



CREW OPERATIONS MANUAL

Expansion for Flight Simulator X: Steam Edition



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Please note that Flight Simulator X: Steam Edition must be installed correctly on your PC prior to the installation and use of this 747-200/300 simulation.

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INTRODUCTION

Everybody's favourite airliner is taking to the skies in a jumbo-sized package for FSX. Commercial Level Simulations bring you the -200 and -300 versions in superb High Definition (HD), and with a great range of liveries and three engine variants, this collection represents great value for anyone who wants to handle some heavy metal.

- 24 highly detailed passenger and cargo exterior models.
- 4 HD airline liveries including manufacturer livery.
- 50 cockpit sounds that include system sounds and a talking First Officer
- Custom 3D landing and runway turn-off lights
- High quality interactive 3D Virtual cockpit (VC)
- 2D panel with custom gauges
- Custom engine reverser spray effects
- Option for showing the wings from the interior view (wingview)
- Pushback truck (can be switched on/off)
- Air stairs for passenger models
- Dynamic wing-flex
- Authentic animations; Passenger doors, cargo doors, flaps, rudder, elevators, undercarriage, engine fans, thrust reversers and spoilers
- High quality individual sound sets
- Detailed flight deck when seen from the exterior.

History

The Boeing 747™ can trace its history back to a failed attempt to produce a military transport aircraft during the 1960s. Although Boeing's CX-HLS proposal was turned down in favour of the Lockheed C-5 Galaxy, it paved the way to fulfilling a requirement from the airline industry for a much larger airliner than the popular 707.

The 747™ first flew in 1969, went into service in 1970n and is still flying today, albeit in a much-modified form. However, it is worth noting that it was never intended to be particularly long-lived. Air transport was expected to go supersonic in the 1970s and so the 747 was designed with conversion to a freighter variant in mind, thus staving off obsolescence. Sadly, although not for the Jumbo, supersonic travel never made it to mainstream operations and the 747 is still plying the world's airways.

Dimensions (Boeing 747-200™)

Height	63ft 5in
Length	231ft 10in
Span	195ft 8in (211ft 5in, 213ft – fueled)
Engine to Ground Distance	Minimum -- 3ft 9in Maximum -- 4ft 6in
Fuselage to Engine Distance	39ft 9in (255in)
Landing Gear	Track – 12ft 7in (inner main gear) 36ft 1in (outer main gear) Wheelbase – 84ft 0in

Performance (Boeing 747-200)

Maximum Fuel Capacity	52,410 US gal (199,158L)			
Maximum Range	7,900 statute miles (12,700km)			
Typical City Range	New York – Tokyo Bangkok – Paris London – Johannesburg			
Maximum take-off weight	833,000lb (374,850kg)			
Range and Target Fuel Burn				
	Boeing 747-200	General Electric	Pratt & Whitney	Rolls-Royce
Fuel Burn - 4 Engines - PPH	23,320	22,628	22,440	
Range	6,370 nm	6,560 nm	6,620 nm	

INCLUDED AIRCRAFT

The following aircraft are included in this 747-200/300 simulation:

747-200 (Passenger) model

747-200 with GE engines

- House
- KLM

747-200 with P&W engines

- House

747-200 with R-R engines

- House
- Virgin Atlantic

747-200 (Cargo) model

747-200F with GE engines

- Air France Cargo
- House

747-200F with P&W engines

- House

747-200F with R-R engines

- House

747-200F (new wing fairing) with GE engines

- House

747-200F (new wing fairing) with P&W engines

- House

747-200F (new wing fairing) with R-R engines

- House

747-200M with GE engines

- House

747-200M with P&W engines

- House

747-200M with R-R engines

- House

747-300 (Passenger) model

747-300 with GE engines

- House
- KLM

747-300 with P&W engines

- House

747-300 with R-R engines

- House

747-300 (new wing fairing) with GE engines

- House

747-300 (new wing fairing) with P&W engines

- House

747-300 (new wing fairing) with R-R engines

- House

747-300 (Cargo) model

747-300F with GE engines

- House

747-300F with P&W engines

- House

747-300F with R-R engines

- House

747-300F (new wing fairing) with GE engines

- House

747-300F (new wing fairing) with P&W engines

- House

747-300F (new fairing) with R-R engines

- House

INSTALLATION

Installation is handled by Steam after purchase of the product. After purchasing the product the files will be downloaded and installation into the Scenery Library will be automatic.

Accessing the aircraft

To access the aircraft in FSX:

1. Click on 'Free Flight'
2. Select 'Commercial Level Simulations' from the 'Publisher' drop-down menu
3. Select 'Boeing' from the Manufacturer drop-down and choose one of the variants

Tick the 'Show all variations' box to see all the available liveries.

Updates

Updates to the product will automatically be deployed, downloaded and installed via Steam to all users who own the product.

Technical Support

To obtain technical support (in English) please visit the Support pages at justflight.com. As a Just Flight customer you can obtain free technical support for any Just Flight or Just Trains product.

For support specifically on the Steam version of the add-on please contact Dovetail Games.

<https://dovetailgames.kayako.com/>

Regular News

To get the latest news about Just Flight products, sign up for our newsletter at justflight.com/newsletter.

You can also keep up to date with Just Flight via Facebook (facebook.com/justflight) and Twitter (twitter.com/justflight).

PAINT KIT

A paint kit is available for 747-200/300 HD FSX in the Support section on the Just Flight website. This contains .psd files for the various models in separate folders.

Note: *Paint kits are intended for experienced users who have the necessary knowledge and software to be able to add new variations to existing aircraft and of the special file formats required. The layered files supplied are in PhotoShop (.psd) format.*



PANEL GUIDE

Primary panel (replicated on First Officer's panel)



1. Airspeed indicator – showing indicated airspeed in knots and current Mach number
2. ADF pointer
3. VOR 1 and VOR 2 DME indicator
4. Artificial horizon and Flight Director guidance
5. HSI – showing heading and course guidance
6. NAV 1 and NAV 2 tuning
7. Flight Mode Annunciators – showing current autopilot and autothrottle modes
8. Altimeter
9. Vertical Speed Indicator encompassing TCAS indications
10. Control surface deflection indicator
11. Radar altimeter
12. Flight Director switch
13. Autothrottle engage paddle

14. Autothrottle speed window
15. Autothrottle mode switch
16. Autopilot engage paddles
17. NAV 1 course
18. Autopilot heading window
19. Autopilot navigation source
20. Autopilot tracking mode
21. NAV 2 course
22. Vertical speed thumbwheel
23. Vertical speed indicator
24. Altitude Select
25. Autopilot Altitude/VS engage
26. Back-up artificial horizon
27. Flaps indicator
28. Temperature gauge
29. Engine instruments
30. Annunciator panel
31. Landing gear extend/ retract handle
32. Simlcons panel switchers – see below:

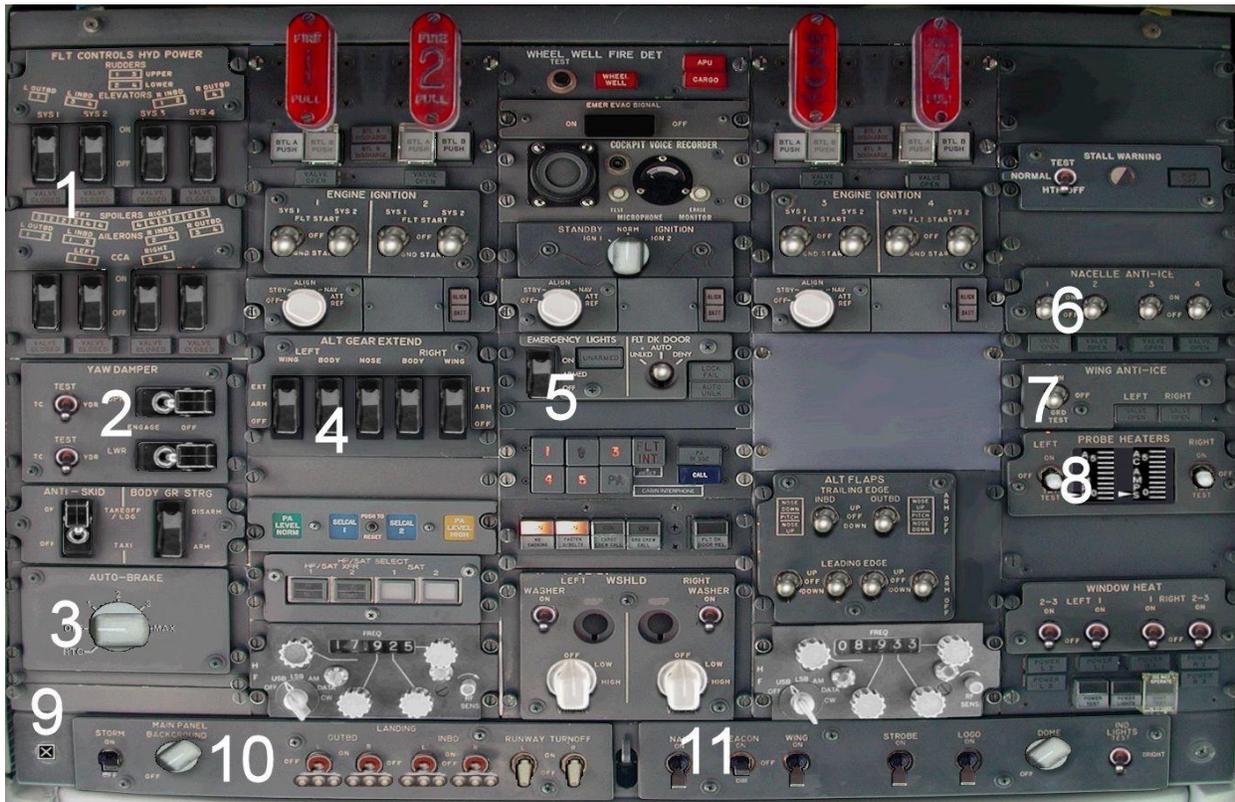
Simlcons



From left to right:

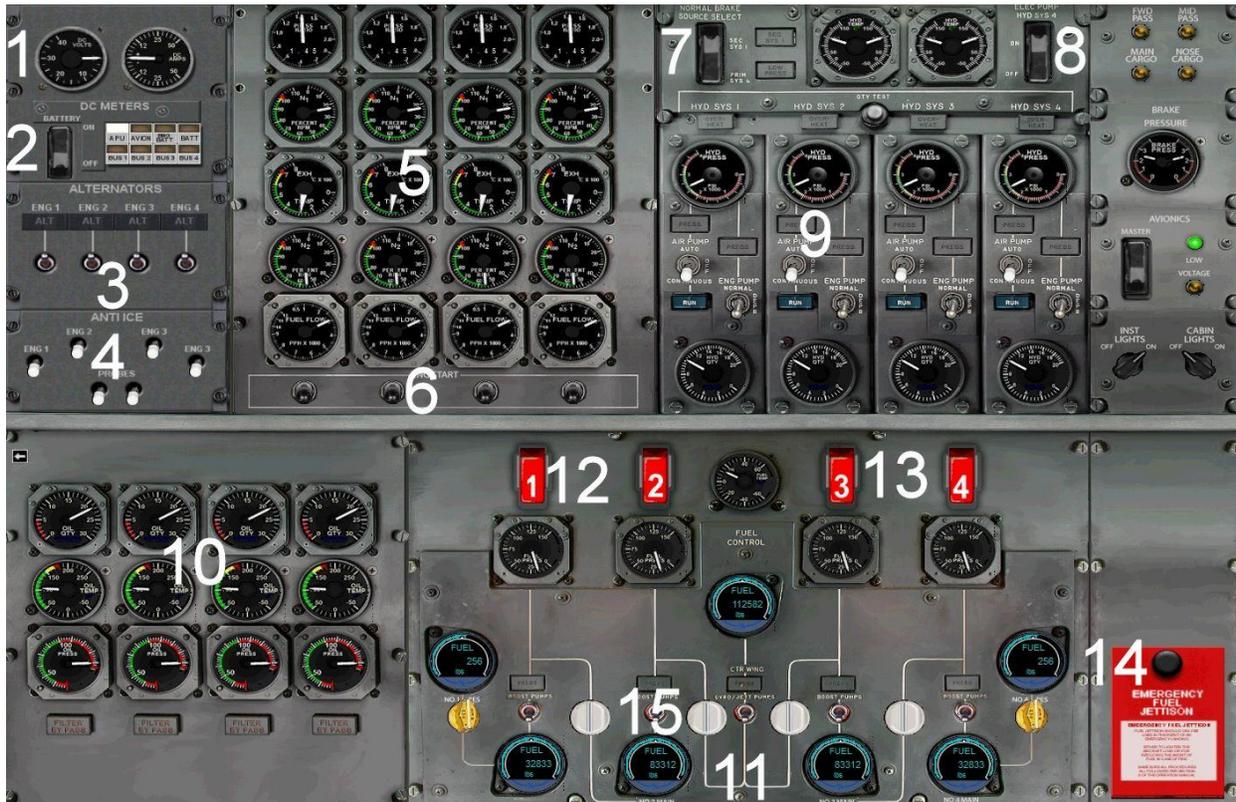
ATC	Click to open ATC dialogue
Kneeboard	Click to open Kneeboard
World Map	Click to open World Map
GPS	Click to open GPS
Overhead	Click to open Overhead panel
Radio	Click to open Radio panel
Throttle	Click to open Throttle panel
Engineer	Click to open Flight Engineer's panel
VC	Click to enable or disable VC – toggles Wingview
Doors/Feature	Click to open Doors and Feature panel
FMC	Click to open the FMC panel
F/O Panel	Click to switch to First Officer's panel

Overhead panel



1. Hydraulics
2. Yaw damper switches
3. Autobrake mode selection
4. Alternate gear extend
5. Emergency lighting switch
6. Engine anti-ice
7. Wing anti-ice
8. Probe heaters
9. Close panel icon
10. Panel lights
11. External lights

Engineer's panel



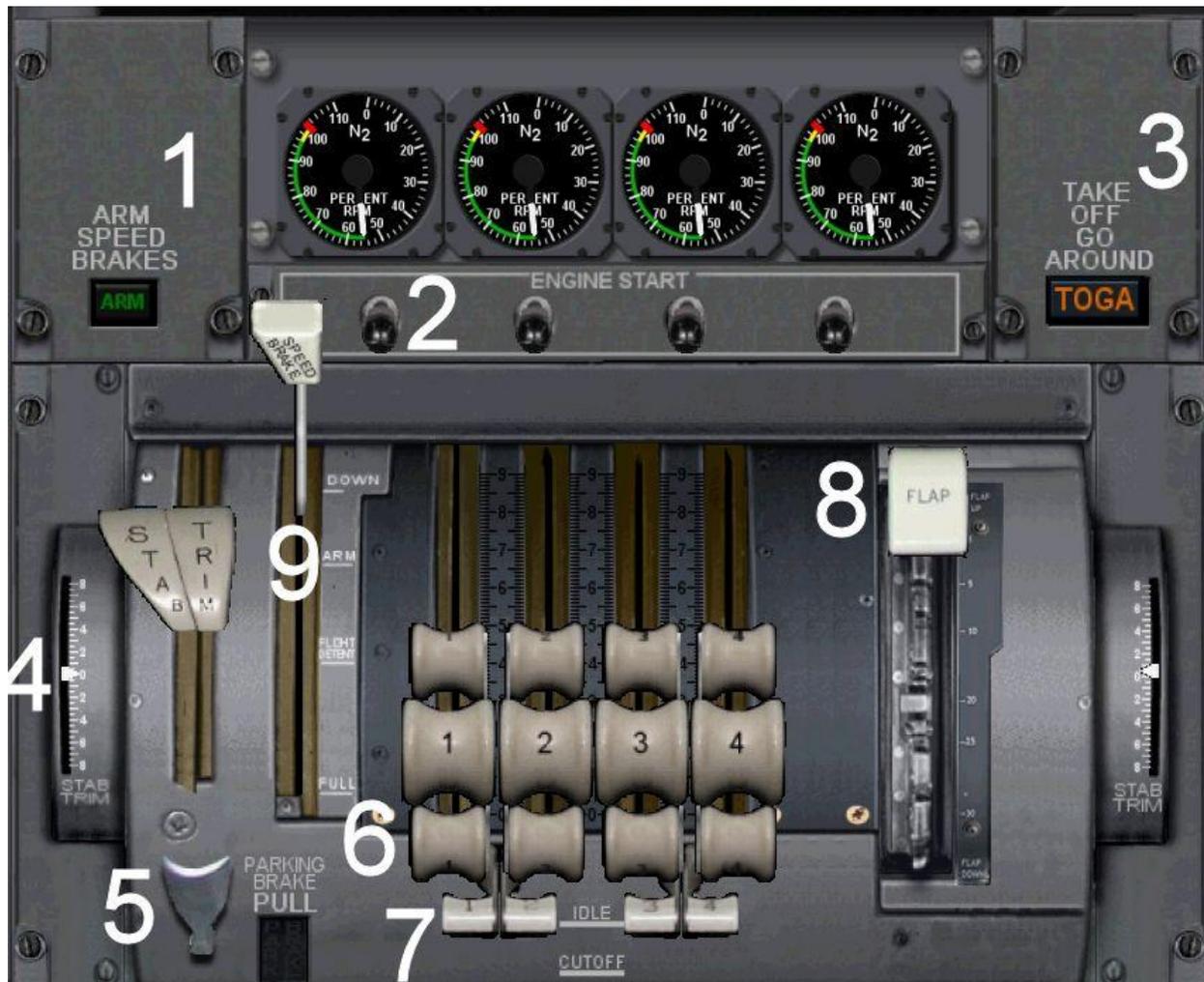
1. Voltmeters
2. Battery switch
3. Electrical alternators
4. Anti-ice switches
5. Engine indicators
6. Engine start switches
7. Normal brake source select
8. Electrical pump
9. Hydraulic control switches
10. Fuel system indicators
11. Fuel quantity indicators
12. Engines 1 and 2 fuel control switches
13. Engines 3 and 4 fuel control switches
14. Fuel dump system
15. Fuel pump control switches

Radio panel



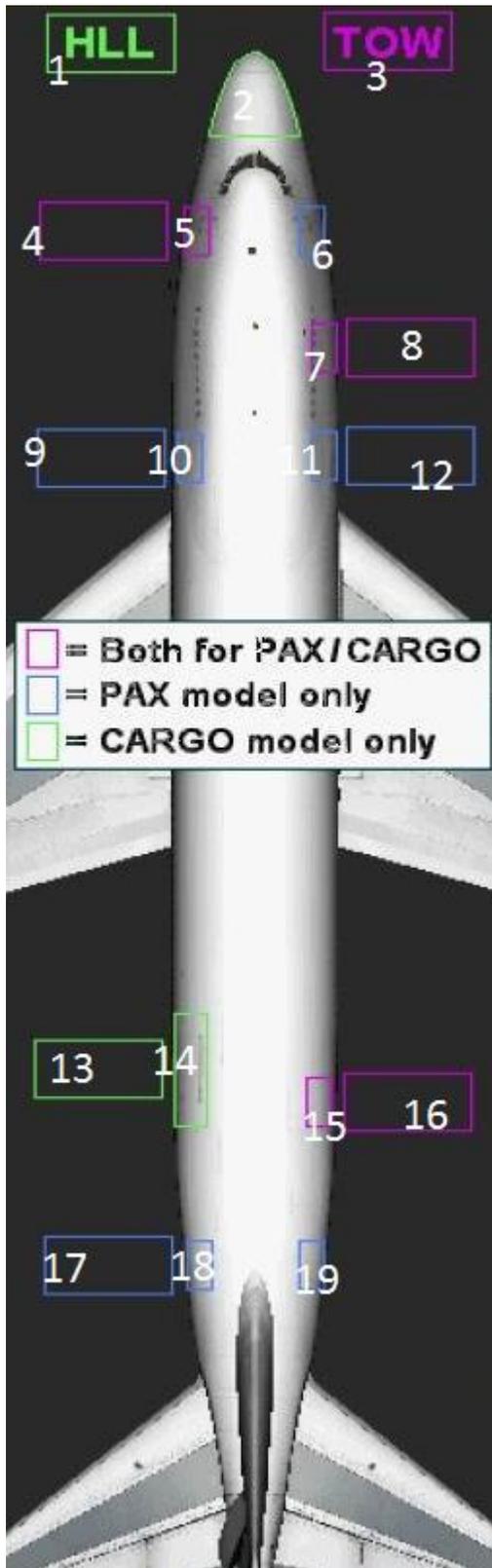
1. ADF frequency tuner
2. NAV 1 frequency
3. COM 1 frequency
4. NAV 2 frequency
5. COM 2 frequency
6. Transponder squawk code tuner
7. TCAS ON/OFF

Throttle panel



1. Speedbrake arm button
2. Engine starters
3. TOGA (take-off/go-around) switch
4. Stabiliser trim handle and indicator
5. Parking brake handle
6. Thrust levers
7. Fuel cut-off switches
8. Flaps lever

Doors and Features panel



1. High Lift Loader activate/deactivate (freighter model only)
2. Cargo nose door open/close (freighter model only)
3. Pushback truck
4. L1 Door airstair
5. Open/close L1 door
6. Open/close R1 door
7. Open/close R2 Door
8. Catering truck
9. L2 Door airstair
10. Open/close L2 door
11. Open/close cargo door
12. Cargo loading Equipment
13. Cargo loading Equipment
14. Open/close large cargo door (combi and freighter only)
15. Open/close cargo door
16. Cargo loading Equipment
17. Catering truck
18. Open/close L4 door
19. Open/close R4 door

FLIGHT MANAGEMENT COMPUTER

The FMC (Flight Management Computer) utilises the internal flight planner in Flight Simulator and so no lengthy procedure is required to input a flight plan into the FMC. Once you have established a flight plan within the default flight planner it is immediately accessible in the FMC. The aircraft autopilot can be slaved to follow the route and the pilot can view enroute waypoints and other critical flight critical information through the FMC pages.



There are essentially two different means of selecting the different pages in the FMC; one is by using the LSKs (Line Select Keys) to the left and right of the display screen on the Main Menu. In this manual we will use the following convention when discussing Line Select Keys:

Each key will be referenced by L or R, denoting its position to the left or right of the CDU display. The prefix number denotes the position of the key within the column. For example, 1L refers to the first key on the leftmost column, and 2R refers to the second button down on the right-hand side of the display.

Alternatively pages can be selected from the Main Menu by selecting the 'Menu' button on the far right on the second row of buttons under the display screen.

To view the Status page, for example, you can press LSK key 2L and then the following screen will be displayed:



To return to the Main Menu, press the 'Menu' button on the second row below the screen.

The two rows of buttons under the display screen can also be used to select different pages. If, say, you want to display the page to set the radios, simply press the RAD/NAV button and the following page will be displayed:



When inputting data that has decimal places (such as radio frequencies) into the FMC, ensure that you enter the decimal point AND both digits after the point. To change the Com 1 frequency, for example, to 121.80, enter the digits with the numerical keypad, making sure you enter the eight and the following zero.

To input the value into Com 1 press LSK 2L.

To use the 'Direct To' feature, select the 'DirTo' button on the first row under the display screen:



To fly direct to SITET, for example, skipping the waypoints SFD, BENBO and DRAKE, first press LSK 5L; this loads the waypoint SITET into the buffer at the upper left.

Now press LSK 1L to finish the command. Your flight plan will now fly directly to SITET, skipping over the other waypoints when the autopilot is slaved to the FMC.

Another feature in the FMC is the ability to calculate and display the V-speeds and approach speeds for the aircraft at its current weight. You can bring up this page by pressing the TOFF/APR button:



Pressing LSK 1L will calculate your V-speeds using your current weight and air density.

Pressing LSK 6R will take you to the approach speed page where you can calculate those speeds too.

When viewing the 'F_Pln' pages you will note the arrow pointing to the right. By utilising the Page Right key above the numerical keypad you can go to the second page of data for the flight plan waypoints.

On the first 'F_Pln' page you can press the LSK to the left of the waypoint and additional data on that waypoint will be offered:



For example, if we want to see the data for BENBO, we would press LSK 3L. The data for BENBO is then displayed. To return to the previous flight plan page, press LSK 6R.

The 'Prog' page is where you input another set of data used by the FMC:



Here you can input your reference speeds and altitudes along with MDA (Minimum Decision Altitude) which will set the bug on your radar altimeter.

Pressing LSK 6R will take you to the fuel prediction page:



This page will show you the estimated fuel on board at the next waypoint and your destination. You can change the display values for the Gross Weight to lb (pounds) or Kg (kilograms) by pressing the [P] key for pounds or the [K] key for kilograms.

You can set the FOB (Fuel On Board) for lb, Kg, litres or gallons by pressing the [P], [K], [L] or [G] keys.

There are other pages such as 'Init' which give you info such as the carrier and flight number. In 'Data' you will find wind speeds and vectors, current temperatures and so on.

FLYING THE BOEING 747

London Gatwick to Palma

To help you get to grips with flying the Boeing 747 here's a flight tutorial which will take you on a scenic shuttle flight from London Gatwick to Palma in Majorca. Our mighty Boeing 747 can remain airborne for over 12 hours, but the 747 has often been pressed into service on short haul charter flights such as this one.

For many years the Boeing 747-200/300 was a long haul stalwart for many of the world's airlines until it was replaced by the more modern 'glass cockpit' Boeing 747-400. Over the years the Boeing 747 was updated, especially in the area of navigation, and our Boeing 747 package includes a Flight Management Computer (FMC) which was retrofitted to most of the early Boeing 747 family, replacing the more cumbersome INS (Inertial Navigation System).

In the real world our 747 would have a complement of three flight crew but we are able to ease the pilot's workload as the role of the Flight Engineer is handled automatically by the simulator software during flight and the pilot's tasks have also been simplified. This is most evident in the modelling of the flight management computer. Any flight created within the FSX flight planner will automatically be transferred to the FMC and will be immediately ready to fly.

Fuel and flight plan

We'll first set up our flight plan to Palma.

Choose a 747-300 and park it at a gate of your choice at Gatwick (EGKK). Set the fuel to 50% full using the Flight Simulator refuelling menu. Rather than getting involved in the intricacies of the fuel system, it is probably easiest for the purposes of this tutorial flight to simply allocate 50% fuel to each tank to achieve the desired fuel load. Once you have done this, clear all the weather in the simulator as it will be an unnecessary distraction. For the same reason, also turn off all AI traffic using the simulator options menu.

Open the integral flight planner within the simulator and set up a flight from EGKK Gatwick to LEPA Palma. Select the 'IFR flight' and 'high altitude airways' options before creating the flight plan. A flight plan will be created within the simulator and displayed on the map screen. At the bottom of this screen adjust the cruising altitude to 31,000ft and save the flight plan. You will be asked if you want to move the aircraft to the active runway at Gatwick but, as we are content at the gate, decline this option.

This tutorial can be flown either from the virtual cockpit or with the 2D panels. The choice is yours, but if you fly with the 2D panels, the bank of icons on the main 2D panel will be your gateway to the various aircraft systems. If you fly from the VC, it is simply a matter of panning your viewpoint.

Throughout this tutorial we will refer to the selection of various icons. If you are flying from the VC you can read this as an instruction to pan your view to the appropriate part of the cockpit rather than to press a panel icon. The only exception to this is the engineer's station, which is only accessible from the 2D panel but will only be used before we taxi for take-off and after landing.

Pre-flight preparations

Our flight plan has been automatically entered into the FMC, but before we take a look at it we should establish aircraft power with the APU (Auxiliary Power Unit) power as quickly as possible.

Open the engineer's panel, but don't worry too much about the number of gauges, switches and dials – for this tutorial we will not need to delve too deeply into their workings. As your confidence increases you may wish to explore this panel in more detail, but for this flight it is not necessary.

When there are specific tasks you need to perform as part of our checklist procedures they will be **highlighted in bold**. These are specific items you need to follow. The first of these is starting the APU

PARKING BRAKE – ON

BATTERY – ON

The battery is required to start the APU and can be found as a toggle switch towards the top left of the Engineer's panel. With the parking brake on and the battery on while you are on the ground with no engine power, the APU is automatically started with power established for us. This is a specific F-Lite feature of this aircraft.

Now that we have power safely established, we can return to the main panel and confirm that our flight plan is indeed in the FMC. Open the FMC using the icon below the autopilot glareshield. You will be presented with the main menu of the unit. Ignoring all the other functions for the moment, you should see the 'FLT PLAN>' option on the right of the unit to view the flight plan. Click on the FMC button immediately to the right of this prompt and the flight plan display should be opened.



Our flight plan to Palma will have been automatically entered here when we created it earlier. There is more than one page of waypoints, which can be scrolled using the UP and DOWN ARROW buttons on the FMC keypad. Scrolling up and down will allow you to view the entire flight route.

We can now go ahead and request clearance from ATC, using the built-in ATC function of FSX. For many flights this default ATC can be a hit-and-miss affair, but fortunately for us it proves to be an asset for this flight, with the ATC controllers giving us both departure vectors to join our route and vectors to line us up with our arrival runway at Palma. This will avoid the inconvenience of calculating an approach route or referring to STAR (Standard Terminal Arrival) charts to navigate us safely to Majorca.

This tutorial is focused on flying the aircraft rather than on chart reading and navigation, but as you gain experience with the aircraft then feel free to fly by the charts. Our routing today will take us out over the English Channel and over the full length of France before crossing into Spain. A short hop from the Spanish coast will bring us onto our final approach into Palma. We can expect a flying time of just under two hours.

The ATC controller will give us our initial heading (following the runway track), an initial altitude clearance and our transponder squawk code. Acknowledging this will automatically tune our radios and set the transponder code as per the request. If you wish to tune the radios yourself, however, open the radio panel using the icon and do so. The primary communication radio COM1 and the transponder panel are both tuned from here by simply clicking the associated rotary knobs.

COMMUNICATION RADIO – SET

TRANSPONDER – SET



You will have been given an initial climb altitude, and we can enter this directly into the autopilot as we will be flying using the auto-flight functions of the aircraft. The altitude window is the rightmost window on the autopilot panel, marked as ALT SEL, at the bottom right of the glare shield.

Dial in the altitude requested by ATC using the mouse over the rotary knob immediately below the window. Immediately to the left of this window is a vertical thumbwheel. This controls our desired vertical speed. The actual vertical speed set can be seen in the VS window above the ALT SEL window. Adjust the thumbwheel until a vertical speed of 2,000 feet per minute is indicated in the VS window.

While we are configuring the autopilot we can return to the FMC to calculate our take-off reference speeds. Open the FMC and press the button marked TOFF/APR (Take-off/Approach). At the top left of this page is an option to automatically calculate our take-off speeds, saving us an awful lot of time! Press the button to the left of this prompt and our take-off speeds will automatically be shown on this page as V1, Vr, and V2.

For the uninitiated, a simple explanation of V1 is the speed at which we are committed to the take-off roll. Beyond V1, except in the direst emergency, we should take the aircraft into the air to deal with all problems as there won't be enough runway left to stop safely. There are very few major emergencies that would warrant an attempt to apply the brakes after V1, and even the loss of an engine would still be dealt with whilst airborne.

Vr is our rotation speed, the speed at which we pull back on the yoke (or joystick) to become airborne.

V2 is our safe initial climb speed, which we need to enter as a target speed in the autothrottle system. The speed window is the first window on the glareshield. Add 10 knots to your V2 speed and enter this total into that window. (If your calculated V2 is 144, for example, enter 154 in this window). Pilots add 10kts as an additional 'comfort zone' during the take-off. That only leaves the heading window to be prepared ahead of flight and this will be done as we take the runway for departure, aligning our chosen heading with the runway centreline heading.

AUTOPILOT ALTITUDE – SET AND CHECKED

VERTICAL SPEED – ARMED 2,000 FPM

AUTOTHROTTLE SPEED – SET AND CHECKED

We can also calibrate our altimeters to the current outside air pressure. The easiest way to do this is to simply press the [B] key within the simulation.

ALTIMETERS – SET AND CHECKED

Engine start and pushback

We are now ready for engine start and can take a short break before pushback. When you are ready, call ATC and ask them for taxi permission to the active runway. If ATC offers you a runway other than runway 26L, use the ATC menu option to request that runway. Once permission is received, we can use this as the cue for engine start and pushback. If you have no interest in engine start sequences you can automate the whole process with the **[CTRL]-[E]** keys and skip forward past the manual start procedure.



Each airline has its own procedure for engine starting, but to keep things simple in this tutorial we will work from right to left, with engines 4-1 in that order. Pushback using **[Control]-[P]** and align yourself with the direction in which you need to taxi to reach runway 26L. Once satisfied that you are in a position to begin to taxi, engage the parking brake and we will start the engines. For your first flight it is easier to pushback first and start the engines later, but as you become more proficient with the 747 you may want to start the engines during the pushback itself.

Open the overhead panel with the icon to switch on the beacon to warn ground crews of our intent to pushback and start.



BEACON – ON

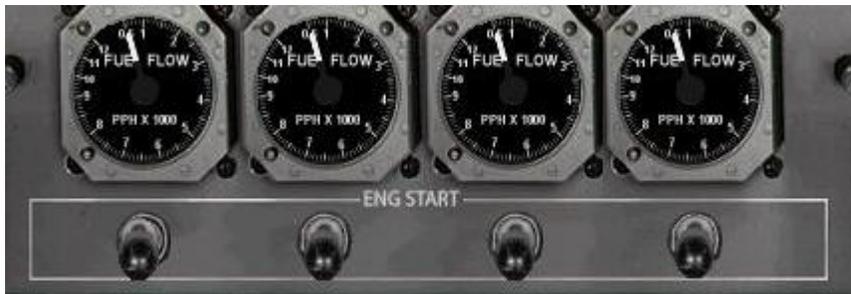
Also open the pedestal panel which can be overlaid simultaneously. Below the thrust lever for each engine is a small orange fuel cut-off switch, one for each engine. Before we start the engines we need to ensure that these cut-off switches are set to OFF (the down position towards the bottom of the screen). Do this now with a mouse-click on each one.

FUEL CUT-OFF SWITCHES – OFF

We can now start each engine in turn, starting with number 4.

Open the engineer's panel using the icon. At the top centre left are the four engine start switches.

ENGINE 4 START SWITCH – ON



After about 10 seconds to allow the engine to start to spool up, we can apply the fuel. The four fuel control switches are at the centre of the panel. Setting the fuel control switch to ON will flip the switch and cover it with a red switch guard.

FUEL CONTROL SWITCH 4 – ON



On the pedestal panel flip the fuel CUT-OFF switch to ON for engine 4.

ENGINE 4 – FUEL CUT-OFF SWITCH – ON

Starting the other three engines is simply a matter of repeating the process with each engine switch in turn.

You have now started all the engines and we are almost ready to depart. We just need to do a little housekeeping with the systems before taxi.

Open the engineer's panel and connect the engine generators to the electrical system. This is done using the four ALTERNATOR switches at the top left of the panel.

ALTERNATOR 1 – ON

ALTERNATOR 2 – ON

ALTERNATOR 3 – ON

ALTERNATOR 4 – ON



Our next task is to establish the four hydraulic systems. The hydraulics section of the engineer's panel is located at the top right. Starting with system 4, flip the **AIR PUMP** switch to **AUTO** and the **ENGINE PUMP** to normal.

HYD SYS 4 – AIR PUMP – AUTO

HYD SYS 4 – ENGINE PUMP – NORMAL

Working right to left, repeat the process for the other three engines.



If all this switching is getting too complicated, remember that you can take it at your own pace, or not at all. Starting the engines with [Control]-[E] means that you do not have to open the engineer's panel at all and can assume that the Flight Engineer is taking care of all this!

We can now return to the overhead panel to finalise our lights and instrument heating. (Welcome back to those of you who skipped the engine start procedure.) We will also engage the yaw dampers – this stops the aircraft from 'dutch rolling' which is a particularly nauseating yawing motion that would outdo any unpleasant fairground ride you care to mention. The yaw dampers will be guarded when armed.

YAW DAMPERS – ON

NAV LIGHTS – ON

PROBE HEATERS – ON

Open the pedestal and set the elevator trim to 4.9 units up.

ELEVATOR TRIM – SET

Taxi

We are now ready to taxi to hold short of the runway given to us by ATC. Release the parking brakes and advance the thrust levers slowly to achieve breakaway thrust. The idea here is to advance the power slowly for a smooth taxi, rather than imitating a bucking bronco at a rodeo. We are quite lightly loaded with fuel so the aircraft will be much more responsive than it would be at heavier weights.

As you begin the taxi, touch the brakes lightly a couple of times to ensure that you have ample braking pressure. If it is not possible to stop the aircraft, now is the time to find out! As failures have not been modelled in this 747 simulation, all should be well, but testing the brakes is good practice nevertheless.

As soon as you are rolling smoothly, you can deploy the flaps. We can use flaps 20 for this take-off. Most airlines use 20 degrees of flaps as a matter of course for all 747 departures.

FLAPS – 20 DEGREES SET

Taxi to runway 26L and hold short. Contact ATC, request take-off clearance and we should be able to get underway. We can now turn on the TCAS system as we make our turn onto the runway. Because we have chosen not to have any AI traffic for this flight it is not strictly necessary, but it's good practice regardless. The TCAS system will alert us of any potential conflict with other aircraft and since its introduction has saved countless lives. The switch can be found on the radio panel, adjacent to the transponder code:

TCAS – ON



As you take the centreline of the runway, come to a stop and hold the aircraft steady with the brakes. You can now align the autopilot heading window with the current runway heading, so dial in the heading of the centreline now, as ATC has asked us to maintain runway heading after departure.

AUTOPILOT HEADING – SET TO RUNWAY HEADING



Arm both the autothrottle and flight director switches:

AUTOTHROTTLE – ARMED

FLIGHT DIRECTOR – ON

Both these switches can be found on the glareshield, to the left of the autopilot windows. The autothrottle switch is the first large ‘paddle’ switch and the flight director is the smaller switch to the immediate left.



We'll go ahead and set take-off power settings ahead of the take-off roll itself. On the EPR gauge of the main panel, adjust the EPR knob so as an EPR value of 1.9 is highlighted. This will be our take-off power requirement.



Take-off and climb

We can now advance the power to take-off. Carefully monitoring the power, advance the thrust levers to 1.5 EPR as indicated by the upper row of engine gauges. Once stabilised, release the brakes and apply full power as the aircraft accelerates.

Remember those V-speeds we discussed earlier? As we pass V1 take a firm hold of the yoke (or joystick) and wait for rotation. At Vr rotate gently but firmly by pulling back on the yoke and the aircraft should take to the air. Try not to be too aggressive and thus avoid a tail strike. Raising the nose of the aircraft by about three degrees per second will work out just fine.

As we achieve a positive climb, raise the gear and also engage the autothrottle into speed tracking mode.

GEAR – UP

AUTOTHROTTLE – SPEED MODE

To latch the autothrottle into this mode press the **IAS/MACH** button immediately below the altitude window of the autopilot deck until **SPD HLD** is indicated in green on the flight mode annunciator panel. This panel can be found immediately below the NAV1 tuning knob on the far left of the glareshield. The flight mode annunciator will always denote in green all of the active autopilot and autothrottle modes.

This will activate the mode where the autothrottle maintains the Indicated Airspeed desired, as the initials suggest. In this case we have selected V2+10 ahead of departure and the autothrottle will attempt to hold this speed for us.

Try and hold the nose at around 15 degrees of pitch until 1,000ft above the runway, and at that point lower the nose slightly and dial the next target speed into the speed window, which will be 210kts. As the aircraft accelerates towards this speed we can retract the flaps a notch.

Once 210kts is achieved we can now work towards retracting the flaps fully. Dial in 230kts as our target speed and retract the flaps to flaps 10.

FLAPS – 10

Once 230 knots is achieved we can finally raise the flaps completely.

FLAPS – UP

By adjusting the speed knob, accelerate the aircraft to 280kts. For many aircraft there is a limitation of 250kts when flying below 10,000ft, but the weight of our Boeing 747 makes it exempt from this rule.

We can now also engage the autopilot climb mode and heading modes. Switch on the autopilot using the **AP** master switch, to the right of the autothrottle. Both paddle switches should raise to the **ON** position. Press the **ALT HOLD** button on the far right of the glareshield so the aircraft will climb to our chosen altitude with the pre-selected vertical speed of 2,000 feet per minute. A green indicator light should illuminate as confirmation.

We can also have the autopilot follow runway heading for us. Rotate the autopilot mode selector switch to the HDG position. You can now release the yoke, as the aircraft is flying both the climb and the heading for us and we are fully on the automatics. By this time ATC will be calling us with a heading to follow towards our chosen course.

Respond to the request and simply dial the heading provided into the autopilot deck; the aircraft will turn appropriately to follow this heading.

FMA INDICATIONS – CONFIRM



We are now flying fully on the automatics and from this point our workload lessens considerably. We can now afford a quick glance outside the aircraft and we should now be heading out across the English Channel with the coast of France ahead of us.

Shortly we can expect ATC to give us a final heading that will allow us to proceed on course. When we receive the “Resume own navigation” cue from ATC we can also transfer into an autopilot mode that allows us to track the flight plan in the FMC, in a manner identical to GPS NAV mode in a light aircraft. Rotate the navigation source selector in the centre of the glareshield to GPS. This will link the route of flight in the FMC and Flight Simulator GPS to the autopilot. Rotate the autopilot mode selector knob to NAV. The aircraft will now be following the navigation course from the FMC.

As we progress through 10,000ft wind the speed in the speed window up to 330kts, which will be our climb speed until we reach cruise. Expect further altitude clearances from ATC. Acknowledge them and dial the new altitude given into the altitude window. Using the thumbwheel, reset the rate of climb to 2,000fpm and press the ALT HLD button again to begin the next climb segment.

Once you pass 17,000ft wind the rate of climb down using the thumbwheel to around 1,600fpm. A 2,000fpm rate of climb is unachievable at higher altitudes in the less dense air and we will be using 1,600fpm as our climb rate for each clearance we receive until levelling off at our cruise height of 31,000ft.

At high altitudes we fly by Mach rather than by indicated airspeed. Monitor the speed gauge closely. The Mach number is noted at the top of the gauge. When the 330kts of climb is equivalent to Mach 0.84 press the **MACH** button on the glareshield to maintain a speed of Mach 0.85.

You should now find yourself well established in French airspace. The Boeing 747 is an extremely fast aircraft and we can expect to cross into Spanish airspace in a little under an hour.



Descent, approach and landing

As we reach our top of descent, just before crossing the Pyrenees, the ATC controller will issue us instructions to descend. This is extremely helpful and avoids us having to calculate our descent path by hand. If we did not have ATC guidance a good rule of thumb is to allow three miles for every 1,000ft we need to descend.

As we start our descent we can tune the ILS for our arrival runway. We will aim for a landing on runway 24R, flying a wide sweeping arc over the island on our final approach, so let's go ahead and set up the radio frequency for the ILS.

Using the NAV1 receiver at the top of the glareshield, enter a frequency of 109.9 and a course of 239, which is our inbound course to the runway. There is no cause for concern if another runway is offered to us; simply choose the ATC menu option to select another approach and request the ILS for runway 24R. These chaps on the Spanish holiday islands are always very obliging! For this flight the ATC controller will guide us all the way around the island, offering us some stunning views along the way, and will line us up with the final approach. It makes things considerably simpler than attempting this vectoring manually.

The ATC controller will shortly start to offer headings to follow. Simply dial these into the heading window and click the heading rotary knob to reselect the autopilot heading mode. Our 747 will turn to follow each heading as it is given to us by ATC. Remember to double-check that you have selected heading mode by confirming that HDG is highlighted green on the FMA.

We will be descending in steps, following the guidance given to us by the controller. As each altitude is given, dial it into the altitude window, select a vertical speed of -2000fpm, and press the **ALT HLD** button to begin the descent. The procedure is exactly the same as the steps during climb, with the one exception of setting a descent of -2000fpm using the thumbwheel rather than a positive climb. As you start your descent, return to the autothrottle IAS mode by pressing the **IAS** button on the glareshield to maintain a 300kt descent.

As we approach 10,000ft in the descent we can start to slow the aircraft to the required 250kts; dial the speed down in the speed window. We will need to adjust the rate of descent to allow the aircraft to decelerate, so wind it back to -1,300fpm. As we approach 6,000ft we can slow down further and start to deploy our flaps. This is actually deploying flaps somewhat earlier than would normally happen, but for the purposes of this tutorial it will allow us additional breathing space in which to configure the aircraft for landing. As you become more proficient with the 747 and its handling you will be able to decelerate and follow the flaps schedule much closer to the arrival airport. As doing so can be quite hectic, this early deployment should avoid an unwanted sense of urgency interrupting the learninGExperience.

Wind the speed back to 270kts, and as 270kts is achieved deploy the first stage of

flaps. This can be confirmed by a quick glance at the flaps indicator on the pedestal. Wind the speed down to 220kts and deploy flaps 10.

As we achieve our final vector to intercept the ILS for the runway, we will be informed of this by ATC and told to maintain this heading and altitude until established on the localiser. At this point slow the aircraft to 180kts and deploy 20 degrees of flaps. We now need to arm the autopilot to track us on the localiser and glideslope of the ILS. Select NAV 1 on the glareshield navigation mode rotary switch, turning it to the left from the current GPS setting. Select APR on the autopilot mode switch immediately below. This will arm the ILS approach mode of the autopilot.

ILS APPROACH MODE – ARMED

As we cross the centreline of the runway the aircraft will automatically capture the localiser and turn us inbound on our final approach. We can now arm the autobrakes and spoilers for landing. The autobrake switch can be found at the bottom left of the overhead panel. The spoilers can be armed from the pedestal panel or by the key combination of [SHIFT]+[I].

SPOILERS – ARMED

AUTOBRAKES – MEDIUM

As the glideslope indicator starts to move down on the HIS, slow the aircraft to 160kts and deploy full landing flaps. As the glideslope centres and is captured by the autopilot, lower the gear and reduce speed by winding the speed window to our landing speed of 144kts.

GEAR – DOWN

FLAPS – FULL FOR LANDING

The HSI should now show us tracking both the localiser and the glideslope, and a view from the window will show the runway dead ahead again. We are in good shape for landing! We can allow the autopilot to take us all the way down to 200ft above the runway. At that point disconnect the autopilot paddle switch.

AUTOPILOT – DISCONNECTED

AUTOTHROTTLE – DISCONNECTED

The aircraft will continue to drift towards the runway, with only a need for slight adjustment, if any, to the yoke. At 50ft above the runway bring the power back to idle and lift the nose slightly to three degrees above the horizon on the HSI. This is our landing flare.

Shortly thereafter the aircraft should make a smooth touchdown on the centreline. The brakes and spoilers that were armed previously will now deploy automatically. Apply reverse thrust using the [F2] key until the speed reduces to 60kts and then release back to idle with the [F1] key. You can now take over manual braking with a light touch on the brakes and decelerate to 10kts as you turn off the runway.

Once clear of the runway, retract the flaps and lower the spoilers.

FLAPS – RETRACTED

SPOILERS – DOWN

The ATC controller will give us guidance to the gate. On arrival at the gate apply the parking brakes. Switch off all four engines by putting all four engine fuel control switches on the engineer's panel to the OFF position (the red guards should lift and the switches be exposed).

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Congratulations! You have flown the 747 all the way from the UK to a safe landing in Majorca. Hopefully you'll have time to take in some sun and sangria before returning to the UK!

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