FOR SIMULATION USE ONLY

OFFICIAL PUBLICATION

2023.001-AFM

AIRCRAFT FLIGHT MANUAL

IRIS TEXAN II

Date of Issue: 21st December 2023
Software Version: V1.2.0

PREFACE

The year 2005 marked a significant milestone for IRIS Simulations, as it was the genesis of our journey. It was during this formative year that we birthed our very first aircraft, the T-6/A Texan II. This aircraft, our inaugural creation, quickly soared to prominence, capturing the hearts of pilots and aviation enthusiasts alike. Over the ensuing years, it cultivated a devoted and growing consumer base that has remained unwavering in their support.

Fast forward to 2015, a pivotal moment arrived as we embarked on a comprehensive redevelopment endeavour. The result was the birth of a reimagined classic – the IRIS Texan Driver. Through meticulous attention to detail and a commitment to excellence, we resurrected this beloved aircraft from the ground up, infusing it with fresh assets that breathed new life into the experience.

And now, in the year 2023, we proudly present our latest offering, a technological marvel custom-tailored for the Microsoft Flight Simulator platform. This new creation stands as a testament to our unceasing dedication to pushing the boundaries of realism and immersion in the world of flight simulation.

The team at IRIS has poured their passion and expertise into crafting this aircraft, with countless hours spent building and rigorously testing it. Our hope is that you, our fellow aviators, will derive as much joy from flying it as we have derived from bringing it to life.

Happy flying and thank you for joining us on this exciting adventure through the skies!

David “DLB” Love-Brice
Director
IRIS Simulations Pty Ltd

ACKNOWLEDGEMENTS

VIRTUAL ROYAL AIR FORCE
RISE ABOVE THE REST

IRIS Simulations would also like to thank the online community from the 'Virtual Royal Air Force' for their testing and evaluation of the IRIS Texan II multiplayer functionality (and frequent fun in the Mach Loop!)

Visit their website for more information on their roleplay simulation community!

IRIS Simulations would also like to credit the following additional individuals and businesses for their support and involvement in the production of this product.

Original Concept Artwork

Magnus Almgren

Digital Media

Ross Mackerracher (Spectre Sim Shorts)

Quality Assurance (Team Texan)

Robbo, Fenix, Jakey, Matt, Roebuck, Spectre, Aero, Bug, Novawing24, Grumpy, Jimmie, Matt S & Zach.

Programming Support

Huge thanks to Dino Cattaneo @ Indiafoxtecho for his permission to use elements of the Indiafoxtecho F-35 avionics into the Texan II product.

Visit his Facebook page to follow his awesome work!

Additional Artwork

Thanks to Zsolt Beleznay for the use of six of his custom Texan paint schemes in this product. Visit his profile on flightsim.to for more custom Texan artwork on PC.

TRADEMARKS

All trademarks, logos and brand names are the property of their respective owners. All company, product and service names used in this product or website are for identification purposes only.

Use of these names, trademarks and brands does not imply endorsement.

AUTHORITY

Users are to regard this Aircraft Flight Manual as an authoritative publication for this product. It is compiled from data available from public operating & technical sources.

These instructions provide you with a general knowledge of the simulated aircraft, its characteristics, and specific normal operating procedures. Instructions in this manual are for a pilot inexperienced in the operation of the simulation aircraft.

DESIGN SOURCES

All references to produce this product are from publicly available sources.

Where required information was not available, modifications were made to provide an expected level of detail for simulation products of this type.

As such IRIS Simulations Pty Ltd cannot guarantee the accuracy of the product or its component parts.

INTENDED USE

This product is for entertainment purposes only.

In accordance with the IRIS Simulations Pty Ltd EULA, this product cannot be used as part of any real-world aviation training.

This product does not cover all aspects of flight operations; accordingly, it may contain errors, limitations, and variations from the actual aircraft.

Should you require use for other applications or purposes, please contact help@irissimulations.com.au to discuss your requirements.

APPLICABILITY

This Flight Manual applies to the IRIS TEXAN II for Microsoft Flight Simulator (MSFS), produced and published by IRIS Simulations Pty Ltd.

OPERATING INSTRUCTIONS

This manual provides the best possible operating instructions, however, on occasions these instructions may prove to be a poor substitute for sound judgment. Adverse weather, terrain and other considerations may require modification of the procedures listed.

PERMISSIBLE OPERATIONS

The Flight Manual takes a 'positive approach' and normally states only what you can do. Unusual operations and configurations are prohibited unless specifically covered herein.

CONTROL AND IDENTIFICATION MARKINGS

The use of block capitals in the text, when identifying switches, controls etc. indicates the actual markings on that item.

AIRSPEEDS

All airspeeds quoted in this manual are 'indicated' unless otherwise stated.

USE OF THE FLIGHT MANUAL

To use the Flight Manual correctly, it is essential to understand the division of the manual into its sections and the subsequent division of the sections. Each section has a table of contents, and best use will be obtained from the Manual by becoming familiar with the table of contents for each section. The index enables easy reference to a particular topic or item by page number.

FREQUENTLY ASKED QUESTIONS

The following are frequently asked questions during testing.

Q. Why can't I open/close the canopy?

A. To close the canopy, make sure the CFS Handle Safety Pin has been removed and the engine is shut down. To open it, make sure the canopy is unlocked and the engine is shut down. If the above conditions are met, the canopy handle should work and the canopy open.

Q. Why do my textures differ in resolution at different points in the aircraft?

A. Cockpit textures do differ in resolution throughout the product. These are in keeping with memory usage across medium end systems, and especially looking toward to Xbox Compatibility.

We have focused on high detail where it is needed (decals and the like) and lower where it is deemed non-essential.

It is our opinion that while not to everyone's liking, it does not necessarily affect the product in a significant way.

Q. I am a Real World Texan II pilot; can I use this for flight training?

A. This is not a training aid, nor is it permitted for being used on any other platform than Microsoft Flight Simulator. For more information, please refer to the INTENDED USE paragraph on Page 4.

Q. How do I add static weapons to my aircraft?

A. The two Mexican Airforce and 33rd FTS aircraft can have weapons added via the CONFIG page. For all other aircraft, manually adding 1068lbs of payload to the stores entry will show static weapons.

Q. I'm a Texan II pilot trainee, can I use this to supplement my training?

A. This software is for entertainment use only in accordance with the IRIS Simulations & Microsoft Flight Simulator EULA and as such, it is NOT to be used as part of any real-world aviation training.

This product does not cover all aspects of flight operations, accordingly it may contain errors, limitations and variations from the actual aircraft.

Q. I have found a bug or would like to request a suggestion, where do I go?
A. Our online issue tracker is available to submit bugs via the link below.

IRIS TEXAN II Submit a Bug Form
https://wkf.ms/3QF2JiM

If you want to see the status of an issue, or if your issue has been submitted before, please visit the following link to view the online issue tracker.

IRIS TEXAN II - Issue Tracking System (Public)
https://view.monday.com/5420738157-cc30b43777dc271d8352c9897f2a63dc?r=use1

INTENTIONALLY BLANK

UPDATING/INSTALLING

IMPORTANT – IF YOU ARE MANUALLY UPGRADING YOUR PACKAGE FROM A PREVIOUS VERSION, PLEASE DELETE THE PREVIOUS VERSION FIRST!

This package is distributed both on the Microsoft Marketplace, Orbx Central and other vendors.

If you have purchased the package though the Microsoft Marketplace or through Orbx Central and you have followed the on-screen instructions, no further action is required from your end, as the plane should be available in the aircraft selection menu as the other default planes and should be automatically updated.

If you have purchased the package directly from the IRIS Simulations storefront and the aircraft is provided as a .zip file containing the iris-aircraft-texan folder, simply copy and paste it into your COMMUNITY folder.

NOTE: The exact location of the folder will depend on your selection where you have installed Microsoft Flight Simulator.

Once you have indicated where your COMMUNITY folder is, just follow the on-screen instructions.

NOTE: If you DO NOT know where the community folder is located, you can follow this procedure:

Within Microsoft Flight Simulator loaded, go to Options / General.

1. Click on "Developers" which you will find at the bottom of the list on the left.

2. Switch Developers Mode on.

3.On the Dev Menu select Tools / Virtual File System.

4. The Community folder location can be found under "Watched Bases"

NOTE: If copying the contents into the Community folder fails because files names are too long you can proceed as follows:

1. Extract the package folder on your desktop or in any known and easily acceptable location.

2. Rename the package folder from “iris-aircraft-texan” to anything short and recognizable such as “IRIS-TEXAN” or just “TEXAN”.

3. Place the renamed package folder in the Community folder.

Alternatively for EXPERT WINDOWS USERS ONLY, it is possible to edit the "LongPathsEnabled” entry in the Windows registry key:

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\FileSystem

Once the aircraft is installed in the Community folder, it will be available in the aircraft selection menu next time you start Flight Simulator.

If Flight Simulator was running during the install process, you need to close it and restart it for the aircraft to appear.

NOTES FROM THE DEVELOPERS

FLIGHT MODEL

Please note that the IRIS TEXAN II flight model is designed to work with the new Flight Simulator flight model (Options->General Options->Flight Model->MODERN).

This is the default option for Microsoft Flight Simulator, and it should be your setting unless you have changed it.

Some users may have changed the flight model to "LEGACY" to use older FSX derived add-on planes. In this case you must revert to the “MODERN” flight model.

With the modern flight model, the IRIS TEXAN II should behave well and be quite stable and easy to fly within the regular flight envelope.

With the above considered, please note that different control devices, sensitivities and calibration may provide a wide range of results. You may need to adjust your control sensitivities and settings to find a setting that feels comfortable for your experience.

Please also note that while this flight model is designed to perform accurately across the flight envelope, stall and spin characteristics may differ to that expected.

INTERACTION

Please note that the IRIS TEXAN II is designed to work with the ‘LOCK’ Cockpit Interaction System (Options->General Options->Accessibility->Cockpit Interaction System->LOCK).

This is the default option for Microsoft Flight Simulator, and it should be your setting unless you have changed it.

Some users may have changed the flight model to ‘LEGACY’ for personal preference. While the IRIS TEXAN II does function with the ‘LEGACY’ interaction system, knobs and switches will operate differently than designed.

DISPLAY GRAPHICS

The IRIS TEXAN II has been designed using XML based graphics on displays. If you experience blurry gauges and displays, please change your antialiasing setting to ‘DLAA’
(Options->General Options->Graphics->Anti-Aliasing->DLAA).

HEAD-UP-DISPLAY (HUD)

The TEXAN II HUD can exhibit a small white artifact at night on some systems. To address this, perform one of the following corrective actions:

1. Turn NANOVG rendering OFF.
   (Options->General Options->Experimental->NANO VG->OFF)
2. Reduce the brightness of the HUD.
3. Switch the HUD from TEXAN II to F-35 Symbology via the Right MFD CONFIG Page.

FLIGHT MANAGEMENT SYSTEM (FMS)

The IRIS TEXAN II doesn't feature FMS functionality outside of the scope required to display flightplan data.

TRIM AID DEVICE (TAD)

We recommend that you turn on AUTORUDDER in the assistance settings to simulate the use of the Trim Aid Device (TAD).
(Options->Assistance Options->Piloting->AUTO-RUDDER).

NOSE WHEEL STEERING (NWS)

To operate the Nose Wheel Steering, please ensure you have a control binding tied to the 'TOGGLE G LIMITER' function. This will toggle the Nose Wheel Steering on and off.

SMOKE GENERATORS

To operate the smoke effects on any of the aircraft for aerobatics, please ensure you have a control binding tied to the 'TOGGLE WING LIGHTS' function.

Operation of the smoke system through the above function is dependent on the following factors:

1. The SMOKE option in the CONFIG page on the MFD should show ARMED and not OFF.
2. When you then use the control binding for the LOGO LIGHTS, 'SMOKE' is indicated on the EICAS to indicate that smoke is being dispensed.

TABLE OF CONTENTS

SECTION 1

DESCRIPTION AND OPERATION

TABLE OF CONTENTS

SECTION 1

CHAPTER 1

DESCRIPTION AND OPERATION

THE AIRCRAFT

TEXAN II: A MODERN TRAINING AIRCRAFT

The T-6B Texan II is a versatile and advanced turboprop training aircraft used by the United States Air Force (USAF), United States Navy (USN), and several other international military forces.

With its roots dating back to the early 2000s, the Texan II has become a staple in military pilot training programs, equipping new aviators with the essential skills and knowledge needed to operate high-performance military aircraft. This two-page brief aims to provide an overview of the T-6B Texan II, including its design, capabilities, and its role in training the next generation of military pilots.

IRIS TEXAN II General Arrangement

ENGINEERED FOR EXCELLENCE

The T-6B Texan II is the result of a collaborative effort between Beechcraft (now part of Textron Aviation) and the Raytheon Company, which later became part of Raytheon Technologies. It was developed as part of the Joint Primary Aircraft Training System (JPATS) program, a cooperative effort between the USAF and USN to streamline pilot training.

Key Features:

Design: The T-6B Texan II sports a robust and modern design. Its single turboprop engine provides reliable and efficient power, while its tandem seating arrangement allows for a student pilot and instructor to fly together. The aircraft's design emulates the feel and handling of high-performance military aircraft, preparing trainees for more advanced stages of their pilot training.

Performance: Powered by a Pratt & Whitney Canada PT6A-68 turboprop engine, the T-6B can achieve a top speed of approximately 320 knots (370 mph) and a maximum altitude of over 31,000 feet. This performance range allows trainees to experience a wide array of flight conditions, including high-speed flight and low-level navigation.

Avionics: The T-6B Texan II is equipped with advanced avionics, including a glass cockpit with a modern heads-up display (HUD) and hands-on throttle and stick (HOTAS) controls. This technology mirrors what trainees will encounter in contemporary military aircraft.

Training Capabilities: The T-6B is an excellent platform for basic flight training, instrument flying, and navigation exercises. It introduces trainees to critical skills such as aerobatics, formation flying, and advanced cockpit management. Additionally, the aircraft is adaptable for simulated weapons training.

ROLE IN MILITARY TRAINING

The T-6B Texan II plays a pivotal role in the initial training stages for prospective military pilots. Its capabilities make it an ideal choice for training pilots who may later transition to jet-powered aircraft. The aircraft's inclusion in the training pipeline ensures that new aviators receive a solid foundation before moving on to more advanced and specialized aircraft, enhancing safety and performance in military aviation.

SUPPORTIVE COURSEWARE

The inclusion of supportive video courseware for the Texan II product is a strategic move that underscores our commitment to enhancing user experience and ensuring our customers receive the utmost value from their purchase.

The IRIS TEXAN II, already known for its exceptional quality and versatility, will now be accompanied by a comprehensive video courseware package that serves as an invaluable resource for both novice and experienced users. These video courses have been meticulously crafted to provide step-by-step guidance, tips, and insights on maximizing your enjoyment of the product.

By incorporating video courseware, we aim to bridge the gap between product purchase and proficient utilization, ensuring that users can harness the TEXAN II full capabilities with confidence. Whether it's honing specific skills, troubleshooting, or exploring advanced features, these video resources will be easily accessible and empower our customers to become IRIS TEXAN II experts.

This initiative not only sets a new standard for customer support but also reinforces our TEXAN II product as the top choice for those seeking an all-inclusive, user-friendly, and educational solution. We are dedicated to simplifying the learning curve and elevating the Texan II experience, making it a valuable addition to any enthusiast's toolkit.

Visit our YouTube page for more videos!

THE COCKPIT

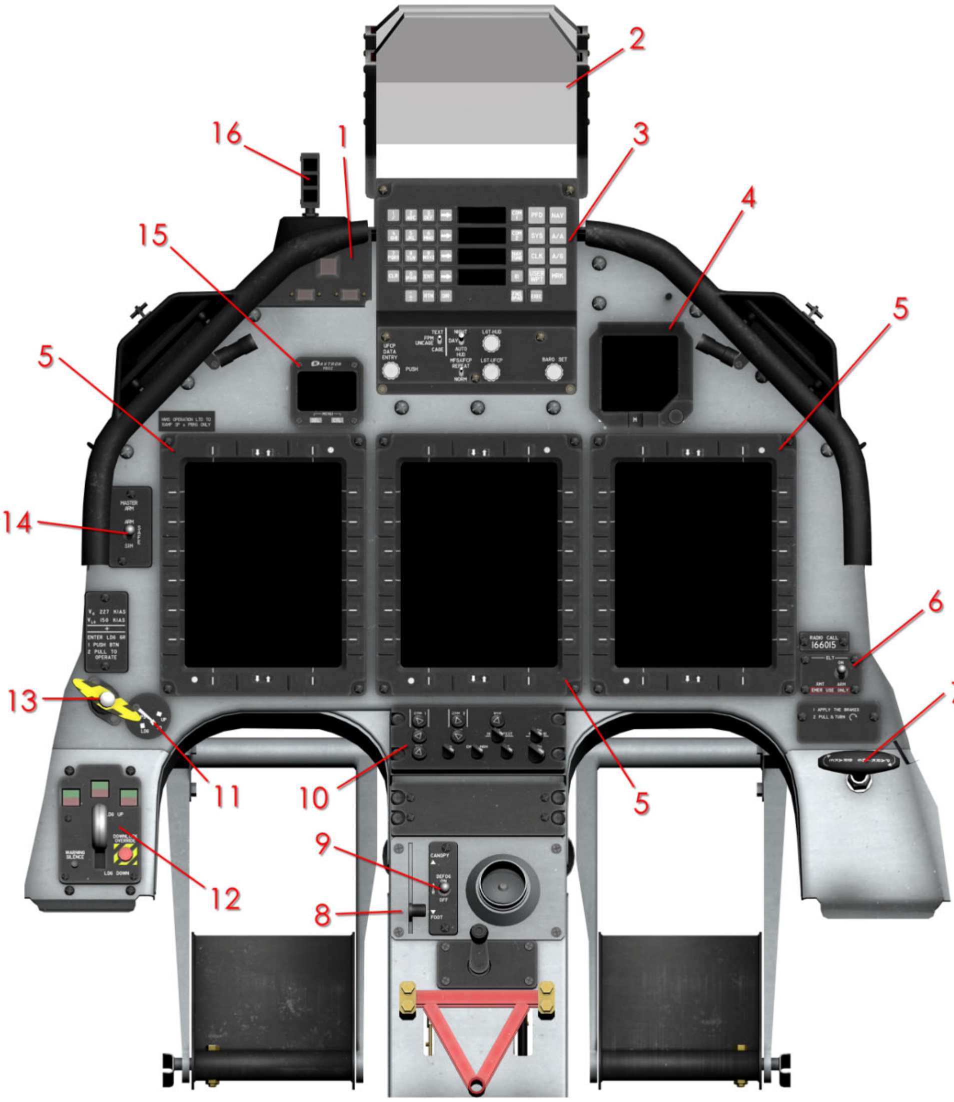


Figure 1-3 Front Instrument Panel

1. MASTER CAUTION/DISPLAY PANEL
2. HEAD UP DISPLAY
3. UP FRONT CONTROL PANEL
4. BACKUP FLIGHT INSTRUMENT
5. MULTIFUNCTION DISPLAY
6. EMERGENCY LOCATOR TRANSMITTER
7. PARKING BRAKE HANDLE
8. VENT CONTROL LEVER
9. DEFOG SWITCH
10. AUDIO CONTROL PANEL
11. FLAP POSITION INDICATOR
12. LANDING GEAR CONTROL PANEL
13. EMERGENCY GEAR EXTENSION HANDLE
14. MASTER ARM SWITCH
15. DIGITAL CLOCK
16. ANGLE OF ATTACK INDEXER

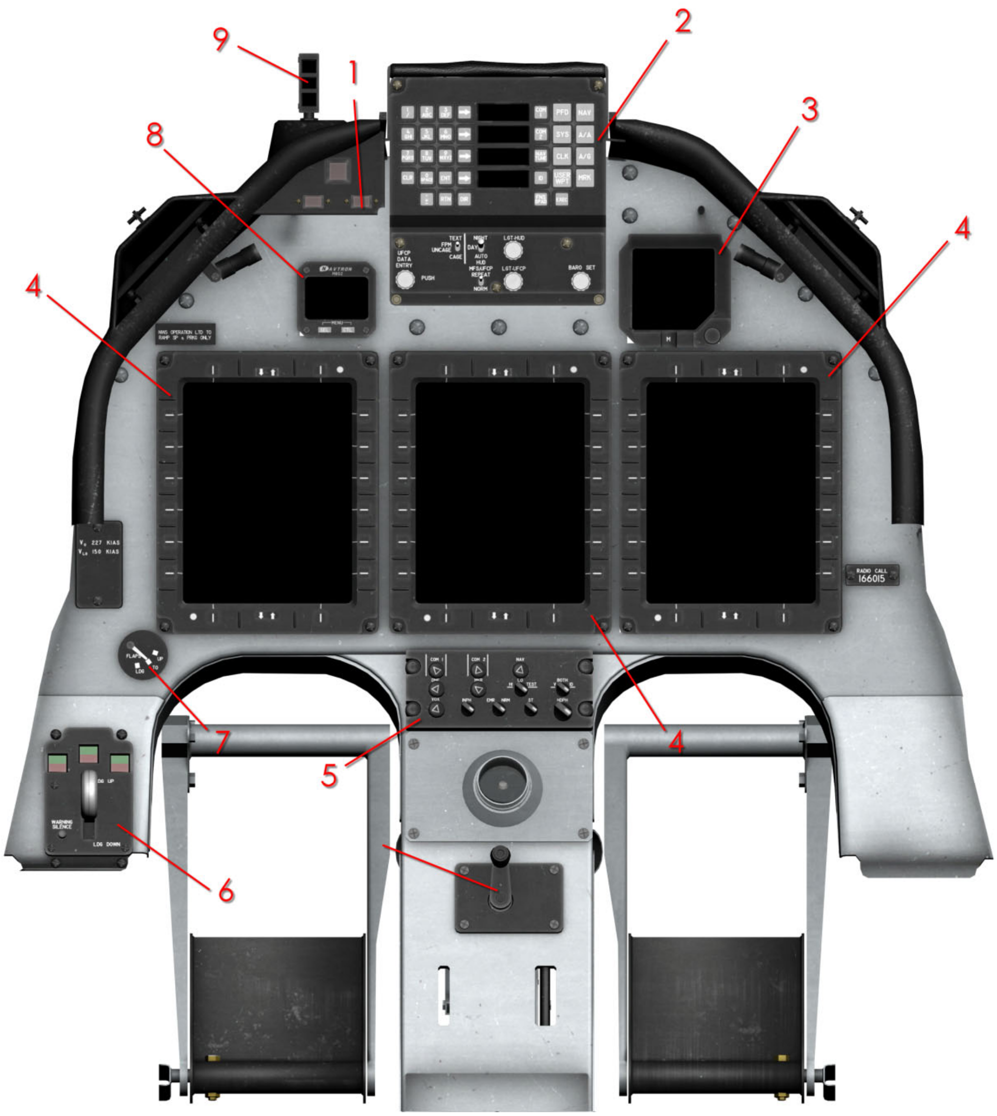


Figure 1-4 Rear Instrument Panel

1. MASTER CAUTION/DISPLAY PANEL
2. UP FRONT CONTROL PANEL
3. BACKUP FLIGHT INSTRUMENT
4. MULTIFUNCTION DISPLAY
5. AUDIO CONTROL PANEL
6. LANDING GEAR CONTROL PANEL
7. FLAP POSITION INDICATOR
8. DIGITAL CLOCK
9. ANGLE OF ATTACK INDEXER

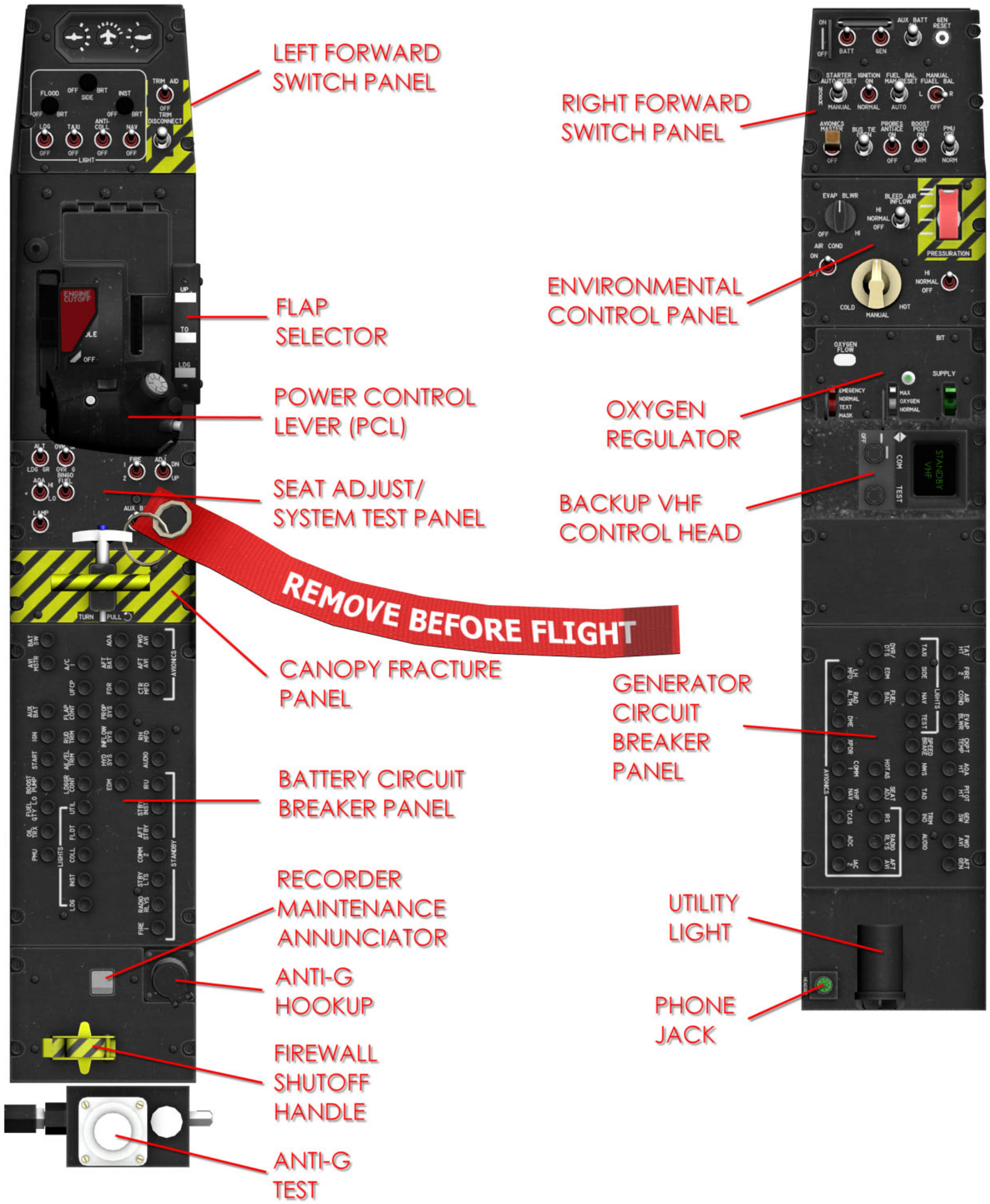


Figure 1-5 Front Console Panels

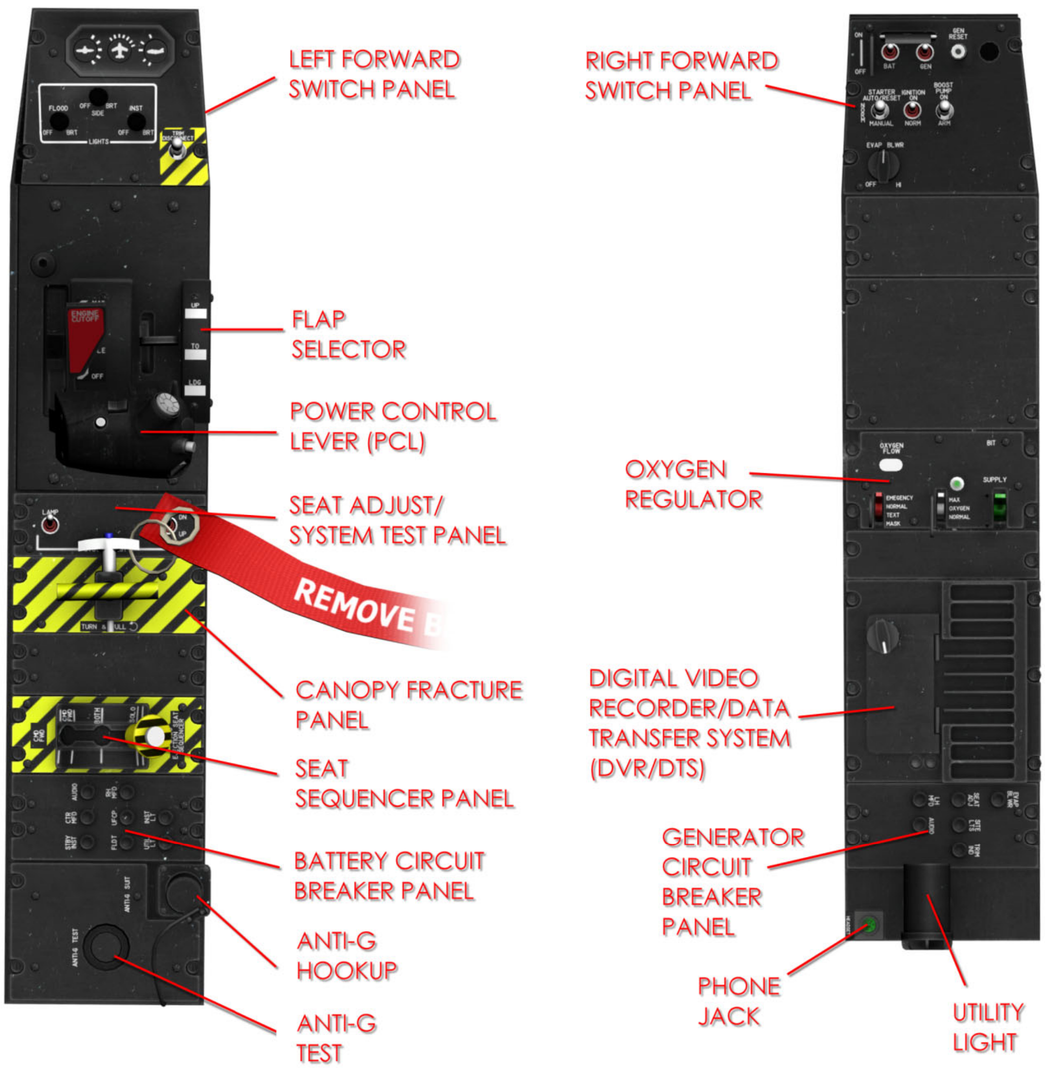


Figure 1-6 Rear Console Panels

ENGINE

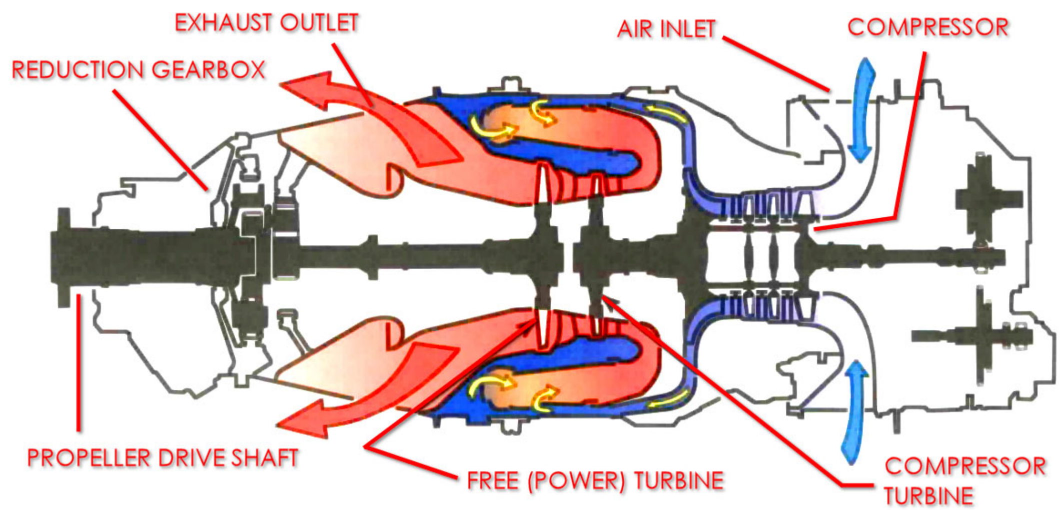


Figure 1-7 Engine

The PT6A-68 is a free-turbine turboprop engine (Figure 1-7) flat rated to produce 1100 shaft horsepower (SHP) as installed in the aircraft. The engine is a reverse-flow design with two independent sections: the gas generator section and the power turbine section.

The gas generator section (the aft half of the engine) consists of the four-stage axial flow compressor, single-stage centrifugal flow compressor, combustion chamber, and single-stage compressor turbine.

The power section (the forward half of the engine) consists of the two-stage axial-flow power turbine, exhaust case, and reduction gearbox.

Oil System

The oil system has a capacity of 18.5 U.S. quarts and provides a constant supply of filtered oil to the engine bearings, reduction gears, accessory drives, and propeller throughout normal and aerobatic flight manoeuvres.

Components include pressure, scavenge, cooling, and breather systems.

The pressure system incorporates two oil pickup elements. One element, normally submerged in oil, picks up oil near the centre of the tank, and a second element picks up oil near the top of the tank to prevent loss of oil pressure during inverted flight.

The scavenging system incorporates two dual-element gear type pumps. The pumps, one located inside, and one outside the accessory gearbox, return scavenged oil from the bearings and gearbox. Cooling is accomplished by routing scavenged oil through an oil cooler located in the lower aft cowl assembly before returning to the oil tank.

The oil tank, integrally cast with the compressor air inlet, is vented into the accessory gearbox by a four-point breather system that includes a breather valve and centrifugal breather. The engine oil pressure indicator may display oil pressures up to 4 psi with the engine shut down due to the design of the oil pressure transmitter.

The oil is filtered by the main oil filter and then by several oil strainers. If the main oil filter becomes clogged, a filter bypass valve allows unfiltered oil to continue to lubricate the engine.

Oil pressure and temperature are sensed by transducers downstream of the main oil pump and the signal is sent to the engine data manager (EDM). The EDM passes the oil pressure data to a signal conditioning unit (SCU) computer that contains the logic to illuminate the warning on the engine indication and crew alerting system (EICAS) under the following conditions.

The SCU activates the red OIL PX warning if oil pressure drops to 40 psi or below when above idle power, or when oil pressure drops to 15 psi or below at idle power.

Additionally, the SCU illuminates the amber OIL PX caution whenever sensed oil pressure is between 15 and 40 psi at idle power, and if the oil pressure drops to between 40 and 90 psi, for 10 seconds, above idle power.

If oil pressure is less than 15 psi at idle power, the amber OIL PX caution extinguishes and the red OIL PX warning remains illuminated. If oil pressure remains between 15 and 40 psi at idle power for 5 seconds or more, both amber and red OIL PX caution/warning illuminate.

NOTE

- *Due to the sensitivity of the signal conditioning unit, a single, momentary illumination of the amber OIL PX caution while manoeuvring is possible but may not indicate a malfunction.*

The SCU contains logic to prevent nuisance caution illumination on the EICAS from normal oil pressure build-up during engine ground start.

Illumination of both red and amber OIL PX caution/warning while the oil pressure gauge indicates normal pressure indicates an SCU failure.

Power for the oil pressure transducer is provided through a circuit breaker, placarded OIL TRX located on the battery bus circuit breaker panel in the front cockpit.

Reduction Gearbox (RGB)

The RGB is a two-stage planetary reduction drive to reduce the power turbine output shaft speed of over 30,000 RPM to the propeller operating speed of 2000 RPM.

The RGB is mounted on the front of the engine and driven by the hot gases impinging on the two-stage power turbine. There is no mechanical connection to the gas generator section.

A chip detector is mounted in the RGB to detect ferrous material in the oil. If the chip detector is activated, a signal is transmitted to the EICAS illuminating a red CHIP warning message indicating oil contamination.

The propeller interface unit (PIU), torque probe, and permanent magnet alternator (PMA) are mounted on top of the RGB, and the air conditioning compressor is mounted on the right side of the RGB and is belt driven by the propeller assembly.

Engine power output is measured by the torque produced by the reduction gearbox.

Propeller

The power turbine drives the aluminium 97-inch, four bladed, constant-speed, variable-pitch, non-reversing, feathering propeller (Figure 1-11) through the reduction gearbox.

The propeller system is designed to maintain a constant speed of 2000 RPM (100% NP) during most flight conditions.

The engine power management unit (PMU) and the propeller interface unit (PIU) automatically control the propeller blade angle (pitch) and propeller speed (NP). Because the engine is flat rated, 100% torque is available from sea level to approximately 12,000 to 16,000 feet MSL on a standard day.

At 100% indicated torque, the engine is producing approximately 2900 foot-pounds of torque at the prop shaft. This equates to approximately 2750 pounds of thrust at sea level, zero airspeed.

Propeller pitch may be defined by three basic conditions: feathered; low pitch (flat or fine); and high pitch (coarse).

Each pitch condition is the measure of the angle between the plane of rotation of the propeller and the chord line of the blade. When feathered, the propeller blades are aligned nearly straight into the wind. When in low pitch, the propeller blade angle is approximately 15° from the reference plane.

The propeller blades will be at low pitch at low speeds and low throttle settings. High pitch is variable between feather and low pitch to maintain NP at a constant 2000 RPM for the given condition.

Normally, propeller governing is automatically set by the PMU and PIU. The PMU controls the propeller RPM by varying the propeller blade angle with oil pressure through the PIU.

The PIU increases the pressure of the oil that is transferred from the PIU, through a tube and stationary transfer sleeve into the hollow rotating propeller shaft.

Pressurized engine oil forces the piston forward to decrease pitch toward fine. When oil pressure against the piston is reduced, the blades turn toward coarse pitch. With the PMU functioning, the mechanical overspeed governor modulates oil pressure to the propeller pitch change piston to limit NP below 106%, while the electronic governor will maintain NP at 100%.

This arrangement keeps the mechanical governor in an underspeed condition with the PMU functioning.

If PMU function is lost or deactivated, the mechanical flyweight overspeed governor modulates oil pressure to the propeller pitch change piston to maintain NP at or below 100±2%.

Manual governing is accomplished by centrifugal force moving the counterweights outward causing oil pressure to dump. With the decreased oil pressure, the feathering spring will drive the blade toward course pitch to keep NP within limits. NP may peak above 100% during power changes and then return to the governed range.

In the event of an engine failure with the power control lever (PCL) out of the cut-off position, the propeller will slowly begin to move toward feather due to the loss of oil pressure, but may not fully feather.

There are two methods to feather the propeller. If the engine is shut down with the PCL and the PMU is in NORM, the PMU sends a signal to the prop servo valve to drain propeller oil pressure.

Placing the PCL to cut-off also activates micro switches that power the feather dump solenoid valve which also dumps oil pressure from the propeller. The feather dump solenoid valve receives power through the PROP SYS circuit breaker located on the battery bus circuit breaker panel in the front cockpit.

Both of these systems dump oil pressure from the propeller allowing the propeller counterweights and feathering spring to rapidly feather the propeller. Either of these systems will provide full propeller feathering.

If the PMU is in OFF, it will not send a signal to the prop servo valve. If the PROP SYS circuit breaker is pulled, the prop feather dump solenoid will not be powered.

If the PCL is placed in cut-off with the PMU in OFF and the PROP SYS circuit breaker pulled, the propeller will not rapidly feather and may not fully feather until after landing.

If the rate of change of propeller RPM, due to, for example, a rapid feathering of the propeller, exceeds the PMU sensor validity check limit, the PMU will assume a sensor failure has occurred. It will switch the PMU to manual mode, and a red X will be displayed for the RPM and torque values.

If the red X's were caused by a propeller RPM rate limit exceedance, cycling the PMU switch will restore the displays.

If the red X's are the result of a faulty sensor and not a rate exceedance, cycling the PMU switch will have no affect and the red X's will remain.

Start and Ignition System

Figure 1-8 Starter Switch Location/s

The STARTER switch, located in both cockpits has three positions: AUTO/RESET, NORM, and MANUAL.

To select MANUAL, the STARTER switch must be lifted over a detent to the MANUAL position.

Selecting MANUAL will engage the starter until the switch is manually moved back to the NORM position.

From the NORM position, AUTO/RESET may be selected by moving the switch forward.

The switch is spring loaded to return to the NORM position.

Momentarily placing the starter switch in the AUTO/RESET position automatically engages the starter and energizes the ignition system. Power for the start control is provided through a circuit breaker, placarded START, located on the battery bus circuit breaker panel in the front cockpit.

The IGNITION switch, located in both cockpits, has two positions: NORM and ON.

During an auto start or normal operation with the ignition switch set to NORM, the PMU will energize and de-energize the igniters as required.

When the IGNITION switch is set to ON or when the igniters are activated in AUTO mode, a green IGN SEL advisory is illuminated. Power for the ignition system is provided through a circuit breaker, placarded IGN, located on the battery bus circuit breaker panel in the front cockpit.

Power Control Lever (PCL)

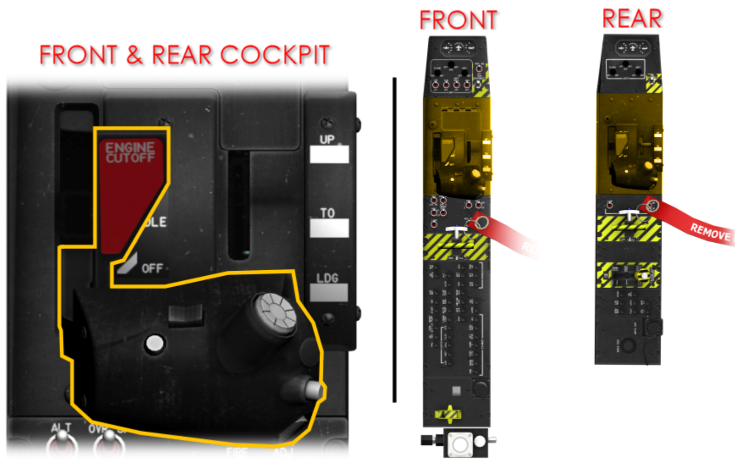


Figure 1-9 Power Control Lever (PCL) Location/s

Engine power is controlled by the PCL mounted in the left console of each cockpit. The PCLs are interconnected with a push-pull rod so that movement of one PCL moves the other.

The front PCL is connected to the fuel management unit (FMU) both electrically and mechanically with a flexible cable. Friction adjustment is provided in the front cockpit only.

The PCL incorporates a cut-off gate to prevent inadvertent engine shutdown.

When the PCL is moved forward to idle during engine start, two roller bearings lock in place on the front side of a rocker cam detent to secure the gate.

Each roller bearing makes an audible click as it locks in place. Lifting the cut-off gate handle moves the rocker-cam out of the way and allows the PCL to move to the cut-off position.

The PCL in each cockpit contains switches for activating the speed brake, rudder trim, UHF and VHF communications, and intercommunications system.

Power Management Unit (PMU) Operation

A dedicated permanent magnet alternator (PMA), mounted on the reduction gearbox, powers the PMU. The PMA supplies 32 VAC, which the PMU converts to DC. The PMU automatically switches to the 28 VDC battery bus when propeller RPM drops below 40-50% Np, or when the PMA fails.

The PMU operates in either flight or ground mode. The aircraft weight-on-wheels switches on the main gear struts control these modes. In ground mode, idle is 60% N1 and in flight mode, idle is approximately 67% N1. Above 10,000 feet PA, the PMU raises N1 to maintain NP above 80% to avoid the stress on the propeller during spins.

Power setting is linear with PCL position throughout the operating envelope of the aircraft; for example, if the max power available at a given condition is 1000 SHP, the engine will schedule 1000 SHP at max PCL, and 500 SHP at 50% of the way between max and idle.

The PMU controls acceleration and deceleration allowing PCL movement as rapidly as desired at any altitude, minimizes propeller effects, and avoids large thrust surges on engine acceleration as the propeller stabilizes at operating RPM.

The PMU provides an auto-start capability during ground starts, monitoring engine parameters as the start progresses. The auto-start feature will automatically terminate the ground start sequence if light-off has not occurred within 10 seconds of selecting AUTO/RESET with the STARTER switch (no start) or if the PMU projects an impending hung or hot start.

The PMU will abort an auto start attempt to avoid a hung or hot start if ITT exceeds 940 °C for 2 seconds, 870 °C for 4 seconds, or 840 °C for 19 seconds.

An auto abort will also occur if N1 acceleration rate to idle is less than 50% of normal.

The engine start sequencing (starter, igniters, and fuel controlled during the start and shut off after a successful start) is available for air-starts, but the automatic shutdown feature is disabled when in flight mode.

For engine starts, the PMU receives inputs from the aircraft IOAT sensor located in the engine inlet plenum. During high temperature operations, radiant heat from the engine may heat soak the IOAT sensor, raising IOAT beyond ambient temperatures.

When this occurs and IOAT is greater than 96 °C but less than 121 °C, the PMU defaults to 121 °C for all PMU functions (including IOAT display).

If IOAT does not exceed 96 °C, the PMU uses the displayed value. If the PMU is activated with IOAT at/or above 96 °C, IOAT and ITT data is invalid (red X'S in counter display and missing ITT pointer) and EDM FAIL warning is displayed on the EICAS display.

If IOAT exceeds 121 °C, the PMU goes offline. This condition is indicated by red X's in the IOAT and ITT counters, removal of the ITT pointer on the EICAS display, and by illumination of the PMU FAIL warning on the EICAS.

The PMU will not reset until IOAT drops below 121 °C. Once the PMU is reset (PMU switch cycled from NORM to OFF and back to NORM), IOAT and ITT returns to normal and the EDM FAIL warning should be removed.

The EDM is functioning normally if the EDM fail was present, but does not appear after the PMU is successfully reset.

Auto Start Operations

To begin an automatic start, advance PCL to auto start position until the green ST READY advisory on the EICAS illuminates. Momentarily selecting the STARTER switch to AUTO/RESET while ST READY remains illuminated, initiates the fully automatic start sequence.

The PMU activates the starter, boost pump, and igniters, and adds fuel at the proper N1 speed.

At approximately 50% N1, the starter and igniters are de-energized and the boost pump is deactivated if fuel pressure is above 10 psi. The engine continues to accelerate to idle speed (60% N1).

The propeller automatically unfeathers during the start as engine oil pressure rises. The PCL may be advanced to IDLE any time N1 is at or above 60%.

During a normal (auto) start, the PMU continuously monitors N1, ITT, and fuel flow. The PMU can automatically stop fuel flow and deactivate the igniters and starter at any time to abort the start if necessary to avoid a hung or hot start or if any engine start parameter is exceeded.

After the PCL has been advanced past the start ready position, the PMU will not cut off fuel to terminate a start. The start must be manually aborted either by moving the PCL back to OFF or, if the PCL has not been moved past the IDLE gate, by reselecting the STARTER switch to AUTO/RESET.

Either action resets the PMU and aborts the auto start. If the PCL has been moved past the IDLE gate, the PCL must be moved to OFF to abort the start.

The PMU also provides air start capability, but does not provide engine protection.

During an air start, automatic N1, ITT, and torque limit protection are unavailable, therefore, the pilot must monitor all parameters and abort the start manually if necessary.

PMU Inoperative (Manual Mode)

Figure 1-10 Power Management Unit (PMU) Switch Location

The PMU is continually self-monitoring, identifying, and accommodating many faults. If faults prevent the PMU from setting the requested power or respecting engine limits, or the pilot switches the PMU OFF, the system will revert to the manual mode.

Illumination of both the PMU FAIL warning and PMU STATUS caution on the EICAS indicates the system is in manual mode. A step change in engine power may occur, but the transition is smooth and easily controllable. This step change will normally be to a lower power condition, except at low altitude cold conditions when a power increase can occur.

The maximum increase in power is 280 shp, and the maximum decrease in power is 550 shp. No step change in NP occurs since the over-speed governor is automatically reset to 100%.

In manual mode, the PCL schedules fuel directly to the engine through the FMU and the pilot must exercise care to ensure N1, temperature, and torque limits are not exceeded. Engine acceleration and deceleration characteristics are essentially unchanged with the PMU OFF; however, care must be exercised to avoid exceeding engine limits.

Since the propeller is operating on the over-speed governor, a torque surge can be expected any time the propeller is accelerated to governing speed from a low power setting, such as a take-off roll or a go-around.

The PMU STATUS caution illuminates 1 minute after landing (weight-on-wheels activation) if fault conditions that are not serious enough to revert the system to manual are encountered in flight.

PMU STATUS caution in flight indicates a fault in either of, or a mismatch between, the weight on-wheels switches, and serves to notify the pilot that the PMU will not revert to ground mode upon landing. This means that idle N1 will not shift from flight idle to ground idle upon landing, and landing distance may be slightly longer than normal.

CAUTION

- *Starts are not recommended with the PMU in the manual mode. However, if a start is performed with the PMU OFF, the pilot must exercise caution in performing the procedure to avoid a hot start.*

FIRE WARNING SYSTEM

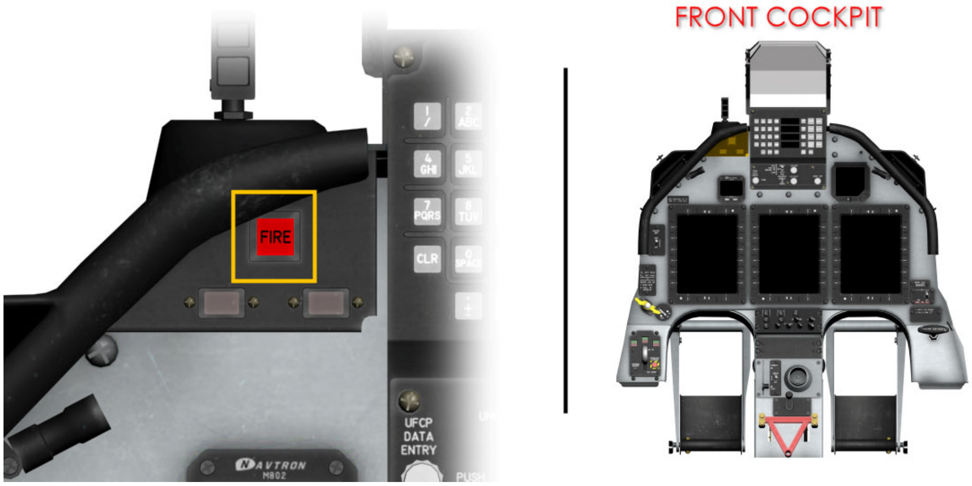


Figure 1-11 Fire Warning Light Location

The aircraft is equipped with a fire warning system that includes dual sensor tubes and responder assemblies. The sensors, mounted around the exterior surface of the engine, signal the respective responder assembly when a high temperature is detected.

The sensor tubes contain helium gas and a hydrogen charged core material. The helium gas responds to the sensor's overall threshold temperature for temperature sensing.

The hydrogen charged core responds to highly localized heat caused by flames and/or escaping hot bleed air gases resulting in the release of hydrogen gas from the core, which increases the helium gas pressure.

Sensor heating expands the helium gas, which in turn pressurizes a diaphragm inside the responder. If the diaphragm pressure reaches or exceeds the preset fire detection point, an electrical circuit triggers the red FIRE annunciator light and sounds the aural tone.

A fire warning system test switch, labelled FIRE, is provided on the front cockpit left console test panel to verify the electrical continuity of the two fire warning systems. Momentarily selecting the placarded 1 or 2 position will check system integrity and lamp operation for the respective system.

When the test switch is set to 1, the upper half of the annunciator will illuminate; when set to 2, the lower half of the annunciator will illuminate.

Flattening, twisting, kinking or denting of the fire warning loop does not affect test or flight operation.

Power for the #1 fire warning system is provided through a circuit breaker, placarded FIRE 1, and located on the battery bus circuit breaker panel in the front cockpit. Power for the #2 system is provided through a circuit breaker, placarded FIRE 2, and located on the generator bus circuit breaker panel in the front cockpit.

WARNING

- *Both FIRE test positions must check OK (all four bulbs in each annunciator) in both cockpits (if occupied).*

FIREWALL SHUTOFF HANDLE

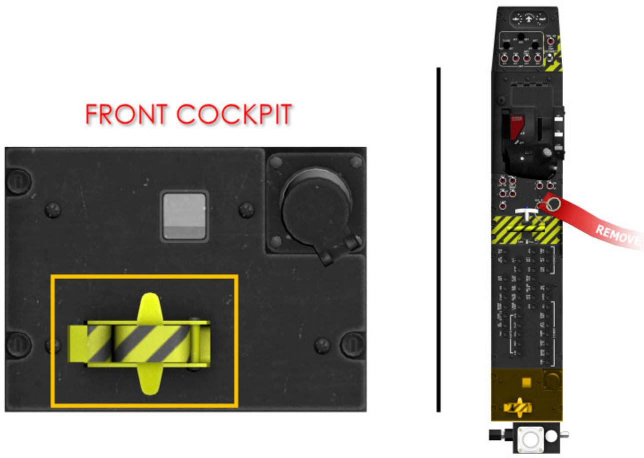


Figure 1-12 Firewall Shutoff Handle Location

The firewall shutoff handle, located on the front left console panel, mechanically operates cables to close valves at the firewall, cutting off fuel and hydraulic fluid to the engine, as well as cutting off bleed air from the engine.

To activate the firewall shutoff valves, lift the handle guard and rotate it out of the way, then pull up on the handle (2 to 2.5 inches). The valves may be reset by pushing the handle down.

FUEL SUPPLY SYSTEM

The fuel system provides approximately 1100 pounds of usable fuel through the single-point refuelling system. Approximately 100 pounds additional fuel is available if manually filled to the base of the filler neck in each wing tank.

Single-point pressure refuelling is the primary refuelling method. Three integral tanks built into a single-piece wing provide fuel storage with usable fuel information listed in the table below.

Fuel Location	Total Gallons	Weight – 6.7 lb/gal (JP-5 / JP-8 / JET A / JET A1)
Left Wing	79	527
Right Wing	79	527
Collector Tank	7	47
TOTAL	164	1100

The fuel system incorporates an auto balance system to keep the fuel level in the wing tanks within 20 pounds of each other. When a fuel imbalance of 20 pounds or more is detected for more than 30 seconds, the transfer valve will close the motive flow line to the light tank.

This action stops fuel in the light tank from being transferred to the collector tank while fuel continues to be transferred from the heavy tank to the collector tank. If the fuel imbalance is not reduced to less than 30 pounds within 2 minutes, the FUEL BAL caution will illuminate and the auto balance system will shut off.

The FUEL BAL caution will remain illuminated until the system is reset.

The fuel system includes the following on the EICAS to indicate fuel system operations:

- The red FUEL PX warning is activated by the low pressure switch and indicates less than 10 psi fuel pressure in the motive flow/return flow supply line.

- The green BOOST PUMP advisory is illuminated manually by selecting the BOOST PUMP switch ON, automatically by the low-pressure switch if the PCL is above the IDLE position, or whenever the starter is activated regardless of fuel pressure. The BOOST PUMP circuit breaker is located on the front cockpit battery bus.

- The amber L FUEL LO and R FUEL LO caution are activated by optical sensors and indicate fuel quantity below approximately 110 pounds in the respective wing tank. The optical sensors are independent of the fuel probes and fuel quantity gages. The FUEL QTY LO circuit breaker is located on the front cockpit battery bus.

- The amber FUEL BAL caution illuminates if indicated fuel imbalance exceeds 30 pounds for 2 minutes, or a fuel probe fails. The FUEL BAL caution will illuminate until the system is reset. To reset the auto balance system and 2-minute timer, place the FUEL BAL switch to MAN/RESET, then return to AUTO position. Resetting the auto balance system will not correct a fuel probe failure.

- The green M FUEL BAL advisory illuminates if the fuel balance switch is in the MAN/RESET position. Selecting the MAN/RESET position enables the manual fuel balance switch. Selecting L or R position stops motive flow fuel from feeding from the respective tank. The FUEL BAL circuit breaker is located on the front cockpit generator bus.

- A pilot-selectable “BINGO, BINGO” audio alert sounds when the total fuel is equal to or less than the value shown on the EICAS display at LSK L3. The alert sounds continuously until a value lower than the fuel total is set via the UFCP. The default value is 400 lbs.

The fuel quantity indicating system uses seven fuel probes: three in each wing tank and one in the collector tank.

For example, if the tanks are full, the outer probe is providing the reading for fuel quantity. The other probes are not used until the fuel level drops below the outboard probe.

The outer probe provides fuel readings until approximately 445±50 pounds, and the middle probe until approximately 308±50 pounds. The inner probe provides fuel readings until approximately 20 pounds since the collector tank only has one probe and divides its capacity equally between the left and right fuel tank readings.

If a fuel probe fails, the amber FUEL BAL caution illuminates and FP FAIL caution illuminates on the EICAS. If the fuel gage does not show an imbalance, then the failed probe is not being used to sense fuel.

When the failed probe is being used, the indicated fuel level in that tank drops to the next fuel probe. For example, if the middle fuel probe fails, the fuel in that tank appears normal until the fuel drops below 445±50 pounds; it then indicates 308±50 pounds until the fuel burns down below 308±50 pounds. After this point, the fuel reading appears normal.

Operations

Fuel gravity drains from outboard to inboard wing cavities where transfer jet pumps supply fuel to and maintain a low, positive pressure in the collector tank. A fuel pickup valve in the collector tank supplies fuel to the engine.

During inverted flight, a weighted rod in the pickup valve closes off the normal fuel pickup, and opens the inverted flight fuel pickup. This provides a minimum of 15 seconds of fuel regardless of orientation, and prevents air ingestion into the fuel system.

A primary jet pump or electric boost pump in the collector tank feeds fuel to the engine-driven low pressure fuel pump. The low pressure fuel pump supplies fuel to the engine-driven high pressure fuel pump which supplies fuel to the FMU. The electric boost pump provides fuel for engine start and serves as a backup to the engine-driven low pressure fuel pump.

If both the electric boost pump and the engine-driven low pressure pump fail, the engine-driven high pressure fuel pump will suction feed sufficient fuel for continued engine operation but will not allow an engine restart. If the engine-driven high pressure fuel pump fails, the engine will flame out and cannot be restarted.

The fuel supply line to the engine incorporates two manually operated shutoff valves and a fuel filter. One shutoff valve is provided to isolate the fuel system for engine or fuel filter maintenance. The firewall shutoff handle in the front cockpit activates the other shutoff valve, which stops fuel flow to the engine.

ELECTRICAL POWER SUPPLY SYSTEM

The electrical system includes a 28 VDC, 300 amp starter/generator, an aerobatic 24 VDC lead-acid battery, a 24 VDC auxiliary battery, and an external power receptacle. Electrical power is distributed through the battery and generator buses connected by the bus tie switch.

Circuit breakers providing protection, are located in both cockpits; battery bus on the left console panels and generator bus on the right. Black circuit breaker collar extensions are installed to provide easy identification and operation of high-use circuit breakers.

Starter/Generator

Figure 1-13 Generator Switch Location/s

Primary aircraft power is provided by the generator function of the starter/generator. The generator provides 28 VDC power which is sufficient to operate all equipment on the generator and battery buses, and charge the battery.

NOTE

- *The generator needs to supply a minimum of 25 volts to charge the battery.*

The generator control switches, placarded GEN, located in each cockpit, are magnetically held on and electrically interlocked, which allows generator control from either cockpit. Moving the generator switch to ON in either cockpit turns generator power on.

Moving the generator switch from the OFF position to ON will trip the switch in the other cockpit to OFF and transfers control to the cockpit with the switch in the ON position. While control of the switches is being transferred, power remains uninterrupted.

If the generator malfunctions in flight, the generator may be reset with the generator reset button, located in either cockpit, or by cycling the GEN switch off and back on. If the red GEN warning illuminates on the EICAS display, the air conditioning is the only equipment automatically shed.

Power is provided through the GEN SW circuit breaker located on the front cockpit generator bus.

Battery

Figure 1-14 Battery Switch Location/s

When the generator is not powering the electrical system, power is provided by an aerobatic, 24 VDC, lead-acid, 42-ampere-hour battery. The battery provides power for engine starts and is capable of powering all electrical systems except air conditioning.

The battery switch, placarded BAT, controls battery power application and are magnetically held on and electrically interlocked, so that battery power may be controlled from either cockpit.

Moving the battery switch to ON in either cockpit turns battery power on. Moving the battery switch from the OFF position to ON, trips the switch in the other cockpit to OFF and transfers control to the cockpit with the switch in the ON position.

While control of the switches is being transferred, power remains uninterrupted. Power is provided through the BAT SW circuit breaker located on the front cockpit battery bus.

Auxiliary Battery

Figure 1-15 Auxiliary Battery Switch Location

Auxiliary power is supplied by a 24 VDC, 5-ampere-hour auxiliary battery, located in the left avionics compartment, and is controlled by the AUX BAT switch on the front cockpit right console.

The auxiliary battery power level may be tested by turning the BAT switch ON and then holding the AUX BAT test switch, located on the front cockpit left console system test panel, for a minimum of 5 seconds and ensuring the test light remains illuminated only while the switch is held on. Power is provided through the AUX BAT circuit breaker located on the front cockpit battery bus.

External Power

An external power receptacle is installed in the left, aft fuselage, below the left avionics bay door.

External power is distributed on the battery bus and is controlled by the battery switch. The aircraft is internally protected from external power over/under voltage.

A voltage sensor is located between the external power connector and the external power relay. If the external voltage level exceeds a nominal level, the external power will be disconnected from the aircraft electrical system.

External Power can be connected via the MFD CONFIG Page on initial power from the BAT BUS.

Bus Tie Switch

Figure 1-16 Bus Tie Switch Location

The BUS TIE switch, located on the front cockpit right console, is used to tie/isolate the battery and generator buses. With the BUS TIE switch engaged (NORM position), the generator feeds both generator and battery bus items. If the bus tie fails, or is set to OPEN, the amber BUS TIE caution on the EICAS illuminates, separating the battery and generator buses.

If the battery or battery bus fails (red BAT BUS warning on the EICAS illuminated) while the BUS TIE caution is illuminated, items on the battery bus will not be powered.

If the generator fails while the BUS TIE caution is illuminated, items on the generator bus will not be powered. Expect a minimum of 30 minutes of battery power to the battery bus items.

If the generator has failed and the BUS TIE switch is in the NORM position, then the battery powers all items except the air conditioner, but for a reduced amount of time. If only the generator bus (red GEN BUS warning on EICAS illuminated) has failed, the items on the generator bus will not be powered, but if the BUS TIE switch is in the NORM position, the generator continues to power the battery bus and charge the battery.

BRAKE SYSTEM

The brake system is a non-boosted, mechanically actuated, and hydraulically operated system, independent of the aircraft hydraulic system. The brake system is not affected by a failure of the aircraft hydraulic system.

Two hydraulic master cylinders provide independent braking from the left and right rudder pedals. The master cylinders are located on the bulkhead frame forward of the aft instrument panel and are interconnected to both the forward and rear cockpit rudder pedals. Toe activated pedals, mounted to the rudder pedal assemblies in each cockpit, operate the corresponding master cylinder, applying pressure to the disk brake unit on the desired main wheel.

The filler plug for the brake reservoir is visible outboard of the forward left ejection seat rail with the canopy open. The filler plug incorporates three colour bands to indicate fluid level in the reservoir and the need for servicing.

The red band at the top of the filler plug indicates the system requires servicing, the green middle band indicates the system is adequately serviced, and the lower red band indicates the system has been over serviced.

PARKING BRAKE

The parking brake (see Figure 1-2) is activated by applying toe brakes while simultaneously pulling and turning the parking brake lever 90° clockwise. The parking brake handle is located in the front cockpit, on the lower right portion of the instrument panel. Turning the handle 90° counterclockwise releases the parking brake.

HYDRAULIC SYSTEM

The hydraulic system consists of one engine driven pump with approximately a 5-quart capacity. The system incorporates a pressure relief valve (3250 to 3500 psi) in the main and emergency systems to prevent damage from high system pressure.

The hydraulic system service bay, located in the lower aft fuselage behind the right wing trailing edge, contains:

- A manual pressure release handle to release the pressurized fluid from the emergency accumulator back to the reservoir.

- A fluid quantity indicator which shows the level of hydraulic fluid in the power package reservoir.

- A ground hydraulic power, sampling, and servicing connection.

NORMAL OPERATION

The hydraulic pump pressurizes the normal system and emergency accumulator to 3000±120 psi through a hydraulic fuse and one-way check valve.

Once pressure exceeds 1800 psi, the system can power the landing gear, main gear doors, flaps, speed brake, and nose wheel steering. If the hydraulic pressure indicator drops below 1800 psi, the hydraulic pressure display changes from white to amber.

An amber HYD FL LO caution illuminates on the EICAS display to indicate that the reservoir level has dropped below approximately 1 quart.

Hydraulic fluid level is checked in the hydraulic system service bay by comparing the position of the green indicating rod to marked indicator windows. The window indicates FULL AC when the fluid level is full, and the accumulator is charged.

If the fluid level is not FULL AC or FULL AD, then depressurize the emergency accumulator by pulling the manual pressure release handle. As the accumulator discharges, the fluid level in the reservoir should increase.

The system must be serviced if the accumulator is fully discharged and the fluid level does not indicate FULL AD. Power for the hydraulic system is provided through a circuit breaker, placarded HYD SYS, located on the battery bus circuit breaker panel in the front cockpit.

With this circuit breaker open, the pressure indication and HYD FL LO sensor is not available, but EHYD PX LO sensor is available.

EMERGENCY OPERATION

Emergency hydraulic pressure is available after the normal system has pressurized the emergency accumulator. Pulling the emergency gear extension handle (see Figure 1-2) in the front cockpit activates the emergency system by isolating the main hydraulic system at the power pack slide assembly and releasing the emergency accumulator pressure through independent emergency lines to extend the landing gear and flaps.

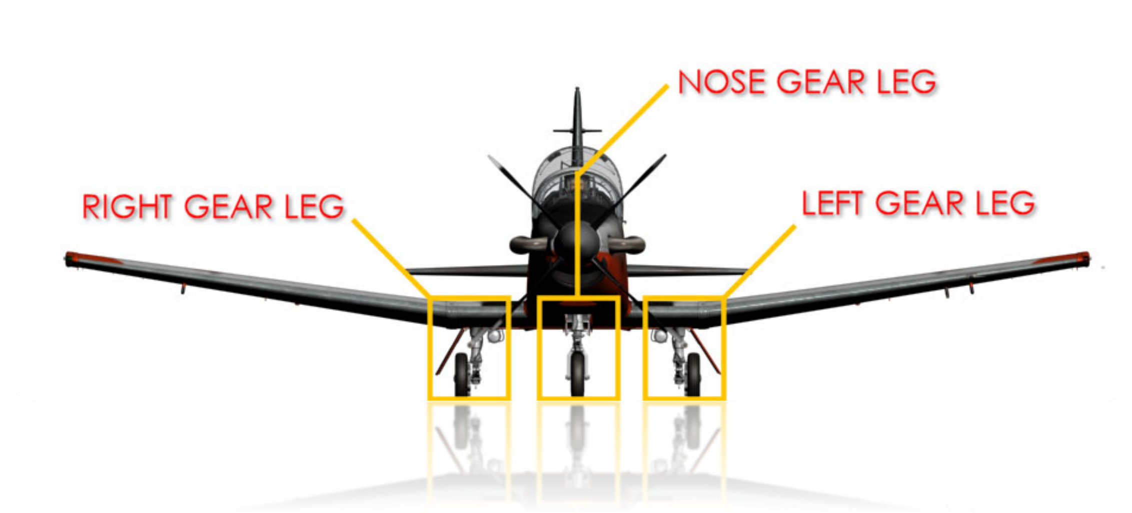
An amber EHYD PX LO caution on the EICAS is illuminated when the emergency accumulator pressure drops below 2400 ±150 psi and is the only indication of the emergency accumulator's status.

A check valve prevents the emergency system from bleeding back into the main system if the main system fails. A hydraulic fuse is used to prevent a leak in the emergency system from depleting the main hydraulic system.

The fluid flow to the emergency accumulator is restricted to a rate below .25 GPM. In the event of an emergency hydraulic system leak that exceeds .25 GPM, the fuse limits fluid loss to a maximum volume of 20-30 cubic inches (0.5 quarts).

The EHYD PX LO caution illuminates, and the landing gear and flaps may be lowered using the main system. If the leak rate is below .25 gallons per minute (GPM), the system depletes the main reservoir until the HYD FL LO caution illuminates, at which time there will still be sufficient fluid in the main reservoir to lower the landing gear and flaps using the main system.

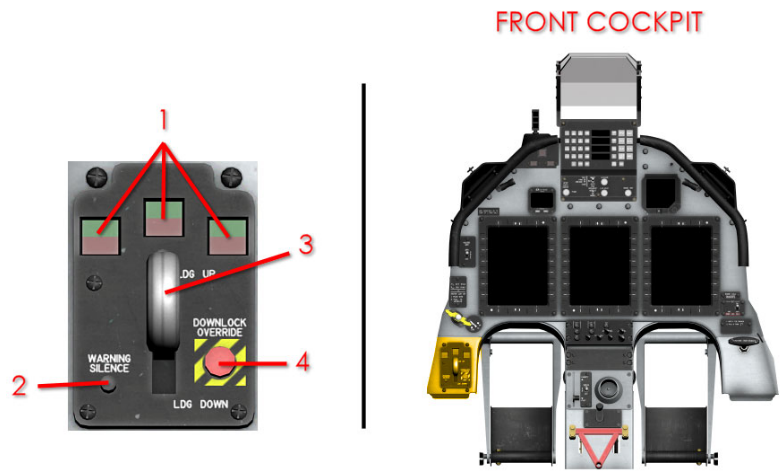
LANDING GEAR SYSTEM



The aircraft is equipped with a retractable tricycle system actuated by the aircraft's hydraulic system. Four actuators, one on each gear and one for the main gear doors, operate the landing gear from either the main or emergency hydraulic systems.

The major components are the two main landing gear with attached outboard gear doors, two inboard gear doors, a steerable nose gear with moveable doors, landing gear handles in each cockpit that provide gear position indications, and an emergency extension handle, placarded EMER LDG GR, in the front cockpit.

CONTROLS AND INDICATORS



1. LANDING GEAR INDICATOR LIGHTS
2. WARNING TONE SILENCE BUTTON
3. LANDING GEAR HANDLE
4. DOWNLOCK OVERRIDE BUTTON

Figure 1-17 Landing Gear Control Unit Location

The control unit, located on the lower left side of the instrument panel in each cockpit, includes a lighted landing gear handle, landing gear position indicator lights, a WARNING SILENCE button, and a DOWNLOCK OVERRIDE button (front cockpit only).

Landing gear handles in each cockpit are linked mechanically, and a soft detent prevents inadvertent control handle movement. Power for the landing gear controls is supplied through a circuit breaker, placarded LDG GR CONT, located on the front cockpit battery bus circuit breaker panel.

The gear indications include a red light in the gear handle and a red and green indicator for each gear. The green indicator illuminates when that gear is down and locked. The gear handle and red indicator illuminate whenever the nose gear is in transit or main gear doors are not closed, or any time the PCL is approaching IDLE with the gear handle UP, regardless of airspeed or position of main gear. The gear handle illuminates when any red indicator is illuminated.

Pressing the LAMP TEST switch, located on the left console, tests the gear handle and indicator lights for both cockpits. Normal gear sequence and indications are as follows:

HANDLE	GEAR	DOORS	GEAR LIGHTS	HANDLE LIGHT
UP	Up	Closed	None	Off
DOWN	Up	Opening	2 Red (Mains)	Red
DOWN	Extending	Open	3 Red	Red
DOWN	Down	Closing	3 Green / 2 Red (Mains)	Red
DOWN	Down	Closed	3 Green	Off

Downlock Override Button

The downlock override button, located in the front cockpit only, can be used to override the downlock solenoid which prevents movement of the landing gear selector handle when the right weight-on-wheels switch is energized (e.g., aircraft on ground, or right weight-on-wheels switch failure).

Only the landing gear handle will raise on the ground or when airborne with a failure of the right weight-on wheels switch.

NORMAL OPERATIONS

The system is hydraulically actuated and electrically sequenced to extend and retract the landing gear and main gear doors.

Main Gear/Doors

When the landing gear handle is lowered, an electrical signal commands a single hydraulic actuator to open both inboard gear doors, which subsequently allows the main gear actuators to unlock and lower the gear.

When the main and nose gear are down and locked, the inboard gear doors close and lock. Internal locks in the main gear actuators engage to lock the main gear down.

The process is reversed for gear retraction. A normal gear extension/retraction sequence takes approximately 6 seconds.

Nose Gear/Doors

When the landing gear handle is lowered and both main gear doors open, an electrical signal commands the nose gear hydraulic actuator to lower the nose gear. When the gear extends it allows the spring-loaded nose gear doors to open.

A spring-strut braces the nose gear folding strut in the over-centre position to lock the nose gear down.

Upon retraction, rollers on each side of the nose gear strut pull the nose gear doors up with the gear and hold them shut. The nose gear is locked in the up position by an internal actuator lock.

Emergency Extension

The emergency extension handle is located on the lower left side of the instrument panel in the front cockpit only, and is placarded EMER LDG GR.

The emergency hydraulic accumulator provides hydraulic pressure through independent lines to the four gear actuators to extend the main gear doors and landing gear. Electrical power is not required to use the emergency gear extension system.

Actuate the emergency gear system by pushing the button on the EMER LDG GR handle and pulling the EMER LDG GR handle out. The main gear doors open and all three gear extend regardless of the landing gear handle position.

Once the gear is down and locked, the inboard main gear doors remain open. Cockpit indications will be a red light in the gear handle, a green nose gear indicator, and red and green indicators for each main gear. The landing gear cannot be retracted after being extended with the emergency system.

Landing Gear Position Warning

The aural landing gear position warning is a 250 Hz tone repeated 5 times per second, transmitted through the audio system, and activates when any one of the following conditions are met.

- Gear handle not DOWN (regardless of gear indications), PCL below a mid-range position (approximately 87% N1), airspeed below 120 KIAS, and flaps UP or TAKE-OFF.

- All gear not indicating down and locked with flaps LDG (regardless of gear door position, power setting, or airspeed).

- Weight on wheels with gear handle not DOWN.

Warning Silence Button

The WARNING SILENCE button may be used to silence the warning horn when activated unless configured with gear UP/flaps LDG, or gear handle UP/aircraft on the ground.

In addition, if LDG flaps are not selected, pressing the WARNING SILENCE button prevents the warning horn from activating when pressed above 120 knots, PCL below a mid-range position (approximately 87% N1), and subsequently the aircraft is slowed below 120 knots.

The aural warning only resets if the PCL is moved above a mid-range position (approximately 87% N1), and then retarded below a mid-range position (approximately 87% N1).

An airspeed sensor prevents aural gear warnings above 120 KIAS, with the gear handle and flaps UP or take-off (TO), regardless of PCL position.

NOSE WHEEL STEERING

Directional control during taxi is accomplished by the use of rudder and/or differential braking, or by using hydraulic nose wheel steering (NWS).

The nose wheel is a free castoring type with 160° of castor (80° either side from centre). Steering is mechanically operated through the rudder pedals and hydraulically driven with pressure supplied by the aircraft hydraulic system.

The nose wheel steering actuator automatically centres the nose wheel when the aircraft is in the air and the nose gear is not up and locked.

An actuator assembly, mounted on the forward side of the nose gear strut, includes a selector valve, servo valve, and rotary actuator. The actuator assembly also provides nose wheel shimmy damping. The selector valve includes a solenoid which is electrically controlled by a switch located on each control stick grip to turn on nose wheel steering.

The servo valve is operated by a push-pull cable connected to the rudder pedals to command left or right steering.

A green advisory message; NWS, on the EICAS page, illuminates when nose wheel steering is selected.

Power for the nose wheel steering system is provided through a circuit breaker, placarded NWS, located on the generator bus circuit breaker panel in the front cockpit.

WING FLAPS

The aircraft is equipped with hydraulically operated, electrically controlled, four-segment split flaps. Normal hydraulic pressure is used for extension and retraction, and emergency accumulator pressure is provided for emergency extension only.

The system includes two flap selectors, two selector valves for normal operation, an emergency extension selector valve, flap actuator, flap torque tube, two flap position indicators, and associated micro switches.

EXTENSION/RETRACTION

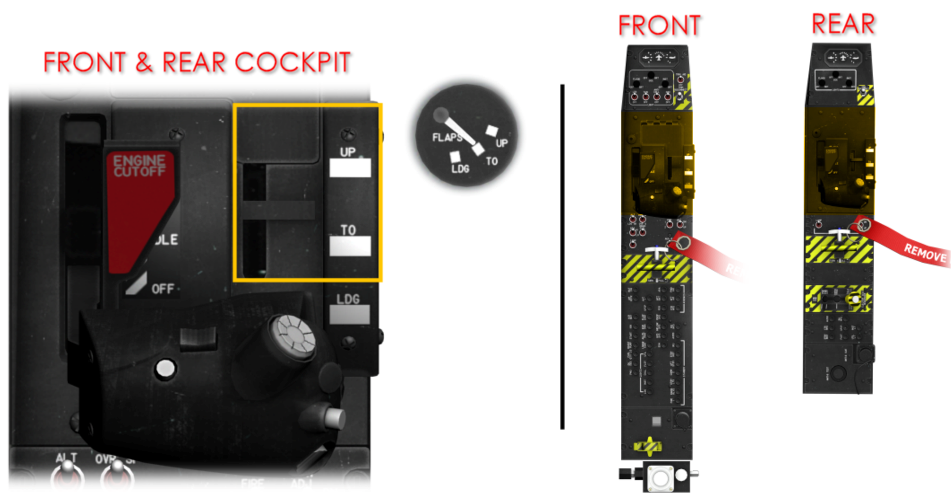


Figure 1-18 Flap Position Lever Location

The flap control system operates the flaps through a centrally located hydraulic actuator. Flap position is controlled by a three-position flap selector, placarded UP, TO (take-off, 23° deflection), and LDG (landing, 50° deflection), located in the left console in each cockpit.

The selectors are interconnected so that operation of one selector is duplicated by the other. Electrical power for the flap system is provided through a circuit breaker, placarded FLAP CONT, located on the battery bus circuit breaker panel in the front cockpit.

During normal operation, the flap selector controls the hydraulic flap actuator, which is connected to the flap torque tube. When hydraulic power is applied to the actuator, the actuator rotates the torque tube and flap segments to the selected setting.

As the torque tube rotates, a cam on the torque tube activates position sensing micro switches to drive the flap indicator in each cockpit.

EMERGENCY EXTENSION

Emergency flap extension is enabled after the emergency landing gear extension handle is operated. Following landing gear extension, setting either flap selector to or LDG controls emergency flap extension to the TO or LDG position.

The emergency selector valve is solenoid operated and is located in the hydraulic power system emergency manifold.

The flaps cannot be retracted after emergency extension until the aircraft is serviced by maintenance.

FLAP INDICATOR

A flap indicator (see Figure 1-2) is located above the landing gear control handle on the lower left side of the instrument panel in each cockpit. The flap position is indicated by a pointer which points at one of three position marks. The position marks match the flap lever markings of UP, TO (take-off), and LDG (landing).

During extension or retraction, the position pointer moves to an intermediate position between the placarded settings to indicate flap motion.

When power is removed from the flap indicator (e.g., battery switch OFF or battery bus failure), the position pointer moves to a position counter clockwise of the UP position.

SPEED BRAKE SYSTEM

The speed brake control system operates a single ventral plate, located between the flaps, through a hydraulic actuator.

The EICAS advisory SPDBRK OUT is illuminated any time the speed brake is extended.

The speed brake is held extended or retracted by hydraulic pressure in the actuator. The actuator incorporates an internal hydraulic uplock to keep the speed brake retracted when the engine is off.

A system of cables, pulleys, and push-pull flexible cables connected from the speed brake to the elevator trim tab actuator automatically inputs pitch trim as the speed brake is operated.

This counteracts some, but not all of the pitch change tendency of the aircraft due to the operation of the speed brake. The speed brake extends to 70° from the stowed position and may not be stopped at an intermediate deflection.

The speed brake switch is a three-position switch, spring-loaded to the centre position, located on the top inside surface of each PCL. Rearward movement of either switch extends the speed brake and forward movement retracts the speed brake.

If the flaps are extended, the speed brake will not extend. Once extended, the speed brake remains extended until either switch is moved forward to retract, the flaps are extended, or the PCL is moved to MAX. Moving the FLAPS selector out of the UP position, or moving the PCL to the maximum power position, trips a micro switch which automatically retracts the speed brake.

The speed brake control circuit responds to the last entry.

Electrical power for the speed brake system is provided through a circuit breaker, placarded SPEED BRAKE, on the generator bus circuit breaker panel in the front cockpit.

FLIGHT CONTROL SYSTEM

The flight control system includes primary and secondary controls which may be operated from either cockpit. The manually operated primary flight controls include conventional ailerons, elevator, and rudder.

Secondary flight controls include electrically actuated pitch/roll/yaw trim systems and a rudder trim aid device (TAD).

A combined aileron/elevator (roll/pitch) trim switch is located on each control stick grip and a rudder (yaw) trim switch is located on each PCL. The control circuits give the rear cockpit priority if trim selection conflicts between cockpits.

A trim interrupt button is located right of the roll/pitch trim switch on the top of the control stick grip. Pressing and holding the button interrupts power to all trim actuators and causes the trim aid device to disengage. A trim disconnect switch, placarded TRIM DISCONNECT, is also installed on the trim control panel in each cockpit.

Actuating the trim disconnect switch removes power from the trim system and cause the trim aid device to disengage. Green TRIM OFF and TAD OFF advisory on the EICAS display in each cockpit illuminates whenever the trim disconnect switch is used.

The three-axis trim positions are displayed on a triple-trim indicator installed on the left console in each cockpit. The trim indicator provides a pictorial indication of the aircraft trim condition.

Three green bands, one on each trim axis, provide the take-off trim setting range for each trim axis. Power for the trim indicator is provided through a circuit breaker, placarded TRIM IND, located on the generator bus circuit breaker panel in the front and rear cockpits.

AILERONS

The aileron system includes the ailerons, control sticks, push-pull rods, and bell cranks. The front and rear control sticks are interconnected by a interconnect tube. The ailerons are deflected by lateral movement of either control stick.

Aileron travel is limited to 20° trailing edge up and 11° trailing edge down. The ailerons are statically mass balanced with weights installed on the leading edges of each aileron.

Aileron Trim

An electromechanical actuator, installed in the centre wing, is connected to a spring box assembly and the centreline bell crank to provide aileron (roll) trim by actually moving the ailerons.

The aileron trim actuator is controlled by a combined roll/pitch trim switch located on the control stick grip in each cockpit. Aileron travel on the ground for roll trim is approximately 6° trailing edge up for either aileron and 6° trailing edge down for the opposite aileron.

Trim position is indicated on the triple-trim indicator on the trim control panel. Power is provided through a circuit breaker, placarded AIL/EL TRIM, located on the battery bus circuit breaker panel in the front cockpit.

Ground adjustable trim tabs are installed at the trailing edge of each aileron. The tabs allow maintenance adjustment of the stick neutral trim input to the control system by varying the aerodynamic forces acting on the ailerons. The ground adjustable trim tabs are limited to 20° tab trailing edge up and 8° tab trailing edge down.

ELEVATOR

The elevator system includes the elevator, control sticks, push-pull rods, down springs, cables, bell cranks, and a bob weight.

The elevator is deflected by fore and aft movement of either control stick. The front and rear control sticks are interconnected by an interconnect tube. Elevator travel is limited to 18° trailing edge up and 16° trailing edge down deflection. The elevator is mass balanced with weights located in the elevator horns. Two down springs fitted to the elevator bell crank provide a balanced control feel.

A bob weight is installed on the front control stick which increases stick forces as G-load on the aircraft increases, to improve control feel and help prevent overstressing the airframe.

Elevator Trim

Elevator (pitch) trim is provided by an electromechanical actuator which drives a tab surface installed on the right side of the elevator.

The actuator is controlled by a combined roll/pitch trim switch located on the control stick grip in each cockpit. Elevator tab travel is limited to 5.5° trailing edge up and 22° trailing edge down.

Trim position is indicated on the triple-trim indicator on the trim control panel. Power is provided through a circuit breaker, placarded AIL/EL TRIM, located on the battery bus circuit breaker panel in the front cockpit.

RUDDER

The rudder system includes the rudder, rudder pedals, cables, pulleys, and a bell crank, with one push-pull rod and two rudder centering springs. The front and rear cockpit rudder pedals are interconnected by tie rods.

Rudder pedal position adjustment is accomplished with a hand crank located on the centre console of each cockpit. The crank is connected to a jackscrew on the pedals. Pedal position can be adjusted a total of 7 inches from forward to aft.

The rudder is deflected by movement of the rudder pedals in either cockpit. Rudder travel is limited to 24° left and 24° right deflection. The rudder surface is statically mass balanced with a balance weight installed in the rudder horn.

Rudder Trim

Rudder (yaw) trim is provided by an electromechanical actuator located in the vertical stabilizer, which drives an anti-servo tab surface on the trailing edge of the rudder. The actuator is controlled by a switch installed on the PCL in each cockpit. Tab deflection with the rudder at neutral is limited to 9° trailing edge right and 9° trailing edge left.

Trim position is indicated on the trim control panel. Power is provided through a circuit breaker, placarded RUD TRIM, located on the battery bus circuit breaker panel in the front cockpit.

TRIM AID DEVICE (TAD)

Figure 1-19 Trim Aid Device (TAD) Switch Location

The rudder trim aid device (TAD) assists directional (yaw) trimming during airspeed and power changes. The TAD senses engine torque, altitude, airspeed, and pitch rate, and computes a desired rudder trim tab position.

The computed signal is applied to the rudder trim tab actuator, which deflects the trim tab to the computed position, resulting in lower out-of-trim forces.

The trim aid device is selected by a magnetically locked switch, placarded TRIM AID, located on the left console in the front cockpit (Figure 1-27). A green TAD OFF advisory illuminates on the EICAS when the system is disengaged.

An amber TAD FAIL caution illuminates on the EICAS display if the system has failed internally. Actuating the trim interrupt button on the control stick grip, or the TRIM DISCONNECT switch on the trim control panel, removes power from the rudder tab actuator, including the reference voltage to the TAD, causing the TAD to disengage, the TRIM AID switch to move to OFF, and the TAD OFF advisory illuminates on the EICAS display.

If the TAD FAIL caution illuminates on the EICAS display, the TAD system must be reset by setting the TRIM AID switch to OFF, and then back to TRIM AID. Power for the TAD is provided through a circuit breaker, placarded TAD, located on the generator bus circuit breaker panel in the front cockpit.

When engaged, the TAD functions continuously without input from the pilot. Manual yaw trim input from the pilot is additive to the trim input that the TAD commands. The TAD automatically sets take-off trim in the yaw axis when the trim aid system is switched on after engine start.

Once take-off trim is set, the system makes no further trim inputs until the aircraft accelerates to at least 80 KIAS and there is no weight on the wheels.

GUST LOCK

A gust lock system is provided in the front cockpit to lock the aileron and rudder surfaces in the neutral position, and the elevator in a nose-down configuration when the aircraft is parked. A spring-loaded yoke on the centre console is lifted, the control stick is positioned so that the gust lock yoke can engage an adapter on the control stick, and the yoke is lowered to the lock position on the column. A flexible cable, connected to a latch assembly which locks the rudder cable, is attached to the lever. The gust lock is disengaged by lifting the yoke, moving the control stick to the side and then aft, and lowering the yoke to the stowed position.

DOORS AND HATCHES

AVIONICS BAY AND BAGGAGE COMPARTMENT DOORS

Access to the avionics bay is provided by two side-hinged doors, one on each side of the aircraft. Each avionics bay door is secured by three latches, one on each of the non-hinged sides.

Access to the baggage compartment is provided by a lockable, top-hinged door on the left side of the aircraft. The baggage compartment door is secured by three latches, one on each of the non-hinged sides.

To open, press a latch inward until the lock-half pops outward, and repeat for the other latches. Each door has a strut attached that may be used to secure the door in the open position. To close the door, stow the strut and close the door against the side of the fuselage.

Press the lock-half of a latch inward until the latch snaps, and repeat for the other latches.

GROUND EGRESS DOORS

Access to the external canopy fracture system (CFS) handles is provided by two lockable doors, one on each side of the aircraft. Each door is secured by a single latch.

To open, press the latch inward, until the lock-half pops outward. To close the door, close the door against the side of the fuselage and press the lock-half of the latch inward until the latch snaps.

ENGINE COWLINGS AND DOORS

The engine compartment area forward of the firewall is enclosed by several fixed and several openable or removable cowlings. The lower portion of the enclosure is fixed and can be removed by maintenance personnel only.

From the spinner aft, the engine compartment is divided into the nose area (forward cowlings), the plenum area (plenum panels), and the accessory area (left and right cowling doors).

The nose area extends from the spinner back plate to just aft of the engine exhaust stacks. The reduction gear box, PIU, chip detector, exhaust stacks and torque probe are accessible with the nose area cowlings removed.

Access to the nose area is provided by an upper and a lower forward cowling, both of which are removable by maintenance personnel.

The plenum area extends from the aft end of the nose area, aft to the second break in the skin. The engine inlet plenum and assorted portions of the oil, fuel, and bleed air lines are accessible with the plenum area cowlings removed. Access to the plenum area is provided by a single upper cowling and two side cowlings (right and left), all of which are removable by maintenance personnel.

The accessory area extends from the aft end of the plenum area, aft to the firewall. The oil tank filler cap and dipstick, oil level sight glass, oil system scavenge pump, FMU, fuel pumps, battery, and other engine accessories are accessible with the left and/or right cowling doors open.

Access to the accessory area is provided by a right cowling door and a left cowling door. The right cowling may be opened by releasing three thumb latches and one lever latch. The left cowling may be opened by releasing one thumb latch and two lever latches. The thumb latches are painted orange on the inner side to improve visibility when open.

A cowling support strut is provided for each accessory cowling to prop the cowling up in the open position. To support the cowling, place the rod end of the strut into the receptacle on the firewall. To stow the strut, pull the rod end out of the receptacle, press the strut end into the clip on the cowling, and close the cowling. Press the latches to the closed position and verify no orange is showing on any of the latches.

CANOPY

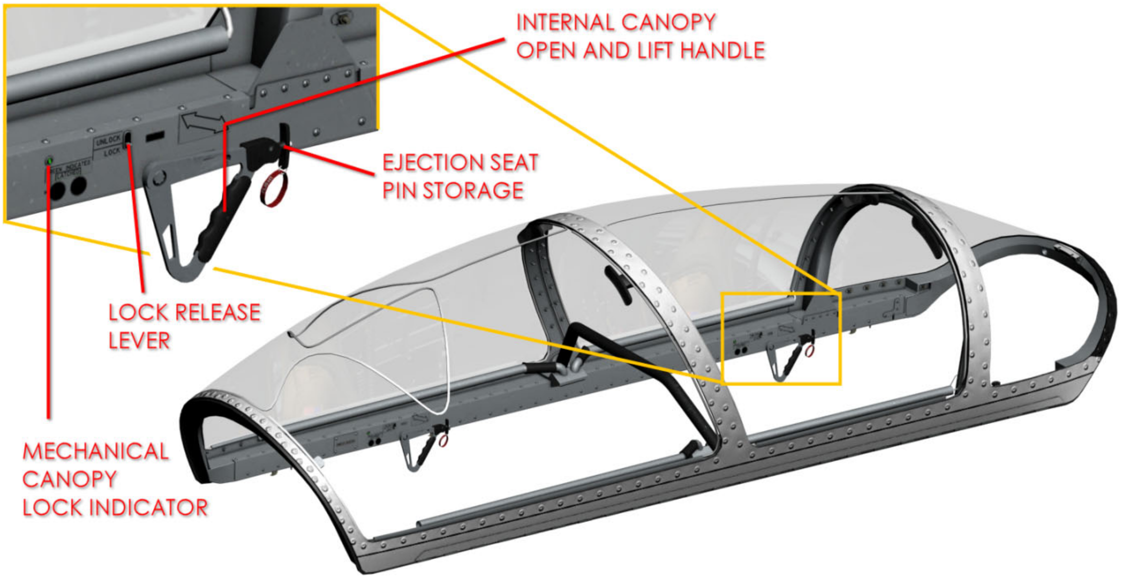


Figure 1-20 Canopy Open/Close

The lockable canopy, which includes the windscreen, is side opening. For bird strike protection, the windscreen and front transparency are thicker than the rear transparency. The windscreen is designed to withstand a 4-pound bird strike at airspeeds up to 270 knots without canopy penetration.

Oil filled spring struts permit opening and closing without power assist from either cockpit. The latch mechanism drives five over entering hooks through a continuous drive rod.

An electrical sensing system which consists of four micro switches, three of which are part of the latch mechanism, and a single canopy sill switch at the forward edge of the canopy, verifies the locked and latched condition. A red CANOPY warning illuminates on the EICAS display when the canopy latch mechanism and micro switches do not indicate the canopy is in the closed and locked position.

For defog and ventilation, warm air is routed through tubes along the sides of the canopy and distributed through a series of flow control holes.

The aircraft key set can be used to lock and unlock the ground egress doors, baggage compartment door, and canopy. A canopy prop strut is located on the left canopy rail, near the forward internal canopy handle, to provide limited cockpit ventilation when the aircraft is parked.

The canopy prop strut pivots down and engages a stop clip on the left longeron, leaving the canopy open approximately 4 inches. To release the prop strut, lift the prop strut up and rotate the prop strut up to the STOWED position.

The canopy has a non-inflatable weather seal and an inflatable pressure seal. The pressure seal is pneumatically inflated using cooled engine bleed air tapped off the anti-G system. The one piece, seamless pressure seal is automatically inflated as soon as bleed air inflow is available (e.g., engine on and bleed air inflow switch NORM or HI) and weight is off the right main landing gear.

CANOPY OPERATING PROCEDURES

To close the canopy from the inside:

WARNING

- *Make sure only one occupant is operating the canopy handle, to avoid pinching fingers or hand.*

NOTE

- *If canopy cannot be locked from the inside, do not accept the aircraft for flight. If crew chief assistance is utilized to close and lock canopy, aircrew must re-open and close canopy from the inside.*

1. Pull canopy lock release handle in either cockpit and hold.

2. Pull canopy over centre and release canopy lock release handle.

3. Make sure internal canopy handle is rotated full OPEN (aft) position and slowly lower canopy rail to canopy sill.

4. Rotate internal canopy handle forward with a slow steady motion until resistance is felt in lock mechanism. Reverse direction just until pressure is relieved, then continue to rotate internal canopy handle forward to LATCHED position.

5. Check proper engagement of canopy hooks by lifting lock release lever. Make sure canopy light and master warning illuminate and internal canopy handle does not rotate aft.

6. Release lock release lever and extinguish master warning. Make sure canopy light extinguishes.

7. Check canopy lock by gently attempting to rotate internal canopy handle aft. When properly locked, internal canopy handle cannot be rotated aft without raising lock release lever.

8. Verify mechanical green indicators visible.

To open the canopy from the inside:

1. Raise lock release lever located aft of internal canopy handle.

2. Hold lock release lever in UNLOCK position while slowly rotating internal canopy handle aft to placarded OPEN position.

3. Lift canopy open.

CANOPY FRACTURING SYSTEM (CFS)

The aircraft uses a dual redundant canopy fracturing system (CFS) to provide a clear path for the pilot(s) during ejection or emergency ground egress. The CFS uses a flexible linear shaped charge (FLSC) installed around the periphery and down the centreline of the front transparency, and a mild detonating cord (MDC) installed in separate parts, one around the periphery, and one down the centreline of the rear transparency (in a diamond pattern).

The CFS has two modes of operation; automatic initiation during ejection, and manual initiation from either internal or external CFS initiators. An internal CFS handle, located on the left console behind the PCL in each cockpit, allows manual activation of the fracturing system for the transparency over the respective cockpit.

There are also two external CFS handles and initiators behind placarded ground egress doors on either side of the aircraft below the canopy sill. Either external CFS initiator will activate the fracturing system for both transparencies.

The front CFS detonates the FLSC around the periphery and down the centreline to sever the transparency into two halves. During rear seat ejection, only the rear transparency centreline diamond pattern detonates.

However, activating the rear cockpit CFS handle or either external CFS handle will detonate both the periphery and diamond pattern of the rear transparency. Force of the detonation jettisons the transparency parts away from the canopy frame.

The CFS is good for only one actuation; if a CFS handle is pulled, the system cannot be reset simply by resetting the handle - at a minimum, system components between the handle and the optical detonator will need to be replaced.

Each CFS initiator includes piezoelectric crystals and a flash lamp bank. When the CFS handle is pulled, the piezoelectric crystal produces an electric charge to fire the flash lamps which provide a light source. The light excites a laser rod, which sends laser energy along fibre optic cables to the optical detonators at the canopy sill. The optical detonators fire plungers across the air gap between the optical detonators on the canopy sill and the CFS acceptor assemblies on the canopy. The acceptor assemblies initiate shielded mild detonating cords attached to the initiation manifolds, which detonate the CFS explosive cords.

Motion of the ejection seat automatically initiates the CFS system through a dual laser initiator connected to the seat by the CFS attach bolt, located on the right seat rail in each cockpit, which precisely times the detonation with the passage of the seat.

This ensures that seat passage occurs during the outward movement of the transparency parts, providing a clear escape path. In the event of canopy fracturing system failure, each seat is fitted with a canopy breaker to fracture the transparency.

WARNING

- *A safety pin is provided for the internal canopy fracturing initiators located in each cockpit console. This pin shall be removed and stowed before flight and re-installed after flight. A stowage box is provided beside the rear ejection seat.*

ENVIRONMENTAL CONTROL SYSTEM (ECS)

The environmental control system provides automatic temperature and pressurization control. Heating and pressurization are provided by conditioned engine bleed air.

Cockpit cooling is provided by a vapour cycle system with an engine-driven compressor.

Fresh air ventilation is available for ground operations and non-pressurized flight. A full set of environmental controls are located in the front cockpit right side console.

Power for the environmental control panel is provided through a circuit breaker, placarded CKPT TEMP, located on the generator bus circuit breaker panel in the front cockpit.

BLEED AIR SUPPLY SYSTEM

Engine bleed air is utilized for the canopy pressurization seal, anti-G system, cockpit heating and defogging, pressurization, and on-board oxygen generation system (OBOGS).

Bleed air is tapped from the engine compressor section at the left and right P3 ports. All bleed air supporting OBOGS, anti-G, and the canopy pressurization seal must first pass through a heat exchanger assembly.

This assembly is divided into two sections. One section supports cooling for anti-G, canopy seal, and OBOGS. The other section is used for all other ECS functions.

Cooling air for the heat exchanger is supplied by two sources. For ground operations, a blower supplies the necessary cooling air flow. With weight off the landing gear, electrical power to the blower is terminated and ram air through the cooling air inlet is ducted to the heat exchanger. Flappers in the heat exchanger inlet duct divert the airflow, depending on whether the cooling air is blower or ram air supplied.

Bleed air from the left side P3 port is used for the OBOGS. The left side P3 bleed air is controlled using the supply lever on the oxygen regulator in each cockpit.

Bleed air from the right side P3 port is used for canopy seal, anti-G, heating/defogging, and pressurization. To prevent right side P3 bleed air from entering the cockpit, both the BLEED AIR INFLOW switch on the environmental control panel and the DEFOG switch on the centre console must be in the OFF position. These two switches control the position of the bi-level flow control and shutoff valve (inflow valve) and bi-level flow control bypass valve (defog valve), respectively, and are located in the front cockpit only.

Power for both the defog valve and the inflow valve is provided through the INFLOW SYS circuit breaker on the forward battery bus.

The BLEED AIR INFLOW switch is a three-position switch placarded HI, NORM, and OFF. This switch controls the position of two solenoids on the inflow valve.

In the OFF position, both solenoids are de-energized and the valve is closed. In the NORM position, one solenoid is energized allowing the inflow valve to partially open. When the switch is set to HI, the second solenoid is energized and airflow through the valve increases.

When the air conditioning compressor is operating and the aircraft is below 7500 feet MSL (pressurization no longer required) the inflow valve is automatically closed regardless of the position of the BLEED AIR INFLOW switch. This improves cooling performance by eliminating warm bleed air from the airflow into the cockpit environment.

When the DEFOG switch is set to ON, the inflow valve is fully opened to maximize the volume of bleed air entering the cockpit.

The ECS has two temperature sensing sources downstream of the heat exchanger to alert the pilot of over temperature conditions in the ECS ducting. A 300 °F temperature switch is located at the rear distribution valve aft of the front ejection seat. Another 300 °F temperature sensor is located upstream of the defog selector in the environmental system duct near the firewall. If the bleed air temperature at either sensor location exceeds 300 °F, an amber DUCT TEMP caution will illuminate.

A manually actuated shutoff valve is located at the firewall. The valve is connected by linkage to the hydraulic system shutoff valve and is actuated, along with the fuel system shutoff valve, by pulling the FIREWALL SHUTOFF handle in the front cockpit on the left console panel.

CANOPY SEAL AND ANTI-G SYSTEM

An anti-G system provides partial protection against the physiological effects of high G manoeuvres. The system utilizes engine bleed air to supply pressure to each pilot's anti- G suit. Each anti-G valve has a weighted rod with an orifice which is displaced toward full open by gravity during positive G acceleration.

As the weighted rod moves further open with increasing G, the pressure in the anti-G suit increases proportionally.

The canopy seal/anti-G electrical shutoff valve is controlled by the BLEED AIR INFLOW switch. Power for this valve is provided through a circuit breaker, placarded INFLOW SYS, on the battery bus circuit breaker panel in the front cockpit. Absence of power leaves the valve closed.

After flowing through the shutoff valve, air proceeds to the heat exchanger for cooling. A water separator is incorporated into the system to protect the anti-G valves from contamination.

A safety valve automatically provides pressure relief if the pressure exceeds 7 psi.

A quick disconnect coupling for the anti-G suit hose connection and a test button are provided on a control panel located on the left side console in each cockpit. When the test button is pressed, the weighted rod is depressed allowing bleed air to flow into the suit.

HEATING AND DEFOGGING SYSTEM

Engine bleed air for heating and defogging is tapped off the right side P3 port and routed to the cockpit through the inflow and/or defog valves. Bleed air continues through or bypasses the heat exchanger, then passes through the ECS portion of the firewall shutoff valve and enters the cockpit through the defog outlets or the foot warmers.

The routing of air in the two cockpits is based on the position of the vent control lever, placarded AIR, located on the centre console in the front cockpit only. When the vent control lever is set to CANOPY, air is routed to the windshield defog outlets in the front cockpit and the canopy defog outlets in both cockpits.

Defog air is provided to the canopy from the mid-lever position and above. When the vent control lever is set to FOOT, air is routed to foot warmer outlets in both cockpits. The vent control lever mechanically positions a butterfly valve in the air ducts in both cockpits to direct the air to the selected location.

The temperature of the air entering the cockpit is normally controlled automatically between 60 and 90 °F as selected by the front cockpit pilot using the temperature control switch placarded TEMP CONTROL.

This switch is a combination potentiometer and a three-position rotary switch. The potentiometer portion of the switch, placarded AUTO, is used for automatic temperature control. To increase cockpit temperature, rotate the switch toward HOT, to decrease cockpit temperature, rotate the switch toward COLD.

Rotating the switch knob to the 6- o'clock position changes control to the manual mode. In the manual mode, the rotary switch is spring loaded to off or null at the manual position. Rotating the switch clockwise or counter clockwise toward COLD or HOT results in directional control of the heat exchanger bypass valve, resulting in warmer or cooler inflow temperatures.

The temperature controller receives input from the cockpit temperature control sensor located in the duct between the two cockpits, the TEMP CONTROL rheostat position, and the cabin temperature sensor located on the rear pressure bulkhead.

These inputs result in an output signal from the controller to the heat exchanger bypass valve to direct more or less bleed air through the heat exchanger as necessary to achieve and maintain the selected temperature.

If the temperature controller detects a temperature in excess of 165 °F at the cockpit temperature control sensor, it directs the heat exchanger bypass valve to move to full closed, forcing maximum bleed air through the heat exchanger.

Power for the temperature controller is provided through a circuit breaker, placarded CKPT TEMP, located on the generator bus circuit breaker panel in the front cockpit.

The DEFOG switch, placarded DEFOG, ON, and OFF, is located on the centre console in the front cockpit. Placing the switch to the ON position does three things:

(1) The defog valve is opened, increasing the bleed air supply

(2) The inflow valve is automatically set to high, further increasing the amount of bleed air entering the cockpit, and

(3) The air conditioning compressor is automatically turned on to dry the air.

Additionally, an ejector downstream of the heat exchanger takes the high pressure bleed air and passes it through a venturi. The resulting drop in static pressure draws ambient cockpit air into the ECS ducting, further increasing the volume of air available for defogging.

If the DEFOG switch is placed to OFF, the electrically controlled defog valve may take up to 40 seconds to close. Operation of the canopy defog increases ITT for a given PCL setting due to the higher bleed air load on the engine.

Adjust the PCL to maintain the ITT within limitations appropriate to the operation, e.g., maximum climb when climbing or maximum cruise power for cruise flight.

Defog is typically required for short intervals during climb to, and cruise at, high altitude and descents from high altitude into humid conditions.

A reduction in flaps UP climb performance of up to 47% may be observed with the defog switch ON and the PCL retarded to maintain the ITT within limits.

PRESSURIZATION SYSTEM

The pressurization system includes a control valve, a safety valve, a control valve regulator, a differential pressure (delta P) regulator, and a solenoid dump valve. The control valve regulator operates in conjunction with the control valve to provide pressure control.

The control valve is interconnected to a 28 VDC dump solenoid which requires power to close. The delta P regulator operates in conjunction with the safety valve to provide redundant control at maximum differential pressure.

For normal operation, electrical power is removed from the dump solenoid through the landing gear weight-on-wheels switch when the aircraft is on the ground. When the aircraft becomes airborne, electrical power is applied to the dump solenoid valve. This allows the control valve regulator to open and close the control valve as necessary to control cockpit pressure.

As the aircraft approaches 8000 feet pressure altitude, the control valve regulator will open and close the control valve to maintain cockpit pressure.

An 8000-foot cockpit altitude is maintained until a differential pressure of 3.6±0.2 psi is reached at 18,069 feet. Cockpit pressure altitude at 31,000 feet is 16,600 feet.

If cockpit pressure altitude rises above 19,000 feet, an amber CKPT ALT caution illuminates. If cockpit differential pressure exceeds 3.9 to 4.0 psi, a red CKPT PX warning illuminates. Cockpit differential pressure and cockpit altitude are displayed on the EICAS display in each cockpit.

The cockpit pressure altitude is presented in feet and is placarded COCKPIT ALT, FT. The cockpit differential pressure display, placarded ΔP, PSI, is just below the cockpit pressure altitude display.

The pressurization control switch, placarded PRESSURIZATION, is a guarded three-position toggle switch on the environmental control panel in the front cockpit. The switch positions are NORM, DUMP, and RAM/DUMP.

The switch guard must be raised to select the DUMP or the RAM/DUMP position. When the pressurization control switch is in the NORM position, the pressurization system operates automatically.

Selecting DUMP removes power from the dump solenoid which opens the dump solenoid electrically and opens the control valve mechanically; however, bleed air inflow continues. Selecting RAM/DUMP opens the control valve, opens the fresh air valve, and closes the defog valve if open; however, bleed air inflow continues. Placing the BLEED AIR INFLOW switch to OFF will stop bleed air inflow and allow the increase of ram air flow into the cockpit.

COCKPIT AND AVIONICS COOLING SYSTEM

Cockpit cooling and avionics cooling is provided by a vapour cycle system, which includes an engine-driven refrigerant compressor, condenser and blower assembly, two air conditioner evaporator and blower assemblies, and a bi-level pressure switch.

The compressor is belt-driven at the front of the engine, just aft of the propeller spinner base plate. Vapour cycle air conditioning system operation is controlled by a toggle switch, placarded AIR COND, ON, OFF, located on the environmental control panel on the forward cockpit right console. When the AIR COND switch is ON, the air conditioning compressor will be engaged. The air conditioning compressor is also powered on when the DEFOG switch is ON.

The evaporator blower assembly in each cockpit is controlled by a rheostat, placarded EVAP BLOWER, on the environmental control panel in each cockpit. The blower assembly produces up to 350-cubic-feet-per-minute flow at the HI setting.

Power for the evaporator blower fan in each cockpit is provided through a circuit breaker, placarded EVAP BLWR, located on the generator bus circuit breaker panel in the front and rear cockpits.

Cooled air is discharged in each cockpit through one eyeball-type outlet mounted on the centre console and through two outlets on each glare shield.

Power for cockpit cooling system is provided through a circuit breaker, placarded AIR COND, located on the generator bus circuit breaker panel in the front cockpit.

Cockpit cooling air is available only when the engine is running, the generator is on line, the generator bus is powered, and either the AIR COND or DEFOG switch is ON.

NOTE

- *The evaporator blowers will be on anytime the AVIONICS MASTER switch is ON.*

- *A bi-level pressure switch will interrupt electrical power to the compressor clutch in the event of abnormally high or low system pressure. This switch is located at the service panel just forward of the right wing and automatically resets when tripped.*

NOTE

- *Air conditioner compressor operation has negligible effect on aircraft engine and field performance. Air conditioning may be on for all take-offs, landings, and ground operations without affecting aircraft/engine performance.*

FRESH AIR VENTILATION

Fresh air ventilation during unpressurized flight can be supplied to the cockpit through the cooling air inlet. Air flows through the cooling air inlet duct through the motor-driven fresh air valve, when opened, to the main inflow duct just forward of the firewall.

The position of the fresh air valve during ground operations and unpressurized flight is controlled by a switch, placarded RAM AIR FLOW, on the environmental control panel in the front cockpit only. Electrical power to the valve is supplied by the hot battery bus.

The valve has three positions: closed, mid open, and full open. This corresponds respectively to the OFF, NORM, and HI positions on the RAM AIR FLOW switch. On the ground, the same blower providing cooling air to the heat exchanger provides air to the motor-driven fresh air valve.

The fresh air valve is automatically closed when approaching 8000 feet pressure altitude as the cockpit begins to pressurize.

INSTRUMENTS

Instruments which are not part of an integrated system are covered in this discussion. The instruments covered are the backup flight instrument and digital clock.

BACKUP FLIGHT INSTRUMENT (BFI)

The backup flight instrument (BFI) is located in the upper right side of the instrument panel in each cockpit and provides attitude, airspeed, vertical, and velocity.

This instrument provides backup indications in the event of failure of the electronic flight instrumentation system or the aircraft electrical system. The backup flight instrument is normally powered by the battery bus. In the event of a battery bus failure, the backup flight instrument is powered by the auxiliary battery, which is activated with the AUX BAT switch on the engine/electrical switch panel in the front cockpit.

Power for the backup flight instrument is provided through a circuit breaker, placarded STBY INST, located on the STANDBY portion of the battery bus circuit breaker panel in the front cockpit.

Power for the backup flight instrument in the rear cockpit is provided through a circuit breaker, placarded AFT STBY, located on the STANDBY portion of the battery bus circuit breaker panel in the front cockpit.

- *Backup instrument lighting operates at a fixed level when the auxiliary battery is powering the system.*

The slip/skid indicator is similar in appearance to the minor graduations of the pitch ladder (both appear as white lines parallel to the horizon). The following characteristics will distinguish the slip/skid indicator from the pitch ladder:

- The pitch ladder display is inhibited in the region where the slip/skid indication is displayed; there is no possibility of the pitch ladder obscuring or even touching the slip/skid indication.

- The slip/skid indicator width is equal to the width of the roll pointer. This width is less than one-half the width of the pitch ladder minor graduations, and less than one-quarter the width of the major graduations.

Magnetic Sensor Unit

The magnetic sensor unit is located in the right wing. The unit is accessed through a panel on the top of the wing. The magnetic sensor unit converts the earth's magnetic lines of flux into an electrical signal, which is provided to the backup instrument.

Front Panel Controls

The pilot interfaces with the indicator using an adjustment knob.

ADJUSTMENT KNOB

The knob can be rotated to the right and left, as well as pushed in. Data to be changed by the adjustment knob increases with a clockwise rotation of the knob and decreases with a counter clockwise rotation of the knob.

A. Barometric Correction:

The adjustment knob is used to change the baro setting at all times except when in the menu mode or when altitude is invalid.

Rotating the knob clockwise increases the barometric setting, while rotating the knob counter clockwise decreases the barometric setting.

The range of the barometric setting is from 22.00 In.Hg to 31.00 In.Hg with increments of 0.01 In.Hg. When standard barometric pressure (29.92 In.Hg) is desired, push in on adjustment knob and a display of STD appears in the barometric display window. The barometric setting value is restored to previous setting after power is cycled.

ATTITUDE FAILURE INDICATIONS

For the attitude failure indication, the pitch ladder, roll pointer, and slip/skid indicator are removed leaving the roll scale and the aircraft symbol visible on a cyan background.

The large characters, ATT FAIL, appear centred above the aircraft symbol.

DIGITAL CLOCK

A digital clock in each cockpit provides Greenwich Mean Time (GMT) in 24-hour format; local time (LT), in 24-hour format; and a resettable elapsed time (ET) counter, operating from 1 second to 99 hours, 59 minutes, and 59 seconds; and count down timer, with a six-digit display showing hours, minutes, and seconds, including a flashing display alarm.

The flight time (FT) function and elapsed time (ET) counter is disabled.

INTEGRATED AVIONICS SYSTEM

Each cockpit provides a full complement of flight instrumentation and engine controls and displays, based around three Multifunction Displays (MFDs), and a Head up Display (HUD).

The HUD is in the front cockpit and provides a flight-path-based attitude display (i.e., attitude, heading, and navigation information). Head Up in Mission (HUM) Circuit Card Assembly (CCA) is responsible for the HUD displays.

Any one of the MFDs in either cockpit can be used as the Primary Flight Display (PFD) to support basic pilot training. The three MFDs are fully configurable to suit specific training requirements.

Instrumentation for primary air data (altimeter, airspeed, and vertical velocity indicator) is also presented on the HUD and MFDs, while engine instrumentation is also available on the MFDs.

A camera system is provided with the HUD to allow HUD symbology to be superimposed over the cockpit view in the rear cockpit. Display of vertical G acceleration, gage, and indexer presentation of angle of attack, are also provided on the HUD. Warning, caution, advisories, and status are placed on the Engine Indication and Crew Alerting System (EICAS) page.

The Navigation (NAV) data Display provides access to the navigation capabilities of the on-board navigation equipment (FMS, IRS, VOR/ILS, and DME).

The stick and throttle grips have Hands On Throttle and Stick (HOTAS) switches for control of simulated weapons delivery and frequently used in-flight functions.

Primary air data information is provided through dual integrated avionics computers (IACs). The dual IACs (IAC 1 and IAC 2) form the core of the integrated avionics system, integrating the various components of the system as well as providing backup capability.

The information from the IACs is presented by three MFDs in each cockpit.

PFD/EICAS/NAV (PEN) CCA is responsible for the symbol generation for the display on the MFDs.

The IACs receive primary data input from the inertial reference system (IRS), air data computer (ADC), global positioning system (GPS), VOR/ILS, distance measuring equipment (DME), traffic alert and collision avoidance system (TCAS), Mode S transponder, radar altimeter system, VHF radio system, UHF radio system, angle of attack (AOA) computer, and engine data manager (EDM).

The IACs also provide REPEAT cockpit control. The MFDs may operate in repeat mode, such that the rear cockpit MFD displays are slaved to the front cockpit and vice versa. The IACs also receive data from these subsystems:

- trim aid device (TAD),
- flight data recorder (FDR), and
- The pitot static system.

The integrated avionics system enters into the initialization state and establishes a default operating condition upon application of power. If a failure is detected, the integrated avionics system component enters the fail state, otherwise it enters the normal state where all functional modes are available.

Integrated avionics system components enter the test state when an initiated built-in test (IBIT) is conducted.

Full IAC 1 failure consists of complete loss of IAC 1. This includes the loss of IAC external power, failure of IAC power supply, and/or complete failure of all PEN/FMS/HUM/GPS cards.

Full IAC failures are indicated as cautions IAC1 FAIL on the EICAS.

When IAC 1 fails, the following events occur (not in order):

- Automatic exit from REPEAT mode
- HUD repeater image does not contain a HUD camera image, only the HUD symbology
- The DVR/DTS stops all the video and audio recording
- The DTS has no capability to load or download data between DTS cartridge and IAC 1
- Both cockpits display video from IAC 2
- FWD Up Front Control Panel (UFCP) displays AFT UFCP presentation
- No communication between PEN, FMS, and HUM data for synchronization

AVIONICS MASTER SWITCH

Figure 1-21 Avionics Master Switch Location

The avionics master switch is placarded AVIONICS MASTER and located on the electrical switch panel in the front cockpit. It powers the left and centre MFDs (both cockpits), IAC 2, UHF radio, ADC, DME, TCAS, RAD ALT, transponder, and the VHF navigation radio.

In conjunction with the avionics systems powered by the battery, placing the avionics master switch in the ON position enables full integrated avionics suite operations. Navigation and primary flight information will be displayed on the left and centre display respectively.

UFCP control of the remaining radio transceivers is enabled and both IACs are keyed to begin synchronized operations. When the avionics master switch is placed in the ON position, it de-energizes electrical relays allowing the forward and aft avionics buses to be powered by the battery and generator buses.

When the AVI MSTR circuit breaker is pulled, placing the avionics master switch in the OFF position will not turn off power to the avionics.

If the battery bus is not powered (BUS TIE switch in NORM position), the generator bus will power the forward and aft AVI generator buses and AVI battery buses regardless of the position of the avionics master switch.

AVIONICS BAYS

Two avionics bays, located behind the rear cockpit on each side of the aft fuselage, house avionics equipment. The bays contain two shelves each, and each bay is accessed through a side-hinged door.

ANTENNAS

Twelve antennas are mounted on and in the aircraft for navigation and communication. The upper TCAS antenna is mounted to the top of the engine cowling.

The upper UHF/transponder antenna is mounted on the upper fuselage aft of the canopy. An antenna selector, located in the left avionics bay, provides automatic switching between the upper UHF antenna and the VHF/UHF communications antenna for optimum UHF transmission and reception.

The GPS antenna is mounted on the top of the vertical stabilizer. Two combination NAV/ILS antennas are mounted one on each side of the vertical stabilizer.

The lower TCAS antenna, ATC transponder antenna, VHF/UHF COMM antenna, DME antenna, and marker beacon antenna are mounted at the bottom of the fuselage. The ELT antenna is mounted inside the dorsal fin.

PITOT STATIC SYSTEM

The aircraft has two independent pitot static systems to provide Mach/airspeed, altitude, and vertical speed indications. The primary pitot system probe near the right wing tip and two static ports on the aft fuselage (upper right-side port and lower left-side port) provide the required pressures to the air data computer.

The secondary pitot probe is located near the left wing tip and the secondary static pressure ports are on the aft fuselage (upper left-side port and lower right-side port).

The pitot probes are protected from icing by electrical heating elements.

Pitot heat for both pitot probes is provided through the probes anti-ice switch, placarded PROBES ANTI-ICE, on the engine/electrical switch panel in the front cockpit.

A green ANTI ICE advisory on the EICAS display illuminates whenever the probes anti-ice switch is used. No heating is provided for the static ports as the ports are protected from icing by airframe location.

Power for pitot anti-ice heat is provided through a circuit breaker, placarded PITOT HT, located on the generator bus circuit breaker panel in the front cockpit.

DATA BUSES

The aircraft is fitted with several data buses for transmission of electronic signals and data between the various integrated systems such as the integrated avionics computer (IAC), engine data manager (EDM), air data computer (ADC), power management unit (PMU), global positioning system (GPS), very high frequency navigation (VHF NAV), audio management unit (AMU), integrated data acquisition recording system (IDARS), and others.

Each data bus provides one channel (PMU, IDARS) or two channels, A and B (all others) for each connected system or unit. The two channels provide system and signal redundancy. If either channel fails, the remaining channel provides all the necessary data to the connected systems.

INERTIAL REFERENCE SYSTEM (IRS)

An inertial reference system (IRS) is installed to provide aircraft attitude (pitch, roll, heading, turn and slip indication, accelerations, velocities), position, and time. The IRS also provides standalone inertial navigation position when standalone GPS navigation is not possible.

The IRS is equipped with a strap-down ring laser gyroscope sensor that measures accelerations and calculates aircraft position. At system start-up, IRS uses GPS information to begin its alignment. If GPS information is not available or unreliable, the aircraft position (latitude and longitude) must be entered manually for the alignment sequence to begin.

The IRS degrade (IRS DEGD) message on the EICAS display indicates that the IRS/GPS hybrid operational mode is degraded, which in turn will cause some HUD symbology to be missing should it remain illuminated. The IRS DEGD message should extinguish approximately 90 seconds after IRS transitions from ALIGN to NAV status.

NOTE

- *Taxi should be delayed until IRS DEGD message is extinguished.*

The IRS DEGD message indicates a precision navigation solution is not available for tactical training modes (A/A, A/G). Basic student mode avionics, except for HUD FPM/CDM and ground track on the TSD, will continue to work normally with IRS DEGD.

Failure of the IRS DEGD message to extinguish may require the IRS to be reset.

AIR DATA COMPUTER (ADC)

The ADC receives pitot/static air inputs and calculates airspeed, altitude, and climb rate parameters for use by the primary flight display and navigation multifunction display.

The ADC includes a configuration module which contains VMO/MMO data. The ADC is automatically powered up when the avionics master switch is set to ON.

Power for the air data computer is provided through a circuit breaker, placarded ADC, located on the generator bus circuit breaker panel in the front cockpit.

The ADC provides air data outputs to the following instruments/ systems:

- IAC 1 and IAC 2
- ATC transponder
- Integrated data acquisition recording system (IDARS)
- Inertial Reference System (IRS)
- Trim aid device (TAD)
- Traffic collision advisory system (TCAS)
- Power management unit (PMU)

The ADC transmits air data outputs over multiple data buses, using ADC A or ADC B channels. If an output is bad, or if either data bus channel fails, an amber ADC A or ADC B FAIL status illuminates on the EICAS display.

If the ADC fails, a warning on the EICAS display displays ADC FAIL in red text.

TOTAL AIR TEMPERATURE

A heated total air temperature (TAT) probe is mounted on the underside of the left wing inboard of the pitot tube. The TAT probe provides air temperature input to the ADC that in turn provides airspeed, altitude, and vertical speed information used by the integrated avionics system and displayed on the multifunction displays.

The TAT probe is heated when PROBES ANTI-ICE switch is in the ON position.

Power for TAT heat is provided by a circuit breaker placarded TAT HT on the front cockpit generator bus circuit breaker panel.

NOTE

- *Avoid sustained ground operations with the PROBES ANTI-ICE switch ON.*

- *Sustained ground operation with the PROBE ANTIICE switch ON may result in a true airspeed (TAS) failure indication on the MFDs due to a TAT probe overheat condition that prevents reliable TAT information to the ADC.*

ENGINE DATA MANAGER (EDM)

The engine data manager (EDM) monitors engine operating parameters and illuminates the appropriate EICAS display when necessary. Non-engine-related functions performed by the EDM include fuel balancing, fuel quantity indication, and determination and display of DC volts, DC amps, hydraulic pressure, cockpit pressure altitude, and cockpit differential pressure.

The EDM transmits engine data outputs using EDM A and EDM B channels. If one output is bad, or if either data bus channel fails, a status message on the EICAS displays EDM A or EDM B INOP in white text, respectively, when on the ground (weight on wheels).

If the EDM fails, a red EDM FAIL warning illuminates on the EICAS display. Redundant power is provided through circuit breakers, placarded EDM, located on the battery bus and generator bus circuit breaker panels in the front cockpit.

ANGLE OF ATTACK SYSTEM

The flap compensated angle of attack (AOA) system includes an AOA vane (near left wing tip), an AOA computer, an AOA display on the PFD, and two AOA indexers (one in each cockpit).

The AOA system provides angle of attack information on the PFD and, when the gear is extended, on the indexers. AOA information is valid for all combinations of weight, configuration, and steady state bank angles.

Anti-ice protection is provided for the AOA system by a heated element in the vane. AOA heat is controlled through the probes anti-ice switch, placarded PROBES ANTI-ICE, located on the electrical switch panel in the front cockpit.

Power for the AOA system is provided by a circuit breaker, placarded AOA, located on the battery bus circuit breaker panel in the front cockpit. Power for the AOA vane anti-ice heat is provided through a circuit breaker, placarded AOA HT, located on the generator bus circuit breaker panel in the front cockpit.

When optimum angle of attack (green band on display, amber donut on indexer) is cross checked and verified with airspeed, angle of attack can be used to fly the aircraft on optimum no-wind airspeed in the landing pattern.

AOA Vane

The AOA vane is positioned on a short post on the left wing leading edge. The wedge-shaped vane aligns with the relative airflow and drives a potentiometer through a belt and pulley system to provide an electronic signal to the AOA computer.

Information from the vane is processed by the AOA computer and transmitted to the IACs and then displayed on the PFD and HUD.

AOA Computer

The AOA computer, located on the avionics shelf under the front glare shield, provides angle of attack information and stall warning at various flap and landing gear configurations.

During all flight conditions, the AOA computer generates an AOA signal for display on the PFD and HUD.

When the landing gear is down, the AOA computer also activates the AOA indexers installed in each cockpit. The AOA computer receives a discrete flap position signal from the flap position micro switch, and adjusts AOA information accordingly.

As aircraft angle of attack approaches the angle for stall (approximately 18 units), the AOA computer activates the stick shaker, providing stall warning (approximately 15-16 units).

INTERCOMMUNICATIONS SYSTEM (ICS)

The intercommunications system (ICS) allows each pilot to monitor incoming navigation and communications radio audio while also communicating between cockpits and ground crew. Two ICS cords are installed to provide redundancy.

Audio Control Panels

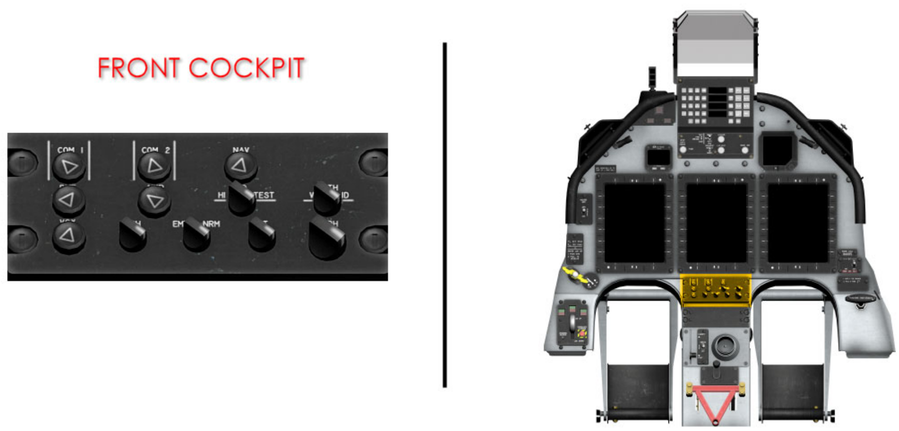


Figure 1-22 Audio Control Panel Location

Audio control panels are located on the centre corner of each instrument panel. The audio control panels provide each pilot the ability to select the desired audio for monitoring, volume control for each system selected, voice/range filtering, and alternate audio selection for abnormal operation.

To select any audio source except ICS, push the respective control to extend it from the retracted (off) position. ICS is always active. Rotate the control clockwise to increase volume, or counter clockwise to decrease volume.

Both front and rear audio control panels include controls for UHF communications placarded COM1 and VHF communications placarded COM2; VHF navigation, placarded NAV; marker beacon, placarded MRK; distance measuring equipment, placarded DME; and interphone threshold adjustment control, placarded VOX.

Each audio control panel also includes a toggle switch, placarded V, ID, and BOTH, to select the voice only (V), recognition or morse code only (ID), or both voice and recognition channels for the VHF NAV radio; and a toggle switch, placarded EMR and NRM, to select raw audio if the amplifier becomes inoperative.

Selecting alternate (EMR) bypasses the amplifier and provides raw audio (no volume control) for communications and side tone, as well as aural warnings.

Interphone communications has two knobs controlling the interphone system. The VOX knob activates the automatic voice activation of the microphone for transmission without keying the interphone key on the power control lever (PCL).

This allows the pilots to set the level where their voices will activate the interphone system. This helps avoid the interphone system from being activated by external noises (wind noise, engine noise, etc.). When released, turning the VOX knob clockwise increase the volume of voice/noise required to automatically active the interphone system.

Conversely, turning the VOX knob counter clockwise decreases the automatic setting. The INPH knob controls the relative volume of the interphone system independent of the other volume settings. Rotating the INPH knob clockwise increases the relative interphone volume and turning the INPH knob counter clockwise decreases the relative interphone volume.

Overall headset volume is controlled by a knob placarded HDPH. Rotating the knob clockwise will increase the volume and counter clockwise will decrease the volume.

The front audio control panel includes a marker beacon test switch, placarded MKR, with HI, LO, and TEST positions to test marker beacon function or select sensitivity level for normal operation. Power for the front cockpit audio amplifier is provided through a circuit breaker, placarded AUDIO, located on the generator bus circuit breaker panel in the rear cockpit.

Power for the rear cockpit audio amplifier and ground crew is provided through a circuit breaker, placarded AUDIO, located on the generator bus circuit breaker panel in the rear cockpit.

Audio Management Unit

An audio management unit is located on the top rail in the right avionics bay. This audio management unit provides audio amplification and control of all communication. An intercommunications (ground crew) amplifier is located under the top rails in the left avionics bay. This amplifier is used for ground crew communications to the cockpits through the ground crew headset jack.

Ground Crew Headset Jack

A ground crew headset jack is provided on the left side of the aft fuselage behind a flip cover. The jack provides an external interphone connection for ground crew use.

The interphone amplifier for ground crew communications is powered when the battery switch in either cockpit is activated. Volume control is provided through the headset control.

COMMUNICATIONS

The communications system includes a COM1 (UHF) transceiver and a COM2 (VHF) transceiver which provide voice communication for air-to-air or air-to-ground communication.

Control of communications transmit capability is provided by the COM1/COM2 key toggle switch on the inboard face of either PCL (Figure 1-13). To transmit on COM1, press the toggle up; to transmit on COM2, press the toggle down.

Any time either cockpit is transmitting on VHF or UHF, the cockpit not transmitting can receive incoming transmissions on the radio not in use (e.g., front cockpit transmitting on UHF, rear cockpit can receive incoming transmission on VHF).

COM1 - Ultra High Frequency (UHF)

The COM1 transceiver provides two-way air-to-air or air-to-ground voice communications over a frequency range of 225.00 to 399.975 MHz in 25 kHz increments (7000 channels).

The audio output has automatic squelch (internally adjustable carrier to noise) with manual disable and squelch override. When COM1 UHF mode is set to BOTH (via the UFCP or the FMS FREQ controls), the UHF continuously monitors both the primary frequency selected and the GUARD frequency (243.00 MHz). Communication frequencies and tuning functions are entered using the UFCP or MFD in the respective cockpit. If the preset database is loaded, up to 99 preset frequencies can be selected from the IACs for retrieval by the UFCP.

The active COM1 frequency is displayed in W1 of the UFCP persistent display.

Power is provided by the generator bus through a circuit breaker, placarded COM1, located on the generator bus circuit breaker panel in the front cockpit.

COM2 - Very High Frequency (VHF)

The COM2 transceiver provides two-way air-to-air or air-to-ground voice communications over a frequency range of 118.00 to 151.95 MHz in 8.33 kHz increments (1358 channels).

The audio output has automatic squelch (internally adjustable carrier to noise) with manual disable and squelch override. Communication frequencies and tuning functions are entered using the UFCP, MFD, or by the VHF standby control head located in the front cockpit. If the preset database is loaded, up to 99 preset frequencies can be selected from the IACs for retrieval by the UFCP.

The active COM2 frequency is displayed in W2 of the UFCP persistent display.

Power is provided through a circuit breaker, placarded COM2, located on the generator bus circuit breaker panel in the front cockpit and by the auxiliary battery with emergency tuning through the backup VHF control head.

TRANSPONDER

The aircraft is fitted with an altitude-reporting Mode S transponder that replies to ground station and airborne interrogations.

Control of the transponder is provided through the UFCP.

The transponder provides three modes of operation: backup, active, and altitude reporting. When in standby (SBY displayed in W4 of the UFCP persistent display), the transponder code may be selected, but the transponder will not respond to ground or airborne interrogations.

When set to active (blank display next to transponder code on W4 of the persistent UFCP display), the transponder code may be selected and the transponder transmits the selected code when interrogated, but will not provide altitude reporting information. When set to altitude reporting (ALT and transponder code displayed in the W4 on the UFCP), the transponder code may be selected and responds to interrogations with the selected code and altitude information received from the air data computer.

The transponder system provides modes A, C, and S for operation in the air traffic control radar beacon system (ATCRBS). The transponder accepts altitude (air data) information from the air data computer via the data bus for altitude encoding. When queried by a radar system (ATC or airborne collision warning), the transponder sends a reply which includes the transponder code and aircraft pressure altitude.

Power is provided through a circuit breaker, placarded XPDR, located on the generator bus circuit breaker panel in the front cockpit.

VERY HIGH FREQUENCY (VHF) NAVIGATION (NAV) SYSTEM

The very high frequency (VHF) navigation (NAV) system provides VHF Omni-directional range (VOR), Omni-directional navigation and instrument landing system (ILS) capability, including localizer (LOC) and glideslope (GLS) reception.

The NAV receiver provides 200 VOR/LOC channels from 108.00 to 117.95 MHz; 40 glideslope channels from 329.15 to 335.00 MHz, which are automatically paired with localizer channels; and a marker beacon receiver tuned to 75.00 MHz

Display for the VOR or ILS frequency is provided on the Up Front Control Panel (UFCP), Primary Flight Display (PFD), and Navigation Display (NAV).

Power for the VHF NAV receiver is provided through a circuit breaker, placarded VHF NAV, located on the generator bus circuit breaker panel in the front cockpit.

The active frequency is displayed on W3 of the UFCP persistent display, as well as on the PFD and NAV pages when selected as NAV source DISTANCE MEASURING EQUIPMENT (DME) The distance measuring equipment (DME) system provides ground station distance measuring capability based on the VOR frequency selected. DME mode selection is provided by controls on the UFCP.

The DME provides distance to the station. Display for the DME is provided on the UFCP, PFD, and NAV display. Power for the DME system is provided through a circuit breaker, placarded DME, located on the generator bus circuit breaker panel in the front cockpit.

MULTIFUNCTION DISPLAY (MFD)

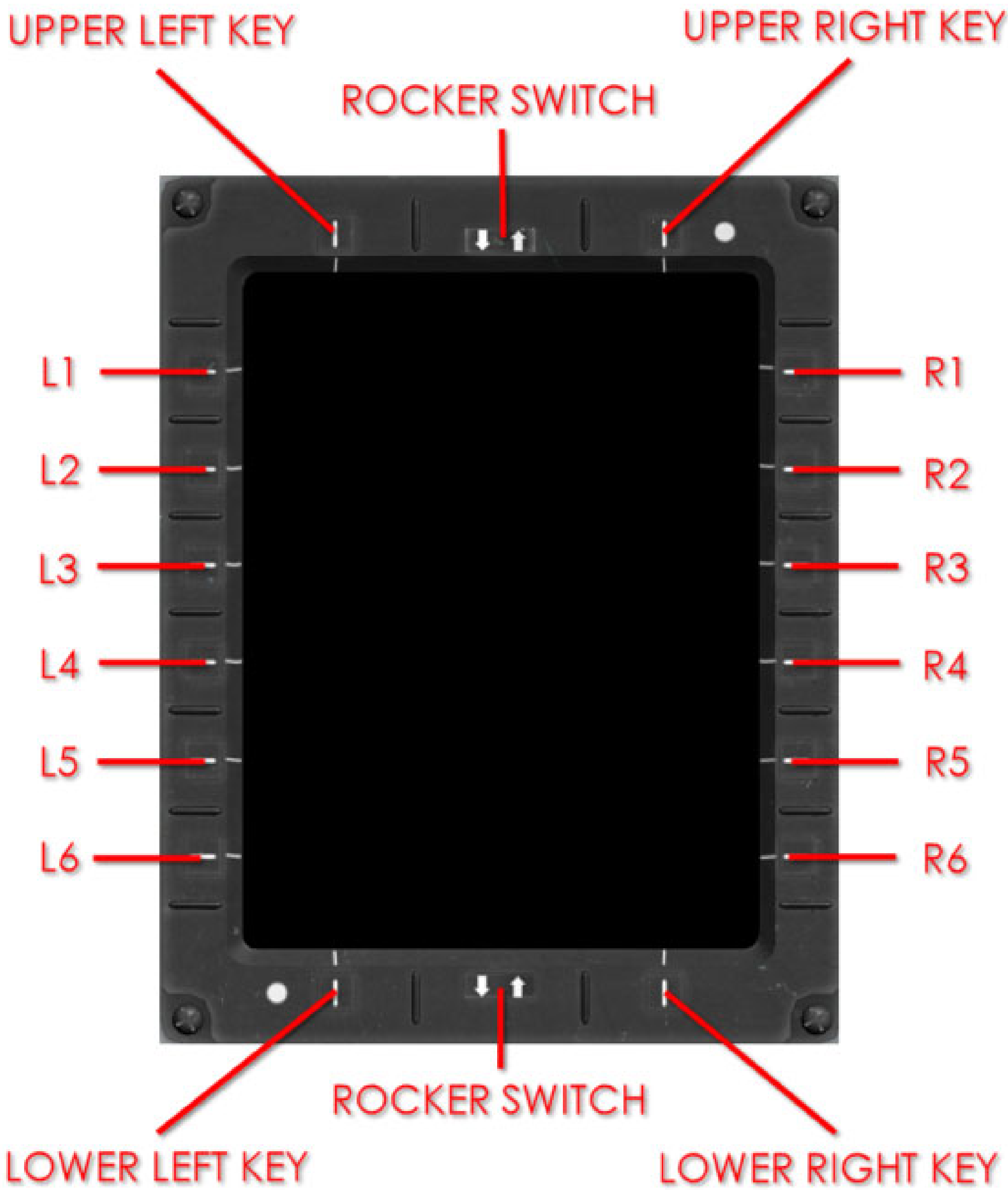


Figure 1-23 Multi-Function Display Line Select Keys (LSK)

Each cockpit features three MFDs that allow for control and display of navigation, communication, flight, aircraft systems, mission, and miscellaneous information.

The basic MFD formats are configured as the PFD, NAV, and EICAS.

The MFDs in both cockpits operate independently from each other, permitting the aircrew to select a wide variety of page layouts to suit particular mission phases and activities.

The MFDs may also operate in repeat mode, such that the rear cockpit MFD displays are slaved to the front cockpit and vice versa.

Each MFD is capable of displaying failure indications as commanded by the IACs. These failures can be attributed to invalid or failed data parameters, or detected failures from other aircraft systems. A failure annunciation is displayed based on the type of symbology depicted: CAS messages appear on the CAS window of the EICAS format and represent the outcome of system-specific fail detection logic.

Digital readouts are replaced by amber asterisks when the corresponding input parameter is invalid. If the digital readout is associated with a pointer on a scale, the pointer symbol is removed.

Digital readouts, and associated pointers and scales, are replaced by a red X when the corresponding input parameter is failed.

Failure indications which may appear on any of the MFDs include:

- No display
- Failed data symbol or indicator is removed from the display and replaced with a similar size red X
- MFD is replaced with a red X across the display
- Inverse video (white TCAS on red field)

If any of the above indications are observed or any other unusual indication is encountered when operating the aircraft, maintenance personnel should be notified.

Start-up and Initialization

The system can operate in one of two modes; basic and advanced. A maintenance action is required in order to switch between the two modes.

NOTE

- *Advanced Mode is not currently simulated in this product.*

In the basic student level default display, the left, centre, and right MFDs will be NAV, PFD, and EICAS respectively. In the basic mode with no MFD failures, the selection of other MFD pages is limited, since the basic mode includes logic which requires a PFD and EICAS to be displayed at all times.

At start-up, the advanced mode allows the pilot to access all the integrated avionics system available master modes and enables the selection of other MFD pages other than PFD and EICAS on the centre and right MFDs.

The default positioning of the three MFDs may be adjusted through the MFD menu page.

This rule applies to both FWD and AFT stations. In the advanced mode, the crew is responsible for MFD screen management to ensure that MFD screens for safe operation of the aircraft are displayed.

However, the EICAS is automatically displayed on the right display during advanced level operations upon initiation of a caution or warning.

Symbology

Each MFD has 16 line select keys (LSK) and 2 rocker switches.

The side LSKs, on the left and right sides of the MFD, numbered from 1 to 6, access a variety of display pages and control functions associated with each MFD page.

The top LSKs are reserved for screen navigation between the currently displayed page and a readily available page. The captions adjacent to these LSKs vary depending on the page displayed.

The bottom LSKs access a variety of control options associated with each MFD page and also provides screen navigation between peer pages.

The upper and lower rocker switches are used to dim/brighten the displays.

Inward facing green chevrons (>, <) associated with LSKs indicate that the currently active page will be modified when activated and provides the pilot the capability to select through several options.

Outward facing green chevrons (<, >) associated with an LSK indicate that a new MFD page (or UFCP page depending on the functionality of the related selection) is displayed when activated (or that a data entry control is available).

The cyan triangles (□, □) associated with an LSK indicate that an associated FMS page will be displayed when activated.

The green dot (□) associated with an LSK is a momentary press/hold/release with a specific control function.

When the page or function associated with the chevron is restricted or unavailable, in line with normal operations, the chevron is removed. When the page or function associated with the chevron has no access due to a failure, the chevron is replaced by a large red X.

Traffic Advisory Alert MFD Behaviour

When a traffic advisory (TA) is reported by the TCAS system, and if the NAV page is not currently being displayed in the cockpit, the integrated avionics system automatically displays the NAV page on an MFD.

Colour Philosophy

To facilitate the reading of information in the integrated avionics system, a colour code has been defined. This colour code applies to all displays and readouts on the MFDs in both FWD and AFT cockpits.

The colour code aims to alert the pilots of conditions requiring either attention or immediate action. It helps the pilots in their operations, as the colour code makes obvious what input or selection is possible or not, and highlights specific information in abnormal conditions.

WARNING ALERTS

Red is associated with the indication of hazardous conditions that require immediate pilot attention and may require immediate pilot action such as: error, failure, malfunction, or danger. Red is also relevant to out-of-range conditions.

CAUTION ALERTS

Amber is used to indicate marginal conditions or to alert of situations where timely pilot intervention or action is required. These situations include failures, out-of-range data, indications trend, invalid data, and traffic alerts.

SELECTION, DATA ENTRY, DEFAULT SETTING, AND PAGE CHANGE

Green colour is used to identify the symbols enabling the selection, data entry, page change capabilities, and setting default data.

Cyan colour is used to identify the FMS-generated pages and the selection capability of the FMS-generated pages.

COLOR-CODING OF MFD INDICATORS

For the integrated avionics system, the color-coding uses Orange, Amber, Cyan, Green, Magenta, and White.

- Orange is used to identify the Ground Track Pointer on the compass rose.
- Orange is used to identify advisory navigation information (DME Hold active) and when flying over a middle marker beacon.

- Cyan is used to identify flying over an outer marker beacon, bearing pointer #2, and associated navigation source information.

- Green is used to identify bearing pointer #1 and associated navigation source information, and condition messages when FMS is the active navigation source (OFS, NPA, and EXEC).

- Magenta is used to identify the reference values and carets that can be selected by the pilot on the various indicators: airspeed indicator, barometric altitude, and compass heading; plus identifying the current navigation information having the FMS as active source (current flight plan leg and waypoint, lateral deviation indicator [diamond symbol], course deviation indicator - scale and messages [ENR, TRM, APP, OFS], and navigation source information).

- White is used to identify flying over an inner marker beacon. White is also used to portray course deviation indications when non-FMS course source is used, navigation source information when non-FMS course source is in use, and inactive flight plan legs and waypoints.

NORMAL OPERATION

White is a default colour. Every other indication or parameter that does not pertain to the colour code described in the previous paragraph is displayed in white.

White and green are used to indicate the normal operational range (e.g., engine indicator dials) and to identify the status and condition messages on the EICAS display.

Reversion Mode

The integrated avionics system operates in reversion mode upon detection of an IAC or PEN failure. When operating in reversion mode, the indications of integrated avionics system failures are shown on the EICAS screen and STS/BIT status screen.

When operating in the basic reversion mode, the IAC forces PFD and EICAS screens to always be displayed. This rule applies to both the FWD and AFT stations. The integrated avionics system provides the following level of automatic MFD screen reversion upon detection of the following MFD failures:

1. If a single MFD fails, the integrated avionics system ensures that the PFD and EICAS screens are always presented. In this scenario, the following rules apply:

    a. PFD screen reversion defaults from centre, then left, then right. The reversion of the PFD screen to another MFD will not cause the EICAS display to move.

    b. EICAS screen reversion defaults from right, then left, then centre. The reversion of the EICAS screen to another MFD will not cause the PFD display to move.

    c. No screen change required if failed MFD does not contain PFD or EICAS.

d. Loss of top screen navigation capability (due to PFD/EICAS rule). This prevents the crew from changing the screen displayed on the MFD.

2. If two MFDs have failed in the same cockpit, the remaining MFD reverts to the PFD screen when the aircraft is in the air and to EICAS screen when the aircraft is on the ground. The pilot can then change this screen to any other screen.

The MFD automatically changes to the EICAS screen upon detection of a Master Caution (MC) or Master Warning (MW) condition while retaining a follow-on ability to access any other available screen.

In advanced mode, the IAC provides the following MFD screen reversion upon detection of MFD failures:

3. No automatic screen changes occur after an MFD failure.

4. Upon detection of a new master warning or master caution indication, one MFD switches to EICAS display. The crew can then switch a display to any other screen presentation.

5. If two MFDs have failed in the same station, the rules for dual MFD failure described in the basic level configuration apply.

MFD Menu

MFD Menu pages 1 and 2 are top-level pages that provide access to all other system level pages.

The navigation between MFD Menu page 1 and 2 is accomplished by pressing the lower right key labelled NEXT on page 1 or the lower right key labelled PREV on page 2.

Each Menu Item can be selected by pressing the associated side LSK if a chevron facing outwards is present between the LSK and the menu item. The green chevron signifies the possibility of selection for non-FMS generated pages while the cyan triangle signifies the possibility of selection for FMS generated pages.

ENGINE INDICATION AND CREW ALERTING SYSTEM (EICAS)

The EICAS displays engine and auxiliary instrument information. Each cockpit features an EICAS engine data display.

The EICAS displays torque, oil pressure, oil temperature, hydraulic pressure, fuel quantity, bingo fuel, fuel flow, indicated outside air temperature (IOAT), current amperage draw, bus voltage, cockpit altitude, cockpit differential pressure, gas generator speed (N1), interstage turbine temperature (ITT), and the warning, caution, status conditions.

All of the above signals are processed by the EDM, then sent to the IAC, and then displayed in each cockpit.

The digital counter on the indicator gauges displays as white text on a black background under normal operating conditions.

If under caution limits, the digital counter displays as black text on an amber background, and if under warning operation the digital counter displays as white text on a red background.

Selecting Bingo Fuel (L3) allows the operator to enter a value, via the UFCP, that is displayed on the EICAS page.

Entered BINGO fuel amount is displayed between 0-1200 pounds. If the operator holds down the LSK for 1 second or more, the default value of 400 pounds is displayed on the EICAS page. Bingo fuel also defaults to 400 pounds on initial power up.

Crew Alert System (CAS)	
Red (Warning) Message	Cause/Explanation
BATT BUS	Battery Bus inoperative
GEN BUS	Generator Bus inoperative
PMU FAIL	Power Management Unit failure
GEN	Generator inoperative
CKPT PX	Cockpit over pressurization; pressure exceeds 3.9 to 4.0 psi
CANOPY	Canopy unlocked/unsafe
FUEL PX	Fuel pressure below 10 psi
OIL PX	Oil pressure below 40 psi above idle, below 15 psi at idle, or oil pressure between 15-40 psi at idle for 5 seconds or more
OBOGS FAIL	OBOGS system failure
CHIP	Engine chip detector indicates oil contamination.
ADC FAIL	Air data computer failed.
EDM FAIL	Engine data manager failed.
CHK ENG	Engine parameters have exceeded operating limitations.
Amber (Caution) Message	Cause/Explanation
CKPT ALT	Cockpit pressure altitude above 19,000 feet
DUCT TEMP	Environmental duct or defog duct above 300 °F
HYD FL LO	Hydraulic reservoir fluid level below 55 cubic inches (1qt)
BUS TIE	BUS TIE switch open, or bus tie inoperative
FUEL BAL	Fuel imbalance exceeds 30 pounds, or fuel probe or EDM fail
EHYD PX LO	Emergency hydraulic pressure at or below 2400 psi
OBOGS TEMP	OBOGS temperature above 200 °F
TAD FAIL	Rudder trim aid device failure
L FUEL LO	Left wing tank below 110 pounds usable fuel
Crew Alert System (CAS) (continued)	
R FUEL LO	Right wing tank below 110 pounds usable fuel

PMU STATUS	PMU has detected and accommodated a fault in-flight or WOW switch failure
OIL PX	Oil pressure between 15-40 psi at idle or if oil pressure drops below 40 and 90 psi, above idle power for 10 seconds or more
FP FAIL	Fuel probe failure
IAC1 FAIL	Integrated avionics computer 1 has failed
IAC2 FAIL	Integrated avionics computer 2 has failed
IAC1 OVHT	Integrated avionics computer 1 over heat
IAC2 OVHT	Integrated avionics computer 2 over heat
IRS FAIL	Inertial reference system (IRS) has failed
L PHT INOP	Left pitot heater is not energized
R PHT INOP	Right pitot heater is not energized
UFCP 1 FAIL	Up front control panel(UFCP) in front cockpit has failed
UFCP 2 FAIL	Up front control panel(UFCP) in rear cockpit has failed
IAC1 CONFIG	Integrated avionics computers 1 and 2 have mismatched configuration
IAC2 CONFIG	Integrated avionics computers 1 and 2 have mismatched configuration
CHK ENG	Engine parameters are outside normal operating ranges
XPDR FAIL	Transponder failure or loss of communication
Green (Advisory) Message	Cause/Explanation
IGN SEL	Ignition on
M FUEL BAL	FUEL BAL switch in MANUAL position
ST READY	PCL positioned for auto start
BOOST PUMP	BOOST PUMP selected by switch, starter relay, or low pressure switch
ANTI ICE	PROBES ANTI-ICE switch on
TAD OFF	Rudder trim aid device selected off
Crew Alert System (CAS) (continued)	
TRIM OFF	TRIM DISCONNECT switch activated

SPDBRK OUT	Speed brake is extended or extending
White (Advisory) Message	Cause/Explanation
ADC A INOP	Internal failure of channel A of the ADC
ADC B INOP	Internal failure of channel B of the ADC
EDM A INOP	Internal failure of channel A of the EDM
EDM B INOP	Internal failure of channel B of the EDM
RPT AFT	Front cockpit multifunction displays (MFD) are repeating IAC2 or aft cockpit MFD information
RPT FWD	Aft cockpit multifunction displays (MFD) are repeating IAC1 or front cockpit MFD information
SMOKE	Condition indication for the smoke system when engaged.
NWS ON	Nose wheel steering is engaged/on
LAMP TEST	Condition indication for the lamp test switch in test position
IRS DEGD	GPS hybrid operational mode is in initialization, acquisition or altitude/clock aiding mode

CREW ALERTING SYSTEM (CAS)

The CAS displays caution, advisory, and status alert messages as shown in the previous table. An aural tone generator directs pilot attention to the alert. The EICAS displays red warning, amber caution, green systems status, and white status illuminations.

The previous table summarizes the warning, caution, and status indications. When additional CAS are available for viewing, MORE (L5) displays on the EICAS page.

Pressing MORE (L5) displays the overflow messages. The subsequent EICAS page displays the RETURN (L5) page indicator to return to the first EICAS page.

The EICAS interconnects with the master caution and warning switch lights on the respective glare shield. The master caution/warning system on each glare shield includes an amber master caution switch light, a red master warning switch light, and a red fire warning annunciator.

MASTER WARN AND MASTER CAUTION SWITCHLIGHTS AND FIRE WARNING ANNUNCIATOR

Resettable, color-coded, master warning and master caution switch lights and a fire warning annunciator are located to the left of and adjacent to the UFCP in each cockpit. The red warning switch lights illuminate MASTER WARN, the amber caution switch lights illuminate MASTER CAUTION, and the red fire warning annunciators illuminate FIRE.

When a warning or caution message on the EICAS display in either cockpit illuminates, the respective MASTER WARN or MASTER CAUTION switch lights will flash in each cockpit.

Pressing the flashing MASTER CAUTION or MASTER WARN switch light in either cockpit will extinguish the lamp and rearm the switch light for subsequent or additional system failures or malfunctions.

Additionally, if the underlying cause of the message on the EICAS display has been alleviated, pressing the MASTER WARN or MASTER CAUTION switch light will also extinguish the message. If the underlying condition persists, the corresponding EICAS message will remain illuminated until the malfunction or failure is alleviated.

Any time the red FIRE annunciator illuminates, the MASTER WARN switch light and master warn tone are triggered. The FIRE annunciator will remain illuminated until the underlying cause of the annunciator (i.e., fire or bleed air leak) has been alleviated.

AURAL WARNING TONE GENERATOR

An electronic tone generator located in the audio management unit (AMU) provides various distinguishable tones for pilot warnings. Tones generated by the AMU are routed to the helmet audio connections, but tone audio volume is fixed and independent of ICS volume.

Tones are activated using the same logic as the individual alert messages. Power for the AMU is provided through a circuit breaker, placarded AUDIO, located on the battery bus circuit breaker panel in the front cockpit and aft generator bus circuit breaker panel.

The following table provides the tone descriptions and the purpose of each tone.

Purpose	Tone Description
Landing Gear Position Warning	250 Hz tone, 5 times per second
Overspeed Warning (VMO/MMO Exceeded)	1600 Hz tone, 5 times per second
Master Warn, Master Caution, Fire	Decaying tone
Over G Warning	Swept frequency tone
Altitude Warning	Voice “Altitude, Altitude”
Bingo Fuel	Voice “Bingo, Bingo”

UP FRONT CONTROL PANEL (UFCP)

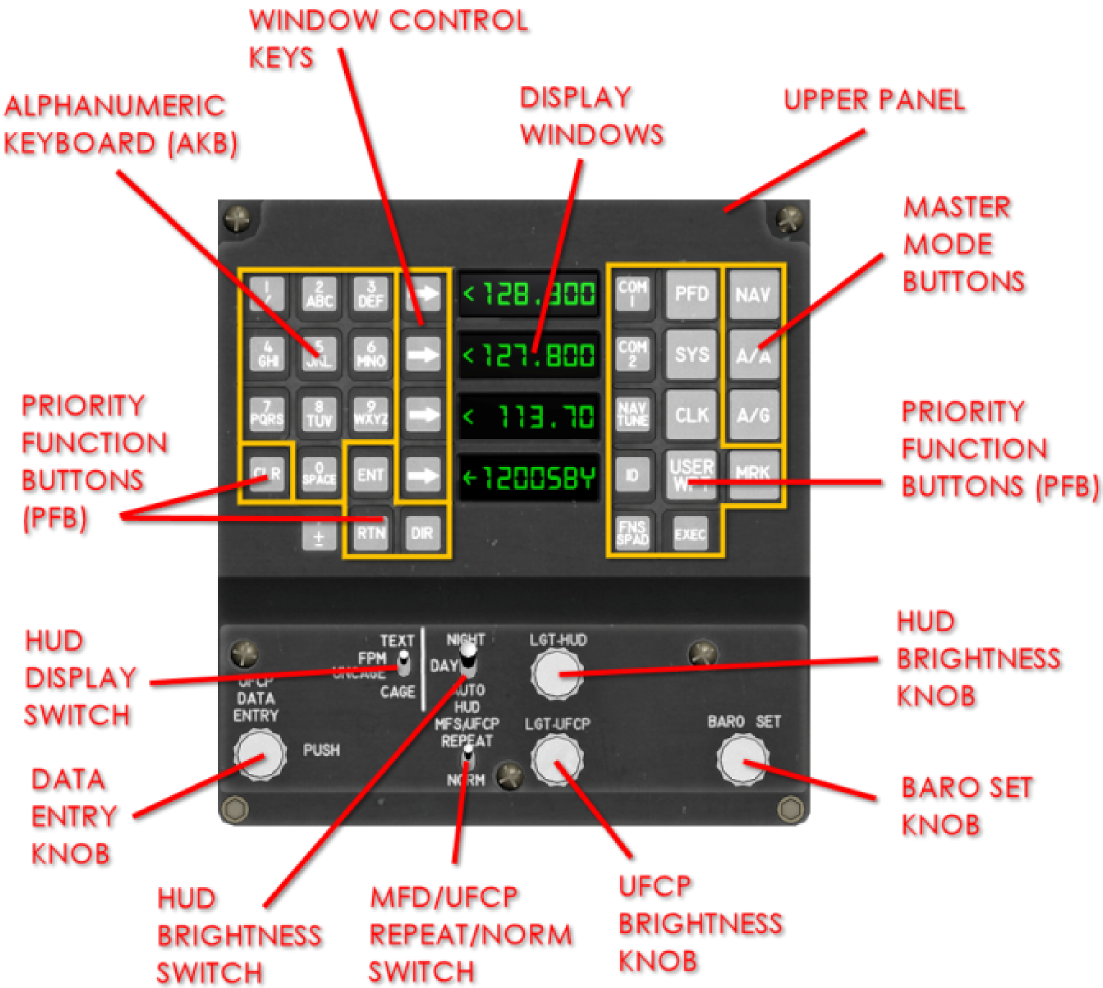


Figure 1-24 Up Front Control Panel (UFCP) (Upper and Lower)

The UFCP provides the primary means for data entry for a wide assortment of data input and data selection required during flight.

The UFCP pilot interface consists of an upper and a lower panel. The UFCP provides four eight-character display windows (window 1 being the uppermost while window 4 is the lowest), an alphanumeric keyboard, option select buttons, master mode buttons, and priority function buttons (PFB) to provide the controls and displays necessary for pilot access to required parameters for data entry.

Alphanumeric Keyboard (AKB)

The AKB is composed of numerals and characters and is situated on the left side of the UFCP upper panel. The AKB is used to enter data in the various modes.

WINDOW CONTROL KEYS

The window control keys are situated on the left side of the display windows and are used to control the display windows. Each window control key is associated with one of the four display windows.

Priority Function Button (PFB)

The PFBs are used to control the mission system and their functions. Pressing a PFB activates the corresponding menu items in the display windows and provides access to the required parameters for data entry.

PFB	Function
COM1 / COM2	Control and display for the UHF or VHF communication radios
NAV TUNE	Enables editing of navigation frequencies
ID	Command button for ATC transponder identification purposes. The ID page displays for 5 seconds to confirm ID function
FMS SPAD	Allows access to scratchpad
PFD	Enables editing of the altimeter, altitude bug, radar altimeter, and the airspeed bug setting
SYS	Provides access to parameters alt, speed, heading (magnetic, true, display, modes, and bingo fuel)
USER WPT	Enables editing of user defined waypoint
CLK	The clock (CLK) function displays GMT and timer control
EXEC	Executes the change in the FMS flight plan
MRK	Generation of MARK ON TOP waypoint
CLR	Clears the MSG alert message displayed on MFD, the data entered in the UFCP display windows and FMS messages and scratchpad
ENT	Used for data entering
RTN	Provides an “undo” function. Pressing RTN makes the windows return to the persistent page.
DIR	Generates steering directly to a selected waypoint

UFCP Upper panel

The UFCP provides selection of Navigation, Air-to-Air, and Air-to-Ground Master Modes. The UFCP also provides radio communication and radio navigation aid management, weapon selection and programming, waypoint management, control of display lighting, selection of display options, setting of display reference parameters, designation of mark points, and clock functions. In the event of a UFCP failure, all data entry capabilities are disabled from the failed unit.

UFCP failures are indicated on the EICAS display with the captions UFCP1 FAIL or UFCP2 FAIL.

UFCP Upper Panel Conventions

Information presented on the UFCP can take one of four forms: navigation, data display, data selection, or data entry.

Any of the selection window display positions, W1, W2, W3, or W4 can take any one of these four forms.

NAVIGATION WINDOW

Navigation windows are used to allow the pilot to navigate to lower level UFCP pages, and are indicated by the contents of the window being right justified.

Pressing the associated key of a navigation window causes the UFCP display windows to show the content for the corresponding lower level page.

DATA DISPLAY WINDOW

Data display windows are used to display data that is not editable by the pilot, and are indicated by the contents of the window being left justified. Pressing the associated key of a data display window has no effect.

SELECTION WINDOW

Selection windows are used to allow the pilot to make a selection from a list of two or more options. They are identified by an inward (>). Each press of the associated key toggles to the next available option (rotating through the options in a circular fashion). The selected option is shown in the window, with the label (if any) starting in the second character position of the window, and the rotating option right justified.

DATA ENTRY WINDOW

Data entry windows are used to allow the pilot to enter data, and are activated by pressing their associated keys. They are identified by a < (non-active edit), ☐ (active edit), or ▪ (edit or press and hold for set value) displayed in the first character position of the window indicating that the data in the window can be modified using the alphanumeric keyboard.

The current data is shown in the window, with the label (if any) starting in the second character position of the window, and the editable data right justified. Leading zeros in the editable data are not displayed unless specified for a particular data item.

Modifying data is accomplished by keying the data on the alphanumeric keyboard (AKB) followed by pressing the ENT key.

For entering communication radio or radio navigation aid frequencies, the values are directly entered on the alphanumeric keyboard. Decimal placement is required for frequencies, trailing zeros are not required with UHF/COM1 and trailing 5s are not required for xxx.x25 or xxx.x75.

Trailing 5s are required for VHF/COM2.

Modifying data using the alphanumeric keyboard is initiated in an active data entry window by pressing an alphanumeric keyboard key, which enters the selected character into the rightmost position, causes underscores to be placed in all other positions available for data entry, and causes the window display to flash.

Once the alphanumeric entry has been initiated, numbers can be entered using the alphanumeric keyboard, and letters can be entered by pressing the associated number key and then rotating the Data Entry Knob until the desired character appears in the window. To select the character, momentarily press the Data Entry Knob. Characters entered from the keyboard appear in the rightmost position in the window, and shift to the left as more characters are entered, replacing the underscores as they shift.

Pressing the CLR key causes the most recently entered character to be removed (shifting the remaining characters, if any, back to the right), and holding the CLR key for 1 second causes all of the entered characters to be removed.

Once the desired data has been entered, press the ENT button for the entered data to be checked for validity based on conditions that depend on the data item being entered. If the data is determined to be valid, it is entered into the field, the characters stop flashing, and the active edit (☐) is returned to non-active (<). If the data is determined to be invalid for that window, the characters flash until the entry in the window is modified.

If the ENT key is pressed when the window has been cleared, the original data is restored in the window, which is then reactivated for data entry. While alphanumeric data entry is in progress, if the RTN key is pressed for 1 second, or 20 seconds pass with no activity, the entered data is discarded and the display navigates to the persistent display.

UFCP Master Modes

The integrated avionics system operates in one of three possible master modes: NAV, air-to-air (A/A), or air-to-ground (A/G). A/A and A/G are disabled in the basic student mode.

The master mode is selected using the NAV, A/A, or A/G hard keys on the panel. In the advanced mode, pressing any of these three keys when not in the mode associated with that key switches the UFCP into that master mode. If one of these three keys is depressed when already in the mode associated with that key, the system remains in that mode and displays the appropriate page.

The master mode selection affects the UFCP persistent display, HUD, and the MFDs.

UFCP Upper Panel Persistent Display

The UFCP persistent display is a default display in the basic mode. In the advanced mode it is dependent on the master mode of the UFCP NAV, A/A, or A/G, and is used to display the most important information for each master mode.

The persistent display is shown when the UFCP RTN key is pressed for 1 second or after 20 seconds of inactivity on the UFCP.

NAV MASTER MODE

The persistent display for the NAV master mode allows the pilot to view and change the current frequencies of the COM1 and COM2 radios and the NAV navaid, as well as view the current transponder code and mode and access the transponder control page.

W1 - displays COM1 UHF frequency and pressing W1 activates the W1 data entry mode and displays an outward facing filled triangle in the left-most character location.

In the case of an FMS failure, W1 has no control functionality.

W2 - displays COM2 VHF frequency. Pressing W2 activates the W2 data entry mode and displays an outward facing filled triangle in the left-most character location. In the case of an FMS failure, W2 displays the COM2 frequency left justified.

If the standby VHF control head is powered, W2 displays REMOTE, indicating control at the standby VHF.

W3 - displays the radio navigation frequency. Pressing W3 activates the W3 data entry mode and displays an outward facing filled triangle in the left-most character location. In the case of an FMS failure, W3 displays the NAV frequency left justified.

W4 - displays the current transponder code and mode. When the W4 key is pressed, the UFCP displays the transponder control page. The transponder code is displayed starting in the second character position of the window, and consists of a four-digit octal number.

The transponder mode is displayed right justified as one of SBY (standby) or ALT (altitude) when the radio is in active mode and ALT is selected.

In the case of an FMS failure, W4 displays the transponder mode code left-justified and operational mode right-justified and has no control functionality.

UFCP Defaults

The UFCP has default values for most data items, and these default values depend on how the UFCP has been powered up. The initial default values apply on the first occasion the UFCP has been powered up, and also apply if the UFCP cannot access the saved values from the previous operation (e.g., after a maintenance operation).

The cold start values apply when the UFCP has been powered up with the aircraft on the ground with power off for more than 90 seconds.

Warm start values apply in all other cases and when the aircraft is in the air.

Return (RTN) Key Functionality

The RTN key is provided as an aid for navigating page hierarchies that have multiple levels. When the UFCP is displaying a lower level page in a hierarchy, pressing the RTN key navigates to the related upper level page in that hierarchy, and pressing and holding the RTN key for 1 second will return the UFCP to the persistent display.

Invalid data

Data is considered to be invalid when the system is unable to compute or relay reliable data to the respective sub-system for reasons other than system failure.

Invalid frequency data is represented by an asterisk in the left-justified first character position and leaving the last entered frequency in the other character positions. Invalid data other than frequencies is represented by placing asterisks in the character positions that would be occupied by the data. During radio tuning, an asterisk may momentarily appear as the frequency changes.

Failed Data

Data is considered to be failed when the system does not receive data from the source, which can occur in several ways, such as:

- External subsystem powered down
- Loss of information from external subsystem for more than 2.5 seconds
- Any other invalid data that is caused by a system or subsystem failure
- Loss of communication from the ADC or IRS for 1 second

Failed frequency data is represented by placing an X in the left-justified, first-character position and leaving the last entered frequency in the other character positions. Failed data that is not a frequency is represented by placing an X in the left-justified, first-character position and leaving the other character positions blank.

Navigation (NAV)

The NAV hard key allows pilots to view information about the current navigation source, to change the current navigation source, and set the VHF NAV course.

The first press of the NAV key displays the NAV page for the current navigation source, and each subsequent press selects the next navigation source, cycling through the available sources (FMS, NAV, and OFF) in a circular fashion.

Selecting the next navigation source using the NAV key is equivalent to selecting the next navigation source using the soft key on the PFD L4 key or NAV L3 key.

NAV - FMS NAVIGATION

The NAV page for FMS navigation allows pilots to view the current navigation source, view the current TO waypoint, view navigational data, and view and change the current VHF navigation course. It also provides access to the FMS execute function.

Key	Window	Action
NAV - FMS	FMS	W1 - The current navigation source FMS is displayed in this window and is left justified.
	WPT	W2 - The current TO waypoint identifier is displayed in this window.
	NAV AID	W3 - Displays NAV AID, no action when pressed.
	CRS NNN	W4 - This is a data entry window with the label CRS and the data consisting of a three-digit number that indicates the current VHF NAV receiver course for the VHF NAV, which has a valid entry range of 001°-360°. The pilot is able to insert a new NAV course using the alphanumeric keyboard followed by a press of the ENT button. This setting controls the selected VHF NAV course for the PFD and NAV displays.

NAV – VOR NAVIGATION

The NAV page allows pilots to view the current navigation source and view and change the current navigation course.

<table>
<tr><th>Key</th><th>Window</th><th>Action</th></tr>
<tr><td rowspan="4">NAV – VOR/LOC</td><td>VOR/LOC</td><td>W1 - This window displays the current navigation source.
The display of VOR or LOC in the window is determined automatically based on whether the currently selected frequency is a VOR or LOC.</td></tr>
<tr><td></td><td>W2 – Blank</td></tr>
<tr><td>NAV AID</td><td>W3 - Displays NAV AID, no action when pressed.</td></tr>
<tr><td>CRS NNN</td><td>W4 - This is a data entry window with the label CRS and the data consisting of a three-digit number that indicates the current VHF NAV receiver course for the VHF NAV, which has a valid entry range of 001°-360°.

The pilot is able to insert a new NAV course using the alphanumeric keyboard followed by a press of the ENT button. This setting controls the selected VHF NAV course for the PFD and NAV displays.</td></tr>
</table>

NAV - TACAN NAVIGATION

The NAV page for TACAN navigation allows pilots to view the current navigation source, view the current TO waypoint, view navigational data, and view and change the current TACAN navigation course. It also provides access to the FMS execute function.

Key	Window	Action
NAV - TCN	TCN	W1 - The current navigation source TCN is displayed in this window and is left justified.
	WPT	W2 - The current TO waypoint identifier is displayed in this window.
	NAV AID	W3 - Displays NAV AID, no action when pressed.
	CRS NNN	W4 - This is a data entry window with the label CRS and the data consisting of a three-digit number that indicates the current TACAN receiver course for the TACAN, which has a valid entry range of 001°-360°. The pilot is able to insert a new NAV course using the alphanumeric keyboard followed by a press of the ENT button. This setting controls the selected VHF NAV course for the PFD and NAV displays.

NAV – NAVIGATION OFF

The NAV page with navigation OFF, allows pilots to view the current navigation source and view and change the navigation course.

Key	Window	Action
NAV – OFF	OFF	W1 - This window displays the current navigation source as OFF.
		W2 – Blank
	NAV AID	W3 - Displays NAV AID, no action when pressed.
	CRS NNN	W4 - This is a data entry window with the label CRS and the data consisting of a three-digit number that indicates the current VHF NAV receiver course for the VHF NAV, which has a valid entry range of 001°-360°. The pilot is able to insert a new NAV course using the alphanumeric keyboard followed by a press of the ENT button. This setting controls the selected VHF NAV course for the PFD and NAV displays.

PFD

PFD priority function button is used to manipulate PFD bug information that is not readily accessible by LSK operation (speed, baro and radar altitude bugs and altimeter settings).

Key	Window	Action
PFD	SETNNNN	W1 - Is a data entry window with the label SET and data consisting of a number with up to four digits that indicates the current altimeter setting in inches of mercury (IN HG) (with no decimal point shown). The setting has an allowable range of 27.00 to 32.00 inches of mercury. Rotating BARO SET knob (BCSK) one click increments or decrements the barometric correction setting by one. The pilot is also able to insert a new Barometric Correction setting using the alphanumeric keyboard followed by a press of the ENT button. When the barometric correction setting is changed (via the UFCP), the change is reflected on the displays of both crew stations (front and aft).
	ABNNNNN	W2 – Is a data entry window with the label AB (Altitude Bug) and data consisting of a 3-, 4-, or 5-digit number representing height above sea level to the nearest foot from -1000 to 55,000 feet. Pressing W2 allows the barometric altitude caret setting to be changed via the UFCP alphanumeric keyboard and ENT buttons.
	RA NNNN	W3 - Is a data entry window with the label RA (radar altimeter) and data consisting of a number with up to four digits that indicates the current radar altimeter setting in feet, with an allowable range of 0-2500 feet. The radar altimeter setting is displayed on the attitude indicator. Pressing W3 allows the radar altimeter setting to be changed via UFCP alphanumeric keyboard, and ENT button. The pilot is able to insert a new radar altimeter setting using the alphanumeric keyboard followed

		by a press of the ENT button.
	SPD NNN	W4 - Is a data entry window with the label SPD and data consisting of a number with up to three digits that indicates the current airspeed bug setting in knots indicated airspeed, with an allowable range of 40 to 360 knots. Pressing W4 allows the speed caret reference setting to be changed via UFCP alphanumeric keyboard, and ENT buttons.

System (SYS)

Depressing the SYS hard key displays the SYS top-level page, as shown in Figure 1-58, and this allows the pilot to access lower-level system control pages.

Key	Window	Action
SYS	ALT/SPD	W1 - Provides access to the ALT/SPD page.
	HEADING	W2 – Provides access to the HEADING page.
	DISPLAY	W3 - Provides access to the DISPLAY page.
	BGO/IP	W4 - Provides access to the BINGO page and waypoint offset.

SYS - ALT/SPD

On the SYS top-level page, depressing the arrow key next to W1 ALT/SPD allows the pilot to access the ALT/SPD page, as well as view and change the altimeter setting units and minimums annunciator status.

Key	Window	Action
SYS – ALT/SPD	PFD	W1 - Allows the pilot to access the ALT/SPD page that has the same control functionality as the PFD key.
	INHG or MBAR	W2 – Toggles the altimeter setting units as INHG or MBAR. The altimeter setting is displayed on the UFCP and the MFDs using the units specified in this window.
	MIN ON/OFF	W3 - Labelled MIN and the options ON and OFF. The selection in this window controls whether or not the MINIMUMS annunciator is displayed on the PFD.
		W4 - Has no display or control functionality.

SYS - HEADING

On the SYS top-level page, depressing the arrow key next to W2 HEADING allows pilots to view and change the heading bug setting, the compass true/magnetic selection, and the bearing pointer sources. System heading is also directly accessed by pressing the lower right LSK of the PFD.

Key	Window	Action
SYS – HEADING	HDG	W1 - Is a data entry window with the label HDG and data consisting of a three-digit number indicating the current heading bug setting, with a valid range of 001 to 360. The current heading bug setting is indicated with reference to either magnetic or true north, depending on the current selection. Pressing W1 activates W1 data entry mode and display a left-facing filled triangle and allows the heading caret setting to be changed by using the alphanumeric keyboard followed by a press of the ENT button.
	MAG or TRUE	W2 – Has options MAG and TRUE. The compass true/magnetic selection made in this window applies across the aircraft. Pressing W2 toggles between MAG and TRUE.
	BP1AAAA	W3 - Is labelled BP1 (bearing pointer #1) and pressing W3 toggles the BP1 source selection between options OFF, FMS, and NAV where NAV is displayed as one of VOR, or LOC. The bearing pointer #1 source selection in this window can also be selected on the PFD, and pages of the MFD.
	BP2AAAA	W4 - Labelled BP2 (bearing pointer #2) and operates in the same manner as W3.

SYS - DISPLAY

On the SYS top-level page, depressing the arrow key next to W3 DISPLAY allows pilots to access lower level system pages.

Key	Window	Action
SYS - DISPLAY	HUD	W1 - Provides access to the HUD page.
	TCAS	W2 – Provides access to the TCAS page.
	G	W3 - Provides access to the G limits page.
	MFD	W4 - Provides access to the MFD page.

SYS - DISPLAY - TCAS

On the lower-level system page, the TCAS page is a navigation window that allows pilots to view and change the TCAS system status, system mode, and flight level setting.

SYS-DISPLAY-TCAS is also directly accessed by pressing LSK R2 on the NAV display.

Key	Window	Action
SYS – DISPLAY - TCAS	TCAS ON or SBY	W1 - Is a selection window labelled TCAS with options ON and SBY. The selection in this window controls the TCAS system mode. Pressing W1 toggles the TCAS status from ON and SBY and displays on both crew stations.
	ABOVE, NORMAL, or BELOW	W2 – Is a selection window with options ABOVE, NORMAL, and BELOW. The selection in this window controls the TCAS system mode. Pressing W2 toggles through the TCAS look angle options ABOVE, NORMAL, and BELOW, and displays on both crew stations.
	FL REL or ABS	W3 - Labelled FL and has options REL and ABS. Pressing W3 toggles through the TCAS flight level setting options FL REL and FL ABS, and displays on both crew stations. The selection in this window controls the TCAS system flight level setting.

		When ABS is selected, the selection applies for 15 seconds and then reverts to REL.
		W4 - Has no display or control functionality.

SYS - DISPLAY - G LIMITS

On the lower-level system page, the G limits page allows pilots to view and change the positive and negative G limit audio alert settings. This value will determine when a discrete over-G tone is heard in the headset. The tone is activated 0.5 prior to reaching this setting.

Key	Window	Action
SYS – DISPLAY - G	POS NN	W1 - Is a data entry window with the label POS left-justified and data consisting of a two digit decimal number indicating the current positive G limit, which has an allowable range of 0.0 to 7.0. Upon data entry mode activation by pressing W1, the pilot is able to increase/decrease the positive G value by using the alphanumeric keyboard followed by a press of the ENT button.
	NEG NN	W2 – Is a data entry window with the label NEG left-justified and data consisting of a two digit decimal number indicating the current negative G limit, which has an allowable range of 0.0 to 3.5. Upon data entry mode activation by pressing W2, the pilot is able to increase/decrease the negative G value by using the alphanumeric keyboard followed by a press of the ENT button.
		W3 - Has no display or control functionality.
		W4 - Has no display or control functionality.

SYS - DISPLAY - MFD

On the lower-level system page, the MFD page allows pilots to view and change the MFD declutter level.

Key	Window	Action
SYS – DISPLAY - MFD	DCLTR 0, 1 or 2	W1 - Is a selection window with the label DCLTR and options 0, 1, or 2. Pressing W1 toggles between the available MFD declutter selections. The selection in this window controls the MFD declutter level.
		W2 - Has no display or control functionality.
		W3 - Has no display or control functionality.
		W4 - Has no display or control functionality.

SYS - DISPLAY – BGO/IP

On the SYS top-level page, depressing the arrow key next to W4 BINGO allows pilots to view and change the bingo fuel level setting. BINGO is also directly accessed by pressing LSK L3 on the EICAS display.

Key	Window	Action
SYS – BINGO/IP	BGONNNN	W1 - Is a data entry window with the label BGO and data consisting of a number with up to 4 digits indicating the bingo fuel level setting (in lbs.), which has an allowable range of 0 to 1200. The pilot can insert a new bingo fuel setting using the alphanumeric keyboard followed by a press of the ENT button.
	IP	W2 - Displays IP right justified and is a navigation window that allows the pilot to access waypoint offset (Initial Point) functions when W2 is depressed.
		W3 - Has no display or control functionality.
		W4 - Has no display or control functionality.

SYS - BINGO - IP

The Initial Point (IP) page provides edit access to the offset steering function available for use to take an indirect approach to a waypoint or target. The IP page permits the pilot to assign an offset to a designated waypoint in delta X and delta Y Cartesian coordinates (X/Y IP) or polar (Bearing/Range) coordinates (B/R IP).

Selecting the IP page displays the windows associated with the initial point function on the UFCP.

Key	Window	Action
SYS – BINGO - IP	B/R or X/Y	W1 - Displays the offset mode, either B/R or X/Y, right-justified. Upon selection of the OFS page, W1 displays the most recently used offset mode (X/Y or B/R) and pressing W1 toggles between offset modes B/R and X/Y and displays on both crew stations.
	X NNNN or R NNN	W2 - Allows the pilot to enter either the across track distance (for an X offset) or the offset bearing (for an R offset). For an across track distance, the label is displayed as X and the data is a number with up to four digits indicating the across track distance, which has an allowable range of 0 to 999.9 nm. When the across track distance is entered using the alphanumeric keyboard, the decimal point is automatically displayed in the second character position from the right. The across track distance also has a selection of L or R for offset distances to the left or right of the track; this selection is displayed in the last character position and is toggled using the +/- key when data entry is active. For an offset bearing, the label is displayed as B and the data is a three-digit number indicating the offset bearing, which has an allowable range of 001to 360 and is always referenced to true north. Pressing ENT activates this change.
	Y NNNN or BNNN	W3 - Allows the pilot to enter either the offset along track distance (for a Y offset) or the offset

		range (for a B offset). For an along track distance, the label is displayed as Y and the data is a number with up to four digits indicating the along track distance, which has an allowable range of 0 to 999.9 nm. For an offset range, the label is displayed as R and the data is a number with up to three digits indicating the offset range, which has an allowable range of 0 to 99.9 nm. When the along track distance or the offset range is entered using the alphanumeric keyboard, the decimal point is automatically displayed in the second character position from the right. Pressing ENT activates this change.
	CONFIRM	W4 - Displays CONFIRM when the desired offset point can be created. Pressing W4 confirms and executes the new flight plan and W4 becomes blank.

Clock (CLK)

The CLK hard key displays the current clock time and provides a count-up timer function. When the user re-enters the clock page, after allowing it to run in the background, the setting of Window 1 and 2 displays the standard default settings and the setting of Window 3 displays either stopped time or running time depending on what was displayed when the user last exited the page.

Key	Window	Action
CLK	TIME Z	W1 - Is a data display window that displays the label TIME Z and W1 has no control functionality.
	HH:MM:SS	W2 - Is a data display window that displays the current time (GMT) in the format HH:MM:SS and has no control functionality.
	START or STOP	W3 - Has an initial default display with the text START, right-justified. When W3 is pressed, the timer activation state is started. When the timer activation state is started, the text STOP is displayed on W3 right-justified. A subsequent press of W3, while the timer is running, sets the timer activation state to stopped (Paused) and the stopped time is displayed on W4.
	R MM:SS	W4 - Displays the letter R left-justified to represent reset and displays the timer right-justified in the format MM:SS where MM is minutes, and SS is seconds. The timer starts counting up from zero to 99:59 and stops and continues to display that time until it is reset. Pressing the associated key while the timer is active pauses the timer, and pressing the associated key while the timer is paused restarts the timer from the paused time. Pressing the associated key for 2 seconds or ore when the timer is active or paused, deactivates the timer, resets the timer count to zero, and restores the display of START.

User Waypoints (USER WPT)

Depressing the USER WPT hard key allows pilots to view and change information about waypoints in the user database.

For the purposes of this simulation, the data captured by the use of the Mark-On-Top function is displayed in this window.

Key	Window	Action
USER WPT	NNWPT	W1 - Displays waypoints from the user database in the format NNWPT where NN is the number of the user waypoint and WPT is a fixed display. The waypoints can be selected for viewing and editing by entering the number (from 1-99) of the desired user waypoints in this window. Pressing W1 activates the W1 data entry mode and display the active data entry triangle in the left-most character location and permit the waypoint number to be changed.
	LAT, LONG or ELEV	W2 - Pressing W2 toggles between LAT, LONG, or ELEV with each display starting in the second character position. When the selection is LAT or LONG, the window also provides functionality for selecting the latitude as N or S or the longitude as E or W. The N or S (when the selection is latitude) or E or W (when the selection is longitude) character is displayed right justified.
	N/S & E/W	W3 - The data displayed is the latitude value when the W2 selection is LAT and pressing W3 toggles between N or S, the data displayed is the longitude value when the W2 selection is LONG and pressing W3 toggles between E or W, the data displayed is the elevation value when the W2 selection is ELEV and W3 has no control functionality.
	DDDMMMM, DDMMMM or NNNNN	W4 - The data corresponding to the selection in window W3 is displayed in window W4, which is a data entry window with no label. The data displayed is the latitude value (a six-digit number) when the W2 selection is LAT, the

		longitude value (a seven-digit number) when the W2 selection is LONG, and the elevation value (a number with up to five digits) when the W2 selection is ELEV. Data can only be entered in this window using the alphanumeric keyboard, and must be a valid latitude or longitude, including leading and trailing zeros (when the selection is LAT or LONG) or an elevation between –32767 and 32767 feet (when the selection is ELEV). The latitude format is DDMMMM where DD is the degrees and MMMM is the minutes of latitude with two decimal places. The longitude format is DDDMMMM where DDD is the degrees and MMMM is the minutes of longitude with two decimal places. When entering the elevation, the value can be toggled from positive to negative (or vice versa) using the +/- key. If no data has yet been entered in W4 for the current waypoint and W2 selection, the text NO DATA is displayed left justified.

Mark-on-Top (MRK)

The MRK hard key allows pilots to create a mark-on-top waypoint.

When the MRK key is pressed, the current aircraft position and current time (GMT) is saved as an FMS waypoint and displayed on the UFCP.

The waypoint can then be viewed or edited using the FMS.

The MRK page displays latitude and longitude of the mark-on-top waypoint, and time (GMT) at which it was created.

Key	Window	Action
MRK	MARK	W1 - Is a data display window that shows the page title MARK and has no control functionality.
	A NNNNNN	W2 - Is a data display window that shows the latitude of the MRK waypoint in the format A NNNNNN where A is either N (north) or S (south) and NNNNNN is the latitude value and has no control functionality.
	ANNNNNNN	W3 - Is a data display window that shows the longitude of the MRK waypoint in the format ANNNNNNN where A is either E (east) or W (west) and NNNNNNN is the longitude value and has no control functionality.
	HH:MM:SS	W4 - Is a data display window that shows the MRK waypoint creation time (GMT) in the format HH:MM:SS and has no control functionality.

Communications Radio (COM1/COM2)

The COM1 and COM2 hard keys allow pilots to access information about the UHF COM1 or VHF COM2 radio.

When the COM1 or COM2 key is pressed, the appropriate page for the radio configured as COM1 or COM2 is automatically displayed.

COM1 - UHF PRESET

The COM1 page allows pilots to view and change the COM1 UHF radio preset, frequency, UHF mode, and squelch setting.

<table>
<tr><th>Key</th><th>Window</th><th>Action</th></tr>
<tr><td rowspan="3">COM1-UHF PRESET</td><td>UHF ##</td><td>W1 - Displays UHF and a two-digit number indicating the current COM1 UHF radio preset number, which has an allowable range of 01 to 20 and can be changed using the UFCP alphanumeric keyboard and pressing the ENT key.

Changing the preset number in this window automatically retunes the COM1 UHF radio to the frequency corresponding to that preset.

If the active UHF frequency is not a preset frequency, the UHF display will not display a preset but rather UHF ## is displayed where ## take the place of the numerals normally present had there been an associated preset available.</td></tr>
<tr><td>UHF Frequency</td><td>W2 - Displays the current COM1 UHF frequency programmed to the UHF preset number displayed in W1.

Pressing W2 activates the W2 data entry mode and allow the UHF frequency to be changed using the alphanumeric keyboard and ENT button.</td></tr>
<tr><td>T/R, TR+G, or G</td><td>W3 - The UHF radio is capable of operating in three active modes.

The usual mode is set to transmit and receive on the selected preset (MAIN) and also to receive on Guard frequency (121.800).
This mode is abbreviated with the caption TR+G.
The radio can also operate without the Guard monitor active.</td></tr>
</table>

		This mode is abbreviated with the caption T/R. Finally, the radio can operate in a Guard-only mode. This mode is abbreviated with the caption G. Pressing the W3 button toggles the UHF mode between available selections T/R (Transmit/Receive), TR+G (Transmit/Receive+Guard Receive), and G (Transmit Receive on Guard).
	SQ ON or OFF	W4 - Displays SQ and the options ON or OFF. Pressing the W4 button toggles the UHF squelch between OFF and ON. The selection in this window controls the COM1 UHF radio squelch setting.

COM2 - VHF PRESET

The COM2 page allows pilots to view and change the COM2 VHF radio preset, frequency, VHF mode, and squelch setting.

Key	Window	Action
COM2-VHF PRESET	VHF ##	W1 - Displays VHF and a two-digit number indicating the current COM2 VHF radio preset number, which has an allowable range of 01 to 20 and can be changed using the UFCP alphanumeric keyboard and pressing the ENT key. Changing the preset number in this window automatically retunes the COM2 VHF radio to the frequency corresponding to that preset. If the active VHF frequency is not a preset frequency, the VHF display will not display a preset but rather VHF ## is displayed where ## take the place of the numerals normally present had there been an associated preset available.
	VHF Frequency	W2 - Displays the current COM2 VHF frequency programmed to the VHF preset number displayed in W1. Pressing W2 activates the W2 data entry mode and allow the VHF frequency to be changed using the alphanumeric keyboard and ENT button.
		W3 - Has no display or control functionality.
	SQ ON or OFF	W4 - Displays SQ and the options ON or OFF. Pressing the W4 button toggles the VHF squelch between OFF and ON. The selection in this window controls the COM2 VHF radio squelch setting.

NAV TUNE – Radio Navigation Aid Tuning

The NAV TUNE hard key allows pilots to view information about their radio navigation aids and transponder. The first press of the NAV TUNE key displays the NAV TUNE page for the last viewed device, and each subsequent press cycles through the devices NAV, DME, and XPDR.

NAV TUNE – VOR/LOC

The NAV TUNE page for the NAV navaid allows pilots to view and change the preset and or frequency of the VHF navaid.

<table>
<tr><th>Key</th><th>Window</th><th>Action</th></tr>
<tr><td rowspan="4">NAV TUNE – VOR/LOC</td><td>VOR or LOC</td><td>W1 – Displays as one of VOR (if NAV is a VOR/ILS tuned to a VOR frequency), LOC (if NAV is a VOR/ILS tuned to a localizer frequency).

If the tuned frequency is part of the preset frequency library the corresponding preset (01 to 20) number is shown. If the frequency has no associated number, ## is shown.

Changing the preset number in this window using the alphanumeric keyboard and ENT buttons automatically retunes NAV to the frequency or channel corresponding to that preset.</td></tr>
<tr><td>IDENT or ###</td><td>W2 – Displays the station IDENT from the FMS database.

If no match to frequency is found, ### is found.</td></tr>
<tr><td>VOR or LOC Frequency</td><td>W3 – If NAV is manually tuned in this window to a frequency or channel corresponding to a preset. The preset number is automatically displayed in W1.

If NAV is tuned to a frequency or channel that does not correspond to a preset, the characters ## displays in place of the preset number in W1.</td></tr>
<tr><td></td><td>W4 – Has no display or control functionality.</td></tr>
</table>

NAV TUNE - TACAN

The NAV TUNE page for the TACAN navaid allows pilots to view and change the preset and or frequency of the VHF navaid.

Key	Window	Action
NAV TUNE – TCN	TCN	W1 - Display window titled TCN.
	IDENT or ###	W2 - Displays the station IDENT from the FMS database. If no match to frequency is found, ### is found.
	TACAN Channel & Band	W3 – Displays the current TACAN Channel and Band. Pressing the W3 LSK allows alteration of the TACAN Channel.
	BAND	W4 – Toggles TACAN Band between X & Y.

NAV TUNE - DME

The NAV TUNE - DME page allows pilots to view the DME frequencies and toggle DME holds on and off.

Key	Window	Action
NAV TUNE - DME	DME	W1 - Display window titled DME.
	DME Frequency	W2 - Consists of the current DME frequency corresponding to the VOR/ILS where NNN.NNA is the current DME frequency and A is H or blank. Pressing W2 toggles between Hold On and Off by alternately displaying an H or blank in the right-most character position.
		W3 - Has no display or control functionality.
		W4 - Has no display or control functionality.

NAV TUNE - XPDR

The NAV TUNE - XPDR allows pilots to view and change the transponder status, code, mode, and standby code.

The aircraft is fitted with an altitude reporting, Mode S transponder which replies to ground station and airborne interrogations.

Control of the transponder is provided through the UFCP.

Key	Window	Action
NAV TUNE - XPDR	XPDR	W1 - Displays XPDR and the options ACT and SBY. Selecting W1 toggles between the active (XPDRACT) or standby (XPDRSBY) mode. If the XPDR is 'not responsive' and W1 button is pushed in an attempt to switch to ACT mode, the system reverts to SBY if the XPDR equipment remains 'not responsive'.
		W2 - Displays data indicating the current transponder mode code. Pressing W2 activates the W2 data entry mode and allow the transponder mode code to be changed via the alphanumeric keyboard and pressing ENT button. When the transponder mode code is changed, the change is reflected on the displays of both crew stations (front and aft). The data entry range for Transponder Mode Code is 0000 to 7777.
	ALT ON or OFF	W3 - Displays ALT and the options ON and OFF. Pressing W3 toggles IFF mode 3 and altitude encoding between ON and OFF.
		W4 - Has no display or control functionality.

Identification Squawk (ID)

The ID hard key allows pilots to initiate an ID squawk from the transponder and view the information contained in the transmission.

Pressing the ID key initiates an ID squawk and displays the ID page. After 5 seconds, the ID page is removed and the UFCP returns to its previous display.

The UFCP page can be changed away from the ID page before 5 seconds have passed by selecting any of the master mode or page navigation hard keys.

Key	Window	Action
ID	XPDR	W1 - Displays the equipment identifier, which is a data display window. The identifier displays as XPDR left-justified.
	NNNN	W2 - Is a data display window that displays data consisting of a four-digit octal number indicating the current transponder code.
	ALT ON, ALT OFF, SBY	W3 - Displays the current transponder mode, which is also a data display window. The transponder mode is displayed as ALT ON left-justified, when selected mode is report altitude, ALT OFF left-justified, when selected mode is do not report altitude or SBY left-justified, if transponder is in standby mode.
	IDENT	W4 - Displays IDENT left-justified and has no control functionality.

UFCP LOWER SWITCH PANEL

The UFCP lower panel consists of switches and knobs that control the pilot selection, text display, flight path marker cage switching, UFCP and HUD UFCP brightness and contrast levels.

The UFCP data entry knob is a rotary/push knob located on the bottom left of the UFCP lower panel and is not simulated in this version of the software.

The UFCP brightness knob is located on the right side of the UFCP lower switch panel. Rotating the UFCP brightness knob clockwise increases (counter clockwise decreases) the brightness of the displays in the UFCP windows.

The UFCP bezel incandescent legend lighting is controlled by the aircraft lighting control (not the UFCP brightness knob).

The HUD brightness knob is located on the right side of the UFCP lower switch panel. Rotating the HUD brightness knob clockwise increases (counter clockwise decreases) the brightness of the symbology.

Rotating the HUD brightness knob fully counter clockwise turns the HUD brightness to a non-visible level.

The HUD brightness knob of the rear UFCP has no effect on the HUD brightness.

The BARO SET knob provides access to adjust the altimeter setting. The altimeter setting may also be entered by keying the value using the AKB keys followed by pressing the ENT key. The altimeter setting is available in W1 after pressing the PFD key.

Press and hold of W1 will set the correction to 29.92 in. Hg. When the barometric correction setting is indicated in inches of mercury, the reading shall display as a four-digit number without a decimal point (e.g., 2992).

Barometric correction setting indicated in millibars shall display as a three or four digit whole number (e.g., 1013 or 999).

Rotating the BARO SET knob one click shall increment or decrement the barometric correction setting by one, regardless of whether the unit is in. Hg or millibars. For a cold or warm start value the barometric correction setting shall be the previous value. Barometric correction setting units that are changed via UFCP are reflected on both FWD and AFT displays.

NOTE

- *For Solo flight, the aft UFCP AUTO HUD/DAY/NIGHT switch should be set to DAY mode.*

The LGT NIGHT/DAY/AUTO HUD switch establishes the MFD brightness mode that is outputted to the MFDs. The DAY/NIGHT SEL controls the MFD day/night illumination.

NIGHT illumination, at its full brightness setting, is approximately 10% of the full brightness presented during DAY mode.

The FWD LGT NIGHT/DAY/AUTO HUD switch works in conjunction with the HUD brightness knobs to control the HUD symbology brightness. The AFT UFCP LGT NIGHT/DAY/AUTO HUD switch has no AUTO HUD control functionality.

When the front UFCP LGT NIGHT/DAY/AUTO HUD brightness mode switch is in the AUTO HUD position, the brightness mode is set to AUTO HUD. The AUTO HUD position, when selected, only impacts the brightness associated with the HUD.

When AUTO HUD position is selected, the lighting associated with MFDs and UFCP display windows operate in the DAY mode. If NIGHT mode is selected in either cockpit, the MFDs and UFCPs in the whole aircraft are placed into the night mode.

When the LGT NIGHT/DAY/AUTO HUD brightness mode switch is in the DAY position in both cockpits, the brightness mode is set to DAY.

If the FWD or AFT LGT NIGHT/DAY/AUTO HUD selection switch is set to DAY and the other cockpit is set to NIGHT, then the FWD and AFT UFCP and MFDs are set to NIGHT.

When both UFCP LGT NIGHT/DAY/AUTO HUD switches are placed to DAY mode from the NIGHT position, the DAY illumination reverts to the lowest possible DAY setting to avoid a sudden burst of illumination from night conditions.

The NIGHT position is intended for use during night and low light operation. When one or both of the FWD and AFT LGT NIGHT/DAY/AUTO HUD brightness mode switches is in the NIGHT position, the brightness mode shall be set to NIGHT.

NOTE

- *Cycling the LGT NIGHT/DAY/AUTO HUD brightness mode switch from day to night and back to day will put MFD brightness at its lowest (DIM) daylight setting.*
- *MFD brightness must be adjusted manually using the individual MFD bezel switches.*

The HUD text window enable and FPM cage switch has three positions: HUD TEXT; FPM UNCAGE, and CAGE.

The HUD text mode repeats the contents of the UFCP four line LED display on the HUD. In HUD text mode, the flight path marker is uncaged.

The FPM UNCAGE mode enables normal HUD operation. UFCP windowed text is not displayed on the HUD when in FPM CAGE mode.

The CAGE mode is used to cage the flight path marker to the climb dive marker and the local vertical axis to eliminate drift effects on the flight path marker lateral positioning. It may be used when strong winds cause the flight path marker to be displayed outside the HUD total field of view (TFOV).

The HUD TEXT and FPM CAGE switch on the rear UFCP has no effect on the HUD.

The MFD/UFCP REPEAT switch is used to cause the display of one cockpit to duplicate that of the other cockpit.

The MFD/UFCP REPEAT switch has two positions: NORM and REPEAT.

When in repeat mode, the associated cockpit UFCP display and MFDs duplicate the screens of the other cockpit's UFCP and MFDs. When operating in repeat mode there is an indication on the EICAS to indicate the system is operating in repeat forward or repeat aft mode.

Selecting repeat in one cockpit has no impact on the other cockpit. When repeat is initiated from the front cockpit, each UFCP provides key presses to IAC2.

When repeat is initiated from the rear cockpit, each UFCP provides key presses to IAC1. Once in repeat mode, selecting REPEAT in the other cockpit has no effect and RPT ERR is displayed on the EICAS. If repeat mode is selected while the UFCP is in data entry mode, modifications are lost upon initiating repeat mode.

Both sets of cockpit MFD controls continue to function in a cooperative manner. The NORM selection of the MFD/UFCP REPEAT switch restores the normal operation of MFDs and UFCP.

PRIMARY FLIGHT DISPLAY (PFD)

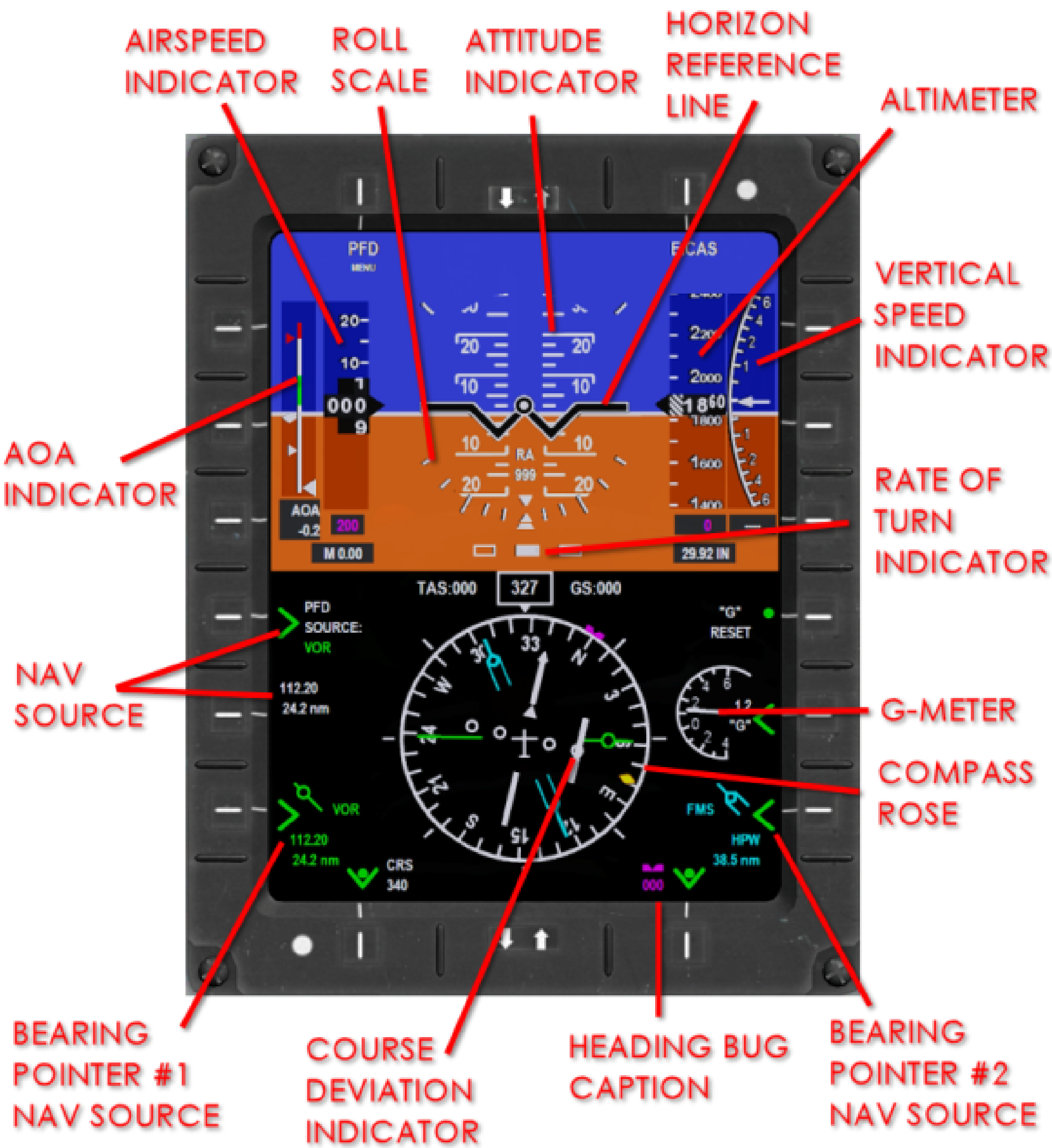


Figure 1-25 Primary Flight Display (TAPE)

Primary air data information, provided through the integrated avionics system, is presented by the MFD in each cockpit.

The attitude, airspeed, vertical speed, glideslope and localizer, angle of attack, turn and slip, and wind indicator along with an altimeter, horizontal situation indicator (HSI), and accelerometer are displayed on the PFD.

Attitude Indicator

The attitude indicator is centrally located on the upper half of the PFD and informs the pilot of the orientation of the aircraft relative to earth.

In the event that data is not available from the IRS, the attitude indicator is removed from the display and replaced with a black background and a red X.

MISCOMPARE DATA

Each IAC continually compares primary flight data with the other IAC. If an IAC detects the other IAC's primary flight data is different by a preset margin or invalid, both IACs will display a miscompare alert.

Miscompare alerts display as amber characters on a black background either on or adjacent to the specific information on the PFD.

Miscompare alerts are provided for roll (ROL), pitch (PIT), heading (HDG), altimeter (ALT), and airspeed (SPD).

HORIZON REFERENCE LINE

The horizon reference line provides a delineation between the attitude indicator blue colour representing the sky and the brown colour representing the ground (or earth's surface). The horizon reference line with respect to the aircraft reference symbol provides the pilot with an indication of aircraft pitch and roll attitude.

When the aircraft pitch attitude is zero, the horizon reference line passes behind the centre circle of the aircraft reference symbol.

When the aircraft roll attitude is zero, the horizon reference line is aligned parallel to the horizontal lines of the aircraft reference symbol.

The horizon reference line moves with respect to the fixed aircraft symbol and accurately depicts current aircraft pitch and roll attitudes. The horizon reference line provides the pilot with cues of pitch and roll rates and functions accurately through 360° of roll and ±90° of pitch.

At pitch angles in excess of ±30°, the horizon reference line and the ground/sky continues to remain visible. As the aircraft pitches upwards (nose rising), the horizon reference line moves in a downward direction and as the aircraft pitches downward (nose diving), the horizon reference line moves in an upward direction.

As the aircraft rolls clockwise (right wing moves downwards), the horizon reference line rotates counter clockwise and as the aircraft rolls counter clockwise (left wing moves downwards), the horizon reference line rotates clockwise.

ATTITUDE ERECT ANNUNCIATOR (ATT ALIGNMENT)

When the inertial reference system attitude erect alignment function has been initiated, a red ATT ERECT annunciation displays centred above the aircraft reference symbol on the PFD.

ROLL ATTITUDE SCALE

The attitude indicator also includes a roll attitude scale to allow the pilot to determine aircraft roll attitude.

It includes a pointer, a zero roll indicator, and markings at 10°, 20°, 30°, 45°, 60°, 90° and 135°. The pointer moves around the roll attitude scale to maintain an alignment in a direction perpendicular to the horizon and pointing toward the ground.

The position indicated on the roll attitude scale by the pointer indicates the current aircraft roll attitude.

Airspeed Indicator

The airspeed indicator (ASI) displays the air data parameters of indicated airspeed, Mach number, and maximum operating airspeed/Mach number (VMO/MMO).

The airspeed displays a continuous readout of the current ASI in knots, both on a scale and on a digital readout. A red airspeed limit band indicates maximum operating airspeed. The airspeed limit band moves to compensate for changes in altitude.

Air data information is supplied to the ASI on dual data buses. Mach information is blanked below 0.30 Mach.

On the tape and dial display formats, the airspeed limit band is displayed as a red section on the airspeed scale from the ADC indicated maximum operating speed (VMO) to the maximum value on the scale (360 knots on the dial display, 450 knots on the tape display).

On the tape display an airspeed trend vector is displayed as a green arrow originating from the centre of the scale and pointing either up or down along the right edge of the scale. This trend vector indicates the expected airspeed of the aircraft in 6 seconds if the current acceleration or deceleration of the aircraft remains the same.

Flap operating speed is indicated by a white band on the right side of the airspeed tape or outside of the airspeed dial from 80 to 150 knots.

SPEED ADVISORY MESSAGE

The speed advisory message consists of the characters SPD in amber text, displayed above the airspeed indicator. It indicates a miscompare error in the airspeed readout, which occurs when the difference between the airspeed data from the two IACs is 5 knots or more (or if one of the IACs reports valid data and the other IAC does not).

AIRSPEED BUG

The airspeed bug consists of two parts; the airspeed bug setting readout and the airspeed bug.

Both are displayed in magenta. The airspeed bug setting can be set or modified using the up-front control panel by pressing the PFD key.

MACH NUMBER READOUT

The current Mach number of the aircraft is displayed as a digital readout with two decimal places below the airspeed indicator scale. The Mach number readout appears when the current aircraft Mach number is greater than 0.30, and turns red when Mach 0.67 is exceeded.

Altimeter

The altimeter indicator differs from the vertical speed and airspeed indicators in that the IAC receives pressure altitude from the ADC and calculates and displays to baro-corrected altitude.

The altimeter, through a selectable function on the UFCP, can provide baro-set data in either inches of mercury or millibars. The baro-setting is displayed on the PFD below the altimeter scale and is controlled directly through the baro-set knob on the UFCP or via keypad entry from the PFD menu on the UFCP.

Air data information is supplied to the altitude indicator on dual data buses. Power is provided through a circuit breaker, placarded ADC, on the generator bus circuit breaker panel in the front cockpit.

On the dial display, a 1000 foot range of altitude is displayed on the scale. Major graduations are displayed every 100 feet and markings every 20 feet.

The current altitude in that range is indicated by a rotating pointer. On the tape display, a 1000 foot range of altitude is displayed on the scale.

Major graduations are displayed every 200 feet and markings every 100 feet. The scale moves up and down so that the current aircraft altitude is always aligned with the centre of the display (i.e., the current altitude on the scale is covered up by the digital altimeter readout).

ALTITUDE BUG

The altitude bug display on the altimeter consists of two parts, the altitude bug setting readout and the altitude bug. The altitude bug is displayed in magenta and displays the point on the scale that corresponds to the selected reference altitude.

The currently displayed range does not contain the altitude bug setting, half of the bug is displayed pegged at the top or bottom end of the range to indicate if the altitude bug setting is above or below the displayed range. The altitude bug setting can be set or modified by pressing the PFD hard key on the UFCP.

ALTIMETER SETTING

The altimeter setting is displayed below the altimeter on the tape display and above the altimeter on the dial display and indicates the current altimeter setting displayed in either inches of mercury or millibars, depending on the current selected pressure units. The altimeter setting can be set or modified using the baro set knob or alphanumeric keypad on the UFCP.

RADAR ALTIMETER

The radar altimeter display consists of the characters RA in white with a digital readout of the current radar altitude value below. The radar altimeter readout is only displayed when the radar altitude is less than 2500 feet and the aircraft bank angle is less than 30° or the pitch angle is less than 15° up or down.

When the radar altitude is less than the radar altimeter setting (set using the UFCP), the readout flashes and changes colour to amber.

Vertical Speed Indicator

The vertical speed indicator (VSI) displays the vertical speed of the aircraft as provided by the air data computer (ADC). Air data information is supplied to the IAC on dual data buses.

The VSI displays the current aircraft vertical speed in ft. /min on a digital readout when vertical speed is 200 ft. /min or greater, as well as a scale with a pointer.

On the tape display, the pointer is a white arrow that moves up or down the scale indicating the current value of vertical speed. On the dial display, the pointer is displayed as a white band from 0 ft. /min up (or down) to the current value of vertical speed.

The scale has a range from ±6000 ft. /min, and the digital readout can display a range from ±9900 ft. /min. When the current aircraft vertical speed is ±6000 ft. /min, the scale pointer is displayed pegged at ±6000 ft. /min respectively.

When the current aircraft vertical speed is greater than ±9900 ft. /min, the digital readout displays ±9999 ft. /min respectively.

Turn and Slip Indicators

The turn and slip indicator shows the rate and direction of turn.

SLIP/SKID INDICATOR

The slip/skid indicator is used in conjunction with the zero degree roll pointer. In a turn, the movement of the slip/skid indicator shows the magnitude and direction of the aircraft slip or skid.

When the aircraft is in a coordinated turn, the slip/skid indicator is positioned directly below the zero degree roll pointer. The maximum movement of the slip/skid indicator occurs when the centre of the indicator is above the centre of one of the outer rate of turn boxes, and the indicator pegs at this extent if it is reached.

RATE-OF-TURN INDICATOR

The rate-of-turn indicator consists of a pointer and a scale. The pointer shifts left and right along the scale to indicate the current aircraft rate and direction of turn.

The scale is calibrated for standard rates of turn, and the outer boxes representing a standard rate turn (3° per second) in each direction. The pointer pegs in either direction when the inner edge of the pointer reaches the outer edge of one of the outer boxes, which indicates that the aircraft rate-of-turn is 4.5° per second or greater.

Angle of Attack (AOA) Indicator

The AOA indicator, provides a continuous display of aircraft angle of attack. On the tape and dial display the indicator is marked with a red range and red carat at 18 units, which indicates stall; a green range from 10 to 11 units, which indicates the normal approach speed (optimum angle of attack or on-speed) range; an upper white carat at 8.8 units, which indicates the maximum endurance angle of attack, and a white carat at 4.4 units, which is the maximum range angle of attack.

AOA TEST

The AOA indicator and stick shaker are normally inhibited when the aircraft is on the ground, and only the red chevron shows on the indexer in each cockpit. An operational test of the AOA system can be performed using the AOA switch located in the system test switch panel in the front cockpit.

Test low first, then high, and release. Holding the test switch to the LOW position:

- Activates the AOA indexer amber donut on the forward and aft cockpit indexers.
- Deactivates the red chevron on the forward and aft cockpit indexers.
- Sets the forward and aft cockpit PFD AOA indicators to the 10.5±0.4 unit position.

Holding the test switch to the HIGH position:

- Activates the green chevron on the forward and aft cockpit indexers.
- Deactivates the amber donut on the forward and aft cockpit indexers.
- Sets the forward and aft cockpit PFD AOA indicators to the 18.0±0.4 unit position.
- Activates the control stick shaker.

Releasing the test switch returns the system to the normal operating mode, illuminating the red chevron, and deactivating the green chevron, AOA indicator, and stick shaker.

STICK SHAKER

A stick shaker, which is activated by the angle of attack (AOA) system, provides stall warning.

The stick shaker includes a small electric motor which drives an eccentric weight. The stick shaker is mounted to the control stick interconnect tube near the aft control stick.

The stick shaker is activated at approximately 5 to 10 knots above stall speed (15-16 units). When activated, the motor spins and the eccentric motion of the weight shakes both forward and aft control sticks to warn of impending stall.

Function of the stick shaker may be checked with the AOA test switch on the test panel in the forward cockpit left console panel. Setting the AOA test switch to the HIGH position while the aircraft is on the ground (weight on wheels) activates the stick shaker.

Power is provided through the AOA system circuit breaker, placarded AOA, located on the battery bus circuit breaker panel in the forward cockpit.

Glideslope and Localizer Indicators

The glideslope and localizer indicators are used to show deviations from the desired path on an instrument landing system (ILS) approach. They are only displayed when the VOR/ILS system is the selected navigation source and is tuned to an ILS frequency.

The glideslope indicator displays the current vertical deviation from the ILS glideslope. It consists of a horizontal centre marker with unfilled circles above and below the scale, and a diamond pointer to represent the glideslope.

The diamond pointer is displayed above the centre marker when the aircraft is below the glideslope and below the centre marker when the aircraft is above the glideslope.

The diamond pointer pegs on the scale when the inner edge of the pointer touches the outer edge of one of the outer scale circles. If the aircraft is below 2500 feet AGL and the glideslope pointer has been on the scale for 5 seconds or more and then goes off the scale, the pointer flashes.

The localizer indicator displays the lateral deviation from the ILS approach path. It consists of a vertical centre marker with unfilled circles to the left and right for the scale, and a diamond pointer to represent the approach centreline.

The diamond pointer is displayed to the left of the centre marker when the aircraft is to the right of the approach path and to the right of the centre marker when the aircraft is to the left of the approach path. The diamond pointer pegs on the scale when the inner edge of the pointer touches the outer edge of one of the outer scale circles.

Horizontal Situation Indicator

The horizontal situation indicator (HSI), makes up the lower half of the PFD display, provides primary heading in addition to primary navigation display, course selection indication, NAV source annunciation, localizer deviation, and selected heading bug.

COMPASS ROSE

The compass rose rotates as the aircraft heading changes such that the current aircraft heading is always located at the top of the display. The scale also incorporates fixed tick marks on the outside of the scale at 45°, 90°, 135°, 180°, 225°, 270° and 315° from the top of the scale to allow pilots to easily read the headings at 45° increments.

There are also alpha-numeric graduation marks (N, 3, 6, E, 12, 15, S, 21, 24, W, 30, 33) displayed every 30° along the 360° rotating compass scale. Major graduation marks are displayed every 10° along the 360° rotating compass scale, except for those 30° locations where the alpha-numeric graduation marks appear.

The compass rose contains an aircraft symbol, located at the centre of the scale, which always points towards the top of the display. The ground track pointer on the HSI indicates the current ground track of the aircraft on the compass rose.

HEADING READOUT

The heading readout on the HSI displays the current heading of the aircraft, from 001° to 360°, inside a box with an attached carat that points to the top point on the compass rose.

The heading is appended outside of the box with either a ° or a T to indicate that the current compass setting is either magnetic or true.

HEADING ANNUNCIATOR

The heading annunciator displayed in amber text indicates an error in the heading readout, which occurs when the difference between the heading data from the two IACs is greater than 6° plus half of the aircraft bank angle (when the bank angle is less than 6°) or greater than 12° (when the bank angle is between 6 and 20° inclusive).

If the aircraft bank angle is greater than 20°, the heading data is not checked for errors. The annunciator is also displayed if one of the IACs reports valid data and the other IAC does not.

HEADING BUG

The heading bug element on the HSI is made up of two parts: the heading bug and the heading bug caption. The heading bug is positioned on the outside edge of the compass rose such that the triangular notch is aligned with the current heading bug value, and it rotates with the compass rose to maintain this alignment.

The heading bug caption, located above the lower right LSK, displays the current heading bug value in a digital readout and allows the operator to modify the heading bug value using the UFCP. When the lower right LSK is pressed on the MFD, the UFCP is changed to display the SYS Heading Level 2 page with the heading (W2) selected for entry.

Entry of a new heading can be accomplished by either turning the UFCP data entry knob until the new value is reached or by entering a new value with the number keys and then pressing the ENT key. The heading bug value can also be set to the aircraft current heading by pressing the lower right LSK for 1 second.

BEARING POINTERS

There are two bearing pointers on the HSI. Bearing pointer #1 is a single line and displayed in green and bearing pointer #2 is double line and displayed in cyan.

Each bearing pointer indicates the heading to its currently slaved navigation source with the head indicating the TO heading and the tail indicating the FROM heading.

If the currently slaved source is FMS, the head points towards the next waypoint. If the currently slaved source is OFF or a VOR in ILS mode, the bearing pointer #1 or #2 is not displayed.

The currently slaved navigation source for each bearing pointer is displayed beside an LSK (L6 for bearing pointer #1 and R6 for bearing pointer #2). These corresponding LSKs also allow for selection of the slaved navigation source.

Selection of a new slaved navigation source for one of the bearing pointers is accomplished by pressing the LSK corresponding to that bearing pointer, which cycles to the next available source (rotating through the available sources in a circular fashion with each successive LSK press).

Depending on the slaved navigation source for bearing pointer #1 and #2, the three lines of descriptive text display as:

Slaved Navigation Source - FMS

First Line	FMS
Second Line	Active waypoint identifier
Third Line	Distance to active waypoint

Slaved Navigation Source - VOR

First Line	VOR
Second Line	Tuned VOR frequency
Third Line	DME Distance to tuned VOR

Slaved Navigation Source - TACAN

First Line	TCN
Second Line	Tuned TACAN Channel
Third Line	DME Distance to tuned TACAN

Slaved Navigation Source - OFF

First Line	OFF
Second Line	Blank
Third Line	Blank

When the bearing pointer #1 or #2 is slaved to VOR/ILS, the third line is only displayed when the DME is available on the paired channel equivalent to the currently tuned VOR/ILS frequency.

When bearing pointer #1 or #2 is slaved to VOR/ILS, and the DME is not tuned to the paired channel equivalent to the currently tuned VOR/ILS frequency, the third line of the needle source readout is blanked.

In the case of invalid or not available (flagged) data and bearing pointer #1 or #2 is slaved to VOR or the VOR/ILS receiver is tuned to an ILS frequency, the bearing pointer is removed from display on the compass rose.

If bearing data from the navigation source slaved to bearing pointer #1 or #2 is failed, the bearing pointer #1 or #2 needle readout descriptive text consists of the following:

Slaved Navigation Source Failed – FMS or VOR

First Line	FMS or VOR
Second Line	Red “X”
Third Line	Blank

GROUND TRACK POINTER

The ground track pointer on the HSI, indicates the current ground track of the aircraft on the compass rose.

COURSE DEVIATION INDICATOR

The course deviation indicator (CDI) on the HSI consists of the head, tail, deviation bar and scale.

The head, tail, and scale are white regardless of the selected navigation source. When the selected navigation source is VOR/LOC and a VOR/LOC station is tuned, the deviation bar will be white. When the selected navigation source is FMS, the deviation bar is magenta.

The CDI head is oriented on the compass rose to indicate either the desired course (when the navigation source is VOR) or desired track (when the navigation source is FMS).

The deviation bar indicates the lateral deviation from the desired course or track by translating along the scale perpendicular to the CDI arrow.

The TO or FROM arrow (displayed in white), indicates whether the selected course takes the aircraft to or from the navigation facility. The To/From arrow always points towards the outside of the compass rose, and is displayed either at the inner end of the CDI head (when the indication is TO) or at the inner end of the CDI tail (when the indication is FROM).

The other CDI annunciators enroute (ENR), terminal (TERM), and approach (APR) apply only in FMS operation and are displayed to indicate the current FMS phase of flight.

The offset (OFS) annunciator is used to indicate when the FMS is navigating an offset path. The selected course for the CDI in VOR operation is displayed at the lower left key and is set using the UFCP.

When the lower left key is pressed, the UFCP page is changed to display the NAV level 1 page. Entry of a new course can be accomplished by entering a new value with the number keys and then pressing the ENT key.

GROUND SPEED

The ground speed indicator indicates the current aircraft speed with respect to ground. In the event of receiving invalid data, the ground speed digital readout is substituted by three amber asterisks and, in the event of a failure, the label "GS" becomes red and the digits are replaced with a single large red "X".

TRUE AIRSPEED

The true airspeed indicator displays the true speed of the aircraft through the air (in knots) which is calibrated airspeed corrected for pressure altitude and temperature.

WIND SPEED AND DIRECTION

The wind speed and direction indicator consists of a rotating arrow that shows wind direction and a digital readout that shows wind speed. The wind speed readout displays a value between 2 and 99 knots, with values greater than 99 knots displayed as 99+.

NAVIGATION INFORMATION DISPLAY

The navigation information is displayed as OFF, VOR/LOC, TACAN or FMS source. Selection of the navigation source is accomplished by pressing L4, which cycles to the next available navigation source with each successive press of L4. When the navigation source is FMS, the source name is displayed in magenta, VOR/LOC in white.

Navigation Source	Displayed Information		
OFF	Blank	Blank	Blank
FMS	Desired Track	Active Waypoint Identifier	Distance to Active Waypoint
TCN	Tuned TACAN Channel	Active TACAN Identifier	Distance to TACAN
VOR not in ILS Mode	Tuned VOR Frequency	Distance to VOR	Blank
VOR in ILS	Tuned ILS Frequency	Distance to tuned ILS	DME Held Frequency
VOR with DME Hold	Tuned VOR Frequency	Distance to tuned DME	DME Held Frequency

The navigation information is displayed in three lines and all information is displayed in white text, with the exception of the DME distance and frequency if DME hold is on, which is displayed in orange, and the FMS active waypoint identifier, which is displayed in white with a magenta background.

MARKER BEACON ANNUNCIATIONS

The marker beacon annunciations are displayed toward the upper right corner of the HSI section of the PFD, when a localizer frequency is tuned, and are used to indicate overflight of the outer (OM), middle (MM), and inner (IM) marker beacons during an ILS precision approach.

When invalid data is received, the marker beacon legend disappears with no appearance of asterisks.

Accelerometer

The accelerometer scale displays the instantaneous normal acceleration of the aircraft in units of “G” from a minimum airframe value of -3.5G to a maximum airframe value of +7G.

The exact instantaneous value is displayed digitally in the centre of the dial.

The current acceleration readout and pointer both change colour to red when the current acceleration is greater than the maximum airframe value or less than the minimum airframe value.

The accelerometer also displays two pointers that indicate the maximum and minimum G load experienced since the last G reset, with digital readouts at the top and bottom ends of the dial to indicate the values of these loads.

The maximum and minimum load pointers and readouts also change colour to red if they are indicating a value greater than the airframe maximum or less than the airframe minimum value.

Maximum and minimum digital readouts have a range of ±9.9G. Pressing R5 toggles the maximum and minimum load digital readouts display on and off.

G RESET

The maximum and minimum load values on the accelerometer can be reset by using the G reset function at R4. Pressing R4 for at least 1 second resets the function.

The maximum and minimum load values are then reset to the current load value unless they have exceeded the maximum or minimum airframe values in which case they cannot be reset using R4.

In case of receiving invalid data, the needle of the G meter (including max/min G carets, and max/min G digital readouts) disappears from the screen and the digital readout digits are replaced by amber asterisks. In the event of a failure, the G meter needle (including max/min G carets and max/min G digital readouts) are removed (if present) from the display.

Declutter Mode

Three levels of declutter, level 0, level 1, and level 2 are provided on the MFD to control the amount of information shown on the display at a given time. The declutter level can be selected using the UFCP and the current declutter level selection applies to the PFD, NAV, and TSD pages.

When declutter level 1 or 2 is activated, the declutter annunciation is displayed below the HSI compass rose. This annunciation is displayed as the boxed text DCLTR # where # is 1 or 2 depending on the selected declutter level. The information removed from the PFD depends on which declutter level is selected.

Advisory Messages

The messages on the PFD and NAV display are used to indicate certain conditions from the TCAS or the FMS. All of the messages display as coloured text on a black background and illuminate based on certain conditions. The TFC annunciations and EXEC annunciations flash and the other annunciations do not.

NAVIGATION DISPLAY (NAV)

The NAV display provides access to the navigation capabilities of the on-board navigation equipment (FMS, VOR/LOC, DME).

Following a cold start, the NAV page compass rose defaults to ROSE MAP display mode, the active navigation source is FMS, bearing pointer #1 and #2 are slaved to OFF, declutter off, and the NAV page range scale is 40 nm.

Following a warm start, the NAV page compass rose defaults to the display mode that was last active prior to shutdown (ROSE MAP, ARC MAP, or ROSE PLAN), the NAV data sub-page displays the options that were last active prior to shut down (AIRPORT, USER WPT, NAVAID, NDB ON/OFF status).

The NAV page defaults to the last active heading reference mode (either True or Magnetic), the active navigation source is the last active nav source (active at last shutdown of the system), bearing pointer #1 and #2 are slaved to the source that was last active for bearing pointer #1 and #2 (active at last shutdown of the system), and the NAV page range scale is set to the last active range scale (active at last shutdown of the system).

FMS Waypoint Information Display

The waypoint information displays the active FMS waypoint. The FMS waypoint information consists of four elements with titles displayed above them. The first element WPT is the active waypoint, the second DIST is the distance to go to the active waypoint, the third TTG is the time to go to the active waypoint, and the final element ETA is the estimated time of arrival to the active waypoint.

Map Display

The map display is the main element of the NAV display. The map operates in one of three formats:

ROSE MAP, ARC MAP, and ROSE PLAN. Pressing the lower left key allows the pilot to cycle through the available display formats.

The basic components of the map display in rose format are similar to the components of the HSI element of the PFD and when the map display is in arc format there are some changes to the basic components.

When the map display is in the rose map format, the compass rose operates similar to the compass rose on the PFD except the compass rose is expanded to fill the extra available screen space on the NAV display and fixed tick marks are added on the outside of the compass scale at 45°, 90°, 135°, 180°, 225°, 270° and 315° around the scale.

When the map display is in the arc map format, the compass rose operates similar except that only the upper 90° arc of the compass is displayed. This 90° arc is expanded to fill the available screen space, and the fixed outer tick marks are displayed at 30° on either side of the top of the scale.

In rose plan format, the FMS active flight plan is displayed with successive waypoints entered (using PREV or NEXT) as a means to review the route of flight. The rose plan is displayed relative to true north.

HEADING BUG

When the map display is in the rose format, the heading bug operates the same as the heading bug in the PFD. When the map display is in the arc format, the heading bug operates the same as the heading bug in the PFD except that when the bug is not in the upper 90° arc range, half of the bug is displayed at the end of the arc in the direction of the shortest turn to bring the bug into view.

Also, the heading bug caption for entry of the heading bug value is not displayed on the NAV display. Entry of the heading value is entered using the shortcut on the PFD or directly on the UFCP.

BEARING POINTERS

The bearing pointers on the NAV display operate the same as the bearing pointers in the PFD except that in the arc format the head or tail of the pointer is only displayed if it is pointing to a value within the 90° range.

FLIGHT PLAN

Flight plan routes are shown on the map display as a series of waypoints connected by solid lines. The active waypoint and flight plan leg are displayed in magenta. All other flight plan waypoints and legs are displayed in white.

Flight plan waypoints and legs are displayed at the appropriate bearing and distance from the aircraft reference symbol on the compass rose (or compass arc) based on the selected map display range and the current aircraft heading.

WAYPOINTS

Off-route waypoints are also displayed on the map display, and these can include user waypoints or International Civil Aviation Organization (ICAO) waypoints from the active FMS database.

Up to 10 ICAO waypoints can be displayed on the map display at a time; if there are more than 10 ICAO waypoints within the current map display range, the 10 nearest to the aircraft are displayed.

CURRENT RANGE

The current map display range is shown at R3 and R4 with the caption RNG on the compass rose, arc and rose plan page. Pressing R3 and R4 cycles the display through the available range options 5, 10, 20, 40, 80, 160, and 320 nm.

Map Display Control

The line select keys are provided to control the NAV compass rose and ARC displays to allow the pilot to change some of the information displayed or to allow access to NAV sub-pages.

MAP DISPLAY DATA

The map display data can be managed by pressing L4 labelled DATA. This displays the associated sub-page where the pilot can remove, by toggling on or off, a selected off-route waypoint from the display.

These waypoint types include airports (AIRPORT), waypoints (USER WPT), VHF navaids (NAVAID), and non-directional beacons (NDB).

NAVIGATION INFORMATION DISPLAY AND SOURCE SELECTION

The navigation information display is located to the left of the map, with the navigation source aligned at L3 and the navigation information directly above at L2.

Selection of the navigation source is accomplished by pressing L3, which cycles to the next available navigation source, rotating through the available sources with each successive button press. The selected source is displayed as OFF, FMS, VOR/LOC, or blank.

The navigation information is displayed in three lines, with the content of the lines depending on the selected navigation source. L2 has functions in addition to the display of the navigation information.

Pressing L2 when the current navigation source is FMS navigates to the FMS LEGS sub-page, and pressing L2 when the current navigation source is VOR or LOC causes the UFCP page to be changed to display the NAV level 1 page with the selected course window selected for entry.

Entry of a new course on the UFCP can be accomplished by turning the UFCP data entry knob until the new value is reached or by entering a new value with the number keys then pressing the ENT key.

The selected course presented on the UFCP and L2 changes as the UFCP data entry knob is rotated.

EMERGENCY LOCATOR TRANSMITTER (ELT)

The aircraft is equipped with an emergency locator transmitter (ELT) system which includes an ELT switch panel, in the front cockpit only, and an ELT transmitter mounted in the tail cone.

The ELT switch has two positions, ON and ARM. The ON position is used to test the function of the ELT transmitter, or manually activate the transmitter.

The ARM position is the normal in-flight position. With the ELT switch in the ARM position, the system is armed to activate in the event of an impact. A transmit annunciator, placarded XMT, illuminates when the ELT switch is set to ON, to indicate the ELT is transmitting.

An impact switch in the remotely mounted ELT transmitter senses any impact loads and activates the transmitter. When activated by the cockpit ELT switch, or by the impact switch in a crash, the transmitter broadcasts on 121.5 MHz and 406 MHz with a unique downward sweeping audio tone.

Power for the ELT comes from an internal battery. The battery allows the ELT to transmit for at least 50 hours.

STANDBY VHF CONTROL HEAD

The standby VHF control head, provides control of VHF radio communications independent of the integrated avionics system. Pushing the function selector knob, placarded PWR, turns on the VHF control head.

Rotating the MODE knob to TST inhibits the automatic squelch circuit permitting receiver noise to be heard, which confirms the receiver is operational. The TX annunciator in the upper left display area indicates that VHF communications is being transmitted.

NOTE

- *When the standby VHF control head is tuned on, REMOTE will be displayed on W2 of the UFCP NAV persistent page.*

The knob, placarded COM2, on the audio control panel must be in the out position to hear the received VHF transmissions in the headset. The VHF transmission is only heard in the cockpit where the COM2 knob is pulled.

Received VHF audio volume is controlled by rotating the audio panel COM2 knob counterclockwise to decrease the volume and clockwise to increase the volume.

Pushing the frequency selector switch interchanges the active and standby frequencies.

Pushing and holding the frequency selector switch down for 2 or 3 seconds causes the standby frequency, second set of numbers, to disappear allowing the active frequency, top set of numbers, to be changed.

The active frequency is changed by rotating frequency selector knobs. The outer knob tunes the transceiver frequency in 1 MHz increments and the inner knob tunes the frequency in 25 kHz increments. Pushing and holding the switch for 2 or more seconds restores the standby frequency display. In the event of a total display failure, pushing and holding the switch for 7 seconds tunes the transceiver frequency to 121.500 MHz

NOTE

- *Standby VHF control is turned off by pushing and holding the function selector knob for 5 seconds.*

LIGHTING SYSTEM

INTERIOR LIGHTING

All instruments, control panels, and displays in both cockpits are lighted for operation during night or reduced light conditions. Additionally, area lights are provided near the circuit breaker panels in each cockpit.

All lighting within the cockpits, except for the electronic displays, is blue/white in colour. All switches and placards required for safe flight are also illuminated.

Balanced lighting output from the instruments, control panels, and displays can be adjusted and maintained throughout the dimmable range.

Balanced lighting is accomplished by dimming controls for the instrument panel, area lighting, and side console lighting, located on the trim control panel in each cockpit.

Instrument panel lighting is controlled by a rheostat knob placarded INST. Area lighting is controlled by a rheostat knob placarded FLOOD. Side panel lighting is controlled by a rheostat knob placarded SIDE. Knee board lights are located on each side of the forward and aft glare shield and are controlled individually.

To set minimum dimming, turn the instrument panel and/or side panel dimming rheostats clockwise to ensure all electroluminescent panels are illuminated, then adjust counter clockwise until desired minimum level is set.

Ensure all panels remain illuminated.

Area Lighting

Area lighting is controlled by a dimming rheostat (FLOOD) located on the forward left console of each cockpit. Rotation allows variable adjustment of the area lights.

Power for the area lighting is provided through a circuit breaker, placarded FLDT, located on the battery bus circuit breaker panel in each cockpit.

Instrument Panel Lighting

Instrument panel lighting and console lighting are controlled by two dimming rheostats located on the forward left console of each cockpit. One control is for the instrument panel (INST), and the other is for the side consoles (SIDE).

Rotation allows variable adjustment of the panel lights. Power for the instrument panel lighting is provided through a circuit breaker, placarded INST, located on the battery bus circuit breaker panel in the front cockpit, and a circuit breaker, placarded INST LT, located on the battery bus circuit breaker panel in the rear cockpit.

Power for the console lighting is provided through a circuit breaker, placarded SIDE, located on the generator bus circuit breaker panel in the front cockpit, and a circuit breaker, placarded SIDE LT, located on the generator bus circuit breaker panel in the rear cockpit.

Utility Light

A utility light is provided on the right console of each cockpit. This light can be detached and relocated to the right canopy rail for use as an area light or map light, or the light may be detached as required for local illumination.

The utility light is powered through a coil cord to allow freedom of movement to any position in the cockpit. A variable dimmer with an OFF position is an integral part of the utility light, as is a selectable red lens for preserving night vision.

Power for the utility lights is provided through a circuit breaker, placarded UTIL, located on the battery bus circuit breaker panel in the front cockpit, and a circuit breaker, placarded UTIL LT, located on the battery bus circuit breaker panel in the rear cockpit.

Knee Board Lights

Knee board lights are mounted on the front of each forward and aft glare shield. The knee board lights are controlled individually. Each light is turned on when the light assembly is positioned downward for usage and turned off when moved to the stowed position.

Light intensity may be adjusted by rotating the bezel assembly. Each knee board light is swivel mounted and can be repositioned for convenience.

Power for the knee board lights is provided through circuit breakers, placarded UTIL in the front cockpit and UTIL LT in the rear cockpit. The circuit breakers are located on the battery bus circuit breaker panel in each cockpit.

EXTERIOR LIGHTING

The aircraft is equipped with exterior lighting that meets the requirements for operation of the aircraft during night and low light conditions.

Landing and Taxi Lights

The landing light is located aft and inboard of the left main landing gear strut, and is exposed as the landing gear is extended. The landing light is oriented to provide ground illumination and visibility during landing.

The landing light illuminates only when all three gear are down and locked.

Control of the landing light is through a toggle switch, placarded LDG, located on the trim control panel in the front cockpit. The landing light control switch head features three bumps to assist in identifying the switch by feel.

Power for the landing light is provided through a circuit breaker, placarded LDG, located on the battery bus circuit breaker panel in the front cockpit.

The taxi light is located aft and inboard of the right main landing gear strut and is exposed as the landing gear is extended. The taxi light is oriented to provide ground illumination and visibility during landing and taxi operations.

The taxi light illuminates only when all three gear are down and locked.

Control of the taxi light is through a switch, placarded TAXI, located on the trim control panel in the front cockpit. Power for the taxi light is provided through a circuit breaker, placarded TAXI, located on the generator bus circuit breaker panel in the front cockpit.

Navigation and Anti-Collision Strobe Lights

The navigation lights include a red light installed at the leading edge of the left wing tip, a green light installed at the leading edge of the right wing tip, and a white light installed at the trailing edge of each wing tip.

The navigation lights are controlled by a switch, placarded NAV, located on the trim control panel in the front cockpit.

Power for the navigation lights is provided through a circuit breaker, placarded NAV, located on the generator bus circuit breaker panel in the front cockpit.

The anti-collision strobe lights are installed on each wing tip near the leading edge.

The anti-collision strobe lights are controlled by a switch, placarded ANTI-COLL, located on the trim control panel in the front cockpit.

Power for the anti-collision strobe lights is provided through a circuit breaker, placarded COLL, located on the battery bus circuit breaker panel in the front cockpit.

SYSTEM/LAMP TEST PANEL

A system/lamp test panel is located aft of the CFS handle panel on the left console panel in the front cockpit. The system/lamp test panel includes the following momentary switches:

- A lamp test switch which illuminates LAMP TEST status messages on the EICAS display; the master caution, master warn, and fire annunciators; the landing gear control handle and gear lights; the transmit lights on the audio control panel; and FDR lights.
  A lamp test switch for the rear cockpit lamps is located on the left console panel in the rear cockpit.

- An auxiliary battery test switch which checks the voltage of the auxiliary battery and the AUX BAT light. Turn the BAT switch ON and then hold the AUX BAT test switch. If the light illuminates when the switch is activated, the auxiliary battery is charged to an acceptable level and is flight capable.
  If the light does not illuminate, the auxiliary battery is at less than 50% capacity.

- An AOA system test switch which, when set to HIGH, configures the AOA indexers, indicator, and stick shaker indications to simulate a high AOA condition.

When set to LOW, the switch configures the AOA indexers and indicator to simulate an on-speed AOA condition.

- A fire detection system test switch which tests the condition of the fire detection system and FIRE warning light. If the FIRE warning light illuminates when the test switch is set to either 1 or 2, the system is functional.

- Altitude and landing gear
- Over SPD and over G
- Bingo fuel

Power for the system test panel is provided through a circuit breaker, placarded TEST, located on the generator bus circuit breaker panel in the front cockpit.

ON-BOARD OXYGEN GENERATING SYSTEM (OBOGS)

NOTE

- *OBOGS operation with mask down or loose fitting may induce OBOGS fail warning. If OBOGS fails with mask down or loose, secure mask. If fault does not automatically clear after securing mask, perform I-BIT check. If I-BIT check passes, no further action is required.*

The aircraft has an on-board oxygen generating system (OBOGS). The OBOGS provides each pilot with an automatically regulated oxygen supply which has a slight positive pressure and no duration limitations.

Oxygen is extracted from conditioned bleed air by pressure swing absorption using a molecular sieve. The OBOGS distribution network includes a plenum which provides a limited supply of oxygen in the event of OBOGS failure.

Duration of the plenum supply is based upon cockpit pressurization, aircraft pressure altitude, pilot regulator settings and pilot demand. If the OBOGS fails, emergency oxygen is provided by manually selecting the ejection seat oxygen supply.

Seat oxygen is supplied through the CRU-60/P connector. If an OBOGS failure occurs, the anti-suffocation valves allow the pilot to breathe cockpit ambient air.

Control of the OBOGS is provided for each cockpit with a panel-mounted oxygen pressure regulator. OBOGS is powered from the hot battery bus and has no pilot resettable circuit breaker.

WARNING

- *Inflight engine failure and/or total loss of electrical power will result in a loss of bleed air supply to the OBOGS concentrator and subsequent OBOGS failure.*

- *Emergency oxygen is available by pulling the green handle on the left side of the ejection seat.*

- *The OBOGS concentrator may malfunction, resulting in zeolite dust in the breathing system without warning illumination. Indications of the malfunction include respiratory irritation, coughing, or the presence of white dust in the oxygen mask. Adequate oxygen concentration is still available to the pilots.*

- *Prolonged inhalation of zeolite dust should be avoided.*

A warning and caution illuminates in each cockpit to indicate OBOGS status. The red OBOGS FAIL warning illuminates to indicate low bleed air pressure upstream of the concentrator, low concentration of oxygen, or an internal failure detected by the OBOGS BIT.

Prior to engine start or with a loss of bleed air, the OBOGS FAIL warning illuminates due to the OBOGS low pressure switch closing from lack of bleed air pressure. The warning extinguishes once the bleed air line is pressurized.

When first activated, the OBOGS power up BIT is initiated and the system enters a sensor warm-up period which lasts approximately 3 minutes, during which the OBOGS FAIL warning is inhibited.

After the 3 minute warm-up, the OBOGS FAIL warning illuminates if a failure is detected during the self-test, or during operation, and remains illuminated until the failure is cleared by the self-test or by resetting the regulators.

WARNING

- *Following OBOGS deactivation or loss of electrical power, concentration monitor activation of the OBOGS FAIL light will be inhibited for 3 minutes during OBOGS warm-up.*
- *There is no indication of OBOGS concentration failure status during this warm-up period. The low pressure switch will still activate the OBOGS FAIL warning during the warm-up period.*

If the temperature in the OBOGS ducting exceeds 200 °F, the OBOGS TEMP caution illuminates.

OXYGEN PRESSURE REGULATOR

A panel-mounted oxygen pressure regulator is installed on the right side console of each cockpit. Each regulator has a supply lever, a concentration lever, a pressure lever, a built in test (BIT) button, a flow indicator (blinker), and a maximum concentration light. Each regulator panel controls OBOGS electrical power and oxygen flow for the respective cockpit.

In the event of hypoxia symptoms, or loss of cabin pressure, the regulator can be “gang-loaded” to provide high oxygen content, pressurized breathing by placing the supply lever to ON, the concentration lever to MAX, and the pressure lever to EMERGENCY.

Oxygen Pressure Regulator Supply Lever

The supply lever has two positions, placarded ON and OFF. When set to OFF, OBOGS electrical power and oxygen flow are cut off to the respective regulator. However, if the supply lever for either regulator is ON, the OBOGS system is operative. Both supply levers must be OFF to disable the OBOGS system.

Oxygen Pressure Regulator Concentration Lever

The concentration lever has two positions, placarded NORMAL and MAX. When the lever is set to the NORMAL position, the regulator directs the OBOGS concentrator to provide the proper oxygen concentration for the present altitude.

Oxygen concentration with the lever in NORMAL position ranges from 25 to 70% for altitudes from sea level to 15,000 feet MSL, and from 45 to 95% for altitudes from 15,000 to 31,000 feet MSL.

When the concentration lever for either regulator is set to MAX, the OBOGS concentrator supplies the highest possible oxygen concentration (95% oxygen, 5% inert gas) to both regulators.

The maximum concentration light illuminates any time either concentration lever is in the MAX position.

Oxygen Pressure Regulator Pressure Lever

The pressure lever has three-positions placarded, respectively, EMERGENCY, NORMAL, and TEST MASK. The EMERGENCY position supplies the pilot with the positive pressure necessary during emergency situations such as cockpit fires or hypoxia symptoms. When the lever is set to NORMAL, the regulator supplies a slight positive pressure in addition to the pressure demanded by the pilot through the mask.

The TEST MASK position supplies highly pressurized flow to check the face-to-mask seal.

Oxygen Pressure Regulator BIT Button

The built in test (BIT) button is used to activate the initiated OBOGS BIT (I-BIT) any time after engine start and the 3 minute warm-up. The I-BIT provides verification that the OBOGS sensor and OBOGS FAIL warning are operating properly.

Momentarily pushing the BIT button opens a valve in the concentrator, which allows ambient air into the concentration monitor. Once the oxygen concentration drops below normal (approximately 20 to 30 seconds), the OBOGS FAIL light should illuminate.

Once the valve closes and oxygen concentration in the monitor returns to normal, the OBOGS FAIL warning should extinguish within 2 minutes.

Oxygen Pressure Regulator Flow Indicator

The regulator flow indicator provides a visual indication of oxygen flow through the regulator. Each breath taken through the regulator activates the flow indicator, which is displayed for the duration of the flow.

BAGGAGE COMPARTMENT

Up to 80 pounds of baggage may be stowed in the baggage compartment behind the left avionics bay. The baggage compartment door is a top-hinged door which opens upward.

A cargo net is installed to secure any objects in the baggage compartment. A flight bag is secured to the forward bulkhead in the baggage compartment.

The flight bag is designed to accommodate the inlet duct covers, exhaust cover/prop restraints, pitot tube covers, and the AOA probe cover.

SECTION 2

NORMAL PROCEDURES

TABLE OF CONTENTS

FLIGHT PLANNNING

Flight planning data, including take-off performance, fuel required, cruise data, and other information required to complete the proposed mission, may be determined from the appropriate performance charts in Appendix A.

Communication requirements are determined from appropriate flight planning and flight information publications.

WEIGHT AND BALANCE

It is the pilot's responsibility to operate the aircraft within the weight and balance limitations specified in Section 3, Operating Limitations.

CREW COORDINATION

INTRODUCTION

A thorough understanding of crew coordination and responsibilities is essential. General requirements for crew resource management (CRM) are directed in applicable service CRM instructions.

CONTROL OF AIRCRAFT AND SYSTEMS

During operations with two pilots, the opportunity for confusion concerning control of the aircraft and aircraft systems exists. A thorough pre-flight briefing and use of standardized procedures will reduce this hazard.

Passing control of the aircraft or aircraft subsystems will be accomplished by positive verbal communication over the ICS. In the event of ICS failure, the pilot requesting control will shake the control stick, and the pilot relinquishing control will raise both hands.

Other examples of systems or actions which require crew coordination include operation of the canopy, brakes, and communication and avionics configuration and operation.

PROCEDURES

NORMAL CHECKLIST

The procedures presented in this section of the manual are for flight crew actively participating in the operation of the aircraft. Essential steps or items which are to be checked in both cockpits, if occupied, are indicated by (BOTH) following the step.

PREFLIGHT BRIEFING

The following discussion of pre-flight briefing requirements is a recommendation of the minimum information that a pre-flight briefing should include, but is not meant to replace local guidelines.

The pilot in command should give a pre-flight briefing for all participating flight crew and ground crew members (if applicable) regarding mission plan and individual responsibilities.

The briefing should include the following items:

1. Communications and Crew Coordination

    a. Frequencies

b. Radio procedures and discipline

c. Change of control of aircraft

d. Navigational aids

e. Identification

f. Clearing procedures

2. Weather

a. Local area

b. Local area and destination forecast

c. Weather alternate

3. Navigation and Flight Planning

a. Climb out

b. Mission planning, including fuel management

c. Penetration

d. Approach/missed approach

e. Recovery

4. Emergencies

a. Aborts

b. Divert fields

c. Minimum and emergency fuel

d. Loss of power

e. Radio failure/ICS failure

f. Loss of sight/lost wingman

g. Downed pilot and aircraft

h. Bird strike

i. Other aircraft emergencies

j. Ejection

PREFLIGHT CHECK

It is the responsibility of the pilot in command to ensure that an exterior and interior inspection and a pre-flight inspection have been performed as outlined. It also is the responsibility of the pilot(s) to accomplish individual inspections outlined in this section.

Upon arrival at the aircraft, the pilot will check with the ground crew to ensure that the aircraft is ready for pre-flight.

These checks are based on qualified personnel having performed all required maintenance post flight and pre-flight inspections. Review appropriate aircraft maintenance records for general aircraft status and for compliance with maintenance inspection requirements.

INTERIOR INSPECTION

REAR COCKPIT (SOLO FLIGHT)

1. Ejection seat – Inspect:

    a. Seat safety pin – Installed and warning streamer is free and clear of ejection seat handle (BOTH)

2. CFS handle safety pin – Installed

3. ISS mode selector – SOLO

    (Verify ISS mode selector lever is locked in SOLO.)

4. Left console circuit breakers – Check in

5. TRIM DISCONNECT switch – NORM

6. Interior lighting – OFF

7. Audio panel – NORM; Volume and VOX knobs - In

8. BAT and GEN switches – OFF

9. STARTER switch – NORM

10. IGNITION switch – NORM

11. BOOST PUMP switch – ARM

12. EVAP BLWR control – As required

13. OBOGS – OFF:

    a. OBOGS supply lever – OFF

    b. OBOGS concentration lever – NORMAL

    c. OBOGS pressure lever – NORMAL

14. Right console circuit breakers – Check in

15. Rear cockpit tie down (solo flight) – Complete as follows:

    a. Solo strap – Attach upper loops to parachute risers and lower loops to lower KOCH fittings.

    b. Oxygen hose/emergency oxygen hose/intercom leads – Route through lower loops of solo strap.

c. Lap straps – Pull tight and wrap solo strap around excess lap strap material.

d. Leg restraints – Fasten leg restraint garters around oxygen hose, emergency oxygen hose, and lap strap bundle (Pull excess leg restraint line tight through leg restraint snubber unit)

e. Ejection seat shoulder harness – Ensure seat harness is fully retracted and shoulder harness control lever is in locked position.

f. Ejection seat – Full down

g. CFS handle safety pin – Tie warning streamer to leg restraint lines.

h. Control stick boot collar – Check for possible restriction to control stick movement.

16. Map containers – Closed

17. Loose articles – Removed and stowed

COCKPIT (ALL FLIGHTS)

1. Strap in – Complete (BOTH)

(Shoulder straps, leg restraint garters, anti-G hose, lap straps, parachute risers, oxygen connections, and communications leads connected; helmet on; visor down.)

(With parachute risers connected, lean forward to full extension of inertia reel straps and then sit back. If inertia reel straps do not fully retract (i.e., if the straps leave any slack), or if binding occurs, notify egress specialist prior to flight.)

2. BAT switch – ON

3. Anti-suffocation valve – Check (BOTH)

(If valve is functioning properly, it will be possible to breathe through valve when you inhale deeply.)

4. External power – As required

5. Seat height – Adjust

6. Rudder pedals – Adjust

7. Flight controls – Check (BOTH)

    (Visually check for free and correct movement and verify full control range is available at selected seat height.)

8. Fire detection system – TEST (FIRE 1 and FIRE 2) (BOTH)

9. LAMP test switch – Check (BOTH)

    (Check for MASTER WARN and MASTER CAUTION [front cockpit only], red gear handle, red and green gear, FDR lights, gear door lights, fire lights, and COM 1 and COM 2 transmit illuminate and LAMP TEST on EICAS.)

10. Flaps – UP

11. Exterior lights – OFF

12. TRIM DISCONNECT switch – NORM (BOTH)

13. Interior lights – As required

14. TRIM AID switch – OFF

15. Trim operation – Check (BOTH):

    a. Aileron, elevator, and rudder trim – Check

    b. Elevator and aileron trim – Set for T/O

    (Set elevator and aileron trim to respective green ranges.)

c. Rudder trim – Set outside green range.

    (Set rudder trim out of green range to check/verify correct TAD operation during the Before Taxi checklist.)

16. EMER LDG GR handle – Check stowed

17. MASTER ARM switch – Safe

18. Clock – Set

19. UFCP lower panel switches – Set:

    a. HUD TEXT/FPM UNCAGE/CAGE – CAGE

    b. LGT NIGHT/DAY/AUTO HUD – AUTO HUD

    c. MFD/UFCP/REPEAT/NORM – NORM

    d. LGT-BRT – As required.

e. LGT-UFCP – As required.

20. Audio panel – As required

21. DEFOG switch – Off

22. ELT switch – ARM

23. PARKING BRAKE – Reset

24. Chocks – Removed

25. GEN switch – OFF (BOTH)

26. FUEL BAL switch – AUTO

27. MANUAL FUEL BAL switch – OFF

28. AVIONICS MASTER switch – OFF

29. BUS TIE switch – NORM

30. PROBES ANTI-ICE switch – Check; OFF

    (Turn probes anti-ice switch ON momentarily to check function, then OFF. Check for ANTI ICE EICAS message and amperage draw increases.)

31. BOOST PUMP switch – Check; ARM

    (Turn BOOST PUMP switch ON momentarily to check function, then ARM. Check BOOST PUMP EICAS message and amperage draw increases.)

32. PMU switch – NORM (lever locked)

33. EVAP BLWR control – As required

34. AIR COND switch – As required

35. BLEED AIR INFLOW switch – OFF

36. PRESSURIZATION switch – NORM (guarded position)

37. RAM AIR FLOW switch – As required

38. TEMP CONTROL switch – AUTO

ENGINE START

CAUTION

- *Do not connect external power if battery voltage is below 22.0 volts. Connecting external power could cause damage to the aircraft battery.*

NOTE

- *The primary method for engine start is battery power.*
- *External power may be used to perform a normal engine start. External power shall be used to perform a normal engine start if battery voltage is less than 23.5 volts. Also, consider using external power when motoring the engine.*

HIGH IOAT AT START >80 °C.

The aircraft IOAT indication is generated by a sensor located in the engine inlet plenum. It is possible, during periods on the ground after engine shutdown, that radiant heat from the engine may heat soak the IOAT sensor, raising IOAT beyond ambient temperatures.

When this occurs and IOAT is greater than 96 °C but less than 121 °C, the PMU will default to 121 °C for all PMU functions (including IOAT display).

If IOAT does not exceed 96 °C, the PMU will use the indicated value. If the PMU is activated with IOAT above 96 °C, IOAT and ITT data will be invalid (red Xs in counter display and missing ITT pointer) and EDM FAIL will be displayed in the bottom of the EICAS display.

IOAT and ITT will remain invalid until the PMU is reset (PMU switch cycled from NORM to OFF and back to NORM). Once the PMU is reset, IOAT and ITT displays should return to normal and the EDM FAIL message should be removed.

NOTE

- *The EDM FAIL message indicates that the engine indicating system has accommodated a fault. Parameters with the EDM FAIL message which do not display red X's and/or missing pointers are functional and may be used normally.*

If IOAT exceeds 121 °C, the PMU will flag the IOAT signal, lose the ability to calculate ITT, and go offline. This condition is indicated by red Xs in the IOAT and ITT counters, removal of the ITT pointer on the EICAS display, and by illumination of the PMU FAIL warning.

The PMU will not rest until IOAT drops below 121 °C. Use the following procedure if IOAT exceeds 80 °C:

1. PCL – Verify OFF
2. PMU – Reset if necessary

   (The PMU has reset if IOAT reads 121 °C or less, the ITT counter and pointer are present on the EICAS display, and the EDM FAIL message is not displayed.)

3. PMU switch – OFF
4. Propeller area – Clear
5. STARTER switch – MANUAL for 20 seconds maximum

   (Observe starter duty cycle cool-down period.)

6. STARTER switch – NORM
7. PMU switch – NORM
8. Verify IOAT indicates 80 °C or less
9. Repeat steps 4 through 8 as necessary
10. Continue with Engine Start (AUTO) procedure

ENGINE START (AUTO)

1. Canopy – Closed and latched (BOTH)

   (Check CANOPY warning extinguished, green canopy mechanical lock indicators visible, and handle does not rotate aft.)

2. Navigation and anti-collision lights – As required

NOTE

- *Anti-collision strobes may be left off if operation is distracting, such as for ground operations at night.*

3. PMU FAIL/PMU STATUS message – Extinguished

(If PMU FAIL or PMU STATUS messages are illuminated, set PMU switch to OFF, then NORM.)

4. PCL – Advance to start position (ST READY advisory)

5. Propeller area – Clear

6. STARTER switch – AUTO/RESET

7. Engine instruments – Monitor and check

8. PCL – Advance past two clicks, then IDLE, at or above 60% N1

9. External power – Disconnect (if used)

BEFORE TAXI

1. GEN switch – ON, warning extinguished

2. AUX BAT switch – ON

3. BLEED AIR INFLOW switch – NORM

4. EVAP BLWR control – As required

5. AIR COND switch – As required

NOTE

- *For hot day operations, optimum cockpit cooling is achieved by selecting RAM AIR FLOW switch to OFF and AIR COND switch to ON.*

6. AVIONICS MASTER switch – ON

NOTE

- *After turning ON the GENERATOR switch, allow approximately 10 seconds before turning ON the AVIONICS MASTER switch to allow battery amperage to stabilize.*

7. Oxygen mask – On and secure

8. OBOGS – Check (BOTH):

   a. OBOGS supply lever – ON

   b. OBOGS concentration lever – NORMAL

c. OBOGS pressure lever – Check EMERGENCY (increased pressure) then back to NORMAL

d. Check flow indicator for normal operation (BOTH)

NOTE

- *After initial power-up, the OBOGS FAIL annunciator will be inhibited for 3 minutes during OBOGS monitor warmup.*

9. Anti-G test – Depress as required (BOTH)

(Verify that anti-G suit inflates when test switch is pressed and deflates when test switch is released.)

10. System test panel – Check:

a. LAMP test switch – Check (BOTH)

b. AOA system test switch – Test:

(1) LOW – Amber donut, 10.5 units

(Check AOA indexer amber donuts illuminate, red chevrons deactivate, and AOA indicators show 10.5±0.4 units.)

(2) HIGH – Green chevron, stick shaker, 18 units

(Check AOA indexer green chevrons illuminate, stick shaker activates, and AOA indicators show 18±0.4 units and text transitions to red.)

c. ALT audio switch – Test

d. LDG GR audio switch – Test

e. OVR SPD audio switch – Test

f. OVR G audio switch – Test

g. BINGO FUEL audio switch – Test

11. Speed brake – Check (ground crew observer if available) (BOTH)

(Check EICAS message present when extended.)

12. Flaps – Check (ground crew observer if available) (BOTH):

    a. Set flaps LDG – Verify flaps move to LDG, indicator reads LDG, and speed brake retracts (message extinguishes)

    b. Set flaps TO – Verify flaps move to TO and indicator reads TO

    c. Attempt to extend speed brake – Verify speed brake does not extend.

13. TRIM AID switch – ON:

    a. Verify TAD OFF message extinguished.

    b. Verify yaw (rudder) trim set-in green range (T/O)

14. PARKING BRAKE – Release

15. Nose wheel steering – ON

    (Limit taxi speeds to the equivalent of a fast walk with nose wheel steering engaged.)

16. Brakes – Check (BOTH)

17. FMS – Check

18. TCAS – ON/TEST

19. UFCP and MFD – Set flight information as required:

    a. INS/GPS – Aligned and location crosschecked.

    b. UHF – As required.

    c. VHF – As required.

    d. VOR – As required.

    e. Transponder – Standby

    f. FMS – As required.

    g. Altitude, G, speed, fuel flags – Set (as required)

20. Flight Instruments – Check pitch, roll, and heading indications, and no flags

21. Altimeters – Set and check (BOTH)

22. Seat safety pin – Remove and stow (as required)

    (show to ground crew observer if available) (BOTH)

23. ISS mode selector – SOLO

24. EICAS display – Check (BOTH)

25. Landing/taxi lights – As required

TAXI

All turns should be made at slow speeds using a minimum of inside wheel braking when taxiing. Limit taxi speeds to the equivalent of a fast walk with nose wheel steering engaged.

On the ground, propeller speed (NP) is a function of PCL position, ambient temperature and pressure, taxi speed, and wind velocity. To stay out of the NP restricted range, advance or reduce PCL setting. Once the aircraft is rolling, idle PCL setting provides sufficient thrust for taxi.

NOTE

- *Minimum radius turns are possible through use of power, full rudder, and differential braking. To preclude unnecessary wear to nose wheel steering and tire, disengage nose wheel steering prior to executing sharp turns with differential braking.*
- *To re-engage nose wheel steering, actuate the nose wheel steering switch prior to applying opposite rudder. Failure to do so may result in nose wheel steering not engaging.*
- *To prevent ground resonance within the propeller, stabilized operation of the propeller in the 62 to 80% NP range is prohibited on the ground.*
- *If brake pressure appears to fade during application, or brakes are not responding as expected, fully release brakes then re-apply.*
- *Both crew members must fully release brakes for this to be effective.*

1. Heading and turn and slip indicators – Proper indications

OVERSPEED GOVERNOR CHECK

Any fault discovered during this check is reason for ground abort. Complete this check in a non-congested area. Monitor oil temperature, and attempt to park facing into the wind for extended ground operations.

NOTE

- *If conditions permit, park aircraft facing into the wind prior to beginning overspeed governor check to enhance oil cooling and reduce engine operating temperatures.*

1. Brakes – Hold as required
2. PCL – IDLE
3. PMU switch – OFF (Verify idle N1 stabilizes between 60 to 70%)
4. PCL – Advance to 100±2% NP (approximately 30% torque) and allow engine to stabilize

   (Verify that propeller remains in governed range with PMU off.)

CAUTION

- Advancing the PCL prior to engine stabilizing with PMU OFF or too rapidly may cause high ITT and engine overtemperature.

5. PCL – Advance slightly and verify NP remains 100±2%
6. PCL – IDLE
7. PMU switch – NORM

   (Verify PMU FAIL message extinguishes, NP returns to 46-50% NP and N1 returns to 60-61%.)

BEFORE TAKE-OFF

1. Minimum power at 60 KIAS – Compute

2. Speed brake – Retracted

3. Flaps – TO

4. Trim – Set for take-off

    (Set all three trim positions to indicate within the green ranges on the trim indicator.)

5. MFD/UFCP/REPEAT/NORM select switch – As required

6. Fuel quantity and balance – Check

7. Engine instruments – Check

8. DVR control – As required

9. Amps – Verify +50 amps or less

10. DEFOG switch – OFF

11. Seat safety pin – Confirm removed and stowed (BOTH)

12. ISS mode selector – As required (Verify ISS mode selector lever is locked in desired detent)

LINEUP CHECK

1. Landing/taxi light – ON

2. Transponder – Mode to ALT

3. Nose wheel steering – Off

4. PROBES ANTI-ICE switch – ON

CAUTION

- *Prolonged use of pitot and AOA heat while on the ground will damage the pitot and AOA heating elements.*

5. EICAS display – Check (BOTH)

TAKE-OFF

NORMAL TAKE-OFF

Upon runway lineup, hold brakes, ensure nose wheel is centered, and disengage nose wheel steering. At pilot's discretion, accomplish either a static runup (30% torque) prior to brake release or execute a rolling take-off.

Once brakes are released, smoothly advance PCL to MAX and cross check engine instruments. Expect a slight amount of right rudder on take-off, even with the TAD engaged.

At VR initiate rotation to 14-16° pitch attitude. If gusty winds are present, increase rotation speed by 1/2 the gust factor (up to 10 knots) in accordance with gust increment recommendations.

Distances from performance charts are predicated on setting 30% torque, releasing brakes and setting take-off power.

CROSSWIND TAKE-OFF

Under crosswind conditions, the aircraft will tend to weather-vane into the wind. The weather-vaning tendency can be controlled with rudder and aileron. Crosswind controls become more effective as airspeed increases.

Use up to full aileron deflection at the beginning of the take-off roll and relax aileron input as speed increases to the amount required to keep wings level at liftoff.

Care should be exercised to prevent inducing an excessive wing low attitude at liftoff. After liftoff, correct for drift. Refer to the Take-off and Landing Crosswind chart in Appendix A.

INSTRUMENT TAKE-OFF (ITO)

Follow normal take-off procedures. Ensure minimum climb gradient requirements are met. Anti-collision/strobe lights, landing light, and taxi light may be turned off if distracting during instrument conditions.

AFTER TAKE-OFF

With a positive rate-of-climb established, retract the landing gear, and raise flaps as required. For climbs out of the terminal area, adjust pitch attitude as necessary to climb and accelerate to the desired climb airspeed of 140-180 KIAS. Charted climb performance is based on 140 KIAS.

If obstacle clearance or noise abatement are not factors, 160-180 KIAS will result in improved forward visibility during the climb. A lower pitch attitude may also be used to reduce the possibility of disorientation during climbs in instrument meteorological conditions.

NOTE

If climbout obstacles are a factor, rotate to 15° nose high on take-off, raise gear, and maintain VOBS take-off speed until clear of obstacles. Raise flaps when clear of obstacles.

If remaining in the terminal area, this checklist should be accomplished in conjunction with the Before Landing checklist.

1. Gear – UP (BOTH)

NOTE

- *The gear may be raised once a positive rate of climb is established. If remaining in the pattern, the pilot may leave the gear down, but must observe the maximum gear extended speed.*

2. Flaps – UP (as required) (BOTH)

NOTE

- *If the flaps are set to LDG and the gear is raised, the gear warning horn will sound and cannot be canceled. Select flaps TO or UP to cancel the horn.*
- *To avoid excessive stick forces, trim nose down as aircraft accelerates to climb speed.*

CLIMB (PASSING 10,000 FEET)

1. OBOGS – Check flow indicator for normal operation (BOTH)

2. DEFOG switch – As required

NOTE

- *With canopy defog ON, expect an increase in ITT of up to 40 °C for a given PCL setting. Cockpit noise will also increase. Performance will decrease with defog on.*

A DUCT TEMP indication is likely at climb or cruise power with canopy defog ON and cockpit temperature controller set to AUTO or MANUAL HOT.

3. Vent control lever – As required

4. Pressurization system – Check

NOTE

- *If readings other than 3.6±0.2 psi are encountered at or above 18,069 feet MSL, notify maintenance after landing.*

OPERATIONS CHECK

At initial level-off and periodically during the flight, perform the following checks:

1. Hydraulic pressure – Check

2. Electrical systems – Check

3. Fuel quantity/balance – Check

4. OBOGS – Check flow indicator for normal operation (BOTH)

5. Engine instruments – Check

6. Pressurization – Check

PRE-STALLING, SPINNING, AND AEROBATIC CHECKS

1. Loose items – Stowed (BOTH)

2. Engine instruments – Check

    (Verify caution and warning messages are extinguished.)

3. Fuel balance – Check less than 50 pounds

DESCENT

The recommended enroute descent procedure is power and configuration as required (200-250 KIAS) and descent rate of 4000 fpm. Descent rates will increase significantly (to 8000-11,000 fpm) with idle power and speed brake extended.

1. PFD – Check (BOTH)

2. Altimeters – Set (BOTH)

3. MASTER ARM switch – As required

4. DEFOG switch – As required

5. Vent control lever – As required

HOLDING

The recommended holding speed is 125-150 KIAS in clean configuration but no slower than maximum endurance speed of 125 KIAS. When fuel endurance is a factor, refer to the Maximum Endurance data.

INSTRUMENT APPROACHES

The aircraft is considered Category "B" for determination of instrument approach minimums.

PENETRATION DESCENT

For a penetration descent, retard the PCL as required to meet a target descent rate (2000-4000 fpm). Attain 200-250 KIAS and use speed brake as required.

LOW ALTITUDE APPROACH

Normally fly instrument approaches at 120-150 KIAS. Prior to the final approach fix, ensure the landing gear is down and flaps are set to TO, and slow to a minimum of 110 KIAS.

With the field in sight and departing the MDA, DA, or DH, slow to 105 KIAS minimum, or the pilot may select landing flaps and slow to 100 KIAS minimum.

Fly GPS approaches using the above airspeeds and configurations.

WARNING

- *The GPS always displays distance to the active waypoint. During GPS approaches, this distance may not be the same as the published DME distance on the instrument approach procedure.*

RADAR APPROACH

Maintain 150-200 KIAS in clean configuration on radar downwind. Slow to 120-150 KIAS on base leg. Prior to glideslope intercept, ensure that landing gear are down and set flaps as required.

Fly final approach at 100-120 KIAS.

CIRCLING APPROACH

Minimum recommended speed prior to final approach is 115 KIAS with gear down and flaps set to TO.

MISSED APPROACH

Smoothly advance PCL to MAX power and retract the speed brake (if extended). Set attitude to 10-15° nose high and execute air traffic control (ATC) missed approach procedure.

Maintain the landing approach speed until clear of obstacles. Reduce power as required to preclude excessive nose high attitude in actual instrument conditions. Refer to the After Take-off checklist.

BEFORE LANDING

Refer to Appendix A for recommended landing data. The flaps may be set to TO prior to lowering gear.

NOTE

- *Prior to landing, set pressurization switch to DUMP if landing field elevation is above 7500 feet MSL.*

1. DEFOG switch – OFF

2. Engine instruments – Check

3. Gear – DOWN (press down firmly) (BOTH)

    (Check three green annunciators illuminated)

4. Brakes – Check, as required

    (Verify positive pressure by actuating toe brakes)

5. Flaps – As required (BOTH)

6. Speed brake – Verify retracted

NOTE

- *Setting flaps to TO or LDG automatically retracts the speed brake.*
- *If conditions require, the pilot may select defog during climbout from missed approach, go around/waveoff, or touch and go.*

GO AROUND/WAVEOFF

The decision to go around/waveoff should be made as early as possible. Go around/waveoff procedures are similar to missed approach. Refer to the After Take-off checklist.

NORMAL LANDING

Prior to entering the traffic area, slow the aircraft to 200-250 KIAS in a clean configuration.

Cross the threshold with final flap setting and control forces trimmed. Coordinate PCL and pitch attitude to maintain proper airspeed and rate of descent.

Retard the PCL to IDLE once landing is assured. Momentary actuation of the stick shaker may occur just prior to touchdown. Airspeed will be dissipated in the flare, and touchdown will normally occur approximately 7 knots below the landing approach speed.

Upon touchdown, smoothly lower the nose gear to the runway once airspeed is below 80 knots unless needed to affect stopping distance.

If nose wheel shimmy occurs after the nose wheel contacts the runway, apply back stick pressure to relieve the weight on the nose wheel, then gently release pressure to re-establish nose wheel contact with the runway.

Use rudder and ailerons to maintain directional control.

Continue to apply brakes as required but avoid differential braking during high-speed portion of landing rollout. N1 will automatically reduce from flight idle (67%) to ground idle (60%), approximately 4 seconds after touchdown.

Engage nose wheel steering as required once taxi speed is achieved.

TOUCH AND GO LANDING

Upon touchdown, smoothly advance the PCL to MAX. Anticipate a slight amount of right rudder as torque increases. Rotate at rotation speed.

The landing gear may be left down when remaining in the pattern, but the pilot must observe the maximum gear extended speed.

After liftoff, proceed with the After Take-off checklist.

CROSSWIND LANDING

Crosswind landings require only a slight adjustment of landing technique. Crab as necessary while in the pattern to accommodate crosswind component.

Once transitioned to final, establish a wing low attitude into the wind to counter drift, and maintain runway alignment with rudder. Maintain the wing low attitude and rudder input throughout the flare.

GUSTY WIND LANDING

During gusty wind conditions, increase landing threshold and touchdown speeds by 50% of the gust increment up to a maximum increase of 10 knots. LDG flaps are not recommended during gusty wind conditions.

ANGLE OF ATTACK (AOA) LANDING

Angle of attack (AOA) landings utilize the normal landing pattern in while maintaining optimum AOA throughout the final/approach turn.

On downwind, slow to optimum AOA (on-speed amber donut on indexer) prior to the perch/abeam position. After the perch/abeam position, maintain on-speed AOA with pitch and maintain controlled descent rate with power.

Maintain an appropriate angle of bank and line up on runway centerline.

On final, coordinate stick and power inputs to land at desired touchdown point while continuing to fly on-speed AOA.

Round out and touch down normally.

MAXIMUM BRAKING

Maximum braking effectiveness is obtained with a steady application of brakes.

The physical limitations of the tire and brake system make it extremely difficult to consistently achieve maximum braking action, particularly at high speeds where the weight component is reduced due to lift.

A smooth, single application, increasing as airspeed decreases, offers the best braking opportunity. Great caution should be used when braking at speeds above 80 KIAS.

Locked brakes are difficult to diagnose until well after the fact. Braking should be discontinued at the first sign of directional control problems and then cautiously reapplied.

At speeds below 80 KIAS, the chances of approaching maximum braking action are greatly increased.

AFTER LANDING

1. ISS mode selector – SOLO (as required)

    (Verify ISS mode selector lever is locked in SOLO)

2. Seat safety pin – Install (BOTH)
3. PROBES ANTI-ICE switch – OFF
4. Flaps – UP
5. Trim interrupt button – Depress

    (Verify TRIM OFF and TAD OFF message illuminated and TAD switch moves to OFF)

6. Trim – Set for take-off
7. MASTER ARM switch – SAFE
8. TCAS – STBY
9. Transponder – STBY

FULL STOP/TAXI BACK CHECKLIST

1. PROBES ANTI-ICE switch – OFF
2. Flaps – TO
3. Trim – Set for take-off
4. Transponder – STBY (as required)
5. Fuel quantity and balance – Check
6. Engine instruments – Check
7. DEFOG switch – OFF
8. Minimum power at 60 KIAS – Compute

AFTER CLEARED ONTO THE RUNWAY:

9. Landing/taxi lights – ON
10. Transponder – ALT
11. Nose wheel steering – OFF

12. PROBES ANTI-ICE switch – ON

13. EICAS display – Check (BOTH)

ENGINE SHUTDOWN

NOTE

- *Allow ITT to stabilize at idle for at least 1 minute prior to shutdown.*

1. PARKING BRAKE – Set

2. Landing and taxi lights – OFF

3. AVIONICS MASTER switch – OFF

4. BLEED AIR INFLOW switch – OFF

5. RAM AIR FLOW switch – OFF

6. AIR COND switch – OFF

7. EVAP BLWR control – OFF (BOTH)

8. OBOGS – OFF (BOTH):

    a. OBOGS pressure lever – NORMAL

    b. OBOGS concentration lever – NORMAL

    c. OBOGS supply lever – OFF

9. PCL – IDLE >60 seconds, then OFF

10. Interior/exterior lights – OFF

11. PMU STATUS message – Extinguished (or notify maintenance)

    (If a fault has been detected, the PMU STATUS message will illuminate 1 minute after touchdown.)

12. FDR light – Extinguished

13. GEN, BAT, and AUX BAT switches – OFF

14. Gust lock – Engage (as required)

BEFORE LEAVING AIRCRAFT

1. PARKING BRAKE – As required

   (If wheel chocks have been installed or if the aircraft is tied down, release the parking brake.)

2. CFS handle safety pins – Install (BOTH)

3. DTS/DVR cartridge – Remove (as required)

4. ISS mode selector – SOLO

   (Verify ISS mode selector lever is locked in SOLO)

5. Oxygen hose and communication cord – Stow with loop forward

6. HUD combiner cover – Install

7. Wheel chocks – Install (as required)

8. Exterior walk-around inspection – Visually check:

   a. Ground for evidence of fuel or hydraulic leaks

   b. Flap condition

   c. Speed brake condition

   d. Gear, gear doors, and wheel well condition

   e. Tires for indication of wear, cuts, or blisters

   f. Access doors, panels, fairings, and ventral fin for damage or missing fasteners

   g. Rudder – Locked (as required)

SECTION 3

OPERATING LIMITATIONS

TABLE OF CONTENTS

INTRODUCTION

Operating limitations include limitations that must be observed for safe operation of the aircraft and engine.

CREW REQUIREMENT

The minimum crew requirement is one pilot. The aircraft shall be flown solo from the front cockpit only.

FLIGHT MANEUVERING LIMITATIONS

CAUTION

- Holding a zero G-loading for over 5 seconds can cause engine damage and possible engine failure, regardless of oil pressure indications.

- Inverted Flight – 15 seconds
- Intentional Zero-G – 5 seconds

PROHIBITED MANEUVERS

Inverted stalls

Inverted spins

Aggravated spins past two turns

Spins with PCL above idle

Spins with landing gear, flaps, or speed brake extended

Spins with PMU off

Spins below 10,000 feet pressure altitude

Spins above 22,000 feet pressure altitude

Abrupt cross-controlled (snap) manoeuvres

Aerobatic manoeuvres, spins, or stalls with a fuel imbalance greater than 50 pounds between wings Tail slides.

ACCELERATION LIMITATIONS

SYMMETRIC

Clean +7.0 to -3.5 G's

Gear and Flaps Extended +2.5 to 0.0 G's

ASYMMETRIC (ROLLING G'S)

Clean +4.7 to -1.0 G's

Gear and Flaps Extended +2.0 to 0.0 G's

NOTE

- Exceeding the acceleration limits locks the max (or min) G reading on the PFD at the exceeded value in red text and cannot be reset without maintenance action on the ground.

WEIGHT LIMITATIONS

Maximum ramp weight - 6950 pounds

Maximum take-off weight - 6900 pounds

Maximum landing weight - 6900 pounds

Maximum zero fuel weight - 5850 pounds

Maximum weight in baggage compartment - 80 pounds

TAXI, TAKE-OFF, AND LANDING LIMITATIONS

NOSE WHEEL STEERING LIMITATIONS

Do not use nose wheel steering for take-off or landing.

CANOPY DEFOG LIMITATIONS

Canopy defog must be off for take-off and landing.

LANDING LIMITATIONS

Maximum rate of descent at touchdown is 780 feet per minute (5.1 G's) when main tires are serviced to maximum landing conditions pressure (225±5 psi).

WIND LIMITATIONS

Maximum crosswind component for dry runway - 25 knots.

Maximum crosswind component for wet runway - 10 knots.

Maximum crosswind component for icy runway - 5 knots.

Maximum tailwind component for take-off - 10 knots.

SECTION 4

FLIGHT HANDLING CHARACTERISTICS

TABLE OF CONTENTS

INTRODUCTION

The information contained in this section describes characteristics of the aircraft during specific phases of flight.

Rather than a systems description or particular training technique, the information provided describes peculiarities which may be encountered in mission oriented operation of the aircraft.

The flight characteristics described in this section are based on actual flight test data.

Where actual flight tests have not been performed, or analyses have not been completed, the information will be identified as projected data.

FLIGHT CONTROL SYSTEM

CONTROL SYSTEM FORCES

The aircraft incorporates a reversible flight control system.

This means the aerodynamic forces are fed back to the pilot from each control surface through a system of push rods, cables and pulleys.

A bobweight and downspring are incorporated into the elevator control system to increase the force in the pitch axis. The bobweight increases pitch force as G forces are increased during maneuvering flight conditions, while the downspring increases the pitch force about the trim speed in steady state flight conditions.

Pitch force during manoeuvring flight conditions is approximately 9 pounds per G at the aft center of gravity and 12 pounds per G at the forward center of gravity.

Lateral and directional control forces increase proportionally for a given control deflection as airspeed increases.

TRIM SYSTEM

The three-axis electric trim system is effective in trimming each axis throughout the flight envelope of the aircraft. The trim rate in each axis is constant throughout the airspeed envelope of the aircraft.

As airspeed increases, trim appears to become more effective. This phenomenon is particularly noticeable in the roll and yaw axes, and pulsing the trim control is necessary to avoid over-trimming at higher airspeeds.

At forward centre's of gravity, near full-up pitch trim will be required at final approach speed with 3-degree approach power.

At forward centers of gravity, a pull force up to 8 pounds may be required to maintain approach speed with power at IDLE during the final portion of the landing with full nose-up pitch trim.

Maximum operating speed will require near full nose-down pitch trim at aft centers of gravity.

NOTE

- During rapid acceleration from low to high speed, the pilot will need to initially trim nose-down to avoid a rapid build-up in forces.

Roll trim changes are relatively small throughout the flight envelope with balanced fuel conditions. The roll trim authority is adequate to trim the aircraft laterally, with the maximum allowable fuel imbalance of 50 pounds at all airspeeds and configurations.

The directional trim system is effective in trimming the aircraft at all speeds within the flight envelope.

At approach speeds or below with flaps in the LDG position, full nose right trim is required at 100% torque.

TRIM AID SYSTEM

Directional trim is commanded by the trim aid computer as a function of engine torque, indicated airspeed, pressure altitude, and pitch rate.

The system will not completely trim the aircraft directionally. The pilot must make the fine trim inputs to keep the aircraft in coordinated/balanced flight throughout the envelope.

Some feedback in the rudder pedals may be felt by the pilot during over-the-top aerobatic manoeuvres as the system commands large trim changes necessary for the airspeed excursions experienced during these manoeuvres.

Additionally, the pilot will encounter feedback from the system during large power changes at low airspeeds when performing touch-and-go landings or go-around manoeuvres.

FLAP AND SPEED BRAKE CONTROLS

The split flaps may be operated at airspeeds up to 150 KIAS.

There is very little pitch trim change when flaps are selected to the take-off position, and there is no apparent aerodynamic buffeting up to 150 KIAS.

Lowering the flaps to the LDG position produces a slight pitch up, which is easily controllable.

Aerodynamic and airframe buffeting is noticeable as airspeed is increased in this configuration.

Buffeting intensifies noticeably as the flap limit airspeed is approached.

Extension of the speed brake at airspeeds throughout the operating envelope produces a slight pitch up tendency, which becomes more pronounced as airspeed increases.

The pitch trim change requirement is reduced by a speed brake/elevator trim interconnect. During speed brake extension, the elevator is trimmed nose down.

During retraction, the mechanical linkage trims nose up.

The pilot will notice this trim change as the control stick moves slightly during speed brake operation.

Flap/Speed Brake Interconnect

A flap/speed brake interconnect (lockout) prevents the use of the speed brake with the flaps extended. If the flaps are extended, the speed brake will not extend if retracted.

If the speed brake has been extended, it will automatically retract if the flaps are set to any position other than UP.

NORMAL FLIGHT CHARACTERISTICS

NON-MANEUVERING FLIGHT CHARACTERISTICS

The aircraft exhibits positive stability in all configurations throughout the flight envelope.

The reversible flight control system becomes more sensitive as airspeed increases. Control forces during climb, cruise, and terminal area flying are light throughout the speed range of the aircraft.

Slight control stick inputs can result in airspeed or altitude deviations, from hands-off trim condition.

NOTE

- The light longitudinal forces are exacerbated by slipstream effects caused by power. Frequent cross-checks of airspeed are required during climb out to prevent deviations from the climb airspeed schedule.
- Lateral-directional control and trim ability are sensitive throughout the flight envelope. Avoid chasing the slip/skid ball.

AEROBATIC MANEUVERING FLIGHT CHARACTERISTICS

Manoeuvre	Recommended Entry Speed (KIAS)
Aileron Roll	180-250
Wingover/Lazy Eight	160-250
Barrel Roll	190-250
Clover Leaf	210-250
Chandelle	180-250
Loop	200-250
Cuban Eight	210-250
Immelmann	210-250
Split S	120-160
Inverted Flight	180-250

The table above lists approved aerobatic manoeuvres and associated recommended entry speeds.

CAUTION

- The aircraft will accelerate rapidly with power in a dive. In a high speed dive with an aggressive pull, it is possible to exceed structural limits if the power is not reduced.

Asymmetric Manoeuvres

Flight tests have demonstrated that the aircraft exhibits a yawing tendency at high roll rates. This yawing tendency is greatest for uncoordinated rolling pull-outs conducted at greater than 2 G.

Follow the guidelines below to minimize yaw in asymmetric manoeuvres.

- As much as possible, maintain coordinated roll and yaw control inputs during asymmetric manoeuvres.
- If rolling pull-outs at greater than +2 G are uncoordinated, limit roll input to one-half lateral stick.
- If uncoordinated rolling manoeuvres are initiated at -1 G, the maximum bank angle change is 180 degrees.

GLIDE PERFORMANCE

Factors which effect glide performance are airspeed, aircraft configuration (landing gear and flaps), angle of bank, and coordinated or uncoordinated flight.

Maximum range power-off glide airspeed differs with changes in aircraft configuration. Power-off glide performance at any particular glide speed will be optimized with a feathered propeller and level wings in balanced/coordinated flight.

Best glide speed in clean configuration is approximately 125 KIAS with a sink rate of 1350 feet per minute and a glide ratio of 2.0 NM/1000 feet.

With the landing gear down and flaps and speed brake retracted, best glide speed is approximately 105 KIAS with a sink rate of approximately 1500 feet per minute and a glide ratio of 1.6 NM/1000 feet.

WARNING

- Improper use of the rudder or ailerons during a slip manoeuvre may cause a departure from controlled flight with insufficient altitude for recovery.

CAUTION

- With the engine out, flaps cannot be deployed prior to extending the landing gear in a power-off glide because the engine driven hydraulic pump is not operating.
- Once the landing gear have been blown down by the emergency hydraulic accumulator, the residual hydraulic pressure remaining in the accumulator may be used to lower the flaps.
- Flaps will extend slowly with residual pressure and may take longer than normal to deploy.

NOTE

- Without normal hydraulic pressure, use of the speed brake in a power-off glide is not possible.
- The zero thrust power setting for the aircraft is 4-6% torque at glide speed. This power setting approximates the performance of the aircraft with the propeller feathered.

STALL CHARACTERISTICS

STALL WARNING

A stick shaker, activated by the angle-of-attack system, provides artificial stall warning in each cockpit a minimum of 5 knots before the stall is reached.

The artificial stall warning margin varies from 5 to 10 knots prior to the stall during power-off, un-accelerated conditions. This margin typically increases during power-on and accelerated/turning stalls in all configurations.

Natural stall warning, in the form of light aerodynamic buffet, occurs approximately 3 knots before the stall during power-off stalls in all configurations. At the same time, a slight nose-down pitching motion may also occur.

During accelerated/turning entries into a stall, moderate buffet occurs well prior to the actual stall.

During un-accelerated, power-on stall entries, there is little perceptible natural buffet prior to the stall.

During stall entry with power on, the pilot will also notice a higher pitch attitude, light longitudinal stick forces, and the need for right aileron in conjunction with right rudder to maintain coordinated flight. With power at 100% engine torque, a pitch attitude of 45° nose up is possible during entry to a wings-level stall.

NOTE

- Activation of the stick shaker is the earliest warning for an inadvertent stall.
- The stick shaker may mask natural aircraft buffet during stall approach and recovery.

STALLS

A roll-off or wing-drop, together with increased buffet is the defining characteristic of an upright, wings-level stall.

Weight (Pounds)	Approximate Stall Speed (KIAS)
5500	80 (UP) / 74 (T.O) / 71 (LDG)
6000	83 (UP) / 77 (T.O) / 74 (LDG)
6500	86 (UP) / 79 (T.O) / 77 (LDG)
6900	89 (UP) / 82 (T.O) / 80 (LDG)

Idle power stall speeds are presented the table above. All flight controls remain effective in the normal sense throughout the approach to stall and stall.

Expect a decrease in stall speed with power on.

With power off, lateral roll-off during a wings-level stall is typically to the right, and occurs near full aft stick. During a wings-level, power-on stall, a left rolling tendency is induced at stall by engine torque before reaching full aft stick.

NOTE

- Above 60% torque, full right rudder and full right aileron may not prevent a left roll-off at stall.

While landing gear position has little effect on stall characteristics, extending the flaps aggravates the roll-off tendency at stall.

Speed brake extension or fuel imbalance (to 50 pounds) have negligible effect on stall characteristics.

Inverted stalls have been performed with power off and power on in the cruise configuration. Stalls at both power configurations are characterized by lighter aileron forces, and a tendency for the nose to wander in yaw.

There is no G break, and there is little buffet or pitching motion as the stall is approached; however, the airspeed indicator will suddenly decrease to zero during the latter stages of the manoeuvre.

A power-off inverted stall is characterized by a slow nose drop with the control stick on the forward stop. During an inverted stall at 100% torque, the aircraft will maintain a pitch attitude of approximately 30° nose above the horizon with full forward stick.

NOTE

- Intentional inverted stalls are prohibited.

ACCELERATED STALLS

An accelerated stall induced by a turning entry and increased G is preceded by pronounced airframe buffet before the stall is reached.

Buffet onset occurs well prior to the actual stall at higher G conditions. However, below 2 G's there may be little natural buffet prior to the actual stall.

During a turning entry, the stall is characterized by a moderately abrupt lateral roll-off (either into or away from the direction of turn). The actual stall speed may vary by several knots depending on the entry from a left or right turn.

An accelerated stall induced by a rapid decrease in airspeed or a pitch up exhibits similar lateral roll-off characteristics.

Sustained heavy buffet in accelerated stalls at greater than 3 G's can produce damaging loads in the fuselage and empennage.

Accelerated stalls initiated at greater than 3 G's do not sustain heavy buffet beyond the period required to recognize the accelerated stall.

For accelerated stalls initiated at greater than 3 G's, do not sustain heavy buffet beyond the period required to recognize the accelerated stall.

STALL RECOVERY

Stall recovery is accomplished as follows:

1. Reduce angle of attack. This may require a reduction in back stick pressure, or moving stick progressively towards neutral, or moving stick forward of the trim position.

2. Advance PCL as required to maintain flying airspeed. Anticipate engine power effects, applying aileron and rudder as necessary to maintain or achieve wings level.

3. Use aileron and rudder control as necessary to maintain wings-level, coordinated flight throughout the recovery.

4. As flying speed is regained, smoothly increase back pressure on the control stick to stop the altitude loss and return to level flight, taking care to avoid entering a secondary, accelerated stall during recovery.

Altitude lost during recovery from a wings-level stall is usually less than 100 feet, assuming a prompt application of recovery power.

Power-on, accelerated and inverted stall recoveries will lose even less altitude to regain flying speed; however, these stalls will most likely result in an unusual attitude requiring more altitude for recovery.

DEPARTURES FROM CONTROLLED FLIGHT

DEPARTURES/OUT-OF-CONTROL FLIGHT (OCF)

A situation in which the aircraft does not respond immediately and in a normal sense to application of flight controls is considered out-of-control flight (OCF) or a departure.

OCF is the seemingly random motion of the aircraft about one or more axes, usually resulting from a stalled condition in which the inertial forces on the aircraft exceed the authority of the aerodynamic controls (ailerons, elevator, and rudder).

For this reason, initial aircraft motions may not be halted by any application of flight controls and motions may be opposite the direction of the applied control.

Certain control applications may intensify the OCF motions. OCF typically results from a stall in accelerated or out-of-balance (uncoordinated) flight conditions or a stall where improper or overly aggressive control inputs are applied.

In general, OCF can be divided into three categories:

Post-stall gyrations, incipient spins, and steady-state spins.

Post-stall Gyrations

Post stall gyrations are the motions of the aircraft about one or more axes immediately following a stall and prior to the incipient spin. A post stall gyration can usually be identified by uncommanded (and often rapid) aircraft motions about any axis, a feeling that the controls are no longer effective nor acting in the normal sense, stalled or near-stalled angle of attack, transient or erratic airspeed indications, and random turn needle deflections.

A post stall gyration can occur at high airspeed (following an accelerated stall) or at low airspeed (following a normal stall). At high airspeed, the post stall gyration will quickly dissipate kinetic energy and may place high stresses on the aircraft structure. At low airspeed, the inertial forces on the aircraft exceed the authority of the aerodynamic controls, rendering the controls mostly ineffective until flying speed is regained.

The post stall gyration can be aggravated or extended through continued application of pro-stall controls or by misapplication of stall recovery controls. Post stall gyrations may be violent and disorienting.

The intuitive response of rapidly applying controls in all axes in an attempt to arrest the motions is generally ineffective and may actually increase the motions, as the flight controls may no longer act in the normal sense.

Neutralizing controls and reducing the power to IDLE is the best response until motions stop and the controls become effective in the normal sense again.

Incipient Spins

The spin-like motion that occurs between a post stall gyration and a fully developed spin is called an incipient spin.

Any stall can progress to an incipient spin if steps are not taken to recover the aircraft at either the stall or post stall gyration, or if pro-spin controls are maintained.

In an incipient spin, the motions appear to be "spin-like" and there is a sustained unsteady yaw rotation, but the aerodynamic and inertial forces are not yet in balance.

As a result, an incipient spin is characterized by oscillations in pitch, roll, and yaw attitudes and rates. The nose attitude will fluctuate from the horizon to vertical (nose down), the yaw rate will increase toward the steady-state spin value, and the wings will rock about the steady-state spin value.

An incipient spin can be identified by an oscillatory spin-like motion, a fully deflected turn needle, a stalled angle of attack, and airspeed that is accelerating or decelerating toward the steady-state value.

Visual indications may be misleading and can lead to the false impression of a steady-state spin. The incipient spin phase of the aircraft lasts approximately 2 turns.

This may be prolonged during intentional spin entries by failure to apply proper pro-spin controls, potentially leading to a spiral.

Steady-State Spins

Steady-state spins are still considered OCF because a control input in any given axis does not have an immediate effect in that axis in the normal sense of the control.

For example, a right aileron input in a left spin will not arrest the roll rotation.

Altitude loss during a typical steady-state spin is approximately 4500 feet for a 6-turn spin.

NOTE

- The aircraft has shown an overall resistance to unintentional spins. However, the aircraft may enter a departure or OCF during various control misapplications, particularly at low airspeed and high power.

DEPARTURE RECOVERY

Recovery from inadvertent loss of aircraft control, including post stall gyrations and incipient spins, can be accomplished by promptly reducing power to IDLE, and positively neutralizing flight controls in all axes.

Patience and the maintenance of neutral controls (including visual verification of control positions) is vital since the dynamics of any aircraft departure may prevent an immediate response of the aircraft to control inputs.

NOTE

- Cycling of control positions or applying anti-spin controls prematurely can aggravate aircraft motion and significantly delay recovery.

Recovery from a confirmed steady-state spin by maintaining neutral controls is possible, but time to recover and altitude loss will be greater than with use of proper anti-spin control.

Consequently, after neutralizing the flight controls and verifying that power is at IDLE, if cockpit indications confirm that a steady-state spin has developed, the appropriate anti-spin control inputs should be made to ensure prompt recovery from the spin.

WARNING

- A spiral is often mistaken for a spin. Anti-spin controls may not be effective in arresting a spiral and may actually aggravate the situation.

CAUTION

- If not in a steady-state spin, as indicated by increasing airspeed, AOA not at a stalled condition (erect or inverted), and oscillatory motions not typical of the spin, check and maintain IDLE power and neutral controls until regaining aircraft control.

SPIRALS

A spiral is a rolling and/or yawing motion of the aircraft that is often mistaken for a spin, but is not steady-state in that airspeed is increasing through 160 KIAS and motions are oscillatory. A spiral can result from misapplication of pro-spin controls (insufficient rudder or aft stick).

It is important to identify a spiral quickly, because the airspeed can increase rapidly in a nose-down attitude.

Maintaining large control deflections as speed increases can result in rapid motions and structural over-stresses. Anti-spin controls may not be effective in arresting the spiral and may actually aggravate the situation.

The best response to a spiral is to reduce the power to IDLE and neutralize the controls until motion stops.

SPINS

A spin requires stalled angle of attack simultaneously with sustained yaw rate. If either of these two conditions is absent, the aircraft will not enter a spin.

For erect stalls, angle-of-attack information is available by direct reference to the angle-of-attack indicator and indirectly through the stick shaker.

Maintaining the AOA below that required to activate the stick shaker is an effective means of avoiding a stall.

For both erect and inverted stalls, maintaining the aircraft in balanced flight (slip ball centred) will prevent build-up in yaw rates required to enter a spin.

SPIN CHARACTERISTICS

Only intentional erect spins with landing gear, flaps, and speed brake up and power at IDLE are permitted.

A spin may be entered by maintaining full aft stick and applying full rudder in the desired spin direction at 80 KIAS.

CAUTION

- Spin entry attitudes greater than 50 degrees nose high may result in low oil pressure and engine damage.

Spins below 10,000 feet MSL are prohibited due to high stresses on the propeller which occur during the spin manoeuvre with the propeller RPM below 80%. To prevent high stresses from occurring, the power management unit (PMU) artificially maintains propeller RPM at 80% with the PCL at IDLE when the aircraft is above 10,000 feet MSL.

NOTE

- During a spin, oil pressure may decrease below 40 psi with idle power. This is acceptable provided no operating limits are exceeded and normal indications return after recovery.

Erect Spins

Entry into idle power, erect spins is characterized by roll and yaw in the direction rudder is applied, resulting in a barrel roll manoeuvre to a near level attitude after completing the first turn.

After completing the initial turn, the nose will pitch to approximately 60° below the horizon, with pitch attitude becoming oscillatory. After completing approximately 3 turns, the spin will have entered a near steady-state condition.

Spin rotation rates will stabilize to approximately 2 to 3 seconds per turn with altitude loss of 400 to 500 feet per turn.

The angle of attack will be 18+ and airspeed will stabilize at 120 to 135 KIAS.

The turn needle will be fully deflected in the direction of the spin. In performing spins to the left, the pilot may notice some differences in pitch attitude and magnitude of pitch, roll, and yaw oscillations.

Spins in either direction may exhibit roll and yaw oscillations after 3 turns with neutral ailerons.

Ailerons have a pronounced effect on spin characteristics.

With ailerons held in the direction of spin rotation, roll and yaw become noticeably oscillatory. With ailerons held full opposite to direction of spin rotation, roll and yaw oscillations are damped out and the spin appears to reach steady state in all axes.

Applying full left aileron simultaneously with right rudder tends to slow the initial entry into a right spin.

Progressive Spins

A progressive spin is a result of misapplication of recovery controls. Reversing the rudder direction during a steady state spin while maintaining full aft stick will result in a spin in the opposite direction.

Progressive spins are characterized by a noticeable nose-down pitch attitude increase after rudder is reversed. The aircraft will continue to rotate in the original spin direction for approximately one and one-half to two additional turns, depending on initial spin direction and centre of gravity location. The airspeed will increase up to 175 KIAS during the reversal.

Continuing to hold full aft stick and opposite rudder will result in a steady-state spin in the opposite direction from the original spin manoeuvre. If a progressive spin is inadvertently encountered, the published departure/OCF procedure provides the best means of recovery.

Aggravated Spins

Entry into an aggravated spin is a result of misapplication of recovery controls.

An aggravated spin is caused by maintaining pro-spin rudder while moving the control stick forward of the neutral position. As the control stick is moved forward of neutral, an immediate increase in nose-down pitch occurs and the roll rate increases significantly.

While still slightly oscillatory, the pitch attitude will decrease to approximately 70° nose down and the roll rate will increase to as much as 280° per second.

Disorientation may be induced by the aggravated manoeuvre. If an aggravated spin is inadvertently encountered, the published departure/OCF procedure provides the best means of recovery.

CAUTION

- Do not perform aggravated spins past two turns with aggravated flight control inputs.
- Sustained aggravated spins (in excess of 2 turns) have the potential to exceed engine operating limits. If an extended aggravated spin is encountered, the pilot should recover the aircraft and check if any engine operating limits were exceeded.

Due to oil pressure restrictions, aggravated spins were conducted only to 4 turns. Spins with greater than 4 turns while holding aggravated flight control inputs may cause oil starvation problems, resulting in damage to the engine.

Inverted Departures/Spins

NOTE

- Intentional inverted departures and spins are prohibited.

Inverted spins have been entered by releasing the controls with the aircraft in a 60° to 90° pitch attitude at maximum power (MAX) and an indicated airspeed of 50 knots.

At control release, the aircraft can be expected to torque roll to the left to a near inverted, nose-level attitude. After slight hesitation, yaw rate will increase as the aircraft enters a right spin, reaching 120° per second after 2 turns are completed.

Spins entered using this technique are flatter than erect spins, with slight pitch oscillations about a mean of 30° nose low. Airspeed will read 40 knots and angle of attack will be pegged at zero during the spin.

Normal acceleration during this spin is typically -1.5 G. These spins have been performed with the aircraft loaded at or near the aft centre of gravity limit.

Inverted incipient spins have also been achieved from an inverted stall at maximum power.

In the inverted spins tested, high engine torque is the primary impetus which drives the aircraft into, and sustains, the inverted spin. By reducing the power to IDLE during the first 2 spin turns, the pilot can expect the spin to terminate without using recovery controls.

Attempts to enter the inverted spin from and inverted stall with power at IDLE and ailerons neutral typically deteriorates into an inverted spiral in the direction of applied rudder, with airspeed rapidly increasing in a steep nose low attitude.

Configuration Effects

NOTE

- Intentional spins in other than cruise configuration at idle power are prohibited.

The effect of power on the erect spin appears to flatten the pitch attitude. At maximum power, the nose rises well above the horizon at the completion of the first spin turn.

Reducing power to IDLE causes a noticeable nose-down pitch with the spin stabilizing as previously described for erect, idle power spins. Due to engine torque effects, right power-on spins take longer to develop, regardless of aircraft configuration, than spins performed to the left.

Applying left aileron at the stall will generally prevent the aircraft from entering a right power-on spin, resulting in a spiral for as long as full power is maintained.

One turn incipient spins have been performed in power-off and power-on configurations with the speed brake extended.

The speed brake position had no noticeable effect on spin or spin recovery characteristics during these spins.

SPIN RECOVERY

CAUTION

- During spin recovery, pitch control inputs well forward of neutral may result in a loss of oil pressure and engine damage.

Erect Spin Recovery

Erect spin recovery is prompt after recovery controls are applied. In all cases, as the control stick is moved forward and rudder is applied opposite to the direction of turn needle deflection, the pitch attitude will steepen and spin rate will initially increase.

Approximately 50 pounds of push force will be required to move the control stick well forward of the neutral position.

Spin rotation will abruptly cease with the aircraft in a steep nose-down attitude within one and one-half turns after applying controls. Controls should be neutralized and a smooth pull-out initiated to stop the loss of altitude and prevent airspeed from building excessively.

Expect to lose approximately 500 feet for every turn of a spin with an additional 1500-2000 feet for a normal dive recovery. An erect spin recovery procedure is as follows:

1. Gear, flaps, and speed brake - Retracted
2. PCL - IDLE
3. Rudder - Full opposite to turn needle deflection
4. Control stick - Forward of neutral with ailerons neutral
5. Smoothly recover to level flight after spin rotation stops

The aircraft should recover from an erect spin with controls (rudder, ailerons, and elevator) free and with PCL at IDLE.

However, the number of additional turns required for spin rotation to cease after releasing controls may increase significantly. Depending on the centre of gravity and how deeply the aircraft is in the spin, several more turns may be required for spin recovery following release of the controls.

Typically, upon release of controls, the rudder pedals will centre and the control stick will move to either the left or right of centre in the direction of the spin and then slowly begin to work forward as up-elevator angle decreases.

The controls-free spin recovery procedure is not the recommended method of recovery.

If the control stick remains at or near full aft travel for more than 4 turns (approximately 2,000 feet of altitude loss) after releasing the controls, the aircraft may not recover from the spin.

Upon verifying steady-state spin indication, initiate anti-spin recovery inputs.

Controls neutral spin recoveries have been demonstrated and, generally, spin rotation will cease within 2 additional turns after neutralizing controls in each axis.

Inverted Spin Recovery

When using the inverted spin recovery, the aircraft recovers within a half turn after the controls are applied. Recovery will not consistently occur if recovery controls are applied with power. Initial recovery attitude will be in a near vertical dive. The recommended inverted spin recovery procedure is as follows:

1. Gear, flaps, and speed brake - Retracted
2. PCL - IDLE
3. Rudder - Full opposite to turn needle deflection
4. Control stick - Aft of neutral with ailerons neutral (up to full aft stick may be used)
5. Smoothly recover to level flight after rotation stops

CAUTION

- Power-on and inverted departures or spins will result in high loads on the engine and torque shaft. These loads are caused primarily by the combination of aerodynamic and gyroscopic moments experienced during these manoeuvres.
- If an inverted or power-on departure is inadvertently encountered, the pilot should suspect possible engine damage and may experience unusual engine operation accompanied by low oil pressure or CHIP annunciator illumination.
- In all cases of inverted or power-on departures, the engine shall be inspected by qualified maintenance personnel after flight.

DIVE CHARACTERISTICS

ALTITUDE LOSS IN DIVE RECOVERY

Altitude loss during dive recovery is determined by four independent factors: angle of dive, altitude at start of pull-out, airspeed at start of pull-out, and acceleration maintained during pull-out.

These factors must be considered collectively in estimating altitude for recovery from any dive.

VERSION CONTROL

V1.0.0

- Release Version

V1.1.0

- AOA Indexer Added to T6B Specific USN and USAF models.
- IndiaFoxtecho F-35 Avionics suite added for HUD and Moving Map simulation.
- Collimated HUD functionality added.
- Aileron Trim indicator animation fixed.
- Backup Flight Instrument (BFI) Barometric Pressure and Altitude Units fixed.
- PFD and BFI metric indications now display correctly.
- Airborne start scenario corrected.
- CONFIG page Lower Left & Right pushbuttons no longer disable the display.
- Master Warning and Caution alarms no longer audible with battery power off.
- CRS text now closes out if changing page with the CRS selection method enabled in the UFCP.
- Reduced issue with Cockpit over pressurisation at altitude.
- Nose Wheel Steering (NWS) indication on EICAS now the correct colour.
- L PHT INOP and R PHT INOP indications now display on EICAS when Pitot Heat turned off.
- LAMP TEST no longer indicates all EICAS messages.
- Oil Pressure now increases more slowly.
- Gear Retraction & Extension now takes slightly longer.

V1.2.0

- Six custom Texan II paint schemes added from artist ZsoltB.
- HUD tinted darker and frame darkened to add contrast to display.
- Canopy glass textures and scratches added.
- Moments of Inertia updated to reduce yaw oscillations on braking.
- HUD Azimuth and Zenith symbology corrected.
- Rudder Trim Indicator fixed.
- Battery slow discharge error fixed.
- HUD AOA E-bracket calibrated.
- Cabin pressure warning corrected.
- Roll on Yaw values reduced to improve flight modelling.
- Static weapons removed (MSFS marketplace version) for compliance.