox Sensor (L2, R2)
Air/Ground Sensors
Strut Comp Prox Sensor (L2, R2)
Truck Tilt Prox Sensor (L2, R2)
MLG Control Prox Sensors
Head-Down Display
Airplane Door Sensors
RDC
Prox Sensing Data Concentrator
Tail Strike Module
CCR Cabinet (2)

Wheels and Brakes General Description

The brake system is an electric brake system that uses electronic and computer technology. The main gear wheels have electrically actuated, multiple-disc carbon brakes.

The brake system has two major subsystems:

- Brake Control and Monitoring System (BCMS)
- Electro Mechanical Braking System (EMBS).

Brake Control and Monitoring System (BCMS)

The BCMS consists of:

- Left Brake System Control Unit (BSCU)
- Right BSCU
- Two nose gear Axle Remote Data Concentrators (ARDC)
- Eight main gear ARDCs
- Ten Tire Pressure Sensors (TPS)
- Eight Brake Temperature Sensors (BTS).

The BSCUs control and monitor:

- Pedal brake control
- Parking brake control
- Autobrake
- Hydroplane/touchdown protection
- Lock wheel protection
- Brake temperature indication
- Tire pressure indication.

Each BSCU has two channels. The left BSCU controls the left inboard and outboard brakes, and the right BSCU controls the right inboard and outboard brakes. Each BSCU transmits brake commands to one of the four Electric Brake Actuator Controller (EBAC)s.

The nose gear ARDCs interface with the TPS on the nose gear.

The main gear ARDCs interface with:

- TPSs
- BTSs.

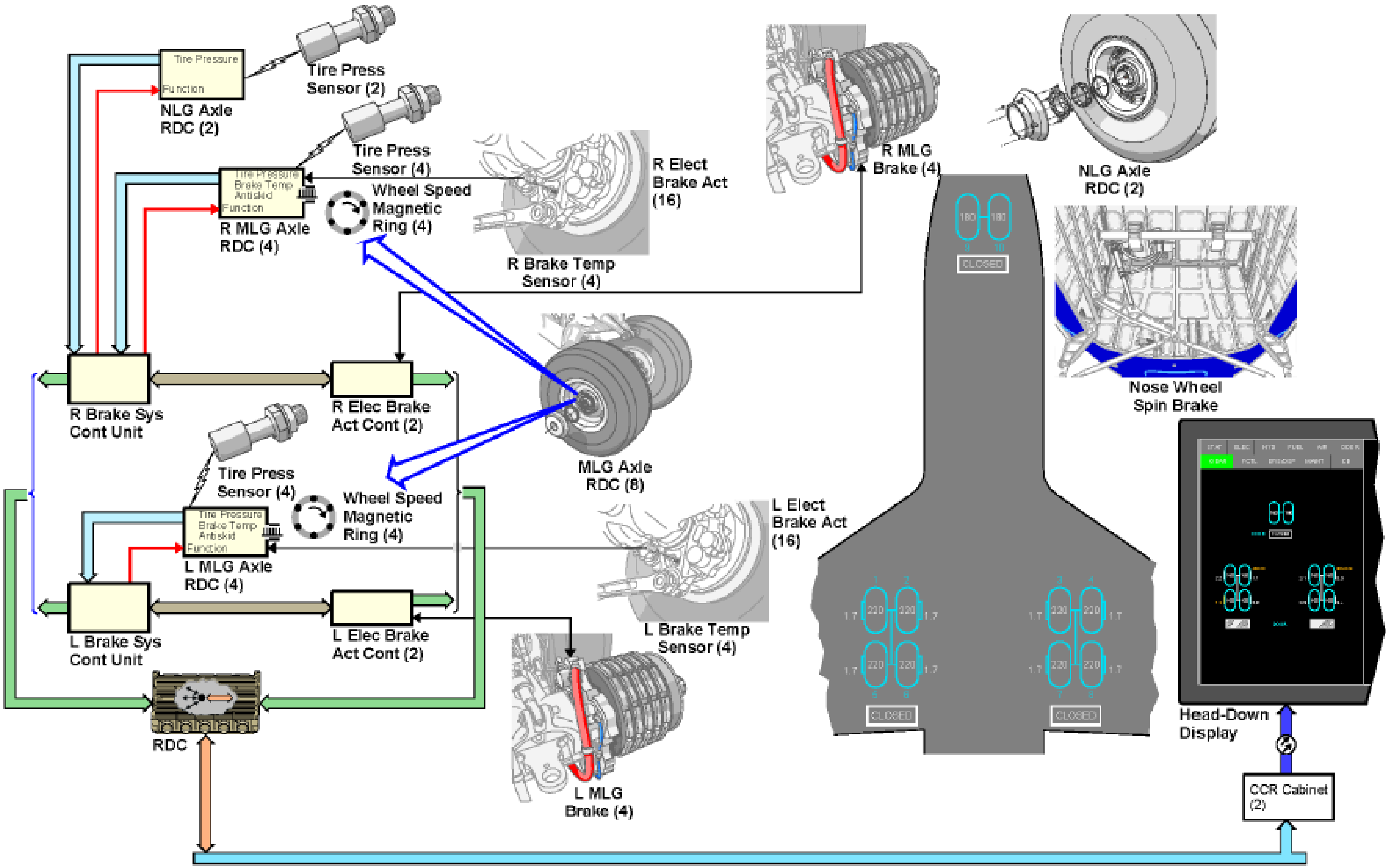
The main gear ARDCs measure wheel speed and perform antiskid control.

The BSCUs connect by data buses to the ARDCs and provide power.

Electro Mechanical Braking System (EMBS)

The EMBS consists of four EBACs and 32 Electric Brake Actuators (EBA), four per main wheel brake.

The EBAs give braking force to the carbon discs and are controlled by the EBACs. The EBAs are a brushless DC motor.


Tire Pressure
Function
NLG Axle
RDC (2)
Tire Press
Sensor (2)
Tire Press
Sensor (4)
Tire Pressure
Brake Temp
Antiskid
Function
R MLG Axle
RDC (4)
Wheel Speed
Magnetic
Ring (4)
R Elect
Brake Act
(16)
R Brake Temp
Sensor (4)
R MLG
Brake (4)
NLG Axle
RDC (2)
Nose Wheel
Spin Brake
R Brake Sys
Cont Unit
R Elec Brake
Act Cont (2)
MLG Axle
RDC (8)
Tire Press
Sensor (4)
Wheel Speed
Magnetic
Ring (4)
Tire Pressure
Brake Temp
Antiskid
Function
L MLG Axle
RDC (4)
L Elect
Brake Act
(16)
L Brake Sys
Cont Unit
L Elec Brake
Act Cont (2)
L Brake Temp
Sensor (4)
L MLG
Brake (4)
RDC
CLOSED
Head-Down
Display
CCR Cabinet
(2)

Wheels and Brakes

Wheels, Tires and Axles

The airplane has 10 wheels and tires. Two wheels are on the Nose Landing Gear (NLG) and eight are on the Main Landing Gear (MLG).

The wheels have two halves that bolt together. Each wheel has:

- A tire fill valve
- An over-pressure valve
- A Tire Pressure Sensor (TPS).

The nose and main gear have Axle Remote Data Concentrators (ARDC) that attach to the mounting adapter that is installed onto each axle. Power and CAN bus signals go to the ARDC through a connector on the back side of the unit.

The ARDCs have an antenna in their outer rim that communicates with the TPS.

The MLG includes a magnet ring. The MLG ARDC uses the magnet ring to measure wheel speed. The MLG ARDCs also monitor the MLG brake temperature sensor.

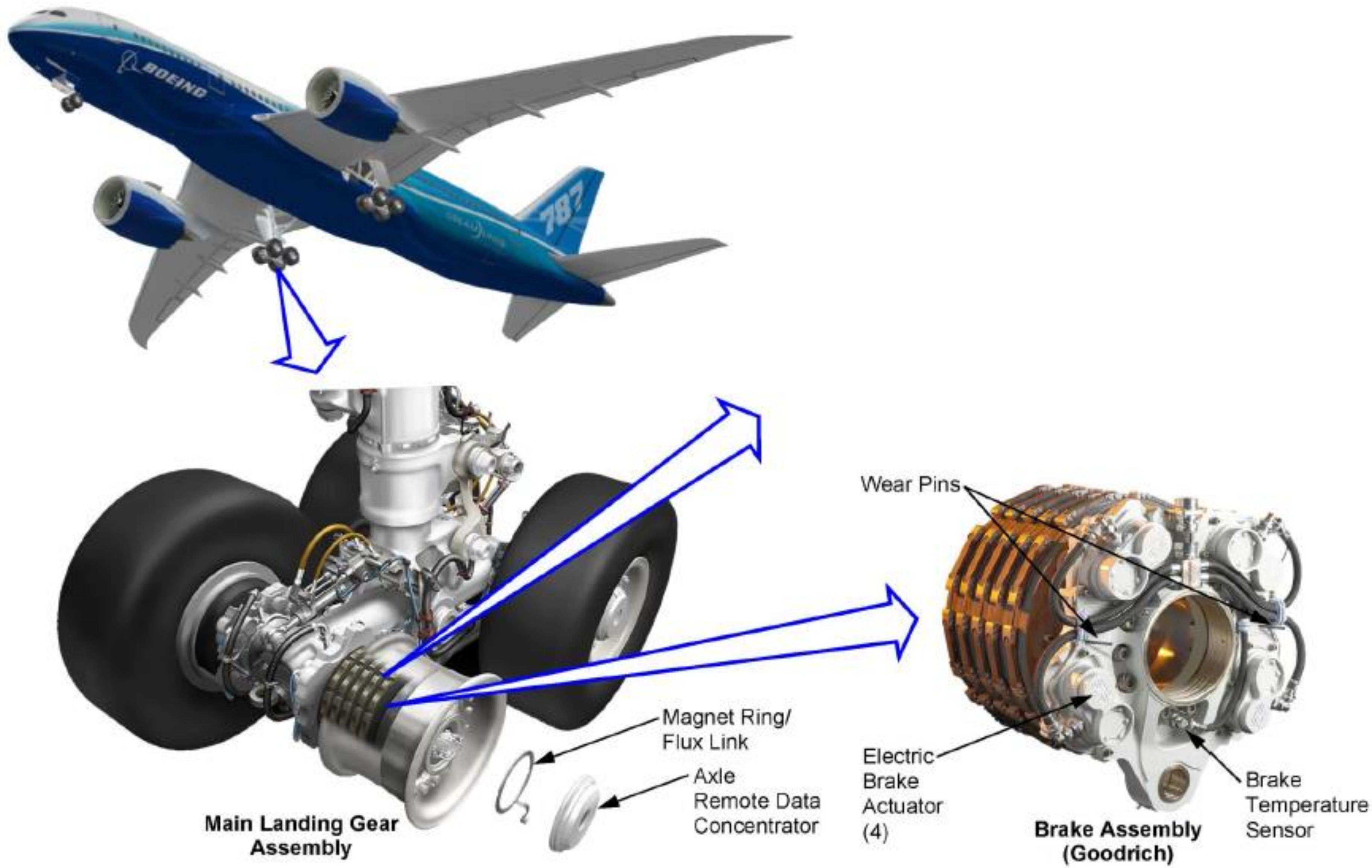
Electro Mechanical Brakes

Each of the eight MLG brakes is an electrically actuated, multiple disc carbon brake. Each brake has:

- Four Electric Brake Actuators (EBA)
- Wear pins
- Brake temperature sensor
- Rotors and stators.

The four EBAs incorporate a DC motor and mount to the brake assembly actuator housing. When energized, the EBAs create a clamping force against the brake assembly.

The EBAs use power only when they change position.


Wear Pins
Magnet Ring/
Flux Link
Axle
Remote Data
Concentrator
Electric
Brake
Actuator
(4)
Brake
Temperature
Sensor
Main Landing Gear
Assembly
Brake Assembly
(Goodrich)

Landing Gear and Brake Controls

The landing gear and brake controls in the flight compartment are in positions where both pilots can use them.

These are the controls in the flight compartment:

- Towing power switch on the P5 overhead panel
- Parking brake lever on the P9 forward aisle stand
- Landing gear lever on the P2 center instrument panel
- Landing gear lever lock override switch on the P2 panel
- Alternate landing gear release switch on the P2 panel
- Autobrake switch on the P2 panel
- Captain and First officer rudder/brake pedals

Description

The towing power switch controls battery power to the electric brake system during towing operations.

The parking brake lever lets the pilots set and release the parking brake.

The landing gear lever lets the pilots raise and lower the landing gear.

The landing gear lever lock override switch lets the pilots raise the landing gear lever. The switch lets the pilots move the lever if the lever lock does not release after takeoff.

The alternate landing gear release switch lets the pilots extend the landing gear with center hydraulic system pressure not available.

The autobrake switch lets the pilots arm the autobrake function for both takeoff and landing.

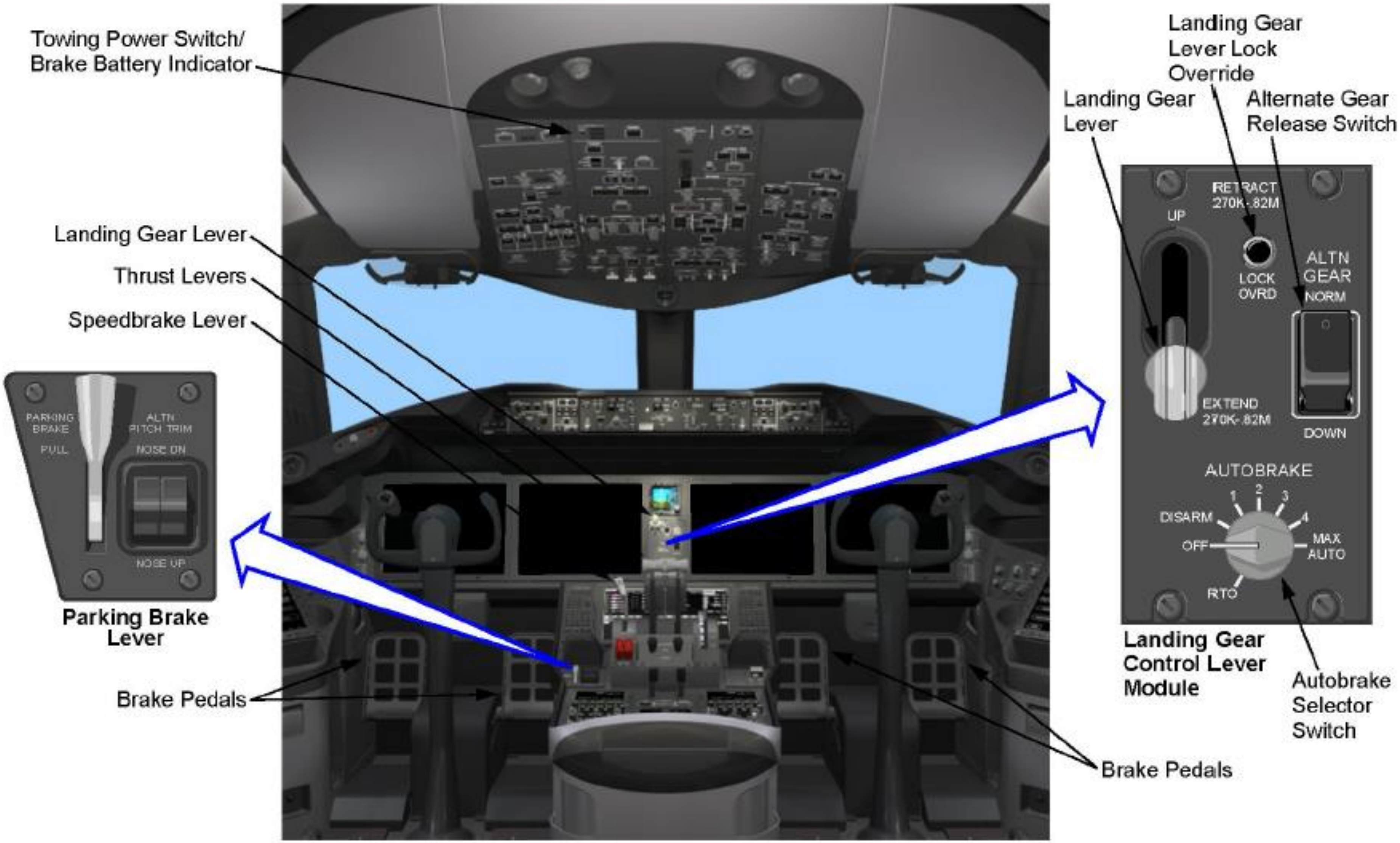
Operation

To set the parking brakes, the pilots push the brake pedals full travel. The pilots can then pull aft on the parking brake lever. When the lever aft and brake pedals are released, the parking brake is set.

The pilots raise the landing gear lever to raise the landing gear. This also activates the landing gear retract braking function.

The pilots pull and turn the autobrake switch to RTO on the ground before takeoff. The pilots turn the switch from 1 to MAX

AUTO in the air before landing. For autobrake to work, the airplane must be on the ground, with high wheel speed. The switch is not in OFF or DISARM, and both thrust levers are at IDLE. The pilots can disarm the autobrake by pushing the brake pedals, stowing the speedbrake lever, or turning the autobrake switch to OFF.


Towing Power Switch/
Brake Battery Indicator
Landing Gear Lever
Thrust Levers
Speedbrake Lever
PARKING BRAKE
PULL
ALTN PITCH TRIM
NOSE DN
NOSE UP
Parking Brake Lever
Brake Pedals
Landing Gear Lever Lock Override
Landing Gear Lever
Alternate Gear Release Switch
RETRACT 270K-.82M
UP
LOCK OVRD
ALTN GEAR
NORM
EXTEND 270K-.82M
DOWN
AUTOBRAKE
1
2
3
4
DISARM
OFF
MAX AUTO
RTO
Landing Gear Control Lever Module
Autobrake Selector Switch
Brake Pedals

Landing Gear and Brake Indication

The landing gear indication system shows data for these different landing gear components:

- Nose Landing Gear (NLG) position
- Main Landing Gear (MLG) position
- NLG and MLG door position
- Parking brake off or on and set
- NLG and MLG tire pressures
- MLG brake temperatures
- Autobrake and antiskid faults.

Hosted functions in the Common Core System (CCS) send this data for display to the Display Crew Alerting System (DCAS). Indications and messages appear on the Head- Down Displays (HDD).

DESCRIPTION

These components send landing gear indication data to the CCS:

- Landing gear lever position switches
- Proximity sensors
- Tire pressure sensors
- Brake temperature sensors
- Proximity Sensing Data Concentrators (PSDC)
- Axle data concentrators
- Brake System Control Units (BSCU)
- Remote Data Concentrators (RDC).

For redundancy, there are two channels of proximity sensors for the landing gear and door positions.

The NLG shows down and locked when the drag braces are overcenter, the sensors show target near, and the lock link over-center with the sensors showing target near. The NLG shows up and locked when drag brace sensors show target far, the lock link overcenter, and the sensors show target near.

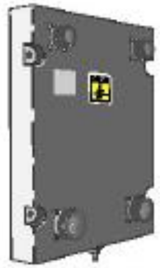
The MLG shows down and locked when the side braces and drag braces are down and over-center, and the sensors show target near. The MLG shows up and locked when the uplock is engaged and the sensors show target near.

Separate proximity sensors appear when the landing gear doors are closed, or not closed (open).

Parking brake indications appear on the HDD and on the NLG strut panel. A blue light on the panel appears when the parking brakes are off. Amber and red lights appear when the parking brake is set and on.

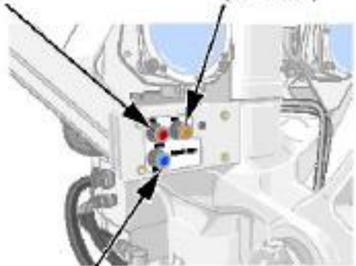
Tire pressure sensors transmit wireless pressure data to the NLG and MLG axle RDCs.

Thermocouples send brake temperature data to the MLG axle RDCs. The axle RDCs send this data to BSCUs. The BSCUs send the data to the CCS through RDCs.

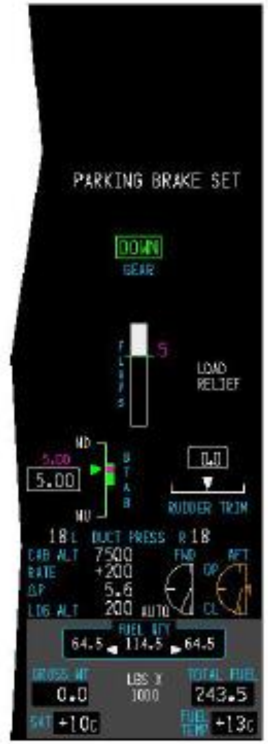


Brake System Control Unit (BSCU)

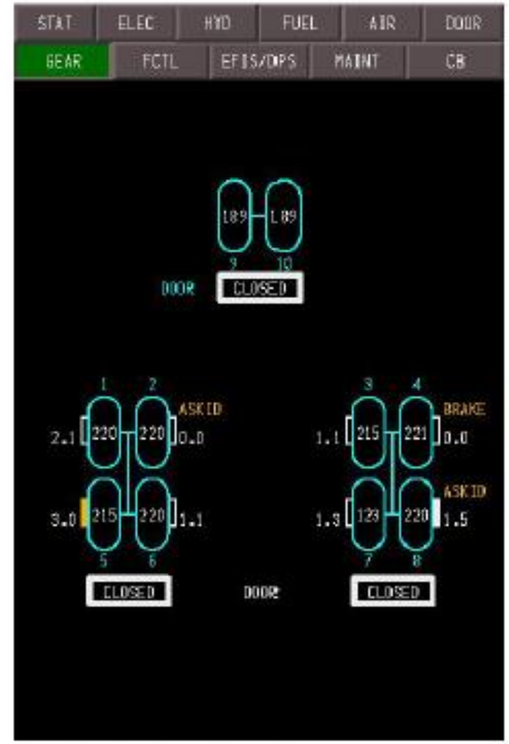
Parking Brake Lever



Nose Wheel Brake Lights



EICAS



Landing Gear Synoptic

Axle RDC

Tire Pressure Sensor

	Brake Normal (White) - 0.0 to 4.9
	Hottest Brake (White) - 3.0 to 4.9 only one brake on each truck at a time
	Brake Overheat (Amber) - > 5.0

Nose Wheel Steering

The Nose Wheel Steering (NWS) system provides directional control for these conditions:

- Ground taxi
- Initial takeoff roll
- Final landing rollout.

NWS control comes from these components:

- Captain steering tiller
- First officer steering tiller
- Both sets of rudder pedals.

The NWS system can move the nose wheels up to 70 degrees left or right of center using the steering tillers. The system can move the nose wheels up to 8 degrees left or right of center, with full deflection of a rudder pedal.

When there are no steering inputs, the nose wheels automatically center.

Description

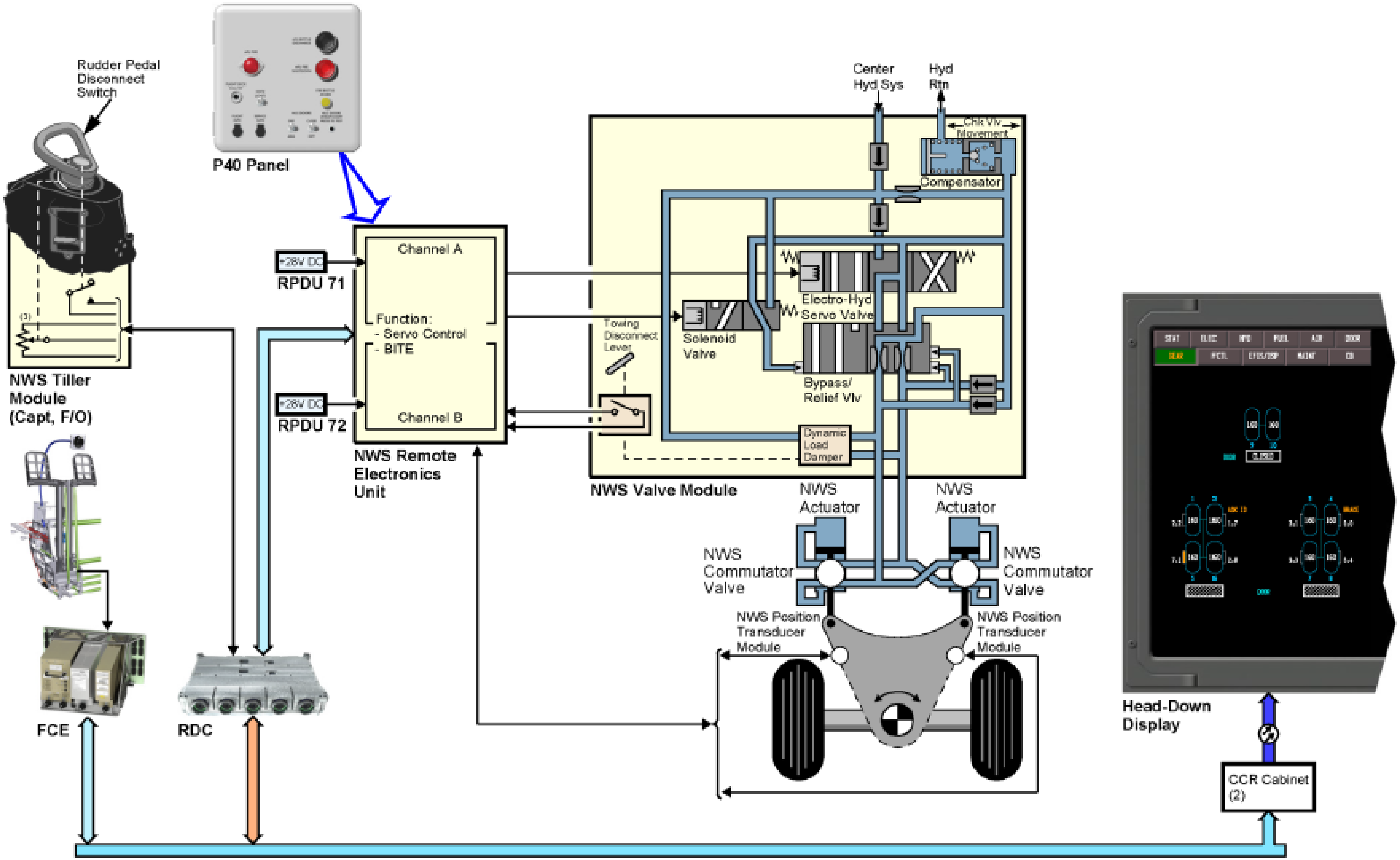
Hydraulic pressure to operate NWS comes from the center hydraulic system.

Tiller steering commands come from position potentiometers inside the NWS tiller modules. Rudder pedal steering commands come from rudder position sensors that go to the Flight Control Electronics (FCE) system. A rudder pedal disconnect switch on each tiller inhibits NWS operation on the ground when testing rudder travel with the rudder pedals.

The tiller, rudder pedal, and rudder pedal disconnect switch inputs go to the Common Core System (CCS).

The dual-channel NWS Remote Electronics Unit (REU) is in the P40 panel on the back of the Nose Landing Gear (NLG) strut. The REU gets NWS commands from hosted functions in the CCS. The REU sends control power to the NWS valve module when the airplane is on the ground. A towing disconnect lever inhibits steering control commands when set for towing.

The NWS REU uses a solenoid valve and an Electro-Hydraulic Servo Valve (EHSV) to control center hydraulic pressure to NWS commutator valves. The commutator valves direct the hydraulic pressure to two NWS actuators regardless of nose wheel position. The actuators move the nose wheel to a commanded position. The REU uses two position transducer modules to compare actual nose wheel position with commanded position for feedback. A compensator holds the nose wheel at a commanded position without additional steering command inputs. A dynamic load damper helps to dampen out nose wheel shimmy at high speeds. A bypass valve lets the nose wheel turn without hydraulics.


Rudder Pedal Disconnect Switch
P40 Panel
NWS Tiller Module (Capt, F/O)
+28V DC
RPDU 71
+28V DC
RPDU 72
Channel A
Function:
- Servo Control
- BITE
Channel B
NWS Remote Electronics Unit
Center Hyd Sys
Hyd Rtn
Chk Vlv Movement
Compensator
Electro-Hyd Servo Valve
Solenoid Valve
Towing Disconnect Lever
Bypass/ Relief Vlv
Dynamic Load Damper
NWS Valve Module
NWS Actuator
NWS Actuator
NWS Commutator Valve
NWS Commutator Valve
NWS Position Transducer Module
NWS Position Transducer Module
FCE
RDC
Head-Down Display
CCR Cabinet (2)