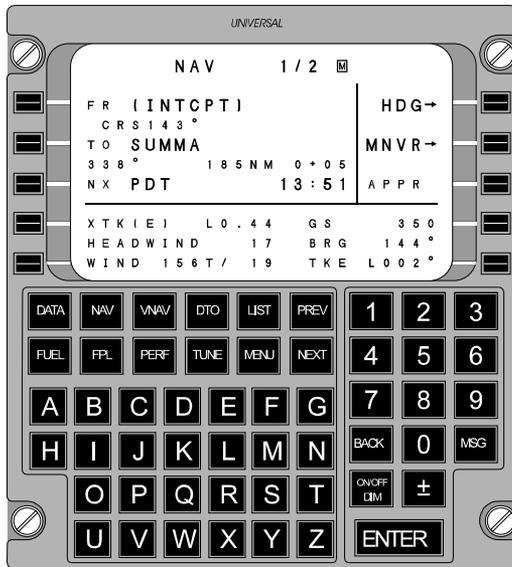


UNS-1B
 UNS-1C
 UNS-1C^{sp}
 UNS-1D
 UNS-1K

UNS
 OPERATOR'S
 MANUAL

FLIGHT MANAGEMENT SYSTEM
 SCN 602



NOTICE

When the FMS is configured for the Advanced Performance Option, a Performance Supplement is provided for insertion at the end of the FUEL AND PERFORMANCE Section.

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Report No. 2423sv602
 Change 1, January 5, 1998

APPLICATION

This Operator's Manual
Report No. 2423sv602
is applicable to

UNS-1B
UNS-1C
UNS-1Csp
UNS-1K
UNS-1D
FLIGHT

MANAGEMENT SYSTEM
possessing software program

Version 602.X

Refer to approved
Airplane Flight Manual Supplement
for certified version.

The software program version
is found on the
Initialization Page
and the S/W Versions page.

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INTRODUCTION

This manual covers operation of software control number SCN 602 as it is used in Universal's UNS-1B, UNS-1C, UNS-1C*sp*, UNS-1D and UNS-1K (all of which are referred to as FMS herein).

The Flight Management System (FMS) is a fully integrated navigation management system designed to provide the pilot with centralized control for the aircraft's navigation sensors, computer based flight planning, and fuel management. For certain aircraft models, performance calculations of takeoff and landing V speeds and engine settings are provided. These are obtained from digitized AFM tables in the FMS. When the FMS is interfaced with certain Collins Pro Line 4 Avionics System, the FMS becomes the navigation control. Unique operational differences exist in this case and are discussed in the applicable Pro Line 4 Supplement.

Sensors

The FMS accepts primary position information from short- and long-range navigation sensor(s). Inputs from DME, VOR or TACAN, Doppler, as well as up to five long range navigation sensors can be utilized to determine the aircraft's position. Because each type of navigation sensor has unique capabilities and functions, the type and number of sensors can be tailored to optimize the user's specific operational requirements. The user may choose from Loran C (LCS), Omega/VLF (OSS), and laser or gyro referenced inertial (IRS) navigation sensors. The FMS will also interface to several varieties of GPS, namely the GPS-950, GPS-1000, GPS-1200, UNS 764-1 and UNS 764-2 combined GPS/OSS sensors, Trimble GPS TASMAN sensor and the Honeywell YG1845 combined IRS/GPS sensor. All configurations can use a multi-channel, scanning DME, or Radio Reference Sensor (RRS). In addition to the navigational inputs, the system also receives true airspeed and altitude information from an air data computer and analog or digital fuel flow data from the aircraft's fuel flow sensors and heading from the aircraft compass system or INS. The FMS may be interfaced with a Doppler system to provide sea surface current calculations for drifting targets.

Best Computed Position

The primary position data received from the sensors is combined in a Kalman Filter within the FMS to derive a "Best Computed Position" (BCP). Utilizing this BCP, the FMS navigates the aircraft along the pilot-programmed flight path, which can include departure procedures (SIDs), airways, inflight maneuvers, holding patterns, arrival procedures (STARs), approaches and runways.

The FMS best computed position is determined by using position inputs from all available navigation sensors and DME distance information from the scanning DME (if installed). If an RRS is installed TACAN information is also used. The system searches the NAV Data Base to determine which DME or TACAN stations are within range and then sequentially tune each station. By interrogating multiple DME or TACAN stations, knowing the geographic coordinates of each station, and correcting the distance computation for slant range using station elevation and aircraft altitude, the FMS is able to compute the position of the aircraft. This DME derived position is then integrated with position information from the Omega/VLF, GPS, Loran C, and inertial sensors, radial from the VOR and TACAN, TAS from the air data computer, and heading information to derive the best computed position as a weighted average of the various sensor inputs. If the aircraft is out of DME range, the FMS will rely upon the long range sensors for position information. After the best computed position is obtained, secondary navigational functions such as course to waypoint, ETA, distance to waypoint, wind, and groundspeed are computed for display. Estimated winds may be defined at various waypoints in the flight plan to give more accurate ETA's.

Flight Planning

Flight planning is accomplished by accessing the internal navigation data base that includes navigation data, and pilot-defined data and company defined routes created on Universal's Offline Flight Planning Program. The pilot selects from waypoints, routes, airways, arrivals and departures, approaches and runways to create the desired flight plan. Accurate and quick flight planning is facilitated by features such as SIDs, STARs, and Approaches for use in terminal areas, and High and Low Altitude airways

for the enroute portion. The pilot with only a few key strokes can generate the most complicated flight plan. These operations are accomplished by selecting the appropriate data from computer-tailored lists, thus eliminating the need to type in actual or other time consuming data from the keyboard and reducing entry errors.

Maneuvers

Inflight maneuver capabilities include FMS controlled departures, procedural turns, turn anticipation, Direct-To functions, VNAV, Heading Mode, holding patterns, selected crosstrack, Pseudo-VOR, arrivals and approaches.

Waypoint Sequencing

The FMS utilizes automatic turn anticipation for leg changes along the flight plan. Turns are commenced at a distance based upon groundspeed, leg change magnitude, and roll steering bank limits for the present altitude. If a leg change incorporates a "fly-over" waypoint, the turn will commence over the waypoint.

Direct-To

The FMS provides maximum flexibility when defining direct-to leg changes. Direct-to maneuvers can be to waypoints or airports on or off the flight plan. If a TO waypoint that is off the flight plan is chosen, the system will prompt the pilot to redefine the NX waypoint in order to link the newly defined leg into the flight plan. The pilot may specify the turn direction when performing a DTO.

Heading Mode

The HDG function of the NAV mode allows the pilot to select and fly a desired heading using keyboard entries from the FMS. When installed with advanced Collins EFIS, the heading bug knob may also be used to control FMS heading.

The Heading Mode may be armed to automatically intercept the current Nav leg as well.

Selected Crosstrack

A parallel course may be established to provide guidance with respect to an offset course, parallel to the leg defined by the FR/TO waypoints. When SXTK (Selected Crosstrack) is entered, the SXTK annunciator on the instrument panel will illuminate, XTK will indicate crosstrack from the selected crosstrack, the system will provide steering to fly the selected crosstrack, and the HSI will be referenced to the parallel (offset) course.

Vertical Navigation (VNAV)

Two VNAV pages with nine VNAV waypoints are available under the VNAV function key. Up to eight VNAV waypoints are automatically prefilled in reference to flight plan waypoints. Waypoints not on the flight plan cannot be accepted.

Additional VNAV features include a computed Top-of-Descent, Target Vertical Speed, and Vertical-Direct-To. For the initial VNAV leg, flight path angle in degrees is displayed under the Target Vertical Speed data field.

Holding Patterns

Holding patterns may be programmed at any waypoint on or off the flight plan or are stored in the navigation data base as part SID, STAR and approach procedures. If defined at a fix on the flight plan, the pattern may be either armed (ARM HOLDING) or directly activated (DTO HOLD). If the fix is not on the flight plan, the hold may only be directly activated. When armed, the aircraft will continue along the current flight plan, and when the hold fix is reached, holding will automatically commence. If the hold is directly activated, the aircraft will proceed from present position direct to the holding fix and automatically perform the appropriate entry to the pattern (parallel, direct or teardrop). Once established in the pattern, the FMS will fly the correct legs, compensating for existing wind conditions. Estimated Time of Arrival (ETA) over the holding fix is constantly displayed.

Terminal Area Procedures

The FMS can fly published SIDs and STARs with procedural legs such as heading-to-radial, heading-to-altitude, course-from-fix-to-DME-distance, DME-arcs and fifteen additional leg types. SIDs and STARs can be easily linked into a flight plan by selecting from menus of procedures available at the departure and destination airports.

Approach Mode

An FMS approach mode provides the operator with ILS-like guidance while flying FMS approaches. During an FMS approach, the system provides signals like those of an ILS for flight director or autopilot coupled approaches. Altitude restrictions may be entered if vertical guidance is desired.

VOR, RNAV, TACAN, GPS, NDB, ILS, LOC and BC approaches may be accessed directly from the navigation data. GPS and NDB approaches can only be flown using GPS, whereas VOR, RNAV and TACAN approaches may be flown as GPS overlay. ILS approaches can be linked to the flight plan, however they can only be actively flown if the aircraft installation includes an advanced EFIS, which is compatible with nav-to-nav captures (e.g., Collins APS-85/86, EFIS B4/C14/E4). LOC and BC approaches will use the raw localizer data for lateral steering, and baro altitude VNAV for vertical deviation.

Approaches can also be defined by the pilot by entering the approach waypoints and the reference navaid. VOR, RNAV, TACAN, ILS, LOC, BC and VFR FMS approaches can be defined. There are no provisions for pilot-defined GPS or NDB approaches.

Data Bases

A self-contained worldwide NAV Data Base stored in non-volatile memory, provides the FMS with information on over 100,000 waypoints, navaids, airports and over 12,000 SIDs, STARs and Approaches. Additionally, the data base has the capability to store up to approximately 200 pilot defined routes utilizing up to 2,500 legs. The operator may choose from a worldwide data base with airports of >2000 foot or >4000 foot runways. In addition a special Eastern Region Helicopter (ERHC) data base exists for helicopter operators.

Company Data Base

A company routes data base can be created using Universal's Offline Flight Planning Program. A total of up to 2500 routes and 250,000 route elements may be stored. 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 data base by use of reference pointers. Company routes can be given names of up to eight characters in length.

Navigation Data Base

A subscription service is available through Universal Avionics Systems Corporation which provides navigation data base updates on a 28 day cycle. The updates are formatted on 3 1/2 inch diskettes and are loaded into the FMS via the Data Transfer Unit.

Dual Cycle Data Base

In the case of the UNS-1C, -1Csp, -1D and -1K, there are two separate data base memory banks to hold the electronic data base. When a 28-day cycle is loaded into the FMS it replaces the data that is in the currently unused data bank (the current data base is in the other memory bank). At the first power-on cycle after the effective start date of the new data base, it will automatically be used for navigation. The advantage to having dual cycle data bases is that the next data base cycle can be loaded into the FMS on the day it is received, rather than the operator having to wait until the effective start date.

In the case of the UNS-1B there is only one data base memory bank and each update completely overwrites the old data.

The data base includes VHF and NDB nav aids with plain-language references, enroute and terminal waypoints, High and Low Altitude airways, and airports. The operator may select either worldwide or regional coverage as best suited to the aircraft operations.

Pilot Defined Navigation Data

In addition to the navigation data base, the FMS can store a substantial amount of pilot-defined data. The pilot route database has the capacity to store up to 200 pilot defined routes with up to 98 legs in each. Pilot-defined data can also include 200 waypoints, 100 Approaches and 100 Runways.

Company Defined Navigation Data

The protected company route data must be generated off-line using a PC and the Universal Flight Planning program. It can only be loaded via disk. A company route can be copied into the active flight plan where it can be edited, but the basic route database cannot be altered by the pilot. A company route is stored in "clearance language," that is, the Departure Airport, SID, Airway(s), STAR, Approach and Destination Airport.

Performance Data Base

For certain aircraft, the AFM charts for takeoff and landing speeds, as well as takeoff, climb and cruise engine settings have been digitized and stored in the FMS. See AIRCRAFT PERFORMANCE SUPPLEMENT in the back of the FUEL & PERFORMANCE Section.

Sensor Watchdog

A sensor "watchdog" automatically protects against a large error being input from a navigation sensor, which 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 (i.e. sensor greater than 50 nm or diverging at > 50 knots) will automatically deselect the sensor.

Nav and Steering Outputs

The FMS provides desired track, bearing, crosstrack, lateral deviation, and related data to the flight guidance system for the HSI displays, and roll steering command for the autopilot/flight director system. In helicopter installations, the roll steering output is limited to 15° bank during normal leg-to-leg changes. For "Direct To" course changes, the output is limited to 20° of bank. In airplane installations, the roll steering during normal leg-to-leg changes is limited to 27° of bank up to 20,000 feet, decreasing linearly from 27° to 15° as the altitude increases to 32,000 feet, and remaining at 15° maximum above 32,000 feet. For "Direct To" course changes, the steering output is limited to 30° of bank up to 20,000 feet, decreasing linearly from 30° to 20° as the altitude increases to 32,000 feet, and remaining at 20° maximum above 32,000 feet. The roll rate is limited to 3° per second in all installations.

MANUALS AFFECTED: Operator's Manual, Report No's. 2421sv600, 2423sv600, 2423sv601, 2423sv602, 2423sv603, 2421sv700, 2423sv700, 2423sv701, 2423sv702, and 2423sv703.

FILING INSTRUCTIONS: Insert this Temporary Change into Section I adjacent to the paragraph entitled Nav and Steering Outputs.

SUBJECT: Nav and Steering Outputs.

APPLICABILITY: Some features depicted below may not be applicable to individual systems. Refer to the appropriate technical manual for individual system applicability.

INSTRUCTIONS: Replace the paragraph under Nav and Steering Outputs with the following text and table:

The FMS provides desired track, bearing, crosstrack, lateral deviation, and related data to the flight guidance system for the HSI displays, and roll steering command for the autopilot/flight director system. The roll steering output limits for both "Direct To" and normal leg-to-leg changes are configuration specific, and are set during initial configuration of the system. These specified limits are restricted to a maximum roll angle of 30°. The roll rate is limited to 3° per second in all installations. Refer to the following table for operational roll angle limits:

HEADING CHANGE	ROLL ANGLE LIMIT
Normal Leg Sequence/Direct To	Standard rate turn not to exceed configured limits.
Procedure Turn	27.8°
Holding	27.8°
FMS Heading	Equal to heading error – not to exceed configured limits
Procedural Headings (SIDs, STARs)	Equal to heading error – not to exceed configured limits
Tear-drop Procedure Turn	10° to 20° (Refer to Tear-drop Procedure Turns in Section V.)

Fuel

The aircraft's engine fuel flow system provides the inputs necessary to integrate real time fuel management information with the navigational functions. During the predeparture phase, the pilot inputs the fuel on board the aircraft to initialize the fuel management functions. During flight, the FMS automatically updates the fuel on board and gross weight as well as provides continuous estimates of the fuel requirements for the programmed flight plan based upon fuel flow and groundspeed. The FMS also provides specific range and endurance data to aid the pilot in optimizing fuel consumption to obtain maximum range or endurance.

NOTE: The Fuel Flow management information provided by the FMS has not been evaluated to the requirements of TSO C44a (Fuel Flowmeters).

Fuel display parameters are advisory only and do not replace primary fuel quantity or fuel flow gauges for fuel load and range planning.

Multiple FMSs

In dual or triple installations, each FMS outputs and makes available to the other system initialization and flight plan information through an interconnecting bus. While all long range navigation sensors are interfaced with both units, each FMS acts as the "master" to the associated sensor. Each FMS computes its own independent position using all available navigation sensors and provides selected information to the associated flight instruments. Each FMS also shares its best computed position with the other system and continuously monitors the other system's position output.

Radio Tuning

Incorporated into the FMS, an optional TUNE mode provides the operator with a centralized means to tune the aircraft's radios, select and store preset frequencies for each radio, and to view the selected (preset or active) frequencies for each radio. The aircraft must be configured with a Radio Tune Unit or Proline 4 or AN/ARN TACAN or 709 DME & 711 VOR for this mode to be operational.

Annunciations

Messages

The FMS contains an array of messages, which alert the operator to system status and flight plan sequencing. When a message is active, "MSG" will appear on the display, and the message can be accessed by pressing the MSG key.

The Message function also is utilized for AFIS and UniLink communications in applicable installations.

Remote Annunciations

Outputs are provided to drive the six external annunciators to alert the pilot of system status or flight plan sequencing (Note: these may be incorporated into the EFIS display):

- | | | |
|-----------|---|---|
| MSG | - | A new message has been generated. |
| WPT | - | (Steady) Lateral waypoint alert.
(Flashing) Vertical waypoint Flight Path Angle alert. |
| SXTK | - | FMS is in selected crosstrack mode. |
| FMS HDG | - | FMS is in Heading Mode. |
| FMS APPR | - | FMS is in Approach Mode. |
| GPS INTEG | - | RAIM is not available or a fault is detected. DME may be still in use. |

Video Interface Option

Only applicable to UNS-1B with Flat Panel CDU, or to UNS-1C, -1Csp, or -1D. This optional feature allows interface with video cameras and cabin display systems for viewing on the FMS color flat panel display. NTSC RGB video format is required for input to the FMS.

SYSTEM COMPONENTS

The basic FMS installation consists of the FMS (containing the display, keyboard, navigation computer and a GPS sensor), a configuration module, a Data Transfer Unit and a GPS antenna.

FMS Display

The FMS utilizes a 4 or 5-inch active matrix liquid crystal color flat panel display. The high resolution display provides alpha-numeric characters, icons and graphics capabilities to facilitate on screen data recognition. This display allows for data display on eleven lines with 24 characters each in two different character sizes. Graphic displays for special photo, search and surveillance flight patterns are provided. The display also supports NTSC RGB format video.

A UNS-1B may use the standard Super CDU, which only contains five colors (green, light green, orange, yellow and red), and has no video.

FMS Keyboard

The full alphanumeric keyboard contains dedicated function keys and, when used in conjunction with the ten line select keys, provides the operator with all the controls necessary to communicate with the internal navigation computer and all associated sensors. The keyboard allows manual data entry, system mode selection and control (selection and deselection) of navigation sensors.

FMS Navigation Computer

The FMS contains the systems powerful central processing unit (nav computer), navigation sensor interface circuits, flight guidance system interface and the navigation data base. The unit processes data from DME, VOR, Air Data, Fuel Flow and up to five long range navigation sensors. A radar joystick input can also be accommodated. At installation, the system is configured with the number and type of long range navigation sensors, which will optimize the FMS system to the aircraft's specific requirements. The long range nav sensors act in addition to the multi-channel scanning DME and VOR sensing capability integrated into the basic circuit.

When the FMS is interfaced with Collins Pro Line 4 Avionics System (e.g., Learjet 60), an EFIS Radar Panel (ERP) is also installed. Refer to the applicable Pro Line 4 Supplement for ERP details. The ERP is *not* required when the FMS is interfaced to Collins Pro Line 4000 (e.g., Falcon 2000, IAI Astra SPX, SAAB 2000, etc.).

Configuration Module

A configuration module is installed on the FMS rear connector. Once it is programmed at the time of installation, it will define all the aircraft interfaces unique to the particular installation.

Short Range Sensors

DME

The FMS's unique auto-scanning DME-DME-DME positioning function uses the internal navigation data base to continually map the stations surrounding the aircraft (VORTACs, DMEs, ILS-DMEs, LOC-DMEs, TACANs). The FMS then automatically tunes and reads these, one every four seconds, utilizing the blind channel of an external digital DME or Universal's Radio Reference Sensor (VOR, DME, TACAN). Range information to all responding DMEs within approximately 250 nautical miles of the FMS position are corrected for slant range error and are then compared with those computed from the nav database to verify reasonableness and to ensure DME position integrity is maintained.

Flights, which never leave areas of multiple DME coverage, can expect exceptional position accuracies. Over-water flights will retain DME accuracy long into the flight, re-establishing this same accuracy well before landfall as DMEs are again received.

VOR

The aircraft's digital VOR receiver or Universal's Radio Reference Sensor provides the FMS with azimuth information from the referenced VOR navaid. This azimuth data combined with the scanning DME distances, provides accurate navigation information for the FMS systems throughout the enroute, terminal and approach modes of operation in accordance with the criteria set forth in AC 20-130A when within range of the required ground based nav aids.

Radio Reference Sensor (RRS)

Universal's Radio Reference Sensor (RRS) functions as a multi-channel DME/TACAN receiver/transmitter and VOR receiver, able to provide DME, VOR and TACAN data simultaneously to two FMS systems. The RRS provides the required navigation information via an ARINC 429 data bus without interfering with the aircraft's existing radios. RRS operation is fully automatic requiring no pilot intervention.

Doppler

The FMS supports two types of Doppler Sensors: the RACAL 91 and the ASN-137. These are mostly used for measuring sea current in search and rescue applications.

Long Range Sensors

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

UNS LCS Loran C Sensor

Universal's Loran C Sensor (LCS) was specifically designed to interface with the Flight Management Systems. The UNS-LCS is a fully automatic multiple chain Loran C Sensor utilizing an E-field blade antenna. The LCS is capable of simultaneously using all available stations in up to three Loran C chains in a true multiple station, multiple chain navigation solution. Although one LCS may be input to more than one FMS, each FMS will accept only one LCS input.

LCS-850 Loran C Sensor (LCS)

Universal's LCS-850 Loran C Sensor (P/N 1045-01) was specifically designed to interface with Universal's Flight Management Systems (FMS) and Navigation Management Systems (NMS). The LCS-850 functions as an automatic Loran C Sensor utilizing an E-Field blade antenna. Station selection is multi-GRI or cross chain operation. The LCS-850 utilizes the following GRIs: 9990, 9980, 9960, 9940, 9610, 8970, 8290, 7980, 7960, 5990 and 5930.

The LCS-850 is for enroute navigation only and is not intended for use during approach.

GPS-1000 and GPS-1200 (GPS)

Universal's Global Positioning System, GPS-1000 and GPS-1200 were designed to interface with UASC's Flight Management System. GPS-1000 and GPS-1200 position is used in conjunction with data from a combination of VOR, DME, IRS, LCS or OSS to form a composite FMS position solution.

The GPS-1000 or GPS-1200 Sensor is the source of three dimensional position and velocity, time and status information. It is a 12-channel receiver, which continuously processes measurements from all satellites in view simultaneously.

The FMS complies with aspects of TSO C-129 class B1 and C1 in regards to waypoint displays, scaling, integrity monitoring, predictive RAIM, etc. when interfaced with the GPS-1000 or GPS-1200. These sensors also comply with FAA Notice 8110.60 for primary means remote/oceanic operations.

In the case of the UNS-1C, -1Csp, -1D, and -1K, the internal GPS sensor is identical to the GPS-1000 sensor, and carries the same approvals.

OMEGA/VLF Sensor (OSS)

Omega/VLF sensors depend upon reception of Omega navigation network and VLF (very low frequency) communication radio signals to compute the aircraft's latitude/longitude coordinates. Omega signals originate from eight stations around the world. Reception from at least two stations is required by those units containing their own rubidium clocks. VLF communication stations supplement the Omega signals.

The FMS will accommodate Omega/VLF sensors systems (OSS) of several different manufacturers. Up to two OSSs may be installed. In some cases, the OSS must retain the manufacturer's Control Display Unit (CDU).

Universal's UNS-764 Omega/VLF Sensor has been designed for use with the FMS. The UNS-764 features five independent receiver channels which track all available Omega and up to eight VLF stations simultaneously. It is a remotely mounted sensor housed in a 2MCU box. An optional back-up mini CDU is also available.

GPS/OMEGA/VLF (GPOSS) Sensor

The UNS 764-1 and 764-2 are combination GPS and Omega/VLF sensors. The Omega/VLF receiver, of both the UNS 764-1 and 764-2, features five independent channels, which track all available Omega, and up to eight VLF stations simultaneously. Advanced synchronization algorithms and the ability to use both primary and discrete Omega frequencies result in typical Omega sync times of under 30 seconds.

The UNS 764-1 GPS sensor component utilizes a dual-channel processing system architecture. All visible satellites are tracked--not just the minimum of four required for GPS operation. Sequential tracking provides more frequent Pseudo-Range measurements, results in a smaller Geometric Dilution of Position (GDOP), and provides a superior tolerance to temporary signal loss due to antenna shading caused by aircraft structures or maneuvering.

The UNS 764-2 GPS sensor component features a 12-channel L1 frequency and C/A code receiver which is exactly the same as the GPS-1200 standalone GPS sensor. The GPS receiver features real time and predictive RAIM, satellite fault detection and exclusion capability and carrier phase tracking. It has a horizontal position accuracy of 30 meters (less than 10 meters with differential). In addition to enroute and terminal operations, the GPS portion of the UNS 764-2 can be certified as one of the two required long range sensors for NAT-MNPS navigation across the North Atlantic. It can be certified for GPS non-precision approaches and meets the requirements of and is certified to TSO C-129, class B1/C1.

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.

The FMS can accept inputs from up to three IRSs. 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 (i.e., it does not degrade with elapsed time). However, the data can have short term perturbations due to aircraft maneuvering or poor satellite geometry. IRSs on the other hand have excellent short term position resolution, however, they will tend to drift with time. A GPS/IRS will output three different sets of data: pure GPS, pure IRS, and hybrid GPS/IRS. It is the latter data that is used by the FMS. Hybrid GPS/IRS data will exhibit the long term accuracy of GPS, and will also exhibit the short term accuracy of an IRS during those periods of poor GPS performance.

Air Data

The FMS accepts digital or analog air data from a remote air data computer. 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.

Data Transfer Unit (DTU)

The Data Transfer Unit (DTU) is a floppy disk drive unit, which is designed to be mounted in the aircraft and used to update the FMS navigation data base within minutes. A portable unit is also available for multi-aircraft operations. The DTU is connected directly to the FMS such that the data is transmitted directly to the FMS during the update process. The update data is contained on 3 1/2 inch diskettes, which refresh the entire navigation data base with each update.

A separate subscription service is available through Universal, which provides navigation data base updates on a 28 day cycle.

The DTU is also used to load aircraft specific performance data into the FMS for computation and display of aircraft performance data. The DTU may also load pilot-defined data created with off-line flight planning software loaded into an IBM compatible computer. FMS inflight data parameters can be written to a disk utilizing the DTU. Maintenance log diagnostic history is also downloaded to a disk using the DTU. FMS software updates can also be loaded via the DTU.

Radio Tuning Unit (RTU)

The optional Radio Tuning Unit (RTU) allows the operator to use the FMS control display unit to tune a selected radio and store up to four preset frequencies for later use by each selected radio. COMMs, NAVs, ATC, ADFs and TACAN are selectable through the RTU depending upon the specific aircraft configuration.

CONFIGURATIONS

The configurations shown on the following pages represent the basic single and dual installations for the UNS-1C, UNS-1C_{sp}, UNS-1B/UNS-1D and UNS-1K FMSs. The configurations shown depict installations using all available long range navigation sensors ports. The configuration for each aircraft will depend on the types and quantities of sensors selected. The maximum number of each input type has been indicated.

Triple configurations are also possible but are not shown here, as they are extensions of the dual installation shown.

Single Systems

In a single FMS installation the FMS simultaneously accepts inputs from either digital DME and VOR receivers or DME/VOR/TACAN from a Radio Reference Sensor (RRS); multiple long-range navigational sensors; the Air Data Computer; and engine fuel flow sensors.

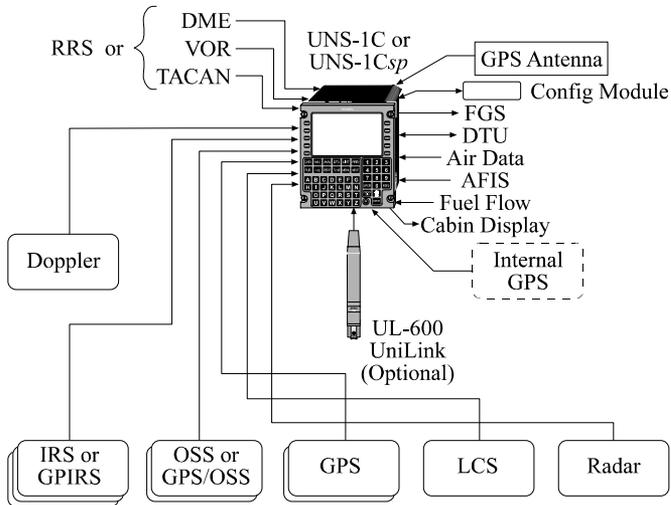
Multiple Systems

In multiple system installations, an interconnection bus provides communications between the FMSs. There is no “Master/Slave” type relationship between the FMSs. Each system makes data available (for example: Initialization, Flight Plan, Fuel) to other interfaced system(s). Crossfill of this data can be initiated by the sending or receiving system

Each system does; however, act as “Master” of its associated sensors, even though that sensor may also be providing data to another system. Typically, the on-side compass and air data computer will supply heading and air data, while fuel flow data will be shared by the systems.

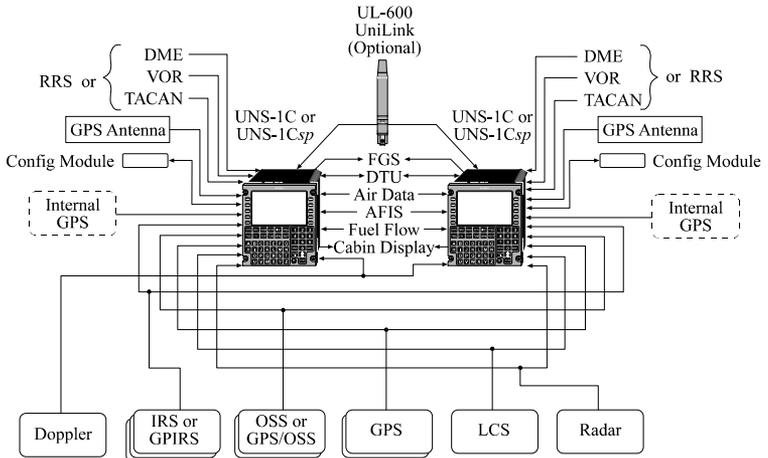
Each FMS computes its own independent position using all available navigation sensors and provides selected information to the associated flight instruments. Each FMS also shares its best computed position with the other system and continuously monitors the other system's position output.

Single UNS-1C and UNS-1Csp FMS Configuration



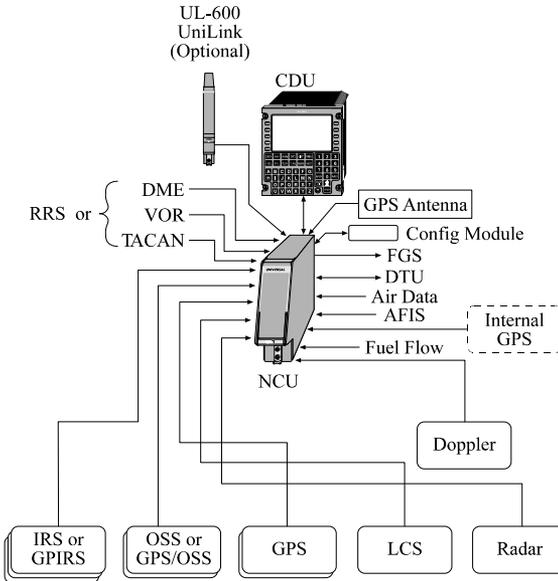
- Long range navigation sensors in various combinations (up to five total)
 - Inertial Reference Sensors (IRS) or GPIRS - Maximum of three.
 - OMEGA/VLF Sensor System (OSS) or GPS/OSS - Maximum of two.
 - Loran C Sensor (LCS) - Maximum of one.
 - GPS Sensor - Three (including internal GPS).
- Radio Reference Sensor (RRS) - One.
- Engine Fuel Flow Sensors - maximum of four;
- Air Data Computer (ADC) - One.
- Distance Measuring Equipment (DME) - One multi-channel digital DME.
- VOR Receiver - One digital VOR.
- TACAN Receiver - One
- Radar joystick (not displayed) input for waypoint definition.
- Data Transfer Unit (DTU) - One.
- Doppler - One

Dual UNS-1C and UNS-1Csp FMS Configuration



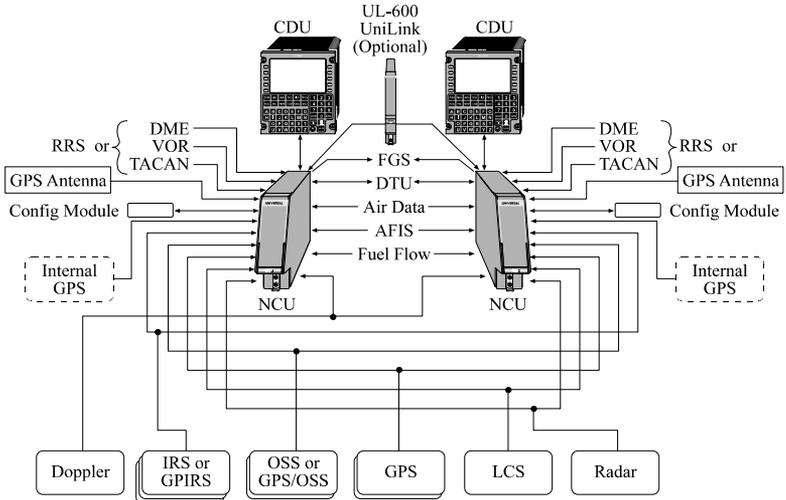
- Long range navigation sensors in various combinations (up to five total)
 - Inertial Reference Sensors (IRS) or GPIRS - Maximum of three.
 - OMEGA/VLF Sensor System (OSS) or GPS/OSS- Maximum of two.
 - Loran C Sensor (LCS) - Maximum of one.
 - GPS Sensor - Three including the internal GPS.
- Radio Reference Sensor (RRS) - One or two.
- Engine Fuel Flow Sensors - maximum of four;
- Air Data Computer (ADC) - One or two.
- Distance Measuring Equipment (DME) - Two multi-channel digital DMEs.
- VOR Receiver - Two digital VORs.
- TACAN Receiver - Two.
- Radar joystick (not displayed) input for waypoint definition.
- Data Transfer Unit (DTU) - One
- Doppler - One

Single UNS-1B/UNS-1D FMS Configuration



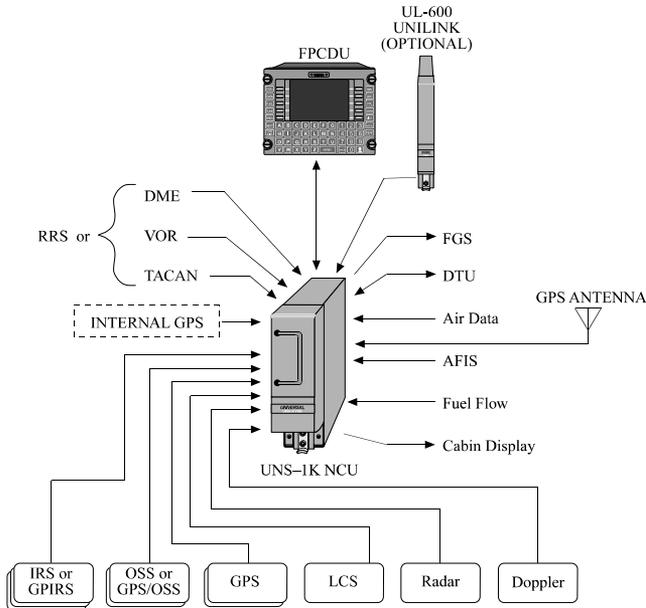
- Long range navigation sensors in various combinations (up to five total)
 - Inertial Reference Sensors (IRS) or GPIRS - Maximum of three.
 - OMEGA/VLF Sensor System (OSS) or GPS/OSS- Maximum of two.
 - Loran C Sensor (LCS) - Maximum of one.
 - GPS Sensor - Three including internal GPS.
- Radio Reference Sensor (RRS) - One.
- Engine Fuel Flow Sensors - maximum of four.
- Air Data Computer (ADC) - One.
- Distance Measuring Equipment (DME) - One multi-channel digital DME.
- VOR Receiver - One digital VOR.
- TACAN Receiver - One.
- Radar joystick (not displayed) input for waypoint definition.
- Data Transfer Unit (DTU) - One.
- Doppler - One

Dual UNS-1B/UNS-1D FMS Configuration



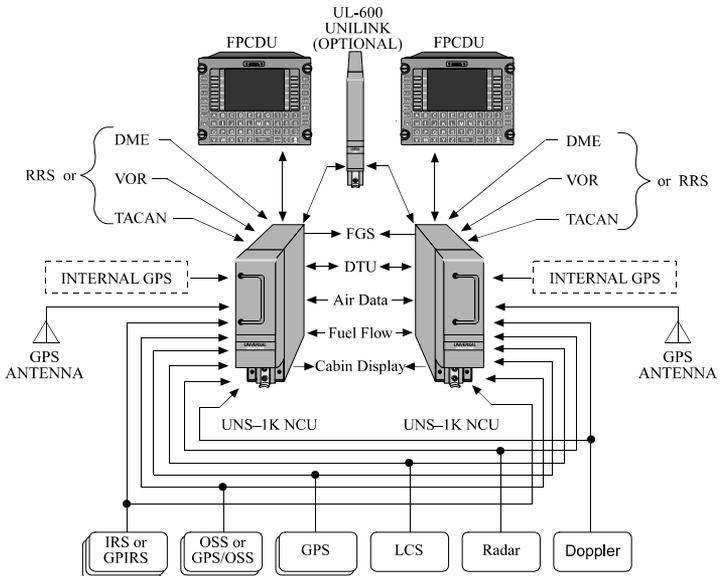
- Long range navigation sensors in various combinations (up to five total)
 - Inertial Reference Sensors (IRS) or GPIRS - Maximum of three.
 - OMEGA/VLF Sensor System (OSS) or GPS/OSS- Maximum of two.
 - Loran C Sensor (LCS) - Maximum of one.
 - GPS Sensor - Three including the internal GPS.
- Radio Reference Sensor (RRS) - One or two.
- Engine Fuel Flow Sensors - maximum of four.
- Air Data Computer (ADC) - One or two.
- Distance Measuring Equipment (DME) - Two multi-channel digital DMEs.
- VOR Receiver - Two digital VORs.
- TACAN Receiver - Two.
- Radar joystick (not displayed) input for waypoint definition.
- Data Transfer Unit (DTU) - One.
- Doppler - One

Single UNS-1K FMS Configuration



- Long range navigation sensors in various combinations (up to five total).
Inertial Reference Sensor (IRS) or GPIRS – Maximum of three.
OMEGA/VLF Sensor System (OSS) or GPS/OSS – Maximum of two.
Loran C Sensor (LCS) – Maximum of one.
GPS Sensor – Three including internal GPS.
- Radio Reference Sensor (RRS) – One.
- Engine Fuel Flow Sensors – Two standard, four optional.
- Air Data Computer (ADC) – One.
- Distance Measuring Equipment (DME) – One multi-channel digital DME.
- VOR Receiver – One digital VOR.
- TACAN Receiver – One.
- Radar Joystick (not displayed) input for waypoint definition.
- Data Transfer Unit (DTU) – One.
- Doppler – One.

Dual UNS-1K FMS Configuration



- Long range navigation sensors in various combinations (up to five total)
 - Inertial Reference Sensors (IRS) or GPIRS - Maximum of three.
 - OMEGA/VLF Sensor System (OSS) or GPS/OSS- Maximum of two.
 - Loran C Sensor (LCS) - Maximum of one.
 - GPS Sensor - Three including the internal GPS.
- Radio Reference Sensor (RRS) - One or two.
- Engine Fuel Flow Sensors – Two standard, four optional.
- Air Data Computer (ADC) - One or two.
- Distance Measuring Equipment (DME) - Two multi-channel digital DMEs.
- VOR Receiver - Two digital VORs.
- TACAN Receiver - Two.
- Radar joystick (not displayed) input for waypoint definition.
- Data Transfer Unit (DTU) - One.
- Doppler – One

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INTRODUCTION

The FMS, provides the operator with all the controls necessary to communicate with its navigation computer and associated navigation sensors. A dimmable eleven-line color flat panel display uses two character sizes and displays colors. Line select keys are located on either side of the display. Function keys are immediately below the display and an alphanumeric keyboard is below and to the right of the function keys. The FMS provides for manual data entry, system mode selection, computed and raw data displays, control (selection and deselection) of navigational sensors, and system message displays. The FMS may be used to tune the aircraft radios if a Radio Tuning Unit (RTU) is installed, or when the aircraft is configured with Collins Pro Line 4, or when an AN/ARN-118 TACAN is installed, or when a 709 DME and 711 VOR is installed. When the FMS is interfaced with a Universal Avionics UniLink data link system or AFIS (Airborne Flight Information System) equipment, the FMS also serves as the send/receive terminal for UniLink or AFIS messages.

GENERAL OPERATING PHILOSOPHY

Data is always entered into the system at a cursor location. When appropriate, the cursor location aligns with one of the ten line select keys which are used to control the cursor. The home position of the cursor is usually off of the display when a page is initially accessed, although some pages have a cursor default position which is on the screen. Pressing the ENTER key completes the entry of data. If there is a logical next field for data entry, the cursor will automatically advance to this next field when the ENTER key is pressed.

Selections are made with the line select keys whenever possible. In some cases a combination of line select keys and reference numbers are used on the same display page. This allows two levels of selection to exist simultaneously on the same display. For example, while the line select keys control the contents or nature of a list, an item from that list can be selected by using a reference number.

Section II
Control & Display

Some selections which will change the active flight plan, guidance of the aircraft, or the stored data base require confirmation. Confirmation is accomplished by pressing the line select key a second time or by pressing the ENTER key. Selection of fields, which do not require confirmation, will cause the page or mode change to occur immediately when the corresponding line select key is pressed.

KEYBOARD



5" FPCDU & UNS-1C/-1Csp



4" FPCDU

Alphabetic and Numeric Keyboards

The alphabetic and numeric keys are used to input characters into a variable field marked by the cursor. The alphabetic keys are located immediately below the function keys and the numeric keys are to the right.

Line Select Keys

Normally, data is entered by using the line select keys to position the cursor, using the alphanumeric keys to input the desired data, and then pressing the ENTER key to complete the entry.

Control Keys

ON/OFF - DIM Key

The ON/OFF-DIM key provides power-up, display dimming, and unit shutdown functions.

Pressing the ON/OFF-DIM key for initial power-up will energize the system and initiate self test of the navigation computer. When self test is initiated, the self-test page will appear. The initialization page will automatically follow the self-test page if all tests are successfully completed. If a failure, which would cause the system to be unusable, occurs, the Initialization page will not appear. Once the initialization page appears, no other page can be displayed until the initialization data is accepted.

After the system is turned on, pressing the ON/OFF-DIM key will cause a control window to be displayed on the right side of the active page with the options BRIGHT, DIM, CANCEL, DISPLAY and OFF selectable using the line select keys.

NOTE: The BRIGHT/DIM provides display dimming only and does not dim the key backlighting. Key backlighting is dimmed along with aircraft instrument dimming.

BRIGHT - Pressing the line select key for BRIGHT will cause the display to steadily brighten as the key is held down.

DIM - Pressing the line select key for DIM will cause the display to steadily dim as the key is held down.

NOTE: If the display is dimmed completely off and other keys are pressed or the location of the BRIGHT Key can't be remembered, press the ON-OFF DIM key twice to restore display.

CANCEL - Pressing the line select key for CANCEL will cause the control window to be removed from the active display page.

DISPLAY - Pressing the line select key for DISPLAY will cause the display adjustment window to be displayed. The display adjustment window presents four options (UP, DOWN, CANCEL and VIDEO) selectable using the line select keys. (Note: VIDEO is only applicable to certain CDU part numbers.) Selecting UP will cause the entire display to shift upwards by as much as one-half character to adjust the parallax for the line select keys. Selecting DOWN will adjust the display downwards an equal amount. Selecting video will cause the display to switch to the video source. Pressing any key while in video mode will cancel video mode. Selecting CANCEL will return the display to the main (BRIGHT/DIM/CANCEL/DISPLAY/OFF) window.

OFF - Pressing the line select key for OFF will cause the CONFIRM OFF window to be displayed. This window has two options (CONFIRM OFF and CANCEL) selectable using the line select keys. Selecting CONFIRM OFF will turn the system off. Selecting CANCEL will return the display to the main (BRIGHT/DIM/CANCEL/OFFSET/OFF) window.

PREV Key

The PREV (previous) key is used to cycle backward, one page at a time, through multiple pages of the same mode.

NEXT Key

The NEXT key is used to cycle forward, one page at a time, through multiple pages of the same mode.

BACK Key

When the cursor is over a data entry field, the BACK key serves as a delete or backspace key.

± Key

The "State Change Key" (±) is used in conjunction with the alpha numeric keys to enter data. It changes + to -, N to S, and L to R. It is also used in strictly alpha fields as a dash or period.

MSG Key

When a system message becomes active, "MSG" will appear on the far right side of the top line on the display. If the Position Uncertain message is active, "POS" will be displayed on the far left side of the top line on the 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. After the messages are viewed, the display may be returned to the previous page by selecting the RETURN option on the MESSAGE page, by pressing the MSG key again, or by pressing the BACK key. Line select key [5L] will either be blank or display a UNILINK, or AFIS if the system is so configured. Pressing this key will access the UniLink or AFIS Menu page.



ENTER Key

The ENTER key is used to store input data. The cursor marks variable parameters by means of reverse field printing (dark letters on a light background). Parameters which cannot be marked by the cursor are not variable and cannot be changed by the normal input processes. Each time the ENTER key is pressed, the variable marked by the cursor will be stored in memory. When the cursor marks a variable, it may be altered through the alphanumeric keys and then stored by pressing the ENTER key. Pressing the ENTER key completes entry of data and is required for all data entries.

Function Keys

Eight function or mode select keys are located immediately below the display. These keys are used to select the basic operating modes of the system for data entry or command inputs. When one of the function keys is pressed, the display will immediately change to the first display page of the selected mode. Where multiple pages exist, subsequently pressing the function key will cycle the display forward one page at a time. The following paragraphs describe the selectable modes in general terms. For a detailed description of each mode and the various display pages under each mode, refer to the function and page descriptions later in this section.

LIST Key

The LIST key is used to provide a list of options appropriate to the data to be entered. While performing data entry, pressing the LIST key presents a list of selections appropriate to the entry being made.

MENU Key

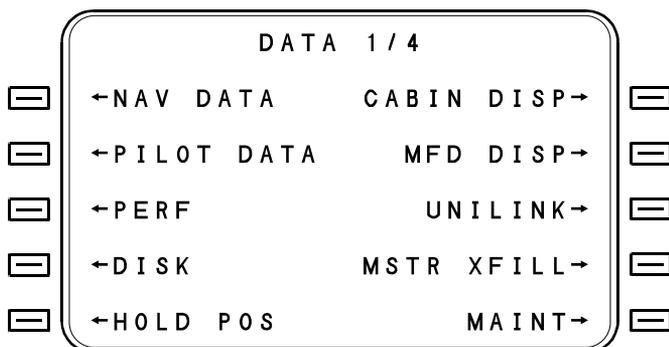
The MENU key is used to present a list of alternate formats or options for the FUEL, FPL or TUNE mode being displayed. A small letter “m” in a box will appear on the title line of any page in which the MENU key is active. Refer to the applicable Section for further details.

DATA Key

The DATA function is used to obtain information and status about the FMS, its NAV Data Base, and the attached sensors which operate with the FMS. Although sensor control is totally automatic, selection and deselection of individual sensors may be accomplished using this function. The DATA function is also used to make additions, deletions, or changes to pilot defined locations.

DATA Page 1 - DATA BASE/DISK/UNILINK/AFIS/HOLD POS/CABIN DISP/MAINT

Pressing the DATA key will allow access to the DATA pages as described below. The initial DATA page allows selection of NAV DATA or PILOT DATA, Disk Menu, AFIS Menu, Hold Position, Cabin Display and Maintenance Menu. When interfaced with Collins Pro Line 4 Avionics System, MFD DISP will appear at line select key 2R. Refer to the applicable Pro Line 4 Supplement for MFD DISP details. PERF, CABIN DISP, UNILINK or AFIS and MSTR XFILL are installation dependent.



NAV DATA

The NAV DATA line select key accesses the Navigation Data Base. See Section IV (Data Base)

PILOT DATA

The PILOT DATA line select key accesses the Pilot data base. See section IV (Data Base)

PERF

The PREF line select key accesses the DATA/PREF page. This page will contain parameters of the performance data base. If performance data base is missing or invalid, all fields will be dashed

DISK

The DISK line select key accesses the DISK MENU page. See section IV (DATA BASE)

HOLD POS

The HOLD POS line select key accesses the HOLD POSITION page. This page displays a snap shot of the FMS position for comparison with sensor positions.

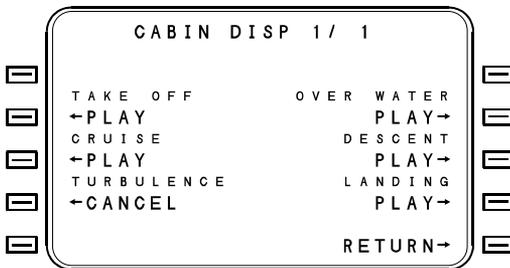
CABIN DISP

The CABIN DISP line select key accesses the CABIN DISP page. When a Universal Avionics Systems Corporation's CD-2000 Cabin Display is installed, the FMS can be configured to control the passenger briefing messages, thus eliminating the need to install the CD-2000 Cockpit Control Unit (CCU).

NOTE: When a CD-2000 is not configured in the FMS, the CABIN DISP line select key will not appear.

To activate a passenger briefing message, press the appropriate key next to the desired message. The key will change from PLAY to CANCEL for the duration of the message, then automatically revert to PLAY when the message ends. The message may be canceled by pressing CANCEL at any time.

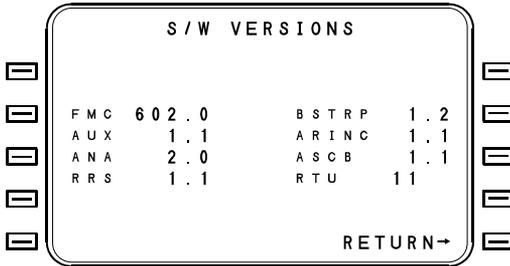
NOTE: The different types of messages and their titles are defined during the installation configuration of the FMS, therefore the actual page appearance in your aircraft may vary from that shown below. From one to six messages can be enabled, and their titles may be different from that shown. The following page is a typical example.



In this example, TURBULENCE message is now playing, and CANCEL will remain displayed for the duration of the message, as defined during configuration of the FMS.

S/W VERS

S/W VERS line select key accesses the S/W VERSIONS page.



S/W VERSIONS - The system software version numbers are displayed as follows (these are for information only):

- **FMC** - The system software version number. The basic software version number (e.g. 602.0) will be followed by a decimal point and another number. 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 Operator's Manual, as operational features will be unaffected.
- **AUX** - The software version number of the AUX processor in the FMS.
- **ANA** - The analog-to-digital input board software version number.
- **RRS** - The software version number of the optional Radio Reference Sensor.
- **BSTRP** - Bootstrap software version.
- **ARINC** - The software version number of the ARINC board.
- **ASCB** - The software version of the ASCB Board.
- **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.

This page displays all software versions applicable to the installation.

DATA Page 2 - Sensor Select Page

The second Data page provides a synopsis of input sensor operation. The second line (following the page title) shows the most significant sensor and the quality factor (Q=) associated with the FMS best computed position. The sensors which may be listed are as follows:

Navigation Mode	Condition
GPS/DME	Valid GPS navigation data received, GPS sensor selected, more than 1 DME station received and DMEPOS variance less than 0.5 nm.
GPS	Valid GPS navigation data received and GPS sensor selected.
DME-DME	More than 1 DME station received and DMEPOS variance less than 2.2 nm.
DME-TACAN	1 DME and TACAN received and DMEPOS variance less than 2.2 nm.
LCS/TACAN	LCS valid and selected, TACAN data received and valid. DME-TACAN conditions are not met.
LCS-DME	LCS valid and selected, 1 DME station received and DMEPOS variance less than 2.2 nm.
TACAN	TACAN data received and valid. Conditions above not met.
DME-VOR	1 DME and VOR received and DMEPOS variance less than 2.2 nm.
DME	Only 1 DME station received and DMEPOS variance less than 2.2 nm.
LCS/OSS	LCS and OSS inputs received and valid. Conditions above not met.
LCS/IRS	LCS and IRS inputs received and valid. Conditions above not met.
OSS/IRS	IRS and OSS inputs received and valid. Conditions above not met.
LCS	LCS received and selected.
OSS	OSS inputs valid. Conditions above not met.
IRS	IRS inputs valid. Conditions above not met.
DOP	All other sensors are invalid or deselected and Doppler is available.
DR	TAS and HDG only valid sensor inputs.
NO SENSOR	No valid sensor inputs present and selected.

Section II
Control & Display

POS	DATA	2 / 4	MSG
IRS 2	NAV	NAV MODE	Q =
← / GPS	NAV	GPS / DME	0 1
← IRS 3	NAV	ADC 1	→
← GPS 1	2	DME	2 →
← GPS 2 (D)		VOR	FAIL →
← GPS 1	2 4	TAC	4 →

The quality factor (Q) is a measure of the system's best estimate of error in tenths of a nautical mile. Each unit of Q corresponds to approximately one-tenth nautical mile error; for example, a Q of 12 would equate to a position accuracy of approximately 1.2 NM or better of the FMS position on a 95% probability basis. A Q of 01 (one) is best, and as the numbers get larger the position is less certain

NOTE: When the aircraft is within 300 NM of DME sources, the POSITION UNCERTAIN message will become active when the Q exceeds 28. Outside of DME range, a Q of 60 is required to activate the POSITION UNCERTAIN message. Once the threshold has been set at 60, it will remain at that value until the Q displayed on the Sensor Summary page is reduced to 10 (at which time 28 will once again become the threshold). When the system position is being corrected by action of the DME, the message displayed will be POSITION CORRECTING.

Next to the line select keys are the status or quality factors of the individual navigation sensors installed. (The *sensor's* quality factor, like the *system's* Q factor, is the *sensor's* best estimate of its error in tenths of a nautical mile.) The status displayed next to each sensor will be one of the following:

D - The associated sensor has been either manually or automatically deselected.

FAIL - The associated sensor has been detected as failed or the system has been turned on and no data was received within 12 seconds.

ALIGN - The associated IRS is in the align mode. The aircraft must remain stationary until alignment is complete.

ATT - The associated IRS is in the attitude mode. No navigational data is available.

NAV - The associated IRS is in the navigation mode (alignment is complete) and navigational data is available.

TEST - Doppler is in self test mode.

UNLOCK - Doppler is in unlock mode.

Each individual sensor's status page may be displayed by pressing the line select key corresponding to the desired sensor. From this sensor status page, the sensor may then be deselected or reselected by pressing the line select key corresponding to the SEL (select) or DESEL (deselect) option.

NORM - All Doppler velocity labels are being received and indicating normal status.

MEM - All Doppler labels are being received, none indicate fail, and one or more indicates memory.

DATA Page 3 - FMS Position

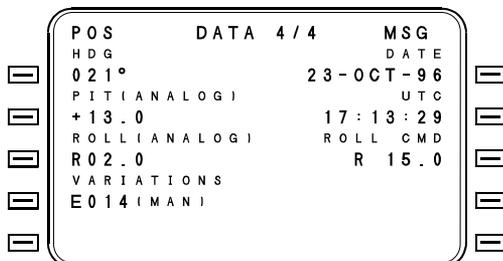
This page shows the FMS system position and all long range sensors with their position differences expressed in radial nautical miles from the FMS position.

DATA 3 / 4					
FMS 1 POS			IRS 2 POS		
N	47	56.40	N	47	55.30
W	110	18.00	W	110	19.20
DIFF S		00	01.40		
W		000	01.20		
←	IRS 1	0.9	OSS 1	11.5	→
	IRS 2	0.4	OSS 2	3.6	→
←	LCS	10.1	FMS 2	0.2	→

When the line select key corresponding to one of the sensors is pressed, that sensor's coordinates and position difference (broken into N-S and E-W components) are displayed just below the FMS position. The selected sensor will be displayed in small characters and the arrow will be removed from the display.

DATA Page 4 - General Data

This is a general purpose data page. If desired, manual entries may be made for date, time, and variation. Provisions are also made for a manual entry of heading data. A manual heading entry would only be made in the event of failure of all heading inputs. Advisory information is provided concerning software version numbers and current aircraft steering commands.



HDG - Displayed within parenthesis is the source of the heading data being used by the navigation computer. Next to this is the present aircraft heading. A "T" indicates that this is a true heading. With the cursor over the HDG entry field, pressing the LIST key will access a display from which optional heading source selections may be made. If the heading is input manually, (MAN) will be displayed (ref: HDG SOURCE Page after this paragraph).

PITCH - Display of analog pitch (degrees) being received from external Vertical Gyro, IRS or AHRS. "+" is up and "-" is down.

ROLL - Display of analog roll (degrees) being received from external Vertical Gyro, IRS or AHRS.

VARIATION - The magnetic variation is automatically computed and displayed between the latitudes of S60 and N73. (MAN), if displayed, indicates the variation has been manually input.

ROLL CMD- Display of roll steering command being sent from the navigation computer to the flight guidance system. An "R" indicates a right roll and an "L" indicates left roll. The digits following the sign are the number of degrees of bank being commanded.

DATE - The date shown is that corresponding to the date in Greenwich, England. Input of the date is numerical by Day-Month-Year; for example, 201092 would be 20th of October 1992.

UTC - Coordinated Universal Time is entered as hours and minutes on a 24 hour format.

NAV Key

The NAV key is used to access the navigation function display pages. There are normally two NAV pages; however, when another NAV mode such as APPROACH or HEADING is selected there will be two or more display pages which are cycled through by pressing the PREV or NEXT function keys.

NAV Function

The NAV function and pages display all the navigation data normally required by the pilots, as well as provide a means of altering the current navigation leg. The navigational data displayed includes the current FR (from), TO (to), and NX (next) waypoints from the flight plan; the distance, course, and bearing to the TO waypoint; the parallel crosstrack left or right of the course; the wind direction and speed, the wind drift angle; and the current groundtrack and groundspeed. Provisions are included in the NAV mode which allow the pilot to define and fly a parallel course, to select and fly a heading, to track a predetermined bearing using a pseudo-VORTAC, or to fly an approach.

Whenever the current navigation leg is valid (TO waypoint displayed on the NAV page) and the position is certain, the HSI flag will be out of view and the desired track and related data will be displayed. Roll steering outputs for flight guidance will be available if the navigation leg and velocity are valid. Velocity will be valid if IRS velocities or heading and TAS are available to the navigation computer.

Normally, leg changes along a flight plan are automatic. Automatic leg changes will not occur if there is no NX waypoint on the NAV page. For example, no automatic leg change will occur when the TO waypoint is followed by a gap (*GAP* or *NO LINK*) or the TO waypoint is the last waypoint on the flight plan. In this situation, the message NEXT LEG INVALID will occur. When the aircraft passes the TO waypoint there will be no leg sequencing, TO/FROM will change to FROM, distance will begin to increase, and the message CURRENT LEG EXTENDED will be displayed. This presentation will alert the pilot that the aircraft is proceeding on an extension of the last valid desired track from the last waypoint.

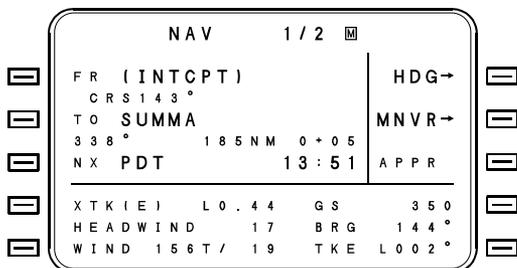
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Fifteen seconds prior to an automatic leg change (or arrival at the TO waypoint) the WPT ALERT message will become active and the WPT alert annunciator will illuminate steady. Pressing the MSG key will display the message. Automatic leg changes occur before the TO waypoint at a distance based upon groundspeed, leg change magnitude, and roll steering bank limit for the present altitude. The maximum distance before the waypoint at which the leg change will occur is 12 NM. If the aircraft passes to the side of a TO waypoint, the leg change will occur abeam the waypoint. If the TO waypoint is designated as a fly-over waypoint (i.e. delayed automatic leg change), the leg change will begin over the waypoint.

When the approach mode is entered, leg changes at the approach waypoints are automatic. In the approach mode, the WPT ALERT message becomes active and the WPT alert annunciator illuminates steady 5 seconds prior to an automatic leg change. When the approach mode has been activated within 50 NM of the end-of-approach point (MAP or runway) and the required navaid is tuned, the FMS will generate the approach mode outputs. These will include bearing and distance to waypoint, desired track, crosstrack, lateral valid, approach annunciator, vertical deviation (glideslope), and vertical valid.

NAV Page 1 (Normal NAV)

The information presented on NAV page 1 correlates with the information displayed on the HSI. The page is accessed from any other mode by pressing the NAV function key. The page provides complete information about the current and next navigation legs, and allows the pilot to alter the current navigation leg or to select another lateral guidance mode.



The NAV page 1 display is divided by a dark horizontal line. Information above the line is formatted in the manner of non-radar position report and includes:

FR - The from field displays the name of the current 'FROM' waypoint and the time of waypoint passage. Under the waypoint name the desired course, distance and ETE to the current 'TO' waypoint appears. Desired course is the course (or desired track) between 'FROM' and 'TO' waypoints. Distance and ETE are from present position to the 'TO' waypoint. ETE is distinguished from clock time by the use of plus (+) sign, clock times use the colon (:) separation.

TO - The name of the current 'TO' waypoint and ETA. Under the TO waypoint is displayed the course, distance and ETE to the next (NX) waypoint.

The name of the NX waypoint and ETA.

On the right side of the page line select keys [1R], [2R] and [3R] are used to access or perform special functions.

HDG - Pressing this line select key will access the FMS HEADING mode (NAV HEADING page).

Section II
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MNVR - Pressing this line select key will access the MNVR (maneuver) definition page. From this page, PVOR, SXTK and Holding Patterns can be defined and activated.

ARM APPR or **ACT APPR** - Pressing this line select key will access the FMS APPROACH mode if there is an approach programmed into the flight plan. If the approach geometry is invalid, this selection will be shown in small green characters with no arrow. When the approach geometry is valid, the selection will change to the normal large orange characters with an arrow ready for selection.

The following supplementary information appears below the line:

XTK (crosstrack), distance left or right of desired course. XTK is appended with (E), (T) or (A) indicating enroute, terminal or approach HSI scaling. A manual selected cross track may be entered in this field

HEADWIND/TAILWIND, displays wind speed.

WIND displays wind direction or speed.

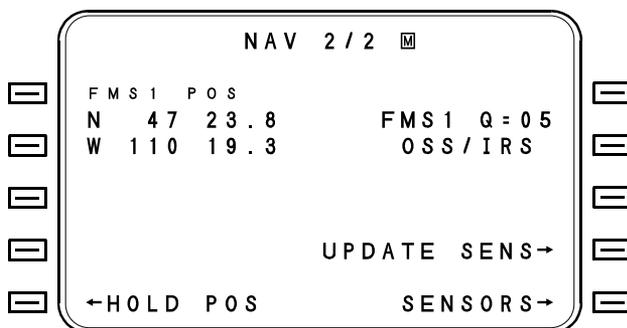
GS displays current groundspeed.

BRG displays bearing from present position to current TO waypoint. For procedural heading legs, desired heading is displayed in this field.

TKE, track angle error is the difference between the aircraft actual track and desired track. For procedural heading legs this displays field heading error which is the difference between desired heading and heading.

NAV Page 2 (NAV Position)

NAV page 2 shows the FMS system position and the quality factor (FMS# Q=) associated with the FMS best computed position. Shown beneath the quality factor is the most significant sensor. Refer to DATA page 2 (Sensor Summary page) for a listing of the sensors which may be displayed and a discussion of the quality factor (Q). NAV page 2 is accessed by pressing the NAV function key, or the PREV or NEXT key, while NAV page 1 is displayed.



FMS# POS - Pressing either line select key will access the DEFINE POSITION page for entry of present position coordinates. <POS> will be displayed in the "WPT" entry field.

HOLD POS - Pressing this line select key will access the HOLD POSITION page.

UPDATE SENS - Pressing this line select key will send current FMS Best Computed Position latitude/longitude to VLF/OMEGA sensors. (Note: Pressing this key will cause no change in this page display).

SENSORS - Pressing this line select key will access DATA page 3 (FMS Position Page).

VNAV KEY

The vertical navigation key provides access to the VNAV function which allows the flight crew to define a desired vertical flight profile along the flight plan route. It then computes the aircraft deviation from that profile for display.

VNAV Function

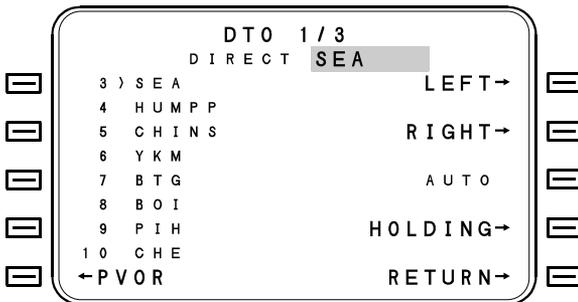
The flight profile is defined by two waypoints with reference altitudes, by the aircraft present position plus one waypoint ahead of the aircraft, or by one waypoint ahead of the aircraft and a target vertical speed. A flight profile which results in a climb will provide VSR (Vertical Speed Required) information only. Vertical waypoint identifiers are prefilled automatically with the current flight plan waypoints (but with no offsets or altitudes).

DTO Key

The DTO (direct to) key accesses the DTO function and is specifically dedicated to changing the flight plan in response to "direct to" clearances. If the "direct to" location is off the flight plan, provisions are made to link the location into the flight plan.

DTO Function

The DTO (direct to) key provides a dedicated function for altering the flight plan in response to "direct to" clearances. When the DTO page is displayed, a leg change from the present position (PP) direct to a flight plan waypoint, a database waypoint, a pilot defined location, or an airport may be made. A DTO command will cancel approach mode and VNAV operation. The turn direction will default to shortest turn; however the pilot can override this by specifying LEFT or RIGHT direction. Pressing AUTO will cancel LEFT or RIGHT and return default to shortest direction.



The cursor is prepositioned when the DTO page is initially displayed. A waypoint may be selected from the flight plan by entering the reference number, entered by using the LIST function, or entered manually by typing in the waypoint identifier. When the ENTER key is pressed, the aircraft will steer directly to that waypoint unless the waypoint is a PVOR.

The right line select keys allow modification of the DTO function.

LEFT, RIGHT, AUTO - These keys allow the specification of a turn direction. AUTO specifies the shortest turn direction.

HOLDING - Pressing this key will access the Holding Pattern Page.

PVOR - Pressing this key will access the PVOR definition page for selection of a radial to be followed into the DTO waypoint.

If a PVOR radial has been entered, the FMS will provide steering for a 45° intercept with the selected pseudo-VOR radial.

RETURN - Pressing this line select key will return the display to NAV page 1.

FUEL Key

The FUEL function provides access to all fuel management functions. Refer to Fuel and Performance in Section V for detailed information.

FPL Key

The FPL (flight plan) function key is used to access the Flight Plan page(s), or to access stored arrivals and routes. The Flight Plan pages may be accessed in order to construct a new flight plan, alter the current flight plan, or to insert a SID, STAR and approach into the flight plan.

Empty FPL Page

The Empty FPL page will be displayed whenever the FPL mode key is pressed and there is no flight plan in the system. This page is used to build flight plans.



XFILL - Pressing this line select key will cause the flight plan to crossfill (copy) from or to the other FMS in a dual installation depending on the crossfill configuration. This option will not be available in a single FMS installation, or if no flight plan is available for crossfill in the originating FMS.

COPY RTE - Pressing the COPY RTE line select key will cause a listing of routes appropriate for the initial waypoint position to be displayed. Entering the reference number of one of the stored routes will copy that route into the flight plan.

Normal FPL Display Pages

The Normal FPL display pages show the flight plan waypoints, ETAs, altitudes (when defined in VNAV), bearings and distances between waypoints. In the case of procedural legs of SIDs, STARS and approaches, path type and terminator are shown. The page also allows editing of the flight plan. This page is accessed by pressing the FPL function key when a flight plan has been defined. Succeeding pages of the flight plan may be displayed by pressing the FPL PREV or NEXT keys, as appropriate.

POS	FPL	2 / 5	MSG
	HDG 165°		
5	(INTCPT)		DEL→
	CRS 143°		
6	SUMMA	19 : 53	INFO→
	093°	138 NM	
7	PDT	20 : 12	TUNE→
	117°	174 NM	
8	BOI	20 : 33	OVFLY→
	113°	248 NM	
9	SLC	21 : 09	

Overfly Waypoints - An asterisk (*) after the waypoint identifier indicates that it has been designated as an overfly waypoint. If a waypoint is designated as overfly, automatic leg changes are delayed until the aircraft is over the waypoint. Overfly waypoints are defined by pressing the OVFLY line select key while the cursor is over the desired waypoint. The overfly designation may be removed in the same manner by pressing CNCL OVFLY. Only geographic points (not procedural legs) may be designated as 'overfly'.

Waypoint Info Mode - When the cursor is placed over a waypoint, up to four options will appear in the right hand column.

OVFLY/CNCL OVFLY - See above description of overfly waypoints.

INFO - Will display all information from the navigation or pilot data base concerning the waypoint or navaid.

TUNE - Only appears when cursor is over a navaid (VOR or NDB). When system is enabled for remote tuning of nav aids, pressing this key will tune radio to the frequency stored in the database.

DEL - Pressing this key twice will delete the selected waypoint from the flight plan.

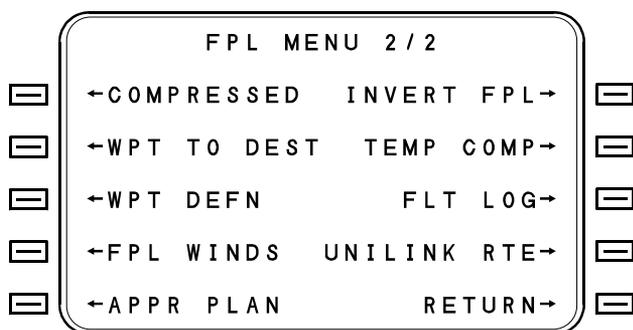
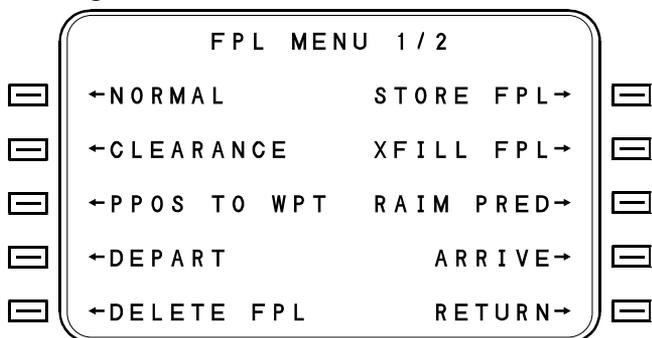
Flight Plan Summary Page

Available only during ground operations prior to departure, the Flight Plan Summary page provides a synopsis of distance, time, and fuel requirements for the planned flight. This page is accessed from the Flight Plan (FPL) mode by using the PREV and NEXT keys. The FPL SUMMARY page is located following the last flight plan page.

FPL SUMMARY			
DEPART		ARRIVE	
KLAX	746 NM	KDEN	
ETD UTC		ETA UTC	
21:30	1+41	23:11	
-8 LCL		-7 LCL	
13:30		16:11	
TAS (MAN)		RESERVES	
451		1600	
FF (MAN)	LBS	MIN FUEL	
1200		3632	

Manual TAS and FF can be entered to show estimated time enroute and estimated fuel required. ETD (Estimated Time of Departure) can be entered so that ETA (Estimated Time of Arrival) can be calculated. If winds are entered for various flight plan waypoints, more accurate ETA's will result. Local UTC offsets can be entered at the departure and arrival locations to display local times. Any of the four times may be entered, and the other three will be calculated based upon estimated time enroute.

FPL Menu Pages



The FPL MENU pages are accessed from any FPL page by pressing the MENU key. The options on these pages allow the pilot to select various display formats for the flight plan waypoints or to view the approach plan. It also allows the insertion of a SID (DEPARTS or STAR and Approach (ARRIVE into the flight plan, deletion of FPL, FPL WINDS, TEMPERATURE COMPENSATION for approach altitudes (if configured) and Inverting the flight plan.

PERF KEY

Press the PERF key to access PERF 1/X. PERF 1/1 provides a synopsis of pertinent inflight performance information. Some aircraft will utilize advanced performance features, with pages for Takeoff, Climb/Cruise and Landing data. Refer to AIRCRAFT PERFORMANCE SUPPLEMENT in the Appendix Section for full description of performance mode.

PERF 1 / 1			
GS	480	TAILWIND	35
ESAD	447	TEMP	ISA+02
DIST	217	GND NM/LB.	375
ETE	00+27	AIR NM/LB.	383
	ETA	13:44	LCL
	NOW	OVHD	SWR
16845	WT LBS	WT	15982
4610	FUEL ONBRD		3747
4+59	ENDURANCE		4+03
2254	RANGE		1828

TUNE KEY

TUNE Operation

Frequency Management is available when the optional Radio Tuning Unit (RTU) is installed, when the aircraft is configured with Collins Pro Line 4, when an AN/ARN-118 TACAN is installed, or when a 709 DME and 711 VOR is installed. Tuning radios or storing preset frequencies does not affect the normal operation of the radio control heads. Manual frequency selections made on the radio control heads, which have priority over the remote tune input can be viewed on the FMS display as the new active frequency. If an RTU, Pro Line 4, AN/ARN-118 TACAN or 709 DME and 711 VOR is not installed, this mode is not functional and the screen will read "MODE NOT OPERATIONAL".

The TUNE page is used to tune the aircraft's radios, select and store preselected frequencies for each radio, and to view the selected frequencies (active and preset) for each radio. The TUNE page is accessed from any mode by pressing the TUNE function key.

MANUAL AFFECTED: Operator's Manuals, Report No. 2423sv602, 2423sv603, 2423sv702 and 2423sv703.

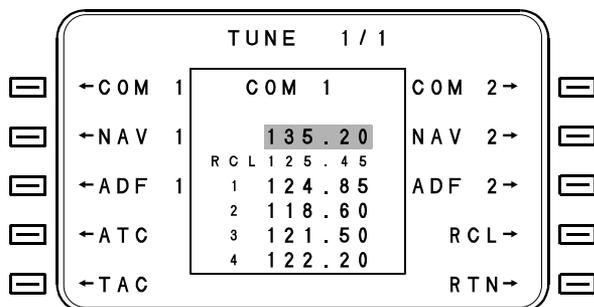
FILING INSTRUCTIONS: Insert this Temporary Change into the Operator's Manual Adjacent to Page 2-26.

INSTRUCTIONS: 1. Revise the first paragraph under TUNE Operation to read as follows;

2. Add the second paragraph below TUNE Operation.

Frequency Management is available when the optional Radio Tuning Unit (RTU) is installed, when the aircraft is configured with Collins ProLine 4, Primus 1000, when an AN/ARN-118 TACAN is installed or when a 709 DME and 711 VOR is installed. Tuning radios or storing preset frequencies does not affect the normal operation of radio control heads. Manual frequency selections made on the radio control heads, which have priority over the remote tune input can be viewed on the FMS display as the new active frequency. If none of the equipment mentioned above is installed, this mode is not functional and the FMS screen will read "MODE NOT OPERATIONAL".

Some control heads such as the Collins RTU-422C are now capable of tuning to 8.33 kHz spacing channels. When 8.33 kHz channels are selected on the control head, the FMS display will show dashes rather than the frequency. This is because the FMS will only recognize 25 kHz channels. RTU tuning is not affected by the display dashes.



When first accessed, the page will initially display the last tuned radio with the cursor over the active frequency.

The selectable radios are displayed next to the line select keys and a control window is located in the center of the display. Any applicable radio may be placed into the control window by pressing the line select key for that radio.

The control window shows the selected radio, the active frequency, and up to four preset frequencies. When the TUNE page is first accessed, the control window will contain the active and preset frequencies of the last radio tuned and the cursor will be on the active frequency field. A new frequency may be entered into the active frequency either directly through the numeric keys or by inputting the reference number (1-4) of one of the preset frequencies. The frequency input is completed by pressing the ENTER key. ACT is displayed next to the actively received frequency from the radio. When a new frequency is being entered, ACT disappears until the ENTER key is pressed and the radio responds.

The TUNE Page has a Recall (RCL) line, which will always contain the last frequency used whenever a new frequency is entered into the Active window. The RCL Key swaps the RCL frequency with the current ACTIVE frequency. Each of the four preset frequencies remain intact until modified by entering a different frequency.

The TAC (TACAN) line select key will only appear when a TACAN or Pro Line 4 FIAS is configured.

A second TUNE page is available when a third COM is configured.

Section II Control & Display

Cursor movement in the control window is controlled using the ENTER key. If the ENTER key is pressed and nothing new has been entered into the active frequency, the cursor will advance to preset position 1. Each time the ENTER key is pressed, the cursor will move down one preset position. After preset position 4, the cursor will return to the home position (active frequency).

The preset frequencies are changed or entered by placing the cursor over the desired preset position, inputting the new frequency, and then pressing the ENTER key. The new frequency may be input directly through the numeric keys or by inputting the reference number (1-4) of one of the preset frequencies. When typing in the frequency, the decimal point will be automatically placed in the proper position. For example, if a frequency of 135.65 is desired, input the numbers 13565. If 118.00 is desired, the number can be input as 118, 1180, or 11800. In any case, when the ENTER key is pressed, the display will read 118.00.

When tuning VOR and ADF frequencies the operator has the option of either entering the actual frequency or the identifier using the LIST function or direct input of identifier.

The ATC line select key is used to gain access to control of the transponder codes. Preselects 3 and 4 are prefilled with codes 1200 and 7700.

LIST Key

The LIST key is used to provide a list of options appropriate to the data to be entered. While performing data entry, pressing the LIST key presents a list of selections appropriate to the entry being made.

MENU Key

The MENU key is used to present a list of alternate formats or options for the FUEL, FPL or TUNE mode being displayed. A small “M” in a box will appear on the title line of any page in which the MENU key is active. Refer to the applicable Section for further details.

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QUICK REFERENCES

This section is intended for filing quick reference material such as the Operator's Checklist.

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INTRODUCTION

This Data Base Section contains information on the Navigation Data Base, Pilot Defined Data Base, Company Routes Data Base, Offline Flight Planning Data Base, Checklist Data Base and performance Data Base. The data bases are all contained on a 3 1/2" floppy disk and are loaded into the FMS via a Data Transfer Unit (DTU).

Performance Data Base

Certain aircraft configured for Advanced Performance options, have available, a performance data base. The performance data base is loaded into the FMS via the DTU. With the performance data base loaded, the FMS will compute and display takeoff and landing speeds, as well as takeoff, climb and cruise engine settings. See Supplement Section in the Appendix of this manual.

Checklist Data Base

A checklist data base is available on certain aircraft with Collins Pro Line 4 equipment. The four part checklist (Normal, Abnormal, Emergency and Crew Notes) is created using a PC and then loaded into Universal's FMS via the DTU.

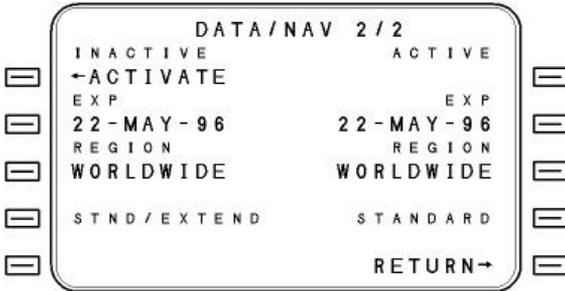
Dual Cycle Data Base

The UNS-1C, UNS-1Csp, UNS-1D and UNS-1K FMS systems have two memory banks for nav data. This allows a future (not yet effective) data base to be loaded and stored until its effective date. The memory bank being used is referred to as the active bank and the memory bank not being used is referred to as the inactive bank. Selection of which bank is active can be accomplished in two ways, either manually or automatically at power up.

Section IV
Data Base

Automatic selection during power up is made possible by the FMS checking the data base expiration dates against the current date. If a data base has expired, it will become inactive and the next cycle data base will become the active data base.

Manual selection of the data base to be active is accomplished from the DATA/NAV 2/2 page. This page is accessed from DATA 1/4 page by selecting NAV DATA [1L] to get DATA/NAV 1/2 and then pressing NEXT. DATA/NAV 2/2 shows the ACTIVE and INACTIVE memory banks. An ACTIVATE prompt will appear on the INACTIVE side of the screen. The inactive bank is made active by pressing the ACTIVATE line select key twice. The FMS will then go through a self test and return to the initialization page.



NAVIGATION DATA BASE

NOTICE

All data contained in both the worldwide and regionalized NAV Data Bases is compiled and supplied by Jeppesen Sanderson, Inc. or an equivalent manufacturer. This includes the original data contained in each new system and the update data periodically supplied in floppy disk format. While every effort is made to ensure that the stored data is accurate, it is the user's responsibility and prerogative to reference Jeppesen's or other publications in order to verify the accuracy of the data that is to be used.

Navigation data is separated into STANDARD data and EXTENDED data. Standard data consists of airports, intersection, VOR and NDB nav aids, plain language descriptions of airports, and High and Low altitude airways. Extended data consists of SIDs, STARs, approaches (including NDB and GPS overlay) and Runway coordinates. The Extended data is available with either precision or non-precision approaches.

The FMS provides the plain language or geographical name for all Navigation data base nav aids and airports that it stores and uses. These plain language names will be provided to the pilot as a special LIST feature for APT's, VOR's and NDB's. The names will be displayed up to twelve characters in length. This helps eliminate difficulty in correlating airports and nav aid names with their identifiers. Many airports and nav aids have no correlation with the named geographical location. North Platte (LBF) and Brunswick (SSI) are typical examples).

The data base is available as a worldwide data base with a choice of either runways ≥ 2000 feet or runways ≥ 4000 feet. The data base is also available as a North American Helicopter region.

The 4000 foot runway data base covers the entire world.

Section IV
Data Base

The 2000 foot runway data base is separated into a choice of two areas: 1) World without Eastern Europe (EEU), Middle East (MES), Africa (AFR) and South Pacific (SPA). 2) World without Latin America (LAM) and South America (SAM).

The North American Helicopter Region includes airports of all runway lengths (hard and soft surfaces) for a geographic area bounded by N50° W95°, N23° W65°. Also included in the North American Helicopter region are the areas for Canada (CAN), United States (USA) and Latin America (LAM).

Refer to the Regional Map in this section.

All data bases (world wide or regionalized) provide or have provisions for the following:

VORs - The station identifier, class, frequency, and geographic coordinates of all VOR stations worldwide or regional, as applicable.

DMEs - The station identifier, geographic coordinates, frequency, and elevation of every DME, TACAN, VORTAC, and ILS-DME world wide or regional, as applicable.

NDBs - The station identifier and geographic coordinates for all NDB stations worldwide or regional, as applicable.

Airports - The airport identifier and geographic coordinates for all airports having at least a 2000-foot or 4000-foot hard surface runway and an instrument approach procedure.

Approaches and Runways - Approaches, approach transitions, missed approach procedures and runways. The approaches are provided along with any approach transition that may be applicable to that particular runway. If an approach transition exists, it is coded with the path terminator type of procedural legs that are found in SIDs and STARs. The FMS contains the approaches, approach transitions, and runways that are provided by the navigation data base supplier for a given region. The approaches specify the applicable runway, the inbound approach course, the approach type, the Final Approach Fix (FAF), the Final Approach Course Fix (FACF), the FAF altitude, and the FACF altitude, and the required navaid. The runway landing thresholds are defined with lat/long coordinates to 0.001 minute, and touchdown elevation to the nearest foot.

The following approach types are included in the data base: ILS, LOC, BC, RNV, VOR, VOR/DME, TACAN, NDB and GPS. The letter "G" following approach listing in the data base indicates the GPS will remain selected during the approach.

High and Low Altitude Airways - High and Low Altitude Airways are available to the pilot for selection during flight planning. When an Airway starting point and an ending point are entered all nav aids and intersections between these two points will be loaded into the flight plan. The procedure is repeated to completely define the airway routing.

Intersections - The geographic coordinates of all enroute and terminal area intersections, waypoints, and turning points, worldwide or regional as applicable.

Procedural Holding Patterns - Holding patterns associated with stored procedures; SIDs, STARs, and approaches are included. Procedural holding patterns are coded with their appropriate leg terminator; either altitude, fix, or manual.

SIDs and STARs - Standard Instrument Departures (SIDs) and Standard Terminal Arrival Routes (STARs) consist of procedural legs, which begin and end at prescribed locations or conditions. The path of these legs can be flown along a heading, a course, a great circle path, or even a constant DME 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. There are a total of twenty types of procedural legs, which may be utilized in the definition of a SID or STAR.

The FMS presents SIDs and STARs in an easy-to-use menu format. The pilot need only select the reference number associated with the departure/arrival procedure he wants. The entire procedure will then be inserted into the flight plan. The legs that comprise the procedure will each be detailed on the flight plan page with all the information needed to describe its path and terminator. Before selecting any departure or arrival, the pilot may view the detailed procedure through the DATA mode on the FMS.

MANUALS AFFECTED: Universal Avionics Systems Corporations' Operator's Manual, Report No. 2423sv602, dated January 5, 1998.

FILING INSTRUCTIONS: Insert this Temporary Change into 2423sv602, Section 4 adjacent to page 4-5.

INSTRUCTIONS: Add the following text below the two existing SIDs and STARs paragraphs.

SID or STAR Containing a Radar Vector

When flying a SID or STAR procedure and the SID or STAR contains a RADAR vector, the charted procedure and the information contained in the navigation database may disagree.

SIDs typically depict vectors at a waypoint via a phrase such as "Via RADAR vectors to assigned route," while STARs typically use a phrase like "EXPECT RADAR vectors to final approach." When using SIDs, such waypoints typically occur at the end of the common portion prior to specific transition legs. When using STARs, this will usually occur at the last waypoint. **The electronic database instructions may specify guidance actions to the FMS which will result in not maintaining an existing heading.** The charted procedure takes precedence and the pilot must remain in compliance with the charted procedure unless other wise directed by ATC.

The actual translation of charted procedures into the electronic navigation database is accomplished in accordance with the rules set forth in ARINC Specification 424, Navigation System Data Base. These rules are adhered to strictly by the industry in attempting to translate procedures into an electronic navigation database. All situations may not be covered, or the correct application of the rules may produce confusing results.

Procedures for a SID or STAR Containing a Radar Vector

1. Compare the chart to the navigation database. If charted SID or STAR procedures specify a heading to be flown while expecting RADAR vectors, review the flight plan data in the FMS to assure the correct heading is coded and followed by a (VECTOR) leg. If this is not the case, be prepared to use other than FMS guidance after the waypoint where the vector leg is to start.

TEMPORARY CHANGE

2. If the charted procedure does not specify a heading, assume that ATC wants you to maintain the existing heading until receiving a specific vector heading. If the navigation database contains headings not shown on the chart, discontinue FMS guidance unless such headings are specifically authorized by ATC.
3. If the navigation database does not contain a vector heading or course to be maintained from the waypoint where the charted vector begins, but merely shows the next waypoint that is part of an enroute transition (SID) or approach transition or approach segment (STAR) after the vector, discontinue FMS guidance over the vector waypoint and maintain heading until instructions are received from ATC. Do not allow the FMS to sequence and commence a turn to the next leg since this would clearly not comply with the intent to maintain heading and await vectors. In all cases where ATC expects the pilot to maintain heading and await further heading information, ATC expects the pilot to overfly the waypoint. In many cases, linking a STAR and approach creates a NO LINK between the last STAR waypoint and the first approach waypoint. Leaving the NO LINK in the flight plan assures that the vector waypoint is overflown, and the last heading maintained, until further pilot action is taken.

MANUAL AFFECTED: Operator's Manuals, Report No. 2423sv602 dated 1/15/98, 2423sv603 dated 1/30/98, 2423sv702 dated 2/26/98, and 2423sv703 dated 2/16/98.

FILING INSTRUCTIONS: Insert this Temporary Change into, Section IV, adjacent to page 4-6.

INSTRUCTIONS: Add the following paragraphs.

Waypoint Naming Conventions

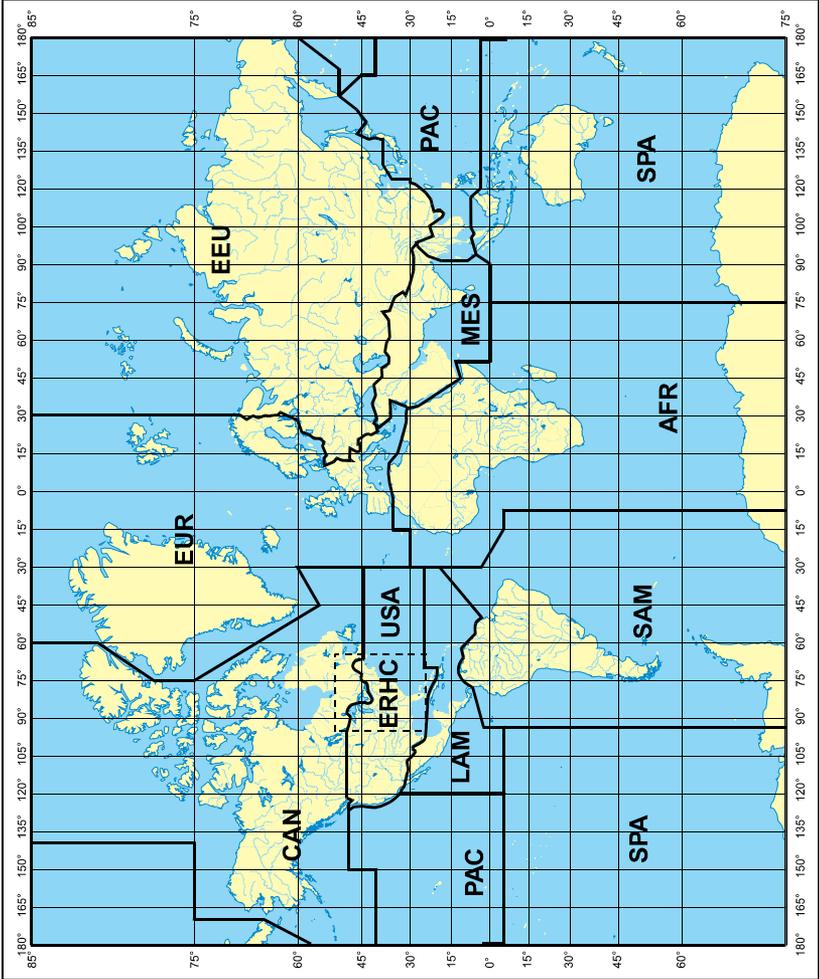
ARINC 424 provides waypoint naming conventions which are used by Jeppesen in the data base. Listed below are the most common ones which may be encountered when accessing the Jeppesen data base.

D235H	DME waypoint on the 235° radial at 8 nm (H is 8th letter)
XYZZ9	'x' point on enroute chart, 29 nm from the XYZ VOR.
12ABC	'x' point on enroute chart, 112 nm from ABC VOR.
FF26	Final Approach Fix for Runway 26
OM26	Outer Marker for Runway 26
MM26	Middle Marker for Runway 26
CF26	Final Approach Course Fix for Runway 26 (usually located on final approach course about 2 nm outside of FAF).
RW26	Threshold coordinates for Runway 26.
MA26	Missed Approach Point for Runway 26.
R-345	DME Arc Terminator on 345° radial.

Latitude/Longitude Named Waypoints (Oceanic)

5275N	N52 W75
75N70	N75 W170
5020E	N50 E20
50E20	N50 E120
5275W	S52 W75
52W20	S52 W120
6030S	S60 E30
60S30	S60 E130

Regional Map



NAVIGATION DATA BASE LOADING

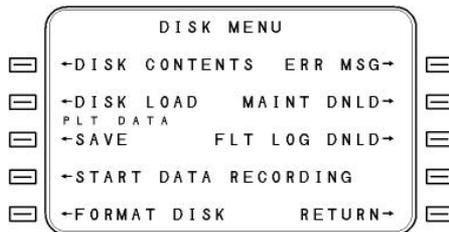
The NAV Data Base is updated through the Data Transfer Unit (DTU). The DTU utilizes 3 1/2" floppy disks as the input media for loading the data base. The entire Nav Data Base is reloaded at each update. Each disk is dated and should be verified to be current. World regions may be changed at will from update to update. Gaps may occur in the stored routes to replace revised waypoints when a new data base is loaded.

A flashing waypoint signifies that, subsequent to the time the route was created, the waypoint has been altered during an update process that retains the same identifier. A waypoint identifier which has been deleted from the data base or has moved more than 25 nm will be replaced by a flashing GAP (*GAP*).

NOTE: Before starting an update, ensure that the DTU slot is clear of any previous disks and the protector is removed.

Loading Data Base Disks

1. Press the ON key on the DTU. A 12 second self test will occur.
2. Press the DATA key to access DATA 1/4.
3. From the DATA MENU page, press the DISK line select key for the DISK MENU page.



4. Press the DISK LOAD line select key. The first DISK LOAD instruction page will be displayed. This page contains instructions for completing the update.

Section IV
Data Base

NOTE: On dual FMS installations, when FMSs are synchronized to this page, data base will be loaded into both systems.

```

      DISK LOAD
=====
1.  SELECT THIS PAGE ON
    ANY FMS TO BE LOADED .
=====
2.  INSERT DISK .
=====
3.  PUSH CONTINUE ON ANY
    CDU .
=====
←CONTINUE          RETURN→
=====

```

Load the disks in order, beginning with the Standard disk.

Insert the first disk and press CONTINUE line select key to continue the update process. The CHECKING DISK TYPE page will display.

NOTE: Do not disturb the DTU or the FMS while the update is in progress.

```

      DISK LOAD
      DISK 1 OF 2
=====
NAV DATABASE          EXPIRES
WORLDWIDE            22-MAY-96
=====
NAVAIDS  ----  ----  NAVNMS
AIRPRTS  ----  ----  NDBNMS
NDBS     ----  ----  AIRWYS
ENRTES   ----  ----  APRNMS
TRMNLS   ----  ----  ILS
←LOAD          CANCEL→
=====

```

Press LOAD line select key. The ERASING MEMORY screen will appear before loading begins.

NOTE: Should an error, which would prevent successful completion of the load occur, a message will appear on the DISK LOAD page.

CAUTION: **PRESSING THE “CANCEL” LINE SELECT KEY AT ANY TIME WILL ABORT THE DATA BASE LOAD. THIS ACTION WILL DUMP THE NAV DATA BASE.**

When a field has completed loading, it will show RCVD. If a multiple disk data base is being loaded, a prompt will appear at line select key [5L] for loading the next disk.

```

      DISK LOAD
      DISK 1 OF 2
NAV DATABASE      EXPIRES
WORLDWIDE        22-MAY-96

NAVAIDS  PASS  PASS  NAVNMS
AIRPRTS  PASS  PASS  NDBNMS
NDBS     PASS  PASS  AIRWYS
ENRTEs   PASS  PASS  APRNMS
TRMNLs   PASS  PASS  ILS
←LOAD 2/2                CANCEL→
  
```

Remove the first disk and insert the next disk and press LOAD line select key. CHECKING DISK TYPE will display while it is determined if the inserted disk is, in fact, the correct one. The DISK LOAD page will then reappear.

Press LOAD line select key. When all standard disks have been loaded, a TESTING prompt will appear at line select key [5R] for a short period of time. After each standard data base is tested for integrity, a PASS, FAIL or NONE will appear next to each data base. FAIL indicates an unloaded or partially loaded data base. NONE indicates that the data base does not exist. When all testing is complete, the DISK LOAD screen will reappear.

```

      DISK LOAD
      DISK 2 OF 2
NAV DATABASE      EXPIRES
WORLDWIDE        22-MAY-96

NAVAIDS  PASS  PASS  NAVNMS
AIRPRTS  PASS  PASS  NDBNMS
NDBS     FAIL  PASS  AIRWYS
ENRTEs   PASS  PASS  APRNMS
TRMNLs   PASS  NONE  ILS
←LOAD NEXT                CHECK ALL→
  
```

If it is desired to load another disk, such as extended data or pilot data, press LOAD NEXT line select key. Repeat the above process until all disks have been loaded.

Section IV
Data Base

After all disks have been loaded (standard, extended, pilot defined and FMS flight plan), a CHECK ALL procedure should be performed.

NOTE: The CHECK ALL function verifies consistency between standard, extended, pilot defined and FMS flight plan data bases. Information that is inconsistent within the pilot defined or FMS flight plan data bases will be either modified or purged.

Press the CHECK ALL line select key to initiate the check all function. (CHECKING) will appear and flash at line select key [5R].

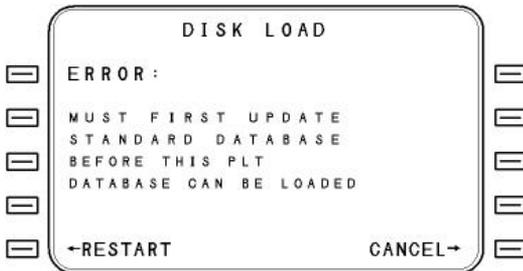
NOTE: The CHECK ALL prompt will only be available if, upon completion of nav data base load, that data base automatically becomes the active data base. Loading a nav data base which has a future effective date will NOT generate a CHECK ALL prompt.

Press RETURN line select key. The display will return to the DISK MENU page to load additional data as required.

Remove disk from DTU and turn off DTU.

Errors / Messages

The system provides annunciation of errors, which could occur during the update process and prevent successful completion of the data base load procedure. Errors are displayed as shown below.



COMMUNICATION ERROR: DTU STOPPED RESPONDING - Time out waiting for DTU.

COMMUNICATION ERROR: FMS AND DTU ARE OUT OF SYNC - The FMS received a response that was inappropriate.

COMMUNICATION ERROR: OPERATION ABORTED BY DTU - DTU sent an unexpected command request.

MANUALS AFFECTED: Operator's Manuals, Report Nos. 2421sv600, 2421sv700, 2423sv600, 2423sv601, 2423sv602, 2423sv700, 2423sv701 and 2423sv702.

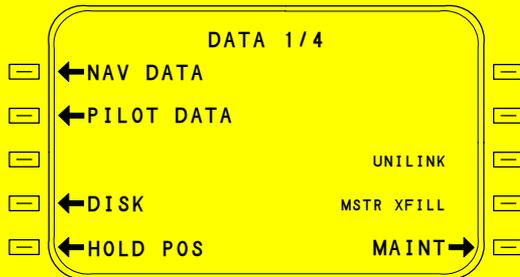
FILING INSTRUCTIONS: Insert this Temporary Change as follows:

- 2421sv600 and 2421sv700, adjacent to page 3-7
- 2423sv600 and 2423sv700, adjacent to page 3-8
- 2423sv601 and 2423sv701, adjacent to page 3-7
- 2423sv602 and 2423sv702, adjacent to page 4-7

INSTRUCTIONS: Replace the **Loading** section (2421sv600, 2421sv700, 2423sv600 and 2423sv700) or the **Loading Data Base Disks** section (2423sv601, 2423sv602, 2423sv701 and 2423sv702) with the following text.

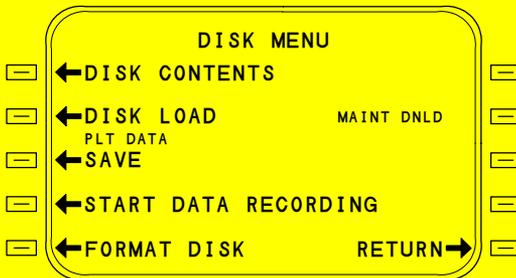
Loading Data Base Disks

1. Press the DATA key for DATA page 1/4.



TEMPORARY CHANGE

2. Press the DISK line select key for the DISK MENU page.

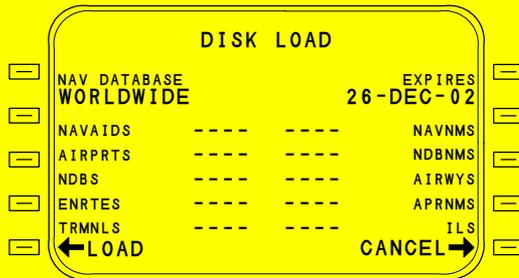


3. Press the ON key on the DTU if it is not already powered up. A 12 second self test will occur.
4. When the self test is complete, insert Standard Disk 1 of 1 into the DTU.
5. Press the DISK LOAD line select key for the DISK LOAD page.

Note: On multiple FMS installations, when FMSs are synchronized to this page, the data base will be loaded into all FMSs.



- Press the CONTINUE line select key (for multiple FMS installations, press the CONTINUE line select key on only one FMS; the others will also respond). The screen below will appear.

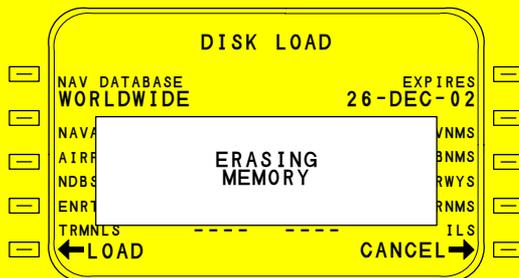


- Press the LOAD line select key. The screen below will appear as the FMS clears memory for the loading process.

Note: Do not disturb the DTU or the FMS while the update is in progress.

Note: Should an error that would prevent successful completion of the load occur, a message will appear on the DISK LOAD page.

CAUTION: PRESSING THE CANCEL LINE SELECT KEY AT ANY TIME WILL ABORT THE DATA BASE LOAD. THIS ACTION WILL ERASE THE NAV DATA BASE.



TEMPORARY CHANGE

After the FMS has cleared memory, it will start loading the new data base. As each field completes loading, RCVD will appear next to it. When all data from the Standard Disk is received, the FMS will test the data for corruption. When testing is complete, the following screen will appear.

DISK LOAD			
NAV DATABASE		EXPIRES	
WORLDWIDE		26-DEC-02	
NAVAIDS	PASS	PASS	NAVNMS
AIRPRTS	PASS	PASS	NDBNMS
NDBS	PASS	PASS	AIRWYS
ENRTES	PASS	PASS	APRNMS
TRMNL	PASS	PASS	ILS
←LOAD	NEXT	CANCEL	→

8. Press the LOAD NEXT line select key.
9. Insert the first Extended disk. The FMS will interrogate the disk and display a screen similar to the one shown below.

DISK LOAD			
DISK 1 OF X		EXPIRES	
PROC DATABASE		26-DEC-02	
WORLDWIDE			
SIDS	----		
STARS	----		
APPROACHES	----		
RUNWAYS	----		
←LOAD		CANCEL	→

Press the LOAD line select key.

Note: The digit shown above as X will be the number of disks in the Extended disk set. This number will vary from set to set.

After the data from a disk in the set is loaded, the FMS will prompt for the loading of the next disk at line select key 5L.

When the data from all the disks in the Extended set is loaded and tested, a screen similar to the following will appear.

DISK LOAD		DISK X OF X	
[]	PROC DATABASE		EXPIRES
[]	WORLDWIDE	26-DEC-02	[]
[]	SIDS	PASS	[]
[]	STARS	PASS	[]
[]	APPROACHES	PASS	[]
[]	RUNWAYS	PASS	[]
[]	←LOAD NEXT	CHECK ALL→	[]

If applicable, press the LOAD NEXT line select key to load the Company Routes data base. Otherwise, proceed as follows.

Note: If disks are loaded prior to their effective date or after their expiration date, the CHECK ALL line select key option described below will not appear. Instead, the line select key will read RETURN.

10. Press the CHECK ALL line select key if this option is displayed. This action will cause the loaded data base to become the active data base.

If the CHECK ALL option is not displayed, press the RETURN line select key to return to the DISK MENU page.

COMMUNICATION ERROR: UNRECOVERABLE ERRORS IN TRANSFERRED DATA - Checksum errors and retry count exceeded, or DTU/FMS protocol data block header is incorrect.

COULD NOT LOAD ALL DATABASES - - TOO LARGE FOR AVAILABLE MEMORY - An attempt is made to load a data base that is too large for the available memory.

DATABASE(S) NOT FOUND ON DISK - The disk, when accessed, contains a header file, but no data base files.

DISK FORMAT ERROR - An attempt is made to format a disk and a format error occurs.

DISK IS FULL - An attempt is made to write Flight Data to the disk, and there is no memory available on the disk.

DISK IS WRITE PROTECTED - The DTU detects that the disk is write protected.

DISK MUST BE EMPTY - - USE ANOTHER DISK, OR PUSH FORMAT DISK ON DISK MENU TO DELETE ALL FILES ON THIS DISK - An attempt is made to do a Plt Database Save, and the disk already contains at least one DOS file.

DISK READ OR WRITE ERROR - The DTU returned a disk read or write error after an attempt is made to read or write to disk.

DTU ALREADY IN USE, OR COMMUNICATION ERRORS - An attempt is made to initiate a disk operation when the DTU is already performing an action initiated by another FMS.

DTU NOT DETECTED - There is no activity on the FMS/DTU bus.

EMPTY DISK OR NON-FMS DISK - An attempt is made to do a disk contents or disk load, and the disk does not contain a header file.

INVALID DATA ON DISK - The disk contains a header file, but an invalid field exists.

INVALID DISK VERSION - The disk version field on the disk header is not compatible with the FMS software version.

LOAD CANCELED BY ANOTHER FMS - The loading operation has been canceled on another FMS.

LOAD CANCELED - The loading operation has been canceled on the FMS being viewed.

MISSING OR UNFORMATTED DISK - No disk is detected by the DTU when accessed, or the disk is not DOS formatted to 720K or 1.44M.

MUST FIRST UPDATE STANDARD DATABASE BEFORE THIS EXTEND OR COMPANY ROUTE DATABASE CAN BE LOADED - An attempt is made to load a NAV extended or company route data base before the NAV standard data base of the same cycle is loaded.

MUST FIRST UPDATE STANDARD DATABASE BEFORE THIS PLT DATABASE CAN BE LOADED - An attempt is made to load a pilot data base that is more recent than the one currently stored.

POWER FAIL - A power failure has interrupted the operation.

DDARINC FAIL - A failure exists on the double density ARINC board.

DISK WAS CHANGED PRIOR TO CONFIRMING THE LOAD - During a disk load; the disk in the DTU was changed after CHECKING DISK TYPE but before the LOAD prompt was pressed.

ADVANCED PERFORMANCE MODE MUST BE ENABLED BEFORE THIS DATABASE CAN BE LOADED - The advanced performance mode has not been configured and must be before a performance data base can be loaded.

MUST LOAD ALL DISKS OF A MULTIPLE DISK DATABASE BEFORE A DIFFERENT TYPE DATABASE CAN BE LOADED - An attempt has been made to load a data base disk before completion of loading a multiple disk data base.

THIS DISK OF A MULTIPLE DISK DATABASE IS NOT LOADED IN SEQUENTIAL ORDER - An attempt has been made to load a disk of a multiple disk data base out of order.

MUST PERFORM A CHECK ALL BEFORE DISK LOAD PROCESS CAN BE CANCELED - The CANCEL prompt has been selected prior to selecting CHECK ALL.

INACTIVE MEMORY BANK FAILURE - - CANNOT LOAD DISK INTO INACTIVE MEMORY BANK - In a dual cycle data base, the inactive data base has failed and disks cannot be loaded into that memory bank.

Nav Data Base Interrogation

Waypoints

Any identifier in the NAV Data Base is opened for interrogation by typing the identifier of the waypoint to be interrogated on the Data Base Menu page (DATA/NAV). The following information is available for each identifier in the data base:

NOTE: The data in the NAV Data Base is not available for manual update and cannot be changed by the pilot.

- The type of identifier is displayed as APT for airports, ENR for enroute (high-altitude or low-altitude) intersections or turning points, NAV for nav aids, NDB for non-directional beacons, or TER for terminal area waypoints.
- The latitude and longitude coordinates will be displayed for all identifiers (APT, ENR, NAV, NDB, and TER).
- The type of nav aid, if the identifier is a nav aid, will be displayed as VOR, DME, NDB, VOR/DME, TACAN, VORTAC, or ILS/DME as applicable.

Section IV Data Base

- The class of navaid, if applicable, will be displayed as LOW, TERM (terminal), HIGH, or UNDF (undefined).
- The frequency of the navaid will be displayed if the navaid is a VOR, DME, VOR/DME, TACAN, VORTAC, ILS/DME, or NDB.
- The station elevation will be displayed if the navaid is a DME, VOR/DME, TACAN, VORTAC, or ILS/DME.
- The declination (orientation relative to true North) of the navaid will be displayed if the navaid is a VOR, VOR/DME, TACAN, or VORTAC.
- If there are two or more locations with the same identifier, a fraction (such as 01/02) will be displayed below the type of identifier. The fraction 01/02 indicates that the data displayed is for the first of two locations with the same name. The value 01/01, if displayed, indicates the location/identifier is unique.

NOTE: The NAV Data Base contains mileage breaks or turning points (unnamed intersections) which are identified on enroute charts only by an "X." To interrogate a mileage break up to and including 99 DME from the associated navaid, input the navaid identifier and then the DME distance to the point. For example, if the mileage break were 54 DME from PDX, then the proper entry would be PDX54. To interrogate a mileage break 100 DME or farther from the associated navaid, input the last two digits followed immediately by the navaid identifier. For example, if the mileage break were 110 DME from FST, then the proper entry would be 10FST.

Terminal Procedures

Selection of the NAV DATA line select key will display the menu page from which the appropriate selection can be made. The data selected under any menu will be for display only, and cannot be modified by the pilot.

SID

This page allows the pilot to enter the airport, runway, SID and transition that he wishes to review.

NAV / SID		1 / 1
SEL TRANS		AIRPORT
1 BKE		KSEA
2 LKV		RUNWAY
		34R
		SID
		SUMMA5
		TRANS
		1
←SID LEGS		RETURN→

SID LEGS - Pressing this key will access the NAV/SID LEGS pages which show all procedural legs that make up the selected SID. The following pages show the legs for the KSEA Rwy 34R, SUMMA5 departure with PDT transition.

NAV / SID		1 / 2
	HDG 341°	
R 1	(829 FT)	↑ 829
	CRS 338° SEA	
R 2	(D - 8.0) SEA	↑ 4000
	→ HDG 070°	
R 3	(R - 139) PAE	
	HDG 165°	
R 4	(INTCPT)	
		RETURN→

NAV / SID		2 / 2
	HDG 165°	
R 4	(INTCPT)	
	CRS 143°	
R 5	SUMMA	

E 6	LKV	
		RETURN→

STAR

This page allows the pilot to enter the airport, runway, STAR and transition that he wishes to review.

NAV/STAR 1/1	
SEL TRANS	AIRPORT
1 GEG	KSEA
2 HAMUR	RUNWAY
3 MLP	34R
4 ODESS	STAR
	ELN3
	TRANS
	1
←STAR LEGS	RETURN→

STAR LEGS - Pressing this key will allow preview of the procedural legs that comprise the selected STAR. The following screen shows the legs for the KSEA Rwy 34R, ELN3 STAR with GEG transition:

NAV/STAR 1/3	
E 1 GEG	
E 2 HAMUR	
E 3 VANTG	
E 4 ELN	
	RETURN→

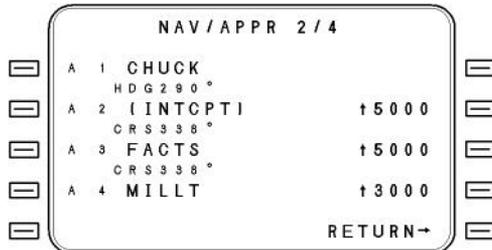
Approach

This page allows the pilot to enter the airport and approach that he wishes to review.

NAV/APPR 1/1	
SEL TRANS	AIRPORT
1 PAE	KSEA
2 SEA	
	APPROACH
	VOR 16L
	TRANS

←APPR LEGS	RETURN→

APPR/LEGS - Pressing this key will allow preview of the approach legs for the selected approach, as shown in the following example:

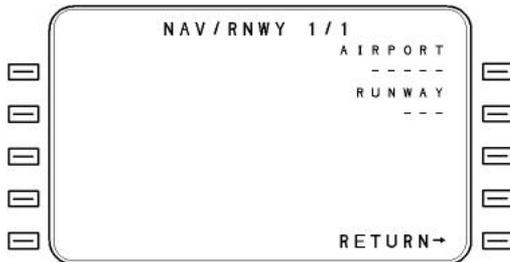


Pressing PREV and NEXT will allow viewing of all pages in sequence.

NOTE: Approach stepdown fixes will not be shown if the altitude for the stepdown fix lies below the straight line flight path angle extending from the FAF altitude to an altitude 50 feet above the MAP.

Runway

This page allows the pilot to enter the airport runway that he wishes to review.



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After selecting the runway of interest, the following page will show all runway data.

NAV/RNWX 1/1			
SEL	RUNWAY	AIRPORT	
1	16L	----	
2	16R	RUNWAY	
3	34L	---	
4	34R		
			RETURN→

Airway

This page allows the pilot to enter a VOR navaid and review which High and Low Altitude Airways are accessible at the navaid.

AIRWAYS 1/3			
REF	WPT		
DFW		1	J105
AIRWAY	IDENT	2	J131
-		3	J21
		4	J25
		5	J33
		6	J4
		7	J42
			RETURN→

Selecting the airway of interest will result in the following display of all nav aids and intersections, which are on the airway.

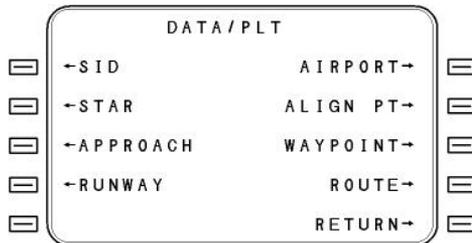
AIRWAYS 1/2			
J4			
1	ILM	9	JAN
2	MULLS	10	STAGE
3	FLO	11	SHY
4	CAE	12	JEFFO
5	IRO	13	DFW
6	ATL13	14	ABI
7	MGM	15	INK
8	MEI	16	CONNE
			RETURN→

PILOT DATA

Pilot Data Menu Page

This menu allows the user to access the pilot defined data base. The data base includes Standard Instrument Departures (SIDs), Standard Terminal Arrival Routes (STARs), Approaches, Runways, Airports, Alignment Points, Waypoints and Routes. For each of these selections, it is possible to create / define new data entries or delete existing ones. To access this page:

1. Press the DATA key to access Data page 1.
2. Press the PILOT DATA line select key.



Use the PILOT DATA SAVE option to create a Pilot Defined data disk. The disk may be formatted using the FMS, or any MS-DOS compatible computer. This disk may include Waypoints, Alignment Points, Airports, Runways, Routes, Approaches, SIDs and STARs. Additionally, it will include the reference data bases that are associated with the SIDs, STARs, Approaches, and Runways. Loading is accomplished in the same manner as the NAV Data base.

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Pilot-defined data provides or has provisions for the following:

Pilot Waypoints - 200 locations are reserved for pilots to input identifiers and geographic coordinates of any point desired. These pilot defined locations can be parking ramp coordinates, VFR airports, or any other location. Once input, each pilot defined location will be retained in the data base until it is manually removed.

Routes - Up to 200 routes (ordered sequence of waypoints or legs) may be defined and stored in the data base. There may be up to 98 waypoints or legs in any one stored route; however, the total number of route leg segments may not exceed 2,500.

Pilot Runways - The geographic coordinates and elevation of pilot defined end-of-approach points may be input and stored in the system's non-volatile memory. The number of runways, which may be defined and stored, is limited to 100.

Pilot Approaches - Memory space is allocated for the pilot to define VFR, VOR, TACAN, ILS, LOC, BC and RNV approach courses and glidepaths to the pilot defined end-of-approach points. GPS and NDB approaches cannot be pilot defined. The number of approaches, which may be defined and stored, is limited to 100.

Pilot Defined Departures and Arrivals - Pilot defined departures and arrivals can be created using procedural legs. These are accessible in the same manner as the prestored SIDs and STARs described above. The FMS will store 100 pilot defined departures and arrivals.

NOTE: An option is available in the FMS configuration to clear all pilot data from the system at start-up. If this option is enabled no pilot data will be available at initialization. A STANDBY mode can be configured to allow the system to be shut down for up to eight hours and retain pilot data. Check with the Aircraft Flight Manual Supplement for the specific configuration of your aircraft.

Data Input

Before constructing a procedure or route the user needs to understand the basic data entry process. Data is manually entered in two steps. First, the data is input onto the displayed page into the cursor entry field. Once correct, the cursor's data is stored in the computer by pressing the ENTER key. **Until the ENTER key is pressed, the value in the cursor has no effect on other parameters in the computer.** Some cursor fields, such as latitude and longitude entry fields, are restricted to numeric input only. Waypoint identifiers may be input onto the cursor by using any of three input processes: the Reference Number Input Process, the List Input Process, and the Direct Entry Process.

Reference Number Input Process

This is the normal input process, and is built into many of the following procedures. At appropriate times, the pilot is presented with a list of selections on the display. These will often be waypoint identifiers; however, the list is also used for the selection of routes, nav aids, etc. as appropriate. A reference number used to make the selection precedes each option.

The selection is made by inputting the reference number into the cursor and then pressing the ENTER key.

- NOTE:**
- If the desired choice is not among those shown on the display page, pressing the PREV or NEXT key to page forward or backward will display additional choices when available.
 - If the reference number input into the cursor is in error, pressing the BACK key will delete the entry.
 - Pilot defined waypoint identifiers are displayed in a light green color.

List Input Process

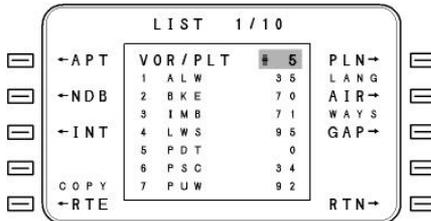
This is the process which is the easiest to use in the event that the Reference Number input process does not present the desired waypoint identifier as one of the available choices.

With the cursor over a waypoint entry field, pressing the LIST key will cause the Normal LIST page to appear. A list of numbered selections appropriate for the entry field will be displayed in a window, and other LIST categories will be displayed next to the line select keys. Any LIST category can be placed in the LIST window by pressing the corresponding line select key.

NOTE: In selecting waypoint identifiers, routes, or NAVAIDs as the LIST categories of possible choices, all efforts are made to use the computer's power in order to present the most optimum lists possible. For example, in selecting a flight plan from amongst the many possible stored routes, the lists presented will begin with those routes originating closest to the departure airport.

LIST Page

The Normal LIST page displays the selected list and presents options for selecting other lists. Pressing the LIST key whenever the cursor is over any field where a data base item is normally entered accesses the page.



The selectable lists are displayed next to the line select keys. A control window is located in the center of the display. Any list may be placed into the control window by pressing the line select key for that list. The selectable lists are APT (airports), NDB, INT (intersections), COPY RTE (routes), Airways and VOR/PLT (a mixture of VORs and pilot defined waypoints). PLN LANG (plain language) is displayed in place of APT, VOR/PLT or NDB if those are displayed (see below).

GAP [3R] - Pressing this line select key when the page has been accessed from a FPL or ROUTE page will insert a gap (*GAP*) into the flight plan or route.

CAUTION: WHEN A GAP HAS BEEN INSERTED, THE FLIGHT PLAN WILL NOT AUTO-SEQUENCE TO THE NEXT LEG. RATHER, THE AIRCRAFT WILL FLY AN EXTENSION OF THE LAST LEG WITH NAV AND VNAV FLAGS OUT OF VIEW ON THE HSI. **IT IS THE RESPONSIBILITY OF THE PILOT TO TAKE APPROPRIATE ACTION TO CONTINUE ACCURATE NAVIGATION OF THE AIRCRAFT.** HE MAY GO "DIRECT TO" A WAYPOINT OR EDIT THE GAP OUT OF THE FLIGHT PLAN.

List Function-Plain Language



By pressing the PLN LANG line select key when APT, VOR/PLT or NDBs are listed, the plain language name of the APT, VOR or NDB will be displayed (up to 15 characters). The reference number can still be used to select the desired item.

Direct Entry Process

Both of the first two input processes call for the selection of one number to input an entire waypoint identifier. They were designed to minimize the requirement for "typing" in each alphanumeric character of an identifier. In those cases where the typing requirement is unavoidable, data entry is accomplished by simply typing in the required data and then pressing the ENTER key.

If the identifier is in the data base, a Waypoint Identification page for that identifier will appear. This page will show the identifier's position coordinates and other pertinent data about the identifier.

- If the coordinates shown are correct, pressing the ENTER key or the ACCEPT line select key will confirm that the correct waypoint is being used.
- If the coordinates shown are incorrect and the identifier was spelled correctly, there is more than one identifier in the data base with that identifier. If this is the case, the fraction adjacent to the identifier's name will read something other than 1/1. Press the PREV or NEXT keys to access the other Waypoint Identification pages. When the desired waypoint is located, pressing the ENTER key or the ACCEPT line select key will confirm this as the correct waypoint for data entry. If the desired data is not located, a pilot waypoint can be defined by selecting the CREATE PLT option.

If the identifier is not in the data base, the DEFINE WPT page will be displayed so that pilot defined waypoint (PILOT WPT) can be entered. A PILOT WPT can be defined by any of three methods:
Latitude/Longitude, where the coordinates of the pilot defined waypoint are entered directly.

Radial/Distance, where a reference waypoint (which can be a waypoint, VOR, NDB or airport) is identified and a radial/distance offset is specified.

Radial/Radial, where two reference waypoints are identified, and the radial for each is specified. This method is useful, for example, in identifying the unnamed intersection of two airways.

PILOT ROUTES

Route Construction

Up to 200 pilot defined routes may be constructed and stored in the data base. The maximum number of legs that can be included in any one route is 98; however, the total number of legs in all the stored routes may not exceed 2500. A SID, STAR and Approach may be included in the route.

With the first ROUTES catalog page is displayed (DATA-PILOT-ROUTES), proceed as follows:

1. Select the CREATE option to display an empty ROUTE page. The cursor will be over the route name field. The route may be given a name with up to eight characters, if desired. If so, then the route title in the directory will be the first waypoint name and the route title.
2. Type in the desired route name and press ENTER.
3. Enter the identifier of the desired waypoint. The LIST function may be used to locate and enter the identifier or the identifier may be typed in. When the identifier is entered, the cursor will advance to the next identifier entry field.

Add Departure SID

With the departure airport defined as the first waypoint, use the following procedure to link a SID to the route:

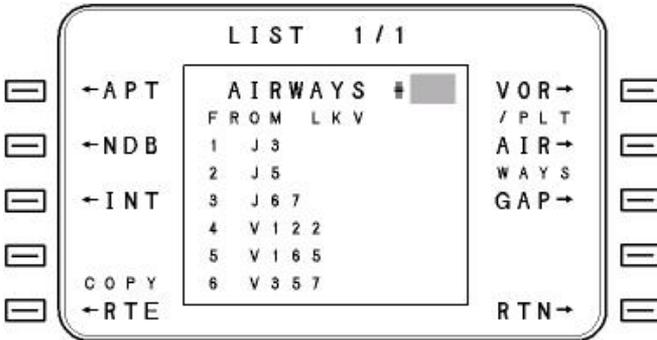
1. Press FPL then MENU keys.
2. Select DEPART line select key. The DEPARTURE 1/1 page will appear with a list of runways for that airport. *Note: If the departure airport has no SIDs or Runways in the data base, then (NONE) will be displayed.*
3. Select the reference number of the departure runway.
4. Select the reference number of the desired SID.
5. Select the reference number of the desired enroute transition.
6. Press ROUTE line select key to return to route pages.
7. Place cursor over first blank waypoint field after SID.

Add Waypoints Using LIST-AIRWAYS Feature

With the route page displayed (usually the last page as the route is being built), position the cursor over the first blank field **following** an intersection or navaid that's in the Navigation data base.

NOTE: If the cursor had been placed after an airport or an off-airway intersection or navaid, the AIRWAYS selection on the LIST page will be displayed in small green font indicating that the selection is not available.

1. Press the LIST function key and press the AIRWAYS line select key [2R]. A list of airways through the previous navaid/intersection will be displayed.



2. Enter the reference number of the desired airway. The airway termination page will then be displayed showing intersections and navaids that make up the selected airway. The closest twelve points will be displayed on the first page, the next closest twelve on page two, etc. Select the reference number of the termination fix, or type in the ident.
3. All waypoints between the initial and termination points will be automatically entered into the route.
4. The cursor will automatically be positioned over the next blank field. Repeat steps 1 and 2 to complete the route using additional airways.

Adding STAR and Approach

Make sure that the last waypoint of the route is the destination airport. Proceed as follows to add a STAR and Approach, if desired.

1. Press FPL then MENU key to display FPL MENU 1/2 page.
2. Press ARRIVE line select key to display ARRIVAL 1/1 page.
3. Select Runway, STAR and Approach using Reference Number process.

Editing Stored Routes

Once a route has been constructed and stored in the data base, it can be accessed at any time for editing. Route editing is always accomplished on the normal ROUTE display page. The following procedure can be used to access the desired ROUTE display page for editing:

1. Access the Data Base Menu page by pressing the DATA-PILOT keys.
2. Access the ROUTES Catalog by selecting the ROUTES option. If the desired route is not displayed, use the NEXT and PREV keys to locate the route.
3. Enter the reference number of the desired ROUTE. The first page of that ROUTE will be displayed.

Insert Gap Into Route

A gap is a break in the route designed to prevent the navigation computer from making an automatic leg change. Gaps have no effect until the route is copied into the flight plan. With the first ROUTE page in view, proceed as follows

1. Use the NEXT and PREV function keys to display the desired waypoint.
2. Use the line select keys to position the cursor over the waypoint that will follow the GAP.
3. Press the LIST function key to access the normal LIST page.
4. Press the GAP line select key. The display will return to the ROUTE page and the gap (*GAP*) will have been inserted.

Gaps are deleted from the route in the same manner as waypoints. To delete a gap from the route, refer to the DELETE WAYPOINT(S) FROM ROUTE procedure in this section.

CAUTION: WHEN A GAP HAS BEEN INSERTED, THE FLIGHT PLAN WILL NOT AUTO-SEQUENCE TO THE NEXT LEG. THE AIRCRAFT WILL CONTINUE TO FLY OVER THE TO WAYPOINT ON LAST DESIRED TRACK (0° ROLL STEERING) WITH NAV AND VNAV FLAGS OUT OF VIEW ON THE HSI. **IT IS THE RESPONSIBILITY OF THE PILOT TO TAKE APPROPRIATE ACTION TO CONTINUE ACCURATE NAVIGATION OF THE AIRCRAFT.** HE MAY GO "DIRECT TO" OR EDIT THE GAP OUT OF THE FLIGHT PLAN.

Designate Route Waypoint as Fly-Over Waypoint

A flyover waypoint is a waypoint that will cause the navigation computer to delay making an automatic leg change until the aircraft is over the waypoint. Flyover waypoints defined in a route have no effect until the route is copied into the flight plan. A flyover waypoint is indicated by an asterisk (*) following the waypoint identifier on the ROUTE display page. With the first ROUTE page in view, the following procedure may be used to designate (or cancel) a waypoint as a flyover waypoint:

1. Use the NEXT and PREV function keys to display the desired waypoint.
2. Use the line select keys to position the cursor over the waypoint to be defined as a flyover waypoint.
3. Press the OVFLY line select key. An asterisk (*) will appear after the waypoint identifier indicating that it is a flyover waypoint.

The waypoint flyover designation is removed in the same manner as it was created; i.e., pressing the CNCL OVFLY key with the cursor over the flyover waypoint identifier.

Add Waypoint(s) To Route

With the first ROUTE page displayed, add a waypoint to the route as follows:

1. Use the NEXT and PREV function keys to display the desired portion of the ROUTE.
2. Use the line select key to position the cursor over the waypoint that will follow the new waypoint.
3. Enter the new waypoint using the LIST function or by typing in the identifier. When the new waypoint is entered, it will be inserted in the position selected and the waypoint under the cursor will have advanced to the next position.

Edit Route Name

With the ROUTE page displayed, edit the Route Name as follows:

1. Press ENTER key to place cursor over the Route Name field.
2. Type in the new route name and press ENTER.

Delete Waypoint(s) From Route

With the first ROUTE page displayed, delete waypoint(s) from route as follows:

1. Use the NEXT and PREV keys to display the desired waypoint.
2. Use the line select key to position the cursor over the waypoint to be deleted.
3. Press DEL line select key.

NOTE: If it is desired to delete the remainder of the route, enter a reference number greater than the reference number of the last waypoint on the route (for example, 98). **Do not enter 99, or the entire flight plan will be deleted.**

Change Waypoint In Route

A waypoint in a route is changed by adding the new waypoint ahead of the old waypoint (waypoint to be changed) and then deleting the old waypoint. With the first ROUTE page displayed, change a waypoint in a route as follows:

1. Use the NEXT and PREV function keys to locate the desired waypoint.
2. Position the cursor over the first waypoint to be changed.
3. Enter the new waypoint using the LIST function or by typing the identifier. When the new waypoint is entered, it will be inserted at the position selected and the waypoint under the cursor will advance to the next position.
4. Enter the reference number associated with the waypoint that will follow the added waypoint. The changed waypoints will be removed from the route.

PILOT DEFINED SIDS

The PLT/SID page is designed to allow the creation or deletion of SID data base records. To edit the SID records, an airport must be defined. A new SID can be defined by either renaming an existing one or creating one by defining a new runway, an enroute transition or by editing (adding or deleting) legs in a common procedure.

Existing SIDs can be deleted (along with all associated transitions) by entering the SID name and then requesting deletion. Individual transitions can be deleted by selecting the transition and the associated SID and then requesting deletion.

This page is also used to gain access to a specific SID procedure that needs to be edited. When the SID is defined, pages will be appended to this page that include the SID procedure legs (PLT/SID 2/3 and 3/3). To access the PLT/SID page press SID prompt on the DATA/PLT menu page.

```

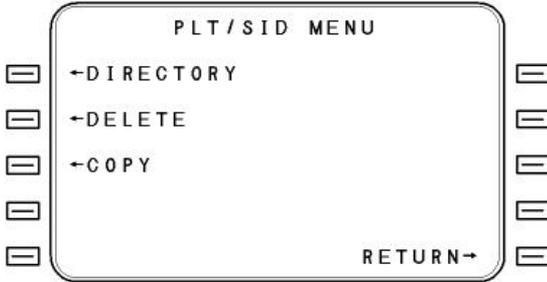
PLT/SID 1/1 [ ]
SEL RUNWAY      AIRPORT
1 16 L          KSEA
2 16 R          RUNWAY
3 34 L          4
4 34 R          SID
                -----
                TRANS
                -----
                RETURN->
  
```

The page consists of required and optional fields. When the page is first entered, the cursor will be placed in the AIRPORT field (first required field entry). The cursor will advance to the next required field only after a valid airport entry has been made. The remaining fields are optional and may be bypassed.

All entry fields [1R through 4R] will display dashes until an entry has been made. After a valid airport is entered, the cursor will advance to the RUNWAY field and the available runways for that airport (including pilot defined) will be displayed. When a runway is selected, the cursor will advance to the SID field. Any predefined SIDs will be displayed at this time (if available) on the left side of the page. The desired SID can be selected by number or a new SID can be created by entering a new name.

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After the SID is entered, a list of enroute transitions will be displayed if any exist. If one or more transitions are available, they will be selectable. If none exist, the transitions may be created. The TRANS field can also be cleared by pressing the respective line select key while no data entries exist in that field.



This page is accessed from the PLT/SID 1/1 page by pressing the MENU key.

DIRECTORY - Pressing this line select key displays a list of all airports that have pilot defined SIDs associated with them.

DELETE - Pressing this line select key enables the user to delete the selected SID.

COPY - This function allows the user to create another SID, with a different name, but with the same attributes as the selected SID.

PLT/SID 2 / 3		
R 1	RW34R	-----
	HDG340°	
C 2	(829FT)	↑829
	CRS338°	SEA
C 3	ID-8.0)	SEA ↑4000
	HDG070°	
C 4	(R-143)	PAE -----
	HDG175°	
C 5	(INTCPT)	-----

These pages contain the SID procedure legs, defined in the SID definition page. The number of pages will depend on the number of SID procedure legs (common and transitions). This page will allow the user to insert legs in the SID procedure. A leg can be inserted after any of the displayed legs by pressing the respective line select key. Similarly an existing leg can be deleted or edited. In both cases, the Leg Path Selection page will be accessed. Page PLT/SID 3/X, 4/X and so on is similar to the second PLT/SID page.

Creating a SID

A SID is made up of one or more procedural legs. A procedural leg is defined as a Leg Path, followed by a Leg Terminator. It is very important to note that not all types of procedural legs can be linked together, due to geometrical constraints and attributes of the individual leg path/terminator combinations.

In learning how to create SIDs and STARs the pilot must learn some new terminology, as well as understand the structures of SIDs and STARs as defined by TERPS criteria. Also, he must understand certain waypoint naming conventions, which are regulated under ARINC 424 Specification, "Navigation System Data Base". This section will cover these and other subjects, and will take the pilot through a detailed example of defining a SID with several runway and enroute transitions.

Procedural Leg Types

Most navigation systems are point-to-point navigators; that is, the route of flight is defined by waypoint latitude/longitudes, and the courses and distances are calculated between the waypoints. This type of leg is called a Track-to-Fix Leg, and is only one of nineteen ways to define a path over the earth. ARINC 424 defines the nineteen different procedural leg types, and the FMS uses all of them to define flight plans, SIDs, STARs and Approaches.

A Procedural Leg has two parts: a Leg Path and a Leg Terminator. The leg *path* defines the path over the earth that the aircraft will fly, and the leg *terminator* defines the end of that leg and the transition point to the next procedural leg.

Three of the procedural leg types use an altitude as the terminator to the path (Course-to-Altitude, Course-from-fix-to-Altitude, and Heading-to-Altitude). When any of these three procedural legs is the current TO leg, then that leg will sequence only when the altitude constraint has been satisfied.

All other procedural legs are terminated in other ways (i.e., a Fix, a DME Distance, an Along Track Distance, Intercept, Radial, etc.). When an altitude is associated with one of these terminators, the FMS displays that altitude *for information only* to the pilot. No leg sequencing or other action occurs based upon that altitude. The leg will sequence only when the path terminator condition is satisfied (i.e., crossing the fix, etc.).

The following list shows all of the possible procedural legs used in the FMS:

<u>LEG PATH</u>	<u>LEG TERMINATOR</u>
Heading To	Altitude
Heading To	DME Distance
Heading To	Intercept
Heading To	Vector
Heading To	Radial
Course To	Fix
Course To	Altitude
Course To	DME Distance
Course To	Intercept
Course To	Radial
Course From Fix To	Altitude
Course From Fix To	Along Track Distance
Course From Fix To	DME Distance (different fix)
Course From Fix To	Vector
Initial Fix	(none)
Procedure Turn	Turn Fix
DME Arc	Radial From Fix
Direct To	Fix
Track from Fix To	Fix

The Elements of a SID

Runway Transitions, Common Segment and Enroute Transitions

A SID can have several *runway transitions*, along with one or more *enroute transitions*. Between the two, there may be a *common segment*. The best way to illustrate these segments is to refer to the example SID (called UNCTST) shown. This SID uses seven of the nineteen leg types, and once these are understood, the others become self evident

CAUTION: THIS EXAMPLE SID IS FOR DEMONSTRATION PURPOSES ONLY, DO NOT TRY TO FLY IT IF YOU ARE EVER VISITING TUCSON AZ.

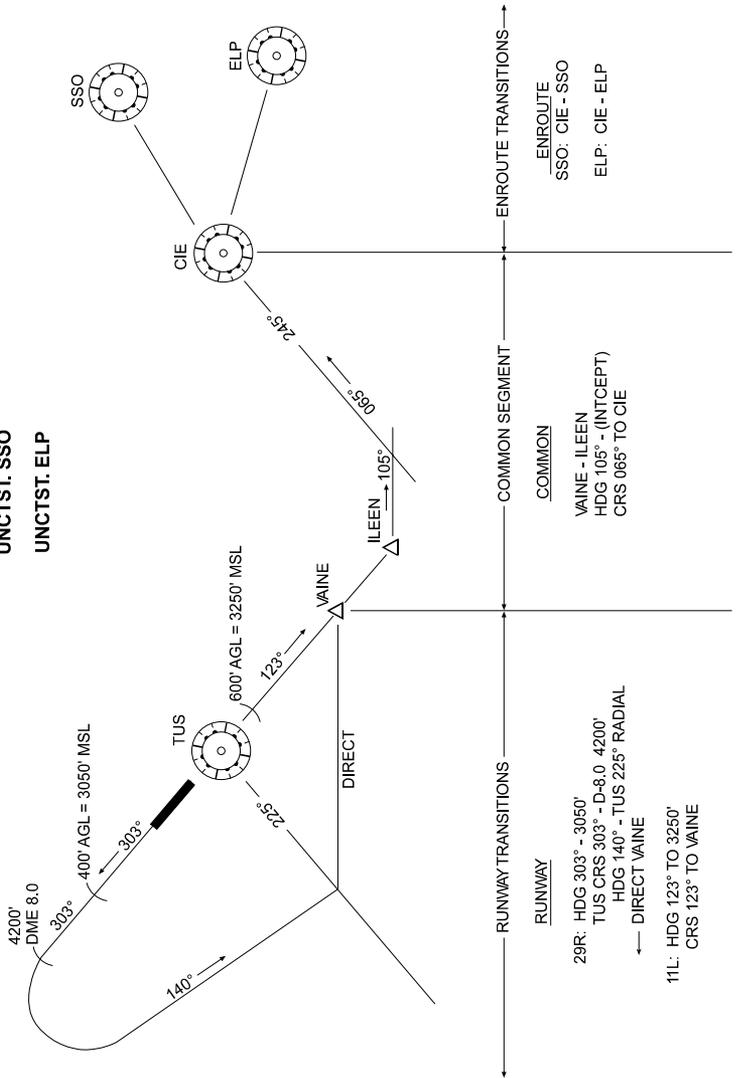
Note that there are two runway transitions: Rwy 11L and Rwy 29R. Each of these transitions uses a unique string of procedural legs to navigate to VAINC intersection. At VAINC, the common segment commences, and terminates at Cochise (CIE) VOR. From CIE, there are two different enroute transitions: one to San Simon (SSO) and the other to El Paso (ELP).

Once this SID is defined and stored in memory, it can be called up by its name UNCTST. When the takeoff runway is selected (11L or 29R), then only those appropriate runway transition legs are inserted into the flight plan. Similarly, when the enroute transition is selected (SSO or ELP), only those enroute legs are inserted into the flight plan.

DEMONSTRATION PILOT DEFINED SID

UNCTST. SSO

UNCTST. ELP



Defining the UNCTST SID

The following screens will take you through the definition process step by step.

First, call up the initial definition screen by pressing DATA-PILOT DATA-SID:

```

      PLT/SID  1/ 1 
SEL/ENTER ARPT  AIRPORT
      (NONE)      - - - -
                    RUNWAY
                    - - -
                      SID
                    - - - - -
                      TRANS
                      - - - -
                    RETURN→

```

Enter KTUS as the airport. The cursor will advance to the runway field and a list of runways, if any will appear.

NOTE: If the runways of interest are not in the data base, press RETURN to access the DATA/PLT page and then press RUNWAY. Define all runways that will be used for the SID, then return to the SID definition page by pressing DATA-PILOT-SID, and entering the airport ident.

Select one of the runways (we'll do 29R first). The cursor will then advance to the SID name field, so enter the name of the SID, in this case UNCTST. The cursor will advance to the Transition field, so enter SSO here. When we finish the initial SID definition for Rwy 29R and SSO, we'll then go back and define the other transitions (Rwy 11L and ELP).

```

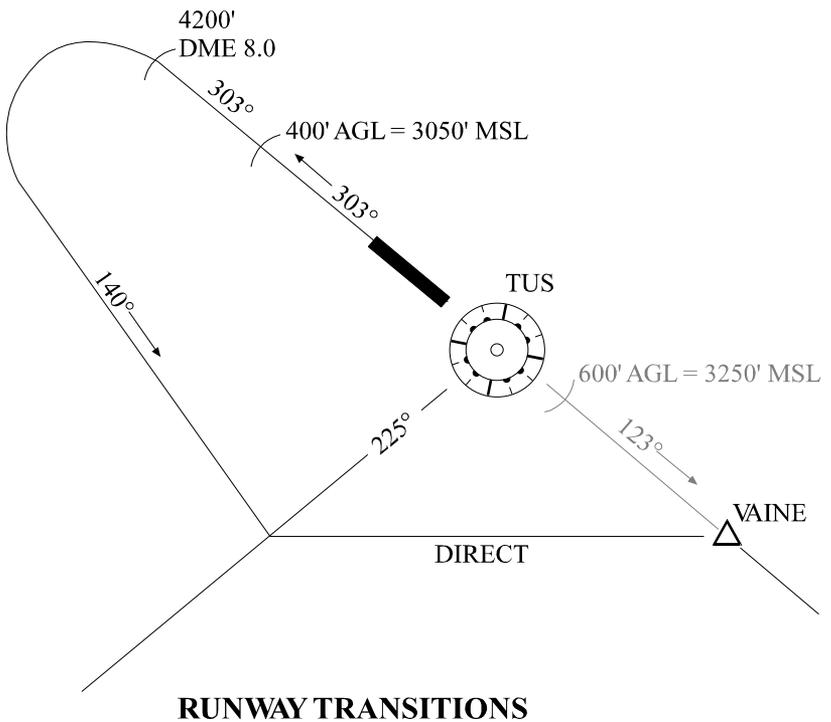
      PLT/SID  1/ 1 
                    AIRPORT
                    KTUS
                    RUNWAY
                    29R
                      SID
                    UNCTST
                      TRANS
                      SSO
←SID LEGS          RETURN→

```

Defining the 29R Transition

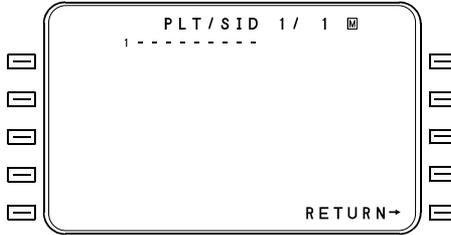
The Rwy 29R transition involves the following leg types:

1. Heading to Altitude (Hdg 303° to 3050 ft)
2. Course from Fix to Along Trk Distance (Crs 303° from TUS to DME 8.0, at or above 4200 ft)
3. Heading to Radial (Lt turn Hdg 140° to TUS R-225°)
4. Direct to Fix (Direct to VAINE intersection)

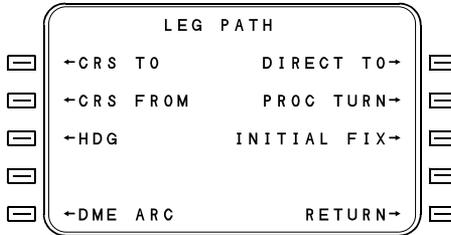


Section IV
Data Base

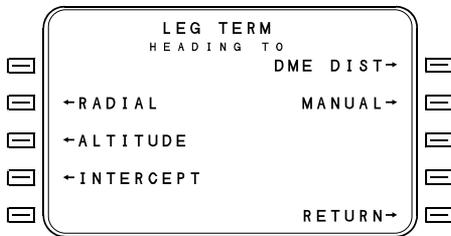
1. Press SID LEGS line select key to display the legs page. Initially this page will be blank.



2. Press the line select key next to '1' [1L]. The following LEG PATH screen will appear:



3. Since the first leg is a Heading to Altitude, press the HDG line select key. The LEG TERM HEADING TO screen will then appear:



- Select the ALTITUDE line select key. The HDG - ALT screen will then appear. Enter the heading and altitude in each field as shown.

- After entering the altitude, the SEGMENT screen will appear. Select the RWY TRAN line select key.

- Press ACCEPT to validate this leg. The screen presentation will return to the SID LEGS screen with the first leg as shown (the 'R' in the left column denotes Runway Transition leg):

In a similar fashion, the remaining three legs of the Rwy 29R transition are entered by selecting the Course From Fix To Along Track Distance, Heading to Radial, and Direct To Fix screens as shown below. Each one is defined as a RWY TRAN leg.

Section IV
Data Base

- Course From Fix to Along Track Distance (CRS 303° from TUS to DME 8.0)

NOTE: To enter the 'At or Above' altitude constraint, press the line select key next to ALT CONST. A page will appear with @ and up/down arrows. '@' indicates 'At' altitude, fl indicates 'at or above'; ± indicates 'at or below' and both arrows indicate an altitude window constraint. Press the fl line select key [2L] and enter 4200.

FIX-CRS-DIST		ALT CONST	
REF FIX	TUS	←- - - - -	←- - - - -
CRS FROM	303°	←-t 4200	←- - - - -
TO TRK DIST	8.0	←- - - - -	←- - - - -
IDENTIFIER	(+8.0)	←- - - - -	←- - - - -
TURN DIR	-----	↑	↑
ALT CONST	↑4200	←-NONE	←-NONE
SEGMENT	RWY TRAN	RETURN→	RETURN→
←ACCEPT	RETURN→		

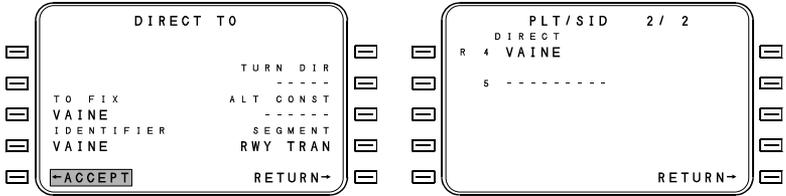
PLT/SID 1/ 1	
HDG 303°	
R 1 (3050FT)	TUS
CRS 303°	↑4200
R 2 (+8.0)	
3 - - - - -	
RETURN→	

- Heading to Radial (Left turn to Heading 140° until intercepting the TUS 225° radial).

NOTE: To specify 'left turn', press the TURN DIR line select key [2R]. A page will appear with LEFT, RIGHT, NONE. Select LEFT.

HDG-RADIAL		PLT/SID 1/ 1	
HDG	140°	HDG 303°	
TO RAD XING	225°	R 1 (3050FT)	TUS
IDENTIFIER	(R-225)	CRS 303°	↑4200
NAVAID	TUS	3 - - - - -	
TURN DIR	LEFT	RETURN→	
ALT CONST	-----		
SEGMENT	RWY TRAN		
←ACCEPT	RETURN→		

- Direct To Fix (Direct to VAINE).

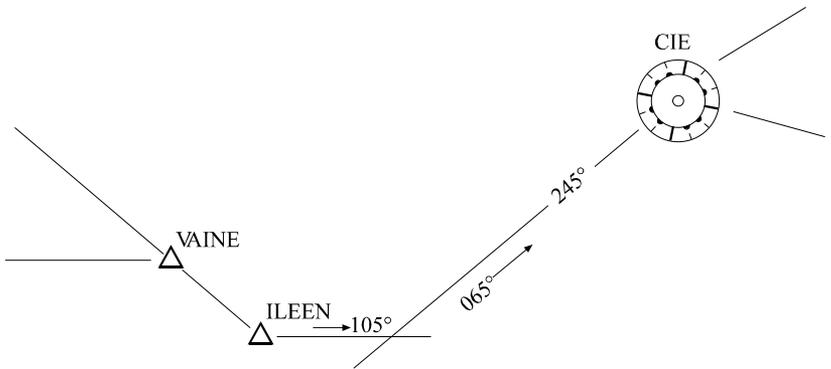


Defining the COMMON SEGMENT

The COMMON SEGMENT legs are as follows:

1. Track to Fix (VAINE to ILEEN)
2. Heading to Intercept (Hdg 105° to Intercept)
3. Course To Fix (Crs 065° to CIE)

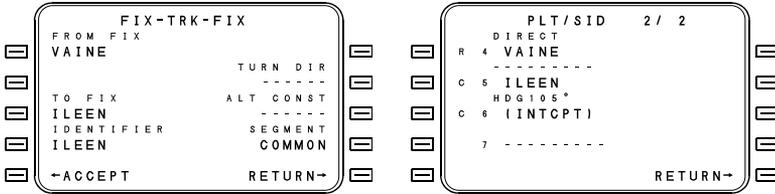
These legs are defined similarly to the runway legs, except that when the SEGMENT screen appears, select COMMON for each leg. The resultant screens are shown below. On the SID LEG page, the 'C' in the left column denotes a Common Segment leg.



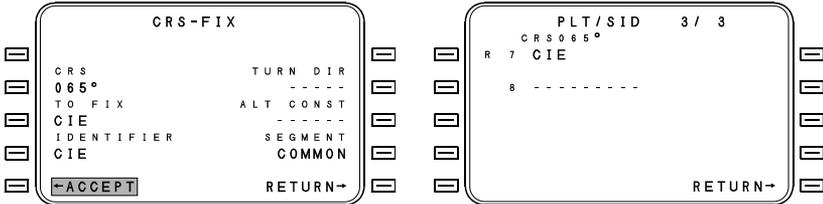
COMMON SEGMENT

Section IV
Data Base

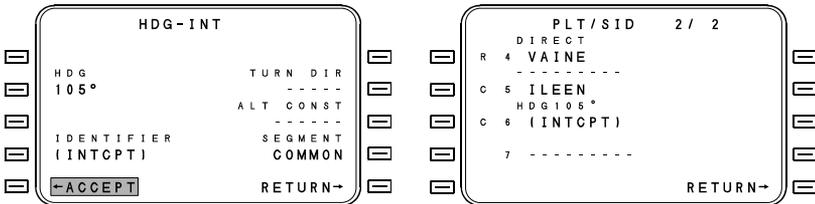
• Track To Fix (VAINE to ILEEN)



• Heading To Intercept (Hdg 105° to Intercept...)



• Course To Fix (Crs 065° to CIE)

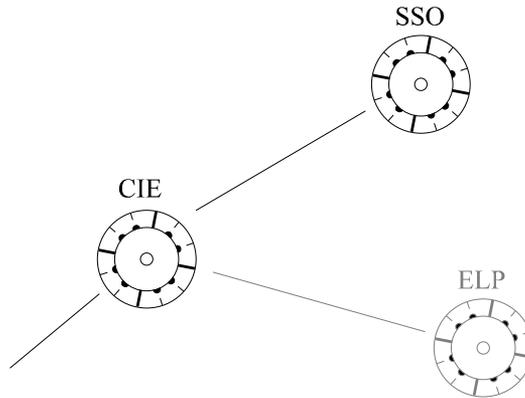


Defining the ENROUTE SEGMENT (SSO)

The enroute segment leg is as follows:

1. Track to Fix (CIE to SSO)

Select the Track to Fix screen, and designate this leg as ENRTE TRAN. On the SID LEG page, the 'E' in the left column denotes an Enroute Transition leg.



ENROUTE TRANSITIONS

- FIX - TRK - FIX (CIE to SSO).

<pre> FIX-TRK-FIX FROM FIX CIE TURN DIR ----- TO FIX ALT CONST SSO ----- IDENTIFIER SEGMENT SSO ENRTE TRAN ACCEPT RETURN→ </pre>	<pre> PLT/SID 3 / 3 CRS 055° C 7 CIE ----- E 8 SSO 9 ----- RETURN← </pre>
--	---

Adding Other Runway and Enroute Transitions

1. From the SID LEGS page, press RETURN line select key to bring up the DEPARTURE page.
2. Place the cursor over the RUNWAY field, and select the number of the other runway for which transition legs are desired, in this case Rwy 11L.

PLT / SID		1 / 1
SEL	RUNWAY	AIRPORT
1	29R	KTUS
2	03	RUNWAY
3	11L	3
4	11R	SID
5	21	UNCTST
6	29L	TRANS
		SSO
←SID LEGS		RETURN→

3. Now press SID LEGS line select key to display the procedural legs pages. Notice that all Runway transitions for 29R are missing, and that the SID legs start at VAINE intersection.

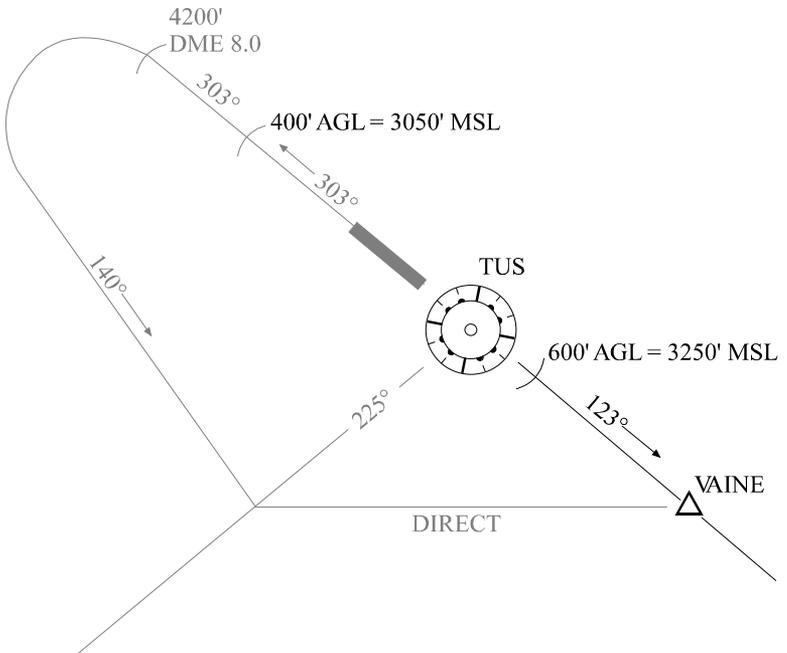
PLT / SID		1 / 2

C 1	VAINE	

C 2	ILEEN	
	HDG 105°	
C 3	(INTCPT)	
	CRS 065°	
C 4	CIE	
		RETURN→

We will, therefore, need to insert the Runway transition legs for Rwy 11L. These legs are as follows:

1. Heading to Altitude (Hdg 123° to 3250 feet)
2. Course to Fix (Crs 123° to VAINE)



RUNWAY TRANSITIONS

Section IV
Data Base

1. Begin by pressing the top left line select key. The leg path page will be displayed.
2. Select HDG, then when Leg Terminator page appears, select ALTITUDE. Fill in the data fields with the appropriate information (Select RWY TRAN when the "Segment" page appears).

HDG - ALT	
HDG	TURN DIR
123°	-----
TO ALT	
3250	
IDENTIFIER	SEGMENT
(3250FT)	RWY TRAN
←ACCEPT	RETURN→

After this initial leg is ACCEPTed, the screen will return to the SID LEGS page. There will be a **GAP** between the first and third legs. This gap was inserted by the FMS because the Heading-to-Altitude leg terminator did not match the next waypoint, in this case VAINE intersection. For now, ignore the gap.

PLT / SID 1 / 3	
HDG 123°	
R 1 (320FT)	
2 *GAP*	

C 3 VAINE	

C 4 ILEEN	
	RETURN→

- Press the second line select key from the top left (next to the Gap). When the Leg Path page appears, select CRS TO, and when the Leg Terminator page appears, select FIX. Fill in the appropriate data (Crs 123° to VAINE), and select RWY TRAN when queried for which segment. The resultant page will appear as follows:

CRS-FIX	
CRS	TURN DIR
123°	-----
TO FIX	ALT CONST
VAINE	-----
IDENTIFIER	SEGMENT
VAINE	RWY TRAN
←ACCEPT	RETURN→

After ACCEPTing this page, the screen will return to the SID LEGS page. Notice that the Gap has disappeared automatically. The reason is that the Course-to-Fix (VAINE) matched the next waypoint exactly.

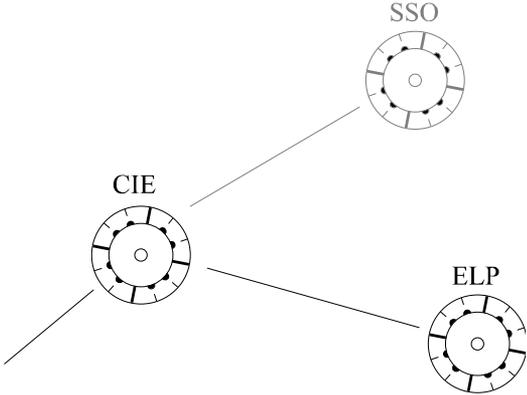
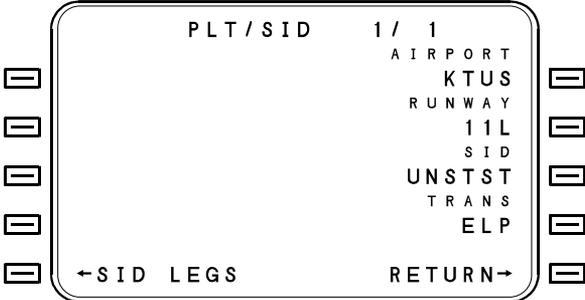
PLT/SID 1 / 2	
	HDG 123°
R 1	(3250FT)
	CRS 123°
R 2	VAINE

C 3	ILEEN
	HDG 105°
C 4	(INTCPT)
	RETURN→

NOTE: Always use a named waypoint as the transition point between Runway and Common and Enroute Segments. This allows proper linking into the flight plan with no gaps. If a “floating waypoint” (e.g., Heading to Altitude or Course to Intercept) is used, a gap will always appear in the flight plan, necessitating editing of the flight plan to eliminate it.

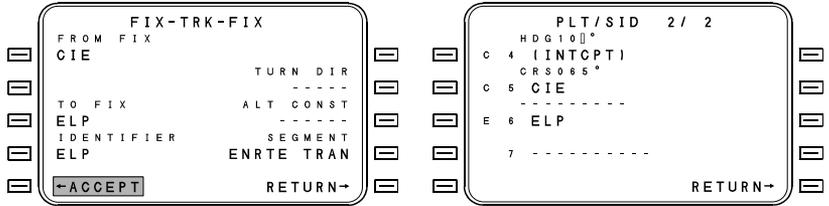
Adding the Last Enroute Transition

1. From the SID LEGS page press RETURN line select key to display the DEPARTURE page.
2. Place the cursor over the TRANSITION field, and change from SSO to ELP.



ENROUTE TRANSITIONS

1. Press SID LEGS line select key to display the SID legs.
2. Press NEXT key to display page 2. Notice now that the enroute leg from CIE to SSO has been eliminated, and that the SID legs end at CIE.
3. Add the ELP transition after CIE by creating a Track To Fix leg segment from CIE to ELP and designate it an ENRTE TRAN segment. The last screens should appear as follows:



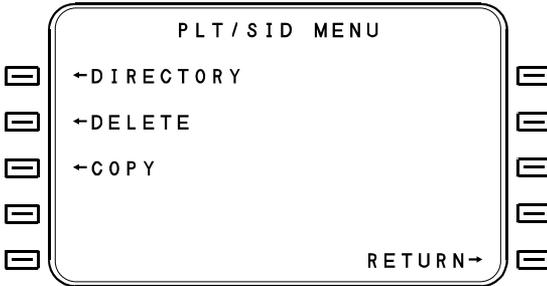
At this point the SID definition is complete, containing both Rwy 11L and 29R transitions, as well as the SSO and ELP enroute transitions. When this SID is selected for use in the flight plan, all legs appropriate to the selected runway and enroute transitions will be correctly linked.

NOTE: If, when linking a SID into the flight plan, a departure runway is not selected, then none of the runway transition legs will be used. The SID will begin at the first Common Segment waypoint. Similarly, if no enroute transition is chosen, no enroute transition legs will be linked into the flight plan, and the SID will end at the last Common Segment waypoint.

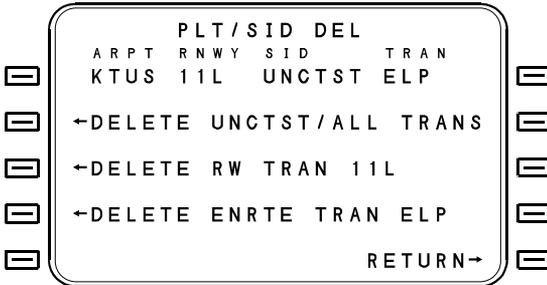
Deleting a Pilot Defined SID

To delete a pilot SID, select the SID by name on the PLT/ SID page.

1. Press the MENU function key, and the following page will appear.



2. Press the DELETE line select key to produce the following page:



3. To delete the SID press line select key [2L] once to highlight that line then press a second time to complete the deletion.
4. To delete the runway transition portion of the SID press line select key [3L] once to highlight that line then press a second time to complete the deletion.
5. To delete the enroute transition portion of the SID press line select key [4L] once to highlight that line then press a second time to complete the deletion.

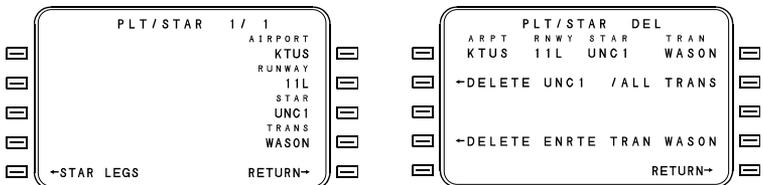
PILOT DEFINED STARS

A STAR is essentially the mirror image of a SID. It can begin with multiple Enroute Transitions, feeding to a Common Segment, and ending with one or more Runway Transitions. Use the same steps as described above for creating a SID, except begin with an Enroute Transition and end with a Runway transition. Many STARS end at a single feeder fix to the airport, and this waypoint would be the last one of the Common Segment. In this case there would be no Runway Transitions.

Deleting a Pilot Defined STAR

The process to delete a pilot STAR is the same as deleting a pilot SID.

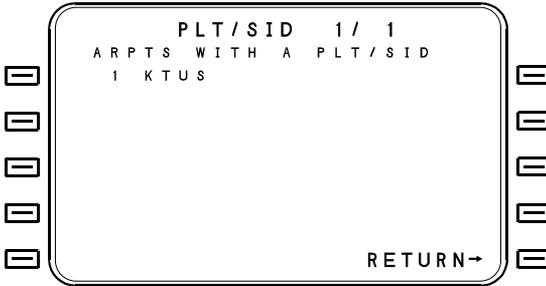
1. Select the STAR using DATA PILOT DATA STAR and entering the name of the STAR to be deleted.
2. Press the MENU key and follow the prompts for deleting the STAR.



3. To delete the entire STAR with all transitions press line select key [2L] once to highlight that line then press a second time to complete the deletion.
4. To delete the named transition press line select key [4L] once to highlight that line then press a second time to complete the deletion.

Pilot SID and STAR Directories

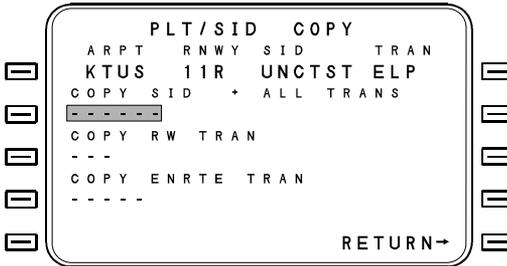
To view a listing of airports with pilot defined SIDs, press DATA-PILOT DATA SID-MENU-DIRECTORY, and a list of airports will appear. Likewise, to view airports with pilot defined STARs, press DATA-PILOT DATA-STAR-MENU-DIRECTORY.



Copying a Pilot SID or STAR

To make a copy of a pilot SID:

1. Press DATA-PILOT DATA-SID, and enter the runway, SID name, and transition.
2. Press MENU-COPY to display the following page:



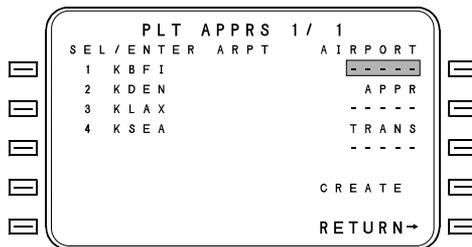
3. Enter the new name for the COPY SID + ALL TRANS, or enter another valid runway under "COPY RW TRAN" to copy the same SID with new runway transitions. A third option is to enter a new enroute transition under "COPY ENRTE TRAN."

Copying a pilot STAR is identical, except begin with the named STAR and press MENU-COPY for the copy page.

Pilot Defined Approaches

Approaches are defined in the Data mode and stored in the Pilot data base. Up to 100 approaches may be defined and stored. Each approach includes a Final Approach Fix (FAF) and an end-of-approach point. The end-of-approach point can be a runway threshold, touchdown point, or a Missed Approach Point (MAP). One or two additional waypoints may be defined along the approach path. Only one of the optional waypoints may be located outside the FAF, and only one may be between the FAF and the end-of-approach point. Additionally, a vertical flight path through the approach waypoints may be defined.

The procedure used to define and store a runway in the data base is explained under DATA KEY - PILOT-DEFINED RUNWAY in this section.



The PLT APPRS pages provide a directory of all the airports with pilot approaches stored in the data base. The number of PLT APPRS pages is dependent upon the number of pilot defined approaches which are stored (up to 100 pilot defined approaches may be stored). The PREV and NEXT keys provide access to other PLT APPRS pages.

AIRPORT - Entering an airport identifier or entering the reference number of one of the listed approaches into this entry field will change the listing to show approaches defined for the entered airport. The CREATE line select key will be available only after entry of an airport identifier.

	PLT APPRS	1 / 1	
SEL	APPROACH	AIRPORT	
1	KTUS RNY 11L	KTUS	
		APPR	

		TRANS	

		CREATE→	
		RETURN→	

APPR - Entering the reference number of one of the listed approaches will prompt entry of transitions for the approach.

	PLT APPRS	1 / 1	
SEL/ENTER	TRANS	AIRPORT	
1	MAVVA	KTUS	
		APPR	
		RNY 11L	
		TRANS	

		APPR DEF→	
		RETURN→	

Approach Transition Page

This page is accessed automatically after a new leg has been defined or an existing leg has been modified or deleted. This page is also accessed from the Pilot Approach Directory page by selecting the TRANS LEGS prompt. The TRANS LEG prompt is displayed after a valid transition name has been entered. Note that the segment identifier 'T' indicates an approach transition.

```

      PLT/APPR  1 /  1
      CRS 3 6 0 °
T  1  DONDO                ↑ 3 5 0 0
      HDG 0 4 5 °
T  2  (INTCPT)
      CRS 3 1 3 °
T  3  SEA
T  4  -----
                                     RETURN→
```

CREATE - Pressing the CREATE line select key will cause the first Approach Definition page to be displayed. The page will have all fields blank except that the ARPT entry field will be pre-filled with the identifier entered on the PLT APPRS directory page.

Approach Definition Page #1

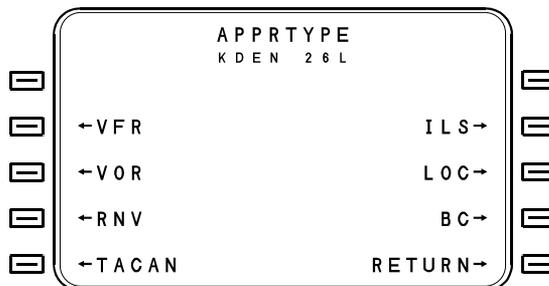
This page displays information about an existing approach, or provides the means to define a new approach. The page defines the designated nav facility for which the approach is based, the date of creation which is automatically entered for reference use, and shows the basic lateral geometry from the FAF to the runway or MAP. Entries made on this page are the minimum required to define an approach. Under the page title is the name of the approach. No entries can be made on this line. As each entry is made, the cursor will automatically advance to the next appropriate entry field when the ENTER key is pressed.

	PLT/APPR 1/ 4			
[]	ARPT	KTUS RNY 11L	FAC	[]
[]	KTUS	09 - FEB 97	TUS	[]
[]	RUNWAY		FREQ	[]
[]	11L		116.00	[]
[]	TYPE		FAF	[]
[]	RNV		RIVIL	[]
[]	FROM FAF TO RUNWAY			[]
[]	INBD CRS 123°	DIST	459	[]
[]	(VERTICAL UNDEFINED)			[]
[]	←DELETE		RETURN→	[]

ARPT - The airport identifier.

RUNWAY - Entering a runway designation will result in a search of the runway data base for coordinates to use in defining an approach. Pressing the LIST key will call up a list of previously defined runways. If a nonexistent runway is entered, the display will automatically revert to the Runway Definition page.

TYPE - Pressing the TYPE line select key will display the APPRTYPE page. Selections on the left (VOR, VFR, RNV and TACAN) define the type of FMS approach. Selections on the right side (ILS, LOC, BC) is for nav-to-nav transitions through the flight guidance system, if the FMS is interfaced with certain advanced EFIS systems. A RETURN option is presented to return the display to the original page with no changes.



The difference between ILS, BC, LOC, VFR, VOR, TACAN and RNV approaches are the Q factor and the nav facility requirements. Should the Q factor or nav input requirements not be met, the HSI NAV flags will come into view.

- **ILS Approach- For installations with compatible EFIS software**, ILS approaches may be created and linked into the flight plan. When ARM APPR is selected on the FMS, the FMS will automatically tune the ILS receiver to the appropriate frequency and the EFIS arms for capture. When the pilot arms APPR on the Flight Guidance System, the aircraft will transition from lateral and vertical FMS mode to approach using the localizer and glideslope signals from the ILS receiver. If the pilot flies the approach with only NAV mode selected on the FGS, then only lateral transitions will be made from FMS to Localizer.
- **LOC Approach** - For LOC approaches, the FMS receives lateral deviation data from the ILS receiver and retransmits it as the lateral FMS deviation output. A pseudo glideslope is computed to the runway, thus allowing full 3-dimensional approach capability.
- **BC Approach** - For Backcourse (BC) approaches, the FMS receives deviation data from the ILS receiver, inverts and retransmits it as FMS lateral deviation. As with LOC approaches, a pseudo glideslope is computed to the runway.
- **VFR Approach** - For any approach in visual conditions. Definition and reception of a primary VOR facility is optional. Quality factor requirements are less stringent for valid navigation (28 or less) than for other approach options. Also can be used anytime runway coordinates have been manually entered by the pilot and inbound course and distance has not been entered.

- **VOR Approach** - For VOR approaches. Collocated DME will be used when available, but does not require it's reception for valid navigation. VOR signals must be received from the reference facility and DME signals must be received from any available facility. When Remote Tune is enabled (programmed into the Configuration Module at installation), selecting APPROACH will tune the VOR receiver to the reference facility. The Q factor must be equal to or less than 10 while 30 to 15 NM from the end-of-approach point. The Q must be equal to or less than 5 while within 15 NM of the end-of-approach point.
- **RNV Approach** - This is selected for RNAV or VOR-DME approaches. VOR and DME signals must be received from the reference facility. When Remote Tune is enabled (programmed into the Configuration Module at installation), selecting Approach will tune the VOR receiver to the reference facility. The Q factor must be equal to or less than 10 while 30 to 15 NM from the end-of-approach point. The Q must be equal to or less than 5 while within 15 NM of the end-of-approach point.
- **TACAN Approach**- This option will only appear when a Radio Reference Sensor (RRS) or separate TACAN sensor is installed. TACAN bearing and distance signals must be received from the reference facility. The Q factor must be equal to or less than 10 while 30 to 15 NM from the end-of-approach point. The Q must be equal to or less than 5 while within 15 NM of the end-of-approach point.

NOTE: If an approach is being created from a VOR Approach where the reference VOR facility has DME, it is recommended that the TYPE selection be RNV. The DME tunes the 15 closest stations once every minute. By selecting RNV, the reference facility DME will be one of every 2 DMEs tuned (instead of only once for every 15 DMEs tuned). Also, the pilot will be warned more quickly if there is a loss of DME from the reference facility.

FAF - The name of the FAF (Final Approach Fix). Entry of an identifier for the FAF will result in the calculation and display of the inbound course and distance on the last line of the page if the runway is defined in the runway data base. The LIST key may be used to call up the FAF name.

If a runway has been previously defined in the runway data base and the pilot enters nothing here, a default name will be displayed when the inbound course and distance entries are made. The default name will be FAFXX where XX is the same as the runway number. The FAF may be passed over only if the runway has been previously defined and stored in the runway data base. If the runway is not in the data base, the FAF must be defined.

INBD CRS - The inbound course from the FAF (Final Approach Fix) to the MAP or runway. The inbound course is computed based on the runway data when a known location is entered in the FAF entry field. This may be overwritten; in which case the pilot entered course will be used to define the MAP. If no name has been entered in the FAF entry field or the runway is not defined in the runway data base, this field will initially be blank and the course must be entered.

FAC - The name of the reference facility. Entering a VOR identifier results in a search of the data base for a navaid of that name. The LIST key may be used to call up a list of facilities.

FREQ - The frequency of the reference facility. When the reference facility identifier is entered, the frequency defaults to the frequency listed in the data base if the reference facility is found.

DIST - The distance from the FAF (Final Approach Fix) to the MAP or runway. The distance is computed based on the runway data when a known location is entered in the FAF entry field. This may be overwritten in which case the pilot entered distance will be used to define the MAP. If no name has been entered in the FAF entry field or the runway is not defined in the runway data base, this field will initially be blank and the distance must be entered.

If course and distance are entered from the FAF, the FMS display will read "FROM FAF TO MAP" above the INBD CRS and DIST line. If runway coordinates from the data base are used to define the end of approach point, the display will read "FROM FAF TO RUNWAY."

DATE - The date of approach creation or the date on which the approach was last modified is displayed for reference. The date defaults to the current date when the approach is created or altered.

Approach Definition Page #2

Approach Definition page 2 shows all the waypoints in the approach in geographical order with their altitudes. Initially, during approach creation, this page will show only the FAF and the RNWY or MAP waypoint from the previous page (APPR page 1). This page allows the entry of optional waypoints in the approach with altitude assignments. One optional waypoint prior to the FAF and one altitude restriction between the FAF and RNWY or MAP are provided for. The altitudes entered on this page form the pseudo glide slope which is followed in the NAV approach mode. Under the page title is the name of the approach. No entries can be made on this line.

PLT / APPR 2 / 4	
KTUS	11L RNY
WASON	AB 6031
5.4 NM	-3.1°
RIVIL	AT 4223
4.9 NM	-3.1°
+ - - - -	- - - - -
- - - - - NM	
RWIIIL	AT 2626
FAF TO RUNWAY	
FPA -3.1°	RETURN→

Optional Waypoint - Allows entry of an optional waypoint prior to the FAF. This waypoint must be entered by name using the LIST or alphanumeric input process. The location of this waypoint must be farther from the runway or MAP than the FAF and must be on the inbound course within $\pm 6^\circ$.

Optional Restriction - Allows for entry of an optional restriction point between the FAF and the RNWY or MAP. The number entered into this entry field (+--.) is the number of miles beyond the FAF at which an altitude restriction exists, and will be used as the name of the optional waypoint. This number must be less than the distance between the FAF and the RNWY or MAP.

Optional Waypoint Altitude - Allows for entry of an altitude constraint in conjunction with the optional waypoint prior to the FAF. The altitude constraint (in the middle of the line) must be defined as AB (At or Above). The distance and flight path angle to the next approach waypoint is displayed in small font.

FAF Altitude - The altitude constraint is always AT. The desired altitude at the FAF is entered at this cursor position. This will result in the computation of a flight path angle from the FAF to the RNWY or MAP.

Optional Restriction Altitude - An altitude may be entered here if its value is between the altitude at the FAF and the end-of-approach point altitude. The altitude constraint is always AB (at or above).

End-of-approach Altitude - The end-of-approach (RNWY or MAP) waypoint altitude. This altitude constraint is always AT. If the runway elevation is stored in the runway data base, this altitude will be used. If the end-of-approach is a MAP, the missed approach altitude must be entered.

FPA - The Flight Path Angle (FPA) from the FAF to the end-of-approach waypoint. This is computed if an FAF altitude is entered. A number may be entered here; in which case a new FAF altitude is computed.

NOTE: FPA is always computed between the FAF altitude and the end-of-approach altitude. Entry of an optional altitude restriction between these two points will not change the displayed angle, though it may result in a bent glide path.

Approach Definition Page #3 (Missed Approach)

Approach Definition page 3 is used to define missed approach legs. To define a missed approach leg, press the line select key to the left of the point to be defined. The system will prompt the operator for entry of a LEG PATH and LEG TERMINATOR for each leg of the procedure defined. 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 turn direction and advisory altitude constraints.

	PLT / APPR 3 / 4		
[]	M 1 (500 FT)		[]
	HDG 233 °		
[]	M 2 (1200 FT)		[]
	HDG 200 °		
[]	M 3 (R - 250)	T M B	[]
	CRS 210 °		
[]	M 4 ALTUR	@ 2300	[]
[]		RETURN →	[]

Approach Definition Page #4

Approach Definition Page 4 shows the coordinates of all the approach waypoints. The FAF is always in the second position and the Runway or MAP is always in the fourth position. Under the page title is the name of the approach. The data presented on this page is for reference only and cannot be changed on this page.

NOTE: When viewing Approach Definition Page 4, there may be a slight difference between the FMS displayed coordinates for the end-of-approach point and the coordinates found on the approach chart. This is due to the electronic data base update occurring before a revised chart is available. These minor variations are considered normal. Minor variations (if any) do not compromise the approach accuracies as set forth in AC 20-130. However, it is the pilot's responsibility to verify that these variations are within the accuracies as set forth in AC 20-130.

PLT / APPR 4 / 4					
K D E N 2 9 L V O R					
W P T 1					
N	39	45.3	W	104	40.0
A L T U R					
N	39	45.3	W	104	44.5
+ 0 2 . 7					
N	39	45.3	W	104	48.0
R W 2 6 L					
N	39	45.3	W	104	51.6
					RETURN→

Change Approach Data

This procedure may be used to change or update a previously defined approach in the data base, provided the approach is not part of the flight plan.

NOTE: The APPROACH IN USE message will be activated if an attempt is made to change an approach that is installed in the flight plan.

1. Access the Pilot Data Base Menu page by pressing the DATA function key and the PILOT DATA line select key.
2. Access the PLT APPRS Directory by selecting the APPROACHES line select key.
3. If the desired airport is not displayed, enter the identifier of the desired airport. The approaches for the entered airport will be listed. Use the NEXT and PREV keys to locate the desired approach if required.
4. Enter the reference number of the desired approach. Then press the APPR DEF line select key to access the first Approach Definition page (PLT APPR 1/4). The NEXT key is used to access PLT APPR 2/4 and PLT APPR 3/4 and PLT APPR 4/4.
5. Use the line select keys as desired to position the cursor on the field to be changed and enter the new data over the old data.

NOTE:

- Changing the runway number will blank all the remaining approach data.
- Changing the approach type (VFR, VOR, RNV) will create another approach to the same runway of the new type without erasing the old approach. The system will not allow two approaches of the same type to the same runway at an airport.

Repeat the above procedure as necessary for all fields that are to be changed.

Delete Entire Approach

The following procedure is used to delete an entire approach from the approach listing, provided the approach is not part of the flight plan.

NOTE: The APPROACH IN USE message will be activated if an attempt is made to delete an approach that is installed in the flight plan.

1. Access the Pilot Data Base Menu page by pressing the DATA-PILOT DATA function keys.
2. Access the PLT APPRS Directory by selecting the APPROACH line select key.
3. If the desired approach is not displayed, enter the identifier of the desired airport. The approaches for the entered airport will be listed. Use the NEXT and PREV keys to locate the desired approach if required.
4. Enter the reference number of the desired approach. Then press the APPR DEF line select key to access the first Approach Definition page (PLT APPR 1/4).
5. Press the DELETE line select key twice to delete the approach.

PILOT RUNWAYS

Pilot Runways Directory

The PLT RNWYS page(s) are accessed from the Pilot Data Base menu page by selecting the RUNWAY option. When the page is first accessed, a list of all runways stored in the data base will be presented alphabetically. The number of PLT RNWYS pages available depends upon the number of pilot defined runways in the data base (up to 100 pilot defined runways may be stored). The PREV and NEXT keys provide access to other PLT RNWYS pages.

PLT RNWYS 1 / 3			AIRPORT
1	K B F I	1 8 L	
2	K B F I	1 8 R	
3	K D E N	2 6 R	
4	K D E N	2 6 R	
5	K D E N	0 8 L	
6	K L A X	3 1 R	
7	K L A X	3 1 R	
8	K S E A	3 1 L	
9	K S E A	3 1 R	RETURN→

AIRPORT - Entering an airport name into this entry field will change the listing to show only those runways for the entered airport. Entering the reference number of one of the listed runways into this field will cause the Runway Creation/Display page (PLT RNWY) with the associated runway data to be displayed.

CREATE - The CREATE line select key will only be available after entry of an airport identifier. Pressing the CREATE line select key will cause the Runway Creation/Display page to be displayed. The Runway Creation/Display page will have all fields blank except that the ARPT entry field will be prefilled.

Runway Creation/Display Page

The PLT RNWY page is accessed from the Pilot Runways Listing page by entering a runway reference number or by selecting the CREATE option, or by entering a nonexistent runway on the Approach Definition page. If the page was accessed by entering a reference number, the information displayed on the page will be completed. If the page was accessed by using the CREATE option, the entry fields will be blank. When making entries on this page, the cursor automatically advances to the next input field.

```

      PLT RNWYS 1 / 1
ARPT
KDEN
RNWY NUMBER      N  - - - - -
                  W  - - - - -
ELEVATION
- - - - -
←ACCEPT          RETURN→
```

ARPT - The airport identifier.

RNWX NUMBER - The runway designation. Typically, there will be a one or two digit number (1 - 36) which may be followed by the letter L, C, or R. However, a single letter (A-Z) may be used to designate an approach that is not associated with a runway.

NOTE: The FMS will not allow user definition of runway numbers that exist in the Navigation Data Base.

ELEVATION - The elevation displayed or to be input is the runway threshold elevation or the elevation plus threshold crossing height (MSL).

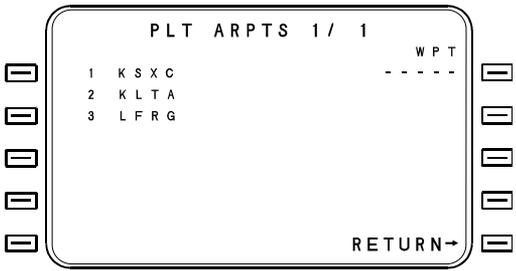
ACCEPT/DELETE/IN USE APPR - When a runway is created or modified and all fields are valid entries, this field will display “ACCEPT” for entry of the data into the data base. When an existing runway is selected for review from the Pilot Runway Directory, this field will display “DELETE” unless the runway is part of an approach that is in the data base in which case the field will read “IN USE.” With “DELETE” displayed, this line select key is used to remove the defined runway from the data base. When first pressed, a cursor will cover the “DELETE” command. The line select key must be pressed a second time for confirmation of this command.

APPR END - The coordinates displayed or to be input are the runway threshold or touchdown point coordinates.

Pilot Defined Airports

Pilot-defined airports may be created for those airports that are not in the Navigation Data Base. Procedures are similar to creating Pilot Runways.

Entry of an identifier in the WPT field will cause the DEFINE ARPT page to be displayed. Identifiers, which exist in the Navigation data base, will flash and will not be accepted.



Identifiers, which exist in the Navigation Data Base, will flash and will not be accepted. Entry of an identifier in the WPT field will cause the DEFINE ARPT page to be displayed.

Alignment Points

Alignment points can be created for several points on an airport for the purpose of initializing IRS sensors. These points may be entered alphanumerically, but only appear on the list function when LIST key is pressed with the cursor over the initialization waypoint field on the initialization page.

```

ALN WPTS 1 / 1
                                WPT
1  BFIAL  -----
2  LOWAL
3  LAXAL

                                RETURN→
  
```

Entry of an identifier in the WPT field will cause the DEFINE ALIGN page to be displayed.

```

DEFINE ALIGN
REF WPT          WPT
-----         ABCDE
N  -----
W  -----
RADIAL/DIST     W  -----
-----°/-----°  GPS POS→
WPT/RADIAL      FMS1 POS→
-----/-----°

←ACCEPT ALIGN    RETURN→
  
```

REF WPT - The reference waypoint from which a radial and distance may be used to define the location of the new pilot defined waypoint is entered here. The identifier will flash if it is not in either the NAV or the Pilot Defined Data Base. A fix may be entered either manually or by using the LIST key.

REF Waypoint Coordinates - If a REF WPT entry is made, these will be the coordinates of that waypoint location. However, a REF WPT entry need not be made because coordinates may be directly entered here from which radial and distance may be taken.

RADIAL/DIST - The cursor is first placed over the RADIAL field, however, if reference coordinates are not defined at line select key [2L] then [3L] is inoperative. When the reference coordinates are defined, the RADIAL/DIST fields are prefilled with the radial and distance of the coordinates at line select key [2R]. When the cursor is over the RADIAL field containing a valid entry and ENTER is press, the cursor will advance to the DIST field. If a manual entry is made in the DIST field, then the coordinates of the entered radial and distance from the reference waypoint are computed and displayed at [2R]. The cursor will advance to ACCEPT. If ENTER is pressed without a DIST entry, then the coordinates will still be computed (rho/theta) but the cursor will advance to the WPT field of the WPT/RADIAL line.

WPT/RADIAL - The cursor is placed over the WPT field when reference coordinates are defined at [2L] and a valid radial is at [3L]. Any data base fix may be entered either manually or by using the LIST key. A valid entry will advance the cursor to the RADIAL field. A valid radial entry will blank the DIST field at [3L]. The coordinates will be computed and displayed at [2R] using the two radial entries (theta/theta). Theta/theta position computation will compute and display the distance at [3L]. The ACCEPT option will appear after the name and coordinates for the waypoint have been defined at [2R].

ACCEPT - When valid coordinates are displayed for the WPT position, this option will become available. The ACCEPT line select key must be pressed twice to enter the defined waypoint into the data base.

WPT - The name of the waypoint being created or modified. The coordinate fields will be prefilled if waypoint is being modified otherwise it will be blank.

WPT Coordinates - This field shows the coordinates of the waypoint being defined. Position coordinates may be entered into this field directly or the field will display coordinates resulting from the reference waypoint computation.

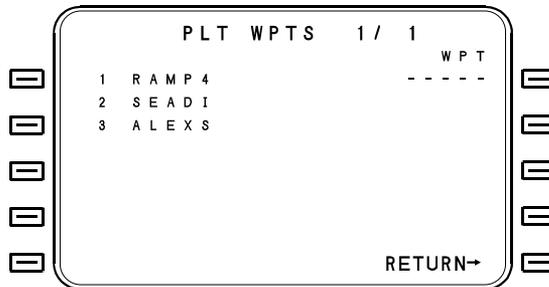
GPS POS - Pressing this line select key will accept, at the instant it is pressed, the GPS present position coordinates to define the position of the waypoint.

FMS# POS - Pressing this line select key will accept, at the instant it is pressed, the FMS present position coordinates to define the position of the waypoint.

Pilot Defined Waypoints

The PLT WPTS page(s) is accessed from the Data Base menu page (DATA page 1) by selecting the PILOT DATA and then WPTS option. When the page is accessed, a list of all pilot defined waypoints stored in the data base will be presented alphabetically. The PREV and NEXT keys provide access to other PLT WPTS pages.

Entry of an identifier in the WPT field will cause the DEFINE WPT page to be displayed. A maximum of five characters can be used to identify a pilot waypoint.



Define Position Pages

The DEFINE POSITION pages provide the means to define the coordinate location of a pilot defined airport, align point, or waypoint by directly entering the coordinates, by selecting FMS or GPS present position coordinates, or by defining the position in reference to another known waypoint location. The page title will reflect the category of waypoint being defined (ALIGN, ARPT, WPT, POS).

The DEFINE ALIGN Page is accessed by entering on undefined align point on the Initialization page, from the Position Menu page (line select key [2L]) or from the pilot defined alignment points directory and identification pages when MODIFY is selectable.

```
DEFINE ALIGN 
REF WPT WPT
----- ABCDE
N ---
W ---
RADIAL / DIST W ---
---.° / ---.° GPS POS→
WPT / RADIAL FMS1 POS→
←ACCEPT ALIGN RETURN→
```

The DEFINE POS page is accessed by pressing the FMS position field line select key on the NAV 2/2 page or the DATA 3/5 page. Positions, including waypoints, align points and airports can be defined by any of five different methods:

1. **Latitude/Longitude**, where the coordinates of the pilot defined waypoint are entered directly.
2. **Radial/Distance**, where a reference waypoint (which can be a waypoint, VOR, NDB or airport) is identified and a radial/distance offset is specified.
3. **Radial/Radial**, where two reference waypoints are identified, and the radial from each is specified. This method is useful, for example, in identifying the unnamed intersection of two airways.
4. **GPS Position**, where the present GPS position data are used to define the waypoint.
5. **FMS Position**, where the present FMS position data (best computed position) are used to define the waypoint.

To define a position by **Latitude/Longitude**:

1. Press the [2R] line select key to highlight the latitude field.

The screenshot shows a terminal-style menu titled "DEFINE POS" with a small square icon to its right. The menu is enclosed in a rounded rectangle. On the left and right sides of the menu, there are five pairs of horizontal lines, representing line select keys. The menu content is as follows:

```

DEFINE POS  [M]
REF WPT                WPT
-----                (POS)
N  - - - - -
W  - - - - -          N  32 38.80
RADIAL/DIST          W  - - - - -
- - - .° / - - - .°   GPS POS→
WPT/RADIAL
- - - - / - - - .°

←ACCEPT ALIGN      RETURN→
  
```

2. Enter the latitude (using the ± key as necessary to toggle the hemisphere between N and S) press ENTER.
3. The cursor will be expanded to enclose the longitude field.
4. Enter the longitude (again, the ± key will toggle the hemisphere between E and W) press ENTER.
5. The legend ACCEPT WPT will appear in the cursor block next to the [5L] line select key. Press either the [5L] line select key, or the ENTER key.

NOTE: The MENU key will provide the option of changing the entry resolution between tenths or arc-minutes, and hundredths of arc-minutes.

To define a position by **Radial/Distance**:

1. The cursor will appear over the REF WPT field when the Define Position page is accessed. Enter the name of the waypoint, navaid or airport from which the new waypoint will be derived. Press ENTER.
2. The confirmation page will display the location (and other applicable data) for the reference waypoint. The legend ACCEPT will appear in the cursor block next to the [5L] line select key. If there are two or more locations or facilities with the same identifier, the page title will indicate 1/2, 1/3, etc., additional locations can be displayed using the NEXT key. When the desired location of the reference waypoint is displayed, press the ACCEPT line select key or the ENTER key.
3. The cursor will move to the RADIAL field. Enter the radial (degrees and tenths - leading zeroes not required) from the reference waypoint on which the newly defined waypoint lies. Press ENTER.
4. The cursor will move to the DISTANCE field. Enter the new waypoint's distance from the reference waypoint (nautical miles and tenths - leading zeros not required). Press ENTER. The coordinates of the newly defined waypoint will be displayed.
5. The legend ACCEPT WPT will appear in the cursor block next to the [5L] line select key. Press either the ACCEPTWPT line select key, or the ENTER key.

To define a position by the **Radial/Radial** method:

1. The cursor will appear over the REF WPT field when the Define Position page is accessed. Enter the name of the first reference waypoint, navaid or airport from which the new waypoint will be derived. Press ENTER.
2. The confirmation page will display the location (and other applicable data) for the reference waypoint. The legend ACCEPT will appear in the cursor block next the [5L] line select key. If there are two or more locations or facilities with the same identifier, the page title will indicate 1/2, 1/3, etc., additional locations can be displayed using the NEXT key. When the desired location of the reference waypoint is displayed, press the ACCEPT line select key or the ENTER key.
3. The cursor will move to the RADIAL field. Enter the radial (degrees and tenths - leading zeroes not required) from the reference waypoint on which the newly defined waypoint lies. Press ENTER.
4. The cursor will move to the DISTANCE field. Do not make an entry in the distance field if you desire a Radial/Radial waypoint definition. Rather, press the [4L] line select key over the WPT field to identify the second reference waypoint. Enter the name or identifier of the second reference waypoint. Press ENTER.
5. The confirmation page will again appear displaying the location for the second reference waypoint. The legend ACCEPT will appear in the cursor block next to the [5L] line select key. Press ACCEPT or the ENTER key.
6. The cursor will move to the RADIAL field. Enter the radial (degrees and tenths - leading zeroes not required) from the second reference waypoint on which the newly defined waypoint lies. Press ENTER. The coordinates of the newly defined waypoint will be displayed.
7. The legend ACCEPT WPT will appear in the cursor block next to the [5L] line select key. Press either the ACCEPT WPT line select key, or the ENTER key.

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Data Base

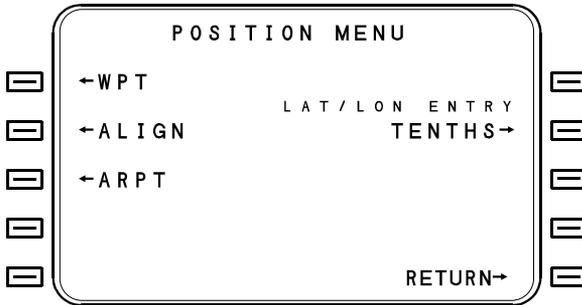
To define a waypoint by the **GPS Position** or **FMS Position** method:

1. Press the [2R] line select key to highlight the latitude field. The GPS POS and FMS POS legends adjacent to the [3R] and [4R] line select keys will illuminate in large orange font, indicating that these options have become available.
2. Press GPS POS or FMS POS as desired.

NOTE: The GPS POS option is only available when the GPS sensor is in NAV mode and supplying valid data. FMS position will be available any time the FMS has valid position data, regardless of the source.

POSITION MENU Page

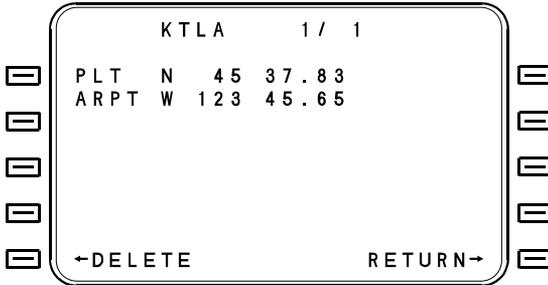
The POSITION MENU page is accessed from the DEFINE POSITION page by pressing the MENU key. This page allows the operator to define waypoints to 1/10th or 1/100th of a minute resolution. This feature allows position resolution to approximately 60 minutes and an accuracy of ± 30 feet, and is useful for defining precise runway touchdown points.



LAT/LON ENTRY- Pressing this line select key will allow selection of either tenths or hundredths of a minute resolution on the DEFINE POSITION page.

Pilot Waypoint Identification Page

This page is accessed by pressing DATA, the PILOT DATA line select key and the WAYPOINT line select key. This page displays the waypoint coordinates and provides the means to modify or delete the waypoint location.



DELETE - Pressing this line select key twice will delete the pilot defined waypoint from the data base.

MODIFY PLT - This line select key will access the DEFINE POSITION display to allow the waypoint location to be redefined.

NOTE: If waypoints are used in RTEs, FPL or approaches the MODIFY PLT line select key will be replaced by an IN USE XXX and may not be modified. DELETE will not be displayed.

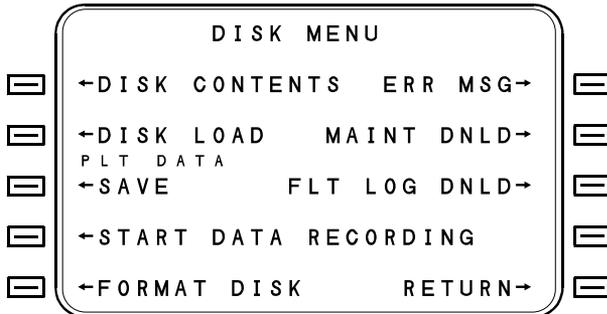
RETURN - This line select key will return the display to the Pilot Waypoints directory.

Pilot Data Save

The current version of the FMS Pilot-Defined Database can be written to a disk and will include the Pilot-Defined Waypoints, Align Points, Airports, Runways, SIDs, STARs, Approaches, and Routes as well as the reference databases associated with the SIDs, STARs, Approaches, and Runways. The FMS Flight Plan disk is loaded through the Data Transfer Unit (DTU). The DTU utilizes a 3 1/2" floppy disk as the input media for loading the data base.

NOTE: Before starting, ensure that the slot is clear of any previous disks and the protector is removed.

1. Press the ON key on the DTU. A 12 second self test will occur.
2. Press DATA function key for DATA Page 1/4. Press DISK line select key. The DISK MENU Page will appear.

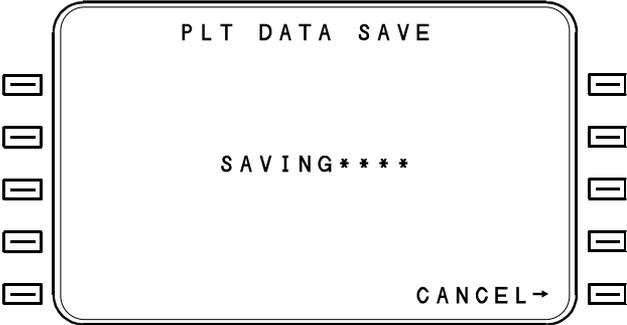


3. Insert Disk.
4. Press the FORMAT DISK line select key [5L] if required. Reformatting will be accomplished in approximately one minute.

NOTE: The disk must be formatted before pressing PLT DATA SAVE.

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- 5. Press the PLT DATA SAVE line select key [3L]. The PLT DATA SAVE Page will appear and the save process will begin for only the FMS from which the SAVE was requested. A separate disk is required for each FMS Pilot-Defined database to be saved.



Pilot Defined Data Base Disk Loading

Pilot Defined Database disk is loaded through the Data Transfer Unit (DTU) by using the same procedures as loading navigation data disks. Refer to Loading Data Base Disks, found earlier in this section. After CONTINUE is pressed the following page will appear.

DISK LOAD	
PILOT DATABASE	CREATED
CREATED BY	09-FEB-95
UNS FMS	
WAYPTS	----- ROUTES
ALN PTS	----- APPRS
AIRPRTS	----- SIDS
RUNWAYS	----- STARS
←LOAD	CANCEL→

When pilot defined diskettes from pilot data save on Off Line Flight Planning are loaded, the pilot data in the FMS will be replaced by data from the disk of the type contained on the disk.

COMPANY ROUTES DATA

A company routes data base can be created using Universal's Offline Flight Planning Program and may be contained on up to four disks. A total of up to 2000 routes and 250,000 route elements may be stored. 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 data base by use of reference pointers. Company routes can be given names of up to eight characters in length.

A company route data base must be loaded with the same Navigation data base that was used for its creation.

Company Routes Data Base Disk Loading

Company Routes Data Base disk(s) are loaded through the Data Transfer Unit (DTU) by using the same procedures as loading Navigation Data disks. Refer to Loading Data Base Disks, found earlier in this section. After CONTINUE is pressed, the following page will appear.

POS	DISK LOAD	MSG
	DISK 1 OF 4	
COMPNY DATABASE		EXPIRES
CREATED BY UNS	30-MAY-96	
OFFLINE FLTPLN		
DB VERSION		
AA REGION 07	CYCLE 044-E	
ROUTES	----	
←LOAD		CANCEL→

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INTRODUCTION

This section of the manual contains those FMS flight operating procedures designed to be used on a typical flight and are arranged in the order they would normally employed. This section also contains procedures, which may be used in the event of an electrical power failure, engine shutdown, or fuel flow system failure.

NOTE: Given the capabilities and versatility of the FMS, many programming options are available to the pilot through which the same results can be achieved. This section does not discuss all the possible programming options for each operation.

NOTE: Some differences may be observed between FMS displayed courses and those published on aeronautical charts. These differences are due to the fact that the charts are published using the VOR radials that define the route, whereas the FMS displays the computed course using local magnetic variation. FPL legs with XXX° displays may vary from the published data by the amount of difference between the defining VOR facility declination (i.e., the angle formed between the VOR 0° radial and True North) and the magnetic variation at the originating waypoint. Mag variation constantly shifts with time, whereas the station declination is constant until the station is realigned. Station declination may vary by several degrees from local mag variation, depending upon how long ago the station was realigned with local variation. Legs that have CRS XXX° or HDG XXX° displays on the FPL pages should agree with the published data on the charts, since these are provided as part of the navigation data base and are not computed by the FMS.

Intentionally left blank

PRE-DEPARTURE

Start-Up

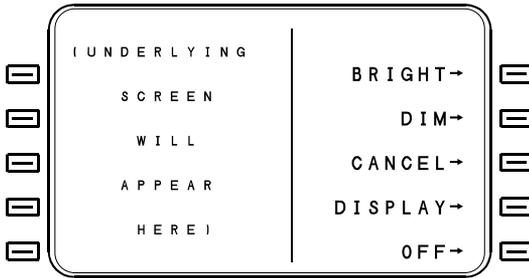
1. Press the ON/OFF key to activate the system. The system will come on and will self test. The self-test page will be displayed showing the results of each test performed. If the self test is successful, the Initialization page will appear. The line at the top of the page will indicate the name of the aircraft as programmed in the Configuration Module.

UNS	
CHALLENGER CL601 3A 162Y	
CPU / PROGRAM	PASS
RAM	PASS
DATABASE	PASS
CONFIG MODULE	PASS
AUXILIARY	PASS
ARINC	PASS
ANALOG	PASS

NOTE: Should a failure message appear while the system is going through self test, one of the following will occur:

- The self test page will not disappear if a serious failure of the FMS occurs.
- Failures of a minor nature will allow the pilot to continue with the initialization process after alerting the pilot of the failure. Press the MSG key to view the message. No other page, except the MSG page, may be viewed until the initialization process is completed.

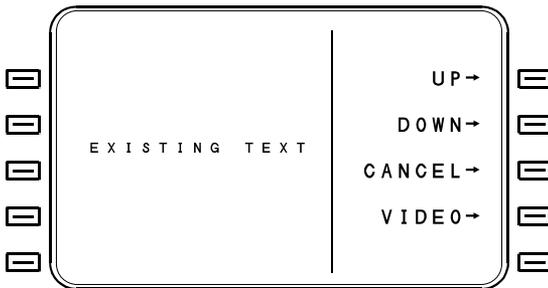
To adjust screen brightness:



1. Press the ON/OFF key again to access the dimming control window.
2. Hold the BRIGHT or DIM line select keys as necessary to change screen intensity.
3. Select the CANCEL line select key to return to the Initialization page.

To adjust display/key alignment:

1. Press the DISPLAY line select key to access the display option window.



2. Press the UP or DOWN line select keys as necessary to align display arrows with line select keys.
3. Select the CANCEL line select key to return to previous display.

To access VIDEO mode:

NOTE: VIDEO option is only available with certain CDU part numbers.

1. With the dimming control window displayed, press the DISPLAY line select key to access the display option window.
2. Press the VIDEO line select key to access the video mode. Active video source will be displayed.
3. Press any key to exit video mode.

INITIALIZATION

The Initialization page automatically appears at the end of the self test if the self test was passed without a fault, which would preclude use of the system.

Typically, the data shown on the Initialization page will be correct, as the position, date and time shown will be from the GPS (as indicated by <GPS> in the Ident field after the GPS transitions to NAV mode). For non-GPS installations, position will be the same as when the system was last powered down.

	POS	INIT 1/1	MSG	
			DATE	
[]	INITIAL POS	01-OCT-95		[]
	ID - - - - -		UTC	
[]	N 47 12.7	17:13:29		[]
	W 122 31.9			
[]	STANDARD/EXTENDED	XFILL→		[]
	NAV DATABASE EXPIRES			
[]	09-OCT-95	MSTR XFILL→		[]
	PERF DB	A12500		
[]	←ACCEPT FMC VER	602.0		[]

1. Press the ACCEPT line select key to accept the data.

If data shown is not correct:

3. Use the line select keys to place the cursor over the fields to be corrected or changed and proceed as follows:

- a) **POS** - Entering an ID (identifier) into this field will automatically update the INITIAL POS coordinates. Input the identifier using the LIST function or type the identifier into the cursor. With the IDENT entry field empty, pressing the ENTER key will access the

DEFINE POS page - Initialization data can be entered on this page in several different ways:

- i) Reference Wpt/Radial/Distance - The cursor will be defaulted to the REF WPT field. Enter a reference identifier, radial and distance. The resulting lat/long will be shown.
- ii) Latitude/Longitude - Press line select key to position cursor over latitude field. Enter latitude and longitude as required. N/S and E/W may be toggled with the ± key.
- iii) GPS Position - If the GPS in NAV mode, line select key [3R] will indicate GPS POS. Pressing this key will load GPS position into the latitude/longitude field. GPS POS is not displayed if a reference waypoint has been entered.

DEFINE POS			
REF	WPT		WPT
	TCM		(POS)
N	47 08.3		
W	122 28.5	N	47 03.37
RADIAL / DIST		W	122 28.51
	180.0° / 5.0		GPS POS
WPT	/ RADIAL		
	----- / ----- °		
←ACCEPT		RETURN→	

b) **DATE** - Enter the date at the zero meridian numerically (DDMMYY).

c) **UTC** - Enter Coordinated Universal Time (hours:minutes).

Press the ACCEPT line select key to accept the initialization data. All data will turn green; indicating that initialization is complete.

NOTE: In the event it is noted that one of the entries on the initialization page was entered in error, (and prior to leaving the initialization page) the erroneous field can be easily corrected as described above by repeating the appropriate steps.

Crossfill Options

Three types of data can be crossfilled from one FMS to the other FMS(s): initialization, flight plan and fuel data. These can either be crossfilled separately or all at once. Crossfill can be configured at installation to either PULL data to the requesting FMS or PUSH data to the receiving FMS. The default crossfill configuration is PULL.

Master Crossfill

The MSTR XFILL prompt will only appear if the master crossfill option is configured, when there are two or more FMSs installed and all data (initialization, fuel and flight plan) on the other system is valid.

The MSTR XFILL function will crossfill flight plan, fuel and initialization data to or from the other FMS. During crossfill, a graphic screen labeled CROSSFILL RECEIVE IN PROGRESS will be displayed on the appropriate FMS.

The MSTR XFILL prompt is available on either the Initialization Page or the DATA 1/4 page.

Using MSTR XFILL is simply a matter of entering all initialization, fuel and flight plan data on one FMS, and then selecting MSTR XFILL on the appropriate FMS(s), then pressing the ACCEPT line select key.

Crossfill

The XFILL prompt will appear in both single and multiple FMS installations and can be used in lieu of or in the absence of MSTR XFILL.

The XFILL prompt allows separate crossfill of initialization, flight plan and fuel data. The prompt appears on the Initialization page, Flight Plan page and Fuel Options page (accessed by FUEL/MENU).

Using XFILL is simply a matter of entering the applicable data and then selecting the applicable XFILL on the blank system. If the XFILL data is initialization data, then ACCEPT line select key will need to be pressed to complete crossfill.

Crossfill of Flight Plan During Flight

Whenever the flight plan is modified during flight, the modified flight plan can be crossfilled to the other FMS by pressing FPL-MENU-XFILL FPL on the appropriate FMS. The new flight plan will replace the old one, and the current FR-TO leg will be automatically linked to the new flight plan if it is contained in that flight plan. If it is not, you must do a manual FR-TO leg change on NAV page 1 or else, a Direct To a waypoint in the new flight plan.

Flight Plans - General

The following discussions give some insight into flight plan and route construction.

Flight plans are created on the flight plan pages. They are created using the same procedures as for the creation of PILOT ROUTES in the data base. The flight plan is the sequence of waypoints the FMS will use to navigate the aircraft along the desired track. The flight plan selected for a particular flight is usable only for that flight unless stored as a route. They are not stored in non volatile memory and are erased at system shutdown. The pilot normally has three options to install a flight plan. He can create a flight plan on the flight plan pages, cross fill from another FMS or Copy a Route from the Pilot or Company Data bases.

FPL Title Lines

The key to many of the Route and Flight Plan procedures lies in understanding the title line of each page display. The following definitions will help one understand exactly where he is in a given procedure and ease the overall workload.

ROUTE - This page heading is for the descriptive data concerning one particular ROUTE. These pages must be accessed (from the ROUTES catalog) to make permanent changes to the ROUTE which is stored in the data base.

FPL - This is the display of FLIGHT PLAN waypoints, usually copied from a data base stored ROUTE, which is used for navigation of a single flight. Changes made to the FPL pages will not affect the ROUTES stored in the data base.

COPY ROUTE - This display of routes is provided for initially selecting a stored ROUTE to be copied into the FPL or into another ROUTE.

FPL MENU and ROUTE MENU - These pages are used to select the various format options for display of a FPL or a ROUTE. The NORMAL option is the only format that will allow changes to be made. Selection of any of the other options on this page will provide additional detailed information concerning the ROUTE or FPL.

Procedure Format

The procedures in this manual are presented in the familiar "by-the-numbers" format.

Insofar as possible, the line select keys are always referred to by the title of the field or option with which they are associated. Options are displayed in orange and usually have an arrow pointing to the associated line select key. Generally, the cursor is moved onto a data entry field through the use of the line select keys. However, in some cases, the cursor will automatically position on the next logical entry field.

Data Entry

Data is manually entered in two steps. First, the data is input onto the displayed page into the cursor entry field. Once correct, the cursor's data is stored in the computer by pressing the ENTER key. **Until the ENTER key is pressed, the value in the cursor has no effect on other parameters in the computer.** Some cursor fields, such as latitude and longitude entry fields, are restricted to numeric input only. Waypoint identifiers may be input onto the cursor by using any of three input processes: the Reference Number Input Process, the List Input Process, and the Direct Entry Process.

Reference Number Input Process

This is the normal input process, and is built into many of the following procedures. At appropriate times, the pilot is presented with a list of selections on the display. These will often be waypoint identifiers; however, the list is also used for the selection of routes, nav aids, etc. as appropriate. Each option is preceded by a reference number, which is used to make the selection.

The selection is made by inputting the reference number into the cursor and then pressing the ENTER key.

- NOTE:**
- If the desired choice is not among those shown on the display page, pressing the PREV or NEXT key to page forward or backward will display additional choices when available.
 - If the reference number input into the cursor is in error, pressing the BACK key will delete the entry.
 - Pilot defined waypoint identifiers are displayed in a light green color.

List Input Process

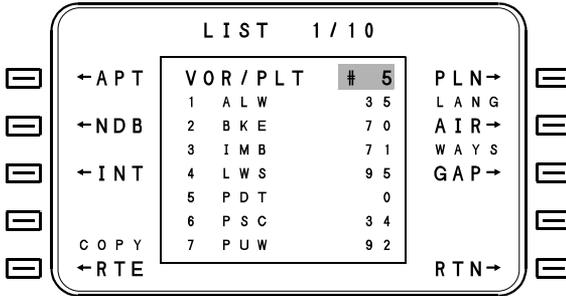
This is the process which is the easiest to use in the event that the Reference Number input process does not present the desired waypoint identifier as one of the available choices.

With the cursor over a waypoint entry field, pressing the LIST key will cause the Normal LIST page to appear. A list of numbered selections appropriate for the entry field will be displayed in a window, and other LIST categories will be displayed next to the line select keys. Any LIST category can be placed in the LIST window by pressing the corresponding line select key.

- NOTE:** In selecting waypoint identifiers, routes, or NAVAIDs as the LIST categories of possible choices, all efforts are made to use the computer's power in order to present the most optimum lists possible. For example, in selecting a flight plan from amongst the many possible stored routes, the lists presented will begin with those routes originating closest to the departure airport.

LIST Page

The Normal LIST page displays the selected list and presents options for selecting other lists. The page is accessed by pressing the LIST key whenever the cursor is over any field where a data base item is normally entered.

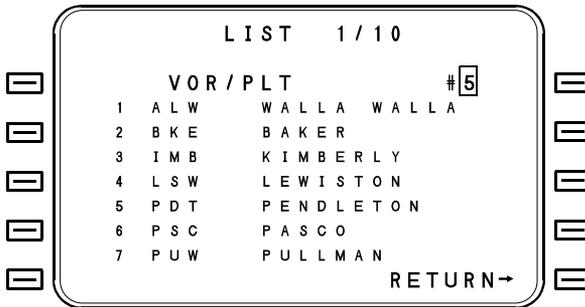


The selectable lists are displayed next to the line select keys. A control window is located in the center of the display. Any list may be placed into the control window by pressing the line select key for that list. The selectable lists are; APT (airports), NDB, INT (intersections), COPY RTE (routes), Airways and VOR/PLT (a mixture of VORs and pilot defined waypoints). PLN LANG (plain language) is displayed in place of APT, VOR/PLT or NDB if those are displayed (see below).

GAP - Pressing this line select key when the page has been accessed from a FPL or ROUTE page will insert a gap (*GAP*) into the flight plan or route.

CAUTION: When a GAP has been inserted, the flight plan will *not* auto-sequence to the next leg. Rather, the aircraft will fly an extension of the last leg with NAV and VNAV flags out of view on the HSI. **IT IS THE RESPONSIBILITY OF THE PILOT TO TAKE APPROPRIATE ACTION TO CONTINUE ACCURATE NAVIGATION OF THE AIRCRAFT.** He may go "Direct To" or edit the gap out of the flight plan.

List Function-Plain Language



By pressing the PLN LANG line select key when APT, VOR/PLT or NDBs are listed, the plain language name of the APT, VOR or NDB will be displayed (up to 15 characters). The reference number can still be used to select the desired item.

Direct Entry Process

Both of the first two input processes call for the selection of one number to input an entire waypoint identifier. They were designed to minimize the requirement for "typing" in each alphanumeric character of an identifier. In those cases where the typing requirement is unavoidable, data entry is accomplished by simply typing in the required data and then pressing the ENTER key.

If the identifier is in the data base, a Waypoint Identification page for that identifier will appear. This page will show the identifier's position coordinates and other pertinent data about the identifier.

- If the coordinates shown are correct, pressing the ENTER key or the ACCEPT line select key will confirm that the correct waypoint is being used.
- If the coordinates shown are incorrect and the identifier was spelled correctly, there is more than one identifier in the data base with that identifier. If this is the case, the fraction adjacent to the identifier's name will read something other than 1/1. Press the PREV or NEXT keys to access the other Waypoint Identification pages. When the desired waypoint is located, pressing the ENTER key or the ACCEPT line select key will confirm this as the correct waypoint for data entry. If the desired data is not located, a pilot waypoint can be defined by selecting the CREATE PLT option.

If the identifier is not in the data base, the DEFINE WPT page will be displayed so that pilot defined waypoint (PILOT WPT) can be entered. A PILOT WPT can be defined by any of three methods:

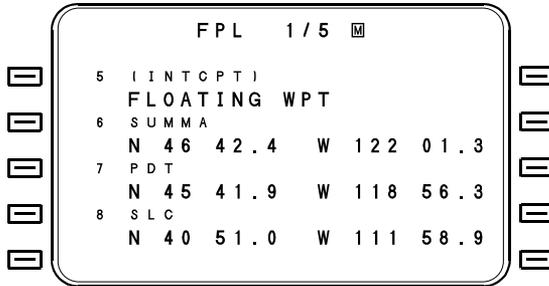
1. **Latitude/Longitude**, where the coordinates of the pilot defined waypoint are entered directly.
2. **Radial/Distance**, where a reference waypoint (which can be a waypoint, VOR, NDB or airport) is identified and a radial/distance offset is specified.
3. **Radial/Radial**, where two reference waypoints are identified, and the radial for each is specified. This method is useful, for example, in identifying the unnamed intersection of two airways.

Once defined this waypoint will be stored in the Pilot data base.

Flight Plan and Editing

After initialization the system is ready to accept a flight plan. Proceed as follows

1. Press the FPL key to access FPL 1/1.



The cursor will appear over an empty field and ready to accept waypoint number "2". Waypoint number "1" will prefill with the airport from the initialization process. UniLink RTE and COPY CO RTE will only be present if the system is configured for these options.

2. Using the direct entry process type in the identifier for the waypoint or press the LIST key and locate the desired waypoint and press the ENTER key. The NEXT and PREV keys will page through 10 pages of waypoints the closest waypoints. The cursor will move to the next waypoint.
3. To insert an airway, insure that the previous waypoint is on the desired airway.
 - a) Press the LIST key to access the LIST page and the AIRWAYS line select key to list the airways. Enter the reference number of the desired airway.
 - b) Enter the airway terminator on the airway terminator page and return to the FPL page.

Continue entering waypoints into the flight plan via the LIST function or direct entry to the destination airport.

Designate Fly-Over Waypoint

An overfly waypoint is a waypoint which will cause the navigation computer to delay making an automatic leg change until the aircraft is directly overhead. An overfly waypoint is indicated by an asterisk (*) following the waypoint identifier on the flight plan display page. The following procedure may be used to designate a flight plan waypoint as an overfly waypoint.

1. Press the FPL key to access the FPL page. If the desired waypoints are not displayed, use the PREV and NEXT keys to page through the flight plan to find the desired waypoint.
2. Use the line select keys to position the cursor over the waypoint to be defined as an overfly waypoint.
3. Press the OVFLY line select key. An asterisk will appear after the waypoint identifier.
4. To remove, the “*” press the same line select key now labeled CNCL OVFLY.

Add Waypoint To Flight Plan

1. Press the FPL function key to access the first FPL (Flight Plan) page. If the desired waypoints are not displayed, use the NEXT and PREV keys to display additional flight plan waypoints.
2. Use the line select keys to position the cursor over the waypoint, which will follow the new waypoint.
3. Enter the new waypoint using the LIST function or by typing in the identifier. When the new waypoint is entered, it will be inserted in the position selected and the waypoint under the cursor will have advanced to the next position.

Delete Waypoint(s) From Flight Plan

1. Press the FPL function key to access the first FPL (Flight Plan) page. If the desired waypoints are not displayed, use the NEXT and PREV keys to display additional flight plan waypoints.
2. Use the line select keys to position the cursor over the waypoint to be deleted.
3. Press DEL line select key twice.

NOTE: If it is desired to delete the remainder of the flight plan, enter a reference number greater than the reference number of the last waypoint on the flight plan. **Do not enter 99 or the entire flight plan will be deleted.**

Change Waypoint In Flight Plan

1. Press the FPL function key to access the first FPL (Flight Plan) page. If the desired waypoints are not displayed, use the NEXT and PREV keys to display additional flight plan waypoints.
2. Use the line select keys to position the cursor over the first waypoint to be changed.
3. Press DEL line select key twice.
4. Enter the new waypoint using the LIST function or by typing the identifier. When the new waypoint is entered, it will be inserted at the position selected and the waypoint under the cursor will advance to the next position.

Delete Entire Flight Plan

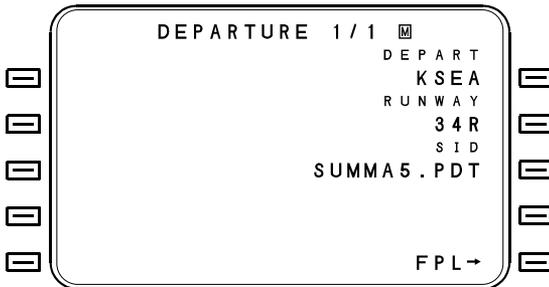
The following procedure will remove the entire flight plan. If this is done during flight, the current navigation leg will remain active. The normal NAV page will display the FR and TO waypoints active when the flight plan was deleted. The NX identifier will, of course, be deleted.

1. Press the FPL function key to access the first FPL (Flight Plan) page.
2. Press MENU key.
3. Press DELETE FPL line select key twice.

Linking a SID into a Flight Plan

If a SID has been issued as part of the ATC clearance, it may be linked into the flight plan.

1. From any FPL page press the MENU key
2. On FPL MENU page 1/2 press DEPART to access the DEPARTURE page
3. The DEPARTURE page will prefill with the departure airport. At the RUNWAY line select key enter the reference number of the runway to be used. The cursor will advance to the SID field and a list of available SIDs will appear.
4. Select the SID by entering the reference number. A list of transitions will appear.
5. Select a transition by entering the reference number. The final screen should appear as follows:



Press the FPL key to return to the active flight plan. The procedural legs of the SID will now be a part of the flight plan as shown on the following page.

ANY TIME A SID, STAR OR APPROACH IS LINKED INTO THE FLIGHT PLAN, THE PILOT SHOULD REVIEW THE RESULTING FLIGHT PLAN TO VERIFY THAT IT IS CONTINUOUS WITH NO GAPS OR DUPLICATED WAYPOINTS, AND THAT IT CONFORMS TO THE INTENDED PATH OF FLIGHT.

FPL 2 / 5	
5	(INTCPT) CRS 143°
6	SUMMA 098°
7	PDT 14 : 37 117° 172 NM
8	BOI 15 : 07 @ FL 370 110° 250 NM
9	SLC 15 : 37 @ FL 370

In the example above, the KSEA SUMMA5 departure with Pendleton transition would read as follows:

Maintain heading 340 until 829 feet, and then course 343 from SEA until passing DME 8 at or above 4000 feet. Then turn right to heading 070 until intercepting the 143 radial of Payne VOR, then turn right to heading 175 to intercept the 143 course into SUMMA intersection, then direct PDT. The remainder of the enroute portion can be entered manually or by using the LIST AIRWAYS feature.

Flight Plan Summary

Available during ground operations prior to departure, the Flight Plan Summary page provides a synopsis of distance, time, and fuel requirements for the planned flight.

FPL SUMMARY			
DEPART			ARRIVE
KLAX	746 NM		KDEN
ETD UTC		ETA UTC	
21:30	1+41	23:11	
-8 LCL		-7 LCL	
13:30		16:11	
TAS (MAN)		RESERVES	
451		1600	
FF (MAN)	LBS	MIN FUEL	
1200		3632	

1. Press the FPL function key to access the FPL mode.
2. Use the PREV and NEXT keys to access the FPL SUMMARY page (located following the last flight plan page).
3. Use the line select keys to position the cursor over each entry field and enter the planned data as follows:

ETD UTC - Enter the estimated time of departure in UTC (Coordinated Universal Time) format. If desired, this may be skipped by pressing the ENTER key and entering the ETD according to local time. The cursor will then advance to the local time zone difference entry field.

Enter the local time zone difference from the zero meridian (up to \pm 13 hours). The time zone sign (\pm) will be prefilled according to the longitude of the first waypoint on the flight plan. The cursor will advance to the local time entry field allowing entry of ETD according to local time.

If the local time zone difference from the zero meridian was not correctly entered it can be changed. To alter the value, use line select key [2L] to place the cursor on the ETD UTC entry field. Press the ENTER key to advance the cursor to the time zone difference entry field and enter the correct value.

ETD LCL - Entry of the estimated time of departure may be made according to the local time zone.

TAS (MAN) - Entering the estimated true airspeed (in knots) will cause the ETE and ETA values to be displayed. This value of TAS will be applied to each leg in the flight plan and will take into account any wind information that has been entered for waypoints in order to predict a groundspeed for each leg.

FF (MAN) - Enter the estimated fuel flow, which will be used to compute minimum fuel (MIN FUEL).

ETA UTC - A manual entry of ETA will change the displayed ETD according to the ETE. Enter the local time zone difference from the zero meridian (up to ± 13 hours). The time zone sign (\pm) will be prefilled according to the longitude of the last waypoint on the flight plan (prior to a gap). The cursor will advance to the local time entry field allowing entry of ETA according to local time.

If the local time zone difference from the zero meridian was not correctly entered it can be changed. To alter the value, use line select key to bring the cursor onto the ETA UTC entry field. Press the ENTER key to advance the cursor to the time zone difference entry field and enter the correct value.

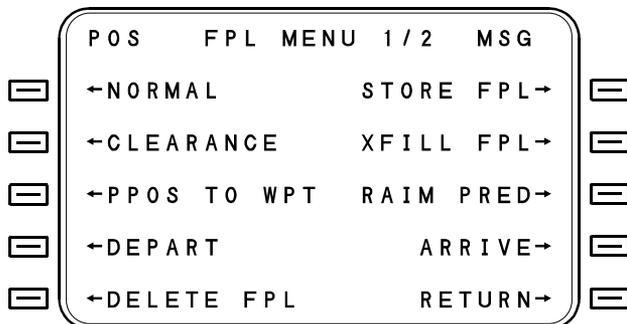
ETA LCL - Entry of the estimated time of arrival may be made according to the local time zone.

RESERVES - The estimated reserve fuel, which is used to compute the MIN FUEL value.

Flight Plan Options

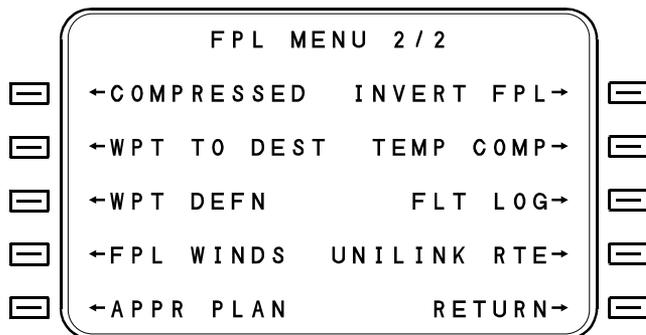
The FPL MENU pages allow the pilot to select various display formats for the flight plan, and perform other functions. To access the FPL MENU pages:

1. Press the FPL key to access a FPL page.
2. Press the MENU key.



Normal Flight Plan Display - NORMAL

Pressing the NORMAL line select key will return the display to the normal FPL display.



Clearance Language Flight Plan Display – CLEARANCE

Pressing the CLEARANCE line select key in clearance language, that is the SID, Airway sequence, STAR and Approach.

FPL CLR 1 / 2 M			
1	KSEA	RW 16 L	DEP →
	SUMMA 5 . LKV		
2	LKV		
	2 5 3 °	1 0 6 NM	
3	OED		
	J 1		
4	FIM		APR →
	FIM . S A D D E S		
5	SMO		RTN →

FPL CLR 2 / 2 M			
	FIM . S A D D E S		
5	SMO		DEP →
	SMO . I L S 2 5 R		
6	KLAX	RW 2 5 L	
			APR →
			RTN →

Present Position to Waypoint - PPOS TO WPT

	F P L	2 / 3	M	
	P P O S	T O	W P T	
		<u>D I S T - N M</u>	<u>T I M E</u>	
4	(R - 1 4 3)			
5	) ( I N T C P T)			
6	S U M M A	8 8 . 2	0 + 1 2	
7	P D T	2 3 0 . 2	0 + 3 1	
8	S L C	6 5 1 . 3	1 + 2 7	
9	D E N	9 8 2 . 8	2 + 1 1	
1 0	S T L	1 6 5 5 . 1	3 + 4 1	

Pressing the PPOS TO WPT line select key will display distance and time from present position to each flight plan waypoint. No changes or entries may be made in this format. The PREV and NEXT keys are used to page through the flight plan waypoints.

Compressed Flight Plan Display - COMPRESSED

	F P L	2 / 3	M	
4	(R - 1 4 3)	1 3	A T L	
5	) ( I N T C P T)	1 4	J V C	
6	S U M M A	1 5	O R L	
7	P D T	1 6	F L L	
8	S L C	1 7	(V E C T O R S)	
9	D E N	1 8	* R N V 2 7 R *	
1 0	S T L	1 9	B A S H O	
1 1	L I T	2 0	A G L E R	
1 2	M E M	2 1	+ 1 . 1	

Pressing the COMPRESSED line select key on FPL MENU 2/2 will allow viewing of the maximum number of flight plan waypoints (up to 18) at one time. The current TO waypoint is shown on the first page with a caret (>). No changes or entries may be made in this format. The PREV and NEXT keys are used to page through the flight plan, one half page at a time.

Waypoint to Destination - WPT TO DEST

F P L 2 / 3 <input type="checkbox"/>	
P P O S T O K M I A	
	<u>D I S T - N M</u> <u>T I M E</u>
4	(R - 1 4 3)
5	) ( I N T C P T)
6	S U M M A 2 7 6 4 . 2 6 + 0 8
7	P D T 2 6 2 2 . 2 5 + 4 9
8	S L C 2 2 0 1 . 1 4 + 5 3
9	D E N 1 8 6 9 . 6 4 + 0 9
1 0	S T L 1 1 9 7 . 3 2 + 3 9

Pressing the WPT TO DEST line select key on FPL MENU 2/2 will display the distance and time from each waypoint to the destination. No entries or changes may be made in this format. The PREV and NEXT keys are used to page through the flight plan waypoints.

Waypoint Definition - WPT DEFN

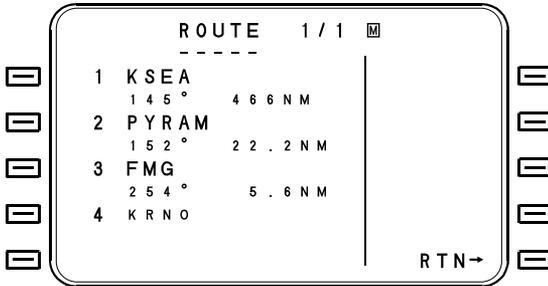
F P L 1 / 5 <input type="checkbox"/>	
5	(I N T C P T)
F L O A T I N G W P T	
6	S U M M A
	N 4 6 4 2 . 4 W 1 2 2 0 1 . 3
7	P D T
	N 4 5 4 1 . 9 W 1 1 8 5 6 . 3
8	S L C
	N 4 0 5 1 . 0 W 1 1 1 5 8 . 9

Pressing the WPT DEFN line select key on FPL MENU 2/2 will display the coordinates of every flight plan waypoint, or "FLOATING WPT" in the case of procedural legs. No entries or changes may be made in this format. The PREV and NEXT keys are used to page through the flight plan waypoints.

Delete Flight Plan - DELETE FPL

Pressing the DELETE FPL line select key twice will delete all waypoints in the active flight plan.

Store Flight Plan - STORE FPL



When STORE FPL line select key is pressed, the display will show the PLT RTE screen with the cursor over the route name field. The current flight plan is now saved as a route in the Pilot Data Base. The destination can be changed to any eight character name to uniquely identify this particular route.

Crossfill Flight Plan (Multiple System installations) - XFILL

Pressing the XFILL line select key will crossfill a flight plan modified on one system to the other. Each system may be configured to PUSH or PULL flight plan data from one system to the other. Check with the Aircraft Flight Manual Supplement the specific configuration.

Invert Flight Plan - INVERT FPL

Pressing the INVERT FPL line select key twice will delete any SID, STAR or Approach from the current FPL, then invert it. The operator must perform a manual FR/TO leg change (or go DTO) to use the new FPL.

Flight Plan Winds

Wind information may be added to individual waypoints in the flight plan in order to provide a more accurate estimate of the trip duration and ETA. Once winds are entered, a manual TAS can be entered on FPL SUMMARY page, and the resulting ETA at destination will be calculated. Once airborne, current TAS will be assumed to be constant for the trip, and the ETA's at each waypoint will be displayed.

To enter FPL winds:

1. Select FPL WINDS on FPL MENU 2/2:
2. Use the line select keys to place the cursor over the waypoints and enter the wind direction. The cursor will advance to the velocity field
3. Enter the velocity. Use the PREV and NEXT keys to access the waypoints.

In flight, when a waypoint with manually entered or a calculated wind becomes the TO waypoint, the manual or calculated wind will be overridden by the current FMS wind and displayed as normal data. Winds at downstream waypoints will be automatically recalculated.

FPL WIND		1 / 2	M
1	K SEA		
	0 . 9 NM		
2	) SEA	2 8 5 T /	2 0
	1 0 1 NM		
3	BTG	(M) 2 6 0 T /	8 0
	2 1 8 NM		
4	LMT	(2 7 8 T /	8 8)
	1 7 3 NM		
5	REO	(M) 2 9 0 T /	1 1 0

All winds must be entered as True, and magnitude in knots. It is not necessary to enter a wind for each waypoint. If a wind is not entered for intermediate waypoints, then the FMS will compute an interpolated wind using manually entered winds at the beginning and ending waypoints of the sequence. These may be overwritten at any time.

WEIGHT and FUEL Initialization

The aircraft's zero fuel weight, reserve fuel, and total fuel on board are entered on FUEL page 1. The zero fuel weight and total fuel on board are used by the system to compute the aircraft's gross weight. Zero fuel weight may be entered directly or may be computed by entering the basic operating, passenger, and cargo weights. Reserve fuel may be entered directly or may be computed by entering the fuel required to the alternate, holding fuel, and extra reserve. Total fuel on board may be entered directly or computed by entering the individual tank fuel loadings. With dual FMS installations, fuel data will crossfill from one system to the other.

FUEL		1 / 5	☐
BASIC WT	LBS	ALTERNATE	
10025		1000	
PAXI 4) @ 175		HOLD	
700		400	
CARGO		EXTRA	
220		200	
ZFW	TOTAL RESRVS		
10945		1600	
GROSS WT	FUEL ONBOARD		
16845		5900	

1. Press the FUEL function key to access FUEL page 1. The BASIC OP WT and reserves plan values will be prefilled with the values last used.

2. Use the line select keys to position the cursor over each entry field and enter the initial aircraft loading data as follows:
 - a) **ZFW** - Enter the aircraft's ZFW (Zero Fuel Weight) in pounds or kilograms. If desired, the ZFW can be computed by using the line select keys to alternately select the BASIC WT, PAX, and CARGO entry fields and entering the individual values.
 - b) **TOTAL RESRVS** - Enter the total fuel reserves for the planned flight in pounds. If desired, the total reserves may be computed by using the line select keys to alternately select the ALTERNATE, HOLD, and EXTRA entry fields and entering the individual values.
 - c) **FUEL ONBOARD** - Depending upon the option selected on the FUEL OPTIONS page, total fuel is entered as a total or is calculated from the individual tank entries. If the BY TANK option was selected, a separate page will be displayed for entering the individual tank values.

FUEL MENU - If a conversion between pounds, kilograms, U.S. Gal., Imperial Gal., or Liters is required, pressing the MENU key while on any FUEL page will access the FUEL OPTIONS page. Entering a known value will cause the other values to be calculated and displayed. The weight/volume conversion is based upon a fuel density of 6.7 lb./gal. The method of entering the total fuel on board is selected on this page using the BY TANK or BY TOTAL line select keys. If the cross-side FMS has already been initialized with fuel data, it may be crossfilled into this FMS by pressing XFILL line select key.

FUEL OPTIONS	
L B S -----	XFILL→
K G S -----	
U S G A L -----	F U E L E N T R Y
	BY TANK→
I M P G A L -----	A V G P A X W T

L I T E R S -----	
	RETURN→

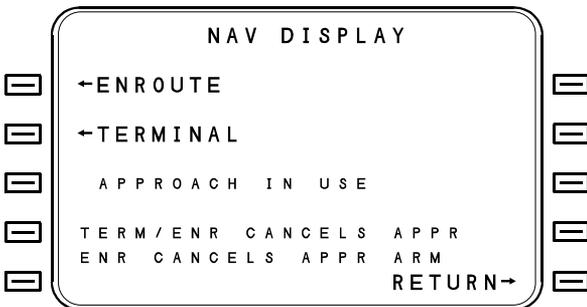
FLIGHT INSTRUMENT INTERFACE

HSI Course Deviation Scaling

The FMS provides both analog and digital deviation information for display on the flight instruments. Where analog data are utilized (for example, with electro-mechanical flight instruments), instrument display sensitivity is determined solely by the FMS. EFIS equipment may use the digital deviation data, in which the display sensitivities will be determined by the EFIS computer.

Deviation Display Sensitivity Selection

Crosstrack instrument display sensitivity is selectable by the crew when desired by using the NAV DISPLAY page. This page is accessed from the NAV MENU page by selecting NAV DISPLAY.



The active mode will be displayed in small font with the text "IN USE" next to it. The other two line select key prompts will be displayed in large font with prompt arrows.

CAUTION: SELECTING ENROUTE OR TERMINAL DURING APPROACH MODE WILL CANCEL THE APPROACH MODE.

ENROUTE - Pressing this line select key will create a display sensitivity of ± 5.0 nm. Selecting ENROUTE will cancel the approach mode if it was active. If APPR ARMED is active when this selection is made, APPR ARMED will cancel. "IN USE" will appear next to ENROUTE when selected.

TERMINAL - Pressing this line select key will create a display sensitivity of ± 1.0 nm. Selecting TERMINAL will cancel the approach mode if it was active. "IN USE" will appear next to TERMINAL when selected.

APPROACH - Pressing this line select key will create a display sensitivity of ± 0.3 nm. "IN USE" will appear next to APPROACH when selected.

Intentionally left blank.

ENROUTE

Flight Plan Navigation

Once the flight plan is entered and the system in the NAV mode, it is ready to navigate the aircraft along that flight plan. No further entries or procedures are necessary. GPS and IRS sensors will be selected on the ground as shown on DATA 2/4. All other sensors will be deselected until the aircraft is airborne. Other sensors are selected via a landing gear squat switch at takeoff. In the event of a squat switch failure the sensors select at 150kts TAS.

Whenever the current navigation leg is valid (TO waypoint displayed on the NAV page) and the position is certain, the HSI flag will be out of view and the desired track and related data will be displayed. Roll steering outputs for flight guidance will be available if the navigation leg and velocity are valid. Velocity will be valid if IRS velocities or heading and TAS are available to the navigation computer. Once coupled to the autopilot, the FMS will navigate the aircraft along a great circle legs between flight plan waypoints. Care should be taken when coupling to the autopilot. In most cases after takeoff, the aircraft will be some distance from the first leg on the flight plan and coupling can result in a major heading change as the FMS steers the aircraft to a 45° intercept of the active FROM-TO leg.

HSI Display

The HSI will display lateral deviation from the current NAV leg. For normal FROM/TO legs where the FROM and TO waypoints are fixed waypoints the course indicator on the HSI or EHSI on an EFIS display will agree with the great circle course between the waypoints. Course deviation will be displayed in the usual manner with full scale deflection of the HSI course needle equal to 5nm when ENROUTE sensitivity is in use.

Certain procedures found in SIDs and Missed Approaches contain legs that are not made up of fixed waypoints but a series of flight path instructions that have no fixed terminator. These include Course to an Altitude or a Heading to a Radial legs. In these situations the system calculates a predicted waypoint based on the aircraft's current trajectory. This predicted waypoint will be displayed on the EFIS and the HSI will display cross track deviation to the predicted waypoint. When a heading is specified in a procedure, the HSI will display a centered needle. The bearing pointer will indicate the proper procedural heading.

NAV Function

The NAV key is used to access the navigation function display pages. There are normally two NAV pages; however, when another NAV mode such as APPROACH or HEADING is selected there will be two or more display pages, which are cycled through by pressing the PREV or NEXT function keys.

FMS Computed Courses versus Published Courses

Some differences may be observed between FMS displayed courses and those published on aeronautical charts. These differences are due to the fact that the charts are published using the VOR radials that define the route, whereas the FMS displays the computed course using local magnetic variation. FPL legs with XXX° displays may vary from the published data by the amount of difference between the defining VOR facility declination (i.e., the angle formed between the VOR 0° radial and True North) and the magnetic variation at the originating waypoint. Mag variation constantly shifts with time, whereas the station declination is constant until the station is realigned. Station declination may vary by several degrees from local mag variation, depending upon how long ago the station was realigned with local variation. Legs that have CRS XXX° or HDG XXX° displays on the FPL pages should agree with the published data on the charts, since these are provided as part of the navigation data base and are not computed by the FMS.

Displays on the NAV page of the FMS for the current leg are displayed using the current position magnetic variation so that the proper desired track is displayed at all times using the magnetic referenced instruments on board the aircraft. Minor differences between the FMS computed courses and those on the published charts have no effect on navigation accuracy, since the FMS provides its position solutions based solely on latitude/longitude calculations.

NAV Page 1 (Normal NAV)

The page is accessed from any mode by pressing the NAV key. The page provides complete information about the current and next navigation legs, and allows the pilot to alter the current navigation leg or select another lateral guidance mode.

NAV 1 / 2 			
	FR SUMMA	17:44	HDG→ 
	146° 243		
	TO LKV	18:23	MNVR→ 
	150° 101NM	0+16	
	NX HARTT	18:40	
	XTKIEJ	L0.00	GS 380 
	TAILWIND	2	BRG 146° 
	WIND 343T/	9	TKE R000° 

FR - The waypoint identifier and time overhead the FROM (FR) waypoint, or the takeoff time for the first leg. Time overhead is defined by automatic leg change. Additional navigational data concerning the leg between the FR and the TO waypoints is displayed on the line below the FR waypoint.

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- **The Great Circle Distance**, expressed in nautical miles, between the aircraft's present position and the TO waypoint.
- **The desired track** (course) between the FR and the TO waypoints. A degree sign (°) signifies a magnetic course and a "T" designates a true course. The selection of True or Magnetic is made with the panel mounted Mag/True selector switch, so the FMS will reflect what is displayed on the HSI.
- **The estimated time enroute**, in hours and minutes, between the aircraft's present position and the TO waypoint. If the time is greater than 99:59, ++. ++ will be displayed.

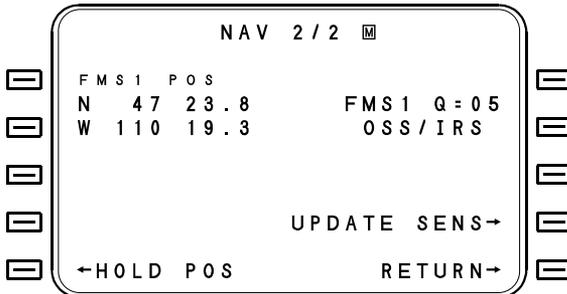
TO - The TO waypoint identifier and the ETA for that waypoint. The Great Circle Distance, course, and ETE between the TO and the NX waypoints is presented on the line below the TO waypoint.

NX - The next waypoint on the flight plan after the current leg and the ETA for that waypoint. The ETA field will be dashes if the next waypoint is a GAP.

XTK - Crosstrack. This is the lateral distance in NM left (L) or right (R) of the extended course centerline between the FR and TO waypoints. A maximum of 99.9 NM may be displayed. (E) represents enroute scaling (5.0 nm); (T) represents terminal scaling (1.0 nm); and (A) represents approach scaling (2° or 0.3 nm whichever is greater). Deviations less than 1.0 nm are displayed to 0.01 nm resolution.

NAV Page 2 (Normal NAV)

When a normal NAV Leg is current, the following page will appear:



FMS# POS - This field displays the current FMS position. Pressing either line select key will access the DEFINE POSITION page for entry of present position coordinates. <POS> will be displayed in the "WPT" entry field.

HOLD POS - Pressing this line select key will access the HOLD POSITION page.

UPDATE SENS - Pressing this line select key will send current FMS BCP latitude/longitude to all sensors. Pressing this key is equivalent to pressing HOLD POS, and ACCEPTing the current lat/long.

SENSORS - Pressing this line select key will access DATA page 3 (FMS POSITION page).

Automatic Leg Changes

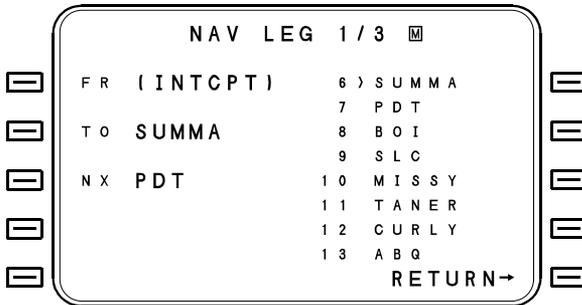
Normally, leg changes along a flight plan are automatic. Automatic leg changes will not occur if there is no NX waypoint on the NAV page. For example, no automatic leg change will occur when the TO waypoint is followed by a discontinuity (*GAP* or *NO LINK*) or the TO waypoint is the last waypoint on the flight plan. Fifteen seconds prior to an automatic leg change (or arrival at the TO waypoint), the WPT ALERT message will become active and the WPT alert annunciator will illuminate steady. Pressing the MSG key will display the message.

Automatic leg changes occur before the TO waypoint at a distance based upon groundspeed, leg change magnitude, and roll steering bank limit for the present altitude. The maximum distance before the waypoint at which the leg change will occur is 12 NM. If the aircraft passes to the side of a TO waypoint, the leg change will still occur at a distance before the waypoint to smoothly intercept next leg. If the TO waypoint is designated as a overfly waypoint (i.e., delayed automatic leg change), the leg change will begin over or abeam the waypoint.

When the approach mode is entered, leg changes at the approach waypoints are automatic. In the approach mode, the WPT ALERT message becomes active and the WPT alert annunciator illuminates steady 5 seconds prior to an automatic leg change. When the approach mode has been selected within 50 NM of the end-of-approach point (MAP or runway) and the required navaid is tuned, the FMS will generate the approach mode outputs. These will include bearing and distance to waypoint, desired track, crosstrack, lateral valid, approach annunciator, vertical deviation (glideslope), and vertical valid.

Manual Leg Change

The FMS provides maximum flexibility when defining manual leg changes. Legs may be chosen with either or both the FR and TO waypoints on or off the flight plan. If a TO waypoint is chosen that is off the flight plan, the system will prompt the pilot to redefine the NX waypoint in order to link the newly defined leg into the flight plan.



1. Press the NAV function key to access NAV page 1.
2. Use the line select keys to choose the FR or TO entry field as desired. A listing of flight plan waypoints will be displayed on the right side of the page.
3. Enter the identifier of the desired waypoint. If the desired waypoint is on the flight plan, enter the associated reference number. If the desired waypoint is not on the flight plan, use the LIST function or type in the identifier.

- NOTE:**
- If a new FR waypoint was entered, the cursor will advance to the TO waypoint entry field for entry of a new TO waypoint. If the TO waypoint displayed is acceptable, pressing the ENTER key will accept the waypoint and clear the cursor.
 - If a new TO waypoint was entered that was not on the flight plan, the cursor will automatically advance to the NX identifier entry field to allow the new TO waypoint to be linked into the flight plan.

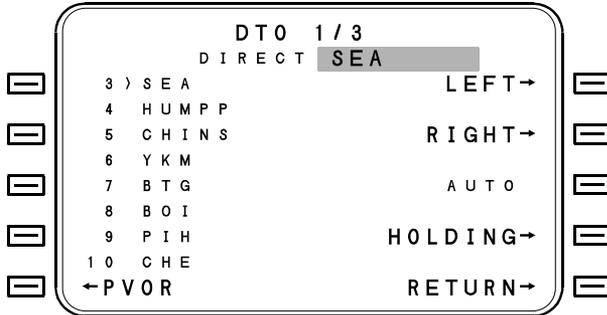
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4. If the cursor advances to the NX identifier entry field and it is desired to link the TO waypoint into the flight plan, enter the reference number of the flight plan waypoint that is to come after the new TO waypoint.

When the new leg is defined, the system will provide flight guidance steering to capture the new leg at an intercept angle of 45°. The HDG function may be used to select a different intercept heading.

Direct-To Function

The FMS also provides maximum flexibility when defining direct to leg changes. Direct to waypoints or airports on or off the flight plan may be chosen. If a TO waypoint that is off the flight plan is chosen, the system will prompt the pilot to redefine the NX waypoint in order to link the newly defined leg into the flight plan.



To go direct to a waypoint:

1. Press the DTO function key to access the Direct To (DTO) routing page. The cursor will be over the DIRECT TO waypoint entry field and a listing of flight plan waypoints will be shown.
2. The turn direction will default to shortest turn, therefore no action will be required by the pilot. The turn direction can be overridden, however, by specifying LEFT or RIGHT direction. Pressing AUTO line select key will cancel LEFT or RIGHT and return default to shortest direction.
3. Enter the identifier of the desired DIRECT TO waypoint. If the desired waypoint is on the flight plan, enter the associated reference number. If the desired waypoint is not on the flight plan, use the LIST function or type in the identifier.

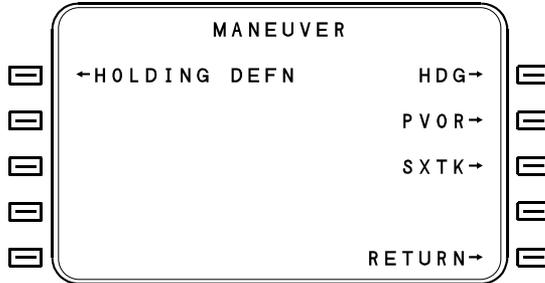
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- NOTE:**
- If the DTO waypoint entered was on the flight plan, the display will return to the normal Nav page (NAV page 1). <PPOS>, present position, will be in the FR waypoint position, the DTO waypoint identifier will be in the TO waypoint position, and the next flight plan waypoint after the new TO waypoint will be in the NX position.
 - If the DTO waypoint entered was not on the flight plan, the display will show a NAV page with flight plan waypoints listed on the right and the FR, TO, and NX waypoints on the left. <PPOS>, present position, will be in the FR waypoint position and the DTO waypoint identifier will be in the TO waypoint position. The cursor will be over the NX identifier entry field to allow the new TO waypoint to be linked into the flight plan.
4. If the cursor advances to the NX identifier entry field and it is desired to link the DTO leg into the flight plan, enter the reference number of the flight plan waypoint that is to come after the new TO waypoint.

When the TO waypoint is entered, the system will compute a course to the DTO waypoint and provide flight guidance steering for a circular turn towards the course so as to roll out on the new course with no crosstrack error.

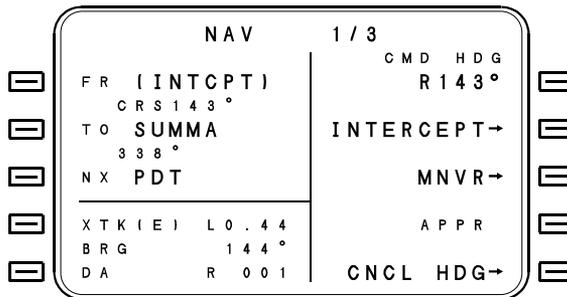
NAV MANEUVER Functions

On NAV Page 1, pressing the MNVR line select key will result in the MANEUVER Options page. By pressing the appropriate line select key, the pilot can select HOLDING PATTERN options, HDG, SXTK and PVOR modes of operation.



NAV Heading Page

The NAV Heading page allows control of the aircraft heading from the FMS, while maintaining a display of information pertaining to the current navigation leg. The page is accessed with the HDG line select key on NAV page 1/1, the MANEUVER page or on the NAV APPR page.



The heading mode in effect (HDG SEL or INTERCEPT) will be displayed immediately below the page heading. The heading mode displayed reflects the option selected using HDG line select key.

NOTE: The current nav leg may sequence due to maneuvering the aircraft with respect to the flight plan.

The data presented on the left side of the page is identical to the data shown on NAV page 1 (Normal Nav) and can be altered using the procedures described for NAV page 1. This data includes the following:

CMD HDG - This is the heading which the FMS will use, as directed by the heading mode selection made with the line select key (INTERCEPT or HDG SEL). The cursor's "home position" is over this entry field so that heading changes are more easily made. When the page is first accessed, the current heading will be flashing. A new heading may be entered or the ENTER key may be pressed to confirm the current heading. When a new heading is typed into this field, the FMS assumes the shortest direction of turn. This may be changed to the long direction with the sign reversal key (\pm) or the BACK key. After a new heading is entered, the ENTER key must be pressed a second time for confirmation.

TURN R (or L) nnn° - Pressing R, L or \pm key when cursor is over CMD HDG field will result in display of "TURN R (or L) _____". Enter the number of degrees from current heading that it is desired to turn (for instance TURN L 10°). In this example, 10° will be subtracted from current heading, and the aircraft will turn to and roll out on that new heading.

INTERCEPT / HDG SEL - This line select key is used to change the heading mode in use. The line will read HDG SEL or INTERCEPT depending upon the mode in use. If the Heading Select (HDG SEL) mode is in use, INTERCEPT will be the selectable option and vice versa. If the CMD HDG does not intercept the current navigation leg, the INTERCEPT option will not be available and the line will read NO INTCP. The heading mode in use is displayed below the page title. In the Heading Select (HDG SEL) mode, the FMS will follow the commanded heading until changed or canceled regardless of the active navigation leg. In the Intercept mode, the FMS will follow the CMD HDG until intercepting the active navigation leg. When the navigation leg is intercepted, the FMS will revert to normal navigation and will again display NAV page 1.

MNVR - Pressing this line select key will access the MANEUVER definition page.

ARM APPR or ACT APPR - If an approach is linked into the flight plan, this key will indicate ARM APPR when 50 nm from destination. If ARM APPR is selected, the key will change to ACT APPR. The reference navaid in the approach will be tuned. If ACT APPR is selected, the flight plan will sequence to the INBOUND course of the approach, and the FMS will automatically enter FHDG mode (if so configured during installation).

CNCL HDG / RETURN - With CNCL HDG displayed, pressing this line select key will immediately cancel the heading mode and the FMS will provide steering to intercept the active navigation leg at a 45° angle. If the heading mode is not active, this line will read RETURN and pressing the line select key will return the display to the page previously displayed.

On Installations Interfaced with Collins C-14 or Compatible EFIS Software,

There will be a two way interface with the Heading Bug. This function allows the FMS to receive selected heading settings that are driven from the heading select knob. These will appear in the command heading window on the FMS. Conversely, when the FMS is in Command Heading Mode, any entry on the FMS will be received by the EFIS, and the heading bug will slew to that value. In either case, the Flight Guidance System (FGS) will fly these headings when NAV is engaged.

Holding Patterns

Holding patterns may be programmed by the pilot at a waypoint on or off the flight plan. When they are part of a SID, STAR or Approach they are included in the navigation data base. 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 terminator of the leg. The FMS will fly each of these legs as follows:

1. HA (Hold to an altitude terminator) - The aircraft will stay in the holding pattern until the specified altitude is reached then sequence to next leg the next time it crosses the holding fix. HA type holding are generally found in SIDs.
2. 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.
3. HM (Hold to a manual terminator) - The aircraft will remain in the holding pattern until an action is taken by the pilot to depart. HM holding patterns are most commonly found at missed approach holding fixes and are the only type of holding patterns the pilot can program manually.

MANUALS AFFECTED: Universal Avionics Systems Corporations' Operator's Manual, Report No. 2423sv602, dated January 5, 1998.

FILING INSTRUCTIONS: Insert this Temporary Change into 2423sv602, Section 5 adjacent to page 5-46.

INSTRUCTIONS: Add the paragraph below so that it follows the last paragraph under "Holding Patterns".

Refer to the ARRIVAL Section, Approach Procedures for information about automatic and manual holding pattern termination.

Holding Pattern Depiction on NAV and FPL Pages

Holding pattern definitions and terminators are displayed below as they appear on NAV and FPL pages. Holding fixes are designated as overfly waypoints on the pages. An asterisk “*” appears following the waypoint on these pages. The letters HLD, preceded by a turn direction arrow and followed by the inbound course designates the holding pattern. A “T” or “o” follows the course and indicates true or magnetic respectively. The terminator will be depicted as an altitude for HA legs, a waypoint name for HF legs and (HOLD) for HM legs. The following are examples:

FPL		2 / 5	
	CRS 221°		
5	) SIMCO*	16 : 32	
	→HLD 221°	SIMCO	
6	(12000 FT)	16 : 36	↑ 12000
	DIRECT		
7	PAE	17 : 06	
	167°	11.1 NM	
8	ERYKA	17 : 08	↑ 5000
	161°	4.0 NM	
9	MGNUM	17 : 09	↑ 4000

Figure 1 Example Flight plan page illustrating an HA leg

FPL		1 / 4		M
1	CYWG	16 : 25		
	240 T	187 NM		
2	) MOT	17 : 17		
	255 T	121 NM		
3	COYNR*	17 : 37		
	→HLD 291 T	COYNR		
4	COYNR	17 : 41		
5	RNV 28 R			

Figure 2 Example Flight plan page illustrating an HF leg

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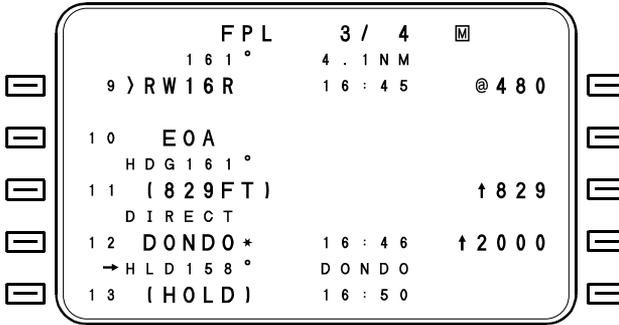


Figure 3 Example Flight plan page illustrating an HM leg

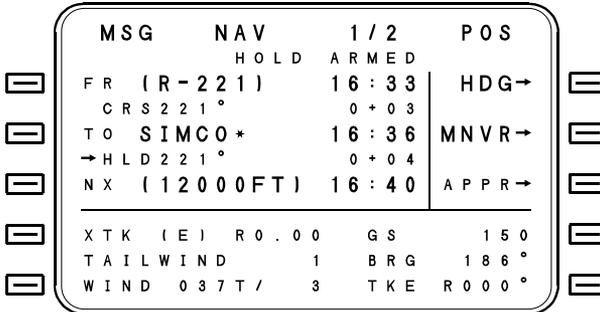


Figure 4 Example Navigation page illustrating an HA leg

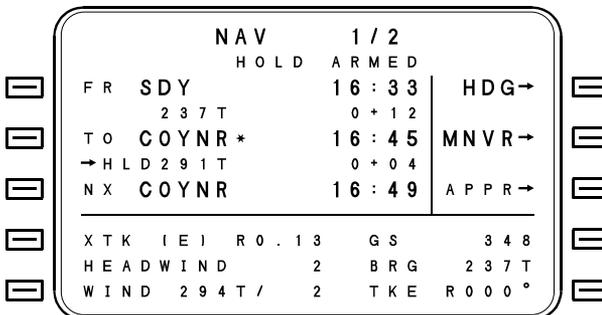


Figure 5 Example Navigation page illustrating an HF leg

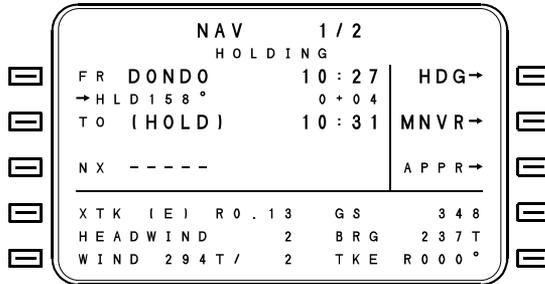
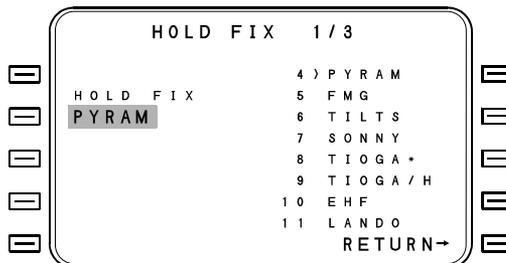


Figure 6 Example Navigation page illustrating an HM leg

When a holding pattern is defined at a fix on the flight plan it may be either armed or directly activated. If armed (ARM HOLDING) the aircraft will continue to fly the flight plan and enter holding upon reaching the holding fix. If directly activated (DTO HOLD) the aircraft will proceed directly to the holding fix and commence holding. If the fix is not on the flight plan, the hold may *only* be directly activated. Once established in the pattern, the FMS will fly the correct legs, compensating for existing wind conditions. Estimated Time of Arrival (ETA) over the holding fix is constantly displayed.

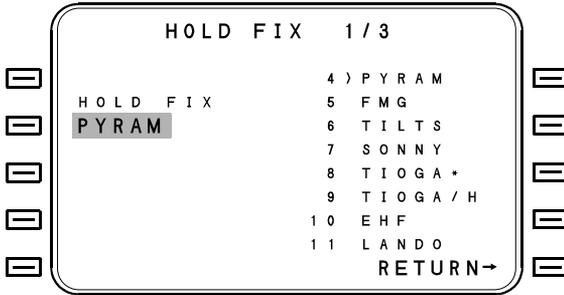
Holding Pattern Depiction on HOLD FIX, NAV LEG And DTO Pages

Waypoints with holding patterns associated whether obtained from the procedural data base or pilot defined are depicted as follows. The “*” designates the waypoint as a fly-over waypoint while a subsequent waypoint designating an HX leg follows with a “/H” to indicate the hold.



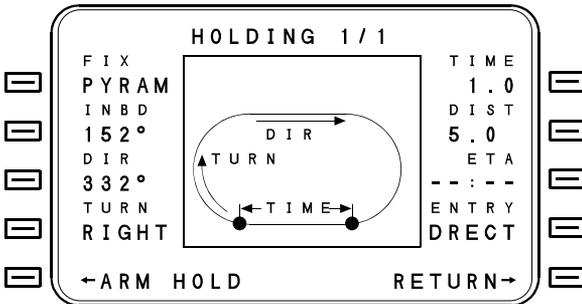
Program a Holding Pattern:

1. Press the MNVR line select key On NAV 1/1 to access the MANEUVER page.
2. Press the HOLDING DEFN line select key to access the HOLD FIX page.



NOTE: If a holding pattern has been previously programmed the HOLDING definition page for that fix will appear.

3. The current TO waypoint will appear in the FIX field. To change the FIX, press the line select key next to the FIX prompt to access HOLD FIX page.
4. Select the TO waypoint or enter the reference number for the desired waypoint to access the Holding Pattern Definition page.



5. Press the ARM HOLD line select key to accept the holding pattern with the default values. TURN will default to Right Hand. TIME will default to 1.0 minutes. Use the line select keys to place the cursor on the INBD, DIR, TURN direction, TIME, or DIST fields to modify them as necessary. The ENTER key must be pressed to accept each data field. The ARM HOLD prompt changes to DTO HOLD after the line select key is pressed. Holding patterns cannot be armed on the ground.

The ENTRY field will display the entry that will be flown when the pattern is activated. Entries will be direct (DRECT), parallel (PARLL) or teardrop (TRDRP). The pilot can modify these when within $\pm 20^\circ$ from AIM holding pattern entry sector boundary line.

6. Press the Entry line select key to access the HOLD ENTRY page. If an optional entry is available it will appear in large font with an arrow. Press the appropriate line select key to change.
7. Estimated Time of Arrival at Fix (ETA) will be displayed in UTC at all times. ETA will be updated each time the FIX is overflown, and will take into account current TAS and wind conditions.

If a holding pattern is armed, it can be disarmed by pressing DISARM HOLD on the MANEUVER page.

The Holding Pattern page can also be accessed from the DTO page by pressing The HOLDING line select key. If this method is used, line select key [5L] will display DTO HOLD.

NOTE: Holding pattern turns are made at standard rate and configuration bank limits do not apply. Should the aircraft Automatic Flight Control System limit the bank angle (i.e.. 1/2 bank) the holding pattern will not be flown to the standard turn rate requirement.

If the TAS and/or wind are too high for the holding pattern, the message "HIGH HOLDING GRNDSPEED" will be generated to alert the pilot that he should slow down. This message will only appear when within 3 minutes of holding fix.

NOTE: If the HIGH HOLDING GRNDSPEED message is generated, the resulting holding pattern may exceed the lateral limits of protected airspace. Groundspeed should be reduced prior to the holding waypoint alert, which occurs 15 seconds prior to the holding fix.

Line select key [2L] on the MANEUVER page will change to PROCEED when the pattern is activated. If PROCEED is subsequently selected, the aircraft will continue the current holding circuit until overflying the holding fix, and will then proceed to the NX waypoint as selected by the pilot. To exit holding, do a DTO a waypoint, create a PVOR or perform a manual leg change.

Line select key [4L] will display CONTINUE HOLD whenever PROCEED has been selected for any holding pattern. This option will continue to display until the holding fix is sequenced the final time. For HA and HF holding patterns the MANEUVER page will display a CONTINUE HOLD when the holding pattern is active. Pressing this key changes the holding pattern to an HM leg.

Editing of Holding Patterns

Prior to activation of a holding pattern all variables fields on the Holding Pattern Definition page are editable. After activation of the holding pattern only the TIME and DIST fields are editable. Procedural holding patterns are considered part of the procedure and any editing of the holding pattern will be treated as procedural edits. Edits to the FIX, INBD/DIR, TURN DIR and TIME/DIST fields on the holding page will remove the procedure. Changing the entry type will not effect the procedure since entry types are not part of the published procedure. The procedure will be cleared on the Arrive/Departure page as appropriate and the Flight Plan Clearance page will display the procedural legs rather than the procedure name.

SXTK - Parallel Course (Selected Crosstrack)

A parallel course may be established to provide guidance with respect to an offset course, which is parallel to the leg, defined by the FR/TO waypoints. The amount of offset is defined by the pilot in this procedure.

1. On MNVR page, press SXTK line select key. Nav page 1 will be displayed with cursor over the SX (Selected Crosstrack) entry field. XTK will move up one line.
2. If necessary, press the sign reversal (\pm) key or the appropriate alpha (L, R) key to change the direction (left or right) of offset.
3. Enter the desired offset in nautical miles and tenths, then press ENTER.

When SX is entered, the SXTK annunciator on the instrument panel will illuminate, XTK will indicate crosstrack from the selected crosstrack, the system will provide steering to fly an appropriate intercept to the selected crosstrack, and the HSI will be referenced to the parallel (offset) course.

To cancel Selected Crosstrack Mode:

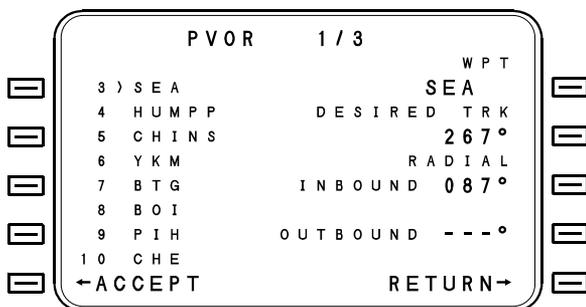
1. On MNVR page, press CNCL SXTK.
2. (An alternate method is to enter a value of 0.0 nm in the SXTK data field on Nav page 1)

NOTE: A selected crosstrack will also be canceled by any leg change. Automatic leg changes will occur at a distance computed to allow smooth capture of the next leg.

NOTE: FMS HDG mode will take priority over selected crosstrack if both modes are active. Both FMS HDG and SXTK annunciators will be illuminated and the deviation display will be referenced to the parallel (offset) course.

Pseudo-VOR Function

The PVOR (Pseudo-VOR) page provides the capability to track to or from any known waypoint on a programmed course or radial. The PVOR page is accessed from NAV page 1 (page 2 when in the Approach mode) or the DTO page by pressing the PVOR line select key.



To program a PVOR from this page:

1. Select a waypoint by accepting the TO waypoint or entering the appropriate reference number of another waypoint in the flight plan in the WPT field. A listing of flight plan waypoints is displayed on the left side of the page. If there are more waypoints in the flight plan, they can be viewed by using the PREV or NEXT keys. A new waypoint may be selected by entering a reference number from the flight plan, using the LIST function, or manually typing in the new identifier. When the waypoint is entered, the cursor will advance to the DESIRED TRK entry field.
2. Enter the **DESIRED TRK**. To follow a desired track outbound from a PVOR, a gap (*GAP*) must follow the PVOR waypoint on the flight plan. (or)
3. Enter the **RADIAL INBND / OUTBND**. The desired track to be flown to or from the PVOR may be identified here by defining a radial to be flown inbound to or outbound from the PVOR waypoint. When selecting a radial to fly outbound from the PVOR waypoint, the waypoint name is changed to <VECTOR>. An external (dashed) course line is drawn through the waypoint to Collins advanced EFIS.

4. Press **ACCEPT** to accept the PVOR. With the cursor over this option, pressing the line select key or the ENTER key will cause the PVOR to become active and return the display to the NAV page with "PVOR" in the FR position and the PVOR waypoint in the TO position. Steering commands will provide a 45° intercept of the PVOR desired track, or the CMD HDG function may be used to define a desired intercept heading.

To delete a PVOR:

1. Conduct a DTO function or a manual leg change, or select the Approach mode, to delete the PVOR function.

Gaps In The Flight Plan

A gap is a break in the flight plan designed to prevent the computer from making an automatic leg change as the TO waypoint is passed. A gap may be desirable, for example, between the destination airport and the alternate airport. Gaps may occur in the stored routes when a new data base is loaded. To insert a gap in a flight plan:

1. Press the FPL key to access the flight plan. Use the PREV and NEXT keys to find the waypoint to follow the gap.
2. Press the line select key next to that waypoint to put the cursor over it.
3. Press the LIST key to access the LIST page.
4. Press the GAP line select key.

Gaps are deleted from the flight plan in the same manner as waypoints. To delete a gap from the flight plan, refer to the DELETE WAYPOINT(S) FROM FLIGHT PLAN procedure in this section.

CAUTION: When a GAP is encountered, the flight plan will *not* autosequence to the next leg. The aircraft will continue to fly over the TO waypoint on last desired track (0° roll steering) with NAV and VNAV flags out of view on the HSI. **IT IS THE RESPONSIBILITY OF THE PILOT TO TAKE APPROPRIATE ACTION TO CONTINUE ACCURATE NAVIGATION OF THE AIRCRAFT.** He may go "Direct To" or edit the gap out of the flight plan.

The fuel management data presented on the fuel mode pages is referenced to the last waypoint prior to a gap on the flight plan if the pilot has not chosen a DESTINATION on the FPL Arrivals page. If a destination has been chosen, the data will be referenced to the destination.

Designate Fly-Over Waypoint(s)

An overfly waypoint is a waypoint which will cause the navigation computer to delay making an automatic leg change until the aircraft is directly over the waypoint. An overfly waypoint is indicated by an asterisk (*) following the waypoint identifier on the FPL (Flight Plan) display page. The following procedure may be used to designate a flight plan waypoint as an overfly waypoint:

1. Press the FPL function key to access the FPL (Flight Plan) page. If the desired waypoints are not displayed, use the NEXT and PREV keys to display additional flight plan waypoints.
2. Use the line select keys to position the cursor over the waypoint to be defined as a overfly waypoint.
3. Press the OVFLY line select key. An asterisk (*) will appear after the waypoint identifier indicating that it is a overfly waypoint.

The waypoint overfly designation is removed in the same manner as it was created; i.e., pressing the CNCL OVFLY key with the cursor over the overfly waypoint identifier.

Vertical Navigation (VNAV)

VNAV General

The Vertical Navigation function allows the flight crew to define a desired vertical flight profile along the flight plan route. It then computes the aircraft deviation from that profile for display. The flight profile is defined by two waypoints with reference altitudes, by the aircraft present position plus one waypoint ahead of the aircraft, or by one waypoint ahead of the aircraft and a target vertical speed. A flight profile which results in a climb will provide VSR (Vertical Speed Required) information only. Vertical waypoint identifiers are prefilled automatically with the current flight plan waypoints (but with no offsets or altitudes).

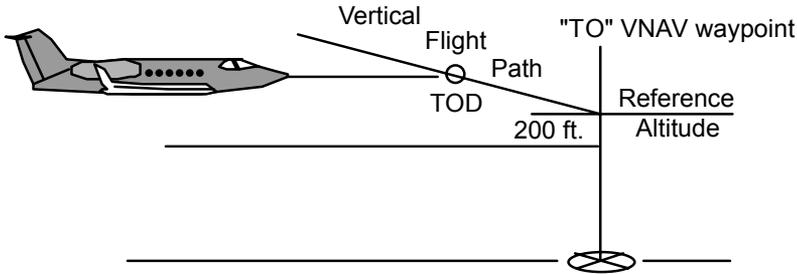
		PATH VNAV 1 / 2			
	TO	TOD	16.9	TGT	V / S
FR	PPOS			- 2200	
	42.6		- 1247	3.1°	
TO	CHUCK	- 5	@FL230		
			- 2391	CNCL	
NX	BTG	- 20	@18000	VNV→	
			- 4084		
	BTG		@ 4000		
			0		
	-----		@-----	VT0→	

The VNAV function has three operating modes: Inactive, Cruise and Descent. These modes are identified by the type of data displayed and by the vertical deviation signal being transmitted. The current mode is determined by the aircraft position relative to the defined path.

- **INACTIVE:** VNAV will be in the Inactive mode until a vertical "TO" waypoint and a vertical flight path (Target Vertical Speed) to that waypoint have been defined.

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- **CRUISE:** The VNAV function will enter the Cruise mode when the "TO" waypoint and the vertical flight path have been defined, the aircraft is not more than 200 feet below the reference altitude of the "TO" waypoint, and the vertical flight path will be intercepted ahead of the aircraft. The Cruise mode shows the distance to the Top-Of-Descent (TOD) point in nautical miles, that is, the distance along the flight plan until the current altitude intersects the pitchover point to intersect the vertical flight path. Flight Path Angle in degrees is displayed under the Target V/S window. When VNAV is selected for display on the ADI, vertical deviation will be displayed prior to TOD capture point.



- **DESCENT:** The Descent mode is activated by crossing the Top-Of-Descent point while in the Cruise mode or by selecting the Vertical TO (VTO) function. Aircraft deviation from the vertical flight path is displayed.

There are basically four different pages associated with the VNAV function:

- **VERTICAL NAVIGATION CRUISE PAGE** - When VNAV is in the Inactive or Cruise mode, this page provides the means to define or intercept the vertical flight profile.

MANUAL AFFECTED: Operator's Manuals, Report No. 2423sv601/701, 2423sv602/702 and 2423sv603/703.

FILING INSTRUCTIONS: Insert this Temporary Change into, Section V as follows; 2423sv601/701 adjacent to 5-46; 2423sv602/702 and 2423sv603/703 adjacent to 5-58.

SUBJECT: VNAV Transition from enroute to approach.

APPLICABILITY: Aircraft which use pitch steering for enroute and approach mode vertical guidance, such as Falcon 2000, 50EX, Astra SPX, Cessna Excel, Learjet 31, 45, 60 and DHC-8.

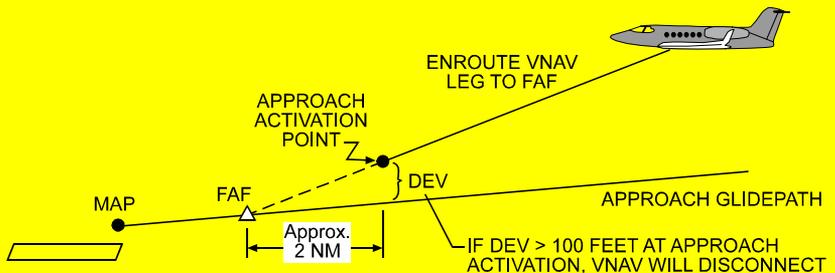
If the aircraft is performing a flight director/autopilot coupled enroute VNAV leg to the approach FAF, a VNAV disconnect may occur when approach activates before the FAF, or is manually activated by the pilot. This automatic VNAV disconnect is intentional, and provides protection from a sudden pitchover or pitch up to capture the final approach glidepath. In these cases the flight director will automatically downmode from VNAV to PITCH HOLD mode.

NOTE: VNAV will only disconnect if the vertical deviation is greater than 100 feet relative to the approach glidepath at the time of approach activation. If it is less than 100 feet, VNAV mode should stay coupled through the transition. See figure below.

Recommended Operational Procedure

There are several options to fly VNAV during approach mode.

- The pilot can manually fly the aircraft to the approach glidepath and reselect VNAV mode on the flight director, or,
- The aircraft can be maneuvered (using some other vertical mode) to a level altitude below the glidepath, and then VNAV mode selected, which will arm the flight director/autopilot for capture.



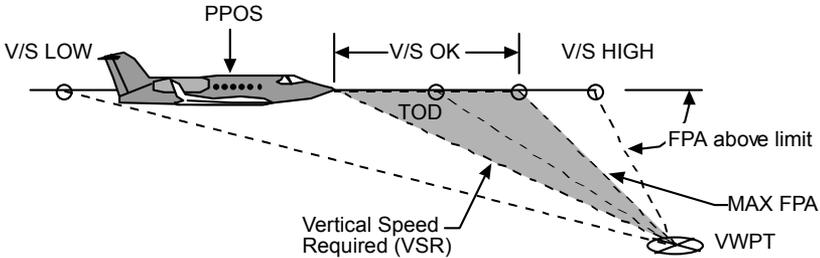
- **VERTICAL WAYPOINT SELECT PAGE** - This page is used to select the flight plan waypoints which are to be used as reference for defining the VNAV waypoints. *Only* flight plan fixes may be used to define vertical waypoints and not floating terminators. Also, there can be no floating leg types (e.g., HDG to ALT, etc.), gaps or *NO LINK* occurrences between the aircraft position and the selected vertical TO waypoint. Once the flight plan waypoints are selected, an offset mileage may be added to define the position of each VNAV waypoint either prior to or following the flight plan waypoint along the flight plan route.
- **VERTICAL NAVIGATION DESCENT PAGE** - This page becomes active once VNAV is in the Descent mode. Aircraft deviation from the vertical flight path is displayed.
- **VERTICAL TO PAGE** - This page provides vertical flight guidance between the aircraft's present position/altitude and any of the nine VNAV waypoint position/target altitudes.

VNAV Setup and Activation

VNAV operations are controlled by the vertical speed input by the pilot for the first waypoint and the vertical speed computed, based on the altitudes, for second and subsequent vertical waypoints. The following information describes how vertical speed is used in the VNAV function.

Target Vertical Speed (TGT V/S)

The target vertical speed entry represents a commanded rate of descent to the first VNAV waypoint from the top of descent (TOD) (not present position). The VNAV function will lock in the top of descent point to achieve the flight path angle dictated by the commanded descent rate. The following figure is a representation of three scenarios for vertical speed entry and top of descent points.



Once Target V/S is entered, then the flight path angle will be calculated and “locked in”. Subsequent groundspeed changes prior to TOD will cause the displayed Target V/S to vary proportionately, in order to maintain the flight path angle.

TGT V/S Affects on TOD Point

The marking V/S OK indicates the first scenario in the figure. In this scenario the TGT V/S entry will be accepted and all values are within limits. A typical TGT V/S entry would be approximately 5 times ground speed to result in a 3° descent angle. As a rule of thumb, a 3° descent Flight Path Angle (FPA) will result in a smooth descent (e.g., @400 kts use 2000 fpm).

In the second scenario V/S HIGH, a high value for TGT V/S has been entered and the Top Of Descent (TOD) is delayed to achieve the desired descent rate. As shown in the figure, this results in the descent angle being increased and the computed change in FPA will exceed the limit that is configured for FPA. This will occur independently of the distance between vertical waypoints. When a high TGT V/S entry causes the calculated path to exceed the FPA limit, the TGT V/S value will blink and a message will be displayed at the top of the page. As a rule of thumb, the TGT V/S entry should be less than 10 times groundspeed for airplanes and less than 16 times groundspeed for rotor craft. The maximum TGT V/S that is enterable is 6000 fpm. If a higher TGT V/S is entered the TGT V/S entry will blink.

In the third scenario V/S LOW, the TGT V/S entry results in a descent rate where the path will not intercept the waypoint at the desired altitude. When the TGT V/S entry is too low, the TGT V/S value will blink and a message will be displayed at the top of the page. In the figure, notice that the descent angle as indicated by V/S LOW falls behind the present position of the airplane. The FMS is designed to execute a smooth transition to the downward pitch angle when the top of descent is reached. If the position of the airplane is already past the top of descent (as indicated in the figure) a rapid downward pitch angle with a descent rate exceeding the entered TGT V/S would be required. The FMS is designed to prevent this from occurring and will not allow the descent rate to exceed the commanded TGT V/S that has been entered by the pilot.

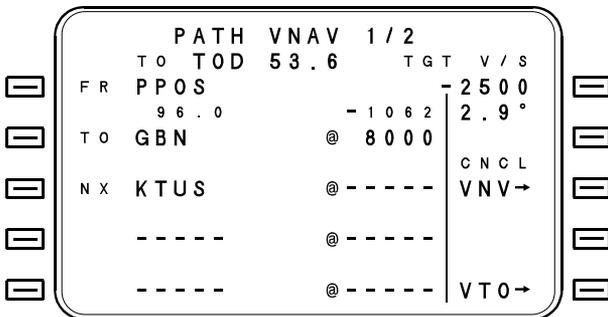
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To summarize, TGT V/S must be greater than its lower limit (i.e., displayed VSR) and less than its upper limit (defined as roughly 10 times GS for aircraft, and 16 times GS for rotorcraft). Maximum Flight Path Angle is configured at the time of installation.

The FMS also implements a pitch change anticipation function so that the vertical speed is increased gradually until the desired TGT V/S value is reached. This avoids a rapid pitch down to achieve the TGT V/S. To do this, the FMS will calculate a transition and will add it to the distance needed to reach the vertical waypoint. As a rule of thumb, the TGT V/S entry to the first vertical waypoint should exceed the minimum VSR by a small amount. If this minimum value is not exceeded the FMS may compute a top of descent behind the present position (due to the transition distance) and the TGT V/S entry will blink. The minimum VSR value is truncated so using a TGT V/S entry that exceeds it slightly will avoid a situation where the TGT V/S is too low by tenths of FPM. If this situation does occur, the TGT V/S entry will blink and a TGT V/S value that is slightly higher should be keyed in.

VNAV Cruise

The VNAV Cruise page will be accessed whenever the VNAV function key is pressed while in the Inactive or Cruise mode. This page is used to define the vertical flight profile and will be active prior to intercepting the vertical flight path (at which time the VNAV Descent page becomes active).

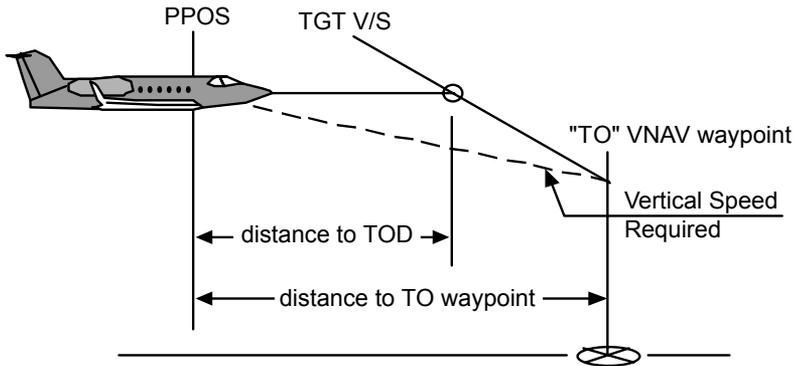


TO TOD xx.x NM - The distance remaining, in nautical miles, from the aircraft's present position to the "Top-Of-Descent" (TOD) location. The TOD location is based upon present groundspeed, present altitude, the altitude for the TO vertical waypoint location, and the "Target Vertical Speed" (TGT V/S) the pilot has entered for the descent.

TGT V/S [1R] - Target Vertical Speed. This manual entry of desired descent rate, in feet per minute, is used for computing the vertical flight path to the "TO" VNAV waypoint. The entry field is prefilled with dashes until the pilot enters a value or until the aircraft reaches the first vertical waypoint (at which point the waypoints are sequenced, the Descent mode is activated, and the VNAV Descent page becomes active). A manual leg change or direct-to operation along the lateral flight path which causes the TO VNAV waypoint to be bypassed will cause the TGT V/S to become invalid. VNAV will remain in the Inactive mode until the TO vertical waypoint is defined and either a valid Target Vertical Speed is entered or VTO is selected (which activates the Descent mode and the VNAV Descent page). The maximum Target V/S which can be entered is that which results in a Flight Path Angle (FPA) which does not exceed the maximum which is programmed into the Configuration Module at the time of installation, and is based upon current groundspeed (maximum configurable is 9.9°). The max target V/S in feet per minute is approximately 10 times groundspeed (knots) for fixed wing, and 16 times groundspeed for rotorcraft. As a rule of thumb, a 3° FPA will result in smooth descents, and can be computed as approximately 5 times groundspeed (e.g., at 400 knots, use $400 \times 5 = 2000$ fpm). Flight Path Angle is computed and displayed below Target V/S.

If a TGT V/S is entered which exceeds the max allowable, then the entry will flash and not be accepted, and a message will be presented to the pilot. Similarly, TGT V/S will not be accepted if there is insufficient time to descend to the vertical waypoint or if crosstrack is greater than 12 nm.

FR PPOS - The FROM waypoint is always PPOS (present position) and is used for calculating the Vertical Speed Required to reach the TO VNAV waypoint at the specified altitude.



Between the FR and TO lines are:

- The **Great Circle Distance**, expressed in nautical miles, between the aircraft's present position and the TO VNAV waypoint.
- The **Vertical Speed Required (VSR)** to descend (or climb) from the aircraft's present position (plus offset distance) and altitude to cross the TO VNAV waypoint at the target altitude.

TO and NX [2L, 3L, 4L, 5L] - Each TO and NX VNAV waypoint is defined by a flight plan waypoint and the offset distance prior to (-) or beyond (+) that flight plan waypoint. Next to the VNAV waypoint location is the target altitude for that vertical waypoint. During VNAV waypoint entry, when the associated line select key is pressed, the Vertical Waypoint Select page is accessed for selection of a flight plan waypoint. When the flight plan waypoint is entered on the Vertical Waypoint Select page, the VNAV display will return to the VNAV Cruise page with the cursor over the offset distance entry field. Pressing the ENTER key expands the cursor to cover the target altitude entry field. Altitudes may be entered as Flight levels (3-digit entry 000 to 640) or as whole altitudes (15,500, for example). Altitudes below 640 feet must be entered as 4 digits (for example 0500 for 500 feet). VNAV waypoint altitudes must be in level or descending sequence in the range from 0 to +64034 ft. An altitude will be invalid, and will flash until it is corrected, if it results in a FPA greater than the maximum programmed into the Configuration Module at installation (maximum configurable is 9.9°).

Above each NX line is the vertical speed required in feet per minute, at the present groundspeed, to follow the vertical flight path between the target altitudes of each VNAV waypoint.

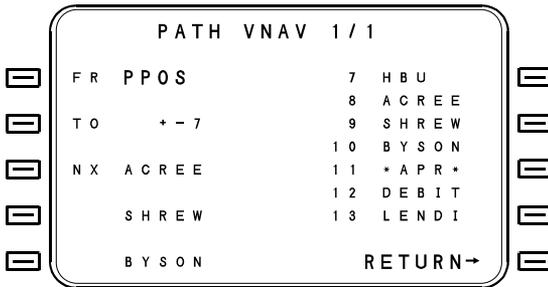
For waypoints after the last programmed VNAV waypoint, altitude of the last waypoint will automatically pre-fill into succeeding waypoints. When the aircraft reaches the last programmed VNAV waypoint, VNAV guidance will be to zero VSR and will maintain level flight.

VTO [5R] - This line select key is used to access the Vertical TO page. This allows vertical flight guidance from the aircraft's present position and altitude to the selected VNAV waypoint target altitude.

VNAV Waypoint Select

VNAV waypoints must lie on the flight plan route. They are defined by first entering a desired flight plan waypoint and then entering any offset mileage prior to or beyond that flight plan waypoint.

Selecting a VNAV waypoint entry field on the VNAV Cruise or Descent page accesses this page. The flight plan waypoint is entered on this page by using the numeric selection entry process. When a VNAV waypoint is entered, the display will return to the previous page and the cursor will be over the offset distance entry field.



FR PPOS [1L] - This line displays along track offset ahead of PPOS that TOD and VSR are referenced to in Cruise mode. This display is not used during descent.

TO and NX [2L, 3L, 4L, 5L] - When this page is displayed, the cursor will be over the waypoint entry field corresponding to the one selected on the Cruise or Descent page. The cursor will be prefilled with the reference number of the FPL waypoint already in use in that VNAV waypoint position, or will be blank if none exists.

All VNAV waypoints must be ahead of the FMS present position and must be sequenced in the same order they occur on the lateral flight plan. When a VNAV waypoint is entered:

- If the preceding VNAV waypoint in the VNAV profile list *follows* it in the lateral flight plan; the new waypoint will flash to indicate an invalid entry.
- If the position in the VNAV profile list was occupied that waypoint (and any subsequent ones) will advance to the next VNAV waypoint position(s), provided it follows the new waypoint in the lateral flight plan. If it precedes the new waypoint in the lateral flight plan, it will be removed from the VNAV profile.
- Any VNAV waypoints following the new waypoint in the profile list which precede the waypoint in the lateral flight plan will be removed from the VNAV profile.

Flight Plan Waypoints - On the right side of the display is a list of flight plan waypoints. The list includes all flight plan waypoints starting with the first waypoint ahead of the aircraft. Other flight plan waypoints (ahead of the FMS present position) may be displayed by pressing the NEXT and PREV keys.

RETURN [5R] - Pressing this line select key will return the display to the previous page with no changes.

The VNAV page will display the vertical speeds required based on present groundspeed to obtain the target altitudes at the VNAV waypoints. Two minutes prior to Top of Descent a "2 MIN TO TOP OF DESCENT" message will become active on the message page. At 15 seconds to Top of Descent or any other VNAV waypoint the WPT annunciator will flash and a "VNAV WPT ALERT" message will be displayed on the message page. The WPT alert annunciator will remain illuminated until vertical leg sequencing occurs. If lateral and vertical waypoints are collocated, the WPT alert annunciator will flash, as vertical waypoints take precedence over lateral waypoints.

Aircraft deviation from the vertical flight path is output to the flight guidance system glideslope deviation pointer. The glideslope pointer is driven to a scale of 750 feet per dot for analog instruments and, normally, 200 feet per dot on Collins C-14 and Compatible EFIS instruments.

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NOTE: The VNAV function and outputs to the glideslope deviation pointer are advisory only and may not be coupled to the autopilot, except in installations with compatible autopilots.

VNAV mode will be canceled under any of the following conditions:

- 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 12.5 nm.
- Enroute FPL gap is encountered.
- Enroute/Approach VNAV waypoint gap is encountered.

If any of these occur 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.

Activating the approach mode, landing the aircraft (as determined by the air/ground sensor), or entering the number "99" as a vertical waypoint will cancel the VNAV mode and will delete the VNAV flight path.

Upon reaching the target VNAV altitude, the target altitude is automatically filled into the subsequent waypoint provided no other vertical navigation is programmed into the flight plan (including vertical guidance in a destination approach). If the target altitude is not filled into the subsequent waypoint, VNAV is canceled and the FGS will revert to pitch hold mode.

VNAV Flight Path Definition Procedure

NOTE: A Flight Plan must already be active, as flight plan waypoints are used to define the VNAV waypoints.

1. Press the VNAV function key. The VNAV Cruise page is displayed, and all entry fields are prefilled with the current flight plan waypoints.
2. Press the TO line select key to define the TO VNAV waypoint. The Vertical Waypoint Select page is displayed. Use the PREV and NEXT keys to view other flight plan waypoints (ahead of the FMS present position).
3. Enter the desired flight plan waypoint using the numeric selection process. This waypoint will be used as a reference to define the VNAV waypoint location.
4. The cursor expands on the VNAV Cruise page to cover the offset distance entry field. Use the \pm key to change the offset sign ("-" for offset prior to the flight plan waypoint, "+" for offset beyond the flight plan waypoint). Enter the offset distance.
5. The cursor expands to cover the target altitude entry field. If an altitude field entry is three digits and less than 640, then it is assumed to be a flight level entry. Otherwise it is assumed to be a regular altitude entry. For example, if "370" is entered, the altitude field will automatically convert to "FL370" for display. If, however, the pilot wants to enter an actual altitude of 370 feet, he must input "0370" in the altitude field. If an altitude is entered which results in a flight path angle greater than the configured maximum FPA, then it will flash and not be accepted.
6. Using line select keys [3L, 4L and 5L] to access the NX entry fields, repeat the above process to define succeeding VNAV waypoints.
 - Above each NX line is the vertical speed required to follow the defined vertical flight path to that VNAV waypoint.
 - All VNAV waypoints must lie ahead of the FMS present position and must be sequenced in the same order as they occur on the lateral flight plan.
7. If vertical flight guidance is desired to the "TO" VNAV waypoint, press line select key [1R] to access the TGT V/S field and enter the desired vertical speed. Invalid entries will cause the V/S entry to flash, and an error message will be displayed (see following section).

8. When the TO VNAV waypoint and the TGT V/S entries have been made, the distance to the TOD will be displayed as well as Flight Path Angle. Vertical Deviation indication will be referenced to the flight path defined by the first VNAV waypoint and VSR. TOD is the point at which the pilot should begin the capture maneuver for the FPA.
9. When the aircraft reaches the last programmed VNAV waypoint, subsequent VNAV waypoints will automatically fill with current VNAV altitude, causing guidance to be to zero VSR and maintaining level flight.

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.

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 > 12.5 nm.

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.

VNAV Descent Mode Procedure

The vertical navigation descent mode is activated by crossing the Top-Of-Descent point while in the cruise mode or by selecting the Vertical To (VTO) function.

PATH VNAV 1 / 2			
TO	TOD	TGT	V / S
FR	PPOS	- 1 2 4 7	- 2 2 0 0
	4 2 . 6		2 . 8 °
TO	CHUCK	- 5 @ FL 2 3 0	
		- 2 3 9 1	C N C L
NX	BTG	- 2 0 @ 1 8 0 0 0	V N V →
		- 4 0 8 4	
	BTG	@ 4 0 0 0	
		0	
	-----	@ -----	V T O →

Waypoint sequencing occurs automatically when the computed straight line flight path angle exceeds the configured maximum FPA.

1. Note the TGT V/S value. Whenever VNAV waypoints are sequenced, the TGT V/S is initialized to the VSR for the new TO waypoint. Using line select key [1R] to access the entry field, a different value may be entered at any time.
2. Above FR PPOS is the vertical deviation of the aircraft above (+) or below (-) the desired vertical flight path.
3. Beneath FR PPOS is the distance to the TO VNAV waypoint and the vertical speed required to cross the VNAV waypoint at the target altitude from the present position, altitude, and groundspeed.

VNAV Direct-To Procedure

VERTICAL TO 1 / 2				
VTO	BTG		VSR	
			FPM	
1	CHUCK	@ FL 3 2 0	- 3 9 8 0	
2	BTG - 2 0	@ FL 2 1 0	- 1 3 6 4	
3	BTG	@ 4 0 0 0	- 3 2 7	
4	-----	@ -----		
5	-----	@ -----		
				RETURN→

VERTICAL TO 2 / 2				
VTO	# 1		VSR	
			FPM	
5	MLP	@ FL 4 2 0	0	
6	GEG	@ FL 3 6 0	- 4 2 8	
7	MWF	@ FL 3 2 0	- 3 2 7	
8	EAT	@ FL 2 4 0	- 1 8 9	
9	KSEA	@ 1 8 0 0 0	- 9 4	
				RETURN→

This procedure is designed to redefine an already established VNAV leg in the event ATC restrictions do not allow following the originally programmed vertical route. For example, suppose that the original vertical plan was to begin a descent from FL 390 at waypoint ABC and arrive over waypoint XYZ at FL 210. However, if the descent clearance is not received until 30 NM past ABC, the following procedure will zero the vertical deviation indicator (glideslope needle) so as to allow a straight-line descent and arrival over XYZ at FL 210 from the present position and altitude.

1. Press the VNAV function key to access the VNAV page.
2. Press the VTO line select key to access the VERTICAL TO page.
3. Enter the reference number of the desired VNAV Direct-To waypoint.
4. If the computed flight path angle is greater than the configured maximum FPA, the reference number will flash, indicating that the path is too steep and cannot be engaged.

VNAV Flight Profile Deletion

1. Press the VNAV function key to access the VNAV page.
2. Press any TO or NX line select key.
3. Enter the number "99."
4. The vertical flight profile will be deleted and the VNAV pages will fill with the next 9 waypoints on the FPL.

VNAV Enroute Pitch Commands with Collins or Honeywell EFIS

If the installation includes an interface with a Collins, Bendix/King or Honeywell Flight Guidance System (FGS) that is compatible with the FMS pitch commands (refer to specific AFMS), then enroute VNAV profiles may be flown while coupled to the Flight Guidance System (FGS). The FMS computes a Vertical Pitch Command, which is recognized when VNAV is selected on the FGS Mode Select Panel.

When the aircraft is two minutes from the Top of Descent capture point the MSG light flashes and the message "2 MIN TO TOP OF DESCENT" appears on the MSG page. This message is removed after from the MSG page after it is acknowledged and the autopilot will attempt to capture the VNAV path. During this two-minute period the pilot may arm VNAV on the FGS Mode Select Panel. (Note that the Altitude Preselector, if installed, must be set to an altitude at least 200 feet below the current altitude before VNAV can be armed on the FGS mode panel.) At 15 seconds to TOD or any other vertical waypoint, a WPT annunciator flashes, and "VNAV WAYPOINT ALERT" appears on the message page. Pressing the MSG key will change the flashing WPT to steady and extinguish the MSG annunciator. The aircraft will then capture and fly the defined VNAV profile. Vertical deviation at capture is dependent upon aircraft speed and the path angle. The Glideslope pointer on the Collins EFIS display may still be off the scale when the path is initially captured.

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If the pilot fails to arm VNAV during this period, the FGS will not allow VNAV to be coupled. This is to preclude any abrupt pitchover maneuver that may occur after the capture point. If the pilot manually flies the aircraft near the vertical profile with vertical deviation and aircraft vertical speed within limits, then VNAV may be re-selected on the FGS Mode Panel.

When an altitude preselector is installed; during descent, if the Altitude Preselector is set at an altitude which is higher than a defined VNAV leg, the aircraft will automatically cancel FGS VNAV mode and level off to Altitude Select Mode when that altitude is encountered.

NOTE: During VNAV descents involving large course changes, the flight director may command descent rates, which do not center the vertical deviation symbol. Flight director cues should be followed and vertical deviation will recenter after the new course is tracked.

ARRIVALS – STARS AND APPROACHES

The navigation data base contains a full compliment of arrival procedures. These include STARS and the majority of approaches found on commercially available navigation charts. Although the following procedure for linking these procedures into a flight plan is shown in one continuous process, STARS and approaches can be programmed independently of each other.

Linking STARS and Approaches into a Flight Plan

When given an Arrival Procedure by ATC, the STAR may be linked into the flight in a similar manner to the way a SID is selected. To link a STAR:

1. From FPL MENU page press the ARRIVE line select key to access the ARRIVAL page. The destination airport will prefill into the ARRIVE field.
2. Enter the reference number for the landing runway from the list in the RUNWAY.

ARRIVAL 1 / 1		ARRIVE
SEL	RUNWAY	RUNWAY
1	03	KABQ
2	08	RUNWAY
3	12	#
4	17	STAR
5	21	-----
6	28	APPR
7	30	-----
8	35	

FPL→

After the runway is selected, the cursor will advance to the STAR field, and a list of STARS for that airport will appear.

3. Select the STAR by entering the reference number from the list.

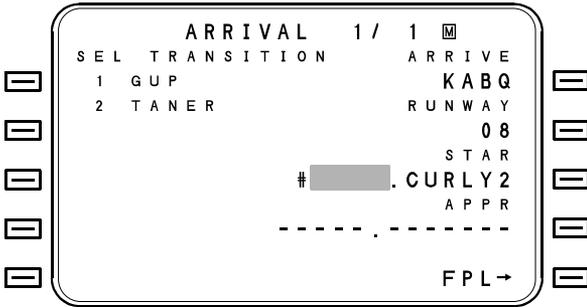
ARRIVAL 1 / 1		ARRIVE
SEL	STAR	RUNWAY
1	CURLY2	KABQ
2	FRIHO2	RUNWAY
3	LAVAN2	08
4	MIERA2	STAR
		#
		APPR

FPL→

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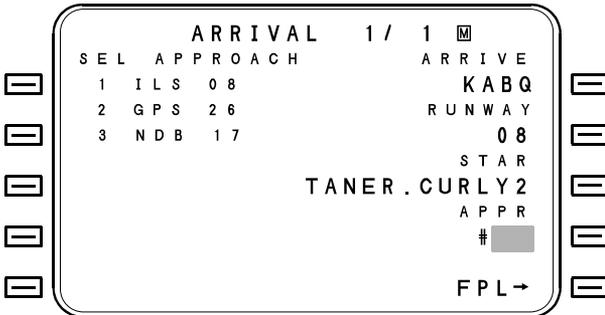
Next, a list of transitions for the selected STAR will appear.

4. Select the transition by entering the reference number of the appropriate transition. A list of approaches will appear.



5. Select the approach by entering the reference number of the approach in use. A list of transitions, if any, will be displayed.
6. Select the desired transition by the reference number entry method.

NOTE: Selecting the approach and its transition may be delayed until later in the flight.



At this point selecting the FPL line select key will return display to the FPL pages, where the STAR legs and approach will now be a part of the flight plan, as shown below:

F P L 4 / 5 			
	1 3 ABQ CRS 302° ABQ	↑ 8000	
	1 4 (PR-TRN) CRS 077°	↑ 8000	
	1 5 ABQ	@ 8000	
	1 6 *ILS08* CRS 077°		
	1 7 ABQ	@ 8000	

Automatic Gaps in Flight Plans

When a SID, STAR and Approach are linked into a Flight Plan, *NO LINK* will be inserted at the transition points if the end waypoint of one procedure is not exactly the same as the beginning waypoint of the next procedure. These can occur at the SID-to-Enroute, the Enroute-to-STAR, and/or the STAR-to-Approach transitions. These discontinuities arise because the FMS does not know what path the pilot intends to use to go from one to the other. **IT IS THE RESPONSIBILITY OF THE PILOT TO RESOLVE THESE DISCONTINUITIES AND EDIT THE FLIGHT PLAN TO ELIMINATE ANY *NO LINK*s.** The pilot may manually eliminate the *NO LINK* using FPL editing techniques, or go "Direct To" another waypoint after the *NO LINK* in order to maintain a continuous flight plan sequence.

NEXT LEG INVALID Message

If a GAP or *NO LINK* exists in the flight plan and is not edited out by the pilot, the message "NEXT LEG INVALID" will occur whenever the GAP or *NO LINK* sequences into the NX position (i.e., it becomes the next waypoint after the current TO waypoint). If it is not eliminated, the FMS will continue to fly on last heading (0° roll steering command) upon passing the TO waypoint and will issue the message CURRENT LEG EXTENDED.

Duplication of Waypoints in the Flight Plan

Sometimes a SID or STAR procedure may duplicate existing waypoints when linked into a flight plan. For instance, if the flight plan were generated on J-45 from STL to Atlanta KATL, the waypoints LAJUG, Nashville (BNA) and Atlanta (ATL) would be inserted automatically at the end. The flight plan would read:

```
5     ....  
6     LAJUG  
7     BNA  
8     ATL  
9     KATL
```

When the ROME 6 Arrival with Nashville transition is linked into the flight plan between the last waypoint and the destination airport, BNA and ATL will be repeated, since they are part of the STAR. A NO LINK will be inserted between ATL and BNA since they don't logically link. The flight plan would now read:

```
6     LAJUG  
7     BNA  
8     ATL  
9     *NO LINK*  
10    BNA  
11    DRAKK  
12    NEUTO  
13    RMG  
14    ERLIN  
15    DALAS  
16    ATL  
17    KATL
```

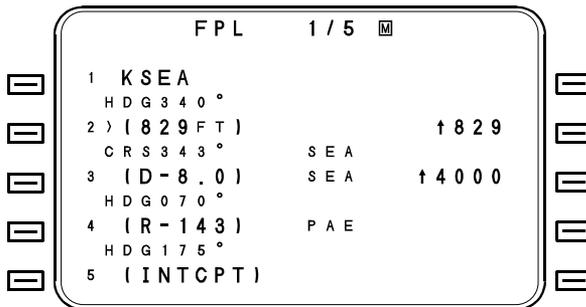
↑
Original flight plan
↓

↑
These are the
ROME 6
Arrival waypoints
↓

The redundant waypoints and NO LINK (Items 7, 8 and 9) must be edited out of the flight plan before reaching BNA or else the aircraft will sequence directly from BNA to ATL instead of navigating the ROME 6 Arrival. The cursor should be placed over Item 7 BNA and the number "10" entered and ENTER key pressed. This procedure will then "close up" the flight plan which will now read correctly as follows:

- 6 LAJUG
- 7 BNA
- 8 DRAKK
- 9 NEUTO
- 10 RMG
- 11 ERLIN
- 12 DALAS
- 13 ATL
- 14 KATL

ANY TIME A SID, STAR OR APPROACH IS LINKED INTO THE FLIGHT PLAN, THE PILOT SHOULD REVIEW THE RESULTING FLIGHT PLAN TO VERIFY THAT IT IS CONTINUOUS WITH NO GAPS OR DUPLICATED WAYPOINTS, AND THAT IT CONFORMS TO THE INTENDED PATH OF FLIGHT.



Approaches - General

The following section describes the aspects of operation of the FMS, which are common to all approach operations, without regard to the type of navigation sensor upon which the approach guidance is predicated.

Later portions of this section provide details specific to certain approach types, e.g., ILS, VOR or GPS approaches, as well as certain exceptions to the general comments made here.

NOTE: All approach modes must use QNH altitude and not QFE. Each altitude type is defined as follows:

QNH - Used in all FMS approach modes. This is the altitude above sea level based on local station pressure (i.e. MSL altitude).

QFE - Do Not Use. This is the height above airport elevation (or runway threshold elevation) based on local station pressure.

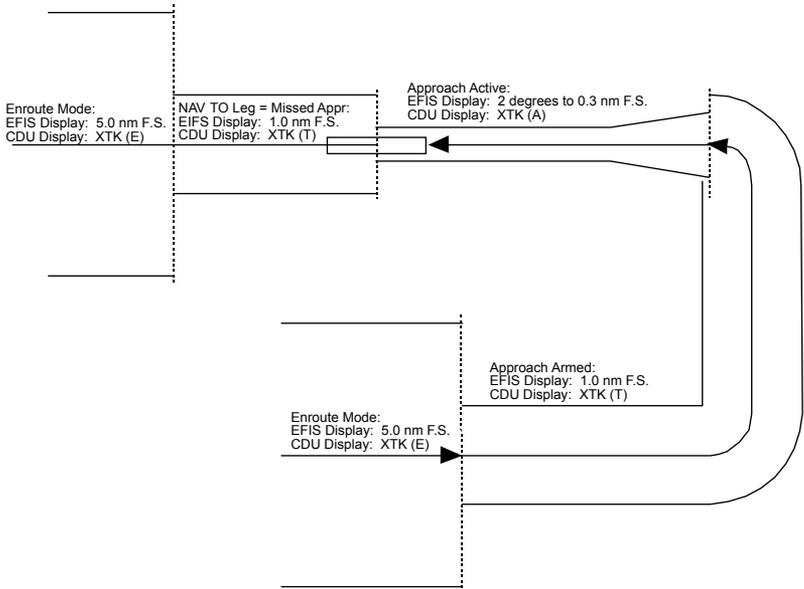
The FMS is approved for a variety of approaches. The approach capabilities of a specific installation depends on the installed sensor suite and the interfaced aircraft flight guidance system. The approved approaches can include the following:

- ILS (FMS defined ILS guided)
- LOC
- LOC-BC
- VOR
- VOR-DME
- TACAN
- RNAV
- GPS Overlay NDB)
- GPS (Stand-alone approaches)
- VFR

The configuration module contains the list of approach types that are permitted for the specific installation. Approaches, which are not on the configuration list, can not be selected.

HSI Course Deviation Indicator

The discussion below describes the scale sensitivities for analog instruments. The Operator's Manual or Technical Manual for the EFIS equipment should be consulted to determine the display sensitivity for these instruments.



Enroute Scaling

When the FMS is operating in the enroute mode, the normal CDI scaling is linear at ± 5.0 nautical miles (e.g., full scale deflection of the CDI needle indicates a deviation of 5.0 miles from the desired track, regardless of the aircraft's distance from the waypoint).

Approach Armed Scaling

When 50 miles from the end-of-approach (direct distance to the runway, not along the flight plan), the “APPR ARM” option becomes available. This is indicated by the appearance of “APPR ARM ->” on Line Select Key [3R] on NAV page 1.

Selecting “APPR ARM” increases the CDI scale sensitivity to ± 1.0 nautical miles, which remains until approach is activated.

If an approach is linked into the flight plan and is not yet armed before reaching 30 nm from the destination, the system will automatically arm and the CDI scaling will change to 1.0 nm.

Approach Activated Scaling

The Approach mode may be activated automatically or manually. When the approach mode is active, angular CDI scaling is invoked. The CDI sensitivity is then ± 2.0 degrees, approximating that of a normally sited localizer on runway of about 9,000 feet in length. (A localizer's course width is normally tailored to produce full scale deviation at a displacement of 350 feet from centerline at the runway threshold. The localizer is typically sited about 1,000 feet beyond the roll-out end of the runway.)

Angular scaling is maintained to the point where full scale CDI deflection is equal to 0.3 nautical miles. At that point the system maintains linear scaling at ± 0.3 nautical miles to the end-of-approach. This point occurs approximately at the Final Approach Fix.

Missed Approach Scaling

Upon cancellation of approach mode (press ‘MISSD APPR’ line select key) to fly the missed approach procedure, HSI deviation will revert to terminal scaling (i.e. ± 1.0 nm). If a leg change, DTO or PVOR is performed to a waypoint that is not part of the missed approach procedure, or PVOR or Hold at any waypoint then scaling will revert to enroute (± 5.0 nm).

Approach Data Base

FMS approaches can only be executed when the approach is defined in the FMS's navigation data base. The approach can be either a published approach, which is included in the Navigation data base, or an approach entered by the operator in the Pilot data base. GPS and NDB overlay approaches are included in the subscription navigation data base and cannot be pilot defined. Pilot data base approaches can be created either through the FMS or with Universal's Off-Line Flight Planning (OFP) software.

A legitimate IFR approach can be constructed in the Pilot Data Base only if the approach is referenced to approved instrument approach procedures (i.e., constructed to exactly duplicate the charted procedure). Runway coordinates and named FAF waypoint must be retrieved from the Navigation data base.

Some different waypoint naming conventions will be seen when approaches are examined. The following are examples of enroute, terminal and approach waypoints:

- D235H 8 mile DME ARC waypoint on 235° radial ("H" is 8th letter)
- R-123 DME ARC terminator on 123° radial
- TUS Typically a navaid, e.g., the TUS VOR (or NDB)
- BASER A pronounceable 5-letter intersection name
- TUS45 A 45 DME fix from the TUS VOR
- 21TRM A 121 DME fix from the TRM VOR
- RYNNB An enroute waypoint located at the RYN NDB
(The letters "NB" are appended to the beacon identifier)

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Approaches may be constructed using enroute waypoints and nav aids, but they will generally contain terminal waypoints as well. Terminal waypoints are maintained in a data base file associated with a particular airport. Examples of approach waypoints are:

- FF26 Final Approach Fix for Runway 26
- OM26 Outer Marker for Runway 26
- MM26 Middle Marker for Runway 26
- CF26 Final Approach Course Fix for Runway 26 (usually located on the final approach course about 2 miles outside the FAF.
- RW26 The threshold coordinates (on centerline) of Runway 26
- MA26 Missed Approach Point for the specified approach to Runway 26
- MA123 The missed approach point for a circling procedure, lying on the 123 degree radial from (or bearing to) the referenced nav aid.

Previously, these waypoints were not identified by name on the approach charts. GPS overlay approaches now include reference to the database names for these approach waypoints.

Approach Guidance

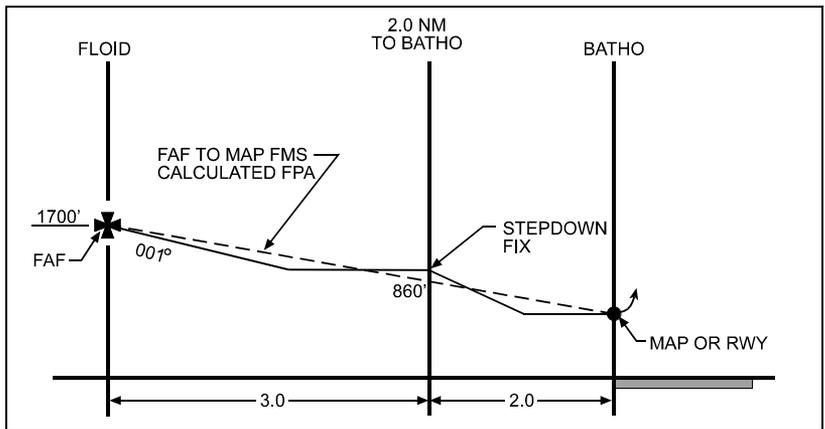
The approach guidance furnished by the FMS is intended to provide a stabilized approach to an appropriate runway threshold crossing height. No "level-off" is provided at MDA, since MDA will often vary as a function of the aircraft approach speed category. The data base altitudes provide for a threshold crossing height of 30 to 50 feet above the touchdown zone of the runway. It is the pilot's responsibility to terminate the descent at MDA if visual contact with the runway environment has not been established.

Non-Precision Approach Glidepath

The FMS calculates a glidepath between the Final Approach Fix (FAF) and Missed Approach Point (MAP) altitudes. When approach is active, vertical deviation is calculated using aircraft position and baro-corrected altitude relative to this glidepath.

In some approaches a step-down fix is depicted on the chart, but this point is not specifically coded in the navigation data base electronic data base.

The figure below depicts a direct glidepath from FAF to MAP as calculated by the FMS. Notice that this glidepath passes under the 860' step-down fix approximately 80'.



FMS calculated glidepath from FAF to MAP

A Flight Path Angle (FPA) is coded in the Navigation data base, which takes into account the step-down fix location. This FPA will always be greater than a computed FPA between the FAF and MAP when a step-down fix is present.

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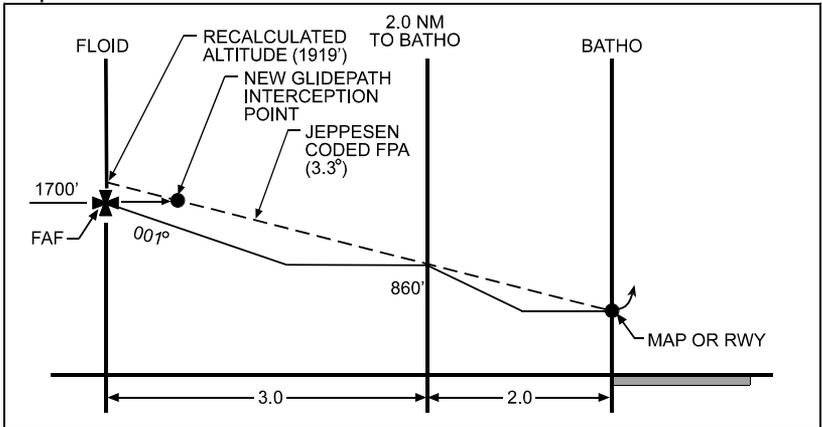
When the database FPA is greater than the FMS computed FPA between FAF and MAP, the FAF altitude will be recalculated to a higher altitude using the data base supplied FPA, such that a single glidepath will be generated which clears all step-down fixes in the approach procedure.

NOTE: There are instances in the database where the FPA is higher than the computed FPA between the FAF and MAP, but there is no step-down fix depicted on the chart. This is due to coding rules that were in effect in the past in which the FPA was not allowed to be less than -3.0 degrees. ***The data base supplier is working to change these FPAs to match the computed FAF/MAP FPA when a stepdown fix is not present.***

In this case, the glidepath intercept point will be some distance past the FAF. When you link an approach, the FAF altitude displayed by the FMS may be higher than the charted FAF altitude. The correct procedure will be to continue level flight past the FAF until the vertical deviation indicator indicates glidepath capture, and then descend.

As always, it is the pilot's responsibility to observe and assure that the published MDA is not violated.

Refer to the following diagram of a typical approach profile with a stepdown fix:



Recalculated glidepath using the Navigation data base coded FPA

In this example (KBXA GPS 36 approach at Bogalusa LA), there is a stepdown fix at 860 feet, 2.0 nm from the MAP. In this case the navigation data base coded FPA of -3.3° will be used to recalculate the FAF altitude of 1919 feet, which will replace the database FAF altitude of 1700 feet. The FAF will still be crossed at 1700' but the new glidepath intercept point will now be approximately 0.6 nm past the FAF. Note that the new glidepath will cause the aircraft to be at exactly 860 feet when 2.0 nm from the MAP.

Approach Types

NOTE: Refer to DATA BASE Section for details of creating Pilot Defined Approaches.

ILS Approaches

ILS approaches are included in some data base part numbers. Depending upon the installation, these approaches may or may not be coupled to the flight director/autopilot. Refer to “ILS and RNAV Approaches with and without Advanced EFIS Configuration” later in this section for more detailed information. In aircraft that do not allow coupling to the FGS, the FMS will provide guidance up to the point where the ILS localizer signal becomes active, and then the pilot must manually transition to ILS guidance using the FGS.

LOC and LOC-BC Approaches

Localizer and Localizer - Back Course approaches are different from FMS initiated ILS approaches in that the localizer signal from the ILS receiver is processed and retransmitted from the FMS, along with vertical guidance (pseudo glideslope) using barometric altimetry from the aircraft air data computer. This feature allows fully coupled 3D ILS-type approaches when there is no ground-based glideslope signal available.

In the case of LOC approaches the localizer signal is retransmitted to the EFIS/FGS in its raw form with the same scaling as received from the ILS receiver.

In the case of LOC-BC approaches, the localizer signal is inverted and mathematically modified to provide scaling similar to a front course localizer signal (i.e. ± 350 ft full scale at the runway threshold). It should be noted that the HSI desired track pointer will indicate the *inbound* course to the landing runway (unlike normal LOC-BC operation in which the desired track pointer is aligned with the front course inbound setting). The reason for this is to allow display of pseudo glideslope on the HSI.

VOR Approaches

VOR data are provided to the FMS either from a digital VOR receiver, or from a UNS Radio Reference Sensor. A collocated DME is not required at the VOR station; however, there must be at least one other DME in the terminal area in order to provide approach guidance.

For VOR approaches the DME is tuned to each of the closest DMEs once every four seconds.

RNAV Approaches (Including VOR-DME)

RNAV and VOR-DME approaches require a collocated DME with the VOR ground station. These types of charted approaches should be defined as RNAV approaches since the DME will be scanned much more often than for VOR type approaches. VOR data are provided to the FMS from a digital VOR receiver, with DME provided through the blind channel of a suitable DME. A UNS Radio Reference Sensor, if installed, is capable of providing both the VOR and DME data.

TACAN Approaches

TACAN approaches require the capability of obtaining both azimuth and distance from a TACAN interrogator / receiver or from a UNS Radio Reference Sensor. TACAN typically provides a considerably more accurate and stable (i.e., non-scalloping) source of azimuth data than conventional VOR. Distance accuracy is the same as a DME.

Since TACAN is primarily a military navigation aid, TACAN approaches are most frequently found at military airfields. TACAN ground stations are collocated with many VORs throughout the airspace system.

GPS Approaches

GPS “Overlays” are only applied to VOR, VOR-DME, NDB and RNAV approaches. ILS, LOC, LDA and SDF approaches are *not* eligible for GPS overlays. Currently GPS supports only nonprecision approaches. (Unaugmented GPS does not have sufficient accuracy -- especially in the vertical plane -- to support precision approaches. It is anticipated that Differential GPS will be required to attain the accuracy required for precision approaches.)

GPS Use During Approaches

It is most important to note that there are some very specific requirements, which must be met in order to execute a GPS overlay approach:

1. The GPS sensor must conform to FAA Technical Standard Order (TSO) C-129 class A1, B1 or C1;
2. The approach waypoint coordinates must conform to World Geodetic System - 1984 (WGS-84) coordinate system (or equivalent).
3. The approach must be approved as a GPS or GPS overlay approach. On Jeppesen charts, the legend “GPS” contained in parenthesis indicates a Phase I or Phase II Overlay approach. A Phase III approach is indicated in the title of the approach; e.g., “GPS or VOR Rwy 26”. Due to the very large number of approaches being converted to GPS, charts for all approved approaches may not have been updated. Jeppesen provides a listing of additional approved Phase III overlay in the “Terminal” section of the Airway Manual.

Therefore, the FMS meets the above requirements when using its internal GPS (if applicable) or is interfaced with a UNS 764-2 GPOSS, GPS-1000 or GPS-1200, and is operating in a region of the world which uses WGS-84 coordinate system. The navigation data base specifically codes approaches which are GPS approved. **Under these conditions, when an RNV, VOR, TACAN, ILS, NDB, LOC, BC or VFR approach is armed and activated then the GPS sensor will remain selected as a navigation sensor and provide position input to the Kalman Filter best computed position.** In the case of RNV, VOR, NDB, and TACAN approaches, if the underlying approach navaid becomes invalid, the approach guidance will continue to remain valid, assuming that the GPS accuracy, flagging and integrity monitoring criteria are satisfactory.

If either of the above conditions is not met, then the GPS sensor will be deselected when the approach is armed or activated. This will be the case if operating with a UNS GPS-950 or UNS-764-1 GPOSS, or if operating in areas of the world not using WGS-84 coordinate system. Even though the GPS sensor can be manually reselected after approach has been initiated, it is not advisable because the GPS accuracy, integrity and continuity of service cannot be assured.

The GPS sensor will be deselected for any pilot defined approach (other than "VFR" type).

GPS Predictive RAIM - RAIM PRED

Since the satellite geometry changes with position and time, the FMS with GPS must also include the capability of determining if a suitable number of satellites, with acceptable geometry, will be available at the FAF and Missed Approach Point at the estimated time of arrival. This prediction automatically occurs when approach mode is activated. If RAIM will not be available at either of those times, then the messages "NO GPS RAIM @ FAF" or "NO GPS @ MAP" are displayed.

GPS INTEG Annunciator

The FMS provides a logic signal to annunciate GPS INTEG whenever the integrity of the GPS position cannot be assured to meet minimum requirements for the particular phase of flight (oceanic, enroute, terminal or approach). Refer to “GPS Sensors” in Section VII for further information regarding criteria under which this annunciator is illuminated.

NOTE: Whenever the GPS INTEG annunciator is illuminated, the pilot should monitor his GPS position by cross reference to other navigation sensors, if available. *GPS-based approaches should not be flown whenever the GPS INTEG annunciator is illuminated.*

GPS Approach Charting

The availability of GPS approach capability can be readily identified on Jeppesen approach charts for U.S. airports.

Phase I or II overlay approaches are identified by the notation GPS in parenthesis in the facility information section of the approach plate, where the navaid identifier and frequency appear.

Phase III overlay approaches include the term “GPS” in the title, as “GPS or VOR Rwy 27”.

GPS stand-alone approaches are also identified by their title (e.g., “GPS Rwy 27”).

NOTE: If the term “GPS” does not appear in the title of the overlay approach, it is the pilot’s responsibility to monitor the underlying approach with the specified navaid for the approach (VOR, NDB, and/or DME as appropriate). Any loss of the reference navaid data should result in a missed approach to a suitable alternate approach or airport.

NDB Approaches

NDB GPS overlay Approaches are intended to be flown using GPS only. There are not provisions for pilot defined NDB approaches. NDB approaches are included in the navigation data base subscription. For NDB GPS overlay approaches, all page data fields are analogous to VOR or RNAV approaches except that the NDB facility will occupy the navaid and frequency fields. Normally the frequency field is formatted as xxx.xx MHz, however, NDB is formatted as xxxx.x KHz.

VFR Approaches

VFR approaches are provided as a pilot aid only, and should not be used in IMC. VFR approaches differ from other FMS approaches in two important respects

1. Since VFR approaches may be programmed at locations where reliable VOR and DME are not available, long-range navigation sensors (e.g., GPS, Loran, Omega, and Inertial) are not automatically de-selected for a VFR approach.
2. Since the FMS may be dependent on long-range sensors for the VFR approach, the systems accuracy standards will be relaxed for these approaches. On VFR approaches a “Q” of 28 is allowed before flagging occurs.

In some cases, especially when using GPS, it should be noted that VFR-type approaches are actually more accurate than some VOR and RNAV approaches. This accuracy improvement will be noted in areas where multiple navigation sensor inputs are available to the FMS. **IFR approaches should not be defined as VFR-type approaches in an attempt to take advantage of potential accuracy improvements.** Defining an approach as VFR will diminish the systems integrity (i.e., its capability of providing suitable warning for out-of-tolerance conditions).

Approach Procedures

NAV Approach Page 1

NAV APPR 1/3 is the first NAV page displayed when the FMS Approach mode is activated. The Approach mode is activated from NAV page 1 by selecting the ACT APPR option when within 50 NM of the destination. NAV approach pages 2 and 3 present the same information as do NAV pages 1 and 2, respectively, when not in the Approach mode.

NAV APPR 1/3			
KABG	ILS 08R	ISPT	111.90
FR	INBOUND		HDG→
077°	3.4NM	-1.5°	
TO	SUPOT	7400FT	MNVR→
077°	6.1NM	-3.0°	MISSD
NX	RW08	5389FT	APPR→
<hr/>			
XTKIA)	R0.44	VDEV	-189
XWIND	L 06	GS	154
WIND	022° / 12	VSR	-408

Arm Approach Mode

When the aircraft is within 50 nm of the runway (direct distance, not along flight plan path), the ARM APPR line select key will become available, and the approach can be armed. When pressed, the key name will change to ACT APPR (see below). The VHF receiver will then be tuned to the VOR or ILS frequency defined in the approach if Remote Tune is enabled (programmed into the Configuration Module at installation) and is applicable to the particular installation. If the ARM APPR key has not been pressed by the time the aircraft reaches 30 nm from the destination, the system will automatically ARM the approach. The XTK will display a (T) to indicate that the HSI sensitivity is 1 mile full scale deflection and ARM APPR will change to ACT APPR. When remote tune is available, the ARM APPR prompt changes to TUNE APPR if the appropriate VOR or ILS frequency is not tuned. Pressing this prompt tunes the VHF receiver.

NOTE: If an ILS approach is linked into the Flight Plan, but the FMS is not configured for advanced EFIS, then ARM APPR will not appear. The FMS will fly all approach transitions up to FAF, but prior to that point the pilot should transition his navigation source and FGS mode to ILS guidance.

Sensors (OSS, LCS and non TSO C-129 GPS) which cannot meet the Terminal or Approach accuracy criteria are automatically deselected for VOR, RNV, GPS, NDB and TACAN approaches. If available, IRS(s) will remain selected during all approaches for position smoothing computations. Loss of *required* primary sensors (e.g. VOR, DME or TACAN) will invalidate the approach (unless a qualified GPS is being used--see above discussion on GPS approaches).

If the pilot takes no further action (i.e., does not press ACT APPR), then the entire approach procedure including DME arcs, procedure turns, etc. will be flown. Upon sequencing through the Approach label (e.g., *RNV 11L*) in the flight plan and maneuvering inbound to the final approach course, the FMS will automatically sequence to the ACTIVE APPR mode.

At any time, if a DTO is performed to a waypoint in the approach, and the approach was previously armed, then the approach will automatically activate.

Activate Approach Mode

If desired, the approach can be manually activated by pressing the ACT APPR option on NAV page 1. When this action is taken all intervening waypoints from the present FR-TO leg to the first approach waypoint will be sequenced, and HSI guidance will be to that waypoint. Desired track pointer will be set to the inbound course of the approach. The FMS will transition to FHDG mode (see Note), and the pilot must manually set up the correct approach intercept angle. Normally this will coincide with radar vectors given by ATC.

NOTE: Some aircraft may be configured to skip auto-activation of heading mode at manual approach activation. In this case the pilot should select Heading Mode on the Flight Guidance System prior to manually activating the approach on the FMS.

When the correct intercept angle is established, the INTERCEPT line select key on NAV page 1 must be pressed in order to allow interception of the final approach course. **Failure to activate INTERCEPT mode will cause the aircraft to maintain current heading and fly through the final approach course.**

When the approach mode is activated, the FMS APPR annunciator will illuminate and the following data will be supplied for flight guidance.

- Bearing to the current active (TO) waypoint.
- Desired track or inbound course for the approach.
- Crosstrack error (lateral deviation) - The HSI course deviation display will be similar to a localizer in that full scale (two dot) deflection indicates a course error of 2 degrees to 0.3 nm.
- Lateral valid (NAV flag out of view) - When the lateral output is valid, the HSI NAV flag will be out of view and the lateral deviation signal may be used. The NAV flag will be out of view when the approach navaid is tuned with a valid nav signal, there are valid ADC inputs, and the system quality factor (Q) is within tolerance. To be within tolerance, the Q factor must be less than 5 for non-VFR approaches while within 15 NM of the end-of-approach point, less than 10 for terminal operations (VOR, RNV and TACAN approaches while from 15 to 30 NM from the end-of-approach point), or less than 28 for VFR approaches.

Section V Operations

- Glidepath (vertical deviation) - The HSI glideslope or vertical deviation display will be similar to an ILS glideslope in that full scale (2 dot) deviation indicates an angular deviation of 0.7° (0.35° per dot). An exception is that on Honeywell EFIS, full scale deviation (2 dot) is equal to 250 ft. On most systems full scale deviation equals 200 ft.
- Vertical valid (Glideslope G/S flag out of view) - When the vertical output is valid, the G/S flag will be out of view and the vertical deviation signal may be used. The G/S flag will be out of view when the lateral output is valid, the aircraft's position is on the "TO" side of the approach, the pilot has programmed a desired vertical path as part of the approach, and the aircraft's position is within the system's vertical approach geometry limits. (The geometry limits are similar to those limits imposed while using an ILS glideslope, based upon distance and altitude.)

NOTE: In some installation EFIS equipment may use the digital deviation data, in which the display sensitivities will be determined by the EFIS computer.

With some autopilots (such as FCC 850 or KFC 3100), during an FMS approach the FGS must be in approach mode (not NAV mode) to allow FGS VNAV mode to couple.

Regardless of actual position, the waypoints will not sequence and the TO waypoint will remain the same until the aircraft is within 5nm of the inbound course and the intercept track is within 80° of the inbound course. Once these conditions are satisfied and the aircraft passes the TO waypoint, an automatic leg change to the next approach waypoint will occur.

While outside the sequencing parameters (5 nm of course or 80° of intercept), an aircraft position which is actually past the TO waypoint will be reflected with a "FROM" flag on the HSI.

The FMS approach definition can only include waypoints that are within $\pm 6^\circ$ of the inbound final approach course as defined by the Final Approach Fix and the end of the runway. Many approaches include several Initial Approach Fixes as “feeder fixes”, depending upon from what direction the aircraft approaches the airport. These are coded as Approach Transitions in the data base, and the proper one is selected at time of linking the approach to the flight plan.

If additional waypoints have been inserted into the flight plan among the approach waypoints, the system will cancel (or not allow activation of) approach mode. However, in the normal NAV mode, the additional waypoints along with the approach waypoints will be sequenced. If a missed approach is flown and the end-of-approach point is passed, the system will continue to give left-right guidance on an extension of the inbound course. The TO/FR flag will change to FROM, and the distance-to-waypoint will increase.

If a missed approach is required, the pilot must press MISSED APPR key on Nav page 1. This action removes the EOA gap from the lateral guidance leg set. Since the end of approach is designated as an overfly waypoint, the approach will continue until that waypoint is sequenced. The missed approach legs will then sequence normally and will provide guidance to the Missed Approach Holding Fix. At that point, the pilot may initiate another approach by pressing ARM APPR, then ACT APPR key on NAV page 1. INBOUND TO the first approach waypoint will appear. Canceling and reactivating the approach too soon, while climbing straight out during the go-around, will cause leg sequencing through all the approach waypoints as the auto sequencing criteria are all satisfied (aircraft track equal to approach course and XTK less than 5 nm).

If an approach is linked to the flight plan, but has not been armed yet, when the aircraft reaches a point 3 nm prior to the first approach waypoint (usually the FAF) the message “APPR ARM AVAIL <NAV>” will appear again. This will allow time to arm and activate the approach prior to reaching the FAF. Once armed, the message will be canceled.

NOTE: Do not fly any approach under IFR unless the FMS is in active approach mode. You must select either ARM APPR or ACT APPR at some time prior to the final approach segment.

Holding During Approach Operations

Two types of holding patterns are defined in the navigation data base. HF holding patterns are used for course reversals in lieu of procedure turns. They appear at or prior to the FAF. HM holding patterns are found at the missed approach holding fix. Both holding pattern types are flown as described in the ENROUTE portion of this section. When both a holding pattern and an approach are armed either HOLD ARMED or APPR ARMED banner will appear on Nav page 1. When a holding pattern is programmed at a waypoint in the approach transition, HOLD ARMED will display. When the holding pattern is exited APPR HOLD will again annunciate. Normal approach activation will occur when the approach label sequences through the TO waypoint and the aircraft is inbound to the runway. When, it is determined by the pilot that it will not be necessary to enter the holding pattern, the DISSARM HOLD function on the Maneuver page can be used to eliminate the holding pattern.

Either holding or approach mode may be active. The active mode is the last one selected. If approach mode is active at the time that a holding pattern is activated, then approach active mode will be downmoded to armed condition, and will remain armed until the holding pattern is exited by PROCEED or DTO. At that point normal approach arm/active logic will take place.

MANUALS AFFECTED: Universal Avionics Systems Corporations' Operator's Manual, Report No. 2423sv602, dated January 5, 1998.

FILING INSTRUCTIONS: Insert this Temporary Change into 2423sv602, Section 5 adjacent to page 5-100.

INSTRUCTIONS: Add the paragraph below so that it follows the last paragraph under "Holding During Approach Operations".

Holding Pattern Termination

Auto or manual termination of a holding pattern is determined by examining the waypoint depiction on the NAV or FPL pages.

Automatic termination applies to a procedural holds usually used as course reversals in lieu of procedure turns. When the holding pattern automatically terminates, the next waypoint to be sequenced is listed after the hold on the NAV page.

NAV 1 / 2 <input type="checkbox"/>			
HOLDING			
FR LIPTE*			HDG→
HLD 123°	LIPTE0+03		
TO LIPTE	19:53	MNVR→	
123° 5.0NM			ACT
NX OBL0E			APPR→
XTK(E)	L0.44	GS	199
HEADWIND	1	BRG	144°
WIND 156T /	1	TKE	L142°

When the holding pattern requires a manual termination, "HOLD" is displayed after the holding pattern on the NAV page.

NAV 2 / 3 <input type="checkbox"/>			
HOLDING			
FR AR*			HDG→
→HLD345			
TO (HOLD)			MNVR→
NX - - - -			APPR
XTK(E)	L0.44	GS	350
HEADWIND	17	BRG	144°
WIND 156T /	19	TKE	L002°

Cold Temperature Compensation - TEMP COMP

Note: Availability of this feature is determined at the time of installation by a setting in the Configuration Module on the VNAV OPT page. If it is disabled, then the feature as described below will not be present.

Under conditions of extreme cold (from 0° C to -50° C) barometric altimetry will contain errors, which result in the actual aircraft altitude being lower than that indicated by the altimeter. Some countries (e.g., Canada, Norway, etc.) have procedures defined whereby the pilot must refer to a table of information relative to landing airport elevation and temperature, and derive altitude corrections which are then added to charted approach altitudes. The feature described in this section automates that process and relieves the pilot of this manual task.

For the FMS to compute Temperature Compensated Altitudes, all of the following conditions must be met on the TEMP COMP page

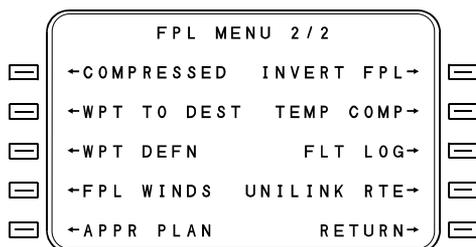
- An airport temperature must be entered.
- An airport elevation must be displayed.
- The Temperature Compensation function must be activated.

When all conditions are met, Altitude Corrections will be added to all altitudes in the approach transition legs, approach legs, and the missed approach legs.

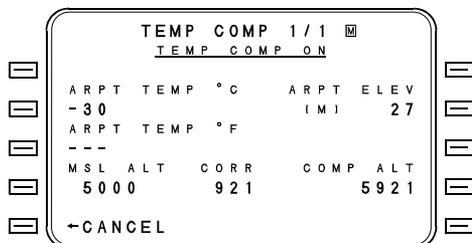
Temperature Compensated Altitudes will be displayed on the FPL page, the APPR PLAN page, the PATH VNAV page, the NAV APPR page and the TEMP COMP page. After the temperature compensation feature is activated, Temperature Compensated Altitudes may be overwritten by entering a manual altitude on the PATH VNAV page. The Temperature Compensation function may be disabled by selecting the CANCEL option on the TEMP COMP page. When Temperature Compensation is canceled, all altitudes, including altitudes, which were manually entered after the Temperature Compensation feature was activated, will have the Altitude Corrections removed. TEMP COMP is also canceled if a new airport and approach are entered in the flight plan.

To Activate Temperature Compensation:

1. Press the FPL key to access a flight plan page
2. Press the MENU key to access FPL MENU page 2/2:



3. Press TEMP COMP to display the TEMP COMP page(s):



Initially the TEMP COMP page will indicate 1/1 until such time that all required data is entered and the feature activated.

4. Enter ARPT TEMP (in either C or F). The temperature must be entered manually by the pilot, and can be in the range of 0° C to -99° C and 32° F to -94° F
5. Enter ARPT ELEV. The ARPT ELEV will be prefilled with the airport or runway elevation from the flight plan approach, but may be manually overwritten.
6. Press the ACTIVATE line select key.

When activated, the subtitle will show TEMP COMP ON and line select key [5L] will change to CANCEL. The number of available TEMP COMP pages will increase to show all waypoints of the approach, including transition and missed approach. Each waypoint with an altitude defined will show charted altitude (MSL ALT), Height Above Airport (HAA), Temperature Correction in feet (CORR) and the resulting Temperature Compensated Altitude (COMP ALT). The Compensated altitudes will be used in the VNAV calculations for enroute VNAV and pseudo-glide slope.

A “calculator function” is available such that any altitude may be entered on page 1 next to line select key [4L], and the resulting temperature correction will be displayed.

TEMP COMP 2 / 4 <input type="checkbox"/>				
MSL	HAA			COMP
ALT		CORR		ALT
T CREAK				
5 7 0 0	5 6 7 3	1 0 5 1		6 7 5 1
T PR-TRN				
5 7 0 0	5 6 7 3	1 0 5 1		6 7 5 1
T CREAK				
5 7 0 0	5 6 7 3	1 0 5 1		6 7 5 1
A LOC				

TEMP COMP 3 / 4 <input type="checkbox"/>				
MSL	HAA			COMP
ALT		CORR		ALT
A CREAK				
5 7 0 0	5 6 7 3	1 0 5 1		6 7 5 1
A ROBOT				
2 3 0 0	2 2 7 3	4 2 1		2 7 2 1
A RW 2 1				
7 3	0	0		7 3
A EOA				

TEMP COMP 4 / 4 <input type="checkbox"/>				
MSL	HAA			COMP
ALT		CORR		ALT
M (4 2 7)				
4 2 7	4 0 0	7 4		5 0 1
M BTG				
4 0 0 0	3 9 7 3	7 3 6		4 7 3 6

If CANCEL is selected on the TEMP COMP page or if a new airport/approach is entered in the flight plan, all corrections will be deleted, and the charted altitudes from the data base will be used.

ILS and RNV Approaches with and without Advanced EFIS Configuration

When Aircraft is Equipped with Collins Advanced EFIS (C-14, E-4, etc.) and APS-85 Autopilot (or similar equipment from other manufactures—see AFMS for the installation).

If an ILS, LOC or BC approach is in the flight plan, the FMS will tune the VHF NAV to the ILS frequency, and blue second course information will appear on the EFIS when ARM APPR is pressed. When ACT APPR is selected, the FMS will enter FHDG mode and the FMS will sequence to the INBOUND course to the first approach waypoint. The pilot must use the heading knob or keyboard entry to set up the correct intercept angle to final approach course. When the aircraft is positioned correctly for localizer intercept (and the pilot has selected INTERCEPT on the FMS and APPR on the FGS mode panel), the EFIS/FGS will automatically transition to the ILS signals and capture localizer and glideslope. After localizer capture, any FMS Q factor warnings will be ignored by the FD/AP in order not to abort a valid approach.

Since the OSS and LCS sensors are automatically deselected when ARM APPR is selected on the FMS, this action may cause a premature POS UNCERTAIN situation with an ILS frequency tuned and few DMEs in the area. For this reason, the ARM APPR action should be delayed as long as possible with ILS, LOC and BC approaches, unless in a terminal area with good DME coverage. (This will not be necessary if an approved GPS is interfaced, since it will not be deselected).

In some cases, the pilot may wish to only ARM the approach and not press ACT APPR. In this case, the FMS will continue to fly all legs and waypoints that make up the transition to the approach. This may include procedure turns or DME arcs. When the FMS proceeds to the inbound leg and sequences the approach label (*ILS 11L* for instance), then the approach will be automatically activated just as if he had pressed ACT APPR. This sequence will send the appropriate logic signals to the EFIS/FGS so that the automatic transition to the raw ILS signals will occur.

In the event that the FMS has a slight position error that causes the aircraft to fly parallel to the ILS inbound course without LOC capture, the FMS will advise the crew with the message "FMS-FLOC DIFF WARN". The pilot should use FMS HDG mode to steer the aircraft to intercept the ILS.

ILS Approaches When Aircraft is Not Equipped with Collins Advanced EFIS and APS-85

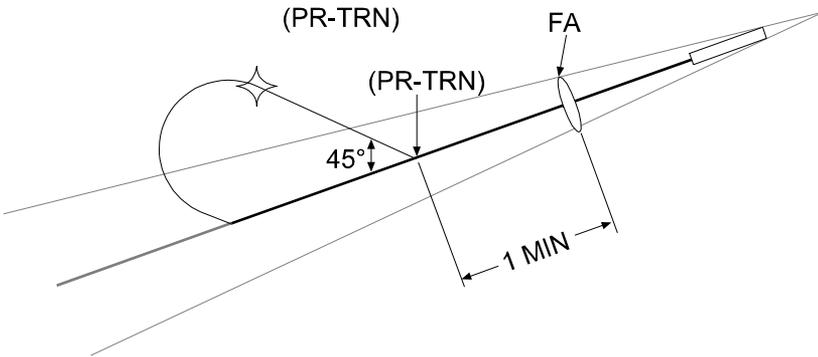
ILS, LOC and BC approaches may be linked into the flight plan using normal procedures. However, when 50 nm from the destination, the ARM APPR option will not appear, and the approach cannot ever be activated. If the waypoints are flown in sequence, including transitions, the FMS will provide roll steering to each waypoint, but all navigation will be predicated upon whatever short range and long range sensors are being used at the time. Localizer and glideslope signals will not be available to display on the ADI/HSI nor to couple to the flight director/autopilot.

All other approach types (VOR, RNAV, GPS, NDB, TACAN and VFR) will work normally.

Procedure Turns

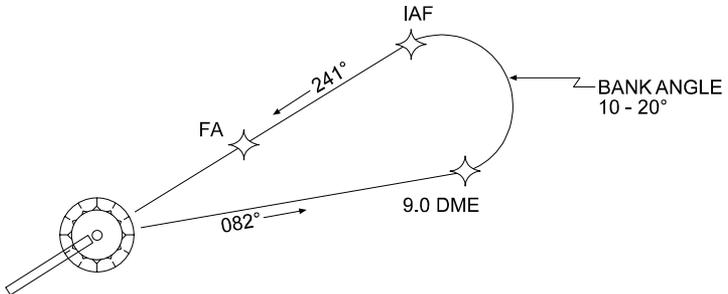
The FMS can fly two different types of procedure turns: the standard procedure turn and the teardrop procedure turn.

Standard Procedure Turn



The standard procedure turn is defined per ARINC 424 (called a PI leg type). When proceeding outbound, the aircraft will cross the FAF and continue for one minute (or less depending upon turn boundary and groundspeed) before turning to the 45° reversal leg. On ARINC 429 Multifunction Displays the notation (PR-TRN) will be displayed at the beginning and end of the 45° outbound leg as shown above. When groundspeed is high, thus causing the aircraft to violate the procedure turn boundary limit (typically 10nm), then the one minute outbound leg will be shortened accordingly.

Teardrop Procedure Turn



Some approaches are coded such that a teardrop is used to accomplish course reversal for the initial approach transition. In these cases the aircraft will proceed outbound from the Navaid using a “Course-from-Fix-to-DME” type leg that is 15 to 30° from the inbound leg, then will turn to capture the Course-to-Fix leg inbound to the IAF or FAF. During the turn, the FMS will command the correct bank angle, typically in the order of 10 - 20°, in order to cause an intercept at or outside of the IAF.

NOTE: The limited bank angle algorithm will only be flown if crosstrack deviation is less than 6 nm at the time of transition from the outbound to the inbound leg. If crosstrack is greater than 6 nm, the FMS will command maximum bank angle (typically 25°) to capture the inbound leg. This is normally not a problem, as these types of approaches are defined such that initial crosstrack deviation is in the order of 3 to 5 nm.

Missed Approach Procedure

When the Go-Around button (certain configurations only) or MSSD APPR line select key is pressed by the pilot, the current approach will be canceled. The *EOA* gap will be removed from the approach, therefore allowing normal leg sequencing after passing the missed approach waypoint (usually MAxx or RWxx). Lateral deviation will revert to ±1.0 nm scaling and vertical dev will flag.

NOTE: Pressing the Go-Around button causes the FGS to enter GA mode. NAV mode should be selected to couple FMS lateral missed approach guidance.

After Landing

Upon touchdown the LANDING summary page will be displayed.

LANDING 1 / 2				
TIME	TAKEOFF	13:43	UTC	
	LANDING	15:37		
	TOTAL	1+54		
FUEL	INITIAL	15300		
	ONBOARD	9267		
	USED	6033	LBS	

At the operator's discretion, the accuracy of the FMS best computed position may be checked against the actual airport coordinates. In addition, each sensor's derived position can be checked against the best computed position.

To compare each sensor's derived position coordinates against the FMS best computed position, proceed as follows:

1. Access the HOLD POS page (LANDING 2/2) by pressing the NEXT key. This page will display the FMS best computed position (FMS # POS) coordinates, the most significant sensor's derived position coordinates, and the difference between the two.
2. Use the line select keys to select other sensor's position coordinates as desired.

NOTE: Minor individual sensor inaccuracies will not always be apparent, as the FMS best computed position is derived from multiple inputs. It is recommended that each sensor's accuracy be checked individually for this reason. Significant differences between an individual sensor's position and the FMS best computed position are continuously guarded against by the sensor "watchdog."

MANUALS AFFECTED: Operator's Manual, Report No. 2423sv602, Change 1 dated June 20, 1997.

FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 5-108 in the Operations section.

REASON: To clarify limitations in the landing page display.

INSTRUCTIONS:

Add the following sentence below the screen graphic on page 5-108.

Upon landing at a high pressure altitude and airport, the landing page may not be displayed.

To compare the best computed position with the actual airport coordinates while on the HOLD POS page:

1. Press the FMS # POS line select key to access the DEFINE POSITION page.
2. Use the REF WPT line select key to position the cursor over the reference waypoint identifier entry field.
3. Enter the airport identifier or the PILOT WPT identifier for the parking ramp coordinates. When the identifier is entered, the distance and radial to the aircraft's present position will be computed and displayed.
4. Press the RETURN line select key to exit the page with no changes.

System Shutdown

1. Press the ON/OFF key. The dimming control window will be displayed.
2. Select the OFF line select key. The CONFIRM OFF control window will be displayed.
3. Select the CONFIRM OFF line select key. The system will shutdown.

Standby Mode

When configured, the STANDBY mode is available. This mode allows the crew to shut down and restart the system within a specified period of standby time and still retain the pilot data, flight plan and fuel data. This option does not work if the system is shut down in the air, or if the aircraft position is greater than 2 nm from the shutdown position.

Flight Log Entry

The Flight Log Entry function records data to the FMS for later download to a disk. This function is only active if the aircraft has been specifically configured for this function. That is, the FLIGHT LOG and FUEL mode configuration option must both be enabled.

Data, which can be saved for later download includes; time and location of engines running, APU, parking brake, rotors turning, time and location of takeoff and landing, fuel values at takeoff/landing/shutdown/download and flight, number. The specific configuration and pilot entry determine the actual data.

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Operations

The FLT LOG page is accessed from FPL MENU page 2/2 by pressing the FLT LOG line select key.

FLT LOG 1 / 1			
EMPTY WTT	LBS	FLT NBR	
10025		C1234	
PAX I 4 I @ 175			
700			
CARGO			
220			
		UPLOAD FUEL	
		+900	
GROSS WT	FUEL ONBOARD		
16845		5900	

NOTE: EMPTY WT, PAX, CARGO and FUEL ONBOARD entries on this page duplicate those on FUEL page 1, including the relationship to zero Fuel Weight. Values can be entered on either page.

EMPTY WT - The empty weight of the aircraft. The empty weight value in this field is programmed into the Configuration Module. Manual entries can be made in this field by placing the cursor over the field and typing in the desired value.

PAX - The passenger weight is input by entering the number of passengers (up to 999). The computer multiplies the number of passengers by the default weight per passenger (175 pounds). This weight may be changed on the FUEL MENU page. Once entered, the default weight will be saved for subsequent use. If passenger value is zero, then zero should be entered rather than leaving the field dashed.

CARGO - The cargo weight is input at this location by bringing the cursor over this field and typing in the desired weight. If cargo value is zero, then enter zero rather than leaving the field dashed.

GROSS WT - Gross weight is not an entered weight but rather, is the sum of Empty Weight, PAX, Cargo and Fuel Onboard.

FLT NBR - Flight number is entered at this location by bringing the cursor over this field and typing in the desired number. A maximum of six digits may be used. The flight number is retained through touchdown and liftoff and need not be entered unless a change is desired.

UPLOAD FUEL - Fuel upload and download entries are made at this location by bringing the cursor over this field and typing in the desired amount. Upload is indicated by using a + and download is indicated by using a -. A total of six numbers may be used including + and -. Upload fuel values are reset after takeoff and do not need to be entered if no change is made.

FUEL ONBOARD - The total fuel onboard value is stored in memory until manually changed. Confirmation is required following initialization.

Position Checks and Updates

Inflight Accuracy Checks

Inflight accuracy checks can be accomplished by pressing the HOLD POS line select key from DATA page 1 or NAV page 2 while over a known ground reference. With the position held, the FMS best computed position can be compared with the known reference or the position determined using other navigation equipment such as VOR, DME, TACAN, ADF, or radar fix to establish the aircraft position.

Check Distance/Radial from a Known Position

This procedure can be used to automatically calculate the distance and radial from any waypoint in the data base to the aircraft's held position.

1. Access the HOLD POS page by pressing the DATA function key and then selecting the HOLD POS line select key.
2. Press the [FMS # POS] line select key to access the DEFINE POSITION page.
3. Verify that the cursor is over the reference waypoint identifier entry field.
4. Enter the identifier of the known position. When the identifier is entered, the distance and radial to the aircraft's HOLD position will be computed and displayed.
5. Press the RETURN line select key to exit the page with no changes.

Check or Change Distance/Radial of Pilot Waypoint from REF WPT

1. Press the DATA function key to access the Data Base Menu page.
2. Select PILOT-WAYPOINT option to access the PLT WPTS directory. Use the NEXT and PREV keys as necessary to locate the desired waypoint.
3. Enter the reference number associated with the desired waypoint or type the identifier. When the identifier is entered, the Waypoint Identification page for that identifier will be displayed.
4. Select the MODIFY PLT line select key to display a DEFINE POSITION page for the waypoint.

NOTE: If the waypoint is being used in a route, flight plan, approach, etc., then MODIFY PLT will not appear, rather, IN USE will indicate that waypoint cannot be edited. Disregard remainder of this procedure.

5. Verify that the cursor is over the reference waypoint identifier entry field and then type in the desired identifier. When that identifier is entered, the Waypoint Identification page for that waypoint will be displayed. When the ACCEPT line select key is pressed, the distance and radial from the reference waypoint to the PILOT WPT will be computed and displayed. The radial or distance may be changed provided that the waypoint is not in use, or you may enter a second reference waypoint and cross radial.
6. Press the ACCEPT WPT line select key twice to enter any change to the PILOT WAYPOINT position.

Best Computed Position Update

All Universal FMS systems are designed so that this procedure should never be necessary during normal operations. However, the procedure does allow for a manual enroute FMS best computed position update over a known point. In general, a best computed position update is accomplished by positioning the cursor over a set of FMS position coordinates and then changing them. The update can be accomplished on the NAV Position page (NAV page 2), on the FMS Position page (DATA page 3), or on a HOLD POS page as described in the following procedure:

NOTE: This procedure affects the system quality (Q) factor.

1. Access the HOLD POS page by pressing the DATA function key and when over a known geographic position, by pressing the HOLD POS line select key.
2. Press the FMS # POS line select key to access the DEFINE POSITION page. Press the line select key to position the cursor over the system's latitude coordinate.
3. Enter the desired latitude and longitude as necessary. First, enter the corrected latitude. When the latitude is entered, the cursor will expand to cover the longitude entry field. Enter the corrected longitude. The \pm key may be used prior to coordinate input to change the hemisphere (N,S,E,W).
4. Press the ACCEPT line select key to accept the coordinate entries. When the coordinates are accepted, the FMS best computed position, as well as all OSS computed positions, will be updated.

NOTE: If the manual input position differs from the frozen position by more than 10.0 arc minutes, a VERIFY POSITION message will be displayed below the coordinates. If the input coordinates are correct, press the ACCEPT line select key.

A snapshot of FMS position will be taken when the HOLD POS line select key is pressed. The FMS will continue to navigate normally. When the new position is entered, the FMS will project current position based on current time and velocities.

Sensor Computed Position Update

The following procedure applies only to OSS sensors configured to accept enroute position updates initiated by the FMS. Inertial sensors will not accept updates once they are out of the ALIGN mode; i.e., while in the NAV mode. Once they are out of the SEARCH mode, LCS sensors will only accept updates if the update position differs by more than five miles. However, an LCS will re-initiate the SEARCH mode if the LCS position varies significantly from that of the update position. Whenever this procedure is accomplished, all OSS sensors capable of accepting updates will be updated. This update can be accomplished on the NAV Position page (NAV page 2).

1. Access NAV page 2.
2. Press the UPDATE SENSORS line select key. This will transmit FMS Best Computed Position to all connected sensors.

NOTE: In a dual installation, OSS 1 will normally be updated by FMS 1 and OSS 2 will normally be updated by FMS 2.

FUEL AND PERFORMANCE

Introduction

The FUEL key provides access to all fuel management functions. Five fuel function pages may be displayed. The first FUEL function page is used during the predeparture phase to input the initial fuel on board, to calculate the gross weight of the airplane, and to construct a reserves plan. The other four FUEL function pages provide a summary of all fuel management functions for the current flight plan, fuel flow, and fuel used.

NOTE: The Fuel Flow management information provided by the FMS has not been evaluated to the requirements of TSO C44a (Fuel Flowmeters).

Fuel display parameters are advisory only and do not replace primary fuel quantity or fuel flow gauges for fuel load and range planning.

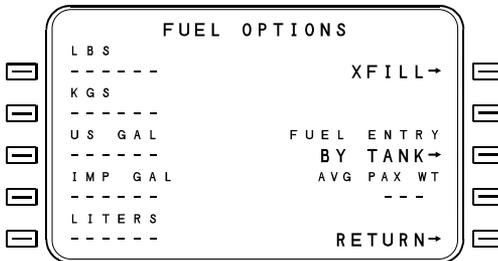
All fuel quantity and gross weight displays are computed values based upon the initial fuel on board as input by the pilot. These values are constantly corrected through inputs from the fuel flow sensors as fuel is burned.

NOTE: It is extremely important to understand that all FMS fuel mode calculations are based on the pilot's initial entry of fuel on board and subsequent automatic or manual fuel flow measurements subtracted over time. There is no direct connection to the aircraft's fuel quantity system by the FMS, so the aircraft's system remains the primary reference for all fuel and range calculations.

FUEL MANAGEMENT

FUEL OPTIONS Page

With any FUEL page displayed, pressing the MENU key will access the FUEL OPTIONS page.



The left side of the display is for viewing conversions. Pressing any of the left line select keys will place the cursor over that respective entry field. Entry of a value into one field will cause all other fields to display the same value converted per the entry field heading.

The right side of the display is for selecting crossfill, tank or total for fuel on board entries, and to return to the prior display.

XFILL- Available only in a dual installation, the XFILL feature causes the fuel onboard to be crossfilled (copied) to or from the other FMS. The system can be configured with either the PUSH or PULL option. Check with the Aircraft Flight Manual Supplement for specific crossfill configuration.

FUEL ENTRY - When TANK is selected, fuel will be entered per tank. When the FUEL ONBOARD line select key of FUEL page 1 is pressed, a per tank format is presented allowing fuel onboard to be entered individually for up to 6 tanks.

AVE PAX WEIGHT – This field allows the entry an average passenger weight value to be used for calculating total passenger weight on FUEL page 1/5. Once entered, the default weight will be saved for subsequent use.

When TOTAL is selected, the fuel on board entry can be made directly onto FUEL page 1 as a total amount.

Pressing FUEL ENTRY will result in display of a list page with options BY TANK or BY TOTAL. Select the appropriate number and press enter.

RETURN - The display will return to the last FUEL page viewed prior to pressing the MENU key.

FUEL Page 1

FUEL page 1 is the fuel and weight entry page. It is used to determine the gross weight of the airplane by entering the values to be used in calculating the weight and to plan the fuel reserves required. The line select keys are used to position the cursor over the data entry fields. Unit of measure is displayed as LBS or KGS and is programmed at installation.

FUEL		1 / 5	☐
BASIC WT	LBS	ALTERNATE	
10025		1000	
PAXI 4	1 @ 175	HOLD	
700		400	
CARGO		EXTRA	
220		200	
ZFW		TOTAL RESRVS	
10945		1600	
GROSS WT		FUEL ONBOARD	
16845		5900	

BASIC WT - The basic operating weight of the aircraft (i.e., Empty Weight plus crew and provisions). The BOW value shown in this field is programmed into the Configuration Module. Entry of a new weight will override the Configuration Module weight, and will be retained in memory for future use.

PAX - There are two methods of entering the total passenger weight. The number of passengers (up to 999) can be entered in the PAX field. The computer multiplies the number of passengers by the default weight per passenger. This weight may be changed on the FUEL OPTIONS paged. Total passenger weight is also manually enterable in the passenger weight field. This method will recalculate the displayed average passenger weight.

Section V
Operations

CARGO - The cargo weight is input.

ZFW - The Zero Fuel Weight is automatically calculated based upon the three prior entries. If desired, this value may be directly entered.

GROSS WT - The sum of the ZFW and FUEL ONBOARD values. Gross weight will not be calculated until FUEL ONBOARD entry is made or confirmed.

ALTERNATE - The fuel required to the alternate landing field.

HOLD - The fuel loaded for holding at the destination.

EXTRA - Additional reserve fuel loaded beyond that for alternate landing field and holding. Extra fuel generally does not change from flight to flight.

TOTAL RESRVS - The Total Reserves value is automatically calculated based upon the three prior reserve fuel entries. If desired, this value may be directly entered.

FUEL ONBOARD - The total fuel on board value is stored in memory until manually changed. Confirmation is required following initialization.

FUEL Page 2

This page displays range and endurance estimates based upon departure time and current parameters. Manual FUEL FLOW and GS (groundspeed) entries may be made to evaluate their effect on the other parameters displayed.

If all entries have been made on FUEL Page 1, then this will be the first page display when the FUEL Key is pressed from another mode.

FUEL 2 / 5 			
FUEL FLOW	LBS		GS
923			452
T/O	19:26	ELAPSED	1+25
TO	SWR	0+56	429 NM
ETA	UTC	21:47	
-7	LCL	14:47	
NOW		OVHD	SWR
16845	FUEL ONBRD		15982
4+59	ENDURANCE		4+03
2254	RANGE		1828

FUEL FLOW - Cumulative fuel consumption in pounds or kilograms per hour for up to 4 engines. Placing the cursor over the FUEL FLOW entry field allows a manual fuel flow entry to be made. When a manual entry is made, the performance displayed on this page will be referenced to that value.

GS - The groundspeed expressed in knots. Placing the cursor over the GS entry field allows a manual groundspeed entry to be made. When a manual entry is made, the performance displayed on this page will be referenced to that value.

NOTE: If Fuel Flow or GS are manually entered, these values will be lost when the fuel function is exited.

T/O - Takeoff time.

ELAPSED - The time elapsed since takeoff.

TO - Time and distance to the final waypoint. The alternate landing field destination may be entered to show predictions for the great circle distance and bearing to the alternate. Press this key to bring cursor over destination ident and enter a new ident as an alternate. The LIST function will present an airport list. An (A) will appear next to the new destination.

ETA - The estimated time of arrival at the TO waypoint location. ETA is based upon the present time and the current groundspeed over the flight planned route. ETA is displayed in terms of UTC and LCL (local) time. The local time zone difference from the zero meridian can be entered up to ± 13 hours. The \pm key is used to toggle the sign with the cursor over the LCL entry field. The sign will prefill with a minus (-) when the longitude of the TO waypoint location is W and prefill with a plus (+) when the longitude is E.

FUEL ONBRD - To the left, under "NOW", is the present fuel on board the aircraft in pounds. The value is equal to the FUEL ONBOARD value last entered on FUEL page 1 (on the ground or in flight) minus the fuel used since that entry was made. To the right, under "OVHD (DESTINATION)," is the calculated fuel remaining over the destination based upon present fuel on board, present groundspeed, and present fuel flow.

ENDURANCE - Under "NOW," the amount of time in hours and minutes that the flight can continue with the present fuel flow. Under "OVHD (DESTINATION)," the estimated amount of time the flight could continue after the destination is reached based upon the calculated FUEL ON BOARD at that location and present fuel flow. ENDURANCE is based on using all available fuel on board the aircraft, including reserves.

RANGE - Under "NOW," the distance in NM that can be traversed with the present fuel flow, fuel on board and groundspeed. Under "OVHD (DESTINATION)," the estimated distance in NM which could be traversed after the destination is reached. This range is based upon the calculated FUEL ON BOARD at that location, present fuel flow, and present groundspeed. RANGE is based upon using all fuel on board the aircraft, including reserves.

FUEL Page 3

FUEL page 3 provides a summary of the fuel requirements for the flight plan. Manual FUEL FLOW and GS (groundspeed) entries may be made to evaluate their effect on the other parameters displayed.

FUEL		3 / 5	<input type="checkbox"/>
FUEL FLOW	LBS		GS
9 2 3			4 5 1
FUEL			
AT DEPARTURE			5 7 1 0
USED			1 2 0 0
ON BOARD			4 6 1 0
REQUIRED			8 8 0
OVERHEAD	SWR		3 7 3 0
RESERVES			1 0 0 0
EXCESS			2 7 3 0

FUEL FLOW - Cumulative fuel consumption in pounds(kilograms). Placing the cursor over the FUEL FLOW entry field allows a manual fuel flow entry to be made. When a manual entry is made, the performance displayed on this page will be referenced to that value.

GS - The groundspeed expressed in knots. Placing the cursor over the GS entry field allows a manual groundspeed entry to be made. When a manual entry is made, the performance displayed on this page will be referenced to that value.

NOTE: If Fuel Flow or GS are manually entered, these values will be lost when the fuel mode is exited.

AT DEPARTURE - The total fuel entered on FUEL page 1 prior to departure. This value will not change if a new fuel entry is made while airborne.

USED - The total fuel used. USED is set to zero whenever a FUEL ON BOARD entry is made on FUEL page 1 while on the ground.

ONBOARD - The fuel on board the aircraft is equal to the total FUEL ON BOARD value last entered on FUEL page 1 (on the ground or in flight) minus the fuel used since that entry was made.

REQUIRED - The estimated fuel required to the destination. Required fuel is based upon present fuel flow and ETE to destination.

OVERHEAD - The estimated fuel on board at the destination. OVERHEAD fuel is equal to ONBOARD minus REQUIRED. The figure flashes if its value is less than zero.

RESERVES - The total reserves value as entered on FUEL page 1.

EXCESS - Excess fuel at destination. EXCESS is equal to OVERHEAD minus RESERVES. The figure flashes if its value is less than zero.

FUEL Page 4

This FUEL Page displays projected landing weight based upon current fuel conditions. All fuel quantity and gross weight displays are computed values based upon the initial values input by the pilot and inputs from the engine fuel flow sensors. The values displayed on this page may not be changed and the line select keys have no function.

FUEL 4 / 5	
LBS	
GROSS WT	16845
FUEL ONBOARD	4700
LANDING WT	13230
OVERHEAD SWR	3747
GND NM / LB	.375
AIR NM / LB	.370
TAILWIND	7
ESAD	633
TEMP	ISA+02

GROSS WT - The current gross weight of the aircraft is based on zero fuel weight plus present fuel on board.

FUEL ONBOARD - The current fuel on board is calculated from the last fuel on board entry and fuel flow inputs subsequent to that entry.

LANDING WT - The landing weight is based on current gross weight minus fuel burn to destination (or the last waypoint prior to a gap). The estimated fuel burn is calculated using present ground speed and fuel flow.

OVERHEAD (DESTINATION) - The calculated fuel remaining over the destination (or the last waypoint prior to a gap) based upon present fuel on board, present groundspeed and present fuel flow.

GND NM/LB(KG) - Ground nautical miles per pound (kg) of fuel. The value shown is based on the present groundspeed and fuel flow.

AIR NM/LB - Air nautical miles per pound (kg) of fuel. AIR NM/LB(KG) is based on TAS and fuel flow.

HEADWIND/TAILWIND - The wind component in knots.

ESAD - Equivalent Still Air Distance. This is the distance the aircraft would have flown since takeoff under zero wind conditions, or the air miles flown.

TEMP - The temperature in terms of the difference between the actual SAT (static air temperature) and the ISA standard SAT based upon current altitude.

FUEL Page 5

FUEL page 5 shows the fuel flow and fuel consumption in pounds(kilograms) per hour for each of up to four engines individually and cumulatively. The number of engines listed depends upon the installation. The fuel flows shown are supplied by the aircraft's fuel flow sensors.

FUEL 5 / 5 <input type="checkbox"/>			
	FLOW	LBS	USED
ENG 1	459		597
ENG 2	464 (MAN)		503
TOTAL	92		1200

FLOW - The fuel flow in pounds (kilogram) per hour. The values shown are obtained from inputs from the engine fuel flow sensors. If the FF for an engine drops to zero for four minutes, FAIL will be displayed. The fail can be removed and input restored by placing the cursor over the FAIL and pressing the BACK key and ENTER key. If fuel flow input has returned (such as after engine shut down and restart) it will be restored to normal operation.

Manual FUEL FLOW entries can be made. Line select keys are used to position the cursor to enter fuel flows for the individual engines. If a manual FF entry is made, (MAN) will be displayed. The maximum FF entry for each engine is 20,000 pph. A manual FF entry can be removed by pressing the BACK and then ENTER keys while the cursor is over then FF entry field.

USED - The cumulative fuel used in pounds(kilograms) for each engine and the total for all engines.

Manual FUEL USED entries may be made. Line select keys are used to position the cursor to enter fuel used for the individual engines. In the event of a power failure, the fuel used figures will be corrected by an amount equal to the present fuel flow times the duration of the power failure.

CAUTION: It should also be noted that if an APU is installed and running, fuel flow will not be monitored by the FMS, and fuel on board entries should be updated as required to compensate.

PERFORMANCE

PERF Page 1

The PERF page provides a synopsis of pertinent inflight performance information. Some aircraft will utilize advanced performance features, with pages for Takeoff, Climb/Cruise and Landing data. If applicable, refer to the AIRCRAFT PERFORMANCE SUPPLEMENT in the back of this section. This PERF page is read-only; no entries can be made.

PERF 1 / 1			
GS	480	TAILWIND	35
ESAD	447	TEMP	ISA_02
DIST	217	GND NM/LB	375
ETE	00+27	AIR NM/LB	383
	ETE	13:44	LCL
	NOW	OVHD	SWR
16845	WT LBS	WT	15982
4610	FUEL ONBRD		3747
4+59	ENDURANCE		4+03
2254	RANGE		1828

Intentionally left blank.

ABNORMAL PROCEDURES

Engine Failure/Shutdown

Should an engine fail or be shutdown in flight, a FUEL FLOW FAIL message will be displayed on the FMS. In addition, the digital fuel flow readout on the Fuel Flow page (FUEL page 5) will read FAIL for that engine. The FUEL FLOW FAIL message and FAIL display will also occur if the fuel flow sensor fails.

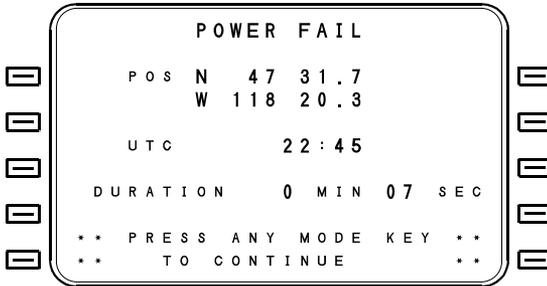
If the engine is still operating properly and a false message is suspected, or if the engine was temporarily shutdown and restarted, a reset may be attempted. With FUEL page 5 displayed, reset is accomplished as follows:

1. Use the line select keys to position the cursor over the word FAIL.
2. Press the BACK and then ENTER keys to reset the readout. If the sensor or interface has failed, the FAIL indication will reoccur after a 4 minute delay. If this occurs, manually input a fuel flow over the word FAIL and press the ENTER key.

If the engine has been shutdown or has failed, the pilot should manually enter a zero value for the fuel flow of the failed engine (in place of the word FAIL). This will reinstate fuel related estimates such as fuel over destination, specific range, etc., for the remainder of the trip.

Power Failure (Inflight Initialization)

These procedures are to be followed after electrical power is restored following a power failure to the FMS. This may include a simultaneous power loss to the OSS, GPS and LCS sensors. For inflight initialization refer to POWER FAILURE FOR OVER SEVEN MINUTES procedure.



Power Failure For Up To Seven Minutes

1. Press the ON/OFF key. If the time span from the beginning of the power failure to the time this key is pressed exceeds 7 seconds, a POWER FAIL page will be displayed. If the time span is less than 7 seconds, the CRT will display the same page that had been in view prior to the power interruption. In either case, the remainder of this procedure remains the same.

NOTE: The latitude/longitude displayed on the POWER FAIL page represents the best computed position coordinates at the time of power failure. The UTC shown is the time of that failure, and the duration of the interruption is displayed in minutes and seconds.

2. Press the DATA key to access the FMS Position page (DATA page 3).
3. Use the line select keys to individually select the best long range sensor that has a position available (GPS preferred).

- NOTE:**
- If the sensor latitude/longitude coordinates are displayed, the power interruption lasted less than 7 seconds. The sensor is continuing to supply the computer with position information, although it will be in error by the distance traveled during those few seconds. **If this is the case, proceed to step 5.**
 - If dashes appear on all sensors, the power interruption lasted longer than 7 seconds. The latitude/longitude coordinates displayed after POS represent the FMS dead reckoning position estimate calculated using the last known groundspeed and track angle for the duration of power loss.
4. If the power interruption lasted longer than 7 seconds:
 - a) Press the FMS # POS line select key to access the DEFINE POSITION page. Press line select key [2R] to position the cursor over the system's latitude coordinates.
 - b) Press the ENTER key twice to re-enter the system's coordinates. The cursor will advance to the ACCEPT option.
 - c) Press the ACCEPT line select key to accept the system's coordinates. This procedure will update and reinitialize the OSS sensors.
 5. Press the DATA key to access the Sensor Summary page (DATA page 2). After a short delay, the quality factor (Q) should decrease to a normal value. Use the OSS 1 line select key to select the OSS Status page. The status line for each OSS sensor should read NAV. The bottom lines should show a return of normal station complement, with SYNC displayed. This may require a short wait.
 6. Press the MSG key and check the CRT for messages. The POS UNCERTAIN message should disappear.

- NOTE:**
- If an inertial sensor is installed, its backup power supply will have kept the IRS navigating through the power loss.
 - If desired, the IRS1 or IRS2 Nav page may be selected instead of the OSS1 Nav page. This is accomplished by positioning the cursor over each FMS best computed position (POS) coordinate line and manually copying the IRS's latitude and longitude coordinates. When the coordinates are entered, the FMS and all OSS and LCS sensors (if still in the SEARCH mode) will be updated to the new position.
 - It is not possible or necessary to update or change the IRS latitude/longitude position coordinates once the initial alignment is correct.

Power Failure For Over Seven Minutes

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

1. Press the ON/OFF key. The system will run through the self-test and then display the Initialization page. The latitude/longitude displayed will be coordinates displayed at the time of the power loss.
2. Press the ACCEPT line select key to accept the initialization data.

NOTE: The system must be initialized before any updated coordinates may be input onto one of the Nav pages.

3. Refer to BEST COMPUTED POSITION UPDATE procedure to update sensor and FMS best computed positions before selecting a flight plan.

NAV Sensor Accuracy Messages

Should one or more messages concerning navigation sensor accuracy be active, the corrective action(s) required may vary with the number and type of sensors which are installed. Rather than attempt to cover every combination of messages possible for the particular mix of sensors installed on an aircraft, included in the following paragraphs are the factors and general thought processes which should be considered in an assessment of the situation.

The FMS integrates information from all available navigation sensors in order to derive a "Best Computed Position." Because each type of Nav sensor has different characteristics affecting their ability to provide accurate latitude/longitude information, the FMS computer must assign a priority to each sensor for use in the position calculations. A conservative approach has been used for automatic sensor deselection to eliminate errant sensors; however, the pilot must still monitor sensor input and evaluate sensor deselection or the need for such deselection. While every effort is made to make these priorities in the smartest way, certain conventions are made.

Messages concerning navigation sensor inaccuracies are especially noteworthy on over water flights where DME-DME position is not available to determine which sensor is inaccurate. Proper action by the crew in manually deselecting the faulty sensor and possibly updating the FMS is necessary to assure accurate tracking. This discussion deals with how to determine which sensor is faulty.

A sensor watchdog gives position difference warnings with FMS messages for OSS, GPS and LCS sensors and for a second FMS in dual installations, at 6, 12, 18, and 24 NM from the FMS Best Computed Position. For IRSs, the sensor watchdog compares 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.

For highly divergent sensors, based on the average position of all the other sensor positions, an individual sensor will be automatically deselected if that sensor's position differs from the average position by more than 50 NM, or if the sensor position is changing from that position at a rate exceeding 50 kts.

Section V Operations

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:

- 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 Q of each sensor?
- How many stations are the OSS or LCS working with?
- Which sensor has done better in the past?
- How does the navigation information compare with the flight plan?

Two examples of actual situations which could arise, and a scenario for solution follows;

- Loran C is assigned second priority, contingent on its having a good quality factor and being inside the LOA (Loran Operating Area), or outside an LOA after flying there from inside an LOA with continuous signal reception.
- Omega/VLF is assigned third priority, contingent again on its quality factor.
- The IRSs provide smoothing of velocity calculations when available. With a single IRS, the position derived from inertial inputs is assigned fourth priority for long term positioning, but a higher priority for short term position keeping. It is normal for the long term IRS position accuracy to drift as a function of time. Inputs from dual and triple IRSs are given more weight; thus the potential error induced by other sensors is minimized due to extremely accurate IRS outputs from multiple IRSs.

Example 1: While flying in a non-DME environment in an aircraft equipped with three IRSs and one OSS, the following messages all become active simultaneously:

IRS 1 DIFF WARNING
IRS 2 DIFF WARNING
IRS 3 DIFF WARNING

The possibility of three like sensors all drifting off simultaneously is extremely remote. It is more likely in this instance that the single OSS sensor is, at least temporarily, contaminating the position data from sensors which are lower in priority. It is important to note that the only sensor, which does not have an active message pertaining to its accuracy, is the suspected "bad apple."

The proper course of action in this case would begin by looking at the latitude/longitude positions of the three IRSs, on the FMS POSITION page (DATA Page 3) to determine if they are close to one another. Remember, the "DIFF" values shown will all be large, but they are showing the difference from each IRS's position to the possibly contaminated FMS position. This is not what we are looking for. We're interested in seeing if the raw coordinates for IRS1 are close to IRS2 and close to IRS3. (The DIFF values can be used to assist in this process if it is realized that we are looking for similarity instead of absolute values.) After finding that all three IRSs are geographically close (allowing for normal errors), it can be assumed that the OSS is indeed the sensor which is pulling the FMS position away.

The proper corrective action would be to access the OSS Status page to deselect OSS 1 and then update the FMS position to the same latitude/longitude as any one of the IRS positions. The three IRS DIFF WARN messages should then disappear.

Example 2: The aircraft is flying in a non-DME environment with two long range nav sensors feeding the FMSs. A message becomes active saying one of them is drifting (i.e., "OSS1 DIFF 6nm" or "LCS DIFF 6NM" or "IRS1 DIFF WARN").

This is a tougher situation and requires a judgment call. Using the "General Rule" described above as a guide; an evaluation must be made to determine which sensor is in error.

Upon determining the problem sensor, deselect it or update it and consider updating the FMS best computed position. The message active on the screen may not indicate the problem sensor as it is based on the priority conventions outlined above. It remains the pilot's responsibility to verify the validity of the error messages.

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SPECIAL MISSIONS

This section of the manual is not applicable to SCN 602.

MANUALS AFFECTED: Operator's Manuals, Report No.'s 2423sv600, 2423sv601, 2423sv602, 2423sv603, 2423sv700, 2423sv701, 2423sv702, and 2423sv703.

FILING INSTRUCTIONS: Insert this Temporary Change into the front of the Sensors and Interfaces Section of each manual.

INSTRUCTIONS: Add the following Video Interface information;

VIDEO INTERFACE

Support of external video sources is an optional feature of systems utilizing the five-inch color flat panel display. This feature allows interface with video cameras and cabin display systems.

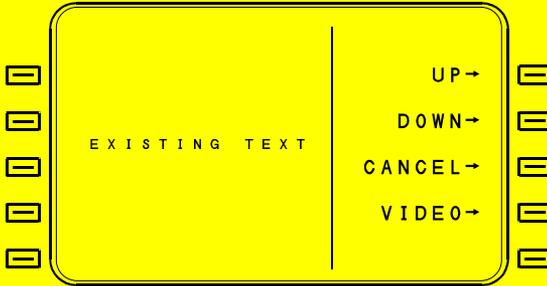
During video mode, the FMS continues to navigate in a normal manner and no CDU messaging will occur. The remote message annunciator will operate in a normal manner. Pressing any CDU key will cause the display to exit video mode.

To Access Video Mode

1. Press the ON/OFF Key to access the dimming control window.



2. Press the DISPLAY Line Select Key to access the display options window.



3. Press the VIDEO Line Select Key to access video mode. The active video source will be displayed.

To Adjust Video Brightness

The two upper right line select keys (1R and 2R) are used to adjust video brightness while in the video mode. Press and hold line select key 1R until display is brightened sufficiently or, press and hold line select key 2R until display is dimmed sufficiently.

To Exit Video Mode

Press any key to exit video mode (with the exception of line select keys 1R and 2R). Pressing a function key will cause that particular function screen to be displayed. Pressing any other key will return the display to that which was being viewed prior to video mode.

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INTRODUCTION

The FMS is capable of interfacing with a variety of sensors providing data used for navigation. These sensors range from complicated devices capable of autonomous navigation to simple ratio sensors. The philosophy is to allow the pilot to control the function of each sensor to allow control and selection for use by the FMS. The following table summarizes sensor selection and deselection occurring at various events.

Powerup On Ground	Select IRS, and any GPS that is in nav or altitude mode. All other sensors are deselected.
Powerup In Air	Select all sensors.
On Ground	Select any GPS that is in nav or altitude aiding mode and deselect any GPS that is not in nav or altitude aiding mode.
Takeoff	Select all sensors except ones that had been previously manually deselected.
Non-VFR Approach Armed	If a GPS or GPS overlay approach contained in the navigation data base is in use, deselect all sensors except IRS, ADS, radios, and the GPS that is currently being used for navigation. Otherwise, deselect all sensors except IRS, ADC and radios.
Approach Canceled (In Air)	Reselects all previously deselected sensors.
Landing	Deselect all sensors except IRS and any GPS that is in nav or altitude aiding mode.

This section contains those operating procedures required to manually select or deselect sensors or stations and procedures to manually input certain flight parameters in the event of a sensor failure.

AIR DATA

ADC Status

The ADC status page, accessed from DATA page 2, displays the status of the air data computer (ADC). The ADC is automatically deselected during ground operations and is automatically selected at liftoff. The ADC can be manually deselected or reselected by using line select key [4R].

ADC 1 / 1	
STATUS	NORMAL (DI) IAS
TAS	216.9
345 (MAN)	MACH 0.642
BARO ALT	SAT
17000 (MAN)	-50
PRESS ALT	ISA+01
16870 (MAN)	SELECT ADC→
←XFILL	RETURN→

The top of the page shows the page title (ADC) and the status of the system. The status field (beneath "ADC") will show NORMAL if the ADC is operational and selected, FAILED if the ADC has failed, XFILL if the data is cross-filled from a second ADC, and (D) if the ADC has been deselected.

TAS - The true airspeed being used by the navigation computer. Dashes will be displayed if there is no TAS input, (MAN) will be displayed if the TAS is a manual entry and (XFL) will be displayed if the XFILL option has been selected. A manually selected TAS overrides a sensor supplied TAS input and will be used even if the ADC is deselected or failed. A manual TAS entry is deleted by pressing the BACK and ENTER keys with the cursor over the TAS entry field.

BARO and TAS ALT - The altitude in feet as supplied by the air data computer. Dashes will be displayed if there is no altitude input, (MAN) will be displayed if the altitude is a manual entry and (XFL) will be displayed if the XFILL option has been selected. A manually selected altitude overrides a sensor supplied altitude. A manual ALT entry is deleted by pressing the BACK and ENTER keys with the cursor over the ALT entry field.

IAS - The indicated airspeed in knots as supplied by the air data computer. IAS will not be displayed on installations, which do not receive IAS from the air data computer.

MACH - The Mach number as supplied by the air data computer. Mach will not be displayed on installations, which do not receive Mach from the air data computer.

XFILL/LOCAL - XFILL will be a line select key option when a second FMS is installed. This will cause TAS, SAT and ALT to be displayed from the other ADC. When [XFILL] is selected "(XFL)" will be displayed next to the TAS, SAT and ALT values, the IAS and MACH data and titles and the [SELECT/DESELECT ADC] option will be removed from the display, and "LOCAL" will replace "XFILL" for reselection of the associated ADC.

SAT - The static air temperature received from the air data computer. Dashes are displayed if there is no input data.

ISA - As displayed on the ADC page, is the difference between SAT and ISA (International Standard Atmosphere) for the current altitude.

DESEL ADC / SELECT ADC [4R] - This line select key is used to alternately select or deselect the ADC sensor. If deselected, "(D)" will be displayed following the sensor status.

The Air Data Computer (ADC) is automatically deselected during ground operations and automatically selected at liftoff. The ADC can, however, be manually deselected and reselected, and manual inputs for True Airspeed (TAS) and altitude (ALT) can be made if necessary.

SHORT RANGE SENSORS

Distance Measuring Equipment (DME)

The DME-DME status and data is displayed on the DME Status page. This page is accessed from DATA page 2.

DME 1 / 1			
STATUS	NORMAL	ID	BACKUP→
BOI (M)	(103)		
BKE	5.6		
LWS	? 96.3		
PDT	78.9		
MAN DME BOI SELECT DME→			
MAN DME ---- RETURN→			

An "(M)" following a station identifier indicates a manually selected station. Manually selected DMEs are automatically deselected when the range exceeds 300 NM. The letter "I" preceding the three-letter designator indicates ILS-DMEs and LOC-DMEs. The distance display is as follows:

- The distance is expressed to the nearest one-tenth nautical mile.
- Dashes indicate no response from the DME station.
- A question mark (?) indicates the distance received from the DME is questionable. The system will not use this input.
- Parentheses () are used for manually selected DME stations to indicate that the distance shown is a computed distance from the aircraft to the DME station, not an actual DME measurement. The parentheses disappear when a DME lock-on is established.

BACKUP/RRS - Only indicated when an RRS is installed. The RRS or a backup DME (the aircraft's primary DME) can be alternately selected. When the backup DME is in use, it will continue to automatically tune stations.

DESELECT DME/SELECT DME - Pressing this Key will allow manual selection/deselection of DME as desired. When deselected, D will appear following DME Status.

During system initialization and ground operations, the DME will be deselected. Upon takeoff, the DME will automatically be selected. In the event of an aircraft weight-on-gear switch failure, the DME will automatically be selected when the TAS reaches 150 kts.

Manual DME Station Selection

Normally, the DME-DME Status page will display four lines showing four different DME stations and their respective distance readings. As the computer automatically tunes all of the available DME stations in the vicinity of the aircraft, the four stations displayed will continually change.

This procedure provides the pilot with the option of directing the computer to tune, and constantly display, one or two specific DME stations.

1. Access the DME Status page by pressing the DATA function key to access DATA page 2 and then selecting the [DME] option.
2. Press the [MAN DME] line select key to position the cursor over the MAN DME entry field.
3. Enter the identifier of the desired DME using the LIST function. The symbol (M) will be displayed after the identifier on the tuned DME listing to indicate a manual selection.

NOTE: When initially selected, the FMS estimate of what the DME distance should be will appear in parenthesis. When a DME lock-on is established, the parenthesis will be removed.

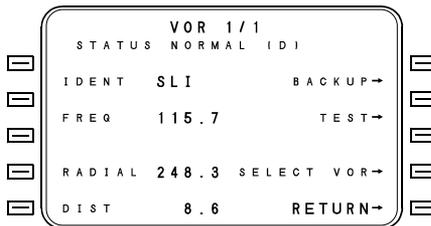
Return To Automatic DME Station Selection

1. Access the DME Status page by pressing the DATA function key to access DATA page 2 and then selecting the [DME] option.
2. Press the [MAN DME] line select key to position the cursor over the MAN DME entry field.
3. Press the BACK and then ENTER keys to delete the manual input.

NOTE: Manually selected stations will be automatically deselected and automatic station selection resumed at over a 300 NM range.

VOR

The VOR status and data are displayed on the VOR Status page. The page is accessed from DATA page 2.



STATUS - This is the operational status of the VOR. The status displayed will either be NORMAL or FAILED.

IDENT - The VOR station identifier. If RRS is installed the LIST key can be used to manually select a station by ident.

FREQ - The VOR station frequency (may be manually entered).

RADIAL - The radial from the VOR to the aircraft's present position. If no VOR radial is received, the radial field will be blank.

DIST - The received DME distance in NM from the VOR to the aircraft's present position. If no DME is associated with the VOR or no distance is received, a computed distance will be displayed in parenthesis.

TEST - Pressing this line select key places the cursor over the VOR station frequency. Frequency may be manually entered.

BACKUP/RRS - Only indicated when an RRS is installed. The RRS or a backup VOR receiver can be alternately selected. When backup information is being used, the pilot must manually select VOR frequencies via Nav control head.

DESEL VOR/SELECT VOR - This line select key is used to alternately select or deselect the VOR. When deselected, "(D)" is displayed following the VOR status.

NOTE: If an RRS is installed the VOR test in accordance with FAR Part 91.25 is performed on this page by entering the appropriate VOR frequency.

During system initialization and ground operations, the VOR will be deselected. Upon takeoff, the VOR will automatically be selected. In the event of an aircraft weight-on-gear failure, the VOR will automatically be selected when the TAS reaches 150 kts.

Manual VOR Station Selection

This procedure provides the pilot with the option of directing the computer to tune, and constantly display, one specific VOR station.

1. Access the VOR Status page by pressing the DATA function key to access DATA page 2 and then selecting the [VOR] option.
2. Press the [IDENT] line select key to position the cursor over the IDENT entry field.
3. Enter the identifier of the desired VOR using the LIST function. STATUS MANUAL indicates a manual selection.

Return To Automatic VOR Station Selection

1. Access the VOR Status page by pressing the DATA function key to access DATA page 2 and then selecting the [VOR] option.
2. Press CANCEL MANUAL line select key [3R].
3. VOR automatically reverts to nearest VOR station and indicates STATUS NORMAL.

TACAN

The TACAN Status and data are on the TACAN Status page. The page is accessed from DATA page 2 and is accessible only when an RRS or a TACAN is configured.

	TACAN 1 / 1		
	STATUS	NORMAL	
		T / R	
[]	IDENT	NUW	TEST →
[]	CHAN	85X	DESEL
[]			TACAN →
[]	RADIAL	153.7	
[]	DIST	48.6	RETURN →

STATUS - This is the operational status of the TACAN. The status displayed will either be NORMAL or FAILED.

IDENT - The TACAN station identifier. If RRS is installed the LIST key can be used to manually select station by Ident.

CHAN - The TACAN station channel. If RRS is installed the Channel number may be manually entered.

RADIAL - The radial from the TACAN to the aircraft's present position. If no TACAN radial is received, the radial field will be blank.

DESEL TACAN/SELECT TACAN - This line select key is used to alternately select or deselect the TACAN Sensor. When deselected, "(D)" is displayed following TACAN status.

TEST - Pressing this line select key places the cursor over the TACAN Channel. Channel may be entered manually for the test. Test is canceled by again pressing the CANCEL TEST line select key [2R].

DIST - The received DME distance in NM from the TACAN to the aircraft's present position. When the station is first tuned a computed distance will be displayed in parentheses until the station is identified.

DESEL TACAN/SELECT - This line is used to alternately select or deselect the TACAN. When deselected, "(D)" is displayed following the TACAN status.

During system initialization and ground operations, the TACAN will be deselected. Upon takeoff, the TACAN will automatically be selected. In the event of an aircraft weight-on-gear switch failure, the TACAN will automatically be selected when the TAS reaches 150 kts.

Manual TACAN Station Selection

4. This procedure provides the pilot with the option of directing the computer to tune, and constantly display, one specific TACAN station.
5. Access the TACAN Status page by pressing the DATA function key to access DATA page 2 and then selecting the [TACAN] option.
6. Press the [IDENT] line select key to position the cursor over the IDENT entry field.
7. Enter the identifier of the desired TACAN using the LIST function. STATUS MANUAL indicates a manual selection.

Return To Automatic TACAN Station Selection

1. Access the TACAN Status page by pressing the DATA function key to access DATA page 2 and then selecting the [TACAN] option.
2. Press the CANCEL MANUAL line select key [2R].
3. TACAN automatically reverts to nearest TACAN station and indicates STATUS NORMAL.

Radio Reference Sensor (RRS)

During system initialization and ground operations, the VOR, DME, and TACAN will be deselected. Upon takeoff, all three will automatically be selected. In the event of an aircraft weight-on-gear failure, they will automatically be selected when the TAS reaches 150 kts.

RRS Deselect

1. Access the VOR, DME or TACAN Status page by pressing the DATA function key to access DATA page 2 and then selecting the [VOR, DME or TAC] option.
2. Press the [DESEL DME/VOR] line select key to deselect the VOR or DME portion of the RRS/TAC.

RRS Reselect

1. Access the VOR or DME or TACAN Status page by pressing the DATA function key to access DATA page 2 and then selecting the [VOR, DME or TAC] option.
2. Press the [SELECT DME/VOR] line select key to reselect the VOR or DME portion of the RRS/TAC.

Doppler

The FMS supports three types of Doppler sensors; the RACAL 91, the CMC 2012 and the ASN-137. The Doppler sensor is automatically selected at takeoff and is deselected at landing. Doppler is also deselected at power up and approach arm.

Doppler Sensor Deselect

1. Access Doppler Status page from DATA page 2.
2. Press the DESEL DOPLR line select key. The Doppler status field will show a (D) when the Doppler is selected.

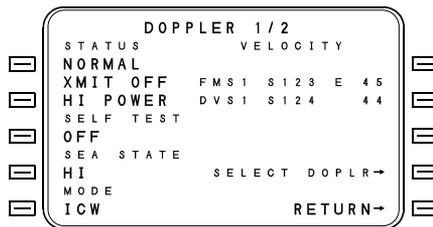
Doppler Sensor Reselect

1. Access Doppler Status page from DATA page 2.
2. Press the SELECT DOPLR line select key. When the Doppler is selected, the (D) in the status field will no longer be displayed.

Doppler Status

Racal 91 Doppler Status

The Doppler Status page is accessed from DATA page 2 by pressing the DOP line select key.



DOPPLER 1/2 page displays the operational status of the Doppler 91. DOPPLER 2/2 page displays diagnostic information for use by maintenance personnel. The DOPPLER 1/2 page is explained below:

STATUS - The status displayed will be displayed as either NORMAL, TEST, UNLOCK or FAIL.

XMIT - Transmit status displayed as either ON or OFF.

POWER - The power level will be displayed as either HI POWER or LO POWER.

SELF TEST - This line select key is used to start or cancel Doppler self test. Pressing this line select key initiates self test indicated by START in the status field. Pressing the line select key during self test will cancel self test indicated by OFF in the status field.

SEA STATE - Pressing this line select key will toggle Sea State between LO and HI.

MODE - Pressing this line select key toggles the mode between CW (Continuous Wave) and ICW (Intermittent Continuous Wave).

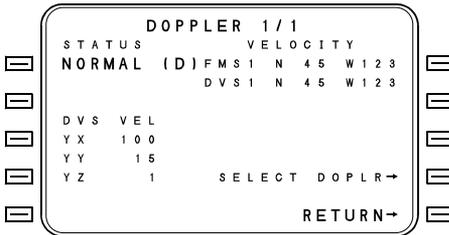
FMS1 - FMS velocity.

DVS1 - Doppler velocity.

DESEL DOPLR - This line select key is used to deselect and reselect the Doppler. When Doppler is deselected, a (D) will appear after the STATUS description.

ASN-137 Doppler Status

The ASN-137 Doppler status page is accessed from DATA page 2 by pressing the DOP line select key.



The DOPPLER 1/1 page displays the operational status of the ASN-137 Doppler. The DOPPLER 1/1 page is explained below.

STATUS - The status displayed will be either NORMAL, MEMORY or FAIL.

DVS VEL - Doppler velocities for the x, y and z components. If any velocity is not received for 1/2 second, the field will be dashed and the information will not be used for navigation solution.

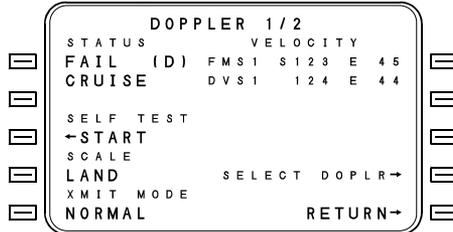
FMS1 - FMS velocity.

DVS1 - Doppler velocity.

SELECT DOPLR - This line select key is used to deselect and reselect the Doppler. When Doppler is deselected, a (D) will appear after the STATUS description.

CMC 2012 Doppler Status

The 2012 Doppler Status page is accessed from DATA page 2 by pressing DOP line select key.



DOPPLER 1/2 page displays the operational status of the 2012 Doppler. The DOPPLER 2/2 page displays diagnostic information for use by maintenance personnel. The DOPPLER 1/2 page is explained below.

STATUS - The status displayed will be NORMAL, TEST or FAIL.

TRACK MODE - Displayed as either CRUISE or HOVER.

SELF TEST - This line select key is used to start Doppler self test. Pressing the key once will bring the cursor over the START prompt. Pressing the key a second time will initiate self-test. Self test cannot be canceled once it has began.

SCALE - This line select key commands scale factor changes between SEA and LAND. Pressing the key once will bring the cursor over the field. Pressing the key a second time will change the scale factor.

XMIT MODE - This line select key commands the transmit mode between SILENT and NORMAL. Pressing this key once brings the cursor over the field. Pressing the key a second time will change the transmit mode.

FMS1 - FMS velocity.

DVS1 - Doppler velocity.

SELECT DOPPLER - This line select key is used to deselect and reselect the Doppler. When Doppler is deselected, a (D) will appear after the STATUS description.

LONG-RANGE SENSORS

GPS Sensors

The FMS uses GPS as a heavily weighted position sensor in its Kalman Filter. The FMS complies with all aspects of TSO C-129 Class B1 and C1 in regards to waypoint displays, scaling, integrity monitoring, predictive RAIM, etc. using its internal GPS or when interfaced to a TSO C-129/B1/C1 GPS sensor such as the GPS-1000 and GPS-1200. In a multi-sensor configuration, the GPS position is monitored the same as DME-DME, OSS, IRS and LCS in relation to the average of all sensors currently selected. A position difference greater than 50 nm or a divergence at greater than 50 knots will cause automatic deselection of the GPS from the position solution.

GPS Management

GPS sensors are automatically selected at power up on the ground or any time while on the ground. Additionally, GPS is selected at power up in the air and at approach mode cancellation if it had been automatically deselected at approach mode arming. GPS is automatically deselected 1) at approach mode arming of a non-GPS overlay or GPS approach, or 2) if the GPS is not approved under TSO C-129, or 3) whenever the GPS position or divergence rate fails the sensor monitor test. The GPS can be manually selected or deselected at any time.

On aircraft equipped with a GPS-1000, GPS satellites can be manually deselected by the crew. A page is available which presents a list of deselected satellites. Individual satellites may be added to or removed from the deselection list.

GPS Operation in Remote/Oceanic Areas

With GPS software SCN 10 or later (GPS-1000 or internal GPS), The FMS can be approved for use as primary means of navigation in remote and oceanic areas in accordance with FAA Notice 8110.60 without use of any other long range navigation sensors (VLF Omega, IRS or Loran-C). In addition to the airborne hardware requirements, an off-line Windows based PC program (available for Universal) must be used to perform RAIM prediction analysis to assure that sufficient GPS integrity will exist for the proposed route of flight.

Operators must obtain a Letter of Authorization from FAA in order to conduct flights in remote/oceanic airspace. A data package is available from Universal Avionics (reference Universal's Service Letter No. 2738 for more information).

GPS Integrity

Receiver Autonomous Integrity Monitoring (RAIM)

A key element of C-129 approval for GPS equipment is Receiver Autonomous Integrity Monitoring (RAIM). RAIM requires that additional usable satellites be available to the system.

RAIM provides a function analogous to the flag for VOR or ILS equipment. In these systems, the system integrity is provided by ground station equipment, which continuously monitors the transmitted signal. If the ground monitor equipment detects an out-of-tolerance condition, it shuts down the transmitter (or effects a transfer to standby equipment). The signal loss causes the flag to be set in the cockpit instruments. Since GPS does not incorporate this type of signal monitoring, the airborne equipment must be capable of detecting out-of-tolerance conditions itself.

RAIM requires at least 5 usable satellites. RAIM is implemented by dropping one satellite at a time out of the navigation solution to permit evaluation of its pseudo-range data. Position is calculated using the remaining 4 satellites. Range to the satellite under evaluation is then calculated on the basis of that position and the current almanac data for the satellite in question. Received pseudo-range is compared to the calculated data for a validity test.

The FMS implements the functions required to provide a GPS Integrity monitor which meets the requirements of TSO C129 categories B1 and C1. The GPS Integrity monitor is implemented within the FMS as a separate function from the FMS sensor monitor. It will independently monitor and display the Integrity status for each configured stand-alone and hybrid GPS sensor using criteria based upon the current phase of flight. It will also alert the aircrew with messages, annunciators, and, under some conditions, the nav flag when the monitor data for the GPS that is currently being used for navigation is either unavailable or in an alarm state.

The GPS integrity monitor is defined for three phases of flight, each with a specified Alarm Limit and Time to Alarm. The Enroute phase is the default phase, and is active whenever the Terminal and Approach phases are not active. The Terminal and Approach phases are defined the same as for the POSN UNCERTAIN message. Each phase of flight limit and alarm time is specified as:

<u>Phase of Flight</u>	<u>Alarm Limit</u>	<u>Time to Alarm</u>
Enroute	2.0nm	27 seconds
Terminal	1.0nm	7 seconds
Approach	0.3nm	7 seconds

The RAIM based integrity monitoring function provides the status of each configured GPS sensor when the GPS sensor is transmitting valid Horizontal Integrity Limits (HIL) and that data less than or equal to 15.9 nm. If RAIM is available, the GPS Integrity status will be RAIM when the HIL data is less than the phase of flight criteria (see above chart) and the Satellite Failure Detected bit is not set. The GPS Integrity status will be ALARM when the Satellite Failure Detected bit is set for the time specified for the phase of flight.

Radio Based (DME, VOR, TACAN) Integrity

In installations with DME or TACAN as a position input, GPS integrity is further monitored by the DME-DME position solution. In those cases where satellite-based RAIM is insufficient due to poor geometry or unhealthy satellites, the integrity monitoring will revert to RADIO on the GPS Status page (assuming a good DME-DME position). Under this condition, GPS will continue to be used as the primary position sensor, with no associated messages to the pilot.

MANUALS AFFECTED: Universal Avionics Systems Corporations' Operator's Manual, Report No. 2423sv602, dated January 5, 1998.

FILING INSTRUCTIONS: Insert this Temporary Change into 2423sv602, Section 7 adjacent to page 7-16.

INSTRUCTIONS: Add the paragraph below so that it follows the last paragraph under "Receiver Autonomous Integrity Monitoring (RAIM)".

Fault Detection and Exclusion (FDE)

If six or more satellites are received, the GPS can determine whether errors exist and 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.

The Radio Based integrity monitoring function provides the status of each configured GPS sensor when the RAIM data from the particular GPS sensor is not available and the Radio monitor is available. The Radio monitor is based upon the difference between the GPS sensor position and the independent radio position solution within the FMS. The radio position solution is derived from the DME, VOR and TACAN receivers. In order for the Radio monitor to be available, the radio solution must meet the following conditions:

1. There must be a minimum of two DMEs received and used for updating the DME position.
2. The DME positions must be valid.
3. The variance in the DME positions must meet minimum requirements for the phase of flight.

If the RAIM function is unavailable, radio monitor is available and is currently being used for monitoring; the GPS Integrity status will be RADIO when the above criteria are satisfied. The GPS Integrity status will be ALARM when the above criteria are exceeded for the time specified for the phase of flight.

GPS INTEG Annunciator

The FMS provides a logic signal to annunciate GPS INTEG whenever the integrity of the GPS position cannot be assured to meet minimum requirements for the particular phase of flight (enroute, terminal or approach).

NOTE: Whenever the GPS INTEG annunciator is illuminated, the first pilot action should be to verify that GPS is in nav and the Q factor is on the GPS Status Page. GPS position should be monitored against other sensors. If available, the GPS will continue to navigate with four satellites tracked.

Pilot notifications of GPS sensor problems are for the GPS sensor, which is currently being used by the FMS for navigation. This notification is in the form of a GPS Integrity annunciator, the FMS Nav Flag (Approach Lateral Valid Flag), and FMS messages. The GPS Integrity annunciator FMS discrete output is used to light an external annunciator.

Section VII
Sensors & Interfaces

The following table lists the FMS/NMS navigation status and associated pilot actions to be taken when the “GPS INTEG” annunciator is active.

Flight Phase	NAV Flag condition	GPS “NOT NAV” message	“POSITION UNCERTAIN” Message	Pilot Action
Oceanic/ Remote Enroute	Valid	Not Issued	Not Issued	Normal systems cross-checks
	Valid	Active (DR Nav Mode)	Not Issued (Q=<6.0nm)	Use most reliable Nav source
	Valid	Active (DR Nav Mode)	Active (Q=>6.0nm)	Use other Nav system
Domestic Enroute	Valid	Not Issued	Not Issued	Normal systems cross-checks
	Valid	Active (DR Nav Mode)	Not Issued (Q=<2.8nm)	Use most reliable Nav source
	Valid	Active (DR Nav Mode)	Active (Q=>2.8nm)	Use other Nav system
Terminal	Valid	Not Issued	Not Issued	Normal systems cross-checks
	Valid	Active (DR Nav Mode)	Not Issued (Q=<1.0nm)	Use most reliable Nav source
	Valid	Active (DR Nav Mode)	Active (Q=>1.0nm)	Use other Nav system
Approach before FAF	Valid	Not Issued	Not Issued	Do not continue Approach based upon GPS alone. Use other Nav sources.
	Invalid if <2nm from FAF or Integ = Alarm	Not Issued	Not Issued	
Approach after FAF	Invalid if Integ=NONE for >5 min or Integ=Alarm	Not Issued	Not Issued	

GPS Status

GPS 1 1 / 4			
GPS	NAV (D)	ADDRESS	
Q	01	-----	
# SATS	06	DATA	
INTEG	RADIO	-----	
HIL	0.06NM	SELECT	
HDOP	1.57	GPS ONLY→	
HDOP	2.46		
273	062580	SELECT GPS→	
277	000000		
VER	0001	RETURN→	

- **NAV** - GPS is in NAV mode.
- **ACQ** - GPS is acquiring satellites.
- **INIT** - GPS is initializing its position from internal almanac.
- **ALT** - GPS is using altitude to supplement poor satellite geometry.
- **TEST** - GPS is in TEST mode.
- **FAIL** - GPS has failed, or 429 data not received from GPS.

GPS Q factors - These are error estimates in tenths of nautical miles (i.e., a Q factor of 01 is equal to 0.1 nm circular error estimate).

SATELLITES - The number of satellites currently being tracked by the GPS.

This page shows ARINC 429 data on labels 273 and 277 from the GPS sensor. The operator may enter a five-digit hex address in the ADDRESS field to view four-digit hex data in DATA field. This page is to be used for diagnostics and troubleshooting. HDOP and VDOP are for reference only. Label 277 will be dashed if a GPS-1200 or a UNS 764-2 is installed.

SELECT/DESELECT GPS - Used to manually select or deselect the GPS sensor.

INTEG - GPS Integrity status is displayed on this line and defined below.

- **RAIM** - Receiver Autonomous Integrity Monitoring (only displayed with a RAIM capable GPS).
- **RADIO** - Radio based (i.e., DME-DME) integrity monitoring.
- **NONE** - No integrity monitoring available. GPS position accuracy is not affected and will continue to be used for navigation. However, the pilot should monitor the FMS accuracy by comparing to other nav sources, if available.
- **ALARM** - Integrity monitoring indicates a GPS error outside limits.

HIL - Horizontal Integrity Limit in nautical miles. RAIM is available when HIL is equal to or less than 2nm enroute, 1nm terminal or 0.3nm approach.

HDOP - Horizontal Dilution of Precision.

VDOP - Vertical Dilution of Precision.

VER - The internal GPS software version.

GPS 1 2 / 4					
SV #	AZ	EL	SNR	STAT	
04	122 T	38°	54	5	
06	93 T	87°	23	4	
29	248 T	11°	18	2	
22	248 T	22°	26	4	
16	223 T	45°	33	9	
13	180 T	02°	04	7	
09	127 T	53°	34	4	
15	35 T	67°	36	4	

RETURN→

INTERNAL GPS, GPS-950 AND GPS-1000

GPS 1 2 / 4					
SV #	AZ	EL	SNR	STAT	
05	97 T	15°	22	3	
23	315 T	77°	41	1	

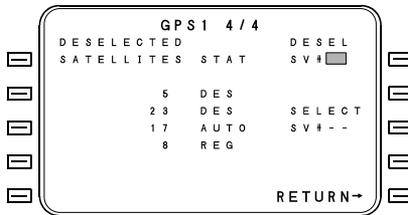
RETURN→

INTERNAL GPS, GPS-950 AND GPS-1000

The above two pages are applicable for the internal GPS, GPS-950 and GPS-1000. They may appear with other GPSs but will not be functional. These pages display the twelve satellites most likely to be in current use by the GPS. Each line displays SV# (Satellite Vehicle Number), Azimuth (deg), Elevation (deg), Signal to Noise Ratio (SNR) and STATUS. (Azimuth will always be true direction from the aircraft). Elevation is in degrees above the horizon (90° is directly overhead the aircraft position). EL may be negative, indicating a satellite below the horizon. SNR is a number from 0 to 63 in dB Hz.

Status is a number from 0 to 9 and is defined as follows:

Status	Definition
0	- Satellite is assigned to a channel
1	- FIND command issued
2	- Waiting to receive almanac and ephemeris data
3	- Waiting to receive complete pseudo range data block
4	- Performing the acquisition/tracking process
5	- Fast sequencing of satellite signal (tracking mode)
6	- Satellite is not assigned to a channel
7	- Lost satellite lock during sequencing process
8	- Waiting for clock message
9	- Satellite not found



INTERNAL GPS AND GPS-1000 ONLY

This page is accessed using the PREV or NEXT key from other GPS Status pages. This page applies to the internal GPS and the GPS-1000. It may appear with other GPSs but will not be functional.

This page displays GPS satellites which have been deselected.

In addition to displaying a list of deselected satellites, this page is also use to manually select or deselect satellites.

A list of satellites appears showing the satellite vehicle (SV) number and the status of each. Status is shown as DES (deselected), REQ (requested for deselection by the FMS) or AUTO (automatically deselected by the GPS).

The crew can deselect a satellite by pressing line select key [1R] to bring the cursor over the DESEL SV# field. The satellite vehicle number is typed in at the cursor location and entered by pressing the ENTER key. The list status will read REQ until the GPS acknowledges the deselection at which time the status becomes DES.

The crew can reselect a satellite by pressing line select key [3R] to bring the cursor over the SELECT SV# field. The satellite vehicle number is typed in at the cursor location and entered by pressing the ENTER key. The satellite will be removed from the list once the GPS acknowledges.

Inertial Reference Sensor (IRS)

Inertial sensors will accept latitude/longitude position information from the FMS only during their alignment mode, i.e., during the initialization procedure.

During initialization, all inertial sensors, which are in the alignment mode, will accept latitude/longitude position information from either FMS. This is true regardless of whether or not both FMS systems are ON, only one is ON, or if one is failed. While in the alignment mode, all inertial sensors will use the last position update they receive from either FMS for their alignment point. Once in the Nav mode, no inertial sensor will accept an update. Manually updating the inertial's position while enroute is not necessary.

Battery protection of inertial sensors negates the need for a position information update following a power failure.

The IRS Status page displays the status of the installed IRS(s) (Inertial Reference System). This page is accessed from DATA page 2.

IRS 1 / 1					
	STATUS	HDG	SET	HDG	
[]	1	FAIL	101°	---	[]
[]	2	NAV	101°		[]
[]	3	NAV (D)	103°		[]
[]	VELOCITY			DESEL 1	[]
[]	FMS1	S123	E420	DESEL 2	[]
[]	IRS1	S124	E421		[]
[]	IRS2	S123	E422		[]
[]	IRS3	S125	E423	SELECT 3	[]

STATUS - This is the operational status of the IRS. The status displayed will be one of the following:

- **ALIGN** indicates that the IRS is in the alignment process. The aircraft should not be moved.
- **NAV** indicates the IRS is in the normal navigational mode.
- **ATT** indicates the IRS is available for attitude outputs only. Navigational outputs are not being provided.
- **FAIL** indicates the unit is not operational.

HDG - The true heading received by the navigation computer from the IRS. Dashes are displayed if no valid data is available.

VELOCITY - Position movement broken into N-S/E-W velocity components.

FMS - The FMS best computed position velocity components.

IRS# - The velocity components being received by the navigation computer from that IRS.

SET HDG - For use with a Laser-type IRS when selected to ATTITUDE on the IRS Mode Selector Unit. In the ATTITUDE mode, the Laser IRS will output both attitude and heading. The heading output is similar to uncorrected DG; that is, it must be manually set once.

1. Press the [SET HDG] line select key to position the cursor over the SET HDG entry field.
2. Enter the desired heading. The TRUE/MAG panel switch will determine whether the entry required and the heading displayed are relative to True or Magnetic North. When the heading is entered, it will be sent to all IRS sensors in the ATT mode.

Inertial sensors will accept latitude/longitude position information from the FMS only while in the alignment mode; that is, during the FMS initialization procedure. Manually updating the inertial sensor's position information while enroute is not necessary. The IRS position coordinates are displayed by the FMS for comparative purposes only.

IRS Deselect/Reselect

1. Access the IRS Status page by pressing the DATA function key and then pressing any [IRS #] line select key.
2. Press the appropriate [DESEL #] or [SELECT #] line select key to deselect or select the desired IRS. When an IRS is deselected, the appropriate IRS STATUS field will indicate (D). When an IRS is selected, the appropriate IRS STATUS field will indicate either NAV, ALIGN, ATT, or FAIL.

Example: IRS 1 is deselected by system no. 1: IRS 1 does not shut off, quit navigating, or stop supplying data. System 1 simply disregards the IRS 1 inputs in its own best computed position computations. The FMS no. 2 system would continue to utilize the inputs from IRS 1 in computing its latitude/longitude position. Deselection of a sensor by any or all FMSs never shuts down that sensor or causes it to cease its own position computations.

GPS/IRS Sensors

GPIR# Page 1/3 - Status

This page is accessed from DATA Page 2, and provides data on the GPS and IRS sensors.

		GPIR1 1/3					
	GPS	HYB	(D)	IRS	NAV	(D)	
[≡]	Q	01		HDG	101°		[≡]
	#SATS	06					
[≡]	INTEG	RAIM		SET	HDG	---	[≡]
	HIL	0.06	NM			SELECT	
[≡]	VELOCITY					IRS	[≡]
	FMS1	S123	E420			SELECT	
[≡]	IRS	S124	E421			GPS	[≡]
	GPS	S123	E422				
[≡]	HYB	S125	E423			RETURN	[≡]

STATUS (IRS)

- **NAV** - IRS has correctly aligned and is in NAV
- **ALIGN** - IRS is in alignment mode
- **FAIL** - No ARINC 429 data received from GPIRS, or else GPIRS is sending FAIL status on 429 bus
- **ATT** - IRS is in ATTITUDE mode. Sensor will not be used for navigation.

STATUS (GPS)

- **HYB** - Navigation mode is using hybrid position from IRS and GPS
- **NAV** - GPS position alone is being used without IRS aiding
- **ALT** - Altitude aiding mode (ADC altitude being used to supplement poor satellite geometry)
- **INIT** - GPS/IRS is initializing position
- **ACQ** - GPS is acquiring satellites for navigation
- **TEST** - GPS is in test mode
- **FAIL** - GPS has failed, or no 429 data is being received.

This page will also show number of satellites being tracked, as well as the North and East component velocities from the IRS, GPS, FMS and HYBRID IRS/GPS.

SET HDG [1R] - IRS heading may be initialized by entering a heading in this field. The value entered is displayed and transmitted on ARINC 429 label 043 for 12 seconds then dashes are displayed in the field again and label stops transmitting. Used for setting IRS heading when in ATT mode. Will indicate ° for magnetic and T for true heading.

The GPS and IRS can be independently SELECTed or DESELECTed from this page.

INTEG - GPS Integrity status is displayed on this line and defined below.

- **RAIM** - Receiver Autonomous Integrity Monitoring (only displayed with a RAIM capable GPS).
- **RADIO** - Radio based (i.e., DME-DME) integrity monitoring.
- **NONE** - No integrity monitoring available. GPS position accuracy is not affected and will continue to be used for navigation. However, the pilot should monitor the FMS accuracy by comparing to other nav sources, if available.
- **ALARM** - Integrity monitoring indicates a GPS error outside limits.

HIL - Horizontal Integrity Limit in nautical miles. RAIM is available when HIL is equal to or less than 2 nm enroute, 1 nm terminal or 0.3 nm approach.

GPIR# Page 2/3 - Comparison

GPIR 1 2 / 3					
FMS 1	POS			IRS	POS
N 33	54.0			N 33	54.8
W 117	57.3			W 117	57.8
	DIFF	N 00	00.8		
		W 000	00.5		
←GPS	20.2	IRS	15.2→		
←HYB	20.7				
					RETURN→

This page is similar to DATA 3/5, but only HYBRid, GPS and IRS positions are shown for comparison to FMS position. Pressing a line select key next to GPS, HYB or IRS will display that position in the upper right hand fields, and show the difference from the FMS position.

GPIR# Page 3/3 - Diagnostics

GPIR 1 3 / 3	
GPIRS	DIAGNOSTICS
270	08DA10
273	056789
274	8745AF
350	604344
352	873243
353	6A7EC2
355	05A5A5
	RETURN→

This page shows contents of ARINC 429 labels from GPIRS as shown in left hand column. Data is in hexadecimal, and is for diagnostic purposes only.

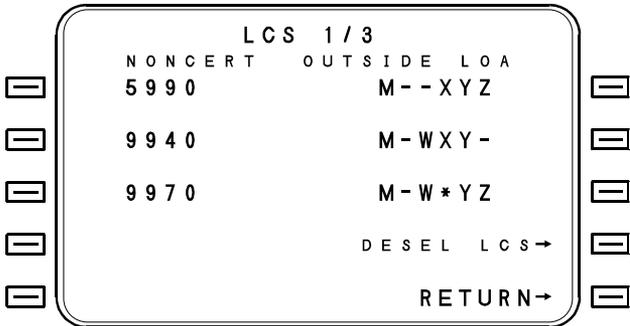
LCS-850 Loran C Sensor

The LCS-850 status page displays the navigational status of the LCS (Loran C Sensor). The page will not be available for display if no LCS is installed. LCS-850 is automatically deselected for ground operations and is automatically selected at liftoff. Universal's LCS-850 automatically tunes the best available stations for the current position considering geometry, field strength, SNR, error estimates, blink, skywave, and interference. The automatic station selection process is continuous while the LCS-850 is operating. Up to 8 stations (non-colocated) on up to 4 GRIs are utilized in the NAV solution to provide multi-GRI/cross chain operation. The LCS-850 is intended to be used in the Enroute phase of flight.

The LCS-850 is for enroute navigation only and is not intended for use during approach.

If desired, the LCS may be strapped to automatically drop out of NAV mode upon crossing an LOA border outbound.

The minimum station tracking requirement is that at least three stations must be tracked on one chain or two stations on each of two chains, non-colocated.



The second line of the display shows the operational status of the LCS. A change in status from NAV to any other status listed below will be accompanied by a LCS NOT NAV message on the Message page. A return to a NAV status will be accompanied by a LCS NAV message on the Message page if the aircraft is in the defined Loran Operating Area (LOA).

NAV indicates the LCS is in the normal navigational mode. The LCS is navigating with sufficient signals inside the LOA, or the LCS is navigating outside the LOA after flying there from inside the LOA provided continuous signal reception has been maintained since before leaving the LOA.

FAILED indicates that the LCS failed initial self-test or an operational failure is detected.

SEARCH indicates that the LCS is searching for sufficient stations to navigate.

INSIDE LOA indicates that the aircraft's present position is inside a defined LOA. This status will be reported even if no stations are being received.

OUTSIDE LOA indicates that the aircraft's present position is outside a defined Loran Operating Area.

The remainder of the lines displayed on the LORAN page show the Loran C chains (GRIs) in use. Up to three GRIs may be displayed. The GRIs are always listed in ascending numerical order.

Manual GRI selection will disable NAV mode in the LCS-850; the mode will remain SEARCH mode until automatic station selection mode is enabled. The LCS-850 is intended to operate in the automatically selected station mode, in the enroute phase of flight.

The letters after the GRI indicate which stations are in use. A capital letter indicates the station's tracking level is sufficient to permit the station to be used in the NAV solution. A lower case capital letter indicates the station is merely being tracked but not incorporated in the NAV solution due to unfavorable signal considering geometry, field strength, variance/covariance error estimates, skywave, and interference. Lower capital letters may also indicate the station is:

1. Transmitting a BLINK warning mode or,
2. SNR makes the signal tracking unsuitable for inclusion in the NAV solution.

A hyphen (-) indicates that the station is not being received, and the signal is not being tracked.

LCS-850 Sensor Deselect

1. Access the LCS Status page by pressing the DATA function key and then selecting the [LCS] line select key.
2. Press the [DESEL LCS] line select key to deselect the LCS. The status line will indicate NAV (D).

LCS-850 Sensor Reselect

1. Access the LCS Status page by pressing the DATA function key and then selecting the [LCS] line select key.
2. Press the [SELECT] line select key to reselect the LCS. The status line will indicate NAV, FAILED, NONCERT, or SEARCH.

GRI (Loran C Chain) Selection

The Loran C chains used by the LCS-850 are listed on the LCS Status page 1/3 by their four-digit GRI (Group Repetition Interval). The Loran C chains and associated GRIs are as follows:

Loran C Chain	GRI	Available Stations
North Pacific	9990	M--XYZ
Gulf of Alaska	7960	M--XYZ
Canadian West Coast	5990	M--XYZ
U.S. West Coast	9940	M-WXY-
North Central U.S.	8290	M-WXY-
South Central U.S.	9610	MVWXYZ
Great Lakes	8970	M-WXYZ
South East U.S.	7980	M-WXYZ
North East U.S.	9960	M-WXYZ
Canadian East Coast	5930	M--XYZ
*Labrador Sea	7930	M-WX--
North Atlantic	9980	M-WX-Z
*Norwegian Sea	7970	M-WXYZ

* - No longer commissioned.

Manual GRI Selection

1. Access the LCS Status page by pressing the DATA function key and then selecting the [LCS] line select key.
2. Use the line select keys to position the cursor over one of the three GRI entry fields.
3. Enter the four-digit GRI for the desired chain. When the GRI is entered, an (M) will be displayed after the GRI to indicate a manual GRI selection.

Return To Automatic GRI Selection

1. Access the LCS Status page by pressing the DATA function key and then selecting the [LCS] line select key.
2. Use the appropriate line select key to position the cursor over the manual GRI entry field.
3. Press the BACK and then ENTER keys to delete the manual input.

LCS-850 Loran C Operating Areas (LOA)

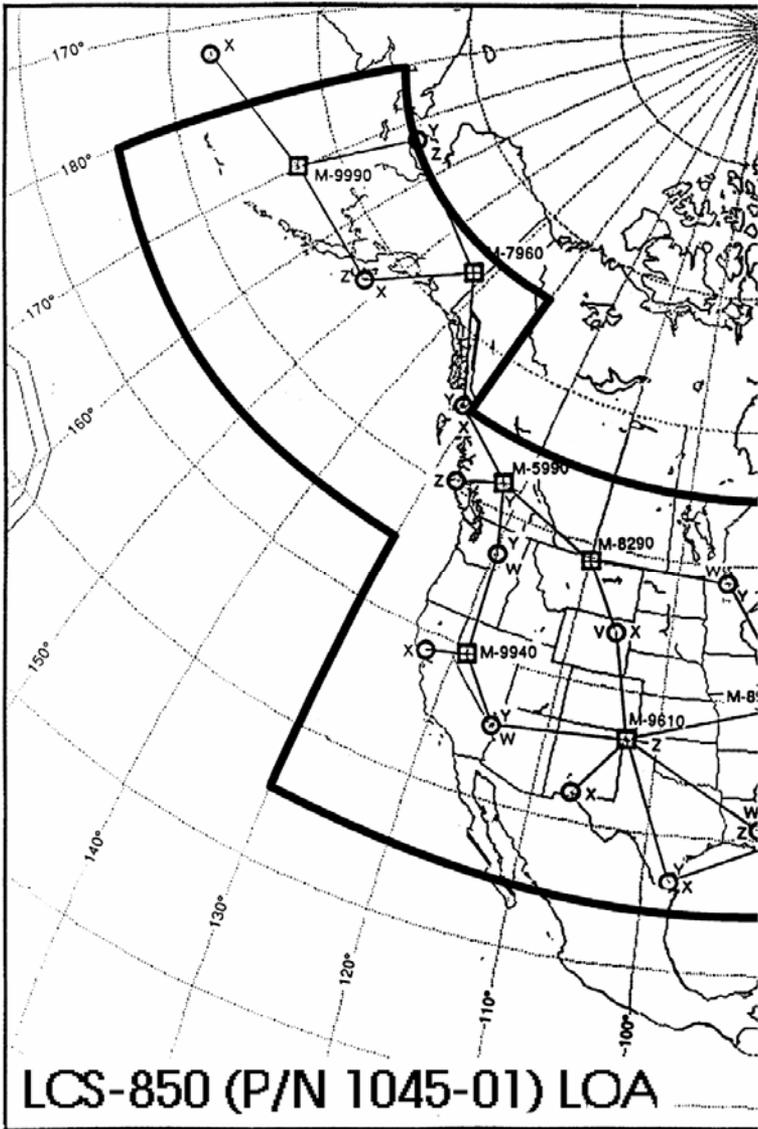
Loran-C sensor software contains a "map" of the LOA within which it is programmed to navigate. If starting a trip outside the LOA, the LCS will enter the SEARCH mode and annunciate "OUTSIDE LOA". Position will be displayed but not used by the system for navigation. Upon entry into the LOA, navigation will begin automatically.

A mix of actual flight results and employment of known conservative signal reception range limits determined LOA boundaries. Range limits were based upon transmitter strength and terrain type with appropriate modifications for actual experience. As implemented in the LCS-850, the LOA is only a "convenience warning boundary" in software, and does not force the LCS to navigate when inadequate signals are present. It also does not relieve the flight crew of the responsibility of knowing when the LCS may be used for IFR navigation and when it must be deselected.

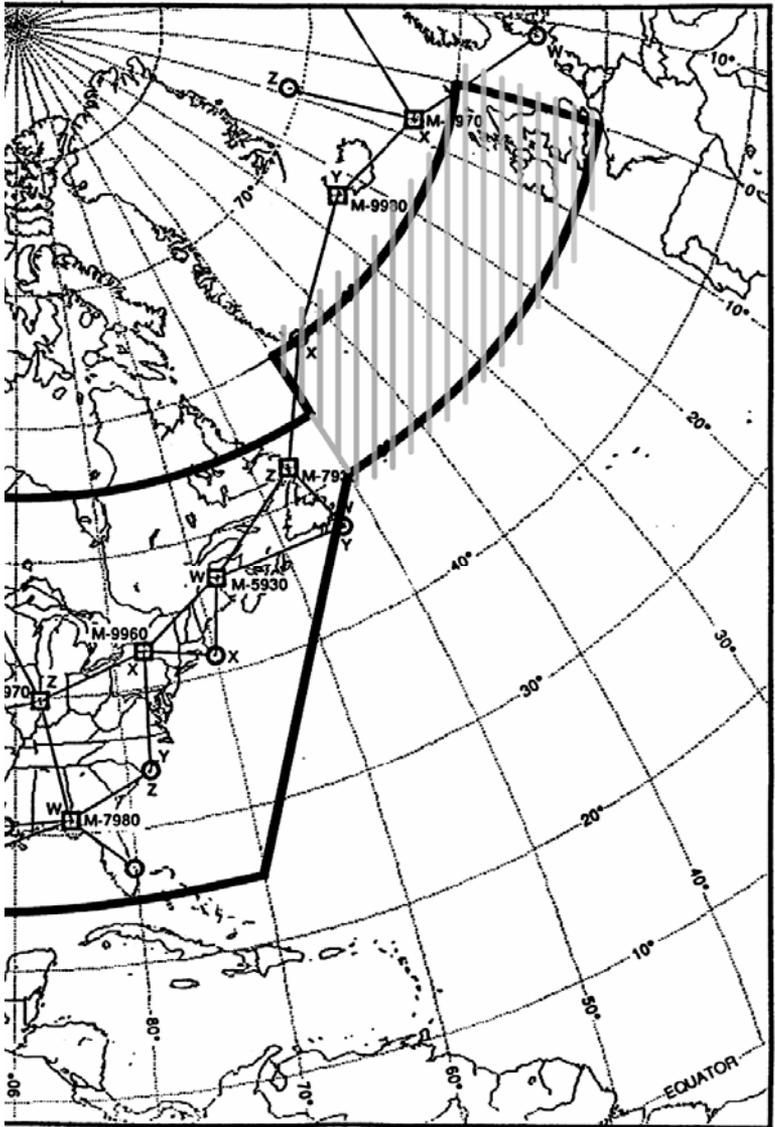
LCS-850 LOA Maps

The LCS-850 LOA Maps are contained on the following pages.

LCS-850 (P/N 1045-01) LOA MAP

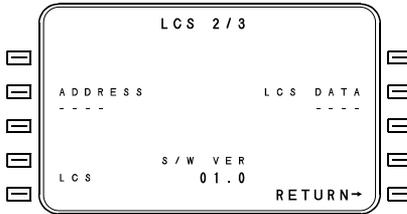


LCS-850 (P/N 1045-01) LOA MAP (CONTINUED)



LCS-850 Loran Page 2/3 - Status

The second LCS status page is primarily a maintenance page.



ADDRESS [2L] - This cursor position accepts a hexadecimal entry to access the LORAN computer.

LCS DATA - This is the response from the LORAN computer to the ADDRESS entry.

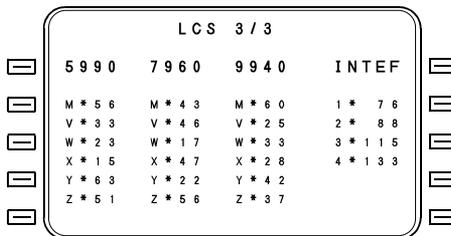
S/W VER - This is the software version number of the LORAN computer.

A Loran Operating Area (LOA) is stored in the LCS memory. The LORAN Status page 1/3 will indicate whether the aircraft's position is inside or outside the stored LOA.

LCS-850 Loran Page 3/3

LCS page 3/3 displays the Loran Signal to Noise Numbers (SNN) and interference frequencies. SNN values can range from 0-63 corresponding to Signal to Noise Ratios of -16 to 3 dB. For example, a SNN of 63 indicates the highest level of Loran signal (3dB or greater) relative to noise level (of 1 dB).

Interference (INTEF) frequencies indicate what frequencies the notch filters are automatically tuned to, to filter out undesirable Continuous Wave Interference. CWI may be due to power noise, or other signals present near the 100 kHz band.



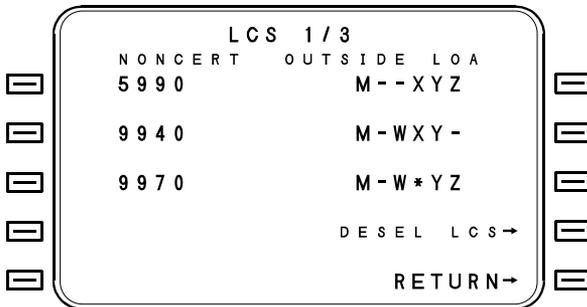
UNC LCS Loran C Sensor (P/N 1040)

The LCS status page displays the navigational status of the UNC LCS (Loran C Sensor) P/N 1040. The page will not be available for display if no LCS is installed. LCS is automatically deselected for ground operations and is automatically selected at liftoff. Universal's LCS automatically tunes the master and all available secondary stations within range in up to three Loran chains.

A 60 nm hysteresis exists on the inside of all LOA boundaries. If a flight begins outside the LOA, the aircraft must fly 60 nm inside the published boundary before LCS NAV mode operation can commence (provided sufficient stations are received).

If desired, the LCS may be strapped to automatically drop out of NAV mode upon crossing an LOA border outbound.

The minimum station tracking requirement is that at least three stations must be tracked on one chain or two stations on each of two chains.



The second line of the display shows the operational status of the LCS. A change in status from NAV to any other status listed below will be accompanied by a LCS NOT NAV message on the Message page. A return to a NAV status will be accompanied by a LCS NAV message on the Message page if the aircraft is in a defined Loran Operating Area (LOA).

NAV indicates the LCS is in the normal navigational mode. The LCS is navigating with sufficient signals inside an LOA, or the LCS is navigating outside an LOA after flying there from inside an LOA provided continuous signal reception has been maintained since before leaving the LOA.

FAILED indicates that the LCS failed initial self-test or an operational failure is detected.

NONCERT indicates that the LCS is navigating outside the Loran Operating Area (LOA) and the navigation computer is not utilizing LCS for position determination.

SEARCH indicates that the LCS is searching for sufficient stations to navigate.

INSIDE LOA indicates that the aircraft's present position is inside a defined LOA. This status will be reported even if no stations are being received.

OUTSIDE LOA indicates that the aircraft's present position is outside a defined Loran Operating Area.

The remainder of the lines displayed on the LORAN page show the Loran C chains (GRIs) in use. Up to three GRIs may be displayed. The GRIs are always listed in ascending numerical order. A maximum of two GRIs may be manually selected. A manually selected GRI is denoted by the (M) displayed immediately after the GRI. The letters after the GRI indicate which stations are in use. A hyphen (-) indicates that the station is not being received, the cycle is not being tracked, or the SNR (signal-to-noise ratio) is unacceptable. An asterisk (*) indicates the station is being received but is not being used because the LCS has automatically deselected the station so that it will not be used for position determination. This may be caused by the station either being beyond the distance limit or operating in the BLINK (warning) mode.

LCS Sensor Deselect

1. Access the LCS Status page by pressing the DATA function key and then selecting the [LCS] line select key.
2. Press the [DESEL LCS] line select key to deselect the LCS. The status line will indicate NAV (D).

LCS Sensor Reselect

1. Access the LCS Status page by pressing the DATA function key and then selecting the [LCS] line select key.
2. Press the [SELECT] line select key to reselect the LCS. The status line will indicate NAV, FAILED, NONCERT, or SEARCH.

GRI (Loran C Chain) Selection

The Loran C chains used by the UNC LCS are listed on the LCS Status page by their four-digit GRI (Group Repetition Interval). The Loran C chains and associated GRIs are as follows:

Loran C Chain	GRI	Available Stations
Northwest Pacific	9970	M-WXYZ
Korea	5970	M-WX-Z
North Pacific	9990	M--XYZ
Gulf of Alaska	7960	M--XYZ
Canadian West Coast	5990	M--XYZ
U.S. West Coast	9940	M-WXY-
North Central U.S.	8290	M-WXY-
South Central U.S.	9610	MVWXYZ
Great Lakes	8970	M-WXYZ
South East U.S.	7980	M-WXYZ
North East U.S.	9960	M-WXYZ
Canadian East Coast	5930	M--XYZ
*Labrador Sea	7930	M-WX--
North Atlantic	9980	M-WX-Z
*Norwegian Sea	7970	M-WXYZ
French	8940	M--X--
Mediterranean	7990	M--XYZ
Northern Saudi	8990	MVWXYZ
Southern Saudi	7170	M-WXYZ

* - No longer commissioned.

Manual GRI Selection

1. Access the LCS Status page by pressing the DATA function key and then selecting the [LCS] line select key.
2. Use the line select keys to position the cursor over one of the three GRI entry fields.
3. Enter the four-digit GRI for the desired chain. When the GRI is entered, an (M) will be displayed after the GRI to indicate a manual GRI selection.

Return To Automatic GRI Selection

1. Access the LCS Status page by pressing the DATA function key and then selecting the [LCS] line select key.
2. Use the appropriate line select key to position the cursor over the manual GRI entry field.
3. Press the BACK and then ENTER keys to delete the manual input.

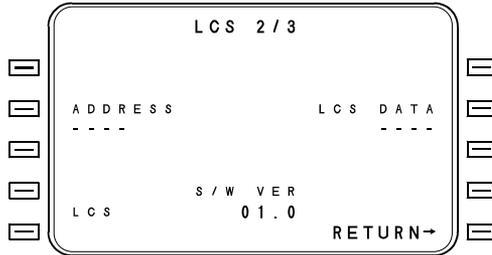
UNC LCS Loran C Operating Areas

Loran-C sensor (P/N 1040) software contains a "map" of the LOA within which it is programmed to navigate. The version number of the LOA is in the LCS Address page. The LCS Address page is accessed by pressing the NEXT or PREV keys while on the LCS Status page. If starting a trip outside the LOA, the LCS will enter the NONCERT mode only. Position will be displayed but not used by the system for navigation. Upon entry into an LOA, navigation will begin automatically.

A mix of actual flight results and employment of known conservative signal reception range limits determined LOA boundaries. Range limits were based upon transmitter strength and terrain type with appropriate modifications for actual experience. As implemented in the FMS, the LOA is only a "convenience warning boundary" in software, and does not force the LCS to navigate when inadequate signals are present. It also does not relieve the flight crew of the responsibility of knowing when the LCS may be used for IFR navigation and when it must be deselected.

UNC LCS Loran Page 2/3 - Status

The second LCS status page is primarily a maintenance page.



ADDRESS [2L] - This cursor position accepts a hexadecimal entry to access the LORAN computer.

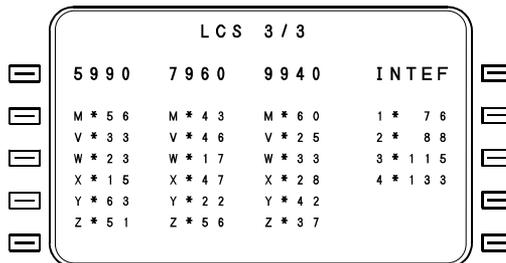
LCS DATA - This is the response from the LORAN computer to the ADDRESS entry.

S/W - This is the software version number of the LORAN computer.

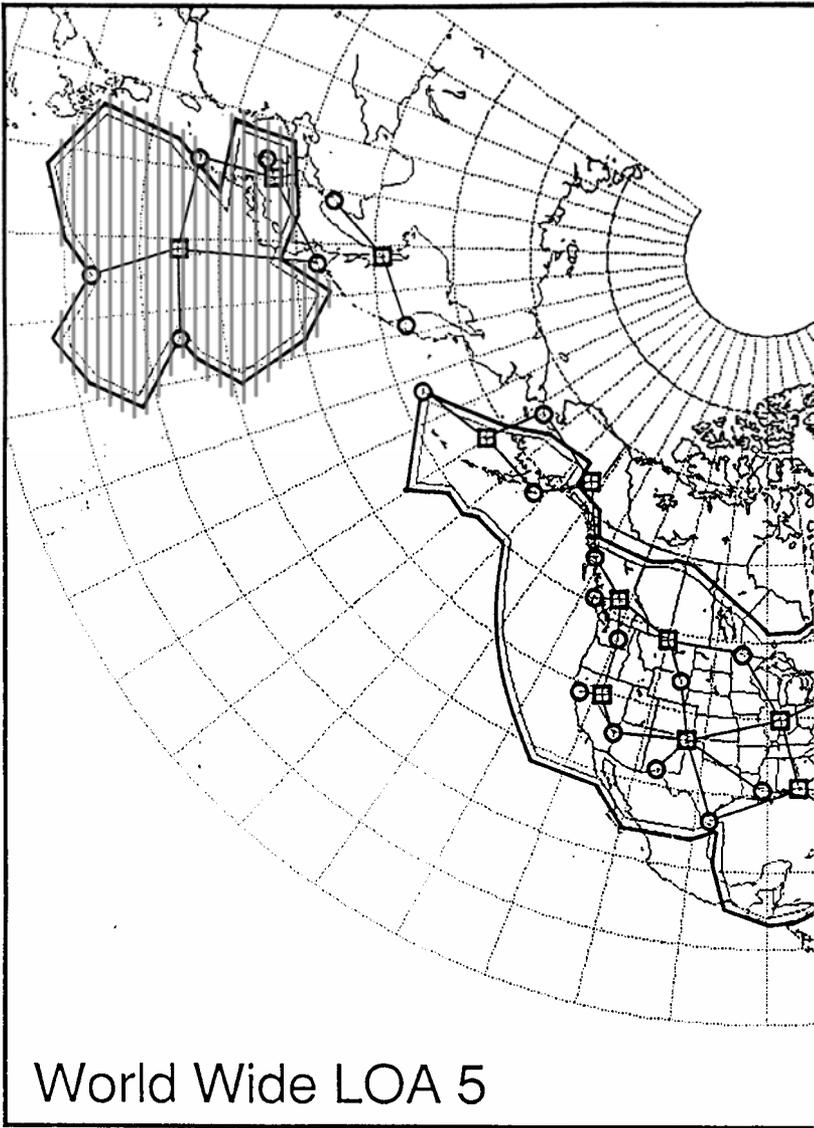
A Loran Operating Area (LOA) is stored in the LCS memory. The LORAN Status page will indicate whether the aircraft's position is inside or outside the stored LOA

UNC LCS Loran (LCS) Page 3/3

LCS Page 3 displays Loran Signal-to-Noise Ratios (SNR) and interference frequencies. SNR values can range from 0 to 63 with 63 being the maximum. This is primarily a maintenance page and appears as follows;

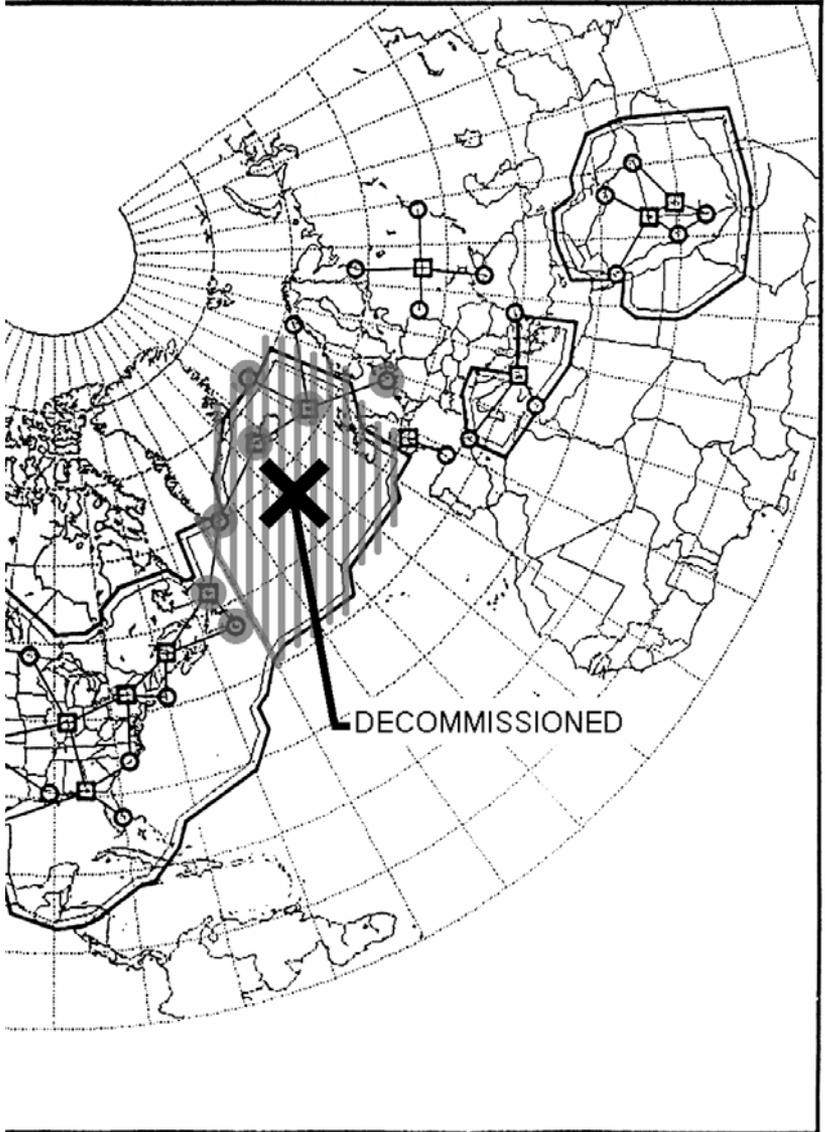


UNC LCS Loran Operating Areas (LOA) - Version 5



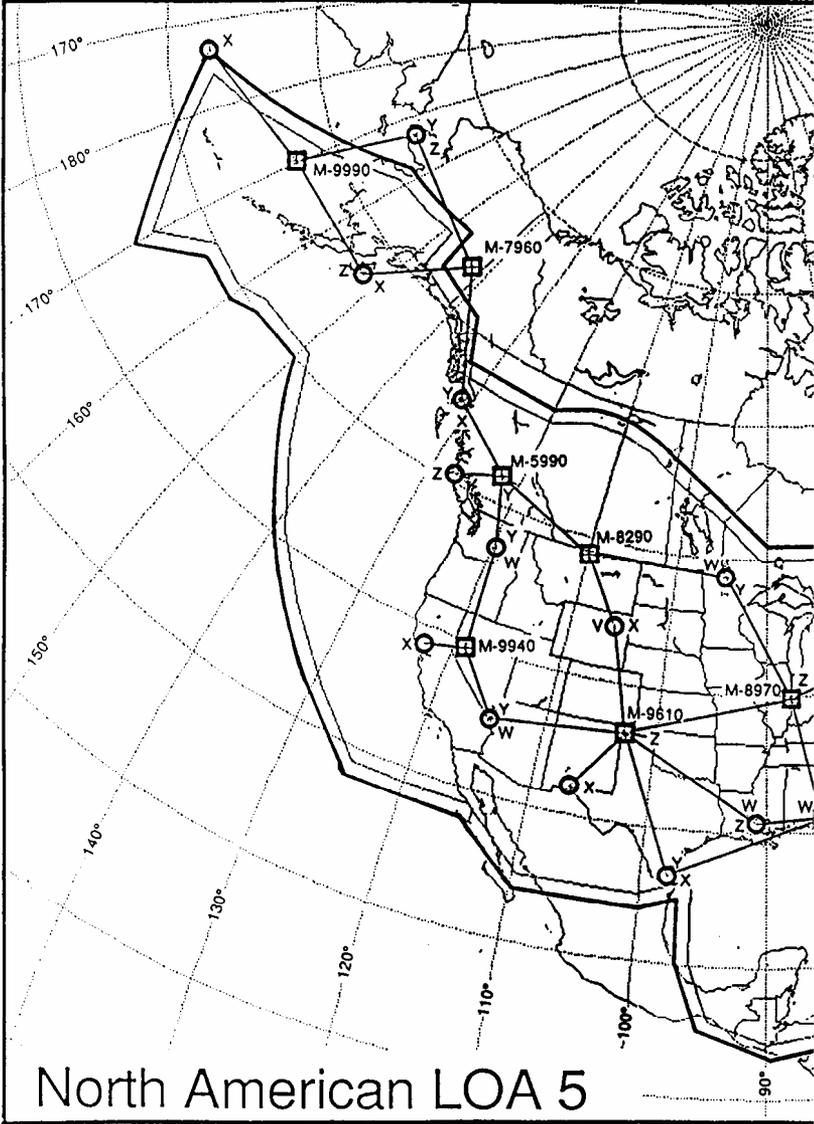
Worldwide LOA 5

UNC LCS Loran Operating Areas (LOA) - Version 5



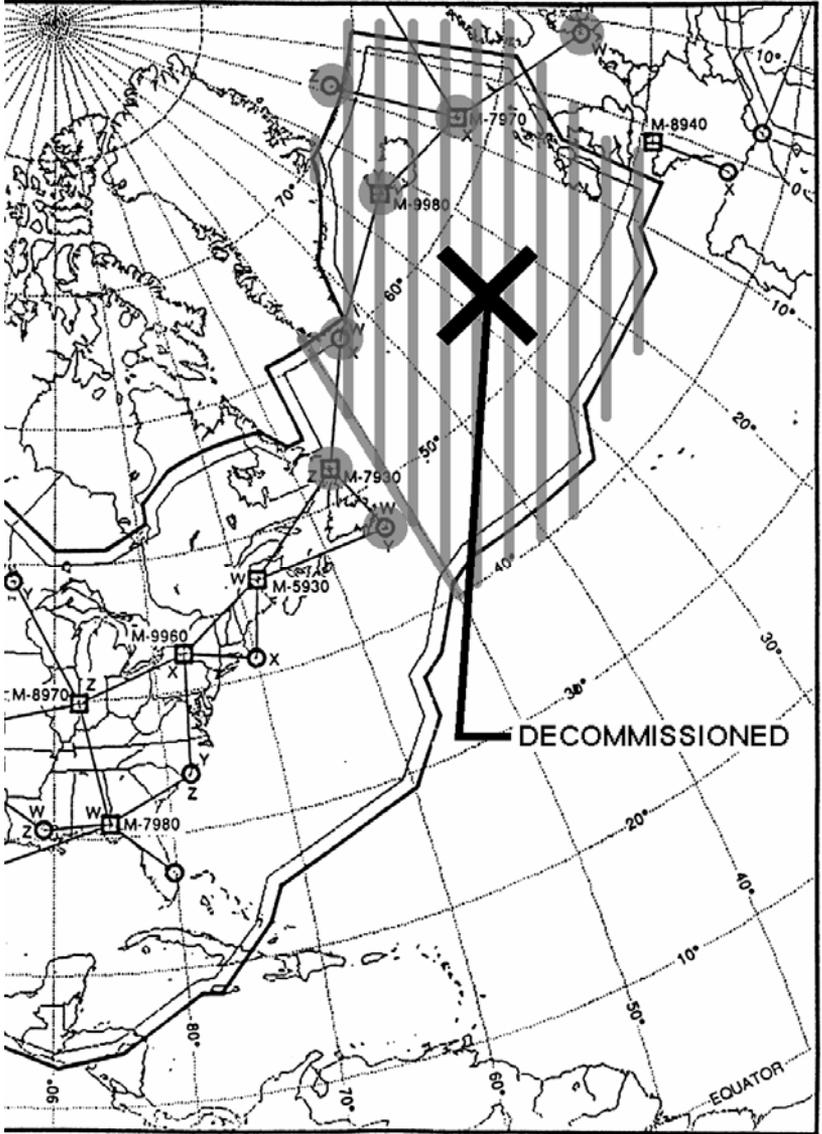
Worldwide LOA 5 (Continued)

UNC LCS Loran Operating Areas (LOA) - Version 5



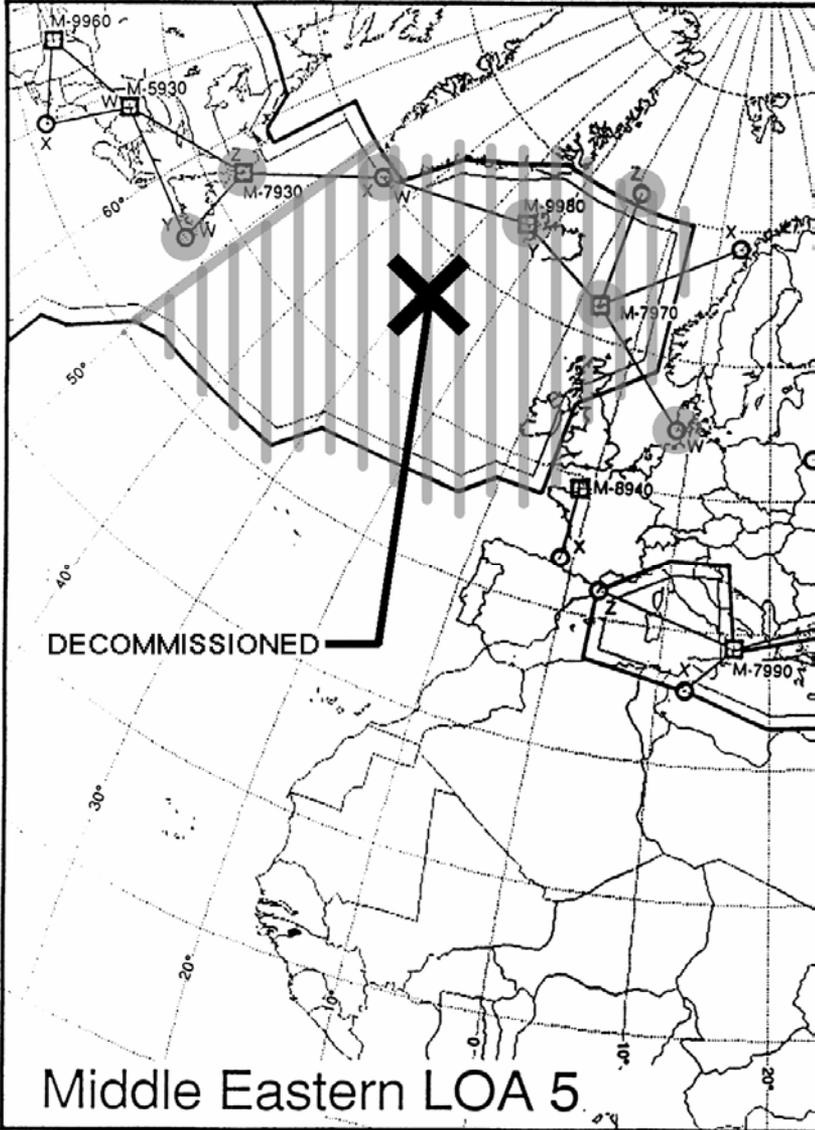
North American LOA 5

UNC LCS Loran Operating Areas (LOA) - Version 5



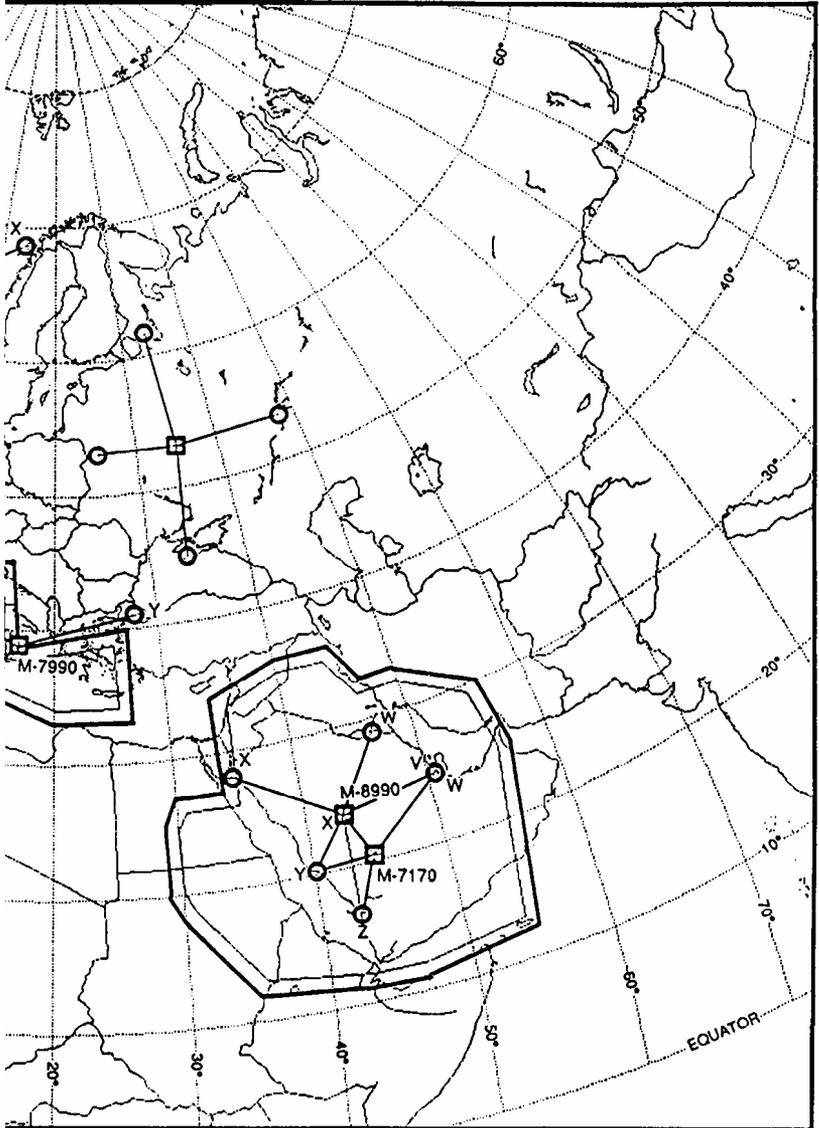
North American LOA 5 (Continued)

UNC LCS Loran Operating Areas (LOA) - Version 5



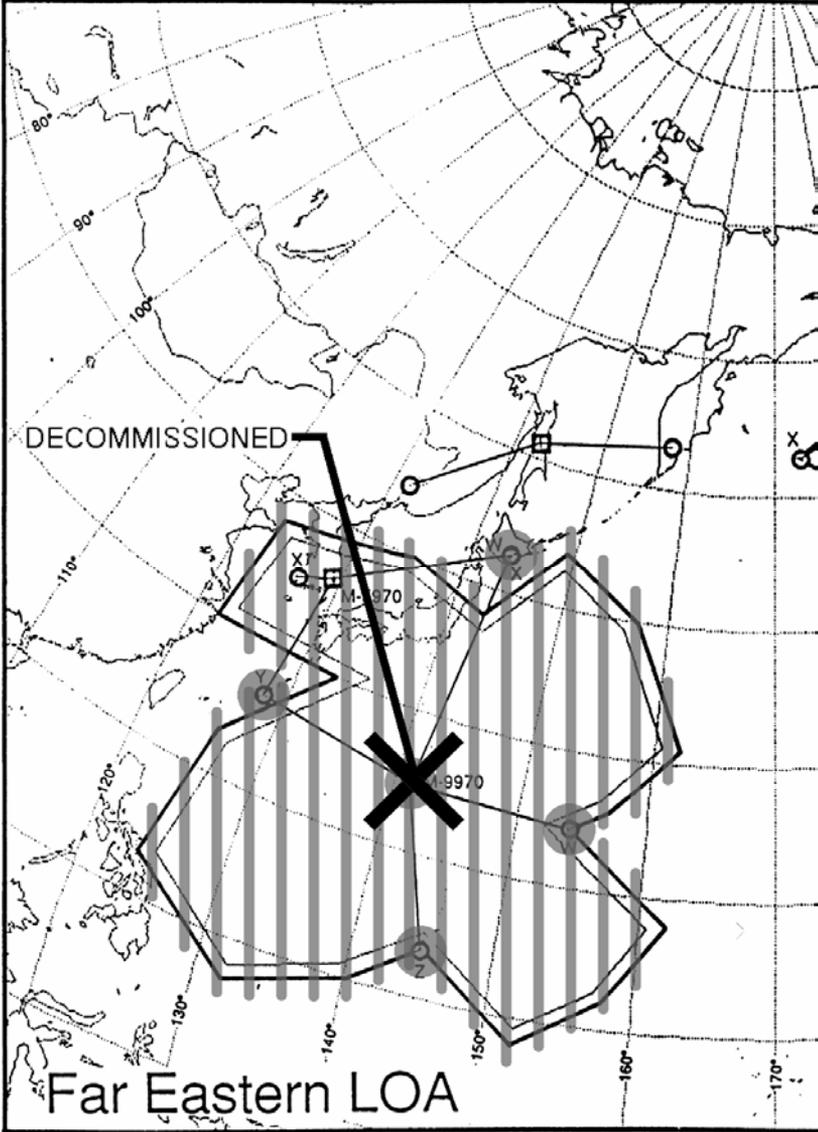
Middle Eastern LOA 5

UNC LCS Loran Operating Areas (LOA) - Version 5



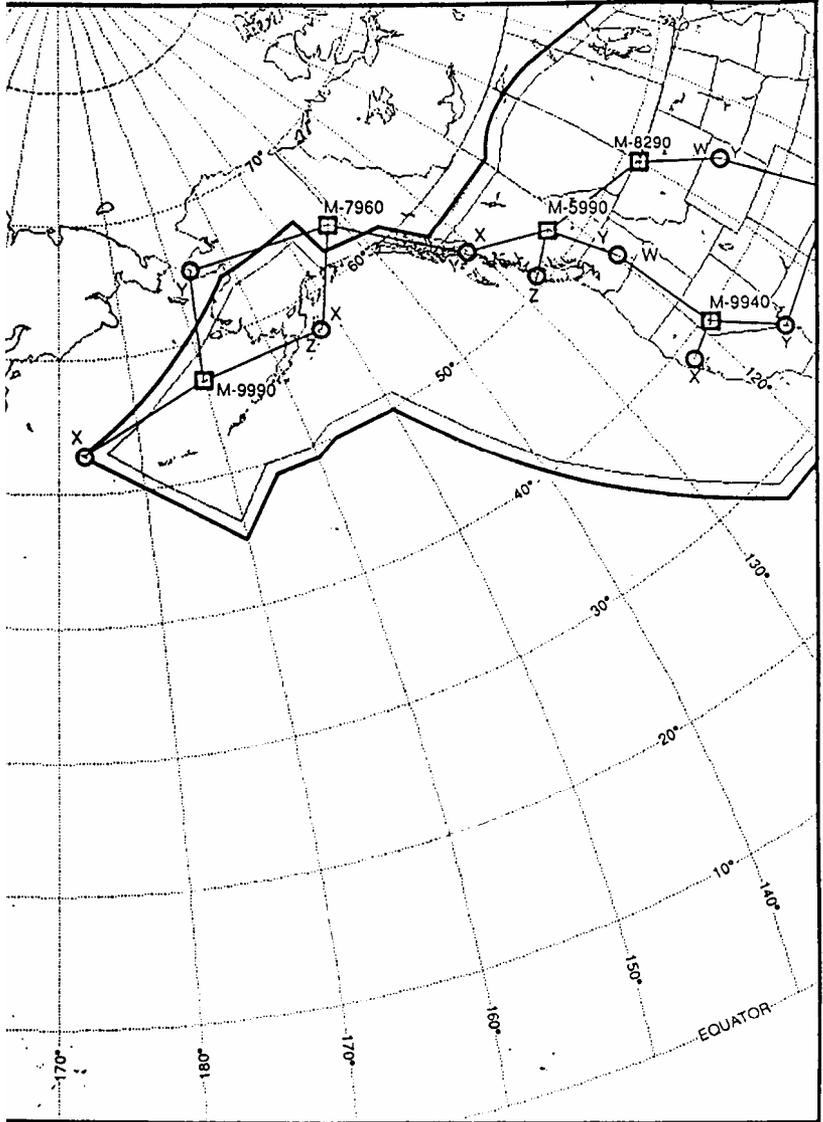
Middle Eastern LOA 5 (Continued)

UNC LCS Loran Operating Areas (LOA) - Version 5



Far Eastern LOA 5

UNC LCS Loran Operating Areas (LOA) - Version 5



Far Eastern LOA 5 (Continued)

HEADING SOURCE

The heading source is displayed on DATA page 4 (General Data). The heading source is automatically selected upon system initialization, dependent upon sensor availability, according to the following priority list:

The heading source priority list is different for each installed FMS in a multiple system. The heading priority list for the **first FMS** is:

IRS 1, AHRS 1, ANALOG, IRS 3, IRS 2, AHRS 2;

And for the **second FMS** is;

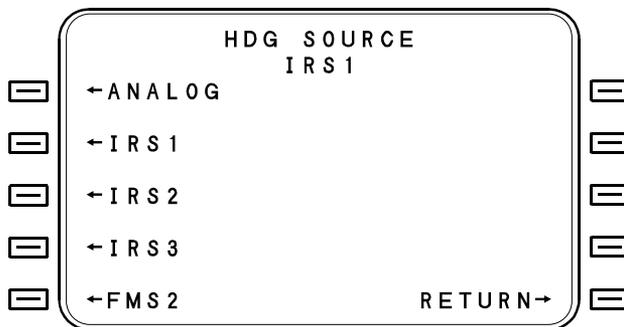
IRS 2, AHRS 2, ANALOG, IRS 3, IRS 1, AHRS 1;

And for a **third FMS** is:

IRS 3, AHRS 1, ANALOG, IRS 1, IRS 2, AHRS 2.

NOTE: ANALOG represents the aircraft compass heading analog output converted to digital format. ANALOG is not utilized in some installations with multiple IRS sources. The priority list for individual installations is a function of the sensors available; however, the list will always follow the order shown here.

The HDG SOURCE page is used for manual heading source selection. It is accessed from DATA page 4 by pressing the LIST key with the cursor over the HDG entry field.



The current heading source is displayed just below the title line. Pressing a line select key will activate that heading source and will return the display to DATA page 4.

ANALOG [1L] - This denotes the aircraft synchro compass heading converted to digital format.

OTHER FMS [5L] - This selects the same heading source used by the opposite system in a dual installation.

RETURN [5R] - This returns the display to DATA page 4 with no change in the heading source.

The system continuously scans the available sources selecting the source with both a valid heading output and the highest priority. For example, if the aircraft is configured with two sensors, IRS 1 and AHRS 1, then AHRS 1 would be initially selected as the heading source while IRS 1 is aligning. However, IRS 1 would automatically be selected as soon as it switched to Nav mode.

If the heading source in use should fail, the FMS will automatically switch to the next available source according to the priority list and the appropriate message (IRS # HEADING FAIL, AHRS # HEADING FAIL, or ANALOG HEADING FAIL) will become active on the message page. The system will not, however, automatically switch away from a heading source that has been manually selected, even if that source should fail. Also, the system will never automatically switch to either another FMS or the MAN heading input mode in search of a valid heading source. These choices do not appear on the automatic selection priority list above and must be manually selected if desired. The pilot should check the HDG SRC (source) menu for possible valid selections. The NO HEADING message will become active whenever the system does not have a valid heading input.

Manual Heading Source Selection

A manually selected heading source will not be automatically changed. To select a heading source:

1. Access DATA pages 4 (General Data) by repeatedly pressing the DATA function key. The current HDG (heading) source is listed in parentheses.
2. Access the HDG SRC page by using the [HDG] line select key to position the cursor on the HDG entry field and then pressing the LIST key.
3. Use the line select keys to select the desired heading source.

Manual Heading Input

In the unlikely event that all other heading sources have failed, the following procedure may be used to manually enter a heading.

NOTE: In the event a Laser-type IRS must be selected to ATTITUDE on the IRS Mode Selector Unit (MSU), the heading for that unit can be manually set. Refer to INERTIAL REFERENCE SENSORS (IRS), this section, for the correct procedure.

1. Access DATA page 4 (General Data) by repeatedly pressing the DATA function key. The current HDG (heading) source is listed in parentheses.
2. Press the [HDG] line select key to position the cursor on the HDG entry field.
3. Enter the desired heading. When the heading is entered, (MAN) will be displayed to indicate that HDG is a manual input.

MAGNETIC VARIATION

The VAR WARNING message is displayed when operating above 72 degrees 45 minutes north latitude or below 59 degrees 45 minutes south latitude. This message occurs 15 minutes latitude prior to leaving the valid region for the magnetic variation model. This gives the crew time to enter a manual variation or take other action if operating an aircraft without a true heading source.

Manual Variation Input

1. Access DATA page 4 (General Data) by repeatedly pressing the DATA function key.
2. Press the [VARIATION] line select key to position the cursor on the VARIATION entry field.
3. Enter the desired variation. If required, use the \pm key to change the E/W prefix prior to making the entry. When the variation is entered, (MAN) will be displayed to indicate that VARIATION is a manual input.

Cancel Manual Variation Input

1. Access DATA page 4 (General Data) by repeatedly pressing the DATA function key.
2. Press the [VARIATION] line select key to position the cursor on the VARIATION entry field.
3. Press the BACK and then ENTER keys to cancel the manual variation and to return to automatic computation of variation.

RADAR/MFD INTERFACE

The FMS and RADAR/MFD interfaces have been accomplished in such a manner that the FMS's flight plan waypoints and legs may be selected for display on the weather radar display. When the FMS is interfaced with Collins Pro Line 4 Avionics System, unique operational differences exist which are discussed in the applicable Pro Line 4 Supplement.

Radar Waypoints

With the mode selector switch on the RADAR/MFD control unit in the Nav position, the "joystick" on the display unit may be used to position the cursor to any point on the RADAR/MFD display where a radar waypoint is desired. For example, a radar waypoint may be desirable to the side of any on-course CB activity. Pressing the ENTER key on the RADAR/MFD control unit will then define a radar waypoint <R1> in the FMS. Up to 25 radar waypoints, <R1> thru <R25>, may be defined.

Radar waypoints must be selected from a list, which is accessed from either the Flight Plan page or the Direct to page by pressing the LIST function key.

Radar waypoints are used in the same manner as any other data base waypoint. Either going direct-to the radar waypoint or modifying the flight plan to include it eliminates any need to "decouple" from the FMS or Nav mode of the flight guidance system by switching to the Heading mode. All radar waypoints will be automatically erased upon FMS initialization.

Radar waypoints are not part of the 200 pilot-defined locations. They will appear on the FMS, as does any other waypoint. When the FPL DTO page is displayed, the last radar waypoint defined is always the first choice on the page.

COLLINS EFIS INTERFACE

The following features are only available to the operator when the FMS system is interfaced to a Collins C-14 EFIS, Pro Line 4 or compatible.

NOTE: When the FMS is displayed or coupled to the Flight Director/Autopilot System, monitor the EFIS heading bug for proper values and reset as required.

Two-Way Interface with Heading Bug

This function allows the FMS to receive selected heading settings that are driven from the heading select knob. These will appear in the command heading window on the FMS. Conversely, when the FMS is in Command Heading Mode, any entry on the FMS will be received by the EFIS, and the heading bug will slew to that value. In either case the Flight Guidance System (FGS) will fly to these heading when NAV is engaged.

Go-Around Function

When the pilot presses the Go-Around button, the current Approach will be canceled. If there are additional waypoints in the flight plan between the end of approach and the destination, then the TO waypoint becomes the first waypoint following the end of approach. This is then referred to as the Missed Approach Procedure.

The Creation and use of ILS Approaches

ILS approaches may be defined and linked into a flight plan using the same procedures as VOR, RNV, VFR and TCN approaches. When ARM APPR is selected on the FMS, the ILS receiver is automatically tuned to the ILS frequency by the FMS, and the EFIS arms for capture. If the pilot arms APPR on the Flight Guidance System, the aircraft will transition from lateral and vertical FMS mode to Approach mode using the localizer and glideslope signals from the ILS receiver. If the pilot flies the approach with only NAV mode selected on the FGS then only lateral transitions will be made from FMS to Localizer.

Automatic Display of Second Course

If an approach is linked into the FMS flight plan, at 50 nautical miles from the end of approach the ARM APPR option will become available. When the approach is armed, the EFIS will automatically display the inbound approach course as the second course on the EHSI.

Enroute VNAV Pitch Commands

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

MANUALS AFFECTED: Operator's Manual, Report No. 2423sv602, 2423sv603, 2423sv604, 2423sv702, 2423sv703, 2423sv704, 2423sv801/901 and 2423sv802/902.

FILING INSTRUCTIONS: Insert this Temporary Change behind the UNILINK tab.

NOTE: Do not remove UniLink Instructions supplements until applicable UniLink Operator's Manuals are obtained.

REASON: New manuals to replace UniLink section. Refer to Service Letter 2807.

INSTRUCTIONS:

The UniLink Section of this manual has been superseded by separate UniLink Operator's manuals. If your FMS is interfaced to a Universal UniLink then refer to the applicable manual as listed below;

UniLink UL-600 or UL-601, refer to report no. 23-20-02.01

UniLink UL-700 or UL-701, refer to report no. 23-20-04.01

These manuals are available online at www.uasc.com or they may be ordered through our Marketing department at (520) 295-2337 or (800) 321-5253. Requests can also be made by emailing info@uasc.com.

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INTRODUCTION

The purpose of this section is to acquaint users of Airborne Flight Information System (AFIS) Weather Advisory Services with the equipment, its capabilities, and its operation. AFIS services are *advisory only*, as they contain elements provided by the National Weather Service and information supplied by the pilot. Therefore, it is the responsibility of the pilot in command to exercise reasonable and prudent judgment in the use of these *advisory* services.

Description

AFIS is an Airborne Flight Information System which interfaces with the FMS. The interface consists of three major capabilities:

1. Access to ground based Global Data Center computers from a portable terminal for the purpose of retrieving current aviation weather.
2. Digital transfer of AFIS weather data into the FMS system for display on the FMS.
3. Air/ground computer link interfacing the FMS to the ground based Global Data Center computers for the purpose of providing enroute weather updates.

AFIS interfaces with ACARS (Airborne Communications Addressing and Reporting System) to provide the computer data link between the aircraft and the Global Data Center. This is a VHF computer link which provides excellent coverage within the continental United States above Flight Level 200. Below this flight level, data link coverage may be expected to deteriorate. Many variables, including the amount of processing time at the GDC, affect the turnaround time for an update. Depending on the nature of the update request, the pilot should expect a turnaround time of five to ten minutes.

AFIS consists of the following components: Global Data Center (GDC), Data Management Unit (DMU), and an optional Antenna Switching Unit (ASU).

Global Data Center (GDC)

The Global Data Center (GDC) is a ground based computer facility built and operated by Global Systems for the purpose of providing aviation weather and message forwarding services to AFIS operators on a subscription basis. The GDC communicates with the operator via data quality telephone lines to the Global Portable Computer and via the ARINC ACARS network directly to the aircraft in flight.

COMPONENTS

Data Management Unit (DMU)

The DMU incorporates a data quality VHF transceiver. This radio is tuned automatically by the DMU computer to the appropriate ground station for the purpose of transmitting data to and receiving data from the Global Data Center while in flight.

Antenna Switching Unit (ASU)

The Antenna Switching Unit (ASU) is required for those installations where the DMU transceiver shares an existing VHF communications antenna. The ASU switches the transmit side of the antenna between the DMU data transmitter and the VHF voice transmitter. During power up, the ASU defaults to the voice transmitter. Pressing the AFIS annunciator on the instrument panel switches the transmit side of the antenna to the DMU data transmitter. Pressing the annunciator again or pressing the "push to talk" button on the VHF communications radio switches the transmit side of the antenna back to the voice transmitter.

Global Data Transfer Unit

If the operator chooses to use Global Flight Plan Data disks, a Global DTU must be installed. This DTU is not the same one used by the FMS for Jeppesen and Pilot defined data loading.

DISPLAYS

AFIS is implemented in the FMS as a feature of the flight planning function (FPL). The AFIS menu is available as a line select key option on the FPL page. Access is also available from the Message page, an option which makes it more convenient to get to the AFIS function on receipt of a message.

There are two basic functions in AFIS:

- **Messaging** - The creation and receipt of messages for/from other AFIS customers or ground facilities. The messages are passed through the ACARS data link to/from the Global Data Center and forwarded. Messages from an aircraft must be flight related; this is a restriction on ACARS data.
- **Weather reporting** - The display of weather data. AFIS can display Terminal weather for up to five airports at a time (including sequence reports, forecasts, NOTAMS, and PIREPS), Winds aloft for up to five reporting locations at a time, and SIGMETs.

AFIS Access

The AFIS MENU Page is accessed either from the MESSAGE page or DATA 1/5 page.

- NOTE:
- The AFIS prompt on the MESSAGE page will be blanked during a disk load or save operation which was initiated from the Disk Menu page.
 - The AFIS prompt will be blanked if the MESSAGE page is accessed prior to completion of required entries on the INITIALIZATION page.

```

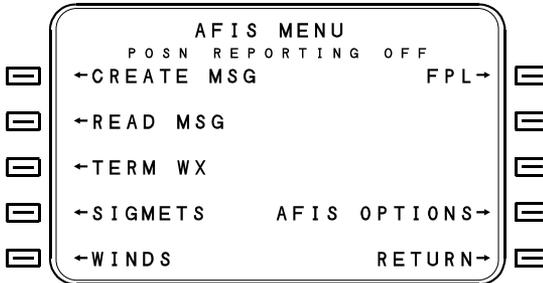
  POS    MESSAGE 1 / 1
  [ ]    [ ]
  [ ]    POSITION UNCERTAIN
  [ ]    OSS 2 MINOR MAIL
  [ ]    ROUTE OVERFLOW
  [ ]    STEERING FAIL
  [ ]    WPT ALERT
  [ ]    [ ]
  [ ]    ~AFIS                      RETURN~
  [ ]    [ ]
  
```

```

  DATA 1 / 4
  [ ]    ~JEPPESEN    CABIN DISP~
  [ ]    ~PILOT
  [ ]    [ ]          AFIS~
  [ ]    ~DISK
  [ ]    ~HOLD POS    MAINT~
  [ ]    [ ]
  
```

AFIS Menu Page

This page allows the selection of each of the AFIS functions.



CREATE MSG [1L] - For creating the text of a message and having it transmitted.

READ MSG [2L] - To display the text of a received message.

TERM WX [3L] - For requesting and reading terminal weather reports, including sequence reports, terminal forecasts, NOTAMS and PIREPS.

SIGMETS [4L] - For requesting and reading pertinent SIGMET reports.

WINDS [5L] - For requesting and reading winds aloft reports.

FPL [1R] - To display the AFIS FPL page.

AFIS OPTIONS [4R] - To display AFIS OPTIONS page.

RETURN [5R] - The display will return to the FPL page.

Messages

CREATE MESSAGE Page

This page is where the header information (From, To, number) is entered and the status of the message text is displayed.

	AFIS CREATE MESSAGE	
[]	TO : OPERATIONS	[]
[]	FR : N10UN	[]
[]	# : 2135551212	[]
[]	←EDIT MSG TEXT (ENTERED)	[]
[]	←XMIT MESSAGE RETURN→	[]

TO [1L] - The intended destination of the message to be sent. Up to 16 characters may be entered.

FR [2L] - The origin of the message. Up to 16 characters may be entered.

[3L] - Telephone number of intended message destination. Up to 17 characters may be entered.

EDIT MSG TEXT [4L] - Pressing the [EDIT MSG TEXT] line select key will access the EDIT MSG TEXT page. To the right of "EDIT MSG TEXT" is a status field which will display one of the following:

- **ENTERED** - A message has been entered on the Edit Message Text page and has not been sent.
- **SENDING** - A message is in the process of being transmitted.
- **SENT** - A message has been entered on the Edit Message Text page and has been transmitted.
- **CLEARED** - The message text page has been cleared (erased).

XMIT MESSAGE / NO COMM [5L] - "XMIT MESSAGE" will be available if a message has been entered on the EDIT MSG TEXT page and it has not yet been transmitted. After the message is transmitted this field will be blank. "NO COMM" will be displayed if communication is not possible.

RETURN [5R] - This will return the display to the AFIS MENU page

EDIT MESSAGE TEXT Page

This page is for entering and editing the text of a flight related message which is to be sent via AFIS on ground-air data link.

	A F I S		
	EDIT MSG TEXT 1 / 1		
☐	1	FLIGHT DELAYED BY	☐
☐	2	THUNDERSTORM AT KDEN	☐
☐	3	PLEASE RESCHEDULE PM	☐
☐	4	MEETING. ALSO ALERT	☐
☐	5	GROUND NEW ETA IS 2	☐
☐	6	PM.	☐
☐	7		☐
☐	8		☐
☐	←	CLEAR MESSAGE	RETURN→

The ± key is used as a space bar to separate words. Note that there is no period symbol available to separate sentences; however, some extra spaces or the typing of an identifying abbreviation such as "STP" (stop) or "PD" (period) may be used instead for enhanced clarity. Each line accepts up to 20 characters. Pressing the ENTER key will advance the cursor to the next line. If the text exceeds eight lines, a second page will display after the ENTER key is pressed at the end of line eight. Up to 14 lines of text is available.

Cursor Control [1L-4L, 1R-4R] - Pressing any of these line select keys will bring the cursor over the entire entry field (line) next to that key.

CLEAR MESSAGE [5L] - Used to clear (erase) the display.

RETURN [5R] - This will return the display to the AFIS MENU page.

READ MESSAGE Page

This page is used to read a message received via AFIS ground-air data link. Up to five messages will remain in queue for reading. It is accessed from the AFIS MENU page by selecting the [READ MSG] option.



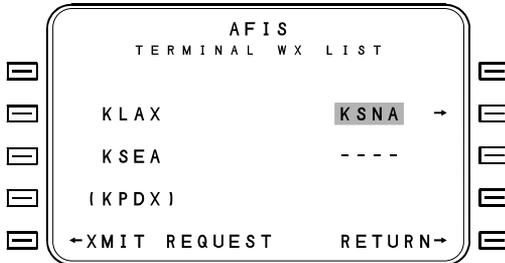
The received message is displayed in eight lines of 20 characters each. Up to 13 display pages (2000 characters) is possible. Each display page is accessed using the NEXT or PREV key. The newest message will be the first one accessed.

RETURN [5R] - This will return the display to the AFIS MENU page from any message page.

Terminal Weather

TERMINAL WEATHER LIST Page

This page is accessed by selecting the TERM WX option on the AFIS MENU page. It is used to request terminal weather reports, including Sequence Reports, Terminal Forecasts, NOTAMS and PIREPS from up to five (5) airports at a time and for viewing the status of requested reports.



Line select keys [2L, 3L, 4L, 2R, and 3R] are used to access the TERMINAL WX page to view received reports or for entry of a new airport identifier for which a report is desired. When the line select key is first pressed the cursor is brought onto that entry field. Pressing the line select key a second time will access the Terminal Weather page. Alternately, a new airport identifier may be entered by typing the identifier and pressing the ENTER key.

Airport identifiers displayed inside parentheses indicate that data has not been received. After entry of a new airport identifier on the Terminal Weather List page, that identifier will be displayed inside parentheses. The parentheses will remain until XMIT REQUEST has been selected and a sequence weather report for that station has been received. While a terminal weather request is pending (WAITING) will be displayed above the XMIT REQUEST prompt.

An airport identifier displayed without parentheses indicates that a sequence weather report has been received and may be viewed by pressing the corresponding line select key twice.

XMIT REQUEST [5L] - Used to transmit the request for terminal weather reports of the airports displayed within parentheses and to transmit a request for the latest terminal weather reports available for the other airports displayed.

RETURN [5R] - Returns the display to the AFIS MENU page.

TERMINAL WEATHER Page

This page is accessed by pressing the line select key on the TERMINAL WX LIST page corresponding to the desired airport. The text is displayed which was uplinked from the Global Data Center for this identifier.

```

      AFIS
    TERMINAL WX 1 / 3
  K S N A           0 9 - F E B - 9 5

  S A :   2 0 5 8   C L R   2 0   2 7 1
  / 6 2 / 4 2 / 1 8 1 2 / 0 0 9
           2 0 0 2   C L R   2 5   2 7 1
  / 6 3 / 4 2 / 1 7 0 8 / 0 1 2
           1 8 4 5   C L R   2 5   2 7 1
  / 6 2 / 4 2 / 1 7 0 8 / 0 1 3
                                     RETURN→
  
```

Terminal area weather is listed below the terminal area identifier and consists of six lines of text. Multiple pages are sometimes used and are accessed by using the NEXT and PREV keys.

If no terminal weather is available, NO DATA will be displayed in the center of the page. If a request has been sent but not yet received, WAITING FOR DATA will be displayed. When new terminal weather is being received, DATA TRANSFER IN PROGRESS will be displayed.

Station Identifier - The identifier corresponding to the displayed reports.

Date - The issue date of the weather reports.

The data available for review includes Sequence Reports, Terminal Forecasts, NOTAMS and PIREPS.

RETURN - Returns the display to the TERMINAL WX LIST page.

SIGMETS

REQUEST SIGMETS Page

The REQUEST SIGMETS page is accessed by selecting the SIGMETS option on the AFIS MENU page. This page provides the means to request all SIGMETS pertinent to an area within 200 NM either side of the great circle route between the displayed from and to waypoints. The FR and TO waypoints correspond to the first and last waypoints (prior to a gap) on the flight plan, but may be altered on this page to request SIGMETS along other great circle routes.

```

      AFIS
    REQUEST SIGMETS

FR:KSEA
TO:KLAX
←DISPLAY SIGMETS
←XMIT REQUEST   RETURN→
  
```

(WAITING) will be displayed above XMIT REQUEST when a request for data has been made but data has not yet been received.

FR [2L] - The from waypoint which will be used for defining the great circle route along which SIGMETS are desired. This will initially be the first waypoint of the flight plan; however, pressing the FR line select key will place the cursor over this identifier entry field and the FR waypoint may be altered.

TO [3L] - The to waypoint which will be used for defining the great circle route along which SIGMETS are desired. This will initially be the last waypoint of the flight plan (prior to a gap); however, pressing the TO line select key will place the cursor over this identifier entry field and the TO waypoint may be altered.

DISPLAY SIGMETS [4L] - This will access the SIGMETS page(s) for display of SIGMETS received with the last requested update. (SIGMETS received from prior updates are not stored in memory.)

XMIT REQUEST [5L] - To transmit a request for the latest SIGMET reports pertinent to the great circle route between the FR and TO waypoints.

RETURN [5R] - Returns the display to the AFIS MENU page.

SIGMETS Page

The SIGMETS page is accessed by selecting the DISPLAY SIGMETS option on the REQUEST SIGMETS page. This page provides a review of all SIGMETs (pertinent to the route defined with the last update request) which are subsequently canceled or amended enroute by the Global Data Center via the data link. SIGMETs may consist of one to 29 pages of text and display their FAA code names followed by text.

	A F I S S I G M E T S 1 / 1 0 9 - F E B - 9 5	
☐	A L P H A Z : S E V C A T E X T F R S O C E N T V A T H R U D E A T 1 4 0 0 0 T O 2 4 0 0 0 F T A L P H A 1 : C A N C E L E D	☐
☐		☐
☐		☐
☐		☐
☐	R E T U R N →	☐

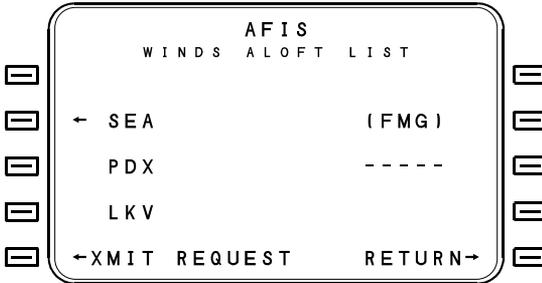
DATE - The issue date of the SIGMET. This field will be blank if no date is supplied by the update.

RETURN [5R] - Returns the display to the REQUEST SIGMETS page.

Winds Aloft

WINDS ALOFT LIST Page

This page is accessed by pressing the WINDS line select key on the AFIS MENU page. It is used to request winds aloft reports from up to five locations at a time and for viewing the status of requested winds aloft reports.



Line select keys [2L, 3L, 4L, 2R, and 3R] are used to access the WINDS ALOFT pages (which are used to view received winds aloft reports) or for entry of a new identifier for which a winds aloft report is desired. When the line select key is first pressed, the cursor is brought onto that entry field. Pressing the line select key a second time will access the Winds Aloft page. Alternately, a new identifier may be entered by typing the identifier and pressing the ENTER key.

Identifiers displayed inside parentheses indicate that data has not been received. After entry of a new identifier on the Winds Aloft List page, that identifier will be displayed inside parentheses. The parentheses will remain until XMIT REQUEST has been selected and a winds aloft report has been received. (WAITING) will be displayed above XMIT REQUEST until new winds aloft data is received.

An identifier displayed without parentheses indicates that a winds aloft report has been received and may be viewed by pressing the corresponding line select key twice.

Valid identifiers include VOR, VORTAC, airport, or waypoint locations.

XMIT REQUEST [5L] - This is used to transmit the request for winds aloft reports of the identifiers displayed within parentheses, and to request the latest winds aloft reports available for the other identifiers.

RETURN [5R] - Returns the display to the AFIS MENU page.

WINDS ALOFT Page

This page is accessed by pressing the line select key on the WINDS ALOFT List page corresponding to the desired station identifier. The winds aloft data is displayed either from AFIS DTU or from AFIS ground-air data link. When uplinked data is shown, the 5,000 and 10,000 foot reports (depicted below) are not shown.

AFIS			
SEA	WINDS	ALOFT	0001Z
5000	280 /	18 -	07
10000	285 /	22 -	11
18000	290 /	25 -	21
24000	290 /	30 -	29
30000	290 /	38 -	37
34000	300 /	42 -	48
39000	300 /	49 -	56
45000	300 /	60 -	62
			RETURN→

Station Identifier - This is the identifier (upper left hand corner) corresponding to the location of the displayed winds aloft reports.

Display - Each line displays the altitude, wind direction (true north), wind velocity (knots), and temperature (degrees Celsius).

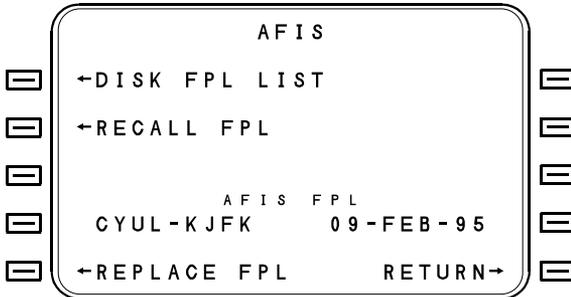
Time - The valid time for the reported winds aloft is displayed in the upper right hand corner.

RETURN [5R] - Returns the display to the WINDS ALOFT List page.

AFIS Flight Plan

FPL Page

This page is accessed by pressing the FPL line select key on the AFIS MENU page. This page is used to access the AFIS disk flight plan and to recall the flight plan. The page also displays the name of the currently received AFIS disk or uplink flight plan and allows insertion of the flight plan as the active FMS flight plan.



When neither a disk nor recall flight plan is available for loading or a flight plan has been selected, dashes are displayed in place of the identifier and date. When a flight plan has been requested from either the DISK FPL LIST line select key or the RECALL FPL line select key., but the flight plan has not yet been received, (WAITING) will be displayed below the dashes. When the flight plan is being received but is not yet complete, (RECEIVING) will be displayed below the dashes. Once the flight plan is received, the REPLACE FPL prompt will appear and the flight plan identifier and date will appear.

When REPLACE FPL line select key [5L] is pressed, REPLACE FPL is blanked and (REPLACING) will flash above that field. Once replacing is complete, REPLACE FPL prompt will reappear.

DISK FPL LIST [1L] - Displays the AFIS Disk FPL List page.

RECALL FPL [2L] - Displays AFIS Recall FPL page.

REPLACE FPL [5L] - Pressing this key initiates the process of replacing the active FMS FPL with the displayed AFIS disk or uplink recall FPL.

DISK FPL LIST Page

This page is accessed by pressing the DISK FPL LIST line select key on the AFIS FPL page. The page is used to select a flight plan from the list for insertion into the FMS as the active flight plan.

AFIS			
DISK FPL LIST 1 / 4			
	SELECT	FPL #	-
K L A X - K S E A	1 4	J U N 9 4	
C Y U L - K J F K	0 6	M A Y 9 4	
K S E A - K G E G	1 0	J U N 9 4	
C Y U L - K J F K	0 6	M A Y 9 4	
K G E G - K B F I	0 3	J U L 9 4	
K B F I - K L A X	0 9	J U N 9 4	
K B L V - E G L L	2 4	M A Y 9 4	
			RETURN→

When this page is selected and there is no disk in the AFIS DTU, the message NO DISK will be displayed in the center page. If there are no flight plans on the disk, the message NO AFIS FLIGHT PLANS ON DISK will appear in the center of the page. When a readable disk is in the AFIS DTU and this page is selected the message READING DISK will appear in the center of the page until the list and SELECT FPL# prompt appear.

The list contains up to 25 AFIS disk flight plan names and may be displayed on multiple pages. Pages are accessed using the NEXT and PREV keys.

SELECT FPL# - Typing a number into the blank and pressing ENTER will automatically change to the AFIS FPL page and the process to select the flight plan from the disk will begin. The selected flight plan will then be displayed on the AFIS FPL page and may be entered as the active FMS flight plan.

RECALL FPL Page

This page is accessed from the AFIS FPL page and allows entry of information required to request a previously defined AFIS FPL. The recalled flight plan will be uplinked via the ground-air data link for insertion into the FMS as an active flight plan on the AFIS FPL page.

AFIS	
RECALL FPL	
FROM	DATE
KBFI	09-FEB-95
TO	ETA
KLAX	20:05
FPL #	

←XMIT REQUEST RETURN→	

There are two methods of selecting a flight plan for recall. Either the FPL# is entered at line select key [4L] or the flight plan FROM, TO DATE, and ETD are entered. Once the desired entry is made the XMIT REQUEST line select key is pressed which transmits the request via the ground-air uplink and automatically returns to the AFIS FPL page for entry into the active FMS flight plan.

FROM [2L] - A four character identifier is entered here for the recall flight plan origination (used in lieu of inserting the FPL#).

TO [3L] - A four character identifier is entered here for the recall flight plan destination (used in lieu of inserting FPL#).

DATE [2R] - Numeric entry of date (DDMMYY) is entered here for the recall flight plan (used in lieu of inserting the FPL#).

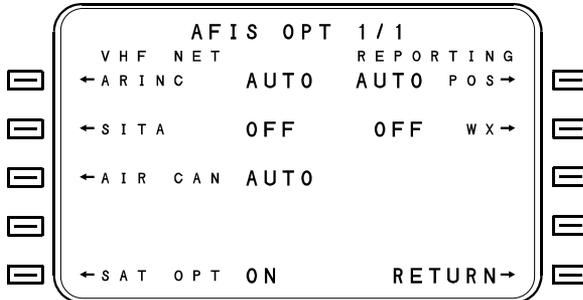
ETD [3R] - A four character numeric entry is entered for the recall flight plan. Minimum time is 0000, maximum is 2359 (used in lieu of inserting the FPL#).

FPL # [4L] - A five character alpha-numeric entry is made here for the recall flight plan. The five characters consist of a single alpha entry followed by four numbers.

XMIT REQUEST [5L] - This key is pressed after the desired recall flight plan has been entered. When this key is pressed, the request is sent via the ground-air uplink and the screen will return to the AFIS FPL page.

AFIS OPTIONS Page

This page is accessed from the AFIS MENU page.



This screen is used to enable or disable the various AFIS OPTIONS. It is important to note that when a prompt reads OFF, the option is disabled and pressing the line select key will select that option. When the prompt reads AUTO, the option is enabled and pressing the line select key will deselect the option.

In multiple FMS installations, option changes made on one FMS will appear on the other FMSs. If the option is not received on the other FMS within three seconds, the field will revert to its previous display.

POS [1R] - This key alternately selects and deselects AFIS Automatic Position Reporting (AUTO/OFF).

WX [2R] - This key alternately selects and deselects Automatic AFIS Weather Reporting (AUTO/OFF).

SAT OPT [5L] - This key alternately selects and deselects the AFIS Satellite Option (ON/OFF).

NOTE: The SAT OPT line select key will select or deselect even when the option is not active. Verify that the AFIS SATCOM option is available before attempting selection.

ARINC [1L] - This key alternately selects and deselects the ARINC VHF Network Option (AUTO/OFF).

SITA [2L] - This key alternately selects and deselects the SITA/AVICOM VHF Network Option (AUTO/OFF).

AIR CAN [3L] - This key alternately selects and deselects the AIR CANADA VHF Network Option (AUTO/OFF).

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INTRODUCTION

This section contains the FMS system messages. Each message the system is capable of displaying is detailed below, including any action(s) which 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 CRT display. When a new system message becomes active, "MSG" will appear on the far right side of the top line on the CRT 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 CRT display may be 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

The system messages are presented in alphabetical order on the following pages. Messages specifying the sensor number (IRS1, IRS2, IRS3, OSS1, and OSS2) 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.

Messages

A/D CODE # - The A/D (Analog/Digital Board) self test failed during self test. "#" 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.

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 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 being used by the aircraft voice communication system. It may also occur when all in-range VHF ground networks have been disabled.

Messages

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 # FAIL - The AHRS input has failed or its status word indicates failure.

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.

AIRPORT DATABASE FAIL - A problem has been found in the airport section of the navigation data base. 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.

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 HSI 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 HSI 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 ARM AVAIL <NAV> - Less than 3.0 nm from first approach waypoint (either FACF or FAF) and approach has not yet been armed or less than 30 nm from EOA waypoint.

1. Arm approach by pressing the ARM APPR on NAV 1/3.

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 data base.

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 systems 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.

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 disappear 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 data base 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.

MANUALS AFFECTED: Universal Avionics Systems Corporations' Operator's Manual, Report No. 2423sv602, Change 1, dated 5 January 1998.

REASON: To add the description and corrective action for the CDU DATA BUS FAIL message.

FILING INSTRUCTIONS: Insert this Temporary Change into Report No. 2423sv602, Messages Section, adjacent to page 6.

INSTRUCTIONS: Add the following text before the CDU UPGRADE REQUIRED message description.

CDU DATA BUS FAIL - This message is generated by the CDU when it has not been refreshed by the FMS navigation computer. The message indicates that the CDU is functioning properly and that either an FMS navigation computer problem or a wiring problem might exist.

1. Power down the FMS using the ON-OFF DIM key (do NOT use the circuit breaker to cycle power to the FMS, and do NOT secure power to the aircraft without first properly powering down the FMS).
2. Power up the FMS again and observe the indicators and annunciators for the FMS powerup self-test.
3. If the CDU DATA BUS FAIL message appears again and the FMS powerup self test occurs normally, a wiring problem exists.
4. If the CDU DATA BUS FAIL message appears again and the FMS powerup self test does not occur, then a problem exists with the FMS navigation computer.

CKLST DATABASES FAIL - Appears if all checklist databases have failed (only with Collins Pro Line 4 interface).

1. Reload checklist data base.

CLOCK TIMER FAIL - The clock timer on the CDU board has failed self test.

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.

CREWNOTES 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.

Messages

DATABASE EXPIRED - The current date is past the NAV Data Base Expiration Date as displayed on the Initialization page and DATA page.

1. Load current navigation data base.

DATABASE FAIL - A part or all of the navigation data base has failed.

1. Reload navigation data base.

DATABASE FULL - The particular pilot data base is full.

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).

ENROUTES DATABASE FAIL - The data base containing enroute intersections has failed.

1. Reload navigation data base.

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.

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-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 0.2 nm and the localizer deviation is greater than 0.039 DDM (1/2 dot).

Messages

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 24 NM. As both FMSs 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 FMSs 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 0.2 nm while ILS localizer deviation is greater than 1/2 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 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.

GPIR # DESELECT - The sensor monitor has determined that the specified GPS data is unreasonable and has deselected the GPS portion of the sensor for use in navigation. The message will be removed after it is displayed once.

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 24 NM.

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.

- | |
|---|
| <ol style="list-style-type: none">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 change 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 24 NM.

Messages

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.

GPS POS ALARM - GPS error is outside of phase of flight limits for specified time.

HEADING REF FAIL - The AC reference for the Analog Heading input has failed.

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.

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 has been entered into the first optional waypoint position in the approach definition pages.

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.

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.

IRS # ALIGN - The specified IRS is in the alignment mode. The aircraft must stay stationary.

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 # DESELECT - The sensor "watchdog" has determined that the specified IRS data is unreasonable and has deselected the sensor for use in navigation.

Messages

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.

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 24 NM.

LCS FAIL # - The message displayed where # is the failure code for the type failure the LCS has detected 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 change to a not navigational mode. The cause of the change is displayed on the LORAN Status page.

LEFT IOC-ONSIDE FAIL - This message will be on the #1 FMS if the onside Input/Output Concentrator (IOC) has failed (only with Collins Pro Line 4 interface).

LEFT IOC-OFFSIDE FAIL - This message will be on the #2 FMS if the offside Input/Output Concentrator (IOC) has failed (only with Collins Pro Line 4 interface).

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 FMSs, either memory bank 1 or memory bank 2 has failed and all data bases in that failed bank are not usable.

1. Reload the navigation data base 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.

Messages

MOT WPT LIST FULL - For MMMSs only when MOT 9 (Mark On Target waypoint number 9) is created meaning the next waypoint added will bump the oldest waypoint from the list.

MOT WPT MEMORY FAIL - This message in appears in MMMSs only. MOT(Mark On Target) waypoint memory section has failed power-up self test.

NAV DATABASES FAILED - All segments of the navigation data base failed simultaneously. This message replaces all individual segment messages.

1. Reload navigation data base.

NDB DATABASE FAIL - A problem has been found in the NDB data base. Access to this data base will not be permitted.

1. Reload navigation data base.

NDB NAME DATABASE FAIL - An error was detected in the NDB plain language name database.

1. Reload navigation data base.

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 GPS 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 GPS RAIM @ FAF - RAIM may not be available at the Final Approach Fix or HIL is greater than 0.3 nm.

NO GPS RAIM @ MAP - RAIM is not available at the Missed Approach Point or HIL is greater than 0.3 nm.

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.

- | |
|---|
| <ol style="list-style-type: none">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 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.

Messages

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 data base.

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.

PERF DATABASE FAILED - The performance database has failed. Advanced performance features will be disabled.

1. Reload performance data base.

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 from the value entered in the gross weight field by more than 2.5%.

1. Press “BACK” “ ENTER” to update or,
2. Enter a manual value in the gross weight field.

PILOT APPR DATABASE FAIL - A problem has been detected in the Pilot defined approach data base.

3. Reload data from Pilot Data Save disk.

PILOT ARPT DATABASE FAIL - A problem has been detected in the Pilot defined airport data base.

1. Reload data from Pilot Data Save disk.

PILOT DATABASES FAILED - The data base of all pilot defined locations has failed.

1. Reload data from Pilot Data Save disk.

PILOT RNWY DATABASE FAIL - A problem has been detected in the Pilot defined runway data base.

1. Reload data from Pilot Data Save disk.

PILOT ROUTE DATABASE FAIL - A problem has been detected in the Pilot defined route data base.

1. Reload data from Pilot Data Save disk.

PILOT SID DATABASE FAIL - A problem has been detected in the Pilot defined SID data base.

1. Reload data from Pilot Data Save disk.

PILOT STAR DATABASE FAIL - A problem has been detected in the Pilot defined STAR data base.

1. Reload data from Pilot Data Save disk.

PILOT WPT DATABASE FAIL - A problem has been detected in the Pilot defined waypoint data base.

1. Reload data from Pilot Data Save disk.

POSITION CORRECTING - This message normally occurs when reacquiring DMEs following an overwater or other non-DME environment flight segment. Best Computed Position is in the process of being corrected.

Messages

POSITION UNCERTAIN - The FMS position is uncertified (not verified). A quality factor "Q" of 28 triggers this message within 300 nm 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 30 nm 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.

POWER SUPPLY # FAIL - Self test for power supply x (1, 2, or 3) has failed. Power supply #1 is 5VDC, #2 is 12VDC for programming database loads, and #3 is 15VDC.

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.

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.

RESEND RTE REQUEST - The route uplink request cannot be delivered to the UniLink.

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 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 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.

ROUTES FAIL - The route data base has failed.

1. Reload data from Pilot Data Save disk.

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 data base has failed.

1. Reload Navigation data base.

RUNWAY IN USE - This runway is in use in an approach or flight plan and cannot be modified or deleted.

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.

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 data base.

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.

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.

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 data base has failed.

- | |
|---|
| <ol style="list-style-type: none"> 1. Reload navigation data base. |
|---|

TERMINAL WEATHER RCVD - Terminal weather data has been received via AFIS Uplink or AFIS DTU.

TEST MODE - The system is in the test mode.

TOP OF DESC DNT 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 80 NM away or is invalid. The XXX and FFF.FF are filled with the identifier and frequency of the nearest valid VOR.

- | |
|---|
| <ol style="list-style-type: none"> 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 determined to be in a failed state by the FMC monitoring the UniLink.

UNILINK/FMC LINK FAIL – The UniLink/FMC file transfer link is declared fail.

UNILINK MSG RCVD - A new UniLink text message has been received.

- | |
|---|
| <ol style="list-style-type: none"> 1. Press the UNILINK prompt to access UniLink Main Menu. 2. Press NEW MSG prompt on the UniLink Main Menu to view message. |
|---|

Messages

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 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.

VHF NAME DATABASE FAIL - The VHF plain language name database has failed.

1. Reload navigation data base.

VHF NAVAID DATABASE FAIL -The navaid data base has failed. The backup navaid data base, containing navaids and airports, will be used.

1. Reload navigation data base.

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 FMSs 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.

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 disappear after it is read.

VOR TUNE FAIL - The 711 VOR has not tuned to the pilot requested frequency.

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 key light will not illuminate for this message. The instrument panel WPT alert annunciator will illuminate steady to alert the pilot of an impending leg change.

WINDS ALOFT RCVD - Winds aloft data has been received via AFIS Uplink or AFIS DTU.

WAYPOINT IN USE - This message occurs when attempting to delete a waypoint from the pilot defined data base which is in use on the flight plan.

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.

GLOSSARY

ABS - Absolute (as contrasted to “relative”). Mode of navigation for the Omega/VLF Sensor System.

absolute accuracy - The ability to determine true geographic position.

ACARS - Airborne Communications Addressing and Reporting System.

ACU - Antenna Coupler Unit; part of the UNC-OSS Sensor System.

ADC - Air Data Computer. Provides True Air Speed (TAS) and altitude. - see also DADC.

additional secondary factor - Calibration factors designed to compensate for the difference in propagation characteristics between land and sea.

ADS - Air Data Sensor.

AFCS - Automatic Flight Control System.

AFIS - Airborne Flight Information Systems.

AHRS - Attitude Heading Reference System.

air data system - A sophisticated system for measuring air temperature, pitot pressure, and static pressure. Used to obtain highly accurate TAS, Mach, altitude, and static air temperature. Also called an “Air Data Computer”. See also ADC.

ALTERR - Altitude Error displayed when the VNAV mode is in use. The number displayed is the difference, in feet, between the actual aircraft altitude and VNAV computed on-glideslope altitude for that point.

ANT - Antenna.

APPR - Approach.

area navigation - Navigation along random routes within the area of coverage of referenced facilities, or within the limits of self-contained area navigational aids, precluding the need to overfly specific navigational facilities.

ARINC - Data interface format (e.g., ARINC 429); ARINC is an abbreviation of "Aeronautical Radio, Inc."

ARPT - Airport.

ARTU - ARINC Radio Tune Unit.

ASU - Antenna Switching Unit.

baseline - The imaginary great circle line connecting a Loran C master station with a secondary station, or the imaginary great circle line connecting two OMEGA or two VLF stations.

baseline extension - The extension of the baseline beyond the Loran-C master or secondary station, or beyond an OMEGA or VLF station.

BCD - Binary Coded Decimal (number representation).

BCP - Best Computed Position; as determined by Universal's FMS. A typically installed fully integrated FMS processes range information from the DME, true airspeed from the Air Data Computer, velocity data from an inertial reference sensor, position data from the VLF/Omega, Loran C, GPS and aircraft heading in order to derive the one best computed position and velocity as a weighted average of the various sensor inputs.

CCU - Cockpit Control Unit.

CDI - Course Deviation Indicator.

CEP - Circular Error Probable.

Checksum - A process (transparent to the user) which generates and checks, special control characters used in validating that data is properly transferred/stored between (computer) components.

CHP - Course Heading Panel.

Clutter - In radar operations, clutter refers to the reception and visual display of radar returns caused by precipitation, chaff, terrain, numerous aircraft targets, or other phenomena.

coast-in - The first point of land reached when flying from seaward.

coast-out - The last point of land crossed when departing seaward.

COMM - Communication.

CPU - A computer's Central Processing Unit.

cross track distance - The distance and direction right or left between the aircraft and the desired track.

CRS - Course.

CRT - Cathode Ray Tube.

CSDB - Commercial Standard Data Bus.

DA - Drift Angle.

DADC - Digital Air Data Computer - see also ADC.

DB - Data Base.

DDA - Double-Density ARINC board. Resides in the Nav Computer Unit.

DDU - Disk Drive Unit.

dead reckoning - The directing of an aircraft and the determination of its position by the application of direction and speed information to a previous position.

Glossary

desired track - In VOR/DME based RNAV, the Rhumb Line course between selected waypoints. In long-range navigation, the Great Circle course between selected waypoints.

DEV - Deviation; compass error caused by magnetism within the aircraft.

deviation - Compass error caused by magnetism within the aircraft.

DEXP - Date of Expiration of stored navaid data base.

DGPS - Differential GPS.

differential GPS - An addition to the NAVSTAR/GPS system which uses corrections from a ground station for the purpose of enhancing GPS accuracy for all users within range of the associated ground station.

direct wave - Radiated energy which follows a line-of-sight path between the source and the receiver or sensor.

diurnal effect - Variation in the height of the ionosphere caused by sunlight; a daily phenomenon.

DME/P - Precision Distance Measuring Equipment.

DMU - Data Management Unit.

DOD - Department of Defense.

dP - Pressure Differential (e.g., cabin to outside).

DR - Dead Reckoning.

DRIFT - Drift angle in degrees left (L) or right (R) of the aircraft heading (caused by wind).

drift - Displacement from the direction in which the aircraft is headed caused by a crosswind component.

drift angle - The angle between aircraft heading and the desired track, expressed in terms of right or left according to the direction in which the aircraft has drifted.

DTK - Desired Track.

DTO - Direct-To; direct route or course.

DTU - Data Transfer Unit.

DZH - Drop Zone (Axis) Heading.

DZL - Drop Zone Length.

EADI - Electronic Attitude Director Indicator.

EFIS - Electronic Flight Information System.

EFIS/MFD - Electronic Flight Information System Multifunction Display.

EHSI - Electronic Horizontal Situation Indicator.

EMI - Electromagnetic Interference.

EOA - End of Approach.

ephemeris - The position of an astronomical body.

ERP - EFIS Radar Panel.

ESAD - Equivalent Still Air Distance. Distance aircraft has flown through air mass eliminating the effect of the wind. This is used extensively by airlines flying fixed routes for comparing operational efficiency.

extended range modal interference - Modal interference affecting OMEGA/VLF signal propagation at ranges that vary from 1,000 to 2,000 nautical miles.

FACF - Final Approach Course Fix.

FAF - See Final Approach Fix.

FAP - See Final Approach Point.

FGS - Flight Guidance System.

Final Approach Fix - The fix from which the final approach (IFR) to an airport is executed and which identifies the beginning of the final approach segment.

Final Approach - IFR - The flight path of an aircraft which is inbound to an airport on a final instrument approach course, beginning at the final approach fix or point and extending to the airport or the point where a circle to land maneuver or a missed approach is executed.

Final Approach Point - The point, applicable only to a nonprecision approach with no depicted FAF (such as an on-airport VOR), where the aircraft is established inbound on the final approach course from the procedure turn and where the final approach descent may be commenced.

Flight Management System - A computer system that uses a large data base to allow routes to be preprogrammed and fed into the system by means of a data loader. The system is constantly updated with respect to position accuracy by reference to conventional navigation aids. The sophisticated program and its associated data base insures that the most appropriate aids are automatically selected during the information update cycle.

FMS - See Flight Management System.

FMS XFILL - Transfer data from one FMS to another in a multiple FMS configuration.

FPA - Flight Path Angle (glide slope) in degrees required for the approach segment between the FR and TO waypoints (current leg).

FPCDU - Flat Panel Control Display Unit. Consists of a color liquid crystal display and a keyboard with function and alphanumeric keys. Main interface between the operator and the Navigation and Flight Management Systems on other Universal products.

FSS - Flight Service Station.

G.C. - Grid Course.

G/S - Glide Slope

GCA - See Ground Controlled Approach.

GCS - Ground Clutter Suppression.

GDC - General Data Center.

GDOP - Geometric Dilution of Position.

GPIRS - Global Positioning System and Inertial Reference System combination sensor.

GPS - Global Positioning System (Satellite navigation).

GPWS - Ground Proximity Warning System.

great circle - The circle formed by a plane passing through the center of a sphere.

GRI - Group Repetition Interval.

Ground Controlled Approach - A radar approach system operated from the ground by air traffic control personnel transmitting instructions to the pilot by radio. The approach may be conducted with surveillance radar (ASR) only or with both surveillance and precision approach radar (PAR). Usage of the term "GCA" by pilots is discouraged except when referring to a GCA facility. Pilots should specifically request a "PAR" approach when a precision radar approach is desired or request an "ASR" or "surveillance" approach when a nonprecision radar approach is desired.

ground wave - Radiated energy which follows the surface of the earth.

group repetition interval - The amount of time, in microseconds, between the start and stop of each Loran C master station transmission. Commonly used for station identification.

HDOP - Horizontal Dilution of Position.

HUD - Heads-Up Display.

IAF - See Initial Approach Fix.

Initial Approach Fix - The fixes depicted on instrument approach procedure charts that identify the beginning of the initial approach segment(s).

INS - Inertial Navigation System.

IRS - Inertial Reference System.

ISS - Inertial Sensor System; see IRS.

Jet Route - A network of air routes based on radials from VOR navigational facilities extending from 18,000 feet MSL up to and including Flight Level 450. Used in the U.S.A.

Kalman Filter - A (computer) processing technique which integrates several similar signals and statistically determines their proper mix to create a composite, best fit, single output.

lane ambiguity resolution - In OMEGA systems, the process of identifying the correct lane, or area between hyperbolic lines of positions.

latitude - Angular distance measured north or south of the Equator from 0 to 90.

LCC - Loran C Navigational Charts.

LCS - Loran C Sensor System.

LDA - Localizer-type Directional Aid.

line of position - A line containing all possible geographic positions of an observer at a given instant of time.

LOA - Loran C Operating Area.

LOA INSIDE - Status indicating that the aircraft's present position is inside a defined LOA. This status will be reported even if no stations are being received.

LOA OUTSIDE - Status indicating that the aircraft's present position is outside a defined Loran Operating Area.

longitude - Any Great Circle which passes through the earth's poles. Measured in angular distance east or west from the zero meridian.

LOP - Line of Position.

Loran C - Long Range Navigation, Version C; navigation systems presently limited to the Northern Hemisphere. Excellent long and short-term accuracy with periodic variation affecting short-term position sensing.

LSK - Line Select Key.

MAP - Missed Approach Point.

MCU - Modular Concept Unit.

meridian - A line of longitude.

MFD - Multi-Function Display.

MLS - Microwave Landing System.

MMMS - Multi-Mission Management System.

MNPS - Minimum Navigational Performance Specifications.

MNVR - Maneuver.

modal interference - Error resulting from the inability of the receiver to differentiate between ground and sky waves.

MOT - Mark On Target.

MPP - Most Probable Position.

Glossary

MSG - Message.

MSU - Mode Selector Unit.

NAS - National Airspace System.

NAT OTS - North Atlantic - Organized Track System.

NAT-MNPS - North Atlantic - Minimum Navigation Performance Specification.

NAVSTAR/GPS - Global Positioning System.

NCU - Navigation Computer Unit.

night effect - An overlapping of ground and sky waves, common at sunrise and sunset, resulting in temporarily erratic indications.

NONCERT - Status indicating that the LCS is navigating outside the Loran Operating Area (LOA) and the navigation computer is not utilizing LCS for position determination.

NOS - National Oceanic Service.

NPU - Navigation Processor Unit.

NVG - Night Vision Goggles.

NVIS - Night Vision.

NVRAM - Non-Volatile RAM; independently power protected computer memory, see also RAM.

Omega - World-wide radio navigation network.

Omega/VLF - Navigation system; long-range system with very good long-term accuracy but poor short-term accuracy.

ONC - Operational Navigation Chart.

orthogonal - Mutually perpendicular. The primary aircraft axes are orthogonally related.

OSS - Omega/VLF Sensor System.

P - Precision.

PAR - Precision Approach Radar.

PCA - Polar Cap Anomaly.

PGS - Pseudo-Glide Slope.

pilotage - Navigation by reference to terrain features, both natural and man-made, usually with the aid of an appropriate aeronautical chart.

PLOC - Pseudo Localizer.

PNR - Point of No Return.

polar cap anomaly - In OMEGA/VLF systems, a propagation anomaly affecting signals traversing polar regions; caused by solar flares.

PPOS - Present Position

PREV - Previous.

propagation anomalies - Inconsistencies in signal phase or frequency.

pseudo range - Distance determined by an uncorrected time measurement.

PT - Procedure Turn.

PVOR - Pseudo-VOR.

Q - Azimuth.

Glossary

Q - Quality Factor (Q); a measure of a system's [probable error] in tenths of a nautical mile. Based on a 95% probability, a Q of 3 would represent a maximum position error of 0.3 nm.

QNE - The barometric pressure used for the standard altimeter setting (29.92 inches Hg).

QNH - The barometric pressure as reported by a particular station.

q Theta - Azimuth.

r Rho - Distance.

R-Nav - Area Navigation.

RAIM - Receiver Autonomous Integrity Monitoring.

RAM - Computer Random Access Memory; each location (e.g., byte) is directly and individually addressable.

rate aiding - The process of correcting LOP's (lines of position) taken at different times

REL - Relative (as contrasted to absolute). Mode of navigation for the Omega/VLF Sensor System.

repeatable accuracy - The ability to return to a previous position, normally measured in nautical miles.

RFI - Radio Frequency Interference.

rho - Navigational term for distance.

rhumb line - A line which makes the same angle with each meridian it crosses.

RIS - Radio Interface Simulator; used for testing Universal's FMS.

ROLL STRG - Roll Steering.

Route - A progression of waypoints, headings, intersections, etc. that are normal and usual in completing a flight between two points.

RP - Release Point.

RPU - Receiver/Processor Unit.

RRS - Radio Reference Sensor. Provides DME, DME/VOR, and TACAN navigation capabilities to the FMS.

RSU - Radio Select Unit.

RTU - Radio Tune Unit.

S/W - Software.

SAR - Search And Rescue.

SCN - Software Control Number.

SEP - Spherical Error Probable.

shore line effect - A refraction ground wave caused by the difference in conductivity between land and water.

skip zone - The gap in radio wave transmission that exists between the outer limits of ground wave reception.

sky wave - Radiated energy which has been refracted by an ionized layer of the atmosphere back toward the surface of the earth.

slant range - The straight line distance between the aircraft and the DME range facility.

slant range error - The difference between slant range and range over the ground.

SMC - Special Mission Computer. Universal's Special Missions Navigation and Flight Management System.

SNR - Signal to Noise Ratio.

SPS - GPS Standard Positioning Service.

Glossary

SSU - Signal Switching Unit; digital to analog signal converter for interfacing FMS digital output to conventional analog flight guidance systems.

Standard Service Volume - Reception limits, expressed in nautical miles, by altitude, of unrestricted navigational facilities for random and unpublished (direct) route navigation.

SX - Selected Crosstrack.

SXTK - Selected Crosstrack.

TERPS - Terminal Instrument Procedures.

theta - Navigational term for azimuth.

time bias - An error caused by differences between time standards.

TKE - Track angle Error.

TOD - Top-Of-Descent.

torquing - A process of applying force to a gyro to intentionally induce precession (drift) so as to correct for the effects of earth rotation and aircraft movement.

track - The actual flight path of an aircraft over the surface of the earth.

track angle error - The difference, in degrees and direction right or left, between the actual aircraft track and the desired track.

TRDRP - Teardrop.

triple mixing - A process of statistically integrating the outputs from three separate inertial navigational systems for increased overall accuracy.

TRK - Track.

TSO - Technical Standard Order; FAA certification standard.

TTG - Time To Go.

UNC-LCS - Universal Avionics Systems Corporation's Loran C Sensor system.

UNC-OSS - Universal Avionics Systems Corporation's Omega Sensor System.

UNS - Universal Navigation System, also FMS

UTC - Coordinated Universal Time. (formerly GMT)

VDOP - Vertical Dilution of Position.

Victor Airways - A network of air routes based on radials from VOR navigational facilities extending from a minimum of 1200 feet above ground level, up to but not including 18000 feet MSL.

VLF - (U.S. Navy) World-wide Very Low Frequency (3-30 kHz) radio communications network. The VLF signals transmitted by these stations can be used to supplement the Omega Navigation System. Refer to Omega/VLF.

VLF/Omega - See Omega/VLF.

VNAV - Vertical Navigation.

voting - A process of comparing the outputs of three systems for the purpose of identifying and eliminating the least correct system.

VSR - Vertical Speed Required.

VTO - Vertical Direct-To.

Waypoint - Any geographical fix defined either in terms of radial and distance from a VOR facility, or in terms of latitude and longitude. Used in area navigation to describe route segments.

WCA - Wind Correctional Angle.

WIND - The wind direction (true) and speed in knots.

wind component (or factor) - That part of the wind vector that is aligned with the aircraft track; tailwind components are positive factors, increasing ground speed over airspeed, and headwind components are negative factors, decreasing groundspeed.

wind correction angle - The difference, in degrees, between aircraft heading and course. Also called a “drift correction”, and sometimes called a “crab angle”, or “cut”.

WP or WPT - Waypoint.

wrong way propagation - In OMEGA/VLF systems, an error caused by the receipt of a relatively strong OMEGA/VLF signal from the opposite direction of that expected.

XFILL - Crossfill.

XTK - Crosstrack. Lateral distance in nm left (L) or right (R) of the extended course centerline between the FR and TO waypoints.

XTK DEVIATION - Deviation from desired track.

XWIND - The current crosswind component direction (L or R) and velocity in knots.

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