The Flight Tutorial

for those new to

iFly Jets: The 737NG

Version 1.1
## Contents

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Introduction

This flight tutorial is for **iFly Jets: The 737NG** only. The purpose of this tutorial is to help users familiarizing the **iFly Jets: The 737NG** aircraft. This tutorial is going to cover all the onboard systems, therefore, it is supposed that the readers should have basic aviation knowledge. This tutorial is suitable for the players who can already fly the default aircrafts provided by the Microsoft Flight Simulator, but yet very familiar with the modern Boeing airplanes. If you are a veteran player who already knows much about the Boeing 737NG, you can skip all about this tutorial.

After reading this tutorial, you will be able to operate all systems of **iFly Jets: The 737NG** on your own, just like a real pilot. **BUT PLEASE KEEP IN MIND THAT THIS TUTORIAL IS FOR IFLY JETS: THE 737NG ONLY, WHICH IS JUST AN ADD-ON OF MICROSOFT FLIGHT SIMULATOR, HENCE, IT IS STRICTLY FORBIDDEN TO APPLY ANY INSTRUCTIONS GIVEN BY THIS TUTORIAL TO ANYWHERE THAT INVOLVS REAL AVIATION.**

The flight taken as the example in this tutorial is from Beijing Capital Airport (ZBAA) to HongKong International Airport (VHHH). The cockpit is under the status of cold and dark. All snapshots are taken from our beta version, which may be different from the final version.
Preparation

In order to verify that your FS’s status is the same with that of this tutorial, some configurations are necessary. Prior running FS, you shall configure the plane’s weight.

Weight Configuration

Run the configuration software of iFly Jets: The 737NG. The software interface is as follow.

The iFly Jets: The 737NG includes a Configuration Manager utility to change the aircraft setup. By default the program is installed to the FS\iFly\737NG\Tool and there is a shortcut on the desktop. To change the default weights, run the Configuration Manager. Now, set the forward and aft cargo compartments to be holding 25% cargo each, 108 passengers, 100% wing fuel tank load and 50% center fuel tank load, just as depicted on this page. Then, the Zero Fuel Weight data of the plane can be obtained. Record the data, because we may need this when configuring the PERF INIT of CDU later. Press “Update Aircraft Load Configuration with New Settings” to update the plane’s configuration file (aircraft.cfg).

Configure FS and the Status of Instrument Panel

You can run FS now. Under the “Select a flight” dialog, select “iFly Jets: The 737NG” from “Choose a category”, and then choose a flight in the “Choose a Flight” according to the type of plane you have bought and the monitor you are using. The “Normal screen” is suitable for 1280x1024 or similar displays, and “Wide screen” is suitable for 1680x1050 or similar displays. Finally, press “Flight Now” to go into FS.
Now our plane is parking at gate NO.221. Before going to the cockpit, some configurations should be made to the plane. Special attention should be paid in order to make sure that the metric units are employed throughout this tutorial.

From the FS menu bar, choose “iFly”→“iFly Jets: The 737NG”→“Styles”. Set the “Unit” to be “Metric System”. It should be emphasized again that if the unit is mistaken, the input of many data will trigger errors when configuring CDU later. The styles used in this tutorial are shown as follow.
In the following, we will configure a cold and dark cockpit. In the same iFly Jets: The 737NG drop-down menu select “Load&&Save”→“Panel State” to get a list of available panel states. Select “iFly 737 Flight Tutorial” and press “Load”.

OK, now you are in the cockpit, and the status of panel is cold and dark.
Exterior Inspection

Note: In the FS, the exterior inspection of the plane actually can be skipped, because this will not threaten the safety of flight. But in order to simulate the complete flight process as much as we can, the exterior inspection step has been included here. If you just want to enter the cockpit as soon as possible, you may skip this section.

Before entering the cockpit, we first go around the exterior of the plane. Our task is to check the plane and to confirm that it meets the requirements of a flight. The exterior inspection of a plane mainly includes:

1. To check if the surface and structure of the plane is clear, not damaged, no missing parts and there are no fluid leakages.
2. To check if the engine inlets and tailpipes are clear, the access panels are secured, and the reversers are stowed.
3. To check if the doors and access panels are closed and locked.
4. To check if all probes are clear without damages.
5. To check if the surface of all antennas and lights are in good condition.

A typical exterior inspection route is given below.

Why the inspection begins from the forward entry? That is because, you, the captain, are taking with your heavy flight case, which is stuffed with all kinds of files and the chart that are indispensable to the flight. So before you go out unburdened and begin the inspection, the first thing you think of is to put the annoying case into the cockpit, Therefore, it is easy to understand why the inspection begins from the forward entry, which is the closest to the cockpit. Of course, there is no compulsive route for the exterior inspection. You can inspect all the items in your own way until all of them are confirmed safe.

OK, now we come to the left forward fuselage where the inspection of temperature sensor, pitot, and angle of attack sensor, is first performed (see the following figure). We should pay attention if the exterior of these parts is complete, if there are deformations or missings, and if the surfaces are clear without covers or blocks inside pipelines. These parts provide basic and crucial data of the plane, so if these equipments are not working properly, it will be a nightmare for the captain after airborne.
In addition, the unopened doors and access panels near the fuselage should also be inspected to check if they all closed and locked. For example, some planes are equipped with ladders, so the ladders should be checked, and if they are not used, you should verify that they are hooked up and the door hooking them is closed and locked.

After finishing the inspection of the left forward fuselage, we come to the nose. We should check the nose wheel to see if there are cracks or damages on the nose wheel. Make sure the surface of the exterior light is complete without missings. Make sure the gear strut, landing gear door, vibration damping equipment, and the nose wheel steering assembly is all in good condition.

Next we come to the right forward of the aircraft. Same as the left forward fuselage, we first check the temperature the sensor, pitot, angle of attack sensor, and then check the unused doors and relevant panels.

Then we continue to walk towards the tail, and our next stop is the right wing root. First we should check the ram air deflector door, which should be open, as shown in the picture below. When the plane is on the ground or flying at a low speed with flaps not retracted completely, this door should be open. Then we check the lights under the fuselage, taking a look if the exterior of the light is OK. Finally, we check the leading edge flaps.
After the right wing root, we come to the front of No.2 engine to check if all access panels on the engine are closed and locked, if the fan leaves, rotor, and tailcone are all in good condition, and if the thrust reverser is stowed.

Then we check the wing, leading edge flaps and slats. Look to see if there is ice, frost, or other pollutions on the surface of the wing. All front edge equipment and the upper surface of the wing surface should be free of ice, snow, or frost.

After checking the wing, we come to the wing tip where we should check the position and strobe lights to see if the light is complete without damage, and check the static discharge wicks in the back. Then we check the aileron and trailing edge flaps located at the back part of the wing. The items to be checked are the same as those of front edge equipment inspection.

Up until now, we have finished the check of the entire wing. Then we should check the right main gear. The inspection items of the main gear are the same as the nose gear. The only difference is that for the main gear, the hydraulic lines and the braking system should also be checked, as shown in the picture below.
After inspected the right main gear, we continue to walk towards the tail. The next we shall inspect is the right aft fuselage. Check should be performed to all the unused doors and cover boards on the fuselage, verify that they are all closed and locked. Check the negative pressure relief door, and verify that it is closed. Check the outflow value and all detectors on the fuselage.

Then we come to the tail to inspect the vertical stabilizer, rudder, horizontal stabilizer, and elevator, verify that all surfaces are free of ice, snow, and frost. Verify that the tail skid is not damaged. Check the static discharge wicks, strobe light, and APU exhaust outlet.

After inspection of the right fuselage and tail, the reader should already know which items should be checked on the left fuselage. Therefore, it will not be repeated again here. The sequence of check is recommended to be Left Aft Fuselage→Left Main Gear→Left Wing Tip and Trailing Edge→Left Wing and Leading Edge→Number 1 Engine→Left Wing Root and Lower Fuselage.
Instrument Panels

After complete exterior fuselage inspection, we now return to the cockpit. Before operation the instrument panels, why not take some time getting familiar with the cockpit? For easier explanation, we first give a number to each panel. This number will be used by the explanation in later sections. For different plane types, the instrument panel may be slightly different.
Electrical Power Up

Now all instrument panels have no electric power supply, so the first thing we would like to do is to turn on the electricity supply.

1. Press SHIFT+6 to open the overhead panel. Check the battery switch (panel 6), verify that the switch is “ON”. Double click the switch to open the guard. If the switch is “ON”, the guard will automatically close after 2 seconds; otherwise the switch is “OFF” and the guard will not be able to close.

2. Check the STANDBY POWER (panel 6), and verify that the switch is positioned at “AUTO”.

3. Check the bus transfer switch (panel 6), verify that the switch is “AUTO” and guard closed.

Now the cockpit has electricity supply, but all instrument panels are driven by battery only. Needless to say, the batteries can only support the system for a short while, so we must go on. Before connecting to any exterior power or APU power, we should check the status of the standby FLAP, the hydraulic system, and the landing gears, making sure that they are all at the correct position.

4. The standby FLAP is driven by electric power, so we should verify that this device is not started. Verify the guard of ALTERNATE FLAPS master switch (panel 1) is closed (the guard can only close when the switch is “OFF”)

5. Then turn off the windshield wipers. In the lower middle part of the overhead panel, check that two windshield wiper selectors (panel 7, 11) are both positioned at “PARK”.

6. Then we check the electric hydraulic pump to verify that it is off. Make sure that two ELECTRIC HYDRAULIC PUMPS switches (panel 13) are both positioned at “OFF”. It should be noted that the No.1 electric hydraulic pump is on the right while the No.2 electric hydraulic pump is on the left.
7. Now press SHIFT+6 or the close button on the upper right corner of the overhead panel to close it, and come back to the main panel. Check the landing gear lever (panel 31) and verify that it is positioned at “DN”.

8. Verify that the three green indicators above the lever are illuminated, while another three red indicators extinguished. The green indicators mean that the landing gear is down and locked. If the landing gear is not down and locked, or is in disagreement with the landing gear lever’s position, the red indicators will illuminate.

By now, we have finished the checking before starting the exterior power or APU power. Then you have two choices 1) to use exterior power, or 2) to use APU power. Either one of them can provide sufficient electric power to the aircraft. In order to explain how to start these two electric powers, we first connect the exterior power, then the APU power, and finally disconnect the exterior power.

OK, now we start to connect the exterior power first.

9. In FS, no ground crew will assist to bring you the power, so we only simulate this process the best we can. First, verify that the plane is not movable in the parking area. Since there is no ground crew to help you, we have to use brakes ourselves. Press SHIFT+5 to open the throttle panel, verify that the brake lever (panel 61) is pulled up, and that the red indicator on the right is illuminated. Then close the throttle panel.

10. Then in the FS menu ➔ “iFly” ➔ “iFly Jets: The 737NG” ➔ “Ground Support” ➔ “Ground Power”, click “Connect”. This simulates the process that the ground crew inserts the power supply they brought into the exterior power socket of the plane. Note that the “Ground Support” option will only be available when the plane is on the ground with no motion and the brakes are on, otherwise this option is grey and unavailable.

11. Back to the cockpit, now take a look at the overhead panel. The blue GRD POWER AVAILABLE light (panel 6) on the overhead panel is illuminated, indicating that a ground power has been connected and its capacity meets the electricity requirement of the plane.

12. There is a GRD PWR switch (panel 6) under the light, which should be pulled down to “ON”. This switch has a spring inside, so it will return to the middle position. Thus the ground power is connected to AC transfer buses. Verify that STANDBY PWR OFF (panel 6), TRANSFER BUS OFF (panel 6) and SOURCE OFF (panel 6) indicators all extinguished.
By now, we have successfully connected the exterior power to provide electricity to the plane. Next we shall start APU. It is OK to have only the exterior power supply and carry out the operations explained in the later sections without starting APU. In order to explain in detail the functionality of every device, we will start APU. If you do not want to start APU, the following steps can be skipped and you can directly go to Preliminary Preflight Procedure.

13. Before starting APU, some security checks should be performed. First press SHIFT+7 to open the After Aisle Stand panel. Find the APU Fire Warning Switch in the most upper Fire Protection Panel (panel 42), and verify that the switch is at its normal position, not pulled out. Then check the OVERHEAT DETECTOR switch, verify that it is positioned at “NORMAL”.

14. Pull the OVERHEAT DETECTOR switch (panel 42) left to “FAULT/INOP” to test the two engines and the APU fault detection circuits. During the test, the indicators – MASTER CAUTION (panel 21), OVHT/DET annunciator (panel 21), FAULT (panel 42), and APU DET INOP (panel 42) – will be illuminated.

15. Pull the OVERHEAT DETECTOR switch (panel 42) right to “OVHT/FIRE” to test the overheat and fire detection loops of two engines, APU and the wheel well fire detector. During the test, fire alarms will sound, and indicators – master FIRE WARN (panel 21), MASTER CAUTION (panel 21), OVHT/DET annunciator (panel 21) and WHEEL WELL fire warning (panel 42) – will illuminate. Press master FIRE WARN light and confirm that the master FIRE WARN indicator extinguishes, that the fire alarm sound stops, that the fire alarm indicators of the two engines and of the APU still illuminated, and that the indicators – ENG 1 OVERHEAT (panel 42) and ENG 2 OVERHEAT (panel 42) – still illuminated, too, till the end of the test.

16. The last system to be tested before starting APU is the fire extinguishers. Pull the EXTINGUISHER TEST (panel 42) switch left to position “1” and verify that the three green lights below all illuminate. When the switch automatically returns to the middle position, the three lights shall extinguish. Then pull the EXTINGUISHER TEST right to position “2” and repeat the above test.
17. This step is to start APU. Pull the APU switch (panel 19) down to “START”, after which the switch will automatically return to “ON”. During the process of starting APU, the light LOW OIL PRESSURE (panel 7) will illuminate, and in the meanwhile, the APU EGT indicator (panel 7) will show that the EGT temperature is getting up.

18. APU is starting, and after a while, we will see that the APU GEN OFF BUS indicator (panel 6) illuminates. If the two APU GEN switches (panel 6) are both positioned “OFF”, please pull them both to “ON”. Now APU should have already started its power supply to the plane. Then have a look at the SOURCE OFF (panel 6), TRANSFER BUS OFF (panel 6), and STANDBY PWR OFF (panel 6) indicators and verify that they have all extinguished.

19. Now, the plane has both the exterior power and the APU power, but this does not mean that both power are providing electricity to the plane simultaneously. The power, which is connected last (in this case, APU) is the one that is truly providing electricity to the plane. Since now APU is providing electricity to the plane, we would like to ask the ground crew to remove the exterior power. The operations is very easy, just the same with step 9 described above, the only difference is that this time you should choose “Disconnet”.
Preliminary Preflight Procedure

1. It is recommended that full IRS alignment be performed before each flight. Between Latitude 78 degree 15 minutes north and Latitude 78 degrees 15 minutes south, IRS can be correctly aligned. According to different latitude of the plane, the alignment time is different, approximately about 5-17 minutes. If you cannot withstand so long a alignment time, you can go to FS menu -> “iFly” -> “iFly Jets: The 737NG” -> “Styles” -> “IRS alignment”, and choose “Fast Alignment Time” to accelerate the alignment, which can reduce the alignment time to about 20% of the normal time. Rotate the two IRS switches (panel 49) to “OFF” then to “NAV”, thus starting the full IRS alignment process. Before the alignment, IRS will carry out self-test, so you can see the “ON DC” light illuminates and about 1-2 seconds later extinguishes as the test ends, after which the light “ALIGN” illuminates, indicating that IRS is entering the alignment status. The initial position can be entered by keyboard on IRS the POS INIT page of CDU. In this tutorial, we will use the POS INIT page to input the initial position.

2. Check the GPS light (panel 49) and the PSEU light (panel 50), and verify that they have all extinguished.

3. Check the EEC (panel 52). Verify that EEC switches are both positioned at “ON”, and that two “REVERSER” lights and two “ENGINE CONTROL” lights have all extinguished.

4. Then we check the oxygen system. Verify that the guard of PASS OXYGEN switch (panel 53) has closed (the guard can only close when the switch is positioned at “NORMAL”). Verify that the “PASS OXY ON” light has extinguished, and that the oxygen pressure is sufficient.
CDU Preflight Procedure

As we have finished the Preliminary Preflight Procedure, the CDU Preflight Procedure can be started. Before checking the flight instrument panel, we must finish some CDU operations, such as checking the IDENT data, inputting the performance data and navigation data. For easier explanation, we give a number to each LSK (Line Select Key) and divide the screen into several blocks, as shown by the figure below.

1. First we access the IDENT page to check data such as the plane type. Of course, this step is not so important for a FS pilot, so if you are short of time, you may skip this step. On the CDU (panel 56), press “PERF INIT”, if the page popping out is not the IDENT page, then press “6L” to access the INIT/REF INDEX page, then press “1L” to arrive at the IDENT page. In this page, we should check if the plane type, engine thrust, and navigation data is correct.

2. Then press “6R” on the IDENT page to access the POS INIT page. Similarly, POS INIT page can also be accessed by INIT/REF INDEX page. If you have correctly initiated IRS during the Preliminary Preflight Procedure, you should see a series of box prompts at “4R”. We should enter the current position of the plane here, as so to complete the IRS alignment. The simplest way is to press “1R” to transfer the last position stored by FMC to the scratchpad, and then to press “4R” to enter the position to IRS.

Let’s see the area of “2L”. We can enter the airport ICAO code here, then the position of the reference airport will be displayed in “2R”. Similarly, we can also transfer to the scratchpad first, and then enter to the IRS system.

Of course, if you like, you can enter the current position into the scratchpad manually, press SHIFT+Z and the current position of the plane will be displayed on the upper left corner of the screen. For the position input, there is only one principle, that is, to enter the position as accurate as possible.

On the POS INIT page, we should also check the “5L” area to see if the current date and time is correct.
3. Now it is ready to enter the route data. Press “6R” on the POS INIT page of the last step to access the RTE page. In the first page of RTE, we should enter the ICAO codes of both the origin airport and destination airport, as well as the takeoff runway and flight number. Among these, the takeoff runway can be entered from the DEPARTURES page, and it is OK if you do not enter the flight number. In “2L”, we can enter an archived route. The route used in this tutorial has been saved as “ZBAAVHHH01”, so enter ZBAAVHHH01 to the scratchpad and press “2L” to complete the process of reading the route. Then press “6R” to activate the route when we can see the white light above the “EXEC” button of CDU illuminates. Press the “EXEC” button to execute the route.

Though it is possible to enter the route as described above, we will explain how to enter the route step by step. First enter “ZBAA” into “1L” and “VHHH” into “1R”. If necessary, enter the flight number into “2R”. The maximum length of a flight number is 8.

Press “NEXT PAGE” to go to the second page of RTE, where the route should be entered. Each line represents a segment of the route.

The left side stands for the route name; and the right side, the last position we should arrive for completing this segment. In other words, we fly from the position on the right side of the upper line, along the route on the left side of the current line, to the position on the right side of the current line. The route enter can also be carried out by entering each waypoint on the LEGS page, which, however, will take a lot of efforts.

The route date used in this tutorial is as follows. ZBAA-RENOB is SID, and SIERA-VHHH is STAR. Many people may ask, how can I find a route? Well, there are many softwares and websites capable of searching routes online, for example, http://rfinder.asalink.net/free/.

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4. Before entering a waypoint, we shall first introduce the Select Desired Waypoint page. When the name of an entered waypoint is not unique in the navigation database, the Select Desired Waypoint page will display automatically. Choose the waypoint by pressing its left corresponding LSK. In this page, the waypoints with the same names will be sorted according to their distances from the current location of the plane or from a waypoint along the route, to which special attention should be paid.

5. Remember what I said at the last step? The starting point of a route is the one on the right side of the upper line, the name of a route is on the left side of the current line, and the last point of the route is on the right side of the current line. In our example, if you ignore SID/STAR, then the first waypoint is KR, so we input “KR” on the right side of the first line, then input “B458” on the left side of the second line, and “WXI” on the right side of the second line. In this way, after entering all segments, the final route is like the figure given below.
Finally, press “6R” to activate the route, after which the white light above the “EXEC” button illuminates, when you should press the “EXEC” button to execute the route.

6. Now we choose the departure procedure of ZBAA. Press “DEP/ARR” button to display the DEP/ARR INDEX page. If the DEP/ARR INDEX page does not display, press “6L” to access the DEP/ARR INDEX page. Then press “1L” to access the ZBAA departure procedure page. In this tutorial, 36R is used to be the takeoff runway, which uses the RENOB-32D procedure. Use “PREV PAGE” and “NEXT PAGE” buttons to find the 36R runway from the right side of the screen.

Press the LSK corresponding to the 36R runway to select it. <SEL> means that the item is selected. After selecting the runway, only the SID procedures that are related to 36R runway will be displayed on the left side of the screen.

Use “PREV PAGE” and “NEXT PAGE” buttons to find the RENOB-32D departure procedure on the left side of the screen. Press the LSK to select the procedure.

7. Next we select the VHHH arrival procedure. Press the “DEP ARR” button to display the DEP/ARR INDEX page. If the DEP/ARR INDEX page does not appear, press “6L” to access the DEP/ARR INDEX page. Then press “2R” to access the VHHH arrival procedure page. In this tutorial, we use SIERA 4B arrival procedure and ILS25R approach procedure. Use “PREV PAGE” and “NEXT PAGE” buttons to find the SIERA 4B approach procedure on the left side of the screen.

Press the LSK of SIERA 4B arrival procedure to select it. <SEL> means that the item is selected.
8. Now the route is finished, next we should check if the entered route is correct. Press the “LEGS” button to enter LEGS page. Use “PREV PAGE” and “NEXT PAGE” buttons to browse page by page if all routes are connected. Usually, after entering or modifying SIR and STAR, some routes will be discontinuous with others.

It is very easy to remove the discontinuous points, just select the first waypoint after the broken route, i.e., “3L” in the right-hand example, it will transfer this waypoint to the scratchpad.

Then select the discontinuous points of the route, i.e., “2L” in the right-hand example. Then the discontinuous point is removed.

Repeat this step until all discontinuous route points are removed. Finally, press “EXEC” to execute this modification.

9. Now the route is completed, next before the FMC (flight management computer) starts running, we should enter the performance data, which, if missing, will result in the FMC unable to calculate many necessary data. Press “PERF INIT”, then press “6L” to access the INIT/REF INDEX page, then press “3L” to access the PERF INIT page. All box prompts here must be filled in, and the dashes are optional. “1L” is the gross weight of the plane; “2L”, fuel weight; and “3L”, net weight of the plane. In other words, 1L = 2L + 3L. Remember that in the initial part of this tutorial, we have obtained the net weight of the plane by using the configuration software? Input that data into “3L”. Before the input, please confirm the weight unit again. In the FS menu bar choose iFly → iFly Jets: The 737NG → Styles, set the “Unit” to be “Metric System”. The fuel data should be entered into “2L”. The fuel data can be automatically obtained by sensor, or be entered manually.
Then enter fuel reserves to “4L”. If the remaining fuel quantity when reaching the destination airport predicted by FMC is less than this value, CDU will display the “USING RSV FUEL” warning.

Cost Index at “4L” is used to calculate the economic speed of climbing, cruising, and descending. Valid entries are 0 to 500. The bigger the value, the higher the ECON speed; and the smaller the value, the lower the ECON speed.

CI is defined as a ratio of the flying time to the cost of fuel. It is determined by divided the dollar cost per hour to operate the aircraft excluding fuel, by the cost of fuel in cents per pound. Here we use CI=80.

10. Then we set the data on the right side. “1R” should be entered the cruise altitude for the route. The unit can be feet or flight level. In our example, we use 32000 feet, so we can enter to the scratchpad either “32000” or “FL320”.

11. This step is not mandatory, so you may skip to the next if you like. “2R”~ “4R” holds the wind speed, wind direction and temperature deviation during the cruise, and the outside air temperature when reaching T/C(top of climb). Wind speed and wind direction must both be entered. And the wind direction data must be 3-digit, which should be added 0 from the left if less than 3-digit. The air temperature data at “3R” and “4R” is necessary for only one of them, because the other data will be calculated automatically. The default unit is degrees Celsius. If you would like to input degrees Fahrenheit, you should add the suffix F after the entered temperature. Generally speaking, there is no weather forecast in FS, so you may just leave these lines blank. If there is no data here, FMC will calculate by using no wind during the cruise and the standard air temperature. In this tutorial, we do not input any data here.

In the right-hand example, we input “090/50” in the scratchpad, and then press “2R” to complete the data input. “090/50” means that the wind direction is 090 degrees and the wind speed is 50 knots.

In the scratchpad, input “5” and then press “3R” to complete the data input. “5” means that the temperature deviation is +5 degrees Celsius.

Now, delete CRZ WIND and ISA DEV data by press DEL key and the corresponding LSK.

Example:

800 dollars per hour for flying time
10 cents per pound, cost of fuel

Equals = a CI of 80

If the cost of fuel increased to 20 cents per pound the CI is 40. The aircraft would fly slower to save fuel.
12. “5R” is the Transition Altitude, above which the system will use Flight Levels (FLs); and below which, feet. The default altitude is 18000. Here we use the default altitude.

13. At the PERF INIT page, press “6R” to access the N1 LIMIT page. “1L” is the data of Selected Temperature and the outside temperature. The maximum temperature of SEL input is 70 degrees Celsius (about 158 degrees Fahrenheit). The higher the temperature input at SEL, the less the FMC calculated takeoff thrust will be. FMC allows a maximum reduction of about 25% in takeoff thrust. If you would like to input the OAT instead of SEL, then add the “/” character before your input, otherwise CDU will consider it as the SEL tempeture. “2L” ~ “4L” are TO, TO-1, and TO-2 takeoff, among which TO-1 means a thrust decrease of about 10%; and TO-2, of about 20%. The selection of a takeoff thrust mode will automatically arm the “2R” ~ “4R” climb thrust modes. In the right-hand example, we press “3L” to select the TO-1 mode, the CLB-1 mode will automatically arm.

The final calculated takeoff N1 data will be displayed in “1R”, whose title will change as the takeoff mode or SEL data input changes. In this tutorial, we use the TO mode without SEL temperature. If you have already entered data, then press DEL and then 1L to delete the SEL data. Press 2L to select the TO mode.

14. Press “6R” at the N1 LIMIT page, then press “NEXT PAGE” to access the second page of TAKEOFF REF. The data in this page should be set as required by actual needs. Input the runway wind data into 1L; the runway slope data, 2L; temperature data, 4L; and thrust reduction altitude, 5L. When climbing above the 5L altitude, the plane will switch from takeoff mode to climb mode. Select the runway status at 1R. 4R displays the takeoff N1 value. 3R, 5R, and 6R should be explained with emphasis. From 6R, we choose if to use the quiet climb, which, if started, will display quiet climb N1 at 3R. When the plane goes into climb mode and its altitude is less than specified by 5R, the plane uses quiet climb N1 as its command thrust, and after climbing above the 5R altitude, returns to normal climb thrust.
15. Press “6R” at the N1 LIMIT page to enter TAKEOFF REF 1/2 page. The takeoff reference page allows the crew to manage takeoff performance. At this page, the “1L” is takeoff flaps setting. The allowed input value is 1, 5, 10, 15, or 25. Here we use FLAP 5. Input 5 into the scratchpad and then press “1L” to complete the input.

Now, V1, VR, and V2 will display on the right side of the screen. Press “1R” ~ “3R” and the three speed data will turn to large font, which means that the data is entered into the system. If any of the data is still in small font, then a “NO V SPEED” warning will appear on the PFD. After the input, the warning will disappear. Besides using the V speed automatically calculated by FMC, you can also input the V speed manually. Input the speed into the scratchpad and then press its corresponding LSK to complete the input.

16. This step is not a must so you may skip to the next. In the configuration software, we obtained the CG data (30.9%) of the plane. Now input this data into the “3L” of TAKEOFF REF 1/2 page. After inputting the CG data, “3.88” will appear on its right, which is the TRIM data indicating that for the current CG, the takeoff TRIM is 3.88 units. Record this data, which will be needed when configuring TRIM later.

17. Then we continue looking at the TAKEOFF REF 1/2 page. If all previously entered data are correct, then “4L”, “5L”, “4R”, and “5R” should all be blank, and “PRE-FLT COMPLETE” appears in the title between “4L” and “4R”. If some required input data is missing or incorrect, then “4L”, “5L”, “4R”, and “5R” will display the page where the required data should be entered. In the right-hand example, we can see that “5L” displays “PERF INIT”, which means that there exists data error at the PERF INIT page. Press “5L” to access the PERF INIT page to re-examine the data.
Preflight Procedure

1. Come back to the overhead panel, press “SHIFT+6” to open the overhead panel. First check the flight control panel (panel 1). Check two FLIGHT CONTROL switches and verify that their guards have closed (the guard can only close when the switch is positioned at “ON”). Because the hydraulic system has not yet been pressurized, we can see that two “LOW PRESSURE” indicators beneath the FLIGHT CONTROL switches are both illuminated.

2. Check two SPOILER switches (panel 1) and verify that their guards have closed (the guard can only close when the switch is positioned at “ON”).

3. Look downwards and check the YAW DAMPER switch (panel 1). Position the switch to “ON” and confirm that the “YAW DAMPER” light above the switch extinguished.

4. Then we look at the right side of the flight control panel. Confirm that two warning lights at the most upper area are illuminated, which are “LOW QUANTITY” and “LOW PRESSURE”. It is easy to understand that because the hydraulic system has not yet started working, it is displayed here that there is warning of the standby hydraulic system.

5. Continue to look down, check the ALTERNATE FLAPS master switch on the left (panel 1) and verify that its guard is closed (the guard can only close when the switch is positioned at “OFF”). Then check the ALTERNATE FLAPS position switch on the right (panel 1) and verify that it is positioned at “OFF”.

6. Continue to look down, check four warning lights below, which should all be illuminated currently. The four warning lights, from upper to lower, are FEEL DIFF PRESS, SPEED TRIM FAIL, MACH TRIM FAIL, and AUTO SLAT FAIL. It should be clarified that in iFly Jets: The 737NG, we have not simulated the systems corresponding to the first.

7. Now we have finished the inspection of the flight control panel. So we check the NAVIGATION Panel (panel 2) beneath it. Verify that VHF NAV transfer switch is positioned at “NORMAL”; and IRS transfer switch, “NORMAL”. For planes with the FMS transfer switch, we should also position this switch at “NORMAL”.

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8. Continue to look down, let us check the DISPLAYS Panel (panel 3). Verify that the SOURCE selector is positioned at “AUTO”; and the CONTROL PANEL switch, “NORMAL”.

9. Then we check the fuel panel (panel 4). Now the two engines of the plane have not yet started, and two Engine Start Levers (panel 62) should both be at CUTOFF. Verify that the ENG VALVE CLOSED lights (panel 4) and the SPAR VALVE CLOSED lights (panel 4) are both illuminated.

10. Position the CROSSFEED selector (panel 4) to “CLOSE” to close the crossfeed valve. Verify that the VALVE OPEN light above extinguishes.

11. Position all 6 FUEL PUMP switches (panel 4) to OFF to close all fuel pumps. Verify that the LOW PRESSURE light of the two center tank fuel pumps extinguish, while those of the 4 main tank fuel pumps illuminate.

12. Now come to the electrical panel (panel 6) and verify that the guards of 2 generator drive DISCONNECT switches are close, and that 2 DRIVE lights above the switches are illuminated. If any switch is disconnected, you must re-connect the switch by going to FS menu -> “iFly” → “iFly Jets: The 737NG” → “Ground Support” → “IDG”, which is the only way to reconnect the switch and to restart its normal operation.

13. Position 2 EQUIPMENT COOLING switches on panel 8 to “NORM” and verify that two OFF indicators beneath the switches have extinguished.

14. Check the EMERGENCY EXIT LIGHTS switch on panel 9 and verify that its guard has closed (the guard can only close when the switch is positioned at “ARMED”). Verify that the NOT ARMED light on the left has extinguished.
15. Check the NO SMOKING switch and FASTEN BELTS switch on panel 10 and verify that they are positioned at “AUTO” or “ON”.

16. Then look at panel 12. Position 4 WINDOW HEAT switches located at the most upper area to “ON” and verify that 4 ON lights above illuminated.

17. Then position 2 PROBE HEAT switches (panel 12) to “OFF” and verify the 8 lights around the switch all illuminated.

18. Position the WING ANTI-ICE switch (panel 12) to “OFF” and verify that the L VALVE OPEN and R VALVE OPEN lights around the switch have both extinguished.

19. Position 2 ENGINE ANTI-ICE switches beside to “OFF” and verify 4 lights above the switches have all extinguished.

20. Continue to look down, let’s check the hydraulic panel (panel 13). Position two ELECTRIC HYDRAULIC PUMPS switches to “ON”, and the inner two ENGINE HYDRAULIC PUMPS switches to “OFF”. Verify that 2 LOW PRESSURE lights above the ENGINE HYDRAULIC PUMPS switches all illuminated and 2 OVERHEAT lights extinguished.

21. Next we come to panel 15. If the landing airport is a high altitude airport, press the High altitude landing switch, which shows “ON”. In our tutorial, the airport for landing is not a high altitude airport (VHHH is constructed on the sea), so it is not necessary to press this button. But of course, it will also be OK if you press it.
22. Next we check the Air Systems (panel 16). First we position TRIM AIR switch to “ON”.

23. Verify that the DUCT OVERHEAT light extinguishes.

23. Verify that the ZONE TEMP light extinguishes.

24. Turn 2 Temperature selectors to “AUTO”.

24. Position 3 Temperature selectors to AUTO.

25. Verify that the RAM DOOR FULL OPEN light illuminates.

26. Position the RECIRCULATION FAN switch to “AUTO”.

26. Position 2 RECIRCULATION FAN switches to “AUTO”.

27. Position 2 Air conditioning PACK switches to “AUTO” or “HIGH”.

28. Position the ISOLATION VALVE switch to “OPEN”.

29. Position 2 Engine BLEED air switches and the APU BLEED air switch all to “ON”.

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30. Verify that 6 warning lights (PACK TRIP OFF, WING-BODY OVERHEAT, and BLEED TRIP OFF) are all extinguished.

31. Continue to look down and we come to the Cabin pressurization panel (panel 17). Position the Pressurization mode selector located on the lower right side to “AUTO”. Two display windows on the left, from upper to lower, show the Flight Altitude and Landing Altitude. Verify that these two altitudes are in compliance with the flight plan, and that 4 warning lights above (AUTO FAIL, OFF SCHED DESCENT, ALTIN, and MANUAL) are all extinguished.

32. Look down to the left Lighting panel (panel 18). Position the LANDING light switches, RUNWAY TURN OFF light switches, and the TAXI light switch to “OFF”.

33. Next we come to the Engine Start panel (panel 19). Position the Ignition select switch to “BOTH”, and 2 ENGINE START switches to “OFF”.

34. Next we come to the Lighting panel (panel 20) located on the right side. Position the ANTI-COLLISION light switches to “OFF”, and the LOGO light switches, POSITION light switches, and WING light switch to their proper positions according to actual needs.

35. Next we look at the Mode control panel (panel 23). Position 2 FLIGHT DIRECTOR switches to “ON”. And if you like to fly as the captain, turn on first the FD on the captain’s side, otherwise first the FD on the F/O side. The “MA” light of the first engaged FD will be illuminates. Set the COURSE on both sides according to actual needs.

36. Then set the Bank Angle Selector. The set can be 10, 15, 25, or 30 degrees. 25 degrees is recommended.
37. Check the Autopilot Disengage Bar and verify that it is lifted up.

38. Then look at the EFIS control panel (panel 22, panel 34). On this panel, we can set the FPV switch, METERS switch, VOR/ADF switches, Mode selector, CENTER switch, Range selector, Map switches, and the TRAFFIC switch as needed.

39. Then we set the MINS altitude knob and the air pressure according to actual needs. In this tutorial, we use RADIO=200 as the MINS altitude, and HPA = 29.92 as the air pressure.

40. Check the Clock (panel 26, panel 39) and verify that the time displayed is correct.

41. Check the Display select panel (panel 24, panel 36) and verify that the MAIN PANEL DISPLAY UNITS selector and the LOWER DISPLAY UNIT selector are both positioned at “NORM”.

42. Check the TAKEOFF CONFIG light and the CABIN ALTITUDE light (panel 24) and verify that 2 lights both extinguish.

43. Continue the inspection on panel 24 and panel 36. Position the Disengage light TEST switch up to “1” and verify 3 lights beside it all illuminated steady amber.

44. Position the Disengage light TEST switch down to “2” and verify that A/P and A/T lights are illuminated steady red, and that FMC light is illuminated steady amber.

Before checking the PFD and ND, confirm that the IRS alignment is complete.

45. Check the PFD (panel 27, panel 38) and ND (panel 28, panel 37), and verify that the displays are all working properly.
46. Then we check the GROUND PROXIMITY panel (panel 40). Verify that the guards of the FLAP INHIBIT switch, of the GEAR INHIBIT switch, and of the TERRAIN INHIBIT switch are all closed (the guard can only close when the switch is positioned at “NORM”), and that the INOP light does not illuminate.

47. Check the AUTO BRAKE selector (panel 25) and turn it to “RTO”. Verify that the AUTO BRAKE DISARM light extinguished, and that the ANTISKID INOP light is also extinguished.

48. Turn the N1 SET selector (panel 25) and the SPEED REFERENCE selector both to “AUTO”. Position the FUEL FLOW switch up to “RESET”, after which the switch will automatically releases to “RATE”.

49. Check the primary and secondary engine indications (panel 30, panel 33), and verify that 2 displays are both working properly, and verify that no exceedance is shown.

50. Check all the radio instruments (panel 43, 45, 46), and verify that these instruments are all working properly. According to different plane types, the radio panel type may also be slightly different.
51. Check the standby instruments (panel 29), and verify that these instruments are all working properly. According to different plane types, the standby instrument type may also be slightly different.

52. Check the SPEED BRAKE lever on panel 57, and verify that it is positioned at “DOWN”. Check the SPEED BRAKE ARMED light and the SPEED BRAKE DO NOT ARM light located on panel 24, and the SPEED BRAKES EXTENDED light located on panel 36. Verify that these three lights are all off.

53. Verify that the Reverse thrust levers located on panel 58 are down, and that the Forward thrust levers are closed.

54. Check if the FLAP lever on panel 59 is the same with the indication given on panel 25. Verify that the FLAP LOAD RELIEF light on panel 25 has extinguished.
55. Verify that the Engine start levers on panel 62 are positioned at “CUTOFF”.

56. Verify that the MAIN ELECT Cutout Switch and the AUTOPILOTE Cutout Switch located on panel 63 are both positioned at “NORMARL”.

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Before Start Procedure

1. Confirm that the N1 BUG on the primary engine indication (panel 30) is the same with the green Reference N1 Readouts.

2. Set the MCP panel (panel 23). Position the AUTOTHROTTLE ARM switch up to “ARM”, and turn the IAS/MACH selector to speed V2. This speed can be obtained from the TAKEOFF page of CDU. Press the LNAV button to arm the LNAV mode. Confirm that the indicator above illuminates. Set the altitude and heading on MCP. Here, we set the takeoff runway direction (359) to be the MCP heading, and CDU’s upper limit of altitude (13770ft) to be the MCP altitude.

When power is first applied, the IAS/MACH display window displays 100 knots. Before the speed display, there is a MCP Speed Condition Symbol. When the command speed cannot be reached due to overspeed or underspeed, it will display. Flashed “A” stands for underspeed limit; and flashed “8”, overspeed limit. The speed limits here include Vmo or Mmo, landing gear limit, and the flap limit.

The display range of the IAS/MACH display window is as follows:
- Using 1 knots increment to display 100 KIAS~Vmo
- Using 0.01M increment to display .60M - Mmo

The autothrottle (A/T) can only be engaged after A/T is armed. If this switch is not positioned at ARM, the plane will not be able to control the throttle automatically. When using the following Autopilot Flight Director System (AFDS) mode, A/T engages automatically:
- LVL CHG
- ALT ACQ
- V/S
- VNAV
- ALT HOLD
- G/S capture
- TO/GA

When the A/T ARM switch is positioned at ARM, the green indicator above illuminates.

In the LNAV mode, Flight Management Computer (FMC) controls the AFDS roll to intercept and track the current FMC route. The current route can be entered and modified by CDU, including SIDs, STARs, and the instrument approaches. To arm LNAV on the ground, all the following conditions should satisfy:
- In the flight plan, the takeoff runway data is effective.
- An active route is entered into FMC.
- The angle between the track of the first leg and the runway heading is less than 5 degrees.
- Select LNAV before engaging the TO/GA.

To engage LNAV in air should satisfy:
- An active route is entered into FMC.
• Within 3 NM to the current route, LNAV can be engaged at any airplane heading.
• Beyond the 3 NM range, the plane must
  • be on an intercept course of 90 degrees or less
  • intercept route segment before active waypoint.

LNAV will disconnect automatically for following reasons:
• Reaching the end of the active route.
• Reaching a route discontinuity.
• Intercepting a selected approach course in VOR LOC mode or APP mode (VOR/LOC armed)
• HDG SEL is selected.

3. Check the fuel panel (panel 4). If the fuel quantity of center tank exceeds 1000 pounds / 460 kilograms, position 2 CENTER FUEL PUMPS switches to “ON”, and confirm that the above LOW PRESSURE lights extinguished. If the LOW PRESSURE light is illuminated, then position 2 CENTER FUEL PUMPS switches to “OFF” to close the fuel pumps. Position 4 FUEL PUMPS switches below to “ON”, and confirm that their LOW PRESSURE lights all extinguished.

4. Check the light panel (panel 20) and verify that the ANTI COLLISION light switch is positioned at “ON”.

5. Check the Stabilizer trim, Aileron trim, and Rudder trim, and verify that they can move freely. Remember Step 16 of the CDU Preflight Procedure? At that time, we got the TRIM value. Now we set the Stabilizer trim according to this value. Check if the indicator is within the green range for takeoff, and if the Aileron trim and Rudder trim are both at neutral positions.

6. Let’s check the hydraulic panel (panel 13). Position two ENGINE HYDRAULIC PUMPS switches to “ON”, and verify that 2 LOW PRESSURE lights above the ENGINE HYDRAULIC PUMPS switches all illuminated.
Pushback Procedure

In the CDU of iFly Jets: The 737NG, the PUSHBACK function is embedded. Click “MENU” → “SIMU” → “PUSHBACK” to access the PUSHBACK configuration page.

At 1L, the straight line distance that needs PUSHBACK should be entered. At 2L, you can choose if the PUSHBACK needs turning. And at 3L, enter the turning angle. After entering the data as shown by the figure, press “4R” to start the PUSHBACK. The plane first moves backwards for 150m, then heads left (front wheel turning right) to turn 90 degrees to complete the PUSHBACK. If you would like to stop the PUSHBACK in the PUSHBACK process, then press “4R”.

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Engine Start Procedure

The engine start procedure can be carried out during the PUSHBACK process, or after the PUSHBACK process. In this tutorial, we start the engine after the PUSHBACK process is completed.

1. Because the N2% RPM should be monitored during the process of starting the engine, we first confirm that second engine indications are displayed on the LOW DISPLAY UNIT (panel 33). If the second engine indications are not displayed, we can press the “ENG” button on panel 25.

2. Go to panel 16, position 2 Air conditioning PACK switches to “OFF”.

3. We first start the left engine. Go to panel 19 to turn the left ENGINE START switch to “GRD”. When the switch stays at “GRD”, observe and confirm that the N2 RPM is increasing.

4. When N1 rotation also starts speeding up, and N2 is at 21%, position the Engine start lever (panel 62) to “IDLE”. At the same time, observe the ENGINE START switch, and verify that it automatically returns to “OFF”. Look at panel 30, and verify that the LOW OIL PRESSURE warning light of the left engine extinguishes. In the whole process, monitor the engine parameters such as N1, N2, FF, EGT, and oil pressure.

After the left engine is stable at idle, repeat step 3-4 to start the right engine.
Before Taxi Procedure

1. Go to panel 6 and position the GENERATOR 1 and 2 switches to “ON”, after which the spring will automatically return to the middle. The same as we said previously, the plane should only be supplied by one power supply. By now, we have been using the APU power, and after this step, the plane will be supplied by 2 generators connected to the engines.

2. Go to panel 12 and position 2 PROBE HEAT switches to “ON”. Verify that 8 indicators on both sides are all extinguished.

3. If it is necessary to start Anti-Ice, go to panel 12 to position the corresponding switch to “ON” and verify that the blue light above the switch illuminated dim.

4. Position 2 PACK switches and the ISOLATION VALVE located on panel 16 to “AUTO”.

5. Position the APU BLEED air switch located on panel 16 to “OFF”.

6. Position the APU switch located on panel 19 to “OFF” to close APU. APU continues to run for a 60 second cooling period.

7. In step 15 of CDU Preflight Procedure, we have configured the takeoff Flap. Now we configure the Flap lever according to the previously set position. In addition, confirm that the Flap Position Indicator located on panel 25 displays the correct angle, and that the green LE FLAPS EXT light illuminates.

8. On the panel 25, press “SYS” to display the Flight Control Surface Position Indicator on the LOWER DISPLAY UNIT. Move the wheel, lever, and rudder in both directions to confirm that they all move freely, and can automatically return to center.

After getting the taxi clearance, we can start taxing. Advance the throttles to about 30%, and close it to about 25% ~ 30% after the plane starts taxing. Align the plane to the 36R runway entry along the taxiways on the ground.
Before Takeoff Procedure

1. Position the LANDING light switches, RUNWAY TURNOFF light switches, and TAXI light switch located on the left side of the Lighting panel (panel 18) to “ON”.

2. Turn 2 ENGINE START Switches located on panel 19 to “CONT”.

3. Turn the Transponder Mode Selector located on panel 45 to the “TA/RA” position.

Check the fuel quantity of the center tank. If the quantity is less than 5000 pounds or 2300 kg, you must turn off the switches of the 2 center tank fuel pumps.
Takeoff Procedure

We are going to takeoff now! After getting the takeoff clearance, confirm that the brakes are released, align the plane with the runway.

1. Advance the thrust lever to about 40% N1, check if the engine is stable and normal.

2. After confirming that everything is OK for the engine, advance the thrust lever to takeoff N1 and press the TO/GA switches, check if the takeoff thrust is correct. (The real TO/GA switch is located below the throttle lever. To press that switch, we must view from the VC mode. Therefore, for more convenient operation, we have added a TO/GA switch on the MCP panel.) Check the FMA (Flight Mode Annunciation) on PFD. Now the status of A/P should be FD; the pitch mode, TO/GA; and the roll mode, blank. The two pictures below show the difference on FMA between before pressing the TO/GA and after pressing the TO/GA.

The three columns inside the FMA, from left to right, are Autothrottle Mode, Pitch Mode, and Roll Mode. “ARM” means that the autothrottle mode is not engaged. The autothrottle servos of the thrust lever are inhibited. The pilot can set the thrust lever manually. The minimum speed protection is provided. “N1” means that the autothrottle is kept at the selected N1 limit shown in the thrust mode display (Look at the first picture of this page, the green 104.2 is the value that N1 is kept at). “TO/GA” means that the current pitch mode is TO/GA. Takeoff is a flight director only function of the TO/GA mode. Flight director pitch and roll commands are displayed and the autothrottle maintains takeoff N1 thrust limit as selected from the FMC. That is to say, under TO/GA, the autopilot system does not control the plane actually, so you should fly the plane manually according to the FD.

After pressing the TO/GA switch and before the speed reaching 60 knots, the F/D pitch command is 10 degrees nose down; and F/D roll command is wings level. After getting above 60 knots, the F/D pitch command becomes 15 degrees nose up.
After the speed reaches 84 knots from 60 knots, the A/T mode displays THR HLD, which means that the thrust lever autothrottle servos are inhibited and that the pilot can set the thrust levers manually. When Airspeed at V1, the panel system automatically calls out “V1”. At VR, rotate toward 15 degrees pitch attitude. During the whole takeoff process, you must monitor the engine instruments, the vertical speed, and the airspeed indicator.

3. When the plane lift-off, the pitch command keeps at 15 degrees until sufficient climbing rate is reached. Then, the pitch command keeps the MCP (the MCP speed we have set is V2) + 20 knots, and the roll command remains wings level.

If the engine failure during the takeoff, the target speed of pitch command is:
- V2, if the speed is less than V2;
- the current speed, if the speed is between V2 and V2+20;
- V2+20, if the speed is higher than V2+20

4. After seeing positive rate of climb displayed on the altimeter, move the landing gear lever to “UP”.

5. Because we have armed the LNAV mode in our previous operations, the LNAV mode will engage after 50ft AGL. If we have not armed the LNAV mode, then after the plane reaches 400ft RA (radio altitude), a roll mode should be selected.

6. The plane continues climbing to 800ft RA, and the A/T ARM mode will start. ARM will display at the autothrottle mode area on FMA.

7. Then the plane will reach its thrust reduction altitude (which can be set in the TAKEOFF 2/2 page of CDU, the allowable input range is 800ft–9999ft, and in our example, is 1000ft), the flight phase change from the takeoff phase to the climb phase. The FMC calculated command thrust also change from takeoff thrust to climb thrust. Verify that the A/T N1 mode is engaged.

8. Press CMD A or CMD B to engage the autopilot, and the flight director status is terminated (A/P status shows that CMD has replaced FD). Pitch engages LVL CHG, and the pitch mode of FMA is MCP SPD. The MCP IAS/MACH display window and speed cursor become V2+20. “MCP SPD” pitch mode means that the plane is using pitch commands to maintain the speed specified on the MCP IAS/MACH window. In summary, now the plane is tracing the current FMC route under the control of AFDS roll commands, keeping the MCP speed under the control of AFDS pitch commands, the throttle locked to the climb N1 value calculated by FMC.
Now, the plane is climbing, we take use of this period to introduce the autopilot system. We will first introduce the difference between Command (CMD) and Control Wheel Steering (CWS). CMD means the autopilot of general meaning, which, after engaged, will let the plane fly automatically according to the selected pitch and bank modes. After engaging the CWS, the autopilot maneuvers plane in response to control pressures applied by the pilot. After the pilot releases the pressure, the autopilot will keep at the current altitude.

Press a separate CMD or CWS can engage each A/P. But the autopilot CMD or CWS mode can only be engaged when satisfies the following two conditions, otherwise the function will be inhibited.
- No pressure is being applied to the control wheel, which means that the pilot must release the control wheel
- STAB TRIM AUTOPILOT cutout switch is positioned at NORMAL

When any of the following situations occurs, the autopilot will disengage:
- Press any A/P disengage switch
- Press any TO/GA switch when a single A/P is engaged the CWS or CMD mode
  - Radio altitude below 2000ft, or
  - Flaps retracted, or
  - G/S engaged
- Press any TO/GA switch after touchdown with both A/Ps under CMD mode
- Press an illuminated A/P engage switch
- Pull down the A/P disconnect bar
- Use any trim switch located on the pilot control wheel
- Position the STAB TRIM AUTOPILOT cutout switch to CUTOUT
- Either left or right IRS system failure or FAULT light illuminated
- Loss of electrical power
- Loss of necessary hydraulic system pressure

Press the CWS engage switch to engage the autopilot, which makes the pitch mode and roll mode both in CWS mode, and CWS P and CWS R displayed on the FMAs. If you release the aileron pressure when the bank is less than 6 degrees, the autopilot will level the wings and to keep the current heading. When any of the following conditions occurs, the heading hold feature with bank less than 6 degrees is inhibited.
- When landing gear down, the radio altitude is less 1500ft
- F/D VOR captured when the airspeed is less than 250 knots
- After F/D LOC captured under APP mode

When meets the following situations, the pitch axis is engaged in CWS; and the roll axis, CMD:
- The command pitch mode is not selected or is disconnected.
- The autopilot pitch is overridden by manual control. When both autopilots are engaged in APP mode, this manual pitch override is inhibited.

When this mode is engaged, CWS P will be displayed on the flight mode area. After CWS P with CMD engage switch is selected, CWS P will change to ALT ACQ when the plane gets close to the selected altitude. After reaching the selected altitude, the ALT HOLD mode will engage. When reaching the selected altitude under ALT HOLD, if the pitch is manually overridden, ALT HOLD will change to CWS P. If the manual control is released within 250ft the selected altitude, CWS P
will change to ALT ACQ, and the plane will return to the selected altitude, and ALT HOLD engaged. If the manual control is maintained until getting more than 250ft from the selected altitude, the pitch will remain in CWS P.

When meets the following situation, the roll axis is connected to CWS; and the pitch axis, CMD:
- The command roll mode is not selected or is disengaged.
- The autopilot roll is overridden by manual control. When both autopilots are engaged in APP mode, this manual roll override is inhibited.

When this mode is engaged, CWS R will be displayed on the flight mode display. When arming VOR/LOC mode or APP mode, CWS R can be used to capture the selected radio course after the CMD engage switch illuminates. Once the radial or localizer is captured, FMA will change from CWS R to VOR/LOC, and A/P will track the selected course.

9. Gradually retract the flaps and watch if the flap and slat slat positions are the same with that of the flap lever.

10. When the flaps and slats are completely retracted, press the VNAV switch to select the VNAV mode, or select the normal climb speed. After VNAV mode engaged, the MCP speed window will be blank.

When VNAV mode is engaged, the AFDS pitch and A/T mode will be commanded by FMC, so as to make the plane fly along the vertical profile.

VNAV is divided into three types:
- VNAV SPD: The AFDS maintains at the speed displayed by the airspeed indicator and/or by the CDU CLIMB or DESCENT page.
- VNAV PTH: The AFDS maintains the FMC altitude or keeps the descent path given by the pitch command.
- VNAV ALT: When a conflict occurs between the VNAV profile and the MCP altitude, the airplane levels at the MCP altitude and the pitch flight mode annunciation becomes VNAV ALT. VNAV ALT maintains altitude.

VNAV can also be armed on the MCP panel before takeoff if the following conditions are satisfied:
- An active route has been entered.
- The performance data have all been entered.
- The flight director switches are both positioned at the “ON” position.

We have introduced the autopilot system above, and now let’s have a look at the current status of the aircraft. The current FMA snapshot picture is given below. Obviously, the plane is now under VNAV SPD mode at the speed given by CDU calculation.

Under the following situations, the MCP speed window will display blank:
- VNAV mode is engaged
- A/T engaged in the FMC SPD mode
- During two engine AFDS go-around

11. After the landing gear is completely retracted, move the landing gear lever to the “OFF” position.
Climb Procedure

OK, now the plane is flying along the FMC route under the control of AFDS. During the climb phase, we have time to introduce some common knowledges and operations. But before the introduction, we first talk about several operation principles that should be followed during the climb phase.

1. If the fuel pump switches of the center tank are positioned at “OFF” during takeoff, and the fuel quantity of the center tank is more than 1000 pounds/500kg, then you should position the fuel pump switch of the center tank to “ON” after the flight altitude gets above 10000ft or the flying airspeed gets above 250 knots.

2. If the fuel quantity of the center tank reaches about 1000pd/500kg during the climb, then position the fuel pump switches of the center tank to “OFF”.

3. When the flight altitude is above 10000ft, position the landing light switch to “OFF”.

4. Set the passenger signs according to needs.

5. At transition altitude, set the altimeters to standard.

Now have a look at the target speed, target altitude, and the heading of the plane. Press LEGS located on CDU to access the LEGS page, as given below:

On CDU, the active airspeed, altitude, and waypoint name are displayed in magenta, while other waypoints and the altitude data are displayed in white. On ND, the active data, including the route, waypoints, speed, and altitude, are displayed in magenta; inactive data, cyan; modified data, white; and offset data, magenta. On PFD, the active speed and altitude are displayed above the speed indications and the altitude indications respectively. From the above LEGS page and the ND snapshot figure, we can see that we are now flying toward HUR/282.

Waypoints along the route are generally divided into 2 categories: One is called normal waypoints, whose positions are stored in the FMC database. It is a fixed point with a latitude and longitude. The other is called conditional waypoints, which are actually conditions instead of geographic positions. When the plane meets these conditions, FMC will consider that the plane has reached these waypoints. The conditions allowable include:

- passing through an altitude
- flying a heading to a radial or DME distance
- intercepting a course
- heading vector to a course or fix.

On ND, it is very easy to distinguish between normal waypoints and conditional waypoints, as shown by the following figure. Besides different waypoint symbols, there are brackets around the name of any conditional waypoint.
On CDU and ND, a waypoint of “passing through an altitude” is displayed as “(XXX)”, in which XXX is the altitude. For example, (700) means to pass the altitude of 700ft. A waypoint of “intercepting a course” is displayed as “(INTC)”; and of “flying a heading to a radial”, as “(ABC123)” where ABC is the navigation station ID and 123 is the radial. A waypoint of “flying a heading to a DME distance” is displayed as “(ABC-12)” where ABC is the navigation station ID and the next 2 digits are the DME distance. If exceeds 100NM, the last two digits will be displayed before the navigation station ID, such as “(23-ABC)”. A waypoint of “heading vector to a course or fix” is displayed as “(VECTOR)”.

For waypoints “intercepting a course” and “flying a heading to a radial or DME distance”, because positioning from the navigation station is necessary, we should check if the current navigation station in use is the required the navigation station.

Generally, conditional waypoints cannot be entered manually by the pilot, while normal waypoints can be entered through the RTE or LEGS page. In the CDU Preflight Procedure, we have learned how to enter the route and waypoints on the RTE page, in the following, we will explain how to enter the waypoints on the LEGS page. Waypoints allowed to be entered in CDU include:

1. Waypoints exist in the navigation database, which you should just enter the waypoint’s ID.
2. Latitude/ Longitude Waypoint. Latitude and longitude waypoints are entered with no space or slash between the latitude and longitude entries. Leading zeroes must be entered. All digits and decimal points (to 1/10 minute) must be entered unless the latitude or longitude are full degrees. For example, N12° W123° is entered as N12W123 and displayed as WPT01. N12° 34.5’ W123° 4.5’ is entered as N1234.5W12304.5 and displayed as WPT02.

3. Place-Bearing/Distance Waypoint entered as a place-bearing/distance. The navigation station must be in the navigation database; bearing, a 3-digit figure which should be added 0 if is less than 3-digit; and the allowable input range, 0.1 ~ 999.9, the decimal part not necessary for integer distances. Such waypoint is displayed on CDU as the navigation station ID plus a 2-digit index, for example, HGH030/10 is displayed as HGH01.

4. Place-Bearing/Place-Bearing Waypoint entered as place-bearing/place-bearing. The navigation station must be in the navigation database; and bearing, a 3-digit figure. Such waypoint is displayed on CDU as the first navigation station’s ID plus a 2-digit index, for example, HGH 090/DSh020 is displayed as HGH01.

After entering correct waypoints into the scratchpad of CDU, and selecting suitable insert positions on LEGS, the waypoint addition is completed. Apart from directly entering the longitude and latitude, other entered waypoints should also be ensured that they all in the navigation database, otherwise a warning message “NOT IN DATABASE” will pop out. If there are more than one waypoints in the database sharing the same ID, CDU will automatically display the Select Desired Waypoint page. After the input on LEGS, a discontinuity of the route may occur, so you need to remove this discontinuity and press EXEC to execute the modified route.

We give an example about how to insert a waypoint named CD050/5 before “CD”.

First enter “CD050/5” into the scratchpad. Because we would like to insert CD050/5 before the point CD, press 3L indicating that we would like to insert a new waypoint before this line.
If the entered point has only one match in the navigation database, skip to the next step. In this example, there are two waypoints in the database using the name CD, so CDU automatically enters the Select Desired Waypoint page. Check the position of the navigation station carefully. The first waypoint displayed on the page is the CD navigation station we want. Press 1L to select this waypoint.

Then we can see that CD050/5 has been entered. The name of CD050/5 displayed on CDU is “CD01”, whose background is grey, indicating that this point is newly modified. After this point, the system has automatically inserted a route discontinuity.

The point after the discontinuous point is CD. Press 5L to transfer the CD point to the scratchpad.

Press 4L to remove this discontinuous point.

Press EXEC to execute the modified route.
Next we introduce some other common operations regarding waypoint modification on the LEGS page.

1. **Delete a waypoint**

   There are two normal ways to delete a waypoint:
   - Use the DEL key to delete the waypoint (not applicable to the active waypoint).
   - Move a waypoint to a place before that waypoint, and then delete all waypoints between these two positions, thus resequencing the route.

   When a waypoint is deleted, all routes before the deleted waypoint remain unchanged. The method of using DEL key to delete a waypoint will cause discontinuity to replace the deleted waypoint.

   ![Image of the LEGS page showing deletion process]

   The current route shows that the waypoint CD is followed by RENOB and KR. Press the DEL key to arm the delete function. DELETE is displayed in the scratchpad.

   ![Image of the LEGS page showing DELETE displayed]

   When DELETE is displayed at the scratchpad, press the line selection key left to CD to delete the waypoint. The boxes indicate that route discontinuity replace the CD. Then remove the route discontinuity and all operations are completed.

   ![Image of the LEGS page showing deletion of route]

2. **Resequencing Waypoints**

   The current route shows that the waypoint HUR25.8 is followed by HUR/264, CD, and RENOB. Suppose that now the plane must go directly from HUR25.8 to CD, then press the LSK left to CD to copy the CD waypoint to the scratchpad.

   ![Image of the LEGS page showing waypoints being resequenced]

   Press 2L to move the waypoint CD behind HUR25.8. Delete the HUR/264 to keep the continuity of the route. Press EXEC to execute the modified route.
3. **Direct To and Intercept Course**

Enter a waypoint into the active waypoint line on RTE LEGS page 1, and then you can fly directly to that waypoint or intercept a course. The INTC CRS prompt is displayed at 6R. The following example shows the result of entering a waypoint WY on the effective waypoint line.

Enter WY at 1L. The figure 168 indicates that the direct course from airplane present position to WY.

Enter into the scratchpad the inbound intercept course to WY point. Here we input 200 into the scratchpad.

Press 6R to change the leg direction.

Press EXEC to execute the modified route. Now the intercept course to WY becomes 200 degrees.

Next we check the active speed, which mainly involves the LEGS page and the CLB page.

On CDU and PFD, the active speed is displayed in magenta. On PFD, the Speed Bug and Selected Speed are both displayed in magenta. They point to the airspeed:

* manually selected in the IAS/MACH window
• indicates the FMC computed airspeed when the IAS/MACH window is blank.

Now the IAS/MACH window on MCP is blank, so FMC computed airspeed is displayed on PFD. From the picture, we can see that the current active speed is 250 knots.

Since the 250 knots is computed by FMC, let us get to know how FMC computes this speed. In the climb phase, FMC mainly considers the following speeds simultaneously:
• The flap restriction speed minus 5kts if the flap is not retracted completely;
• The gear restriction speed minus 5kts if the gear is not retracted completely;
• The IAS/MACH window speed if the IAS/MACH window is not blank;
• The target speed computed by FMC according to the current climbing mode, for example, the ECON speed, RTA speed, MAX RATE speed, etc.;
  • ECON indicates the speed is based on a cost index.
  • MAX RATE indicates the speed is based on the maximum altitude over the shortest period of time.
  • MAX ANGLE indicates the speed is based on the maximum altitude over the shortest horizontal distance.
• Speed Restriction if is entered;
• Specified Waypoint Speed if any.

In our example, because flap and gear are retracted completely, IAS/MACH window is blank, and no specified waypoint speed is available, the active speed will be the smaller one between the Target Speed and the Speed Restriction. This is where the 250kts comes from. After the flight altitude exceeds 10000ft, there will no longer be Speed Restriction, so the plane will fly with the Target Speed.

Here we will explain how to modify the autopilot speed. We cannot modify the flap restriction speed and gear restriction speed, so when flying at any of these two speeds, the restriction always applies unless the flap or gear is completely retracted. The speed displayed on the IAS/MACH window can be modified, so if the IAS/MACH window is not blank, then turn directly the IAS/MACH Selector to adjust the speed. If the IAS/MACH window is blank, then press the Speed Intervention (SPD INTV) Switch beside to display the speed, and then you can modify the speed.

When modifying the Speed Restriction, you must enter both the speed and the altitude, using “/” to divide them.

When modifying the Target Speed, you can directly enter an IAS or MACH, or select the speed according to different climb modes. The speed under any mode will be influenced by various factors, mainly including the plane weight, cruising altitude, cost index, and the maximum and minimum speed displayed on the PERF LIMITS page. Press NEXT PAGE on the PERF INIT page to access the PERF LIMITS page, where you can set the maximum and minimum speed for each flight phase, and the time deviation tolerance under the RTA mode. We will introduce the RTA mode later.
Enter the calibrated airspeed or MACH into a waypoint on the LEGS page to specify the speed restriction when approaching this waypoint. The input of calibrated airspeed should be a 3-digit figure; and of the MACK speed, a decimal figure with 1, 2, or 3 decimal places. If the waypoint has a restriction speed, the speed will be displayed in large font; otherwise, the FMC calculated speed at the time the aircraft passes this waypoint will be displayed in small font. The restriction speed can be entered altogether with the restriction altitude, using “/” to divide between them.

Next we check the active altitude, which mainly involves the LEGS page and the CLB page.

The Selected Altitude Bug and Selected Altitude located above the PFD altitude indications both display the altitude of the MCP ALTITUDE Display. Rotate the Altitude Selector, and you can adjust the MCP ALTITUDE in 100ft increments. The Calculated Waypoint Altitude or the Specified Waypoint Altitude is displayed on the LEGS page. At or above altitude restrictions are
entered with a suffix letter A (example: 6890A). At or below altitude restrictions are entered with a suffix letter B (example: 13770B). Mandatory altitude restrictions are entered without any suffix letter (example: 20000). Altitude restrictions that are between two altitudes are displayed with the lower limit first, followed by a suffix letter A, then the upper limit, followed by a suffix letter B (example: 6890A13770B). For waypoints along the cruising phase, altitude entry is not allowed from the LEGS page.

The cruising altitude is displayed on the CLB page.

During the takeoff and climb phase, the AFDS uses the lowest altitude among the three ones as the active altitude; while during the descent phase, the highest altitude as the active altitude. From the LEGS page, we can see that currently the altitude restriction is between 6890ft and 13770ft, and that the next altitude restriction is between 8850ft and 13770ft, after which there will be no altitude restrictions, except, of course, for the cruise altitude. Now our MCP altitude setting is 13800ft, therefore, we should set the MCP altitude to the cruising altitude when the plane passes the waypoint “HUR25.8”. **Otherwise, the plane will remain flying at the altitude of 13800ft after passing the waypoint “HUR25.8”**.

We would like to emphasize again that before the plane passes the waypoint “HUR25.8”, you must adjust the MCP altitude to a higher altitude or the cruising altitude, otherwise the plane will remain flying at the current MCP altitude.

The altitude input on the LEGS page and CLB page can be of 3-digit (xxx), 4-digit (xxxx), 5-digit (xxxxx), or the flight level (FLxxx). The FMC will display the altitude or flight level in the correct form automatically according to the transitional altitude (for details about the transitional altitude, please refer to step 12 of the CDU Preflight Procedure). A 3-digit entered figure stands for the altitude or flight level with in increments of 100ft. Zeros should be added from the left if the figure is less than three digits. If the transitional altitude = 18000ft, examples of 3-digit (xxx, FLxxx) entries are given as follows:

- Enter 008 or FL008 for 800ft, which is displayed as 800
- Enter 015 or FL015 for 1500ft, which is displayed as 1500
- Enter 115 or FL115 for 11500ft, which is displayed as 11500
- Enter 250 or FL250 for 25000ft, which is displayed as FL250

A 4-digit input stands for a rounded to the nearest 10ft. Leading zeros are necessary if the figure is less than 4-digit.

If the transitional altitude = 18000ft, examples of 4-digit (xxxx) entries are given as follows:

- Enter 0050 for 50ft, which is displayed as 50
- Enter 0835 for 835ft, which is displayed as 840
- Enter 1500 for 1500ft, which is displayed as 1500
- Enter 8500 for 8500ft, which is displayed as 8500
- Enter 9994 for 9994ft, which is displayed as 9990

A 5-digit input stands for a rounded to the nearest 10ft.

If the transitional altitude = 18000ft, examples of 5-digit (xxxxx) entries are given as follows:

- Enter 00050 for 50ft, which is displayed as 50
- Enter 00835 for 835ft, which is displayed as 840
- Enter 01500 for 1500ft, which is displayed as 1500
- Enter 09995 for 9995ft, which is displayed as 10000
- Enter 25000 for 25000ft, which is displayed as FL250

Next we look back on the route, let’s look at the first page of Progress on CDU.
This page provides a lot of general flight progress data. The first line displays the last waypoint we have passed and the altitude, time, and fuel quantity remained when passing through that waypoint. The second line displays the waypoint we are now approaching, and the distance-to-go (DTG) from present position to the waypoint, predicted arrival time, and the predicted fuel quantity remained when reaching that waypoint. The third line displays the next waypoint and its corresponding data. The fourth line displays the corresponding data when reaching the destination airport. The data of this line is very important, which should be checked often during the flight. Confirm that the plane has sufficient fuel to reach the destination airport. If the fuel quantity displayed at 4R is less than the RESERVES value of PERF INIT of CDU, CDU will display a “USING RSV FUEL” warning message. 5L displays the time and flight distance to T/C (top–of–climb), T/D (top–of–descent), S/C (step climb), and E/D (end of descent) according to the current flight phase. 5R displays the total fuel quantity of the plane at the moment. 6L shows the current wind speed and wind direction. From the current Progress page, we can see that we have just passed the waypoint “OR” and are now flying toward the waypoint “(HUR282)”. Then look at the ND display. As can be expected, the white “OR” waypoint has been passed, and now the plane is flying towards the waypoint “(HUR282)”. This is because we have armed the LNAV mode before takeoff and have been flying according to FD commands after takeoff. Therefore, after the plane passes a waypoint, FMC will automatically switch to the next waypoint.

Now the plane is flying toward the waypoint “(HUR282)”. From the name, we can know that this is a conditional waypoint. The plane flies straight along the direction 359° until reaching 282 degree radial of the HUR station and will then switch to the next waypoint. Verify that 2 COURSE on MCP have both selected 282 degrees. We select “VOR” for ND display mode on the EFIS page, and then we can see the following display.
Because the current conditional waypoint is related to the navigation station, we should confirm if the autopilot has received the data of the correct navigation station. Various data of the navigation station are displayed on both sides below the ND. If necessary, select the HUR station (frequency: 113.60) manually.

OK, continue flying, and then…

OK, now the VOR course deviation indicator points to the middle position, indicating that the aircraft has reached 282 degree radial of the HUR station. FMC has automatically switched to the next waypoint, and the plane starts turning. The current waypoint has become “(HUR-26)”. Now the display of PFD and of ND is as follows:

We can see that the plane is using an angle of about 25 degrees to turn. This angle can be set in the MCP.

Rotate the switch to
• set the maximum turning bank angle for AFDS
• select 10, 15, 20, 25, or 30 for the command bank angle
Look carefully the “(HUR282)” and “(HUR-26)” on ND, between which there are differences. The obvious difference is that the plane passes through “(HUR282)” and then turns to approach the next waypoint; however, the plane seems to turn to and intercept the next waypoint before reaching “(HUR-26)”. This demonstrates that there are many types of legs between 2 waypoints. In iFly Jets: The 737NG, the following types are supported: Track to Fix, Direct to Fix, Course to Fix, Arc to Fix, Radius to Fix, Heading. Next we will give an introduction on each of these types. It should be noted that the following example is only for explanation purpose and is not the snapshot pictures of our ZBAA-VHHH trip.

1. Track to Fix

A Track to Fix leg is intercepted and acquired as the flight track to the following waypoint. Track to a Fix legs are sometimes called point-to-point legs for this reason. In the following two figures, the leg between WY and GS01 is Track to Fix.

The left figure stands for “fly-by” the WY waypoint, which means that the plane can make a turn before reaching WY, and fly straight along the WY-GS01 line afterwards. The right figure stands for “fly-over” the WY waypoint, which means that the plane must pass through WY and after which can make a turn and get back to the WY-GS01 line.

2. Direct to Fix

A Direct to Fix leg is a path described by an aircraft's track from an initial area direct to the next waypoint.
In the above figure, the leg between WY and GS01 is Direct to Fix. The plane passes the WY waypoint and then turns directly to the GS01 waypoint. In this example, the WY waypoint is a fly-over point. If the WY point is a fly-by point, there will be no difference between Direct to Fix and Track to Fix.

3. **Course to Fix**

A Course to Fix leg is a path that terminates at a fix with a specified course at that fix.

In the above figure, the leg between the waypoint (650) and CJ is a Course to Fix. The plane passes the (650) point and turns left, after which flies along the 269 degree course toward the CJ point.

4. **Arc to Fix**

Arc to a Fix or AF Leg defines a track over ground at specified constant distance from a database DME Navaid

In the above figure, the plane passes the waypoint (LJB-24) and flies clockwise along the 27NM radius of LJB station towards the LJB27 waypoint. This leg is Arc to Fix.

5. **Radius to Fix**

Radius to Fix or RF Leg defines a constant radius turn between two database fixes, lines tangent to the arc and a center fix.

In the above figure, the legs to WPT01 and WPT02 are Radius to Fix.
6. Heading

Heading leg is generally used for conditional waypoints. In the above figure, the leg to waypoint (2290) is of this type. There is a suffix “HDG” after the waypoint direction.

In iFly Jets: The 737NG, all waypoints entered through CDU are fly-by waypoints, and all legs entered through CDU are Track to Fix legs. Waypoints and legs of other types can only be realized by editing procedures like SID/STAR. For details about the format of SID/STAR program, please refer to FS root\iFly\737NG\Manual\Procedures Introduction.pdf.

After the plane climbs over the transition altitude, the barometric setting display located below the PFD altitude indication will turn into amber, with a square box around it, indicating that we need to set the Barometric Standard Switch located on EFIS to “STD”. Press the “STD” switch, and then the system will use the standard barometric setting (29.92 inches Hg/1013 HPA) as the barometric altitude reference.

Then look at the CLB page of CDU. In the following two figures, the left one stands for the situation when the plane is below FL260; and the right one, above FL260.

Below FL260, the plane uses CAS as the target speed of the autopilot system; and after getting above FL260, switches automatically to Mach climb. Therefore, if you look at the CAS speed and MACH speed on PFD, you will see that CAS keeps the same while MACH increases when the plane is below FL260, and that CAS decreases while MACH keeps the same when the plane is above FL260. And if the IAS/MACH display of MCP is not blank, the display on it will automatically changeover between IAS and MACH when the plane passes the altitude FL260.

Other information displayed on the CLB page is sort of general, and the only other place where explanation is needed is the “ENG OUT” at 5R.

Press 5R to show the right-hand page. All data on this page are about one engine inoperative condition. In the right-hand figure, we can know that the FMC calculated CLB speed when suffering one engine inoperative is 210 knots; the maximum climbing altitude, FL182; the thrust mode, CON mode; and N1=98.0. This page can be selected at any time, even when the two engines of the plane are both working properly. Now press “ERASE” at 6R to go back to the previous page.
If you press the “N1 LIMIT” button on CDU now, you will see the display as the right-hand figure. Currently we have selected the AUTO mode, so FMC will calculate the N1 limit for each flight phase. You can select various N1 LIMIT modes at the following 4 lines. Pilot selected mode is automatically replaced by AUTO selection when the autopilot next changes vertical mode. The figures on the right stands for the calculated N1 limit values of the two engines for each mode.

The last line is the thrust reduction configuration for the climb phase, has the same meaning as the thrust reduction configuration for the takeoff phase. If you select the thrust reduction mode, after climbing above 10000ft, the plane will increase the thrust gradually, and after climbing above 15000ft, return to the normal thrust, and then the thrust reduction configuration will be deleted.

Continue climbing for a while, and then we will see a green circle on the ND, marked “T/C”. This is the T/C (top-of-climb) point, which we have introduced previously. After passing this point, the plane reaches the cruise altitude and begins the cruise phase. The green arc in the figure is the altitude range arc, which means that according to the current vertical speed and ground speed, the plane will reach the MCP altitude when it reaches the arc on the map. The altitude range arc is calculated according to the current vertical speed and ground speed, and the higher the plane flies the lower the vertical speed will be, so usually, the altitude range arc occurs before the T/C point. As the altitude rises, the deviation between these two points will become smaller.

As shown in the right-hand figure, the plane passes the T/C point, ends the CLB phase, and begins the cruise phase.
Cruise Procedure

In FS, the cruise phase is a little bit boring. We take use of this period to introduce about the cruise-related pages, autopilot, and some other knowledge about FMC.

Press “CRZ” on CDU to access the cruise page. If before reaching the T/C point, the climb page is displayed on CDU, then after passing the T/C, cruise page will be automatically displayed. Through the cruise page, we can select various cruise modes, just as in the climb page.

First we introduce about the STEP CLIMB. During the flight, as the fuel gets less, the plane weight decreases gradually, hence the optimum altitude increases gradually. Therefore, FMC will calculate a climb point according to the cruise altitude, optimum altitude, aircraft weight, and the step to altitude entered at 1R of the cruise page, so that the minimum trip cost can be achieved in the ECON mode, or the minimum trip fuel consumption be achieved in the LRC or pilot selected speed modes. This point is the Step Climb point (S/C).

As shown in the following figure, now 1R of the Cruise Page displays dashes, which means that there is no entry at the moment. In such case, FMC will not calculate the S/C point.

Now enter FL330 at 1R, telling FMC that we would like to step climb to FL330. Then 2R will display the FMC predicted arrival time at the S/C point as well as the distance between S/C and the current position. When the distance between the aircraft and the T/D (top-of-descent) point or the distance between the S/C point and the T/D point is less than 100NM, FMC will not calculate the S/C point. In such case, 2R will still display the T/D data. It is easy to distinguish from the 2R title whether the current 2R display is S/C or T/D.

The FMC calculated S/C point is displayed as a green circle along the route, marked “S/C”. The position of this point is where the plane should start step climb. Now the distance between the S/C point and the aircraft is about 596NM, which exceeds the maximum display distance of ND. Therefore, we should turn the Mode Selector on EFIS to the PLN position, and then press “STEP>” at 6R on the LEGS page of CDU, “NEXT PAGE”, or “PREV PAGE” to select the center point of the ND display. As shown by the figures below, after EFIS selects the PLN mode, a “<CTR>” will be displayed following the waypoint name on the LEGS page. This is a Map Center Label, indicating that currently, ND is displaying all maps with this point as the center. Every time you press 6R, the next waypoint will be selected as the center of ND, and press “NEXT PAGE” or
“PREV PAGE” will select the corresponding point of the previous page or of the next page to be the ND center point.

Through the PLN mode and the selection of a proper ND display range, we will find the S/C point on the ND display.

Now the aircraft is about 600NM to the S/C point. To facilitate our presentation, we enter FL323 as our step to altitude, and then we will see that the S/C point is about 50NM away from us.

When the plane reaches the S/C point, “NOW” will be displayed at 2R, indicating that the plane can start climbing.
Now we should reset the cruise altitude to FL323. Rotate the altitude selector on MCP to set the altitude to 32300, and then press the neighboring Altitude Intervention (ALT INTV) Switch.

When the plane is performing VNAV climb, if the MCP altitude is below the cruise altitude, then every time you press the ALT INTV, the lowest restriction altitude, if any, will be deleted. If the aircraft is flying at this restriction altitude, then the plane is going to restart climbing. If the MCP altitude is above the cruise altitude, then the cruise altitude will be set as the MCP altitude.

When the plane is performing VNAV cruise, if the MCP altitude is above the cruise altitude, after pressing ALT INTV, the cruise altitude will be set as the MCP altitude. If the MCP altitude is below the cruise altitude, then after pressing ALT INTV, the plane will start early descent.

When the plane is performing VNAV descent, every time you press ALT INTV, the highest restriction altitude, if any, will be deleted. If the plane is flying at this restriction altitude, the plane is going to restart descending.

Now the cruise altitude is set to FL323, and the CRZ page becomes the Cruise Climb page, as shown below.

The Cruise Climb page shows the data of the cruise climb phase until the plane reaches a new altitude. This page is very similar to the CLB page. At 2R of the Cruise Climb page, the ETA and distance for climbing to the new altitude are displayed. During the cruise climb phase, the VNAV mode uses the climb thrust and cruise speed to climb to the new altitude.

The VNAV climb mode will work until the aircraft reaches the new altitude. After that, the mode will automatically switch back to cruise. We have shown the step climb function above, and next, we will come back to FL320 and return to the normal fly. The selection of a lower cruise altitude
can only be performed on CDU. Reinput FL320 on the CRZ page as the cruise altitude, and then press EXEC to execute the modified route.

The Cruise Descent page shows the data of cruise descent phase until the plane reaches a new altitude. Similar to the cruise climb mode, at 2R of the Cruise Descent page, the ETA and the distance for descending to the new altitude are displayed. During the cruise descent phase, VNAV mode uses the descending rate of 1000ft/min and the cruise speed to descend to the new altitude. The VNAV descent mode will work until the new altitude is reached, after which the mode will switch back to cruise automatically.

Then we come to see the RTA (required time of arrival) on the CRZ page. If you look carefully, you will see that RTA is also available in the CLB page. In iFly Jets: The 737NG, the RTA can be used in CLB, CRZ, and DES phases. To put it simple, the RTA is to specify the arrival time at a certain waypoint, which can lead the FMC automatic calculation of a suitable speed, so that the aircraft can reach the waypoint in time. Next we give an example. First press “LEGS” on CDU to access the LEGS page.

Then press 6R to access the RTE DATA page. The RTE DATA page shows the ETA to every waypoint on the TRE LEGS page. This page also shows the wind data of the cruise waypoints, which we will explain later. The display is given as follows.

It can be seen that the RTE DATA page resembles a supplement to the LEGS page. All waypoints are arranged in order. If a waypoint is a non-cruise waypoint, then the wind data can be entered from the right area.

The ETA to each waypoint is displayed in the middle of the RTE DATA page. In the above figure,
we can see that the aircraft is estimated to arrive at the WXI waypoint at 0746z. OK, now we request the plane to arrive at the WXI point earlier at 0740z. The RTA page is the third page of Progress page. Press “PROG” and “NEXT PAGE” on CDU to access the RTA progress page. Of course, you can also access the RTA progress page by pressing “RTA->” on the CRZ page. After entering the page, you will see a blank display.

Now the waypoint we would like to reach on time is WXI, so input WXI at 1L. After the input, the display is:

There are lots of data on the display now, so we give an explanation about each of them.

1L: the entered waypoint to which an arrival time should be specified. This waypoint must be in the flight plan, otherwise a warning of “NOT IN FLIGHT PLAN” will display.

2L: the speed which satisfies the RTA requirements. In addition, this speed is restricted by the maximum speed, minimum speed, and the restriction speed.

3L: display the restriction speed.

4L: display the distance to the RTA waypoint.

5L: display the ETA to the RTA waypoint calculated according to the maximum speed on the PERF LIMITS page.

6L: press this LSK and you will access the PERF LIMITS page.

1R: After entering the RTA waypoing, the ETA calculated based on the current flight plan and performance data is initially displayed. Here you can also enter a specified ETA, in the following formats:

• XXXXXX (hr/min/sec)
• XXXX (hr/min)
• XXXX.X (hr/min/tenths of min).

Entry of “A” after RTA specifies arrival time of at or after.
Entry of “B” after RTA specifies arrival time of at or before.

2R: display the time error. If the time error is within the TIME ERROR TOLERANCE range shown on the PERF LIMITS page, then the display is “ON TIME”.

3R: show the current GMT time.

4R: display the FMC predicted altitude and ETA when reaching the ETA waypoint.
5R: the ETA to the RTA waypoint calculated according to the minimum speed on the PERF LIMITS page. If the time we entered at 1R is between 5R and 5L, then the plane can arrive on time, provided that other speed restrictions are not taken into account.

Let’s have a try. Input “0740” at 1R, telling FMC that we would like to reach the WXI waypoint at 0740z, and then press “EXEC” to complete the modification. Now the display is like the following:

```
ACT RTA PROGRESS 3/4
RTA NPT NPT
RTA SPD TIME ERROR
753 ON TIME
SPP REST
--/-
DIST--/ WXI ALT/RTA
208NM ML320/0740:088
FIRST--RTA WINDOW--LAST
0735:36 0758:52
```

Now, FMC recalculates the flying speed and increases it from 0.615 mach previously to 0.755 mach. At this speed, we can reach the WXI waypoint on time. OK, now we try inputting an RTA time again. Input “0730” at 1R.

```
ACT RTA PROGRESS 3/4
RTA NPT NPT
RTA SPD TIME ERROR
820 LATE 07:58
SPP REST
--/-
DIST--/ WXI ALT/RTA
208NM ML320/0737:58
FIRST--RTA WINDOW--LAST
0735:36 0758:52
```

0730z is beyond the time limit displayed at 5L, which means that the plane is impossible to reach the WXI waypoint so fast. Now the FMC calculated speed is 0.82 mach, being the upper limit speed on the PERF LIMITS page. 2R shows “LATE 07:58”, which means that we will reach the WXI waypoint with a delay of 7 minute 58 seconds. Look at 4R, really, we will arrive at 07:37:58.

Next we delete the RTA mode and come back to a normal mode such as ECON. Press “DELETE”, and then press 1L to delete the RTA point. Or after the aircraft passes an RTA point, that RTA point will be deleted automatically. After deleting the RTA point, CDU might give a warning message “SELECT MODE AFTER RTA”. Have a check and select a suitable cruise mode.

After the introduction of RTA, we come back to see the RTE DATA page.

```
ACT RTE DATA 1/7
S JW 0727z--/-
WXI 0746z--/-
AKOMA 0803z--/-
ZBO 0813z--/-
OBLIK 0827z--/-
```

We have said that the right half of the RTE DATA page displays the wind data. The display of wind data is only available for cruise waypoints. For example in the above figure, the 5 waypoints
are all cruise waypoints, so on their right side, the dashes mean that you can input data. If a waypoint is not a cruise waypoint, the right side will be blank.

Entry must include both the wind direction and wind speed. The wind direction data is of 3-digit, with leading zeros if less than 3 digits. After entering the wind data, the data of this line will turn to large font. This wind data will be propagated to all following cruise waypoints, until the next waypoint where the wind data is entered manually. For example, we enter “030/45” at 3R.

The wind data of the point AKOMA is displayed in large font, which means that it is entered manually. The wind data of AKOMA will be propagated to the following waypoints, the propagated data in small font. Then we enter “020/50” at 1R.

Now you must be familiar with how FMC propagates the wind data to the following waypoints. FMC starts the propagation from the first waypoint where the wind data is manually entered, till the next waypoint where the data is manually entered, or to the last waypoint of the cruise phase.

Besides entering the wind data from the RTE DATA page, we can also enter from the CRZ WIND at 2R of the PERF INIT page. First we delete the SJW wind data. Press “DELETE” and then press 1R to delete the wind data of the SJW. Then come to the PERF INIT page and enter “050/30” at 2R, as shown by the following figure.

Now we come back to the RTE DATA page. It can be seen that the wind data of the SJW and of the WXI waypoint are the data that we entered just now on the PERF INIT page. If we delete the AKOMA point data now, then FMC will use the entered data on the PERF INIT for the whole cruise phase.
In addition, it should be pointed out that FMC does not use the wind data entered from the page as the only wind data for calculation. FMC combines the actual wind data at the moment outside the aircraft with the entered wind data by certain proportions to perform the calculation. The closer to the current position, the higher the proportion of the actual wind data; otherwise, the higher the proportion of the entered wind data. Let us end the introduction of the weather data here, and delete all the weather data entered just now to come back to the original status.

Then we come to introduce the Fix Information page. The FIX INFO page is used to identify waypoint fixes, which can also be displayed on ND. If necessary, these points can also be directly copied into the routes. We have provided two modes of FIX INFO pages: the standard mode and the enhanced mode. The standard mode provides 2 independent FIX INFO pages, and the enhanced mode provides 4 independent FIX INFO pages. By selecting “iFly” → “iFly Jets: The 737NG” → “Styles” from the FS menu, you can select the mode you prefer.

You can access the page by pressing the “FIX” key on CDU. FIX INFO page is as follows:

Input the FIX point at 1L. FIX points acceptable by the standard mode CDU include airports, navigation stations, and other points that already exist in the navigation database. Besides these points, the enhanced CDU can also accept longitude latitude position, Place-Bearing / Distance, and Place-Bearing / Place-Bearing. We select the ND mode to be the MAP mode on EFIS, and then press the “STA” switch to open the STA display. Now look at the ND display as given below:
There is an OC navigation station right forward to the route, which we will take as an example. Input “OC” at 1L. Because more than one waypoint inside the database are sharing the ID of OC, CDU automatically enters the Select Desired Waypoint page. Select the proper point on the Select Desired Waypoint page (usually the first point is closest to the aircraft at the moment, but this is not always the case, so you must check carefully). The page is displayed as given below:

The area between 1L and 1R displays the radial as well as the distance between the fix and the aircraft. This information is updated continuously according to the aircraft position. 5L displays the abeam point, and calculates the ETA, DTG, and ALT information. Let’s have a look at the ND as shown by the figure below.

Now the symbol of the OC navigation station has turned into green with a circle around it. There appears a radial perpendicular to the route, with the intersection being the abeam point. According to the data displayed on the FIX INFO page, this point is about 3NM to the route. The ETA of passing this point is 0725.6z; and the altitude, FL320.
2L~4L display the radial/distance, which can be entered one by one, or be entered together at a time. The input of the radial should be of 3-digit, with 0 added from the left if less than 3 digits; of the distance, the standard mode CDU supports a maximum of 511NM, and the enhanced CDU supports a maximum of 9999NM. The input of distance can be a decimal with one figure after the decimal dot.

We input “/7” at 2L; “100” at 3L; and “120/10” at 4L. The CDU display after the input is shown as follows:

```
2L 118/7 236/7
3L 100/6 0725.8 7 FL320
4L 120/10 090/6 0725.6 3 FL320
```

Now several radials and circles have appeared on the ND display.

We have entered a distance at 2L, so a circle (the small one) appears on the ND, below which our entered distance is marked. From this we can see that the circle has an intersection with the route. The radial from the OC point to this intersection is of 118 degrees. The small font “118” at 2L stands for this radial. If there is no intersection of the entered distance and the route, the radial will be displayed as “---”, indicating that the data is invalid. The following ETA, DTG, and ALT are predicted data information of the intersection. If the entered distance has more than one intersection with the route, only the information of the first point will be displayed on CDU.

Then we look at 3L. We have only entered the radial, so a radial is displayed on the ND, below which our entered data is marked. Similarly, there is an intersection point between the radial and the route, so the distance between the OC point and the intersection point is displayed in small font at 3L. If there is no intersection point between the radial and the route, the distance is displayed as “---”, indicating that the data is invalid. If there are more than one intersection points between the radial and the route, only the information of the first point will be displayed on CDU.

We have entered the radial as well as the distance at 4L. A circle and a radial appear on the ND simultaneously, their intersection being our entered point. Obviously, this intersection is not on the
route, so the following ETA, DTG, and ALT information is all blank.

Another function of the FIX INFO page is that we can copy the entered points at 2L~5L to the route. It is easy to do so: Press the LSK of a 2L~5L point, so that the position of this point is transferred to the scratchpad, access the LEGS page to input in the same way as entering a longitude latitude position. Of course, if you only enter a radial or a distance into 2L~4L, the radial or distance having no intersection with the aircraft route, this point will not be transferred to the scratchpad, and it cannot be inserted into the route.

Next we come to introduce the OFFSET. The function of OFFSET is to let the aircraft deviate from the preset route and fly on one side of it. When the weather forward is bad or for some other reason that the original route should be avoided, this function can be used. OFFSET can specify a range within 99.9NM left or right to the route. The access to the OFFSET page can be achieved through the INIT/REF INDEX page, or through the RTE page after the aircraft takes off. After entering the OFFSET page, the display of CDU and ND are given as follows:

Enter an offset distance at 2L in the format of Lxx, xxL, Rxx, or xxR, 1 decimal place is possible. L stands for offset to the left; and R, to the right. Here we input “L10”, means to offset 10NM to the left, and then press EXEC to execute the offset setting. Now the CDU and ND display are as follows:

It can be seen from the ND that FMC has replanned another parallel route 10NM left to the original one. The new route is displayed with short dashes. The AFDS will maneuver the plane to
approach this offset and then fly along it. The offset is not available for some legs such as:

- End of flight plan waypoint
- Discontinuity
- Departure procedure
- Departure transition
- Approach transition
- Approach procedure
- Holding pattern
- Some legs containing fly-over waypoints
- Course change greater than 135 degrees

In the meanwhile, we notice that CDU 3L and 4L display some information. At 3L, you can enter the start waypoint of the offset, which must be a waypoint of the route. If the current leg is valid for offset (i.e. none of the above 9 situations), dashes will be displayed. Otherwise if the leg is invalid for offset, boxes will be displayed, indicating that you have to input a start waypoint for the offset. The offset will start from the first valid offset leg after the start waypoint. If no input data is available, the offset FMC will start the offset from the first valid offset leg in the flight plan. At 4L, you can input the end waypoint of the offset. If no input data is available, the offset will continue until reaching an invalid offset leg. If you look carefully, you will find that the “OFST” light located right to the CDU keyboard is now illuminated, indicating that FMC is using the offset function. Now we delete the OFFSET configuration and come back to the normal course. Press “DELETE” and then press 2L to delete the offset.

Here we will introduce another page that is useful for the cruise phase - the NAV STATUS page. Press 6R on INIT/REF INDEX page, or press the corresponding LSK on POS SHIFT 3/3 or PROGRESS 1/3 page to access the NAV STATUS page.

The data on this page is easy to understand. The only necessary explanation is about the white letter “A” at 1L and 1R. This letter represents the tuning mode of the receiver. “A” stands for automatic, which means that 2 receivers automatically search the optimal navigation station. “P” stands for procedural, which means that the current waypoint is a conditional waypoint which requests the navigation station to provide position information, and the receiver will automatically tune to the frequency of the specified navigation station. “M” stands for manual, which means that the current receiver is using a manually set frequency.

You can directly enter a frequency at 1L or 1R to tuning the receiver, or press “DEL” and then press 1L, or 1R, to reset the receiver to auto mode. This is important, because you may forget the resetting to auto mode after modifying the receiver’s frequency, which causes the problem that the autopilot system will be unable to maintain the LNAV mode when the current waypoint becomes a conditional waypoint.

The last page we will introduce is the NAV OPTIONS page, which can be accessed by pressing NEXT PAGE or PREV PAGE on the NAV STATUS page.
By now, we have introduced about most cruise-related CDU pages, and pages have not been introduced mainly provide various information to the crew, however, it will not be a big problem if you do not look at them…In the following, we will introduce the autopilot modes that are usable during the cruise phase. Some modes have already been introduced in the takeoff or climb phase, which we will not repeat here.

The most often used mode for the cruise phase is VNAV+LNAV. Besides, the roll mode of HDG SEL or VOR/LOC, and the pitch mode of ALT HOLD, MCP SPD, or V/S may also be used during the cruise phase. The VNAV mode and LNAV mode have already been introduced in the takeoff phase and the climb phase respectively, so let’s go on to introduce other modes.

**HDG SEL**: the aircraft turns to and maintain the heading specified by the MCP heading window. The operation is easy: turn the heading selector to choose a heading, and then press the Heading Select (HDG SEL) Switch. The FMA roll mode displays “HDG SEL” while the HDG SEL switch illuminates.

- The aircraft will make the turn in the direction (left or right) closest to the current heading.
- The bank angle is restricted by the bank angle selector.
- In VOR LOC mode or APP mode (VOR/LOC ARM), the HDG SEL mode will be automatically disengaged when intercepting the selected radio course.

Now let’s try to use HDG SEL. The current ND display is as follows:

![ND Display](image)

We are flying along the route with a heading 233. Suppose that we need to adjust the heading to 250 degrees. First we turn the heading selector to 250, and then press HDG SEL. One thing should be reminded that the area above this selector is to control the bank angle, so you had better touch the switch from a lower position so as to avoid mistaken operation.
Now the plane starts turning right to and then maintains at 250 degrees. The final ND display is as follows:

Press the LNA V button again to return to the LNA V mode. If the aircraft deviates too far from the route, the LNA V mode may not be usable. In such case, you should first use HDG SEL to an intercept course of 90 degrees or less and intercept the route segment before the active waypoint, then engage LNA V mode.

VOR/LOC: the AFDS tracks the VOR course or tracks selected localizer course along the inbound front course bearing. If the aircraft receives a VOR signal when the VOR/LOC switch is pressed, then it will start tracking the VOR course. And if the aircraft receives a LOC signal when the VOR/LOC switch is pressed, then it will start tracking the LOC course. In the cruise phase, only VOR mode is used. After adjusting the VOR frequency and confirming receiving the correct frequency, turn the course selector located on the MCP panel to select a suitable course, and then press the VOR/LOC button. The press of VOR/LOC button may start either the VOR/LOC mode or the ARM VOR/LOC mode. If the current position of the aircraft is of a big angle or distance from the selected course, the aircraft will arm the VOR/LOC mode, and engages the HDG SEL mode in the meanwhile, the MCP heading window displaying the current heading. Under such circumstance, you should use the heading selector to select a suitable heading so as to ensure that the plane can intercept the course. After the VOR/LOC mode is started, the FMA roll mode will display “VOR/LOC” in green. If the ARM is started, the FMA roll mode will display “HDG SEL”, below which “VOR/LOC” displayed in white.

It should be explained that 737NG has two independent AFDSs and two independent NAV receivers. So which AFDS is using which NAV receiver actually? Let us look at the overhead panel:

The left VHF NAV Transfer Switch is used to select the NAV receiver:
• **BOTH ON 1** – The NAV 1 signal is used by the captain side panel, the FO side panel, CMD A, and CMD B.
• **NORMAL** – The NAV 1 signal is used by the captain side panel and CMD A, while the NAV 2 signal is used by the FO side panel and CMD B.
• **BOTH ON 2** – The NAV 2 signal is used by the captain side panel, the FO side panel, CMD A, and CMD B.

Now let’s try to use VOR/LOC. First we search a nearby navigation station. Select or enter “117.7” on the radio panel or on the NAV STATUS page of CDU. If you are using the radio panel, then first use the frequency selector to select the STANDBY frequency, and then press the transfer switch to transfer the active and standby frequencies.

Then use the course selector on MCP to select 190 as the VOR course.

Now the ND display is as follows. Our objective is to make the plane fly along the green dashes, which is our selected course.

Press VOR LOC.
Now the FMA display is as follows. Because the current distance from our target course is relatively far, the roll mode displays HDG SEL, the VOR/SEL mode armed.

Select a suitable intercept heading: Select 139 on the heading window of MCP.

The plane starts turning to heading 139 so as to intercept the VOR course. The ND display is as follows:

After intercepting the course, the aircraft will fly along the VOR course, and the FMA display as below:
Let’s come back to the LNAV mode and let the plane continue flying along the route. Now we introduce some pitch modes that can be used during cruise phase such as ALT HOLD, LVL CHG, and V/S.

ALT HOLD: provides pitch commands to maintain the MCP selected altitude or the altitude at the time the ALT HOLD switch is pressed. If the altitude at the time the ALT HOLD switch is pressed is within the range of ±250ft from the MCP selected altitude, the AFDS will maintain the MCP selected altitude, and the ALT HOLD switch light extinguishes. If the difference between these two altitudes is bigger than ±250ft, the AFDS will maintain the altitude when the ALT HOLD switch is pressed, and the ALT HOLD switch light illuminates. Under both circumstances, the pitch mode of FMA displays “ALT HOLD”.

When ALT HOLD maintains the MCP selected altitude:
• Select a new MCP altitude, so as to arm the V/S mode
• Before selecting the new MCP altitude, LVL CHG, V/S, VNAN climb, and VNAN descent are all inhibited.

The ALT HOLD mode will be inhibited after intercepting the glideslope.

The current aircraft status is as follows:

Let’s try pressing the ALT HOLD button. Now the FMA display and MCP display are as follows:

It can be seen that after pressing the ALT HOLD button, the FMA pitch mode becomes “ALT HOLD”; and the throttle mode, “MCP SPD”. This means that the plane is now using the altitude hold mode. In addition, because the aircraft altitude is within ±250ft from the MCP altitude when we pressed the ALT HOLD switch, the plane maintains the MCP altitude, which results in the extinguishment of the ALT HOLD switch light on the MCP panel. The autothrottle is kept at the
speed specified by the MCP IAS/MACH window, and the IAS/MACH window displays the current speed.

If we modify the MCP altitude before pressing the ALT HOLD switch, for example, reduce it by 1000ft, and then press the ALT HOLD switch, then we can observe that the ALT HOLD switch light illuminates, indicating that now the aircraft is flying at the altitude when the ALT HOLD switch is pressed.

**LVL CHG:** LVL CHG mode coordinates the pitch control and thrust control to realize automatic climb and automatic descent at a selected speed to a specified altitude. Actually, you may consider LVL CHG mode as a simplified version of VNAV climb mode or descent mode. By controlling simultaneously aircraft’s speed and pitch, the LVL CHG mode let the aircraft reach the altitude specified in the MCP altitude window at the speed specified by the MCP speed window. After reaching the MCP altitude, the pitch mode automatically changes to ALT HOLD mode; and the speed mode, SPEED mode. The LVL CHG mode will be inhibited after intercepting the glideslope.

If the MCP altitude is higher than the aircraft’s altitude, then the LVL CHG switch light will illuminate after pressing the LVL CHG switch. The FMA autothrottle mode displays “N1”, indicating that the autothrottle holds limit thrust (the thrust is determined by the configuration on N1 LIMITS page of CDU). The FMA pitch mode displays “MCP SPD”, indicating that the plane is maintaining the speed specified on the IAS/MACH display of MCP by using the pitch command. Let’s have a try. At present, the plane is using VNAV+LNAV and flying at the cruise altitude of FL320. We modify the MCP altitude to be 33000. Now the FMA display and MCP display are as follows:

![FMA Display and MCP Display](image)

Then press the LVL CHG switch and pay attention to the engine parameters. Now the aircraft starts increasing thrust and climbing.

If the MCP altitude is lower than the aircraft’s altitude, then the LVL CHG switch light will illuminate after pressing the LVL CHG switch. The FMA autothrottle mode displays “RETARD”, indicating that the autothrottle is moving the thrust lever to the idle position. After N1 decreases, the FMA autothrottle mode will display “ARM”, indicating that the autothrottle mode is not engaged. The crew can set the thrust levers manually. The autothrottle only provides a minimum speed protection. The FMA pitch mode displays “MCP SPD”, indicating that the plane is keeping at the speed specified by the IAS/MACH speed window of MCP by using the pitch command. Let’s have another try. At present, the aircraft is using VNAV+LNAV and flying at the cruise altitude of FL320. We modify the MCP altitude to be 31000. Now the FMA display and the MCP display are as follows:
Then press the LVL CHG switch and pay attention to the engine parameters. Now the aircraft starts moving the throttle to the idle position. And in order to keep the speed, the aircraft descents to preselected altitudes at selected airspeeds.

The target speed under the LVL CHG mode satisfies the following principles:
- If the autothrottle works under the SPEED mode when LVL CHG is connected, this will be the target speed
- If the autothrottle does not work under the SPEED mode when LVL CHG is connected, the aircraft speed at that time will be the target speed
- The target speed can be modified by using the IAS/MACH selector on MCP

V/S: the vertical speed mode can keep a specified vertical speed by controlling the aircraft’s pitch. The autothrottle will start the SPEED mode when V/S mode is engaged. The V/S mode has two statuses: arm and engaged. If the current pitch mode is ALT HOLD maintaining at the MCP altitude, and a new MCP altitude has been selected (higher or lower than the current altitude by over 100ft), then V/S gets armed. When V/S is armed, rotate the V/S thumbwheel to engage the V/S mode. If any of the following situations exists, the V/S mode is inhibited:
- ALT HOLD mode remains the same as the MCP selected altitude
- Intercept the glideslope in the APP mode

After pressing the V/S switch, the V/S mode will be armed or engaged, and the FMA pitch mode will display “V/S”. Under the V/S ARM mode, the “V/S” is displayed in white at the second line of FMA pitch mode. After arming or engaging the V/S mode, the vertical speed display will display the current vertical speed instead of a previous blank screen. Then you can select a selected vertical speed by using the V/S thumbwheel.

The principles of the vertical speed display are given as follows:
- Blank when the V/S mode is not engaged
- Shows the current vertical speed when the V/S mode is engaged by the V/S switch
- Shows the selected V/S when setting V/S with V/S thumbwheel
- The range of display is -7900 ~ +6000ft/min
- The V/S speed increment of display is 50ft/min if V/S is less than 1000ft/min
- The V/S speed increment of display is 100ft/min if V/S equals or is greater than 1000ft/min

Now let’s see an example of how to perform the V/S mode. At present, the aircraft’s autopilot mode is VNAV+LNAV, as given below.
First we use the MCP altitude selector to select 33000 as our target altitude. Then press the V/S switch. Now the MCP display is as follows.

Both the SPEED switch and the V/S switch are illuminated, while the VNAV switch is extinguished. In other words, the original VNAV mode is decomposed into SPEED+VS mode. The vertical speed display turns from a blank screen to the current vertical speed, which is “-0050” in the figure, indicating that the plane has a minor sink rate. Then we look at PFD. Now there is a red bug on the PFD V/S indicator, which is pointing near “0”. This bug indicates the speed selected in the MCP vertical speed window.

Then have a look at the FMA display. The same as the MCP display, the speed mode is “MCP SPD”; roll mode, “LNAV”; and pitch mode, “V/S”.

Now rotate the V/S thumbwheel to select the climb rate +1000.
Now on PFD, the red bug on the V/S indicator points at the scale “1000”.

OK, now the plane will climb till 33000ft under a climb rate of +1000ft/min. After reaching 33000ft, the plane will automatically start the ALT HOLD mode and keep at the MCP altitude. Next, you can try by yourself to return to 32000ft by using the V/S mode, and then reuse the LNAV mode.

By now, we have introduced in detail the use of FMC and AFDS relating to the cruise phase. During the remaining time of the cruise phase, we will keep using the VNAV+LNAV mode. It should be noted that if you have used the FS time acceleration function, we recommend that the maximum acceleration during the autopilot flight do not exceed 8x, and that the acceleration should only be used during the time when the aircraft is flying level with stable speed.
Descent Procedure

During the descent phase, the following procedure should be performed. The following 5 steps must be completed before the aircraft gets below the altitude of 10000ft.

1. If the fuel quantity of the center tank is less than 3000pd or 1400kg, close the 2 center tank fuel pumps (panel 4).

2. On the cabin pressurization panel (panel 17), verify that the correct landing altitude has been set. If it is not correct, rotate the landing altitude selector to set the landing altitude manually.

3. Enter the VREF speed on the APROACH REF page.

4. According to the approach requirements, check and modify the RADIO/BARO minimums altitude. Press the 2 red areas above the switch to select RADIO or BARD, and then press the 2 red areas below to select a suitable RADIO/BARO minimums altitude.

5. Set the autobrake according to conditions of the runway and the weather.

The descent phase begins at the T/D (top-of-descent). Let’s have a look at ND.
We can see that there is a green circle near the point RUBIC, beside which “T/D” is marked. This is the T/D point, which, after being passed by the aircraft, the descent phase begins. The methods of starting the descent phase include:

- The descent phase starts automatically if the aircraft passes the T/D point under the VNAV cruise mode.
- Start the descent phase by pressing 6R and then pressing EXEC when 6R of the DES page of CDU displays “DES NOW>”.
- Start the descent phase by pressing ALT INTV switch if the MCP altitude is lower than the cruise altitude and the aircraft is within 50NM from the T/D point under the VNAV cruise mode.

No matter how the descent phase is started, you **MUST** set the MCP altitude to be lower than the cruise altitude. Otherwise, the plane will stay at the MCP altitude even if it has started the descent phase. This concept is similar to the climb phase, during which the MCP altitude provides altitude intervention.

If the aircraft starts the descent phase by the last two methods, it actually starts the early descent mode, instead of a normal descent phase. VNAV starts the early descent with -1000ft/min until intercepts the idle descent path. VNAV uses FMC SPD as the autothrottle mode; and VNAV PTH, as the pitch mode. The dashes in the following figure represents the flight path of an early descent. After intercepting the idle descent path, the aircraft will descend along the idle descent path.

Here we will say a little more about ALT INTV. When the MCP altitude is lower than the cruise altitude, the early descent mode will be started if ALT INTV is pressed when the plane is within 50NM from the T/D. But if ALT INTV is pressed when the plane is more than 50NM from the T/D, it only means to set a new cruise altitude.
In this tutorial, we will use the first method to go into the descent phase. Before reaching the T/D, we set the MCP altitude to an altitude constraint lower than the cruise altitude, or just set it to be the landing airport’s altitude. Here we set the MCP to be 13000, which is the altitude constraint of the MANGO point in CDU.

Then there is not much left that we can do, just wait for the plane to descend automatically after it passes the T/D. If we do not set the MCP altitude, FMC will display a warning message “RESET MCP ALT” on CDU when the plane is about 5NM from the T/D.

After the plane passes the T/D point, the autothrottle moves thrust levers to the idle position and the FMA display becomes:

After the throttle reaches the idle position, the autothrottle mode will change to ARM mode.

The roll mode keeps being LNAV. There is not much to explain about this, because it is the same as the climb phase and the cruise phase. But we should explain in detail about the pitch mode. VNAV can perform the descent in two modes: Path Descent (displayed as VNAV PTH) and Speed Descent (displayed as VNAV SPD). In the following, we will detail the explanation about these two descent modes.

1. **Path Descent**

During the path descent process, FMC uses idle thrust and pitch control to keep the vertical path. The descent path starts from the T/D point, and the following factors are also taken into account when performing the path calculation:
The target speed can be changed via LEGS or DES page. You can also enter the wind data on the Descent Forecast page. It should be emphasized that the path descent uses the target speed for planning purposes only. There is no attempt to maintain the target speed. In other words, the target speed is used to plan the descent path, but when the aircraft actually flies along this descent path, it may be hard to keep the target speed due to various factors such as wind and maneuver.

If the aircraft does not have all necessary information to path descent, FMC will revert to speed descent mode, or VNAV will be disengaged. If the airspeed increases significant due to unexpected tailwind, CDU will display the message “DRAG REQUIRED” in order to keep along the path. If the speed limit is exceeded, VNAV will be disengaged.

2. Speed descent

During the speed descent process, FMC uses idle thrust and pitch control to let the aircraft descend in compliance with the altitude restriction and speed restriction specified by the flight plan, similar to a descent under altitude changing mode.

Besides that FMC is able to switch automatically from the path descent mode to the speed descent mode, we can also switch between these two modes manually (if both of them are available) through the CDU DES page. As shown in the figure below, now the page title indicates that the path descent mode is now active, and if 5R is pressed, it will change to the speed descent mode.

From the above FMA snapshot picture, we can see that the aircraft is now using the path descent mode. Look at the ND, and you will see that a scale appears at the lower right corner of the screen after the aircraft starts the descent phase, as shown in the figure below:

The magenta symbol is called VNAV path pointer; and the white scale, the deviation scale. Their function is similar to the ILS glideslope indicator, i.e., to indicate the deviation between the aircraft and the FMC planned descent path. The scale can show an deviation of ±400ft. If the deviation is more than ±400ft, the deviation figure will be displayed above or below the scale.

Now the aircraft is descending automatically under autopilot control. Next we will introduce one by one some commonly used CDU pages and some other operations. First we introduce the DES page. Press “DES” on CDU to access the Descent Page. The following picture is the DES page during the descent phase. If you access the DES page during a non-cruise phase, some data will be
different from the picture below, which we will explain later.

The Descent Page is used to monitor, revise, and select the descent path. We have already said that the descent mode can be selected as the path mode or the speed mode. The speed can be selected as the ECON mode, or specified by manual input. The default descent mode of VNAV is ECON PATH.

1L displays the end of descent altitude, which cannot be deleted or modified by the crew.

2L displays the target speed. It can be seen from the figure that currently the target speed is 0.633M. It should be emphasized again that the path descent uses the target speed for planning purposes only. There is no attempt to maintain the target speed. When the aircraft is above FL260, the target speed is the mach speed; below FL260, the indicated airspeed. The crew can enter the target speed manually.

3L displays the speed restriction. From the figure we can see that when the aircraft altitude is less than 10000ft, the maximum speed is limited to 240 knots. The crew can manually enter or delete this limit. If the flap is extended, the flap limit speed will be displayed here. The flap limit speed cannot be deleted or modified manually.

4L displays the vertical deviation, which is only displayed when the aircraft is in the descent phase. It indicates the deviation of the current aircraft altitude from the calculated vertical path. LO represents lower than the path; and HI, higher than the path.

5L displays “<ECON” if the current descent mode is non-economic mode. Press 5L, and it will return to the ECON descent mode.

6L, if pressed, will access the descent forecast page. The data input of the descent forecast page is usually performed before the descent for more precise descent path calculation.

1R displays the next waypoint constraint from the RTE LEGS page. This data is only displayed when the aircraft is in the descent phase.

2R displays the time and distance to a certain point. If the aircraft is not in the descent phase, it will display some T/D-related data; otherwise, the relevant data of reaching the 1R waypoint.

3R displays the waypoint and altitude that serves as the basis for the vertical bearing (V/B) display on line 4R. Normally displays the same waypoint/altitude restriction that is displayed on the 1R. This data is only displayed when the aircraft is in the descent phase.

4R shows the vertical path parameters related to the present vertical path. FPA displays the current flight path angle. V/B is the flight path angle required if the aircraft flies straight towards the 3R point under the altitude restriction. V/S shows the vertical speed necessary to fly the displayed V/B. In short, if we fly in compliance with V/S, we will be able to pass the waypoint at the specified altitude. This data is only displayed when the aircraft is in the descent phase.

The function of 5R has already been introduced, i.e., to perform changeover between two descent modes.

6R, if pressed, will access the RTA page. The descent RTA is the same as the cruise RTA. This place may also display DES NOW or ERASE. These have all been introduced already, so we will not repeat.
Now we introduce about the Descent Forecast page, which is used to enter the wind data of different altitudes. These entered data will help FMC for more precise descent path calculation. Now look at the snapshot picture.

The data to be entered on the Descent Forecast page mainly include three lines, 3L/R~5 L/R, i.e. the altitude data and the corresponding wind data at this altitude. In addition, you can also enter the altitude specified to open or close the de-icing system. When you access the page initially, 3L/R~5 L/R are all displayed as dashes. If you would like to enter the wind data for a certain altitude, you must first enter an altitude at any dashes on the left. After the entry, CDU will automatically sort the entered altitudes. For example, let’s enter “5000” at 4L, then we will find that the entered altitude appears displayed at 3L, because CDU has automatically sorted the altitudes. Then enter “FL210” at 4L, after which FL210 is displayed at 3L; and 5000, 4L. Next we can enter the wind direction and wind speed at 3R and 4R for these two altitudes. The entry must be pairs of wind direction and wind speed, with “/” in the middle, and the wind direction must be a 3-digit figure, which should be added leading zeros if less than 3 digits.

In the CDU, there is a function of selecting an alternate destination airport. Although we are not going to use this function in this tutorial, we will still give a brief introduction about it. On the INIT/REF INDEX page, APPROACH REF page, or the first page of RTE, press ALTN DEST to access the Alternate Dests page.

When you access the page initially, line 1~5 are all blank. We have entered 2 alternate airports at line 1 and line 2, VMMC and ZGSZ, to facilitate our explanation.

Totally 5 items can be entered at 1L~5L. Apart from an airport, we can also input other points existing in the navigation database such as a navigation station or a waypoint. After the entry, the VIA, DTG, ETA, and FUEL following this line will automatically display. If you press the LSK corresponding to 1R~5R, the 2/6~6/6 page of the Alternate Dests will be accessed. The contents of the 2/6~6/6 pages will be introduced later.

How to know the alternate airports nearby? Let’s press 6R. Now CDU starts searching the whole navigation database for the nearest airports, which, after the search, will be sorted in distance order.
If you do not know the nearby airports, you can access the Nearest Airport page and choose some suitable airports, and then press 6R to return to the ALTERNATE DESTS page to input the chosen airports. Note: you can not select airports on the Nearest Airport page, because it is just for reference.

Now come back to the ALTERNATE DESTS page. Press 1R to access the Alternate Dests Page 2/6. Relevant information of the airports or points displayed on ALTERNATE DESTS page 1/6 is shown here, as given by the following picture.

On this page, we can choose the method of flying to the specified point at 5L. There are two choices: DIRECT or MISSED APP, which can be selected by pressing 5L. DIRECT means to fly from the current position to the specified point directly; and MISSED APP, to fly to the specified point after reaching the destination airport. In the figure above, we selected DIRECT; and in the figure below, MISSED APP.

Compare these two pictures, and you will find that one more data is displayed at 3R under the MISSED APP mode, which stands for the distance from the destination to the specified point.

Now we have finished the introduction about the alternate destination airport, and let’s have a look at the aircraft status. The plane has already passed the RUBIC point and is now flying towards the MANGO point.
In most cases, ATC will ask you to fly a holding pattern at a certain point. The busier an airport is, the more often you are asked to fly a holding pattern. In 737NG, you can not only set a certain point inside the route to be the HOLD point, but also set a certain point outside the route to be the HOLD point. Now let us suppose that ATC asks us to fly holding pattern at the MANGO point. First press the “HOLD” button on CDU. If there is no HOLD point in the current route, CDU will display the following:

This is an LEGS page with “HOLD AT” information. The only difference between this page and a normal LEGS page lies in the last line, where you can enter a holding fix into the left side, or use the right side button to select the aircraft’s current position to be the holding fix.

We enter “MANGO” into the scratchpad (of course, you can also press 1L to transfer this waypoint to the scratchpad), as shown below:

Then press 6L to input the MANGO point into the system. Because MANGO is in the active route, CDU automatically displays the HOLD page, as given below. If MANGO is not in the active route, the scratchpad will display “HOLD AT MANGO”. Then press 1L~5L to insert the point into a proper position.

Then press “EXEC” to execute the route. Now you can see from the LEGS page that another MANGO point has appeared behind the original MANGO point. “HOLD AT” is marked in the heading display area of the new MANGO waypoint, indicating that this is a holding fix.
Meanwhile a holding pattern symbol is displayed on the ND.

Let’s have a look at the HOLD page before the aircraft reaches the holding fix. Press “HOLD” to access the HOLD page.

1L shows the ID of holding fix, where the MANGO we entered just now is displayed. If we have chosen PPOS in the LEGS page with “HOLD AT”, FMC would have specified “PPOS” as the ID of holding fix.

2L is to enter the quadrant and the radial of holding pattern. The valid entry is X/XXX (quadrant/radial), XX/XXX (quadrant/radial), or XXX (radial), for example, NE/040. If you have already entered data at 3L, 2L will be displayed as dashes.

3L is to enter the holding inbound course and turn direction. The valid entry is XXX (inbound course), XXX/X (inbound course /turning direction), /X or X (turning direction). If you have already entered data at 2L, 3L will be displayed as dashes.

4L is to be enter the holding pattern leg time, i.e. the flight time required for the straight line segment of the holding pattern. The valid input format is XXX.X. This data can be entered
manually, and if there is no manual enters, FMC will assume the holding pattern leg time to be: 1.0min under 14000ft, and 1.5min above 14,000ft.

5L is to enter the holding pattern leg distance, i.e. the length of the straight line segment of the holding pattern. You can only enter one of 4L and 5L. After the entry, the other one will automatically be displayed as dashes.

6L will display “ERASE” if the route is under modification, and will delete modification after being pressed. If there is no route modification, it displays “NEXT HOLD”. If there exists any successive holding pattern on the route, it will display the next holding pattern. If there is no successive holding pattern on the route, it will access the LEGS page with “HOLD AT” after being pressed.

1R shows the altitude and speed at the holding fix. Its format is the same with that of the LEGS page.

2R shows the calculated time of flying over the holding fix next time.

3R shows the estimated time when ATC gives clearance to end the holding pattern flight. You are not required to enter this data. The purpose of this data is to help FMC calculate the performance data more accurately.

4R shows the current fuel quantity, and predicts the time the aircraft can keep holding, which is displayed in the format of “hour+minute”. In other words, if ATC asks you to hold 30min, but the data displayed here is less than 30, then you must tell ATC that you will run out of fuel…

5R shows the best holding speed calculated based on the current altitude and conditions.

6R displays “EXIT HOLD” if the aircraft is now flying a holding pattern. After being pressed, it will display “EXIT ARMED”, and the “EXEC” light will illuminate. Press the “EXEC” to execute. This tells the AFDS: end the holding pattern after completing the current pattern. If you press “EXIT ARMED” again, the former command of exiting the holding pattern will be canceled, and the aircraft will keep flying holding pattern.

This is all of the page introduction. Generally speaking, the most often used items are 3L, 4L, and 5L. The input of these 3 items can modify the direction and length of the holding pattern. Let’s look at some examples.

Modify the LEG TIME to be 2 minutes, and you can see that the straight line segment of the holding pattern on ND becomes a little longer.

Then, enter 15.0NM at LEG DIST, and you will see that the straight line segment of the holding pattern on ND becomes a further longer. At the same time, LEG TIME displays as dashes, because only one of LEG DIST and LEG TIME can be displayed.
Enter “050” at INBD CRS/DIR, and you will find that the whole holding pattern figure turns around. Now the holding inbound course (the direction pointed by the white arrow in the figure) becomes 050.

Have another try and enter “180” at INBD CRS/DIR, and you will see that the whole figure rotates a big angle.

And in the last example, enter “/L” at INBD CRS/DIR, which changes the turning direction of holding pattern. After the input, the plane will turn left to fly the holding pattern. The ND display is given as follows.
Now we return to the initial holding pattern setting, i.e. the aircraft will turn right to fly the HOLD leg after passing the MANGO point.

Now the HOLD page title shows the ACT status, indicating that the holding pattern is being performed at the moment.

In our tutorial, we only fly one circle of the holding pattern. Now the aircraft already enters the outbound leg, so our next task is to tell autopilot to exit to the normal route after completing the current holding pattern. First press “EXIT HOLD” at 6R, and the screen displays as follows:
Now 6R becomes “EXIT ARMED”, and the EXEC light on CDU illuminates. Press the EXEC button to execute.

Now 6R still displays “EXIT ARMED”. If now ATC again asks you to continue flying holding pattern, then press 6R to cancel the former exit command.

After the aircraft reaches the MANGO point again, it will return to the original route, and FMC will delete the holding fix, as shown by the figure below.

During the descent phase, sometimes ATC asks us to select other STAR procedures due to weather reasons etc. In such cases, we can access the ARR page of CDU to re-select a suitable procedure. Pay attention that after selecting a suitable procedure, we must go back to the LEGS page to remove the Discontinuity Waypoints that have appeared in CDU and check if the route is correct. After repeated modifications, the route in CDU may become a mess. In such case, we recommend not to use LNAV and VNAV, but to use other autopilot modes.

Finally let’s see another page, the Approach Reference Page. The Approach Reference Page shows the approach planning information and the approach speed reference (VREF).
On the page, 1L displays the aircraft weight, which, if in small font, means that the data is calculated by FMC automatically. This data is the same as that on the PERF INIT page. It can also be entered manually, which will be displayed in large font. After exiting this page, the FMC automatically calculated weight data will replace the manually entered data.

3L and 4L show the landing runway length in the flight plan, the ILS frequency, etc.

1R~3R are the landing reference speed under three flap settings.

4R displays selected approach reference flap and speed setting. Usually by pressing the LSK corresponding to 1R~3R, the flap and speed setting will be transferred to the scratchpad, after which you can press 4R to enter the speed into FMC. Besides transferring the 1R~3R data, we can also enter them manually, the format should be FF/SSS, SSS, /SSS, FF/ or F/, where F and FF stands for flap data, the allowable input values including 0, 1, 2, 5, 10, 15, 25, 30, and 40; and SSS, the speed data.

5R shows the wind correction for approach. which is +05 knots by default. It can be entered manually, the maximum being +20 knots.

In this flight, we use flap40 as the approach flap setting. So press 3R and “40/132” is displayed in the scratchpad, indicating that the flap setting is 40 degrees; and the landing speed, 132.

Then press 4R to complete the enter of approach reference flap and speed.

By now, all operation related to CDU is completed. In the following Approach Procedure, we will mainly operate the aircraft for landing, instead of configuring various equipment.
Approach and Landing Procedure

Usually after passing the transition altitude, the aircraft can start the approach procedure, and the procedure should be completed before reaching the initial approach fix or starting the visual approach.

1. Set the passenger signs as needed. Generally, two switches are both positioned at AUTO or ON.

2. After descending to the transition altitude, press STD located in the middle of the switch to release from the standard barometric mode, then set and check the altimeters. Press the two red boxes located above the switch to select IN or HPA. Then press the two red boxes located below to adjust to a proper barometric value.

3. Gradually extend the flaps as needed.

4. Down the landing gear lever to extend the landing gear, verify that the three green lights are illuminated.

5. Set the engine start switch (panel 19) to the position CONT.

6. Press the input box area beside the spoiler lever, and verify that the SPEED BRAKE ARMED light located on the panel 24 is illuminated.

7. Start landing along the glideslope by using the AFDS or manual control.
8. When the aircraft reaches the 50ft radio altitude, disengage the A/P and A/T, start manual control. Close the thrust levers to the idle position and flare the aircraft.

9. After touchdown, apply reverse thrust, and verify that the spoiler has extended and that the autobrake works properly.

10. After the speed is reduced to 60 knots, move the reverse thrust levers to be at the reverse idle.

11. After exiting from the runway, retract the spoiler.

12. Before reaching the taxi speed, turn the autobrake switch (panel 25) to position “OFF” to close the autobrake function, continue manual brake as needed.

13. Start APU if necessary. Pull the APU switch (panel 19) down to position “START”, which will initiate an autostart procedure. The switch will automatically return to the position “ON”. The same as starting APU before the takeoff, the LOW OIL PRESSURE light will illuminate during the APU starting process; and the APU EGT indicator, show the EGT temperature rise.

14. After landing, the probe heat system should be turned off. Pull the probe heat switch (panel 12) up to position “OFF”.

15. Turn on or turn off the landing light, taxi light, and strobe light as needed.

16. Turn the engine start switch (panel 19) to position “OFF”.

17. Retract the flaps.

18. Turn the Transponder Mode Selector located on panel 45 to position “STANDBY”.

19. Taxi to the specified parking area according to airport instructions.

The above are all the basic operations during the approach and landing phase, next we will explain in detail about the AFDS operation during the landing phase.

AFDS, when engaged to one A/P, can provide guidance for non-precision approach. After pressing the VOR/LOC switch, the aircraft will track VOR or track the localizer. In addition, the aircraft descent can also be accomplished using VNAV, LVL CHG, or V/S.
AFDS, when engaged to one or two A/P, can provide guidance for precision approach. In this case, the aircraft can intercept and track the course and the glideslope simultaneously.

**Approach (APP) Mode with Dual A/Ps**

Approach mode permits both A/Ps to be engaged simultaneously. Before selecting the approach mode, one NAV receiver must be tuned to an ILS frequency. For a dual A/P approach., the second NAV receiver must be tuned to the ILS frequency and the corresponding A/P must be engaged in CMD before reaching the 800ft radio altitude.

**Localizer and Glideslope Armed**

After setting the ILS frequency and the course, press the APP switch to choose the approach mode. The APP switch illuminates and VOR/LOC and G/S will be displayed in white on FMA, indicating that VOR/LOC and G/S modes are armed. The APP mode permits two A/Ps to be engaged simultaneously.

**Localizer Capture**

The LOC capture point is not fixed, because it is affected by the intercepting angle and the rate of closure. After LOC is capture, the white VOR/LOC armed symbol on FMA will disappear, while a green VOR/LOC symbol appears, indicating that the LOC has been captured. The aircraft turns heading to track the LOC.

**Glideslope Capture**

Before localizer captured, the glideslope capture is inhibited. The glideslope will be captured when the glideslope indicator shows about 0.5 dots. After capturing the glideslope, a green G/S symbol will replace the white G/S armed symbol on FMA. If the localizer has already been captured, the APP light will extinguish. The previously engaged pitch mode will be disengaged, and the aircraft starts tracking the glideslope. The thrust mode displays GA.

After both VOR/LOC and G/S are captured, you can use any of the following methods to exit the APP mode:

- Press the TO/GA switch
- Disengage the A/P and turn off two F/D switches
- Change the frequency of the NAV receiver

**After LOC and G/S Capture**

If the second A/P has not yet engaged, the plane will automatically engage after LOC and G/S are captured if the aircraft has passed the 1500ft radio altitude and the corresponding NAV receiver has received the ILS frequency. After two A/Ps both engaged in CMD, white FLARE will be displayed on FMA, informing that FLARE mode is armed. After two A/Ps engaged, the A/P status on FMA will change from 1CH or SINGLE CH to CMD, and A/P GA mode armed.

After localizer and glideslope capture during a dual autopilot approach, CWS cannot be engaged by manually overriding pitch and roll. Manual override of autopilots causes autopilot disengagement.

**800ft Radio Altitude**

Before reaching the radio altitude of 800ft, the second A/P must be engaged in CMD to execute a dual channel A/P approach. Otherwise CMD engagement of the second A/P will be inhibited.

**Flare**

At about the 50ft radio altitude, The A/P flare maneuver starts. A green FLARE symbol replaces the white FLARE armed symbol on the FMA. At about the 27ft radio altitude, A/T begins retarding thrust to idle. A/T FMA displays RETARD. Two seconds after touchdown, A/T will
disengage automatically. You must disengage A/P manually after touchdown, and operate the aircraft to perform landing rollout manually.

The above is all about the double A/P APP mode. Next we will introduce about the single A/P APP mode.

**Approach (APP) Mode with Single A/P**

In APP mode, a single A/P approach can be executed when only one A/P is engaged in CMD. Comparing with the dual A/P approach, the operation is all the same except the following:

- No automatic flare and touchdown capability, and no FLARE symbol will be displayed on FMA
- After capturing the LOC, A/P status will remain being 1 CH or SINGLE CH
- The A/P go-around is not available

Apart from landing, we should also know how A/P carries out the go-around.

**Go-Around**

Press any of the TO/GA switches to engage the GA mode. The A/P GA mode can only be armed when dual A/P is engaged and that the FLARE is armed. If both A/Ps cannot operate simultaneously, you may use the manual F/D go-around.
No matter A/P is engaged or not, A/T GA mode will be armed with the A/T Arm switch at ARM, and the aircraft satisfies the following 2 conditions:
• descending below 2000ft radio altitude
• above 2000ft radio altitude with flaps not up or G/S captured
GA mode can be divided into A/P GA and F/D GA, which now we will introduce.

A/P Go-Around
The A/P GA mode requires dual A/P operation after FLARE armed and prior to the A/P sensing touchdown.

After pressing the TO/GA switch:
• If A/T is armed, GA will be automatically engaged and the A/T Engaged Mode annunciation on the FMA indicates GA
• The A/T advances to the full go-around N1 limit.
• The pitch engages TO/GA, so “TO/GA” is displayed in the Pitch Engaged Mode annunciation on the FMA
• F/D pitch commands 15 degrees nose up until a suitable climb rate is reached
• F/D roll commands maintenance of the current ground track. The Roll Engaged Mode annunciation on the FMA is blank.
• The ILS/MACH display window is blank.

The termination condition of A/P GA mode includes:
• When below 400ft radio altitude, AFDS maintains GA mode until two A/Ps and two F/Ds are all disengaged.
• When above 400ft radio altitude, a different pitch mode or roll mode is selected
  • If the roll mode is changed first:
    • The selected roll mode engages in single A/P roll operation, and is controlled by the A/P that engages in CMD first
    • In TO/GA mode, the pitch remains controlled by double A/Ps
  • If the pitch mode is changed first:
    • The selected pitch mode engages in single A/P pitch operation, and is controlled by the A/P that engages in CMD first
    • The second A/P is disengaged
    • The roll mode engages in CWS R
  • the A/T GA mode is terminated when:
    • another pitch mode is selected
    • ALT ACQ mode engaged.

When the pitch mode is engaged in TO/GA, the aircraft will automatically engage the ALT ACQ mode when approaching the selected altitude and the ALT HOLD mode will be engaged at the selected altitude.

F/D Go-Around
If two A/Ps are both disengaged, a manual F/D go-around is available under the following conditions:
• When the aircraft is flying below 2000ft radio altitude
• When the aircraft is flying above 2000ft radio altitude with flaps not up or G/S captured
• F/D is not in the takeoff mode

After pressing any of the TO/GA switches:
• If A/T is armed, GA will be automatically engaged. The A/T advances thrust to the full go-around N1 limit.
• If A/P is engaged, disengage the A/P.
• The pitch engages TO/GA, so “TO/GA” is displayed in the Pitch Engaged Mode annunciation
on the FMA
• F/D pitch commands 15 degrees nose up until the expected climb rate is reached
• F/D roll commands maintenance of the current ground track. The Roll Engaged Mode
  annunciation on the FMA is blank.
• The ILS/MACH display window is blank.

The termination method of TO/GA after F/D go-around:
• When below 400ft radio altitude, the two F/Ds switches must be both turned off.
• When above 400ft radio altitude, then select a different pitch mode or roll mode
  • If the roll mode is changed first:
    • F/D roll engages in the selected mode
    • F/D pitch mode remains in TO/GA
  • If the pitch mode is changed first:
    • F/D pitch engages in the selected mode
    • F/D roll mode automatically changes to HDG SEL
• the A/T GA mode (if engaged) is terminated when:
  • another pitch mode is selected
  • ALT ACQ annunciates engaged.
Shutdown Procedure

After taxiing to the parking area, we can start the shutdown procedure.

1. Pull out the parking brake lever (panel 61), and verify that the parking brake warning light right to the lever illuminates.

2. A while later the engine will be shutdown, so before that, we should start APU power or exterior power supply.

   If we prefer to use APU power, just pull 2 APU GENERATOR bus switches (panel 6) down to “ON”, because we have already started APU after touchdown.

   If we would like to use exterior power, then go to FS menu → “iFly” → “iFly Jets: The 737NG” → “Ground Support”, and select the Ground Power. If the choices are grey, it means that the aircraft has not stopped completely or the brake is not on.

   After connecting the ground power, the GND POWER indicator (panel 6) located on the overhead panel will illuminate. Position the switch below to “ON” and the exterior power becomes in use. The switch will automatically return to center.

3. OK, it’s the time to shut down the engine. Before shutdown, you’d better let the engine work for 3min as to cool the engine hot sections. Time at or near idle, such as taxiing before shutdown, is applicable to this 3min period. Pull the 2 start levers (panel 62) down to “CUTOFF” to shut down the engine.

4. Pull the FASTEN BELTS switch and NO SMOKING switch (panel 10) up to “OFF” to turn off the passenger signs.

5. Turn off the ANTI COLLISION light (panel 20) as needed.

6. Turn off all fuel pumps (panel 4).
7. Turn on or off the galley power (panel 6) as needed.

7. Turn on or off the CAB/UTIL power and IFE/PASS SEAT power (panel 6) as needed.

8. Turn off the wing anti-ice switch and 2 engine anti-ice switches (panel 12).

9. On the hydraulic system panel (panel 13), turn off 2 ENGINE HYDRAULIC PUMPS, and turn on 2 ELECTRIC HYDRAULIC PUMPs.

10. Turn on or off the recirculation fan switches (panel 16), the number of switches may be different according to the aircraft type.

11. Position 2 air conditioning pack switches (panel 16) to “AUTO”, and the isolation valve switch (panel 16) to “OPEN”.

12. Position 2 engine bleed air switches and the APU bleed air switch (panel 16) all to “ON”.

13. Turn on or off the various outside light switches located on panel 18 and panel 20 according to actual needs.

14. Turn off 2 FD switches on panel 23.

15. Position the APU switch located on panel 19 to “OFF”. APU continues to run for a 60 second cooling period. Shutdown occurs automatically after 60 seconds.
Secure Procedure

After the shutdown procedure, the secure procedure is started.

1. Turn 2 IRS mode selectors located on panel 49 both to “OFF” to close 2 IRSs.

2. Position the EMER EXIT LIGHTS switch located on panel 9 to “OFF”.

3. Position the 4 WINDOW HEAT switches located on panel 12 to “OFF”.

4. Position the 2 air conditioning pack switches (panel 16) to “OFF” to turn off the air conditioning.

5. Position 2 engine bleed air switches and the APU bleed air switch (panel 16) to “OFF”.

6. Position 2 generator switches and 2 APU generator switches (panel 6) to “OFF”. The switches will automatically return to center.

7. Finally, position the battery switch located on panel 6 to “OFF”.

By now, you have completed the whole flight process. Well done, captain!

Our tutorial is going to end here. We hope that this tutorial can help you better understand all the systems and operations of iFly Jets: The 737NG.

Wish you continue enjoying flying in FS!

The iFly Developer Team