CHAPTER 11 – FLIGHT CONTROLS

LIST OF ILLUSTRATIONS

STALL PROTECTION SYSTEM

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1. INTRODUCTION

Flight controls are operated conventionally with control wheels, control columns and rudder pedals for the pilot and copilot. The control surfaces are actuated either hydraulically or electrically. The flight control systems include major control surfaces, components and subsystems that control the attitude of the aircraft during flight. The flight controls are divided into primary and secondary flight controls.

The primary flight controls include:

- Ailerons (roll control)
- Elevators (pitch control)
- Rudder (yaw control)

The ailerons, elevators and rudder are controlled by a network of cables, pulleys, push/pull rods and levers that transmit control inputs to the related hydraulic power control units.

The aileron and elevator controls are equipped with control disconnects which permit the pilot or the copilot to maintain sufficient lateral and longitudinal control in the event of a control jam. The rudder control is equipped with an anti-jam mechanism that permit both pilots to maintain sufficient directional control, however, additional force is required to obtain surface travel.

In the event of a total electrical power failure, the primary flight controls will remain hydraulically powered ACMP 3B, which will be powered ny the ADG in an emergency.

The secondary flight controls include:

- slats and flaps,
- ground spoilers
- aileron and rudder trim
- horizontal stabilizer trim
- multifunctional spoilers.

NOTE

The multifunctional spoilers consists of two spoilers on each wing. The outboard spoilers are referred to as the SPOILERONS and the inboard spoilers are referred to as the FLIGHT SPOILERS.

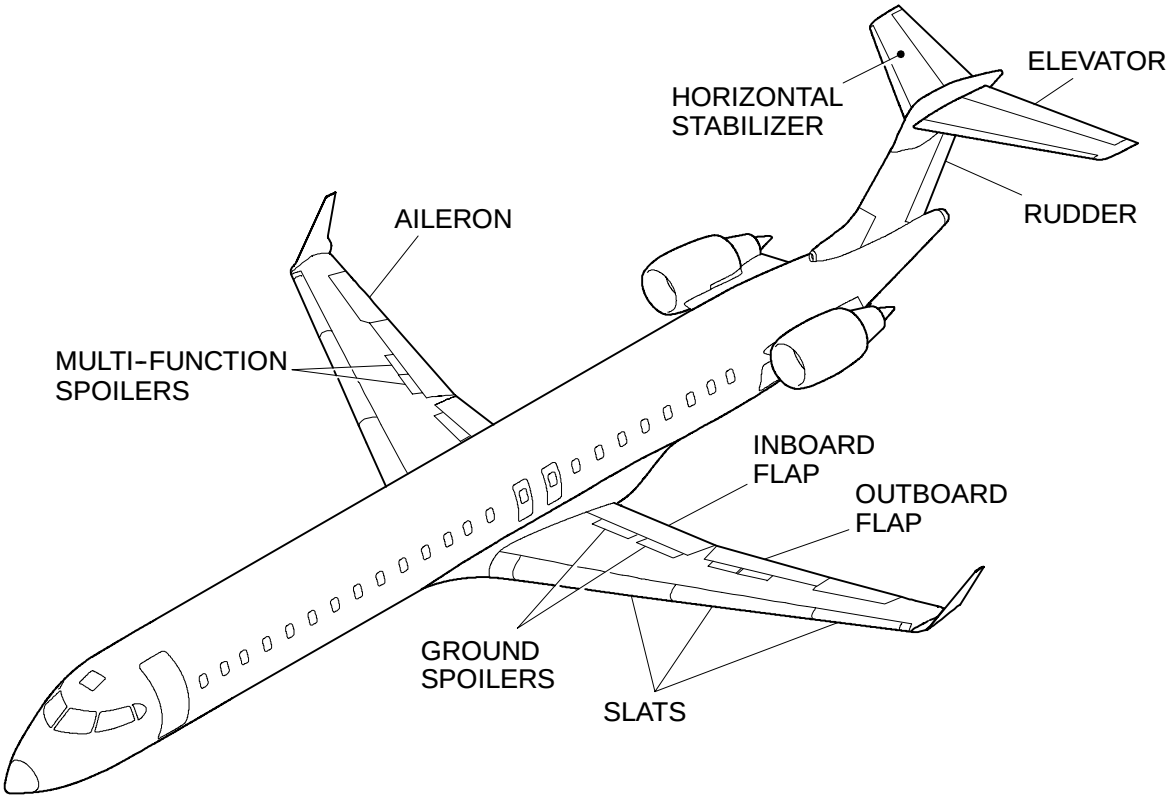
Lateral (roll) control of the aircraft is provided by the ailerons, assisted by the multifunctional spoilers.

Directional (yaw) control of the aircraft is provided by the rudder, assisted by yaw dampers.

Longitudinal (pitch) control of the aircraft is provided by the elevators, assisted by a moveable horizontal stabilizer.

The spoiler control system provides the aircraft with ground lift dumping, roll assist, proportional lift dump and speed reduction in decent for landing. Multifunctional spoilers assist the ailerons for turn coordination and are also used in the ground lift dumping function. The ground spoilers only deploy on the ground as part of the ground lift dumping function.

There are two spoiler/stabilizer control units (SSCUs) that automatically control operation of the spoilers, horizontal stabilizer trim, pitch feel control and rudder travel limiting.



Flight Controls – General
Figure 11–10–1

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1. AILERONS

Lateral control of the aircraft is provided by the ailerons with assist from the multifunction spoilers.

The aileron control systems consist of two control circuits. Under normal conditions, the two systems are interconnected through a roll disconnect mechanism, and there is simultaneous movement of both aileron surfaces from either pilot control wheel. The pilot operates the left aileron system and the copilot operates the right aileron system. Both systems are similar in operation. The autopilot is connected to the right control system only.

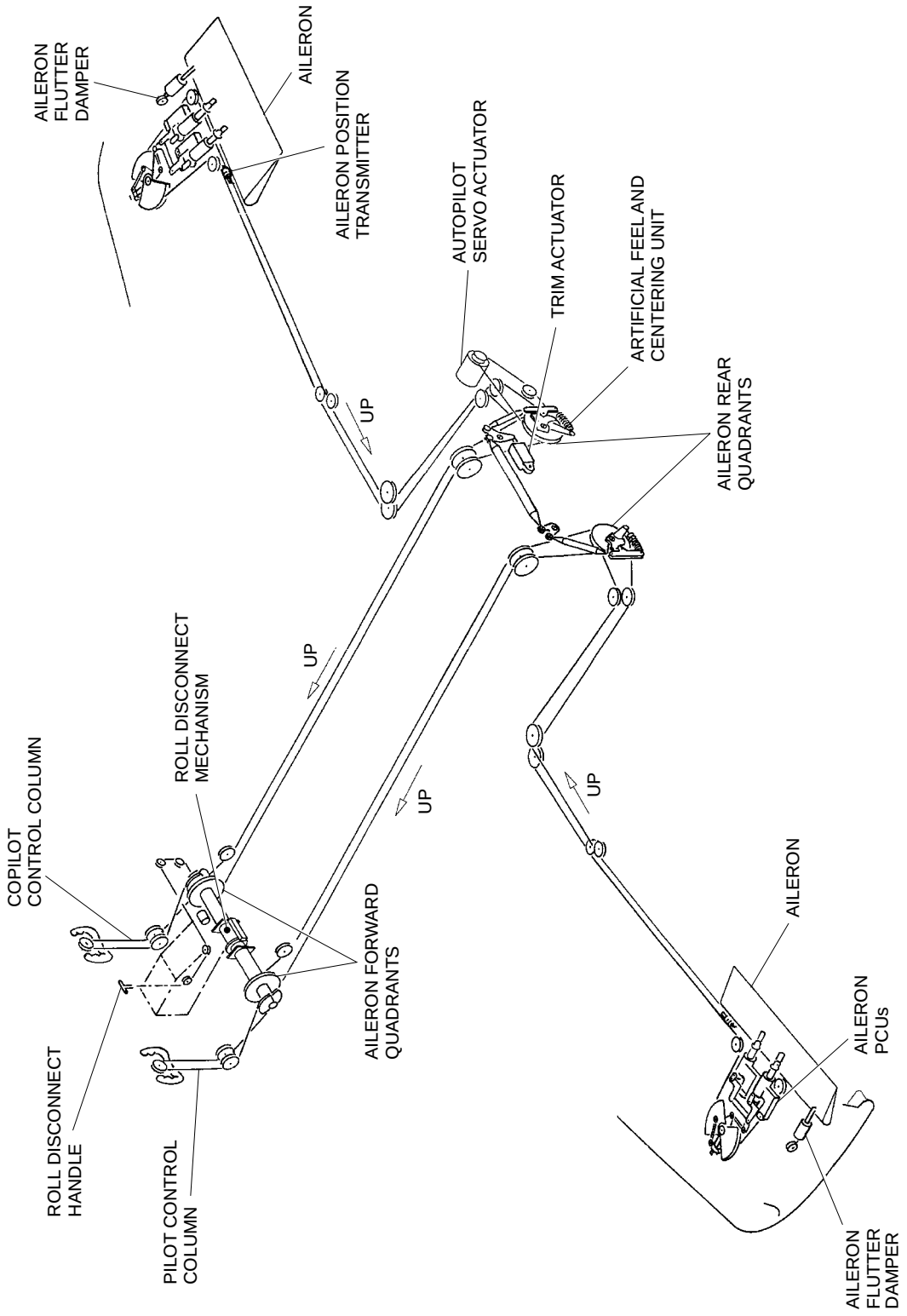
Each aileron is hydraulically powered by two power control units (PCUs) and mechanically controlled by rotation of either control wheel. The left aileron PCUs are powered by hydraulic systems 1 and 3 and the right aileron PCUs are powered by hydraulic systems 2 and 3.

Control wheel movement also generate electrical inputs to the spoiler and stabilizer control units (SSCUs) for roll assist which is provided by the multifunctional spoilers.

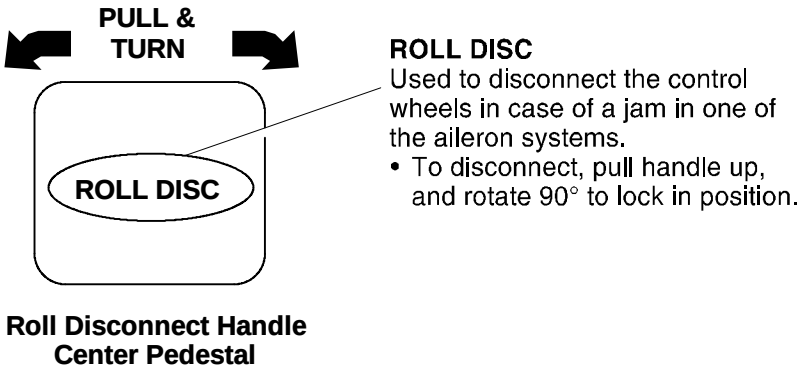
Control wheel centering and artificial feel is provided by mechanical feel units. A flutter damper is attached to each aileron to prevent surface flutter in the event of hydraulic fluid loss at the PCUs during flight. On the ground, flutter dampers provide gust lock function.

In the event of an aileron control jam, the left and right systems can be mechanically separated by pulling a roll disconnect handle. The roll disconnect allows limited lateral control using the unaffected aileron control system and the opposite side spoilerons. Twenty seconds after pulling the roll disconnect handle, two roll select lights on the glareshield illuminate. The flight crew must then select the roll priority on the operable side to obtain control of all spoilerons.

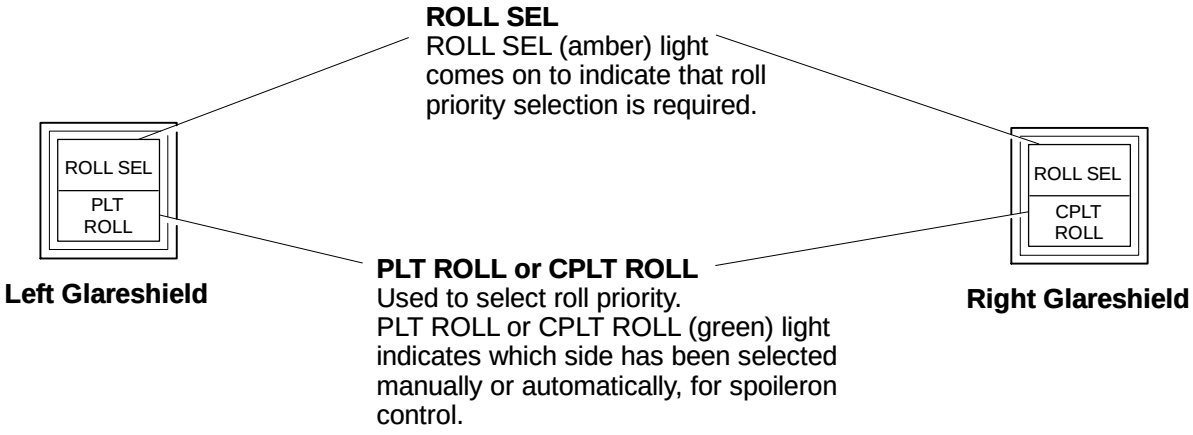
In the event of a PCU runaway, the spoiler and stabilizer control units command the spoilerons on both sides to respond to control inputs. After the roll disconnect handle is pulled, the roll priority should be selected.



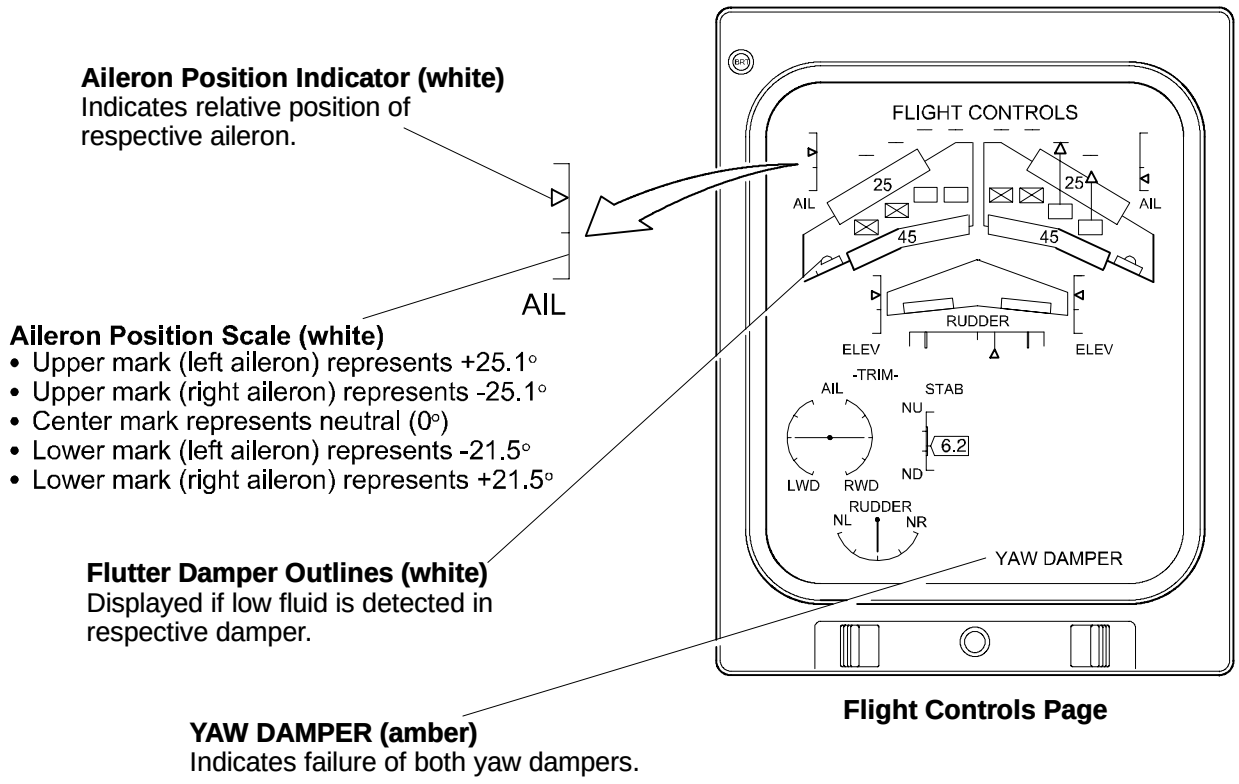
Aileron Control General Arrangement
Figure 11–20–1



Ailerons – Emergency Control
Figure 11–20–2



Ailerons Glareshield Emergency Control
Figure 11–20–3

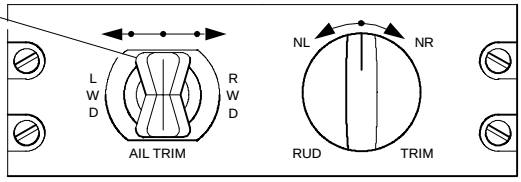


Flight Controls Page

EICAS Flight Control – Synoptic Page
Figure 11–20–4

Aileron trim is electrically operated and manually controlled using the trim selector on the center pedestal. Operation of the aileron trim will cause control wheel rotation.

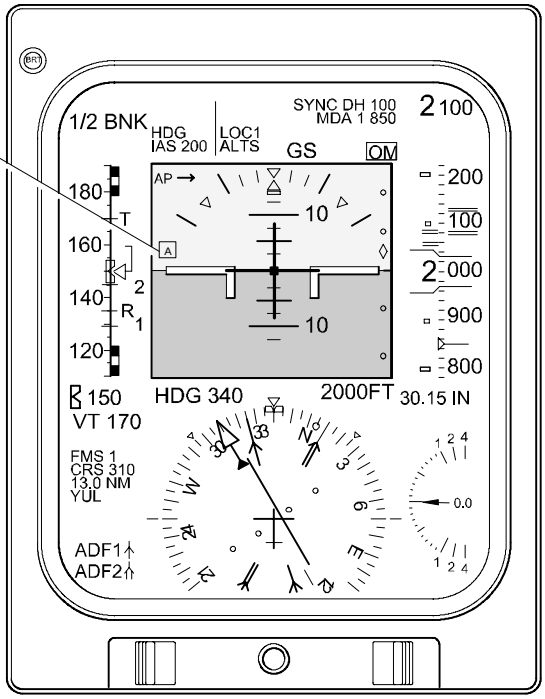
AIL TRIM
Used to control aileron trim.
Spring loaded to center position.
- LWD – Trims left wing down.
- RWD – Trims right wing down.



Aileron / Rudder Trim Panel
Center Pedestal

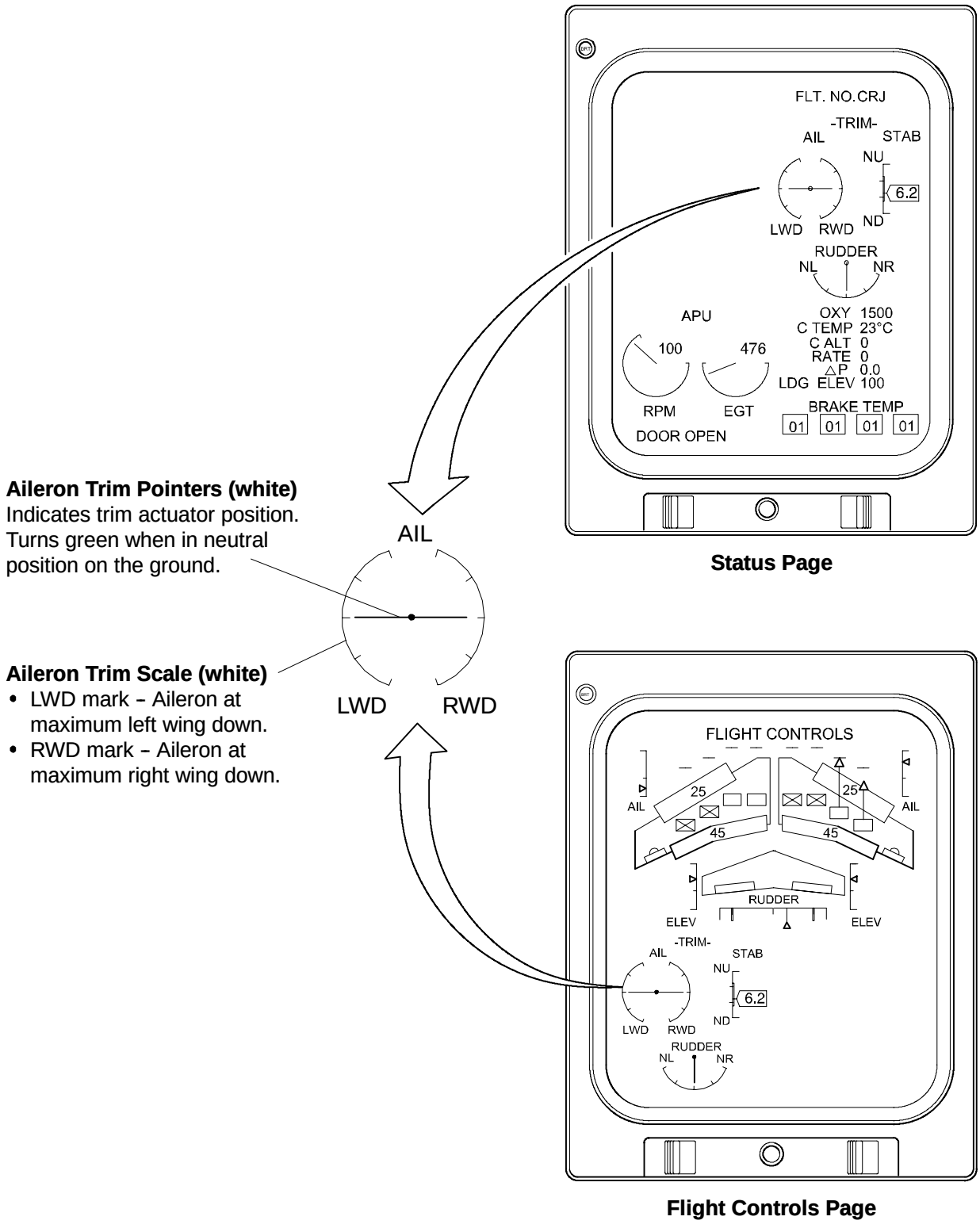
Aileron Trim Controls
Figure 11–20–5

Aileron Mistrim Indicator (yellow)
Indicates that the ailerons are in a mistrim condition, when the autopilot is engaged.

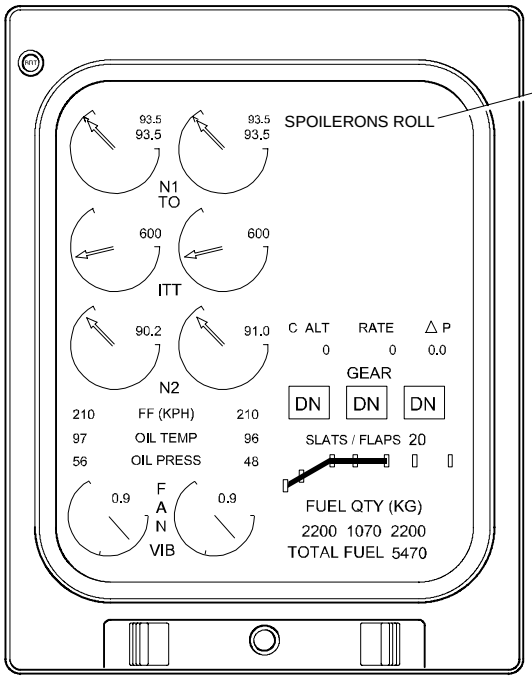


Primary Flight Display
Pilot's and Copilot's Instrument Panels

Aileron Mistrim Flag <1015>
Figure 11–20–6



Aileron Trim EICAS Indications
Figure 11–20–7

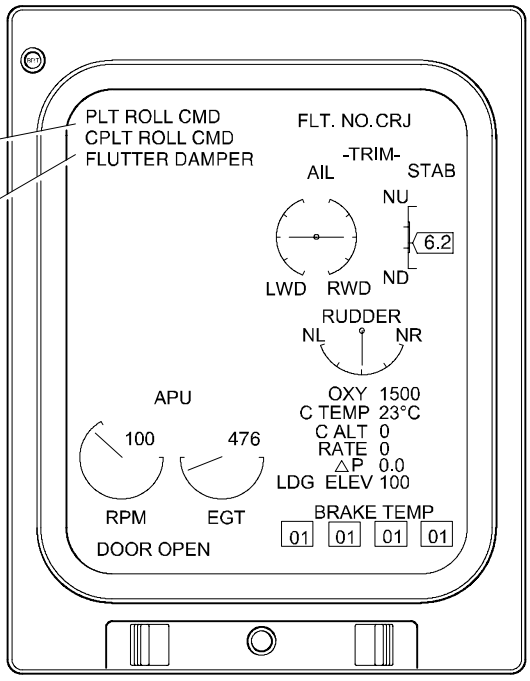


SPOILERONS ROLL caution (amber)
Indicates that roll disconnect has been selected and either no roll priority has been selected or both roll priorities have been selected.

Primary Page

PLT or CPLT ROLL CMD advisory (green)
Indicates that pilot or copilot roll authority has been selected.

FLUTTER DAMPER status (white)
Indicates that low fluid level is detected in a flutter damper. (Refer to the flight controls synoptic page for the affected flutter damper.)



Status Page

Spoilerons and Roll Selection – EICAS Indications <1001>
Figure 11–20–8

A. System Circuit Breakers

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
Ailerons	Trim	AIL TRIM	DC BUS 2	2	F3	
	Trim Indication	AIL/RUD TRIM IND	BATTERY BUS	1	L7	

1. RUDDER

Directional (yaw) control is provided by the rudder and assisted by yaw dampers.

The rudder is hydraulically powered by three power control units (PCUs). The PCUs receive mechanical inputs from the rudder pedals. Each hydraulic system powers one of the three PCUs. Both pedal sets move simultaneously when operated from either the pilot or the copilot station.

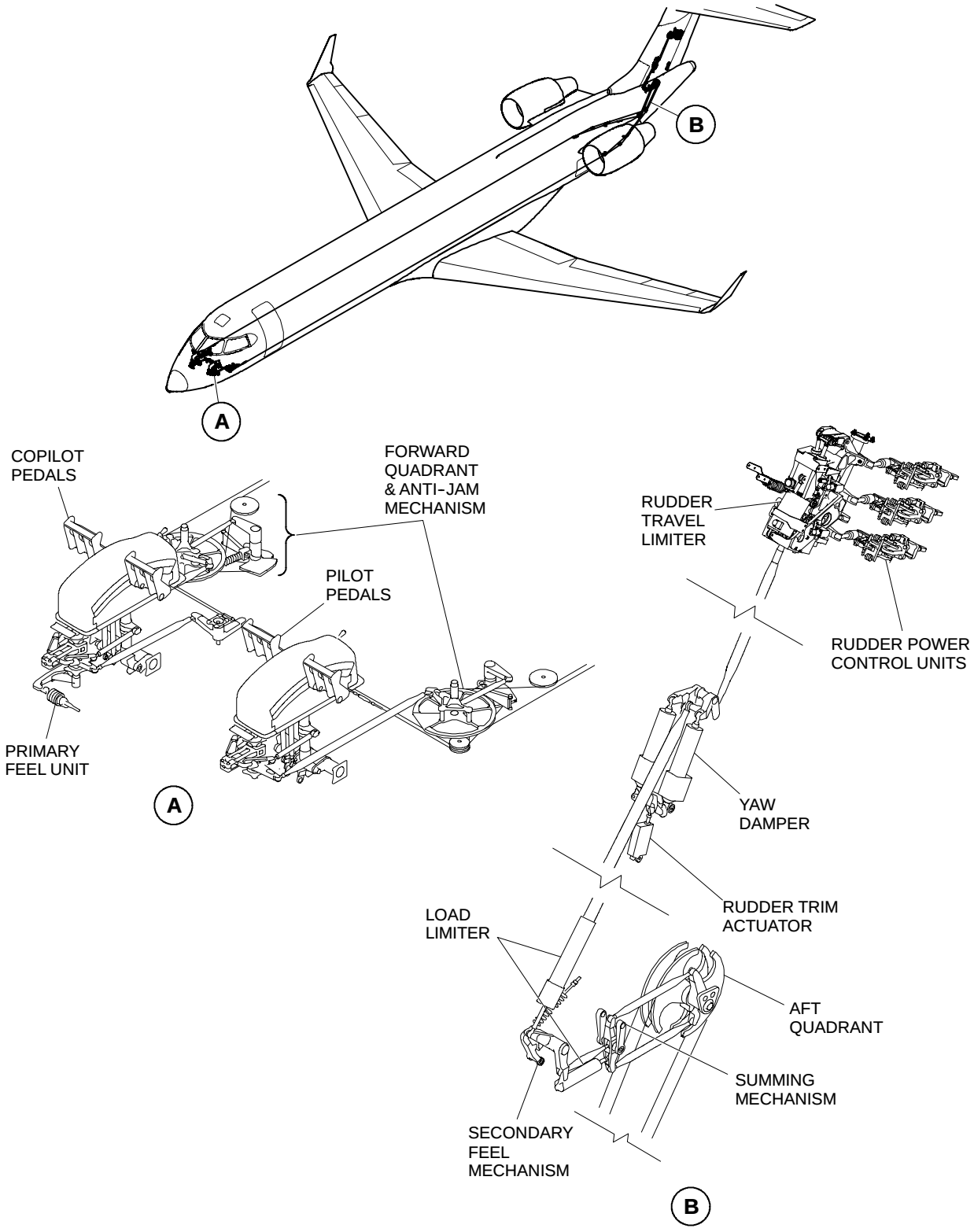
Rudder pedal centering and artificial feel is provided by a primary feel unit, located at the right pedal pivot. A secondary feel unit, located in the aft fuselage, ensures that the rudder remains centered in the event of a control disconnect.

In the event of a control jam, both pilot's and copilot's pedals will remain operable through anti-jam mechanisms, however additional pedal force will be required to obtain rudder deflection.

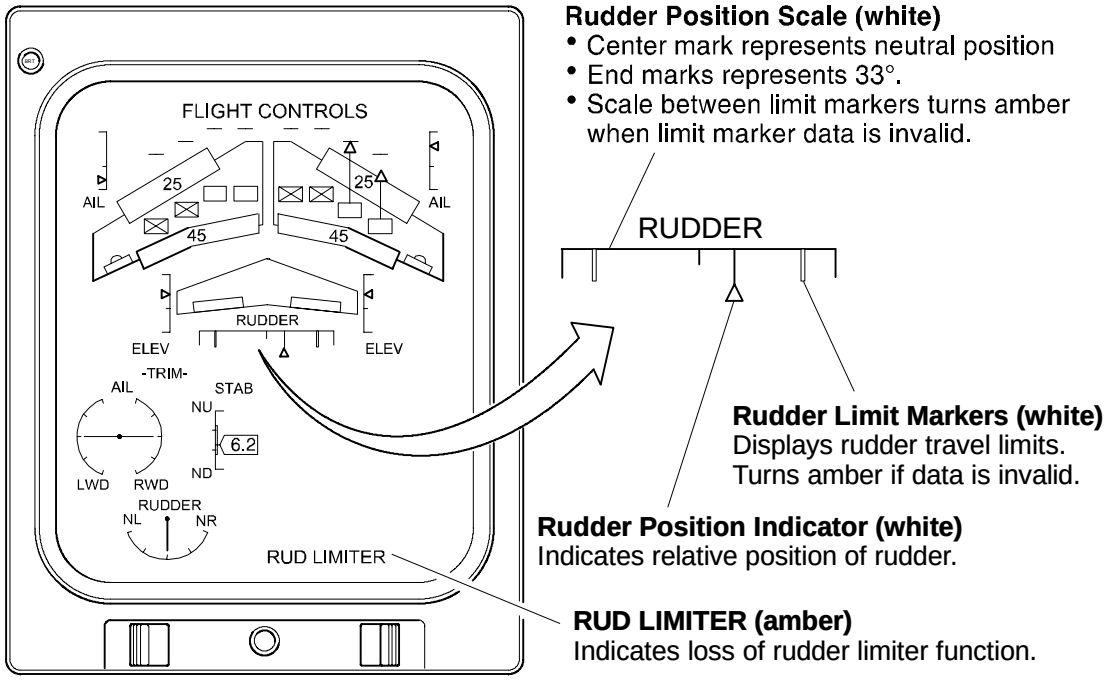
A rudder travel limiter assembly (RTL) is incorporated within PCU assembly to reduce rudder travel. The RTL is automatically controlled, relative to airspeed and flap position, by the spoiler and stabilizer control units (SSCUs). The SSCUs gradually reduce the rudder travel from 33° to 4° (either side of neutral) as the aircraft speed increases. This will avoid overstressing the fuselage at higher airspeeds and prevents the aircraft from entering a severe sideslip.

The rudder trim is electrically operated and manually controlled using the trim selector on the center pedestal. Operation of the rudder trim will not cause rudder pedal deflection.

Two independent yaw damper systems operate continuously in flight to improve the airplane's directional stability and turn coordination by damping out oscillations in yaw. Each yaw damper actuator automatically respond to inputs received from one flight control computer. One yaw damper system must be engaged to engage the autopilot.

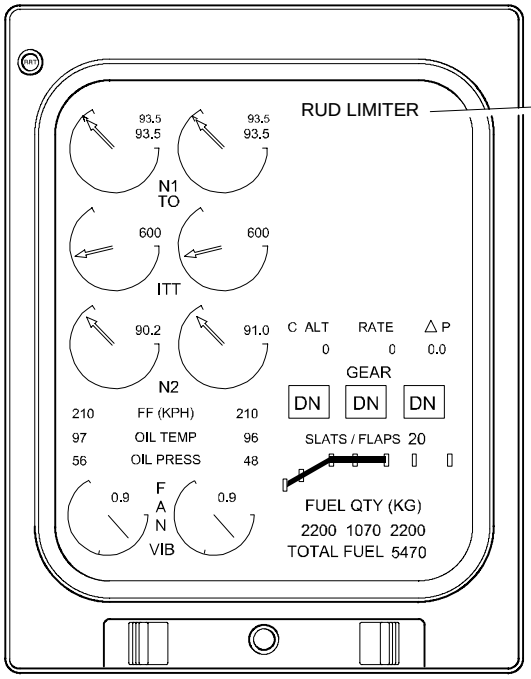


Rudder System
Figure 11–30–1



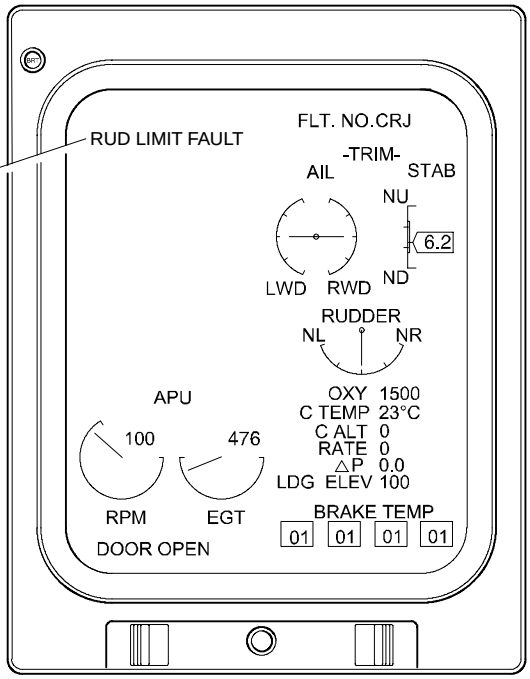
Flight Controls Page

Rudder – Flight Control Synoptic Page
Figure 11–30–2



RUD LIMITER caution (amber)
Indicates loss of rudder limiter function.

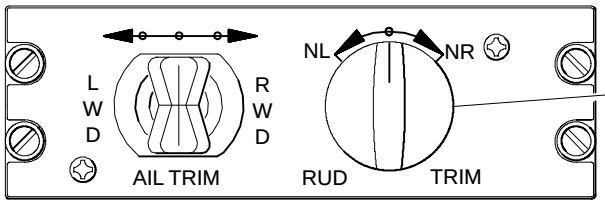
Primary Page



RUD LIMIT FAULT status (white)
Indicates loss of redundancy in rudder limiter.

Status Page

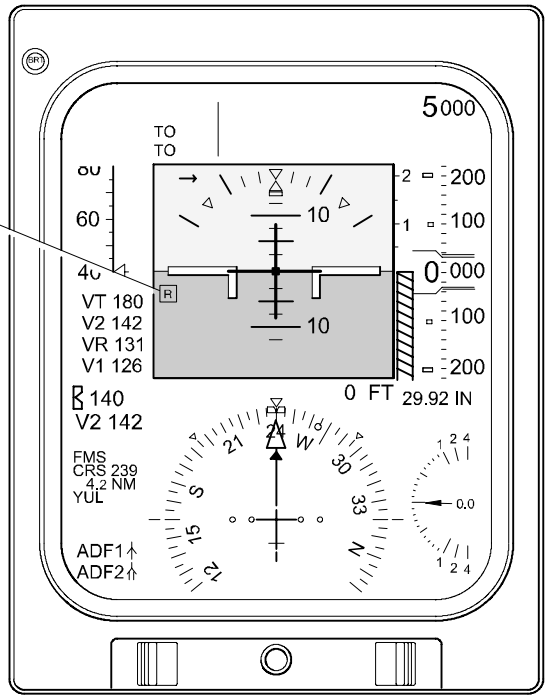
Rudder Limiter – EICAS Indications <1001>
Figure 11–30–3



RUD TRIM
Used to control rudder trim.
Spring loaded to centre position.
- NL – Increases rudder trim to nose left.
- NR – Increases rudder trim to nose right.

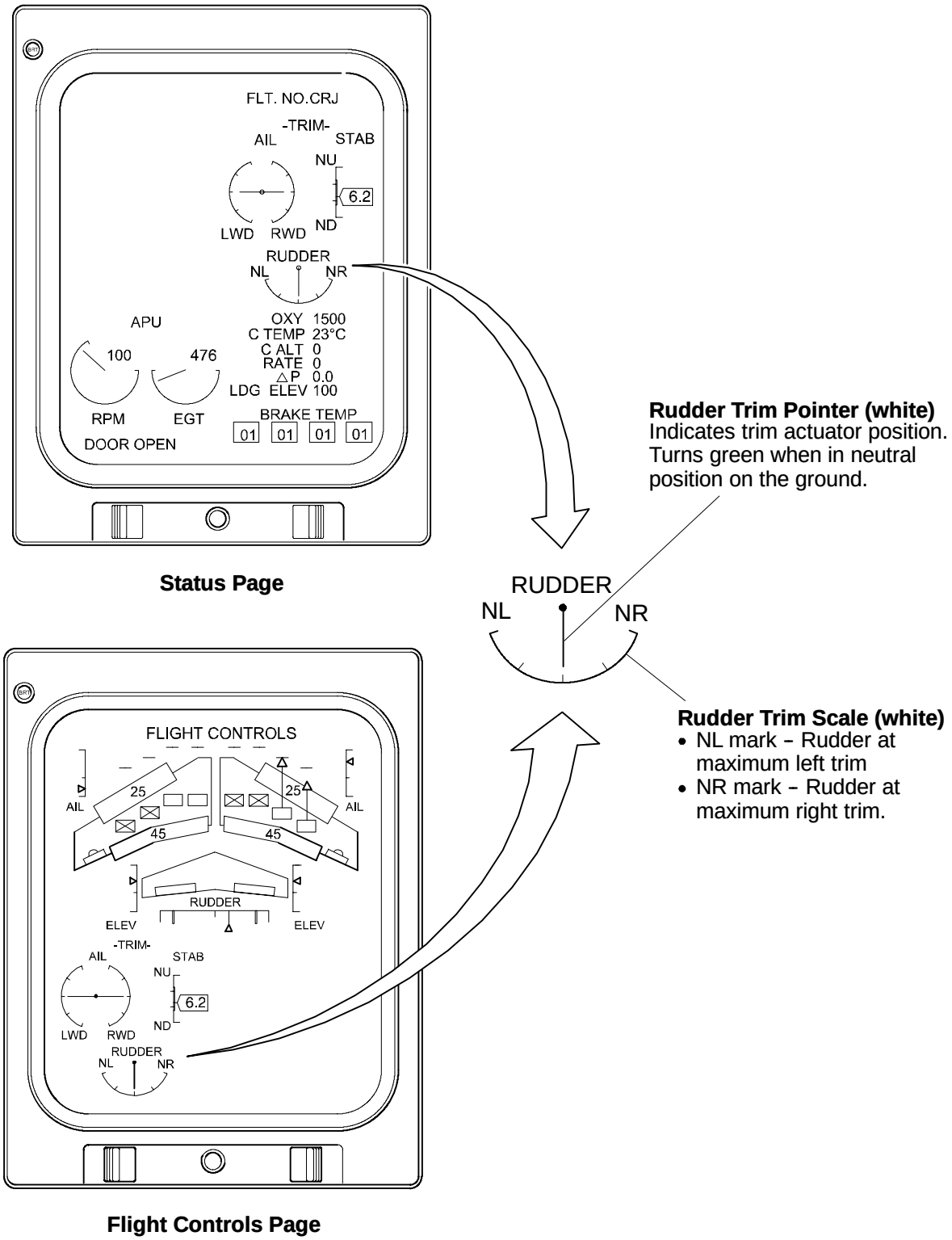
Aileron/ Rudder Trim Control Panel
Center Perdestal

Rudder Mistrim Indicator (yellow)
Indicates that the rudder is in a mistrim condition, when the autopilot is engaged.

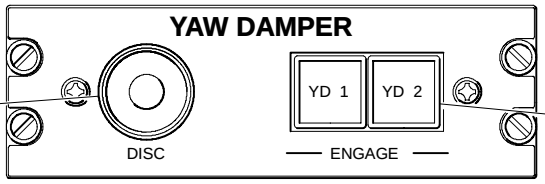


Primary Flight Display
Pilot's and Copilot's Instrument Panels

Rudder Trim Control Panel and Primary Flight Display Flag <1015>
Figure 11–30–4



Rudder Trim – EICAS Indications
Figure 11–30–5

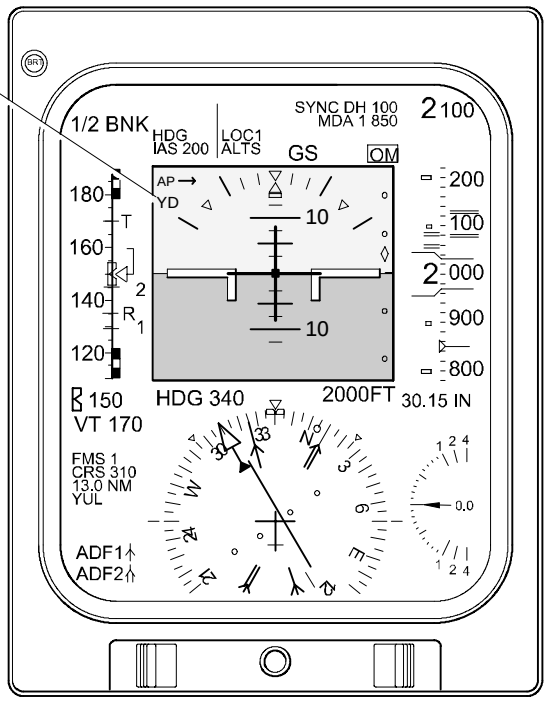


DISC
Used to disengage yaw dampers

ENGAGE
Used to engage respective yaw damper channel.

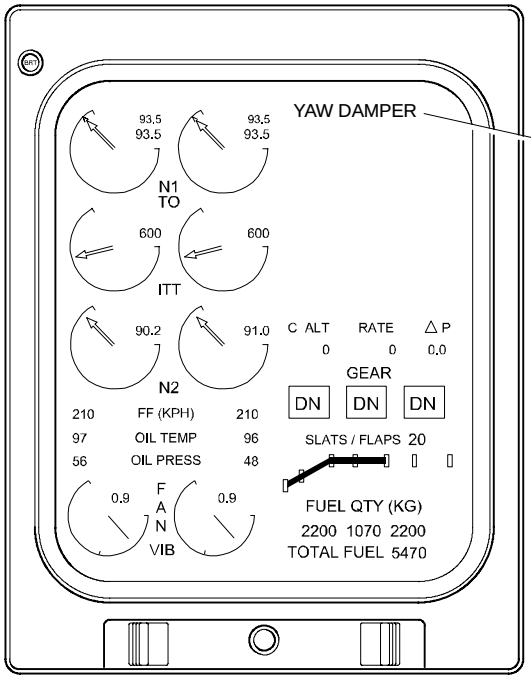
Yaw Damper Panel
Center Pedestal

YD (amber)
Indicates that both yaw dampers have been disengaged.



Primary Flight Display
Pilot's and Copilot's Instrument Panels

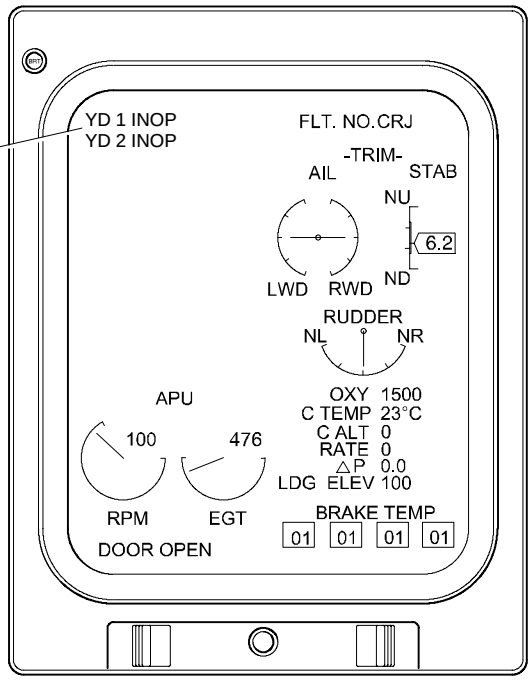
Yaw Damper Controls and Primary Flight Display Flag <1015>
Figure 11–30–6



YAW DAMPER caution (amber)
Indicates both yaw dampers are off or failed.

Primary Page

YD 1 or 2 INOP status (white)
Indicates that respective yaw damper has failed or is off.



Status Page

Yaw Damper – EICAS Indications <1001>
Figure 11–30–7

A. System Circuit Breakers

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
Rudder	Trim	RUDDER TRIM	DC BUS 2	2	F2	
	Trim Limiter	PFEEL 2 RTL	DC ESSENTIAL		R5	
	Trim Indication	AIL/RUD TRIM IND	BATTERY BUS	1	L7	

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1. ELEVATORS

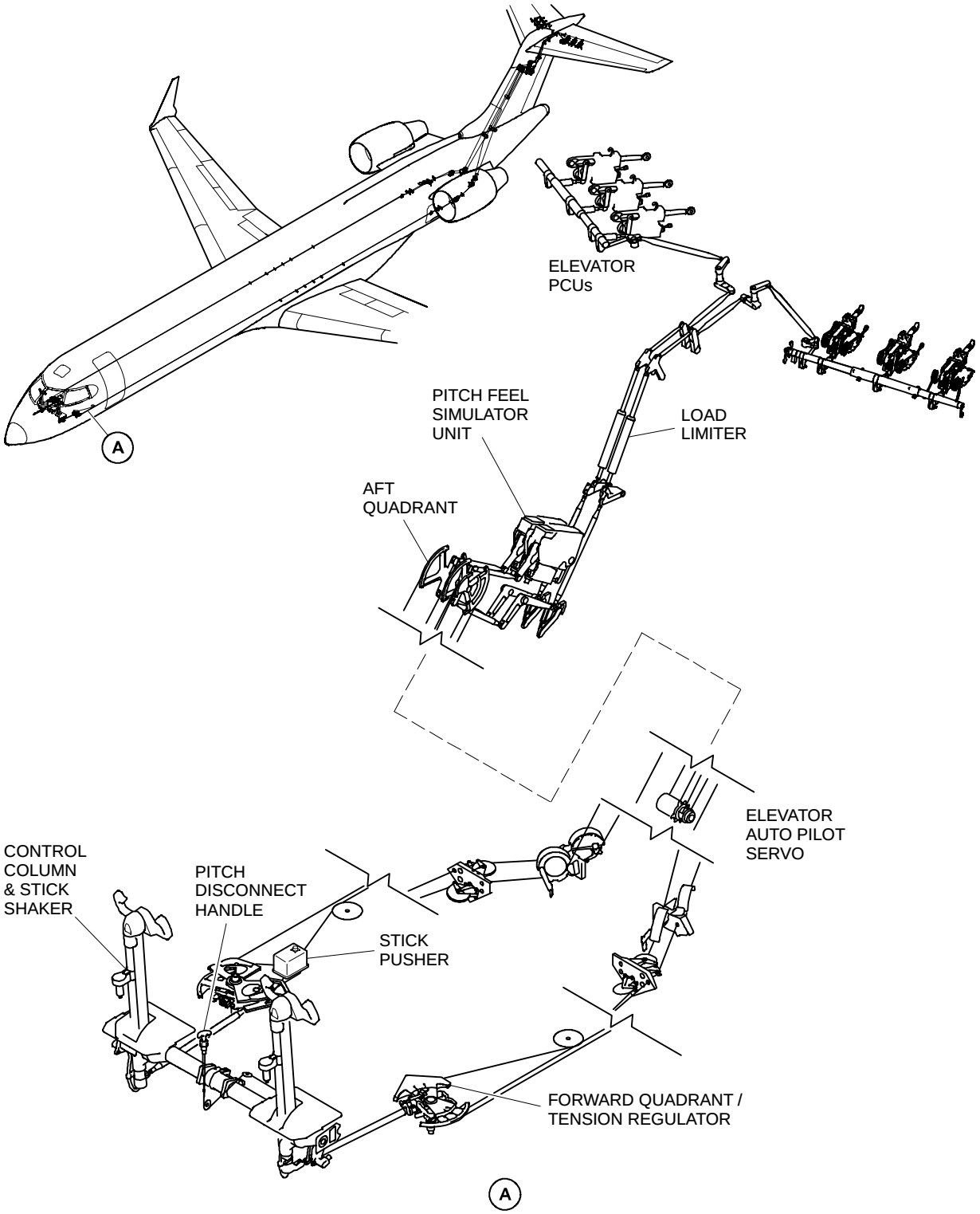
Longitudinal (pitch) control is provided by the elevators, assisted by a moveable horizontal stabilizer.

Two separate elevator control systems are provided. The left elevator system is controlled by the pilot and the right system is controlled by the copilot. Under normal conditions, the two systems are interconnected through a pitch disconnect mechanism. Forward and aft movement of either control column inputs simultaneous movement of both elevator surfaces. Both systems are similar, with the exceptions that the autopilot is connected to the left elevator system and the stall protection system is connected to the right elevator system.

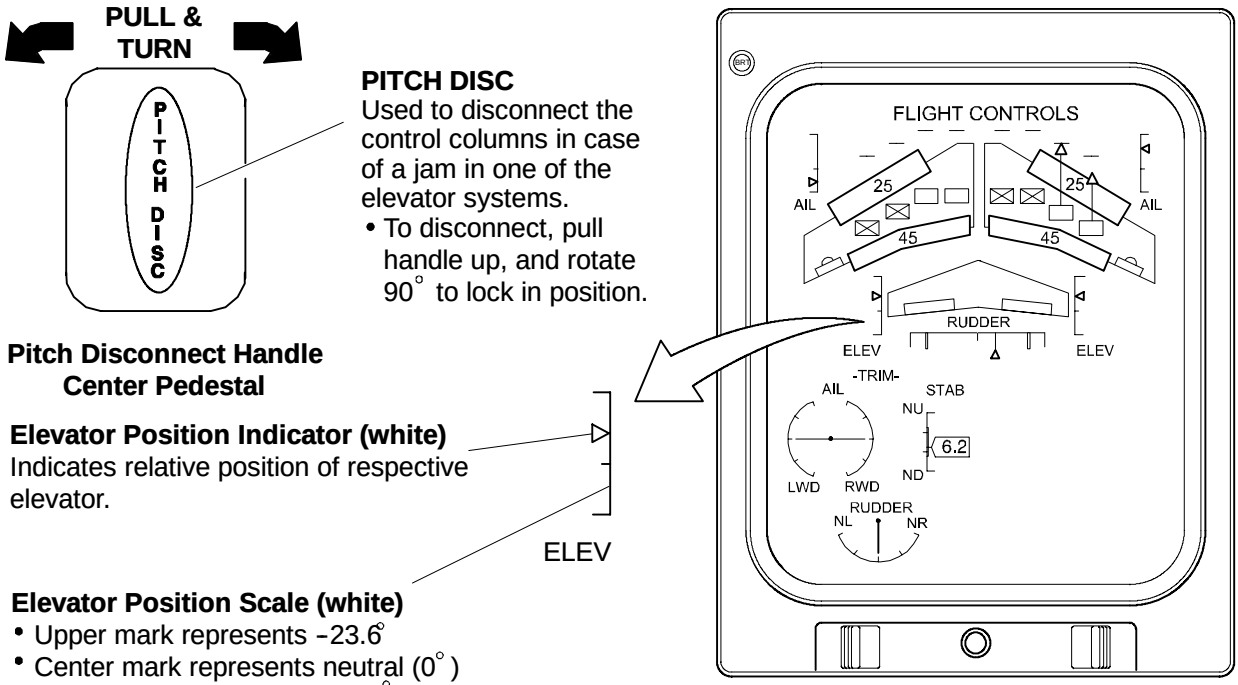
Each elevator is hydraulically powered by three power control units (PCUs) which receive mechanical inputs the control columns. Each hydraulic system powers one of the three PCUs of each elevator. Elevator flutter damping is incorporated in the PCUs.

Control column centering and artificial feel is provided by electro-mechanical pitch feel units. The spoiler and stabilizer control units (SSCUs) automatically vary the control column artificial feel force as a function of the horizontal stabilizer position, flap extension and aircraft acceleration.

In the event of an elevator control jam, the left and right elevator systems can be mechanically separated by pulling a PITCH DISC handle and turning it 90° to lock the handle in place. The operable side can then be used to maintain pitch control.

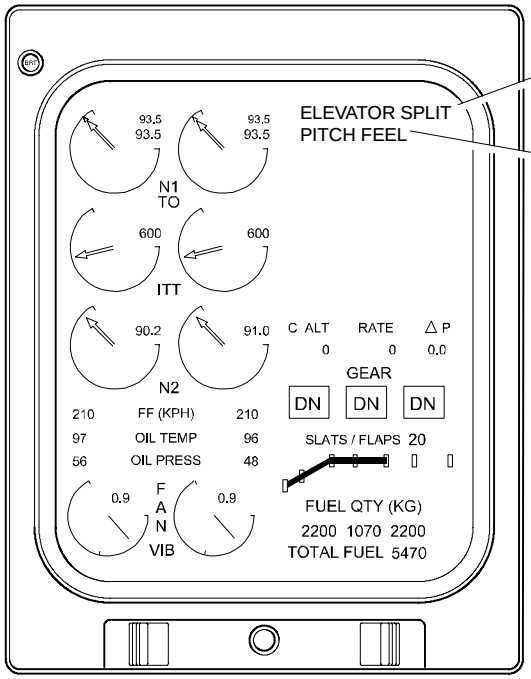


Elevator System
Figure 11–40–1



Flight Controls Page

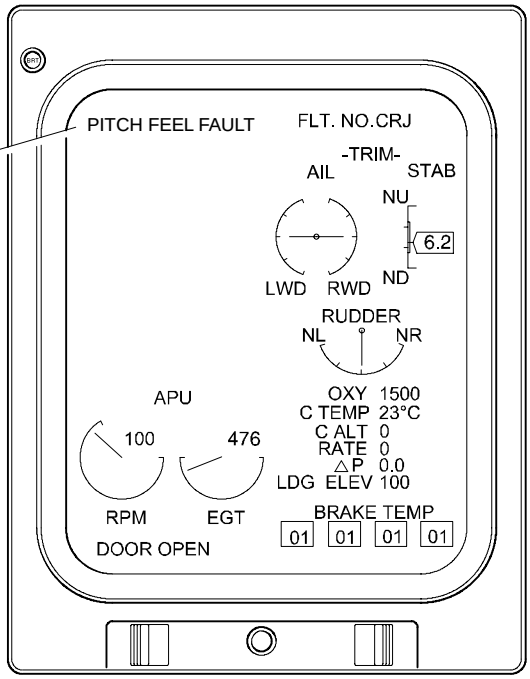
Elevator Emer Controls and Flight Control – Synoptic Page
Figure 11–40–2



ELEVATOR SPLIT caution (amber)
Indicates that left and right elevator surface mismatch exceeds 6° (below 250 knots) or 3° (above 250 knots).

PITCH FEEL caution (amber)
Indicates a failure of the pitch feel system.

Primary Page



PITCH FEEL FAULT status (white)
Indicates loss of redundancy in the pitch feel system (one actuator failed).

Status Page

Elevator – EICAS Indications <1001>
Figure 11–40–3

A. System Circuit Breakers

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
Elevators	Pitch Feel	PFEEL 1	DC BUS 1	1	F2	
		PFEEL 2 RTL	DC ESSENTIAL	2	R5	

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1. HORIZONTAL STABILIZER TRIM

Horizontal stabilizer trim system provides pitch trim by varying the angle of the horizontal stabilizer. The horizontal stabilizer is positioned by a screw jack driven by two electric motors and controlled by the spoiler and stabilizer control units (SSCUs) through selection of the STAB TRIM engage switches. Each motor has a magnetic brake to prevent trim runaway. Trim range is from +2° (leading edge up) to -13° (leading edge down).

The horizontal stabilizer trim is operated manually by the pilot control wheel trim switches or automatically by the autopilot. Trim disconnect switches are provided on each control wheel.

The SFECU's operate in one of four modes in the following priority:

- Manual trim - Nose-up or nose-down trim commands (from the control wheel switches) are sent to the the slat/flap electronic control unit (SFECU). The SFECU moves the screw jack at a rate that is dependent on Mach airspeed.

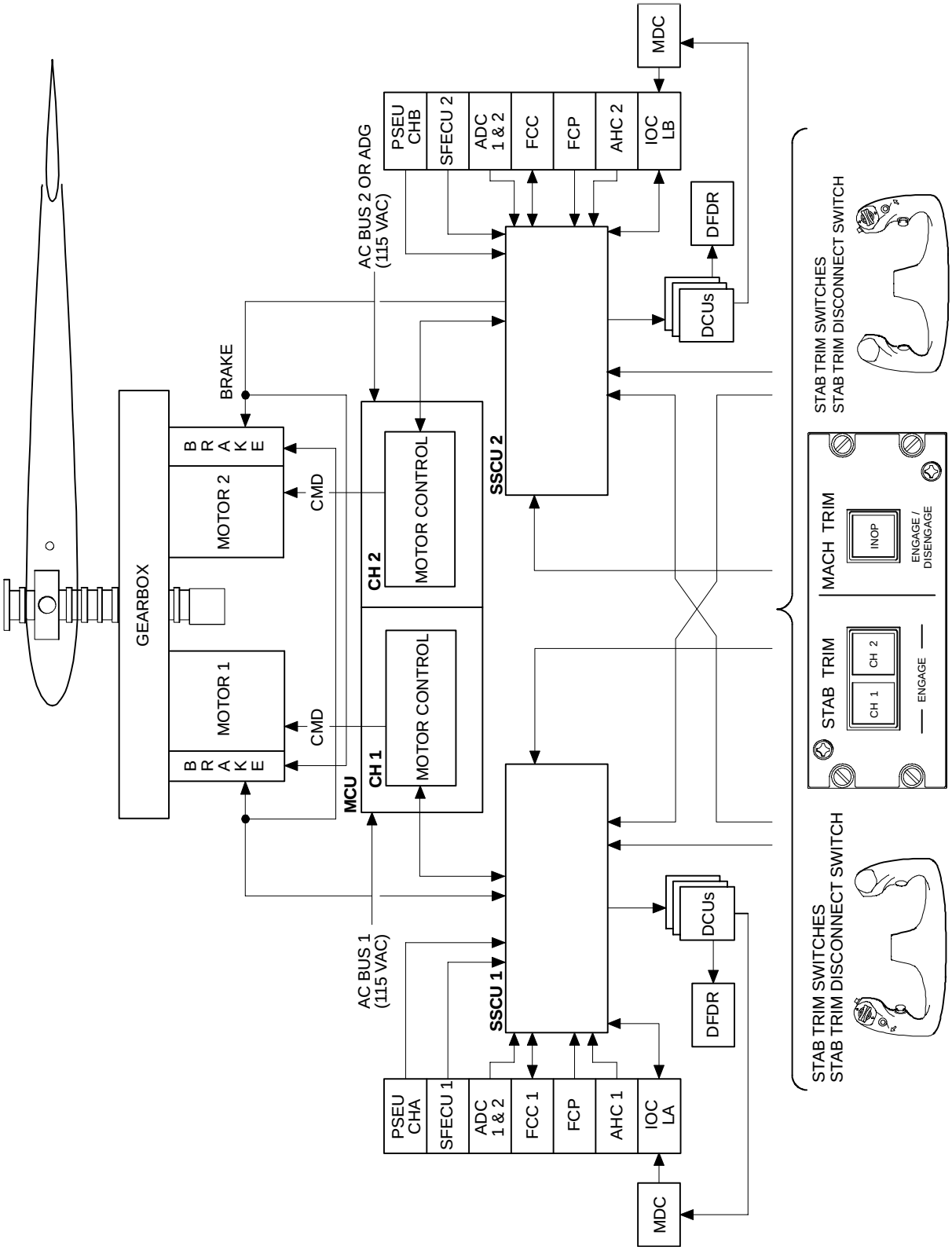
- Autopilot trim - When the AP is engaged and air loads begin to build up on the elevator, the flight control computer, through the SSCU, sends signals to the screw jack motor controllers to aerodynamically trim the aircraft.

- AUTO trim - Auto trim occurs when the flaps are moving between 0 and 20° in either direction. When the flaps are extended or retracted, trim commands (via the SSCU's) are sent to the screw jack motor controllers to compensate for aircraft pitching caused by flap configuration changes.

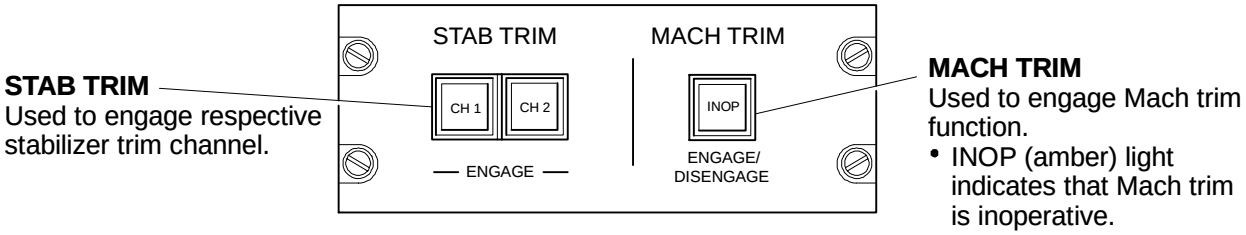
- Mach trim - When the Mach Trim is engaged, the horizontal stabilizer trim is adjusted (at a rate of 0.03° to 0.06° per second) to compensate for the aircraft tendency to pitch down at increasing Mach numbers. The Mach Trim function is disabled when the autopilot is engaged.

On every aircraft power-up, each SSCU performs a Computer Power-On-Self-Test (CPOST). Following the CPOST, the computer performs a System Power-On-Self-Test (SPOST). The SPOST is divided into two parts, SPOST1 and SPOST2. SPOST1 checks the integrity of specific flight control system components and the check lasts up to 60 seconds. SPOST2 (Pilots SSCU Test) is performed automatically following aircraft power-up, but only once per 50 flight cycles. The SPLR/STAB IN TEST advisory message will only appear for up to 60 seconds during the SPOST2.

If required, SPOST2 may be manually initiated (after SPOST1 is complete) by depressing one Stab Disconnect Switch and the Mach Trim engage switch simultaneously for 5 seconds.



Horizontal Stabilizer Trim Control System Schematic
Figure 11–50–1

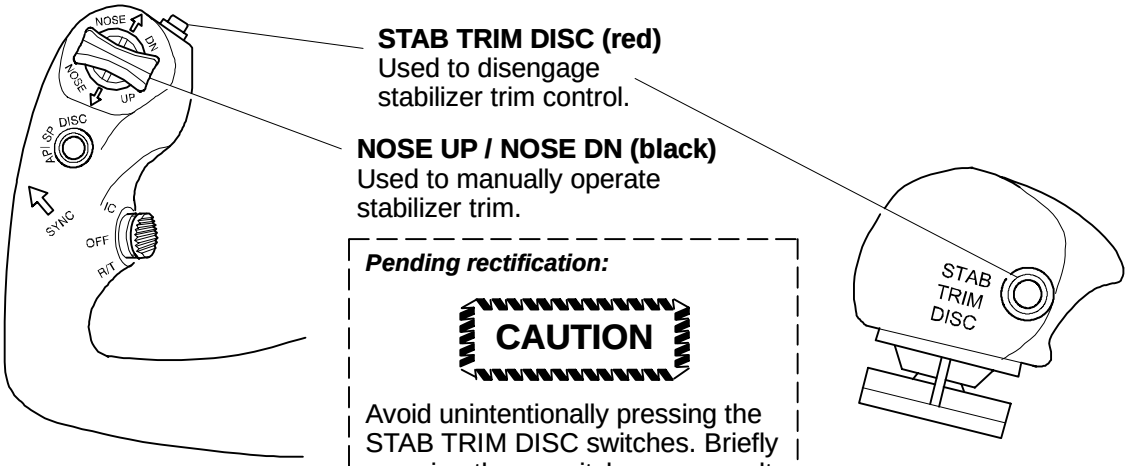


STAB TRIM
Used to engage respective stabilizer trim channel.

MACH TRIM
Used to engage Mach trim function.
- INOP (amber) light indicates that Mach trim is inoperative.

Stabilizer/ Mach Trim Panel
Center Pedestal

Stabilizer/ Mach Trim Control Panel
Figure 11–50–2



STAB TRIM DISC (red)
Used to disengage stabilizer trim control.

NOSE UP / NOSE DN (black)
Used to manually operate stabilizer trim.

Pending rectification:

CAUTION

Avoid unintentionally pressing the STAB TRIM DISC switches. Briefly pressing these switches can result in disengaging one or both STAB TRIM channels. If this occurs, it will not be possible to re-engage the STAB TRIM channel(s) in flight.

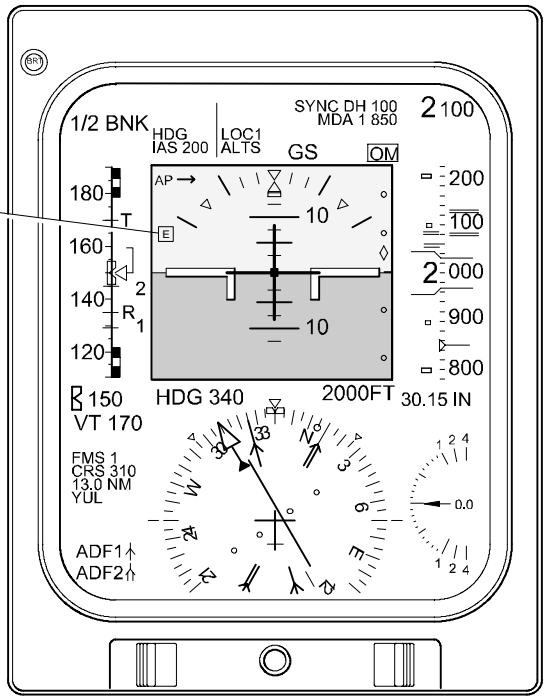
TOP VIEW

Clacker indicates that stabilizer has been in motion for more that 3 seconds (possible trim runaway condition).

Pilot's Control Wheel
(Copilot's Opposite)

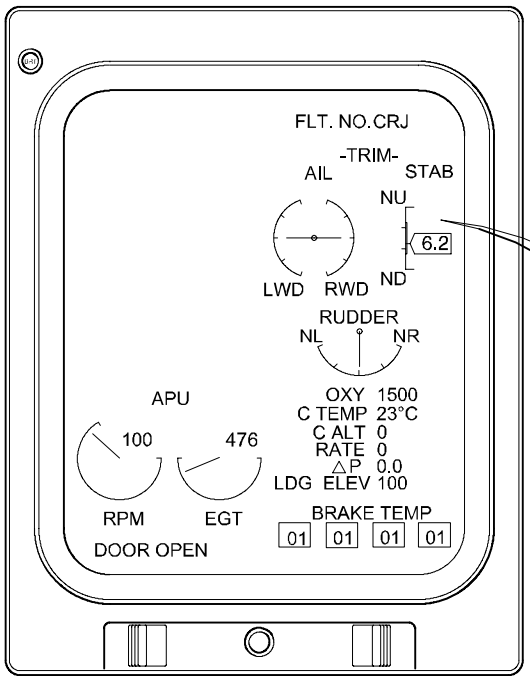
Stabilizer Trim – Pilot's Control Wheel
Figure 11–50–3

Elevator Mistrim Indicator (yellow)
Indicates that the horizontal stabilizer is in a mistrim condition, when the autopilot is engaged.

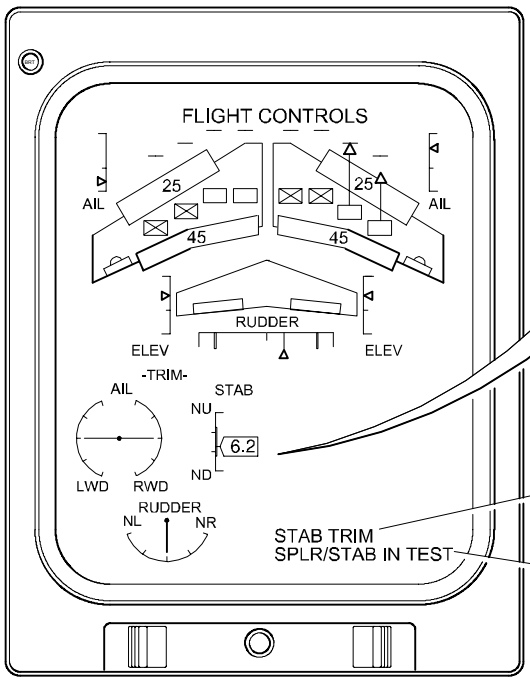


Primary Flight Display
Pilot's and Copilot's Instrument Panels

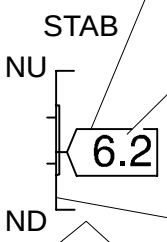
Elevator Mistrim Primary Flight Display Flag <1015>
Figure 11–50–4



Status Page



Flight Controls Page



Stabilizer Trim Pointer
Moves up and down along the trim scale to indicate trim position.
- Green – Stabilizer position is in take–off configuration.
- White – Stabilizer position is not in take–off configuration.

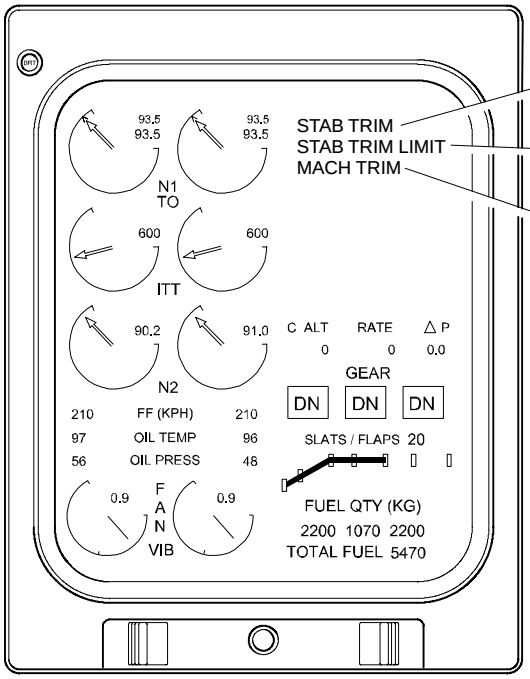
Stabilizer Trim Readout
Displays stabilizer trim position.
- Green – Stabilizer position is in take–off configuration.
- White – Stabilizer position is not in take–off configuration.

Stabilizer Trim Scale (white)
- Green band – Stabilizer trim take–off range.
- ND mark – Stabilizer at maximum nose down trim limit.
- NU mark – Stabilizer at maximum nose up trim limit.
- Intermediate marks – 5 trim units and 10 trim units.

STAB TRIM (amber)
Indicates that both channels of the control unit are disengaged or have failed.

SPLR/STAB IN TEST (green)
Indicates that the spoiler and stabilizer control system is in self test mode.

Stabilizer Trim EICAS Indications
Figure 11–50–5



STAB TRIM caution (amber)
Indicates that both channels of the control unit are disengaged or have failed.

STAB TRIM LIMIT caution (amber)
Indicates that stabilizer trim is at or greater than 14 trim units.

MACH TRIM caution (amber)
Indicates that Mach trim is not engaged or has failed on both channels.

Primary Page

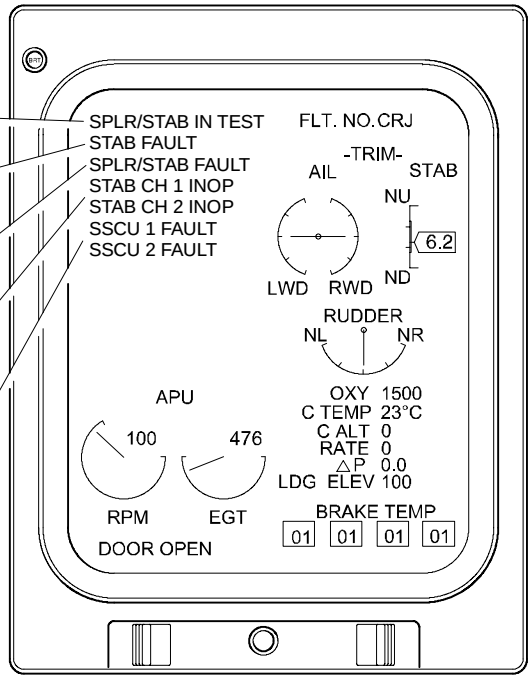
SPLR/STAB IN TEST advisory (green)
Indicates that the spoiler and stabilizer control system is in self test mode.

STAB FAULT status (white)
Indicate loss of redundancy in stabilizer trim control.

SPLR/STAB FAULT status (white)
Indicates a fault in the spoiler and stabilizer control unit.

STAB CH 1 or 2 INOP status (white)
Indicates respective stabilizer trim channel is not engaged or has failed.

SSCU 1 or 2 FAULT status (white)
Indicates that one of two spoiler and stabilizer control modules has failed or is not powered.



Status Page

Stab Trim EICAS Indications <1001>
Figure 11–50–6

A. System Circuit Breakers

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
Horizontal Stabilizer Trim	Control Unit	SSCU 1 CH A	DC BUS 1	1	F1	
		SSCU 1 CH B	DC BUS 2	2	F1	
		SSCU 2 CH A	DC ESSENTIAL		R3	
		SSCU 2 CH B			R4	

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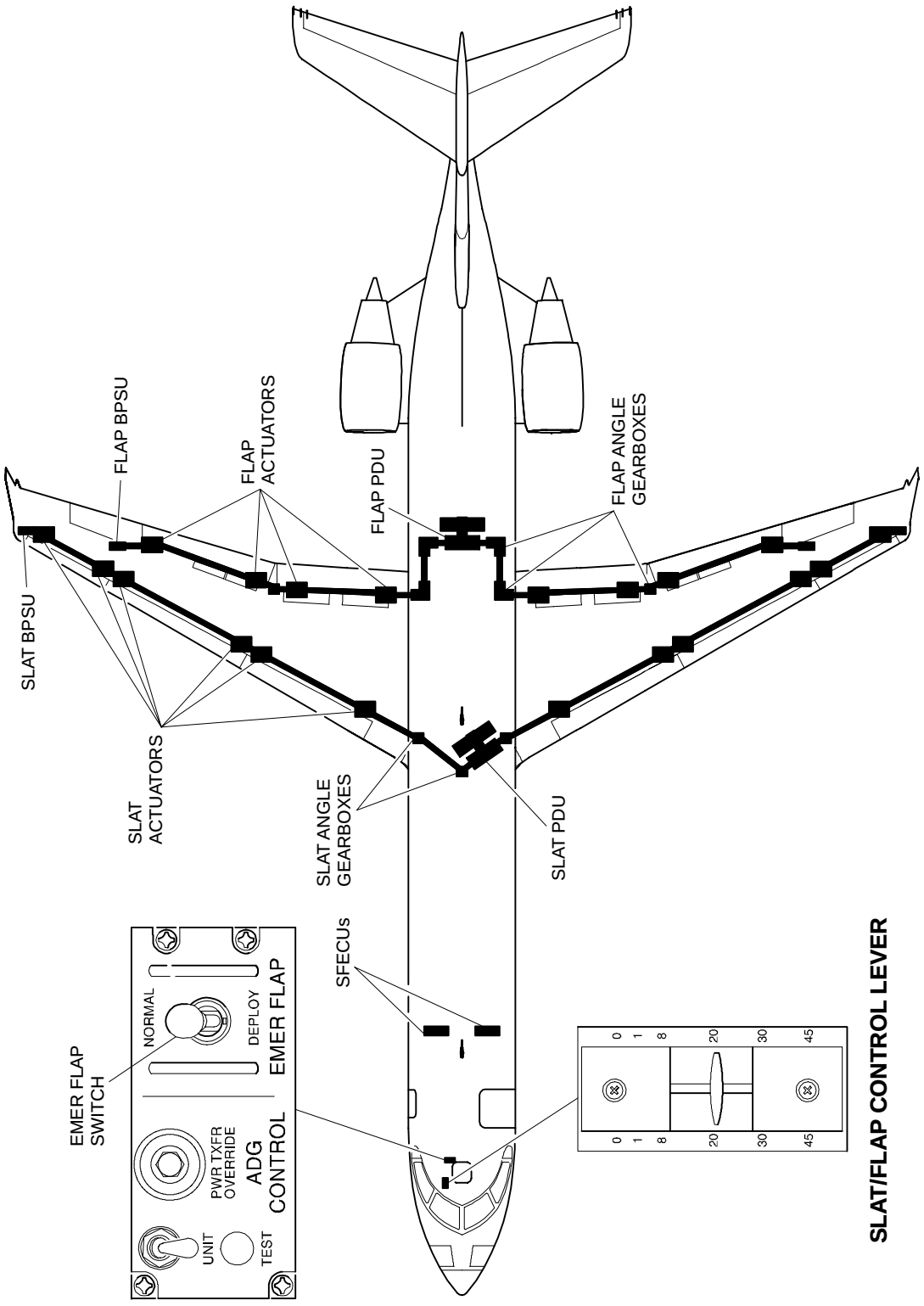
1. FLAPS AND SLATS

The flap and slat systems provide lift augmentation during take-off and landing. Each wing has three leading edge slats and two trailing edge flaps. Both systems are selected and operated by a single electronic slat/flap control lever, located on the center pedestal. During extension, the slats move forward and down on geared tracks, the flaps move slightly aft and down around hinge pivots.

Each system is driven by a dual motor power drive unit. The power drive units drive the flaps and slats through a series of drive shafts, gearboxes and actuators. Brake position sensor units, mounted at the outboard ends of each drive system, provide braking for asymmetric protection and provide surface position feedback to the slat/flap electronic control units (SFECUs). Flap skew sensors and slat disconnect sensors provide fault detection in the event of a failure in a drive system.

When a slat/flap selection is made, the SFECUs release the system brakes and command the power drive units to deploy or retract the slats and flaps to the selected position. An overspeed clacker will sound if the airspeed is too high for the selected flap setting.

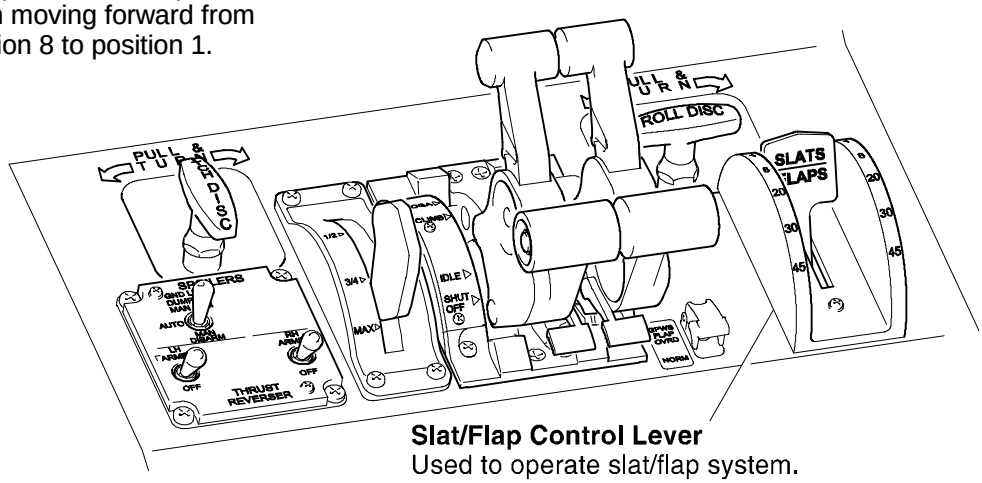
If one of the two power drive unit motors fails, the system will remain functional at half speed. In the event of mechanical failure of the control lever, an emergency flap switch will allow limited slat and flap selection. When the emergency flap switch is actuated, the SFECUs will override the control lever selection, and extend the flaps to 20° and extend the slats. If emergency flap deployment is selected at an airspeed higher than 230 knots, the control unit will delay deployment of the slats and flaps until the airspeed is reduced below 230 knots.



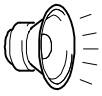
Slats/ Flaps Control System
Figure 11–60–1

NOTE

Gates are provided at positions 8 and 20. Lever must be pushed downward to overcome gate when moving rearward from position 20 to position 30 and when moving forward from position 8 to position 1.



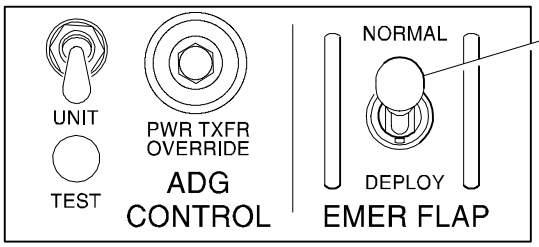
Slat/Flap Control Lever
Used to operate slat/flap system.
Position 0 - slats and flaps fully retract.
Position 1 - slats go to 20°.
Position 8 - flaps go to 8°.
Position 20 - flaps go to 20°.
Position 30 - slats go to 25° (full travel) and flaps go to 30°.
Position 45 - flaps go to 45° (full travel).



Clacker indicates that airspeed is too high for selected flap setting.

Pending rectification
The overspeed clacker may sound during a go-around maneuver while retracting flaps from 45° (30°) to 8° with IAS at or above 185 KIAS even if the overspeed cue (red/black checkerboard) is set at 220 KIAS. This occurrence is related to the slats transition from 25° to 20°. The clacker sound will discontinue as soon as the slats reach 20° position.

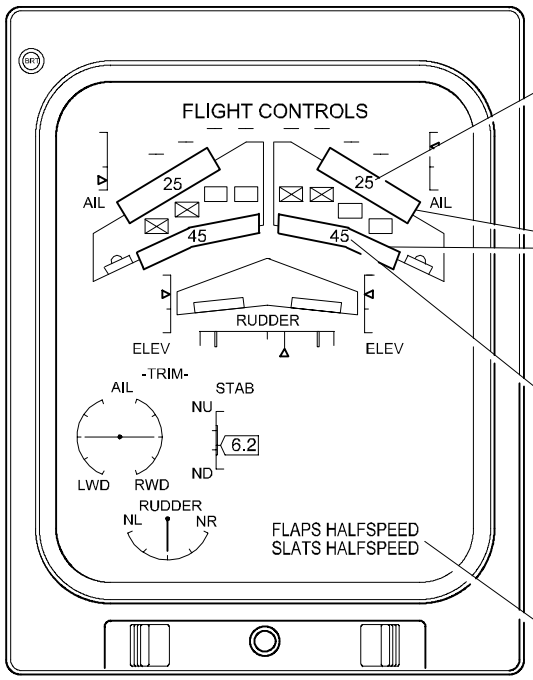
Slats/ Flaps – Control
Figure 11–60–2



EMER FLAP
Used to operate the slats and flaps in the event of a control lever failure.

Emergency Flap Deploy Control Center Pedestal

Emergency Flap Deploy Control Panel
Figure 11–60–3



Slat Position Readout
Indicates slat position in degrees.
- Green – Normal operation.
- White – Surface mismatch.
- Amber dashes – Invalid data.

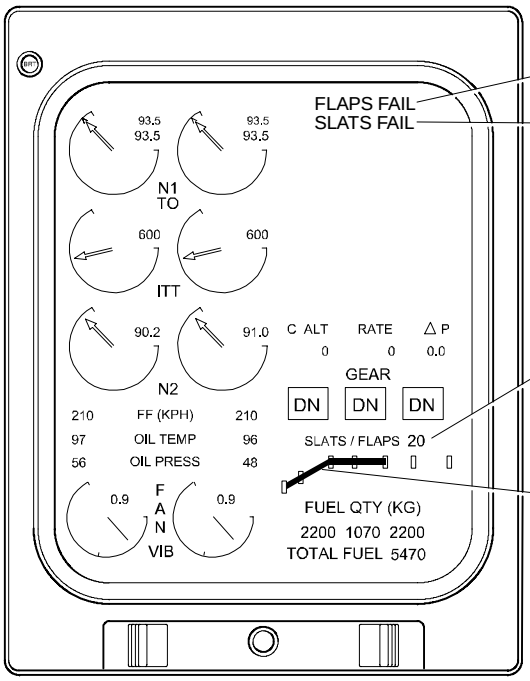
Flap and Slat Outlines
- Green – System fully operational.
- White – System at half speed.
- Amber – System failed.
- Half Intensity Magenta – Invalid data.

Flap Position Readout
Indicates flap position in degrees.
- Green – Normal operation.
- White – Surface mismatch.
- Amber dashes – Invalid data.

SLATS or FLAPS HALFSPEED (white)
Indicates that one channel of the respective system has failed.

Flight Controls Page

Slats/ Flaps Position – Flight/Control Synoptic Page
Figure 11–60–4



Primary Page

FLAPS FAIL caution (amber)
Indicates that both flap channels have failed.

SLATS FAIL caution (amber)
Indicates that both slat channels have failed.

Flap Position Readout
Indicates flap position in degrees.
- Green – Normal operation.
- White – Flaps miscompare is detected.
- Two amber dashes – Invalid data.

Slats/Flaps Position Bar
Displays slat and flap deployment.
- Green – Normal operation.
- White – Miscompare is detected.
- No Bar – Position data is missing or invalid.

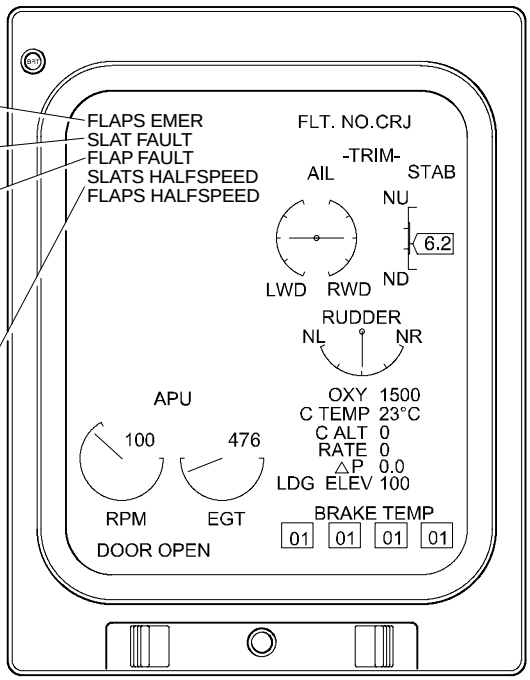
White markers along bar represent detents.

FLAPS EMER advisory (green)
Indicates that emergency flap switch is in deploy position.

SLAT FAULT status (white)
Indicates that left or right slat disconnect sensor has detected a mismatch.

FLAP FAULT status (white)
Indicates that emergency flap switch has failed, loss of cross-channel talk, flap skew detection or sensor failure, or any flap actuator fault.

SLATS or FLAPS HALFSPEED status (white)
Indicates that one channel of the respective system has failed or system is operating on ADG power.



Status Page

Slats/ Flaps EICAS Indication <1001>
Figure 11–60–5

A. System Circuit Breakers

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
Flaps and Slats	Flaps	FLAPS CONT CH 1	DC ESSENTIAL	2	R1	
		FLAPS CONT CH 2	BATTERY BUS	1	L5	
	Slats	SLATS CONT CH 2			L6	
		SLATS CONT CH 1	DC ESSENTIAL	2	R2	

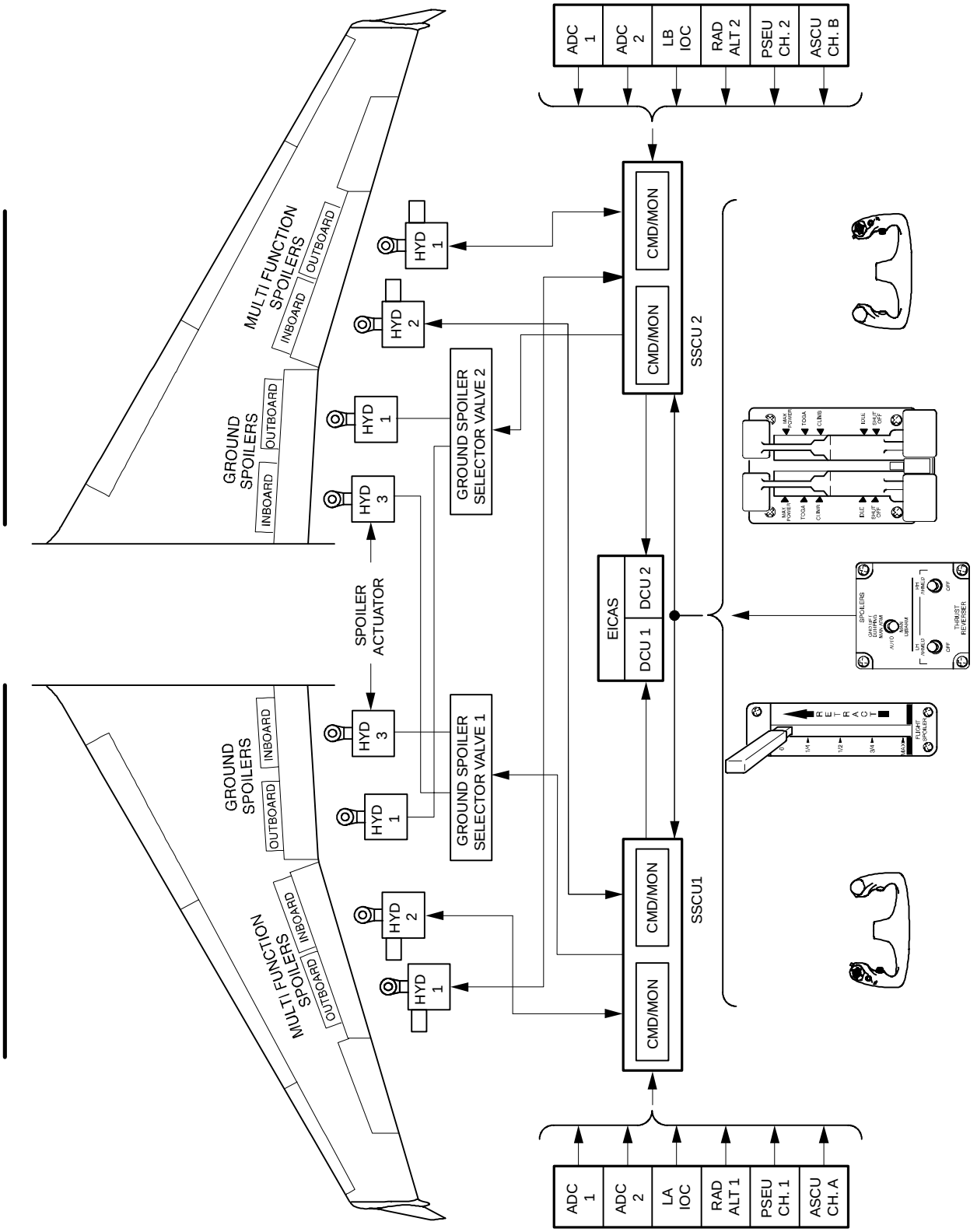
1. SPOILERS

Spoiler control consist of two multi-functional spoilers and two ground spoilers on each wing. Each spoiler is actuated by a single electro-hydraulic power control unit. The multi-functional spoilers provide roll assist and proportional lift dumping functions. The ground spoilers provide ground lift dumping function only. Spoiler operation is controlled by two, dual channel, spoiler and stabilizer control units (SSCUs).

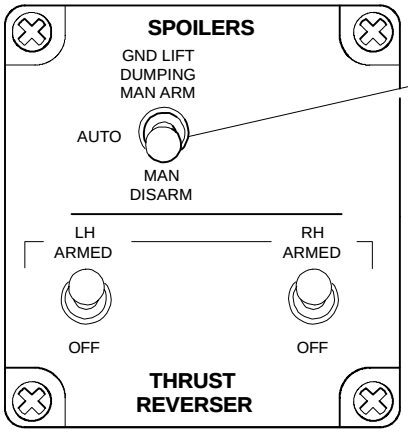
Roll assist is provided by asymmetric deployment of the multi-functions spoilers. Deployment is relative to control wheel inputs, Mach number and flap position. Roll assist is used to improve lateral control of the aircraft at low airspeeds.

Proportional lift dumping is provided by symmetric deployment of the multi-functional spoilers. Deployment is relative to the position of the flight spoiler control lever. Proportional lift dumping is used for speed control and to stabilize the airplane on the glide path or during rapid descents.

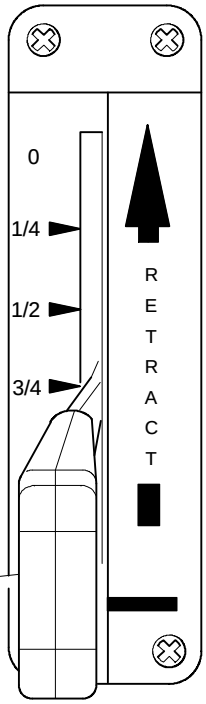
Ground lift dumping is used to assist in aircraft braking on the ground. Ground lift dumping is provided by full deployment of multifunctional spoilers and the ground spoilers Ground lift dumping is normally automatic but can be manually controlled by the GND/LIFT DUMPING switch on the center pedestal. Automatic deployment is triggered on the basis of engine throttle position, radio altitude, wheel speed and weight-on-wheels conditions.



Spoiler Control System
Figure 11–70–1



GND LIFT DUMPING
Used to select ground lift dumping.
- AUTO – Arms the ground lift dumping system for automatic deployment when the airplane is in the landing configuration.
- MAN ARM – Manually arms the ground lift dumping system if automatic arming fails.
- MAN DISARM – Disarms the ground lift dumping system in the event of an inadvertent deployment or failure of automatic system.

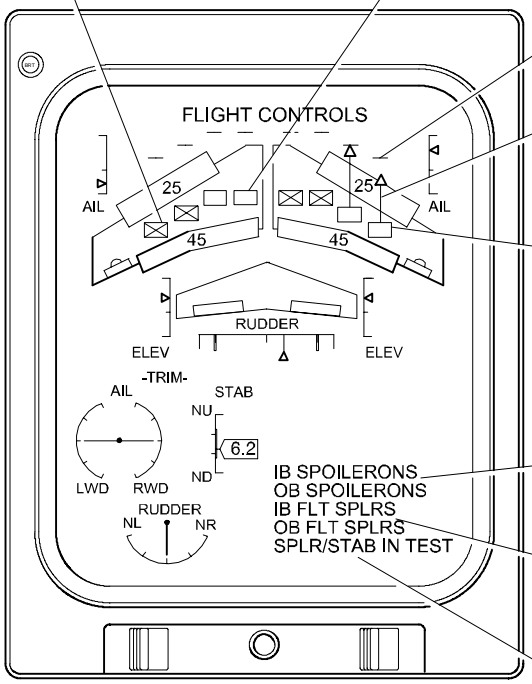


Flight Spoiler Control Lever
Used to control proportional lift dumping.

Spoiler Control Panel and Lever
Figure 11–70–2

Ground Spoiler Outline
- Green – Spoiler is operative.
- White – Loss of redundancy.
- Amber – Spoiler is inoperative.

Spoiler X Marking (amber)
Indicates input data is invalid.



Flight Controls Page

Maximum Spoiler Deployment Mark (white)
Indicates full deployment point of respective spoiler.

Spoiler Position Indicator (white)
Indicates position of respective spoiler. Indicator is not displayed when respective spoiler is retracted or input data is invalid.

Multi-Function Spoiler Outline
- Green – Spoiler is operative.
- White – Loss of roll asist, proportional lift dumping or redundancy.
- Amber – Spoiler is inoperative.

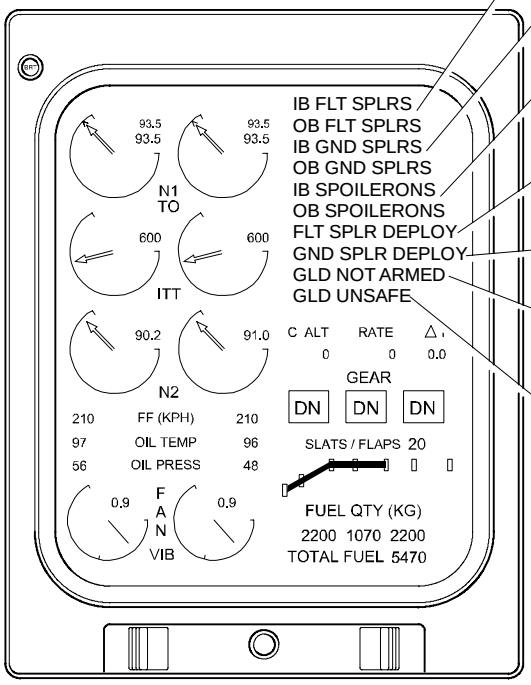
IB or OB SPOILERONS (amber)
Indicates loss of roll assist capability for respective multi-function spoilers.

IB or OB FLT SPLRS (amber)
Indicates loss of proportional lift dumping capability for respective multi-function spoilers.

SPLR/STAB IN TEST (green)
Indicates that the spoiler and stabilizer control system is in self test mode.

NOTE
To prevent nuisance messages, no other cockpit function should be carried out while SPLR / STAB IN TEST is displayed (about 60 seconds)

Spoilers – Flight/Control Synoptic Page
Figure 11–70–3



Primary Page

IB or OB FLT SPLRS caution (amber)
Indicates loss of proportional lift dumping capability for respective multi-function spoilers.

IB or OB GND SPLRS caution (amber)
Indicates that respective ground spoilers are inoperative.

IB or OB SPOILERONS caution (amber)
Indicates loss of roll assist capability for respective multi-function spoilers.

FLT SPLR DEPLOY caution (amber)
Indicates that any flight spoiler is deployed >3 degrees or the flight spoiler handle out of the 0 position with the aircraft either in go-around or the radio altitude is below 300 feet.

GND SPLR DEPLOY caution (amber)
Indicates that a ground spoiler is deployed and airplane is not on the ground.

GLD NOT ARMED caution (amber)
Indicates that ground lift dumping is not armed and airplane is in either approach or take-off configuration.

GLD UNSAFE caution (amber)
Indicates that ground lift dumping mode is unsafe (possible inadvertant deployment of spoilers due to failure of two or more input sensors).

Spoilers – EICAS Indications – Primary Page <1001>
Figure 11–70–4

FLT SPLR DEPLOY advisory (green)
Indicates that any flight spoiler is deployed >3 degrees or the flight spoiler handle out of the 0 position with the aircraft not in go-around or the radio altitude is above 300 feet.

GND SPLR DEPLOY advisory (green)
Indicates that a ground spoiler is deployed and airplane is on the ground.

GLD MAN ARM advisory (green)
Indicates that ground lift dumping is manually armed.

SPLR/STAB IN TEST advisory (green)
Indicates that the spoiler and stabilizer control system is in self test mode.

GLD MAN DISARM status (white)
Indicates that ground lift dumping is manually disarmed.

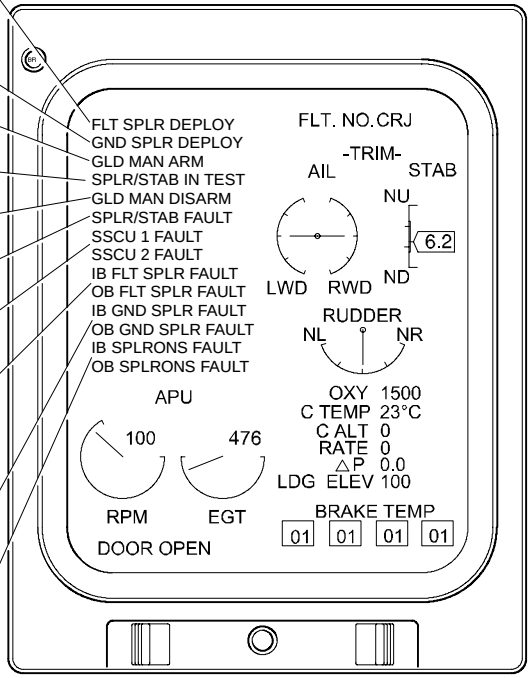
SPLR/STAB FAULT status (white)
Indicates a fault in the spoiler and stabilizer control unit.

SSCU 1 or 2 FAULT status (white)
Indicates that one of two spoiler and stabilizer control modules has failed or is not powered.

IB or OB FLT SPLR FAULT status (white)
Indicates a loss in redundancy of proportional lift dumping capability for respective multi-function spoilers.

IB or OB GND SPLR FAULT status (white)
Indicates a loss in redundancy of respective ground spoilers.

IB or OB SPLRONS FAULT status (white)
Indicates a loss in redundancy of roll assist capability for respective multi-function spoilers.



Status Page

Spoilers – EICAS Indications – Status Page
Figure 11–70–5

A. System Circuit Breakers

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
Spoilers	Control Unit	SSCU 1 CH A	DC BUS 1	1	F1	
		SSCU 1 CH B	DC BUS 2	2	F1	
		SSCU 2 CH A	DC ESSENTIAL		R3	
		SSCU 2 CH B			R4	

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1. STALL PROTECTION SYSTEM

The purpose of the stall protection system is to provide warning of an impending stall when the aircraft attitude approaches a high angle-of-attack (AOA) and to prevent stall penetration when the aircraft nears the computed stall angle. The system alerts the flight crew by means of visual and aural warnings.

Angle of attack vanes located on each side of the forward fuselage measure the aircraft attitude in relation to the ambient airstream. The stall protection computer uses the AOA information and airspeed to compute the stall angles.

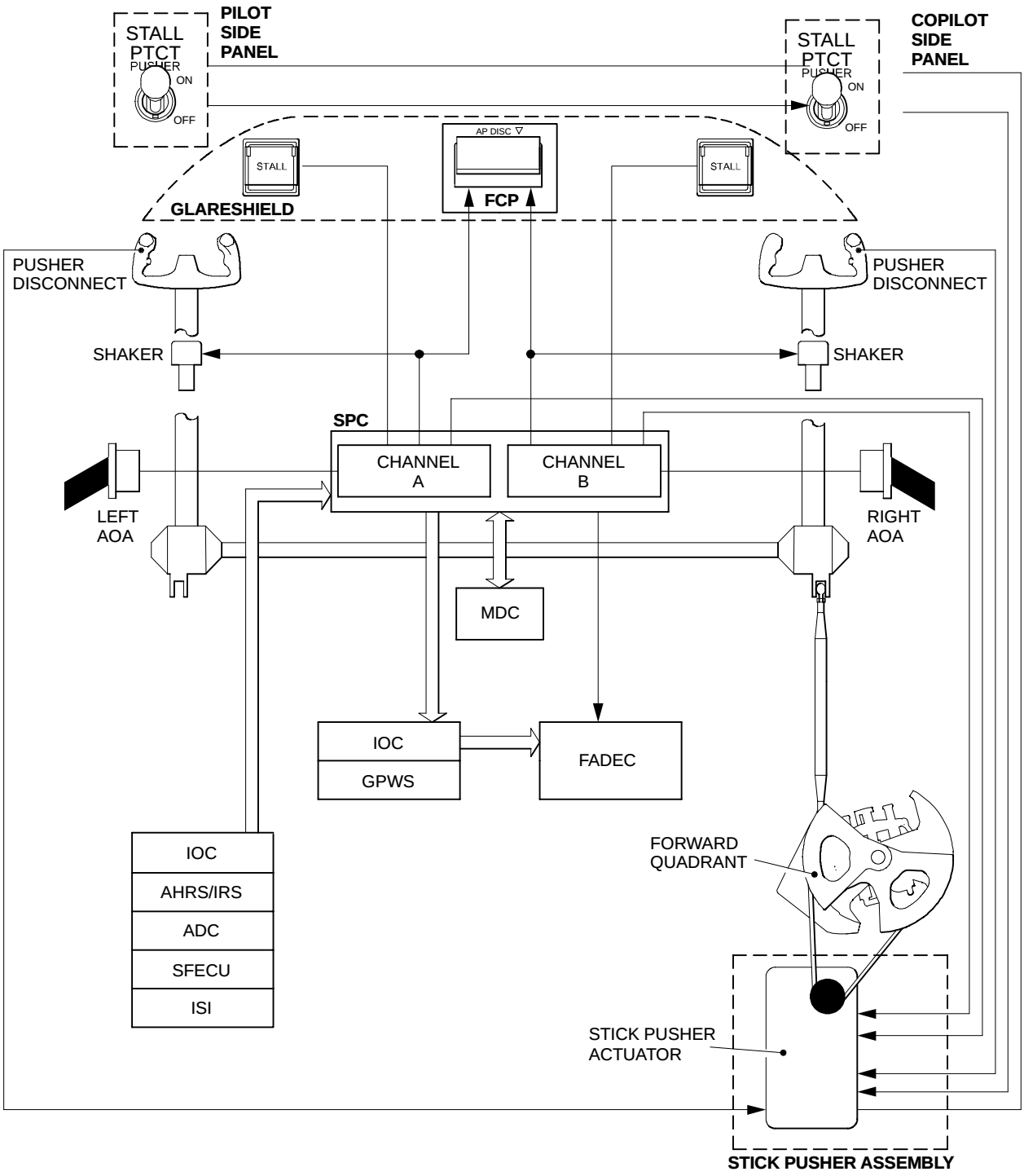
When the aircraft approaches a high AOA, the stall protection computer will:

•Warn the crew of an impending stall through the stick shaker.

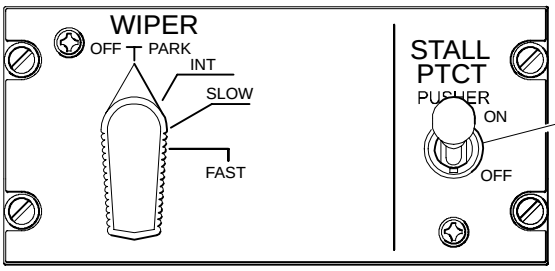
•Activate the engines auto-ignition system.

•Disengage the autopilot.

If the angle of attack continues to approach the critical stall point, the stick pusher is activated to push the control column forward to give the aircraft a pitch down attitude. The stick pusher can be selected off at the stall protection panel.



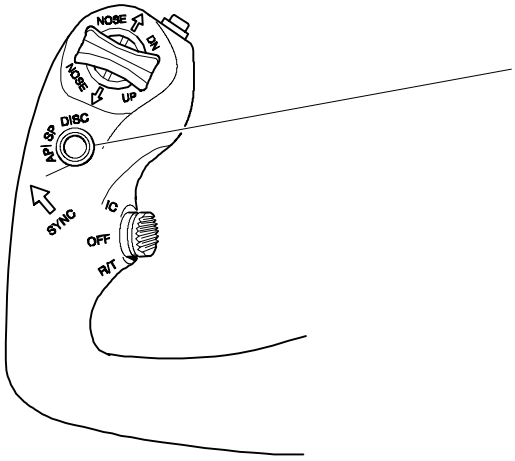
Stall Protection System Schematic
Figure 11–80–1



Stall Protection Panel
Pilot and Copilot Side Panels

STALL PTCT PUSHER
Used to control operation of stick pusher.

NOTE
Both pilot and copilot switches must be selected on to engage the stick pusher.

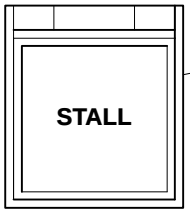


Pilot and Copilot Control Wheels

AP/SP DISC (red)
Used to disengage the autopilot and to momentarily deactivate the stall protection system.
- Press to disengage the autopilot and to momentarily disable the stick pusher.
- Release to reactivate the stick pusher.

NOTE
When pressed for 4 seconds or longer, the STALL FAIL caution message will come on. The caution message will go out approximately 1 second after the switch is released.

Stall Protection Controls
Figure 11–80–2



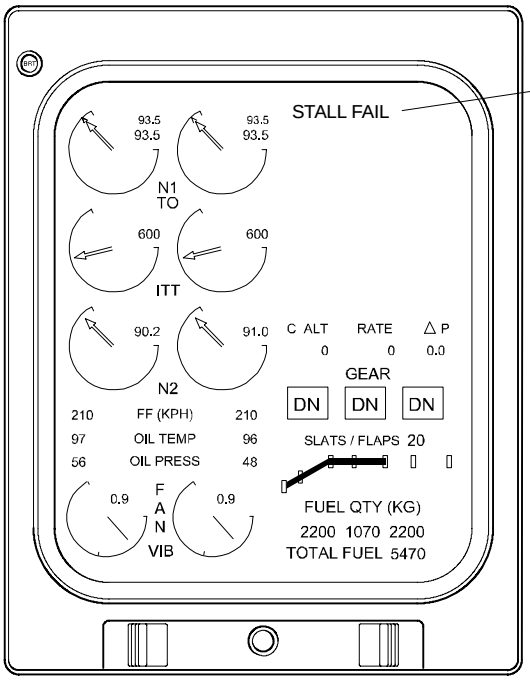
STALL (Guarded)
Used to initiate stall protection system test while airplane is in a weight-on-wheels condition.
- STALL (red) light flashes to indicate an impending stall condition

Warbler tone alerts flight crew of impending a stall condition.

Left and Right Glareshield

Stall Test
To initiate stall protection system test, momentarily press STALL light, and verify that:
- Auto-ignition is activated
  (CONT IGNITION status message on EICAS and illumination of ON light on ignition panel.
- Pilot's stick shaker is activated and, after 3 seconds, copilot's stick shaker is activated.
- After approximately 7 seconds, stick pusher is activated and STALL light comes on.
- Press AP/SP DISC to verify stick pusher stops and STALL light goes out.
- 1Pilot's stick shaker stops, copilot's stick shaker stops and auto-ignition is deactivated.

NOTE
Pressing STALL light a second time during the stall protection test, will interrupt the test sequence.



STALL FAIL caution (amber)
Indicates that pusher is deactivated or has failed or one channel of the stall protection computer has failed or angle of attack sensor has failed.

Primary Page

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Stall Protection – Test and EICAS Indications <1001>
Figure 11–80–3

A. System Circuit Breakers

SYSTEM	SUB-SYSTEM	CB NAME	BUS BAR	CB PANEL	CB LOCATION	NOTES
Stall Protection System	Pusher	STALL PROT STICK PUSHER	BATTERY BUS	1	Q1	
	Computer	STALL PROT L CH			Q2	
		STALL PROT R CH	DC ESSENTIAL	2	U5	

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