OPERATOR’S MANUAL

SCN 802 and 902
Flight Management Systems

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.

When the FMS contains Multi-Mission Management System, Software 901, the Multi-Mission Management System Supplement must be inserted behind the SPECIAL MISSIONS Tab in this manual.

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Manual Affected


Filing Instructions

Insert this Temporary Change in the front of the manual.

Purpose

Recommend to operators that they not use the Crossfill (XFILL) option.

Instructions

Add the following text.

If your FMS is configured for Crossfill, Universal Avionics recommends that Crossfill not be used. If it is used then the flight plan on the receiving FMS must not be edited after it has been received.

Universal Avionics has identified a software anomaly affecting Crossfill operations and it will be corrected in a future software upgrade. A Service Bulletin will be issued to announce this upgrade.

To determine whether the FMS is configured for Crossfill or Synchronous mode: from DATA page 1 press MAINT / CONFIG / ARINC / RECEIVE. The ARINC RCV page will display. If CROSSFILL 1 or CROSSFILL 2 appears on the page then it is configured for Crossfill mode. If SYNC appears on the page then it is configured for Synchronous mode.
APPLICATION

This Operator’s Manual
Report No. 2423sv802/902
is applicable to

UNS-1C+          UNS-1E
UNS-1Csp+        UNS-1Esp
UNS-1D+          UNS-1F
UNS-1K+          UNS-1L

FLIGHT MANAGEMENT SYSTEM
and
MULTI-MISSION MANAGEMENT SYSTEM
possessing software programs

Version 802.X and 902.X

NOTICE
When being used for Multi-Mission Management System (SCN 902.X), this manual must contain the supplement located behind the Special Missions tab.

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.
# LIST OF EFFECTIVE PAGES

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This manual provides operational procedures of software control numbers (SCN) 802 and 902 as used in Universal Avionics Systems Corporation’s (UASC’s) UNS-1C+, UNS-1Csp+, UNS-1D+, UNS-1E, UNS-1Esp, UNS-1F, UNS-1K+ and UNS-1L Flight Management Systems (FMSs).

SCN 802/902 evolved from previous SCNs 801/901. Most of the software improvements are transparent to the operator and allow the FMS compatibility with the latest technology avionics equipment. Service Bulletins issued by UASC provide a complete description of changes introduced with the new software.

Note that FMS and MMMS are used interchangeably in this manual. The 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 Systems, the FMS becomes the navigation control. Unique operational differences exist in this case and are discussed in the applicable Pro Line 4 Supplement.

The Multi-Mission Management System (MMMS) provides the added capability to automatically steer along one of six search patterns. Refer to the Special Missions Section for detailed information on search patterns.
Section I
System Description

Sensors
The FMS accepts primary position information from short and long range navigation sensors. Inputs from DME, VOR or TACAN and Doppler, as well as up to five long range navigation sensors, can be used 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 can choose from Loran C and laser or gyro referenced inertial (IRS) navigation sensors. The FMS also interfaces with several varieties of GPS, namely the GPS-950, GPS-1000, GPS-1200, GLS-1250 and GNSS-2400 with or without GLONASS capability, 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 (ADC), 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
Primary position data received from each sensor is combined in a Kalman Filter, contained within the FMS, to derive a Best Computed Position (BCP). Using 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.
Section I  
System Description  

The FMS BCP is determined by using position inputs from all available navigation sensors and DME distance information from the scanning DME (if installed). If a RRS is installed, TACAN information is also used. The system searches the Navigation Database to determine which DME or TACAN stations are within range, then sequentially tunes 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 GPS, Loran C and IRS sensors, radial information from the VOR and TACAN sensors, TAS from the ADC and heading information to derive the BCP as a weighted average of the various sensor inputs. If the aircraft is out of DME range, the FMS will rely upon long range sensors for position information. After the BCP is obtained, secondary navigational functions such as course to waypoint, estimated time of arrival (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 a more accurate ETA.

Flight Planning  

Flight planning is accomplished by accessing the internal Navigation Database, which includes both navigation and pilot-defined data, and company-defined routes created on UASC’s Offline Flight Planning Program. The pilot selects from waypoints, routes, airways, arrivals, departures, approaches and runways to create the desired flight plan. The user may also create tactical waypoints, which are temporary pilot-defined waypoints limited to use with the 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 phase. These operations can be 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.
Section I
System Description

**Maneuvers**

Inflight maneuver capabilities include FMS-controlled departures, procedural turns, turn anticipation, Direct-To functions, vertical navigation, heading mode selection, holding patterns, selected crosstrack, Pseudo-VOR, arrivals and approaches.

**Waypoint Sequencing**

The FMS uses 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 an overfly waypoint, the turn will commence over the waypoint.

**Direct-To**

The FMS provides maximum flexibility when defining Direct-To leg changes. Direct-To (DTO) maneuvers can be to waypoints or airports on or off the flight plan. If an upcoming (TO) waypoint off the flight plan is chosen, the system will prompt the pilot to redefine the next (NX) waypoint in order to link the newly defined leg into the flight plan. The pilot can 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 electronic flight instrument system (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 course may be established to provide guidance with respect to an offset course, parallel to the leg defined by the From and To (FR/TO) waypoints. When selected crosstrack (SXTK) is entered, the SXTK annunciator on the instrument panel will illuminate. Crosstrack (XTK) will indicate crosstrack from the SXTK, the system will provide steering to fly the selected XTK, and the HSI will be referenced to the parallel (offset) course only until the next waypoint sequences. SXTK will then automatically cancel.
Vertical Navigation

The vertical navigation (VNAV) function allows the flight crew to define a desired vertical flight profile along the flight plan. It also computes aircraft deviation from that profile. Crossing altitudes provide a nearly seamless transition from cruise, enroute descent and approach phases of flight.

Two VNAV pages displaying six VNAV waypoints are available under the VNAV 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 (TOP) and Target Vertical Speed (TVS), support for holding patterns and vertical DTO. For the initial VNAV leg, flight path angle in degrees is displayed under the TVS data field.

Holding Patterns

Holding patterns may be programmed at any waypoint on or off the flight plan or stored in the Navigation Database as part of SID, STAR and approach procedure. 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 activated directly. 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 flight plan legs, compensating for existing wind conditions. ETA over the holding fix is constantly displayed.
Section I
System Description

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

The FMS approach mode simulates an instrument landing system (ILS) 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, GLS, non-directional beacon (NDB), ILS, localizer and BC approaches may be accessed directly from the Navigation Database. 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.

In addition, the pilot can define approaches by entering the approach waypoints and the reference navaid. VOR, RNAV, TACAN, ILS, LOC, BC, GWS and visual flight rules (VFR) approaches can be defined. There are no provisions for pilot-defined GPS or NDB approaches.

Databases

FMS databases include the Navigation Database and the Pilot-Defined Database, which includes a Company Routes Database. In addition, when the Collins Pro Line 4 800 system is configured, the FMS has provisions to maintain a Checklist Database. A Performance Database is also provided for certain aircraft.
Manual Affected


Filing Instructions

Insert this Temporary Change adjacent Page 1-7.

Purpose

Provide information regarding data loading via the Solid State Data Transfer Unit (SSDTU).

Instructions

Add the following text after the second paragraph under Navigation Data Base on page 1-7.

NOTE: Throughout this manual you will see references to DTU and/or DTU-100 as well as Zip disk. Universal Avionics has introduced a new Solid State DTU (SSDTU) capable of using USB or secure digital (SD) data storage devices. Therefore the term “disk” used herein now refers to any of the media (Zip disk, USB, or SD). Further, the FMS load screens will still refer to “DISK” when loading data. The loading procedures will remain unchanged regardless of the storage device being used, except where noted.

Both DTU-100 and SSDTU will power up automatically when power is applied to the aircraft.

- The DTU-100 will show red and green lights on the front when initially powered, then just green when ready for operation.

- The SSDTU faceplate LEDs will flash amber-green-blue, and then the Status LED will show a constant green to indicate the SSDTU is ready for operation. A blue LED will indicate the currently active data storage device port on the SSDTU.
Dual Cycle Database Loading

The FMS has two separate database memory banks to hold the electronic database. This feature allows a future (that is, not yet effective) database to be loaded and stored until its effective date. At the first power-on cycle after the effective start date of the new database, it will automatically be used for navigation. The advantage of a dual cycle database is that the next database cycle can be loaded into the FMS on the day it is received, rather than waiting until its effective start date.

Navigation Database

The self-contained worldwide Navigation Database, stored in non-volatile memory, provides the FMS with information for over 100,000 waypoints, navigational aids (navaids), airports and over 12,000 SIDs, STARs and approaches. The database includes VHF and NDB navaids with plain-language references, enroute and terminal waypoints, and high and low altitude airways. The database is available with airports having ≥2000 feet runways, ≥4000 feet runways or ≥5000 feet runways and is also available in a North American helicopter region version.

A subscription service is available through UASC that provides Navigation Database updates on a 28 day cycle. The updates are formatted on disks and are loaded into the FMS via the Data Transfer Unit (DTU).

Pilot-Defined Database

The Pilot-Defined Database stores all data created by the pilot and has the capability to store up to approximately 200 pilot-defined routes composed of up to 2,500 legs. It also stores up to 200 waypoints, 100 runways and 100 approaches, and also alignment waypoints, airport reference points, SIDs, STARs and routes. Through the use of a personal computer software package called Universal Flight Planning, user-defined data can be created and loaded into the FMS via the DTU. The database is non-volatile and a an available configuration option clears all pilot data at FMS powerup. However, the default setting for this option is to retain pilot data at powerup.
Company Routes Database

A Company Routes Database is created using UASC’s Offline Flight Planning Program and loaded via the DTU. A total of up to 2500 routes and 250,000 route elements can 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) are accessed from the Navigation Database by use of reference pointers. Company routes can be given names of up to eight characters in length. A company route can also be copied into the active flight plan, where it can be edited, but the pilot cannot alter the basic route database.

Performance Database

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 the AIRCRAFT PERFORMANCE SUPPLEMENT in the back of the FUEL & PERFORMANCE Section.

Sensor Watchdog

A sensor "watchdog" automatically detects sensor information that appears erroneous and could cause an error in the BCP. This is accomplished by comparing each sensor to the unweighted average of all 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 position error > 50 nm or speed error > 50 knots) automatically deselect the sensor.

Navigation and Steering Outputs

The FMS provides desired track, bearing, XTK, lateral deviation and related data to the flight guidance system (FGS) for the HSI displays, and roll steering command for the autopilot/flight director system. The roll steering output limits for both normal and DTO 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.
**Section I**

**System Description**

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<td>Holding</td>
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</table>

**Fuel**

The aircraft’s engine fuel flow system provides the inputs necessary to integrate real time fuel management information with navigational functions. During the pre-departure 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 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 multiple installations, each FMS provides system initialization and flight plan information through an interconnecting bus to other systems. While all long range navigation sensors are interfaced with both units, each FMS acts as the "master" to the associated sensor. Each FMS computes an independent position using all available navigation sensors and provides selected information to the associated flight instruments. Each FMS also shares its BCP 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 pilot with a centralized means to tune the aircraft's radios, select and store preset frequencies for each radio and view the selected (preset or active) frequencies for each radio. The aircraft must be configured with a Radio Tuning Unit, Primus, Pro Line 4, AN/ARN TACAN or 709 DME & 711 VOR for this mode to be operational. Refer to the TUNE KEY description in the Control and Display section of this manual for detailed information on radio tuning.

Annunciations

Messages

The FMS contains an array of messages that 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 used for the airborne flight information system (AFIS) and UASC’s UniLink two-way data link in applicable installations.
Remote Annunciations

Outputs are provided to cause the six external annunciators to alert the pilot of system status or flight plan sequencing. These annunciations 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

This optional feature allows interface with video cameras and cabin display systems for viewing on the FMS color flat panel display. National Television Standards Committee Red-Green-Blue 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, an ADC, a DTU and a Radio Tuning Unit.

FMS Display

The FMS uses a 4 or 5-inch active matrix liquid crystal color flat panel display. The high resolution display provides alphanumerical 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.

FMS Keyboard

The full alphanumerical keyboard contains dedicated function keys that, when used in conjunction with the ten line select keys (LSKs), provides the pilot 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 has a powerful central processing unit (navigation computer), navigation sensor interface circuits, flight guidance system interface and the Navigation Database. The unit processes data from the ADC, the fuel flow system, the DME and VOR sensors 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; this optimizes the FMS to the aircraft’s specific characteristics. The long range navigation 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.) systems.
Short Range Sensors

DME

The FMS's unique auto-scanning DME-DME-DME positioning function uses the internal Navigation Database to continuously 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, using the blind channel of an external digital DME or UASC's RRS (VOR, DME, TACAN). Range information from all responding DMEs within approximately 300 nautical miles of the FMS position are corrected for slant range error, then compared with those computed from the Navigation Database to verify accuracy and to ensure DME position integrity is maintained.

Flights that never leave areas of multiple DME coverage can expect exceptional position accuracy. 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 UASC's RRS provides the FMS with azimuth information from the received VOR navaid. This azimuth data, combined with the scanning DME distances, provides accurate navigation information for the FMS 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 navaids.

Radio Reference Sensor

UASC's RRS functions as a multi-channel DME/TACAN receiver/transmitter and VOR receiver, able to provide DME, VOR and TACAN data simultaneously to two FMSs. 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 and requires no pilot intervention.
Section I
System Description

Doppler
The FMS supports the RACAL 91, the ASN-137 and the CMC 2012 Doppler sensors. These are primarily used for measuring sea current data in search-and-rescue operations.

Long Range Sensors
The FMS can interface with four types of long range navigation sensor: Loran C, IRS, GPS, (including GLS and GNSS) and GPS/IRS.

UASC Loran C Sensor (LCS)
The LCS is specifically designed to interface with UASC’s FMSs. The LCS is a fully automatic multiple chain Loran C sensor using 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.

UASC LCS-850 Loran C Sensor
The LCS-850 is specifically designed to interface with UASC’s FMSs and Navigation Management Systems (NMSs). The LCS-850 functions as an automatic Loran C sensor using an E-Field blade antenna. Station selection is multi-GRI or cross chain operation. The LCS-850 uses 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 operations.
Global Positioning System

UASC’s GPS-1000, GPS-1000A and GPS-1200 GPS sensors are designed to interface with UASC’s FMSs. GPS-1000, GPS-1000A and GPS-1200 position output is used in conjunction with data from a combination of VOR, DME, IRS or LCS to form a composite FMS position solution.

The GPS-1000, GPS-1000A or GPS-1200 sensor is the source of three dimensional position, 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 with regard to waypoint displays, scaling, integrity monitoring, predictive RAIM, etc., when interfaced with the GPS-1000, GPS-1000A or GPS-1200. These sensors also comply with FAA Notice 8110.60 for primary means of remote/oceanic operations.

In all FMSs, the internal GPS sensor is identical to the GPS-1000 sensor, and carries the same approvals.

GNSS-2400

The GNSS-2400 GPS/GLONASS sensor system is essentially the same as the GPS-1000 and GPS-1000A but has the capability to also use the GLONASS GPS Satellite constellation.

GLS-1250 (GNSS Landing System Sensor)

The GLS-1250 GNSS Landing System sensor is designed to interface with the FMS to provide the capability to execute SCAT-1 (Special Category 1) approaches at suitably equipped airports.

The GLS-1250 consists of a GNSS (GPS+GLONASS) receiver and a VHF data link receiver. The GLS-1250 operates in conjunction with SCAT-1 ground stations, which provide differential corrections and certain other data. These enhance the accuracy and integrity of the three-dimensional GNSS position data to support precision approaches.

The GPS-1250 also provides uncorrected GNSS position data to the FMS for enroute, terminal and non-precision approach operations (GLONASS data are not used on SCAT-I approaches, as the SCAT-1 ground stations do not transmit differential corrections for the GLONASS satellites).
GPS/OMEGA/VLF (GPOSS) Sensor

The UNS 764-1 and 764-2 are combination GPS and Omega/VLF sensors. Because of the closure of the Omega stations in September 1997, the Omega/VLF side of this sensor is no longer usable. After complying with UASC Service Bulletin No. 1XXX.34-2576, the GPS side of these sensors may be used for navigation.

The UNS 764-1 GPS sensor component uses a dual channel GPS 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 GPS portion of the UNS 764-1 can be used as a supplemental sensor for short range domestic enroute navigation only.

The UNS 764-2 GPS sensor component features a 12-channel L1 frequency and C/A code receiver identical to 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.

GPS WAAS (GWS) Sensor

In specific installations, the FMS interfaces with a GWS sensor currently in use only by the FAA for WAAS evaluation.
Inertial Reference Sensor

IRSSs are designed around either conventional gyroscopes or laser-reference gyroscopes. Those sensors using conventional gyroscopes depend upon accelerometers mounted on a gyroscope’s stabilized platform to sense velocity in all three axes. With laser-reference gyroscopes, 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 axis 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.

GPS/IRS

Combination GPS/IRS (GPIRS) 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. Conversely, IRSs have excellent short term position resolution; however, they tend to lose accuracy over time. A GPIRS sensor will output three different sets of data: pure GPS, pure IRS and hybrid GPS/IRS. It is this last data that is used by the FMS. Hybrid GPS/IRS data will exhibit the long term accuracy of GPS and the short term accuracy of an IRS during periods of poor GPS performance.
Section I
System Description

Configuration Module

A configuration module is installed on the FMS rear connector. It is programmed at the time of installation, and defines all the aircraft interfaces unique to the particular installation.

Air Data Computer

The FMS accepts digital or analog air data from a remote ADC. True airspeed, barometrically corrected or non-corrected altitude, and static air temperature are monitored. Barometrically corrected altitude is required for vertical guidance display during approaches and for VNAV below 18,000 feet. ADCs from various manufacturers can be interfaced with the FMS.

Data Transfer Unit

The DTU is designed to be mounted in the aircraft and is used to rapidly update the FMS Navigation Database. A portable unit is also available for multi-aircraft operations. The DTU is connected directly to the FMS so that the data is transmitted directly to the FMS during the update process. The update data will refresh the entire Navigation Database with each update.

A subscription service that provides Navigation Database updates on a 28 day cycle is available through UASC.

The DTU is also used to load aircraft specific performance data into the FMS for calculation and display. The DTU can 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 using 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

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. Communications, navigation, air traffic control, automatic direction finders and TACAN are selectable through the RTU, depending upon the specific aircraft configuration. Both 25kHz and 8.33 kHz spacing is supported.
The configuration diagrams shown on the following pages represent the basic single and dual installations for the UNS-1C+/1E, UNS-1Csp+/1Esp, UNS-1D+/1F and UNS-1K+/1L FMSs. The configurations depict installations using all available long range navigation sensor ports. The configuration for each aircraft will depend on the type and number of sensors selected. The maximum number of each input type has been indicated.

Other configurations are 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 RRS, multiple long-range navigational sensors, the ADC and engine fuel flow sensors.

Multiple Systems

In multiple FMS installations, communication between FMSs is accomplished through an interconnection bus. There is no “Master/Slave” type relationship between the FMSs. Each FMS makes data available (Initialization, Flight Plan, Fuel) to other interfaced FMS(s). Crossfill of this data can be initiated by either the sending or the receiving system. Each FMS acts as “Master” of its associated sensors, even though that sensor may also be providing data to another FMS. Typically, the on-side compass and ADC will supply heading and air data, while fuel flow data will be shared by the FMS.

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 BCP with the other system and continuously monitors the other FMSs’ position output.
Section I
System Description

Single UNS-1C+/1E and UNS-1Csp+/1Esp FMS Configuration

- Long range navigation sensors in various combinations (up to five total)
- IRS or GPIRS sensors - Maximum of three
- Loran C sensor - Maximum of one
- GPS, GLS or GNSS sensor - Three (including internal GPS)
- (RRS - One
- Engine Fuel Flow sensors - Maximum of four
- ADC - One
- DME sensor - One multi-channel digital
- VOR sensor - One digital
- TACAN sensor - One
- Radar joystick (not displayed) input for waypoint definition
- DTU - One
- Doppler sensor - One
Dual UNS-C+/1E and UNS-1Csp+/1Esp FMS Configuration

- Long range navigation sensors in various combinations (up to five total)
- IRS or GPIRS - Maximum of three
- Loran C sensor - Maximum of one
- GPS, GLS or GNSS sensor - Three including the internal GPS
- RRS - Maximum of two
- Engine Fuel Flow sensors - Maximum of four
- ADC - Maximum of two
- DME sensor - Two multi-channel digital
- VOR sensor - Two digital
- TACAN sensor - Two
- Radar joystick (not displayed) input for waypoint definition
- DTU - One
- Doppler sensor - One
Section I
System Description

Single UNS-1D+/1F FMS Configuration

- Long range navigation sensors in various combinations (up to five total)
- IRS or GPIRS - Maximum of three
- Loran C sensor - One
- GPS, GLS or GNSS sensor - Three including internal GPS
- RRS - One
- Engine Fuel Flow sensors - Maximum of four
- ADC - One
- DME sensor - One multi-channel digital
- VOR sensor - One digital
- TACAN sensor - One
- Radar joystick (not displayed) input for waypoint definition
- DTU - One
- Doppler sensor - One
Dual UNS-1D+/1F FMS Configuration

- Long range navigation sensors in various combinations (up to five total)
- IRS or GPIRS - Maximum of three
- Loran C sensor - One
- GPS, GLS or GNSS sensor - Three including the internal GPS
- RRS - Maximum of two
- Engine Fuel Flow sensors - Maximum of four
- ADC - Maximum of two
- DME sensor - Two multi-channel digital.
- VOR sensor - Two digital
- TACAN sensor - Two
- Radar joystick (not displayed) input for waypoint definition
- DTU - One
- Doppler sensor - One
Section I
System Description

Single UNS-1K+/1L FMS Configuration

- Long range navigation sensors in various combinations (up to a total of five)
- IRS or GPIRS - Maximum of three
- Loran C sensor - One
- GPS, GLS or GNSS sensor - Three including internal GPS
- RRS - One
- Engine Fuel Flow sensors - Two standard, four optional
- ADC - One
- DME sensor - One multi-channel digital
- VOR sensor - One digital
- TACAN sensor - One
- Radar Joystick (not displayed) input for waypoint definition
- DTU - One
- Doppler sensor - One
Long range navigation sensors in various combinations (up to five total)
- IRS or GPIRS - Maximum of three
- Loran C sensor - One
- GPS, GLS or GNSS sensor - Three including the internal GPS
- RRS - Maximum of two
- Engine Fuel Flow sensors - Two standard, four optional
- ADC - Maximum of two
- DME - Two multi-channel digital
- VOR sensor - Two digital
- TACAN Sensor - Two
- Radar joystick (not displayed) input for waypoint definition
- DTU - One
- Doppler sensor - 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, Primus 1000, or when an AN/ARN-118 TACAN, AN/ARN-154 TACAN, IMS ARCDU 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 (LSKs) that 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 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 LSKs whenever possible. In some cases a combination of LSKs 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 LSKs control the contents or nature of a list, an item from that list can be selected by using a reference number.
Some selections that change the active flight plan, guidance of the aircraft or stored database require confirmation. Confirmation is accomplished by pressing the LSK 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 LSK is pressed.

**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 LSKs 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 that causes 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.

When the system is on, pressing the ON/OFF DIM key will display a control window on the right side of the active page. BRIGHT, DIM, CANCEL, DISPLAY and OFF options are displayed and selectable using the LSKs.

**Note:** The BRIGHT/DIM provides display dimming only and does not dim the key backlighting. Dimming the key backlighting is accomplished with aircraft instrument dimming.

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

**DIM** - Pressing the LSK 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 LSK for CANCEL will cause the control window to extinguish from the active display page.
DISPLAY - Pressing the LSK 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 LSKs. (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 LSKs. 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 LSK for OFF will cause the CONFIRM OFF window to be displayed. This window has two options (CONFIRM OFF and CANCEL) selectable using the LSKs. 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. LSK [5L] will either be blank or display either a UNILINK or an AFIS prompt, if the system is configured for either of those options. 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 that cannot be marked by the cursor are not variable and cannot be changed by the normal input processes. Whenever 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

Ten function 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 a function key 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, VNAV or TUNE mode being displayed. The 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, the Navigation Database, and attached sensors that operate with the FMS. Although sensor control is completely automatic, selection and deselection of individual sensors can be accomplished using this function. The DATA function is also used to make additions, deletions, or changes to pilot-defined locations.
Data Page 1

Pressing the DATA key will allow access to the Data Pages as described below. Data Page 1 allows selection of Navigation Data, Pilot Data, Company Data, the Disk Menu, TAWS, Cabin Display, EFIS Display, UniLink or AFIS Menu, Master Crossfill and Maintenance Menu. CABIN DISP, EFIS DISP, UNILINK or AFIS and MSTR XFILL are installation dependent.

NAV DATA - The NAV DATA LSK accesses the Navigation Database. Refer to Section IV (DATABASE).

PILOT DATA - The PILOT DATA LSK accesses the Pilot Database. Refer to Section IV (DATABASE).

CO DATA - The CO DATA (COMPANY DATABASE) LSK accesses the CO DATA page. Refer to Section IV (DATABASE).

DISK - The DISK LSK accesses the Disk Menu page. Refer to Section IV (DATABASE).

TAWS - TAWS (Terrain Awareness Warning System) appears when TAWS is configured. This LSK accesses the TAWS pages. Refer to the TAWS Operator’s Manual.
Section II
Control & Display

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

**Note:** When a cabin display is not configured in the FMS, the CABIN DISP LSK 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 might differ from that shown below. From one to six messages can be enabled, and their titles might differ from that shown. The following page is a typical example.

![Cabin Display Interface](image)

In this example, the TURBULENCE message is now playing, and CANCEL will remain displayed for the duration of the message, as defined during configuration of the FMS.
EFIS DISP - The EFIS DISP LSK accesses the EFIS Display Page. This page is only available in either a Collins Pro Line 4 800 or 4000 (Basic, Enhanced and CRJ) installation and allows control of the number of background waypoints that are displayed on the MFD. Refer to the EFIS operators manual.

UNILINK - The UNILINK LSK accesses the UniLink page when this option is configured. Refer to Section VIII (UniLink UL-60X) or Section IX (UniLink UL-70X).

AFIS - The AFIS LSK accesses the AFIS Menu Page when this option is configured. Refer to Appendix A.

MSTR XFILL - Pressing the MSTR XFILL LSK crossfills initialization, flight plan and fuel data from or to the other system in a multiple FMS installation. This prompt will not appear unless the system is configured for Master Crossfill. Refer to Section V (Operations).

MAINT - The MAINT LSK accesses the Maintenance Page.

CONFIG, STATIC TEST and DYNAMIC TEST options are available for installation checkouts. The MAINT LOG saves diagnostic history in nonvolatile memory. Pressing the PERF VER LSK will display the Performance Database Page when applicable.
S/W VERS - From MAINT Page 1/1, LSK [5L] accesses the S/W VERSIONS page.

The system software version numbers are displayed as follows (for information only):

- **FMC** - The system software version number. The basic software version number (e.g. 802.0) is followed by a decimal point and additional 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.
- **CDU** - The software version number for the Control and Display Unit.
- **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

Data Page 2 provides a synopsis of input sensor operation. The second line (following the page title) shows the most significant sensor and the quality factor (Q=) or (ANP/RNP=) associated with the FMS best computed position. Sensors that may be listed are:

<table>
<thead>
<tr>
<th>Navigation Mode</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS/DME</td>
<td>Valid GPS navigation data received, GPS sensor selected, more than 1 DME station received and DMEPOS variance less than 0.5 nm.</td>
</tr>
<tr>
<td>GPS</td>
<td>Valid GPS navigation data received and GPS sensor selected.</td>
</tr>
<tr>
<td>DME-DME</td>
<td>More than 1 DME station received and DMEPOS variance less than 2.2 nm.</td>
</tr>
<tr>
<td>DME-TACAN</td>
<td>1 DME and TACAN received and DMEPOS variance less than 2.2 nm.</td>
</tr>
<tr>
<td>LCS/TACAN</td>
<td>LCS valid and selected, TACAN data received and valid. DME-TACAN conditions are not met.</td>
</tr>
<tr>
<td>LCS-DME</td>
<td>LCS valid and selected, 1 DME station received and DMEPOS variance less than 2.2 nm.</td>
</tr>
<tr>
<td>TACAN</td>
<td>TACAN data received and valid. Conditions above not met.</td>
</tr>
<tr>
<td>DME-VOR</td>
<td>1 DME and VOR received and DMEPOS variance less than 2.2 nm.</td>
</tr>
<tr>
<td>DME</td>
<td>Only 1 DME station received and DMEPOS variance less than 2.2 nm.</td>
</tr>
<tr>
<td>LCS/IRS</td>
<td>LCS and IRS inputs received and valid. Conditions above not met.</td>
</tr>
<tr>
<td>LCS</td>
<td>LCS received and selected.</td>
</tr>
<tr>
<td>IRS</td>
<td>IRS inputs valid. Conditions above not met.</td>
</tr>
<tr>
<td>DOP</td>
<td>All other sensors are invalid or deselected and Doppler is available. (Heading and true air speed are required; they can be either manually entered or sensed.)</td>
</tr>
<tr>
<td>DR</td>
<td>TAS and HDG only valid sensor inputs.</td>
</tr>
<tr>
<td>NO SENSOR</td>
<td>No valid sensor inputs present and selected.</td>
</tr>
</tbody>
</table>
The estimate of position error is displayed under the NAV MODE sensor field. Refer to the Position Certainty portion of this section for a description of the quality factor (Q) and Required Navigational Performance/Actual Navigational Performance (RNP/ANP).

**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 read POSITION CORRECTING.

Next to the LSKs 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 the specified timeout period. Each sensor has a specified timeout period, but are usually 2-3 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, GLS, GNSS or GPS is in self test mode.

UNLOCK - Doppler is in unlock mode.

DGPS - GLS is receiving differential corrections.

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.

ALT - GPS (GPIRS), GNSS or GLS is in altitude aiding mode.

ACQ - GPS (GPIRS), GNSS or GLS is acquiring satellite data.

INIT - GPS (GPIRS), GNSS or GLS is initializing.

Each individual sensor's status page may be displayed by pressing the LSK corresponding to the desired sensor. From this sensor status page, the sensor may then be deselected or reselected by pressing the LSK corresponding to the SEL (select) or DESEL (deselect) option.
Data Page 3

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.

Pressing LSK [1L] will access the Define Position Page, allowing the pilot to directly enter the aircraft’s position. See Define Position Pages in the Database section of this manual.

When the LSK corresponding to one of the sensors is pressed, that sensor’s position is displayed in the upper right of the page and the position difference (broken into N-S and E-W components) is displayed just below the FMS position. The selected sensor will be displayed in small characters and its selection arrow will be removed from the display.

Data Page 4

This is a general purpose data page. If desired, manual entries may be made for heading, date, time and variation. A manual heading entry can is normally only 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 the heading source page from which optional heading source selections may be made. If the heading is input manually, (MAN) will be displayed. Refer to Section VII (Sensors and Interfaces) for more information.

**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. The date can be manually changed.

**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 Pages. There are normally three Navigation Pages; however, when another Navigation mode such as Approach or Heading is selected, there will be four or more pages, which are cycled through by pressing the PREV or NEXT keys.

Navigation Function

The Navigation function and pages display all the navigation data normally required by the pilot, 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 on 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; the current track and groundspeed; and the position certainty value.

When the current navigation leg is valid (that is, the TO waypoint is displayed on the Navigation 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 Navigation 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 appear. 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 appear. This will alert the pilot that the aircraft is proceeding on an extension of the last valid desired track from the last waypoint.
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 steadily. 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 twelve 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 flyover waypoint (delayed automatic leg change), the leg change will begin over the waypoint. When Selected Crosstrack is active, leg sequencing may occur early or late with small course changes of 20° or less. Automatic cancellation of Selected Crosstrack will occur when the course change is greater than 20°. If the Selected Crosstrack function is used, the flight crew should monitor aircraft flight path and the flight plan to manually cancel Selected Crosstrack prior to, and no later than, the next waypoint as required.

When Approach mode is entered, leg changes at the approach waypoints are automatic. In Approach mode, the WPT ALERT message becomes active and the WPT alert annunciator illuminates steadily five seconds prior to an automatic leg change. When the approach mode has been activated within 50 nm of the end-of-approach point (either the missed approach point or runway) and the required navigational aid 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.

**Estimate of Position Accuracy**

The FMS computes and displays an estimate of position uncertainty to advise the user of the system’s position accuracy. The estimate is the 95% probability that the FMS position is within a certain distance of the actual position.

The FMS can be configured to display the estimate of accuracy as a Quality (Q) factor or Actual Navigational Performance (ANP).
The Q factor 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.

ANP is also a measure of the system’s best estimate of error, calculated to allow for flight technical error, in hundredths of a nautical mile. For example, if ANP = 1.00 nm, then there is roughly a 95% chance that the FMS position is within 0.91 nm of the actual position.

The Required Navigation Performance (RNP) value is the limit to position uncertainty the system will allow for continued flight and are specified for each phase of flight. RNP values are derived from two sources: FMS default values or manual entry. Upon change of flight phase, the FMS automatically sequences to the appropriate default RNP value for that flight phase as shown in the following table.

<table>
<thead>
<tr>
<th>Flight Phase</th>
<th>RNP Limit</th>
<th>Q Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oceanic</td>
<td>6.0</td>
<td>60</td>
</tr>
<tr>
<td>Enroute</td>
<td>2.8</td>
<td>28</td>
</tr>
<tr>
<td>Terminal</td>
<td>1.0</td>
<td>10</td>
</tr>
<tr>
<td>Approach</td>
<td>0.5</td>
<td>5</td>
</tr>
</tbody>
</table>

**Note:** Manually entered RNP values override FMS default values.

A position uncertain message will be displayed when the Q/ANP value is greater than these Q/RNP limits.
TEMPORARY CHANGE


FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 2-19 in the Control and Display section.

REASON: To correct wind displayed on the Nav 1/3 page.

INSTRUCTIONS:

Replace the screen displays on page 2-19 with the following revised screens.

Q Configured

ANP/RNP Configured

Navigation Page 1 appears as shown below for the NASA T-38.
Navigation Page 1

The information presented on Navigation Page 1 correlates with the information displayed on the HSI. The page is accessed from any other 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 to select another lateral guidance mode.

Navigation Page 1 appears as one of the two pages shown below for all installations except the NASA T-38.

Navigation Page 1, Q Configured

Navigation Page 1, ANP/RNP Configured

Navigation Page 1 appears as shown below for the NASA T-38.

Navigation Page 1’s 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 identifier of the current FROM waypoint and the time of waypoint passage. Under the waypoint identifier the desired course, distance and estimated time enroute (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.

FR  (INTCPT)  CR5 143°  TO SUMMA  338°  185NM 0:37  NX PDT 13:51 APPR

XTE (E) L0.96 GS 426
WND 134°/101 G 0:06

FR  (INTCPT)  CR5 143°  TO SUMMA  338°  185NM 0:37  NX PDT 13:51 APPR

XTE (E) L0.96 ARRIVE
WND 134°/101 ANP 0:19
REMIS 1220LB RNP(M) 2:50
TEMPORARY CHANGE


FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 2-20 in the Control and Display section.

REASON: To clarify the description of the wind field.

INSTRUCTIONS:

Replace the WND paragraph on page 2-20 with the following.

WND – This field displays the filter wind direction and wind speed, in knots, as computed by the Nav function. Wind direction is differentiated with a “T” for True or a degree sign (°) for Magnetic. Wind direction is always True, regardless of the position of the panel mounted Mag/True selector switch, except while in Approach Mode. When operating in polar regions (between N72 and S60 degrees latitude), wind display remains in degrees True in Approach mode.
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**TO** - The identifier of the current TO waypoint and ETA. Under the TO waypoint is displayed the course, distance and ETE to the next (NX) waypoint. The following line displays the name of the NX waypoint and ETA.

**NX** - The identifier of the current NX waypoint and either the identifier of the reference waypoint, the ETA, the turn direction, or nothing, depending on leg type.

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

**HDG** - Pressing this LSK will access the Navigation Heading page.

**MNVR** - Pressing this LSK will access the Maneuver Definition page. From this page, PVOR, SXTK and Holding Patterns can be defined and activated.

**APPR or ARM APPR or ACT APPR or TUNE APPR or CANCEL APPR or MISSD APPR** - Pressing this LSK will access the FMS APPROACH mode if there is an approach programmed into the flight plan. If the approach geometry is invalid, only **APPR** will appear and this option will not be selectable. When the approach geometry is valid, the option becomes selectable. See the Operations section for detailed information on the approach options.

The following supplementary information appears below the line:

**XTK** - Crosstrack is the 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 crosstrack may be entered in this field.

**WND** - This field displays the filter wind direction and wind speed as computed by the Nav function. The first value displayed is the filtered wind direction in degrees and the second value is the filtered wind speed, in knots.

**DESTINATION/FUEL OVERHEAD (NASA T-38 ONLY)** - These fields are adjacent to LSK [5L]. They display the identifier of the final waypoint in the flight plan and the fuel overhead (from Fuel Page 2) for this waypoint. Units are displayed as either pounds (LB) or kilograms (KG), depending on which is selected on Fuel Option Page 1.

FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 2-21 in the Control and Display section.

REASON: To correct wind display on the screen graphic.

INSTRUCTIONS:

Replace the NAV 2/3 screen graphic on page 2-21 with the following.
GS (Non NASA T-38 Installations Only) - Displays current groundspeed.

ARRIVE (NASA T-38 Only) - Pressing ARRIVE, LSK [4R], accesses the Arrival Page. Refer to Arrivals - STARs and Approaches in the Operations section of this manual.

ANP/Q - If ANP/RNP is configured, this field displays the ANP value. If Q is configured, the Q value is displayed.

RNP - If ANP/RNP is configured, this field displays the RNP value. If the pilot manually enters a value for RNP, (M) is displayed next to the value indicating a manual entry. If no indication is displayed in parenthesis, the value is a system default value (refer to Position Certainty text in this section). To manually enter an RNP, press LSK [5R] to highlight the field, then enter the desired value. When Q is configured, LSK [5R] is inoperable.

Navigation Page 2

Navigation Page 2 is accessed by pressing the NAV key, then by pressing the NEXT key while Navigation Page 1 is displayed or the PREV key when Navigation Page 3 is displayed.

This page displays FR/TO/NX waypoint information and crosstrack, wind and groundspeed information similar to Navigation Page 1. In addition, headwind/tailwind, bearing to current terminator and track angle error are displayed.

<table>
<thead>
<tr>
<th>NAV 2/3</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR (INTCPT)</td>
<td>HDG</td>
</tr>
<tr>
<td>CRS 143°</td>
<td></td>
</tr>
<tr>
<td>TO SUMMA</td>
<td>MNVR</td>
</tr>
<tr>
<td>338° 185NM 0+37</td>
<td></td>
</tr>
<tr>
<td>NX PDT 13:51 APPR</td>
<td></td>
</tr>
<tr>
<td>XTK(E) L0.44 GS 350</td>
<td></td>
</tr>
<tr>
<td>HEADWIND 17 BRG 144°</td>
<td></td>
</tr>
<tr>
<td>WIND 156°/19 TKE L002°</td>
<td></td>
</tr>
</tbody>
</table>

HEADWIND/TAILWIND - Displays wind component.

BRG - Displays the bearing to the current terminator.

TKE - Track angle error is the difference between the aircraft actual track and desired track. For procedural heading legs, this field displays field heading error, which is the difference between actual heading and desired heading.
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Navigation Page 3

This page shows the FMS system position and position certainty associated with the FMS best computed position. Shown beneath the quality factor is the most significant sensor. For RNP/ANP configured systems, this line displays the RNP and ARP values.

Navigation Page 3 with Q Configured

Navigation Page 3 with ANP/RNP Configured

**FMS# POS** - Pressing either LSK [2L] or [3L] will access the Define Position Page for entry of present position coordinates.

**HOLD POS** - Pressing this LSK will access the Hold Position Page.

**UPDATE SENS** - Pressing this LSK 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 LSK will access Data Page 3.
VNAV KEY

The VNAV key provides access to the Vertical Navigation (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). VNAV altitudes at flight plan waypoints can also be programmed on the Flight Plan Pages.

DTO Key

The DTO key accesses the Direct-To (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

When the DTO page is displayed, a leg change from present position (PPOS) 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. If a DTO is activated during a Hold, the Hold is automatically cancelled and the DTO page is displayed. 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.
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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 pseudo-VOR (PVOR).

The right LSKs 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 Pseudo-VOR (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 PVOR radial.

**RETURN** - Pressing this LSK will return the display to Navigation Page 1.

**FUEL Key**

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

The FPL key is used to access the Flight Plan Pages, 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 or approach into the flight plan.

Empty Flight Plan Page

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

**UNILINK RTE** - If UniLink is configured and the UPLINK RTE option is enabled, UniLink Route option [2R] is displayed as an available option. Pressing LSK [2R] displays the UniLink Route Page. This page allows the user to request a flight plan from a ground host computer and to review, load, or reject an uplinked flight plan. Refer to either the UniLink UL-60X or UL-70X sections of this manual if applicable.

**COPY PLT RTE** - Pressing the COPY RTE LSK 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.

**COPY CO RTE** - If a Company Route Database is installed, COPY CO RTE is displayed as an option at LSK [4R]. Pressing this LSK displays the CO RTE Page

**XFILL** - Pressing this LSK will cause the flight plan to crossfill 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.
Normal Flight Plan Pages

The Normal Flight Plan Pages are accessed by pressing the FPL key when a flight plan has been defined. These 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. Other pages of the flight plan may be displayed by pressing the PREV or NEXT keys, as appropriate.

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 LSK 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 Options - When the cursor is placed over a waypoint, up to five options will appear in the right hand column.

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

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

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

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

OFSET - If the highlighted waypoint terminates a leg type that can have an altitude constraint, then OFSET is displayed. Selecting LSK
[5R] will display the Path VNAV page with the cursor over the corresponding vertical waypoint's offset field.

**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 Pages by using the PREV and NEXT keys. The Flight Plan Summary Page follows the last Flight Plan Page.

![FPL SUMMARY](image)

Manual true air speed (TAS) and fuel flow (FF) can be entered to show ETE and estimated fuel required. ETD (Estimated Time of Departure) can so 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. Refer to the Operations section of this manual for more information.
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Flight Plan Menu Pages

The Flight Plan Menu Pages are accessed from any Flight Plan 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 (through the DEPART option) or a STAR or Approach (through the ARRIVE option) into the flight plan, deletion of the flight plan, entry of wind information into the flight plan, activation of temperature compensation for approach altitudes (if configured) and inverting the flight plan.
PERF KEY

Pressing the PERF (Performance) key accesses the Performance Pages. These pages provide a synopsis of pertinent inflight performance information. There are three Performance options available, depending on aircraft configuration. If the Basic option is configured, there is one Performance page. If the Manual option is configured, there are two Performance pages. If the Advanced option is configured, there are four Performance pages. If configured for Manual or Advanced performance, refer to the AIRCRAFT PERFORMANCE SUPPLEMENT in the back of this section.

Performance Page 1 is identical in all three options. It is accessed in all three options by pressing the PERF key. The page is read-only; no entries can be made. An example is shown below.

Note: The number represented by “X” in the illustration will vary depending on which Performance option is configured. If Basic, X will equal 1; if Manual, X will equal 2; if Advanced, X will equal 4.
Section II
Control & Display

Performance Menu Page

The Performance Menu Page is accessible by pressing the MENU key from any of the Performance Pages.

![PERF MENU]

This page allows selection of various options for the takeoff, climb/cruise, and landing Performance functions; entry of information to calculate the Equal Time Point (ETP) and the Point of No Return (PNR); and selection of either Imperial or SI temperature and distance units.

TUNE KEY

Tune Operation

The Tune function is used for frequency management when any of the following are installed and/or configured:

- Radio Control Unit (RCU)
- Radio Tuning Unit (RTU)
- Pro Line 4 800 (Standard or FIAS)
- Pro Line 4 4000
- 709 DME and 711 VOR
- ARN-118 TACAN
- ARN-153 TACAN
- ARN-154 TACAN

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. Both 25 kHz and 8.33 kHz spacing is supported. If none of the equipment mentioned above is installed, this mode is not functional and the FMS screen will read “MODE NOT OPERATIVE”.

2-30
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 key.

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 LSKs 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 LSK for that radio.

The control window shows the selected radio, the active frequency, and up to four preset frequencies. When 8.33/25 kHz is configured, the frequency is displayed in thousandths. When 25kHz is configured, the frequency is displayed in hundredths. 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) LSK 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.
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.

The ATC LSK is used to gain access to control of the transponder codes. Preselects 3 and 4 are prefilled with codes 1200 and 7700.
Communication List Pages

Placing the cursor over any COM option (e.g., COM 1 or COM 2 in the previous illustration) on a Tune Page and then pressing the LIST key accesses the Communication List Pages.

The pilot can choose the desired communication frequency by entering its reference number. Information displayed on the pages is explained below.

**Tuning Flight Phase** - This field will display one of the following five states:

- **PRE DEPARTURE** - This flight phase becomes active either
  - upon FMS powerup, or
  - when, in the Landing flight phase, the active flight plan is changed.

The FMS will display airport communications from the closest database airport within 50 nm of present position.

- **DEPARTURE** - This flight phase becomes active when, in either the Pre Departure flight phase or the Landing flight phase, the aircraft transitions from On-Ground to In-Air.

If transitioning from the Pre Departure flight phase, the FMS will display the same airport communications as listed in the Pre Departure flight phase.

If transitioning from the Landing flight phase, the FMS will display airport communications within 50 nm of the point where the aircraft transitions from On-Ground to In-Air.

In both cases, selected enroute communications are also displayed.
ENROUTE - This flight phase becomes active either

- when in the Departure flight phase, the aircraft’s distance from the departure point becomes greater than 15 nm from the departure point AND is either greater than 40 nm from the arrival point or a flight plan is not active, or
- when in the Arrival flight phase, the active flight plan is changed.

The FMS will display enroute communications along the flight path based on present position. If a flight plan is active, the FMS will also display airport communications from the flight plan’s destination airport.

ARRIVAL - This flight phase becomes active when, in either the Departure or the Enroute flight phase, the aircraft is In-Air and less than 40 nm from the arrival point.

The FMS will display airport communications from the flight plan’s destination airport. If the arrival point is not an airport, the FMS will display airport communications from the closest airport in the Navigation Database within 50 nm of the arrival point.

LANDING - This flight phase becomes active when, in either the Departure, the Enroute or the Arrival flight phase, the aircraft transitions from In-Air to On-Ground.

The FMS will display airport communications from the closest database airport within 50 nm of present position.

Airport Identifier or FIR/RDO Indicator - Either an airport identifier or a Flight Information Region Radio (FIR/RDO) indicator, depending on whether the listed communication is airport or enroute.

Communication Type - The following table lists all communication types.

<table>
<thead>
<tr>
<th>Communication Type Acronym</th>
<th>Communication Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC</td>
<td>Area Control Center</td>
</tr>
<tr>
<td>ACP</td>
<td>Airlift Command Post</td>
</tr>
<tr>
<td>APP</td>
<td>Approach Control</td>
</tr>
<tr>
<td>ARR</td>
<td>Arrival Control</td>
</tr>
<tr>
<td>ASO</td>
<td>Automated Surface Observation System</td>
</tr>
<tr>
<td>ATI</td>
<td>Automatic Terminal Information System (ATIS)</td>
</tr>
<tr>
<td>AWO</td>
<td>Automatic Weather Observing System</td>
</tr>
<tr>
<td>Communication Type Acronym</td>
<td>Communication Type</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>CLD</td>
<td>Clearance Delivery</td>
</tr>
<tr>
<td>CPT</td>
<td>Clearance Pre-Taxi</td>
</tr>
<tr>
<td>CTA</td>
<td>Control Area</td>
</tr>
<tr>
<td>CTL</td>
<td>Control</td>
</tr>
<tr>
<td>DEP</td>
<td>Departure Control</td>
</tr>
<tr>
<td>DIR</td>
<td>Director (Approach Control Radar)</td>
</tr>
<tr>
<td>EFS</td>
<td>Enroute Flight Advisory Service</td>
</tr>
<tr>
<td>EMR</td>
<td>Emergency</td>
</tr>
<tr>
<td>FSS</td>
<td>Flight Service Station</td>
</tr>
<tr>
<td>GND</td>
<td>Ground Control</td>
</tr>
<tr>
<td>GTE</td>
<td>Gate</td>
</tr>
<tr>
<td>HEL</td>
<td>Helicopter</td>
</tr>
<tr>
<td>INF</td>
<td>Information</td>
</tr>
<tr>
<td>MUL</td>
<td>Multicom</td>
</tr>
<tr>
<td>OPS</td>
<td>Operations</td>
</tr>
<tr>
<td>RDO</td>
<td>Radio</td>
</tr>
<tr>
<td>RDR</td>
<td>Radar</td>
</tr>
<tr>
<td>RFS</td>
<td>Remote Flight Service Station</td>
</tr>
<tr>
<td>RMP</td>
<td>Ramp/Taxi Control</td>
</tr>
<tr>
<td>RSA</td>
<td>Airport Radar Service Area (US Class C Airspace)</td>
</tr>
<tr>
<td>TCA</td>
<td>Terminal Control Area (US Class B Airspace)</td>
</tr>
<tr>
<td>TMA</td>
<td>Terminal Control Area</td>
</tr>
<tr>
<td>TML</td>
<td>Terminal</td>
</tr>
<tr>
<td>TRS</td>
<td>Terminal Radar Service Area</td>
</tr>
<tr>
<td>TWE</td>
<td>Transcribed Weather Broadcast</td>
</tr>
<tr>
<td>TWR</td>
<td>Tower</td>
</tr>
<tr>
<td>UAC</td>
<td>Upper Control Area</td>
</tr>
<tr>
<td>UNI</td>
<td>Unicom</td>
</tr>
<tr>
<td>VOL</td>
<td>VOLMET</td>
</tr>
</tbody>
</table>
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QUICK REFERENCES

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INTRODUCTION

This section contains information regarding the Performance Database, Checklist Database, Offline Flight Planning Database, Navigation Database, Pilot-Defined Database and Company Routes Database. A data transfer unit (DTU) is used to load databases into the FMS. All databases involve the same instructions for loading. The Navigation Database loading procedures are provided in this section and all other databases may follow these instructions for loading.

A Check All procedure is conducted on the Navigation Database and any other pilot-defined data to ensure consistency. Information in the Pilot-Defined Database and FMS flight plan disks inconsistent with the Navigation Database will be modified or deleted.

Performance Database

Certain aircraft may be configured for advanced performance options, for which a Performance Database is available. The performance database is loaded into the FMS via the DTU. With the Performance Database loaded, the FMS will compute and display takeoff and landing speeds, as well as takeoff, climb and cruise engine settings. A supplement is provided for these aircraft and is inserted into the back of the FUEL AND PERFORMANCE Section.

Checklist Database

A Checklist Database 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, then loaded into UASC’s FMS via the DTU.

Flight Planning Data

Offline PC-created flight plan data can be loaded into the FMS via the DTU. Types of flight plan data include standard instrument departures (SIDs), standard terminal arrival routes (STARs), approaches, airports, runways, company routes, pilot routes, pilot waypoints and tactical waypoints.

FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 4-2 in the Database section.

REASON: FMS SCN 802.3/902.3 suppresses the “NEW MAINT LOG EXISTS” message upon landing.

INSTRUCTIONS:
Add the following NOTE immediately after the first paragraph in the Maintenance Data section.

NOTE: In SCN 802.3/902.3 and higher, this message is not automatically displayed upon landing.
Maintenance Data

The FMS stores a diagnostic history of all configured sensors. Whenever a sensor failure is detected, a maintenance log is created automatically. The crew can also create a manual maintenance log. Automatic maintenance log entries will only be made during flight but manual entries can be made in the air or on the ground. The creation of a maintenance log is indicated one minute after touchdown by the appearance of a “NEW MAINT LOG EXISTS” message.

Access to the maintenance log is gained from Data Page 1 by one of the following two methods:

- Pressing MAINT, line select key (LSK) [5R], to display Maintenance Page 1
- Pressing MAINT LOG, LSK [1R]

The maintenance log can be downloaded to a disk via the DTU, which can then be read into a standard word processor. The log indicates whether it was created automatically or manually. Each log contains a status label indicating the nature of failure.

Interpretation of the diagnostics is contained in the applicable Technical Manual.

Maintenance Data Downloading

The following procedure is for downloading maintenance data to a disk via the DTU:

1. Press the DATA key to display Data Page 1.
2. Press DISK, LSK [4L], to display the Disk Menu Page.
3. Press MAINT DNLD, LSK [2R]. The Maintenance Download Page will appear and the ‘CHECKING DISK’ message will appear on the page. If the disk is properly formatted and empty, the maintenance data download will begin. Because the data is converted to ASCII as it is downloaded, it could take up to ten minutes to download. Should the Disk Error Page appear, follow the prompts to correct the error. The “COMPLETE” message will appear after the download is complete.
4. Remove the disk from the DTU.
5. Open the file in a PC text editor program as ASCII type file (i.e., .txt extension).
NAVIGATION DATABASE

NOTICE

All data contained in both the worldwide and regional Navigation Databases are 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 disk format. While every effort is made to ensure that the stored data is accurate, it is the pilot’s responsibility and prerogative to refer to Jeppesen’s charts or other publications in order to verify the accuracy of the data that is to be used.

Navigation data consists of airports, intersections, VOR and NDB navigational aids (navaids), plain language descriptions of airports, high and low altitude airways, SIDs, STARs, approaches and runway coordinates.

The FMS provides the plain language or geographical name for all Navigation Database navaids and airports that it stores and uses. These plain language names will be provided to the pilot as a special LIST feature for airports, VORs and NDBs. Plain language names up to 15 characters in length are displayed on the LIST Page and up to 24 characters on the Waypoint Select Pages. This helps eliminate difficulty in correlating airports and navaid names with their identifiers. Many airports and navaids have no correlation with the named geographical location. North Platte (LBF) and Brunswick (SSI) are typical examples.

The database is a worldwide database, available with either ≥ 2000 feet runways, ≥ 4000 feet runways or ≥ 5000 feet runways. The database is also available as a North American helicopter region.

REASON: Revise the Approaches and Runways paragraph to further described Advanced Approach operation.

FILING INSTRUCTIONS: Insert this Temporary Change into Report No. 2423sv802/902, Section IV, adjacent to page 4-4. This Temporary Change replaces Temporary Change dated 16 March 2004, which should be removed and replaced with this Temporary Change.

INSTRUCTIONS: Revise the second paragraph under Approaches and Runways on page 4-4 with the following.

The following approach types are included in the database: ILS, LOC, BC, VOR, VOR/DME, VOR/DME/RNAV, RNAV, TACAN, NDB, GPS and GLS. The letter “A” preceding an approach listing in the database indicates the approach is Advanced. Advanced Approaches are supported when the FMS is configured to use roll command steering during approach guidance. If an FMS is configured for deviation steering, such approaches will be advisory only. The letter “D” preceding an approach indicates the approach has been deleted. The letter “I” preceding an approach indicates the approach is invalid. The letter “G” following an approach listing in the database indicates that GPS is retained for approach guidance.
All databases 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 worldwide.

**NDBs** - The station identifier and geographic coordinates for all NDB stations.

**Airports** - The airport identifier and geographic coordinates for all airports having at least a 2000 foot, 4000 foot or 5000 foot hard surface runway and an instrument approach procedure.

**Approaches and Runways** - These include approaches, approach transitions, missed approach procedures and runways. The approaches are coded with the path terminator type of procedural legs found in SIDs and STARs. 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 required navaid. The runway landing thresholds are defined with latitude and longitude coordinates to 0.001 minute, and touchdown elevation to the nearest foot.

The following approach types are included in the database: ILS, LOC, BC, VOR, VOR/DME, VOR/DME/RNAV, RNAV, TACAN, NDB, GPS and GLS. The letter “G” following approach listing in the database indicates that GPS guidance is either approved or required to fly 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 ending point are entered, all navajids and intersections between these two points will be loaded into the flight plan. This procedure is repeated to completely define the airway routing.

**Intersections** - The geographic coordinates of all enroute and terminal area intersections, waypoints and turning points.

**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** - SIDs and 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 chosen. 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.

**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 might 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 might 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 otherwise directed by air traffic control (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 Database*. These rules are adhered to strictly by the industry in attempting to translate procedures into an electronic navigation database. Not all situations might be covered, or the correct application of the rules might produce confusing results.
The procedures for a SID or STAR containing a RADAR vector are listed below.

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 ensure that the correct heading is coded and followed by a (VECTOR) leg. If this is not the case, be prepared to navigate by means other than FMS.

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.
Navigation Database Loading

The Navigation Database is updated through the DTU and is contained on one disk. The entire Navigation Database is reloaded at each update. The disk is dated and should be verified as current. Gaps might occur in stored routes when a new database containing revised waypoints is loaded.

Dual Cycle Navigation Database Loading

The FMS has two memory banks for navigation data. This feature allows a future (not yet effective) database to be loaded and stored until its effective date. The memory bank used is referred to as the active bank and the memory bank not being used is the inactive bank. Selection of an active bank can be accomplished in two ways, either manually or automatically at power up.

Automatic selection upon powerup is performed by the FMS, which checks the database expiration date against the current date and time. When a database expires, its status becomes inactive and the next cycle database becomes the active database.

Note: During automatic selection, the FMS defaults to 0901 UTC as the effective time on the effective date as established by the US Federal Aviation Administration and other civil aviation authorities. However, some civil authorities use 0001 UTC as the effective time for database information. If so, the next database cycle must be manually selected for activation between 0001 UTC and 0901 UTC on the effective date.

FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 4-10.

INSTRUCTIONS: Replace the Loading Data Base Disks section with the following text.

1. Press the DATA key for Data Page 1/4.

   DATA 1/4
   ─── NAV DATA ───
   ─── PILOT DATA ───
   ─── DISK ───
   ─── HOLD POS ───


   DISK MENU
   ─── DISK CONTENTS ───
   ─── DISK LOAD ───
   ─── SAVE ───
   ─── START DATA RECORDING ───
   ─── FORMAT DISK ───

3. Insert the Navigation Database zip disk into the DTU-100.

**Note:** In multiple FMS installations, press the DISK LOAD line select key on each FMS to load data base in both FMSs.

5. The DISK LOAD Page will display after the FMS has checked for the disk type.
6. Select LOAD, LSK [5L]. A screen displays “ERASING MEMORY”, which should be expected as the FMS must clear the memory before loading the data base. The data base load status, indicated by percent complete, is then displayed.

**Note:** In multiple FMS installations, press the LOAD line select key on each FMS to load data base in both FMSs. This may be accomplished at any time while the data base is loading in the first FMS.

**Note:** Do not disturb the DTU-100 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.
After the data base has completed loading, the FMS will test the data for corruption. When testing is complete, a screen similar to the following will appear.

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.

7. 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.
Section IV
Database

To manually select an active database, access DATA/NAV Page 2. This page is accessed from Data Page 1 by pressing NAV DATA, LSK [1L], to display DATA/NAV Page 1, then by pressing the NEXT key.

DATA/NAV Page 2 displays the active and inactive memory banks. An ACTIVATE prompt will appear on the inactive side of the page. The inactive bank becomes active by selecting ACTIVATE, LSK [1L] or [1R], twice. The FMS will then perform a self test and return to the Initialization Page. The revision letter for the active database and database region is displayed only when included in the navigation data. Text at LSKs [4R] and [4L] provide additional description of the database if required.

Loading Database Disks
1. Press the DATA key for Data Page 1.

2423sv802/902 4-11

DISK MENU

DISK CONTENTS
DISK LOAD
SAVE
START DATA RECORDING
FORMAT DISK

3. Insert the Navigation Database zip disk into the DTU.


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

5. Press LOAD, LSK [5L]. The following page will appear. Load status indicated by percent complete will display as the database loads.

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

Note: Should an error preventing successful completion of the load occur, a message will appear on the Disk Load Page.

CAUTION: PRESSING CANCEL, LSK [5R], AT ANY TIME WILL ABORT THE DATABASE LOAD. THIS ACTION WILL ERASE THE NAVIGATION DATABASE.
After the database has completed loading, the FMS will test the data for corruption. When testing is complete, a page similar to the following will appear.

If applicable, press LOAD NEXT, LSK [5L], to load the Company Routes Database. Otherwise, proceed as follows.

**Note:** If disks are loaded prior to their effective date or after their expiration date, the CHECK ALL option at LSK [5R] described below will not appear. Instead, LSK [5R] will read RETURN.

6. Press CHECK ALL, LSK [5R], if this option is displayed. This action will cause the loaded database to become the active database.

   If the CHECK ALL option is not displayed, press RETURN, LSK [5R], to return to the Disk Menu Page.
Database Status

Database Status Pages are available to display the current status of both the active and inactive database banks. They are accessed by the following procedure.

1. Press the DATA key for Data Page 1.

```
DATA 1/4

NAV DATA  CABIN DISP
PILOT DATA
CO DATA  UNILINK
DISK     MSTR XFILL
TAWS     MAINT
```

2. Press NAV DATA, LSK [1L], for DATA/NAV Page 1.

```
DATA/NAV 1/2

SID       WPT IDENT
STAR      30-OCT-03
APPROACH WORLDWIDE
RUNWAY    2000 FT
AIRWAY    RETURN
```
3. Press the NEXT key for DATA/NAV Page 2.

Note: Pressing ACTIVATE, LSK [1L] or [1R], twice manually activates the inactive database. Note that this will result in a complete restart of the FMS.

4. Press DB STATUS, LSK [5L], for Database Status Page 1. This page shows the status of the active database.

The status is displayed for each type of data as follows:

PASS - Database checked and all areas of a particular type are good.

FAIL - Database checked and any one area of a particular type has failed.

NONE - No records found or disk not loaded.

5. Press the NEXT key for Database Status Page 2. This page shows the status of the inactive database.

6. Press RETURN, LSK [5R], to return to DATA/NAV Page 2.
Loading Errors / Messages

The system provides annunciation of errors than can occur during the update process and therefore prevent successful completion of the database load procedure. Errors are displayed as shown below.

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

CANNOT FORMAT DISK - The DTU detects that the disk is write protected.

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.

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 database that is too large for the available memory.

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

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

DISK ERROR: DISK NOT PRESENT - No disk is detected by the DTU when accessed, or the disk is not formatted.
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 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 perform a Pilot Database save or maintenance download, and the disk already contains at least one DOS file.

DISK READ OR WRITE ERROR - An attempt is made to read or write to the disk, and has encountered an error.

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.

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

EMPTY DISK OR NON-FMS DISK - An attempt is made to perform a Disk Contents or Disk Load, and the disk does not contain a header file.

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

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 file is not compatible with the FMS software version.

LOAD CANCELLED - The loading operation has been cancelled on the FMS being viewed.

MUST FIRST UPDATE NAV DATABASE BEFORE THIS COMPANY ROUTE DATABASE CAN BE LOADED - An attempt is made to load a Company Route Database before the Navigation Database of the same cycle is loaded.

MUST FIRST UPDATE NAV DATABASE BEFORE THIS PLT DATABASE CAN BE LOADED - An attempt is made to load a Pilot-Defined Database that is more recent than the one currently stored.
TEMPORARY CHANGE

Manual Affected

Filing Instructions
Insert this Temporary Change adjacent page 4-17

Purpose
To emphasize the existence of non-unique identifiers.

Instructions
Add the following text at the bottom of page 4-17 after the last bullet under Waypoints.

NOTE: The navigation data base contains a number of non-unique identifiers (i.e., multiple items using the same identifier). VORs and NDBs often occur with the same identifier at the same or nearly the same location. Airports and enroute waypoints also sometimes occur with the same identifier at the same location.

WARNING: AIRCREWS MUST USE EXTREME CAUTION TO MAKE SURE THEY ARE SELECTING THE DESIRED ITEM. BECAUSE THE NAVIGATION DATA BASE HAS NUMEROUS DUPLICATE IDENTIFIERS, THE CREW HAS THE ULTIMATE RESPONSIBILITY OF PROPERLY IDENTIFYING THEIR SELECTED ITEM TO ENSURE IT IS CORRECT.
MUST PERFORM A CHECK ALL - The CANCEL prompt has been selected prior to selecting CHECK ALL.

POWER FAIL - A power failure has interrupted the operation.

Navigation Database Interrogation

Waypoints

Any waypoint in the Navigation Database is opened for interrogation by typing its identifier on the Database Menu Page. The following information is available for each identifier in the database:

Note: The data in the Navigation Database 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 navaids, 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 navaid, if the identifier is a navaid, will be displayed as VOR, DME, NDB, VOR/DME, TACAN, VORTAC, or ILS/DME as applicable.

• 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, multiple pages will be displayed next to the type of identifier in X/Y format. For example, 1/2 indicates the data displayed is for the first of two locations with the same name. The value 1/1, if displayed, indicates the location/identifier is unique.

Note: The Navigation Database 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, enter the navaid identifier, 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, enter 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.

**Flashing Identifiers and Route Elements**

Navigation Database items used in defining pilot data are checked for movement and deletion when the Navigation Database is loaded. A flashing identifier or element signifies that, subsequent to the time the route was created, it has been moved or otherwise affected by a Navigation Database change during an update process.

If an approach waypoint moves 0.1 to 0.25 arc minute, the affected airport, approach, transition identifiers and leg terminators will flash. If the waypoint moves more than 0.25 arc minute or is not found, the affected airport, approach and transition identifiers will flash, and leg terminators will be replaced with a flashing *GAP*.

If a waypoint or runway used in a final approach is moved or deleted, the pilot approach is deleted. Deleted approach identifiers will flash and be preceded with a “D” on the Pilot Approach Directory Page.

If a SID or STAR waypoint moves 0.25 to 0.5 arc minute, the affected airport, runway, SID/STAR, transition identifiers and leg terminators will flash. If the waypoint moves more than 0.5 arc minute or is not found, the affected airport, runway, SID/STAR and transition identifiers will flash, and a flashing *GAP* is inserted in pilot routes containing SIDs/STARs and flight plans.

If a Navigation Database waypoint in a pilot route moves 0.5 to 1.4 arc minute, the affected route identifier and leg terminator will flash. If the waypoint moves more than 1.4 arc minute or is not found, the route identifier will flash, and a *GAP* will be inserted into the pilot route.

To correct a flashing waypoint, place the cursor over the waypoint and press ENTER. To remedy a flashing *GAP*, reenter the waypoint if it is still in the Navigation Database, then delete the *GAP* from the route or edit the flight plan to establish a new routing.
Terminal Procedures

Pressing NAV DATA, LSK [1L] on Data Page 1, will display DATA/NAV Page 1, from which SID, STAR, approach, runway and airway information can be reviewed and selected. The data selected under any menu will be for display only, and cannot be modified by the pilot. Information pertaining to the active Navigation Database is displayed on the right side of the page.

**SID**

Pressing SID, LSK [1L] on DATA/NAV Page 1, displays the NAV/SID Page. This page allows the pilot to enter an airport, runway, SID and transition to review.
SID LEGS - Pressing SID LEGS, LSK [5L] on the NAV/SID Page, will access the SID Legs Pages. These pages show all procedural legs that make up the selected SID. The following pages show the legs for KSEA Runway 34R, SUMMA6 SID with LKV transition.
STAR

Pressing STAR, LSK [2L] on DATA/NAV Page 1, displays the NAV/STAR Page. This page allows the pilot to enter an airport, runway, STAR and transition to review.

STAR LEGS - Pressing STAR LEGS, LSK [5L] on the NAV/STAR Page, will allow preview of the procedural legs that comprise the selected STAR. The following page shows the first few legs for KSEA Runway 34R, OLM4 STAR with BTG transition (the remaining legs are accessed by pressing the NEXT key):
Approach

Pressing APPROACH, LSK [3L] on DATA/NAV Page 1, displays the NAV/APPR Page. This page allows the pilot to enter an airport and approach to review.

**Note:** The following approaches are available to the pilot: GLS, GPS, NBD, ILS, BC, LOC, RNAV, VOR and TACAN. Any other approach type is not displayed.

**APPR LEGS** - Pressing APPR LEGS, LSK [5L], displays the Approach Legs Page, which allows viewing of pertinent approach information and previewing of the waypoints in the approach. An example of the first Approach Legs Page is shown below.

Approach Page 1 displays the following information:

**APPROACH (LSK [1L])** - This field displays the airport identifier, approach type and runway number.

**FACILITY (LSK [2L])** - This field displays the facility identifier if one is supplied by the database. If one is not supplied, this field is blank.

**FREQUENCY (LSK [3L])** - If the approach type is GLS, this field displays the channel identification. If not GLS and a facility is defined, this field displays the frequency or channel for that facility. If not GLS and a facility is not defined, this field displays only dashes.
TEMPORARY CHANGE


FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 4-23 in the Operations section.

REASON: Add further information about the GPS Approval field on Approach Plan Page 1.

INSTRUCTIONS:

Revise the last paragraph with the following.

GPS REQUIREMENT/APPROVAL - If GPS is required for this approach, the field displays GPS REQD. If GPS is not required, but the GPS sensor is retained at approach activation, this field displays GPS APRVD. Otherwise, this field is blank.

NOTE: Localizer-based approaches retain the GPS sensor during approach, but do not use GPS for final approach guidance and therefore will not display GPS APRVD. Refer to Approach Types in the Arrivals section for more information.
INBOUND COURSE (LSK [4L]) - This field displays the inbound course of the leg to the end of approach (EOA). However, if the leg to the EOA is an RF leg, this field displays only dashes.

GPS REQUIREMENT/APPROVAL (LSK [1R]) - If GPS is required for this approach, the field displays GPS REQD. If GPS is approved for this approach, the field displays GPS APRVD. Otherwise, this field is blank.

FAF (LSK [3R]) - This field displays the designation of the FAF waypoint.

EOA (LSK [4R]) - This field displays the designation of the EOA waypoint.

The remaining Approach Legs Pages list the waypoints in the approach.

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 missed approach point (MAP).
Runway

Pressing RUNWAY, LSK [4L] on DATA/NAV Page 1, displays the Navigation Runway Directory Page. This page allows the pilot to enter an airport runway to review.

Note: A pilot-defined runway is distinguished from a runway defined in the Navigation Database by a percent symbol, %, next to its identifier.

After selecting a runway, the Navigation Runway Definition Page displays all runway data.
Airway

Pressing AIRWAY, LSK [5L] on DATA/NAV Page 1, displays the Airways Page. This page allows the pilot to enter a VOR navaid and to review the high and low altitude airways accessible at the navaid.

Selecting the airway of interest will display all nav aids and intersections along the airway.
Intentionally left blank
PILOT-DEFINED DATA

The pilot can create and store a substantial amount of pilot-defined data, including waypoints, alignment waypoints, airports, runways, routes, approaches, SIDs and STARS. Additionally, it will include the reference databases that are associated with the SIDs, STARs, approaches and runways. This data can be saved on disk for future use and reloaded into the FMS. Instructions for saving and loading pilot-defined data are provided at the end of this section.

Pilot-defined data includes 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 entered, each pilot-defined waypoint will be retained in the database until it is manually removed.

**Pilot Alignment Waypoints** - 100 locations are reserved for pilots to input identifiers and geographic coordinates for the purpose of aligning long range navigational equipment. These alignment waypoints are intended for reference only and cannot be used for flight planning or enroute navigation.

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

**Pilot Runways** - The geographic coordinates and elevation of pilot-defined runways may be input and stored in the system’s non-volatile memory. The number of runways that can be defined and stored is limited to 100.

**Pilot Approaches** - The pilot can define VFR, VOR, TACAN, ILS, LOC, BC, GWS and RNV approach courses and glidepaths to pilot-defined EOAs. GPS, GLS and NDB approaches cannot be defined by the pilot. The number of approaches that can be defined and stored is limited to 100.

**Pilot Departures and Arrivals** - Pilot-defined departures and arrivals can be created using procedural legs. These are accessible in the same manner as the pre-stored SIDs and STARs described above. The FMS can store 100 pilot-defined departures and 100 pilot-defined 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. Refer to the Aircraft Flight Manual Supplement for the specific configuration of your aircraft.

Data Input

Before constructing a procedure or route the pilot needs to understand the basic data entry process. Data is manually entered in two steps. First, the data is entered onto the displayed page. Once correct, the 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 can be entered using any of three input processes: the Reference Number Input Process, the List Input Process, or the Direct Entry Process. Refer to the Operations Section of this manual for a detailed description and instruction for the input processes.

Pilot Data Page

This page allows the pilot to access the pilot-defined database. The database includes SIDs, STARs, approaches, runways, routes, company routes, airports, waypoints and alignment waypoints. For each of these selections except company routes, it is possible to define new data entries or delete existing ones. No modifications can be made to company route data. To access the Pilot Data Menu Page:

1. Press the DATA key to access Data Page 1.
2. Press PILOT DATA, LSK [2L].
Pilot-Defined SIDs

The PLT/SID Page is designed to allow the creation or deletion of SID database 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 and enroute transition or by editing (adding or deleting) legs in a common procedure.

This page is also used to gain access to specific SID procedures that require editing. When the SID is defined, pages will be appended to the first page, including the SID procedure legs (PLT/SID Pages 2 and 3). To access the PLT/SID Page, press SID, LSK [1L], on the Pilot Data Menu Page.

The page consists of required and optional fields. When the page is first accessed, 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 runways) are displayed on the left. When a runway is selected, the cursor will advance to the SID field. Any predefined SIDs will be displayed at this time 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.

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, transitions can be created. The TRANS field can be cleared by pressing the respective LSK while no data entries exist in that field.
The PLT/SID Menu Page is accessed from PLT/SID Page 1 by pressing the MENU key.

DIRECTORY - Pressing LSK [1L] displays a list of all airports that have pilot-defined SIDs associated with them.

DELETE - Pressing LSK [2L] enables the pilot to delete the selected SID.

COPY - Pressing LSK [3L] allows the pilot to create another SID under a different name with the same attributes as the selected SID.
PLT/SID Page 2 and following pages are accessed by pressing the NEXT and PREV keys from PLT/SID Page 1.

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 pilot to insert legs in the SID procedure. A leg can be inserted after any of the displayed legs by pressing the respective LSK. Similarly, an existing leg can be deleted or edited. In both cases, the Leg Path Selection Page will be accessed. PLT/SID Pages 3, 4, etc., are similar to the PLT/SID Page 2.

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. 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. An understanding of certain waypoint naming conventions, which are regulated under ARINC 424 Specification, “Navigation System Database”, is also recommended. 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 23 ways to define a path over the earth. ARINC Specification 424 defines the 23 different procedural leg types. The FMS uses all leg types 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, that leg will sequence only when the altitude constraint has been satisfied.

All other procedural legs are terminated in other ways (for example, a fix, a DME distance, an along-track distance, an intercept, a 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 (for example, crossing the fix, etc.). The following list shows the possible procedural legs used in the FMS:
<table>
<thead>
<tr>
<th>LEG PATH</th>
<th>LEG TERMINATOR</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heading To Altitude</td>
<td>VA</td>
<td></td>
</tr>
<tr>
<td>Heading To DME Distance</td>
<td>VD</td>
<td></td>
</tr>
<tr>
<td>Heading To Intercept</td>
<td>VI</td>
<td></td>
</tr>
<tr>
<td>Heading To Manual Terminator (Vector)</td>
<td>VM</td>
<td></td>
</tr>
<tr>
<td>Heading To Radial</td>
<td>VR</td>
<td></td>
</tr>
<tr>
<td>Course To Fix</td>
<td>CF</td>
<td></td>
</tr>
<tr>
<td>Course To Altitude</td>
<td>CA</td>
<td></td>
</tr>
<tr>
<td>Course To DME Distance</td>
<td>CD</td>
<td></td>
</tr>
<tr>
<td>Course To Intercept</td>
<td>CI</td>
<td></td>
</tr>
<tr>
<td>Course To Radial</td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>Course From Fix To Altitude</td>
<td>FA</td>
<td></td>
</tr>
<tr>
<td>Course From Fix To Along Track Distance</td>
<td>FC</td>
<td></td>
</tr>
<tr>
<td>Course From Fix To DME Distance (different fix)</td>
<td>FD</td>
<td></td>
</tr>
<tr>
<td>Course From Fix To Manual Terminator (Vector)</td>
<td>FM</td>
<td></td>
</tr>
<tr>
<td>Initial Fix (none)</td>
<td>IF</td>
<td></td>
</tr>
<tr>
<td>Procedure Turn Turn Fix</td>
<td>PI</td>
<td></td>
</tr>
<tr>
<td>DME Arc Radial From Fix</td>
<td>AF</td>
<td></td>
</tr>
<tr>
<td>Direct To Fix</td>
<td>DF</td>
<td></td>
</tr>
<tr>
<td>Track from Fix To Fix</td>
<td>TF</td>
<td></td>
</tr>
<tr>
<td>Hold To Altitude</td>
<td>HA</td>
<td></td>
</tr>
<tr>
<td>Hold To Fix</td>
<td>HF</td>
<td></td>
</tr>
<tr>
<td>Hold To Manual Terminator (Vector)</td>
<td>HM</td>
<td></td>
</tr>
<tr>
<td>Precision Arc Fix</td>
<td>RF</td>
<td></td>
</tr>
</tbody>
</table>
### Waypoint Naming Conventions

ARINC Specification 424 provides waypoint naming conventions used by Jeppesen in the database. Listed below are examples of the most common ones that might be encountered when accessing the Jeppesen database.

<table>
<thead>
<tr>
<th>Waypoint</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D235H</td>
<td>DME waypoint on radial 235° at 8 nm (H is 8th letter)</td>
</tr>
<tr>
<td>XYZ29</td>
<td>Point identified by “X” on enroute chart, 29 nm from the XYZ VOR</td>
</tr>
<tr>
<td>12ABC</td>
<td>Point identified by “X” on enroute chart, 112 nm from the ABC VOR</td>
</tr>
<tr>
<td>FF26</td>
<td>FAF for Runway 26</td>
</tr>
<tr>
<td>OM26</td>
<td>Outer Marker for Runway 26</td>
</tr>
<tr>
<td>MM26</td>
<td>Middle Marker for Runway 26</td>
</tr>
<tr>
<td>CF26</td>
<td>FACF for Runway 26 (usually located on final approach course about 2nm outside of FAF)</td>
</tr>
<tr>
<td>RW26</td>
<td>Threshold coordinates for Runway 26</td>
</tr>
<tr>
<td>MA26</td>
<td>MAP for Runway 26</td>
</tr>
<tr>
<td>R-345</td>
<td>DME Arc Terminator on radial 345°</td>
</tr>
</tbody>
</table>

#### Latitude/Longitude Named Waypoints (Oceanic)

<table>
<thead>
<tr>
<th>Waypoint</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5275N</td>
<td>52N 075W</td>
</tr>
<tr>
<td>75N70</td>
<td>75N 170W</td>
</tr>
<tr>
<td>5020E</td>
<td>50N 020E</td>
</tr>
<tr>
<td>50E20</td>
<td>50N 120E</td>
</tr>
<tr>
<td>5275W</td>
<td>52S 075W</td>
</tr>
<tr>
<td>52W20</td>
<td>52S 120W</td>
</tr>
<tr>
<td>6030S</td>
<td>60S 030E</td>
</tr>
<tr>
<td>60S30</td>
<td>60S 130E</td>
</tr>
</tbody>
</table>
Oceanic waypoints (OWPTs) are used for aircraft position reporting upon entry to and exit from oceanic control areas. In the Navigation Database, these waypoints have a five character identifier consisting of the latitude and longitude of the waypoint. The FMS converts this five character identifier to a seven character identifier for screens allowing the display of seven characters or more. For fields that allow less than seven character identifiers, the five character identifier is displayed. When manually entering a waypoint identifier, the FMS accepts either the five or seven character OWPT identifier.

For example, an oceanic waypoint with coordinates of 52:00:00 North Latitude, 75:00:00 West Longitude has the five letter identifier 5275N in the Navigation Database. When the FMS converts it to a seven letter identifier, it is displayed as 52N075W.
The Elements of a SID
Runway Transitions, Common Segment and Enroute Transitions

A SID can have several runway transitions and one or more enroute transitions. Between the two, there might be a common segment. The best way to illustrate these segments is to refer to the example SID (called UNCTST) shown below. 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 ATTEMPT TO FLY THIS SID UNDER ANY CIRCUMSTANCES.

Note there are two runway transitions: Rwy 11L and Rwy 29R. Each of these transitions uses a unique string of procedural legs to navigate to the VAINE intersection. At VAINE, the common segment commences. The common segment 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.

**Note:** If a runway is deleted from the Navigation Database, any pilot-defined SID runway transition based on that runway will also be deleted.
Defining a SID

**Note:** This instruction set is for the demonstration pilot-defined SID described on the previous page, but may be referred to when defining any other pilot-defined SID.

1. Access the initial SID Definition Page by pressing the key sequence **DATA > PILOT DATA > SID**:

   ![SID Definition Page](image)

   2. Enter KTUS at LSK [1R] 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 database, press **RETURN, LSK [5R]**, to access the DATA/PLT Page, then press **RUNWAY, LSK [4L]**. Define all runways that will be used for the SID, then return to the SID Definition Page by pressing the key sequence **DATA > PILOT DATA > SID** and entering the airport identifier.

   3. Select the runway (29R is first in this example). The cursor will advance to the SID identifier field at LSK [3R].

   4. Enter the identifier of the SID, which in this example is UNCTST. The cursor will then advance to the Transition field.

   5. Enter SSO at LSK [4R]. Repeat this step to define the UNCTST.ELP (Rwy 11L and ELP).
Defining a Transition

**Note:** This instruction set is for the demonstration pilot-defined SID described on the previous pages, but may be referred to when defining any other transition.

The Rwy 29R transition involves the following leg types:

- Heading to Altitude (Hdg 303° to 3050 ft)
- Course from Fix to Along Trk Distance (Crs 303° from TUS to DME 8.0, at or above 4200 ft)
- Heading to Radial (Lt turn Hdg 140° to TUS R-225°)
- Direct to Fix (Direct to VAINE intersection)
1. From PLT/SID Page 1, select SID LEGS, LSK [5L], to display the SID Legs Page. Initially, this page is blank.

   ![PLT/SID Page 1/1M](image)

2. Press LSK [1L]. The following Leg Path Page will appear:

   ![LEG PATH](image)

3. Since the first leg is a Heading to Altitude, press HDG, LSK [3L]. The LEG TERM HEADING TO Page will then appear:

   ![LEG TERM HEADING TO](image)
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4. Press ALTITUDE, LSK [3L]. The HDG - ALT Page will then appear. Enter the heading and altitude in each field as shown.

   HDG-ALT
   ┌─────────────┐ ┌─────────────┐
   │ HDG         │ TURN DIR      │
   │ 303°        │               │
   │ TO ALT      │               │
   │ 3050FT      │               │
   │ IDENTIFIER  │ SEGMENT       │
   │ (3050FT)    │               │
   │ ←ACCEPT     │ RETURN        │

5. After entering the altitude, the SEGMENT Page will appear. Press RWY TRAN, LSK [1L].

   SEGMENT
   ┌─────────────┐
   │ ←RWY TRAN   │
   │ ←COMMON     │
   │ ←ENRTE TRAN │
   │ RETURN      │

6. Press ACCEPT to validate this leg. The display will return to the SID Legs Page with the first leg as shown (the ‘R’ in the left column denotes runway transition leg):

   PLT/SID 1/1
   ┌─────────────┐
   │ HDG 303°    │
   │ R 1 (3050FT)│ 3050       │
   │ 2           │
   │ RETURN      │

The remaining three legs of the Rwy 29R transition are entered in a similar manner by selecting the Course From Fix To Along Track Distance, Heading to Radial, and Direct To Fix Pages as shown below. Each one is defined as a runway transition leg.

- 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 LSK next to ALT CONST. A page will appear allowing selection of ‘@’, ‘↑’, ‘↓’ or ‘↓↑’. ‘@’ indicates ‘at’ altitude, ‘↑’ indicates ‘at or above’; ‘↓’ indicates ‘at or below’ and both arrows indicate an altitude window constraint. Press LSK [2L] and enter 4200.
- Heading to Radial (Left turn to Heading 140° until intercepting the TUS 225° radial).

**Note:** To specify 'left turn', press TURN DIR, LSK [2R]. A page will appear allowing selection of LEFT, RIGHT or NONE. Select LEFT.

- Direct to Fix (Direct to VAINE).
Defining a Common Segment

**Note:** This instruction set is for the demonstration pilot-defined SID described on the previous pages, but may be referred to when defining any other common segment.

The common segment legs are as follows:

- Track to Fix (VAINE to ILEEN)
- Heading to Intercept (Hdg 105° to Intercept)
- Course To Fix (Crs 065° to CIE)

These legs are defined similarly to the runway legs, except when the Segment Page appears, select COMMON, LSK [2R], for each leg. The resultant pages are shown below. On the SID Leg Page, the ‘C’ in the left column denotes a common segment leg.

![COMMON SEGMENT Diagram](image-url)
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- Track To Fix (VAINE to ILEEN)

- Heading To Intercept (HDG 105° to Intercept)

- Course To Fix (CRS 065° to CIE)
Defining an Enroute Segment

**Note:** This instruction set is for the demonstration pilot-defined SID described on the previous pages, but may be referred to when defining any other enroute segment.

The enroute segment leg is as follows:

- Track to Fix (CIE to SSO)

Select the Track to Fix display from the Leg Path Menu Page, and designate this leg as ENRTE TRAN. On the SID Leg Page, the ‘E’ in the left column denotes an enroute transition leg.
Adding Other Runway and Enroute Transitions

**Note:** This instruction set is for the demonstration pilot-defined SID described on the previous pages, but may be referred to when defining any other runway or enroute transition.

1. From the SID Legs Page, press RETURN, LSK [5R], to bring up the Departure Page.

2. Place the cursor over the RUNWAY field, and enter the number of the other runway for which transition legs are desired, in this case Rwy 11L.

3. Press SID LEGS, LSK [5L], to display the Procedural Legs Pages. Notice all runway transitions for 29R are missing, and the SID legs start at the VAINE intersection.
The runway transition legs for Rwy 11L must be inserted. These legs are as follows:

- **Heading to Altitude** (HDG 123° to 3250 feet)
- **Course to Fix** (CRS 123° to VAINE)
1. Press LSK [1L]. The Leg Path Page is displayed.

2. Select HDG. When the Leg Terminator Page appears, select ALTITUDE. Fill in the data fields with the appropriate information (Select RWY TRAN when the Segment Page appears).

After the initial leg is accepted, the display 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 does not match the next waypoint, in this case VAINE intersection. Ignore the gap at this time.
3. Press LSK [2L] from the SID Legs Page. 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 the segment. The resultant page will appear as follows:

![Diagram of CRS-FIX page]

4. Press ACCEPT. The page will return to the SID Legs Page. Notice the *GAP* has disappeared automatically. The Course-to-Fix (VAINE) now matches the next waypoint exactly.

![Diagram of PLT/SID page]

**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, which must be deleted.
Adding the Last Enroute Transition

1. From the Sid Legs Page, press RETURN, LSK [5R], to display the Departure Page.

2. Place the cursor over the TRANSITION field and press ENTER. Change the transition from SSO to ELP.

ENROUTE TRANSITIONS
3. Press SID LEGS, LSK [5L], to display Sid Legs Page 1.

4. Press the NEXT key to display Sid Legs Page 2. Notice the enroute leg from CIE to SSO has been eliminated, and the SID legs end at CIE.

Add the ELP transition after CIE by creating a Track Between Two Fixes leg segment from CIE to ELP and designate it an ENRTE TRAN segment. The last pages 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 key to display the page below.

2. Press DELETE, LSK [2L], to display the following page:

3. To delete the SID, press LSK [2L] once to highlight the line, then press a second time to complete the deletion.

   To delete the runway transition portion of the SID, press LSK [3L] once to highlight the line, then press a second time to complete the deletion.

   To delete the enroute transition portion of the SID, press LSK [4L] once to highlight the 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 in the pilot-defined SID portion of this section 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 are no runway transitions.

**Note:** A pilot-defined STAR is distinguished from a STAR defined in the Navigation Database by a percent symbol, %, next to its identifier.

Deleting a Pilot-Defined STAR

The process to delete a pilot STAR is similar to deleting a pilot SID.

1. Select the STAR using the key sequence DATA > PILOT DATA > STAR and entering the identifier of the STAR to be deleted.

2. Press the MENU key and follow the prompts for deleting the STAR.

- To delete the entire STAR with all transitions, press LSK [2L] once to highlight that line, then press a second time to complete the deletion.

- To delete the named transition, press LSK [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 the key sequence DATA > PILOT DATA > SID > MENU > DIRECTORY, and a list of airports will appear. Likewise, to view airports with pilot-defined STARs, press the key sequence DATA > PILOT DATA > STAR > MENU > DIRECTORY.

Note: A pilot-defined STAR or SID is distinguished from a NAV defined STAR or SID by a percent symbol, %, next to its identifier.

Copying a Pilot SID or STAR

To make a copy of a pilot SID (STAR):

1. Press the key sequence DATA > PILOT DATA > SID (STAR), select the airport, then enter the runway, SID (STAR) name and transition.

2. Press the key sequence MENU > COPY to display the PLT/SID (STAR) Copy Page:

3. Enter the new name for the copy SID (STAR) + all trans, or enter another valid runway under “COPY RW TRAN” to copy the same SID (STAR) with new runway transitions. A third option is to enter a new enroute transition under “COPY ENRTE TRAN.”
TEMPORARY CHANGE


REASON: To correct the number and location of waypoints allowed in Pilot-Defined approaches.

FILING INSTRUCTIONS: Insert this Temporary Change into Report No. 2423sv802/902, Section IV, adjacent to page 4-55.

INSTRUCTIONS: Revise the first paragraph under Pilot Defined Approaches on page 4-55 with the following.

Pilot-defined approaches are stored in the Pilot Database. Up to 100 approaches may be defined and stored. Each approach includes a FAF and an EOA. The EOA can be a runway threshold, touchdown point or a MAP. Up to 12 waypoints can be defined along the approach path, including the FAF and EOA. Additionally, a vertical flight path through the approach waypoints may be defined.
Pilot-Defined Approaches

Pilot-defined approaches are stored in the Pilot Database. Up to 100 approaches may be defined and stored. Each approach includes a FAF and an EOA. The EOA can be a runway threshold, touchdown point or a MAP. One or two additional waypoints can be defined along the approach path. Only one of the optional waypoints can be located outside the FAF, and only one can be located between the FAF and the EOA. Additionally, a vertical flight path through the approach waypoints may be defined.

Approaches are created and/or defined on Approach Definition Page 1, described later in this section.

The Pilot Approach (PLT/APPR) Page is accessed by selecting APPROACH, LSK [3L], from the DATA/PLT Page.

The PLT/APPR Pages provide a directory of all the airports with pilot approaches stored in the database. The number of PLT/APPR Pages is dependent upon the number of pilot-defined approaches that are stored (up to 100 pilot-defined approaches may be stored). The PREV and NEXT keys provide access to other PLT/APPR Pages.
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AIRPORT - Entering an airport identifier or entering the reference number of one of the listed airports in this entry field will change the listing to show approaches defined for the entered airport. If an airport identifier is not entered in LSK [1R], pressing LSK [2R] will display a list of all pilot database approaches. The APPR DEF (Approach Definition) LSK will be available only after entry of an airport identifier.

APPR - Entering the reference number of one of the listed approaches will prompt entry of transitions for the approach. Pressing APPR DEF, LSK [5L], after entering an approach reference number will display Approach Definition Page 1 for the entered approach. Selecting APPR DEF without entering an approach reference number will display an empty Approach Definition Page where the pilot can define an approach.

TRANS - Enter the reference number or identifier for a transition, if desired and available.

REASON: To further clarify the causes of an INVALID message when creating a pilot defined approach.

FILING INSTRUCTIONS: Insert this Temporary Change into Report No. 2423sv802/902, Section IV, adjacent to page 4-57.

INSTRUCTIONS: Revise the fourth paragraph under Pilot Approach Definition Page 1 on page 4-57 with the following.

INVALID: INVALID will appear when an approach contains an RF leg, and

- If the fix prior to the RF leg is not within 90 ft of the start of the RF leg, or
- The course into and out of the RF leg is not within 6° of the tangent course at the beginning and end of the RF leg, respectively.
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Pilot Approach Definition Page 1
Pilot Approach Definition Page 1 is accessed from PLT/APPR Page 1 by selecting APPR DEF after an airport has been entered. This page either prefills with information for an existing approach or appears empty to allow definition of a new approach. The page defines the designated navigation facility for which the approach is based, if applicable, and shows the basic lateral geometry from the FAF to the runway or MAP.

Under the page title is the name of the approach. No entries can be made on this line. The terms ADVANCED or INVALID might appear under the name of the approach.

ADVANCED: If the approach has an RF leg, or a turn of more than 6°, ADVANCED will appear.

INVALID: If the approach does not contain a FAF or an EOA, or if crosstrack error is greater than 90 feet, or if actual aircraft bearing differs from computed bearing by more than 6°, INVALID will appear.

Entries made on this page are the minimum required to define an approach. As each entry is made, the cursor will automatically advance to the next appropriate entry field when the ENTER key is pressed.

ARPT - The airport identifier. If a different airport identifier is entered (e.g., KTUS in the example page above), then all enterable fields will clear to allow definition of a new approach for that airport.

RUNWAY - Entering a runway designation will result in a search of the runway database for coordinates to use in defining an approach. If a nonexistent runway is entered, the display will automatically revert to the Runway Definition Page. If a different runway is entered (e.g., 16R in the example Page above), the APPR TYPE Page (discussed below) will display to allow section of the approach type for that runway.
When the field is highlighted, pressing the LIST key will display the Approach Runways List Page.

Entering the reference number of the desired runway will select that runway and advance the display to the APPR TYPE Page, discussed below. The pilot may also define a new runway by pressing the CREATE LSK [3R]. This will display the Runway Creation and Display Page, discussed under the Pilot-defined Runways heading in the Database section of this manual.

**TYPE** - Pressing TYPE, LSK [3L], will display the APPR TYPE Page. A RETURN option is presented to return the display to the original Page with no changes.

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

**Note:** Approach types that have already been defined for the current runway cannot be selected and appear in small font.

- **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.

- **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.

- **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.

- **GWS Approach** - In specific installations, the FMS interfaces to a GWS sensor currently in use only by the FAA for WAAS evaluation. There is no facility associated with a pilot-defined GWS approach. At approach activation, Approach Navigation is set valid. After 10 seconds, GPS status input from GWS is monitored for WAAS PA (Precision approach) to maintain Approach Navigation Valid. This option will not be available if a GPS-WAAS sensor is not configured.

- **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.

**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.

**LEG TO EOA** - If the leg to the EOA is not an RF leg and both the FAF and the EOA are defined, these fields display the computed inbound course and distance from the FAF to the EOA point; otherwise, these fields display only dashes.

If the runway’s latitude and longitude are undefined, the pilot can enter new values into these fields only when the FAF is defined and in the database.

If the runway’s latitude and longitude are defined, the pilot can enter new values into these fields only when the approach type is either VFR or GWS. For all other approach types, the pilot can enter new values into these fields only when the reference facility is defined.

**APPROACH VERTICAL STATUS** - If any flight path angle (FPA) in the approach exceeds the Approach FPA Limit or is a climb, this field displays (VERTICAL INVALID). Otherwise, if the altitude at either the FAF or the EOA is undefined, this field displays (VERTICAL UNDEFINED). Otherwise, this field is blank.

**APPR IN FPL** - If the approach is in the current flight plan (FPL), this field displays APPR IN FPL. Otherwise, this field is blank.
**FAC** - The identifier of the reference facility. This field is blank if the approach type is GWS. Otherwise, the field is capable of displaying the identifiers for:

1. TACANs and VORTACs for TACAN approaches
2. VOR/DMEs and VORTACs for RNV approaches
3. VOR navigational aids for VOR and VFR approaches
4. ILS localizers for ILS, LOC and BC approaches

When the field is highlighted, the LIST key will call up a list of the nearest reference facilities to the airport.

**FREQ** - The frequency of the reference facility. When the reference facility identifier is entered, the frequency defaults to the frequency listed in the database if the reference facility is found. The field is blank for GWS approaches.

**FAF** - The identifier of the FAF. 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 database. The LIST key may be used to call up a list of available waypoints that can be selected as the FAF.

If a runway has been previously defined in the runway database and the pilot makes no manual entry, a default identifier will be displayed when the inbound course and distance entries are made. The default identifier will be FAFXX where XX is the runway identifier (the directional designators “L”, “R” or “C” are dropped in this identifier configuration). The FAF may be passed over only if the runway has been previously defined and stored in the runway database. If the runway is not in the database, the FAF must be defined.

**EOA** - The identifier of the EOA. This field initially prefills with the runway identifier if the runway’s latitude and longitude are defined. When the FAF is defined and in the database, the LIST key may be used to call up a list of available waypoint identifiers that can be selected as the EOA.

If the inbound course and distance have been defined and are valid and the FAF is a database waypoint, the FMS computes the EOA using the course and distance from the FAF and this field displays MAXXX, where XXX is the runway identifier. Any subsequent modification to the EOA will clear all waypoints from the approach segment and reinitialize the approach to contain only the FAF and the
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EOA. Also, any subsequent modifications to the FAF in this condition will change the EOA back to the runway identifier.

**Pilot Approach Procedure Plan Pages**

The Pilot Approach Procedure Plan Pages are accessed by pressing the NEXT key from Pilot Approach Definition Page 1. These Pages list the waypoints in the approach.

![Image](image.png)

The number of Pages depends on the number of legs in the approach. Four legs are shown per Page; the last leg on one Page will be repeated as the first leg on the next Page. If applicable, additional information for each leg is shown in smaller font above the leg as follows:

- **AF** - Crosstrack in meters and path reference fix identifier
- **DF** - The word “DIRECT”
- **CA, CD, CF, CI and CR** - Course
- **FA, FC and FD** - Course and path reference fix identifier
- **FM** - Course
- **PI** - Path reference fix identifier
- **RF** - Crosstrack in meters
- **TF** - Track and distance to fix
- **VA, VD, VI, VR and VM** - Heading

Any altitude constraints associated with each leg terminator are also shown in addition to the information listed above. If the current TO leg terminator has an altitude constraint in the approach final segment, the computed flight path angle will also appear above the leg. Also on this line, the FAF and EOA waypoints are identified as such.

The pilot may enter a flight path angle at LSK [5L] as long as the following conditions are met:

1. The EOA has an AT (@) altitude constraint
TEMPORARY CHANGE


FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 4-63.

REASON: To clarify the Change Approach Data instructions.

INSTRUCTIONS: Add the following text after step 4 in the Change Approach Data section.

5. To edit field data, press the applicable left LSK. The Leg Path page is displayed.
6. Press EDIT, LSK [4R], to display the segment information page.
7. Press the applicable LSK of the field to be edited. Either the field will highlight, indicating direct entry of the new value, or a new page is displayed where entries may be made or selected from a list of options.
2. The entered flight path angle does not exceed the approach flight path angle limit.

3. The entered flight path angle does not cross below an AT OR ABOVE altitude constraint for the FAF.

Leg identifiers appear to the left of each leg. “T” is displayed if the leg is in the approach transition, “A” is displayed if the leg is in the approach, and “M” is displayed if the leg is in the missed approach.

**Change Approach Data**

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

**Note:** The APPR IN FPL message will appear at LSK [5L] on Pilot Approach Definition Page 1 if an attempt is made to change an approach that is installed in the flight plan.

1. Access the Pilot Database Page by pressing the DATA function key and the PILOT DATA LSK.

2. Access the PLT APPRS Directory by selecting the APPROACH LSK [2R].

3. Enter the reference number of the desired airport. 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 LSK to access Approach Definition Page 1. The NEXT key is used to access the Approach Procedure Plan Pages.

5. Use the LSKs 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.

**Note:** 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 the same airport.

Repeat the above procedure as necessary for all fields that are to be changed.
Pilot Approach Menu Page

The Pilot Approach Menu Page is accessed from the Pilot Approach Page by pressing the MENU key. The Pilot Approach Page is shown below on the left **before** an approach has been selected; if the MENU key is now pressed, the Pilot Approach Menu Page appears as below on the right.

Note that the only available option is DIRECTORY; the other two options are not selectable.

The Pilot Approach Page is shown below on the left **after** an approach has been selected and the approach is not in the current flight plan; if the MENU key is now pressed, the Pilot Approach Menu Page appears as below on the right.

Note that all options are now selectable.

If the selected approach is in the current flight plan, the Pilot Approach Menu Page appears as below.

Note that the DELETE option is not selectable and that the advisory APPR IN FPL appears at LSK [5L].
DIRECTORY - Selecting this option displays the Pilot Approach Directory Pages.

The number of Pages depends on the number of airports in the database with pilot-defined approaches. No entries can be made to this Page.

Note: Airport identifiers with percent signs (%) to the right designate pilot-defined airports.

DELETE - Selecting this option when available displays the Pilot Approach Delete Page. If a transition was also selected on the Pilot Approach Page, this page appears as shown below on the left. If a transition was not selected on the Pilot Approach Page, this page appears as shown below on the right.

Note that when a transition is not selected on the Pilot Approach Page, the option to delete only the transition at LSK [3L] is not selectable.

Pressing LSK [2L] twice will delete the approach and all its associated transitions from the Pilot Database and return the display to the Pilot Approach Menu Page.

Pressing LSK [3L] twice will delete only the selected transition from the Pilot Database and return the display to the Pilot Approach Menu Page.

WPT DEFN - Selecting this option displays the Pilot Approach Waypoint Definition Pages.
The number of pages depends on the number of waypoints in the approach. No entries can be made to this page.

These pages display the defining latitude and longitude for each waypoint in the approach. Depending on installation configuration, latitude and longitude can be displayed to tenths, hundredths, or thousandths; only the tenths configuration is shown above.

If required navigation performance (RNP) is defined in the Pilot Database for a waypoint, it is displayed above the longitude for that waypoint.
Pilot-Defined Runways

Pilot Runway Directory Pages

The Pilot Runway Directory Page(s) is accessed from the Pilot Database Page by selecting RUNWAY, LSK [4L]. When the page is first accessed, a list of all runways stored in the database will be presented alphabetically. The number of Pilot Runway Directory Pages available depends upon the number of pilot-defined runways in the database (up to 100 pilot-defined runways may be stored). The PREV and NEXT keys provide access to other Pilot Runway Directory Pages.

**AIRPORT** - Entering an airport identifier into this field will change the listing to show only those pilot-defined runways for the entered airport. Entering the reference number of one of the listed runways into this field will cause the Runway Creation and Display Page (PLT RNWY) with the associated runway data to be displayed.

**CREATE** - The CREATE LSK will only be available after entry of an airport identifier. Pressing the CREATE LSK will cause the Runway Creation and Display Page to be displayed. The Runway Creation and Display Page will have all fields blank except the ARPT entry field, which is prefilled.

**Note:** A pilot-defined runway is distinguished from a NAV defined runway by a percent symbol, %, next to its identifier.
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Pilot Runway Creation and Display Page

The Pilot Runway Creation and Display Page is accessed several ways:

1. From the Pilot Runways Directory Page by entering a runway reference number.
2. From the Pilot Runways Directory Page by selecting the CREATE option.
3. From the Approach Runways List Page by selecting the CREATE option.
4. From the Define Runway Page by pressing the RETURN option.
5. From the FPL and Pilot Route INFO function.

When making entries on this page, the cursor automatically advances to the next input field.

ARPT - The airport identifier. When accessed by methods 1 or 3 above, the AIRPORT field will be prefilled with information from the previous pages. If accessed by option 2 above, the entry fields will be blank.

The pilot can insert an airport identifier. If the identifier is not in the defined in the airport database, the Define Airport Page will be displayed.

RNWY NUMBER - The runway identifier. If the page is accessed from the Pilot Runways Directory Page, the runway will be prefilled from the information on that page.

The pilot may enter a runway number 1 thru 36 with or without an L, C, or R after the number or a single letter of the alphabet, as a runway identifier. If the entered number or letter is not in the Pilot or Navigation Runway Databases, pressing ENTER after entering a runway number will display the Define Runway Page.

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**Note:** The FMS will not allow pilot definition of runway identifiers that exist in the Navigation Database.

**RNWY HDG** - The runway heading. Once the runway’s latitude and longitude are defined, this field allows entries for a runway heading (000.0 thru 360.0 degrees). Headings will be magnetic if the pilot has selected magnetic and the FMS is within the MagVar region; otherwise, entries will be True. If the runway’s latitude and longitude are not defined, this field is unavailable for editing.

**ELEVATION** - The elevation of the runway in feet. Once the runway’s latitude and longitude are defined, the pilot may enter a runway elevation between –1500 and 64034 feet. If the runway’s latitude and longitude are not defined, this field is unavailable for editing.

**ACCEPT/DELETE/IN USE XXXX** - 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 database. When an existing runway is selected for review from the Pilot Runway Directory, the runway definition has not been modified, and the runway is not currently part of a SID, STAR or approach defined in the database, this field will display “DELETE”. With “DELETE” displayed, this LSK is used to remove the defined runway from the database. When first pressed, a cursor will cover the “DELETE” command. The LSK must be pressed a second time for confirmation of this command. If the runway is part of a SID, STAR or approach defined in the database, the field will read “IN USE XXXX,” where XXXX will read SID, STAR or APPR, as appropriate. In this case, LSK [5L] is inoperative.

**APPR END** - The coordinates displayed or to be input are the runway threshold or touchdown point coordinates. Pressing LSK [2R] will display the Define Runways Page.

**RNWY LENGTH** - The runway length. The pilot may enter a runway length between 0 and 32,766 feet for the selected runway.
Company Routes Data

Note: The term “Company Routes” is used to describe company airports and waypoints in addition to routes.

A company routes database can be created using Universal’s Offline Flight Planning Program and may be contained on up to four disks. Up to 2000 routes and 250,000 route elements can be stored. The actual number of routes and route elements depends on the size of navigation data stored in the FMS. Each route will consist of at least one but not more than 98 legs (route elements). Route elements refer to waypoints, airways and terminal area procedures (SIDs, STARs and Approaches) from the Navigation Database. Company defined waypoints and airports are also supported and can be loaded with the company routes database. Company routes can be given names of up to eight characters in length.

Company Route Directory Pages

The Company Route Directory Pages are accessed by selecting CO ROUTE, LSK [5L], from the Pilot Data Page. These pages allow the pilot to select a company route to review. The number of pages depend on the number of company routes in the directory.

SELECT ROUTE - Enter the reference number of the company route to review, then press ENTER to confirm. A valid entry will display the Normal Company Route Page for the associated route. An invalid entry will flash.

RTE NAME - Enter the 8-character of the identifier of the company route to review, then press ENTER to confirm. Entering a valid company route identifier will display the associated route on the Normal Company Route Page. If more than one match for an entered company route identifier is found, the Company Routes Directory Page will display all routes using that identifier. An invalid entry will flash.
REF FIX - Enter a reference fix identifier in this field, either with the alpha numeric keys or via the LIST function. The FMS searches the Navigation and Pilot Databases for the reference fix entered. If the reference fix identifier is found, the Waypoint Identification Pages for all matching records will be displayed. If an identifier not recognized by the FMS is entered in the reference fix field, the Define Position Page shall be displayed.

Normal Company Route Pages

The Normal Company Route Pages are accessed from the Company Directory Page by entering a valid route. This page allows the pilot to review a company route. Pressing any LSK [1L] thru [5L] places the cursor over the adjacent terminator identifier, if one exists. Selecting a terminator identifier will display the INFO prompt at LSK [2R]. Pressing LSK 2R to select the INFO prompt will display the Waypoint Identification Page.
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Copy Company Route Page
Pressing the COPY CO RTE option from the Empty Flight Plan Page accesses this page.

1. Enter the route reference number at LSK [2R]. Press Enter. Entering a valid route reference number will display that route on the Normal Flight Plan Pages.

2. Enter the Company Route Name at LSK [3R]. Press Enter. Entering a valid company route name shall result in that route being displayed on the Normal Flight Plan Pages.

3. Enter a Reference Fix at LSK [4R], either with the alphanumeric keys or via the LIST function. The FMS will search the Navigation and Pilot Databases for the reference fix entered in this field. If the reference fix identifier is found, the Waypoint Identification Pages for all matching records will be displayed. If an identifier not recognized by the FMS is entered in the reference fix field, the Define Position Page shall be displayed.
Company Routes Database Disk Loading

A Company Route Database can be loaded if both of these conditions are met:

1. The regions and the expiration date of all disks in the Company Route Database match the Navigation Database.

2. The Company Route Database must be loaded with the same Navigation Database that was used for its creation. The same Company Route Database may be reloaded, but any other company disks cannot.

Company Routes Database disk(s) are loaded through the DTU by using the same procedures as loading Navigation Database disks. Refer to Loading Database Disks, found earlier in this section. After CONTINUE is pressed, the following page will appear.
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**Pilot-Defined Airports**

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

**Pilot Airports Directory Page**

The Pilot Airports Directory Page is accessed by selecting AIRPORT, LSK 1R, from the Pilot Data Menu Page. A list of all pilot airports found in the database is displayed on the left side of the page. Entering an airport identifier or a reference number in the WPT field will display the Pilot Airport Identification Page for that airport. If the entered airport identifier or reference number is not found in the Navigation or Pilot Databases, the Define Airport Page shall be displayed, from which the pilot may create an airport. Invalid entries will flash.
Pilot Airport Identification Page

The Pilot Airport Identification Page is accessed several ways:

1. From the Pilot Airports Directory Page by entering a runway reference number or an existing pilot-defined airport identifier.

2. From the Define Airport Page by pressing either the ACCEPT or RETURN options.

3. From the FPL and Pilot Route INFO function.

Delete/Accept - If this option prompts DELETE at LSK [5L], pressing twice will delete the airport from the pilot database and return the pilot to the Pilot Airport Directory Page.

If the airport’s defining data has been affected by a Navigation Database update, LSK [5L] will prompt ACCEPT. Pressing LSK [5L] will confirm the changes to the waypoint definition.

Modify - Pressing LSK [4R] will display the Define Airport Page from which the pilot may change the airport definition.

An airport is considered “in use” if one the following conditions exist: the airport is currently in use in the flight plan, is part of a pilot-defined Route, Approach, SID, or STAR, or contains a pilot-defined runway. If the airport is in use when this page is accessed, LSK [4R] with display IN USE, followed by the procedure type or runway.

In addition, when the airport is not in use, its elevation (between -1500 feet and 14,882 feet) may be entered at LSK [2L]. If an elevation is entered at LSK [2L] or the airport defining data has been affected by a Navigation Database update, ACCEPT is displayed at LSK [5L]. Pressing LSK 5L shall store the airport and/or airport changes in the pilot database. The DELETE option at LSK [5L] will not be displayed.
Pilot-Defined Alignment Waypoints

Alignment waypoints can be created at an airport for the purpose of initializing IRS sensors. The Pilot Alignment Waypoints Directory Page, shown below, is accessed by selecting ALIGN PT, LSK [2R], from the Pilot Data Page. These waypoints 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 Directory Page.

If an undefined alignment waypoint is entered at LSK [1R], the Define Align Page is displayed. The pilot may define an alignment waypoint on this page.

Pilot Alignment Waypoint Identification Page

Entry of a waypoint identifier or reference number at LSK [1R] on the Directory Page will display the Pilot Alignment Waypoint Identification Page.

Delete - Pressing LSK [5L] twice will delete the pilot-defined alignment waypoint from the database.

If the waypoint’s defining data has been affected by a Navigation Database update, LSK [5L] will prompt ACCEPT. Pressing LSK [5L] will confirm the changes to the waypoint definition.
Modify - Pressing LSK [4R] will display the Define Alignment Page from which the pilot may change alignment waypoint information.

Note: If waypoints are used in Routes, FPL or Approaches, the MODIFY LSK will be replaced by an IN USE XXX and can not be modified. DELETE will not be displayed.

Return - This LSK will return the display to the Pilot Alignment Waypoints Directory Page.

If the alignment waypoint has been defined using the radial/distance or radial/radial method, the reference waypoint coordinates are displayed on this page.

Pilot-Defined Waypoints

The Pilot Waypoints Directory Page is accessed from the Pilot Data Menu Page by selecting the WAYPOINT option, LSK [3R]. When the page is accessed, a list of all pilot-defined waypoints stored in the database will be presented alphabetically. The PREV and NEXT keys provide access to additional Pilot Waypoint Pages. Entry of an invalid waypoint identifier at LSK [1R] will display the Define Waypoint Page, from which a waypoint may be defined.

If a waypoint has been affected by a change to the FMS’s Navigation Database, the waypoint will flash on the Directory Page.
Pilot Waypoint Identification Page

Entry of a valid waypoint identifier or reference number in the WPT field on the Directory Page will cause the Pilot Waypoint Identification Page to be displayed. This page allows the pilot to view waypoint information as well as delete or modify the waypoint.

Delete - Pressing LSK [5L] twice will delete the pilot-defined waypoint from the database.

If the waypoint’s defining data has been affected by a Navigation Database update, LSK [5L] will prompt ACCEPT. Pressing LSK [5L] will confirm the changes to the waypoint definition.

Modify - Pressing LSK [4R] will display the Define Waypoint Page from which the pilot may change waypoint location. Refer to the Define Position Pages portion of this section.

Note: If a waypoint is used in one of the following Navigation data types: route, FPL, SID, STAR or approach, the MODIFY LSK will be replaced by “IN USE XXXX”, where XXXX indicates the Navigation data type in which the waypoint is used. In this case, the waypoint cannot be modified.

Return - This LSK will return the display to the Pilot Waypoints Directory Page.

If the waypoint has been defined using the radial/distance or radial/radial method, the reference waypoint coordinates are displayed on this page.
**Tactical Waypoints**

The FMS provides the capability to store up to 100 tactical waypoints. Tactical waypoints are temporary pilot-defined waypoints limited to use in the flight plan. They cannot be used in search patterns or pilot-defined SIDs, STARs and Approaches. If the flight plan is stored as a route, tactical waypoints will become a flashing *GAP*. The FMS prompts the pilot to delete all tactical waypoints at powerup.

Tactical waypoints may be loaded from a flight plan disk or created by the pilot on the Define Tactical Waypoint Page.

**Pilot-Defined Routes**

**Route Construction**

Up to 200 pilot-defined routes may be constructed and stored in the database. 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.

**Create a Route**

1. Press the DATA function key, then Pilot data LSK [2L].
2. Select ROUTE, LSK [4R] to display the Pilot Routes Page.
3. Select CREATE ROUTE, LSK [3R], to display an empty Pilot Route Page.
4. Use the List or direct entry method to enter the identifier of the first waypoint or airport in the route. Press ENTER. If the airport or waypoint is in the database, the applicable Identification Page will prompt the pilot to accept the entry.
5. The cursor will advance to the next identifier entry field. Continue entering waypoints to complete the route.
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 the DATA key
2. Press PILOT DATA, LSK [2L].
3. Press ROUTE, LSK [4R].
4. Enter the reference number for the chosen route.
5. The Pilot Route Page will display. Press the MENU key.
6. Press DEPART, LSK [4L].
7. Departure Page 1 will appear with a list of runways for that airport.

**Note:** If the departure airport has no SIDs or runways in the database, then (NONE) is displayed.

8. Enter the reference number of the departure runway.
9. Enter the reference number of the desired SID.
10. Enter the reference number of the desired enroute transition.
11. Press PLT RTE, LSK [5R], to return to the Route Pages.
Add Waypoints Using the 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 is in the Navigation Database.

**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 key.
2. Press AIRWAYS, LSK [2R]. A list of airways through the previous navaid/intersection will be displayed.

![LIST 1/1](image)

3. Enter the reference number of the desired airway. The Airway Termination Page will then be displayed showing intersections and nav aids that make up the selected airway. The closest twelve points will be displayed on the first page, the next closest twelve on the second page, etc. Enter the reference number of the termination fix.
4. All waypoints between the initial and termination points will be automatically entered into the route.
5. The cursor will automatically be positioned over the next blank field. Repeat steps 1 and 2 to complete the route using additional airways.
Add 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 the DATA key
2. Press PILOT DATA, LSK [2L].
3. Press ROUTE, LSK [4R].
4. Enter the reference number for the chosen route.
5. The Pilot Route Page will display. Press the MENU key.
6. Press ARRIVE, LSK [4R].
7. Arrival Page 1 will appear with a list of runways for that airport.

   Note: If the airport has no STARS or approaches in the database, then (NONE) will be displayed.

8. Enter the reference number of the arrival runway.
9. Enter the reference number of the desired STAR.
10. Enter the reference number of the desired STAR transition.
11. Enter the reference number of the desired approach.
12. Enter the reference number of the desired approach transition.
13. Press PLT RTE, LSK [5R], to return to the Route Pages.

Edit Stored Routes

Once a route has been constructed and stored in the database, 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 Route Display Page for editing:

1. Press the DATA function key. Select Pilot Data, LSK [2L].
2. Select ROUTE, LSK [4R] to access the Route Directory Page.
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. From the Normal Route Display Page, insert a gap using the following procedure:

1. Use the NEXT and PREV keys to display the desired waypoint.
2. Use the LSKs to position the cursor over the waypoint that will follow the GAP.
3. Press the LIST key to access the Normal LIST Page.
4. Press GAP, LSK [3R]. 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. THE PILOT 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 Normal Route Display Page. From the Normal Route Display Page, the following procedure may be used to designate (or cancel) a waypoint as a flyover waypoint:

1. Use the NEXT and PREV keys to display the desired waypoint.
2. Use the LSKs to position the cursor over the waypoint to be defined as a flyover waypoint.
3. Press OVFLY, LSK [4R]. 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 CNCL OVFLY, LSK [4R], with the cursor over the flyover waypoint identifier.

Add Waypoint(s) to Route

From the Normal Route Display Page, add a waypoint to the route as follows:

1. Use the NEXT and PREV keys to display the desired portion of the Route.
2. Use the LSKs 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 advance to the next position.

Edit Route Name

From the Normal Route Display Page, edit the route name as follows:

1. Press the 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

From the Normal Route Display Page, delete waypoint(s) from the route as follows:

1. Use the NEXT and PREV keys to display the desired waypoint.
2. Use the LSKs to position the cursor over the waypoint to be deleted.
3. Press DEL, LSK [1R], twice.

**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. From the Normal Route Display Page, change a waypoint in a route as follows:

1. Use the NEXT and PREV keys to locate the desired waypoint.
2. Use the LSKs to 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.
Route Menu Page

The Route Menu Page is accessed by pressing the MENU function key from any Pilot Route or Company Route Page.

NORMAL - Pressing LSK [1L] displays the Normal Pilot Route Pages if the Route Menu Page was accessed from the Pilot Route Pages. The Normal Company Route Pages are displayed if the Route Menu Page was accessed from Company Route Pages. The Normal Route Page shows the route waypoints, 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 route. Following pages of the route may be displayed by pressing the PREV or NEXT keys, as appropriate.

When the cursor is placed on a waypoint, up to three options appear on the right side of the page:

Del - Pressing this key twice will delete the selected waypoint from the route.

Info - Will display all information from the pilot database concerning the waypoint or navaid.

Ovfly - Overfly waypoints are defined by pressing the OVFLY LSK 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'.

COMPRESSED - Pressing LSK [2L] displays the Compressed Format Route Pages. The Compressed Route Pages allow the pilot to view more waypoints of the route on a single page to quickly review long Pilot or Company Routes.

DEPART - Pressing LSK [4L] displays the Departure Page. Refer to the OPERATIONS Section for more information.
DELETE RTE - Pressing DELETE RTE, LSK [5L], twice will delete the selected route. This option is unavailable when the Route Menu Page is accessed from the Company Route Pages.

WPT TO DEST - Pressing LSK [1R] displays the Waypoint to Destination Pages. The Waypoint to Destination Pages allow the pilot to view the Company or Pilot Route distance in nautical miles and time in hours and minutes from various route waypoints to the destination.

WPT DEFN - Pressing LSK [2R] displays the Waypoint Definition Pages. The Waypoint Definition Pages allow the pilot to view the coordinates of the Company or Pilot route waypoints.

PLT ROUTES - Pressing LSK [3R] displays the Pilot Route Directory Pages if the Route Menu Page was accessed from the Pilot Route Pages. The Company Route Directory Pages are displayed if the Route Menu Page was accessed from Company Route Pages.

ARRIVE - Pressing LSK [4R] displays the Arrival Page. Refer to the OPERATIONS Section for more information.
Define Position Pages

The Define Position Pages provide the means to define the coordinate location of a pilot-defined airport, runway, waypoint, alignment waypoint or tactical waypoint. The location may be defined by directly entering the coordinates, by selecting FMS or GPS present position coordinates, or by defining the position in reference to another known waypoint or waypoints. The page title will reflect the category of waypoint being defined (ALIGN, ARPT, RNWY, WPT, POS, TACT).

DEFINE ALIGN Page - The Define Alignment Waypoint Page is accessed by entering an undefined alignment waypoint on the Initialization Page, from the Position Menu Page (LSK [2L]) or from the pilot-defined alignment points Directory and Identification Pages when MODIFY is selectable.

DEFINE ARPT Page - The Define Airport Page is accessed by entering an undefined airport identifier in the airport field on the Pilot Airport Directory Page. It is also accessed from the Position Menu by pressing LSK [3L].

DEFINE RNWY Page - The Define Runway Page is accessed by entering an undefined runway name in the runway ID field on the Pilot Runway Directory or on Define Approach Page 1.

DEFINE WPT Page - The Define Waypoint Page is accessed by entering an undefined waypoint name point in any waypoint field except those for align points, airports and runways. It is also accessed from the Position Menu by pressing LSK [1L].

DEFINE POS Page - The Define Position Page is accessed by pressing the FMS Position LSK on Navigation Page 3 (LSK [2L]) or on Data Page 3 (LSK [1L]).
**DEFINE TACT Page** - The tactical waypoint is a pilot-defined temporary waypoint limited to use in the flight plan. The Define Tactical Waypoint Page is accessed from the Position Menu by pressing LSK [4L].

The following options and fields are described for the Define Alignment Waypoint Pages; however, the discussion is similar for all other Definition Pages.

**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 Database. 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, coordinates can also be directly entered here from which radial and distance may be taken without the need for entering a REF WPT.

**RADIAL/DIST** - If reference waypoint coordinates are not defined at LSK [2L], then [3L] is inoperative.

When the reference waypoint coordinates are defined, selecting LSK [3L] will highlight the RADIAL field. Entering a valid radial advances the cursor to the DIST field. Entering a valid distance will cause the coordinates of the newly defined waypoint to be calculated and displayed at LSK [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.
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**WPT/RADIAL** - These fields define the waypoint identifier and radial for a second reference waypoint, which can be used with the first waypoint coordinates, radial and distance to compute coordinates for the new waypoint. The new waypoint coordinates are computed as theta/theta.

The cursor is placed over the WPT field when reference coordinates are defined at [2L] and a valid radial is at [3L]. Any database 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 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 LSK must be pressed twice to enter the defined waypoint into the database.

**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** - Selecting this option will accept, at the instant it is pressed, the GPS present position coordinates to define the position of the waypoint.

**FMS# POS** - This option becomes available when the cursor is parked at either the REF WPT Coordinates field at LSK [2L] or the WPT Coordinates field at LSK [2R]. Selecting this option will accept the FMS’s present position coordinates to define the position of the reference waypoint or the new waypoint, respectively.
Definition Methods

Positions can be defined by any of the five following methods:

- **Latitude/Longitude** - the coordinates of the pilot-defined waypoint are entered directly.
- **Radial/Distance** - a reference waypoint (which can be a waypoint, VOR, NDB or airport) is identified and a radial/distance offset is specified.
- **Radial/Radial** - 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.
- **GPS Position** - the present GPS position data are used to define the waypoint.
- **FMS Position** - the present FMS position data (best computed position) are used to define the waypoint.

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

1. Press LSK [2R] to highlight the latitude field.
2. Enter the latitude (using the ± key as necessary to toggle the hemisphere between N and S). The cursor will expand to enclose the longitude field.
3. Enter the longitude (again, the ± key will toggle the hemisphere between E and W).
4. The prompt ACCEPT WPT will appear at LSK [5L]. Press either LSK [5L] or the ENTER key to accept the waypoint.

**Note:** Use the MENU key to change the entry resolution between tenths, hundredths or thousandths of arc-minutes.
To define a position by **Radial/Distance:**

1. Enter the name of the reference waypoint, navaid or airport from which the new waypoint will be derived in the REF WPT field, or use the LIST key to choose from a list of available reference waypoints. Press ENTER.

2. The Confirmation Page will display the location (and other applicable data) for the reference waypoint. The ACCEPT prompt will appear next to LSK [5L]. If there are two or more locations or facilities with the same identifier, the page title will indicate 1/2, 1/3, etc., and additional locations can be viewed by pressing the NEXT key. When the desired location of the reference waypoint is displayed, press the ACCEPT LSK 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 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 ACCEPT WPT prompt will appear next to LSK [5L]. Press either the ACCEPT WPT LSK, or the ENTER key.
To define a position by the **Radial/Radial** method:

1. Enter the name of the first reference waypoint, navaid or airport from which the new waypoint will be derived at LSK [1R], or use the LIST key to choose from a list of available reference waypoints.

2. The Confirmation Page will display the location (and other applicable data) for the reference waypoint. The ACCEPT prompt will appear next to LSK [5L]. 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 LSK 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.

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 LSK [4L] to identify the second reference waypoint. Enter the name or identifier of the second reference waypoint, or use the LIST key to choose from a list of available reference waypoints.

5. The Confirmation Page will again appear displaying the location for the second reference waypoint. Press either ACCEPT, LSK [5L], or ENTER.

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. The coordinates of the newly defined waypoint will be displayed.

7. The ACCEPT WPT prompt will appear next to LSK [5L]. Press either ACCEPT, LSK [5L], or ENTER.

**Note:** If the reference waypoint has been deleted in a Navigation Database update, the REF WPT and RADIAL/DIST fields will display dashes.
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Database

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

1. Press LSK [2R] to highlight the latitude field. The GPS POS and FMS POS legends adjacent to the [3R] and [4R] LSKs will illuminate in large orange font, indicating that these options have become available.

2. Press GPS 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 pilot to define waypoints to tenths, hundredths and thousandths of a minute resolution. This feature allows position resolution to approximately 8 feet, and is useful for defining precise runway touchdown points.

LAT/LON ENTRY- Pressing the LSK adjacent to TENTHS, HUNDREDTHS or THOUSANDTHS allows selection of either tenths, hundredths or thousandths of a minute resolution on the display.

**WPT/ALIGN/ARPT/TACT** - Pressing the LSK adjacent to any of these prompts will display the Define Position Page for that selection.
Pilot Data Save and Loading

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, alignment waypoints, 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 DTU. The disk must be formatted, using either the FMS or any Windows-based personal computer equipped with a ZIP Drive, in order to save the pilot data.

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

1. Press the DATA key for Data Page 1.
2. Press DISK, LSK [4L], to display the Disk Menu Page.

```
   DISK MENU
   - DISK CONTENTS
   - DISK LOAD  MAINT DNL/DTA
   - PLT DATA
   - SAVE
   - START DATA RECORDING
   - FORMAT DISK  RETURN
```

3. Insert the zip disk into the DTU.
4. Press FORMAT DISK, LSK [5L], if required. Formatting might take several seconds.

**Note:** The disk must be blank or formatted before pressing PLT DATA SAVE. Refer to the following section for instructions.
Section IV
Database

5. Press PLT DATA SAVE, LSK [3L]. The Pilot 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.

Data Recording

Data from the flight may be recorded and downloaded to disk via the DTU. The Data Recording option is accessed from the Disk Menu Page. When the Data Recording prompt is selected, the data file name and extension is created and the output of data begins.

Data Recording is stopped automatically approximately twenty seconds after the strut switch is toggled to the "on ground" position.

The pilot may also manually stop recording by selecting STOP DATA RECORDING, LSK [5L], from the Data Menu Page.

Flight data recording is performed simultaneously by up to 3 FMSs, recording to 3 different files. The flight data recording file names will designate which FMS generated data recording and the sequential number of the record. For example, the first flight data recording from FMS #1 will have the file name: "FLTDATA1.001", the third flight data recording from FMS #2 will have the associated file name: "FLTDATA2.003". So in the model FLTDATAX.YYY, X represents the FMS number (1,2 or 3) and Y represents a flight data recording number from 001 to 099.
1. Press the DATA key to access Data Page 1.

2. Select LSK [4L], DISK, to display the Disk Menu Page.

3. Press LSK [4L], START DATA RECORDING. The prompt will change to STOP DATA RECORDING and all other options on the Disk Menu Page will become unavailable for selection.

4. Pressing LSK [4L], STOP DATA RECORDING, stops the recording process and makes available for selection all other options on the Disk Menu Page.

**Format Disk**

The Format Disk function does not actually format ZIP disks; it only erases them. ZIP disks must be formatted using a personal computer with ZIP Drive.

1. Press the DATA function key to display Data Page 1.

2. Press LSK [4L], DISK, to display the Disk Menu Page.

3. Press the FORMAT DISK prompt, LSK [5L].

4. Press LSK [5L], FORMAT, to erase the disk.

**Pilot Database Disk Loading**

Pilot-defined Database disk is loaded through the DTU by using the same procedures as loading navigation data disks. Refer to Loading Database Disks, located earlier in this section. After CONTINUE is pressed the following page will appear.
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INTRODUCTION

This section of the manual contains FMS flight operating procedures designed to be used on a typical flight and arranged in the order in which they would normally be 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. The aeronautical charts are published using the VOR radials that define the route, whereas the FMS displays the computed course using local magnetic variation. Flight Plan 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. Magnetic 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 magnetic variation, depending upon how long ago the station was realigned with local variation. Legs that have CRS XXX° or HDG XXX° displays on the Flight Plan Pages should agree with the published data on the charts, since these are provided as part of the navigation database 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 turn on and perform a self-test. A Self Test Page will display the results of each test performed. If the self-test is successful, the Initialization Page will appear.

   **Note**: Should a failure message appear while the system is performing the self test, one of the following will occur:

   - The Self Test Page will remain onscreen 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 Message Page, may be viewed until the initialization process is completed.

   ![Self Test Page](image)

   **UNS - 1**
   **CHALLENGER CL601 3A**

   - CPU PASS
   - RAM PASS
   - DATABASE FAIL
   - CONFIG MODULE PASS
   - AUXILIARY PASS
   - ARINC PASS
   - ANALOG PASS

2. The line at the top of the Initialization Page will indicate the name of the aircraft as programmed in the Configuration Module.

3. Following the Initialization Page, a Copyright Page is automatically displayed for five seconds.
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Operations

4. If tactical waypoints exist in the FMS memory, this page is displayed after the Copyright Page. Press line select key (LSK) [4L] to keep tactical waypoints. Press LSK [5L] twice to delete tactical waypoints.

INITIALIZATION

The Initialization Page automatically appears at the end of the self test if the self test passed without fault.

Position, date and time fields on the Initialization Page are prefilled with information obtained from the GPS (as indicated by <GPS> at LSK [1L]). For non-GPS installations, position will be the same as when the system was last powered down.

Press the ACCEPT LSK to accept the GPS position, time and date.

**Note:** The ACCEPT prompt is only available when all data fields display valid data.

Information, including initialization, flight plan and fuel data from the Initialization Page may be crossfilled to another FMS using the Crossfill and Master Crossfill options at LSK [3R] and LSK [4R], respectively.
Correct Erroneous Data on Initialization Page

Position, date and time information may be entered manually on the Initialization Page if any of the initial data is incorrect. Use the LSKs to place the cursor over the fields to be corrected or changed and proceed as follows:

**Position** - Entering a valid waypoint identifier at LSK [1L] will display the Waypoint Selection Page. Accepting a waypoint on the Waypoint Selection Page will cause the FMS to fill the coordinates of that waypoint on the Initialization Page.

Entering an invalid identifier into this field will display the Define Alignment Waypoint Page. Refer to the DATABASE Section of this manual for instructions for entering data on the Define Alignment Waypoint Page.

Pressing ENTER with the cursor over an empty field at LSK [1L] will display the Define Position Page. Initialization data can be entered on this page in five different ways:

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

**LAT/LON** - Pressing LSK [2L] allows the pilot to enter valid latitude and longitudes. Pressing +/- or “N”, “S”, “E”, “W” will change the N/S/E/W field.

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

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

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

**Note:** The FMS will only allow access to the Initiation, Tune, Crossfill and Message Pages and the ON/OFF/CANCEL Window Page if ACCEPT is not selected in the Initiation Page.

**Note:** If an error message appears indicating an entry on the Initiation Page (and prior to leaving the Initiation Page), the erroneous field can be corrected by repeating the previous 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 is configured at installation to either PULL data to the requesting FMS or PUSH data to the receiving FMS. The default crossfill configuration is PULL.

**Crossfill** - 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). When crossfill is configured as Pull, it is an available option when all of the following conditions are met:

- One or two crossfill input busses are configured.
- The INIT crossfill option is enabled on the Crossfill Options Page.
- Valid date, time and data is available from at least one transmitting FMS.
When crossfill is configured as Push, it is an available option when all of the following conditions are met:

- 429 XFILL output bus configured.
- The INIT crossfill option is enabled on the Crossfill Options Page.
- Valid and verified date, time and data is available from at least one FMS.

**Master Crossfill** - Master crossfill allows the pilot to crossfill all data (initialization, flight plan and fuel data) at the same time. The prompt appears on the Initialization Page and Data Page 1. When master crossfill is configured as Pull, it is an available option all of the following conditions are met:

- One or two crossfill input busses configured.
- The master crossfill option is enabled on the Crossfill Options Page.
- Fuel units on at least one transmitting FMS the same as on the receiving FMS.
- Valid and verified date, time and coordinate and verified fuel data on at least one transmitting FMS.

When crossfill is configured as Push, it is an available option when all the following conditions are met:

- 429 XFILL output bus configured.
- The MASTER crossfill option is enabled on the local FMS's Crossfill Options Page.
- Fuel units on the local FMS the same as on at least one receiving FMS.
- Valid and verified date, time and coordinate and fuel data on the local FMS.

**Crossfill Data**

Press the applicable crossfill LSK, [3R] or [4R], to crossfill data.

In a dual crossfill bus configuration, the Initiate Crossfill Page is displayed when XFILL is selected and the Master Crossfill Page is displayed when MSTR XFILL is selected.

Select the applicable LSK for the FMS from which information will be sought. Data will then crossfill from the chosen FMS to the other.
Press ACCEPT, LSK [1L], on the receiving FMS to complete the crossfill and validate the data.

**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 the key sequence 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 perform a manual FR-TO leg change on NAV Page 1, or a Direct To a waypoint in the new flight plan.

**Adjust Screen Brightness**

1. Press the ON/OFF key to access the dimming control window.
2. Hold the BRIGHT or DIM LSKs to adjust screen intensity.
3. Select the CANCEL LSK to return to the previous display.

**Adjust Display/Key Alignment**

1. Press ON/OFF key to access the dimming control window.
2. Press DISPLAY, LSK [4R], to access the display option window.
3. Press the UP or DOWN LSKs as necessary to align display arrows with LSKs.
4. Select the CANCEL LSK to return to previous display.

**Access Video Mode**

*Note:* The Video option is only available with certain CDU part numbers.

1. Press the ON/OFF key to access the dimming control window.
2. Press the DISPLAY LSK to access the display option window.
3. Press the VIDEO LSK to access the video mode. Active video source will be displayed.
4. Press any key to exit video mode.

**Flight Plans - General**

A flight plan is the sequence of waypoints the FMS uses 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. Flight plans are stored in the volatile memory and are erased at system shutdown.

The pilot normally has three options to install a flight plan. A flight plan can be created on the Flight Plan Pages, cross filled from another FMS or copied from a Route contained in the Pilot or Company Databases.

**Flight Plan 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 provide a guide for the pilot in using flight plans.

**ROUTE** - A page with this heading displays the descriptive data of a particular route. These pages are accessed from the Routes Directory Page where the pilot may make permanent changes to the ROUTE, which is stored in the database.

**FPL** - A page with this heading displays flight plan waypoints, usually copied from a database stored route. These waypoints are used for navigation of a single flight. Changes made to the Flight Plan Pages will not affect the routes stored in the database.

**COPY ROUTE** - A page with this heading displays routes available for selection when copying a stored route into a flight plan or another route.
**FPL MENU and ROUTE MENU** - These pages are used to select the various format options for display of a flight plan or a route. Only the NORMAL option allows changes to be made. Selection of any other option on this page will provide additional detailed information concerning the route or flight plan.

**Data Entry**

Generally, the cursor is moved to a data entry field by the use of LSKs. However, in some cases, the cursor will automatically position on the next logical entry field.

Data is manually entered in two steps. First, data is entered onto the displayed page in a cursor entry field. Once entered, 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. Generally, an invalid entry will flash and pressing the BACK key will delete an entry.

Options are displayed in orange and usually have an arrow pointing to the associated LSK.

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 many characteristics of this process are included in the other input processes. 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, navaids, etc. 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 field and pressing the ENTER key.

Note: If the desired choice is not among those shown on the 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 process is the easiest to use when the desired waypoint identifier is not presented as an available selection.

With the cursor over a waypoint entry field, pressing the LIST key will display the Normal LIST Page. A list of numbered selections available for entry in this field will be displayed in a window, and other LIST categories will be displayed next to the LSKs. Any LIST category can be placed in the LIST window by pressing the corresponding LSK.

Note: When selecting waypoint identifiers, routes, or navaids using the List Input Process, the computer will present the most optimum lists possible. For example, in selecting a flight plan, the lists present those routes originating closest to the departure airport first.

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 a field where a database item is normally entered.
Selectable lists are displayed next to the LSKs. A control window is located in the center of the display. Any list may be placed into the control window by pressing the LSK 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 when those are selected.

**RWY** - The Runway option is available at LSK [4L] when a reference airport has been specified. The list of runways contain all pilot or Navigation runways that exist for the reference airport, and is accessible only in the Pilot SID, Pilot STAR, Pilot Approach Transition, and Pilot Missed Approach Definition Pages.

**COPY RTE** - The Copy Route Page is displayed when LSK [5L] is pressed.

**GAP** - Pressing this LSK when the page has been accessed from a Flight Plan or Route Page will insert a gap (identified onscreen by the symbol "*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. THE PILOT MAY GO "DIRECT TO" OR EDIT THE GAP OUT OF THE FLIGHT PLAN.

**PLN LANG** - By pressing the Plain Language LSK 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 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 then pressing the ENTER key.

If the identifier is in the database - The Waypoint Identification Page for that identifier will appear. This page displays 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 LSK will confirm 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 database with that identifier. If this is the case, the fraction adjacent to the identifier's name will read something other than 1. Press the PREV or NEXT keys to access the other Waypoint Identification Pages. Locate the cursor over the waypoint and press the ENTER key or the ACCEPT LSK to confirm. 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 database - The Define Waypoint Page will be displayed where the pilot may create a pilot-defined waypoint. There are five methods for creating a waypoint:

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.

Refer to the DATA BASE Section for more information about creating pilot-defined waypoints.

**Flight Plan Pages**

Pressing the FPL key displays Flight Plan Page 1 if a flight plan has been defined. The Flight Plan Pages are often designated FPL N/X, where N is the current page number and X is the total number of pages required to show all the waypoints in the flight plan.

The Flight Plan Pages show the flight plan waypoints, ETAs, altitudes (when defined by the Vertical Navigation function), bearings and distances between waypoints. In the case of procedural legs of SIDs, STARs and approaches, path type and terminator are also shown. A caret (>) marks the current TO waypoint.

The page also allows editing of the flight plan. Preceding or succeeding pages of the flight plan can be displayed by pressing the PREV or NEXT keys, respectively. Below is shown a typical Flight Plan Page.
When a waypoint is selected by placing the cursor over it with the associated left side LSK, up to five options appear on the right side of the screen:

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

**INFO** - Pressing this key will display all information from the navigation or pilot database concerning the waypoint or navigational aid.

**TUNE** - This option only appears when the cursor is over a navigational aid such as VOR or NDB. When the system is enabled for remote tuning of navigational aids, pressing this key will tune the radio to the frequency stored in the database.

**OVFLY** - Pressing this key will define the selected waypoint as an overfly 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 Pages. If the selected waypoint is already an overfly waypoint, this option will read CNCL OVFLY, and the overfly designation can be removed by pressing this key. Only geographic points, not procedural legs, can be designated as overfly.

**OFSET** - If the selected waypoint terminates a leg type that can have an altitude constraint, OFSET is displayed. Pressing this key displays the Path Vertical Navigation Page with the cursor over the corresponding vertical waypoint’s offset field.
Flight Plan Construction and Editing

Flight Plan Construction

This section provides instructions for creating a flight plan. After initialization, the system is ready to accept the flight plan. With no flight plan defined in the FMS, pressing the FPL key will display the Empty Flight Plan Page.

1. Press the FPL key to access Flight Plan Page 1.

The cursor appears over an empty field and is ready to accept waypoint number "2". Waypoint number “1” will prefill with the airport from the initialization process. UniLink RTE and COPY CO RTE option will appear only 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. The NEXT and PREV keys are used to page through 10 pages of the closest waypoints. Press ENTER to select a waypoint. The cursor will move to the next empty field.

3. To insert an airway, verify the previous waypoint is on the desired airway.

Press the LIST key to access the LIST Page and the AIRWAYS LSK to list the airways. Enter the reference number of the desired airway.

Enter the airway terminator on the Airway Terminator Page and return to Flight Plan Page 1.

Continue entering waypoints into the flight plan to the destination airport.
Note: Pressing LSK [1L] will place the cursor over the origin waypoint. DEL and INFO will be displayed at LSK [1R] and [2R], respectively. Selecting LSK [1R] twice will delete the waypoint and display the Flight Plan Page. Selecting LSK [2R] will display the Airport Information Page for that airport.

UNILINK RTE - This option is displayed when UniLink is configured and if the UPLINK RTE option on FMC Configuration Page 2 is enabled. Selecting this option displays the UniLink Route Page.


COPY CO RTE - If a company route is installed in the database, pressing LSK [4R] will display the Company Route Directory Page where the copy route option appears.

XFILL - This option will appear if the XFILL mode is configured as PULL, Flight Plan Crossfill is enabled, one or two input busses are configured and a flight plan is stored in the database. Selecting this option displays the Flight Plan Crossfill Page.

Flight Plan Editing

Insert a SID into a Flight Plan

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

1. From any Flight Plan Page, press the MENU key.
2. On Flight Plan Menu Page 1, press DEPART, LSK [4L], to access the Departure Page.
3. The Departure Page will prefill with the departure airport. Enter the reference number of the runway at LSK [2R]. 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.
6. 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.

**CAUTION:** 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.

In the example above, the KSEA SUMMA6 departure with Baker City transition would read as follows:

1. Maintain heading 341 to 829 feet.
2. Fly course 341 until crossing waypoint NEZUG at or above 4000 feet.
3. Turn right to heading 070 until interception of Payne VOR radial 139.
4. Turn right to heading 165 until interception of course 146 into the SUMMA intersection.
5. Fly direct to BKE.

**Note:** A SID containing a RADAR vector might specify guidance actions to the FMS resulting in not maintaining an existing heading. The pilot should compare the SID chart to the FMS
flight plan to ensure that the correct heading is coded prior to the RADAR vector leg. If it is not, the pilot must be prepared to discontinue FMS guidance after the waypoint where the vector leg starts.

If the SID chart does not specify a heading, the pilot must assume that ATC requires the existing heading maintained until specified otherwise. If the SID provided by the database contains headings not shown on the SID chart, the pilot must discontinue FMS guidance unless such headings are specifically authorized by ATC.

If the SID provided by the database does not contain a RADAR vector heading or required course from the waypoint where the RADAR vector on the chart begins, the pilot must discontinue FMS guidance of the RADAR vector waypoint and maintain the present heading until instructed otherwise by ATC.

**Add Waypoint to Flight Plan**

1. Press the FPL key to access Flight Plan Page 1. Identify the waypoint that will follow the inserted waypoint. If the desired waypoint is not displayed, use the NEXT and PREV keys to display additional flight plan waypoints.

2. Use the LSKs 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.
Delete Waypoint from Flight Plan

1. Press the FPL key to access Flight Plan Page 1. If the desired waypoint is not displayed, use the NEXT and PREV keys to display additional flight plan waypoints.
2. Use the LSKs to position the cursor over the waypoint to be deleted.
3. Press DEL, LSK [1R], 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 key to access Flight Plan Page 1. Identify the waypoint to be changed. If the desired waypoint is not displayed, use the NEXT and PREV keys to display additional flight plan waypoints.
2. Use the LSKs to position the cursor over the waypoint to be changed.
3. Press DEL, LSK [1R], 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.

Insert or Delete Gaps in 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 database is loaded. To insert a gap in a flight plan:

1. Press the FPL key to access the Flight Plan Page 1. Use the PREV and NEXT keys to find the waypoint to follow the gap.
2. Press the LSK next to that waypoint to put the cursor over it.
3. Press the LIST key to access the LIST Page.
4. Press the GAP LSK.
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. PERFORM A 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 Flight Plan Arrival Page. If a destination has been chosen, the data will be referenced to the destination.

**Delete Entire Flight Plan**

The following procedure will remove the entire flight plan. If this is performed during flight, the current navigation leg will remain active. The Normal Navigation Page will display the FR and TO waypoints active when the flight plan was deleted. The NX identifier will be deleted.

1. Press the FPL key to access Flight Plan Page 1.
2. Press the MENU key.
3. Press the DELETE FPL LSK twice.
Enter an Altitude

An altitude can be entered for CF, FC, FD, TF, PI, AF, DF, IF and RF leg types. An altitude can not be entered if the waypoint is active in approach. If a waypoint is in the approach common segment but approach is not active, then the altitude constraint entry is invalid if the altitude is less than the “at or above” constraint, greater than the “at or below” constraint, or defined as an “at” constraint in the Navigation Database. Altitude constraints are edited with the same procedures as entering an altitude. Refer to VNAV section for entering offset altitudes.

1. Press the FPL key to access Flight Plan Page 1.

2. Press the right LSK associated with the flight plan waypoint. The cursor will highlight the ALT/FL field. Altitude for the waypoint can be entered as follows:
   - Flight Level - Enter the three numeral designations for the flight level. (370 = FL370)
   - Altitude - Enter the altitude 16000
   - Altitude Below 640 ft. - Enter the altitude with a lead 0. (0137 = 137 ft.)
Flight Plan Summary Page

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.

1. Press the FPL key to access Flight Plan Page 1.

2. Use the PREV and NEXT keys to access the Flight Plan Summary Page (located following the last Flight Plan Page).

3. Use the LSKs 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 ± 13 hours). The time zone sign (±) 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 entered correctly, it can be changed. To alter the value, press LSK [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 estimated time enroute (ETE) and estimated time of arrival (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 (±) 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, press LSK [2R] 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 ETA 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 Menu

The Flight Plan Menu Pages allow the pilot to select various display formats for the flight plan and perform other functions. To access the Flight Plan Menu Pages:

1. Press the FPL key to access Flight Plan Page 1.
2. Press the MENU key.

(FLT LOG Configured), or

(FLT NBR Configured)
Compressed Flight Plan

Selecting COMPRESSED, LSK [1L] on Flight Plan Menu Page 1, displays the Compressed Flight Plan Pages. These pages allow viewing of up to nine flight plan waypoints at one time. The current TO waypoint is shown on the first page with a caret (>). Also shown for each waypoint are any altitude or altitude window constraints.

No entries can be made to these pages. The PREV and NEXT keys are used to scroll through the flight plan. The pilot can return to the Flight Plan Pages by pressing the FPL key.

Clearance Language

Selecting CLEARANCE, LSK [2L] on Flight Plan Menu Page 1, displays the SID, airway sequence, STAR and approach in Clearance language. The number of Clearance Pages depends on the number of waypoints in the flight plan. No entries can be made to these pages. The PREV and NEXT keys are used to scroll through the flight plan waypoints.
Present Position to Waypoint

Selecting PPOS TO WPT, LSK [3L] on Flight Plan Menu Page 1, displays distance and time from present position to each flight plan waypoint. Procedural legs (also known as “floating waypoints”) will not show distances or times. If the time to a waypoint is greater than 9+59, the time to that waypoint will appear as “++++”. No entries can be made to these pages. The PREV and NEXT keys are used to scroll through the flight plan waypoints.

<table>
<thead>
<tr>
<th>FPL 2/3</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPOS TO WPT</td>
<td></td>
</tr>
<tr>
<td>DIST-NM</td>
<td>TIME</td>
</tr>
<tr>
<td>4 (R-143)</td>
<td>88.2 0+12</td>
</tr>
<tr>
<td>5 (INTCPT)</td>
<td></td>
</tr>
<tr>
<td>SUMMAM</td>
<td>230.2 0+31</td>
</tr>
<tr>
<td>SLC</td>
<td>651.3 1+27</td>
</tr>
<tr>
<td>DEN</td>
<td>982.8 2+11</td>
</tr>
<tr>
<td>STL</td>
<td>1655.1 3+41</td>
</tr>
<tr>
<td>LIT</td>
<td>1918.8 4+16</td>
</tr>
</tbody>
</table>

Departure Page

Selecting DEPART, LSK [4L] on Flight Plan Menu Page 1, displays the Departure Page. This page is used to select departure procedures to be inserted in a flight plan or pilot route. The Departure Page is also accessed from the Route Menu, but for review only; no changes can be made to departure data in this case.

<table>
<thead>
<tr>
<th>DEPARTURE 1/1</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEL RUNWAY</td>
<td>DEPART</td>
</tr>
<tr>
<td>1 16 L</td>
<td>KSEA</td>
</tr>
<tr>
<td>2 16 R</td>
<td>RUNWAY</td>
</tr>
<tr>
<td>3 34 L</td>
<td></td>
</tr>
<tr>
<td>4 34 R</td>
<td>SID</td>
</tr>
</tbody>
</table>

All entry fields [1R thru 4R] will display dashes until an entry has been made. After a valid departure airport has been entered, the cursor will advance to the RUNWAY field and available runways for that airport will be displayed on the left side of the screen. When a runway has been entered, the cursor will advance to the SID field. Any predefined SIDs will be displayed. After the SID is entered, a list of enroute transitions is displayed, if available. Enter a transition, if applicable.

Delete Flight Plan
Selecting DELETE FPL, LSK [5L] on Flight Plan Menu Page 1, twice will delete the active flight plan.

**Store Flight Plan**

Selecting STORE FPL, LSK [1R] on Flight Plan Menu Page 1, displays the Normal Pilot Route Page, with the cursor over the route name field. The current flight plan is now saved as a route in the Pilot Database. The route name can be changed to any eight character name to uniquely identify this particular route.

![Route Name Field](image)

**Crossfill Flight Plan**

This option is only available on multiple systems installations. Selecting XFILL FPL, LSK [2R] on Flight Plan Menu Page 1, crossfills 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 the Aircraft Flight Manual Supplement for specific configuration. Additional Crossfill information is provided in an earlier portion of this section.

**RAIM Prediction**

The RAIM Prediction option is displayed only if any configured GPS has RAIM capability. Selecting RAIM PRED, LSK [3R] on Flight Plan Menu Page 1, will display the RAIM Prediction Page. See the ARRIVALS - STARS AND APPROACHES subsection of the OPERATIONS section for detailed information.
Arrival Page

Selection of ARRIVE, LSK [4R] on Flight Plan Menu Page 1, will display the Arrival Page. See the ARRIVALS - STARS AND APPROACHES subsection of the OPERATIONS section for detailed information.

Reference Altitude

This option is available only if a UASC Terrain Awareness Warning System (TAWS) or UASC Vision-1 system is installed and configured to support it. It is accessed by pressing REF ALT, LSK [1L] on Flight Plan Menu Page 2. The Reference Altitude Pages display the waypoint altitude constraints (if any) that are supplied by the FMS to TAWS or Vision-1. If a waypoint does not have an altitude constraint associated with it but lies between two waypoints that do, the FMS will attempt to interpolate an altitude for that waypoint. The current TO waypoint is shown in the second position on the first page with a caret (>). The PREV and NEXT keys are used to scroll through the flight plan waypoints.

The pilot should review these pages if a Flight Path Intent Alert from TAWS or Vision-1 is received, in order to determine how the FMS has interpreted the flight plan profile. If necessary, the pilot should enter an additional waypoint altitude on the Flight Plan Pages to more precisely define the profile, since the FMS’s interpolation might not match the path intended. Symbols are placed in front of each altitude to define the constraint:

- @: AT altitude
- c: variable constraint
- - (dash): no altitude constraint
- x: Vertical Navigation altitude
- (blank space): reference altitude
Waypoint to Destination

Selecting WPT TO DEST, LSK [2L] on Flight Plan Menu Page 2, displays the distance and time from each waypoint to the destination. No entries can be made to these pages. The PREV and NEXT keys are used to scroll through the flight plan waypoints.

Waypoint Definition

Selecting WPT DEFN, LSK [3L] on Flight Plan Menu Page 2, will display the coordinates of every flight plan waypoint, or "FLOATING WPT" in the case of procedural legs. No entries can be made to these pages. The PREV and NEXT keys are used to scroll through the flight plan waypoints.
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 the Flight Plan 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 Flight Plan winds:

1. Select FPL WINDS, LSK [4L] on Flight Plan Menu Page 2:

2. Use the right hand LSKs to place the cursor over the desired waypoint and enter the wind direction (as True). The cursor will advance to the velocity field.

3. Enter the velocity in knots. Use the PREV and NEXT keys to access each waypoint as desired.

The current TO waypoint is indicated by a caret (>). Manually entered wind data is indicated by a small “M” in parentheses to the left of the data. If a waypoint (or waypoints) with no manually entered wind data lies between two waypoints that do have manually entered wind data, the FMS will calculate interpolated wind data for that waypoint or waypoints. Interpolated wind data is indicated by the data being enclosed in parentheses. This interpolated data can be overwritten with manual data at any time.

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 data and displayed as normal data. Winds at downstream waypoints will be automatically recalculated.

FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 5-32.

INSTRUCTIONS: Replace the Flight Log section with the following text.

Flight Log

FLT LOG is displayed at LSK [3R] when FLIGHT INFO is configured to FLT LOG (from the FMS Configuration Page) and the fuel mode is enabled. Selecting LSK [3R] displays the Flight Log Entry page. See the ARRIVALS – SYSTEM SHUTDOWN subsection of the OPERATIONS section for detailed information.

Flight Number

FLT NBR is displayed at LSK [3R] when FLIGHT INFO is configured to FLT NBR (from the FMS Configuration Page).

When an FMS ARINC TX port is configured to XPDR LS429, the assigned flight ID number data will be transmitted to the Mode S Transponder for aircraft identification.

In Collins Pro-Line 4-4000 installations, the assigned flight ID number is transmitted on the IOC output bus.

In IMS installations, the assigned flight ID number is transmitted on the 429 GAMA bus.

Press LSK [3R] to highlight the field, input the flight ID number and press ENTER.
**Approach Plan**

Approach Plan is an option only if an approach is entered in the flight plan. Otherwise, this field is blank. Selecting APPR PLAN, LSK [5L] on Flight Plan Menu Page 2, will display the Approach Plan Pages.

The Approach Plan Pages provide the pilot with a convenient summary of pertinent approach information. See the ARRIVALS - STARS AND APPROACHES subsection of the OPERATIONS section for detailed information.

**Invert Flight Plan**

Selecting INVERT FPL, LSK [1R] on Flight Plan Menu Page 2, deletes any SID, STAR or approach from the current flight plan, then inverts it. The pilot must perform a manual FR/TO leg change (or select DTO) to use the new flight plan.

**Temperature Compensation**

If the Temperature Compensation option is enabled, selecting TEMP COMP, LSK [2R] on Flight Plan Menu Page 2, will display the Temperature Compensation Page. See the ARRIVALS - STARS AND APPROACHES subsection of the OPERATIONS section for detailed information.

**Flight Log**

If the Flight Log option is enabled, selecting FLT LOG, LSK [3R] on Flight Plan Menu Page 2, displays the Flight Log Pages. See the ARRIVALS - STARS AND APPROACHES subsection of the OPERATIONS section for detailed information.

If instead Flight Number is configured under the Flight Information option, this LSK displays FLT NBR. If Flight Number is configured, the pilot can enter a flight number in this field if desired.

**UniLink Route**

If UniLink is configured and the UniLink Route option is enabled, selecting UNILINK RTE, LSK [4R] on Flight Plan Menu Page 2, displays the UniLink Route Page. Refer to the applicable UniLink pilot’s manual for detailed information.
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 Page 1 is shown below on the left for the NASA T-38 and below on the right for non-NASA T-38 installations.

1. Press the FUEL key to access Fuel Page 1. The BASIC WT and Reserves plan values will be prefilled with the values last used.

2. Use the LSKs 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 LSKs 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 LSKs 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 OPTIONS PAGE - 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 LSKs. If the cross-side FMS has already been initialized with fuel data, it may be crossfilled into this FMS by pressing XFILL LSK.
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 Navigation Display Page. This page is accessed from the Navigation Menu Page by selecting NAV DISPLAY.

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

ENROUTE - Pressing this LSK will create a display sensitivity of ±5.0 nautical miles (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. ENROUTE sensitivity is selected by the FMS during normal enroute operations.

TERMINAL - Pressing this LSK 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. TERMINAL sensitivity is selected by the FMS when the Approach mode is armed and when within 30nm of the departure airport.
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**APPROACH** - Pressing this LSK will create a display sensitivity of ±0.3 nm. “IN USE” will appear next to APPROACH when selected. APPROACH sensitivity is selected by the FMS.
ENROUTE

Flight Plan Navigation

Once the flight plan is entered and the system is in Navigation mode, the FMS is ready to navigate the aircraft along the flight plan. No further entries or procedures are necessary. GPS and IRS sensors will be selected on the ground as shown on Data Page 2. 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 Navigation 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 leg 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 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.

Navigation Function

The NAV key is used to access the Navigation Pages. There are normally two Navigation Pages; however, when another Navigation mode such as Approach or Heading is selected, there will be two or more display pages that are accessed by pressing the PREV or NEXT keys.

FMS Computed Courses versus Published Courses

Some differences may be observed between FMS displayed courses and those published on aeronautical charts. Aeronautical charts are published using the VOR radials that define the route, whereas the FMS displays the computed course using local magnetic variation. Flight Plan 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. Magnetic 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 magnetic variation, depending upon how long ago the station was realigned with local variation. Legs that have CRS XXX° or HDG XXX° displays on the Flight Plan Pages should agree with the published data on the charts, since these are provided as part of the Navigation Database and are not computed by the FMS.

Information on the Navigation Pages for the current leg are displayed using the current position magnetic variation so 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.
Navigation Page 1

**Note:** This section discusses Navigation Pages when not in Approach mode. Refer to the discussion under the Approach Procedures heading later in this Operations section for a description of Navigation Pages when in Approach mode.

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.

On all installations except the NASA T-38, Navigation Page 1 appears similar to the example below.

![Navigation Page 1 Example](image1)

On the NASA T-38, Navigation Page 1 appears similar to the example shown below.

![Navigation Page 1 NASA T-38 Example](image2)
Effect of Procedural VECTOR Legs on Fuel/Time Calculations

Each VM leg in a flight plan adds 50 nm to the flight plan length. VM leg paths are designated on Flight Plan Pages as HDG ###, and VM leg terminator waypoints are designated as “(VECTOR)”, as illustrated by waypoint 6 on the screen shown below. When procedures with VM legs are linked to the flight plan, a “*NO LINK*” might or might not follow the VM terminator waypoint.

For such legs, the FMS creates a leg terminator waypoint at the end of the heading vector leg 50 nm from the origin. This allows EFIS & MFD systems to present a leg for display. The leg segment appears on these displays at the waypoint from which the vector begins and terminates 50 nm from the fix. When a VM leg becomes the active navigation leg, the waypoint is always 50 nm ahead of the aircraft on the specified heading. VM legs require either a manual leg change or a Direct-To operation for the FMS to sequence to the next leg.

Once the FMS has sequenced to the next leg of the flight plan, the additional distance is included in certain fuel and time calculations. The results of these calculations are displayed on:

- Fuel Page 2
- Performance Page 1
- Flight Plan Present Position to Waypoint Pages
- Flight Plan Waypoint to Destination Pages

As a consequence, the FMS will indicate on these pages that more fuel and time are required to complete the flight than is actually needed.
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FR - The waypoint identifier and time overhead of the FROM (FR) waypoint, or the takeoff time for the first leg. Time overhead is defined by automatic leg change. Additional navigational data for the leg between the FR and the TO waypoints is displayed on the line below the FR waypoint. The data displayed depends on current leg type (refer to the Procedural Leg Types subsection in the Database section to review the types of procedural legs).

- **TF or DF.** Turn direction, desired course, and the great circle distance in nm from present position to the leg terminator.
- **AF or RF.** Turn direction, arc radius in nm, and the identifier of the reference fix or waypoint at the center of the arc.
- **VA, VD, VI, VM or VR.** Turn direction and desired heading.
- **HA, HF or HM.** Turn direction, desired course and (HA and HM only) the identifier for the reference (hold) fix.
- **All Other Leg Types.** Turn direction, desired course and (FA, FC, FD and FM only) designation of the reference fix.

Additionally, ETE is displayed for leg types TF, CF, DF, RF or HF while holding is active. If ETE is greater than 99:59, then “++.++” is displayed.

TO - The TO waypoint identifier and either the ETA for that waypoint (leg types TF, CR, DR, RF or HF) or the identifier for the reference waypoint for the TO terminator (leg types CD, CR, FC, FD, VD or VR). For all other leg types, only the TO waypoint identifier is displayed.

Additional navigational data for the leg between the TO and the NX waypoints is displayed on the line below the TO waypoint. The data displayed depends on current leg type (refer to the Procedural Leg Types subsection in the Database section to review the types of procedural legs).

- **TF.** Turn direction, desired course, and the great circle distance in nm from present position to the leg terminator.
- **DF.** Turn direction and the text “(DIRECT)”. 
- **AF or RF.** Turn direction, arc radius in nm, and the identifier of the reference fix or waypoint at the center of the arc.
- **VA, VD, VM or VR.** Turn direction and desired heading.
- **HA, HF or HM.** Turn direction, desired course and the identifier for the reference (hold) fix (HA and HM only).
• **VI, CI or PI.** Turn direction and IF identifier (if Next leg is IF/TF) or flight plan leg length in nm (if Next leg is TF without IF) from present position to the leg terminator.

• **All Other Leg Types.** Turn direction, desired course and (FA, FC, FD and FM only) designation of the reference fix.

**NX** - The next waypoint identifier after the current TO waypoint and either the ETA for that waypoint (leg types TF, CR, DR or RF), the identifier for the reference waypoint for the TO terminator (leg types CD, CR, FC, FD, VD or VR) or either “LEFT” or “RIGHT” (leg type PI). For all other leg types, only the NX waypoint identifier is displayed.

**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 99.9nm may be displayed. (E) represents enroute scaling (5.0nm), (T) represents transition scaling (1.0nm), and (A) represents approach scaling (2° or 0.3nm, whichever is greater). Deviations less than 1.0 nm are displayed to 0.01nm resolution.

**WND** - The wind direction and speed computed by the Navigation computer.

**DESTINATION/FUEL OVERHEAD (NASA T-38 Only)** - These fields are adjacent to LSK [5L]. They display the final destination in the flight plan and the fuel overhead for this destination from Fuel Page 2. Units will be displayed as either pounds (LB) or kilograms (KG), depending on which is selected on Fuel Options Page 1. If the destination and fuel overhead are not entered at Fuel Page 2, these fields display dashes.

**GS (Non NASA T-38 Installations Only)** - The aircraft groundspeed in knots.

**ARRIVE (NASA T-38 Only)** - Selecting ARRIVE, LSK [4R], accesses the Arrival Page. See the ARRIVALS - STARS AND APPROACHES subsection of the OPERATIONS section for detailed information.

**Q or ANP** - The position error. When Q is configured, the Q value is displayed in this field. When ANP/RNP is configured, the ANP value is displayed.

**RNP** - If ANP/RNP is configured, this field displays the RNP value. If the pilot manually enters a value for RNP, (M) is displayed next to the value indicating a manual entry. If the value displayed is a published value, (P) is displayed next to the value. If no indication is displayed in
parentheses, the value is a system default value (refer to Position Certainty text in the CONTROL AND DISPLAY Section).

To manually enter an RNP:

1. Press LSK [5R] to highlight the field then enter a numerical value for RNP between 0.01 thru 99.99.
2. Press ENTER to accept the data.

To delete the manual entry and return the RNP to the highest priority level, press LSK [5R] to highlight the field, then press ENTER.

When Q is configured, LSK [5R] is inoperable.

**Navigation Page 2**

Press the NEXT/PREV keys to access Navigation Page 2. On most installations, the page will resemble the example shown below.

![Navigation Page 2 Example](image)

This page displays FROM, TO and NX waypoint information similar to Navigation Page 1. In addition, headwind, bearing to current terminator and track angle error is displayed.

**HEADWIND** - Displays the headwind or tailwind computed by the FMS.

**BRS** - Displays the bearing to the current leg terminator.

**TKE** - Displays the track angle error (TKE). The TKE is the difference between desired track and actual track, both in relation to true north. For procedural legs of type VA, VD, VI, VM or VR, TKE will be set equal to heading error, the difference between desired heading and actual heading. A positive value of TKE (i.e. desired track greater than actual track, or desired heading greater than actual heading) will be indicated by an L preceding the three digit angular value, and a negative value will be preceded by an R.
Navigation Page 3

Navigation Page 3, also called the Navigation Position Page, is accessed by pressing the NEXT/PREV keys.

FMS# POS - This field displays the current FMS position. Pressing either LSK [2L] or LSK [3L] will access the Define Position page for entry of present position coordinates.

HOLD POS - Pressing this LSK will access the Hold Position page (refer to discussion following this section).

RNP/ANP (Q) - When RNP/ANP is configured, pressing LSK [1R] allows entry of an RNP value. Refer to the Navigation Page 2 portion of this section for instructions. When Q is configured, the current value of Q is shown and LSK [1R] is inoperable.

UPDATE SENS - Pressing this LSK will send current FMS best computed position (BCP) latitude/longitude to Loran and inertial (ground-only) sensors. Pressing this key is equivalent to pressing HOLD POS and accepting the current latitude/longitude.

SENSORS - Pressing this LSK will access Data Page 3.
Hold Position Page


![Hold Position Page](image)

The position in the upper left of the page is supplied by the FMS. Pressing LSK [1L] allows this position to be manually updated, if desired.

Configured long range navigation sensors appear adjacent to LSKs [3L] through [5L], [3R] and [4R]. A crossfilled FMS, if one is available, will appear adjacent to LSK [5R]. Pressing the associated LSK for each sensor will cause its position to be displayed in the upper right of the page. For example, sensor GPIR3 is currently selected in the illustration above.

The difference in position between the FMS and the selected sensor is displayed below the two positions. In addition, the difference in distance between the FMS’s position and the selected sensor’s position is displayed next to the identifier of each sensor in nm. For example, the difference in distance between the FMS’s position and the position for GPS2 in the illustration above is 0.6 nm.
### Navigation Menu Page

The Navigation Menu Page is accessed by pressing the MENU key from any Navigation Page.

<table>
<thead>
<tr>
<th>NAV MENU 1/1</th>
</tr>
</thead>
<tbody>
<tr>
<td>● NAV DISPLAY</td>
</tr>
<tr>
<td>● MAP DISPLAY</td>
</tr>
<tr>
<td>● LAT/LONG XING</td>
</tr>
<tr>
<td>● MONOCHROME</td>
</tr>
<tr>
<td>● FMS 2ND CRS</td>
</tr>
</tbody>
</table>

**Note:** Options available depend on installation configuration.

**NAV DISPLAY** - Selecting LSK [1L] will display the Navigation Display Mode Page. The pilot may change the display mode (enroute, approach and terminal) from this page by selecting the applicable LSK. When in Approach mode, selecting any other mode from this page will disarm approach if armed and cancel approach if active.

**MAP DISPLAY** - Selecting LSK [2L] displays the Map Display Page. Refer to the Map Display Page portion of this section.

**MONOCHROME** - Selecting LSK [4L] when labeled MONOCHROME changes the FMS display to bright green only and changes the label for this selection to COLOR. When COLOR is selected, the FMS display returns to full color and the label changes back to MONOCHROME.

**FMS 2ND CRS** - This is a configurable option for Collins Pro Line 2 and Pro Line 4 4000 systems which enable the autopilot to respond to FMS roll steering commands. Selecting this LSK toggles the FMS 2ND CRS on and off.

**PATTERNS** - This option is only available in FMS Software Version 902. Refer to the Special Missions section of this manual (applicable to FMS Software Version 902 only) for detailed information.

**DRIFT TGT** - This option is only available in FMS Software Version 902. Refer to the Special Missions section of this manual (applicable to FMS Software Version 902 only) for detailed information.

**LAT/LONG XING** - Selecting LSK [3R] displays the Latitude/Longitude Crossing Points Page. Refer to the Latitude/Longitude Crossing Points Page portion in this section.
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**FIX** - Selecting LSK [4R] displays the Fix Page. Refer to the Fix Page portion of this section.

**RETURN** - Selecting LSK [5R] returns to the Navigation Pages.

**MAP Display Page**


![MAP DISPLAY](image)

On this page, pressing LSK [1L] toggles the MAP Display on or off. When the MAP Display is on, the FMS transmits the missed approach legs along with flight plan records for depiction on the Navigation display. This does not occur when the MAP Display is off.

The MAP Display also turns on automatically when any of the following occur:

- either the TO or the NX waypoint is in the missed approach
- the approach is cancelled prior to reaching the FAF
- the approach is exited because of manual leg change
- a new approach is inserted into the flight plan

Pressing RETURN, LSK [5R], returns to the Navigation Menu Page.
Latitude/Longitude Crossing Points Page

The Latitude/Longitude Crossing Points Page is accessed by selecting LSK [3R] from the Navigation Menu Page. For an entered latitude, the FMS computes the longitude at which the aircraft will cross that latitude. For an entered longitude, the FMS computes the latitude at which the aircraft will cross that longitude. The FMS then displays the computed latitude or longitude, ETA and Distance to Go to intersection (DTG) values. Crossing points may also be defined or erased on this page.

To define a crossing point:

1. If computing a crossing longitude is desired, press LSK [1L] to move the cursor to the LAT field and enter the latitude of the first crossing point. The corresponding longitude, ETA and DTG will automatically fill their respective fields.

2. If computing a crossing latitude is desired, press ENTER to advance the cursor to the LONG field and enter the longitude of the first crossing point. The corresponding latitude, ETA and DTG will automatically fill their respective fields.

3. Repeat this process up to three more times as desired by pressing LSK [2L], [3L] or [4L].

To delete a crossing point:

With the cursor over a crossing point, selecting LSK [5L] will erase the point.

Pressing RETURN, LSK [5R], returns to the Navigation Menu Page.
Fix Page

Selecting LSK [4R] from the Navigation Menu Page accesses the Fix Pages. The Fix Pages are used to compute the relative position of the aircraft (with respect to any fix and the intersection points of a radial or a distance) from the fix to present position on the flight plan. This page displays the calculated radial distance and ETA to abeam, radial or distance intersections between any one of up to nine fixes and the present position on the flight plan. A message annunciator alerts the crew when the abeam intersection is sequenced.

![Fix Page Display](image1)

To define a fix:

1. Enter a fix identifier at LSK [1L]. Press ENTER. The radial and distance from the fix to present position is displayed.

2. Enter a radial value at LSK [2L]. The distance from the fix to the radial intersection, DTG and ETA will be displayed.

Note: Pressing ENTER instead of entering a radial in the RAD field will move the cursor to the DIS field where the distance from the fix to the radial intersection can be entered. The radial from the fix to the radial intersection, ETA and DTG will be displayed.

3. Another radial or distance can be entered at LSK [3L].

4. If desired, define additional fixes by pressing the NEXT or PREV keys to access additional Fix pages and repeating steps 1 through 3.

To erase a fix:

Selecting LSK [5L] will erase all data from the current Fix Page.
To turn abeam on or off:

An Abeam intersection is the intersection of the shortest line from a fix to the flight plan. If an intersection is ahead for the entered fix and if the abeam distance is less than 200nm, abeam information is automatically displayed at LSK [4L]. The radial and distance from the fix to the intersection, DTG and ETA are displayed. The pilot may turn abeam on or off by selecting LSK [4L].

Automatic Leg Change

Normally, leg changes along a flight plan are automatic. Automatic leg changes will not occur if there is no NX waypoint on the Navigation 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 12nm. 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 50nm 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 key to access Navigation Page 1.
2. Use the LSKs 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.

Note: 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.

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 not on 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 directly to a waypoint:

1. Press the DTO key to access the Direct-To (DTO) Page. The cursor will be over the DIRECT-TO waypoint entry field and a listing of flight plan waypoints will be shown.

   The turn direction will default to shortest turn, therefore no action will be required by the pilot. However, the turn direction can be changed by selecting LSKs [1R] and [2R], LEFT or RIGHT direction. Pressing LSK [2R] will cancel LEFT or RIGHT and return default to shortest direction.

2. Enter the identifier of the desired DTO waypoint or, 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 enter the identifier manually.

   Note: If the DTO waypoint entered was on the flight plan, the display will return to the Navigation Page. <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.

   Note: If the DTO waypoint entered was not on the flight plan, the display will show a Navigation 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.

**Note:** On all installations except the NASA T-38, if the DTO point is an airport not on the flight plan AND a STAR for the original destination airport has not already been linked to the flight plan, the FMS will automatically change the default airport on the Arrival Page to the DTO airport. If a STAR for the original destination airport has already been linked to the flight plan, that airport will remain the default airport on the Arrival Page, and the pilot must select the DTO airport as the new default airport on the Arrival Page before linking a STAR to the flight plan.

On the NASA T-38 only, if the DTO point is an airport not on the flight plan, the FMS will automatically change the default airport on the Arrival Page to the DTO airport, whether or not a STAR for the original destination airport has already been linked to the flight plan.

Refer to the Link a STAR to the Flight Plan heading later in this section for more information.

3. 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.
Navigation Maneuver Functions

The Maneuver Page is accessed by selecting LSK [2R] from Navigation Page 1. The pilot may define a holding pattern, perform a DTO HOLD or disarm a holding pattern by pressing LSK [1L]. The Heading, Pseudo VOR and Selected Crosstrack page are accessed by selecting the applicable LSK from the Maneuver Page.

If a holding pattern has been defined, DTO HOLD/PROCEED, DISARM HOLD and CONTINUE HOLD options will also be displayed on the Maneuver Page.

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 Database. 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.
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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. ETA over the holding fix is constantly displayed.

If a holding pattern is defined and the hold is not armed or activated, the definition of the last hold defined will be retained even if the HOLDING page is exited.

A holding pattern can be disarmed by pressing DISARM HOLD on the Maneuver Page.

Refer to the ARRIVAL Section, Approach Procedures for information about automatic and manual holding pattern termination.
Holding Pattern Depiction on Navigation and Flight Plan Pages

Holding pattern definitions and terminators are displayed below as they appear on Navigation and Flight Plan Pages. Holding fixes are designated as overfly waypoints on the pages. An asterisk “*” appears following the waypoint on these pages. The letters HLD, proceeded by a turn direction arrow and followed by the inbound course designates the holding pattern. A “T” or “°” 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:

Example Flight Plan Page Showing HA Leg

Example Navigation Page Showing HM Leg
Section V
Operations

Holding Pattern Depiction on HOLD FIX, NAV LEG and DTO Pages

Waypoints with holding patterns, whether obtained from the procedural database or defined by the pilot, are depicted as shown. 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.

![Holding Pattern Diagram](image-url)
Program a Holding Pattern

1. Select the MNVR LSK on Navigation Page 1 to access the Maneuver Page.

2. Press LSK [1L], HOLDING DEFN. If a holding pattern is in the Navigation Database, or a holding pattern has been previously programmed, the Holding Page is displayed.

   The TO waypoint for the next hold fix in the Flight Plan is in the FIX field. Information from the Navigation Database or information previously programmed is displayed in its applicable field.

3. To program a holding pattern, select the FIX LSK. The Hold Fix Page is displayed.

4. On the Hold Fix Page, select the TO waypoint or enter the reference number for the desired waypoint to access the Holding Pattern Definition page.

5. Press LSK [5L], ARM HOLD (see following illustration), to accept the holding pattern with the default values. To modify information in the INBD, DIR, TURN direction, TIME or DIST fields, press the LSK associated with the field. Enter the correct data then press ENTER to accept the data.
The ARM HOLD prompt changes to DTO HOLD after the LSK is pressed. Holding patterns cannot be armed on the ground.

The ENTRY field displays the entry to be flown when the pattern is activated. Entries can be direct (DRECT), parallel (PARLL) or teardrop (TRDRP). The pilot can modify these when within ±20° from AIM holding pattern entry sector boundary line by pressing LSK [4R], ENTRY, to access the HOLD ENTRY Page. Available entries are displayed. Press the appropriate LSK to change.

**Note:** ETA is displayed in UTC at all times. ETA will be updated each time the FIX is overflown and accounts for current TAS and wind conditions.

**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 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 is annunciated. 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.
View a Previously Defined Holding Pattern

1. Select the MNVR LSK on Navigation Page 1 to access the Maneuver Page.

2. Press LSK [1L], HOLDING DEFN. If a holding pattern is in the Navigation Database, or a holding pattern has been previously programmed, the Holding Page is displayed.

   The TO waypoint for the next hold fix in the flight plan is in the FIX field. Information from the Navigation Database or information previously programmed is displayed in its applicable field.

3. To change the holding pattern, select the FIX LSK. The Hold Fix Page is displayed.

4. Enter the reference number for the hold fix. The Holding Pattern Definition Page is displayed with the previously defined holding pattern information filled.

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.
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**Commanded Heading Page**

The Commanded 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 CMD HDG LSK on Navigation Page 1, the Maneuver Page or on the Navigation Approach Page.

**Note:** The HDG prompt is available as a configuration option. It may or may not be available on all installations.

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 LSK.

**Note:** The current navigation 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 Navigation Page 1 and can be altered using the procedures described for Navigation 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 LSK (INTERCEPT or HDG SEL). The cursor's position defaults to this entry field so heading changes can be made easily. 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 (±) 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 ± 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 LSK is used to change the heading mode currently in use. The line will read HDG SEL or INTERCEPT depending upon the mode. 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 INTCPT. The heading mode in use is displayed below the page title. In the Heading Select 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 commanded heading until intercepting the active navigation leg. When the navigation leg is intercepted, the FMS will revert to normal navigation and will display Navigation Page 1.

**MNVR** - Pressing LSK [3R] will access the Maneuver Definition Page. ARM APPR or ACT APPR - If an approach is linked to the flight plan, LSK [4R] indicates ARM APPR when 50nm 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, selecting this option immediately cancels the heading mode and the FMS provides steering to intercept the active navigation leg at a 45° angle. If the heading mode is not active, RETURN is displayed and pressing the LSK will return the display to the page previously displayed.

On Installations Interfaced with Collins C-14 or Compatible EFIS Software, there is a two way interface with the Heading Bug. This function allows the FMS to receive selected heading settings driven from the heading select knob. These 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) flies these headings when Navigation mode is engaged.
Pseudo-VOR Function

The Pseudo-VOR (PVOR) Page provides the capability to track to or from any known waypoint on a programmed course or radial. The PVOR Page is accessed from Navigation Page 1 (or Page 2 when in the Approach mode), the Maneuver Page or the DTO Page.

To Program a PVOR:

1. Select a waypoint by accepting the TO waypoint or entering the appropriate reference number of another waypoint from 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. 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

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.

3. Press accept LSK [5L] to accept the PVOR. The PVOR is active and the display returns to the Navigation 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:
Perform a DTO function or a manual leg change, or select the Approach mode to delete the PVOR function.

Selected Crosstrack - Parallel Course (SXTK)
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. From the Maneuver Page, press LSK [3R], SXTK. Navigation 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 (±) key or the appropriate alpha (L, R) key to change the direction (left or right) of offset.
3. Enter the desired offset in nm 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:
From the Maneuver Page, press LSK [3R], CNCL SXTK.
(An alternate method is to enter a value of 0.0nm in the SXTK data field on Navigation Page 1)

Note: A selected crosstrack is also 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.
Vertical Navigation

Vertical Navigation General Information

The Vertical Navigation (VNAV) function allows the flight crew to define a desired vertical flight profile along the flight plan. It also computes aircraft deviation from that profile.

Some installations provide for flight director/autopilot-coupled Enroute VNAV and Approach VNAV operations while others may provide only advisory displays of VNAV information.

The vertical flight profile consists of a series of vertical waypoints, each of which contains a reference flight plan fix, an along-track offset and a target altitude.

VNAV operations are controlled by the target vertical speed entered by the pilot for the first waypoint and the vertical speed computed, based on the altitudes, for second and subsequent vertical waypoints. A flight profile which results in a climb will provide vertical speed required (VSR) information only and the VNAV deviation display will be set invalid.

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.

The VNAV function has four operating states: Inactive, Cruise, Enroute Path Descent and Approach Path. The current state is determined by the aircraft position relative to the defined path.

- **INACTIVE**: VNAV will be in the Inactive state until a VNAV TO waypoint and a vertical flight path (target vertical speed) to that waypoint have been defined.

- **CRUISE**: The VNAV function will enter the Cruise state when the VNAV TO waypoint and the vertical flight path have been defined, the aircraft is not more than 200 feet below the reference altitude of the VNAV TO waypoint and the vertical flight path will be intercepted ahead of the aircraft. VNAV Cruise state is activated by entry of a valid VNAV TO waypoint and entry of a target vertical speed.
The Cruise state shows the distance to the top of descent point (TOD) in nm; 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 (FPA) is displayed in degrees. When VNAV is selected for display on the aircraft instruments, vertical deviation will be displayed prior to TOD capture point.

- **ENROUTE PATH DESCENT**: The Descent state is activated by crossing the Top-Of-Descent point while in the Cruise state or by selecting the Vertical-To (VTO) function. Aircraft deviation from the vertical flight path is displayed.

- **APPROACH PATH**: The Approach Path state is entered when the approach state is activated automatically or manually by the pilot from either the inactive or enroute path descent state. The VNAV Approach Path state is described in detail in the ARRIVAL section of this manual.

VNAV mode will cancel under any of the following conditions:

- The ADC altitude becomes invalid.
- The ADC altitude is not barometer-corrected below 18,000 feet.
- The ADC is deselected.
- A manual altitude is entered.
- A “POSITION UNCERTAIN” message appears.
- Selected Crosstrack Mode is activated.
- The Cancel VNAV LSK is pressed.
- Crosstrack deviation becomes greater than 12.5 nm.
- A gap in the Enroute flight plan is encountered.
- An Enroute/Approach VNAV waypoint gap is encountered.
- A valid vertical leg does not exist after sequencing a Hold Fix.
If any of these occur prior to entering a VNAV leg, the system will revert to the INACTIVE State and TOD will be removed. Vertical deviation will be set invalid.

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 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.

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 VNAV TO 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).
VNAV Menu Page

The VNAV Menu Page is accessible from any VNAV Page by pressing the MENU key.

The pilot may enter a default target vertical speed and flight path angle for VNAV from this page. Press the applicable LSK to highlight the field, then enter the desired value and press ENTER.

VNAV Setup and Activation

For VNAV to operate, at least one vertical waypoint must be defined for the flight profile. The reference Flight Plan fix, offset distance and target altitude must be entered to define each vertical waypoint. Target vertical speed must be entered to activate VNAV mode.

Entering Vertical Waypoints

Vertical waypoint altitudes may be manually entered on the VNAV Path Page or on the Flight Plan Pages. If an offset VNAV waypoint is required, the function can be entered only on the VNAV Path Page by entering an offset mileage before or after the fix. The VNAV Path Page can be accessed from the Flight Plan Pages by pressing the left LSK adjacent to the waypoint identifier, then the OFFSET LSK [5R].
VNAV Flight Path Definition Procedure

**Note:** A flight plan must be active, as flight plan waypoints are used to define VNAV waypoints.

1. Press the VNAV key. The VNAV Path Page is displayed and all entry fields are prefilled with the current flight plan waypoints.

   ![VNAV Path Page](image)

   - TCMP VNAV PATH 2/3
   - ALT HOLD
   - TOD 24.6/0+08
   - FR PPOS
   - TO RADDY
   - NX BEVIS

   - Entry Field
   - Target Altitude Entry Field

   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. The terminators of the following leg types are not displayed: Heading to Manual Terminator, Course from Fix to Manual Terminator, Course to Altitude, Heading to Altitude, Hold to Altitude, Course to Intercept, Heading to Intercept, Course to Radial, Heading to Radial, Heading to DME Distance.

   Enter a waypoint by selecting the reference number of the waypoint and pressing ENTER.

   A valid vertical leg may include conditional legs (Heading to Intercept, Heading to Radial, Heading to DME Distance, Course to Intercept, Course to Radial, and Course to DME Distance), hold

REASON: To reference the Cold Temperature Compensation section, which clarifies the differences between SCN 802.0/902.0/802.1/902.1 and 802.2/902.2 and later on temperature-compensated manually entered altitudes per SCN 802.2/902.2 release.

FILING INSTRUCTIONS: Insert this Temporary Change into Report No. 2423sv802/902, Section V, adjacent to page 5-69. This Temporary Change replaces Temporary Change dated 16 March 2004 filed at this same location, which may be removed and discarded.

INSTRUCTIONS: Insert the following NOTE after the fourth paragraph but before “5. Press LSK [4L] to …”.

NOTE: Under certain circumstances, manually entered altitude constraints used in conjunction with Temperature Compensation may produce VNAV disconnect. Refer to the Cold Temperature Compensation section in OPERATIONS for further information about how manually entered VNAV altitude constraints are affected by this feature.

The following vertical legs are invalid: Heading to Altitude, Course to Altitude, Course from Fix to Altitude and Hold to Altitude. VNAV uses such legs as if they were a gap in the flight plan and will cancel when the FMS enters one of these legs. VNAV may be activated after transitioning out of the leg to continue with the flight path.

3. Altitude constraints for conditional legs and manual termination legs are advisory information only, therefore the terminators of such legs are invalid vertical waypoints.

4. The cursor expands to cover the offset distance entry field. Use the ± 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, if desired.

The cursor expands to cover the target altitude entry field. Entries to this field may be either altitudes or flight levels. Altitudes should be entered as either 4 or 5 digits (more or less than 10,000 ft). Flight levels should be entered as either 2 or 3 digits (above or below flight level 100) i.e. FL090 is entered as 09. The flight level is automatically inserted when this flight level format is used. If an altitude is entered which results in a FPA greater than the configured maximum FPA, it will flash and not be accepted. A drop down message (FPA TOO STEEP) is displayed.

5. Press LSK [4L] to access the NX entry field and repeat the above process to define the NX waypoint.

6. Press the NEXT key to view succeeding VNAV waypoints on VNAV Path Page 2. Repeat the above process to define all succeeding waypoints.

7. Press LSK [1R] to access the target vertical speed field and enter the desired vertical speed. This field will prefill with dashes until the pilot enters an altitude. It then displays the default target vertical speed from the VNAV Menu Page. This value can be accepted by pressing the ENTER key or overwritten manually. Invalid entries will cause the V/S entry to flash, and an error message will be displayed (see the Target Vertical Speed portion of this section).
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8. When the TO VNAV waypoint and the target vertical speed entries have been made, the distance and time to the TOD will be displayed, as well as FPA. Vertical deviation indication will be with respect 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.

8. 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.

Refer to the ARRIVAL section in this manual for VNAV mode during approach.

**VNAV Flight Profile Deletion**

1. Press the VNAV key to access the Vertical Navigation Page.
2. Press any TO or NX LSK.
3. Enter the number "99."

The vertical flight profile will be deleted and the Vertical Navigation Pages will fill with the next six waypoints on the flight plan.
**Target Vertical Speed**

The target vertical speed (TVS) entry represents a commanded rate of descent to the first VNAV waypoint from the TOD (not present position). The VNAV function calculates the TOD to achieve the FPA dictated by the commanded descent rate.

When the TVS to the first waypoint is entered, the flight path angle will be calculated and “locked in”. Subsequent groundspeed changes prior to TOD will cause the displayed TGT V/S to vary proportionately in order to maintain the flight path angle.

The TVS entry must exceed the minimum vertical speed required but be less than the maximum vertical speed allowed. If the TVS entry is less than the minimum vertical speed required, the FMS computes a TOD point behind the present position and the TVS entry will blink. If the TGT V/S entry exceeds the maximum vertical speed allowed, the FMS calculates a TOD point that would result in an FPA exceeding configured limits. The entry will blink. The maximum vertical speed allowed is defined as roughly ten times GS for fixed-wing aircraft and sixteen times GS for rotary-wing aircraft. Maximum FPA is configured at the time of installation.

The following figure is a representation of three scenarios produced by three different vertical speed entries and their corresponding TOD points.
TVS Entry between Maximum and Minimum Vertical Speed Allowed

In this scenario the TVS entry will be accepted and all values are within limits. A typical TVS entry would be approximately five times ground speed to result in a 3° descent angle. As a rule of thumb, a 3° descent FPA will result in a smooth descent (e.g., @ 400 knots use 2000 fpm).

TVS Entry Above Maximum Vertical Speed Allowed

In the second scenario, a high value for TVS has been entered and the TOD is delayed to achieve the desired descent rate. As shown in the figure, the descent angle is increased and the computed change in FPA will exceed the limit configured for FPA. This occurs independently of the distance between vertical waypoints. When a high TVS entry causes the calculated path to exceed the FPA limit, the TVS value will blink and the drop down message (TGT VS TOO HIGH) is displayed. The maximum TVS that can be entered is 6000 fpm.

TVS Entry Lower than Minimum Vertical Speed Required

In the third scenario, V/S LOW, a low TVS entry results in a descent rate where the path will not intercept the waypoint at the desired altitude. When the TVS entry is too low, the TVS value will blink and a message (TGT VS TOO LOW) is 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 TOD is behind or too far ahead of the present position of the airplane (as indicated in the figure), a rapid downward pitch angle with a descent rate exceeding the entered TVS would be required. The FMS is designed to prevent this from occurring and will not allow the descent rate to exceed the commanded TVS entered by the pilot.

The FMS also implements a pitch change anticipation function so the vertical speed is increased gradually until the desired TVS value is reached. This avoids a rapid pitch down to achieve the TVS. To do this, the FMS calculates a transition and adds it to the distance needed to reach the vertical waypoint.
VNAV Cruise State

VNAV Path Page 1

VNAV Path Page 1 is accessed when the VNAV key is pressed while in the Inactive or Cruise mode. This page is used to define the vertical flight profile and is active prior to intercepting the vertical flight path (at which time the VNAV Descent page becomes active).

Message Annunciations

Two minutes prior to TOD, a TOP OF DESCENT ALERT message will activate on the Message Page. At fifteen seconds prior to TOD, the WPT annunciator will flash and a VPATH CAPTURE message will activate on the Message Page. At fifteen seconds prior to any vertical waypoint, a VERTICAL WPT ALERT message will activate. The WPT alert annunciator will remain illuminated until vertical leg sequencing occurs. If lateral and vertical waypoints are co-located, the WPT annunciator will flash, as vertical waypoints take precedence over lateral waypoints.

<table>
<thead>
<tr>
<th>VNAV PATH 1/2</th>
<th>TGT V/S</th>
<th>1500</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VDEV</td>
<td>-2000</td>
</tr>
<tr>
<td></td>
<td>FR PPOS</td>
<td>-2.2</td>
</tr>
<tr>
<td></td>
<td>TO RADDY</td>
<td>-15</td>
</tr>
<tr>
<td></td>
<td>102 NM</td>
<td>-1.161</td>
</tr>
<tr>
<td></td>
<td>BEVIS</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>14000</td>
<td></td>
</tr>
</tbody>
</table>

TGT V/S [1R] - This entry of TVS, in feet per minute, is used for computing the vertical flight path to the TO VNAV waypoint.
The maximum TVS that can be entered is one which results in a FPA not exceeding the maximum programmed into the configuration module at the time of installation. Refer to the Target Vertical Speed portion of this section for more information.

If a TVS is entered which exceeds the maximum, then the entry will flash and not be accepted, and a message will be presented to the pilot. Similarly, TVS will not be accepted if there is insufficient time to descend to the vertical waypoint or if crosstrack is greater than twelve nm.

**TOD xx.x NM** - The distance remaining, in nm, and time from the aircraft's present position to the TOD. The TOD is based upon present groundspeed, present altitude, the altitude for the VTO waypoint location and the TVS the pilot has entered for the descent.

When the TVS is valid, the FPA for the current leg is displayed next to the TOD field.

**FR PPOS [2L]** - 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 VNAV TO Waypoint **Distance**, expressed in nm. The distance from PPOS to the first vertical waypoint. If the vertical waypoint is above current altitude, then this field displays “CLIMB”. If the aircraft is in a hold, this field displays dashes.

- The VNAV TO Waypoint **Flight Path Angle**, in degrees. Displays the FPA for the current vertical leg.

- The VNAV TO Waypoint **Vertical Speed Required**, in feet per minute. Displays the vertical speed required to obtain the target altitude at the VNAV TO waypoint from PPOS.

**TO and NX [3L, 4L]** - 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 offset distance is the target altitude for that vertical waypoint.

Between the TO and NX lines are:

- The NX Vertical Waypoint **Distance**, in nm. Displays the distance from the VNAV TO waypoint to the NX vertical waypoint.

- The NX Vertical Waypoint **Flight Path Angle**, in degrees. Displays the FPA for the next vertical leg.

- The NX Vertical Waypoint **Vertical Speed Required**, in feet per minute. Displays the vertical speed required to obtain the target altitude at the NX vertical waypoint from the VNAV TO 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 LSK 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. Refer to the Vertical-To procedure in this section for detailed information.
VNAV Path Page 2

VNAV Path Page 2 is accessed by pressing the NEXT or PREV key from VNAV Path Page 1. The pilot can enter altitudes and offsets associates with flight plan waypoints and a vertical speed to descent to the desired altitude on this page.

This page displays subsequent vertical waypoints, and their distance, FPA, VSR and altitude as described on VNAV Path Page 1.

**LSK [1L] thru [4L]** - Pressing any of these LSKs displays the Vertical Waypoint Select Page.

**LSK [1R] thru [4R]** - Pressing any of these LSKs places the cursor over the altitude field where the altitude may be entered or edited.

**CNCL VNV** - This option is displayed when VNAV is active and an approach is not active. Pressing LSK [5L] cancels VNAV mode. If an approach is active in the flight plan, CNCL VNV is displayed as an unavailable option.
Vertical-To Procedure

This procedure is similar to the Direct-To procedure for lateral flight paths, but is used in vertical flight paths. It is designed to redefine an already established VNAV leg.

1. Press the VNAV key to access the VNAV Page.
2. Press the VTO LSK to access the Vertical-To Page.
3. Vertical waypoints are listed below the VTO entry field. The offset distance, altitude and vertical speed required are displayed next to the respective vertical waypoint. Invalid waypoints are displayed in small font.
   Enter the reference number of the desired VNAV Direct-To waypoint.
4. If the entered vertical waypoint does not satisfy the altitude constraint, the entry will flash within the cursor.

When choosing a VTO waypoint that results in a climb, the vertical waypoint field flashes to indicate an illegal entry has been made. The FMS does not allow climbs during VNAV. The drop down message NO CLIMB VTO will display on the message screen.
VNAV Enroute Path Descent State

VNAV descent mode is activated by crossing the TOD point while in the cruise mode or by selecting the Vertical To (VTO) function.

TGT V/S - TGT V/S (TVS) is the vertical speed required that was computed for the next leg. If that results in an FPA higher than configured limits, then VSR is recalculated to be within the FPA limit.

VDEV - Vertical deviation above (+) or below (-) the vertical flight path is displayed above the FR PPOS field.

All other fields and functions are identical to Cruise mode VNAV Path Page 1. Refer to the Cruise state portion of this section for their descriptions.

Holding Pattern while in VNAV Enroute Descent State

A holding pattern can be a valid vertical leg for VNAV if both the Hold Entry Fix (waypoint preceding the hold leg terminator) and Hold Fix have an AT altitude constraint, either manually entered or input to the flight plan from the Navigation Database. The FMS can provide VNAV path steering during holding patterns if the preceding conditions are valid and the altitude constraint at the Hold Fix is less than or equal to the constraint at the Hold Entry Fix. If the altitude constraint at the Hold Fix is equal to the constraint at the Hold Entry Fix, VNAV will remain in the path mode and hold altitude at the Hold Entry Fix.
When a holding pattern is inserted into a flight plan, an entry altitude may be programmed at the holding fix. VNAV descent to this altitude, prior to entering the hold, may be performed by entering the TVS as with any enroute waypoint.

**Note:** Entering a holding pattern into the flight plan between PPOS and the TOD will cancel the TOD calculation. An attempt to reenter the TOD information will result in a LEG RESTRICTION message. The TOD is recalculated when the holding pattern is completed or removed from the flight plan.

When creating an along-track-offset from a Hold Entry Fix on the VNAV Path Page, entry of a positive offset distance is considered an invalid entry. When creating an along-track-offset off of a Hold Fix, entry of a negative offset distance is considered an invalid entry.

Once a holding pattern is programmed and armed, a (HOLD) waypoint field is inserted into the flight plan as illustrated below.

```
VNAV PATH 1/2 M
TGT V/S
-1500

TOD 67.1/0+21 -3.34°
FR PPOS
53.1 NM -0.85° -84
TO TUS @15000
VDEV 3000 --.---
NX (HOLD) @12000

VTO→
```

To descend during the holding pattern, VNAV must be active and a (HOLD) altitude lower than or equal to the entry altitude must be entered for the (HOLD) waypoint on the Flight Plan or Vertical Navigation Pages before the holding pattern is sequenced. This allows descending to the holding fix with VNAV active and descending to a lower altitude during the hold.
The lower altitude represents a level VNAV path. The initial vertical deviation in the hold will equal the difference between the entry altitude and the holding altitude.

When flying a holding pattern and arriving at the constraint altitude, VNAV will remain in the path mode and hold altitude at the Hold Fix. When PROCEED is selected, VNAV will sequence the Hold Fix at the same time as LNAV sequences the Hold Fix.
**Note:** When flying a holding pattern while in VNAV mode, the FMS commanded bank angle may exceed the configured roll angle limit in order to fly the defined flight path.

In installations that provide coupled VNAV enroute operations, the FMS will provide vertical steering to the entry altitude and subsequent vertical steering in the hold at a constant vertical speed (approximately 650 fpm). Pitch steering commands to FGSs with coupled VNAV will provide smooth transitions during the hold entry to hold descent path change and level off commands when the lower altitude is reached.

In installations that do not provide coupled enroute VNAV, but provide VDEV displays, the pilot must use a manual descent or vertical guidance mode appropriate to descend to the holding altitude.

VNAV Descent while in a holding pattern is depicted on VNAV Path Page 1 as shown below:

![VNAV Descent in Hold](image)

The TVS and FPA are zero. VDEV represents the altitude remaining during the descent and will display zero once the lower holding altitude has been reached. The VNAV TO waypoint distance, FPA and vertical speed required fields display dashes. When the aircraft levels at the holding altitude, VDEV will be zero.

Vertical deviation scaling (feet per dot) is determined by the display device and may be different for Cruise, Enroute Descent and Approach states. Consult the Aircraft Flight Manual or AFMS for the specific scaling. As the aircraft descends during the hold to the HOLD @ altitude, the deviation will decrease to centered deviation when reaching the level VPATH of the HOLD altitude.
VNAV Transition from Enroute to Approach State

For the FMS to provide VPATH approach operation, the database approach must have AT altitude constraints from the FAF and RWY or MAP waypoints. Circle to land approaches and approaches where the MAP is beyond the runway threshold do not have AT altitude codings, therefore, VPATH approach operation is not available.

Manual Approach Activation

When an approach is manually activated, VNAV disconnects when transitioning from Enroute to Approach mode. This automatic VNAV disconnect is intentional and provides protection from a sudden pitchover or pitch up to capture the final approach VNAV path.

There are two recommended operational procedures to fly VNAV during Approach mode.

- The pilot can manually fly the aircraft to the approach VNAV path 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 VNAV path. Then select VNAV mode, which will arm the flight director/autopilot for capture.

Automatic Approach Activation

For automatic approach activation, the VNAV approach path will become valid when the VNAV sequences onto the FAF/RWY (or MAP) leg. If enroute VNAV was active prior to the sequence, the system attempts to provide a smooth transition from the enroute path to the approach FPA path.
Manual Affected

Filing Instructions
Insert this Temporary Change adjacent Page 5-83.

Purpose
To correct VDEV value.

Instructions
Replace the illustration for Automatic Approach Activation at the top of page 5-83 with the following illustration.
Note: VNAV will disconnect if the vertical deviation is greater than 175 feet relative to the approach VNAV Path at the time of VNAV leg sequence to the approach VNAV path. If it is less than 175 feet, VNAV mode will stay coupled through the transition.

VNAV Enroute Pitch Commands with Collins, Honeywell or Thales EFIS

If the installation includes an interface with a Collins, Bendix/King or Honeywell FGS compatible with the FMS pitch commands (refer to specific AFMS), then enroute VNAV profiles may be flown while coupled to the 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 TOD, the MSG light flashes and the message 2 MIN TO TOP OF DESCENT appears on the Message Page. Pressing the MSG key will acknowledge the message and remove it from the page. 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 Select Panel.)
At 15 seconds to TOD or any other vertical waypoint, a WPT annunciator flashes, and VNAV WAYPOINT ALERT appears on the Message Page. After acknowledgment of the message, the aircraft will capture and fly the defined VNAV profile. Vertical deviation at capture is dependent upon aircraft speed and the path angle. The VNAV pointer on the Collins EFIS display may still be off the scale when the path is initially captured. 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 pitch over 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.

**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 re-center after the new course is tracked.

### VNAV Error Messages

The following error messages will appear on the Vertical Navigation Page whenever an invalid entry is made in TVS or altitude data fields.

**ADC ALT INVAL** - (1) Aircraft altitude is < FL180 and only pressure altitude is available, or (2) ADC altitude has failed.

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

**CLEAR MAN ALT** - A manual entry for altitude was made on the ADC Status Page.

**CLR SXTK** - Aircraft is flying a selected crosstrack distance prior to VNAV activation.

**CLR XFILL ALT** - A VNAV plan is defined, but crossfilled altitude is being used by the system.

**FPA TOO STEEP** - FPA is steeper than maximum FPA configured at time of installation.

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

**LINK NAV/FPL** - VNAV distance is invalid because the VNAV plan is not linked to the guidance legs.
NO CLIMB VTO - The FMS does not permit a VTO procedure which results in a climb.

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

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

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

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

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

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

TOP OF DESCENT ALERT - Appears two minutes prior the TOD to indicated approaching TOD.

VERTICAL WPT ALERT - Appears fifteen seconds prior to intercepting a VNAV TO waypoint.

VPATH CAPTURE - Appears fifteen seconds prior to TOD to indicate intersecting VPATH.

XTK TOO GREAT - Current crosstrack is > 12.5 nm.
Intentionally left blank
Temporary Change

Manual Affected

Filing Instructions
Insert this Temporary Change at the front of the ARRIVAL section.

Purpose
To provide mitigation steps for CDU Data Bus Failure until software is upgraded.

NOTE: This Temporary Change does not apply to installations using SCN 802.5/902.5 and later.

Instructions
Insert the following text at the front of the ARRIVAL section.

Erroneous FMS Operation during a Holding Pattern Course Reversal Approach Transition

In FMS software version 802.0/902.0 through 802.4/902.4, a CDU DATA BUS FAIL message can occur at automatic approach activation when an approach transition includes a holding pattern course reversal at the FAF.

The failure occurs when an approach transition, with a holding pattern course reversal, is linked to the flight plan, resulting in a *NO LINK* or *GAP* being inserted into the flight plan and not being removed from the flight crew prior to automatic approach activation.
Recognition of the failure can be determined by:

- The CDU DATA BUS FAIL message in red text displaying on the FMS CDU.
- The distance to the next waypoint (FAF) will stop counting down.
- The lateral deviation display will be active but erroneous.
- The vertical deviation will be invalid and stowed.

Flight Crew procedures:

- Ensure the underlying NAVAID is tuned and displayed for VOR/NDB/LOC/BC overlay approaches.

- Procedural mitigations:
  - DO NOT enter this type of transition in the flight plan, or
  - The flight crew should ensure that all *NO LINK* or *GAP* entries before the FAF have been removed from the flight plan, or
  - Manually activate the approach more than 2 nm prior to the FAF.
ARRIVALS - STARS AND APPROACHES

The Navigation Database 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.

Link a STAR to the Flight Plan

When given an Arrival Procedure by ATC, a STAR may be linked into the flight plan in a manner similar to that for linking a SID. To link a STAR:

1. From Flight Plan Menu Page 1, press ARRIVE, LSK [4R], to access the Arrival Page. The destination airport will prefill the ARRIVE field.

2. A list of runways is displayed. Enter the reference number for the landing runway in the RUNWAY field.

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 and press ENTER.

4. A list of transitions for the selected STAR will appear. Select the transition by entering its reference number. 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 approach transition by entering the reference number.

Note: Selecting the approach and its transition may be delayed until later in the flight.
Selecting FPL, LSK [5R], returns the display to the Flight Plan Pages, where the STAR legs and approach will now be a part of the flight plan, as shown.

![FPL Chart](image)

**Note:** A STAR containing a RADAR vector might specify guidance actions to the FMS resulting in not maintaining an existing heading. The pilot should compare the SID chart to the FMS flight plan to ensure that the correct heading is coded prior to the RADAR vector leg. If it is not, the pilot must be prepared to discontinue FMS guidance after the waypoint where the vector leg starts.

If the STAR chart does not specify a heading, the pilot must assume that ATC requires the existing heading maintained until specified otherwise. If the STAR provided by the database contains headings not shown on the STAR chart, the pilot must discontinue FMS guidance unless such headings are specifically authorized by ATC.

If the STAR provided by the database does not contain a RADAR vector heading or required course from the waypoint where the RADAR vector on the chart begins, the pilot must discontinue FMS guidance of the RADAR vector waypoint and maintain the present heading until instructed otherwise by ATC.

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 insures that the RADAR vector waypoint is overflown and the last heading maintained.
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. 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 Flight Plan 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 deleted by the pilot, the message NEXT LEG INVALID will occur whenever the *GAP* or *NO LINK* sequences to the NX position. If it is not deleted from the flight plan, the FMS will continue to fly on last heading (0° roll steering command) upon passing the TO waypoint and issue the message CURRENT LEG EXTENDED.
Duplication of Waypoints in the Flight Plan

Sometimes a SID or STAR procedure might 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
```

The redundant waypoints are automatically edited out of the flight plan before reaching BNA. 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 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 used for approach.

Later portions of this section provide details specific to certain approach types, 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 depend on the installed sensor suite and the interfaced aircraft FGS. The approved approaches can include the following:

- ILS (FMS-defined, ILS-guided)
- LOC
- LOC-BC
- VOR
- VOR-DME
- TACAN
- RNAV
- WAAS
- GPS Overlay (NDB)
- GPS (Stand-alone approaches)
- VFR
- GLS

The configuration module contains a list of approach types permitted for the specific installation. Approaches not on the configuration list cannot 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 Mode:
EFIS Display: 5.0 nm F.S.
CDU Display: XTK (E)

NAV TO Leg = Missed Appr:
EFIS Display: 1.0 nm F.S.
CDU Display: XTK (T)

Approach Active:
EFIS Display: 2 degrees to 0.3 nm F.S.
CDU Display: XTK (A)

Approach Armed:
EFIS Display: 1.0 nm F.S.
CDU Display: XTK (T)

Enroute Mode:
EFIS Display: 5.0 nm F.S.
CDU Display: XTK (E)

Enroute Scaling

When the FMS is operating in the enroute mode, the normal CDI scaling is linear at ± 5.0 nm. Full scale deflection of the CDI needle indicates a deviation of 5.0 nm from the desired track, regardless of the aircraft’s distance from the waypoint.

REASON: SCN 802.1/902.1 release requires an update to the Approach Activated Scaling section.

FILING INSTRUCTIONS: Insert this Temporary Change into Report No. 2423sv802/902, Section V, adjacent to page 5-94.

INSTRUCTIONS: Replace the Approach Activated Scaling section with the following text.

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°, approximating that of a normally sited localizer on a 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.)

NOTE: For NASA T-38 high Flight Path Angle Simulated Shuttle Approaches, CDI sensitivity is ±10.0° in SCN 802.1/902.1 and higher.

Angular scaling is maintained to the point where full scale CDI deflection is equal to 0.3 nm. The system maintains linear scaling at ± 0.3 nm to the end-of-approach. This point occurs approximately at the FAF.

NOTE: For NASA T-38 high Flight Path Angle Simulated Shuttle Approaches, linear full scale CDI deflection is equal to 0.3 nm at approximately the end-of-approach point in SCN 802.1/902.1 and higher.
Section V
Operations

**Approach Armed Scaling**
When 50 miles from EOA (direct distance to the runway), the APPR ARM option becomes available at LSK [3R] on Navigation Page 1.

Selecting APPR ARM increases the CDI scale sensitivity to ± 1.0 nm, which remains until approach is activated.

If an approach is linked into the flight plan and is not 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°, approximating that of a normally sited localizer on a 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 nm. The system maintains linear scaling at ± 0.3 nm to the end-of-approach. This point occurs approximately at the FAF.

**Missed Approach Scaling**
Upon cancellation of Approach mode, HSI deviation will revert to terminal scaling (i.e. ± 1.0 nm).
Approach Database

FMS approaches can only be executed when the approach is defined in the FMS's Navigation Database. The approach can be either a published approach, which is included in the Navigation Database, or an approach defined by the pilot and stored in the Pilot Database. Published approaches include: GLS, GPS, NDB, ILS, BC, LOC, RNAV, VOR and TACAN. Pilot-defined approaches include ILS, BC, LOC, RNAV, VOR, TACAN, VFR and GWS. GPS, GLS and NDB overlay approaches are included in the subscription Navigation Database and cannot be pilot-defined.

A legitimate IFR approach can be constructed in the Pilot Database only if the approach is constructed with regard to approved instrument approach procedures (i.e., constructed to exactly duplicate the charted procedure). Runway coordinates and named a FAF waypoint must be retrieved from the Navigation Database.

Different waypoint naming conventions are possible. 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
TEMPORARY CHANGE


FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 5-96 in the Operations section.

REASON: Update approach guidance information to reflect NavDB Cycle 0711 improvements.

INSTRUCTIONS:

Remove the Non-Precision Approach Glidepath section on pages 5-96 through page 5-98.

Beginning with Navigation Database Cycle 0711, altitude constraints (AT, AT/ABOVE and AT/BELOW) on the FACF, FAF and any intermediate fixes are coded in the Navigation Database. The FMS will use these coded altitudes to calculate the glidepath, rather than the FMS-computed altitudes. The Non-Precision Approach Glidepath section of the Operator's manual is therefore no longer valid.
Approaches may be constructed using enroute waypoints and navaids, but will generally contain terminal waypoints as well. Terminal waypoints are maintained in a database file associated with a particular airport. Examples of approach waypoints are:

- FF26 - FAF for Runway 26
- OM26 - Outer Marker for Runway 26
- MM26 - Middle Marker for Runway 26
- CF26 - FACF for Runway 26 (usually located on the final approach course 2 miles before the FAF).
- RW26 - The threshold coordinates (on centerline) of Runway 26
- MA26 - MAP for the specified approach to Runway 26
- MA123 - The MAP for a circling procedure, lying on the 123 degree radial from (or bearing to) the referenced navaid.

GPS overlay approaches include reference to the database names for these approach waypoints.

**Approach Guidance**

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 minimum descent altitude (MDA), since MDA will often vary as a function of the aircraft approach speed category. The database 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 FAF and MAP altitudes. When Approach mode 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 is not specifically coded in the Navigation Database.

The following figure depicts a direct glidepath from FAF to MAP as calculated by the FMS. Note this glidepath passes under the 860 foot step-down fix by approximately 80 feet.
FMS calculated glidepath from FAF to MAP

A FPA is coded in the Navigation Database, 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.

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 database-supplied FPA. 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 in effect in which the FPA was not allowed to be less than -3.0°.

In this case, the glidepath intercept point will be some distance past the FAF. When an approach is linked, the FAF altitude displayed by the FMS might 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 Database-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 Database-coded FPA of -3.3° will be used to recalculate the FAF altitude of 1919 feet, replacing the database FAF altitude of 1700 feet. The FAF will still be crossed at 1700 feet, 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 the Database Section of this manual for details of creating pilot-defined approaches.

**ILS Approaches**

ILS approaches are included in some database part numbers. Depending upon the installation, these approaches may or may not be coupled to the FGS. 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, at which point 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’s 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 feet 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 UASC radio reference sensor (RRS). A co-located 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 co-located DME with the VOR ground station. These types of charted approaches are 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 UASC RRS, if installed, is capable of providing both the VOR and DME data.

RNAV approaches are basically GPS approaches and do not require an approach facility. Other sensor capabilities may be authorized on RNAV (GPS) approaches, such as GPS WAAS and DME-DME RNP.

TACAN Approaches
TACAN approaches require the capability of obtaining both azimuth and distance from a TACAN interrogator/receiver or from a UASC RRS. 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 for a DME.

Since TACAN is primarily a military navigation aid, TACAN approaches are most frequently found at military airfields. TACAN ground stations are co-located with many VORs throughout the airspace system.

WAAS Approaches
This pilot-defined, GPS-based navigation approach uses the GWS as its primary sensor.
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. The FMS does not use the GPS for ILS, LOC and BC approaches, but rather, keeps the GPS valid for reference during approach transitions or prior to the missed approach. Currently GPS supports only non-precision 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 that 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 an RNAV (GPS) or GPS overlay approach. A Phase III approach is indicated in the title of the approach; e.g., “VOR or GPS Rwy 26”. Due to the very large number of approaches being converted to RNAV (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.
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, GLS-1250, GNSS-2400, and is operating in a region of the world which uses WGS-84 coordinate system. The Navigation Database 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 BCP.** In the case of RNAV, 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 any 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.

**GPS Predictive RAIM**

Since 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 MAP at the ETA. 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.

**Note:** When using a GLS to fly a non-precision approach, the Predictive RAIM feature is inaccessible. The GLSs perform an integrity check equal to a Predictive RAIM and subsequently displays dashed on the Predictive RAIM Page.
During enroute operations, it is also required to provide pilot-requested predictions of RAIM availability at the destination for a period of ETA ± 15 minutes in five minute increments. The RAIM PREDICTION feature is available at LSK [3R] on Flight Plan Menu Page 1:

When LSK [3R] is pressed, the following page will be displayed:

RAIM availability is displayed in terms of meeting enroute, terminal and approach criteria (i.e., 2.0 nm, 1.0 nm and 0.3 nm respectively) at the destination airport at the estimated arrival time shown. If any RAIM availability is shown to be other than APPR for the ±15 minute window, then the pilot should not plan to rely on GPS for position determination during the approach.

**Note:** The predictive RAIM feature will only work with GPS sensors certified to TSO C-129 Class B1/C1. Other GPS sensors, such as the GPS-950 and UNS-764-1 GPOSS, will not support this feature, and dashes will always be displayed in the availability fields.
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 the SENSORS AND INTERFACES Section for further information regarding criteria under which this annunciator is illuminated.

**Note:** Whenever the GPS INTEG annunciator is illuminated, the pilot should monitor 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 and 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 “VOR or GPS Rwy 27”.

GPS stand-alone approaches are also identified by their title (e.g., “GPS Rwy 27”). Note that RNAV approaches with GPS requirements are identified by the title “RNAV (GPS).”

**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. NDB approaches that are not approved for GPS overlay are deleted from the database. There are no provisions for pilot-defined NDB approaches. NDB approaches are included in the Navigation Database 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 or xxx.xxx 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 during instrument meteorological conditions (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 and inertial) are not automatically deselected for a VFR approach.

2. Since the FMS may be dependent on long-range sensors for the VFR approach, the system’s 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 system’s integrity (i.e., its capability of providing suitable warning for out-of-tolerance conditions).

GLS Approaches

A GPS Landing System (GLS) approach is a combination of navigation database entries (FMS) and uplinked data from the differential ground station (GLS). The FMS must have a GLS approach in its database and have the approach loaded into the flight plan. The GLS has this same approach uplinked from the ground station. In order for the approach to be flown by the FMS, both approaches must be available. The uplinked data from the ground station is used by the GLS to compute the lateral and vertical guidance that is sent to the FMS.

While a GLS approach is active, the FMS displays crosstrack and vertical deviation received from the GLS, transmits those values to the guidance displays, and uses those values to compute steering commands (similar to what the FMS does for localizer approaches).
TEMPORARY CHANGE


FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 5-106 in the Arrival section.

REASON: Add further information about the GPS Approval field on Approach Plan Page 1.

INSTRUCTIONS:

Revise the last paragraph with the following.

GPS REQUIREMENT/APPROVAL - If GPS is required for this approach, the field displays GPS REQD. If GPS is not required, but the GPS sensor is retained at approach activation, this field displays GPS APRVD. Otherwise, this field is blank.

NOTE: Localizer-based approaches retain the GPS sensor during approach, but do not use GPS for final approach guidance and therefore will not display GPS APRVD. Refer to Approach Types in the Arrivals section for more information.
## Approach Plan Pages

If an approach is entered into the flight plan, selecting APPR PLAN, LSK [5L] on Flight Plan Menu Page 2, displays the Approach Plan Pages. These pages provide the pilot with a convenient summary of pertinent approach information.

<table>
<thead>
<tr>
<th>APPR PLAN 1/2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>APPROACH</td>
<td></td>
</tr>
<tr>
<td>KDEN VOR 26L</td>
<td>GPS APRVD</td>
</tr>
<tr>
<td>FREQ</td>
<td>FACILITY</td>
</tr>
<tr>
<td>117.00</td>
<td>FAF</td>
</tr>
<tr>
<td>LEG TO EOA</td>
<td>EOA</td>
</tr>
<tr>
<td>260° / 7.1NM</td>
<td>RW26L</td>
</tr>
</tbody>
</table>

Approach Plan Page 1 displays the following information:

**APPROACH (LSK [1L])** - This field displays the airport, approach type and runway number.

**FACILITY (LSK [2L])** - This field displays the facility identifier if one is supplied by the database. If one is not supplied, this field is blank.

**FREQUENCY (LSK [3L])** - If the approach type is GLS, this field displays the channel identification. If not GLS and a facility is defined, this field displays the frequency or channel for that facility. If not GLS and a facility is not defined, this field displays only dashes.

**LEG TO EOA (LSK [4L])** - This field displays the inbound course and distance of the leg to the EOA. However, if the leg to the EOA is an RF leg, this field displays only dashes.

**GPS REQUIREMENT/APPROVAL (LSK [1R])** - If GPS is required for this approach, the field displays GPS REQD. If GPS is approved for this approach, the field displays GPS APRVD. Otherwise, this field is blank.

**FAF (LSK [3R])** - This field displays the designation of the FAF waypoint.

**EOA (LSK [4R])** - This field displays the designation of the EOA waypoint.

The remaining Approach Plan Pages list the waypoints in the approach.
Approach Procedures

Navigation Approach Page 1

Navigation Approach Page 1 is the first Navigation Page displayed when the FMS Approach mode is activated. The Approach mode is activated from Navigation Page 1 by selecting the ACT APPR option when within 50 nm of the destination.

On all installations except the NASA T-38, Navigation Approach Page 1 appears similar to the example below.

![Example 1](image1)

**ANP/RNP Configured**

On the NASA T-38, Navigation Approach Page 1 appears similar to the example below.

![Example 2](image2)

**ANP/RNP Configured**

The second line of text on Navigation Approach Page 1 displays the airport, approach type, approach runway, navaid and frequency of navaid, respectively. The remaining items are explained below.

**FR** - This field displays the previous leg identifier. Pressing LSK [1L] displays the Manual Leg Page. Making a leg change on this page cancels the Approach mode.

FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 5-108 in the Operations section.

REASON: To clarify the description of the wind field.

INSTRUCTIONS:

Replace the WND paragraph on page 5-108 with the following.

WND – This field displays the filter wind direction and wind speed, in knots, as computed by the Nav function. Wind direction is differentiated with a “T” for True or a degree sign (°) for Magnetic. Wind direction is always True, regardless of the position of the panel mounted Mag/True selector switch, except while in Approach Mode. When operating in polar regions (between N72 and S60 degrees latitude), wind display remains in degrees True in Approach mode.
For Course to Fix legs and Track from Fix to Fix legs, the text below the FR line displays the desired track for the next leg, length of next leg and flight path angle of next leg. For Precision Arc to Fix legs, the text below the FR line displays the turn direction and radius of the arc.

**TO** - This field displays the terminator fix for the current leg and its altitude. If the FR waypoint is a fix, then pressing LSK [2L] displays the Manual Leg Page. Making any change on this page will cancel Approach mode. If the FR waypoint is a floating waypoint, pressing LSK [2L] will display the DTO page. Performing a DTO cancels Approach mode.

For Track from Fix to Fix legs, the text below the TO line displays the desired track for the next leg, length of next leg and flight path angle of next leg. For Precision Arc to Fix legs, the text below the TO line displays the turn direction and radius of the arc.

**NX** - Displays the terminator for the next leg and altitude. Pressing LSK [3L] when no NX leg is identified will display the Manual Leg Page. Making a change or entering a next leg on this page will cancel Approach Mode.

**HDG** - Pressing LSK [1R] will display the Commanded Heading Page, if configured.


**CNCL/MISD APPR** - Pressing LSK [3R] when MISD is displayed will execute a missed approach procedure. Pressing LSK [3R] when CNCL is displayed will cancel Approach mode.

**XTK** - The crosstrack distance from the current leg. An (E), (T) or (A) in this field indicates whether enroute, transition, or approach phase of flight crosstrack scaling is active, respectively.

**WND** - The filtered wind direction computed by the FMS in degrees. The second value in this field is the filtered wind speed, in knots.

**VDEV (Non NASA T-38 Installations Only)** - The vertical deviation from the current leg.

**VSR (NASA T-38 Only)** - Vertical speed required to fly the current leg.

**GS (Non NASA T-38 Installations Only)** - Groundspeed.

Q/ANP - The position error. When configured for ANP, the actual navigational performance is displayed. When configured for Q, the Q factor is displayed.

RNP - If ANP/RNP is configured, this field displays the RNP value. An (M) indicates a manual entry. If no indication is displayed in parentheses, the value is a system default value. To manually enter an RNP, press LSK [5R] to highlight the field, then enter the desired value. When Q is configured, LSK [5R] is inoperable.

Navigation Approach Page 2

Navigation Approach Page 2 displays similar information as Navigation Approach Page 1. The information below the horizontal line differs and is explained in the following text.

![NAV APPR 2/4](image)

**NAV APPR 2/4**

KABQ ILS 08R ISPT 111° 90 FR INBOUND

077° 34 NM - 1.50° HDG→

TO SUPOT 7400 FT MNVR→

077° 61 NM - 13.0° CNCL

NX RW08 5389 FT APPR→

XTK(A) R0.44 VDEV - 189

XWIND L 06 GS 154

WIND 022° / 12 VSR - 408

Navigation Approach Page 2

**XWIND** - The crosswind component in knots.

**VSR** - Vertical speed required to fly the current leg.

Navigation Approach Pages 3 and 4 present the same information as Navigation Pages 2 and 3, respectively, when not in Approach mode.
TEMPORARY CHANGE


FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 5-110 in the Operations section.

REASON: Update approach guidance information to reflect NavDB Cycle 0711 improvements.

INSTRUCTIONS:
Revise the second paragraph on this page with the following.

When an approach is linked into the flight plan, the Flight Plan Page will display At (@) or Crossing (X) altitudes at the FAF. At (@) altitudes will be displayed at the MAP or runway fix.
Approach Depiction on Flight Plan Pages

An approach is designated on the Flight Plan Pages by asterisks. The first waypoint in the approach is denoted by an asterisk on each side of the label, as shown on Flight Plan Page 1 below (i.e. *GPS 08*). The EOA is designated by *EOA* as shown on Flight Plan 2 below.

When an approach is linked into the flight plan, the Flight Plan Page will display At ( @ ) altitudes at the FAF and MAP or runway fix. These altitudes are the coded altitudes from the Navigation Database that are published on the approach plates.

Editing any approach label or waypoint between the approach labels on the Flight Plan Pages will invalidate the approach. The waypoints will remain on the Flight Plan Pages, but the approach will not arm or activate, and the FMS will fly the waypoints as terminal waypoints. Subsequently, the APPR indication and ARM APPR or ACT APPR selectable option will not appear on the Navigation Page. To restore the use of the approach segment, the approach must be re-entered into the flight plan.
Arm Approach Mode

When the aircraft is within 50 nm of the runway (direct distance), the ARM APPR option will become available on Navigation Page 1, and the approach can be armed. When selected, the prompt will change to ACT APPR. The VHF receiver will then be tuned to the VOR or ILS frequency defined in the approach if the Remote Tune option is configured and applicable to the particular installation. If ARM APPR has not been selected by the time the aircraft reaches 30nm 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. If the Remote Tune option 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 the FAF, but prior to that point the pilot should transition the navigation source and FGS mode to ILS guidance.

Sensors (Loran C and non TSO C-129 GPS) that cannot meet the terminal or approach accuracy criteria are automatically deselected for VOR, RNV, GPS, GLS, 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 activate the approach), 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.

REASON: SCN 802.1/902.1 release requires an update to the Activate Approach Mode section.

FILING INSTRUCTIONS: Insert this Temporary Change into Report No. 2423sv802/902, Section V, adjacent to page 5-112 and 5-113.

INSTRUCTIONS:

1. Replace the third bullet under Activate Approach Mode on page 5-112 with the following revised text:
   • 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° to 0.3 nm. (10.0° for NASA T-38 high Flight Path Angle Simulated Shuttle Approaches.)

2. Replace the fifth bullet under Activate Approach Mode on Page 5-112 thru 5-113 with the following revised text:
   • GlideSLOPE (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 feet and that. Full Scale deviation equals 1000 feet for NASA T-38 high Flight Path Angle Simulated Shuttle Approaches. On most systems, full scale deviation equals 200 feet.
Activate Approach Mode

The approach can be activated manually by selecting the ACT APPR option on Navigation Page 1. 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 FGS prior to manually activating the approach on the FMS.

When the correct intercept angle is established, the INTERCEPT LSK on Navigation Page 1 must be pressed 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 Approach mode is activated, the FMS APPR annunciator will illuminate and the following data will be supplied for flight guidance.

- Bearing to the currently 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° 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 can be used. The NAV flag will be out of view when the approach navaid is tuned with a valid 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 EOA, less than 10 for terminal operations (VOR, RNV and TACAN approaches while from 15 to 30 nm from the EOA), or less than 28 for VFR approaches.
- GlideSLOPE (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 feet. On most systems, full scale deviation equals 200 feet.

- **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 can 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 installations, EFIS equipment may use the digital deviation data, in which the display sensitivities will be determined by the EFIS computer.

With some FGSs (such as FCC 850 or KFC 3100) during an FMS approach, the FGS must be in Approach mode (not Navigation 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.

REASON: To further clarify Advanced Approaches.

FILING INSTRUCTIONS: Insert this Temporary Change into Report No. 2423sv802/902, Section V, adjacent to page 5-114.

INSTRUCTIONS: Revise the first paragraph on page 5-114 with the following.

An FMS approach which includes waypoints more than ±6° of the inbound final approach course as defined by the FAF and the end of the runway are Advanced Approaches. Any approach containing an RF (precision arc) leg will also be labeled as Advanced. Many approaches include several initial approach fixes as “feeder fixes”, depending upon the direction from which the aircraft approaches the airport. These are coded as Approach Transitions in the database, and the proper one is selected at time of linking the approach to the flight plan.
The FMS approach definition can only include waypoints that are within ±6° of the inbound final approach course as defined by the FAF and the end of the runway. Many approaches include several initial approach fixes as “feeder fixes”, depending upon the direction from which the aircraft approaches the airport. These are coded as Approach Transitions in the database, 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 EOA 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 select MISSD APPR on Navigation Page 1. This action removes the EOA gap from the lateral guidance leg set. Since the EOA 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. The pilot may initiate another approach by pressing ARM APPR and then ACT APPR on Navigation 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, the message “APPR ARM AVAIL <NAV>” will appear again when the aircraft reaches a point 3 nm prior to the first approach waypoint (usually the FAF). This allows time to arm and activate the approach prior to reaching the FAF. Once armed, the message is canceled.

**Note:** Do not fly any approach under IFR unless the FMS is in active Approach mode. The pilot must select either ARM APPR or ACT APPR at some time prior to the final approach segment.
Holding During Approach Operations

Holding pattern setup is described in more detail in the ENROUTE portion of this section. Holding while in VNAV Descent mode is described in the VNAV portion of this section.

When both a holding pattern and an approach are armed, either the HOLD ARMED or the APPR ARMED banner will appear on Navigation Page 1. When a holding pattern is programmed at a waypoint in the approach transition, the FMS will enter the hold and HOLD ARMED will display. When the holding pattern is exited, Approach mode will arm automatically and APPR ARMED 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. If the pilot determines not to enter the holding pattern, the DISARM HOLD function on the Maneuver Page can be used to eliminate the holding pattern.

Either Holding or Approach mode may be active. If Approach mode is armed at the time that a holding pattern is activated, it will remain armed until the holding pattern is exited.

Holding Pattern Termination

Automatic or manual termination of a holding pattern is determined by examining the waypoint depiction on the Navigation or Flight Plan Pages.

Automatic termination applies to a procedural holds usually used as course reversals instead of procedure turns. When the holding pattern automatically terminates, the next waypoint to be sequenced is listed after the hold on the Navigation Page.

When the holding pattern requires a manual termination, “HOLD” is displayed after the holding pattern on the Navigation Page.

FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 5-116 in the Operations section.

REASON: Update approach guidance information to reflect NavDB Cycle 0711 improvements.

INSTRUCTIONS:
Revise the second paragraph on this page with the following.

When an approach is linked into the flight plan, the Flight Plan Page will display At (@) or Crossing (X) altitudes at the FAF. At (@) altitudes will be displayed at the MAP or runway fix. The vertical path between these points is the reference for deviation displays.
VNAV During Approach Operations

The FMS computes crossing altitudes to allow construction of an uninterrupted VNAV path from the enroute waypoints to approach activation and allows the pilot to establish an uninterrupted VNAV profile from the initial approach fix to MAP.

When an approach is linked to the flight plan, the flight plan and Vertical Navigation Pages will display At (@) altitudes at the FAF and MAP or runway fix. These altitudes are the coded altitudes from the Navigation Database that are published on the approach plates. The vertical path between these points is the reference for deviation displays.

**Note:** It is possible to program an enroute VNAV segment to terminate at a published minimum enroute altitude that is below the FMS computed crossing altitude for the FAF. If VNAV is active when sequencing to the FAF, the FMS will interpret this segment as a climb segment and cancel VNAV mode. To ensure availability of VNAV guidance for the final approach segment, pilots must either ensure that no vertical discontinuities exist between the enroute segment and the approach segment or ensure that VNAV is not active when sequencing to the FAF. For the latter case, normal approach VNAV arming and activation will occur 2 nm prior to the FAF.

The FMS computes a crossing altitude at a constrained waypoint such that the descent path to the next waypoint is within FPA limits. The FPA limit can be configured to achieve the desired path descent performance and can be modified by the pilot during flight. The target FPA can vary from 0.0° to a maximum of 9.0°. The enroute FPA limit for an aircraft installation is programmed at installation. Initial default value for target FPA is 3.0°. In no case can the pilot select a target FPA that exceeds the configured enroute FPA limit value.
If the approach common segment also includes an FACF, and the published FACF has an altitude constraint associated with it in the Navigation Database, a crossing altitude for the FACF will be calculated and displayed with an “X” designator in the flight plan and Vertical Navigation Pages. Crossing altitudes at the FACF are calculated by projecting the final approach FPA from the FAF to the FACF and checking that this crossing altitude is at or above the published restriction. At no time will crossing altitudes for the FACF be allowed to be set below the published restriction.

Crossing altitudes for waypoints in approach transition segments are calculated for waypoints with published and coded altitude constraints by using the target FPA from the VNAV menu.

The target FPA is projected back up the transition. Crossing altitudes are calculated and displayed on the lateral and VNAV flight plan with an “X” next to the altitude to indicate it is an FMS calculated altitude. These crossing altitudes may be higher than the altitudes published on the approach plates as selected by the target FPA, but in no case will they be lower than the published altitudes. In the event that a waypoint is coded with a constraint that is higher than the FMS target FPA calculated crossing altitude, the published constraint will be displayed. Crossing altitudes are not computed for variable constraints on the following legs:

- Legs terminated with an altitude: Heading to Altitude, Course to Altitude, Fix to Altitude or Hold to Altitude.
- Heading legs: Heading to intercept, Heading to Radial, Heading to DME distance, or Heading to manual termination.
- Course legs: Course to Intercept, Course to Radial, Course to DME Distance, Fix to Manual Termination.

Altitude constraints, whether manually entered or sourced from selected procedures, take precedence over FMS computed crossing altitudes.
TEMPORARY CHANGE


REASON: To update the Cold Temperature Compensation section:

- Clarify the differences between SCN 802.0/902.0/802.1/902.1 and 802.2/902.2 and later on temperature-compensated manually entered altitudes per SCN 802.2/902.2 release.
- Add an example FPL page with Temperature Compensation activated.

FILING INSTRUCTIONS: Insert this Temporary Change into Report No. 2423sv802/902, Section V, adjacent to page 5-118. This Temporary Change replaces Temporary Change dated 16 March 2004 filed at this same location.

INSTRUCTIONS: Replace the Temperature Compensation section with the following text.

Cold Temperature Compensation

NOTE: Availability of this feature is determined at the time of installation by a setting in the configuration module on the VNAV Options Page. If it is disabled, then the feature as described below will not be available.

Under conditions of extreme cold, barometric altimetry may be inaccurate, causing the actual aircraft altitude to be lower than that indicated by the altimeter. Some countries (e.g., Canada and Norway) 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 Temperature Compensation Page:

- An airport temperature must be entered.
- An airport elevation must be displayed.
- The temperature compensation function must be activated.
Temperature-compensated altitudes will be displayed on the Flight Plan Pages, the Approach Plan Pages, the Path Vertical Navigation Page, the Navigation Approach Page and the Temperature Compensation Page.

An inverse “T” appears next to all altitudes on the FPL pages to indicate Temperature Compensation is active and that these altitudes have had an altitude correction applied (either manually or by the temperature compensation function).

After the temperature compensation feature is activated, temperature-compensated altitudes may be overwritten by entering a manual altitude on the Path VNAV Pages or the Flight Plan Pages.

In SCN 802.0/902.0 and 802.1/902.1, when all conditions are met, altitude corrections will be added to all altitudes that are in the approach transition legs, approach legs and missed approach legs.

CAUTION: IN SCN 802.0/902.0 AND 802.1/902.1, WHEN TEMPERATURE COMPENSATION IS ACTIVATED, DEACTIVATED OR WHEN THE INPUT TEMPERATURE IS CHANGED, MANUALLY ENTERED ALTITUDES IN THE APPROACH TRANSITION, APPROACH AND MISSED APPROACH LEGS WILL BE COMPENSATED. THESE PREVIOUS MANUALLY ENTERED VNAV ALTITUDE CONSTRAINTS MUST BE RE-ENTERED.

In SCN 802.2/902.2 and higher, manually entered altitudes will not have an altitude correction applied when the temperature compensation function is activated. All manually entered altitudes must consider the temperature correction before they are entered into the FMS, even if the temperature compensation function is not active.
**CAUTION:** IN SCN 802.2/902.2 AND HIGHER, WHEN ALTITUDES ARE MANUALLY ENTERED BEFORE OR AFTER TEMPERATURE COMPENSATION IS ACTIVATED, IT MAY PRODUCE VNAV PATHS WITH CLIMB SEGMENTS, AND RESULT IN A VNAV DISCONNECT.

The temperature compensation function can be disabled by selecting the CANCEL option on the Temperature Compensation Page. In SCN 802.0/902.1 and 802.1/902.1 when temperature compensation is canceled, all altitudes will have the altitude corrections removed. In SCN 802.2/902.2 and higher when temperature compensation is canceled, only the navigation database derived altitudes will have the altitude correction removed. Temperature compensation is also canceled if a new airport and approach are entered in the flight plan.

**Activate Temperature Compensation**

1. Press the FPL key to access the Flight Plan Pages.
2. Press the MENU and NEXT keys to access Flight Plan Menu page 2:

   ![FPL Menu 2/2](image)

3. Press TEMP COMP to display the Temperature Compensation Page(s):

   ![Temperature Compensation Page](image)

Initially, the Temperature Compensation Page will indicate 1 of 1 until all required data is entered and the feature activates.
4. Enter ARPT TEMP (in either °C at LSK [2L] or °F at LSK [3L]). The temperature must be entered manually by the pilot, and can be in the range of 0 °C to -70 °C or 32 °F to -94 °F.

5. Enter ARPT ELEV at LSK [2R]. The ARPT ELEV will be prefilled with the airport or runway elevation from the flight plan approach, but can be manually overwritten.

6. Press the ACTIVATE LSK.

A “calculator function” is available such that any altitude can be entered on Temperature Compensation Page 1 at LSK [4L], and the resulting temperature correction will be displayed.

When activated, the subtitle will show TEMP COMP ON and LSK [5L] will change to CANCEL. The number of available Temperature Compensation 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-glideslope.

**TEMP COMP Page 2/4**

<table>
<thead>
<tr>
<th>MSL</th>
<th>COMP</th>
<th>ALT</th>
<th>HAA</th>
<th>CORR</th>
<th>ALT</th>
</tr>
</thead>
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<tr>
<td>T CREAK</td>
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<td>5 873</td>
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**TEMP COMP Page 4/4**

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<th>HAA</th>
<th>CORR</th>
<th>ALT</th>
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<td>4 00</td>
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<td>4 736</td>
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</tr>
</tbody>
</table>
If CANCEL is selected on Temperature Compensation Page 1 or if a new airport/approach is entered in the flight plan, all corrections will be deleted, and the charted altitudes from the database will be used.

**NOTE:** Any manual change to airport temperature or elevation will deactivate Vertical Navigation if it is active.
Cold Temperature Compensation

**Note:** Availability of this feature is determined at the time of installation by a setting in the configuration module on the VNAV Options Page. If it is disabled, then the feature as described below will not be available.

Under conditions of extreme cold, barometric altimetry be inaccurate, causing the actual aircraft altitude being lower than that indicated by the altimeter. Some countries (e.g., Canada and Norway) 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 Temperature Compensation 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 missed approach legs.

Temperature-compensated altitudes will be displayed on the Flight Plan Pages, the Approach Plan Pages, the Path Vertical Navigation Page, the Navigation Approach Page and the Temperature Compensation Page. After the temperature compensation feature is activated, temperature-compensated altitudes may be overwritten by entering a manual altitude on the Path VNAV Pages or the Flight Plan Pages. The temperature compensation function can be disabled by selecting the CANCEL option on the Temperature Compensation Page. When temperature compensation is canceled, all altitudes, including altitudes that were manually entered after the temperature compensation feature was activated, will have the altitude corrections removed. Temperature compensation is also canceled if a new airport and approach are entered in the flight plan.

**Activate Temperature Compensation**

1. Press the FPL key to access the Flight Plan Pages
2. Press the MENU and NEXT keys to access Flight Plan Menu page 2:

3. Press TEMP COMP to display the Temperature Compensation Page(s):

Initially, the Temperature Compensation Page will indicate 1 of 1 until all required data is entered and the feature activates.

4. Enter ARPT TEMP (in either °C at LSK [2L] or °F at LSK [3L]). The temperature must be entered manually by the pilot, and can be in the range of 0° C to -70° C or 32° F to -94° F

5. Enter ARPT ELEV at LSK [2R]. The ARPT ELEV will be prefilled with the airport or runway elevation from the flight plan approach, but can be manually overwritten.

6. Press the ACTIVATE LSK.

When activated, the subtitle will show TEMP COMP ON and LSK [5L] will change to CANCEL. The number of available Temperature Compensation 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-glideslope.

A “calculator function” is available such that any altitude can be entered on Temperature Compensation Page 1 at LSK [4L], and the resulting temperature correction will be displayed.

A Note: Any manual change to airport temperature or elevation will deactivate Vertical Navigation if it is active.
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 the 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 FGS in order not to abort a valid approach.

In some cases, the pilot might wish only to 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 the pilot 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 pilot 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 can be linked into the flight plan using normal procedures. However, when the aircraft is 50 nm from the destination, the ARM APPR option will not appear, and the approach can never 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 $45^\circ$ reversal leg. On ARINC 429 multi-function displays, the notation (PR-TRN) will be displayed at the beginning and end of the $45^\circ$ outbound leg as shown above. When groundspeed is high, causing the aircraft to violate the procedure turn boundary limit (typically 10 nm), then the one minute outbound leg will be shortened accordingly.

**Teardrop Procedure Turn**

![Diagram of 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 $15^\circ$ to $30^\circ$ from the inbound leg, then turn to capture the Course-to-Fix leg inbound to the initial approach fix or FAF. During the turn, the FMS will command the correct bank angle, typically in the order of $10^\circ$ - $20^\circ$, 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 $25^\circ$) to capture the inbound leg. Typically, this is not a problem, as these types of approaches are defined such that initial crosstrack deviation is in the order of 3 to 5 nm.
TEMPORARY CHANGE


FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 5-124 in the Operations section.

REASON: To clarify limitations in the landing page display.

INSTRUCTIONS:

Add the following sentence below the screen graphic on page 5-124.

Upon landing at a high pressure altitude and airport, the landing page may not be displayed.
Missed Approach Procedure

When the Go-Around button (certain configurations only) or MSD APPR LSK is pressed by the pilot, the current approach will be canceled. The *EOA* gap will be removed from the approach, allowing normal leg sequencing after passing the MAP (usually MAxx or RWxx). Lateral deviation will revert to ±1.0 nm scaling and vertical deviation will flag.

**Note:** Pressing the Go-Around button causes the FGS to enter GA mode. Navigation mode should be selected to couple FMS lateral missed approach guidance.

The initial legs of missed approaches are often of type CA or VA; however, the aircraft might or might not already be at or above the specified altitude when the initial leg sequences.

On aircraft with installed EFISs or multifunction displays (MFDs), if the initial leg of a missed approach procedure is of type CA or VA, the waypoint identifier will not appear on the EFIS MAP display (the identifier field will be blank) until the leg becomes the active navigation leg. If the aircraft is at or above the specified altitude, the FMS will immediately sequence past the waypoint. If the aircraft is below the specified altitude, the EFIS will display the specified altitude adjacent to the leg terminator identifier. The leg identifier will appear as XXXX, where XXXX is the specified altitude for the leg.

After Landing

Upon touchdown, the Landing Summary Pages will be displayed.

```
LANDING 1/2

TIME TAKEOFF 09:27 UTC
Landing 14:43
TOTAL 5:16

FUEL INITIAL 21906
ONBOARD 9278
USED 12628 LBS
```

At the pilot's discretion, the accuracy of the FMS BCP can 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 Landing Summary Page 2 by pressing the NEXT key. This page will display the FMS BCP (FMS # POS) coordinates, the most significant sensor's derived position coordinates, and the difference between the two.

2. Use the LSKs to select other sensors' position coordinates as desired.

**Note:** Minor individual sensor inaccuracies are not always apparent, as the FMS BCP is derived from multiple inputs. For this reason, it is recommended that each sensor's accuracy be checked individually. Significant differences between an individual sensor's position and the FMS BCP are continuously guarded against by the sensor "watchdog."

**To compare the BCP with the actual airport coordinates while on Landing Page 2:**

1. Press the FMS # POS LSK to access the Define Position Page.

2. Use the REF WPT LSK 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 LSK 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 LSK. The CONFIRM OFF control window will be displayed.

3. Select the CONFIRM OFF LSK. 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 Flight Log. That is, the FLIGHT LOG and FUEL mode configuration option must both be enabled.

Data can be saved for later download, including time and location of engines running, auxiliary power unit (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.

The Flight Log Page is accessed from Flight Plan Menu Page 2 by pressing the FLT LOG LSK.

### FLT LOG

<table>
<thead>
<tr>
<th>BASIC WT</th>
<th>LBS</th>
<th>FLT NBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>10025</td>
<td></td>
<td>C1234</td>
</tr>
<tr>
<td>PAX</td>
<td>41 @ 175</td>
<td></td>
</tr>
<tr>
<td>CARGO</td>
<td>220</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** BASIC 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.

**BASIC WT** - The weight of the aircraft minus passengers, cargo, and fuel. The default 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 placing the cursor over this field and entering the desired weight. If cargo value is zero, then enter zero rather than leaving the field dashed.

**GROSS WT** - Gross weight is not entered but is computed as the sum of Empty Weight, PAX, Cargo and Fuel Onboard.
FLT NBR - Flight number is entered at this location by placing the cursor over this field and entering the desired number. A maximum of ten digits may be entered. 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 placing the cursor over this field and entering the desired amount. Upload is indicated by using a + and download is indicated by using a -. A total of six numbers may be inputted including + / -. 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 LSK from Navigation Page 2 while over a known ground reference. With the position held, the FMS BCP can be compared with the known reference or the position determined using other navigation equipment such as GPS, LORAN or IRS 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 database to the aircraft’s held position.

1. Press the DATA key to access Data Page 1, then the NEXT key to access Data Page 3.
2. Press FMS # POS, LSK [1L], to access the Define Position Page.
3. Verify 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 LSK to exit the page with no changes.

Check or Change Distance/Radial of Pilot Waypoint from REF WPT
1. Press the DATA key to access Data Page 1.

2. Select the PILOT option, then the WAYPOINT option to access the Pilot Waypoints 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 enter the identifier in the waypoint entry field. When the identifier is entered, the Waypoint Identification Page for that identifier will be displayed.

4. Select the MODIFY PLT LSK to display the 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 the waypoint cannot be edited. Disregard the remainder of this procedure.

5. Verify the cursor is over the reference waypoint identifier entry field, then enter the desired identifier. When the identifier is entered, the Waypoint Identification Page for the waypoint will be displayed. When the ACCEPT LSK is pressed, the distance and radial from the reference waypoint to the pilot waypoint will be computed and displayed. The radial or distance may be changed provided the waypoint is not in use, or you may enter a second reference waypoint and cross radial.

6. Press the ACCEPT WPT LSK twice to verify a change to the pilot waypoint position.
Best Computed Position Update

All Universal FMS systems are designed to automatically calculate the BCP. However, a manual enroute FMS BCP update over a known point can be performed. In general, a BCP update is accomplished by positioning the cursor over a set of FMS position coordinates and then changing them. The update can be accomplished from the Navigation Position Page (Navigation Page 2), the FMS Position Page (Data Page 3) or a Hold Position Page as described in the following procedure:

**Note:** This procedure affects the system quality (Q) factor.

1. Access the Hold Position Page by pressing the DATA key. When over a known geographic position press the HOLD POS LSK.

2. Press the FMS # POS LSK to access the Define Position Page. Press the LSK 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 in entered, the cursor will expand to cover the longitude entry field. Enter the corrected longitude. The ± key may be used prior to change the hemisphere (N,S,E,W).

4. Press the ACCEPT LSK to accept the coordinate entries. When the coordinates are accepted, the FMS BCP, 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 LSK.

A snapshot of FMS position will be taken when the HOLD POS LSK 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.
Intentionally left blank
FUEL AND PERFORMANCE

The FUEL key provides access to all fuel management functions. Five fuel function pages can be displayed. Fuel Page 1 is used during the pre-departure phase to enter the initial fuel on board, to calculate the gross weight of the airplane and to construct a reserves plan. The other four Fuel 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 entered by the pilot. These values are constantly corrected through inputs from the fuel flow sensors as fuel is consumed.

**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 left LSK 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.

**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** - 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. When TANK is selected, fuel will be entered per tank. When the FUEL ONBOARD LSK of Fuel Page 1 is pressed, a per tank format is presented, allowing fuel onboard to be entered individually for up to six tanks. When TOTAL is selected, the fuel onboard entry can be made directly on Fuel Page 1 as a total amount.

**AVG PAX (CREW) WEIGHT** - This field allows the entry an average passenger weight value to be used for calculating total passenger weight on Fuel Page 1. Once entered, the default weight will be saved for subsequent use.

**Note:** On the NASA T-38, this function is labeled AVG CREW WT.

**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 aircraft by entering the values to be used in calculating the weight and to plan the fuel reserves required. The LSKs 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.

On all installations except the NASA T-38, Fuel Page 1 appears similar to the example below.

<table>
<thead>
<tr>
<th>BASIC WT LBS ALTERNATE</th>
<th>BASIC WT LBS ALTERNATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>10025</td>
<td>1000</td>
</tr>
<tr>
<td>PAX (41) @ 175</td>
<td>HOLD 400</td>
</tr>
<tr>
<td>CARGO 220</td>
<td>EXTRA 200</td>
</tr>
<tr>
<td>ZFW 10945</td>
<td>TOTAL RESRVS 1600</td>
</tr>
<tr>
<td>GROSS WT 16845</td>
<td>FUEL ONBOARD 5900</td>
</tr>
</tbody>
</table>

On the NASA T-38, Fuel Page 1 appears similar to the example below.

<table>
<thead>
<tr>
<th>BASIC WT LBS ALTERNATE</th>
<th>BASIC WT LBS ALTERNATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREW/ 21 @ 240</td>
<td>HOLD 480</td>
</tr>
<tr>
<td></td>
<td>EXTRA</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>ZFW 8820</td>
<td>TOTAL RESRVS</td>
</tr>
<tr>
<td>GROSS WT 12570</td>
<td>FUEL ONBOARD 3750</td>
</tr>
</tbody>
</table>

**BASIC WT** - The basic operating weight of the aircraft (i.e., empty weight), up to six digits, max 999999. The basic weight 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 (Non NASA T-38 Installations Only)** - 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 Page. Total passenger weight can also be entered manually in the passenger weight field.
This method will recalculate the displayed average passenger weight (max 999).

**CREW (NASA T-38 Only)** - Identical in operation to the PAX function on Non T-38 installations except the term “crew” is used, not “passengers.”

**CARGO (Non NASA T-38 Installations Only)** - The cargo weight is input up to six digits (max 500000).

**POD ON (OFF) (NASA T-38 Only)** - Pressing LSK [3L] will toggle on or off pod weight. When on and units are set to LBS, the value 240 will appear in parentheses and 240 pounds will be added to the zero fuel weight. When on and units are set to KGS, the value 110 will appear in parentheses and 110 kilograms will be added to the zero fuel weight. When off, the value 0 will appear in parentheses and no pod weight will be added to the zero fuel weight.

**ZFW** - The zero fuel weight (ZFW) is automatically calculated based upon the three prior entries. If desired, this value may be directly entered (max 999999). Calculated weights are limited to six digits.

**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. No entry possible here.

**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 (300000 max) (max accepted is 299997).

**FUEL ONBOARD** - The total fuel on board value is stored in memory until manually changed (max 600000). 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 Page 2 Display](image)

**FUEL FLOW** - Cumulative fuel consumption in pounds or kilograms per hour for up to four engines. Placing the cursor over the FUEL FLOW entry field allows a manual fuel flow entry to be made. A manual entry is indicated by “(EST)” to the right of the entry. 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. A manual entry is indicated by “(EST)” to the left of the entry. 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 place the cursor over the destination identifier and enter a new identifier as an alternate. The LIST function will present an airport list.“(A)” will appear next to the new destination.
ETA - The ETA 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 ± 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 or kilograms. 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 entries may be made to evaluate their effect on the other parameters displayed.

**Note:** None of the predictions listed on the page will be displayed until the quantity of fuel onboard is confirmed.

<table>
<thead>
<tr>
<th>FUEL FLOW</th>
<th>LBS</th>
<th>GS</th>
</tr>
</thead>
<tbody>
<tr>
<td>923</td>
<td></td>
<td>451</td>
</tr>
</tbody>
</table>

| FUEL AT DEPARTURE | 5710 |
| FUEL USED         | 1200 |
| FUEL ONBOARD      | 4610 |
| FUEL REQUIRED     | 880  |
| FUEL OVERHEAD SWR | 3730 |
| FUEL RESERVES     | 1000 |
| FUEL EXCESS       | 2730 |

**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 fuel mode is exited.

**AT DEPARTURE** - The total fuel entered on Fuel Page 1 prior to departure. This value will display dashes if a new fuel entry is made while airborne.

**USED** - The total fuel used. USED is set to zero whenever a FUEL ONBOARD 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.
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**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 LSKs have no function.

<table>
<thead>
<tr>
<th>FUEL 4/5</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
</tr>
<tr>
<td>LBS</td>
</tr>
<tr>
<td>GROSS WT</td>
</tr>
<tr>
<td>FUEL ONBOARD</td>
</tr>
<tr>
<td>LANDING WT</td>
</tr>
<tr>
<td>OVERHEAD</td>
</tr>
<tr>
<td>GND NM/LB</td>
</tr>
<tr>
<td>AIR NM/LB</td>
</tr>
<tr>
<td>TAILWIND</td>
</tr>
<tr>
<td>ESAD</td>
</tr>
<tr>
<td>TEMP</td>
</tr>
</tbody>
</table>

**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 nm per pound (kg) of fuel. The value shown is based on the present groundspeed and fuel flow.

**AIR NM/LB** - Air nm 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 either 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 (or three engines and one APU) individually and cumulatively, and the APU if configured. The number of engines listed depends upon the installation. The fuel flows shown are supplied by the aircraft's fuel flow sensors. APU fuel flow data will appear on Fuel Page 5 when an APU fuel flow source is configured. The total fuel value is entered on Fuel Page 1.

![Fuel Flow Table]

**FLOW** - The fuel flow in pounds (kilograms) per hour. The values shown are obtained from inputs from the engine fuel flow sensors. If the fuel flow 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. The LSKs are used to position the cursor to enter fuel flows for the individual engines. If a manual fuel flow entry is made, (MAN) will be displayed. The maximum fuel flow entry for each engine is 20,000 pph. A manual fuel flow entry can be removed by pressing the BACK and then ENTER keys while the cursor is over then fuel flow entry field.

**USED** - The cumulative fuel used in pounds (kilograms) for each engine and the total for all engines.

Manual fuel used entries can be made. The LSKs 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:** NOTE THAT APU FUEL FLOW IS A CONFIGURABLE OPTION. WITH SOME DIGITAL FUEL FLOW DISPLAYS, IT IS DISPLAYED AUTOMATICALLY. A MANUAL ENTRY IS POSSIBLE ON ALL INSTALLATIONS SO CONFIGURED.

IF FUEL FLOW IS NOT MONITORED BY THE FMS, FUEL ON BOARD ENTRIES SHOULD BE UPDATED AS REQUIRED TO COMPENSATE.
PERFORMANCE

Performance Pages

The Performance Pages provide a synopsis of pertinent inflight performance information. There are three performance options available, depending on aircraft configuration. If the Basic option is configured, there is one Performance Page. If the Manual or Advanced options are configured, there are multiple Performance Pages. Aircraft using the advanced performance features available on these additional pages can monitor and track Takeoff, Climb/Cruise and Landing. If configured for Manual or Advanced performance, refer to the AIRCRAFT PERFORMANCE SUPPLEMENT in the back of this section.

Performance Page 1 is identical in all three options. It is accessed in the Basic and Manual options by pressing the PERF key. In the Advanced option, it is accessed by pressing the PERF key only if Performance Page 1 is set as the default Performance Page. Refer to the Aircraft Performance Supplement for other methods of accessing Performance Page 1 in the Manual and Advanced options.

The page is read-only; no entries can be made. An example is shown below.

Note: The number represented by “X” in the illustration will vary depending on which Performance option is configured. If Basic, X will equal 1; if Manual, X will equal 2; if Advanced, X will equal 4.

<table>
<thead>
<tr>
<th>PERF 1/X</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>GS 400</td>
<td>TAILWIND</td>
</tr>
<tr>
<td>ES AD 121</td>
<td>TEMP</td>
</tr>
<tr>
<td>DIST 6</td>
<td>GND NM/LB</td>
</tr>
<tr>
<td>ETE 0+00</td>
<td>AIR NM/LB</td>
</tr>
<tr>
<td>ETA 00:05</td>
<td>LCL</td>
</tr>
<tr>
<td>NOW</td>
<td>OVDH</td>
</tr>
<tr>
<td>25257</td>
<td>WT</td>
</tr>
<tr>
<td>11862</td>
<td>FUEL</td>
</tr>
<tr>
<td>11+30</td>
<td>ENDURANCE</td>
</tr>
<tr>
<td>4602</td>
<td>RANGE</td>
</tr>
</tbody>
</table>
Performance Menu Page

The Performance Menu Page is accessible by pressing the MENU key from any of the Performance Pages.

The Performance Menu Page above is shown as it will appear for installations with either Basic or Manual configurations. Only the Equal Time Point/Point of No Return (ETP/PNR) option is available. For installations with an Advanced configuration, additional options are available, including takeoff tracking, climb/cruise tracking, landing tracking, temperature unit selection and altitude unit selection. Refer to the Aircraft Performance Supplement in the back of this section for more information on these options.

Equal Time Point/Point of No Return (ETP/PNR)

The Equal Time Point (ETP) is the enroute point where flying to the destination will take as long as flying back to the point of departure. The ETP is adjusted for winds and may not be the equidistant point of the trip. The Point of No Return (PNR) is the enroute point to which the aircraft can travel and from which it can return (under the same wind conditions) to the departure point without requiring extra fuel.

ETP/PNR Page 1

ETP/PNR Page 1 is accessible from the Performance Menu Page by selecting LSK [5L] if there is a blank entry on ETP/PNR Page 2 (If there are no blank entries on ETP/PNR Page 2, selecting LSK [5L] on the Performance Menu Page will access ETP/PNR Page 4). The operator can enter up to four airport codes, any two of which can be used as the starting point and ending point for the ETP/PNR calculations. An example of the page is shown below.
For each airport, the screen shows the direct time to the airport from present position, the direct distance to the airport from present position and the fuel overhead from present position for each airport.

For example, the screen above shows that direct time to Gander Airport (CYQX) from present position is 4 hours, 51 minutes; that direct distance to Gander Airport from present position is 1850 nautical miles and that fuel overhead with regard to Gander Airport from present position is 1976 pounds.

**Note:** If fuel overhead is a negative number, the entry will be displayed in red characters and proceeded by a minus sign.

Upon entering ETP/PNR page 1, the cursor lies in the field adjacent to LSK [2L]. If no airport code has been entered, the field will show dashes. The operator can manually enter a new airport code or change a preexisting code, or the operator can use the List function key to select from a list of airport codes. If the code entered by the operator is not in the Navigation Data Base, the Define Airports page shall be displayed so that the operator can define and add the airport the Data Base. The operator may access the field for each airport by pressing the associated LSK.
ETP/PNR Page 2

ETP/PNR Page 2 is accessible from ETP/PNR Page 1 by pressing the NEXT key. An example of the page is shown below.

This page displays some of the data required to calculate the ETP/PNR between two airports. The airports are selected from those entered on ETP/PNR Page 1. The items on this page are discussed below.

Coast Out Airport, LSK [2L]. The Coast Out airport is the starting point for the ETP/PNR calculations. The operator enters the code for this airport by pressing LSK [2L], which accesses the Airport Selection Menu. An example is shown below.

The operator selects the Coast Out airport by pressing the number key corresponding to the desired airport and then pressing the [ENTER] key. The number selected will appear in the highlighted field adjacent to LSK [1R]. For example, to choose Gander Airport as the Coast Out airport, the operator would press the [2] key and then the [ENTER] key.

Coast In Airport, LSK [3L]. The Coast In airport is the ending point for the ETP/PNR calculations. The operator enters the code for this airport by pressing the LSK [3L]. This will access the Airport Selection Menu, and the operator selects the Coast In airport in the same manner as the Coast Out airport.
Current FPL Winds, LSK [4L]. This item displays cruising wind information for the current flight plan. The default is information supplied by the wind sensor. If sensed winds are not available, the field will display dashes. The operator has the option of entering current wind information manually. A manual entry will be indicated by the letter “M” in parentheses next to the item.

Fuel On-board, LSK [5L]. This item displays the amount of fuel on-board. The default is information supplied by the fuel sensor. If sensed fuel is not available, the field will display dashes. The operator has the option of entering fuel on-board information manually. A manual entry will be indicated by the letter “M” in parentheses next to the item.

Coast Out Airport Winds, LSK [2R]. This item displays information for winds aloft at the Coast Out airport. If the airport is along the current flight plan and flight plan wind information is available, the item will display this information. If the information is not available, the field will display dashes. The operator has the option of entering Coast Out airport wind information manually. A manual entry will be indicated by the letter “M” in parentheses next to the item.

Coast In Airport Winds, LSK [3R]. This item displays information for winds aloft at the Coast In airport. If the airport is along the current flight plan and flight plan wind information is available, the item will display this information. If the information is not available, the field will display dashes. The operator has the option of entering Coast In airport wind information manually. A manual entry will be indicated by the letter “M” in parentheses next to the item.

Fuel Flow, LSK [4R]. This item displays fuel flow. The default is information supplied by the fuel flow sensor. If sensed fuel flow is not available, the field will display dashes. The operator has the option of entering fuel flow information manually. A manual entry will be indicated by the letter “M” in parentheses next to the item.

True Air Speed (TAS), LSK [5R]. This item displays true air speed. The default is information supplied by the true air speed sensor. If sensed true air speed is not available, the field will display dashes. The operator has the option of entering true air speed information manually. A manual entry will be indicated by the letter “M” in parentheses next to the item.
ETP/PNR Page 3

ETP/PNR Page 3 is accessible from ETP/PNR Page 2 by pressing the NEXT key. An example of the page is shown below.

This page displays information that the operator must enter for the FMS to calculate the engine out and pressure loss cases for the ETP/PNR waypoints. All items must be entered manually by the operator. The items on this page are discussed below.

**Coast Out Airport Engine Out Winds, LSK [2L]**. This item displays information for winds at the predicted engine out altitude at the Coast Out airport.

**Coast In Airport Engine Out Winds, LSK [3L]**. This item displays information for winds at the predicted engine out altitude at the Coast In airport.

**Engine Out Fuel Flow, LSK [4L]**. This item displays the fuel flow for the predicted engine out scenario.

**Engine Out True Air Speed, LSK [5L]**. This item displays the true air speed for the predicted engine out scenario.

**Coast Out Airport Pressure Loss Winds, LSK [2R]**. This item displays information for winds at the predicted pressure loss altitude at the Coast Out airport.

**Coast In Airport Pressure Loss Winds, LSK [3R]**. This item displays information for winds at the predicted pressure loss altitude at the Coast In airport.

**Engine Out Fuel Flow, LSK [4L]**. This item displays the fuel flow for the predicted pressure loss scenario.

**Engine Out True Air Speed, LSK [5L]**. This item displays the true air speed for the predicted pressure loss scenario.
ETP/PNR Page 4

If there are no blank entries on ETP/PNR Page 2, selecting LSK [5L] on the Performance Menu Page will access ETP/PNR Page 4. ETP/PNR Page 4 is also accessible from ETP/PNR Page 3 by pressing the NEXT key. An example of the page is shown below.

This page displays the ETP and PNR as calculated with the information entered or supplied on the ETP/PNR Pages 2/4 and 3/4. The ETP and PNR are displayed as Distance To Go (DTG), Estimated Time Enroute (ETE) and Estimated Time of Arrival (ETA). The page also displays the Coast Out and Coast In airports as selected on ETP/PNR Page 2, and allows the operator to select which data set to use in calculating the ETP and PNR, either the Engine Out set or Pressure Loss set.

Pressing LSK [1L] accesses the Case Selection Menu. An example is shown below.

The operator selects the type of ETP/PNR to be calculated by pressing the number key corresponding to the desired case and then pressing the [ENTER] key. The number selected will appear in the highlighted field adjacent to LSK [1R]. For example, to choose the Pressure Loss case, the operator would press the [3] key and then the [ENTER] key.
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Once the ETP and/or PNR have been reached, the DTG, ETE and ETA will display asterisks. If the ETP and/or PNR cannot be calculated, the DTG, ETE and ETA will display dashes.
ABNORMAL PROCEDURES

Engine Failure/Shutdown

Should an engine fail or be shut down 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 shut down and restarted, a reset may be attempted. With Fuel Page 5 displayed, reset is accomplished as follows:

1. Use the LSKs 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 four 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 GPS and Loran C sensors. For in-flight initialization refer to POWER FAILURE FOR OVER SEVEN MINUTES procedure.

**POWER FAIL**

- **POS N 47 31.7**
- **W 118 20.3**
- **UTC 22:45**
- **DURATION 0 MIN 07 SEC**
- **** PRESS ANY MODE KEY ****
- **** TO CONTINUE. ****

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 seven seconds, a Power Fail Page will be displayed. If the time span is less than seven seconds, the display will show 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 BCP 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 LSKs 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 seven seconds. The sensor is continuing to supply the FMS with position information, although it will be in error by the distance traveled during those few seconds.

If dashes appear on all sensors, the power interruption lasted longer than seven 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. Press the DATA key to access the Sensor Summary Page (Data Page 2). Verify the sensors return to navigation and reselect if necessary. After a short delay, the quality factor (Q) should decrease to a normal value.

5. Press the MSG key and check the display 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 Navigation Page can be selected. This is accomplished by positioning the cursor over each FMS BCP (POS) coordinate line and manually copying the IRS’s latitude and longitude coordinates. When the coordinates are entered, the FMS and all Loran C 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 can be applied when electrical power is restored or when the system is powered up 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 LSK to accept the initialization data.

   **Note:** The system must be initialized before any updated coordinates may be input onto one of the Navigation Pages.

3. Refer to the BEST COMPUTED POSITION UPDATE procedure to update sensor and FMS BCPs before selecting a flight plan.
Navigation Sensor Accuracy Messages

Should one or more messages concerning navigation sensor accuracy be active, the corrective action(s) required will 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 BCP. Because each type of sensor has different characteristics affecting its 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 GPS and Loran C sensors and for a second FMS in dual installations, at 6, 12, 18, and 24 nm from the FMS BCP. For IRSs, the sensor “watchdog” compares the rate of change of the IRS position against that of the FMS BCP. 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 knots.

Always check the latitude/longitude position of all sensors whenever any navigation sensor's accuracy message becomes active. Action should be taken only checking the following items.
Section V
Operations

- 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 is the Loran C sensor working with?
- Which sensor has performed best in the past?
- How does the navigation information compare with the flight plan?

Two examples of actual situations that could arise and a scenario for their solutions follow.

- Loran C is assigned second priority, contingent on its having a good quality factor and being inside a Loran Operating area (LOA), or outside an LOA after flying there from inside an LOA with continuous signal reception.

- 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 sensors of the same type 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. Note that the only sensor not having an active message regarding its accuracy is the suspected faulty item.

The proper course of action in this case would begin by looking at the latitude/longitude positions of the three IRSs on Data Page 3 to determine if they are close to one another. 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 for the important point. Determining whether the raw coordinates for all three IRSs are close is important. After finding that all three IRSs are geographically close (allowing for normal errors), it can be assumed that the Loran C sensor is causing the error in the FMS position.

The proper corrective action would be to access the OSS Status Page to deselect the Loran C sensor, and then to 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 navigation sensors feeding the FMSs. A message appears warning of drift in one of the sensors (e.g., “LCS DIFF 6NM” or “IRS1 DIFF WARN”). This requires more thought and making 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 BCP. 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.
This section of the manual is not applicable to SCN 802.

Special Missions, also known as Multi-Mission Management System, is applicable to SCN 902.

This section and the rest of this manual will apply to SCN 902 when the Multi-Mission Management System Supplement is inserted here.
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INTRODUCTION

The FMS is capable of interfacing with a variety of sensors which provide 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 for use by the FMS. The following table summarizes sensor selection and deselection occurring at various events.

<table>
<thead>
<tr>
<th>Event</th>
<th>Selection/Deselection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powerup On Ground</td>
<td>Select IRS, and any GPS that is in navigation or altitude mode. All other sensors are deselected.</td>
</tr>
<tr>
<td>Powerup In Air</td>
<td>Select all sensors.</td>
</tr>
<tr>
<td>On Ground</td>
<td>Select any GPS that is in navigation or altitude aiding mode and deselect any GPS that is not in navigation or altitude aiding mode.</td>
</tr>
<tr>
<td>Takeoff</td>
<td>Select all sensors except those previously manually deselected.</td>
</tr>
<tr>
<td>Non-VFR Approach Armed</td>
<td>If a GPS or GPS overlay approach contained in the navigation database 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.</td>
</tr>
<tr>
<td>Approach Canceled (In Air)</td>
<td>Reselects all previously deselected sensors.</td>
</tr>
<tr>
<td>Landing</td>
<td>Deselect all sensors except IRS and any GPS that is in nav or altitude aiding mode.</td>
</tr>
</tbody>
</table>

This section contains operating procedures required to manually select/deselect sensors or stations and procedures to manually input certain flight parameters in the event of sensor failure.
AIR DATA

ADC Status

The ADC Status Page, accessed from DATA 2/4, LSK [2R], 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 (LSK) [4R].

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 to the right of the value if the TAS is a manual entry and (XFL) will be displayed to the right of the value 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 while the cursor is over the TAS entry field.

**BARO and PRESS ALT** - The altitude in feet as supplied by the air data computer. (MAN) will be displayed to the right of the value if the altitude is a manual entry and (XFL) will be displayed to the right of the value 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 while the cursor is over the ALT entry field.
IAS - The indicated airspeed in knots as supplied by the ADC. IAS will not be displayed on installations which do not receive IAS from the ADC.

MACH - The Mach value as supplied by the ADC. Mach will not be displayed on installations which do not receive Mach from the ADC.

XFILL/LOCAL - XFILL will be a LSK option when two or more FMSs are installed. This will cause TAS, SAT and ALT to be displayed from the transferring ADC. When XFILL is selected, XFL is displayed next to the TAS, SAT and ALT values, and the IAS and MACH data and titles will not appear. The SELECT/DESELECT ADC option will also not appear. LOCAL will replace XFILL for reselection of the associated ADC.

SAT - The static air temperature received from the ADC. Dashes are displayed if there is no input data.

ISA - The difference between SAT and ISA (International Standard Atmosphere) for the current altitude.

DESEL ADC / SELECT ADC [4R] - This LSK is used to alternately select or deselect the ADC sensor. If deselected, (D) will be displayed following the sensor status.
SHORT RANGE SENSORS

Distance Measuring Equipment (DME)

If DME is configured, the DME-DME status and data is displayed on the DME Status Page. This page is accessed from Data Page 2.

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:

- 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.

**NVD INHB** - Pressing LSK [2R] will display Navaid Inhibit Page 1 (described later in this section).

FILING INSTRUCTIONS: Insert this Temporary Change adjacent to page 7-5.

REASON: To specify the entry method when manually selecting a DME Station.

INSTRUCTIONS: Replace step 3 in the Manual DME Station Selection with the following text.

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.
DESELECT DME/SELECT DME - Pressing LSK [4R] 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 Data Page 2 by pressing the DATA function key and pressing NEXT. Select the DMS option to display the DME Status Page.
2. Press the MAN DME LSK to position the cursor over the MAN DME entry field.
3. Enter the identifier of the desired DME. 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 parentheses. When a DME lock-on is established, the parentheses will be removed.
Return To Automatic DME Station Selection

1. Access Data Page 2 by pressing the DATA function key and pressing NEXT. Select the DMS option to display the DME Status Page.

2. Press the MAN DME LSK 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 when the distance to the manually selected station exceeds 300 nm.

VOR

When VOR is configured, VOR status and data are displayed on the VOR Status Page. The page is accessed from Data Page 2.

<table>
<thead>
<tr>
<th>VOR 171</th>
<th>STATUS NORMAL (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BACKUP</td>
</tr>
<tr>
<td></td>
<td>NVD</td>
</tr>
<tr>
<td></td>
<td>IDENT SL1</td>
</tr>
<tr>
<td></td>
<td>INHBT</td>
</tr>
<tr>
<td></td>
<td>FREQ 115.7</td>
</tr>
<tr>
<td></td>
<td>TEST</td>
</tr>
<tr>
<td></td>
<td>RADIAL 248.3</td>
</tr>
<tr>
<td></td>
<td>SELECT VOR</td>
</tr>
<tr>
<td></td>
<td>DIST 8.6</td>
</tr>
<tr>
<td></td>
<td>RETURN</td>
</tr>
</tbody>
</table>

**STATUS** - This is the operational status of the VOR. The status displayed will be one of the following:

- NORMAL
- TEST - when in Test tuning mode
- MANUAL - when in Manual tuning mode
- FAIL - when the RRS has failed and the RRS is the VOR in use (not the backup)

In addition, (D) will appear to the right of any of the above when the VOR has been deselected.

**IDENT** - The VOR station identifier. If RRS is installed, LSK [2L] and the LIST key can be used to manually select a station by identifier. In these cases, the identifier will be followed by (M). Manual mode is exited by either pressing LSK [3R], by pressing the sequence [2L] >
BACK > ENTER. Manual mode is automatically entered when the distance to the manually selected VOR station exceeds 180 nm.

**FREQ** - The VOR station frequency. The frequency can be entered manually by pressing LSK [3L] to highlight the field, then entering the desired frequency. If an invalid frequency is entered, or a valid frequency is entered but a signal is not detected within eight seconds, the value will flash.

**RADIAL** - The radial from the VOR station to the aircraft’s present position. If no VOR radial is received, the radial field will be blank. If the radial is invalid, the field will display dashes. If the received radial is not within six degrees of the expected value, it will be followed by a question mark (?).

**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 parentheses. If the received distance is not within 45 nm of the expected value, it will be followed by a question mark (?).

**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 message “BACKUP IN USE” will appear beneath the Status line.

**NVD INHBT** - Pressing LSK [2R] will display Navaid Inhibit Page 1 (described later in this section).

**TEST** - This option only appears on the master FMS in installations with two or more FMSs. It is always available in single FMS installations.

During Normal mode, this option reads TEST. Pressing LSK [3R] will select Test tuning mode; this option will then read CANCEL TEST. Selecting CANCEL TEST will revert to Normal mode.

When Manual tuning mode is active, this option reads CANCEL MANUAL. Pressing LSK [3R] will revert to Normal mode.

**DESEL VOR/SELECT VOR** - This LSK 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 Data Page 2 by pressing the DATA function key and pressing NEXT. Select the VOR option.

2. Press the IDENT LSK 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 Data Page 2 by pressing the DATA function key and pressing NEXT. Select the VOR option to display the VOR Status Page.

2. Press CANCEL MANUAL, LSK [3R].

VOR automatically reverts to nearest VOR station and indicates STATUS NORMAL.
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.

<table>
<thead>
<tr>
<th>STATUS</th>
<th>IDENT</th>
<th>CHAN</th>
<th>RADIUS</th>
<th>DIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORM</td>
<td>NUW</td>
<td>85X</td>
<td>153.7</td>
<td>48.6</td>
</tr>
</tbody>
</table>

**STATUS** - This is the operational status of the TACAN. The status displayed will be one of the following:

- NORMAL
- TEST - when in Test tuning mode
- MANUAL - when in Manual tuning mode
- FAIL - when an RRS communications failure is detected

In addition, (D) will appear to the right of any of the above when the TACAN has been deselected.

**IDENT** - The TACAN station identifier. If RRS is installed, LSK [2L] and the LIST key can be used to manually select a station by identifier. In these cases, the identifier will be followed by (M). Manual mode is exited by either pressing LSK [2R], by pressing the sequence LSK [2L] > BACK > ENTER or when the distance to the manually selected TACAN station exceeds 180 nm.

**CHAN** - The TACAN station channel. The channel can be entered manually by pressing LSK [3L] to highlight the field, then entering the desired channel. If an invalid channel is entered, or a valid channel is entered but a signal is not detected within eight seconds, the value will flash.
**RADIAL** - The radial from the TACAN station to the aircraft’s present position. If no TACAN radial is received, the radial field will be blank. If the radial is invalid, the field will display dashes. If the received radial is not within six degrees of the expected value, it will be followed by a question mark (\(?\)).

**DIST** - The received distance in nm from the TACAN to the aircraft’s present position. If no distance is received, a computed distance will be displayed in parentheses. If the received distance is not within 45 nm of the expected value, it will be followed by a question mark (\(?\)).

**NVD INHBT** - Pressing LSK [1R] will display Navaid Inhibit Page 1 (described later in this section).

**TEST** - During Normal mode, this option reads TEST. Pressing LSK [2R] will select Test tuning mode; this option will then read CANCEL TEST. Selecting CANCEL TEST will revert to Normal mode. When Manual tuning mode is active, this option reads CANCEL MANUAL. Pressing LSK [2R] will revert to Normal mode.

**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**

This procedure provides the pilot with the option of directing the computer to tune, and constantly display, one specific TACAN station.

1. Access Data Page 2 by pressing the DATA function key and pressing NEXT. Select the TACAN option to display the TACAN Status Page.

2. Press the IDENT LSK to position the cursor over the IDENT entry field.

3. Enter the identifier of the desired TACAN using the LIST function. STATUS MANUAL indicates a manual selection.
Return to Automatic TACAN Station Selection

**Note:** ARN-154 TACAN does not have the capability for automatic station selection. ARN-154 TACAN stations must be manually selected; therefore, the following information does not apply.

1. Access Data Page 2 by pressing the DATA function key and pressing NEXT. Select the TACAN option to display the TACAN Status Page.

2. Press CANCEL MANUAL, LSK [2R].

3. TACAN automatically reverts to nearest TACAN station and indicates STATUS NORMAL.

**Navaid Inhibit Page**

This page is accessed by pressing the NVD INHBT option from the DME Status Page, the VOR Status Page or the TACAN Status Page.

The pilot can disable up to two navigational aids (navaids) of each type by pressing the LSK next to the desired field to highlight it, then by either directly entering the station identifier or by pressing the LIST key to access a list of stations. If the pilot attempts to inhibit a navaid that is already inhibited, the entered value will flash.

The navaid is uninhibited by pressing the LSK next to the desired navaid to highlight it, the pressing the sequence BACK > ENTER.
Radio Reference Sensor (RRS)

During system initialization and ground operations, the VOR, DME and TACAN will be deselected. Upon takeoff, all three sensors 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, then selecting the VOR, DME or TAC option.

2. Press the DESEL DME/VOR/TACAN LSK to deselect the VOR, DME or TACAN portion of the RRS/TAC.

RRS Reselect

1. Access the VOR, DME or TACAN Status Page by pressing the DATA function key to access DATA page 2, then selecting the VOR, DME or TAC option.

2. Press the SELECT DME/VOR/TACAN LSK to reselect the VOR, DME or TACAN portion of the RRS/TAC.

Doppler

The FMS supports three types of Doppler sensors: the RACAL 91, the CMC 2012, the ASN-137 and the ASN-157. 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 Data Page 2 by pressing the DATA function key and pressing NEXT. Select DOP to access the Doppler Status Page.

2. Press the DESEL DOPLR LSK. The Doppler status field will show a (D) when the Doppler is selected.
Doppler Sensor Reselect

1. Access Data Page 2 by pressing the DATA function key and pressing NEXT. Select DOP to access the Doppler Status Page.

2. Press the SELECT DOPLR LSK. When the Doppler is selected, the (D) in the status field will no longer be displayed.

Doppler Status

Racal 91 Doppler Status

Racal 91 Doppler Status Page 1 is accessed from Data Page 2 by pressing the DOP LSK.

Doppler Status Page 1 displays the operational status of the Doppler 91. Doppler Status Page 2 displays diagnostic information for use by maintenance personnel. Doppler Status Page 1 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 LSK is used to start or cancel Doppler self test. Pressing this LSK initiates self test indicated by START in the status field. Pressing the LSK during self test will cancel self test indicated by OFF in the status field.

**SEA STATE** - Pressing this LSK will toggle Sea State between LO and HI.

**MODE** - Pressing this LSK toggles the mode between CW (Continuous Wave) and ICW (Intermittent Continuous Wave).
FMS1 - FMS velocity.

DVS1 - Doppler velocity.

DESEL DOPLR - This LSK is used to deselect and reselect the Doppler. When Doppler is deselected, a (D) will appear after the STATUS description.

ASN-137/ASN-157 Doppler Status

ASN-137/ASN-157 Doppler Status Page 1 is accessed from Data Page 2 by pressing the DOP LSK.

![Doppler Status Page 1](image-url)

Doppler Status Page 1 displays the operational status of the ASN-137/ASN-157 Doppler. Doppler Status Page 1 is explained below.

**STATUS** - Status is NORMAL, MEMORY or FAIL.

**DVS VEL** - Doppler velocities for the x, y and z components in nm/hr. 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 LSK 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 the DOP LSK.

Doppler Status Page 1 displays the operational status of the 2012 Doppler. Doppler Status Page 2 displays diagnostic information for use by maintenance personnel. Doppler Status Page 1 is explained below.

**STATUS** - The status displayed will be NORMAL, TEST or FAIL.

**TRACK MODE** - Displayed as either CRUISE or HOVER.

**SELF TEST** - This LSK is used to initiate a Doppler self test. Pressing LSK [3L] once will bring the cursor over the START prompt. Pressing LSK [3L] a second time will initiate self-test. Self test cannot be canceled once it has begun.

**SCALE** - This LSK commands scale factor changes between SEA and LAND. Pressing LSK [4L] once will bring the cursor over the field. Pressing LSK [4L] a second time will change the scale factor.

**XMIT MODE** - This LSK commands the transmit mode between SILENT and NORMAL. Pressing LSK [5L] once brings the cursor over the field. Pressing LSK [5L] a second time will change the transmit mode. When SILENT is selected, the Vx, Vy and Vz velocities will not be used for navigation.

**FMS1** - FMS velocity.

**DVS1** - Doppler velocity.

**SELECT DOPPLER** - This LSK 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-129a Class B1 and C1 with regard to waypoint displays, scaling, integrity monitoring, predictive RAIM, etc. using its internal GPS. It also interfaces with TSO C-129a/B1/C1 GPS sensors such as the GPS-1000, GPS-1000A and GPS-1200; the GNSS-2400 combined GPS and GLONASS sensor; and the GLS-1250 SCAT-1 sensor. In a multi-sensor configuration, the GPS position is monitored the same as DME-DME, IRS and Loran C Sensor 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 an approach not designated as a GPS or GPS overlay approach or 2) if the GPS is not approved under TSO C-129a 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. Only one GPS sensor at a time will provide a position to the FMS. The sensor that will be chosen by the Kalman Filter is based on FMS number and sensor type. The following table defines the GPS selection hierarchy.
<table>
<thead>
<tr>
<th>FMS #1 uses:</th>
<th>FMS #2 uses:</th>
<th>FMS #3 uses:</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLS #1</td>
<td>GLS #2</td>
<td>GLS #1</td>
</tr>
<tr>
<td>GLS #2</td>
<td>GLS #1</td>
<td>GLS #2</td>
</tr>
<tr>
<td>GNSS #1</td>
<td>GNSS #2</td>
<td>GNSS #3</td>
</tr>
<tr>
<td>GPS #1</td>
<td>GPS #2</td>
<td>GPS #3</td>
</tr>
<tr>
<td>GNSS #3</td>
<td>GNSS #3</td>
<td>GNSS #1</td>
</tr>
<tr>
<td>GPS #3</td>
<td>GPS #3</td>
<td>GPS #1</td>
</tr>
<tr>
<td>GNSS #2</td>
<td>GNSS #1</td>
<td>GNSS #2</td>
</tr>
<tr>
<td>GPS #2</td>
<td>GPS #1</td>
<td>GPS #2</td>
</tr>
<tr>
<td>(Hyb) GPIRS #1</td>
<td>(Hyb) GPIRS #2</td>
<td>(Hyb) GPIRS #3</td>
</tr>
<tr>
<td>(Hyb) GPIRS #3</td>
<td>(Hyb) GPIRS #3</td>
<td>(Hyb) GPIRS #1</td>
</tr>
<tr>
<td>(Hyb) GPIRS #2</td>
<td>(Hyb) GPIRS #1</td>
<td>(Hyb) GPIRS #2</td>
</tr>
<tr>
<td>(Aut) GPIRS #1</td>
<td>(Aut) GPIRS #2</td>
<td>(Aut) GPIRS #3</td>
</tr>
<tr>
<td>AIDED C-IV #1</td>
<td>AIDED C-IV #2</td>
<td>AIDED C-IV #3</td>
</tr>
<tr>
<td>(Aut) GPIRS #3</td>
<td>(Aut) GPIRS #3</td>
<td>(Aut) GPIRS #1</td>
</tr>
<tr>
<td>AIDED C-IV #3</td>
<td>AIDED C-IV #3</td>
<td>AIDED C-IV #1</td>
</tr>
<tr>
<td>(Aut) GPIRS #2</td>
<td>(Aut) GPIRS #1</td>
<td>(Aut) GPIRS #2</td>
</tr>
<tr>
<td>AIDED C-IV #2</td>
<td>AIDED C-IV #1</td>
<td>AIDED C-IV #2</td>
</tr>
</tbody>
</table>

On aircraft equipped with a GPS-1000, GPS-1000A, GLS-1250 and/or GNSS-2400, 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), and GNSS-2400 sensors, 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 (IRS or Loran-C). In addition to the airborne hardware requirements, an off-line Windows based PC program (available from 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 the FAA in order to conduct flights in remote/oceanic airspace. A data package is available from Universal Avionics (refer to Universal’s Service Letter No. 2738 for more information).

GPS Integrity

Receiver Autonomous Integrity Monitoring (RAIM)

A key element of C-129a 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 monitor 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 C-129a 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:

<table>
<thead>
<tr>
<th>Phase of Flight</th>
<th>Alarm Limit</th>
<th>Time to Alarm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enroute</td>
<td>2.0nm</td>
<td>27 seconds</td>
</tr>
<tr>
<td>Terminal</td>
<td>1.0nm</td>
<td>7 seconds</td>
</tr>
<tr>
<td>Approach</td>
<td>0.3nm</td>
<td>7 seconds</td>
</tr>
<tr>
<td>Oceanic</td>
<td>6.0nm</td>
<td>27 seconds</td>
</tr>
</tbody>
</table>

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 is less than or equal to 15.9nm. 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.

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 Fault Detection and Exclusion, or FDE. Remote/Oceanic operations certification requires that FDE be provided and continuously monitored by the GPS.
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.

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 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.

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.

The following table lists the FMS/NMS navigation status and associated pilot actions to be taken when the GPS INTEG annunciator is active.

<table>
<thead>
<tr>
<th>Flight Phase</th>
<th>NAV Flag condition</th>
<th>GPS NOT NAV message</th>
<th>POSITION UNCERTAIN Message</th>
<th>Pilot Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oceanic/Remote Enroute</td>
<td>Valid</td>
<td>Not Issued</td>
<td>Not Issued</td>
<td>Normal systems cross-checks</td>
</tr>
<tr>
<td></td>
<td>Valid</td>
<td>Active (DR Nav Mode)</td>
<td>Not Issued (&lt;6.0nm off-trk)</td>
<td>Use most reliable Nav source</td>
</tr>
<tr>
<td></td>
<td>Invalid</td>
<td>Active (DR Nav Mode)</td>
<td>Active (&gt;6.0nm off-trk)</td>
<td>Use other Nav system</td>
</tr>
<tr>
<td>Domestic Enroute</td>
<td>Valid</td>
<td>Not Issued</td>
<td>Not Issued</td>
<td>Normal systems cross-checks</td>
</tr>
<tr>
<td></td>
<td>Valid</td>
<td>Active (DR Nav Mode)</td>
<td>Not Issued (&lt;2.8nm off-trk)</td>
<td>Use most reliable Nav source</td>
</tr>
<tr>
<td></td>
<td>Invalid</td>
<td>Active (DR Nav Mode)</td>
<td>Active (&gt;2.8nm off-trk)</td>
<td>Use other Nav system</td>
</tr>
<tr>
<td>Terminal</td>
<td>Valid</td>
<td>Not Issued</td>
<td>Not Issued</td>
<td>Normal systems cross-checks</td>
</tr>
<tr>
<td></td>
<td>Valid</td>
<td>Active (DR Nav Mode)</td>
<td>Not Issued (&lt;1.0nm off-trk)</td>
<td>Use most reliable Nav source</td>
</tr>
<tr>
<td></td>
<td>Invalid</td>
<td>Active (DR Nav Mode)</td>
<td>Active (&gt;1.0nm off-trk)</td>
<td>Use other Nav system</td>
</tr>
<tr>
<td>Approach before FAF</td>
<td>Valid</td>
<td>Not Issued</td>
<td>Not Issued</td>
<td>Do not continue Approach based upon GPS alone. Use other Nav sources.</td>
</tr>
<tr>
<td></td>
<td>Invalid if &lt;2nm from FAF or Integ = Alarm</td>
<td>Not Issued</td>
<td>Not Issued</td>
<td></td>
</tr>
<tr>
<td>Approach after FAF</td>
<td>Invalid if Integ=NONE for &gt;5 min or Integ=Alarm</td>
<td>Not Issued</td>
<td>Not Issued</td>
<td></td>
</tr>
</tbody>
</table>
GLONASS

GLONASS (GLObal NAVigation Satellite System) is a Russian space-based navigation system similar to GPS. When fully deployed, GLONASS will consist of twenty-four satellites equally spaced in three orbital planes, so that a minimum of five satellites will be visible at any time to a viewer anywhere in the world.

The GLS-1250 and GNSS-2400 sensors are capable of tracking the signals of up to twelve GPS and GLONASS satellites in any combination. The signals from all satellites tracked can be used in the position solution. However, the FAA prohibits use of GLONASS either for predicting RAIM availability for non-precision approaches or for predicting FDE availability in remote/oceanic areas.

GPS/GLS/GNSS Status

GPS/GLS/GNSS status and data are displayed on the Status Pages. These pages are accessed from Data Page 2 by pressing the appropriate LSK.
For a low speed GPS configuration, only Status Page 1 is available. For GLS, GNSS and high speed GPS, all four pages are available. The fields and options for all configurations are explained below.

**GPS/GLS/GNSS** - The status of the sensor. The following are possible:

- **NAV** - The sensor is in NAV mode.
- **ACQ** - The sensor is acquiring satellites.
- **INIT** - The sensor is in startup initialization.
- **ALT** - The sensor is using altitude to supplement poor satellite geometry.
- **TEST** - The sensor is in SELF-TEST mode.
- **FAIL** - The sensor has failed or 429 data is not being received from the sensor.
- **DGPS** - The sensor is in the differential mode (GLS-1250 only).

**Q or EPU factors** - These are error estimates describing the radius of the circle-of-position of 95% probability.

If Q is configured, the value will range from 01 to 99. 01 equals 0.1 nm radius, 02 equals 0.2 nm radius, etc., through 98 which equals 9.8 nm radius. A value of 99 indicates that the sensor is no longer usable by the FMS.

If ANP/RNP is configured, EPU (Estimated Position of Uncertainty) will be a value in x.x format, indicating the radius in nautical miles; e.g., an EPU of 0.5 indicates a circle of 0.5 nm radius.

**# SATELLITES** - The number of satellites currently being tracked by the sensor. For the GLS-1250 and the GNSS-2400, this number is further broken down into GPS and GLO satellites.
INTEG - Integrity status is displayed on this line and defined below.

- **RAIM** - Receiver Autonomous Integrity Monitoring (only displayed with a RAIM capable sensor).
- **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 horizontal position error outside alarm limits applicable to the phase of flight.

**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.

**273, 277 & 352 (GPS & GNSS Only)** - These items are used primarily by technicians for diagnostics and troubleshooting.

**VER (GPS & GNSS Only)** - The internal software version.

**MVERT (GLS Only)** - Vertical aircraft offset. This value is a constant computed at system installation; for UASC systems, it is set to zero.

**VPLMAX** - (GLS Only) - Maximum vertical protection limit allowed before approach. Not exceeding this limit ensures that the GLS will meet continuity requirements for precision approaches.

**ADDRESS & DATA (GPS Only)** - These items are used primarily by technicians for diagnostics and troubleshooting.

**TEST & DIAG (GLS Only)** - These items are used primarily by technicians for diagnostics and troubleshooting.

**SELECT/DESEL GPS ONLY (GPS Only)** - This option is only available for high speed GPS configured for Collins Pro Line 4 with the FIAS option enabled. Choosing SELECT GPS ONLY will deselect all selected sensors except GPS, the ADC and the selected heading source and change the selection to DESEL GPS ONLY. Choosing DESEL GPS ONLY will select all allowable, previously deselected sensors.
**SELECT/DESELECT GPS/GLS/GNSS** - Used to manually select or deselect the sensor.

**Note:** Status Pages 2 through 4 are available for GLS, GNSS and high speed GPS only.

<table>
<thead>
<tr>
<th><strong>GPS 1 2/4</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SV#</strong></td>
</tr>
<tr>
<td>04</td>
</tr>
<tr>
<td>06</td>
</tr>
<tr>
<td>29</td>
</tr>
<tr>
<td>22</td>
</tr>
<tr>
<td>16</td>
</tr>
<tr>
<td>13</td>
</tr>
<tr>
<td>09</td>
</tr>
<tr>
<td>15</td>
</tr>
</tbody>
</table>

**Internal GPS, GPS-950 and GPS-1000 Status Page 2**

<table>
<thead>
<tr>
<th><strong>GLS 1 2/4</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SV#</strong></td>
</tr>
<tr>
<td>04 GPS</td>
</tr>
<tr>
<td>06 GPS</td>
</tr>
<tr>
<td>29 GLO</td>
</tr>
<tr>
<td>22 GPS</td>
</tr>
<tr>
<td>16 GLO</td>
</tr>
<tr>
<td>13 GLO</td>
</tr>
<tr>
<td>09 GLO</td>
</tr>
<tr>
<td>15 GPS</td>
</tr>
</tbody>
</table>

**GLS-1250 Status Page 2**

<table>
<thead>
<tr>
<th><strong>GNSS 1 2/4</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SV#</strong></td>
</tr>
<tr>
<td>04 GPS</td>
</tr>
<tr>
<td>06 GPS</td>
</tr>
<tr>
<td>29 GLO</td>
</tr>
<tr>
<td>22 GPS</td>
</tr>
<tr>
<td>16 GLO</td>
</tr>
<tr>
<td>13 GLO</td>
</tr>
<tr>
<td>09 GLO</td>
</tr>
<tr>
<td>15 GPS</td>
</tr>
</tbody>
</table>

**GNSS-2400 Status Page 2**

Status Pages 2 and 3 display the satellites most likely to be in current use by the sensor. Each line displays:

**SV#** - Satellite Vehicle Number. GLO or GPS designate GLONASS or GPS satellites respectively.
AZ - Azimuth (deg). Azimuth will always be true direction from the aircraft.

EL - Elevation (deg). 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 - Signal to Noise Ratio. SNR is a number from 0 to 63 in dB Hz.

STAT - Status. Status is a number from 0 to 9 defined as follows:

<table>
<thead>
<tr>
<th>Status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Satellite is assigned to a channel</td>
</tr>
<tr>
<td>1</td>
<td>FIND command issued</td>
</tr>
<tr>
<td>2</td>
<td>Waiting to receive almanac and ephemeris data</td>
</tr>
<tr>
<td>3</td>
<td>Waiting to receive complete pseudo range data block</td>
</tr>
<tr>
<td>4</td>
<td>Performing the acquisition/tracking process</td>
</tr>
<tr>
<td>5</td>
<td>Fast sequencing of satellite signal (tracking mode)</td>
</tr>
<tr>
<td>6</td>
<td>Satellite is not assigned to a channel</td>
</tr>
<tr>
<td>7</td>
<td>Lost satellite lock during sequencing process</td>
</tr>
<tr>
<td>8</td>
<td>Waiting for clock message</td>
</tr>
<tr>
<td>9</td>
<td>Satellite not found</td>
</tr>
<tr>
<td>D</td>
<td>Satellite is deselected</td>
</tr>
</tbody>
</table>

If the sensor is receiving more than eight satellites, their data are displayed on Status Page 3, which is identical in structure to Status Page 2. If the sensor is receiving eight or fewer satellites, Status Page 3 will still be active but all of its data fields will be blank.
This page is accessed using the PREV or NEXT key from other Status Pages. This page applies to the internal GPS, GPS-1000, GPS-1000A, GNSS-2400 and the GLS-1250. It might appear with other sensors but will not be functional.

This page displays satellites that have been deselected.

In addition to displaying a list of deselected satellites, this page is also used to manually select or deselect satellites.

A list of satellites appears showing the satellite vehicle (SV) number. For GPS configurations, the status of each satellite is also shown.
Section VII
Sensors & Interfaces

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 LSK [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.

For GLS installations configured as GLS-GLO, all GLONASS satellites are automatically deselected and cannot be manually selected; the DES GLO SV#-- and SEL GLO SV#-- fields are unavailable.

The crew can reselect a satellite by pressing LSK [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 sensor acknowledges.

For the GNSS-2400 satellites may be deselected individually by entering the SV# in the DES GPS or DES GLO field. Up to 14 satellites of each type may be manually deselected. Entering a 99 in these fields will deselect all the satellites of that type and ALL will display in the list of deselected satellites.

To reselect the satellites, enter the SV# or 99 in the SEL GPS or SEL GLO fields. If ALL satellites have been selected using 99, they cannot be reselected individually.

Inertial Reference Sensor (IRS)

IRSs will accept latitude/longitude position information from the FMS only during their alignment mode, i.e., during the initialization procedure.

During initialization, all IRSs that 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). This page is accessed from Data Page 2.

**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 alignment mode. The aircraft should not be moved. If the IRS is in the alignment mode and is selected, then time to NAV information in minutes is displayed in parentheses.

- **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 magnetic or true (whichever is configured) heading received by the navigation computer from the IRS. Dashes are displayed if no valid data are 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 LSK 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.

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 # LSK.

2. Press the appropriate DESEL # or SELECT # LSK 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 FMS1. IRS1 continues to function normally, but FMS1 disregards the IRS1 inputs in its own best computed position computations. FMS2 would continue to use the inputs from IRS1 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# Status Page 1
This page is accessed from Data Page 2, and provides GPS and IRS sensor data.

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** - GPIRS is in initialization
- **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 also shows Q or EPU, the number of satellites being tracked and the North and East component velocities from the IRS, GPS, FMS and HYBrid IRS/GPS.
SET HDG [2R] - IRS heading may be initialized by entering a heading in this field. The value entered is displayed and transmitted to the IRS for 12 seconds, after which dashes are displayed in the field again and transmission ceases. This function is used for setting IRS heading when in ATT mode. The field will indicate ° for magnetic and T for true heading.

The IRS and GPS can be independently selected or deselected from this page at LSKs [3R] and [4R], respectively.

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 horizontal position error outside alarm limits applicable to the phase of flight.

**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# Status Page 2**

This page is similar to Data Page 3, but only Hybrid, GPS and IRS positions are shown for comparison to FMS position. Pressing a LSK next to GPS, HYB or IRS will display that position in the upper right hand fields, and show the difference from the FMS position. The selected sensor identifier will be shown in small font and become unavailable as an option.

**GPIR# Status Page 3**

This page shows the values of key ARINC 429 labels from GPIRS, listed in the left hand column. This page is for use primarily by technicians for diagnostic and troubleshooting purposes.
The LCS-850 Status Pages display the navigational status of UASC’s Loran C sensor LCS-850. The page will not be available for display if an LCS-850 is not installed. The LCS-850 is automatically deselected for ground operations and is automatically selected at liftoff. The LCS-850 automatically tunes the best available stations for the current position, taking into account 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 eight stations (non-colocated) on up to four group repetition intervals (GRIs) are used in the NAV solution to provide multi-GRI/cross chain operation. The LCS-850 is for enroute navigation only and is not intended for use during approach. If desired, the LCS-850 may be strapped to automatically drop out of NAV mode upon outbound crossing of a Loran Operating Area (LOA) border.

Minimum station tracking requires that at least three stations 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-850 and the status of the LOA. A change in LCS-850 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 NAV status will be accompanied by a LCS NAV message on the Message Page if the aircraft is in the defined LOA.
LCS-850 Status Messages

NAV - indicates the LCS-850 is in the normal navigational mode. The LCS-850 is navigating with sufficient signals inside the LOA, or the LCS-850 is navigating outside the LOA after flying there from inside the LOA, provided continuous signal reception has been maintained since before leaving the LOA.

FAIL - indicates that the LCS-850 failed initial self-test or an operational failure is detected.

SEARCH - indicates that the LCS-850 is searching for a sufficient number of stations for navigation.

LOA Status Messages

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 LOA.

The remainder of the lines displayed on the LCS-850 Status 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 until automatic station selection mode is enabled. The LCS-850 is intended to operate in the automatically selected station mode during the enroute phase of flight.
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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 being tracked but not incorporated in the NAV solution due to unfavorable signal condition, considering geometry, field strength, variance/covariance error estimates, skywave and interference. Small capital letters can also indicate that:

1. The station is transmitting a BLINK warning mode, or
2. The 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 LCS-850 Status Page 1 by pressing the DATA function key, and then selecting the LCS LSK.
2. Press the DESEL LCS LSK to deselect the LCS-850. The status line will indicate NAV (D).

**LCS-850 Sensor Reselect**

1. Access LCS-850-850 Status Page 1 by pressing the DATA function key and then selecting the LCS LSK.
2. Press the SELECT LSK to reselect the Loran C Sensor. 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 LCS-850 Status Page 1 by their four-digit GRI. The Loran C chains and associated GRIs are as follows:

<table>
<thead>
<tr>
<th>Loran C Chain</th>
<th>GRI</th>
<th>Available Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Pacific</td>
<td>9990</td>
<td>M--XYZ</td>
</tr>
<tr>
<td>Gulf of Alaska</td>
<td>7960</td>
<td>M--XYZ</td>
</tr>
<tr>
<td>Canadian West Coast</td>
<td>5990</td>
<td>M--XYZ</td>
</tr>
<tr>
<td>U.S. West Coast</td>
<td>9940</td>
<td>M-WXY-</td>
</tr>
<tr>
<td>North Central U.S.</td>
<td>8290</td>
<td>M-WXY-</td>
</tr>
<tr>
<td>South Central U.S.</td>
<td>9610</td>
<td>MVWXYZ</td>
</tr>
<tr>
<td>Great Lakes</td>
<td>8970</td>
<td>M-WXYZ</td>
</tr>
<tr>
<td>South East U.S.</td>
<td>7980</td>
<td>M-WXYZ</td>
</tr>
<tr>
<td>North East U.S.</td>
<td>9960</td>
<td>M-WXYZ</td>
</tr>
<tr>
<td>Canadian East Coast</td>
<td>5930</td>
<td>M--XYZ</td>
</tr>
<tr>
<td>*Labrador Sea</td>
<td>7930</td>
<td>M-WX--</td>
</tr>
<tr>
<td>North Atlantic</td>
<td>9980</td>
<td>M-WX-Z</td>
</tr>
<tr>
<td>*Norwegian Sea</td>
<td>7970</td>
<td>M-WXYZ</td>
</tr>
</tbody>
</table>

*No longer commissioned.

Manual GRI Selection

1. Access LCS-850 Status Page 1 by pressing the DATA function key, and then selecting the LCS LSK.
2. Use the LSKs 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-850 Status Page 1 by pressing the DATA function key, and then selecting the LCS LSK.
2. Use the appropriate LSK to position the cursor over the manual GRI entry field.
3. Press the BACK and then ENTER keys to delete the manual input.
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 Loran C Sensor 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-850 to navigate when inadequate signals are present. It also does not relieve the flight crew of the responsibility of knowing when the LCS-850 may be used for IFR navigation and when it must be deselected.
LCS-850 LOA Maps

LCS-850 (P/N 1045-01) LOA Map
LCS-850 (P/N 1045-01) LOA Map (Continued)
LCS-850 Status Page 2

LCS-850 Status Page 2 is primarily a maintenance page for use by technicians.

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 LOA is stored in the LCS-850’s memory. LCS-850 Status Page 1 will indicate whether the aircraft's position is inside or outside the stored LOA.

LCS-850 Status Page 3

LCS-850 Status Page 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 a reference noise level of 1 dB.

Interference (INTEF) frequencies indicate the frequencies to which the notch filters are automatically tuned in order to filter out undesirable continuous wave interference (CWI). CWI may be due to noise on the power distribution system or other signals present near the 100 kHz band.
The LCS Status Pages display the navigational status of the LCS, P/N 1040. The page will not be available for display if no LCS is installed. The 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.

Minimum station tracking requires that at least three stations 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 and the status of the LOA. 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 LOA.

**LCS Status Messages**

**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.

**FAIL** - indicates that the LCS failed initial self-test or an operational failure is detected.

**SEARCH** - indicates that the LCS is searching for a sufficient number of stations for navigation.

**LOA Status Messages**

**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 LOA.

The remainder of the lines displayed on LCS Status Page 1 show the GRI of the Loran C chains in use. Up to three Loran C chains may be displayed. The chains are always listed in ascending numerical order. A maximum of two chains may be manually selected. A manually selected chain is denoted by the (M) displayed immediately after the chain’s 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 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 might be caused by the station being beyond the distance limit or operating in the BLINK (warning) mode.
LCS Deselect
1. Access LCS Status Page 1 by pressing the DATA function key, and then selecting the LCS LSK.
2. Press the DESEL LCS LSK to deselect the LCS. The status line will indicate NAV (D).

LCS Reselect
1. Access LCS Status Page 1 by pressing the DATA function key, and then selecting the LCS LSK.
2. Press the SELECT LSK to reselect the LCS. The status line will indicate NAV, FAILED, NONCERT, or SEARCH.

GRI Selection
The Loran C chains used by the LCS are listed on LCS Status Page 1 by their four-digit GRI. The Loran C chains and associated GRIs are as follows:

<table>
<thead>
<tr>
<th>Loran C Chain</th>
<th>GRI</th>
<th>Available Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest Pacific</td>
<td>9970</td>
<td>M-WXYZ</td>
</tr>
<tr>
<td>Korea</td>
<td>5970</td>
<td>M-WX-Z</td>
</tr>
<tr>
<td>North Pacific</td>
<td>9990</td>
<td>M--XYZ</td>
</tr>
<tr>
<td>Gulf of Alaska</td>
<td>7960</td>
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</tr>
<tr>
<td>U.S. West Coast</td>
<td>9940</td>
<td>M-WXY-</td>
</tr>
<tr>
<td>North Central U.S.</td>
<td>8290</td>
<td>M-WXY-</td>
</tr>
<tr>
<td>South Central U.S.</td>
<td>9610</td>
<td>MVWXYZ</td>
</tr>
<tr>
<td>Great Lakes</td>
<td>8970</td>
<td>M-WXYZ</td>
</tr>
<tr>
<td>Southeast U.S.</td>
<td>7980</td>
<td>M-WXYZ</td>
</tr>
<tr>
<td>Northeast U.S.</td>
<td>9960</td>
<td>M-WXYZ</td>
</tr>
<tr>
<td>Canadian East Coast</td>
<td>5930</td>
<td>M--XYZ</td>
</tr>
<tr>
<td>*Labrador Sea</td>
<td>7930</td>
<td>M-WX--</td>
</tr>
<tr>
<td>North Atlantic</td>
<td>9980</td>
<td>M-WX-Z</td>
</tr>
<tr>
<td>*Norwegian Sea</td>
<td>7970</td>
<td>M-WXYZ</td>
</tr>
<tr>
<td>French</td>
<td>8940</td>
<td>M--X--</td>
</tr>
<tr>
<td>Mediterranean</td>
<td>7990</td>
<td>M--XYZ</td>
</tr>
<tr>
<td>Northern Saudi</td>
<td>8990</td>
<td>MVWXYZ</td>
</tr>
<tr>
<td>Southern Saudi</td>
<td>7170</td>
<td>M-WXYZ</td>
</tr>
</tbody>
</table>

*No longer commissioned.
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Sensors & Interfaces

Manual GRI Selection

1. Access LCS Status Page 1 by pressing the DATA function key, and then selecting the LCS LSK.
2. Use the LSKs 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 LCS Status Page 1 by pressing the DATA function key, and then selecting the LCS LSK.
2. Use the appropriate LSK to position the cursor over the manual GRI entry field.
3. Press the BACK and then ENTER keys to delete the manual input.

Loran C Operating Areas

LCS software contains a "map" of the LOA within which it is programmed to navigate. The version number of the LOA 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.
LCS Status Page 2

LCS Status Page 2 is primarily a maintenance page for use by technicians.

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 LOA is stored in the LCS memory. Loran Status Page 2 will indicate whether the aircraft's position is inside or outside the stored LOA.

LCS Status Page 3

LCS Status Page 3 displays Loran SNN and interference frequencies. SNN values can range from 0 to 63 with 63 being the maximum. This is primarily a maintenance page and appears as follows:
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Loran Operating Areas (LOA) - Version 5

World Wide LOA 5

Worldwide LOA 5
Loran Operating Areas (LOA) - Version 5

Worldwide LOA 5 (Continued)
Loran Operating Areas (LOA) - Version 5

North American LOA 5
Loran Operating Areas (LOA) - Version 5

North American LOA 5 (Continued)
Loran Operating Areas (LOA) - Version 5

Middle Eastern LOA 5
Middle Eastern LOA 5 (Continued)
Loran Operating Areas (LOA) - Version 5

Far Eastern LOA

Far Eastern LOA 5
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, depending 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 FMS1 is:

IRS 1, AHRS 1, ANALOG, IRS 3, IRS 2, AHRS 2

For FMS2:

IRS 2, AHRS 2, ANALOG, IRS 3, IRS 1, AHRS 1

For FMS3:

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 used 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 Heading 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.

Note: The IC00L and IC00R options are only available on Embraer installations.

The current heading source is displayed just below the title line. Pressing a LSK will activate that heading source and 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 Page 4 (General Data) by repeatedly pressing the DATA function key. The current HDG (heading) source is listed in parentheses.

2. Access the Heading Source Page by using the HDG LSK to position the cursor on the HDG entry field, and then pressing the LIST function key.

3. Use the LSKs to select the desired heading source.

Manual Heading Input

In the unlikely event that all other heading sources have failed, the following procedure can be used to manually enter a heading.

Note: In the event that 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 LSK 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.

Cancel Manual Heading Input

1. Access Data Page 4 (General Data) by repeatedly pressing the DATA function key.

2. Press the HDG LSK to position the cursor on the HDG entry field.

3. Press the LIST function key.

4. Press the LSK for the desired heading source.
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 LSK to position the cursor on the VARIATION entry field.
3. Enter the desired variation. If required, use the ± 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 LSK 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.
The FMS and RADAR/MFD interfaces have been accomplished in such a manner that the FMS's flight plan waypoints and legs can 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:** For aircraft interfaces that support the two-way interface with the heading bug, the FMS is displayed or coupled to the Flight Director/Autopilot System. The EFIS heading bug should be monitored 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. This feature is NOT supported in the CRJ 700 aircraft interface.

**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. In the CRJ 700 aircraft interface, transition from FMS to ILS guidance will NOT occur automatically. The flight crew must select the ILS navigation source prior to FAF.
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. Coupled VNAV is NOT supported in the CRJ 700 aircraft interface.

HONEYWELL MD80 EFIS INTERFACE

The FMS can be configured to support Honeywell MD-80 EFIS. This interface requires the EDZ 810 EFIS display. The EDZ 810 XTK scaling is required by the MD-80 EFIS. Coupled LNAV is supported. Coupled VNAV is NOT supported by this interface.

COLLINS PROLINE 21 INTERFACE

The FMS can be configured to interface with Collins ProLine 21 system, which provides ADC, AHRS, Digital Fuel, Go-Around and Strut data.

Air Data Computer

The ProLine 21 system may have either simple or dual ADC installations. When the FMS is receiving valid ADC data, it will display the ADC in use on Data Page 2 and on the ADC STATUS Page. On dual ADC installations there is an external ADC reversion switch in the cockpit; ProLine 21 allows only one reverted ADC at a time.
**Attitude Heading Reference System**

The ProLine 21 has dual AHRS installed. If the AHRS in use should fail, the FMS will annunciate the AHRS FAIL message and automatically switch to the other AHRS. The pilot can manually select as a heading source, any valid AHRS via the Heading Source Page. The FMS will not automatically revert to the offside AHRS when the reversion switch is activated but rather, the offside AHRS must manually be selected via the Heading Source Page.

**SEXTANT IMS 100**

The FMS can be configured to support the Sextant IMS currently used on the deHavilland DHC8 series 400 aircraft. The IMS supports both LNAV and VNAV functions along with cockpit advisories. Radio Tuning of the onside DME and VOR is available through the FMS.

**Air Data Computer**

ADC data can be crossfilled from the offside FMS should the IMS bus fail. An external reversion switch in the cockpit allows manual ADC reversion.

**Attitude Heading Reference System**

The IMS 100 has dual AHRS providing magnetic heading, pitch angle and roll angle.
VIDEO INTERFACE

Support of external video sources is an optional feature of systems using 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 navigation 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.

   ![Dimming Control Window]

   - UNDERLYING TEXT
   - BRIGHT
   - DIM
   - CANCEL
   - DISPLAY
   - OFF

2. Press the DISPLAY LSK to access the display options window.

   ![Display Options Window]

   - UNDERLYING TEXT
   - UP
   - DOWN
   - CANCEL
   - VIDEO

3. Press the VIDEO LSK to access video mode. The active video source will be displayed.
To Adjust Video Brightness

LSKs [1R] and [2R] are used to adjust video brightness while in video mode. Press and hold LSK [1R] until the display is brightened sufficiently, or press and hold LSK [2R] until the display is dimmed sufficiently.

To Exit Video Mode

Press any key to exit video mode (with the exception of LSKs [[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 the content that was being viewed prior to entering video mode.
TEMPORARY CHANGE


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 that 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.
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 (LSK) option on Data Page 1. Access is also available from the Message Page, an option which makes it more convenient to access 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 Page 1.

**Note:** The AFIS prompt on the Message Page will not appear during a disk load or save operation which was initiated from the Disk Menu Page.

**Note:** The AFIS prompt will not appear if the Message Page is accessed prior to completion of required entries on the Initialization Page.

![MESSAGE 1/1]

![DATA 1/4]
AFIS Menu Page

This page allows the selection of the following AFIS functions.

**CREATE MSG [1L]** - For generating the text of a message and having it transmitted.

**READ MSG [2L]** - For displaying 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]** - For displaying the AFIS Flight Plan Page.

**AFIS OPTIONS [4R]** - For displaying the AFIS Options Page.

**RETURN [5R]** - For returning the display to the accessing page, either the Message Page or Data Page 1.
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.

TO - The intended destination of the message to be sent. Up to 16 characters may be entered.

FR - The origin of the message. Up to 16 characters may be entered.

# - Telephone number of intended message destination. Up to 17 characters may be entered.

EDIT MSG TEXT [4L] - Pressing LSK [4L] will access the Edit Message 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 Edit 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 Message Text Page and has not yet been transmitted. After the message has been 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.

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.
Appendix A
Airborne Flight Information System (AFIS)

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 form the AFIS Menu Page by selecting the [READ MSG] option.

![AFIS Read Message Page](image)

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 accessed first.

RETURN [5R] - This line select key returns 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 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 Weather 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 Weather List Page corresponding to the desired airport. The text is displayed which was uplinked from the Global Data Center for this identifier.

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 Weather 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 200nm on either side of the great circle route between the displayed from and to waypoints. The FROM 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.

(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 FROM line select key will place the cursor over this identifier entry field and the FROM 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 FROM 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.

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 are 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.

<table>
<thead>
<tr>
<th>Station Identifier</th>
<th>Display</th>
<th>Time</th>
<th>RETURN [5R]</th>
</tr>
</thead>
</table>

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

Flight Plan 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 the 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.


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 Flight Plan List Page

This page is accessed by pressing the DISK FPL LIST line select key on the AFIS Flight Plan Page. The page is used to select a flight plan from the list for insertion into the FMS as the active flight plan.

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 Flight Plan Page and may be entered as the active FMS flight plan.
Recall Flight Plan Page

This page is accessed from the AFIS Flight Plan Page and allows entry of information required to request a previously defined AFIS flight plan. 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 Flight Plan Page.

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 Flight Plan 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 instead of inserting the FPL#).

**TO [3L]** - A four character identifier is entered here for the recall flight plan destination (used instead of inserting FPL#).

**DATE [2R]** - Numeric entry of date (DDMMYY) is entered here for the recall flight plan (used instead 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 instead 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 Flight Plan 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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<tr>
<td>MSG KEY</td>
<td>Messages-1</td>
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<tr>
<td>SYSTEM MESSAGES</td>
<td>Messages-1</td>
</tr>
</tbody>
</table>
TEMPORARY CHANGE


FILING INSTRUCTIONS: Insert this Temporary Change in the front of the Messages Section.

REASON: Remove message prompts which are no longer generated by FMS SCN 802.3/902.3 and higher.

INSTRUCTIONS:

The following messages may be deleted from this manual when operating FMS SCN 802.3/902.3 and higher:

- NO VOR RECEIVED
- NO TACAN RECEIVED
- NO DME RECEIVED
- RRS RECOVER
- RRS (DME TACAN VOR) RECOVER
INTRODUCTION

This section contains the FMS system messages. Each message the system can display is detailed below, including any action(s) that might be necessary by the crew to correct the abnormality. A box around the procedures following the message definition indicates crew action. No action is specified for messages that are of an advisory nature only.

MSG KEY

If the Position Uncertain message is active, "POS" will be displayed on the far left side of the top line on the CDU display. When a new system message becomes active, "MSG" will appear on the far right side of the top line on the CDU display. Pressing the MSG key will cause the Message Page to be displayed showing the active messages. The current messages (those messages generated since the page was last accessed) will be displayed at the top of the list. After the messages are viewed, the CDU display is returned to the previous page by selecting the RETURN option on the Message Page or by pressing either the MSG or BACK keys.

SYSTEM MESSAGES

System messages are presented in alphabetical order on the following pages. Messages specifying the sensor number (GPS1, IRS2 and LCS2) are listed below with the number symbol (#) in place of the sensor number. However, the sensor number is used in the actual message. All messages are suppressed for the first thirty seconds after takeoff in order to minimize distractions to the pilot.
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 appear 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 the heading source on Data Page 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.

ABEAM WAYPOINT ALERT - This message is displayed fifteen seconds prior to the sequencing time for an abeam intersection.

ABNORMAL CKLIST DB FAIL - Appears if the abnormal Checklist Database has failed (only with Collins ProLine 4 800 configuration).

1. Reload the Checklist Database.

ADC ALT REQD FOR APRCH - Approach is active and the pilot has selected either a manual or crossfill altitude, which cannot be used for approach guidance.
ADC ALT REQD FOR VNAV - VNAV mode is either cruise or descent and the pilot has selected either a manual or crossfill altitude, which cannot be used for VNAV guidance.

ADC INPUT FAIL - An Air Data Computer (ADC) failure is detected.

| Manual entries of TAS and altitude may be made on ADC Page 1. |
| 1. Check circuit breaker for ADC or air data converter unit (ACU) if installed. |
| 2. Press the DATA key until Data Page 2 is accessed. |
| 3. Press the line select key (LSK) at ADC to access ADC Page 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 data management unit (DMU) has invalid configuration data. This will disable the air/ground data link. This message will remain on the Message Page until the condition clears.

AFIS DOWNLINK FAIL - The AFIS DMU has determined that a downlink communication has failed. The last request should be repeated.

AFIS FPL RCVD - Either an uplinked flight plan from the Global Data Center or a disk flight plan from the AFIS data transfer unit (DTU) has been received and processed.

AFIS NO COMM - The AFIS DMU has failed to establish contact with the ground station. The last request should be repeated. This message will remain on the Message Page until the condition clears.
Messages

AFIS UPLINK FAIL - The AFIS DMU has determined that an uplink communication has failed. The last requested information will probably not be received.

AFIS VHF LINK DISABLED - The AFIS DMU has determined that the VHF link is disabled. This may result when (in a shared antenna system) the VHF antenna is being used by the aircraft voice communication system. It may also occur when all in-range VHF ground networks have been disabled.

AFIS VHF MODEM FAILURE - The AFIS DMU has determined that the VHF modem unit within the AFIS is not operational. This message will remain on the Message Page until the condition clears.

AHRS # HEADING FAIL - The AHRS heading has failed while in use as the FMS heading source. This message is suppressed while the aircraft is on the ground.

1. Press the DATA key to access Data Page 4.
2. Place cursor over the HDG field.
3. Press the LIST key to access a display of alternate heading sources.
4. Select an alternate heading source.

AHRS # INPUT FAIL - The AHRS input has failed or its status word indicates failure.

AIRPORT DATABASE FAIL - A problem has been found in the airport section of the Navigation Database. Verify airport coordinates of interest. There is a high probability that the system will fail the initial self-tests the next time it is turned on. After landing and shutdown, turn the system off and then on again in order to troubleshoot.

1. Reload the Navigation Database.

AIRWAY DATABASE FAIL - A problem has been detected in the airway section of the Navigation Database.

1. Reload the Navigation Database.

ALERTER ABOVE VNAV ALT - In the Primus 1000 installation, VNAV is in descent mode and the altitude alerter has been dialed above the VNAV altitude.

ALERTER ALT INVALID - In the Primus installation for Cessna Excel, the selected altitude is either not received over the Primus input bus or
it is invalid. This message will display until alerter altitude is received and valid.

**ALIGN PT DATABASE FAIL** - A problem has been detected in the alignment waypoints database.

1. Reload Pilot Database.

**ALT INVALID FOR VNAV** - VNAV is in descent mode, but (1) only pressure altitude is available and the aircraft is below 18,000 feet, or (2) ADC altitude has failed.

**ALTITUDE INVALID** - The altitude portion of the ADC is not usable. A manual entry of altitude may be made on the ADC Status Page.

1. Press the DATA key until Data Page 2 is accessed.
2. Press the line select key at ADC to access the ADC Status Page.
3. At the BARO ALT field, enter the current BARO altitude.

**ANALOG ATTITUDE FAIL** - Displayed if analog inputs are being used for Doppler navigation and become invalid for more than five seconds. This 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 Page 2.
2. Press ADC prompt to access the ADC Status Page and verify TAS and altitude.
3. Press the DATA key to access Data Page 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 FMS instrument reference input.
**APC INPUT FAIL** - In the RC-135 aircraft installation, the aircraft performance computer (APC) Receive Bus is configured but no signal has been received for three seconds.

**APC STATUS** - In the RC-135 aircraft installation, the APC has detected a partial failure or sensor input failure.

**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 section of the Navigation Database that has rendered it unusable.

1. Reload the Navigation Database.

**APPROACH IN USE** - The currently accessed approach is in use in the flight plan and cannot be modified or deleted.

**APPROACH SEGMENT FULL** - A leg has been inserted into the approach segment and the approach segment leg limit has been reached.

**ARINC # FAIL** - ARINC #1 or 2 board failure is detected. This message will only occur following the self test on system initialization. Communication with other onboard systems may be affected.

**ARPT COMS DATABASE FAIL** - A failure has been detected in the airport communications section of the Navigation Database. Access to some airport communications will be prevented.

1. Reload the Navigation Database.

**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 the Navigation Database.

**ASCB FAIL** - ASCB board failure has been detected during or after the power-up self test. This message will remain on the Message Page until the condition clears.

**ASCB TX INOPERATIVE** - The ASCB board will not transmit. This message will clear when acknowledged or when the condition clears.

**ASCB LEFT BUS FAIL** - ASCB left system bus has failed. FMS operation may be degraded. This message will clear when acknowledged or when condition clears.
**ASCB RIGHT BUS FAIL** - ASCB right system bus has failed. FMS operation may be degraded. This message will clear when acknowledged or when condition clears.

**AUXILIARY BOARD FAIL** - The Auxiliary Board has failed self test.

**BACKUP DATABASE FAIL** - The backup navaid database has failed.

**BARO ALT NOT AVAILABLE** - Barometric altitude is not available from installation of an ADC without barometric altitude or from loss of barometric altitude. This message will clear after acknowledgement or when the condition clears.

**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.

**CKLIST DATABASES FAIL** - Appears if all Checklist Databases have failed (only with Collins Pro Line 4 interface).

1. Reload the Checklist Database.

**CLOCK TIMER FAIL** - The clock timer on the CDU board has failed self test.

**COMP ARPTS DATABASE FAIL** - A part or all of the company airports database has failed.

**COMP ROUTE DATABASE FAIL** - A part or all of the company route database has failed.

**COMP WPTS DATABASE FAIL** - A part or all of the company waypoints database has failed.
Messages

CONFIG DATA FAILED - The FMS configuration data has failed.

CONFIG MODULE FAILED - Communication with or data in the configuration module has failed. Attempt to store configuration to determine cause.

CONFIG UPDATE REQUIRED - Configuration module and FMS configuration data has failed, requiring the FMS to be configured for installation.

CREW CKLIST DB FAIL - Appears if the crew notes database has failed (only with Collins Pro Line 4 interface).

CROSSFILL FAIL: BAD DATA - A flight plan 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 flight plan 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, resulting in guidance displays being 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 passes its self test.

DATABASE EXPIRED - The current date is past the Navigation Database Expiration Date as displayed on the Initialization Page and the Data Pages.

1. Load an up-to date Navigation Database.

DATABASE FAIL - Part or all of the Navigation Database has failed.

1. Reload the Navigation Database.

DATABASE FULL - The particular Pilot Database (SID, STAR or Approach) is full and a procedure is created or modified that exceeds the Database capacity.
DATABASE VAX LOADED - The database was loaded from a VAX host computer instead of a DDU.

DEAD RECKONING MODE - (DR) True air speed and heading are the only sensors being used for navigation.

DEMONSTRATION MODE - The aircraft identification is configured as “DEMO” and sensor data is simulated internally.

1. Do NOT use this FMS for navigation.

DISCRETE I/O FAIL - The discrete input/output self test 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 Page is not currently 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 occur when a Disk submenu page is not being displayed.

DME TUNE FAIL - An ARINC 709 series DME has not tuned to the pilot requested frequency. The message appears regardless of the select status of the DME and is cleared when the radio successfully tunes.

DOPLR MODE CONTROL FAULT - Doppler status is a state other than that commanded for more than ten seconds.

DOPPLER ARINC FAIL - One or more specific labels from the Doppler have not been received by the FMS for ten 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 questionable and has been deselected for navigation.

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 enroute intersections section of the Navigation Database has failed.

1. Reload the Navigation Database.

**ENROUTES COMS DATABASE FAIL** - The enroute communications section of the Navigation Database has failed.

1. Reload the Navigation Database.

**ERP # FAIL** - This message will be on the #1 FMS if the #1 EFIS Radar Panel (ERP) has failed. The message will be on the #2 FMS if the #2 ERP has failed (only with Collins Pro Line 4 interface).

**ETP ALERT** - This message displays when the distance to go (DTG) to the equal time point (ETP) is five nm.

**FMC BATTERY LOW** - Self test has detected that the FMC battery is low. Navigation is still possible; however, at shutdown the position, date and time may be lost.

1. Return the FMS to UASC 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 # GLS MISMATCH** - GLS and FMS deviations differ by more than one dot (that is, 10°).

**FMS-BC DIFFERENCE WARN** - The FMS is in approach mode on a backcourse type approach and the track angle error is less than 3°, crosstrack error is less than 0.2 nm and the localizer deviation is greater than 0.039 DDM (1/2 dot).

**FMS DIFFERENCE > xxNM** - The sensor "watchdog" has sensed that the latitude/longitude positions of the two systems in a dual installation differ from each other by an amount that warrants pilot attention. "xx" can be six, twelve, eighteen or twenty-four nm. Since both FMSs normally use the same sensors, this should not happen. If it does:
1. Check the Navigation Pages on each FMS and follow the system displaying the smallest difference between the FMS and sensor latitude/longitude positions.

2. If the FMSs are using 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. Only the TUNE and MSG keys are allowed.

**FMS NETWORK COMM FAIL** - Indicates the FMS’s internally programmed Ethernet address has failed. The FMS will operate normally but cannot communicate with the DTU or other line replaceable units on the network.

**FMS PART NUMBER MISMATCH** - The FMS installed has a different part number from that stored in the configuration module. 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 that the fuel flow displays are reasonable values.
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.
Messages

**FUEL NOT CONFIRMED** - The FMS was powered up from the Standby mode and the fuel has not been confirmed on Fuel Page 1.

**GLONASS DEPENDENT NAV** - The FMS is in GPS Navigation mode, the GLS/GNSS sensor is in Navigation mode and the total number of GPS satellites is less than four and at least one GLONASS satellite is in use for navigation.

**GLS FACILITY INVALID** - A GLS ground station failure is indicated.

**GLS # CONFIG MODULE FAIL** - A mismatch has occurred between data stored in the configuration module and data calculated by the GLS sensor.

**GLS # DESELECT** - The sensor monitor has determined that the GLS data is unreasonable and has deselected the sensor. This message will be removed after it is read.

**GLS # DIFFERENCE > xxNM** - The sensor “watchdog” has sensed that the latitude/longitude position as determined by GLS #1 or #2 differs from the FMS best computed position by an amount that warrants pilot attention. "xx" can be six, twelve, eighteen or twenty-four nm.

**GLS # FAIL** - A failed status has been determined for the indicated GLS.

1. Press the DATA key to access Data Page 2.
2. Place cursor over sensor to access the Sensor Status Page.
3. Check the sensor status.

**GLS # NOT NAV** - The specified GLS has changed to a non-navigational condition (that is, it is none of the following: DGPS, Navigation, Altitude-Aiding or Fault). The GLS Status Page will show the cause of the change.

**GLS VDL FAIL** - This message will follow an APPR FACILITY INVALID message. It informs the crew that the approach facility may be operational but the GLS VHF datalink board has failed.

**GNSS # DESELECT** - The sensor monitor has determined that the specified GNSS data is unreasonable and has deselected the GNSS sensor for use in navigation. The message will be removed after it is displayed once.

**GNSS # DIFFERENCE > xxNM** - The sensor “watchdog” has sensed that the latitude/longitude position as determined by the GNSS differs
from the FMS best computed position by an amount that warrants pilot attention. "xx" can be six, twelve, eighteen or twenty-four nm.

**GNSS # FAIL** - A failed status has been determined for the indicated GNSS.

1. Press the DATA key to access Data Page 2.
2. Place cursor over sensor to access the Sensor Status Page.
3. Check the sensor status.

**GNSS # NOT NAV** - The specified GNSS has changed to a non-navigational condition (that is, it is none of the following: Navigation, Altitude-Aiding or Fault). This message will be removed after it is displayed once or when the GNSS goes into Navigation or Altitude-Aiding mode. The GNSS Status Page will show the cause of the change.

1. Press the DATA key to access Data Page 2.
2. Place cursor over sensor to access the Sensor Status Page.
3. Check the sensor status.

**GPIRS # DESLECT** - The sensor monitor has determined that the specified GPS data is unreasonable and has deselected the GPS portion of the sensor.

**GPIRS # DIFFERENCE > xxNM** - The sensor “watchdog” has sensed that the latitude/longitude position as determined by the GPS portion of the GPIR# (1, 2 or 3) differs from the FMS best computed position by an amount that warrants pilot attention. "xx" can be six, twelve, eighteen or twenty-four 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.

1. Press the DATA key to access Data Page 2.
2. Check the sensor status.
**Messages**

**GPIR # GPS NOT NAV** - The GPS portion of the specified GPIRS has changed to a non-navigational condition (that is, it is none of the following: Navigation, Altitude-Aiding or Fault). The 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 six, twelve, eighteen or twenty-four nm.

**GPS # FAILED** - A failed status has been determined for the indicated GPS, either because the position data is missing or invalid or because the status label indicates that a Fail status exists.

1. Press the DATA key to access Data Page 2.
2. Place cursor over sensor to access the Sensor Status Page.
3. Check the sensor status.

**GPS # NOT NAV** - The specified GPS has changed to a non-navigational condition (that is, it is none of the following: Navigation, Altitude-Aiding or Fault) for at least three minutes. The 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. This message is displayed sixty seconds after the condition appears and remains as long as the condition exists. This message is suppressed on the ground or while operating in the FIAS ‘GPS only’ mode.

**GPS-RADIO POS DIFFERENCE** - The sensor monitor

**HEADING REF FAIL** - The AC reference for the Analog Heading input has failed.

**HIGH GROUNDSPEED FOR ARC** - The current leg is an AF or RF and the groundspeed is too high for the aircraft to stay within the bounds of the arc.

**HIGH GNDSPD FOR HOLDING** - In holding mode, the current groundspeed is excessive for holding airspace. This may be due to
either high winds or high TAS. The pilot should lower airspeed if feasible.

**IC600L HEADING FAIL** - In the Cessna Bravo, Cessna Ultra, or Embraer 145, the heading source has failed while in use.

**IC600R HEADING FAIL** - In the Cessna Bravo, Cessna Ultra, or Embraer 145, the heading source has failed while in use.

**IC600-L BUS FAIL** - In the Cessna Bravo, Cessna Ultra, or Embraer 145 configuration, label 371 has reported invalid hardware equipment condition, operational mode or data word content, or is not detected on the left-side bus.

**IC600-R BUS FAIL** - In the Cessna Bravo, Cessna Ultra, or Embraer 145 configuration, label 371 has reported invalid hardware equipment condition, operational mode or data word content, or is not detected on the right-side bus.

**ILLEGAL FACILITY TYPE** - The entered facility is of an invalid type for this approach.

**ILLEGAL WAYPOINT** - A turn center waypoint has been entered for a pilot-defined RF leg that defines a radius greater than 32 nm.

**ILS DATABASE FAIL** - An error has been detected in the ILS database and access to the ILS database is not allowed.

**IMS BUS FAIL** - Either invalid hardware equipment condition, operational mode or data word content is detected on the bus, or no condition at all is detected. This applies to the Sextant IMS configuration used on deHavilland DHC-8 S400.

**INSIDE LOA** - The aircraft is inside a defined LORAN Operating Area (LOA). This message will be removed after it is displayed.

**INVALID ARINC VERSION** - ARINC circuit boards are installed with software versions that are not compatible with the FMS software version.

**INVALID CONFIGURATION** - The FMS configuration is invalid. Further information can be found in the applicable FMS Configuration Manual.

**INVALID CONFIG - TAWS** - Any of several errors or mismatches made during FMS configuration for TAWS can cause this message to display.
Messages

**INVALID CONFIG - VISION 1** - Vision-1 is configured as enabled but the high speed UNS-429 bus is not configured.

**INVALID FUEL CONFIG** - The fuel flow sensor configuration is invalid or incomplete. The fuel flow function will be disabled.

**INVALID ROUTE UPLINK** - UniLink has detected an error during a flight plan uplink.

**IRS # ALIGN** - The specified IRS is in the alignment mode. The aircraft must remain stationary at this time.

**IRS # ALIGN FAULT** - The entered position failed the 3+3T test or the latitude comparison test. Re-enter position.

**IRS # ATTITUDE** - The specified IRS is in the attitude reference mode. Navigation data is not available.

**IRS # CODE 01** - (Delco only) Turn specified NAV unit off.

**IRS # CODE 02** - (Delco only) Select ATT mode on specified IRS.

**IRS # CODE 03** - (Delco only) Check heading output from the specified IRS.

**IRS # DC FAIL** - The backup battery or DC bus is below 17 VDC.

**IRS # DC FAIL ON DC** - The last shutdown of the system was due to a power interrupt and not because of IRS failure.

**IRS # DESELECT** - The sensor monitor has determined that the specified IRS data is unreasonable and has deselected the sensor for use in navigation.

**IRS # DIFFERENCE WARNING** - IRS position difference exceeds a rate of two knots.

**IRS # FAIL** - An inertial reference system failure is detected in the IRS indicated.

1. Press the DATA key to access Data Page 2.
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 Page 4.
2. Press HDG to place the cursor over the heading field.
3. Press the LIST key to access the Heading Source Page.
4. Check the heading source and change if desired.

**IRS # NAV** - IRS Alignment is complete and the specified IRS is in Navigation Mode.

**IRS # ON BATTERY** - The specified IRS is being powered by a DC power source or standby battery.

**IRS # READY NAV** - In installations using Delco IRS only, the IRS align status is 5.

**LAT/LONG XING WPT ALERT** - This message displays fifteen seconds prior to sequencing time for latitude or longitude intersection.

**LCS DESELECT** - The sensor "watchdog" has determined that the LCS sensor position is unreasonable and has deselected the sensor for use in navigation.

**LCS DIFFERENCE > xxNM** - The sensor "watchdog" has sensed that the latitude/longitude position as determined by the LCS differs from the FMS best computed position by an amount that warrants pilot attention. "xx" can be six, twelve, eighteen or twenty-four nm.
**Messages**

**LCS FAIL #** - This message is displayed when the LCS has failed. The # is the failure code. Failure codes are as follows:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LCS Program Checksum Fail</td>
</tr>
<tr>
<td>2</td>
<td>LCS ARINC Self Test Fail</td>
</tr>
<tr>
<td>3</td>
<td>LCS Memory Test Fail</td>
</tr>
<tr>
<td>9</td>
<td>LCS is not communicating with the FMS</td>
</tr>
</tbody>
</table>

1. Press The DATA key to access Data Page 2.
2. Place cursor over the LCS sensor to access the Sensor Status Page.
3. Check the sensor status.

**LCS NAV** - The LCS has changed to Navigation Mode. This message will not display if the LCS is deselected while airborne.

**LCS NOT NAV** - LCS has changed to either Fail or Search Mode. The cause of the change is displayed on the LCS Status Page.

**LEFT IOC-OFFSIDE FAIL** - This message will be displayed on the #2 FMS if the offside input/output concentrator has failed (only with Collins ProLine 4 or ProLine 21 configuration).

**LEFT IOC-ONSIDE FAIL** - This message will be displayed on the #1 FMS if the onside input/output concentrator has failed (only with Collins ProLine 4 or ProLine 21 configuration).

**LOC STEERING ACTIVE** - An LOC or BC Approach is active and the localizer signal is used in the roll steering equation.

**MANUAL LEG CHANGE REQD** - The aircraft is on a CA, FA, or VA leg and barometric altitude is not available to the FMS. The crew must make a manual leg chance 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 databases in the failed bank are unusable.

1. Reload the Navigation Database into the other bank.

**MODE KEYS INOP - DISK PAGE** - A disallowed mode key was pressed while any Disk Page (except Disk Menu) is displayed. The MSG key is the only key allowed.

FILING INSTRUCTIONS: Insert this Temporary Change adjacent to the Message-19 page.

REASON: Revise the NEW MAINT LOG EXISTS message and add new message prompts generated by the FMS SCN 802.3/902.3 release.

INSTRUCTIONS:

Revise the following:

**NEW MAINT LOG EXISTS** - In SCN 802.0/902.0 thru 802.2/902.2, this message is displayed one minute after landing when any diagnostic history event has been recorded during the previous flight. In 802.3/902.3 and higher, this message is not automatically displayed upon landing.

1. Refer to "Maintenance Data Download" section of this manual for procedure to download and display the Maintenance Log.

Add the following:

NAV RADIO DESELECT – Generated in SCN 802.3/902.3 and higher only. This message is displayed when position data is not valid and two or more radio sensors are configured. All configured radio sensors are deselected (DME, VOR and TACAN).
**MOT WPT LIST FULL** - For MMMSs only. The next mark-on-target (MOT) waypoint added to the list will scroll the oldest waypoint from the circular buffer.

**MOT WPT MEMORY FAIL** - For MMMSs only. The MOT waypoint memory section has failed during power-up self test.

**NAV DATABASES FAILED** - All segments of the Navigation Database failed simultaneously. This message replaces all individual segment messages.

1. Reload the Navigation Database.

**NDB DATABASE FAIL** - A problem has been found in the non-directional beacon (NDB) section of the Navigation Database. Access to this database will not be permitted.

1. Reload the Navigation Database.

**NDB NAME DATABASE FAIL** - An error was detected in the NDB plain language name database.

1. Reload the Navigation Database.

**NEW MAINT LOG EXISTS** - This message is displayed one minute after landing when any diagnostic history event has been recorded during the previous flight.

1. Refer to "Maintenance Data Download" section of this manual for procedure to download and display the Maintenance Log.

**NEXT LEG UNDEFINED** - A gap is in the next flight plan waypoint position. The flight plan must be edited by the pilot to eliminate the gap. If the gap is not eliminated, the aircraft will fly to the current TO waypoint, and after waypoint passage will continue to fly the same desired track with the TO/FROM flag now indicating FROM. The WPT annunciator will remain illuminated after waypoint passage and a **CURRENT LEG EXTENDED** message will appear on the message page.

**Note**: The gap placed at the end of the approach before the destination airport does not trigger this message.

1. Press the FPL key to access the flight plan.
2. Edit the flight plan to remove the gap.
NEXT VNAV LEG INVALID - The VNAV leg following the current leg is either undefined, too steep, or a climb; FMS vertical guidance will become invalid after crossing the current vertical TO waypoint. The pilot must take action to define a valid NEXT VNAV leg. This message will apply to procedural legs in SIDs, STARs and approaches which are "floating waypoints", e.g., heading to intercept a VOR radial.

This message also appears if the TO vertical waypoint is the second or subsequent approach waypoint of an ILS approach with the ILS approach configured as “advisory.”

NO DME RECEIVED - A radio reference sensor is configured and closest fifteen DME stations are all within 300 nm but the stations that are received are either invalid or unreasonable.

NO HEADING - No heading information is being received. This message will not be displayed while on the ground. If a valid heading source was available, it should have already been automatically selected.

1. Press the DATA key to access Data Page 4.
2. Press HDG to place the cursor over the heading field.
3. Press the LIST key to access the Heading Source Page. Change the heading source if desired.
4. If no other heading source is available, manually input the aircraft's heading on Data Page 4.

NO INTERCEPT - The system is in the heading intercept mode and the selected heading will not intercept the current navigation leg.

NO RAIM @ FAF - RAIM is not available at the Final Approach Fix, or the horizontal integrity limit is greater than 0.3 nm. This message does not appear on GWS approaches.

NO RAIM @ MAP - RAIM is not available at the Missed Approach Point, or the horizontal integrity limit is greater than 0.3 nm.

NO SATELLITE INTEG - GPS integrity monitoring is not available for twenty-seven seconds in Enroute flight phase and for seven seconds in Terminal flight phase. In Approach phase after FAF, GPS integrity monitoring is not available and HDOP is greater than 4.0 for seven seconds.

NO TACAN RECEIVED - The closest five TACAN stations are all within 130 nm but the stations that are received are either invalid or
unreasonable. This message will not appear when on the ground or if VOR/TACAN is deselected.

**NO VOR RECEIVED** A radio reference sensor is configured and the closest five VOR stations are all within 130 nm but the stations that are received are either invalid or unreasonable. This message will not appear when on the ground or if VOR/TACAN is deselected.

**NONVOLATILE MEMORY FAIL** - The non-volatile memory (NVM) 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 the Checklist Database.

**OFFSIDE FLAP POS FAILED** - No offside flap position input is detected in the Lear 45 Primus 1000 installation.

**ONSIDE FLAP POS FAILED** - No onside flap position input is detected in the Lear 45 Primus 1000 installation.

**OTHER FMS HEADING FAILED** - An FMS is using the heading source from another FMS, and that heading source has failed.

1. Press the DATA key to access Data Page 4.
2. Place cursor over the HDG field.
3. Press the LIST key to access the Heading Source Page and select another source if available.

**OUTSIDE LOA** - The aircraft is outside of a defined LORAN operating area. This message will be removed after it is displayed.

**OVERSPEED INVALID** - The FMS doesn’t receive one or more of the following input labels required for Overspeed mode: Label 206, Indicated Airspeed, label 207, Max allowable Airspeed, label 331, Longitudinal Acceleration and Pitch Angle, label 324.

**PERF DATABASE FAILED** - The Performance Database has failed. Advanced performance features will be disabled.

1. Reload the Performance Database.
Messages

**PERF DB ID MISMATCH** - The Performance Database identifier entered on the configuration pages does not agree with the Performance Database identifier on the disk that is loaded. Advanced performance features will be disabled.

**PERF T/O GW UPDATE REQD** - The current gross weight differs by more than 2.5% from the value entered in the gross weight field.

1. Press the key sequence BACK > ENTER to update, or
2. Enter a manual value in the gross weight field.

**PILOT ALIGN DB UPDATED** - This message appears after the Check All process. It indicates a change to the pilot alignment waypoint database based on loaded or resident navigation data, and requires redefinition or confirmation by the pilot.

**PILOT APPR DATABASE FAIL** - A problem has been detected in the Pilot-Defined Approach Database.

1. Reload data from the Pilot Data Save disk.

**PILOT APPR DB UPDATED** - Displayed following the Check All Process. Indicates pilot approach data has been updated by the system as a result of a navigation data update. Requires definition or confirmation by the pilot.

**PILOT ARPT DATABASE FAIL** - A problem has been detected in the Pilot-Defined Airport Database.

1. Reload data from Pilot Data Save disk.

**PILOT ARPT DB UPDATED** - This message appears after the Check All process. It indicates a change to the pilot airport database based on loaded or resident navigation data, and requires redefinition or confirmation by the pilot.

**PILOT DATABASES FAILED** - The database 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 Database.

1. Reload data from Pilot Data Save disk.
PILOT ROUTE DATABASE FAIL - A problem has been detected in the Pilot-Defined Route Database.

1. Reload data from Pilot Data Save disk.

PILOT ROUTE DB UPDATED - This message appears after the Check All process. It indicates a change to the pilot route database based on loaded or resident navigation data, and requires redefinition or confirmation by the pilot.

PILOT SID DATABASE FAIL - A problem has been detected in the Pilot-Defined SID Database.

1. Reload data from Pilot Data Save disk.

PILOT SID DB UPDATED - This message appears after the Check All process. It indicates a change to the pilot SID database based on loaded or resident navigation data, and requires redefinition or confirmation by the pilot.

PILOT STAR DATABASE FAIL - A problem has been detected in the Pilot-Defined STAR Database.

1. Reload data from Pilot Data Save disk.

PILOT STAR DB UPDATED - This message appears after the Check All process. It indicates a change to the pilot STAR database based on loaded or resident navigation data, and requires redefinition or confirmation by the pilot.

PILOT WPT DATABASE FAIL - A problem has been detected in the Pilot-Defined Waypoint Database.

1. Reload data from Pilot Data Save disk.

PILOT WPT DB UPDATED - This message appears after the Check All process. It indicates a change to the pilot waypoint database based on loaded or resident navigation data, and requires redefinition or confirmation by the pilot.

PNR ALERT - This message displays when the distance to go (DTG) to the point of no return (PNR) is five nm.

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.

POSITION UNCERTAIN - The FMS position is uncertain (not verified).
Messages

If configured for Q, a quality factor 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.

If configured for ANP/RNP, ANP values have reached the maximum limit per phase of flight. The RNP value in use may be a manual RNP or System RNP.

1. Refer to the Best Computed Position Update Procedure. Performing this procedure will deactivate this message.

**PROGRAM CHECK FAIL** - A problem has been found in the program software.

1. Monitor the system closely. There is a high probability that the system will fail the initial self-tests the next time it is turned on.
2. After landing and shutdown, power down the system and then up again in order to troubleshoot.

**PRO LINE 21-L BUS FAIL** - In the ProLine 21 configuration, label 360 is not detected on the left bus for two seconds.

**PRO LINE 21-R BUS FAIL** - In the Pro Line 21 configuration, label 360 is not detected on the right bus for two seconds.

**RADIUS REQ EXCESS BANK** - The orbit radius entered is less than the minimum aircraft turn radius required under current conditions. This message is presented in MMMSs only.

**RCU # FAIL** - A failure has been detected in the specified radio control unit.

**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-OFFSIDE FAIL - This message will be displayed on the #1 FMS if the offside input/output concentrator has failed (only with Collins ProLine 4 interface).

RIGHT IOC-ONSIDE FAIL - This message will be displayed on the #2 FMS if the onside input/output concentrator has failed (only with Collins ProLine 4 interface).

ROUTE CAPACITY EXCEEDED - An attempt has been made to create a route with over 98 waypoints or to store more than 200 routes

ROUTE DATABASE FULL - An attempt has been made to use more than 3000 waypoints in all routes.

RRS DATA BUS FAIL - RRS communication link with the FMS has failed.

RRS (DME, TACAN, VOR) RECOVER - The FMS has recovered from a ‘No (DME, TACAN, VOR) Received’ condition.

RRS (DME, TACAN, VOR) SELF TEST FAIL - The FMS has detected a failure during RRS (DME, TACAN, VOR) self test mode.

RRS (DME, TACAN, VOR) TUNE FAIL - The RRS did not tune the requested frequency within eight seconds.

RRS RECOVER - Data from an RRS is being received again after a failure.

RRS TUNE BUS FAIL - The RRS does not detect any tune requests from the FMS for at least two seconds.

RTU # FAIL - A failure has been detected in the specified radio tuning unit.

RUNWAY DATABASE FAIL - The runway section of the Navigation Database has failed.

1. Reload the Navigation Database.

RUNWAY IN USE - The specified runway is part of a SID, STAR or approach and cannot be modified or deleted.
Temporary Change

Manual Affected

Filing Instructions
Insert this Temporary Change adjacent Page 26 of the Messages section.

Purpose
Clarify the impact of the SATELITTE POS ALARM warning.

Instructions
Replace the text under SATELITTE POS ALARM with the following.

This message displays when the RAIM algorithm has detected a satellite failure that has not been excluded within the time to alarm for the current phase of flight. In addition to this alarm message, the FMS will turn on the GPS Integrity annunciator and change the INTEG field on the GPS or GNSS Sensor Status page from “RAIM” to “ALARM.”

WARNING: THE SATELLITE POS ALARM AND THE GPS INTEGRITY ANNUNCIATOR MUST NOT BE IGNORED. THEY ARE INDICATORS OF INTEGRITY LOSS FOR THE POSITION OUTPUT BY THE GPS/GNSS SENSOR. WHEN INTEGRITY LOSS IS DECLARED, THE GPS/GNSS POSITION CANNOT BE TRUSTED AND NAVIGATION MUST BE BASED ON OTHER NAVIGATION SOURCES.
**Messages**

**SATELLITE POS ALARM** - GPS error is any of the following:
- greater than two nm for more than twenty-seven seconds in the Enroute phase of flight
- greater than one nm for more than seven seconds during the Terminal phase of flight
- greater than 0.3 nm for more than seven seconds during the Approach/Non-Precision phase of flight

**SCAT-1 UNAVAILABLE** - The GLS sensor has detected either an FMS or GLS failure that prevents flying the SCAT-1 approach type.

**SID DATABASE FAIL** - The SID section of the Navigation Database has failed.

1. Reload the Navigation Database.

**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 version number stored in the configuration module.

**SPCL MISSION MEMORY FAIL** - A failure of non-volatile memory that contained search pattern or navigation data has been detected (MMMSs only).

**SPEED TOO FAST FOR TURN** - The current lateral guidance leg is an RF leg and the groundspeed is too high for the aircraft to stay within the bounds of the arc.

**STAR DATABASE FAIL** - The STAR section of the Navigation Database has failed.

1. Reload the Navigation Database.

**STEERING FAIL** - A continuous roll steering self-test failure has occurred. This failure can be reset as follows:

1. Press the DATA key to access Data Page 4.
2. Position the cursor over the ROLL CMD line.
3. Press the BACK key and then the ENTER key to reset.

**TACAN FAIL** - TACAN input has failed.
**TACTICAL DATABASE FULL** - All 100 available tactical waypoint slots have been used.

**TAS INVALID** - The true airspeed data from the ADC is not usable. A manual input of true airspeed may be made on the ADC Status Page.

1. Press the DATA key until Data Page 2 is accessed.
2. Press the line select key at ADC to access the ADC Status Page.
3. At the TAS field, enter current true airspeed. A manual TAS overrides any ADC input.

**TAWS FAIL** - TAWS A739 is configured and is not receiving a valid 172 label. Or, TAWS FMS fixed-pages is configured and label 123 is not valid.

**TAWS FPL/TERRAIN THREAT** - Label 272, bit 12 is set to 1 by the TAWS.

**TCAS NOT CONFIGURED** - The TFC button on the EFIS radar panel has been pressed and the FMS is not configured for Traffic Collision Avoidance System (TCAS) (only with Collins ProLine 4 800 interface).

**TERMINALS DATABASE FAIL** - The terminal intersection section of the Navigation Database has failed.

1. Reload the Navigation Database.

**TERMINAL WEATHER RCVD** - Terminal weather data has been received via AFIS Uplink or AFIS DTU.

**TEST MODE** - The FMS is in test mode.

**TOP OF DESCENT ALERT** - Estimated time to the top of descent point is less than two minutes.
TUNE NAV# - TO XXX ON FFF.FF - When not in approach mode, there are fewer than two DME stations available, the navigation mode is not GPS/DME, GPS or DME/DME and the current tuned VOR is greater than eighty nm away or is invalid. The XXX and FFF.FF are filled with the identifier and frequency of the nearest valid VOR.

1. Press the TUNE line select key to remotely 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 FMS monitoring the UniLink has determined the UniLink to be in the failed state.

UNILINK MSG RCVD - A new UniLink text message has been received.

1. Press the UNILINK prompt to access the UniLink Main Menu Page.
2. Press the NEW MSG prompt on the UniLink Main Menu Page to view message.

UNILINK RTE INVALID - An FMS uplink message containing route data that has failed error check and been rejected has been received.

UNILINK ROUTE RCVD - An FMS uplink message containing route data that has passed error check and is ready for review has been received.

UNILINK WX MAP RCVD - A new UniLink weather map has been received from Universal Weather and Aviation, Inc.

1. Press the UNILINK prompt to access the UniLink Main Menu Page.
2. Press NEW WX prompt on the UniLink Main Menu Page to view the new weather map.

UPLINK MESSAGE RCVD - A message has been received from the Global Data Center.
VARIATION WARNING - The aircraft is out of the auto-variation model range (above N72 degrees, 45 minutes and below S59 degrees, 45 minutes latitudes), there is no manual input, and the TRUE MAGNETIC switch is in the MAGNETIC position.

1. Press the DATA key to access Data Page 4.
2. Press the VARIATION line select key to place the cursor over the variation field.
3. Enter a manual east or west variation.

VERIFY MANUAL RNP - A manual RNP has been entered and then a flight phase transition occurs and the new RNP limit is less than the manually entered RNP. Or, a manual RNP has been entered and a leg with a lower database RNP value is sequenced to in a linked flight plan.

VERTICAL WPT ALERT - This message appears approximately fifteen seconds prior to a VNAV mode vertical leg change. The WPT and MSG annunciators on the instrument panel flash, along with the FMS MSG light. Pressing the MSG key will change the flashing WPT to steady, turn off the MSG light, and show the VNAV WPT ALERT message.

VHF NAME DATABASE FAIL - The VHF plain language name section of the Navigation Database has failed.

1. Reload the Navigation Database.

VHF NAVAID DATABASE FAIL - The navaid section of the Navigational Database has failed. The backup navaid database, containing navaids and airports, will be used.

1. Reload the Navigation Database.

VNAV DISCONNECT - An altitude or flight level has been entered on a flight plan page that has resulted in a VNAV disconnect. Return to the VNAV Path Page to re-activate VNAV. This message will clear after it is read.

VOR TUNE FAIL - An ARINC 711 VOR has not tuned to the pilot requested frequency.

VPATH CAPTURE - This message is annunciated fifteen seconds prior to sequencing to Top of Descent or initiating the capture to vertical path from a tactical mode.
WAAS LAT PA LIMIT - This message is displayed when the horizontal protection limit for the WAAS sensor is greater than horizontal alert limit for precision approach while in WAAS precision approach mode.

WAAS VERT PA LIMIT - This message is displayed when the vertical protection limit for the WAAS sensor is greater than the vertical alert limit for precision approach and the horizontal protection limit for the WAAS sensor is less than the horizontal alert limit for precision approach while in WAAS precision approach mode.

WAYPOINT ALERT - The aircraft position is within fifteen seconds of a leg change while enroute, (or five seconds while using approach procedural legs) prior to the TO waypoint. The MSG light will not illuminate for this message. The instrument panel WPT alert annunciator will illuminate to alert the pilot of an impending leg change.

WAYPOINT IN USE - This message occurs when attempting to delete a waypoint from the Pilot-Defined Database that is in use in the flight plan.

WINDS ALOFT RCVD - Winds aloft data has been received via AFIS uplink or AFIS DTU.

XFILL CONFIG MISMATCH - Crossfill data has been pushed to an FMS not configured to receive that data type. This message alerts the crew that crossfill data was sent and received but not accepted. Once read, this message is removed from the Message Page.

400 Hz REF FAIL - 400 Hz AC power has failed and there is no input to the analog roll steering. This message is suppressed if the system is installed in an "all digital" aircraft. It remains on the Message Page as long as the condition exists.

+3 VOLT PWR SUPPLY FAIL - Self test for power supply has failed.
+5 VOLT PWR SUPPLY FAIL - Self test for power supply has failed.
+8 VOLT PWR SUPPLY FAIL - Self test for power supply has failed.
-8 VOLT PWR SUPPLY FAIL - Self test for power supply has failed.
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** - Aircraft Communications Addressing and Reporting 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; also, Automatic Dependent Surveillance.

**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.

baseline extension - The extension of the baseline beyond the Loran-C master or secondary 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.

CPDLC - Controller-Pilot Data Link Communications.

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.

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.

**DTG** - Distance to Ground

**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.

**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 non-precision 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 database 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.

**GLS** - GPS Landing System. A system allowing a GPS precision approach by using differentially corrected satellite data.

**GNSS** - Global Navigation Satellite System.

**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. See 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 non-precision 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.

GWS - GPS WAAS Sensor. See WAAS.

HDOP - Horizontal Dilution of Position.

HUD - Heads-Up Display.

IAF - See Initial Approach Fix.

ILS - Instrument Landing System

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.

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.


**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.

**MSG** - Message.
Glossary

**MSU** - Mode Selector Unit.

**NAS** - National Airspace System.

**NAT OTS** - North Atlantic - Organized Track System.


**NAVSTAR/GPS** - Global Positioning System.

**NCU** - Navigation Computer Unit.

**NDB** - Non-Directional Beacon.

**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.

**ONC** - Operational Navigation Chart.

**OOOI** - Out, Off, On, In. A set of events describing the time at which an aircraft leaves the departure gate (Out), leaves the ground (Off), touches down (On), and opens its doors at the arrival gate (In).

**orthogonal** - Mutually perpendicular. The primary aircraft axes are orthogonally related.

**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.

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

**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.
**Glossary**

**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.


**SNR** - Signal to Noise Ratio.

**SPS** - GPS Standard Positioning Service.

**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.
\( \text{theta} \) - Navigational term for azimuth.
\( \text{time bias} \) - 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.
\( \text{track angle error} \) - The difference, in degrees and direction right or left, between the actual aircraft track and the desired track.
TRDRP - Teardrop.
\( \text{triple mixing} \) - 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.
TVS - Target Vertical Speed
UASC - Universal Avionics Systems Corporation.
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)
VDL - VHF Data Link.
VDOP - Vertical Dilution of Position.
TEMPORARY CHANGE


FILING INSTRUCTIONS: Insert this Temporary Change between pages Gloss-12 and Gloss-13 in the Glossary.

REASON: To clarify the description of the wind field.

INSTRUCTIONS:

Replace the WIND paragraph with the following.

WIND – This field displays the filter wind direction and wind speed, in knots, as computed by the Nav function. Wind direction is differentiated with a “T” for True or a degree sign (°) for Magnetic. Wind direction is always True, regardless of the position of the panel mounted Mag/True selector switch, except while in Approach Mode. When operating in polar regions (between N72 and S60 degrees latitude), wind display remains in degrees True in Approach mode.
Glossary

**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.

**WAAS** - Wide Area Augmentation System. GPS-based navigation and landing system that provides precision guidance to aircraft at thousands of airports and airstrips where there is no precision landing capability.

**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.

**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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