Tutorial Flight

Boeing 747-8i

Microsoft Flight Simulator

V1 – June 2023

Overview:
This tutorial flight will familiarize you with normal operations of the MSFS Boeing 747-8i (B748), from gate to gate. Today's flight will be from Chicago O'Hare Airport (KORD) to Washington Dulles Airport (KIAD), and we will be carrying a full passenger load of 364.

Route: KORD MOBLE ADIME ASHEN J60 DJB J162 MGW GIBBZ4 KIAD
Cruise Altitude: 37,000' (FL370)
Distance: 590 NM
Alternate: KPHL
Passengers: (364) 67,408 lbs
Baggage/Cargo: 16,049 lbs
Total Payload: 83,457 lbs

<u>Fuel:</u>

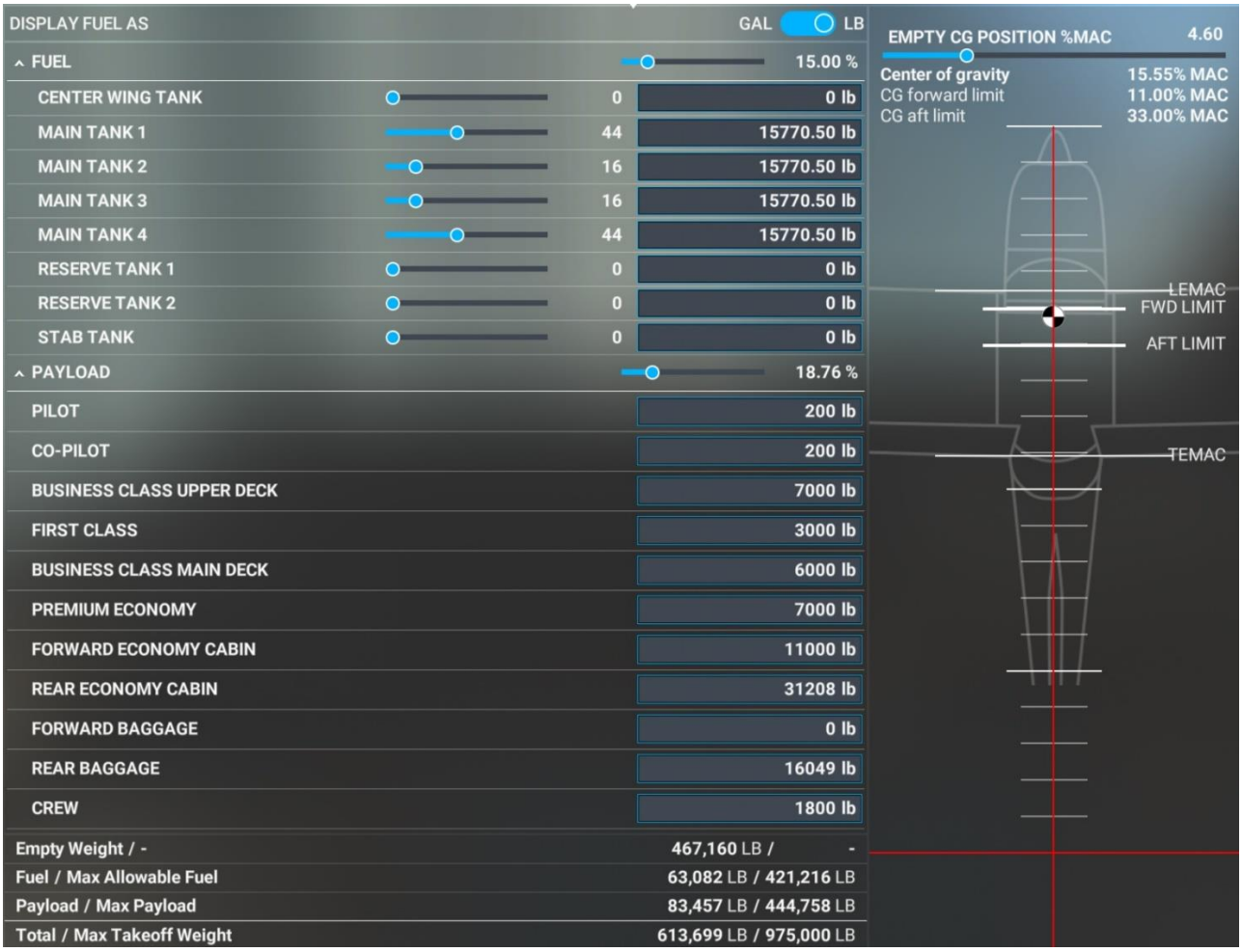
Trip Fuel:	81 mins / 25,916 lbs
Holding/Contingency:	30 mins / 9,530 lbs
Alternate:	36 mins / 11,874 lbs
Reserve:	45 mins / 13,762 lbs
Taxi:	2,000 lbs
Block Fuel:	63,082 lbs

A Note About TOGGLE AUTOPILOT MASTER Key Bind
Boeings do not have any controls in the plane that will toggle autopilot. They have separate buttons for engaging autopilot and disconnecting autopilot. When disconnecting autopilot, a CAS warning "AUTOPILOT DISC" will be triggered, and the only way to clear it is by pressing an autopilot disconnect button again. The master warning button on the glareshield will not clear this warning. If you only have a key bound to toggling autopilot, then you will not be able to clear the message, because a second press will engage autopilot. It is recommended to set up two separate Keybinds, one for AUTOPILOT ON, and another for AUTOPILOT OFF, so that you can clear the warning by double pressing the AUTOPILOT OFF key.

World Map:

Select the 747-8i in the aircraft selection menu, then open the WEIGHT AND BALANCE page and enter the fuel and payload. Note that we are working in pounds, so you may need to toggle the unit selector in the top right to select LB. When entering the fuel amounts, you will probably want to type them in manually in the boxes, especially with short flights that only have fuel in the main tanks, because you can't get the tanks to have even amounts in them using the sliders, because the inboard tanks are larger than the outboard ones. When entering the payload weights, you may want to type in the weights into each box instead of using the slider, so that you will get a more accurate CG (center of gravity). After entering the weights, your page should look like the image below.

Pay special attention to the Center of Gravity when loading a large aircraft like the 747, as loading out of limits can cause the aircraft to be unflyable and cause errors when programming the aircraft systems. You can use the Empty CG Position slider to adjust the Center of gravity if needed after loading the aircraft.



For the world map flight plan, select KORD as the departure airport, and select “GATE B 17 – GATE HEAVY” as the spawn point, then click FLY.

Cold & Dark:
The aircraft will be powered down. Take a moment to familiarize yourself with the cockpit panels and screens before you get started with the cockpit setup checklist.

<u>Cockpit Intro:</u>
There are six primary display screens in the 747 cockpit – two primary flight displays (PFD), three multi-function displays (MFD) and one central Engine Indicating and Crew Alerting System (EICAS) display. The PFDs contain the primary flight instruments, including the attitude indicator, heading indicator, altimeter, airspeed indicator and the autopilot/flight director mode annunciator (FMA). Each MFD can display a variety of data including the navigation display (map), checklists, systems synoptics and secondary engine information; the pilots can control the contents displayed on each MFD through the MFD control panel on the glareshield. In addition, there are three control data units (CDU) that provide an interface to the flight management computer (FMC). In MSFS, the two primary CDUs located on either side of the lower MFD operate independently and can be used; the third CDU located at the aft of the center pedestal is a mirror of the captain-side CDU and is a display only.

Glareshield - Above the displays, outlined in red below is the glareshield panel, which contains the autopilot mode control panel (MCP), the MFD control panel, the navigation display (ND) controls and the PFD input controls.

CDU – On either side of the lower MFD, outlined in blue below, there are two CDUs – these provide a flight computer interface, one each for the pilot and co-pilot.

Radio Tuning Control – On the pedestal between the pilot seats, outlined in orange below, there are the pilot and co-pilot radio tuning panels – these provide input for the aircraft radios.

Fuel Control Switches – On the pedestal below and behind the throttles, outlined in yellow below, are the fuel control switches for the engines – these are the master switches controlling whether the engines can run or not.

Parking Brake Handle – On the pedestal to the left of the throttles, outlined in purple below, is the parking brake handle. Pull up/back to set the parking brake, push down/forward to release the parking brake.

Transponder Control – On the pedestal below the co-pilot radio panel, outlined in green below, is the transponder control panel.

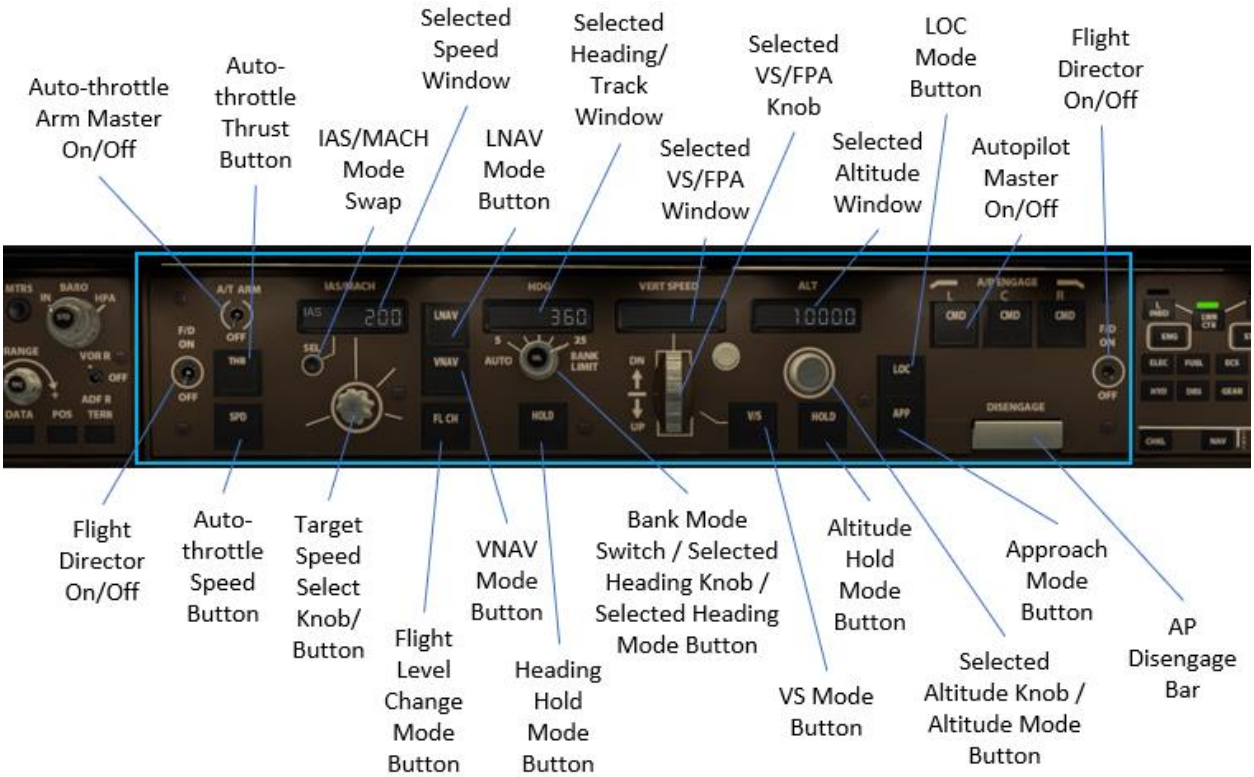
Glareshield:

The glareshield is comprised of two central/shared control panels and two side-specific control panels on each side.

1. Autopilot Mode Control panel (MCP)
   This is the control panel for all autopilot and auto-throttle functions.
2. MFD Control Panel
   This panel controls what is displayed on each of the three MFDs.
3. PFD Control Panel
   Provides pilot input for approach minimums and altimeter barometric pressure setting, as well as mode buttons for altimeter meters display and the flight path vector (FPV) display.
4. ND Control Panel
   Provides pilot input for any Navigation Display (ND [map]) on the MFD, including knobs for range and mode, as well as toggle buttons for various data display options.

Autopilot Mode Control Panel (MCP):

The Autopilot Mode Control Panel is the primary interface for interacting with the autopilot and auto-throttle. The MCP allows the pilots to command the various modes of the autopilot.

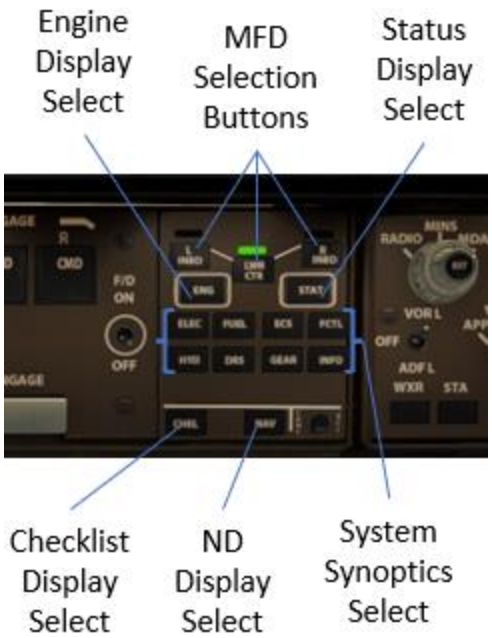


	Speed Knob (rotate and push) Rotate: Rotating the knob changes the selected speed or selected mach when the Selected Speed Window is open (displayed). Push: Pushing in on the button will toggle the Selected Speed Window when VNAV mode is active. By default, with VNAV mode active, the window will close (no display visible); pressing the button will cause the window to open and allow the target speed value to be changed by rotating the knob.
	Heading Knob (inner rotate, outer rotate and push) Inner Rotate: Rotating the inner knob changes the selected heading or track; the selected value will be displayed in the Selected Heading/Track Window. Outer Rotate: Rotating the outer knob changes the bank limit (in degrees) to be used when in Selected Heading mode. By default this should be set to AUTO, but can be manually set to values from 5 degrees to 25 degrees with 5 degree increments. Push: Pushing in on the button will toggle Selected Heading mode.

	Altitude Knob (rotate and push) Rotate: Rotating the knob changes the selected altitude; the selected value will be displayed in the Selected Altitude Window. The knob has knob-turn acceleration allowing a minimum increment of 100' and max of 1000'. Push: Pushing in on the button has a number of functions when in VNAV mode. Generally the first press of the button will initiate a climb or descent, in VNAV SPD mode to the altitude displayed in the Selected Altitude Window. Subsequent presses of the button will delete altitude constraints in the current phase of flight (climb or descent).

MFD Control Panel:

The MFD Control Panel located on the glareshield to the right of the Autopilot MCP is the interface for selecting the content displayed on each of the MFDs.



MFD Selection Buttons: These buttons control which MFD is currently being controlled by the panel (left inboard, lower center and right inboard). The currently selected pane is indicated by an illuminated green bar above the button.

Engine Display Select: Pressing this button will cause the secondary engine display page to appear on the currently selected MFD.

Status Display Select: Pressing this button will cause the status display page to appear on the currently selected MFD.

System Synoptics Select: There are eight synoptics display buttons available. Pressing any of these will cause the selected item to display on the currently selected MFD.

Checklist Display Select: Pressing this button will cause the checklist page to appear on the currently selected MFD. To simplify checklist interaction, you can click directly on the screen to interact with the checklist.

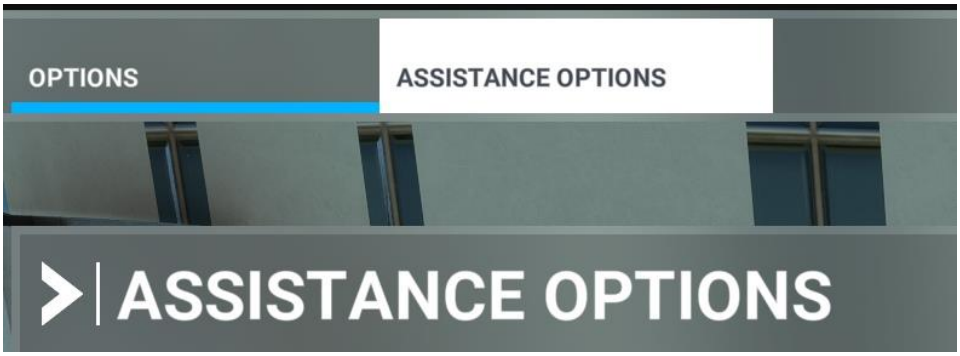
ND Display Select: Pressing this button will cause the Navigation Display (ND) to appear on the currently selected MFD.

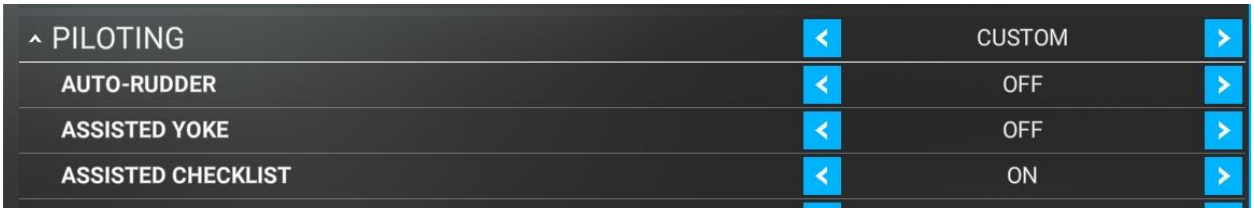
Overhead Panel:

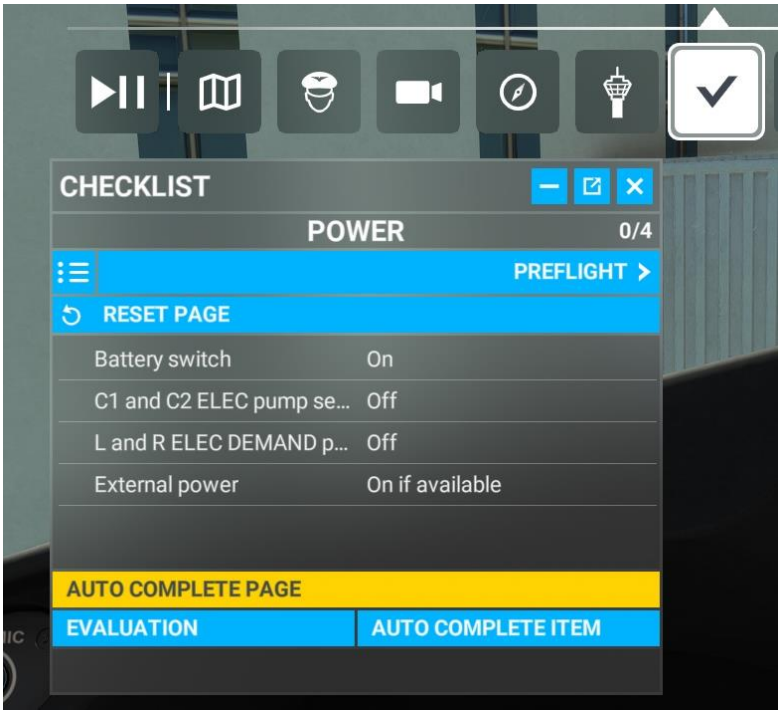
1 – Lighting Panel	Controls for cockpit and exterior aircraft lighting.
2 – Hydraulic Panel	Controls for the aircraft hydraulic system.
3 – Electrical Panel	Controls for the battery, auxiliary power unit (APU), external power and generators.
4 – IRS Panel	Controls for the IRS.
5 – Emergency Lights	Control for the emergency lights.
6 – Engine Panel	Controls for the engine start system.
7 – Fuel Panel	Controls for the fuel system.
8 – Anti-Ice/Window Panel	Controls for anti-ice systems and window heat/wiper systems.
9 – Air Conditioning Panel	Controls for cabin air and engine-driven air conditioning packs.

Sim Checklists:

All the checklists in this document, and more, are also available in the in-sim checklists. The ones in this tutorial maybe be slightly different for the sake of the tutorial, so in addition to this tutorial, it is recommended to check out the sim checklists as well. They can be accessed by clicking the checkmark button on the top menu bar. If you have the “PILOTING -> ASSISTED CHECKLIST” setting set to ON in the assistance options, it will give you additional checklist functionality including an evaluation mode which will walk you through each checklist item one at a time, highlighting each control and changing the camera to help you find the control, a button to autocomplete individual items, and a button to auto complete an entire page.







Follow the Cockpit Setup checklist below to get powered on and ready to get started with your flight. (Note that some items may already be in the following states.)

POWER Checklist

Overhead Electrical: Battery	On
Overhead Electrical: Standby Power Selector	Auto
Overhead Hydraulic: Demand Switches	Off
Overhead Electrical: EXT PWR 1 & 2	On if available

PREFLIGHT Checklist (Abbreviated)

Overhead: IRS Selectors	NAV
Overhead: Emergency Lights Switch	Guard closed
Overhead: Wiper Selectors	Off
Overhead: Yaw Damper Switches	On
Overhead Lights: Nav Lights	On
Overhead Lights: Logo Lights	On
Panel Lights	As Required
Pedestal: Parking Brake	Set

You should now have power to all screens and are ready to begin setting up the CDU for this flight.

CDU Setup:
You are looking at the IDENT page. To get started, press the line select key (LSK) next to POS INIT>

POS INIT page: the GPS POS should already be populated, since the aircraft has already acquired a GPS position; you may confirm the coordinates with the airport chart if you like. Press the LSK next to GPS POS to copy the position into the scratchpad, then press the LSK next to SET IRS POS. The IRS will not fully align until this step is done. Press the LSK next to ROUTE> to proceed.

RTE 1 page 1: Enter origin and destination airport IDENTs on page 1. Your ORIGIN is KORD and your DEST is KIAD. If your flight number is not already populated, you can enter it now (e.g. BOE1).

RTE 1 page 2: Press the NEXT PAGE button to begin entering your route. The left column contains airways and the right column contains waypoints.

Remember your route is: MOBLE ADIME ASHEN J60 DJB J162 MGW

Type MOBLE into the scratchpad with the keyboard, then click on the top right LSK. The page should now look like this:

Repeat the above with ADIME and ASHEN, placing the waypoints in subsequent rows below MOBLE. Now we will enter our two airways. You should have three rows filled and an empty fourth row – enter J60 into the scratchpad and press the **left** LSK on the fourth row.

It should look like this:

After entering an airway, you can either enter the exit waypoint in the right (TO) column, or you can enter another airway below that connects with the prior airway. In your case, since our flight plan calls for changing from airway J60 to J162 at DJB, we can simply enter airway J162 on the next line and the FMS will automatically determine that we want to change airways where the two intersect at DJB.

Enter J162 into the scratchpad and then press the **left** LSK on the fifth row; the FMS should automatically fill DJB on the right column of the fourth row, indicating that we will fly airway J60 from ASHEN to DJB and then join airway J162.

Lastly, we want to enter our airway exit from J162, which is the final enroute leg of our flight plan. Enter MGW into the scratchpad and then press the **right** LSK on the fifth row – the page should now look like this:

Now that our enroute plan is entered, you can go enter your departure and arrival details, since we already know what they will be. Press the DEP ARR button on the CDU screen to go to the DEPARTURES page.

DEPARTURES page: We are departing from runway 27L today; use the NEXT PAGE button to page through the RUNWAYS until you see 27L and then press the LSK next to 27L. We will not be using a SID today, so you should see a <SEL> indication next to runway 27L, indicating that we have selected 27L for our departure. Now click the LSK next to <INDEX to go back to the DEP/ARR INDEX page.

ARRIVALS page: From the DEP/ARR INDEX page, click the LSK next to ARR> to enter the ARRIVALS page. On the ARRIVALS page, we can select our STAR (arrival procedure) and our approach as well. You should see your planned arrival procedure GIBBZ4, on the first page (use NEXT PAGE to page through all options). Click the LSK next to GIBBZ4; this will show GIBBZ4 as selected and prompt you to choose a transition (TRANS); since we are joining the arrival at MGW, press the LSK next to MGW. You will now see the STAR and TRANS are both indicated as selected with <SEL> shown to the right of each entry.

Now you can select the approach – you are planning ILS 01R, so select that with the adjacent LSK. You will be prompted to choose a transition; in this case, because the GIBBZ4 arrival is a vectors arrival, we will not choose an approach transition. The page should look like this, showing GIBBZ4 via MGW selected, and showing ILS 01R without a transition selected as well:

Now, we can go inspect our flight plan using the LEGS page and the PLAN view on the Navigation Display (ND). Press the LEGS button on the CDU to navigate to the LEGS page.

LEGS page: You can review your legs page and flight plan to ensure your plan is as you expect and clear any discontinuities. Use the NEXT PAGE/PREV PAGE buttons to navigate through the pages of the plan. The LEGS page displays each leg of the plan.

On the ND control panel on the glareshield left side, rotate the map format knob to the PLN position to select the PLAN map mode. Adjust map range as desired and use the LSK next to STEP> on the CDU to step through your flight plan on the map. Since we have not yet activated the plan, legs will be shown as a dashed blue line. Make sure each leg is as you expect it. If you find a discontinuity, for example between AIR and MGW, you can simply press the DEL key on the CDU keyboard and then click the left

LSK next to the discontinuity to remove it; you should then see AIR and MGW connect with a dashed blue line on the ND.

Once you are finished inspecting legs, you can return to the RTE page by clicking the RTE key on the CDU.

RTE 1 page: Back on the RTE 1 page, you are ready to ACTIVATE> your flight plan – press the LSK next to ACTIVATE>. The EXEC button on the CDU should now be lit up with a green light, indicating the route has been modified and is ready for execution. Press EXEC. You will notice the top of the RTE page now shows header ACT RTE 1, indicating that RTE 1 is now the active route in the flight computer. You will also notice the flight path turns magenta on the ND, since this is now the route that the flight director and autopilot will follow if/when engaged.

Next press the LSK next to ALTN> to enter your alternate airport KPHL.

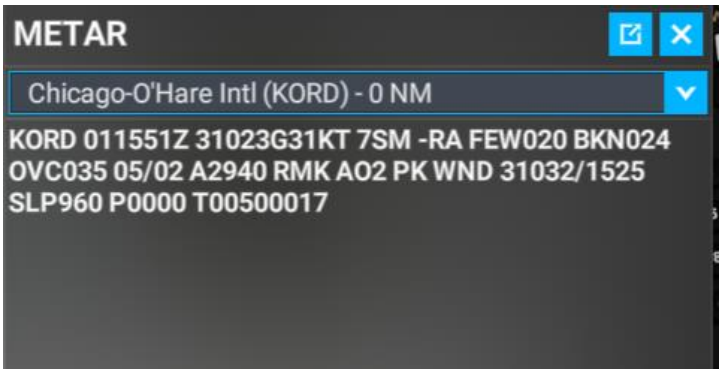
ALTN page: Enter KPHL into the scratchpad and then press the left LSK on the first row to add KPHL as the first alternate. You can enter additional alternate airports if desired. Press the RTE button on the CDU to return to the ACT RTE 1 page. Now press the LSK next to PERF INIT> to begin entering performance data for the flight.

PERF INIT page: You will see GR WT (gross weight) empty and FUEL shows the sensed fuel value. You may enter your ZFW (zero fuel weight) manually, or you can simply click on the LSK next to ZFW to populate the current ZFW automatically into the scratchpad – press the LSK next to ZFW a second time to enter the value. The CDU will now calculate the gross weight value and that will be displayed in the GR WT field. Enter your final reserves, which for this flight is 13,762 lbs – all weights are entered in thousands of pounds, so enter 13.8 into the scratchpad and press the LSK next to RESERVES.

Next, enter your cruise altitude, 37000, into the scratchpad. Press the LSK next to the CRZ ALT field. This change will prompt you to EXEC the change; go ahead and accept the change by pressing EXEC. Now enter 50 into the scratchpad and press the LSK next to the COST INDEX field to load a cost index of 50 into the FMS. Press the LSK next to THRUST LIM> to navigate to the THRUST LIM page to setup takeoff and climb thrust values.

THRUST LIM page: This page allows you to set a derated thrust for takeoff and climb, either via a selected fixed derate value or with a selected temperature derate. For this flight, we will use full thrust for takeoff and climb, so we will leave the values as they are, with TO showing <SEL> and CLB showing <ARM>. Navigate to the TAKEOFF page by pressing the LSK next to TAKEOFF>.

TAKEOFF page: The Takeoff page requires entries on both the first and second page before calculated v-speeds will be available. It is best to start on page 2, so press the NEXT PAGE button to get to page 2. Enter the current wind from ATIS or METAR into the scratchpad in the format HDG/SPD, so if winds are reported from 285 degrees at 12 knots, you would enter 285/12; if winds are reported as 40 degrees at 6 knots, you would enter 40/6. In this example, winds are from 310 degrees at 23 knots, gusting to 31 knots. We will enter 310/23 into the scratchpad and then press the LSK next to the WIND field.



After entering the winds, enter the outside air temperature (OAT) into the scratchpad; in the example above, the OAT is 5C, so enter 5 into the scratchpad and then press the LSK next to REF OAT field. Once winds and OAT are filled, press the PREV PAGE button to return to page 1 of the TAKEOFF page.

For this takeoff, you will use flaps 10, so enter 10 into the scratchpad and then press the LSK next to the FLAPS field. Skip past the THRUST field and press the LSK next to CG to load the takeoff CG into the scratchpad, the press the LSK next to CG a second time to load the value – once entered a takeoff trim value will be displayed which you can use to set takeoff trim later.

Next, for each of the takeoff V speeds (V1, VR, V2) press the LSK next to the speed field to load the adjacent value in the REF column directly into the V speed field.

VERY IMPORTANT: You need to put the V2 speed in the MCP speed window (the selected speed on the autopilot panel). In this example, our V2 speed is 161 knots; you need to look up at the glareshield and enter 161 into the speed window.

Now that you have set up your route, performance data and takeoff data, the last step is to set up VNAV for your flight. On this flight, we will use the ECON speeds calculated from the cost index you entered on PERF INIT. Press the VNAV button on the CDU to open the VNAV CLB page.

CLB page: Confirm the CRZ ALT field shows your entered cruise altitude and review the calculated ECON SPD for the climb. Press the NEXT PAGE button to navigate to the VNAV Cruise page.

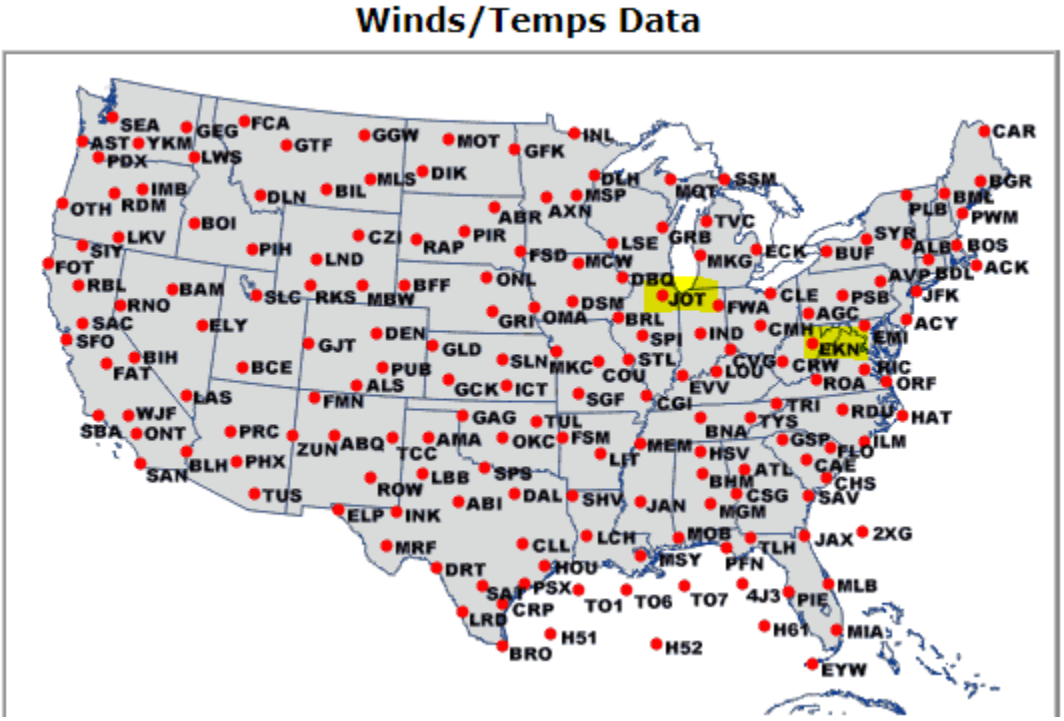
CRZ page: On this page you can see and confirm your cruise altitude and you can see the predicted ECON cruise speed, as well as the distance to top of descent (T/D), the current predicted fuel and arrival time at your destination, as well as the calculated optimal and max altitude based on predicted speeds and weights. Press the NEXT PAGE button to navigate to the VNAV Descent page.

DES page: As with the other VNAV pages, you can review data related to your descent here, including where the end of descent (E/D) is, what the next descent constraint is and what the predicted ECON

speed for descent will be. We need to give VNAV some winds aloft data to help the FMC provide an acute descent profile. Press the LSK next to FORECAST> to enter the descent forecast page.

DESCENT FORECAST page: This page is where you can give the FMC multiple wind references. These are entered as rows of ALTITUDE in the left column and WIND DIR/SPD in the right column. It is recommended to provide at least three values; finding values for this page will depend on whether you are flying with live weather or a preset. In this example, we are using live weather, so you need to find several references for winds aloft at your arrival route. If you used simbrief to create your flight plan, you can get these values from the FLIGHT LOG. Windy.com also has this data available via their interactive map. Today, we will use the FAA's aviation weather website to collect winds aloft data. In a web browser, go to https://www.aviationweather.gov/windtemp.

On that page look at the Winds/Temps Data map – in our case the closest station to our arrival route is EKN.



First click on EKN and you will see a text list of wind data – find EKN in the first column.

Winds/Temps Data

Level: Low High 14Z-21Z Northeast (Boston) Print

```
 (Extracted from FBUS31 KWNO 201400)
FD1US1
DATA BASED ON 201200Z
VALID 201800Z   FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT  3000    6000    9000   12000   18000   24000  30000  34000  39000
BDL 1705 3010+09 3113+03 3320-02 3321-12 3133-23 285237 276247 276358
BGR 9900 0110+05 3414+00 3114-04 0110-16 0415-29 064143 052548 321748
CAR 3605 0709+04 0209+01 0112-03 0319-15 0324-28 012943 013050 012052
PWM 3008 3408+07 2910+01 2911-04 3519-17 3525-29 313740 304544 313550
EMI 1016 1115+10 1113+06 1311+02 0812-10 2206-20 241936 242446 244757
ACK 0806 3509+09 3414+02 3218-01 2935-12 2943-24 277236 277747 277958
BOS 9900 3010+08 3216+02 3220-03 3237-14 3052-24 287138 288347 287557
BML 9900 0307+06 0208+01 3506-03 0223-15 0229-27 033941 363649 332851
ACY 1016 1111+11 1307+05 9900+02 3007-11 2517-20 243235 253446 254757
ALB 9900 3407+10 3213+03 3215-01 3419-12 3230-23 294239 285848 285458
BUF 0815 9900+12 9900+05 9900+00 0510-11 3606-24 282240 263748 273458
JFK 1210 9900+10 9900+04 3212+00 3308-11 3016-22 263736 264547 265558
PLB 0406 0211+08 0113+02 3617-02 0123-13 3527-25 343340 343049 332656
SYR 0807 9900+11 3506+05 3209+00 3624-12 3420-24 292840 274448 274058
CLE 1415 1320+12 1224+06 1123+01 0818-09 0416-21 990037 221048 241659
CMH 1119 1323+12 1121+07 1020+02 0913-09 0509-20 181336 192448 201559
CVG 0921 0923+13 0920+08 0814+03 0613-09 0716-21 111736 131648 121058
AGC 1215 1226+12 1119+06 1117+00 0812-10 9900-21 241736 252247 252658
AVP 1407 9900+11 9900+04 3607+01 0213-11 3508-23 263336 264048 264558
PSB      1210+12 1012+05 9900+01 0921-11 9900-22 252237 263147 253858
ORF 1015 1115+12 1411+08 1510+02 2215-08 2019-19 233234 243544 254756
RIC 0921 1017+11 1211+08 1613+01 2206-09 2314-19 222334 243644 245257
ROA 0926 1229+11 1521+07 1616+02 1910-09 1915-21 181835 203645 226158
CRW 1224 1528+13 1519+08 1314+02 1214-10 1513-20 151336 151647 202557
EKN      1332+12 1416+07 1314+01 1110-10 1509-20 181736 201947 224157
```

Today you will enter data for 9000’, 24000’ and 39000’

In the 9000’ column, you see 1416+07.
The first two digits 14 represent the heading – in this case we need to add a 0 to the end to get 140.
The second two digits 16 represent the speed – in this case 16 knots.
The last digits +07 are the temperature, in degrees Celsius – in this case +07 degrees C.

In the 24000’ column, you see 1509-20.
The first two digits 15 represent the heading – in this case we need to add a 0 to the end to get 150.
The second two digits 09 represent the speed – in this case 9 knots.
The last digits -20 are the temperature, in degrees Celsius – in this case -20 degrees C.

In the 39000’ column, you see 224157.
The first two digits 22 represent the heading – in this case we need to add a 0 to the end to get 220.
The second two digits 41 represent the speed – in this case 41 knots.
The last digits 57 are the temperature, in degrees Celsius – in this case -57 degrees C; temperatures above 24000’ are automatically negated, so any temp reported above 24000’ will always be negative.

There are many special cases for this hard-to-read report – this website is a good reference for decoding winds aloft:
https://www.cfinotebook.net/notebook/weather-and-atmosphere/winds-and-temperatures-aloft

To enter the values decoded above, you first enter the altitude in the scratchpad – so for the example above, enter 9000 in the scratchpad and then press the LSK next to the first empty ALT line. Next, we will enter the corresponding wind data in format DIR/SPD, so for the 9000’ example above, enter 140/16 in the scratchpad and then press the LSK next to the WIND DIR/SPD entry for the 9000’ entry we just

made. It should look like this:

Repeat the above for the two additional data points at 24000’ and 39000’. It should look like this:

Once this is complete, you can press the RTE button on the CDU and you are finished setting up the CDU for your flight.

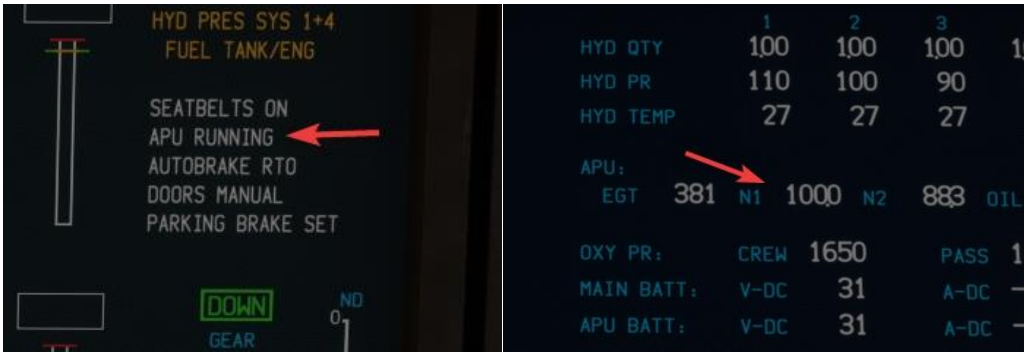
Pushback and Engine Start:

After setting up the CDU, you are ready to push back and start up. First, you need to get the APU started so you can remove external power.

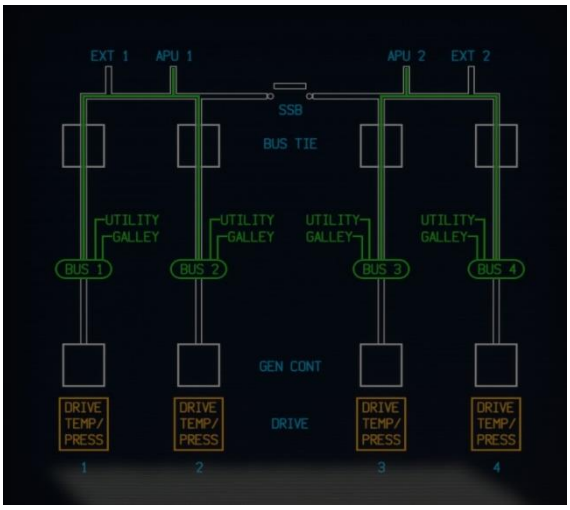
APU Start – Abbreviated Checklist

Overhead Fuel: MAIN 1,2,3,4 FWD/AFT Pumps	On
Overhead Fuel: L/R CTR Pumps	As Required
Overhead Fuel: L/R STAB Pumps	As Required
Overhead Electrical: APU	Start
Overhead Electrical: APU GEN L/R	On when AVAIL lit
Overhead Air: Trim Air Switches	On
Overhead Air: Recirculation Switches	On
Overhead Air: Packs Switches	On
Overhead Air: Isolation Valve Switches	On
Overhead Air: APU Bleed Air Switch	On

Press the STAT button on the MFD control panel to bring up the STAT page on the lower MFD. Watch the APU section of the STAT page to see the RPM and watch for a white CAS message on the EICAS showing APU RUNNING.



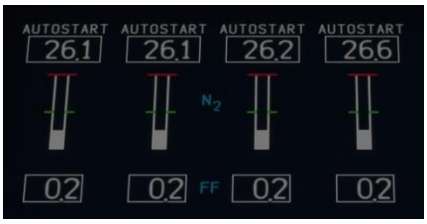
Once the APU is started, the two APU GEN switches on the overhead electrical section should say AVAIL in white. Press both switches to turn the APU generators on. Press the ELEC button on the MFD control panel to show the electrical synoptic screen on the lower MFD. On this screen confirm that APU 1/2 have green lines connecting the APUs to the BUSES. This indicates that power is being provided to the aircraft from the APU and external power can be disconnected in preparation for pushback and engine start. Press the ENG button on the MFD control panel to display the secondary EICAS page on the lower MFD.



Pushback & Engine Start – Abbreviated Checklist

Overhead Pass Signs: Seat Belts	On
Overhead Electrical: EXT PWR 1/2	Off
Overhead: Anti-ice Switches	Auto
Overhead: Window Heat Switches	On
Overhead Lights: BEACON	Both
Overhead: Packs Switches	Off
Overhead Hydraulics: Hydraulic Demand Pumps	Auto
Pedestal: Parking Brake	Off
Pushback	As required
Pedestal: Fuel Control 4	Run
Overhead Engine: Start 4	Start
Engines 1, 2 & 3	Repeat Procedure
EICAS: Monitor N2	Running

Watch the N2 gauge on the ENG page on the lower MFD – the AUTOSTART text will appear above the N2 gauge while the engines are in the auto start process and this text will change to RUNNING once each engine is running and ready.



FUEL TANK/ENG:
On the ECIAS display you may see an amber message “FUEL TANK/ENG”. Because we don’t have fuel in our center, stab, or reserve tanks, and all the main tanks have the same amount of fuel in them, this means we are in the Tank To Engine state (“FUEL TANK/ENG”). This means we should make sure that the OVRD 2 and 3 fuel pump switches are turned off, and the FUEL X FEED 1 and 4 switches are turned off. This should clear the message.

After Start/Pushback – Abbreviated Checklist

Pedestal: Parking Brake	On
Overhead: Packs Switches	On
Overhead Electrical: APU	Off
Pedestal: Transponder Mode	TA ONLY
Pedestal: Flaps	Set
Pedestal: Trim	Set
Glareshield MCP: Altitude	Set for initial climb
Glareshield MCP: Heading	Set for runway heading
Glareshield MCP: Flight Director	On
Glareshield MCP: Baro Knob to local pressure	Set
Taxi Route	Verify

As part of the above checklist, set your flaps to your takeoff flaps position of 10, and set your takeoff trim using the standard trim key binds to the value indicated on the TAKEOFF CDU page. Taxi to and hold short of the departure runway per ATC instructions.

Takeoff:

Now that you have taxied to the runway, you are ready to prepare for takeoff. For this flight, because there is not a departure procedure, you will follow ATC instructions. For the purpose of this flight, you will assume an assigned initial altitude of 5000' and an assigned heading of runway heading (273). This means you will want to arm VNAV per the checklist below, but you will not arm LNAV because our departure will be in heading mode. Make sure you have set the MCP heading window to the runway heading of 273 (runway heading for RW27L), and the MCP altitude window to 5000.

Your MCP should look like this for takeoff:

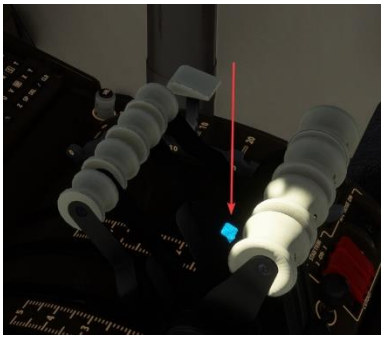
VNAV will command a climb to 5000' and TOGA lateral mode will keep you level until you engage heading mode.

Before Takeoff – Abbreviated Checklist

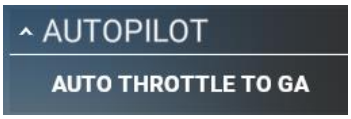
Flight Controls	Check
V Speeds	Confirm on PFD
Glareshield MCP: Speed Window	Confirm V2 Speed Set
Glareshield MCP: Altitude Window	Confirm Set
Pedestal: Transponder Mode	TA/RA
Pedestal: Speed Brake	DN
Autobrake	RTO Set
Flaps	Confirm Set
Trim	Confirm Set
Overhead Lights: Landing Lights	On
Overhead Lights: Strobe Lights	On
Line Up: Confirm on assigned runway	Confirm
Glareshield MCP: LNAV	Arm as required
Glareshield MCP: VNAV	Arm as required
PFD: FMA Confirm TOGA - TOGA	Confirm
Glareshield MCP: A/T ARM	Armed (on)
Pilot/Copilot MFDs	Configure as desired

Once you have completed the above before takeoff checklist items, taxi on to the runway and line up for takeoff.

Now you are ready to begin your takeoff. Confirm your PFD FMA shows TO/GA - TO/GA for roll and pitch modes and that your auto-throttle arm switches are on. To engage the auto-throttle to set takeoff power, you will need to press the TOGA button once (or use a control binding for AUTO THROTTLE TO GA).



Once you press the TOGA button, the auto-throttle will smoothly move your throttles to takeoff power and you will begin accelerating for takeoff. Rotate at the Vr speed indicated on the PFD and follow the flight director guidance for takeoff. After you have passed 50' AGL, you can engage the autopilot.



NOTE ABOUT TAKEOFF THRUST: The EEC will calculate takeoff thrust, which will be indicated on the EICAS N1 gauge by the green line and the % value will be indicated in green above gauges. When TOGA is pressed the auto-throttle will take command of the levers and command takeoff thrust; the FMA will indicate THR REF mode. At 80kts the mode will change to HOLD – this disables the auto-throttle servos and leaves the throttles in manual control. Some hardware throttles create noise and the thrust can be inadvertently changed to the current hardware throttle lever position if not careful. To avoid this, it is important to have the throttles set manually to the green line on the N1 gauge before pressing TOGA. Once at thrust reduction height (by default, 1,500' AGL), the auto-throttle mode will change back to THR REF and climb power will be set.

Takeoff – Abbreviated Checklist

Pedestal: Parking Brake	Off
Throttles: Increase to 30% N1 and verify indications	Verify
Throttles: Increase to target N1 (Green Line)	Set
Throttles: TOGA (press before 50 kts)	On
PFD: FMA Confirm A/T mode THR REF	Check
PFD: FMA Confirm A/T mode HOLD at 80 kts	Check

Climb:

Now that you are airborne, climbing to your initial altitude of 5,000' confirm you have raised your landing gear and retract flaps per the schedule on the PFD speed tape. Confirm that the auto brake is reset to OFF.

After Takeoff – Abbreviated Checklist

Landing Gear	Up
Flaps	Retract per schedule
Auto Brake	Off
Overhead: Lights	As required

After passing 1,500' AGL the EICAS should show CLB thrust, and the auto-throttle will adjust throttle position and power to set climb thrust. You will see on the PFD FMA that the auto-throttle mode changes back to THR REF indicating that the auto-throttle servos are maintaining climb thrust. You will also note that VNAV SPD is the active pitch mode now and that the MCP speed window is closed (blank) meaning that the FMS and VNAV are controlling the target airspeed, which is indicated on the PFD in

magenta above the speed tape. You can also now press the SEL button on the MCP heading knob to activate HDG SEL roll mode to maintain the assigned runway heading.

As you approach your initial altitude of 5,000', you will see the FMA pitch mode change to VNAV ALT, indicating that you are capturing (or have captured) the MCP altitude. The auto-throttle mode will change to SPD mode to maintain the VNAV target speed.

Now you are ready to proceed on your route to KIAD. Air traffic control has cleared you direct to MOBLE and instructed you to climb to your cruise altitude of 37,000'. To accomplish this, first arm LNAV by pressing the LNAV button on the MCP – you will see LNAV in white letters below HDG SEL indicating that LNAV is armed.

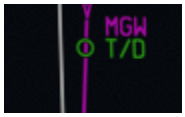
On the CDU, press the LEGS button to display the LEGS page. On the LEGS page you should see the first row shows MOBLE in magenta – this is the active leg, however because we are not currently on the flight path, we need to tell the FMS to draw a new path from our present position to MOBLE – to do this, press the left LSK next to MOBLE – you will see the text MOBLE appear in the scratchpad – now press the same left LSK button again – this will create a direct to MOBLE – and you will be prompted to press EXEC. Press EXEC. You will now see the active roll mode change to LNAV on the PFD FMA and the plane will begin a turn towards MOBLE – you are now following the FMS flight plan.

Now that you have begun to navigate to MOBLE, it is time to start your climb. Set 37000 in the MCP altitude window. Once that is set, you can command the plane to start a VNAV climb to that altitude by pressing in once on the altitude knob. The plane will begin a climb, you will see the PFD FMA now reflects VNAV SPD as the pitch mode and THR REF as the auto-throttle mode.

The plane will climb to cruise altitude and proceed on your flight plan course. As you pass through 18,000' (the climb transition altitude), you will see the barometric pressure setting on the PFD turns amber, prompting you to press the STD button on the BAROSET knob on the glareshield – this will set your altimeter to standard pressure.

Cruise:

Now that you have climbed to your cruise altitude, you can check your flight progress with the ND, the VNAV CRZ page and the PROG page. The PROG page will show you the distance to go, the ETA and estimated fuel on board. The VNAV CRZ page will show the distance to top of descent and the expected arrival time at that point. The top of descent is also indicated on the ND with a T/D marker in green. The T/D point is calculated by the FMS based on winds, weight and the descent flight path so can move as conditions change.

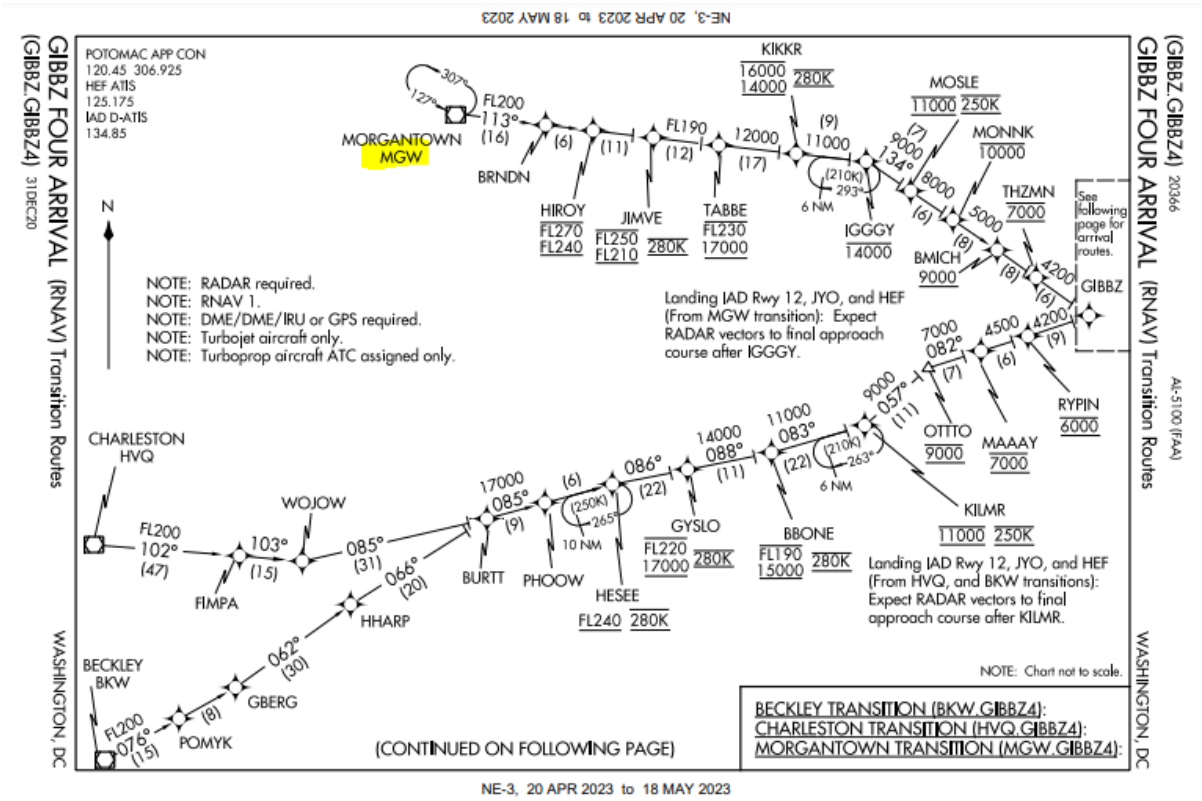


Cruise – Abbreviated Checklist

Glareshield: Baroset	Std
Overhead Pass Signs: Seat Belts	Off/As required
Overhead: Lights	Off/As required

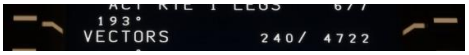
During cruise is a good time to review your arrival and approach procedures. You will be flying the GIBBZ4 arrival and the ILS 01R approach. Charts can be accessed for free in the United States from a number of sources – you can see all the charts on the AirNav website here https://airnav.com/airport/KIAD.

The GIBBZ4 arrival chart has two pages – on the first page (below) you can see the route you will follow starting at MGW, which is the arrival transition you selected in the FMC. You will set your MCP altitude to the lowest altitude of 7,000' at THZMN. The FMS will meet all altitude constraints on the arrival and will do it's best to meet the speed restrictions as well; you may need to apply speed brakes at some points during the arrival to slow down for speed constraints.

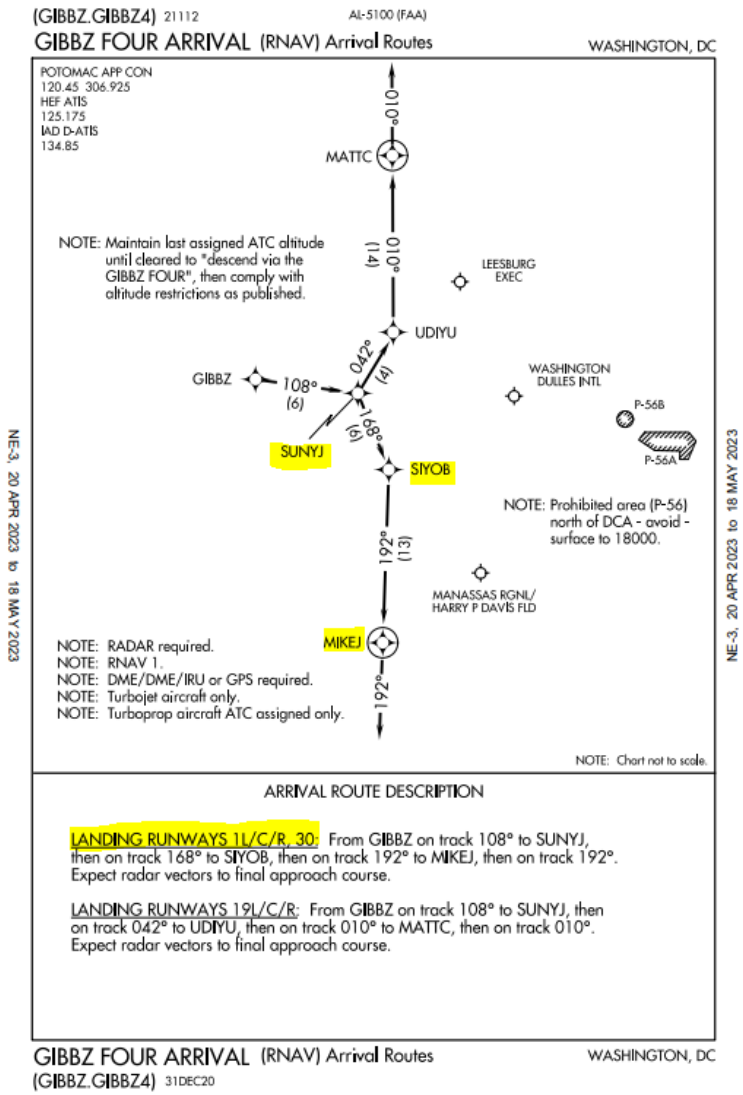


After GIBBZ you need to look at the second page of the arrival, where you see specific instructions for your landing runway (1R). For landing runway 1R, you will follow the route to the south after GIBBZ. The FMS has already loaded these legs because you selected ILS 1R as the approach. You can confirm that these legs are included in the LEGS page on the CDU.

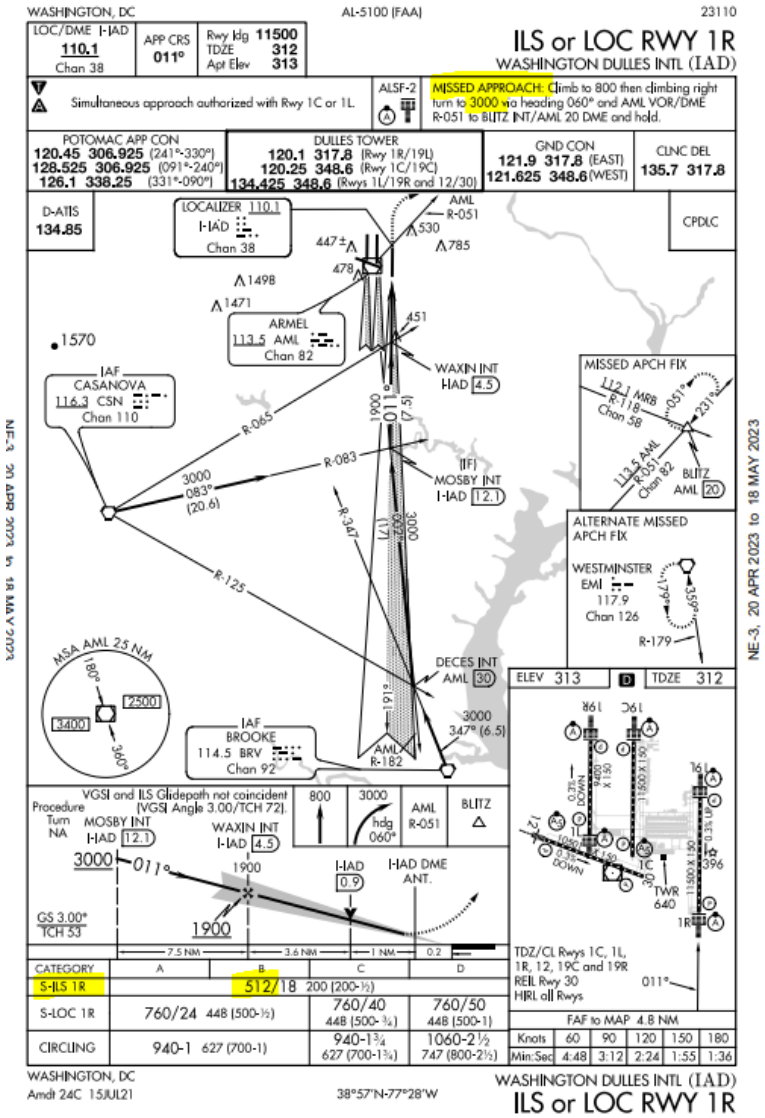
Like many arrival procedures, this arrival ends with a vectors leg – this means that the procedure ends at MIKEJ and you are supposed to continue flying south, on a heading of 193, until you receive instructions from ATC to turn and intercept the approach course. This is depicted in the CDU like this:



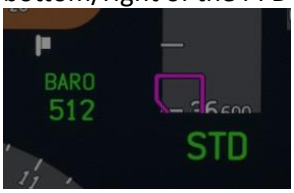
The FMS will command the plane to continue flying that heading until you tell it what to do next. Once you reach this vectors leg, we will lower our MCP altitude to the final approach altitude and use another direct to function to turn towards the approach.



The ILS 01R approach chart contains a few pieces of information you need to configure the aircraft for the approach. The first item are the minimums, which you will set on the PFD. The minimums are listed on the bottom of the approach chart. You will be flying a straight-in ILS approach, so look for the row marked S-ILS 1R. The barometric minimum altitude is the first number (512) so the minimums for this approach are 512' above sea level. This corresponds to 200' above the touch down zone elevation.



Enter the minimums on the PFD now – above the PFD and next to the BAROSET knob is a knob marked MINS. The outer knob selects whether you want to set BARO or RA mins, and in this case you want BARO mins – confirm the outer knob is set to BARO. Next use the inner knob to adjust the minimums value. As you turn the knob, this will be displayed near the bottom/right of the PFD in green text.



The second item you need to note on the approach chart is the missed approach altitude. At the top of the chart, there is text describing the missed approach procedure, and this contains an altitude to climb to. You will use that value later on to set your missed approach altitude once established on the ILS approach so that the autopilot is primed to climb to that altitude if you have to go around.

Descent:
As you approach the top of descent (T/D) point, it is time to prepare for descent. To descend via the FMS calculated VNAV profile, you will need to reset the MCP altitude window to a lower altitude. For this tutorial flight, we will set the MCP altitude to 7,000', which is the lowest altitude constraint on the arrival procedure. You can do this at any time during cruise, but we recommend doing so about 10NM before the T/D. Check the VNAV CRZ page and once the distance TO T/D is 10nm, set the MCP altitude window to 7000. In addition, set your seat belt sign to on for descent, and set your AUTOBRAKE knob to 3.

Next you need to set your approach ref speeds in the CDU. On the CDU, press the INIT REF button, then the INDEX LSK to open the Approach Ref page.

APPROACH REF page: On this page you can choose an approach flaps setting and corresponding VREF speed. The options will be Flaps 20, Flaps 25 and Flaps 30. You will use Flaps 30 for this landing, so press the right LSK next to the Flaps 30 row, which will copy the flap and VREF speed to the scratchpad, then press the right LSK next to the FLAP/SPEED field to insert those values. This will set the proper VREF speed on the PFD.

DESCENT Checklist

Overhead Pass Signs: Seat Belts	On
Glareshield MCP: Altitude	Set lower as required
Cancel/Recall Switch	Push
Autobrake	Set as required (3)
Glareshield: Baroset at transition altitude	Local pressure (as req'd)
Glareshield: Approach Mins	Set as required
CDU: Approach Ref	Set as required

Upon reaching T/D, the plane will begin to decelerate, if required, to reach the descent speed schedule on the CDU VNAV DESCENT page. When this happens, if required, the T/D marker will move slightly ahead to show when the deceleration will finish and where the descent will actually begin. Upon reaching the second T/D, the aircraft will begin a descent along the computed descent path. The target speed will adjust as required to attempt to comply with descent speed constraints.

The initial descent segment is done at/near idle thrust. The FMS calculates an initial descent segment based on the input winds and aircraft weight to allow a descent near idle from the T/D to the first altitude constraint. Upon reaching the first altitude constraint of the arrival, the FMS then follows a computed geometric path through the remaining constraints to the end of the descent (E/D).

As you descend through 18,000' the STD baro indication on the PFD will turn amber; this is your prompt to set the local barometric pressure, which you can do by pressing the STD button on the baro knob to change modes back to a selected pressure and then set the current local pressure. You can also use the 'B' key to accomplish this and automatically set the local barometric pressure.

Continue the descent until 7,000' at THZMN.

Approach:
As you descend through 10,000' switch your landing lights on, confirm the seat belt signs are on and confirm that the FMS has commanded a speed lower than 240kts – use speed brakes to decelerate if required.

Once the autopilot has leveled the plane off at 7,000' upon reaching the THZMN leg, we are ready to prepare for the approach and landing. For this approach, you will be simulating some typical ATC instructions that would be reasonable in a real life approach.

Upon reaching SIYOB descend to 5000' and reduce speed to 220 kts. To do this, first press the speed knob to display/open the speed window, then use the knob to reduce speed to 220. Opening the speed window allows you to take manual control of the target airspeed. The PFD will reflect the newly set speed in magenta.

Next, select flaps 5; since the max speed for flaps 5 is 240 kts, we can safely lower flaps to the 5 position now that we are slowing from 240 to 220.

Next, lower the MCP altitude to 5000'. For this part of the descent, you will use VS mode. Press the VS/FPA button to engage VS mode, and use the VS select knob to select -800 to establish a descent at 800 feet per minute.

The plane will now descend to 5000' at 220 kts. Continue in LNAV to MIKEJ.

You can now arm the SPEED BRAKES by moving the handle on the pedestal to the ARMED position. The armed position is similar to the DN position, but with the lever pulled out. The lever is very sensitive, so might take some careful movements to get it into position. EICAS will display a SPEEDBRAKES ARMED if it is in the correct position.

Upon reaching MIKEJ, the plane will continue on the vectors heading of 193 in LNAV mode. Once you are past MIKEJ and level at 5000', open the LEGS page by pressing the LEGS button on the CDU.

To simplify intercepting the approach, press the left LSK next to MOSBY – you will see MOSBY appear in the scratchpad. Press the left LSK next to VECTORS on the top line to initiate a direct to MOSBY to intercept the approach. You will be prompted to press EXEC – do so now.

Now the plane will begin a left turn to intercept the final approach. Begin a descent to 3,000’ by setting the altitude in the MCP altitude window to 3000 and once again selecting VS mode with a -800 descent rate.

As you approach MOSBY, about 1NM prior to reaching MOSBY, press the APP button on the MCP panel to arm approach mode. The PFD FMA should show LOC as the active roll mode, indicating that the localizer has been captured, and should show G/S in white as the armed pitch mode.

After MOSBY, reduce speed to 180 knots by using the MCP Speed knob to lower the target speed to 180. Set flaps 20 after completing this step.

Prior to reaching WAXIN, you will intercept the glideslope for the approach and you will see the active pitch mode change to G/S on the PFD FMA.

Now that the glideslope has been captured, you can set your MCP altitude to the missed approach altitude identified earlier when reviewing the approach. In this case, the missed approach altitude is 3,000’. Since that was the last altitude you selected for descent, you do not need to change it – confirm 3000 is dialed into the MCP Altitude window.

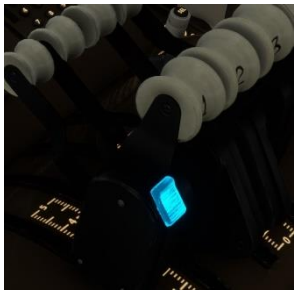
As you approach WAXIN, lower the speed target using the MCP Speed knob to VREF + 5. The VREF speed is calculated on the APPROACH REF page and indicated on the PFD in the speed window. Lower the landing gear and set flaps to 30 for landing.

Final Approach – Abbreviated Checklist

Overhead Lights: Landing Lights	On
Glareshield MCP: Altitude	Set for missed approach
Glareshield: Minimums	Set as required
Autobrake	Set as required (3)
Landing Gear	Down
Flaps	Set for landing
Pedestal: Speed Brake	Armed

Passing 1,500’ AGL the FMS will check for auto land conditions; you may execute an auto land on this approach. If all conditions are met for auto land, you will see the text LAND 3 indicated on the PFD below the FMA. This indicates that auto land conditions have been met and you will see in the PFD FMA that ROLLOUT and FLARE modes become armed.

You should be prepared to disconnect the auto throttle during flare, which you can do either with the A/T ARM switches on the Glareshield MCP, or with the side button on the throttles.



Once flare mode becomes active promptly disconnect the auto-throttle and bring the thrust to idle in preparation for engaging reverse thrust upon touchdown.

Upon touchdown, engage reverse thrust. Rollout mode will use rudder and nosewheel steering to maintain runway centerline and the autopilot will remain engaged until deactivated. As you slow below 60 knots, return thrust to idle and disconnect the autopilot to take manual control of steering. Hold down the brakes until autobrake disengages to take manual control of the braking.

Taxi and Parking:

Exit the runway and complete the below checklist. Taxi to the gate.

After Landing – Abbreviated Checklist

Overhead Lights: Landing Lights	Off
Overhead Lights: Strobe Lights	Off
Overhead Lights: Taxi/Turn Off Lights	As required
Autobrake	Off
Flaps	Up
Pedestal: Speed Brake	Retract
Glareshield MCP: AP	Off
Glareshield MCP: A/T Arm Switch	Off
Glareshield MCP: F/D	Off
Overhead Electrical: APU	Start
Overhead Electrical: APU GEN 1/2	On when AVAIL lit

Upon reaching the gate, the APU should be running and ready to take the electrical load while shutting down the engines. Park at the gate, set the parking brake and then select both engines FUEL CONTROL switches to CUTOFF to shut down the engines.

Once the engines have spooled down, turn off the beacon light and connect external power, if available. Once external power is connected, set the APU to off.

747 Fuel System Addendum

Here is some extra information about how to manage the 747 fuel system, which requires more hands on for longer flights.

The 747-8i has four main fuel tanks, a center wing tank, two reserve tanks and a stabilizer tank.
(For reference, the -8F does not have a stabilizer tank)

Fueling priority

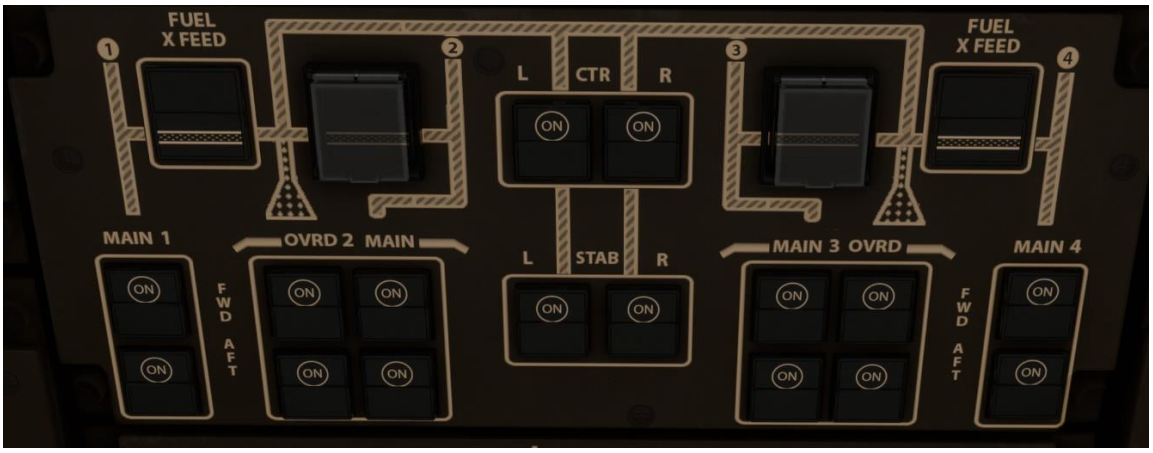
The plane should be fueled in the following order: Main tanks equally -> Main 1&4 full, fill main 2&3 -> center -> reserve/stab as needed.
The reserves can be used to reduce wing flex on takeoff, the stabilizer tank will move the CG aft.

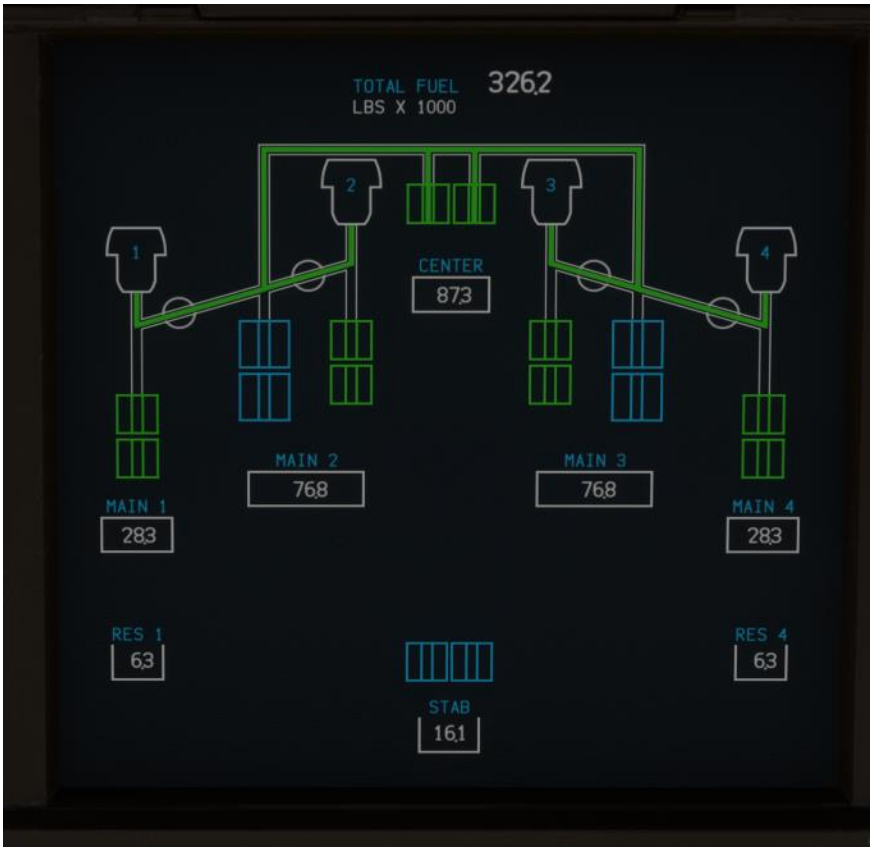
Stages in flight

Every flight has a progression through several stages as fuel is used from the tanks. Assuming that, when starting the flight, every tank contained fuel, the plane would first use fuel from the center tank (stab tank feeds into the center tank), then the inboard main tanks (until all main tanks have the same amount), then every main tank equally. With shorter routes, center and stab tanks would not be in use, or the flight might start in a tank-to-engine state - in this case, some of the following stages would be skipped.

Fuel in center tank

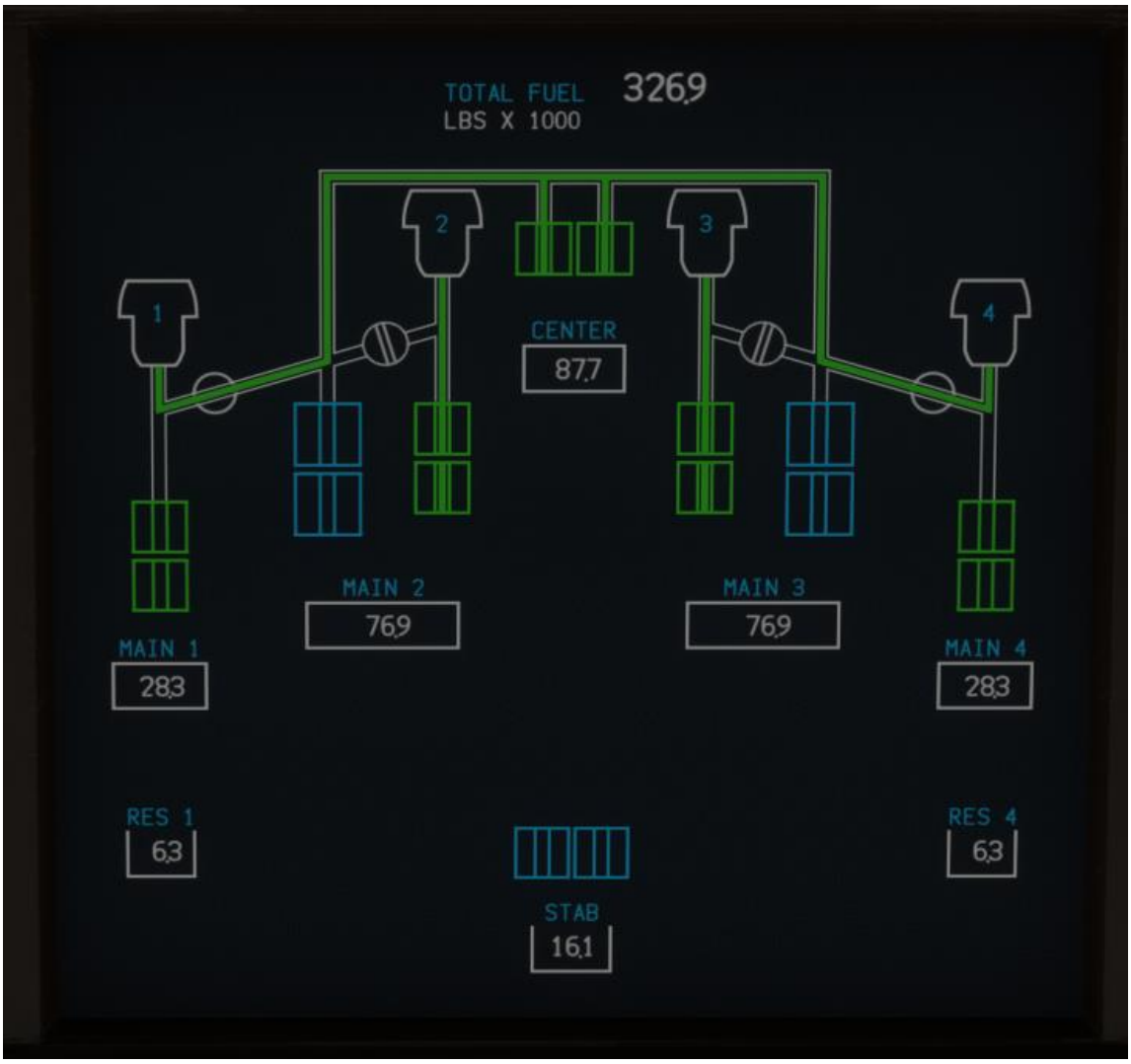
During flight, fuel in the center tank would be used first. A "FUEL LOW CTR" EICAS message will appear when the threshold is reached to turn the pumps off. It is possible for this message to appear in climb, then after reaching cruise phase, a "FUEL OVD CTR" EICAS message would prompt the user to turn them back on until reaching a lower threshold. This is normal: the threshold during climb is higher to protect the pumps at steeper attitudes. In this phase, the center pumps will feed all four engines. All main pumps, override pumps and center pumps should be on. If/when the center tank is empty, the center pumps should be turned off.





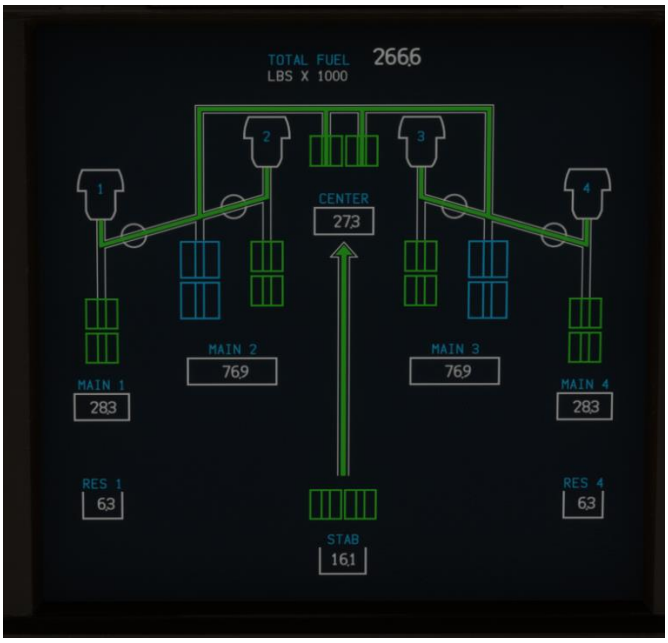
Takeoff configuration with fuel in the center tank

If there is fuel in the center tank on takeoff, every pump switch should be turned on (stab only if there is fuel in the stabilizer tank) and the system will automatically close crossfeed valves 2 and 3, as well as command the override pumps off (they will be "armed", cyan). The override pumps will remain armed while the center tank feeds the engines. The crossfeed valves will be automatically opened after takeoff.



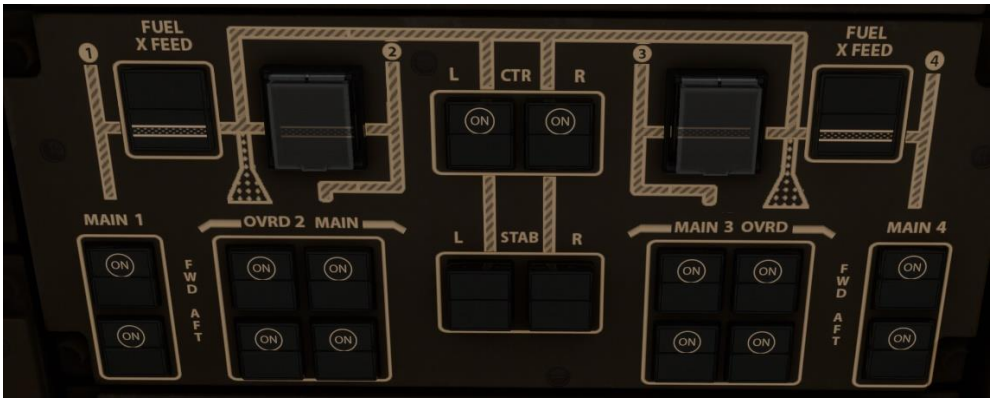
Fuel in the stabilizer tank

The stabilizer tank, besides providing additional fuel capacity, can be used to move the CG towards the aft. While there is fuel in this tank, the stab pumps should be turned on, and the fuel system will manage the pumps and transfer fuel from the stab tank to the center tank.



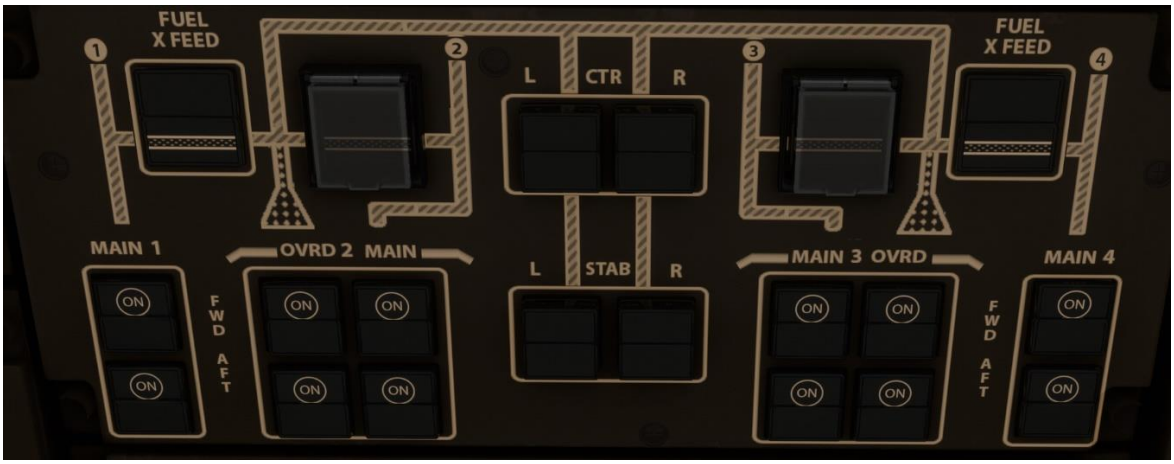
When the stab tanks are commanded off by the system, but the switches are on, they are in "armed" state and will display in cyan on the synoptics.

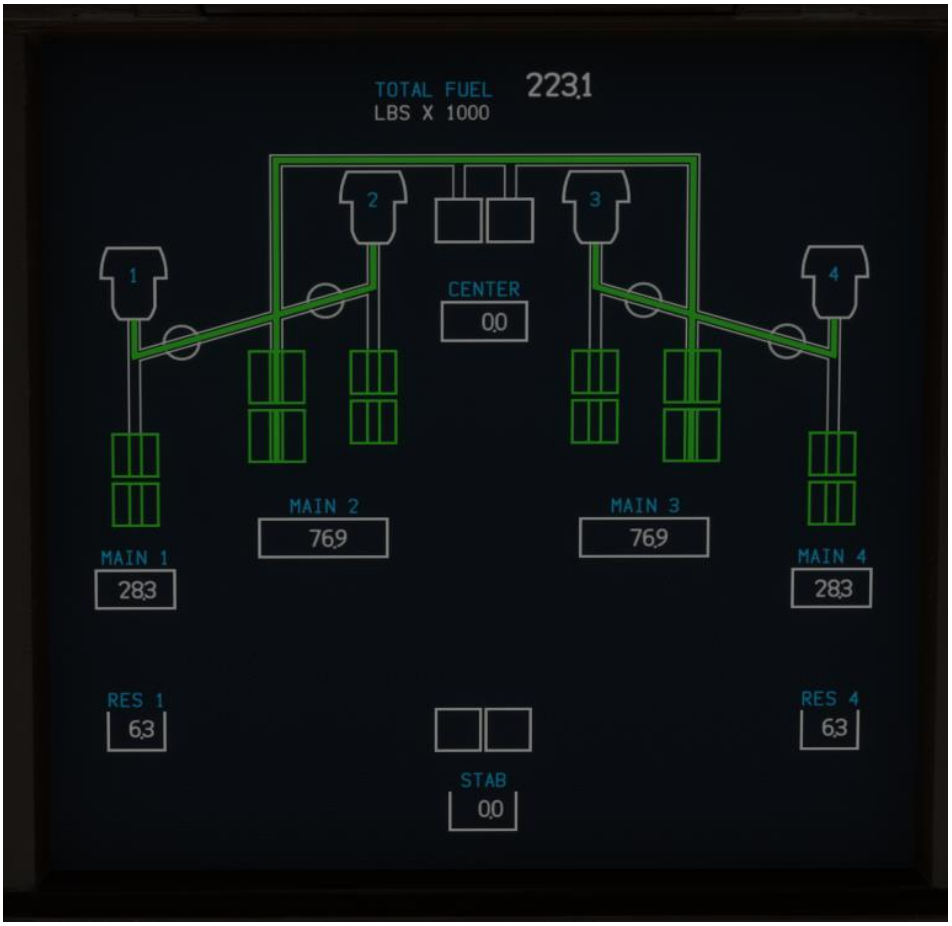
The stab pumps should be turned off if the stab tank is empty.



Center tank empty

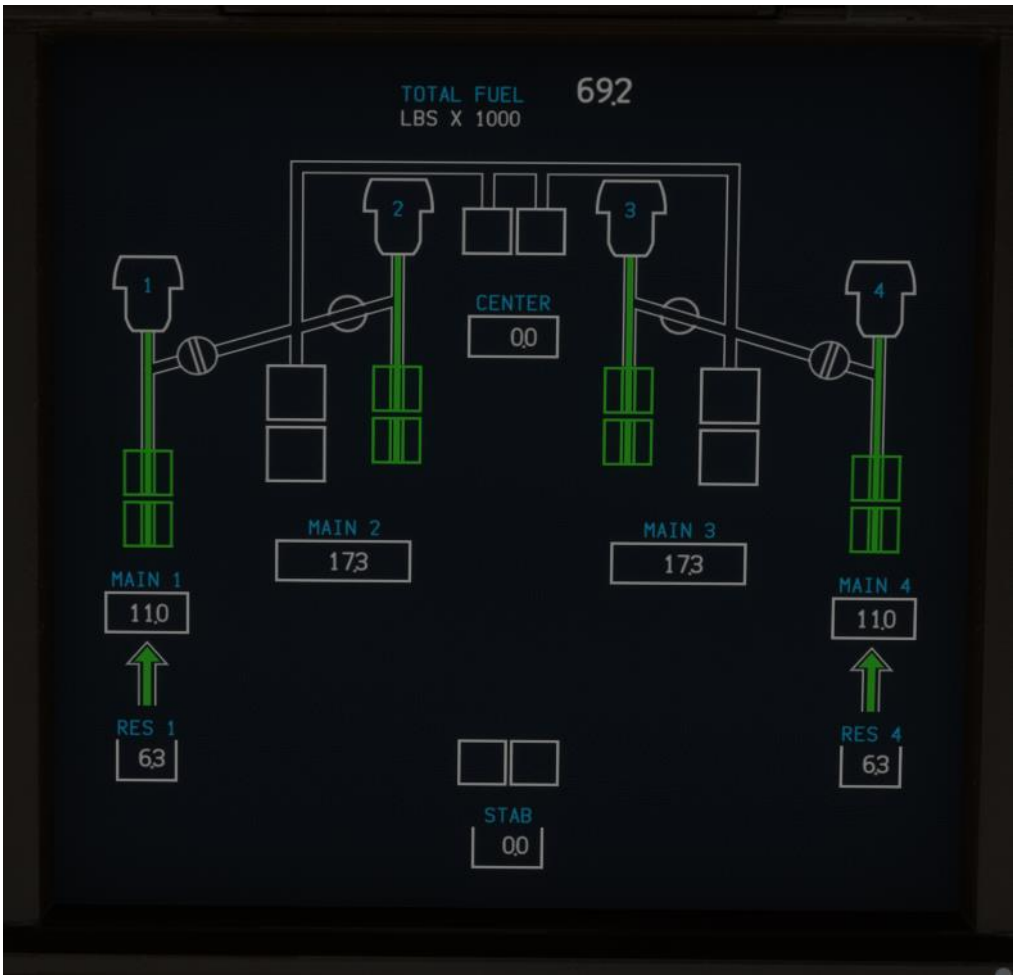
When the center tank is empty, but the inboard mains (2&3) have more fuel than the outboards, the override pumps, using a higher pressure than the regular main pumps, will feed all four engines through the crossfeed valves. In this stage, crossfeed 1 & 4 should be open. Crossfeeds 2&3 are automatic (their switches are under a guard cover), and should never be closed under normal circumstances.





Tank-to-Engine

When the inboard mains have reached a fuel level that is equal to the outboard main + reserve tank quantity, and the center and stab tanks are also empty, the plane has reached the Tank To Engine state ("FUEL TANK/ENG" on the EICAS). When that happens, the override pumps must be turned off and crossfeed 1&4 closed. When this is done, each main tank will feed its corresponding engine directly. The plane should stay in this state until landing.

Reserve tanks

The fuel in the reserve tanks will be gravity transferred automatically into the outboard mains (1&4) when their fuel level falls below 13 400 lbs.