



X-Plane 1000

Pilot Operating Manual

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The Garmin G1000	6
The X-Plane 1000	7
"Pop-Up" X1000 Panels.....	8
Primary Flight Display (PFD).....	8
Multi-Function Display (MFD).....	8
Invoking, moving, sizing, and closing "Pop-Up" X1000 panels	9
Invoking a pop-up X1000 panel	9
Moving a pop-up X1000 panel.....	10
Re-sizing a pop-up X1000 panel.....	10
Closing a pop-up X1000 panel	11
X1000 Primary Flight Display (PFD).....	12
[PFD] Controls & Features.....	12
[PFD] Setting the COM1 and COM2 Frequencies/Channels	17
[PFD] Setting the NAV1 and NAV2 Frequencies	18
[PFD] Setting the Altimeter (barometric pressure).....	19
[PFD] Setting the Altimeter (units).....	20
[PFD] Setting the Transponder	21
[PFD] Operating the Timer.....	22
[PFD] Navigating to the Nearest Airport.....	23
[PFD] Invoking the Inset Map.....	24
[PFD] Navigating with VORs	25
[PFD] The OBS Function	26
[PFD] Direct-To (a waypoint)	28
[PFD] Flight Plans	29
[PFD] Initializing / Deleting a Flight Plan.....	29
[PFD] Inserting a Waypoint	30
[PFD] Deleting a Waypoint.....	32
[PFD] Activating a Leg	34
[PFD] Selecting a Standard Instrument Departure (SID).....	36
[PFD] Selecting a Standard Instrument Arrival (STAR).....	39
[PFD] Selecting an Approach Procedure	42
[PFD] Activating an Approach Procedure	45
[PFD] ILS Approaches	46

[PFD] Storing a Flight Plan.....	48
X1000 Multi-Function Display (MFD).....	50
[MFD] Controls & Features	50
[MFD] Engine Indication System (EIS).....	54
[MFD] Setting the Fuel Totalizer	55
[MFD] Declutter Function	56
[MFD] Map Functions	57
[MFD] Setting the COM1 and COM2 Frequencies/Channel	58
[MFD] Setting the NAV1 and NAV2 Frequencies	59
[MFD] Direct-To (a waypoint)	60
[MFD] Direct-To (a waypoint) with (VNAV) Descent Profile	61
[MFD] CURRENT VNV (VNAV) PROFILE (Panel).....	64
[MFD] Flight Plans.....	66
[MFD] Initializing / Deleting a Flight Plan.....	66
[MFD] Inserting a Waypoint.....	68
[MFD] Deleting a Waypoint	71
[MFD] Activating a Leg	73
[MFD] Selecting a Standard Instrument Departure (SID)	75
[MFD] Selecting a Standard Instrument Arrival (STAR)	79
[MFD] Selecting an Approach Procedure.....	83
[MFD] Activating an Approach Procedure	87
[MFD] Storing a Flight Plan	89
[MFD] Loading a Flight Plan	90
X1000 Audio Panel.....	91
[Audio Panel] Controls & Features	91
COM Radio Key Group	91
Cabin PA/Speaker Group	91
NAV Radio Key Group	91
Pilot Intercom Volume Rotary	91
Display Backup Key	91
Autopilot Panel [PFD and MFD].....	92
Autopilot On/Off.....	92
Heading Mode.....	92

Navigation Mode.....	93
Approach Mode	93
Vertical Speed Mode.....	93
Flight Level Change Mode.....	94
Flight Director (display).....	94
Altitude Mode	95
Vertical Navigation (VNAV) Mode	95
(Localizer) Back-Course Mode	95
Nose Up.....	95
Nose Down.....	95
Using the Autopilot with a VOR	96
Using the Autopilot with an ILS Approach	97
X1000 VNAV descent and RNAV approach Tutorial & Companion Video	98
About this tutorial.....	98
ALDAN ONE ARRIVAL [@ 2:40 in video].....	99
Programming the ALDAN ONE ARRIVAL [@ 5:48 in video]	101
Reconciling the ALDAN ONE procedure altitudes [@ 7:12 in video]	104
Waypoint Altitudes [@ 7:53 in video].....	105
Designating a Waypoint Altitude [@ 10:40 in video]	106
Current VNV Profile [@ 12:40 in video]	107
Setting the Flight Path Angle (FPA) [@ 13:06 in video]	108
Setting the Vertical Speed Target (VS TGT) [@ 13:35 in video]	109
PFD Flight Plan Target Altitude [@ 15:30 in video]	110
Calculation of Required VS (VS REQ) and Vertical Deviation (V DEV) [@ 18:10 in video]	111
PFD V-DEV and VS-TGT Chevrons [@ 18:47 in video].....	113
Placing the Autopilot in VNAV Mode [@ 19:14 in video]	114
Top of Descent [@ 20:10 in video]	115
Managing Airspeed [@ 26:40 in video]	116
Changing a Waypoint Designated Altitude [@ 30:45 in video]	117
VNAV Direct-To Waypoint [@ 31:11 in video].....	118
Re-Computing the VNAV Profile [@ 32:45 in video]	120
RNAV (GPS) Y RWY 5R APPROACH [@ 33:55 in video]	121
Programming the RNAV (GPS) Y RWY 5R APPROACH [@ 33:55 in video]	122

Programming the Decision Altitude [@ 36:18 in video]	125
Automatic Designation of Altitudes prior to Final Approach Fix [@ 37:12 in video]	127
Activating the Approach [@ 39:37 in video].....	128
At the Final Approach Fix [@ 45:00 in video]	129
At Minimums [@ 50:00 in video].....	131
Activating a Missed Approach [@ 51:30 in video].....	132
X1000 (Multiple) Approaches Tutorial.....	133
About this tutorial.....	133

The Garmin G1000



The Garmin G1000 is an advanced integrated flight instrument system that comprises two display units, serving as primary flight display, and multi-function display respectively. When combined, these units present flight instrumentation, position, navigation, communication and identification information to the pilot, replacing conventional flight instruments and avionics.

The G1000 was first announced in March 2003, when the Cessna Aircraft Company selected it for their Citation Mustang aircraft (in development at that time). Other aircraft manufacturers also announced their intention to adopt the G1000 as standard equipment shortly afterwards, and the first deliveries began in June 2004, for both Cessna and Diamond Aircraft models.

To date, the G1000 has been certified in more than 50 aircraft models, representing 19 different aircraft manufacturers. There are over 16,000 G1000 systems flying worldwide, in all manner of aircraft, including piston-engine singles, turboprops, rotorcraft, and business jets.

Garmin G1000 Specifications:

- ✓ Physical dimensions 2 x (12.4" W x 8.27" H) / 2 x (31.5 x 21 cm)
- ✓ Weight – 45 lbs. (20.4 kg.)
- ✓ Display size – 2 x 10.4 inch (optional 2 x 15-inch)
- ✓ Display resolution – XGA (1024 x 768 pixels)
- ✓ Transmit power - 16 Watts
- ✓ Built-in VHF Comm with 8.33/25 kHz channel spacing
- ✓ Moving-map MFD with engine/fuel gauge cluster, checklist capability
- ✓ Mode-S transponders with Traffic Information Service (TIS)
- ✓ Worldwide terrain and obstacle database
- ✓ Operating altitude - Up to 55,000 feet
- ✓ Operating temperature -20°C to + 55°C minimum
- ✓ Navigation database coverage area - Americas, International / Worldwide
- ✓ Large-format LCD displays – interchangeable for use as PFD or MFD
- ✓ Fully integrated CNI suite with WAAS-upgradable GPS
- ✓ Available with two- or three-axis, fail-passive flight control system
- ✓ Ethernet data-bus connectivity
- ✓ Selectable PFD flight view presentations
- ✓ Interfaces for terrain, traffic, lightning and weather sensors
- ✓ Full reversionary display capability

The X-Plane 1000



The Laminar Research / X-Plane 11 G1000 system will be referred to here as the X1000. This has been developed to resemble the real model, both in appearance and function. However, the capability and operation of these devices in the simulator may differ in some areas to the real product.

The X1000 system is featured in some of the aircraft shipped by default in X-Plane 11. Additionally, as a core component of the simulator, the X1000 panels can be 'dropped' into any third-party aircraft 2D-panel, and used immediately.

Despite some differences that relate to the individual aircraft's powerplant(s), every X1000 system comprises a Primary Flight Display (PFD) on the left side of the instrument panel, and a Multi-Function Display (MFD) on the right-side of the instrument panel. These are separate units with distinct functionality. However, as with the real system, the MFD may double as a PFD, if needed in an emergency (but not vice-versa).

The X1000 panels are modeled in 3D within the aircraft cockpit. However, 2D 'pop-up' representations are also supported, which may be dragged to separate monitors, or dedicated display panels in fixed-base home cockpits.

“Pop-Up” X1000 Panels

Pop-up X1000 Primary Flight Display (PFD) and Multi-Function Display (MFD) panels are provided in every X-Plane default aircraft that features the X1000 system. These are 2D representations that can be moved, sized, and dragged per the needs of the pilot. For the purposes of this guide, only the pop-up X1000 panels will be featured. However, commands may also be input using the panels built directly into the 3D cockpit.

Primary Flight Display (PFD)



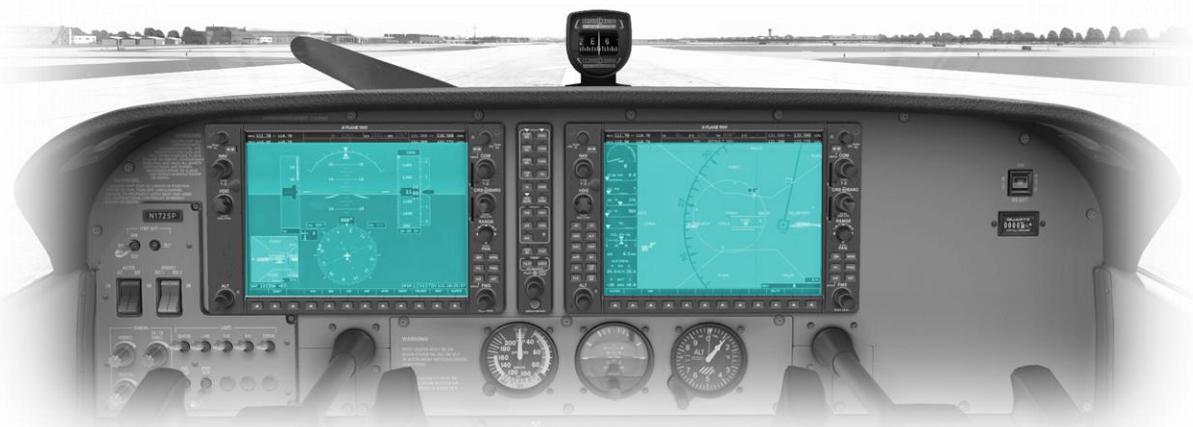
Multi-Function Display (MFD)



Invoking, moving, sizing, and closing “Pop-Up” X1000 panels

Invoking a pop-up X1000 panel

To invoke a pop-up X1000 PFD or MFD panel, position and click the mouse-pointer anywhere inside the **DISPLAY** area of (any) X1000 panel situated in the 3D cockpit.



Moving a pop-up X1000 panel



To move the pop-up X1000 panel to the desired location on your computer screen, first place the mouse-pointer anywhere on the outer-frame. The top-center is recommended, as shown here by the white arrow.

Now click and drag the pop-up X1000 panel to the desired location on your computer screen.

Re-sizing a pop-up X1000 panel

Place the mouse-pointer at the top-center of the X1000 frame. Two click-spots will appear.

The click-spot in the **UPPER-RIGHT** of the X1000 frame invokes 'Window Mode' (see below).





In 'Window Mode' the X1000 panel can be re-sized by dragging the window frame - in the same manner as any other window supported by your operating system.

Alternatively, you may re-size the window by simply dragging the edge of the frame, when the Windows "Hand" pointer is displayed.

Closing a pop-up X1000 panel

Place the mouse-pointer at the top-center of the X1000 frame. Two click-spots will appear.

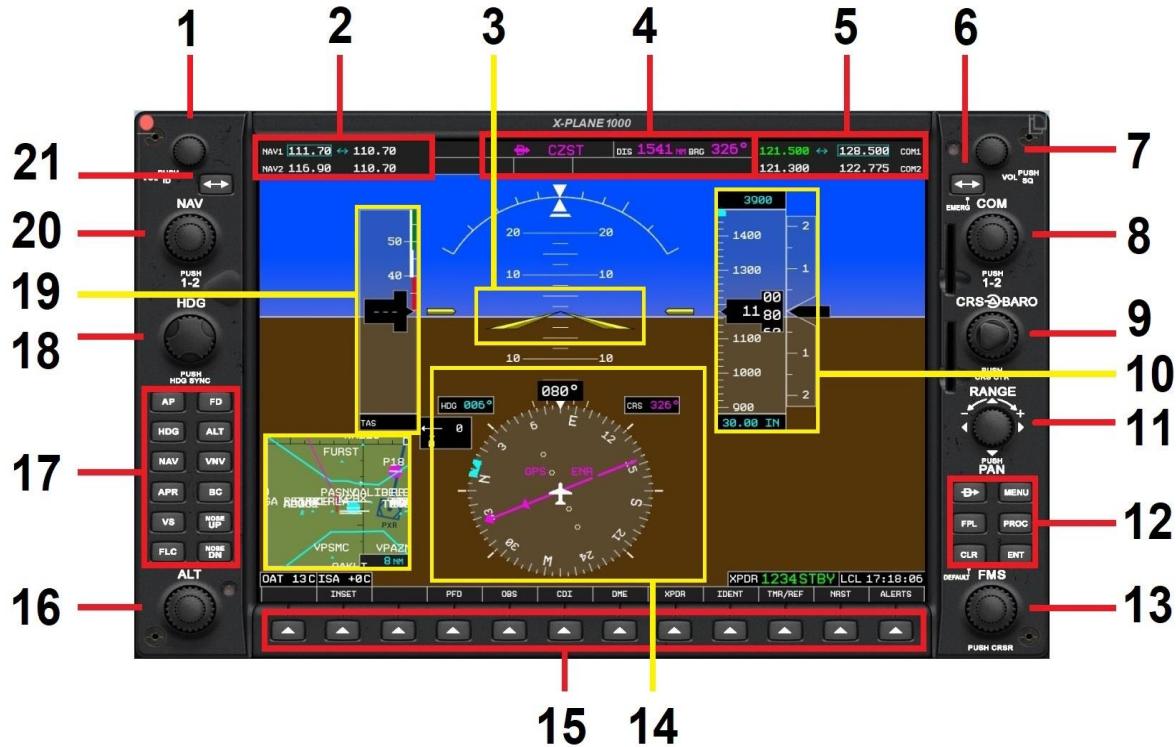
The (red) click-spot in the **UPPER-LEFT** of the X1000 frame closes the pop-up.



X1000 Primary Flight Display (PFD)

[PFD] Controls & Features

This section identifies the controls and features of the X1000 PFD (Primary Flight Display). Where relevant, these are discussed in more detail later in the guide.



1	NAV Audio Squelch	Toggles the Morse code audio identifier (of the selected NAV radio frequency) ON and OFF. Note that when toggling to 'Off', the Morse will finish its cycle before the audio is cut.
2	Active & Stand-by NAV1 and NAV2 Frequencies	This area of the display panel features the active and stand-by frequencies for the NAV1 and NAV2 radios. The active frequency is on the right, and the stand-by frequency is on the left.

3	Attitude Indicator	Displays the aircraft's attitude, relative to the horizon. In Flight Director mode, displays an inverted-V style Flight Director
4	Next Waypoint	This area of the display panel features the next waypoint in your flight plan, together with the distance and bearing to that waypoint from the current location.
5	Active & Stand-by COM1 and COM Frequencies	This area of the display panel features the active and stand-by frequencies for the COM1 and COM2 radios. The active frequency is on the left, and the stand-by frequency is on the right.
6	COM Frequency Toggle	Toggles between the active and stand-by COM1 or COM2 radio frequency.
7	COM Audio Squelch	Toggles the audio of the selected COM radio frequency ON and OFF. Note that when toggling to 'Off', the message will finish before the audio is cut.
8	COM Rotary	Click the center of this control to switch between COM1 and COM2 in the 'Active & Standby COM Frequencies' area. Use the outer and inner rotary controls to adjust the numeric and decimal portion of the stand-by COM frequency respectively.
9	CRS/BARO Rotary	Use the outer rotary control to set the altimeter barometric pressure. Use the inner rotary control to adjust the CDI (Course Deviation Indicator) when the HSI is in VOR/LOC or GPS-OBS mode. Pressing the inner rotary will reset the selected course to the bearing or the localizer front course, depending on selected navigation source.

10	Altimeter	Displays current altitude, Baro Minimum Reference Altitude, Autopilot Selected Altitude, Vertical Speed, and Barometric Altimeter Setting.
11	Joystick	This rotary control adjusts the map range (zoom level) display). Rotate clockwise to zoom out, and counter-clockwise to zoom in. Push in the center to activate or de-activate panning.
12	Flight Plan Key Group	<p>Direct-to Key: Used to establish a direct course to a selected waypoint, or Map Pointer position.</p> <p>FPL Key: Invokes the Flight Plan Page, to create or edit the active flight plan.</p> <p>CLR Key: Cancel or erase an entry. Click and HOLD this key to clear pages from the main display.</p> <p>MENU Key – Displays menu of options that is context-driven.</p> <p>PROC Key – Selects approaches, departures and arrivals associated with a waypoint in the flight plan.</p> <p>ENT Key – Confirms the current selection or operation.</p>
13	FMS Rotary	Click the center of this control to activate the flight plan cursor (when the Flight Plan Page is displayed). When viewing the flight plan, use the outer rotary to SELECT the next or previous waypoint. Use the inner rotary to commence input of a new waypoint, and to change each character in the waypoint identifier. Use the outer rotary to move to the next or previous character within the waypoint identifier.

14	Horizontal Situation Indicator (HSI)	Display the (magnetic) heading currently being flown. Also supported is an adjustable heading bug used in conjunction with the autopilot (in HDG mode), and a course indicator (used in conjunction with a GPS flight plan, or a VOR). Bearing pointers can also be displayed here.
15	Soft Keys	Context-driven keys. The function of these keys will depend on the action being performed by the pilot.
16	ALT Rotary	<p>Used to select the Autopilot Selected Altitude (displayed above the altimeter). The Autopilot Selected Altitude is used by the Autopilot in certain modes and operations, such as altitude hold or altitude capture.</p> <p>The outer rotary increments or decrements in units of 1,000 feet. The inner rotary increments or decrements in units of 100 feet.</p>
17	Autopilot Key Group	Autopilot mode control – see Autopilot Panel
18	HDG Rotary	<p>Used to a control the heading bug which forms part of the HSI. Click the center of this rotary to synchronize the heading bug with the current heading.</p> <p>Click the rotary at the 9-o'clock position to move the heading bug clockwise, and the 3-o'clock position to move the heading bug counter-clockwise.</p>

19	Airspeed Indicator	<p>Displays the Airspeed in knots (relative to the air around the aircraft).</p> <p>Numeric labels are shown at intervals of 10 knots. Minor increments are shown at intervals of five knots.</p> <p>A color-coded speed range is also displayed, which differs for individual aircraft. The colors denote flaps operating range (white), normal operating range (green), caution range, and never-exceed speed (red). A red range is also present for airspeeds that are dangerously low.</p> <p>On twin-engine aircraft, a red mark for V_{MC} and a blue mark for V_{YSE} will be displayed on the speed tape.</p>
20	NAV Rotary	<p>Click the center of this control to switch between COM1 and COM2 in the 'Active & Standby COM Frequencies' area.</p> <p>Use the outer and inner rotary controls to adjust the numeric and decimal portion of the stand-by NAV frequency respectively.</p>
21	NAV Frequency Toggle	<p>Toggles between the active and stand-by COM1 or COM2 radio frequency.</p>

[PFD] Setting the COM1 and COM2 Frequencies/Channels



- Click the CENTER of the COM Rotary to select either COM1 or COM2.
- Click the COM Frequency Toggle Key to swap the standby and active COM frequency.
- Click the COM Outer Rotary at the 3 O'clock or 9 O'clock position to increment/decrement the frequency/channel - numeric portion.
- Click the COM Inner Rotary at the 3 O'clock or 9 O'clock position to increment/decrement the frequency/channel – decimal portion.
- Click the COM Frequency Toggle Key to swap the standby and active COM frequency/channel.

[PFD] Setting the NAV1 and NAV2 Frequencies



- Click the CENTER of the NAV Rotary to select either NAV1 or NAV2.
- Click the NAV Outer Rotary at the 3 O'clock or 9 O'clock position to increment/decrement the frequency - numeric portion.
- Click the NAV Inner Rotary at the 3 O'clock or 9 O'clock position to increment/decrement the frequency - decimal portion.
- Click the NAV Frequency Toggle Key to swap the standby and active NAV frequency.

[PFD] Setting the Altimeter (barometric pressure)

Altimeters measure changes in barometric pressure, and therefore need to be calibrated at the start of the flight, and periodically during the flight. Calibration involves inputting the barometric pressure for the current location, if the airplane is flying below the transition altitude.



- Click the CRS/BARO Outer Rotary at the 3 O'clock or 9 O'clock position to increment/decrement the altimeter (barometric pressure) setting.
- The altimeter barometric pressure setting is displayed immediately below the altitude scale.

[PFD] Setting the Altimeter (units)

Altimeter barometric pressure uses one of two units – ‘Inches of mercury’ (inHg), or Hectopascal (hPa). The X1000 system provides for the input, and display, of the current barometric pressure in either of these units.



- Click the **PFD** Soft Key.
- Click the **ALT UNIT** Soft Key.
- Click the **IN** or **HPA** Soft Key to select the desired units.
- Click the **BACK** Soft Key (twice) to return to the default Soft Key options.

[PFD] Setting the Transponder

A transponder (sometimes abbreviated to XPDR) is an electronic device that assists Air Traffic Control in locating aircraft that are within a given area of radar coverage. Transponders produce a response when 'swept' by ground-based radar, and this is highlighted on ATC radar screens. Prior to, or during the flight, the pilot inputs a transponder ("squawk") code that identifies his aircraft. When flying according to IFR (Instrument Flight Rules), a unique (four digit) code will be assigned by ATC. When flying according to Visual Flight Rules (VFR), a generic code is used, and this depends on the airspace in question. In US airspace, the VFR transponder code is 1200.



- Click the **XPDR** Soft Key.
- Click the **STBY** Soft Key to place the transponder in 'Stand-By' mode. It will not respond to radar interrogation.
- Click the **ON** Soft Key to place the transponder in 'On' mode.
- Click the **ALT** Soft Key to report altitude to ATC, also known as "Squawking Mode Charlie".
- Click the **VFR** Soft Key to set the transponder code to 1200 (for Visual Flight Rules in US airspace).
- Click the **CODE** Soft Key to manually input a transponder code assigned by ATC. Use the Soft Keys (0 through 7) to input the desired code.
- Click the **IDENT** Soft Key to place the transponder in 'Ident' mode. This will temporarily highlight your location on the ATC radar screen, before returning the transponder to the previous mode.
- Click the **BACK** Soft Key to return to the default Soft Key options.

[PFD] Operating the Timer

The X1000 PFD features a built-in timer that is useful for procedures and holds that involve a time-component, or for keeping track of elapsed flight time.

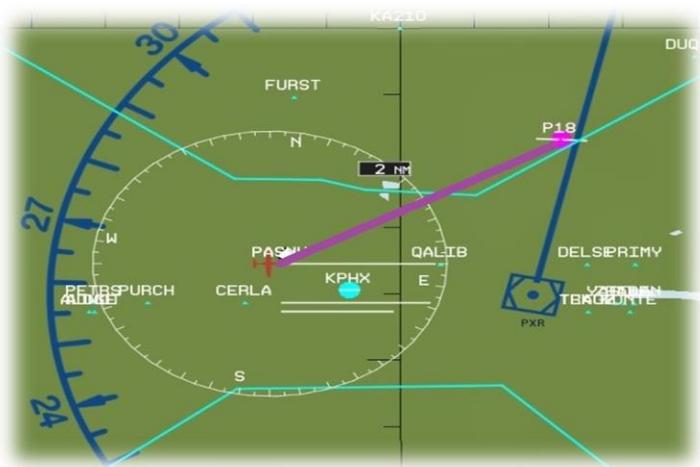


- Click the **TMR/REF** Soft Key to invoke the Timer pop-up.
- Click the **ENT** Soft Key to start the timer.
- Click the **ENT** Soft Key (a second instance) to stop the timer.
- Click the **ENT** Soft Key (a third instance) to reset the timer.
- You can also click the **FMS Rotary** at the 3 O'clock or 9 O'clock position to place the cursor over the time and then select "DN" to have the timer count down to zero from a given time you entered.
- Click the **TMR/REF** Soft Key again to hide the Timer pop-up.

[PFD] Navigating to the Nearest Airport



- Click the **NRST** Soft Key to invoke the 'Nearest Airports' pop-up. This displays a list of the nearest airports, sorted by distance (least to most). The first airport in the list (the nearest) is selected by default.
- Click the **FMS Rotary** at the 3 O'clock or 9 O'clock position to select the next or previous airport in the list. In the example above, the selected airport is P18 / 050 degrees / 3.8 Nautical Miles.
- By highlighting a tower or CTAF frequency associated with the airport, you can press **ENT** to set the frequency in the standby of your boxed COM radio.
- Click the **Direct-To** Soft Key, followed by the **ENT** Soft Key to accept the change in flight plan.



The magenta line on the Map page indicates the new active leg, connecting your current location to the desired nearest airport waypoint.

[PFD] Invoking the Inset Map

The X1000 PFD features an inset navigation map that, when invoked, appears in the lower-left of the main display. This is centered around the aircraft's current location. The orientation of the Inset Map is always 'North Up'.



- Click the **INSET** Soft Key to invoke the Inset Map.
- Click the **DCLTR** Soft Key once, twice or three times, for the desired 'De-Clutter' setting.
- Click the **TOPO** Soft Key to toggle the display of topographic information.
- Click the **TERRAIN** Soft Key to toggle the display of terrain warning.
- Click the **OFF** Soft Key to clear the Insert Map.
- Click the **BACK** Soft Key to return to the default Soft Key options.

[PFD] Navigating with VORs

A VOR (VHF omni directional radio range) is a ground-based short-range radio navigation station used for aircraft navigation. A network of VOR stations exist across the globe, and these provide pilots with the ability to fly towards, or away from, the desired station along a specific 'radial'.

The X1000 PFD provides the capability to navigate using two VOR stations simultaneously. These are selected by tuning the NAV1 and NAV2 frequencies respectively.

The location of the aircraft relative to the chosen VOR, is superimposed on the PFD Horizontal Situation Indicator (HSI). The aircraft appears in the center, with the selected radial (course) shown at the upper-right. The location of the desired radial is displayed by the green bar, informing the pilot which direction to steer to intercept that radial.



- Tune the NAV1 frequency to the desired VOR1 station.
- If required, tune the NAV2 frequency to the desired VOR2 station.
- Click the **CDI** Soft Key to select VOR1 or VOR2.
- Click the CRS Rotary at the 3 O'clock or 9 O'clock positions to set the desired course to the VOR.
- The HSI will now display your aircraft's position relative to the desired radial. In the above example, the chosen radial is 292 degrees, the desired course to the VOR is 112 degrees. This is confirmed on the HSI at the upper-right, also by the (outer) pointer (highlighted in red). The inner pointer (highlighted in yellow) indicates this aircraft in a position where the selected course leads TO the VOR (the inner green triangle points towards the VOR).
- To enable DME (Distance Measuring Equipment) information (for VOR stations that support this), press the PFD button, followed by the DME button.

[PFD] The OBS Function

The Omni Bearing Selector (OBS) function provides the pilot with the capability to fly to, or from, any waypoint or fix via a chosen bearing (instead of directly).

Let's assume we are starting from KLAX (Los Angeles International), with a simple flight plan that includes only one destination waypoint – KTOA (Zamperini Field). A direct flight from KLAS to KTOA would be a course of 142 degrees. However, let's assume that (for some reason) we wish to approach KTOA from the North - on a southbound course of 180 degrees. The OBS Function allows us to do this.



- Click the **OBS** Soft Key (with the device in GPS mode and approaching the desired waypoint).
- Click the CRS Rotary at the 3 O'clock or 9 O'clock positions to set the desired course to your upcoming waypoint (180 degrees in this example).
- Note that this will also allow us to fly away from a waypoint on a selected course, since the GPS will not advance through the flight plan while OBS mode is active.



The magenta line (left) represents your new course.

In this example, the pilot would steer an intercept course from his current location (KLAX) to the magenta line, and then make a right-turn to follow this on a bearing of 180 degrees to KTOA.

[PFD] Direct-To (a waypoint)

At any time during a flight, the pilot may elect to proceed directly to a given waypoint. The chosen waypoint need not be in an existing Flight Plan (although it can be), and hence 'Direct-To' differs from 'Activate Leg' (see: [\[PFD\] Activating a Leg](#)).



- Click the **CDI** Soft Key (if required) to place the device in GPS mode.
- Click the **INSET** Soft Key (if required) to invoke the inset map.
- Click the **Direct-To** Soft Key.
- Ensure the cursor is highlighted (as shown above). To highlight the cursor, click the FMS Rotary at the center.

For each character in your waypoint identifier:

- Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to set the desired character (A to Z and 1 to 9).
- Click the FMS Outer Rotary at the 3 O'clock position or 9 O'clock position to move to the next or previous character in the waypoint identifier.
- Click the **ENT** (Enter) Key to accept the new waypoint.
- You might get a "duplicate waypoints" screen that asks you to confirm your selection, if more than one waypoint with the same identifier exists in the database. Press **ENT** to confirm the selection of the current waypoint among the duplicates
- Click the **ENT** (Enter) key to assume direct-to navigation to the waypoint

[PFD] Flight Plans

A flight plan comprises a series of waypoints or procedures that collectively form the route that an aircraft may take from origin to destination. In this chapter, simple flight plans will be used that may not be representative of the complexity of real-life routes. These are for illustrative purposes only.

[PFD] Initializing / Deleting a Flight Plan

Before inputting a new flight plan, it's important to initialize the X1000 Flight Plan Page - by deleting any existing flight plan that may be present.



Click the **FPL** Key to invoke the Flight Plan Page.

The previous flight plan (if present) is displayed.



Click the **MENU** Key to invoke the Page Menu.



Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to select the 'Delete Flight Plan' option in the Page Menu.

Click the **ENT** (Enter) Key.

[PFD] Inserting a Waypoint

Waypoints may be manually inserted into your flight plan. This is normally done in the sequence you will encounter them during the flight, although the method described here also allows for the insertion of a waypoint anywhere in the plan.



In this example, the flight plan starts at KLAX (Los Angeles), and terminates at KSFO (San Francisco). The initial waypoint is already present in the flight plan.

Click the **FPL** Key to invoke the Flight Plan Page.

Ensure the cursor is highlighted (as shown to the left). To highlight the cursor, click the FMS Rotary at the center.



Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to place the cursor at the desired line in the flight plan.

If the currently line is unoccupied, the new waypoint will appear here.

If this line is occupied, the new waypoint will be inserted prior to the current line.



Click the FMS Inner Rotary at the 3 O'clock position to initiate the input of your waypoint identifier.



For each character in your waypoint identifier:

- Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to set the desired character (A to Z and 1 to 9).

Click the FMS Outer Rotary at the 3 O'clock position or 9 O'clock position to move to the next or previous character in the waypoint identifier.



Click the ENT (Enter) Key twice to accept the new waypoint.

[PFD] Deleting a Waypoint

Waypoints may be deleted at any line in your flight plan. However, the deletion of a waypoint may result in a discontinuity. Discontinuities occur when route segments within the flight plan cannot be joined together - usually due to missing or ambiguous waypoints.



In this example, the flight plan starts at KLAX (Los Angeles), and terminates at KSFO (San Francisco).

Click the **FPL** Key to invoke the Flight Plan Page.

Ensure the cursor is highlighted (as shown to the left). To highlight the cursor, click the FMS Rotary at the center.



Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to place the cursor at the desired line in the flight plan.



Click the **CLR** Key.



Click the ENT (Enter) Key to delete the waypoint.

[PFD] Activating a Leg

Use the “Activate Leg” menu option to resume navigation at a specific leg (waypoint to waypoint) within your flight plan, bypassing previous legs.



In this example, the flight plan starts at KLAX (Los Angeles), and terminates at KSFO (San Francisco). There is also an intermediate waypoint – LADLE.

Click the **FPL** Key to invoke the Flight Plan Page.

Ensure the cursor is highlighted (as shown to the left). To highlight the cursor, click the FMS Rotary at the center.



Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to place the cursor at the desired line in the flight plan. This will be the waypoint that represents the END of the leg to be activated.

In the example to the left, the leg to be activated is:

LADLE to KSFO



Click the **MENU** Key to invoke the Page Menu.

The 'Activate Leg' option should be selected by default. If not, click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to select the 'Activate Leg' option in the Page Menu.

FLIGHTPLAN		
KLAX / KSFO		
	DTK	DIS
KLAX		
LADLE		
›KSFO	306°	293NM
<hr/>		

Click the ENT (Enter) Key to activate the leg.

The magenta arrow highlights the END waypoint of the active leg.

The active leg is now: LADLE to KSFO

[PFD] Selecting a Standard Instrument Departure (SID)

[From Wikipedia] A Standard Instrument Departure (SID) is an air traffic control coded departure procedure that has been established at certain airports to simplify clearance delivery procedures.

Although a SID will keep aircraft away from terrain, it is optimized for air traffic control route of flight and will not always provide the lowest climb gradient. It strikes a balance between terrain and obstacle avoidance, noise abatement (if necessary), and airspace management considerations.



Before selecting a procedure, the flight plan must contain at least one airport (which will be the departure airport) as the first waypoint.

In this example, the flight plan starts at KDCA (Reagan National) and terminates at KRDU (Raleigh Durham).

Click the **FPL** Key to invoke the Flight Plan Page.



Click the **PROC** Key to invoke the Procedures Page.

Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to highlight **'SELECT DEPARTURE'**.

Click the **ENT** (Enter) Key to invoke the 'SELECT DEPARTURE' page.



SELECT DEPARTURE	
KDCA	
Washington Nation	
DEPARTURE	CLTCH1
RUNWAY	RW19
TRANSITION	MAULS
LOAD?	

A "LOAD (procedure)" confirmation is displayed to confirm the selections made.

Click the ENT (Enter) Key twice to confirm the selections and commit the procedure to the flight plan.

FLIGHTPLAN		
KDCA / MAULS		
KDCA	DTK	DIS
Departure-KDCA-CLTCH1		
›RW19	006°	1.2NM
(515)	185°	0.9NM
CAPVC	190°	5.8NM

The individual waypoints comprising the selected arrival procedure are now inserted into the flight plan.

The first waypoint (the runway itself) is marked as the active waypoint.

[PFD] Selecting a Standard Instrument Arrival (STAR)

[From Wikipedia] A Standard Terminal Arrival (STAR) is a flight route defined and published by the air navigation service provider that usually covers the phase of a flight that lies between the last point of the route filled in the flight plan and the first point of the approach to the airport, normally the initial approach fix (IAF). Hence, a STAR connects the en-route phase with the approach phase of the flight.



Before selecting a procedure, the flight plan must be properly constructed, with a departure airport as the first waypoint, and an arrival airport as the final waypoint.

In this example, the flight plan starts at KDCA (Reagan National) and terminates at KRDU (Raleigh Durham).

Click the **FPL** Key to invoke the Flight Plan Page.



Click the **PROC** Key to invoke the Procedures Page.

Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to highlight 'SELECT ARRIVAL'.

Click the **ENT** (Enter) Key to invoke the 'SELECT ARRIVAL' page.



The SELECT ARRIVAL page displays the available arrival procedures for the **final waypoint** (arrival airport) in the flight plan. **Note:** This is not influenced by highlighting a waypoint in the flight plan.

Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to select the desired arrival procedure.

Click the **ENT** (Enter) Key.



The available transitions / fixes for the selected procedure are displayed.

Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to select the desired transition.

Click the ENT (Enter) Key.



The available runways at the arrival airport are displayed.

Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to select the desired departure runway.

Click the ENT (Enter) Key.



A "LOAD (procedure)" confirmation is displayed to confirm the selections made.

Click the ENT (Enter) Key to confirm the selections and commit the arrival procedure to the flight plan.

FLIGHTPLAN		
KDCA / KRDU		
Arrival-KRDU-ALDAN1	ROA	DTK DIS
.ROA 237° 47.7NM		
TIVAE 137° 10.0NM		
SBV 137° 54.6NM		
Arrival-KRDU-ALDAN1		

The individual waypoints comprising the selected arrival procedure are now inserted into the flight plan.

[PFD] Selecting an Approach Procedure

[From Wikipedia] An **Approach Procedure** is a series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually. If your flight plan includes a **Standard Arrival Procedure** (STAR), an **Approach Procedure** will normally follow a STAR.



When selecting an approach, the flight plan must contain at least one airport. Otherwise, the nearest airport will be used.

In this example, the flight plan starts at KDCA (Reagan National) and terminates at KRDW (Raleigh Durham).

Click the **FPL** Key to invoke the Flight Plan Page.



Click the **PROC** Key to invoke the Procedures Page.

Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to highlight 'SELECT APPROACH'.

Click the **ENT** (Enter) Key to invoke the 'SELECT APPROACH' page.



The SELECT APPROACH page displays the available approach procedures for the **final waypoint** (arrival airport) in the flight plan. This is not influenced by highlighting a waypoint in the flight plan.

Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to select the desired approach procedure.

Click the ENT (Enter) Key.



The available transitions / fixes for the selected approach are displayed.

Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to select the desired transition.

Click the ENT (Enter) Key.



The option is now presented to input the minimums for the approach.

Click the FMS (Inner) Rotary at the 3 O'clock position to toggle MINIMUMS between OFF and BARO.

Click the FMS (Outer) Rotary at the 3 O'clock position to move the cursor to the (minimums) altitude.

Click the FMS (Inner) Rotary at the 3 O'clock and 9 O'clock positions to increment / decrement the (minimums) altitude.

Click the ENT (Enter) Key **twice** to load the procedure into the flight plan. It has not yet been activated.

FLIGHTPLAN			
KLAX / KSFO			
KSFO	DTK	DIS	
	148°	0.0NM	
Approach-KSFO-I28R			
›MENLO	iaf	307°	279NM
CEPIN		335°	4.4NM
AXMUL	faf	285°	4.5NM

The individual waypoints comprising the selected approach procedure are now inserted into the flight plan.

[PFD] Activating an Approach Procedure

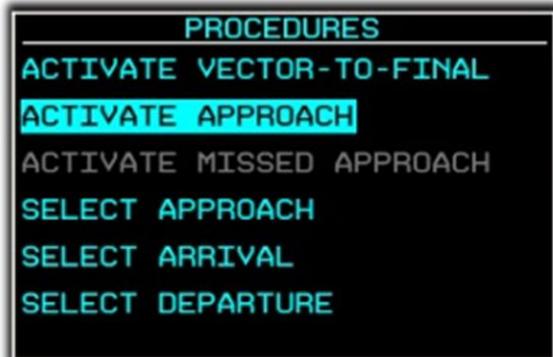
Use the "Activate Approach" menu option once ATC clears you for an instrument approach via a transition or an initial approach fix. This will switch the active flight plan to the approach flight plan. Instead of flying to the center of the airport from an arbitrary direction, the X1000 will now guide you according to the (previously) selected approach procedure.



When selecting an approach, the flight plan must contain at least one airport. Otherwise, the nearest airport will be used.

In this example, the flight plan starts at KDCA (Reagan National) and terminates at KRDU (Raleigh Durham).

Click the **FPL** Key to invoke the Flight Plan Page.



Click the **PROC** Key to invoke the Procedures Page.

Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to highlight 'ACTIVATE APPROACH'.

Click the **ENT** (Enter) Key.



Approach navigation is now activated. This can be confirmed by reviewing the Flight Plan Page. The initial approach fix for the selected procedure is now the active waypoint.

[PFD] ILS Approaches

An **Instrument Landing System (ILS)** is a ground-based instrument **approach** system that provides precision lateral and vertical guidance to an aircraft approaching and landing on a runway, using a combination of radio signals and, in many cases, high-intensity lighting arrays to enable a safe landing during instrument conditions. The system provides the pilot with a 'localizer' (for lateral guidance) and a 'glideslope' for vertical guidance.

[PFD] Set the Nav1 or Nav2 frequency for the ILS approach



- Click the CENTER of the NAV Rotary to select either NAV1 or NAV2.
- Click the NAV Outer Rotary at the 3 O'clock or 9 O'clock position to increment/decrement the frequency - numeric portion.
- Click the NAV Inner Rotary at the 3 O'clock or 9 O'clock position to increment/decrement the frequency - decimal portion.
- Click the NAV Frequency Toggle Key to swap the standby and active NAV frequency.

[PFD] The Course Deviation Indicator (CDI)

If the ILS frequency was tuned to NAV1, click the CDI button once to select LOC1. If the ILS frequency was tuned to NAV2, click the CDI button again, to select LOC2.

With the appropriate selection made (LOC1 or LOC2), the ILS localizer course deviation indicator (CDI) is superimposed on the **Horizontal Situation Indicator (HSI)**.



Steer a course to intercept the localizer. If this is displayed to the left of the aircraft (within the HSI), steer left. If this is displayed to the right of the aircraft, steer right. In the example above, the aircraft is currently to the left of the localizer - the pilot must steer right to intercept.

[PFD] The Glide Slope Indicator and Vertical Speed Pointer

Climb, or descend, to intercept the glideslope. If the Glide Slope Indicator (1) is above center, you are low, and should increase the rate of ascent. If the Glide Slope Indicator (1) is below center, you are high, and should increase the rate of descent.

The Vertical Speed Pointer (2) indicates to the pilot if the aircraft is currently ascending (above center), or descending (below center). The value displayed inside is the current rate of ascent, or descent, in feet per minute.

In the example above, the aircraft is currently above the glide-slope and descending at a rate of 200 feet per minute.

[PFD] Storing a Flight Plan

Flight plans may be stored for use again later. A stored flight plan in X-Plane 11 uses a. fms extension, and appears in folder:

- X-Plane/Output/FMS Plans/

Note: Flight plans may be stored using the PFD (Primary Flight Display) or the MFD (Multi-Function Display). However, flight plans may only be **loaded** using the MFD. See: [\[MFD\] Loading a Flight Plan](#)



Click the **FPL** Key to invoke the Flight Plan Page.



Click the **MENU** Key to invoke the Page Menu.



Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to select the 'Store Flight Plan' option in the Page Menu.

Click the ENT (Enter) Key.

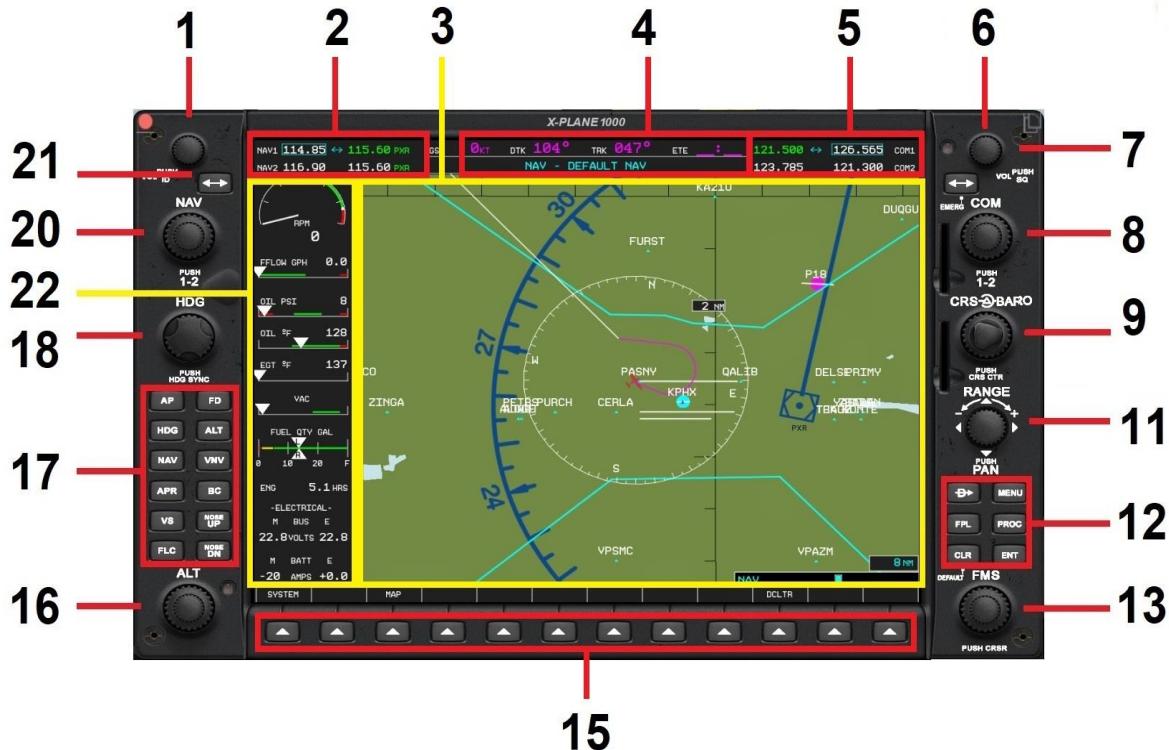
The flight plan filename is constructed automatically: Origin airport code + Destination airport code + ".fms".

Using the example from this guide, the flight plan (from KLAX to KSFO) would be named: **KLAXKSFO.fms**

X1000 Multi-Function Display (MFD)

[MFD] Controls & Features

This section identifies the controls and features of the X1000 MFD (Multi-Function Display). Where relevant, these are discussed in more detail later in the guide.



1	NAV Audio Squelch	Toggles the Morse code audio identifier (of the selected NAV radio frequency) ON and OFF. Note that when toggling to 'Off', the Morse will finish its cycle before the audio is cut.
2	Active & Stand-by NAV1 and NAV2 Frequencies	This area of the display panel features the active and stand-by frequencies for the NAV1 and NAV2 radios. The active frequency is on the right, and the stand-by frequency is on the left.

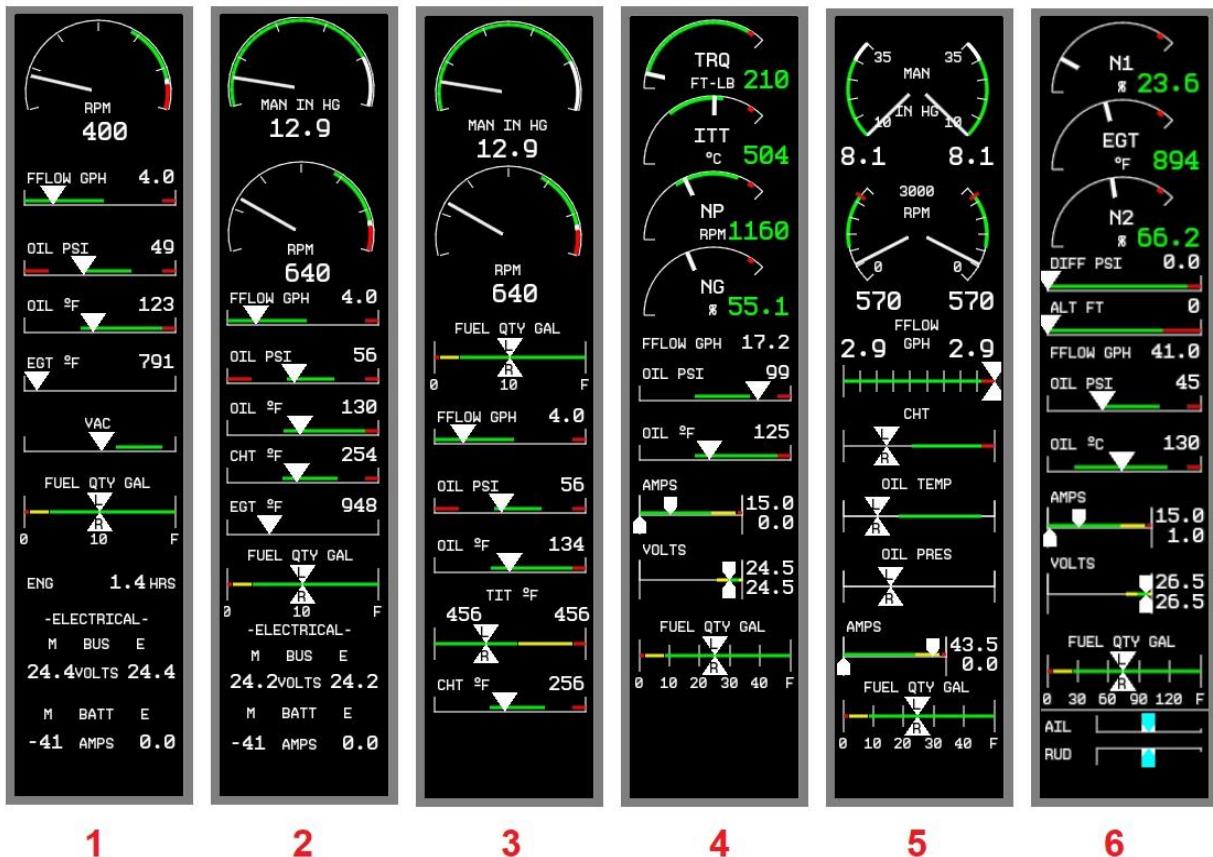
3	Navigation Map	The Navigation Map displays aviation data (airports, VORs, airways, airspaces), geographic data (cities, lakes, highways, borders), topographic data (map shading indicating elevation), and hazard data (traffic, terrain, weather)
4	Data Fields	This area of the display panel shows information pertaining the activate navigation leg. It shows ground speed (GS), desired track (DTK) to the active waypoint, ground track (TRK) and estimated time enroute (ETE) to the active waypoint.
5	Active & Stand-by COM1 and COM Frequencies	This area of the display panel features the active and stand-by frequencies for the COM1 and COM2 radios. The active frequency is on the left, and the stand-by frequency is on the right.
6	COM Frequency Toggle	Toggles between the active and stand-by COM1 or COM2 radio frequency.
7	COM Audio Squelch	Toggles the audio of the selected COM radio frequency ON and OFF. Note that when toggling to 'Off', the message will finish before the audio is cut.
8	COM Rotary	<p>Click the center of this control to switch between COM1 and COM2 in the 'Active & Standby COM Frequencies' area.</p> <p>Use the outer and inner rotary controls to adjust the numeric and decimal portion of the stand-by COM frequency respectively.</p>
9	CRS/BARO Control	<p>Use the outer rotary control to set the altimeter barometric pressure.</p> <p>Use the inner rotary control to adjust the CDI (Course Deviation Indicator) when the HSI is in VOR/LOC or GPS-OBS mode.</p> <p>Pressing the inner rotary will reset the selected course to the bearing or the localizer front course, depending on selected navigation source.</p>

11	Joystick	This rotary control adjusts the map range (zoom level) display). Rotate clockwise to zoom out, and counter-clockwise to zoom in. Push in the center to activate or de-activate panning.
12	Flight Plan Key Group	<p>Direct-to Key: Used to establish a direct course to a selected waypoint, or Map Pointer position.</p> <p>FPL Key: Invokes the Flight Plan Page, to create or edit the active flight plan.</p> <p>CLR Key: Cancel or erase an entry. Click and HOLD this key to clear pages from the main display.</p> <p>MENU Key – Displays menu of options that is context-driven.</p> <p>PROC Key – Selects approaches, departures and arrivals associated with a waypoint in the flight plan.</p> <p>ENT Key – Confirms the current selection or operation.</p>
13	FMS Rotary	Click the center of this control to activate the flight plan cursor (when the Flight Plan Page is displayed). When viewing the flight plan, use the outer rotary to SELECT the next or previous waypoint. Use the inner rotary to commence input of a new waypoint, and to change each character in the waypoint identifier. User the outer rotary to move to the next or previous character within the waypoint identifier.
15	Soft Keys	Context-driven keys. The function of these keys will depend on the action being performed by the pilot.

16	ALT Rotary	Used to select the Autopilot Selected Altitude (displayed above the altimeter). The Autopilot Selected Altitude is used by the Autopilot in certain modes and operations, such as altitude hold or altitude capture. The outer rotary increments or decrements in units of 1,000 feet. The inner rotary increments or decrements in units of 100 feet.
17	Autopilot Key Group	Autopilot mode control – see Autopilot Panel
18	HDG Rotary	Used to control the heading bug which forms part of the HSI. Click the center of this rotary to synchronize the heading bug with the current heading. Click the rotary at the 9-o'clock position to move the heading bug clockwise, and the 3-o'clock position to move the heading bug counter-clockwise.
20	NAV Rotary	Click the center of this control to switch between COM1 and COM2 in the 'Active & Standby COM Frequencies' area. Use the outer and inner rotary controls to adjust the numeric and decimal portion of the stand-by NAV frequency respectively.
21	NAV Frequency Toggle	Toggles between the active and stand-by COM1 or COM2 radio frequency.
22	Engine Indication System (EIS)	Displays dial gauge(s), horizontal bar indicators, and other readouts for critical engine and electrical systems. This is context-driven, and depends on the aircraft-type. See: [MFD] Engine Indication System (EIS)

[MFD] Engine Indication System (EIS)

The Engine Indication System (EIS) is a feature built-into the Multi-Function Display (MFD) that presents critical engine, electrical and fuel information to the pilot. The information displayed depends on the engine-configuration, and is therefore fixed for a specific make and model of aircraft.



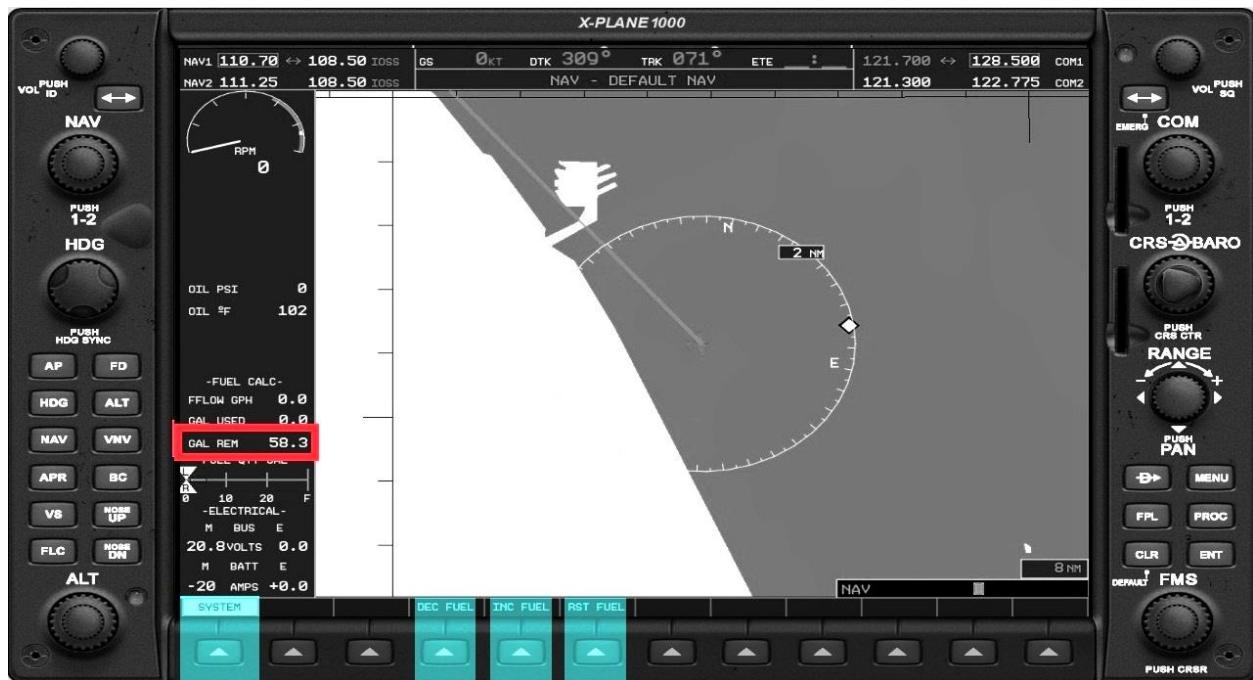
1 2 3 4 5 6

1	Single-Engine Fixed-Pitch Propeller	Cessna 172 and similar
2	Single-Engine Constant-Speed Propeller	Cessna 182 and similar
3	Single-Engine Turbocharged / Turbo-normalized	Cessna 400 and similar
4	Single-Engine Turboprop	Lancair Evolution and similar
5	Twin-Engine Piston	Beechcraft Baron and similar
6	Single Engine Jet	Fictional

[MFD] Setting the Fuel Totalizer

The X1000 maintains two independent fuel readouts – the fuel gauge data comes from sensors in the tanks, whereas the fuel totalizer data is based on the pilot's knowledge of the exact amount of fuel added prior to each flight, and the measured fuel flow during flight.

To set the fuel totalizer, the pilot notes the precise quantity of fuel added prior to the flight (provided by the FBO), and increments the fuel-remaining display accordingly.



- Click the SYSTEM Key.
- Click the DEC FUEL Key to decrement the fuel remaining.
- Click the INC FUEL Key to increment the fuel remaining.
- Click the RST FUEL Key to reset the fuel remaining to full tanks, and reset the USED fuel to 0.

During the flight, the fuel-totalizer will be decremented according to the measured fuel flow en-route.

[MFD] Declutter Function

Use this Key to toggle between the available declutter modes for the Navigation Map. This allows the pilot to customize the level of detail displayed on the map, to fit the requirements at the current stage of the flight.



- Click the DCLTR Key to invoke each declutter mode in succession.

DCLTR-1: Declutters land data;

DCLTR-2: Declutters land and Special-Use Airspace (SUA) data;

DCLTR-3: Declutters everything except the active flight plan detail;

[MFD] Map Functions

Click the MAP Key to access the Map Functions:



- Click the MAP Key.
- Click the TOPO Key to toggle the display of topographical data (terrain elevation) on the Navigation Map
- Click the TERRAIN Key to toggle the display of terrain warning on the Navigation Map. Terrain that is less than 1000ft below the plane's current altitude is displayed in yellow, terrain that is less than a 100ft or even above the plane's current altitude is displayed in red.
- Click the AIRWAYS Key to toggle the display of low and high-altitude (IFR) airways on the Navigation Map. [This will also depend on the declutter mode currently in effect]. You can display all airways, or only lower-level (Victor) or only upper-level (Juliet) airways.
- Click the NEXRAD Key to toggle the (simulated) display of NEXRAD (Next-Generation Radar) weather data on the Navigation Map. The data displayed here is derived from the X-Plane 11 weather engine, and not sourced in real-time from the National Climate Data Center.
- Click the BACK Key to exit the MAP functions.

[MFD] Setting the COM1 and COM2 Frequencies/Channel



- Click the CENTER of the COM Rotary to select either COM1 or COM2.
- Click the COM Outer Rotary at the 3 O'clock or 9 O'clock position to increment/decrement the frequency/channel - numeric portion.
- Click the COM Inner Rotary at the 3 O'clock or 9 O'clock position to increment/decrement the frequency/channel – decimal portion.
- Click the COM Frequency Toggle Key to swap the standby and active COM frequency/channel.

[MFD] Setting the NAV1 and NAV2 Frequencies



- Click the CENTER of the NAV Rotary to select either NAV1 or NAV2.
- Click the NAV Outer Rotary at the 3 O'clock or 9 O'clock position to increment/decrement the frequency - numeric portion.
- Click the NAV Inner Rotary at the 3 O'clock or 9 O'clock position to increment/decrement the frequency - decimal portion.
- Click the NAV Frequency Toggle Key to swap the standby and active NAV frequency.

[MFD] Direct-To (a waypoint)

At any time during a flight, the pilot may elect to proceed directly to a given waypoint. The chosen waypoint need not be in an existing Flight Plan (although it can be), and hence 'Direct-To' differs from 'Activate Leg' (see: [\[MFD\] Activating a Leg](#)).



- Click the **Direct-To** Soft Key.
- Click the FMS Inner Rotary at the 3 O'clock position to initiate the input of your waypoint identifier.
- For each character in your waypoint identifier:
 - ✓ Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to set the desired character (A to Z and 1 to 9).
 - ✓ Click the FMS Outer Rotary at the 3 O'clock position or 9 O'clock position to move to the next or previous character in the waypoint identifier.
- Click the **ENT** (Enter) Key to accept the new waypoint.
- You might get a "duplicate waypoints" screen that asks you to confirm your selection, if more than one waypoint with the same identifier exists in the database. Press **ENT** to confirm the selection of the current waypoint among the duplicates
- Click the **ENT** (Enter) key to assume direct-to navigation to the waypoint

[MFD] Direct-To (a waypoint) with (VNAV) Descent Profile

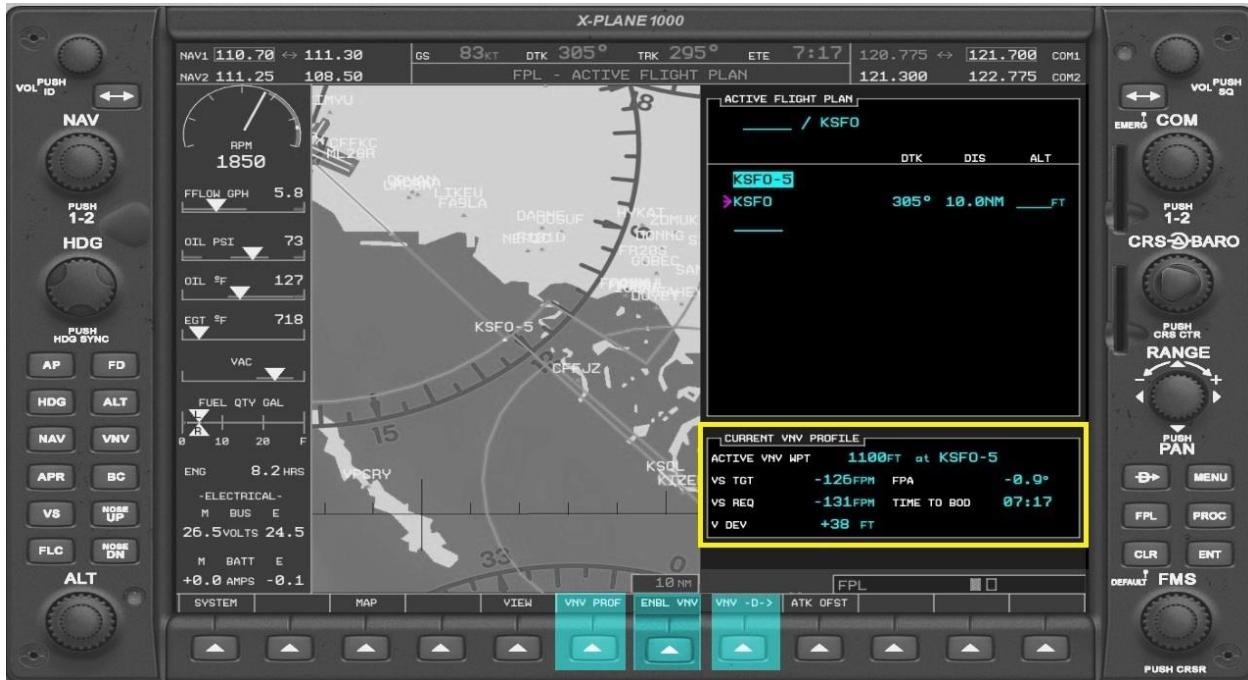
A 'Direct-To' instruction can be made with an associated flight path angle. This generates a descent path that is ahead of the current location (with subsequent guidance once top of descent is achieved).

- Click the **Direct-To** Soft Key.
- Click the FMS Inner Rotary at the 3 O'clock position to initiate the input of your waypoint identifier.
- For each character in your waypoint identifier:
 - ✓ Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to set the desired character (A to Z and 1 to 9).
 - ✓ Click the FMS Outer Rotary at the 3 O'clock position or 9 O'clock position to move to the next or previous character in the waypoint identifier.
- Click the **ENT** (Enter) Key **ONCE** to accept the new waypoint.
- Click the FMS Outer Rotary at the 9 O'clock position **THREE** times to move the cursor to the VNV (altitude) field.



- Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to increment or decrement the desired altitude (in units of 100 feet).

- Click ENT to accept the altitude. If the active waypoint is an airport, select MSL or AGL as the reference of the altitude value you just entered (1000ft AGL is a good estimate for the traffic pattern altitude, if your destination is a VFR airport). Click ENT to accept either MSL or AGL. Note that when you selected AGL, the entered altitude will be automatically corrected to match your intention to arrive at the selected altitude above ground level.
- Click the FMS Outer Rotary at the 9 O'clock position ONE time to move the cursor to the OFFSET field (unlabeled).
- If there is a requirement to level-off at the desired altitude BEFORE reaching the waypoint:
 - ✓ Click the FMS Outer Rotary at the 9 O'clock position ONCE to move the offset field.
 - ✓ Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to increment or decrement the desired offset distance (in units of 1 mile).
- If there is no requirement to level-off BEFORE reaching the waypoint, leave the offset at +0NM,
- Click the ENT (Enter) Key twice to accept the new waypoint.
- Prior to commencing your descent to the waypoint:



- ✓ Click the FPL (Flight Plan) Soft Key to enter Flight Plan mode (if not already active)
- ✓ Click the ENBL VNV (Enable VNAV) Soft Key to enable VNAV mode
- ✓ Click the VNV -D-> (VNAV Direct-To) Soft Key to compute, or re-compute, the VS TGT, VS REQ and VDEV variables from your current location, and commence the VNAV approach to waypoint

If required, the computed FLIGHT PATH ANGLE (FPA) may be adjusted. This will result in the calculation of a new TOP OF DESCENT:

- Click the VNV PROF (VNAV Profile) Soft Key
- Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to increment or decrement the desired DESCENT ANGLE to the waypoint (or waypoint offset).

- ✓ Click the **CNCL VNV** (Cancel VNAV) Soft Key to terminate VNAV mode

[MFD] CURRENT VNV (VNAV) PROFILE (Panel)

This panel displays information that enables the pilot to remain within the chosen VNAV descent profile. Data is displayed in this panel **ONLY** when:

- ✓ The aircraft is either close to, or beyond, the top of descent.
- ✓ The aircraft is above the next altitude it needs to descend to.
- ✓ The chosen descent profile is sensible (not steeper than 6 degrees FPA or 2000fpm target VS)



ACTIVE VNV WPT	Active VNAV Waypoint	The approaching waypoint that is the subject of the VNAV computations.
VS TGT	TARGET Vertical Speed	Used to set the vertical speed desired, or display vertical speed to achieve the desired flight path angle at the current ground speed. Note that the steepest descend that can be selected is 2000 fpm.
VS REQ	REQUIRED Vertical Speed	The vertical speed required to arrive at the designated waypoint (or waypoint offset) at the pre-set altitude.
V DEV	Vertical Speed DEVIATION	Vertical deviation from the desired flight path (in feet). If the pilot adheres to VS TGT, this value will remain stationary. If the pilot adheres to VS REQ, this value will become zero when arriving at the designated waypoint (or waypoint offset).
FPA	Flight Path Angle	Used to set the flight path angle to the designated waypoint (or waypoint offset) or display the FPA required for the desired vertical speed. Note that the steepest FPA that can be selected is 6 degrees.

TIME TO TOD	Time to TOP OF DESCENT	If the desired flight path is ahead of the current position, this is the time remaining until flight path intercept.
TIME TO BOD	Time to BOTTOM OF DESCENT	If the aircraft is already descending on the desired flight path, this is the time to remaining before the levelling-off.

[MFD] Flight Plans

A flight plan comprises a series of waypoints or procedures that collectively form the route that an aircraft may take from origin to destination. In this chapter, simple flight plans will be used that may not be representative of the complexity of real-life routes. These are for illustrative purposes only.

[MFD] Initializing / Deleting a Flight Plan

Before inputting a new flight plan, it's important to initialize the X1000 Flight Plan Page - by deleting any existing flight plan that may be present.



Click the FPL Key to invoke the Flight Plan Page.

The previous flight plan (if present) is displayed.



Click the **MENU** Key to invoke the Page Menu.



Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to select the 'Delete Flight Plan' option in the Page Menu.

Click the **ENT** (Enter) Key.

[MFD] Inserting a Waypoint

Waypoints may be manually inserted into your flight plan. This is normally done in the sequence you will encounter them during the flight, although the method described here also allows for the insertion of a waypoint anywhere in the plan.



In this example, the flight plan starts at KLAX (Los Angeles), and terminates at KSFO (San Francisco). The initial waypoint is already present in the flight plan.

Click the **FPL** Key to invoke the Flight Plan Page.

Ensure the cursor is highlighted (as shown to the left). To highlight the cursor, click the FMS Rotary at the center.



Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to place the cursor at the desired line in the flight plan.

If the currently line is unoccupied, the new waypoint will appear here.

If this line is occupied, the new waypoint will be inserted prior to the current line.



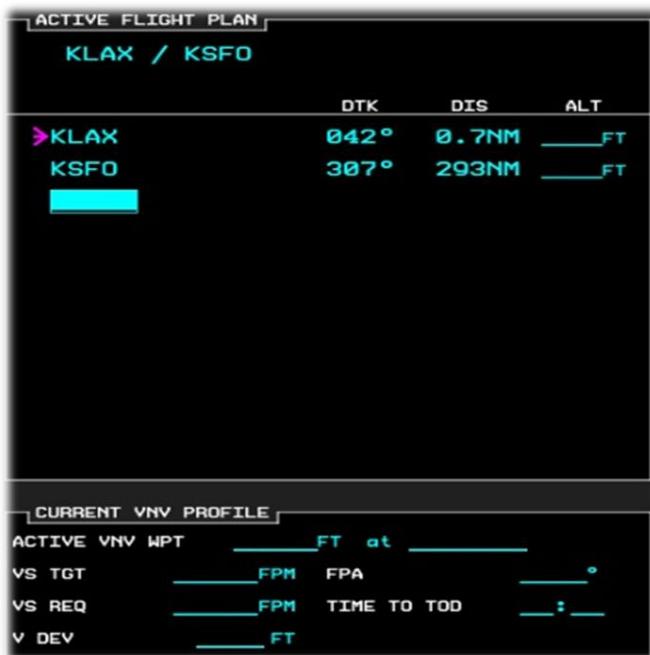
Click the FMS Inner Rotary at the 3 O'clock position to initiate the input of your waypoint identifier.



For each character in your waypoint identifier:

- Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to set the desired character (A to Z and 1 to 9).

Click the FMS Outer Rotary at the 3 O'clock position or 9 O'clock position to move to the next or previous character in the waypoint identifier.



Click the ENT (Enter) Key twice to accept the new waypoint.

[MFD] Deleting a Waypoint

Waypoints may be deleted at any line in your flight plan. However, the deletion of a waypoint may result in a discontinuity. Discontinuities occur when route segments within the flight plan cannot be joined together - usually due to missing or ambiguous waypoints.



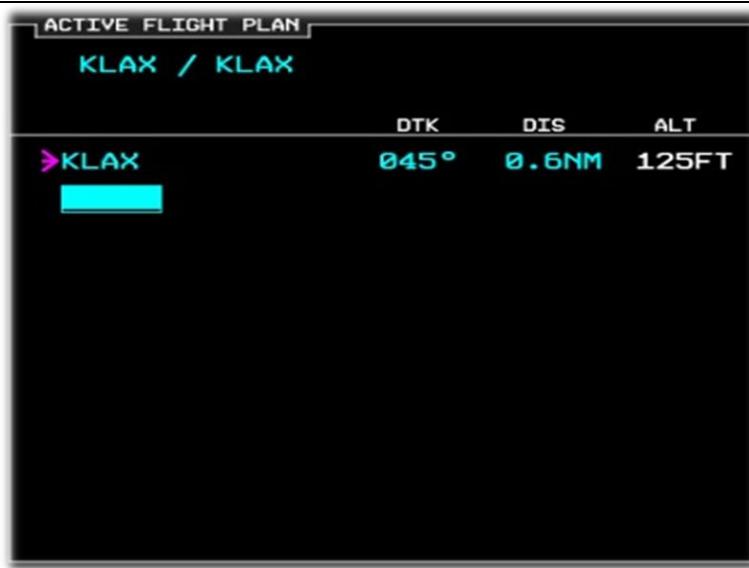
In this example, the flight plan starts at KLAX (Los Angeles), and terminates at KSFO (San Francisco).

Click the **FPL** Key to invoke the Flight Plan Page.

Ensure the cursor is highlighted (as shown to the left). To highlight the cursor, click the FMS Rotary at the center.



Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to place the cursor at the desired line in the flight plan.



[MFD] Activating a Leg

Use the “Activate Leg” menu option to resume navigation at a specific leg (waypoint to waypoint) within your flight plan, bypassing previous legs.

ACTIVE FLIGHT PLAN			
KLAX / KSFO			
	DTK	DIS	ALT
➤KLAX	045°	0.6NM	125FT
LADLE	080°	3.0NM	_____FT
KSFO	306°	295NM	13FT

In this example, the flight plan starts at KLAX (Los Angeles), and terminates at KSFO (San Francisco). There is also an intermediate waypoint – LADLE.

Click the **FPL** Key to invoke the Flight Plan Page.

Ensure the cursor is highlighted (as shown to the left). To highlight the cursor, click the FMS Rotary at the center.

ACTIVE FLIGHT PLAN			
KLAX / KSFO			
	DTK	DIS	ALT
➤KLAX	045°	0.6NM	125FT
LADLE	080°	3.0NM	_____FT
KSFO	306°	295NM	13FT

Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to place the cursor at the desired line in the flight plan. This will be the waypoint that represents the END of the leg to be activated.

In the example to the left, the leg to be activated is:

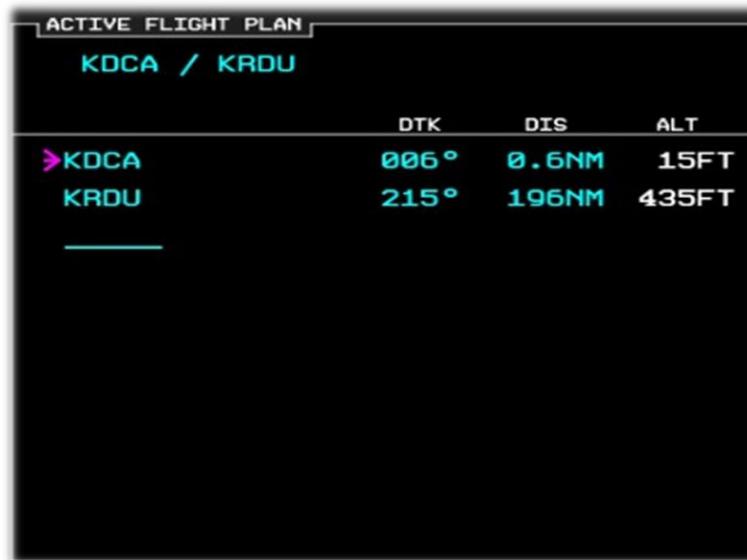
LADLE to KSFO



[MFD] Selecting a Standard Instrument Departure (SID)

[From Wikipedia] A Standard Instrument Departure (SID) is an air traffic control coded departure procedure that has been established at certain airports to simplify clearance delivery procedures.

Although a SID will keep aircraft away from terrain, it is optimized for air traffic control route of flight and will not always provide the lowest climb gradient. It strikes a balance between terrain and obstacle avoidance, noise abatement (if necessary), and airspace management considerations.



Before selecting a procedure, the flight plan must be properly constructed, with a departure airport as the first waypoint, and an arrival airport as the final waypoint.

In this example, the flight plan starts at KDCA (Reagan National) and terminates at KRDU (Raleigh Durham).

Click the **FPL** Key to invoke the Flight Plan Page.



Click the **PROC** Key to invoke the Procedures Page.

Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to highlight '**SELECT DEPARTURE**'.

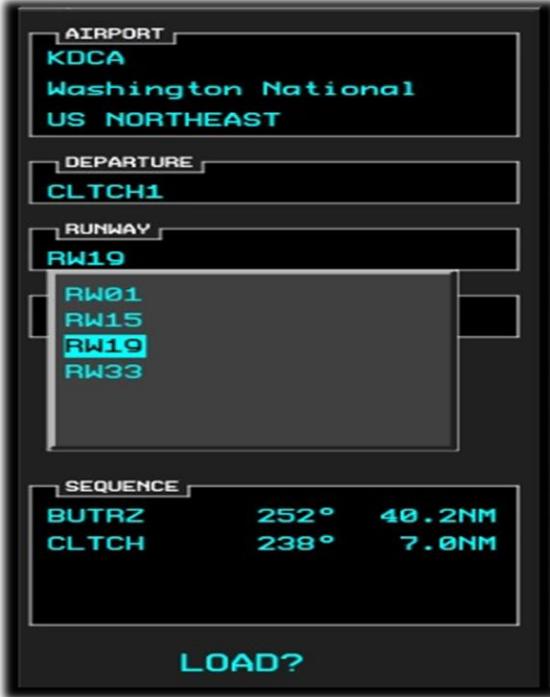
Click the **ENT** (Enter) Key to invoke the 'SELECT DEPARTURE' page.



The SELECT DEPARTURE page displays the available departure procedures for the **initial waypoint** (departure airport) in the flight plan. **Note:** This is not influenced by highlighting a waypoint in the flight plan.

Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to select the desired procedure.

Click the ENT (Enter) Key.



The available runways at the departure airport are displayed.

Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to select the desired runway.

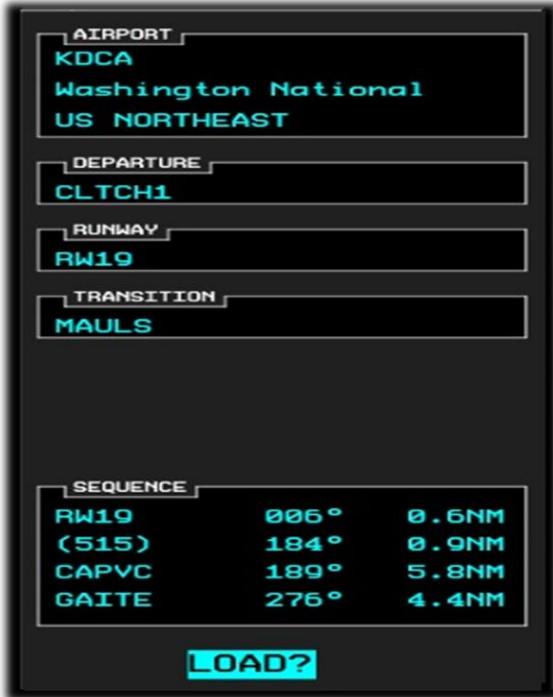
Click the ENT (Enter) Key.



The available transitions / fixes for the selected procedure are displayed.

Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to select the desired transition.

Click the ENT (Enter) Key.



A "LOAD (procedure)" confirmation is displayed to confirm the selections made.

Click the ENT (Enter) Key to confirm the selections and commit the procedure to the flight plan.

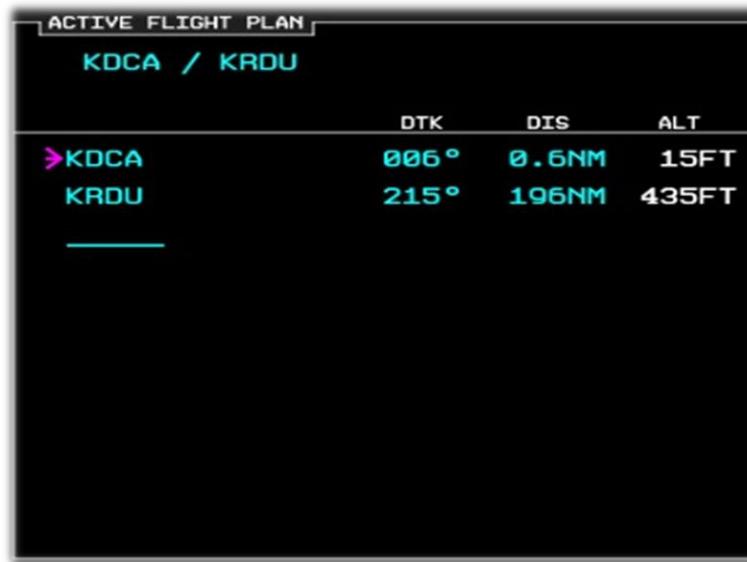
ACTIVE FLIGHT PLAN			
KDCA / KRDU	DTK	DIS	ALT
KDCA			
Departure-KDCA-CLTCH1			
RW19			
➤(515)	186°	1.0NM	515FT
CAPVC	191°	4.6NM	_____FT
GAITE	277°	4.4NM	_____FT
DMKRT	255°	4.9NM	_____FT
BUTRZ	258°	28.9NM	_____FT
CLTCH	238°	7.0NM	_____FT
Departure-KDCA-CLTCH1.MAULS			
KERRK	245°	28.2NM	_____FT

The individual waypoints comprising the selected procedure are now inserted into the flight plan.

The first waypoint (after the runway itself) is marked as the active waypoint.

[MFD] Selecting a Standard Instrument Arrival (STAR)

[From Wikipedia] A Standard Terminal Arrival (STAR) is a flight route defined and published by the air navigation service provider that usually covers the phase of a flight that lies between the last point of the route filled in the flight plan and the first point of the approach to the airport, normally the initial approach fix (IAF). Hence, a STAR connects the en-route phase with the approach phase of the flight.



Before selecting a procedure, the flight plan must be properly constructed, with a departure airport as the first waypoint, and an arrival airport as the final waypoint.

In this example, the flight plan starts at KDCA (Reagan National) and terminates at KRDU (Raleigh Durham).

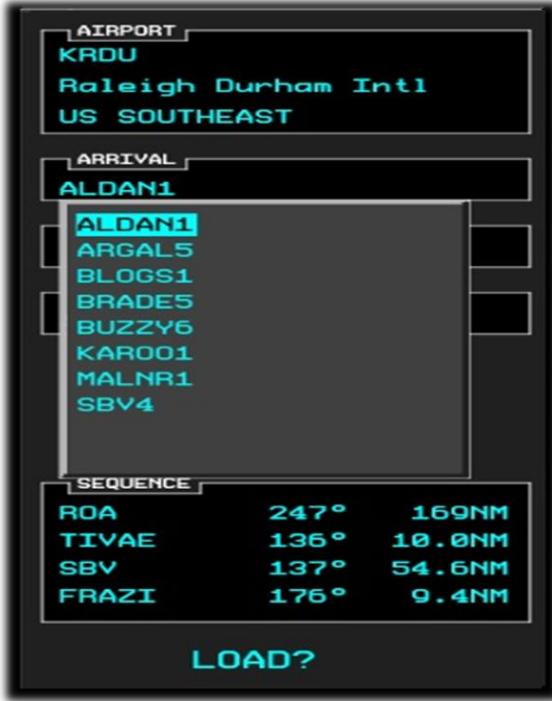
Click the **FPL** Key to invoke the Flight Plan Page.



Click the **PROC** Key to invoke the Procedures Page.

Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to highlight '**SELECT ARRIVAL**'.

Click the **ENT** (Enter) Key to invoke the 'SELECT ARRIVAL' page.



The SELECT ARRIVAL page displays the available arrival procedures for the **final waypoint** (arrival airport) in the flight plan.
Note: This is not influenced by highlighting a waypoint in the flight plan.

Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to select the desired arrival procedure.

Click the ENT (Enter) Key.



The available transitions / fixes for the selected procedure are displayed.

Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to select the desired transition.

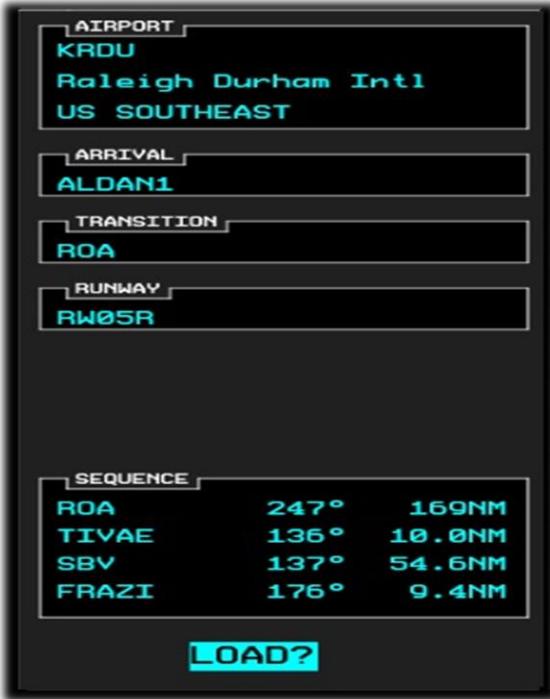
Click the ENT (Enter) Key.



The available runways at the arrival airport are displayed.

Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to select the desired departure runway.

Click the ENT (Enter) Key.



A "LOAD (procedure)" confirmation is displayed to confirm the selections made.

Click the ENT (Enter) Key to confirm the selections and commit the arrival procedure to the flight plan.

ACTIVE FLIGHT PLAN

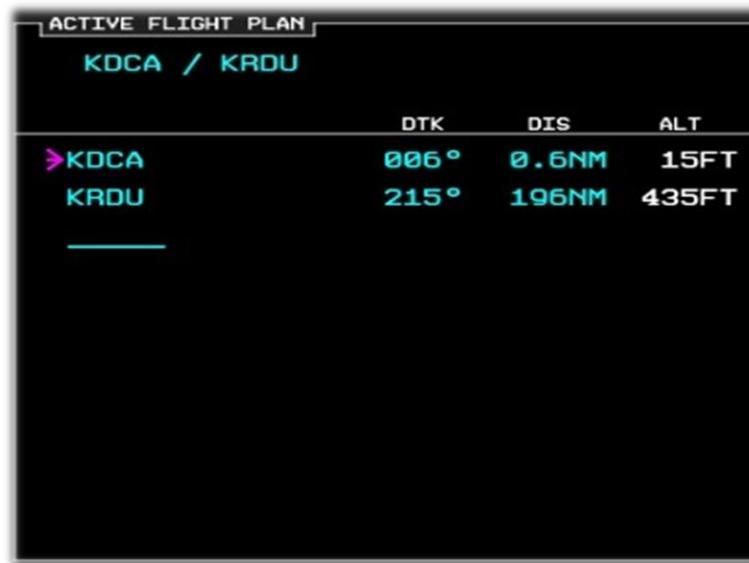
KDCA / KRDU

	DTK	DIS	ALT
Arrival-KRDU-ALDAN1.ROA			
ROA	247°	169NM	_____FT
TIVAE	137°	10.0NM	_____FT
SBV	137°	54.6NM	17000FT
Arrival-KRDU-ALDAN1			
FRAZI	176°	9.4NM	_____FT
FAVKO	176°	5.5NM	12000FT
ALDAN	176°	2.2NM	12000FT
FOBAT	176°	5.3NM	_____FT
BILLA	176°	4.2NM	_____FT
BLNKR	177°	11.5NM	8000FT

The individual waypoints comprising the selected arrival procedure are now inserted into the flight plan.

[MFD] Selecting an Approach Procedure

[From Wikipedia] An **Approach Procedure** is a series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually. If your flight plan includes a **Standard Arrival Procedure** (STAR), the **Approach Procedure** will normally follow the execution of the STAR.



Before selecting a procedure, the flight plan must be properly constructed, with a departure airport as the first waypoint, and an arrival airport as the final waypoint.

In this example, the flight plan starts at KDCA (Reagan National) and terminates at KRDU (Raleigh Durham).

Click the **FPL** Key to invoke the Flight Plan Page.



Click the **PROC** Key to invoke the Procedures Page.

Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to highlight '**SELECT APPROACH**'.

Click the **ENT** (Enter) Key to invoke the 'SELECT APPROACH' page.



The SELECT APPROACH page displays the available approach procedures for the **final waypoint** (arrival airport) in the flight plan. This is not influenced by highlighting a waypoint in the flight plan.

Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to select the desired approach procedure.

Click the ENT (Enter) Key.



The available transitions / fixes for the selected approach are displayed.

Click the FMS Inner Rotary at the 3 O'clock position or 9 O'clock position to select the desired transition.

Click the ENT (Enter) Key.



The option is now presented to input the minimums for the approach.

Click the FMS (Inner) Rotary at the 3 O'clock position to toggle MINUMUMS between OFF and BARO.

Click the FMS (Outer) Rotary at the 3 O'clock position to move the cursor to the (minimums) altitude.

Click the FMS (Inner) Rotary at the 3 O'clock and 9 O'clock positions to increment / decrement the (minimums) altitude.

Click the ENT (Enter) Key twice to load the procedure into the flight plan. It has not yet been activated.

ACTIVE FLIGHT PLAN			
KDCA / KRDU			
	DTK	DIS	ALT
KRDU	048°	0.0NM	435FT
Approach-KRDU-R05RY			
FOGAP iaf	273°	16.6NM	<u>3400FT</u>
PECIT	144°	10.6NM	<u>3400FT</u>
PURME faf	054°	6.0NM	<u>2400FT</u>
RW05R map	054°	6.1NM	<u>452FT</u>
(597)	052°	1.1NM	<u>597FT</u>
POBIC	055°	3.2NM	<u>FT</u>
ZEBUL	100°	17.1NM	<u>2600FT</u>
hold	269°	00:36	<u>FT</u>

The individual waypoints comprising the selected approach procedure are now inserted into the flight plan.

[MFD] Activating an Approach Procedure

Use the "Activate Approach" menu option once ATC clears you for an instrument approach via a transition or an initial approach fix. This will switch from en-route (ENR) or terminal (TERM) navigation to approach (APR) navigation. Flight plan navigation is canceled, and approach navigation is activated. Instead of flying to the center of the airport from an arbitrary direction, the X1000 will now guide you according to the (previously) selected approach procedure.



Before activating a procedure, the flight plan must be properly constructed, with a departure airport as the first waypoint, an arrival airport as the final waypoint, and a (previously) selected approach procedure already loaded.

In this example, the flight plan starts at KDCA (Reagan National) and terminates at KRDU (Raleigh Durham).

Click the **FPL** Key to invoke the Flight Plan Page.



Click the **PROC** Key to invoke the Procedures Page.

Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to highlight 'ACTIVATE APPROACH'.

Click the **ENT** (Enter) Key.

ACTIVE FLIGHT PLAN			
KDCA / KRDU			
	DTK	DIS	ALT
KRDU	048°	0.0NM	435FT
Approach-KRDU-R05RY			
›FOGAP iaf	219°	205NM	3400FT
PECIT	144°	10.6NM	3400FT
PURME faf	054°	6.0NM	2400FT
RW05R map	054°	6.1NM	452FT
(597)	052°	1.1NM	597FT
POBIC	055°	3.2NM	FT
ZEBUL	100°	17.1NM	2600FT
hold	269°	00:36	FT

Approach navigation is now activated. This can be confirmed by reviewing the Flight Plan Page. The initial approach fix for the selected procedure is now the active waypoint.

[MFD] Storing a Flight Plan

Flight plans may be stored for use again later. A stored flight plan in X-Plane 11 uses a. fms extension, and appears in folder:

- X-Plane/Output/FMS Plans/
-



Click the FPL Key to invoke the Flight Plan Page.



Click the MENU Key to invoke the Page Menu.



Click the FMS Outer Rotary at the 3 O'clock or 9 O'clock position to select the 'Store Flight Plan' option in the Page Menu.

Click the ENT (Enter) Key.

The flight plan filename is constructed automatically: Origin airport code + Destination airport code + ".fml".

Using the example from this guide, the flight plan (from KLAX to KSFO) would be named: **KLAXKSFO.fms**

[MFD] Loading a Flight Plan



- Click the FPL (Flight Plan) Key to invoke the Flight Plan Page
- Ensure the cursor is NOT active
- Click the FMS (Inner) Rotary at the 3 O'clock position to invoke the FLIGHT PLAN CATALOG
- Click the center of the FMS (Inner) Rotary to activate the cursor
- Use the FMS (Outer) Rotary to select the desired flight plan
- Click the ENT (Enter) Key to load the flight plan

X1000 Audio Panel

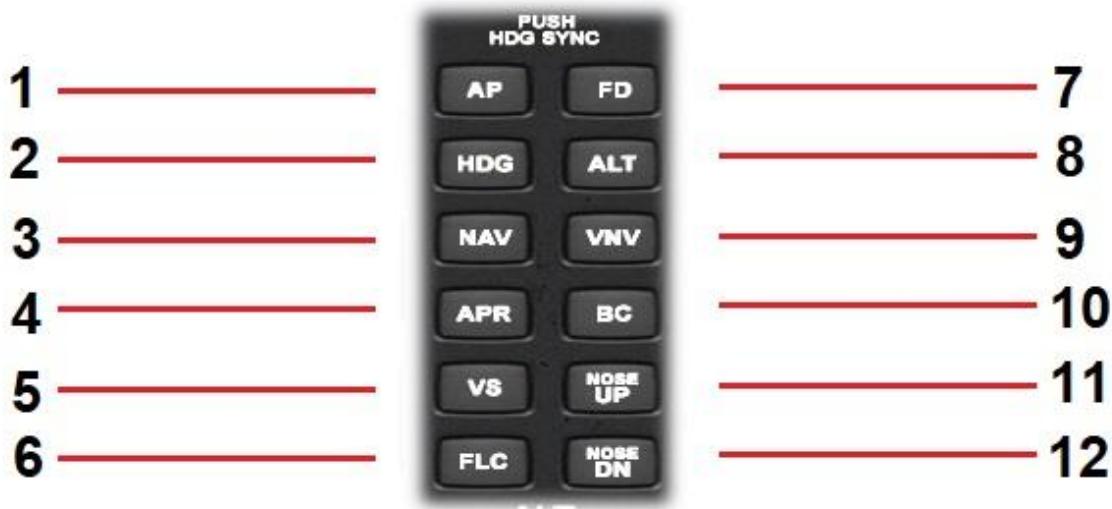
[Audio Panel] Controls & Features

	1 COM Radio Key Group 2 Cabin PA/Speaker Group 3 NAV Radio Key Group 4 Pilot Intercom Volume Rotary 5 Display Backup Key	<p>COM1 Mic: Selects the COM1 radio for transmitting and receiving (audio).</p> <p>COM1: Selects the COM1 radio for receiving (audio).</p> <p>COM2 Mic: Selects the COM2 radio for transmitting and receiving (audio).</p> <p>COM2: Selects the COM2 radio for receiving (audio).</p> <p>MKR/MUTE: Enables or mutes the marker beacon Morse Code audio.</p> <p>DME: Enables or mutes the DME (radio station) Morse Code audio.</p> <p>NAV1: Selects the NAV1 radio for receiving (audio).</p> <p>NAV2: Selects the NAV2 radio for receiving (audio).</p> <p>ADF: Enables or mutes the ADF (radio station) Morse Code audio.</p> <p>Adjusts the audio volume for the pilot intercom.</p> <p>Toggles the X1000 system between normal and to 'Display Backup' modes. This is used in the event of a failure of the Primary Flight Display (PFD). The Multi-Function Display (MFD) acts as a substitute for the PFD.</p>
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Autopilot Panel [PFD and MFD]

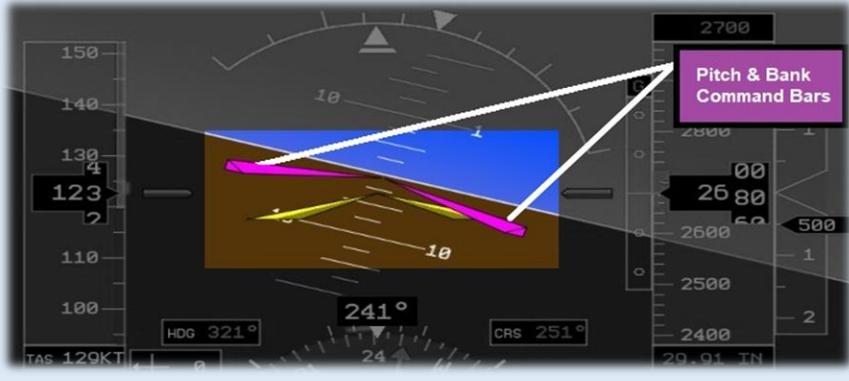
Important

Autopilot functionality is dependent on the model of autopilot that is installed in the aircraft, and how the aircraft itself is equipped. The examples given in this section apply to the Laminar Research Cessna 172 equipped with the X1000, and may differ from your aircraft.



		Autopilot On/Off
1	AP	<p>This is a toggle button, used to engage and dis-engage the autopilot system respectively.</p> <p>When the autopilot is initially engaged, the pilot still has full manual control of the aircraft, because no autopilot mode has yet been selected.</p>
2	HDG	<p>Heading Mode</p> <p>This is a toggle button, used to engage and dis-engage HEADING mode respectively.</p> <p>When this mode is engaged, the autopilot will turn the aircraft to the heading selected by the pilot. The pilot may select the desired heading using the HDG Rotary control in conjunction with the "Heading Bug" that appears at the perimeter of the Horizontal Situation Indicator (HSI).</p> <p>The image shows the Autopilot Control Panel on the left and the Horizontal Situation Indicator (HSI) on the right. A red arrow points from the "HDG" button on the control panel to the HSI. The HSI displays a compass rose with headings 0, 90, 180, and 270 degrees. A magenta "ENY" label is visible on the HSI. The control panel also features a "PUSH HDG SYNC" button at the top.</p>

3	NAV	<h2>Navigation Mode</h2> <p>If the X1000 is currently in “GPS” mode (controlled by the CDI Key), selecting this autopilot-mode will direct the aircraft laterally, according to any programmed flight plan.</p> <p>If the X1000 is in “VOR” or “LOC” mode (controlled by the CDI Key), selecting this autopilot-mode will direct the aircraft to fly to, or from, the chosen VOR radial, or ILS localizer.</p>	
4	APR	<h2>Approach Mode</h2> <p>Select this mode to engage approach mode.</p> <p>The autopilot will capture the glide path associated with the chosen approach.</p> <p>Note: The autopilot may not capture if a significant deviation exists. The aircraft must therefore be positioned appropriately before engaging this mode.</p>	
5	VS	<h2>Vertical Speed Mode</h2> <p>Select this mode to capture and hold the current vertical speed (VS) while making a change to a new altitude. The vertical speed will be prioritized by the autopilot at the expense of airspeed (IAS).</p> <p>Optionally, you may also specify a level-off altitude (using the ‘ALT’ Rotary control). The autopilot will level-off at this altitude, and VS mode will de-activate accordingly.</p>  <p>Caution is required when using ‘VS’ mode, to maintain a safe airspeed. The selected rate of climb/descent may exceed the performance capability of the aircraft, resulting in airspeed that is too low, or too high. The pilot must manage this manually.</p>	

		<h2>Flight Level Change Mode</h2> <p>Select this mode to capture and hold the current airspeed (IAS) while making a change to a new altitude. The airspeed will be prioritized by the autopilot at the expense of vertical speed.</p> <p>Optionally, you may also specify a level-off altitude (using the 'ALT' Rotary control). The autopilot will level-off at this altitude, and FLC mode will de-activate accordingly.</p> 
6	FLC	<p>In aircraft not equipped with auto-throttle, the pilot may need to make manual adjustments to the power setting, to assist the autopilot in maintaining the desired airspeed while also ascending/descending as instructed.</p>
7	FD	<h2>Flight Director (display)</h2> <p>Use this Key to toggle the 'Flight Director' display on, or off.</p> <p>The flight director computes and displays the proper pitch and bank angles required for the aircraft to follow the desired flight plan.</p> <p>When the autopilot is engaged, the Flight Director Pitch and Bank Command bars (see below) are always displayed. However, when the autopilot is disengaged, these may be toggled on, or off (using the FD Key).</p> <p>The pilot can manually fly the aircraft according to the flight plan - by aligning the attitude indicator with the Pitch and Bank Command bars.</p> 

8	ALT	Altitude Mode Select this mode to hold the current altitude. This may also be accomplished using VS mode (where VS is set to '00').
9	VNV	Vertical Navigation (VNAV) Mode Select this mode to engage VNAV mode (where a flight plan exists, and the active waypoint has a VNAV designated altitude present). See RNAV/VNAV Tutorial.
10	BC	(Localizer) Back-Course Mode At some airports, and ILS localizer exists to serve the same physical runway in both directions. This is called a front-course, and back-course. When approaching a runway using the localizer back course, the course deviation indicator (CDI) works in reverse, and to compensate for this, the pilot may select BC (back course) mode. With the flight director ON, click BC to arm localizer back course mode, which will engage when a localizer signal is intercepted in reverse sending. In airplanes not equipped with this button, back-course mode is activated by intercepting a localizer at an intercept angle > 105 degrees.
11		Nose Up With the autopilot in VS mode, use this Key to increase the rate of ascent. With the autopilot in PIT mode, use this Key to increase the pitch attitude. With the autopilot in FLC mode, use this Key to decrease the target airspeed.
12		Nose Down With the autopilot in VS mode, use this Key to increase the rate of descent. With the autopilot in PIT mode, user this Key to decrease the pitch attitude. With the autopilot in FLC mode, use this Key to increase the target airspeed.

Using the Autopilot with a VOR

The autopilot can be used to intercept and track a VOR radial.



- Tune the NAV1 or NAV2 frequency to the desired VOR1 station.
- Click the CDI Soft Key to select VOR1 or VOR2 (tuned by NAV1 or NAV2)
- Click the CRS Rotary at the 3 O'clock or 9 O'clock positions to set the desired course to the VOR.
- The HSI will now display your aircraft's position relative to the desired radial. In the above example, the chosen radial is 360 degrees, and the aircraft is currently positioned to the right of this radial to fly a course of 180 degrees to the VOR.
- Click the 'NAV' Key to select 'Navigation' mode. The autopilot will select the appropriate course to intercept the desired radial. In this example, the selected course is 153 degrees.
- When radial intercept is near, the autopilot will gradually adjust course to make a smooth intercept, and will then track the desired radial until otherwise instructed.

Note: A VOR indication displayed in white at the top of the display bezel instructs the pilot that the autopilot is "armed", and waiting to capture and track the signal as soon as the needle comes alive, at which point the indication will be displayed in green.

Using the Autopilot with an ILS Approach

The autopilot can be used to intercept and track a localizer signal and glideslope.



- Tune the NAV1 or NAV2 frequency to the desired Localizer.
- Click the CDI Soft Key to select LOC1 or LOC2 (tuned by NAV1 or NAV2)
- The HSI will now display your aircraft's position relative to the selected localizer. In the above example, the aircraft is positioned to the right of the localizer, and the autopilot will steer left to intercept.
- Click the 'NAV' Key to select 'Navigation' mode. The autopilot will track the localizer to the runway threshold, provided the course deviation is not too great at the time navigation mode is engaged.
- Click the 'APR' Key to select 'Approach' mode. The autopilot will track the localizer and glideslope to the runway threshold, provided the course deviation is not too great at the time navigation mode is engaged.

Note: A LOC indication displayed in white at the top of the display bezel instructs the pilot that the autopilot is "armed", and waiting to capture and track the localizer as soon as the needle comes alive, at which point the indication will be displayed in green.

Note: A GS indication displayed in white at the top of the display bezel instructs the pilot that the autopilot is "armed", and waiting to capture and track the glideslope as soon as the needle comes alive, at which point the indication will be displayed in green.

X1000 VNAV descent and RNAV approach Tutorial & Companion Video

[From Wikipedia]

Area Navigation (RNAV) is a method of instrument flight rules (IFR) navigation that allows an aircraft to choose any approved course (using GPS) rather than directly to and from individual navigation aids. This can conserve flight distance, reduce congestion, and allow flights into airports without dedicated navigation aids. Area navigation used to be called "random navigation", hence the acronym RNAV.

Vertical Navigation (VNAV) is a flight function that directs the vertical movement of an aircraft (i.e. gains or losses in its altitude). If used in the cruise, VNAV causes an aircraft to climb or descend according to vertical elements of a pre-programmed flight plan. When used on approach to landing, VNAV follows a calculated approach path from a final approach fix (or waypoint) to the runway.



Important

Flight plan waypoints and procedures change over time. The sample flight plan, and approach procedures used here may no longer be current, or available for selection during your flight. For this reason, it may not be possible to replicate this tutorial precisely in X-Plane. The preferred method is to read through the tutorial, in parallel with watching the companion video.

About this tutorial

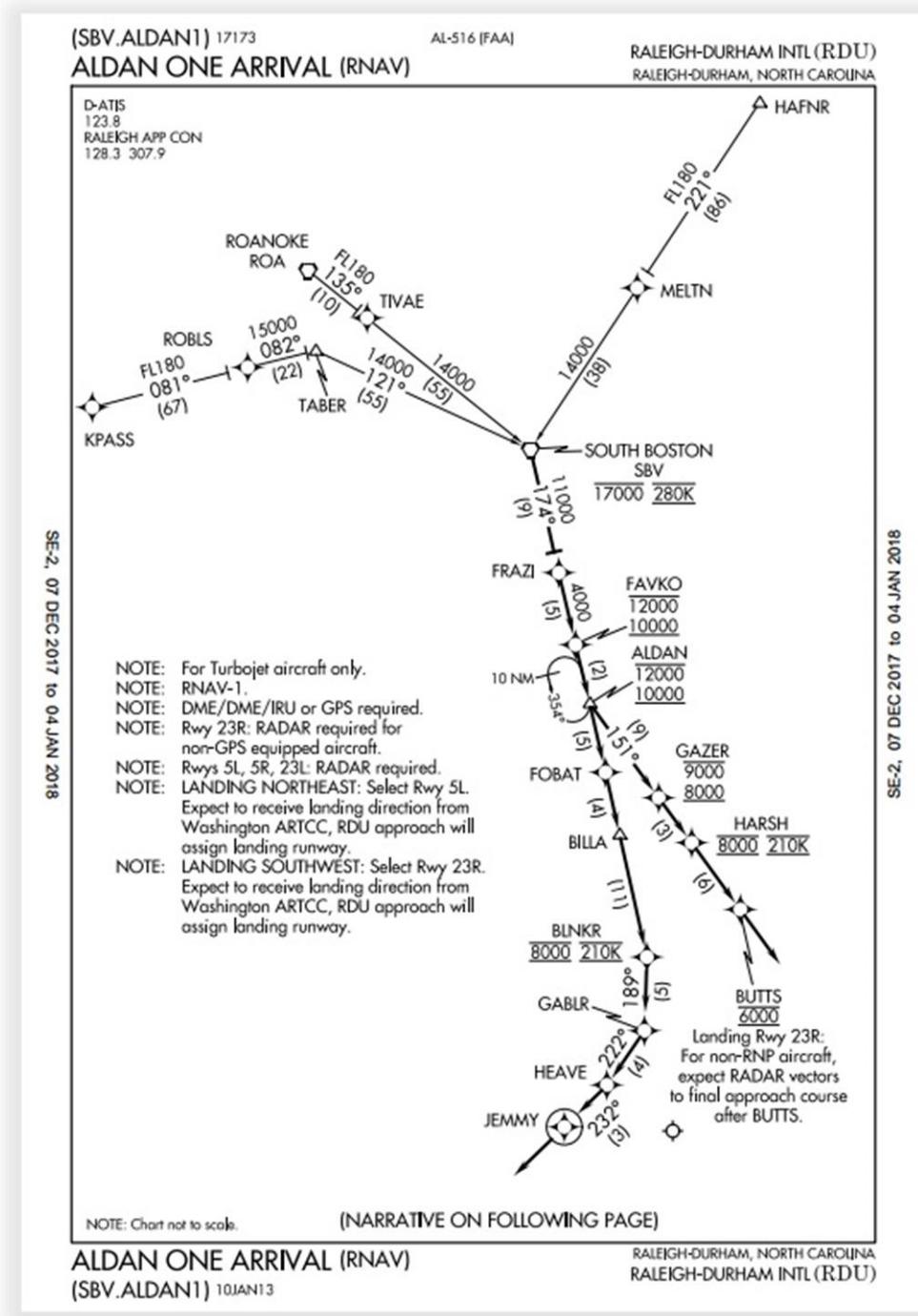
This tutorial covers an automated VNAV descent via a STAR, with an RNAV(GPS) approach. A companion video has been created by Philipp Ringler from Laminar Research:

<https://www.youtube.com/watch?v=2chCP1XObek&feature=youtu.be&t=12m00s>

The approach will be flown using the Laminar Research Cirrus Vision SF50 aircraft.

ALDAN ONE ARRIVAL [@ 2:40 in video]

The Standard Terminal Arrival Route (STAR) demonstrated in this tutorial is the ALDAN ONE ARRIVAL (RNAV) into KRDU Raleigh Durham International. The published procedure is shown below:



The ALDEN ONE procedure is for turbojet aircraft equipped with RNAV1 capability only. RNAV1 capability means that the aircraft can maintain a total system error of not more than 1 nautical mile for 95% of the total flight time.

Transition

Our aircraft is approaching KRDU (Raleigh Durham International) from the North-West. The transition waypoint will be the ROANOKE VOR (ROA).

Runway

We will assume that runways 5L and 5R are in use at the time of this arrival. Our intended runway will be 5R.

Programming the ALDAN ONE ARRIVAL [@ 5:48 in video]

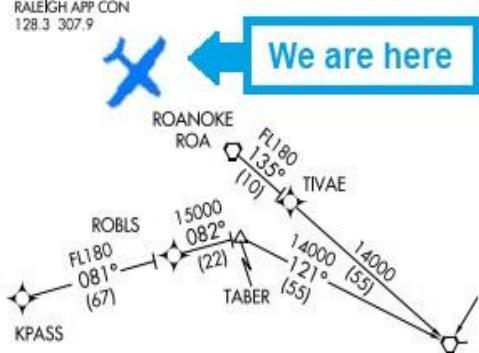


Prior to the approach phase of this flight, a simple flight plan has already been programmed into the X1000.

This consists of just two waypoints: 'ROA' (the Transition waypoint) and 'KRDU' (the destination waypoint).

D-ATIS
123.8
RALEIGH APP CON
128.3 307.9

We are here





- Click the Proc Soft Key to invoke the 'PROCEDURES' page.
- Use the FMS Rotary to highlight 'SELECT ARRIVAL'.
- Click the ENT (Enter) Key



- Use the FMS Rotary to highlight 'ALDAN1'
- Click the ENT (Enter) Key



- Use the FMS Rotary to highlight 'ROA'
- Click the ENT (Enter) Key



- Use the FMS Rotary to highlight 'RW05R'
- Click the ENT (Enter) Key **twice** to load the procedure

Reconciling the ALDAN ONE procedure altitudes [@ 7:12 in video]

With procedure ALDAN1 already loaded into the flight plan, we can reconcile the individual waypoints with the published chart, and confirm the VNAV information concurs with this.



- Click the FPL Soft Key to invoke the 'ACTIVE FLIGHT PLAN' page.
- Compare the ALT (altitude) column in the flight plan page with the published altitudes for the same waypoints in the [ALDAN1 Arrival Procedure](#). As expected, these values reconcile.

Waypoint Altitudes [@ 7:53 in video]

The [MFD] ACTIVE FLIGHT PLAN page utilizes four different color-code/font combinations in the ALT (Altitude) column.

ACTIVE FLIGHT PLAN			
	DTK	DIS	ALT
»ROA	159°	2.7NM	12000FT
Arrival-KRDU-ALDAN1.ROA			
TIVAE	137°	10.0NM	26000FT
SBV	137°	54.6NM	17000FT
Arrival-KRDU-ALDAN1			
FRAZI	176°	9.4NM	12000FT
FAVKO	176°	5.5NM	12000FT
ALDAN	176°	2.2NM	12000FT
FOBAT	176°	5.3NM	12000FT
BILLA	176°	4.2NM	12000FT
BLNKR	177°	11.5NM	8500FT

Legend:

- Reference Altitude (does not comply with published restriction)
- Designated Altitude (complies with published restriction)
- Reference Altitude (complies with published restriction)
- Designated Altitude (does not comply with published restriction)

- A white font indicates a 'Reference Altitude'. This provides information to the pilot, but is NOT part of the VNAV profile for the flight plan.
- A blue font indicates a 'Designated Altitude'. The VNAV profile for the flight plan utilizes this altitude at the designated waypoint.
- A small font indicates the altitude complies with the published restrictions (if any) at the designated waypoint.
- A LARGE font indicates the altitude does NOT comply with the published restriction (if any) at the designated waypoint.

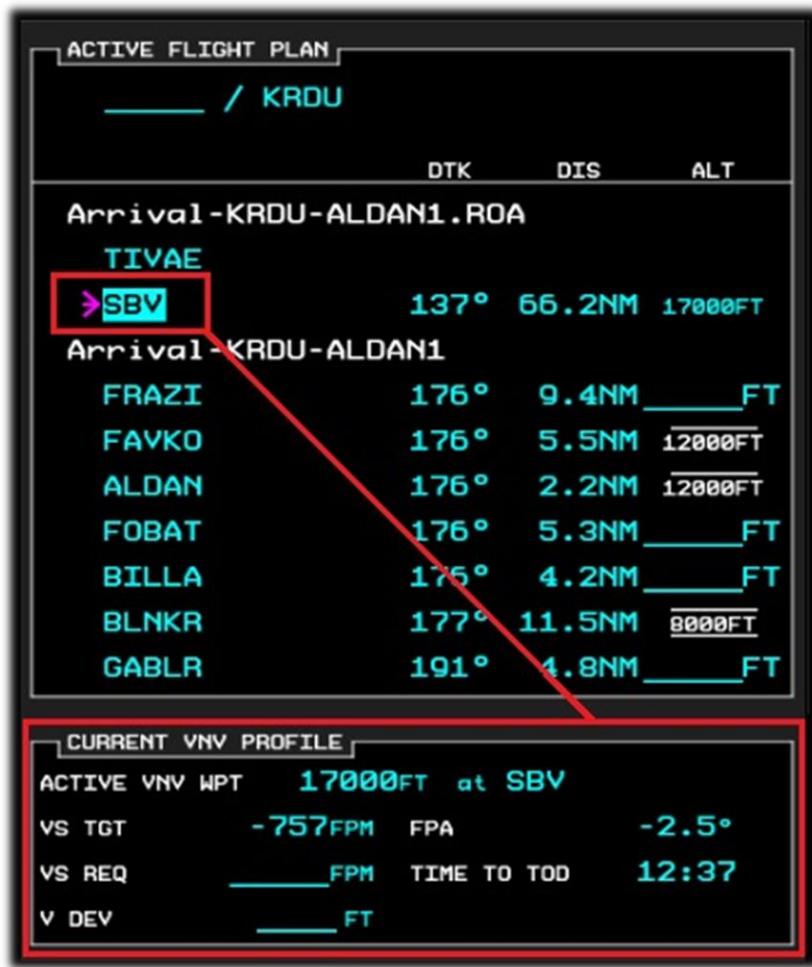
Designating a Waypoint Altitude [@ 10:40 in video]

To toggle a waypoint altitude in the flight plan between a (white font) 'Reference Altitude' and a (blue font) 'Designated Altitude':



- Click the center of the FMS Rotary to activate the cursor
- Use the FMS Rotary to highlight the altitude field alongside the desired waypoint
- Click the ENT (Enter) Key

Current VNV Profile [@ 12:40 in video]



The CURRENT VNV PROFILE panel displays the VNAV data associated with the (currently) active waypoint in the flight plan.

Setting the Flight Path Angle (FPA) [@ 13:06 in video]

The (descent) Flight Path Angle (FPA) for the active waypoint can be adjusted. Changing the FPA will impact the VS TGT (target vertical speed), and this will be re-calculated automatically.



- Click the VNV PROF (VNAV Profile) Soft Key
- Use the FMS (Inner) Rotary to adjust the FPA up, or down, in units of one tenth of one degree.

Setting the Vertical Speed Target (VS TGT) [@ 13:35 in video]

The (descent) Vertical Speed Target (VS TGT) for the active waypoint can be adjusted. Changing the VS TGT will impact the Flight Path Angle (FPA), and this will be re-calculated automatically.



- Click the VNV PROF (VNAV Profile) Soft Key
- Use the FMS (Outer) Rotary to highlight VS TGT.
- Use the FMS (Inner) Rotary to adjust the VS TGT up, or down, in units of one hundred feet per minute.

PFD Flight Plan Target Altitude [@ 15:30 in video]

The designated VNAV altitude for the current waypoint is displayed in the PFD. This is the magenta value shown in the upper-right corner of the altitude scale.



Calculation of Required VS (VS REQ) and Vertical Deviation (V DEV) [@ 18:10 in video]

When the time remaining to the active waypoint is within one minute, the Required Vertical Speed (VS REQ) and Vertical Deviation (VDEV) are automatically calculated, and continuously updated in real-time.



ACTIVE VNV WPT	Active VNAV Waypoint	The approaching waypoint that is the subject of the VNAV computations.
VS TGT	TARGET Vertical Speed	The vertical speed required to achieve the desired flight path angle at the current ground speed.
VS REQ	REQUIRED Vertical Speed	The vertical speed required to arrive at the designated waypoint (or waypoint offset) at the pre-set altitude.
V DEV	Vertical Speed DEVIATION	<p>Vertical deviation from the desired flight path (in feet).</p> <p>If the pilot adheres to VS TGT, this value will remain stationary.</p> <p>If the pilot adheres to VS REQ, this value will become zero when arriving at the designated waypoint (or waypoint offset).</p>

FPA	Flight Path Angle	Used to set, and display, the flight path angle to the designated waypoint (or waypoint offset).
TIME TO TOD	Time to TOP OF DESCENT	If the desired flight path is ahead of the current position, this is the time remaining until flight path intercept.
TIME TO BOD	Time to BOTTOM OF DESCENT	If the aircraft is already descending on the desired flight path, this is the time to remaining before the levelling-off.

PFD V-DEV and VS-TGT Chevrons [@ 18:47 in video]

The Target Vertical Speed (VS TGT) and Vertical Speed Deviation (V DEV) are displayed on the PFD with magenta chevrons to the left, and right, of the altitude scale.



Placing the Autopilot in VNAV Mode [@ 19:14 in video]

In the Cirrus, coupling the autopilot to VNAV mode is accomplished by clicking the VNV button on the center console:



The VPTH (Vertical Path) ARM indication will be displayed by the PFD:



Top of Descent [@ 20:10 in video]

At top of descent (TOD), the autopilot initiates the descent according to the VNAV profile for the active waypoint. The vertical speed determined by the autopilot is that necessary to adhere to the desired Flight Path Angle (FPA), which is -3.5 degrees in this case.



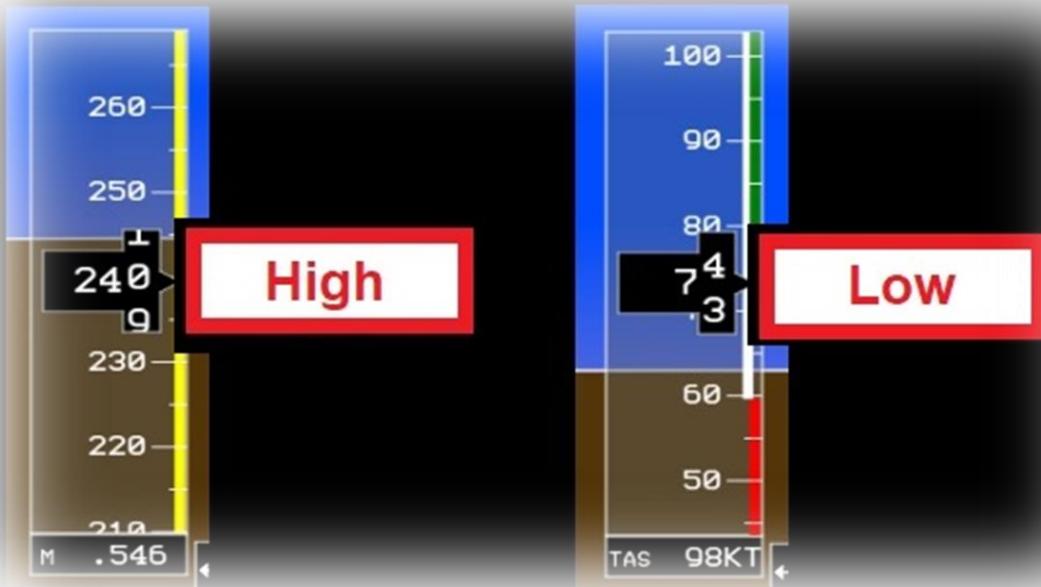
- When the indicated mode is ALTV, the autopilot will level off at the VNAV altitude.
- When the indicated mode is ALTS, the autopilot will level off at the SELECTED altitude.



Managing Airspeed [@ 26:40 in video]

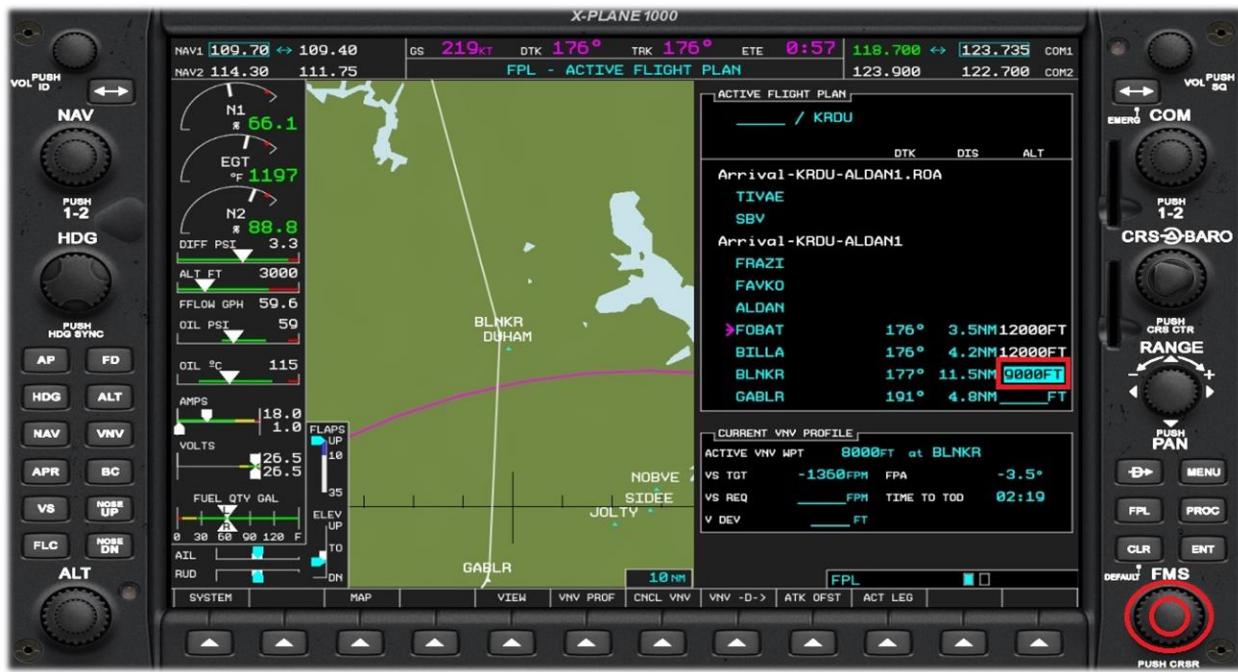
Many aircraft, including the Cirrus, are not equipped with auto-throttle. The pilot is responsible for managing the airspeed manually, even when the autopilot has control. This is important when the autopilot is coupled to a VNAV Flight Plan. The pilot must take care to ensure the airspeed does not get too high during a descent, or too low following a level-off by the autopilot.

Whenever the autopilot indicates ALTV it means it's going to level off sooner than at the pilot selected altitude – the pilot should be ready to advance the throttle and keep the plane from becoming too slow in this case.



Changing a Waypoint Designated Altitude [@ 30:45 in video]

If ATC issues the pilot with a revised altitude for a given waypoint, this may be altered in the flight plan accordingly:

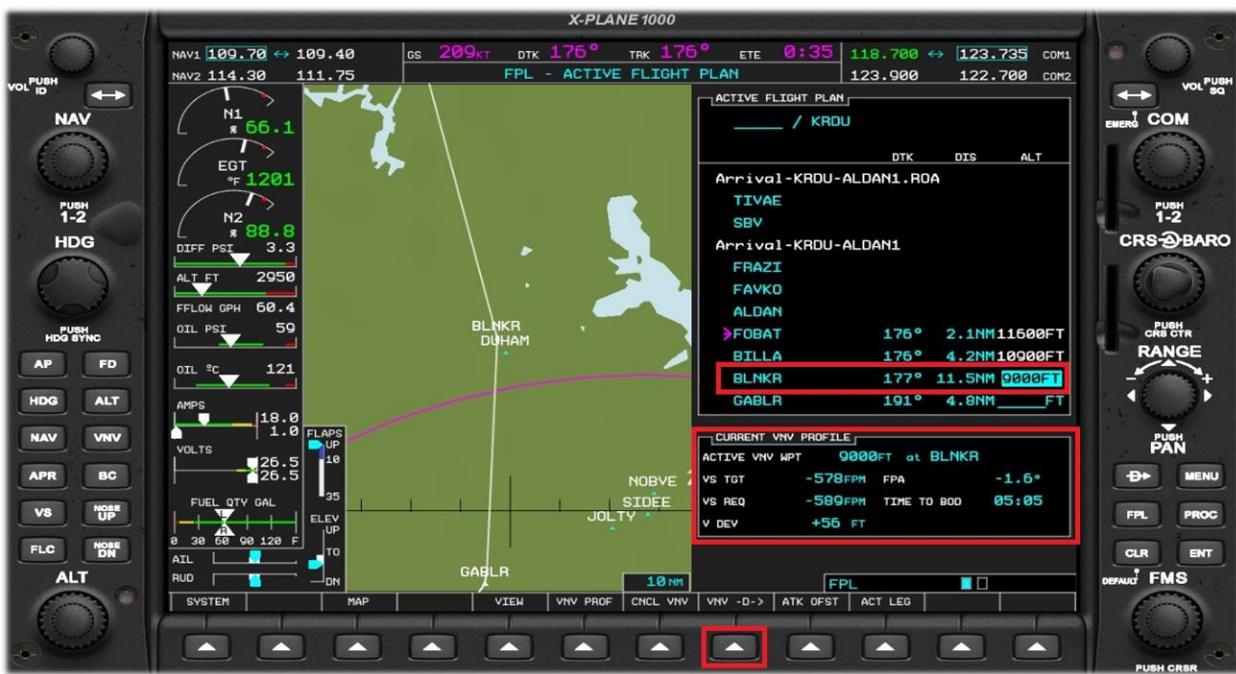


- Click the center of the FMS Rotary to activate the cursor
- Use the FMS (Outer) Rotary to highlight the desired waypoint
- Use the FMS (Inner) Rotary to increment, or decrement, the altitude

In this example, the altitude has been set to 9,000 feet by the pilot. The large blue font indicates this is a DESIGNATED (VNAV) altitude that does NOT comply with the published altitude for the procedure.

VNAV Direct-To Waypoint [@ 31:11 in video]

The VNV -D-> (VNAV Direct) Soft Key may be used at any time to initiate a VNAV descent to a specific waypoint, bypassing intermediate waypoints:



Ensure the PFD altitude bug does not conflict with this instruction. If a conflict exists, reduce the altitude bug accordingly:



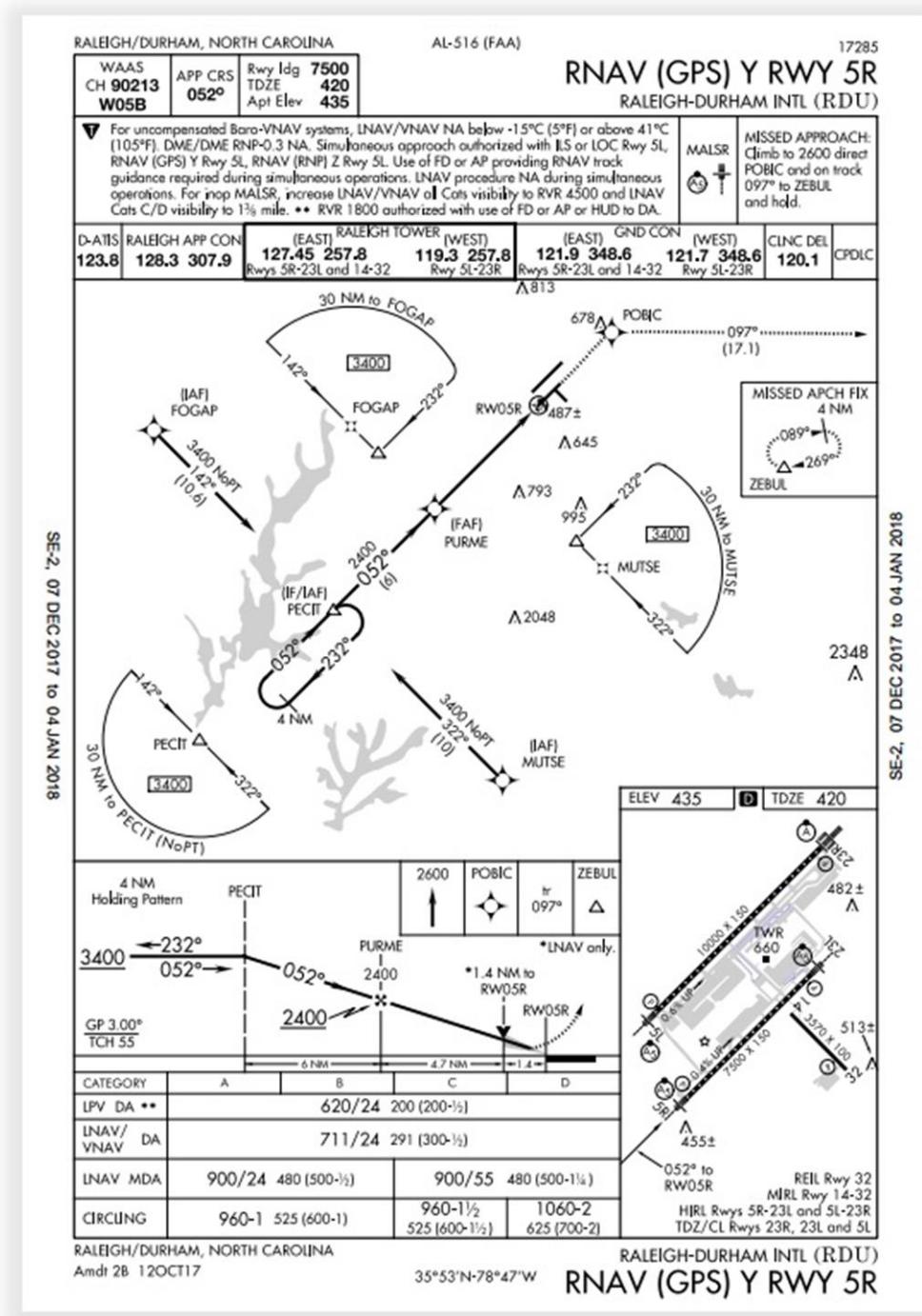
Re-Computing the VNAV Profile [@ 32:45 in video]

During a VNAV decent, the VNV -D-> (VNAV Direct) Soft Key may be used to re-compute the VNAV Profile if the designated altitude has been changed:



RNAV (GPS) Y RWY 5R APPROACH [@ 33:55 in video]

The approach demonstrated in this tutorial is the RNAV (GPS) Y RWY 5R APPROACH into KRDU Raleigh Durham International. The published procedure is shown below:



Programming the RNAV (GPS) Y RWY 5R APPROACH [@ 33:55 in video]

ACTIVE FLIGHT PLAN

/ KRDU

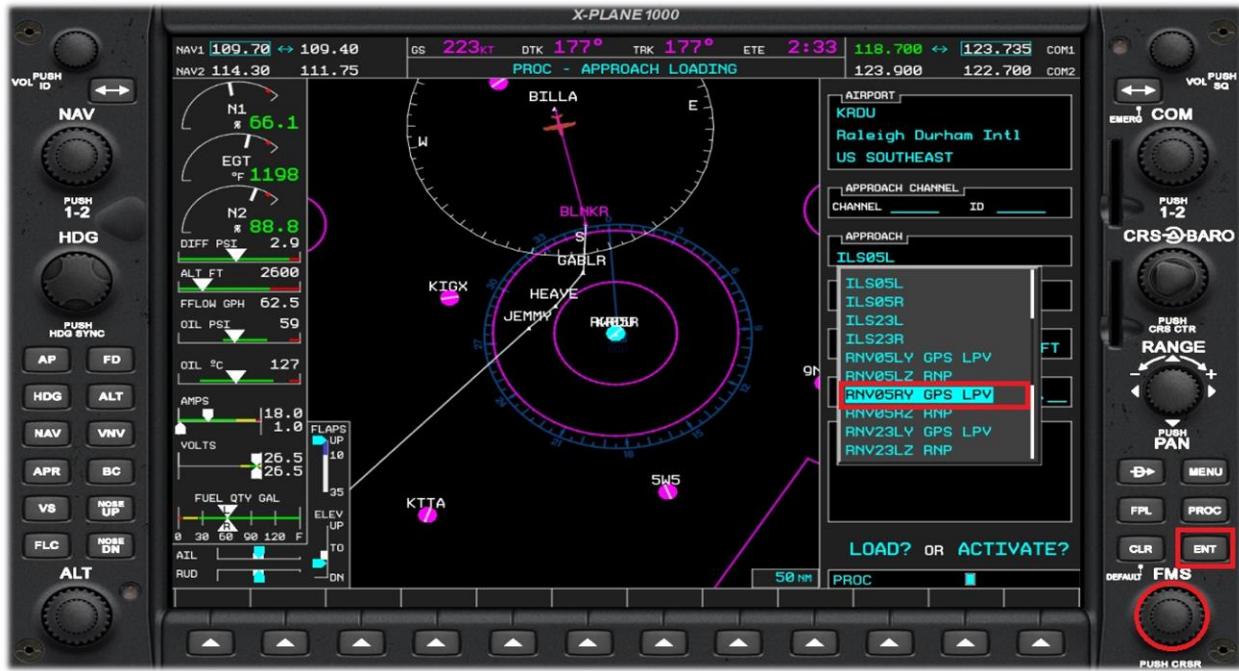
	DTK	DIS	ALT
Arrival-KRDU-ALDAN1			
FRAZI			
FAVKO			
ALDAN			
FOBAT			
BILLA			
BLNKR	177°	9.5NM	8000FT
GABL	191°	4.8NM	_____FT
HEAVE	224°	4.0NM	_____FT
JEMMY	234°	3.0NM	_____FT
VECTORS	226°	0.0NM	_____FT

The ALDAN1 arrival requires radar vectors (from ATC) to the initial approach fix.

In this tutorial, the initial approach fix is 'FOGAP'.



- Click the Proc Soft Key to invoke the 'PROCEDURES' page.
- Use the FMS Rotary to highlight 'SELECT APPROACH'.
- Click the ENT (Enter) Key



- Use the FMS Rotary to highlight 'RNV05RY'
- Click the ENT (Enter) Key



- Use the FMS Rotary to highlight 'FOGAP'
- Click the ENT (Enter) Key



- Use the FMS Rotary to highlight 'RW05R'
- Click the ENT (Enter) Key

Programming the Decision Altitude [@ 36:18 in video]

This will be a 'Localizer Performance with Vertical Guidance' (LPV) approach – requiring a decision altitude, which will be 620 feet. To program the decision height:



- Click the FMS (Inner) Rotary to select 'BARO' in the MINIMUMS box.
- Click the ENT (Enter) Key to highlight the altitude alongside.



- Use the FMS (Inner) Rotary to set the MINIMUMS altitude to 620 FT
- Click the ENT (Enter) Key **twice** to load the approach

Automatic Designation of Altitudes prior to Final Approach Fix [@ 37:12 in video]

Altitudes PRIOR to the Final Approach Fix (FAF) are automatically DESIGNATED (blue). Altitudes AFTER this point are REFERENCE only by default. This is because vertical guidance is provided by other methods at, and beyond, the final approach fix. A good example would be an ILS approach.



When the pilot activates the approach, the VNAV profile(s) for the DESIGNATED altitude waypoints will also become active.

Activating the Approach [@ 39:37 in video]

The ALDAN1 arrival features ATC vectors to the initial approach fix, at which point the approach should be activated. To simulate this, we will activate the approach immediately, thus bypassing the vectors.



- Click the PROC Key
- Use the FMS Rotary to select 'ACTIVATE APPROACH'
- Click the ENT (Enter) Key

At the Final Approach Fix [@ 45:00 in video]

At the final approach fix (PECIT), VNAV disengages, and the glideslope indicator changes from V (VNAV) + Chevron to G (Glide Path) + Diamond. The Horizontal Situation Indicator (HSI) now confirms we have Localizer Performance with Vertical Guidance (LPV) Sensitivity. If the latter were not confirmed (LNAV+V instead of LPV) it would be necessary to alter the minimums (to 711 feet) according to the published procedure.



- Click the APR (Approach) Button to capture the Glide Path.

Unlike VNAV mode, Glide Path mode will override the autopilot bug altitude. There is no need for the pilot to adjust this to avoid a conflict.

By the final approach fix:

The pilot will have verified the approach guidance is correct (LPV in this case), and the mode annunciator is as expected (GP in this case).



The pilot is briefed of the missed approach procedure, should this be called for at the minimums (620 feet in this case).

The pilot performs the GUMPS check (Gas, Undercarriage, Mixture, Prop, Switches). Mixture and Prop do not apply when flying the Cirrus.

At Minimums [@ 50:00 in video]

If unable to proceed at the minimums (620 feet), the pilot will increase power to initiate a positive rate of climb, retract the gear and flaps, and execute a missed approach.

When beyond the minimums, the PFD mode switches to suspended. The pilot is in control of the aircraft:



Activating a Missed Approach [@ 51:30 in video]

The PROC Key / Procedures Menu can be used to activate the missed approach:



However, due to the urgency of the situation, a faster method is provided to activate a missed approach:



- Click the SUSP (Suspend) Soft Key to activate the missed approach procedure.

Note: In aircraft equipped with a TO/GA (take-off/go-around) button, triggering the TO/GA button will also activate the missed approach.

X1000 (Multiple) Approaches Tutorial



Important

Flight plan waypoints and procedures change over time. The sample flight plans, and approach procedures used here may no longer be current, or available for selection during your flight. For this reason, it may not be possible to replicate these tutorials precisely in X-Plane.

About this tutorial

This tutorial is VIDEO ONLY, created by Philipp Ringler from Laminar Research. The video covers multiple approach types (ILS, GPS LNAV, GPS LPV, LOC BCRS, VOR GPS overlay and VOR-DME).

<https://www.youtube.com/watch?v=pNwoDDpy9lw>

The approaches are flown using the Laminar Research Cessna 172 / X1000 aircraft.