

UNIVERSAL[®] AVIONICS
SYSTEMS CORPORATION

OPERATOR'S TRAINING MANUAL

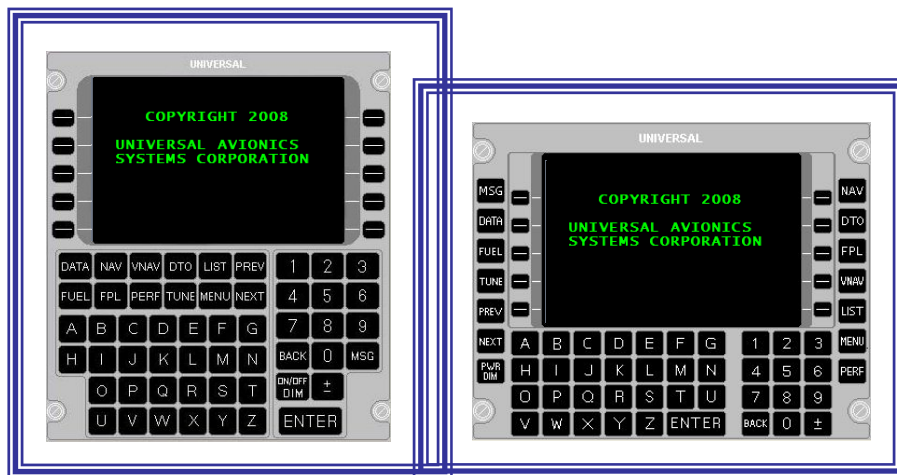
for

**FMS and MMMS 1E, 1Esp, 1F, & 1L
1C+, 1Csp+, 1D+, & 1K+**

Covering SCN-801, 802, & 803

with

**MULTI MISSION MANAGEMENT SYSTEM (MMMS)
90X Series**



**This manual is not for operational use;
it is intended for training purposes only.**

UNIVERSAL AVIONICS
SYSTEMS CORPORATION
3260 East Universal Way
Tucson, AZ 85706
(520) 573-7627 (800) 595-5906

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**THE INFORMATION PRESENTED IN THIS
MANUAL IS FOR
TRAINING PURPOSES ONLY**

This manual is to provide the reader with a basic understanding of the system(s) described.

For detailed and current information regarding operation of equipment, refer to the appropriate UNS Operator's Manual or Technical Manual.

The information provided in this manual is correct at the time of printing however no field revision service is available.

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GENERAL DESCRIPTION

The systems are one of two configurations:

1. **UNS-1E/1Esp & 1C+/1Csp+** - a stand alone, one unit, combined Flat Panel Control Display Unit (FPCDU) and Navigation Computer Unit (NCU) containing an internal GNSS receiver, navigation computer elements and liquid crystal color display. An external configuration module is mounted to the interface connector. Throughout the remainder of this manual, referral to the UNS-1E will include the UNS-1Esp.
2. **UNS-1F 1L, 1D+, & 1K+** - A display only FPCDU and a separate remotely mounted Navigation Computer Unit (NCU) with a rack mounted Configuration Module. The UNS-1F & 1L NCU also contains a GPS receiver.

SCN-800/900, 801/901, 802/902, 803/903 are software versions designed to run on several Universal Avionics FMS systems. SCN 90X is a Multi-Missions version of the 80X software and is designed to run on MMMS systems. Either software version can run in the UNS-1E, UNS-1Esp, UNS-1F, and UNS-1L. This software will also run on the upgraded UNS-1C+, 1C+sp, 1D+, and 1K+.

The system software version is displayed on the INIT (Initialization) page following completion of the power on self test, or may be accessed under the DATA key. The version is also on the FMC/NCU data plate.

The decimal point in the software version indicates minor software changes. To the right of the decimal point for example, 801.1 to 801.2 are minor changes. If written in the aircraft flight manual as 801.X, no re-certification is required, and no revision of the Flight Manual Supplement or Operators Manual is required.

Where the above software versions differ from one another in operation, a statement explaining the differences will be included.

SOFTWARE DIFFERENCES

The 80X/90X Software Control Numbers (SCN) was developed to operate with the advent of the UNS-1E, UNS-1Esp, UNS-1F and UNS-1L generation Flight Management Systems. Upgrade improvements for the UNS-1C, 1D, and 1K are also available, allowing these systems to use the 80X series software. Most of the software improvements allow these FMS's to work with new avionics technology and are transparent to the operator. The software differences listed below are directed at the FMS operator and specifically cover changes that will be seen by the operator. A complete description of changes and improvements are available through the corresponding Universal Avionics Service Bulletins. The Multi-Mission Management System (MMMS), 90X series software, provides the capability to automatically steer along one of six search patterns.

SCN 800/900 was created to allow SCN 604/704 to operate in the new generation FMS. SCN 800/900 was short lived, as there were only minor changes to this software from SCN 604/704. (See Operators Training Manual, Report Number 3039sv60X/70X) Major operational changes for the new generation FMS begins with SCN 801/901.

SCN 801/901

- The enroute VNAV format changed to 6 vertical waypoints to work in conjunction with vertical waypoints on flight plan pages.
- A better transition from Enroute VNAV to Approach VNAV allows VNAV to stay coupled during approach activation.
- Descent in holding patterns is now available.
- An OFFSET function on the flight plan pages allows for creation of offset VNAV waypoint through flight plan pages.
- NAV MENU options allow for calculating ABEAM POINT, Radial Crossing, and 4 LAT/LONG crossing points.
- For a pilot created waypoint, airport, or alignment point, the FMS retains and displays the defining parameters.
- The FMS will now notify the pilot when pilot defined routes and terminal area procedures are affected by a new navigation database.
- For lat/long waypoints the FMS allows for either 5 (ARINC) or 7 character format.
- Precision Arc (RF) leg is available for lateral support in flight plans.
- A new NAV page with ANP and RNP is added to the NAV display.
- Creation of new temporary Tactical Waypoints for use in flight plans are now available.
- Adds Top of Descent (TOD) to TAWS display

Refer to the applicable UASC service bulletin for a complete list of SCN 801/901 changes.

SCN 802/902

- The COMPRESSED option is now on flight plan menu page 1, LSK 1L, with a new presentation.
- A new option, REF ALT, is on page 2, LSK 1L. REF ALT is a TAWS related function.
- On the flight plan menu arrival page under approach, RNP RNAV approaches are now separated from GPS approaches, with the designation of RNV.
- The FMS is now capable of flying RNP RNAV approaches with multiple legs between the FAF and MAP to include precision arc, track to fix, and course to fix legs with pseudo glideslope to less than RNP 0.3 on aircraft so certified.
- The NAV menu contains a new feature, MAP DISPLAY allowing for the suppression of the missed approach transition on the map mode of the pilots flight display.
- The performance menu page contains a new option ETP/PNR, Equal Time Point and Point of No Return.
- Configuration allows for pilot inputs to determine engine failure and pressurization failure ETP/PNR.
- The tune function of the FMS now contains a communication frequency database.
- The method of construction of pilot approaches has changed allowing for multiple fixes between the FAF and MAP. (Not discussed in this document)
- Modification of seven-character oceanic waypoint identifier format to “xxNxxxW”.
- If the DTO function is used to go to an alternate airport and the ENTER key is pressed without the entry of a NX waypoint, the FMS will add the alternate airport identifier to the end of the flightplan for quick entry of the arrival information.

Refer to the applicable UASC service bulletin for a complete list of SCN 802/902 changes.

SCN 803/903

- Added a new route clearance page, accessed from the Pilot Route menu page, which displays pilot-defined routes in clearance language format.
- Added configuration setting to display and specify the time of day the navigation database expires.
- Modified selected crosstrack mode to maintain the parallel offset for certain leg types through leg sequencing in order to comply with PRNAV and RNP RNAV.
- Modified selected crosstrack entry field on the NAV page to correctly interpret the entered selected crosstrack value when the commanded heading mode is active.
- Added a synchronized dual FMS feature. Pilot actions that affect LNAV, VNAV and FUEL are automatically and bidirectionally crossfilled.
- Added the use of runways for tactical operations such as DTO, PVOR, and HOLD.
- Added emergency divert feature to the DTO function. An emergency divert to a nearby airport was previously available through the use of the LIST function to access a list of nearby airports. This new feature will allow direct access to nearby airports from the DTO page and provide additional information such as range, bearing and maximum runway lengths.
- Added a Hold at Present Position (HOLD PPOS) option that enables pilot to enter a holding pattern at the current present position.
- Modified software to allow missed approach selection for advisory approaches.
- Modified software to restore the capability to do manual predicted RAIM for BC, LOC and ILS approach types.
- Modified software to display approach magnetic variance accurately in the unique case when a flight plan is entered where there is no origin and an extra waypoint after the destination.
- Removed the Quality (Q) factor as a display option for Estimated Position Uncertainty (EPU).
- Removed logic that allows display of EPU in Kalman Variances on the GWS Status page. EPU is now derived solely from and displayed as the GWS sensor horizontal figure of merit (HFOM).

UNS-1E & 1C+ DESCRIPTION

The UNS-1E Flight Management System incorporates a navigation computer, a 12-channel GNSS or GPS receiver, and control/display functions all contained in one Dzus-mounted unit with 5-inch color flat panel display. Analog and digital interface versions are available.

The UNS-1E is certified to TSO C115b and C129a classes A1/B1/C1. It meets the GPS navigation operational approvals and Minimum Navigation Performance Specifications (MNPS) for navigation within North Atlantic Track (NAT) airspace. Dual UNS-1E installations meet the requirements for GPS as Sole Means of Navigation in oceanic/remote airspace, IAW 8110.60.

The internal 12-channel GNSS receiver provides real-time and predictive Receiver Autonomous Integrity Monitoring (RAIM), Fault Detection and Exclusion (FDE), step detection, and manual satellite de-select capabilities. Navigation can be done with GNSS accuracy throughout all phases of flight. RNAV, GPS and GPS-overlay approaches are contained in the database along with their transitions and missed approach procedures.

The sophisticated software program provides features including flight planning capabilities with SID/STAR procedures and airways, a Best Computed Position, auto-scanning DME-DME, enroute maneuvers such as Direct-To, heading commands, and PVOR tracking, VNAV, holding patterns; a 3-D approach mode and more. There is also fuel management and optional frequency management. In addition to a 32-megabyte NAV database capacity, memory is allocated for aircraft-specific performance features. The UNS-1E incorporates RS-422 inputs and outputs for support of an optional external Flat Panel Control Display Unit (FPCDU).

The color flat panel display on the UNS-1E can accommodate external RGB video sources. This optional feature allows you to interface exterior video cameras, as your applications require.

Video signals can also be accommodated from a Cabin Display System. These signals must be in a RGBS format.

UNS-1Esp & 1Csp+ DESCRIPTION

The UNS-1Esp & 1Csp+ incorporate the same navigation computer, twelve-channel GNSS receiver, and control/display functions as found in our UNS-1E Flight Management System, but is more compact and lighter weight. The UNS-1Esp & 1Csp+ is an all digital system and is specifically designed to provide the most advanced flight management features and capabilities for those aircraft with full digital interface architectures.

UNS-1F & 1D+ DESCRIPTION

The UNS-1F FMS & 1D+ takes the features of the UNS 1E, adds additional interface capabilities, and divides it into the Navigation Computer Unit (NCU) which houses a 12-channel GNSS receiver and a 5" color Flat Panel Control Display Unit (FPCDU). Because the FPCDU is only 3.5 inches deep, it will fit in either the panel or pedestal. Also available is an optional 4" color flat panel display, which is only 3.25 inches deep. Whether the cockpit is analog or digital, the UNS-1F communicates with most all flight guidance systems, autopilots, and cockpit displays.

UNS-1L & 1K+ DESCRIPTION

The UNS-1L & 1K+ are designed with features and capabilities from Universal's top-of-the-line Flight Management Systems (FMS). Incorporated into a more compact, lightweight system, It has a color display, line select keys, and intuitive operating program, to comfortably manage the most complex flight maneuvers efficiently and quickly for increased flight safety. The internal 12-channel GNSS receiver enables operations throughout all phases of flight, including approaches.

Like the UNS 1E and 1F, the UNS-1L is certified to TSO C115b and C129a classes A1/B1/C1. It meets the GPS navigation operational approvals and Minimum Navigation Performance Specifications (MNPS) for navigation with North Atlantic Track (NAT) airspace. Dual UNS-1L installations meet the requirements for GPS as Sole Means of Navigation in oceanic/remote airspace IAW 8110.60 and AC 20-138a.

A 4" color Flat Panel Control Display Unit (FPCDU) is used with the UNS-1L. Because the FPCDU is only 3.25 inches deep, it will fit in either the panel or pedestal.

Fuel sensor inputs are accommodated in a variety of formats. Two engine capability is standard with an option of up to four engines. The UNS-1L communicates with virtually all flight guidance systems, autopilots, and cockpit displays, both analog and digital.

The software provides features including access to the largest NAV database in the industry, flight planning capabilities with SID/STAR procedures and airways, a Best Computed Position (BCP) for secondary navigation functions, auto-scanning DME-DME-DME, enroute maneuvers such as Direct-To, heading commands, VNAV, holding patterns and 3-D approach mode, fuel management, and optional frequency management. Memory has also been allocated for aircraft-specific performance features for selected aircraft types.

DATA TRANSFER UNIT (DTU-100)

DESCRIPTION

Universal's Data Transfer Unit (DTU) is a small lightweight 100 Mb disk ZIP drive unit that is mounted in the aircraft. The DTU will be directly wired to each FMS and will require a dedicated +28 VDC. The DTU-100 has an Ethernet port to provide a high-speed interface to the FMS (This is also available as a Portable Data Transfer Unit).

The DTU will be used for multiple tasks, which are:

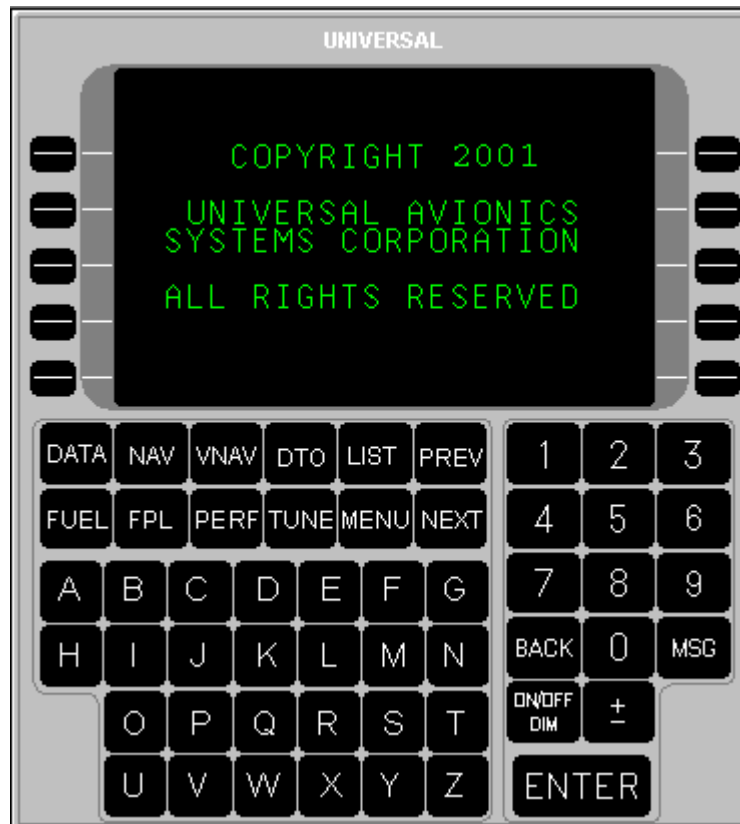
- Updating navigation worldwide or regional data base every 28 days
- Loading pilot data defined off-line, such as routes, approaches, and pilot wpts
- Down loading pilot data from the FMS, such as routes, approaches and pilot wpts
- Loading aircraft specific performance data
- Down loading maintenance log
- Down loading flight log
- Down loading computer diagnostic data

ETHERNET INTERFACE

The FMS can interface with the Avionics Local Area Network. The FMS's Ethernet controller connects to a 10BASE-T twisted shielded pair cable. The FMS, through the Avionics Local Area Network will connect to other Universal Avionics products such as the DTU and TAWS.

SYSTEM COMPONENTS

5" FLAT PANEL CONTROL DISPLAY UNIT (FPCDU), UNS-1E/Esp, 1F, 1C+/1C+sp, & 1D+



- Color display
- 5-inch diagonal flat panel display
- Graphics capabilities
- External Video capabilities
- Full alpha keyboard
- Full numeric keyboard
- Eleven function keys
- Ten line-select keys
- Pilot-friendly menu operation
- DZUS rail mount

SYSTEM COMPONENTS

4" FLAT PANEL CONTROL DISPLAY UNIT

UNS 1L & 1K+ (UNS-1F & 1D+ option)



- Color display
- 4-inch diagonal flat panel liquid crystal display
- Full alpha keyboard
- Full numeric keyboard
- Eleven function keys
- Ten line-select keys
- Pilot-friendly menu operation
- DZUS rail mount

SYSTEM COMPONENTS

DATA TRANSFER UNIT (DTU-100)



- Database loading via ZIP disk
- Accommodates PC100 ZIP disk
- Read capability:
 - Navigation Database updates
 - UNS Off-Line Flight Planning Disks
 - Jeppesen-Jet Plan Flight Plan Disks
 - Pilot defined database disks
 - Electronic Check List Disk
 - Performance database disk
- Write capability:
 - Pilot Data downloading
 - Flight Data Recording
 - Avionics Diagnostics
- Aircraft mounted or portable versions available
- Built-in self test

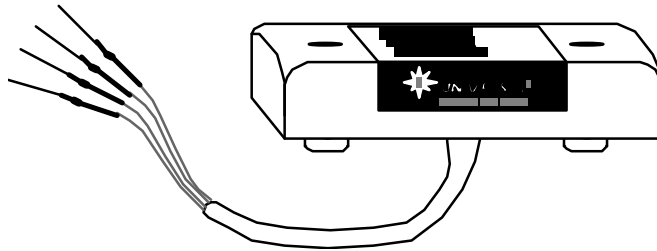
SYSTEM COMPONENTS

NAVIGATION COMPUTER UNIT (NCU) (UNS-1F, UNS-1L, UNS-1D+, & 1K+)



- Navigation Management
 - Digitally coupled lateral/vertical guidance
- Sensor/communications Management
 - Eight ARINC 429 high/low speed ports
- Fuel Management
 - Four Fuel Flow inputs
- Frequency Management
- 32 megabyte NAV database capacity

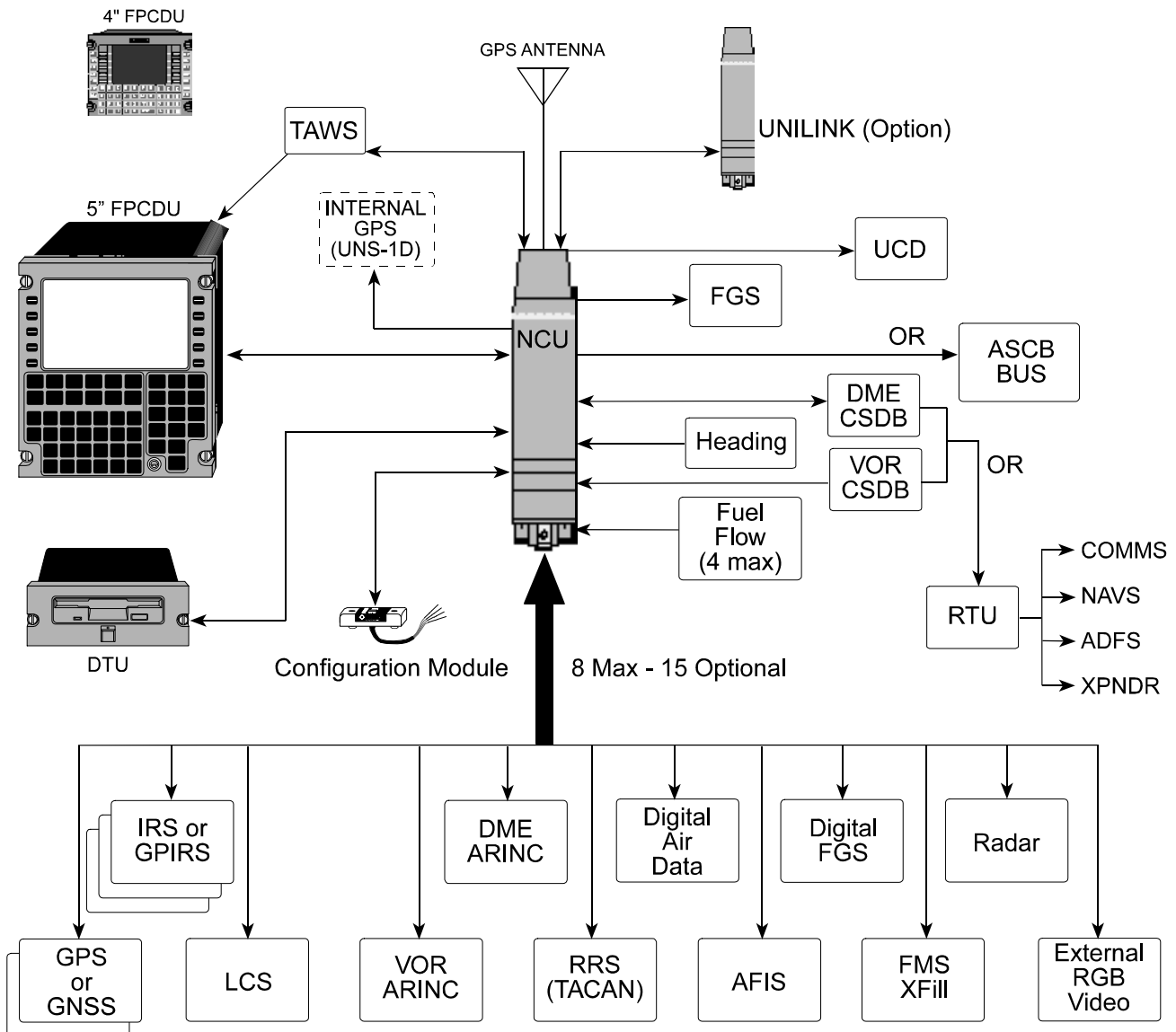
SYSTEM COMPONENTS CONFIGURATION MODULE



- Serially connected EEPROM
- Connector-mounted or Rack-mounted aircraft Configuration Module
- Eliminates strapping wires
- Programmed through CDU at installation
- Sets up NCU for aircraft/sensor interface:
 - Sensor Inputs
 - Fuel Flow
 - Air Data
 - Instruments
 - FGS

SYSTEM DESCRIPTION

UNS-1F, 1L, 1D+, & 1K+ BLOCK DIAGRAM



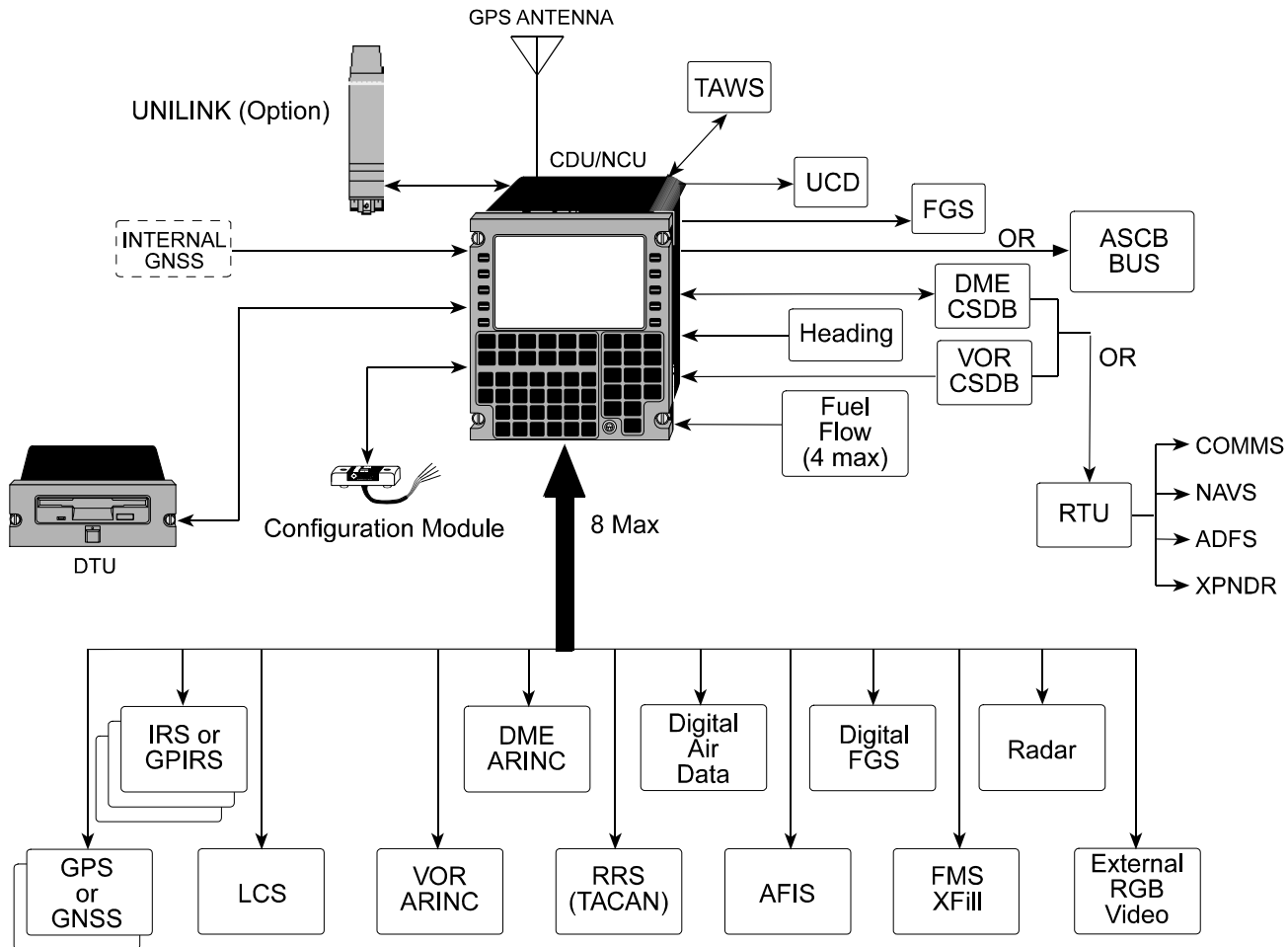
- Navigation System Management
- Pilot Data Storage
- Fuel Management Monitoring
- Lateral Guidance and Steering
- Vertical Guidance

- Navigation Database
- Flight Planning
- Frequency Management
- AFIS Advisory System Interface
- UniLink Interface

Available in multi FMS installations

SYSTEM DESCRIPTION

UNS-1E/1Esp & 1C+/1Csp+ BLOCK DIAGRAM



- Navigation System Management
- Pilot Data Storage
- Fuel Management Monitoring
- Lateral Guidance and Steering
- Vertical Guidance
- Navigation Database
- Flight Planning
- Frequency Management
- AFIS Advisory System Interface
- UniLink Interface

Available in multi FMS installations.

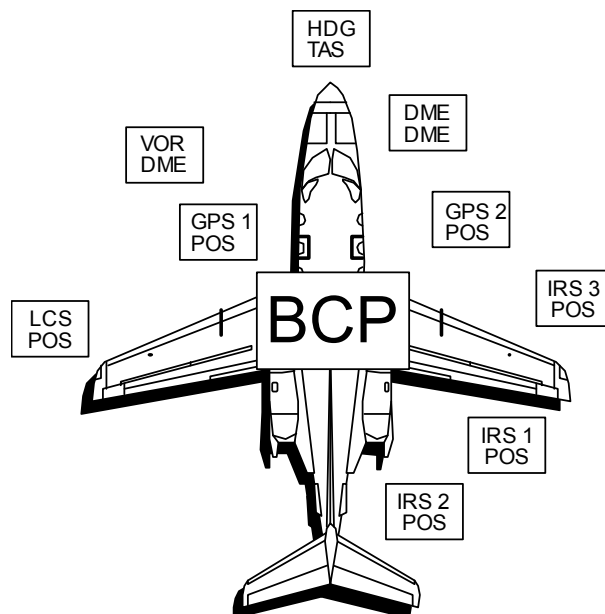
NAVIGATION MANAGEMENT OR HOW IT WORKS

Universal Avionics' Flight Management Systems are centralized control and master computer systems, designed to consolidate and optimize the acquisition, processing, interpretation, and display of certain aircraft navigational and performance data.

FMS systems may be installed as GPS or GNSS only or multi-sensor systems. Digital Air Data information (including baro-corrected altitude and true airspeed) and heading input is required in all installations.

The NCU (or FMC) has multiple ports through which data from external sensors can be received. The long range navigation sensors that may be accommodated include Inertial, GNSS, GPS, and Loran C. A radar joystick for remote waypoint entry can also be accommodated. When a DME interface is included, the DME input is considered a short range sensor and is from a multi-channel DME. All DME stations within approximately 300nm of the aircraft position are scanned, and up to 15 are continuously tracked. If VOR input is provided, it will be used for VOR/VOR-DME /RNAV (VOR DME) approaches when GPS integrity does not meet integrity requirements. VOR will be used enroute as a last resort sensor, and any VOR used must be less than 180nm away.

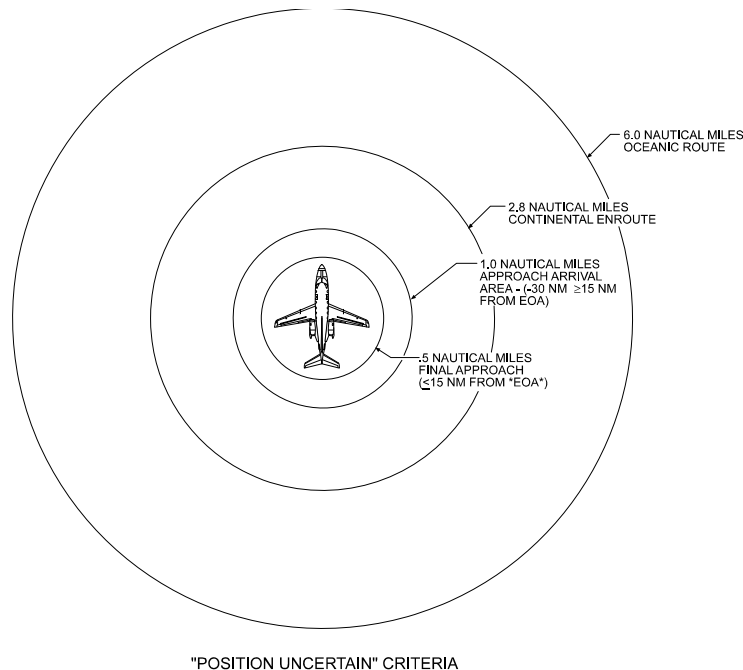
Each individual navigational sensor is specifically designed for primary navigation. The FMS takes advantage of a particular sensor's good properties while minimizing its liabilities. The system processes multiple range information from the DME, True Air Speed data from the Air Data Computer, velocity and/or position information from the long range navigation sensors, and aircraft heading, in order to derive one Best Computed Position (BCP). This is accomplished through the Kalman Filtering of the various sensors.



POSITION UNCERTAIN

Once established, the confidence, or certainty of the FMS's BCP to a 95% probability is expressed as Actual Navigation Performance (ANP). ANP is expressed in hundredths of a nautical mile.

(0.07) The lower the value, expressed in nautical miles, the more accurately it knows its position. For example, an ANP of 0.10 means the FMS is 95% confident of its position within a circle with radius of 0.10 nautical mile. If ANP = 1.00, it is only confident of its position within 1.0nm radius of a circle. An ANP of 5.00 would indicate a confidence (certainty) of position of 5.0nm. In earlier systems, "Q" was used and is similar to ANP.



There are set maximum boundaries for the size of the circle, or the amount of uncertainty that the FMS is permitted to have. This is called Required Navigation Performance (RNP) when enroute and over 300nm from the last known DME site (typically when oceanic), the ANP factor must be 6.00 or less (6.0nm). When the aircraft is within DME range (typically over land) the ANP must be 2.80 (2.8nm) or less. For terminal operations, the ANP must be 1.00 (1.0nm) or less. Approach operations require an ANP of 0.30 (0.3nm) or less or 0.50 (0.5nm) or less depending on the approach. If these parameters are exceeded, the system will display a "position uncertain" message and during an approach the system will go invalid for navigation.

RNP parameters are continually being reviewed and changed by Civil Aviation Authorities and ICAO. To allow the FMS the flexibility to accommodate the ever changing RNP standards, an FMS feature is available that allows for Required Navigation Performance to be manually set by the pilot when the default FMS values do not monitor what is required.

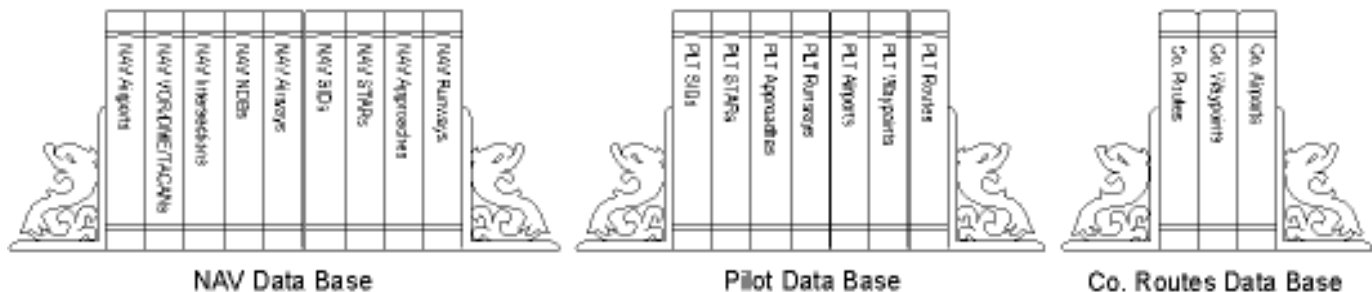
NAVIGATIONAL FEATURES

NAVIGATION DATABASE

The FMS memory is a non-volatile flash RAM (no battery required). The stored navigation database provides the capacity for complete coverage for SIDs, STARs, Approaches, High/Low Airways, Nav aids, IFR intersections, airports with IFR Approach, and Navigation Reference System data points in the worldwide database. Worldwide 5000 foot runway length, 4000 foot runway length, or 2000 foot runway length database subscription services are available. In addition, trip kits for other than the subscribed runway length are available upon request.

DUAL CYCLE DATABASE

The UNS-1L, UNS-1E, UNS-1Esp, and UNS-1F contain a dual memory bank that is capable of holding the next cycle database before it becomes effective. When the current database expires, the next cycle database will automatically become active. When the FMS is powered up, one of the functions of the self test is to determine which database is active by comparing effective dates and expiration dates. When an expired database is manually activated, it will remain the active database until the current database is manually activated.



PILOT DATA STORAGE

Extensive memory space is also allocated for Pilot Defined Data. The system can store up to 200 pilot created flight plan routes comprised of up to 98 waypoints each, and up to 200 pilot defined waypoints, 100 arrivals/departures, 100 approaches, 100 runways, 100 airports, 100 alignment points, and 100 tactical waypoints. Up to 25 radar waypoints can be stored in volatile memory. Once stored, pilot defined data is easily accessed and may be added to the flight plan with a few simple keystrokes.

COMPANY ROUTES DATA

A protected company routes database can be created using an off-line, Universal's Flight Planning Program. The FMS allows for the creation and storing of a maximum of 2000 routes, with the ability to create and store 200 Company Waypoints and 100 Company Airports. Each route will consist of at least one but not more than 98 legs (route elements). Route elements reference waypoints, airways and terminal area procedures (SIDs, STARs, and approaches) from the navigation database by use of reference pointers. Company Routes can be given names of up to eight characters in length. A Company Routes database will allow routes to be viewed and copied to the active flight plan, but the flight crew cannot modify the routes themselves. A configuration option has been added that will cause all pilot data to be cleared at each power on cycle. This feature is mainly for airline operations in which no leftover pilot data are allowed in the FMS between power cycles.

A Company Route database must be loaded with the same NAV data that was used for its creation. The Company Routes database disk is loaded through the Data Transfer Unit (DTU) by using the same procedures as loading the NAV data disk.

OFF LINE FLIGHT PLANNING

FMS-created pilot data can be downloaded to a Zip disk through the DTU for review using a compatible PC computer. The off line features allow you to modify or add to your pilot defined data and upload it via Zip disk to the FMS, determine ETE while varying routes, study the effect of winds, compute fuel requirements and reserves, upload flight plans from various flight planning services and do FDE predictions for GPS sole means remote oceanic routes IAW AC 20-138a, Para 12e(2), (3), & (5)vi.

FUEL MANAGEMENT MONITORING

The fuel management function enables the pilot to plan fuel requirements while on the ground. Input from the aircraft's fuel flow sensors, along with pilot supplied data, enable the FMS to calculate and display significant real-time fuel management information throughout the flight. Enroute, alternate destinations, ground speed, or fuel flow values may be temporarily entered to check various "what if" scenarios.

FREQUENCY MANAGEMENT

With compatible radios and/or an optional Radio Tune Unit (RTU), the communications transceivers, VOR receivers and TACAN (if installed) may be tuned through the CDU. This function provides 4 presets for each radio that may be stored by alpha identifiers or tuning from a list of identifiers and instant recall of the last frequency entered.

LATERAL GUIDANCE AND STEERING

Using the best computed position and the flight plan created by the pilot, the FMS computes Great Circle route legs to navigate the aircraft along the programmed flight path. Optional maneuvering procedures provided include; direct to (DTO), Pseudo – VOR (radial tracking), FMS Heading, Selected Cross-Track (SXTK), Holding Patterns, SIDs, STARs, and Approaches. The FMS provides desired track, bearing, cross-track, lateral deviation, and related data to the flight guidance system for the EFIS displays, and roll steering commands for the autopilot/flight director system. The system anticipates leg changes and provides "smart turns" to eliminate "S" turning. Pilots can designate waypoints for over flight. The roll steering command is gain-scheduled based on altitude for gentle turns and a configurable multiplier for ILS approach emulations. The bank limit is configured at time of installation to match flight guidance system limits.

VERTICAL GUIDANCE

A 6-waypoint enroute vertical navigation descent profile may be programmed through the VNAV page and additional waypoints may be entered through the flight plan. The FMS will display the vertical speeds required based on present ground speed to obtain the target altitudes at the VNAV waypoints. A computed Top of Descent Point, based on target vertical speed, is displayed. When the Top of Descent Point is reached, the system provides vertical deviation from the vertical flight path for output to a vertical deviation pointer. The resultant calculated Flight Path Angle (FPA) is limited to settings in the configuration module set at time of installation. Vertical steering is also provided to the autopilot. A Vertical Direct To (VTO) feature is available. In the approach mode, a pseudo glide slope may be defined. Deviation signals similar to an ILS glide slope are available for output to the EFIS and flight guidance systems.

UNILINK

The FMS can interface with the UASC UniLink unit that supports air-to-ground digital data communications. UniLink uses a variety of media, such as VHF radio, in-flight phone, and SatCom to communicate with service providers such as Universal Weather.

AFIS INTERFACE

The FMS system provides for interface with the Airborne Flight Information System Weather Advisory Services. AFIS data may be transferred to the FMS for display on the CDU. Through a VHF data link the interface provides the capability for two way data transfer between the aircraft and the ground, providing messaging, weather, and flight plan service uploading.

SENSOR WATCHDOG

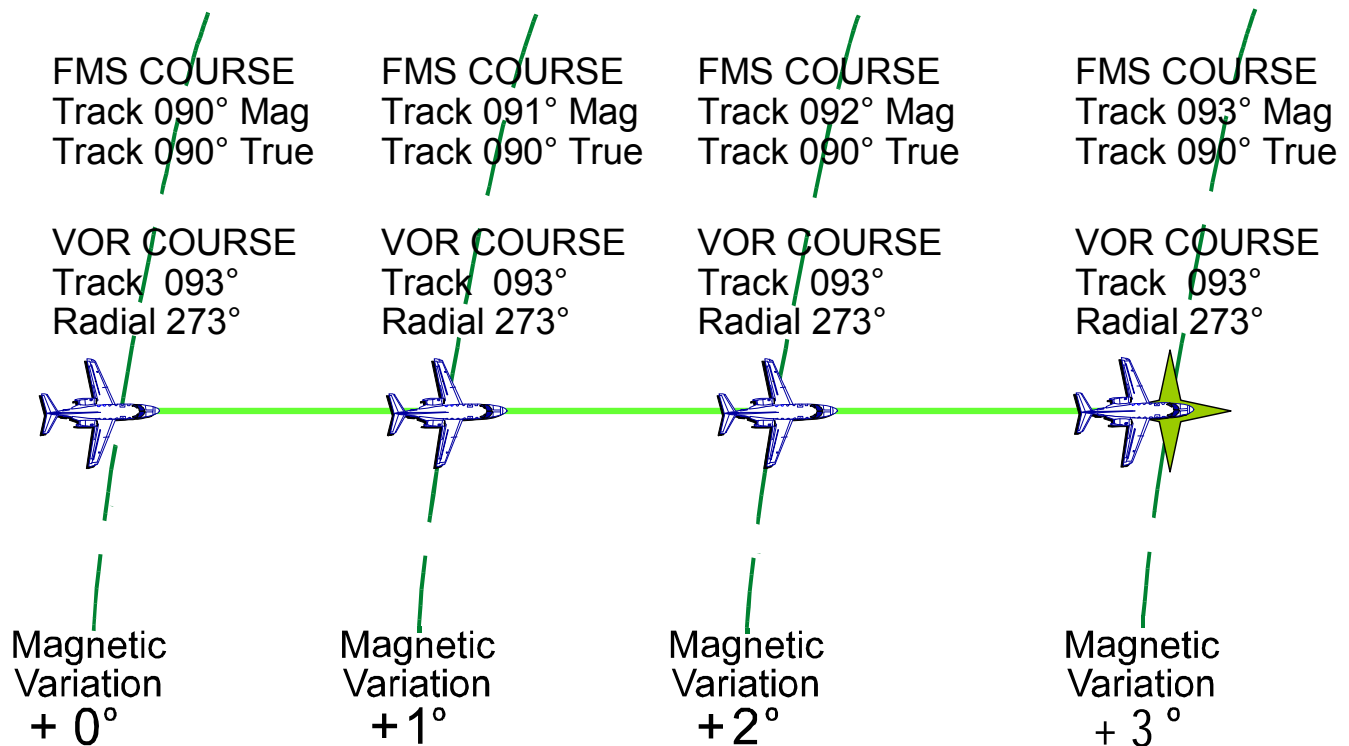
A sensor “watchdog” automatically detects sensor information that appears erroneous that could cause an error in the best computed position. This is accomplished by comparing each sensor, the unweighted average of all sensors and deselecting faulty sensors. If the difference exceeds a preset value, the “watchdog” will activate the appropriate messages to alert the pilot and in extreme cases automatically deselect the sensor.

FMS OPERATIONS IN HIGH LATITUDES

The Universal FMS requires a true heading source (IRS) when flying in the Polar Regions starting at 73° North and 60° South latitude. The magnetic variation model that the FMS uses to convert between magnetic and true heading does not extend into the Polar Regions, thus, a true heading source is required for the FMS to navigate in these regions. No input into the FMS is required by the pilot; however, the True/Mag switch installed in the aircraft must be placed in the True position. In these regions all FMS heading and bearing information will be presented in true. At 72° 45' North and 59° 45' South latitude, a message will be presented by the FMS warning that the aircraft is about to leave the zone where the magnetic variation is automatically calculated by the FMS.

NOTE: For short flights, there are techniques for non IRS aircraft to operate within these Polar Regions or in areas of magnetic unreliability.
Contact UASC Customer Training for more information @ 1-800-595-5906.

FMS vs VOR NAVIGATION



The FMS navigates by use of true heading and computes a great circle course between lat/long waypoints. Any magnetic input to the FMS is converted to true by use of a magnetic variation model. This model covers latitudes from 73°N to 60°S. FMS navigation in the Polar Regions requires a true heading source (IRS) input to the FMS. FMS output to the aircraft flight instruments uses the same magnetic model for conversion. The magnetic variation model converts the FMS true heading to magnetic heading based on the current lat/long of the aircraft. As the track of the aircraft passes over magnetic variation changes, the FMS magnetic heading, bearing, & track changes although the true heading, bearing, & track remains the same. A VOR extends radials in all directions, it is known as a rhomb line. The magnetic bearing of these radials is based on the magnetic variation or declination of the VOR station and does not change regardless of the distance from the VOR. When a FMS bearing is compared to a VOR bearing, a difference may be observed. This difference is the magnetic variation difference between the lat/long of the aircraft and the lat/long of the VOR and the difference between the types of navigational courses.

Report No. 3040sv80X/90X

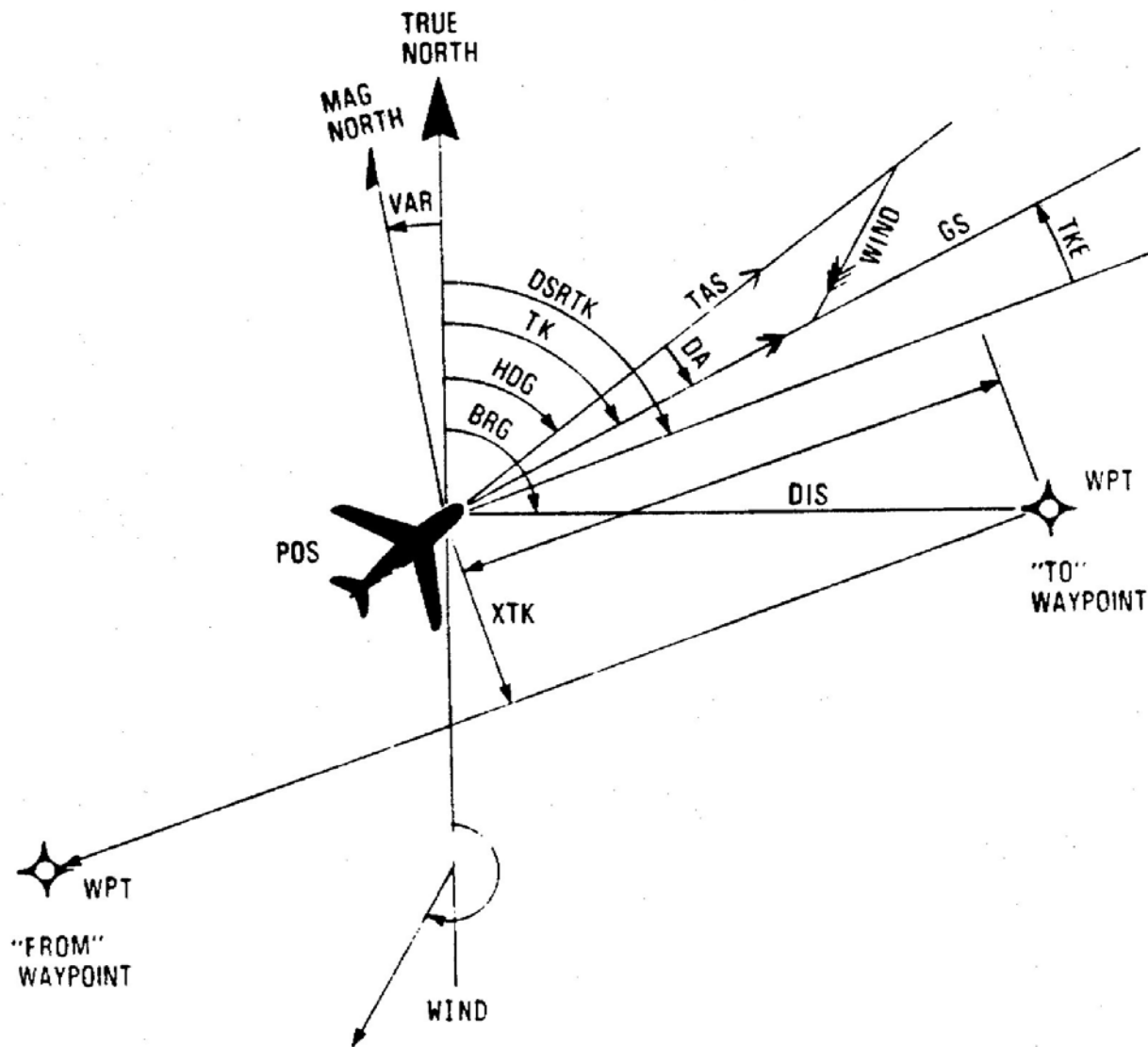
APPLICATION OF MAGNETIC VARIATION TO FMS NAVIGATION

Compliance requirements for application of magnetic variation to various navigation leg types of the FMS is dependent upon the type of leg and where in the navigational process it is used. If the leg is part of a database terminal area procedure, the magnetic variation to be used is the value that the system extracts from the database as specified per RTCA DO-201A/EUROCAE ED-77.

The chart below explains the application of magnetic variation to the leg types listed. Airport MAGVAR is not available in SCN 801; therefore the FMS will use System MAGVAR in lieu of Airport MAGVAR.

Leg Type	MAGVAR Region Reference Point	MAGVAR Source for Procedure Leg
CA, CD, CI, CR, VA, VD, VI, VM, VR	Departure or Arrival Airport as appropriate	Airport MAGVAR if available, else System MAGVAR at airport
CF (not in approach common segment), FA, FC, FD, FM, PI, AF	Reference Fix	Fix Declination if available, else System MAGVAR at Reference Fix
DF, IF, RF (not in approach common segment)	Reference Fix	System MAGVAR at Reference Fix
TF (not in approach common segment)	Prior Fix of leg	System MAGVAR at Prior Fix
IF, TF, CF, RF (in approach common segment)	Airport	Facility declination if available, else Airport MAGVAR if available, else System MAGVAR at Airport

NAVIGATIONAL RELATIONSHIPS



NAVIGATION RELATIONSHIP DEFINITIONS

BRG	Bearing – it is the direction of waypoint from the aircraft usually measured in magnetic degrees, but could be provided in true degrees.
DA	Drift Angle – it is the effect of wind on the aircraft heading resulting in the track of the aircraft.
DIS	Distance – it is the measured length between two navigational points or the aircraft and a waypoint.
DSRTK	Desired Track – it is the preferred path over the ground.
GS	Ground Speed – it is the speed of the aircraft relative to the ground.
HDG	Heading – it is the direction of the aircraft relative to either magnetic or true North.
POS	Position – it is the current location of the aircraft usually identified by a latitude and longitude or radio navigational aid.
TAS	True Air Speed – it is the speed of the aircraft relative to the air mass with in which it's flying.
TK	Track – it is the actual path of the aircraft over the ground.
TKE	Track Error – it is angle between the desired track and the actual track of the aircraft.
VAR	Variation – it is the angular measurement between magnetic and true North.
WPT	Waypoint – A navigational point usually identified by a latitude and longitude or radio navigational aid, but with a modern FMS, could be a condition.
XTK	Crosstrack – The distance of the aircraft from the desired track usually measured in nautical miles.

GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)

The Global Navigation Satellite System is a navigational system using orbiting satellites to plot latitude and longitude positions on the earth. Two countries currently support GNSS programs, the United States of America with the Global Positioning System (GPS) and Russia with the Global Orbiting Navigation Satellite System (GLONASS). Future GNSS programs are planned by Europe with Galileo to be deployed in 2012. Galileo is a joint initiative of the European Commission (EC) and the European Space Agency (ESA). Another GNSS program under development is China's Beidou Compass with a planned 30 medium orbit and 5 geosynchronous satellites. Currently the US GPS is required when flying GPS approaches.

GLOBAL ORBITING NAVIGATION SATELLITE SYSTEM (GLONASS)

GLONASS is a Soviet space-based navigation system, now operated by Russia, comparable to the American GPS system. The operational system contains 21 satellites in 3 orbital planes, with 3 on-orbit spares. GLONASS provides 100 meters accuracy with its C/A (deliberately degraded) signals and 10-20 meter accuracy with its P (military) signals. Satellite design life is 1 to 2 years. There is an on-board cesium clocks that provides time accuracy to 1000 nanoseconds. GLONASS uses Frequency Division Multiple Access (FDMA) as a means of satellite identification which is not compatible with the US GPS.

GALILEO POSITIONING SYSTEM

The Galileo Positioning System, simply known as Galileo, is named after the Italian astronomer Galileo Galilei. The system will be comprised of 30 spacecraft on three orbital planes at an altitude of 23,222km. The satellite life expectancy is less than 12 years and will use Code Division Multiple Access (CDMA) technology, the same as is used by GPS. A reason given for an independent system is that GPS is a military system and that a civil infrastructure, including airplane navigation and landing, should not rely solely upon GPS.

Galileo's open service will be broadcast in two bands. Reception of two bands will achieve an accuracy of 4m horizontally and 8m vertically; one band will provide 15m horizontally and 35m vertically. The encrypted commercial service will be available for a fee and use three bands with accuracy of less than 1m. An encrypted public regulated service and safety of life service will be more robust to help prevent jamming and enhance problem detection reliability to within 10 seconds.

BEIDOU SATELLITE NAVIGATION AND POSITIONING SYSTEM

Beidou Navigation System is named after the Big Dipper constellation, which is known in Chinese as *Běidǒu*. The new system will be a constellation of 35 satellites, which include 5 geostationary orbit (GEO) satellites and 30 Medium Earth Orbit (MEO) satellites that will offer complete coverage of the globe. There will be two levels of service provided; free service for those in China, and licensed service for the military.

- The free service will have a 10 meter location-tracking accuracy, will synchronize clocks with an accuracy of 50 ns, and measure speeds within 0.2 m/s.
- The licensed service will be more accurate than the free service, can be used for communication, and will supply information about the system status to the users.

GLOBAL POSITIONING SYSTEM (GPS)

GPS satellites continuously transmit highly monitored position and timing data that allows a GPS receiver to determine its range to the transmitting satellite. By observing and tracking multiple satellites, the GPS receiver can determine its position in longitude, latitude, and altitude, allowing navigation to be performed. Additionally, the GPS receiver can independently monitor the integrity of its own position without reference to other navigation systems. GPS permits earth-centered position coordinates to be determined which provides aircraft position referenced to the World Geodetic System of 1984 (WGS-84).

GPS has achieved its Initial Operating Capability but is subject to some limitations and gaps in coverage. Current receiver technology is capable of determining (and predicting) satellite availability and the resultant level of GPS usability for various phases of flight. GPS is approved, when using properly certified and installed equipment for IFR enroute, terminal operation, and GPS approaches. GPS approaches are found in countries throughout the world.

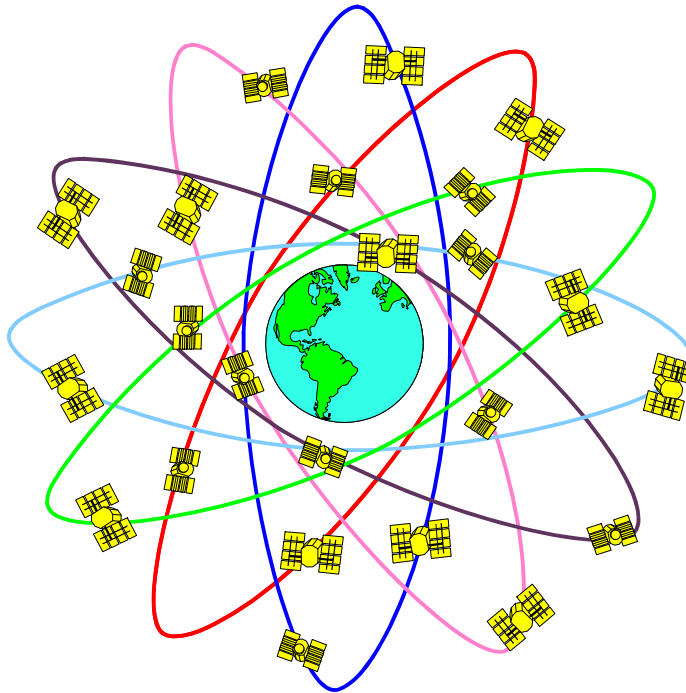
GPS PRINCIPLES OF OPERATION

GPS consists of three distinct functional segments: the space segment, control segment and the user segment. Following discussion of those elements includes coverage of Receiver Autonomous Integrity Monitoring (RAIM), Fault Detection and Exclusion (FDE) and Horizontal Integrity Limit (HIL).

The space segment consists of a minimum constellation of 24, with a maximum of 30 satellites allowing for the worldwide reception of at least 4 satellites in view. The satellites are arrayed in six planes. Each plane is inclined 55 degrees to the Equator and contains a minimum of four satellites in 10,898 nautical mile orbits. Each satellite completes an orbit in 11 hrs 58 min or slightly more than two orbits per day. When 24 satellites are available, this will insure a minimum of four satellites to be in view from any point on the Earth's surface 24 hours per day. When 30 satellites are available, this will insure a minimum of five satellites to be in view from any point on the Earth's surface 24 hours per day.

The principle behind GPS operation is in knowing the precise location of each satellite in the system and when each satellite transmits specially coded information. The GPS receiver, by knowing where each satellite is located and exactly when it transmits its data, measures the length of time it takes for the data to arrive and so determines its range to each visible satellite. GPS uses Code Division Multiple Access (CDMA) as a method of satellite identification. By using multiple satellites, the GPS receiver can then calculate its position. Some GPS systems allow for a minimum of three satellites and an altitude input from the aircraft Air Data computer to calculate a position, known as "ALTITUDE AIDING". Four satellites are required for the GPS receiver to solve for position and altitude. The Universal Avionics GPS requires the acquisition of four satellites in order to go to the NAV mode and can use the "ALTITUDE AIDING" mode once airborne.

On May 1, 2000 Selective Availability, or “S/A” was removed from the civilian GPS channel eliminating the intentional error input by the US Military. With the current level of satellite position and timing accuracy available to civil users, GPS provides a minimum position resolution of less than 20 meters. In practice, with good satellite coverage, much finer resolutions are possible. With single channel the GPS position error should be less than 20 meters 95% of the time and less than 30 meters 99.99% of the time.



**GPS Nominal Constellation
24 Satellites in 6 Orbital Planes**

4 Satellites in each Plane
20,200 km Altitudes, 55 Degree Inclination

The data, sent to the GPS receiver, includes vehicle status, clock correction, synchronization, signal propagation corrections, and precise satellite ephemeris (position) data. Collectively, this information is referred to as an almanac and is the data from which the GPS receiver measures its distance from the satellite(s) in view. Almanac data is encoded such that the receiver can verify that only valid and current information is being sent.

There are two levels of system accuracy (or Code) available; Coarse Acquisition (C/A) Code and Precision (P) Code. To date, P-Code data is restricted to military applications and with the use of two channels for increased position accuracy provides better accuracy than the single channel provided to civilian users.

The user segment consists of the GPS receiver/processor and its associated antenna(s). In aircraft applications, the preferred antenna location is on the upper fuselage where the antenna can have the best horizon-to-horizon, unobstructed view.

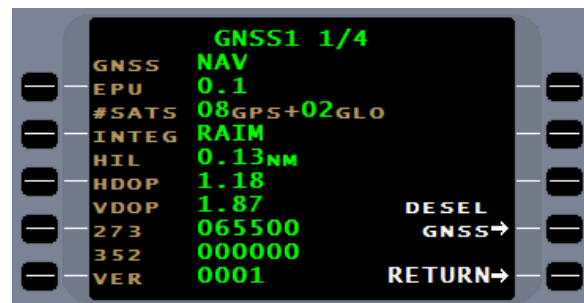
The GPS receiver looks for and selects the best positioned satellites, determines its range to each of them and using the location of each satellite, converts that into GPS position. Doppler shift measurement of the signal can be used to determine aircraft velocity.

GPS derived position information is provided to the FMS as a part of its position determining processes.

The GPS receiver downloads and stores the “almanac” data transmitted by each satellite as a background processor function. New almanac data is uplinked to the satellite system weekly. Clock correction data is received and processed by the GPS receiver. This automatically updates FMS UTC time. Almanac data is used to perform RAIM prediction calculations that are required when flying GPS based approaches.

RECEIVER AUTONOMOUS INTEGRITY MONITORING (RAIM)

A minimum of four satellites is required for the GPS to determine position and enter “NAV” mode. If any of the satellites received and tracked were providing erroneous data, these errors could cause significant navigation errors. To reduce this possibility the GPS receiver incorporates a process known as RAIM (Receiver Autonomous Integrity Monitoring). This is a process that involves using signals from five or more satellites to verify accuracy. With at least five satellites tracked, one satellite can be dropped from the position solution and range to the satellite back calculated from the position solution determined by the remaining satellites. This calculated value is compared with the received pseudo-range to determine validity. With only five satellites, which satellite is providing faulty data cannot positively be determined. The RAIM status of the GPS sensor is displayed on the GPS sensor status page, accessed under DATA page 2.



The integrity status will be displayed as RAIM, RADIO (in DME-DME installations where this data can be used to ensure GPS integrity), NONE or ALARM (accompanied by annunciator and message).

FAULT DETECTION AND EXCLUSION (FDE)

If six or more satellites are received, the GPS can determine whether errors exist and determine which satellite is providing faulty data. The GPS can then exclude that satellite from the position solution, still leaving five satellites available to protect RAIM. This process is known as FDE (Fault Detection and Exclusion). Remote/Oceanic operations certification requires that FDE be provided and continuously monitored by the GPS.

HORIZONTAL INTEGRITY LIMIT (HIL)

At any given time, the GPS or GNSS sensor's ability to perform FDE is determined by the number of satellites in view and their geometric position relative to the aircraft. The GPS will compute a parameter called the "Horizontal Integrity Limit" (HIL). HIL is defined as the radius of a circle in the horizontal plane, with its center being at the indicated position, which describes the region that is assured to contain the true position. HIL will bind the true position with a probability of 99.99%. Certification requirements for use of GPS require that the GPS be able to exclude errors within specific HIL limits for various phases of flight. If the HIL value exceeds the requirement for the current phase of flight beyond a specified time limit, the integrity status goes to "ALARM" and a GPS integrity message and annunciator will be presented. Since the limits are tighter for the approach phase of flight than the enroute and terminal phases, alarms are more likely to occur in this phase of flight. With the removal of SA, violating any of the HIL parameters is highly unlikely. The calculated HIL value will be displayed on the GPS status page accessed under the DATA 2 page.



<u>Phase of Flight</u>	<u>Alarm Limit</u>	<u>Time to Alarm</u>
ENROUTE (Outside 30nm from Departure or Destination)	2.0 Nautical miles	After 27 seconds
TERMINAL (Within 30nm of Departure or Destination)	1.0 Nautical miles	After 7 seconds
APPROACH (Approach mode active on FMS)	0.3 Nautical miles	After 7 seconds

If the GPS integrity annunciator illuminates, pilot action will vary with phase of flight as well as navigation sensor options connected to the FMS.

GPS PRIMARY MEANS OF NAVIGATION

The FMS, in conjunction with either an internal GPS or an appropriate external GPS, is certifiable for use as a primary means of navigation in remote/oceanic airspace using GPS in accordance with the provision of FAA Notice 8110.60 and AC 20-138a. Software requirements in addition to a RAIM prediction program are required to verify that adequate integrity will exist for the proposed flight. Universal Avionics Service Letter No. 2738 provides additional details on this subject.

GPS SYSTEM INFORMATION AND STATUS

Information concerning the current operational status of GPS is available from the US Coast Guard Navigation Center:

- (a) (703) 313-5900 24 Hour Service Desk
- (b) (703) 313-5907 a continually updated taped message of satellite status, signal outages, and duration.
- (c) Home page <http://www.navcen.uscg.gov/>
- (d) Yuma Almanac <http://www.navcen.uscg.gov/gps/almanacs.htm>

SPACE BASED AUGMENTATION SYSTEM

Space Based Augmentation System (SBAS) is a system used to enhance the three dimensional accuracy of GNSS by relaying to SBAS capable receivers correction data that is used to refine its position. Covering North America is the Wide Area Augmentation System (WAAS), covering Europe is the European Geostationary Navigation Overlay Service System (EGNOS), and covering Japan is the MTSAT Satellite Augmentation System (MSAS)

The Space Based Augmentation System is used to measure and correct GNSS satellite errors. This is used to refine the GPS position both laterally and vertically. FMS installations that have SBAS certification will allow the aircraft to fly RNAV approaches with a SBAS calculated glideslope.

SBAS uses a series of ground base stations that dynamically determine satellite error and transmit this data to a central processing computer. This computer maps a correction grid for the SBAS coverage area. Geosynchronous satellites transmit this data to SBAS capable GNSS which use the data to refine the GNSS position.

LONG RANGE SENSORS

The UNS FMS can be interfaced with various types of long range navigation sensors: GPS, Loran C Sensor (LCS), Inertial Reference Sensors (IRS), and GPS/IRS.

INTERNAL GPS AND GPS-1000/1000a

The UNS FMS incorporates an internal twelve channel GPS or GNSS receiver that has a real-time and predictive RAIM (Receiver Autonomous Integrity Monitoring) capability. Additionally, the FMS can be interfaced with the Universal GPS-1000 or GNSS as auxiliary or back-up receivers. Both are twelve channel RAIM systems.

LORAN C SENSOR

The UNS FMS is compatible with several models of Loran C Sensors. The Loran C Sensor is not selected on the ground but is automatically selected upon lift-off. The Loran C Sensor uses ground stations to compute its position. The position accuracy is sufficient for enroute navigation. Loran C has a limited coverage area in the world.

INERTIAL REFERENCE SENSOR (IRS)

Inertial Reference Sensors are designed around either conventional gyroscopes or the ring-laser gyroscopes. Those sensors utilizing conventional gyros depend upon accelerometers mounted on a gyro stabilized platform to sense velocity in all three axes. With laser-reference gyros, the difference in resonant frequency between light beams traveling in opposite directions is used to sense the rotation about each aircraft axis. These angular rate changes are combined with accelerometer measurements on each of those axes to determine the aircraft's orientation in space and to track its position. Whichever method is used, conventional or laser, the acceleration forces are the basis for computing directional velocities and for keeping track of the aircraft's present latitude/longitude position in the earth's coordinate system. Units from several manufacturers can be accommodated.

GPIRS

Combination GPS/IRS sensors are able to provide position and velocity data that take advantage of the best attributes of individual GPS and IRS sensors. GPS data has good long term accuracy, but its accuracy can vary on the short term. IRS has good short term accuracy, but can drift on the long term. GPIRS uses the best attributes of both systems.

AIR DATA

The UNS FMS accepts digital air data from a remote air data computer, with the UNS-1D+ & 1F also accepting analog air data. True Airspeed, barometrically corrected or non-corrected altitude, and Static Air Temperature are utilized. Baro-corrected altitude is required for vertical guidance display during approaches and for VNAV below 18,000 feet. Air Data Computers from various manufacturers can be interfaced with the FMS.

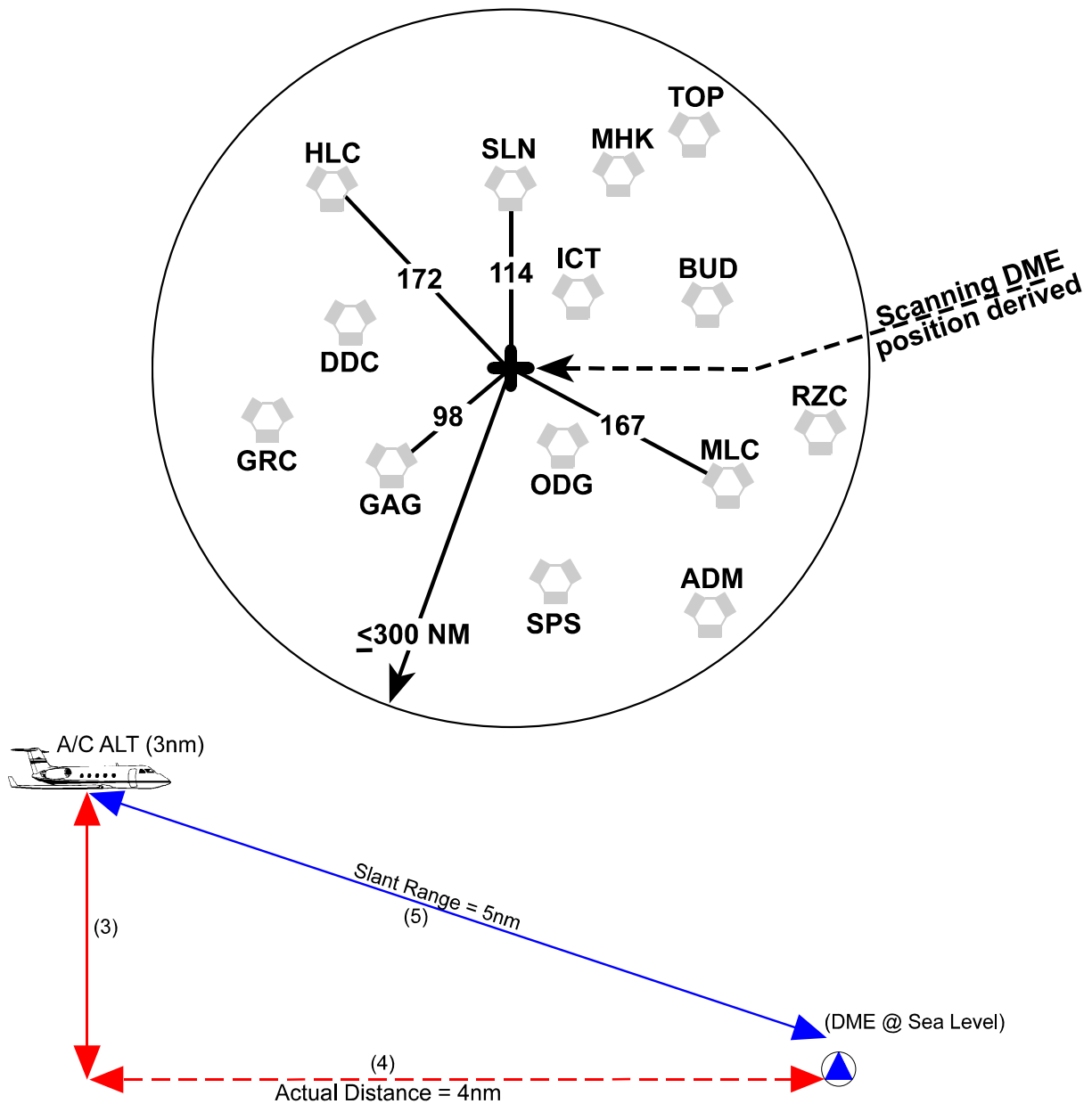
SCANNING DME OPERATION

RHO/RHO/RHO NAVIGATION

Using the “SCANNING DME” (or DME/DME/DME) function position is determined by measuring ranges to multiple DME sites of known location (longitude, latitude). The system’s own position can be determined to typically 0.3nm accuracy, although < 0.1nm accuracy is possible. The accuracy is a function of the number of DME available and the relative positioning of the DME sites. The more there are and the more widely dispersed they are, the better the accuracy of calculated position. The FMS will use the NAV database and find the 15 closest DME stations within 300nm. It then uses the 3rd channel of the DME to take a 4 second interrogation of the station. The FMS knows its own altitude (from the air data system) and the elevations (MSL from the navigation database) of each DME site. It’s therefore able to correct for “slant range” errors. A quality control of the acquired distance is accomplished by comparing the distance received to FMS calculated distance to the station. If the two distances do not agree within required parameters, the received DME distance is not used in the DME position calculation. The only time the FMS drops below 15 stations is if it cannot receive a total of 15 stations or if there are fewer than 15 stations within 300nm.

RHO/RHO/RHO POSITIONING

Continuous Automatic DME/DME/DME Position



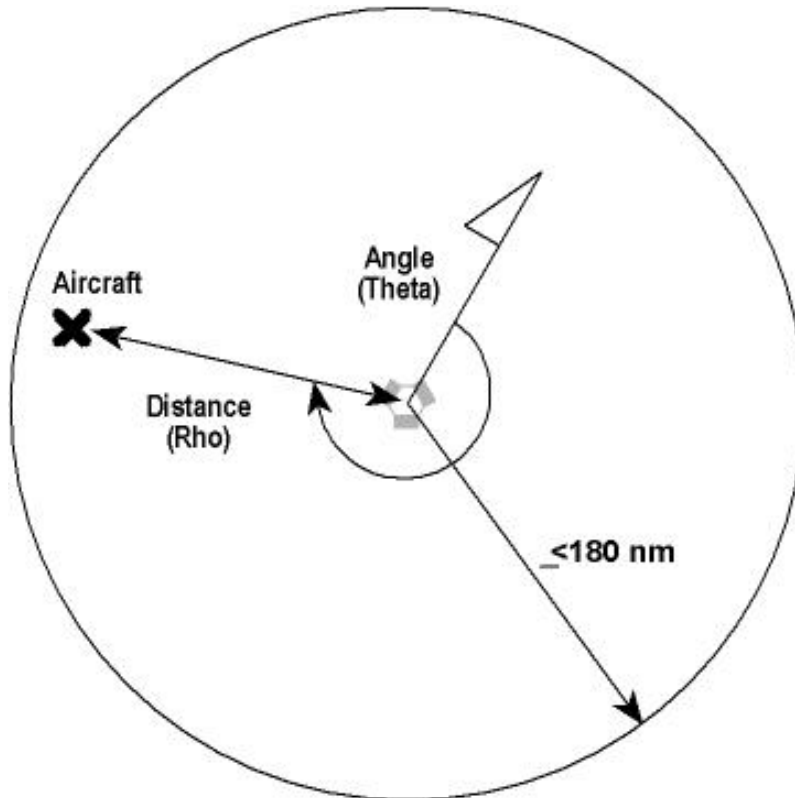
From Navigation Sensors and Air Data Computer:
Approximate aircraft position
Aircraft altitude

From database:
VORTAC and VOR/DME
Frequency
Coordinates
Elevation

POSITION BY RADIAL AND DISTANCE

RHO/THETA POSITIONING

VOR is only used for enroute position information when the aircraft is located in a part of the world where only one DME is available. The FMS will then use radial and distance from a VOR/DME for position information. Distance is calculated by DME and the FMS corrects for slant range. The radial is provided by the VOR. Knowing the lat/long of VOR/DME will allow the FMS to calculate the aircraft position.



From Navigation Sensors and Air Data Computer:

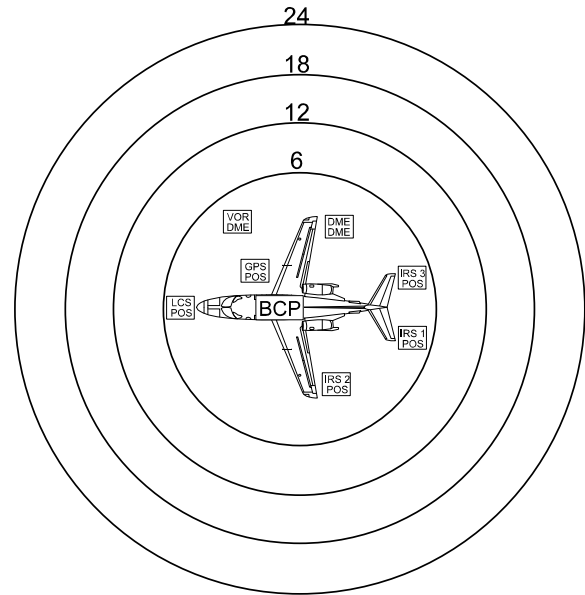
- Approximate aircraft position
- Aircraft altitude

From database:

- VORTAC and VOR/DME
- Frequency
- Coordinates
- Elevation

SENSOR DIFFERENCES

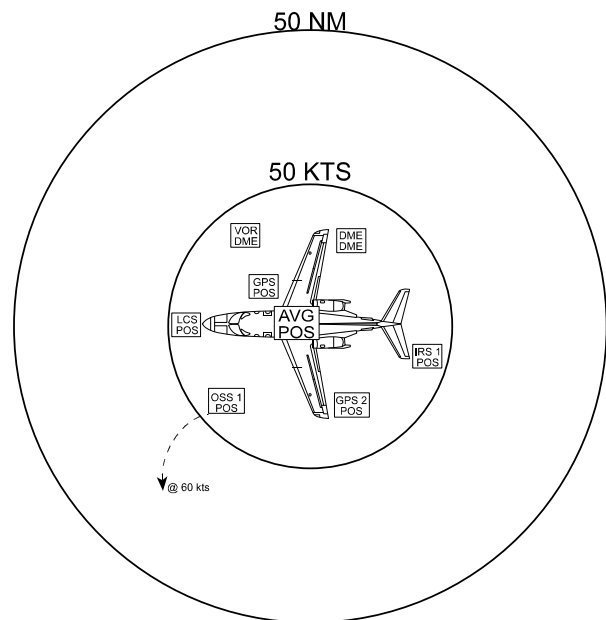
A sensor watchdog gives position difference warnings with FMS messages for a second FMS in dual installations and LCS sensors at 6, 12, 18, and 24nm from the FMS Best Computed Position. For IRS, the sensor watchdogs compare the rate of change of the IRS position against that of the FMS Best Computed Position. A decision on the part of the pilot to update or to deselect a sensor must take into account the position error involved, the error growth rate, and the stations being received.



MESSAGE -- LCS1 DIFFERENCE > 6NM

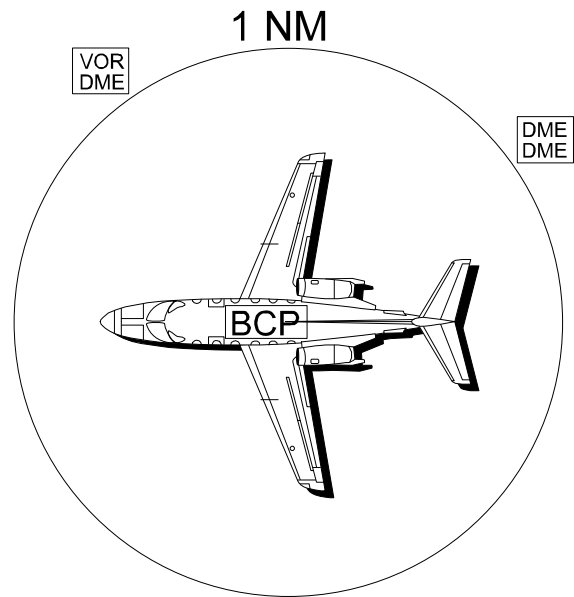
SENSOR MONITOR

For highly divergent sensors, based on the average position of all the other sensors, an individual sensor will be automatically deselected if the sensor's position differs from the FMS position by more than 50nm or if the sensor position is changing from the FMS position at a rate exceeding 50 kts. The DME derived position is used twice in this average position computation.



POSITION CORRECTING

The FMS Best Computed Position is continuously compared to DME/TACAN/VOR (Radio) position information. If a difference of greater than 1 nautical mile is detected, the FMS BCP will be corrected to the short-range (radio) position and a “Position Correcting” message will be triggered. This scenario commonly occurs when re-entering DME coverage after extended over water operations. However, the recent use of GPS as the primary navigation sensor during over water legs has virtually eliminated the need for “Position Correcting”.

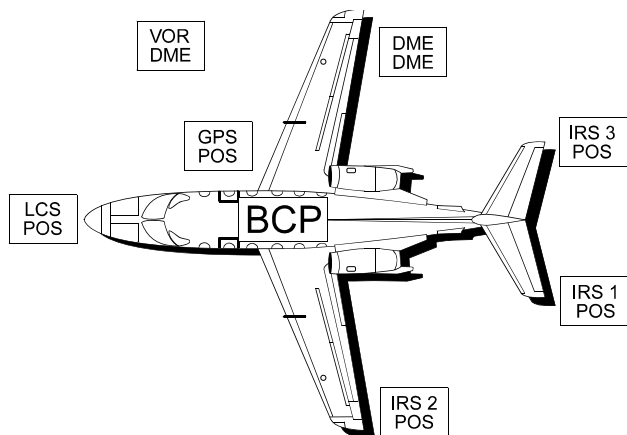


NAV SENSOR

Always check the latitude/longitude position of all sensors whenever any navigation sensor's accuracy message becomes active. Action should be taken only after the following examination.

Factors to consider include:

- If outside DME coverage, which sensor(s) was more accurate upon leaving DME coverage?
- Are the coordinates of more than one sensor in agreement?
- How long has the IRS(s) been in NAV?
- What is the ANP of each sensor?
- Which sensor has done better in the past?
- How does the navigation information compare with the flight plan?



CDU OPERATIONS GENERAL PROCEDURE FORMAT

I. DATA ENTRY

- A. Data entry is at the cursor location.
- B. The cursor may be moved over a data entry field by Line Select [LS] keys, sometimes by the [ENTER] key, or sometimes automatically.
- C. Until the [ENTER] key is pressed, the value at the cursor has no effect.
- D. Some data entry fields are restricted to numbers only.
- E. Waypoint identifiers may be input by direct entry of the Alphanumeric identifier or by reference number when included on a list.
- F. Any selection which will change the active flight plan, guidance of the aircraft, or stored database, requires confirmation by pressing the key a second time.










II. 5 CDU COLORS

- A. GREEN General and secondary data.
- B. ORANGE Optional selections which are available.
- C. LIGHT GREEN The selected option when other options are available.
- D. YELLOW Data pertinent to the current NAV Leg or most significant data on the page.
- E. RED Failure.

On a monochromatic CDU, reverse video, framing, and other techniques are used to highlight important information.

III. KEYBOARD

A. 36 Alpha and numeric keys.

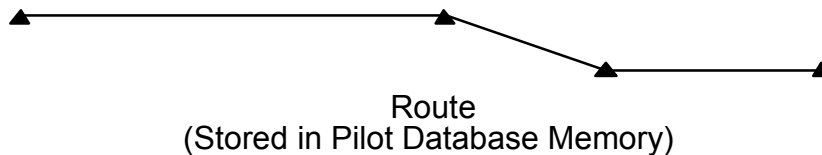
B. 11 Function keys,         
 and 

C. 6 Control keys,      and 

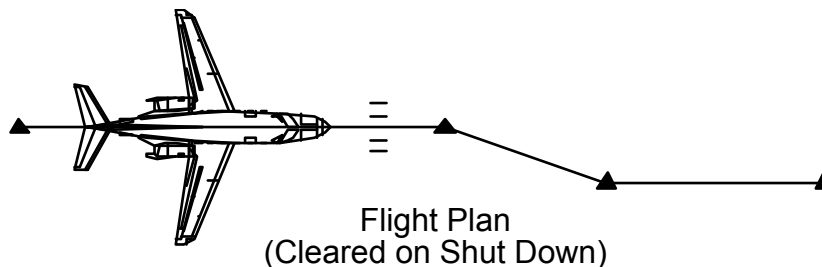
D. 10 Line Select keys, [LSK-1L] top left [LSK-5R] bottom right.

ROUTES VS FLIGHT PLAN PHILOSOPHY


- A. With Universal FMS systems, the FLIGHTPLAN is always the “Active” plan you are flying now. When the FMS is turned off, the flightplan is cleared.
- B. ROUTES are permanently stored groups of waypoints which may be assembled, viewed, edited, or deleted independently of the flightplan. Routes are stored in the pilot database for later use.

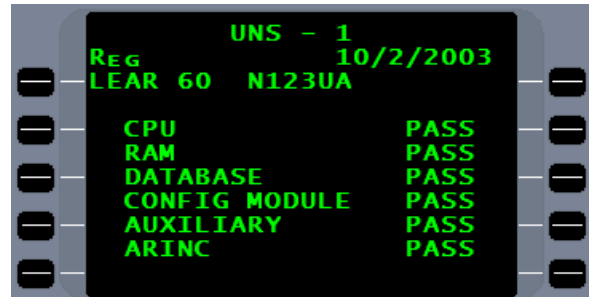


- C. The flightplan may be a copy of a stored ROUTE, and may be assembled, viewed, edited, or deleted independently of the stored Routes.
- D. A copy of the flight plan may be stored as a ROUTE through the FPL MENU page. As a ROUTE it may be further edited without affecting the flightplan .



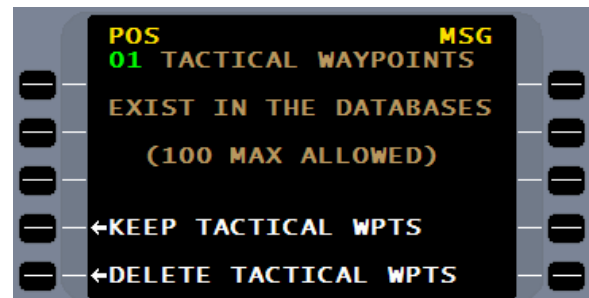
POWER ON

Press  key to power up. The system will perform a Power On Self Test (POST). This checks both hardware and software components of the FMS and, if all test areas “PASS”, then the FMS is operating correctly. If a “**FAIL**” occurs, it could be either critical or non-critical. If a non-critical fail occurs, the FMS will continue to the initial page, but the FMS will not be working at optimum. By cycling power, a reboot of the FMS may clear non-critical failures. A critical fail will halt the FMS POST. An attempt to clear the fault by cycling power has only a limited chance of working, but is still worth a try. Unless the fail is expected, maintenance will be required for any failure.

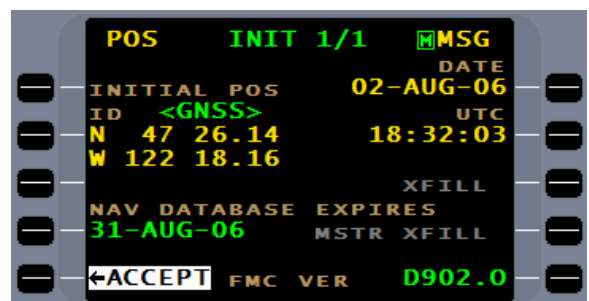





CAUTION: DEMO mode configured in the FMS sets the unit to a test demonstration capability. It should not be configured in the aircraft prior to flight. If an aircraft FMS is configured as DEMO, the FMS will ignore sensor inputs and WILL NOT navigate.

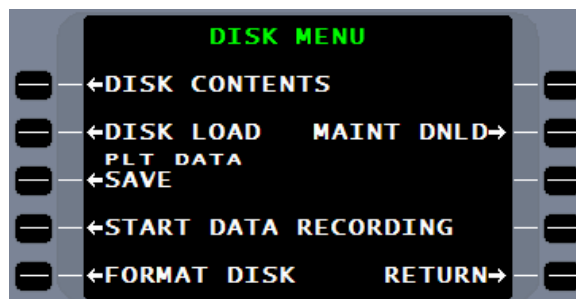
Following the POST, if tactical waypoints exist in the pilot database, a statement “TACTICAL WAYPOINTS EXIST IN THE DATABASES (100 MAX ALLOWED)” will be presented. Also presented are two line select keys, 1) KEEP TACTICAL WPTS, 2) DELETE TACTICAL WPTS. A choice must be made to advance to the initial page. Tactical waypoints are covered latter.





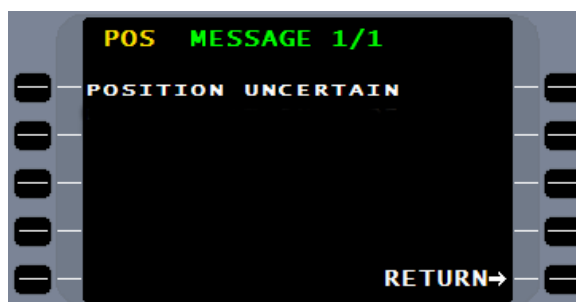
After successful completion of self-tests and copyright display and possible need to make a Tactical Waypoint determination, the initialization page will be displayed. The colors presented on the FMS are dependent on whether the aircraft has an EFIS and, if so, the EFIS manufacturer and model. The display colors do not affect the operation of the FMS.



The  symbol displayed indicates the availability of a MENU page for that function and can be accessed using the  key. Pressing the  key from the initialization page will display the **DISK MENU** page to allow DTU operations for entering of databases, etc. The use of this page will be covered latter.

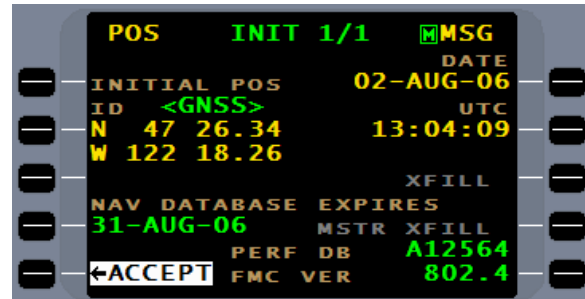


Pressing the  key will display current system messages. Pressing the  key again or the "RETURN" line select key will return to the previously displayed page.

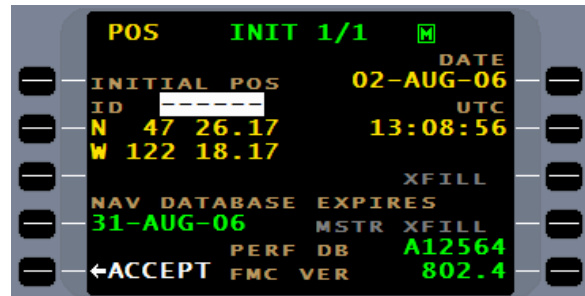


INITIALIZATION

The “**INITIAL POS**” displays the Latitude and Longitude and the source. If “<GNSS>” or “<GPS>” is present next to “ID”, the source for the FMS position is the GNSS or GPS.



Normally the GNSS or GPS is the most accurate source and pressing the line select key next to “ACCEPT” will position the FMS at the displayed coordinates. If the “<GNSS>” or “<GPS>” is not displayed, the displayed coordinates are those of the FMS when it last stopped navigating. These coordinates can be accepted through the “ACCEPT” line select key. By selecting the number 1L line select key, the cursor will be placed next to “ID”.

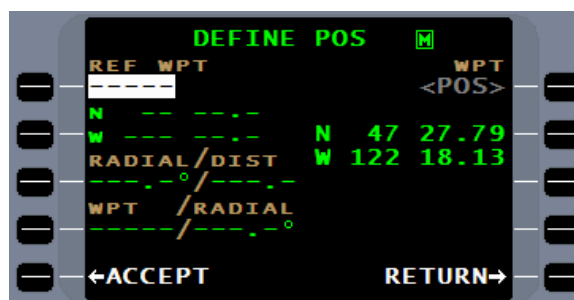


Entering an align point. Pressing **LIST** will present a list of airports and pilot created align points although an entry can be made with the use of the alphanumeric keys. Since it is important for the initial position to be as accurate as possible, the use of the “<GNSS>” or “<GPS>” coordinates should be the highest priority. If “<GNSS>” or “<GPS>” coordinates are not available, use a pilot created align point or manually insert the aircraft parking spot coordinates.

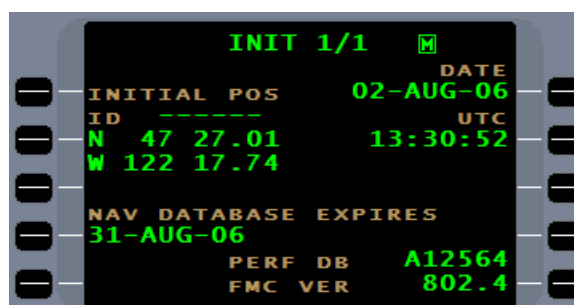
With the cursor in the ID field, by pressing the **LIST** key the airports/pilots align point list will be displayed. Ten pages of lists are available. The cursor will pre-fill the list number of the waypoint closest to the initial position coordinates. Distances from initial position are shown. If an ALIGN PT is created it will appear under the **APT/PLT** listing. Enter the correct number in the cursor field and press **ENTER**.



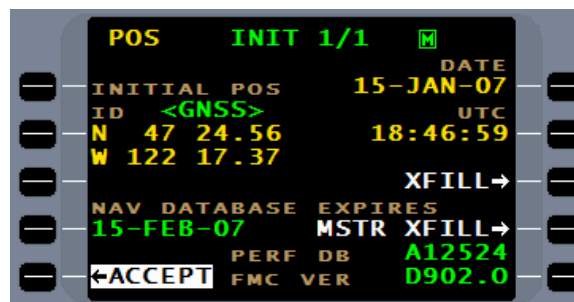
By selecting the 2L line select key, a “**DEFINE POS**” page will appear. This page may be used to define the aircraft’s position in relation to a known fix or by the direct entry of latitude and longitude. The procedures to use this page will be discussed later.




If the “<GNSS>” or “<GPS>” position is accepted (strongly recommended), initialization is complete. If the initial position identifier is filled in and entered, the cursor moves to the date entry field. Revise date and time as necessary. When the GNSS or GPS are in NAV mode, UTC and date are automatically updated. Allowing the GPS to correct the date and time is strongly recommended. Press **ENTER** to advance the cursor. When all data is correct, press the ACCEPT line select key to accept the data. When pressed, the ACCEPT line select key will disappear as will “<GNSS>” or “<GPS>” if used for initial coordinates.

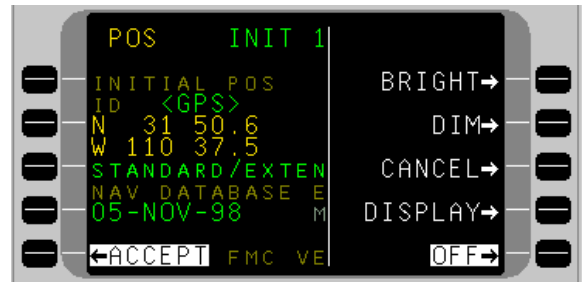


In Multiple FMS installations, a "Xfill" line select key will be available to crossfill initialization data. After initialization is completed on the first system "Xfill" is available to crossfill data. The Xfill feature is configured at time of installation and may be initialization data only, fuel initialization data only, flight plan data only, or "Master Xfill" which crossfills all three. Master Xfill is only available on the ground and will be available only after initialization, flight plan, and fuel entries have been made on one FMS. During crossfill operations, the banner CROSSFILL RECEIVE IN PROGRESS will blink to show system activity.




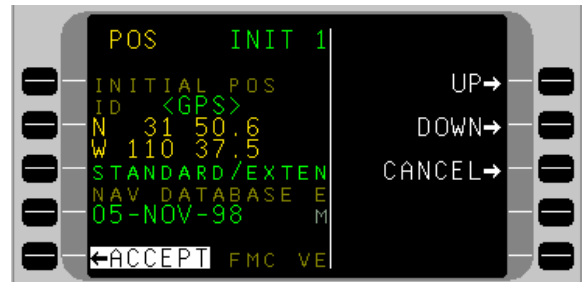
NOTE: Crossfill operation can be configured to push data to the other FMS or pull data from another FMS. Check with the appropriate flight manual supplement for the proper operation.

By pressing the  key, an overlay will be brought up that allows for controlling the brightness of the screen. Press and hold the BRIGHT or DIM line select key to set the preferred screen brightness.

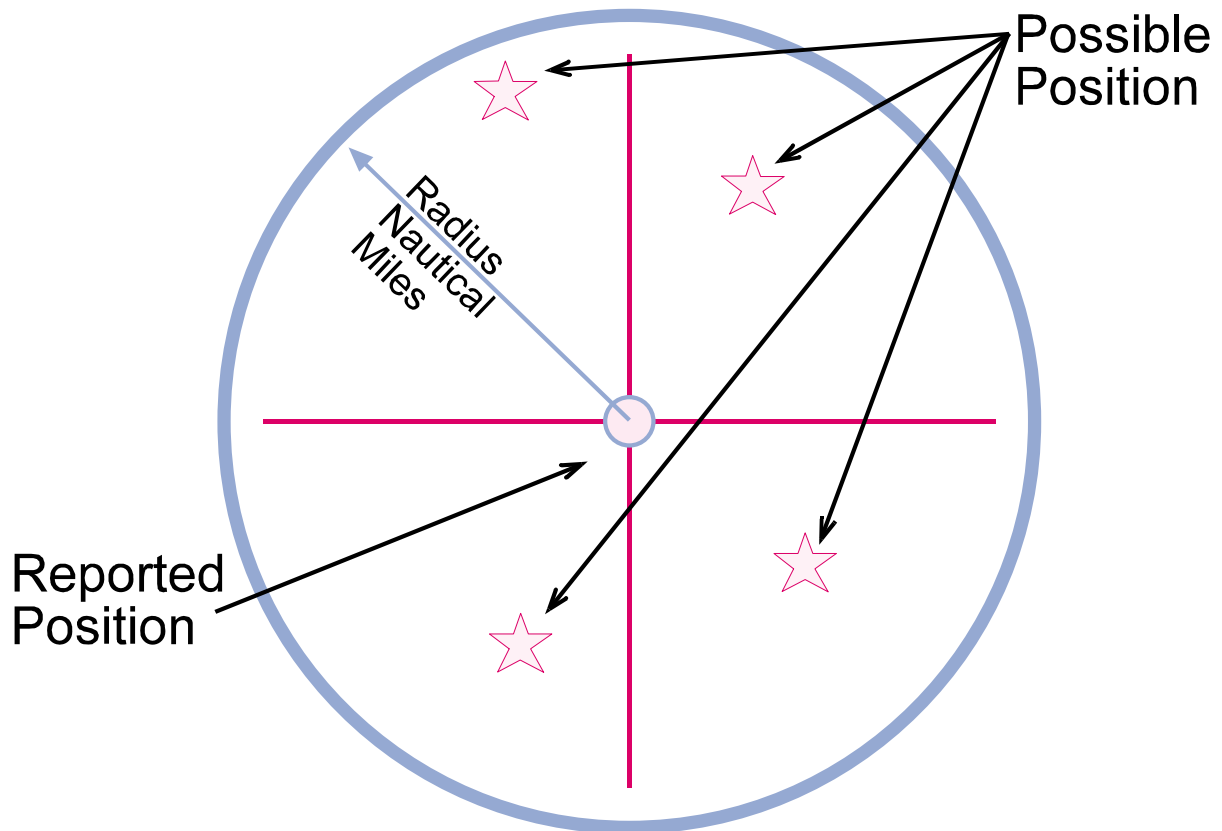


The position of the FMS relative to the pilot may cause a parallax between the display on the screen and the line select keys. To correct any parallax, press the DISPLAY line select key and an overlay will be presented that allows for UP and DOWN line adjustment.

Press the CANCEL line select key to remove the current overlay or the  key to close the entire overlay.

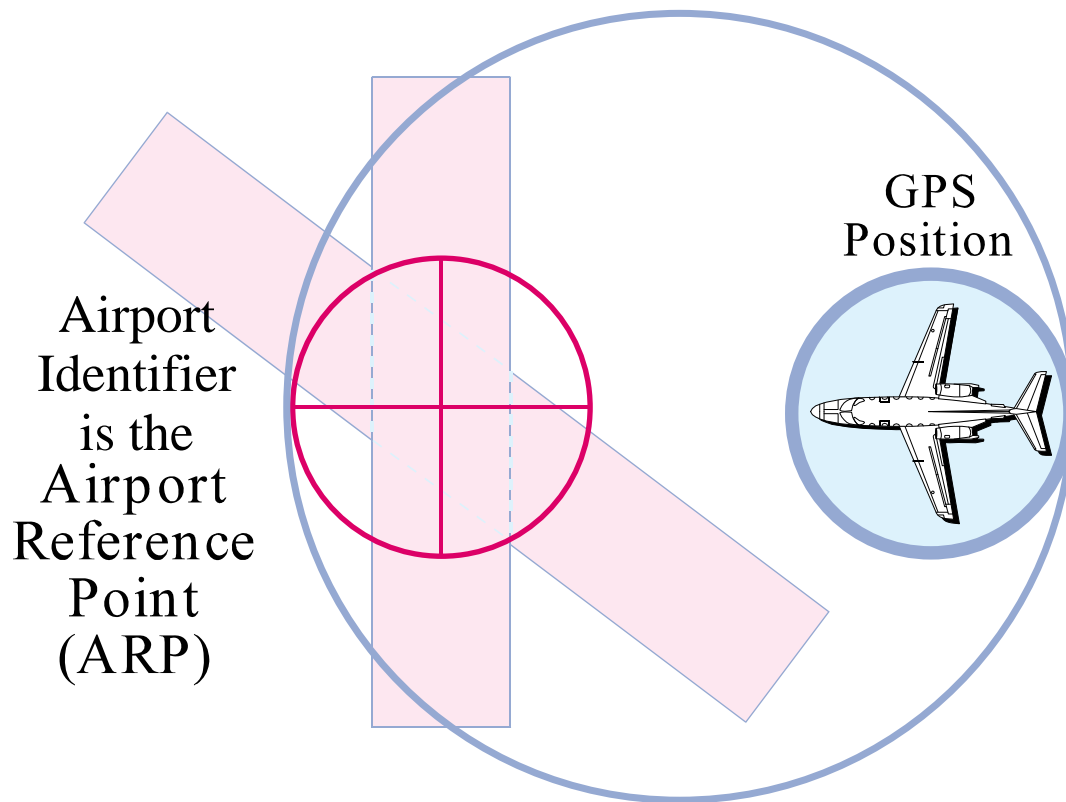


CIRCLE OF POSITION



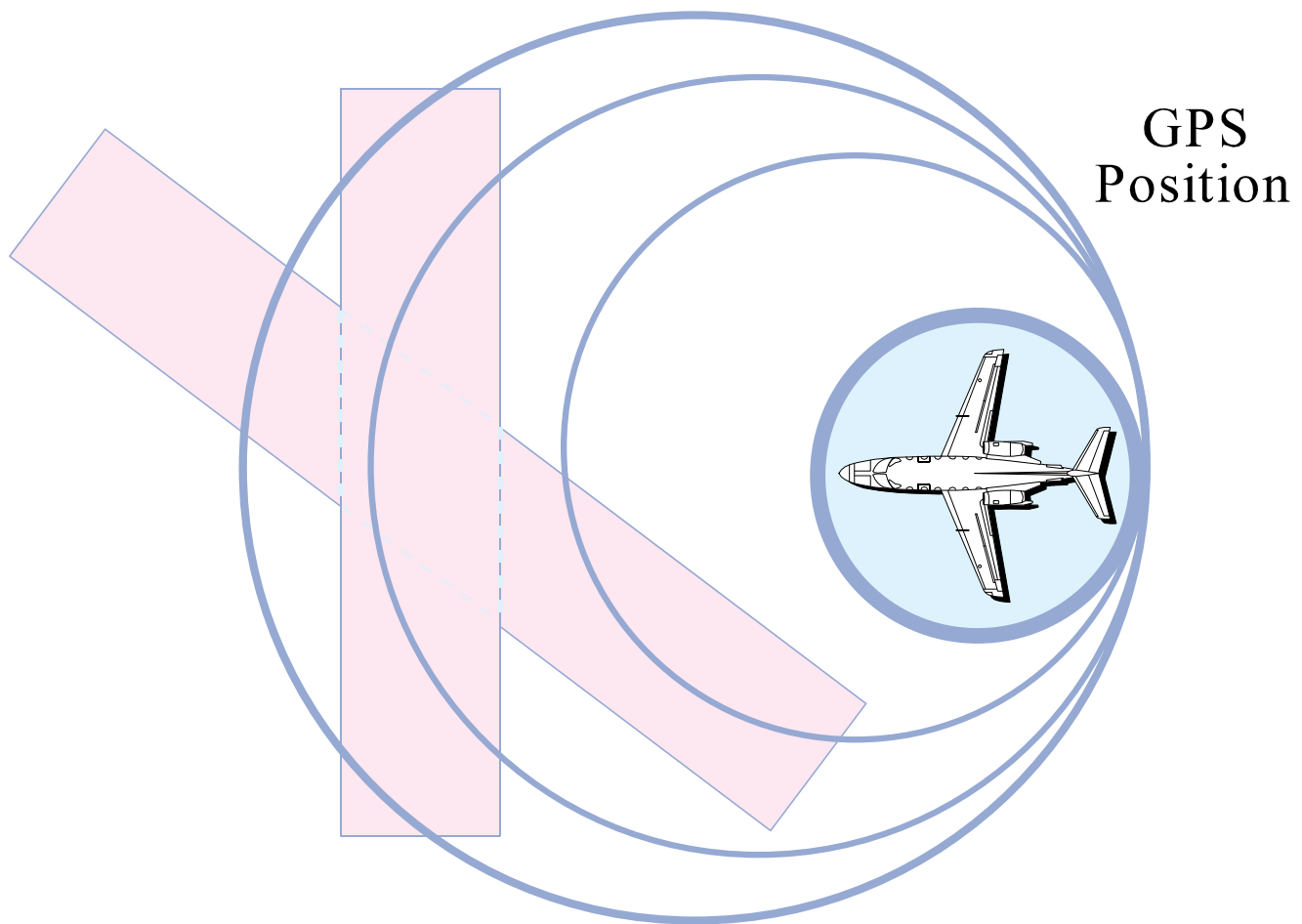
All navigation sensors will produce not a position, but a circle of position. The sensor will compute a position, but because of errors induced by the limits of the sensor's capabilities, other possible positions exist. A circle is drawn around 95% of the possible positions computed as a result of the measured sensor error (2 Sigma). This becomes the Circle of Position. The accuracy of the sensor is measured by calculating the radius of the circle. Thus the true position of the sensor has a 95% probability of being within the defined Circle of Position. The radius of the Circle of Position for the FMS best computed position is known as the Actual Navigation Performance (ANP) of the FMS and is displayed in hundredths of a nautical mile.

USING GNSS or GPS FOR THE FMS INITIAL POSITION



To support the justification for accepting the GNSS or GPS position in lieu of the ICAO airport identifier, the following is presented. GNSS or GPS will acquire the position of the aircraft at its current parking location and present that position to the pilot for initialization. If the pilot decides to place the airport identifier in the ID field in lieu of the <GNSS> or <GPS> indicator, the Airport Reference Point (ARP) will be used to initialize the FMS position. Now the FMS has two sources for its position, the ARP and the GNSS or GPS position. With this position information the FMS calculates its circle of position to include both points. This circle could be very large depending on the distance of the aircraft from the ARP. If the aircraft were to takeoff with the circle of position larger than the RNP for the terminal phase of flight, a position uncertain message will appear. Using the GNSS or GPS position for the initial position will avoid this and is strongly recommended.

CONSOLIDATING THE FMS POSITION

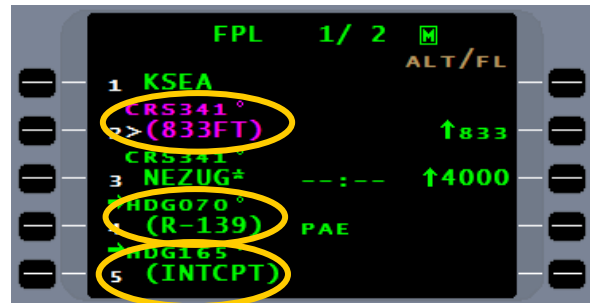


If the ARP is used to initialize the FMS position, the accuracy of the initial position could produce a large circle of position. With time, the FMS will reduce the size of the circle of position to the Horizontal Integrity Limits of the GNSS or GPS and the FMS position will become the GNSS or GPS position. This, however, could take some time. If the FMS presents a position uncertain message (ANP exceeds RNP) after takeoff, the FMS will continue to consolidate the NAV sensor input and eventually the position uncertain message will disappear. Even during the time the position uncertain message is displayed, the FMS will continue to navigate to the best tolerances possible.

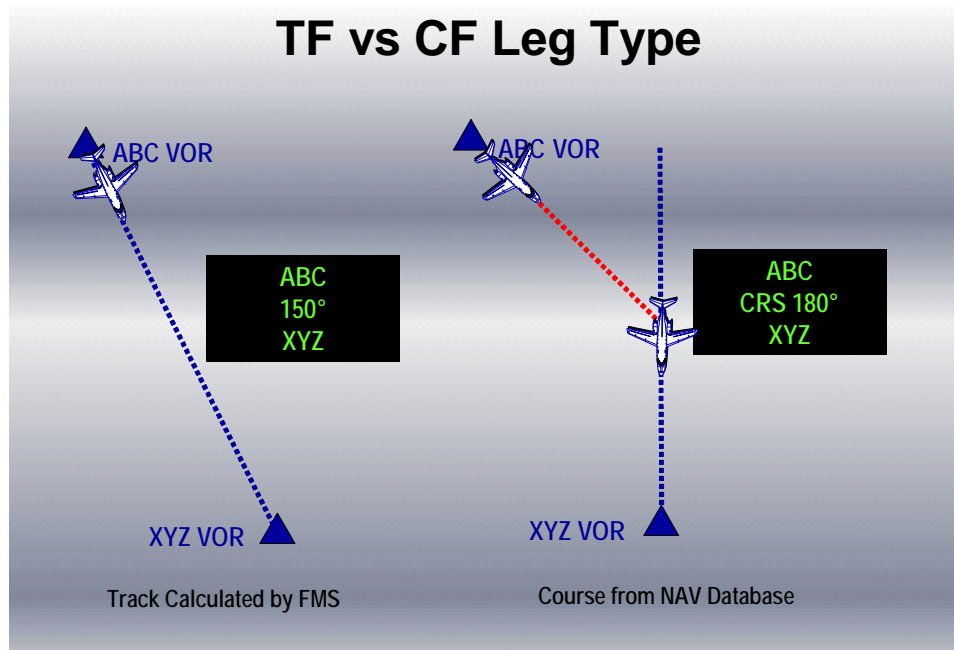
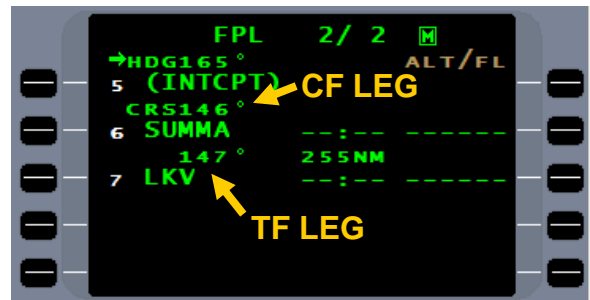
NAVIGATIONAL LEGS

For the FMS to navigate requires a path over the ground and a point of termination to signal the FMS to sequence to the next leg. Aeronautical Radio Incorporated (ARINC), in their specification 424, defines 23 navigational legs that are used by industry software engineers. These navigational legs enable the FMS to emulate a pilot navigating the aircraft. The specific leg types are defined later in this manual.

Newer generation FMS provide the ability to terminate a navigational leg by other than a lat/long. This would be a condition and, therefore, the terminating waypoint would be referred to as a conditional waypoint. Conditional waypoints are identified by parentheses. When the condition is met, such as by reaching an altitude, the FMS will sequence to the next leg. Conditional waypoints are found in departure and arrival procedures.

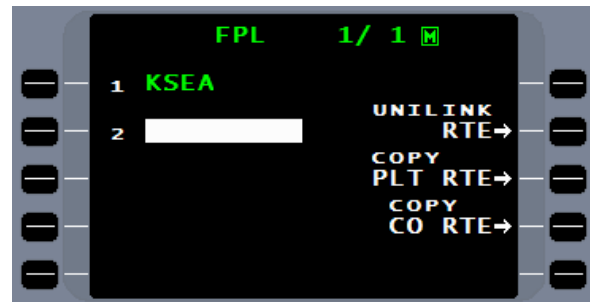


Two of the ARINC 424 leg types are similar and tend to confuse pilots; these are Track to Fix (TF) and Course to Fix (CF). A TF leg is created with in the FMS using starting and ending lat/long waypoints. The FMS calculates a great circle course between the two points using true heading. A continuation of this course line would bisect the center of the earth and, if flown without stopping, would return to the starting point. A CF leg is created and stored in the NAV database in departure and arrival procedures and is identified by CRS preceding the course. If the previous leg terminates at a point not directly in line with the CF leg, the FMS will command a turn to intercept that leg. The maximum intercept angle is 45°, but will turn only to what is required for the intercept.

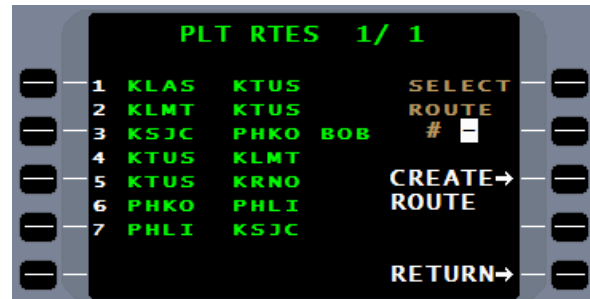


FLIGHTPLAN

Pressing the **[FPL]** key will display the first flightplan page. The first flightplan waypoint will pre-fill with the nearest airport if the ARP is less than 3nm from the aircraft. The cursor will be ready to accept the next point. The COPY PLT RTE and COPY CO RTE (if applicable) line select key will be displayed. The flightplan may be constructed, or a route from the pilot or company database may be copied into the flightplan by pressing the appropriate line select key.

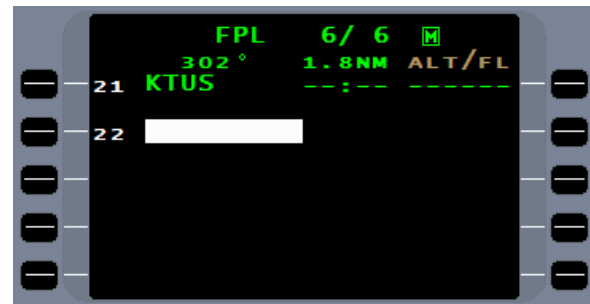


The routes' directory of all existing stored routes may be accessed through the COPY (CO) (PLT) ROUTE LIST pages. Listed routes will be in geographical/alphabetical order. The **[PREV]** or **[NEXT]** keys may be used to move to the page with the desired route.



At the cursor enter the list number of the desired route and press **[ENTER]**.

The route will be copied and the cursor will return after the last waypoint to enter additional points if desired.



Several ROUTE segments can be assembled to the flightplan by the use of the copy route available on the LIST page.

A “Company Routes” database can be created off line with the Universal Flight Planning program and loaded via disk. This database will allow routes to be viewed and copied to the active flight plan, but the flight crew cannot modify the routes themselves. Company waypoints and airports can also be created offline.

FLIGHTPLAN CREATION TIPS

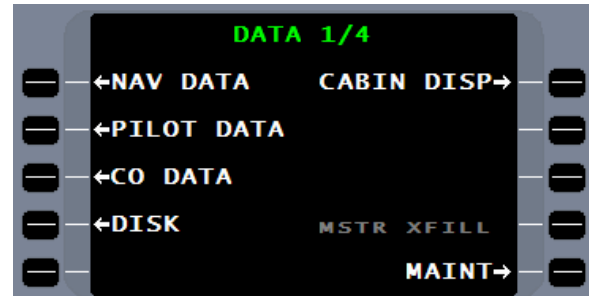
The following tips will assist the new FMS user in remembering how to enter the various flightplan components into the flightplan. The information following the flightplan creation tips will cover flightplan creation in detail.

1. Placing a departure airport on the flightplan/route is required for selection of a SID. This should be accomplished automatically by the FMS during Initialization. It is not recommended that the arrival airport be added to the flightplan until after all airways are entered. This will create a NO LINK and airway entry problems.
2. A departure is created through the FPL MENU key by selecting DEPART.
3. Airways are selected through the LIST function.
4. To enter an airway, use the LIST function which requires a reference waypoint. On the flight plan, this is accomplished by placing a cursor on the flightplan with a line select key. The waypoint prior to or above the cursor position is the reference waypoint.
5. Placing a destination airport on the flightplan /route is required for selection of a STAR and/or approach.
6. A STAR and an approach are selected through the FPL MENU key by selecting ARRIVE.
7. The selection of a runway on the arrival page is used to direct a STAR to a specific runway.
8. A STAR need not be entered for an approach to be selected. Pressing the line select key next to APPR will bring up the available approaches for that airport.
8. When selecting an approach, recommend selecting a transition for the approach when available.

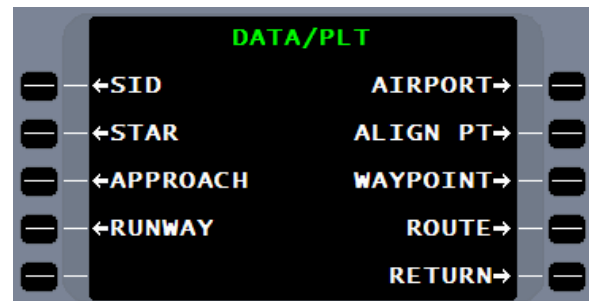
FLIGHTPLAN & ROUTE CREATION

Although Pilot Flightplans and Pilot Routes are accessed through different function keys, the method for their creation is basically the same.

The UNS-1 provides for storage of up to 200 pilot defined routes. Stored routes may contain a SID, route of flight waypoints, a STAR, and an approach. To create a pilot defined route or edit an existing one, press the "PILOT DATA" line select key.



Press the ROUTE line select key for the routes catalog page.

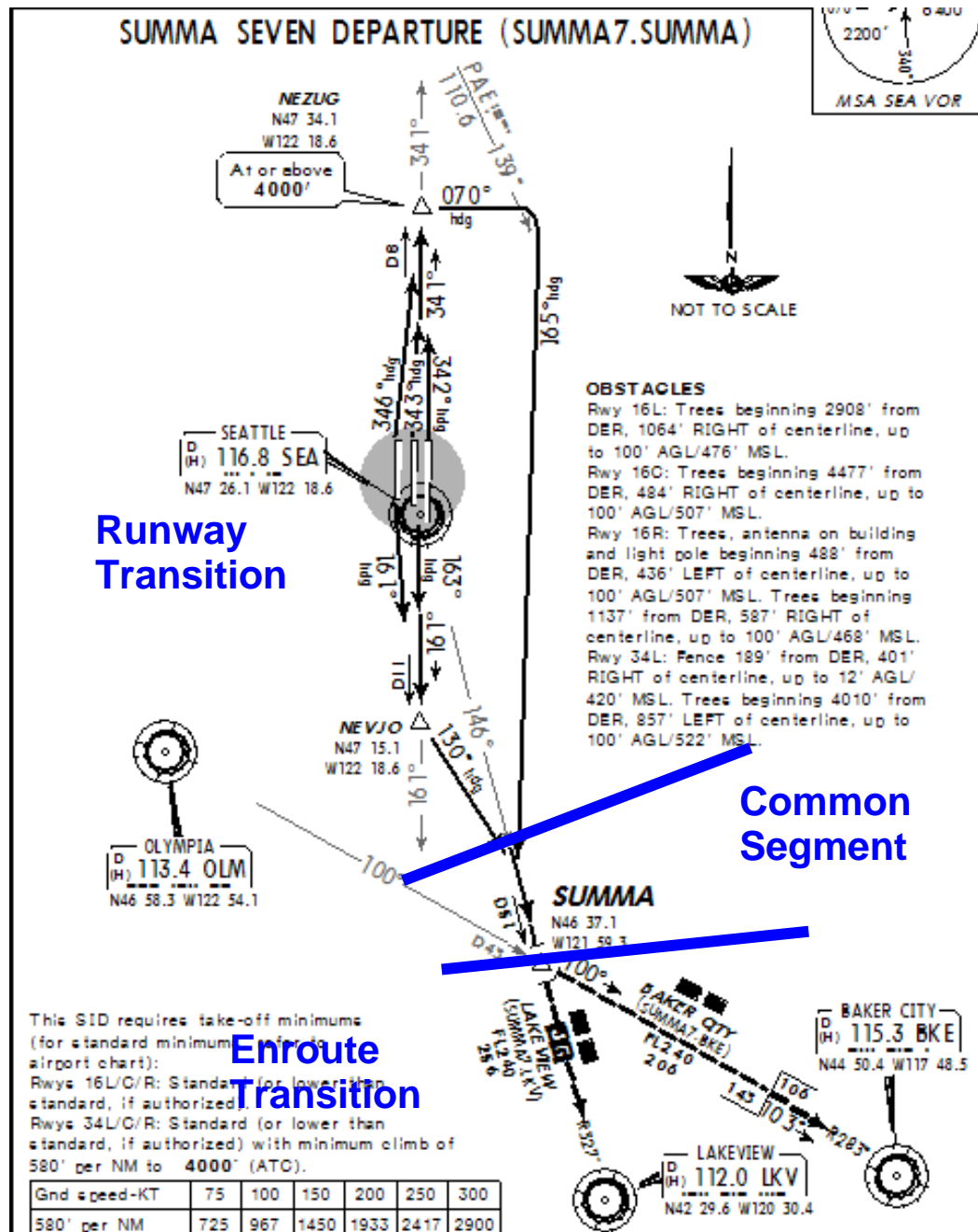


The stored routes will be listed in alphabetical order. The route titles listed here will always begin with the first route waypoint, plus the route name defined by the pilot, or the last waypoint if no name is entered during route construction.

To view or edit an existing route, enter the number of the route from the list at the cursor. Where NAV data has changed within a PLT RTE with the activating of a new NAV database, the route will flash indicating that editing is required. To create a new route, press the CREATE ROUTE line select key.



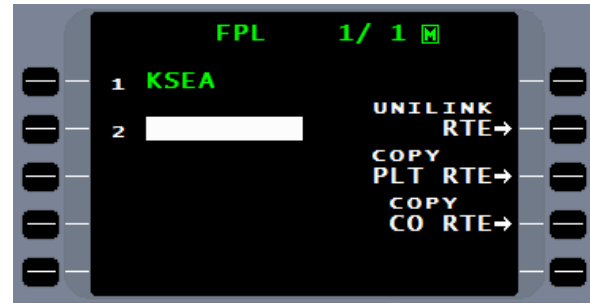
DEPARTURE SELECTION OF THE SID



Standard Instrument Departures (SID) can have up to three segments.

1. Runway Transition – unique routing from one or more runways
2. Common Segment – all transitions pass through this segment
3. Enroute Transition – unique routing to one or more enroute waypoints

Enter a SID or if there is no SID at the airport, enter the first waypoint on the route of flight. A radar vector or direct type SID will not appear in the SID listing.



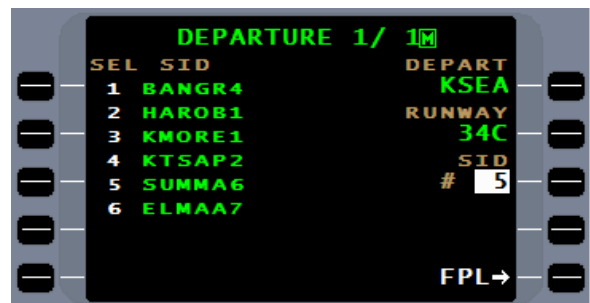
Press the **MENU** key to display the flightplan menu. Press the DEPART line select key.



The DEPARTURE 1/1 page will be displayed. Select Runway 34C by entering number 3 from the runway list in the cursor then press **ENTER**. This will identify the Runway Transition.



Select the Summa 6 SID by entering number 5 in the cursor then press **ENTER**. This will identify the SID and take the routing through the Common Segment.



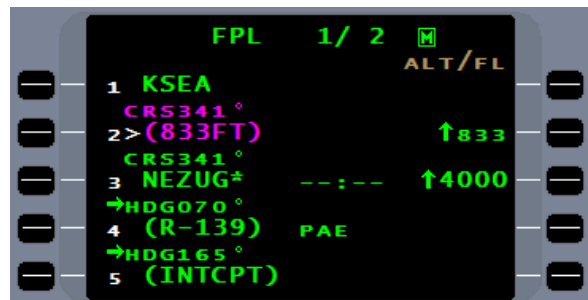
Select the LKV transition by entering number 2 in the cursor and then pressing **ENTER**. This will identify the Enroute Transition.



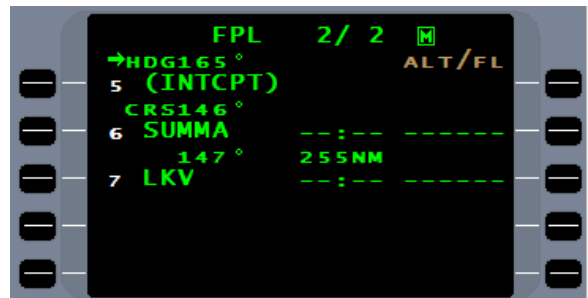
The SID is now linked to the flightplan. Return to the flightplan by pressing the FPL line select key.



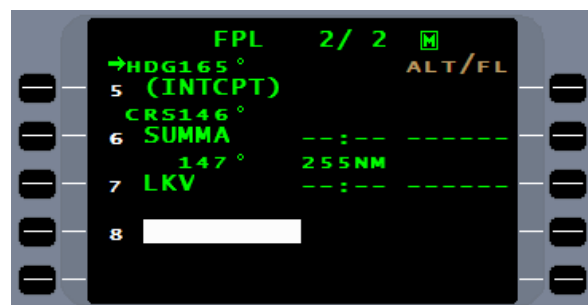
Page 1/ 2 of the flightplan page will appear.



By using the **NEXT** key, move to page 2/ 2 to continue building the route.



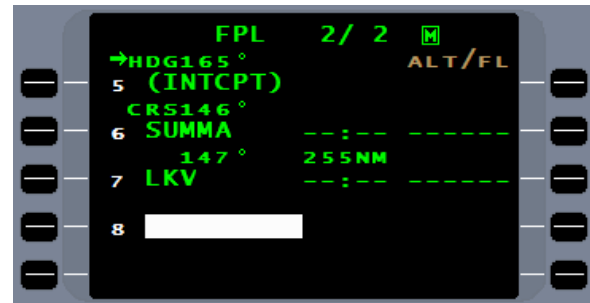
Use the line select key to place a cursor on the page below **LKV**. The **ENTER** key will also make the cursor appear and move down the page.



LIST FUNCTION

The LIST function allows for direct entry of a VOR, APT, NDB, Intersection, Airway, GAP, or another route.

The LIST function begins by using the waypoint above the cursor as the reference point. Thus, before the LIST function will work, a cursor must be placed on the page. If the cursor position is a “*NO LINK*”, the “*NO LINK*” must be deleted before using the LIST key or the AIRWAYS line select key will not be selectable.



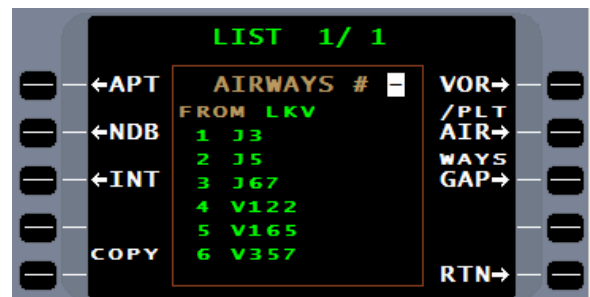
The LIST function uses a smart search to take the seven closest waypoints in an elliptical pattern in the current direction of the aircraft's route of flight and presents them on page 1/10 in alphabetical order. The remaining nine pages will continue to present waypoints in an ever increasing distance from the reference point. One technique to help in the LIST functions direction of search is to place the destination identifier in the route of flight.



The PLN LANG line select key will display the name of the fix beside the identifier where applicable. Placing the number of the desired waypoint in the cursor will enter the fix in the flightplan cursor. The closest waypoint to the reference waypoint is defaulted in the field, but entering a number will overwrite the default number.



Selecting the AIRWAYS line select key will present a list of airways that use **LKV** as a waypoint. The AIRWAYS selection will not be available where the LIST reference point is not a waypoint on an airway. The route of flight calls for J5. Enter 2 in the cursor field and press **ENTER**



NOTE: The active NAV database being used will affect the data that is provided by the list function.

A list of waypoints for airway J5 is presented on two pages.



Use the **NEXT** key to move to page 2/ 2 for selection of **LANDO** the airway change over point. Enter 2 for **LANDO** and press **ENTER**. Use the airway list function to enter J65 to KOFFA and J104 to TUS with the same procedure as above.



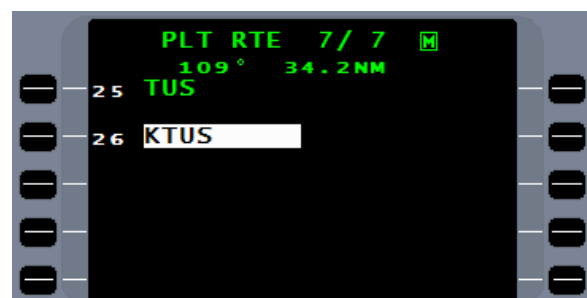
An alternate method for selection of an airway end point is to directly, with the use of the alphanumeric keys, enter the waypoint in the **TO** field. A waypoint entry not on the airway will result in a flashing waypoint in the **TO** field.



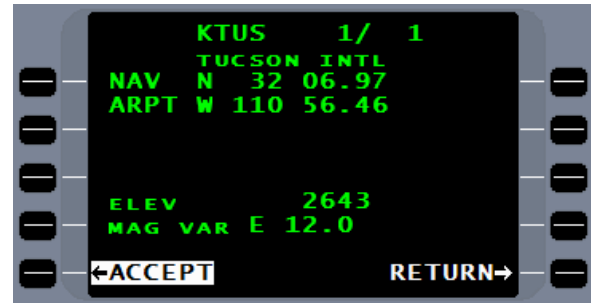
With the route of flight completed to **TUS**, the entry of the destination airport is necessary for the FMS to present the STAR and Approach.



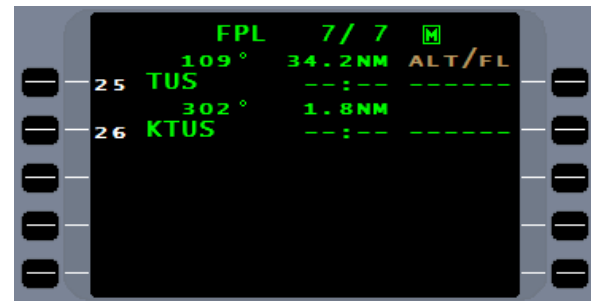
Either enter KTUS directly in the cursor field or use the airport option in the **LIST** function to search for KTUS.



Pressing **ENTER** will cause the FMS to access the NAV database and present the found information. Verify the information before accepting it. With the cursor over the **ACCEPT** line select key, the **ENTER** key will accept the displayed information.



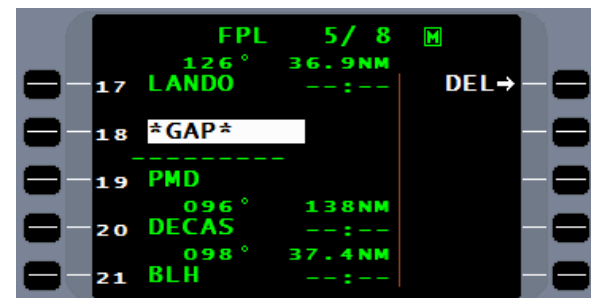
The Pilot Route creation may be terminated at this point for entry of the STAR and Approach at the time of the flight. If runway information for selection of the STAR and Approach are not available at the time of departure, the flightplan can be edited in flight to add them.



The COPY RTE line select key will allow selection of an existing route and copy it into the route being created. This feature can be useful if a series of waypoints that aren't part of a published procedure are routinely issued in a clearance. This small segment of waypoints can be stored as a pilot route and inserted where required to expedite creation of the route of flight.



The GAP line select key in the LIST function will insert a *GAP* into the route of flight preventing automatic leg sequencing beyond the GAP. This feature can be used to mark a clearance limit or allow a break for search and rescue.



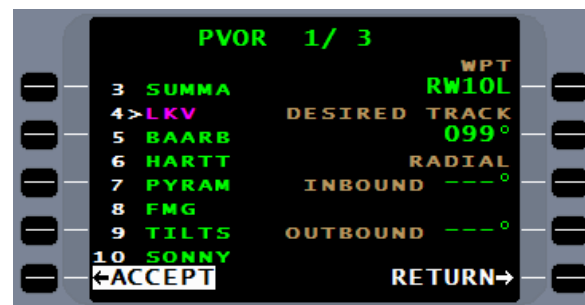
With SCN 803, when doing tactical operations such as PVOR, DTO, and HOLD, the LIST function will provide a RWY option.



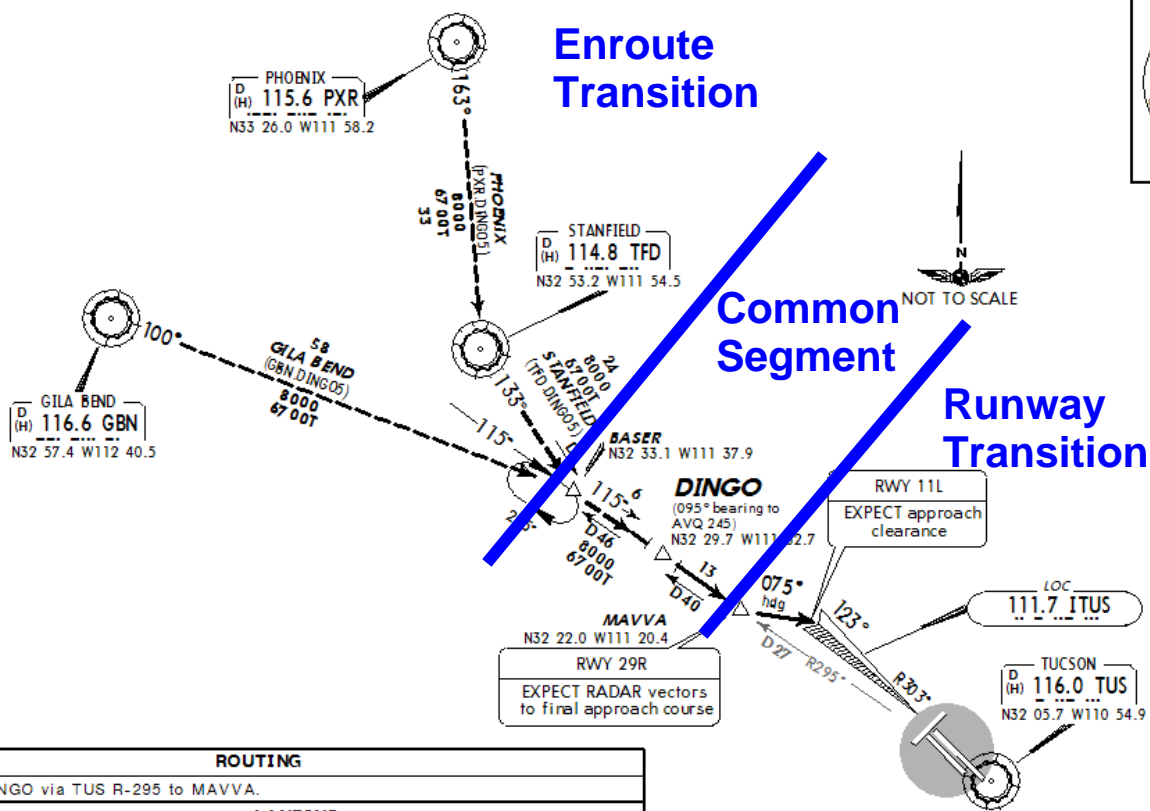
The RWY option will present the airport identifier and runway. The runway coordinates are that of the runway threshold.



When the RWY option is used with PVOR, the runway heading is automatically entered as the DESIRED TRACK. Accepting this will present, on the NAV page, a PVOR with runway course information.



ARRIVAL SELECTION OF STAR AND APPROACH

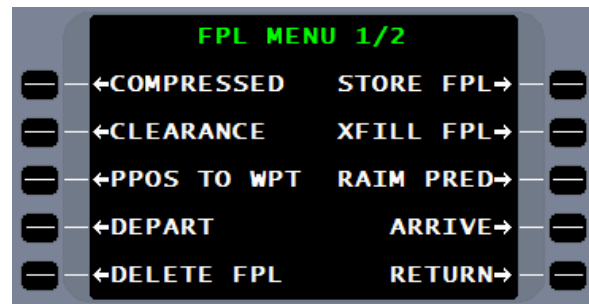


ROUTING	
From over DINGO via TUS R-295 to MAVVA.	
RWY	LANDING
11L	From MAVVA via 075° heading to intercept ITUS localizer or TUS R-303 and EXPECT approach clearance for runway 11L.
29R	EXPECT RADAR vectors to final approach course for runway 29R.

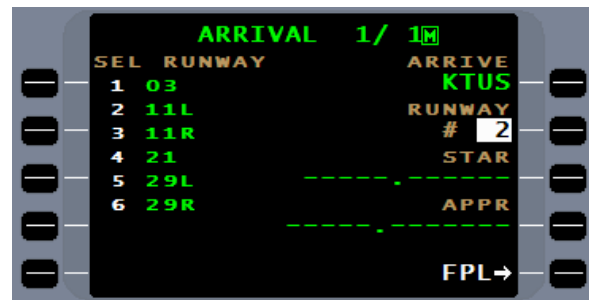
Standard Terminal Arrival Route (STAR) can have up to three segments.

1. Enroute Transition – unique routing from one or more enroute waypoints
2. Common Segment – all transitions pass through this segment
3. Runway Transition – unique routing to one or more runways

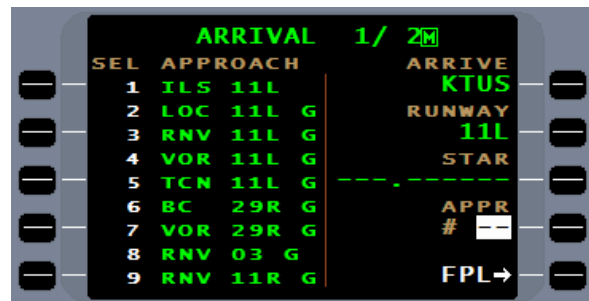
To add a STAR and/or approach, select the flightplan or route menu. Then press the ARRIVE line select key.



Select the arrival runway, **11L**, by entering 2 in the cursor field. The selection of the runway is necessary for determining the runway transition of the STAR. When entering an arrival, always enter a runway. Select the one most likely to be the active runway for landing. If the selection is incorrect, it can be changed by returning to the arrival page and pressing the runway line select key.



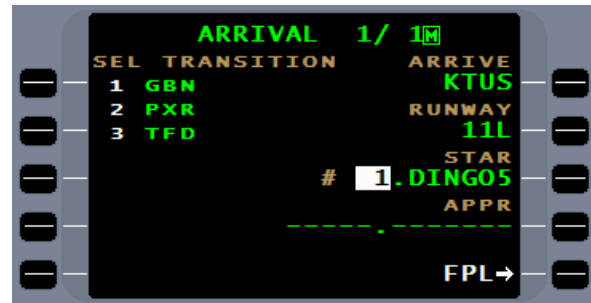
If no STAR is available, use the line select key and go directly to APPR for selection of the Approach.



Enter the number for selection of the STAR and press the **ENTER** key.

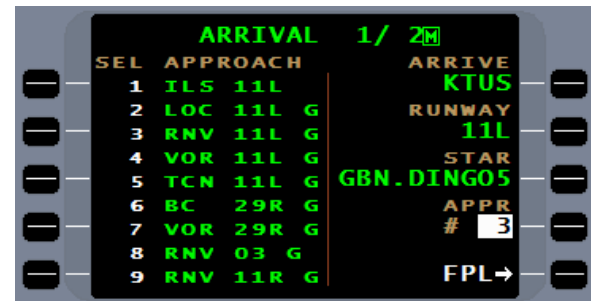


If a transition is presented, enter the number and the cursor will move to the approach selection. If (NONE) appears, press the **ENTER** key or APPR line select key for the approach selection.



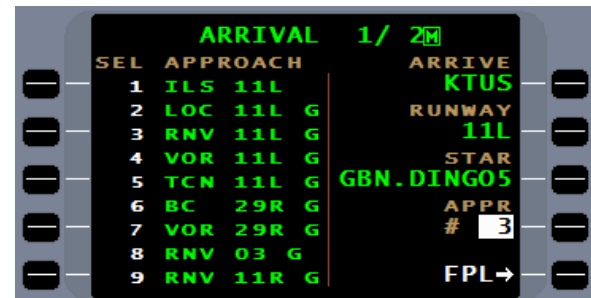
Select the approach by entering the corresponding number in the cursor and pressing enter.

More approaches are available in the approach section through **ARRIVAL** page 2.



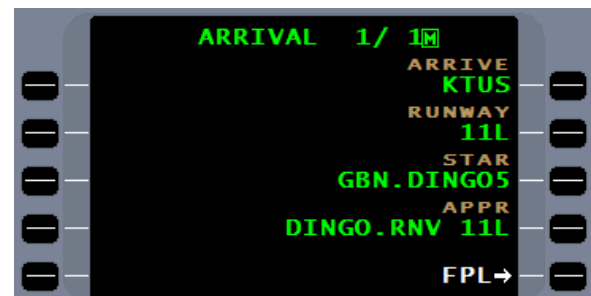
NOTE: The “G” following the approach does not indicate the approach is a GPS approach overlay, but merely that the FMS will retain the GNSS OR GPS sensor to assist in navigation accuracy. The “G” will not be present for approaches not surveyed in accordance with WGS-84 or when GNSS or GPS is not authorized by the country of origin.

If a transition is presented, make the appropriate selection and the arrival is complete.



NOTE: It is strongly recommended that you select a transition, even if you don’t anticipate having to fly to the beginning of the transition, otherwise vital approach procedures may be unavailable.

Press the PLT RTE or FPL line select key to return to the pilot route or flightplan.



STORING & NAMING THE ROUTE

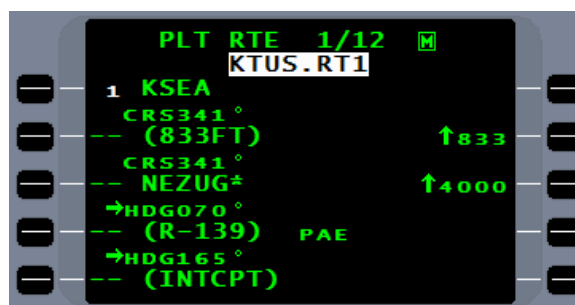
If the plan is to use this flightplan in the future, the flightplan needs to be stored as a pilot route. The flightplan menu offers the STORE FPL line select key for this purpose. Pressing this key will make an electronic copy of the flightplan and store it as a pilot route.



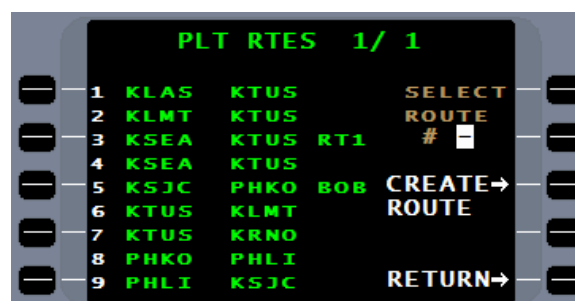
A route may be given a name with up to 8 alphanumeric characters if desired. The name on the route directory will be the first waypoint plus the given name. If no name is entered, the FMS default name is the first waypoint plus the last waypoint. An example for the route Seattle International to Tucson International is "KSEA KTUS".



By entering a unique name, this route can be identified from another KSEA KTUS route. Enter the desired title at the cursor (the \pm key will place a period that can be used for a space), and press **ENTER**. It is recommended that the destination identifier be used in the title since the title will automatically replace the destination on the RTE page.

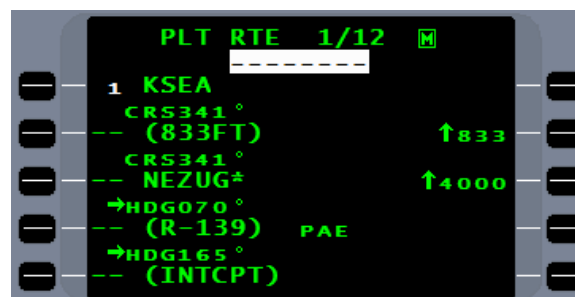


The name field is especially useful when 2 routes have the same origin and destination but different routing.



To move the cursor to the title field, remove the cursor from the page and then press **ENTER**.

The title will not be copied with the route to the flightplan.



ROUTE AND FLIGHTPLAN SUMMARY PAGE

Located after the last page of the pilot route or flightplan is the **PLT RTE SUMMARY** or **FPL SUMMARY** page. This page can be used to estimate time enroute and fuel required. It can be used to determine takeoff and arrival times for both UTC and local. The **FPL SUMMARY** page is available only on the ground because real time information is available in flight. The **PLT RTE SUMMARY** page is always available to the associated pilot route.

Using the associated line select keys for **TAS** or **GS**, **FF**, and **RESERVES**, the necessary information can be entered for the FMS to do the required calculations. These figures will become default for future SUMMARY pages.

On the **FPL SUMMARY** page **TAS** is used and, as a result, time in route can be adjusted for wind. The forecast wind page is discussed later.

By entering **GS**, **FF**, and **RESERVES** along with the **ETD UTC** the arrival time can be calculated in UTC. By entering the local differential from UTC, local arrival can be determined. To access the **LCL** line, press lineselect key 2 followed by the **ENTER** key. By entering a new time in either **ETD** or **ETA**, the associated times will be adjusted. By entering the forecasted winds into the flightplan (discussed latter), the **FPL SUMMARY** page will adjust the time in route.

The **FPL SUMMARY** page is similar to the **PLT RTE SUMMARY** page. A CO RTE SUMMARY page is also associated with each company route.

PLT RTE SUMMARY		
DEPART	1240NM	ARRIVE
KSEA		KTUS
ETD UTC	--+--	ETA UTC
--:--		--:--
-- LCL		-- LCL
--:--		--:--
GS (MAN)		RESERVES
0		0
FF (MAN)	LBS	MIN FUEL
0		-----

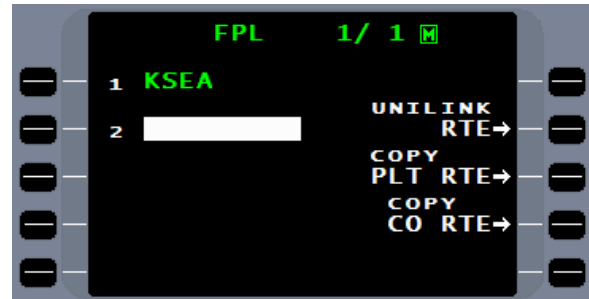
FPL SUMMARY		
DEPART	1347NM	ARRIVE
KSEA		KTUS
ETD UTC	--+--	ETA UTC
--:--		--:--
-- LCL		-- LCL
--:--		--:--
TAS (MAN)		RESERVES
0		0
FF (MAN)	LBS	MIN FUEL
0		-----

PLT RTE SUMMARY		
DEPART	1240NM	ARRIVE
KSEA		KTUS
ETD UTC		ETA UTC
14:00	2+53	16:53
- 7 LCL		- 7 LCL
07:00		09:53
GS (MAN)		RESERVES
430		1500
FF (MAN)	LBS	MIN FUEL
1500		5826

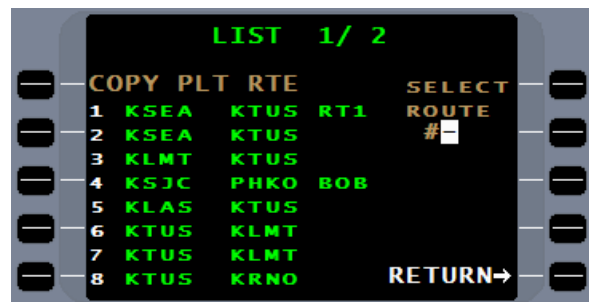
FPL SUMMARY		
DEPART	1347NM	ARRIVE
KSEA		KTUS
ETD UTC		ETA UTC
14:00	3+07	17:07
- 7 LCL		- 7 LCL
07:00		10:07
TAS (MAN)		RESERVES
430		1500
FF (MAN)	LBS	MIN FUEL
1500		6191

COPYING PILOT ROUTE TO FLIGHTPLAN

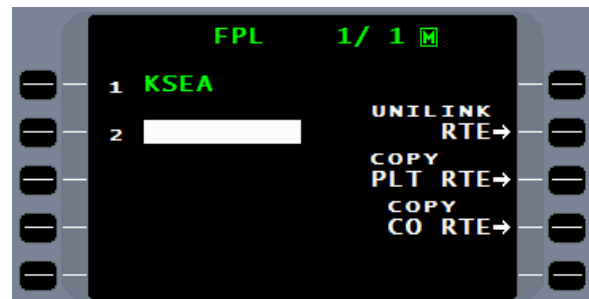
Pressing the **FPL** key will display the first flightplan page. If required, to delete an existing flightplan and copy a ROUTE, press the **MENU** key and then the “DELETE FPL” line select key. The key must be pressed a second time to confirm deletion. The “COPY RTE” line select key will be displayed. A route from the pilot database may be copied into the flight plan by pressing the COPY PLT RTE line select key.



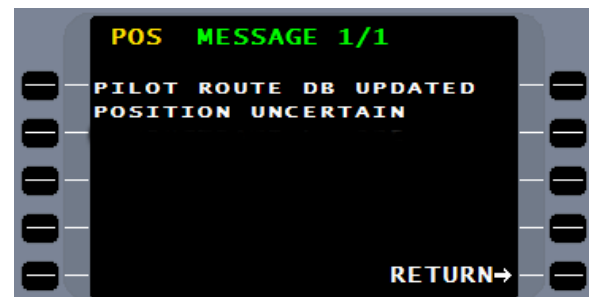
The route directory of all existing stored routes is accessed through the COPY ROUTE LIST pages. The route titles will always begin with the first waypoint plus the pilot defined route name or the last waypoint if no route name was entered. Listed routes will be in geographical/alphabetical order. The **PREV** and **NEXT** keys may be used to move through the pages. Enter the route number into the **SELECT ROUTE** field and press **ENTER**. The selected route will be copied to the flightplan.



Company routes and Unilink routes can be accessed in the same manner as the pilot routes and copied to the flight plan.



The Navigation database is updated every 28 days. As a result of refined methods for determining positions, the location of some waypoints may change with a new database. If changes to the pilot database occur, a message will be presented following the accepting of the initial page. If a relocated navigation waypoint is contained within a stored route or in pilot defined data, the change will be noted by flashing of the name of the stored route or procedure, and the individual waypoint as follows:



Minor Change - waypoint name flashes
To remedy, place cursor over the waypoint and press **ENTER**.

Major Change - flashing *GAP* appears
To remedy, reenter the waypoint if it's still in the NAV database, delete the *GAP* from the route, or edit the flightplan to establish a new routing.

FLIGHTPLAN AND PILOT ROUTE MENU

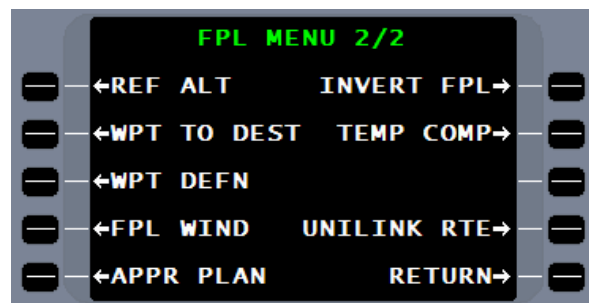
The availability of a menu is identified by **M** in the upper right corner of the page. Pressing the **MENU** function key will present the corresponding menu.

The **FPL MENU** and **PLT RTE MENU** have many of the same options. SCN 801 has COMPRESSED on page 2 and NORMAL on page 1. The NORMAL (SCN 801) selection will return to the normal flightplan or pilot route legs.

The DEPART and ARRIVE options are the same for both the FPL and PLT RTE.

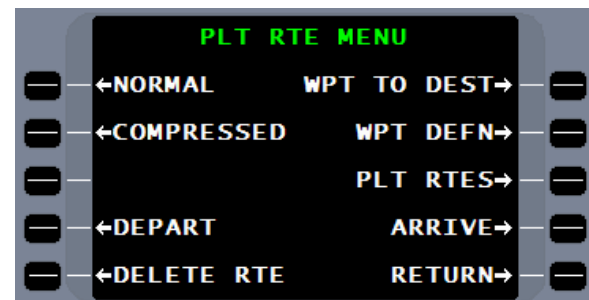


Pressing the **MENU** key a second time or using the **NEXT** key can access **FPL MENU 2/2**.

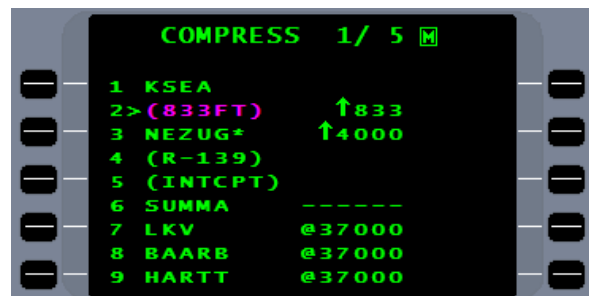


Both the DELETE RTE and DELETE FPL selections will delete the selected pilot route or the current flightplan. A double push of the line select key is required.

Selection of PLT RTES returns to the PLT RTE catalog page.



The COMPRESSED option will take the flightplan or pilot route and compress the waypoint list for quick review of the route of flight. No editing can be done through this option. The COMPRESSED format, starting in SCN 802, differs from that of SCN 801 by adding altitude information.



The CLEARANCE option presents the flightplan in a format that resembles an ATC clearance. This option is available for the flightplan and, in SCN 803, pilot route menus.



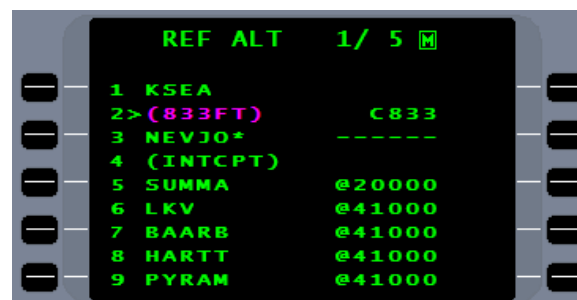
The PPOS TO WPT option will present the flightplan waypoints with the distance from the aircraft's present position and the time. Time enroute for FPL on the ground is a function of the speed entered on the SUMMARY page. In flight, time is calculated using the current aircraft ground speed or if flightplan forecast winds are entered, TIME will be adjusted for forecast winds.



On FPL MENU 1/2, XFILL FPL and RAIM PRED are discussed later.



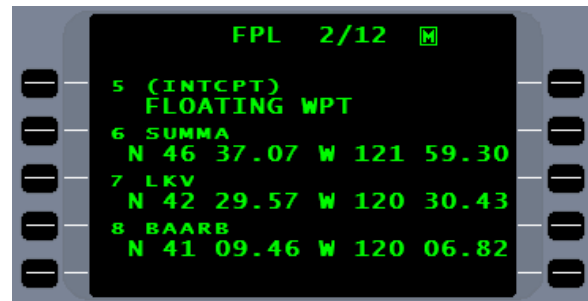
Beginning with SCN 802, on FPL MENU 2/2, if TAWS is installed, a new option, REF ALT is added on line select key 1L, to display TAWS and VNAV altitudes and database altitude constraints.



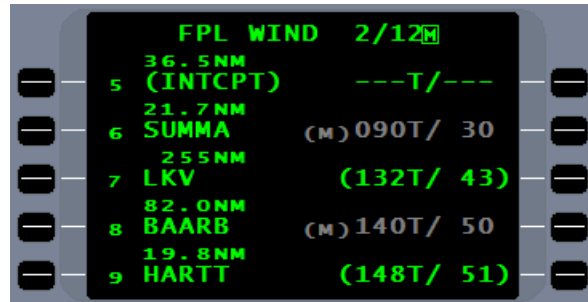
WPT TO DEST or waypoint to destination is distance from a listed waypoint to the flightplan destination. Time enroute for FPL on the ground or pilot route is a function of the speed entered on the SUMMARY page. In flight, for the flightplan, time is calculated using the current aircraft ground speed or if flightplan forecast winds are entered, TIME will be adjusted for forecast winds.



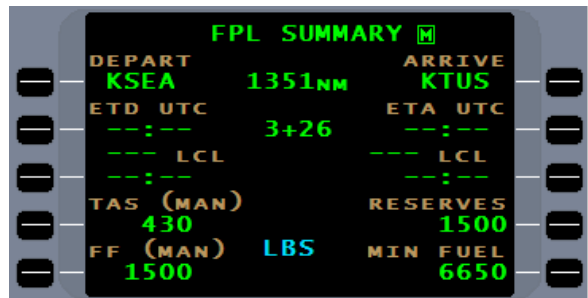
WPT DEFN will show how the waypoint is defined. A floating waypoint (also known as a conditional waypoint) is not terminated at a latitude/longitude position or fix, but by a set of conditions such as a course to altitude or heading to intercept. (See Procedural Leg Types)



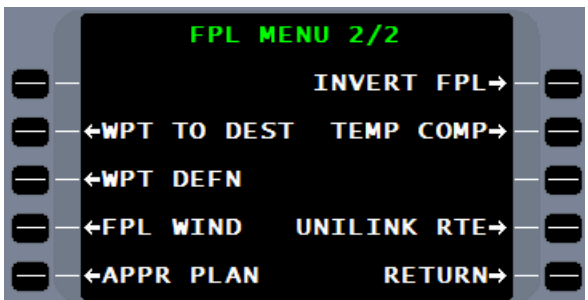
Forecasted winds can be entered into the flightplan through the FPL WIND menu option. Pressing the line select key on the right side adjacent to the waypoint allows for a manual entry of wind direction (true heading) and velocity. A manual wind entry need not be input at every waypoint. The FMS will interpolate winds between manual entries. During flight the FMS will use the current wind for time calculations to the next manual wind entry waypoint and forecast winds from that point on. As the waypoint with the manual wind entry is over flown, the manual wind will be replaced with the current wind and the subsequent waypoints will reflect the current wind until the next waypoint with a manual wind entry.



Together with the pilot route summary page, the affect of forecast winds on time enroute and fuel required can be estimated.



Selection of the INVERT FPL option will result in the flightplan route of flight being reversed. The SID, STAR, and Approach will be dropped and with the entry of a new SID, STAR, and approach, the FMS will present a new flightplan to the original departure point.

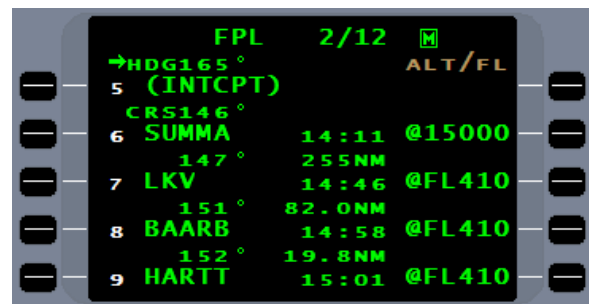
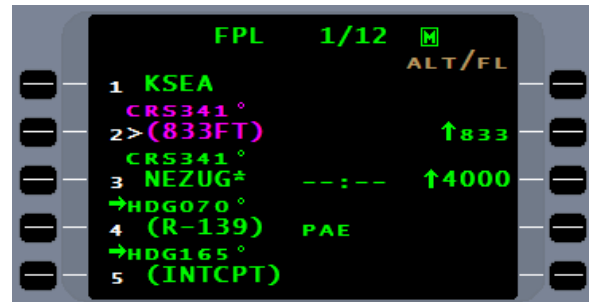


TEMP COMP will be covered in the approach section.

Other MENU options such as UNILINK RTE are covered with the purchase of optional FMS equipment.

FLIGHTPLAN ANALYSIS AND EDITING

FPL 1/12 offers the following information. The “TO” waypoint is identified by the change in color and by the “>” sign. When a SID is used for the departure, in most cases, the first navigation leg will reflect a climb in the takeoff corridor in accordance with standard takeoff procedure. In this case, runway course to 833ft MSL equals 400ft AGL. The FMS will then command the aircraft to turn and intercept the 341° course to **NEZUG**. The identifier, **NEZUG** is followed by an “*”. This indicates that it is an overfly waypoint, requiring the aircraft to physically fly over the waypoint before the FMS will sequence to the next leg. The aircraft will then turn right as indicated by the “→” to a heading of 070°. Upon crossing the PAE 139° radial the aircraft will be commanded to turn right to a heading of 165° to intercept the SEA 146° course to **SUMMA** intersection. ETA time is computed based on groundspeed when airborne. Altitudes displayed to the right of the page are advisory only. Only altitudes displayed on the left, as leg terminators, will affect a leg change.



NOTE: When a leg terminates with an altitude, that altitude must be met before the FMS will sequence to the next leg.

If a runway change occurs, a new SID can be selected by pressing the **MENU** key, then DEPART.



By pressing the RUNWAY line select key, the runway options will appear. Select the new runway such as number 2 for 16R and press enter.



Since the SID selection remains the same, press FPL to return to the flightplan.



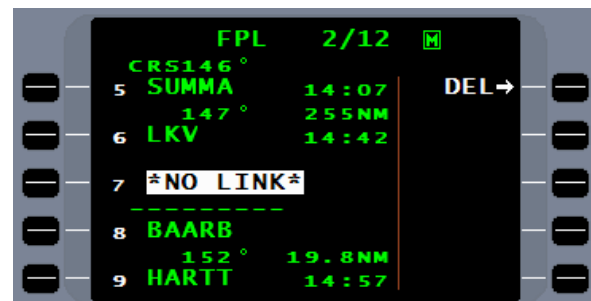
The new SID routing reflecting a runway 16R departure has replaced the old SID routing for runway 34R.



When the SID, Route of Flight, STAR, and approach are linked together to make the flightplan, a common point between each part is required to maintain continuity. When that point does not exist, the FMS places a flashing “*NO LINK*” in the flightplan to alert the pilot of the need to review, and if necessary, edit the flightplan. When the flightplan was created the SID terminated at LKV and the airway began at LKV; continuity. The waypoint LKV however was linked to the SID not to the airway. In the process of replacing the SID routing from runway 34R to 16R, LKV along with the rest of the 34R SID was deleted leaving BAARB as the beginning of the airway. The new SID routing for 16R was then entered with LKV as the SID termination. Since the airway now begins at BAARB, there is no common point for continuity thus a “*NO LINK*”. SCN 803 has logic that has improved the linking process when a runway change is made for a SID or STAR.



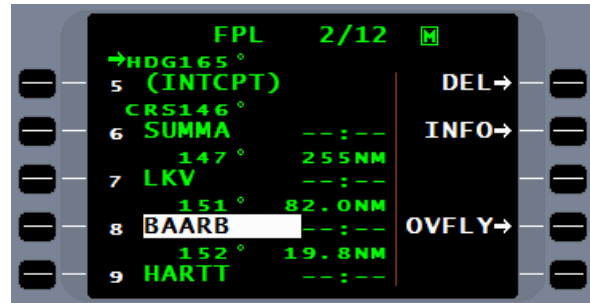
To remove the “*NO LINK*” press the adjacent line select key which will bring up an overlay with DEL. Pressing the DEL line select key will highlight DEL and pressing it a second time will delete the “*NO LINK*”.



NOTE: It is important to review the route or flightplan after linking a SID or STAR procedure to address any “*NO LINK*” messages that may have been added.

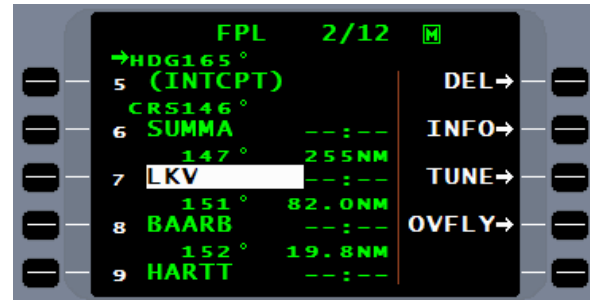
NOTE: At the end of the flightplan a “*NO LINK*” will separate the last waypoint of a STAR or approach from the destination airport. This “*NO LINK*” should not be deleted.

The “*NO LINK*” is removed and the cursor is now over BAARB. The overlay window in addition to DEL also contains INFO and OVFLY.



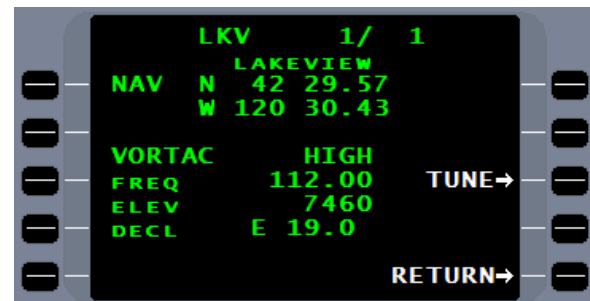
Press the line select key for the VOR LKV and the overlay window appears.

If the aircraft is equipped with remote tunable VHF NAV radios, the LKV frequency can be tuned by pressing the TUNE line select key.

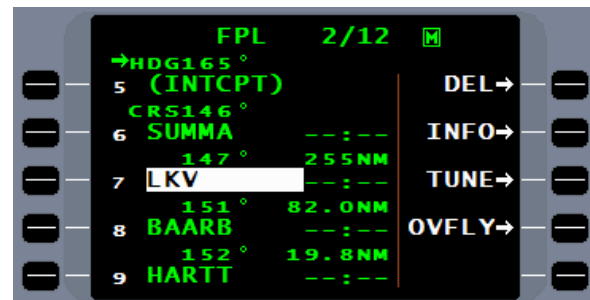


Pressing the INFO line select key will access information about this VOR.

The TUNE option is again available.

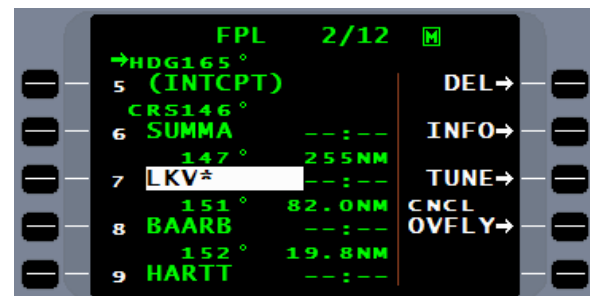


The FMS will make all turns as “Smart Turns”. In a smart turn the aircraft will lead the turn. (See following figure)

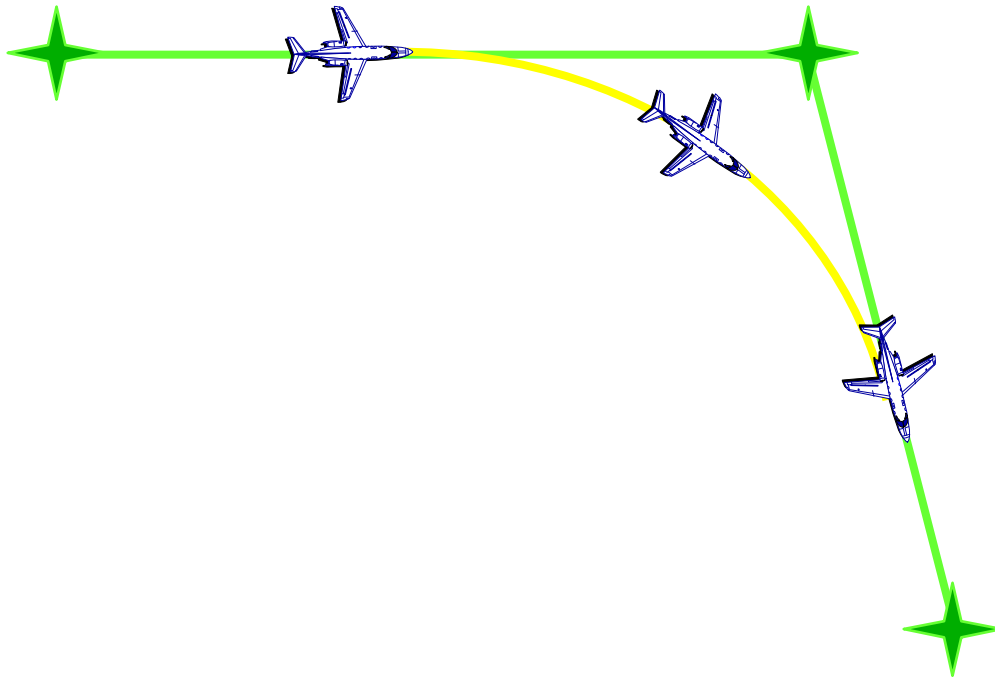


A waypoint can be designated as an overfly waypoint by pressing the OVFLY line select key. The asterisk identifies the waypoint as over fly.

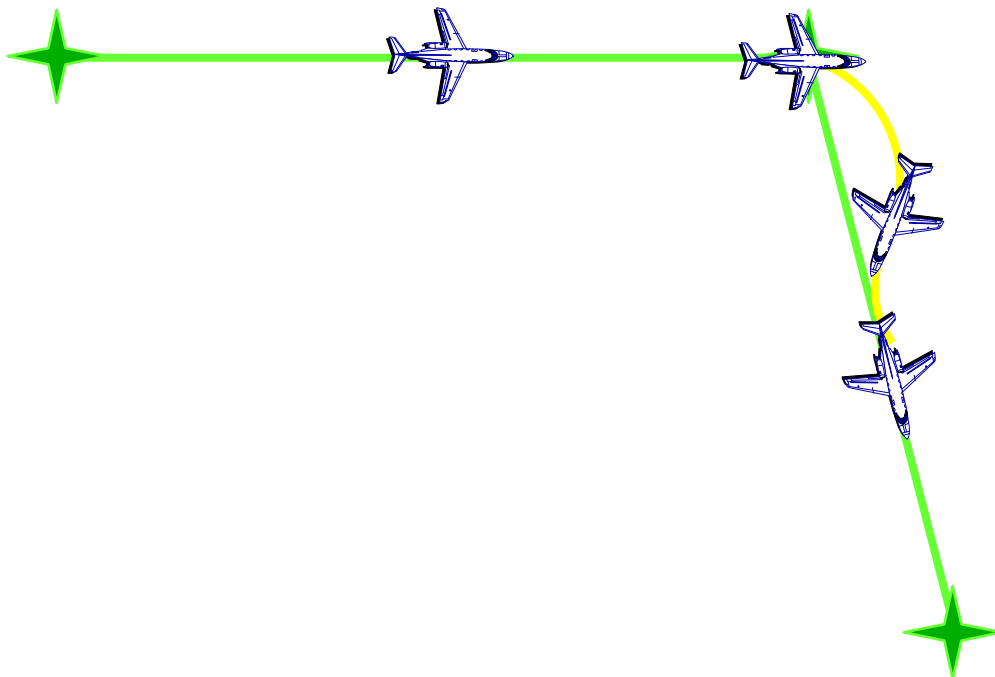
To cancel an overfly waypoint press the CNCL OVFLY line select key.



WAYPOINT AND TURN TYPES

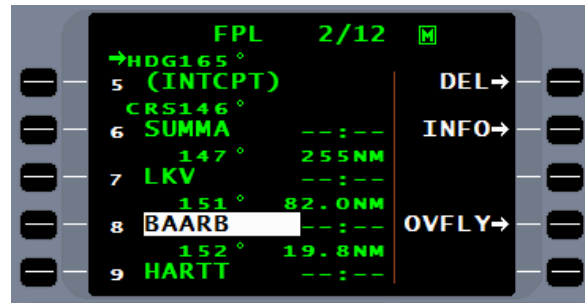


Fly By or Smart Turn
Based on angle of turn, ground speed, and turn limits

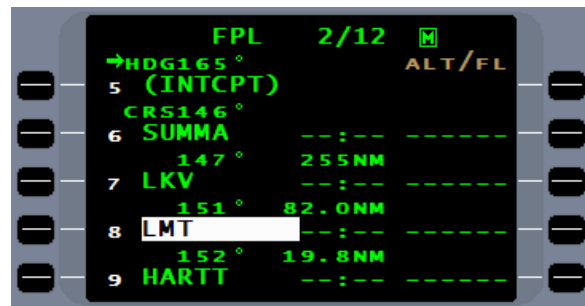


Fly Over
Indicated by waypoint being followed by an “*”

To add a new waypoint to the flightplan, first place the cursor at the point on the page where the waypoint will be entered.

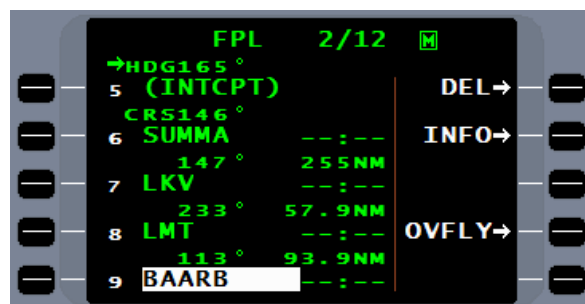


When the new waypoint is entered, the existing waypoint will be moved down.



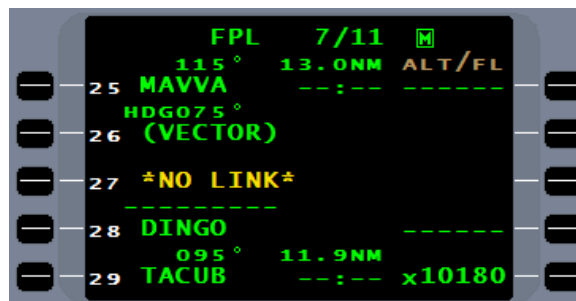
New waypoints may be added with use of the LIST function or by direct entry with the alphanumeric keys.

A pilot waypoint can be created directly in the flightplan. (Covered later)



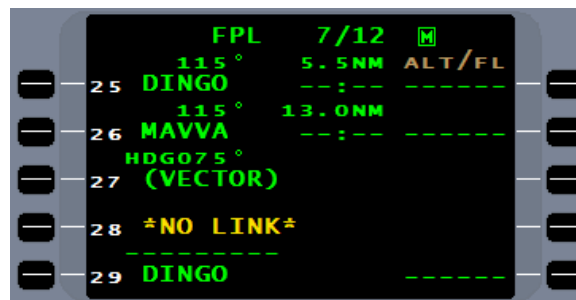
Frequently a STAR will terminate at one point and the approach will begin at another. When this is the case, a “*NO LINK*” will appear indicating that the flightplan requires review, and if necessary, editing.

When a VECTOR is included in the procedure, this represents a “VM” leg or vector to manual termination. Pilot intervention will be required for the FMS to sequence beyond this leg. Pilot intervention may be in the form of a FMS heading change, a manual leg change, or a Direct To (DTO). Caution should be used when deleting the vector leg, for the vector leg represents a required heading as a terminator to a SID or STAR. In such cases, it may be prudent to leave the vector leg and the “*NO LINK*”. If an ATC clearance is issued to bypass the vector leg, use of the DTO function will direct the aircraft to the correct waypoint.

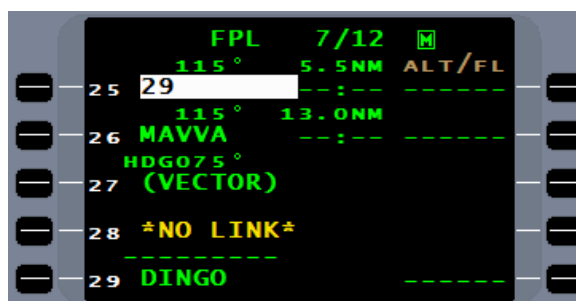


NOTE: When a SID or STAR terminates in a VECTOR, the FMS uses an arbitrary 50nm to define the vector. This additional mileage is added to the overall flightplan distance.

A method to quickly edit out multiple waypoints is as follows. To establish continuity between the STAR and approach, waypoints, 26, 27, and 28, must be edited out of the flightplan. Place the cursor over the first waypoint to be deleted.



Determine the first waypoint number that will replace the waypoint or waypoints to be deleted and enter that number in the waypoint field. In this case, the approach waypoint, DINGO, will replace the STAR waypoint, DINGO. Enter the number “29” at waypoint number 25.



After pressing the **ENTER** key, the approach waypoint, DINGO will be moved into waypoint 25 and all intervening waypoints will be deleted.



WAYPOINT NAMING CONVENTIONS

ARINC 424 provides waypoint naming conventions that are used by the database supplier in the database. Listed below are the most common ones that may be encountered when accessing the navigation database.

D235H	DME waypoint on the 235° radial at 8nm (H is 8th letter of the alphabet)
XYZ29	'x' point on enroute chart, 29nm from the XYZ VOR
12ABC	'x' point on enroute chart, 112nm from ABC VOR
FF26	Final Approach Fix for Runway 26
OM26	Outer Marker for Runway 26
CF26	Final Approach Capture Fix for Runway 26 (usually located on final approach course outside of FAF)
RW26	Threshold coordinates for Runway 26
MA26	Missed Approach point for Runway 26

Latitude/Longitude Named Waypoints (Oceanic) listed in Navigation database. Not all Latitude/Longitude waypoints are listed in the NAV database. When entering a waypoint name not covered in the NAV database a DEFINE WAYPOINT page will appear.

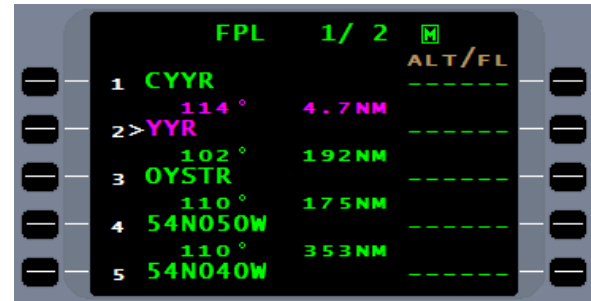
ARINC 424 Format	SCN 801 Format	SCN 802 and 803
5540N	N55W040	55N040W
50N30	N50W130	50N130W
5705E	N57E005	57N005E
48E70	N48E170	48N170E
5275W	S52W075	52S075W
52W20	S01W160	01S160W
6030S	S60E030	60S030E
02S70	S02E170	02S170E

NOTE: The Navigational Database contains latitude longitude waypoints in those areas where air navigation is probable. The Navigational Database contains many of the above examples, but some of the examples lie within areas of the world where there is little air navigation. In those areas where latitude longitude named waypoints do not produce a Navigational Database waypoint; a Pilot waypoint must be created.

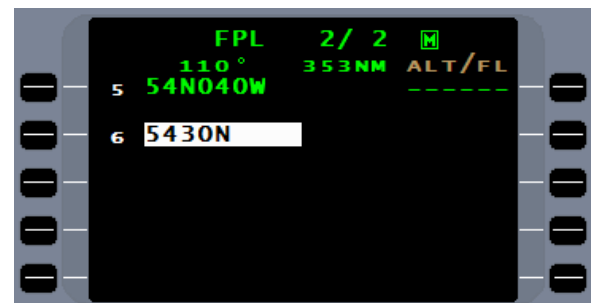
OCEANIC WAYPOINTS

The NAV database contains latitude and longitude identified waypoints for many areas of the world. These are areas where the aircrew would expect to receive lat/long waypoints, such as the North Atlantic Track (NAT) between North America and Europe.

Latitude/Longitude (lat/long) waypoints listed in the flightplan will be displayed in a seven character alphanumeric format and can be entered in the flightplan in this format or the ARINC format.



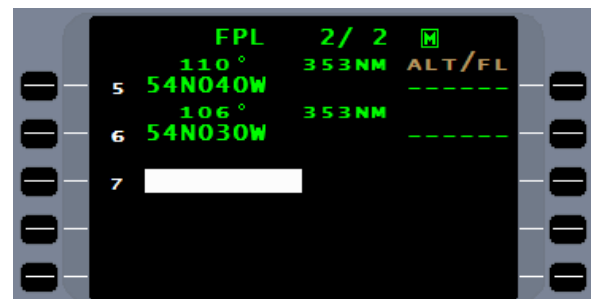
The ARINC lat/long waypoint naming convention is also recognized by the FMS and lat/long waypoints can be entered into the flightplan in this format.



After entering the desired lat/long waypoint into the flightplan press the **ENTER** key. The lat/long will be displayed in degrees, minutes, and hundredths of minutes. All lat/long waypoints are stored in both the NAV and pilot database using the ARINC format, but the seven character format is recognized and can be used to enter the lat/long waypoint.



Once entered into the flightplan, the waypoint will be displayed in the seven character format. SCN 802 and subsequent use the lat/long format of xxNxxxW. An example is 54N030W.



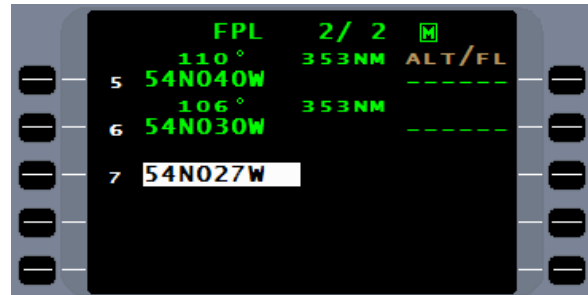
SCN 801 uses the format of NxxWxxx. An example is N55W030.



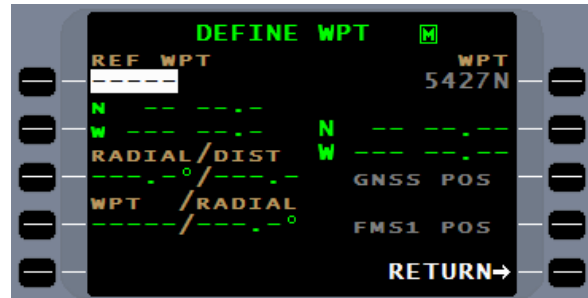
PILOT DEFINED WAYPOINTS

A pilot defined waypoint can be created using one of three techniques. Pilot defined waypoints can contain up to 5 alphanumeric characters or seven for lat/long. Pilot waypoints can be created almost anywhere a NAV waypoint can be entered and are stored in pilot data.

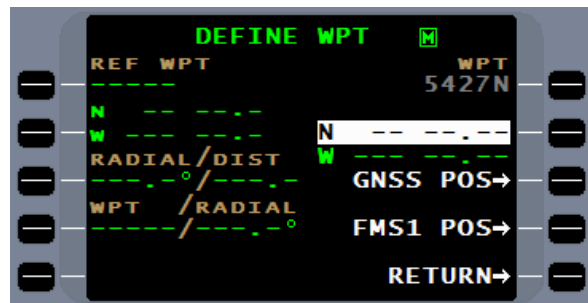
The first method to define a waypoint is by latitude and longitude. The waypoint 54°00.00'N 027°00.00'W is entered using either the ARINC naming convention, entered as 5427N, or enter the waypoint using the format 54N027W. Enter this directly into the flightplan by first pressing the line select key at the desired location and entering 54N027W and press **ENTER**.



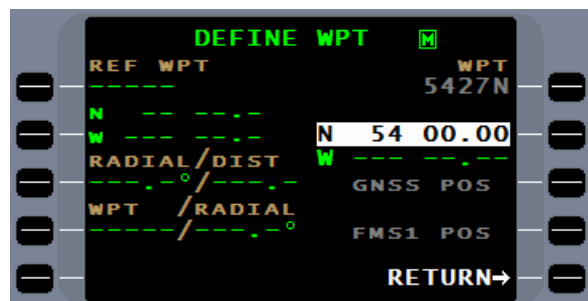
Since this waypoint is not in the NAV database, the DEFINE WPT page will automatically appear. Notice that the ARINC format is used to name the waypoint.



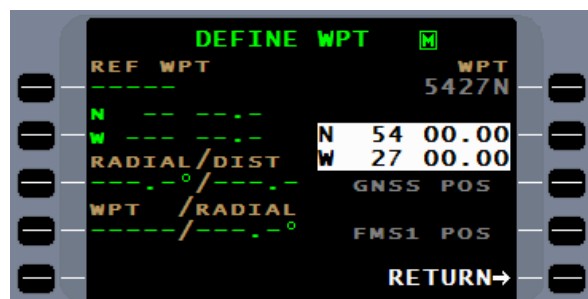
Since defining this waypoint is by latitude and longitude, press the line select key 2R to bring a cursor to the North coordinates.



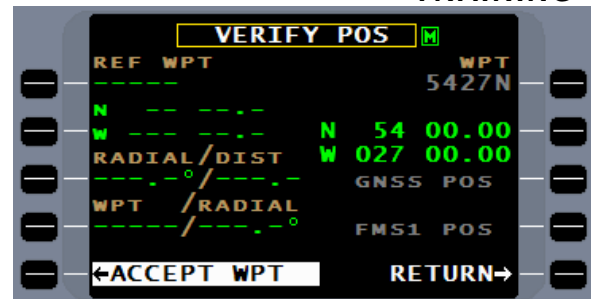
Enter the coordinates in degrees, minutes, and 100^{ths} of minutes or, with a menu selection, 1000th of minutes and press **ENTER**.



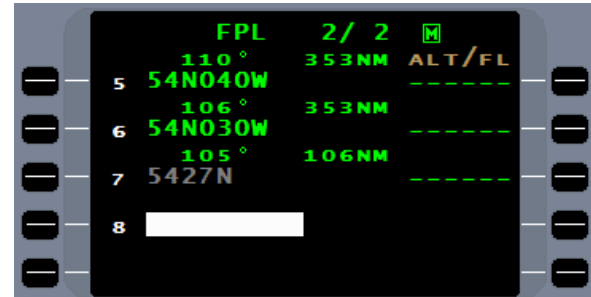
The cursor moves from latitude to longitude. Enter the coordinates and press **ENTER**.



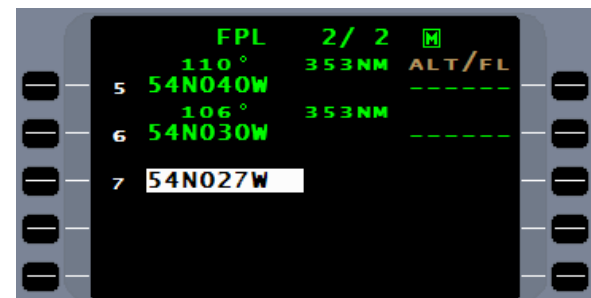
If the coordinates are acceptable, press or ACCEPT WPT line select key.



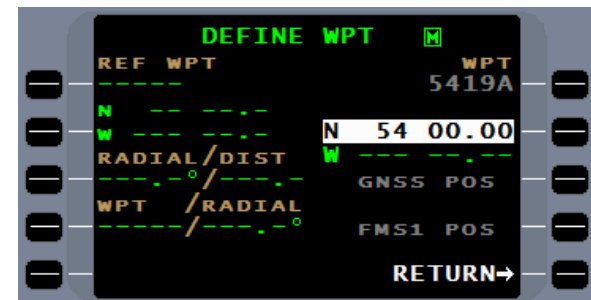
The new waypoint is entered into the flightplan. The color of a pilot waypoint is different to identify it as a pilot created waypoint.



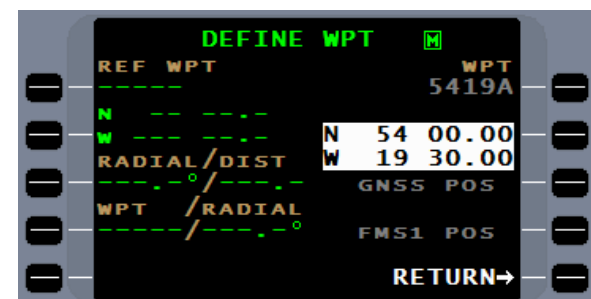
Once the pilot waypoint is created, it can be used and entered using either the ARINC format or the seven character format, but will be displayed using the ARINC format.



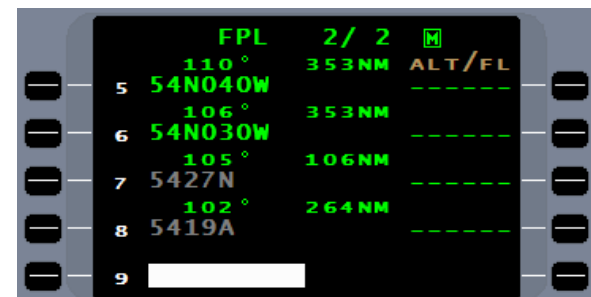
If the naming convention does not provide a name for the waypoint or the name selected is already in use, create a name up to five characters and place it in the flightplan.



The coordinates 54°00.00'N 19°30.00'W are to be entered into the flightplan. The naming convention name of 5419N is in use.



With a small modification to the name, **5635A**, and using the above procedures the waypoint is added to the flightplan.



The second way to define a pilot waypoint is to use radial and distance from a known fix. The known fix can be either a NAV waypoint or a previously created pilot waypoint. The waypoint LKV50 is defined as 50 nautical miles on the 150-degree radial from the LKV VOR. The name, LKV50 is based on the ARINC naming convention by using the first three letters of the reference waypoint and the distance from that waypoint.

Since the waypoint name of LKV50 does not exist in the database, when LKV50 is entered into the flightplan, the DEFINE WPT page is presented.

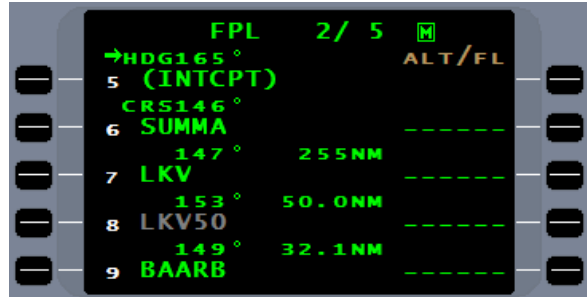
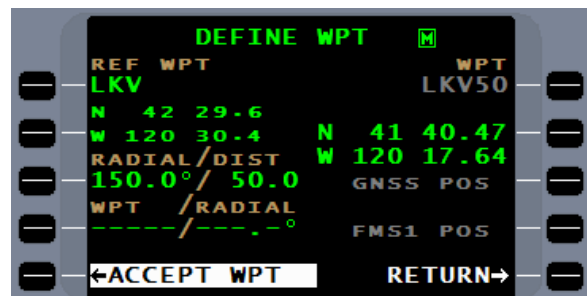
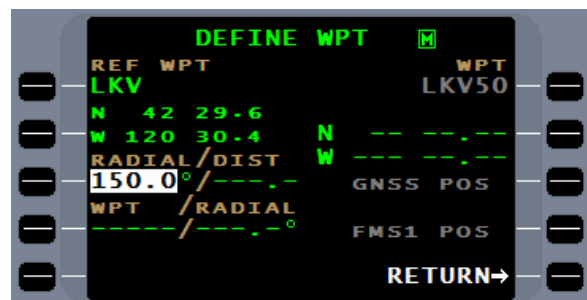
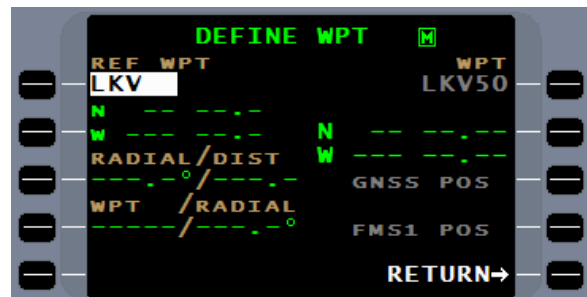
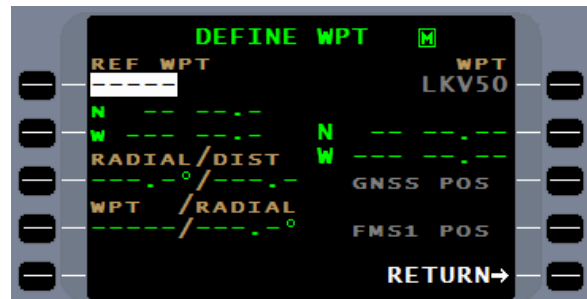
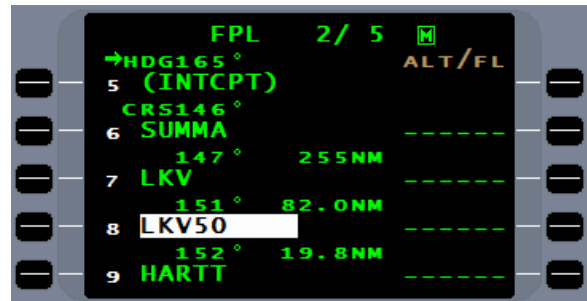
The reference waypoint is FMG; enter this at the REF WPT line select key, press **ENTER**, verify, and accept.

The cursor will move to allow entry of the radial.

Pressing the **ENTER** key will move the cursor to the distance line. After entry of the distance, pressing the **ENTER** key will command the FMS to calculate a Lat/Long.

NOTE: The radial and DME entries are four character fields requiring the inclusion of a tenth of a degree or mile respectively.

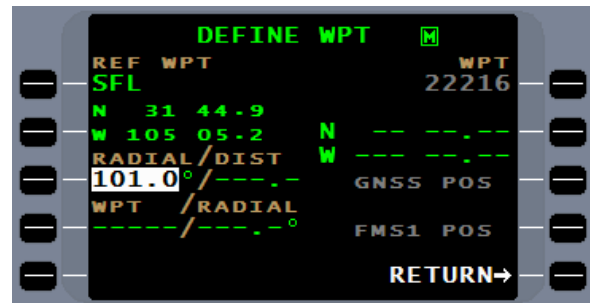
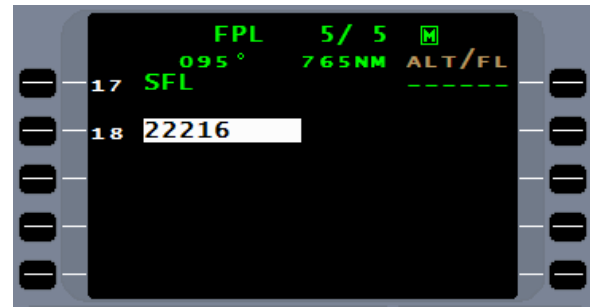
Accepting the Lat/Long will place the waypoint into the flightplan.



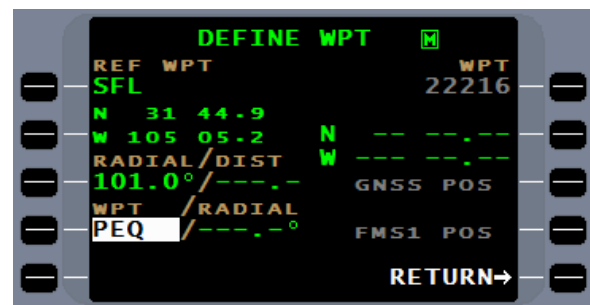
The third method of defining a pilot waypoint is to use the crossing radials of two fixes. This method is particularly good when changing from one airway to another where no turn point is defined.

Naming this type of waypoint is not covered in the ARINC 424 naming convention, therefore a name must be created that helps to identify the location. The example uses the two crossing victor airways.

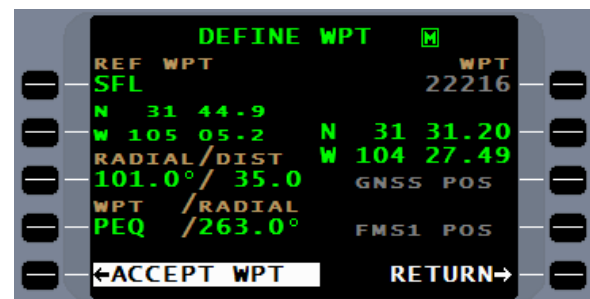
V-222 departs the SFL VOR and crosses the V-16 airway inbound to PEQ. Entering 22216 will again present the DEFINE WPT page. Enter SFL and the radial.



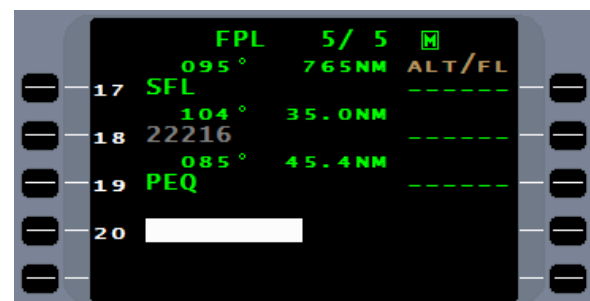
Do not enter a distance for the first fix, instead, with the **ENTER** key or the line select key, move the cursor to WPT; enter the second fix.



Entering the radial and pressing **ENTER** will cause the FMS to calculate the lat/long of the crossing point. If the two radials do not intersect, the last waypoint radial will flash. If the two reference waypoints are more than 200nm from each other, a waypoint will not be calculated.



Accepting the new waypoint will place it in the flightplan. The turn point is now identified and the follow on waypoint can be entered into the flightplan.



PILOT WAYPOINTS AND CUSTOMIZED FLIGHTPLAN

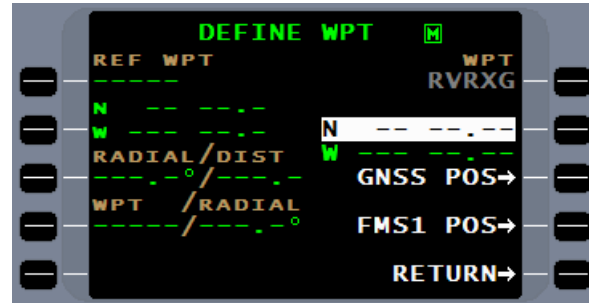
To create a customized route of flight in a flightplan using pilot waypoints for landmarks, the following technique may be of value.

First map out the route of flight and identify the landmarks, then name the waypoints with a maximum of five alphanumeric characters.

Through visual pilotage, navigate the aircraft towards the waypoint. Enter the name of the waypoint in the flightplan and press **ENTER**.

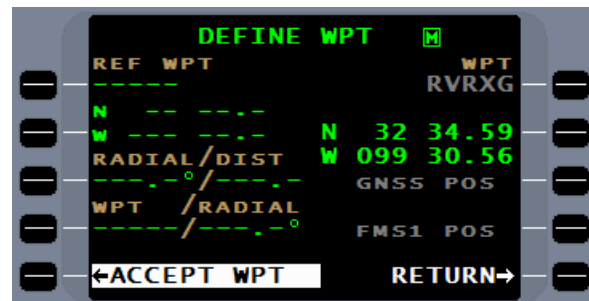


On the DEFINE WPT page, press the lat/long line select key. Notice that GNSS POS and FMS1 POS lines become bold and selectable.



As the aircraft crosses the landmark for RVRXG, press either GNSS POS or FMS1 POS and the lat/long is entered into the field.

Pressing GNSS POS will use the pure GNSS position. Pressing FMS POS will use the FMS best computed position.



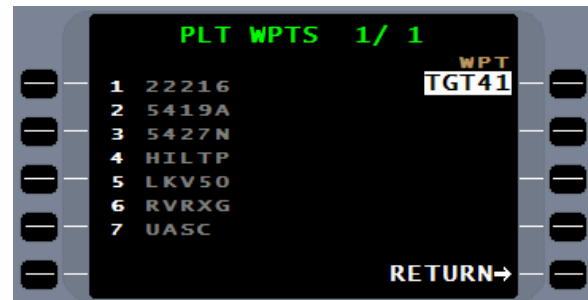
Accepting this waypoint will enter it into the flightplan. By storing this flightplan as a pilot route, this flightplan may be flown exactly as it was created.



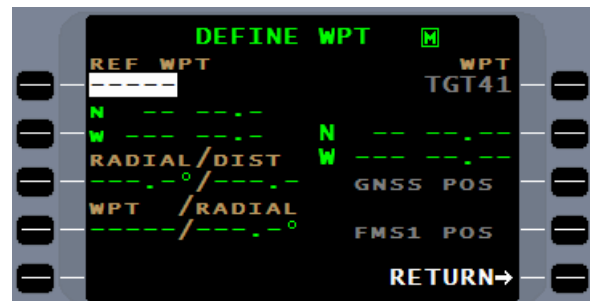
TACTICAL WAYPOINTS


Tactical waypoints were created primarily for military use. Up to 98 Tactical waypoints may be created with the same procedure as in creating a pilot waypoint. A menu option will allow for designation of the waypoint as Tactical. Once a waypoint is created, the user should retain the name of the waypoint, for there is no easily obtainable list of Tactical waypoints viewable in the FMS. Tactical waypoints can be used in the FMS flightplan but cannot be stored in the pilot database as part of a Route, SID, or STAR. If a Route, SID, or STAR is stored with Tactical waypoints, a *GAP* will be entered in lieu of the Tactical waypoint. Tactical waypoints are available through the LIST function under VOR/PLT. The special missions erase discrete, when activated, will erase all Tactical waypoints along with the pilot database.

To create a Tactical waypoint, enter up to 5 alphanumeric characters in a waypoint field.



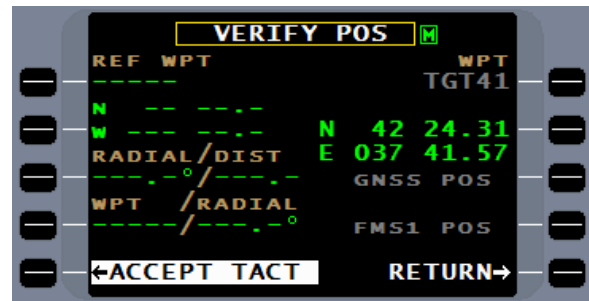
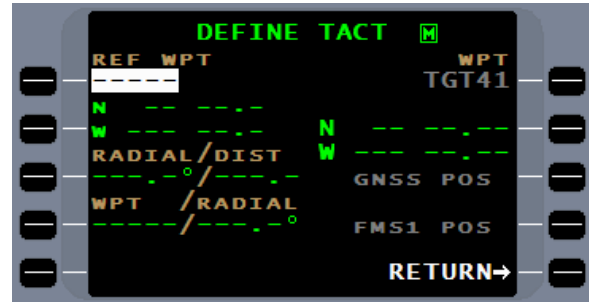
As with pilot waypoints, the new waypoint name must not be in use in another database. After entry of the waypoint the DEFINE WPT page will be presented.



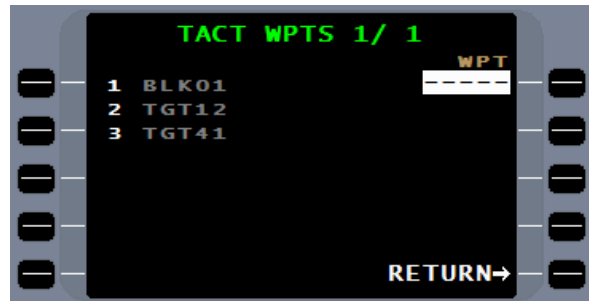
Pressing the  key will present the POSITION MENU. Selecting the TACT line select key will change the waypoint to a Tactical waypoint. In addition there are other line select key options for to further define the lat/long or designate the type of waypoint to be defined.



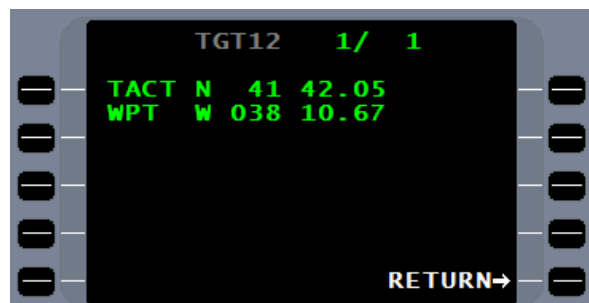
With the waypoint labeled as Tactical, the DEFINE TACT page is presented. From this page the creation data is entered in the same way as in creating a pilot waypoint.



When the tactical waypoint is accepted, the FMS will present a **TACT WPTS** page, listing all of the Tactical waypoints.



From this page, entering the reference number will produce the lat/long of the tactical waypoint,

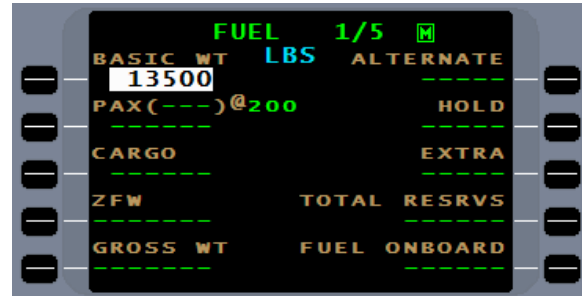


NOTE: If the FMS contains tactical waypoints, upon FMS power up and following the power on self test, a question page will be presented asking whether to operator wants to retain or delete tactical waypoints. See POWER ON section.

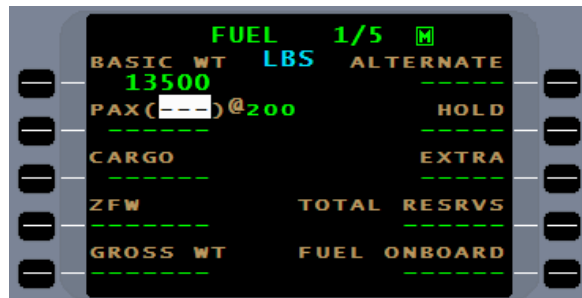
FUEL PLANNING

The FMS can assist the pilot in managing and forecasting fuel usage. This feature is optional and for best results, fuel initialization should be accomplished before takeoff, but can be done anytime during the flight.

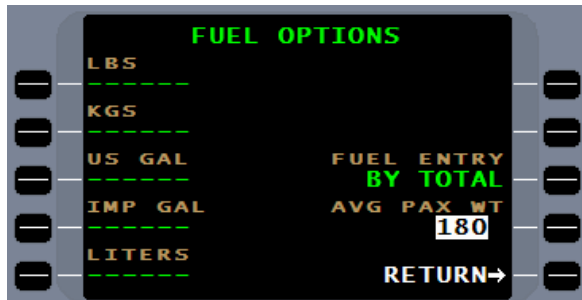
Pressing the **FUEL** key will access the first **FUEL** page for initialization of fuel data. The basic weight or basic operating weight (BOW) displayed here is stored in the FMS configuration module programmed at time of installation. If needed, the weight may be adjusted by using the line select key to place the cursor here.



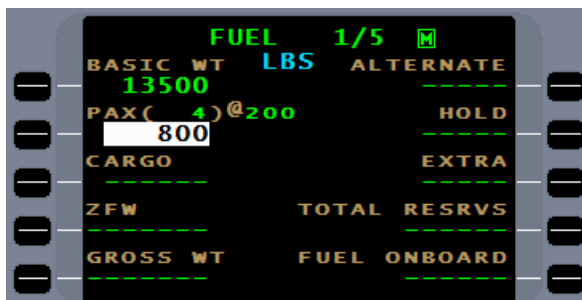
Entries made in the PAX field will be calculated at the weight displayed. Use a weight that reflects the average weight of passengers most frequently on this aircraft. Since this calculation is most frequently used in aircraft performance calculations, the more accurate the weight, the more accurate the calculation.



The "default" weight setting may be changed by pressing the **MENU** key. The 5R line select key will allow access to set the "**AVG PAX WT**".



When the number of **PAX** is entered, the FMS computes the total passenger weight.



NOTE: The fuel initialization page will not suffice as a replacement for required weight and balance computations for certificate holders.

The **PAX** total weight field will allow for further adjustments in the passenger weight, if necessary, by directly entering the desired value. Press the **ENTER** key to confirm passenger weight.

The FMS screen displays the following data:

FUEL 1/5		ALTERNATE
BASIC WT	13500	---
PAX (4) @ 200	500	HOLD
CARGO	---	EXTRA
ZFW	---	TOTAL RESRVS
GROSS WT	---	FUEL ONBOARD

Enter the **CARGO** weight. Enter "0" if appropriate.

The FMS screen displays the following data:

FUEL 1/5		ALTERNATE
BASIC WT	13500	---
PAX (4) @ 200	800	HOLD
CARGO	250	EXTRA
ZFW	---	TOTAL RESRVS
GROSS WT	---	FUEL ONBOARD

NOTE: Fuel initialization requires that the **PAX** and **CARGO** field have an entry to calculate **ZFW**. If "0" is appropriate, enter "0".

With the **CARGO** weight entered, the FMS computes the zero fuel weight (**ZFW**) and the cursor moves to the **FUEL ON BOARD** field.

If desired, the **ZFW** field can be entered directly by pressing the adjacent line select key. An entry directly in the **ZFW** field will remove the **PAX** and **CARGO** entries.

The FMS screen displays the following data:

FUEL 1/5		ALTERNATE
BASIC WT	13500	---
PAX (4) @ 200	800	HOLD
CARGO	250	EXTRA
ZFW	14550	TOTAL RESRVS
GROSS WT	---	FUEL ONBOARD

There are two entry methods for entering **FUEL ONBOARD**. Entering fuel BY TOTAL is recommended.

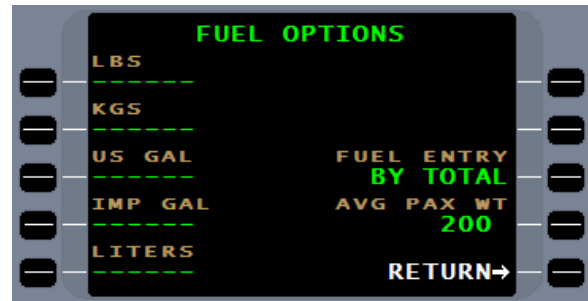
The BY TOTAL method will allow a direct fuel entry into the **FUEL ONBOARD** field.

The FMS screen displays the following data:

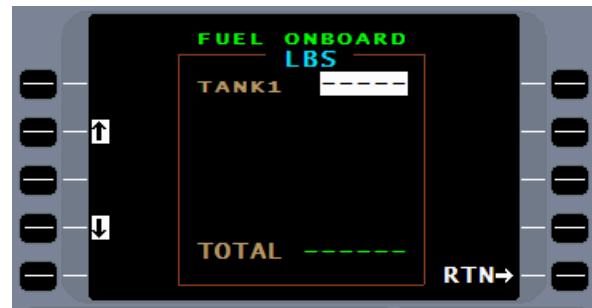
FUEL 1/5		ALTERNATE
BASIC WT	13500	---
PAX (4) @ 200	800	HOLD
CARGO	250	EXTRA
ZFW	14550	TOTAL RESRVS
GROSS WT	---	FUEL ONBOARD

NOTE: For those aircraft with digital fuel quantity systems that enter the fuel directly into the FMS, the pilot must confirm the quantity by pressing **ENTER**.

The **BY TOTAL** or **BY TANK** method can be selected through the **FUEL OPTIONS** menu. The **FUEL ENTRY** line select key will allow for a selection of the preferred method.



Entering fuel BY TANK can be used if the aircraft has no fuel totalizer. Pressing the **FUEL ONBOARD** line select key of the FUEL page 1/ 5, will present the fuel entry by tank page.



When the **TANK 1** quantity is entered, the cursor moves to **TANK 2**.

Line select keys 2L and 4L will move the cursor up or down if needed.



By pressing the **ENTER** key on a blank tank cursor field the total fuel is computed. Pressing the RTN line select key will cause a return to the FUEL page 1/5.

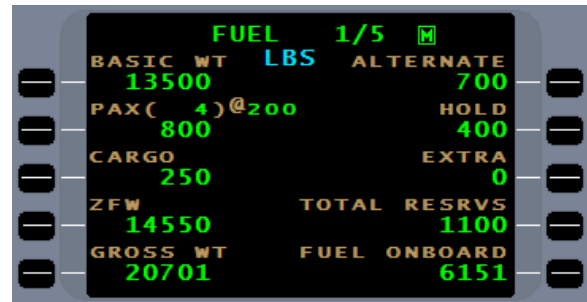
The Fuel on board entry should be made as accurately as possible to provide the best fuel predictions. The maximum fuel entry for each tank is 99,999. There is no correlation between a specific aircraft fuel tank and the FMS tank entries.



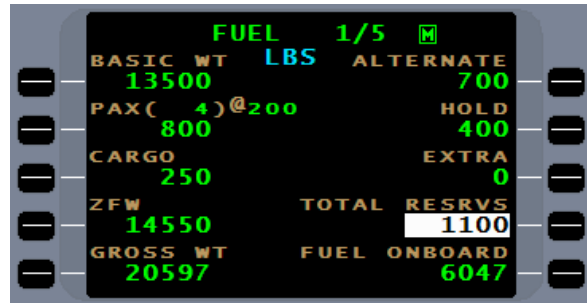
CAUTION: It is important to note that all fuel quantity readings on the FMS are based on fuel quantity inputs by the pilot, minus the fuel flow inputs to the system by the aircraft. On most aircraft there is no connection between these readings and the aircraft's fuel gauging system. On aircraft with digital fuel quantity systems, direct entry by the aircraft to the FUEL ONBOARD field is possible.

Entry of the **ALTERNATE**, **HOLD**, and **EXTRA** fields will result in the FMS calculating the aircraft fuel reserves. A number must be entered into each field is required to complete the calculation.

The **TOTAL RESRVS** are used for FMS fuel management calculations and in enroute performance calculations.

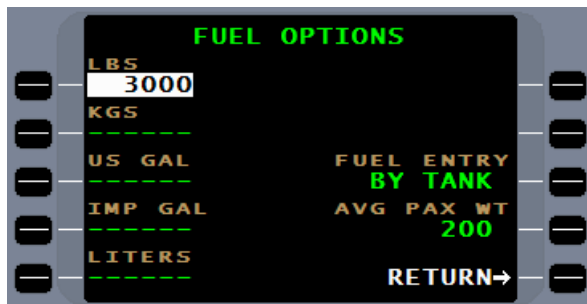


An entry into the **TOTAL RESRVS** field can be made directly by pressing the adjacent line select key.

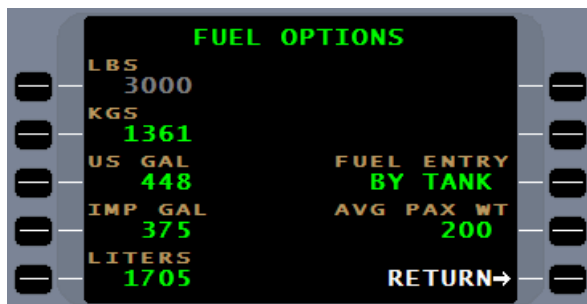


NOTE: If the **FUEL** key is pressed after fuel data has been initialized, the first page displayed will be FUEL page 2/5.

Pressing the **MENU** key for the **FUEL OPTIONS** menu page displays the FMS conversion calculator. This calculator will convert the weight of fuel to the volume of fuel. It uses the standard weight of Jet A fuel which is 6.7 pounds per gallon.



Conversions are made automatically by pressing any line select key on the left and entering a number followed by pressing **ENTER**. This is a very useful tool on international trips.



When in flight pressing **FUEL** will default to page 2. Flightplan information is imported to this display.

Press the line select key 3L to enter the UTC offset time for the calculation of destination ETA local.

FUEL 2/5		
FUELFLOW	LBS	GS
1205		428
T/O	22:52	ELAPSED 0+01
TO	KTUS	2+04 895NM
ETA UTC	00:59	
- 7 LCL	17:59	
NOW	OVHD	KTUS
5966	FUEL ONBRD	3457
4+57	ENDURANCE	2+52
2117	RANGE	1226

Page 3 will display the current fuel summary information.

FUEL 3/5		
FUELFLOW	LBS	GS
1205		429
FUEL		
AT DEPARTURE		6000
USED		134
ONBOARD		5865
REQUIRED		2463
OVERHEAD	KTUS	3402
RESERVES		1500
EXCESS		1902

On page 4 a summary of aircraft weight information is displayed along with specific range and other information.

FUEL 4/5		
	LBS	
GROSS WT		20373
FUEL ONBOARD		5823
LANDING WT		17937
OVERHEAD	KTUS	3387
GND NM/LB		0.352
AIR NM/LB		0.357
HEADWIND		6
ESAD		60
TEMP		ISA+02

FUEL page 5 displays the fuel flow inputs received from each engine, and totals used. Number of engines is configurable at time of installation. Should fuel flow input fail or be inaccurate, pressing the appropriate ENG line select key will allow for manual fuel flow entries.

FUEL 5/5		
	FLOW	USED
	LBS	
ENG 1	600	112
ENG 2	605	113
TOTAL	1205	224

In the event of a fuel flow failure lasting longer than four minutes, the flow field will show FAIL.

The fail can be removed and input restored by placing the cursor over the FAIL with the adjacent line select key and pressing the **BACK** key followed by the **ENTER** key. If fuel flow input has returned (such as after an engine shut down and restart), normal operation should be apparent.

NOTE: To reset fuel used without first turning off the FMS, use the right line select keys adjacent to each engines fuel used. Place the cursor into the field, enter a "0" and press the **ENTER** key.

NOTE: It should also be noted that APU fuel flow from aircraft with an on board APU could be monitored by the FMS with proper installation and the selection of a configuration option.

DESTINATION/ALTERNATE FUEL PLANNING

Fuel page 2/5 will allow planning to an alternate destination. The "TO" field displays the flightplan destination as the default. Press line select key 2L to place the cursor over the "TO" field to calculate a "what if" scenario to an alternate destination. Manually enter the alternate ICAO identifier or press the **[LIST]** key to access the AIRPORTS list with distances from present position. Choosing an alternate airport from the list will return to the **FUEL 2/5** page and **(A)** will indicate alternate airport calculations.

FUEL 2/5		
FUELFLOW	LBS	GS
1205		423
T/O	22:52	ELAPSED 0+18
TO	KPHX(A)	1+23 587NM
ETA	UTC 00:34	121°
- 7	LCL 17:34	
NOW	OVHD	KPHX
5624	FUEL ONBRD	3950
4+40	ENDURANCE	3+16
1972	RANGE	1385

Alternate calculations are based on the aircraft fuel consumption from present position to overhead the alternate airport. Fuel on Board overhead the alternate, endurance, and range is based on present fuel on board, present groundspeed, and present fuel flow. Manual fuel flow and Manual groundspeed may be entered by using line select keys [1L] and [1R] for planning purposes and may be deleted by using the back key or exiting the fuel pages.

On Fuel pages 2 and 3, line select key 1L displays current fuel flow.

FUEL 3/5		
FUELFLOW	LBS	GS
1205		433
FUEL		
AT DEPARTURE		5000
USED		34
ONBOARD		4966
REQUIRED		3505
OVERHEAD	KTUS	1461
RESERVES		1500
EXCESS		-39

By pressing the line select key an alternative fuel flow can be manually entered that will allow for hypothetical fuel planning scenarios.

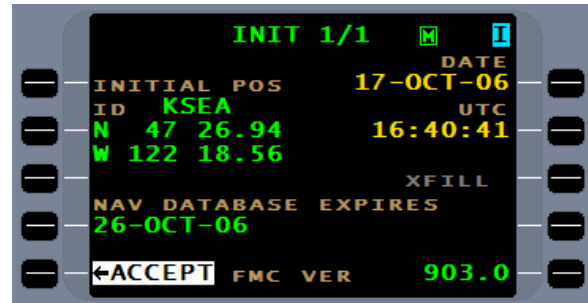
To return to actual fuel flow, press the 1L line select key, press the **[BACK]** key followed by the **[ENTER]** key.

FUEL 3/5		
FUELFLOW	LBS	GS
1100(EST)		433
FUEL		
AT DEPARTURE		5000
USED		63
ONBOARD		4936
REQUIRED		3171
OVERHEAD	KTUS	1765
RESERVES		1500
EXCESS		265

SYNCHRONOUS DUAL FMS OPERATIONS

A feature offered in SCN 803 is Synchronous operation. Synchronous dual FMS operations allow for a two FMS installation to appear to operate as one. The two FMS can be operated in independent mode or SYNC mode. When in independent mode, an "I" will appear in the upper right corner.

The FMS may be configured to start in either Synchronous or Independent mode.



SYNC mode will automatically transfer the following data between the two FMS:

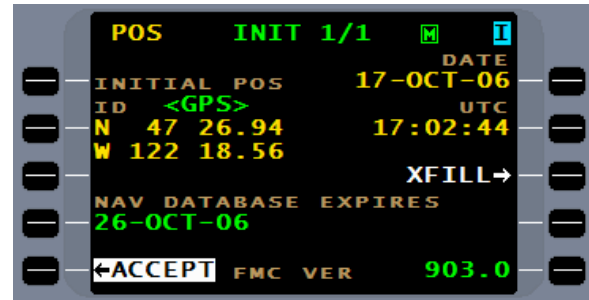
- Flightplan entry or modification
- Direct To (DTO) operations
- Selective Crosstrack (SXTK)
- Vertical Navigation (VNAV)
- Command Heading
- Pseudo VOR (PVOR)
- Temperature Compensation
- Manual RNP entry
- FMS approach arm and activation
- Manual leg changes
- Fuel page 1 entries and local time difference on Fuel page 2

When in SYNC mode, each FMS will maintain its own navigation, sensor monitoring, databases, performance, and radio management. Navigation cues will be independent (time-to-go, distance-to-waypoint, crosstrack error, bearing-to-waypoint, etc.). Moving map displays will be independent. The message function will be independent. Manual selections of pilot preferences such as map display of missed-approach and EFIS scaling will be independent.

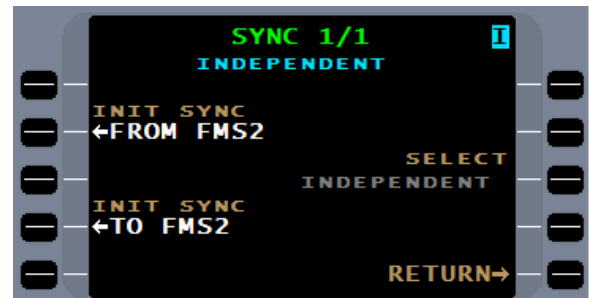
Because each FMS is navigating independently even while in SYNC mode, it is possible for one FMS to leg sequence slightly ahead or behind the other FMS.

NOTE: Sync mode will not be available for Special Missions mode (SCN 90X). Search pattern operation will be independent.

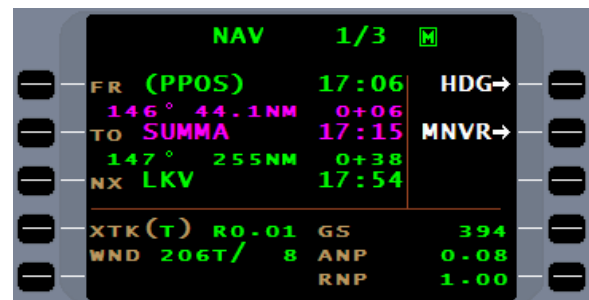
When configured for synchronous operation, the limited crossfill functions available are initial, tune presets, and ADC. All other crossfill functions are part of synchronous operations. With the acceptance of one initial page, crossfill becomes available. Crossfill with pull configurations is displayed to the right. In triple FMS installations, only two FMS can be configured for SYNC mode, the third FMS is configured for crossfill and can receive information from the other two FMS by normal crossfill.



After accepting the INIT page and so configured, the two FMS will automatically attempt to synchronize; a “SYNC IN PROGRESS” message may be displayed at this time. To manually initiate synchronous operations, select the NAV menu and the SYNC option. Choose the direction for the first transfer of information. If current navigational information is on FMS 1, to sync FMS 2 with FMS 1, select TO FMS2. This will send FMS 1 information to FMS 2. After the initial sync, inputs on either CDU will automatically be transferred to the other. Synchronous operation can be initiated from either FMS.



When in synchronous operation, the “I” will disappear and any NAV, VNAV, flightplan, or fuel inputs on one FMS control display unit (CDU) will automatically be sent to the other FMS and be displayed on that CDU. When in synchronous operation, INDEPENDENT can be initiated from the SYNC option on the NAV menu and will require pushing the line select key twice. An “FMS SYNC LOSS” message will appear if loss of the FMS sync mode occurs that was not initiated by the pilot.



An FMS in SYNC mode will remain in SYNC mode at approach activation.

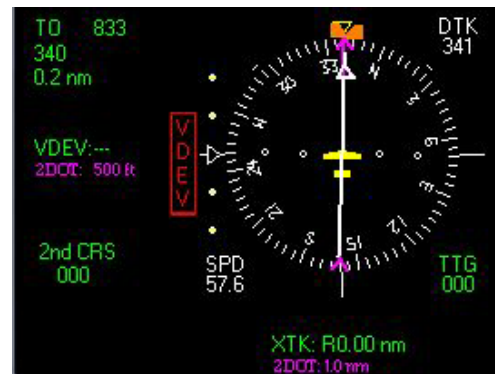
NAVIGATION DISPLAYS

During normal navigation, three NAV pages are displayed. When needed, additional pages are added as in the case when approach mode is active or if the command heading mode is in use.

On most departure procedures, a takeoff leg will be included in the NAV database that allows the FMS to provide guidance from takeoff roll to the end of second segment climb which is normally 400ft. This leg may not be included on the departure chart. Where departure procedures require a higher altitude, that altitude terminator will replace the 400ft terminator.



The FMS can be used to maintain heading on the runway, with the current NAV leg from KSEA of CRS341° to the leg terminator, 833 feet, and HSI displayed as it would appear during takeoff. The course arrow will provide heading prior to rotation. The heading bug must be manually slewed to the runway heading.



After becoming airborne, the FMS will provide course steering to the HSI for this leg.



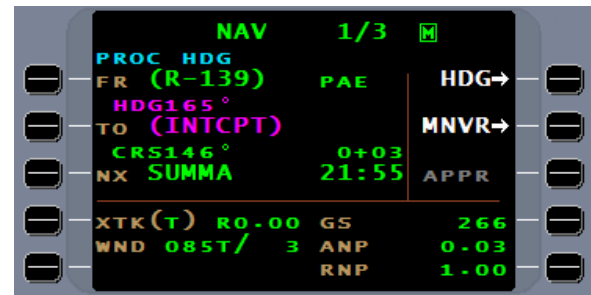
NAV page 1 and 2 are similar in what they display. Both will display from (FR), to (TO), and next (NX) information, crosstrack (XTK), phase of flight ("T" terminal shown), wind heading and speed (WIND), and ground speed (GS), but, in addition, NAV 1 will display ANP and RNP. In addition, NAV page 2 will display tailwind or headwind component, bearing (BRG), and track error (TKE).



In-flight, NAV page 1 and 2 will display from (**FR**), to (**TO**), and next (**NX**) waypoints with course, distance, time remaining, and estimated time of arrival in UTC for the next waypoint.



When flying procedural legs distance may not be displayed on the FMS NAV page,...



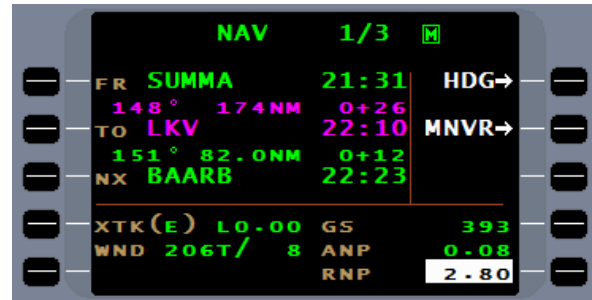
...but will be presented on the HSI.



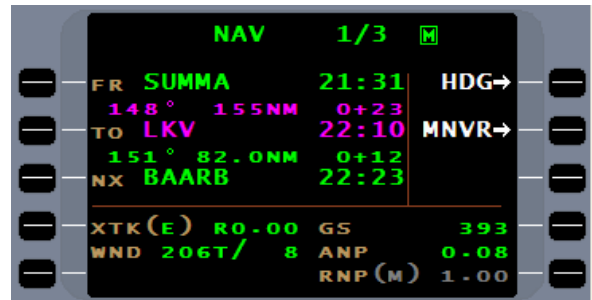
XTK (cross track), defines actual aircraft distance right or left of course centerline. The (**E**) designates that the FMS is in the enroute phase of flight. Wind information displayed is direction (true enroute and terminal, and magnetic when approach active) and speed. **HEADWIND** or **TAILWIND** component is displayed on page 2. **BRG** (bearing) from the aircraft position to the “**TO**” waypoint and **GS** (ground speed) are also provided. **TKE** (track error) is displayed in degrees right or left of the course centerline.



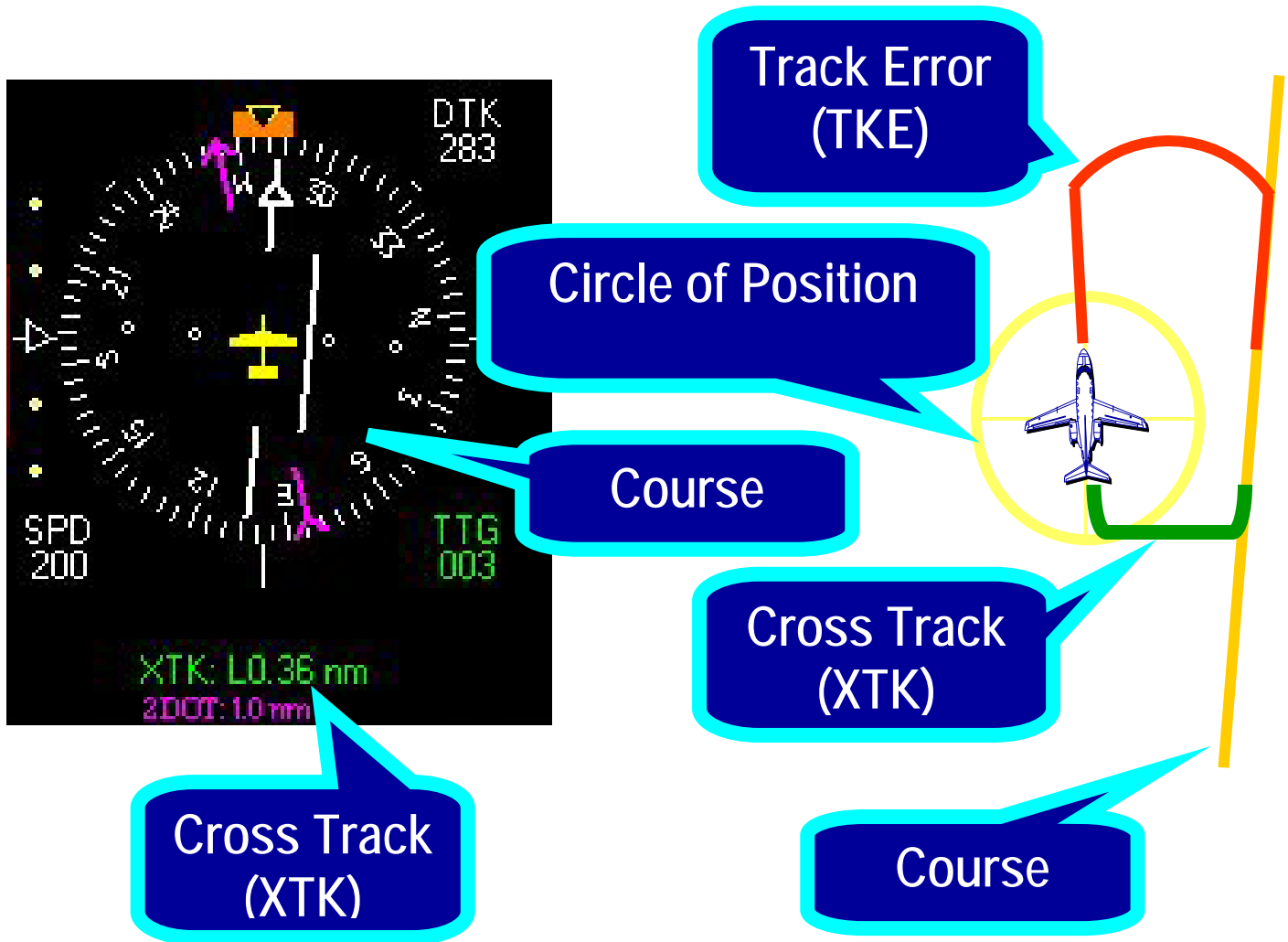
If it becomes necessary to set **RNP** to other than default, press line select key 5R.



Enter the desired **RNP** and press **ENTER**. The **(M)** will indicate that the **RNP** is manually set. To remove the manual entry and revert to default, press the **RNP** line select key, press **BACK** followed by **ENTER**.

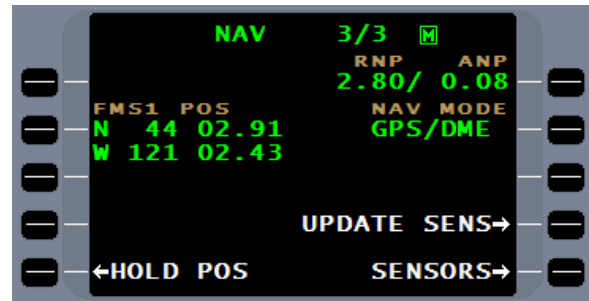


CIRCLE OF POSITION AND COURSE



ANP is the radius of the circle of position based on a 95% probability that the aircraft is within the circle. The FMS uses the center of the circle of position to determine the cross-track distance. It is necessary that the pilot ensure the entire circle of position clears all obstacles and airspace restrictions, since the location of the aircraft within the circle of position cannot be determined. The track error is the angle of the path over the ground relative to the course.

NAV page 3 displays the FMS best computed present position, the Actual Navigation Performance (**ANP**), Required Navigation Performance (**RNP**), and the most significant NAV sensor(s) currently used. When two sensors have close to equal weighting in the NAV solution, they will be displayed together under **NAV MODE**, such as **GPS/DME**.



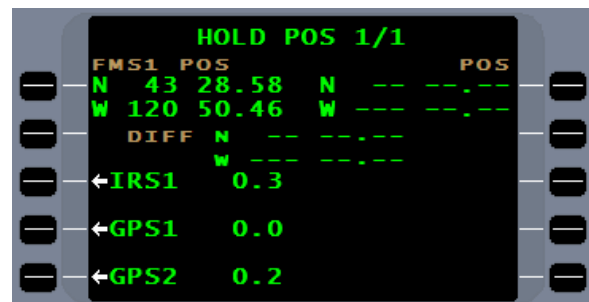
By pressing the 1R line select key, **RNP** can be entered to meet the current flight requirements as on NAV page 1.

Also available are line select keys for UPDATE SENSORS, SENSORS, and HOLD POSITION.

The UPDATE SENS (update sensors) line select key will send a 30-second present position signal to Loran C for update. On the ground, a compatible IRS set to align mode can use the lat/long information to complete alignment. The Inertial Reference System or Inertial Navigation System cannot currently be updated in flight through the FMS.

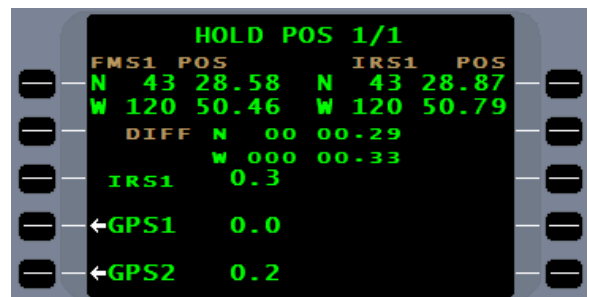
The SENSORS line select key is a shortcut to DATA page 3.

The HOLD POSITION line select key will take a snapshot of FMS and all sensor position's at the moment it is pressed. This would normally be used to verify or update the FMS position over a known geographical point. It may also be used to record the coordinates of a location over flown.



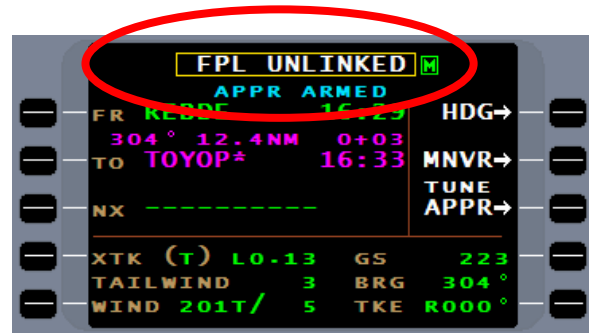
Press the HOLD POS line select key to display the **HOLD POS** page. The frozen FMS position is displayed and line select keys are available for all sensors connected.

With the selection of a NAV sensor, the right hand field will display the sensor position and below it is the difference in position between this sensor and the FMS position. Each available sensor may be compared to the FMS position in this way. While the coordinates shown on the **HOLD POS** page are frozen, the FMS will continue to navigate normally, and this view of sensor positions has no effect on navigation.



FLIGHTPLAN UNLINKED

Whenever the FMS cannot connect the current NAV leg (the “FM” “TO” leg) to the flightplan, a FPL UNLINKED banner or message will appear at the top of the page. This can occur when going direct to a waypoint that is not part of the current flightplan, if manually changing the NAV leg to a leg that is not part of the flightplan, or if going direct to a waypoint that is currently part of a departure or arrival procedure.

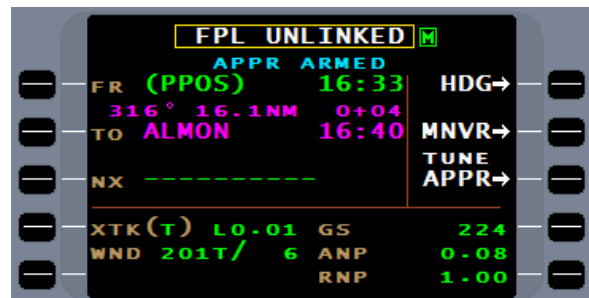


In most cases, but not all, the FMS will prompt for a “NX” waypoint,



...but if one is not selected, a FPL UNLINKED message will be presented.

When the FPL UNLINKED message is present, on NAV page 1 or 2 the “NX” line will be empty.



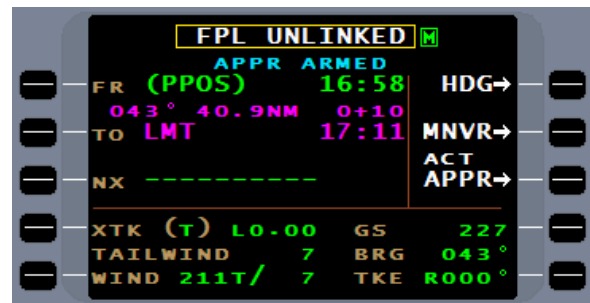
The “NX” line is the interface between the NAV leg and the flightplan.



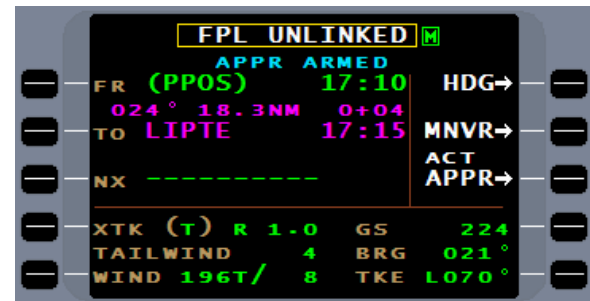
Once the waypoint in the “**NX**” line moves to the “**TO**” line, it no longer belongs to the flightplan. If the flightplan is deleted or modified, the waypoints in the “**FM**” “**TO**” lines will be unaffected, but the waypoint in the “**NX**” line will be deleted.



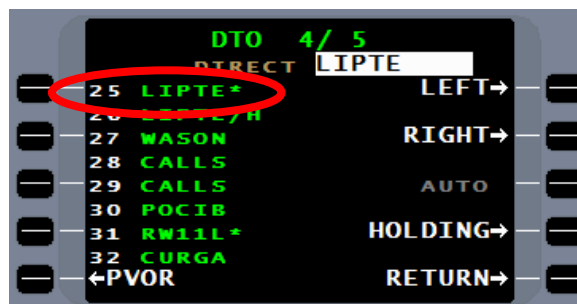
It may be correct to have the FPL UNLINKED message if the current NAV leg does not have a follow on waypoint; such as going direct to a fix and expecting vectors.



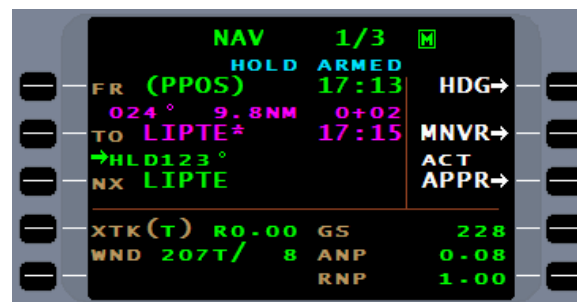
If, however, the NAV leg needs to reconnect to the flightplan, the pilot must use one of the two following procedures.



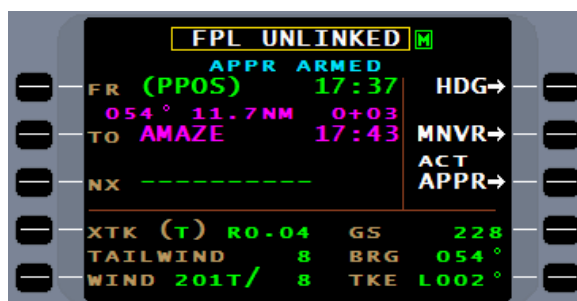
Press the DTO function and a list of the flightplan waypoints will be presented. From the list, select the current “TO” waypoint of the current NAV leg and press the **ENTER** key.



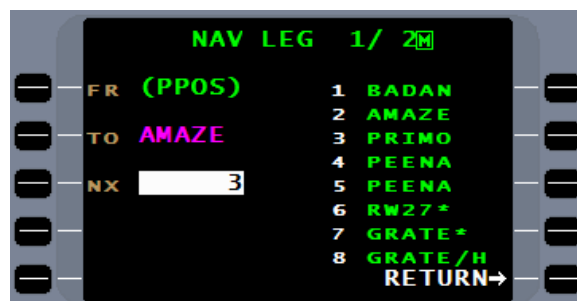
The FMS will reconnect the NAV leg to the flightplan. The aircraft should be unaffected.



Another method is to press the “NX” line select key. When there is no waypoint in this line, the “NX” key will respond by listing the flightplan waypoints.




Enter the reference number of the follow on waypoint and the FMS will connect the NAV leg to the flightplan.



The NAV leg will now sequence into the flightplan.



CROSSTRACK INSTRUMENT DISPLAY SCALING

Crosstrack Instrument Display Sensitivity is automatically selected by the phase of flight but can be manually selected by using the NAV DISPLAY page. Bring up NAV MENU by pressing the  key when NAV page is displayed. Press the NAV DISPLAY line select key.



CAUTION: Selecting ENROUTE or TERMINAL during approach mode will cancel the approach mode.

The CDI scale is set automatically according to the aircraft's phase of flight. The NAV DISPLAY will allow the CDI scale to be changed from the default, which is based on phase of flight. A selection of a scale other than default will result in that scale staying in effect through a phase of flight change. To restore the default scale, select the scale appropriate for the phase of flight.



Selecting the TERMINAL line select key or the APPROACH line select key will change the CDI scaling, but will not change the GPS and FMS position error alarm limits. This must be accomplished by manually changing the RNP.

In accordance with TSO 129 the following apply to CDI display sensitivity. **Full scale deflection (2 dots)**

Enroute display sensitivity	$\pm 5.0\text{nm}$
Terminal display sensitivity	$\pm 1.0\text{nm}$
Approach display sensitivity	$\pm 0.3\text{nm}$

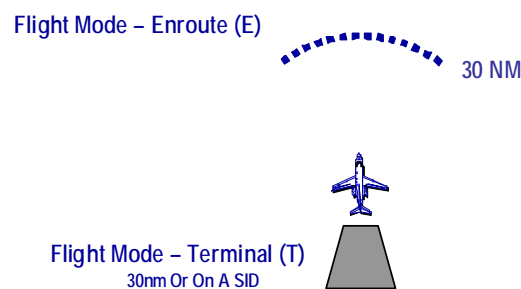
NOTE: If the pilot commands a DTO to the FAF or MAP leg while the aircraft is greater than 30nm from destination, the NAV scaling will remain at the enroute value (5.0nm) until the aircraft reaches 30nm from destination. At that time the scaling will automatically change to the terminal value (1.0nm).



PHASE OF FLIGHT

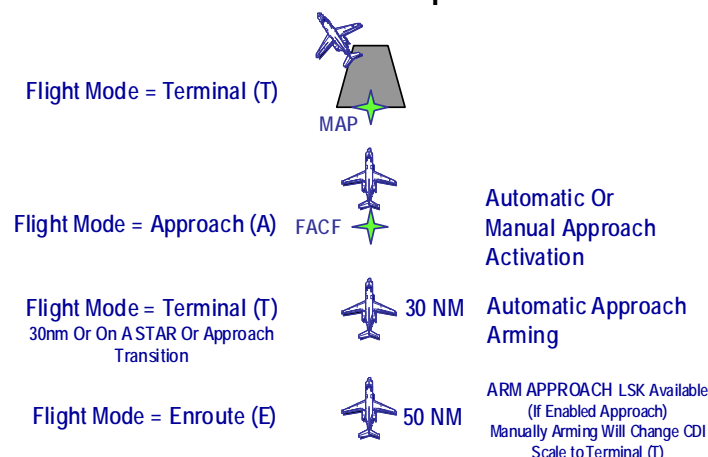
Enroute, Terminal, and Approach are the three phases or modes of flight programmed into the FMS. The terminal phase of flight will automatically be set upon completing initialization and is the airspace within 30nm of the departure airport. The 30nm is the radius of a circle measured from the departure airport's ARP. Upon crossing this circle the FMS will automatically change to the enroute phase of flight.

Departure Airport




When approaching the arrival airport, how the FMS operates depends upon whether an FMS flyable approach is entered into the flightplan. With an approach in the flightplan, the FMS will offer an ARM APPR (arm approach) line select key. If selected, as part of arming the approach, the FMS will set the CDI scale to terminal. If not selected, at 30nm, which is the beginning of standard terminal airspace, the FMS will automatically set the CDI to terminal and arm the approach. With no FMS approach in the flightplan, flight mode terminal will automatically occur at 30nm with no manual method of changing it prior to 30nm. The reference location for the 30nm or 50nm regarding change of flight phase is the ARP; for auto approach arming, the reference point is the end of approach point.

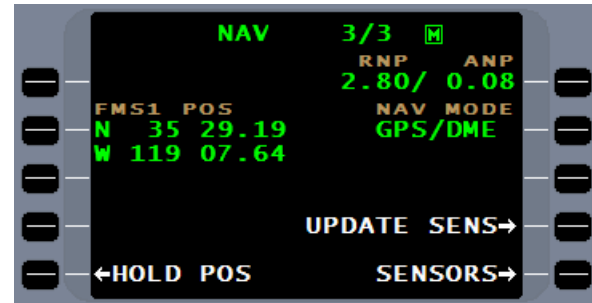
Arrival Airport



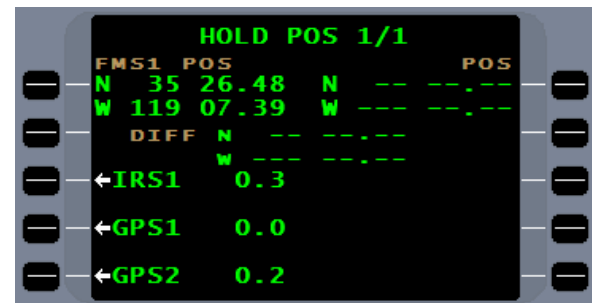
FMS AND SENSOR POSITION UPDATING

CAUTION: UNS systems are designed so that manual position updating should not be necessary during normal operations. Manually updating a FMS that uses GPS for navigation could result in the GPS being deselected and the FMS reverting to DR navigation. **Strongly recommend that manual update not be used unless there is a loss of ALL NAV sensors except ADC and heading.**

Press the  key until displaying the NAV page with the LAT/LONG; normally **NAV 3/3**. Press the HOLD POS line select key while over a known reference point.

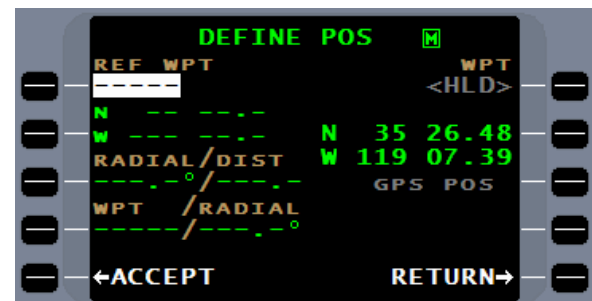


Press the 1L line select key to move to the DEFINE POS page.



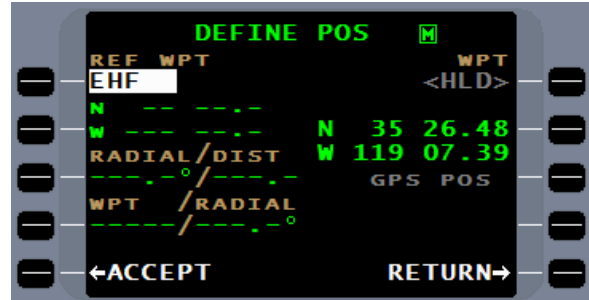
The **DEFINE POS** page will be displayed and the cursor will default to the **REF WPT** field. If the correct hold position coordinates are known, they could be entered directly by pressing the coordinates field line select key 2R.

This will allow entry of known coordinates or the **GPS POS** by pressing the line select key [3R] if GPS is operational. The position can also be updated by reference to a known position.



Press the **REF WPT** line select key to display the cursor. The identifier of a known position may be entered directly or by the LIST function.

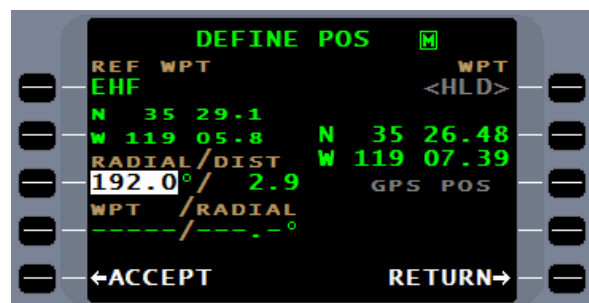
with the FMS position near EHF, enter EHF and press **ENTER**.



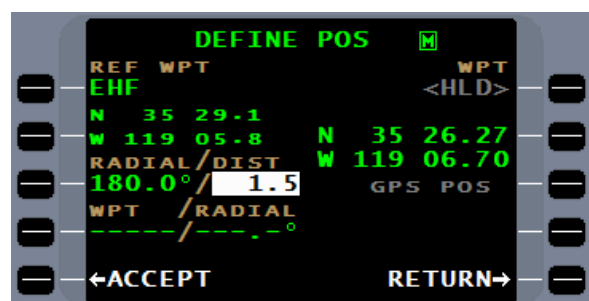
Accept the navigation data.



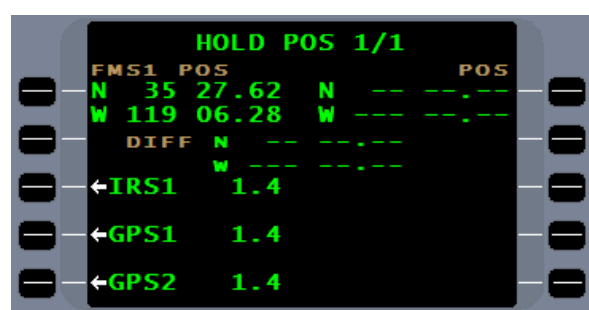
The display will now show the calculated radial and distance of the FMS from the referenced facility.



A check of the aircraft VOR and DME reveals that it was on the EHF 180-degree radial at 1.5nm at the time the HOLD line select key was pressed. To update the FMS position to reflect the VOR radial and DME, enter 180.0 for the radial and 1.5 for the distance and press **ENTER** or ACCEPT.



The new position coordinates for the 180° at 1.5nm position from the EHF VORTAC will be calculated and displayed. If this position update to the FMS position is greater than 10 arc minutes, a VERIFY pop up message will be displayed. The FMS will be updated to the new position and a position update will be transmitted to all sensors. Capable sensors will be updated. The display will return to the HOLD POS page and the magnitude of the update to each sensor will be displayed.



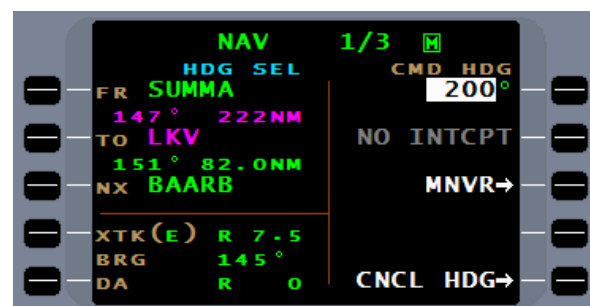
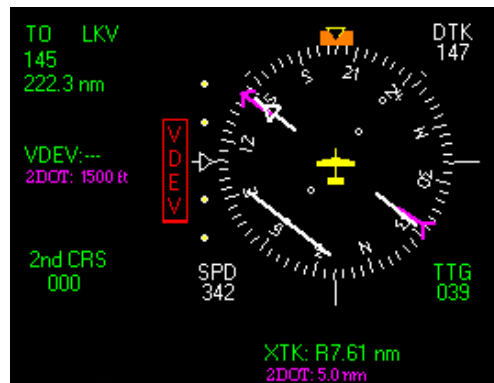
FMS HEADING MODE

The FMS has two heading functions, procedural heading and command heading. Procedural heading is used when the FMS is navigating on departure or arrival procedures. The FMS will align the HSI course arrow with the procedural heading. No action is required on the part of the pilot; intercepts and leg sequencing are controlled by the FMS.

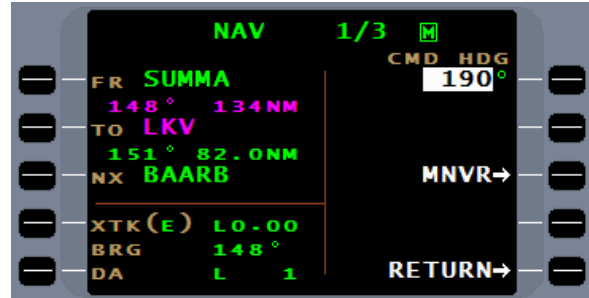


Selecting HDG on the NAV page will allow the pilot to control the heading of the aircraft through the FMS.

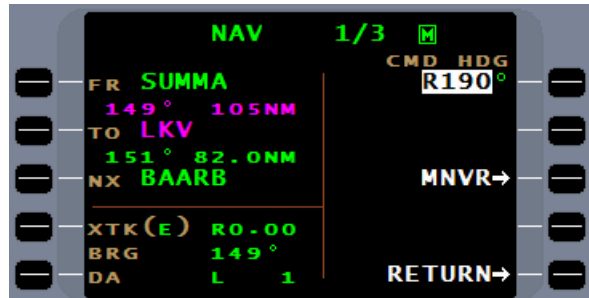
Most current generation EFIS allow for interactive heading. This means that by selecting HDG and pressing **ENTER**, the pilot can turn the heading bug to the desired heading and the aircraft will turn to that heading. That heading will also be presented in the command heading field.



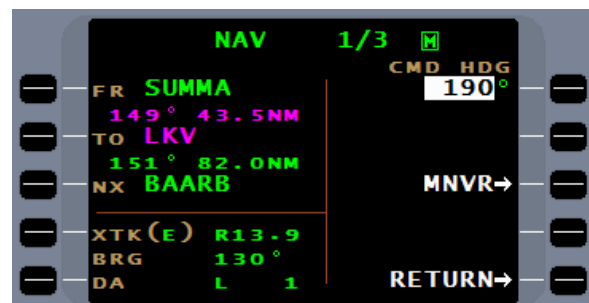
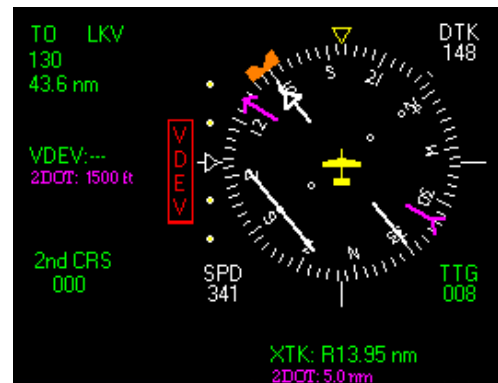
For aircraft without interactive heading or, if by choice, the pilot chooses to enter the desired heading into the **CMD HDG** field directly; press HDG and the current heading of the aircraft will be presented in flashing mode. Enter the desired heading and press **ENTER**.



The FMS will ask to confirm the turn direction or allow the pilot to change the turn direction. To change the turn direction, use the **±** key. Press **ENTER** to confirm the turn direction.



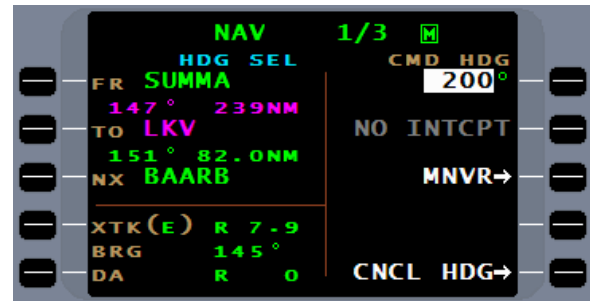
The FMS will command a heading change to the CMD HDG, but the heading bug will only respond if the EFIS has interactive heading.



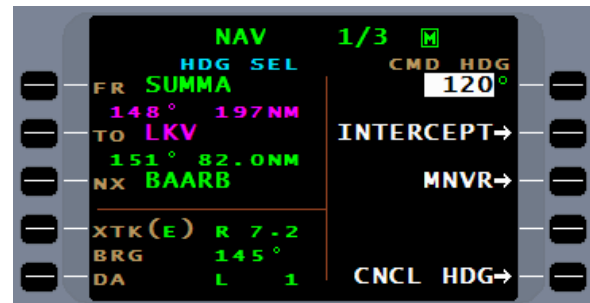
Once the FMS is placed in command heading, it will stay in command heading until the pilot initiates a process to exit command heading.

There are three ways to exit command heading, one is to use DTO. Selection of a DTO waypoint will automatically cancel command heading.

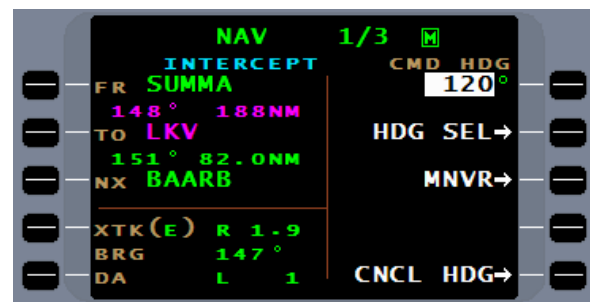
Another way to exit command heading mode is to press CNCL HDG. When CNCL HDG is pressed, the FMS will exit command heading and return to the FR/TO NAV leg. The maximum intercept angle will be 45°, but the FMS will only turn to the intercept angle required depending on crosstrack distance.



The last way to exit command heading is to enter a new heading that will intercept the current NAV leg and then tell the FMS to intercept.

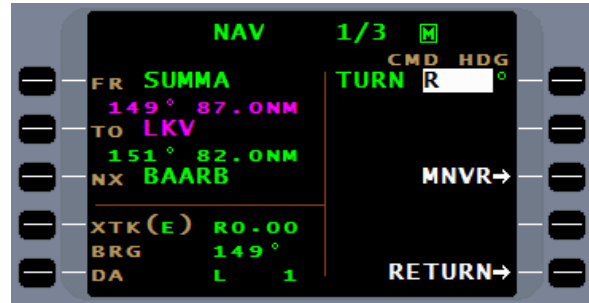


Pressing INTERCEPT will display and **INTERCEPT** subheading, resulting in the FMS intercepting and joining the current FR/TO leg. In the enroute and terminal phase of flight, an **INTERCEPT** option will be presented with an intercept angle between 1° and 115°.

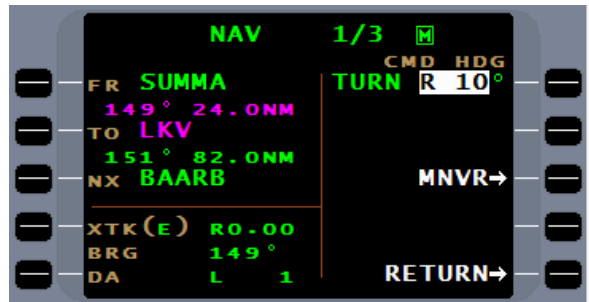


At anytime there is a need to cancel intercept, pressing HDG SEL will cause the FMS to revert back to command heading in a non-intercept mode; the **INTERCEPT** option will again be presented.

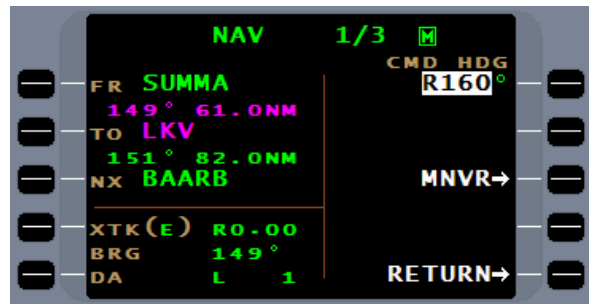
Another command heading function is to turn left or right a specific number of degrees. This is accomplished by first selecting the turn direction. Press the “L” or “R” key to select the direction of turn.



With **TURN R** presented, enter the number of degrees.



Pressing **ENTER** will result in the new heading being computed. Pressing **ENTER** again will cause the FMS to command a turn to the computed heading.



CAUTION: Selecting the turn direction first will result in the FMS changing the aircraft direction by the number of degrees entered; the number entered is not the heading to which the aircraft will turn.

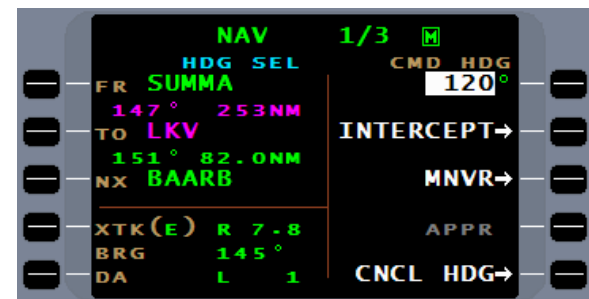
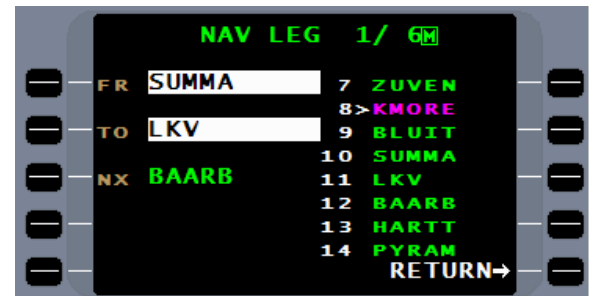
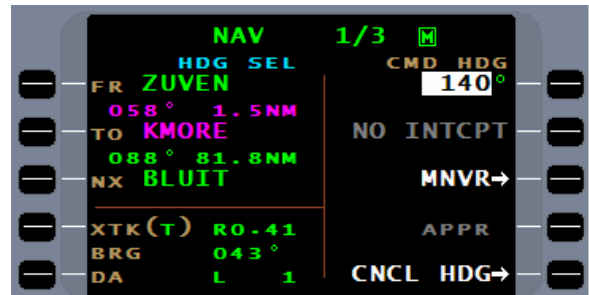
MANUAL LEG CHANGE OPERATION

Manual leg changes can be made from the NAV page 1 or 2. To change the leg, press the line select key adjacent to the “FR” or “TO” field, as desired.

This procedure can be used when ATC gives vectors to intercept a NAV leg or airway which is not currently the active NAV leg.

When the line select key is pressed, the display will show a list of current flightplan waypoints for selection. Enter the number for the new “FR” waypoint and press **ENTER**.

The cursor will move to the “TO” field and default to the next sequential waypoint. Either push **ENTER** a second time which will return the screen back to NAV page 1 or 2 with the new “FR” – “TO” waypoints, or enter the number of the desired “TO” waypoint and then push **ENTER**. If only a new “TO” waypoint is desired, move the cursor by using the **ENTER** key and enter the appropriate number. In lieu of using waypoint numbers from the flightplan list, any waypoint name can be entered by using the **LIST** function or typing the name in directly.



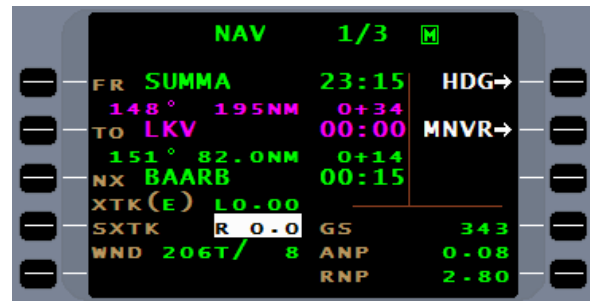
SELECTED CROSSTRACK OPERATION

Use the selected cross-track feature to parallel either the current NAV LEG through SCN 802, or the entire flightplan in SCN 803 and subsequent.

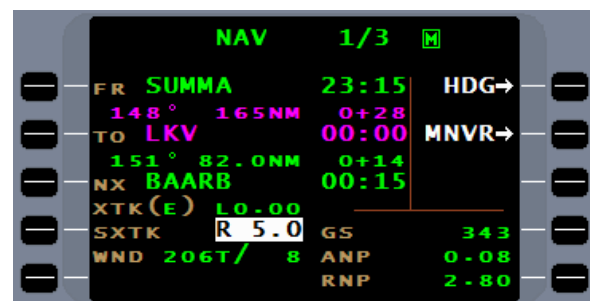
Crosstrack is available on the **MANEUVER** page by selecting SXTK.



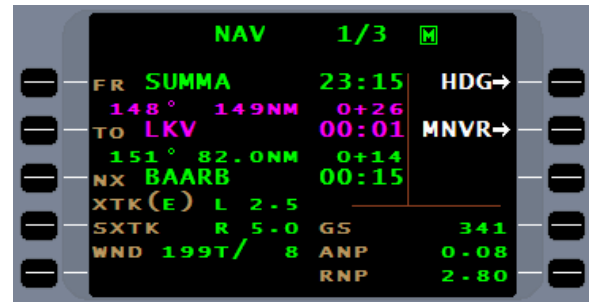
Selecting SXTK will display the SXTK field and cursor on the NAV pager. A desired offset may be entered either left or right of course in tenth of a nautical mile updates.



Press the \pm key to select left or right of course. Then enter 5.0 for the crosstrack distance followed by the **ENTER** key.



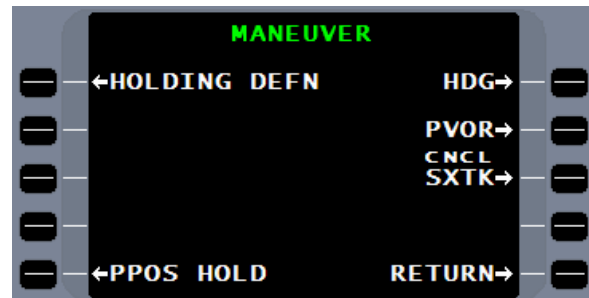
Pressing the **ENTER** key will result in the FMS commanding a turn to intercept the SXTK course. The intercept angle will be only what is needed, but will be limited to a maximum of 45°.



On a map display, the original course line will remain and show the relationship of the SXTK course on the HSI to the original course.



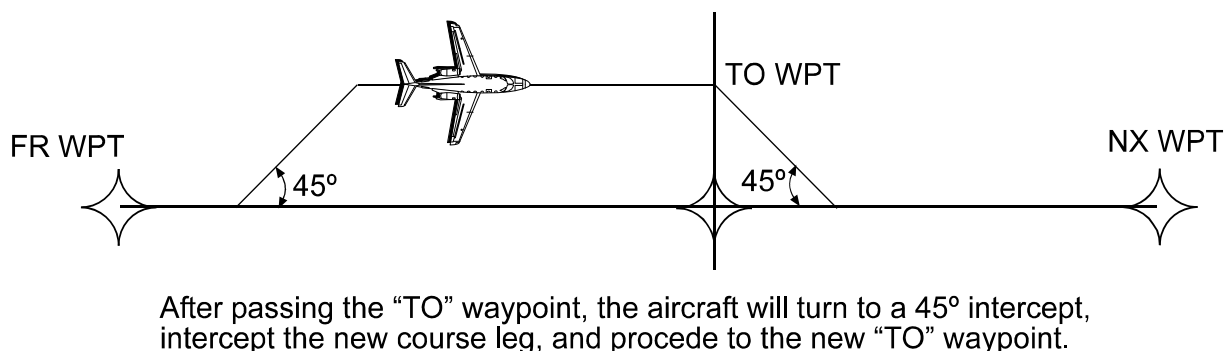
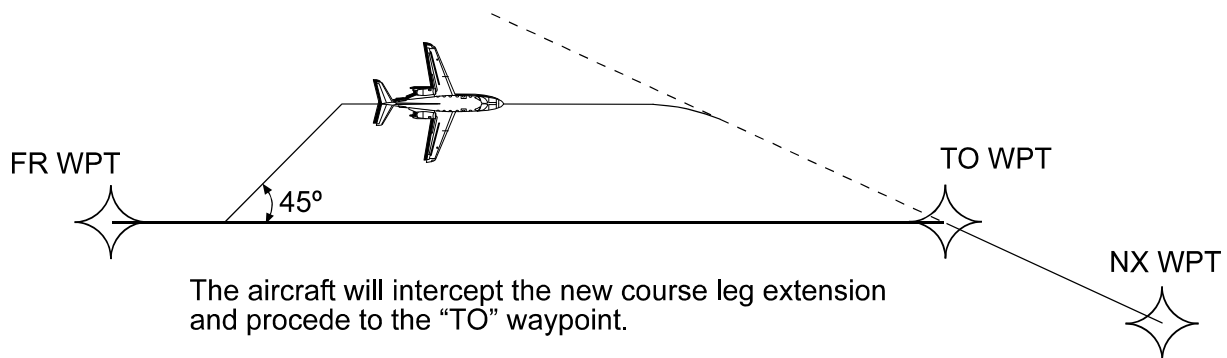
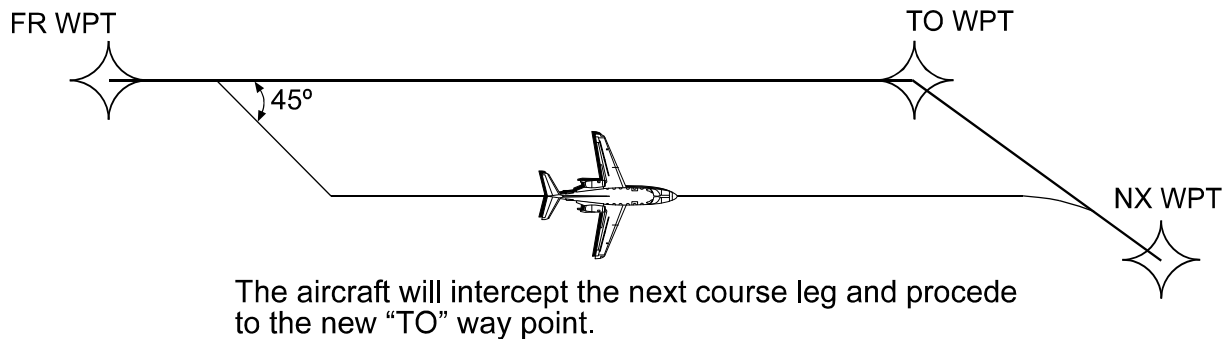
To cancel the selected crosstrack, use the MNVR line select key then press CNCL SXTK. The FMS will then command a change in heading to intercept the original NAV leg.



SCN 803 will continue paralleling the current flightplan until reaching the FMS approach which will result in automatic cancellation or use the above procedure to cancel SXTK early.

Through SCN 802, selected crosstrack function will parallel the “From To leg” until either cancelled or reaching the next leg change over point. Upon reaching the TO waypoint, one of three scenarios will occur.

- (1) The aircraft will intercept the next leg and proceed on course.
- (2) The aircraft will intercept an extension of the next leg.
- (3) Upon reaching the leg change over point, the aircraft will turn to a 45° intercept angle and intercept the new leg.



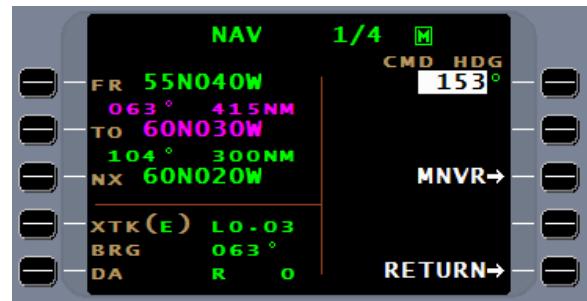
To continue with the SXTK, a technique is to use the aircraft flight guidance system to maintain heading prior to leg changeover, then reenter the desired crosstrack distance after leg changeover. Reselect FMS NAV mode and the aircraft will recapture the desired course.

NOTE: The use of FMS CMD HDG is not recommended. In this mode the FMS may not automatically sequence to the next leg.

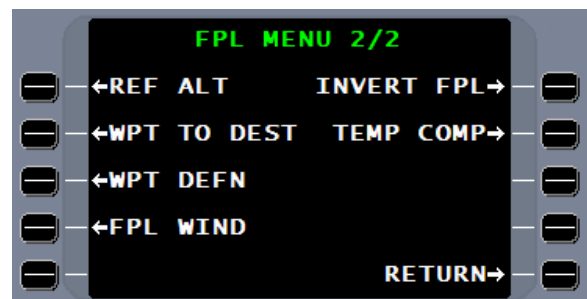
OCEANIC COURSE REVERSAL

If the aircraft is not beyond the equal time point or point of no return and an emergency requires the aircraft to return to the coast-out point, the FMS procedure to accomplish this is as follows.

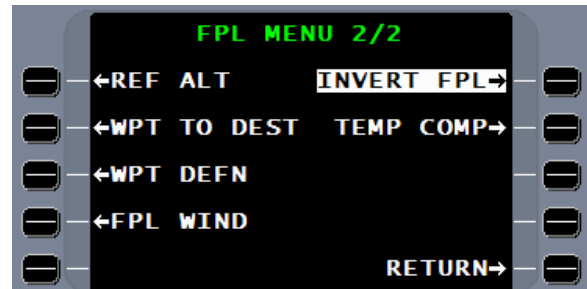
The first step is to turn the aircraft 90° to the current course. There may be specific turn directions required, observe regulatory requirements.



Under **FPL MENU 2/2** use the INVERT FPL tool to reverse the flightplan.



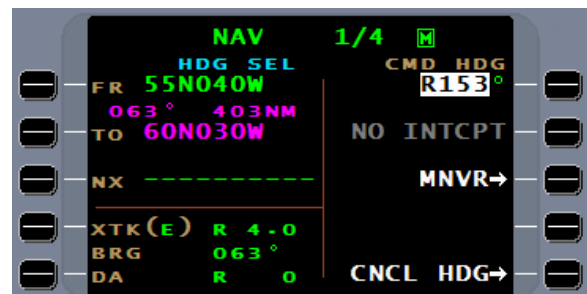
This will require a double push on the line select key.



This flightplan will now show the return routing.



Although the flightplan may show return routing, the NAV page will still retain the original NAV leg.



A manual leg change will be needed to provide the new NAV leg. Push the “FR” line select key and enter the correct “FR” waypoint.



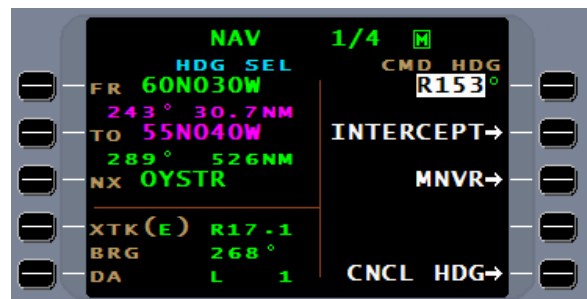
Complete the NAV leg by entering the correct “TO” waypoint and press the **ENTER** key.



Although this represents the correct NAV leg, reversing course requires an offset. Use selective crosstrack (SXTK) and enter the appropriate offset distance. If a right turn was initially made, with the flightplan reversed, the SXTK will be to the left of the new NAV leg.



On the CMD HDG page press INTERCEPT to have the FMS intercept and navigate the NAV leg.



The FMS will follow the SXTK offset for as far as needed along the new flightplan route.



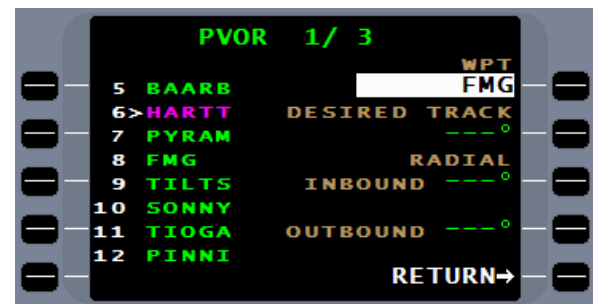
PSEUDO VOR OPERATION (RADIAL TRACKING)

The FMS provides the capability to track to or from any known waypoint on a programmed radial; similar to tracking on a VOR radial. This Pseudo VOR feature is accessed from the NAV page, by pressing the MNVR line select key.

From the **MANEUVER** page, select the PVOR line select key.



The **PVOR** definition page will display the current "TO" waypoint from the flightplan, and subsequent waypoints will be displayed in a list. The desired PVOR point may be chosen from the list, manually entered at the cursor, or the **LIST** feature may be used. After the waypoint is identified, the cursor will move to the **DESIRED TRACK** field.



A desired track may be entered directly and the radial for inbound tracking will be calculated...



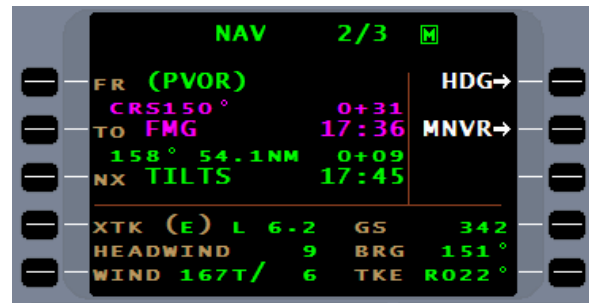
...or by using the line select key or **ENTER** key to move the cursor to the **INBOUND** field, an inbound radial may be defined and the desired track will be calculated.



Once the definition is made, the ACCEPT line select key will be available.



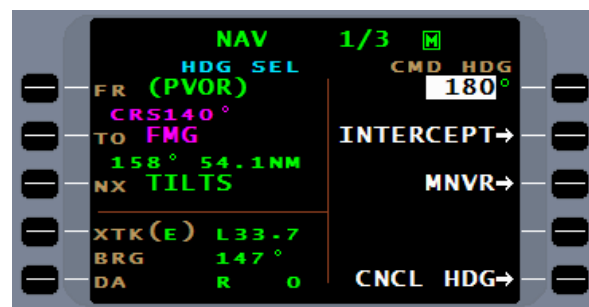
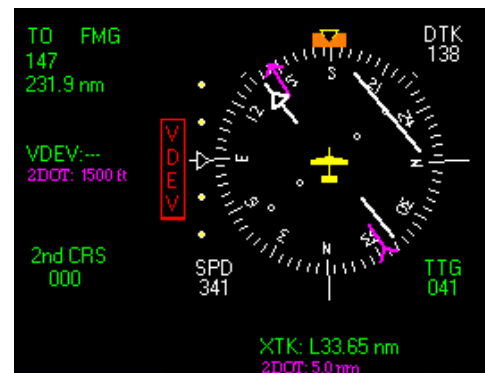
Pressing ACCEPT will change the current NAV leg to the PVOR and an intercept angle of up to 45° towards the defined radial will be commanded.



If on radar vectors, the CMD HDG mode may be used to fly the intercept. In this case, the INTERCEPT line select key under HDG must be pressed for the aircraft to intercept the PVOR radial.

Performing a DIRECT TO, making a manual leg change or selecting the approach mode will cancel the PVOR mode.

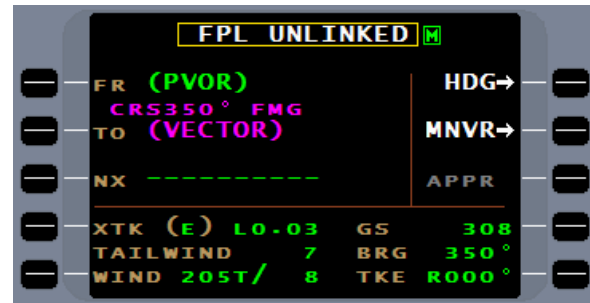
When a PVOR inbound to a waypoint not on the flightplan is selected, the leg will terminate at the PVOR waypoint and the system will prompt entry of a next point.



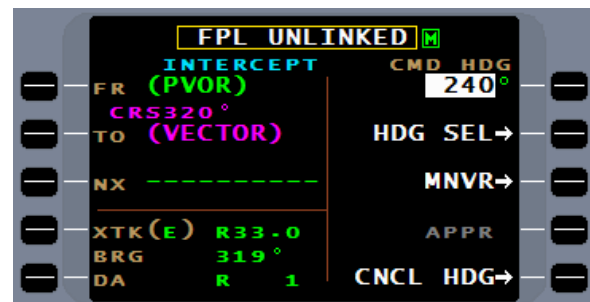
To fly outbound on a radial, first select a waypoint from which to fly. If the waypoint is on the flightplan, do not select it from the flightplan list, but enter it with either the LIST key or type it in manually. Another option is to place a GAP following the flightplan waypoint. This will help prevent inadvertent leg sequencing.



When a PVOR outbound is defined, the next leg will be undefined. It will be up to the pilot to exit PVOR by a manual leg change, DTO, or selecting approach arm when available.



Again, if on a heading that will intercept, remember to press the INTERCEPT option on command heading or the aircraft will fly through the PVOR course.



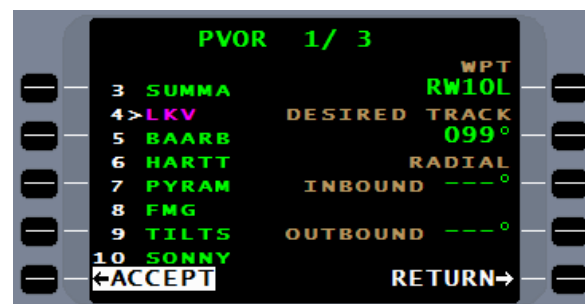
With SCN 803, when doing PVOR, the LIST function will provide a RWY option.



The RWY option will present the airport identifier and runway. The runway coordinates are that of the runway threshold.



When the RWY option is used with PVOR, the runway heading is automatically entered as the **DESIRED TRACK**. Accepting this will present, on the NAV page, a PVOR with runway course information.

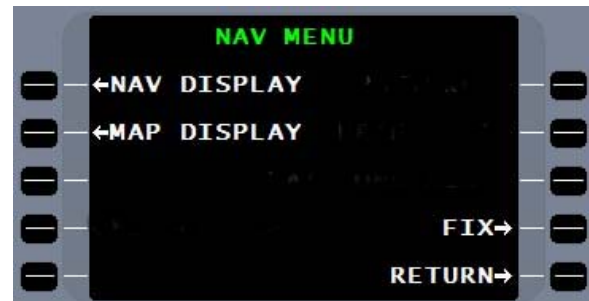


ABEAM POINT & RADIAL CROSSING

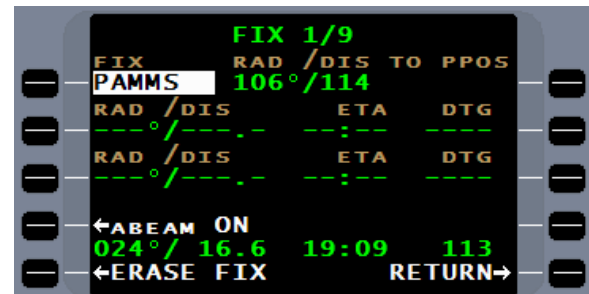
The clearance is direct Grand Turk (GT) report abeam PAMMS intersection.



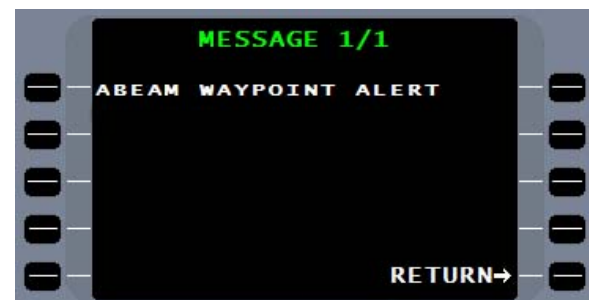
To have the FMS assist in identifying when the aircraft is abeam the requested waypoint, go to the **NAV MENU** and select the FIX line select key.



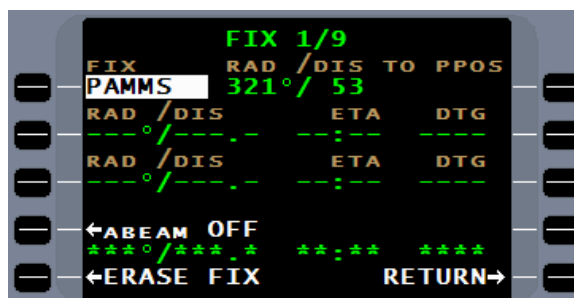
The FMS will present the **FIX 1/9** page. There are 9 duplicate pages allowing for 9 fixes. Entering the FIX for which you are to report abeam, the FMS will present the current radial and distance from that fix. At the bottom of the page is the calculated abeam point, with **ETA** (estimated time of arrival) and **DTG** (distance to go). The “ABEAM ON/OFF” option will turn off the abeam alert. “ERASE FIX” will clear the fix cursor field to allow entry of a new fix.



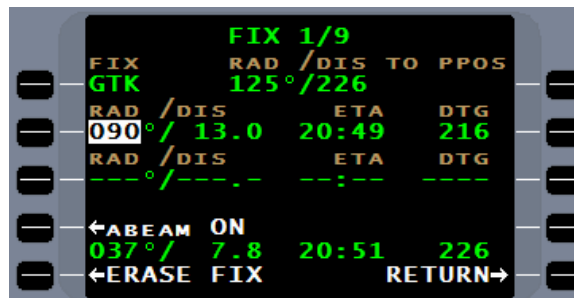
Following the line select key “ABEAM WAYPOINT ALERT” will be by either “ON” or “OFF”. With “ON” in view, 2nm before reaching the abeam point the FMS will present an ABEAM WAYPOINT ALERT message.



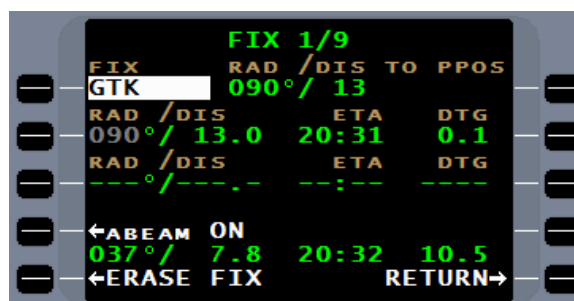
When past the abeam point, the abeam field will present "***".



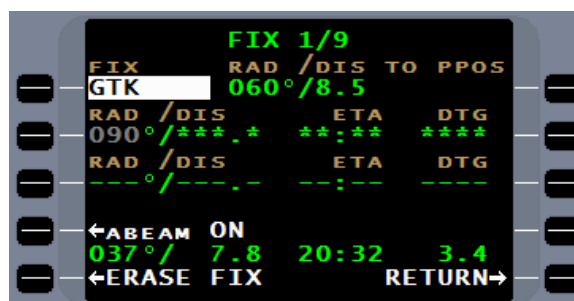
The **FIX** page can also calculate a distance, **ETA**, and **DTG** to a crossing radial from the fix.



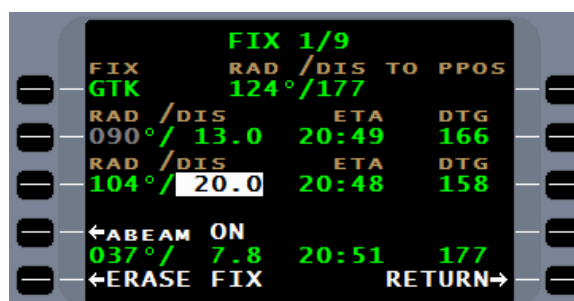
No message will be presented when the entered radial is crossed.



The fields will present "***" upon crossing the radial.



By entering a distance into the **DIS** field, the FMS will calculate the crossing radial for that distance. To get to the **DIS** field, press the adjacent line select key and press **ENTER**.

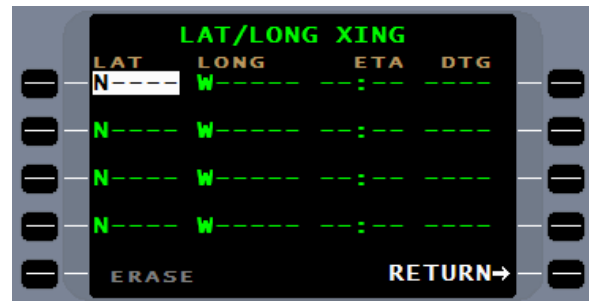


LATITUDE LONGITUDE CROSSING (LAT/LONG XING)

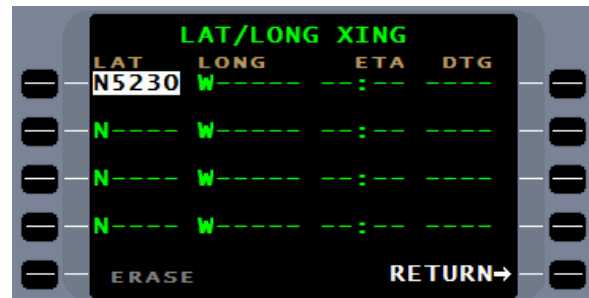
Selectable through the **NAV MENU** is a LAT/LONG XING feature that will alert the pilot when a desired latitude or longitude is being crossed.



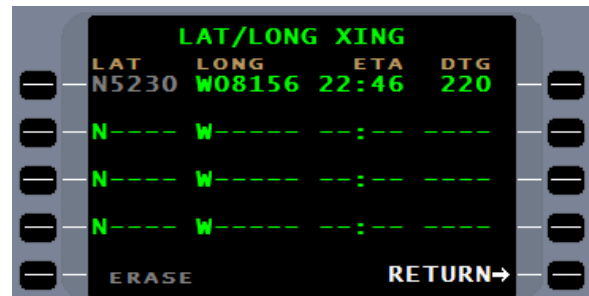
After pressing the LAT/LONG XING line select key, the **LAT/LONG XING** page will be displayed and the cursor will default to the first **LAT** field.



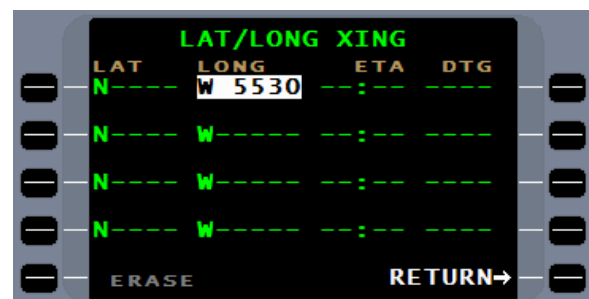
Enter the latitude in degrees and minutes...



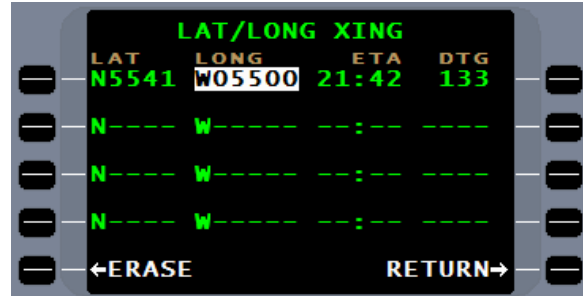
...and the FMS will calculate the longitude for the crossing waypoint. In addition, the FMS will calculate Estimated Time of Arrival (**ETA**) and Distance To Go (**DTG**).



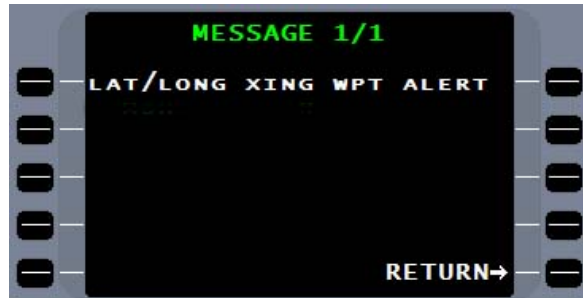
With the cursor in the **LAT** field, pressing the **ENTER** key will move the cursor to the **LONG** field.



By entering the longitude the FMS will calculate the latitude, **ETA**, and **DTG**.

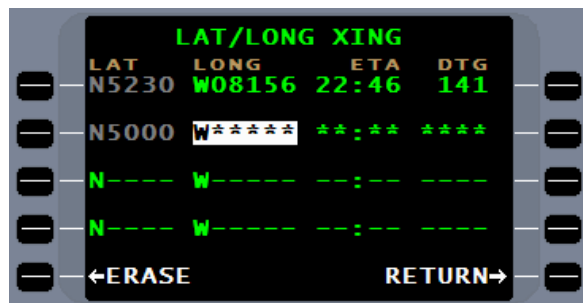


When within 2nm of the LAT/LONG waypoint, the FMS will present the message LAT/LONG XING WPT ALERT.



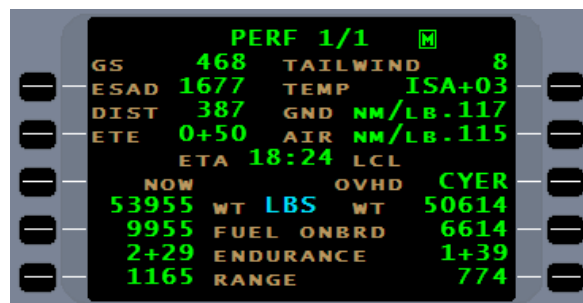
The entering of invalid data will result in the FMS being unable to calculate a waypoint.

The “ERASE” option will erase the line on which the cursor field is active.



CRUISE PERFORMANCE

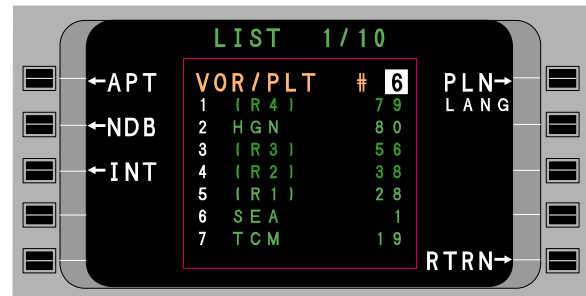
When airborne, by pressing the PERF line select key, the **PERF 1/1** page will provide a synopsis of in flight performance information found on the fuel and flightplan pages. Manual entries may not be made on this page.



NOTE: Aircraft with performance databases will have more than one **PERF** page, but page one will not change. Use of the performance database is covered later.

RADAR WAYPOINT ENTRIES

Radar waypoint entries may be made to the FMS. This requires an Avionics System with a Radar/MFD and FMS interface. When entered, radar waypoints will appear on the VOR/PLT waypoint list and the Direct To function may be used or waypoints may be added to the flightplan by way of the **LIST** key. Up to 25 waypoints may be entered and they will be identified as <R1> through <R25>. All radar waypoints are erased upon the next initialization. During DTO the last radar waypoint defined will be the first choice on the list.



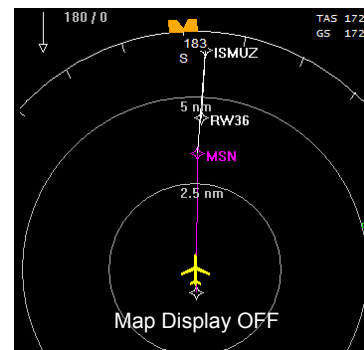
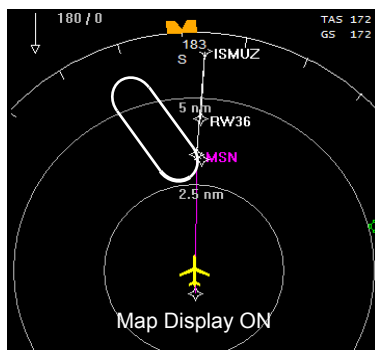
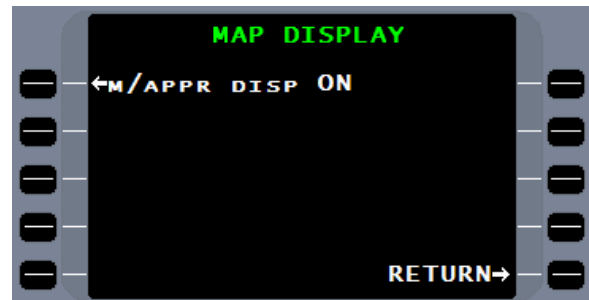
MAP DISPLAY & NAV DISPLAY

SCN 802 and subsequent added on the **NAV MENU**, the MAP DISPLAY option. This will allow the pilot to inhibit the display of the missed approach segment on the mapping mode of the pilot flight display.



The MAP DISPLAY will automatically turn on if any of the following occur:

1. Either the TO or the NX waypoint is a missed approach segment waypoint
2. The approach is cancelled prior to reaching the FAF
3. The approach is exited because of a manual leg change
4. A new approach is inserted into the flightplan

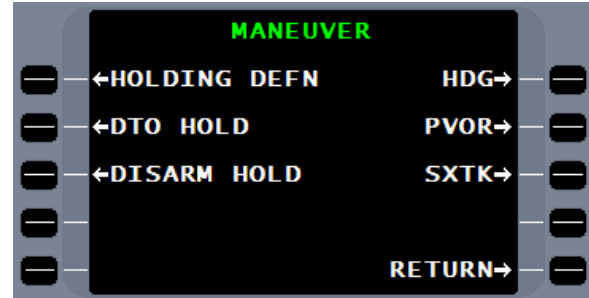


HOLDING PATTERNS

The FMS will define holding patterns, determine holding pattern entry procedures, and fly three types of holding patterns; hold to manual termination (HM), hold to fix (HF), and hold to altitude (HA). The FMS NAV database will include holding patterns required to complete the SID, STAR, or approach procedure. A pilot can only create an HM or hold until manually terminated pattern.

The automatic holding pattern feature of the FMS is accessed from the NAV page using the MNVR line select key.

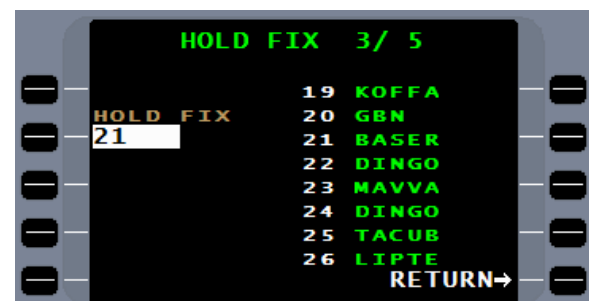
The **MANEUVER** page allows access to select the HOLDING DEFN line select key.



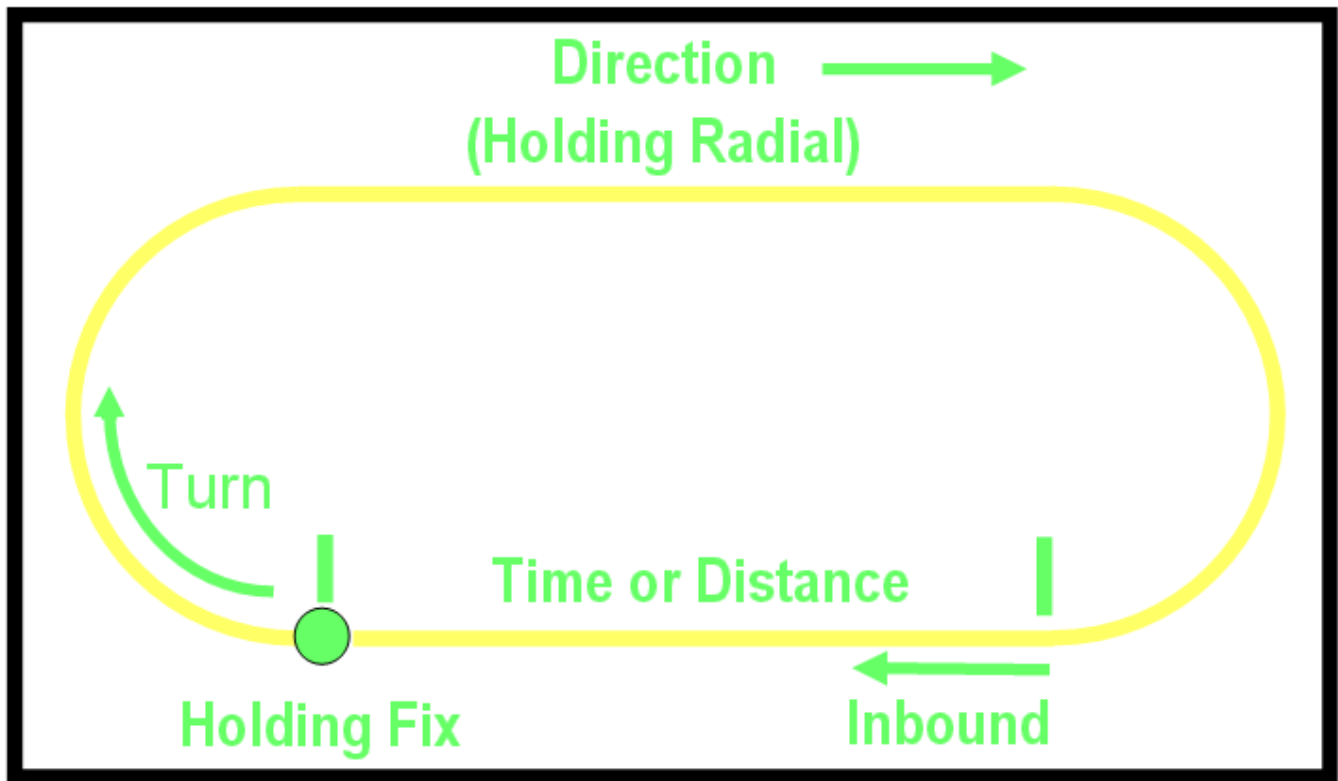
The **HOLDING** definition page will be displayed if the flightplan contains a holding plan. There is a published holding pattern shown at BASER intersection on the DINGO5 arrival chart, but since the holding procedure is not required to complete the STAR, it will not be found in the database. If there is a requirement to anticipate holding at BASER as published, the holding pattern must be defined in the FMS and entered into the flightplan. To build this holding pattern, first press the line select key adjacent to **FIX**, to enter **BASER** intersection.



If there is no holding pattern defined in the flightplan, the **HOLD FIX** page will be displayed in lieu of the **HOLDING** definition page. A waypoint can be entered into the **HOLD FIX** cursor field by direct type in, use of the LIST key, or by selecting a waypoint from the flightplan list. A waypoint selected from the flightplan list will allow the holding pattern to be entered into the flightplan. Use the reference number for **BASER** to select it as the FIX on the HOLDING definition page.



Holding Patterns (RH)



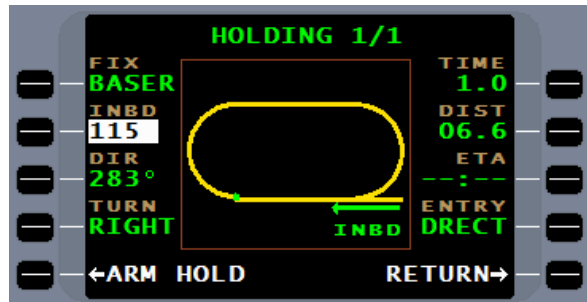
The FMS flies holding patterns according to TERPS procedures, but is waved to fly in countries using PANOPS procedures. The HOLDING definition diagram will define time or distance relative to the inbound leg. DIR is the direction of the outbound leg, but it is also the holding radial. The FMS will compensate for the effect of winds to fly the inbound leg according to the time or distance entered.

To fly holding patterns, the FMS uses in-flight winds. The vector trigonometry that the computer does is the classic wind triangle problem can be done on an E6B computer. The track / ground speed vector is known from a succession of position fixes. The heading / TAS vector comes from the aircraft's heading source and air data systems. Any differences between heading TAS and track / ground speed are assumed to be wind.

To edit the holding pattern inbound radial (**INBD**), use the adjacent line select key to activate the field.



Press **ENTER** following the entry of the holding pattern inbound course. The cursor will advance to complete the editing.



The **DIR** field is the course outbound. If the clearance is to hold on a radial, the radial can be entered into the **DIR** field and the **INBD** field will be automatically calculated and entered.



The holding pattern turn direction may be changed by using the \pm key or entry of L or R key.



The cursor will automatically advance to **TIME**. Time is entered in minutes and tenths of a minute and will default to one minute.

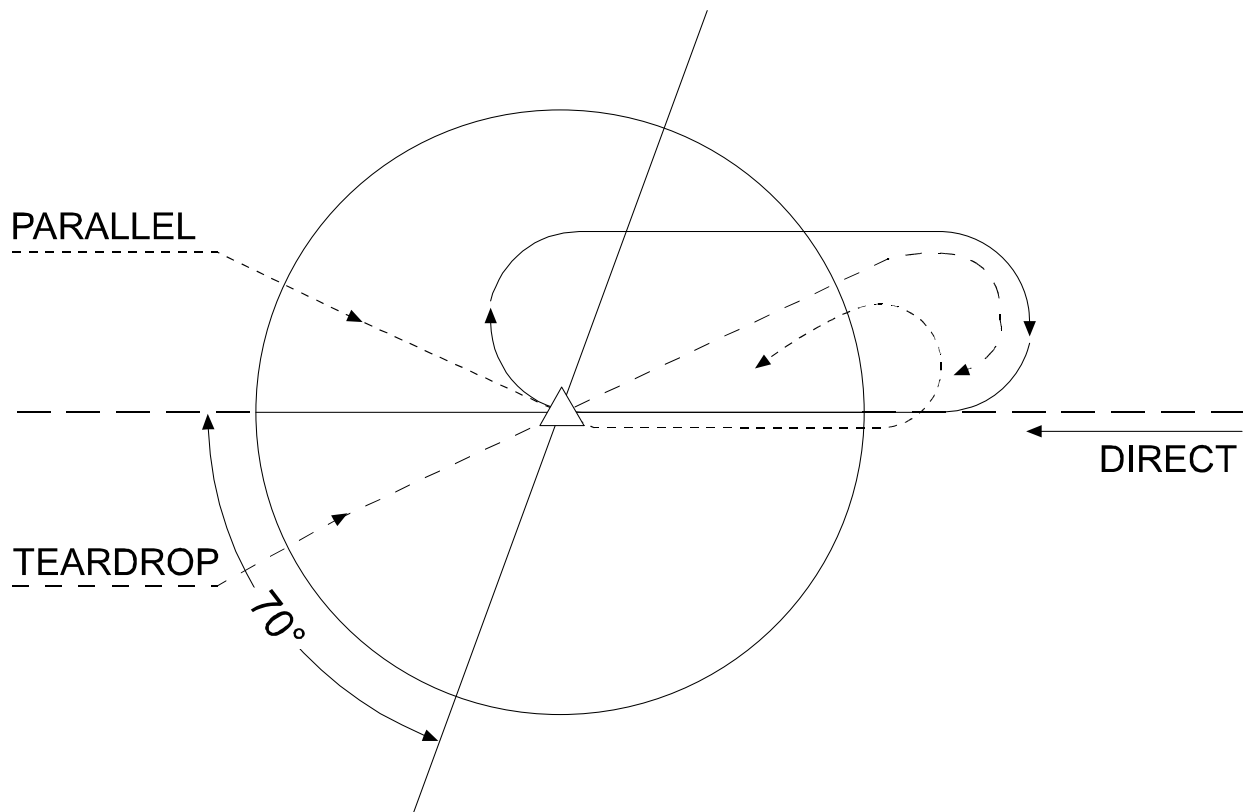


To enter a distance for the inbound leg requires manually selecting the **DIST** line select key. Distance for the inbound leg is entered in nautical miles and tenths of a nautical mile. When distance is selected, the diagram will show **DIST** for the inbound leg.



The entry procedure is calculated based on the navigational leg prior to the holding waypoint.

Depending on the inbound course to the hold, the FMS will enter the pattern using a direct, teardrop, or parallel entry, per standard procedure, as shown below:



A parallel or teardrop entry will recalculate from the lateral guidance legs when 15 seconds from the hold fix, in order to use the most current wind and ground speed. While in the holding pattern and 15 seconds from the hold fix, the next holding pattern is computed. PROCEED entered any time will take effect immediately and upon the passing of the holding fix the FMS will proceed to the next waypoint. If distance is used for leg determination and a teardrop entry is being made, the track out bound will be calculated to afford a continuous turn inbound to roll wings level on the inbound course.

Based on the dividing line between entry procedures, the FMS will allow a $\pm 20^\circ$ area where either entry may be used.



By pressing the **ENTRY** line select key, an alternate entry procedure may be selected if available. If not within the $\pm 20^\circ$ area, no option will be presented.



With the holding definition completed, it can be entered into the flightplan.



Pressing the ARM HOLD line select key will enter the holding definition into the flightplan.



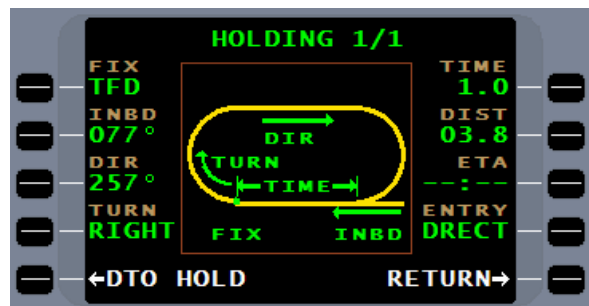
A DTO HOLD option is presented and can be used to go present position direct to the holding entry waypoint.



The holding fix will be coded as overfly with the addition of the (*). The terminator for the holding pattern is **(HOLD)**, which indicates it is a manually terminated holding pattern. The → indicates direction of turn, in this case, a right hand turn. **HLD** indicates it's a holding pattern and **115°** indicates the inbound course.



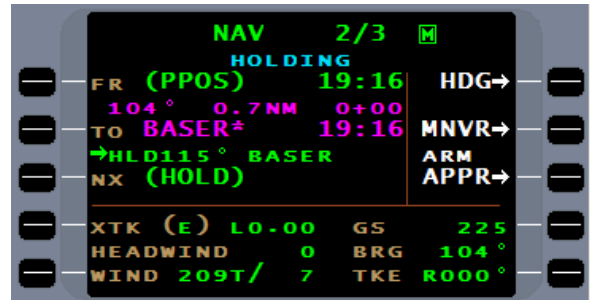
An off flightplan waypoint will present only a DTO HOLD option. The **HOLDING** page will retain the definition for the holding pattern if a nother page is selected, but if a new holding fix is selected, the current holding pattern definition will be lost.



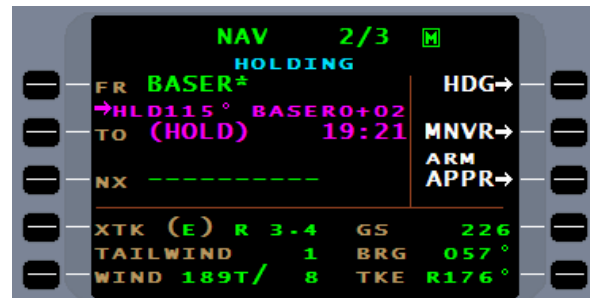
The NAV page will present **HOLD ARMED** when on the navigational leg prior to the holding fix.



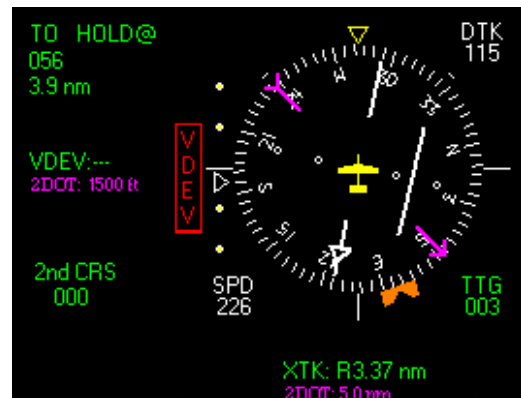
When within 15 seconds of crossing the holding fix, the FMS will present **HOLDING**. At this time the FMS holding definition is locked and the FMS has calculated the affect of wind. The pattern will be flown so as to fly the inbound leg according to the defined time or distance.



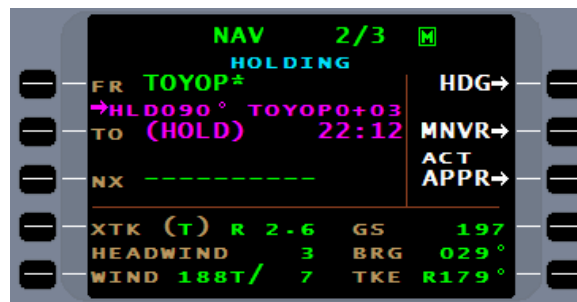
When the holding patten is entered, the leg terminator (**HOLD**) will be the **TO** waypoint.



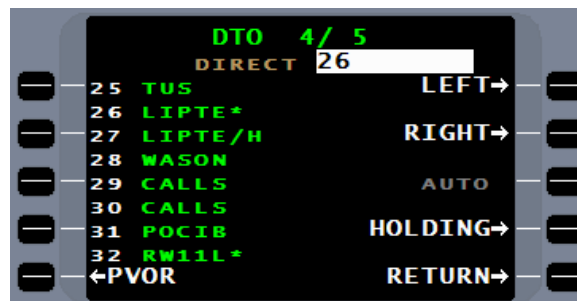
With the holding leg active, the HSI course arrow will define the holding pattern inbound leg, the milage window will be line of sight nautical miles to the holding fix, and the FMS bearing pointer will point to the holding waypoint.



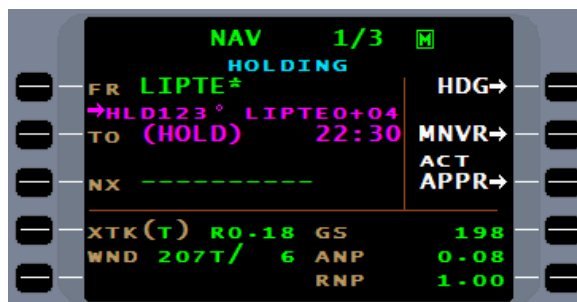
With the aircraft established in holding, there are three ways to exit the holding pattern.



The direct to (DTO) function with the selection of a new waypoint will automatically cancel the holding pattern.



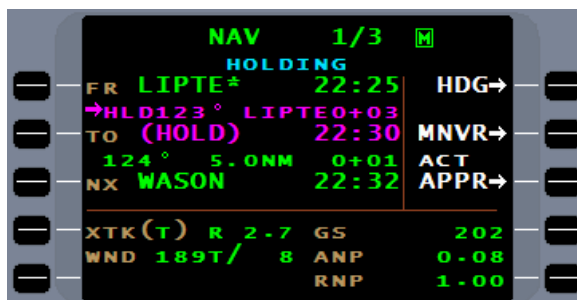
A manually terminated holding pattern with follow on waypoints can be exited by proceeding on course with the use of PROCEED. This is the second method of exiting a manually terminated holding pattern.



Under the MANEUVER page is a proceed option that will, in effect, change the HM leg to an HF leg.



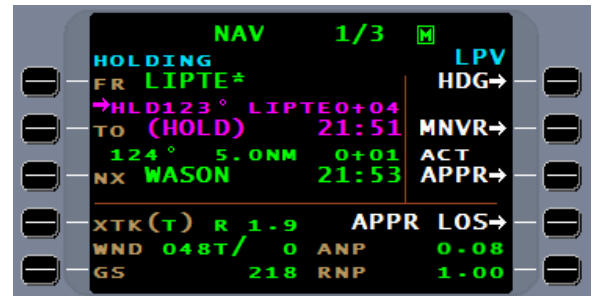
Selecting PROCEED will result in the aircraft finishing the holding pattern and upon crossing the holding fix the next time will result in the aircraft exiting the holding pattern and proceeding on course.



To terminate the holding pattern early, first select PROCEED.



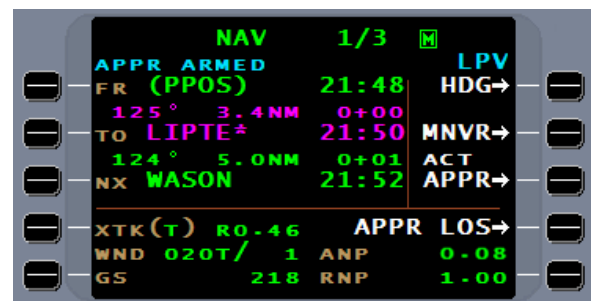
As above, PROCEED will result in the FMS exiting the holding pattern upon crossing the holding fix.



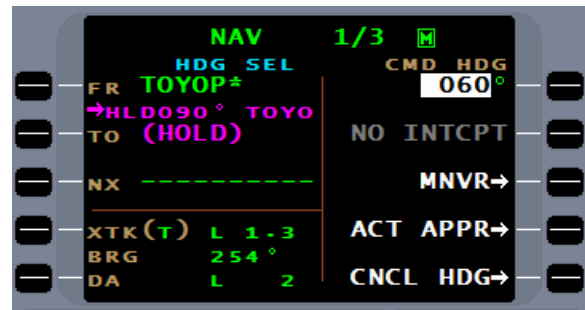
To initiate an early exit, use DTO to turn direct to the holding fix.



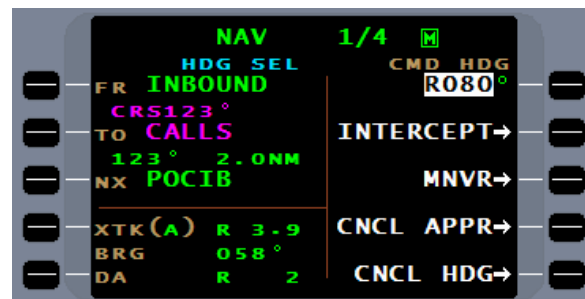
PROCEED will remove the holding pattern and upon crossing the holding fix, the aircraft will continue on course.



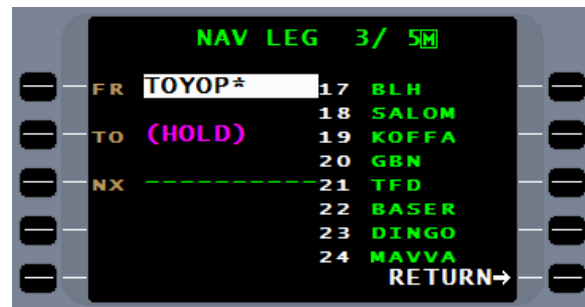
Radar vectors to either a manually activated approach or to a new manually selected NAV leg is the third way to exit a holding pattern.



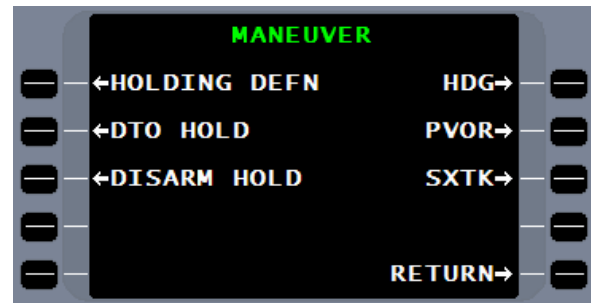
Once the new heading is entered into the **CMD HDG** function, activate the approach.



With the new heading active, manually select the new NAV leg using the manual leg change technique.



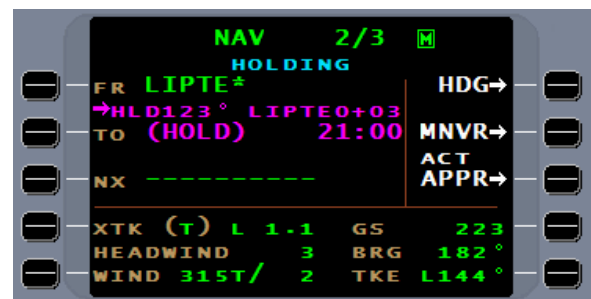
Prior to reaching the hold, pressing the DISARM HOLD line select key will produce the HOLDING page with an option to DISARM HOLD.



Pressing the DISARM HOLD line select key will remove the holding pattern from the flightplan and the aircraft will continue on the flightplan.



The DISARM HOLD function will not remove the holding pattern if the FMS is committed to the holding pattern. The subheading **HOLDING** indicates the FMS is committed to holding.

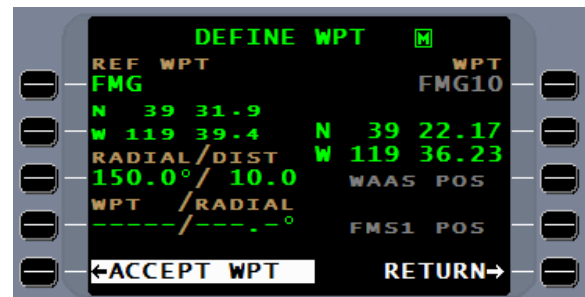


HOLDING WITH PILOT WAYPOINT

To hold at a non-database waypoint requires the creation of a pilot waypoint. Enter the name of the pilot waypoint; recommend the use of the ARINC waypoint naming convention presented in the pilot waypoint section of this manual.



Use one of the procedures described in the section on creating pilot waypoints to define the fix over which the aircraft will hold.



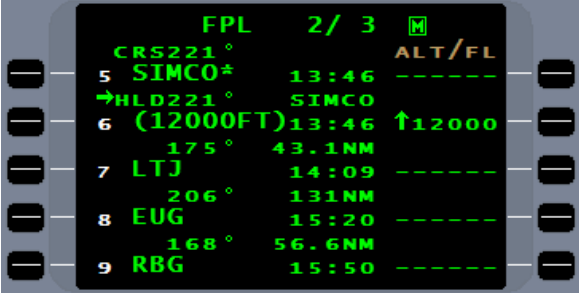
Once the fix is accepted, the FMS will return to the HOLDING 1/1 page to enable the pilot to complete the definition of the holding pattern.



PROCEDURAL HOLDING PATTERNS

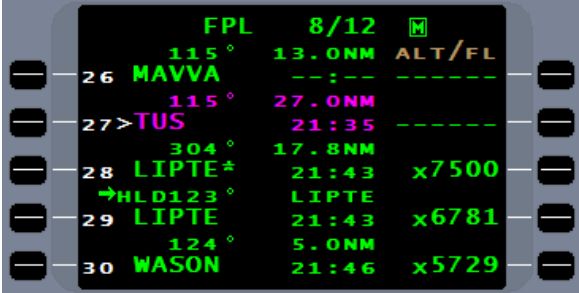
When holding patterns are part of a published procedure (SID, STAR or Approach) they are stored in the navigation database. By linking the procedure into the flightplan, any holding patterns that are part of the procedure are included at the designated holding fixes. Holding patterns are identified by ARINC 424 as HA, HF, and HM leg types. They are all defined in the same manner except for the type of leg terminator. The FMS will fly each of these legs as follows:

HA (Hold to an altitude terminator) - The aircraft will stay in the holding pattern until the specified altitude is reached, then a sequence to next leg will occur the next time the aircraft crosses the holding fix. HA type holding is generally found in SID's.




	FPL	2/ 3	M	ALT/FL
5	CRS221°	13:46		-----
	→HLD221°	SIMCO		
6	(12000FT)	13:46		↑12000
	175°	43.1NM		
7	LTJ	14:09		-----
	206°	131NM		
8	EUG	15:20		-----
	168°	56.6NM		
9	RBG	15:50		-----

HF (Hold to a fix terminator) - The aircraft will sequence to the next leg after crossing the holding fix the second time. HF holding patterns are usually used as course reversals in lieu of procedure turns. The terminator is the second LIPT. This leg type is easily identified by the same identifier being repeated with the hold path as the separator.



	FPL	8/12	M	ALT/FL
	115°	13.0NM		ALT/FL
26	MAVVA	---		-----
	115°	27.0NM		
27	>TUS	21:35		-----
	304°	17.8NM		
28	LIPT*	21:43		x7500
	→HLD123°	LIPT		
29	LIPT	21:43		x6781
	124°	5.0NM		
30	WASON	21:46		x5729

Once the aircraft has entered the HF pattern ...



	NAV	2/3	M	
	HOLDING			
FR	LIPT*			HDG→
	→HLD123°	LIPT0+05		
TO	LIPT	21:49		MNVR→
	124°	5.0NM		ACT
NX	WASON			APPR→
XTK (T)	R0-02	GS	121	
TAILWIND	1	BRG	119°	
WIND	197T/	7	TKE	R173°

...the FMS will present an option under the **MANEUVER** page to CONTINUE HOLD. This will, in effect, change the HF leg to an HM leg.



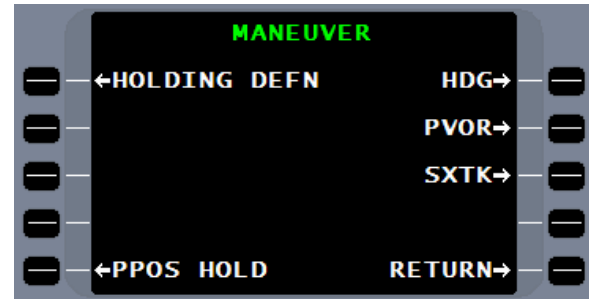
The normal way to exit the holding pattern when flying an approach transition, is to use the proceed option on the maneuver page.

To terminate the holding pattern early, first select PROCEED, and then DTO the holding fix. PROCEED will remove the holding pattern and upon crossing the holding fix, the aircraft will continue on course.



HOLD AT PRESENT POSITION

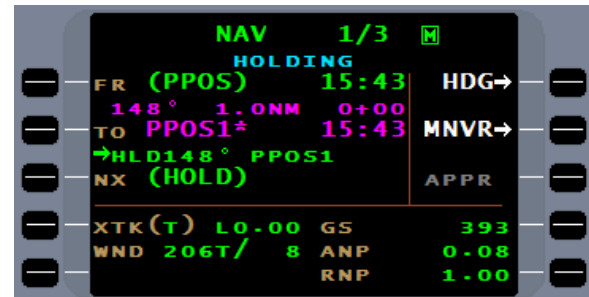
Hold at present position is a feature available with SCN 803. On the **MANEUVER** page, is the option PPOS HOLD.



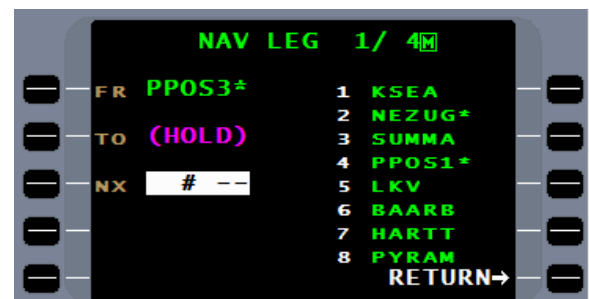
Selection of this option will display the **HOLDING 1/1** definition page. A standard holding pattern will be defaulted onto the page with PPOS1 as the FIX and INBD the heading of the aircraft. PPOS1 is a point 15 seconds ahead of the aircraft. The default holding pattern may be edited if necessary. Pressing DTO HOLD will result in the FMS commanding the aircraft to proceed to the defined holding pattern.



The first holding fix will be named PPOS1. Subsequent present position holding fixes will be named PPOS2, PPOS3, etc.; to a max of nine.

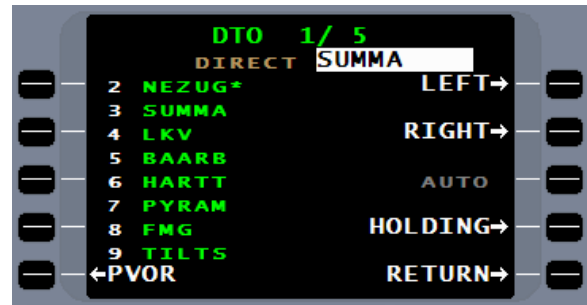


If PROCEED is used to exit the holding pattern, the FMS will prompt for the follow on waypoint. It will not automatically select a point.



DIRECT TO OPERATION (DTO)

Upon pressing **[DTO]** the **DTO** page will show the current flightplan waypoints and to proceed direct to any one of them, select the reference number from the list. The FMS will automatically calculate the shortest direction to turn to the selected waypoint. If a specific turn direction is desired, line select keys are available to specify turn direction. Insure both the turn direction and the desired waypoint are first selected before pressing **[ENTER]**.



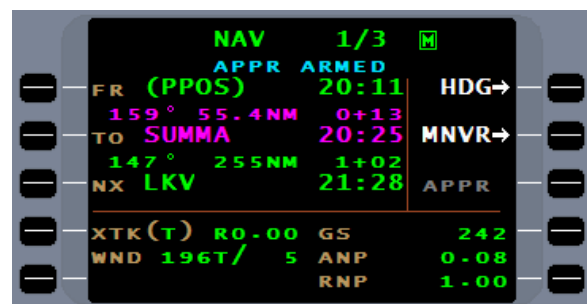
A waypoint may be directly typed in or use the **[LIST]** key to present waypoints.



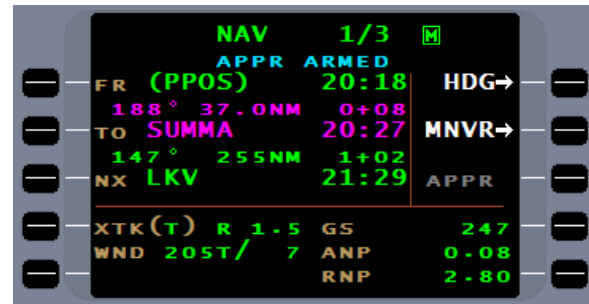
If an off flightplan waypoint is used, the FMS will prompt for the **NX** (next) waypoint in order to reconnect with the flightplan. If there is no next waypoint, press the **[ENTER]** key to proceed to the NAV page.



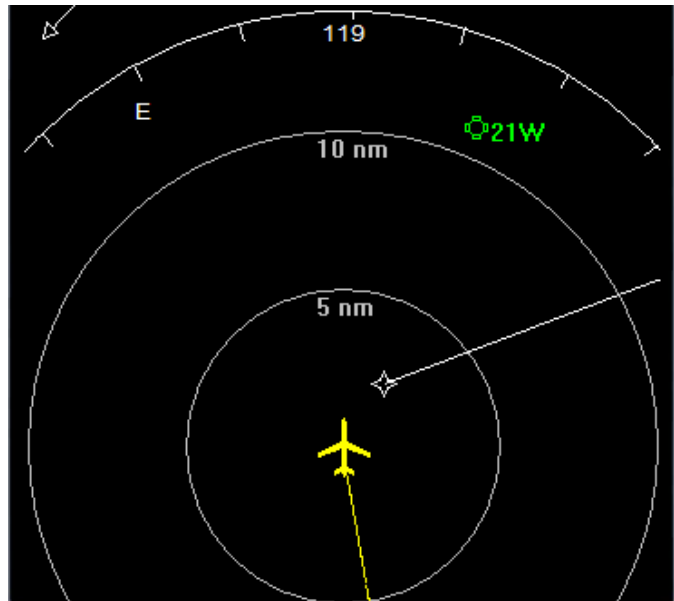
With a flightplan waypoint selected, the FMS will automatically present the **NAV** page.



With a direct to procedure, the FMS will calculate **(PPOS)**, present position, and then calculate a TF or Track to Fix leg to the “**TO**” waypoint.

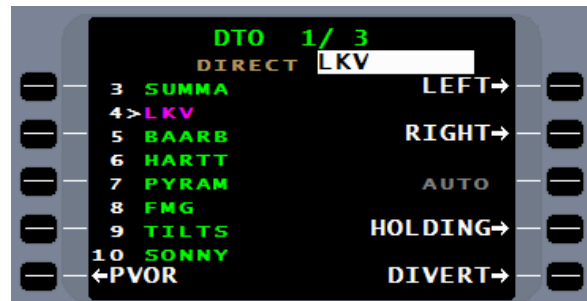


The PPOS is calculated at a point where the aircraft is estimated to complete the turn on a heading that will proceed direct to the select waypoint. The PPOS will be displayed on a MAP, indicating the point at which the FMS has estimated the aircraft will complete the turn.

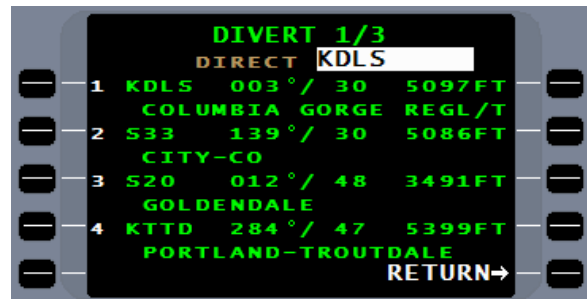


EMERGENCY DIVERT SCN 803

Available in SCN 803 is the emergency divert option. From the DTO page, line select key 5R offers DIVERT.



When selected, the divert option will present three pages showing the twelve nearest airports. Included is the dynamically calculated bearing and distance to that airport, the length of the longest runway, and the airport name.



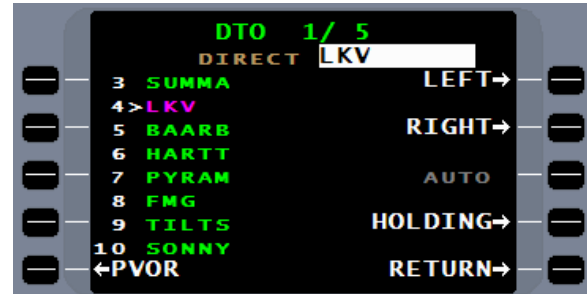
Entering the identifier or the reference number will produce a direct to NAV leg. This airport identifier will automatically be added to the end of the flightplan for quick addition of an FMS approach.



DTO AN EMERGENCY OR DIVERT AIRPORT SCN 801 & 802

The DTO function can be used together with the LIST function to aid the pilot during an emergency or divert to a nearby airport.

Select the DTO function to bring up the DTO page.
The LIST function will use the aircraft position as the reference waypoint.



From the LIST page select APT.



Airports and their distance to the aircraft will be listed.



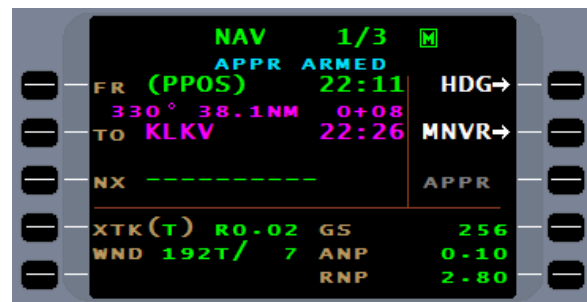
Use of the PLN LANG line select key will assist in the selection of a divert airport. Information on this airport can be obtained from the NAV directory under the DATA page 1. (Covered later) The number of the closest airport is defaulted into the cursor. Press **ENTER**.



The selected airport, KLKV is entered as the **TO** waypoint and a prompt for next appears. Entering a NX waypoint is not required. However, in SCN 801, to do an FMS approach at the divert airport, enter the line number of any waypoint from the flightplan list except a waypoint from a terminal procedure.

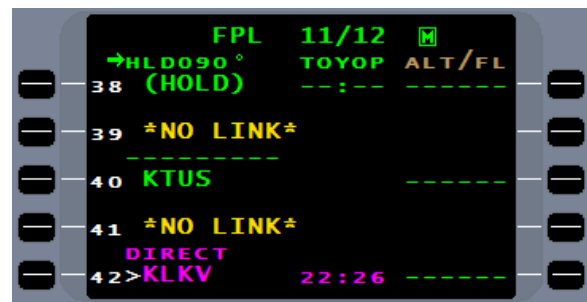


With the **ENTER** key pressed, the NAV page displays FR (PPOS) – TO KLKV.



In SCN 802, pressing the **ENTER** key with no entry in the NX field, will result in the airport automatically being entered at the end of the flightplan.

With the airport at the end of the flightplan, entering an approach is easy.



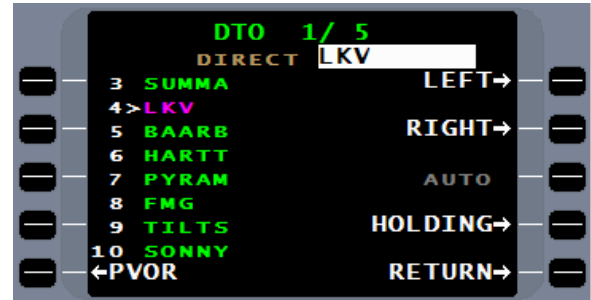
AREA NAVIGATION (RNAV) WITH DIRECT TO

The FMS is capable of navigating to any point that is defined or can be defined. The DTO or direct to function can be used for Area Navigation (RNAV).

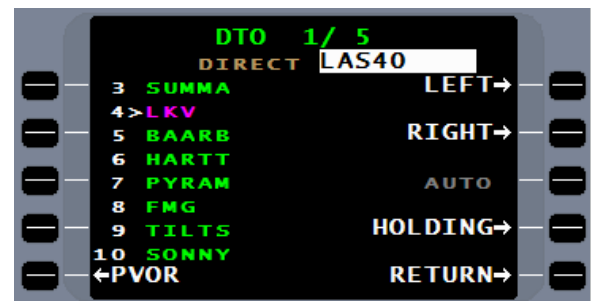
Pressing the DTO key displays the standard **DTO** page.

The FMS is capable of navigating to any point that is defined or can be defined. The DTO or direct to function can be used for area navigation (RNAV).

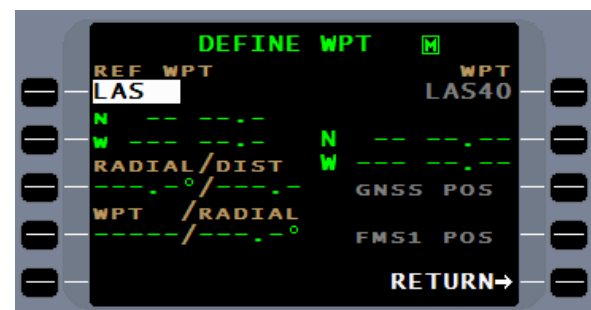
Pressing the DTO key displays the standard DTO page with the TO waypoint as the default in the cursor field.



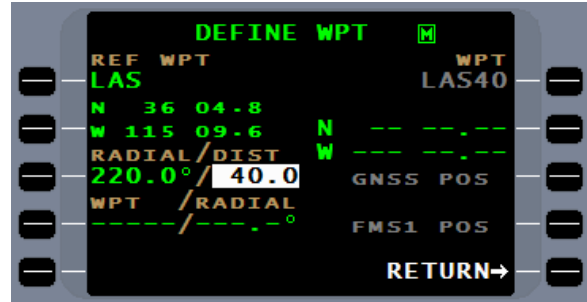
The random waypoint is the LAS 220 radial at 40nm. Using the ARINC 424 naming convention, the waypoint LAS40 is entered into the cursor. If the name LAS40 is in use, modify it slightly to a waypoint name that is not in use.



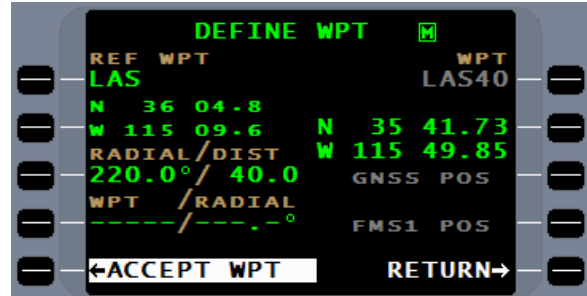
Press the **ENTER** key and the **DEFINE WPT** page is displayed. Since the random or pilot created waypoint is defined relative to LAS, LAS is entered into the **REF WPT** cursor field.



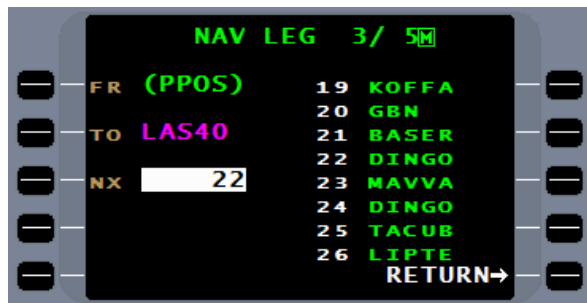
Enter 220.0 and 40.0nm to define the new waypoint. The **ENTER** key will move the cursor from **RADIAL** to **DIST**.



Pressing the ACCEPT WPT line select key will move to a page that prompts for the next waypoint. To make this waypoint a Tactical waypoint, press **MENU** and select TACT.



Select the NX waypoint and press **ENTER**. If no NX waypoint is selected, the flightplan will become unlinked from the NAV page.



The **NAV 1/3** is now displayed with the FMS directing the aircraft from **(PPOS)** present position direct to **LAS40** with **DINGO** as the **NX** waypoint.



Any "TO" waypoint that is followed with a "NX" waypoint is "linked" to the flightplan and will appear on the FPL pages prior to the "NX" waypoint.



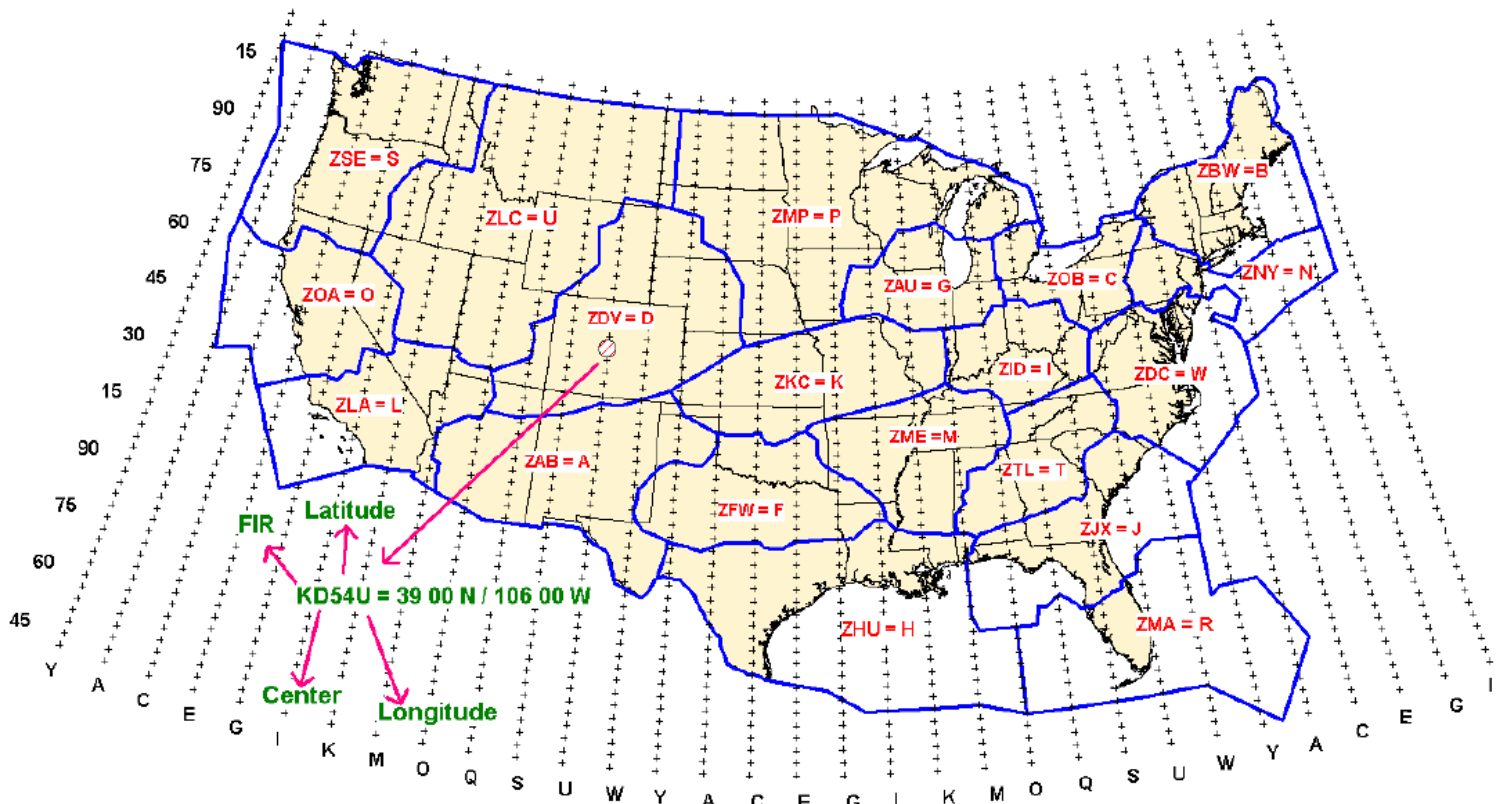
NAVIGATION REFERENCE SYSTEM

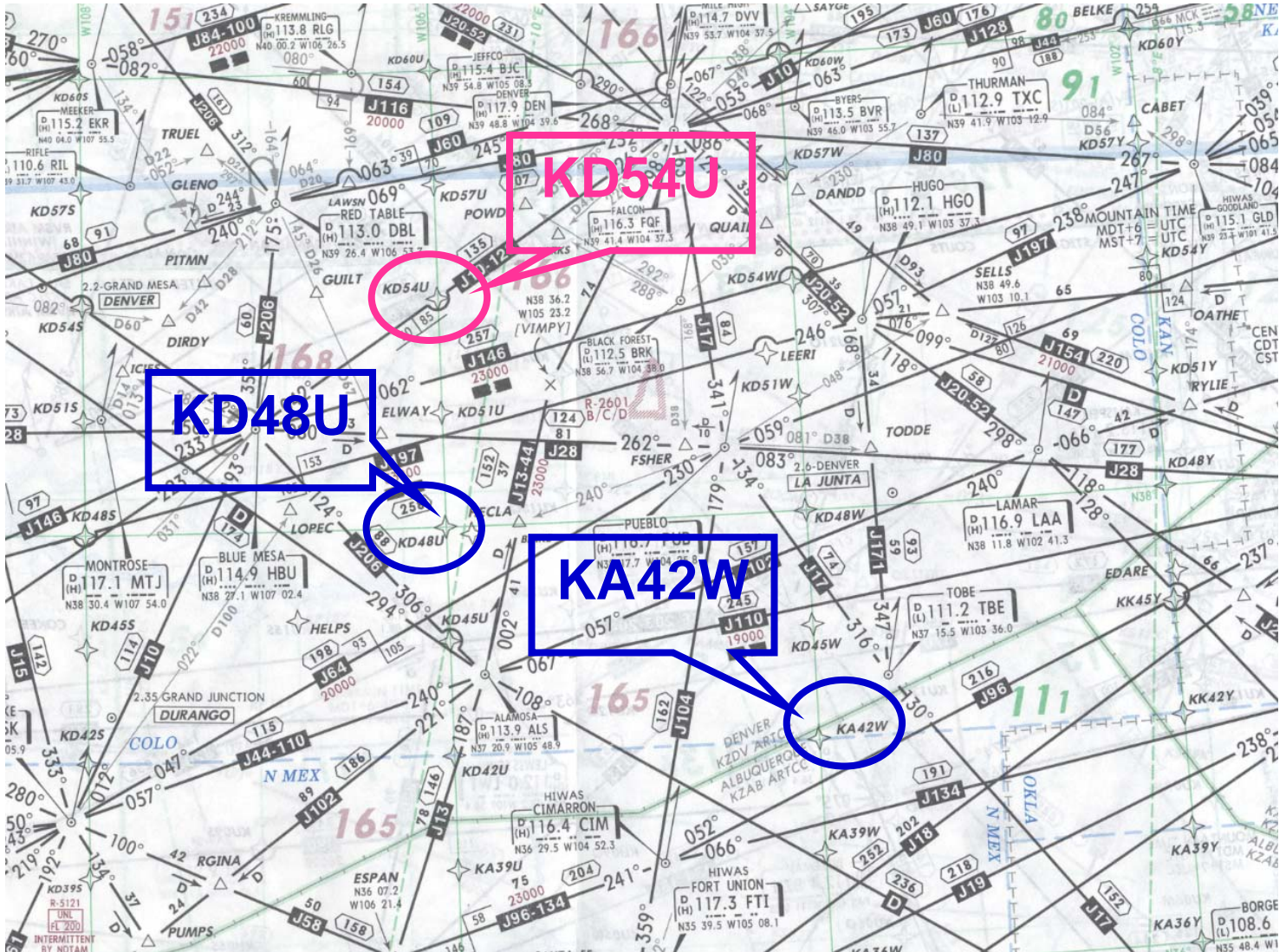
By definition, aircraft navigating by IFR approved GPS are considered to be area navigation (RNAV) aircraft and have special equipment suffixes. Most aircraft using Universal Avionics FMS have IFR approved installations and, therefore, fall under the above definition. The FAA High Altitude Airspace Redesign (AC 90-99) uses the Navigation Reference System (NRS) of waypoints enabling capable aircraft to fly point-to-point navigation or RNAV.

The waypoints defined under the Navigation Reference System are included in the SCN 80X navigation database.

Navigation Reference System

Waypoints every 30 minutes of latitude and every 2 degrees of longitude
(Grid origin is at the Equator south of Greenwich, England)





NRS waypoints are entered manually by typing in the waypoint identifier, pressing the **ENTER** key, verifying, and accepting it. Refer to appropriate FAA documentation for further guidance on using the Navigation Reference System.

	FPL	3/ 6	M
9	KS06I	111°	130NM ALT/FL
10	KU78M	118°	248NM
11	KD48U	112°	472NM
12	KA42W	111°	112NM
13	PNH	124°	153NM

VERTICAL NAVIGATION OPERATIONS

Six waypoints are available under the VNAV function and additional waypoints are available through the flightplan pages. Descent through a holding pattern and enhanced VNAV interface between enroute and approach are available. The VNAV page will display the vertical speeds required based on present ground speed to obtain the target altitudes at the VNAV waypoints. When a target vertical speed is entered, it will also display Top Of Decent (TOD) with distance and time to top of decent and Flight Path Angle (FPA).

Aircraft deviation from the vertical flight path is output to the flight guidance system vertical deviation indicator (VDI). Scaling of the VDI is EFIS and phase of flight specific.

Enroute VNAV profiles may be flown on many aircraft while coupled to the Flight Guidance System (FGS). The FMS computes a Vertical Pitch Command that is recognized when VNAV is selected on the FGS Mode Select Panel.

The VNAV mode will be exited and all vertical waypoints will be canceled if any of the following conditions occur while in the VNAV mode:

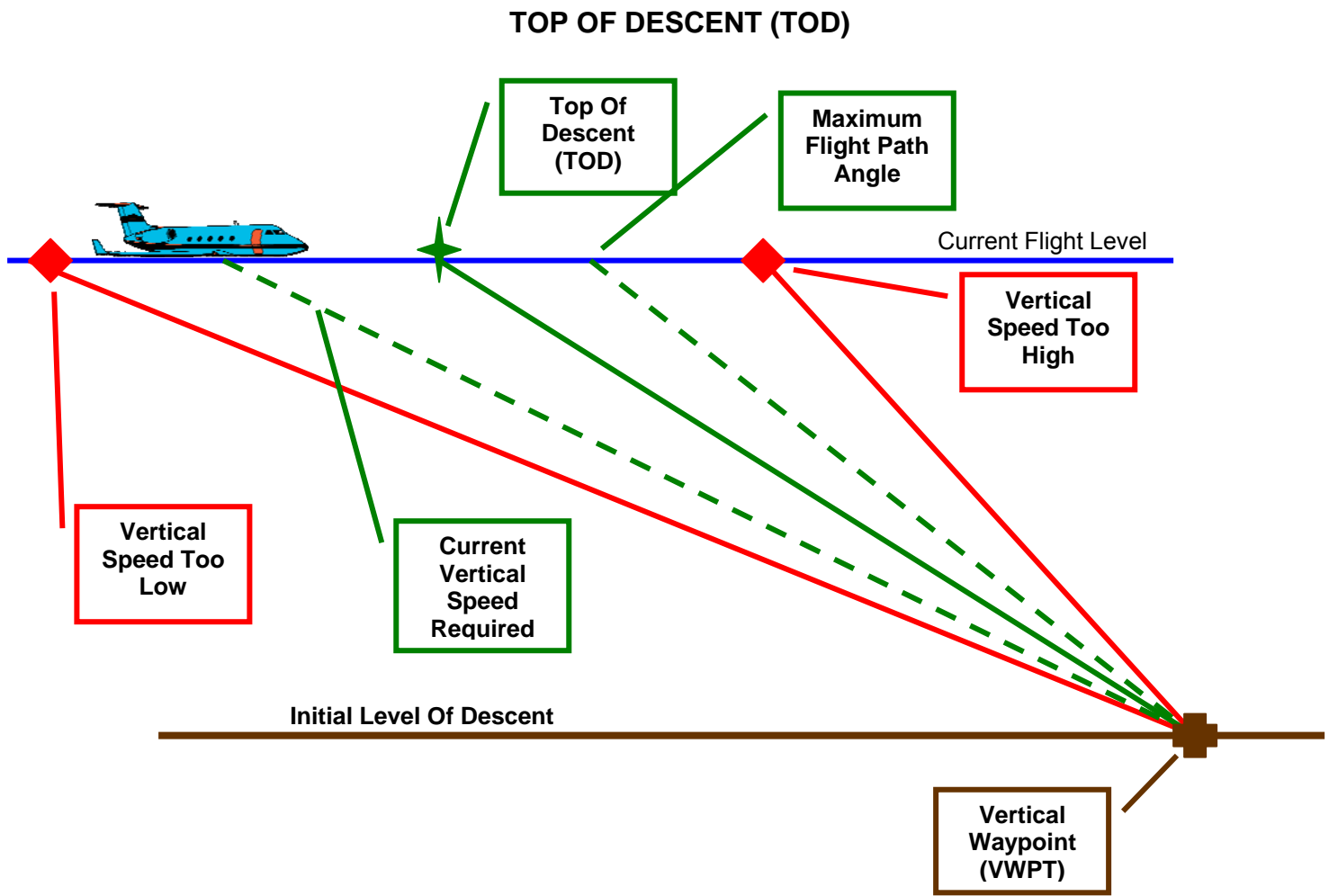
- ADC altitude becomes invalid
- ADC altitude is not baro-corrected below 18,000 feet
- ADC is deselected
- A manual altitude is entered
- POSITION UNCERTAIN message appears
- Selected Crosstrack Mode is activated
- Cancel VNAV line select key is activated
- Crosstrack deviation becomes greater than 12.5nm
- Enroute FPL gap is encountered
- Enroute/Approach VNAV waypoint gap is encountered
- A valid vertical leg does not exist after sequencing a Hold Fix

If any of the above occurs prior to entering a VNAV leg, the VNAV page will not be canceled and the VNAV data on the page may be used for planning purposes.

Should any target vertical speed value be rejected, a message will be displayed at the top of the path VNAV page giving the reason.

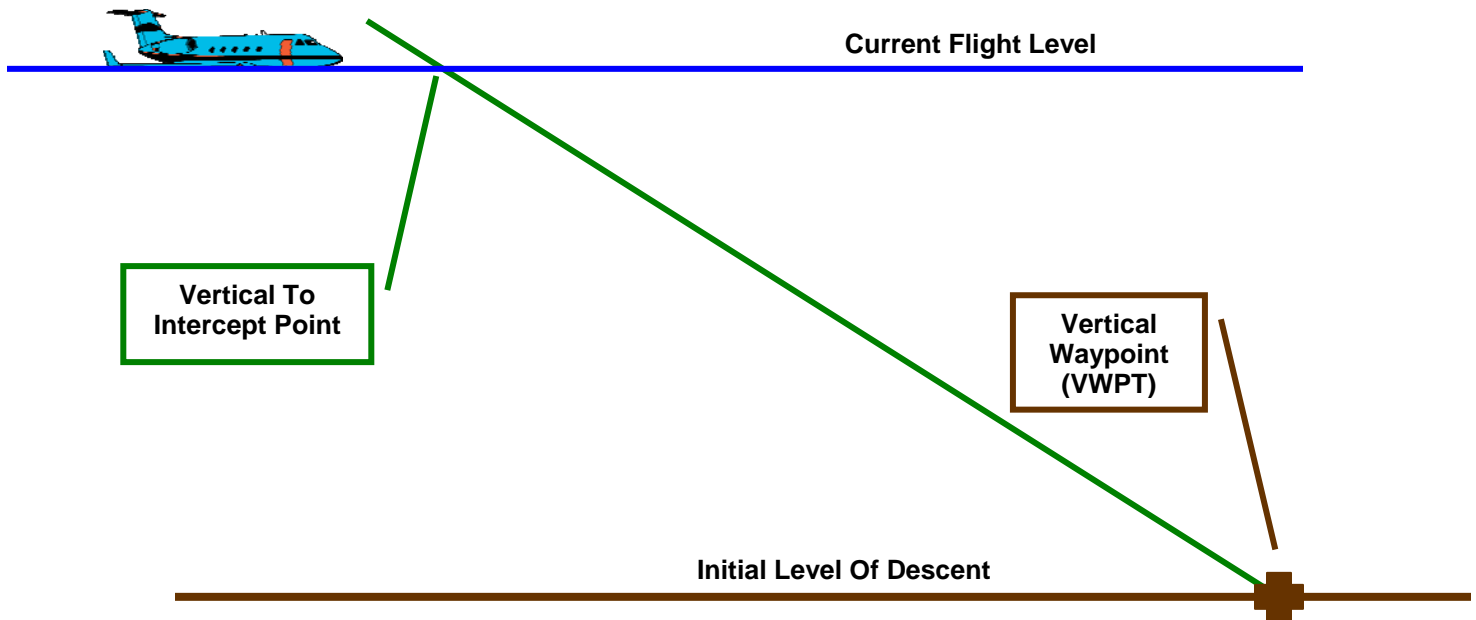
VNAV provides for a complete overfly of the descent waypoint prior to descent and a level off prior to the level off waypoint.

VERTICAL NAVIGATION



Two minutes prior to TOD – TOP OF DESCENT
 Fifteen seconds to TOD – VPATH CAPTURE
 Fifteen seconds to VWPT – VERTICAL WAYPOINT ALERT
 Level Off calculated to be level prior to VWPT

VERTICAL TO (VTO)



"Vertical To" intercept point ahead of aircraft to allow ease of capture
Fifteen seconds to VWPT – VERTICAL WAYPOINT ALERT
Level Off calculated to be level prior to VWPT

VNAV ERROR MESSAGES

The following error messages will appear on the VNAV page whenever an invalid entry is made in the TGT V/S or altitude data fields.

ADC ALT INV – 1 Aircraft altitude is < FL 180 and only pressure altitude is available, or 2 ADC altitude is failed

APPR ALT – RESTR – An altitude entry for an approach waypoint that violates the database constraints is entered

CLEAR MAN ALT – A manual entry for altitude was made on the ADC status page

CLR SXTK – Aircraft is flying a selected crosstrack distance prior to VNAV activation

CLR XFIL ALT – A VNAV plan is defined, but crossfilled altitude is being used by the system

FPA TOO STEEP – Flight path angle is steeper than maximum FPA configured at time of installation

LEG RESTRICTION – Entry is attempted when the active vertical leg is a GAP, HA, FA, CA, VA, HM, HF, or PI leg that does not have an altitude constraint

LINK NAV/FPL – VNAV distance is invalid because the VNAV plan is not linked to the guidance legs

NO ENTRY – APPR – Entry is attempted for an approach waypoint when the approach is active

NO ENTRY – HOLD – Entry is attempted during an active vertical holding leg

NO ENTRY – VERT – Entry is attempted when the aircraft is in active VM or FM leg

NO VWPT ALT – VNAV distance is invalid because the VNAV TO waypoint is undefined

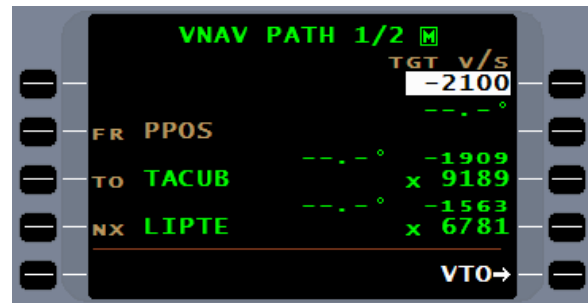
TARGET V/S HIGH – Value exceeds 6000 fpm or maximum flight path angle programmed in configuration module.

TARGET V/S LOW – Entered value is less than minimum required value

VPATH CAPTURE – Appears 15 seconds prior to TOD point or any other VNAV waypoint to indicate intersecting vertical waypoint

XTK TOO GREAT – Current crosstrack is > 12.5nm.

Press **VNAV** to display the VNAV definition page. The cursor will default to the TGT V/S line.



To create a Top of Descent point (TOD), first determine a bottom of descent and altitude. Then press the line select key for the VNAV **TO** waypoint and select the bottom of descent point from the list.

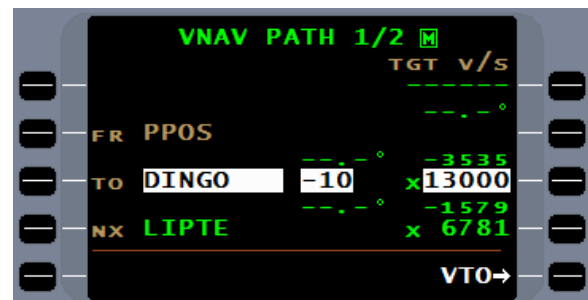
Select the reference number for the desired waypoint from the list, and press **ENTER**.



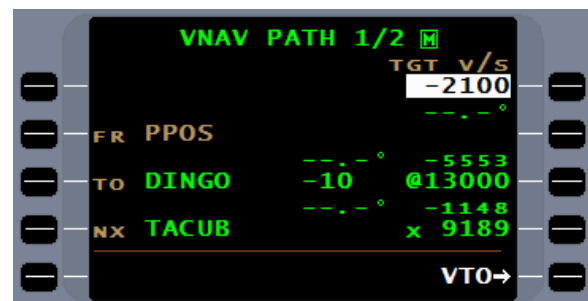
The cursor remains over the waypoint to allow an offset to be entered, if desired. This will move the vertical waypoint. With “-” the waypoint is moved to a point prior to the FIX and with the “+” the waypoint is moved after the FIX. The **±** key toggles the “+” and “-”.



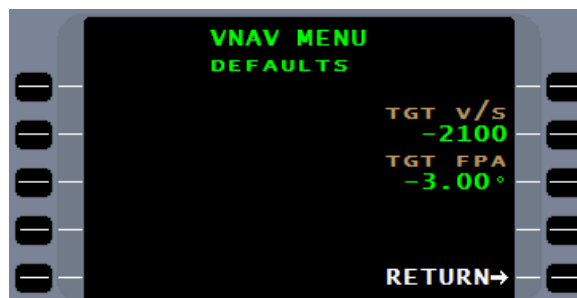
Press **ENTER** and the cursor will move to the altitude entry field. ALT field entries can either be in altitude or flight level. If 4 or 5 digits are entered, the entry will be interpreted as an altitude. If 2 or 3 digits are entered, the entry will be interpreted as a flight level and, once the **ENTER** key is pressed, the letters “FL” will be inserted ahead of the digits. To enter 850 feet, it must be entered as 0850 or the FMS will consider it a flight level.



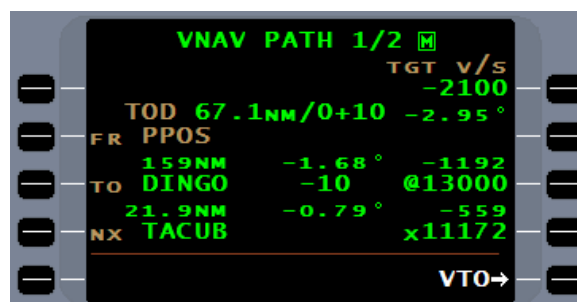
Press **ENTER** and the cursor will move to the TGT V/S field.



A VNAV MENU allows for creating a DEFAULT TGT V/S. The TGT V/S can be changed as desired on the VNAV PATH page without affecting the default value. The TGT FPA field is used for interface between the enroute VNAV and approach VNAV and is covered latter.

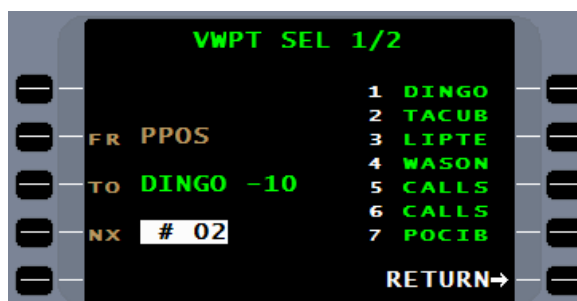


The distance and time are computed to the TOD and the FPA of -2.95° will be displayed. Once the FPA is calculated it becomes the criteria for the descent. Changes in ground speed will result in the TGT V/S changing in order to fly the FPA.

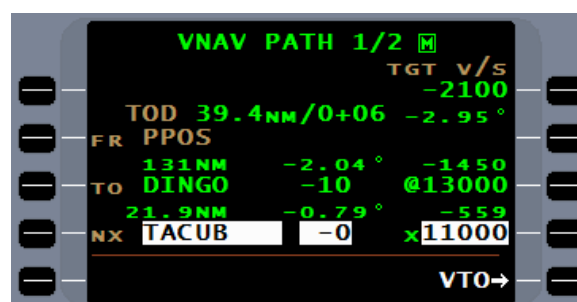


A holding pattern entered in the flight plan between the aircraft and the TOD will result in cancelation of the TOD calculation. An attempt to reenter the TOD information will result in a LEG RESRICTION message being presented. No TOD calculation can be made until the aircraft is past the holding pattern or the holding pattern is removed from the flightplan.

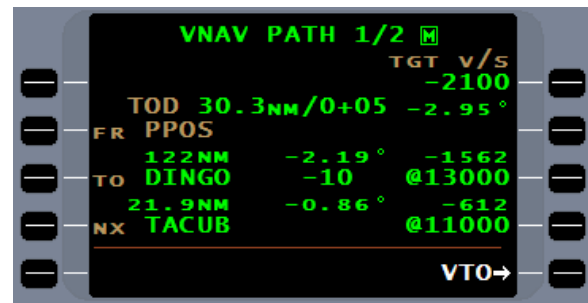
To create a vertical profile by entering followon waypoints, start by pressing the **NX** line select key. Additional vertical waypoints are created by using the line select keys following the **NX** line select key and on page 2.



Enter the reference number for the next waypoint and press **ENTER**. Complete the field entries in the same manner as in creating the TOD.



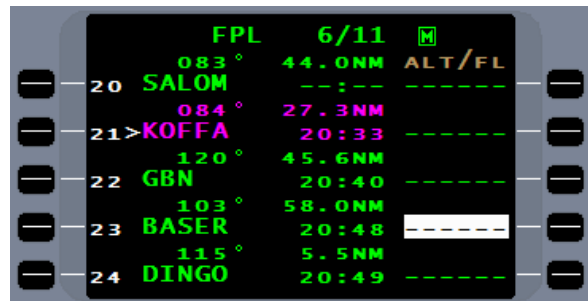
Distance, FPA (flight path angle), and VSR (vertical speed required) have been calculated between the TO VNAV waypoint and the NX VNAV waypoint



A total of 6 VNAV waypoints can be created in the VNAV pages. Two on page 1 and four on page 2. The CNCL VNV (cancel VNAV) line select key is available on page 2.



Direct entry of VNAV altitudes may be made in the flightplan. Adjacent to the flightplan waypoints are dashed lines that can be selected by the adjacent line select key for entry of an @ altitude or flight level. Waypoints selected and their altitudes will automatically appear on the VNAV page.

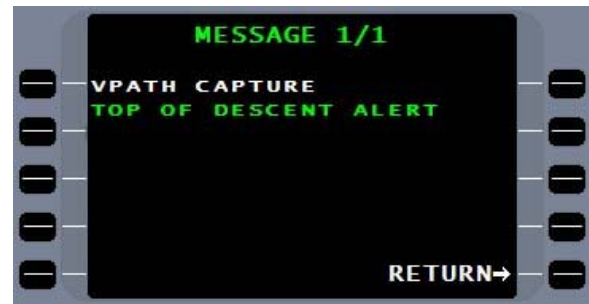


Two minutes prior to the TOD, the “TOP OF DESCENT ALERT” message will appear and remain on the message page until passing TOD.

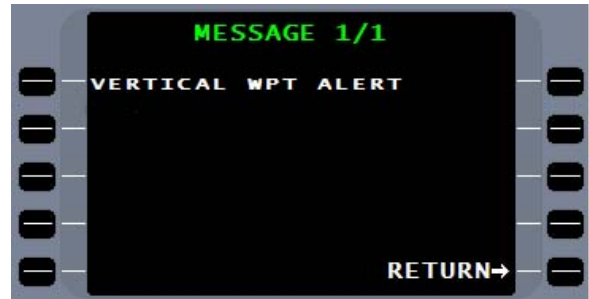


NOTE: For aircraft with flight guidance capable of coupling to the FMS VNAV, to capture FMS VNAV the pilot must first acknowledge the TOP OF DESCENT ALERT message, and then arm flight guidance VNAV.

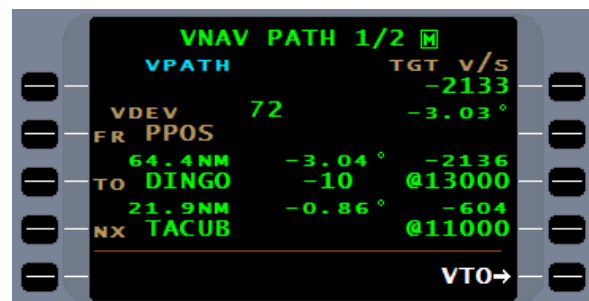
Fifteen seconds prior to the TOD, a VPATH CAPTURE message will appear indicating capture of the vertical path.



Fifteen seconds prior to a vertical waypoint (not the TOD) the VERTICAL WPT ALERT message will be presented.

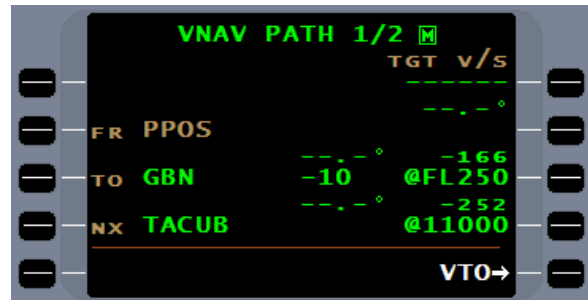


VDEV and an indication of deviation, in feet, above or below the programmed flight path will replace the TOD. The HSI vertical deviation indicator will display this deviation if the aircraft is capable. Vertical steering signals will be provided to a compatible FGS.

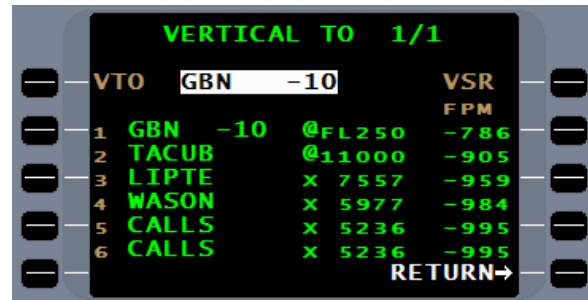


VERTICAL DIRECT TO (VTO)

To access the Vertical Direct To mode on the VNAV PATH page, press the VTO line select key. This mode allows for creating an immediate descent FPA to a vertical waypoint. If the VNAV waypoint has not been previously created, create the VNAV waypoint by pressing the VNAV TO line select key and define the point.

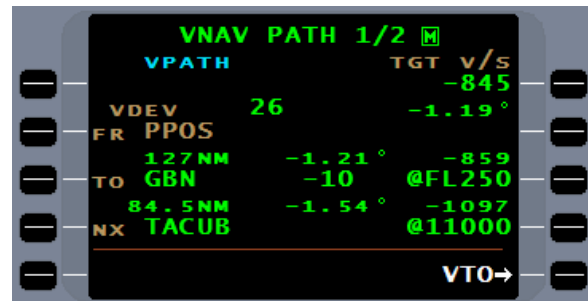


The VERTICAL TO list page will display a listing of all defined VNAV waypoints. Enter the reference number of the desired waypoint in the cursor field to proceed vertically direct to the VNAV waypoint. After **ENTER** is pressed the display will change back to the VNAV descent page.



The TGT V/S will be the vertical speed required that is displayed when VTO was selected. The VTO line select key is still available to establish a new vertical clearance.

Using DTO or the DTO Holding Fix feature will not cancel the VNAV mode for waypoints prior to TOD.



Pressing the CNCL VNAV line select key on VNAV PATH page 2 at any time will cause the mode to cancel and VNAV displays will go invalid. To continue the descent simply press VTO line select key then the **ENTER** key.



CAUTION: Once a descent is commenced, entering a higher TGT V/S to comply with a “best rate” clearance from ATC may result in the aircraft leveling off and proceeding to a newly computed TOD and FPA based on the higher descent rate. If ATC request a “best rate” descent, **DO NOT** use FMS VNAV.

VNAV DESCENT IN HOLDING

When a holding pattern is inserted into a flight plan, a holding pattern entry altitude may be programmed at the holding fix. VNAV descent to the holding point entry altitude, prior to entering the hold, may be performed by creating a TOD or by using VTO as with any enroute waypoint.

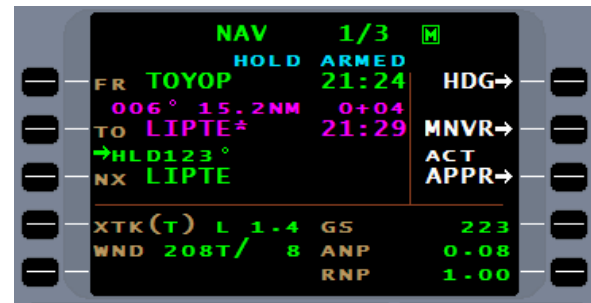
Once a holding pattern is programmed and armed, a (HOLD) waypoint field will be inserted into the flightplan. To descend during the holding pattern, a (HOLD) altitude must be programmed for this waypoint in the altitude field of the FPL or VNAV page that is lower than the Holding pattern entry altitude. This allows descending to the holding fix with VNAV active and descending to a lower altitude during the hold. Since the holding pattern legs may vary due to wind and changing airspeeds, a fixed VPATH calculation to the lower altitude is impractical. The lower holding pattern altitude will represent a level VNAV path and the initial vertical deviation in the hold will equal the difference between the entry altitude and the holding descent altitude. Depending on the vertical scaling of the particular indicator or EFIS, this may result in a full scale down deflection of the VDEV indicator when the difference between entry altitude and the lower (HOLD) @ altitude exceeds the scale of the display. Vertical Deviation Scaling (feet per dot) is determined by the display device and may be different for Enroute, terminal, and approach modes. Consult the Aircraft Flight Manual or Supplement for the specific scaling. As the aircraft descends during the hold to the (HOLD) @ altitude, the deviation will decrease to centered deviation when reaching the level VPATH of the (HOLD) altitude.

In installations that provide coupled VNAV enroute operations, the FMS will provide vertical steering to the entry altitude and subsequent vertical steering in the hold at a constant vertical speed of approximately 650 feet per minute. Pitch steering commands to Flight Guidance Systems with coupled VNAV will provide smooth transitions during the hold entry to hold descent path change and level off commands when the lower altitude is reached.

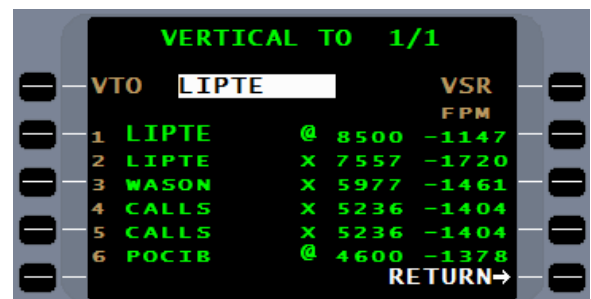
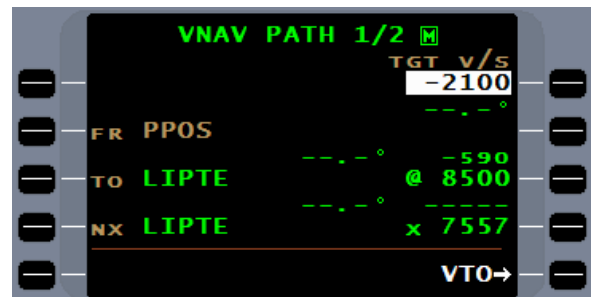
CAUTION: In installations that do not provide coupled enroute VNAV or when pilots choose not to use coupled enroute VNAV, but are provided VDEV displays, the pilot must use great care to avoid excessive descent rates caused by trying to push the nose of the aircraft over in an attempt to center the vertical deviation indicator (VDI). Recommend disregarding the VDI when using a manual descent or use vertical flight guidance mode; selecting either VS or IAS as appropriate to descend to the holding altitude.

NOTE: SCN 80X cannot fly a descent in a procedure turn. A manually controlled descent by the pilot will be required to fly a procedure turn approach transition that requires a descent.

To descend in holding, first create the holding pattern or use holding pattern from the NAV database. A holding pattern cannot be created in an active VNAV leg. At the (HOLD) waypoint enter the desired altitude. The altitude must be equal to or less than the hold entry altitude.

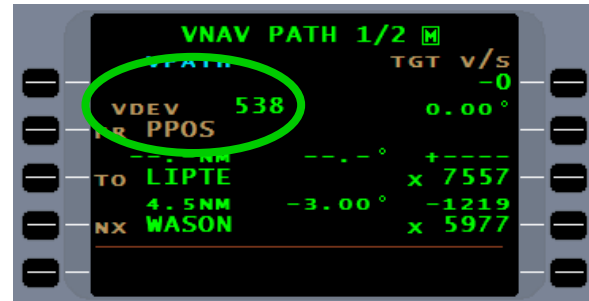


To activate the VNAV leg during the hold, the vertical entry of the holding pattern must be via an active VNAV leg. In other words, by either a VTO to the holding entry waypoint or TOD VNAV leg that goes to the holding entry waypoint, VNAV must be active prior to entering the holding pattern. If you're entering the holding pattern at your current altitude, then starting the descent once established in holding, use the VTO function and initiate a level VTO VNAV leg to the holding entry waypoint.

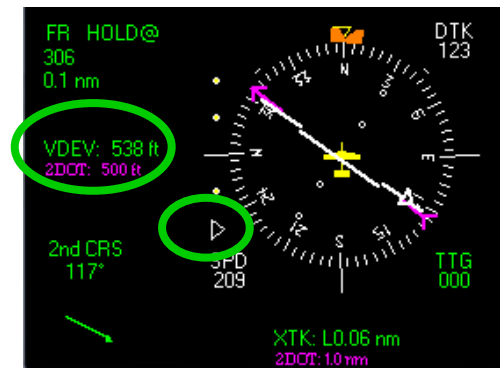


VNAV cannot be initiated if the aircraft is established in holding; a pilot controlled descent must be used. Once the aircraft exits the holding pattern a TOD NAV leg or VTO NAV leg may be initiated.

Once in the holding pattern the VNAV page will show the aircraft in a descent. The VDEV will represent the altitude remaining during the descent and will indicate "0" once the altitude has been reached.



The VDI of the pilot's flight display will show the bottom of the descent and will center when the aircraft reaches that altitude. The FMS will command to the flight director and autopilot to descend at approximately 650 feet per minute rate of descent. The pilot must follow the flight director or use the autopilot VNAV during this operation. To follow the VDI will result in an excessive rate of descent. For advisory VNAV, the pilot should use the flight director with vertical speed selected and the altitude select set to the final holding pattern altitude.



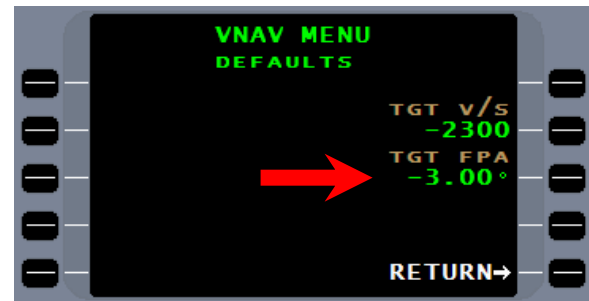
During the holding descent the NAV page will show the aircraft in holding, but will not indicate that VNAV is active.



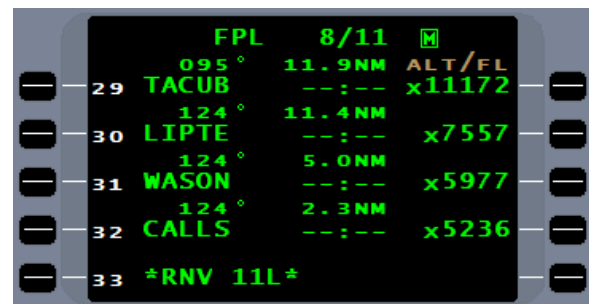
ENROUTE VNAV

Enroute VNAV is an FMS tool designed to establish a flight path angle to minimize power adjustments during descent.

The vertical flight path is based on a target flight path angle set by the pilot under the VNAV MENU. The pilot can set the target flight path angle (**TGT FPA**) between 0.00° and 9.00°. During installation a maximum of less than 9.00° can be set in the FMS configuration. The pilot will set the **TGT FPA** according to the descent characteristics of the aircraft. Recommend starting at -3.00° and adjusting as necessary.

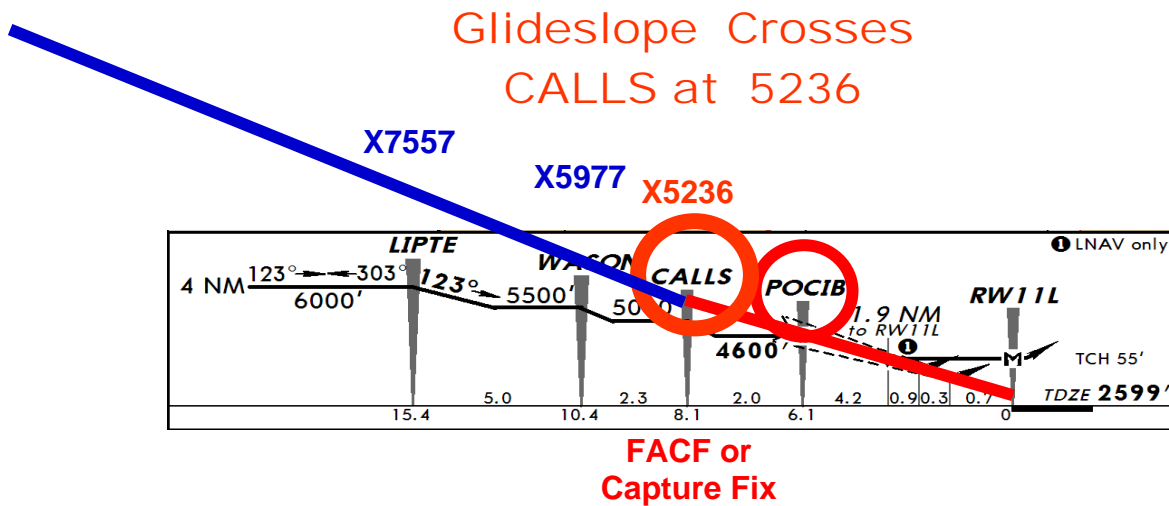


When an approach transition or, in some cases, a STAR procedure is entered into the flightplan, the FMS will calculate vertical crossing altitudes based on the **TGT FPA** entered by the pilot.



An "X" preceding the altitude in the flightplan and on the VNAV page indicates the altitude was calculated by the FMS.





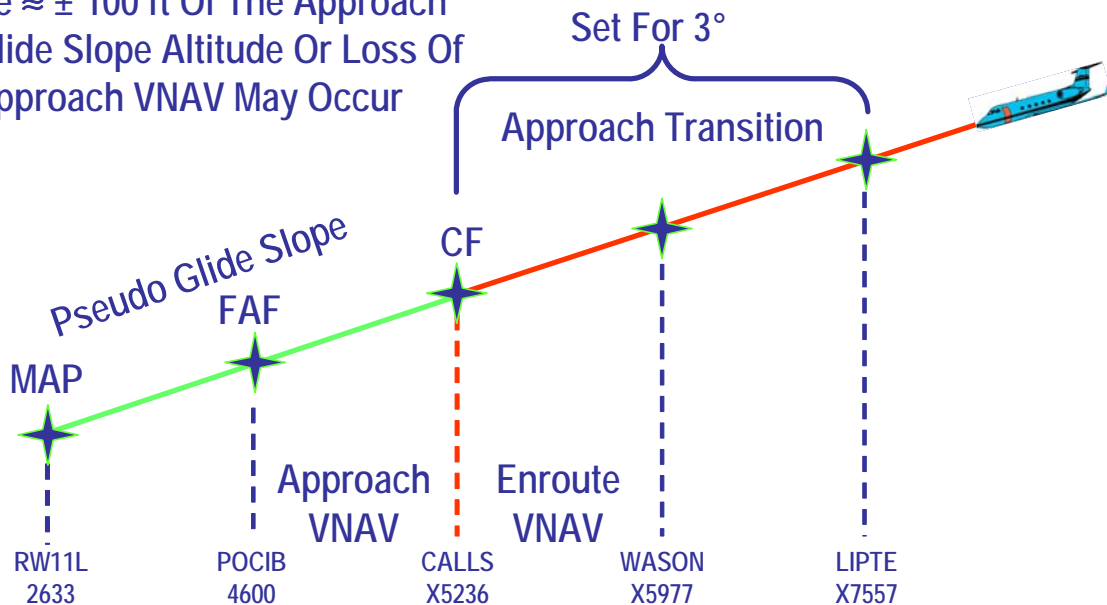
The FMS will use the approach segment, final approach course fix (FACF) or approach capture fix and pseudo glideslope crossing altitude to back calculate the enroute VNAV flight path angle. To calculate this starting point, the approach database glideslope is projected by the FMS and where that glideslope crosses the approach capture fix, in this case CALLS intersection, an altitude is calculated, 5236. This altitude is used by the FMS enroute VNAV to start the back calculation of waypoint VNAV crossing altitudes. Database altitude restrictions, “at, at-or-above, or at-or-below”, are entered into the calculation to insure these restrictions are not violated. These altitude restrictions may result in the FMS creating an angle that is different than the TGT FPA entered by the pilot.

VNAV PATH 2/2			
+1	8.9NM	-3.18°	-2485
	LIPTE		x 7557
+2	4.1NM	-3.00°	-2603
	WASON		x 5977
+3	2.3NM	-2.99°	-2134
	CALLS		x 5236
+4	0.0NM	0.00°	0
	CALLS		x 5236
←CNCL VNV			

FPL 8/11			
29	095°	11.9NM	ALT/FL
	TACUB	--:--	x11172
30	124°	11.4NM	
	LIPTE	--:--	x7557
31	124°	5.0NM	
	WASON	--:--	x5977
32	124°	2.3NM	
	CALLS	--:--	x5236
33	*RNV 11L*		

VNAV Transition

The Altitude Of The Aircraft Must
Be $\approx \pm 100$ ft Of The Approach
Glide Slope Altitude Or Loss Of
Approach VNAV May Occur

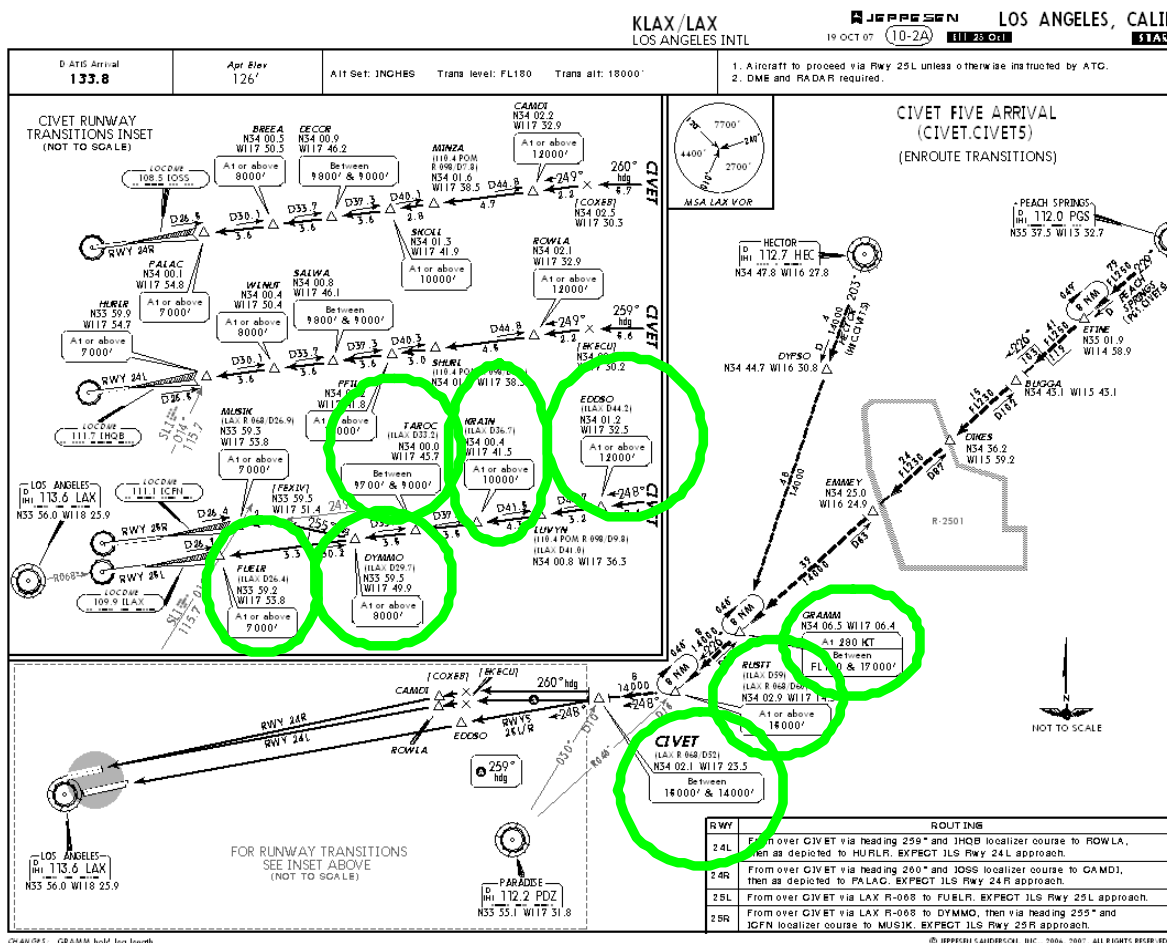


It is possible for the FMS enroute VNAV to interface directly into the FMS approach glideslope. Since the termination point of the enroute VNAV through the approach transition is at the start of the approach glideslope, the capture fix, the FMS should drop the enroute VNAV and immediately activate the approach VNAV. For the transition to be successful the aircraft must be within plus or minus 100 feet of the transition altitude, in this case the transition altitude is 5236 feet MSL.

NOTE: It is possible to manually enter an enroute VNAV transition waypoint altitude that is below the FAF altitude. The VNAV leg following this lower altitude will be calculated by the FMS as a climb, which the FMS cannot do. The result will be a cancellation of the approach pseudo glideslope.

For a STAR to contain enroute VNAV calculated altitudes, the STAR must contain at least one VNAV restriction, “at, at-or-above, or at-or-below”, as a starting point. Most STAR procedures do not contain altitude restrictions; on expect altitudes which do not meet the criteria of an altitude restriction. Altitude constraints must come from the NAV database or pilot database. From that altitude the FMS uses the target flight path angle to begin the calculation of the VNAV path. The FMS, using the approach transition or STAR altitude restrictions of “at-or-above or at-or-below”, will create windows over waypoints with altitude restrictions. The FMS will calculate its vertical glidepath to fly through these windows. If the bottom or top of a window restricts the originally calculated flight path, the FMS will create a new FPA for the affected segments that will accommodate the altitude restriction, and then begin the flight path angle from that point. A pilot altitude input will further alter the windows, but cannot be used to create a VNAV path where none was created by the FMS.

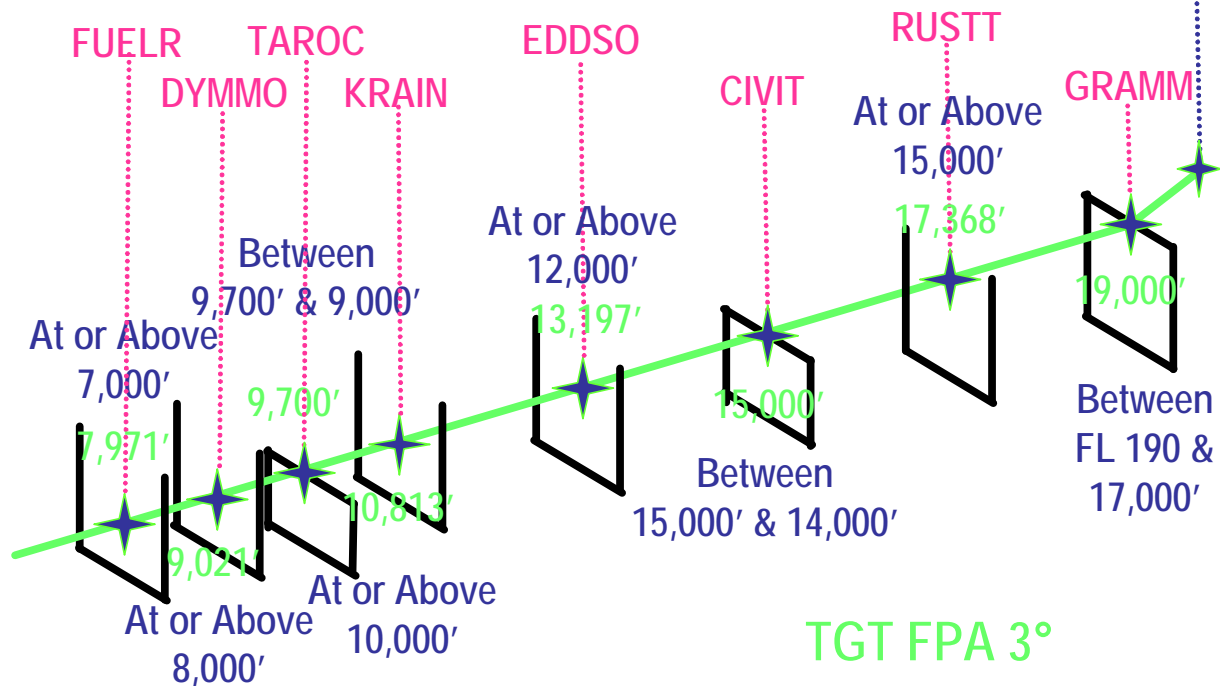
ALTITUDE WINDOWS



The KLAX CIVET FIVE ARRIVAL contains many altitude restrictions and, therefore, when entered into the flightplan will result in an enroute VNAV path being calculated.

TARGET FPA

KLAX CIVIT5 ARRIVAL RWY 25L

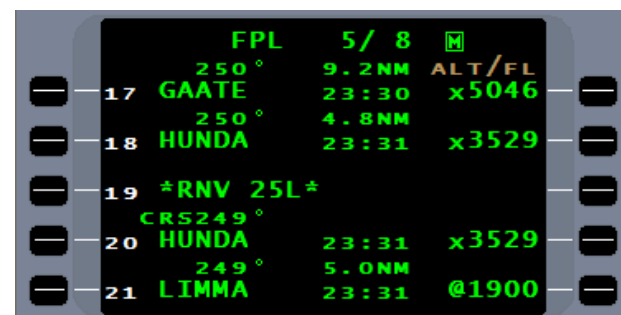
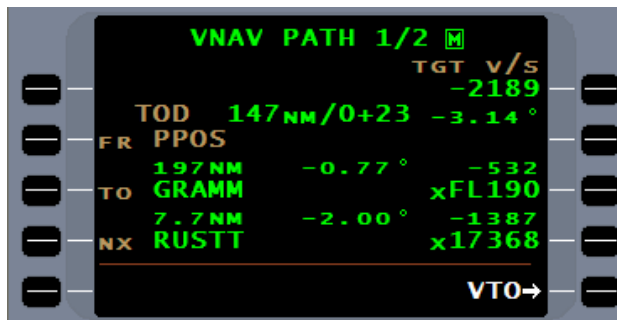


The FMS enroute VNAV tool will use the altitude restrictions of the CIVIT FIVE arrival to create altitude windows. The enroute TGT FPA must fall within these windows or the FMS will recalculate the angle to fit within the altitude restriction windows.

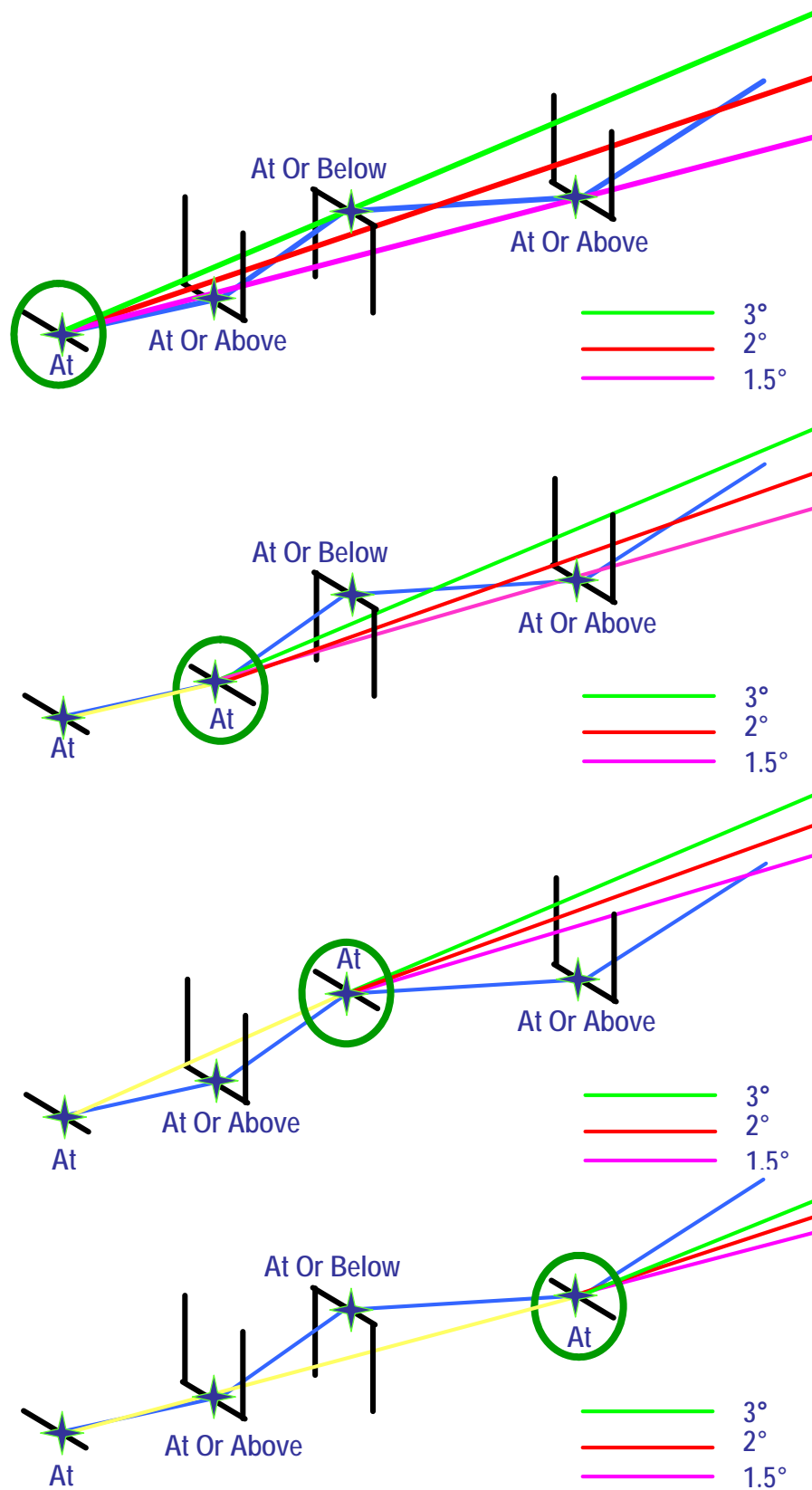
It is possible to create a top of descent that will merge into an enroute VNAV and then transition into an approach pseudo glideslope as depicted below.

KLAX CIVIT5 ARRIVAL

Vertical Profile



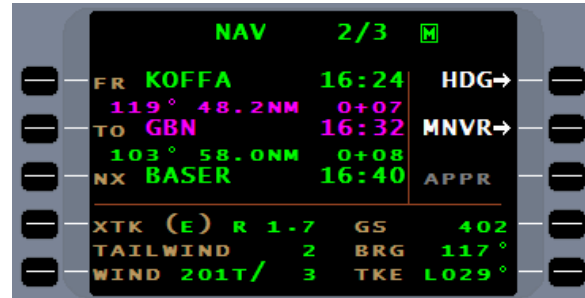
Altitude restrictions may result in the enroute VNAV creating angles other than that of the TGT FPA. The examples below show three flight path angles.



ARRIVAL PROCEDURES

Using the FMS during approaches is discussed in detail in the FMS approach section. The following is a brief overview of the arrival.

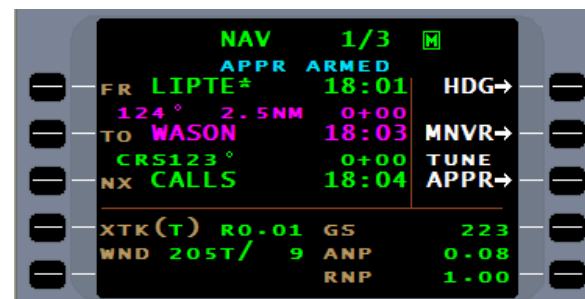
With the aircraft more than 50nm from the arrival airport and an FMS approach in the flightplan, a subdued **APPR** will be presented at line select key 3R.



Within 50nm of the runway threshold and with an approach entered in the flightplan, the ARM APPR line select key is made available.

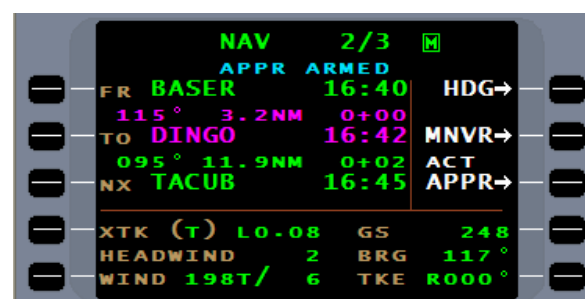


Pressing ARM APPR line select key will present the TUNE APPR line select key if NAV radios are required for the approach, are not already set to the correct frequency, and are remotely tunable through the FMS. When 30nm from the threshold the system will auto arm the approach if not previously manually armed. Line select key 3R will then indicate TUNE APPR if the NAV radio are required. A subheading of **APPR ARMED** is presented.



When within 30nm or if the approach is manually armed, the FMS will change the CDI scale from enroute **(E)** to terminal **(T)**.

With remote tunable radios, pressing the TUNE APPR line select key will tune the radio to the approach reference facility, and then change to ACT APPR. If NAV radios are not remotely tunable or the NAV radio is already tuned to the approach facility, ARM APPR will go directly to ACT APPR. At the same time the NAV receiver is tuned, the system will deselect any sensors not meeting approach criteria. If an RTU is installed a TUNE APPR line select key will momentarily appear, otherwise, the ACT APPR key will be presented.



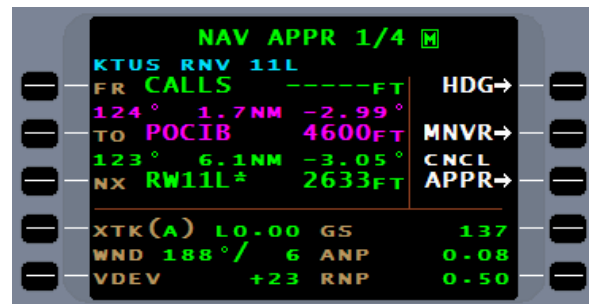
APPROACH ACTIVATION

When to use automatic and manual approach activation is covered in detail in the Approach Operations section of this manual. Approach activation is characterized by two changes in the interface to the aircraft flight guidance system and EFIS or flight instruments. The FMS will output expanded left/right deviation signals and pseudo glideslope, and the XTK (T) (Terminal) changes to XTK (A) (Approach) changing HSI scaling to .3nm full scale deflection.

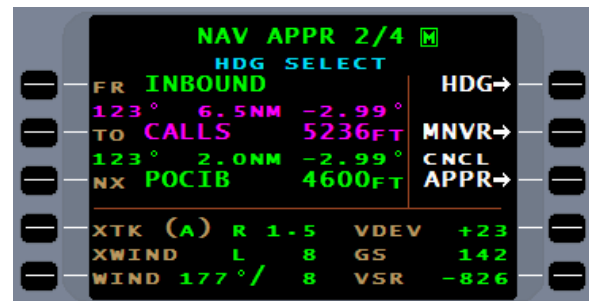
ENROUTE TO APPROACH VNAV

The procedure for the aircraft to perform a flight director/autopilot coupled enroute VNAV to the approach VNAV transition is covered in both the VNAV and FMS Approach Operations section. If not done correctly, a VNAV disconnect may occur when the approach activates or is manually activated by the pilot. This automatic VNAV disconnect is intentional, and provides protection from a sudden pitch-over or pitch-up to capture the final approach glidepath. In these cases the flight director will automatically change from VNAV to PITCH HOLD mode. See FMS Approach Operations for more information.

When the FMS goes into the approach active mode, two **NAV APPR** pages are added. **NAV APPR 1** will present the approach waypoints with distance, altitude, and glideslope angle. Winds will be presented in magnetic degrees and **VDEV** (vertical deviation) display distance above or below the glideslope.

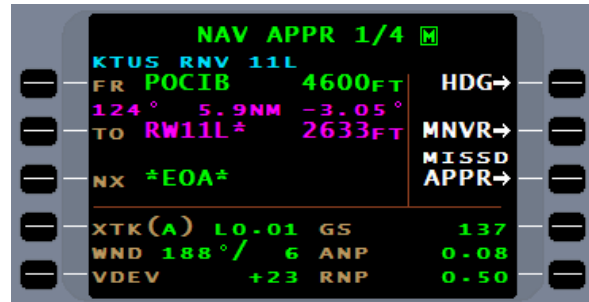


The lower section of the **NAV APPR 2** will add **VDEV** and **VSR** information. The **VDEV** will now emulate a glideslope i.e. deviation will decrease as you fly towards the glideslope and then give you vertical guidance down to the runway.



NOTE: While approach is active, the winds are presented in magnetic degrees and the crosswind component (**XWIND**) is calculated.

At the FAF (Final Approach Fix) POCIB, inbound, the CNCL APPR option line select key will automatically change to MISSD APPR option.



In the event of a missed approach, the FMS offers the option of flying the missed approach procedure through the FMS. All "Missed Approach" waypoints (MAXX or RWXX) and "Missed Approach" holding waypoints are automatically designated as "Fly Over" waypoints. If the approach linked to the flight plan is navigation database defined, the published missed approach procedure is included with the approach; if it is pilot defined, during creation of the approach, the missed approach procedure can also be defined. In either case, when you press MISSD APPR, line select key, *EOA* is deleted from the NX line of the NAV page and the first waypoint of the missed approach is entered. The aircraft will continue to the missed approach waypoint followed by the first leg of the missed approach procedure. On aircraft with a go-around mode interfaced to the FMS, pressing the go-around button while the MISSED APPROACH option is displayed will remotely press the MISSD APPR line select key.

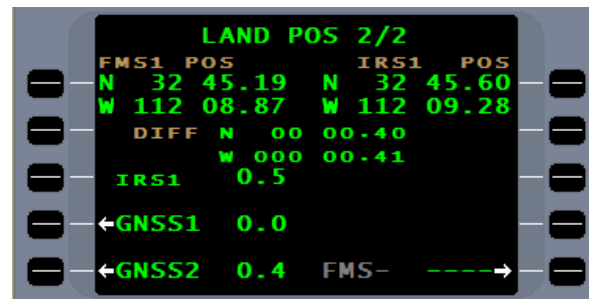


Upon touchdown, the **LANDING** summary page will be displayed. This is triggered by a 3 second input from the squat switch.



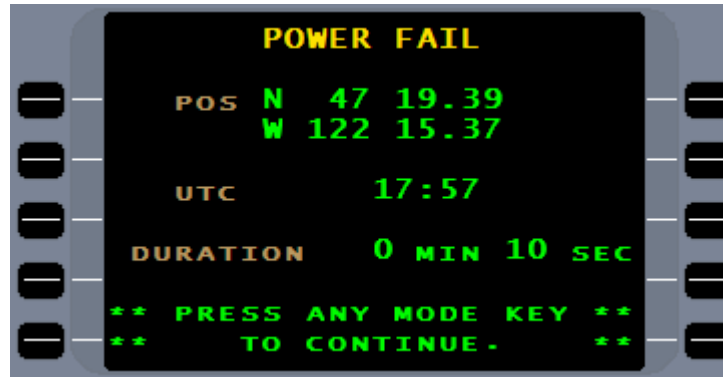
Press the **NEXT** key for landing page 2. This page will provide lat/long for NAV sensors to FMS best computed position.

From the **LANDING** page only the MSG and TUNE pages can be accessed and still return to the **LANDING** page. Once any another function is selected, the **LANDING** pages cannot be accessed.



POWER FAILURE PROCEDURES

These procedures are to be followed after electrical power is restored following a power failure or interrupt to the FMS. This may include a simultaneous power loss to the GPS and other NAV sensors.



POWER FAILURE FOR UP TO SEVEN MINUTES

If the time span is less than seven seconds, the FMS, with no input from the operator, will power up and display the same page that was in view prior to the power interruption.




If the time span of the power failure exceeds seven seconds but less than seven minutes, the FMS will automatically power up and a **POWER FAIL** page will be displayed.

1. Press the NAV key to access NAV page 2. Check the FMS position and navigation sensors.
2. If the position is reasonable and GPS is in NAV, check NAV page 1 or 2 to verify correct NAV leg.
3. Monitor GPS position until aircraft is back on track and the WIND on the NAV page stabilizes.

POWER FAILURE OVER SEVEN MINUTES


The following procedure should be applied when electrical power is restored or if the system is turned on in flight for the first time.

This procedure takes into consideration that the GPS will find the aircraft's position. The time required for this to happen depends on how long the system was without power and how far the aircraft has flown from the shut down position of the FMS. The GPS will use its Almanac data and its last known position to acquire satellites.

1. Press the  key. The system will run through the self-test and then display the Initialization page. The latitude/longitude will be the coordinates displayed at the time of power loss.
2. Wait for the <GPS> to appear in the ID field, press the ACCEPT line select key to accept the GPS position for initialization.
3. If <GPS> does not appear in the ID field in a reasonable length of time, enter the best estimate of the aircraft's position in the Lat/Long field. If radial and DME from a nearby VOR is available, this can be used to initialize the aircraft position. Press line select key 2L for the DEFINE POS page.
4. Once the system is initialized and the FMS position is accepted, press the  key and reenter the flightplan. The flightplan will not be found intact. It may be necessary to do a manual leg change on NAV page 1 or 2 to insure the aircraft will rejoin the desired flight path as smoothly as possible. The FMS will begin navigating immediately.
5. Monitor the FMS position until aircraft is back on track and the WIND on NAV page stabilizes.
6. Previously entered fuel data under the  function key will not be found intact. Following a power loss, the current fuel on board must be reentered into the total fuel on board field along with other FUEL page initialization information.


NOTE: Loss of power will cause the FMS screen to go full bright when power is restored.



SYSTEM SHUTDOWN PROCEDURE

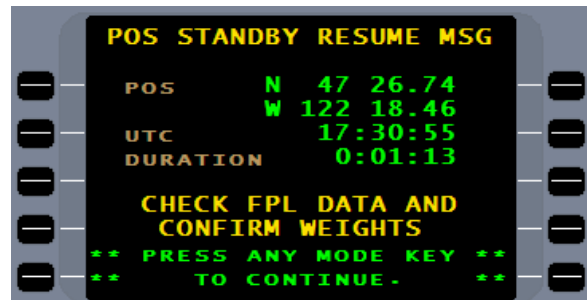
Press the  key. In the overlay, press the OFF line select key, and then select the CONFIRM OFF line select key. The FMS will shut down. It is strongly recommended that the FMS be shut down by the normal shutdown method before removing power from the FMS by turning off the avionics master switch or the aircraft's batteries. Failing to do so will place the FMS in a power failure mode.

PLEASE INCLUDE THIS ON YOUR CHECKLIST.

FMS STAND-BY MODE

When the standby mode is activated, the FMS will hold flight plan and fuel inputs for a configurable time of 0, 2, 4, 6, or 8 hours. The FMS will power down, but the flightplan and fuel inputs are saved. Press the  key and line select key 5R will present OFF/STBY. Select this line select key and CONFIRM STBY will appear adjacent to line select key [5R].

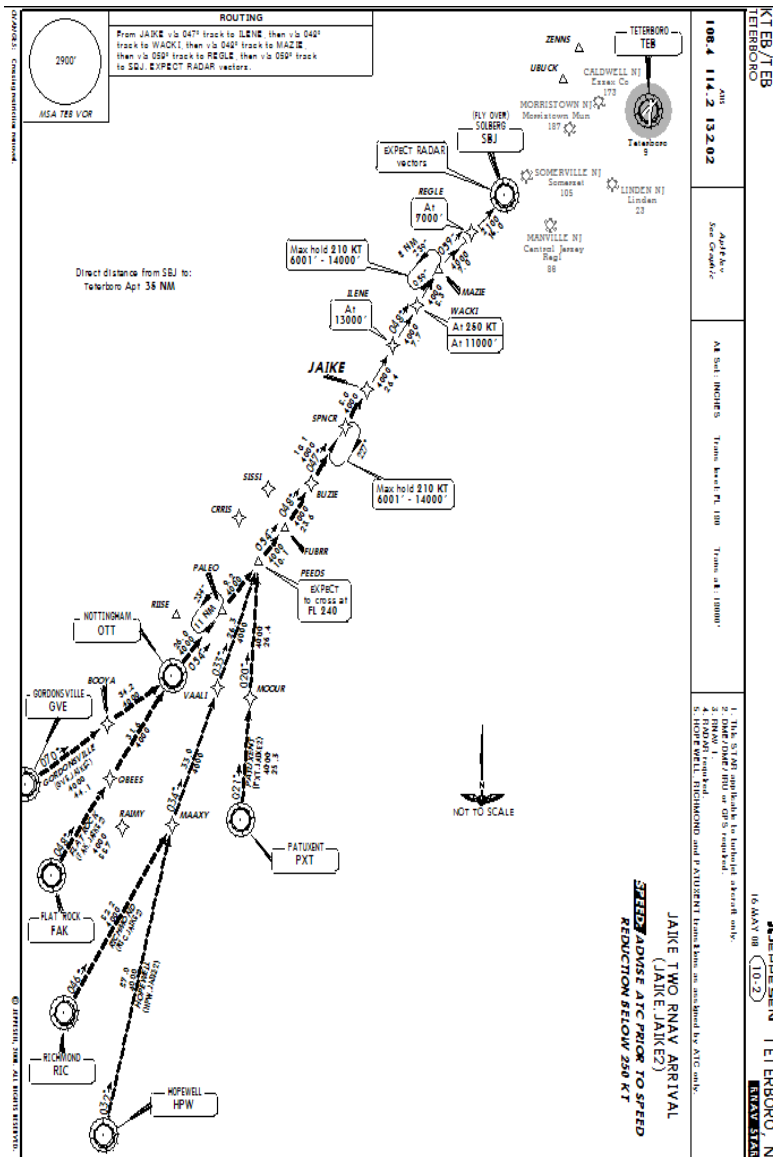
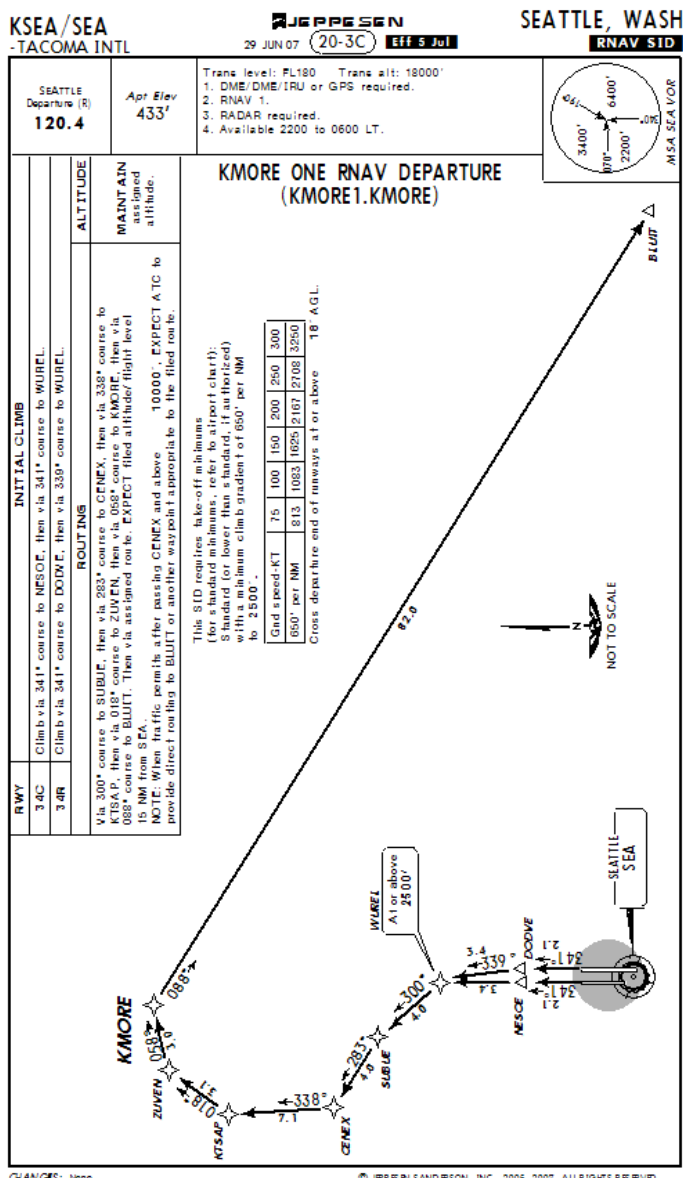
Using the  will reactivate the FMS and, following the power on self test (POST), a **STANDBY RESUME** page will appear. Press any MODE key (i.e. NAV, DATA, or FPL) to move to the initialization page. After initialization a check of the flightplan and fuel pages will show flightplan and fuel information will be present. Confirm the flightplan waypoints and confirm the fuel on board on FUEL page 1 by pressing the  key.



It is recommended that the FMS be put in STBY if electrical power will be removed from the FMS during engine start.

RNAV DEPARTURES AND ARRIVALS

RNAV departures and arrivals are addressed in AC 90-100a. Aircraft may be qualified to fly these procedures by either the use of GNSS/GPS or RNP. Most aircraft using Universal FMS are qualified under the GNSS/GPS category. GPS RAIM integrity is required when flying the procedure. If the GPS integrity annunciator light illuminates while flying the procedure, notify ATC. For complete procedures to fly these RNAV arrivals and departures, refer to AC 90-100a as amended.

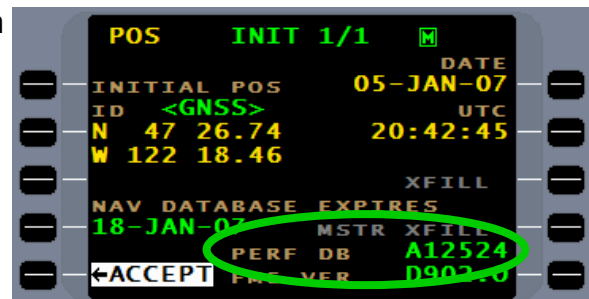


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For illustration purposes only; May not be used for navigation

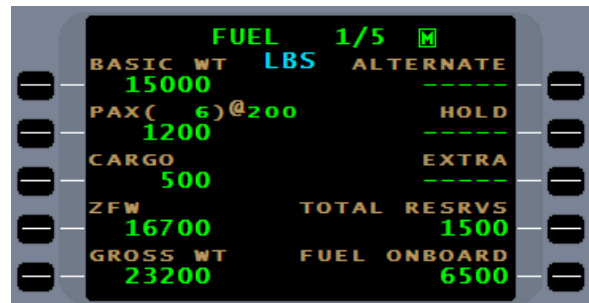
AIRCRAFT PERFORMANCE TAKEOFF & LANDING

The Universal Avionics FMS, for some aircraft, will provide a program to calculate aircraft performance. With the aircraft performance database loaded, the performance pages are accessed by pressing the **PERF** key. Performance calculations may include V speeds, balanced field length, climb and cruise, and other information. For Aircraft with an available performance database installed on the FMS, procedures are as follows. (The examples are of an Advanced Performance Database for a Learjet 60, but other database procedures are similar. Contact Universal Avionics for a complete list of aircraft with a performance database.)

FMS containing a performance database will show on the initial page a **PERF DB** line and a number that indicates the aircraft for which the performance data was created.



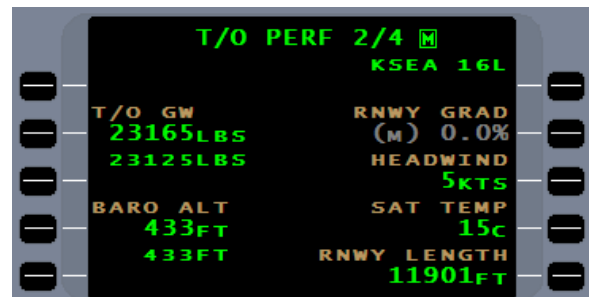
Before accessing the performance database, complete **FUEL** page 1.



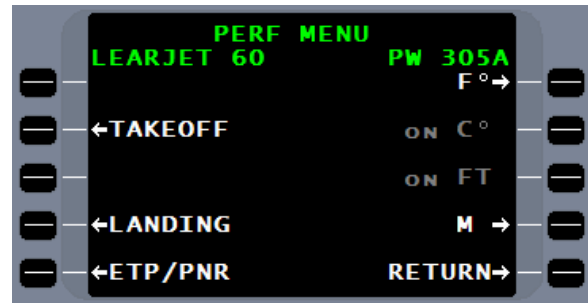
While on the ground, press **PERF** and the FMS will automatically display the **T/O PERF 2/4** page. For the FMS to provide data to compute takeoff performance, the aircraft must be on the ground. The computed gross weight from FUEL page 1 is taken and entered into the **T/O GW** field. If desired, a manual figure can be entered. Press the **ENTER** key to confirm takeoff gross weight and the cursor moves to the **BARO ALT** field.



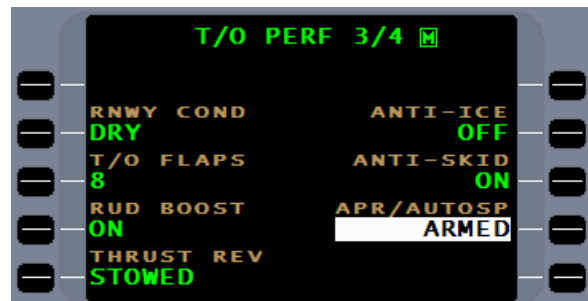
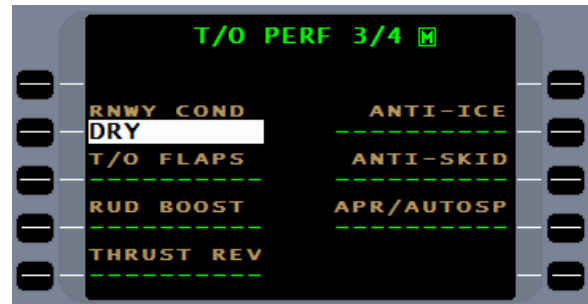
Confirm the existing entries or enter the required information into **BARO ALT**, **RNWX GRAD**, **SAT TEMP**, and **RNWX LENGTH** fields. Baro Alt and SAT are taken from the ADC input. Runway length is taken from entering the runway on the departure page.



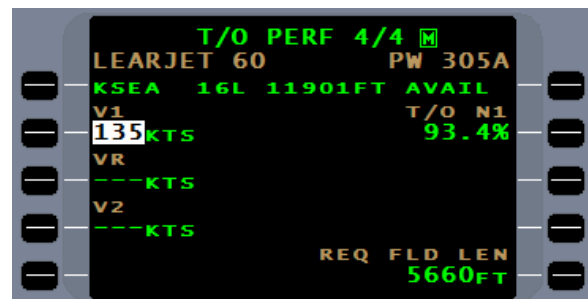
A performance menu allows for changing the temperature scale from Fahrenheit to Celsius and the runway length from feet to meters. It also allows for selection of TAKEOFF or LANDING for out of sequence computations.



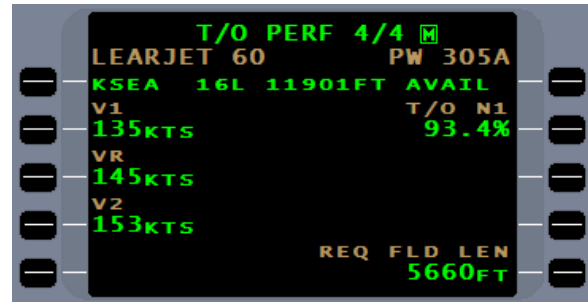
Upon completion of page 2, the cursor will move to page 3. Confirm the existing entry or enter the required information and the cursor moves to the next field. Pressing the line select key adjacent to the entry field will provide options for the field. Once all fields are complete, the next press of the **ENTER** key will advance the cursor to the next page.



When all required information is entered into the FMS, the **V₁** speed will be calculated and subsequent pushes of the **ENTER** key will calculate and confirm **V_R** and **V₂** speeds. With the Advanced Performance Database data such as **T/O N1** and **REQ FLD LEN** are calculated.



On some aircraft the V speeds can be entered directly from the FMS to the EFIS airspeed indicator.

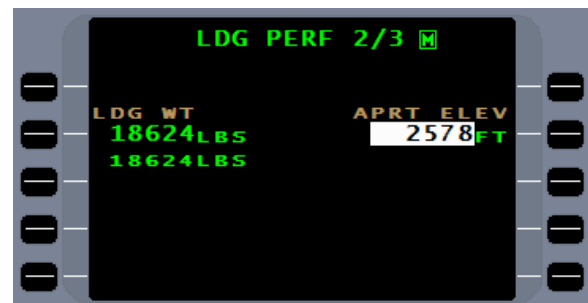
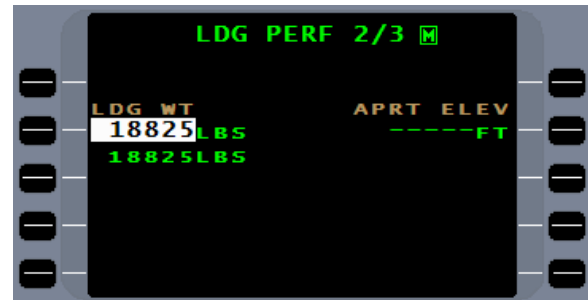


The landing performance page will automatically become available when the aircraft is within 120nm of destination airport, but can be selected earlier in the flight by going to the menu page. Pressing the **PERF** key will immediately present **LDG PERF 2/3**.

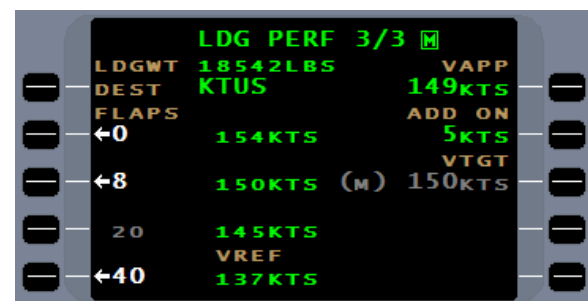
The FMS will calculate an estimated landing weight and place it in the **LDG WT** field. Accept this weight or enter a manually calculated weight and press

ENTER

With an approach and runway selected, the **APRT ELEV** field will be prefilled when the cursor is moved to that location. The cursor will move through the remaining fields as it did in the takeoff mode.



Depending on the aircraft type, further V speed adjustments can be made. In this example, an additional 5 knots are added for wind gusts.



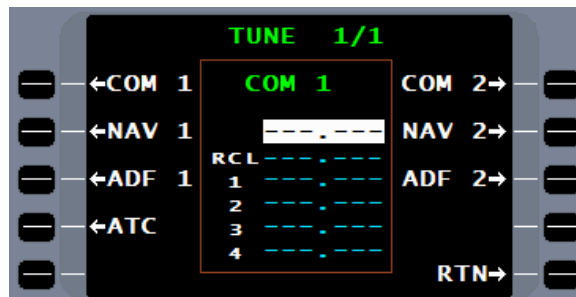
Procedures may differ for calculating performance for different aircraft types.

FMS REMOTE TUNE

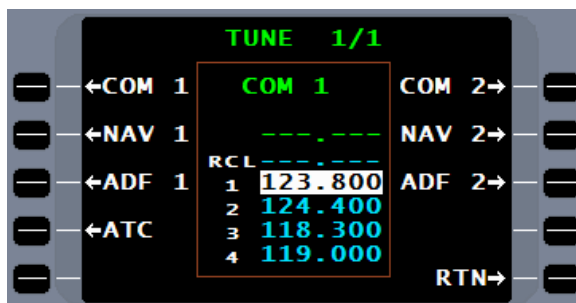
On aircraft with remote tunable radios, the FMS can be used to tune radios.

Press the TUNE function key to bring up the **TUNE** page.

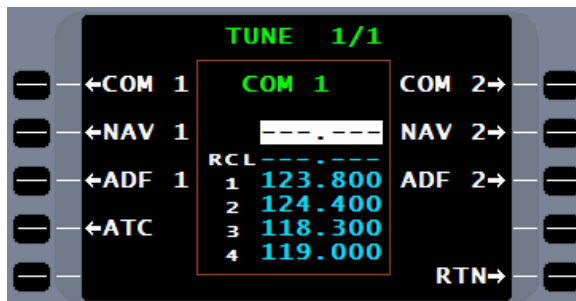
When configured to 8.33 kHz spacing during installation, three spaces to the right of the decimal place are presented.



To preprogram frequently used frequencies, press the **ENTER** key and the cursor moves to preset frequency 1. Enter the desired frequency and press **ENTER**. The cursor will then move to frequency 2. Proceed as with preset frequency 1 until the four preset frequencies are filled and...

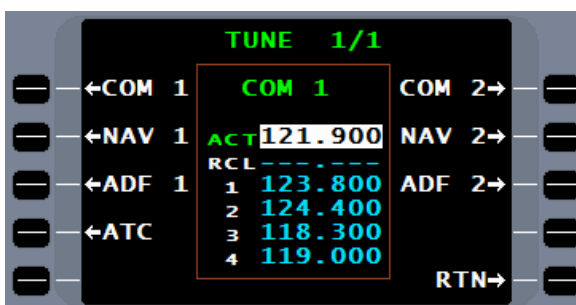


...when completed with frequency 4, press the **ENTER** key and the cursor moves to the **ACT** field.

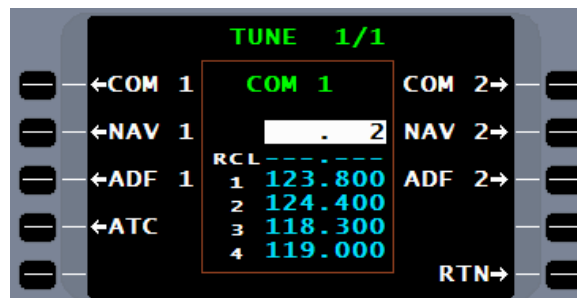


The frequency **ACT** or activation field will, when a frequency is entered, tune the selected radio.

Enter the desired frequency and press the **ENTER** key. When the frequency stops blinking and ACT appears, the selected radio is tuned. The radio display will reflect the new frequency.

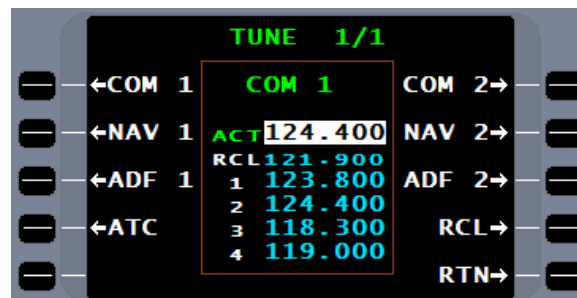


To use the preset frequencies, enter the desired preset line number (1 – 4) and press **ENTER**

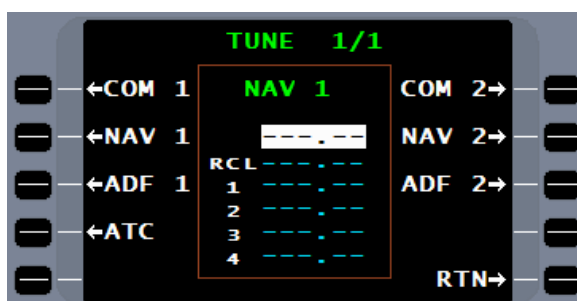


The selected frequency will appear in the **ACT** field and be tuned.

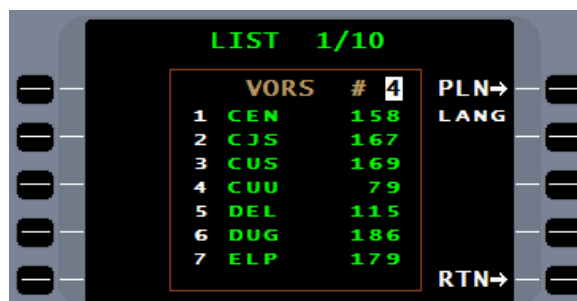
The frequency previously in the **ACT** field will move to the RCL or recall field. If this frequency needs to be recalled, press the RCL line select key and the RCL frequency will appear in the **ACT** field and be tuned. The RCL frequency is replaced by the frequency in the **ACT** field when it is superseded.



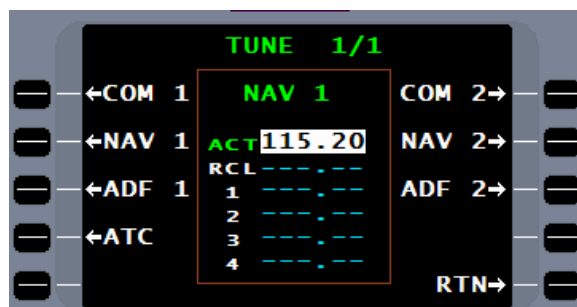
Use the line select keys to select the desired radio. Only those radios that can be remotely tuned will appear next to line select keys.



For ADF and NAV radios, entering the identifier by the **LIST** key or direct entry...



...will result in the frequency being entered into the frequency field.

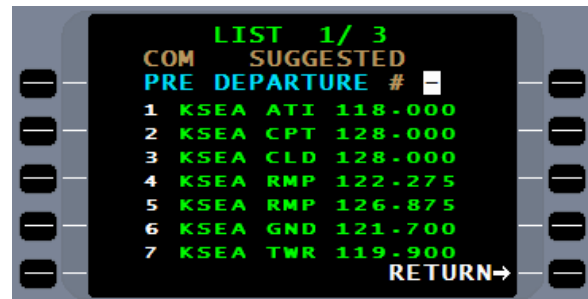


SCN 802 and 803 imports communication frequencies through the NAV database. To access the frequency database, with the cursor in the COM frequency field, press the LIST key.

Depending on the phase of flight, a list of frequencies will appear over several pages. Entering the number of the desired frequency in the cursor field will enter that frequency into the COM frequency field.

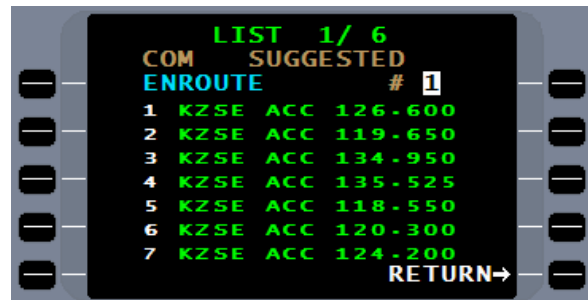
Following are screens presenting selected phases of flight.

In the **PRE DEPARTURE** phase, the FMS lists frequencies from the closest airport with in 50nm. Power up or changing the flightplan will cause the FMS to enter the **PRE DEPARTURE** phase.



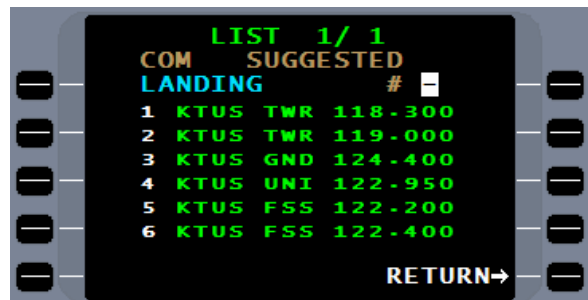
The DEPARTURE phase is entered when the FMS transitions from ground to flight.

The **ENROUTE** phase is entered when the aircraft is more than 15nm from the departure airport, but less than 40nm from the arrival airport.



The ARRIVAL phase is entered when the aircraft is with in 40nm of the arrival airport. Frequencies are from the flight plan arrival airport or, if no arrival airport in the flight plan, the closest airport with in 50nm.

The **LANDING** phase is entered when the aircraft transitions from flight to ground. The FMS lists frequencies from the closest airport with in 50nm.

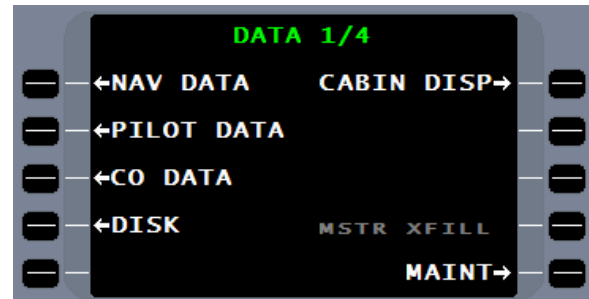


DATA FUNCTION PAGES

DATA 1/4 is the database menu page. It allows access to the navigation database, pilot database, company database, and disk or DTU operations.

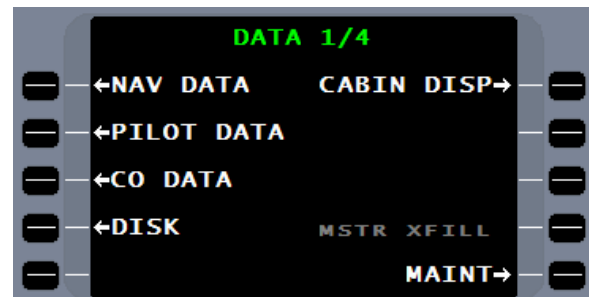
PERF, UNILINK AFIS, MFD DISP, and CABIN DISP line select keys will be displayed on aircraft that have these options. The MAINT line select key is a maintenance function and allows access to the configuration mode.

The MFD DISP line select key (not shown) allows selection/deselection of the progress data on the MFD in Pro Line IV installations.

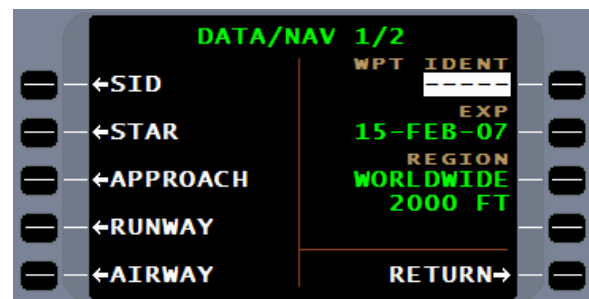


NAVIGATION DATABASE INTERROGATION

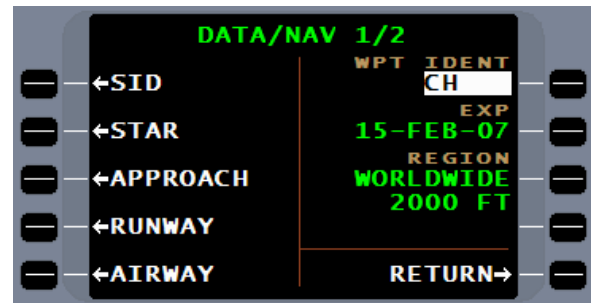
To interrogate the contents of the navigation database, press the “NAV DATA” line select key.



The **DATA/NAV** page allows access to airports and waypoints by identifier, SID, STAR, APPROACHES, RUNWAYS, and AIRWAYS. The active database region and its expiration date are displayed.



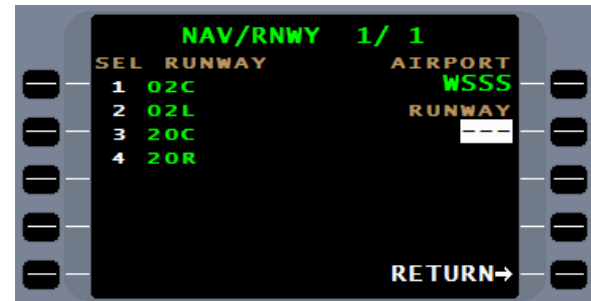
By entering an ICAO identifier, into the **WPT IDENT** field, the database information will be displayed.



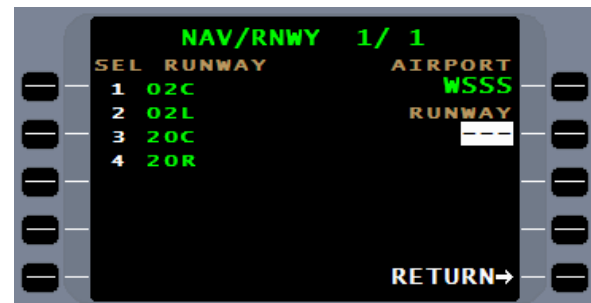
For identifiers with more than one waypoint, use the **NEXT** or **PREV** key to cycle through the pages.



To access SID, STAR, APPROACH, RUNWAY, or AIRWAY, first select the appropriate line select key then enter the ICAO identifier.

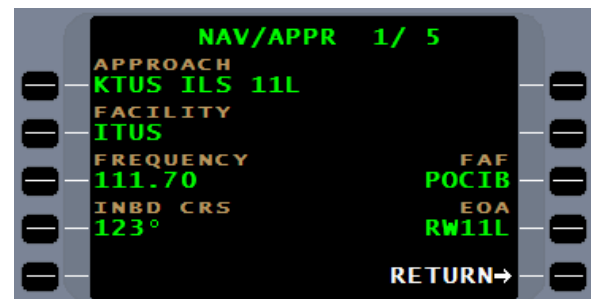


The runway database includes magnetic heading, elevation, approach end lat/long, and length.



The Navigation Database includes ILS, GLS, LOC, BC, RNAV, GPS, VOR, and NDB approaches.

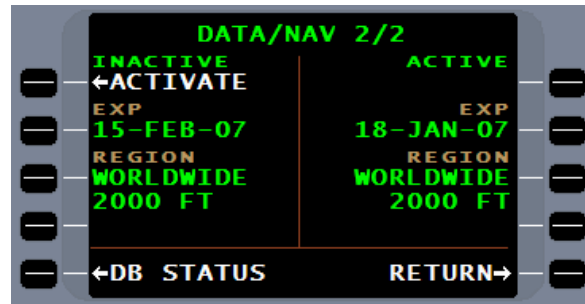
ILS facilities (ident, frequency, inbound course, final approach fix, and end of approach) are included in the approach database.



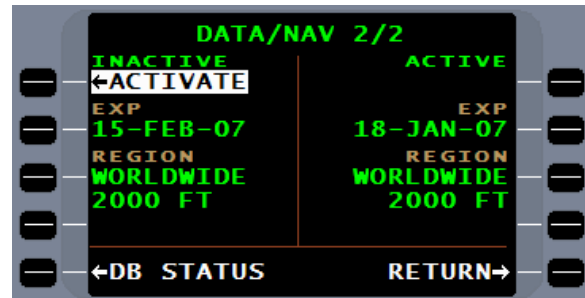
DUAL DATABASE

The UNS 1E, 1F, 1L, 1C+, 1D+, and 1K+ have dual navigation database storage. This allows for one database to be active for current navigation and a second database to be inactive and used for past or future navigation.

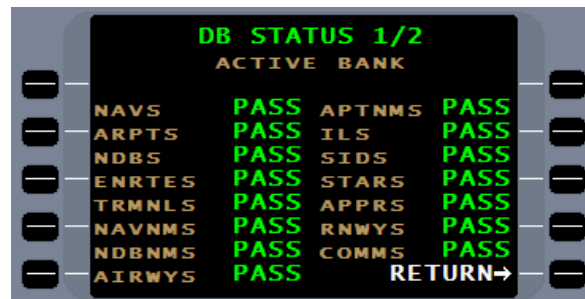
From **DATA/NAV 1/2** press the **NEXT** key to move to page 2. The subheading **ACTIVE** indicates the database currently being used for navigation. The **INACTIVE** database is either an expired database or a future database. When a new database is loaded, it automatically erases the inactive database and replaces it. When the active database expires, which occurs in most locations at 0900 UTC on the date of expiration (803 allows for configuring a different time for countries requiring it), the FMS upon the next power up will activate the now current NAV database. **ACTIVE** will now be the subheading of the newly activated database. Automatic activation of a new NAV database will only occur on the ground during FMS power on and self test.



The need for manual activation of the inactive NAV database is rare, but can be accomplished by pressing twice the **ACTIVATE** line select key. This will result in the FMS automatically rebooting with the selected database now being active. Manual activation of a database can only be accomplished on the ground and flightplan and fuel entries will be lost during the reboot. The reasons for activating an inactive database may be selecting a new regional database or to temporarily activate an old database if the current database is corrupt.

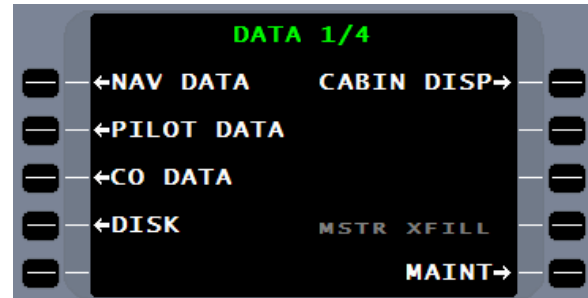


The **DB STATUS** line select key allows the operator to check the results of the database test. Page 2 is the **INACTIVE BANK** of the NAV database.

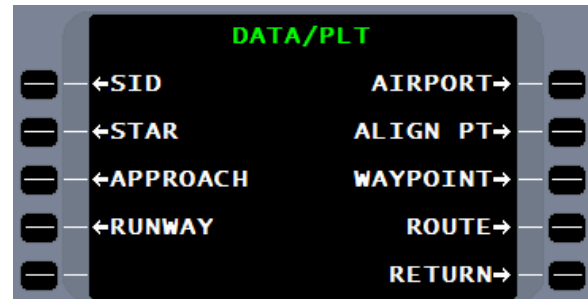


PILOT DATA

The PILOT DATA line select key will access the PILOT DATA page.



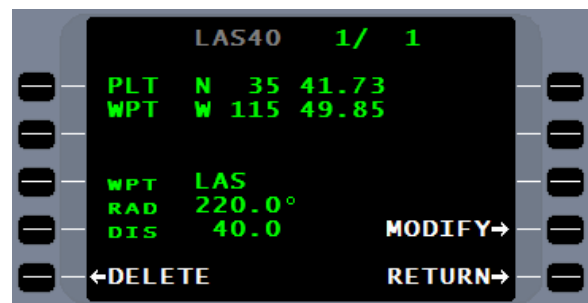
Pilot created data can be accessed through selection of the appropriate line select key. The ROUTE selection was covered earlier under flightplan and Route Creation. Pilot creation of SID, STAR, Approaches, Runways, and Airports will be discussed in another section.



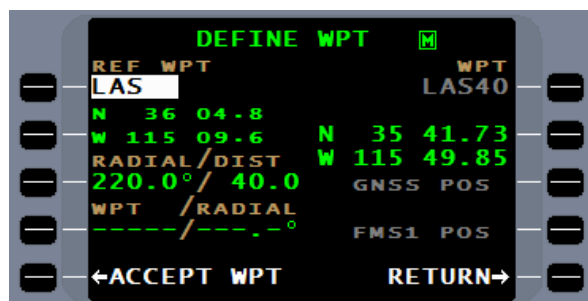
The creation of pilot waypoints was presented earlier under Pilot Defined Waypoints. Pressing the WAYPOINT line select key will bring up a list of the created waypoints in alphabetical order. To view waypoint creation information, either place the number of the waypoint or the alphanumeric designator for the waypoint into the WPT field and press **ENTER**.



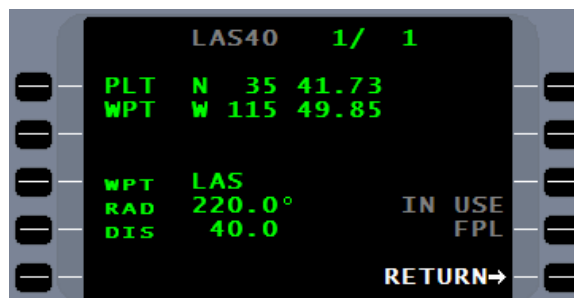
The latitude and longitude, and creation information, i.e., reference waypoint, radial, and distance, is presented along with line select keys for DELETE and MODIFY. Pressing the DELETE line select key twice will remove the pilot waypoint from the database.



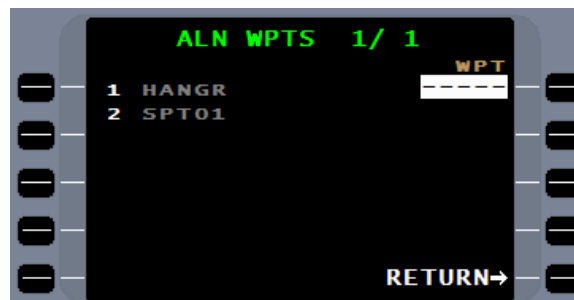
The MODIFY line select key will bring up the DEFINE WPT page and allow for modification of the waypoint position.



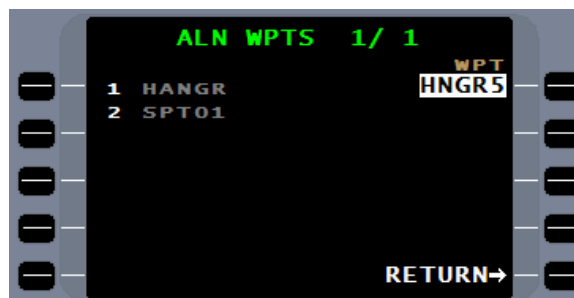
If the selected pilot waypoint is in use by the current flight plan (or a pilot created route, airport, SID, STAR, or approach) IN USE FPL will be presented on the right side of the page. No modification or deletion of the waypoint will be allowed.



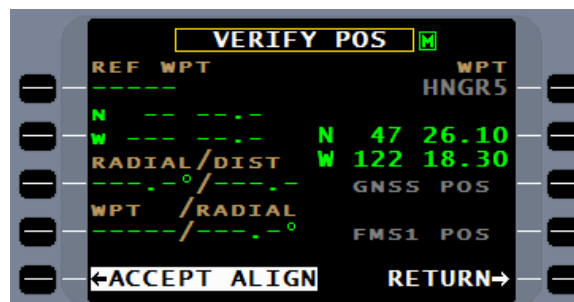
By pressing the ALIGN PT line select key, the ALN WPTS page is available to create alignment points on an airport for IRS or INS navigation equipment. A hangar align point may be created for initialization in a hangar where GPS reception would be inhibited.



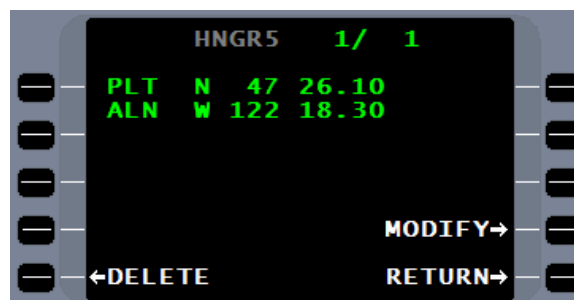
With the alphanumeric keys insert a pilot created name into the WPT field and press the **ENTER** key.



The DEFINE ALIGN page follows the same format as defining a waypoint.



To modify or delete the alignment point, use the appropriate line select keys.

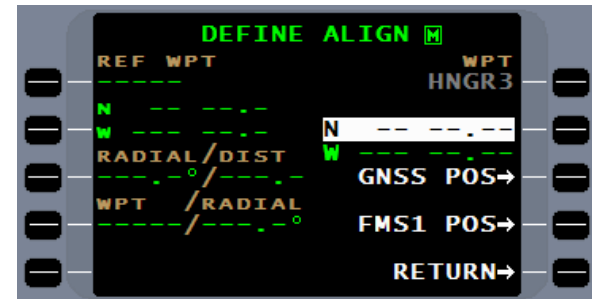


A technique to create an alignment point to be used during initialization for an aircraft in a hangar, first, park the aircraft just in front of the hangar in a location where a lat/long position can be determined by the GPS.

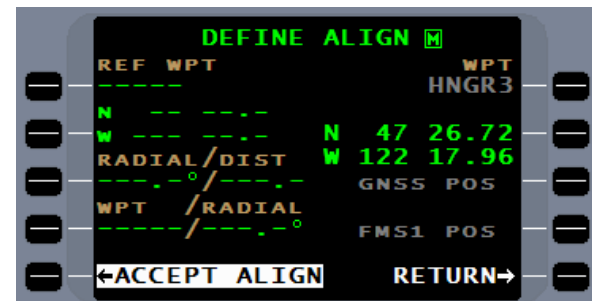
Go to the align page and give the alignment point a four or five character alphanumeric name.



Enter the name by pressing the **ENTER** key and the **DEFINE ALIGN** page appears. Press the 2R line select key as if to enter a lat/long. The GNSS POS and FMS1 POS line select key will become available for selection. Press the GNSS line select key and the GPS lat/long will be entered.



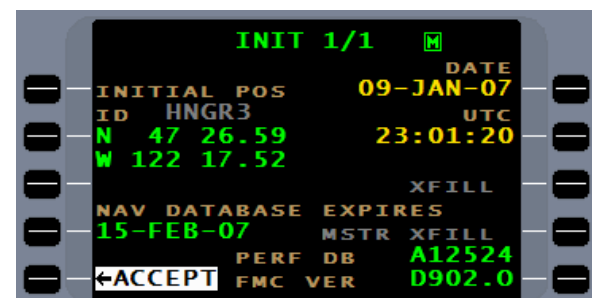
Accept the alignment point and it will now become part of the pilot database.



On the initialization page with the cursor in the ID field, press the **LIST** key. A list of airports and pilot alignment points will be presented. Enter the reference number for the **HNGR3** align point and press the **ENTER** key.



HNGR3 is entered in the **ID** field and the associated lat/long is listed below.



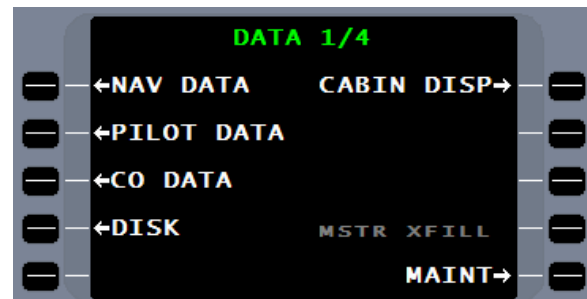
COMPANY ROUTES DATA

A protected company routes database can be created using Universal's Offline Flight Planning Program and may be stored on up to four disks. A total of 2000 routes and 250,000 route elements may be stored. Each route will consist of at least one but not more than 98 waypoints (route elements). Route elements will reference waypoints, airways, and terminal area procedures (SID, STAR, and approaches) from the Navigation database by use of reference pointers. Company routes can be given names of up to eight characters in length. A company routes database will allow routes to be viewed and copied to the active flightplan, but the flight crew cannot modify the routes themselves. Also included are company defined waypoints and airports. A maximum of 200 company waypoints and 100 company airports may be created using the Universal flight planning Program.

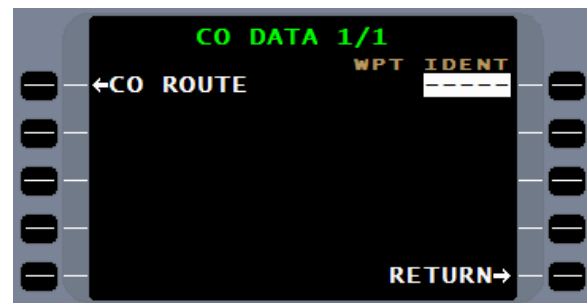
A company routes database must be loaded with the same Navigation data that was used for its creation. Company routes database disk(s) are loaded through the Data Transfer Unit (DTU) by using the same procedures as loading Navigation data disks.

NOTE: A configuration option is available that will clear all pilot defined data at power-up. This feature is intended for airline operations in which the FMS will always power up in a cleared state with no leftover pilot defined data from a previous crew.

Company routes are not created on the FMS but through the Universal Flight Planning program on a PC computer. These routes are entered into the FMS through the DTU after a NAV database update and must be updated through UFP and reentered after each NAV database update. These routes may be viewed through the CO DATA line select key on **DATA 1** which will present the **CO DATA** page.



Company routes may be accessed through the CO ROUTE line select key. Company waypoints and airports may be viewed through the **WPT IDENT** field. Enter the identifier of the company waypoint or airport and the FMS will present the waypoint information. The FMS will not list the company waypoints or airports as it does in the pilot database. The Universal Flight Planning Program must be used to view a list of company waypoints and airports.

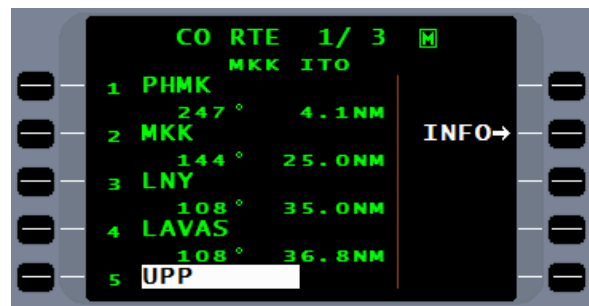


For the SSDTU, CO data must come from a uasc folder on the flash memory drive or SD memory card. See LOADING THE NAV DATABASE.

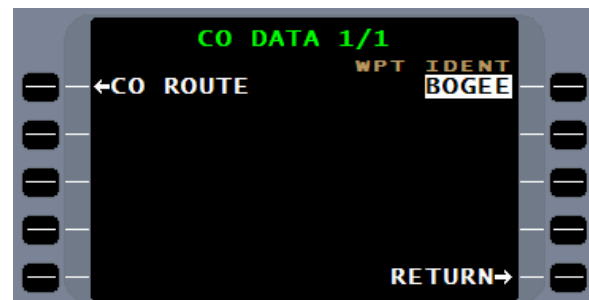
Select the company route to be reviewed and press the **ENTER** key. The route number, name, or a reference fix may be used for selection.



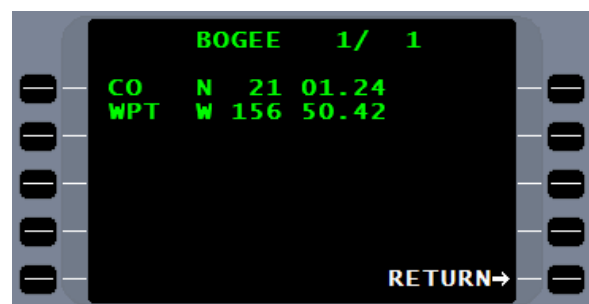
The route structure can be reviewed, but no alteration can take place until the company route is copied into the flightplan function.



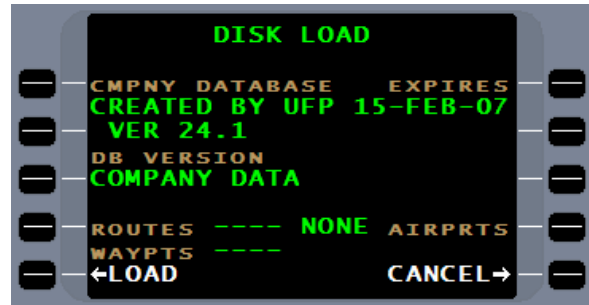
To view the coordinates of a company waypoint, enter the identification of the waypoint into the **WPT IDENT** field and press **ENTER**.



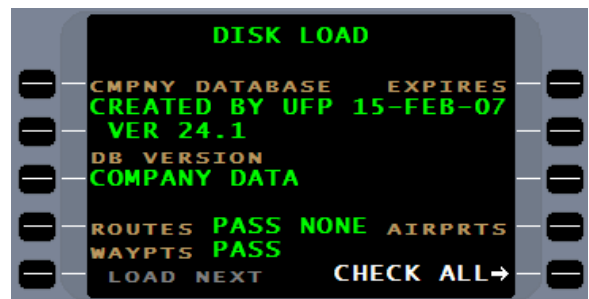
The lat/long coordinates are displayed.



To load the company database, first insure the NAV data for period of the company database is loaded. Then insert the company data disk and press load. If following a NAV database load, press load next. Company data information will be presented. Press load.



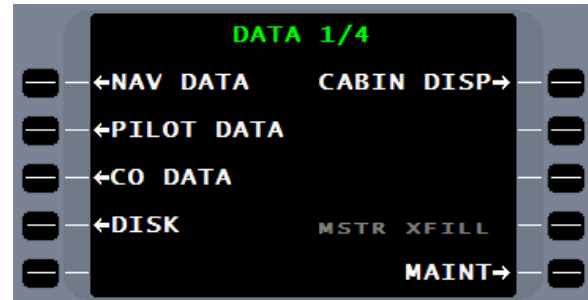
The FMS will load the database and, when testing is complete, a CHECK ALL line select key will be presented. CHECK ALL must be pressed to advance the FMS.



The company database is now loaded.

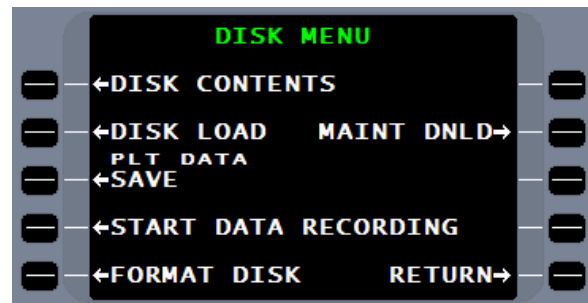
DATA DISK FUNCTIONS

Press the **DATA** key, and then press the DISK line select key to access the DTU functions.



The **DISK MENU** page provides line select keys for access to DISK CONTENTS, DISK LOAD, PLT DATA SAVE, and FORMAT DISK. The DTU is also used for maintenance functions such as START DATA RECORDING, MAINT DNLD, and FLIGHT LOG.

The disk format function is available for the reuse of disks when saving pilot data.



Formatting with the SSDTU will automatically add a "uasc" folder to the drive.

CAUTION: Disk format will erase all data on the diskette and prepare it for recording.

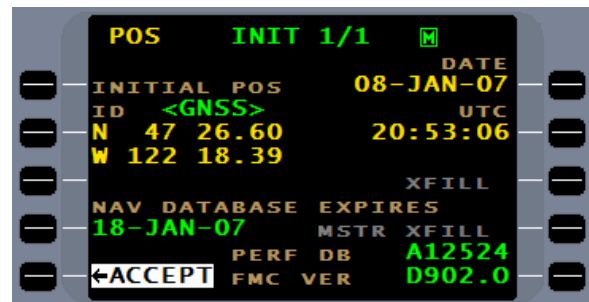
LOADING THE NAV DATABASE

The DTU 100 uses one ZIP disk to load the NAV database and an Ethernet data bus for a high speed data transfer. A normal database load should take approximately three minutes. Lift the cover. It is spring loaded to close after inserting the Zip disk. Once power is applied to the FMS the DTU 100 is powered and in communication with the NCU. The navigation database will be totally contained on a 100mb or 250mb Zip disk. Use the following procedure to load the NAV database in your FMS. With a Solid State Data Transfer Unit (SSDTU), a flash memory drive or SD memory card is used in lieu of the ZIP disk.

For the SSDTU, a folder named “uasc” must reside on the flash memory drive or SD memory card. The NAV data files are placed in the uasc folder. If you download your NAV database from UASC, unzip the NAV data into the uasc folder. A Flash memory drive received from UASC will already contain the uasc folder with the NAV data.

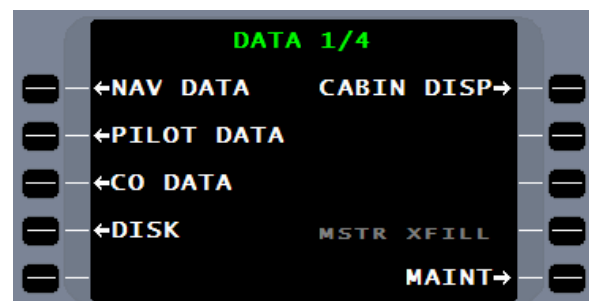
The DISK MENU may be located by two means.

Turn on the FMS. After the FMS completes its power on self-test and the **INIT** page appears, press the **[MENU]** key.

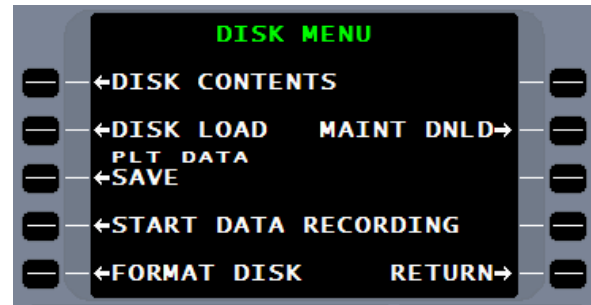


NOTE: The expiration date shown on the initialization page is the expiration date of the ACTIVE database. The expiration date of the newly loaded database will not be shown until it becomes active.

If you are no longer on the INIT page, press the DATA key and you should be on **DATA 1/4**.

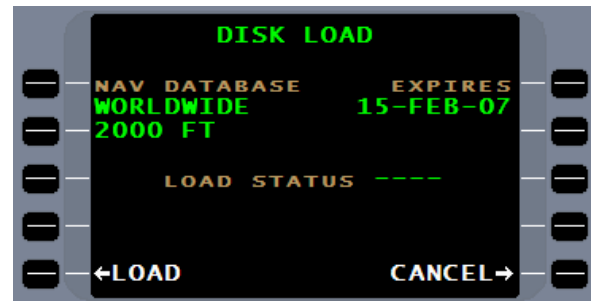


Press the DISK line select key and the **DISK MENU** will appear. Insure the ZIP disk is inserted into the DTU then press DISK LOAD to start the load process.

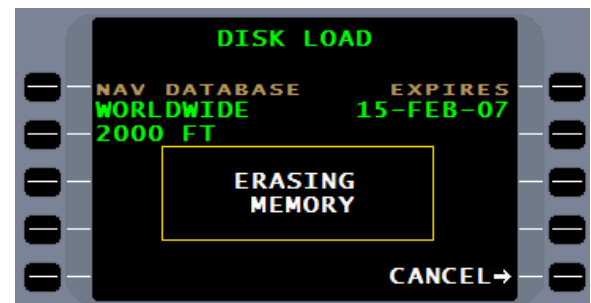


NOTE: The DISK LOAD and PLT DATA SAVE functions are available only when the aircraft is on the ground.

The FMS will read the disk and display the data to be loaded.

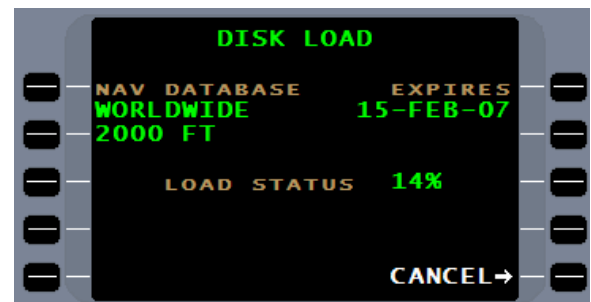


Press LOAD and the FMS will first erase the inactive database preparing it to receive the data to be loaded.

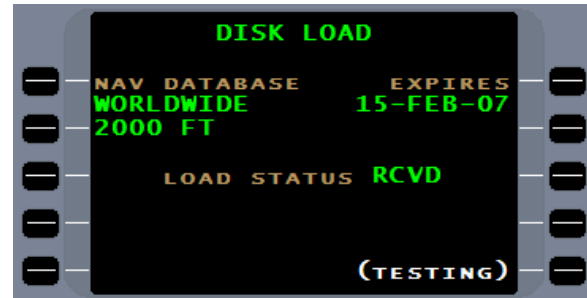


Multi FMS NAV database loads need not be done simultaneously. Pressing LOAD at anytime on the number 2 or 3 FMS will load the NAV database independent of the number one system.

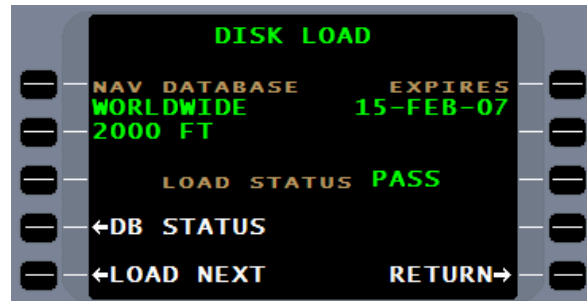
The FMS will load the NAV database with the percent load status being displayed.



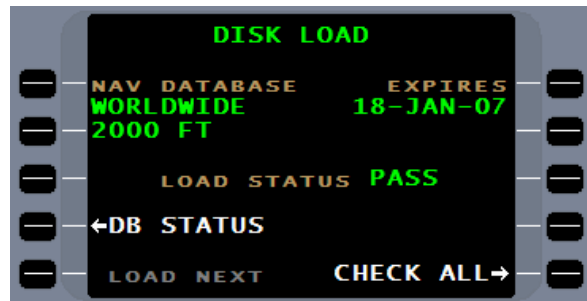
Once download is complete, the FMS will test the download to insure all data is correctly received.



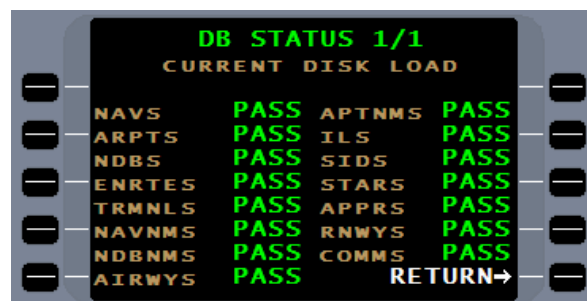
Once the testing is complete, a **LOAD STATUS** of **PASS** or **FAIL** will be presented and the FMS will offer options to load another disk such as a company database or view the database status in its entirety.



If the NAV database will become the active database, a CHECK ALL line select key will be presented. Press the CHECK ALL line select key to advance the FMS. CHECK ALL will always be present when a current database is loaded.



Pressing the DB STATUS line select key will present the **DB STATUS** page to check the status of the **CURRENT DISK LOAD**.

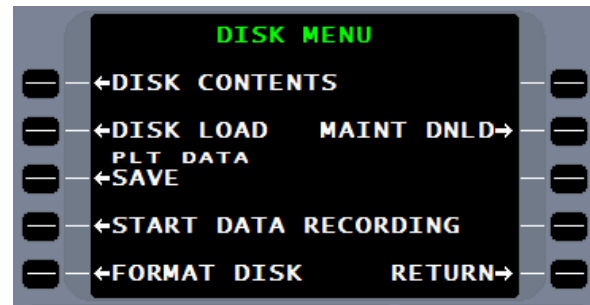


The loading of the NAV Database is now complete.

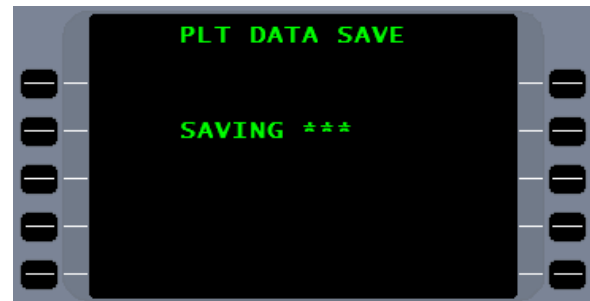
PILOT DATA SAVE

The PLT DATA SAVE line select key provides for the saving of pilot created routes, waypoints, align points, airports, SID, STAR, approaches, and runways. Saving is done on a DTU 100, via Zip disk. The pilot data save function is a method of transferring data from the FMS to the Universal Flight Planning program. It is also a method of backing up the pilot data for the same reason as backing up a computer hard drive. If a requirement to service the FMS develops, the saved pilot data may be required for reloading of pilot data in the FMS.

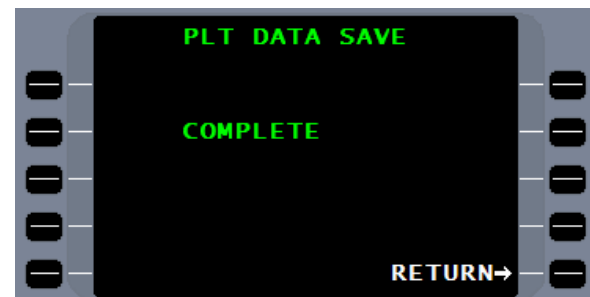
First insert a blank Zip disk or a flash memory drive/SD card with an empty uasc folder into the DTU. Then, press the PLT DATA SAVE line select key.



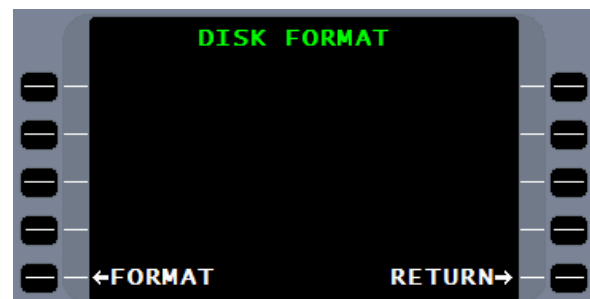
The FMS will first determine if the Zip disk is blank, then it will present a **PLT DATA SAVE** page indicating the pilot data is being saved.



When the FMS is completed saving the pilot data, a **COMPLETE** will be presented.



DISK FORMAT can be used to erase a Zip disk, thus, making it useable to save pilot data. Press the DISK FORMAT line select key on the DISK MENU page and a **DISK FORMAT** page will be presented. Pressing the FORMAT line select key will immediately start the format process. Formatting with the SSDTU will automatically add a "uasc" folder to the drive.



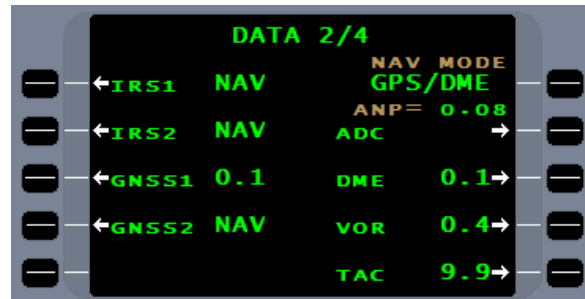
CAUTION: Disk format will erase all data on the diskette and prepare it for recording.

NAVIGATION SENSORS

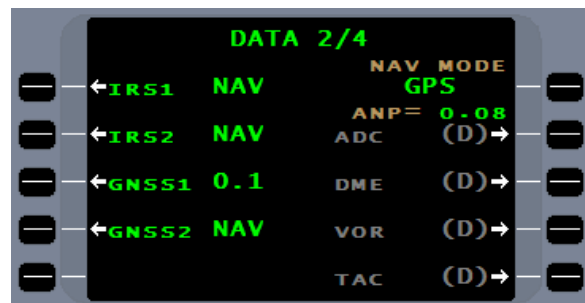
DATA 2/4 is the sensor summary page. The status of all sensors is displayed here. Access to sensors for control and more detailed information is through this page.

Also displayed are the primary sensors currently in use to calculate the best computed position and the “ANP”, actual navigation performance.

In SCN 80X, DME and VOR status will not be presented in installations that do not provide inputs to the FMS from these sensors..

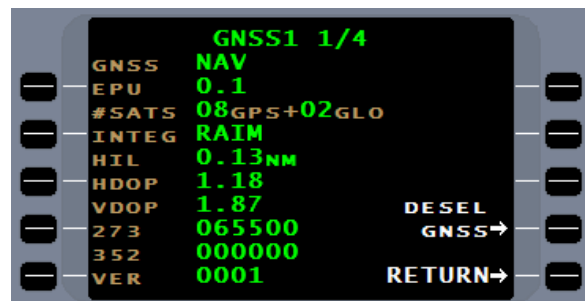


Sensors other than GPS, IRS, or GPIRS will normally be deselected on the ground.

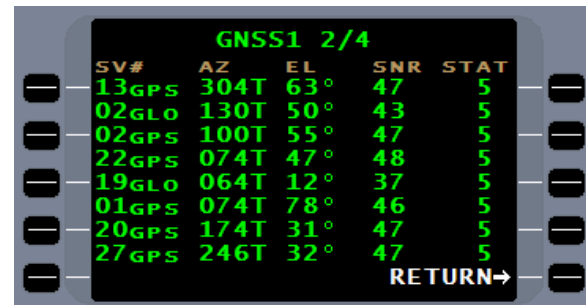


Pressing the line select key adjacent to a NAV sensor will bring up more information about that sensor. Examples are GNSS and DME.

The **GNSS1 1/4** information is as follows: the GNSS is in NAV mode, The EPU or estimate of position uncertainty is 0.1nm, number of satellites being used is 8 GPS and 2 GLONASS, the integrity is RAIM, the HIL or horizontal integrity limit is 0.13nm, HDOP or horizontal dilution of position is 1.18, VDOP or vertical dilution of position is 1.87, the status line or code 273 is 065500, the error code line or 352 is 000000, and the software version is 0001.



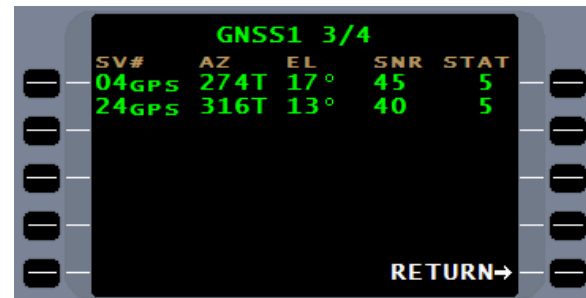
GNSS1 2/4 and **GNSS 3/4** will present satellite information to include satellite vehicle number, azimuth, elevation, signal to noise ratio, and status.



GNSS1 2/4

SV#	AZ	EL	SNR	STAT
13GPS	304T	63°	47	5
02GLO	130T	50°	43	5
02GPS	100T	55°	47	5
22GPS	074T	47°	48	5
19GLO	064T	12°	37	5
01GPS	074T	78°	46	5
20GPS	174T	31°	47	5
27GPS	246T	32°	47	5

RETURN→

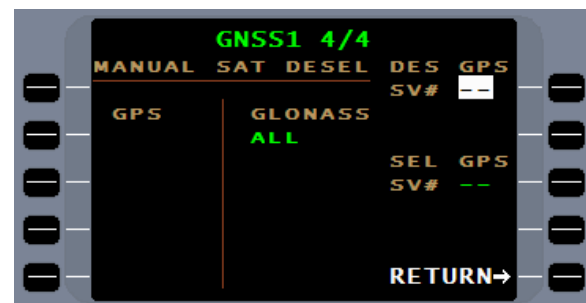


GNSS1 3/4

SV#	AZ	EL	SNR	STAT
04GPS	274T	17°	45	5
24GPS	316T	13°	40	5

RETURN→

GNSS1 4/4 allows for manual deselection of satellites. This feature should not be used except by qualified avionics technicians. The automatic fault detection and exclusion function will automatically remove unusable or faulty satellites from the GNSS accuracy calculation.



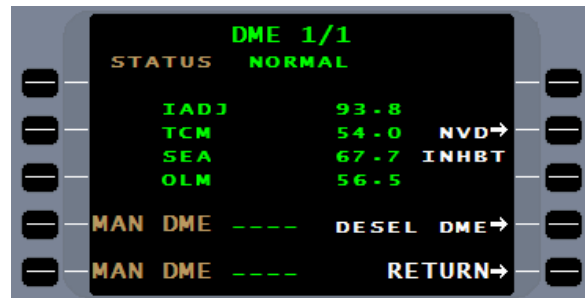
GNSS1 4/4

MANUAL	SAT	DESEL	DES	GPS
			SV#	--
GPS		GLONASS		
		ALL		
			SEL	GPS
			SV#	--

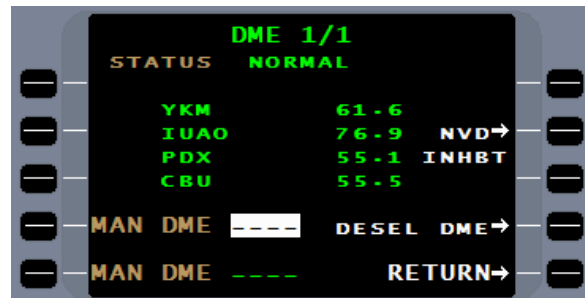
RETURN→

GPS information will be similar to that displayed in the GNSS pages.

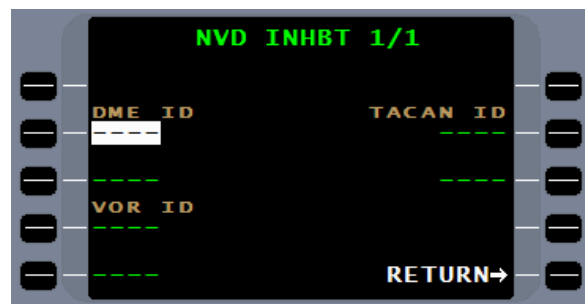
The DME sensor will scan up to 15 DME stations. Only 4 stations are displayed at a time. The FMS will compare the received distance with the database computed distance for quality control. If the station signal distance does not agree with the computed distance, the FMS will question the received distance and will not use it in computing the DME position.



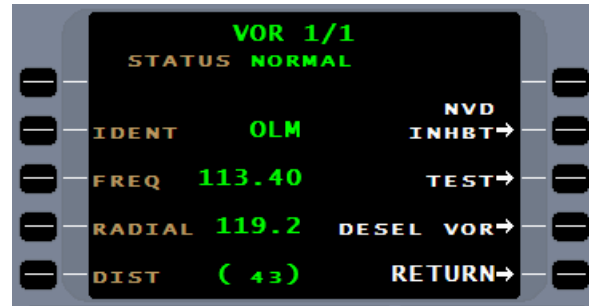
By pressing the **MAN DME** line select key and pressing **LIST**, the pilot may select from the list a DME station. Selecting this DME station will insure that it is part of the list of DME stations scanned by the FMS.



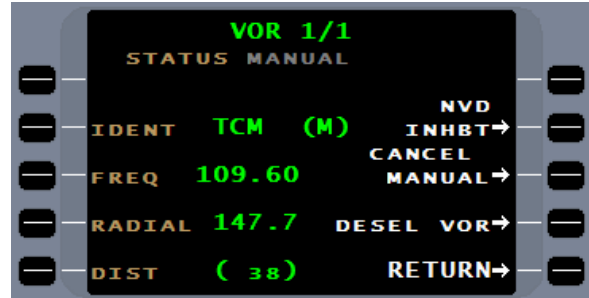
SCN 802 and subsequent offer **NVD INHBT 1/1**, which will allow the selection of a navaid and force the FMS to exclude that navaid.



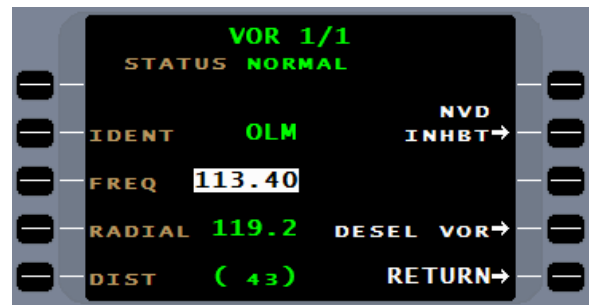
The VOR is primarily used during the flying of a VOR approach. Enroute, if the FMS can only receive one DME station, the VOR radial of that station will be used to do a Rho – Theta calculation of a lat/long for inclusion in the FMS best computed position. A reasonableness test will be done to ensure the selected VOR is valid.



The VOR can be tuned through the VOR page by use of the LIST function to enter the ident or frequency. The **(M)** indicates manual selection.

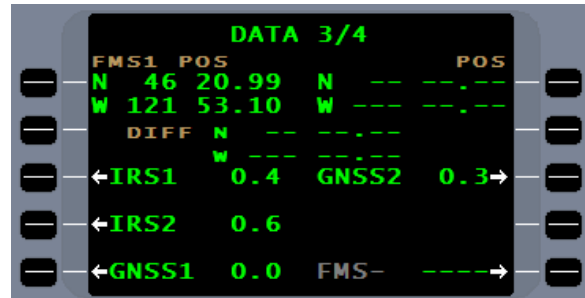


Pressing the TEST line select key will allow the entry of a VOR frequency. This function is primarily used by an avionics technician when integrating the VOR and FMS, but can be used by the pilot to test the remote tuning capability of the FMS and when doing a periodic calibration test of the VOR.



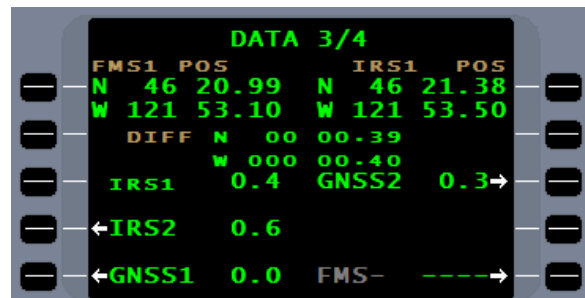
POSITION SUMMARY PAGE

DATA 3/4 is the position summary page. FMS position may be compared to another long range sensor listed by pressing the appropriate line select key.



DATA 3/4			
FMS1 POS		POS	
N	46 20.99	N	-- --.---
W	121 53.10	W	-- --.---
DIFF		N	-- --.---
	W		-- --.---
←IRS1	0.4	GNSS2	0.3→
←IRS2	0.6		
←GNSS1	0.0	FMS-	-----→

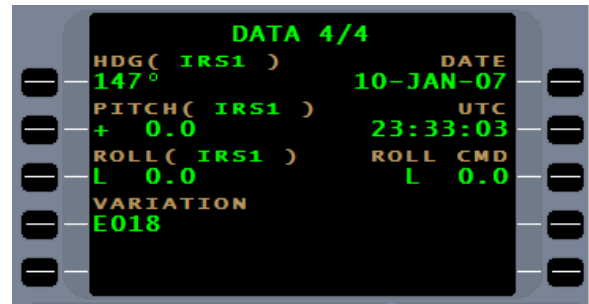
The difference between the two sensors will be computed and displayed.



DATA 3/4			
FMS1 POS		IRS1 POS	
N	46 20.99	N	46 21.38
W	121 53.10	W	121 53.50
DIFF		N	00 00.39
	W	000	00.40
IRS1	0.4	GNSS2	0.3→
←IRS2	0.6		
←GNSS1	0.0	FMS-	-----→

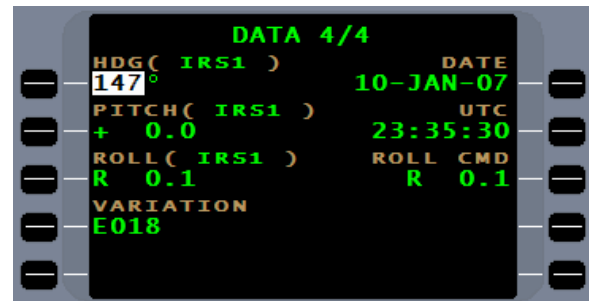
GENERAL DATA PAGE

DATA 4/4 is the general data page. Date and time corrections can be entered here after initialization, but should not be necessary as updating is automatic by the GPS when in NAV mode. A manual heading entry can be made here in the event of a system failure. The **PITCH** and **ROLL** lines will display output from IRS or AHRS if sent to the FMS. Roll command (**ROLL CMD**) is the output from the FMS to the aircraft FGS. If failed, can be reset at the adjacent line select key (See FMS Trouble Shooting for Pilots).



The magnetic variation is automatically computed and displayed between the latitudes of S60 and N73. (MAN), if displayed, indicates the variation displayed is a manually input.

Pressing the HDG data field line select key will bring the cursor into view over the current heading. A manual heading entry may be entered, or the **LIST** function may be selected to change the heading source.



CAUTION: You should only enter a manual heading if you intend to update this field with every heading change made in the aircraft.

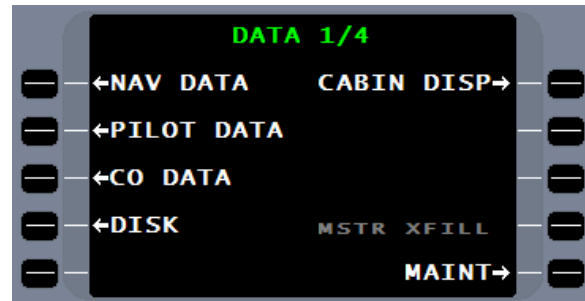
This list shows all heading sources available to the FMS. A different heading source may be manually selected by pressing the appropriate line select key. If a manual heading is entered, to exit the manual heading requires selection of a heading source from the **HDG SRC** page.



If multiple heading sources are available, the FMS will automatically select the back-up source from its priority list in the event of loss of the primary source.

MAINTENANCE

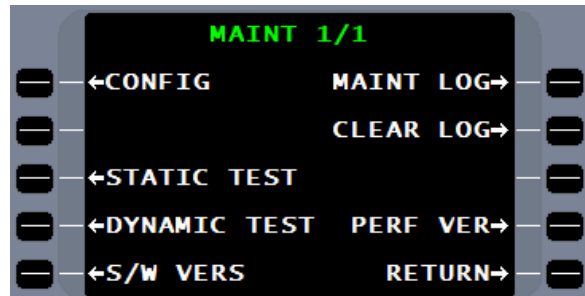
Selection of the MAINT line select key will allow access to the maintenance pages. This function is used during installation to configure and test the FMS. Changing the configuration should only be done by qualified personal and requires an access code to change the configuration.



IMPORTANT! The configuration of the FMS should be on file with the aircraft records. If not, press the CONFIG line select key and copy the information on each page then file with the aircraft records. Universal Avionics does not maintain a record of aircraft configurations; **this configuration is necessary for FMS maintenance and software upgrades.**

MAINT 1/1 will allow access to the S/W VERS (Software Version) and PERF VER (Performance Version) line select keys.

MAINT LOG, CLEAR LOG, STATIC TEST, and DYNAMIC TEST are maintenance functions and are not discussed here.

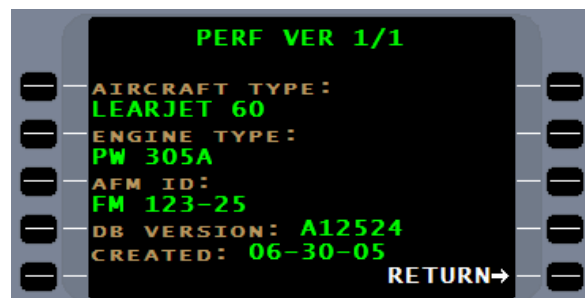


The **S/W VERSION** page will list all software within the FMS and the current version. FMC (Flight Management Computer) is the current operating system on the FMS.



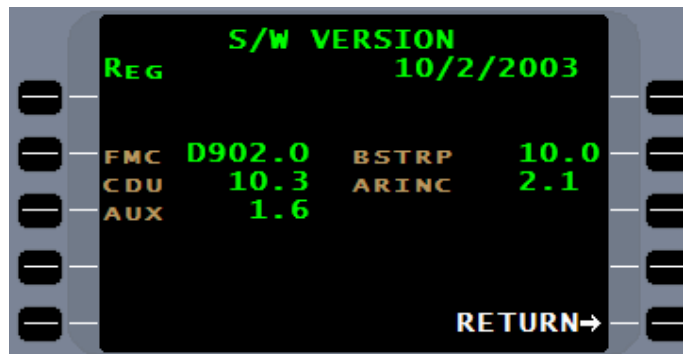
If there is a performance database for aircraft in which the FMS is installed, the **PERF VER** page provides information about that database.

Contact the aircraft OEM for Performance Database availability.



SOFTWARE

S/W VERSION – The system software version numbers are displayed as follows (these are for information only):



- **FMC** – Flight Management Computer, the system software version number. The basic software version number will be followed by a decimal point and number (801.2). The original software release will be “.0”, and any subsequent variations on that basic software will be “.1”, “.2”, etc. These variations of the basic software version will contain changes of minor impact only and will not require a new Supplemental Type Certificate (STC), as operational features will be unaffected.
- **CDU** – Control and Display Unit software
- **AUX** – Software version number of the AUX processor in the FMS
- **ANA** – Analog-to-digital input board software version number, when installed
- **RRS** – Software version number of the optional Radio Reference Sensor, when installed
- **BSTRP** – Bootstrap software version
- **ARINC** – Software version number of the ARINC board
- **ASCB** – Software version of the ASCB Board, when installed
- **ERP** – Appears in lieu of RTU when EFIS Radar panel is installed
- **RTU** – For configurations with the optional frequency management capabilities, this is the radio tuning unit software version number.

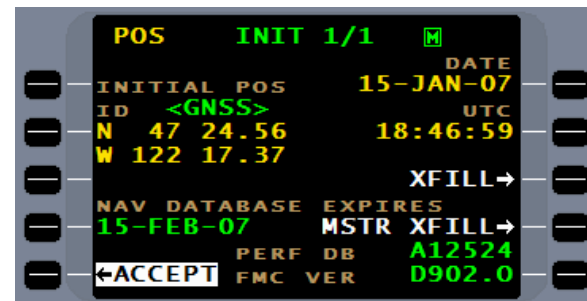
“XFILL” IN MULTIPLE FMS INSTALLATIONS

In multiple FMS installations, a “XFILL” option will be available (if so configured) to crossfill initialization, flightplan, and fuel data. In addition, other Xfill features are available when needed by the pilot. With SCN 803, synchronous dual FMS operations are available. If this feature is configured, crossfill will be automatic and manual crossfill will not be available.

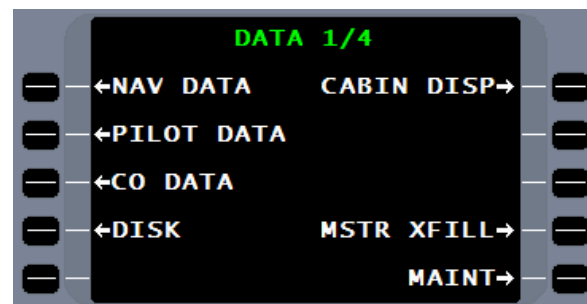
The FMS can be configured by maintenance for either PUSH or PULL. With the PUSH mode the transmitting FMS will initiate the crossfill process. With the PULL mode the receiving FMS will initiate the process. The PULL configuration is the default configuration.



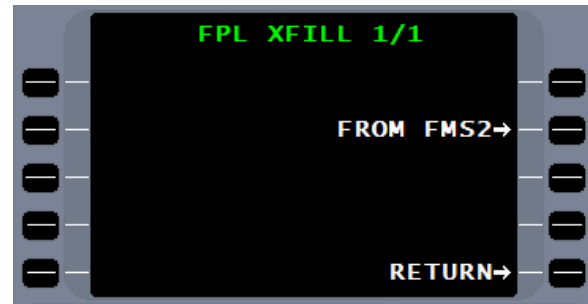
On the initial page MSTR XFILL and XFILL are options that can be selected. XFILL will crossfill date, time, and position. The MSTR XFILL will crossfill initial page, flightplan, and fuel information. Through the crossfill bus each FMS is made aware of the crossfill status of the other FMS. Before the MSTR XFILL option is made available the transmitting FMS must show that initialization, flightplan, and fuel information is complete and available. Also, with the PULL option selected, the receiving FMS should not be initialized. The procedure for the receiving FMS is to turn it on only, do not activate the ACCEPT key.



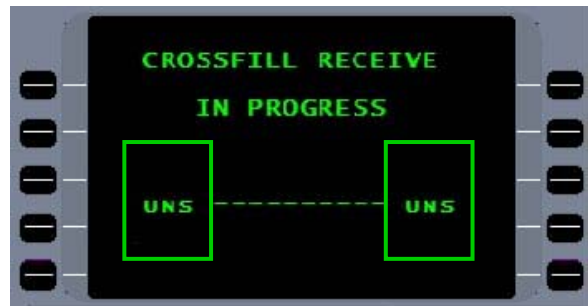
If the accept key is pressed, on **DATA 1/4** the MSTR XFILL option is also available. With the pull option configured, pressing this MSTR XFILL will execute the crossfill and return to the initial page. With the push option configured, use this MSTR XFILL to push data to the other FMS.



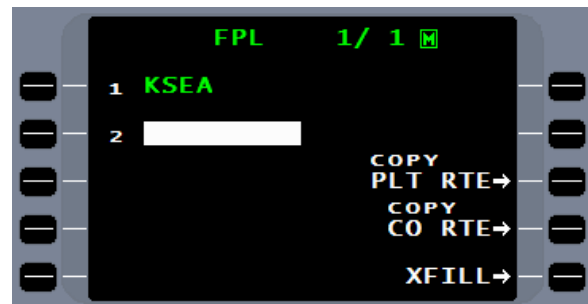
On a dual installation, a crossfill request will result in the presentation of a **FPL XFILL** page with a line select key for a “TO” or “FROM” the other FMS. With a triple FMS installation a crossfill request will be followed by the presentation of the dual crossfill screen. The specific FMS must be selected for crossfill to continue. A FROM will be presented in a PULL mode and a TO will be presented in a PUSH mode.



When crossfill commences, a CROSSFILL RECEIVE page will be presented showing that the crossfill is in progress. This page will remain until the crossfill is complete.



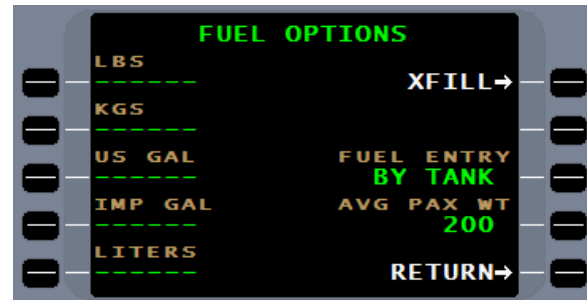
When an empty flightplan exists, a flightplan PULL mode XFILL option is available on FPL page one. Pressing the XFILL line select key will pull the flightplan from the other FMS.



A XFILL FPL option exists on the **FPL MENU 1/2** page to crossfill a flightplan following a flightplan edit; use the FPL MENU XFILL FPL line select key. A crossfill of the flightplan will overwrite the existing flightplan.

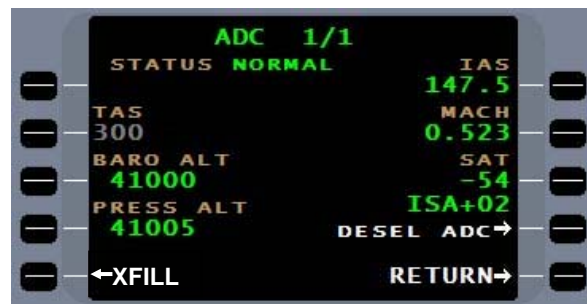


To crossfill fuel information requires selection of the **FUEL OPTIONS** menu. Selecting the XFILL line select key will crossfill all information on FUEL 1/5 and destination local time difference from FUEL 2/5.



In addition to the above crossfill capabilities, in multiple FMS configuration, one FMS will monitor position and NAV sensor information of the other FMS(s) and notify the pilot if a discrepancy occurs.

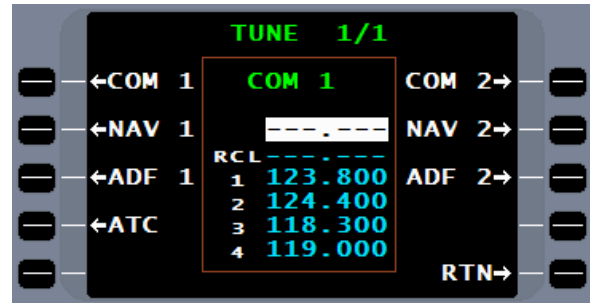
Air Data Computer information, including TAS, SAT, and Altitude, in one FMS can be crossfilled to another FMS through a XFILL line select key if the aircraft has dual air data computers. The receiving FMS ADC page will indicate that the data is crossfill data. In addition, the XFILL line select key of the transmitting FMS will disappear. The receiving FMS XFILL line select key will change to LOCAL allowing for selection of the FMS's own ADC. Also on the receiving FMS, when crossfill is in effect, IAS and mach data will disappear.



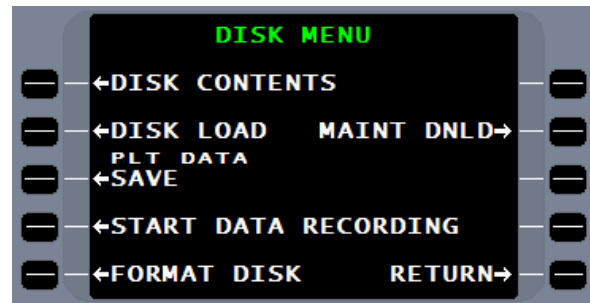
On DATA page 4, pressing the heading line select key followed by the **LIST** key will produce the HDG SRC page. The line select key, FMS 2, when selected, will crossfill the heading source used by FMS 2 to FMS 1. The transmitting FMS's ability to crossfill will now disappear thus preventing the FMS's from selecting each other when no heading source exists.



In a multiple FMS configuration the pilot stored pre-select frequencies will automatically be sent to the other FMS(s) via the crossfill bus unless this option has been disabled through the crossfill configuration page.



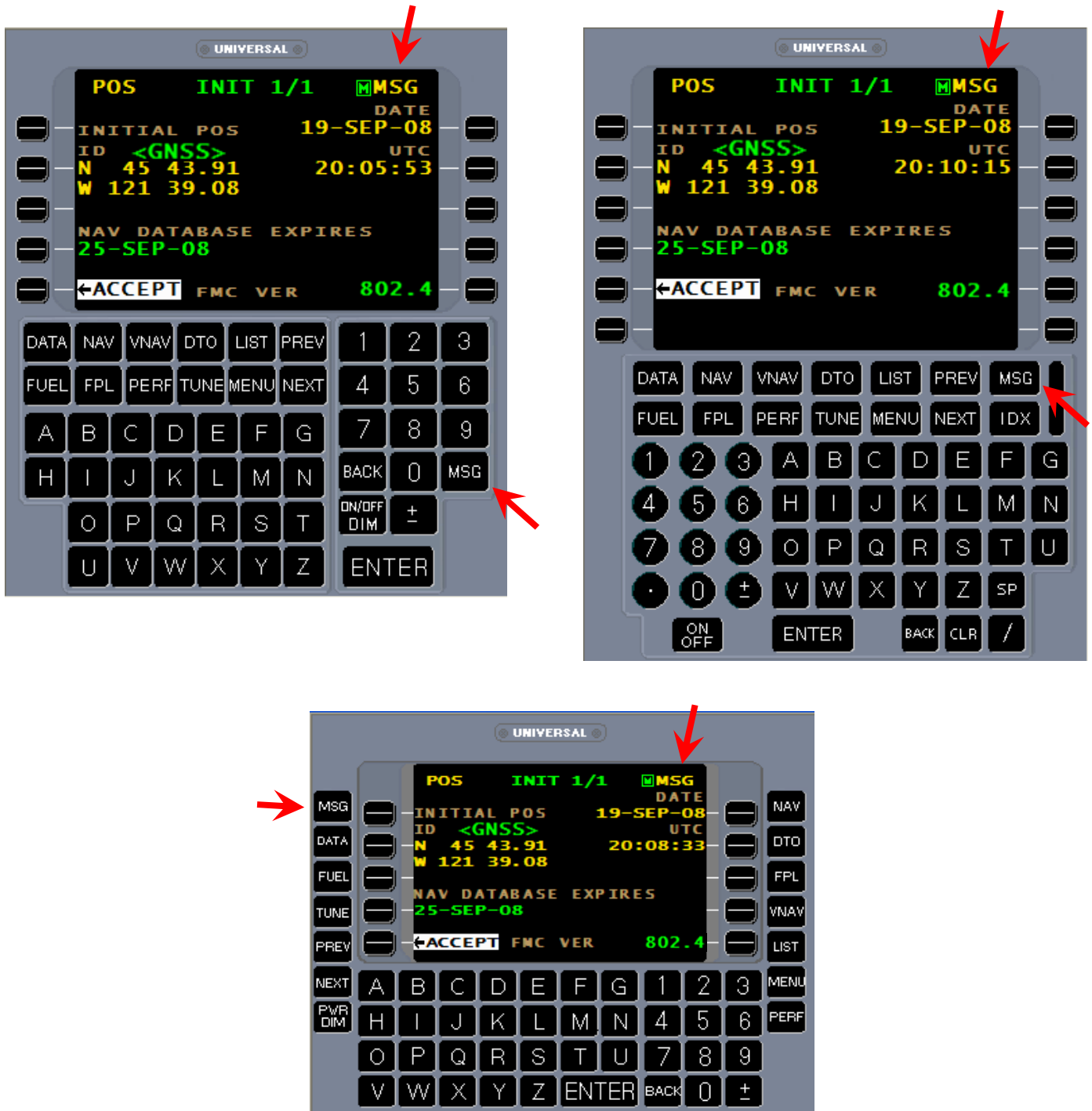
In multiple FMS installations, there exists the ability to load the NAV database into all FMS. It is not necessary to synchronize the data load process, just push DISK LOAD on the selected FMS at any time and the FMS will load the NAV database.



MESSAGE (MSG) FUNCTION

A message annunciator on the instrument panel or EFIS along with a flashing MSG in the upper right corner on the FMS display will announce the presence of a new message on the MSG page.

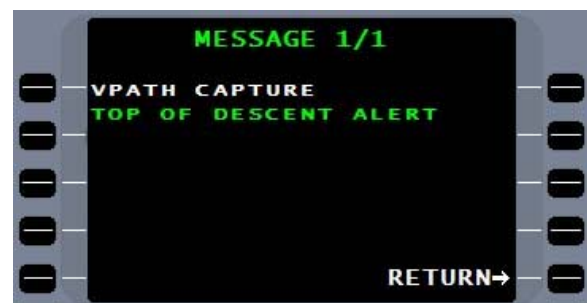
By pressing the **MSG** key, located to the lower right of the numeric keys on the 1Ew and 1Fw with both CDU and MCDU, and the upper left of the CDU on the 1Lw, the message page will be presented.



Messages displayed on the message page will be color-coded. The specific color will depend on FMS DISPLAY configuration. A message presented for the first time will be in either white or amber. Some messages will drop off after the first interrogation of the message page or if the message is automatically resolved.



Other messages will reappear until the condition is corrected or changed. After the first interrogation, these messages will reappear in green or white.



FMS DISPLAYED MESSAGES

INTRODUCTION

This section contains the FMS system messages. Each message the system can display is detailed below, including any action(s) that may be necessary by the crew to correct the abnormality. A box around the procedures following the message definition indicates crew action. No action is specified for messages that are of an advisory nature only.

MSG KEY

If the Position Uncertain message is active, “POS” will be displayed on the far left side of the top line on the CDU display. When a new system message becomes active, “MSG” will appear on the far right side of the top line on the CDU display. Pressing the MSG key will cause the MESSAGE page to be displayed showing the active messages. The current messages (those messages generated since the page was last accessed) will be displayed at the top of the list. After the messages are viewed, the CDU display is returned to the previous page by selecting the RETURN option on the MESSAGE page or by pressing either the MSG or BACK keys.

SYSTEM MESSAGES

System messages are presented in alphabetical order on the following pages. Messages specifying the sensor number (GPS1, IRS2 and LCS2) are listed below with the number symbol (#) in place of the sensor number. However, the sensor number is used in the actual message. All messages are suppressed for the first thirty seconds after takeoff in order to minimize distractions to the pilot.

A/D CODE # - The A/D (Analog/Digital Board) self test failed. “#” is the error code from 1 to 9. This message will only come on following system initialization. Heading and fuel flow inputs may be affected and should be checked if the system must be used. Codes are as follows:

- 1 - A/D Program Checksum Fail
- 2 - +15 VDC Self test Fail
- 3 - -15 VDC Self test Fail
- 9 - No Communication between A/D board and FMS

A/D HEADING FAIL – The present system heading source, A/D (synchro analog-to-digital), was serving as the primary heading source but has failed. This message will be removed after it is displayed. Unless a NO HEADING message is also active, the system will have automatically selected another valid heading source. No action is necessary if another valid heading was selected. A check should be made on the appropriate DATA page to ensure that the heading source selected is the one desired and the heading is correct. This message is suppressed while the aircraft is on the ground.

1. Check heading source on Data 4/4.
2. Place cursor over the HDG field.
3. Press the LIST key to access a display of alternate heading sources.
4. Select an alternate heading source.
5. A manual heading can be entered at the HDG field on DATA page 4/4.

ABEAM WAYPOINT ALERT – This message is displayed 15 seconds prior to the sequencing time for an Abeam intersection.

ABNORMAL CKLIST DB FAIL – Appears if the abnormal checklist database has failed (only with Collins Pro Line 4 interface).

1. Reload checklist database.

ADC ALT REQD FOR APRCH – An approach has been attempted, but XFILL or MAN altitude is being used by the system.

ADC ALT REQD FOR VNAV – A VNAV problem has been entered, but XFILL or MAN altitude is being used by the system.

ADC INPUT FAIL – An Air Data Computer (ADC) failure is detected.

Manual entries of TAS and altitude may be made on ADC 1/1.

1. Check circuit breaker for ADC or ACU if installed.
2. Press the DATA key until DATA 2/4 is accessed.
3. Press the line select key at ADC to access ADC 1/1.
4. At the TAS field, enter current true airspeed. A manual TAS overrides any ADC input.
5. At the BARO ALT field enter the current BARO altitude.
6. TAS and Altitude inputs must be updated as required.

If a second FMS is installed air data may be crossfilled from the other system.

NOTE: Without valid air data inputs to the FMS, VNAV is not available and any leg type terminators requiring altitudes will not be sequenced.

AFIS ARINC FAILURE – The FMS has determined that a failure is present on the AFIS ARINC bus.

AFIS CONFIG INVALID – The AFIS DMU has invalid configuration data. This will disable the air/ground data link. This message will remain on the MSG page until the condition clears.

AFIS DOWNLINK FAIL – The AFIS DMU has determined that a downlink communication has failed. The last request should be repeated.

AFIS FPL RCVD – Either an uplinked FPL from the Global Data Center or a disk FPL from the AFIS DTU has been received and processed.

AFIS NO COMM – The AFIS DMU has failed to establish contact with the ground station. The last request should be repeated. This message will remain on the MSG page until the condition clears.

AFIS UPLINK FAIL – The AFIS DMU has determined that an uplink communication has failed. The last requested information will probably not be received.

AFIS VHF LINK DISABLED – The AFIS DMU has determined that the VHF link is disabled. This may result when (in a shared antenna system) the VHF antenna is being used by the aircraft voice communication system. It may also occur when all in-range VHF ground networks have been disabled.

AFIS VHF MODEM FAILURE – The AFIS DMU has determined that the VHF Modem unit within the AFIS is not operational. This message will remain on the MSG page until the condition clears.

AHRS # HEADING FAIL – The AHRS heading has failed while in use as the FMS heading source. This message is suppressed while the aircraft is on the ground.

1. Press the DATA key to access Data 4/4.
2. Place cursor over the HDG field.
3. Press the LIST key to access a display of alternate heading sources.
4. Select an alternate heading source.

AHRS # INPUT FAIL – The AHRS input has failed or its status word indicates failure.

AIRPORT DATABASE FAIL – A problem has been found in the airport section of the navigation database. Verify airport coordinates of interest. There is a high probability that the system will fail the initial self-tests the next time it is turned on. After landing and shutdown, turn the system off and then on again in order to troubleshoot.

1. Reload the navigation database.

AIRWAY DATABASE FAIL – A problem has been detected in the Airways database.

1. Reload the navigation database.

ALERTER ABOVE VNAV ALT – In the Primus 1000 installation, VNAV is engaged and the altitude alerter has been dialed above the VNAV altitude.

ALERTER ALT INVALID – In Primus installation for Cessna Excel, selected altitude is either not received over the Primus input bus or it is invalid. Message will display until Alerter Altitude is received and valid.

ALIGN PT DATABASE FAIL – A problem has been detected in the Align Points database.

1. Reload pilot database disk.

ALT INVALID FOR VNAV – A VNAV problem is defined, but (1) only pressure altitude is available and the aircraft is below 18,000 feet, or (2) altitude has failed.

ALTITUDE INVALID – The altitude portion of the Air Data Computer is not usable. A manual entry of altitude may be made on the ADC Status page.

1. Press the DATA key until DATA 2/4 is accessed.
2. Press the line select key at ADC to access ADC 1/1.
3. At the BARO ALT field, enter the current BARO altitude.

ANALOG ATTITUDE FAIL – Displayed if analog inputs are being used for Doppler NAV and those inputs go invalid for more than 5 seconds. Message remains while inputs are invalid.

ANALOG BOARD FAIL – A failure is detected on the Analog Board. The outputs to the NAV may be affected, and depending upon installation, heading and fuel flow in some systems may also be affected. Verify on the DATA pages that the heading, TAS, and altitude inputs are reasonable.

1. Press the DATA key to access DATA 2/4.
2. Press ADC prompt to access ADC page and verify TAS and altitude.
3. Press DATA key to access DATA 4/4.
4. Verify HDG.
5. If NAV is analog type, do not use for navigation display.

ANALOG INST FAIL – The Analog Waypoint Bearing or Desired Track self test has failed or the instrument reference is missing.

1. Check 26 VAC circuit breakers for FMC instrument reference input.
--

APPR FACILITY INVALID – Presented with no message annunciator if the approach facility becomes invalid during an approach.

APPROACH DATABASE FAIL – A problem has been detected in the approach database.

1. Reload navigation database.

APPROACH IN USE – The currently accessed approach is in use in the flight plan and cannot be modified or deleted.

ARINC # FAIL – ARINC #1 or 2 board failure is detected. This message will only occur following the self test on system initialization. Communication with other onboard systems may be affected.

ARPT NAME DATABASE FAIL – A failure has been detected in the airport geographical names database. Access to some airport names will be prevented.

1. Reload navigation database.

ASCB FAIL – ASCB board failure has been detected during or after power-up self test. Message will remain on MSG page until the condition clears.

ASCB TX INOPERATIVE – The ASCB board will not transmit. Message will clear when acknowledged or when condition clears.

ASCB LEFT BUS FAIL – ASCB left system bus has failed. FMS operation may be degraded. Message will clear when acknowledged or when condition clears.

ASCB RIGHT BUS FAIL – ASCB right system bus has failed. FMS operation may be degraded. Message will clear when acknowledged or when condition clears.

AUXILIARY BOARD FAIL – The Auxiliary Board has failed self test.

BACKUP DATABASE FAIL – The backup navaid database has failed.

BARO ALT NOT AVAILABLE – BAROMETRIC ALTITUDE IS NOT AVAILABLE FROM INSTALLATION OF AN ADC WITHOUT BAROMETRIC ALTITUDE OR FROM LOSS OF BAROMETRIC ALTITUDE. MESSAGE WILL CLEAR AFTER ACKNOWLEDGEMENT OR WHEN THE CONDITION CLEARS.

CKLST DATABASES FAIL – APPEARS IF ALL CHECKLIST DATABASES HAVE FAILED (ONLY WITH COLLINS PRO LINE 4 INTERFACE).

1. Reload checklist database.

CLOCK TIMER FAIL – THE CLOCK TIMER ON THE CDU BOARD HAS FAILED SELF TEST.

COMP ARPTS DATABASE FAIL – A PART OR ALL OF THE COMPANY AIRPORTS DATABASE HAS FAILED.

COMP ROUTE DATABASE FAIL – A PART OR ALL OF THE COMPANY ROUTE DATABASE HAS FAILED.

COMP WPTS DATABASE FAIL – A PART OR ALL OF THE COMPANY WAYPOINTS DATABASE HAS FAILED.

CONFIG DATA FAILED – THE FMS CONFIGURATION DATA HAS FAILED.

CONFIG MODULE FAILED – COMMUNICATION WITH OR DATA IN THE CONFIGURATION MODULE HAS FAILED. ATTEMPT TO STORE CONFIGURATION TO DETERMINE CAUSE.

CONFIG UPDATE REQUIRED – CONFIGURATION MODULE AND FMS CONFIGURATION DATA HAS FAILED REQUIRING THE FMS TO BE CONFIGURED FOR INSTALLATION.

CREW CKLIST DB FAIL – APPEARS IF THE CREW NOTES DATABASE HAS FAILED (ONLY WITH COLLINS PRO LINE 4 INTERFACE).

CROSSFILL FAIL: BAD DATA – A FPL CROSSFILL TASK HAS FAILED DUE TO A COMMUNICATIONS ERROR.

CROSSFILL FAIL: BUS – A CROSSFILL TASK HAS FAILED DUE TO A CROSSFILL BUS TIMING OUT OR AN ARINC BOARD FAILURE.

CROSSFILL FAIL: FPL CHGD – A FPL CROSSFILL TASK HAS FAILED DUE TO THE FLIGHT PLAN BEING EDITED IN THE OTHER FMS DURING CROSSFILL.

CSDB SELFTEST FAIL – CSDB SERIAL PORTS HAVE FAILED SELF TEST. VOR, DME, OR RTU FUNCTION MAY BE DISABLED.

CURRENT LEG EXTENDED – PRESENTED WHEN THE AIRCRAFT FLIES PAST THE TERMINATOR OF THE CURRENT LEG AND NO NEXT LEG IS DEFINED WHICH RESULTS IN GUIDANCE DISPLAYS BEING TO AN EXTENSION OF THE CURRENT LEG. TO/FROM WILL SHOW FROM AND DISTANCE FROM WAYPOINT WILL INCREASE.

DATABASE CORRECTING – A minor failure has been detected in the database and an error correcting process is being run. Access to the database is restricted until the correction process has been completed and the database tests good.

DATABASE EXPIRED – The current date is past the NAV Database Expiration Date as displayed on the Initialization page and DATA page.

1. Load current navigation database.

DATABASE FAIL – A part or all of the navigation database has failed.

1. Reload navigation database.

DATABASE FULL – The particular pilot database is full.

DATABASE VAX LOADED – The database was loaded from a VAX host computer instead of a DDU.

DEAD RECKONING MODE – (DR) TAS and Heading are the only sensors being used for navigation.

DEMONSTRATION MODE – The aircraft identification is configured as “DEMO” and sensor data is simulated internally.

1. Do not use this FMS for navigation.

DISCRETE I/O FAIL – Self test of the discrete I/O has failed.

DISK FORMAT FAILURE – An attempt to format a disk was unsuccessful. This message will only be displayed when not in the disk submenu.

DISK FULL – REPLACE IT – The disk in the DTU has become full while Data Recording was active and a Disk function page was not displayed. If a Disk page was displayed when the disk became full, then the message is displayed on a Disk Error page.

DISK WRITE FAILURE – An attempt to write to a disk in the DTU was unsuccessful. This message will only be displayed when not in the disk submenu.

DME TUNE FAIL – An ARINC 709 series DME has not tuned to the pilot requested frequency. The message is cleared when the radio successfully tunes.

DOPLR MODE CONTROL FAULT – Doppler status is a state other than that commanded for more than 10 seconds.

DOPPLER ARINC FAIL – One or more specific labels from the Doppler have not been received by the FMS for 10 seconds. The message will clear once the label(s) are read.

DOPPLER BASED DR – All sensors except Doppler are deselected or failed.

DOPPLER DESELECT – The specified Doppler data is unreasonable and has been deselected.

DOPPLER FAIL – Doppler is selected and has failed.

EFIS #1 SEL HDG FAIL – The pilot’s heading bug input from the Collins EFIS has failed.

EFIS #2 SEL HDG FAIL – The copilot’s heading bug input from the Collins EFIS has failed.

EMERGENCY CKLIST DB FAIL – Appears if the emergency checklist database has failed (only with Collins Pro Line 4 interface).

ENROUTE DATABASE FAIL – The database containing enroute intersections has failed.

1. Reload navigation database.

ERP # FAIL – This message will be on the #1 FMS if the #1 EFIS Radar Panel (ERP) has failed. The message will be on the #2 FMS if the #2 ERP has failed (only with Collins Pro Line 4 interface).

FMC BATTERY LOW – Self test has detected that the FMC battery is low. Navigation is still allowable; however, at shutdown the position, date and time may be lost.

1. Return the FMS to Universal Avionics for repair.
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FMC DATALINK QUEUE FULL – The FMC datalink queue is full and subsequent FMC transmission attempts may result in the loss of the datalink message.

FMS # GLS MISMATCH – GLS and FMS deviations differ more than one dot (10 degrees).

FMS-BC DIFFERENCE WARN – The FMS is in approach mode on a backcourse type approach and the track angle error is less than 3 degrees, crosstrack error is less than 0.2nm and the localizer deviation is greater than 0.039 DDM (1/2 dot).

FMS DIFFERENCE > xxNM – The sensor “watchdog” has sensed that the latitude/longitude positions of the two systems in a dual installation differ from each other by an amount that warrants pilot attention. “xx” can be 6, 12, 18 or 24NM. As both FMS’s normally utilize the same sensors, this should not happen. If it does;

1. Check the NAV pages on each FMS and follow the system displaying the smallest DIFFS between FMS and sensor latitude/longitude positions.
2. If the FMS’s are utilizing different sensor inputs, refer to the “NAV SENSOR ACCURACY MESSAGES” section of this manual.

FMS-FLOC DIFF WARN – During an FMS-ILS approach, the aircraft is inbound on the same desired track as the ILS, and FMS deviation is less than 0.2nm while ILS localizer deviation is greater than ½ dot.

1. Select FHDG mode and manually steer the aircraft to intercept the ILS localizer.

FMS INIT NOT COMPLETE – A disallowed mode key was pressed while on the Disk Menu page when it was accessed from the Initialization page.

FMS NETWORK COMM FAIL – Indicates the FMS’s internally programmed Ethernet address has failed. The FMS will operate normally but cannot communicate with the DTU or other network LRUs.

FMS PART NUMBER MISMATCH – The FMS installed has a different part number than the configuration stored. Verify installation is correct.

FPL CAPACITY EXCEEDED – The pilot attempted to enter more than 98 waypoints in a flight plan.

FPL DISK MINOR ERROR – When a flight plan disk is loaded, the number of records found on the disk do not match the number of records in the header file on the disk. The flight plan should be completely reviewed for accuracy.

FUELFLOW FAIL – A fuel flow failure is detected. Manual fuel flow entries may be made.

1. Press the FUEL key until the FUEL FLOW page is accessed.
2. Check the fuel flow displays for reasonableness.
3. Enter manual fuel flows if necessary.
4. Update the fuel used values manually if required.

FUEL FLOW SELFTEST FAIL – Self test of the fuel flow measurement circuitry has failed.

FUEL NOT CONFIRMED – The FMS was started up in the Standby mode and the fuel has not been confirmed on FUEL page 1.

GLONASS DEPENDENT NAV – The FMS is in GPS NAV mode, the GNSS sensor is in NAV mode and the total number of GPS satellites is less than four and at least one GLONASS satellite is in use.

GLS FACILITY INVALID – GLS ground station failure.

GLS # CONFIG MODULE FAIL – A mismatch has occurred between the configuration module and the GLS.

GLS # DESELECT – The sensor monitor has determined that the GLS data is unreasonable and has deselected the sensor. This message will be removed after it is read.

GLS # DIFFERENCE > xxNM – The sensor “Watchdog” has sensed that the latitude/longitude position as determined by GLS #1 or #2 differs from the FMS best computed position by an amount that warrants pilot attention. “xx” can be 6, 12, 18 or 24NM.

GLS # FAIL – A failed status has been determined for the indicated GLS.

1. Press the DATA key to access DATA 2/4.
2. Place cursor over sensor to access the Sensor Status Page.
3. Check the sensor status.

GLS # NOT NAV – The specified GLS has change to a not navigational (neither DGPS, Navigation, nor Altitude aiding nor Fault) condition. GLS status page will show the cause of the change.

GLS VDL FAIL – This message will follow an APPR FACILITY INVALID message. It informs the crew that the approach facility may be operational but the GLS VHF Data Link board has failed.

GNSS # DESELECT – The sensor monitor has determined that the specified GNSS data is unreasonable and has deselected the GNSS sensor for use in navigation. The message will be removed after it is displayed once.

GNSS # DIFFERENCE > xxNM – The sensor “Watchdog” has sensed that the latitude/longitude position as determined by the GNSS differs from the FMS best computed position by an amount that warrants pilot attention. “xx” can be 6, 12, 18 or 24NM.

GNSS # FAIL – A Fail status has been determined for the indicated GNSS.

1. Press the DATA key to access DATA 2/4.
2. Place cursor over sensor to access the Sensor Status Page.
3. Check the sensor status.

GNSS # NOT NAV – The specified GNSS has changed to a not navigational (neither DGPS, Navigation, Altitude aiding nor Fault) condition. This message will be removed after it is displayed once or when the GNSS goes into NAV or altitude aiding mode. GNSS status page will show the cause of the change.

1. Press the DATA key to access DATA 2/4.
2. Place cursor over sensor to access the Sensor Status Page.
3. Check the sensor status.

GPIRS # DESLECT – The sensor monitor has determined that the specified GPS data is unreasonable and has deselected the GPS portion of the sensor.

GPIRS # DIFFERENCE > xxNM – The sensor “Watchdog” has sensed that the latitude/longitude position as determined by the GPS portion of the GPIR# (1, 2 or 3) differs from the FMS best computed position by an amount that warrants pilot attention. “xx” can be 6, 12, 18 or 24NM.

GPIR # FAILED – A Fail status has been determined for the GPS portion of the indicated GPIRS, because the position data is missing or invalid or the status label indicates a FAIL status exists.

1. Press the DATA key to access DATA 2/4.
2. Check the sensor status.

GPIR # GPS NOT NAV – GPS portion of the GPIRS has changed to a not navigational (neither NAV nor Alt) condition. GPS status page will show the cause of the change.

GPS # DESELECT – The sensor monitor has determined that the specified GPS data is unreasonable and has deselected the sensor for use in navigation. The message will be removed after it is displayed once.

GPS # DIFFERENCE > xxNM – The sensor “Watchdog” has sensed that the latitude/longitude position as determined by GPS# (1, 2, or 3) differs from the FMS best computed position by an amount that warrants pilot attention. “xx” can be 6, 12, 18 or 24NM.

GPS # FAILED – A Fail status has been determined for the indicated GPS, because the position data is missing or invalid or the status label indicates a **FAIL** status exists.

1. Press the DATA key to access DATA 2/4.
2. Place cursor over sensor to access the Sensor Status Page.
3. Check the sensor status.

GPS # NOT NAV – GPS has changed to a not navigational (neither NAV nor Alt) condition for more than 3 minutes. GPS status page will show the cause of the change.

GPS ONLY NAVIGATION – Displayed if a non-RAIM GPS is the only position sensor available. Message is displayed 60 seconds after condition exists and remains as long as condition exists. Message is suppressed on the ground or while operating in the FIAS ‘GPS only’ mode.

HEADING REF FAIL – The AC reference for the Analog Heading input has failed.

HIGH GROUNDSPED FOR ARC – An AF or RF is the current leg and the groundspeed is too high for the aircraft to stay within the bounds of the arc.

HIGH GNDSPD FOR HOLDING – In holding mode, the current groundspeed is excessive for holding airspace. This may be due to either high winds or high TAS. The pilot should lower airspeed if feasible.

IC600L HEADING FAIL – In the Cessna Bravo, Cessna Ultra, or Embraer 145, the heading source has failed while in use.

IC600R HEADING FAIL – In the Cessna Bravo, Cessna Ultra, or Embraer 145, the heading source has failed while in use.

IC600-L BUS FAIL – In the Cessna Bravo, Cessna Ultra, or Embraer 145 configuration, label 371 does not have a valid SSM, or is not detected on the left bus.

IC600-R BUS FAIL – In the Cessna Bravo, Cessna Ultra, or Embraer 145 configuration, label 371 does not have a valid SSM, or is not detected on the right bus.

ILLEGAL FACILITY TYPE – The entered facility is of an invalid type for this approach.

ILLEGAL WAYPOINT – A waypoint that is more than 6° from being on the inbound course or is greater than 99.9nm from the FAF has been entered into the first optional waypoint position in the approach definition pages. Or, a turn center waypoint has been entered for a pilot defined RF leg that creates a radius greater than 32nm.

ILS DATABASE FAIL – An error has been detected in the ILS database and access to the ILS database is not allowed.

IMS BUS FAIL – A valid SSM is not detected on the bus. This applies to the Sextant IMS configuration used on deHavilland DHC-8 S400.

INSIDE LOA – The aircraft is inside a defined LORAN Operating Area (LOA). This message will be removed after it is displayed.

INVALID ARINC VERSION – Two ARINC circuit boards are installed which do not have the same software version number.

INVALID CONFIGURATION – The FMS configuration is unknown. This message can only occur on the ground.

INVALID FUEL CONFIG – The fuel flow sensor configuration is invalid or incomplete. The fuel flow function will be disabled.

INVALID ROUTE UPLINK – UniLink has detected an error during a FPN uplink.

IRS # ALIGN – The specified IRS is in the alignment mode. The aircraft must stay stationary.

IRS # ALIGN FAULT – The entered position failed the 3+3T test or the latitude comparison test. Re-enter position.

IRS # ATTITUDE – The specified IRS is in the attitude reference mode. Navigation data is not available.

IRS # CODE 01 – (Delco only) Turn specified NAV unit off.

IRS # CODE 02 – (Delco only) Select ATT mode on specified IRS.

IRS # CODE 03 – (Delco only) Check heading output from the specified IRS.

IRS # CODE 04 – (Delco only) Re-align specified IRS. Ground only.

IRS # CODE 06 – (Delco only) Check loaded DATA (position) in specified IRS.

IRS # DC FAIL – The backup battery or DC bus is below 17 VDC.

IRS # DC FAIL ON DC – The last shutdown of the system was due to a power interrupt and not because of IRS failure.

IRS # DESELECT – The sensor “watchdog” has determined that the specified IRS data is unreasonable and has deselected the sensor for use in navigation.

IRS # DIFFERENCE WARNING – The sensor “watchdog” has sensed that the latitude/longitude position as determined by IRS# (1, 2, or 3) differs from the FMS best computed position by an amount that warrants pilot attention.

IRS # FAIL – An inertial reference system failure is detected in the IRS indicated.

1. Press the DATA key to access DATA 2/4.
2. Place cursor over sensor to access the Sensor Status Page.
3. Check the sensor status.

IRS # HEADING FAIL – The compass heading source, IRS# (1, 2, or 3) was serving as the primary heading source but has failed. This message will be removed after it is displayed. Unless a NO HEADING message is also active, the system will have automatically selected another valid heading source. No action is necessary if another valid heading was selected. A check should be made on the appropriate DATA page to ensure that the heading source selected is the one desired and the heading is correct.

1. Press the DATA key to access DATA 4/4.
2. Press HDG to place the cursor over the heading field.
3. Press the LIST key to access the HDG SRC page.
4. Check the heading source and change if desired.

IRS # NAV – The specified IRS is in the navigation mode. Alignment is complete.

IRS # ON BATTERY – The specified IRS is being powered by a DC power source or standby battery.

IRS # READY NAV – In installations using Delco IRS only, the IRS align status is 5.

LAT/LONG XING WPT ALERT – This is displayed 15 seconds prior to sequencing time for latitude or longitude intersection.

LCS DESELECT – The sensor “Watchdog” has determined that the LCS sensor position is unreasonable and has deselected the sensor for use in navigation.

LCS DIFFERENCE > xxNM – The sensor “Watchdog” has sensed that the latitude/longitude position as determined by the LCS differs from the FMS best computed position by an amount that warrants pilot attention. “xx” can be 6, 12, 18, or 24NM.

LCS FAIL # - This message is displayed when the LCS has failed. The # is the failure code. Failure codes are as follows:

- 1 - LCS Program Checksum Fail
- 2 - LCS ARINC Self Test Fail
- 3 - LCS Memory Test Fail
- 9 - LCS is not communicating with the FMS

1. Press The DATA key to access DATA 2/4.
2. Place cursor over the LCS sensor to access the Sensor Status Page.
3. Check the sensor status.

LCS NAV – LCS has changed to navigational mode.

LCS NOT NAV – LCS has changed to a not navigational mode. The cause of the change is displayed on the LORAN Status page.

LEFT IOC-OFFSIDE FAIL – This message will be displayed on the #2 FMS if the offside Input/Output Concentrator (IOC) has failed (only with Collins Pro Line 4 interface).

LEFT IOC-ONSIDE FAIL – This message will be displayed on the #1 FMS if the onside Input/Output Concentrator (IOC) has failed (only with Collins Pro Line 4 interface).

LOC STEERING ACTIVE – An ILS, LOC or BC Approach is active and the localizer signal is used in the roll steering equation.

MANUAL LEG CHANGE REQD – The aircraft is on a CA, FA, or VA leg and barometric altitude is not available to the FMS. The crew must make a manual leg change to sequence the waypoint.

MEMORY BANK # FAIL – In dual cycle memory bank FMS's, either memory bank 1 or memory bank 2 has failed and all databases in that failed bank are not usable.

1. Reload the navigation database in the other bank.

MODE KEYS INOP – DISK PAGE – A disallowed mode key was pressed while any disk function page is displayed, other than Disk Menu.

MOT WPT LIST FULL – For MMMSs only. When MOT 9 (Mark On Target waypoint number 9) is created, the next waypoint added will bump the oldest waypoint from the list.

MOT WPT MEMORY FAIL – This message appears in MMMSs only. The MOT (Mark On Target) waypoint memory section has failed during power-up self test.

NAV DATABASES FAILED – All segments of the navigation database failed simultaneously. This message replaces all individual segment messages.

1. Reload navigation database.

NDB DATABASE FAIL – A problem has been found in the NDB database. Access to this database will not be permitted.

1. Reload navigation database.

NDB NAME DATABASE FAIL – An error was detected in the NDB plain language name database.

1. Reload navigation database.

NEW MAINT LOG EXISTS – This message is displayed one minute after landing when any diagnostic history event has been recorded during the previous flight.

1. Refer to “Maintenance Data Download” section of this manual for procedure to download and display the Maintenance Log.

NEXT LEG UNDEFINED – A GAP is in the next flight plan waypoint position. The flight plan must be edited by the pilot to eliminate the GAP. If the GAP is not eliminated, the aircraft will fly to the current TO waypoint, and after waypoint passage will continue to fly the same desired track with the TO/FROM flag now indicating FROM. The WPT annunciator will remain illuminated after waypoint passage and a **CURRENT LEG EXTENDED** message will appear on the message page.

NOTE: The gap placed at the end of the approach before the destination airport does not trigger this message.

1. Press the FPL key to access the flight plan.
2. Edit the flight plan to remove GAP.

NEXT VNAV LEG INVALID – Next lateral leg is not valid for VNAV. This message will apply to procedural legs in SIDs, STARs and approaches which are “floating waypoints”, e.g., heading to intercept a VOR radial.

NO DME RECEIVED – RRS DME list was tuned and no data was received for 5 minutes.

NO HEADING – No heading information is being received. This message will not be displayed while on the ground. If a valid heading source was available, it should have already been automatically selected.

1. Press DATA key to access DATA 4/4.
2. Press HDG to place the cursor over the heading field.
3. Press LIST key to access HDG SRC page. Change heading source if desired.
4. If no other heading source is available, manually input the aircraft’s heading on DATA 4/4.

NO INTERCEPT – System is in the heading intercept mode and the selected heading will not intercept current NAV leg.

NO RAIM @ FAF – RAIM may not be available at the Final Approach Fix or HIL is greater than 0.3nm.

NO RAIM @ MAP – RAIM is not available at the Missed Approach Point or HIL is greater than 0.3nm.

NO SATELLITE INTEG – GPS integrity monitoring is not available for 27 seconds in Enroute and for 7 seconds in Terminal phase of flight. In Approach phase after FAF, GPS integrity monitoring is not available and HDOP is greater than 4.0 for 7 seconds.

NO TACAN RECEIVED – RRS TACAN list was tuned and no data was received for 5 minutes.

NO VOR RECEIVED – RRS VOR list was tuned and no data was received for 5 minutes.

NONVOLATILE MEMORY FAIL – The non-volatile memory has failed the power-up test. Some or all of the NVM parameters may be lost. This message can only occur following system initialization.

NORMAL CKLIST DB FAIL – Appears if the normal checklist database has failed (only with Collins Pro Line 4 interface).

1. Reload checklist database.

OFFSIDE FLAP POS FAILED – No offside flap position input is detected in the Lear 45 Primus 1000 installation.

ONSIDE FLAP POS FAILED – No onside flap position input is detected in the Lear 45 Primus 1000 installation.

OTHER FMS HEADING FAILED – The FMS is using heading from the other FMS, and that heading has failed.

1. Press the DATA key to access DATA 4/4.
2. Place cursor over the HDG field.
3. Press the LIST key to access the HDG SRC page and select another source if available.

OUTSIDE LOA – The aircraft is outside of a defined LORAN Operating Area (LOA). This message will be removed after it is displayed.

OVERSPEED INVALID – The FMS doesn't receive one or more of the following input labels required for Overspeed mode: Label 206, Indicated Airspeed, label 207, Max allowable Airspeed, label 331, Longitudinal Acceleration and Pitch Angle, label 324.

PERF DATABASE FAILED – The performance database has failed. Advanced performance features will be disabled.

1. Reload performance database.

PERF DB ID MISMATCH – The performance database ID entered on the configuration pages does not agree with the performance database ID on the disk that is loaded.

PERF T/O GW UPDATE REQD – The current gross weight differs more than 2.5% from the value entered in the gross weight field.

1. Press "BACK" "ENTER" to update or,
2. Enter a manual value in the gross weight field.

PILOT ALIGN DB UPDATED – This message displays after the Check All process. Indicates a change to the pilot alignment point database based on loaded or resident navigation data. Requires redefinition or confirmation by the pilot.

PILOT APPR DATABASE FAIL – A problem has been detected in the Pilot defined approach database.

1. Reload data from Pilot Data Save disk.

PILOT APPR DB UPDATED – Displayed following the Check All Process. Indicates pilot approach data has been updated by the system as a result of a navigation data update. Requires definition or confirmation by the pilot.

PILOT ARPT DATABASE FAIL – A problem has been detected in the Pilot defined airport database.

1. Reload data from Pilot Data Save disk.

PILOT ARPT DB UPDATED – Displayed following the Check All Process. Indicates a change to the pilot airport database based on loaded or resident navigation data. Requires redefinition or confirmation by the pilot.

PILOT DATABASES FAILED – The database of all pilot defined locations has failed.

Reload data from Pilot Data Save disk.

PILOT RNWY DATABASE FAIL – A problem has been detected in the Pilot defined runway database.

1. Reload data from Pilot Data Save disk.

PILOT ROUTE DATABASE FAIL – A problem has been detected in the Pilot defined route database.

1. Reload data from Pilot Data Save disk.

PILOT ROUTE DB UPDATED – Displayed following the Check All process. Indicates a change to the pilot route database based on loaded or resident navigation data. Requires redefinition or confirmation by the pilot.

PILOT SID DATABASE FAIL – A problem has been detected in the Pilot defined SID database.

1. Reload data from Pilot Data Save disk.

PILOT SID DB UPDATED – Displayed following the Check All Process. Indicates pilot SID data has been updated by the system as a result of the navigation data update. Requires redefinition or confirmation by the pilot.

PILOT STAR DATABASE FAIL – A problem has been detected in the Pilot defined STAR database.

1. Reload data from Pilot Data Save disk.

PILOT STAR DB UPDATED – Displayed following the Check All Process. Indicates pilot STAR data has been updated by the system as a result of the navigation data update. Requires confirmation by the pilot.

PILOT WPT DATABASE FAIL – A problem has been detected in the Pilot defined waypoint database.

1. Reload data from Pilot Data Save disk.

PILOT WPT DB UPDATED – Displayed following the Check All Process. Indicates a change to the pilot waypoint database based on loaded or resident navigation data. Requires redefinition or confirmation by the pilot.

POSITION CORRECTING – This message normally occurs when reacquiring DMEs following an over water or other non-DME environment flight segment. Best Computed Position is in the process of being corrected.

POSITION UNCERTAIN – The FMS position is uncertain (not verified). A quality factor “Q” of 28 triggers this message within 300nm of DME sources. In approach mode, a “Q” of 28, 10 or 5 may also trigger this message depending upon the distance from the end-of-approach point and the type of approach. In terminal operations a Q of 10 or more within 30nm of departure or destination airport will create this message. A “Q” of 60 triggers the message outside of DME range, unless operating on valid IRSs only. In the event the POS UNCERTAIN message occurs under these conditions, the message can be removed and the “Q” reset to a lower number by selecting the HOLD function and then verifying the FMS Best Computed Position.

1. Refer to Best Computed Position Update Procedure. This action will deactivate this message.

PROGRAM CHECK FAIL – A problem has been found in the program software.

1. Monitor the system closely. There is a high probability that the system will fail the initial self-tests the next time it is turned on.
2. After landing and shutdown, turn the system off and then on again in order to troubleshoot.

PRO LINE 21-L BUS FAIL – In the Pro Line 21 configuration, label 360 is not detected on the left bus for 2 seconds.

PRO LINE 21-R BUS FAIL – In the Pro Line configuration, label 360 is not detected on the right bus for 2 seconds.

RADIUS REQ EXCESS BANK – The orbit radius is less than the minimum aircraft turn radius (under current conditions). This message is presented in MMMSs only.

RESET ALT PRESELECT – The aircraft is within two minutes of a VNAV Top of Descent, and the altitude preselector has not been reset to an altitude at least 200 feet below current altitude. VNAV cannot be armed on the flight guidance system until the altitude preselector has been reset to a lower altitude.

RIGHT IOC-ONSIDE FAIL – This message will be displayed on the #2 FMS if the onside Input/Output Concentrator (IOC) has failed (only with Collins Pro Line 4 interface).

RIGHT IOC-OFFSIDE FAIL – This message will be displayed on the #1 FMS if the offside Input/Output Concentrator (IOC) has failed (only with Collins Pro Line 4 interface).

ROUTE CAPACITY EXCEEDED – An attempt has been made to create a route with over 98 waypoints.

ROUTE DATABASE FULL – An attempt has been made to create over 200 routes, or to use over 3000 waypoints in all routes.

RRS DATA BUS FAIL – RRS communication link with the FMS has failed.

RRS (DME, TACAN, VOR) RECOVER – The FMS has recovered from a ‘No (DME, TACAN, VOR) Received’ condition.

RRS (DME, TACAN, VOR) SELF TEST FAIL – The FMS has detected a failure during RRS self test mode.

RRS (DME, TACAN, VOR) TUNE FAIL – The RRS did not tune the requested frequency within a specified time (VOR = 8 sec, TACAN = 8 sec, DME = 4 sec).

RRS RECOVER – Unit has recovered from one of the above conditions.

RRS TUNE BUS FAIL – The RRS has not received any tuning labels from this FMS.

RTU # FAIL – A failure has been detected in the specified Radio Tuning Unit.

RUNWAY DATABASE FAIL – The runway database has failed.

1. Reload navigation database.

RUNWAY IN USE – This runway is in use in an approach or flight plan and cannot be modified or deleted.

SATELLITE POS ALARM – GPS error is outside of phase of flight limits for specified time.

SCAT-I UNAVAILABLE – The GLS sensor has detected either an FMS or GLS failure that prevents flying the SCAT-I approach type.

SID DATABASE FAIL – The SID database has failed.

SIGMETS RCVD – SIGMETS data has been received via AFIS Uplink or AFIS DTU.

SOFTWARE CONFIG MISMATCH – The loaded version of software does not match the installation compatibility version number stored in the configuration module.

SPEED TOO FAST FOR TURN – RF leg is current lateral guidance leg and the groundspeed is too high for the aircraft to stay within bounds of the arc.

SPCL MISSION MEMORY FAIL – During power up the special missions portion of the memory failed. Any pending special mission status will be lost.

STAR DATABASE FAIL – The STAR database has failed.

1. Reload navigation database.

STEERING FAIL – Roll steering self-test failure (continuous). This failure may be reset.

1. Press the DATA key to access DATA 4/4. 2. Position the cursor over the ROLL CMD line. 3. Press the BACK key then the ENTER key to reset.

TACAN FAIL – TACAN input has failed.

TACTICAL DATABASE FULL – All 98 available tactical waypoint slots have been used.

TAS INVALID – The True Airspeed portion of the Air Data Computer is not usable. A manual input of TAS may be made on the ADC Status page.

1. Press the DATA key until DATA 2/4 is accessed.
2. Press the line select key at ADC to access ADC 1/1.
3. At the TAS field, enter current true airspeed. A manual TAS overrides any ADC input.

TAWS FAIL – TAWS A739 is configured and is not receiving a valid 172 label. Or, TAWS FMS fixed-pages is configured and label 123 is not valid.

TAWS FPL/TERRAIN THREAT – Label 272, bit 12 is set to 1 by the TAWS.

TCAS NOT CONFIGURED – The TFC Button on the EFIS Radar Panel (ERP) has been pressed and the FMS is not configured for TCAS (only with Collins Pro Line 4 interface).

TERMINALS DATABASE FAIL – The terminal intersection database has failed.

1. Reload navigation database.

TERMINAL WEATHER RCVD – Terminal weather data has been received via AFIS Uplink or AFIS DTU.

TEST MODE – The system is in test mode.

TOP OF DESCENT ALERT – Estimated time to TOD is less than two minutes.

TUNE NAVAID – The navaid specified in the approach definition is not tuned at entry to approach mode and should be tuned to get valid displays.

TUNE NAV# - TO XXX ON FFF.FF – For VOR or RNV, there are less than 2 DME stations available, and the current tuned VOR is greater than 80NM away or is invalid. The XXX and FFF.FF are filled with the identifier and frequency of the nearest valid VOR.

1. Press the TUNE line select key to remote tune the VOR receiver to the displayed frequency if Remote Tune is enabled (programmed into the Configuration Module at installation). Otherwise, manually tune the VOR using the control head.

UNILINK FAIL – The UniLink unit has been determined to be in a failed state by the FMC monitoring the UniLink.

UNILINK MSG RCVD – A new UniLink text message has been received.

1. Press the UNILINK prompt to access UniLink Main Menu.
2. Press NEW MSG prompt on the UniLink Main Menu to view message.

UNILINK ROUTE RCVD – Receipt of an FMC route uplink which passes error check and is ready to be reviewed.

UNILINK RTE INVALID – Receipt of an FMC route uplink which fails error check and is rejected.

UNILINK WX MAP RCVD – A new UniLink weather map has been received from Universal Weather and Aviation.

1. Press the UNILINK prompt to access UNILINK Main Menu.
2. Press NEW WX prompt the UniLink Main Menu to view the new weather map.

UPLINK MESSAGE RCVD – A message has been received from the Global Data Center.

VARIATION WARNING – The aircraft is out of the auto-variation model range (above N72 degrees, 45 minutes and below S59 degrees, 45 minutes latitudes), there is no manual input, and the TRUE MAGNETIC switch is in the MAGNETIC position.

1. Press the DATA key to access DATA 4/4.
2. Press the VARIATION line select key to place the cursor over the variation field.
3. Enter a manual East or West variation.

VERIFY MANUAL RNP – A manual RNP has been entered and then a flight phase transition occurs and the new RNP limit is less than the manually entered RNP. Or, a manual RNP has been entered and a leg with a lower database RNP value is sequenced to in a linked flight plan.

VERTICAL WPT ALERT – This message appears approximately 15 seconds prior to a VNAV mode vertical leg change. The WPT and MSG annunciators on the instrument panel flash, along with the FMS MSG light. Pressing the MSG key will change the flashing WPT to steady, turn off the MSG light, and show the VNAV WPT ALERT message.

VHF NAME DATABASE FAIL – The VHF plain language name database has failed.

Reload navigation database.

VHF NAVAID DATABASE FAIL – The navaid database has failed. The backup navaid database, containing navaids and airports, will be used.

1. Reload navigation database.

VNAV DISCONNECT – An altitude or flight level has been entered on a FPL page that has resulted in a VNAV disconnect. Return to the PATH VNAV page to re-activate VNAV. This message will clear after it is read.

VOR TUNE FAIL – The 711 VOR has not tuned to the pilot requested frequency.

VPATH CAPTURE – This message is annunciated 15 seconds prior to sequencing Top of Descent or initiating the capture to vertical path from a tactical mode.

WAAS LAT PA LIMIT – This message is displayed when HPLwaas is greater than HALpa while in WAAS PA mode.

WAAS VERT PA LIMIT – This message is displayed when VPLwaas is greater than VALpa and HPLwaas is less than HALpa while in WAAS PA mode.

WAYPOINT ALERT – The aircraft position is within 15 seconds of a leg change while enroute, (or 5 seconds while using approach procedural legs) prior to the TO waypoint. The MSG light will not illuminate for this message. The instrument panel WPT alert annunciator will illuminate to alert the pilot of an impending leg change.

WAYPOINT IN USE – This message occurs when attempting to delete a waypoint from the pilot defined database which is in use on the flight plan.

WINDS ALOFT RCVD – Winds aloft data has been received via AFIS uplink or AFIS DTU.

XFILL CONFIG MISMATCH – Crossfill data has been pushed to an FMS not configured to receive that data type. This message alerts the crew that crossfill data was sent and received but not accepted. Once read this message is removed from the MESSAGE page.

400 Hz REF FAIL – 400 Hz (AC) power has failed and there is no input to the analog roll steering. This message is suppressed if the system is installed in an “all digital” aircraft. It remains on the message page as long as the condition exists.

+3 VOLT PWR SUPPLY FAIL – Self test for power supply has failed.

+5 VOLT PWR SUPPLY FAIL – Self test for power supply has failed.

+8 VOLT PWR SUPPLY FAIL – Self test for power supply has failed.

-8 VOLT PWR SUPPLY FAIL – Self test for power supply has failed.

VNAV ERROR MESSAGES

VNAV Error Messages

The following error messages will appear on the VNAV page whenever an invalid entry is made in TGT V/S or altitude data fields.

ADC ALT INV – (1) Aircraft altitude is < FL180 and only pressure altitude is available, or (2) ADC altitude is failed.

APPR ALT – RESTR – An altitude entry for an approach waypoint that violates the database constraints is entered.

CLEAR MAN ALT – A manual entry for altitude was made on the ADC status page.

CLR SXTK – Aircraft is flying a selected crosstrack distance prior to VNAV activation.

CLR XFILL ALT – A VNAV plan is defined, but crossfilled altitude is being used by the system.

FPA TOO STEEP – Flight path angle is steeper than maximum FPA configured at time of installation.

LEG RESTRICTION – Entry is attempted when the active vertical leg is a GAP, HA, FA, CA, VA leg or a HM or HF leg that does not have any altitude constraints.

LINK NAV/FPL – VNAV distance is invalid because the VNAV plan is not linked to the guidance legs.

NO ENTRY – APPR – Entry is attempted for an approach waypoint when the approach is active.

NO ENTRY – HOLD – Entry is attempted during an active vertical holding leg.

NO ENTRY- VERT – Entry is attempted when the aircraft is in active VM or FM leg.

NO VWPT ALT – VNAV distance is invalid because the VNAV TO waypoint is undefined.

TARGET V/S HIGH – Value exceeds 6000 fpm or maximum flight path angle programmed in configuration module.

TARGET V/S LOW – Entered value is less than minimum required value.

XTK TOO GREAT – Current crosstrack is > 12.5nm.

The following error messages will appear on the VNAV page whenever an invalid entry is made in TGT V/S or altitude data fields.

V/S TOO HIGH – Value exceeds 6000 fpm or maximum flight path angle programmed in configuration module.

V/S TOO LOW – Entered value is less than minimum required value.

ADC ALT INV – (1) Aircraft altitude is < FL180 and only pressure altitude is available, or (2) ADC altitude is failed.

CLR XFILL ALT – A VNAV plan is defined, but crossfilled altitude is being used by the system.

CLEAR MAN ALT – A manual entry for altitude was made on the ADC status page.

LEG RESTRICTION – The FMS is on a Procedure turn, VECTOR or other floating leg type.

XTK TOO HIGH – Current crosstrack is > 12.5nm.

CLR SXTK – Aircraft is flying a selected crosstrack distance prior to VNAV activation.

FPA TOO STEEP – Flight path is steeper than maximum FPA in configuration module.

ANNUNCIATORS

In addition to the message annunciator, there are six other annunciators that may be required and are mounted on the instrument panel or are displayed through the EFIS.

WPT – Will illuminate in conjunction with a WAYPOINT ALERT message on the FMS. Only the WPT annunciator will illuminate the MSG annunciator will not illuminate.

When on and steady, alerts the pilot to a lateral waypoint change and will occur 15 seconds prior to the changeover waypoint while enroute and 5 seconds during approach.

When on and flashing, alerts the pilot to a vertical waypoint change and will occur 15 seconds prior to the changeover waypoint while enroute and 5 seconds during approach.

SXTK – Will be illuminated during the time the FMS is in selected crosstrack mode.

FMS HDG – Will be illuminated during the time the FMS is in command or procedural heading mode.

FMS APPR – Will be illuminated during the time the FMS is approach active.

GPS INTEG – Will illuminate if the GPS Horizontal Integrity Limits (HIL) for the current phase of flight have been violated. During approach active, for an approach for which GPS is being used, this annunciator will illuminate if RAIM is not available.

DR – Will illuminate if the FMS is not receiving NAV sensor input from any other source and the FMS is determining its position solely from dead reckoning (DR).

FMS TROUBLE SHOOTING FOR PILOTS

When the FMS does not respond in the expected way, the anomalous output is often not the FMS, but an erroneous input or no input to the FMS from a related piece of equipment. When the pilot creates a squawk, maintenance may be at a loss as to whether the problem is the FMS or an interfaced system.

To assist both the pilot and maintenance personnel, the following trouble shooting guidelines were created. The following are the most common problems that are seen by pilots. For a complete list of FMS messages, refer to the FMS Message section.

Symptoms:

A/D HEADING FAIL – The present system heading source, A/D (synchro analog-to-digital), was serving as the primary heading source but has failed. This message will be removed after it is displayed. Unless a NO HEADING message is also active, the system will have automatically selected another valid heading source. This message is suppressed while the aircraft is on the ground.

Action:

No action is necessary if another valid heading was automatically selected by the FMS. A check should be made on the appropriate DATA page to ensure that the heading source selected is the one desired and the heading is correct. Check heading source on Data 4/4. Place cursor over the HDG field. Press the LIST key to access a display of alternate heading sources. Select an alternate heading source. A manual heading can be entered at the HDG field on DATA page 4/4, but once entered, all new heading changes will have to be entered manually as well.

Symptoms:

ADC INPUT FAIL – An Air Data Computer (ADC) failure is detected. TAS and altitude will not be input automatically. Altitude is used in DME positioning. TAS affects wind computations, DR capability, and VNAV will not be available.

Action:

Check circuit breaker for ADC or ACU if installed. Press the DATA key until DATA page 2 is accessed. Manual inputs should be made. If a second FMS is installed air data may be crossfilled from the other system. Check ADC data from ADC status page and record for maintenance. Note that without valid air data inputs to the FMS, VNAV is not available and any leg type terminators requiring altitudes will not be sequenced

Symptoms:

AHRS # HEADING FAIL – The AHRS heading source was serving as the primary heading source and has failed. This message is suppressed while the aircraft is on the ground.

Action:

The FMS should automatically select an alternate heading source if one is available. A manual heading may also be entered, but heading updates must be made each time the aircraft changes heading. (See DATA page section) Record information from heading source page for maintenance.

Symptoms:

ALT INVALID – The altitude portion of the Air Data Computer is not usable. If using VNAV above 18,000 feet and only non-barocorrected altitude is available, this message will appear when descending through 18,000 feet. (If the TAS INVALID message is also active, the ADC Status page, under the DATA key, will indicate “ADC FAILED.”)

Action:

A manual input of altitude may be made on the ADC status page (under the DATA key). VNAV will not be available

Symptoms:

ANALOG BOARD FAIL – A failure is detected on the Analog Board. The outputs to the NAV may be affected, and depending upon installation, heading and fuel flow in some systems may also be affected. Verify on the DATA pages that the heading, TAS, and altitude inputs are reasonable.

Action:

On the ADC page verify TAS and altitude. On DATA page 4 verify HDG. If NAV is analog type, do not use for navigation.

Symptoms:

ANALOG INST FAIL – The Analog Waypoint Bearing or Desired Track self test has failed or the instrument reference is missing.


Action:

Check 26 VAC circuit breakers for FMC instrument reference input.

Symptoms:

CDU DATA BUS FAIL – Communication between the CDU and the NCU has failed.

Action:

If FMS does not recover automatically, cycle power by turning the unit off using the  key. Document for maintenance whether FMS information to flight instruments remained or was lost as indicated by flags on the NAV instruments. Document whether FMS recovered automatically or recycling power was required.

Symptoms:

FMC BATTERY LOW – Self test has detected that the internal battery is low. Navigation is still allowable; however, at shutdown the position, date and time may be lost.

Action:

Advise maintenance of the message and the need to return the FMS to Universal Avionics for repair.

Symptoms:

FMS DIFF > xxMM – The sensor watchdog has sensed that LAT/LONG positions of two FMS's in a dual installation differ by an amount that warrants crew attention. Xx will equal 6, 12, 18 or 24nm.

Action:

Review DATA page 3 to determine which FMS is correct and use that FMS for navigation.

Symptoms:

FUELFLOW FAIL – A Fuel Flow failure is detected.

Action:

The FMS is not receiving fuel flow input from the aircraft engine fuel sending units. Manual fuel flow entries may be made. Also check the Fuel Flow displays for reasonableness. The Fuel Used values may be manually updated if required. To recover automatic fuel flow, position cursor over failed fuel flow field and press the **BACK** key followed by the **ENTER** key.

Symptoms:

GPS# DESELECT – The sensor monitor has determined that the specified GPS data is unreasonable and has deselected the sensor for use in navigation.

Action:

Record GPS status page information for maintenance. Monitor HIL on GPS status page and when it meets phase of flight accuracy, reselect GPS. On over water legs it is possible that GPS could get deselected when, in fact, the IRS is in error. If review of the GPS status page indicates GPS to have a valid position, the pilot may choose to deselect the IRS and reselect GPS.

Symptoms:

GPS # DIFFERENCE > xxNM – The sensor “Watchdog” has sensed that the latitude/longitude position as determined by GPS# (1, 2, or 3) differs from the FMS best computed position by an amount that warrants pilot attention. “xx” can be 6, 12, 18, or 24nm.

Action:

Select Data page 2 and attempt to determine whether GPS, DME, or other NAV sensors are in error. The NAV sensor that is pulling off the best computed position must be deselected. In areas of the world where there are few DME stations or where the surveyed position of the DME stations is questionable, deselecting DME may be necessary.

Symptoms:

GPS# FAILED – A Fail status has been determined for the indicated GPS because the position data is missing or invalid or the status label indicates a FAIL status exists.

Action:

Review DATA page 2/GPS. Record GPS information for maintenance.

Symptoms:

GPS NOT NAV – GPS has changed to a not navigational condition for more than 3 minutes.

Action:

On Data page 2 select GPS. Review and record GPS information for maintenance.

Symptoms:

IRS # DESELECT – The sensor watchdog has determined that the specified IRS data is unreasonable and has deselected the sensor for use in navigation.

Action:

Review DATA page 2 and compare FMS position to IRS position.

Symptoms:

IRS # DIFF WARN – The sensor “Watchdog” has sensed that the latitude/longitude position as determined by IRS# (1, 2, or 3) differs from the UNS best computed position by an amount that warrants pilot attention.

Action:

This usually indicates an IRS drift of greater than two nautical miles per hour. Review DATA page 3 and compare FMS position to IRS position through NAV menu.

Symptoms:

IRS # HDG FAIL – The compass heading source, IRS# (1, 2, or 3), was serving as the primary heading source but has failed. This message will be removed after it is displayed. Unless a NO HEADING message is also active, the system will have automatically selected another valid heading source.

Action:

No action is necessary if another valid heading was selected. A check should be made on DATA page 4 to ensure that the heading source selected is the one you desire and the heading is correct.

Symptoms:

NO GPS INT@FAF – No response is received from the sensor or HIL exceeds 0.3nm.

Action:

Select an approach that does not require GPS. If time is available, select GPS on data page 2 and review page information.

Symptoms:

NO GPS INT@MAP – No response is received from the sensor or HIL exceeds 0.3nm.

Action:

Same as NO GPS INT@FAF

Symptoms:

NO HEADING – No heading information is being received. This message will not be displayed while on the ground. If a valid heading source was available, it should have already been automatically selected. Check the HDG SOURCE menu (DATA page 4) for a valid available heading source, or manually select either the other FMS as the heading source or manually input the aircraft's heading.

Action:

Go to data page 4 and check heading input to FMS. Select alternate heading source, if available.

Symptoms:

POS UNCERTAIN – The FMS position is unreasonable (not verified). An ANP of 28 (2.8nm) triggers this message within 300nm of DME sources. In Terminal, an ANP of greater than 10 (1.0nm) and during approach active, an ANP of greater than 5 (0.5nm) may also trigger this message depending upon the distance from the end-of-approach point. An ANP of 60 triggers the message outside of DME range, unless operating on valid IRS only.

Action:

Go to data page 2 and identify NAV sensors being used for computing the Best Computed Position. In some instances where DME stations are few and far between or are unreliable, deselecting DME and using GPS as the primary sensor may help restore the required quality of navigation.

Symptoms:

POS UNCERTAIN on ground – After successful initialization and the aircraft is being taxied; a position uncertain message is presented.

Action:

Check for valid heading source on DATA page 4. Heading failed message is suppressed on the ground. Record information for maintenance.

Symptoms:

STEERING FAIL – Roll steering self-test failure (continuous).

Action:

This failure may be reset by positioning the cursor over the ROLL CMD line on Data page 4, then depressing the BACK key and then the ENTER key. Verify heading and TAS under Data section.

Symptoms:

TAS INVALID – The True Airspeed portion of the Air Data Computer is not usable.

Action:

A manual input of TAS may be made on the ADC Status page (under the DATA key). If the ALT INVALID message is also active, the ADC Status page, under the DATA key, will indicate “ADC FAILED.” Crossfill heading and/or TAS from offside FMS if available.

Symptoms:

Winds differ between FMS's in dual FMS installation.

Action:

Between the FMS's compare heading information from DATA page 4 and TAS from the ADC page. Determine which FMS heading or TAS information is incorrect. Record this information for maintenance and use the FMS displaying correct information.

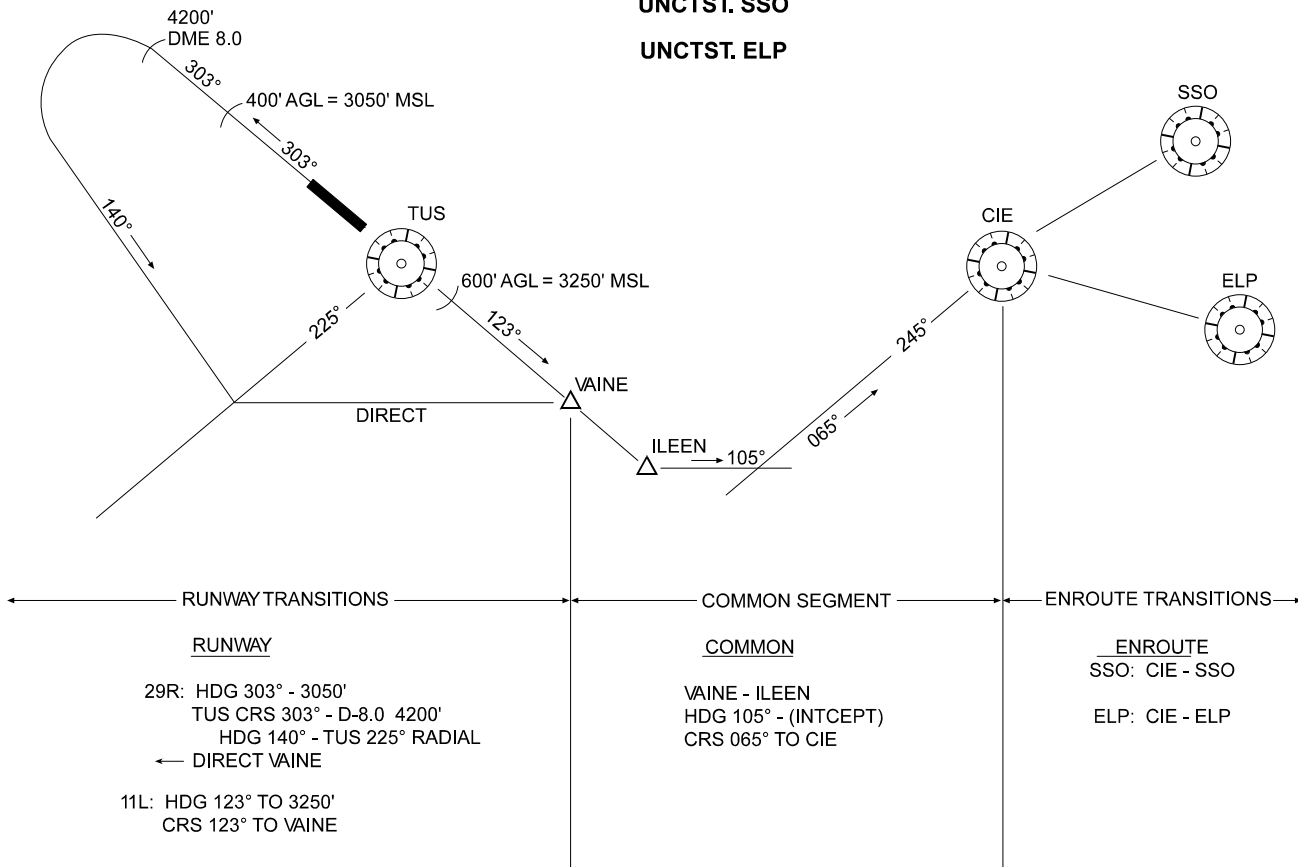
SID/STAR LEGS

SIDs and STARs are made up of a runway segment, a common segment, and an enroute segment. Each SID may have several runway and enroute transitions, but only one common segment.

DEMONSTRATION PILOT DEFINED SID

UNCTST. SSO

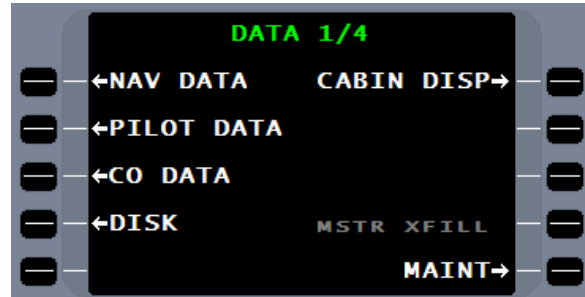
UNCTST. ELP



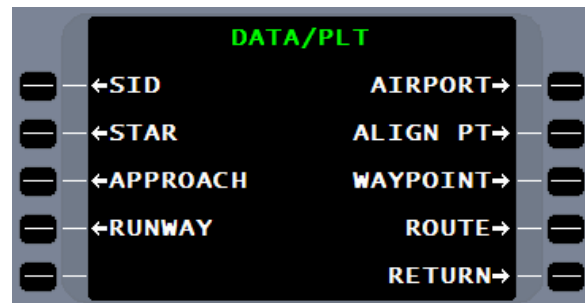
PILOT DEFINED SID

Pilot defined SIDs are constructed, viewed, or edited through DATA page 1.

Press the PILOT DATA line select key to display the DATA/PLT page.



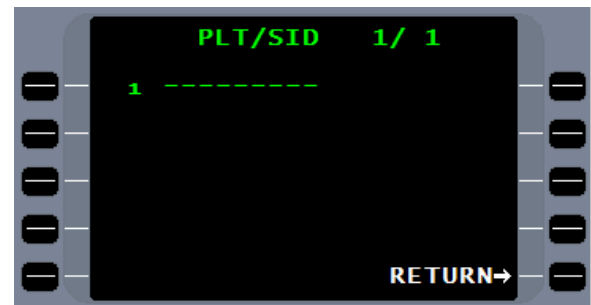
To create a SID, press the SID line select key on the DATA/PLT page.



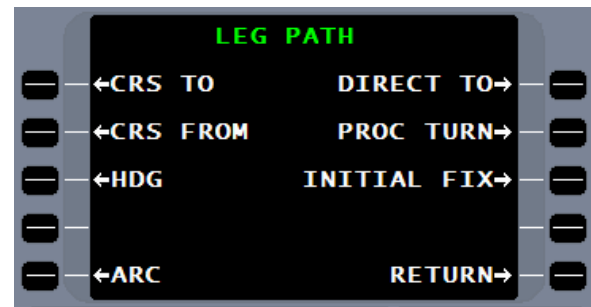
Enter the airport identifier, select the desired runway, and then create a name for the SID with 5 to 7 characters. Create and enter the identifier for the desired transition. Now press the SID LEGS line select key to define each leg of the SID.



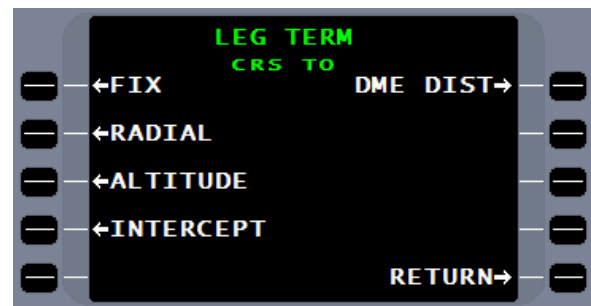
Press the 1L line select key to begin defining the SID. A SID should normally start with a climb on runway course to 400 feet AGL.



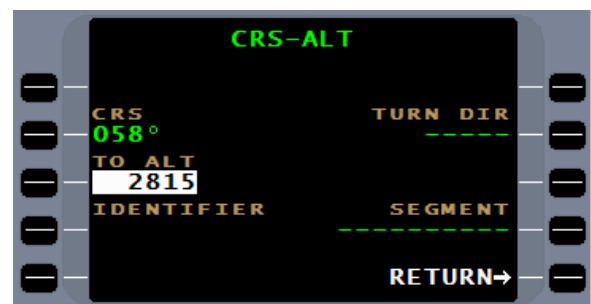
Press the CRS TO line select key to identify the initial leg.



Press the ALTITUDE line select key to terminate the leg.



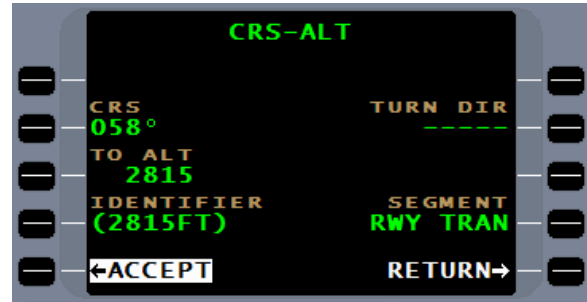
Now define the HDG and TO ALT with the runway heading and the 400 feet AGL altitude expressed in MSL numbers. Press **ENTER** to move to the SEGMENT page.



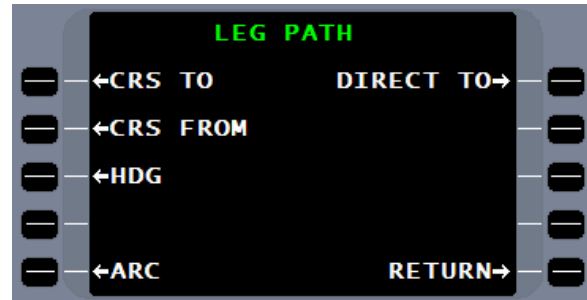
Press the RWY TRAN line select key to identify this leg with a particular runway.



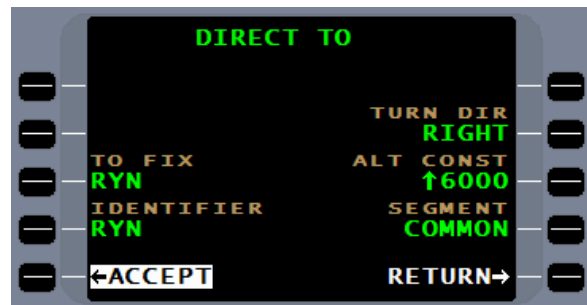
When the display returns to the **CRS-ALT** page, press **ENTER** or the ACCEPT line select key.



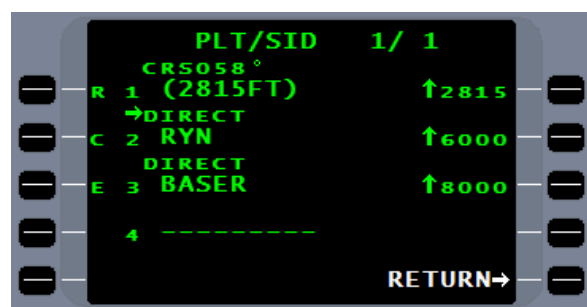
The following SID legs are constructed in the same manner, with a **LEG PATH** menu page and, when required, a LEG TERM menu page to select the definition page for each leg. Each of the leg definition pages provides an altitude constraint field. The information entered in this field will be advisory only unless altitude was selected as the leg terminator.



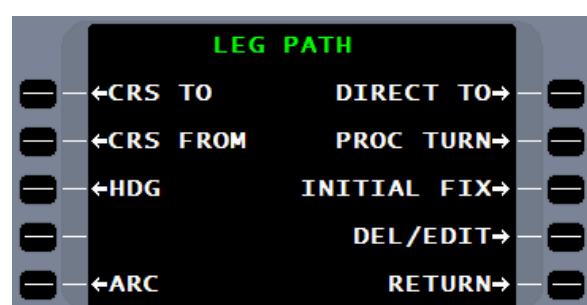
Select the next leg, use the line select keys to access and enter the required information, then press the **ENTER** key to confirm the required information.



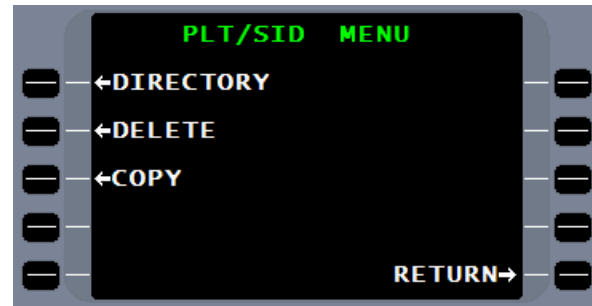
To edit a SID leg already that is already created, press the appropriate line select key to the left of the leg to be edited.



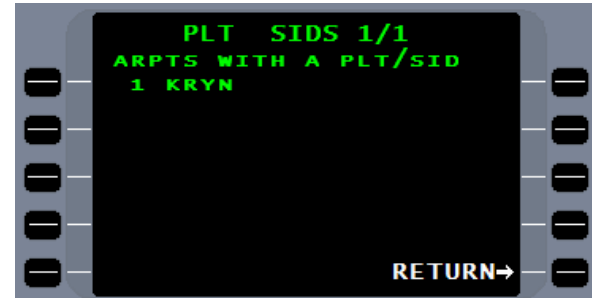
Pressing the line select key next to any of the SID legs on the **LEG PATH** menu page will now contain a DEL/EDIT line select key.



Press RETURN twice to return to the PLT/SID page. Press the **MENU** key to display the **PLT/SID MENU** page. This page will offer a COPY line select key to provide for the copying of the previously displayed SID in order to add other transitions, a DELETE line select key for the deletion of the SID or transitions, and a DIRECTORY line select key for selection of a directory.



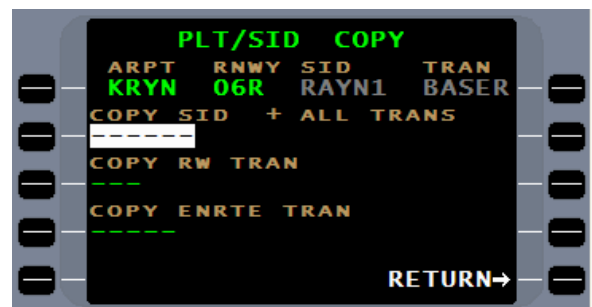
This directory page lists all airports with a pilot defined SID stored in the pilot database.



To delete a pilot created SID, press the DELETE line select key under the PLT/SID MENU page. A PLT/SID DEL menu will provide options for deleting all or part of the SID.



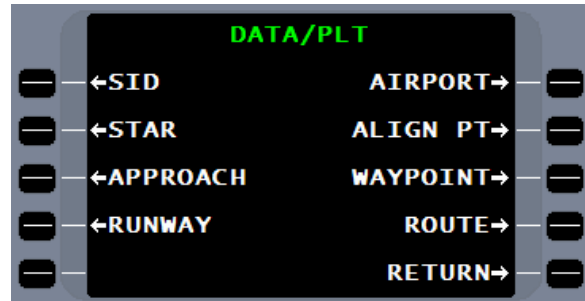
The PLT/SID COPY function allows for making a copy of the SID or portions of it for creating new SIDs or transitions. Enter the new name in the appropriate field and then edit the newly created copy to make a new SID or transition.



PILOT DEFINED STAR

The same procedures and editing conventions that were used to construct, view, and edit pilot defined SID are used in pilot defined STAR.

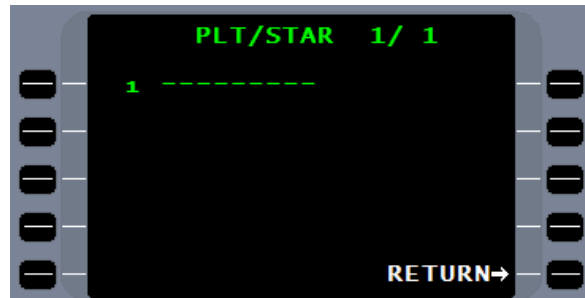
From the **DATA/PLT** page, select the STAR line select key.



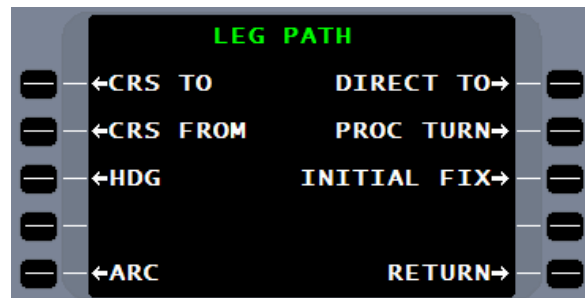
On the **PLT/STAR** definition page follow the prompts to enter airport, runway, name the STAR, and the transition. Press the STAR LEGS line select key.



Press the 1L line select key to define the beginning point of the STAR.



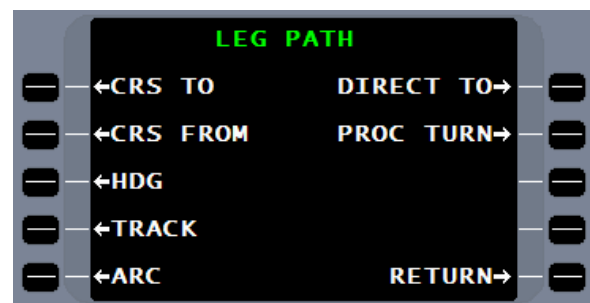
Press INITIAL FIX line select key.



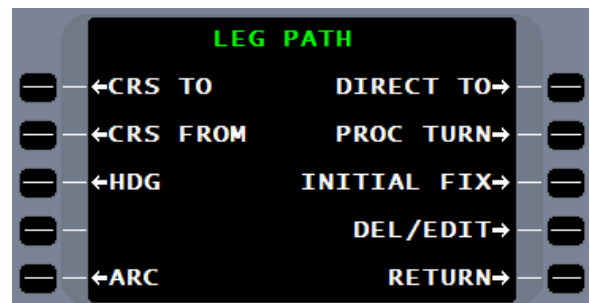
Enter the identifier and select the ENRTE TRAN line select key.



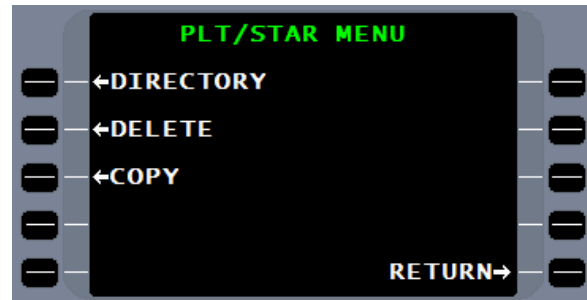
The following STAR legs are constructed in the same manner with the **LEG PATH** menu page and, where required, the LEG TERM menu page leading to definition pages for each leg. As with SIDs, the altitude entered is advisory only, unless altitude is selected as the leg terminator.



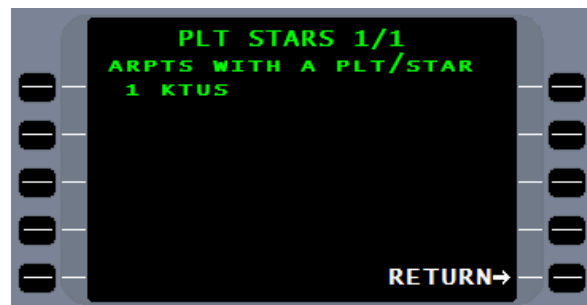
To edit a STAR leg already entered, press the appropriate line select key to the left of the leg to be edited, and the **LEG PATH** menu page will now contain a DEL/EDIT line select key option.



Press RETURN twice to return to the PLT/STAR page. Press the **MENU** key to display the PLT/STAR MENU page. This page will display a copy of the previously displayed STAR to add other transitions, deletion of the STAR or transitions, and selection of a directory. Press the DIRECTORY line select key.



This directory page lists all airports with a pilot defined STAR stored in the pilot database.



The DELETE and COPY line select key options provide for the same features, as did their counter parts in the pilot SID function.

PILOT DEFINED APPROACHES

The FMS is approved for a variety of pilot defined approaches. Many of the approach types are restricted to special mission aircraft. It is strongly recommended that general aviation aircraft use only the VFR pilot defined approach. The approach capabilities of a specific installation depend on the installed sensor suite and the interfaced aircraft flight guidance system. Pilot defined approaches include the following:

ILS	FMS Defined – ILS Guided – requires NAV to NAV EFIS
LOC	must be WGS-84 surveyed – TSO 129 EFIS or analog
LOC-BC	must be WGS-84 surveyed – TSO 129 EFIS or analog
VOR/VOR DME	Requires VHF NAV input to FMS or RRS
TACAN	Requires RRS Sensor or approved TACAN sensor
RNAV VOR DME	Requires VHF NAV input to FMS or RRS
VFR	Pilot Defined, used only in VFR conditions

The creation of a Pilot defined VFR approach will be discussed in this section. Pilot defined database approaches can be created through the aircraft's FMS CDU or the Universal Flight Planning Program 24.0 and later.

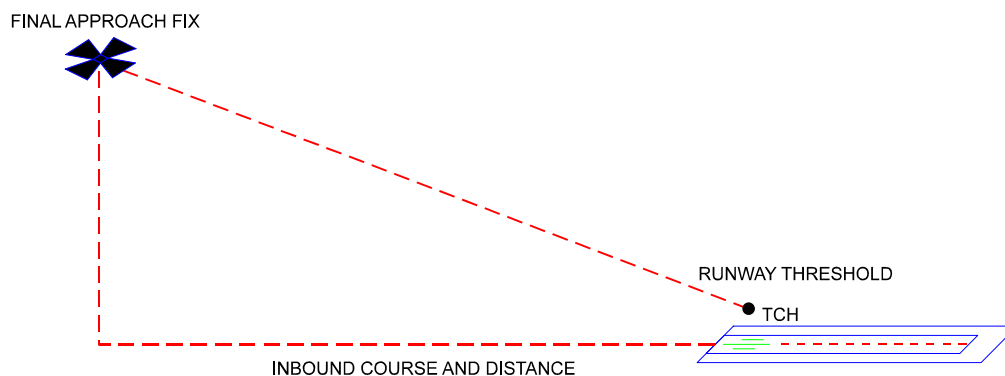
NOTE: The creation of other than VFR approaches is reserved for special mission aircraft and is not covered in this document. Federal Air Regulations prevent the creation of RNP RNAV or GPS approaches other than by an authorized database manufacturer.

The lateral definition of the final approach course is composed of three components:

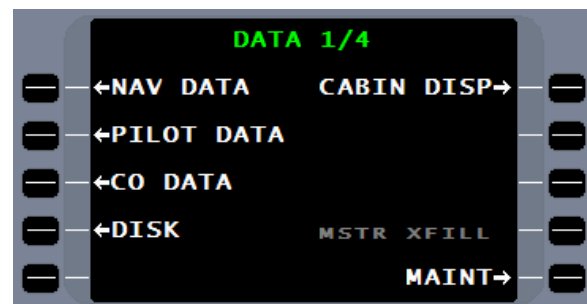
1. Final Approach Fix Location
2. Inbound course and distance
3. Runway threshold location

When any two of these components are defined, the third will be calculated by the FMS.

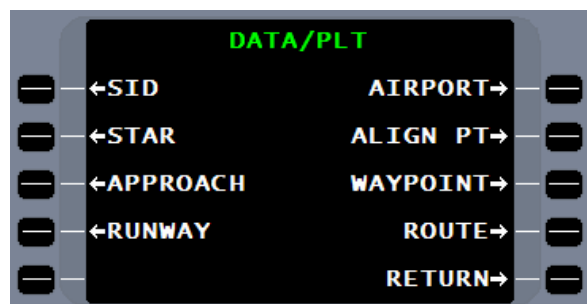
NOTE: If the runway location and FAF are defined, the FMS will calculate the inbound course/distance. This will be displayed as “From FAF to RUNWAY”. If the FAF and inbound course/distance are defined, the FMS will calculate a Missed Approach Point (MAP) for the runway. This will be displayed as “FROM FAF TO MAP”. If the runway location and the inbound course/distance are defined, the FMS will calculate the FAF. This will be identified as FFX, where XX is the runway number.



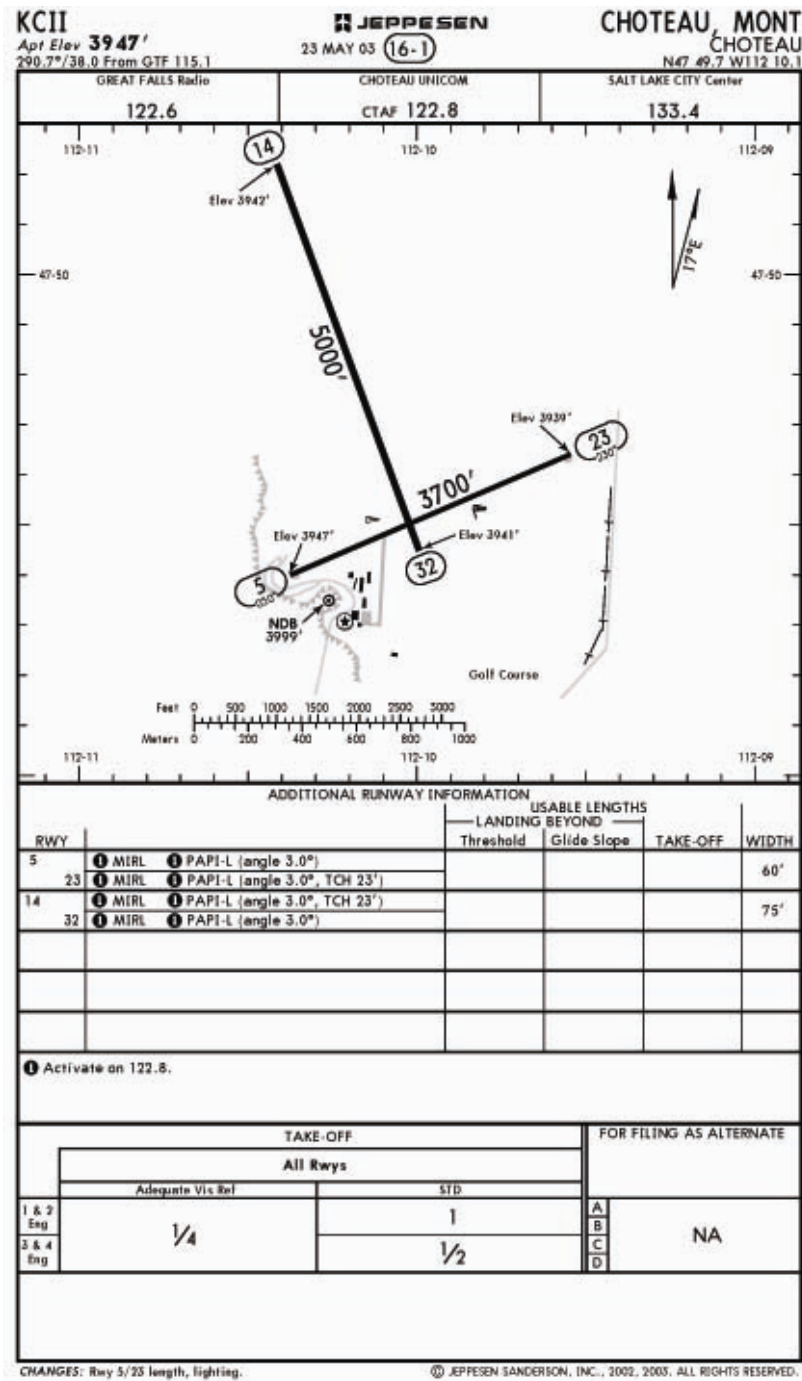
Pilot defined approaches are created, viewed, or edited through the data function. From DATA page 1, press the PILOT DATA line select key.



On the DATA/PLT page, press the APPROACH line select key.



The airfield at Choteau Montana has a NDB approach only to runway 23. When conditions allow for landings on runway 14, a VFR approach would significantly improve the safety of a night landing.



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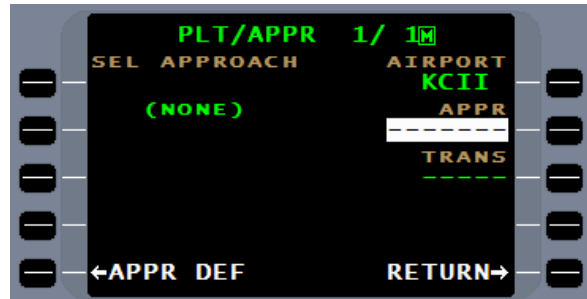
With pilot approach selected, the **PLT/APPR** directory page is displayed, listing all Airports with pilot defined approaches stored in the database or none. Enter the identifier into the airport field.



After entry of the airport identifier, all pilot defined approaches for that airport will be listed or none and the APPR DEF line select key will allow creation of a pilot defined approach.

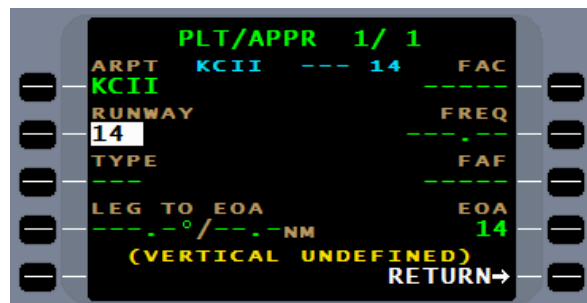


Press the APPR DEF line select key to create an approach.

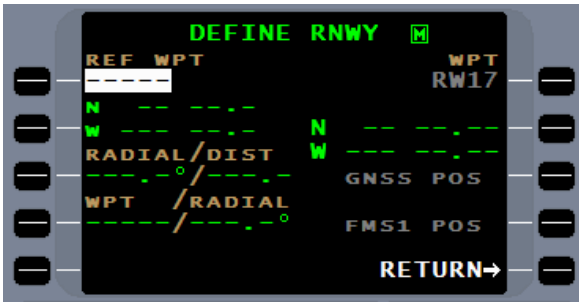


The **PLT APPR** page prompts you to enter the Runway Number. If the runway is in the NAV database, the **LIST** function may be used to find the runway.

Typically the entry will be a one or two digit number (1-36) which may be followed by the letter L, C, or R. A single letter (A-Z) may be used to designate an approach that is not associated with a runway.



If the runway entered is not stored in the Navigation or Pilot database, the **DEFINE RNWY** page will be displayed for input of the runway threshold coordinates and elevation.



DEFINE RNWY ☒

REF WPT	WPT
---	RW17
N ---	N ---
W ---	W ---
RADIAL/DIST	GNSS POS
WPT /RADIAL	FMS1 POS
---	---
RETURN→	

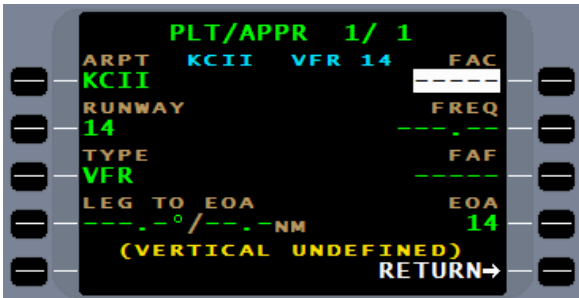
The page will now display approach types from which VFR will be selected. (For flight departments requiring other than VFR for their special mission requirements, contact UASC training for a custom training class @ 1-800-595-5906.)



APPR TYPE
KCII 14

←VOR	GWS→
←VFR	ILS→
←RNV	LOC→
←TACAN	BC→
RETURN→	

At the cursor, a reference VOR navigation facility for the approach may be added, if available. The **LIST** function may be used. It is recommended that the VOR be on or within 10nm of the airport.

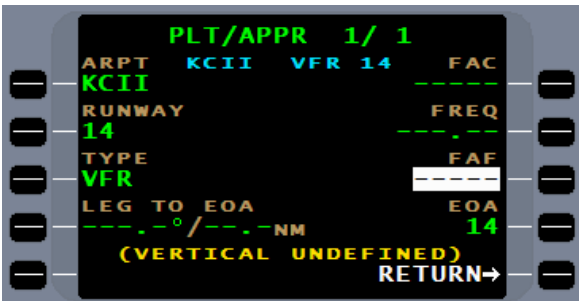


PLT/APPR 1/ 1

ARPT	KCII	VFR 14	FAC
KCII	---	---	---
RUNWAY	14	FREQ	---
TYPE	VFR	FAF	---
LEG TO EOA	---	EOA	14
---	---	(VERTICAL UNDEFINED)	
RETURN→			

NOTE: When entering navigation data, always verify that you are using the correct facility, as there may be several facilities with the same identifier. If the list feature is used, only facilities in the area will be chosen, when entering facility by ID, all facilities with that identifier will be accessed from the database.

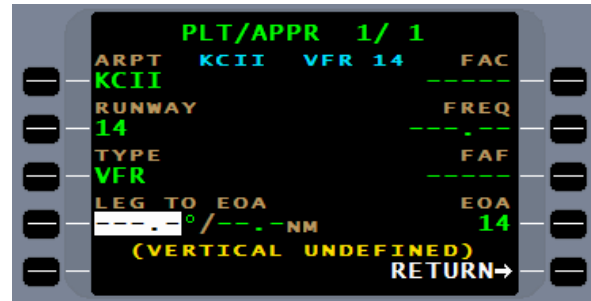
If a waypoint is available for the FAF, entering it will result in the automatic calculation and entry of course and distance to the threshold of the runway.



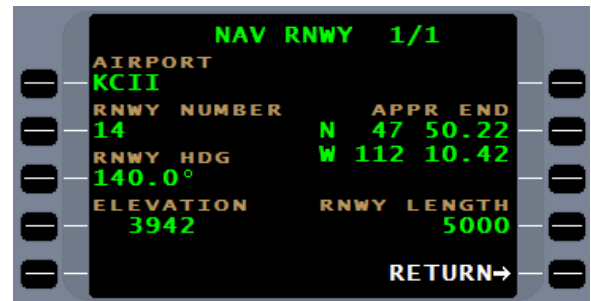
PLT/APPR 1/ 1

ARPT	KCII	VFR 14	FAC
KCII	---	---	---
RUNWAY	14	FREQ	---
TYPE	VFR	FAF	---
LEG TO EOA	---	EOA	14
---	---	(VERTICAL UNDEFINED)	
RETURN→			

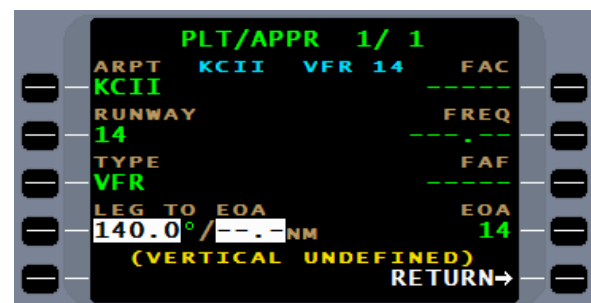
The method for this example will be to enter the course and distance and allow the FMS to calculate the FAF location. Normally, 5nm is use for distance.



For more exact determination of the runway alignment, through the DATA/NAV page, the runway information may be obtained.



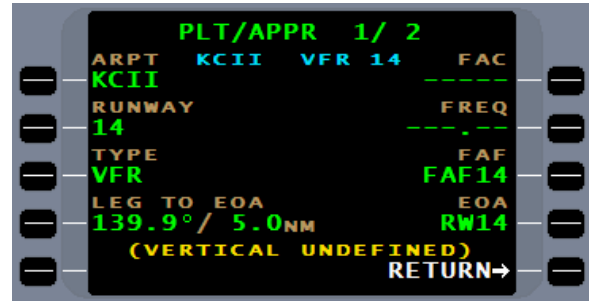
With the course data entered, press the **ENTER** key.



Enter the distance from the runway threshold to the FAF and the FMS will calculate the FAF point.



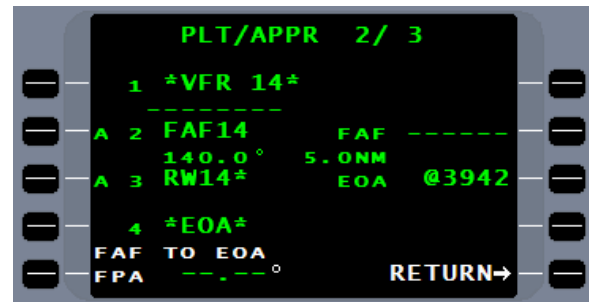
Very slight variations to the inbound course may be calculated by the FMS but, the consequence will be negligible. The footnote on page 1 of (VERTICAL UNDEFINED), will prompt to move to page 2.



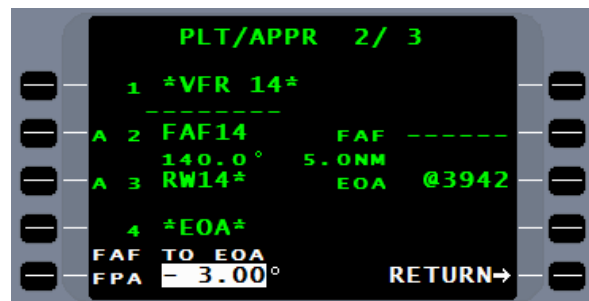
If an approach to a Missed Approach Point (MAP) in lieu of an approach to the RUNWAY coordinates is desired, the calculated INBD CRS and DIST may be changed to manual entries. If manual entries are made for CRS/DIST, the FMS will calculate a Missed Approach Point (based on the specified CRS/DIST from the FAF). The FMS will show MAXX in place of the runway waypoint.

The lateral definition of the approach is now complete and (VERTICAL UNDEFINED) is displayed indicating that the optional vertical parameters have not been defined. To define the vertical parameters for Pseudo- G/S steering information, press the **NEXT** key to display PLT APPR page 2.

To define the vertical flight path for the approach, the angle must be entered next to the FPA. The displayed runway altitude will be from the runway database and is not the threshold crossing altitude. Adjustments to the threshold altitude will be made later.

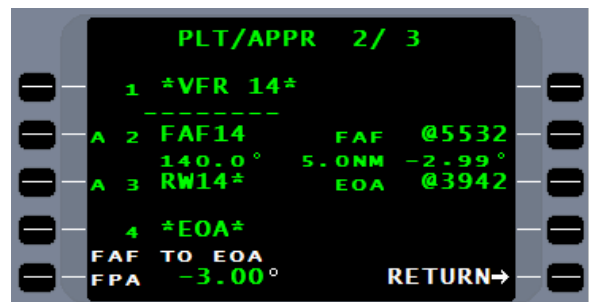


The standard for an approach glideslope is -3.00°.

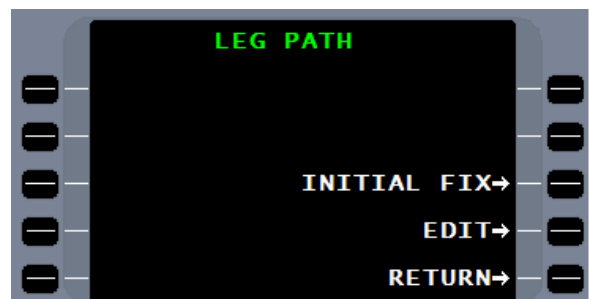


With the FPA entered, pressing the **ENTER** key will result in the FMS calculating the altitude at the FAF.

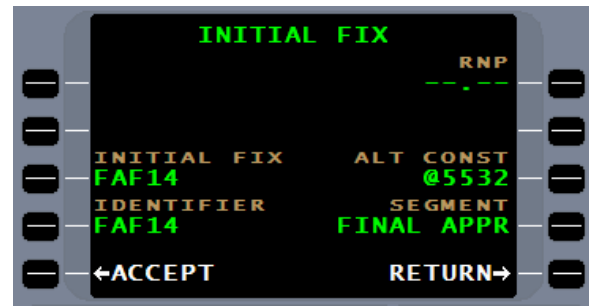
To add a capture fix or edit the current leg, press the line select key adjacent to the location where the waypoint will be entered. If a new waypoint is entered, the FAF14 will move down allowing for the new waypoint.



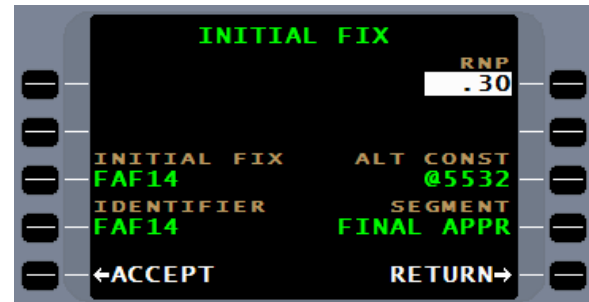
Upon pressing the line select key, the **LEG PATH** page will be displayed. To edit the current leg, press the EDIT line select key.



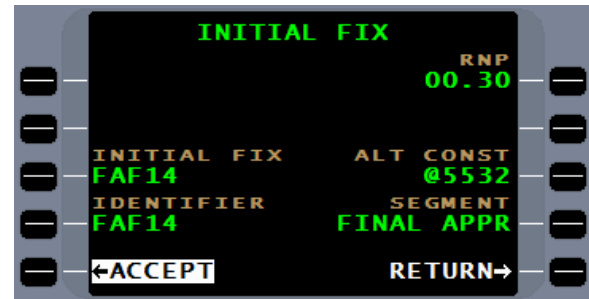
Selecting the EDIT line select key will allow for the changing of previous entered data or the entering of new data.



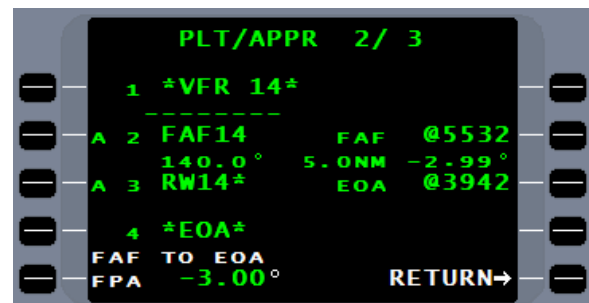
An RNP to monitor FMS navigation accuracy may be entered.



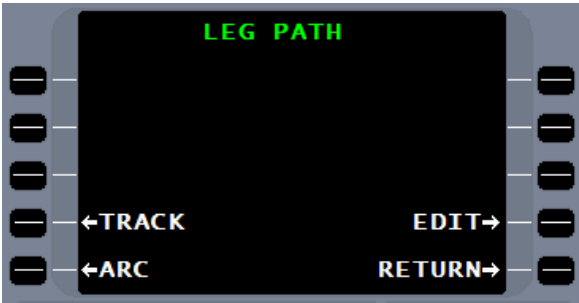
Pressing ACCEPT will save the new data.



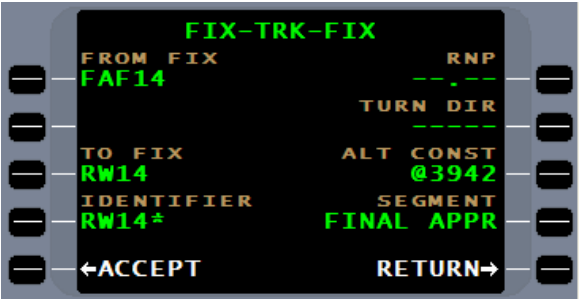
To correct the altitude at RW14 to reflect the threshold crossing altitude, press line select key 3L next to RW14 and...



...select EDIT.



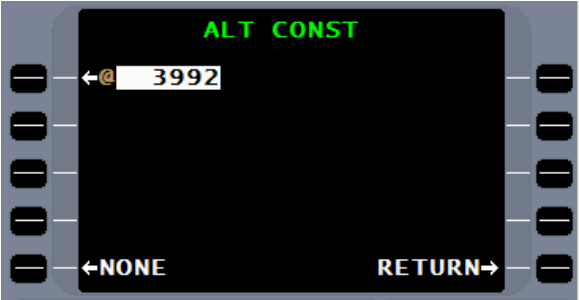
Select 3R to change the altitude to the correct crossing altitude.



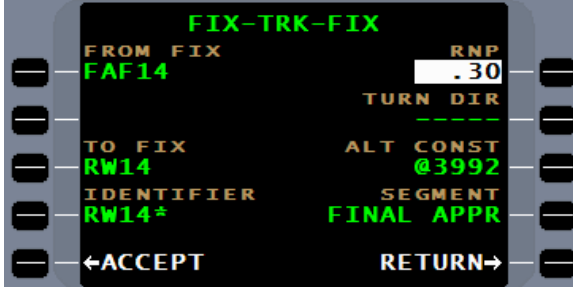
Select 1L to change the "@" altitude.



Adding 50' will correctly reflect the EOA altitude for crossing the threshold.



Entering RNP for this leg may, also, be done.

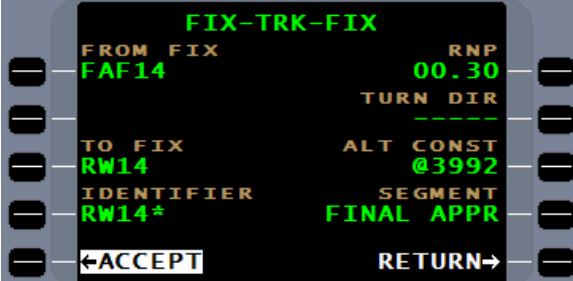


FIX-TRK-FIX

FROM FIX	RNP
FAF14	.30
	TURN DIR

TO FIX	ALT CONST
RW14	@3992
IDENTIFIER	SEGMENT
RW14*	FINAL APPR
←ACCEPT	RETURN→

Press ACCEPT to save the additions

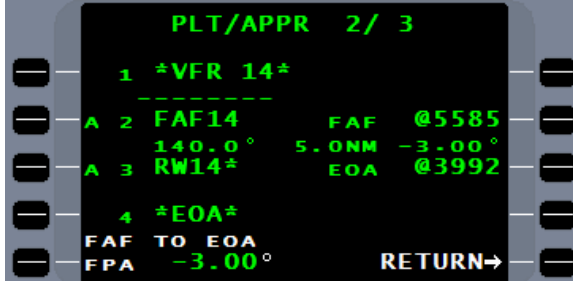


FIX-TRK-FIX

FROM FIX	RNP
FAF14	00.30
	TURN DIR

TO FIX	ALT CONST
RW14	@3992
IDENTIFIER	SEGMENT
RW14*	FINAL APPR
←ACCEPT	RETURN→

The FAF14 to RW14 leg now reflects correct course and altitude parameters.



PLT/APPR 2/ 3

1	*VFR 14*		

A 2	FAF14	FAF	@5585
	140.0°	5.0NM	-3.00°
A 3	RW14*	EOA	@3992
4	*EOA*		
FAF TO EOA			
FPA	-3.00°		
		RETURN→	

To add a missed approach, move to page 3 and select waypoint 5 line.



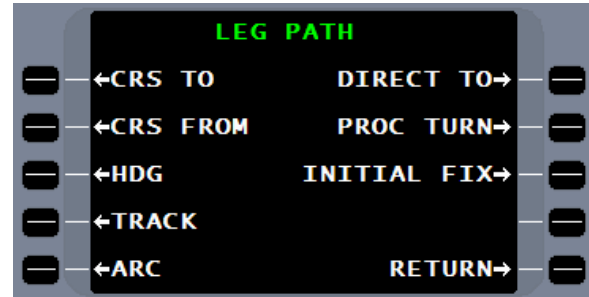
PLT/APPR 3/ 3

4	*EOA*
5	-----
FAF TO EOA	
FPA	-3.00°
	RETURN→

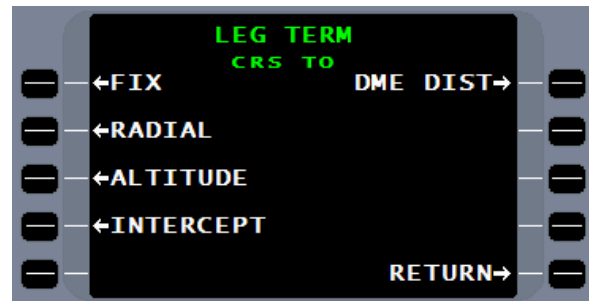
If desired, a missed approach procedure may be added to the approach. PLT Approach page 3 is used to define Missed Approach legs. To define a missed approach leg, select the leg type and press the appropriate line select key. The system will prompt the operator for entry of a LEG PATH and LEG TERMINATOR for each leg of the defined procedure. Menu pages for each LEG PATH and LEG TERMINATOR will retrieve input pages for entry of the appropriate data. Optional inputs for these legs will be the turn direction and the advisory altitude constraints.

The LEG PATH MENU page will be displayed to choose the path of the first leg.

Typically the first leg will be a climb on runway heading or course to 400 AGL. Press the CRS TO line select key to begin the missed approach definition.



Press the ALTITUDE line select key to terminate the leg.

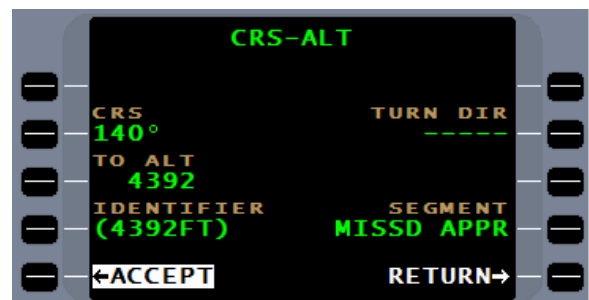


Enter the course 140° at the cursor and press **ENTER**

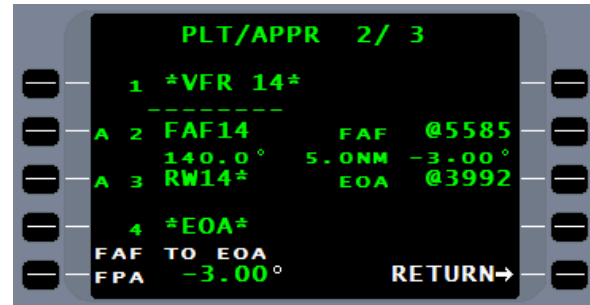


Since there is no TURN DIR to be entered, accept this leg.

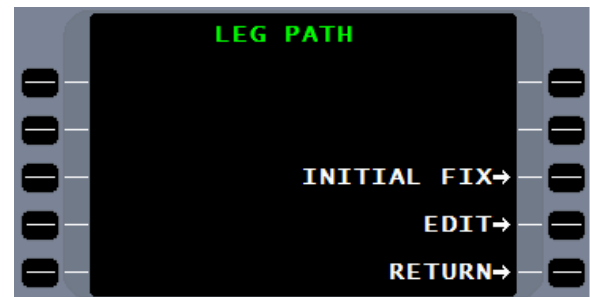
Additional legs may be entered as necessary. A turn to crosswind and again to downwind can be added.



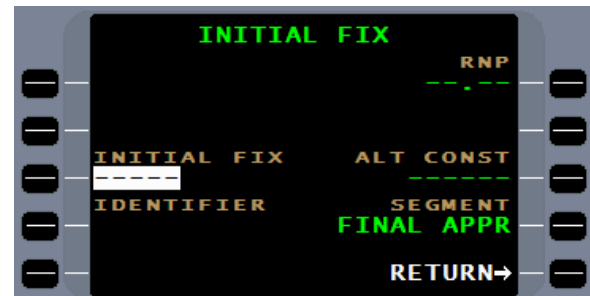
To add a capture fix, from **PLT/APPR 2/3**, press 2L.



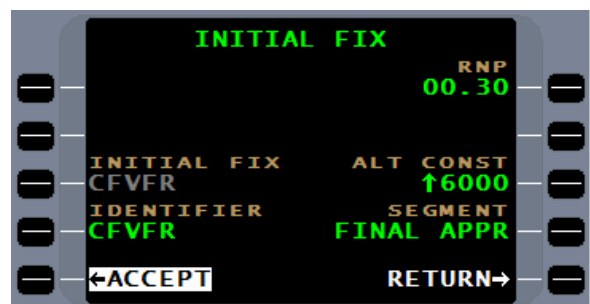
Select INITIAL FIX.



Enter the waypoint to be the capture fix. If the NAV database does not contain a waypoint, use the “pilot waypoint creation method”, and create one.



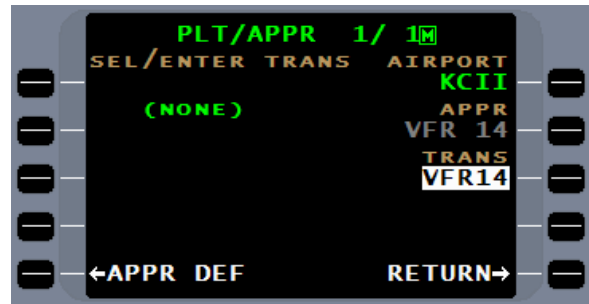
The “pilot created waypoint”, CFVFR, is entered.



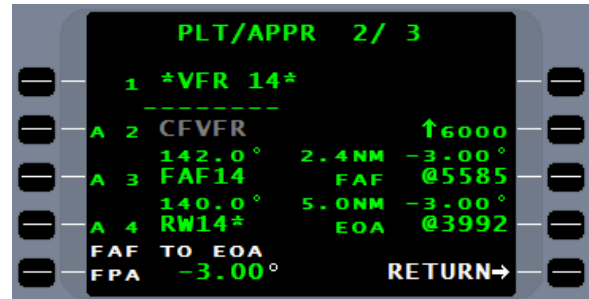
The approach segment is now complete and can be flown as is.



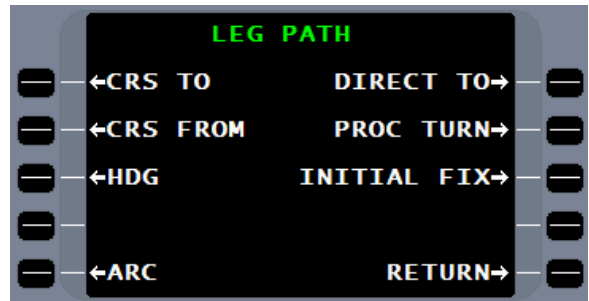
To add an approach transition, return to pilot approach page and enter the name for the transition. More than one transition can be created for each approach. With the name entered, press the **ENTER** key and then go to pilot approach page 2.



Select line select key 1L.



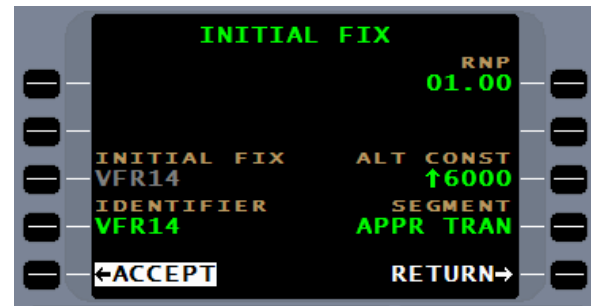
To begin the transition, select INITIAL FIX.



Enter the desired waypoint, either from the NAV database or pilot created.



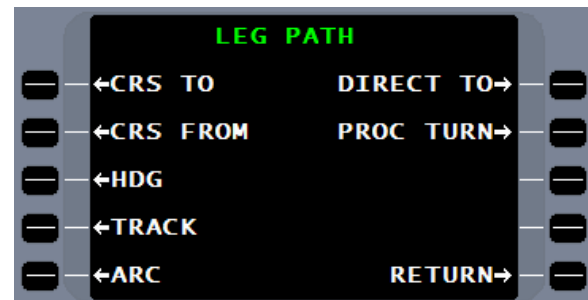
With the optional altitude constraint entered, accept the initial fix to the approach transition.



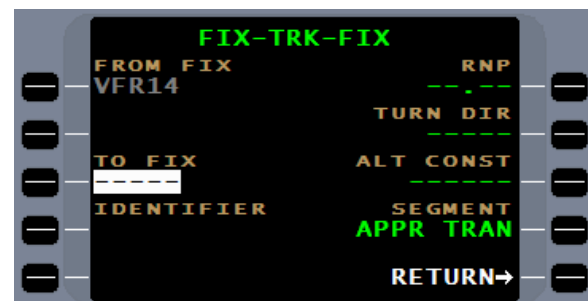
To link the approach transition to the approach segment, the fix CFVFR should be entered a second time, following the waypoint VFR14. To do this, press the line select key below the VFR14 waypoint.



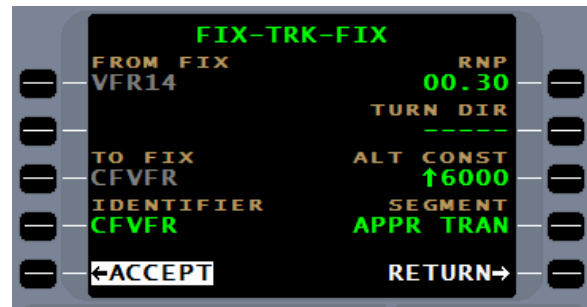
For this leg, TRACK will be selected.



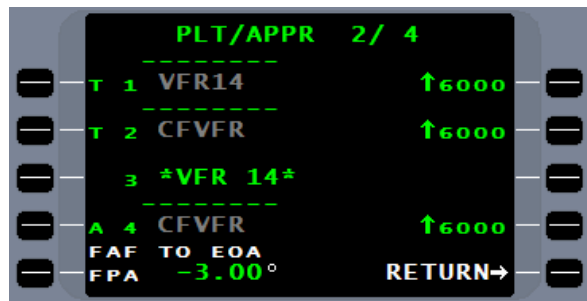
Enter CFVFR as the “TO” fix.



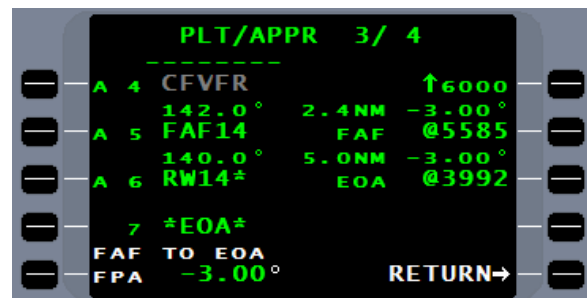
With the optional altitude constraint entered, accept the entered data.



The approach transition is now complete and...



...will transition automatically into the approach segment. The FMS will go approach active upon crossing CFVFR.



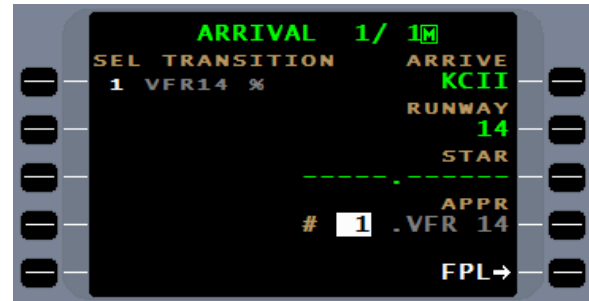
If a missed approach is required, the FMS will guide the pilot on the runway course until reaching 400' AGL, at which time the pilots VFR navigation will take over. Additional missed approach legs may be constructed to navigate the aircraft to downwind.



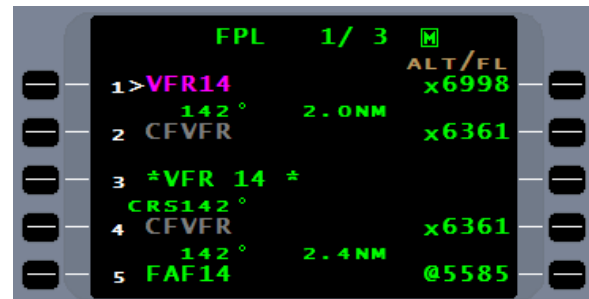
Pilot created data, including SID, STAR approaches, airports, and runways, will be displayed in a subdued color and be followed by a “%” symbol, denoting that it is pilot created.



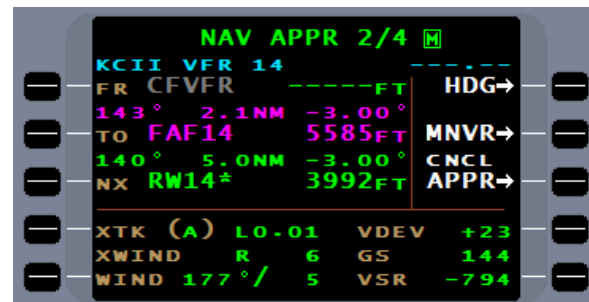
Entering a pilot approach to the flight plan is accomplished the same way any NAV data approach would be entered.



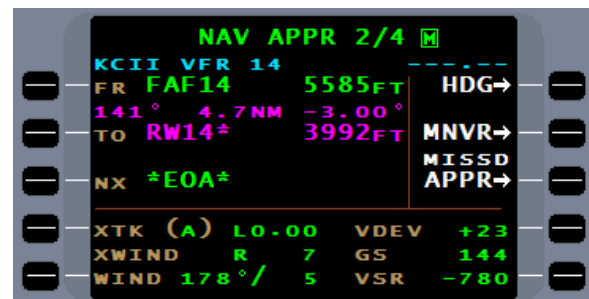
Except for the color of the waypoints, the pilot approach will be displayed in the flightplan as any waypoint would be displayed.



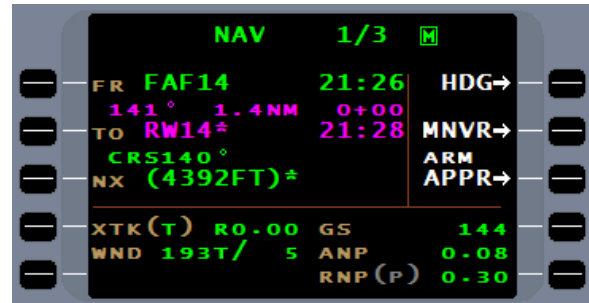
The active pilot approach will be displayed the same as a NAV database enabled approach.



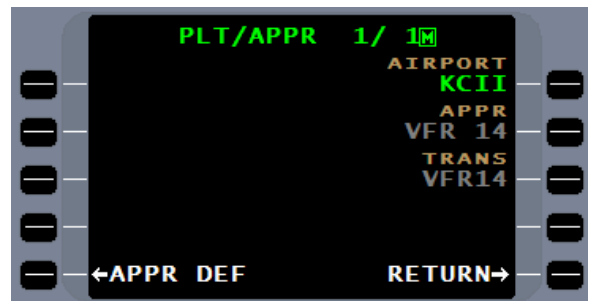
When crossing the final approach fix, the MISSED APPR option will be presented.



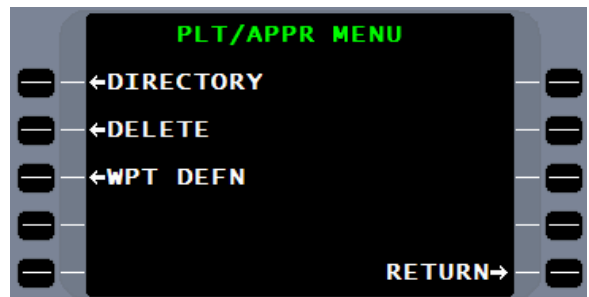
The selected missed approach, again, will respond the same as a NAV database enabled approaches missed approach segment.



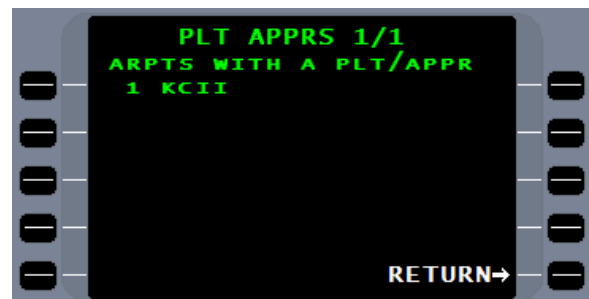
The **MENU** option available and represented by the **M** symbol supports several options.



Select the **DIRECTORY** option to...



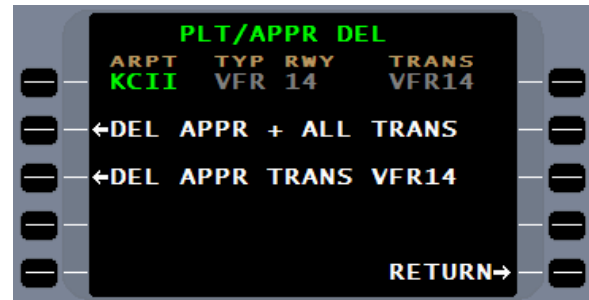
...display a list of airports for which pilot approaches are created.



Select **DELETE** to...



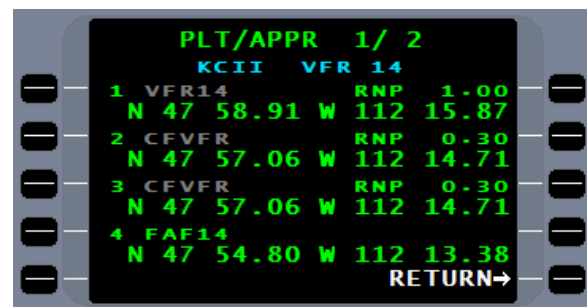
...present options to delete the entire approach and transitions or just a specific transition.



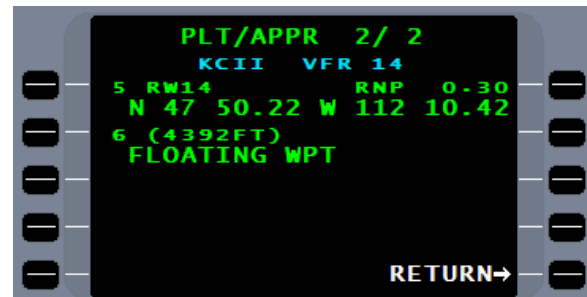
The waypoint definition option will...



...display the approach latitude and longitude with RNP or...



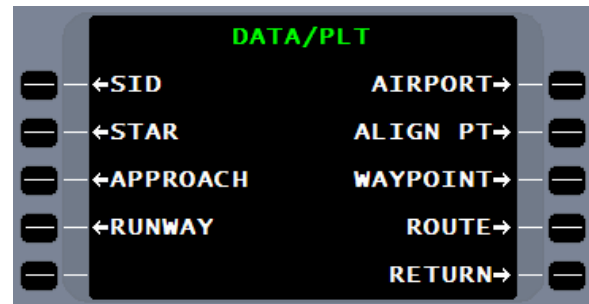
...the definition of a conditional or floating waypoint.



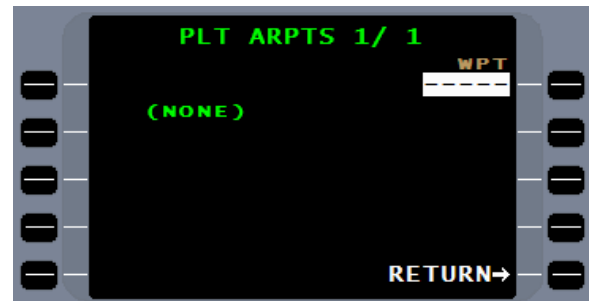
NOTE: Training for the creation of approaches by pilots other than VFR is covered in a customized class by contacting the UASC Training Department.

PILOT DEFINED AIRPORT

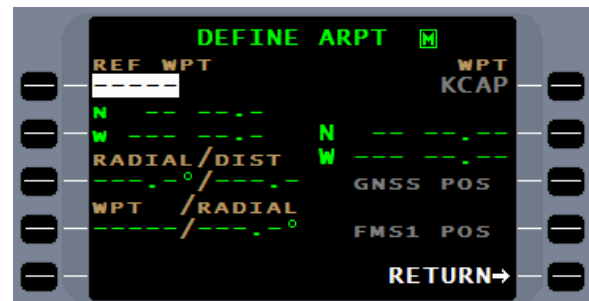
For private airports and other airports not included in the NAV database, the FMS offers the pilot the capability to define an airport. From the DATA/PLT page select AIRPORT.



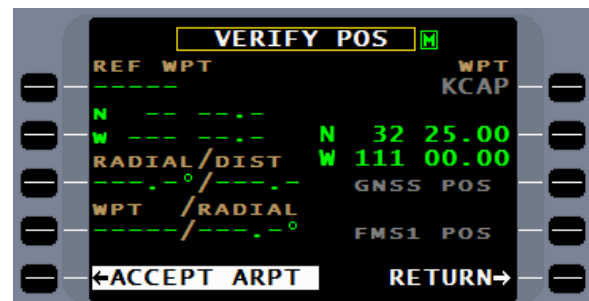
The **PLT ARPTS** page will list all the pilot created airports and offer the ability to create a new airport. First select an identifier that is not already being used in the NAV or pilot database. If the identifier selected is already in use, when the **ENTER** key is pressed the identifier will flash and not move to the DEFINE ARPT page.



Once the identifier is accepted, the **DEFINE ARPT** page will allow for defining the airports geographic reference point, usually the center of the airfield. The coordinates can be entered in the same manner as defining a pilot created waypoint. Use either radial-and-distance from a known fix, or the crossing radials of two known fixes, or directly enter the latitude and longitude.



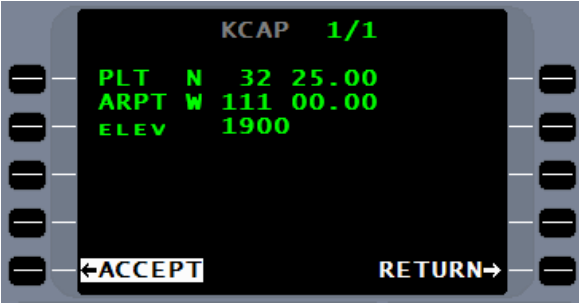
After entering the Airport reference point by one of the above methods, press either the **ENTER** key or the ACCEPT ARPT line select key.



The next page allows for entering the airport altitude.



Accept the altitude and the airport is defined.



The **PLT ARPTS** page now reflects the created airport.

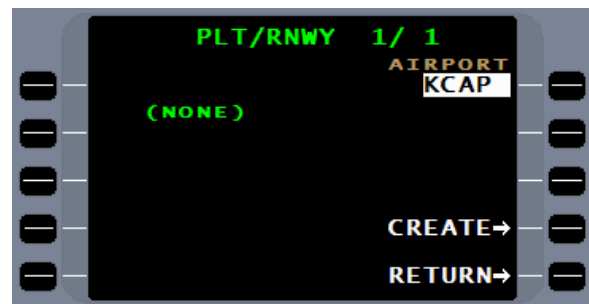


PILOT DEFINED RUNWAY

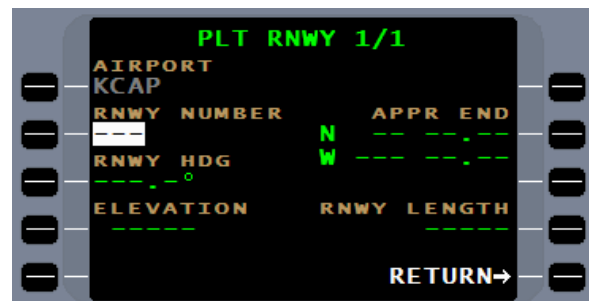
For the pilot defined airport a runway can be defined. Through the DATA/PLT page select **RUNWAY**.



After entering the airport identifier, press **ENTER** and the CREATE line select key becomes available.



Pressing the CREATE line select key brings up the PLT RNWX page. Enter the runway identifier and press the **ENTER** key. A [L], [C], or [R] may be added for left, center, or right.



The runway end or threshold coordinates must now be entered. Use the same procedures as with the DEFINE AIRPORT page.

DEFINE RNWY [M]

REF WPT	WPT
---	RW16
N ---	N ---
W ---	W ---
RADIAL/DIST	GNSS POS
WPT/RADIAL	FMS1 POS
---	---

RETURN→

Accept these runway end coordinates and move to the next page.

VERIFY POS [M]

REF WPT	WPT
---	RW16
N ---	N 32 25.50
W ---	W 111 00.15
RADIAL/DIST	GNSS POS
WPT/RADIAL	FMS1 POS
---	---

←ACCEPT RNWY RETURN→

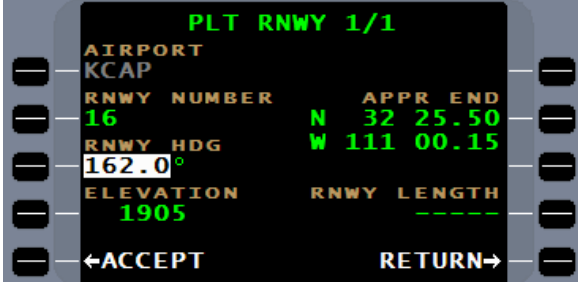
Enter the runway end altitude, which may or may not be the same as the airport geographic reference point.

PLT RNWY 1/1

AIRPORT	RNWKY NUMBER	APPR END
KCAP	16	N 32 25.50
	RNWKY HDG	W 111 00.15
	---	---
ELEVATION	RNWKY LENGTH	
1905	---	

RETURN→

Enter the runway heading. It can be defined to the tenth of a degree.




PLT RNWY 1/1

AIRPORT	KCAP		
RNWX NUMBER		APPR END	
16	N	32	25.50
RNWX HDG	W	111	00.15
162.0°			
ELEVATION		RNWX LENGTH	
1905		-----	

←ACCEPT RETURN→

Finally, define the Runway length.

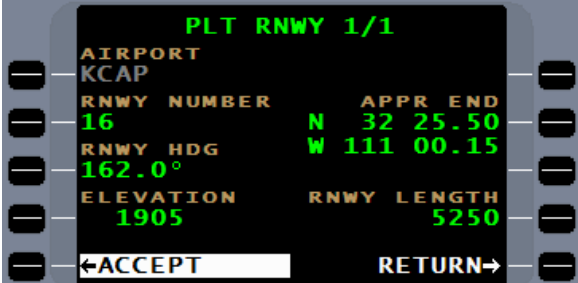


PLT RNWY 1/1

AIRPORT	KCAP		
RNWX NUMBER		APPR END	
16	N	32	25.50
RNWX HDG	W	111	00.15
162.0°			
ELEVATION		RNWX LENGTH	
1905		5250	

←ACCEPT RETURN→

Accept the defined runway.

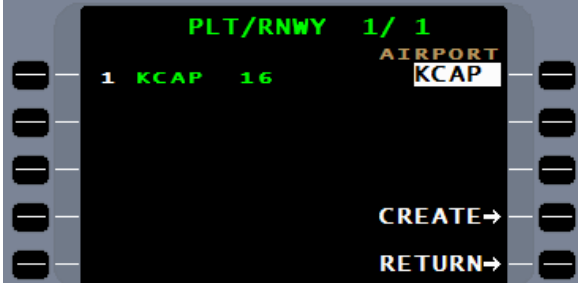


PLT RNWY 1/1

AIRPORT	KCAP		
RNWX NUMBER		APPR END	
16	N	32	25.50
RNWX HDG	W	111	00.15
162.0°			
ELEVATION		RNWX LENGTH	
1905		5250	

←ACCEPT RETURN→

Review the newly created pilot runway.



PLT/RNWX 1/ 1

AIRPORT	KCAP		
1 KCAP 16			

CREATE→ RETURN→

EQUAL TIME POINT (ETP) & POINT OF NO RETURN (PNR)

Begin on **ETP/PNR 1/4** by entering divert airports to include departure and arrival airports.

ETP/PNR 1/4			
	DTG	DTG	FUEL
	TIME	DIST	OVHD
		NM	LBS
ARPT1	CYYR	0	
ARPT2	EINN	1821	
ARPT3	BIRK	1336	
ARPT4	LPAZ	1760	

To calculate ETP and PNR, on page 2 enter the COAST OUT and COAST IN airports from a list compiled from page 1.

ETP/PNR 2/4			
NORMAL			
COAST OUT	CYYR	WINDS OUT	
COAST IN	EINN	WINDS IN	
FPL WINDS		(LBS/HR)	FF
FOB (LBS)		TAS	

Pressing line select key 1 or 2 will bring up the list of airports from page 1.

ALTN ARPTS		SELECT
		#
1	CYYR	
2	EINN	
3	BIRK	
4	LPAZ	
		RETURN

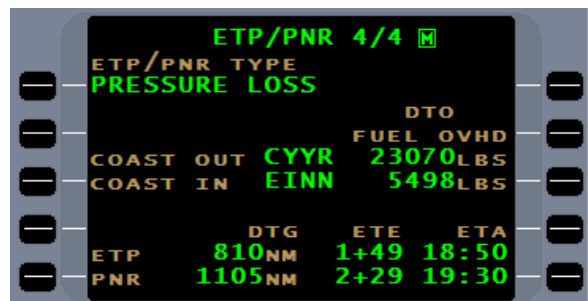
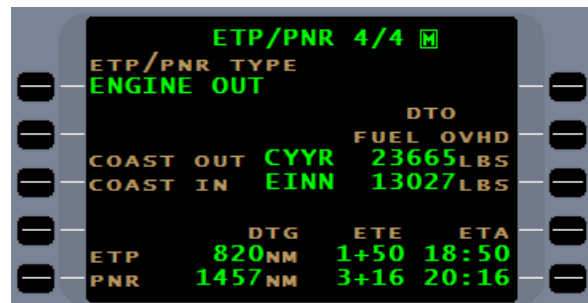
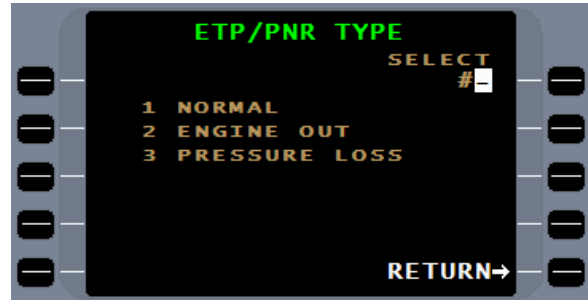
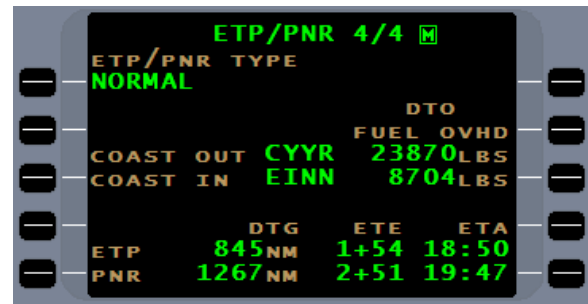
Information for FPL WINDS, FOB, FF, and TAS will be pre filled by the FMS if available. WINDS OUT and WINDS IN will be filled from forecast flightplan winds if available or can be manually entered by the pilot.

ETP/PNR 2/4			
NORMAL			
COAST OUT	CYYR	WINDS OUT	
COAST IN	EINN	WINDS IN	
FPL WINDS		(LBS/HR)	FF
FOB (LBS)		TAS	

For ENG OUT and PRESSURE LOSS ETP/PNR calculations, required information must be entered manually.

ETP/PNR 3/4			
ENG OUT		PRESSURE LOSS	
CYYR	180T/ 5 (M)	WINDS (M)	CYYR 180T/ 3
EINN	290T/ 10 (M)	WINDS (M)	EINN 290T/ 10
FF (LBS/HR)	2500 (M)	(LBS/HR)	FF 4400
TAS	380 (M)	(M)	TAS 400

Display of ETP/PNR information for NORMAL, ENGINE OUT, and PRESSURE LOSS is selectable by pressing 1L line select key.



PROCEDURAL LEG TYPES

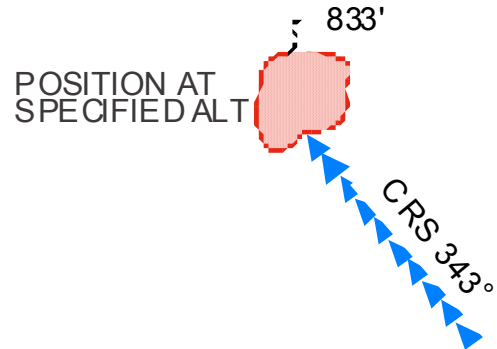
SIDS, STARS, APPROACH TRANSITIONS, MISSED APPROACHES

Standard Instrument Departures (SID) and Standard Terminal Arrival Routes (STAR) consist of procedural legs that begin and end at prescribed locations or conditions. A procedural leg has two parts: a leg path and a leg terminator. The path of these legs can be flown along a heading, a course, a great circle path, or even a constant arc. The termination of a leg can occur at a specific geographic fix, at a VOR radial crossing, or when the aircraft attains a certain altitude. The FMS with SCN 80X will fly the different procedural leg types as defined in ARINC 424, of which airport departures and arrivals are comprised.

The following make up the twenty-three leg types that are currently in use:

Heading to Altitude	VA
Heading to a DME Distance	VD
Heading to a Next Leg Intercept	VI
Heading to a Manual Termination	VM
Heading to a Radial Termination	VR
Course to an Altitude	CA
Course to a DME Distance	CD
Course to a Next Leg Intercept	CI
Course to a Radial Termination	CR
Course to a Fix	CF
Tracking Between Two Fixes	TF
Direct to a Fix	DF
Course from a Fix to an Altitude	FA
Course from a Fix to an Along Track Distance	FC
Course from a Fix to a DME Distance	FD
Course from a Fix to a Manual Termination	FM
Constant DME Arc to a Fix	AF
Constant Arc Radius to a Fix	RF
Hold to a Fix	HF
Hold to an Altitude	HA
Hold to a Manual Termination	HM
Initial Fix	IF
Procedure Turn to Intercept	PI

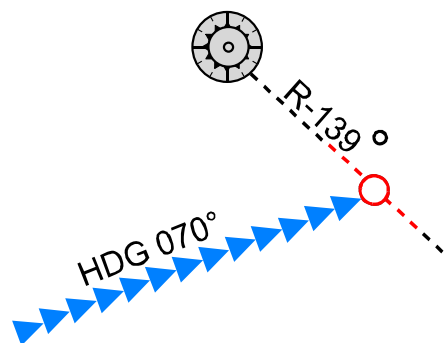
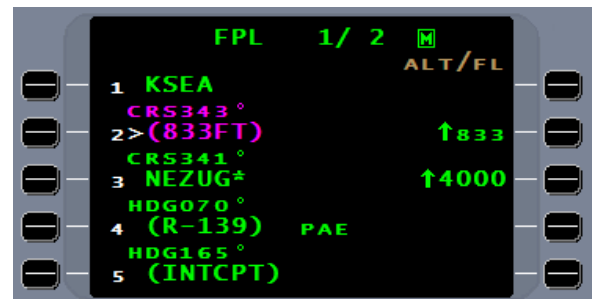
The following illustrates the Seattle airport (KSEA), Runway 34L, using the SUMMA SIX departure with the Lakeview (LKV) transition as shown in the Flight and Departure section of this manual. Listed with each screen is the exact procedural leg type used to navigate this departure. Remaining procedural leg types not used in this departure follow with an appropriate example of each.



COURSE TO ALTITUDE (CA)

The aircraft will fly runway course 343° until reaching 833 feet.

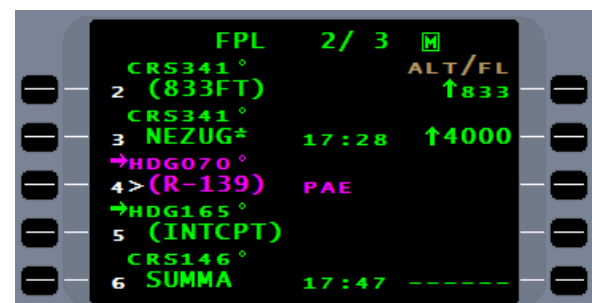
Course to Altitude



HEADING TO RADIAL (VR)

The aircraft will turn right to a heading of 70° until crossing the PAE 139° radial.

Heading to Radial

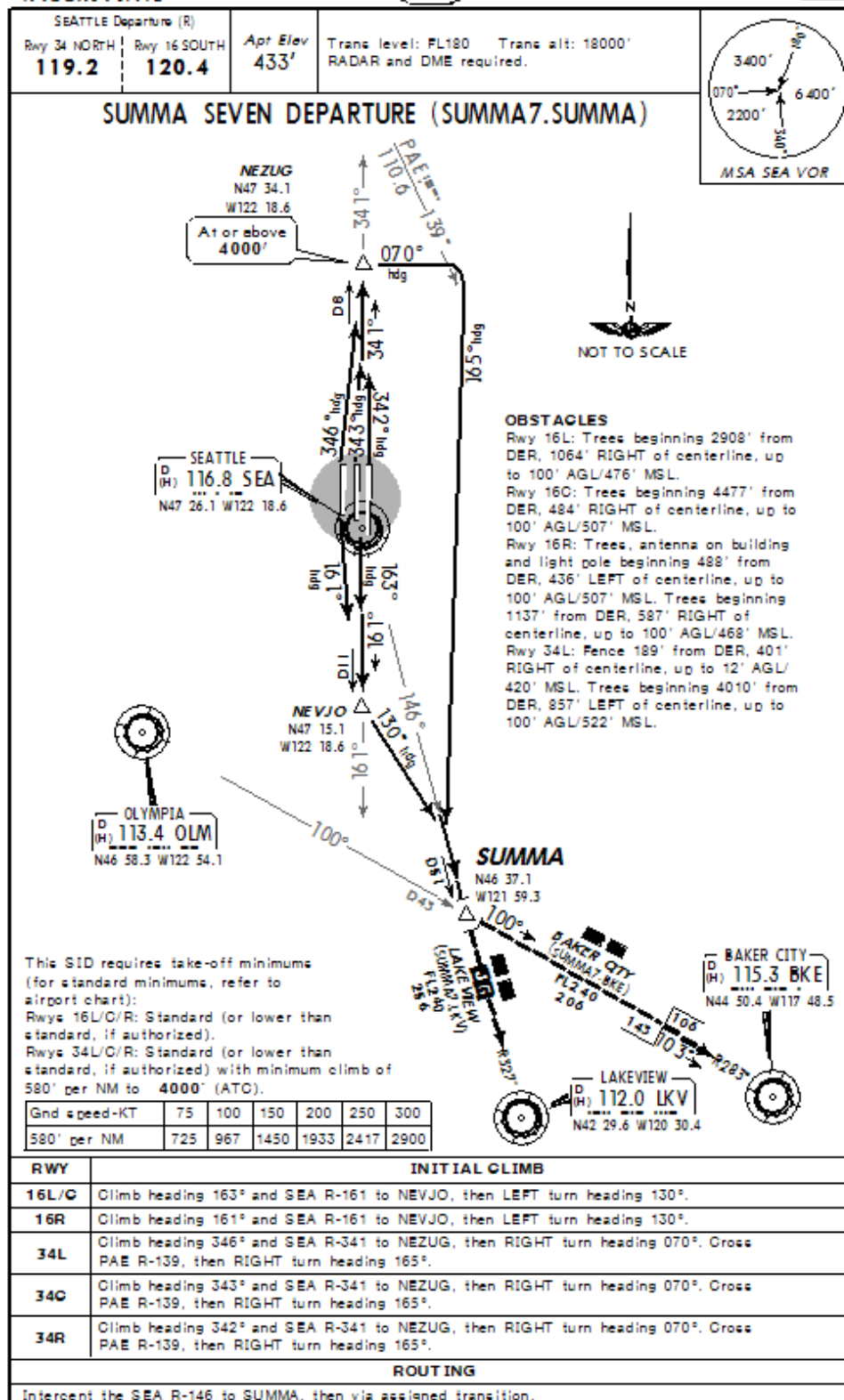


KSEA/SEA
-TACOMA INTL

JEPPesen
14 NOV 08 20-3G Eff 20 Nov

SEATTLE, WASH

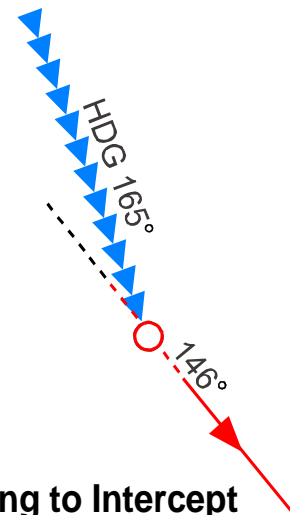
SID



CHANGES: Procedure revised, renumbered, runways 16L/34R added. MSA.

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HEADING TO INTERCEPT (VI)

The aircraft will turn right to 165° HDG until intercepting course 146° inbound to SUMMA.

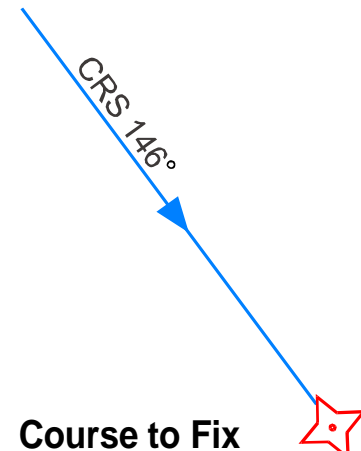
Heading to Intercept

	FPL	2/ 5	M	ALT/FL
→	HDG070°			
4	(R-139)	PAE		
→	HDG165°			
5>	(INTCPT)			
	CRS146°			
6	SUMMA	17:48	-----	
	147°	255NM	-----	
7	LKV	18:59	-----	
	151°	82.0NM	-----	
8	BAARB	19:22	-----	

COURSE TO FIX (CF)

The aircraft will turn left, intercept, and fly 146° course to SUMMA intersection.

Course to Fix

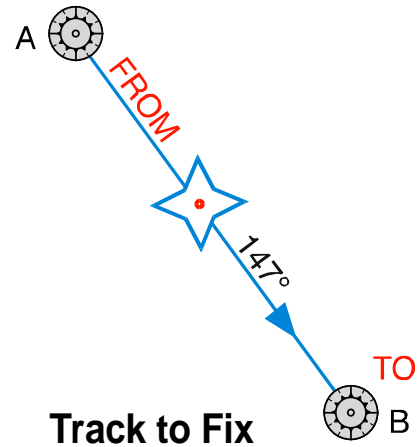


A diagram illustrating a course to fix. A blue arrow points towards a red star symbol, which represents the intersection point. The arrow is labeled 'CRS 146°'.

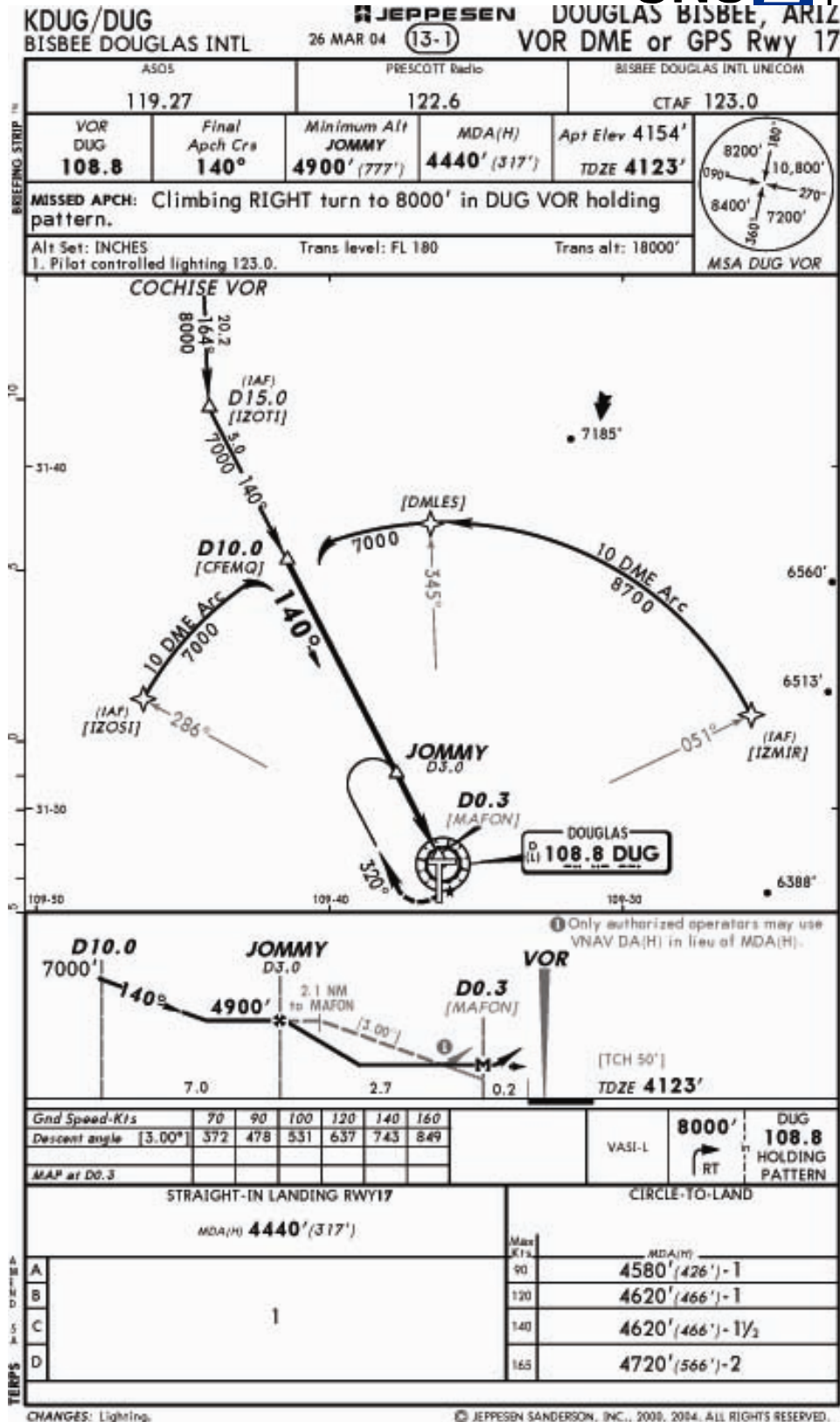
	FPL	2/ 5	M	ALT/FL
→	HDG165°			
5	(INTCPT)			
	CRS146°			
6>	SUMMA	17:42	-----	
	147°	255NM	-----	
7	LKV	18:21	-----	
	151°	82.0NM	-----	
8	BAARB	18:33	-----	
	152°	19.8NM	-----	
9	HARTT	18:36	-----	

TRACK TO FIX (TF)

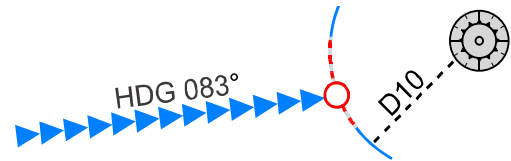
After SUMMA, the aircraft will fly a TRACK to FIX LEG of 147° initially from SUMMA to LKV VOR.



	FPL	2/ 5	ALT/FL
→ HDG 165°			
5 (INTCPT)			
CRS 146°			
6 SUMMA	17:42	-----	
147°	255NM	-----	
7 > LKV	18:21	-----	
151°	82.0NM	-----	
8 BAARB	18:34	-----	
152°	19.8NM	-----	
9 HARTT	18:37	-----	



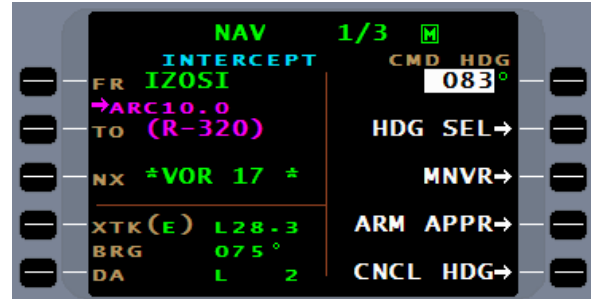
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HEADING TO DME DISTANCE (VD)

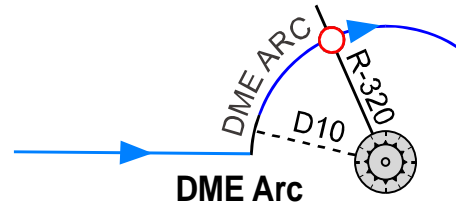
The VD leg is a heading to intercept DUG 10nm ARC which is defined by the leg IZOSI to DUG 320° radial.

Heading to DME Distance

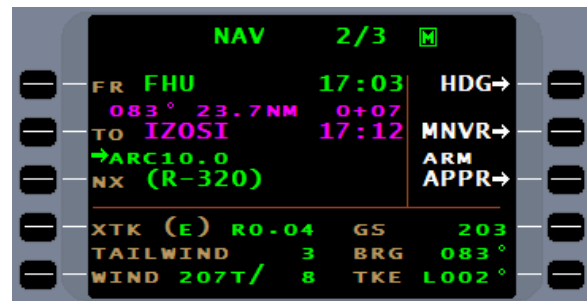


ARC TO FIX (AF)

Upon intercepting the DUG 10 DME ARC, the aircraft will arc right to follow the 10 DME ARC to the terminator of DUG R-320.

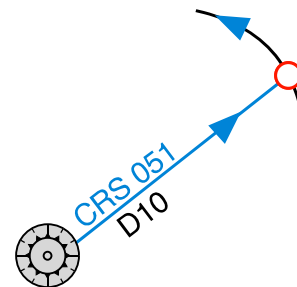


DME Arc



FIX TO DME DISTANCE (FD)

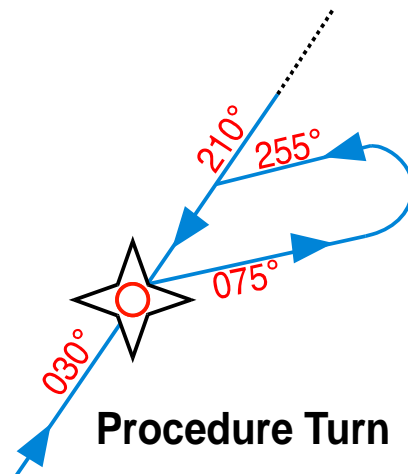
From the DUG VOR, the aircraft will track outbound on 051° course 10nm to IAF of IZMIR. The aircraft will then turn left and follow the 10 DME ARC to the terminator, DUG R-345.



Course from Fix to DME Distance

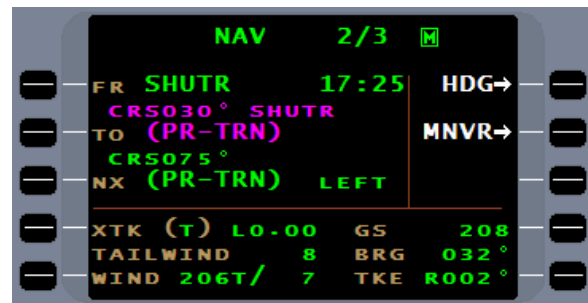


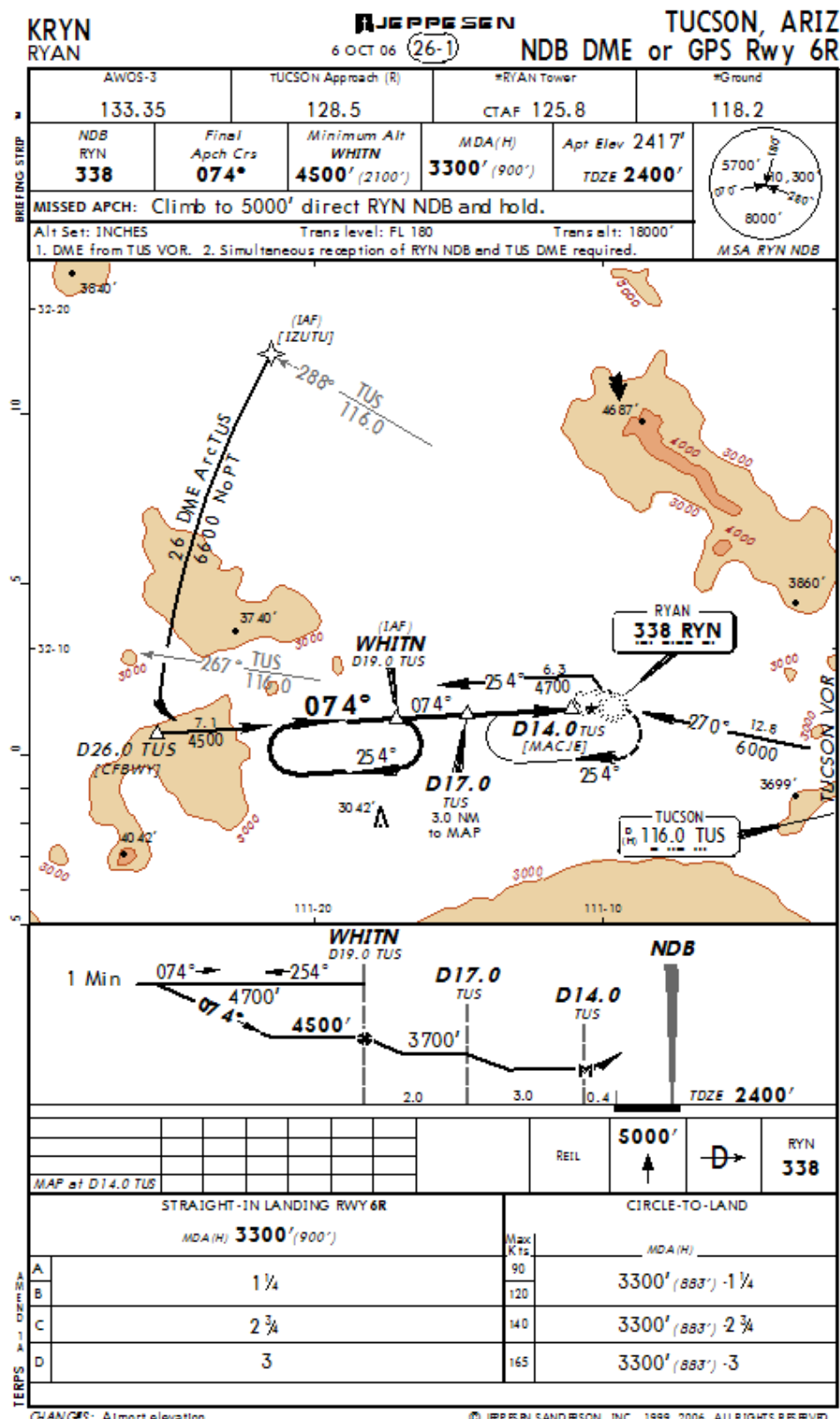




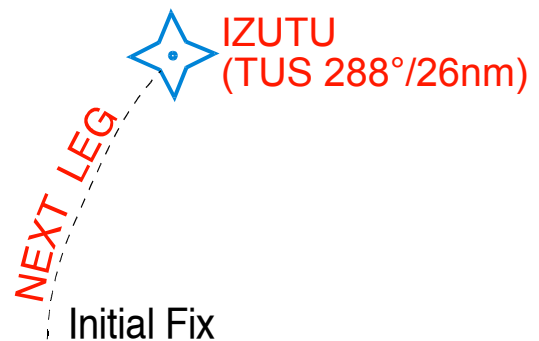
PROCEDURE TURN TO INTERCEPT (PI)

After arriving at SHUTR, the aircraft will turn to 030° then to 075° followed by a turn left to 255° at the correct time/distance interval to intercept 210° course inbound.



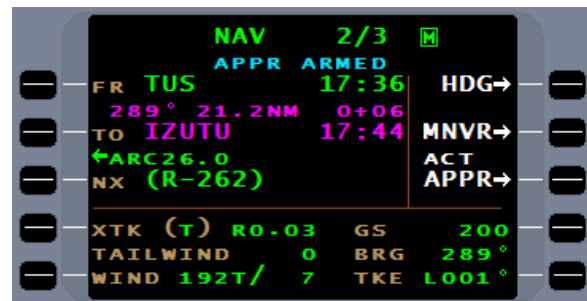


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INITIAL FIX (IF)

IZUTU, defined by the TUS 288° radial at 26nm, is designated "Initial Fix" for NDB DME or GPS Rwy 6R approach at KRYN. The aircraft will fly direct from TUS VOR to IZUTU. The difference between the FMS course of 289° and the TUS VOR radial of 288° is attributed to the VOR declination of 12°E and the FMS magnetic variation of 11°E.

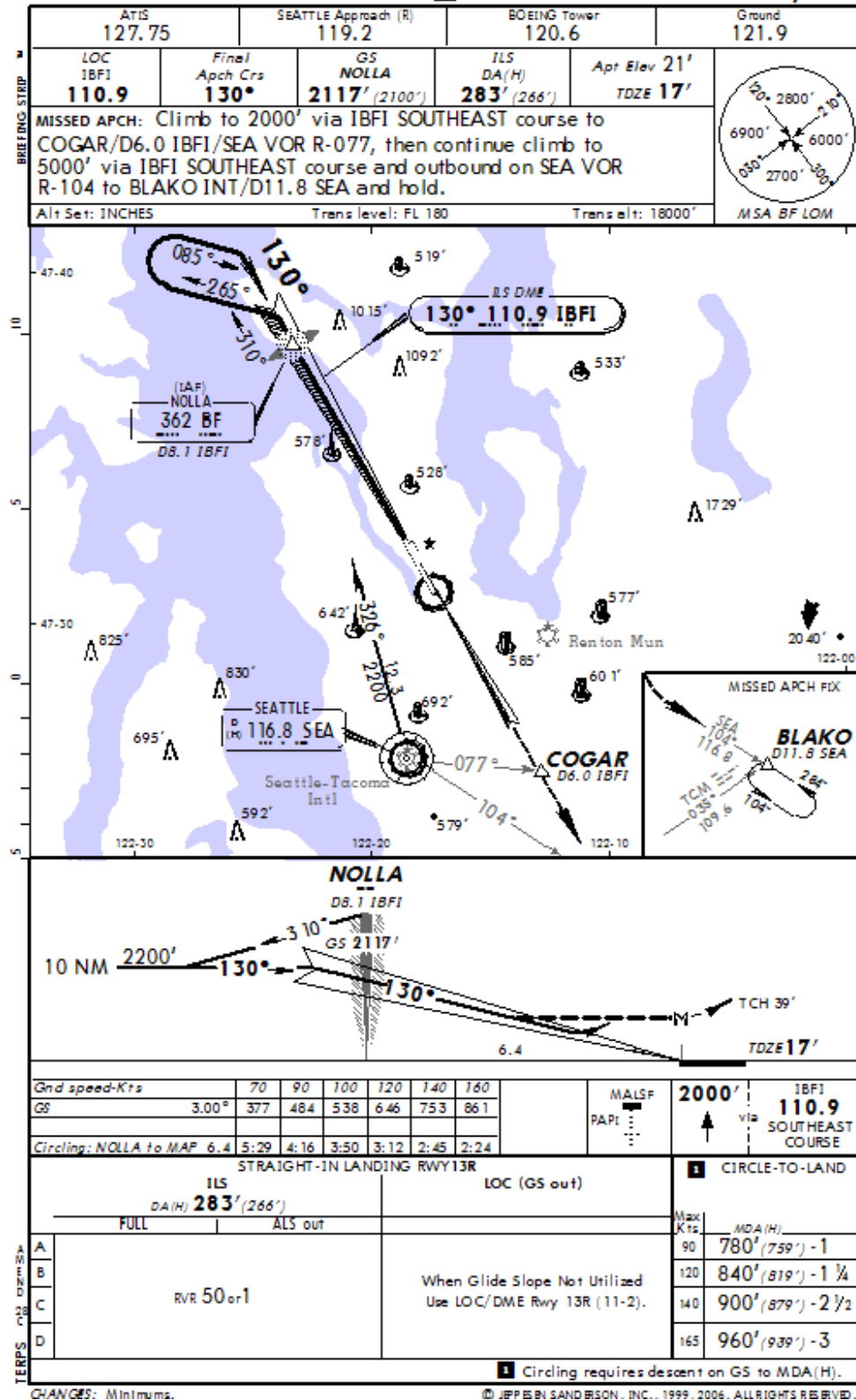


KBFI/BFI

BOEING FLD/KING CO INTL

JEPPESSEN

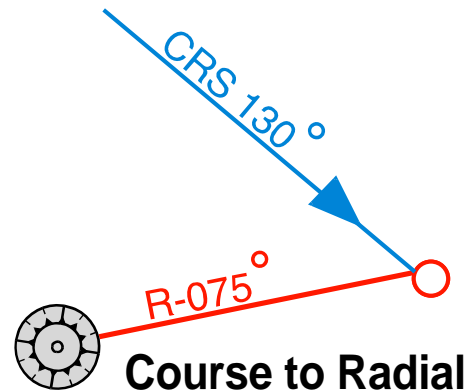
3 NOV 06 (11-1)

SEATTLE, WASH
ILS Rwy 13R

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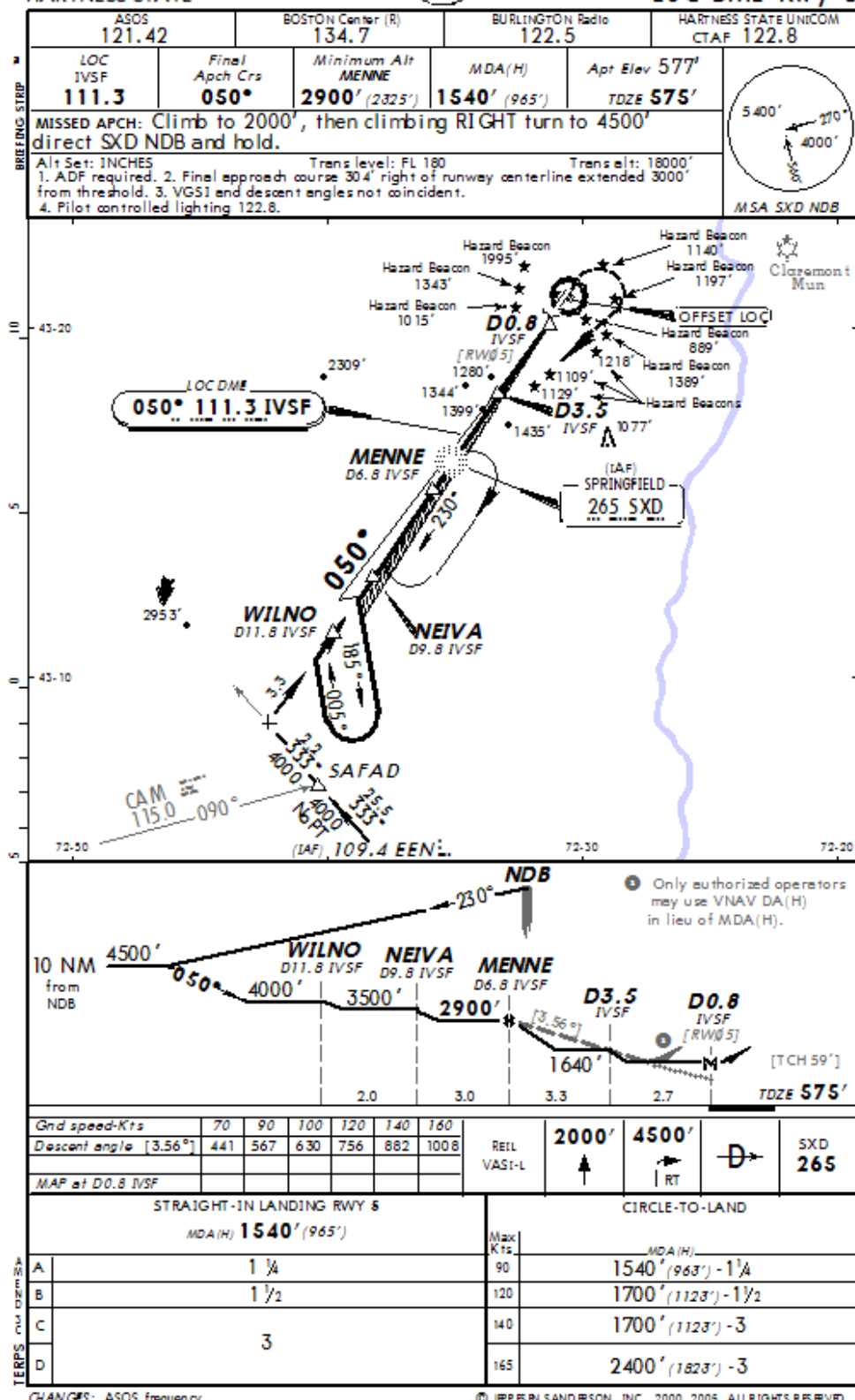
COURSE TO RADIAL (CR)

On the Missed Approach from the ILS RWY 13R the aircraft will climb out the 130° localizer course to intercept the 075° radial from SEA and then on to the 101° radial of SEA.



	FPL	9/10	ALT/FL
32	*EOA*		
33	CRS130° (421FT)		↑421
34	COGAR CRS130° (INTCPT)	22:55	↑2000
35	CRS104°		
36	BLAKO*	22:58	↑5000

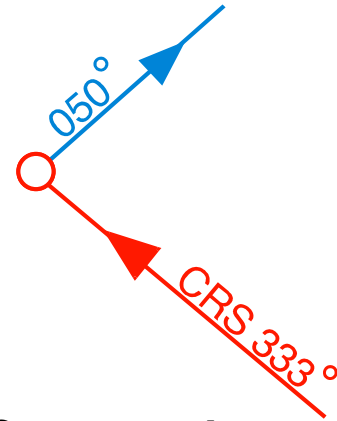
KVSF/VSF
HARTNESS STATE
JEPPESSEN
 25 FEB 05 (11-1)

SPRINGFIELD, VT
LOC DME Rwy 5


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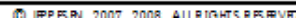


COURSE TO INTERCEPT (CI)

From EEN the Initial Approach Fix (IAF), on a course of 333° through SAFAD, the aircraft will intercept the Localizer course of 050° for the LOC DME Rwy 5 approach.

Course to Intercept

	FPL	2/ 5	M
5	EEN	049° 2231NM	ALT/FL
		19:21	-----
6	SAFAD	334° 25.5NM	x6428
		19:29	
7	(INTCPT)		↑4000
	CRS050°		
8	WILNO	19:31	x4673
	CRS050°		
9	NEIVA	19:31	x4037



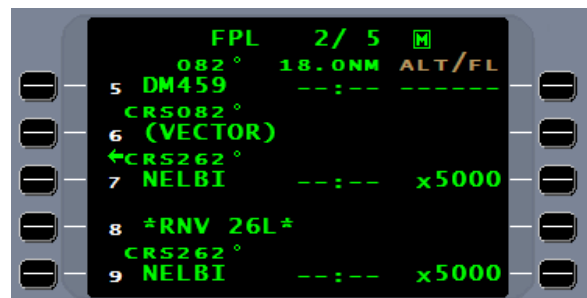
Report No. 3040sv80X/90X



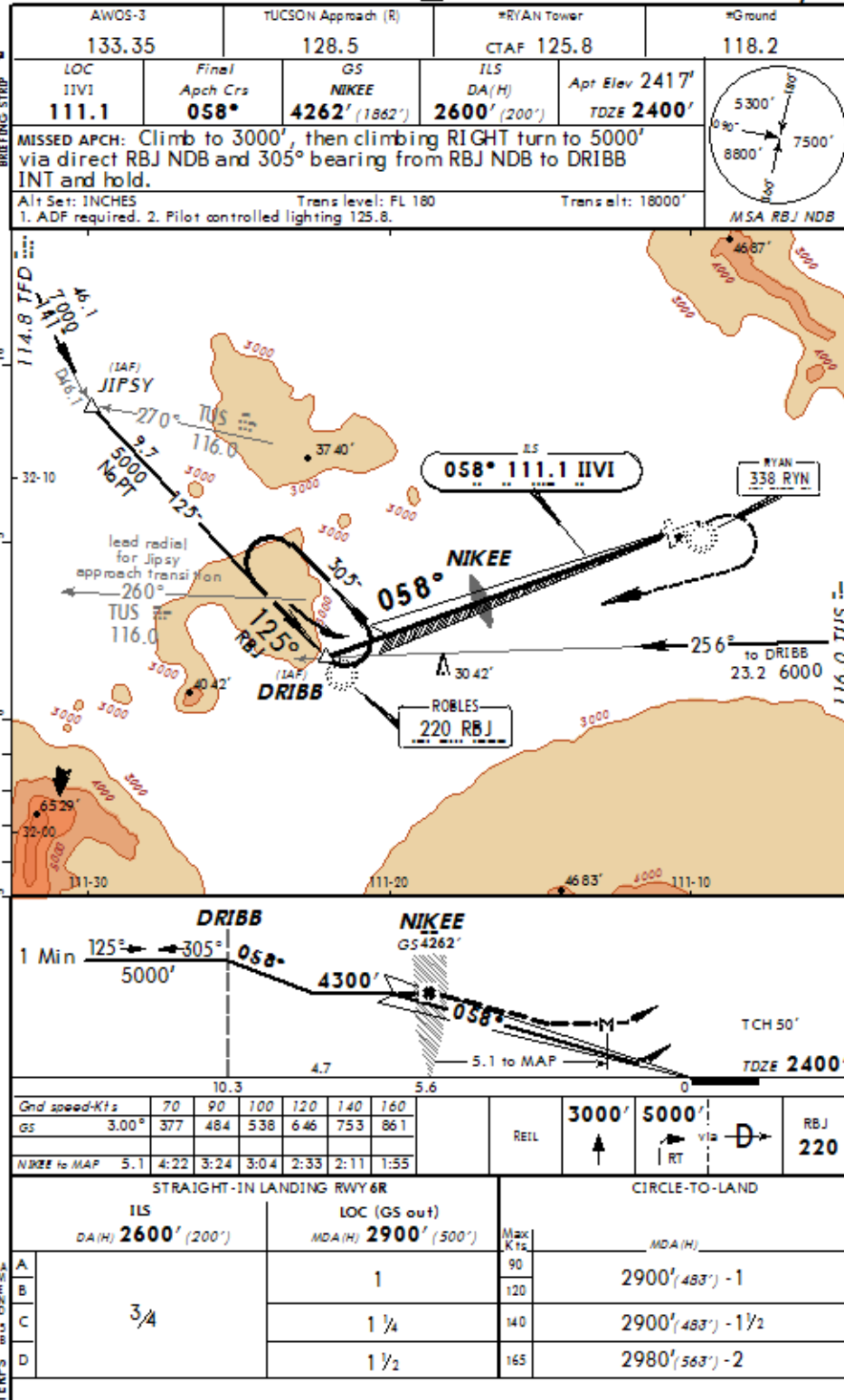
FIX TO MANUAL TERMINATION (FM)

FMS arrival guidance to aircraft on the EDDM BETOS26 RNAV Transition will maintain the current track with course of 082° and the leg will terminate with (VECTOR). After entering this leg the pilot will expect ATC vectors.

FIX TO MANUAL TERMINATION



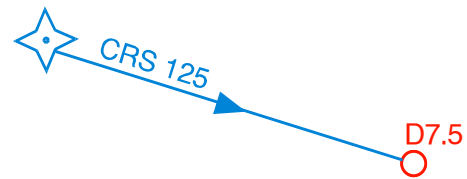
KRYN
RYAN
JEPPESSEN
 20 OCT 06 (21-1)

TUCSON, ARIZ
ILS or LOC Rwy 6R


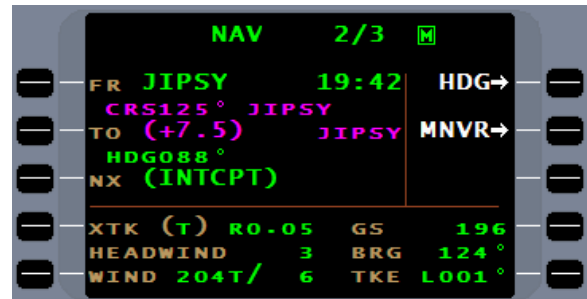
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FIX TO A DISTANCE ON COURSE (FC)

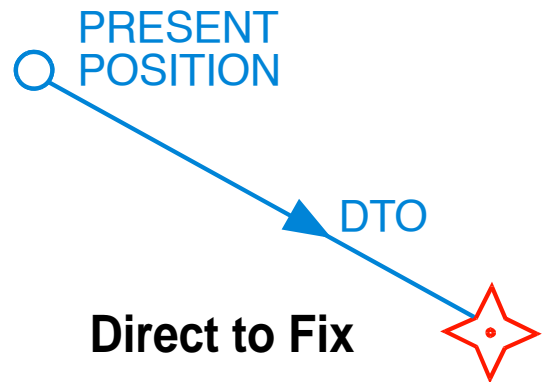
The aircraft will fly a course of 125° from JIPSY to (+7.5) DME that is the lead-in RADIAL for the ILS intercept. The aircraft will then turn left to 88° HDG at (+7.5).



Course from Fix to Along Track Distance







DIRECT TO FIX (DF)

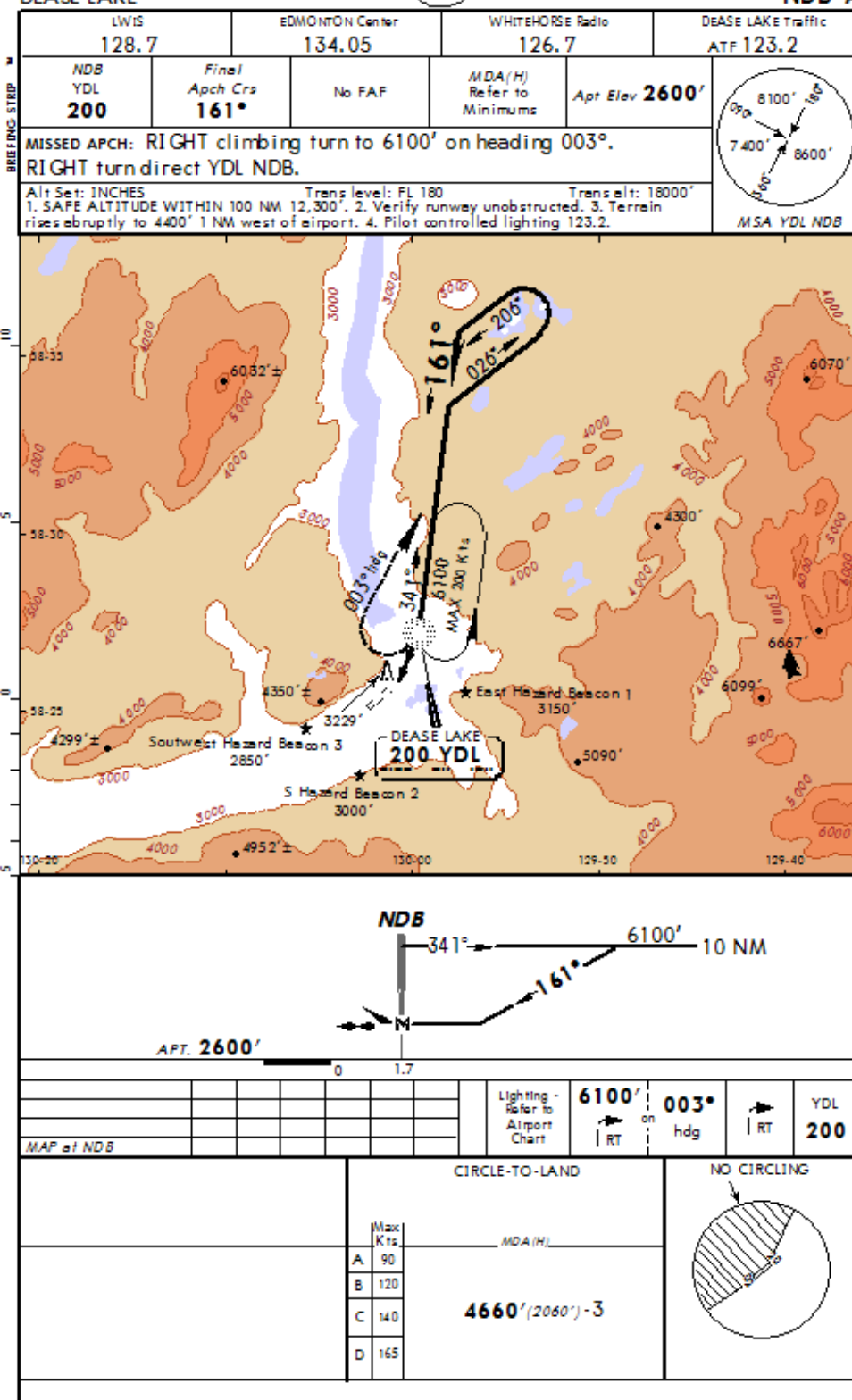
During the missed approach when the FMS reaches 2849FT, the FMS will proceed direct to CURGA.

	FPL	11/12	ALT/FL
38	*EOA*		
	CRS123°		
39	(2849FT)		↑2849
	DIRECT		
40	CURGA	19:56	-----
	214°	13.9NM	
41	REBDE	20:00	-----
	304°	14.5NM	
42	TOYOP*	20:05	↑6000

CYDL/YDL
DEASE LAKE

JEPPESSEN

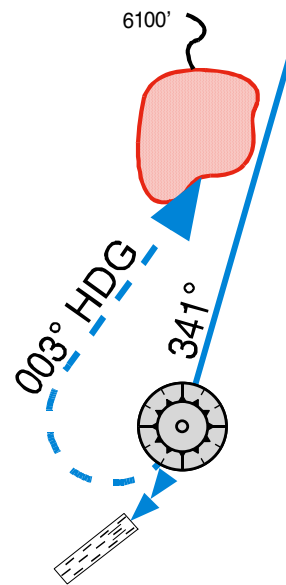
27 JAN 06 (16-1)

 DEASE LAKE, BC
NDB-A


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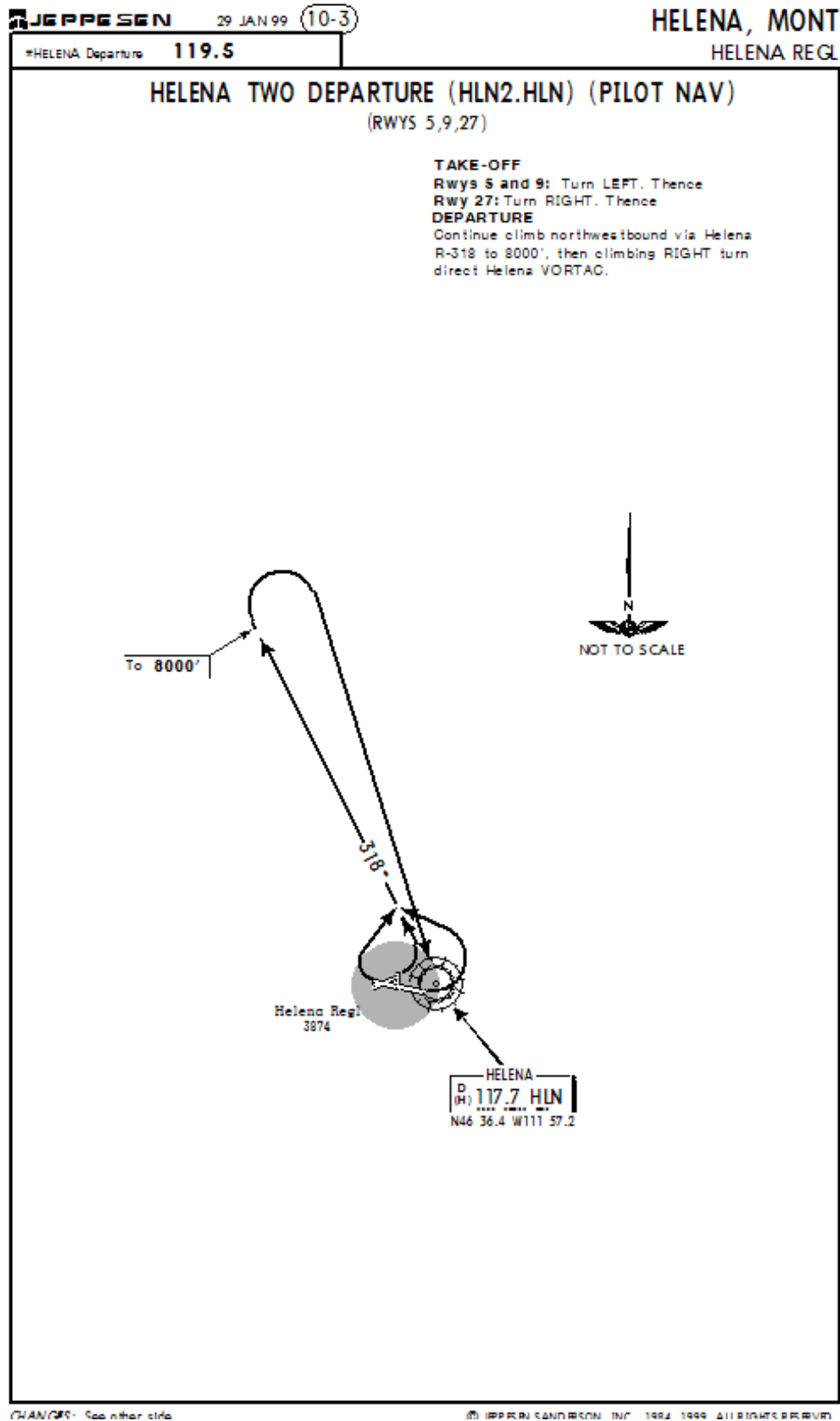


Heading to Altitude

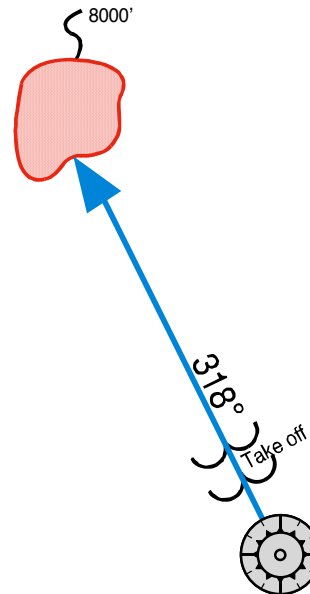
HEADING TO ALTITUDE (VA)

On the missed approach, the FMS will command a right climbing turn on a heading of 003 to an altitude of 6100' and then direct YDL. The difference in heading is due to the FMS magnetic variation model.

		FPL	5/ 6	ALT/FL
17	YDL*	159°	4.0NM	@4660
18	*EOA*			
19	CRS158°			
	(4660FT)			↑4660
20	→HDG360°			↑6100
	(6100FT)			
	→DIRECT			
21	YDL*			@6100



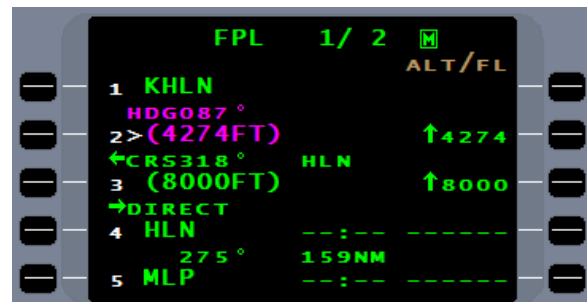
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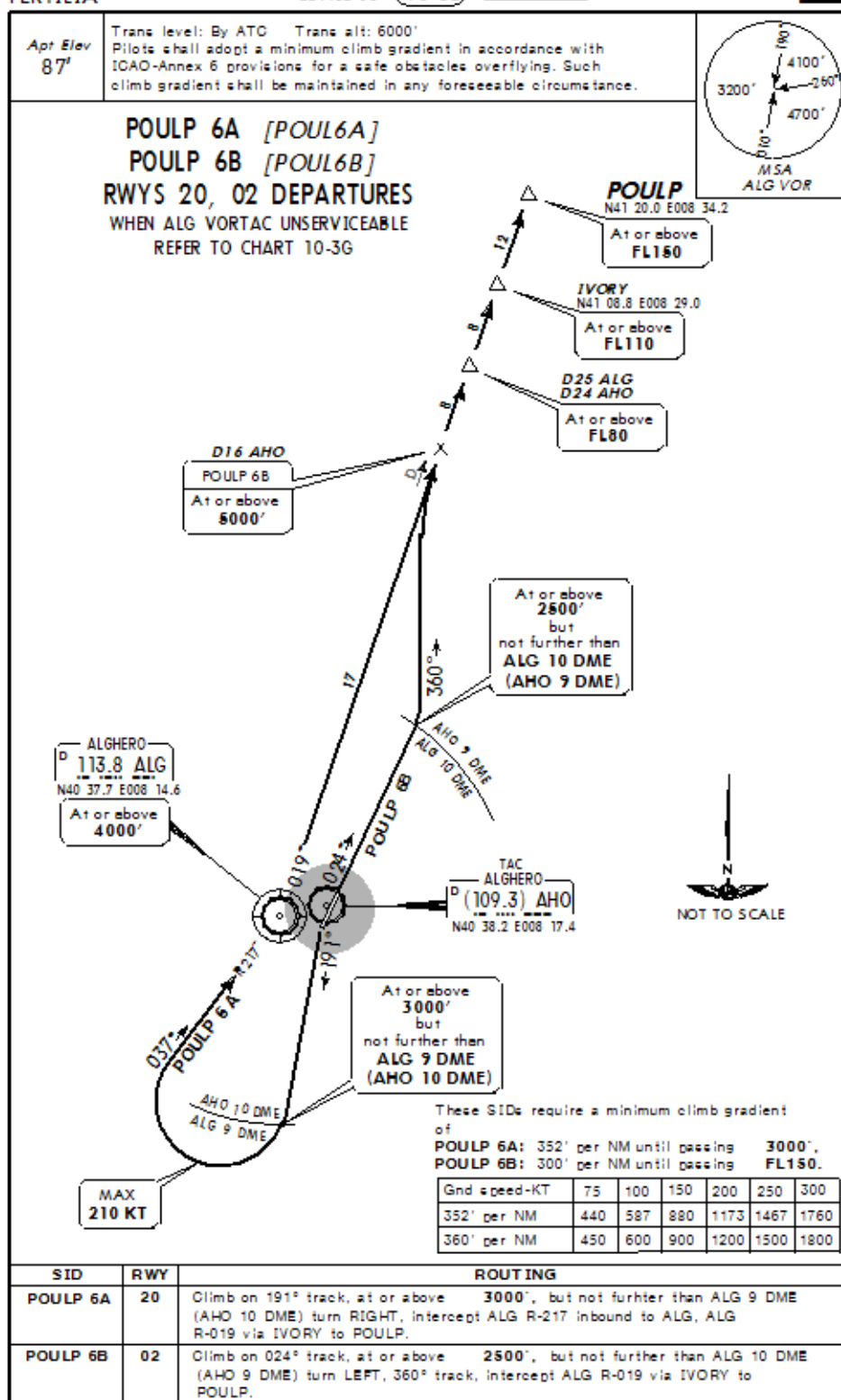
COURSE FROM FIX TO ALTITUDE (FA)

Following takeoff, the aircraft will turn and follow the 318° course from the HLN VOR to 8000'.

Course from Fix to Altitude



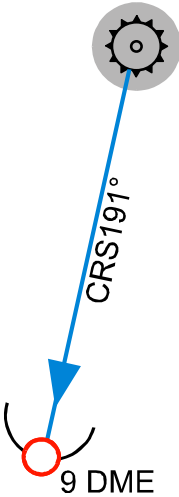
LIEA/AHO
FERTILIA
JEPPesen
 22 AUG 08 **10-3E** Eff 28 Aug

ALGHERO, ITALY
SID


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COURSE TO DME DISTANCE (CD)

After takeoff, the aircraft will follow the 191° course of ALG VOR no farther than 9 DME.

Course to DME Distance



KTUS/TUS
TUCSON INTL
JEPPESON

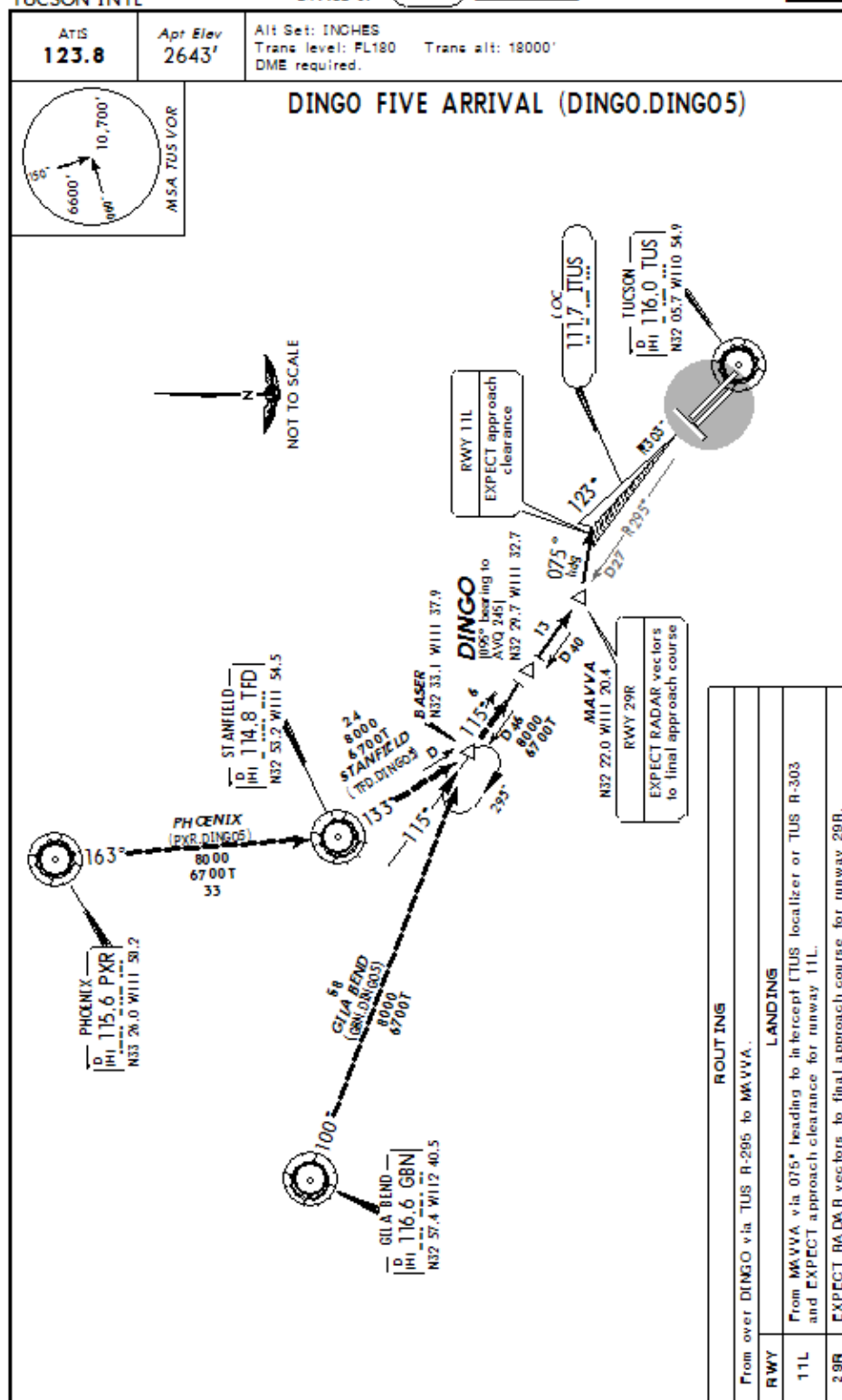
24 AUG 07

10-2

Eff 30 Aug

TUCSON, ARIZ

STAR



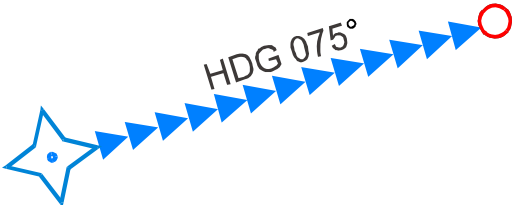
CHANGES: DINGO formation, new format.

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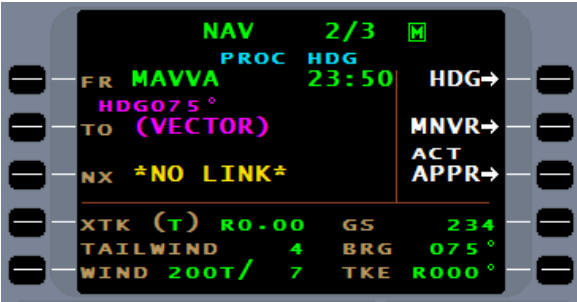
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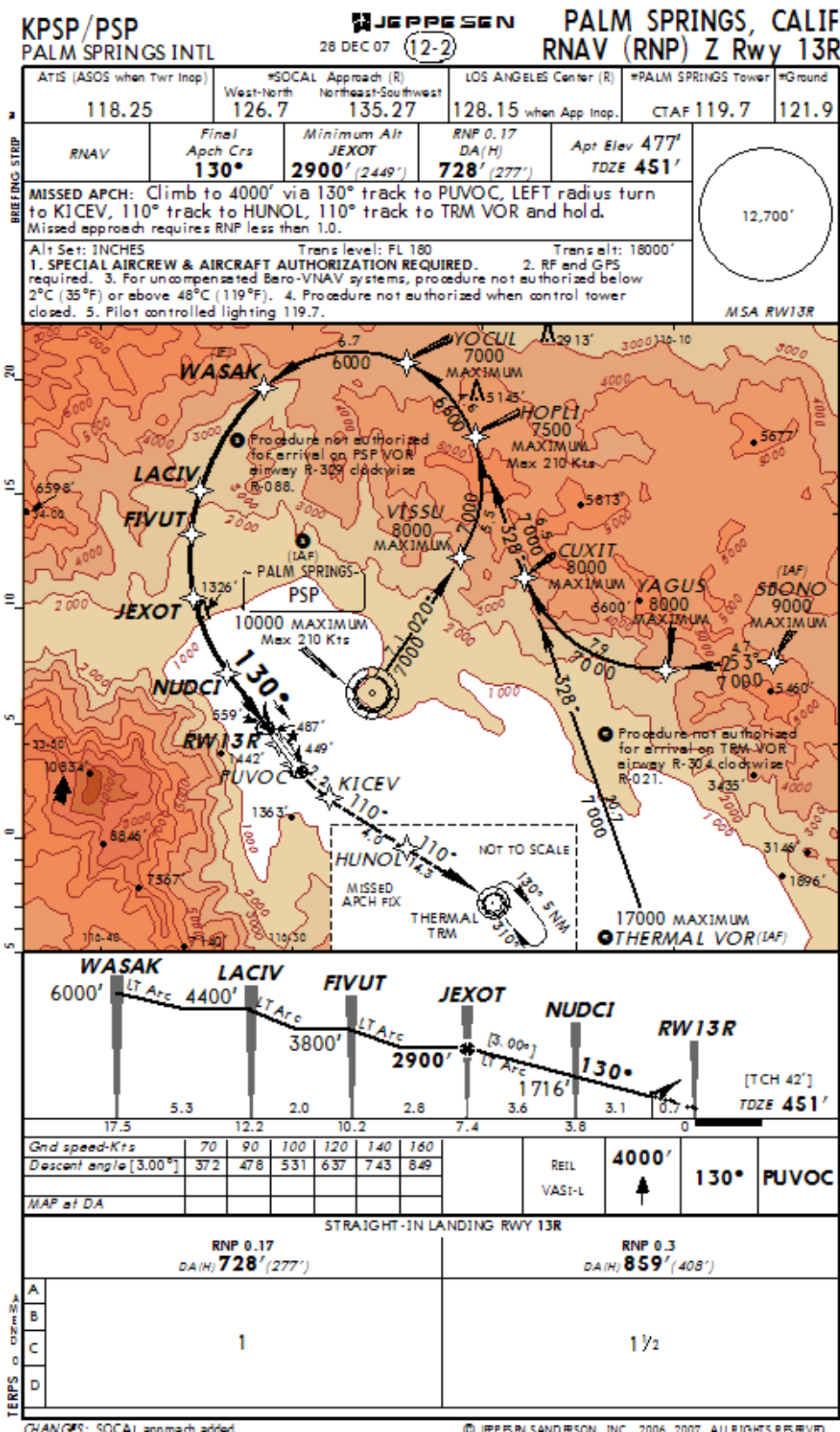


HEADING TO MANUAL TERMINATION (VM)

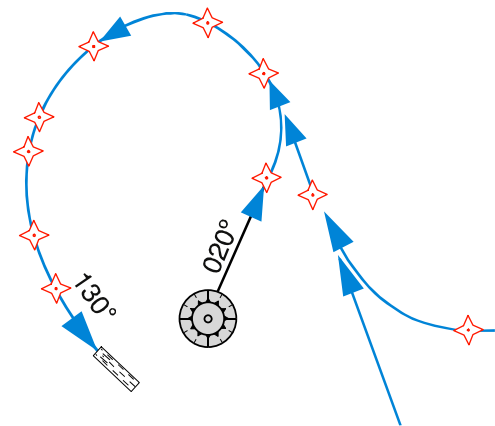
Upon crossing MAVVA intersection, the aircraft will turn to a heading o 075° until manually terminated.

Heading to Manual Termination





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Radius to Fix

RADIUS TO FIX (RF)

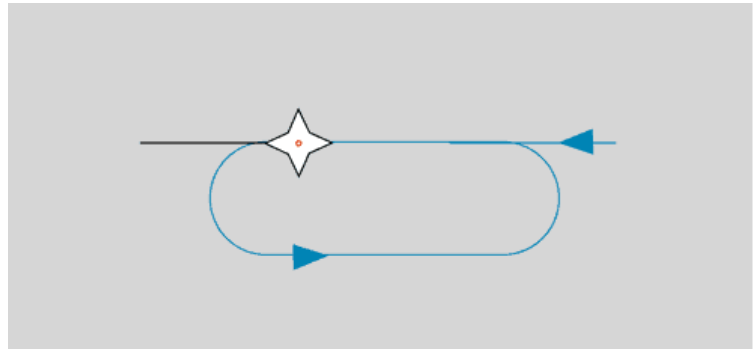
On this RNAV (RNP) approach, the FMS must navigate on a series of radius to fix or precision arcs until reaching minimums. These arcs are not based on a ground-based navaid.

	FPL	7/11	M	
25	PSP	304° 19.8NM	ALT/FL	x10000
26	VISSU	020° 7.1NM		x8000
27	HOPLI			x7500
28	YOCUL			x7000
29	WASAK			x6108

	FPL	8/11	M	
29	WASAK			x6108
30	*RNV 13R*			
31	WASAK	CRS213°		x6108
32	LACIV			x4432
33	FIVUT			x3807

	FPL	9/11	M	
33	FIVUT			x3807
34	JEXOT			x2900
35	NUDCI			
36	RW13R*	130° 3.8NM		@493
37	*EOA*			

HF HA and HM LEGS
HOLD TO FIX
HOLD TO ALTITUDE
HOLD TO MANUAL TERMINATION



The HF leg – Hold to a fix – will result in one orbit of the hold. It will sequence legs and exit after one circuit. This type of hold is frequently used in an approach where a holding pattern is used in lieu of a procedure turn.

	FPL	8/12	M	
26	115° MAVVA	13.0NM	ALT/FL	-----
27	115° >TUS	27.0NM	21:35	-----
28	304° LIPTE*	17.8NM	21:43	x7500
29	→HLD123° LIPTE	21:43	x6781	-----
30	124° WASON	5.0NM	21:46	x5729

The HA leg – Hold to Altitude – is provided for a climb in the holding pattern. On reaching the terminating altitude, the system will cross the holding fix then sequence legs to proceed on course to the next waypoint in the flightplan.

	FPL	2/ 3	M	
5	CRS221° SIMCO*	13:46	ALT/FL	-----
6	→HLD221° (12000FT)	SIMCO	13:46	↑12000
7	175° LTJ	43.1NM	14:09	-----
8	206° EUG	131NM	15:20	-----
9	168° RBG	56.6NM	15:50	-----

The HM leg – Hold to a manual termination does exactly as the name implies. Leg sequencing requires pilot's intervention.

	FPL	7/12	M	
22	119° GBN	45.6NM	ALT/FL	-----
23	103° >BASER*	58.0NM	19:16	-----
24	→HLD115° (HOLD)	BASER	19:16	-----
25	115° DINGO	5.5NM	19:17	-----
26	115° MAVVA	13.0NM	19:21	-----

FMS APPROACH OPERATIONS

The FMS is approved for a variety of approaches. The approach capabilities of a specific installation depend on the installed sensor suite and the interfaced aircraft flight guidance system. The approved approaches include the following:

GLS	Global Navigation Satellite Landing System – requires GLS 1250
ILS	FMS Defined – ILS Guided – requires NAV to NAV Avionics
LOC/LOC-BC	Requires LOC input to FMS –must be WGS-84 surveyed
RNAV (GPS)	Requires GPS 1000/1000a, GNSS, or GLS 1250
RNAV (VOR DME)	Requires GPS or VOR/DME
RNAV (RNP)	Requires compliance with AC 90-101
VOR/VOR DME	Requires VOR and DME sensor input to FMS
NDB	GPS required flying the approach
TACAN	Requires RRS Sensor, approved TACAN sensor, or GPS
VFR	Pilot Defined, used only in VFR conditions

APPROACH DATABASE

FMS approaches can only be executed when the approach is defined in the FMS navigation database. The approach can be either a published approach, which is included in the Navigation database, or an approach entered by the operator in the Pilot database. Pilot database approaches can be created through the Aircraft's FMS CDU or in the Universal Flight Planning Program, UFP 25.0 or later.

The approach database includes navigation-sourced approaches for all runways, including circling approaches. These include GLS ILS, LOC, BC, RNAV (GPS), RNAV (VOR DME), VOR, VOR/DME, and NDB approaches.

TERMINAL WAYPOINTS

Translating terminal waypoints from approach chart to database can be sometimes confusing for the pilot. When the charted waypoint identification cannot be directly entered into the FMS approach database, Jeppesen, with the guidance of ARINC 424, will translate the waypoint identification into names the FMS can use. The information on the next page provides for a better understanding of the ARINC 424 terminal waypoint naming convention.

TERMINAL WAYPOINT NAMING CONVENTION

IAW ARINC Specification 424

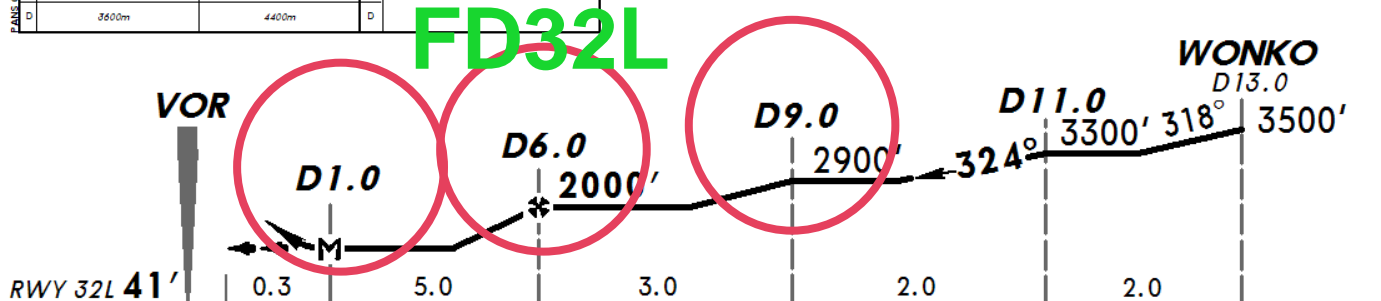
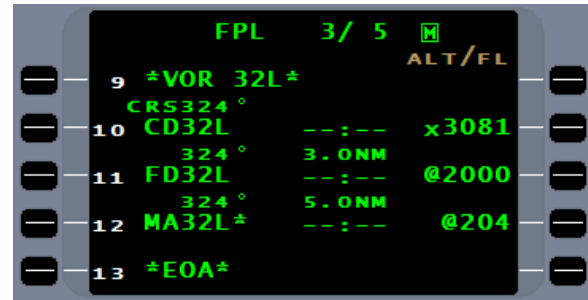
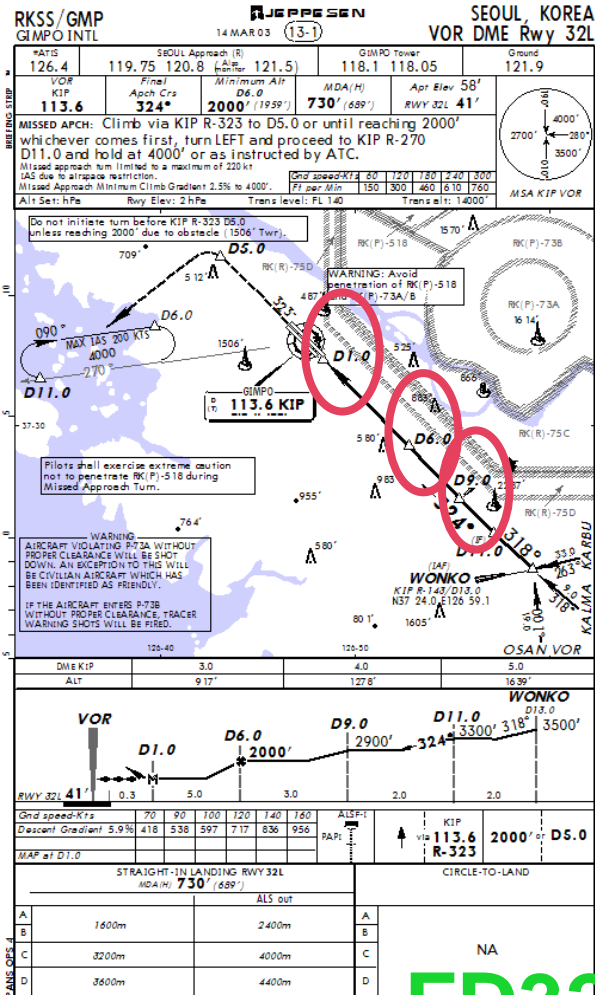
Initial Approach Fix (IAF)	AX__
Intermediate Approach Fix (IF)	IX__
Final Approach Course Fix (FACF)	CX__ Frequently used as the Capture Fix
Final Approach Fix	FX__
Missed Approach Point (MAP)	RW__ At threshold MA__ Not at threshold
Touchdown Point (TDP)	TX__
Step Down Fix (SX)	SX__

Where “__” equals runway

Where “X” above equals:

ILS	=	I
LOC	=	L
Backcourse	=	B
VOR	=	V
VOR/DME	=	D
VOR @ DME (DME not used)	=	S
NDB	=	N
RNAV (VOR/DME)	=	R
TACAN	=	T
GPS	=	P
RNAV (GPS)	=	E
LAAS	=	J
WAAS	=	K

The “X” in the first section is replaced by a letter in the second section and, with the addition of the runway identification, constitutes the waypoint name.



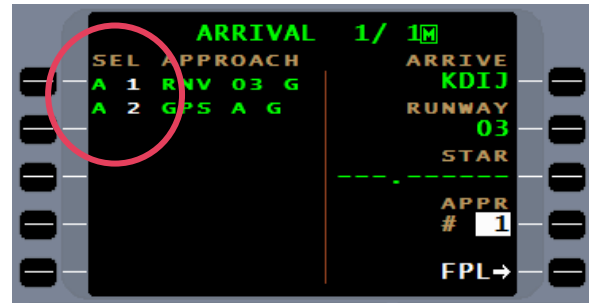
MA32L **CD32L**

The above shows that the charted waypoint identifiers were changed in the database to names in accordance with the ARINC 424 Terminal Waypoint Naming Convention.

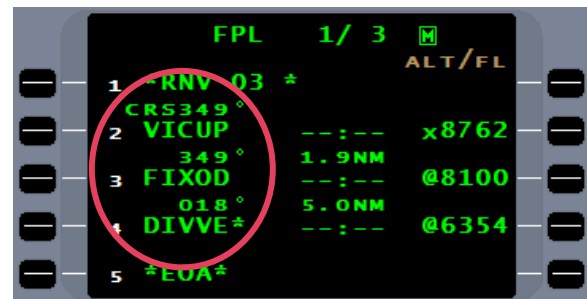
- | | | |
|-------|---|---|
| MA32L | = | Missed Approach Point not at the Runway Threshold |
| FD32L | = | Final Approach Fix for a VOR/DME approach |
| CD32L | = | Final Approach Course Fix (or Capture Fix) for a VOR/DME approach |

ADVANCED APPROACHES

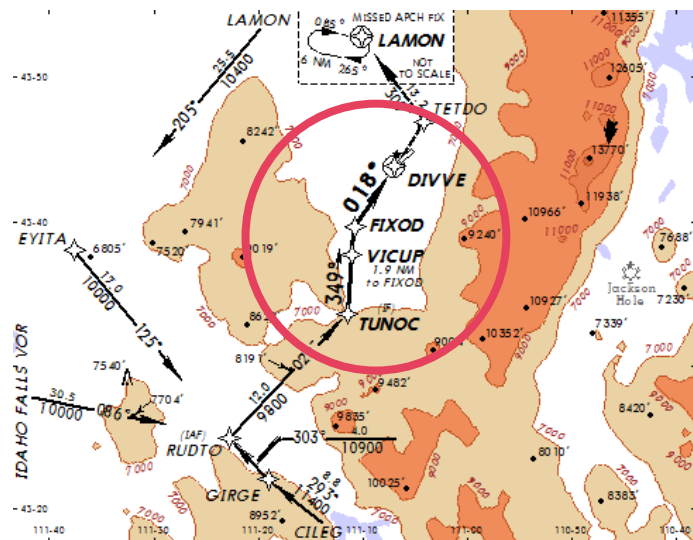
An “A” preceding an approach on the arrival page indicates the approach requires advanced avionics equipment in order to fly the procedure.



One of the reasons for an approach to be classified as advanced is if the turn at the final approach fix (FAF) exceeds 6°. A second reason for the advanced classification of an approach is the use of a radius to fix (RF) leg. For an autopilot receiving navigational guidance from an FMS, to fly an approach active advanced FMS approach, requires roll steering. Older autopilots flew this in deviation steering. This was considered unsafe. Current designed autopilots will allow for the flying of these approaches. During FMS installation, the autopilot capabilities are selected determining whether advanced approaches can be flown by the aircraft.



A turn of 6° or more can be part of a VOR approach, a NDB approach, as well as a RNAV approach.



Track to Fix (TF), Course to Fix (CF), and Radius to Fix (RF) legs can be used in advanced approach types. Currently, RF legs are used only in RNAV (RNP) advanced approach types, but potentially could be used in RNAV (GPS) approach types.

FMS APPROACH TYPES

ILS APPROACHES

NAV-TO-NAV ILS approaches can be flown with the use of the FMS and a NAV to NAV compatible EFIS, flight guidance system, and autopilot. With the approach active and upon localizer intercept, the FMS will transfer aircraft navigation to the EFIS for navigation during the approach segment. During the approach transition or ATC vectoring, the FMS is the source for aircraft navigation. If the pilot goes missed approach, the FMS will reassume aircraft navigation.

Selection of flight director approach mode is required for the FMS to hand off navigation to the EFIS. This must be accomplished prior to localizer intercept for both auto activation when flying an approach transition or when flying vectors with FMS heading to localizer intercept. On vectors to intercept the localizer, select flight director approach mode then press FMS heading INTERCEPT. This will result in the NAV-TO-NAV transfer taking place and the aircraft intercepting the localizer and turning to final.

GPS will be used to assist the FMS in navigating the aircraft during vectors or on the approach transition where the approach is surveyed IAW WGS-84. At non WGS-84 surveyed airports, GPS will be deselected upon approach arming and approach transition navigation for the ILS must come from other NAV sensors such as DME-DME and IRS or the FMS will be DR.

For aircraft without NAV-TO-NAV capability, the ILS will be coded as advisory. The approach transition and missed approach can be flown with the FMS, but VHF/ILS guidance must be selected by the pilot to fly the approach segment.

LOCALIZER AND BACKCOURSE APPROACHES

On aircraft with localizer input to the FMS, localizer and localizer backcourse approaches can be flown. The FMS uses the localizer to calculate the final approach course. Since the localizer is only one dimensional, to determine the location of the final approach fix and missed approach point, the FMS will retain the GPS. Using the GPS requires the approach be surveyed IAW WGS-84.

The backcourse approach flown with conventional navigation would require selecting the localizer front course on the course arrow and selecting B/C on the flight director. When flying a backcourse approach with the FMS, the course arrow will reflect the landing runway inbound course and, on most aircraft, selection of B/C on the flight director is not required. In addition, on most backcourse approaches, a barometric glideslope is available. This will make the approach similar to an ILS; MDA minima must still be observed.

RNAV APPROACHES

RNAV approach denotes the ability to fly a final approach course that is either not using a ground base navaid or is not directly inline with a ground base navaid. The three types of RNAV approaches are identified by the parentheses following RNAV and are GPS, VOR DME, and RNP.

RNAV (GPS) AND GPS APPROACHES

Most aircraft that fly RNAV (GPS) approaches do so as GPS approach certified aircraft. Through SCN 801 software, RNAV (GPS) approaches are listed in the NAV database as GPS approaches. SCN 802 and 803 software can differentiate between RNAV (GPS) and GPS stand alone approaches. The approach transitions throughout the world can vary significantly and regulations for flying these transitions are country specific. Using GPS requires the approach surveying to be IAW WGS-84. RNAV (GPS) approaches may have as many as three sets of minima of which two may be flown by the 80X series software. LNAV only requires lateral navigation and all GPS approach certified aircraft may use the LNAV MDA (Minimum Descent Altitude). LNAV/VNAV will be flown to a DA (Decision Altitude) and to fly to a DA with a barometric glideslope requires compliance with AC 90-97. LPV (Localizer Precision with Vertical Guidance) requires a SBAS (Space Based Augmentation System), and example being WAAS which covers North America, Hawaii, and the Caribbean. SBAS will not be available for SCN 80X software.

RNAV (VOR DME) APPROACHES

Since the late 1960's, RNAV equipment using radial distance (Rho-Theta) has been used by pilots to fly area navigation. Approaches were created using this type of RNAV equipment and, although these approaches are being phased out, many of these approaches are still in existence. The UASC FMS can use a combination of GNSS or GPS and VOR DME to fly these approaches. If the words "or GPS" are not in the title of the approach, the use of VOR DME is required and must be an input to the FMS.

RNAV (RNP) APPROACHES

To fly these approaches requires SCN 802 or 803. These approaches have multiple legs in the final segment; using radius to fix, course to fix, and track to fix legs. The quality of navigation is based on RNP and approaches may have multiple sets of minima based on the ANP capabilities of the aircraft. These approaches are Special Aircraft and Aircrew Authorization Required (SAAAR); requiring FAA approval under AC 90-101.

NOTE: Global Navigation Satellite Landing System (GLS) approaches are covered in a supplement given to those operators authorized to fly this approach.

VOR AND VOR/DME APPROACHES

VOR and VOR/DME approaches can be flown as a GNSS or GPS overlay approach if the words “or GPS” are in the title of the approach. VOR and DME are required if the approach is non overlay, GPS is unavailable, or the approach is not surveyed IAW WGS-84; making GPS unusable. If the country of origin does not authorize the use of GNSS or GPS with the statement “or GPS” or mandate the use of GPS as does Canada and the USA, the FMS will deselect the GNSS or GPS at time of approach arming. Transport Canada and the FAA mandate that the GPS will be retained for FMS navigation for all VOR or VOR/DME approaches. In these two countries, to make a non overlay approach legal, the VOR must be monitored either internally within the FMS or externally by, at a minimum, the VOR RMI needle. The FMS does not know whether the approach is a GPS overlay or not; it only knows whether to use GPS or deselect it. Due to limitations of the FMS, the FMS can only present one type of VOR approach to a specific runway. Where a VOR and VOR/DME approach both go to the same runway, only the VOR/DME approach profile will be presented. Most VOR approaches will have a baro constructed glideslope.

NDB APPROACHES

Through the FMS, NDB (Non Directional Beacon) approaches can only be flown with the use of GNSS or GPS. All worldwide WGS-84 surveyed NDB approaches will be available in the SCN 80X NAV database with GNSS or GPS retained. To make a non overlay NDB approach legal, the NDB must be tuned and identified and the NDB RMI needle must be selected. Most NDB approaches will have a baro constructed glideslope.

TACAN APPROACHES

TACAN (Tactical Air Navigation) approaches are normally affiliated with military operations. TACAN approaches are flown by the FMS similar to the way it flies VOR/DME approaches. The UASC FMS is capable of flying TACAN approaches with the use of GPS and/or TACAN. TACAN input to the FMS can be by way of the UASC RRS or a digital TACAN radio. Most TACAN approaches will have a baro constructed glideslope.

VFR APPROACHES

Created through the FMS as a pilot approach, the FMS will fly VFR approaches. VFR approaches will use all usable NAV sensors to fly the approach to include DME, VOR, and GPS. Where the pilot has created the definition for a baro glideslope, the FMS will present it.

WGS-84 SURVEYING

For the purpose of explaining WGS-84, it needs to be presented in the context of how it affects the flying of FMS approaches. First of all, WGS-84 is the World Geodetic System of 1984.

Technically, it defines the shape and size of the ellipsoid of revolution (an oblate spheroid) that is considered to be the best mathematical model of the Earth. From a pilot's perspective, it's the mathematical calculation of the shape of the Earth. This mathematical model is used to calculate latitude and longitude and is the system used by GPS to calculate latitude and longitude.

When navigating, it is important to agree on exactly where the latitude/longitude coordinates are located. Those agreeing to use WGS-84 to define the shape of the world and, therefore, to calculate latitude/longitude coordinates, will know exactly where that point is on the surface of the Earth.

Countries using WGS-84 to survey airports will provide more precise navigation for those aircraft navigating with FMS and GPS navigational tools. GPS cannot be used to fly approaches where WGS-84 surveying is not in use.

On the Jeppesen Corporation web site is a list of WGS-84 compliant countries.

FMS APPROACH CONFIGURATION

THE ENABLED APPROACH

During the installation of the FMS, the engineer will determine which approaches are flyable through the FMS and which are not. Those that are flyable are enabled in the FMS configuration. The criteria for enabled includes available NAV sensors, type and model of primary flight display, and type of autopilot.

With an enabled approach, the FMS will be the source for navigation throughout the entire approach; from transition through final segment through missed approach. It will be the source of presentation for the primary flight display.

THE ADVISORY APPROACH

When the FMS installation does not meet the criteria for a specific approach type, it is configured as advisory. The advisory configuration applies only to the approach final segment; that part which guides the aircraft to the runway. The FMS can still navigate the approach transition and missed approach. The pilot can select this approach to assist in flying the approach transition and missed approach, but must use navigation other than the FMS to fly the final segment to the runway.

An example would be an ILS with a procedure turn. The FMS will guide the aircraft through the procedure turn; the pilot will then select the ILS as the source of guidance and fly the final segment towards the runway. If a missed approach is required, the pilot may reselect the FMS for missed approach guidance.

APPROACH SEGMENTS

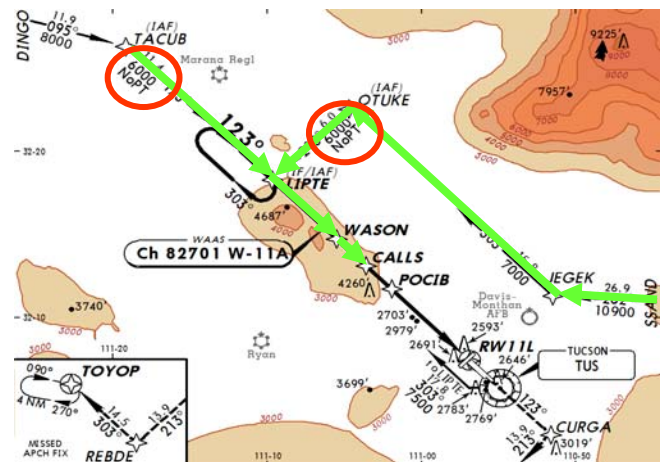
For the purpose of FMS operations, Jeppesen will take a normal approach chart and identify three segments; the transition, the approach, and the missed approach. These segments are loaded into the FMS individually to make up a complete approach.

TRANSITION SEGMENT

The transition segment is the maneuvering segment. It allows the FMS to navigate the aircraft through a series of legs or procedures to align it with the final approach. The transition segment may be edited as necessary and the remainder will be unaffected. Transitions consist of the following:

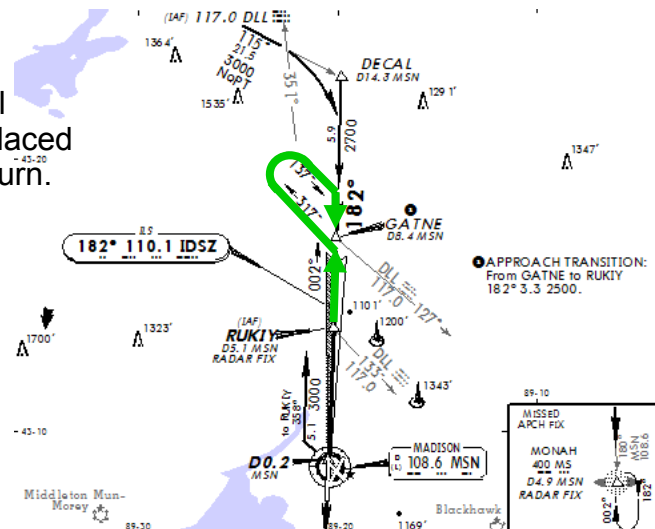
No Procedure Turn (No-PT)

A series of navigational legs designed to align the aircraft with the final segment without entering a procedure turn or holding pattern



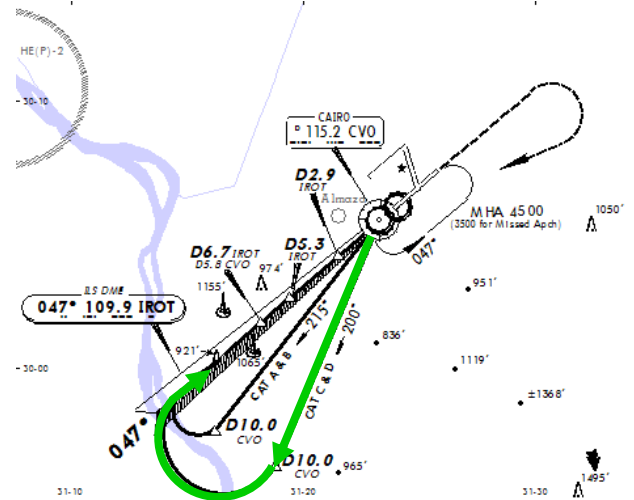
Procedure Turn

A procedure to allow the pilot to reverse the course of the aircraft and align it with the final approach course; this procedure is being replaced by the holding pattern in lieu of a procedure turn.



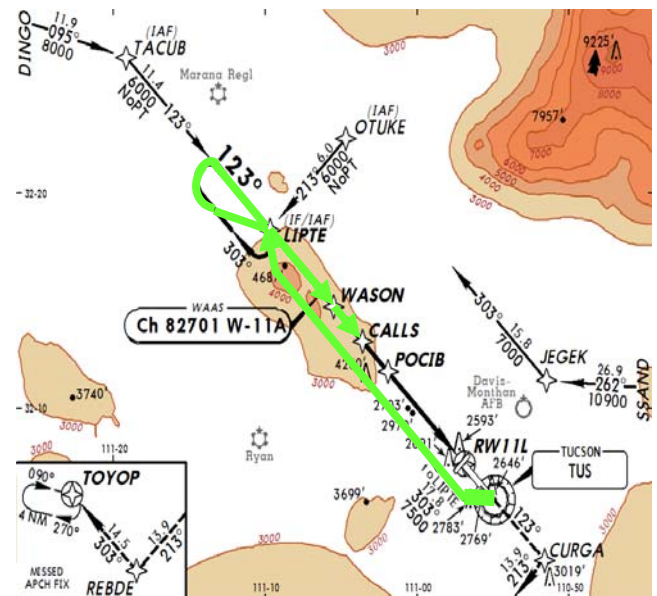
Teardrop

After crossing a designated fix, proceed outbound on a specific course for a specific distance. Turn inbound to intercept the final approach course back towards the designated fix. The procedure resembles the shape of an ice cream cone. When a Category A & B and a Category C & D procedure are presented on the chart, only the Cat C & D will be in the database.



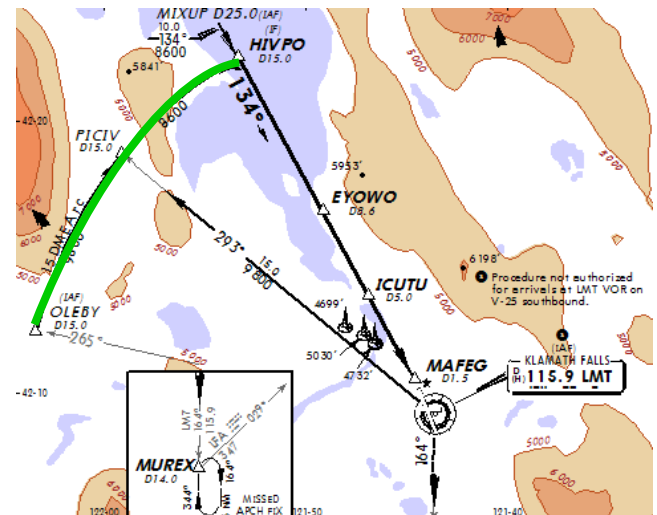
Holding Pattern In Lieu Of A Procedure Turn

A holding pattern is used to reverse course when the aircrafts position is not conveniently aligned to turn directly to final. Occasionally used to descend to an altitude more in line with the final approach fix altitude



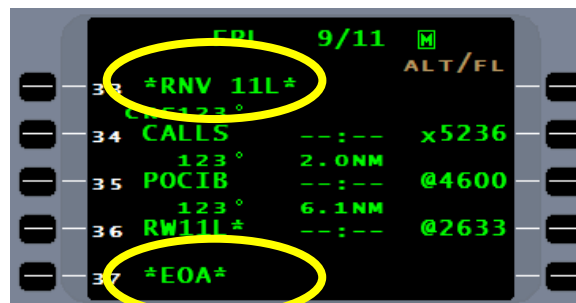
Arcs

Designed to fly a constant distance path relative to a DME until turning to the final approach segment



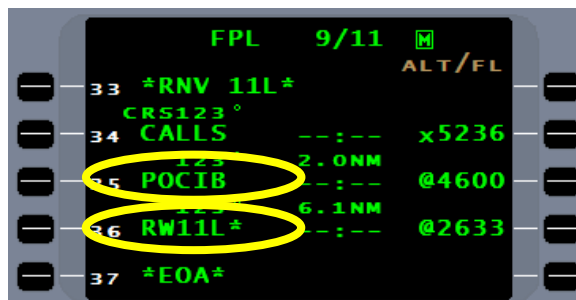
THE APPROACH SEGMENT

The approach segment is the FMS navigation that takes the aircraft to the runway. It is identified as those waypoints that follow the approach label and are terminated by the *EOA* or End Of Approach label.



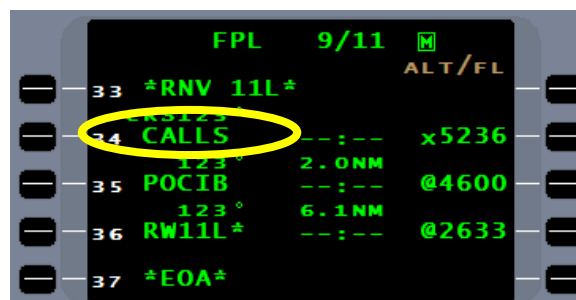
A final approach fix (FAF) is required for all FMS approaches and where the approach design does not call for one, Jeppesen will add one to the approach database per ARINC 424 guidance.

A missed approach point (MAP) is required and is normally identified by “RW” or “MA”, which are ARINC 424 names for this point. RW is defined as being co-located at the runway threshold and MA is a missed approach point not at the runway threshold. Although these identifiers are used a great deal, they are not required and other names may be used to identify the missed approach point.



SCN 802 and 803 allow for step down fixes to be used between the FAF and the MAP and will be presented when in the NAV database.

If a waypoint is found prior to the FAF in the approach segment of the FMS database, it is a final approach capture fix “FACF”; often called a final approach course fix. This waypoint is used by the FMS during an automatic activation of an approach. As the FMS sequences this waypoint and meets other requirements, it will go approach active. Since the FMS needs a buffer zone for approach activation of at least 2nm prior to the FAF, the capture fix is used as the activation point. No capture fix will be any closer than 2nm, but may be as far as 10nm with an average distance of 5nm. All RNAV approaches will contain waypoints that are usable as capture fixes and most of other types of approaches will also contain capture fix waypoints. When an approach design does not present a waypoint that can be used as a capture fix, no capture fix will be presented in the FMS approach segment. When this happens, the FMS will create an activation point that is 2nm from the FAF. This waypoint is transparent to the pilot, but is necessary for FMS automatic activation. A capture fix waypoint may be the same waypoint as the last waypoint in the approach transition and, therefore will be listed twice in the flightplan. This is correct for the UASC FMS systems; do not delete one of these waypoints.

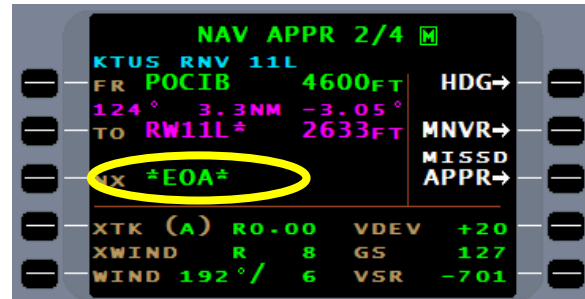


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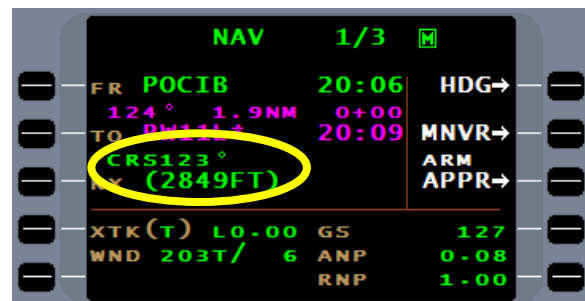
The approach segment must **NOT** be edited or it will void the approach. An edited approach, including approach label and *EOA*, will violate the integrity of the approach segment and these waypoints can no longer be flown as an FMS approach.

THE MISSED APPROACH SEGMENT

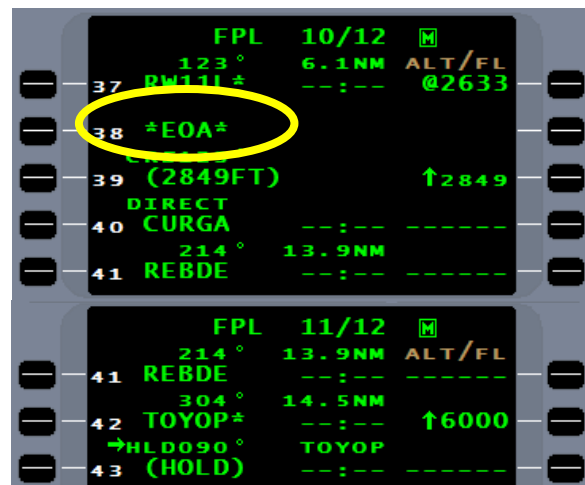
When approach active and sequenced past the FAF, the FMS will present a MISSED APPR line select key. With the pressing of this key, the FMS can be placed in the missed approach mode of flight. The FMS will continue to navigate the aircraft to the MAP and, when crossing that point, the FMS will enter the missed approach segment.



One of the functions of the missed approach line select key is to sequence the *EOA* on the NAV page allowing the FMS to move into the missed approach segment. The *EOA* will act as a GAP and prevent sequencing. By removing it during *EOA* sequencing, the FMS will sequence to the first navigation leg of the missed approach segment. This leg is often times a course to altitude (CA) leg. This leg, when not part of the charted procedure, is created by either Jeppesen per ARINC 424 guidance or required by the state of origin of the procedure, i.e. FAA. This leg is often a database entry only and not found in the published missed approach procedure. It is intended to insure the aircraft is at a safe altitude before sequencing to the first charted leg of the missed approach. The *EOA* will not be removed from the flightplan, only from the NAV page. This will insure the integrity of the approach is maintained to ensure the approach is available if needed again.



The missed approach line select key can be remotely pressed through the go-around system of the aircraft flight director. The missed approach line select key is only available upon crossing the missed approach point, thus the selection of the aircraft go-around system or takeoff/go-around system (TOGA), other than after crossing the FAF on an active FMS approach, will have no effect on the FMS.



The missed approach mode will terminate all FMS vertical guidance and return the FMS phase of flight to terminal.

As with all missed approaches, if the pilot uses the aircraft go-around system, the aircraft pitch up, wings level command will come from the aircraft flight director. The FMS will not provide any vertical guidance during missed approach. To reconnect the flight director to the FMS, flight director NAV mode must be selected.

APPROACH ARMING

The purpose of arming the approach is to prepare the FMS to fly the selected approach. At 50nm from the arrival airport, with an FMS approach in the flightplan, the FMS will present an arm approach line select key which will allow for manual arming of the approach. Between 50nm and 30nm from the airport the primary reason for manual arming is to place the FMS into terminal phase of flight early. Automatic approach arming occurs when the aircraft enters the terminal area at 30nm from the airport. Some approaches have the initial approach fix (IAF) more than 30nm from the arrival airport. Since the FMS is required to be in the terminal phase of flight before crossing the IAF and since the FMS will not automatically go to terminal until 30nm, arming the approach manually will accomplish this.

What does arming the approach do?

It sets the phase of flight to terminal if more than 30nm from the airport.

It analyzes the NAV sensor requirements to fly the approach. NAV sensors are categorized as required, approved, and not approved to navigate for the approach. A required NAV sensor example is the GPS for a RNAV (GPS) approach or a localizer for a localizer based approach. An approved NAV sensor would be the use of GPS on a VOR approach. A not approved sensor would be GPS on a VOR approach in a non WGS-84 country.

If a ground based navaid is required or approved for the approach, the FMS will check to see if it is tuned. If not, if the FMS can tune the NAV radio, the FMS will offer a tune approach line select key. The FMS will not tune a VHF NAV radio without first asking permission by use of the tune approach line select key. Pressing the line select key will tune the VHF radio to the required frequency. If the required VHF NAV radio is not tuned, just prior to activation the FMS will push a message alerting the pilot to the need to tune the radio. Without a required NAV sensor the FMS cannot fly the selected approach and when the FMS attempts to activate the approach, red flags will appear for navigation on the primary flight display.

If GPS is used for the approach, a GPS RAIM prediction will automatically be performed.

AUTO APPROACH ACTIVATION VS MANUAL APPROACH ACTIVATION

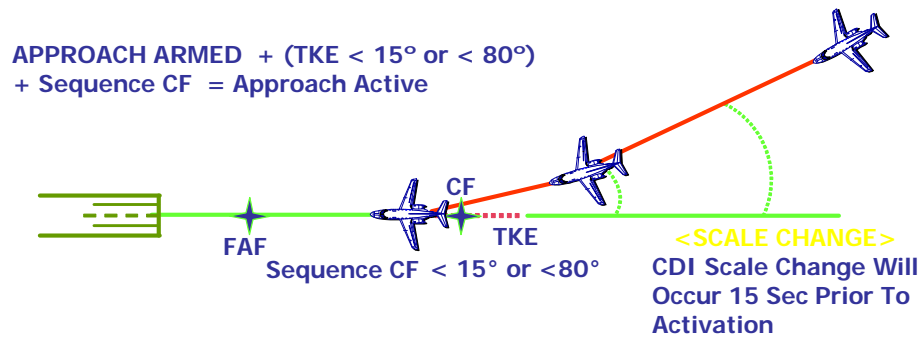
There are two ways to activate an approach, automatically and manually. Which one to use is dependant upon how the aircraft will navigate to the beginning of the final approach segment.

AUTO ACTIVATION

Auto activation is used when flying an approach transition. The FMS will remain in the terminal phase of flight until reaching the activation point and then activate the approach. Fifteen seconds prior to activation, the FMS will present a “<SCALE CHANGE>” banner that announces the CDI scale change from terminal to approach. The activation point is defined by a set of criteria that is somewhat based on the makeup of the approach. The criteria are as follows:

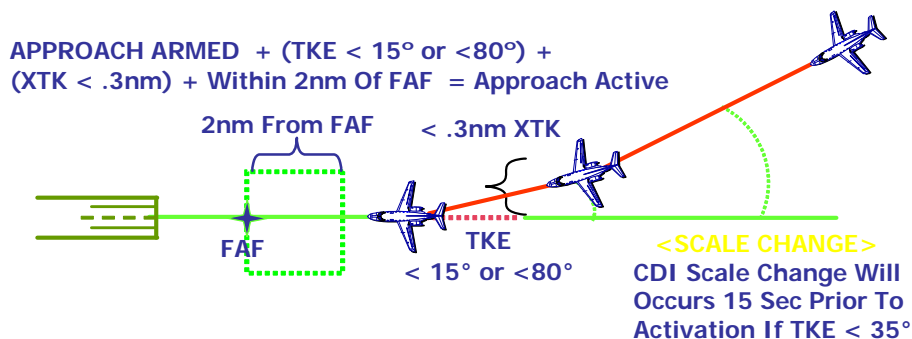
- The approach must be armed. This is accomplished automatically at 30nm from the airport and can be manually armed up to 50nm from the airport. If on missed approach, the FMS will not automatically arm until placed on a navigational path to a point in the flightplan ahead of the approach. It will then automatically arm.
- The angle of intercept or track error must be within either 15° or 80° of the final approach course. If the FMS is installed in an aircraft of older design that uses an analog autopilot with deviation steering when approach active, the angle of intercept will be set to 15° through configuration in the FMS. If the FMS is installed in an aircraft with a newer design that uses a digital autopilot, the angle of intercept will be set to 80° of the final approach course. The setting of 80° will also allow for the flying of advanced approaches.
- If the approach design incorporates a capture fix or FACF in the approach segment, that waypoint must sequence from the “TO” waypoint to the “FR” waypoint. With the other two criteria complete, the FMS will go approach active. There is no requirement that the criteria be completed in a specific order. Depending upon the transition, either the angle of the intercept or capture fix sequencing will activate the approach.
- If the approach design does not incorporate a capture fix, another criterion is added and that is a crosstrack of 0.3nm to ensure on CDI approach scale. Without a capture fix, the FMS must designate a point prior to the FAF of 2nm. This point will not be visible on the FMS or NAV display, but is required to allow time for the FMS to activate the approach prior to the FAF. The “<SCALE CHANGE>” banner will precede the activation point by 15 seconds.

AUTOMATIC ACTIVATION WITH APPROACH CAPTURE FIX



With a designated waypoint as the approach capture fix, the FMS will begin automatic approach activation with a **<SCALE CHANGE>** banner at the top of the NAV page that will occur 15 seconds prior to activation. The approach should already be armed due to automatic arming at the 30nm point; as a result the FMS is now concerned with angle of intercept and capture fix sequencing. If the leg prior to the capture fix is directly in line with the final approach course, angle of intercept is not a factor and as the FMS sequences the capture fix the FMS will go approach active. If the leg prior to the capture fix is an arc or a 90° turn to final, the FMS will sequence and begin the turn to final. As the angle decreases past 80° or 15° degrees, depending on FMS configuration, the FMS will go approach active.

AUTOMATIC ACTIVATION WITHOUT APPROACH CAPTURE FIX



Without a designated waypoint as the approach capture fix, the FMS will, again, begin automatic approach activation with a **<SCALE CHANGE>** banner at the top of the NAV page that will occur 15 seconds prior to activation. The angle of intercept of either 80° or 15° degrees will be a factor. To the above, the FMS will add a criterion of crosstrack of less than 0.3nm from the final approach course to ensure the aircraft is within the CDI approach scale of 0.3nm. Without a designated capture fix the FMS will go approach active 2nm prior to the final approach fix. This will give the FMS its required buffer allowing time for the FMS to activate all approach components.

MANUAL APPROACH ACTIVATION

“Radar vectors to final”, are the words that will result in the need to manually activate the approach. All the criteria required to automatically activate the approach will be eliminated with the exception of approach arming. Manually activating the approach will immediately present the final approach segment in an approach active condition and extend the final approach course to 50nm from the airport. The first waypoint inside the approach label will become the “TO” waypoint. This will either be the capture fix or the final approach fix depending upon the design of the approach. The heading control of the aircraft will now be dependent upon a configuration option. Most aircraft use command heading enabled as their configuration option. Unless command heading is in use when activating the approach, upon activation, the FMS will present the command heading function with the aircraft heading being the active command heading. As discussed later, normal procedure will place the aircraft on the ATC heading first then activate the approach. Any mapping display will present final approach course and waypoints.

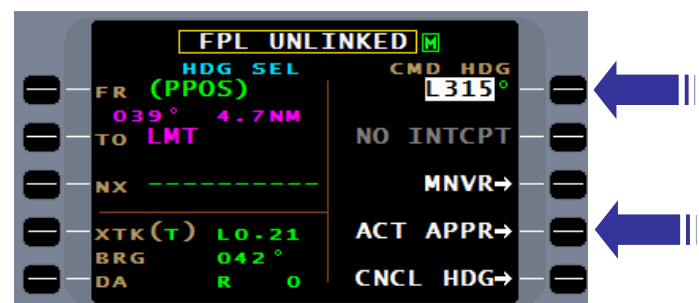
Procedures for flying and manually activating an approach are as follows:

Upon ATC placing the aircraft on radar vectors to final;
First activate command heading and turn the heading bug to the ATC assigned heading (if interactive heading)...



...or enter the ATC heading through the **CMD HDG** field.

If currently using flight director heading mode, to transfer to FMS heading mode, a technique is to allow the aircraft to complete the turn with flight director heading, then activate the approach. Now the two headings will be the same. Select flight director NAV mode and the FMS command heading will be navigating the aircraft.



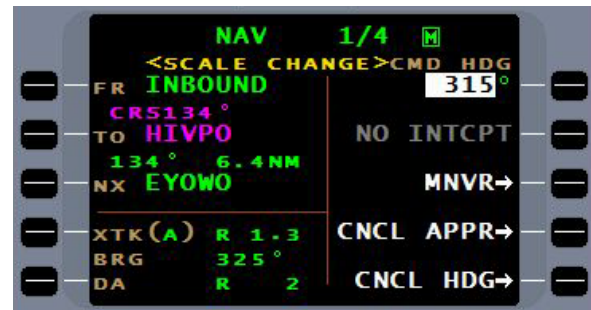
While in the turn or after completing the turn, press the ACT APPR line select key to manually activate the approach.

NOTE: If on radar vectors following a missed approach, wait until the aircraft is on downwind before activating the approach to avoid inadvertent sequencing of the approach.

With activation, the course arrow will align itself with the final approach course and the CDI will display the aircraft offset from the final approach course. Glideslope will become active when within a lateral distance of 12.5nm of the final approach course.



The FMS NAV page will show the **TO** waypoint as the first waypoint on the approach segment and the **FR** waypoint as **INBOUND**, which is the extension of the final approach course. **<SCALE CHANGE>** takes place now since the FMS could not anticipate activation. Depending on FMS configuration, the **CMD HDG** function will automatically activate with the aircraft heading as the command heading. If **CMD HDG** is in use before approach activation, following approach activation, the heading in use will remain the active heading.



If the FMS configuration is command heading disabled, following activation, the **CMD HDG** function will not be accessible. Heading control for vectoring is assumed to be by flight director heading mode.



RULES FOR APPROACH ACTIVATION

It is critical to know when to allow automatic activation of the approach and when to manually activate the approach. The following rules will provide guidance regarding the activation method to choose.

- 1. When flying an approach transition, allow the FMS to automatically activate the approach.**

(This will insure that approach transition guidance is not lost before the final approach segment is reached.)

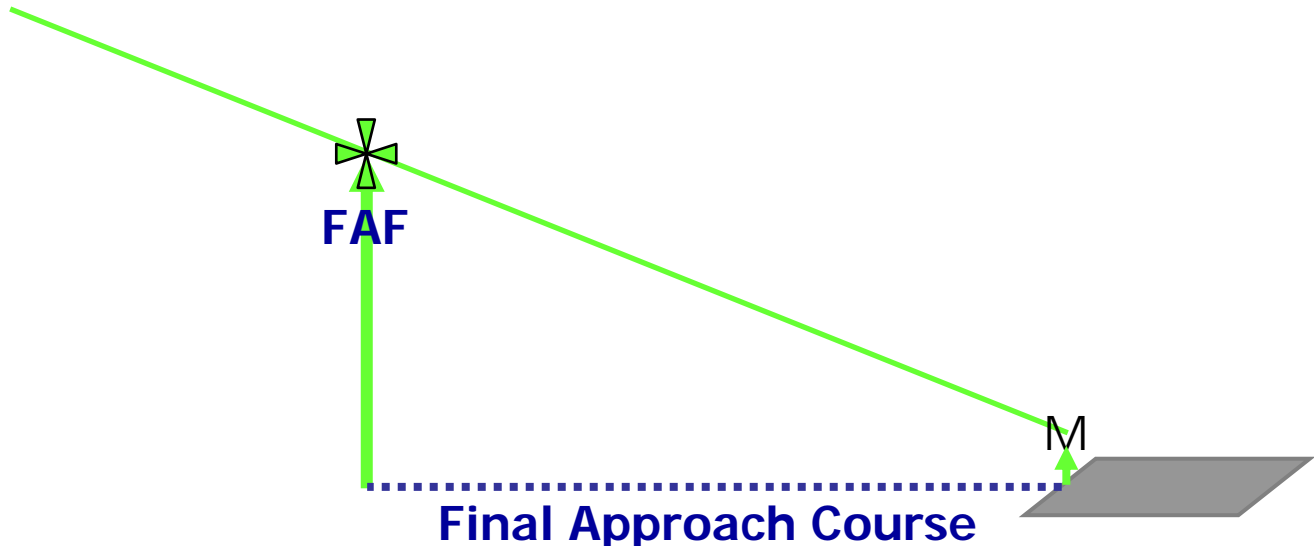
- 2. When on vectors to the final approach course and after placing the aircraft on the assigned heading, manually activate the approach.**

NOTE: When on vectors following a missed approach, wait until downwind before activating the approach to avoid inadvertent leg sequencing.

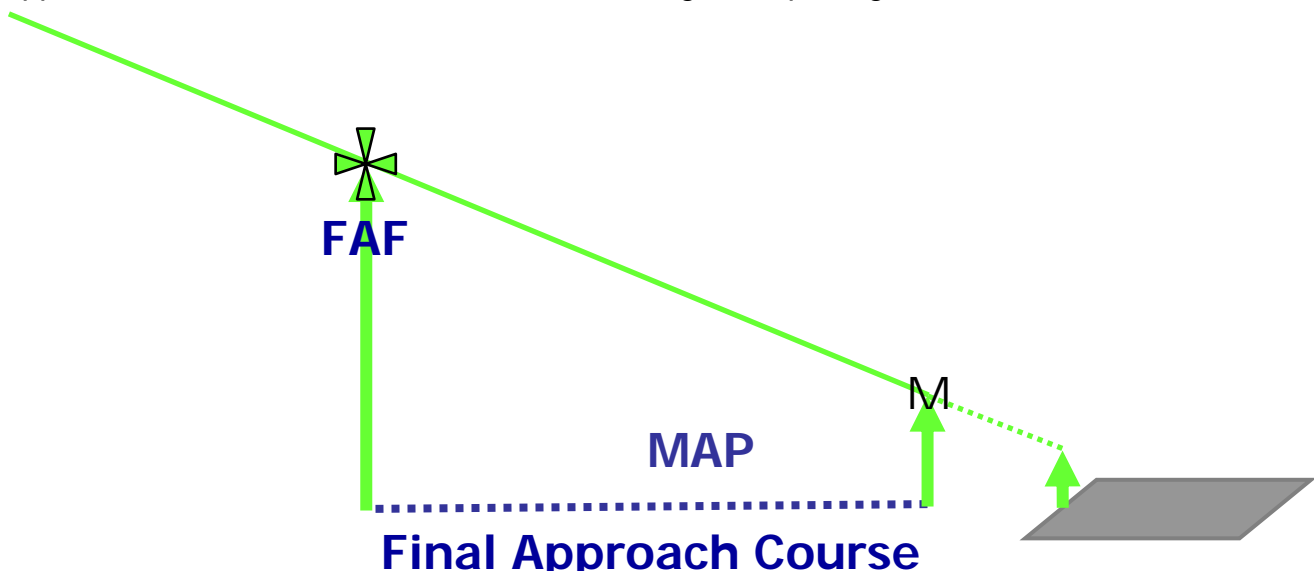
NOTE: Placing the aircraft on the assigned heading first will insure the FMS will not capture an incorrect heading when the approach is activated.

VERTICAL APPROACH NAVIGATION

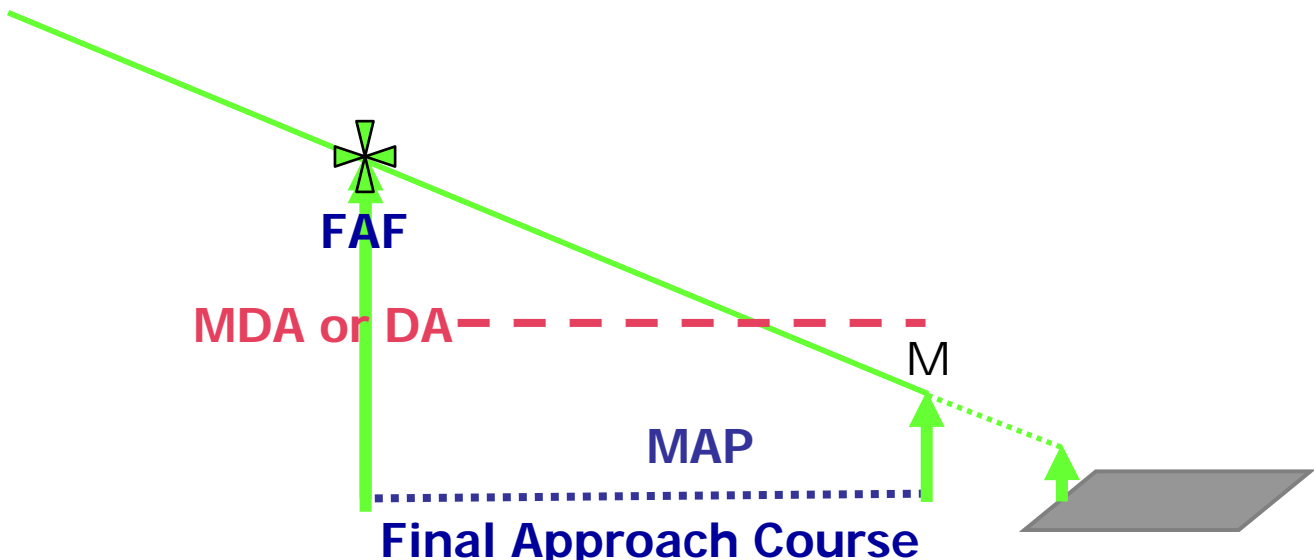
From the navigation database as part of the approach definition is vertical navigation. The FMS uses barometric altimeter inputs through the air data computer to monitor the altitude of the aircraft relative to the defined approach glidepath or glideslope. The definition for the approach vertical navigation is computed by first starting at the runway threshold crossing altitude, then computing an angle that will pass through the final approach fix database altitude. This angle is used to project a glideslope over the approach pseudo localizer or final approach course. The intent of this glideslope is to guide the aircraft towards the runway threshold to cross at the threshold crossing altitude. For any approach with the final approach course in line with the runway, an attempt will be made to code a vertical path.



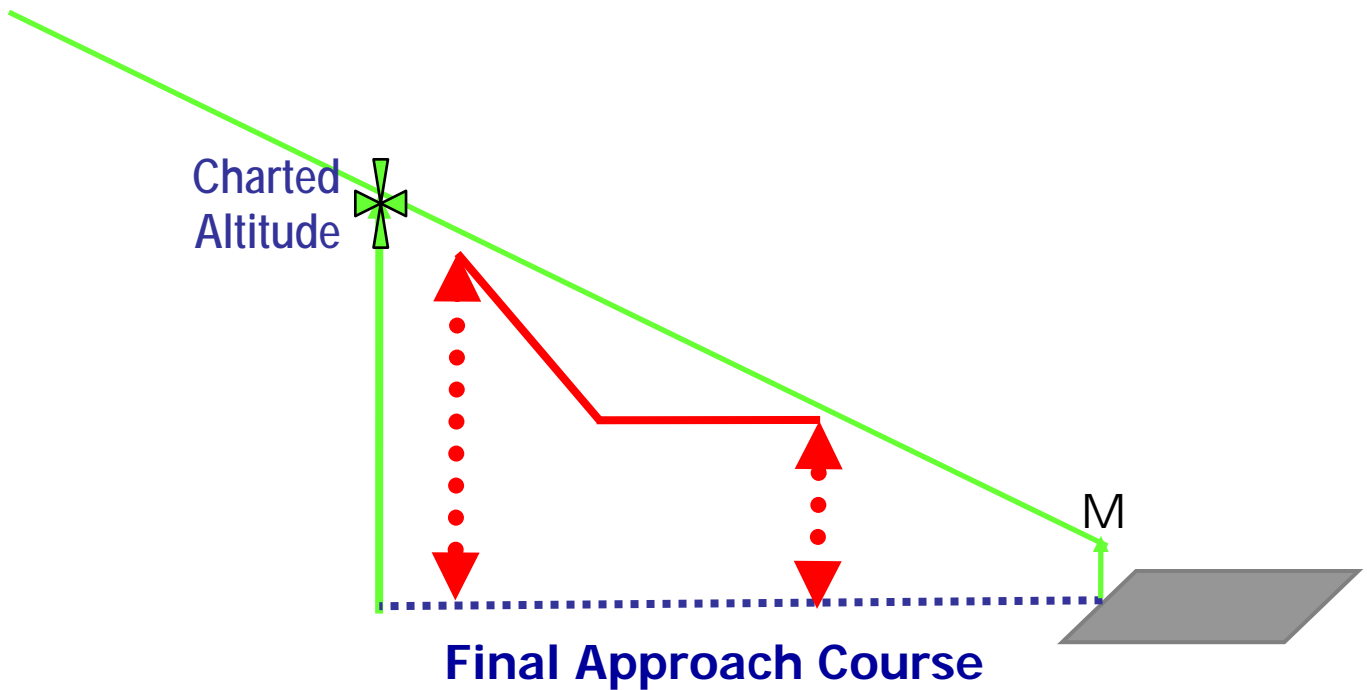
If the missed approach point is prior to the runway threshold, the database altitude at the missed approach point is that which is computed from where the glideslope crosses the missed approach point on the way to threshold. Although the intent of the glideslope is to guide the aircraft to threshold at the threshold crossing height, the threshold and crossing altitude is not part of the approach definition. The altitude at which the glideslope crosses the missed approach point is in the approach definition and is used to calculate the glideslope angle.



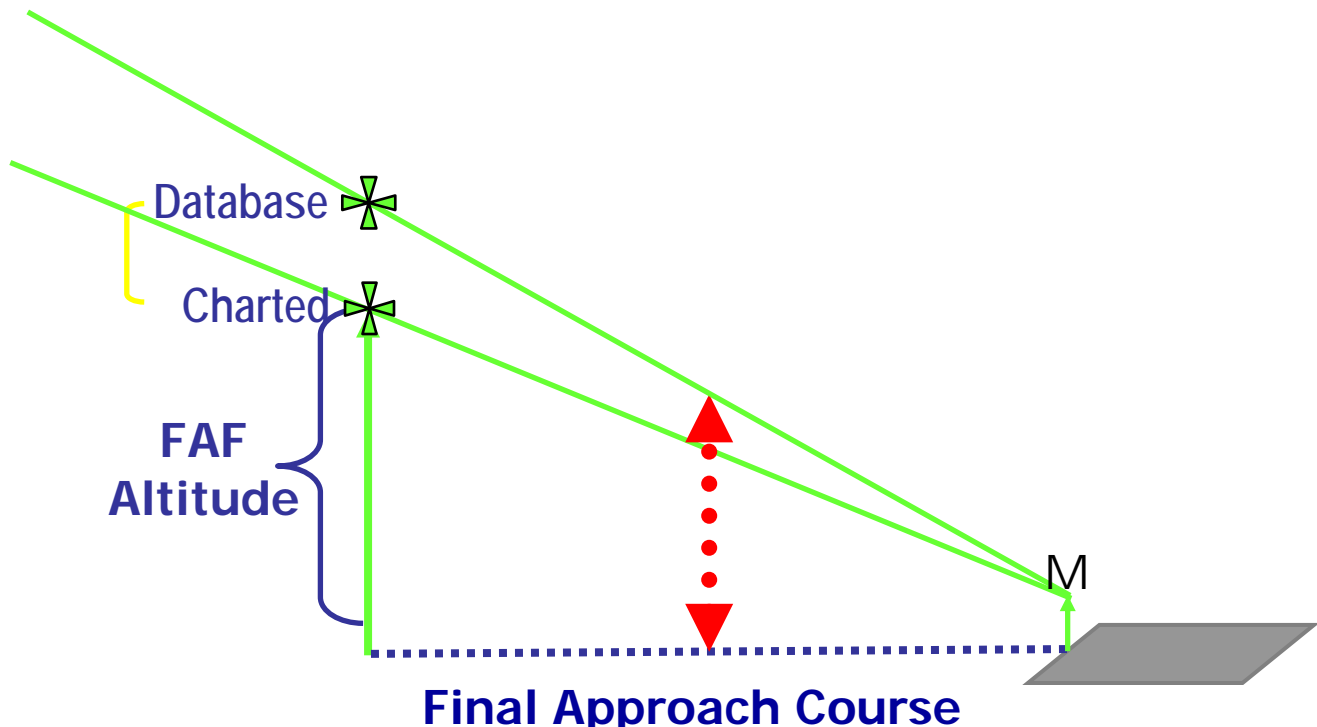
The minimum descent altitude or decision altitude are not in the FMS database and are the responsibility of the pilot. The FMS glideslope will terminate at the missed approach point and the aircraft glideslope indicator will bias out of view. The altitude of glideslope termination will normally be lower than the MDA or DA. A decision to continue below the MDA or DA is the responsibility of the pilot even though the FMS glideslope will continue below that altitude.



If step down fixes are part of the charted approach, they are figured into the glideslope calculation to ensure the glideslope will clear the step down altitudes. If the glideslope is above the step down altitudes, there is no problem.

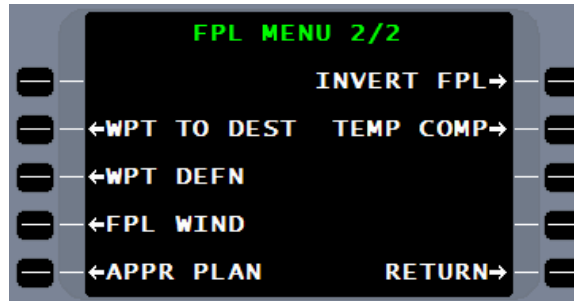


If the step down fix altitude is higher than the calculated glideslope, the glideslope is recalculated to an angle that will clear the step down fix. The altitude at the final approach fix in the FMS database will be higher than the charted final approach fix altitude.

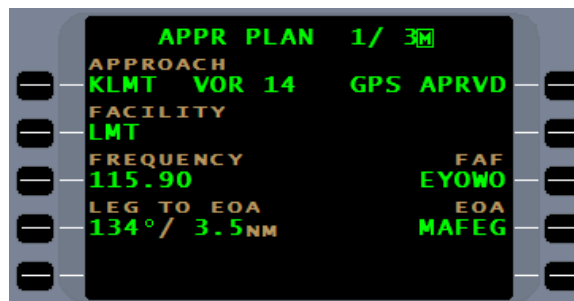


FMS APPROACH PLAN

Located on **FPL MENU 2/2** is the approach plan (APPR PLAN). This FMS tool is an important part of planning the FMS approach.



Page 1 of the **APPR PLAN 1/3** will provide a basic definition of the approach selected to include type of approach, NAV facility, if any, the status of GPS for the approach, final approach information.

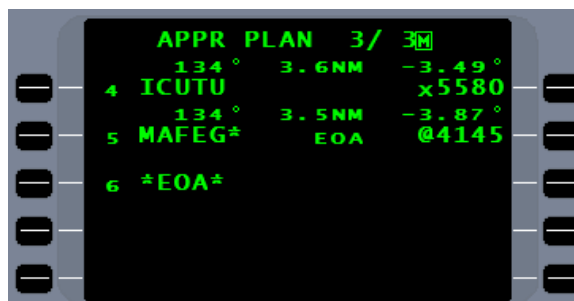


Page 2 and 3 and any pages to follow will present final segment waypoints, course, distance, glideslope angle, and altitudes.

This information can be used to help determine where to configure the aircraft, to determine glideslope intercept altitudes, and to determine approach power settings based on vertical flight path angle.



For approaches with multiple step-down fixes such as RNAV (RNP) approaches, several pages may be needed to display all the approach segment waypoints.

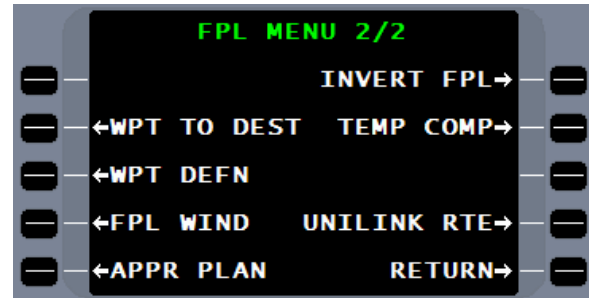


NOTE: Step down fixes in the approach are only available for SCN 802 and 803 NAV database.

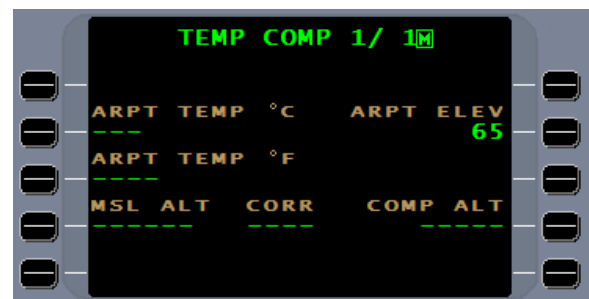
TEMPERATURE COMPENSATION

The accuracy of a barometric altimeter is affected by non-standard temperature. A colder than standard temperature (International Standard Atmosphere, ISA) will result in the true MSL altitude being lower than the indicated altitude and hotter than standard temperature will result in the MSL altitude being higher than indicated. When the FMS created glideslope uses barometric altimeter inputs to monitor the aircraft's altitude relative to the VNAV path, non-standard temperature will result in a slight error between the actual and indicated position on the glideslope. Many countries have created standard correction table for very cold conditions. This correction table has been incorporated in a temp comp feature in the FMS.

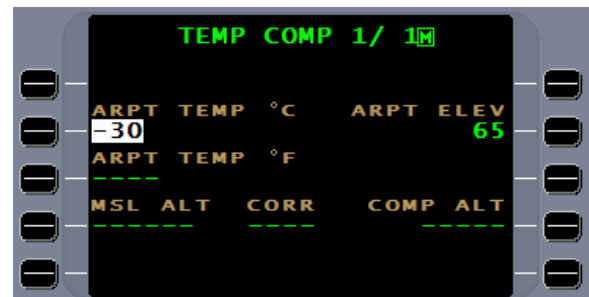
TEMP COMP, when activated by a technician in the FMS configuration section, is available on **FPL MENU 2/2**.



Selection of the TEMP COMP line select key will present the **TEMP COMP** page.



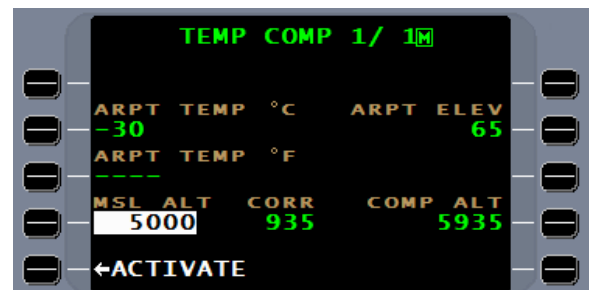
By entering a temperature, either Celsius or Fahrenheit, into the **ARPT TEMP** line, altitude adjustments can be made.



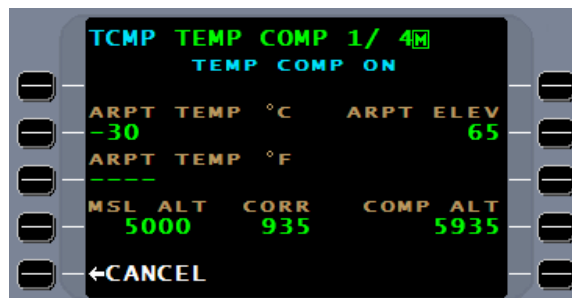
NOTE: The temperature entered can only be at or below freezing. The \pm key need not be pushed for a Celsius entry. The temperature range that can be entered is 0°C to -70°C and +32°F to 94°F.

By entering an **MSL ALT**, the amount of compensation and the compensated altitude are calculated and presented.

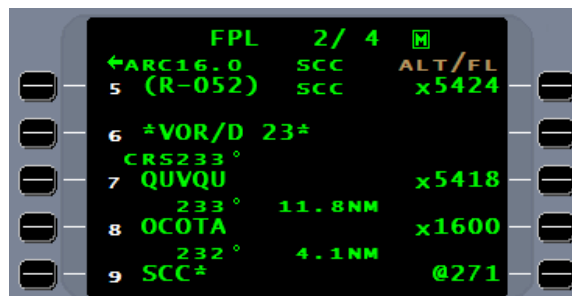
Activating line select key 5L will apply the temperature compensation to the selected FMS approach or VNAV plan.



The subheading **TEMP COMP ON** signifies that temperature compensation is active. Temp comp will stay active for any approach selected at the current airport listed on the flightplan. Deleting the current airport from the flightplan, deleting the flightplan, or cycling FMS power will cancel temp comp.

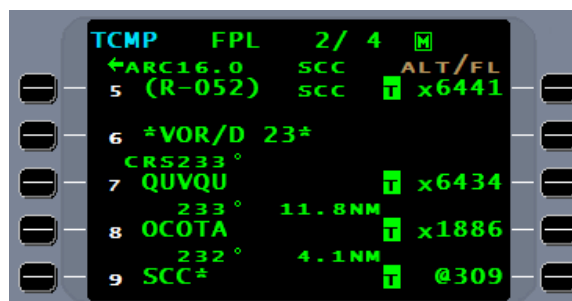


To the right are the altitudes before applying the temperature compensation.

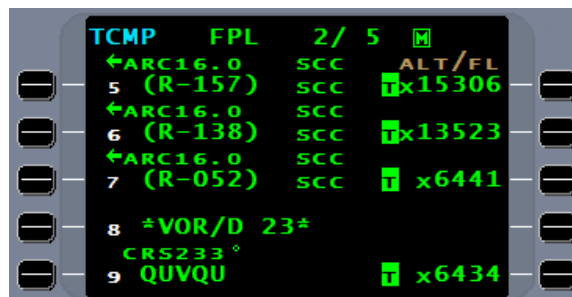


With temperature compensation on and a **-30°C** temperature entered, the altitudes are adjusted.

TCMP on the flightplan and NAV page will indicate the temperature compensation feature is active and the **T** prior to the altitude indicates a temperature corrected altitude.



Temperature compensation will be projected throughout the enroute VNAV waypoints.

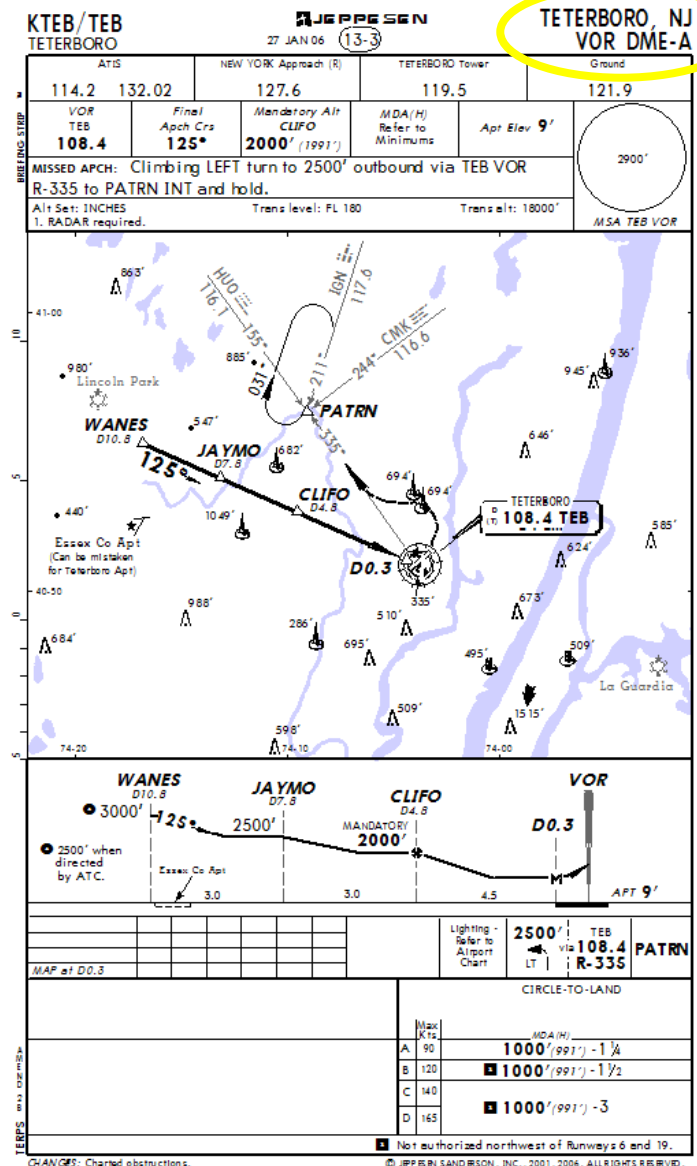
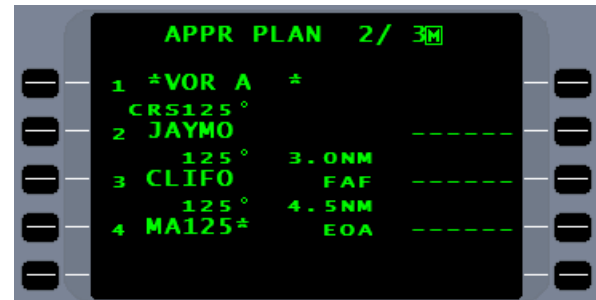


VERTICAL NAVIGATION NOT PROVIDED

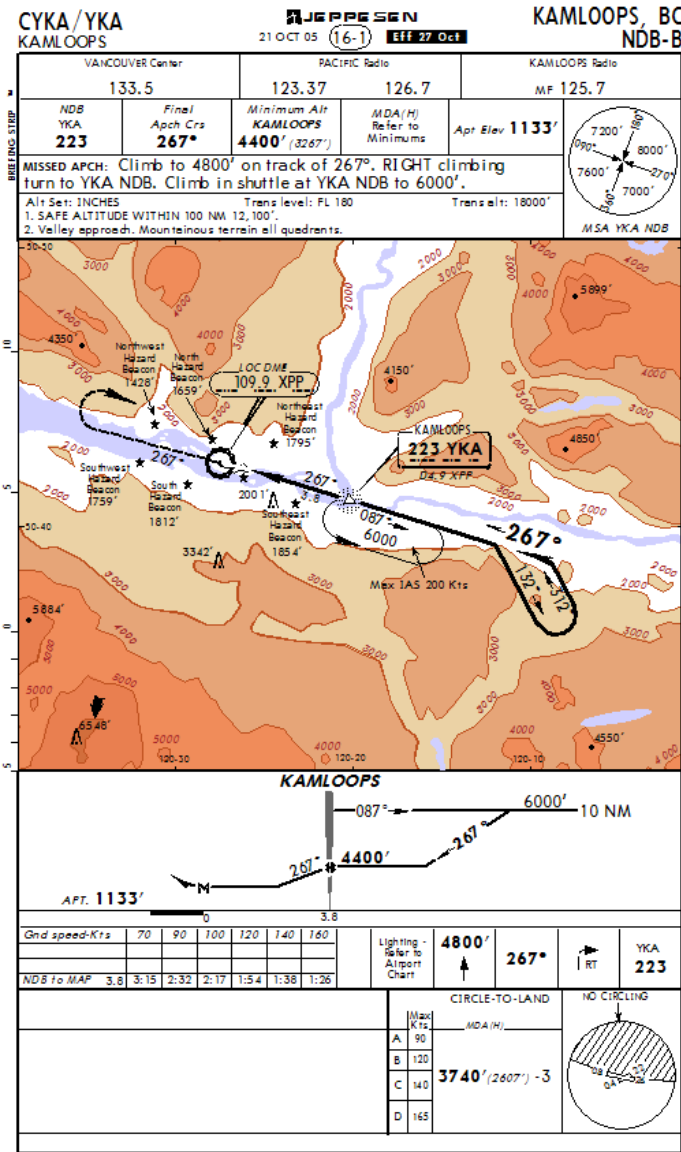
Vertical navigation is not always available in the FMS approach definition for the following reasons:

CIRCLING ONLY APPROACH

If the approach is a circling only approach with only circling minimums listed and the inbound course is not inline with the runway, vertical navigation may not be provided. An example would be this VOR A approach. Since vertical navigation is designed to take the aircraft to the runway threshold, in this example there is no runway threshold, thus, no glideslope. Coding criteria is under development to add vertical navigation to circling only approaches where the inbound course is not in line with any runway. When this coding is available, approach definitions will be coded as they are reviewed.

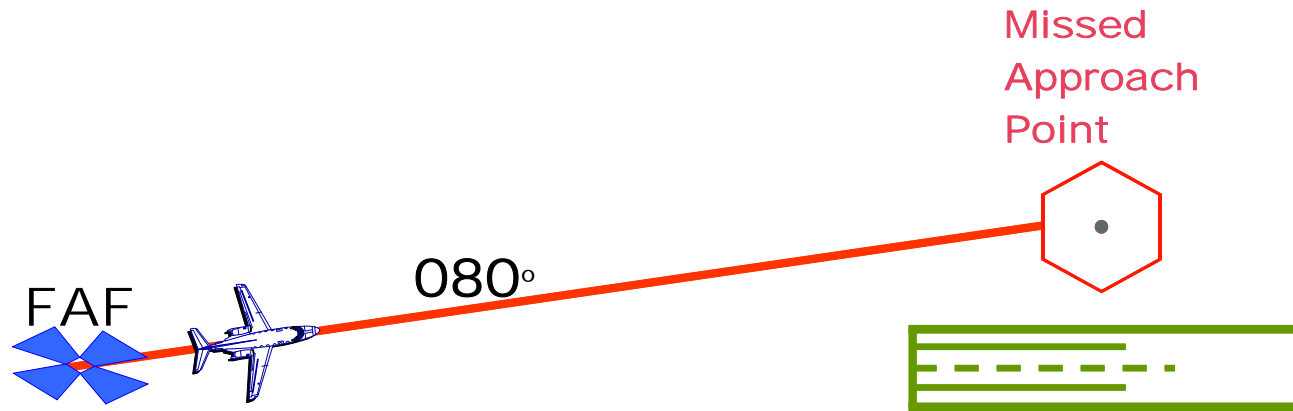


In some situations, if the inbound approach course is inline with the runway, a vertical flight path may be available.

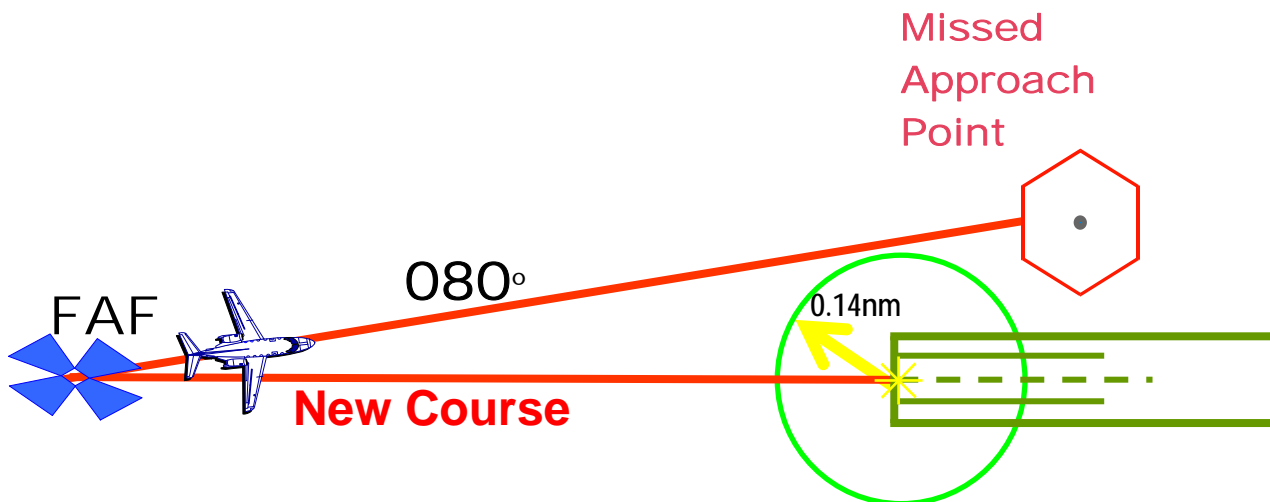


MISSED APPROACH POINT IS AFTER THE RUNWAY THRESHOLD

If the missed approach point is beyond the runway threshold such as in the case where the navaid is the missed approach point, for the glideslope to cross the threshold at threshold crossing height (TCH) would require an altitude tag on the missed approach point (MAP) that would be lower than the runway elevation. That would not be permitted, so no glideslope is created.



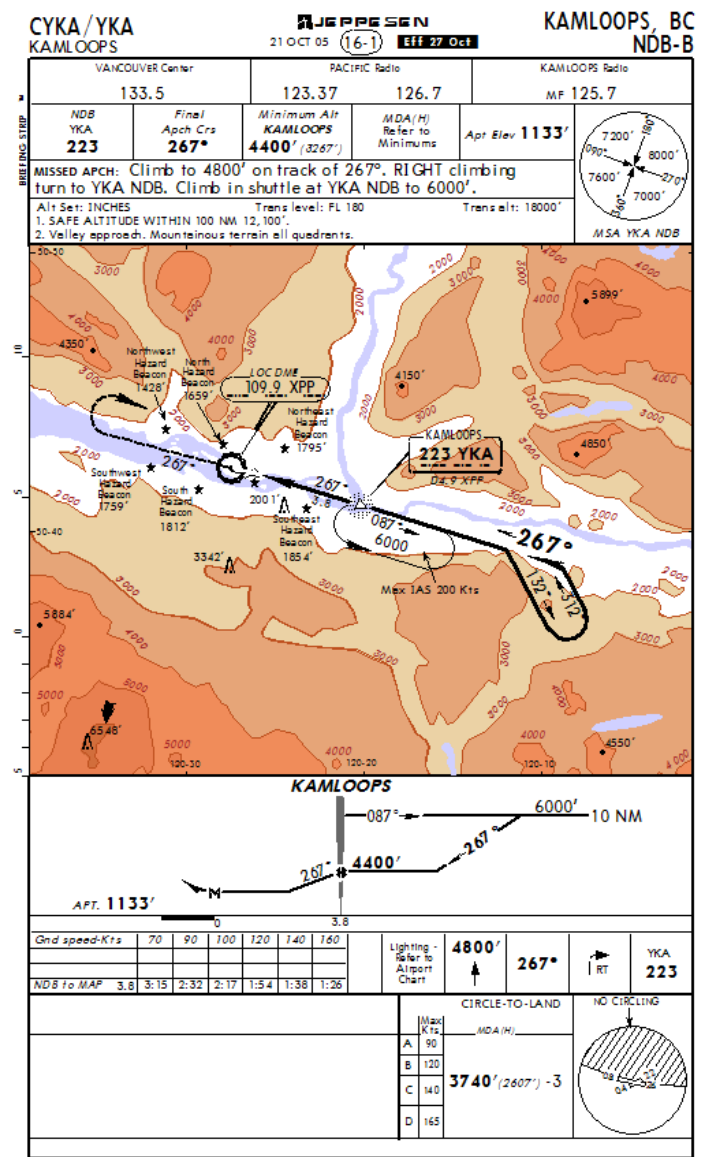
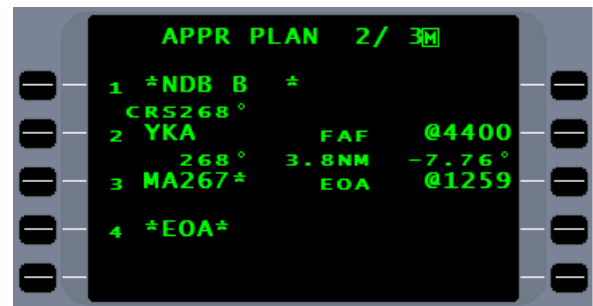
With ARINC 424 guidance, however, if the inbound course is considered to be in line with the runway, but the missed approach point (MAP) lies more than 0.14nm from the threshold of the runway, the inbound course may be redirected to the threshold. With the threshold as the missed approach point, a glideslope can now be created. In effect, there are now two approaches, one for conventional navigation and one for FMS/GPS navigation.



If the Missed Approach Point is within 0.14nm of the threshold, vertical navigation will be directed to that point to cross the threshold at the threshold crossing height.

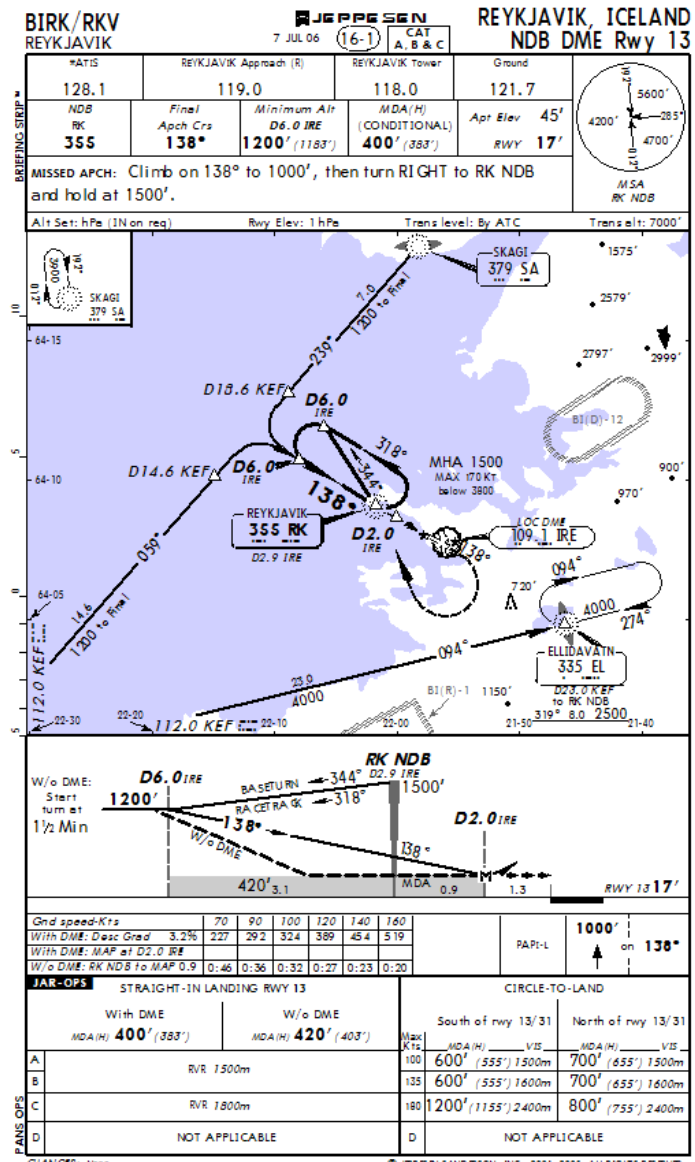
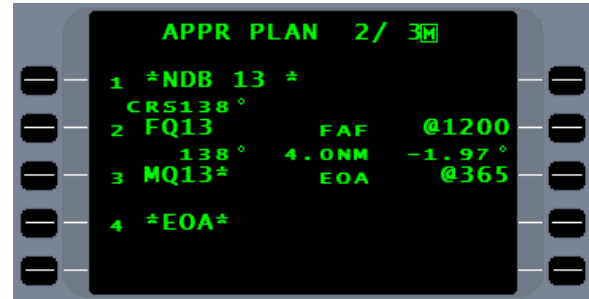
GLIDESLOPE ANGLE TOO STEEP

If the charting source (country of origin) designates a vertical flight path angle, it is published in the database. If the pseudo glideslope is created by Jeppesen, there is no maximum angle. At time of publishing, the highest glideslope angle in the NAV database is -7.76° .



GLIDESLOPE ANGLE TOO SHALLOW

If the country of origin designates a vertical flight path angle, it is published in the database. If the pseudo glideslope is created by Jeppesen and their calculation is less than 3° , the angle on most approaches is raised to 3° . At time of publishing, a glideslope angle of -1.97° is the lowest angle in the NAV database.

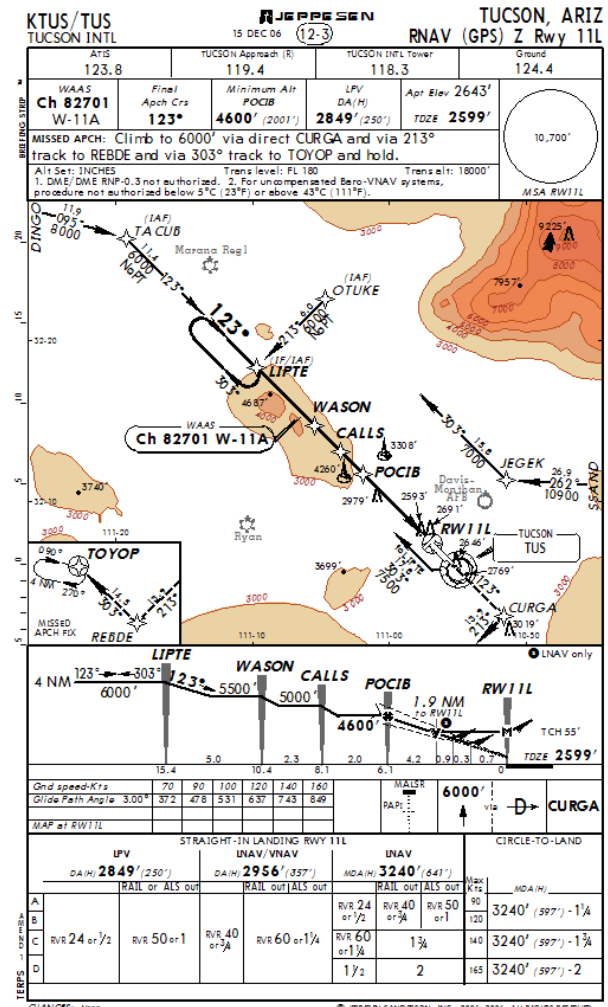
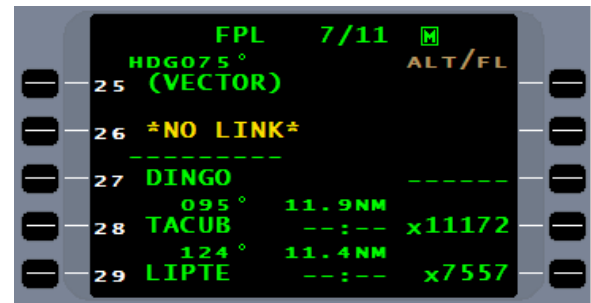


NOTE: Rules for glideslope creation IAW ARINC are ever changing. The approach definition is only changed when the approach is reviewed or changed by the source (state of origin).

For the RNAV (GPS) Z 11L approach, selecting the DINGO transition will result in the aircraft leaving the STAR at DINGO intersection for automatic approach activation at CALLS intersection.

Unless the pilot is familiar with ATC procedures at this airport and can, therefore, modify the flightplan for the arrival, the decision to choose either the STAR or the approach transition would be totally arbitrary. Keeping both procedures available may be the best decision.

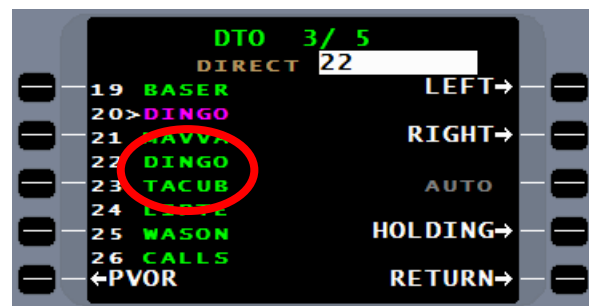
The choice will be made when inbound to DINGO intersection. Simply doing nothing will continue the aircraft on the STAR.



To choose the DINGO approach transition, when inbound to **DINGO**...



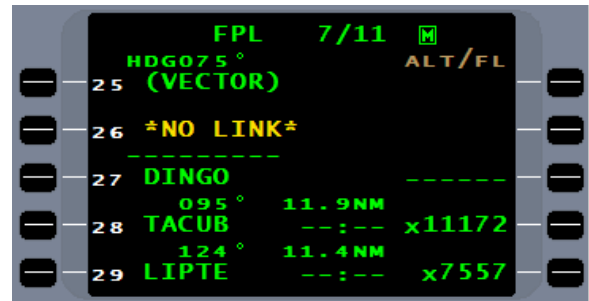
...press DTO and select the **DINGO** that begins the approach transition.



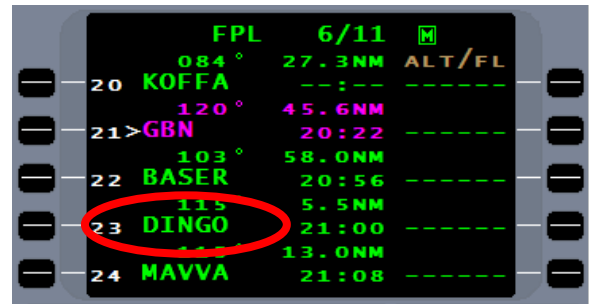
The aircraft will continue to **DINGO**, but will then turn to **TACUB**.



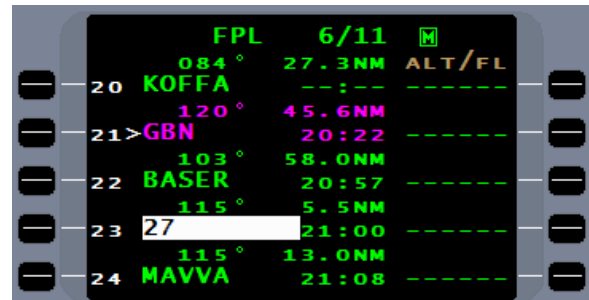
If knowledge of the ATC procedures at Tucson International Airport allows for editing of the flightplan to fly the DINGO approach transition, the technique of moving **DINGO** of the approach transition (#27) up to...



...replace **DINGO** of the STAR (#22) will be the easiest way.



Enter the number 27 into the cursor field of waypoint number 23...



...and press the **ENTER** key. The FMS will guide the aircraft to leave the DINGO5 STAR at **DINGO** intersection and fly the DINGO transition for the approach.

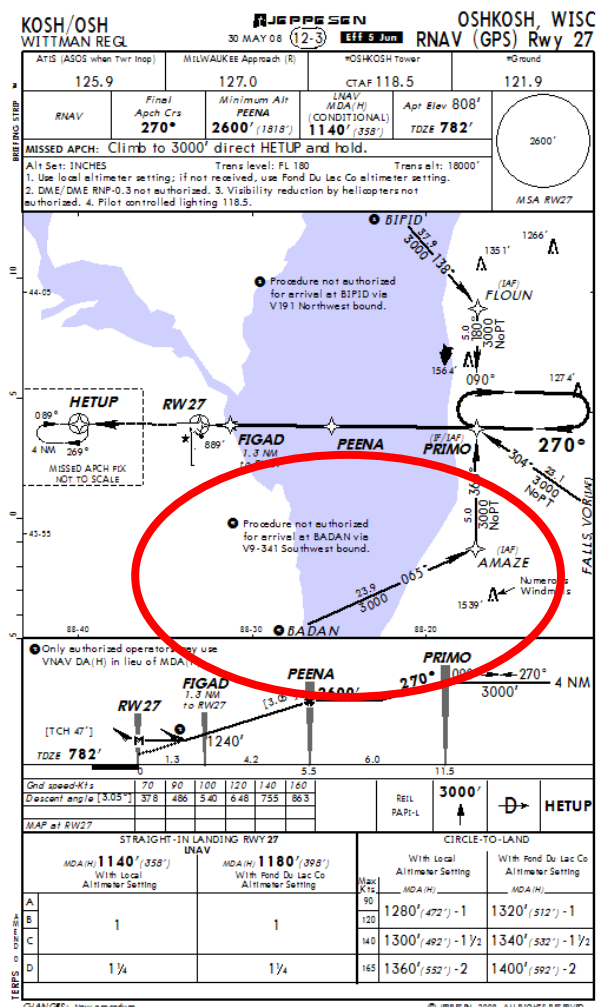


SELECTING THE APPROACH TRANSITION

On many occasions ATC may give a clearance direct to a waypoint in the terminal area, but when selecting the approach transition, this waypoint is not listed. Such is the case when cleared direct to the waypoint AMAZE on the approach chart of the Wittman Regional, Oshkosh, Wisconsin GPS Rwy 27. To select the appropriate transition that will include AMAZE, find the waypoint that feeds into amaze and that is also on the list of approach transitions. In this case, the choice is the **BADAN** approach transition.

It can be difficult some times to identify the correct approach transition. If the wrong transition is selected, simply go back to the approach transition selection field and choose a different one.

Many countries will use a waypoint on the enroute chart as the beginning of the approach transition. In this case the approach chart may not contain the waypoint on the approach transition list.



LINKING THE NAV LEG TO THE FLIGHTPLAN

There are two techniques to link the current NAV leg to the flightplan. One way is to press the **NX** line select key.



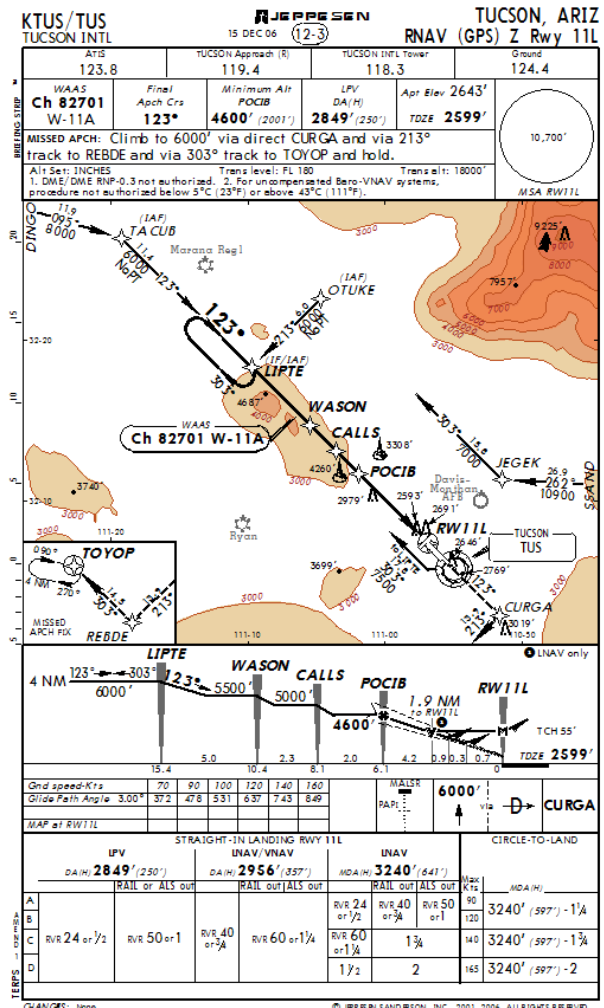
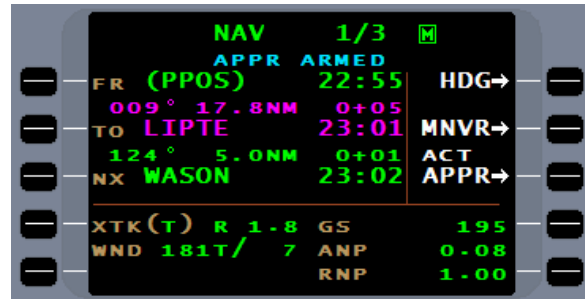
This will allow for selection of the follow on way point from the flightplan.



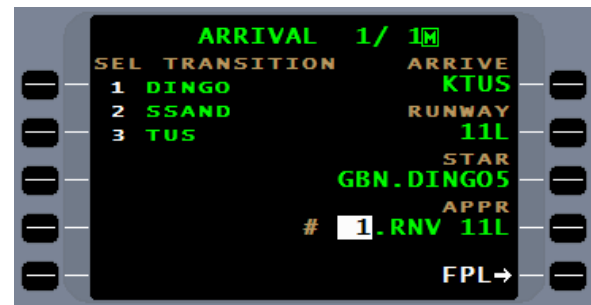
Once the waypoint is selected, the **NAV** page is now linked to the flightplan.



The first step is to go direct to **LIPTE**.



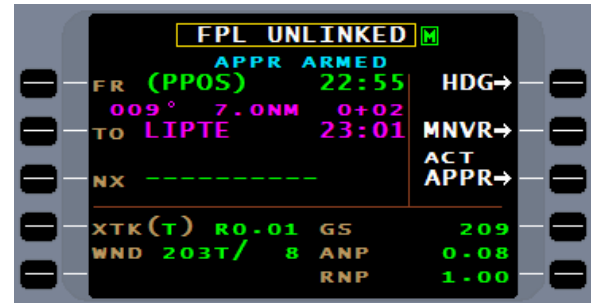
While the aircraft is enroute to LIPTE intersection, the pilot must change the approach transition...



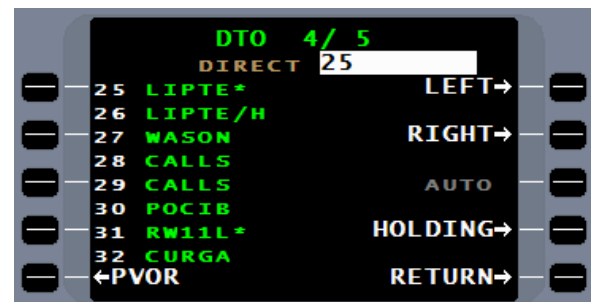
...to the **TUS** approach transition which contains the holding pattern for course reversal.



Through SCN 802, the flightplan will become unlinked from the NAV page because original waypoint in the DINGO transition was removed during the approach transition change. SCN 803 may attempt to reconnect to the flightplan.

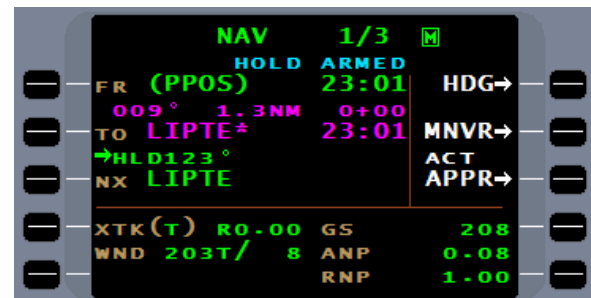


A second technique to re-link the NAV page to the flightplan is to use the DTO function. Select the desired waypoint, in this case **LIPTE*** with the asterisk, which is the entry point for the holding pattern. Being that this is a hold to fix (HF) pattern, selection of the second LIPTE (**LIPTE/H**) will result in the FMS not entering the holding pattern.



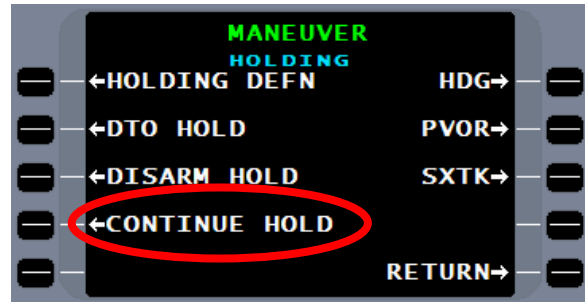
CAUTION: For SCN 803, if it automatically links to the flightplan, confirm the FMS has selected the correct waypoint for holding pattern entry. Being that this is a hold to fix (HF) pattern, selection of the second LIPTE (**LIPTE/H**) will result in the FMS not entering the holding pattern.

The FMS **NAV** page is now linked to the flightplan and will enter the holding pattern for the course reversal and the approach transition.

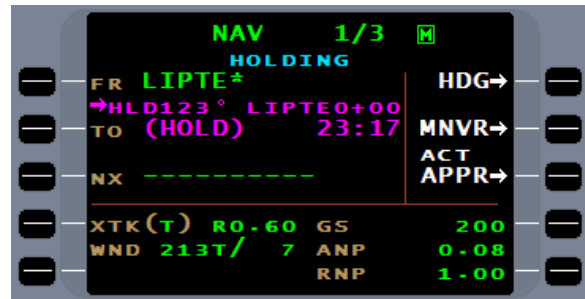


HOLDING DURING THE APPROACH TRANSITION

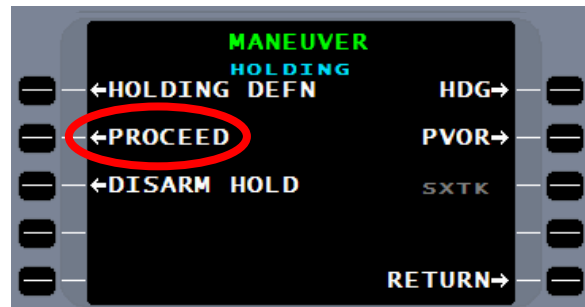
Once the aircraft has entered the holding pattern and if there is a requirement to continue holding, an option to continue the hold is provided.



If the option “CONTINUE HOLD” is used, the holding pattern will be converted to hold until manually terminated (HM). This will require pilot action to exit the holding pattern.



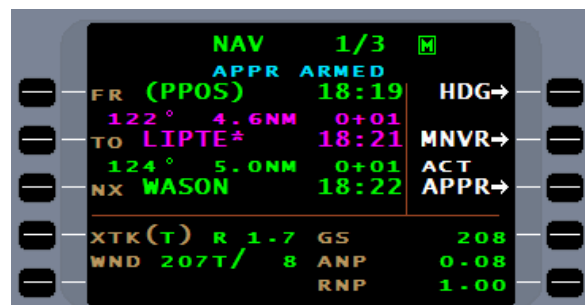
When it is time to exit the holding pattern and fly the approach, select “PROCEED”.



The “PROCEED” option will convert the holding pattern into a HF pattern and the aircraft will now exit holding upon crossing the holding waypoint.



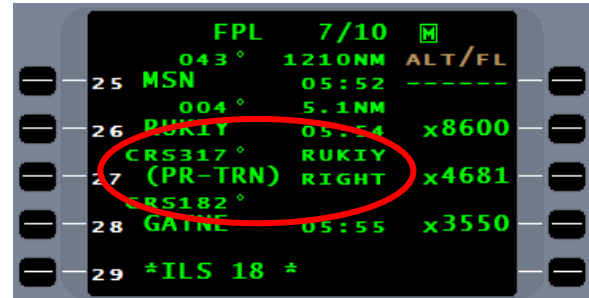
While on the outbound leg, to terminate a holding pattern and proceed direct to exit before completion of the holding pattern, first press “PROCEED”. This will clear the holding pattern from the flightplan. Then, use the DTO function to proceed direct to the holding fix.



FLYING A PROCEDURE TURN

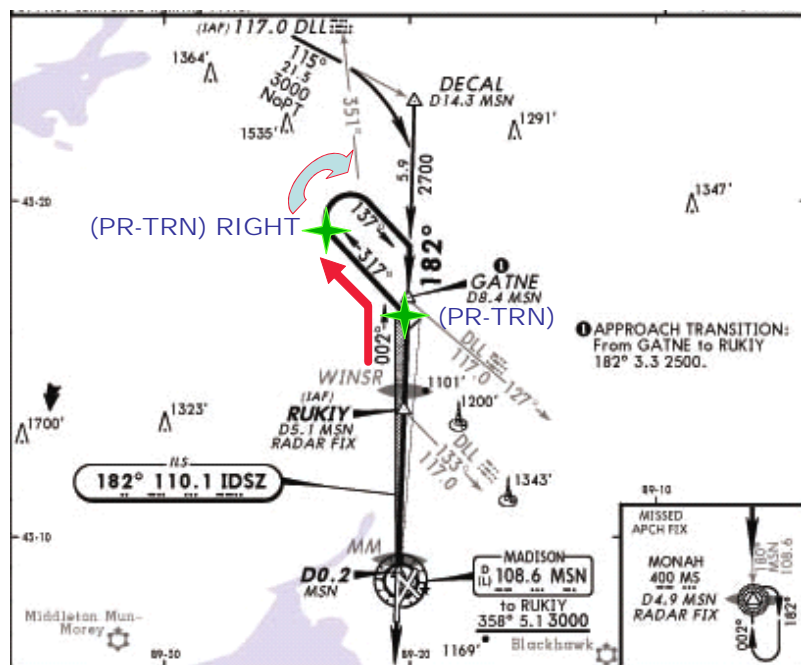
Although the classic procedure turn is not being used on the new generation approaches, it is still used in a large number of conventional approaches.

The selection of the transition will bring the procedure turn definition into the flightplan. This will also arm the procedure turn program that will create the procedure turn as this procedure is needed.

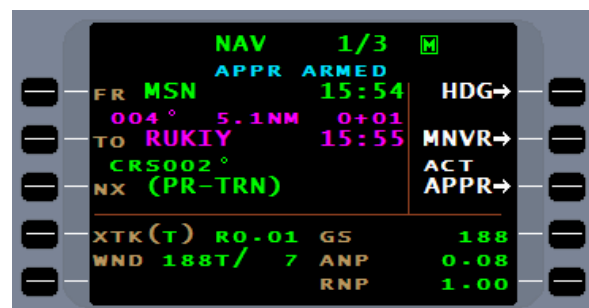


For the procedure turn program to calculate the procedure turn, it requires the definition of the procedure turn which it obtains from the flightplan, the winds, and groundspeed. With this information the FMS will create the two turn points for the procedure turn.

The procedure turn program will calculate the procedure to ensure the minimum amount of airspace is use, but yet completing the turn far enough out to allow for safe approach activation.



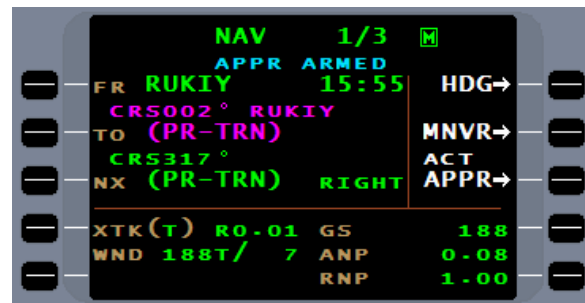
When the FMS sequences for presentation of the (PR-TRN) as the NX waypoint, the FMS will capture wind and groundspeed and calculate the lat/long of the two procedure turn waypoints. Since they are lat/long points, the FMS will navigate to them and calculate mileage for presentation on the primary flight display. If this procedure is flown again, the FMS will capture new winds and ground speed for the calculation of the waypoint lat/long.



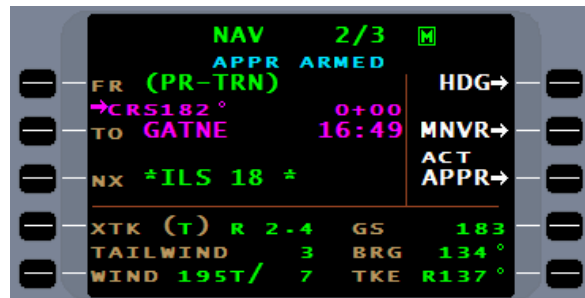
If the aircraft has a map display, the procedure turn waypoints will be presented. Later generation map displays will draw the complete procedure.



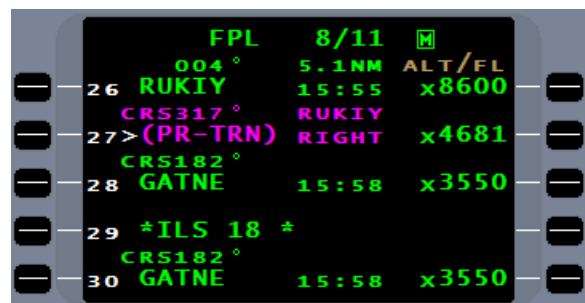
Since the FMS navigates to a specific waypoint, the pilot can more easily maintain situational awareness. The “**RIGHT**” following the second (**PR-TRN**) will force the FMS to make a right turn when sequencing.



Upon sequencing the second (**PR-TRN**) waypoint, the inbound course and the follow on waypoint will become the **TO** waypoint. The “→” next to the course leg indicates a mandatory right turn.

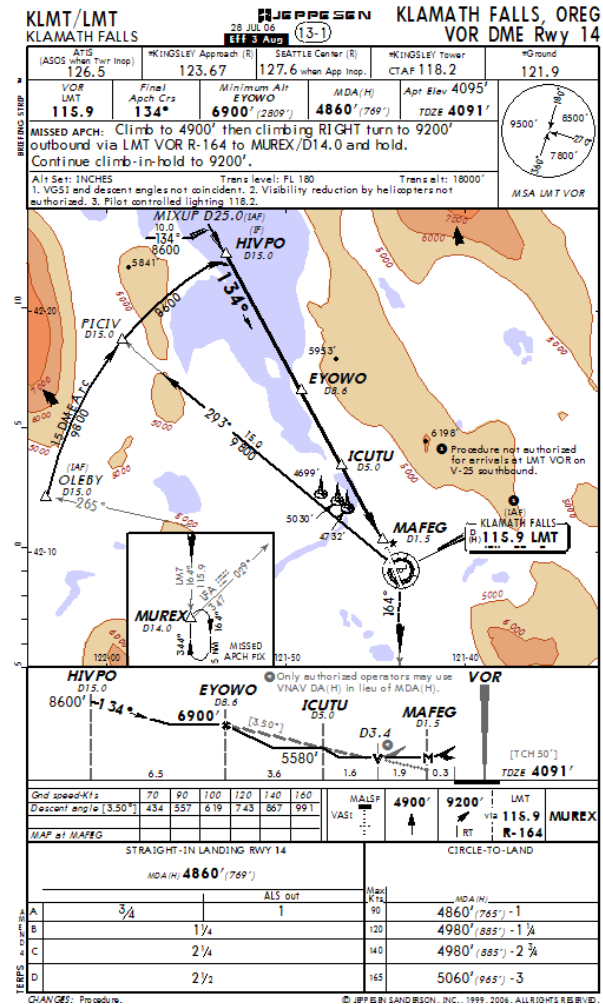


Although the procedure turn waypoints are presented on the FMS and map display, the flightplan will not display these waypoint.

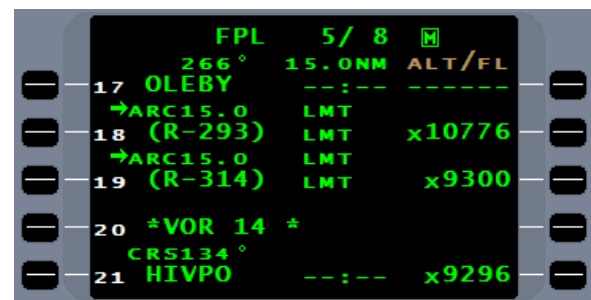


FLYING AND INTERCEPTING ARCS

An arc leg (AF) is a procedural leg that cannot be created in the flightplan and must come from the database.



The leg definition of the arc leg on the OLEBY transition to the KLMT VOR DME Rwy 14 approach is as follows. The arrow indicates the direction of arc, in this case a right arc. The distance of 15.0 is the arc distance from the LMT VOR.

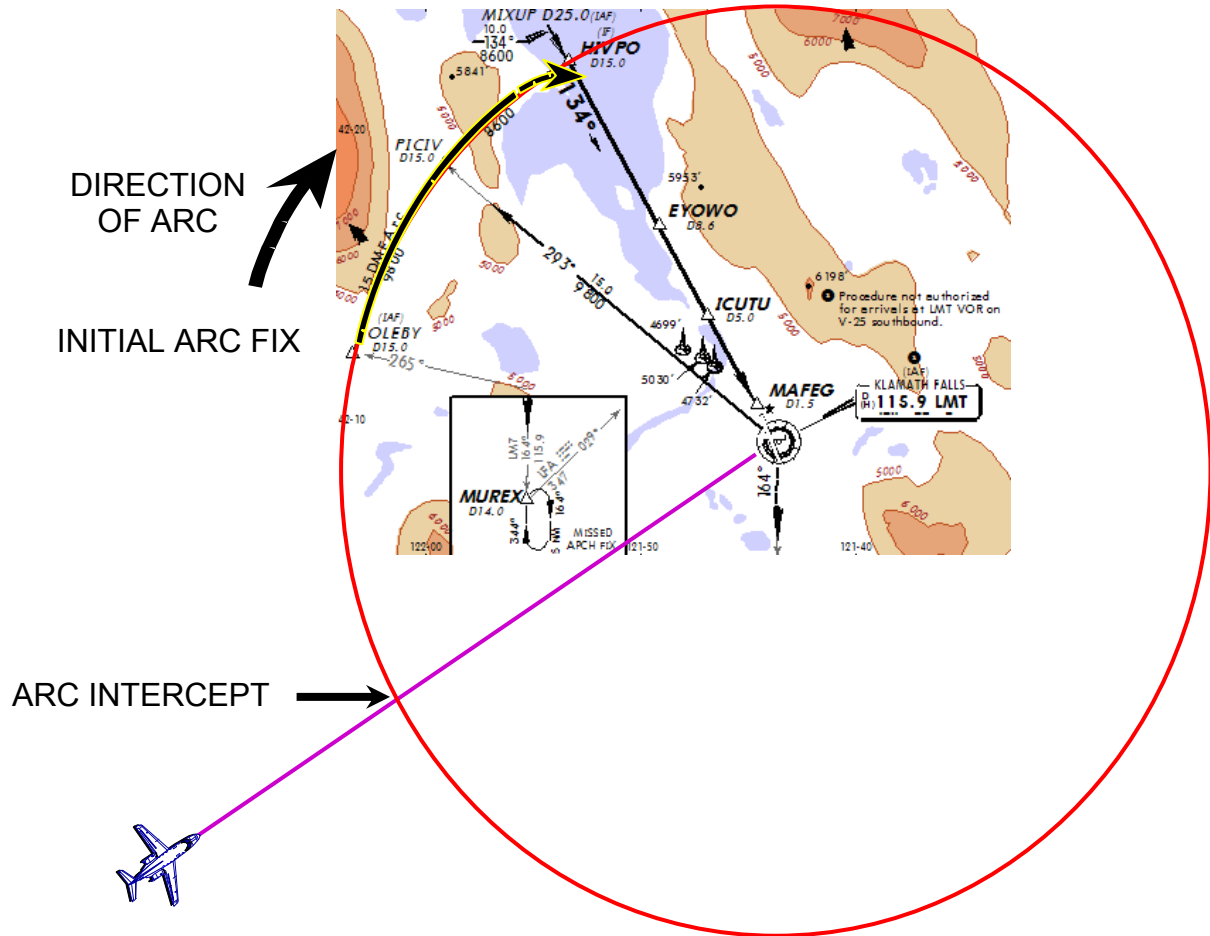


Sequencing onto an arc leg is no different than sequencing onto any other FMS leg. Once established on the arc leg the presentation on the HSI may be different than the conventional method of flying an arc.



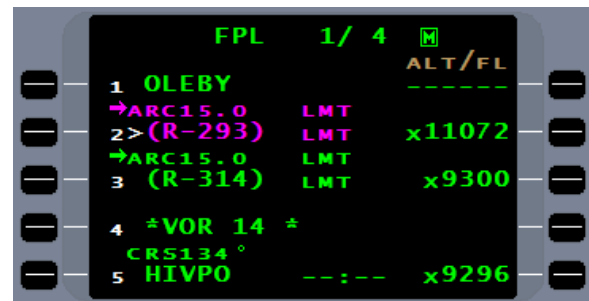
The course arrow will indicate a tangent to the arc and when established will be at the top of the HSI. The CDI will indicate the distance left or right of the arc as it does with a TF or CF leg. As the aircraft flies the arc, the compass rose will rotate indicating a changing aircraft heading. If an FMS bearing pointer is available and selected, it will point to the leg terminator to the arc.



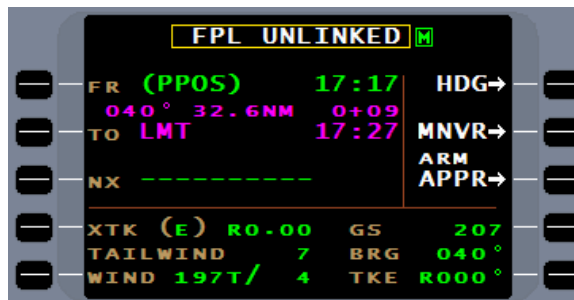


On occasion when flying inbound to a VOR DME a clearance is given to intercept the arc rather than proceeding direct to the initial fix of the arc; then join the approach. By implementing a special procedure, the FMS can intercept an arc while on course to the VOR DME.

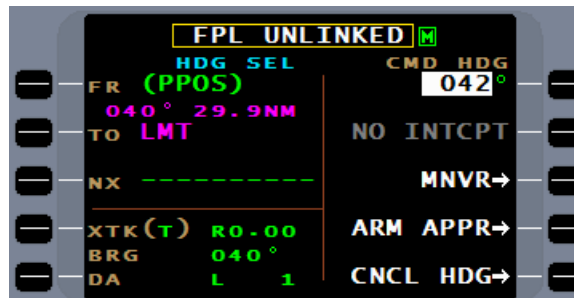
When the approach is identified, insure it's in the flightplan with the arc transition selected.



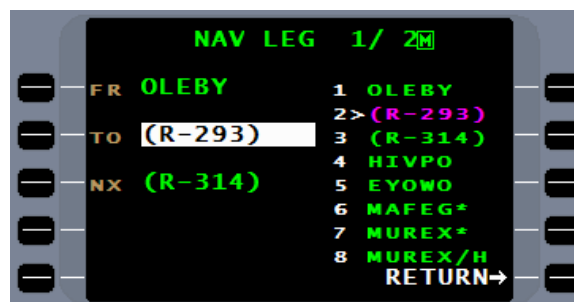
Whether on an airway or direct to the VOR DME, allow the FMS time to zero the crosstrack (**XTK**) and track error (**TKE**). With this accomplished, the FMS heading has compensated for winds and will track to the VOR DME.



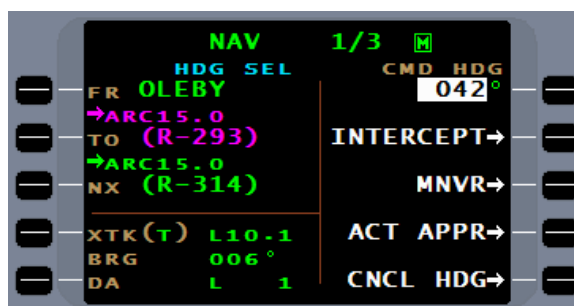
The next step requires understanding that the difference between tracking to the VOR and heading to the VOR is the affect of wind. Now that the FMS has compensated for wind, the FMS can be placed in command heading on the current heading of the aircraft. Select the heading line select key followed by the **[ENTER]** key. For the short time needed, the FMS will continue towards the VOR DME.



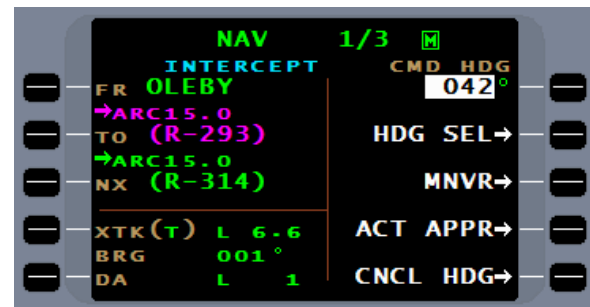
To continue with the procedure requires a manual leg change with the initial arc fix entered as the from (**FR**) waypoint. The sequential waypoint will automatically be entered into the **TO** waypoint. Press **[ENTER]** to accept this new leg.



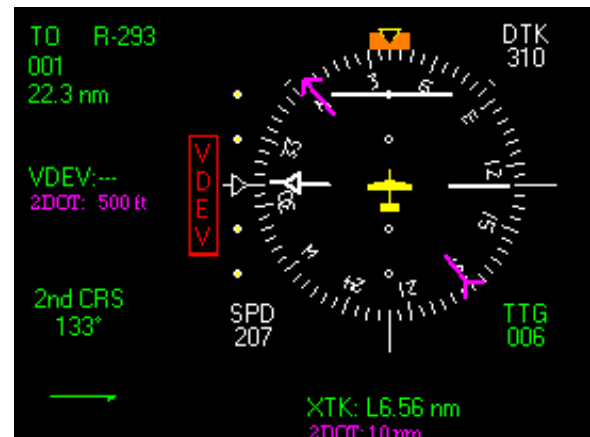
Since the FMS projects the active NAV leg behind the **FR** waypoint and, being that this is an arc leg, the FMS heading function will see an intercept at the point where the projected course to the VOR crosses the projected arc leg.



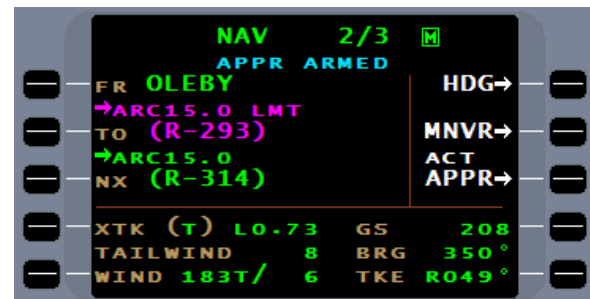
With intercept selected, the FMS will guide the aircraft towards the arc and with a smart turn will intercept the arc. The crosstrack will indicate the aircraft distance from the arc.



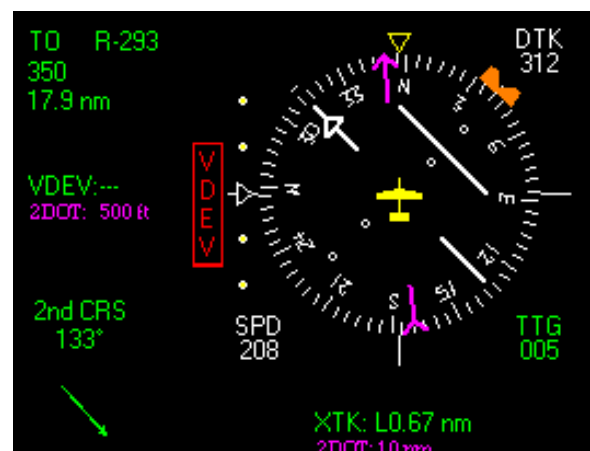
The HSI will present a tangent to the arc. The FMS bearing pointer will point to the waypoint at the end of the arc segment. Distance is line-of-sight to the **TO** waypoint



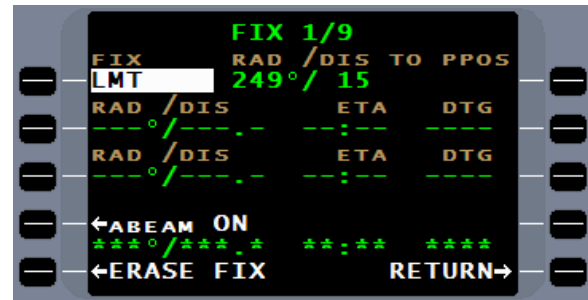
When the FMS captures the arc leg the heading mode will cancel.



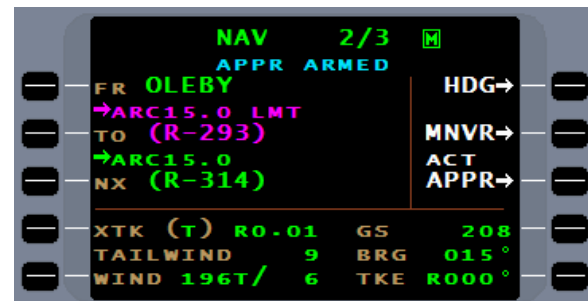
The HSI will turn to orient the course arrow with the direction of flight.



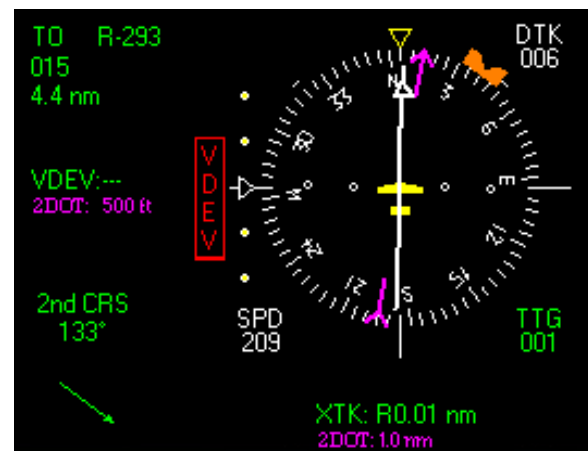
The aircraft cannot leave the last assigned altitude until on a published segment of the arc. For the example approach, this will be when crossing OLEBY, which is on the 265° radial of the LMT VOR. There are three ways to identify when crossing OLEBY. One, and probably the best way, is to use the VOR bearing pointer and when it indicates the 265° radial, the aircraft is at OLEBY. The second way is to use the PFD or MFD map display to identify OLEBY. The third way is to use the FIX tool under the NAV menu. Enter LMT and the dynamically calculated radial of the aircraft relative to LMT will be presented.



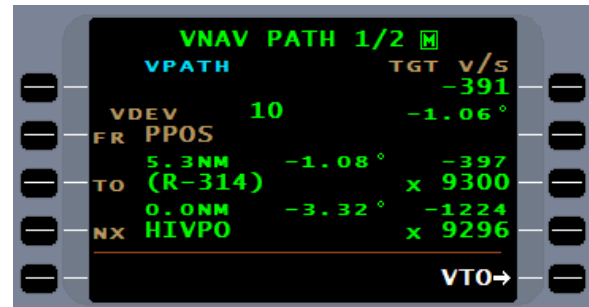
When established on the arc, **XTK** and **TKE** will be close to zero.



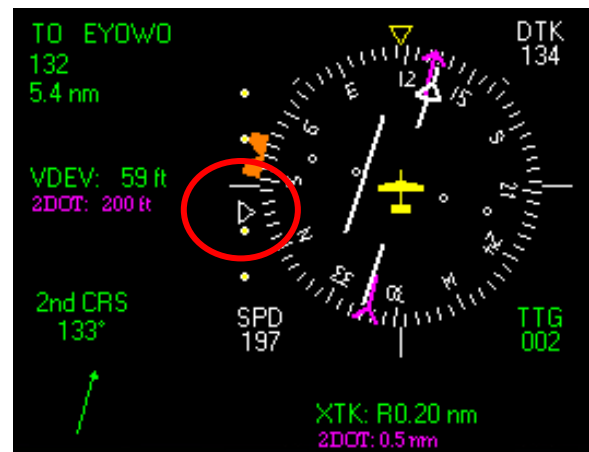
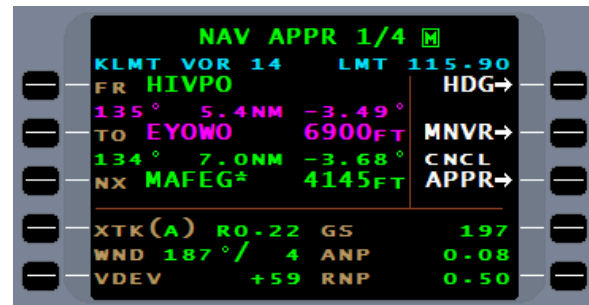
The course arrow will be at the top of the display and the CDI will be centered. Mileage will be line-of-sight to the intersection of the LMT 15DME/293RADIAL.



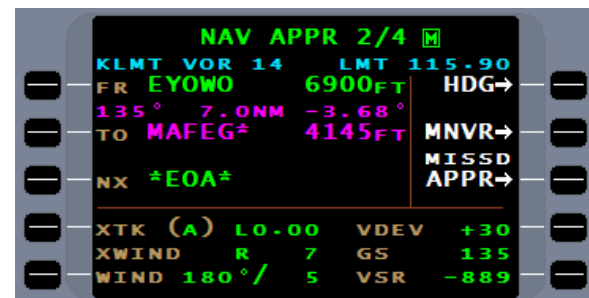
If enroute VNAV is used to descend in the arc, VTO must not be activated until passing OLEBY.



As the FMS intercepts the inbound course and meets the criteria for approach activation, enroute VNAV will cancel and the FMS will automatically transition into approach VNAV.



The FMS will guide the aircraft towards the runway threshold both laterally and vertically.

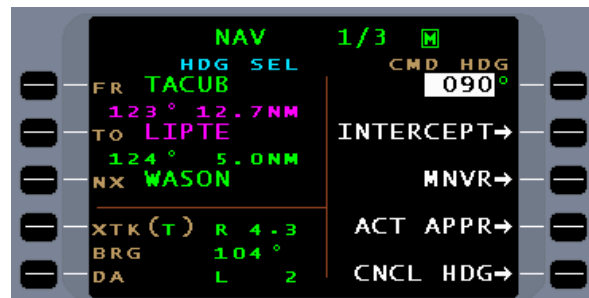


VECTORS TO AN APPROACH TRANSITION LEG

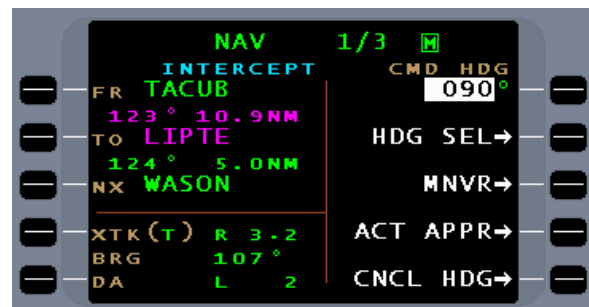
If vectors are given to intercept an approach transition leg, first insure the desired leg is displayed as the "FR" and "TO" waypoints. If necessary, do a manual leg change.



If the heading direction in the CMD HDG field will intercept this leg, an INTERCEPT line select key will be presented.



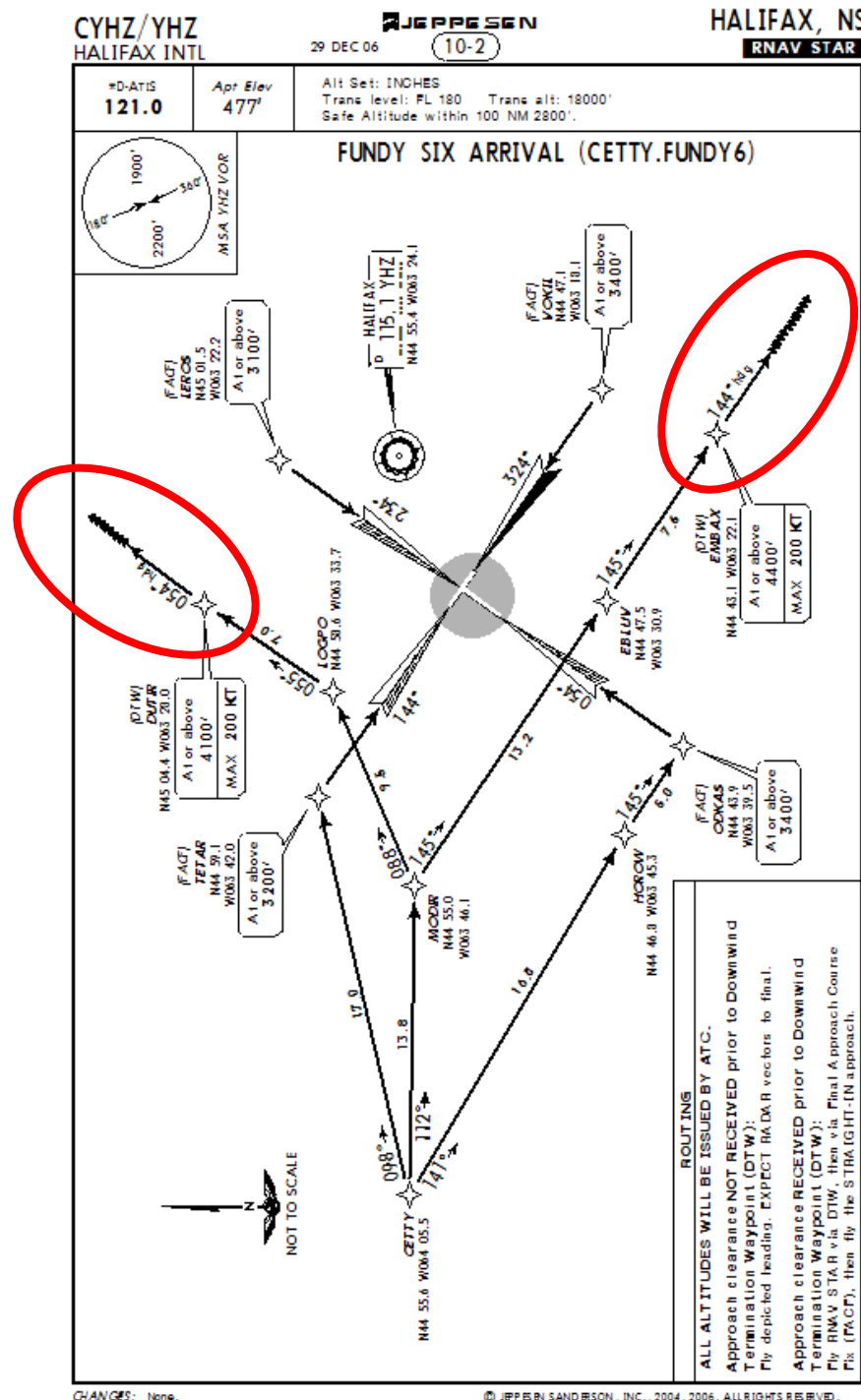
Press this line select key and the aircraft will intercept this leg and proceed to the TO fix. Remember, even though this is vectors, this is not vectors to the final approach course and automatic approach activation applies. If the given vectors are to intercept the inbound course and the intercept will take place before the course fix associated with the approach label, manually activating the approach is an option. Understand the clearance before activating the approach.



ARRIVALS WITH A VECTOR LEG

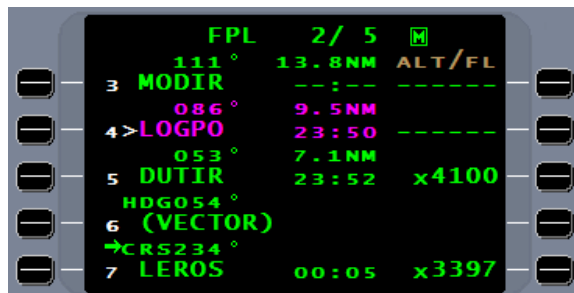
Flying arrivals with a vector to manually terminated leg (VM) may require a variation to normal procedures.

The following arrival is typical of those having a VM leg prior to the final approach course which is usually a course to fix leg (CF). The ovals identify the VM legs on the chart.

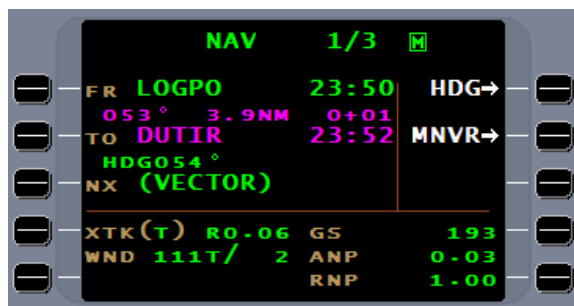


The recommended way to fly this arrival is described below. The scenario is to an ILS advisory approach, but is the same procedure for enabled approaches.

The flightplan shows a track to fix leg (TF) leg preceding the vector to manually terminated leg (VM), followed by a course to fix leg (CF). The arrival is correctly coded with the TF, VM, CF legs allowing for the FMS to control the turn to join the CF leg.



Fly the TF leg as depicted until crossing the TF leg terminator; in this case, **DUTIR**.



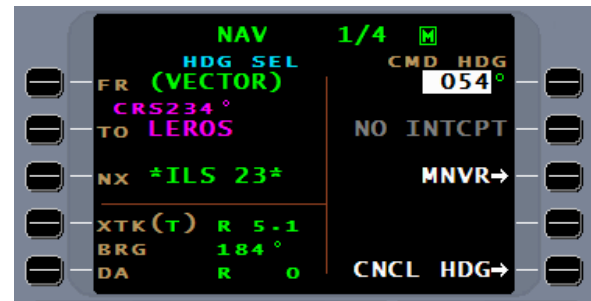
Upon sequencing to the VM leg...



...select command heading (CMD HDG) and press **ENTER**.

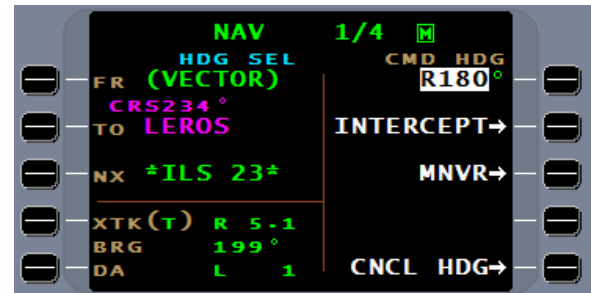


As soon as **ENTER** is pressed, the FMS will automatically sequence to the CF leg.

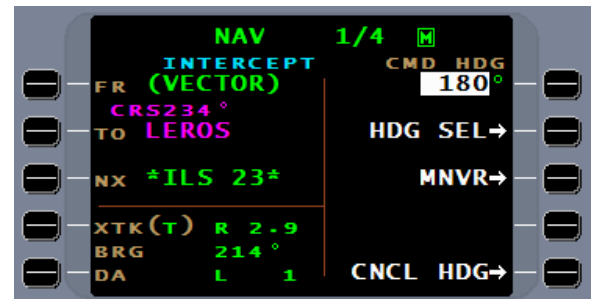


Now, per ATC vectors, use FMS **CMD HDG** to turn the aircraft to an intercept heading for the CF leg.

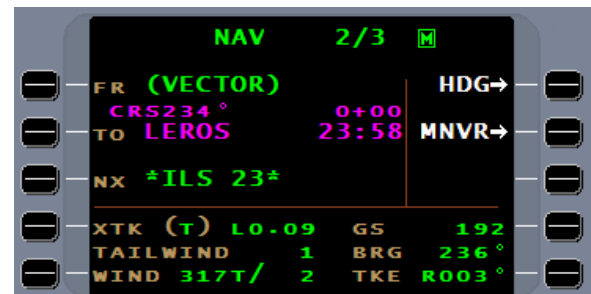
If the approach is flyable by the FMS, manually activate the approach at this time. Refer to the FMS Operator's Training Manual for flying Vector's to Final.



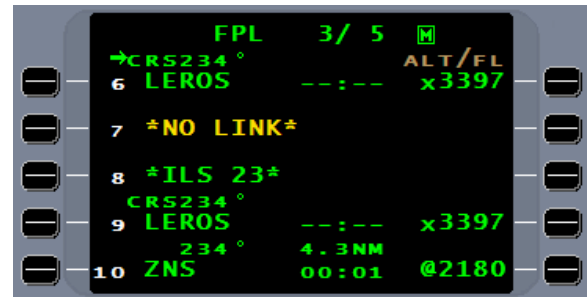
Press **INTERCEPT** when cleared and join the CF leg or final approach course.



Follow the CF leg to join the approach.

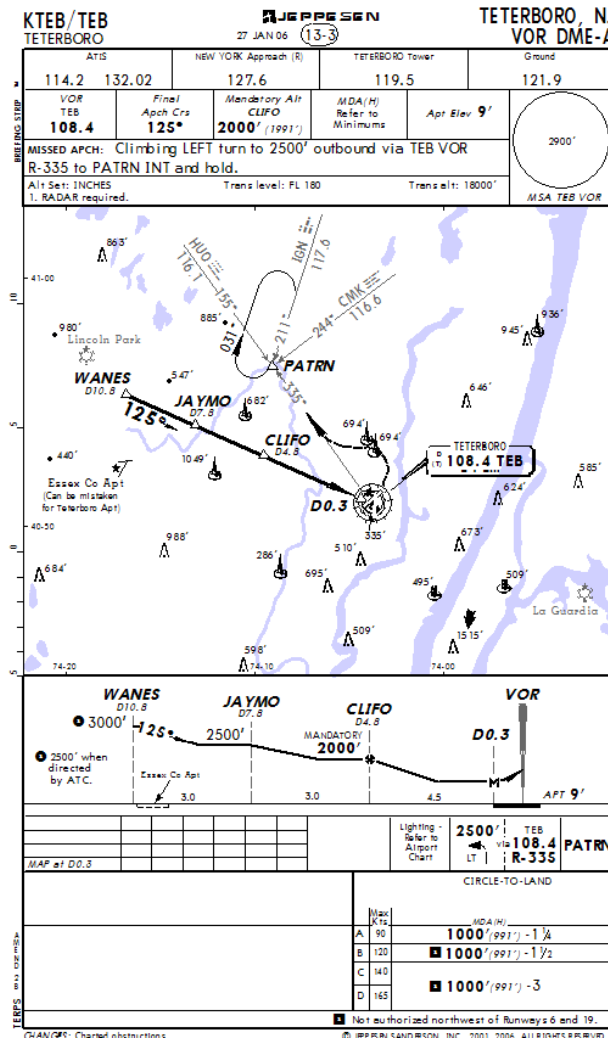


When selecting the arrival and the approach, a ***NO LINK*** may appear. In most cases the ***NO LINK*** should be deleted as is the case with the above scenario, but there are rarer scenarios where it should be retained.

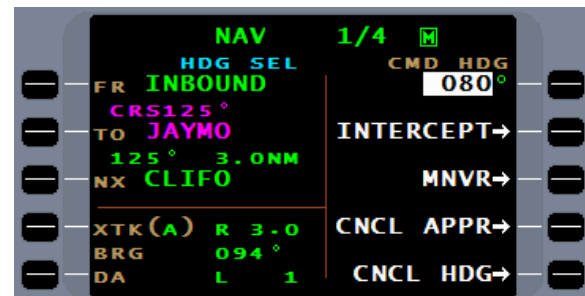


PVOR TO EXTEND AN APPROACH CENTERLINE

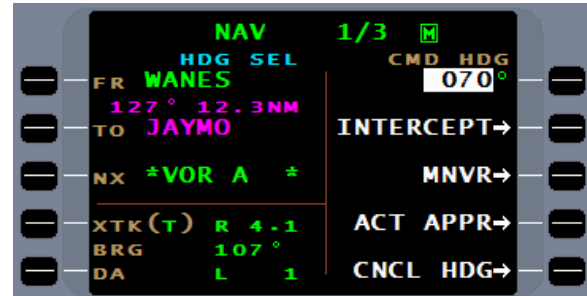
The clearance is to fly the assigned heading and intercept the Teterboro VOR DME or GPS-A final approach course outside WANES intersection. There are three ways to extend this approach centerline.



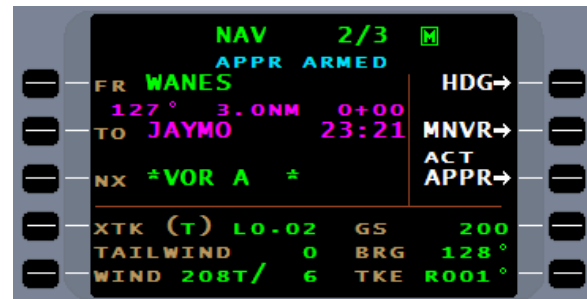
One way is to manually activate the approach. This will extend the inbound course for intercept, but, review of the approach will show a problem in manually activating this approach. The flightplan shows that **JAYMO** is associated with the approach label and with manual approach activation, WANES intersection will be eliminated from the NAV page. WANES intersection is a step-down fix. Vectors to a course intercept before WANES will pose a question as to where to step down. With the distance from WANES to **JAYMO** being 3nm, one solution is to descend when on course and 3nm from **JAYMO**.



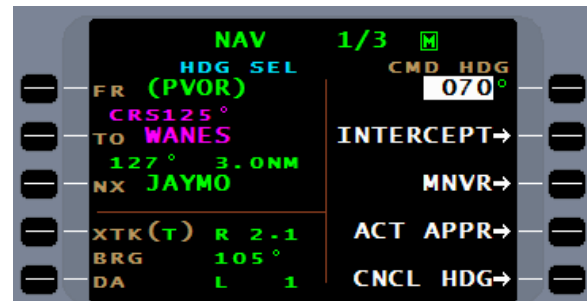
A second method is to do a manual leg change by selecting **WANES** as the **FR** waypoint and **JAYMO** as the **TO** waypoint. The course will now extent behind **WANES** for intercept.



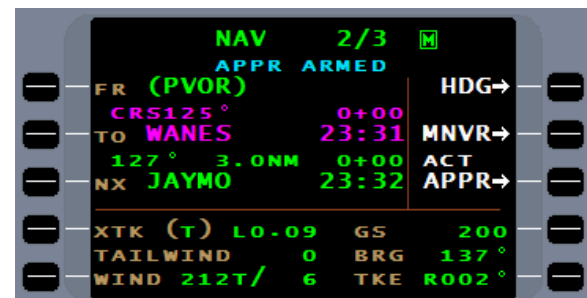
Since **WANES** intersection is a step-down fix, vectors to a course intercept before **WANES** will pose a question as to where to step down. With the distance from **WANES** to **JAYMO** being 3nm, one solution is to descend when on course and 3nm from **JAYMO**.



A different solution is to make **WANES** a pseudo VOR (PVOR). Entering a track of 125° will result in a radial being extended from **WANES**. A heading of 070° will intercept the PVOR radial and, by pressing the INTERCEPT line select key, the aircraft will intercept, capture this radial, and fly inbound to **WANES**.



Upon passing **WANES** a step down from 3000 feet to 2500 feet may be made.



PVOR & THE RUNWAY LIST OPTION SCN 803

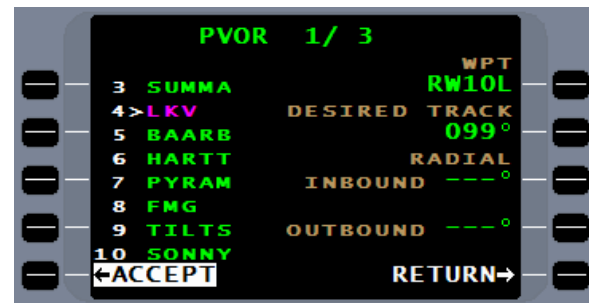
When doing tactical operations such as PVOR, DTO, and HOLD, the LIST function will provide a RWY option.



The RWY option will present the airport identifier and runway. The runway coordinates are that of the runway threshold.



When the RWY option is used with PVOR, the runway heading is automatically entered as the DESIRED TRACK. Accepting this will present, on the NAV page, a PVOR with runway course information.



FLYING THE ILS APPROACH

The flying of a NAV-to-NAV ILS approach requires advanced avionics to include EFIS, flight director, and autopilot. There are both procedures and techniques to flying the NAV-to-NAV ILS approach.

The FMS will not fly the ILS approach; in other words, it cannot process both the localizer and glideslope, create the three dimensional path, and then send the navigation to the aircraft flight guidance system. In cooperation with some EFIS and autopilots, the FMS will allow for the automatic transfer of navigation control to the aircraft flight guidance for the flying of the ILS final approach segment. To do this requires an advanced autopilot, flight director, and one of the following Electronic Flight Instrument Systems (EFIS):

Universal Avionics EFI 890R
Collins Proline 4 4000
Collins EFIS 86

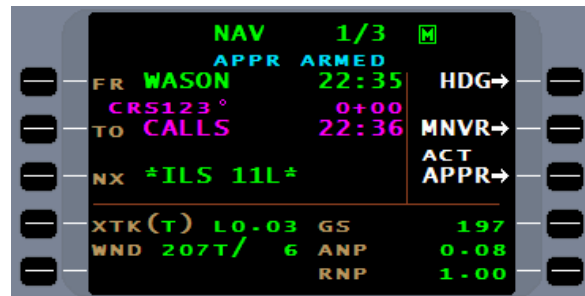
From a pilot's perspective, the flying of an ILS NAV-to-NAV approach is the same as any other FMS approach with one exception. The exception is the required signal the EFIS gives to the FMS that indicates it's ready to receive the NAV-to-NAV transfer. The signal occurs when the pilot selects approach mode on the flight director. The EFIS will then send communication to the FMS that it is ready for the transfer. When the FMS detects the ILS localizer and has received the transfer ready notification from the EFIS, it will notify the EFIS to assume navigation control of the aircraft. The EFIS will now present navigation commands to the flight director and autopilot.

Following the arming of the approach, the FMS will require that the ILS frequency be tuned and will prompt with the TUNE APPR line select key. If this is not accomplished, further prompting by FMS message will occur.



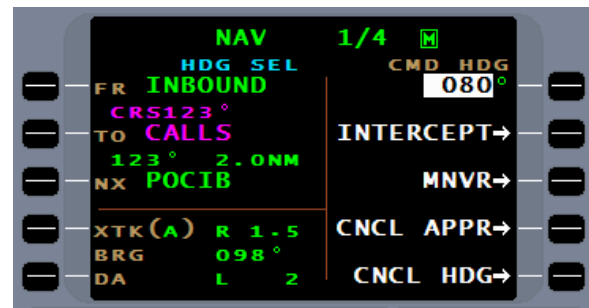
For automatic activation when flying an approach transition, arm the aircraft flight director approach mode prior to the capture fix.

As the FMS becomes approach active, it will transfer navigation control to the EFIS.



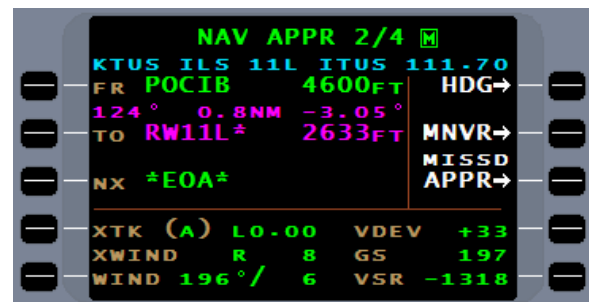
NOTE: Follow automatic approach activation, if the FMS has a slight position error that causes the aircraft to fly parallel to the ILS inbound course without VHF LOC capture, the FMS will advise the pilot with the message "FMS-FLOC DIFF WARN". The pilot should use FMS HDG mode to steer the aircraft to intercept the ILS.

When on vectors to the final approach course, manual activation of the approach is required. Follow the rule that first requires using the FMS heading mode to place the aircraft on the assigned heading, and then activate the approach. Follow ATC vectors to the intercept leg. When the FMS presents a heading intercept line select key, first arm the aircraft flight director approach mode, then press the FMS intercept line select key.



NOTE: It is extremely important that flight director approach mode be armed before pressing the FMS intercept line select key. The navigation transfer may not take place if this sequence is not followed and the aircraft will fly through the ILS final approach course.

The ILS missed approach will operate the same as any other FMS approach. Selecting the FMS MISSED APPR line select key either directly or remotely through the aircraft go-around system will result in the FMS regaining navigational control of the aircraft and following the missed approach procedure.



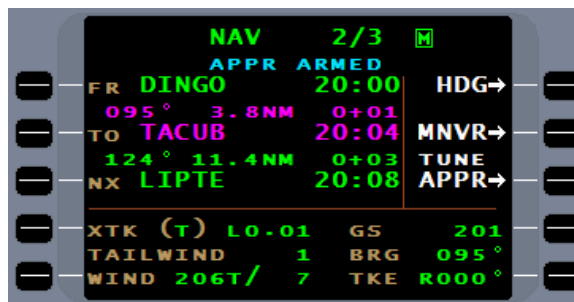
As with all missed approaches, if the pilot uses the aircraft go-around system, the aircraft pitch up, wings level command will come from the aircraft flight director. The FMS will not provide any vertical guidance during missed approach. To reconnect the flight director to the FMS, flight director NAV mode must be selected.

At some airports ATC guidance will direct the aircraft to intercept and proceed inbound on the localizer without clearance to fly the approach. Retaining the aircraft flight director approach mode will result in capture of the glideslope when clearance to do so was not given. A technique to accomplish this is as follows. Select the aircraft flight director approach mode to transfer navigational control to the EFIS. Once the transfer is complete, reselect NAV mode on the aircraft flight director. Once transfer to the EFIS is made, the FMS will not retake navigational control until a missed approach is executed. The aircraft will now follow the localizer without capturing the glideslope. When cleared for the approach, select aircraft flight director approach mode to capture the glideslope upon intercept.

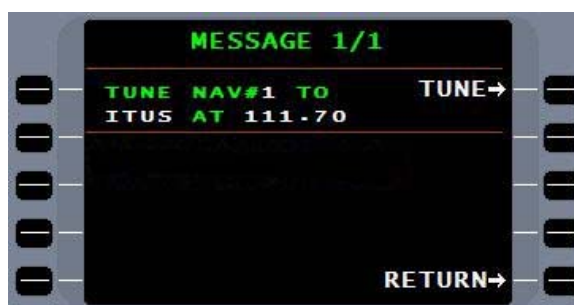
FLYING THE LOCALIZER AND BACKCOURSE APPROACH

Both the localizer and back course approaches are flown with the FMS providing navigational control throughout the entire approach. The FMS must have VHF NAV radio input for reception of the localizer. The FMS will identify the line over the ground created by the localizer and be able to follow it. This, however, will not allow the FMS to identify the final approach fix and missed approach point. The FMS will use GNSS/GPS to identify the Lat/Long of the FAF and MAP, therefore, the approach must be surveyed IAW WGS-84. This is also the reason the LOC and BC approaches will be followed on the arrival page with a "G".

Following the arming of the approach, the FMS will require that the ILS frequency be tuned and will prompt with the TUNE APPR line select key.



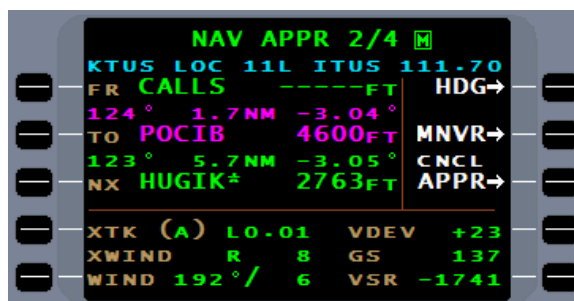
If this is not accomplished, further prompting by FMS message will occur. Failure to tune the VHF radio to the required frequency will result in the FMS being unable to fly the approach with flagging of the NAV display on the Primary Flight Display (PFD).



Upon going approach active and the VHF localizer acquired, the FMS will push a message "LOC STEERING ACTIVE" to verify the localizer is the guidance for course steering. NAV mapping will change to display VHF course guidance.

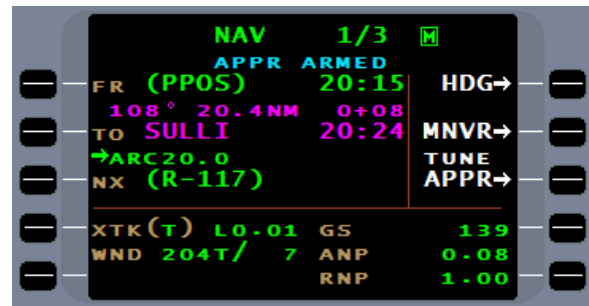


In addition to lateral navigation with the use of the localizer, vertical navigation is available with a barometric glideslope for a three dimensional approach.

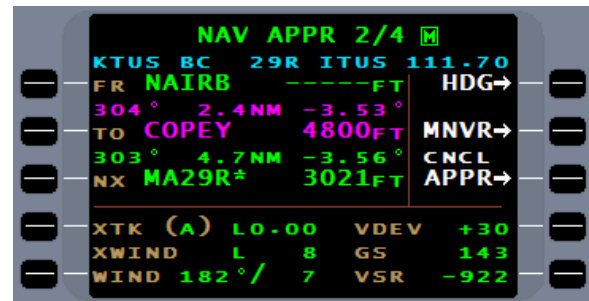


If the localizer approach meets the criteria for a glideslope, the approach will contain a baro VNAV glideslope. Check the approach plan on flightplan menu page 2 for glideslope availability.

Following the arming of the backcourse approach, the FMS will require that the localizer frequency for the back course approach be tuned and will prompt with the TUNE APPR line select key. If this is not accomplished, further prompting by FMS message will occur.



The FMS will present both lateral and vertical guidance for the backcourse approach the same as a localizer approach.



Upon going approach active and the VHF localizer acquired, the FMS will push a message "LOC STEERING ACTIVE" to verify the localizer is the guidance for course steering. NAV mapping will change to display VHF course guidance



The difference between a conventional back course approach and an FMS flown back course approach is the course arrow will point to the landing runway of the back course approach and the pressing of the aircraft flight director BC switch for most aircraft is not required.

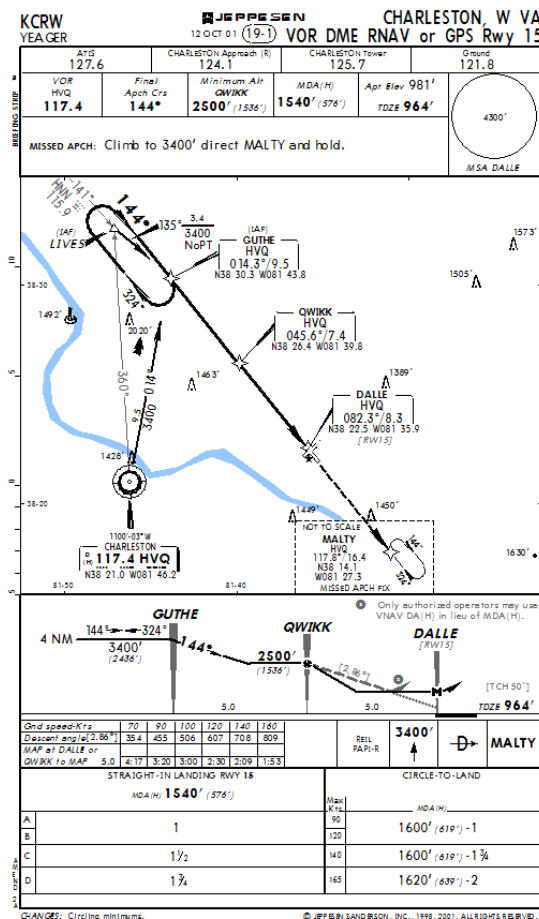


If the backcourse approach meets the criteria for a glideslope, the approach will contain a baro VNAV glideslope. Check the approach plan on flightplan menu page 2 for glideslope availability.

FLYING THE RNAV APPROACH

RNAV (VOR DME)

RNAV approaches began in the late 1960's with the advent of the moving station RNAV computer. At that time the term RNAV was defined as random area navigation. Later, random was dropped from the definition, but the term RNAV was retained. The moving station RNAV computer used a VOR DME input to calculate a radial distance (Rho theta) waypoint and would direct the aircraft to that point. Approaches using radial distance waypoints were created and named RNAV. With the introduction of the new RNAV approach in 2000 using lat/long waypoints, a name change was made to the original RNAV approach to precede RNAV with the words VOR DME. The newest naming convention has these approaches named as RNAV (VOR DME). Many approaches never receive the new name because they are decommissioned before implementation. The FMS will fly these approaches using lat/long in lieu of radial distance waypoints. The example below shows both methods of identifying a waypoint.

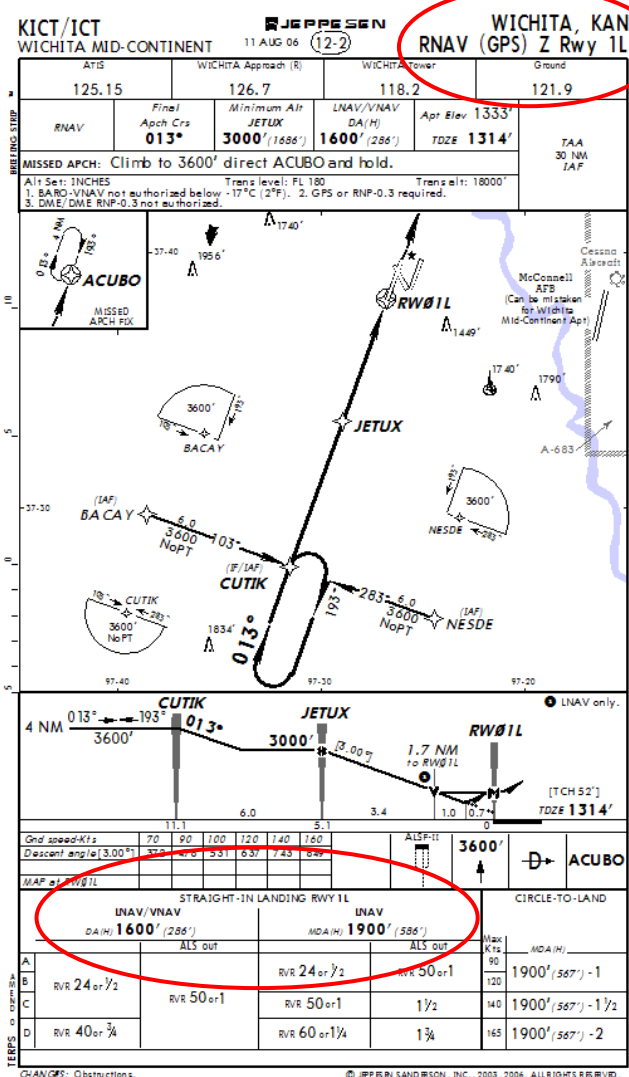
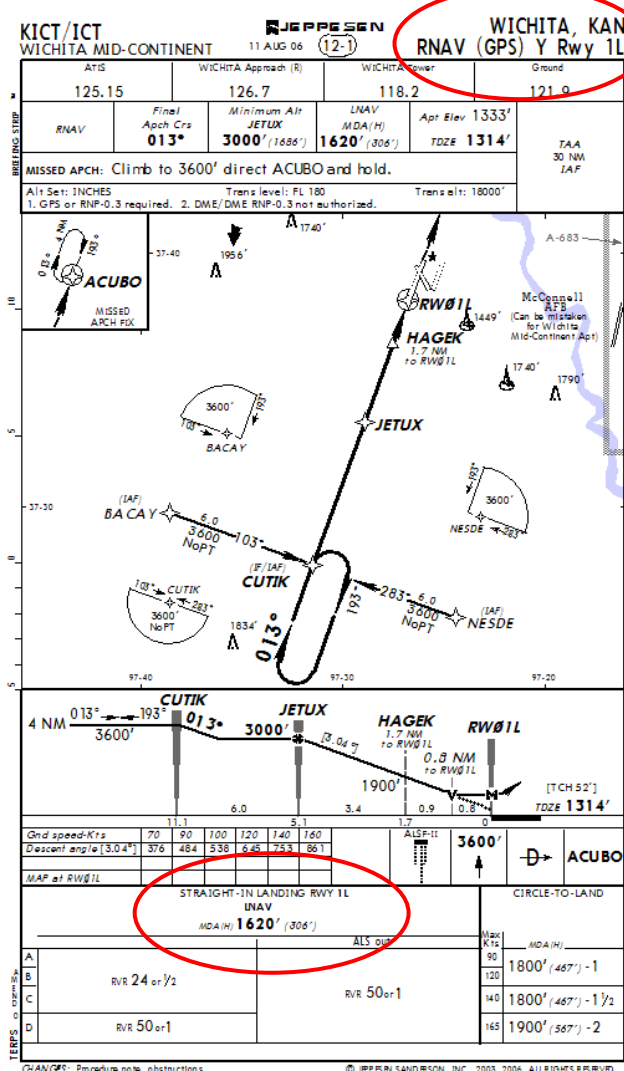


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If the RNAV (VOR DME) approach meets the criteria for a glideslope, the approach will contain a baro VNAV glideslope. Check the approach plan on flightplan menu page 2 for glideslope availability.

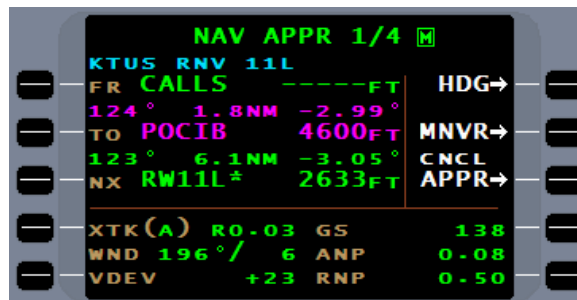
RNAV (GPS)

RNAV (GPS) approaches, originally named RNAV, were created in February 2000 to allow a multi sensor FMS the ability to fly approaches using GPS, DME-DME, or any NAV sensor or combination of NAV sensors capable of meeting RNP 0.3 to fly to LNAV/VNAV or LNAV minima. Due to a problem with implementation, the use of these approaches was withdrawn and re-released in February of 2001 as RNAV (GPS). RNAV (GPS) can be flown under GPS approach certification or RNP certification IAW AC 90-101. Most aircraft fall under the GPS certification. Notes on the approach plate such as "DME/DME RNP 0.3 not authorized" do not apply to aircraft flying under GPS approach certification. DME/DME is retained by the FMS, but GNSS/GPS is required for the approach. Since the release of RNAV (GPS) approaches, RNAV (VOR DME) approaches and RNAV (RNP) approach types are gathered under the RNAV umbrella. RNAV approaches are further being separated by the use of the letters "Y" and "Z". These letters are used to differentiate between two RNAV approaches that go to the same runway. The Universal FMS will have the RNAV (GPS) with LNAV/VNAV minimums which is normally the "Z" approach.

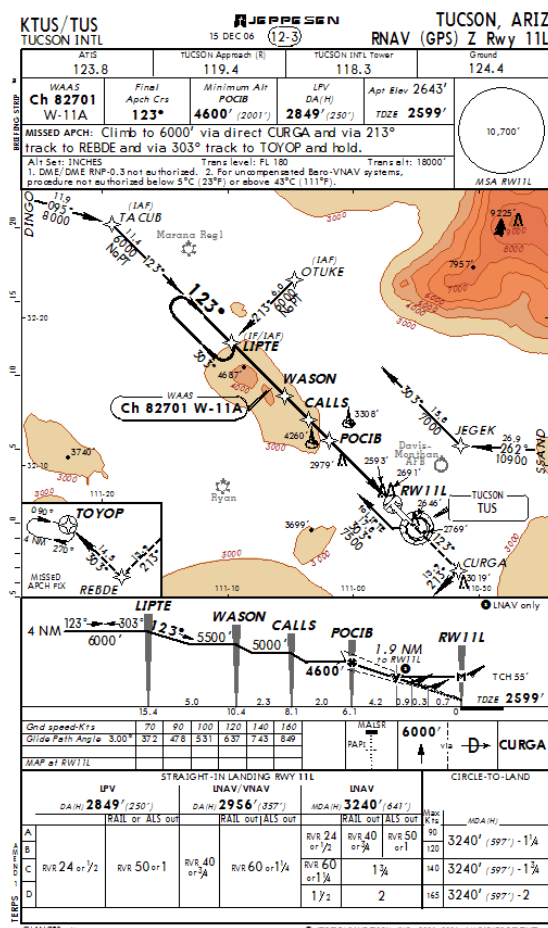
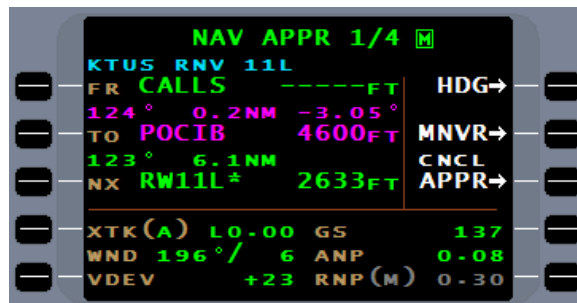


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When approach active, SCN 801, 802, and 803, may state RNP 0.5 on NAV page 1; the monitoring of GPS HIL to 0.3 is what makes the approach legal to fly.



The RNP may be manually changed to RNP 0.30, but since RNP is not the criteria under which the approach is flown, this is not necessary.



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When RNAV (GPS) approaches were commissioned SCN 801 development was too far along to use this name in the NAV database, thus, RNAV approaches are listed by SCN 801 in the FMS NAV Database as GPS approaches. When communicating with ATC, the nomenclature of RNAV will be used.

In SCN 802 and 803, RNAV approaches are now separated from GPS approaches and are listed as RNV. The RNV approach is also the identifier for the RNAV VOR DME approach. Although the RNAV VOR DME approaches are slowly being phased out, there are still a large number within the US and a few in other countries of the world. The FMS does not differentiate on the ARRIVE page between the two types of RNV approaches. When the FAA commissions a RNAV (GPS) approach to a runway where a RNAV (VOR DME) approach exists, in most cases, the RNAV (VOR DME) approach will be decommissioned, but if both exist, the database will only contain the RNAV (GPS).



The approach minimums are in three categories LPV (Localizer Precision with Vertical Guidance), LNAV/VNAV (Lateral Navigation/Vertical Navigation), and LNAV (Lateral Navigation only). The LPV approach minima will require Space Based Augmentation System (SBAS) and will be available with SCN 1000/1100.

The LPV and LNAV/VNAV minimums use a DA (Decision Altitude) for vertical navigation approved FMS installations. In other nonprecision approaches, where vertical navigation is available through the FMS, the pilot must still observe the MDA (Minimum Descent Altitude).

LNAV minimums are based on no vertical navigation being available or non compliance with AC 90-97. This approach will be flown as any non-precision approach where the pilot controls the vertical descent.

TERPS

1
B

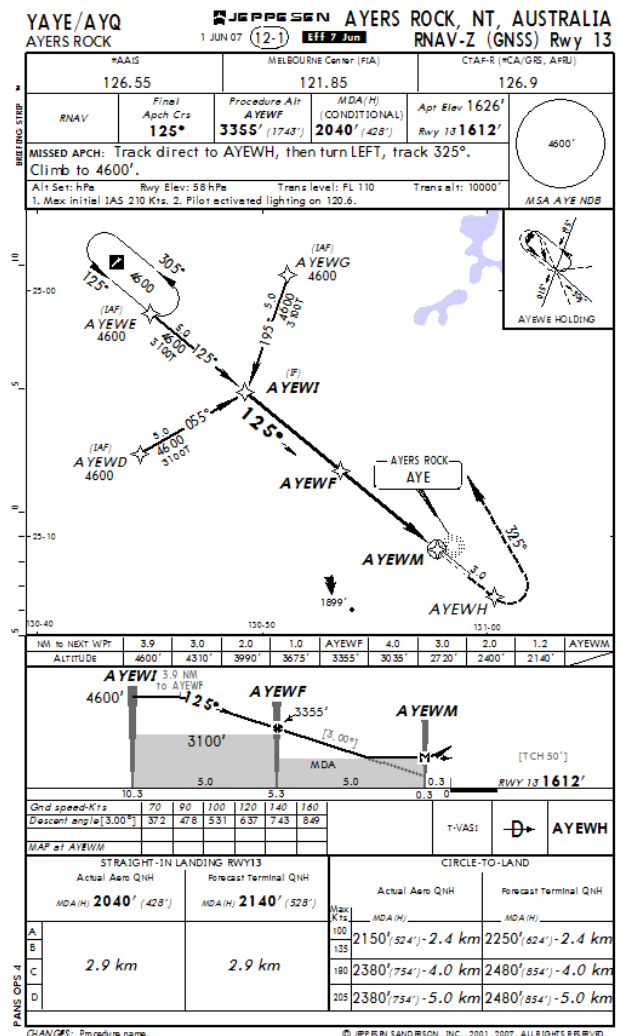
02m3A

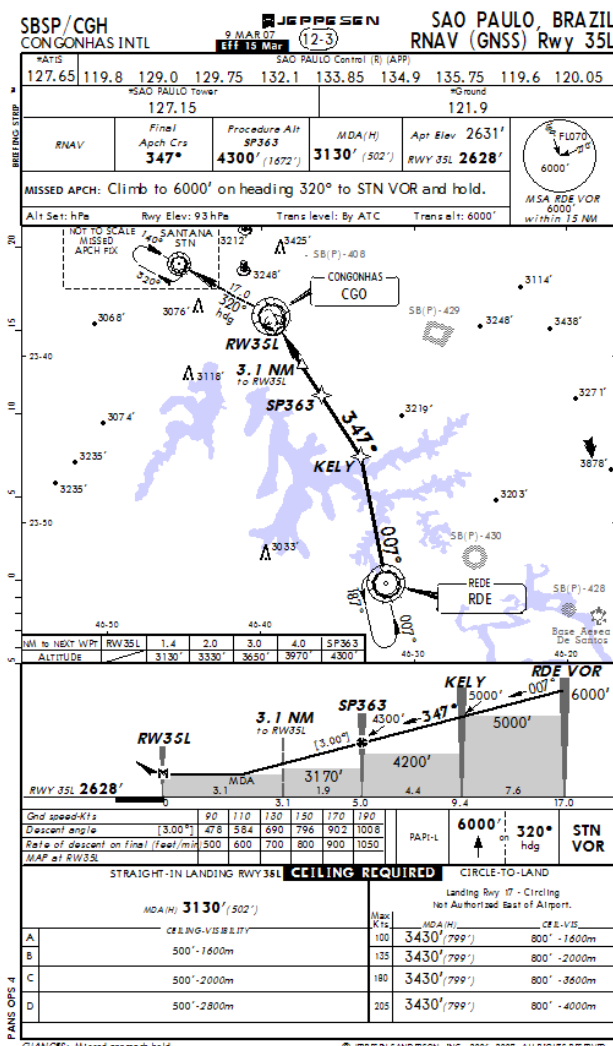
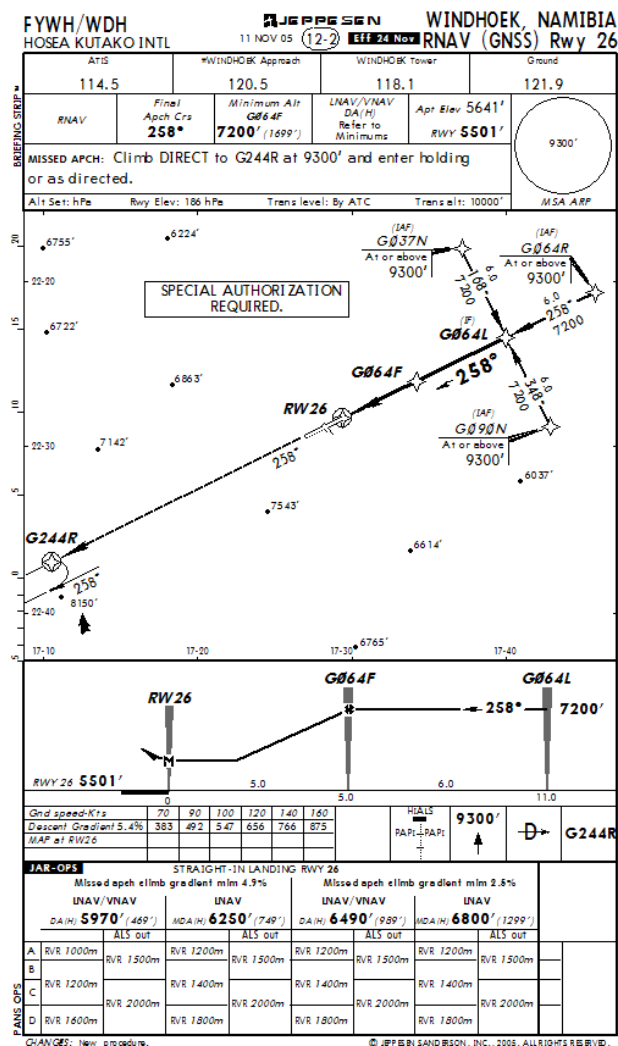
STRAIGHT-IN LANDING RWY 17R										CIRCLE-TO-LAND		
LPV		LNAV/VNAV			LNAV			Max Kts	MDA(H)			
DA(H) 1540' (258')		DA(H) 1600' (318')			MDA(H) 1840' (558')							
	RAIL or ALS out		RAIL out	ALS out		RAIL out	ALS out					
A	RVR 24 or 1/2	RVR 40 or 3/4	RVR 24 or 1/2	RVR 40 or 3/4	RVR 50 or 1	RVR 24 or 1/2	RVR 40 or 3/4	RVR 50 or 1	90	1840' (545')-1		
B									120			
C								RVR 50 or 1	1 1/2		140	1840' (545')-1 1/2
D							RVR 40 or 3/4	RVR 50 or 1		RVR 60 or 1 1/4	1 3/4	165

CHANGES: GPS note removed, WAA5 channel.

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NOTE: In SCN 802 and 803, stand alone GPS approaches, although slowly being phased out, are flown in the same manner as the RNAV (GPS) approach.

If the RNAV (GPS) approach meets the criteria for a glideslope, the approach will contain a baro VNAV glideslope. Check the approach plan on flightplan menu page 2 for glideslope availability.

GPS PREDICTIVE RAIM (RECEIVER AUTONOMOUS INTEGRITY MONITORING)

GPS satellite geometry changes with position and time. RAIM prediction will estimate the satellite availability and the geometry to determine whether a GNSS/GPS approach can be flown. Automatic RAIM prediction is accomplished at both approach arming and activation when GPS is retained in the approach for navigation. The prediction program will calculate predictive RAIM for both the FAF lat/long and the MAP lat/long. The pilot will only receive notice by message if the predictive RAIM fails to meet approach criteria. If RAIM will not be available, a CDU message “NO RAIM AT FAF” or “NO RAIM AT MA” is displayed. This meets the RAIM prediction criteria for most countries IAW TSO 129; a few countries may have requirements for a manual RAIM prediction.

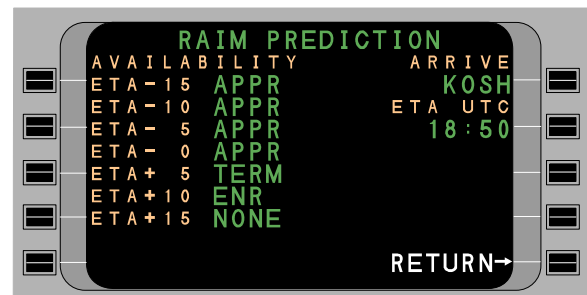
Prior to take off and during the enroute phase of flight the pilot may review the RAIM available accuracy at the destination for the period of time 15 minutes before to 15 minutes after ETA. A manual RAIM prediction program is available under the flightplan menu. This program may be used if a stand alone or overlay GPS non-precision approach is planned.

To access RAIM prediction press **[FPL]** key then **[MENU]** key. FPL MENU 1/2 will be displayed.

Press the line select key for “RAIM PRED” and the RAIM PREDICTION page will be displayed.



If any RAIM availability is shown to be other than APPR for the 30 minute window, then the pilot should plan for a non GPS approach and not plan to rely on GPS for aircraft position during the non-precision approach. However, the RAIM prediction program only predicts RAIM; it will not prevent the pilot from attempting a GPS approach. The real time integrity and accuracy of GPS will be the only criteria that will prevent a GPS approach from being flown.



The display presented, APPR, TERM, ENR, or NONE is determined by the length of the radius of the circle of position as determined from the number of satellites and their geometry. These labels meet the GPS Horizontal Integrity Limit (HIL) for that phase of flight.

Guidelines are:

Enroute	ENR	< 2.0NM
Terminal	TERM	< 1.0NM
Non-Precision Approach	APPR	< 0.3NM
NONE	RAIM not available	

PROBLEMS WITH RAIM PREDICTION

The GPS almanac is released every seven days and is automatically down loaded by the GPS in the FMS. During the power up of the GPS the almanac date is compared to that transmitted by the GPS satellites. If the residing almanac is out of date a new one is down loaded.

The problem occurs in that real world satellite changes may not be reflected in almanac data currently in the receiver. In other words, when on day five a RAIM prediction is made the satellites used may not reflect the real world.

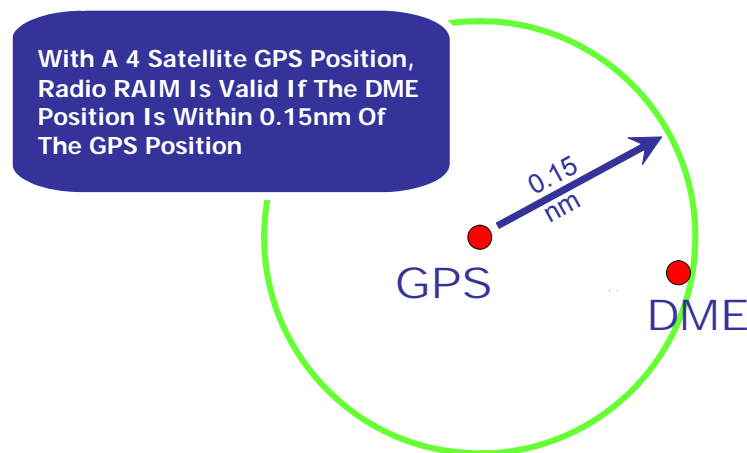
Another problem occurs when a RAIM prediction is made in that the program assumes an almost level horizon. If the GPS based approach is in mountainous terrain, satellites used during the prediction program may be masked by the mountainous terrain.

To sum it up, RAIM prediction is not perfect, but it is required.

RAIM DURING THE APPROACH

For a GPS based approach to become active, real time RAIM must be available. This can be accomplished by receiver RAIM, the reception of five or more satellites, or radio RAIM. To verify the accuracy of a non RAIM GPS position, it is permitted to use a scanning DME position. If the non RAIM GPS position is within 0.15nm of the scanning DME position, the FMS will accept this in lieu of a five satellite RAIM calculation.

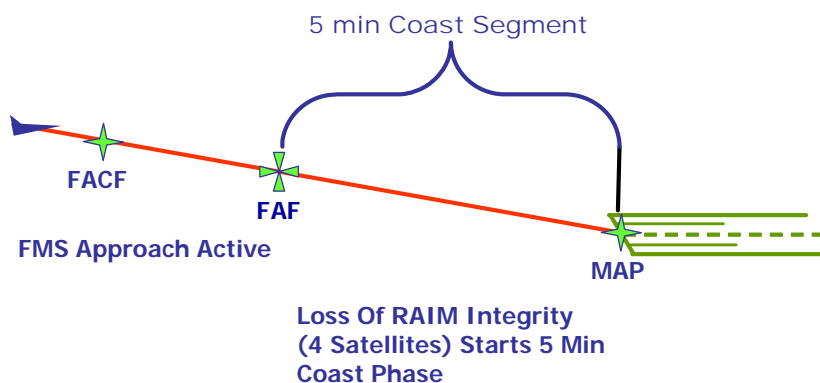
Radio RAIM Operation



For all practical purposes, the use of radio RAIM will be transparent to the pilot. It can be observed on the GNSS/GPS page on DATA page 2 by the INTEG line reading RADIO, but this is not frequently monitored by the pilot.

THE FIVE MINUTE COAST SEGMENT

For activation of the GNSS/GPS approach, RAIM must be available. If RAIM integrity is available until crossing the FAF, then the aircraft enters the five minute coast segment. During this segment if RAIM integrity is down graded to a four satellite non RAIM position, GPS navigation will be allowed to continue for up to five minutes. The assumption is that loss of RAIM will not immediately degrade the GPS accuracy to a level that prohibits continued GPS navigation for a short period and that period is five minutes. The five minute count begins with the loss of RAIM and could occur at any point between the FAF and MAP. The absolute minimum required to continue an approach during the five minute coast segment is four satellites with an HDOP of < 4 .



If GPS navigation is lost any time between the FAF and MAP and is required to continue the approach, primary flight display navigation will be flagged and if runway environment is not visible, the pilot must execute a go-around. With missed approach selected on the FMS, phase of flight will revert to terminal and the flags on the primary flight display navigation will be removed. The FMS will search for any valid NAV sensor to continue navigation to include, as a last resort, dead reckoning (DR).

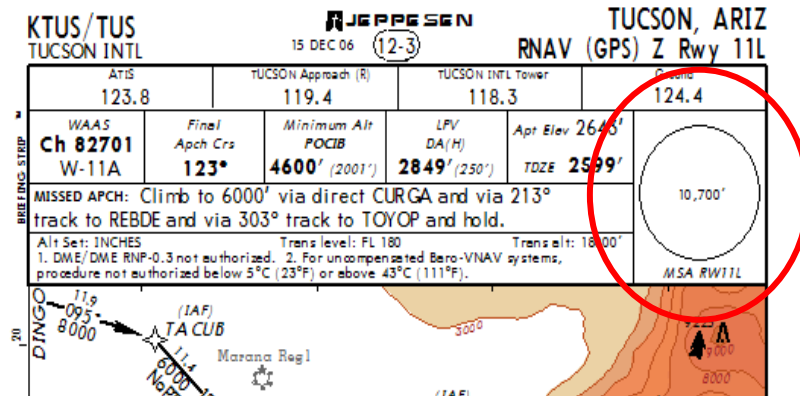
NOTE: A GPS RAIM prediction program finding of other than APPR will not prevent the FMS from flying a GPS approach. When the GPS approach is active between the point of activation and the FAF, a failure of GPS system to provide RAIM with the necessary HIL accuracy will result in the cancellation of the approach and navigation instruments will be flagged accordingly.

GPS APPROACHES CANNOT NOT BE FLOWN WHEN THE GPS INTEG ANNUNCIATOR IS ILLUMINATED.

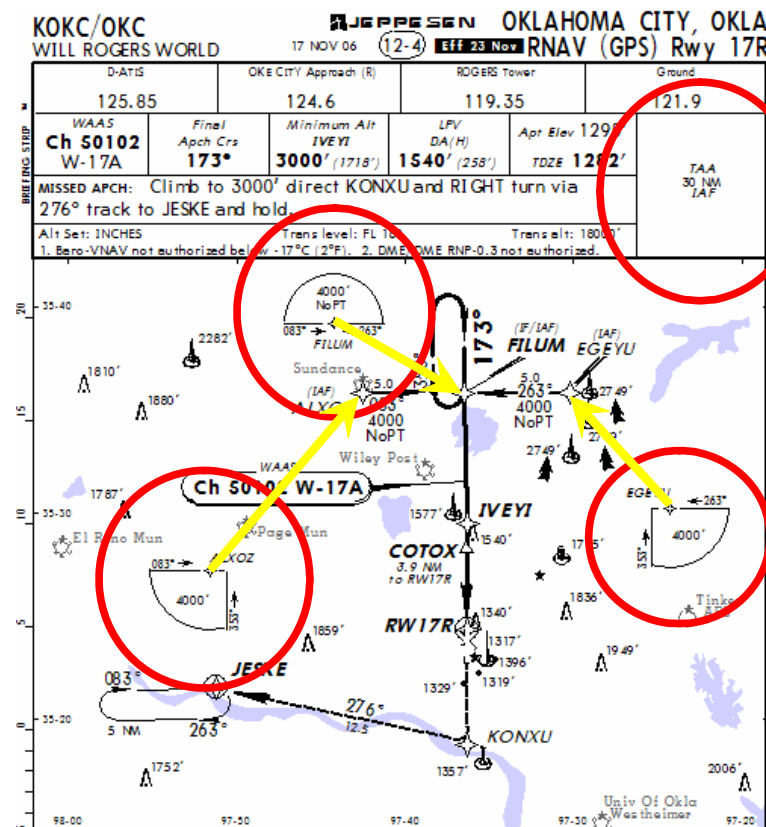
When flying an approach where GPS is the only NAV sensor, illumination of the GPS INTEG ANNUNCIATOR will result in the approach being flagged and a missed approach must be executed.

RNAV (GPS) APPROACH CHARTING

Jeppesen charts will provide on RNAV approaches either a MSA (minimum safe altitude) or, for US charts, a TAA (Terminal Arrival Area) which is discussed in the Aeronautical Information Manual. If TAA is presented, the 30nm distance for calculating the sectors is taken from the associated IAF.



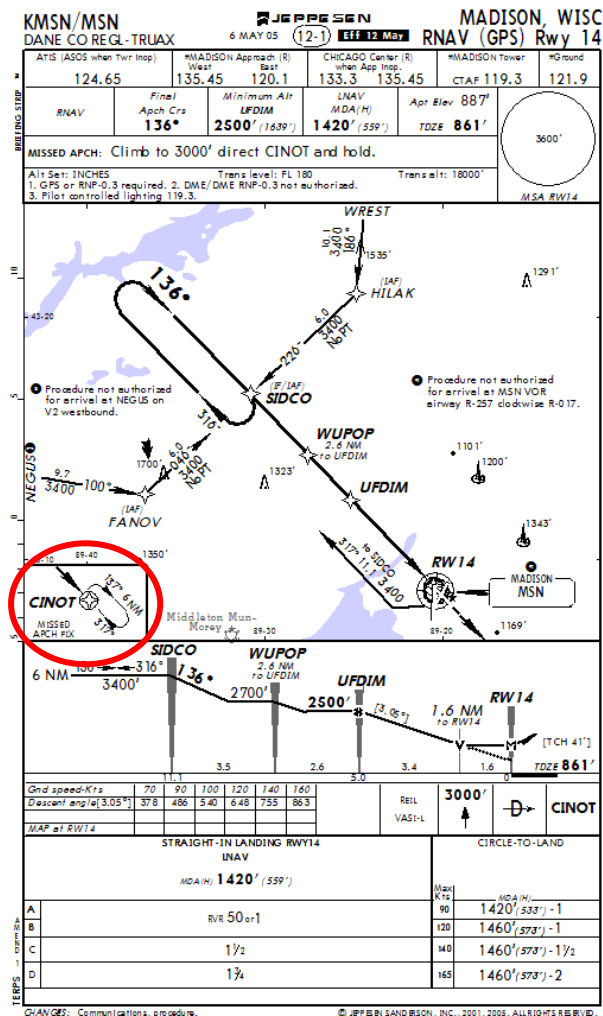
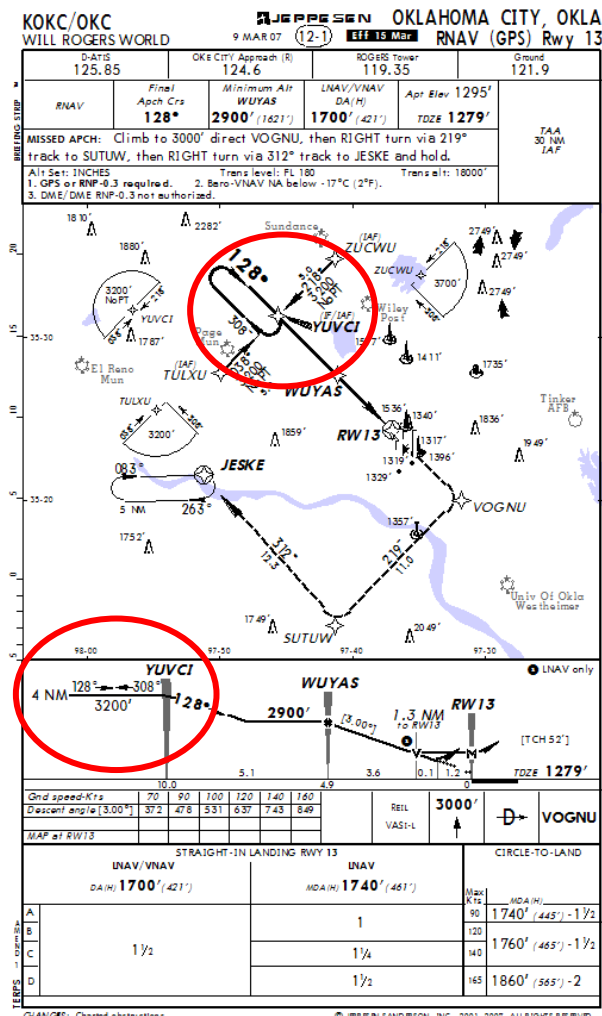
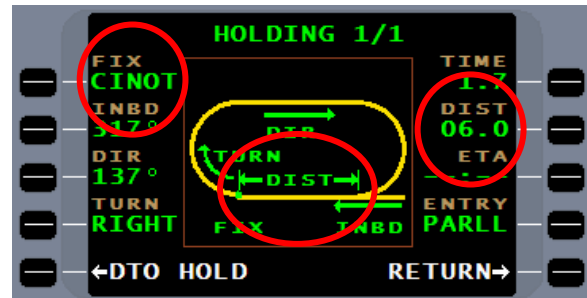
Minimum Safe Altitude (MSA)



Terminal Arrival Area (TAA)

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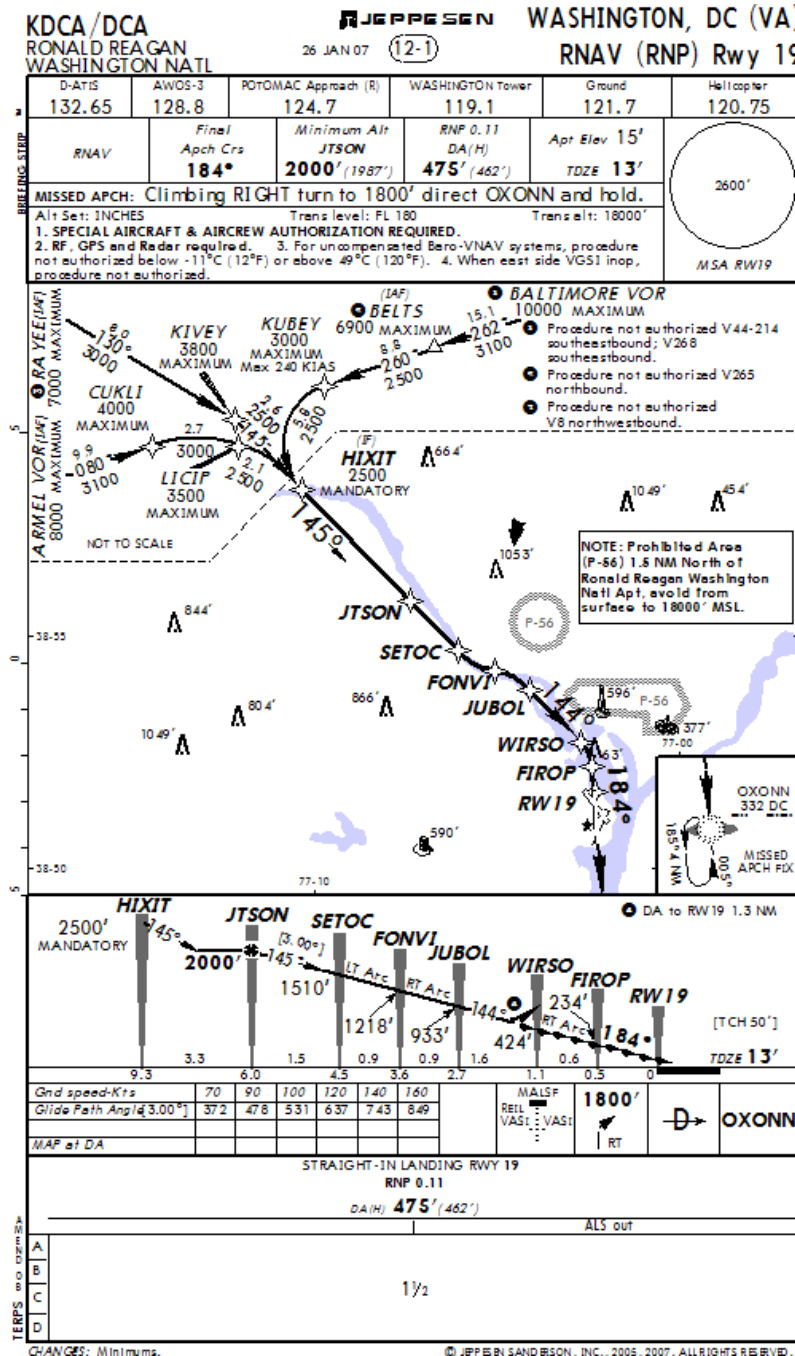
For most countries, RNAV approach charting for holding pattern leg length is based on distance not time. The NAV approach database will reflect distance for the inbound leg and can be seen on the holding definition page under MNVR. Some countries still use time; check the holding definition page to determine holding definition for the approach selected.



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RNAV (RNP)

RNAV (RNP) approaches require special aircraft and aircrew authorization IAW AC 90-101. FAA requirements dictate that unless the FMS installation qualifies under AC 90-101, the FMS NAV database may not contain these approaches. A special NAV database is available from UASC for qualified aircraft. For qualified clients customized training is available.



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FLYING VOR AND VOR/DME APPROACHES

VOR and VOR DME approaches may be flown with the use of GNSS/GPS if the approach is designated as an overlay approach and the words “or GPS” are in the title of the approach. In this case the reception of the VOR is not required, in fact, the VOR may be listed in the current NOTAMS as unusable for navigation and the approach could still be flown using GPS.

Reception of VOR and DME may be required where the approach is a non-overlay. In this case the FMS may deselect GPS during the approach arming process and must have VOR and DME to continue the procedure. If the FMS is configured where only GPS is available to the FMS for navigation, the FMS will be unable to fly the VOR approach and an attempt to do so will result in the FMS failing to go approach active with navigation being red flagged on the primary flight display.

Where both the GPS and VOR DME are available to the FMS and the approach permits the use of both, the FMS will use both and if one fails, the FMS will continue on the remaining NAV sensors. A message stating loss of the NAV sensor has occurred, but no flagging of the navigation display will occur. This may be the case in the rare occasion where GPS satellite reception is lost.

Some countries such as the United States and Canada mandate that all VOR approaches retain the use of GNSS/GPS when flying the approach. This may give the impression that all VOR approaches are overlay when, in fact that is not the case. For the approach to be overlay it must contain the words “or GPS” in the title of the approach. To make a non-overlay approach legal the reception of VOR is required. This can be accomplished by the reception of the VOR by the FMS. For those aircraft without reception of VOR by the FMS, the pilot may use the FMS, but must have a view of the VOR for navigation. In most cases, the use of the VOR bearing pointer may suffice. Where the approach is a VOR DME approach, FMS distance may substitute for DME. On the arrival page if the approach name is followed by a “G”, the approach will retain the GPS for navigation even if it is not an overlay approach.

The FMS uses a maximum of three letters to identify an approach type. Both VOR and VOR DME approaches are identified by the letters VOR. Where both types of approaches are available to the same airport runway, only the VOR DME procedure will be found in the FMS database. The removal of the VOR approach from the database is done by UASC NAV Data Services through a screening software program.

If the approach meets the criteria for a glideslope, the approach will contain a baro VNAV glideslope. Check the approach plan on flightplan menu page 2 for glideslope availability.

FLYING THE NDB APPROACH

Since the FMS does not use the NDB as a NAV sensor, the use of GPS is required. It, therefore, should go without saying that the approach surveying must be IAW WGS-84 for the FMS to fly the approach. If the approach is designate as an overlay approach and the words “or GPS” are in the title of the approach, the reception and viewing of the NDB is not required to fly the approach. If the NDB approach is not surveyed IAW WGS-84, the FMS approach database will not contain the approach.

Recent changes to international procedures allow for the use of GPS to aide in the approach navigation of NDB approaches that are surveyed IAW WGS-84. SCN 802 and 803 approach database will contain all NDB approaches surveyed IAW WGS-84 and the GPS will be retained to assist with navigation. If the words “or GPS” are not in the approach title, the NDB must be used, but the FMS may be use to supplement NDB navigation.

If the NDB approach meets the criteria for a glideslope, the approach will contain a baro VNAV glideslope. Check the approach plan on flightplan menu page 2 for glideslope availability.

FLYING THE TACAN APPROACH

Tactical air navigation (TACAN) approaches are flown in a similar fashion to VOR DME approaches. The use of GPS will be included if the letter “G” follows the approach name on the arrival page. If it is a non-overlay approach, the use of TACAN is required by most civil aviation authorities.

FLYING THE VFR APPROACH

VFR approaches are created by the pilot in the FMS pilot database. Once created the approach is entered into the flightplan in the same way any approach is entered into the flightplan. The approach can be automatically or manually activated and, if a glideslope was defined as part of the approach, it will be presented. This approach is only legally flown in VMC conditions.

ARRIVAL AND APPROACH

ARRIVAL

Outside of a 50nm radius of the *EOA*, with an approach entered in the flightplan, a diminished APPR will appear at line select key 3R. Arming the approach cannot be accomplished at this time.



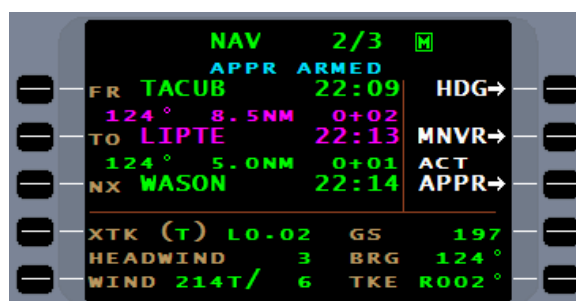
Within 50nm radius of the *EOA*, the ARM APPR line select key will become available. The approach may be armed manually, but will automatically ARM when within a 30nm radius of the airport. Arming manually may be required if the initial approach fix is more than 30nm from the airport. This will set the flight mode to terminal prior to crossing the IAF.



If the approach uses a ground base navaid, the FMS will request that the navaid be tuned to that frequency. If FMS tune capabilities exist, a TUNE APPROACH line select key will be presented. Pressing this key will tune the VHF radio to the required frequency.

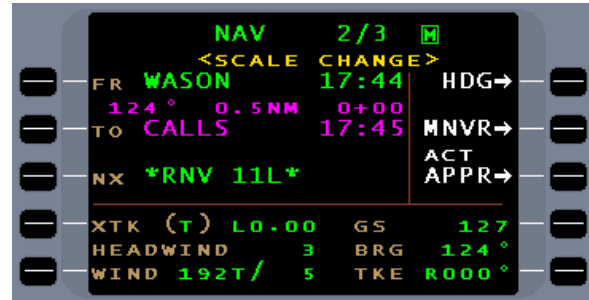


Note that XTK (E) Enroute automatically displays XTK (T) Terminal when within 30nm or if the ARM APPR line select key is pressed prior to 30nm. With either manual automatic approach arming, the ARM APPR line select key will change to ACT APPR.

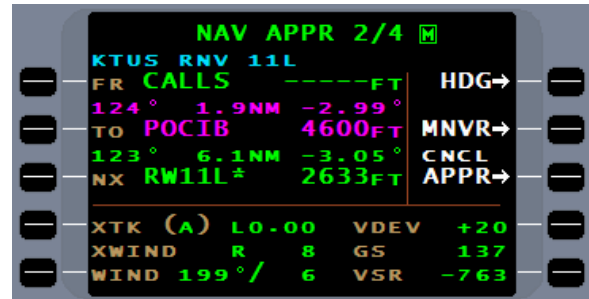


AUTOMATIC APPROACH

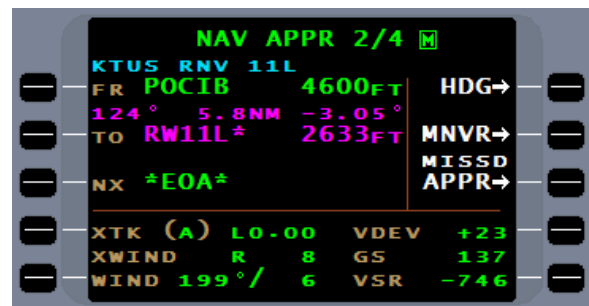
For automatic approach activation, a **<SCALE CHANGE>** banner will precede activation by 15 seconds announcing terminal to approach CDI scale change.



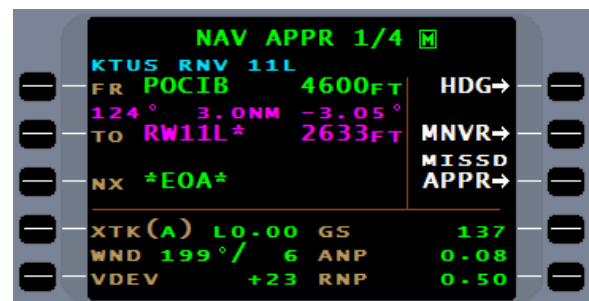
Whether by manual or automatic approach activation, when activated, the FMS will present the **NAV APPR** pages 1 and 2. Line select key 3R will display CNCL APPR. Selecting this line select key will take the FMS out of approach mode and back to terminal; the waypoints will not change.



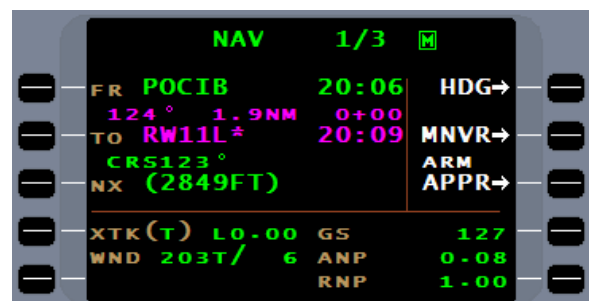
When past the Final Approach Fix (FAF), a MISSED APPR line select key will be presented. Selecting this directly or remotely through the aircraft go-around system will place the aircraft in the missed approach mode. All FMS supplied vertical navigation is terminated. Lateral navigation only will take the aircraft to the missed approach point.



NAV APPR 1/4 provides ANP and RNP information for the flying of RNAV (RNP) approaches. Pilot may find the information provided on **NAV APPR 2/4** more useful.

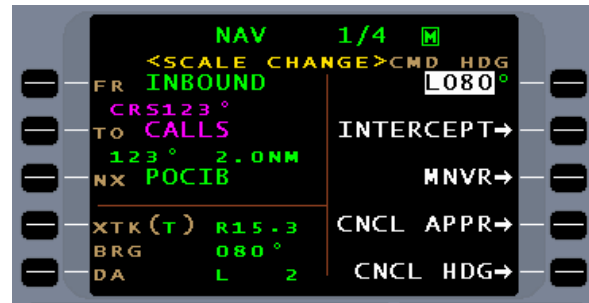


Following the pressing of missed approach, the FMS will guide the aircraft to the missed approach point. The missed approach point is always a flyover waypoint. On most NAV data missed approach procedures, a safety leg is included to insure the aircraft is above a safe altitude before entering the first published missed approach leg. Since this is a conditional waypoint, when entered the FMS will determine if the aircraft meets the condition and, if so, will immediately sequence.

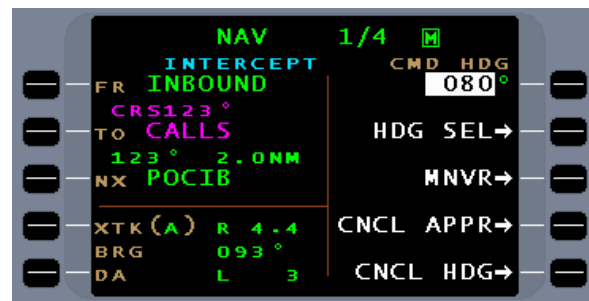


MANUAL APPROACH

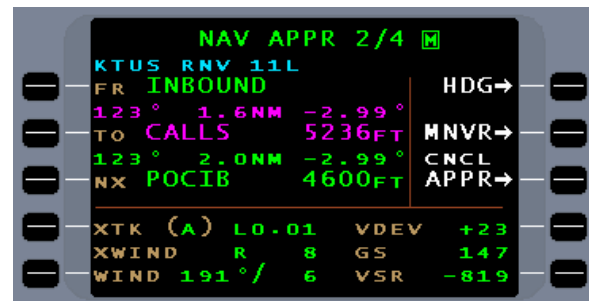
Where radar vectors to the final approach course are given by ATC, once in the turn or on the ATC heading, manually activate the approach.



Press the INTERCEPT line select key to arm the capture of the inbound approach course.

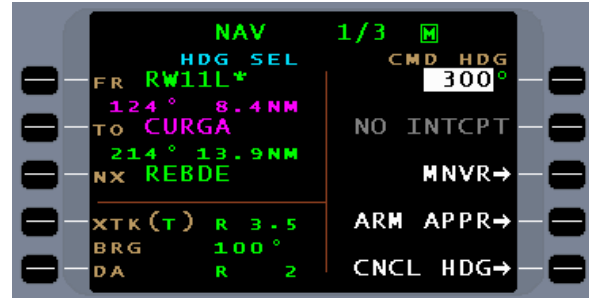


When the inbound course is captured, the heading mode will cancel. The approach has been activated manually, so over flying CALLS intersection will not affect the FMS.

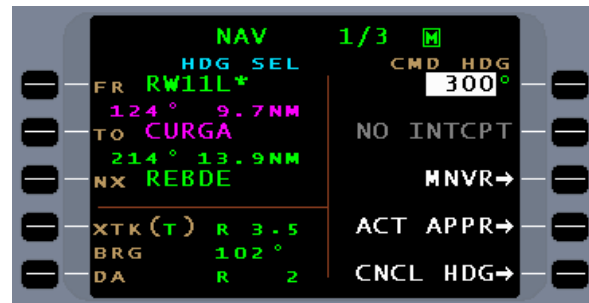


VECTORS FROM A MISSED APPROACH

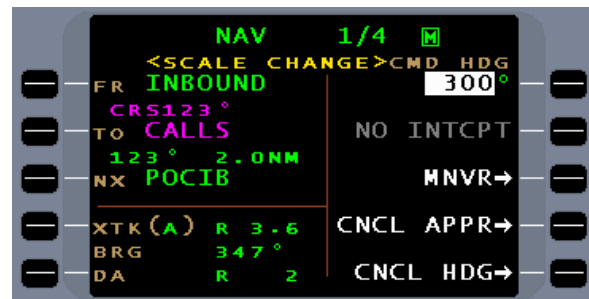
If on vectors from the missed approach, to avoid inadvertent sequencing of the FMS, wait until downwind until manually activating the approach. Because the approach will not automatically arm following a missed approach, first arm the approach.



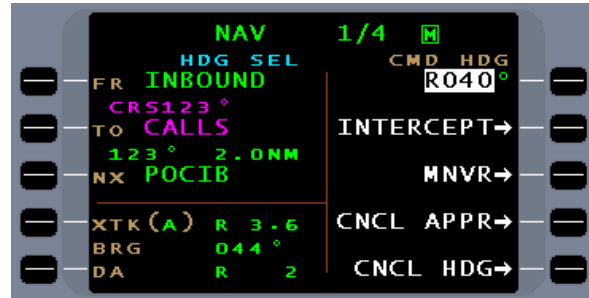
The ACT APPR line select key will now be presented for activation of the approach.



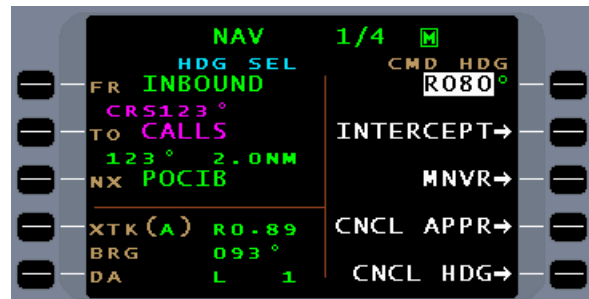
With activation of the approach, the FMS **NAV** page will be presented with crosstrack indicating the distance offset from the final approach course. The HSI course arrow will align with the inbound course. If a map display is available, final segment waypoints will appear.



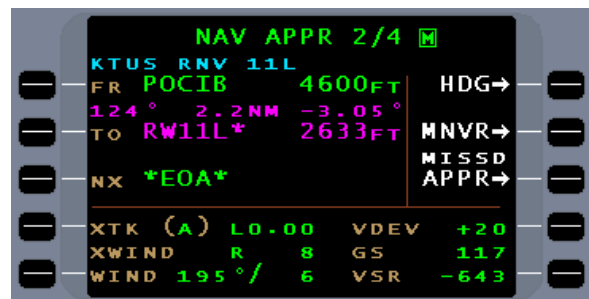
If a turn to base leg is given before the turn to intercept final, an intercept option may be presented. Until cleared for approach, intercept should not be pressed. This will avoid an inadvertent turn to final when not cleared to do so.



When the turn to intercept is given and the words “cleared approach” are spoken by ATC, pressing the INTERCEPT line select key will arm the FMS to capture the inbound course.



Once the approach course is captured, normal approach procedures apply.



APPROACH WITH STEPDOWN FIX

For approaches with stepdown fixes between the final approach fix and missed approach point, these fixes will be presented in SCN 802 and SCN 803. Crossing altitude at the FAF may be preceded by either a “@” or “X”.

	FPL	9/11	ALT/FL
33	*VOR 11L*		
	CRS 123°		
34	CALLS	22:46	x5247
	123°	2.0NM	
35	POCIB	22:47	x4600
	123°	3.4NM	
36	PARCS	22:49	x3500
	123°	2.7NM	
37	RW11L*	22:50	@2633

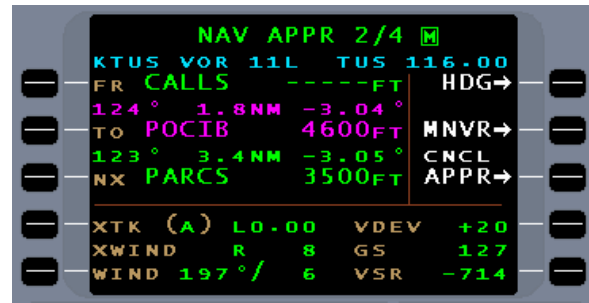
When approach active, the FMS approach will be flown as normal.

	NAV APPR 2/4	
KTUS	VOR 11L	TUS 116.00
FR	INBOUND	HDG→
123°	0.9NM	-3.04°
TO	CALLS	5247FT
123°	2.0NM	-3.04°
NX	POCIB	4600FT
		MNVR→
		CNCL
		APPR→
XTK (A)	L0.00	VDEV +20
XWIND	R 8	GS 127
WIND	197°/ 6	VSR -758

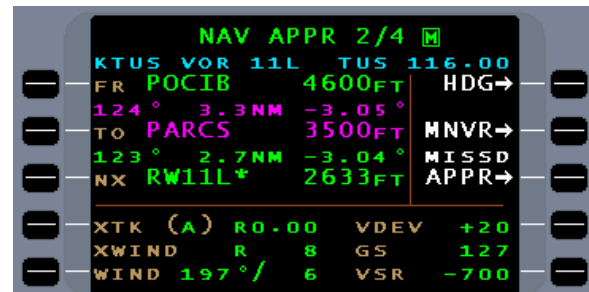
Map display of approach segment waypoints will now include the stepdown fix.



Normal sequencing will occur to include the stepdown fix.



Upon crossing the FAF, distance information will be to the stepdown fix. If the FMS glideslope is used, the glideslope calculation will clear the stepdown fix altitude. For lateral only navigation, stepdown may occur when crossing the stepdown fix.



NOTE: If deviation from the final approach course leg is made prior to activating the missed approach segment as in a circling approach, the FMS might command an unwanted turn to the missed approach point or runway threshold when FMS missed approach is activated. It is recommend when deviation from the final approach course is necessary, the first leg of the missed approach should be made with pilot navigation until a DTO with the FMS to the appropriate missed approach waypoint can be made.

ADVISORY APPROACHES

Advisory approaches are identified at time of FMS installation and are so labeled in the FMS configuration. If the installation of the FMS will not allow for the required NAV sensor to be available during the final approach segment, that part of the approach cannot be flown by the FMS; thus, the classification of advisory.

Advisory approaches can be selected and entered into the flightplan, but the approach segment cannot be flown through the FMS to other than terminal tolerances. Advisory approaches can, however, be used for the transition and missed approach portion of the approach. Procedural turns, arcs, holding patterns in lieu of procedural turns, vectors, and straight in approaches to the FAF can be flown. Sometime before the FAF, select the VHF radio as the source to fly the approach segment.

Most aircraft installations do not allow for the ILS to be an enabled approach. If an approach transition is to be flown, the FMS can be used to do this. Where to leave the FMS and select VHF navigation is technique, and may vary by transition type.

With an advisory approach in the flightplan, the NAV page will present navigation, but the line select key 3R will not present the ARM, ACCT APPR, CNCL APPR, MISSD APPR options that are required of an enabled approach. The exception is SCN 802.6 and subsequent and SCN 803.X which will present a MISSD APPR line select key when crossing the FAF to facilitate the executing of a missed approach.

MISSED APPROACH FROM AN ADVISORY APPROACH SCN 801 Through 802.5

Missed approach navigation guidance is available and can be accessed by reselecting FMS on the flight director if the following guidance is utilized.

Through SCN 802, because of the ***EOA*** or End of Approach gap, the FMS will not automatically sequence to the first missed approach leg.



Through SCN 802, since the approach is advisory only, the FMS will not present a MISSED APPR line select key after passing the FAF.



A technique is to delete ***EOA*** from the flightplan as soon as the approach is linked to it. Because this is an advisory approach, the rule requiring no editing between the approach label and ***EOA*** without consequence does not apply.



CAUTION: When removing the ***EOA*** the leg follow the MAP may be altered. It is the pilot's responsibility to insure navigational compliance with the intent of the missed approach procedure.

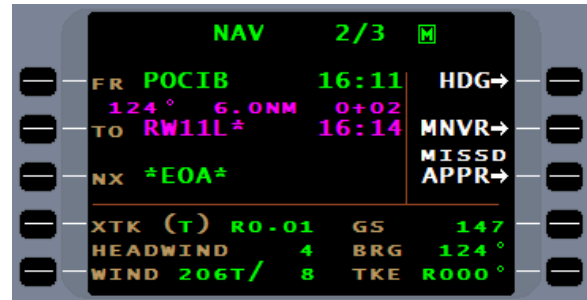
CAUTION: Editing of the ***EOA*** from the flightplan only applies to advisory approaches. The removal of ***EOA*** from an enabled approach will make the approach unflyable.

With ***EOA*** gone, the FMS will automatically sequence from the missed approach point to the first leg in the missed approach segment. Once the aircraft is stabilized following the missed approach, reselect FMS as the source of aircraft navigation and the FMS will provide missed approach guidance through the HSI.

NOTE: With the use of the aircraft go-around or TO/GA system, most aircraft will require reselecting the NAV mode on the NAV selector panel.

MISSED APPROACH FROM AN ADVISORY APPROACH SCN 802.6 and 803

With SCN 802.6 and subsequent and 803.X, to facilitate the use of the missed approach segment when flying an advisory approach in terminal (T), a MISSED APPR option is presented when crossing the final approach fix.



Pressing the MISSED APPR line select key directly or electronically through the aircraft go around system, will sequence *EOA* on the NAV page and allow for the FMS to move into the missed approach segment upon crossing the missed approach point. Because the FMS is flying an advisory approach, XTK scale will remain in terminal (T) throughout the approach. Once stabilized on the missed approach, the pilot must select FMS as the source of guidance.



NOTE: In SCN 802.6 and subsequent the technique of deleting the *EOA* is no longer applicable.

NOTE: With the use of the aircraft go-around or TO/GA system, most aircraft will require reselecting the NAV mode on the NAV selector panel.

AVIONICS INTERFACE

It is beyond the scope of this manual to provide operating procedures for all of the avionics interface options that exist, however, the following outlines approach procedures for the more standard installations of the Universal FMS throughout the industry. For more information, contact the avionics integrator or installer or appropriate FAR part 142 training facilities.

For the vast majority of installations, to include the Collins EFIS 85, 86, and most analog installations, the following apply:

For enroute navigation, the NAV select panel will be in NAV.

For approach navigation, the NAV select panel will be in Approach. The selection of approach before or after approach activation is determined by the avionics involved.

For ILS NAV-to-NAV with the Collins EFIS 86 and APPS 85 autopilot, on vectors to final the flight guidance approach mode must be selected before pressing intercept on the FMS heading mode.

Collins Proline 4 4000 with APPS 85 autopilot, the following apply:

For enroute navigation, the NAV select panel will be in NAV.

For ILS NAV-to-NAV on vectors to final, the flight guidance approach mode must be selected before pressing intercept on the FMS heading mode.

For approach navigation on localizer and backcourse approaches, select approach mode on the NAV select panel and for backcourse, select BC on the NAV select panel. Vertical guidance will be displayed, but autopilot and flight director capture is not available.

For all other FMS approaches, retain NAV on the NAV select panel for lateral navigation and VNAV on the NAV select panel for vertical navigation.

Citation Aircraft:

Citation 550 Bravo – Primus 1000: NAV for lateral and VNAV for vertical. All non-precision approaches are certified with the exception of BC and LOC due to no VOR.

Citation 560 Excel – Primus 1000: NAV for lateral and VNAV for vertical. All non-precision approaches are certified including BC and LOC.

Citation 560 XLS – Primus 1000: NAV for lateral and VNAV for vertical. All non-precision approaches are certified including BC and LOC.

Citation 560 Ultra - Primus 1000: NAV for lateral and VNAV for vertical. All non-precision approaches are certified including BC and LOC.

Citation 560 Encore – Primus 1000: NAV for lateral and VNAV for vertical. All non-precision approaches are certified including BC and LOC.

CJET 525 SPZ-5000: NAV for lateral. There are no vertical modes with this interface. No VNAV display.

CJET 525 CJ1 and CJ2 Proline 21: NAV for lateral. There are no autopilot vertical modes with this interface. VNAV will display enroute and approach.

Bombardier Learjet:

Lear 31a – KFC 400: NAV for lateral and VNAV for vertical enroute and APP for approach.

Lear 40 & 45 – Primus 1000: NAV for lateral and VNAV for vertical enroute and APP for approach. All non-precision approaches are certified including BC and LOC.

Lear 60 – Proline 4: NAV for lateral and VNAV for vertical enroute and APP for approach. All non-precision approaches are certified including BC and LOC.

Bombardier DeHavilland:

DeHavilland Dash 8 (Q-400): NAV for lateral and VNAV for vertical. All non-precision approaches are certified including BC and LOC.

Embraer:

EMB-145 – Primus 1000: NAV for lateral. There are no autopilot vertical modes with this interface. VNAV will display enroute and approach. All non-precision approaches are certified including BC and LOC.

MULTI MISSION MANAGEMENT SYSTEM (MMMS)

The Multi-Mission Management System (SCN 90X) has the ability to fly any one of six predefined search patterns along with drifting target navigation for maritime search and rescue operations. It can also integrate the use of TACAN and Doppler for navigation. The six search patterns are:

- 1) ***Rising Ladder***, consists of a series of parallel legs that resemble the rungs of a ladder
- 2) ***Sector***, in which a center point is overflown on selected tracks resulting in a pie-shaped ground track
- 3) ***Expanding Square***, a series of legs which together resemble a squared-off spiral
- 4) ***Orbit***, which consists of flying a constant radius circle
- 5) ***Race Track***, a pair of parallel legs
- 6) ***Border Patrol***, in which a route segment is flown and reversed until canceled

From NAV page 1 or 2, press the **MENU** key. The **NAV MENU** page is displayed. Press the line select key for PATTERNS.



A **SEARCH PATTERNS** page is displayed.



Upon selection of one of these patterns, the FMS will display a page where the crew will be prompted to "fill in the blanks". Once this has been done the ACTIVATE option will be presented. Selection of this will cause the FMS to output steering commands to intercept the initial leg. Selection of the SEARCH option will then provide steering commands to fly each succeeding leg.

BORDER PATROL

For our demonstration, we will depart KDGL, in Douglas, Arizona and patrol the southwestern border of New Mexico.

First create a pilot route using the following pilot waypoints:

NM1	- N	31	14.30	W	109	21.20
NM2	- N	31	12.40	W	109	09.80
NM3	- N	31	22.20	W	109	07.50
ES4	- N	31	20.20	W	108	56.10

From the search patterns page, press line select key 3R for Border Patrol.

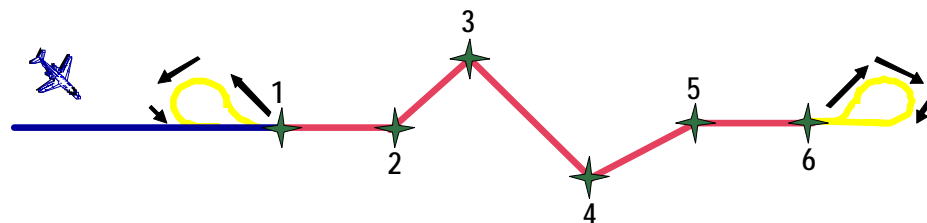
From the **BORDER** page, press the line select key for COPY ROUTE. The route we just created is now displayed on the list. Select the number for NM1 - ES4. The display will return to the **BORDER** page. Turn direction can also be set at this time by pressing 3L or 3R line select key. When selecting the turn direction, it is important to note the method the FMS uses for reversing course.



Press the ACTIVATE line select key to activate the pattern. The display will change to **NAV SRCH 1/3** page. In the Activate mode, the FMS will provide steering at up to a 45-degree intercept angle or by FMS CMD HDG to intercept the initial leg or an extension of that leg. Leg changes will be inhibited to allow maneuvering of the aircraft to intercept this leg.



In the ACTIVATE mode the initial leg will continue in both directions. Once intercepted, SEARCH will need to be selected for the FMS to navigate the search pattern. If the aircraft intercepts the pattern beyond the first waypoint and SEARCH is pressed, the FMS will navigate on the nearest pattern leg.



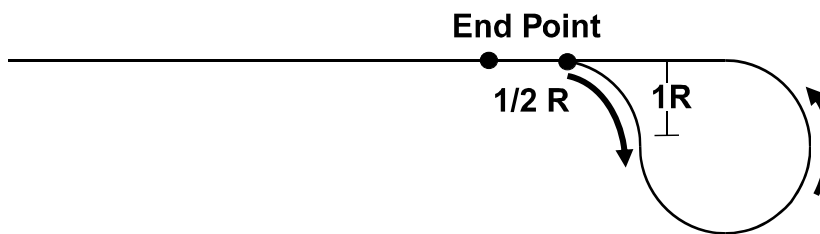
During flight, active information to the initial waypoint is displayed. Press line select key 5R to activate the **SEARCH** mode. Note that an icon of a circle is displayed on the pattern. This denotes the aircraft is in-bound to the next leg. As the aircraft passes the initial waypoint, the icon changes to a triangle, indicating the aircraft is presently bound for the end point of that leg.



As the end of the pattern is reached, the FMS will reverse the pattern. As ES4 is crossed, the icon changes to a circle and all information is referenced to ES4 as viewed on NAV SRCH 1/3.



The aircraft will continue on the present desired track for a distance equal to 1/2 the minimum turn radius (R) under present conditions (altitude, groundspeed and steering limits). The FMS will then command a right turn until crosstrack is equal to 1R. Now the FMS will command a turn in the reverse direction and fly on a circular arc to intercept the new leg.



Minimum turn radius may be calculated using the following formula.

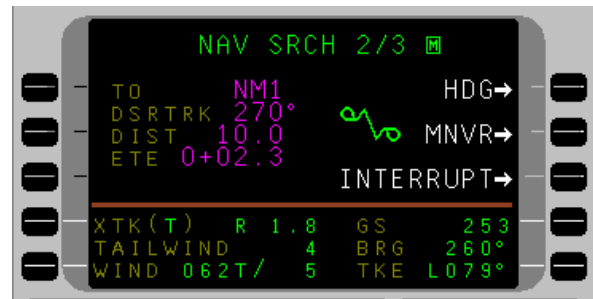
$$R = v^2/g \tan\Phi$$

Where: V = ground speed (Knots)
G = a gravitational constant equal to 68682
Φ = degrees of bank

In this case, at 250 kts, steering limits are 24.5 degrees; therefore, the turn radius will be 2.0nm.

Following the course reversal will result in the aircraft intercepting the leg before the next waypoint and fly the pattern in reverse order.

HSI information is displayed on **NAV SRCH 2/3** along with wind direction and velocity, groundspeed, distance, and estimated time enroute.



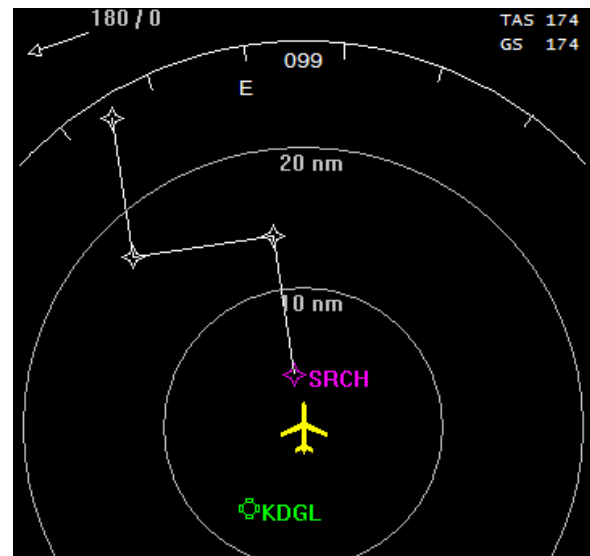
DSRTRK Desired track

BRG Bearing to start or "TO" waypoint

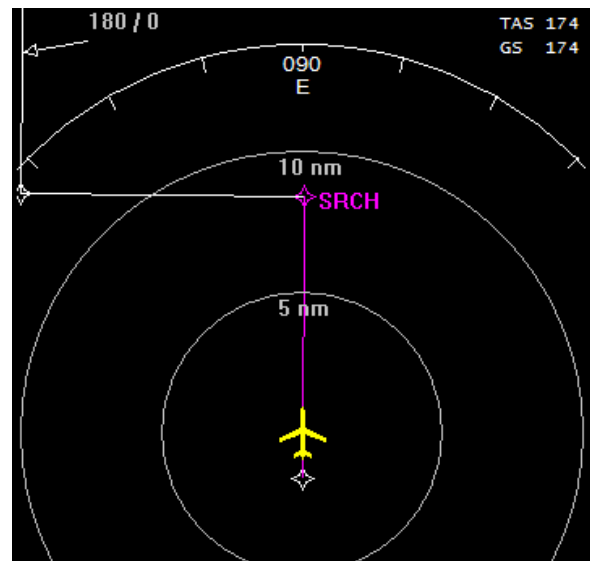
XTK Cross track in (100thnm) when crosstrack less than 10nm

TKE Track angle error

The FMS will display on an MFD map several of the pattern legs. The FMS is currently in ACTIVE mode proceeding to the active waypoint which the FMS named SRCH.



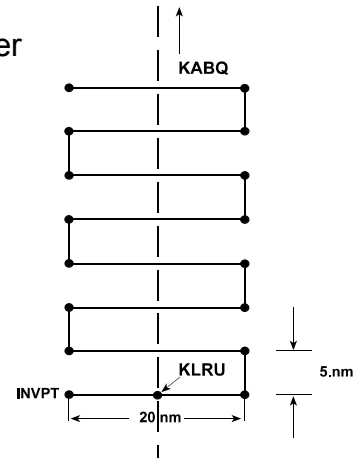
The FMS is now in SEARCH mode with the first leg displayed as the active leg. The SRCH waypoint will always be displayed as the waypoint to which the FMS is navigating.



RISING LADDER PATTERN

There is an aircraft flying from Las Cruces, New Mexico to Albuquerque that is overdue. Since there are no specifics on where the aircraft may have gone down, the decision is made to search the route between KLRU and KABQ using the Rising Ladder Pattern. Heading direct to KLRU, a search pattern is constructed that will allow searching the area ten miles on either side of the direct route between Las Cruces and Albuquerque. The parameters of the search pattern to fit these requirements are defined.

From the SEARCH PATTERNS page, select the Rising Ladder pattern. The course from KLRU to KABQ is 360° and that will define the search axis. With this data one can make the following entries on the RISING LADDER page:



IWPT - The **Initial Waypoint** can be input using the list or direct entry process. Since the pattern is to start 10nm from the search axis, a pilot defined waypoint 10nm on the 270° bearing from KLRU is created. Press line select key 2L to place the cursor at the IWPT field and enter NM1 as the name for this waypoint. This brings up the DEFINE WPT page to define "IWPT".



ITRK - The **Initial Track** is 90° to the search axis, so 085.8 is entered in the ITRK field.

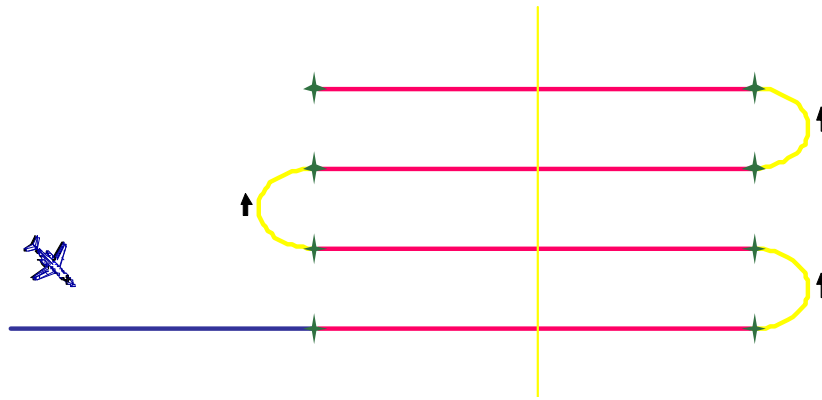
ITRN - The **Initial Turn** direction will be to the North, so L is entered in this field.

LNTH - To look 10nm on either side of the search axis 20.0 entered for the leg **Length**.

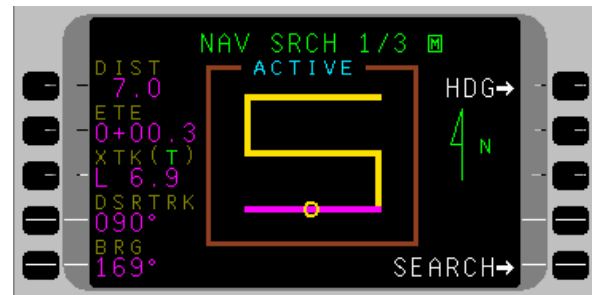


LSPC - 5.0 is chosen for the **Leg Spacing** to enable a scan of 2.5nm on each side of the aircraft.

The cursor now highlights the ACTIVATE line select key. Press this key to activate the pattern.

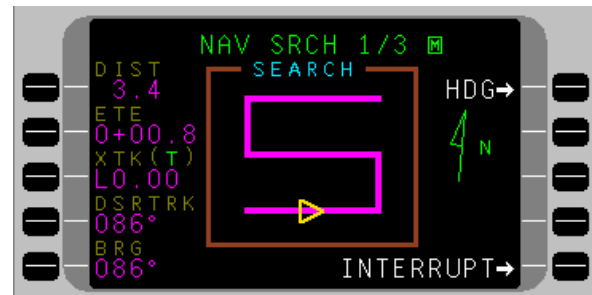


The display will change to **NAV SRCH 1/3** page. The FMS will provide steering to the initial leg or an extension of the initial leg at up to a 45° intercept angle or may be navigated by FMS CMD HDG. Leg changes are inhibited to allow maneuvering of the aircraft as necessary. The Circle on the search pattern icon indicates the search pattern is active. The SEARCH mode must be selected before reaching the first turn point for the FMS to follow the search pattern.

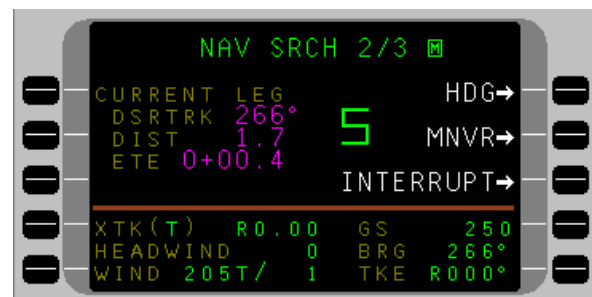


To activate the search mode, press the SEARCH line select key.

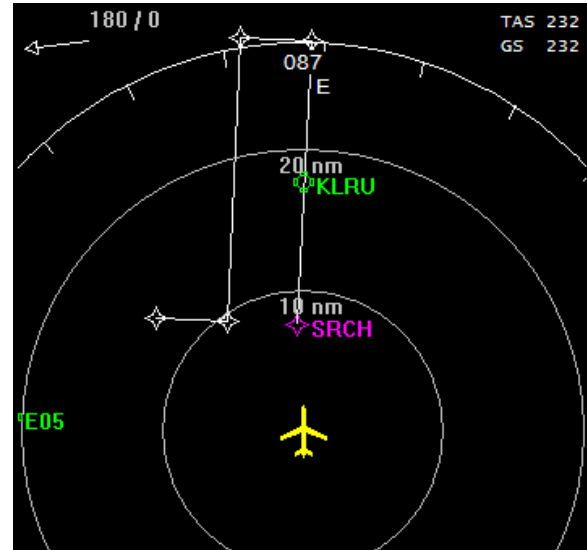
The circle changes to a yellow triangle to indicate the search leg is active. Progress of the search pattern can be followed on **NAV SRCH 1/3**. The triangle indicates what search leg is active, and the circle shows what transition to the next search leg is active.



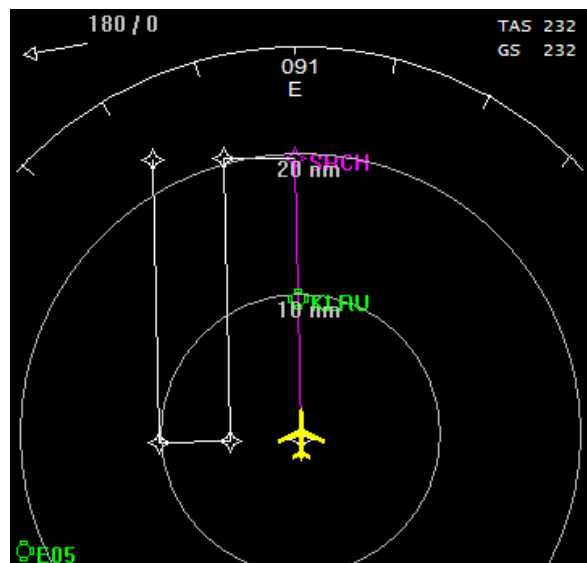
The **NAV SRCH 2/3** page adds additional information.



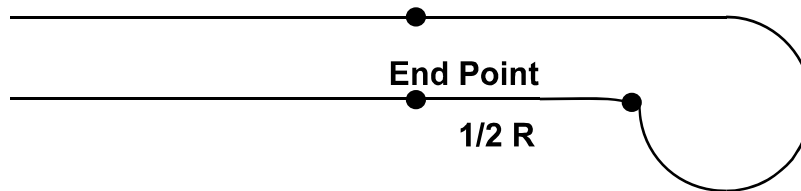
The FMS will display on an MFD map several of the pattern legs. The FMS is currently in ACTIVE mode proceeding to the active waypoint which the FMS named SRCH.



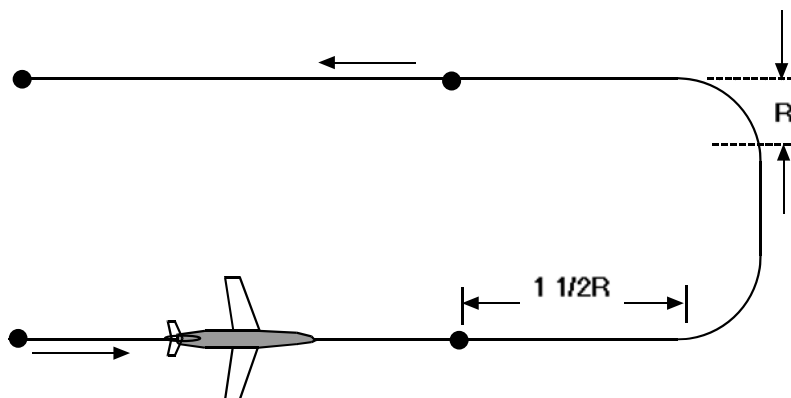
The FMS is now in SEARCH mode with the first leg displayed as the active leg. The SRCH waypoint will always be displayed as the waypoint to which the FMS is navigating.



The Rising Ladder search pattern, as well as the Race Track, presents the problem of connecting the alternate straight legs with varying separation distances. The FMS will approach the problem by flying to a point one half of the minimum turn radius (R) past the end waypoint of the leg and then steer to the new leg. If the separation between legs is less than $2R$, the FMS will turn in a direction to increase crosstrack to the new leg. At a crosstrack distance equal to the midpoint between the leg separation and the $2R$ separation, the FMS will reverse its turn direction and fly on a circular arc to intercept the new leg.

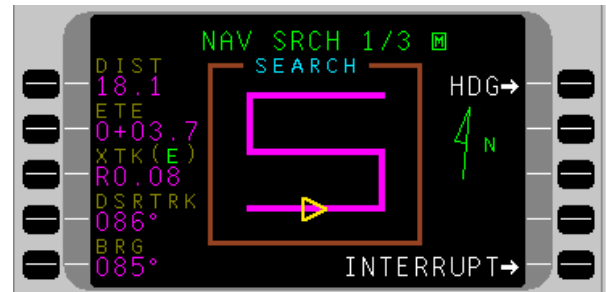


If the separation between legs is greater than or equal to $2R$, the FMS will continue on the straight path to a point $1 \frac{1}{2}R$ beyond the end point. It will then command a turn onto a track perpendicular to the new desired track. At a crosstrack of $2R$, the FMS will command steering on a circular arc to intercept the new leg. It will intercept the new leg before the end point and then fly the great circle path to the next end point.



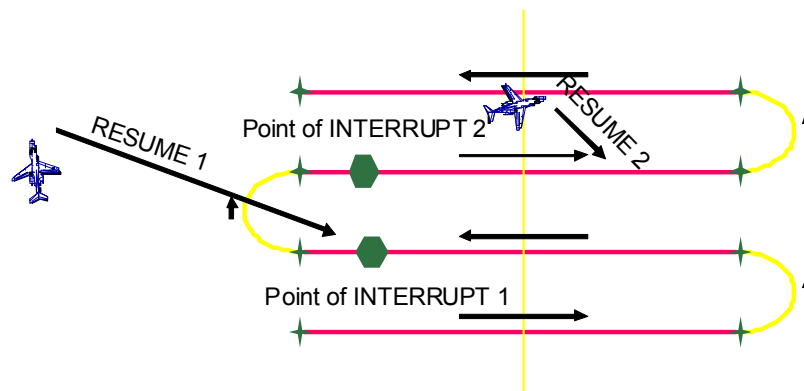
INTERRUPT AND RESUME

While in the search pattern, smoke is spotted off to the west. On **NAV SRCH 1/3** page, press the INTERRUPT line select key. This will allow for maneuvering of the aircraft to investigate the smoke, but resume search on the same leg on the pattern. Press the HDG line select key and enter 286 degrees.



After investigating this, it turns out to be a small brush fire. Maneuver the aircraft back to the INTERRUPT point either manually or with the heading mode to be on course in the correct direction, and then press RESUME. The aircraft will now resume the search pattern.

The rising ladder pattern will not sequence to the next leg until the current leg is complete. When resume is selected, the FMS will calculate an intercept to the active pattern leg with up to a 45° intercept angle. In example RESUME 1, the FMS will proceed to the point of interrupt and then turn to pick up pattern navigation. In RESUME 2, the FMS will turn the aircraft in the navigational direction of the active leg to intercept a point along that leg.



To search a rising ladder leg that is currently not active, the FMS must first complete the current leg or, to immediately go to a new leg, the pilot must redefine a new starting point.

CANCELLATION

A search pattern that is active at the time of cancellation will be reset to its initial condition. If selected again, the flight guidance will be to the initial leg of the search pattern and the search pattern commenced from there.

If INTERRUPT is selected prior to cancellation, the search pattern will *not* be reset, it will be flown from the interrupt point if selected again.

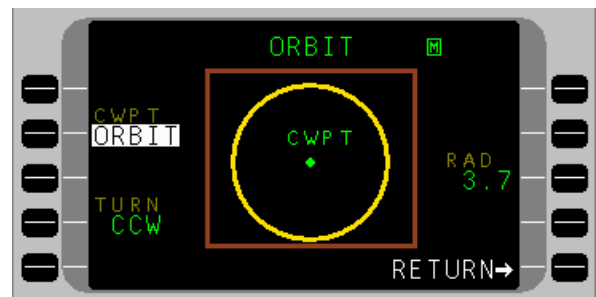
Press the DTO function key to conduct a direct-to operation, or from NAV SRCH 2/3 page, select the MNVR option then PVOR. The search pattern will be canceled and removed from the NAV display.

ORBIT

When the crash site is located, to orbit the site an orbit pattern may be used. Press **MENU** from the NAV pages, select PATTERNS and from the **SEARCH PATTERNS** page press the ORBIT line select key.

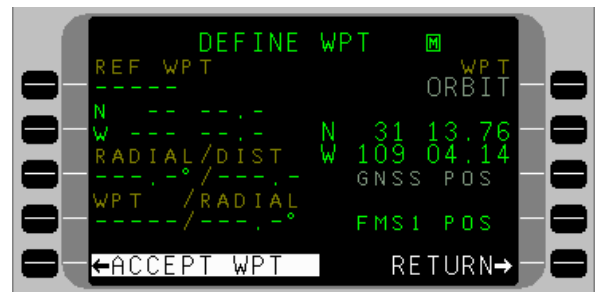


First create a pilot waypoint that will be the center of the orbit pattern. Enter the pilot waypoint name at the cursor and press **ENTER**

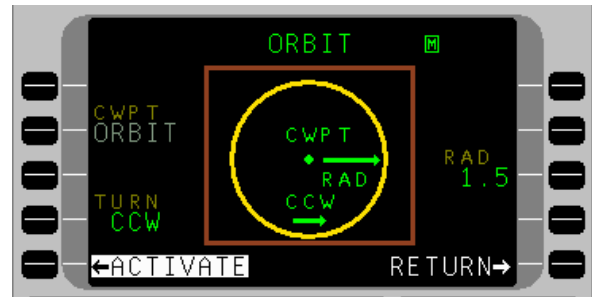


This will bring up the **DEFINE WPT** page. Prior to crossing over the crash site, press line select key 2R. Then press 4R to define the waypoint as the FMS present position.

Press **ENTER** to accept this position and the display returns to the **ORBIT** page.



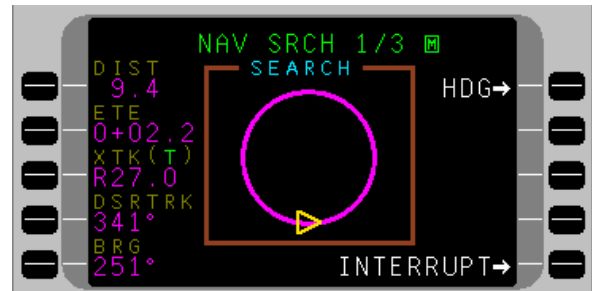
Select the turn direction and radius. With the cursor over the turn direction field, press **ENTER** to accept the CCW default. If a CW turn were desired, the **±** will toggle the field. The cursor will advance to the RAD field. Enter 1.5 for the radius. Press the ACTIVATE line select key.



If the aircraft speed is too high to maintain the orbit at maximum bank, a message "RADIUS REQ EXCESS BANK" is displayed.

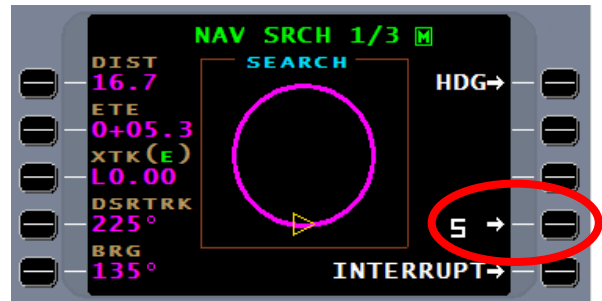


On **NAV SRCH 1/3**, select the SEARCH option. The distance and ETE are reference to the initial entry point on the circle. This waypoint is generated as the closest point on the circle from the aircraft at the time activate is selected. Since the aircraft is flying circular arc, desired track will be constantly changing. Bearing will be to the center waypoint.

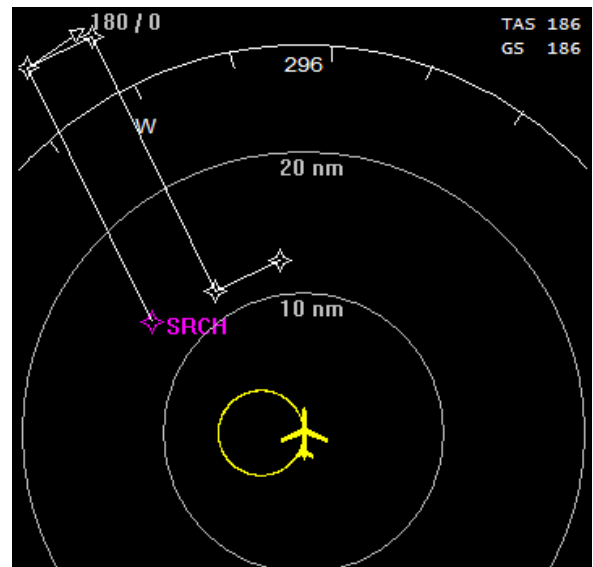


NOTE: While inbound to the orbit, distance displayed will be the circumference of the circle regardless of the actual distance from the OWPT.

The crash site was found while on the rising ladder pattern. Interrupt was initiated from the rising ladder pattern and the aircraft flew to the orbit site. If a requirement exists to rejoin the rising ladder pattern, selection of the line select key with the rising ladder symbol will result in the termination of the orbit pattern and the return to the rising ladder pattern.



With the rising ladder pattern in interrupt status, the MFD map will continue to display the rising ladder legs while flying the orbit pattern.

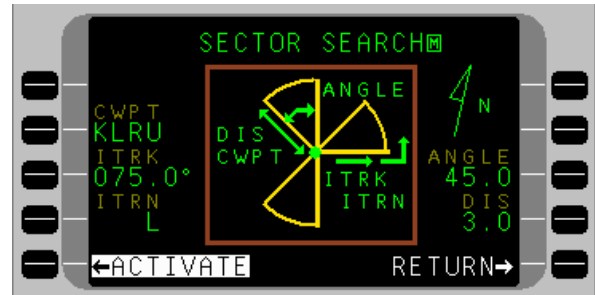


SECTOR

The sector search pattern consists of a series of legs that all overfly the center of a circular search area. The crew will define the center waypoint, the leg lengths, angle between legs, and direction of turn.

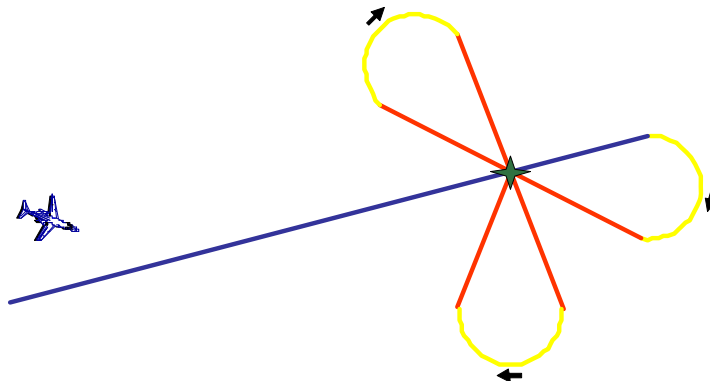
A search will be conducted around KLRU.

From the PATTERNS page, press the Sector line select key. Our center waypoint (CWPT) will be KLRU. Enter this in the cursor field. Since we are already southwest of this point, we will make our initial track (ITRK) 075.0 degrees. In the ITRK field, line select key 3L, enter 750 and press **ENTER**. We wish to make left turns at the end of each leg. In the ITRN field, line select key 4L, "L" will be prefilled, just press **ENTER**. If right turns are desired just press **±** key for "R" and then press **ENTER**. For an angle between legs we will enter 45.0 degrees. In the ANGLE field, line select key 3R, enter 450 and press **ENTER**. Finally, our leg distances will be 3.0nm. In the DIS field, line select key 4R, enter 30 and press **ENTER**. Note that the distance is TO and FROM the CWPT. Each track is made of one 3nm leg to the CWPT and one 3nm leg from the CWPT.

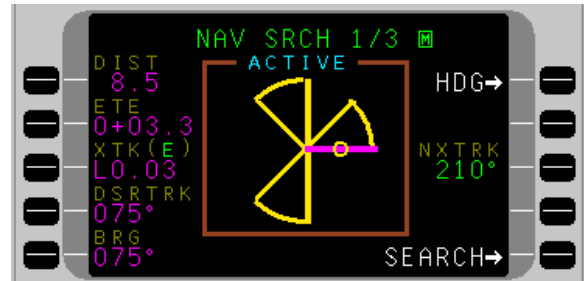


ACTIVATE the sector search.

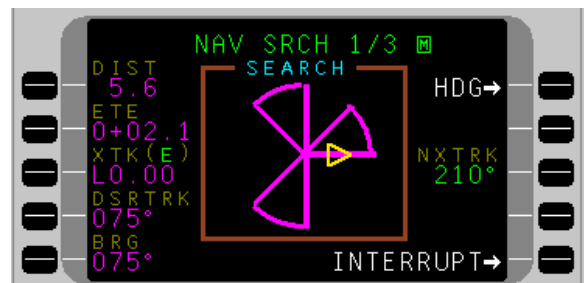
The FMS will create the initial leg for intercept and pressing SEARCH the FMS will fly the pattern.



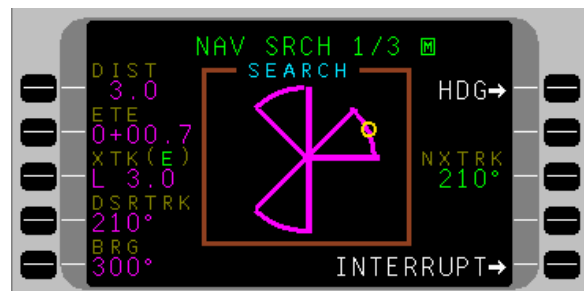
Press the SEARCH line select key to select SEARCH.



The FMS will steer the aircraft to cross the CWPT on the desired course (075). The circle icon will change to a triangle.

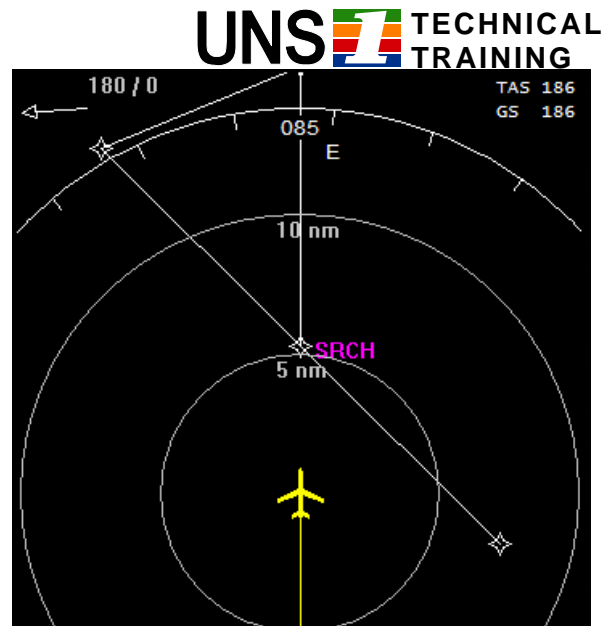


The next track leg (NXTRK) is displayed on the right side 210°. At the end of the FROM leg, the icon will again change to a circle and move to the curved line connecting the two legs, indicating the aircraft is maneuvering to intercept the next leg.



NOTE: Keep in mind that each leg in the sector search sequences is as follows: Initial first leg STARTS from CWPT center waypoint. The first leg ENDS at the selected distance. The second leg STARTS at the same selected distance on the next track and ENDS at the CWPT center waypoint. During the turn between legs all DIST, ETE, XTK (E), BRG references the NEXT leg START point. The search pattern shown on the CDU screen is "pictorial only". The arrow - circle icon will move only on the right side of the pattern.

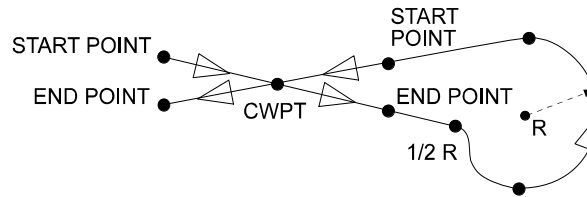
The FMS will display on an MFD map several of the pattern legs. The FMS is currently in ACTIVE mode proceeding to the active waypoint which the FMS named SRCH.



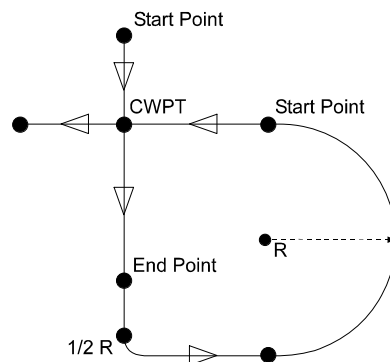
The FMS is now in SEARCH mode with the first leg displayed as the active leg. The SRCH waypoint will always be displayed as the waypoint to which the FMS is navigating.



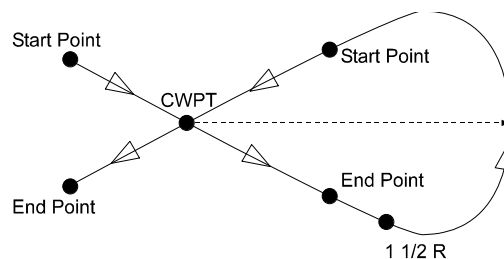
The FMS will fly on the same track for a distance of one half the minimum turn radius (R) of the aircraft under present ground speed plus steering limits. It will then maneuver the aircraft to intercept the new leg in one of three ways.



If the distance between the end point of a leg and the start point of the next leg is less than $2R$ and the aircraft is in a TO position relative to the new leg, the FMS will turn in the direction to increase crosstrack to the new leg. At a crosstrack distance equal to the midpoint between the leg separation and the $2R$ separation, the FMS will reverse its turn direction and fly on a circular arc to intercept the new leg. It will intercept the new leg before the endpoint.



If the distance between the end point of a leg and the start point of the next leg is less than $2R$ and the aircraft is in a FROM position relative to the new leg, the FMS will turn to intercept a leg outbound parallel at a spacing of $2R$ to the new leg. At a point on this parallel leg, the FMS shall fly on a circular arc to intercept the new leg before the endpoint.

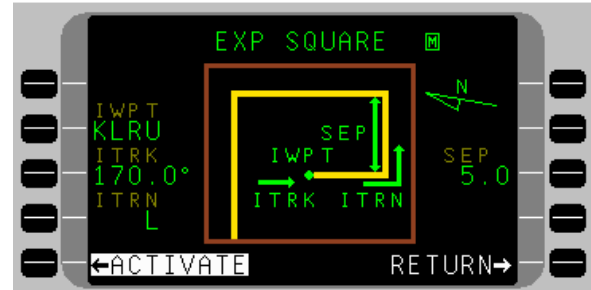


If the distance between the end point of a leg and the start point of the next leg is greater than or equal to $2R$, the FMS will continue on a straight path to a point $1 1/2 R$ beyond the end point. It will then command a turn onto an orbit segment. At a crosstrack of $2R$ relative to the new leg, the FMS will command steering on a circular arc to intercept the new leg before the end point.

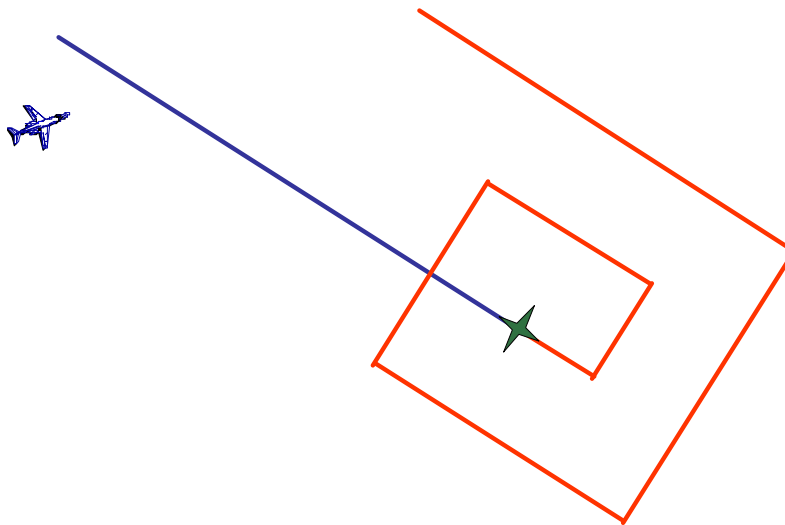
EXPANDING SQUARE

The expanding square pattern consists of a series of legs flown with conventional turn anticipation, where the leg length will be incremented by the leg separation distance after every other leg is flown.

The expanding square is defined by entering the initial waypoint (IWPT), initial track (ITRK), initial turn (ITRN), and leg separation distance (SEP). The pattern is activated the same as the other patterns.



The initial leg will be the greater of the specified separation or twice the minimum aircraft turn radius. This leg length will be established when the expanding square is selected.



RACE TRACK

The race track pattern consists of a pair of parallel legs connecting fly-over waypoints that are connected by special turn sequences. These turn sequences use the same rules as the rising ladder.

The racetrack is defined by entering the IWPT, ITRK, ITRN, leg length (LNTH), and leg spacing (LSPC). The pattern is activated and SEARCH is initiated in the same manner as the other patterns.



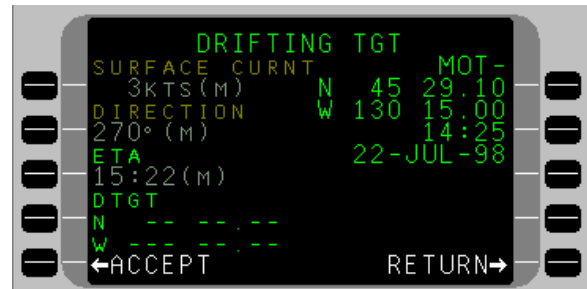
DRIFTING TARGET

Drifting target (DTGT) information, surface current speed, and direction of drifting target are derived from the calculated difference between MMMS velocities and DATA from an external Doppler Sensor. Manual entries may also be entered. MMMS calculates a delta position using current speed, direction, and ETA, then compares the Delta position to the original position to generate the estimated DTGT location.

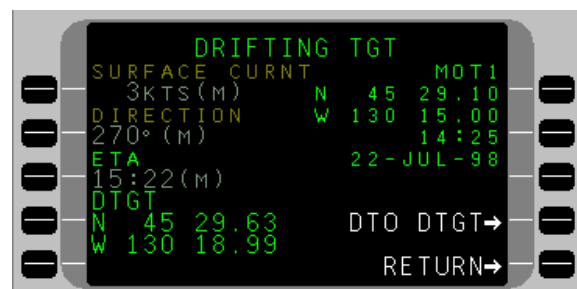
Press the **NAV** key then the **MENU** key to display the NAV MENU. Press DRIFT TGT line select key. For aircraft equipped with Doppler navigation equipment, the surface current and direction is calculated by the FMS and displayed.



For aircraft not equipped with Doppler, manual entries can be made. In the SURFACE CURNT field, line select key 1Lw, manually enter the surface current speed in knots. In the DIRECTION field, line select key 2L; manually enter the direction of surface current. Activating the Mark On Target switch mounted in the cockpit will enter the coordinates of a drifting target by sending a discrete input to the FMS. This will cause the FMS present position, normally overhead the target, to be entered with UTC. Manual entry of the drifting waypoint location may be made by pressing 1R line select key to enter coordinates, 2R line select key to enter time of the fix, and 3R line select key to enter the date. (DD-MM-YY format)



Once these entries are made, press the ACCEPT line select key. The present location of the drifting target will be displayed at the lower left display field and the DTO DTGT line select will be available. Selecting DTO DTGT will cause the FMS to proceed to the calculated coordinates.



Pressing line select key 4R, DTO DTGT, will exit the drifting target page and display the NAV 1/3 or 2/3 page while turning the aircraft to fly direct to the DTGT co-ordinates.

It will then be necessary to return to the DTGT page, press line select key 3L and input the ETA manually. This will add the time to waypoint and recalculate the DTGT position.



Mark On Target (MOT) waypoint list page is accessed from the DRIFTING TGT page by pressing line select key 1R, (cursor over Latitude Field) then press the list key. Up to nine targets (MOT Co-ordinates) may be stored by Number, Date, and Time. Pressing line select key 5L twice deletes all of the waypoints on the page. Use line select key 5R to return to the NAV page.



FLIGHTPLAN ERASE

An installation and configuration option is a flight plan Erase discrete that, together with a switch in the aircraft cockpit will erase the current flight plan, pilot routes, and pilot defined waypoints. This process is nonreversible and does not affect the NAV database.

MONOCHROME

A special part number CDU has faceplate lighting compatible with NVG (Night Vision Goggles). The UNS-1 MMMS has the option to display monochrome instead of color. This is selected on the NAV MENU page.

