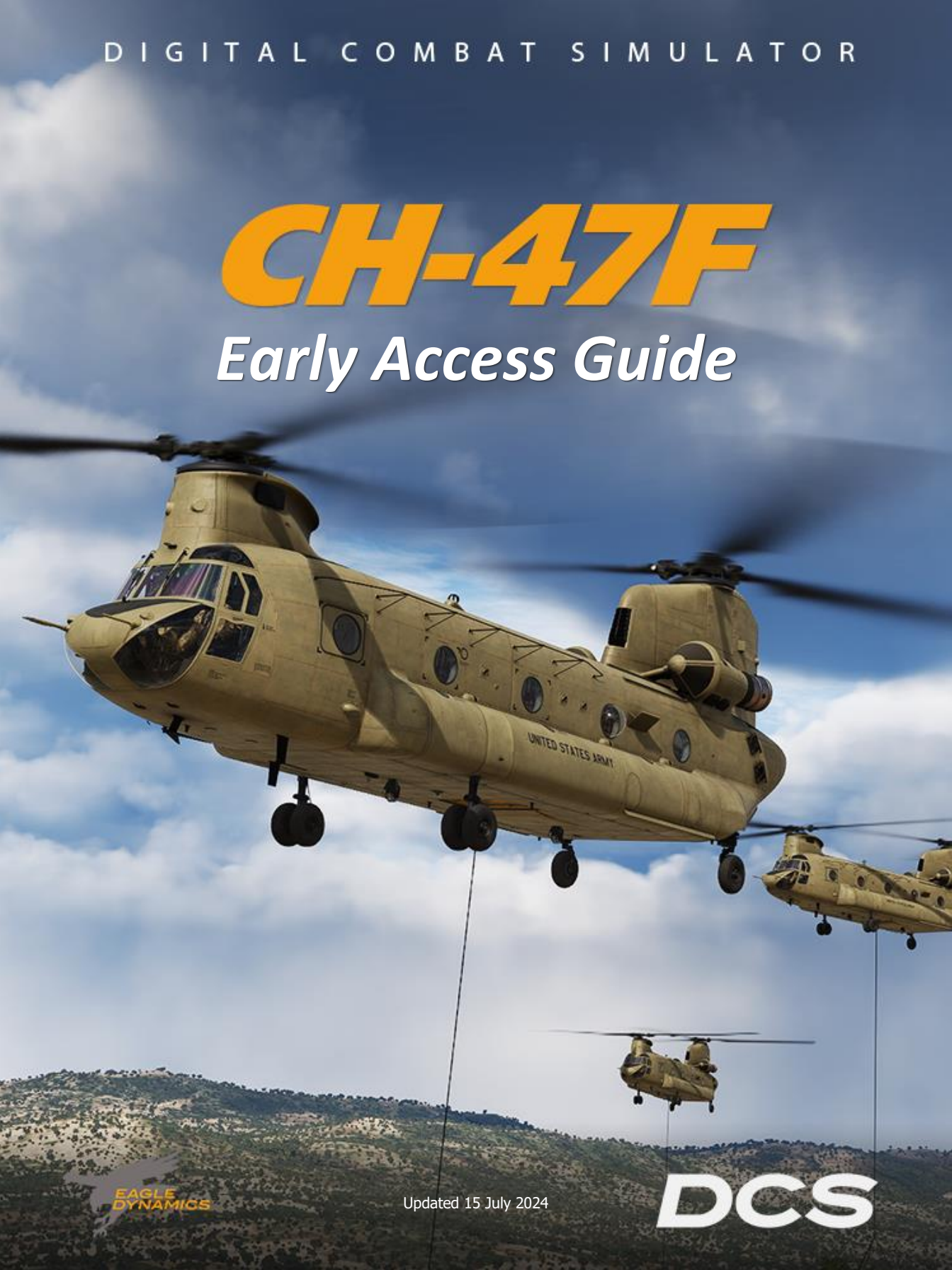
DIGITAL COMBAT SIMULATOR

CH-47F

Early Access Guide



EAGLE DYNAMICS

Updated 15 July 2024

DCS

INTRODUCTION

Thank you for your purchase of DCS: CH-47F!

DCS: CH-47F brings one of the most powerful heavy-lift helicopters in the world to Digital Combat Simulator. This module features the most realistic PC simulation of the CH-47F, which includes accurately simulated flight dynamics, avionics, and systems. Although the CH-47 has a long and distinguished history dating back to the 1960's in the service of many nations, this module simulates the CH-47F as it existed in United States Army service between the years 2011 and 2013.

Since its introduction, the CH-47F has become the most produced heavy-lift helicopter in the U.S military and civilian service. Known for its high speed, sling-load capabilities, and its ability to insert or extract large numbers of troops at high elevation landing zones, the CH-47F has seen significant use during combat operations in Iraq, Afghanistan, and Syria; and has also been an important asset for providing humanitarian aid during numerous disasters around the world. When large numbers of troops, supplies, or equipment need to be airlifted across the battlefield in a hurry, the CH-47F is the airframe that will deliver.

You call, we haul!

Key features:

- Fully modeled interior including mouse-clickable, 6DOF cockpits along with a highly detailed external model.
- Detailed pilot, copilot, and side gunner models and animations.
- "Bob" AI crewmember to assist with cockpit tasks.
- Integrated "glass" cockpit with five Multi-Function Displays (MFD) and independent Control Display Units (CDU) for the Pilot and Copilot.
- Night vision goggles equipped with Heads-Up Display (HUD) symbology overlays, for flight operations at nap-of-the-earth altitudes during night.
- Side door- and tail ramp-mounted M60D 7.62mm machine gun positions.
- New cargo loading capability for internal cargo.
- Single-point sling-loading capability for external cargo.
- Radar and missile warning defensive systems.
- Fly missions in the Black Sea region or one of the many DLC maps like the Persian Gulf, Syria, and more.
- Multiplayer cooperative and head-to-head gameplay, to include cooperative multi-crew in the same aircraft.
- Feature-rich Mission and Campaign editors facilitate user-created content.
- Huge array of land, air, and sea units to operate alongside and against.

NOTE: Multi-crew gameplay, multi-point sling-loading, night vision goggles, Heads Up Display, the ramp gunner position, alternative defensive gun options, and the missile warning system will be coming later in Early Access.

Sincerely,
The DCS: CH-47F Team
03 July 2024

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LATEST CHANGES

Significant changes to the guide will be noted on this page.

DCS FUNDAMENTALS

US Army photo
by Mark Marcus, PEO Aviation

HEALTH WARNING!

Please read before using this computer game or allowing your children to use it.

A very small proportion of people may experience a seizure or loss of consciousness when exposed to certain visual images, including flashing lights or light patterns that can occur in computer games. This may happen even with people who have no medical history of seizures, epilepsy, or "photosensitive epileptic seizures" while playing computer games.

These seizures have a variety of symptoms, including light-headedness, dizziness, disorientation, blurred vision, eye or face twitching, loss of consciousness or awareness even if momentarily.

Immediately stop playing and consult your doctor if you or your children experience any of the above symptoms.

The risk of seizures can be reduced if the following precautions are taken, (as well as a general health advice for playing computer games):

- Do not play when you are drowsy or tired.
- Play in a well-lit room.
- Rest for at least 10 minutes per hour when playing the computer game.

INSTALLATION AND LAUNCH

To install Digital Combat Simulator (DCS) and the DCS: CH-47F module, you will need to be logged into Windows with Administrator rights.

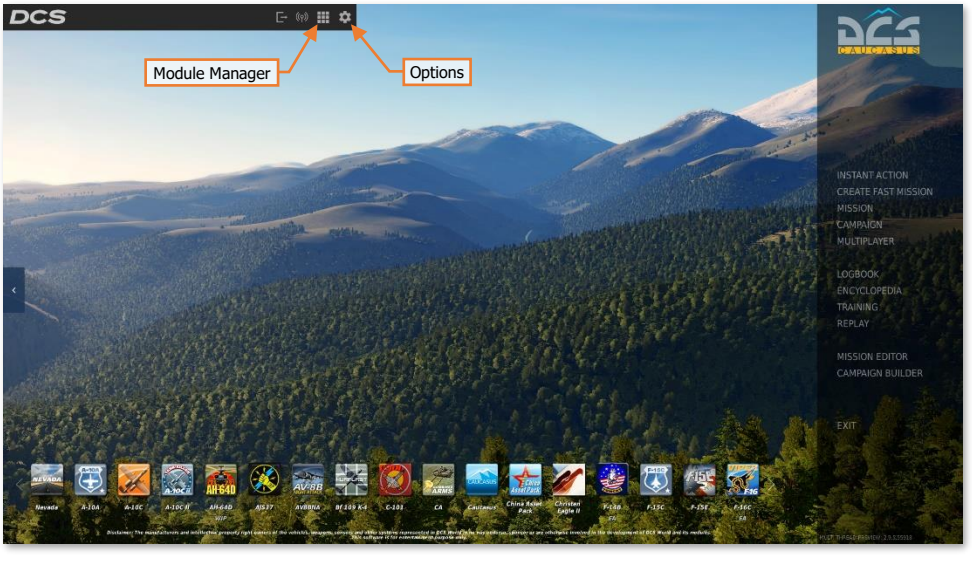
DCS is the PC simulation environment that the DCS: CH-47F simulation operates within. When DCS is launched, you in turn launch DCS: CH-47F.

As part of DCS, a map of the Caucasus region, the Su-25T "Frogfoot" attack aircraft, and TF-51 training aircraft are also included for free.

After purchasing DCS: CH-47F from our e-Shop, start DCS by executing the icon on your desktop. Upon initialization, the DCS Main Menu page is opened. From the Main Menu, you can read DCS news, change your wallpaper by selecting any of the icons at the bottom of the page, or select any of the options along the right side of the page.

Select the Module Manager icon at the top of the Main Menu. Upon initial entry into the Module Manager, a pop-up window titled Install Modules should automatically display, listing any DCS products that you have purchased and have yet to install. Ensure DCS: CH-47F is checked, and then click OK. Alternatively, you can select the Modules tab, scroll down until you locate the DCS: CH-47F entry, and click Install. In either case, DCS will close and automatically proceed with an update to download and install the necessary files. After the download and installation is complete, DCS will automatically restart.

To get started quickly, you can select Instant Action and play any of the missions listed for the CH-47F.



Configure Your Game

Before jumping into the cockpit, the first thing we suggest is to configure your game. To do so, select the Options button at the top of the Main Menu screen. You can read a detailed description of all Options in the DCS User Manual. For this Early Access Guide, we will just cover the basics.

SYSTEM Tab

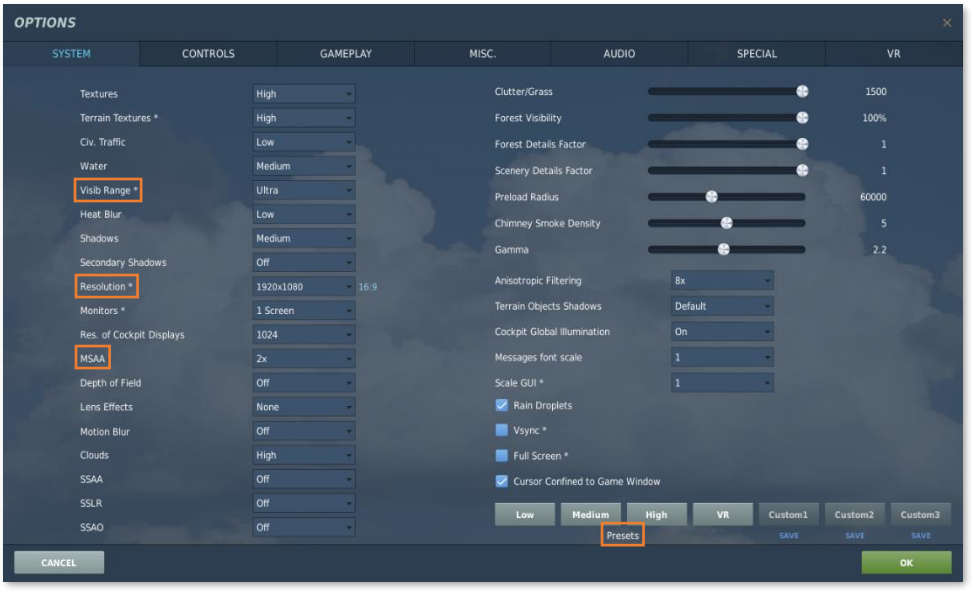
This tab allows you to configure your graphics options to best balance aesthetics with performance.

There are Presets options along the bottom of the page, but you can further adjust your graphics settings to best suit your computer. If you have lower performance, we suggest selecting the "Low" button and then increase graphics options to find your best balance.

Items that most affect performance include Visibility Range, Resolution, and MSAA. If you wish to improve performance, you may wish to first adjust these system options.

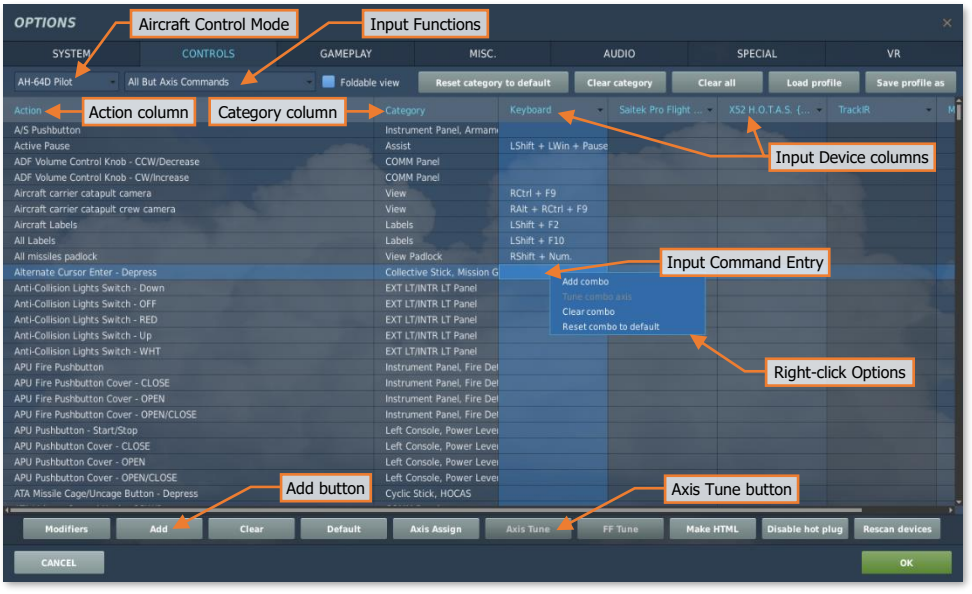
Items that have an asterisk (*) displayed next to them will require a restart of DCS to take effect.

Note that some missions may enforce different Civ. Traffic settings that override the individual user selection on this tab. This may result in higher or lower levels of expected civilian traffic scenery, or none at all.



CONTROLS Tab

This tab provides an interface to set up your controls and functional bindings.



Aircraft Control Mode. From this drop-down menu, select "CH-47F" or "CH-47F Gunner Station". The default seating position when starting a mission in the DCS: CH-47F will always be the Pilot seat.

Input Functions. This displays various categories of input functions, such as axis devices, views, cockpit functions, etc. Additionally, "Search…" can be selected from the Input Functions drop-down to manually filter the Action column according to keyword matches.

Action column. This column along the left side of the screen displays the action associated with the corresponding input command entries.

Category column. This column to the right of the Action column displays the function group or cockpit panel each Action is grouped within.

Input Device columns. These columns display which input devices have been detected, including your keyboard, mouse, joysticks, throttles, or rudder pedals, and which input commands from the respective input devices will perform the corresponding Action.

Add button. To assign an input command to an Action, left-click the input command entry that corresponds with the desired Action under the desired input device column, then press the Add button along the bottom row. Alternatively, a double left-click on the desired command entry using mouse can be used, or right-clicking on the command entry and selecting "Add combo". Any of these methods will display the ASSIGNMENT PANEL.

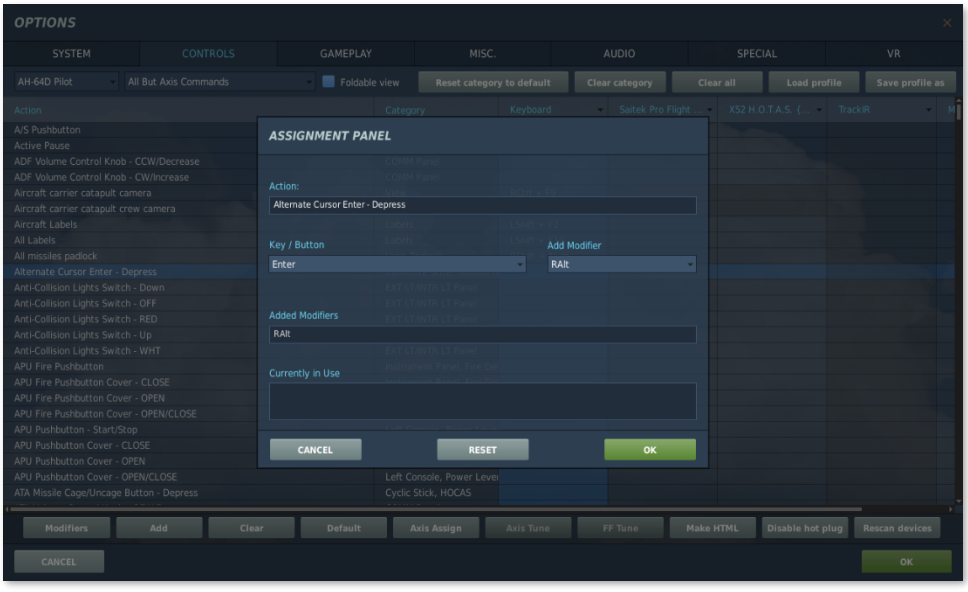
Default button. After assigning a command to an Action, you may revert to the default command assignment for that command entry by clicking on the corresponding entry to highlight, and then clicking the Default button. This can also be accomplished by right-clicking on the command entry and selecting "Reset combo to default".

Clear button. If you wish to remove all commands from an input device for that Action, click on the corresponding command entry to highlight, and then click the Clear button. This can also be accomplished by right-clicking on the command entry and selecting "Clear combo".

Axis Tune button. This button becomes available if an axis command entry is highlighted. When this button is clicked, the AXIS TUNE PANEL is displayed. This can also be accomplished by right-clicking on the command entry and selecting "Tune combo axis".

ASSIGNMENT PANEL

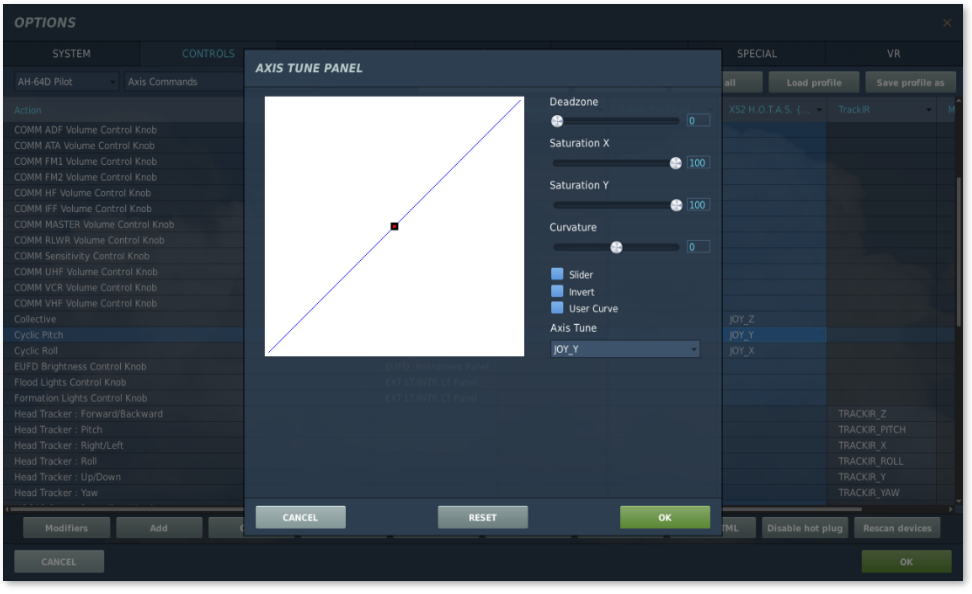
When this panel is displayed, simply press the button (or combination of buttons) or move the axis of the device to assign it to that Action.



- **Example 1:** If setting a pitch axis for a joystick, first select **Axis Commands** from the Input Functions drop down. Find the box where your Joystick input device and the "Pitch" Action intersect and double-click the left mouse button in the box. In the ASSIGNMENT PANEL, move your joystick forward and back to assign the axis. Press OK when finished.
- **Example 2:** If setting a keyboard or controller device button, first select **All But Axis Commands** as the Input Function category, or the category that contains the desired Action you wish to edit. Find the box where your input device and the Action intersect, and double-click the left mouse button in the box. In the ASSIGNMENT PANEL, press the keyboard or controller device button you wish to assign to the Action. Press OK when finished.
- If you make a mistake during the assignment process, press the RESET button and try again.
- If another Action is already assigned to that button or button combination, that Action will be shown under Currently In Use.

AXIS TUNE PANEL

When this panel is displayed, the selected axis can be assigned a dead zone, different response curves, and other tuning.



GAMEPLAY Tab

This tab primarily allows you to adjust the game to be as realistic or casual as you want it to be. Choose from various difficulty settings like labels, tooltips, unlimited fuel and weapons, etc. You can also set your preferred language and units of measurement.

Turning Mirrors off can assist with improving performance.

Note that some missions may enforce different gameplay settings that override the individual user selection on this tab. This may result different gameplay behavior than the user expects, such as enforcing no labels or restricting information on the F10 map.

MISC Tab

This tab contains miscellaneous features to further tune the game to your preference.

Note that some missions may enforce different gameplay settings that override the individual user selection on this tab. This may result different gameplay behavior than the user expects, such as enforcing no external views or Battle Damage Assessment overlays.

AUDIO Tab

Use this tab to adjust the audio levels within the game, enable/disable various audio effects, or manage your Voice Chat settings.

SPECIAL Tab

Use this tab to modify module-specific options by selecting the CH-47F from the module list along the left side of the screen.

Trimmer Mode. This selection provides options for simulating force trim functions for various input devices.

- Default – As soon as the Centering Device Release button (trimmer) is released, the new trimmed position of the player's stick will be applied immediately.
- Central Position Trimmer Mode – After the Centering Device Release button (trimmer) is released, the new trimmed position of the player's stick will be applied immediately; however any further control inputs will only be applied in each axis after the stick is returned to the neutral position in that axis (pitch and roll axes are monitored separately).
- Joystick Without Springs and FFB – This option is used for joysticks lacking any spring resistance or Force-Feedback (FFB).

Collective Brake Mode. This selection determines whether the Thrust Brake switch must be depressed to allow the Thrust Control Lever to be moved in its axis.

- THRUST BRAKE control has to be depressed to move collective – The Thrust Brake switch on the Thrust Control Lever grip must be depressed to move the Thrust Control Lever in its axis.
- Collective moves freely – The Thrust Control Lever may be moved freely in its axis without needing to depress the Thrust Brake switch on the Thrust Control Lever grip.

ENG COND & Rotor Brake Levers. This selection determines whether the Engine Condition Levers must be moved inward past their gates using separate commands.

- GATE DETENT control has to be used to move the lever through gates – The Engine Condition Levers must be commanded inward from the gate stops to retard their positions from FLIGHT to GROUND, or from GROUND to STOP.
- Lever moves through detents, GATE movement engaged automatically – The Engine Condition Levers may be moved freely from FLT to GND, or from GND to STOP, without commanding the levers inward around each gate.

Gun Aiming Method. This selection determines how the door- or ramp-mounted guns will be aimed by the player.

- Gun follows camera LOS – The door/ramp guns will be aimed in the same direction as the player's viewpoint, based on manual View commands or other input devices such as head-tracking devices or VR headsets.
- Gun aimed with controller only – The door/ramp guns will be aimed independently from the player's viewpoint, requiring separate aiming commands using the keyboard, mouse, or other input axes.

VR Tab

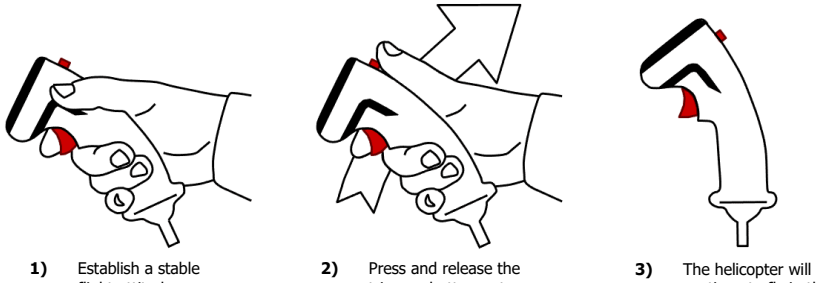
This tab allows you to enable support for a wide variety of VR Headsets and adjust their functionality. When using VR, be particularly aware of the Pixel Density setting as it can have a dramatic effect on game performance.

Force Trim in DCS

Most helicopters are rarely flown with either the cyclic or the pedals in the neutral position. Many helicopters feature a "force trim" system to reduce pilot workload. Such systems produce a force gradient which maintains the position of the cyclic (and pedals in some cases) using springs or magnetic brakes. The pilot can apply pressure against this force gradient if desired, or they can release the pressure entirely by pressing a button on the cyclic. When this button is no longer pressed, the force gradient is re-applied and holds the controls at their new position(s). This button is often called the "force trim release" or "force trim interrupt" button since it releases or interrupts the force gradient holding the controls in place (the term "Trimmer" is also used to describe this button). In the context of the CH-47, this button is called the Centering Device Release (CD REL) button.

The closest simulation of real-world force trim functionality is facilitated through the use of force-feedback gaming sticks. However, since most flight simulation enthusiasts use more conventional spring-centered joysticks, a special trim function is available in the simulation, with several options available to the player. These options are set using the Trimmer Mode drop-down selections (described above), but the underlying logic is based around establishing a new "center point" for the cyclic and pedals.

To trim the controls in their current position, press and release the "Trimmer" button, then immediately return the stick and pedals to their neutral positions. It is recommended that players unfamiliar with this force trim simulation spend some time in the cockpit on Active Pause **[LShift + Lwin + Pause]** or while sitting on the ground and observe the behavior of the simulated controls within the cockpit relative to their physical controls in their hands.



1) Establish a stable flight attitude

2) Press and release the trimmer button, return the stick to neutral

3) The helicopter will continue to fly in the trimmed attitude

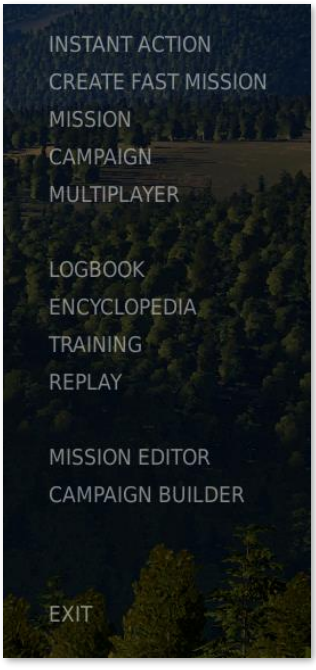
Trimming Procedure

Another means to observe this simulated trimming procedure is to display the Controls Indicator overlay while in game by pressing **[RCtrl + Enter]**. You can reset trim at any time by pressing **[LCtrl + T]**, which will re-synchronize the simulated controls within DCS with your physical joystick and/or pedals.

Fly a Mission

Now that you have configured your game, let's get to why you purchased DCS: CH-47F, to fly some missions! You have several options to fly a single or multi-player mission.

On the Main Menu page, you have the options to fly the CH-47F in an INSTANT ACTION mission, CREATE FAST MISSION, load a MISSION, play a CAMPAIGN, go through a TRAINING lesson, or create a mission in the MISSION EDITOR. You also have the option to jump online and fly with others in MULTIPLAYER.



INSTANT ACTION. Simple missions that place you in the task of your choice. These missions are grouped according to which map they take place in, so selecting a different map from the list along the right side of the Instant Action mission list may provide additional missions to choose from.

CREATE FAST MISSION. Set various mission criteria to allow a mission to be created for you.

MISSION. More in-depth, stand-alone combat missions.

CAMPAIGN. Linked missions to create a campaign narrative.

MULTIPLAYER. Create your own multiplayer session or join a multiplayer session already in progress.

TRAINING. Lessons that provide step-by-step instructions in tasks such as starting the CH-47F, takeoff and landing, navigation, or employing weapons.

MISSION EDITOR. Use this very powerful tool to create your own missions.

To get started, we suggest one of the "Free Flight" INSTANT ACTION missions. Later, you can also use these missions to practice starting up the aircraft, takeoffs, landings, navigation, and sensor / weapon employment.

Game Problems

If you encounter a problem, particularly with controls, we suggest you back up and then delete the **Saved Games\DCS\Config** folder in your home directory, which is created by DCS on your operating system drive at first launch. Restart the game and this folder will be rebuilt automatically with default settings, including all the controller input profiles.

If problems persist, we suggest consulting our online technical support forums.

Useful Links

- DCS homepage
- DCS: CH-47F Forum

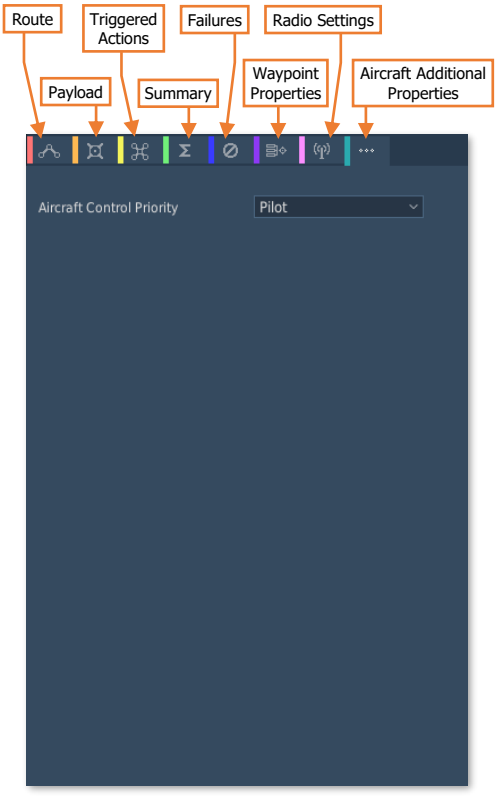
Note about this manual

(N/I). This denotes a system or function within this manual that is not implemented in DCS: CH-47F.

Mission Editor Options

Whether you are creating a mission for yourself and a friend to play online, or creating a large-scale mission for many players in many aircraft, there are a few important options regarding the DCS: CH-47F that should be properly configured within the Mission Editor.

Each DCS aircraft will have several tabs displayed on their Airplane Group or Helicopter Group panes, each with a specific purpose in preparing the aircraft for the mission.



Route. Allows the mission creator to program a series of waypoints that the aircraft should fly during the mission. If the aircraft is to be controlled by AI during the mission (Skill option is not set to Player nor Client), advanced waypoint actions may be added to any waypoint which may dictate specific actions that the AI should perform.

Payload. Allows the mission creator to specify the fuel, weapons, and munitions that should be carried by the aircraft during the mission.

Triggered Actions. Allows the mission creator to program AI tasks that will be performed when/if triggered within the mission. These will only apply if the aircraft is being controlled by AI.

Summary. Allows the mission creator to review a route summary of the flight plan programmed on the Route tab.

Failures (Player only). Allows the mission creator to program any number of emergency conditions or component failures that may occur during the mission.

Waypoint Properties. Attributes may be assigned to Mission Editor waypoints. *(work-in-progress)*

Radio Settings (Player/Client only). Allows the mission creator to configure preset radio frequencies used by the radio sets, if such capability exists for that aircraft.

Aircraft Additional Properties. Allows the mission creator to configure any remaining properties that are unique to the aircraft type.

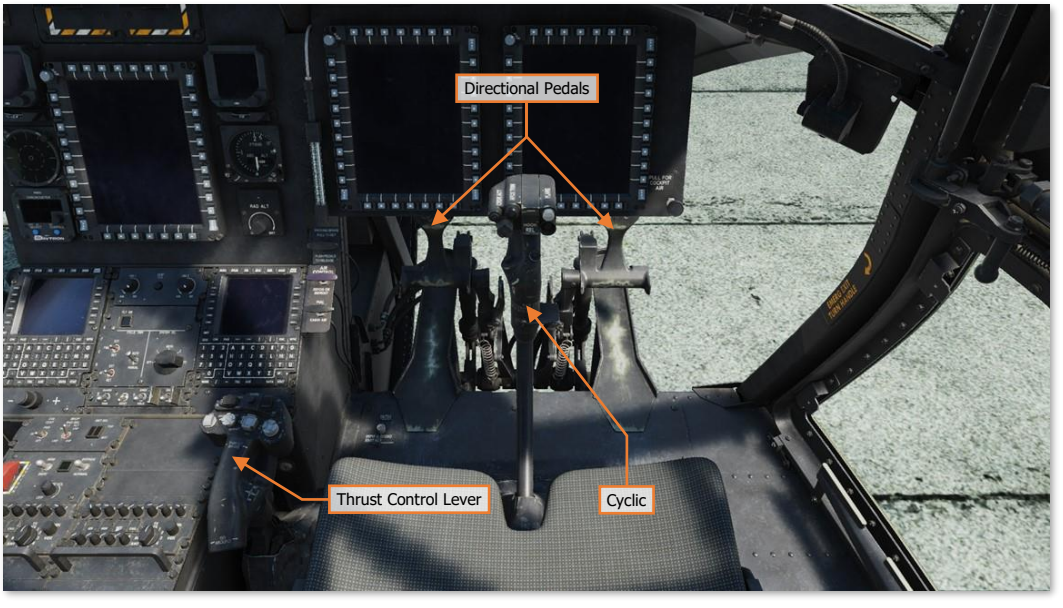
- **Aircraft Control Priority.** Configures the "multicrew" control handover logic when two players are occupying the same CH-47F during a multiplayer session. As the pilot-in-command, the Pilot will always have initial control of the aircraft.
    - **Pilot.** The Pilot has priority control of the aircraft.
        - The Copilot must request control from the Pilot, after which the Pilot may grant or deny the request to transfer the flight controls.
        - The Pilot can take control from the Copilot at any time but cannot give control to the Copilot without a transfer request from the Copilot.
    - **Co-Pilot.** The Copilot has priority control of the aircraft.
        - The Pilot may request control from the Copilot, after which the Copilot may grant or deny the request to transfer the flight controls.
        - The Copilot can take control from the Pilot at any time and can give control to the Pilot at any time.

- **Ask Always.** Neither crewmember has priority control of the aircraft.
  - The crewmember that does not have control must request control. The crewmember that has control may grant or deny the request to transfer the flight controls.
- **Equally Responsible.** Neither crewmember has priority control of the aircraft.
  - The crewmember that does not have control may take control at any time.
  - The Copilot may give control to the Pilot at any time, but the Pilot cannot give control to the Copilot.

FLIGHT CONTROL

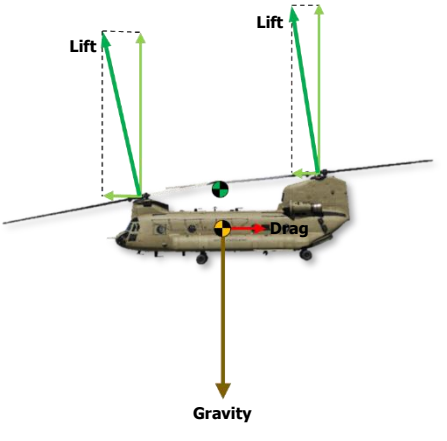
The primary helicopter flight controls include the **Cyclic**, **Thrust Control Lever**, and **Directional Pedals**.

- The **Cyclic** is used to pitch the nose up and down to control airspeed, and roll the aircraft left and right to perform turns while in forward flight or to translate left and right while in a hover.
- The **Thrust Control Lever** is used to control the amount of lift the rotors produce for maintaining a constant altitude or climbing and descending.
- The **Directional Pedals** are used to differentially tilt the rotor disks in opposite directions for yawing the nose left and right while in low speeds or in a hover; and on the ground to turn the nose when taxiing without the aid of the hydraulic steering actuator.



Just as fixed-wing aircraft use the physics of opposing forces to fly and maneuver through the air, helicopters also rely on opposing forces to maintain controlled flight. However, the physical forces involved in rotary-wing flight are much more difficult to maintain in a state of balance and require constant attention by the pilot to maintain controlled flight.

Although DCS: CH-47F includes keyboard commands for manipulating the flight controls, it is highly recommended that analog control devices of some form are utilized. If you do have a joystick, it may be equipped with a throttle handle for controlling the Thrust Control Lever; and/or a twist grip, which will allow you to control the Directional Pedals.



THE CH-47F

US Army photo
by 1LT Austin Lachance

AIRCRAFT HISTORY

The CH-47F is the evolution of the U.S. Army's heavy lift capability that dates back to the era when the practical helicopter was still a nascent concept in aviation. In the 1950's, the U.S. military was seeking helicopter designs that could fulfill a variety of new missions, ranging from transporting small squads of troops around the battlefield, performing medical evacuation or search and rescue, or even transporting large artillery emplacements or ballistic nuclear missiles. At the same time, the limitations of the piston engine were giving way to the efficiency of the gas turbine engine, which provided significantly more power compared to similarly sized piston engines. This increase in power and efficiency opened the door for the procurement of the U.S. Army's heavy lift helicopter.

Evolution of the tandem-rotor cargo helicopter

In 1952, Piasecki Helicopter Corporation began producing the H-21 for the U.S. military as an assault transport and search and rescue helicopter. The H-21 featured a tandem-rotor design that was originally conceived and patented by Dragoljub Kosta Jovanovich, a Serbian-American helicopter engineer and pioneer in autogyro technology, during development of the MC-4.

Piasecki H-21 (US Army)

Tandem-rotor helicopters do not require a tail rotor to counter the torque of a main rotor for directional stability. Rather, two equally sized main rotors are mounted to the forward and rear sections of the fuselage, which rotate in opposite directions to cancel the opposing torque forces of each rotor system. The tandem-rotor design permits all available engine power to be utilized for lift and propulsion, and the longitudinal center-of-gravity limits are more permissible. These characteristics are particularly advantageous for cargo helicopters, but at the expense of increased mechanical complexity and the requirement of larger landing areas to accommodate the total area of two main rotors.

In 1956, the U.S. Army and the U.S. Marine Corps began utilizing the Sikorsky CH-37 heavy lift helicopter. With the ability to carry up to 26 troops or three M422 lightweight utility vehicles internally, the single rotor CH-37 and its characteristic clamshell nose doors could indeed carry an increased payload compared to the tandem-rotor H-21. However, the CH-37 was powered by two large and heavy radial piston engines, limiting its payload capabilities and overall airframe design.

Sikorsky CH-37 (US Army)

In the same year the CH-37 entered service, Piasecki Helicopter Corporation had been renamed to Vertol Aircraft Corporation and set out to design a new tandem-rotor helicopter to replace the H-21. The prototype, Vertol Model 107 or V-107, was powered by two turboshaft engines; which was in contrast to the singular 9-cylinder radial piston engine that powered the H-21.

The turboshaft engine, a new form of gas turbine optimized to produce shaft horsepower rather than direct thrust, was a significant improvement over contemporary piston engine designs, providing an increase in available engine power for less weight, while occupying less volume.

In April of 1958, the V-107 performed its maiden flight and, in June of that same year, the U.S. Army ordered ten production V-107 airframes for development, designated as YHC-1A. However, the order was subsequently reduced to just three airframes to fund the development of an even larger derivative of the V-107, known as the Vertol Model 114, or V-114.

Although the Army never procured any additional YHC-1A airframes, the design would go on to serve with the U.S. Marine Corps and U.S. Navy for over 40 years as the CH-46, as well as numerous military and civilian operators around the world.

YHC-1A prototype (Boeing-Vertol)

U.S. Army Medium Transport Helicopter

On the June 25th, 1958, the U.S. Army requested proposals for a medium transport helicopter. Bell, Kaman, McDonnell, Sikorsky, and Vertol responded with various designs and, on March 4th, 1959, the Army awarded a contract to Vertol for the construction of five prototype V-114 airframes, designated as the YHC-1B. Although the potential for lucrative contracts with multiple military services would otherwise be good news for Vertol, the financial and engineering burden from concurrently developing two new helicopter designs put strain on the company. In March of 1960, Boeing Airplane Company bought Vertol Corporation, renamed to Boeing-Vertol, bringing additional funding and expertise to the simultaneous development of the YHC-1A and YHC-1B programs.

Third YHC-1B prototype (Boeing-Vertol)

The YHC-1A and YHC-1B followed the same airframe configuration, with two counter-rotating main rotors mounted atop forward and aft rotor pedestals and a pair of turboshaft engines mounted to either side of the rear rotor pedestal. The forward and aft rotor systems were linked to the engines through a series of gearboxes, with a driveshaft running along the top of the fuselage over the interior cabin to the forward rotor pedestal. These gearboxes combined the power of both engines, allowing a single engine to power both rotors if the other engine had failed. Both airframes included a long interior bay for troops or cargo, with a crew access door along the right side of the forward fuselage and a hydraulically powered tail ramp at the rear.

Compared to the YHC-1A, the YHC-1B fuselage had an additional length of 7 feet, and an additional overall length of 15 feet (with both rotor systems turning), and an empty weight that was 10,000 pounds greater than that of the YHC-1A. The YHC-1B was powered by two Lycoming T-55-L-5 turboshaft engines rated at 2,220 shp (shaft horsepower) each, which were scaled-up derivatives of the Lycoming T53 engine that powered the Bell UH-1 utility helicopter. For comparison, the YHC-1A was powered by two General Electric T58-GE-6 turboshaft engines rated at only 850 shp each.

The YHC-1B performed its maiden flight on September 21st, 1961. In July of 1962, the YHC-1B was re-designated as the YCH-47A as part of the new tri-service designation system established within the U.S. Department of Defense, with the U.S. Army taking delivery of its first production CH-47A's the following month. Delivery of CH-47A airframes to operational Army units began in April of 1963.

CH-47A

The CH-47A could carry 33 fully equipped troops in sidewall seating on each side of the interior cabin, 24 casualty litters with two attendants, or 6,000 pounds of internal cargo. Alternatively, 20,000 pounds of payload could be carried externally in a "sling-load" configuration. The rear loading ramp could be set to any position to permit easy loading or offloading of cargo, troops, or even small vehicles; or it could be deployed in flight to deliver air-dropped cargo or paratroopers. The interior cabin included an integrated winch system to assist with the handling of cargo through the rear tail ramp; or be employed as a rescue hoist through a central hatch within the center of the cabin for recovering personnel while in a stationary hover.

CH-47A deployed to Vietnam (US Army)

The production CH-47A's were powered by improved T55-L-7 engines, which were rated for 2,200 shp each at a continuous power setting, but could maintain 2,650 shp for up to 10 minutes if necessary. With a maximum gross weight of 33,000 pounds, the CH-47A could carry a payload greater than its own operational weight. The CH-47A was also equipped with an auxiliary power unit (APU), allowing it to be operated from remote locations.

The minimum crew was a pilot, a copilot, and a crew chief. However, additional crewmembers could be carried as necessary for the handling of cargo or to provide aircraft security using a pair of door-mounted M60D machine guns on either side of the fuselage, just aft of the cockpit, and a third M60D mounted at the tail ramp.

Vietnam War

A CH-47A departing a mountaintop combat outpost in Vietnam in 1967 (US Army)

The first use of the CH-47 in combat was in July of 1965 when the 228th Assault Support Helicopter Battalion (ASHB), 1st Cavalry Division (Airmobile), was deployed to Vietnam from Fort Benning, Georgia with 57 CH-47A's.

CH-47's performed a variety of missions in Vietnam, including the movement of infantry around the battlefield, rapid movement of artillery between fire bases, resupply and logistics support, and of particular note: recovery of downed aircraft. Throughout the Vietnam War, the CH-47 fleet recovered over 11,000 aircraft with a replacement value of over $3 billion (USD). One particular ASHB set a record by recovering 73 aircraft within a one-month period alone.

At the peak of the type's employment in Vietnam, 22 operational CH-47 units were simultaneously deployed to the theater.

A total of 354 CH-47A's were eventually delivered to the Army. A total of 141 U.S. Army CH-47's were lost during the Vietnam War to combat or wartime operational accidents, to include A, B, and C model airframes.

ACH-47A Experimental Gunships

In late 1965, four CH-47A's were refitted as experimental "Armed/Armored CH-47" gunships, and were accordingly designated as ACH-47A. The ACH-47A's were modified with a nose-mounted turret, weapon pylons mounted to the mid-fuselage, two additional flank gunner hatches toward the rear fuselage, and a tail gunner position at the tail ramp. These provisions allowed the ACH-47A to provide fire support for friendly ground forces using an arsenal of weapons:

- Two forward-firing M24A1 20mm cannons mounted to the external pylons.
- Two XM159 19-tube rocket launchers or two forward-firing gatling-style M18 7.62mm Miniguns mounted to the external pylons.
- One M5 40mm automatic grenade launcher mounted to the nose turret.
- Five M2 .50 caliber machine guns or five M60D 7.62mm machine guns, or a combination of such, mounted to the flank gunner positions on each side of the fuselage and the tail ramp.

ACH-47A "Easy Money" in Vietnam (US Army)

In April of 1966, three of the four ACH-47A aircraft were deployed to Vietnam with the evaluation unit, which had been re-designated as the 53rd Aviation Detachment Field Evaluation (Provisional), but the unit has been more famously known as "Guns-A-Go-Go". These three aircraft, nicknamed by their crews as "Easy Money", "Stump Jumper", and "Birth Control", were to undergo combat trials while the fourth ACH-47A, nicknamed "Co$t of Living", remained at Edwards Air Force Base in California for further testing.

Unfortunately, one of the ACH-47's, "Stump Jumper", was involved in a ground accident on August 5th, 1966, after colliding with a parked CH-47A and was destroyed as a result. Subsequently, "Co$t of Living" was withdrawn from testing at Edwards AFB and was deployed to Vietnam along with the remaining ACH-47A's.

In December of 1966, the 53rd Aviation Detachment was re-designated as the 1st Aviation Detachment (Provisional), and attached to the 228th ASHB at An Khe in support of 1st Cavalry Division operations.

ACH-47A's in flight over Vietnam (US Army)

On May 5th, 1967, while engaged in combat near Bong Son, "Co$t of Living" was lost when a forward mounting pin securing one of the M24 20mm cannons vibrated loose during a gun run. The cannon swung upward, firing into the forward rotor system, causing the blades to separate and the aircraft to tumble into the ground. The remaining two ACH-47's, "Easy Money" and "Birth Control", continued to operate throughout 1967 and provide valuable fire support to friendly ground forces and refine mission tactics and techniques.

On February 22nd, 1968, while supporting ground forces re-capturing Hue during the Tet Offensive, "Birth Control" received numerous hits from ground fire and was forced to make an emergency landing. Under heavy fire, "Easy Money" provided suppressive fires and safely extracted the downed crewmembers.

"Easy Money" was subsequently withdrawn from combat and the experimental ACH-47 program was terminated.

CH-47B and CH-47C

The CH-47B was an interim variant while the CH-47C was developed, with 108 airframes built. The CH-47B featured upgraded T55-L-7C engines rated at 2,400 shp at continuous power, with a maximum power setting of 2,850 shp; redesigned rotor blades with a slight increase in length; strakes along the lower rear fuselage to improve flight stability, and a blunted aft rotor pylon instead of the tapered trailing edge on the CH-47A.

The first CH-47C flew on October 14th, 1967; with initial deliveries arriving at U.S. Army units in early 1968, and the first CH-47C's arriving in Vietnam in September of 1968. A total of 270 CH-47C's were delivered to the Army.

The CH-47C included a series of upgrades across three sub-variants. The original CH-47C was equipped with the same T55-L-7C engines that had powered the CH-47B. The "Super C" sub-variant included a pitch stability augmentation system (PSAS), more powerful T55-L-11 engines rated for 3,000 shp at continuous power or 3,750 shp at maximum power, and an increased maximum gross weight of 46,000 pounds. However, the -11 engines suffered from reliability problems and were replaced with the more reliable -7C engines until 1970, at which time the issues with the -11 engines had been resolved. This led to the "Baby C" sub-variant, which was identical to the "Super C" with the exception of -7C engines.

CH-47C stationed in West Germany in the mid-1970's (US Army)

To accommodate the increase in engine power, a more robust power transmission system was also installed in the CH-47C. The additional lifting power allowed the CH-47C to achieve higher speeds than the previous variants; but more importantly, the CH-47C was able to lift a single M198 155mm howitzer. The CH-47C also featured an increase in fuel capacity, and the ability to utilize fuel bladders installed within the interior cabin to extend its range, if necessary. Eventually, C models would also receive crashworthy fuel cells and fiberglass rotor blades.

CH-47D

Two CH-47D's from B Company "Big Windy", 5-158 Aviation Regiment (GSAB), flying low over Germany (US Army)

In 1979, Boeing-Vertol initiated the CH-47D upgrade program, which would constitute a re-manufacture of existing A, B , and C model CH-47's into D model airframes. The CH-47D featured a refurbished fuselage, improved avionics and communications, composite rotor blades, a single-point pressure refueling system, T55-L-712 turboshaft engines, and an uprated transmission. Lift capacity was increased to 13,900 pounds internally or 22,800 pounds externally. Notably, the CH-47D also included a new 3-point hook system, allowing the aircraft to balance unstable or multiple external payloads underneath the aircraft during sling-load operations.

The first CH-47D prototype took flight in May of 1979; and the type entered service with the U.S. Army in May of 1982.

Throughout the 1980's and 1990's, the CH-47D fleet was heavily relied upon by the U.S. Army in times of conflict and natural disasters.

In 1989, during the invasion of Panama, CH-47's participated in multiple air assaults in which ground forces were inserted to secure mission objectives.

On February 24th, 1991, during the Gulf War, 40 CH-47's and 60 UH-60's took part in the largest helicopter air assault in history, transporting an entire brigade of the 101st Airborne Division deep into Iraq, cutting off Iraqi forces within Kuwait to prevent their reinforcement or escape.

CH-47D's during Operation Desert Storm (US Army)

Global War on Terror

Following the terrorist attacks of September 11th, 2001, the United States began Operation Enduring Freedom to seek out and eliminate Al-Qaeda forces within Afghanistan and remove the Taliban from power.

During the subsequent military campaign, the power and payload capabilities of the CH-47D proved to be a vital asset over the high elevations of Afghanistan. Throughout the conflict, CH-47's performed countless air assaults across the country in support of U.S. and allied forces. With the limited road network and constant threat of improvised explosive devices (IEDs), CH-47's also became a critical logistics lifeline for remote forward operating bases and combat outposts.

A CH-47D of the 104th Aviation Regiment (PA National Guard) in Afghanistan on November 10th, 2003 (SGT Greg Heath, US Army)

MH-47 Special Operations Aircraft

Starting in the mid-1980's, a number of CH-47 airframes were modified to support the 160th Special Operations Aviation Regiment (Airborne). These aircraft, consisting of MH-47D, -47E, and -47G variants, were fitted with improved navigation and communications equipment, adverse weather radar, forward-looking infrared sensors, advanced defensive countermeasures, enlarged fuel tanks, in-flight refueling probes, an external rescue hoist, and additional weaponry.

Notably, the Common Avionics Architecture System (CAAS) installed in the MH-47G SOA variant subsequently became a key feature in the Army's CH-47F modernization program.

US Army Rangers fast-roping from an MH-47 of the 160th Special Operations Aviation Regiment (SSG Russell Klika, US Army)

CH-47F

In May of 1998 the U.S. Army initiated the Improved Cargo Helicopter program to modernize the CH-47D fleet and reduce its operating costs. The new F model would bring the CH-47 into the 21st century and significantly enhance the U.S. Army's heavy lift capability.

(Rockwell Collins)

The CH-47F includes a new airframe with larger, single-piece, milled sections; thus reducing vibrations and maintenance costs. The CH-47F is powered by two Honeywell T55-L-714A engines, rated at 4,868 shp each; and external lift capacity is increased from 22,800 pounds to 28,000 pounds. The F model is also rapidly deployable, with the teardown and build-up times reduced by 50% compared to the D model.

Flight control is enhanced with a new Digital Advanced Flight Control System (DAFCS), which provides an unprecedented level of automation and control, especially at low speeds or in a hover. However, the most significant aspect of the CH-47F upgrade program was the installation of the Common Avionics Architecture System (CAAS) by Rockwell Collins, featuring five Multi-Function Displays (MFD) that replaces the old analog instruments of the CH-47D and includes an improved hands-on control system.

Although originally developed for the MH-47 and MH-60 fleets to support the special operations mission of the 160th SOAR, CAAS was also incorporated into the CH-47F and UH-60M fleets as part of the U.S Army's modernization efforts throughout the 2000's.

CH-47D cockpit (SSgt Jeremy T. Lock, USAF)

CH-47F cockpit (A1C Sarah Dowe, USAF)

CAAS provides a more efficient human-machine interface to the pilots and incorporates a series of removable memory devices and a Data Transfer System to rapidly upload mission planning and navigation data during start-up. If necessary, either pilot may create or edit the flight plan, routing, or other mission data while in flight using a pair of Control Display Units (CDU), Multi-Function Control Units (MFCU), and an onboard Digital Aeronautical Flight Information File (DAFIF) database. Horizontal Situation Displays (HSD) include digital moving map underlays, flight plan and navigational data, and threat and terrain avoidance overlays to enhance the overall situational awareness of the aircrew.

The first CH-47F prototype took flight in June of 2001, and the first deliveries to the U.S. Army occurred in 2006.

Natural Disaster Support and Humanitarian Assistance

Since the beginning of its existence, the CH-47 has been a major asset in the aftermath of natural disasters and providing humanitarian assistance.

In January of 1964, less than two years after the first CH-47A airframe was delivered to the U.S. Army, a single CH-47 that had been undergoing high altitude testing at Edwards AFB was sent to a flood-stricken area of northern California. In the subsequent rescue and resupply efforts, 47% of all cargo airlifted by the helicopters during the relief efforts had been transported by the single CH-47. In May of 1966, just four months after the floods in northern California, a CH-47A took part in rescue and evacuation operations in Alaska following an earthquake.

In the following decades, CH-47's around the world have delivered humanitarian aid to distant regions or settlements, assisted in rescue efforts of civilians, and supported first responders and emergency personnel following natural disasters. Notably, CH-47's have even assisted in flood control by helping to repair breached levees; the latter of which was seen along the U.S. Gulf coast in the aftermath of Hurricane Katrina in September of 2005.

CH-47D drops sandbags to repair a breached levee in Louisiana on September 25th, 2005

Proliferation and Export

Since 2006, Boeing Helicopters (formerly Boeing-Vertol) has produced over 500 CH-47F's domestically for the United States Army and foreign partners. Over 20 nations' militaries and multiple civilian agencies operate various models and configurations of the venerable CH-47. The CH-47F model specifically is in service with Australia, Canada (as the CH-147), the Netherlands, Saudi Arabia, Singapore, Turkey, United Arab Emirates, and the United Kingdom (as the HC Mk6).

UK Royal Air Force HC Mk6 (UK MoD)

Royal Netherlands Air Force CH-47F (RNLAF)

Partnered with Boeing, AgustaWestland has produced a variant of the CH-47F (designated ICH-47F) for the Italian Army, and Kawasaki Industries has produced variants of the CH-47D (designated CH-47J and JA) for the Japanese Air Self Defense Force and Japanese Ground Self Defense Force. Other variants of the CH-47 have been in operation by Argentina, Egypt, Greece, Iran, Japan, Libya, Morocco, Nigeria, Republic of China, Republic of Korea, Spain, Thailand, and Vietnam.

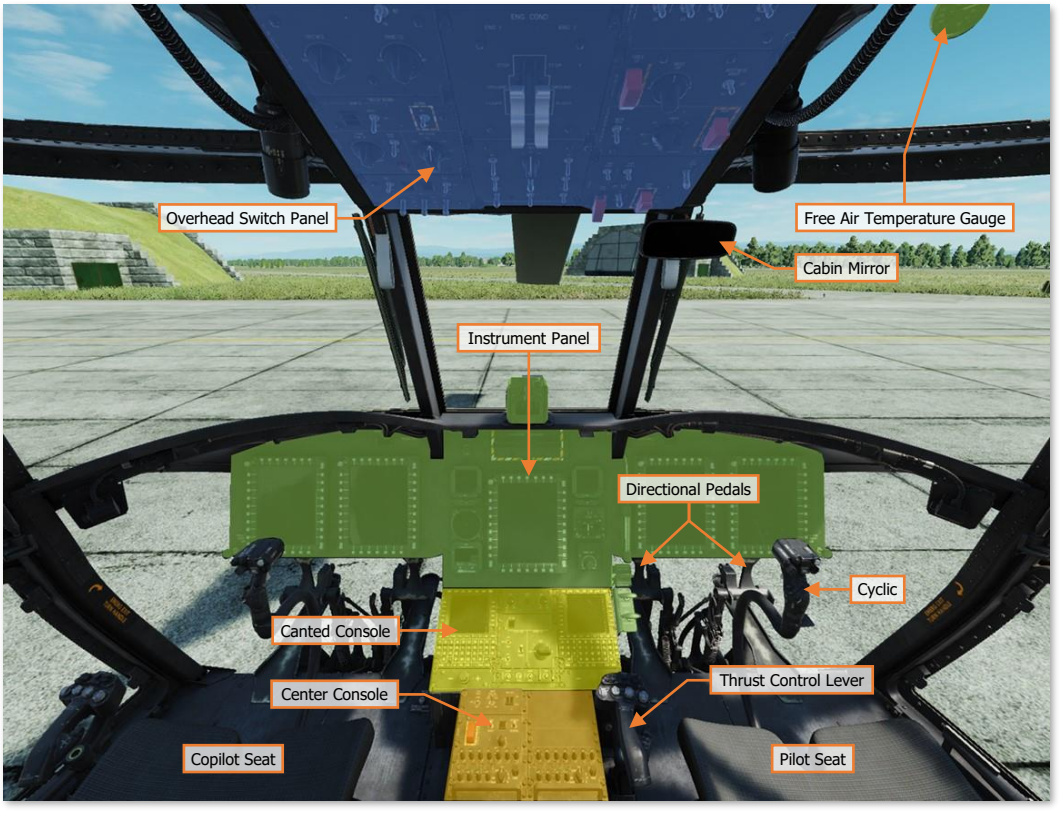
In total, over 1,500 CH-47's have been produced since 1961. The CH-47 is expected to remain in active service with the U.S. Army and other nations beyond 2060, achieving an astonishing century of continued aviation service.

COCKPIT OVERVIEW

The CH-47 uses a side-by-side cockpit layout, with the Pilot (PLT) occupying the right seat and the Copilot (CP) occupying the left seat. Each crewstation is provided with a set of flight controls, a Control Display Unit (CDU), and pair of MFDs (Multi-Function Displays). A fifth MFD is located in the center that may be utilized by both crewmembers, along with standby flight instruments and controls for the remaining aircraft systems.

The Pilot's primary task is to operate the flight controls. When operating in Visual Meteorological Conditions (VMC), the Pilot maintains focus outside the cockpit and maneuvers the aircraft as necessary to avoid threats, terrain, obstacles, and other hazards to flight. When operating in Instrument Meteorological Conditions (IMC), the Pilot maintains focus inside the cockpit on the primary flight instrumentation to navigate along the flight plan.

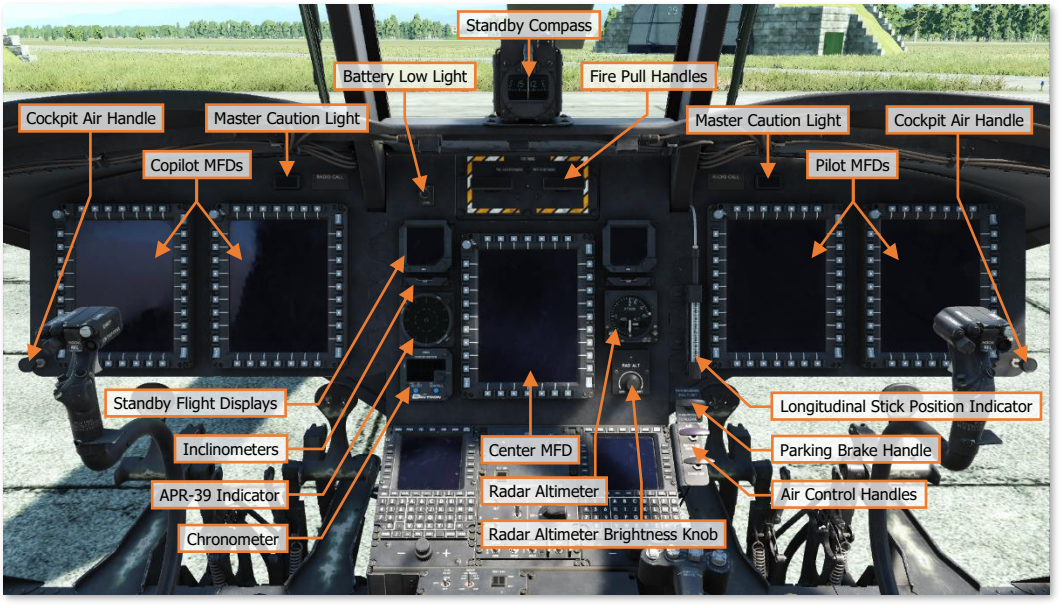
The Copilot's primary task is to assist the Pilot in maintaining awareness of any threats or hazards to flight, back up the Pilot as necessary in operating the flight controls in VMC or IMC, manage the aircraft navigation and communication systems during the mission, and announce/complete crew checklist items when appropriate.



It is important to have a general understanding of where the various controls are located. To help locate items more easily, the cockpit has been delineated into six primary areas: **Instrument Panel**, **Canted Console**, **Center Console**, **Overhead Switch Panel**, No. 1 Power Distribution Panel, and No. 2 Power Distribution Panel.

The text boxes above that correspond with each primary area may be selected to jump to a more detailed description of that instrument panel or console, to include the **Cyclic**, **Thrust Control Lever**, and Multi-Function Control Unit. Selecting the image of the instrument panel or console will return the manual back to this page.

Instrument Panel



Each text box above may be selected to jump to a more detailed description of that instrument or panel. Selecting the image of the instrument or panel will return the manual back to this page.

The Multi-Function Displays (MFD) are described in a dedicated section later in this chapter.

The APR-39 Indicator is described in the Aircraft Survivability Equipment (ASE) chapter.

Standby Compass

The standby magnetic compass is used by the aircrew for heading reference when there has been a failure of primary power, or the navigation system has become unreliable.

Due to magnetic variances and other inaccuracies during normal flight maneuvers, the standby magnetic compass should not be relied upon for precise heading or navigation information. Visual landmarks may be used to maintain awareness of aircraft position and aid in navigation back to maintenance facilities or friendly-controlled areas.

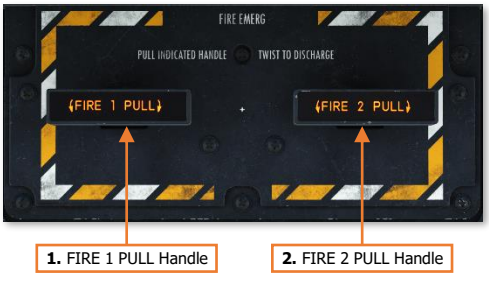
Illumination of the compass face may be adjusted by a brightness knob.

Battery Low Light

The BAT LOW light illuminates when neither DC bus 1 nor DC bus 2 are powered and the onboard battery voltage drops below 20 volts.

Fire Pull Handles

The FIRE 1 PULL and FIRE 2 PULL handles control the engine fire suppression equipment. Each handle includes internal warning lights that illuminate when a fire is detected in the corresponding engine compartment.



1. **FIRE 1 PULL Handle.** The FIRE 1 PULL handle illuminates when a fire is detected within the left engine nacelle.
2. **FIRE 2 PULL Handle.** The FIRE 2 PULL handle illuminates when a fire is detected within the right engine nacelle.

After a handle is pulled outward, fuel flow to the corresponding engine is shut off and the fire extinguishing system is armed, which incorporates a pair of fire bottles containing pressurized fire extinguishing agent.

- If the handle is rotated counterclockwise after being pulled outward, the forward fire bottle is discharged into the corresponding engine compartment.
- If the handle is rotated clockwise after being pulled outward, the aft fire bottle is discharged into the corresponding engine compartment.

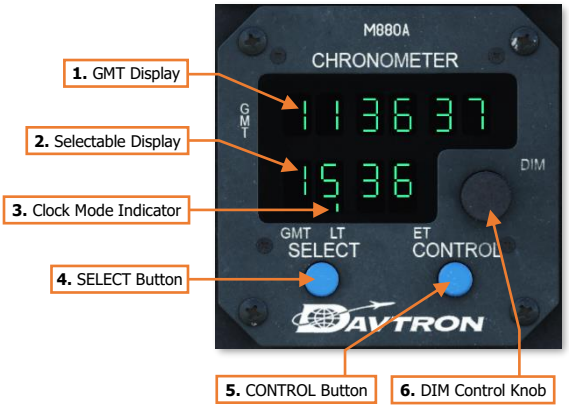
Master Caution Lighted Pushbuttons

The Master Caution lighted pushbuttons alert the aircrew to observe the MFD WCA messages for warning and caution messages indicating conditions that require their immediate attention.

Pressing either lighted pushbutton or the Acknowledge button on the Cyclic Grip extinguishes the MASTER CAUTION lights and ceases the corresponding voice warning message, if present.

Chronometer

The Chronometer is a digital clock that includes simultaneous presentation of two time zones and a stopwatch timer function.



1. **GMT Display.** Displays Greenwich Mean Time in HH:MM:SS format.
2. **Selectable Display.** Displays Greenwich Mean Time (GMT) or Local Time (LT) in HH:MM format.

   When set to Elapsed Time (ET), displays a stopwatch timer in a MM:SS format between 00:00 and 59:59, or in HH:MM format when displaying an elapsed time ≥ 1 hour.
3. **Clock Mode Indicator.** Indicates the clock mode displayed within the Selectable Display window, as GMT, LT, or ET.
4. **SELECT Button.** Cycles the clock mode between GMT, LT, and ET modes, acknowledges the timer alarm aftter reaching 00:00 in ET mode, or is used to adjust the time in GMT or LT mode. When manually adjusting the clock time, pressing the SELECT button will advance the time adjustment to the next display field.

   When the SELECT button is pressed and held for 3 seconds, the clock will enter a test mode. Each display field should display "8" and each tick mark of the Clock Mode Indicator should illuminate.
5. **CONTROL Button.** Operates the stopwatch function of the digital clock when in ET mode, acknowledges the timer alarm aftter reaching 00:00 in ET mode, or is used to adjust the time in GMT or LT mode. When manually adjusting the time, pressing the CONTROL button will increment the currently flashing display field.

   In ET mode, the first press of the CONTROL button will start the timer counting upward from 00:00. The second press of the CONTROL button will stop the time. The third press will reset the timer to 00:00.
6. **DIM Control Knob.** Adjusts the brightness of the GMT Display, Selectable Display, and Clock Mode Indicator.

When the clock mode is set to GMT, pressing the SELECT and CONTROL buttons simultaneously enables the clock displayed in the GMT Display to be set. Once enabled, the first digit of the hour data field will flash. Pressing the CONTROL button will increment the digit by 1 value. Pressing the SELECT button will advance to the next digit in the hour data field, followed by each digit in the minutes data field, followed by each digit in the seconds data field. An additional press of the SELECT button will accept the time that has been entered.

When the clock mode is set to LT, pressing the SELECT and CONTROL buttons simultaneously enables the Local Time displayed in the Selectable Display to be set. Once enabled, the first digit of the hour data field will flash. Pressing the CONTROL button will increment the digit by 1 value. Pressing the SELECT button will advance to the next digit in the hour data field. An additional press of the SELECT button will accept the time that has been entered. The minutes data field is automatically synchronized with GMT and cannot be edited.

When the clock mode is set to ET, pressing the SELECT and CONTROL buttons simultaneously enables a countdown timer between 00:01 and 59:59 to be set in the Selectable Display. Once enabled, the first digit of the minute data field will flash. Pressing the CONTROL button will increment the digit by 1 value. Pressing the SELECT button will advance to the next digit in the minute data field, followed by each digit in the seconds data field. An additional press of the SELECT button will accept the entered countdown timer that has been entered.

After a countdown timer has been entered, pressing the CONTROL button will initiate the countdown timer. Upon reaching 00:00, an alarm will sound, the Selectable Display will begin to flash, and the timer will begin to count upwards from 00:00. The alarm may be reset by pressing either the SELECT button or the CONTROL button.

Radar Altimeter

The radar altimeter provides a continuous indication of altitude above ground level up to 1,500 feet, and up to ±45° in pitch or roll. The radar altimeter itself is powered by DC bus 2, with the Radar Altimeter indicator in the center section of the Instrument Panel providing a backup indication of altitude above ground level in case the MFD's have malfunctioned or failed.

1. **HI Indicator Light.** Illuminates when the indicated radar altitude has exceeded the upper reference altitude set by the HI setting knob.
2. **LO Indicator Light.** Illuminates when the indicated radar altitude has dropped below the lower reference altitude set by the LO setting knob.
3. **Altitude Scale.** The indicator range is 0 to 1,500 feet, with major tick marks placed at 100-foot increments between 0 and 200 feet, and 500-foot increments from 500 to 1,500 feet. Minor tick marks are placed in 10-foot increments from 0 to 200 feet, and 100-foot increments from 200 to 1,500 feet.
4. **Analog Altitude Indicator.** Indicates the aircraft altitude above ground along the outer Altitude Scale.
5. **Digital Altitude Indicator.** Indicates the current radar altitude in 1-foot increments from 0 to 1,500 feet.

   An OFF flag will be displayed in front of the digital indicator when the radar altimeter is powered off.
6. **LO Setting Knob.** Adjusts the position of the lower reference altitude setting, indicated by the "L" altitude reference indicator along the Altitude Scale.
7. **HI Setting Knob.** Adjusts the position of the upper reference altitude setting, indicated by the "H" altitude reference indicator along the Altitude Scale.

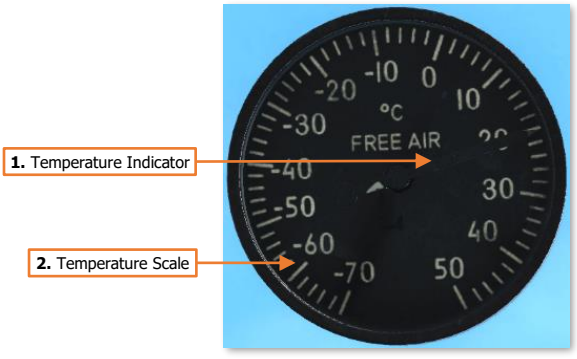
Radar Altimeter Brightness Knob

The RAD ALT brightness knob adjusts the brightness of digital altitude indicator readout and the HI and LO indicator lights on the radar altimeter directly above the knob itself.

Free Air Temperature Gauge

The Free Air temperature gauge is embedded within the Pilot's overhead window and indicates the temperature of the external air mass via a probe directly protruding from the gauge itself through the overhead window to the outside of the aircraft.

1. **Temperature Indicator.** Indicates air temperature in Celsius (°C) as directly measured outside the cockpit.
2. **Temperature Scale.** Each major tick mark corresponds with 10-degree increments, with minor tick marks corresponding to 2-degree increments.



Longitudinal Stick Position Indicator

The Longitudinal Stick Position Indicator references the position of the cyclic longitudinal pitch control relative to the neutral position. The indicator is mechanically linked to the pitch input bell crank and is rigged to indicate Neutral (marked by an "N" in the center of the indicator) when the aircraft center-of-gravity (CG) is in a neutral position, the aircraft is in a free air hover, and the DAFCS is engaged.

The scale of the indicator is calibrated in inches (in.), with the furthest forward position corresponding to a forward longitudinal pitch position of +8 inches, and the furthest aft position corresponding to an aft longitudinal pitch position of -8 inches.

Parking Brake Handle

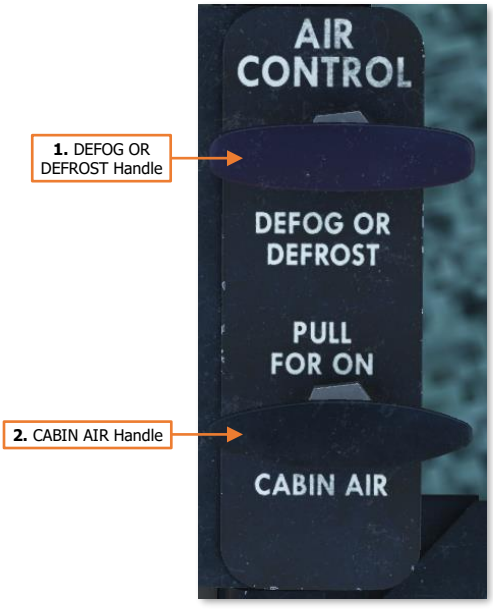
The parking brake handle can be used by the Pilot to set the wheel brakes without needing to continuously apply pressure to the directional pedals themselves. To set the brakes using this method, the brakes are engaged by applying pressure to the directional pedals at either crewstation and the Pilot then pulls the parking brake handle out. The pressure on the directional pedals may then be released.

To release the brakes after they have been set using the parking brake handle, the Pilot or the Copilot may simply apply brake pressure using the directional pedals, and the parking brake handle will snap inward.

Air Control Handles

The AIR CONTROL handles mounted on the right side of the Instrument Panel allow the Pilot to adjust the amount of heated or ventilated air flowing into the forward section of the cockpit or the aft cabin. (N/I)

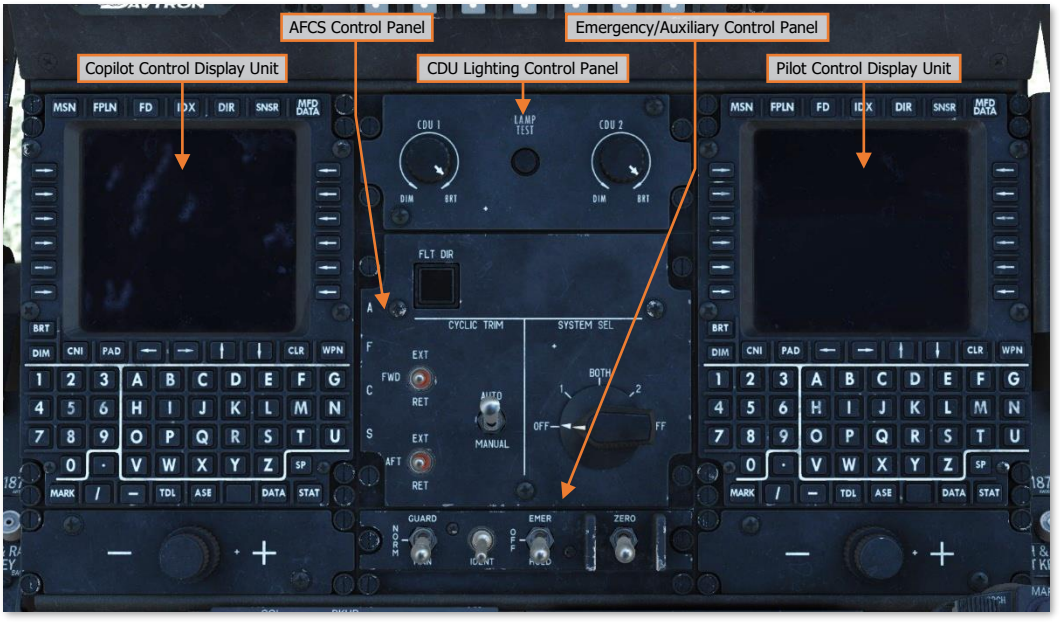
1. **DEFOG OR DEFROST Handle.** When pulled outward, heated or ventilated air will flow into the forward nose section, where it is directed across the windshield and the windows of each jettisonable door for defrosting and defogging purposes. The further the handle is pulled outward, the greater the flow of air into the forward nose section.
2. **CABIN AIR Handle.** When pulled outward, heated or ventilated air will flow into the aft cabin. The further the handle is pulled outward, the greater the flow of air into the aft cabin.



Pilot & Copilot Cockpit Air Handles

The COCKPIT AIR handles mounted on the far left and far right sides of the Instrument Panel, outboard of the MFDs, allow the Pilot and Copilot to adjust the amount of heated or ventilated air flowing into their side of the cockpit. The further the handle is pulled outward, the greater the flow of air into the respective crewstation. (N/I)

Canted Console

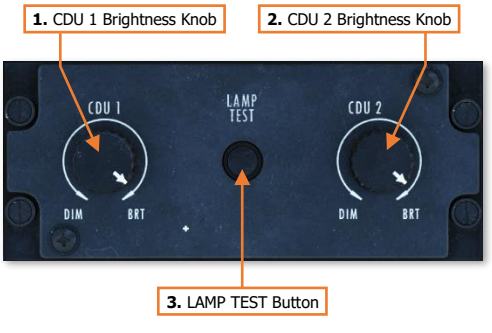


Each text box above may be selected to jump to a more detailed description of that instrument or panel. Selecting the image of the instrument or panel will return the manual back to this page.

The Control Display Units (CDU) and AFCS Control Panel are described in dedicated sections later in this chapter.

CDU Lighting Control Panel

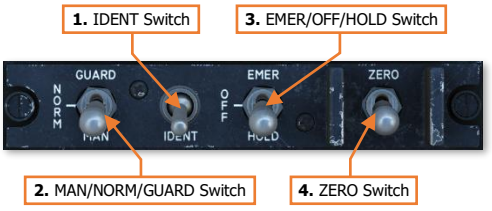
The CDU Lighting control panel allows either crewmember to adjust the CDU panel backlighting or test the cockpit indicator lights for functionality.



1. **CDU 1 Brightness Knob.** Adjusts the brightness of the Copilot's CDU keyboard backlighting on the left side of the Canted Console.
2. **CDU 2 Brightness Knob.** Adjusts the brightness of the Pilot's CDU keyboard backlighting on the right side of the Canted Console.
3. **LAMP TEST Button.** Illuminates all indicator lights within the cockpit to verify their function, which includes the following:
   - FIRE PULL handles
   - FD CPLR light
   - JUMP lights
   - APU RDY light
   - UTIL PRES light
   - ANT SEL lights
   - ASE ARM light
   - ICS indicator lights

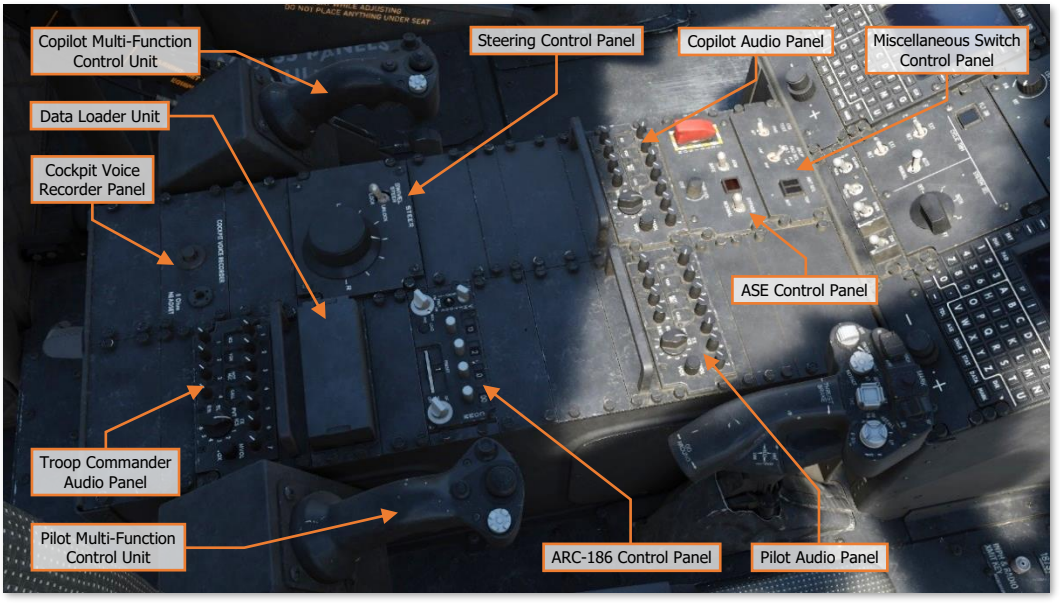
Emergency/Auxiliary Control Panel

The Emergency/Auxiliary control panel allows the aircrew to manually control several key functions of the communication system independently of the CDUs.



1. **IDENT Switch.** When momentarily pressed to the forward position, the transponder performs an identification-of-position function. This is used to momentarily highlight the aircraft position when replying to non-encrypted transponder interrogations (non-Mode 4 interrogations). (N/I)
2. **MAN/NORM/GUARD Switch.** Allows the crew to rapidly configure the radios for emergency transmissions or manually control the VHF-AM/FM (V3) radio through the ARC-186 Control Panel.
    - **GUARD.** Commands the following radios to the corresponding GUARD frequencies:
        - Tunes the VHF-FM (F1) radio to 40.500 MHz.
        - Tunes the UHF-AM (U2) radio to 243.000 MHz.
        - Tunes the VHF-AM/FM (V3) radio to 121.500 MHz.
    - **NORM.** Enables control of all radio communications through the Control Display Units (CDU).
    - **MAN.** Enables manual control of the VHF-AM/FM (V3) radio via the ARC-186 Control Panel.
3. **EMER/OFF/HOLD Switch.** Allows the crew to rapidly configure the transponder for emergency transmissions or prevent the inadvertent erasure of IFF codes after the aircraft is powered down.
    - **EMER.** Commands the transponder to the following settings:
        - If the transponder mode is set to STANDBY, sets the transponder to NORMAL.
        - Modes 1, 2, 3/A, C, and S are enabled.
        - Mode 3/A is set to the Emergency code of 7700.
        - Antenna Select Mode is set to DIVERSITY.
    - **OFF.** Enables normal transponder operation through the Control Display Units (CDU).
    - **HOLD.** Prevents Mode 4 IFF codes from being zeroized following aircraft shutdown. (N/I)
4. **ZERO Switch.** When set to the forward position, all navigation, communication, and transponder data will be erased within the aircraft. (N/I)

Center Console



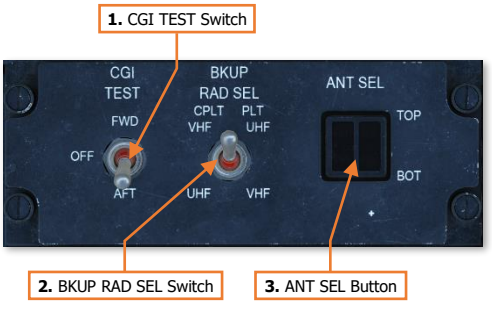
Each text box above may be selected to jump to a more detailed description of that instrument or panel. Selecting the image of the instrument or panel will return the manual back to this page.

The Multi-Function Control Unit (MFCU) functions are described in a dedicated section later in this chapter.

The ASE Control Panel is described in the Aircraft Survivability Equipment (ASE) chapter.

Miscellaneous Switch Control Panel

The Miscellaneous Switch control panel allows the aircrew to test either CGI system, select a backup radio configuration in the event the ICU becomes inoperative, and toggle which fuselage antennas are utilized by the VHF-FM (F1) and VHF-AM/FM (V3) radios.



1. **CGI TEST Switch.** Tests proper operation of the Cruise Guide Indicator system. When set to the FWD or AFT positions, the CGI pointer on the MFD Vertical Situation Display (VSD) should move to the white test band to indicate proper system operation.
   - **FWD.** Tests the CGI system circuits on the forward rotor system.
   - **OFF.** Normal, spring-centered position of the switch.
   - **AFT.** Tests the CGI system circuits on the aft rotor system.
2. **BKUP RAD SEL Switch.** Allows the aircrew to select which backup radio is assigned to the Pilot and Copilot in the event the Interface Control Unit (ICU) becomes inoperative. Only the Pilot and Copilot have the

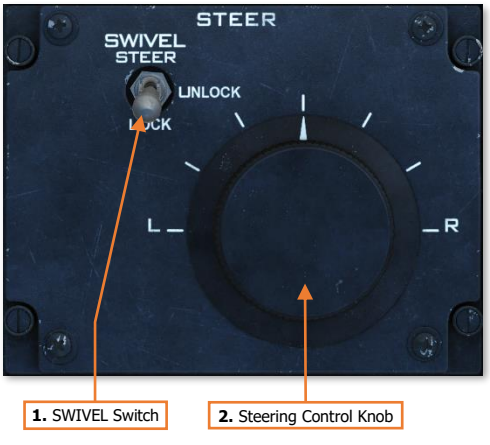
capability to transmit over a radio in Backup (BU) mode. All remaining crewstations will only retain ICS capability.

- **CPLT VHF – PLT UHF.** The UHF-AM (U2) radio is assigned to the Pilot. The VHF-AM/FM (V3) radio is assigned to the Copilot.
- **CPLT UHF – PLT VHF.** The VHF-AM/AM (V3) radio is assigned to the Pilot. The UHF-AM (U2) radio is assigned to the Copilot.

3. **ANT SEL Button.** The Antenna Select button selects which antennas are utilized by the VHF-FM (F1) and VHF-AM/FM (V3) radios for communications. Each press of the button will toggle between the two selections. One of two indicator lights on the button itself will illuminate to indicate the current antenna configuration.
   - **FM VHF (Left) Indicator Light.** The VHF-FM (F1) radio will transmit and receive via the forward VHF antenna on the top of the fuselage. The VHF-AM/FM (V3) radio will transmit and receive via the VHF antenna on the bottom of the fuselage.
   - **VHF FM (Right) Indicator Light.** The VHF-FM (F1) radio will transmit and receive via the VHF antenna on the bottom of the fuselage. The VHF-AM/FM (V3) radio will transmit and receive via the forward VHF antenna on the top of the fuselage.

Steering Control Panel

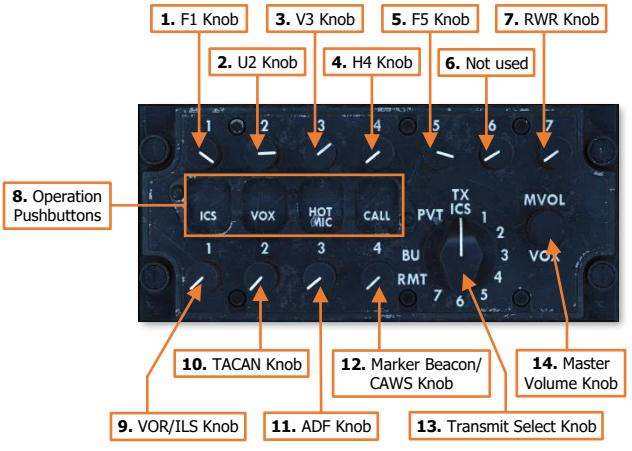
The Steering control panel allows the aircrew to steer the aircraft using the aft landing gear during 4-wheel ground taxi. It also allows ground crews to set the aft landing gear to freely rotate during towing operations.



1. **SWIVEL Switch.** Controls the commanded position of the aft wheel swivel locks and enables/disables the power steering actuator.
   - **STEER.** Enables the Steering Control knob and the power steering actuator on the aft right landing gear. The swivel locks on each aft landing gear are disabled, allowing the aft left wheel to rotate freely and the aft right wheel to be rotated by the power steering actuator.
   - **UNLOCK.** Disables the Steering Control knob and the power steering actuator on the aft right landing gear. The swivel locks on each aft landing gear are disabled, allowing both of the aft wheels to rotate freely, which allows the aircraft to be towed by ground personnel.
   - **LOCK.** Disables the Steering Control knob and the power steering actuator on the aft right landing gear. The swivel locks and centering cams on each aft landing gear are enabled, allowing both of the aft wheels to rotate to the neutral positions and lock in place when the aircraft weight is lifted off the aft wheels.
2. **Steering Control Knob.** Controls the commanded position of the power steering actuator on the aft right landing gear when the SWIVEL switch is set to the STEER position. Rotating the Steering Control knob from out of the center position toward either direction will command the power steering actuator so that the aft right wheel rotates in the opposite direction, resulting in the nose turning in the direction of the knob rotation. The further the knob is rotated away from the center position, the further the power steering actuator rotates the aft right wheel, reducing the turning radius.

Control Audio Panels

The Control Audio Panels adjust the volumes of the intercom, radios, and other audio sources to the corresponding crewstation, and allows the crewmember to manage their voice transmissions within the aircraft intercom or through a radio.



1. **F1 Knob.** Adjusts the volume of the FM1 radio. Rotating the knob clockwise will increase the volume level; and pulling the knob outward will mute the audio from the FM1 radio.
2. **U2 Knob.** Adjusts the volume of the UHF radio. Rotating the knob clockwise will increase the volume level; and pulling the knob outward will mute the audio from the UHF radio.
3. **V3 Knob.** Adjusts the volume of the VHF radio. Rotating the knob clockwise will increase the volume level; and pulling the knob outward will mute the audio from the VHF radio.
4. **H4 Knob.** Adjusts the volume of the HF radio. Rotating the knob clockwise will increase the volume level; and pulling the knob outward will mute the audio from the HF radio.
5. **F5 Knob.** Adjusts the volume of the FM2 radio. Rotating the knob clockwise will increase the volume level; and pulling the knob outward will mute the audio from the FM2 radio.
6. **Not used.** No function.
7. **RWR Knob.** Adjusts the volume of the voice warning messages received from the APR-39 Radar Warning Receiver system. Rotating the knob clockwise will increase the volume level; and pulling the knob outward will mute the audio from the RWR.
8. **Operation Pushbuttons.** Selects the activation method of the crewmember's microphone.
   - **ICS.** No function.
   - **VOX.** When pressed and held for two seconds, the crewmember's microphone will be enabled in VOX mode and will be activated any time the voice level exceeds the threshold set by the Master Volume (MVOL/VOX) knob, or when the Push-To-Talk switch for the crewstation is pressed. To disable VOX mode, briefly press and hold the VOX button or enable HOT MIC mode.
   - **HOT MIC.** When pressed and held for two seconds while the Transmit Select knob is not set to PVT, the crewmember's microphone will be enabled in HOT MIC mode and is continuously activated. To disable HOT MIC mode, briefly press and hold the HOT MIC button or enable VOX mode.

     If the Transmit Select knob is set to PVT, the crewmember's microphone will be enabled in HOT MIC mode and VOX mode will be disabled. When the Transmit Select knob is rotated to any other position besides PVT, HOT MIC mode will be disabled.
   - **CALL.** While pressed and held, the crewmember's voice will be transmitted over the aircraft intercom to all crewstations. When released, CALL mode is disabled.
9. **VOR/ILS Knob.** Adjusts the volume of audio received through the VOR/LOC receiver from the tuned VOR station or ILS localizer. Rotating the knob clockwise will increase the volume level; and pulling the knob outward will mute the audio from the VOR/LOC receiver.

10. **TACAN Knob.** Adjusts the volume of audio received through the TACAN receiver from the tuned TACAN station. Rotating the knob clockwise will increase the volume level; and pulling the knob outward will mute the audio from the TACAN receiver.

11. **ADF Knob.** Adjusts the volume of audio received through the ADF receiver from the tuned NDB station. Rotating the knob clockwise will increase the volume level; and pulling the knob outward will mute the audio from the ADF receiver.

12. **Marker Beacon/CAWS Knob.** Adjusts the volume of audio received through the Marker Beacon receiver or audio tones from the Central Aural Warning System. Rotating the knob clockwise will increase the volume level; and pulling the knob outward will mute the audio from the Marker Beacon receiver and CAWS.

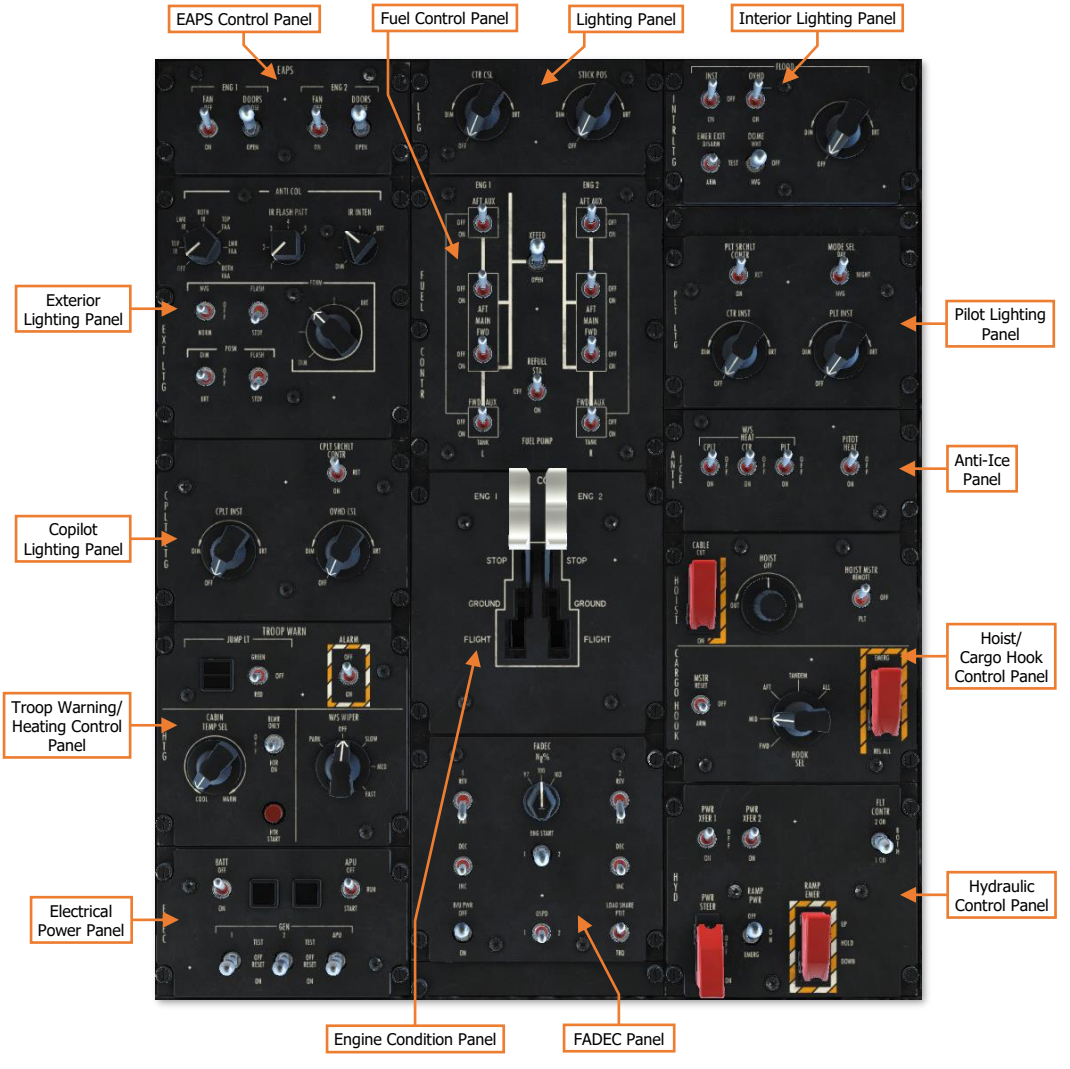
13. **Transmit Select Knob (TX).** Selects the transmission mode of the crewmember's microphone on the ICU audio circuits when the Radio/ICS Transmit switch on the Pilot or Copilot's Cyclic Grip is pulled to the second detent, when the Pilot or Copilot depresses the floor-mounted foot switches, or when any other crewmember presses the Push-To-Talk switch on their microphone cord. All audio sources will be heard by the crewmember based on the Control Audio Panel settings, but the crewmember's voice will only be transmitted through the intercom net or radio selected by this knob.

    - **PVT.** The crewmember's voice transmissions will only be heard by other crewmembers on the corresponding private intercom net. The Pilot and Copilot are on one private intercom net; all remaining crewstations are on a separate private intercom net.
    - **ICS.** The crewmember's voice will be transmitted over the aircraft intercom.
    - **1.** The crewmember's voice will be transmitted over the VHF-FM (F1) radio.
    - **2.** The crewmember's voice will be transmitted over the UHF-AM (U2) radio.
    - **3.** The crewmember's voice will be transmitted over the VHF-AM/FM (V3) radio.
    - **4.** The crewmember's voice will be transmitted over the HF-AM (H4) radio.
    - **5.** The crewmember's voice will be transmitted over the VHF-FM (F5) radio.
    - **6.** No function.
    - **7.** No function.
    - **RMT (Pilot & Copilot only).** The crewmember's voice will be transmitted over the radio selected by the Radio Select switch on the Thrust Control Grip.

      The RMT function is only available on the Pilot and Copilot Control Audio Panels. This selection has no function on all remaining Control Audio Panels within the aircraft.
    - **BU.** When selected on the Pilot or Copilot Control Audio Panels, the crewmember's voice will be transmitted over intercom or the backup radio selected for the corresponding crewstation using the BKUP RAD SEL switch on the Miscellaneous Switch Control Panel. When selected on any other Control Audio Panel, the crewmember's voice will only be transmitted over intercom.

14. **Master Volume Knob (MVOL/VOX).** Adjusts the overall volume level of all audio sources received within the crewmember's helmet when VOX mode is disabled. When VOX mode is enabled, adjusts the sensitivity threshold level of the crewmember's microphone.

Overhead Switch Panel

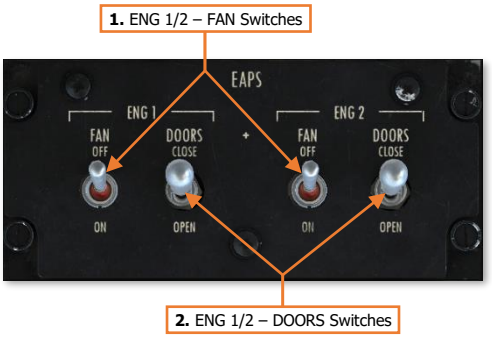


Each text box above may be selected to jump to a more detailed description of that instrument or panel. Selecting the image of the instrument or panel will return the manual back to this page.

The Hoist/Cargo Hook Control Panel is described in the Transport Operations chapter.

EAPS Control Panel

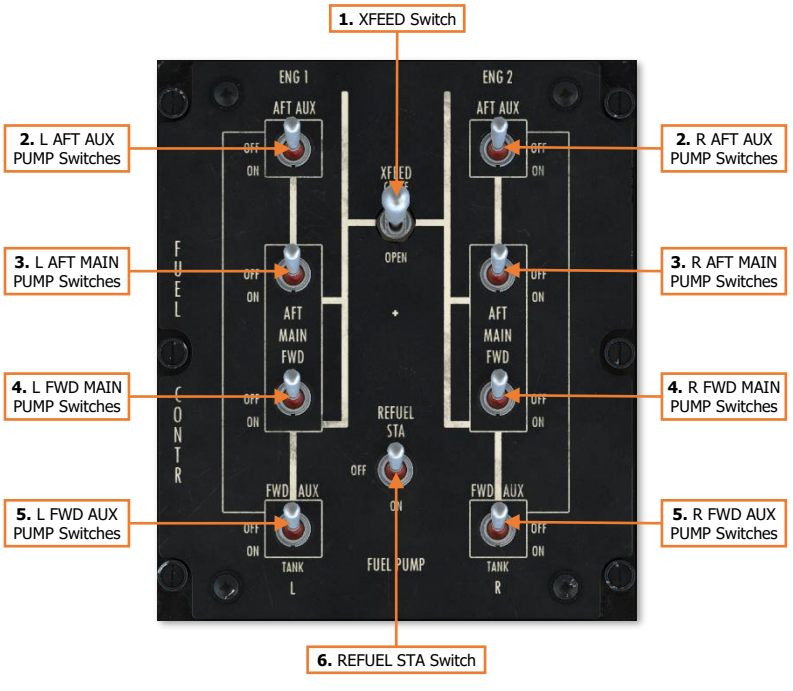
The Engine Air Particle Separator control panel manages the function of the EAPS assemblies, if installed. (N/I)



1. **ENG 1/2 – FAN Switches.** Toggles power to the air particle evacuation fans on the engine EAPS assemblies.
2. **ENG 1/2 – DOORS Switches.** Controls the electronic actuators that open and close the intake bypass doors in the engine EAPS assemblies.
   - **CLOSE.** Commands the bypass doors to the closed position.
   - **OPEN.** Commands the bypass doors to the open position in the event that debris has created a blockage in the EAPS assembly.

Fuel Control Panel

The Fuel Control panel manages the fuel boost pumps, crossfeed valve, and powers the external refueling station.

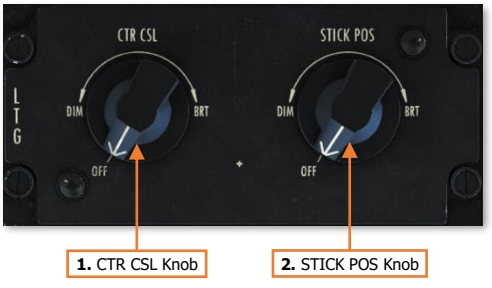


1. **XFEED Switch.** Controls the sources of fuel supplied from the main fuel tanks to the engines.
   - **CLOSE.** Commands the crossfeed valve to the closed position. Engine 1 is supplied with fuel from the left main fuel tank; engine 2 is supplied with fuel from the right main fuel tank.
   - **OPEN.** Commands the crossfeed valve to the open position. Both engines are supplied with fuel from both main fuel tanks.

2. **AFT AUX PUMP Switches.** Enables/disables the boost pumps in the aft auxiliary fuel tanks.
3. **AFT MAIN PUMP Switches.** Enables/disables the aft boost pumps in the main fuel tanks.
4. **FWD MAIN PUMP Switches.** Enables/disables the forward boost pumps in the main fuel tanks.
5. **FWD AUX PUMP Switches.** Enables/disables the boost pumps in the forward auxiliary fuel tanks.
6. **REFUEL STA Switch.** Enables/disables power to the external refueling panel within the forward section of the right fuel pod.

Lighting Panel

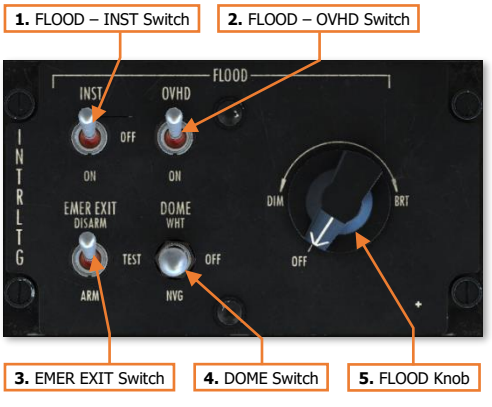
The Lighting panel controls the nighttime backlighting of the center cockpit panels and stick position indicator.



1. **CTR CSL Knob.** Adjusts the brightness of the panel backlighting on the Canted Console and Center Console.
2. **STICK POS Knob.** Adjusts the brightness of the Longitudinal Stick Position Indicator illumination.

Interior Lighting Panel

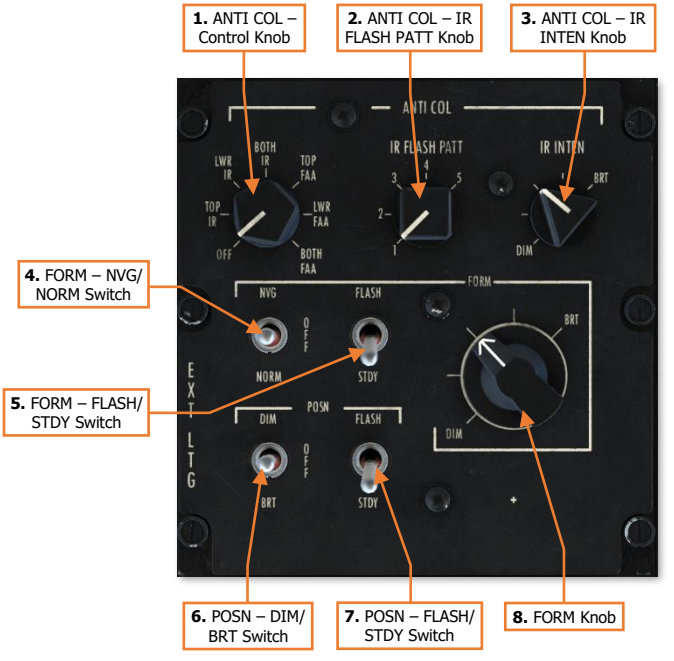
The Interior Lighting panel controls the floodlights and dome lights within the cockpit and the removable emergency light devices within the aft cabin.



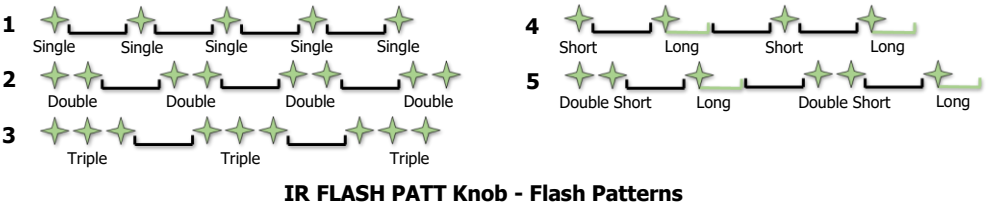
1. **FLOOD – INST Switch.** Enables/disables the cockpit floodlights under the Instrument Panel glareshield and the stalk lights on either side of the cockpit and Center Console.
2. **FLOOD – OVHD Switch.** Enables/disables the cockpit floodlights mounted to the aft bulkhead behind the Pilot and Copilot seats.
3. **EMER EXIT Switch.** Controls the operation and charging of the removable emergency exit lighting devices mounted over the right cabin door, left escape hatch, and tail ramp.
    - **DISARM.** The emergency lights will not illuminate and will be charged by the aircraft battery.
    - **TEST.** The emergency lights will illuminate, powered by their internal battery supply.
    - **ARM.** The emergency lights will not illuminate unless there is an electrical failure or hard landing. The lights will be charged by the aircraft battery.
4. **DOME Switch.** Controls the cockpit dome lights mounted on either side of the Overhead Switch Panel.
    - **WHT.** Enables the white lamps within the cockpit dome lights.
    - **OFF.** Disables the cockpit dome lights.
    - **NVG.** Enables the NVG-compatible blue/green lamps within the cockpit dome lights.
5. **FLOOD Knob.** Adjusts the brightness of the cockpit floodlights, if enabled via the INST or OVHD switches.

Exterior Lighting Panel

The Exterior Lighting panel controls the anti-collision, position, and formation lights on the external fuselage.



1. **ANTI COL – Control Knob.** Selects either or both anti-collision light assemblies for operation in either visible red light or IR light that is only visible by night vision goggles (NVGs).
   - **OFF.** Disables both anti-collision light assemblies.
   - **TOP IR**. The anti-collision light mounted on top of the aft rotor pylon will emit IR light based on the IR FLASH PATT and IR INTEN knob settings. The anti-collision light mounted on the underside of the fuselage will not emit.
   - **LWR IR**. The anti-collision light mounted on the underside of the fuselage will emit IR light based on the IR FLASH PATT and IR INTEN knob settings. The anti-collision light mounted on top of the aft rotor pylon will not emit.
   - **BOTH IR**. Both anti-collision lights will emit IR light based on the IR FLASH PATT and IR INTEN knob settings.
   - **TOP FAA**. The anti-collision light mounted on top of the aft rotor pylon will intermittently illuminate using visible red light. The anti-collision light mounted on the underside of the fuselage will not illuminate.
   - **LWR FAA**. The anti-collision light mounted on the underside of the fuselage will intermittently illuminate using visible red light. The anti-collision light mounted on top of the aft rotor pylon will not illuminate.
   - **BOTH FAA**. Both anti-collision lights will intermittently illuminate using visible red light.
2. **ANTI COL – IR FLASH PATT Knob.** Selects one of five options that vary the flash pattern of the anti-collision light(s) when the ANTI COL knob is set to the TOP IR, LWR IR, or BOTH IR positions.



IR FLASH PATT Knob - Flash Patterns

3. **ANTI COL – IR INTEN Knob.** Adjusts the brightness of the anti-collision light(s) when the ANTI COL knob is set to the TOP IR, LWR IR, or BOTH IR positions.

4. **FORM – NVG/NORM Switch.** Enables/disables the exterior formation lights on top of the center fuselage and on top of the aft rotor pylon, in either visible green light or IR light that is only visible by NVGs.
    - **NVG.** Sets the formation lights to emit IR light at the brightness level set by the FORM knob.
    - **OFF.** Sets the formation lights to off.
    - **NORM.** Sets the formation lights to illuminate visible green light at the brightness level set by the FORM knob.
5. **FORM – FLASH/STDY Switch.** Toggles the formation lights between flashing and steady modes.
6. **POSN – DIM/BRT Switch.** Sets the brightness levels of the red/green position lights on either side of the fuselage and the white position light on the aft rotor pylon above the tail ramp.
    - **DIM.** Sets the position lights to dim.
    - **OFF.** Sets the position lights to off.
    - **BRT.** Sets the position lights to bright.
7. **POSN – FLASH/STDY Switch.** Toggles the position lights between flashing and steady modes.
8. **FORM Knob.** Adjusts the brightness of the exterior formation lights on top of the center fuselage and on top of the aft rotor pylon.

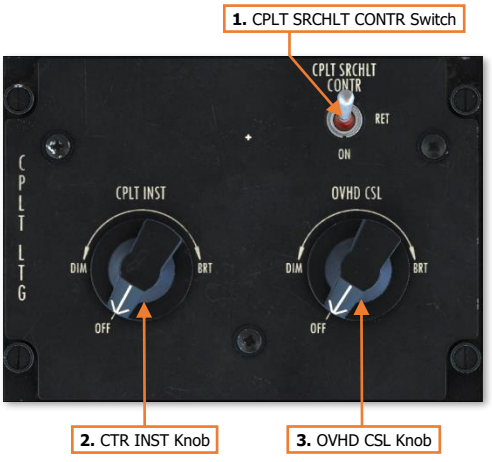
Pilot Lighting Panel

The Pilot Lighting panel controls the nighttime backlighting of the center and right sections of the Instrument Panel, allows the Pilot to control the position of the searchlight, and selects the intensity of cockpit indicator lights.

1. **PLT SRCHLT CONTR Switch.** Enables the Pilot to control the position of the searchlight.
    - **RET.** The Searchlight Position Switch on the Pilot's Thrust Control Grip is disabled and the searchlight will retract to its stowed position.
    - **ON.** The Searchlight Position Switch on the Pilot's Thrust Control Grip is enabled.
2. **MODE SEL Switch.** Selects the overall intensity of the cockpit for the corresponding time of day.
    - **DAY.** Cockpit indicator lights are set to maximum intensity.
    - **NIGHT**. Cockpit indicator lights are set to lower intensity. The ICS indicators on the Center Console will be controlled by the CTR CSL knob on the Lighting Panel.
    - **NVG**. Cockpit indicator lights are set to lower intensity. The ICS indicators on the Center Console will be controlled by the CTR CSL knob on the Lighting Panel. The MFD and CDU displays will be limited in intensity.
3. **CTR INST Knob.** Adjusts the brightness of the panel backlighting of the center of the Instrument Panel.
4. **PLT INST Knob.** Adjusts the brightness of the panel backlighting on the right side of the Instrument Panel in front of the Pilot seat.

Copilot Lighting Panel

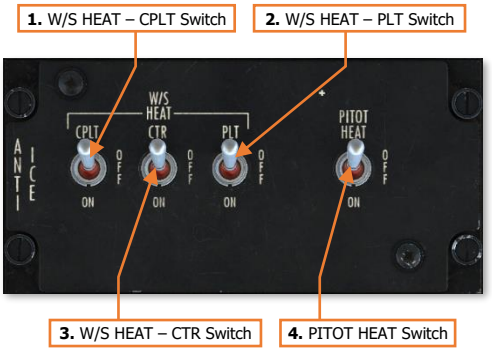
The Copilot Lighting panel controls the nighttime backlighting of the left section of the Instrument Panel and the Overhead Switch Panel, and allows the Copilot to control the position of the searchlight.



1. **CPLT SRCHLT CONTR Switch.** Enables the Copilot to control the position of the searchlight.
   - **RET.** The Searchlight Position Switch on the Copilot's Thrust Control Grip is disabled and the searchlight will retract to its stowed position.
   - **ON.** The Searchlight Position Switch on the Copilot's Thrust Control Grip is enabled.
2. **CPLT INST Knob.** Adjusts the brightness of the panel backlighting on the left side of the Instrument Panel in front of the Copilot seat.
3. **OVHD CSL Knob.** Adjusts the brightness of the panel backlighting on the Overhead Switch Panel.

Anti-Ice Panel

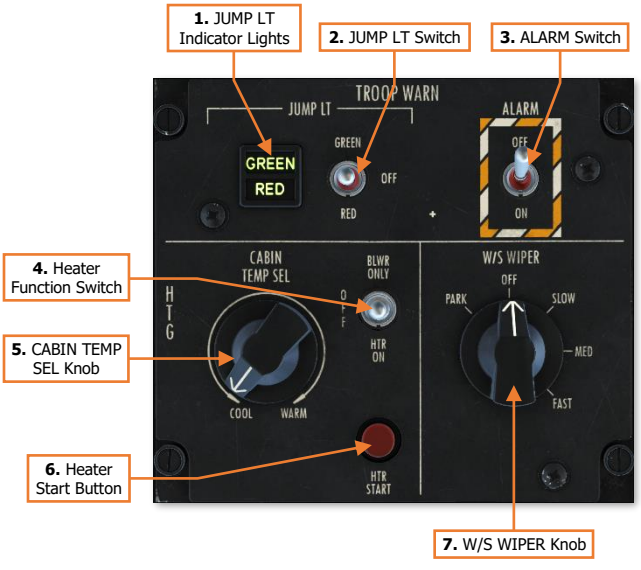
The Anti-Ice panel controls the electrical heating elements on the cockpit windshields and external air pressure instruments.



1. **W/S HEAT – CPLT Switch.** Enables/disables the heating elements in the Copilot windshield.
2. **W/S HEAT – PLT Switch.** Enables/disables the heating elements in the Pilot windshield.
3. **W/S HEAT – CTR Switch.** Enables/disables the heating elements in the center windshield.
4. **PITOT HEAT Switch.** Enables/disables the heating elements in the pitot tubes, the static ports, and the yaw ports.

Troop Warning/Heating Control Panel

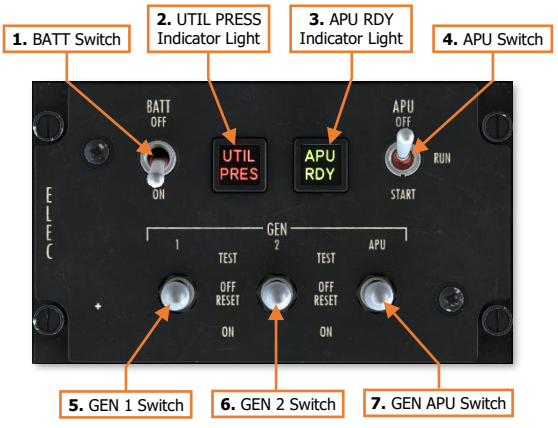
The Troop Warning/Heating Control panel allows the aircrew to provide visual and audio warning signals to personnel within the aft cabin or control the combustion heater in cold weather.



1. **JUMP LT Indicator Lights.** When the red or green jump lights in the aft cabin are illuminated, the corresponding indicator light illuminates within the cockpit.
2. **JUMP LT Switch.** Controls the jump warning light assemblies in the aft cabin. A pair of red and green jump lights are mounted just aft of the cockpit facing aft; and another pair of red and green jump lights are mounted in the tail ramp section facing forward.
    - **GREEN.** Enables the green jump light only.
    - **OFF.** Disables both jump lights.
    - **RED.** Enables the red jump light only.
3. **ALARM Switch.** When pressed to the ON position, an alarm bell will continuously sound in the aft cabin.
4. **Heater Function Switch.** Enables or disables the supply of ventilated or heated air into the aircraft interior.
    - **BLWR ONLY.** Forces unheated, ventilated air from the aircraft exterior into the cockpit and aft cabin using an electrically powered blower.
    - **OFF.** Disables the supply of ventilated and heated air to the cockpit and aft cabin.
    - **HTR ON.** Forces heated air supplied by the combustion heater into the cockpit and aft cabin.
5. **CABIN TEMP SEL Knob.** Adjusts the duration that the heater is permitted to operate before it is automatically shut down. Rotating the knob clockwise will allow the heater to operate for increased duration, increasing the duration of the heating effect within the aircraft interior.
6. **HTR START Button.** Momentarily pressing this button when the Heater Function switch is set to the HTR ON position initiates the combustion heater's start sequence, using aircraft fuel for heating.
7. **W/S WIPER Knob.** Sets the speed for the windshield wiper or returns the wiper to the PARK position.
    - **PARK.** Holding the knob in this position will move the windshield wiper to its designated parking location. When released, the knob will be spring-loaded to the OFF position.
    - **OFF.** Powers off the windshield wiper at its current position.
    - **SLOW.** Powers the windshield wiper and sets the motion to slow speed.
    - **MED.** Powers the windshield wiper and sets the motion to medium speed.
    - **FAST.** Powers the windshield wiper and sets the motion to fast speed.

Electrical Power Panel

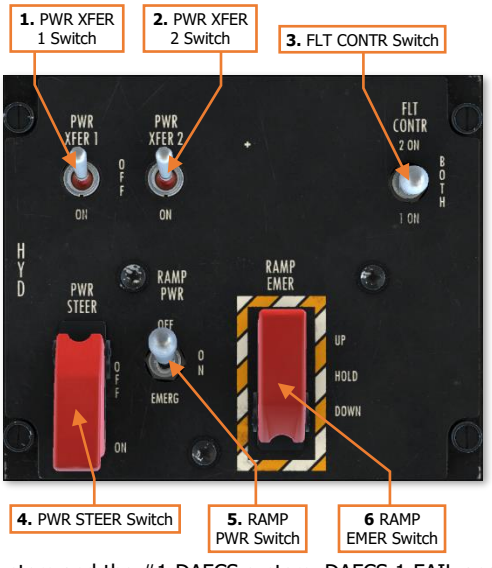
The Electrical Power panel is used to control battery and AC generator power or start/stop the Auxiliary Power Unit (APU).



1. **BATT Switch.** Enables/disables power from the 24-volt battery to the essential bus.
   - **OFF.** Battery power is distributed to the battery bus only.
   - **ON.** Battery power is distributed to the battery bus and the essential bus.
2. **UTIL PRES Indicator Light.** Illuminates when the Utility hydraulic system pressure is outside normal operating parameters.
3. **APU RDY Indicator Light.** Illuminates when the APU has been started and the exhaust gas temperature (EGT) is within normal parameters.
4. **APU Switch.** Controls the operation of the Auxiliary Power Unit (APU) located in base of the aft rotor pylon.
   - **OFF.** Commands the APU to shut down.
   - **RUN.** Prepares the APU to start when the APU is not operating. Enables APU operation after a start sequence is initiated by the APU Digital Electronic Sequencing Unit (DESU).
   - **START.** Commands the APU DESU to initiate a start sequence. When released, the switch will be spring-loaded to the RUN position. (See APU Start in the Procedures chapter for more information.)
5. **GEN 1 Switch.** Controls the AC power output from Generator 1 mounted on the aft transmission.
   - **TEST.** Generator 1 is connected to Generator Control Unit 1 to determine whether it is providing the correct AC power while remaining disconnected from AC bus 1.
   - **OFF/RESET.** Generator 1 is disconnected from the AC bus 1 and Transformer-Rectifier 1. This position also resets the generator.
   - **ON.** Generator 1 is connected to the AC bus 1 and Transformer-Rectifier 1.
6. **GEN 2 Switch.** Controls the AC power output from Generator 2 mounted on the aft transmission.
   - **TEST.** Generator 2 is connected to Generator Control Unit 2 to determine whether it is providing the correct AC power while remaining disconnected from AC bus 2.
   - **OFF/RESET.** Generator 2 is disconnected from the AC bus 2 and Transformer-Rectifier 2. This position also resets the generator.
   - **ON.** Generator 2 is connected to the AC bus 2 and Transformer-Rectifier 2.
7. **GEN APU Switch.** Controls the AC power output from the APU generator.
   - **TEST.** The APU generator is tested to determine whether it is providing the correct AC power while remaining disconnected from AC busses and the transformer-rectifiers.
   - **OFF/RESET.** The APU generator is disconnected from AC bus 1, AC bus 2, and both transformer-rectifiers. This position also resets the generator.
   - **ON.** The APU generator is connected to AC bus 1, AC bus 2, and both transformer-rectifiers.

Hydraulic Control Panel

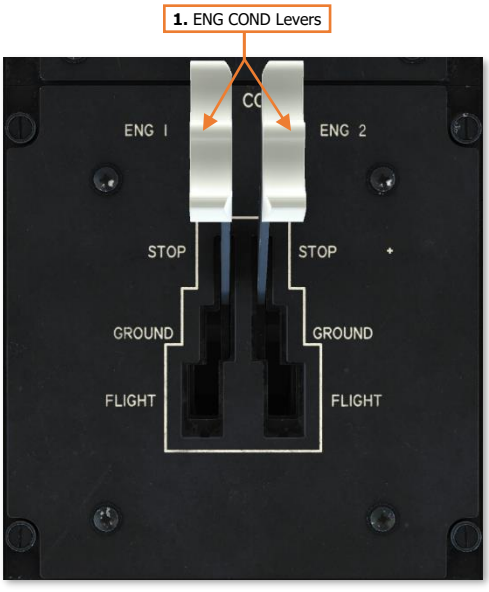
The Hydraulic control panel allows the aircrew to perform checks of the flight control systems prior to starting the engines or perform emergency actions in case of a malfunction within the Utility hydraulic system.



1. **PWR XFER 1 Switch.** Enables/disables the Power Transfer Unit (PTU) that connects the Utility hydraulic system to the #1 Flight Control hydraulic system. If the APU is operating, the #1 Flight Control system will be pressurized to allow the flight controls to be checked prior to engine start.
2. **PWR XFER 2 Switch.** Enables/disables the Power Transfer Unit (PTU) that connects the Utility hydraulic system to the #2 Flight Control hydraulic system. If the APU is operating, the #2 Flight Control system will be pressurized to allow the flight controls to be checked prior to engine start.
3. **FLT CONTR Switch.** Selectively disables either of the flight control systems during ground operations. The switch shall remain in BOTH during flight.
   - **2 ON.** Disables the #1 Hydraulic Flight Control system and the #1 DAFCS system. DAFCS 1 FAIL and #1 HYD FLT CONT caution messages will be displayed.
   - **BOTH.** Both Hydraulic Flight Control systems and both DAFCS systems are enabled.
   - **1 ON.** Disables the #2 Hydraulic Flight Control system and the #2 DAFCS system. DAFCS 2 FAIL and #2 HYD FLT CONT caution messages will be displayed.
4. **PWR STEER Switch (Guarded).** Isolates the wheel brake and steering systems from the remainder of the Utility hydraulic system in the case of a hydraulic failure in the wheel brake or steering systems.
   - **OFF.** The wheel brake and steering systems are isolated from the Utility hydraulic system. Brakes may still be used in a limited capacity. The swivel locks on the aft wheels will remain in the locked position.
   - **ON.** The wheel brake and steering systems are powered by the Utility hydraulic system for normal operation. The wheel brakes and power steering functions are fully operational.
5. **RAMP PWR Switch.** Enables/disables Utility hydraulic pressure to the tail ramp or enables emergency ramp control from the cockpit.
   - **OFF.** The tail ramp is not powered by the Utility hydraulic system.
   - **ON.** The tail ramp is powered by the Utility hydraulic system.
   - **EMERG.** Enables emergency tail ramp control from the cockpit via the guarded RAMP EMER switch.
6. **RAMP EMER Switch (Guarded).** The tail ramp may be opened or closed in an emergency situation, which may include smoke and fume elimination from the aircraft interior or an emergency egress after landing.
   - **UP.** When pressed and held, the tail ramp will move upwards to the closed position.
   - **HOLD.** Disables emergency ramp movement and is spring-loaded to this position when released.
   - **DOWN.** When pressed and held, the tail ramp will move downwards to the open position. The tail ramp will continue to open for 5 seconds after the switch is released to the HOLD position, to allow the ramp tongue to fully retract if emergency ramp movement was initiated from a fully-closed state.

Engine Condition Panel

The Engine Condition panel controls the engine condition when the FADEC is operating in Primary mode; or the engine condition, acceleration, and/or engine output when the FADEC is operating in Reversionary mode.



1. **ENG COND Levers.** Sets the operating condition of the engines to either GROUND or FLIGHT, manually controls acceleration or deceleration of the engines when switching between GROUND and FLIGHT, manually sets intermediate operating speeds between GROUND and FLIGHT, and performs engine start and shutdown.

   Each ENG COND lever is spring-loaded to the outboard direction, which creates a physical gate that prevents the levers from being inadvertently retarded from FLIGHT to GROUND, or from GROUND to STOP. When intending to move a lever aft of a gate, the ENG COND lever must be pushed inboard to clear the gate before it can be retarded.

   - **STOP.** Setting the ENG COND lever to this position will shut off fuel flow to the engine and/or abort an engine start in progress.

     Setting the ENG COND lever to this position will also reset the ENG 1 FAIL or ENG 2 FAIL warning messages after an aborted engine start, permitting another engine start attempt.

     Current faults and fault information from the last engine cycle will be presented on the DECU BIT display in the aft cabin.

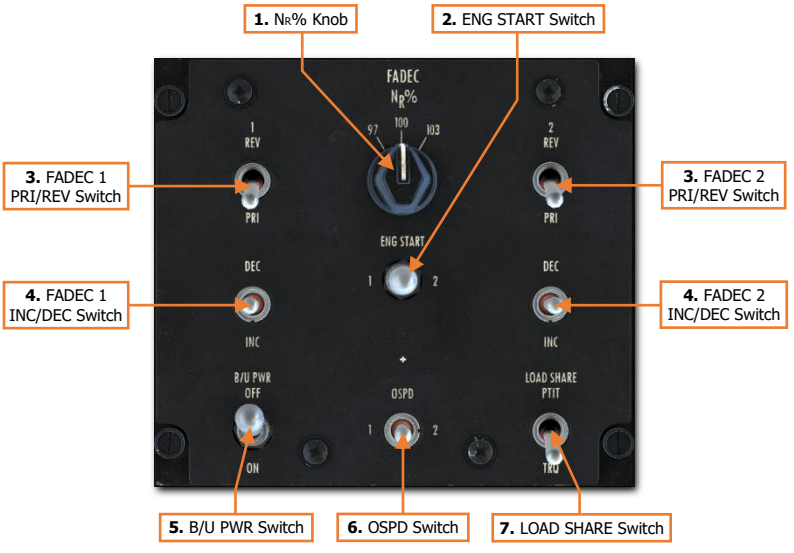
   - **GROUND.** Setting the ENG COND lever to this position will set the engine to ground idle speed of 50-59% N_G. Current faults will be presented on the DECU BIT display in the aft cabin.

   - **FLIGHT.** Setting the ENG COND lever to this position will set the engine to maintain a constant NR, based on the position of the N_R% knob on the FADEC panel. The DECU for each engine will automatically regulate engine speed to equally balance either the temperature or torque load between each engine (load-sharing), based on the position of the LOAD SHARE switch on the FADEC panel.

     The DECU BIT display in the aft cabin is deactivated when not performing a Power Assurance Test.

FADEC Panel

The FADEC panel manages the Full Authority Digital Electronic Control functions of each engine's Digital Electronic Control Unit (DECU), initiate the engine start sequence, adjusts the rotor speed (N_R) trim, and allows a test of either engine's overspeed protection circuits.



1. **N_R% Knob.** Adjusts the rotor speed trim between 97% and 103% N_R.
   - **97.** Sets the rotor speed (N_R) to the minimum setting of 97%.
   - **100.** Marks the center detent corresponding with the optimal rotor speed (N_R) of 100%.
   - **103.** Sets the rotor speed (N_R) to the maximum setting of 103%.
2. **ENG START Switch.** Initiates an engine start sequence to the corresponding engine or motors the engine when not performing an engine start. The switch is spring-loaded to the center position.
   - **1.** Initiates a start sequence or motors the left engine while pressed and held to this position.
   - **2.** Initiates a start sequence or motors the right engine while pressed and held to this position.
3. **FADEC PRI/REV Switches .** Manually selects an operating mode for the corresponding engine's DECU.
   - **REV.** The DECU is manually set to Reversionary (backup) mode. The DECU may automatically be set to Reversionary mode if a hard fault failure occurs within the Primary mode.
   - **PRI.** The DECU is manually set to Primary (normal) mode.
4. **FADEC INC/DEC Switches.** Manually adjusts the engine speed (N_G) when the corresponding engine's DECU is operating in Reversionary mode. The switch is spring-loaded to the center position.
   - **DEC.** Decreases the engine speed (N_G) speed while pressed and held to this position.
   - **INC.** Increases the engine speed (N_G) speed while pressed and held to this position.
5. **B/U PWR Switch.** Enables/disables backup power to the Primary mode of each engine DECU when the corresponding engine's alternator has failed or if the engine speed is <48% N_G.

6. **OSPD Switch.** If the N_R is >81.3%, tests the NP overspeed protection circuits of the corresponding engine. The switch is spring-loaded to the center position.
   - **1.** Reduces the left engine overspeed detection threshold to a rotor speed of 79% ±1 N_R. The fuel flow into the left engine will be reduced to a ground idle condition.
   - **2.** Reduces the right engine overspeed detection threshold to a rotor speed of 79% ±1 N_R. The fuel flow into the right engine will be reduced to a ground idle condition.
7. **LOAD SHARE Switch.** Selects the load-sharing function based on the Power Turbine Inlet Temperature (PTIT) of each engine or the Torque (TRQ) output of each engine. If the selected LOAD SHARE function fails, the load-sharing function will revert to N_G matching.
   - **PTIT.** The DECU for each engine will automatically regulate engine speed to equally balance the temperature load between each engine. This may be selected if one engine is running hotter than the other.
   - **TRQ.** The DECU for each engine will automatically regulate engine speed to equally balance the torque load between each engine. This is typically the preferred selection.

Power Distribution Panel 1

Power Distribution Panel (PDP) 1 is on the left side of the aft cockpit bulkhead, outboard of the Copilot seat.

Power Distribution Panel 2

Power Distribution Panel (PDP) 2 is on the right side of the aft cockpit bulkhead, outboard of the Pilot seat.

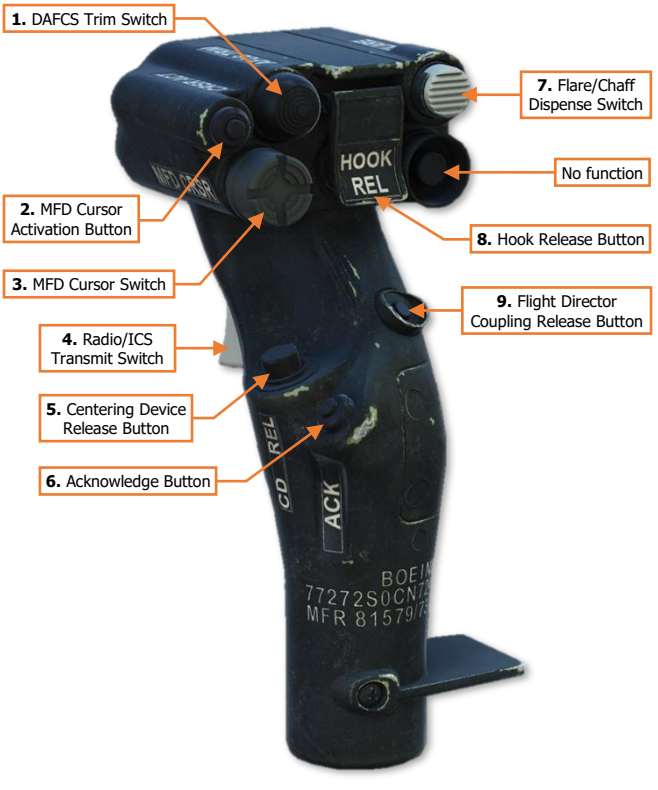
CYCLIC, THRUST CONTROL LEVER, & MFCU HAND CONTROLS

The cyclic and thrust control lever hand controls allow the Pilot and Copilot to control many of the aircraft functions regarding sensors, communications, and defensive systems without removing their hands from the flight controls. Alternatively, either crewmember may use the Multi-Function Control Unit (MFCU) to interact with aircraft systems without interfering with the flight controls if the other crewmember is actively flying the aircraft.

The Pilot and Copilot cyclic, thrust control lever, and MFCU grips are identical in form and function. However, the Pilot and Copilot control unique MFD cursors that are operated independently of the other.

Cyclic Grip

The Cyclic Grip is used to control the DAFCS trim, the crewmember's helmet microphone, the MFD cursor, and countermeasure functions. It also includes a guarded button for the external hook release.



1. **DAFCS Trim Switch.** Adjusts the flight controls in the pitch and roll axes independently of the cyclic position. Pressing the switch electronically commands the corresponding flight control input direction to the DAFCS. (N/I)
2. **MFD Cursor Activation Button.** Commands the highlighted item underneath the MFD cursor to be selected/activated.
3. **MFD Cursor Switch.** Controls the MFD cursor movement, allowing bezel options to be selected by the cursor in lieu of pressing the MFD bezel buttons; or cursor-selection of points on the MFD itself.
4. **Radio/ICS Transmit Switch.** Manually activates the crewmember's helmet microphone.
   - **ICS Transmit (1st Stage).** Transmits over the intercom system (ICS).
   - **Radio Transmit (2nd Stage).** Transmits over the intercom net or radio selected by the Transmit Select knob on the crewmember's Control Audio Panel.
5. **Centering Device Release Button.** When depressed and held, the force feel trim is interrupted, releasing the magnetic brakes on the cyclic and directional pedals. While force feel trim is interrupted, Bank Angle Hold and Heading Hold will be disengaged, and the Flight Director Coupling will be disabled.

When the button itself is released, the force feel trim will re-engage the magnetic brakes on the cyclic and directional pedals, set a new force trim reference point at the current cyclic/pedal positions in pitch, roll and yaw, and the Flight Director will return to the last selected heading or course.

- **NOTE:** *Currently in Early Access, the function of the CD REL button is facilitated by the Trim Control command* **[T]** *within the Flight Control category. The trim position may be reset by pressing the Trim reset command* **[LCtrl+T]** *within the Flight Control category.*

6. **Acknowledge Button.** Extinguishes an illuminated MASTER CAUTION light and ceases the corresponding voice warning message, if present.
7. **Flare/Chaff Dispense Switch.** Momentarily pressing this switch to either position will manually dispense flares from the tail dispensers or chaff cartridges from the mid-fuselage dispensers.
   - **Forward.** Dispenses a single flare program.
     - **NOTE:** *Currently in Early Access, a single flare program consists of four flares, with two ejected from each side.*
   - **Aft.** Dispenses a single chaff program.
     - **NOTE:** *Currently in Early Access, a single chaff program consists of two chaff cartridges, with one cartridge ejected from each side.*
8. **Hook Release Button (Guarded).** If the CARGO HOOK MSTR switch on the Overhead Switch Panel is set to the ARM position, the cargo hooks selected by the HOOK SEL knob will open to release any payload carried under sling load. (See the Hoist/Cargo Hook Control Panel for more information.)

   If the forward and/or aft hooks are selected, they will open and then close. If the center hook is selected, it will open until the CARGO HOOK MSTR switch is set to the OFF position or the CARGO HOOK switch on the Hoist Operator's Panel in the aft cabin is set to the RESET position.
9. **Flight Director Coupler Release Button.** Disengages the coupled modes of the Flight Director.

Thrust Control Grip

The Thrust Control Grip is used to control the DAFCS modes, communications, and searchlight functions. It also includes a switch for adjusting the HUD brightness and declutter levels if equipped with night vision goggles.

1. **Searchlight Mode Switch.** Toggles the crewmember's searchlight between visible or covert lighting.
   - **IR.** When turned on, the searchlight will emit IR light that is only visible by night vision goggles (NVGs).
   - **WHT.** When turned on, the searchlight will emit visible white light.
2. **Searchlight Intensity Switch.** Toggles the crewmember's searchlight on or off and adjusts the intensity.
   - **BRT (Forward).** Momentarily pressing the switch forward to the BRT position will increase the searchlight brightness.
   - **DIM (Aft).** Momentarily pressing the switch aft to the DIM position will decrease the searchlight brightness.
   - **ON/OFF (Depress).** Depressing the switch will toggle the crewmember's searchlight on and off.
3. **Searchlight Position Switch.** Adjusts the rotation and elevation position of the crewmember's searchlight.

   This switch will have no effect on the searchlight position unless crewmember's SRCHLT CONTR switch is set to the ON position. (See Pilot Lighting Panel and Copilot Lighting Panel for more information.)

4. **Thrust Brake Switch.** When pressed, the magnetic brakes holding the Thrust Control Lever at its current position will be released, allowing the lever to be moved freely.

   If Altitude Hold is enabled, it will be momentarily disengaged while the Thrust Brake is released.

5. **Go Around Switch.** Activates Go Around mode for the Flight Director. (N/I)

6. **Mark Button.** No function.

7. **Hover Altitude Switch.** Adjusts the hover altitude when Altitude Hold is enabled.

   - **UP.** A momentary press will increase the hover altitude by 1 foot. A continuous press will command a climb at a rate of 3 feet-per-second. (N/I)
   - **DN.** A momentary press will decrease the hover altitude by 1 foot. A continuous press will command a descent at a rate of 3 feet-per-second. (N/I)

8. **Radio Select Switch.** Selects the radio and frequency for transmission if the Transmit Select knob is set to the RMT position on the crewmember's Control Audio Panel.

   - **F-UP/F-DN.** Selects the frequency for transmission over the crewmember's selected radio. (N/I)
   - **R-UP/R-DN.** Selects the radio for transmission. (N/I)
   - **RECALL.** Recalls the previous frequency settings for the crewmember's selected radio. (N/I)

9. **DAFCS Hold Mode Switch.** Enables and disables the corresponding DAFCS hold modes. (N/I)

   - **ALT.** Enables/disables Altitude Hold mode. (N/I)
   - **IN/RA.** Toggles the Altitude Hold reference source between Inertial (IN) and Radar (RA). Inertial is the default setting. (N/I)
   - **PH.** Enables/disables Position Hold mode. (N/I)
   - **TRC.** Enables/disables Translational Rate Command mode. (N/I)

10. **HUD Control Switch.** Not implemented.

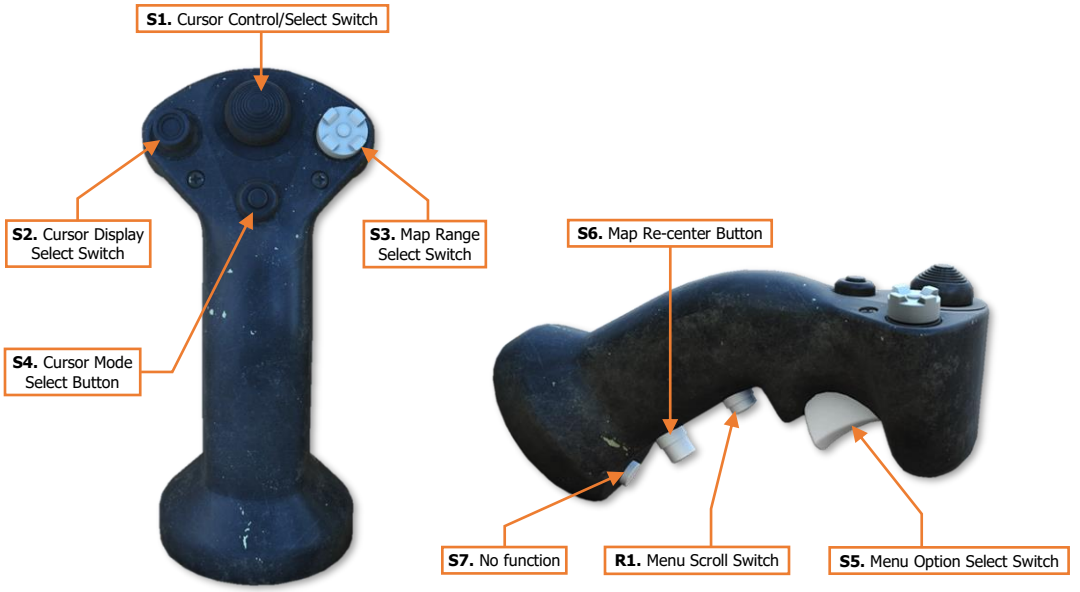
Multi-Function Control Unit (MFCU)

The MFCU grip is used to control the MFD cursor, MFD menu options, HSD moving map options, and HUD brightness and declutter levels if equipped with night vision goggles. The MFCU grip allows the non-flying crewmember to interact with MFD options and their HUD without interfering with the flight controls.

The MFCU is operated in one of three modes: Display, Map, or HUD mode. The functions of each button and switch on the grip will be determined on the current MFCU mode to which the crewmember has selected.

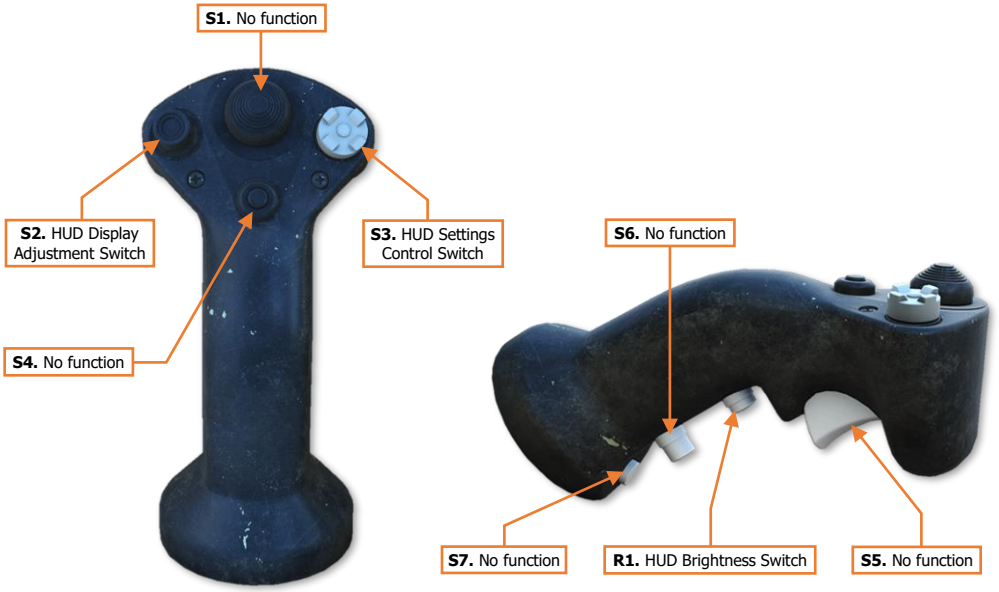
Display (D) or Map (M) Modes

Not implemented.



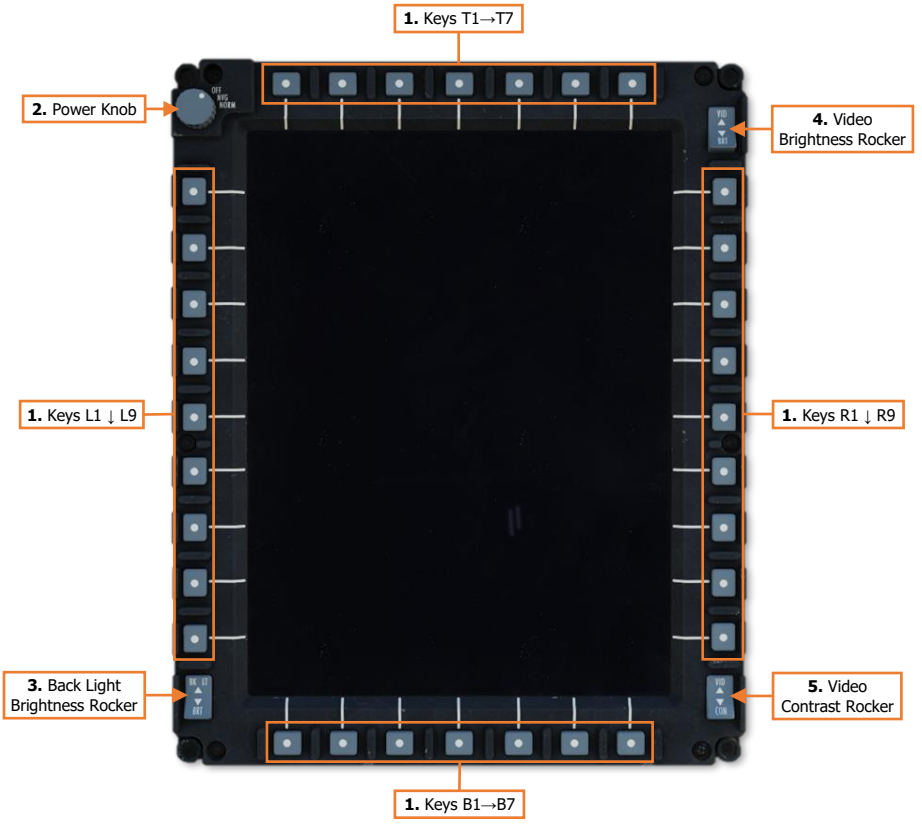
HUD (H) Mode

Not implemented.



MULTI-FUNCTION DISPLAYS (MFD)

The Multi-Function Displays (MFDs) are 6 x 8 inch color liquid crystal displays that allow the Pilot and Copilot to access different pages and/or formats of information. Each page may display different information or access different functions. There are two MFDs for each crewstation and a common MFD in the center that is shared between each crewstation. Any MFD can display any page, sub-page, or format. Many functions that would be controlled by switches or physical controls in other aircraft are included as MFD functions in the CH-47F.



1. **Keys.** Selects the option corresponding with the displayed text adjacent to the MFD button itself.
   - **T1-T7.** The top row of buttons are numbered from T1 starting on the far left to T7 on the far right.
   - **L1-L9.** The left column of buttons are numbered from L1 starting on the top to L9 at the bottom.
   - **R1-R9.** The right column of buttons are numbered from R1 starting on the top to R9 at the bottom.
   - **B1-B7.** The bottom row of buttons are numbered from B1 starting on the far left to L7 on the far right.
2. **Power Knob.** Enables/disables the MFD and sets the overall brightness level.
   - **OFF.** Turns off the MFD.
   - **NVG.** Sets the MFD to NVG-friendly nighttime brightness levels.
   - **NORM.** Sets the MFD to daytime brightness levels.

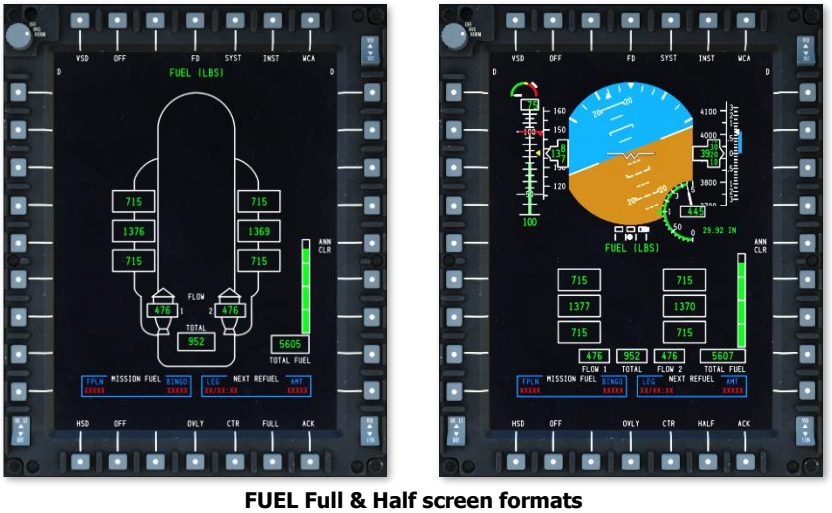
3. **Back Light Brightness Rocker (BK LT BRT).** Adjusts the overall brightness setting of the MFD display within the overall brightness level selected by the Mode Knob.
4. **Video Brightness Rocker (VID BRT).** Adjusts the brightness of the video or map underlay independently of the primary symbology displayed on the MFD.
5. **Video Contrast Rocker (VID CON).** Adjusts the contrast of the video or map underlay independently of the primary symbology displayed on the MFD.

Full & Half Screen Formats

This section is still a work-in-progress and will be updated later in Early Access.

Each MFD format, with the exception of the Vertical Situation Display (VSD), may be displayed in either a full screen format or a half-screen format. This allows the pilots to essentially display three different MFD formats at any given time on the two MFDs on their side of the cockpit.

In the example below, the MFD FUEL format is displayed in full screen on the left MFD, and half screen on the right MFD. The text label above MFD Key B6 corresponds with the currently displayed screen format. When MFD Key B6 is pressed, the MFD will be toggle between full screen and half screen, with the VSD displayed in the upper half when set to half screen.



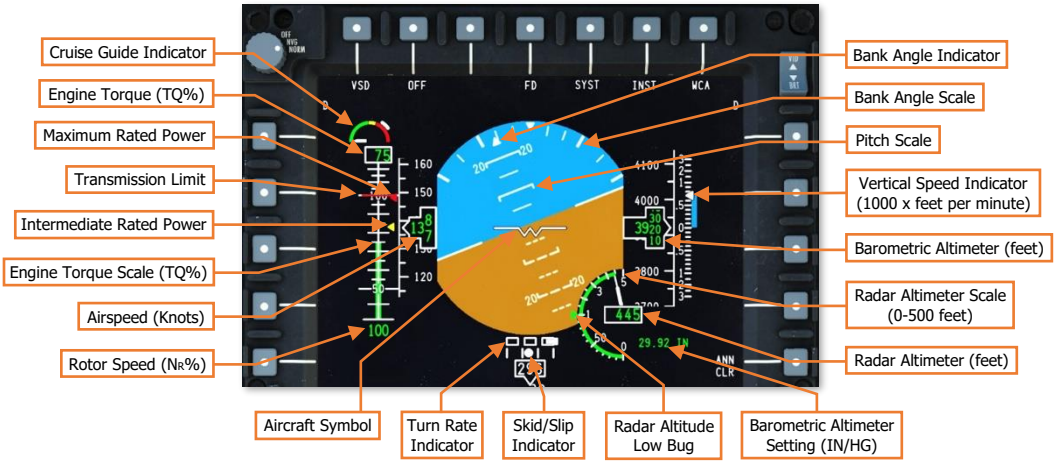
FUEL Full & Half screen formats

When MFD Key T1 is pressed while a full screen format is displayed, the current MFD mode will switch to half screen format and the VSD will be displayed in the upper half. If the MFD is displaying the POWER TRAIN format, the bottom half will switch to display the Engine instruments half of the combined POWER TRAIN format.

Vertical Situation Display (VSD) Format

This section is still a work-in-progress and will be updated later in Early Access.

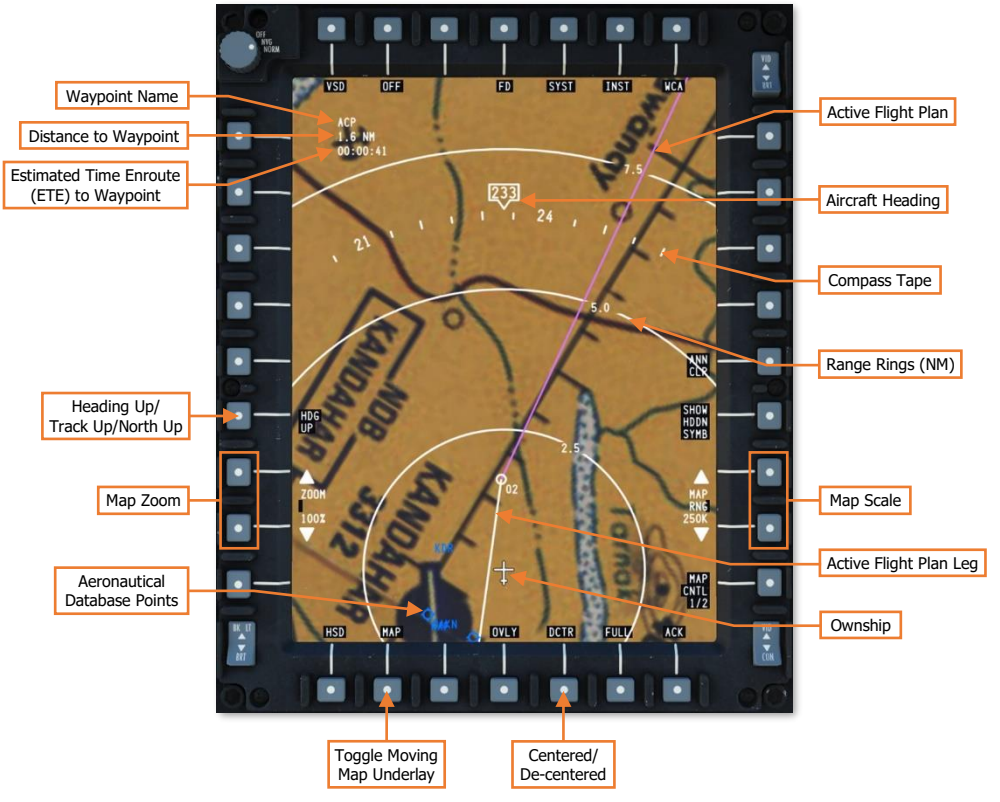
The VSD format is displayed on the MFD by selecting VSD (T1).



Horizontal Situation Display (HSD) Format

This section is still a work-in-progress and will be updated later in Early Access.

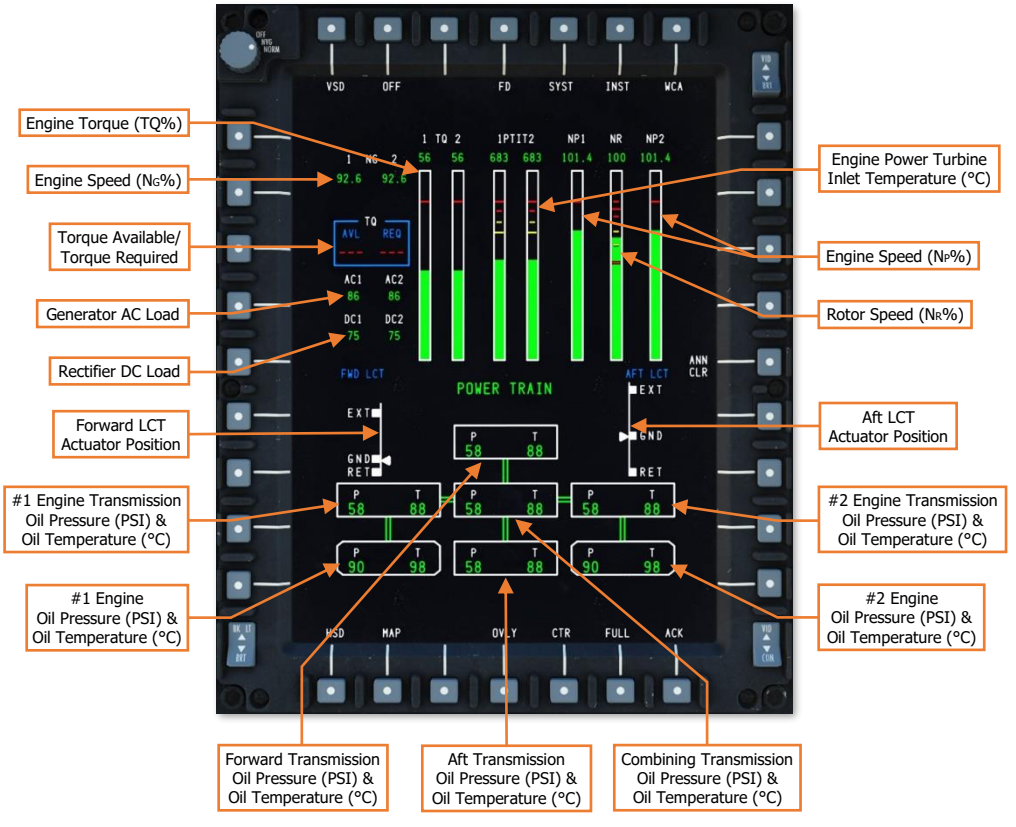
The HSD format is displayed on the MFD by selecting HSD (B1).



Instruments (INST) Power Train Format

This section is still a work-in-progress and will be updated later in Early Access.

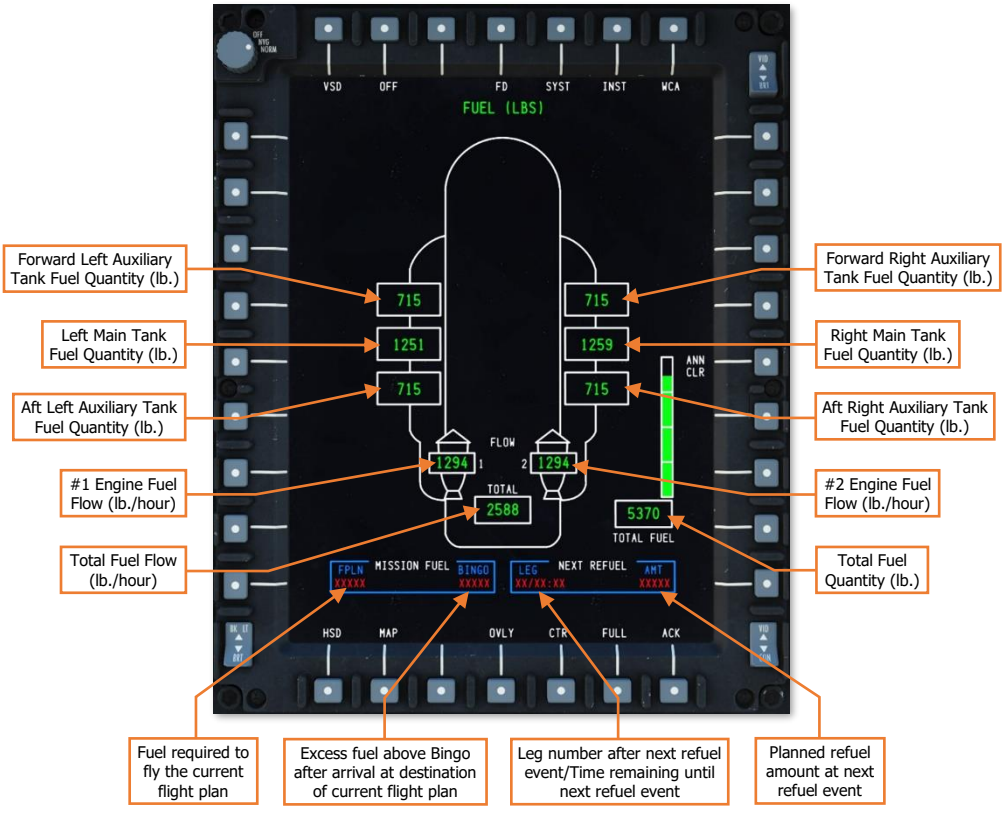
The POWER TRAIN format is displayed on the MFD by selecting INST (T6), which toggles between POWER TRAIN and FUEL when set to a full-screen format, or cycles between the ENGINE, POWER TRAIN, and FUEL formats when set to a half-screen format below the VSD.



Instruments (INST) Fuel Format

This section is still a work-in-progress and will be updated later in Early Access.

The FUEL format is displayed on the MFD by selecting INST (T6), which toggles between POWER TRAIN and FUEL when set to a full-screen format, or cycles between the ENGINE, POWER TRAIN, and FUEL formats when set to a half-screen format below the VSD.



CONTROL DISPLAY UNIT (CDU)

This section is still a work-in-progress and will be updated later in Early Access.

The Control Display Units are the aircrew's primary avionics interface for data entry and operation of the flight planning, navigation, and mission management functions of the CAAS. Each CDU includes a color LCD screen, variable function keys along each side for selecting on-screen information or functions, an alphanumeric keyboard, function keys for rapidly accessing specific CDU pages or functions, and a dual concentric rotary knob for rapidly scrolling or incrementing/decrementing values within on-screen data fields.

1. **Function Keys.** Displays the corresponding CDU page or performs the corresponding function.
   - **MSN.** Displays the Mission page.
   - **FPLN.** Displays the Flight Plan page.
   - **FD.** Displays the Flight Director page.

- **IDX.** Displays the Index page.
- **DIR.** Displays the Direct-To page.
- **SNSR.** Displays the Sensor Menu page.
- **MFD DATA.** Not implemented.
- **CNI.** Displays the Communication/Navigation/IFF page.
- **PAD.** Saves the contents of the on-screen scratchpad to memory and then clears the scratchpad.
- **WPN.** No function.
- **MARK.** Displays the ownship present position within the on-screen scratchpad and simultaneously stores the present position into the next available Mark location (90-99) within the point database.
- **TDL.** Not implemented.
- **ASE.** Not implemented.
- **(Blank).** No function.
- **DATA.** Displays expanded data for Air Control Points or DAFIF points.
- **STAT.** Displays the Status page.

2. **Line Select Keys (LSK).** Selects the option corresponding with the displayed text adjacent to the MFD button itself.
   - **L1-L6.** The left column of buttons are numbered from L1 starting on the top to L6 at the bottom.
   - **R1-R6.** The right column of buttons are numbered from R1 starting on the top to R6 at the bottom.
3. **Brightness Keys.** Incrementally adjusts the brightness of the CDU display.
   - **BRT.** Increases the brightness level of the CDU display.
   - **DIM.** Decreases the brightness level of the CDU display.
4. **Line Scrolling Keys.** Horizontally scrolls through text that extends beyond the on-screen display limits. Momentarily pressing the key will perform an incremental scroll. Pressing and holding the key will scroll continuously until the key is released.
5. **Scrolling/Paging Keys.** Vertically scrolls through text that extends beyond the on-screen display limits. Momentarily pressing the key will perform an incremental scroll. Pressing and holding the key will scroll continuously until the key is released.

   When multiple pages of data are available, indicated in the top right corner of the CDU display, pressing the scrolling/paging keys will access the next or previous page of data.
6. **Clear Key.** Deletes the data or message currently displayed within the on-screen scratchpad.
7. **Alphanumeric Keys.** Enters the corresponding number, letter, or decimal/period into the scratchpad at the current position of the scratchpad cursor. The SP key will enter a blank space.
8. **Application Keys.** Enters the corresponding slash or dash into the scratchpad at the current position of the scratchpad cursor or performs a unique function when entered into certain CDU data fields.
   - **Slash (/).** When multiple data blocks are being entered, the slash separates each data block within the scratchpad prior to entry into a singular CDU data field.
   - **Dash (-).** When entered into a CDU data field, entering a dash within the scratchpad prior to entry into a data field will either delete the data from the corresponding data field or revert the data field to its default value(s).

9. **Multi-Function Knob.** Increments, decrements, or scrolls through certain CDU data field values. (N/I)
    - **Outer knob.** Performs primary/coarse adjustments to data fields or the left side of a delimited field.
    - **Inner knob.** Performs secondary/fine adjustments to data fields or the right side of a delimited field.

CDU Display

The CDU display itself is divided into a series of data fields along with a scratchpad for data input, with the left and right LSK data fields indicating the function currently assigned to the physical Line Select Keys on either side of the display.

1. **Page Title.** Displays the name of the currently displayed CDU page.

2. **Page Number.** Displays current page number and total number of pages in a #/# format. If only one page is present, this field will be blank. The ↑ and ↓ keys may be used to vertically scroll through each page.

3. **Line Select Key (LSK) Data Fields.** Displays the sub-page that will be entered, function or action that will be commanded, or data field that will accept the contents of the scratchpad, when the corresponding line select key on either side of the CDU display is pressed.

4. **Scratchpad.** The scratchpad is used to input and temporarily hold data prior to input, or display prompts for crewmember actions, or provide feedback following crewmember actions. When the alphanumeric keys are used to input date, a green cursor line will indicate where the next alphanumeric character will be inserted, which can be scrolled left and right using the ← and → keys.

   After data is input into the scratchpad, pressing a Line Select Key (LSK) will select a corresponding data field on the display to accept the data. If the data is invalid or in the incorrect format, the scratchpad will display an "INVALD ENTRY" message. The CLR button must be pressed to clear the message and another attempt to input data into the scratchpad may be made.

   If a dash (-) is entered into the scratchpad and then entered into a LSK data field, the corresponding value within the data field will either be replaced by the default value or deleted entirely.

If a function or action is commanded that requires confirmation, the scratchpad will display a "CONFIRM" message. To confirm the function or action, press the corresponding LSK a second time. To cancel the action, press the CLR key.

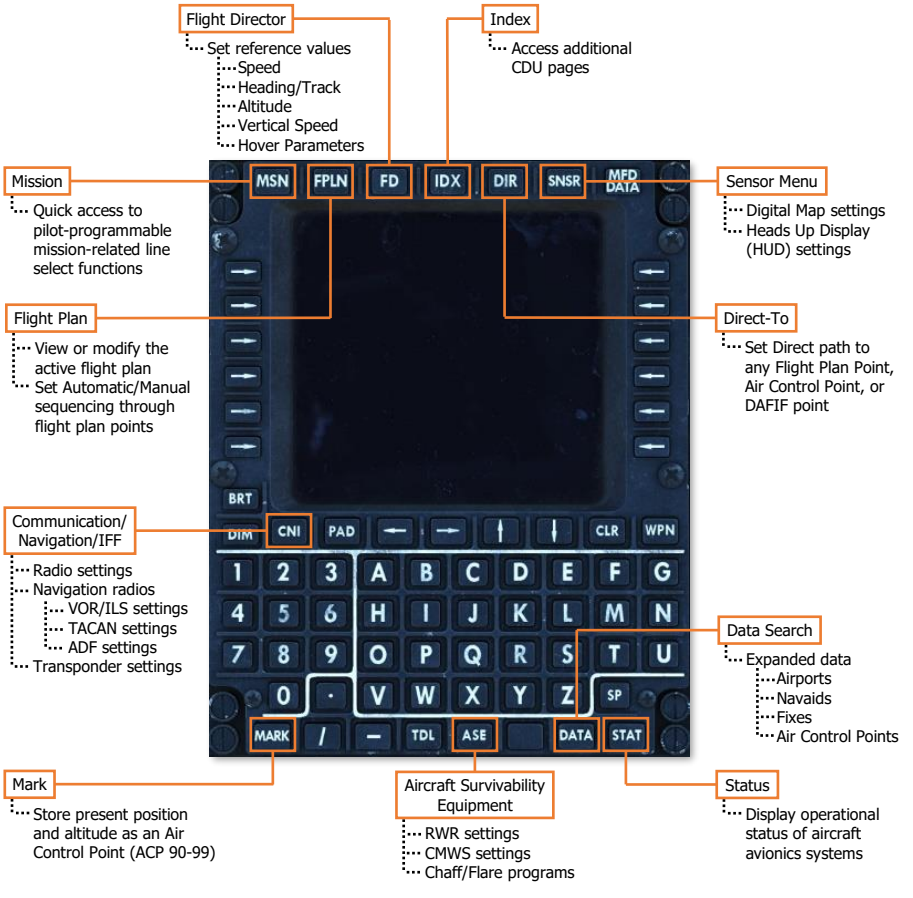
5. **Annunciations.** Messages or advisories that are intended to inform the crewmembers about system modes or statuses, but do not require immediate crewmember actions, are displayed on both CDU screens. If multiple messages are present, an arrow will be displayed on this line, allowing the crewmember to vertically scroll through each message using the ↑ and ↓ keys.

CDU Page Structure

Commonly used pages are assigned unique function keys along the top and bottom of the CDU. Pressing these function keys will open the corresponding CDU page for crewmember access. Pages that are less commonly used, or typically only used during ground operations or maintenance checks, are available via the CDU Index page, which may be accessed by pressing the IDX button along the top of the CDU.

Each of the CDU page labels in the figure below and on the following page may be left-clicked to immediately move to the corresponding manual section describing the function of that page.

NOTE: *This section is still a work-in-progress and links to other pages will be updated later in Early Access.*



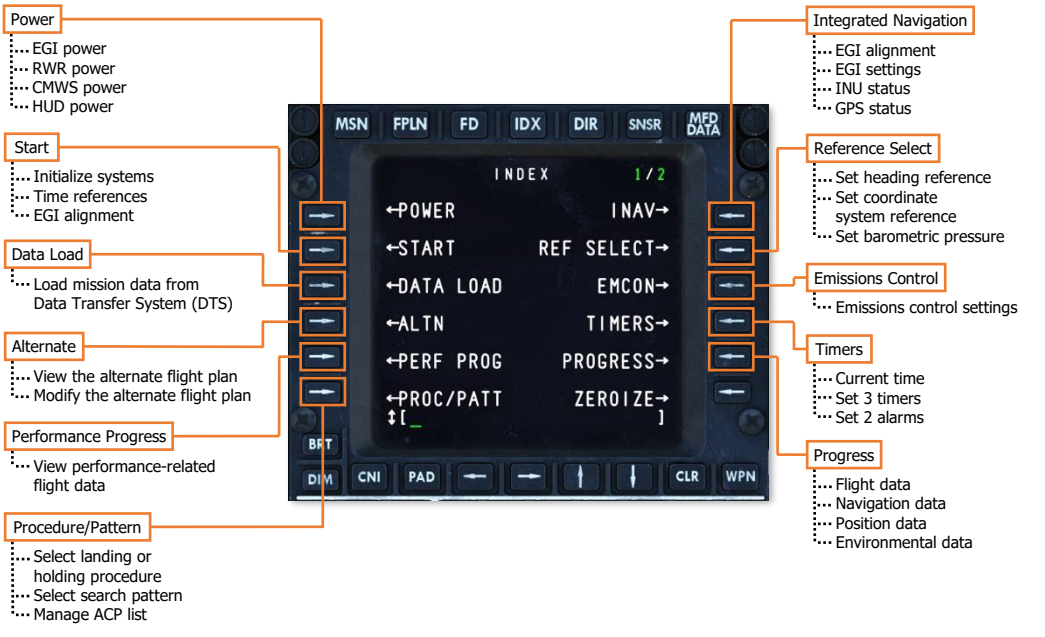
CDU INDEX Page

The Index page provides a list of 19 additional CDU pages that are not assigned to a dedicated CDU function key. The index itself is composed of two pages that may be selected via the ↑ and ↓ Scrolling/Paging keys.

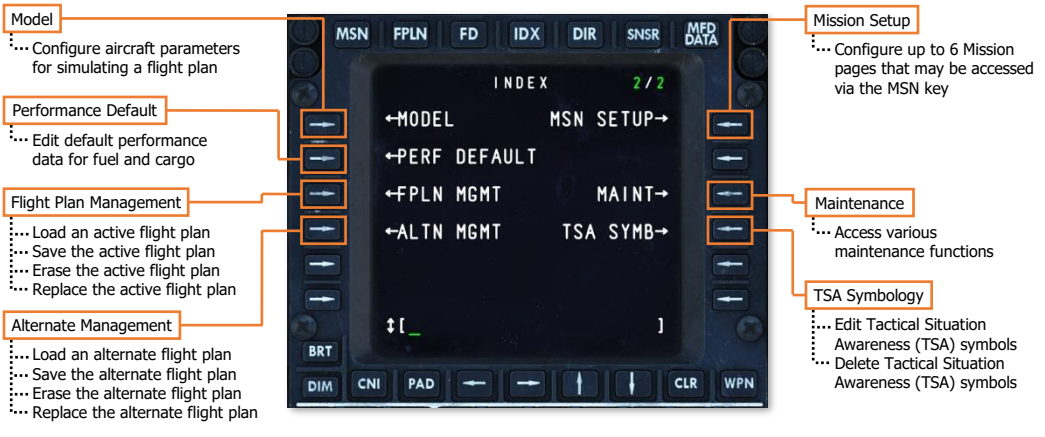
Each of the CDU page labels in the figure below and on the following page may be left-clicked to immediately move to the corresponding manual section describing the function of that page.

NOTE: *This section is still a work-in-progress and links to other pages will be updated later in Early Access.*

CDU Index Page 1/2



CDU Index Page 2/2



CDU POWER Page

The Power page provides the crew with a consolidated CDU page to ensure sensitive aircraft electronics are properly powered down prior to switching off the AC generators, which removes power from the AC busses.

1. **EGI1 Power.** Enables/disables power to EGI 1.
2. **EGI2 Power.** Enables/disables power to EGI 2.
3. **RWR Power.** Enables/disables power to the AN/APR-39 radar warning receiver.
4. **TCN Power.** Enables/disables power to the AN/ARN-153 Tactical Air Navigation System (TACAN). (N/I)
5. **HUD Power.** Enables/disables power to AN/AVS-7 Heads-Up Display. (N/I)
6. **ATIRCM/CMWS Power.** Enables/disables power to the AN/AAR-57 missile warning system.
7. **SHUTDOWN.** Disables power to all systems at once if the aircraft is weight-on-wheels.

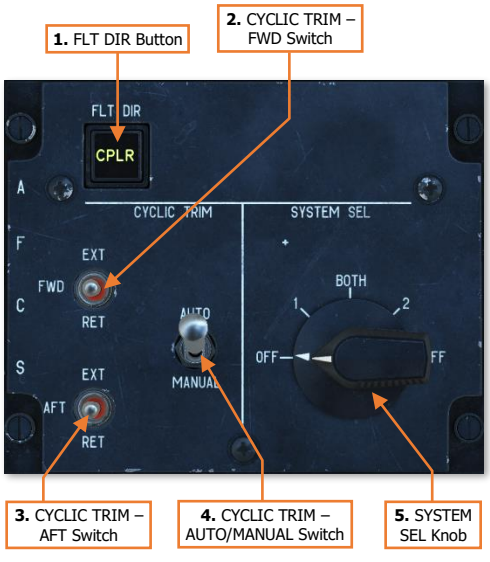
   When pressed, CONFIRM will be displayed in the scratchpad for three seconds. If SHUTDOWN (LSK L6) is pressed a second time during this 3-second window, the aircraft EGI present position will be stored within the aircraft memory and all electronic systems displayed on the page will be powered off.

DIGITAL ADVANCED FLIGHT CONTROL SYSTEM (DAFCS)

This section is still a work-in-progress and will be updated later in Early Access.

AFCS Control Panel

The Advanced Flight Control System control panel manages the flight control systems, LCT actuator settings, and the Flight Director coupling to the DAFCS.



1. **FLT DIR Button**. Couples the Flight Director to the DAFCS for automatic flight control if a Flight Director mode is selected.

   When the Flight Director is successfully coupled, the "CPLR" indicator light will illuminate.

2. **CYCLIC TRIM – FWD Switch.** Manually adjusts the forward Longitudinal Cyclic Trim actuator when the CYCLIC TRIM is set to MANUAL. The switch is spring-loaded to the center position.
   - **EXT.** Extends the forward LCT actuator while pressed to this position.
   - **RET.** Retracts the forward LCT actuator while pressed to this position.
3. **CYCLIC TRIM – AFT Switch.** Manually adjusts the aft Longitudinal Cyclic Trim actuator when the CYCLIC TRIM is set to MANUAL. The switch is spring-loaded to the center position.
   - **EXT.** Extends the aft LCT actuator while pressed to this position.
   - **RET.** Retracts the aft LCT actuator while pressed to this position.
4. **CYCLIC TRIM – AUTO/MANUAL Switch.** Sets the control of the forward and aft Longitudinal Cyclic Trim actuators to automatic control by the Flight Control Computers (FCC) or manual control by the aircrew.
   - **AUTO.** FCC 1 automatically controls the position of the forward LCT actuator and FCC 2 automatically controls the position of the aft LCT actuator.
   - **MANUAL.** The positions of the forward and aft LCT actuators are manually controlled via the CYCLIC TRIM – FWD and CYCLIC TRIM – AFT switches.
5. **SYSTEM SEL Knob.** Selectively enables one or both DAFCS flight control systems.
   - **OFF.** Each Flight Control Computer (FCC) is disabled. CYCLIC TRIM switches remain operational.
   - **1.** FCC 1 is enabled. FCC 2 is disabled.
   - **BOTH.** FCC 1 and FCC 2 are both enabled.
   - **2.** FCC 1 is disabled. FCC 2 is enabled.

PROCEDURES

US Army photo
by Mark Marcus, PEO Aviation

When describing cockpit controls or specific tasks performed in each crewstation, the following symbols will be used to denote each crewstation or cockpit control effects between the crewstations.

PLT Denotes a task that is performed by the Pilot.

CP Denotes a task that is performed by the Copilot.

FE Denotes a task that is performed by the Flight Engineer.

PLT / CP Denotes a task that may be performed by either the Pilot or Copilot.

PLT & CP Denotes a task that is performed by both the Pilot and Copilot.

Ⓟ Denotes a cockpit control, option, or setting that is "pilot-specific" to only one crewstation. A change performed by one pilot will not affect the other pilot's crewstation. Any item that does not have this symbol is "common" between crewstations, in that a change performed at one crewstation will otherwise affect both crewstations.

"Pilot" Denotes the crewmember occupying the right crewstation within the cockpit.

"pilot" Denotes the crewmember manipulating the aircraft flight controls in the conduct of performing a specific flight maneuver, which may be the Pilot or the Copilot.

AIRCRAFT START

This section is still a work-in-progress and will be updated later in Early Access.

Prior to Starting APU

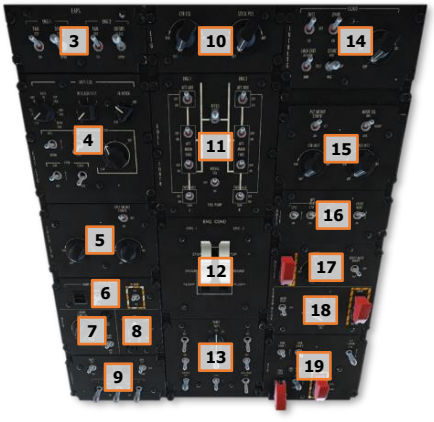
After an external preflight inspection and walk-around has been performed by the aircrew to ensure the aircraft is flightworthy and all gear and equipment is properly secured in the cabin, the pilots enter the cockpit and secure their intercom cables and seat restraints while the flight engineer takes position near the tail ramp.

If not already performed during the preflight inspection, the pilots inspects their crewstation to ensure all switches and knobs are set appropriately prior to starting the APU.

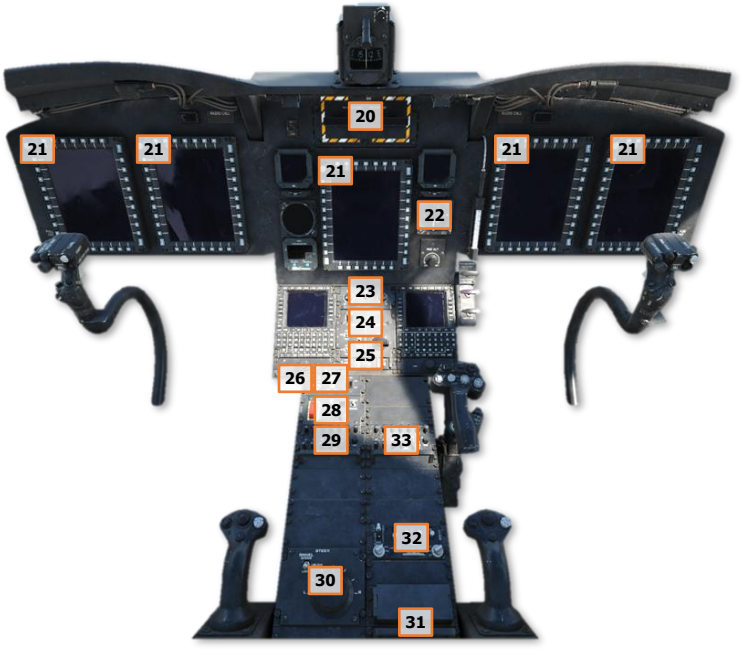
Interior Checks

1. PLT & CP Directional Pedal positions – Ensure matched.
2. PLT & CP No. 1 and No. 2 Power Distribution Panels – Check all circuit breakers in.

Check the following on the Overhead Switch Panel:



3. PLT / CP EAPS Control Panel – Set as follows:
   - Engine 1/2 Fan switches – OFF
   - Engine 1/2 Doors switches – CLOSE
4. PLT / CP EXT LTG Panel – As required.
5. PLT / CP CPLT LTG Panel – As required.
6. PLT / CP TROOP WARN switches – OFF.
7. PLT / CP HTG switch & knob – As required.
8. PLT / CP W/S WIPER Knob – OFF.
9. PLT / CP ELEC Power Panel switches – OFF.
10. PLT / CP LTG Panel – As required.
11. PLT / CP FUEL CONTR Panel – Set as follows:
    - XFEED switch – CLOSED.
    - REFUEL STA switch – OFF.
    - FUEL PUMP switches – OFF.
12. PLT / CP ENG COND Levers – STOP.
13. PLT / CP FADEC Panel – Set as follows:
    - N_R% switch – 100.
    - Engine 1/2 PRI/REV switches – PRI.
    - ENG START switch – Spring loaded to the center position.
    - Engine 1/2 INC/DEC switches – Spring loaded to the center position.
    - B/U PWR switch – OFF.
    - OSPD switch – Spring loaded to the center position.
    - LOAD SHARE switch – TRQ.
14. PLT / CP INTR LTG Panel – As required.
15. PLT / CP PLT LTG Panel – As required.
16. PLT / CP ANTI ICE switches – OFF.
17. PLT / CP HOIST Control switches & knob – OFF.
18. PLT / CP CARGO HOOK Control switches – Set as follows:
    - MSTR Switch – OFF.
    - HOOK SEL Switch – As required.
    - EMERG REL ALL Switch – OFF, cover down.
19. PLT / CP HYD switches — Set as follows:
    - PWR XFER switches – OFF.
    - FLT CONTR switch – BOTH.
    - PWR STEER switch – ON, cover down.
    - RAMP PWR switch – ON.
    - RAMP EMER switch – HOLD, cover down.



Check the following on the Instrument Panel:

20. PLT / CP FIRE PULL handles – In and horizontal.

21. PLT / CP MFD Power knobs – As required.

22. PLT / CP Radar Altimeter – Set as required.

Check the following on the Canted Console:

23. PLT / CP CDU 1/2 Brightness knobs – As required.

24. PLT / CP AFCS Panel – Set as follows:

- Cyclic Trim switch – Auto.
- SYSTEM SEL switch – OFF.

25. PLT / CP Emergency/Auxiliary Control Panel – Set as follows:

- MAN/NORM/GUARD switch – NORM.
- EMER/OFF HOLD switch – OFF.
- ZERO switch – OFF.

Check the following on the Center Console:

26. PLT / CP CGI Test switch – OFF.

27. PLT / CP BKUP RAD SEL switch – As required.

28. PLT / CP ASE Panel – Set as follows:

- JETTISON switch – OFF, cover down.
- ARM/SAFE switch – SAFE.
- BYPASS/NORMAL switch – NORMAL.

29. CP Copilot Control Audio Panel – As required.

30. PLT / CP STEER Panel – Set as follows:

- SWIVEL switch – LOCK.
- STEER knob – Centered.

31. PLT / CP Troop Commander Control Audio Panel – As required.

32. PLT / CP ARC-186 Control Panel – Set as follows:

- Mode Select knob – TR.
- Frequency Control knob – As required.
- Manual frequency rotaries – As required.

33. PLT Pilot's Control Audio Panel – As required.

APU Start

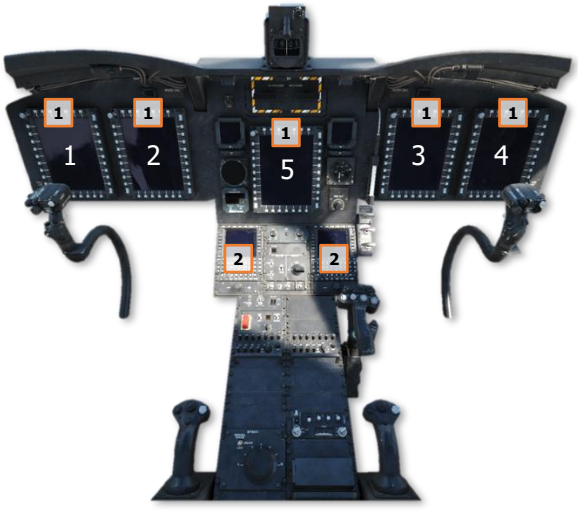
The APU start sequence is fully automatic and controlled by the APU Digital Electronic Sequencing Unit (DESU). When the APU start is initialized, a nitrogen pre-charge will force hydraulic fluid from the APU start accumulator cylinder to discharge through the APU starter, allowing the APU compressor to spool up to sufficient speed for combustion. Once the APU has reached a sufficient speed for the gas generator to become self-sustaining, the DESU will disengage the APU starter and the APU RDY light will illuminate on the Electrical Power Panel.

1. CP BATT switch – On.
2. CP TROOP WARN – ALARM & JUMP LT switches – As required; to warn that APU is about to start.
3. FE Fireguard – Posted.
4. CP **UTIL PRES** Light – Verify on.
5. CP APU switch – RUN for 5 seconds, START for 2 seconds, then back to RUN position.
6. CP **APU RDY** Light – Verify on.
7. CP UTIL PRES Light – Verify off within 30 seconds after APU RDY light illuminates.
8. CP APU GEN switch – On.
9. PLT / CP WCA page – Verify the following: (N/I)
   - #1 RECT OFF & #2 RECT OFF messages – Verify not active.
   - UTIL HYD PRES LO message – Verify not active within 30 seconds of APU RDY light illuminating.
   - **APU ON** advisory message – Verify active.

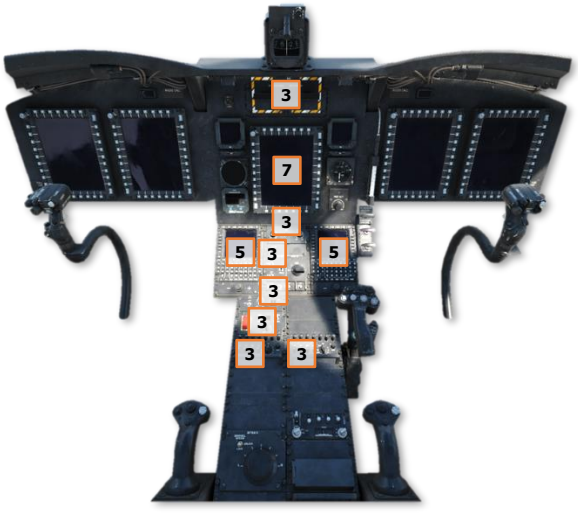
NOTE: *The WCA page and its messages are not implemented at this stage of Early Access.*

After Starting APU

Once the APU has been started and the MFDs have initialized, perform the following:



1. PLT & CP MFDs – Set as follows:
   - MFD 1 – VSD/FUEL (Half).
   - MFD 2 – POWERTRAIN (Full).
   - MFD 3 – POWERTRAIN (Full).
   - MFD 4 – VSD/HSDH (Half).
   - MFD 5 – WCA (Full).



2. CP PWR XFER 1 & PWR XFER 2 switches – ON.

- WCA - Verify #1 HYD FLT CONTR & #2 HYD FLT CONTR messages are not active within 30 seconds. (N/I)

3. PLT / CP LAMPS TEST button – Press and hold; check the following lights illuminate:

- GREEN & RED JUMP LT indicator lights (Overhead Switch Panel)
- UTIL PRES & APU RDY lights (Overhead Switch Panel)
- FIRE 1 PULL & FIRE 2 PULL Handle lights (Instrument Panel)
- CPLR light (Canted Console)
- FM1 VHF & VHF FM1 lights (Center Console)
- ARM light (Center Console)
- ● ICS, VOX, HOT MIC, & CALL lights (Control Audio Panels)

4. PLT / CP LAMPS TEST button – Release; check the lights extinguish.

5. PLT & CP Avionics and aircraft systems – Initialize and configure as appropriate for mission.

Before Engine Start

Prior to starting the engines, a DECU pre-start Built-In-Test (BIT) is performed to ensure the FADEC system for each engine is functioning properly.

6. CP B/U PWR switch – ON.

7. CP WCA page – Verify the following: (N/I)

- ENG1 FAIL & ENG1 FAIL messages are not active.
- ENG1 FADEC & ENG2 FADEC messages are not active.
- REV1 FAIL & REV2 FAIL messages are not active.

8. CP ENG COND levers – GROUND.

9. FE DECU fault code – Verify 88 is displayed.

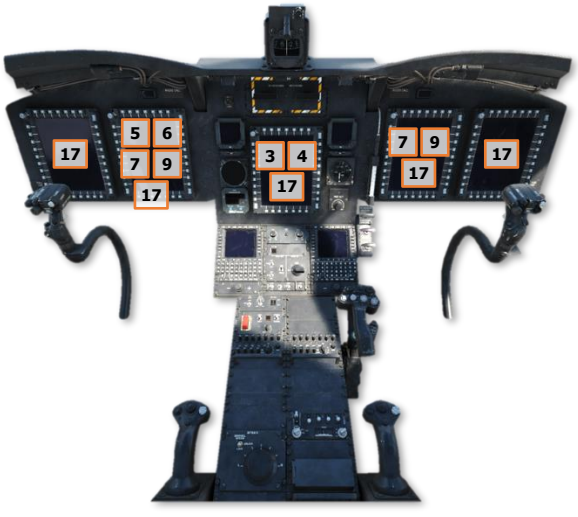
10. CP ENG COND levers – STOP.

11. PLT Ignition Lock switch – ON. (N/I)

NOTE: *The WCA page and its messages are not implemented at this stage of Early Access.*

Engine Start

Prior to starting the engines, perform the following:



1. FE Area around helicopter – Clear.

2. PLT / CP Searchlights – As required.

3. CP L MAIN FUEL pumps – ON.

- WCA – Verify ENG1 FUEL PRESS LO message is not active. (N/I)

4. CP XFEED switch – OPEN.

- WCA – Verify ENG2 FUEL PRESS LO message is not active. (N/I)

NOTE: Motor or start the second engine within 3 minutes of starting the first engine to avoid excessive wear on the N_P bearings and seal.

During normal operations, Engine 1 is started first, followed by Engine 2.

5. CP First engine – Start as follows:

- ENG COND lever – GROUND.
- ENG START switch – Press and hold until N_G ≥12%.
- POWER TRAIN page – Verify:
  - Engine N_G – ≥50% within 45 seconds after start initiated.
  - Engine oil pressure – ≥5 PSI.

6. CP Second engine – Repeat step 5 after first engine start sequence is complete.

7. PLT / CP POWER TRAIN page – Verify all transmissions ≥7 PSI.

8. CP ENG COND levers – FLIGHT.

9. PLT / CP Check N_R – 100% ±1.

10. CP GEN 1 & GEN 2 switches – ON; wait 2 seconds after turning on GEN 1 before turning on GEN 2.

11. CP APU GEN switch – OFF.

12. CP ENG COND levers – Retard 5° to initialize a DECU post-start Built-In Test (BIT).

13. FE DECU fault code – Verify 88 is displayed.

14. CP ENG COND levers – FLIGHT.

15. CP PWR XFER 1 & PWR XFER 2 switches – OFF.

16. CP APU switch – OFF.

17. PLT / CP Systems – Check N_R, torque, engine, transmission, fuel, and WCA for normal indications.

Ground Operations

After the engines are started, the fuel pumps, crossfeed valve, and FADEC system for each engine are checked and verified to be functional; and the final steps of configuring the avionics for the mission are performed.

Fuel Pumps & Crossfeed Check

1. CP All FUEL PUMP switches – OFF.
- WCA – Verify **ENG1 FUEL PRESS LO** & **ENG2 FUEL PRESS LO** messages are active.

2. CP AFT L MAIN PUMP switch – ON.
- WCA – Verify ENG1 FUEL PRESS LO & ENG2 FUEL PRESS LO messages are not active.

3. CP AFT L MAIN PUMP switch – OFF.

4. CP FWD L MAIN PUMP switch – ON.
- WCA – Verify ENG1 FUEL PRESS LO & ENG2 FUEL PRESS LO messages are not active.

5. CP FWD L MAIN PUMP switch – OFF.

6. CP AFT R MAIN PUMP switch – ON.
- WCA – Verify ENG1 FUEL PRESS LO & ENG2 FUEL PRESS LO messages are not active.

7. CP AFT R MAIN PUMP switch – OFF.

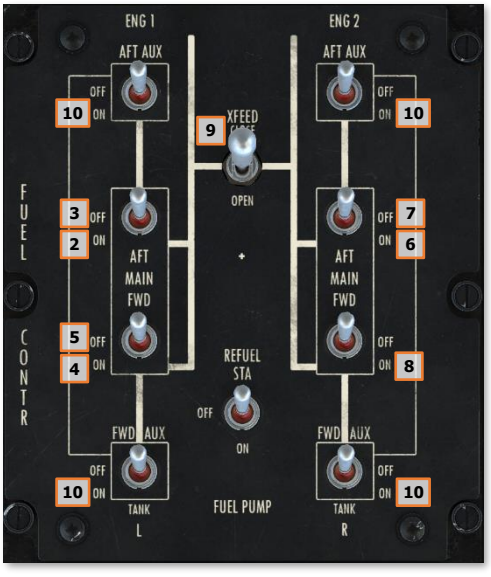
8. CP FWD R MAIN PUMP switch – ON.
- WCA – Verify ENG1 FUEL PRESS LO & ENG2 FUEL PRESS LO messages are not active.

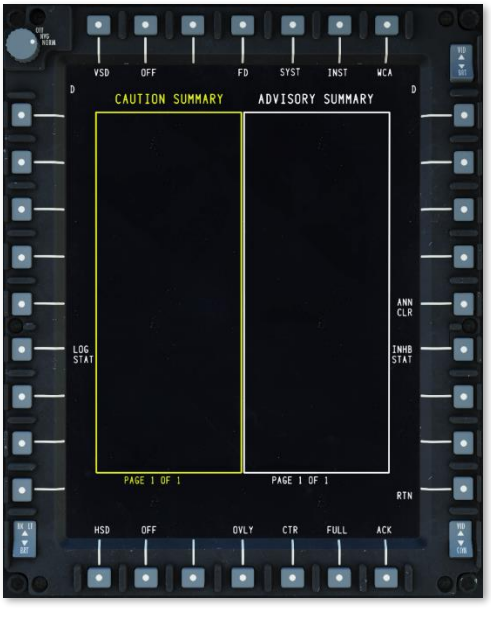
9. CP XFEED switch – CLOSE.
- WCA – Verify **ENG1 FUEL PRESS LO** message is active.

10. CP All AUX PUMP switches – ON.
- WCA – Verify all AUX PRESS messages are not active.

11. CP Fuel pumps & crossfeed – Set as follows:
- All FUEL PUMP switches – ON.
- XFEED switch – CLOSE.
- WCA – Verify ENG1 FUEL PRESS LO & ENG2 FUEL PRESS LO messages are not active.
- WCA – Verify all AUX PRESS messages are not active.

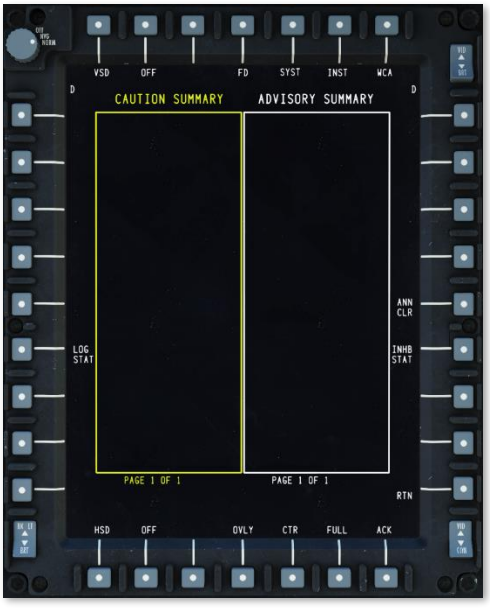
NOTE: *The WCA page and its messages are not implemented at this stage of Early Access.*





FADEC Reversionary System Check

If performing the first flight of the day, the behavior and correct functionality of the FADEC system is verified:



1. CP FADEC 1 PRI/REV & FADEC 2 PRI/REV switches – PRI.
2. CP N_R% knob – 100.
3. CP FADEC 1 PRI/REV switch – REV.
   - WCA – Verify **ENG1 FADEC** message is active.
4. CP FADEC 1 INC/DEC switch – DEC.
   - Check for a decrease in engine 1 N_G and torque and a corresponding increase in engine 2 N_G and torque.
5. CP FADEC 1 INC/DEC switch – INC.
   - Check for an increase in engine 1 N_G and torque and a corresponding decrease in engine 2 N_G and torque.
6. CP FADEC 1 PRI/REV switch – PRI.
   - WCA – Verify ENG1 FADEC message is not active.
7. CP FADEC 2 PRI/REV switch – REV.
   - WCA – Verify **ENG2 FADEC** message is active.
8. CP FADEC 2 INC/DEC switch – DEC.
   - Check for a decrease in engine 1 N_G and torque and a corresponding increase in engine 2 N_G and torque.
9. CP FADEC 2 INC/DEC switch – INC.
   - Check for an increase in engine 1 N_G and torque and a corresponding decrease in engine 2 N_G and torque.
10. CP FADEC 2 PRI/REV switch – PRI.
    - WCA – Verify ENG2 FADEC message is not active.

NOTE: *The WCA page and its messages are not implemented at this stage of Early Access.*

TAXI

The CH-47 may perform hover taxi (<25 feet and <20 knots) or air taxi (<100 feet and/or >20 knots) operations like any other helicopter, but ground taxi is typically used when feasible. Ground taxi allows the aircraft to be re-positioned away from other aircraft and ground support equipment using a lower power setting, which minimizes the rotor wash effects on the aircraft surroundings. This prevents foreign object damage to other aircraft, blowing dust/snow, and allows ground personnel to continue operations on the flight line with minimal disturbance.

The CH-47 uses two rotating tail wheels to facilitate taxi maneuvers on the flight line, which can be selectively locked to the rear position or unlocked for free-swiveling. Power steering control is provided by a hydraulic actuator on the right tail landing gear, controlled by the STEER rotary knob on the Center Console.

Before Taxi

Ensure the POWER TRAIN page is displayed on MFD prior to 2- or 4-wheel taxi operations to monitor LCTs. Prior to initiating ground taxi, perform the following:

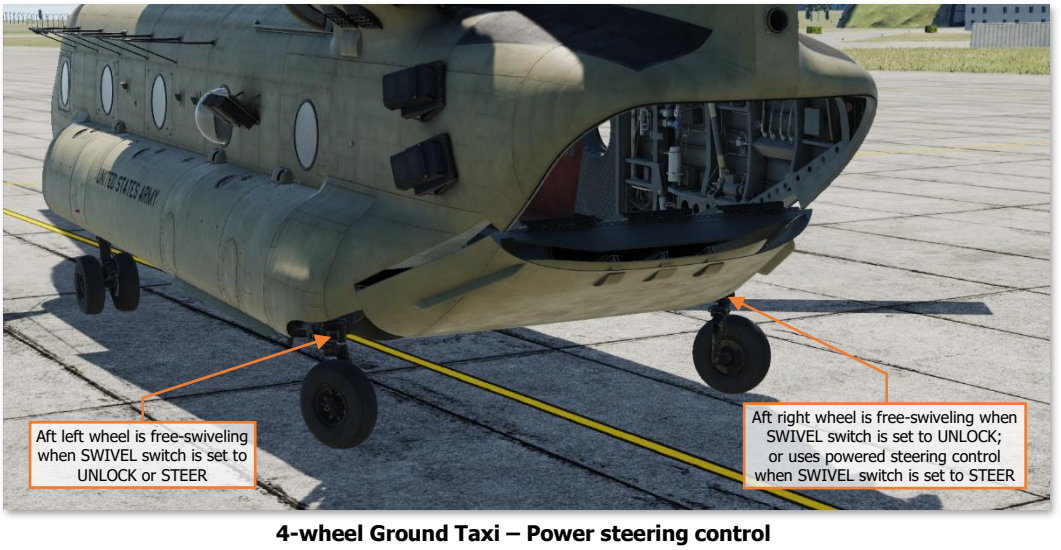
1. PLT / CP SWIVEL switch – As required.
2. PLT / CP AFCS control panel – As required.
3. PLT / CP Cyclic Trim indicators – Verify in GND positions.
4. PLT & CP MFDs – Configure as necessary for taxi.
5. FE Chocks – Remove and secure.
6. FE Tail ramp and cabin door – As required.
7. FE Crew, passengers, and mission equipment – Verify ready for taxi.
8. PLT & CP HUD – Adjust as necessary.
9. PLT / CP Parking brake – Release by applying wheel brake pressure; ensure Parking Brake handle is inward.

Ground Taxi (4-wheel)

The searchlight should be used to assist with ground taxi under low-light conditions. When utilizing night vision goggles, the Searchlight Mode switch on the Thrust Control Grip should be set to the IR position. Four-wheel ground taxi is typically performed in the following manner:

1. FE Ensure both aft wheels are in the trail position.
2. CP SYSTEM SEL knob (AFCS control panel) – OFF.
3. CP SWIVEL switch (Steering control panel) – STEER.
4. PLT Raise the thrust lever to start forward taxi movement. Once forward movement has been established, lower the thrust lever back to the ground detent. The wheel brakes may be used to control taxi speed as necessary.

   NOTE: When the aircraft is lightly loaded, the LCT actuators may cycle between RET and GND. If this occurs, position the cyclic 2 inches aft of center. If the LCT actuators continue to cycle between RET and GND, set the CYCLIC TRIM – AUTO/MANUAL switch on the AFCS panel to MANUAL and set them to GND position with the FWD and AFT switches if necessary. When ground taxi is complete, return the CYCLIC TRIM – AUTO/MANUAL switch to the AUTO position.
5. CP Steering Control knob – Rotate as necessary to control aircraft heading during ground taxi. Ensure the aircraft is clear of personnel and equipment before performing a turn.
6. CP Steering Control knob – Rotate to center, or as necessary, to bring aft wheels back to trail position before stopping ground taxi movement.
7. CP SWIVEL switch – LOCK, when ground taxi is complete.

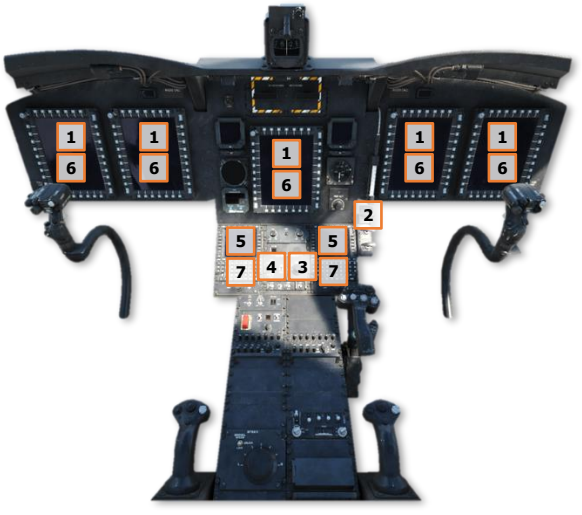


4-wheel Ground Taxi – Power steering control

TAKEOFF

Before Takeoff

Perform the following prior to departing on the mission and/or flight plan:



1. PLT / CP Systems – Check N_R, torque, engine, transmission, fuel, and WCA for normal operation and indications.
2. PLT / CP Parking brake – As required. (Ensure released, unless operating on uneven or sloped terrain or taking off from a confined area)
3. PLT / CP AFCS SYSTEM SEL knob – As required.
4. PLT / CP Cyclic Trim switch – Check.
5. PLT / CP Transponder – As required.
6. PLT & CP MFDs – Configure as required.
   - Verify desired NAV mode is selected.
   - Select bearing indicators as required.
7. PLT / CP Flight Director – Set guidance modes as required.
8. FE Crew, passengers, and mission equipment – Verify ready for takeoff.

VMC Takeoff (from the ground)

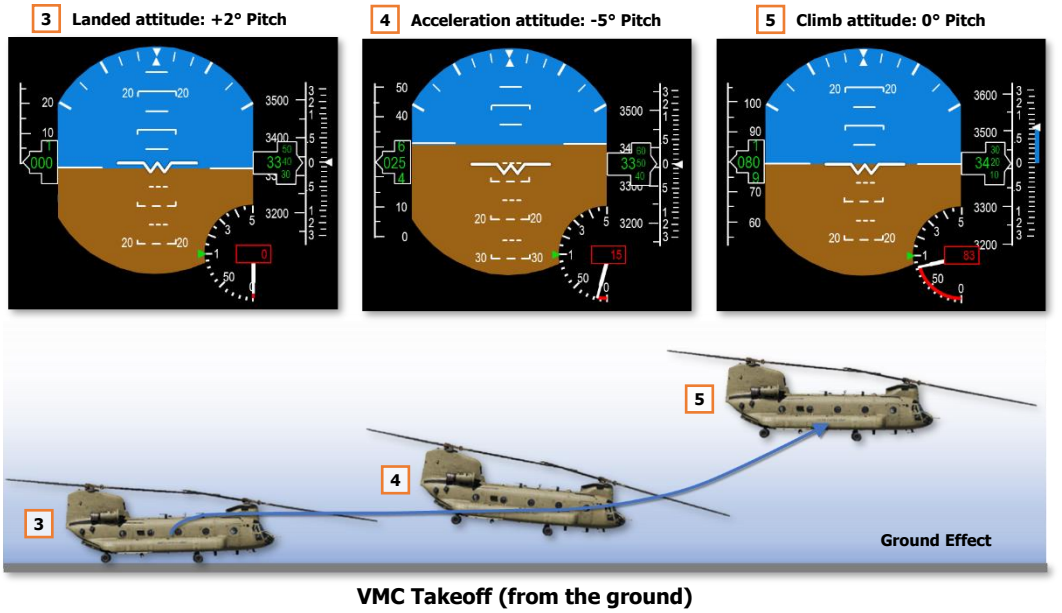
A VMC Takeoff may be performed from the ground or from a stationary hover. When performing the maneuver from the ground, the maneuver is typically performed in the following manner:

1. Press and hold the force trim (Centering Device Release button).
2. With the cyclic and pedals in their neutral positions, pull up on the thrust lever until the aircraft is airborne. Continue increasing thrust to approximately 10% above the torque required to hover in ground effect (TQ – REQD).
3. As the aircraft leaves the ground, apply forward cyclic to obtain a -5° pitch attitude. Use forward/aft cyclic inputs as necessary to maintain this attitude as the aircraft accelerates through effective translational lift (ETL). Once a -5° pitch attitude is attained, the force trim may be released if desired to allow Heading Hold to engage.
4. Once through ETL, use forward/aft cyclic inputs as necessary to obtain the desired climb airspeed and adjust the thrust lever as necessary to clear any obstacles and obtain the desired rate of climb.

   NOTE: A minimum climb rate of 500 feet per minute (FPM) is typically desired. However, depending on the nature of the takeoff area, additional thrust may be necessary to achieve a higher rate of ascent and a steeper climb angle in order to clear obstacles.

   Use left/right cyclic inputs to maintain the desired ground track and left/right pedal inputs to maintain the takeoff heading until the aircraft has ascended through 50 feet AGL or is clear of all obstacles within the takeoff area.

   Once the aircraft has climbed above 50 feet AGL and is clear of obstacles, adjust the pedals to place the aircraft "in trim" ("Trim ball" centered on the Skid/Slip Indicator).
5. Use the DAFCS Trim switch on the cyclic as necessary to adjust attitude for the desired airspeed. (N/I)
6. Release the wheel brakes, if not performed prior to takeoff.



VMC Takeoff (from the ground)

VMC Takeoff (from a hover)

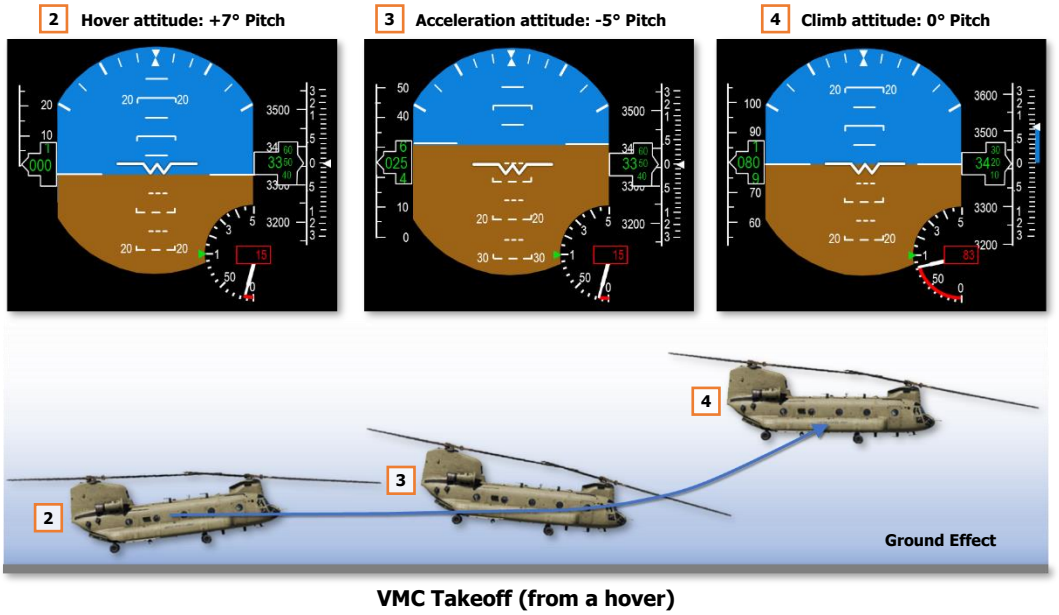
A VMC Takeoff may be performed from the ground or from a stationary hover. When performing the maneuver from a hover, the maneuver is typically performed in the following manner:

1. Press and hold the force trim (Centering Device Release button).
2. While maintaining a stationary hover, apply forward cyclic to obtain a -5° pitch attitude and adjust the thrust lever as necessary to prevent altitude loss. Continue increasing thrust to approximately 10% above the torque required to hover in ground effect (TQ – REQD).
3. Use forward/aft cyclic inputs as necessary to maintain a -5° attitude as the aircraft accelerates through effective translational lift (ETL). Once a -5° pitch attitude is attained, the force trim may be released if desired to allow Heading Hold to engage.
4. Once through ETL, use forward/aft cyclic inputs as necessary to obtain the desired climb airspeed and adjust the thrust lever as necessary to clear any obstacles and obtain the desired rate of climb.

   NOTE: A minimum climb rate of 500 feet per minute (FPM) is typically desired. However, depending on the nature of the takeoff area, additional thrust may be necessary to achieve a higher rate of ascent and a steeper climb angle in order to clear obstacles.

   Use left/right cyclic inputs to maintain the desired ground track and left/right pedal inputs to maintain the takeoff heading until the aircraft has ascended through 50 feet AGL or is clear of all obstacles within the takeoff area.

   Once the aircraft has climbed above 50 feet AGL and is clear of obstacles, adjust the pedals to place the aircraft "in trim" ("Trim ball" centered on the Skid/Slip Indicator).
5. Use the DAFCS Trim switch on the cyclic as necessary to adjust attitude for the desired airspeed. (N/I)
6. Release the wheel brakes, if not performed prior to takeoff.



VMC Takeoff (from a hover)

LANDING

Before Landing

Prior to landing, perform the following:

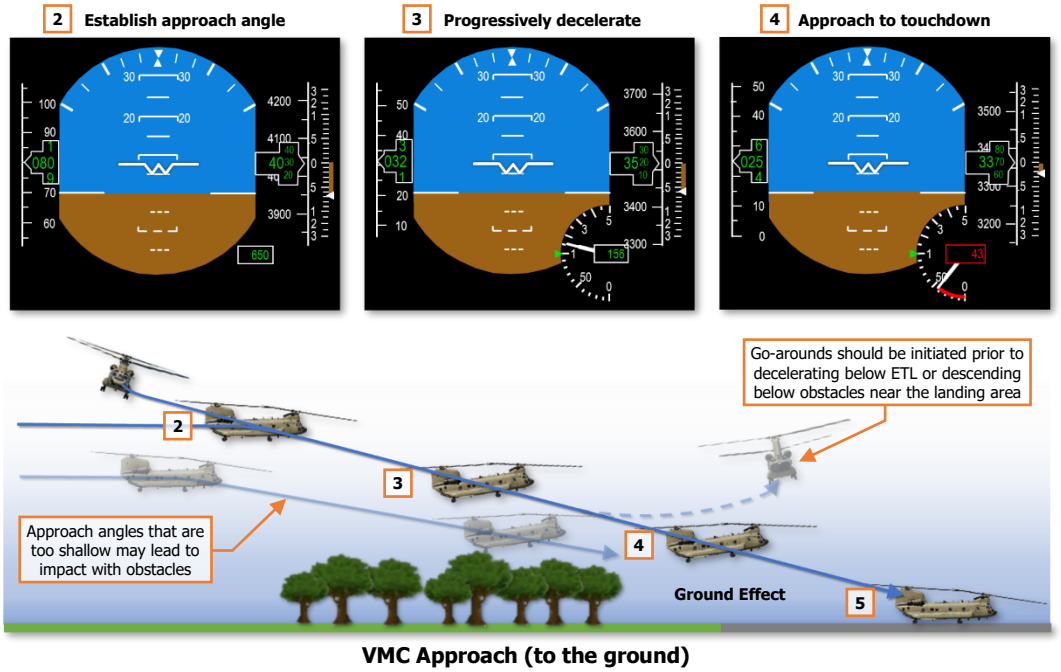
1. PLT / CP Parking brake – As required. (Ensure released, unless intending to land on uneven or sloped terrain)
2. PLT / CP AFCS control panel – Verify and set as required.
3. PLT / CP DAFCS modes – As required.
4. PLT / CP MFDs – Configure as required for landing.
5. PLT / CP SWIVEL switch – As required.
6. PLT & CP Searchlights – As required.
7. FE Crew, passengers, and mission equipment – Check.
8. PLT & CP Performance considerations – As required.

VMC Approach

A VMC Approach may be performed to the ground or to a stationary hover. When performing the maneuver to the ground, the maneuver is typically performed in the following manner:

1. Evaluate the landing area and select an approach direction and approach angle that is appropriate for the local winds, any obstacles in the vicinity of the landing area, and the available power margins for the given gross weight and environmental conditions.
2. When the desired approach angle is intercepted (whether on final or while still in a base turn toward the landing area), lower the thrust lever to establish a descent at a constant angle toward the intended point of touchdown. Apply aft cyclic to initiate a deceleration at a rate appropriate for the remaining distance to touchdown. Adjust the pedals to maintain the aircraft "in trim". ("Trim ball" centered on the Skid/Slip Indicator).

   NOTE: Steep approach angles should only be utilized if adequate power is available to maintain a slow rate of descent, or if the aircraft performance is such that a hover out of ground effect (OGE) may be performed.
3. Use left/right cyclic inputs to maintain the desired ground track. As the aircraft gets closer to the surface, the speed of the aircraft across the surface toward the touchdown point will appear to increase. Use forward/aft cyclic inputs to progressively decelerate as the apparent closure rate increases. The rate of deceleration should be managed so that the aircraft reaches zero forward velocity at touchdown.
4. As the aircraft descends below 50 feet AGL or below the obstacles surrounding the landing area, adjust the pedals to align the aircraft with the landing direction.
5. Once the aircraft touches down, adjust the cyclic to eliminate any remaining velocity. Once the aircraft is stationary, position the cyclic 1.5 inches aft of center and laterally neutralized, center the pedals, and smoothly lower the thrust lever to the ground detent.



VMC Approach (to the ground)

Roll-on Landing

A Roll-on Landing is performed when the aircraft's power margin is insufficient to perform a normal approach and a suitable landing area such as a runway, a road, or other improved surface is available. The maneuver is typically performed in the following manner:

1. When the desired approach angle is intercepted (whether on final or while still in a base turn toward the landing area), lower the thrust lever to establish a descent at a constant angle toward the intended point of touchdown. Adjust the cyclic throughout the approach to maintain the desired airspeed. Adjust the pedals to maintain the aircraft "in trim". ("Trim ball" centered on the Skid/Slip Indicator).

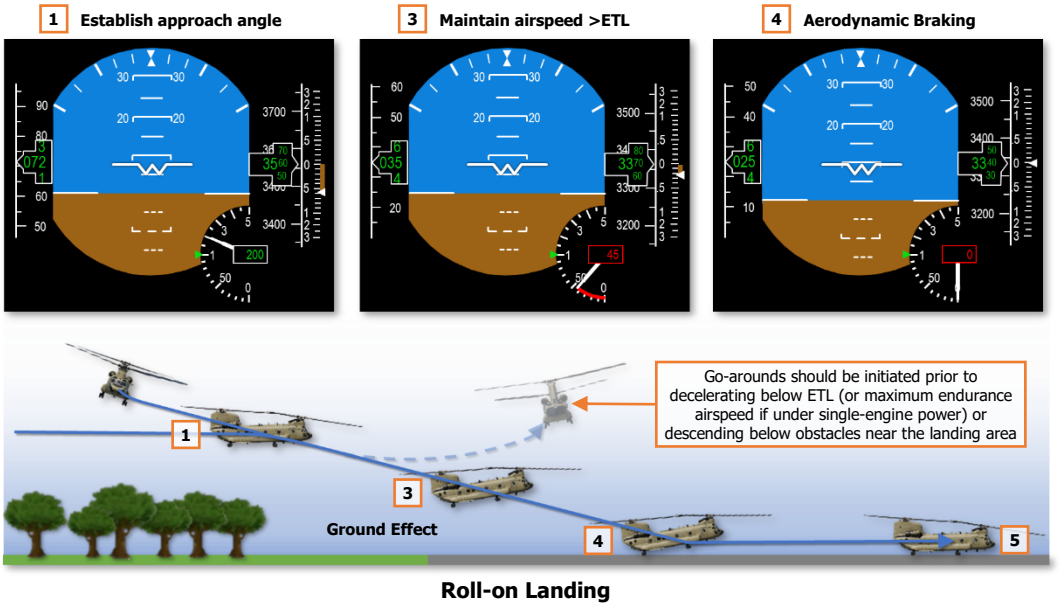
2. Use left/right cyclic inputs to maintain the desired ground track and left/right pedal inputs to maintain the aircraft "in trim". Once clear of obstacles in the approach path, but no later than 100 feet above the highest obstacle (AHO), use forward/aft cyclic inputs to initiate a progressive deceleration to touchdown on the aft landing gear, while remaining above ETL (24 knots) until touchdown.

3. As the aircraft descends below 50 feet AGL or below the obstacles surrounding the landing area, adjust the pedals to align the aircraft with the landing direction.

4. After touchdown on the aft landing gear, lower the thrust lever while applying aft cyclic to maintain the landing attitude (not to exceed +20° pitch), until the cyclic reaches 1 inch aft of center. Once the cyclic reaches 1 inch aft of center, maintain the landing attitude by adjusting the thrust lever to utilize aerodynamic braking. Use left/right cyclic inputs to maintain the ground track across the landing surface and left/right pedal inputs to maintain heading.

   NOTE: The primary aerodynamic braking force is from the aft rotor system. Due to the differential collective pitch, applying greater aft cyclic input than is necessary to maintain the landing attitude after touchdown will lessen the effectiveness of the aft rotor system and can increase the roll-out distance.

5. Once the aircraft is stationary or sufficiently slowed, smoothly lower the thrust lever until the forward landing gear contacts the ground. Apply wheel brakes as necessary to stop any remaining forward movement, position the cyclic 1.5 inches aft of center and laterally neutralized, center the pedals, and continue smoothly lowering the thrust lever to the ground detent.

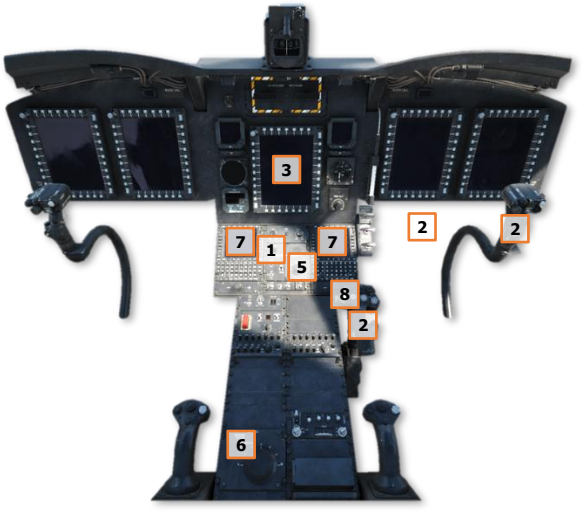


Roll-on Landing

AIRCRAFT SHUTDOWN

After Landing Check

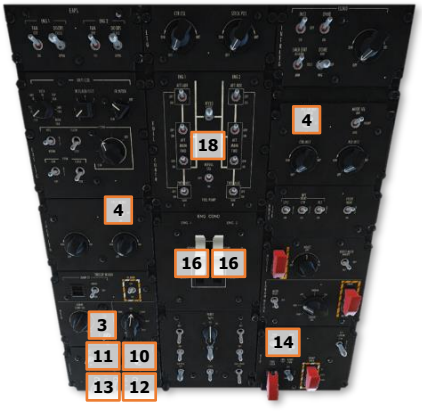
Perform the following after arriving at the final destination at the end of the mission:

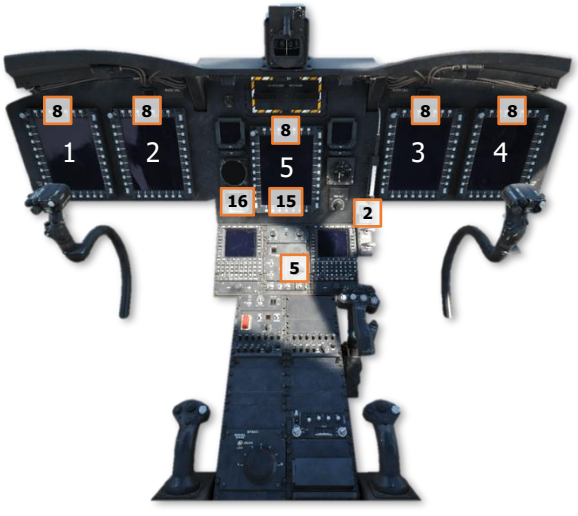


1. PLT / CP Flight Director - Decoupled.
2. PLT / CP Flight controls – Neutralize.
   - Position cyclic 1.5 inches aft of center and laterally centered.
   - Position directional pedals to center.
   - Position Thrust Control Lever at ground detent.
3. PLT / CP Cyclic Trim indicators – Verify in GND positions.
4. FE Ground Contact indicator lights – Verify illuminated.
5. PLT / CP AFCS SYSTEM SEL knob – As required.
6. PLT / CP SWIVEL switch – As required.
7. PLT / CP Transponder – Standby; or as required.
8. PLT & CP Searchlights – As required.
9. PLT / CP ANTI ICE switches – OFF; or as required.

Aircraft Shutdown

Once stationary in the designated parking location, perform the following:

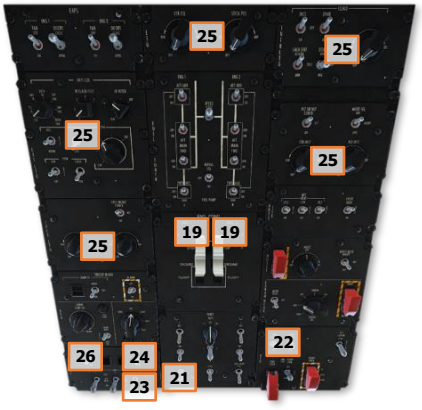


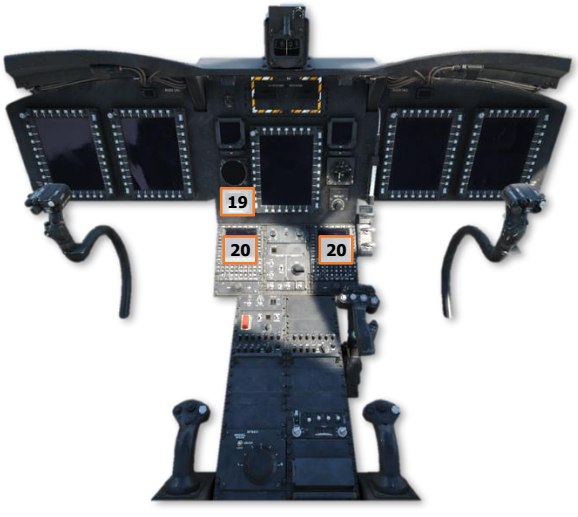


1. PLT / CP Flight controls – Neutralize.
   - Position cyclic 1.5 inches aft of center and laterally centered.
   - Position directional pedals to center.
   - Position Thrust Control Lever at ground detent.
2. PLT Parking Brake – Brakes set; handle is pulled outward.
3. CP Heater Function switch – OFF.
4. PLT & CP Searchlights – Off, and stow as required.
5. PLT / CP AFCS SYSTEM SEL knob – OFF.
6. FE Ramp – As required.
7. FE Wheel chocks – Place.
8. PLT & CP MFDs – Set as follows:
   - MFD 1 – VSD/FUEL (Half).
   - MFD 2 – POWERTRAIN (Full).
   - MFD 3 – POWERTRAIN (Full).
   - MFD 4 – VSD/HSDH (Half).
   - MFD 5 – WCA (Full).
9. FE Fireguard – Posted.
10. CP APU switch – RUN for 5 seconds, START for 2 seconds, then back to RUN position.
11. CP **APU RDY** Light – Verify on.
12. CP APU GEN switch – On.
13. CP GEN 1 & GEN 2 switches – OFF; wait 2 seconds after turning off GEN 1 before turning off GEN 2.
14. CP PWR XFER 1 & PWR XFER 2 switches – ON.
15. PLT / CP Cyclic Trim indicators – Verify in GND positions.
16. CP ENG COND levers – GROUND; set the Chronometer to ET mode using the SELECT button, and press the CONTROL button start a timer for a 2-minute engine cooldown.
17. FE DECU fault code – Verify 88 is displayed.
18. CP Fuel pumps & crossfeed – Set as follows:
    - XFEED switch – CLOSE.
    - REFUEL STA switch – As required
    - All FUEL PUMP switches – OFF.

19. CP ENG COND levers – STOP after 2 minutes have elapsed on Chronometer.
20. PLT & CP Avionics and aircraft systems – Perform shutdown.
21. PLT / CP B/U PWR switch – OFF.
22. CP PWR XFER 1 & PWR XFER 2 switches – OFF after rotors have stopped.

    NOTE: Wait at least 15 seconds after EGI1 and EGI2 have been set to OFF on the CDU Power page before turning off the APU generator.
23. CP APU GEN switch – OFF.
24. CP APU switch – OFF.
25. PLT & CP Interior and exterior lighting – OFF.
26. CP BATT switch – OFF.
27. PLT Ignition Lock switch – OFF. (N/I)





NAVIGATION

US Army photo
by SGT Aubree Rundle

MISSION DATABASE

The CH-47F's mission database consists of 89 unique Air Control Points (ACP) that can be uploaded from a removable Data Transfer Cartridge (DTC), an additional 10 non-loadable ACPs within the aircraft memory for marking locations during the mission, and a Threat file containing enemy locations that should be avoided. The ACPs serve as geographical coordinates of waypoints for navigation and routing, and the Threat file includes known or suspected locations of enemy forces and air defenses.

Air Control Point (ACP) List

ACPs within the mission database are stored in one of two partitions, depending on their type. Pre-planned ACPs used for navigation may be uploaded from the DTC; and may be added, edited, or deleted from the cockpit. Additional ACPs known as Marks may be created in flight but cannot be uploaded from the DTC.

Air Control Points	Marks
01-89	90-99

Air Control Point (ACP) Partitions

- **Air Control Points partition.** Points for depicting navigation waypoints.
- **Marks partition.** Points for storing the ownship position while in flight.

CDU PROC/PATT Page

The Procedures/Patterns page allows the aircrew to insert a specific type of flight procedure or search and rescue pattern into the flight plan.

1. **Procedures.** Not implemented.
2. **Patterns.** Not implemented.
3. **ACP LIST page.** Displays the CDU Air Control Point List page.

CDU ACP LIST Page

The ACP List page is used to display position and identification information for Air Control Points and Marks residing within the mission database. ACPs may also be copied or imported into the active or alternate flight plans from this page.

Air Control Point (ACP) List

Air Control Points are displayed in the ACP list through the indexes of 1 and 89, and are used for navigation and routing purposes.

1. **ACP Index.** Displays the number of the ACP for which information is currently displayed on CDU.
2. **ACP Position (ACP POSN).** Displays the coordinates of the ACP displayed on CDU. If coordinate data is present in the scratchpad, pressing LSK L1 will enter the data into this field, updating the ACP position.

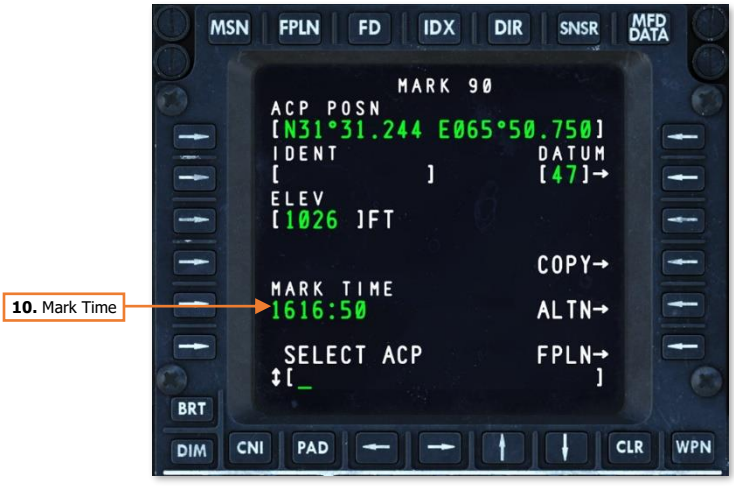
   This function may also be used to immediately recall any ACP within the mission database by entering the ACP index number (e.g., "3", "07", or "15") into the scratchpad and then pressing LSK L1.
3. **ACP Datum Code (DATUM).** Displays the datum code of the ACP displayed on the CDU. If a datum code is present in the scratchpad, pressing LSK R2 will enter the code into this field, updating the ACP datum. (N/I)
4. **ACP Identification (IDENT).** Displays the identification of the ACP displayed on the CDU. If a slash is entered into the scratchpad followed by up to nine characters, pressing LSK L2 will enter the characters into this field, updating the ACP identification.
5. **ACP Elevation (ELEV).** Displays the elevation (in feet) of the ACP displayed on the CDU. If elevation data is entered into the scratchpad, pressing LSK L3 will enter the data into this field, updating the ACP elevation.
6. **Select ACP.** Selects the ACP(s) for copy to another ACP number or import into the active or alternate flight plan.
7. **Copy ACP.** Not implemented.
8. **ALTN page.** Displays the CDU ALTN page. Any ACP(s) that have been selected using LSK L6 may be imported into the alternate flight plan by pressing the LSK adjacent to the desired location within the alternate flight plan point sequence.

9. FPLN page. Displays the CDU FPLN page. Any ACP(s) that have been selected using LSK L6 may be imported into the active flight plan by pressing the LSK adjacent to the desired location within the active flight plan point sequence.

Mark List

Marks are displayed in the ACP list within the indexes of 90 through 99 and are used for storing the ownship's position during overflight of tactically significant locations, which may be referenced later in the mission or after the mission is complete.

The data fields on the ACP List page when Marks 90-99 are identical in function to those when ACPs 1-89 are displayed, with the additional data field of MARK TIME.



10. Mark Time. Displays the time at which the Mark was stored within the mission database.

Adding an ACP

Air Control Points may be added to the mission database from the CDU ACP LIST page, which is accessed via the CDU Index page, followed by the CDU Procedures/Pattern page.

To add a new ACP, perform the following:

1. CDU IDX Key – Press.
2. PROC/PATT (LSK L6) – Select.
3. ACP LIST (LSK L6) – Select.
4. Scroll/Paging Keys (↓/↑) Keys – Press as necessary to scroll up (or down) within the ACP List to an empty ACP index.
5. CDU Alphanumeric Keys – Enter position data into the scratchpad.
   - Input MGRS coordinates in a 6-digit, 8-digit, or 10-digit format as a continuous string without spaces. *MGRS input is not implemented*.

     41R QQ 70174 94529 would be input as:

     [41RQQ7017494529_]
   - Input Latitude/Longitude coordinates in Degrees-Minutes-Decimals format as a continuous string without spaces.
     - A minimum of 4 digits are required for the Nort h/South and East/West fields.
     - The leading zero in the East/West field is not required to be input.
     - Any trailing zeros after the decimals are not required to be input.

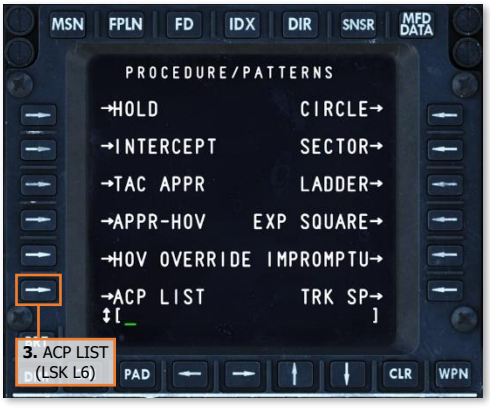
     N31°33.000′ E°065°50.000′ may be input as

     [N3133E6550_]

     N31°33.247′ E°065°50.767′ may be input as:

     [N3133.247E6550.767_]
6. ACP POSN (LSK L1) – Select to enter scratchpad data as ACP position.

   NOTE: When the ACP position is entered, the datum will default to 47 (WGS-84) and the elevation will default to 0 feet above mean sea level (MSL).



7. CDU Alphanumeric Keys – Enter identification data into the scratchpad.
8. IDENT (LSK L2) – Select to enter scratchpad data as ACP identification.
9. CDU Alphanumeric Keys – Enter elevation data into the scratchpad.
10. IDENT (LSK L2) – Select to enter scratchpad data as ACP elevation.

Editing an ACP

Each data field of an existing Air Control Point may be edited in the same manner in which new data is entered when adding an ACP to the mission database.

To edit an existing ACP, perform the following:

1. CDU IDX Key – Press.
2. PROC/PATT (LSK L6) – Select.
3. ACP LIST (LSK L6) – Select.
4. Scroll/Paging Keys (↓/↑) Keys – Press as necessary to scroll up (or down) within the ACP List to the Air Control Point that is intended to be edited.

   or

4. CDU Alphanumeric Keys – Enter the ACP index number that is intended to be edited into the scratchpad (e.g., "3", "07", or "15") and then press LSK L1 to immediately recall the ACP.
5. CDU Alphanumeric Keys – Enter position, identification, and/or elevation data into the scratchpad.
6. ACP POSN (LSK L1) – Select to enter scratchpad data as ACP position.

   or

6. IDENT (LSK L2) – Select to enter scratchpad data as ACP identification.

   or

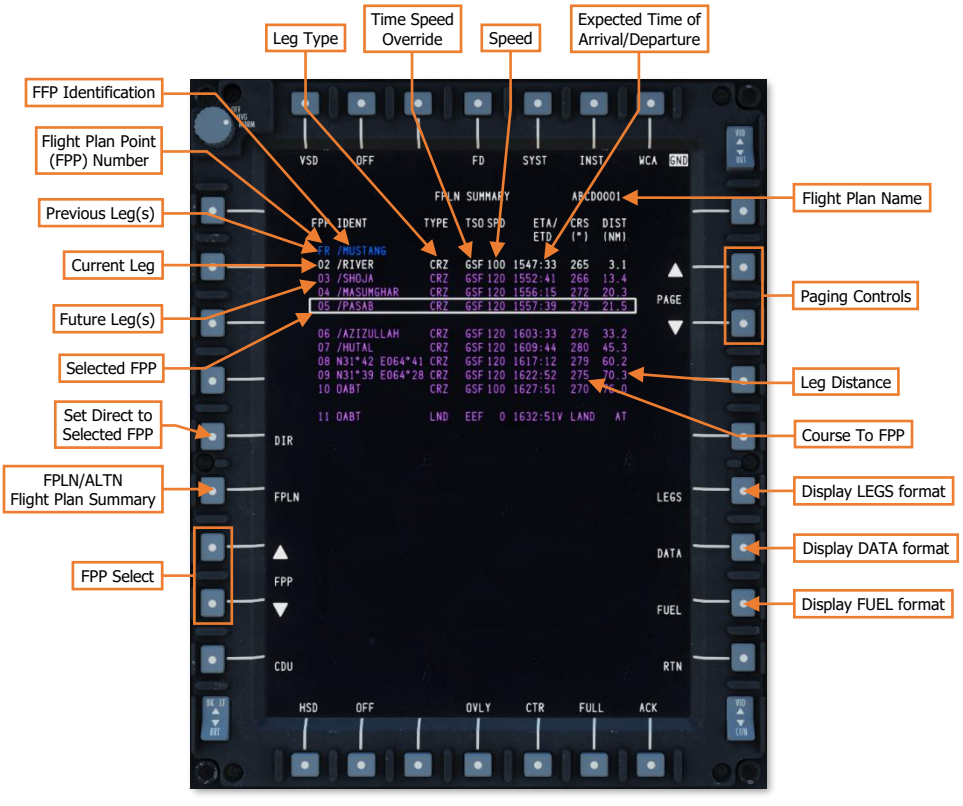
6. ELEV (LSK L3) – Select to enter scratchpad data as ACP elevation.

FLIGHT PLANS

The CH-47F mission database can store 2 unique flight plans, each consisting of up to 125 flight plan point (FPP) entries. Flight plans may consist of any combination of ACPs from the mission database or aeronautical points from the Digital Aeronautical Flight Information File (DAFIF). However, "direct" routes may be plotted from the aircraft's current position to any ACP or aeronautical point within the database at any time.

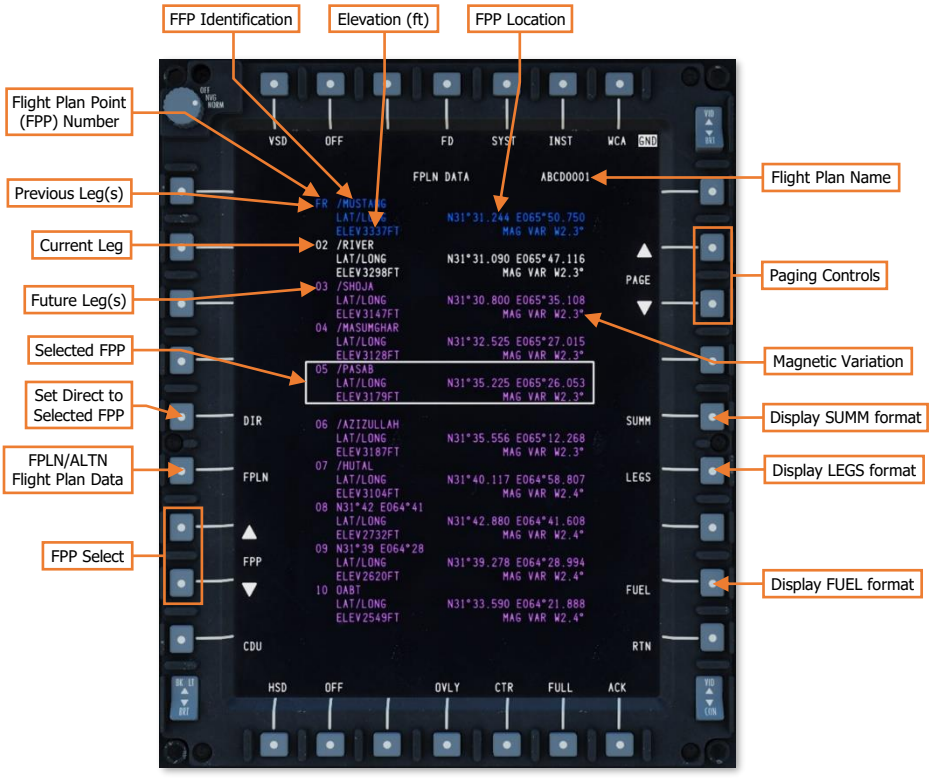
MFD Flight Plan (FPLN) Format

The FPLN SUMMARY format is displayed on the MFD by selecting SYST (T5), and then selecting FPLN (L6).



Flight Plan Data (FPLN DATA) Format

The FPLN DATA format is displayed on the MFD by selecting SYST (T5), selecting FPLN (L6), and then selecting DATA (R7).



CDU Fight Plan Pages

The active flight plan, abbreviated as FPLN, is the current flight sequence to which the navigation system is referenced, and is signified by a magenta line on the MFD Horizontal Situation Display (HSD) format. The active flight plan may be reviewed, modified, saved, erased, or replaced via the CDU FPLN pages, accessed via the FPLN key along the top of the CDU itself.

CDU FPLN Page

The Flight Plan page displays navigation information regarding the active flight plan (FPLN), provides access to expanded data pages regarding any flight point (FPP), and allows the crew to access additional CDU pages to make manage or modify the active flight plan.

1. **Flight Plan ID.** Displays the name of the active flight plan. (N/I)
2. **COURSE/OFFSET.** Not implemented.
3. **SEQ MODE.** Toggles the sequence mode between AUTO and MAN.
   - **AUTO.** Navigation will automatically sequence to the next FPP within the active flight plan.
   - **MAN.** Navigation must be manually sequenced to the next FPP by the crew.
4. **History FPP.** Flight plan points that have already been passed are displayed in blue. The most recently passed FPP will be identified as the "From FPP" in place of its flight plan number, indicating the current navigation is from the previous FPP to the current FPP.
5. **To FPP.** The flight plan point that is selected for navigation, along with the course and distance, is highlighted in white and designated by the "↓TO↓" symbol directly above its flight plan number.
6. **Future FPP.** Upcoming flight plan points are displayed in magenta, along with the planned course and distance from each preceding FPP displayed in green.
7. **FPLN DATA pages.** Displays the CDU Flight Plan Data page for the corresponding flight plan point.
8. **FPLN MGMT page.** Displays the CDU Flight Plan Management page.
9. **MOD FPLN page.** Displays the CDU Modify Flight Plan page.

CDU FPLN MGMT Page

The Flight Plan Management page allows the crew to rename the active flight plan (FPLN), re-number flight plan points (FPP) within the active flight plan after changes have been made, change between the active and alternate flight plans, and access flight plans on the data transfer cartridge via the Data Transfer System (DTS).

1. **FPLN NAME.** Enters scratchpad data as the name of the flight plan. (N/I)
2. **PERF RESET.** Resets the performance parameters of the active flight plan to their default values. (N/I)
3. **RENUMBER.** Re-numbers the flight plan point indexes within the active flight to chronological order, which may be necessary after performing modifications to the active flight plan itself.
4. **LOAD PLAN.** Loads the active flight plan from the data transfer cartridge. (N/I)
5. **ERASE FPLN.** Erases the active flight plan.
6. **ADD ALTN.** Adds the flight plan points from the alternate flight plan to the active flight plan. (N/I)
7. **REPLACE FPLN.** Replaces the active flight plan with the alternate flight plan. (N/I)
8. **REPLACE ALTN.** Replaces the alternate flight plan with the active flight plan. (N/I)
9. **SAVE FPLN.** Saves the active flight plan to the data transfer cartridge. (N/I)

CDU DIRECT-TO Page

The Direct-To page allows the crew to create a direct route to any flight plan point (FPP) in the active flight plan, any Air Control Point (ACP) within the mission database, or any DAFIF point within the navigation database. When displayed, any flight plan point may be selected using line select keys L2-L5, or the alphanumeric keys may be used to manually enter the identification of any ACP or DAFIF point, regardless of whether the entered point is part of the active flight plan or not. (See Selecting a Direct Route for more information.)

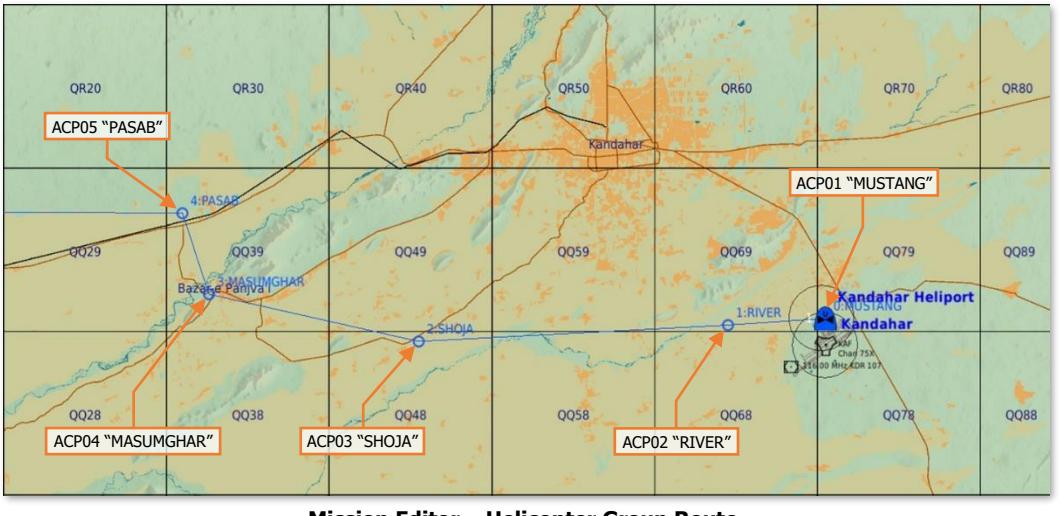
1. **DIRECT TO.** Creates a direct route to the corresponding ACP or a DAFIF point identification entered into the scratchpad. If no ACP or DAFIF point exists within the databases that match the data entered into the scratchpad, or if the scratchpad is empty, the scratchpad will display INVALID ENTRY.
2. **Flight Plan Name.** Displays the name of the active flight plan. (N/I)
3. **Flight Plan Points.** Creates a direct route to the corresponding flight plan point.
4. **FPLN DATA pages.** Displays the CDU Flight Plan Data page for the corresponding flight plan point.
5. **FPLN MGMT page.** Displays the CDU Flight Plan Management page.
6. **MOD FPLN page.** Displays the CDU Modify Flight Plan page.

Creating a Flight Plan using the Mission Editor

When using the Mission Editor, waypoints placed on the map from the Helicopter Group's Route tab will auto-populate into the DCS: CH-47F as flight plan points (FPPs) within the active flight plan (FPLN). Each waypoint following the initial Helicopter Group position (waypoint 0) will be displayed as an ACP on the HSD, as part of the active flight plan, and listed within the ACP list in accordance with their sequence within the Mission Editor.

The first ACP (ACP01), will be placed at the starting location of the helicopter, which will be waypoint 0 in the Mission Editor. All subsequent waypoints will be imported into the aircraft as ACPs numbered one digit greater than their waypoint number shown in the Mission Editor.

NOTE: It is currently only possible to generate the active flight plan in the Mission Editor. The alternate flight plan (ALTN) will be empty of flight plan points. However, flight plan points may be added to either the active flight plan or the alternate flight plan from the cockpit, if desired, after the mission starts.



Mission Editor – Helicopter Group Route

Creating a Flight Plan using the CDU FPLN page

Flight plans may be created using existing DAFIF points within the navigation database, ACPs within the mission database, or by directly entering coordinates using MGRS or Latitude/Longitude coordinate formats.

When creating an entirely new flight plan, the existing flight plan must be deleted. (See Erasing a Flight Plan for more information.)

To add flight plan points (FPP) to a new flight plan (FPLN), perform the following:

1. CDU FPLN Key – Press.
2. CDU Alphanumeric Keys – Enter point data.
   - Input a DAFIF point by entering the ID of the aeronautical point.

     Kandahar airfield would be input as:

     [OAKN_]

   - Input an Air Control Point by entering a slash (/) followed by the ID of the ACP.

     ACP01 "MUSTANG" would be input as:

     [/RIVER_]

   - Input MGRS coordinates in a 6-digit, 8-digit, or 10-digit format as a continuous string without spaces. *MGRS input is not implemented*.

     41R QQ 70244 90825 would be input as:

     [41RQQ7024490825_]

   - Input Latitude/Longitude coordinates in Degrees-Minutes-Decimals format as a continuous string without spaces.
     - A minimum of 4 digits are required for the Nort h/South and East/West fields.
     - The leading zero in the East/West field is not required to be input.
     - Any trailing zeros after the decimals are not required to be input.

     N31°31.000′ E°065°50.000′ may be input as

     [N3131E6550_]

     N31°31.244′ E°065°56.750′ may be input as:

     [N3131.244E6550.75_]

3. Add FPP (LSK L2) – Select the key adjacent to the "END" identifier to place the FPP at the start of the flight plan.

   The "END" identifier will move to the following position within the flight plan sequence.

4. CDU Alphanumeric Keys – Enter coordinates, a slash and the name of an ACP, or the name of an aeronautical point.

5. Scroll/Paging Keys (↓/↑) Keys – Press as necessary to scroll down (or up) within the flight plan sequence.

6. Add FPP (LSK L2-L5) – Select the key adjacent to the "END" identifier to place the FPP at the next entry at the end of the flight plan.

   The "END" identifier will move to the following position within the flight plan sequence. Repeat steps 4, 5, and 6 as necessary until all FPPs are added to the flight plan sequence as intended.

   As each FPP is added, the flight plan will be re-drawn on the HSD as appropriate.

   NOTE: If it is desired to insert any FPPs into an existing flight plan, or to remove FPPs from the route, see Modifying a Flight Plan on the following pages.

Modifying a Flight Plan using the CDU FPLN page

Flight plans may be modified by adding or removing flight plan points, and then all changes may either be confirmed by the crew or canceled to resume the existing flight plan. When a flight plan is being modified, it will be displayed on the HSD in white while the existing active flight plan remains displayed in magenta.

To remove a flight plan point (FPP) point from the active flight plan (FPLN), perform the following:

1. CDU FPLN Key – Press.
2. MOD FPLN (LSK R6) – Select.
3. Minus (-) Key – Press to enter a minus symbol into the CDU scratchpad.
4. Scroll/Paging Keys (↓/↑) Keys – Press as necessary to scroll down (or up) within the flight plan sequence.
5. Remove FPP (LSK L2-L5) – Select the key adjacent to the FPP entry to be removed from the flight plan.

   Repeat steps 3, 4, and 5 as necessary until all FPPs that are intended to be removed have been removed from the flight plan sequence.

   As each FPP is removed, the modified flight plan will be re-drawn on the HSD as appropriate.
6. EXECUTE (LSK R6) – Select to confirm the modifications to the flight plan. The existing magenta flight plan will be removed from the HSD, and the modified flight plan will change from white to magenta.

   or

6. CANCEL MOD (LSK L6) – To cancel the modifications to the flight plan. The modified flight plan will be removed from the HSD.

To insert a flight plan point (FPP) point into the active flight plan (FPLN), perform the following:

1. CDU FPLN Key – Press.
2. MOD FPLN (LSK R6) – Select.
3. CDU Alphanumeric Keys – Enter point data.
   - Input a DAFIF point by entering the ID of the aeronautical point.

     Kandahar airfield would be input as:

     [OAKN_]
   - Input an Air Control Point by entering a slash (/) followed by the ID of the ACP.

     ACP04 "MASUMGHAR" would be input as:

     [/MASUMGHAR_]
   - Input MGRS coordinates in a 6-digit, 8-digit, or 10-digit format as a continuous string without spaces. *MGRS input is not implemented.*

     41R QQ 32614 92283 would be input as:

     [41RQQ3261492283_]
   - Input Latitude/Longitude coordinates in Degrees-Minutes-Decimals format as a continuous string without spaces.
     - A minimum of 4 digits are required for the Nort h/South and East/West fields.
     - The leading zero in the East/West field is not required to be input.
     - Any trailing zeros after the decimals are not required to be input.

     N31°32.000′ E°065°27.000″ may be input as

     [N3132E6527_]

     N31°32.524′ E°065°27.014′ may be input as:

     [N3132.524E6527.014_]

4. Scroll/Paging Keys (↓/↑) Keys – Press as necessary to scroll down (or up) within the flight plan sequence.
5. Add FPP (LSK L2-L5) – Select the key adjacent to the desired location within the flight plan to which the FPP will be inserted.

   Repeat steps 3, 4, and 5 as necessary until all FPPs are added to the flight plan sequence as intended.

   As each FPP is added, the modified flight plan will be re-drawn on the HSD as appropriate.

6. EXECUTE (LSK R6) – Select to confirm the modifications to the flight plan. The existing magenta flight plan will be removed from the HSD, and the modified flight plan will change from white to magenta.

   or

6. CANCEL MOD (LSK L6) – To cancel the modifications to the flight plan. The modified flight plan will be removed from the HSD.

Erasing a Flight Plan using the CDU FPLN MGMT page

All flight plan points (FPPs) may be deleted by erasing the entire active flight plan (FPLN) itself from the CDU FLPN MGMT page.

To erase the active flight plan (FPLN), perform the following:

1. CDU FPLN Key – Press.
2. FPLN MGMT (LSK L6) – Select.
3. ERASE FPLN (LSK R1) – Select.

Flight plan points (FPPs) may be subsequently added on the CDU FPLN page to create a new flight plan. (See Creating a Flight Plan for more information.)

Selecting a Direct route using the CDU DIRECT-TO page

Any point within the mission or navigation databases may be selected for a direct route to that point. When a direct route is created, a white line will be plotted from the ownship's present position to the point, and the active flight plan will be modified accordingly.

Selecting a Direct Route to a Flight Plan Point

To create a direct route to a flight plan point (FPP) within the active flight plan (FPLN), perform the following:

1. CDU DIR Key – Press.
2. Scroll/Paging Keys (↓/↑) Keys – Press as necessary to scroll down (or up) within the flight plan sequence.
3. Select FPP (LSK L2-L5) – Select the key adjacent to the FPP entry to be selected for direct routing.

If the point that is selected for creation of a direct route is a flight plan point (FPP) within the active flight plan sequence, all FPPs that precede it will be displayed in blue, with the TO navigation calculated from the FPP that immediately precedes the FPP selected for direct routing.

A direct route to a flight plan point may also be selected utilizing the MFD FPLN format.

Selecting a Direct Route to an ACP or DAFIF Point

To create a direct route to any ACP within the mission database or any DAFIF point within the navigation database, perform the following:

1. CDU DIR Key – Press.
2. CDU Alphanumeric Keys – Enter point data.
   - Input a DAFIF point by entering the ID of the aeronautical point.

     Bost airfield would be input as:

     [OABT_]
   - Input an Air Control Point by entering a slash (/) followed by the ID of the ACP.

     ACP05 "PASAB" would be input as:

     [/PASAB_]
3. DIRECT TO (LSK L1) – Select.

If the point that is selected for creation of a direct route is not a flight plan point (FPP) within the active flight plan sequence, the point will be inserted at the beginning of the flight plan.

TRANSPORT OPERATIONS

US Army photo
by SGT Amber Robinson

TRANSPORT OPERATIONS

The CH-47F is one of the most versatile heavy lift helicopters in service, with the ability to insert or extract large numbers of ground troops (or even small vehicles) virtually anywhere on the battlefield, deliver large volumes of cargo and supplies, or carry external payloads of up to 28,000 pounds, including artillery howitzers. The aft cabin includes seating for up to 32 fully-equipped ground troops, but can also be rapidly re-configured by the flight crew for internal payload via the Cargo On/Off Loading System (COOLS), which features integrated roll-on/roll-off components for easy handling of cargo pallets.

The hydraulic tail ramp serves as the primary means for troops to enter or exit the helicopter during air assaults, or it can be set level with the aft cabin floor to act as an additional load-bearing element for internal payloads. When a forklift or other onloading equipment is unavailable, such as in a field environment, several ramp extensions may be deployed from the tail ramp itself to aid in loading of cargo pallets or small vehicles. A hydraulic winch motor and hoist mechanism is also integrated within the aft cabin to aid in cargo handling or to serve as a rescue hoist, which can be rigged to recover personnel through the center access hatch in the cabin floor.

The Triple Cargo Hook System allows the CH-47F to carry three separate external payloads and deliver them to three separate destinations within the same flight, without the need to land the helicopter. A single external payload may be loaded on the center hook, two external payloads may be loaded on the forward and aft hooks in a tandem configuration, or three external payloads may be loaded on each hook.

Triple Cargo Hook System

The cargo hook system may be controlled from the cockpit using the Hoist/Cargo Hook Control Panel, located on the right side of the Overhead Switch Panel, and/or from the Hoist Operator Panel located within the aft cabin.

Hoist/Cargo Hook Control Panel

The Hoist/Cargo Hook control panel configures the winch mechanism for hoist or internal cargo loading operations and configures the cargo hook release mechanisms when performing external sling-load operations.

1. **CABLE CUT Switch (Guarded).** When the guard is opened and the switch set to the ON position, a ballistic cartridge severs the winch cable.
2. **HOIST Control Knob.** Controls the hoist/winch cable drum rotation when the HOIST MSTR switch is set to the PLT position.
   - **OUT.** Rotates the cable drum to reel the winch cable outward. The reel speed may be increased by rotating the knob counter-clockwise.
   - **OFF.** Disables cable drum rotation and is spring-loaded to this position when released.
   - **IN.** Rotates the cable drum to reel the winch cable inward. The reel speed may be increased by rotating the knob clockwise.
3. **HOIST MSTR Switch.** Enables/disables hoist/winch operation from the cockpit or aft cabin.
   - **REMOTE.** Enables hoist/winch operation via the Hoist Operator station in the aft cabin.
   - **OFF.** Disables hoist/winch operation.
   - **PLT.** Enables hoist/winch operation via the Hoist/Cargo Hook control panel in the cockpit.
4. **CARGO HOOK MSTR Switch.** Enables/disables cargo hook release commands from the Pilot and Copilot Cyclic Grips in the cockpit and the Winch/Hoist Control Grip at the Hoist Operator station in the aft cabin.
   - **RESET.** Extinguishes the FWD HOOK OPEN and AFT HOOK OPEN caution messages after either hook has been commanded to open.
   - **OFF.** Disables the hook release commands from the Cyclic Grip and the Winch/Hoist Control Grip. Closes the center cargo hook and extinguishes the MID HOOK OPEN caution message after the center hook has been commanded to open.
   - **ARM.** Enables the hook release commands from the Cyclic Grip and the Winch/Hoist Control Grip.
5. **HOOK SEL Knob.** If the CARGO HOOK MSTR switch is set to the ARM position, selects which cargo hook(s) will open when commanded to release via the Cyclic Grips or the Winch/Hoist Control Grip in the aft cabin.
   - **FWD.** Only the forward cargo hook will open.
   - **MID.** Only the center cargo hook will open.
   - **AFT.** Only the aft cargo hook will open.
   - **TANDEM.** Only the forward and aft cargo hooks will open.
   - **ALL.** All three cargo hooks will open.
6. **EMERG REL ALL Switch.** All three cargo hooks will be commanded to open regardless of the positions of the CARGO HOOK MSTR switch or the CARGO HOOK SEL knob.

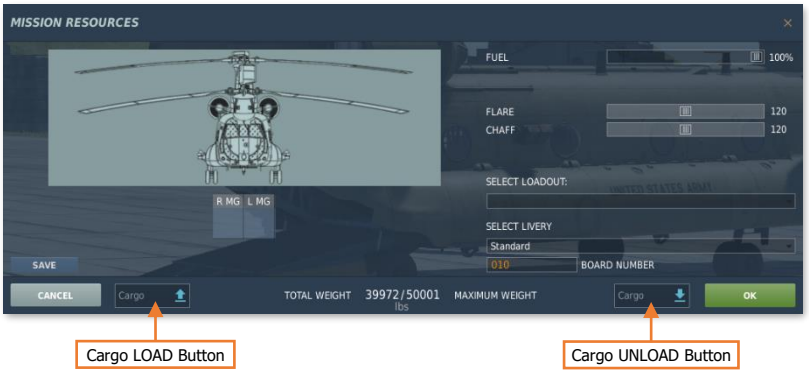
Transporting Cargo Internally

When loading or unloading cargo with the DCS: CH-47F, ensure the tail ramp has been fully deployed to include the ramp extensions. If the tail ramp is already deployed to the ground, an additional command **[LShift-G]** to lower the ramp will deploy the ramp extensions.

- **Stage 1.** Ramp raised; cargo door (ramp "tongue") deployed from tail ramp to enclose the aft cabin.
- **Stage 2.** Ramp raised; cargo door retracted.
- **Stage 3.** Ramp partially lowered, parallel to fuselage.
- **Stage 4.** Ramp fully lowered to the ground.
- **Stage 5.** Ramp fully lowered to the ground; ramp extensions deployed.

Ramp Extensions Deployed

Options for loading and unloading cargo is accessed via the Rearming and Refueling Window **[LAlt + `]**. The Cargo LOAD button is displayed on the left side and the Cargo UNLOAD button is displayed on the right side.



Left-clicking these buttons will display the corresponding LOAD CARGO or UNLOAD CARGO panels respectively. Each panel provides an interface for interacting with the internal cargo loading capability of the CH-47F.

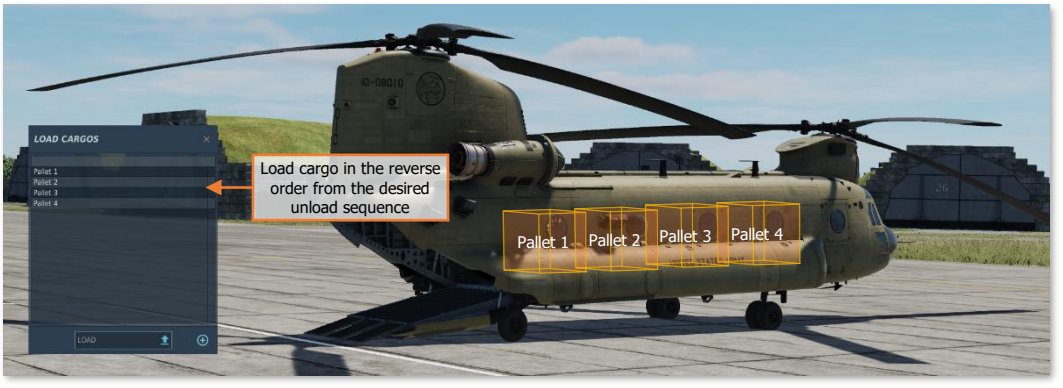
The Cargo Resources button on the LOAD CARGO panel accesses the local warehouse functions.

NOTE: *The Cargo Resources function is a work-in-progress.*

Loading Cargo

When the LOAD CARGO panel is displayed, all cargo within 150 feet of the helicopter will be listed, based on the cargo object's NAME entered in the Mission Editor. Any cargo object may be loaded within the CH-47F by left-clicking on the corresponding entry in the list, and then left-clicking the LOAD button at the bottom of the panel.

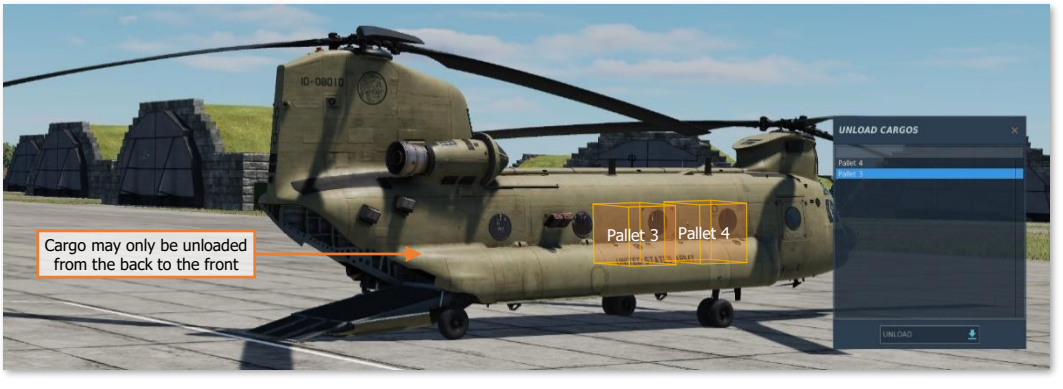
Cargo is loaded sequentially from the front of the cabin toward the rear of the cabin. If there is a need to unload specific cargo objects prior to others, such as delivering cargo to multiple destinations during a single flight, ensure the cargo is loaded in the reverse order from which it will need to be unloaded.



In the image above, four cargo objects are named Pallet 1 through 4, with Pallet 1 representing the cargo to be delivered at the first destination, and Pallet 4 representing the cargo to be delivered at the final destination. Pallet 4 is loaded first in the front of the cabin to be offloaded as the final cargo delivery, with each Pallet loaded in reverse sequence, so that Pallet 1 is loaded near the tail ramp to be offloaded as the first cargo delivery.

Unloading Cargo

When the UNLOAD CARGO panel is displayed, all cargo within the helicopter will be listed, based on the cargo object's NAME entered in the Mission Editor. All cargo will be shown in the list from front to back, with the final entry in the list highlighted, representing the first and only cargo object that can be unloaded. To unload the highlighted cargo object, left-click the UNLOAD button at the bottom of the panel.



When unloaded, cargo objects will be placed on the ground approximately 70 feet directly behind the helicopter.

Transporting Cargo Externally

Transporting external payloads, also known as "sling-loading", may be performed with many types of payloads in various operating environments, and is the task in which the CH-47 particularly excels.

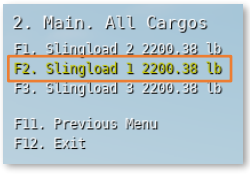
Transporting cargo by sling-load is typically utilized when:

- The weight of the payload exceeds the internal load-bearing capacity of the aft cabin.
- The dimensions of the payload exceeds the internal volume of the aft cabin.
- The payload must be delivered to a location that does not permit the helicopter itself to land.
- The payload must be delivered to a location in a rapid manner that would otherwise take too long to offload from within the aft cabin.

When performing sling-load operations with the DCS: CH-47F, available cargo options within the vicinity may be accessed via the Communications Menu **[\]**.

While the Main menu is displayed in the top right corner, selecting F6. All Cargos... **[F6]** will access the cargo selection sub-menu.

When the All Cargos sub-menu is displayed, all cargo within 2 kilometers (1.075 NM) of the helicopter will be listed in descending order by proximity, based on the cargo object's NAME entered in the Mission Editor, along with the cargo's weight. Any cargo object may be selected for sling-load using the CH-47F by pressing the corresponding function key **[F1 – F10]**.



When a cargo is selected for sling-load, a red smoke grenade will be discharged at the location of the corresponding payload for visual recognition.

Attaching a Sling-load to the Center Cargo Hook

Once a cargo object has been selected for sling-load and visually recognized, perform an approach to a position just short of the object in the same manner as performing a VMC Approach to a stationary hover.

Prior to approaching the cargo and attempting a hook up, perform the following:

1. CP ARM/SAFE switch (ASE Control Panel) – SAFE.
2. CP CARGO HOOK MSTR switch – ARM.
3. CP HOOK SEL knob – ALL.
4. CP EMERG REL ALL switch – Verify set to aft position and switch cover closed.

Hover forward toward the cargo object at an altitude that will ensure the aircraft (to include the landing gear) will remain clear of the cargo itself. As the cargo passes under the nose and out of sight, smoothly bring the helicopter to a stationary hover to allow the sling-load cable to be hooked up to the cargo.

Departing and Maneuvering with a Sling-load

After receiving confirmation the cargo has been successfully hooked, increase the thrust slightly to begin a slow ascent while maintaining a stationary hover directly over the cargo.

As the slack is removed and the cargo is lifted off the ground, take note of the radar altimeter height. Using this value, round up to the nearest 5 foot interval, and then add 10 feet to determine the appropriate hover height while carrying the cargo.

As an example, if the radar altimeter indicates 23 feet when the cargo is lifted off the ground, this value would be rounded up to 25 feet, with an additional 10 feet to equate to a hover height of 35 feet.

After hooking up the cargo and prior to departing, perform the following:

1. PLT & CP Radar Altimeter - Determine sling-load hover height.
2. CP Hover Power check – Perform. Take note of the current torque value that is required to maintain a stationary hover with the sling-load.
3. CP Before Takeoff check – Perform.
4. CP CARGO HOOK MSTR switch – OFF, after ascending above 200 feet above the highest obstacle (AHO) and accelerating above best single-engine airspeed (70-80 knots).

When maneuvering with a sling-load underneath the aircraft, maneuvers should be kept slow and deliberate to minimize oscillations of the cargo; and climbs and descents should be performed in a manner that keeps the cargo clear of obstacles.

- When departing with the cargo after hook up, or when arriving at the destination, climb and approach angles should be utilized that ensure the cargo will clear any obstacles in the surrounding area.
- Acceleration to cruise airspeed and deceleration during the approach to the destination should be slow and smooth, and excessive pitch attitudes should be avoided.
- Turns should be performed with slow and smooth roll rates to achieve the desired bank angle.

If the sling-load must be detached at any point in the flight, whether it be upon arrival to the cargo destination or in an emergency, see Releasing a Sling-load for more information.

Releasing a Sling-load

A sling-load may be released in one of three ways, depending on the circumstances. Under normal circumstances, the sling-load may be released using the HOOK REL button on the Pilot and Copilot Cyclic Grips in the cockpit, or by the CARGO HOOK REL button on the Winch/Hoist Control Grip at the Hoist Operator station in the aft cabin. In an emergency, the sling-load may be released electrically by the Pilot or Copilot using the EMERG REL ALL switch on the Hoist/Cargo Hook Control Panel in the cockpit, or manually by a crewmember rotating the EMERGENCY RELEASE lever in the center hatch in the aft cabin.

When operating below 200 feet above the highest obstacle (AHO) or decelerating below best single-engine airspeed (70-80 knots), the CARGO HOOK MSTR switch is set to the ARM position to enable release via the Cyclic Grips or Winch/Hoist Control Grip, and the HOOK SEL knob is set to the ALL position. Under such conditions, when the aircraft is at low altitude and/or airspeed, this procedure provides redundancy in that multiple crewmembers may immediately release all payloads at once if continued flight with a sling-load would put the safety of the crew and the aircraft in jeopardy.

Prior to the approach to cargo drop-off area, perform the following:

1. CP Before Landing check – Perform.
2. CP ARM/SAFE switch (ASE Control Panel) – SAFE.
3. CP CARGO HOOK MSTR switch – ARM.
4. CP HOOK SEL knob – ALL.

This will ensure that all sling-loads can be released during the approach if necessary to ensure the safety of the crew and aircraft.

Once the intended drop-off area has been visually recognized, perform a slow and deliberate VMC Approach to a stationary hover at an altitude over the ground that was noted prior to departing with the sling-load, while ensuring the approach angle will provide sufficient clearance between the sling-load and obstacles surrounding the drop-off area.

After achieving a stationary hover over the intended drop-off area, perform the following:

5. CP HOOK SEL knob – As required, to release the intended cargo. (See the Hoist/Cargo Hook Control Panel for more information.)
6. PLT Thrust lever – Decrease slightly to begin a slow descent until the cargo contacts the ground.
7. PLT HOOK REL button – Press and hold until the cargo is detached.
8. CP CARGO HOOK MSTR switch – OFF. The center cargo hook will close, and the MID HOOK OPEN message will extinguish.
9. CP CARGO HOOK MSTR switch – RESET, if necessary to extinguish the FWD HOOK OPEN and AFT HOOK OPEN messages.

NOTE: When commanded to open, the center hook will remain open until the CARGO HOOK MSTR switch is set to the OFF position. Subsequent attempts to hook up any cargo will fail until this is step is performed.

AIRCRAFT SURVIVABILITY EQUIPMENT (ASE)

US Air Force photo
by TSgt Gregory Brook

AIRCRAFT SURVIVABILITY EQUIPMENT

The CH-47F features a suite of passive defensive systems that are designed to ensure the survival of the aircraft while operating in a hostile threat environment. The various defensive systems installed on the aircraft are known collectively as Aircraft Survivability Equipment (ASE).

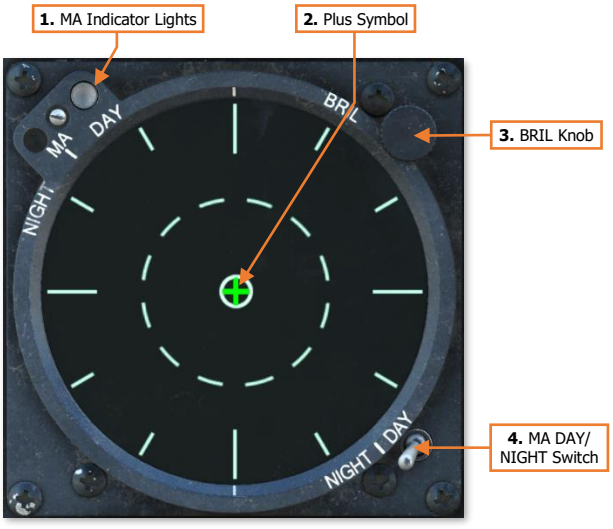
The ASE kit installed on the CH-47F includes a radar warning receiver (RWR), a missile warning system (CMWS), chaff and flare countermeasures dispensers, and infrared suppression components integrated into the fuselage.

CH-47F Aircraft Survivability Equipment (ASE)

APR-39 Indicator

The APR-39 Indicator provides visual indications of radar threats detected by the APR-39 radar warning receiver and missile threats detected by the AAR-57 missile warning system.

A maximum of 7 radar and/or missile threats may be displayed on the indicator.

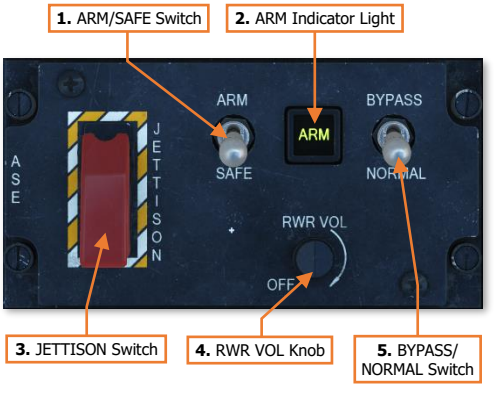


1. **MA Indicator Lights.** No function.
2. **Plus Symbol.** Indicates the APR-39 radar warning receiver is operating.
3. **BRIL Knob.** Adjusts the brightness of the indicator display itself.
4. **MA DAY/NIGHT Switch.** No function.

(See Radar Signal Detecting Set for more information.)

ASE Control Panel

The ASE control panel controls the countermeasure dispensers and the overall volume of the threat warning audio received across the intercom system.

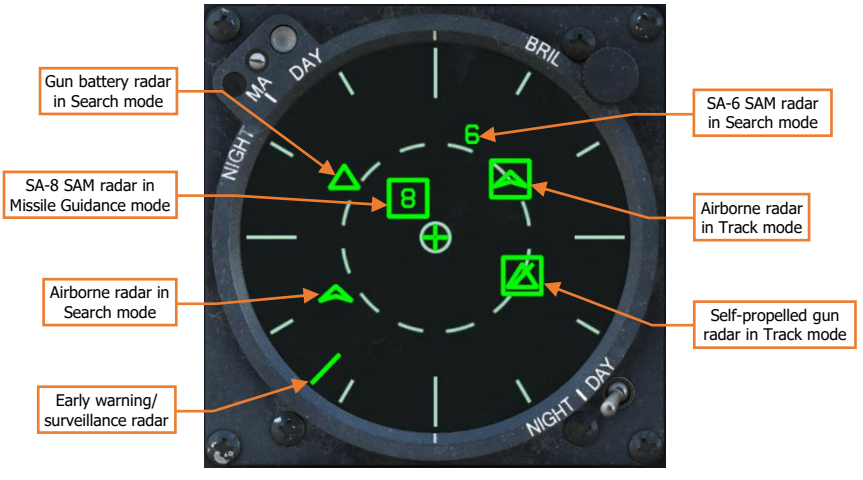


1. **ARM/SAFE Switch.** Arms chaff and flare dispensers for automatic or manual dispensing. Chaff/flare dispensing is inhibited with aircraft weight-on-wheels regardless of the switch position.
   - **ARM.** Chaff/flare dispensing is permitted.
   - **SAFE.** Chaff/flare dispensing is inhibited.
2. **ARM Indicator Light.** Illuminates when the countermeasure dispensers have been armed for dispensing chaff and flares.
3. **JETTISON Switch.** Jettisons all flares from the tail-mounted flare dispensers in an emergency. If the CMWS is powered off, the BYPASS/NORMAL switch must be in the BYPASS position to enable flare jettison.
4. **RWR VOL Knob.** Adjusts the overall volume of the threat warning audio from the APR-39 radar warning receiver and the AAR-57 missile warning system. Rotating the knob clockwise will increase the volume level.
5. **BYPASS/NORMAL Switch.** Not implemented.

RADAR SIGNAL DETECTING SET

The AN/APR-39A(V)1 provides detection of threat radar emissions by using a series of external antennas to passively detect and identify radar signals. Threat indications are provided to the aircrew by displaying threat symbols on the APR-39 Indicator in the center of the Instrument Panel. In addition, the APR-39 generates audio voice warnings describing the type of threat, threat direction, and the operating mode of the radar, allowing the crew to remain focused outside for obstructions to flight.

The APR-39 Indicator is an azimuth-only top-down display with the center of the display representing the aircraft, and radar threat symbols displayed 360° in azimuth around it. If a threat symbol is displayed at the top of the display, the associated radar is directly in front of the aircraft. If the threat symbol is displayed at the bottom of the display, the associated radar is directly behind the aircraft.



The nature of the threat is indicated by the type of symbol, and the relative lethality of the threat is indicated by the distance from the center of the display at which the threat symbols are positioned. Radar symbols that represent more lethal threats to the aircraft are shown closer to the center of the display. As a threat radar progresses from a search/acquisition mode, to target tracking, and then to missile guidance, the symbol will be incrementally moved toward the center of the display to symbolize its increasing lethality against the aircraft.

New threat detected. A newly detected radar is displayed in a bolded symbol format for 3 seconds following initial detection.

Radar in Search/Acquisition mode. The detected radar is operating in a search or target acquisition mode, with the symbol positioned outside the dashed white circle.

Radar in Track mode. The detected radar is operating in a target tracking mode, with the symbol positioned just inside the dashed white circle and enhanced by a box.

Radar in Missile Guidance mode. The detected radar is operating in a missile guidance mode, with the symbol positioned inside the dashed white circle and further enhanced by a flashing box.

Threat signal lost. A radar that is no longer detected will be displayed in a dashed, or "ghost", symbol format for 10 seconds before being removed from the display.

When performing defensive maneuvers, the symbols that are closer to the center of the display (especially those that are actively engaging the aircraft) should take priority consideration over those along the outer area.

A complete list of all RWR symbols and their corresponding threat systems can be found in Appendix B.

RWR Audio Warnings

The APR-39 will report radar threats in one of two audio formats, Normal or Terse, which can be toggled by pressing LSK L4 on the CDU ASE Control page. The overall volume of the threat warning audio may be adjusted using the RWR VOL knob on the ASE Control Panel, or each crewmember may independently adjust the volume of the audio warnings using their respective Control Audio Panel.

NORMAL. The RWR will report radar threats by threat classification, clock direction, and lethality when initially detected. If any detected threat elevates in lethality, the RWR will repeat the audio report to include the current clock direction and increased lethality.

- **Initial audio report of an SA-8 radar:** "SA-8, 1 o'clock, searching."
- **Updated audio report of an SA-8 radar:** "SA-8, 1 o'clock, tracking."

TERSE. The RWR will report radar threats only by lethality when initially detected. If any detected threat elevates in lethality, the RWR will repeat the audio report with the increased lethality.

- **Initial audio report of an SA-8 radar:** "Radar searching."
- **Updated audio report of an SA-8 radar:** "Radar tracking."

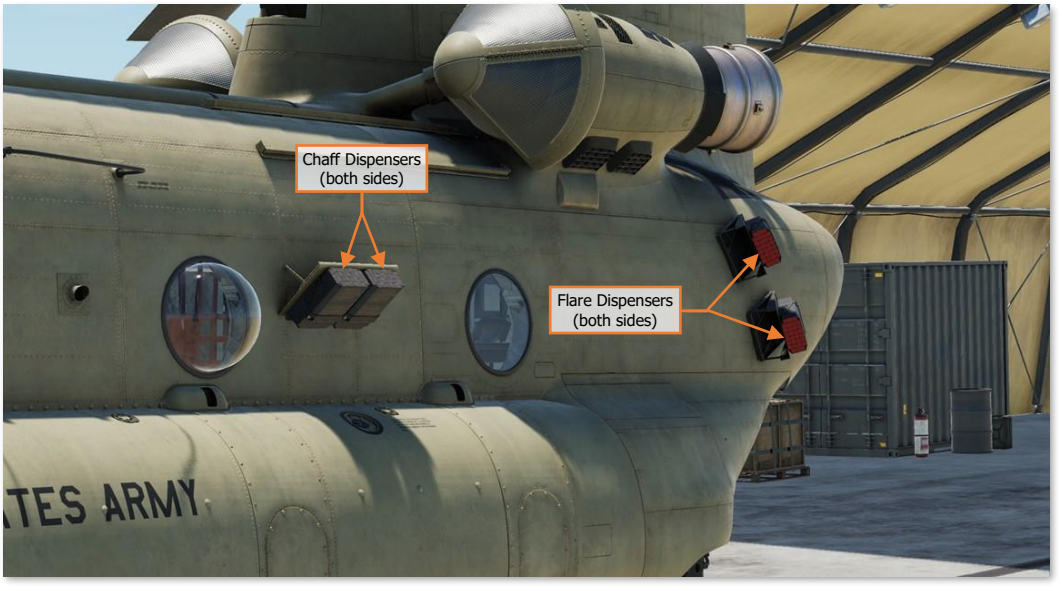
RWR Activation

The APR-39 radar warning receiver may be activated and deactivated from the CDU Power page. To activate the RWR, perform the following:

1. CDU IDX Button – Press.
2. POWER (LSK L1) – Select.
3. RWR (LSK L3) – Select, to toggle the RWR power between ON and OFF.

COUNTERMEASURES DISPENSERS

The CH-47F is equipped with eight expendable countermeasures dispensers: four dispensers for chaff and four dispensers for flares. Due to each dispenser's mounted location and orientation, the countermeasures loaded in each dispenser are not interchangeable between chaff and flares.



The countermeasure dispensers may be armed while on the ground using the ASE Control Panel, but the weight-on-wheels (WOW) switch will inhibit dispensing unless the BYPASS/NORMAL switch is set to the BYPASS position. Either crewmember may arm the dispensers, configure the chaff and flare program settings, or dispense countermeasures by pressing the Chaff/Flare Dispense switch on the Cyclic Grip.

The total quantity of all chaff and flare cartridges is indicated on the CDU ASE Control page. (N/I)

Chaff Dispensers

The chaff dispensers are mounted midway down the fuselage, between the third and fourth cabin windows, with two dispensers on each side. Each dispenser can hold 30 chaff cartridges, for a total inventory of 120 chaff cartridges.

Chaff may only be dispensed manually by pressing the Chaff/Flare Dispense switch on the Cyclic Grip.

Flare Dispensers

The flare dispensers are mounted on opposing sides of the tail, just aft of the engine nacelles, with two dispensers on each side. Each dispenser can hold 30 flare cartridges, for a total inventory of 120 flare cartridges.

Flares may be dispensed manually by pressing the Chaff/Flare Dispense switch on the Cyclic Grip, or automatically by the AN/AAR-57 Common Mission Warning System.

NOTE: *CMWS is not implemented at this time, therefore flares may only be dispensed manually.*

ASE HAND CONTROLS

The Pilot and Copilot may manually dispense chaff or flare programs using the controls on their respective Cyclic Grips, and both crewmembers may use the ASE Control Panel on the Center Console to arm the countermeasure dispensers or set the CMWS to NORMAL or BYPASS mode.

Cyclic & Thrust Control Lever Controls

The Pilot and Copilot Cyclic Grips include a two-way switch for dispensing chaff and flares. Momentarily pressing this switch to either position will manually dispense flares from the tail dispensers or chaff cartridges from the mid-fuselage dispensers.

- **Forward.** Dispenses a single flare program.
  - **NOTE:** *Currently in Early Access, a single flare program consists of four flares, with two flares ejected from each side.*
- **Aft.** Dispenses a single chaff program.
  - **NOTE:** *Currently in Early Access, a single chaff program consists of two chaff cartridges, with one chaff cartridge ejected from each side.*

APPENDICES

US Army photo
by CPT Brian Harris

APPENDIX A – ABBREVIATED CHECKLISTS

Procedures

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Procedures

Abbreviated checklists for performing start-up, ground taxi, takeoff, landing, and shutdown procedures.

Aircraft Start

Once the interior checks are complete, perform the following:

1	CP BATT switch – On
2	CP TROOP WARN – ALARM & JUMP LT switches – As required; to warn that APU is about to start.
3	FE Fireguard – Posted.
4	CP **UTIL PRES** Light – Verify on.
5	CP APU switch – RUN for 5 seconds, START for 2 seconds, then back to RUN position.
6	CP **APU RDY** Light – Verify on.
7	CP UTIL PRES Light – Verify off within 30 seconds after APU RDY light illuminates.
8	CP APU GEN switch – On.
9	PLT / CP WCA page – Verify the following: • #1 RECT OFF & #2 RECT OFF messages – Verify not active. • UTIL HYD PRES LO message – Verify not active within 30 seconds of APU RDY light illuminating. • **APU ON** advisory message – Verify active.

Once the APU has been started and the MFDs have initialized, perform the following:

10	PLT & CP MFDs – Set as follows: • MFD 1 – VSD/FUEL. • MFD 2 – EICAS (Full). • MFD 3 – EICAS (Full). • MFD 4 – VSD/HSDH. • MFD 5 – WCA.
11	CP PWR XFER 1 & PWR XFER 2 switches – ON. • WCA - Verify #1 HYD FLT CONTR & #2 HYD FLT CONTR messages are not active within 30 seconds.
12	PLT / CP LAMPS TEST button – Press and hold; check the following lights illuminate: • **GREEN** & **RED** JUMP LT indicator lights (Overhead Switch Panel) • **UTIL PRES** & **APU RDY** lights (Overhead Switch Panel) • **FIRE 1 PULL** & **FIRE 2 PULL** Handle lights (Instrument Panel) • **CPLR** light (Canted Console) • **FM1 VHF** & **VHF FM1** lights (Center Console) • **ARM** light (Center Console) • ● ICS, VOX, HOT MIC, & CALL lights (Control Audio Panels)

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13	PLT / CP LAMPS TEST button – Release; check the lights extinguish.
14	PLT & CP Avionics and aircraft systems – Initialize and configure as appropriate for mission.
15	PLT Parking Brake – Brakes set; handle is pulled outward.
16	CP B/U PWR switch – ON.
17	CP Perform DECU pre-start BIT.
18	PLT Ignition Lock Switch – ON. (N/I)
19	FE Area around helicopter – Clear.
20	PLT / CP Searchlights – As required.
21	CP L MAIN FUEL pumps – ON. • WCA – Verify ENG1 FUEL PRESS LO message is not active.
22	CP XFEED switch – OPEN. • WCA – Verify ENG2 FUEL PRESS LO message is not active.
23	CP First engine – Start as follows: • ENG COND lever – GROUND. • ENG START switch – Press and hold until N_G ≥12%. • POWER TRAIN page – Verify: ○ Engine N_G – ≥50% within 45 seconds after start initiated. ○ Engine oil pressure – ≥5 PSI.
24	CP Second engine – Repeat step 5 after first engine start sequence is complete.
25	PLT / CP POWER TRAIN page – Verify all transmissions ≥7 PSI.
26	CP ENG COND levers – FLIGHT.
27	PLT / CP Check N_R – 100% ±1.
28	CP GEN 1 & GEN 2 switches – ON; wait 2 seconds after turning on GEN 1 before turning on GEN 2.
29	CP APU GEN switch – OFF.
30	CP Perform DECU post-start BIT.
31	CP PWR XFER 1 & PWR XFER 2 switches – OFF.
32	CP APU switch – OFF.
33	PLT / CP Systems – Check N_R, torque, engine, transmission, fuel, and WCA for normal indications.
34	CP Perform fuel pump and crossfeed check.
35	CP Fuel pumps & crossfeed – Set as follows: • All FUEL PUMP switches – ON. • XFEED switch – CLOSE. • WCA – Verify ENG1 FUEL PRESS LO & ENG2 FUEL PRESS LO messages are not active. • WCA – Verify all AUX PRESS messages are not active.
36	CP Perform FADEC Reversionary system check.

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Ground Taxi

Ensure the POWER TRAIN page is displayed on MFD prior to 2- or 4-wheel taxi operations to monitor LCTs. Prior to initiating ground taxi, perform the following:

1	PLT / CP SWIVEL switch – As required.
2	PLT / CP AFCS control panel – As required.
3	PLT / CP Cyclic Trim indicators – Verify in GND positions.
4	PLT & CP MFDs – Configure as necessary for taxi.
5	FE Chocks – Remove and secure.
6	FE Tail ramp and cabin door – As required.
7	FE Crew, passengers, and mission equipment – Verify ready for taxi.
8	PLT & CP HUD – Adjust as necessary.
9	PLT / CP Parking brake – Release; ensure Parking Brake handle is inward.

Before Takeoff

Perform the following prior to departing on the mission and/or flight plan:

1	PLT / CP Systems – Check N_R, torque, engine, transmission, fuel, and WCA for normal indications.
2	PLT / CP Parking brake – As required. (Ensure released, unless operating on uneven or sloped terrain or taking off from a confined area)
3	PLT / CP AFCS SYSTEM SEL knob – As required.
4	PLT / CP Cyclic Trim switch – Check.
5	PLT / CP Transponder – As required.
6	PLT & CP MFDs – Configure as required. • Verify desired NAV mode is selected. • Select bearing indicators as required.
7	PLT / CP Flight Director – Set guidance modes as required.
8	FE Crew, passengers, and mission equipment – Verify ready for takeoff.

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Before Landing

Prior to landing, perform the following:

1	PLT / CP Parking brake – As required. (Ensure released, unless intending to land on uneven or sloped terrain)
2	PLT / CP AFCS control panel – Verify and set as required.
3	PLT / CP DAFCS modes – As required.
4	PLT / CP MFDs – Configure as required for landing.
5	PLT / CP SWIVEL switch – As required.
6	PLT & CP Searchlights – As required.
7	FE Crew, passengers, and mission equipment – Check.
8	PLT & CP Performance considerations – As required.

After Landing

Perform the following after arriving at the final destination at the end of the mission:

1	PLT / CP Flight Director - Decoupled.
2	PLT / CP Flight controls – Neutralize. • Position cyclic 1.5 inches aft of center and laterally centered. • Position directional pedals to center. • Position Thrust Control Lever at ground detent.
3	PLT / CP Cyclic Trim indicators – Verify in GND positions.
4	FE Ground Contact indicator lights – Verify illuminated.
5	PLT / CP AFCS SYSTEM SEL knob – As required.
6	PLT / CP SWIVEL switch – As required.
7	PLT / CP Transponder – Standby; or as required.
8	PLT & CP Searchlights – As required.
9	PLT / CP ANTI ICE switches – OFF; or as required.

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Aircraft Shutdown

Once stationary in designated parking location, perform the following:

1	PLT / CP Flight controls – Neutralize. • Position cyclic 1.5 inches aft of center and laterally centered. • Position directional pedals to center. • Position Thrust Control Lever at ground detent.
2	PLT Parking Brake – Brakes set; handle is pulled outward.
3	CP Heater Function switch – OFF.
4	PLT & CP Searchlights – Off, and stow as required.
5	PLT / CP AFCS SYSTEM SEL knob – OFF.
6	FE Ramp – As required.
7	FE Wheel chocks – Place.
8	PLT & CP MFDs – Set as follows: • MFD 1 – VSD/FUEL (Half). • MFD 2 – POWERTRAIN (Full). • MFD 3 – POWERTRAIN (Full). • MFD 4 – VSD/HSDH (Half). • MFD 5 – WCA (Full).
9	FE Fireguard – Posted.
10	CP APU switch – RUN for 5 seconds, START for 2 seconds, then back to RUN position.
11	CP **APU RDY** Light – Verify on.
12	CP APU GEN switch – On.
13	CP GEN 1 & GEN 2 switches – OFF; wait 2 seconds after turning off GEN 1 before turning off GEN 2.
14	CP PWR XFER 1 & PWR XFER 2 switches – ON.
15	PLT / CP Cyclic Trim indicators – Verify in GND positions.
16	CP ENG COND levers – GROUND; set the Chronometer to ET mode using the SELECT button, and press the CONTROL button start a timer for a 2-minute engine cooldown.
17	FE DECU fault code – Verify 88 is displayed.
18	CP Fuel pumps & crossfeed – Set as follows: • XFEED switch – CLOSE. • REFUEL STA switch – As required • All FUEL PUMP switches – OFF.
19	CP ENG COND levers – STOP after 2 minutes have elapsed on Chronometer.
20	PLT & CP Avionics and aircraft systems – Perform shutdown.
21	PLT / CP B/U PWR switch – OFF.
22	CP PWR XFER 1 & PWR XFER 2 switches – OFF after rotors have stopped.

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23	CP	APU GEN switch – OFF.
24	CP	APU switch – OFF.
25	PLT & CP	Interior and exterior lighting – OFF.
26	CP	BATT switch – OFF.
27	PLT	Ignition Lock switch – OFF. (N/I)

APPENDIX B – RWR THREAT SYMBOLS

The Radar Signal Detecting Set and Common Missile Warning System provides the crew with warning indications of radar and missile threats in azimuth, accompanied by audio alerts.

The threat symbols under the "RWR" column correspond with how the radar or missile threat will appear on the APR-39 Indicator.

The quoted words or phrases under the "AUDIO" column correspond with the associated audio alert that will be heard over the ICS when the radar or missile threat is detected.

Air defense radar systems are further identified by their type in small font under the "RADAR SYSTEMS" column. The table below lists the definition of each type abbreviation following the radar system's designation/name to identify the radar's function within their respective units.

TYPE	DESCRIPTION	TYPE	DESCRIPTION
CWAR	Continuous-Wave Acquisition Radar	**STR**	Search and Tracking Radar
EWR	Early Warning Radar	**TAR**	Target Acquisition Radar
FCR	Fire Control Radar	**TI**	Target Illumination
RR	Ranging Radar	**TTR**	Target Tracking Radar
SR	Surveillance Radar		

Air Defense Radar Systems

RWR	AUDIO	THREAT TYPE	AIR DEFENSE SYSTEM	RADAR SYSTEMS
| Radar Bearing	**"Radar"**	Early warning radars Surveillance radars Target acquisition radars	S-75, S-125, S-200 S-200, S-300 PPRU-M1	1L13 "BOX SPRING" SR/EWR 5G66 "TALL RACK" SR/EWR AN/FPS-117 "SEEK IGLOO" SR/EWR P-19 "FLAT FACE B" SR/TAR ST-68U "TIN SHIELD" TAR 9S80M1 "DOG EAR" TAR
2	**"SA-2"**	SA-2 air defense battery	S-75	SNR-75 "FAN SONG" TTR RD-75 Amazonka RR
3	**"SA-3"**	SA-3 air defense battery	S-125	SNR-125 "LOW BLOW" TTR
5	**"SA-5"**	SA-5 air defense battery	S-200	5N62 "SQUARE PAIR" TTR/TI
6	**"SA-6"**	SA-6 air defense battery	2K12 Kub	1S91 "STRAIGHT FLUSH" TAR/TI
7	**"HQ-7"**	CSA-7/HQ-7B air defense unit	Hóng Qí-7	HQ-7 ACU TAR Type 345 TTR
8	**"SA-8"**	SA-8 air defense unit	9K33 Osa	"LAND ROLL" TAR/TTR
10	**"SA-10"**	SA-10 air defense battery	S-300PS	64N6E "BIG BIRD" TAR 5N66M "CLAM SHELL" TAR 30N6E "FLAP LID" TTR
11	**"SA-11"**	SA-11 air defense battery	9K37M Buk-M1	9S18M1 "SNOW DRIFT" TAR 9S35 "FIRE DOME" TTR
13	**"SA-13"**	SA-13 air defense unit	9K35 Strela-10M3	9S86 "SNAP SHOT" RR

15	"SA-15"	SA-15 air defense unit	9K331 Tor-M1	"SCRUM HALF" TAR/TTR
	"2S6"	SA-19 air defense unit	2S6M Tunguska	1RL144 "HOT SHOT" TAR/TTR
	"ZSU"	ZSU-23-4 air defense gun unit	ZSU-23-4 Shilka	RPK-2 "GUN DISH" FCR
	"Gun"	Self-propelled air defense gun unit	Flakpanzer Gepard M163 Vulcan ADS	MPDR-12 TAR / Albis FCR AN/VPS-2 RR
	"Gun"	Air defense gun battery	S-60, KS-19	SON-9 "FIRE CAN" FCR
RA	"Rapier"	Rapier air defense unit	Rapier FSA	Rapier PU SR DN 181 Blindfire TTR
RO	"Roland"	Roland air defense unit	Roland TÜR Marder Roland	MPDR-3002S SR MPDR-16 TAR / DOMINO-30 TTR
HK	"Hawk"	Hawk air defense battery	MIM-23B I-Hawk	AN/MPQ-50 TAR AN/MPQ-46 TTR AN/MPQ-55 CWAR
PT	"Patriot"	Patriot air defense battery	MIM-104C Patriot PAC-2	AN/MPQ-53 STR
SA	"SAM"	NASAMS air defense battery	NASAMS 2	AN/MPQ-64F1 Sentinel STR

Other Threat Symbols

RWR	AUDIO	TYPE	THREATS
	"Fixed Wing"	Airborne radar system	
	"Fixed Wing, Launch"	Missile radar seeker detected by RWR	Active radar-homing missiles

APPENDIX F – FORMULAS

Use these calculation and conversion formulas for pre-mission planning or while in flight. Desired resultants are bolded.

Speed/Time/Distance Calculations

Ground Speed Required (knots) = (Distance ÷ Minutes) × 60

Time of Flight (mins) = (Distance ÷ Ground Speed) × 60

Fuel/Endurance Calculations

Bingo Fuel (lbs) = (Time of Flight ÷ 60) × Fuel LB/HR

Objective Time (mins) = ([Total Fuel – Bingo Fuel] ÷ Fuel LB/HR) × 60

Fuel/Range Calculations

Specific Fuel Range (SFR) Factor = Ground Speed ÷ Fuel LB/HR

Flight Range (NM) = SFR × Total Fuel

Distance Conversion

km to **NM** = [km] ÷ 1.85

NM to **km** = [NM] × 1.85

Altitude/Elevation Conversion

Feet to **Meters** = [ft] ÷ 3.281

Meters to **Feet** = [m] × 3.281

Latitude/Longitude Conversion

DDD-MM-SS.SS to **DDD-MM.MMM**

SS.SS ÷ 60 = .MMM

DDD-MM.MMM to **DDD-MM-SS.SS**

.MMM × 60 = SS.SS

Safe flying!

The Eagle Dynamics SA team

South Carolina National Guard photo
by SSG Roberto Di Giovine