EFFECTIVITY:ALL

EMERGENCY/PARKING BRAKE SYSTEM

Introduction

The emergency/parking brake subsystem function is to provide an alternative way to stop the aircraft in case of main brake system failure, and to provide means to keep the aircraft parked even when the hydraulic power system is turned off.

The figure EMERGENCY/PARKING BRAKE SYSTEM - INTRODUCTION provides further data on the preceding text.

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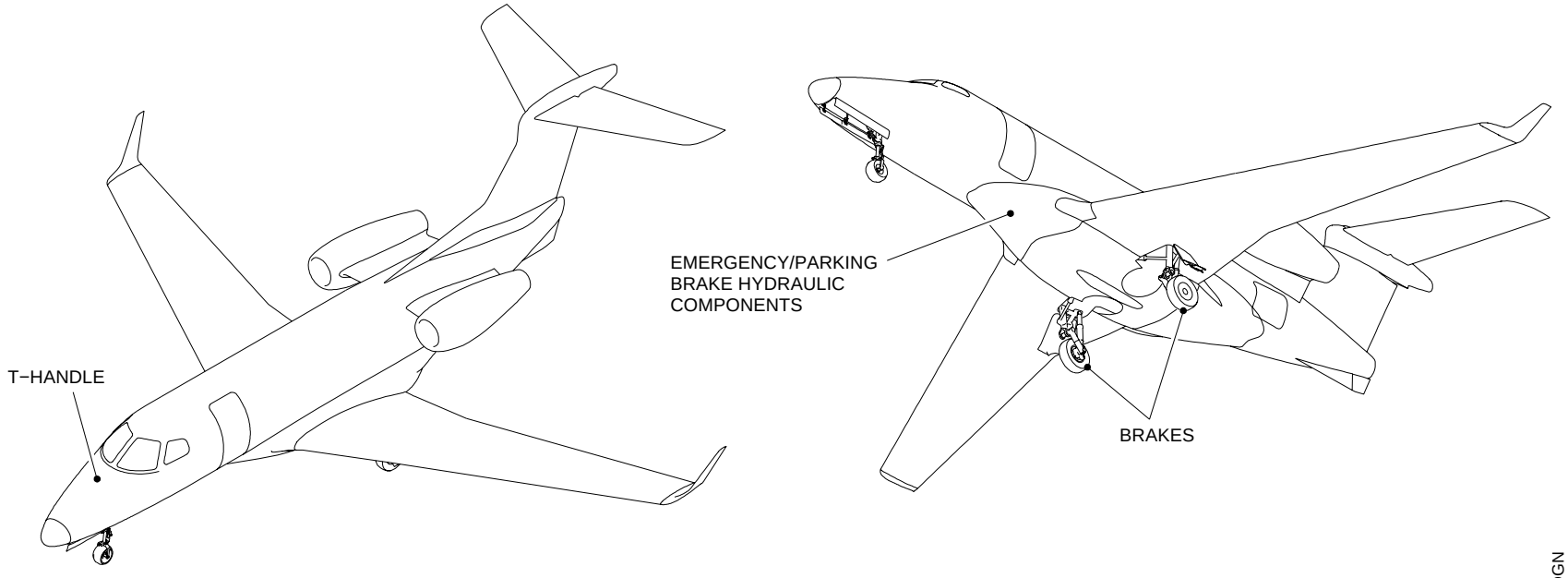

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Selected Aircraft: 165

EMERGENCY/PARKING BRAKE SYSTEM - INTRODUCTION

General Description

A pilot operated T-handle controls actuation of the emergency/parking brake system. The T-handle is located at the control pedestal and is mechanically linked to the emergency/parking brake valve through a cable, which is guided by pulleys.

To use the parking brake function, the pilot pulls the handle until the end of the stroke and rotates 90 degrees right (clockwise) to lock it at the fully applied position. To release the handle from the actuated position it has to be pulled a little bit more, rotated 90º to the left (counter clockwise) and returned to the stowed position. This feature avoids inadvertent release of the system.

To use the emergency brake function, the pilot pulls the handle until the “PARK BRAKE” lamp illuminates, which indicates that the pressure is equal to or higher than the brake contact pressure. Established the reference point, the pilot can increase the brake command pressure by moving the handle up, or decrease this pressure by moving the handle down.

SYSTEM INTERFACES

The emergency/parking brake subsystem has the following interfaces:

HYDRAULIC INTERFACES

The pressure to the emergency/parking brake subsystem is supplied through a check valve installed in its pressure line.

ELECTRICAL INTERFACES

The Pressure Transducer and the Pressure Switch send signals to, and receive electrical power from the GEA (Garmin Engine/Airframe unit) 2.

NORMAL OPERATION

In case of loss of hydraulic power, the emergency brake system is available. However, due to the accumulator size, the amount of hydraulic power available is limited. Therefore, it is not recommended taxiing the aircraft after the landing stop.

The brake accumulator is able to provide hydraulic power for at least 6 brake applications at full lever stroke.

CAS (Crew Alerting System) MESSAGES

The CAS indications are generated to indicate a failure condition for the flight crew to perform appropriate corrective actions.

The following CAS messages related to the emergency/parking brake subsystem can be generated:

- “EMER BRK LO PRES” - CAUTION: This message appears when the gas chamber pressure of the hydraulic accumulator is less than 1,800 psi.
- “PARK BRK NOT REL” - ADVISORY: This message appears when the aircraft is configured for takeoff and the brakes are not released.

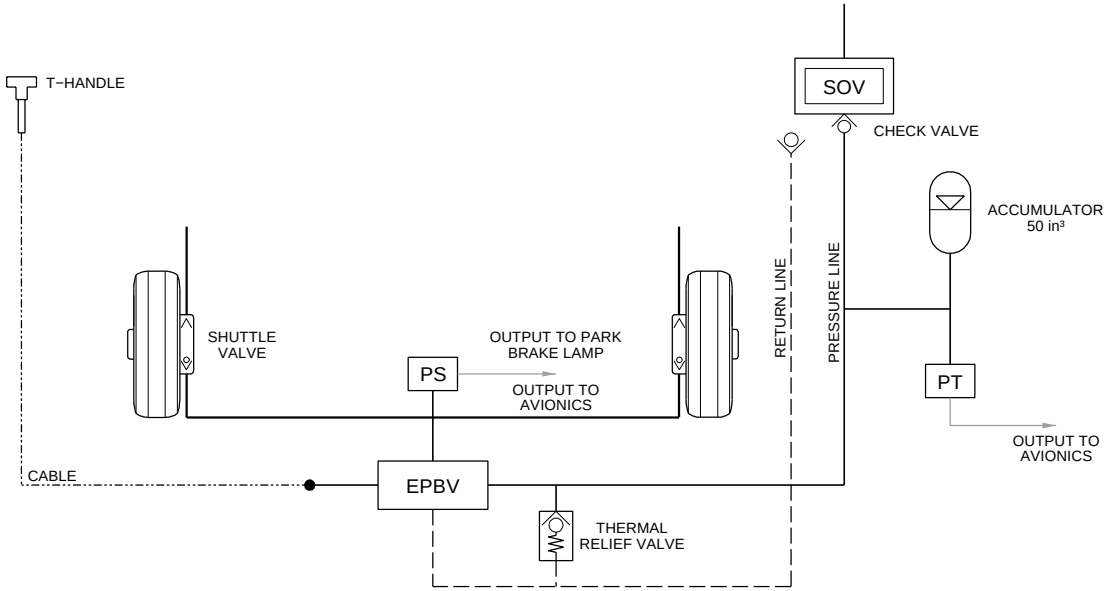
AURAL WARNING

The following Aural Warning message related to the emergency/parking brake subsystem can be generated:

- “NO TAKEOFF BRAKES”: This aural warning comes on when the aircraft is configured for takeoff and the brakes are not released.

The figure EMERGENCY/PARKING BRAKE SYSTEM - SCHEMATIC OF THE SYSTEM provides further data on the preceding text.

EFFECTIVITY:ALL



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EMERGENCY/PARKING BRAKE SYSTEM - SCHEMATIC OF THE SYSTEM

Components

T-HANDLE AND CABLE

The pilot operated T-handle controls the emergency/parking brake valve actuation. A mechanical lock is provided at the end of the stroke, by turning the handle clockwise. To release the brakes, the handle shall be rotated counterclockwise in combination with a pulling movement. A spring located inside the emergency/parking brake valve automatically stows the handle.

The connection between the emergency/parking brake valve and handle is done by means of a steel cable, guided through pulleys. One end of the cable connects to the output link of the T-handle via a clevis and pin, and the other end of the cable connects to the brake valve pulley cam by means of a ball end.

EMERGENCY/PARKING BRAKE VALVE

The emergency/parking brake valve is manually operated by the pilot through a T-handle located at cockpit center pedestal.

There are three (3) ports in the valve's body:

- Supply port: It is connected to the pipe which comes from the accumulator and provides hydraulic pressure.
- Brake port: It is connected to the pipe which goes to the brake assemblies. Upon operation of the valve, the hydraulic pressure is sent through this port.
- Return port: It is connected to the pipe which goes to the hydraulic system reservoir.

When the pilot actuates the T-handle, it generates a rotation of the valve pulley cam which causes a proportional displacement of a piston and a set of springs. The return port is closed and, the more the piston is displaced, the greater the pressure released through the brake port. When the valve is fully actuated (parking brake position), the pressure at the brake port is at pressure supply level.

When the valve is in the non-actuated position, the brake port is open to the return line.

ACCUMULATOR

This is a metal bellows-type accumulator with a volume of 50 in^3 (819.4 cm^3).

This type of construction provides a hermetically sealed accumulator factory-charged with gas (helium). These features eliminate the need of a gas pre-charge pressure check.

The accumulator volume capacity is able to provide at least six (6) full brake applications in case of hydraulic system failure, or to keep the aircraft parked for a 24-hour period (considering a slope of 5 degrees).

THERMAL RELIEF VALVE

The thermal relief valve is a pressure-actuated, two-way, relief valve, with two (2) hydraulic ports that connect the hydraulic line of the accumulator to the hydraulic system return line. It operates when pressure increases due to temperature variation in order to protect hydraulic components from overpressurization.

CHECK VALVE

The check valve is an in-line mounted component with a spherical seat seal that provides sealing efficiency in one direction and flow in the opposite direction.

EMERGENCY/PARKING BRAKE SYSTEM SHUTOFF VALVE

A solenoid-type shutoff valve, two-way two-position, normally closed, is installed in the system to segregate the hydraulic system from emergency/parking brake system in order to ensure that the hydraulic system will be available even if a leakage occurs on the emergency line downstream of the check valve.

PRESSURE TRANSDUCER

The pressure transducer provides electrical information proportional to the pressure sensed at the emergency brake line. It is installed downstream of the accumulator.

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Its information is presented to the pilot on the Multifunction Display (MFD) in the synoptic status page.

The transducer is hermetically sealed.

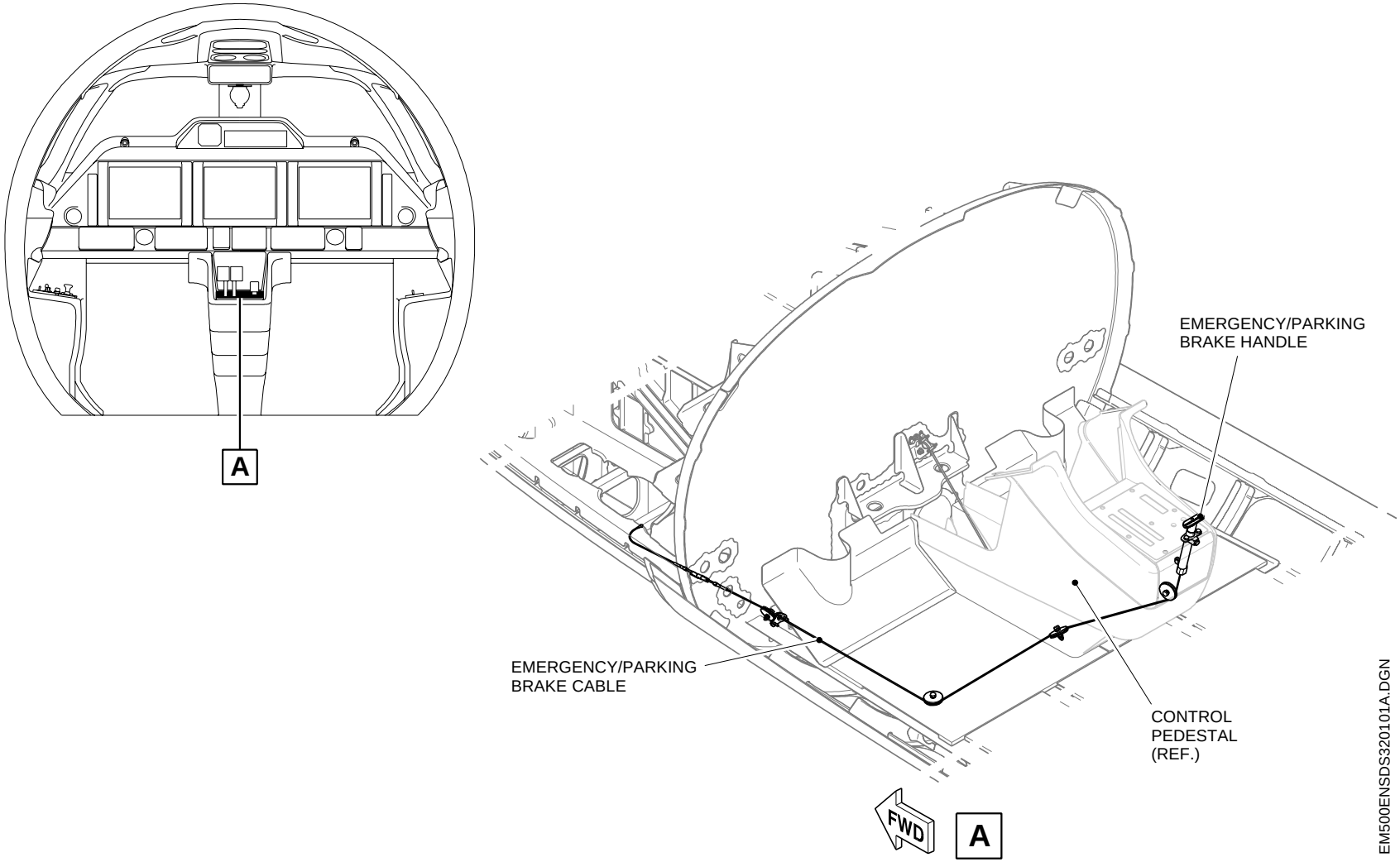
PRESSURE SWITCH

The pressure switch has a piston-type sensing element and is used to indicate emergency/parking brake application when hydraulic pressure increases in the brake line. It is located in the wing-to-fuselage fairing.

The processed signal of the pressure switch is used to illuminate the “PARK BRAKE” lamp on the cockpit.

The figure EMERGENCY/PARKING BRAKE SYSTEM - COMPONENTS POSITION provides further data on the preceding text.

EFFECTIVITY:ALL



EMERGENCY/PARKING BRAKE SYSTEM - COMPONENTS POSITION – Sheet 1

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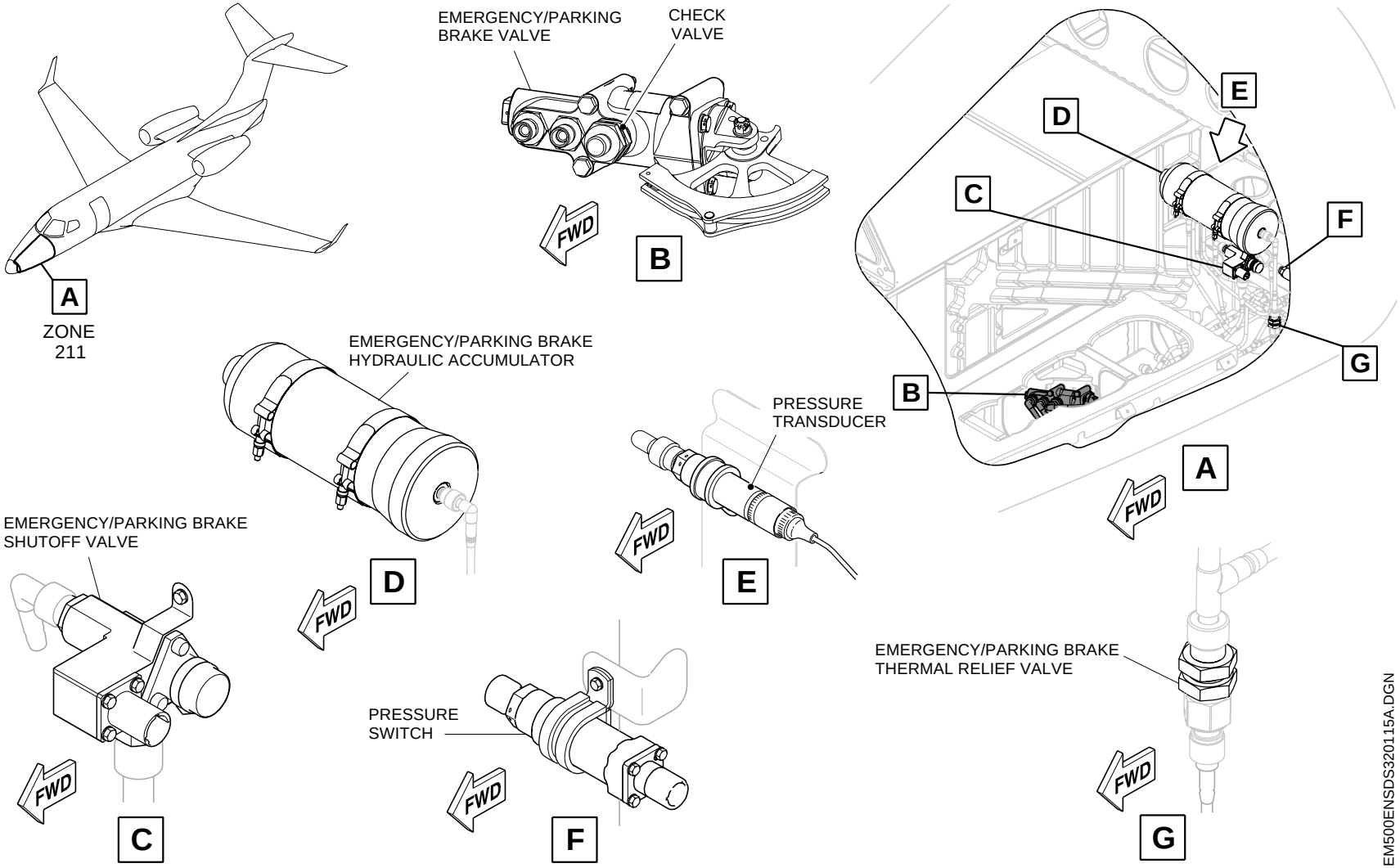

EMERGENCY/PARKING BRAKE SYSTEM - COMPONENTS POSITION – Sheet 2

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EFFECTIVITY:ALL

MAIN BRAKE SYSTEM

EFFECTIVITY:ALL

Introduction

The main brake subsystem function is to control hydraulic pressure to the brakes as a function of brake pedal displacement and to provide anti-skid protection to prevent main tires skidding during braking and minimize stopping distance.

The main brake subsystem operates with hydraulic fluid. Hydraulic power, supplied at 3,000 psi (20.69 MPa (Megapascal)) maximum, is provided by the hydraulic power subsystem through a constant flow engine driven pump. For details, see AMM SDS 29-10-00/1.

The figure MAIN BRAKE SYSTEM - INTRODUCTION provides further data on the preceding text.

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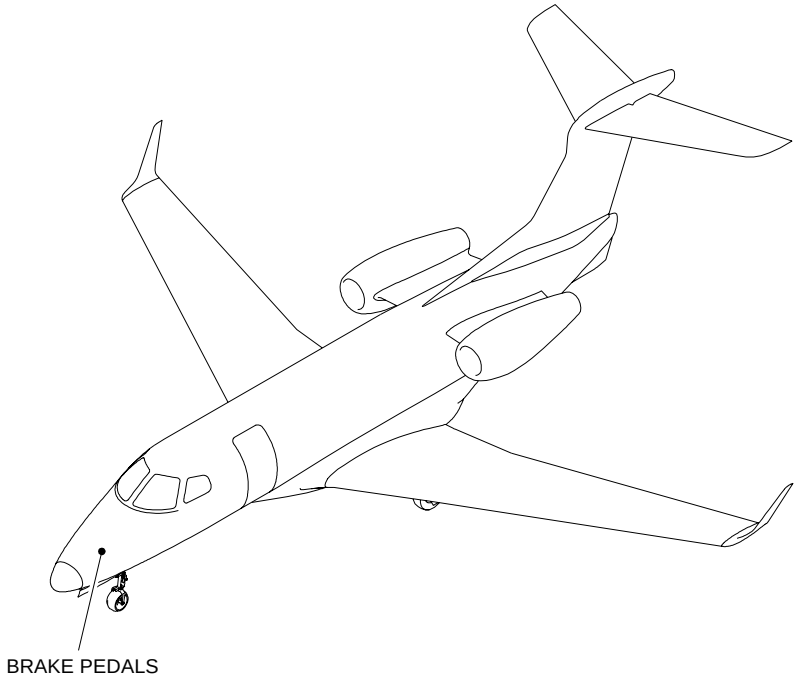

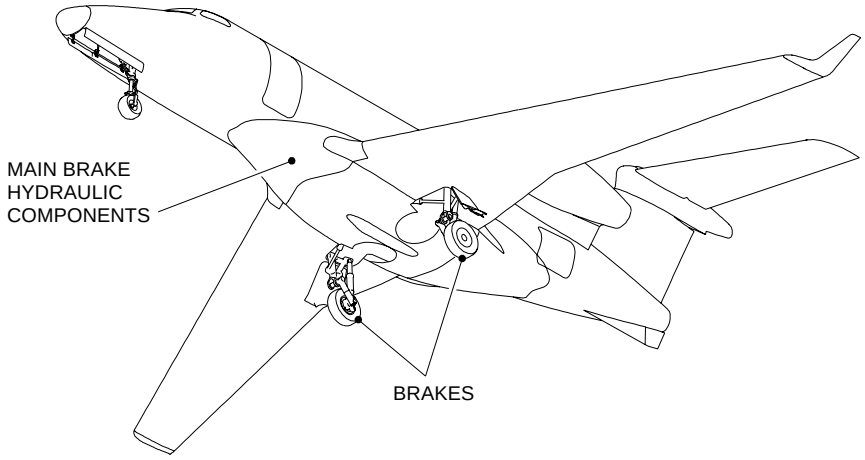

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Selected Aircraft: 165

MAIN BRAKE SYSTEM - INTRODUCTION

General Description

The main brake subsystem delivers hydraulic pressure to the brakes as a function of the brake pedals input.

Each brake pedal of the pilot station is connected to a pedal position transducer (PPT (Pedal Position Transducer)), one for the left brake pedal and one for the right brake pedal. Each copilot station brake pedal is mechanically linked to the respective pilot station brake pedal.

Two brake pedals PPTs (dual coil LVDT (Linear Variable Differential Transducer)) provide the LH (Left-Hand)/RH (Right-Hand) brake pedal displacement information to the BCU (Brake Control Unit). The Pedal Position Transducer produces an electrical output proportional to the position of the corresponding pedal. Each PPT produces two independent outputs for redundancy.

The subsystem provides differential brake capability for aircraft directional control from either pilot or copilot station brake pedals. Pressure to the right hand brake is controlled through the right hand brake pedals, and pressure to the left hand brake is controlled through the left hand brake pedals.

The main brake subsystem is a brake-by-wire type equipped with antiskid functionality to prevent tire skidding and minimize stopping distance. The subsystem is electronically controlled by a digital Brake Control Unit (BCU), which controls both left and right hand brakes independently.

Wheel speed information is derived from two axle mounted wheel speed transducers, each one of them driven by the associated hubcap which is integral to the wheel assembly. These transducers are variable reluctance devices whose outputs are sent to the BCU.

Hydraulic pressure is available to the BCV (Brake Control Valve) through a brake SOV (Shutoff Valve), electronically controlled by the BCU. This SOV provides pressure only when the pedals are pressed and the aircraft is on ground. It also provides pressure to the BCVs during the BCU built in tests. In case of failure or leakage in the main brake subsystem, the SOV prevents this problem from affecting the other hydraulic consumers.

Each wheel brake is commanded by a dedicated, electrohydraulic Brake Control Valve (BCV). The BCU measures the output from the wheel speed transducer, pedal transducer and pressure transducer and provides a commensurate electrical command to the associated BCV.

Brake pressure information is derived from two brake pressure transducers installed on the brake line downstream of the brake control valves. The output of each transducer is a current signal proportional to the commanded brake pressure and is sent to the BCU.

Wheel speed information is derived from two axle mounted wheel speed transducers, each one of them driven by the associated hubcap which is integral to the wheel assembly. These transducers are variable reluctance devices whose outputs are sent to the BCU.

Check valves are provided on the return port of the hydraulic components to prevent backflows to the brakes, which could cause inadvertent brake application.

The main Brake subsystem has the functionalities described below:

ANTISKID PROTECTION

The antiskid control function, which is provided by the Brake Control Unit (BCU), is a fully proportional adaptive closed loop control system that provides efficient braking under all runway conditions.

The signals which control the left and right brake valves are derived from all input signals entering the BCU. The primary input signal is the Brake Pedal signal and it sets the level of the valve current output. The higher the Brake Pedal signal the higher the valve current signal. All of the other input signals to the BCU modify the valve current being commanded by the brake pedal.

If a skid is detected by the BCU, by comparing the signal from the two Wheel Speed Transducers, the signal to the BCV is modified to reduce the pressure to the brakes below the skid threshold.

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In case of a wheel speed failure the antiskid function is disabled, because there is no way to monitor tire skids.

In case of a too low brake pressure for the commanded pedal input, the Brake Pressure Transducer input causes the valve signal development to modify the valve current by increasing its output to raise the pressure to the brake.

The system provides antiskid protection when both wheel speed reference speeds are above 30 kt during acceleration. The antiskid function is available during all the braking action, and there are no means to turn it off from the cockpit controls.

In case of any pressure transducer fault, the Pressure Feedback Function becomes inactive and the antiskid relies only on the wheel speed information. The function remains inactive until a complete Start-Up test or In-Flight Test is performed satisfactorily.

The anti-skid dropout velocity is 10 kt.

LOCKED WHEEL PROTECTION

The locked wheel protection relieves brake pressure to recover deep skid which would result in a locked wheel condition that the anti-skid function alone could not prevent.

Individual locked wheel protection is provided.

A locked wheel condition exists when the wheel speed of either wheel drops to less than 30% of the reference velocity. A reference velocity for the wheels is defined as the speed that the wheel would have with negative acceleration of 25 ft/sec^2 (7.62 m/sec^2).

The dropout speed for this functionality is 30 kt, allowing differential braking.

TOUCHDOWN PROTECTION

The touchdown protection function allows the wheels to spin up/rotate at touchdown even if the pilot commands braking through the brake pedals prior to touchdown. This avoids tire blow out condition at touchdown.

Touchdown protection is provided to prevent any brake application prior to weight-on-wheels or before the main wheels have spun up.

GEAR RETRACT BREAKING

Gear retract braking function provides a brake pressure application during gear retraction to stop the wheels rotation before it enters into the wheel well.

If both WOW (Weight-on-Wheels) indicates airborne and the gear select input changes state from down to up selected, the BCU algorithm apply a ramped pressure demand to stop the wheels.

Failure of gear handle discrete to “down” will result in loss of in flight brake function.

The gear retract braking sequence is started 5 seconds after the transition of the gear signal from down to up selection. The gear retract braking sequence is terminated 10 seconds after the transition of the gear signal from down to up selected.

NOTE: The NLG (Nose Landing Gear) bay has a nose wheel spin brake pad to stop the NLG wheel rotation when it enters in the wheel well during the gear retraction. For more information refer to AMM SDS 32-21-00/1.

INTEGRATED MAINTENANCE / BIT (Built-in Test)

The main brake subsystem provides the fault monitoring, functional consequence, failure indications and status indications for the individual LRU (Line Replaceable Unit)s of the Main Brake subsystem.

The BIT functions consist of Start-Up Test, Continuous Test, or event initiated In Flight Test.

- Start-Up Test (ST (Start-Up Test)): The ST basic function is to test the BCU internal processing capability. This test does affect braking capability (momentarily). It is intended to be performed when the aircraft is stationary or at very low wheel speed.
- Continuous Test (CBIT (Continuous Built-In Test)): The purpose of the CBIT is to monitor the function of the BCS (Brake Control

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System) LRUs in its normal use (in the air or on the ground). The CBIT is a background test and does not interfere with braking control functions.

- In-Flight Test (IFT (In-Flight Test)): The purpose of the IFT is to check critical functions (i.e. operation of the SOV and BCVs) prior to landing.

The BIT provides fault isolation for the following LRUs, components of the Main Brake Control subsystem and the interconnection between components of the BCS.

- Brake Control Unit
- Wheel Speed Transducers
- Pedal Position Transducers
- Discrete Inputs (WOW, Landing Gear Control Lever Position)
- Pressure Transducers
- Brake Control Valves
- Shutoff Valve

Isolated faults are reported to CMC (Central Maintenance Computer).

SYSTEM INTERFACES

The main brake subsystem has the following interfaces.

HYDRAULIC INTERFACES

The main brake subsystem interfaces with the hydraulic system through its hydraulic fitting ends and lines.

ELECTRICAL INTERFACES

The BCU is powered with 28 V DC from the DC Bus 2.

The BCU is electrically bonded by direct grounding to the aircraft structure.

NORMAL OPERATION

The brakes are actuated through the pedals installed in the cockpit. The pressure applied to the brakes are proportional to the pedal displacement, except when the pressure applied causes tire skidding. In this case the system dumps the pressure to a level that will avoid tire skidding.

ABNORMAL OPERATION

In case of an “ANTI-SKID FAIL” message, the brake is still available through pedals without anti-skid capability, requiring a smooth brake application.

In case of a hydraulic system loss, the “HYD LO PRESS” message appears in the CAS (Crew Alerting System) and the pilot may use the emergency/parking brake subsystem, which still has hydraulic energy for at least 6 brake applications through its accumulator.

In case of a failure which leads to a brake loss, the “BRAKE FAIL” message is displayed and the pilot reverts to the emergency/parking brake subsystem.

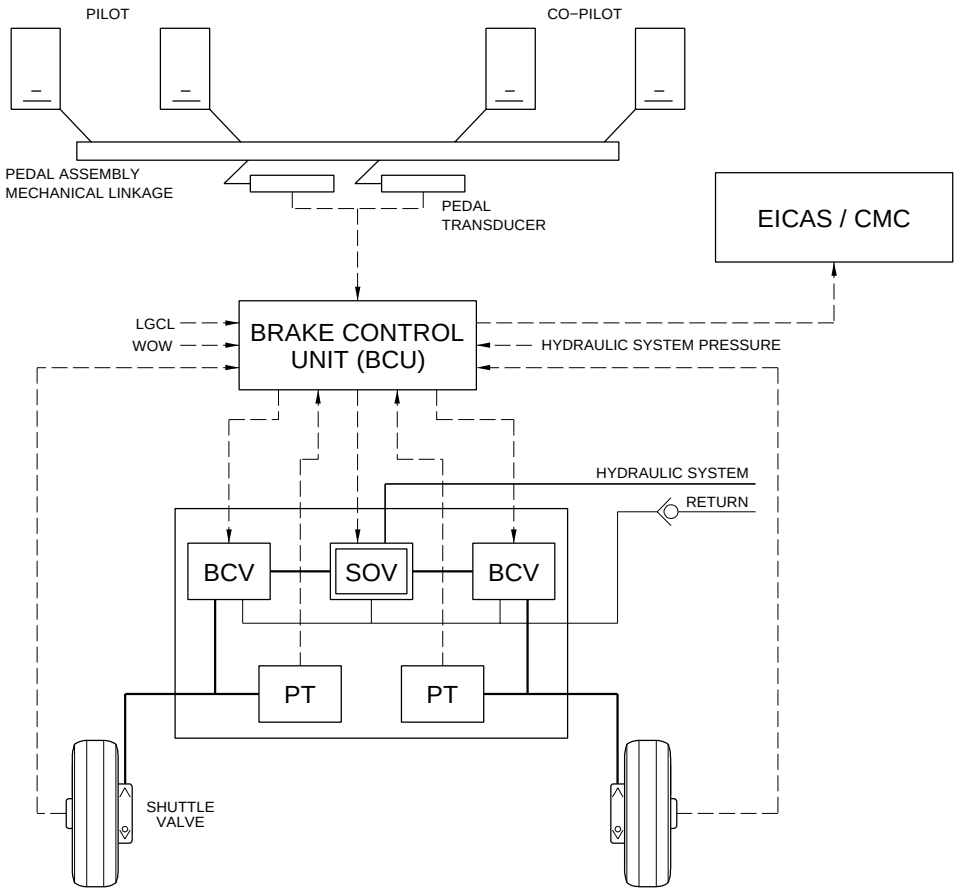
CAS MESSAGES

The CAS indications are used to indicate a failure condition so flight crew can perform appropriate corrective actions.

The following CAS messages related to the main brake subsystem can be generated:

- “ANTI-SKID FAIL” - CAUTION: When this message appears the brake is still available through pedals without anti-skid capability, requiring a smooth brake application.
- “BRK FAIL” - CAUTION: This message will be displayed whenever there is a failure which leads to a brake loss.

The figure MAIN BRAKE SYSTEM - SCHEMATIC OF THE SYSTEM provides further data on the preceding text.



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MAIN BRAKE SYSTEM - SCHEMATIC OF THE SYSTEM

Components

BRAKE CONTROL MODULE

The Brake Control Module comprises the following LRU:

- One (1) Shutoff Valve;
- Two (2) Brake Control Valves;
- One (1) Manifold;
- Two (2) Pressure Transducers.

MANIFOLD

The manifold is used for mounting the brake control module LRUs. It contains interconnecting ports to connect the shutoff valve, brake control valves, pressure transducers and the necessary hydraulic ports for connecting to aircraft hydraulic system.

PEDAL POSITION TRANSDUCER

The brake control unit interfaces with two pedal position transducers installed on the pilot pedals (pilot and copilot pedals are mechanically linked). Each PPT communicates through two separate channels.

The pedal position transducer has a dual redundant Linear Variable Differential Transformer (LVDT) and a return spring. The two LVDT segments inside a PPT are assembled in parallel and are subject to the same displacement.

The PPT provides an electrical signal to the BCU proportional to its displacement, which in turn is proportional to the brake pedal displacement.

The two signals are isolated outputs, and are used by the BCU to provide the correct hydraulic pressure commanded to the brakes and monitor the PPT to identify any failures.

BRAKE CONTROL UNIT

The Brake Control Unit is the device responsible of processing all the data sent by the BCS sensors (WST (Wheel Speed Transducer)s, PT (Pressure Transducer)s and PPTs) and landing gear system components (proximity switches, LGCL (Landing Gear Control Lever)) and provide an electrical signal to control the SOV and BCV pressure supply to the brakes.

The BCU contains two identical circuit card assemblies, each one with capability to accomplish all the BCU functions.

The BCU contains two electrical connectors. One is used for the BCU interfaces to the electrical system, avionics system and BCS components and the other is used for ground maintenance and download recorded data.

The BCU contains software functions for the brake application, anti-skid control, pressure feedback, touchdown protection, locked wheel protection, spin down control, built-in-test (BIT), continuous test (CBIT), startup test (ST) and in-flight test (IFT) for warning and maintenance purposes.

SHUT OFF VALVE

The SOV is a 3-way, 2-position, normally closed solenoid operated hydraulic valve that, when electrically actuated, allows hydraulic pressure to be supplied to the brake system. Conversely, the SOV allows hydraulic pressure (in the brake system) to be dumped to return if the electrical signal is removed.

When energized, the SOV provides full hydraulic system pressure to the brake control valves.

The SOV is electrically bonded to the aircraft structure through its the mounting surface.

The SOV incorporates the use of a check valve in the return port in order to prevent return line pressure surges from interfering with normal operation. The check valve is subjected to the tests as an internal part of the SOV.

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BRAKE CONTROL VALVE

The BCV is used to control pressure to individual brakes for normal aircraft braking. During normal operation, current supplied by the BCU dictates the proportional level of output pressure to be supplied to the wheel brake. The valve is also used to remove/release brake pressure when an indication of wheel skidding becomes present and the BCU identifies the pressure higher than desired.

The BCV is electrically bonded by direct grounding to the aircraft structure through the mounting surface of the BCV.

PRESSURE TRANSDUCER

The PT assembly is a hydraulic device that provides brake pressure information in the form of an electrical signal to the BCU.

The PT is provided with an adapter which is connected to the hydraulic line and provides the means to put in contact the sensing surface of the PT and the hydraulic fluid.

WHEEL SPEED TRANSDUCER

The WST is a single output, variable reluctance type signal generator. A drive cap provides the motion transfer from the wheel to the WST. The Wheel Speed Transducer is retained within the axle. The WST derives its energy from an internal permanent magnet and requires no external excitation for the signal generation.

The self-aligning coupling subassembly is solidly attached to the shaft of the WST, and assures proper motion transfer between the wheel drive cap and the WST by compensating for axial, parallel and angular misalignment between the center lines of the WST, the axle, and the wheel drive cap.

The WST is electrically bonded by direct grounding to the aircraft structure and through the mounting surface of the WST.

The figure MAIN BRAKE SYSTEM - COMPONENTS provides further data on the preceding text.

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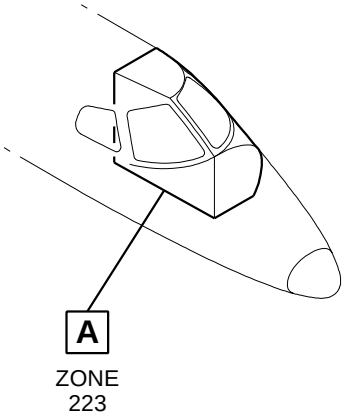

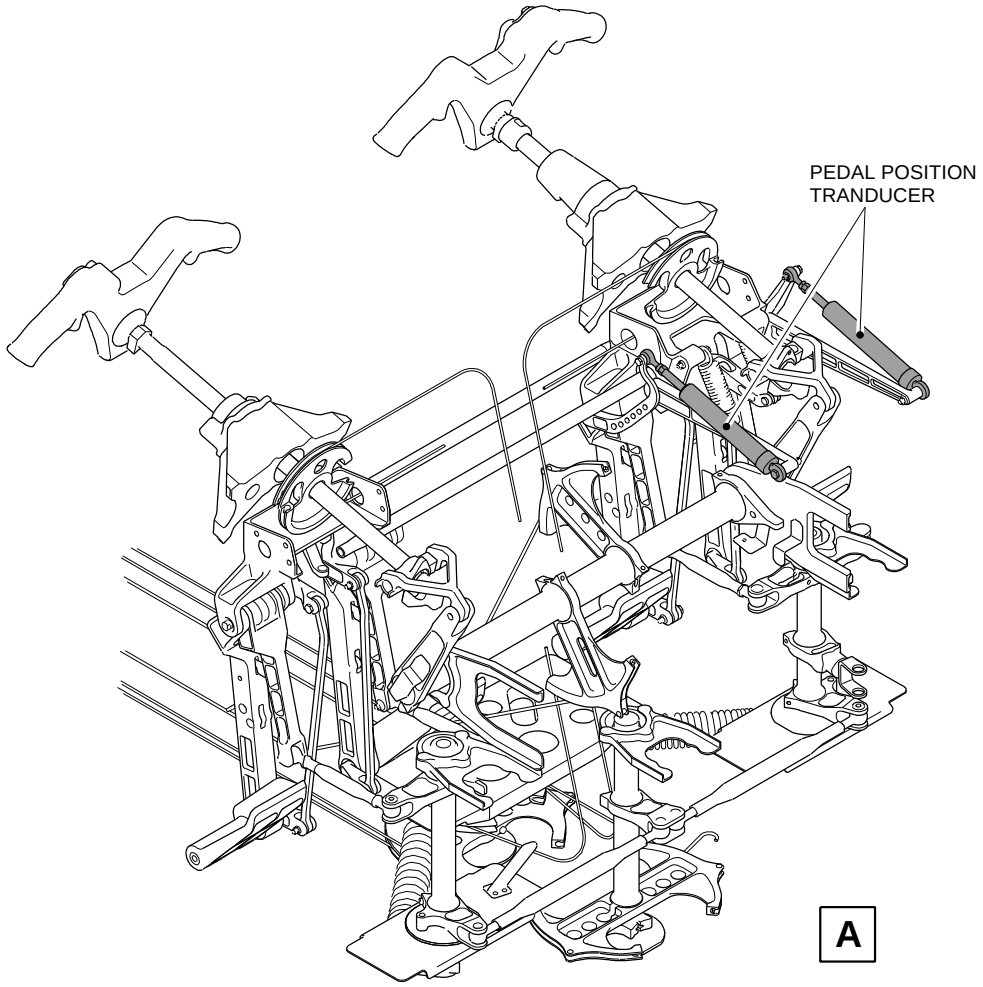

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MAIN BRAKE SYSTEM - COMPONENTS – Sheet 1

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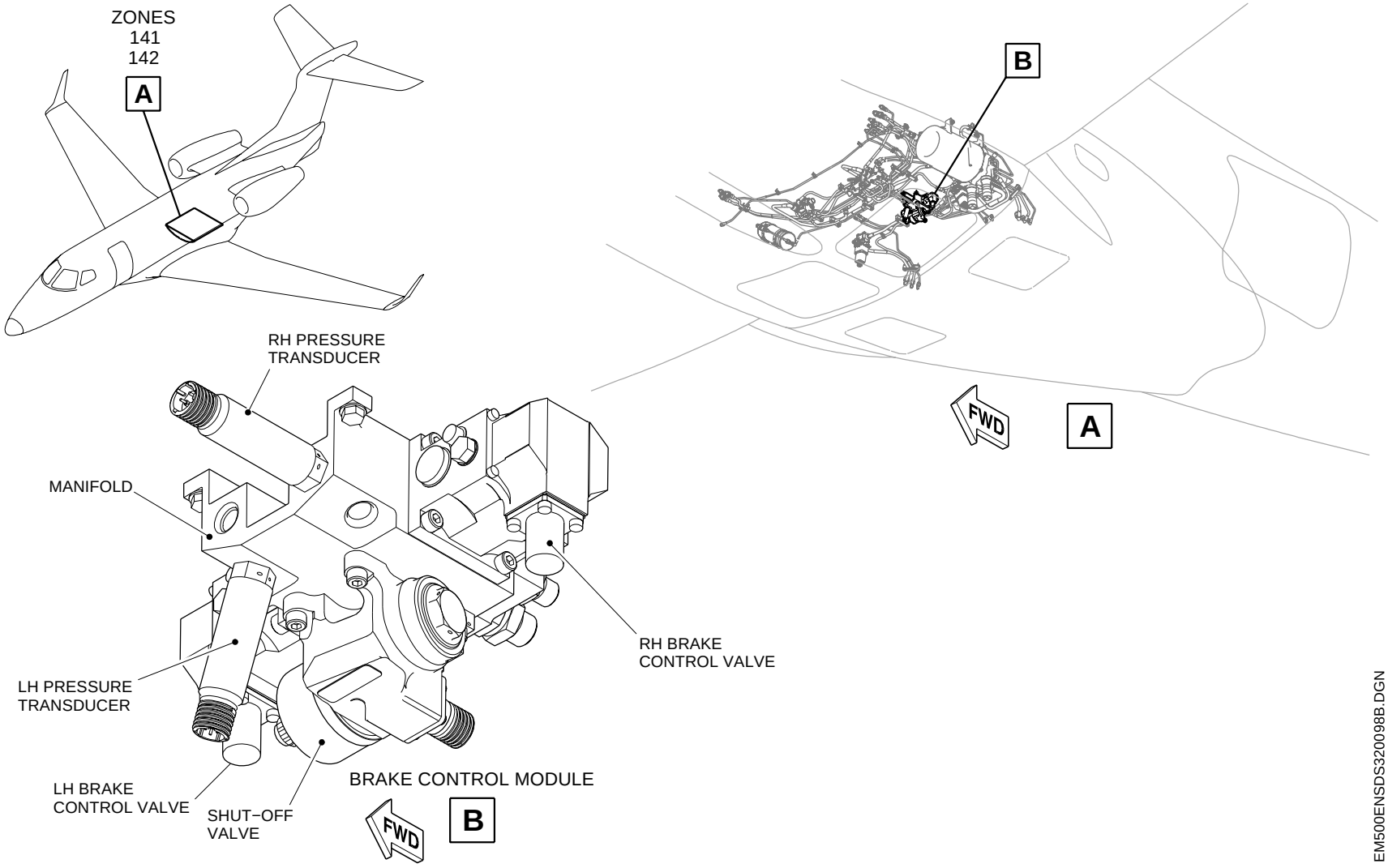

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MAIN BRAKE SYSTEM - COMPONENTS – Sheet 2

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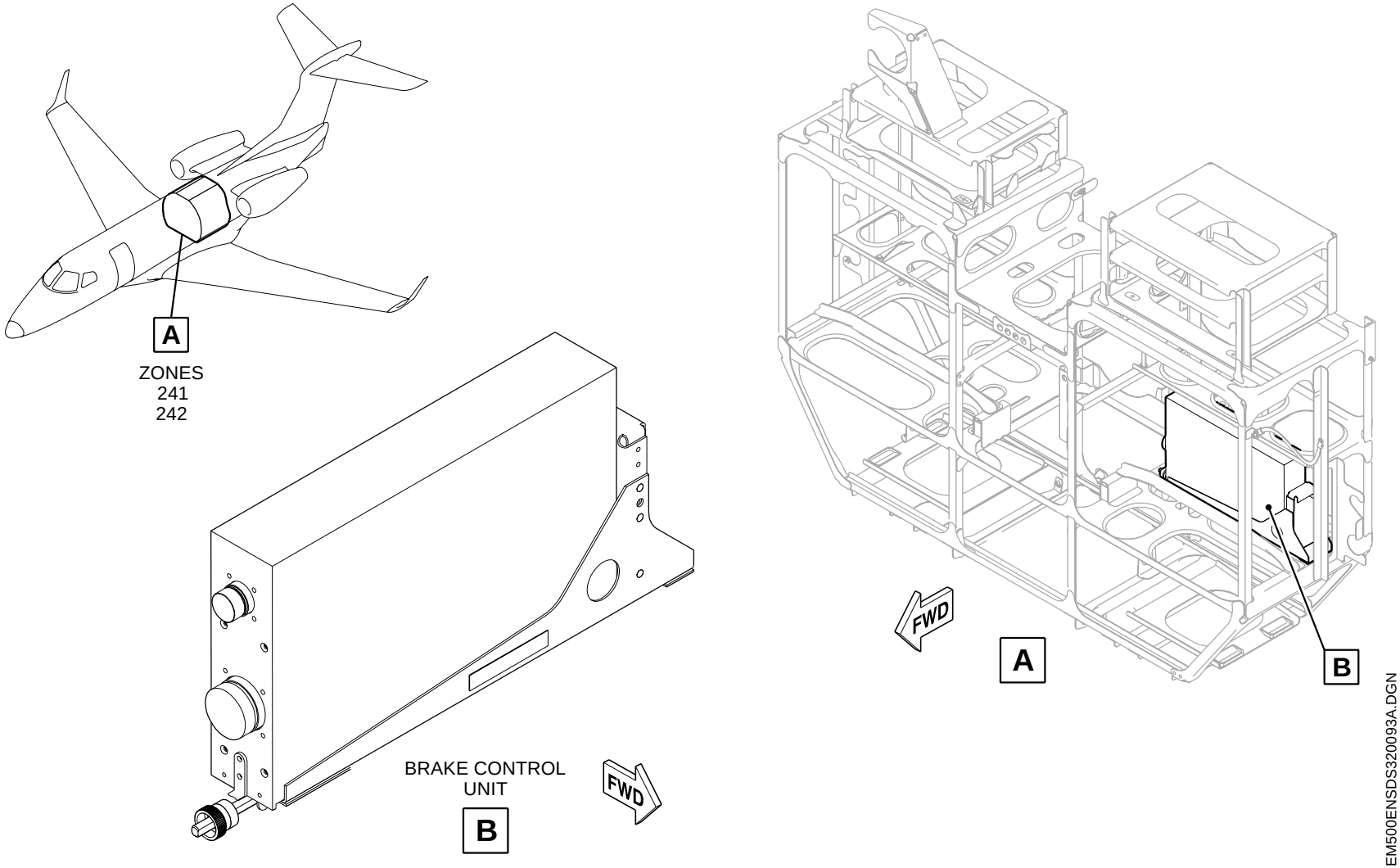

MAIN BRAKE SYSTEM - COMPONENTS – Sheet 3

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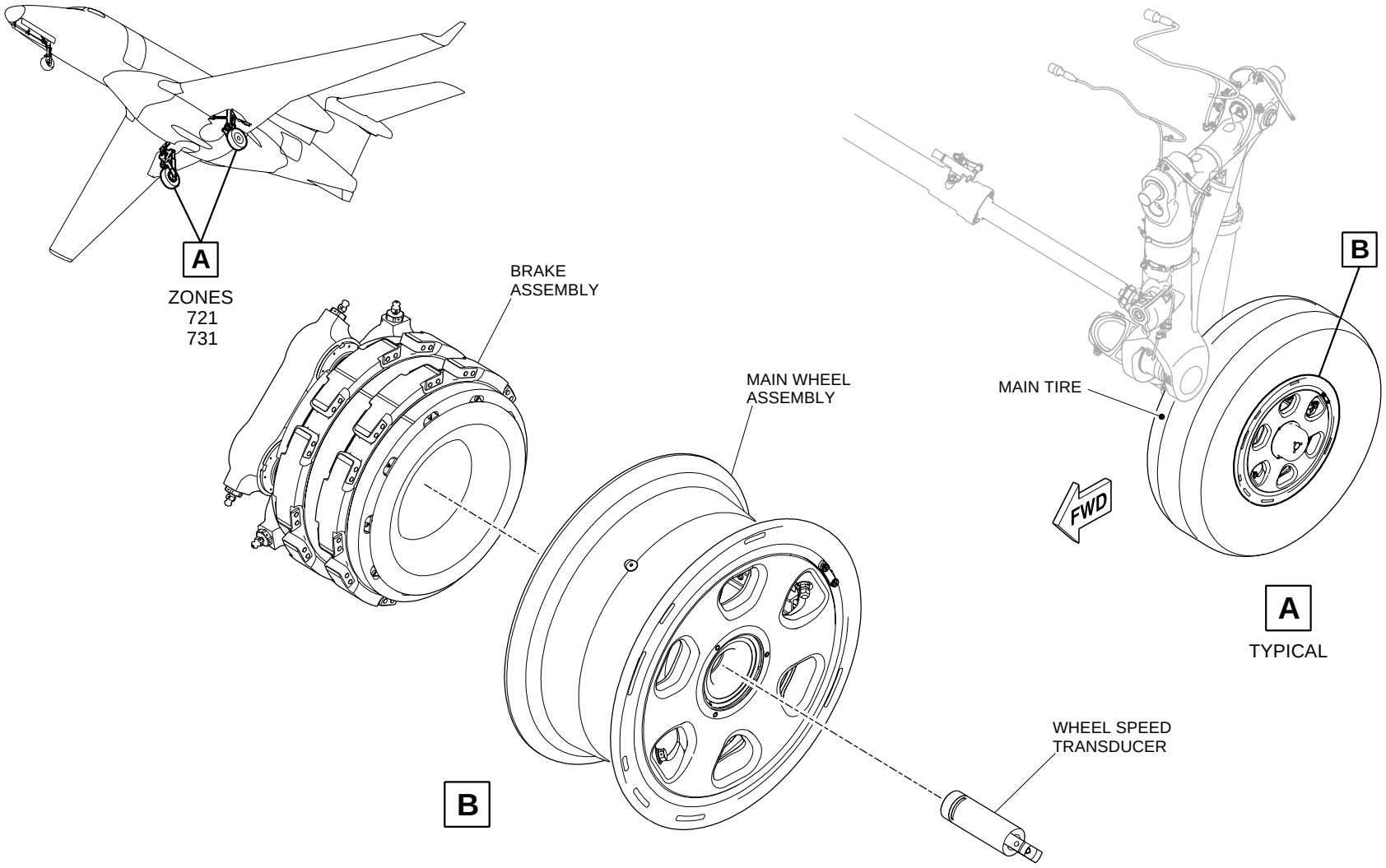

MAIN BRAKE SYSTEM - COMPONENTS – Sheet 4

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SPOILERS AND AIR BRAKES

Introduction

The spoiler system provides the aircraft with further roll authority in addition to the aileron commands (Roll Spoiler Function), increases drag and dump lift on landing and RTO (Rejected Takeoff) reduces required stopping distance (Ground Spoiler Function), and creates a steeper angle of descent (Speed Brake Function).

EFFECTIVITY: ON EMBRAER 505 ACFT WITH STEEP APPROACH SYSTEM

The spoiler system provides the aircraft with further roll authority in addition to the aileron commands (Roll Spoiler Function), increases drag and dump lift on landing and RTO reduces required stopping distance (Ground Spoiler Function), creates a steeper angle of descent (Speed Brake Function), and increase drag and dump lift creating a steeper glide path descent angle during final approach (Steep Approach Function).

General Description

The SPOILERS AND AIR BRAKES includes these subsystems:

- MULTIFUNCTION SPOILER MECHANICAL COMPONENTS (AMM SDS 27-64-00/1)
- MULTIFUNCTION SPOILER HYDRAULIC ACTUATION (AMM SDS 27-65-00/1)
- MULTIFUNCTION SPOILER ELECTRICAL SYSTEM (AMM SDS 27-66-00/1)

There are four spoiler panels, one pair in each wing, which perform three functions on the aircraft:

- The roll spoiler function deploys the spoiler panels asymmetrically to increase the roll capability of the aircraft. The spoiler panel deflection is a function of the control wheel command. This function is enabled with any flap position.
- The ground spoiler function deploys the spoiler panels symmetrically on the ground during a RTO or landing to increase drag, improve braking efficiency and reduce the stopping distance.
- The speed brake function deploys the spoiler panels symmetrically in the air to increase the drag and the descent rate of the aircraft.

EFFECTIVITY: ON EMBRAER 505 ACFT WITH STEEP APPROACH SYSTEM

There are four spoiler panels, one pair in each wing, which perform three functions on the aircraft:

- The roll spoiler function deploys the spoiler panels asymmetrically to increase the roll capability of the aircraft. The spoiler panel deflection is a function of the control wheel command. This function is enabled with any flap position.
- The ground spoiler function deploys the spoiler panels symmetrically on the ground during a RTO or landing to increase drag, improve braking efficiency and reduce the stopping distance.
- The speed brake function deploys the spoiler panels symmetrically in the air to increase the drag and the descent rate of the aircraft.
- The steep approach function deploys the spoiler panels symmetrically in the air to create steeper glide path descent angle during final approach.

Components

MULTIFUNCTION SPOILER MECHANICAL COMPONENTS (AMM SDS 27-64-00/1)

The multifunction spoiler mechanical components transmit the movement of the power control unit to the spoiler panels after the electrical input from the FCE (Flight Control Electronics).

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MULTIFUNCTION SPOILER HYDRAULIC ACTUATION (AMM SDS 27-65-00/1)

The multifunction spoiler hydraulic system comprises two PCU (Power Control Unit)s, one on each wing, which control and actuate the spoiler panels. They are controlled by the FCE (Flight Control Electronics) and the actuation is hydraulically powered.

MULTIFUNCTION SPOILER ELECTRICAL SYSTEM (AMM SDS 27-66-00/1)

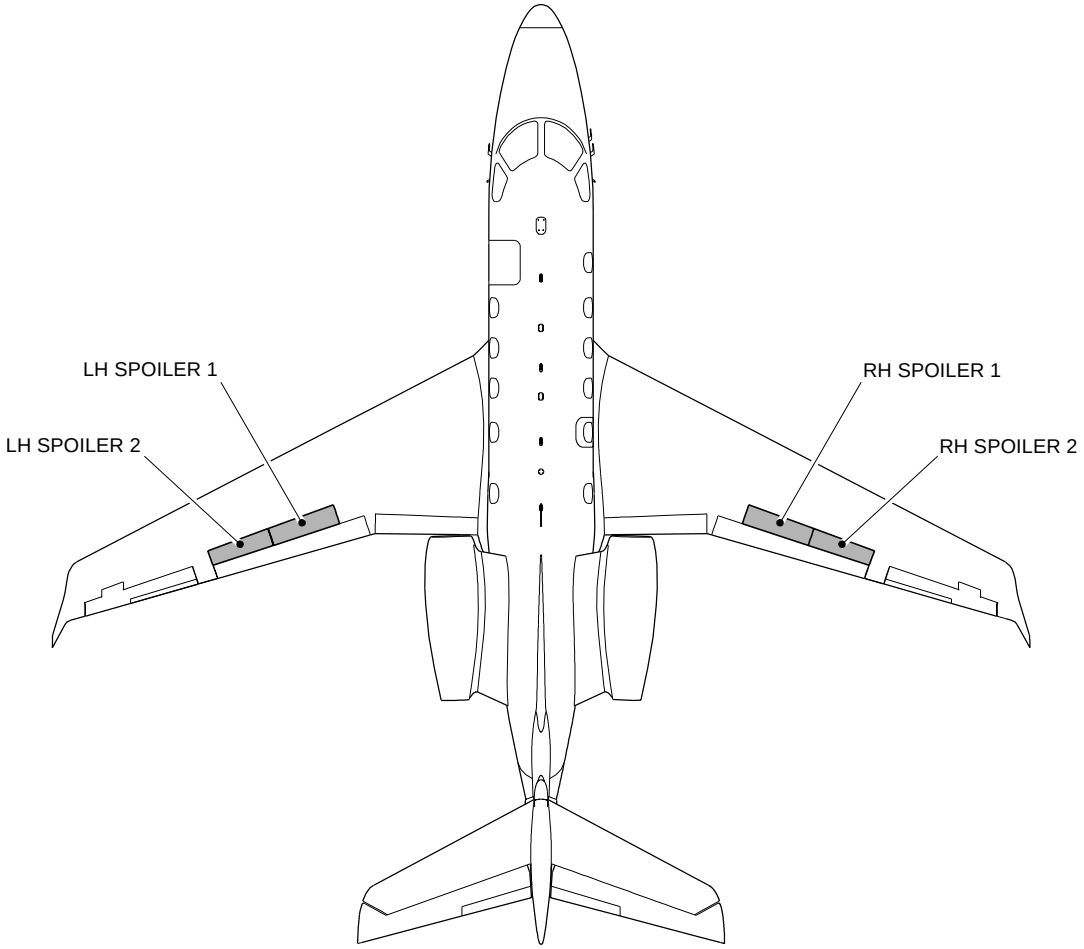
The multifunction spoiler electrical system comprises an electronic unit (FCE (Flight Control Electronics) 2) which controls and monitors the two PCU (Power Control Unit)s. FCE 2 uses the inputs from avionics, control wheel and surfaces LVDT (Linear Variable Differential Transducer)s, and FCE 1 to command the PCUs.

Operation

Refer to AMM SDS 27-66-00/1 for operation description.

The figure SPOILERS AND AIR BRAKES - MULTIFUNCTION SPOILER SYSTEM provides further data on the preceding text.

EFFECTIVITY:ALL



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SPOILERS AND AIR BRAKES - MULTIFUNCTION SPOILER SYSTEM – Sheet 1

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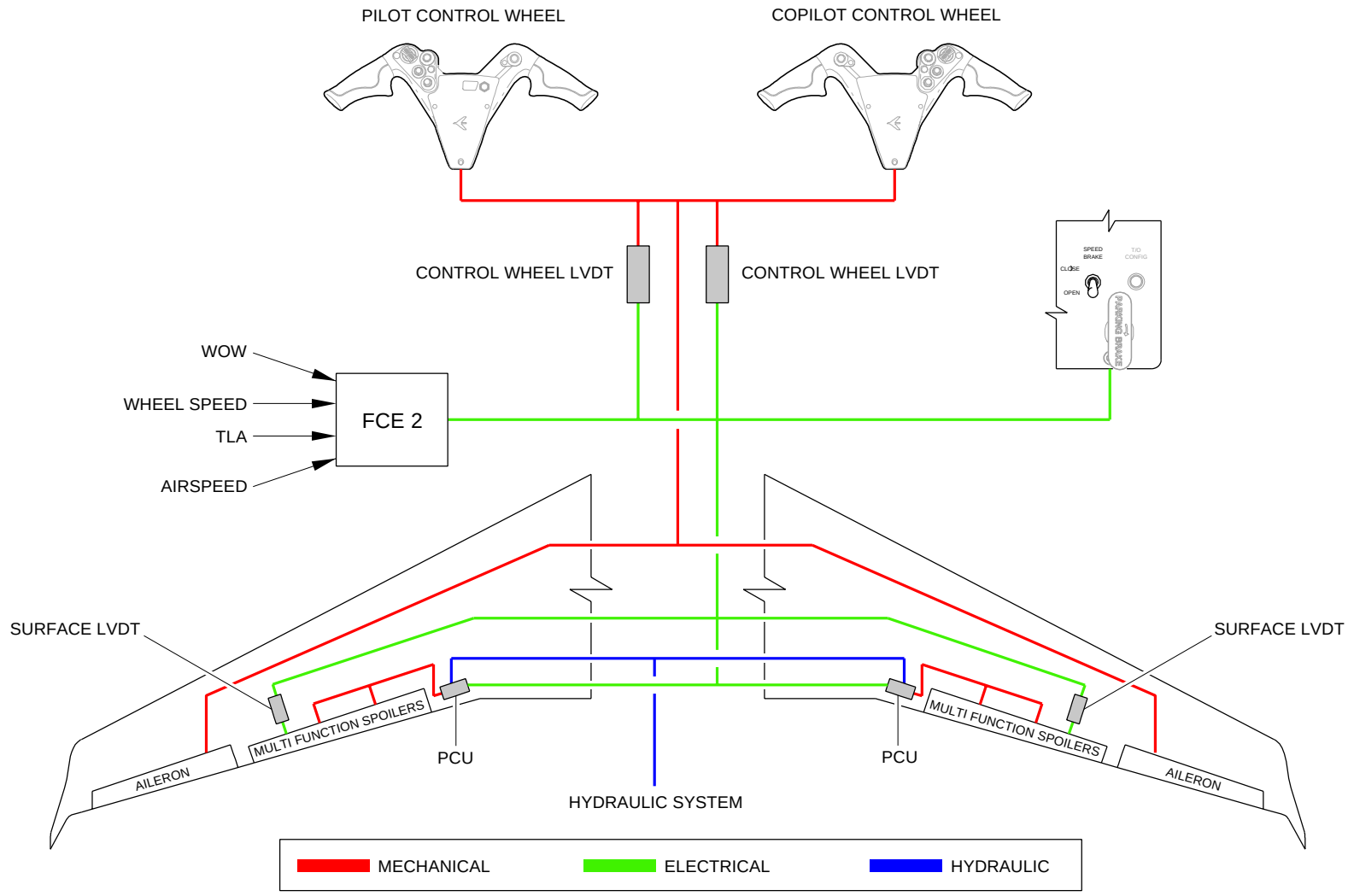

SPOILERS AND AIR BRAKES - MULTIFUNCTION SPOILER SYSTEM – Sheet 2

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Selected Aircraft: 165

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WHEELS AND BRAKES

Introduction

The functions of the wheels and brakes subsystem are given below:

- Allow the aircraft to move on the ground (wheels sub-subsystem);
- Control the speed of the aircraft when it is on the ground (with the normal and emergency brake sub-subsystems);
- Apply and hold the brakes on, when the aircraft is parked (parking brake);
- Apply the brakes when the landing gear retracts (normal brake sub-subsystems).

General Description

The WHEELS AND BRAKES includes these subsystems:

- MAIN BRAKE SYSTEM (AMM SDS 32-41-00/1)
- EMERGENCY/PARKING BRAKE SYSTEM (AMM SDS 32-43-00/1)
- WHEELS, TIRES AND BRAKES (AMM SDS 32-45-00/1)

The brake system is divided into main brake subsystem and emergency/parking brake subsystem. These subsystems comprise the tires, wheels, and brake assemblies.

Components

MAIN BRAKE SYSTEM (AMM SDS 32-41-00/1)

The main brake subsystem function is to control hydraulic pressure to the brakes as a function of brake pedal displacement and to provide anti-skid protection to prevent main tires skidding during braking and minimize stopping distance.

EMERGENCY/PARKING BRAKE SYSTEM (AMM SDS 32-43-00/1)

The emergency/parking brake subsystem function is to provide an alternative way to stop the aircraft in case of main brake system failure, and to provide means to keep the aircraft parked even when the hydraulic power system is turned off.

WHEELS, TIRES AND BRAKES (AMM SDS 32-45-00/1)

The functions of the wheels, tires and brakes subsystem are to provide interface between aircraft and ground (wheels and tires), transfer the wheel rotation movement to the wheel speed transducers (Drive cap, installed on main wheels), allow aircraft to stop or control speed when moving on the ground (Brake).

The figure WHEELS AND BRAKES - WHEELS AND BRAKES SCHEMATICS AND COMPONENTS provides further data on the preceding text.

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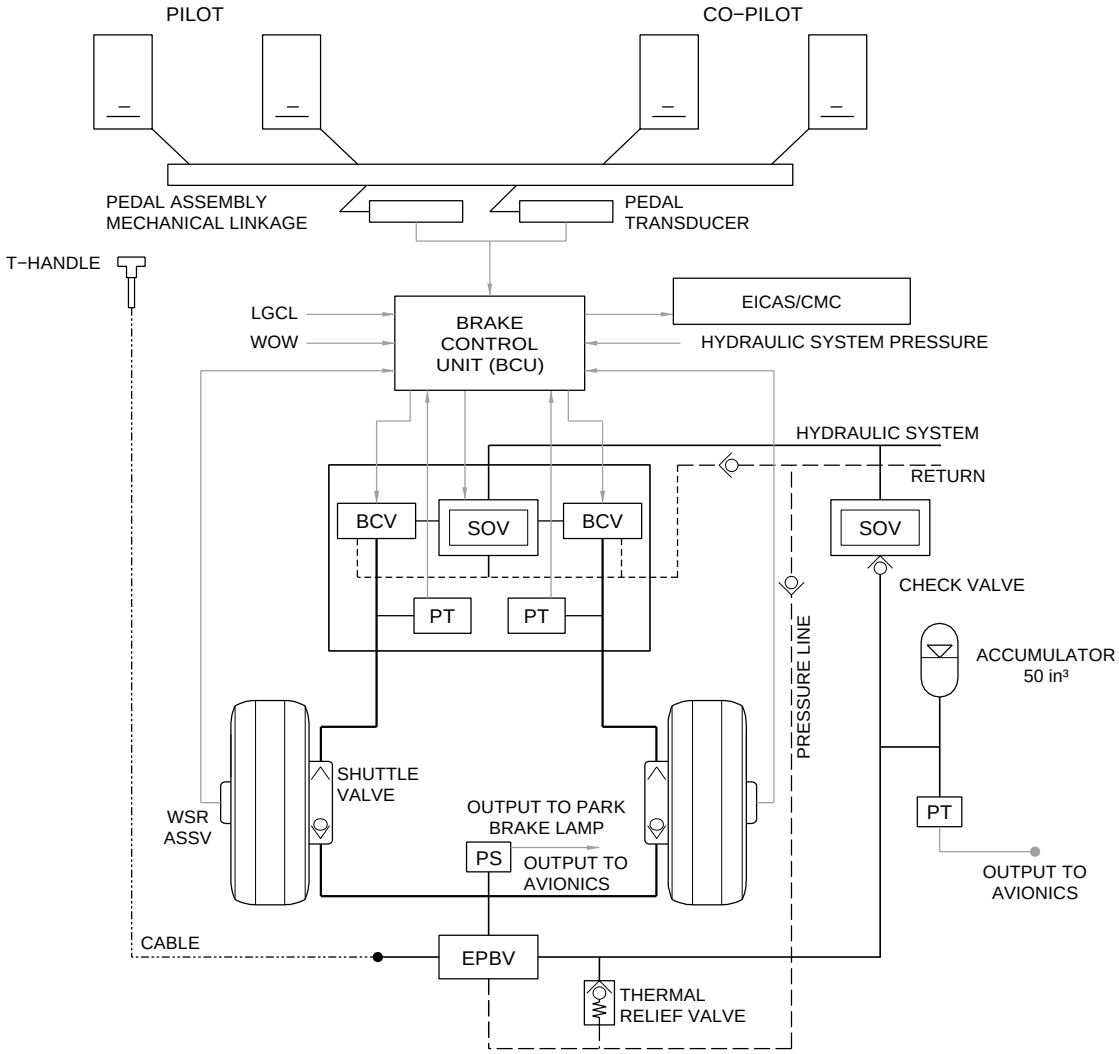

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WHEELS AND BRAKES - WHEELS AND BRAKES SCHEMATICS AND COMPONENTS – Sheet 1

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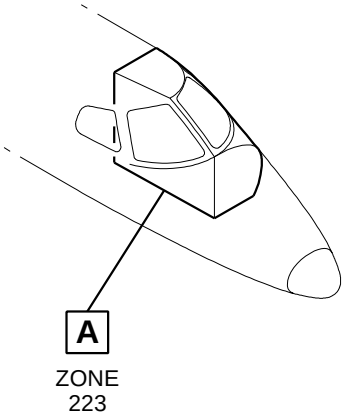

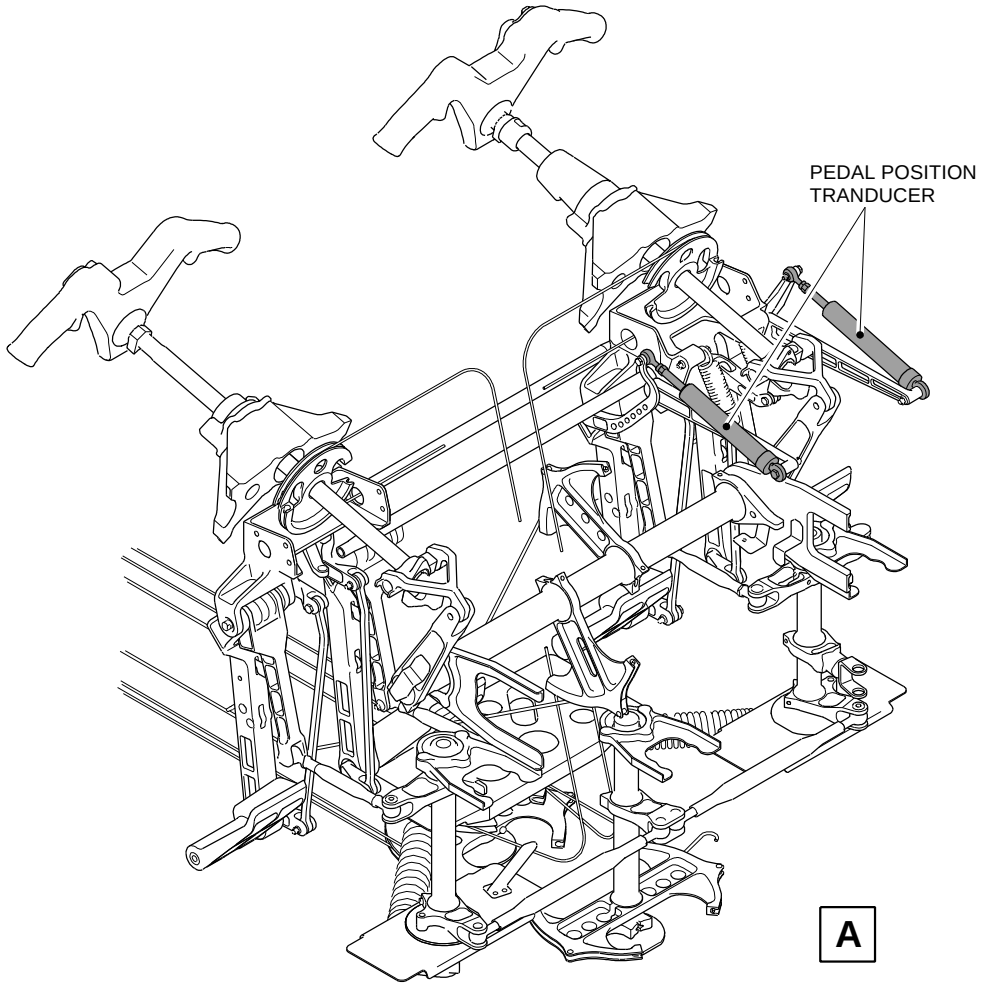

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WHEELS AND BRAKES - WHEELS AND BRAKES SCHEMATICS AND COMPONENTS – Sheet 2

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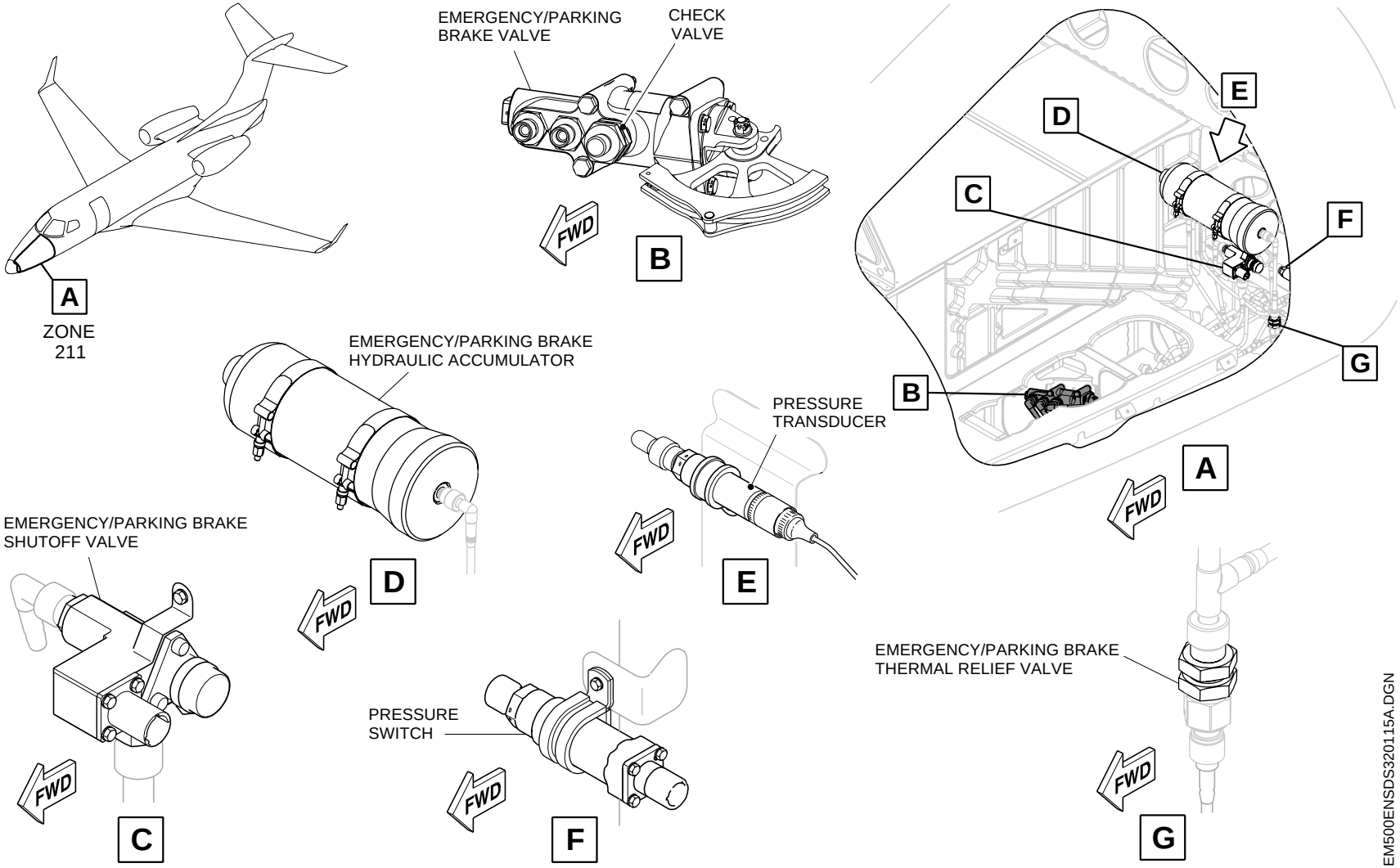

WHEELS AND BRAKES - WHEELS AND BRAKES SCHEMATICS AND COMPONENTS – Sheet 3

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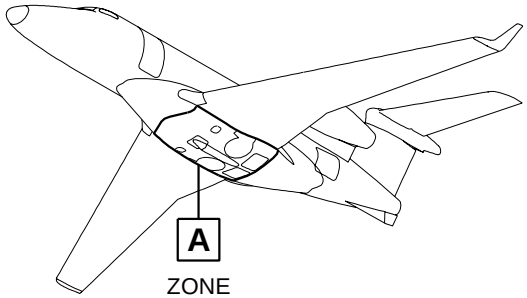

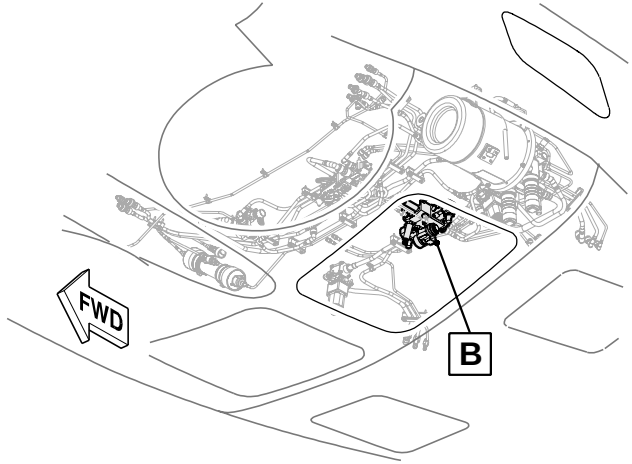

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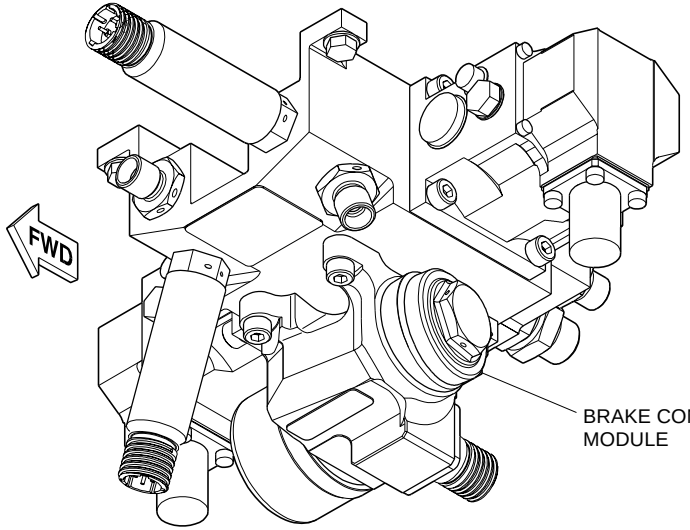

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WHEELS AND BRAKES - WHEELS AND BRAKES SCHEMATICS AND COMPONENTS – Sheet 4

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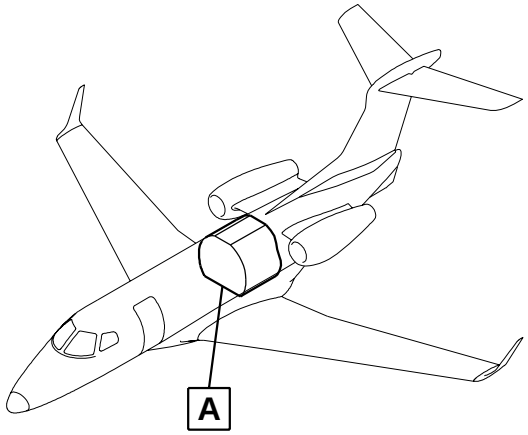

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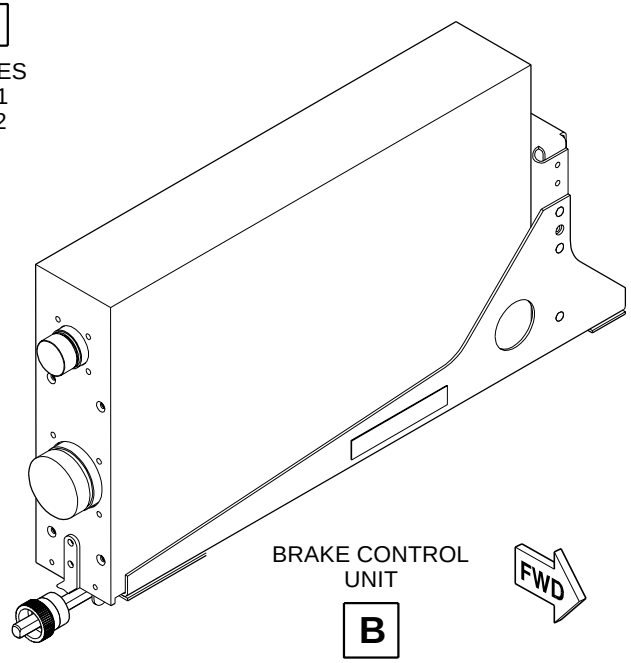

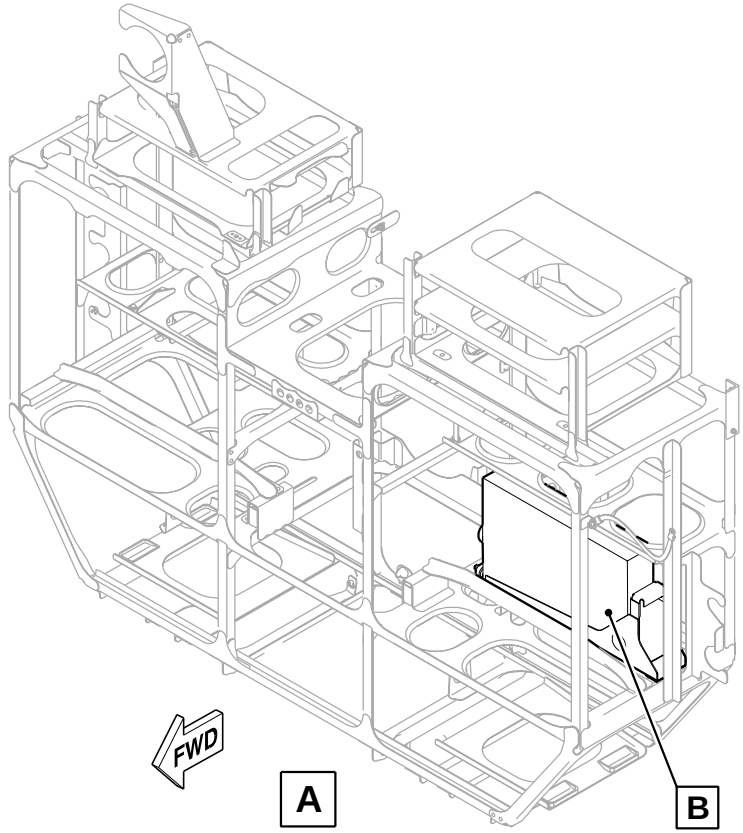

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WHEELS AND BRAKES - WHEELS AND BRAKES SCHEMATICS AND COMPONENTS – Sheet 5

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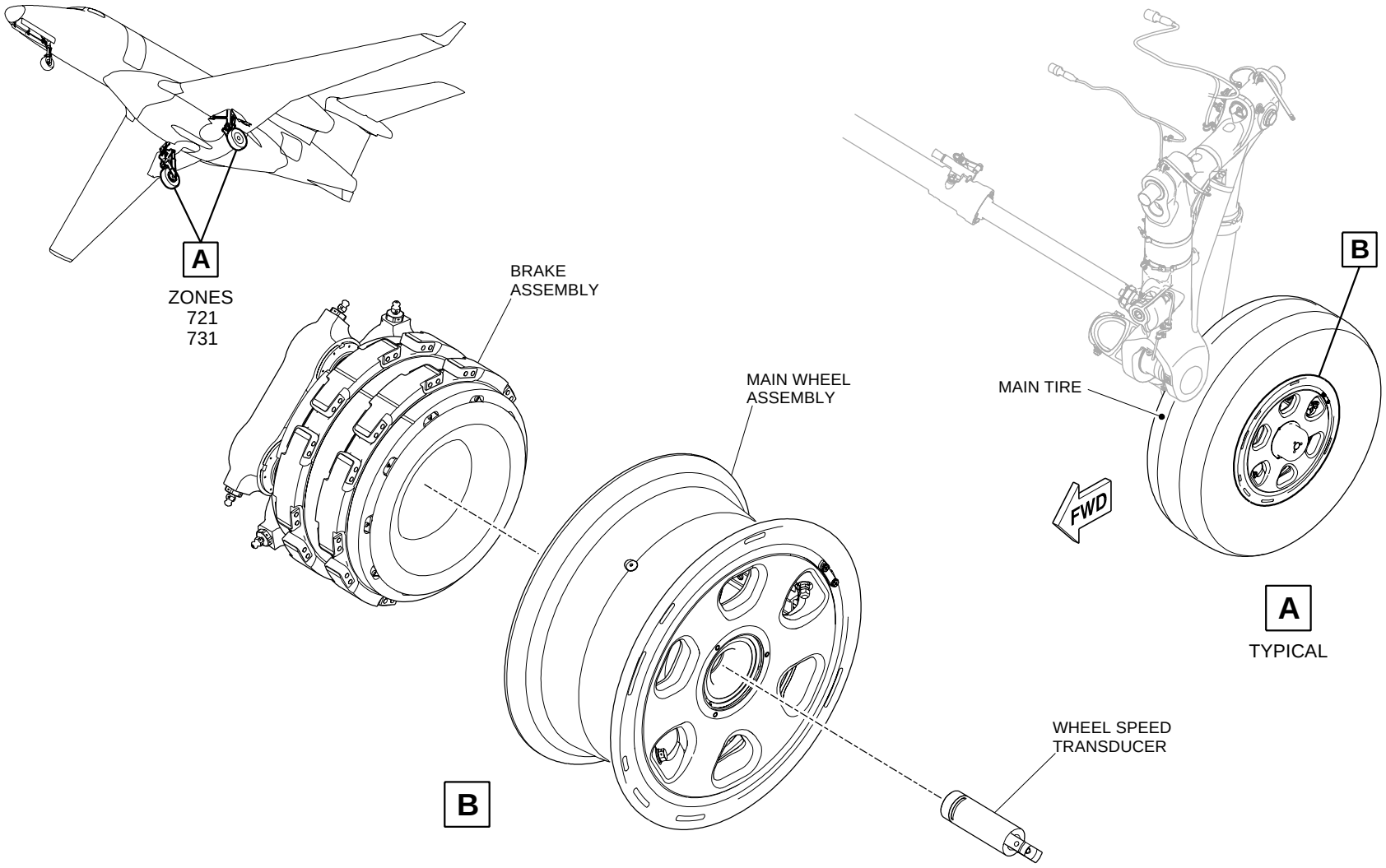

WHEELS AND BRAKES - WHEELS AND BRAKES SCHEMATICS AND COMPONENTS – Sheet 6

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MULTIFUNCTION SPOILER ELECTRICAL SYSTEM

EFFECTIVITY:ALL

Introduction

The multifunction spoiler electrical system comprises an electronic unit (FCE (Flight Control Electronics) 2) which controls and monitors the two PCU (Power Control Unit)s. FCE 2 uses the inputs from avionics, control wheel and surfaces LVDT (Linear Variable Differential Transducer)s, and FCE 1 to command the PCUs.

The figure MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - BLOCK DIAGRAM provides further data on the preceding text.

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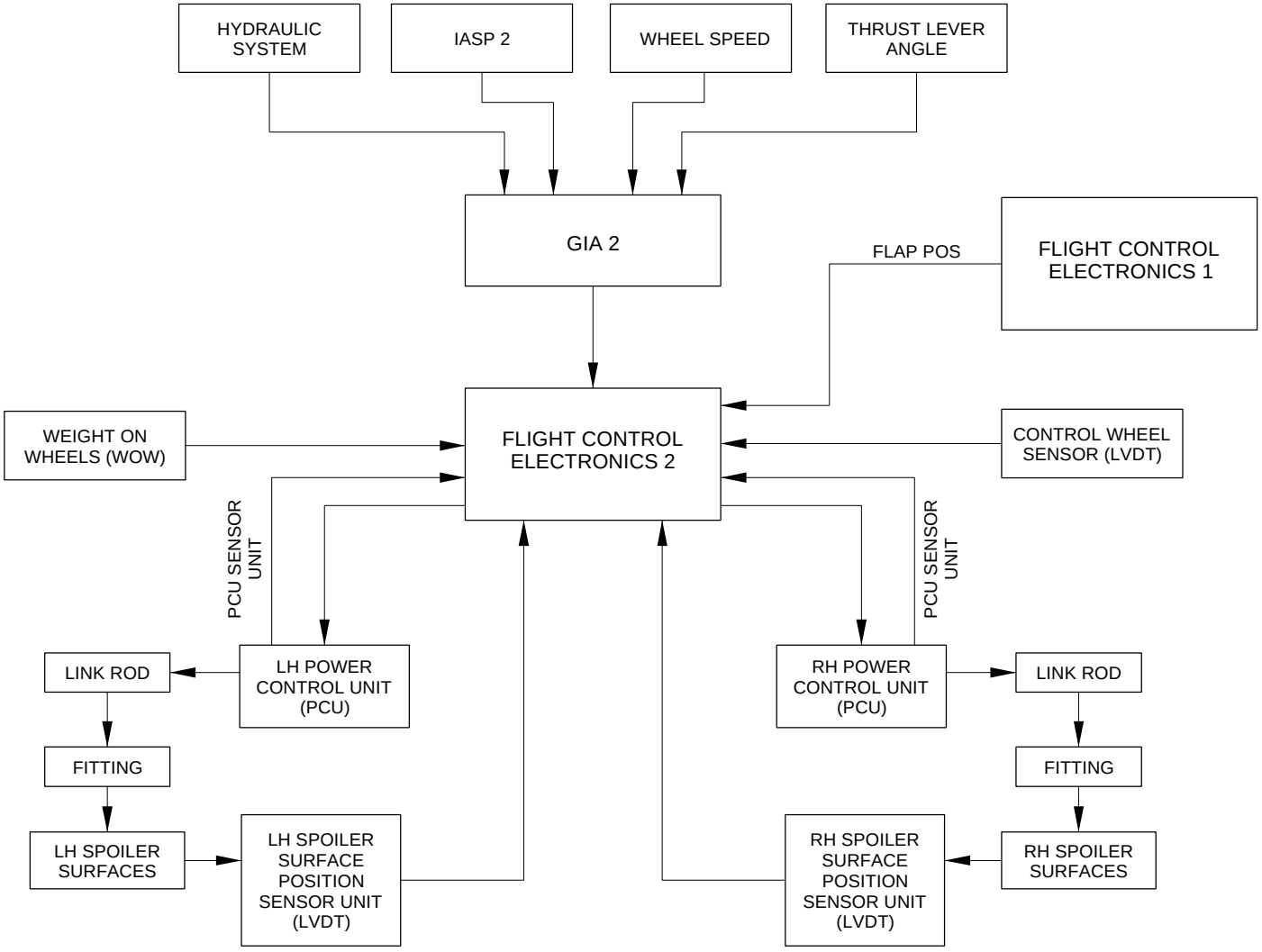

MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - BLOCK DIAGRAM

General Description

FCE 2 uses the control wheel LVDT data input to be used in the roll spoiler function, and receives the surface position data from the surface LVDT.

From FCE 1, the FCE 2 receives flap position information to be used in the roll spoiler and speed brake functions.

From the avionics, FCE 2 receives calibrated airspeed for use in the speed brake and ground spoiler functions, wheel speed of main landing gears and TLA (Thrust Lever Angle) data for use in the ground spoiler function, and hydraulic pressure data for use in the spoiler command-response monitoring logic.

Airspeed data is provided by the IASP (Integrated Air Data and Stall Protection Probe) 2, wheel speed data is provided by the BCU (Brake Control Unit),TLA information is provided by the FADEC (Full Authority Digital Engine Control)s and hydraulic pressure data is provided by a dedicated sensor in the hydraulic system. All these bits of information are provided to the avionics, which retransmits the data to FCE 2.

The FCE 2 uses the information above to command the PCU , to provide synoptic indication to be shown on the MFD (Multi-Function Display), fault information for CAS (Crew Alerting System) messages, and to generate CMC (Central Maintenance Computer) messages and aural warnings.

The figure MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - SPEED BRAKE SWITCH LOCATION provides further data on the preceding text.

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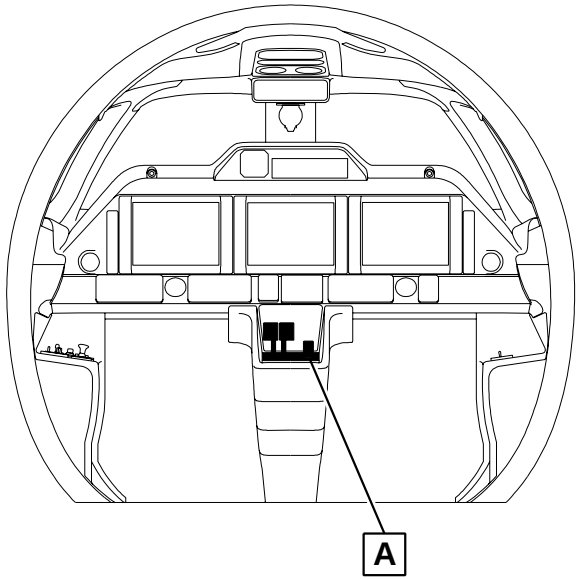

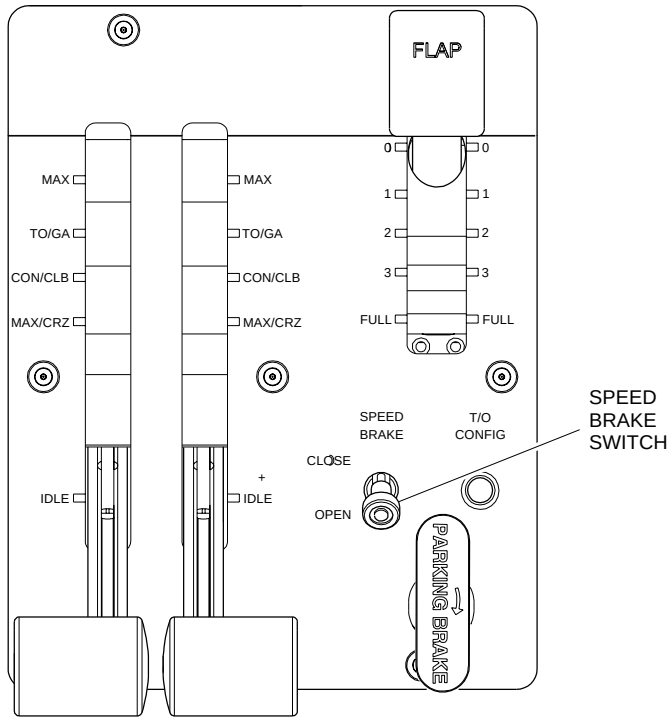

CONTROL STAND ASSEMBLY

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MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - SPEED BRAKE SWITCH LOCATION

Components

FCEs

FCE 1 and FCE 2 are located in the center electronics compartment in the center fuselage. They are accessed by removing the lower panel in the aft bulkhead. All FCE connectors have different part numbers and can not be incorrectly installed. Incorrect harness connection between FCE 1 and FCE 2 is also avoided by insufficient harness lengths. In the event of cross assembly of any connector, the system will indicate an error and shut down due to the incapability of control loop closure.

CONTROL WHEEL LVDT

Control wheel LVDTs are installed on the aileron forward torque tube, in the forward fuselage. The LVDTs are located under the center console, in the cockpit. It can be accessed by removing a cover on the center console. Electrical bonding is achieved through the LVDT pigtail harness.

SURFACE LVDT

The surface LVDT is installed on the wing trailing edge. One end of the LVDT is attached to a support fixed on the wing spar II, and the other end is attached to a support on the spoiler outboard panel. Electrical bonding to the aircraft interface connector is achieved through the LVDT pigtail harness. LVDT is accessed by extending the flaps.

The figure MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - COMPONENT LOCATION provides further data on the preceding text.

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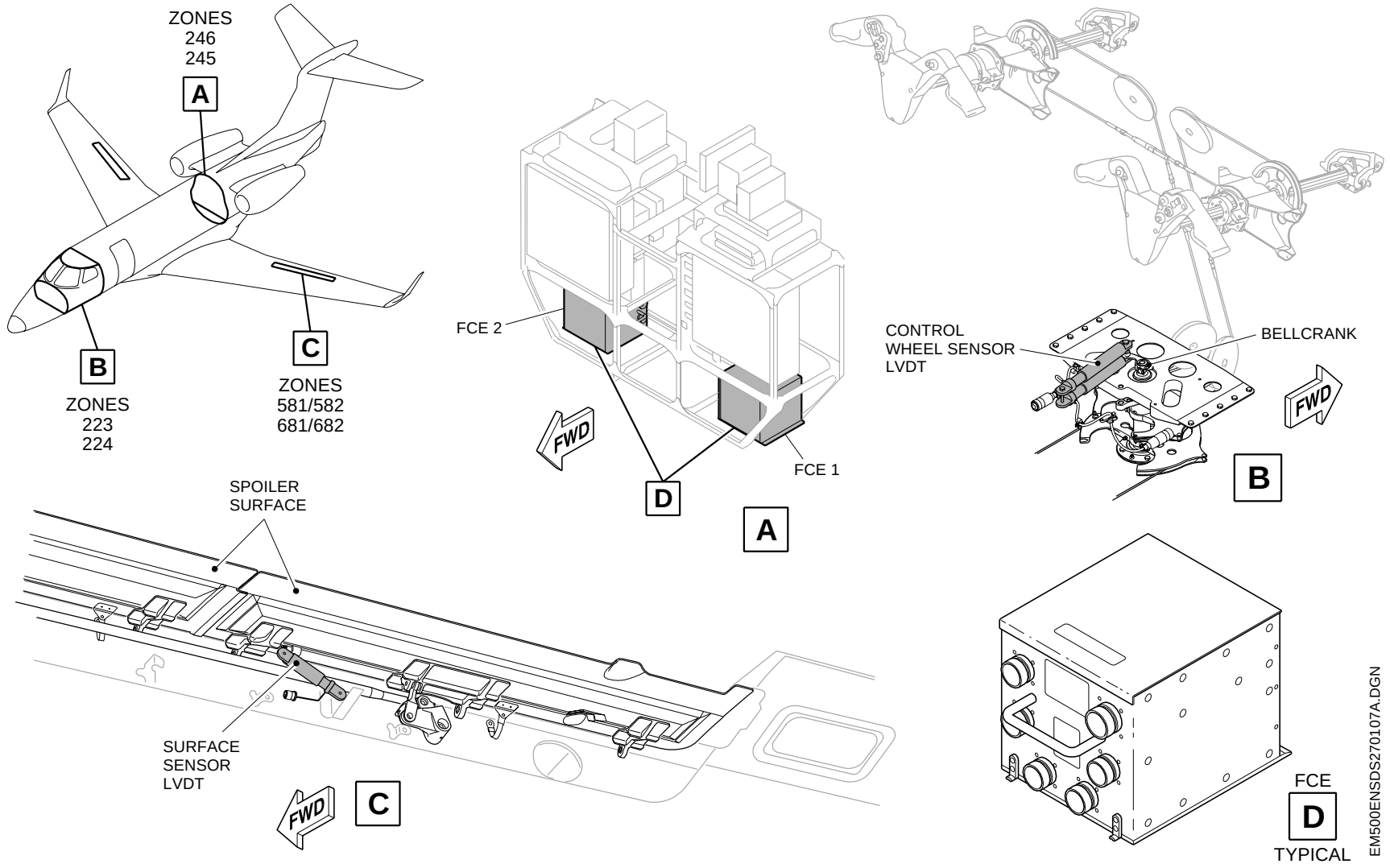

MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - COMPONENT LOCATION

Operation

ROLL SPOILER FUNCTION

In the roll spoiler function, the spoiler panels deploy asymmetrically to increase the roll capability of the aircraft. The spoiler panel deflection is a function of the control wheel command. This function is only enabled when flaps are at any position different from Flap 0.

SPEED BRAKE FUNCTION

In the speed brake function, the spoiler panels deploy symmetrically in the air to increase drag and descent rate of the aircraft. There are only two valid positions for the speed brake function: "OPEN" or "CLOSE". The speed brake is commanded through a switch located on the center console in the cockpit. When the speed brake switch is moved rearward (to “OPEN” position), the spoiler panels deploy with the function of speed brake at 35 degrees, and when the speed brake switch is moved forward (to “CLOSE” position), the spoiler panels close.

Speed brake function has the following interlocks:

- Airspeed
- TLA
- Flap position

EFFECTIVITY: ON EMBRAER 505 ACFT WITH STEEP APPROACH SYSTEM

STEEP APPROACH FUNCTION

The Spoiler Control System has also a configurable function, which is enabled through hardware straps: Steep Approach Mode, which allows EMB-505 to perform approach and landing with glide path ramp steeper than the usual 3°. The steep approach function is enabled by the pilot through the speed brake switch installed in the pedestal. It engages only when flaps reach the FULL position.

GROUND SPOILER FUNCTION

In the ground spoiler function, the spoiler panels deploy symmetrically on ground during an RTO (Rejected Takeoff) or landing to increase drag, improve braking efficiency, and reduce the stopping distance. Ground spoiler function works without any specific pilot action, that is, it is not necessary to actuate any specific switch to enable this function. When all conditions to deploy the spoilers are met, all spoilers deploy to 35 degrees. There are 3 main conditions in which spoilers are deployed as ground spoilers:

- Aircraft on ground
- Thrust levers in the idle position
- Ground Spoilers armed

ABNORMAL OPERATION

Some of the failure modes on the spoiler control system disable all three functions, others affect only one of them.

When a failure on the thrust lever idle discretes is detected, only the ground spoiler function is disabled. Roll spoiler and speed brake remain operational.

When a fault on any of the control wheel LVDTs is detected, only the roll spoiler function is disabled. Speed brake and ground spoiler remain operational.

When a fault on the speed brake switch is detected, only the speed brake function is disabled. Roll spoiler and ground spoiler remain operational.

If the fault occurs on any of the surface LVDTs, on the PCU, or on the FCE, all three functions are disabled.

ELECTRICAL RIGGING

Electrical rigging of the control wheel LVDTs, spoiler surface LVDTs, and spoiler PCU LVDTs is performed through the FCE, and initiated with the aid of a rigging kit (FIXTURE - RIGGING AND MAINTENANCE INTERFACE, FLIGHT CONTROL SYSTEM (GSE 062)). The FIXTURE - RIGGING AND MAINTENANCE INTERFACE, FLIGHT CONTROL SYSTEM (GSE 062) comprises a laptop computer running the rigging software, an ARINC 429 card, and an electrical cable used to connect

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the laptop to the aircraft maintenance panel located in the forward left cabinet in the center fuselage. The FCE enables rigging only when the three conditions below are satisfied:

- At least three out of four WOW (Weight-on-Wheels) discretes indicate that the aircraft is on ground.
- The electrical cable (from FIXTURE - RIGGING AND MAINTENANCE INTERFACE, FLIGHT CONTROL SYSTEM (GSE 062)) is connected to the maintenance panel.
- The FCE is receiving fresh information via ARINC 429 bus.

INDICATION AND ALERTING

There is only one synoptic indication for the spoiler system. In normal operation, there are 3 possible indications for it. When spoilers are operating as roll spoilers, synoptic indication is “CLOSED”, the same indication shows when spoilers are operating as speed brakes and the panels are closed. When spoilers are deployed as speed brakes, the indication is "SPDBRK". When deployed as ground spoilers, the indication is "GND SPLR". In abnormal conditions, there are 3 possible indications: when there is a fault on the spoiler system that affects only the ground spoiler function or all functions, the indication is "FAIL" in yellow. If the aircraft is not ready for takeoff due to a fault on the spoiler system, the indication is "SPDBRK", in red. If the spoiler panel position can not be determined (spoiler sensor is failed for example), the indication is a red X.

The CAS messages are described below:

MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - CAS MESSAGES

MESSAGE	LEVEL	DESCRIPTION
NO TO CONFIG	Warning (Red)	If any of the following conditions is satisfied when the throttles are advanced to the Takeoff setting or when the Takeoff Configuration Test button is pressed: • Spoilers not retracted • Flaps out of Takeoff position • Pitch Trim out of green band • Parking brake applied Simultaneously, the Aural warning is set with the “No Takeoff Spoilers” message and the spoiler indication in the MFD changes to "SPDBRK".
GND SPLR FAIL	Caution	The ground spoiler function is not available.
SPOILER FAULT	Advisory	Speed brake and roll spoiler functions are not available.
SPDBRK SW DISAG	Advisory	There is a mismatch between the speed brake switch position and the spoiler surfaces. The surfaces retract automatically during a go-around maneuver or during low speed operation, and remain latched off until the speed brake switch is set to the “CLOSED” position.

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The aural warning associated to the multifunction spoiler control system is listed in the table below:

MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - SPOILER CONTROL SYSTEM AURAL WARNINGS

MESSAGE	DESCRIPTION
"No Takeoff Spoiler"	All spoiler panels are deployed more than 30 degrees, or spoiler panels in one wing are deployed more than 5 degrees with the control wheel within ± 30 degrees during takeoff run, or when takeoff config button is pressed before takeoff.

EFFECTIVITY: ON EMBRAER 505 ACFT WITH STEEP APPROACH SYSTEM

INDICATION AND ALERTING

There is only one synoptic indication for the spoiler system. In normal operation, there are 4 possible indications for the spoiler system. When spoilers are operating as roll spoilers, the synoptic indication is “CLOSED”. The same indication shows when spoilers are operating as speed brakes and the panels are closed. When spoilers are deployed as speed brakes, the indication is "SPDBRK". When deployed as ground spoilers, the indication is "GND SPLR". When Steep Approach Mode is engaged, the indication is "STEEP". In abnormal conditions, there are 3 possible indications: when there is a fault on the spoiler system that affects only the ground spoiler function or all functions, the indication is "FAIL" in yellow. If the aircraft is not ready for takeoff due to a fault on the spoiler system, the indication is "SPDBRK", in red. If the spoiler panel position can not be determined (for example, spoiler sensor is failed), the indication is a red X.

The CAS messages are described below:

EFFECTIVITY: ON EMBRAER 505 ACFT WITH STEEP APPROACH SYSTEM (Continued)

MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - CAS MESSAGES

MESSAGE	LEVEL	DESCRIPTION
NO TO CONFIG	Warning (Red)	If any of the following conditions is satisfied when the throttles are advanced to the Takeoff setting or when the Takeoff Configuration Test button is pressed: • Spoilers not retracted • Flaps out of Takeoff position • Pitch Trim out of green band • Parking brake applied Simultaneously, the Aural warning is set with the “No Takeoff Spoilers” message and the spoiler indication in the MFD changes to "SPDBRK".
GND SPLR FAIL	Caution	The ground spoiler function is not available.
SPOILER FAULT	Advisory	Speed brake and roll spoiler functions are not available.

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EFFECTIVITY: ON EMBRAER 505 ACFT WITH STEEP APPROACH SYSTEM (Continued)

MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - CAS MESSAGES

MESSAGE	LEVEL	DESCRIPTION
SPDBRK SW DISAG	Advisory	There is a mismatch between the speed brake switch position and the spoiler surfaces. The surfaces retract automatically during a go-around maneuver or during low speed operation and remain latched off until the speed brake switch is set to the "CLOSED" position.
STEEP FAIL	Caution	Steep Approach Mode required data was lost during steep approach
STEEP NOT AVAIL	Advisory	Steep Approach Mode is not available

The figure MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - SPOILER INDICATION AND ALERTING provides further data on the preceding text.

EFFECTIVITY: ON EMBRAER 505 ACFT WITH STEEP APPROACH SYSTEM

The figure MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - SPOILER INDICATION AND ALERTING provides further data on the preceding text.

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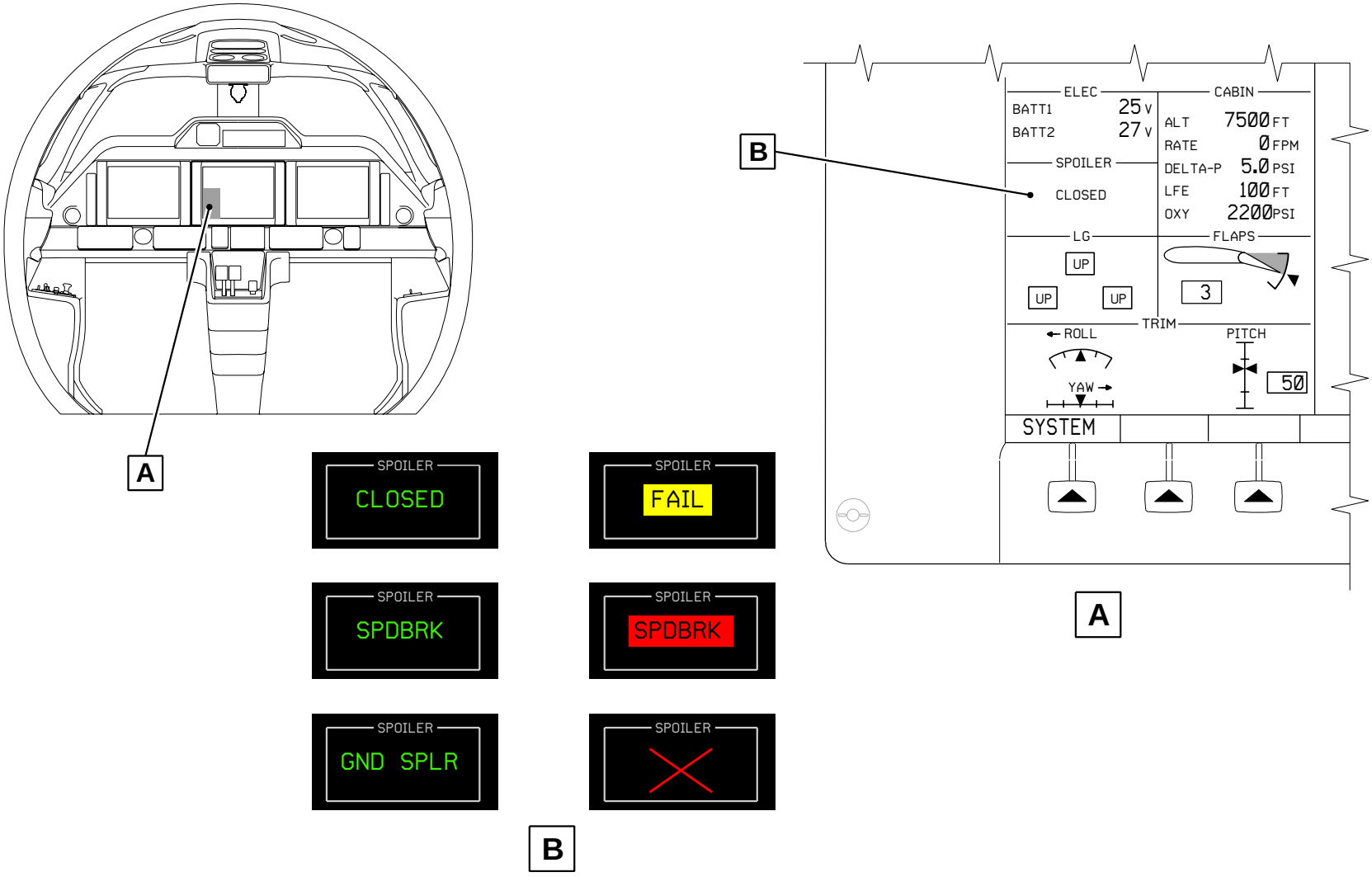

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MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - SPOILER INDICATION AND ALERTING

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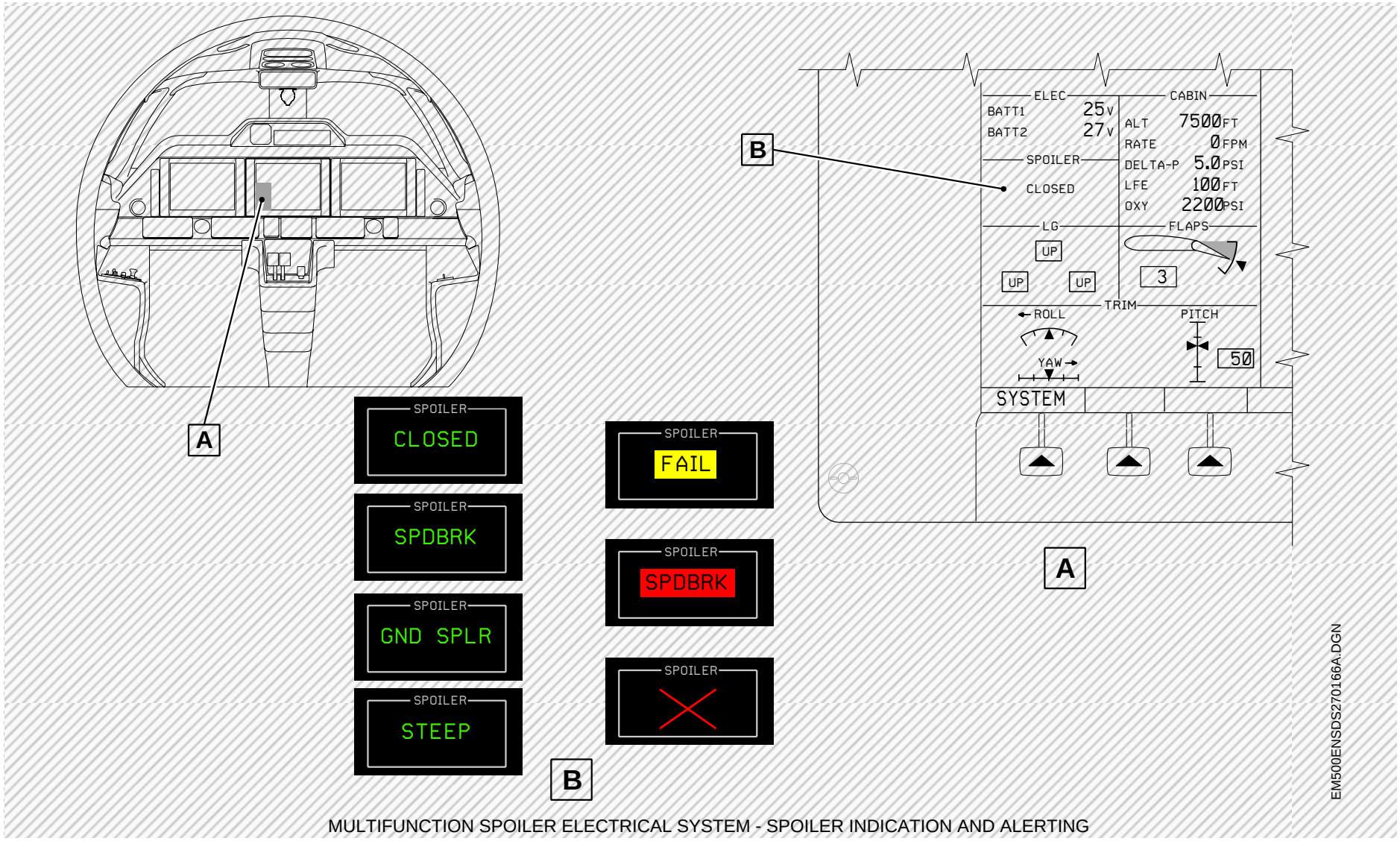
EFFECTIVITY:ON EMBRAER 505 ACFT WITH STEEP APPROACH SYSTEM



MULTIFUNCTION SPOILER ELECTRICAL SYSTEM - SPOILER INDICATION AND ALERTING

Selected Aircraft: 165

Training Information Points

FAILURE REPORTING AND TROUBLESHOOTING

The Spoiler system is integrated to the aircraft central maintenance system (AMM SDS 45-45-00/1). Thus, in the event of a failure, a maintenance message is registered in the CMC in order to provide the maintenance crew with details about that failure.

EFFECTIVITY:ALL

MULTIFUNCTION SPOILER HYDRAULIC ACTUATION

Introduction

The multifunction spoiler hydraulic system comprises two PCU (Power Control Unit)s, one on each wing, which control and actuate the spoiler panels. They are controlled by the FCE (Flight Control Electronics) and the actuation is hydraulically powered.

General Description

The LH (Left-Hand) and RH (Right-Hand) wings PCUs are identical and interchangeable. The PCUs have unbalanced actuation areas and are powered by the hydraulic system. Its mounting is designed so that the aircraft mounting bracket flange will absorb the operational loads, while the PCU mounting bolts keep the PCU in place and free from operational loads.

The PCU extension will deploy the spoiler surfaces while the PCU retraction will retract the spoiler surfaces.

Components

The PCU assembly has two major components, the manifold assembly and the actuator assembly, combined into the manifold assembly in order to minimize weight for a small envelope.

The manifold is attached to the rear wing spar with four bolts, and houses all hydraulic valves, electrical components and actuator components described below:

- Actuator Assembly
- Solenoid Operated Pilot Valve Assembly
- MSV (Mode Select Valve)
- EHSV (Electro-Hydraulic Servo Valve)
- LVDT (Linear Variable Differential Transducer)
- Inlet Filter
- HDLV (Hold-Down Lock Valve)
- Thermal Relief Valve

The figure MULTIFUNCTION SPOILER HYDRAULIC ACTUATION - MULTIFUNCTION SPOILER - HYDRAULIC SYSTEM provides further data on the preceding text.

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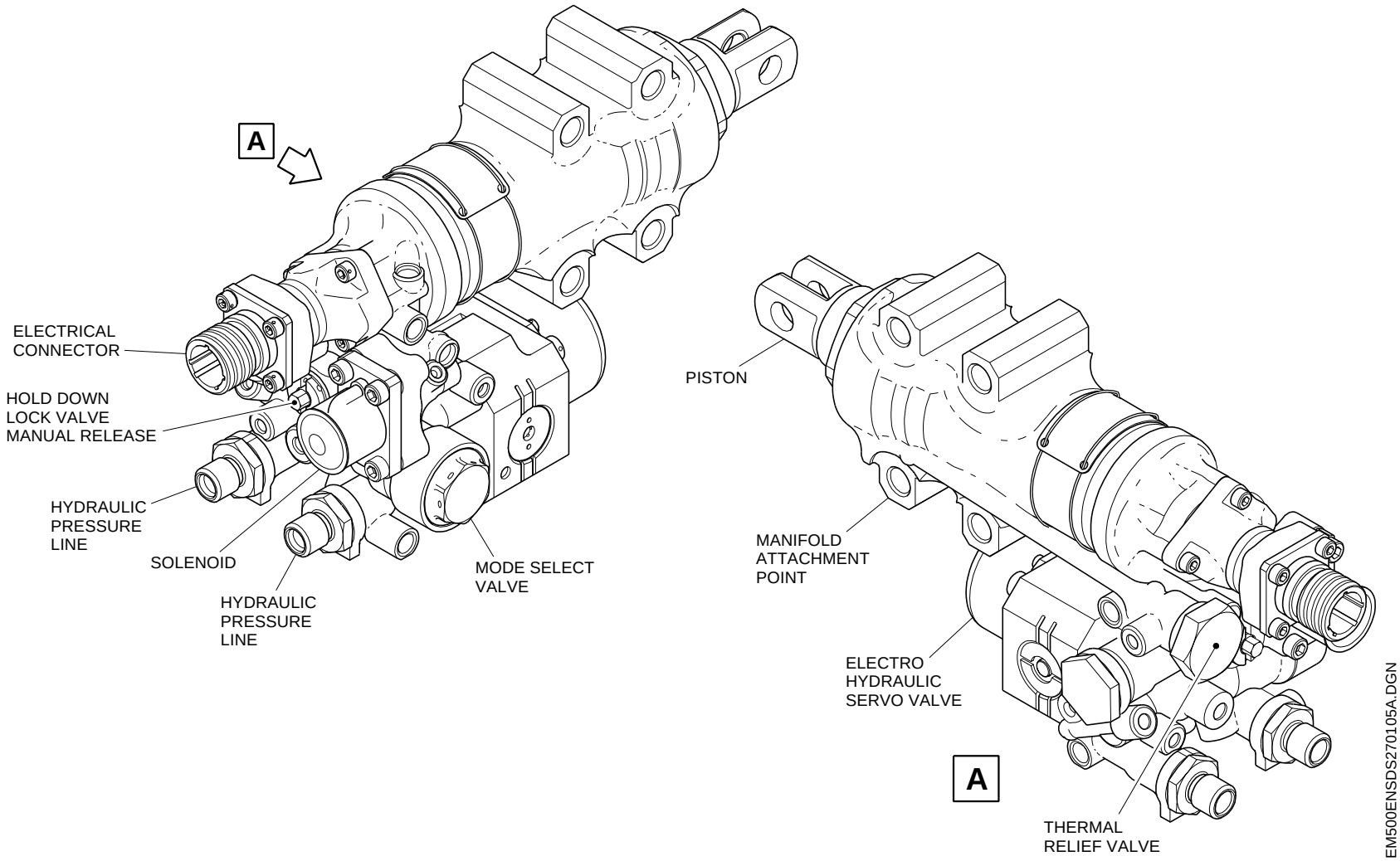

MULTIFUNCTION SPOILER HYDRAULIC ACTUATION - MULTIFUNCTION SPOILER - HYDRAULIC SYSTEM

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