IXEG

international x-plane engineering group

737 CLASSIC

Tutorial Series
Full Flight with FMS

Full Flight with FMS

RESOURCES

There is a YouTube video of Captain Jan Vogel performing this lesson. The video can be found at:

http:www.youtube.com

INTRODUCTION

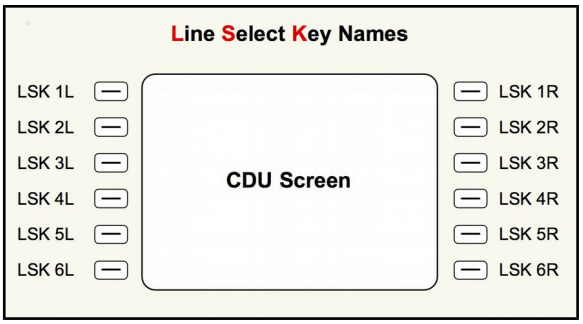
This tutorial will consist of a complete flight from Nice, France (LFMN) to Geneve, Switzerland (LSGG) and will utilize the full capabilities of the Flight Management Systems (FMS) for the entirety of the flight. This flight is particularly beautiful, being that it crosses the western Alps. During this flight, we will introduce you to the FMS´s lateral and vertical navigational features, commonly referred to as LNAV and VNAV. We will simulate a *turnaround* scenario where you are in the incoming captain, replacing the previous captain who had just arrived.

INSTRUCTOR BRIEFING

The FMS is a complex system, consisting of several components working together in order to do its job. Its primary job, of course, is to manage the flight, hence its name. Management, by its very nature, is always towards a stated objective and in the airliner business, the objective is profitability.

Part of that very complex profitability equation requires the aircraft to fly its routes as safely and cheaply as possible and the FMS combines the routing required by aviation authorities with the known performance of the 737 to generate flight parameters. Of course the captain can adjust parameters of the FMS as needed to exchange speed for efficiency, but sometimes you need speed to keep customers happy and happy customers are part of that profitability equation.

We will be entering initial positioning information, route information and performance related information into the FMS during the preflight phase in this tutorial. The FMS will then calculate an optimal, four-dimensional path in time and space and subsequently give you or the autopilot cues to steer the aircraft along this path during the flight. In addition, the FMS will estimate time and fuel values at different points along this path. During data entry, we will be using the Line Select Keys quite a bit. Refer to the image below for the names of these keys. Let's get going and see how it all works!



PREFLIGHT

FLIGHT SETUP

Using the X-Plane menus:

- Set the weather to good visibility and no clouds.
- Set the temperature to be +20C or 68F.
- Set the pressure to 1013 or 29.92.
- Set the winds to be zero or light from the northeast (i.e. 030/5).

Choose any time of day that you like; however, we suggest early morning or late afternoon for best visual effect over the alps, as X-Plane renders wonderful mountain scenery.

You will need charts to plan the flight, so consult a IFR chart for the area (*skyvector.com*). Also consult charts for the LFMN runway 04R BODRU6A SID and the VOR-05 approach at LSGG. Google may help you locate one.

Please note that real ATC procedures and their names change all the time. This tutorial reflects data as of early 2016. Depending on when you conduct this flight, the names and/or coding of may have changed. If this is the case, you will need to improvise!

Using the X-Plane menu, set the aircraft on the ramp at LFMN airport. Then, using the IXEG *preflight* menu, choose a ZFW (zero-fuel-weight) of ca. 45.000kgs (99.000lbs), a fuel load of 5.000kgs (11.000lbs) and the startup option *turnaround.*

Preflight Menu

COCKPIT PREPARATIONS

As you walk through the aircraft galley to your office, you greet the previous flight crew exiting the cockpit. The outgoing captain gives you a quick brief, *"The aircraft is fine Captain, the APU is still running though, the requested ground power hasn't arrived."* You see them off with an *"enjoy your stay in Nice!"*

The ramp agent approaches you, having noticed that the APU is running, and asks if you still want the ground power to be connected. The APU is very loud and uses a lot of fuel, so you say "*Oui, S'il vous plait!*"

- Open the ground handling menu and connect the GPU. You will see the *ground power avail* light come on.
- Move the corresponding generator switches to ON to connect both generator buses to the ground power.
- Turn off the APU bleed air, air conditioning packs and then shut down the APU.

While your first officer does the outside check, you start preparing the cockpit. Use can use the *procedure guide* to help you along if you like.

- On the pressurization panel, set a flight altitude of FL220 and landing altitude of 1400 feet.
- Enter no TASS into the FMS N1 page, we will be using full power take-off this time.
- Set up the PERF INIT page with the relevant data as shown below.

Perf Init Page

- On the RTE page 1 enter the origin airport, *LFMN* and the destination airport, *LSGG*.

RTE Page 1

Next we will enter the lateral routing, but before we do, we will go over the typical phases of flight very briefly. The whole subject of flight phases, waypoints, departures and airways can be a bit daunting and seem complicated at first. With time and practice though, it will become 2nd nature.

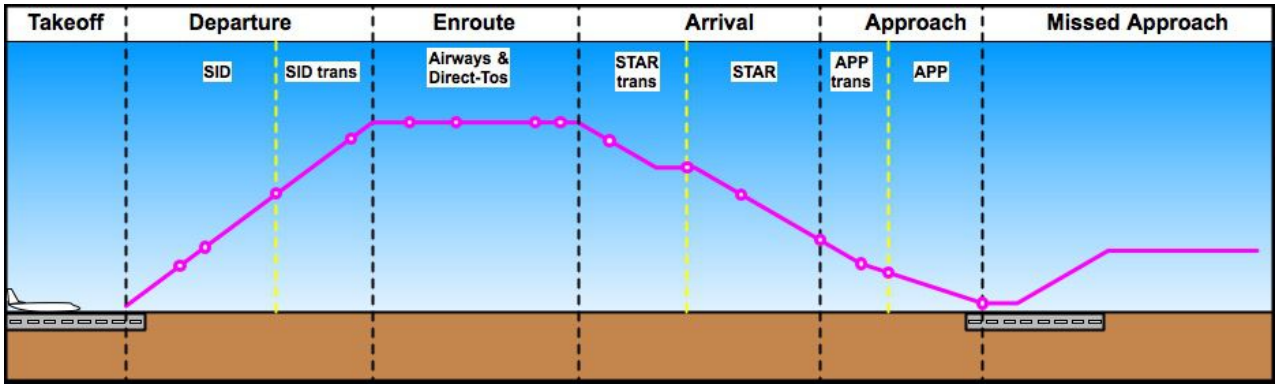
The FMS will follow a route that consists of a sequence of individual waypoints in order to guide it from the origin to the destination.

The FMS contains an internal database that holds the geographic latitude and longitude coordinates for an enormous number of points around the world, such as airports, fixes, navigation aids and so forth. Entering a long route, one point at a time, is very cumbersome, and so within its internal database, the FMS also holds information about *procedures* and *airways*, which are essentially, *groups of points*. In this way, you can enter a single procedure or an airway and the FMS will automatically put all the single points that make up those procedures and airways into the route. It is very much a convenience.

A typical route will begin with a runway at an airport. This runway waypoint is generally followed by a *Standard Instrument Departure (SID)* and possibly a *SID transition.* SIDs and SID transitions are kind of like branches of a tree, spreading out and which branch you take generally depends on which direction you are departing. This section of the route is referred to as *the departure.*

After the departure comes the *enroute* part. The enroute part consists of airways and *direct-to* points, which are simply points you head directly towards. After the enroute part of the route comes the *arrival* part. Just like with a SID, an arrival procedure may also contain a transition. Arrival procedures are called *Standard Terminal Arrival Procedures* or *STARs* for short. After the arrival comes the *approach* part. The approach again, may have a transition component or not. The approach part ends at the landing runway threshold and after the runway threshold may be a

procedure called the *missed approach*, which is a group of waypoints also. The diagram below shows all the phases of flight.



Phases of a typical flight

The flow depicted above is not rigid though, it simply depicts all the possible options. Your airport, for example, might not have any SID procedures, or it may be that the enroute part is so short that no airway is needed. Also, you might decide to just fly straight from an enroute point to the approach itself and not use any arrival procedure. Any of these combinations can be put into the FMS lateral planning and which you choose is influenced by several factors which we will cover only casually in this tutorial.

At a bare minimum though, you need to enter a destination airport and at least one waypoint to get the LNAV routing function of the FMS to work. Successful VNAV routing; however, requires more information to be input into the FMS, which we see a bit later.

Route entry into the FMS usually works best when you enter the route in the same sequence the airplane will fly; therefore, we will begin by entering the departure runway and then the departure procedure (SID).

- Select the *DEP/ARR* button on the CDU. Choose the *DEP* line for LFMN. You should see the following CDU page:

LFMN Departure Page

The FMS shows you all the runways and departure procedures that are available for LFMN. If the list is too long to be displayed on one page, which it usually is, then you can use the *NEXT PAGE* and *PREV PAGE* buttons to view all available choices. Note the page number in the upper right hand corner of the CDU screen to see if there are more pages that can be viewed.

We are wanting to fly a departure to the fix, BODRU, which is a fix in the direction of LSGG.

- Press *NEXT PAGE* until you find the SID departures associated with BODRU. They can be identified by their name, which will partially resemble the fix name they are associated with. In this case, you will see 4 departures to BODRU, all named *BODR6*, but with suffixes of A, E, W and X! So which is the right one?

The difference in these similar departure procedures is that each begins on a differing runway, but they all end at the same point, BODRU. It is not obvious at this point which SID matches which runway though. You could look it up on the SID chart, but there is an easier way using the FMS.

- Select runway 04R on the right side of the CDU.

Selecting the runway first will cause the FMS to filter and display only those departure procedures applicable to runway 04R, and will not display irrelevant procedures. If you scroll through the pages, you will find that the choice of departures for BODRU is now narrowed down to only two options for the specified departure runway.

In cases like this, when you have two procedures that both begin and end at the same point, the difference in the two is the routing between the two points. One route may be used during the night, when a noise abatement policy is in effect and another used during the day. Which to use is usually specified by ATC.

- Scroll through the pages using *NEXT PAGE*, find and select the BODR6A departure

BODR6A Departure

We have just entered the departure procedure and next we want to enter the *enroute* part. In the airline business, we generally receive our flight plans from a company dispatcher. For this flight we received the following flight plan.

```
LFMN BODR6A BODRU UN853 OKTET UM733 GIPNO DCT BELUS BELUS1N LSGG
```

The above format can be read: `From Via To Via To Via To` ....and so forth. So we are going:

From *LFMN*

(via *BODR6A* SID)	(to *BODRU*)	then
(via *UN853* airway)	(to *OKTET*)	then
(via *UM733* airway)	(to *GIPNO*)	then
(via *Direct*)	(to *BELUS*)	then
(via *BELUS1N* Arrival)	(to *LSGG*).	

- Select the *RTE* button to go to the RTE page 1.
- Use the *NEXT PAGE* button to go to RTE page 2.

This RTE page 2 shows our current routing in a condensed format similar to what is shown above, listing procedures and airways on a single line, whereas the LEGS page shows every single point in the route. You will note that the left side shows the VIA entries and the right side shows the TO entries. It is quite logical then, to enter the enroute information shown above by entering first the VIA name and then the TO name. Note that you can only enter *airways* and *Direct To* points on this RTE page. As you enter airways and TO points, the FMS will automatically populate the LEGS with relevant waypoints, pulling this information from its database. The FMS knows which waypoints are associated with which airways.

Now we have already entered the SID, BODR6A, and so all points in the SID, up to and including BODRU were automatically input for us by the FMS as well. We will now begin entering the enroute portion of the route by first entering the airway, UN853, which passes through the BODRU fix. If we tried to enter an airway that did NOT pass through the TO point on the previous line, BODRU in this case, the FMS would throw an error message and not allow that airway to be entered, so you want to be sure you have a continuous route where all VIA airways and TO points connect to one another. You can see BODR6A, our VIA, is already entered on the first line, and it is going TO BODRU.

- Enter *UN853* and put it on the VIA side under BODR6A, then enter *OKTET* and put it on the TO side under BODRU. The CDU should look as shown below.

RTE Page 2 with airway UN853

- Select the *LEGS* page. You can now see all the waypoints added by the FMS needed to

follow the airway to OKTET from BODRU.

- Select the *RTE* page and go back to page 2 to continue enroute entries.
- Enter the remainder of the route up to BELUS. NOTE: To enter a Direct TO point like BELUS, do not enter a VIA, only enter the TO point and the FMS will automatically create a DIRECT entry on the VIA side of the CDU. The RTE page should now look as shown below.

RTE Page w/Airway Entries

With the enroute portion entered, it is now time to enter the arrival and approach. Earlier in this tutorial, we were not completely honest when we said that we enter the information in the same order the plane flies. We do for the climb and enroute yes, but we generally enter the arrival and approach information *backwards*. That is, we start by selecting the approach procedure and then enter the arrival procedure (*STAR*) after. The final step after entering the STAR will be to connect the first point in the STAR to the last point in the enroute portion, if necessary. If these points happen to be the same point already, then the FMS will know that and and there will be nothing left to do for route entry. If they did not match, you would get what is called a discontinuity, or *DISCO*, but we do not cover such in this tutorial. Now truth be told, you can enter the procedures and points in any order you desire, but this is the most logical and general pattern that is typically used. Lets enter the STAR and Approach.

- Go to the *DEP/ARR* page, press *ARR* for LSGG and you should see the following:

Arrival Options for LSGG

- Select the VOR05 approach.

Like with the SIDs, when selecting an approach, the FMS will only show relevant STARs that connect to the selected approach. This filtering process also works if you select a STAR before an approach, it will only show the applicable approaches connecting to that STAR.

Now if you happen to accidentally pick the wrong procedure, then just press the *DEP/ARR* button again and go through the process again. The full list of procedures will be shown again and you can select a different procedure. You can also use this technique to preview procedure routing by choosing different ones and examining the EHSI display to see the various routings.

- Select the *BELU1N* STAR from the left side of the CDU. The CDU should now look like the image below.

STAR and Approach Selections at LSGG

You can easily review your routing on both the RTE and LEGS pages by using the *NEXT* and *PREV* keys and compare what you have entered to what you filed in the flight plan, As we showed earlier, the format on the RTE page is practically the same as the written flight plan. Your RTE page 2 should now look like this:

RTE Page with VIA and TO entries

Note that the page numbers now show *2/3.* As you add waypoints, more and more pages will automatically be added. If you go to the 3rd page, it should look like the image below.

Last page of the RTE.

One cool feature of the FMS that is used in the airline industry, is what is called a *company route*. A company route is a pre-defined route containing only enroute phase information, with all the waypoints included. You enter the name of the company route on the RTE page 1 and all the airways and enroute waypoints will be added for you. You simply need to specify the departure and arrival procedures to complete the route entry. Some routes can get up to 10 pages long or more with 30+ line entries and entering the route using a company route makes this process much less painful. In addition, you may save routes that you have entered and share them with your friends. You can find out more about entering company routes in the IXEG Pilot Handbook, Chapter 11, *Flight Management.* So, if you are satisfied with the route entered, you should *ACTIVATE* it.

- From any page of the RTE or LEGS pages, press the Line Select Key (LSK) next to the ACTIVATE prompt. This will cause the *EXEC* key to illuminate.
- Press the EXEC key to EXECUTE the route calculations. The routing on the EHSI will change to a magenta color.

Note that *activating* is a one time step for each new route entered. Unless you change the departure airport on RTE page 1 (which erases the previous route completely) and enter a new route, you will not see the ACTIVATE prompt again once EXEC has been pressed. Lets inspect all the waypoints along the route now.

- Select the LEGS button to go to the LEGS page 1
- On the left side of the center pedestal, find the map mode selector knob and turn it to *PLAN* mode. Its not labeled so you need to look for the word PLAN.
- To the right of the map mode selector knob, set the *RANGE* knob to 20.

If you now look at your EHSI map, you will see your flight plan displayed. When the EHSI is in *PLAN* mode, the map is always North UP, otherwise it is Forward Up.

Plan mode on EHSI, with North Up

Now look to the bottom right of the CDU screen and you will notice that the prompt at LSK 6R has changed to the word *STEP* and you also will see a *<CTR>* prompt at the first waypoint. This is called *STEP mode* and exists when on the LEGS page and only when the EHSI map mode is set to *PLAN*. In this mode, you simply press the button next to the STEP prompt and you can examine all the waypoints in your flight plan. Give it a try to get a feel for how it works. This is a great tool to review the part of your plan that is not on your map yet.

In examining the route, you may notice that the STAR goes over the airport (to GVA VOR) and then circles back on a downwind heading and then ends in a waypoint called *VECTORS* to the approach. What would most likely happen here in reality, is ATC would take you off the STAR as you pass CBY VOR and then vector you onto the VOR approach path.

FINAL PREPARATIONS

Alright, the route is now in the FMS and it is time to complete the setup for this flight. The passengers are all on board and are getting really hot. It is time to start the APU and get some air conditioning going!

If you performed the previous tutorials, you should be familiar with the steps needed to get everything ready. Consult the *Normal Procedures* to help you along and check that you completed everything.

- Perform the *PREFLIGHT* checklist,
- Perform the *BEFORE START* checklist.

START-UP AND TAXI

Once you are ready to go, you receive start-up clearance from ATC and begin the pushback. Start the engines, configure the plane for takeoff and taxi to runway 04R and prepare for departure.

FLIGHT OPERATIONS

TAKE-OFF AND DEPARTURE

For this departure, we will be using the autopilot and FMS as much as possible. The instructions that follow only relate to operation of the FMS. By now, we expect that you know how to perform a takeoff and the relevant procedures to be performed during and after takeoff from previous tutorials.

- Turn on both FD switches, beginning with the pilot side first.
- Set the auto-throttle switch to ARM.
- Takeoff, ensure auto-throttle engagement in N1 mode, maintain @ 17 degrees pitch.

To keep the noise away from the rich and beautiful in Nice, we need to make a turn towards the sea immediately after takeoff. We cannot engage LNAV until we are at least 400 feet AGL. Normally, you would direct the call to engage LNAV to your copilot, but of course we do not have one and so, in order to be ready quickly, we suggest you position the mouse cursor over the LNAV button on the MCP. An even better option is to assign a joystick button to the custom IXEG command, *LNAV_mode_toggle*. That way you can concentrate on flying while switching the *flight director* lateral mode to LNAV.

- Above 400 AGL, engage *LNAV* mode.
- Above 1000 AGL, engage Autopilot A

When the autopilot engages, the vertical mode will switch to *MCP SPD* (from *TOGA*) and you can then control the speed of the aircraft with the SPD knob on the MCP, but we will not make any changes to the speed, rather we will engage the VNAV.

- Engage *VNAV* mode

With VNAV engaged, the autopilot will now get its speed commands from the FMS and will pitch the aircraft down accordingly at the acceleration altitude to increase speed. This is the point where you will retract the flaps and clean up the aircraft for the climb. The autopilot is now controlling the aircraft both laterally and vertically and should follow the magenta flight plan on the EHSI.

With the aircraft settling into the flight, we can monitor several aspects of the flight, including route and performance data. The FMS provides us with quite a bit of information on several differing pages of the CDU. We can select different pages depending on the information we want to examine. Some pages are not quite relevant though, such as the cruise and descent pages, being that we are still in the climb phase. During the climb, we will utilize the LEGS and CLB pages.

- Press the *CLB* button to go to the climb page. It should look as shown below.

The CLB page shows you information pertaining to the planned climb speed, speed restriction altitude, current speed and altitude limits and distance/time to the Top of Climb (T/C).

Climb Page

IXEG 737 climbing out from LFMN

The climb is generally uneventful; however, as you pass through 10,000 feet the aircraft climbs through the speed restriction altitude and the ATC speed limit of 250 will be removed and the aircraft will accelerate to the regular climb speed ~= 287Kts.

While it is easy to think that accelerating an aircraft during the climb involves adding more power, the engines are already at near full power, and so accelerating the aircraft requires lowering the pitch angle until the aircraft speeds up, at which point it will begin to climb more aggressively.

Climb Page over 10,000 feet, commanded speed @ 287Kts

With the cruise altitude set at 22,000 feet, the aircraft will slow its climb and level off at the planned cruise altitude. The flight phase will change from *climb* to *cruise* (*enroute*) and the CDU will automatically switch from the *CLB* page to the *CRZ* (cruise) page. While we cruise towards Geneva, let us examine the route ahead on the EHSI.

- Increase the range on the EHSI map to 80NM
- Select MAP mode for the EHSI.

If you look at the EHSI now, you can see a pretty hefty kink in the route from BODRU to OKTET. This seems like a fuel-consuming, wasteful little detour that does not gain us anything, so we decide to ask ATC if we may take a shortcut after BODRU, skip OKTET and go directly to GIPNO instead.

Kink in route from BODRU to OKTET

ATC is kind enough to oblige us and grant us permission to take a shortcut to GIPNO after BODRU, so lets enter that into the FMS:

- Press the *LEGS* page button. Ensure you are on page 1 of the LEGS page.

Now we want the waypoint GIPNO to be right after BODRU instead of OKTET.

- Click on the *LSK* next to the GIPNO waypoint.

This step will copy the waypoint name into the scratchpad. Alternatively, you could type GIPNO manually using the keypad, but the COPY operation is more convenient.

- Select the LSK next to OKTET

This step will replace OKTET with GIPNO, thereby placing GIPNO directly after BODRU. This tells the FMS that you want to go straight from BODRU to GIPNO. When you take a point that is part of the current route and move it up in the route order, we call this a *shortcut* and all the points in between will be removed from the route. If you were to enter a point after BODRU that is NOT part of the current route, then that is called an *insertion*, which is a kind of detour and would create what is called a discontinuity, which is not covered in this tutorial.

So we have now modified the route and if you look at the CDU, you will see a highlighted label, *MOD* at the top of the CDU screen. You will also get a preview of the newly modified route on the EHSI, via a white dashed line. Note that a modified route is only a *proposed* route to the FMS, it is NOT the route the FMS will follow until we accept the modification, which we do in another step below.

Modified route shown with white dashes. MOD label shown on CDU.

With the route modified, you will also note that the EXEC key illuminates, indicating that we are ready to execute a modified route if we choose. We can hit EXEC to accept the new route, or we can select LSK 6L (*<ERASE*) which will erase the modification and return us to the normal route. We want to execute the modified route however.

- Press the illuminated *EXEC* key.

Upon execution, the white dashed line becomes a magenta line and the previous route will disappear. With the new route executed, and while still in the cruise phase, lets examine the descent.

- Increase EHSI MAP range to 160NM.
- We recommend that you pause the sim and read through the following section. The descent is a complex event and there is lots of information to process when using VNAV.

To descend from 22,000 feet at a reasonable rate, we require about 69NM (*3.3NM per 1000' of descent*) to get down to sea level. LSGG is at an elevation of 1411 feet, and so the total distance to descend is actually closer to 67NM. At this point, we want to look for a green circle on the magenta route, with the label *T/D*, which represents the top of descent point. When you pass this point in VNAV, the aircraft should start to descend, but in this map view, the T/D symbol does not appear around 65-70NM from the airport, it is actually very close to the airport, Why is this?

If you recall, we entered a STAR procedure into the FMS, which is an *arrival* procedure and is designed to align us with the approach. The particular arrival that we entered is a long and drawn

out path, passing well over the airport, then heading out some distance downwind until ATC gives you *vectors* to the VOR approach. So the T/D is actually in the correct spot for the procedure we entered, even if a little confusing to read on the EHSI.

Now if we were going to fly the entire STAR and approach, then everything would be fine; however, being smart pilots, we suspect that ATC might allow us to fly a more direct path to the approach, saving some fuel and time. If this is the case, then we would have to start our descent much sooner than is currently shown by the T/D symbol and we would like to know where that point might be so we don't miss it. We have a few options:

- We could simply estimate when to start the descent based on distance from the airport, and do so manually using the AP. If we estimate poorly though, then we might be too high or arrive at the approach altitude too early, which requires leveling off and burning more fuel.
- We could add an altitude restriction, maybe changing the restriction at INDIS to, /7000A (*be at 7000 feet or higher*), which would get us down early also, but again, burn more fuel when leveling off prior to starting the approach.

What we would like to do is glide all the way from the *top of descent* down to the approach and so what we are going to do, is to use a shortcut, just as we did above, and cut the arrival so as to be a shorter path because in this X-Plane tutorial, we are our own ATC and we are going to allow ourselves to fly the approach *straight in*. I told you I had a feeling ATC would cooperate :) If all goes well, the FMS will calculate a new T/D point for us and show us on the EHSI where it is.

We are going to shortcut from INDIS to the first waypoint of the VOR approach, which if you have your charts handy, will see that point to be *GVA14*. So on the LEGS page of the CDU, we want GVA14 to appear right after INDIS.

- Shortcut GVA14 waypoint to just after INDIS, the route will be *modified*.
- Prepare to hit the EXEC button right after un-pausing the sim.
- Un-pause the sim
- Press the EXEC button to execute the new route.
- Press the CRZ button to go to the cruise page.

As before, a new magenta route will be calculated and if you look at the EHSI, your map should look as shown below. You can now see the T/D symbol in a more reasonable location. Also, if you look at the right side of the cruise page on the CDU, the FMS will show you the distance to the T/D point as well as the estimated zulu time of arrival.

As you head towards the T/D point, it is a good time to review and get ready for the approach by setting up the *APPROACH REF* page, setting the speed bugs and minimums reference (*orange cursor to 1890 feet*).

- Tune the navigation radios to GVA VOR *115.75.*
- Turn the course selectors to 046.
- Read the approach checklist, (*ignore the altimeters*).

As the plane approaches the T/D, you will get a FMS warning, *RESET MCP ALT.* The plane cannot descend from our current cruise of 22,000 unless the altitude dialed into the MCP ALT is set lower than 22,000; therefore, we must reset it to a lower value before we reach the T/D point, otherwise, the plane will not begin its descent.

- Set the *MCP ALT* to 5300 ft. and then clear the message. 5300 ft. is the altitude specified at the initial approach fix for the VOR approach.

As you pass the T/D point, observe how the throttles retard and the plane starts to descend. The CDU will automatically switchover from the cruise page to the descent page, where various bits of information relating to the descent are available. Note that you will be descending ~280 kts more or less, which is the target speed highlighted on the CDU. At this point, you can ride the descent all the way to the approach and watch the FMS do what it does, or better yet, read ahead a bit while you are descending as there are several things to be done before the busy approach phase.

The next significant event is the crossing of the speed restriction altitude, *SRA*, which occurs at 10,000 ft. Below 10,000 ft., ATC requires us to be at 250 kts or below and so the plane will need to decelerate before going below the SRA. It will do so by automatically, leveling off at 10,000' with throttles at idle and slow down from drag. Once the speed slows ~ 245 kts, it will begin to descend again, but at a bit shallower rate due to the slower speed. The point at which the aircraft begins to decelerate is denoted by a green circle on the magenta route. In fact, all green circles on the magenta route without a label (unlike T/C and T/D points) denote a point of deceleration.

While descending, there are a few prudent things we can do to keep ourselves situationally aware and ensure comprehension of the information presented to us.

- On the *PERF INIT* page (access via *INIT REF* button, then *INDEX*), set the transition altitude to 7000 feet.

This is the correct transition altitude value for LSGG. If you forget to do this, the approach altitudes will look funny on the CDU. (i.e. 53 instead of 5300).

- Press the *DES* button to select the descent page again.
- Finish reading the approach checklist.

If at any time during the descent, the speed gets a bit too high relative to the highlighted target speed on the CDU, then the FMS should display the alert message *DRAG REQUIRED*, at which point we will help things a bit by moving the speed-brake lever to the *FLIGHT* detent position and

creating some extra drag. As the plane slows back to the target speed, then the message will disappear automatically and you can stow the speed-brake. If the descent path is a bit steep and the speed does not slow appreciably, then you can clear the message using the *CLR* button and simply leave the speed-brakes deployed until the aircraft speed again aligns with the target speed. You will be responsible for remembering to retract the speed-brakes on your own in this case. Now lets review how we want to fly the VOR approach:

If you look at the approach chart, you can see that we should pass INDIS at 7000 feet. Watch the EHSI and altitude as you do to make sure the FMS and autopilot are doing their job! After INDIS, the plane should descend to 6000 feet for waypoint GVA14, and further descend again after that towards GVA12. Now because we set our MCP ALT to 5300 ft. earlier, the plane will acquire and maintain 5300 ft. We will hold this altitude until reaching the GVA12 waypoint, which is the final descent point prior to beginning the approach phase.

If the FMS and AP have done their job well, the aircraft will begin slowing as it gets closer to the initial approach fix, GVA12. Keep an eye on the highlighted *TGT SPD* on the descent page as the plane begins to slow below 240 kts. At some point, the highlighted speed will switch to the *SPD REST* field and show a speed restriction, *210/FLAPS* as shown below.

210/FLAPS Speed Restriction

A speed restriction is a restriction of the aircraft speed for a given reason. Speed restrictions are imposed by 3 sources. (1) ATC below the SRA, to keep planes slow as they converge near airports. (2) A waypoint speed, to control the LNAV routing and traffic flow near airports and (3) Flap settings, to keep from

breaking the flaps (when accelerating) or stalling the aircraft (when decelerating).

If you look at the TGT SPEED field, you will note the target speed is 184 kts, but the plane cannot fly this slow without the flaps deployed, and as of now, they are not; therefore, the slowest the plane is permitted fly with flaps up is 210 kts. As such, the FMS sets this restricted target speed to keep the aircraft within safe limits, even though the desired target speed is 184 kts at the next waypoint.

The appearance of this 210/FLAPS speed restriction is our cue that the plane needs to slow down some more (*to hit that 184 kt target*) and that means its time to deploy the flaps. Flaps are deployed per a speed schedule, that is

Whenever that happens, help the plane by deploying flaps on schedule. Take care not to overspeed the flaps. If you deploy them too early (fast), VNAV will disconnect due to overspeed.

If the indication on the DES page is 210/FLAPS then deploy FLAPS 1 at 220kts. If it is 190/FLAPS then deploy FLAPS 5 at 200kts. Basically wait until roughly 10 KTS faster than the indication to deploy the next logical step of flaps.

Make sure that you are going slow enough when passing GVA14. The approach is steep and challenging. The plane will start descending to 5300 feet, but it only has about 2 NM to loose 700 feet. This is a very steep path.

We will use the FMS to guide us laterally (LNAV), while monitoring that with raw data from the VOR receivers (on the First Officers EHSI, for example).

Vertically we will use the V/S mode of the autopilot. We won´t be using VNAV since the 737-300 is not certified for a so-called “BARO VNAV” approach, though it technically could do it. So we will use adjustment of the vertical speed to stay on the desired profile – but you can “cheat” by referencing the vertical deviation indicator – which will give you an altitude cue much like glideslope.

Approaching GVA12 you increase the MCP ALT to 7000 feet, this will disconnect VNAV and change the pitch mode to V/S. This will also engage the autothrottle in SPD mode, so you can control it directly. Use these modes to control the descent. If V/S and SPD don´t engage automatically, engage them by pushing the corresponding buttons.

The V/S should be roughly -1.200 fpm. This is a bit steeper than the regular groundspeed x 5, because the approach is a bit steeper. There may also be a table on your approach plate that will show you V/S for certain G/S.

When starting the final descent, immediately lower the landing gear, and start slowing the plane down to the final approach speed (Vref + 5). Reduce the vertical speed as needed (less groundspeed → less vertical speed). It is a lot harder to slow down at -3.75 degrees slope, so start early.

Observe the vertical deviation bar – you want to keep it centered. Crosscheck your altitude at the distinct checkpoints (DME) depicted on the approach chart to make sure you are on profile.

Don´t forget to arm the speedbrake and read the FINAL checklist.

Timely before approaching the minimum of 1890´, deselect the MCP SPD mode, and regain control of the thrust levers with your joystick throttle.

At the minimum, disconnect the autopilot and complete the landing manually.

After landing, turn of the runway to the right, and park the aircraft as you have done before.

Don´t be discouraged if this does not work out right the first time, it is a very challenging approach.