

X-Plane

Cessna Citation X Honeywell FMZ Flight Management System

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Flight Management Systems



A Flight Management System (FMS) is a centralized computer system used in airliners, and other highperformance aircraft, to manage many of the aircraft systems, including (but not limited to) the flight plan.

Contemporary airliners rely on the FMS to automate a wide variety of tasks, previously performed by navigators and flight engineers. The presence of an FMS reduces the workload in the cockpit, allowing the aircraft to be operated by (usually) just two crew members.

To accomplish its assigned tasks, an FMS will interface with many aircraft systems, including engine, fuel, hydraulic, electrical, and navigation devices such as GPS, the on-board Inertial Navigation System, and the "Nav" radios.

A Flight Management System is an integration of several components, including:

✓ Multipurpose Control & Display Unit (MCDU)

A small screen and touch-keypad that provides the interface through which the pilot operates the FMS.

✓ Flight Management Computer

The computer hardware and software that runs the system. This is not visible to the pilot in the cockpit and is usually located elsewhere in the aircraft.

✓ Primary Flight Display (PFD) / Navigation Display (ND) / Engine Indication / Crew Alerting System (EICAS)

One or more electronic displays (usually CRT or LCD) that provide the pilot with navigation direction and information, engine performance, and aircraft system information (depending on the mode selected).

The X-Plane Citation X Flight Management System

The Laminar Research / X-Plane Citation X flight management system resembles the Honeywell FMZ system, which is used in many business jets, including those manufactured by Cessna, Gulfstream, Bombardier, Dassault, and Hawker.

Rival systems are built by Thales and Collins. Despite differences, these systems perform many of the same functions.

Due to the immense complexity of a real-life flight management system, the version modelled in X-Plane is simplified and does not support every capability. However, the functions necessary to program and execute a flight plan are present, including the use of published arrival and departure procedures (SIDs and STARs) and instrument approaches.

The "Pop-Up" MCDU and Radio Panel

For convenience, a pop-up MCDU and radio panel is provided in the X-Plane Cessna Citation X. These 2D panels can be moved and sized per the needs of the pilot. For the purposes of this guide, we will present the pop-up MCDU and radio panels only. However, commands may also be input using the same panels built into the 3D cockpit.

Invoking, moving, sizing, and closing the "Pop-Up" panels

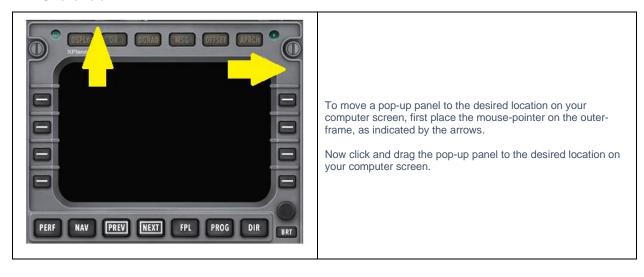
Invoking the pop-up MCDU and radio panels



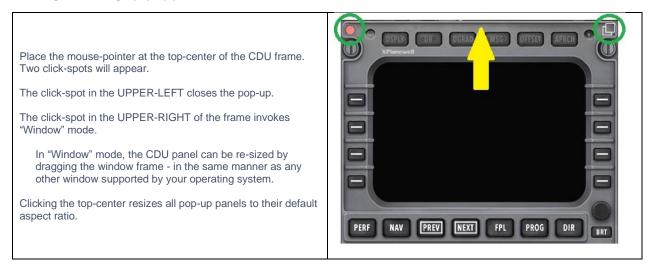
To invoke the pop-up MCDU and radio panels, position and click the mouse-pointer anywhere inside the **DISPLAY** area of either panel in the 3D cockpit.

See highlighted areas in image to left.

Moving a pop-up panel



Re-sizing and closing a pop-up panel



Components of the MCDU

The Control Display Unit (CDU) provides the interface between the pilot and the flight management computer (FMC). It consists of a display panel, and a series of keys that are grouped together according to their function.



Display

This panel provides a simple output display to the pilot, allowing him to program the unit, make commands, and select available options.



Scratch Pad

This area of the MCDU Display is used for keypad input.

Inputs made by the pilot are initially displayed here, before a Line Select Key is chosen, to move this text to the appropriate line of the MCDU display (above the scratch pad).



Line Select Keys

These keys are used to make selections from the options provided alongside them, in the MCDU Display.

The keys on the leftside of the unit align with the options on the left-side of the display, and viceversa.



Keypad

Used to input text into the scratch pad area on the MCDU display.



Page Keys

These keys are used to select the page presented in the Display Area.

The primary functions of the CDU are grouped by "Page". This simplifies the presentation and provides a logical workflow to the pilot.



Clear Key

These key clears text currently displayed in the "Scratch Pad"

Programming the CDU

In this section of the guide, the pilot will program the CDU with initialization data, followed by a manually input flight plan.

The flight plan used in this example originates at EDDS (Stuttgart) and terminates at EDDF (Frankfurt).

We will depart runway 25 at EDDS and use the ETAS4B Standard Instrument Departure (SID).

The route-segment of the flight plan will be via the "Z12" AIRWAY to TOSTU.

We will arrive EDDF via the CHA transition waypoint and the SPES3B Standard Instrument Arrival (STAR), followed by the ILS approach to runway 25.

The full route is as follows:

EDDS25 ETAS4B KETEG Z12 TOSTU CHA SPES3B ILS25L

Important

Flight plan waypoints and procedures change over time. The sample flight plan used here may no longer be current, and some of these waypoints may not be available for selection during <u>your</u> flight. Therefore, it is not recommended you attempt to duplicate these steps in X-Plane - but instead use the examples below as guidelines for inputting and managing your own flight plan.

Loading a previously saved flight-plan is discussed later in this guide, in the section Loading a (saved) Flight Plan.

Flight Plan (FPL) Page

The "FPLN" button is used to invoke the FLIGHT PLAN (FPL) page, for inputting and displaying the route and procedures for the upcoming flight.



Origin Airport



Destination Airport



Programming the Departure



Selecting a Standard Instrument Departure (SID)



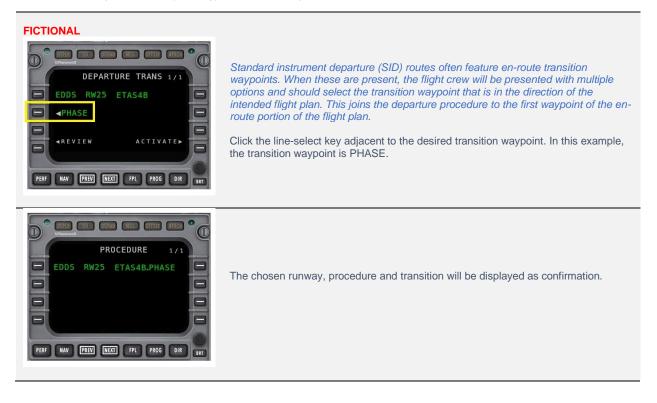
Standard instrument departure (SID) routes, also known as departure procedures (DP), are published flight procedures followed by aircraft on an IFR flight plan immediately after takeoff from an airport [Source Wikipedia]

Select the desired Standard Instrument Departure (SID) for the chosen runway. In this example, we will be following the ETAS4B procedure.

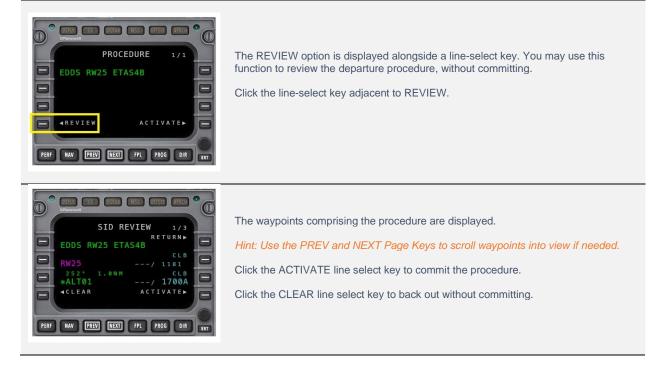
Hint: Use the PREV and NEXT Page Keys to scroll the desired runway into view if needed.

Selecting a Standard Instrument Departure (SID) Transition

Note: None of the departure procedures at EDDS have transitions, so the example below is fictional. The transition waypoints shown in the example below are (in reality) for a different airport.



Committing the Flight Plan

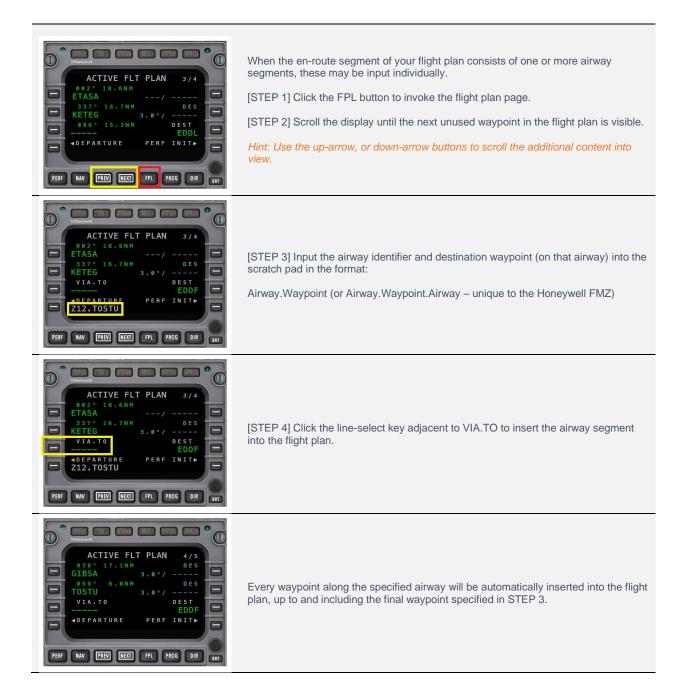


Inputting en-route waypoints

Note: The use of waypoint KETEG is for convenience and would normally be useful only for a different flight plan.



Inputting en-route airways



Inputting Pilot Waypoints

Note: The waypoint included in this example is not part of the intended flight plan and is used for demonstration purposes only.

Image:	 Pilot defined waypoints may be included in your flight plan where needed. These are waypoints that do not have official identifiers, and are created by the flight crew by inputting the specific latitude and longitude in the format: N / S Degrees, Decimal Minutes E / W Degrees, Decimal Minutes Example: N 1 ° 1.1 E 150 ° 59.9 would be input as N0101.1E15059.9 [STEP 1] Click the FPL button to invoke the flight plan page. [STEP 2] Scroll the display until the next unused waypoint in the flight plan is visible. <i>Hint: Use the up-arrow, or down-arrow buttons to scroll the additional content into view.</i>
ACTIVE FLT PLAN 3/3 CO2' 18.6NM DES ETASA 3.0*/ VIA.TO DEST VIA.TO DEST SAVE ACTIVE FLT PLAN TO PW001 PRF NAV PRV NEX FPL PROG DR BET	[STEP 3] Input a fictional pilot waypoint identifier into the scratch pad
ACTIVE FLT PLAN 3/3 O 22 18.6 NM ETASA ETASA VIA.TO SAVE ACTIVE FLT PLAN TO DEST DEST PLAN TO PERF NAV PERF INIT ETASA ETAS	[STEP 4] Click the line-select key adjacent to VIA.TO
PILOT WAYPOINT 1/1 WAYPOINT WOO1 LAT LON P/B/D OR P/B/P/B WPT LIST N4908.8E0855.6 PRF NAV PRV NEXT FPL PROG DIR BET	[STEP 5] Input the latitude and longitude of the chosen waypoint into the scratch pad.



[STEP 6] Click the line select key adjacent to LAT LON to add the waypoint to the en-route waypoints database.

[STEP 7] Follow the steps for <u>Inputting en-route waypoints</u> to insert the waypoint into your flight plan.

Saving a Flight Plan

Saved flight plans are stored in the Output/FMS Plans folder.

Flight plans may be saved for use again later. A saved flight plan in X-Plane uses a. fms extension.

Important:

A feature of the Honeywell FMZ system is that flight plans may <u>not</u> be saved once they have been closed (see: <u>Closing the Flight</u> <u>Plan</u>). This is how the real device operates, and therefore this restriction applies in X-Plane.



Closing the Flight Plan

The Honeywell FMZ system requires that you 'close' the flight plan before programming the arrival. This is accomplished by selecting the destination airport code as the final waypoint in the flight plan.



Performance Initialization (PERF) Page Group

The "PERF" (Performance) key is used to initialize the performance parameters used by the flight management system for the duration of the flight.

Hint: The flight plan must be closed for these entries to have any effect.

Note: Failure to input performance data may lead to unpopulated data in other FMS pages.



Click the PERF button followed by the PERF INIT button to invoke the first of five PERFORMANCE INIT pages. These are used to change the default computation parameters used by the FMS.

PERFORMANCE INIT Page 1 / 5

✓ Information only

Hint: Use the NEXT and PREV buttons to cycle through the pages.



PERFORMANCE INIT Page 2 / 5

This page supports the option to change:

- Climb speed and Mach number
- Cruise speed and Mach number
- ✓ Descent speed, Mach number and default vertical path angle

The FMS will pass these values to the flight director (for display) when the autopilot is engaged in VNAV mode.

Note: The Citation X doesn't have an auto-throttle, so thrust must always be set by the crew.

Hint: Input the new data (into the scratch pad) in the same format as currently populated, and then click the adjacent line-select key.



PERFORMANCE INIT Page 3 / 5

This page supports the option to change:

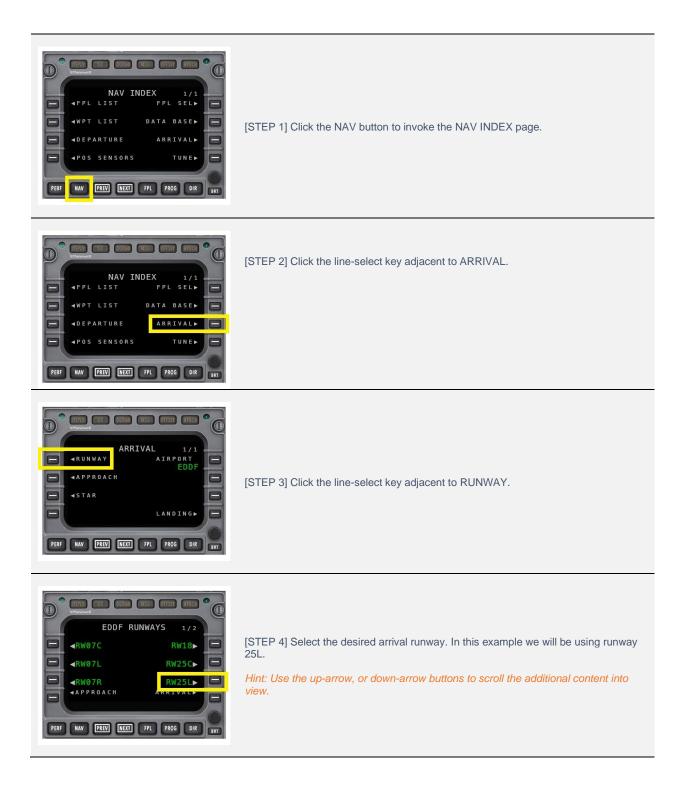
✓ Step Climb Increment (thousands of feet)

A step-climb is a series of incremental altitude changes that occur when the aircraft performance allows (due to fuel burn). This parameter defines the increment that will be used by the FMS to compute when the next step climb is feasible.

Hint: Input the new data (into the scratch pad) in the same format as currently populated, and then click the adjacent line-select key.

Programming the Arrival

Note: The Honeywell FMZ system requires that you 'close' the flight plan before programming the arrival. This is accomplished by inputting the destination airport code as the final waypoint in the flight plan. See: <u>Closing the Flight Plan</u>





[STEP 5] Select the desired approach type. In this example we will be using the ILS to runway 25L.

Hint: Use the up-arrow, or down-arrow buttons to scroll the additional content into view.



[STEP 6] Select the desired transition waypoint. In this example we will be using CHA.

Hint: Use the up-arrow, or down-arrow buttons to scroll the additional content into view.

Note: Transition waypoint CHA is for non-RNAV aircraft and is used here for convenience. A more likely transition waypoint for this aircraft and flight plan would be DF626, followed by a short-cut from ATC.

Continued in next chapter: Selecting a Standard Instrument Arrival (STAR)

Continued from previous chapter: Programming the Arrival



[STEP 7] Select the STAR (Standard Arrival) procedure. In this example we will be using SPES3B.

Hint: Use the up-arrow, or down-arrow buttons to scroll the additional content into view.



[STEP 8] The runway, transition, approach type and arrival procedure (STAR) are displayed for confirmation.

Hint: Use the PREV and NEXT Page Keys to scroll waypoints into view if needed.

Click the ACTIVATE line select key to commit the procedure.



Use the up-arrow, or down-arrow buttons to scroll the >>DISCONTINUITY<< message into view.

Click the DEL button to enable the DELETE function.

Click the line-select key adjacent to the waypoint immediately above the >>DISCONTINUITY<< message to remove this and stitch together the flight plan waypoints immediately above and below.

The two waypoints either side of the >>DISCONTINUITY<< are now joined together.

Altitude Constraints



When altitude constraints are in effect, these are displayed adjacent to relevant waypoints of the flight plan.

Altitudes displayed in small font are computed by the FMS using performance data.

Constraints displayed in large font (shown here) are sourced from the specific departure or arrival procedure to which that waypoint belongs. These always take precedent over computed constraints.

When the autopilot is in VNAV mode, and during a climb phase of the flight, the crew may set a top of climb altitude using the Altitude Select Rotary, and the FMS will command climbs to each of the altitude constraints in the flight plan, as the associated waypoint is reached. Note that the FMS will never command a climb beyond the altitude set by the Altitude Select rotary.

When the autopilot is in VNAV mode, and during a descent phase of the flight, the crew may set a bottom of descent altitude using the Altitude Select Rotary, and the FMS will command descents to each of the altitude constraints in the flight plan, as the associated waypoint is reached. Note that the FMS will never command a descent below the altitude set by the Altitude Select rotary.

Note: The Citation X has no auto-throttle. During climb the crew must advance the throttle to the CLB (Climb) position and retard it to the CRZ (cruise) position for level flight or retard the throttle further to comply with any speed restriction in level flight. During descent, the crew must manually adjust the throttle to maintain the desired airspeed.



Manual Input of Altitude Constraints



Altitude constraints may be manually input by the crew for a given waypoint, or waypoints.

[STEP 1] Click the FPL button to invoke the flight plan page.

[STEP 2] Scroll the display until the next unused waypoint in the flight plan is visible.

Hint: Use the up-arrow or down-arrow buttons to scroll the additional content into view.



[STEP 3] Input the desired altitude constraint expressed as thousands of feet or a flight level (e.g. FL180)

[STEP 4] Click the line-select key adjacent to the waypoint to which the altitude constraint applies.

Speed Constraints

Note: The speed constraint included in this example is fictional and is used for demonstration purposes only.



When speed constraints are in effect, these are displayed adjacent to relevant waypoints of the flight plan.

Constraints displayed in small font (shown here) are computed by the FMS using performance data.

Constraints displayed in large font are sourced from the specific departure or arrival procedure to which that waypoint belongs. These always take precedent over computed constraints.

The Citation X does not feature an auto-throttle, and therefore speed constraints during descent are for information only and must be managed by the crew.

Manual Input of Speed Constraints



Speed constraints may be manually input by the crew for a given waypoint, or waypoints.

[STEP 1] Click the FPL button to invoke the flight plan page.

[STEP 2] Scroll the display until the next unused waypoint in the flight plan is visible.

Hint: Use the up-arrow or down-arrow buttons to scroll the additional content into view.



[STEP 3] Input the desired speed constraint in the format shown in the example.

[STEP 4] Click the line-select key adjacent to the waypoint to which the speed constraint applies.

Reviewing the completed Flight Plan

MCDU Review





Note the location of any speed and altitude constraints in the flight plan.

Note also the missed-approach waypoints at the end of the flight plan - should the landing be aborted.

MFD Review



Examine the shape of the flight plan on the Multi-Function Display (MFD) to ensure it corresponds with your Electronic Flight Bag (EFB) or other documentation.

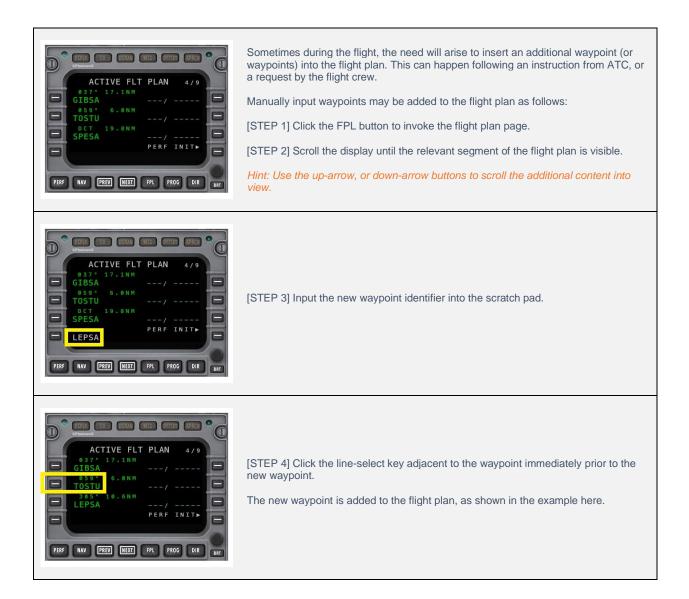
For instructions using the MFD, see:

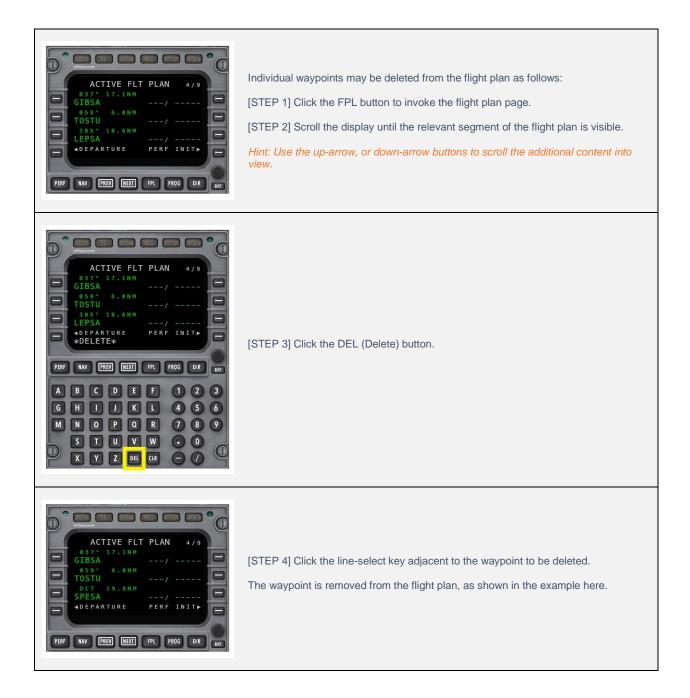
https://x-plane.com/manuals/Citation_X_Pilot_Operating_Manual.pdf

Direct to a waypoint

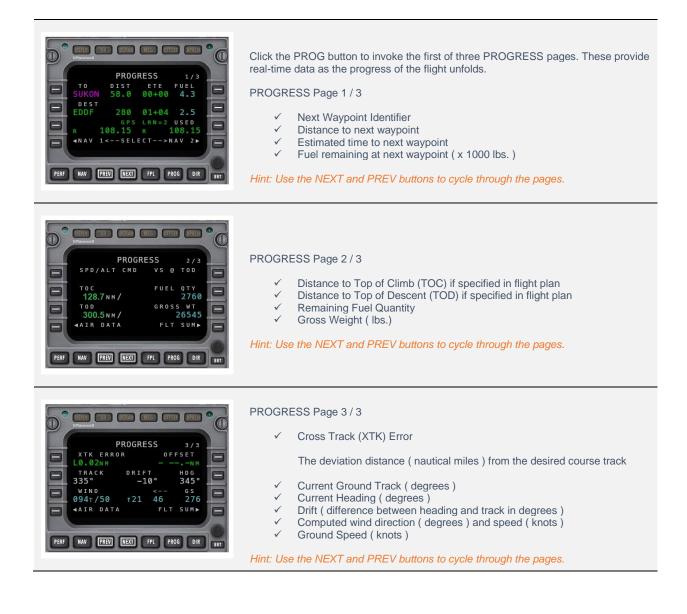


Inserting a waypoint into an existing flight plan





PROGRESS Page Group



Resetting the Flight Plan

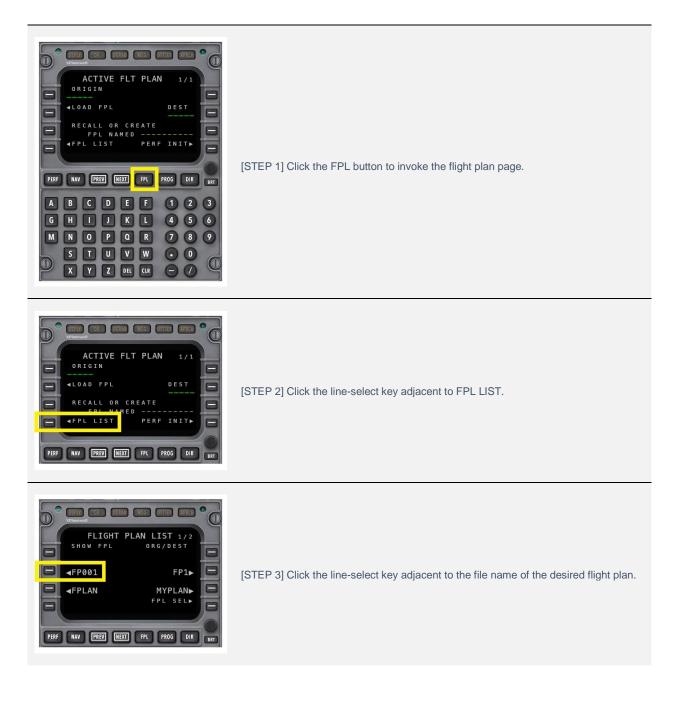


Loading a (saved) Flight Plan

Saved flight plans are stored in the Output/FMS Plans folder.

Flight plans that have been generated previously (and saved in the appropriate format for X-Plane) may be loaded into the Flight Management System. The following file (extension) types are acceptable:

- ✓ FLP (compatible with aircraft for both X-Plane and other simulators, supports airways)
- ✓ FMS (compatible with X-Plane, with support for airways and procedures)





[STEP 4] Click the line-select key adjacent to ACTIVATE.