Honeywell

Business and Commuter Aviation Systems
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FMZ Series Flight Management System

Software Version 4.8

Pilot’s Operating Manual

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LIST OF EFFECTIVE PAGES

Original . . . 0 . . . Aug 1997

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	Subheading and Page	Revision
	Operational Example (cont)	
	4-19	0
	4-20	0
	4-21	0
	4-22	0
	4-23	0
	4-24	0
	4-25	0
	4-26	0
	4-27	0
	4-28	0
	4-29	0
	4-30	0
	4-31	0
	4-32	0
	4-33	0
	4-34	0
	4-35	0
	4-36	0
	4-37	0
	4-38	0
	4-39	0
	4-40	0
	4-41	0
	4-42	0
	4-43	0
	4-44	0
	Performance	
	5-1	0
	5-2	0
	5-3	0
	5-4	0
	5-5/5-6	0
F	5-7/5-8	0
	5-9	0
	5-10	0
	5-11	0
	5-12	3
	5-13	0
	5-14	2
	5-15	0
	5-16	0
	5-17	0
	5-18	0
	5-19	0
	5-20	0
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	5-44	0
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	5-53	0
	5-54	0
	5-55	0
	5-56	0
	5-57	0
	5-58	0
	5-59	0
	5-60	0
	Navigation	
	6-1	0
	6-2	0
	6-3	0

Subheading and Page	Revision	Subheading and Page	Revision
Navigation (cont)		6-49	0
6-4	0	6-50	0
6-5	0	6-51	0
6-6	0	6-52	0
6-7	0	6-53	0
6-8	0	6-54	0
6-9	0	6-55	0
6-10	0	6-56	0
6-11	0	6-57	0
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6-27	0	6-73	0
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6-29	0	6-75	0
6-30	0	6-76	0
6-31	0	6-77	0
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6-34	0	6-80	0
6-35	0	6-81	0
6-36	0	6-82	0
6-37	0	6-83	0
6-38	0	6-84	0
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6-45	0	6-91	0
6-46	0	6-92	0
6-47	0	6-93	0
6-48	0	6-94	0

Subheading and Page	Revision
Navigation (cont)	
6-95	0
6-96	0
6-97	0
6-98	0
6-99	0
6-100	0
6-101	0
6-102	0
6-103	0
6-104	0
6-105	0
6-106	0
6-107	0
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6-129	0
6-130	0
6-131	0
6-132	0
6-133	0
6-134	0
6-135	0
6-136	0
6-137	0
6-138	0
6-139	0

Subheading and Page	Revision
6-140	0
6-141	0
6-142	0
6-143	0
6-144	0
6-145	0
6-146	0
6-147	0
6-148	0
6-149	0
6-150	0
6-151	0
6-152	0
6-153	0
6-154	0
6-155	0
6-156	0
6-157	0
6-158	0
6-159	0
6-160	0
6-161	0
6-162	0
Flight Plan	
7-1	0
7-2	0
7-3	0
7-4	0
7-5	0
7-6	0
7-7	0
7-8	0
7-9	0
7-10	0
7-11	0
7-12	0
7-13	0
7-14	0
7-15	0
7-16	0
7-17	0
7-18	0
7-19	0
7-20	0
7-21	0

Table of Contents

Table of Contents (cont)

Table of Contents (cont)

Section **Page**

Table of Contents (cont)

Section **Page**

6 NAVIGATION (cont)

Table of Contents (cont)

Section **Page**

6 NAVIGATION (cont)

Table of Contents (cont)

Table of Contents (cont)

Table of Contents (cont)

List of Tables

List of Procedures

Table of Contents (cont)

List of Procedures (cont)

1. Introduction

This pilot's manual describes the components, typical operational example, and normal and abnormal operating procedures for the Honeywell Business and Commuter Aviation Systems Flight Management System (FMS).

This manual covers all FMS operations and options. Depending on equipment installed, specific aircraft may not have all the features described.

Sections 1 through 3 describe the FMS capabilities and components. Section 4 describes a normal operational example for the FMS. Sections 5 through 9 detail the features and specialized capabilities of the FMS.

Since many topics are covered in this manual, use the index to find specific topics. Also, there are many cross references within the manual.

This revision of the pilot's manual is based on **NZ4.8 or later software**.

Refer to page 14-4 for information on ordering additional copies of this manual or other Honeywell FMS publications.

FMS components are listed in table 1-1.

Model	Unit	Part No.
Cockpit Mounted		
CD-800	Control Display Unit (Mono)	7004403-VAR
CD-810	Control Display Unit (Color)	7007549-VAR
DL-800	Data Loader	7004607-VAR
DL-900	Data Loader	7016600-VAR
Remote Mounted		
IC-800	Integrated Avionics Computer	7017300-VAR
NZ-2000	Navigation Computer	7018879-VAR

FMS Components
Table 1-1

2. System Description

The Honeywell flight management system (FMS) controls a complete range of FMS functions. This section describes the major functions that are part of the FMS.

The primary purpose of an FMS is to manage navigation sensors to produce a composite position. Using the composite position along with flight planning capabilities, the FMS can control navigation, performance, and guidance work for the flight. The FMS consists of three components:

- Control Display Unit (CDU)
- Navigation Computer (NZ)
- Data Loader (DL)

Section 3, System Components, describes each of the components of the system. Figure 2-1 is a block diagram of the FMS system. The FMS has the following major functions:

NAVIGATION

- The navigation function computes the aircraft position and velocity for all phases of flight (oceanic, enroute, terminal, and approach), including polar navigation.
- The navigation function automatically blends or selects position sensors to compute an optimum position.
- The pilot can deselect individual sensors when required.

FLIGHT PLANNING

- The flight planning function computes the active flight plan with both lateral and vertical definition.
- Flight plans can be loaded from a flight planning service or by using a personal computer (PC) and a 3.5-inch diskette.

DATA BASE

- The data base contains worldwide coverage of navaids, airways, standard instrument departure/standard terminal arrival route (SID/STAR) procedures, approach procedures, airports, and runways.
- The data base can store pilot-defined flight plans and waypoints.

LATERAL NAVIGATION (LNAV)

- LNAV guides the aircraft along a predetermined flightpath at a pilot-selected bank angle for increased passenger comfort.
- LNAV maintains the aircraft within airway or protected airspace.
- LNAV automatically flies pilot-defined or data base holding patterns, including entry and exit procedures.

VERTICAL NAVIGATION (VNAV)

- VNAV gives a complete vertical profile for entire flight.
- VNAV is integrated with the lateral flight plan.
- Some ARINC 429 based aircraft are advisory VNAV only (e.g., NASA GII, EMBRAER 145).

PERFORMANCE

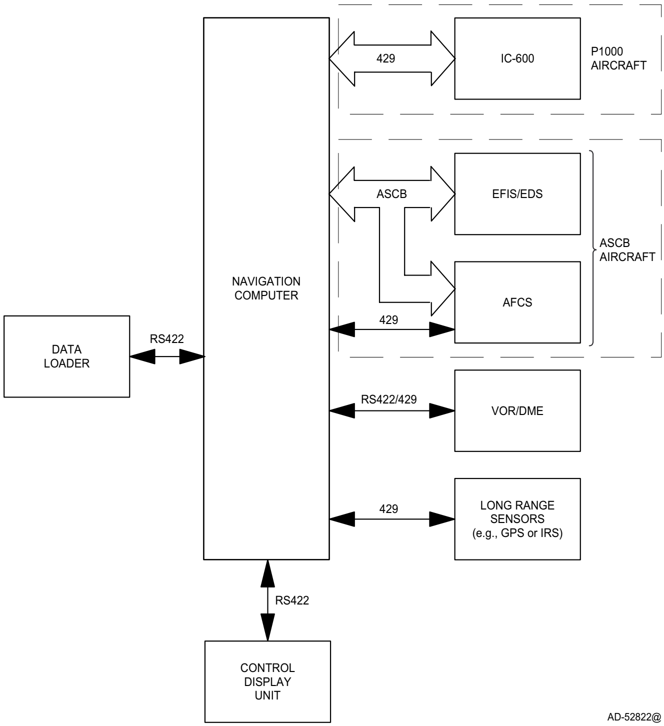
- Performance contains fuel management and time estimates for the flight.
- Performance estimates optimum altitude, cruise modes, step climbs, what-if situations, and stored flight plan planning.
- Performance has automatic speed targets.

AIRBORNE FLIGHT INFORMATION SYSTEM (AFIS™)

Interfaces to the AlliedSignal Global AFIS™.

NAVIGATION DISPLAYS

- Navigation displays are shown on the electronic flight instrument system (EFIS).
- Electronic maps integrate route map data with auxiliary navigation data to display the aircraft's situation at any time.
- Electronic displays integrate map data with weather radar displays.



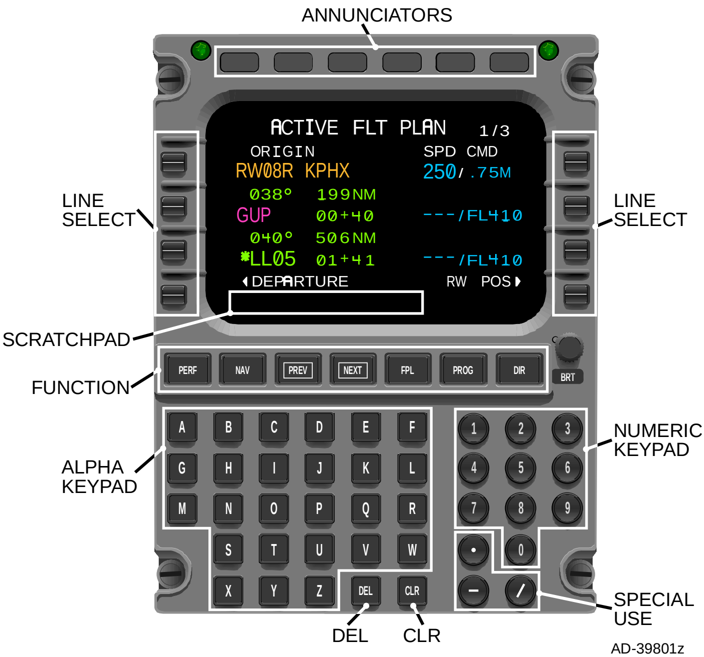
FMS Block Diagram
Figure 2-1

NOTES: 1. In P2000 installations, the navigation computer (EFIS) and AFCS are integrated into one unit (Integrated Avionics Computer).

2. Some installations do not use the ASCB interconnect to EFIS/EDS.

3. System Components

This section describes each system component and its function. The control display unit (CDU), shown in figure 3-1, is the pilot interface to the system. The function of the CDU is described in this section. It is necessary to know the general rules and operating characteristics of the CDU in order to understand the specific operations of the FMS.



CDU With Flight Plan
Figure 3-1

CONTROL DISPLAY UNIT (CDU)

CDU operation is designed to be simple and to minimize crew workload in all phases of flight. The CDU serves as the pilot interface with the navigation computer. Pilots enter data using the alphanumeric keyboard and the line select keys.

Architecture

The CDU consists of a keyboard, a cathode ray tube (CRT) display, and the electronics required to communicate with the navigation computer. The keyboard consists of line select keys (both sides of the CRT display), alphanumeric keys, function keys, annunciators, and a bright/dim control.

CRT

The CD-800 Control Display Unit has a monochrome CRT while the CD-810 Control Display Unit has a full-color CRT. Other than color, both model CDUs operate the same. The CRT contains nine lines. Each line contains twenty-four characters. The first line is a title line and the ninth line is the scratchpad.

- **Color Assignments** - Color on each CD-810 Control Display Unit page is designed to highlight important information. Color assignments are coordinated as much as possible with other displays. Refer to table 3-1 for a definition of color assignments.

Parameter	Assigned Color
Vertical	Cyan (Blue)
Atmospheric Data	Cyan (Blue)
Lateral	Green
FROM Waypoint	Yellow
TO Waypoint	Magenta
Prompts and Titles	White
Flight Plan Names	Orange
Index Selections	Green

FMS CD-810 Color Coding Scheme
Table 3-1

- **Viewing Angle** - All symbols are visible at a viewing angle of 45° from the sides, 15° from the top, and 30° from the bottom.

Alphanumeric Keys

The CDU alphanumeric keyboard is used by the pilot for input to the FMS. The alphanumeric keys make entries to the scratchpad only. The letters of the alphabet, the numbers 0-9, the decimal, the dash, and the slash, are each represented with a CDU key, as shown in figure 3-1.

Scratchpad

The bottom line on the CRT is the scratchpad. The scratchpad is a working area where the pilot can enter data and/or verify data before line selecting the data into its proper position. Alphanumeric entries are made to the scratchpad using the keyboard. As each key is pushed, the character is displayed in the scratchpad. Information in the scratchpad does not affect the FMS until it is moved to another line on the display. Data is retained in the scratchpad throughout all mode and page changes.

The scratchpad has an editing mode. While the editing mode is available all the time, it is most useful when entering messages for functions such as AFIS. Procedure 3-1 contains the procedure for using the scratchpad editing mode.

Step	Procedure 3-1 Scratchpad Editing Mode
1	The editing mode is entered by ending the scratchpad entry to be edited with a dash (—) and by pushing the PREV key.
2	In the editing mode, the PREV and NEXT keys move an inverse video cursor in the scratchpad.
3	The character in the inverse video field can be removed with the CLR key or a new character can be typed over it.
4	Pushing the DEL key deletes the entire scratchpad entry.
5	The editing mode is exited when the scratchpad entry is moved to a line by pushing a line select button.

The scratchpad also displays advisory and alerting messages. The scratchpad has the following display priority:

- Alerting messages
- Advisory messages
- Delete function
- Entry and line selection

Line Select Keys

There are four line select keys on each side of the CRT display. Data is selected to a line from the scratchpad or vice-versa using the line select keys. These keys are identified from top to bottom as 1L through 4L on the left side and 1R through 4R on the right side. The line select keys are the most often used keys on the CDU.

- **Direct Access Prompts/Function Selects** - In the case of an index display, the line select keys are used to select functions from the index. In displays other than index, the bottom line select keys (4L, 4R) are primarily used for direct access to other functions in the FMS. The functions most likely to be accessed from the present page and phase of flight are displayed as prompts. An example is the ARRIVAL prompt which is displayed on the active flight plan pages when within 200 NM of the destination. These types of prompts reduce the number of key strokes in order to minimize pilot workload. The pilot can also access functions through the main navigation and performance indices.

- **Transfer Line Data to Scratchpad** - If the scratchpad is empty, pushing a line select key transfers the respective line data to the scratchpad.

- **Transfer of Scratchpad Data to Line Fields** - Once data has been entered into the scratchpad either through line selection or manual keyboard entry, it can be transferred to any of the allowable line select fields on a page. To transfer the data, push the line select key adjacent to the line where the scratchpad data is intended.

Clear (CLR) Key

This key performs the following functions:

- When a message is displayed in the scratchpad, pushing the CLR key deletes the message.

- When a scratchpad entry begins with an asterisk (*) or pound sign (#), pushing CLR removes the entire entry.

- When an alphanumeric entry is made in the scratchpad, one character is cleared from the scratchpad (from right to left) each time the CLR key is pushed. If the CLR key is held down after the first character is cleared, other characters are cleared, one at a time, until the key is released. Refer to Scratchpad (page 3-3), for use of the CLR key editing feature.

Delete (DEL) Key

The DEL key is used to delete items from the FMS. When the DEL key is pushed, *DELETE* is displayed in the scratchpad. The DEL key can be line selected to delete waypoints or other items displayed in the CDU data fields. When there is a message displayed, the delete operation is inhibited. Delete is also used to return default values after entries have been made. Finally, as noted under Scratchpad (page 3-3), DEL can also be used in the scratchpad edit mode. While in the editing mode, with a dash (—) at the end of the scratchpad entry, pushing DEL deletes the entire scratchpad entry.

Function Keys

The seven function keys, located directly below the screen, access primary functions, indices (menus), and paging.

- **Performance (PERF) Key** - Pushing the PERF function key displays page 1 of the performance index. The pilot can select any of the index functions by pushing the respective line select key, as shown in figures 3-2 and 3-3. Refer to Performance Index (page 5-2), for more details.

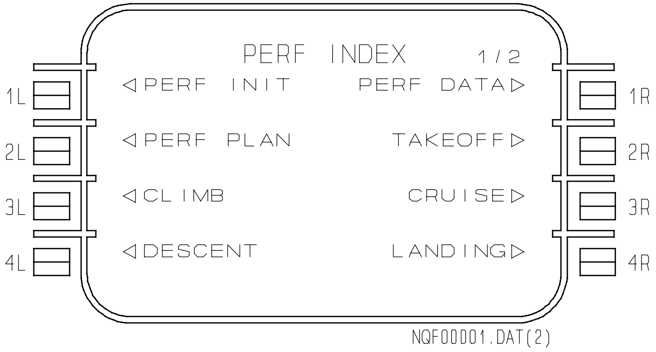


Figure 3-2

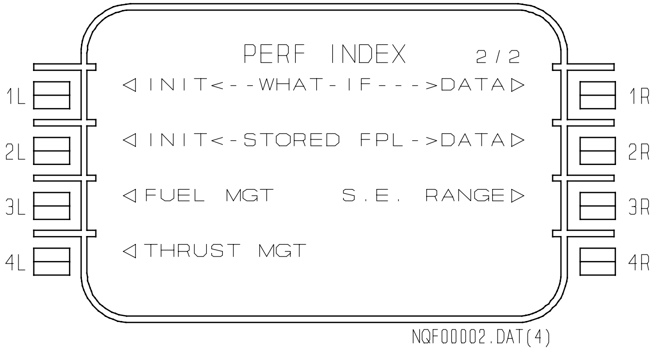


Figure 3-3

- **Navigation (NAV) Key -** Pushing the NAV function key displays page 1 of the navigation index, as shown in figures 3-4 and 3-5. The pilot can select any of the index functions by pushing the respective line select key. On aircraft with the Collins system, there is a third index page for EFIS options. Refer to Navigation Index (NAV) (page 6-1), for more details.

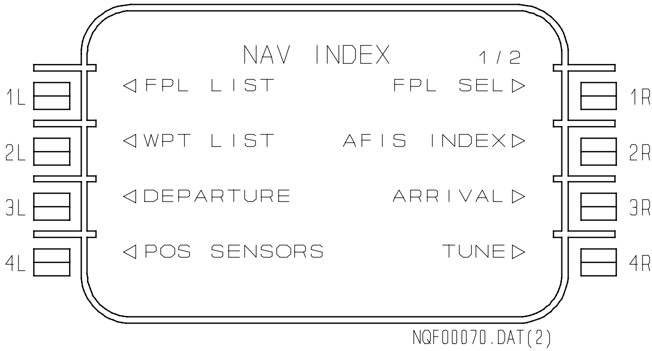


Figure 3-4

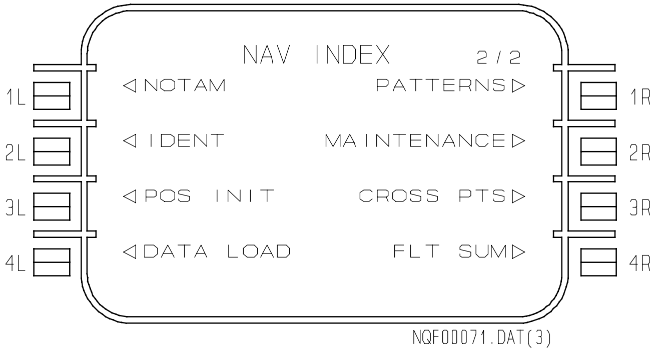


Figure 3-5

- **Paging (PREV)/(NEXT) Keys -** The specific page and number of pages in a particular function or menu display are shown in the upper right-hand corner of the display. The page number format is AA/BB where AA is the current page and BB is the total number of pages available. Page changes are made by pushing the PREV (previous) and NEXT keys. The keys can be held down for repeated page changing. Refer to Scratchpad (page 3-3), for use of the PREV and NEXT keys for editing.

- **Flight Plan (FPL) Key** - Pushing the FPL key displays the first page of the active flight plan, even if another page of the active flight plan is being displayed. An example page is shown in figure 3-6. If no flight plan is entered, the pilot can perform the following:

  - Manually create a flight plan.
  - Select a stored flight plan.
  - Load a flight plan from a disk.
  - Create a stored flight plan.

  Refer to Flight Plan (page 7-1), for more details.

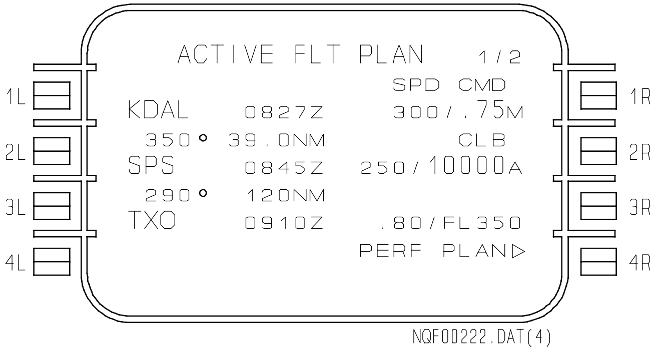


Figure 3-6

- **Progress (PROG) Key -** Pushing the PROG key displays the first progress page, even if another page of progress is being displayed. This mode shows the current status of the flight. The first progress page displays the estimated time enroute (ETE), distance to, and fuel projection for the TO waypoint and destination. It also displays the current NAV mode, the number of long range NAVs used, and the navaids that are presently tuned for radio updating. A typical progress page is shown in figure 3-7. Refer to Progress (page 8-1), for more details.

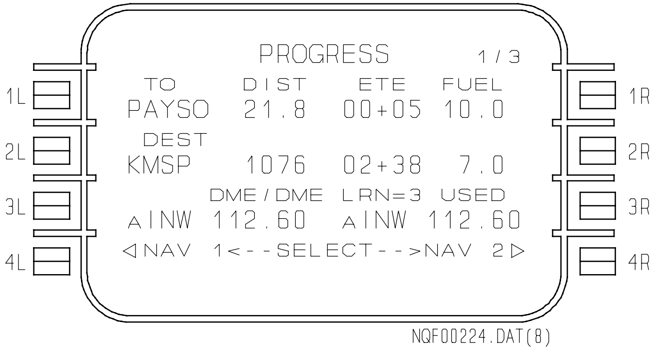


Figure 3-7

- **Direct-To/Pattern/Intercept (DIR) Key -** Pushing the DIR function key displays the active flight plan with the DIRECT, PATTERN, and INTERCEPT prompts, as shown in figure 3-8. If other than an active flight plan page is displayed when pushing the button, the first page of the flight plan is displayed. If the active flight plan is already displayed when pushing the button, the display remains on the same page with prompts displayed. DIRECT is the primary function. PATTERN and INTERCEPT must be selected at 4L or 4R, respectively. Refer to Direct/Pattern/Intercept (page 9-1), for more details.

Active Flight Plan in DIR Mode
Figure 3-8

Accessing Any FMS Function

The FMS prompts the pilot at 4L and 4R for the most likely functions to be selected. Using these prompts, the FMS steps the pilot through procedures such as initialization. At any time, it is possible to operate out of sequence or to access other areas of the FMS. Follow procedure 3-2 to access any function of the FMS.

Step	Procedure 3-2 Accessing Any FMS Function
1	Determine the required function. **All** functions are available at **all** times from the PERF, NAV, FPL, PROG, or DIR keys.
2	Select the appropriate PERF, NAV, FPL, PROG, or DIR key.
3	If PERF or NAV is selected, read the menu list for the required function or feature.
4	Select the correct function or feature.
5	The FMS displays the function or feature selected.
6	Continue work using the prompts at 4L and 4R if part of a sequence, such as initialization, is being completed.

Annunciators

There are six annunciators located at the top of the CDU keyboard panel. These annunciators can also be repeated on the electronic flight instrument system (EFIS) or other remote annunciators. White and amber annunciators are used on the CDU. White indicates an advisory annunciation and amber indicates an alerting annunciation.

- **Display (DSPLY)** - DSPLY is an advisory (white) annunciation. This annunciator is lit when the CDU displays flight plan type pages other than the first page of the active flight plan. This purpose is to provide a distinction with flight plan data controlling the aircraft. When airborne, the DSPLY annunciator is lit in the following cases:

  - When displaying a flight plan page other than page 1.
  - When displaying a stored flight plan page.

- When displaying any of the review pages for SIDs and STARs approaches.
- When displaying CHANGE ACTIVE LEG message.
- When defining INTERCEPT waypoint on the active leg.

- **Dead Reckoning (DR)** - DR is an alerting (amber) annunciation. This annunciator is lit when operating in the DR mode for longer than 2 minutes. The DR mode is defined as the loss of radio updating and all other position sensors.

- **Degraded (DGRAD)** - DGRAD is an alerting (amber) annunciation. This annunciator is lit when the FMS cannot guarantee the position accuracy for the present phase of flight due to sensor availability. The approved sensors for the flight phases are listed in table 3-2.

Flight Phase	**Approved Sensors (Navigation Mode)**				
	GPS	**DME/DME**	**VOR/DME**	**IRS**	**VLF**
Departure or Terminal	X	X	X	(see note)	
Enroute	X	X	X	(see note)	X
Oceanic	X	X	X	X	X
VOR/DME or VOR Approach	X	X	X		
GPS Approach	X				
NDB Approach	X	X			
NOTE: The FMS uses the IRS as the navigation mode for a limited time in these phases of flight. The time is determined in the FMS by estimating when the drift rate error of the IRS exceeds 1.7 NM for departure and 2.8 NM for enroute.					

Approved Sensors for Flight Phase
Table 3-2

The DGRAD annunciator is lit if both of the following conditions are valid:

- The sensors being used for navigation are not approved for the current phase of flight.

- The FMS is the selected aircraft navigation source on EFIS/ electronic display system (EDS).

If the DR annunciator lights when the DGRAD annunciator is lit, the DGRAD annunciator is turned off.

- **Message (MSG)** - MSG is an advisory (white) annunciation. This annunciator is lit when a message is displayed in the scratchpad. The annunciator goes out after the message(s) has been cleared from the scratchpad.

  Messages are displayed in the CDU scratchpad at various times. They inform or alert the pilot as to system status. Messages are divided into the following two major groups:

  - ADVISORY MESSAGES - Advisory messages contain information that is helpful to the pilot. Advisory messages are usually the result of a pilot action on the CDU (e.g., making an entry with the incorrect format).

  - ALERTING MESSAGES - Alerting messages alert the pilot to FMS status assuming the pilot is not looking at the CDU (e.g., a message annunciating a sensor failure). Alerting messages also light the FMS MESSAGE annunciator on the front panel. Alerting messages are a higher priority than advisory messages.

  Messages are stacked for display in priority order on a first in, last out basis. In cases where there are multiple messages stacked, the message annunciator stays lit until all messages are cleared. Only one message can be cleared per CLR key push.

- **Offset (OFFSET)** - OFFSET is an advisory (white) annunciation. The annunciator is lit when a lateral offset has been entered on PROGRESS page 3. The annunciator goes out when the offset is removed.

- **Approach (APRCH)** - APRCH is an advisory (white) annunciation. The annunciator indicates the FMS is in the approach mode of operation. In this mode, the EFIS deviation sensitivity and FMS tracking gains are increased. The approach annunciator is lit if the following conditions are valid:

  - The FMS is the selected aircraft navigation source on EFIS/EDS.

  - A non-precision instrument approach must have been activated from the navigation data base. If no approach, or an ILS, LOC, LOC-BC, landing directional aid (LDA), simplified directional facility (SDF), or MLS approach is selected, the APPROACH annunciator does not light.

  - The aircraft position is between 2 NM outside the final approach fix (FAF) and the missed approach point.

  - The DGRAD annunciator must be off.

  - The FMS must be using approved sensors for the selected approach procedure. Approved sensors for non-precision approach procedures are shown in table 3-3.

Approach Procedure	**Approved Sensors (Navigation Mode)**		
	GPS	**DME/DME**	**VOR/DME**
GPS	X		
VORDME	X	X	X
VOR	X	X	X (see note)
NDB	X	X	
NOTE: VOR approaches where the procedure specified navaid does NOT have DME capability can be flown by the FMS only if GPS or DME/DME is available.			

Approved Sensors for Approach
Table 3-3

Brightness Control

Both manual and automatic (photo sensor) brightness controls are used to increase or decrease the CRT display brightness. The brightness knob manually adjusts the brightness of the CRT display. After the adjustment is made, the photo sensors monitor the ambient light and maintain the brightness level over various lighting conditions. The brightness can be adjusted so that, during daylight hours, the display cannot be seen.

NAVIGATION COMPUTER

The FMS has different hardware configurations. The NZ-2000 Navigation Computer and IC-800 Integrated Avionics Computer (IAC) are two examples. For purposes of this manual, the computer function of the FMS, regardless of hardware configuration, is referred to as the NZ.

The NZ has two primary functions and multiple secondary functions. The primary functions are position computation and flight planning. These functions work with the associated guidance in both the lateral and vertical axes. The navigation data base (NDB) contained in the NZ is essential to these functions. The data base is used to store waypoints, navaids, airways, procedures, airports, and other navigation data.

The NZ connects to a variety of short range and long range navigation sensors. The primary short range sensors are VOR/DME and DME/DME. Long range sensors include inertial reference system (IRS), very low frequency (VLF)/omega, and global positioning system (GPS). Using the available sensors, the NZ develops an FMS position based on a blend or mix of sensor inputs. Based on the position and the flight plan, the FMS generates information for display on the CDU and EFIS.

The lateral navigation function of the FMS can calculate navigation information relative to selected geographical points. The pilot can define flight plan routes worldwide. The system outputs advisory information and steering signals that show the pilot or flight guidance system (FGS) how to guide the aircraft along the desired route. Routes are defined from the aircraft’s present position to a destination waypoint along a great circle route or through a series of great circle legs defined by intermediate waypoints.

DATA LOADER

The data loaders, shown in figures 3-9 and 3-10, are used to transfer data to and from the NZ through an RS-422 interface. The data loader can be permanently mounted in the aircraft or used as a portable unit. The data loader uses 3-1/2 inch disks for transfer of data. The DL-800 Data Loader uses 720 KB disks and the DL-900 Data Loader uses either 720 KB or 1.44 MB disks. The data loader can be used to transfer navigation data base information, flight plans, AFIS information, and maintenance data.

DL-800 Data Loader
Figure 3-9

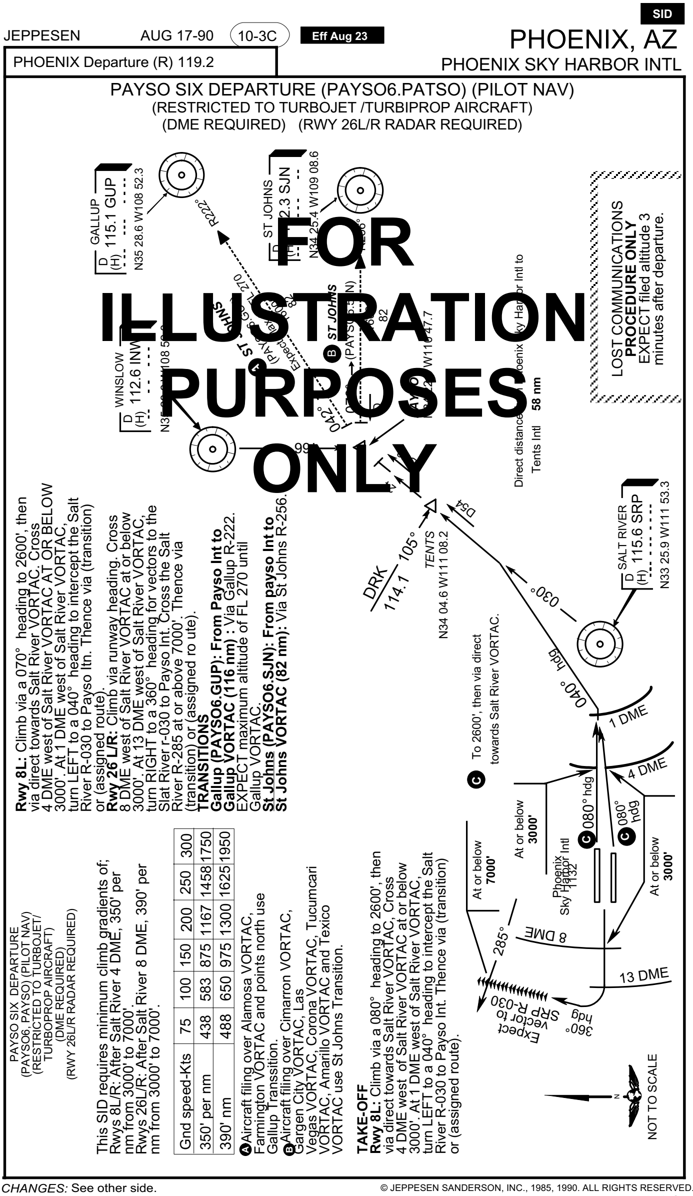
DL-900 Data Loader
Figure 3-10

4. Operational Example

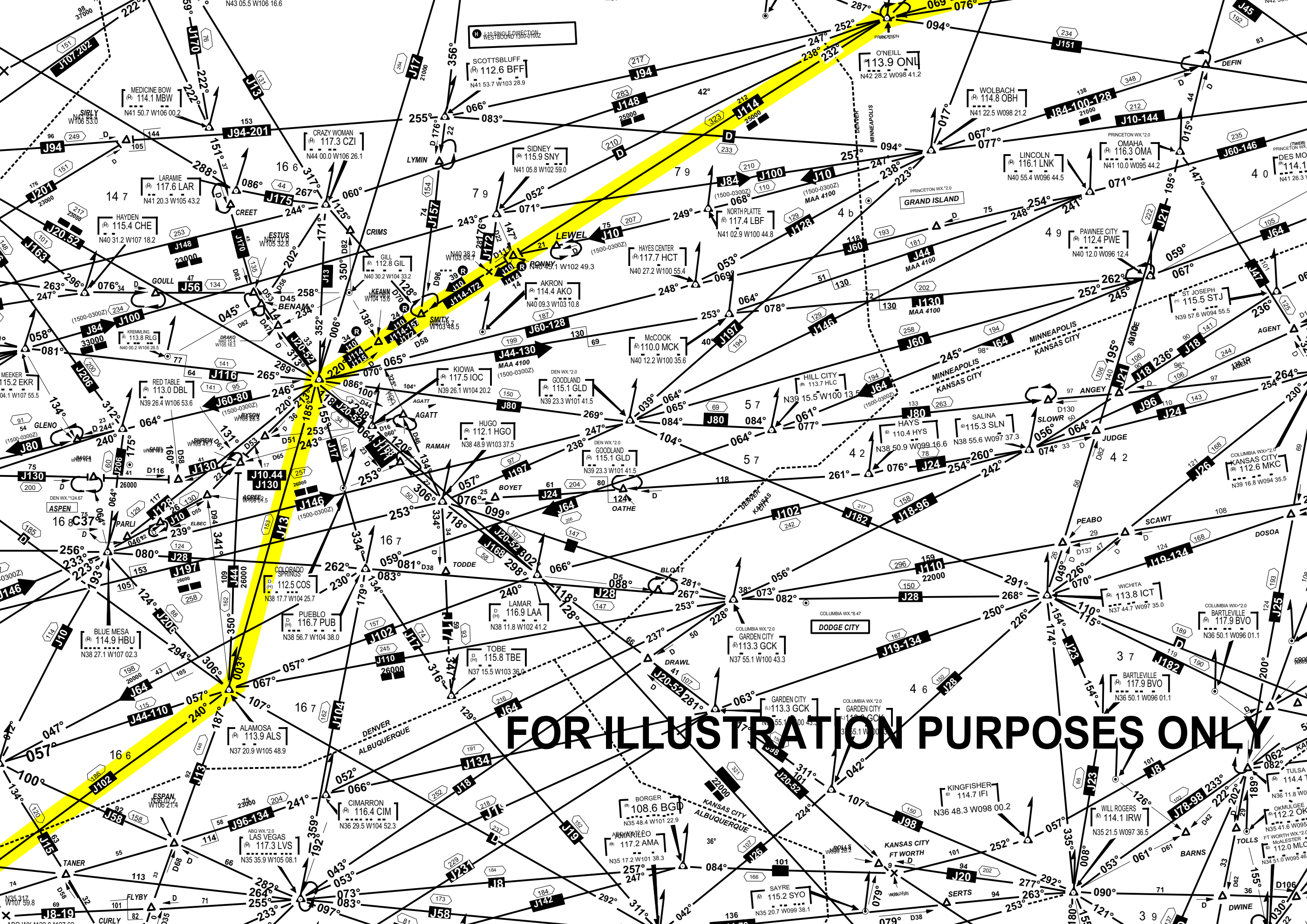
This section describes the normal operational procedures of the flight management system using a flight plan from Phoenix, Arizona (KPHX), to Minneapolis/St. Paul, Minnesota (KMSP). KMSP is forecast to be instrument meteorological conditions (IMC) at arrival time, therefore, Duluth, Minnesota (KDLH) is used as the alternate. The flight departs Phoenix from runway 08R to the PAYSO6 departure with the Gallup transition (KPHX RW08R PAYSO6.GUP) shown in figure 4-1. Enroute, shown in figure 4-2, is through J102 to the Alamosa (ALS) VOR, direct to the Denver (DEN) VOR, J114 to the O'NEIL (ONL) VOR, then direct to the Mason City (MCW) VOR. The arrival is through the Mason City transition to the MEINZ5 arrival, shown in figure 4-3, followed by the Farmington transition to the ILS approach for runway 29L at KMSP (MCW.MENIZ5 FGT.ILS RW29L KMSP). The ILS 29L approach is shown in figure 4-4.

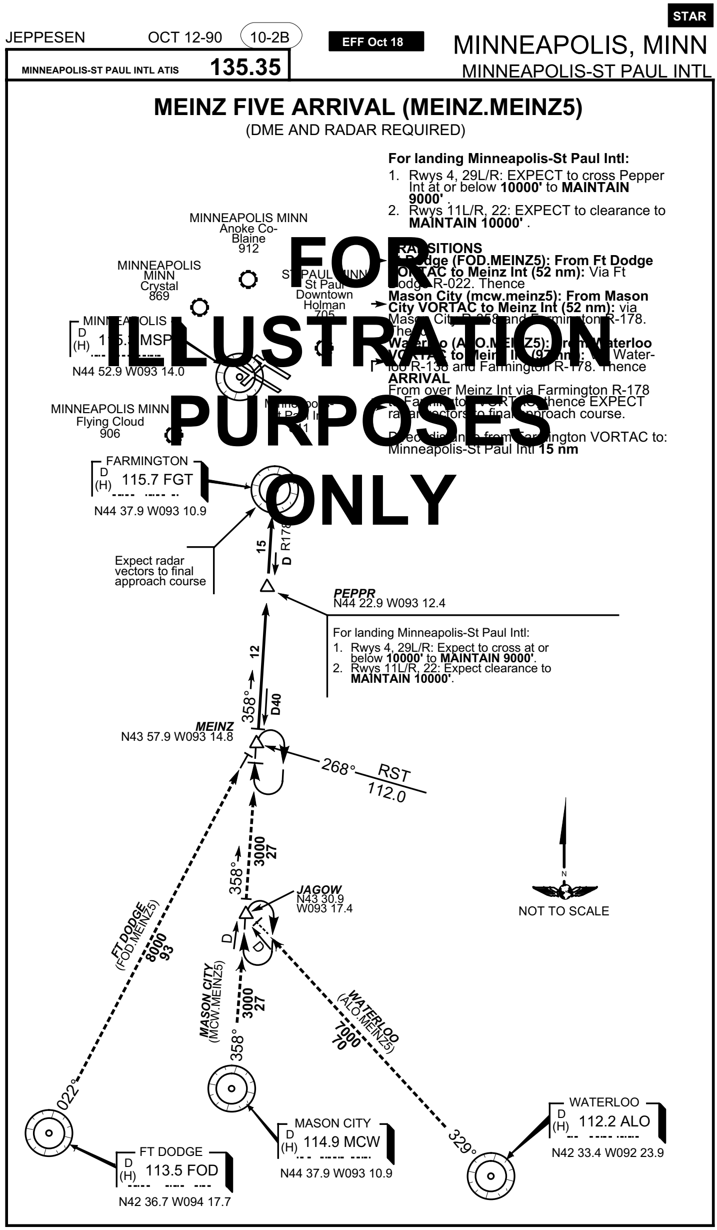
This navigation route, including the standard instrument departure (SID), standard terminal arrival route (STAR), and approach, may not reflect the current air traffic control situation.

This example often references Sections 5 through 9 for more detailed information. Section 10 can be used for questions about entry format.

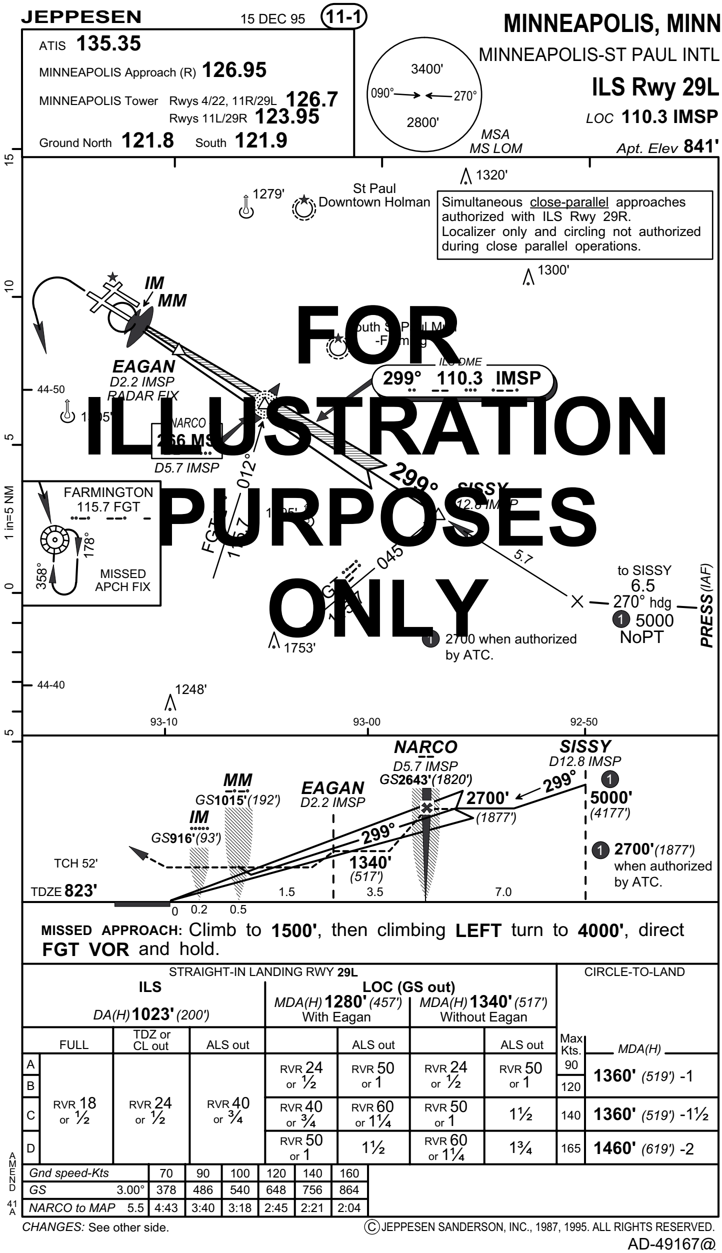


PAYSO6 Departure
Figure 4-1


J-10 SINGLE DIRECTION WESTBOUND 1500-0100Z
SCOTTSBLUFF 112.6 BFF N41 53.7 W103 28.9
O'NEILL 113.9 ONL N42 28.2 W098 41.2
MEDICINE BOW 114.1 MBW N41 50.7 W106 00.2
WOLBACH 114.8 OBH N41 22.5 W098 21.2
CRAZY WOMAN 117.3 CZI N44 00.0 W106 26.1
SIDNEY 115.9 SNY N41 05.8 W102 59.0
OMAHA 116.3 OMA N41 10.0 W095 44.2
LINCOLN 116.1 LNK N40 55.4 W096 44.5
LARAMIE 117.6 LAR N41 20.3 W105 43.2
NORTH PLATTE 117.4 LBF N41 02.9 W100 44.8
GRAND ISLAND
HAYDEN 115.4 CHE N40 31.2 W107 18.2
GILL 112.8 GIL N40 30.2 W104 33.2
HAYES CENTER 117.7 HCT N40 27.2 W100 55.4
PAWNEE CITY 112.4 PWE N40 12.0 W096 12.4
AKRON 114.4 AKO N40 09.3 W103 10.8
ST JOSEPH 115.5 STJ N39 57.6 W094 55.5
McCOOK 110.0 MCK N40 12.2 W100 35.6
MEEKER 115.2 EKR
RED TABLE 113.0 DBL N39 26.4 W106 53.6
KIOWA 117.5 IOC N39 26.1 W104 20.2
GOODLAND 115.1 GLD N39 23.3 W101 41.5
HILL CITY 113.7 HLC
HAYS 110.4 HYS N38 50.9 W099 16.6
SALINA 115.3 SLN N38 55.6 W097 37.3
HUGO 112.1 HGO N38 48.9 W103 37.5
KANSAS CITY 112.6 MKC N39 16.8 W094 35.5
COLORADO SPRINGS 112.5 COS N38 17.7 W104 25.7
WICHITA 113.8 ICT N37 44.7 W097 35.0
BARTLESVILLE 117.9 BVO N36 50.1 W096 01.1
PUEBLO 116.7 PUB N38 56.7 W104 38.0
LAMAR 116.9 LAA N38 11.8 W102 41.2
DODGE CITY
GARDEN CITY 113.3 GCK N37 55.1 W100 43.3
BLUE MESA 114.9 HBU N38 27.1 W107 02.3
TOBE 115.8 TBE N37 15.5 W103 36.0
ALAMOSA 113.9 ALS N37 20.9 W105 48.9
DENVER ALBUQUERQUE
KANSAS CITY ALBUQUERQUE
MINNEAPOLIS KANSAS CITY
KINGFISHER 114.7 IFI N36 48.3 W098 00.2
CIMARRON 116.4 CIM N36 29.5 W104 52.3
BORGER 108.6 BGD N35 48.4 W101 22.9
WILL ROGERS 114.1 IRW N35 21.5 W097 36.5
LAS VEGAS 117.3 LVS N35 35.9 W105 08.1
AMARILLO 117.2 AMA N35 17.2 W101 38.3
SAYRE 115.2 SYO N35 20.7 W099 38.1
KANSAS CITY FT WORTH
FOR ILLUSTRATION PURPOSES ONLY



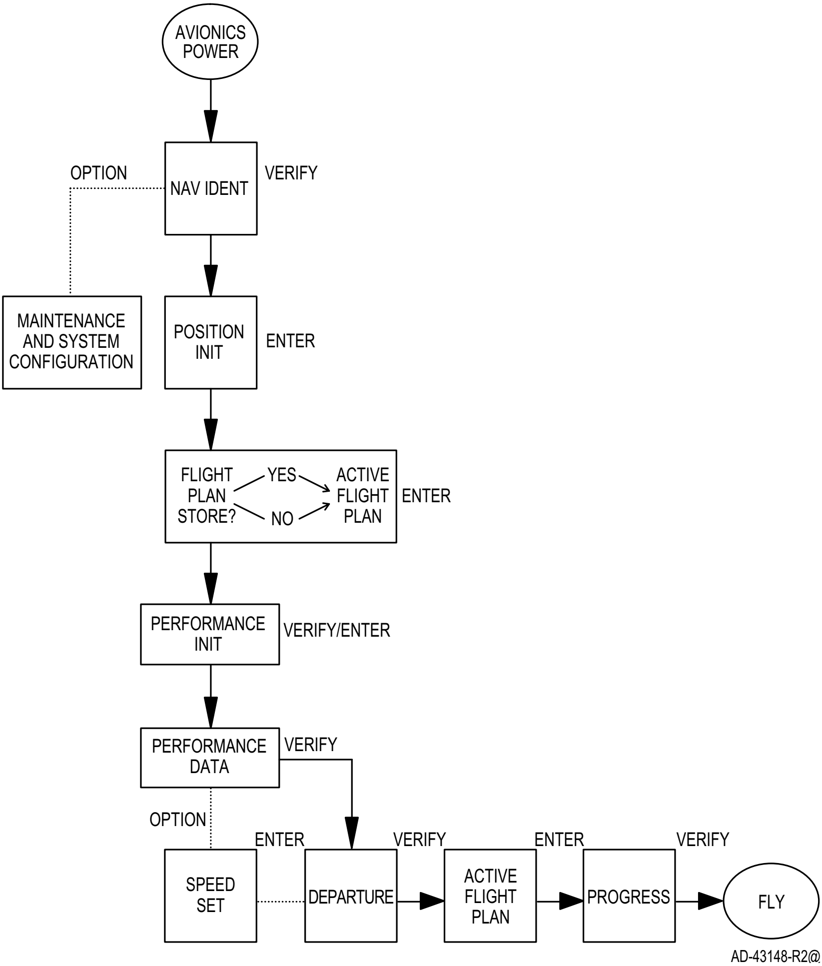
KPHX to KMSP Flight MEINZ5 Arrival
Figure 4-3



KPHX to KMSP Flight ILS 29L Approach
Figure 4-4

PREDEPARTURE

The FMS guides the pilot through the ground initialization process using the lower right line select key (4R). After completing the page (or pages) for each step, select the lower right key (4R) to move to the next step. Figure 4-5 is a flowchart that shows the preflight procedure for a normal flight.



FMS Preflight Procedure Flow Chart
Figure 4-5

Power-up

- **NAV IDENT 1/1 -** The page, shown in figure 4-6, is displayed when power is first applied. The pilot must verify the date and the greenwich mean time (GMT) clock. Greenwich mean time is used for universal coordinated time (UTC) in the FMS. A battery maintains the current date and time.

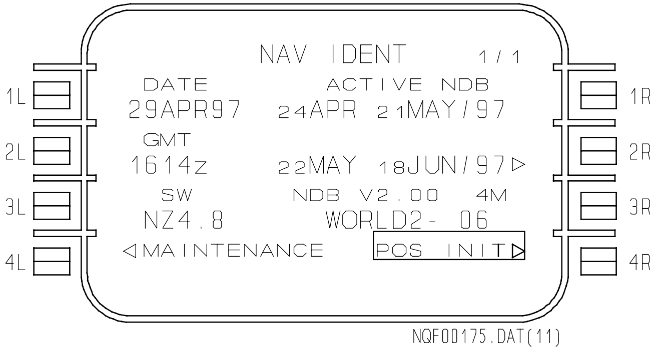


Figure 4-6

Corrections to date or time are made by entering the correct information into the scratchpad using the alphanumeric key pad, as shown in figure 4-7. On installations where time and date are synchronized with GPS, entry is not allowed.

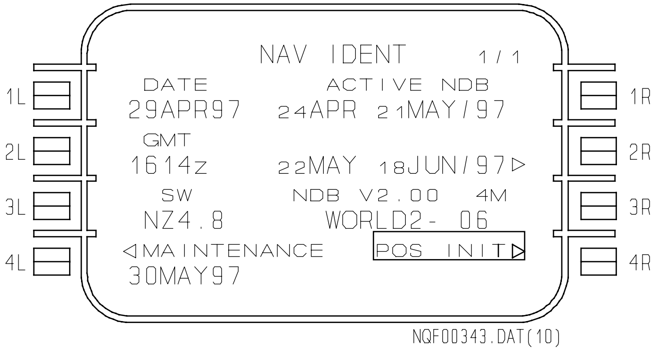


Figure 4-7

In this example, the correct date is entered into the display using the line select key (1L) adjacent to the date, as shown in figure 4-8.

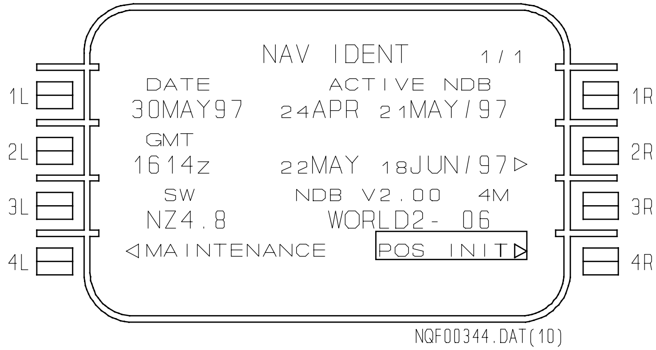


Figure 4-8

The software identifier is displayed at 3L for verification. The software identifier must be referenced when maintenance action is requested.

The maintenance prompt (4L) can be used to verify the FMS system operating configuration. Refer to page 6-121 for details on MAINTENANCE.

Navigation data base (NDB) information is displayed on the right side of the NAV IDENT page. The active data base dates are shown at 1R. The dates for the alternate period are shown at 2R. On power-up, the FMS automatically chooses the active NDB that corresponds to the date. To switch the active NDB periods, push the line select key (2R) adjacent to the carat, as shown in figure 4-9.

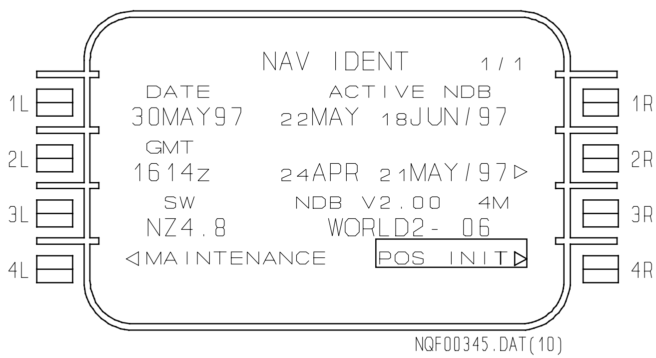


Figure 4-9

The WORLD2 08, shown in figure 4-9, indicates worldwide coverage and cycle of the NDB. Refer to page 6-155 for NDB updating procedures.

The next initialization step (POS INIT in inverse video) is displayed and selected at 4R. Refer to page 6-120 for details on NAV IDENT.

POSITION INITIALIZATION

- **POSITION INIT 1/1 -** The page, shown in figure 4-10, displays the LAST POS coordinates at 1L. At 2L, the closest RAMPX within 3 NM of the last position (1L) is displayed (refer to RAMPX, page 6-146). If no RAMPX waypoint is available, the closest airport reference point (ARP) within 3 NM of the last position (1L) is displayed. If no ARP is available, the pilot is prompted to enter a waypoint or coordinates. In this example, the KPHX ARP is shown.

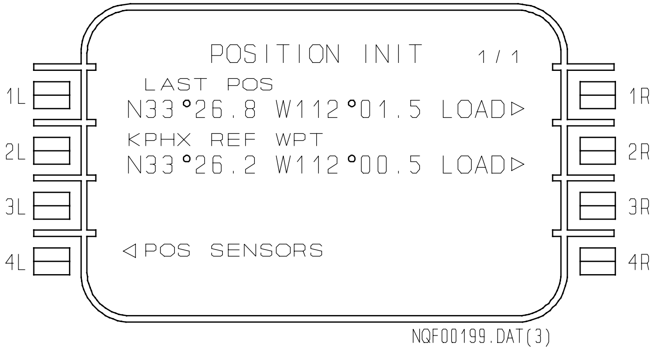


Figure 4-10

To initialize position, select the appropriate LOAD prompt (1R or 2R) for the position to be initialized. The selected position becomes the FMS position (3L), as shown in figure 4-11. This will initialize connected sensors. Refer to page 6-145 for details on position initialization.

Each FMS must be individually initialized to position. Positions are never transferred from FMS to FMS. They are only compared. After initialization, the FLT PLAN prompt is displayed in the bottom right corner (4R) indicating the next step to be performed. Select this prompt to continue the preflight process.

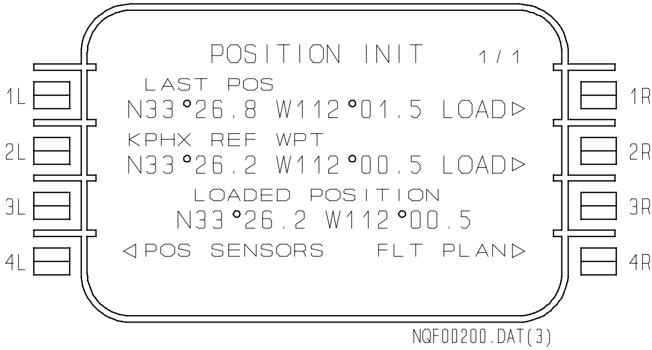


Figure 4-11

ACTIVE FLIGHT PLAN

If the initialization coordinates are within three miles of an airport in the data base, the airport (KPHX in this example) is already loaded in the ORIGIN line, as shown in figure 4-13. An optional entry of estimated time of departure (ETD) can be calculated in order to provide the estimated time of arrivals (ETAs) prior to takeoff. This will support predictive RAIM calculations (refer to page 6-71).

Figure 4-12

The destination (KMSP) is entered in the scratchpad and line selected to the DEST prompt at 2R, as shown in figure 4-12.

If there is a stored flight plan with the same origin and destination, the FLT PLAN LIST page is displayed (refer to page 7-12). If this is the case, select the RETURN prompt (1R) to continue this example. Refer to page 7-11, for details on creating/changing flight plans.

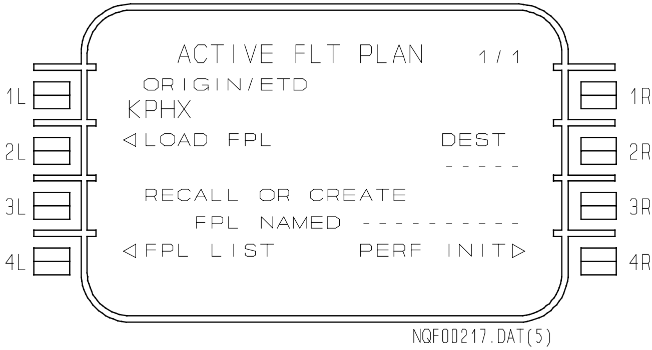


Figure 4-13

Waypoint Entry

Enter the enroute waypoints in the line labeled VIA.TO. Begin with the Gallup (GUP) VOR, as shown in figure 4-14. The entry is made by typing the identifier in the scratchpad and using the line select key adjacent to the VIA.TO prompt. Refer to pages 7-2 and 7-14 for waypoint entry options.

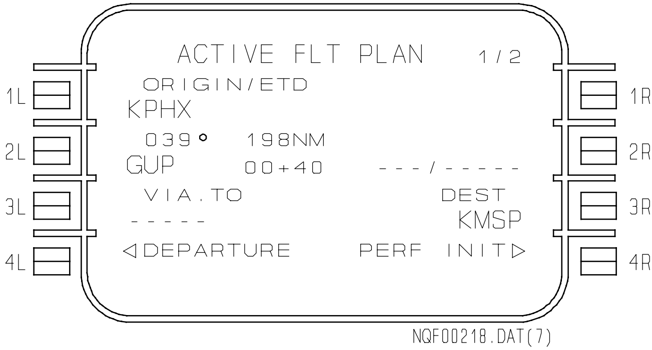


Figure 4-14

Airway Entry

The next entry in this example is a high altitude airway (e.g., J102) to the Alamosa (ALS) VOR. To enter an airway, the first waypoint on the airway (e.g., GUP) must be in the flight plan. Next, use the VIA.TO format to enter the airway identifier followed by a period as well as the last waypoint on the airway (J102.ALS), as shown in figure 4-15. Insert this entry on the line following the first waypoint.

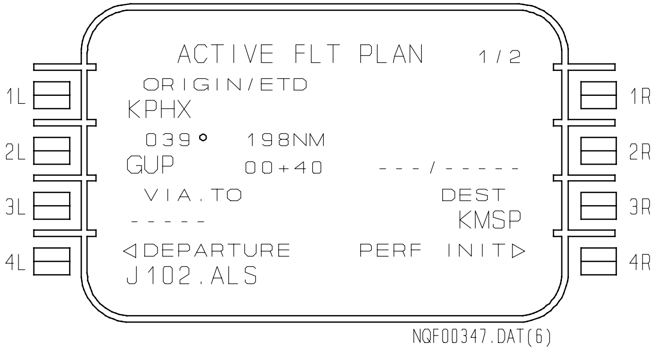


Figure 4-15

The FMS retrieves all waypoints that define J102 between GUP and ALS, as shown in figure 4-16. The FMS then inserts them in the flight plan. Refer to page 7-15 for details about airway entry.

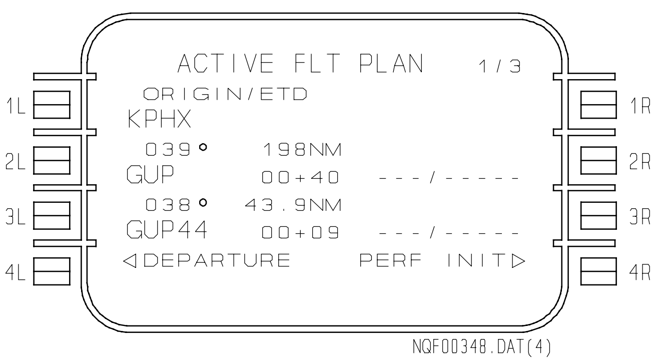


Figure 4-16

In this example, GUP44 is a significant intersection on J102 located 44 miles from the Gallup (GUP) VOR. This same convention is used for other unnamed intersections. For distances greater than 100 NM, the hundreds digit is dropped and the number is prefixed to the navaid ident.

The upper right corner of the FLT PLAN page indicates that there are 3 flight plan pages. Pushing the NEXT key on the CDU shows page 2 of the flight plan, as shown in figure 4-17. Refer to page 6-139 for AUTO PAGE information.

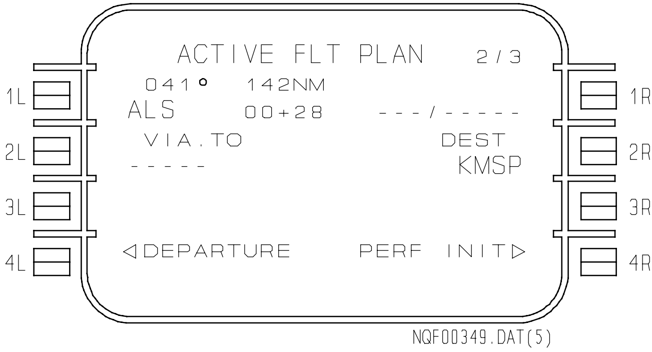


Figure 4-17

The remainder of the flight plan to Mason City (DEN, J114.ONL, MCW) is entered in the same manner as previously described.

The flight plan is closed by moving KMSP to the VIA.TO line by pushing the line select key (3R) adjacent to KMSP, as shown in figure 4-18. This action moves KMSP to the scratchpad.

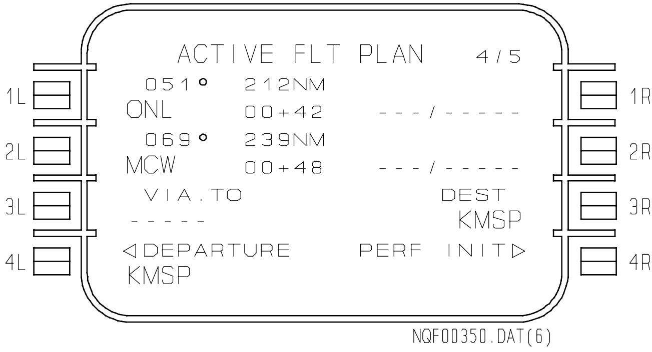


Figure 4-18

Push the line select key (3L) adjacent to the dashed line, as shown in figure 4-19. The destination must be included as the last flight plan waypoint to get ETE/ETD to the destination on the progress page. The destination is also required to calculate the PERF DATA.

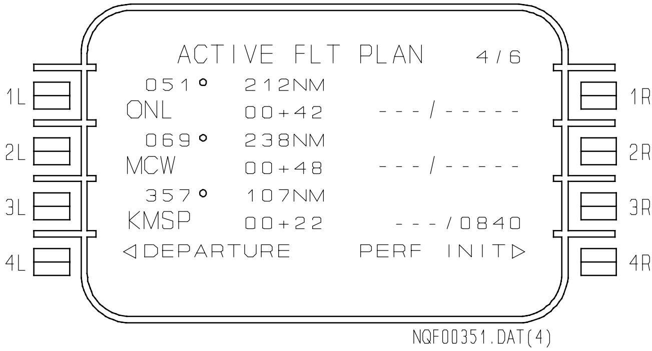


Figure 4-19

Pushing the NEXT key advances the page to where KMSP appears at the end of the flight plan, as shown in figure 4-20.

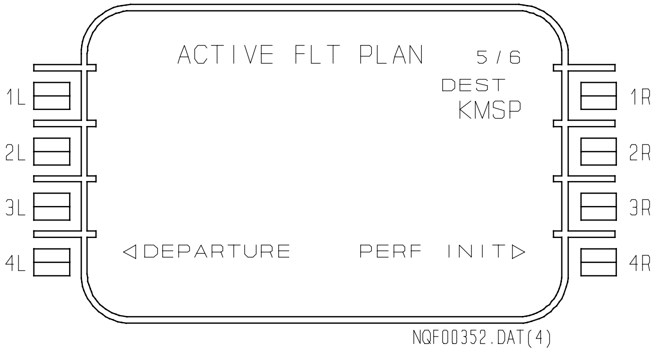


Figure 4-20

The alternate flight plan example is entered by stepping to the alternate page, shown in figure 4-21. This is accomplished by pressing the NEXT key.

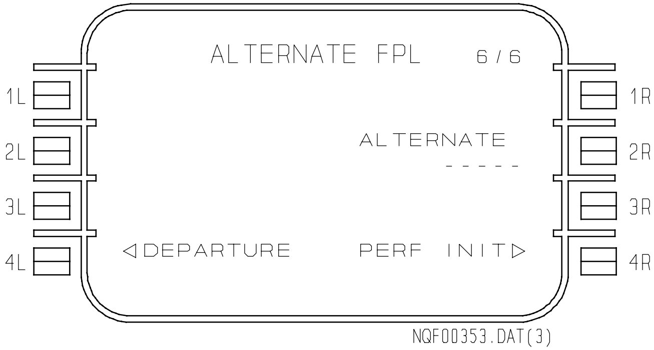


Figure 4-21

Enter the identifier for the alternate destination (2R). Duluth (KDLH) is used for this example, as shown in figure 4-22.

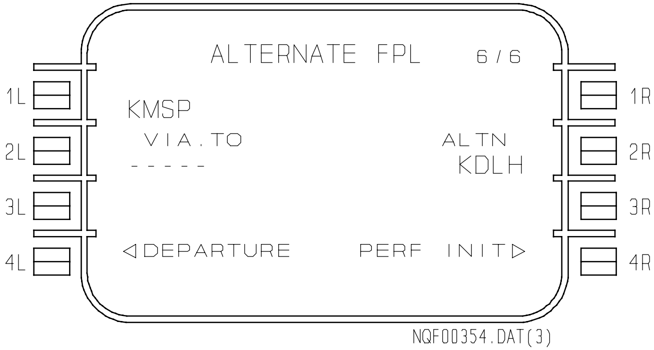


Figure 4-22

The route to KDLH through the GOPHER (GEP) VOR, shown in figure 4-23, is entered the same way as for the enroute flight plan. The alternate flight plan is closed by moving KDLH to the VIA.TO line as was done with KMSP in the active flight plan.

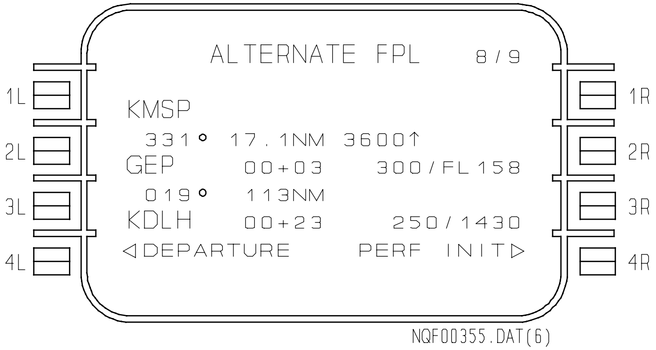


Figure 4-23

This completes the flight plan definition. Push the lower right line select key (4R) to begin performance initialization (PERF INIT). Refer to page 7-1 for additional flight planning details.

PERFORMANCE INITIALIZATION

Performance initialization is required to complete vertical navigation (VNAV) and performance calculations. There are five PERFORMANCE INIT pages when FULL PERF is selected. This example illustrates the FULL PERF initialization. Refer to page 5-5, for other performance initialization options. The following values are used in the planning of this example flight plan. Actual numbers used depends on the aircraft type.

BOW:	43,000 lb
FUEL:	14,000 lb
CARGO:	200 lb
PASSENGER:	5 @ 170 lb
CRUISE ALTITUDE:	41,000 ft
WINDS ALOFT:	250° @ 125 kts @ FL 410
SPEED SET:	Active

The default values for most performance initialization data are the values from the previous flight. Assuming the aircraft is flown the same way each flight, performance initialization consists of verifying the default values, making changes where required, and entering items such as wind and weight.

Depending on the state of the configuration module, weights will be displayed in either pounds or kilograms.

Data verified and entered under performance initialization effects several performance functions important to the completion of the flight. For example, understating wind may indicate sufficient fuel to complete the flight. In reality, more fuel may be required. A careful review of initialization data is required to ensure accurate predicted aircraft performance.

If VSPEED pages have not been activated through the FMS SETUP page or through the aircraft data base, some of the page prompts in this example will be different. Refer to VSPEED LABELS (page 6-142), for additional details. The default setting of VSPEED pages on the FMS SETUP is aircraft dependent.

All data must be entered on the PERF INIT pages in order for the FMS to display VNAV predictions.

Refer to pages 5-5 through 5-27, for a detailed explanation of PERF INIT entries.

- **PERFORMANCE INIT 1/5 -** Figure 4-24 displays the following:

  - Aircraft Type (1L)
  - Tail Number (1R)
  - Data Source (2L)
  - Access to Aircraft Data Base Loading (4L).

  The tail number (1R) must be entered on this page if the FULL PERF has been selected as the data source (refer to aircraft tail number on page 5-10).

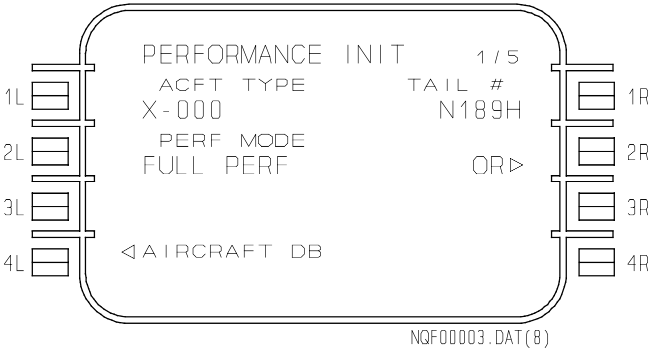


Figure 4-24

- **PERFORMANCE INIT 2/5** - Figure 4-25 displays the current speed schedules for climb, cruise, and descent. The current descent angle is also displayed. To change any mode, select the OR prompt for the respective mode or enter the calibrated airspeed (CAS)/Mach data directly. Default values can be restored by using the *DELETE* function on the appropriate line.

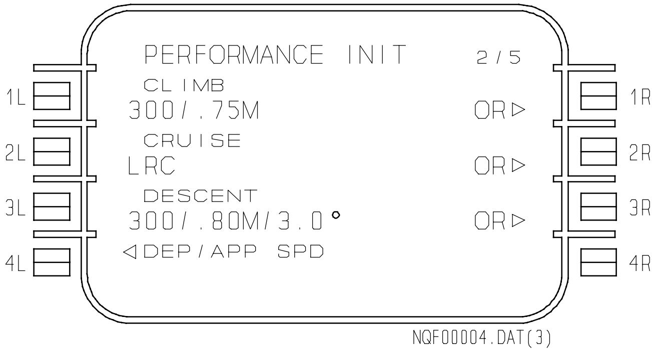


Figure 4-25

The descent angle entered on this page is used as the default value for each path. It is also used for computing top of descent (TOD) points.

The FMS uses the climb, cruise, and descent speed schedules to supply a speed command to flight director/autothrottle systems.

As an example, when the OR prompt for cruise is selected, the cruise mode page, shown in figure 4-26, is displayed. The cruise mode desired can be selected from the available list. This action makes the selected cruise mode active and returns the display to PERFORMANCE INIT 2/5. In this example, long range cruise (LRC) is the active mode.

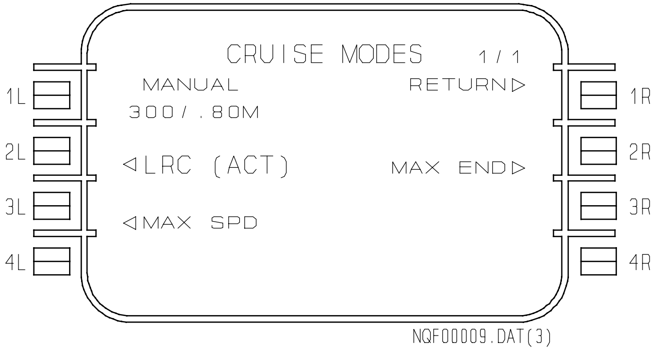


Figure 4-26

- **PERFORMANCE INIT 3/5** - Figure 4-27 contains the step climb increment that is used for performance planning, fuel reserve, and fuel allowance for takeoff and landing. TO/LDG FUEL powers up with the default values from the aircraft data base file. Entering *DELETE* restores any of these lines to the default values. The FUEL RESERVE line has an OR option. Refer to page 5-20 for details on this page.

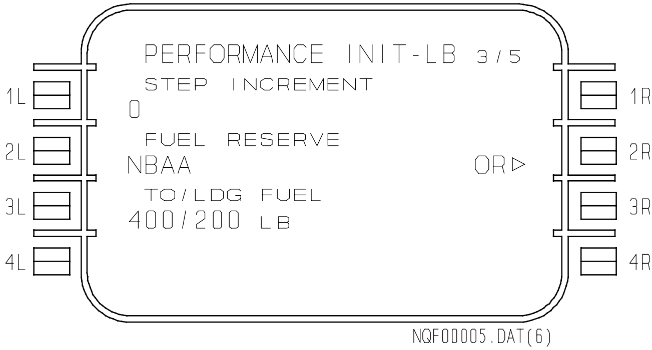


Figure 4-27

- **PERFORMANCE INIT 4/5** - Figure 4-28 contains the following:

    - Transition Altitude (1L)
    - Speed/Altitude Limit (1R)
    - Initial Cruise Altitude (2L)
    - ISA Deviation (2R)
    - Cruise Winds (3L and 3R).

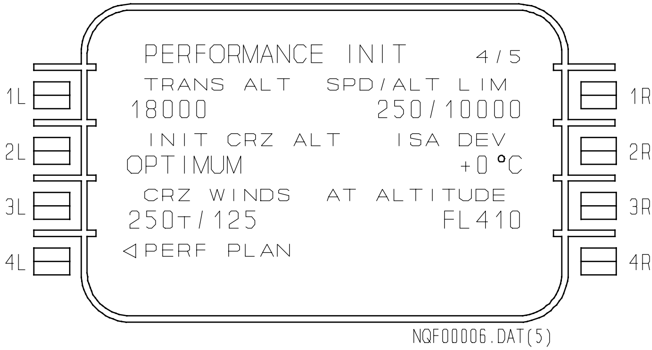


Figure 4-28

Above the transition altitude, ACTIVE FLT PLAN and the PERF PLAN page altitudes are displayed as flight levels. Constraints from SIDs, STARs, and approaches are displayed in feet or flight levels as defined in the navigation data base.

The SPD/ALT LIM is used to limit the speed target to the speed limit for altitudes below the restriction altitude. When in descent and the descent speed is higher than the speed limit, the speed target is reduced before the restriction altitude is reached. This allows for the slowdown. The limit can be changed or eliminated by entering *DELETE*.

Initial cruise altitude can be entered. If **OPTIMUM** is displayed, the optimum cruise altitude is computed. It is displayed in small characters when PERFORMANCE INIT is completed. The optimum cruise altitude is rounded to the nearest 1000 feet.

Average cruise wind and ISA Dev can be entered on this page. This is an optional entry. The FMS <u>assumes</u> zero wind and ISA Dev if no entry is made. Wind information at each waypoint can also be entered on the PERF PLAN pages. Refer to Performance Plan (page 5-33), for details.

- **PERFORMANCE INIT 5/5** - Passenger and cargo weights are entered to calculate gross weight, as shown in figure 4-29.

  When performance initialization is complete, the CONFIRM INIT prompt is displayed in the lower right corner of this page. The CONFIRM INIT line select key (4R) must be pushed to initiate the calculation of performance data. Refer to PERFORMANCE INIT 5/5 (page 5-25), for details.

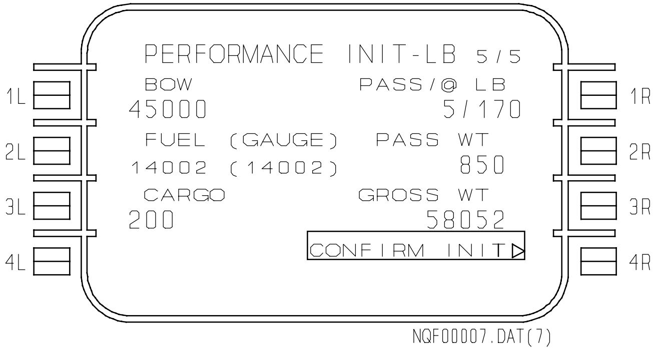


Figure 4-29

PERFORMANCE DATA

There are four pages of PERF DATA. The data is based on the PERFORMANCE INIT pages as well as the active flight plan. Performance data is displayed for the destination and the alternate destination if one has been entered. These pages are continuously updated during the flight.

- **PERF DATA 1/4** - Figure 4-30 displays the following:

  - Cruise/Ceiling Altitude (1L)
  - Step Increment (1R)
  - ETE (2L and 2R)
  - Fuel Required (3L and 3R)
  - Fuel Figure of Merit (FOM) (3L and 3R).

Fuel required is the total fuel, which includes the following:

- Takeoff Allowance
- Enroute (Climb/Cruise/Descent)
- Landing Allowance
- Reserves.

Refer to Performance Data (page 5-28), for additional details.

Pilot entries are permitted on the cruise altitude and step increment lines only. The cruise altitude increases automatically if the altitude selector is dialed above the current cruise altitude.

Some aircraft with advisory only VNAV do not have altitude sector information available.

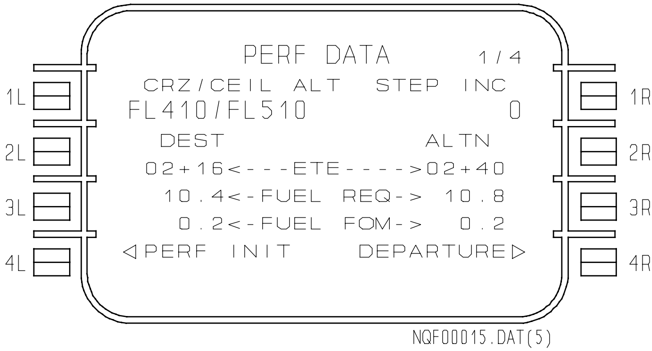


Figure 4-30

- **PERF DATA 2/4** - Figure 4-31 displays the following:

  - Distance to Go (1L and 1R)
  - ETA (2L and 2R) (only displayed when airborne or following an entry of ETD on the active flight plan)
  - Estimated Fuel Remaining (2L and 2R)
  - Estimated Gross Weight (3L and 3R).

No entries are permitted on this page. Refer to PERF DATA 2/4 (page 5-30), for additional details.

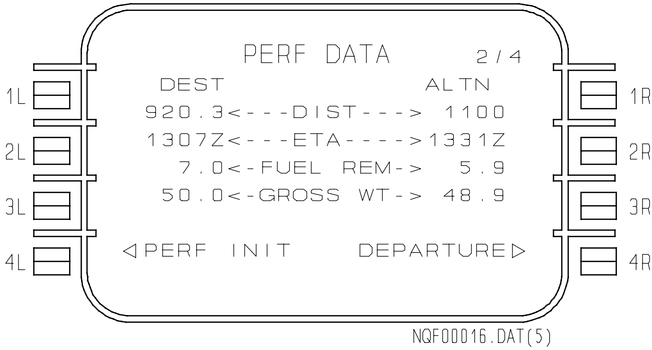


Figure 4-31

- **PERF DATA 3/4** - Figure 4-32 displays the following:

  - Average Cruise Wind (1L)
  - Average Cruise Headwind or Tailwind (1R)
  - Preflight Plan Destination Fuel Remaining (2R)
  - Updated Plan Destination Fuel Remaining (3R) (only displayed when airborne)
  - Difference between Preflight and Updated Plan (3R) (only displayed when airborne).

  No entries are permitted on this page. Refer to PERF DATA 3/4 (page 5-31), for additional details.

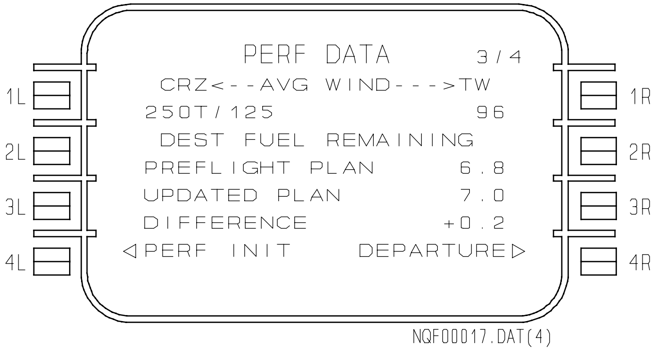


Figure 4-32

- **PERF DATA 4/4** - Figure 4-33 displays the following:

  - Method of Reserve Calculation (1L)
  - Required Reserve (2R)
  - Preflight Plan Fuel Remaining (2R)
  - Updated Plan Fuel Remaining (3R) (only displayed when airborne)
  - Difference between Preflight and Updated Plan (3R) (only displayed when airborne).

  The DEPARTURE prompt is displayed on the lower right corner of all the PERF DATA pages indicating the next step. If a runway has already been selected, the prompt is TAKEOFF instead of DEPARTURE. Refer to PERF DATA 4/4 (page 5-32), for additional details.

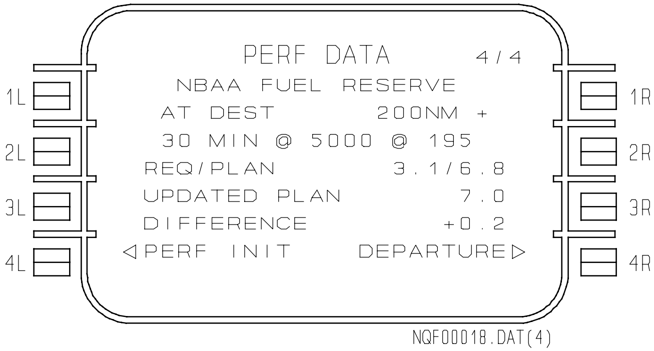


Figure 4-33

DEPARTURE SELECTION

Selecting the DEPARTURE prompt displays the DEPARTURE RUNWAYS page, shown in figure 4-34. The available runways for the origin airport are displayed. In this example, runway 08R is selected with line select 3L.

After the runway is selected, the SIDs page is displayed with the possible departure procedures, as shown in figure 4-35. Select the appropriate procedure from the list. For this example, PAYSO6 at 3R is selected. If no SID is to be used, the ACTIVATE prompt (4R) selects the runway and displays the ACTIVE FLT PLAN page. Procedures used in these examples may not be current. Refer to page 6-35 for additional details.

Figure 4-34

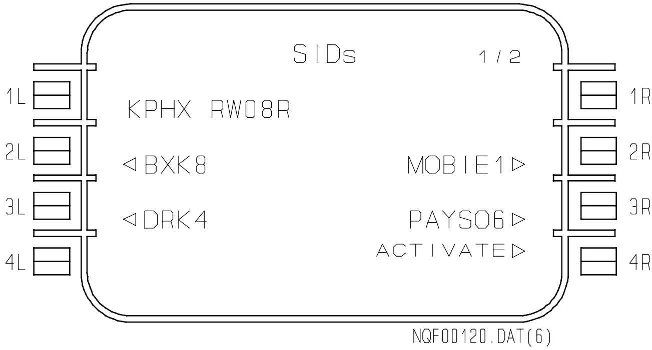


Figure 4-35

The next page, shown in figure 4-36 lists the enroute transitions for the selected departure. For this flight, the GALLUP (GUP) transition shown in figure 4-37 is selected (2L). At this point, the choices are to REVIEW (4L) or ACTIVATE (4R) the SID. ACTIVATE (4R) inserts the runway and procedure into the active flight plan. The SID contains both the lateral waypoints and any vertical constraints for the procedure contained in the data base. Refer to page 6-35 for details on DEPARTURE.

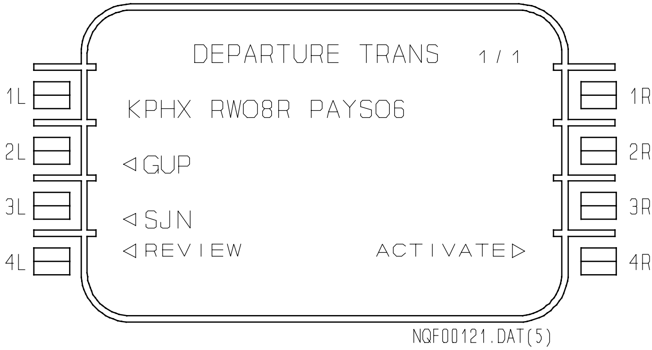


Figure 4-36

NOTE: Selecting at least a runway from DEPARTURE ensures that the runway position (RW POS) prompt is displayed on the flight plan (FLT PLN) pages.

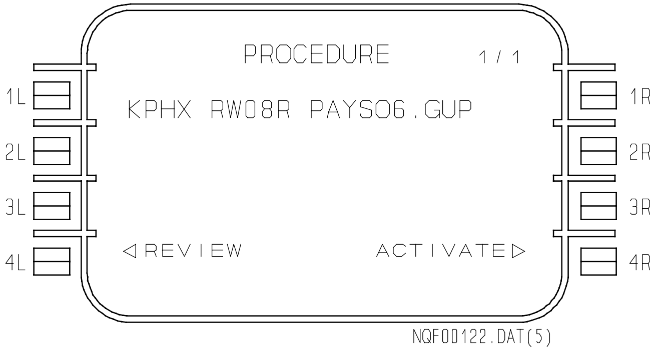


Figure 4-37

Flight Plan Discontinuities

If a discontinuity occurs in a flight plan when adding a SID or STAR, it is caused by the lack of a common point between the flight plan and the inserted SID or STAR. The discontinuity can be removed by one of the two following methods:

- Press the DEL key and the adjacent line select key to delete the discontinuity.

- Move any waypoint into the line where the discontinuity is located.

Takeoff Data

Activating the departure returns the display to the ACTIVE FLT PLAN page, shown in figure 4-38. If the VSPEED pages are configured (refer to page 6-142), the TAKEOFF prompt is displayed in the lower right corner (4R) indicating the next step. If the VSPEED pages are not configured, the RW POS prompt is displayed (refer to page 4-30). Takeoff is completed using three pages.

NOTE: VSPEEDs are not configured for all aircraft types.

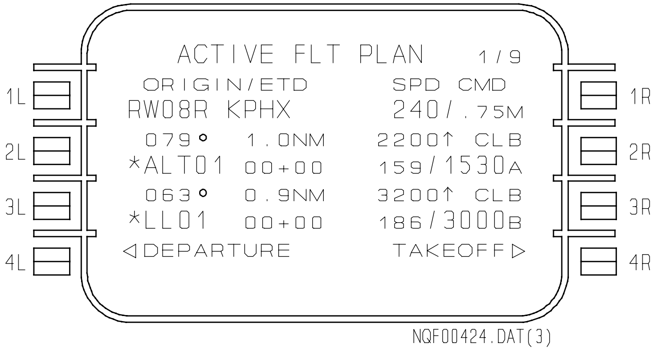


Figure 4-38

- **Takeoff 1/3** - Figure 4-39 displays the following:

  - Runway (1L)
  - Runway Length (1R)
  - Temperature (2L)
  - Surface Wind (2R)
  - Pressure Altitude (3L)
  - BARO (Barometric) Setting (3L)
  - Runway Elevation (3R).

Runway information is retrieved from the data base. Temperature is sensed or entered. Barometric Setting (BARO set) is retrieved from the digital air data computer (DADC) or can be entered manually.

Surface wind is a required entry and is normally the only entry made on this page. This assumes that temperature is sensed by the DADC. Refer to Takeoff (page 5-37), for additional details.

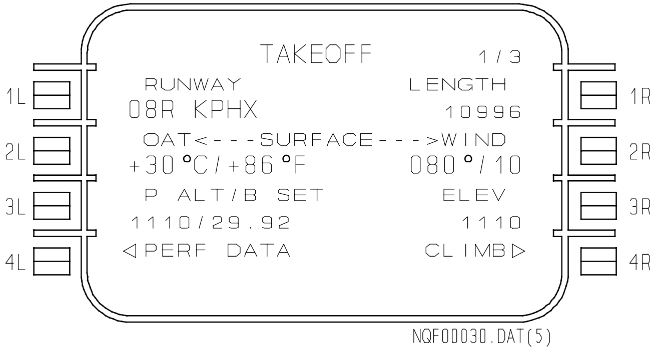


Figure 4-39

- **Takeoff 2/3** - Figure 4-40 displays calculation of the following:

  - Headwind or Tailwind (1L)
  - Crosswind (1R)
  - Density Altitude (2L).

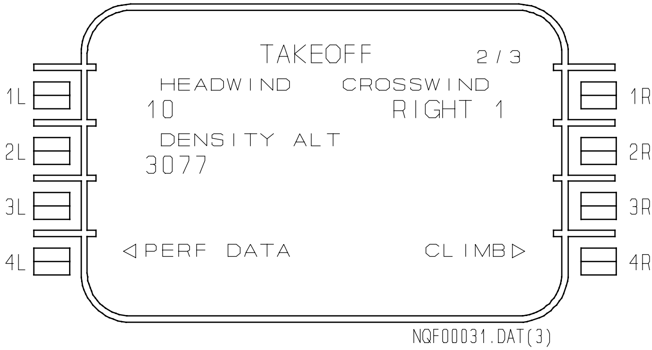


Figure 4-40

- **Takeoff 3/3** - Takeoff speeds can be entered on the page shown in figure 4-41. This page can be configured with up to six speeds with various labels.

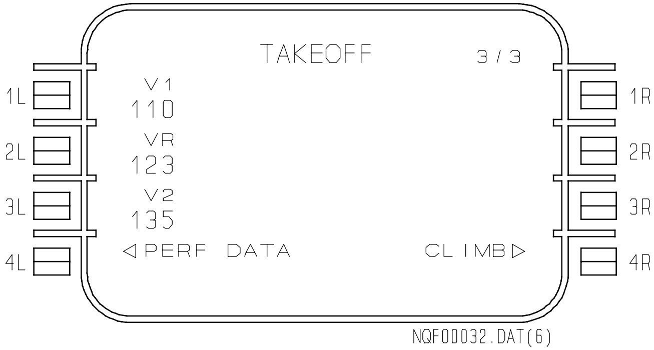


Figure 4-41

RUNWAY POSITION

If a departure runway has been selected, the prompt at 4R of the active flight pages displays RW POS when all other actions are completed. Once the aircraft is at the runway threshold, the FMS and long range sensors can be updated to the runway threshold position. **This is an optional action.** Under normal circumstances, it is recommended that the IRSs **not be updated** at the end of the runway. Updates are made by pushing the line select key (4R) adjacent to the RW POS prompt on the ACTIVE FLT PLAN page, as shown in figure 4-42. This will display the POSITION INIT page.

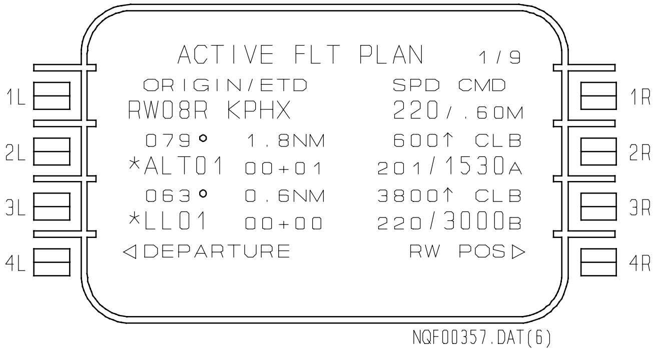


Figure 4-42

- **Position INIT 1/1 -** The page, shown in figure 4-43, displays the coordinates for the selected runway and makes them available for loading. Refer to page 6-145 for details on position initialization.

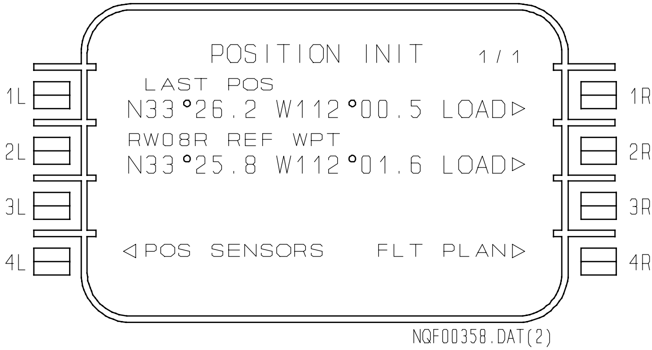


Figure 4-43

- **Threshold Position Update -** Pushing the line select key (2R) adjacent to the runway coordinates will load the runway threshold position into the FMS. This is shown in figure 4-44. The position is also loaded into sensors set to receive an update.

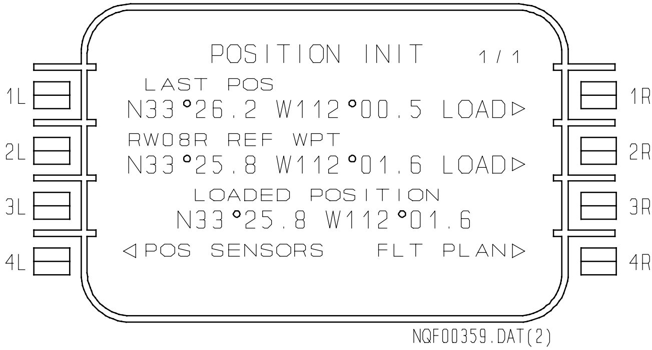


Figure 4-44

TAKEOFF

The FMS considers the aircraft airborne when it exceeds 50 kts groundspeed (GSPD) or 80 kts IAS or weight-off-wheels. When airborne, the ACTIVE FLT PLAN page displays the ETA for each waypoint in place of estimated time of enroute (ETE), as shown in figure 4-45. If an ETD was entered prior to takeoff, ETAs are already displayed. Once airborne, the ETA for the FROM waypoint is replaced with the actual crossing time. ETEs for any waypoint in the flight plan are available on PERF PLAN pages (refer to page 5-33) or PROGRESS page 1 (refer to page 8-1).

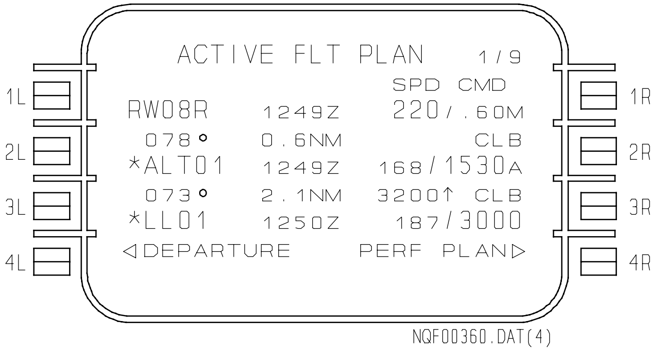


Figure 4-45

The FMS can be selected and coupled to the flight director shortly after takeoff. Initially, the FMS is armed on the flight director. When within the capture zone, the FMS captures and begins lateral guidance. Refer to page 7-21 for LNAV details.

If VNAV coupling is required, the flight director VNAV mode can be engaged. The FMS begins generating vertical guidance if the altitude selector has been set to the appropriate altitude. The FMS does not command a climb above, or descent below, the altitude selector. Refer to page 7-22 for VNAV details. VNAV coupling is not enabled for aircraft with advisory only VNAV.

The DEPARTURE prompt is displayed on the active flight plan pages until the aircraft is more than 50 nautical miles (NM) from the origin airport. The DEPARTURE prompt is displayed only when the origin is an airport.

- **Waypoint Sequencing** - On takeoff, the runway becomes the FROM waypoint and remains on the top line of the ACTIVE FLT PLAN page. The TO waypoint appears on the second line. As the aircraft passes the TO waypoint, all waypoints scroll up one line, as shown in figure 4-46. This process is called waypoint sequencing.

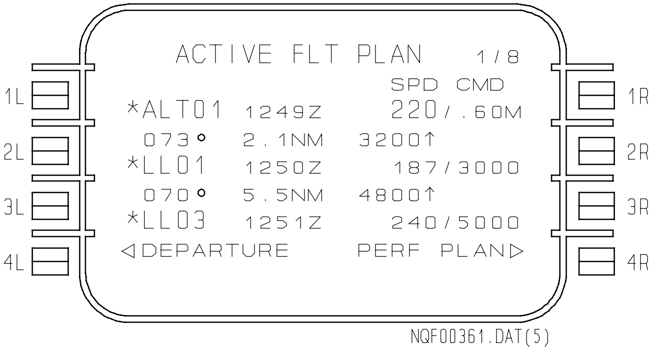


Figure 4-46

- **PROGRESS 1/3** - Information available on PROGRESS page 1/3 can be displayed by depressing the PROG function key, as shown in figure 4-47. This page includes the NAV mode (DME/DME) and the number of long range navigation (LRN) sensors being used (LRN=3).

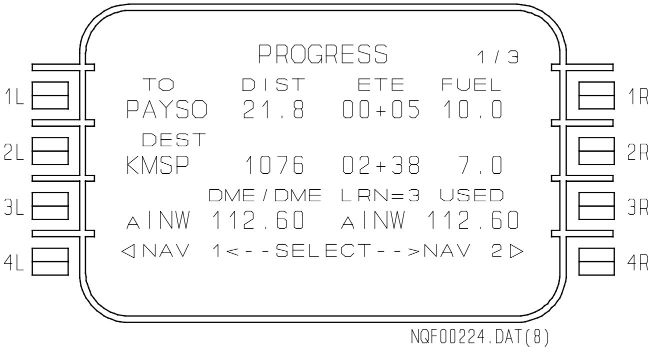


Figure 4-47

ACTIVE FLT PLAN page 1 and PROGRESS page 1 are considered the primary pages of the FMS during flight. Refer to page 8-1 for additional information on PROGRESS pages.

- **PROGRESS 2/3** - Figure 4-48 displays the following:

  - Speed Command (1L)
  - Altitude Command (1L)
  - Top of Climb (TOC) (2L)
  - Current Fuel Quantity (2R)
  - Top of Descent (TOD) (3L)
  - Current Gross Weight (3R).

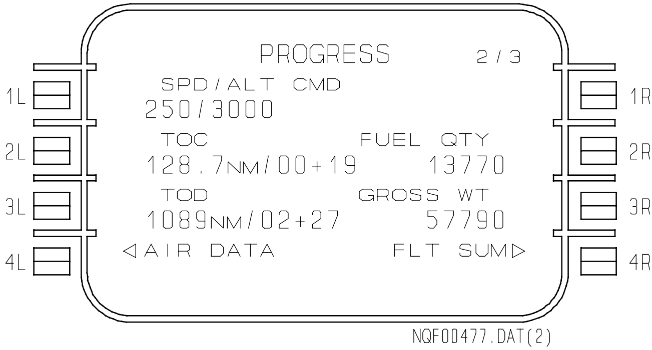


Figure 4-48

The TOC and TOD points are not displayed as waypoints as part of the ACTIVE FLT PLAN. However, they are displayed on the map and vertical profile (if available). The positions of these points are dynamically updated. Their position relative to other waypoints in the flight plan can change. Changes to the flight plan also affect the TOC and TOD positions.

CLIMB

As the climb continues, intermediate altitude clearances can be entered using the altitude selector. The FMS sets the target altitude to the selector altitude, or the next altitude constraint, whichever is lower. If an altitude constraint is associated with a waypoint, it can be entered on the ACTIVE FLT PLAN page adjacent to the waypoint. The FL180 at or above constraint on PAYSO was entered this way, as shown in figure 4-49.

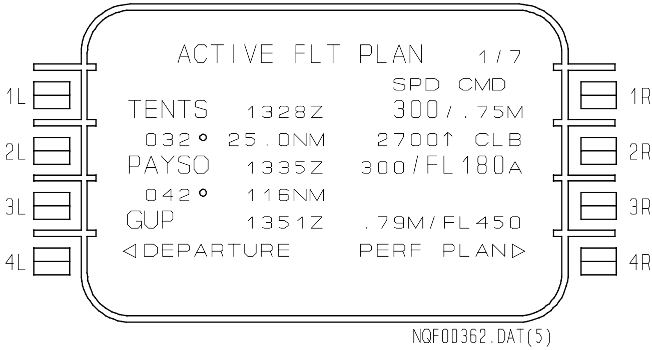


Figure 4-49

ENROUTE

Once at cruise altitude, the information on PROGRESS 2/3 reflects the commanded speed and altitude information for the cruise segment, as shown in figure 4-50. In this example, long range cruise was selected as the active cruise mode and .79M represents the long range cruise speed for current conditions.

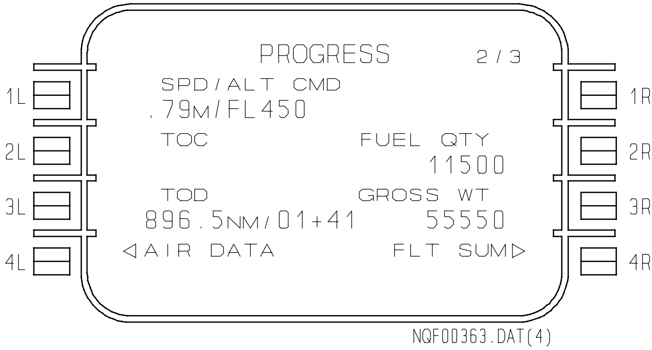


Figure 4-50

As the flight progresses, clearance revisions can be completed by making changes to the flight plan. The flight plan can be changed by adding or deleting waypoints or by performing a direct-to a waypoint downstream in the flight plan. A direct-to can also be made to a waypoint not currently in the flight plan.

If the revision is after the active waypoint, the aircraft does not change course or react to the flight plan change.

If the revision affects the active waypoint, the new entry must be confirmed. Confirmation is required because the revision modifies the flight plan and instructs the aircraft to change course immediately.

Revisions, such as clearance direct from present position to another point, are accomplished by performing a direct-to. This action makes the aircraft change course immediately.

Pushing the DIR key displays the DIRECT TO prompt on the active flight plan page. If the direct-to waypoint is already in the flight plan, pushing the line select key to the left of that waypoint modifies the flight plan. If the direct-to waypoint is not in the flight plan, enter the IDENT for the direct-to waypoint in the upper left corner of the page where the dashes are located.

For further information on DIRECT TO operation, refer to DIRECT TO (page 9-1).

DESCENT

The FMS calculates a top of descent (TOD) point based on the destination elevation and any entered altitude constraints. If VNAV is engaged and the altitude selector is set to a lower altitude, the aircraft descends at the TOD. If VNAV is not engaged or the altitude selector is not set lower, the aircraft remains at altitude through the TOD. In the latter case, the descent can be initiated by setting a lower altitude and selecting an appropriate flight director mode or manually flying the descent. Once in descent, the FMS sets the target altitude to the altitude selector or the next constraint, whichever is higher.

ARRIVAL

When within 200 flight plan (or track) miles of the destination airport, the ARRIVAL prompt is displayed at 4R, as shown in figure 4-51. Pushing this key will select an arrival procedure or runway. The ARRIVAL page can always be accessed from the NAV INDEX.

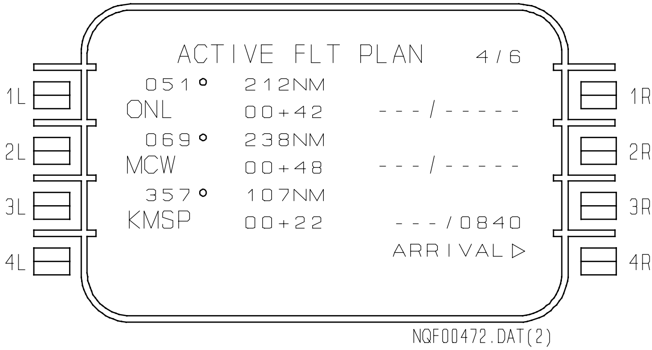


Figure 4-51

Selecting the ARRIVAL prompt will display the ARRIVAL page, as shown in figure 4-52. The destination airport is displayed at 1R with access to select runway, approach, and/or STAR. While the selection can be made in any order, this example selects 2L to choose an approach. Selecting an approach automatically selects a runway.

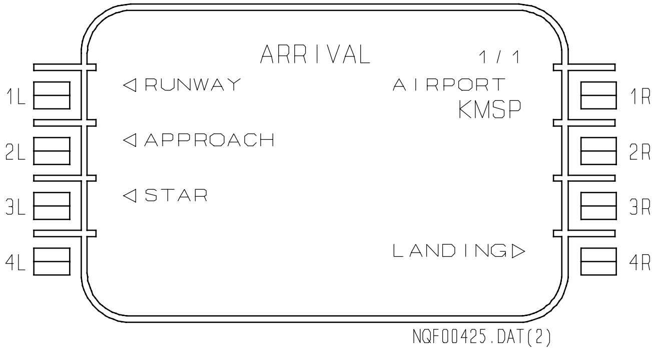


Figure 4-52

The APPROACH page is displayed with the available approach procedures, as shown in figure 4-53. Select the assigned or required approach. Selecting an approach also includes the missed approach procedure.

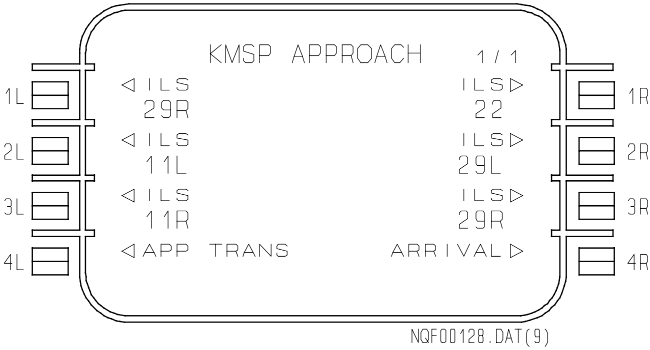


Figure 4-53

Following an approach selection, the APPROACH TRANS page shown in figure 4-54, is displayed. Select the appropriate transition.

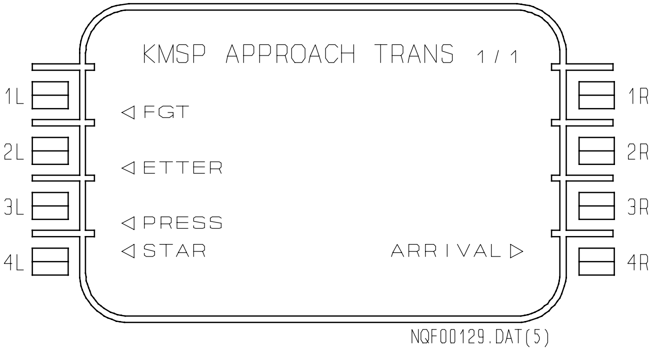


Figure 4-54

After the approach is selected, the STARs page is displayed with the available arrival procedures as shown in figure 4-55. If an arrival procedure has been assigned, select it from the list. From this list, the MEINZ5 arrival is selected (1R).

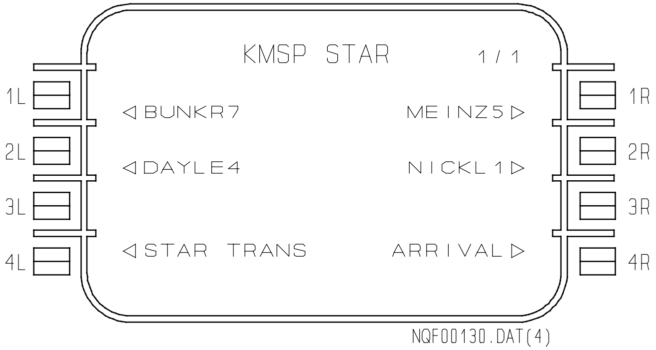


Figure 4-55

If a STAR has transition fixes, the STAR TRANS page is automatically displayed as shown in figure 4-56. If assigned, select the STAR transition. For this flight, the Mason City (MCW) transition (1R) is selected. After the transition is selected, the ARRIVAL page is displayed with a summary of the selections, as shown in figure 4-57. If no STAR and/or STAR TRANS is to be used, the ARRIVAL prompt (4R) returns the system to the ARRIVAL summary page that has the ACTIVATE prompt, as shown in figure 4-57. The ACTIVATE prompt at 4R inserts the selected procedures in the active flight plan. The procedures used in this example may not be current. Refer to page 6-43 for additional ARRIVAL details.

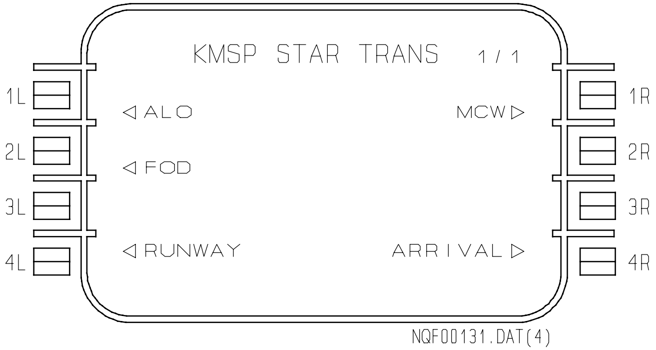


Figure 4-56

Figure 4-57

APPROACH

Once the arrival selection is activated, the FMS guides the aircraft along the STAR and approach procedure. If a precision approach (ILS) is selected as in this example, final approach should be flown using the flight director ILS mode. If a non-precision approach is selected, the FMS can be used for guidance on final approach. Refer to approach on page 6-50, for additional details.

LANDING

Activating the arrival returns the display to the ACTIVE FLT PLAN page. If the SPEED SET pages have been configured (refer to page 6-142), the LANDING prompt is displayed in the lower right corner (4R) indicating the next step. If the SPEED SET pages have not been configured, the LANDING prompt is not displayed. Landing is completed using three pages.

- **LANDING 1/3** - Figure 4-58 displays the following:

  - Runway Number (1L)
  - Runway Length (1R)
  - Temperature (2L)
  - Surface Wind (2R)
  - Pressure Altitude/Barometric (BARO) Setting (3L)
  - Runway Elevation (3R).

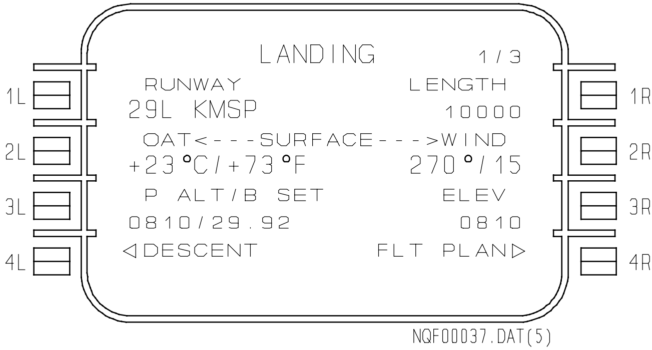


Figure 4-58

Runway information comes from the data base. For landing, both surface temperature and wind are required entries. The BARO setting is received from the DADC. It is used by the FMS to calculate the pressure altitude for the runway elevation.

- **LANDING 2/3** - The page, shown in figure 4-59, displays the following calculated values:

  - Headwind or Tailwind (1L)
  - Crosswind (1R)
  - Density Altitude (2L).

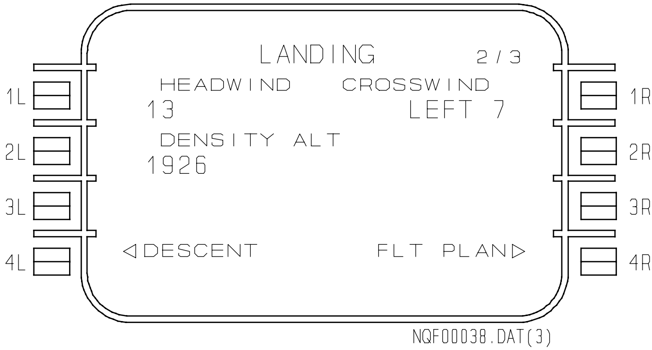


Figure 4-59

- **LANDING 3/3** - The page, shown in figure 4-60, is used to enter landing speeds. This page can be configured with up to six speeds with various labels. Refer to SPEED SET (page 6-142), for additional details.

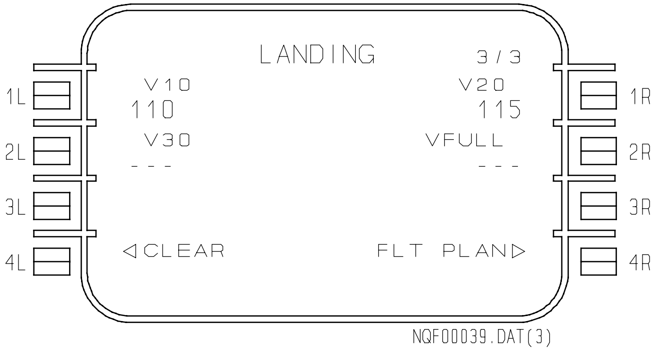


Figure 4-60

MISSED APPROACH

The MISSED APPROACH pages contain waypoints for the missed approach segment. These pages follow the ACTIVE FLT PLAN pages if an approach from the NAV data base has been activated. This is shown in figure 4-61. The first waypoint on the MISSED APPROACH page 1 is the missed approach point (MAP). The MAP is also in the active flight plan. When activated, the missed approach is inserted into the flight plan after the MAP.

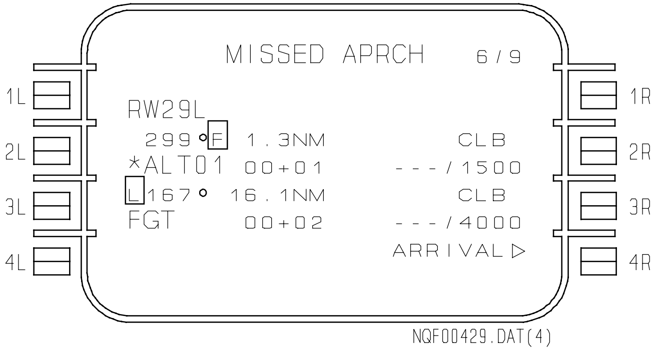


Figure 4-61

Two nautical miles before sequencing the final approach fix (FAF) or five nautical miles from the runway end, the MISSED APPR prompt is displayed at 4L on the ACTIVE FLT PLAN page. At this point, the missed approach can be activated by selecting the MISSED APPR prompt (4L) or toggling the takeoff/go-around (TOGA) switch. The missed approach is inserted into the active flight plan.

The MISSED APPR prompt should not be selected until the decision to miss the approach has been made. When MISSED APPR is selected, any portion of the flight plan that is past the MAP is replaced with the **missed approach** procedure. Refer to Missed Approach (page 6-54), for additional details.

ALTERNATE FLIGHT PLAN

The alternate flight plan pages are shown in figure 4-62. If an alternate is entered, these pages follow the active flight plan and missed approach (if entered) pages. If a flight plan to an alternate has been entered, the ALTERNATE prompt is displayed on the active flight plan page when the aircraft is within 25 NM of the destination. If a missed approach has been entered, the ALTERNATE prompt is not displayed until after the missed approach is selected. If an ALTERNATE is selected before the destination is reached, the FMS guides the aircraft to the original destination and then to the alternate. ALTERNATE should not be armed for the alternate until a decision is made to divert to the alternate. To proceed to the alternate without going to the original destination, use the direct (DIR) key.

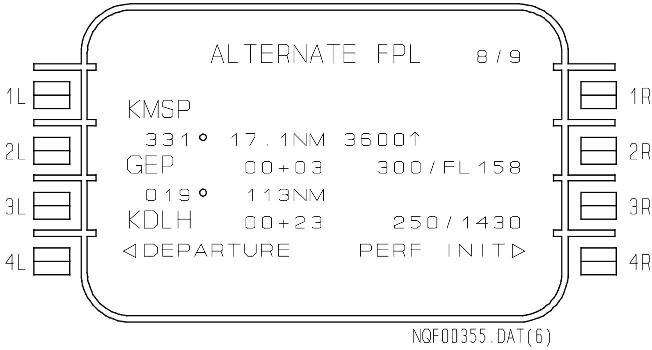


Figure 4-62

If the flight plan contains an approach, the ALTERNATE prompt is displayed only after the missed approach has been activated.

CLEARING OF FLIGHT PLANS

The active flight plan is automatically cleared 30 seconds after removing power. This applies both on the ground and in flight.

Activating a stored flight plan deletes the previous flight plan. Activating a stored flight plan while in flight is permitted, but the pilot is required to confirm that the present active flight plan is to be replaced. Whether on the ground or in flight, a stored flight plan or portion of a flight plan can be inserted into the active flight plan as a string of waypoints starting at the point of insertion. Flight plans can also be cleared one waypoint at a time by using the CDU DEL key.

While on the ground, entering a new origin after some or all of the flight plan has been defined, is permitted. If the new origin is already a waypoint in the flight plan, the waypoints before the first appearance of the new origin are deleted. If the new origin is not already a waypoint in the flight plan, the whole flight plan is deleted. Deleting the origin clears the entire flight plan. This applies to both active and stored flight plans.

Within approximately 30 seconds after landing, a CLEAR FPL prompt is displayed at the bottom right corner of the screen. Selecting this prompt clears the entire active flight plan.

Another action that can be performed on the ground that results in clearing the active flight plan is to activate the previously inactive data base on the NAV IDENT page of the CDU.

5. Performance

The FMS performance is based on the entries made by the pilot during the initialization process, flight plan, data input to the FMS, and input from aircraft systems. With this information, the FMS can control a variety of mission planning and speed control functions for the aircraft.

The CDU pages that control performance perform like the navigation pages. As a general rule, when the system supplies the information, items are displayed in **small characters**. They are displayed in **large characters** when the pilot makes an entry. There are several areas of initialization within the performance functions of the FMS. In order for the FMS to calculate, the initialization pages must be reviewed and the CONFIRM INIT prompt at 4R on the last page of initialization must be pushed.

Performance information in the FMS is based on data entered by the pilot and calculated by the FMS. Mission planning data has not been evaluated by the FAA for accuracy and is not approved by the FAA.

FMS fuel quantities are displayed two different ways. When displaying current fuel on board, the quantity is in pounds (e.g., 16250). When displaying planned fuel remaining at waypoints and fuel required, the quantity is displayed in thousands of pounds (e.g., 12.3, meaning 12,300). Fuel quantities that reflect the gauge value are displayed in pounds. Fuel quantities associated with the flight plan are displayed in thousands of pounds. **The FMS fuel management data is advisory information only. It must not be used in lieu of the aircraft's primary fuel flow indicator display.**

PERFORMANCE INDEX

The performance index (PERF INDEX) pages are accessed by pushing the PERF function key shown in figure 5-1.

PERF Index Access
Figure 5-1

When the PERF button is pushed, PERF INDEX page 1/2 is displayed, as shown in figure 5-2. Page 2/2 is displayed by using either the PREV or NEXT paging keys, as shown in figure 5-3. (Note: Prompt at 3R is not available for all aircraft.) These pages display performance functions that can be selected at any time. Push the line select key adjacent to the respective function to select the function. Page numbers to the outside of each button correspond with pages in this manual that describe the button function. These pages are examples of the index when FULL PERF is selected.

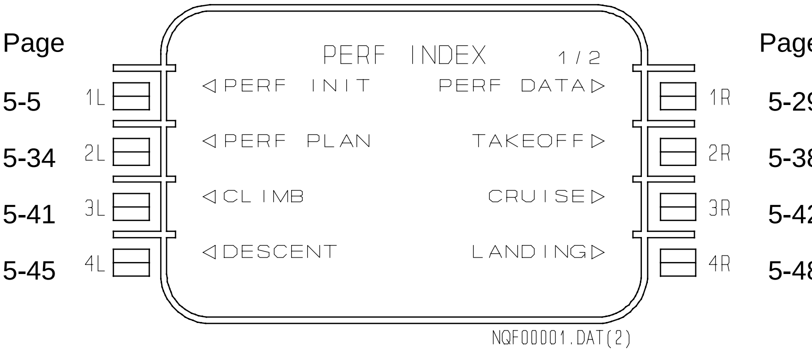


Figure 5-2

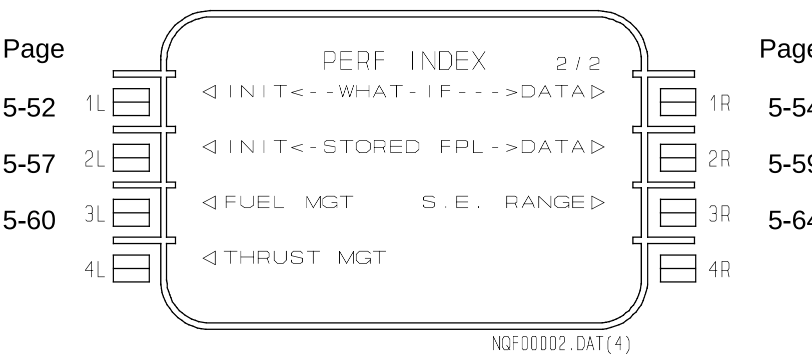
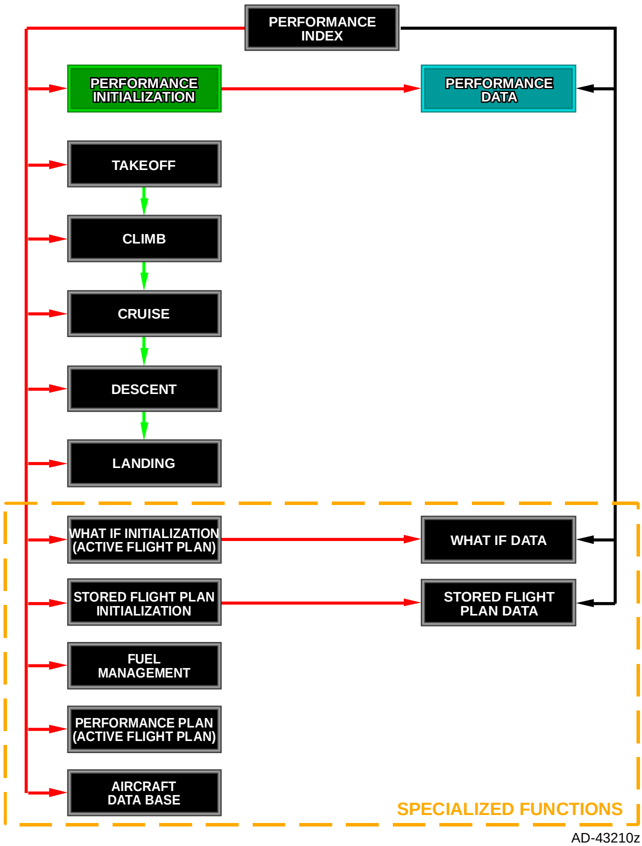


Figure 5-3

Performance Index Organization

There are several functions in the performance area, shown in figure 5-4, that require initialization. For these, when the related INITIALIZATION selection is complete, the lower right prompt can be selected to compute the data that was input during INITIALIZATION. The computed data is used for FMS and autothrottle (if applicable) control functions.



Performance Index Organization
Figure 5-4

PERFORMANCE INITIALIZATION

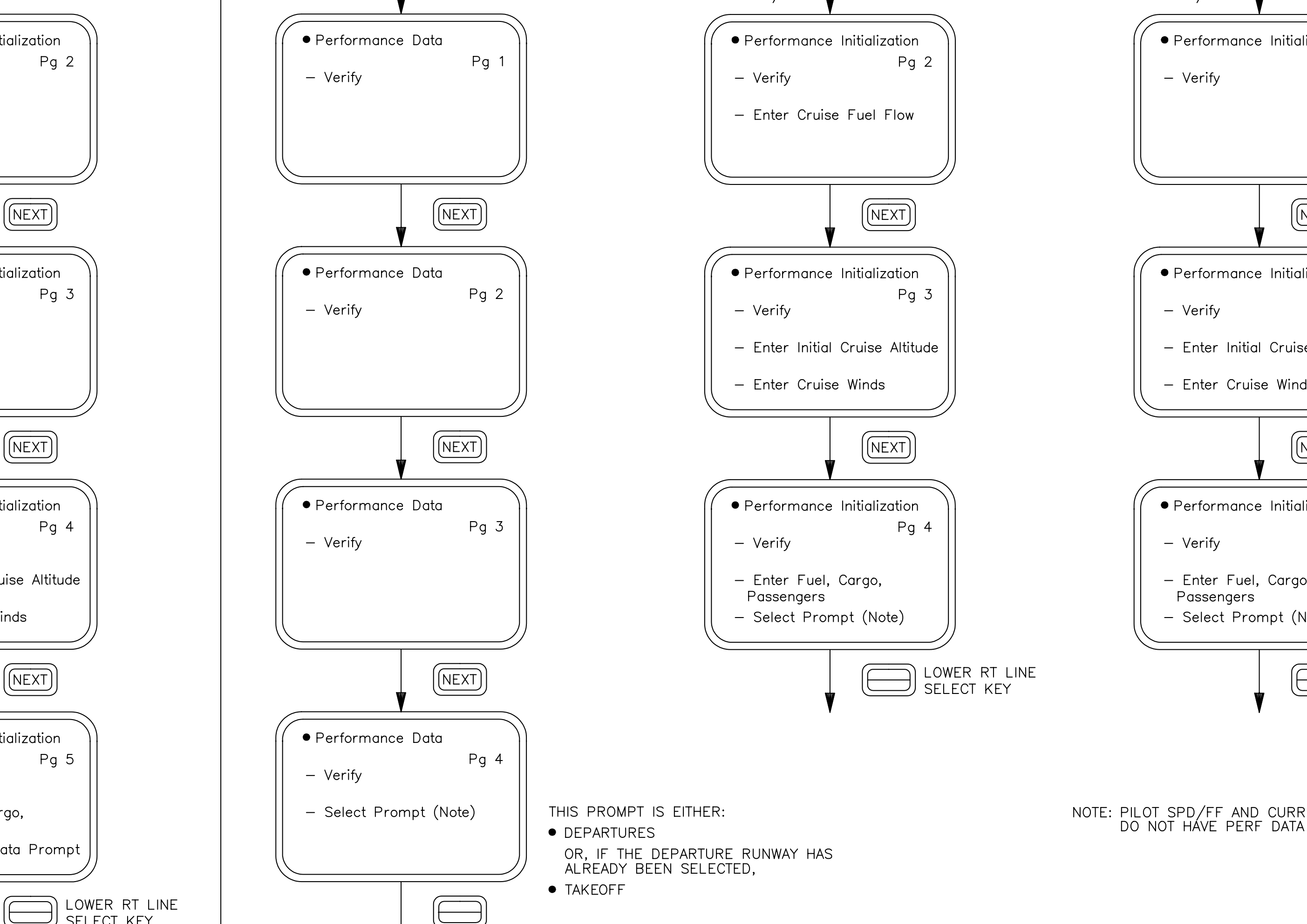
The pilot can select from one of three methods listed below to complete a performance initialization.

- **Full Performance** - The FMS uses an uploaded and learned aircraft data base file to perform time and fuel requirement calculations. The time requirement calculations are also based on pilot-entered speed schedules and winds. Computed cruise speed schedules such as long range cruise (LRC) and maximum speed can be selected.

- **Pilot Speed/Fuel Flow** - The FMS uses pilot-entered speed schedules and winds to perform time requirement calculations. The fuel requirement calculations are based on pilot-entered cruise fuel flow. Adjustments are made for the higher fuel flow in climb.

- **Current Ground Speed/Fuel Flow** - The fuel requirement calculations are based on the current fuel flow, displayed on the FUEL MGT page. If a fuel flow entry is made on that page, it takes the place of the sensed fuel flow. The time requirement calculations are based on the current groundspeed when airborne. While on the ground, the FMS uses the default groundspeed.

Figure 5-5 shows the sequence of initialization and data pages for each of the three methods of performance calculations. <u>**The pilot should verify and review all the entered and computed data.**</u>



THIS PROMPT IS EITHER:

- DEPARTURES

  OR, IF THE DEPARTURE RUNWAY HAS ALREADY BEEN SELECTED,

- TAKEOFF

NOTE: PILOT SPD/FF AND CURR
DO NOT HAVE PERF DATA

Full Performance Method

There are five pages of performance initialization. Many items are recalled from the previous flight to reduce the number of required inputs. These items can be changed. The only items that are required entries for each flight are fuel quantity (unless gauge value is available), cargo weight, and the number of passengers. An average cruise wind should be entered if it is available. The cruise altitude may be left at optimum or it can be entered.

- **PERFORMANCE INIT 1/5** - The page, shown in figure 5-6, contains information about the following:

  - **1L -** Aircraft Type (ACFT TYPE) is displayed on this line. No entry is permitted here. The aircraft type is loaded from the aircraft data base. Refer to Data Load (page 6-155), for details on loading an aircraft data base.

    If no aircraft data base has been loaded, this line is blank. An aircraft data base must be loaded in order to select the FULL PERF option.

    Normally, an aircraft data base only needs to be loaded when the FMS is installed. The aircraft data base is retained from flight to flight and updated by the learning process.

    The pilot should verify that the ACFT TYPE data field has the correct aircraft type. The system generates incorrect performance predictions if the FMS contains the wrong AIRCRAFT DB.

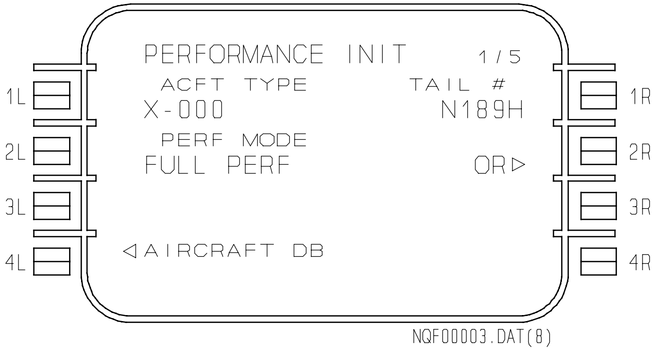


Figure 5-6

- **1R -** Aircraft tail number (TAIL #) is displayed on this line. The tail number must be entered in this field before going to the next page. Once entered, it is saved. No action is required on future flights. The tail number is used to name the aircraft data base file when it is downloaded to the data loader. This creates a unique aircraft data base file for each aircraft when the file is saved to a disk.

- **2L -** The FMS has three perf modes or methods of performance calculations. Use the OR prompt at 2R to change the modes (see figure 5-7).

- **4L -** This prompt accesses the AIRCRAFT DB down/uploading. The prompt is only available if there is a data loader connected to the FMS and the aircraft is on the ground.

• **PERF MODE 1/1** - Selecting the OR prompt at 2R, as shown in figure 5-6, displays the PERF MODE page, as shown in figure 5-7. The PERF MODE page is used to select the mode for performance calculation.

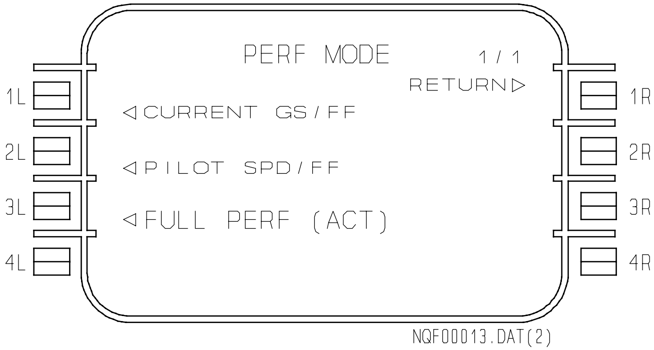


Figure 5-7

- **1L -** When CURRENT GS/FF is selected, performance calculations are based on current groundspeed and current fuel flow. However, while on the ground, the FMS default groundspeed is used. This groundspeed is displayed at 1R on the first page of any stored flight plan. Once airborne, the current groundspeed is used. The current fuel flow is displayed at 1R of the FUEL MGT 1/2 page. However, the value can be overridden by a pilot entry. The overridden value is then used.

- **2L -** Selecting PILOT SPD/FF bases performance calculations on pilot-entered speed schedules and cruise fuel flow. The cruise fuel flow must be entered at 2R of PERFORMANCE INIT 2/4 when using this option. Automatic adjustments are made for the higher fuel flow in a climb. Entered winds and, once airborne, sensed winds are included in the groundspeed predictions used for time enroute estimates.

- **3L -** Selecting FULL PERF bases performance on pilot selections and the learned aircraft performance. An aircraft data base must be loaded before this option is available.

  When either current GS/FF (1L) or PILOT SPD/FF (2L) are selected, the following inputs and features are **not** available:

  PERFORMANCE INIT 3/5 page (This reduces the total number of PERFORMANCE INIT pages to 4).
  The What-if and stored flight plan functions.
  The PERF DATA pages.
  The CLIMB page.
  The CRUISE pages.
  The DESCENT page.
  Optimum and maximum altitude computations.
  Cruise speed schedules:
  Long Range Cruise (LRC).
  Maximum Speed (MAX SPD).
  Maximum Endurance (MAX END).
  Point of No Return (PNR) page.
  Equal Time Point (ETP) page.

- **PERFORMANCE INIT 2/5 -** The page, shown in figure 5-8, is used to set the speed schedules for climb, cruise, and descent. It also is used to set the default descent angle. In FULL PERF and PILOT SPD/FF, these speed schedules are used for making groundspeed predictions. In the CURRENT GS/FF mode, the groundspeed predictions are unaffected by the speed schedules. The active FMS speed target, used by the flight director and autothrottle (if available), uses the appropriate speed schedule based on the phase of flight.

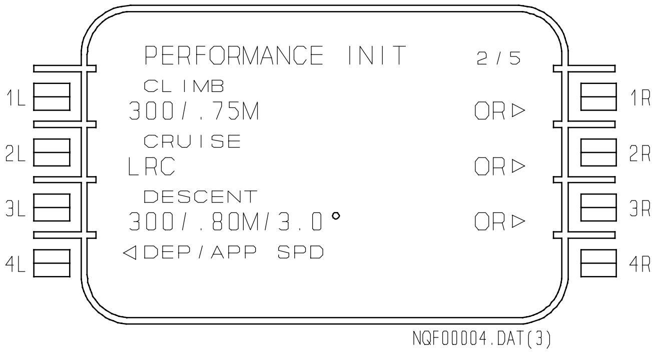


Figure 5-8

  - **1L and 3L** - The climb and descent speed schedules are always displayed as both a calibrated airspeed (CAS) and a MACH. Changes can be made by entering a CAS, a MACH, or both separated by a "/". The leading "/" is optional when entering a MACH only. Entering *DELETE* returns the default climb or descent speed schedule.

    The active speed target is the CAS at lower altitudes and MACH at higher altitudes. The crossover altitude is where both the CAS and the MACH translate to the same true airspeed (TAS). The FMS always uses the CAS or MACH entry that provides the lowest TAS at the current altitude.

  - **2L** - The cruise speed schedule can be either a CAS/MACH pair, only CAS, only MACH, or a system-generated cruise speed schedule. Entries of a CAS, a MACH, or both are accepted. Entering *DELETE* returns the default cruise speed schedule which is LRC in FULL PERF and 300/.80 in the other two modes. The two other system-generated schedules, MAX SPD and MAX END, can be selected on the CRUISE MODES page only.

If both a CAS and MACH are entered, the active speed target is the CAS or MACH that provides the lowest TAS at the current altitude.

If the LRC or MAX SPD schedules are active, the speed target is issued as a MACH at higher altitudes and CAS at lower altitudes. This is determined by the V_{mo}/M_{mo} crossover altitude. If the cruise speed schedule is MAX END, the speed target is always CAS.

If only a MACH cruise speed is entered, but the cruise altitude is low, the TAS may become excessive. Enter both a CAS and a MACH or use LRC to avoid this situation.

- **3L** - In addition to the speed entries, a default descent angle can be entered in this field. The angle is entered directly on this page without the optional leading "//". Refer to Descent on page 5-44 for additional information.

- **4L** - Selection of this line provides access to the DEPARTURE, APPROACH, and GO-AROUND speed pages. See figures 5-12 thru 5-14 starting on page 5-17.

- **1R, 2R, and 3R** - Selecting one of the OR prompts will display the CLIMB, CRUISE, or DESCENT MODES page, respectively, as shown in figures 5-9 thru 5-11.

• **CLIMB MODES** - The page, shown in figure 5-9, is only available when using FULL PERF. This page shows both the manual and default speed schedule as well as which schedule is active.

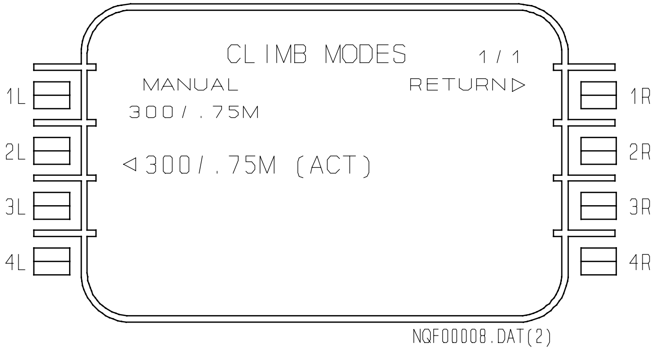


Figure 5-9

- **1L** - This field is used to enter CAS, MACH, or both separated by a "/". After an entry is made, the display returns to the PERFORMANCE INIT 2/5 page.

- **2L** - Selecting this prompt activates the default climb schedule and returns to the PERFORMANCE INIT 2/5 page.

- **1R** - The RETURN prompt can be used to return to the PERFORMANCE INIT 2/5 without making any selection on the page.

- **CRUISE MODES** - The page, shown in figure 5-10, is only available when using FULL PERF. The available modes for cruise are listed on this page with the active mode annotated.

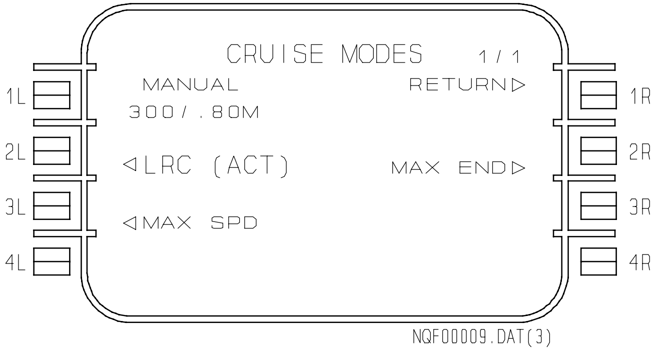


Figure 5-10

- **1L -** A MANUAL cruise speed can be entered and activated at 1L. If an entry is made directly on the PERFORMANCE INIT 2/5 page, it is recorded under the manual entry on this page.

- **2L, 3L, and 2R** - Pushing the line select key for a mode makes it the active cruise mode. The display then returns to the PERFORMANCE INIT 2/5 page.

- **1R** - The RETURN prompt returns to the PERFORMANCE INIT 2/5 page with no action performed.

- **DESCENT MODES -** The page, shown in figure 5-11, is only available when using FULL PERF. The page shows the available descent modes as well as which mode is active.

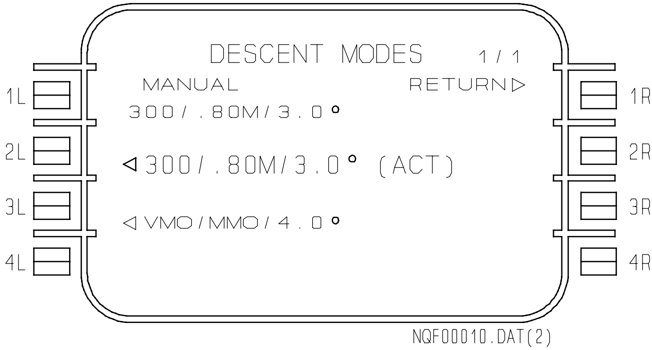


Figure 5-11

- **1L -** This field is used to enter CAS, MACH, or both. The descent angle can also be entered separately or following a CAS/MACH speed entry (e.g., 280/.73/3.5). After an entry is made, the display returns to the PERFORMANCE INIT 2/5 page.
- **2L -** Selecting this prompt activates the default descent speed/angle schedule and returns to the PERFORMANCE INIT 2/5 page.
- **3L -** Selecting this prompt activates the VMO/MMO descent speed/angle and returns to the PERFORMANCE INIT 2/5 page. Changes to the descent angle can be entered directly. This mode should only be used when flying vertical flight level change (VFLCH) or flight level change (FLCH). If VNAV is controlling a path (VPATH), the high speed reversion function changes the VNAV mode to VFLCH if the speed comes to within 5 knots of V_{mo}.
- **1R -** The RETURN prompt can be used to return to the PERFORMANCE INIT 2/5 page without making any selection on this page.

- **DEPARTURE SPEED -** The page, shown in figure 5-12, is used to enter speed limit and restriction limits. These are used to compute speed targets during departure.

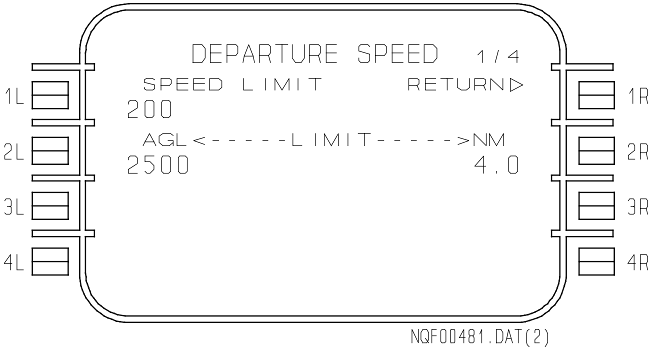


Figure 5-12

- **1L -** This field is used to enter the departure speed limit. The default value is 200 knots.
- **2L -** This field is used to enter the upper limit of the departure area. The default value is 2500 feet.
- **1R -** The RETURN prompt can be used to return to the PERFORMANCE INIT 2/5 page without making any selection on this page.
- **2R -** This field is used to enter the horizontal limit of the departure area. The default value is 4.0 NM.

- **APPROACH SPEED -** The page, shown in figure 5-13, is used to enter speed limit and restriction limits. These are used to compute speed targets during approach.

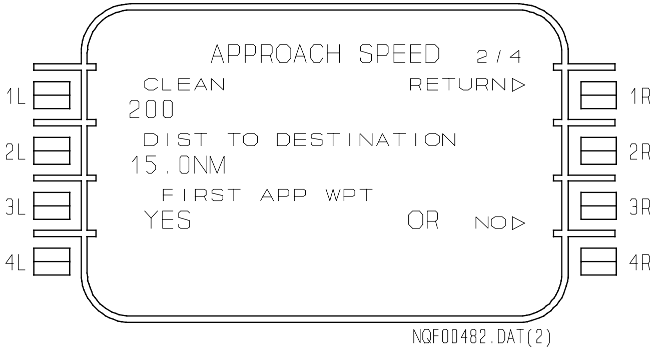


Figure 5-13

- **1L -** This field is used to enter the approach speed limit. The default value is 200 knots.
- **2L -** This field is used to enter the distance out from the destination where the approach speed schedule begins. The default value is 15.0 NM.
- **3L and 3R -** Selecting YES for this option starts the approach speed schedule at the first approach waypoint when it is further out than the distance entered at 2L. The default value is YES. 3R is used to change the selection.
- **1R -** The RETURN prompt can be used to return to the PERFORMANCE INIT 2/5 page without making any selection on this page.

- **GO-AROUND SPEEDS** - The page, shown in figure 5-14, is used to enter the go-around speed.

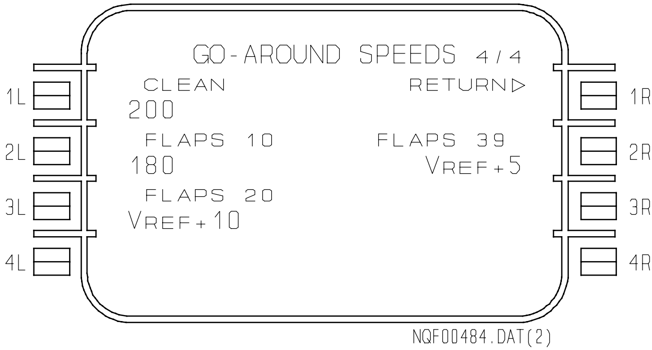


Figure 5-14

- **1L** - This field is used to enter the go-around speed. The default value is 200 knots.
- **1R** - The RETURN prompt can be used to return to the PERFORMANCE INIT 2/5 page without making any selection on this page.

- **PERFORMANCE INIT 3/5** - The page, shown in figure 5-15, is used to review and/or select a step increment for predicted step climbs. It is also the method used for fuel reserve calculations as well as takeoff and landing fuel allowances. The page is only available in the FULL PERF mode.

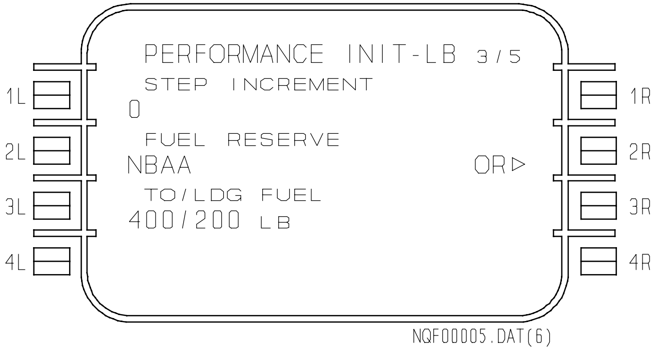


Figure 5-15

- **1L** - Entries for a step increment must be in thousands of feet. The three trailing zeros may be omitted. For example, a 4000-foot step climb increment can be selected by entering "4" or "4000". Entering *DELETE* returns the selection to no step or 0 feet. Step climbs are used for long range flights to optimize the aircraft performance. As the aircraft burns fuel, the optimum altitude goes up. If a step increment is selected, the FMS computes the bottom of step climb (BOSC) point. The BOSC is where the aircraft is light enough to climb by the amount of the step increment to a new cruise altitude. There may be more than one step climb calculated for a flight.

  When a step increment is selected, time and fuel predictions assume that the step climbs will be made. Therefore, a step increment should only be selected when the intent is to make the step climbs. If clearance is not given or the step climb is not going to be made, the step increment should be set to 0 in order to maintain accurate time and fuel predictions.

- **2L** - The method of calculating fuel reserve is displayed on this line. Entering *DELETE* returns to the default reserve mode which is National Business Aircraft Association (NBAA) rules. If one of the other two modes (pounds remaining or time remaining) has been selected on the FUEL RESERVE page, an entry can be made directly on this page, as shown in figure 5-16. For example, if 1000 LB is displayed, an entry of "2000" changes the reserve quantity to 2000 LB.

- **2R** -This line accesses the FUEL RESERVE page, as shown in figure 5-16.

- **3L -** The default values of Takeoff/Landing Fuel (TO/LDG FUEL) are supplied from the aircraft data base. However, manual entries can be made. Manual entries are saved for the next flight. Entering *DELETE* returns the default values.

  The takeoff fuel allowance includes fuel burn for taxi and takeoff. The fuel required calculation is made from after takeoff to landing plus reserves. The takeoff fuel allowance is added to the fuel required calculation. Takeoff fuel allowance is decremented by fuel flow. However, it is not decremented past zero. Following takeoff or when the takeoff allowance has been decremented to zero, fuel remaining values are adjusted to account for actual fuel burned.

  The landing fuel allowance is a buffer amount of fuel that the FMS incorporates into the total fuel required computation. The landing fuel is intended to cover the ground operation after landing. The value can be changed at any time.

• **FUEL RESERVE 1/1 -** The page, shown in figure 5-16, is where the fuel reserve mode is changed or modified. The fuel reserve page contains three modes.

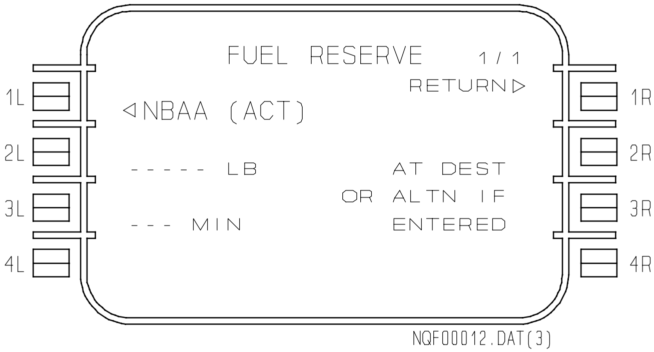


Figure 5-16

- **1L -** Selecting this prompt activates the NBAA reserve mode. The NBAA fuel reserve requirement is the sum of the two following items:

  The fuel required to fly the alternate flight plan (from the destination to the alternate destination). If the alternate flight plan is less than 200 NM or if there is no alternate flight plan, the NBAA standard 200 NM alternate flight plan is assumed.

  Fuel required to hold for 30 minutes at 5000 feet at the reserve holding speed at the alternate.

- **2L -** A fuel reserve in pounds can be entered. The specified fuel reserve applies at the destination, or at the alternate destination if one has been entered.

- **3L -** A fuel reserve in minutes can be entered. The time entered is converted to pounds of fuel assuming flight at 5000 feet at the reserve holding speed. The fuel reserve applies to the destination or the alternate destination if one has been entered.

• **PERFORMANCE INIT 4/5 -** The page, shown in figure 5-17, does not require that an entry be made. However, a flight-specific item such as the cruise wind is a recommended entry. In addition, initial cruise altitude is usually entered.

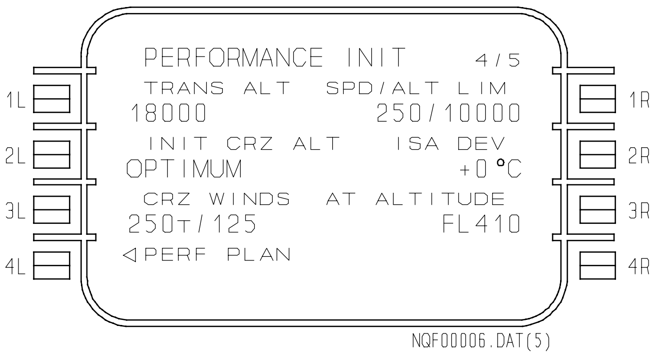


Figure 5-17

- **1L -** The transition altitude can be entered here. The FMS uses the input to determine how to display altitudes. Altitudes above the transition altitude are displayed as flight levels (FL) and below in feet. Entering *DELETE* returns the default of 18,000 feet.

- **1R -** Speed limits associated with altitudes, not waypoints, can be entered. For U.S. operation, 250 knots below 10,000 feet is entered. The FMS speed target is limited to this speed below the restriction altitude. The limit can be adjusted as required. Entering *DELETE* removes the limit and displays dashes. This is the only field that can be left with dashes.

- **2L -** INIT CRZ ALT - The default cruise altitude of OPTIMUM is displayed if the performance (PERF) mode is FULL PERF. For the other two performance modes, entry prompts are displayed. An entry of cruise altitude in FL or feet can be made. If OPTIMUM is left unchanged, the FMS calculates the OPTIMUM cruise altitude when the CONFIRM INIT prompt on the last initialization page is pushed.

  After performance initialization is complete, the calculated altitude is displayed in small characters on this page. The method of setting the altitude is displayed on this line following the calculated altitude as follows:

  • "(OPTIMUM)" indicates that the altitude is the optimum
  • "(ALT SEL)" indicates that the altitude was set by the altitude preselector
  • "(FP LIM)" indicates that the altitude has been limited by the flight plan.

  Entering *DELETE* at any time returns to the default of OPTIMUM. If the performance is already initialized, the optimum altitude is recomputed.

  For the other two performance modes, entering *DELETE* returns the entry prompts and the performance function is deinitialized. If an altitude is entered that is lower than the altitude selector, the entry is rejected and a CDU message "RESET ALT SEL?" is displayed. The cruise altitude has to be equal to or greater than the altitude selector.

After entering an initial cruise altitude, setting the altitude selector to a higher altitude will adjust the cruise altitude to that higher altitude. This action does not change the initial cruise altitude. However, it does change the cruise altitude as displayed on the PERF DATA pages (refer to page 5-28). Performance data is recalculated to reflect the higher cruise altitude.

The FMS uses the initial cruise altitude to determine where the cruise phase of flight begins. This is critical to performance planning. In flight, the FMS switches speed targets from climb to cruise when leveling at the entered or calculated initial cruise altitude or higher.

NOTES:

1. Once in flight, if the actual cruise altitude is lower than the entered or calculated initial cruise altitude, the initial cruise altitude entry should be adjusted to the lower value. This places the FMS in the cruise mode and adjusts the performance predictions to account for the lower cruise altitude.

2. The speed target for a level-off below the entered or calculated initial cruise altitude is the climb speed target.

Additional Definition of Optimum Altitude

The optimum altitude has different definitions based on the cruise speed mode. For the LRC and manual cruise speeds, the optimum altitude is where the specific range is optimized. This altitude is typically close to the ceiling altitude. The MAX SPD optimum altitude is where true airspeed is maximized. This altitude tends to be close to the V_{MO}/M_{MO} crossover altitude. For MAX END speed, the optimum altitude is where the fuel flow is minimized.

The OPTIMUM altitude is short-trip limited. This means the computed altitude is adjusted downward if the flight is not long enough for a climb to the optimum altitude. Regardless of short-trip limiting, the cruise altitude is always set at least as high as the altitude selector.

- **2R -** The forecast temperature deviation at the **cruise altitude** can be entered in this field. The deviation is relative to the International Standard Atmosphere (ISA). If no entry is made, the displayed default of zero is used. Do not input the temperature deviation at the field elevation. Temperature impacts most performance predictions: the climb gradient, the ceiling altitude, the fuel consumption, the groundspeed predictions, and more. For additional information, refer to the explanation of the Wind and Temperature Model on page 5-33.

- **3L & 3R -** An average cruise wind and corresponding altitude can be entered at 3L and 3R. No entry is required, but it is recommended. If no entry is made, the FMS assumes zero wind. When the cruise wind is entered at 3L, prompts are displayed at 3R. The altitude must also be entered before the cruise wind is accepted. Entering *DELETE* returns the default value to zero.

- **4L -** This prompt is used to access the PERF PLAN pages where individual waypoint wind and temperature entries can be made. Individual wind and temperature can be entered at this time in the initialization process or after completing initialization.

• **PERFORMANCE INIT 5/5 -** The page, shown in figure 5-18, is used to calculate the aircraft gross weight.

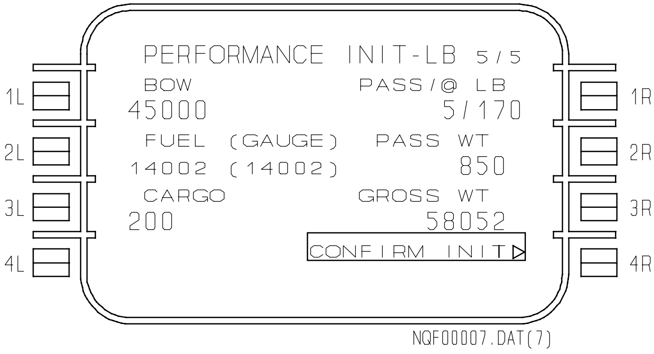


Figure 5-18

- **1L -** Basic operating weight (BOW) is retained in memory but it should be verified on each flight. A new entry can be made at any time. Entering *DELETE* returns the entry prompts.

- **2L -** Fuel weight must be entered before each flight. The fuel weight is not saved and is set to entry prompts on powerup. Once engine fuel flow is detected or a fuel flow is entered manually on the FUEL MGT page, the fuel weight starts to decrement. Entering *DELETE* returns entry prompts. Some aircraft read and display the gauge quantity.

- **3L & 1R -** Cargo weight and passenger count must be entered in order to compute performance data. The average weight per passenger can also be adjusted.

- **4R -** When performance initialization is complete, the CONFIRM INIT prompt is displayed in the lower right corner of this page. The CONFIRM INIT prompt must be selected for the performance function to calculate and for the VNAV function to be available. After confirming initialization, the prompt at 4R becomes PERF DATA on all PERF INIT pages.

Pilot Speed/Fuel Flow (SPD/FF) Method

The PILOT SPD/FF method of performance initialization has a total of four pages. See performance initialization block diagram on page 5-7 for flow of pages. PERFORMANCE INIT 3/5 for FULL PERF is not used. The performance initialization is similar to the FULL PERF initialization with the following exceptions:

- The PERFORMANCE INIT 2/4 page (page 2/5 for FULL PERF) displays entry prompts at 2R for entry of cruise fuel flow (CRZ FF). There are no OR prompts at 1R and 3R. Note, if the PILOT SPD/FF performance mode is first selected while the aircraft is airborne, the current fuel flow is displayed in this field. This is done to prevent dropping performance initialization and VNAV.

- The PERFORMANCE INIT 3/4 page (page 4/5 for FULL PERF) displays entry prompts for the cruise altitude at 2L. The optimum altitude selection is not available.

- The PERFORMANCE INIT 4/4 page (page 5/5 for FULL PERF) does not show the PERF DATA prompt. There are no PERF DATA pages for this mode. Consequently, there is no requirement to select this prompt.

Current Groundspeed/Fuel Flow (GS/FF) Method

The CURRENT GS/FF method of performance initialization is similar to the PILOT SPD/FF initialization with the following exceptions:

- There is no need to enter cruise fuel flow on the PERFORMANCE 2/5 page. The 2R location is blank.

- The climb, cruise, and descent speed schedules on the PERFORMANCE INIT 2/5 page are used to set FMS speed targets to the flight director. They are not used for performance calculations.

- The cruise wind and temperature entries on the PERFORMANCE INIT 3/4 page are not needed. The time and fuel requirements are based on current conditions only.

Switching Performance Methods

The performance method can be switched manually. In some cases, there is automatic reversion. The following applies:

- Switching between FULL PERF and PILOT SPD/FF causes the current fuel flow to be used as the PILOT SPD/FF cruise fuel flow baseline. A subsequent entry of cruise fuel flow can still be made.

- If the FULL PERF or PILOT SPD/FF methods are being used and becomes invalid, the FMS automatically reverts to the CURRENT GS/FF method.

- If the FMS reverts to the CURRENT GS/FF method, the PROGRESS page displays fuel and time at destination based on current GS and FF.

PERFORMANCE DATA

The four PERF DATA pages are available if the performance mode is FULL PERF. The performance data is only displayed when there is an active flight plan and the performance initialization has been completed. Any time changes are made to the flight plan, performance is updated. In flight, factors such as unexpected winds or routing changes alter the predictions.

When performance data is recalculating, the displayed data is blanked during the few seconds of calculation. This operation is the general rule for all pages displaying the performance data.

- **PERF DATA 1/4** - The page, shown in figure 5-19, displays the overall fuel and time requirements along with the cruise altitude. If an alternate flight plan has been entered, data for both the destination and the alternate destination is presented.

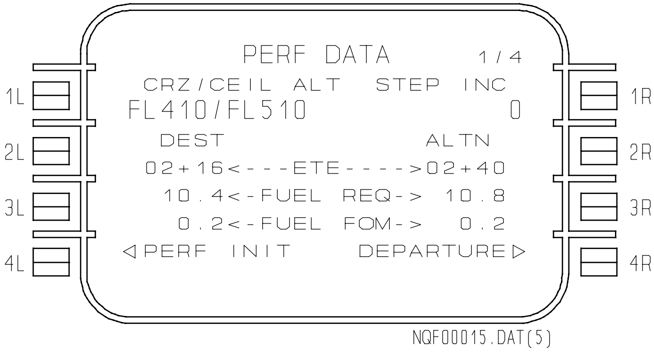


Figure 5-19

- **1L -** The computed cruise and ceiling altitudes are displayed. Cruise altitude can be entered in FL or feet. Entering *DELETE* is interpreted as a request to recompute the optimum altitude. The ceiling altitude cannot be entered.

- **1R -** The step increment can be entered using the same rules as during performance initialization.

- **2L and 2R -** This line displays ETE to the destination and the alternate destination. No entry is permitted.

- **3L and 3R -** This line displays total fuel requirement and the fuel figure of merit (FOM). The fuel required includes the fuel to fly the mission, the takeoff and landing allowances, plus reserves. The fuel FOM is an estimate of the accuracy of the fuel remaining calculation expressed in thousands of pounds. In figure 5-19, the FUEL FOM is 0.2 meaning fuel remaining numbers have an estimated accuracy within ± 200 pounds.

  If the alternate mission is less than 200 NM and the NBAA reserve mode is used, the fuel required to the destination is higher than to the alternate destination. That is because the reserve at the destination includes the 200 NM minimum alternate plus 30 minutes of loiter, whereas, at the alternate, only 30 minute of loiter is included.

- **4L and 4R -** The prompt at 4L on all PERF DATA pages is PERF INIT. The prompt at 4R on all PERF DATA pages is either DEPARTURE, if a departure runway has not been selected, or TAKEOFF, if a departure runway has been selected.

Additional Details About Cruise Altitude

At first, the cruise altitude is either the same as the initial cruise altitude entered during initialization, or the computed optimum altitude. The cruise altitude can also be moved up automatically if the altitude selector is dialed up to a higher altitude after the initialization is complete. The initial cruise altitude on the PERFORMANCE INIT 4/5 page is not affected by the automatic adjustments. If the cruise segment is flown at an altitude below the displayed cruise altitude, the new cruise altitude should be entered. Otherwise, a climb prediction is still made.

Additional Details About Ceiling Altitude

The ceiling altitude is the highest attainable altitude of the aircraft for the given cruise conditions. The ceiling altitude is limited to the certified ceiling altitude. The altitude depends on the cruise speed mode as well as the gross weight and the air temperature. Prior to reaching cruise, predicted top of climb (TOC) values are used. Once in cruise, the current weight and outside air temperature are used. For the MAX SPEED and the MAX END cruise modes, the ceiling altitude is the highest altitude that can be attained. For the LRC or a manual cruise speed mode, the ceiling altitude is computed for the LRC schedule or for the entered CAS or MACH. If a high manual mach number is entered, the ceiling altitude is lower than if the MAX SPD mode is chosen.

- **PERF DATA 2/4** - The page, shown in figure 5-20, is only a display page. No entries are allowed. It displays the calculated data listed below.

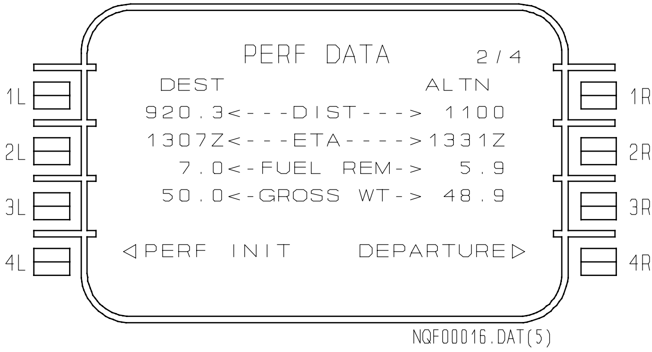


Figure 5-20

- **1L and 1R** - Flight plan distance to go to the destination and the alternate destination are displayed.

- **2L and 2R** - Once airborne, the ETA at the destination and the alternate destination are displayed. These fields are blank while on the ground. Also shown is the predicted fuel quantity remaining at the destination and alternate destination.

- **3L and 3R** - The predicted gross weight at the destination and alternate destination are displayed.

- **PERF DATA 3/4** - The page, shown in figure 5-21, is also a display only page. The page shows wind information and keeps track of how the fuel predictions have changed since takeoff. There are no entries on this page.

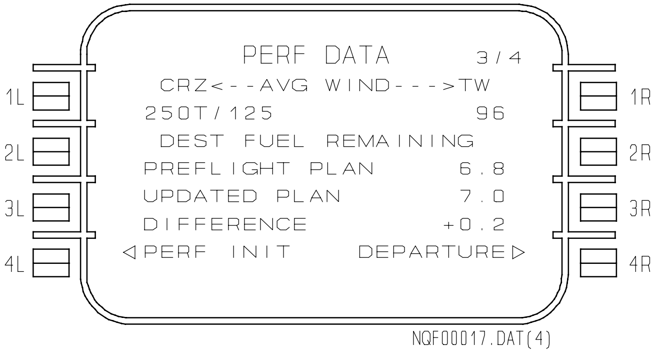


Figure 5-21

- **1L** - The average cruise wind for the remainder of the flight plan is displayed. This is estimated by the performance mission predictions. The wind is computed based on sensed wind and entered wind.

- **1R** - The same wind as in 1L but resolved into average headwind or tailwind component is displayed.

- **2R** - The preflight fuel remaining at the destination is displayed. At takeoff, this value is frozen for the remainder of the flight.

- **3R** - After takeoff, the latest estimate of fuel remaining at the destination as well as the difference to the preflight plan are displayed. On the ground, these displays are blank. This gives the pilot a way to compare how well the flight is tracking to the preflight plan.

- **PERF DATA 4/4 -** The page, shown in figure 5-22, displays information about fuel reserve requirements. There are no entries on this page.

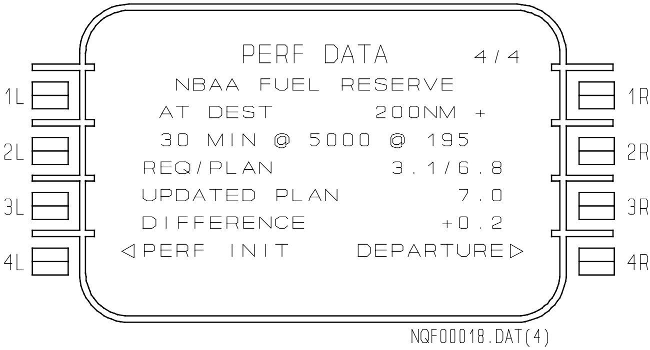


Figure 5-22

- **1L & 1R -** The method of reserve calculation is displayed as chosen on the performance initialization pages. Figure 5-22 shows the default mode of NBAA reserves. If the mode is pounds or minutes, the fuel reserve at the destination is displayed when there is no alternate destination. With an alternate flight plan, these two modes show the fuel reserve at the alternate destination.

- **2R -** The required (REQ) fuel reserve and the predicted fuel remaining (PLAN) are displayed. If the PLAN fuel remaining is greater than the REQ fuel, there is sufficient fuel reserve on board. The PLAN fuel remaining is frozen at takeoff. The REQ fuel changes if the reserve mode is changed.

- **3R -** The UPDATED PLAN is only displayed while airborne. It represents the most recent estimate of the fuel remaining. While in flight, this quantity should be compared to the REQ fuel in order to see if there is sufficient fuel reserve on board. The difference between preflight and updated plan is also displayed.

PERFORMANCE PLAN

PERF PLAN is selected from the PERF INDEX or from the ACTIVE FLT PLAN. The PERF PLAN pages display the estimated fuel remaining and estimated time enroute (ETE) for each leg of the flight, as shown in figure 5-23. No flight plan changes can be made from this page. The PREV and NEXT keys are used to review the entire flight plan. In addition to this information, this page shows a wind/temperature (W/T) prompt (right line-selects) for each waypoint.

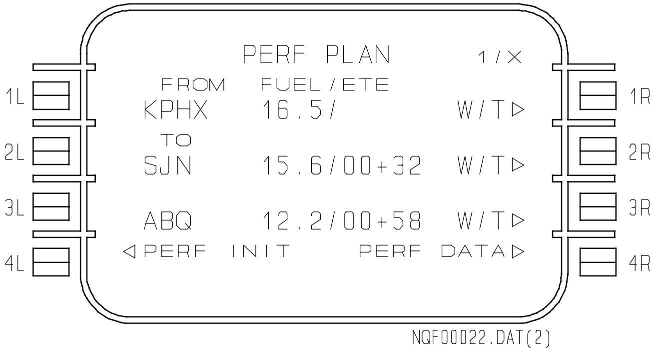


Figure 5-23

Selecting this prompt for a specific waypoint displays the WIND/TEMP page. This page is used for entries and for display of wind and temperature information.

Wind and Temperature Pages

- **WIND/TEMP** - When the WIND/TEMP page is first selected, it displays the predicted altitude as well as the predicted wind and temperature at that altitude for that waypoint. This is shown in figure 5-24. Entries can be made on this page.

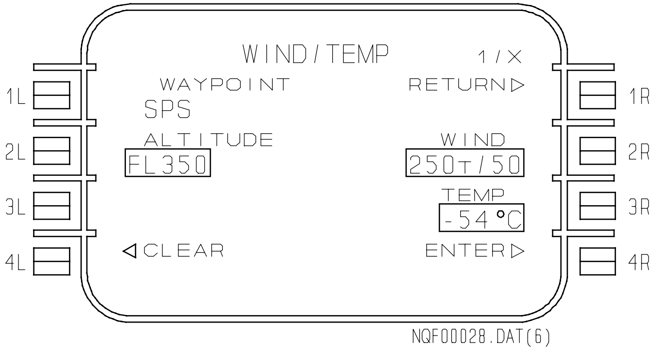


Figure 5-24

- **1L** - The waypoint is displayed. No entry is allowed. However, the PREV and NEXT keys can be used to cycle through the waypoints in the flight plan.

- **1R** - Pushing this prompt returns the display to the PERF PLAN page.

- **2L** - The predicted altitude from the performance computations is displayed here. Altitude entries can be made. They are used to assign an altitude to an entered wind and/or temperature.

- **2R** - The wind displayed is the wind being used for performance computation. This wind is a blend of sensed wind (when airborne) and entered winds. Additional explanation is provided below. Wind entries in degrees true and magnitude can be entered.

- **3R** - The predicted static air temperature is a blend of sensed and entered values. Additional explanation is provided below. Temperature is entered in degrees celsius (° C).

- **4L** - When an entry is made, the CLEAR prompt is displayed. For an entry to be complete, an altitude as well as a wind and/or temperature must be entered. When the entry is complete, the data is displayed in inverse video and the ENTER prompt appears.

- **4R** - The ENTER prompt is displayed after entry of wind and/or temperature. Selecting this prompt enters the information displayed in inverse video.

WIND AND TEMPERATURE MODEL BLENDING

The FMS wind and temperature model blends wind and temperature entries with the current position sensed wind and temperature. The sensed wind and temperature are blended in proportion to the distance away from the aircraft. For example, at present position, sensed wind and temperature are blended at 100%. At 350 NM, sensed wind and temperature are blended 50% and entered at 50%. At 700 NM, the blend is 20% sensed and 80% entered.

WIND AND TEMPERATURE MODEL ENTRIES

When viewing the WIND/TEMP page, the blended wind and temperature are displayed. Because of this blending, the page does not necessarily reflect the exact pilot entry. The following describes the effect of each type entry on the wind and temperature used by the FMS:

- **No Entry** - If wind or temperature are not entered on any page, a wind of zero and International Standard Atmosphere (ISA) temperature is assumed for each waypoint at every altitude. Performance planning is based on zero wind and ISA temperature plus the blended sensed wind and temperature as previously described.

- **Average Entry Only** - If an average wind and/or temperature (ISA DEV) is entered on the PERF INIT 4/5 page, it applies to every waypoint in the flight plan. The wind is ramped down from the entered altitude to produce a lower wind at lower altitudes. At altitudes above the tropopause, the wind is assumed to be constant.

- **Entry at Waypoint** - Wind and temperature can also be entered at each waypoint on the WIND/TEMP page. When an entry is made at an individual waypoint, it erases any previous entry. The entry is applied to each waypoint forward in the flight plan until a waypoint with another entry is encountered. This permits long flight plans to be subdivided into segments for the purpose of making wind/temperature entries. After an entry has been made, the 4L prompt CLEAR is displayed. This prompt serves as a reminder of where entries have been made. It also clears those entries.

RECOMMENDED ENTRIES

If the wind and temperature are forecast to be fairly constant over the route of flight, an average wind and temperature (ISA DEV) entered on the PERFORMANCE INIT 4/5 page is sufficient. If the flight is short, this is typically a good approximation. The ISA DEV entry should be left at zero if no forecast is available. The temperature variation at high altitudes are usually small and do not impact planning as much as wind variations.

If the wind and temperature are predicted to be significantly different at various flight plan waypoints, waypoint entries should be made. This can be done after an average entry is made or in place of average entries. Waypoint entries are applied forward, so a few representative entries can be made for segments of any length.

For long flight plans, it is recommended to enter the best estimate of the average cruise wind. For shorter flight plans, entered wind matters for preflight. Once in cruise, the sensed wind takes precedence (refer to Wind and Temperature Model Blending, page 5-35).

WIND AND TEMPERATURE AND PERFORMANCE PLANNING

Temperature and especially the wind can play a significant role in performance planning. The wind can account for as much as one-third of the groundspeed. If flying a fixed Mach number, the true airspeed is roughly 5% higher if the temperature is increased by 20° C. The increased temperature also affects the fuel flow, the max attainable altitude, etc. Therefore, the closer the entered winds and temperatures are to the actual encountered conditions, the better the FMS performance predictions.

TAKEOFF

- **TAKEOFF 1/3 -** The page, shown in figure 5-25, displays data base information about the departure runway (if one has been selected). The only computed data is shown on the TAKEOFF 2/3 page.

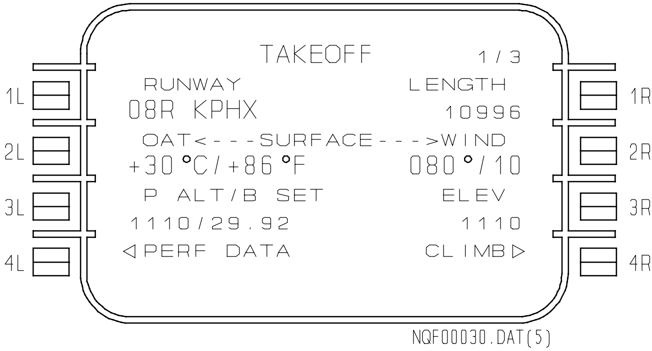


Figure 5-25

- **1L -** The selected runway identifier is displayed. If no runway has been selected on the DEPARTURE pages, the field displays dashes. Entries are allowed and can be made using the two-digit identification (e.g., 29 meaning 290°). Entries in degrees require a three digit input. The runway heading is used to resolve the wind into head/tail and crosswind components.

- **1R -** The length of the runway is displayed. If no runway has been selected, entry prompts are displayed. An entry can be made, but it is not used for any computation.

- **2L -** The outside air temperature is displayed in this field. An entry can be made in degrees celsius. Entries in degrees fahrenheit require a leading "/". The temperature is used to compute density altitude.

- **2R -** The surface wind can be entered here. The wind entry is used to compute the head/tail and crosswind components.

- **3L & 3R -** The pressure altitude, barometric (BARO) setting, and the BARO altitude from the air data computer (ADC) are displayed here. Entry of BARO setting is permitted and can be made in inches or millibars. Use *DELETE* to return to the previous units. When a runway has been selected, the pressure altitude is computed based on the field elevation and the ADC baro setting. The pressure altitude is used for the density altitude computation. Entries can be made, but they only impact the density altitude.

• **TAKEOFF 2/3** - The page, shown in figure 5-26, displays the calculated data from the information on the TAKEOFF 1/1 page. No entries are made on this page.

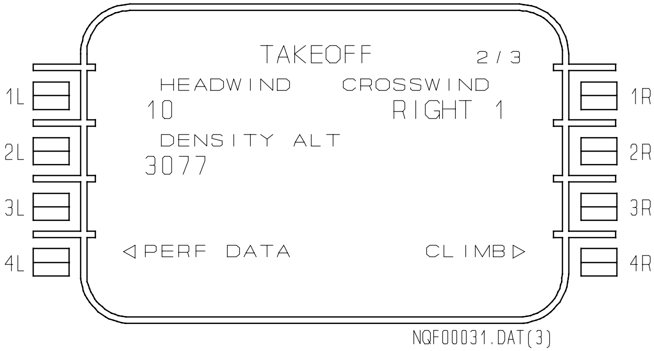


Figure 5-26

- **1L & 1R** - Head/tailwind and crosswind resolved by the runway heading and the surface wind entry are displayed.

- **2L -** Density altitude computed from the pressure altitude and the surface temperature is displayed.

- **TAKEOFF 3/3** - The page, shown in figure 5-27, is used to enter takeoff speeds. There are no computed V-speeds available.

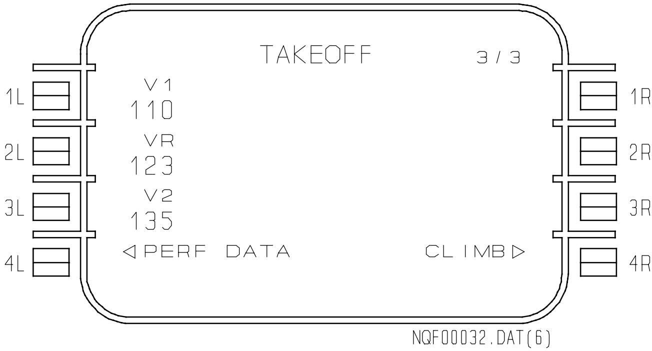


Figure 5-27

This page is only displayed if takeoff VSPEEDS have been configured. Takeoff VSPEED LABELS can be configured manually on the T.O. VSPEEDS LABELS page. It can be automatically configured by loading an aircraft data base that has the aircraft specific takeoff VSPEED LABEL defined in it. Access to the T.O. VSPEEDS LABELS page is from the VSPD LABELS prompt on the FMS SETUP page (refer to VSPEED LABELS on page 6-142). Labels for up to 6 V-speeds can be configured.

NOTE: The VSPEEDS LABELS page is automatically configured to the aircraft type defaults when the aircraft data base is loaded.

These speeds are displayed on the electronic flight instrument system (EFIS) for some, but not all, aircraft types.

- **1L through 3R** - Enter each V-speed on the appropriate line. The entered speeds are canceled when the aircraft is 1500 feet AGL and more than 10 knots above the highest VSPEED.

CLIMB

The climb page is available only if the FULL PERF mode is used. The performance initialization must be completed before data is displayed. Some items are for display only, but a speed schedule and TOC altitude can be entered.

- **CLIMB 1/1** - The page, shown in figure 5-28, displays the following data.

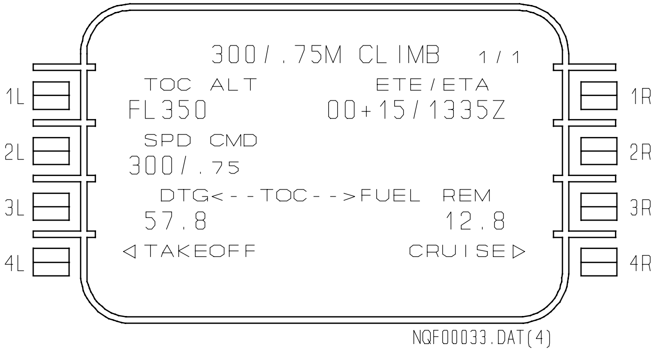


Figure 5-28

- **1L -** Top of climb altitude (TOC ALT) is displayed here. It is the same altitude as the cruise altitude on the PERF DATA 1/4 page. An entry is allowed in FL or in feet. An entry changes the cruise altitude displayed on all perf pages. Entering *DELETE* initiates a re-computation of the optimum altitude.

- **1R -** The estimated time enroute (ETE) to TOC (on the ground) and the estimated time of arrival (ETA) (airborne or if ETD entered) at TOC are displayed. No entries are permitted.

- **2L -** The speed command displayed in this field is the current climb speed command in CAS/MACH. The controlling speed (CAS or MACH) is displayed in large characters and the other in small characters. The speed command can be less than the selected speed schedule (shown in the title). This is because of the speed/altitude limit or climb speed constraints.

A speed schedule can be entered on this page. Either CAS or MACH or both can be entered. If a speed is entered on this page, it changes and selects the manual speed schedule on the OR page of PERFORMANCE page 2. If only CAS or only MACH are entered, the manual speed retains the previous value for the unentered item. For example, if a CAS value is entered, the manual speed schedule is changed to the new CAS value and the previous MACH value. Both CAS and the corresponding MACH value are selected as the active climb speed schedule. Entering *DELETE* returns to the default speed schedule.

- **3L & 3R -** The distance to go (DTG) to TOC and the fuel remaining (FUEL REM) at TOC are displayed on this line. No entries are permitted.

CRUISE

The two CRUISE pages are available only if the FULL PERF mode is used. The performance initialization must be completed before data is displayed. Some items are for display only, but entries of speed schedule and cruise altitude can be entered.

The two CRUISE pages can be accessed through the PERF INDEX or from prompts on the CLIMB or DESCENT pages.

- **CRUISE 1/2 -** The page, shown in figure 5-29, has a title that reflects the CRUISE speed mode selected during PERF INIT. In this example, the speed mode is long range cruise.

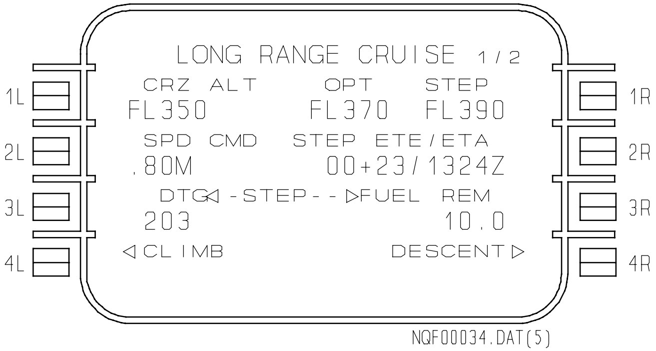


Figure 5-29

- **1L** - The cruise altitude is displayed here. It is the same altitude as the cruise altitude on the PERF DATA 1/4 page. Entries are made in FL or in feet. Entering *DELETE* initiates a re-computation of the optimum altitude.

- **1R** - The optimum altitude and step climb altitude are displayed here. No entries are permitted. The optimum altitude is the current optimum altitude depending on the current gross weight, temperature, and scheduled cruise speed. The current airspeed does not matter. This is because the optimum altitude definition changes with the speed mode. The step altitude is simply the cruise altitude plus the step increment.

- **2L** - The speed shown in this field is the current cruise speed command, either a CAS or a MACH. Only the controlling speed is shown even if the cruise speed mode is a CAS/MACH pair. CAS, MACH or both (separated by a "/") can be entered. Entering *DELETE* returns to the default speed schedule LRC. Changing the speed schedule on this page also changes the PERFORMANCE INIT 2/5 page. The MAX SPD and the MAX END cruise speed modes can only be selected from the PERFORMANCE INIT 2/5 page.

- **2R** - The ETE and ETA to the bottom of step climb (BOSC) point are displayed. No entries are permitted. Data only is displayed if the performance function is planning a step.

- **3L & 3R** - The distance to go (DTG) and the fuel remaining (FUEL REM) at the BOSC point are displayed. No entries are permitted. Data is only displayed when a step climb is planned.

Additional Detail about Step Climb

The data is only displayed if a step increment has been selected and the mission prediction is planning a step. For example, if the flight plan is short enough, no step climb may be computed even though a step increment has been entered. For long flight plans, multiple step climbs may be planned. Data for the next step is displayed on the CRUISE 1/2 page.

If the cruise altitude is not at or close to the optimum altitude, the distance to the step reflects the distance to TOC. This is because a step can be taken as soon as the TOC is reached.

When the cruise speed mode is MAX SPEED, the optimum altitude and the step information pertains to maximizing the true airspeed and not the range.

Recommended Use of Step Climbs

Step climbs are most useful when the pilot wants to optimize the range of the aircraft. Cruise speed modes of LRC or a manual speed schedule are most applicable for optimizing range. Cruise speed modes of MAX SPD or MAX END are used to maximize speed or time. The step climb calculation always calculates the optimum altitude for the chosen cruise speed mode.

It is not uncommon for the first step climb to be immediately available when initial cruise altitude is reached. If this is the case, the distance to bottom of step climb is the same as the distance to TOC. It is displayed as PAST if a level off is made at the initial cruise altitude.

VNAV and Step Climbs

When the aircraft approaches the BOSC point, the FMS issues the vertical track alert. The alert reminds the pilot to set the altitude selector to a higher altitude (if cleared by ATC). This allows VNAV to automatically initiate the climb. If the aircraft is past the BOSC, the pilot must initiate the climb by dialing up the altitude selector and pushing the flight level change button.

NOTE: Alerts are not issued for aircraft with advisory VNAV.

- **CRUISE 2/2 -** The page, shown in figure 5-30, shows range and TOD information. No entries are permitted.

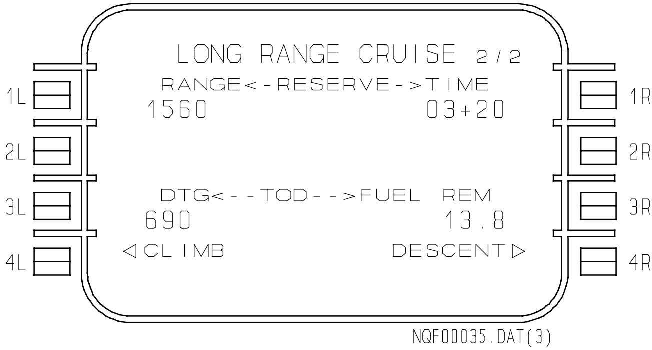


Figure 5-30

- **1L & 1R -** This line shows the range in nautical miles where the fuel remaining equals the reserve fuel. The corresponding time to reserve fuel is also given. The predictions are based on flying the active flight plan to the destination at the given cruise speed schedule. Assuming the range to reserve goes beyond the destination, the predictions after the destination are made at the cruise altitude but with zero winds.

- **3L & 3R -** These two lines display the distance to TOD and predicted fuel remaining at TOD.

DESCENT

The descent page is available only if the FULL PERF mode is used. The performance initialization must be completed before data is displayed. Some items are for display only, but speed schedule and descent angle can be entered.

- **DESCENT 1/1 -** The page, shown in figure 5-31, has a title line that reflects the selected descent speed schedule.

  - **1L -** Bottom of descent altitude (BOD ALT) is displayed. The BOD altitude is the destination elevation if there are no altitude constraints in the descent. If there are one or more descent altitude constraints, the active BOD constraint is always displayed.

  - **1R -** The time to BOD (ETE) and when airborne, the time of arrival (ETA) at BOD, are displayed. No entries are permitted.

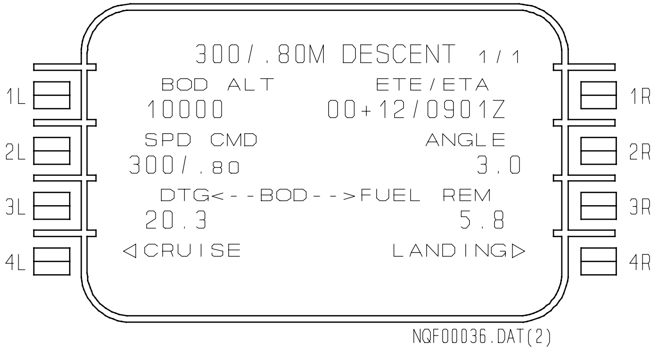


Figure 5-31

- **2L -** The speed command displayed in this field is the current descent speed command in CAS/MACH. The controlling speed (CAS or MACH) is displayed in large characters and the other in small characters. The speed command may be less than the selected speed schedule (shown in the title). This is because of the speed/altitude limit or descent speed constraints.

  A speed schedule can be entered on this page. Either CAS or MACH or both can be entered. If a speed is entered on this page, it changes and selects the manual speed schedule on the OR page of the PERFORMANCE 2 page. If only CAS or MACH are entered, the manual speed retains the previous value for the unentered item. For example, if a CAS value is entered, the manual speed schedule is changed to the new CAS value and the previous MACH value. Both CAS and the corresponding MACH value are selected as the active descent speed schedule. Entering *DELETE* returns to the default speed schedule.

- **2R -** The default descent angle is displayed here. Entries change the PERFORMANCE INIT 2/5 page. In VFLCH, the TOD is set using this angle. However, the angle (rate) of descent is controlled by the thrust setting. In VPATH, this is the angle used for VNAV to control.

- **3L & 3R -** The distance to go (DTG) to BOD and the fuel remaining at BOD are displayed on this line. No entries are permitted. If no altitude constraint has been entered for the descent, the BOD coincides with the destination.

- **4R -** Within 200 NM of the destination, the ARRIVAL prompt is shown on the DESCENT (and FLIGHT PLAN) page. Once an arrival runway is selected, the LANDING prompt is displayed.

Additional Details about Default Descent Angle

The default descent angle is used to place the TOD. If there are no altitude constraints in the descent, the destination elevation is the reference point. The descent angles can also be entered individually at any altitude constraints or they are supplied as part of an arrival or an approach. In that case, the TOD is based on the active BOD and the entered angle. The descent angle displayed on this page is always the default descent angle from PERF INIT. It could, therefore, differ from the angle flown on any individual path.

LANDING

- **LANDING 1/3 -** The page, shown in figure 5-32, displays data base information about the arrival runway if one has been selected.

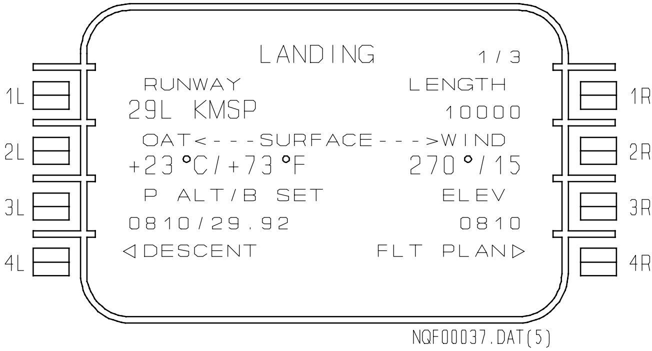


Figure 5-32

- **1L -** The selected runway identifier is displayed. If no runway has been selected on the ARRIVAL pages, the field displays dashes. Entries can be made using the two-digit identification (e.g., 29 meaning 290°). Entries in degrees require a three digit input. The runway heading is used to resolve the wind into head/tail and crosswind components.

- **1R -** The length of the runway is displayed. If no runway has been selected, entry prompts are displayed. An entry can be made, but it is not used for any computation.

- **2L -** Entry prompts are displayed in this field. An entry can be made in degrees celsius. Entries in degrees fahrenheit require a leading "/". The temperature is used to compute density altitude.

- **2R -** The surface wind can be entered. The wind entry is used to compute the head/tailwind and crosswind components.

- **3L & 3R -** Entry prompts are displayed. When an arrival runway has been selected, the field elevation and the ADC BARO setting are used to compute the pressure altitude. Entry of BARO setting is permitted and can be made in inches or millibars. Use *DELETE* to return to the previous units. The density altitude is computed from the pressure altitude and the temperature on this page.

• **LANDING 2/3 -** The page, shown in figure 5-33, displays the only calculated data from the information on the LANDING 1/1 page.

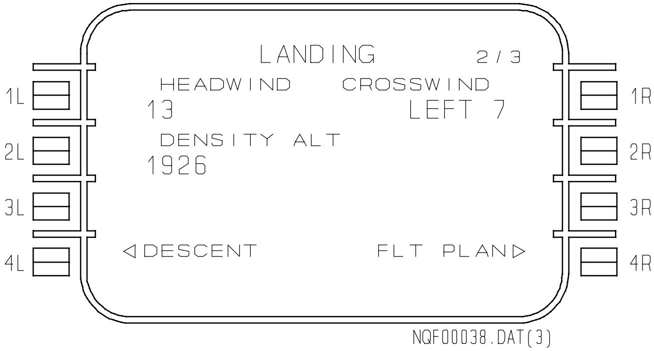


Figure 5-33

- **1L & 1R -** Head/tailwind and crosswind resolved by the runway heading and the surface wind entries are displayed.

- **2L -** Density altitude computed from the pressure altitude and the surface temperature is displayed.

  No entries are permitted on this page.

- **LANDING 3/3 -** The page, shown in figure 5-34, is used to enter landing speeds. There are no computed V-speeds available.

  This page is only displayed if landing VSPEEDS have been configured. Landing VSPEED LABELS can be configured manually on the T.O. VSPEEDS LABELS page. It can be automatically configured by loading an aircraft data base that has the aircraft specific landing VSPEED LABEL defined in it. The LDG VSPEED LABELS page is accessed from the VSPD LABELS prompt on the FMS SETUP page (refer to VSPEED LABELS on page 6-142). The labels for all the V speeds can be customized and up to 6 speeds selected. Figure 5-34 illustrates V speed labels based on flap settings.

  Landing speeds can be entered anytime and are canceled upon landing. These speeds are displayed on the EFIS for some aircraft types.

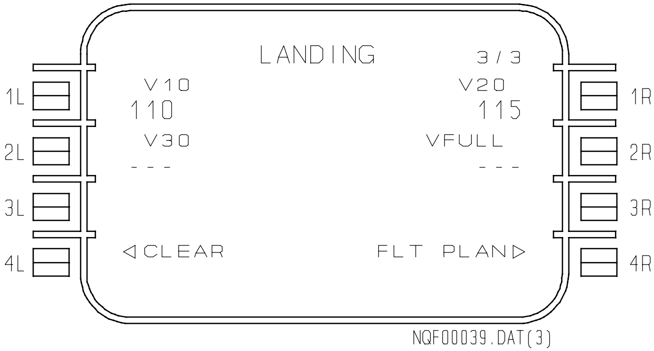


Figure 5-34

  - **1L through 3R** - Enter each V-speed on the appropriate line.

WHAT-IF INITIALIZATION

The what-if function is only available in the FULL PERF mode. The pilot can use this function to evaluate changes before activating them. The what-if function uses the active flight plan. Therefore, only the effect of performance parameters can be evaluated.

For example, an altitude change can be checked before requesting air traffic control (ATC) approval. If, after evaluation, the pilot wants to make the change, the what-if performance initialization can be activated.

The four WHAT-IF INIT pages are initialized in the same manner as the PERFORMANCE INIT pages 2 through 5. However, some specific rules apply. WHAT-IF INIT 1/4 page is shown in figure 5-35.

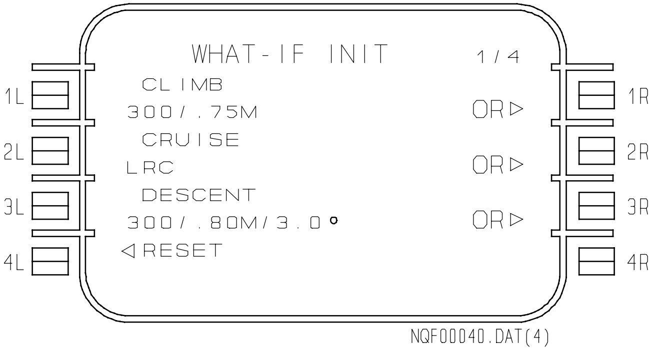


Figure 5-35

Rules for the What-If Initialization

- All entry parameters default to the selections made on the PERFORMANCE INIT page and are displayed in small characters.

- If an entry is made, it is displayed in large characters. This differentiates between WHAT-IF INIT values and the active PERFORMANCE INIT values.

- Entering *DELETE* returns an entry back to the active PERFORMANCE INIT value.

- Optimum cruise altitude can only be selected by typing in "OPT" or "OPTIMUM". Entering *DELETE* to the cruise altitude returns the active PERFORMANCE INIT cruise altitude.

- LRC and NBAA reserve can not be selected by entering *DELETE* as on the active PERFORMANCE INIT. These modes must be line-selected on the WHAT-IF INIT pages.

- When all required changes to WHAT-IF INIT have been made, the CONFIRM INIT prompt on page 4 must be selected to begin calculations. This is shown in figure 5-36.

- Once the what-if data has been computed, all initialization parameters are displayed in large characters. At that point the what-if initialization no longer tracks changes made to the active initialization.

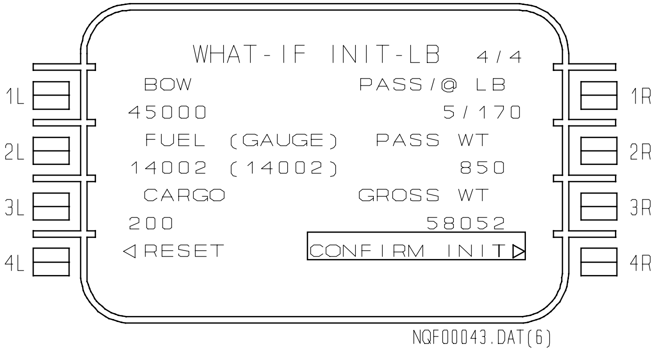


Figure 5-36

Resetting the What-If Initialization

The RESET prompt at 4L on all WHAT-IF INIT pages displays a page for reset of the WHAT-IF INIT pages, as shown in figure 5-37. If YES is selected, any changes made in WHAT-IF INIT are canceled. All of the WHAT-IF INIT values are reset to match the PERFORMANCE INIT values. If NO is selected, the display changes back to WHAT-IF INIT values with no change.

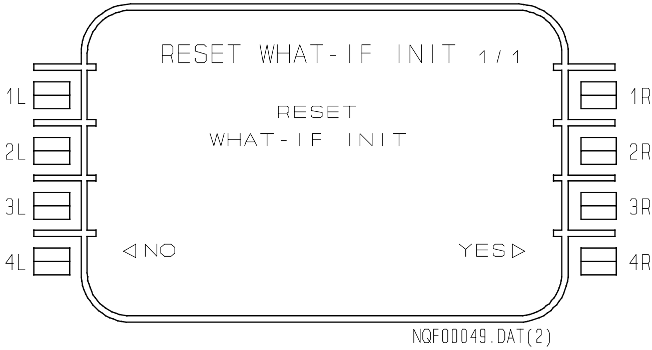


Figure 5-37

WHAT-IF DATA

There are three WHAT-IF DATA pages. The first is similar to the PERF DATA 1/4 page. The other two are similar to the two CRUISE pages. On all three pages, the WHAT-IF SEL prompt at 4R displays a page that is used to select the WHAT-IF conditions to the active PERFORMANCE INIT, as shown in figure 5-41. The 4L prompt accesses back to the WHAT-IF INIT values.

- **WHAT-IF DATA 1/3 -** The page, shown in figure 5-38, displays the cruise and ceiling altitude and step increment for the WHAT-IF conditions. The next three lines are a comparison between the active and the what-if performance predictions.

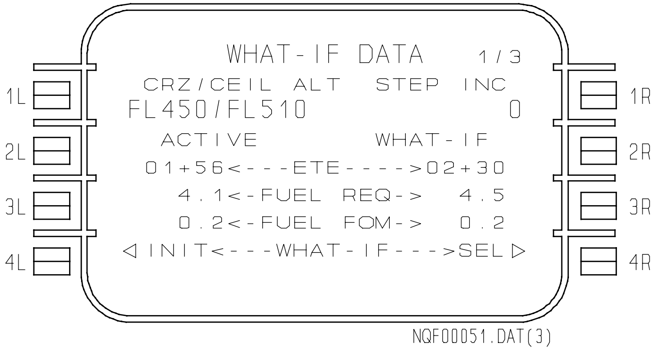


Figure 5-38

- **1L & 1R** - A change to the WHAT-IF cruise altitude and step increment can be entered on this page. Entering *DELETE* resets the cruise altitude or the step increment back to the active PERFORMANCE INIT. Optimum can only be selected on the WHAT-IF INIT 3/4 page. If optimum is selected, the calculated cruise altitude is affected by the distance to the active flight plan TOD. If far away from the TOD, the calculated cruise altitude tends to be at or close to the ceiling altitude. If close to the TOD, the calculated cruise altitude tends to be at or close to the current aircraft altitude.

- **Lines 2 & 3** - Time and fuel required, the fuel figure of merit (FOM) to the destination for the current performance initialization settings, and the what-if settings are displayed for comparison. No entries are permitted.

• **WHAT-IF DATA 2/3** - The page, shown in figure 5-39, displays the same data as the CRUISE 1/2 page. However, the data applies to the what-if initialization only.

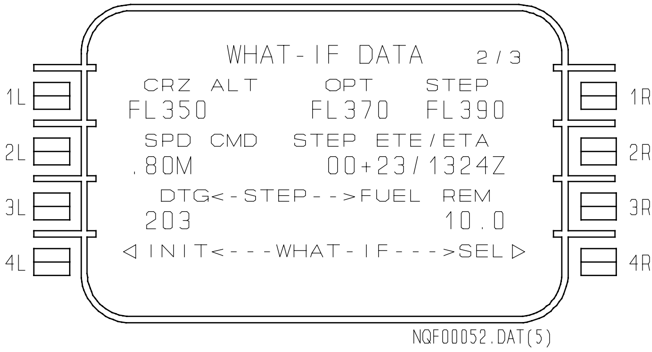


Figure 5-39

- **1L** - The what-if cruise altitude is displayed and can be entered. Entering *DELETE* returns to the active PERFORMANCE INIT cruise altitude. Optimum can only be selected on the WHAT-IF INIT 3/4 page.

- **1R** - This line displays the current optimum altitude for the what-if cruise speed mode. The step altitude is also displayed if a what-if step increment has been selected. A step climb is not planned when the aircraft can complete the step climb before reaching the TOD.

- **2L -** The what-if cruise speed is displayed and can be entered. Entering *DELETE* returns to the active PERFORMANCE INIT cruise speed. LRC can only be selected on the WHAT-IF INIT pages.

- **2R, 3L & 3R -** These fields display the step climb data if a what-if step increment has been selected.

• **WHAT-IF DATA 3/3 -** The page, shown in figure 5-40, displays the same data as the CRUISE 2/2 page. However, the data applies to the what-if initialization only. No entries are permitted on this page.

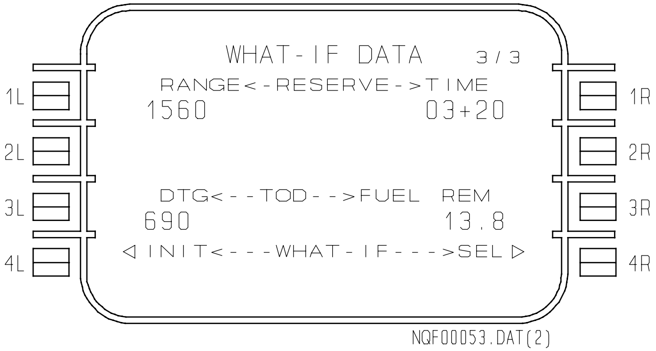


Figure 5-40

• **WHAT-IF SELECT 1/1 -** The page, shown in figure 5-41, has the option to activate the what-if initialization. If YES is selected, the PERFORMANCE INIT is set equal to the WHAT-IF INIT. Subsequently, the PERF DATA is recomputed. If NO is selected, the display returns to the WHAT-IF DATA with no changes made.

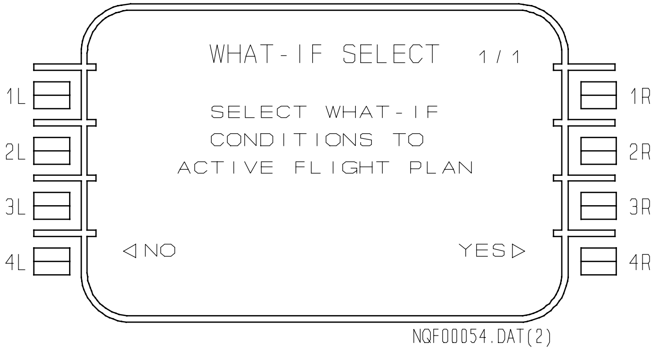


Figure 5-41

STORED FLIGHT PLAN INITIALIZATION

The stored flight plan function is only available in the FULL PERF mode. This function is used to calculate performance data for a stored flight plan. This may be done to look at the next flight in order to load the proper amount of fuel on board and estimate the flying time. The information entered in the STORED FPL INIT is deleted from the FMS when power is removed.

- **STORED FPL INIT 1/5 -** The page, shown in figure 5-42, gives access to either the FPL LIST page (4L) or the FPL SELECT (4R) page. Follow procedure 5-1 to retrieve a stored flight plan.

Figure 5-42

Step	Procedure 5-1 Retrieve a Stored Flight Plan for Performance Calculations
1	Select FPL LIST at 4L, as shown in figure 5-42.
2	Line-select the desired flight plan from the FLIGHT PLAN LIST x/x pages. This moves the flight plan name down to the scratchpad. In this example, the KPHX-KDAL1 flight plan is selected.
3	Select the FPL SEL prompt at 4R of the FLIGHT PLAN LIST x/x page. The FLT PLAN SELECT page is displayed.
4	Line-select 1L (FLT PLAN) on the FLT PLAN SELECT page. This step enters the flight plan name from the scratchpad.
5	Select the STORED FPL PERF prompt (3R), as shown in figure 5-43.  **Figure 5-43**
6	STORED FPL INIT 2/5 is displayed where initialization can begin. By selecting the PREV key, it can be confirmed that the stored flight plan was selected.

- **STORED FPL INIT pages 2/5 through 5/5** - The initialization is similar to the main performance initialization on PERFORMANCE INIT pages 2/5 through 5/5. The same rules that apply to the what-if initialization also apply here. The main rule is that the defaults are the active initialization parameters which are displayed in small characters. Some exceptions apply, however, and are listed below.

RULES FOR THE STORED FLIGHT PLAN INITIALIZATION

The initialization rules are the same as for the what-if initialization with the following exceptions:

- The cruise altitude defaults to OPTIMUM regardless of the active performance init. This is because the active cruise altitude may not be the best for a stored flight plan. For example, the stored flight plan may be a short leg that requires a low cruise altitude while the current flight may be flown at a high altitude and visa versa.

- The takeoff fuel allowance is set to the general default. While in flight, the active and the what-if init both have zero fuel for the takeoff allowance.

- The fuel must always be entered. This is required for computing a gross weight. Since fuel is not known at this time, a rough estimate is sufficient. When the fuel required is computed, that fuel weight can be re-entered to refine the estimate if it is significantly different from the entered fuel.

  When all required entries are made, the CONFIRM INIT prompt is displayed as 4R. The CONFIRM INIT prompt must be pushed to start the calculation.

STORED FLIGHT PLAN (FPL) DATA

- **FPL DATA 1/1 -** The page, shown in figure 5-44, shows the stored flight data available. The title contains the name of the flight plan being calculated. The page is similar to the PERF DATA 1/4 page.

  - **1L -** The cruise altitude chosen on the initialization pages or the computed optimum cruise altitude is displayed. The cruise altitude can be entered directly on this page. Entering *DELETE* reselects and recomputes the optimum cruise altitude.

  - **1R -** The step increment chosen is displayed. A new entry can be made.

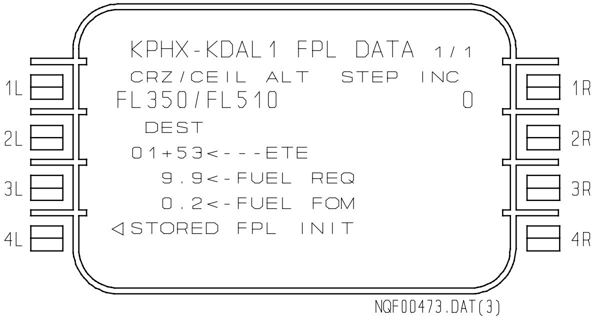


Figure 5-44

- **2L & 3L** - The ETE, the total fuel requirement, and the fuel FOM are displayed for the stored flight plan. The fuel required includes the takeoff allowance, the enroute fuel, the fuel reserve, and the landing allowance.

FUEL MANAGEMENT

- **FUEL MGT 1/2** - The page, shown in figure 5-45, shows the current fuel quantity, fuel flow, ground speed, true airspeed, ground specific range and air specific range.

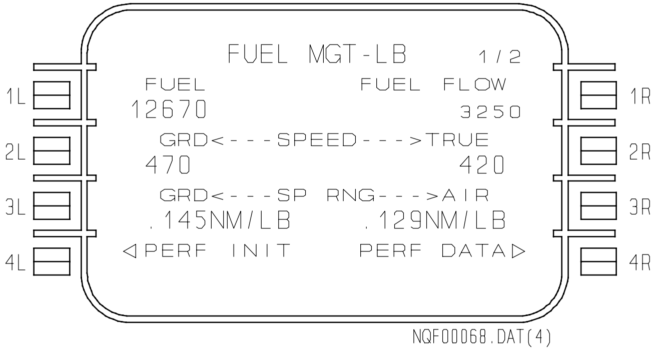


Figure 5-45

- **1L -** The current fuel weight calculated by the FMS is displayed in large characters. It is the same value as the fuel weight on the PERFORMANCE INIT 5/5 (or 4/4). If the performance initialization has not been completed, dashes are displayed. An entry can be made to change the PERFORMANCE INIT 5/5 page. Entering *DELETE* displays dashes. This deinitializes the performance function, and if engaged, causes VNAV to drop.

- **1R -** The sensed fuel flow is displayed in small characters when received by the FMS. Pilot entries can be made and are displayed in large characters. Entering *DELETE* returns the display to the sensed fuel flow if one is available.

  Additional Explanation of Fuel Quantity and Fuel Flow

  The current fuel weight (or fuel quantity) is a computed value and is not based on a gauge input. The fuel weight is decremented by the displayed fuel flow after it has first been initialized. Entering a manual fuel flow can cause significant differences between the FMS fuel quantity and the actual fuel quantity to develop. For this reason, it is recommended that no entry of fuel flow be made unless the sensed fuel flow is not available.

  NOTE: Entry of a fuel flow here is <u>not</u> the same as entry on PERF INIT 2/5 for pilot entered GS/FF mode.

- **2L & 2R -** The current groundspeed and airspeed are displayed on this line. No entries are permitted.

- **3L & 3R** - The ground specific range and the air specific range are displayed on this line. No entries are permitted. The specific ranges are based on the speeds above as well as the fuel flow at 1R.

• **FUEL MGT 2/2** - The page, shown in figure 5-46, shows the individual and total engine fuel flow including APU and fuel used.

The individual engine breakdown of the total fuel flow on the FUEL MGT 1/2 page is shown at this page. The fuel used display is normally the cumulative from the last powerup on the ground. The total fuel used is the same as what is displayed at 2L on the FLIGHT SUMMARY page which can be reset (refer to page 6-161). Resetting fuel used on the FLIGHT SUMMARY page also resets individual engine fuel used on this page.

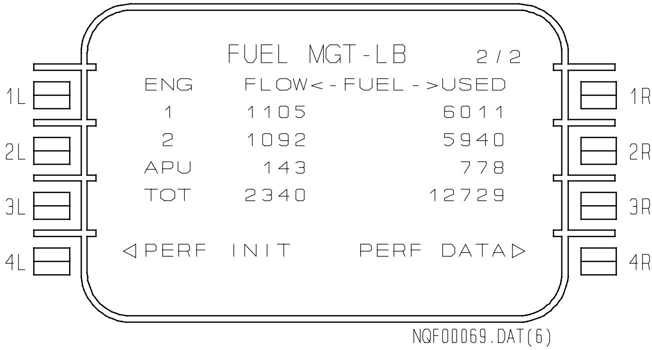


Figure 5-46

SINGLE ENGINE

Once performance is initialized, the page, shown in figure 5-47, displays performance information assuming single engine operations. Access to the CRUISE page is provided at 4L.

In the event of actual single engine operation, the FMS calculates all performance information based on single engine. The titles of pages displaying performance data are changed to indicate single engine operations.

NOTE: This page is not available on all aircraft.

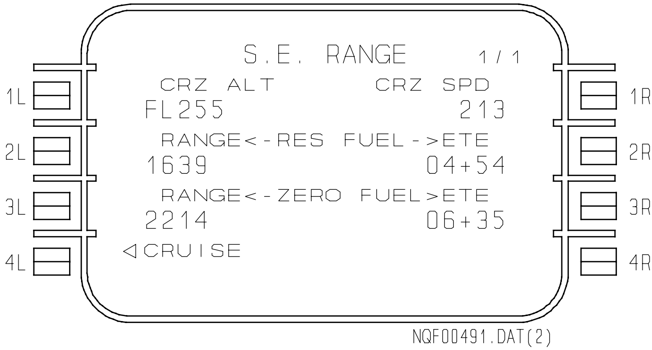


Figure 5-47

AIRCRAFT DATA BASE

The aircraft data base includes information specific to the aircraft type and learned information specific to the tail number. An aircraft data base for each aircraft type is furnished by Honeywell. It is available on the last of the regular navigation data base disks received each month. The aircraft data base must be loaded in order to have the FULL PERF option available.

The aircraft data base can be downloaded from the aircraft using the data loader. This downloaded file is identified by tail number and contains the learned information. It is recommended that the aircraft data base be downloaded periodically. The downloaded file can be used to upload when needed (i.e., when replacing the FMS). Uploading this saved file preserves the learned information so the system will not have to start over again.

Refer to page 6-156 for steps to uploading and downloading aircraft data bases. Aircraft data bases cannot be cross loaded from one FMS to another.

6. Navigation

NAVIGATION (NAV) INDEX

The NAV INDEX pages are accessed through the NAV function key on the control display unit (CDU), as shown in figure 6-1.

AD-39803z

NAV Index Access
Figure 6-1

When the NAV button is pushed, NAV INDEX 1/2 page, shown in figure 6-2, is displayed. Page 2/2, shown in figure 6-3, is displayed by using either the PREV or NEXT paging keys. These displays show navigation functions that can be selected at any time. Push the line select key adjacent to the respective function to select the function. Page numbers adjacent to each button correspond with page numbers in this manual that describe the button function.

The prompt at 2R on page 1/2, shown in figure 6-2, is one of the following: AFIS INDEX (if installed), ACARS (refer to page 6-35) (if installed), or DATA BASE, as shown in figure 6-4 (if AFIS or ACARS are not installed).

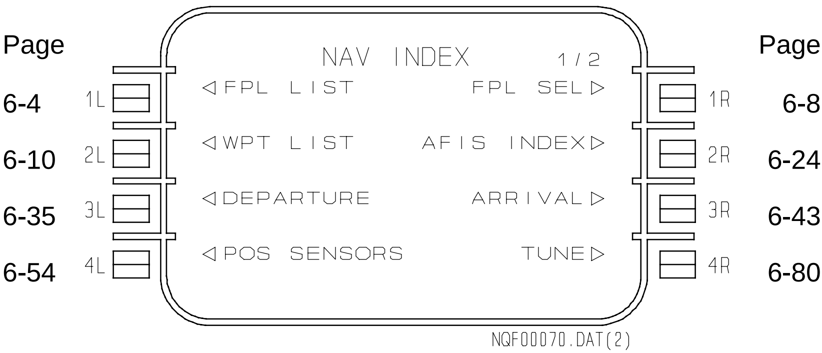


Figure 6-2

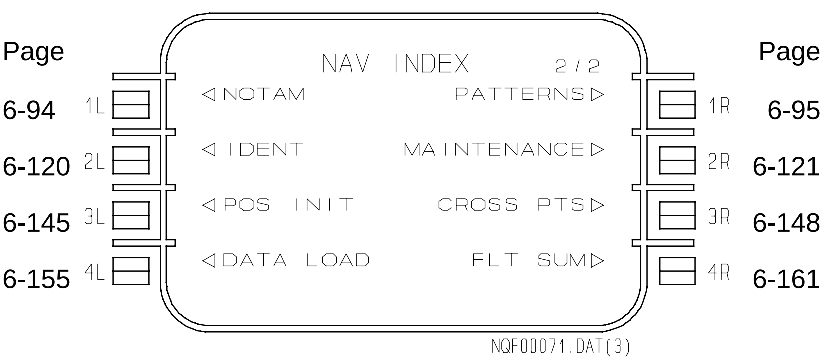


Figure 6-3

Optional Navigation Index Selections

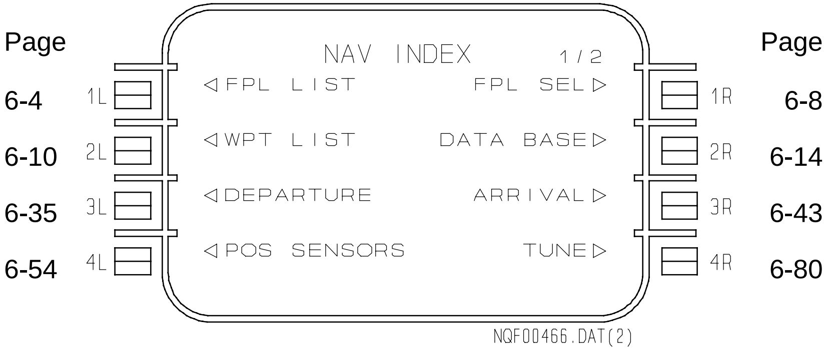


Figure 6-4

On aircraft with the Honeywell FMS installed with a Collins system, there is a third NAV INDEX page used to select options for EFIS displays, as shown in figure 6-5.

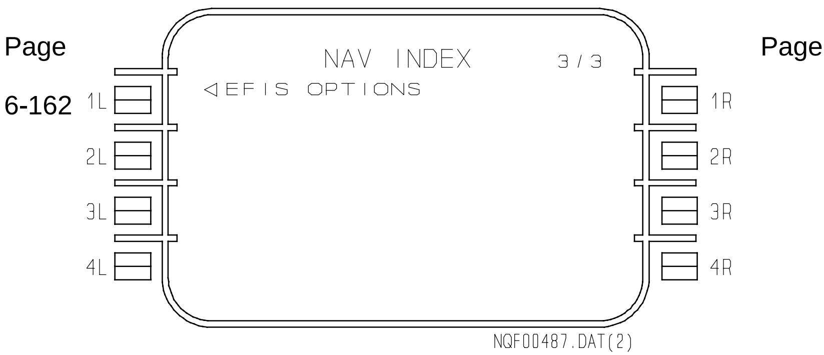


Figure 6-5

FLIGHT PLAN LIST

The FLIGHT PLAN LIST page displays a list of the pilot defined flight plans that have been stored in the FMS memory. From this page, the pilot can define a flight plan, delete a flight plan, or select a flight plan to activate.

When no flight plans are stored in the FMS, the FLIGHT PLAN LIST page, shown in figure 6-6, is blank.

Figure 6-6

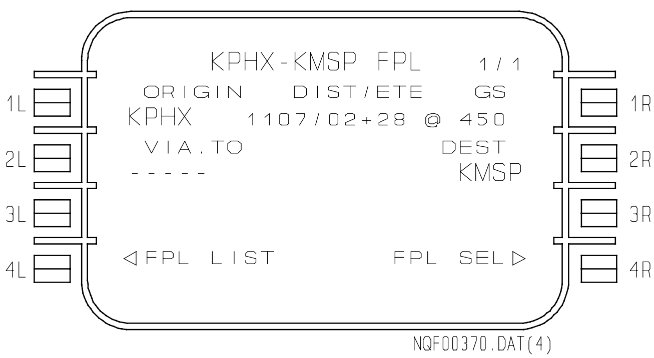
If flight plans have been defined, the page, shown in figure 6-7, lists the flight plans by name.

Figure 6-7

Defining Stored Flight Plans

Stored flight plans, like active flight plans, can be defined between any navaids, intersections or airports. A flight plan from Phoenix to Minneapolis is used to illustrate how to define a flight plan in procedure 6-1.

Step	Procedure 6-1 Defining a Stored Flight Plan
1	Select FPL LIST from the NAV INDEX.
2	Enter the flight plan name in the scratchpad. In this example, KPHX-KMSP is entered (refer to page 10-3 for flight plan name format).

Step	Procedure 6-1 Defining a Stored Flight Plan
3	Select SHOW FPL (1L), shown in figure 6-8.  **Figure 6-8**
4	The FMS places KPHX as the origin and KMSP as the destination, as shown in figure 6-9.  **Figure 6-9** If the flight plan name is specified as the origin and destination identifier separated by a dash (-), the FMS automatically fills in the origin and destination. A single alphanumeric character can be added following the destination identifier to distinguish multiple flight plans between the same origin and destination. If other formats for the flight plan name are used, the pilot can fill in the origin and destination.

Step	Procedure 6-1 Defining a Stored Flight Plan
5	Enter groundspeed at 1R if a speed other than the one shown is required. The FMS displays the distance and estimated time enroute (ETE) for a direct flight from Phoenix to Minneapolis. ETE is calculated based on the groundspeed (GSPD) at 1R. Distance and time are updated as waypoints and added to the flight plan. The defaulted groundspeed is 300 knots.
6	Enter the route for the flight plan at the VIA.TO prompt. The following cannot be used in stored flight plans: • Temporary waypoints. • Standard instruments departures (SIDs) or standard terminal arrival routes (STARs). • Alternate flight plan and destination. • Speed or angle constraints. • Another stored flight plan.
7	Stored flight plans can contain patterns. If SPECIAL MISSIONS, under FLIGHT CONFIG, is set to ON, a larger selection of patterns can be stored (refer to Flight Configuration on page 6-139).
8	Close the flight plan by entering the destination waypoint as the last waypoint in the flight plan. This can be done by line selecting the destination from the right side of the page and inserting it on the left side of the page.

Deleting Stored Flight Plans

The DEL key is used to remove stored flight plans from the FMS memory. Procedure 6-2 describes two methods for deleting a flight plan.

Step	Procedure 6-2 Deleting a Stored Flight Plan
1	Select FLP LIST from the NAV INDEX.
2	Push the DEL key (*DELETE* is displayed in the scratchpad). Push the line select key adjacent to the flight plan name to erase it from the FMS memory. **OR use step 3.**
3	Push the line select key adjacent to the desired flight plan name. Select SHOW FPL (1L). Delete the origin on the stored flight plan display page.

FLIGHT PLAN SELECT

- **FLT PLAN SELECT 1/1 -** The page, shown in figure 6-10, is used to select a stored flight to be the active flight plan. It can also calculate performance data of the stored flight plan. This page can be accessed from the FLIGHT PLAN LIST page (prompt at 4R) or from the NAV INDEX page.

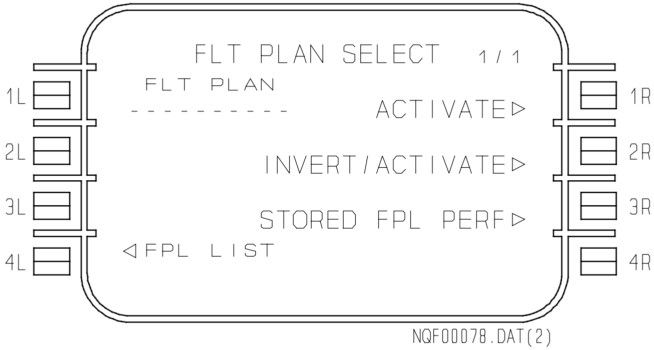


Figure 6-10

To select and activate a stored flight plan, follow procedure 6-3.

Step	Procedure 6-3 Select and Activate a Stored Flight Plan
1	Select FPL LIST from the NAV INDEX.
2	Select desired flight plan from the list by pushing the adjacent line select key. The name is displayed in the scratchpad.
3	Select FPL SEL at 4R.
4	Push the line select key adjacent to the FLT PLAN prompt (1L) to insert the flight plan name. As an alternative, the flight plan name can be entered directly from the key pad instead of being selected from the list. If a flight plan name is entered that has not been previously defined, the FMS displays pages that are used to enter an undefined flight plan.
5	Select ACTIVATE by pushing 1R, INVERT/ACTIVATE by pushing 2R, and 3R to select STORED FPL PERF, as shown in figure 6-11.  **Figure 6-11**

Step	Procedure 6-3 Select and Activate a Stored Flight Plan
6	If an active flight plan exists when one of the activate prompts is selected, the FMS requires a confirmation step, as shown in figure 6-12.  **Figure 6-12**

PILOT WAYPOINT LIST

- **PILOT WPT LIST 1/1** - The page, shown in figure 6-13, contains a list of pilot defined waypoints that are stored in memory and any temporary waypoints (refer to temporary waypoints, page 7-3). Procedure 6-4 is used to store pilot defined waypoints. Pilot defined waypoints can be defined using latitude/longitude (lat/lon), place/bearing/distance (PBD), or place/bearing/place/bearing (P/B/P/B) as described in the procedure.

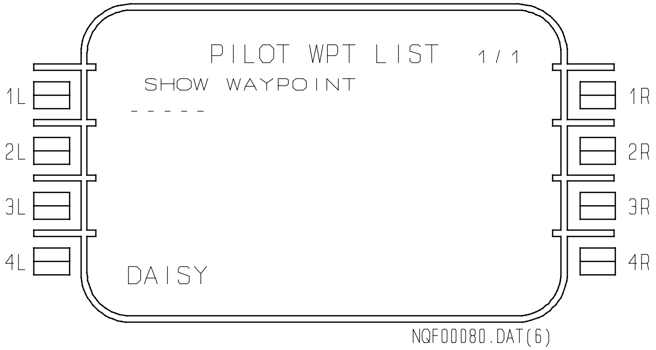
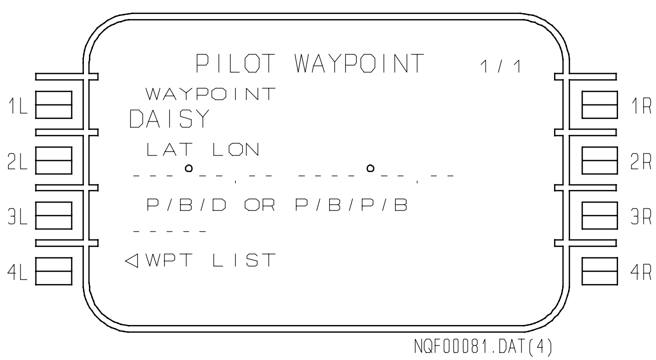
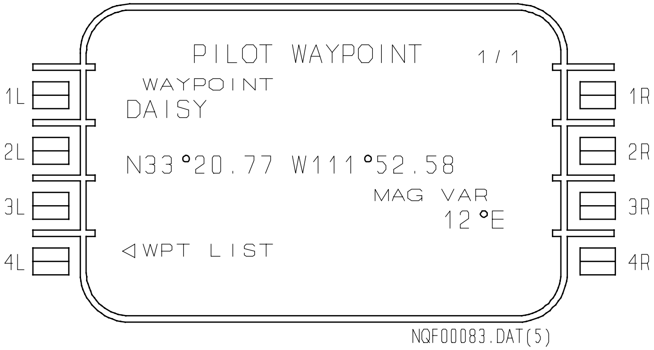
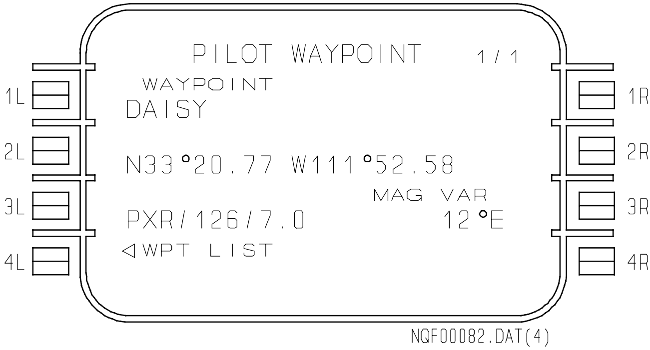
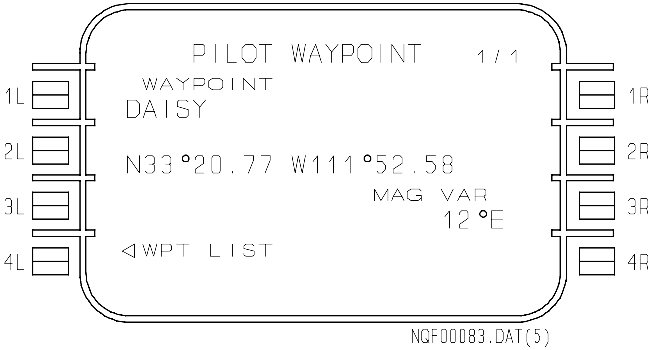


Figure 6-13

Step	Procedure 6-4 Defining and Storing Waypoints
1	Select WPT LIST from the NAV INDEX.
2	Enter an identifier of one to five characters and line select to the SHOW WAYPOINT line (1L). DAISY is used for this example.
3	The display changes to the definition display is shown in figure 6-14. Define DAISY by one of the following three ways: step 4 (lat/lon), 6 (PBD), or 8 (P/B/P/B).  **Figure 6-14**

Step	Procedure 6-4 Defining and Storing Waypoints
3 (cont)	If a previously used identifier is entered, the definition for the waypoint is displayed. This prevents the duplication of waypoint names. A page, similar to figure 6-14, is displayed if an undefined waypoint is entered on any page that accepts waypoint entries (except the POS INIT page). In this case, however, the RETURN prompt is displayed at 1R. The RETURN prompt can be used before or after a waypoint is defined. The RETURN prompt is used to return to the page where the undefined waypoint was entered. If the waypoint is not defined, the waypoint entry remains in the scratchpad. If the waypoint is defined, the waypoint entry is completed.
4	Enter Latitude/Longitude and select to 2L. N3320.77W11152.58 is used in this example.
5	The defined waypoint, shown in figure 6-15, is displayed.  **Figure 6-15**
6	**-OR-** Enter Place/Bearing/Distance and select to 3L. Use the example, PXR/126/7, where PXR defines place, 126 defines bearing in degrees, and 7 defines distance in nautical miles. Bearing inputs are assumed to be magnetic. True bearings are designated by placing the letter **T** after the bearing.

Step	Procedure 6-4 Defining and Storing Waypoints
7	The defined waypoint is displayed, as shown in figure 6-16.  **Figure 6-16**
8	**-OR-** Enter Place/Bearing/Place/Bearing and select to 3L. Use the example, PXR/130/TFD/358, where PXR defines a place, 130 is the radial from PXR in degrees, TFD defines a second place and 358 defines the radial from TFD in degrees. Bearing inputs are assumed to be magnetic. True bearings are designated by placing the letter **T** after the bearing.

Step	Procedure 6-4 Defining and Storing Waypoints
9	The defined waypoint, shown in figure 6-17, is displayed. When a waypoint is defined by P/B/P/B, only the coordinates are stored and displayed.  **Figure 6-17**

DATA BASE

The pilot can interrogate the NAV data base stored in the FMS by selecting DATA BASE from the NAV INDEX and using the DATA BASE function shown in figure 6-18. **If AFIS or ACARS is installed, the DATA BASE prompt is not displayed on the NAV INDEX. As is always the case, the data base functions described in this section can be executed from the pilot waypoint list (WPT LIST) page**.

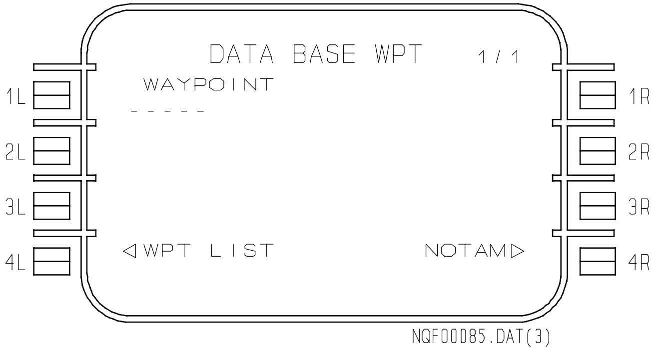


Figure 6-18

A waypoint identifier of the data base can be entered in the upper left line by entering the identifier in the scratchpad and line selecting to 1L. The following items can be displayed from the navigation data base:

- Airports
- Runways
- Navaids
- ILSs
- Intersections.

The waypoint list (WPT LIST) (4L) and NOTAM (4R) pages can be accessed using the prompts at the bottom of the DATA BASE WPT page.

Airports

Figures 6-19 and 6-20 display the following airport data:

- **Page 1/2**
  - Identifier (1L)
  - Waypoint Type (1R)
  - Airport Name (2L)
  - Country (3L)
  - Coordinate Position (3L).

Figure 6-19

- **Page 2/2**
  - Identifier (1L)
  - Field Elevation (2L)
  - Magnetic Variation (2R).

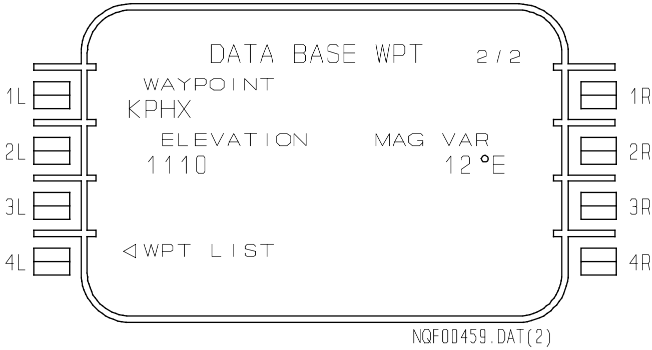


Figure 6-20

Runways

Figures 6-21 and 6-22 displays the following information for runways:

- **Page 1/2**
  - Runways Identifier (1L)
  - Waypoint Type (1R)
  - Airport Name and Country (2L)
  - Coordinate Position (3L).

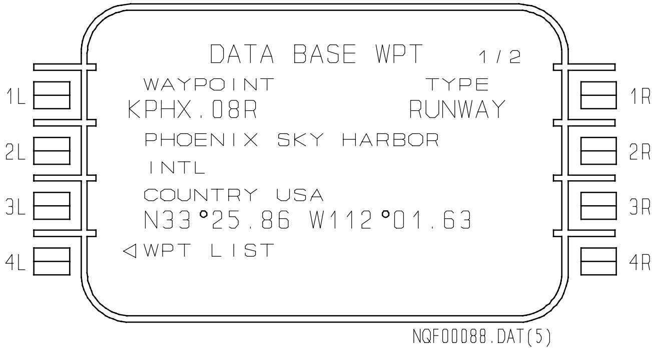


Figure 6-21

- **Page 2/2**
    - Identifier (1L)
    - Runway Heading and front or back course if the runway has an associated ILS (1R)
    - Elevation (2L)
    - Magnetic Variation (2R)
    - Length and Stopway (3L)
    - ILS Glideslope if applicable (3R).

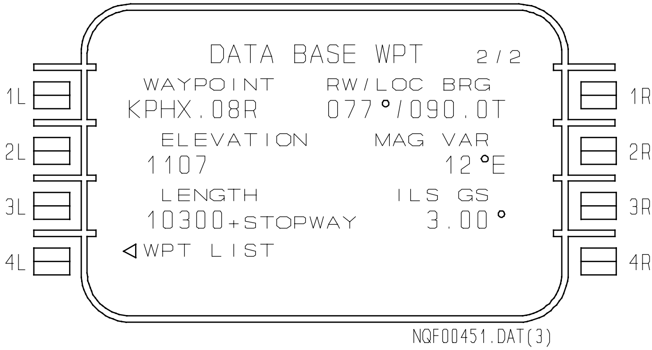


Figure 6-22

Navaids

Figure 6-23 displays the format used to display information about Navaids:

- Waypoint Identifier (1L)
- Country (1L)
- Frequency (1R)
- Type (2L)
  - DME (distance measuring equipment)
  - N DME (non co-located)
  - TACAN
  - N TACAN (non co-located)
  - VORTAC
  - VORDME
  - VOR
  - N VOR (non co-located)
- Class (2R)
  - HA (high altitude)
  - LA (low altitude)
  - T (terminal)
  - UR (unrestricted)
- Coordinate Position (2L)
- Elevation (3L)
- Magnetic Declination (3R).

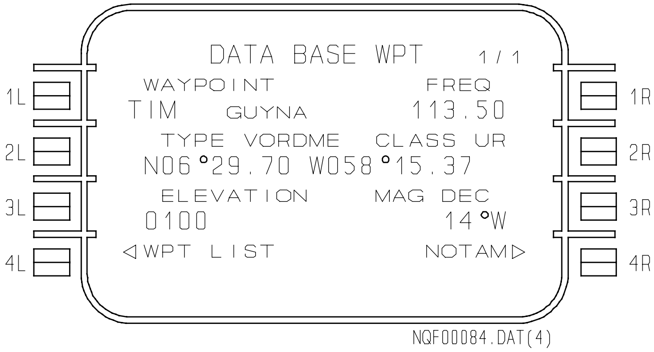


Figure 6-23

Magnetic declination is defined as the difference between the zero degree radial of the station and true north. For many navaids, this is not equal to the local magnetic variation due to the constantly changing earth magnetic field. If magnetic declination is not available, magnetic variation is displayed.

Figure 6-24 displays the DATA BASE WPT page for a nondirectional beacon. The letters **NB** are entered after the identifier.

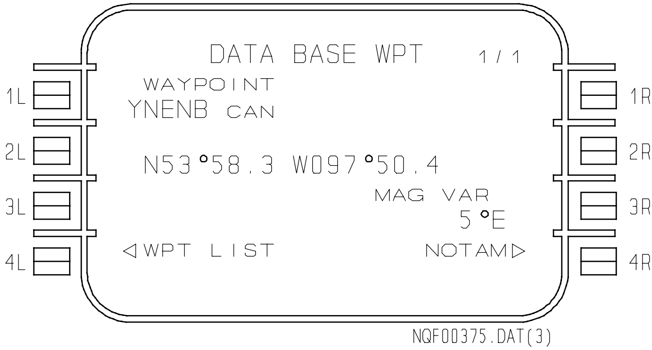


Figure 6-24

Instrument Landing Systems

- **DATA BASE WPT 1/1** - Figure 6-25 displays the following data for instrument landing systems:

  - ILS Identifier (1L)
  - Country (1L)
  - Front Course (1R)
  - Frequency (1R)
  - Type (2L):
    ILS
    LOC (localizer)
    LOCDME (localizer with DME)
    ILSDME (ILS with DME)
    MLS
  - Category (2R)
    I
    II
    III
  - Localizer Antenna Coordinates (2L)
  - Magnetic Declination (3R).

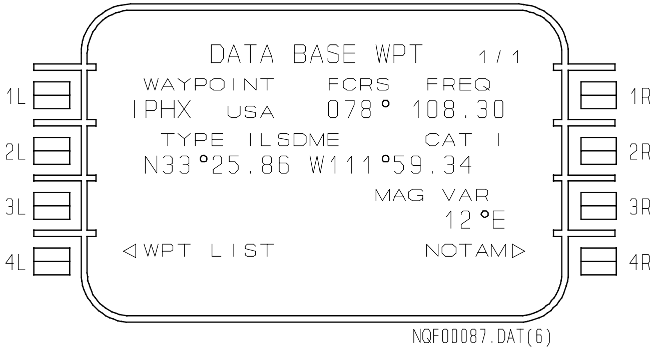


Figure 6-25

Intersections

- **DATA BASE WPT 1/1 -** Figure 6-26 displays the following data for intersections:

  - Intersection Identifier (1L)
  - Country (1L)
  - Intersection Coordinates (2L)
  - Magnetic Variation (3R)

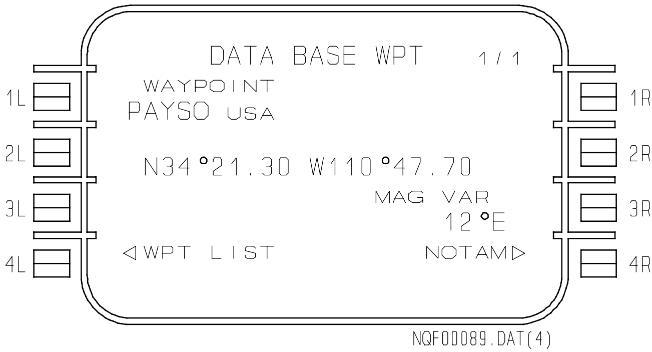


Figure 6-26

Multiple Waypoints

If a waypoint identifier is entered on any page and the FMS finds more than one definition for the identifier, the WAYPOINT SELECT page is displayed. The pilot must choose which definition to use. When inserting waypoints into a Flight Plan, the location closest to the previous waypoint is shown at the top of the page. For all other cases, the location closest to the aircraft position is shown at the top of the page.

For example, if Thermal California (TRM) is entered on the DATA BASE WPT page, the FMS displays all the TRM waypoints found on the WAYPOINT SELECT page, as shown in figure 6-27.

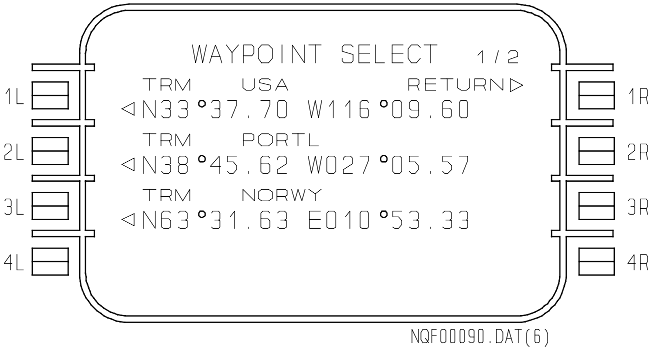


Figure 6-27

Push the line select key adjacent to the desired waypoint. If RETURN (1R) is pushed, no waypoint is selected.

Pilot Defined Waypoints

If a pilot defined waypoint is entered on the DATA BASE WPT page, the FMS switches to the PILOT WAYPOINT page and displays the waypoint as well as data about the waypoint.

Undefined Waypoints

If an identifier is entered on the DATA BASE WPT page and the FMS cannot find a waypoint in the navigation data base with that identifier, the FMS goes to the PILOT WAYPOINT page for waypoint definition.

FMS DATA BASE

The FMS data base consists of two parts: a navigation data base and a custom or pilot defined data base. The navigation data base is loaded into the FMS and can not be changed by the pilot. Using the custom data base, the pilot can customize the FMS by defining waypoints and storing flight plans.

Navigation Data Base

The FMS retrieves information from the navigation data base about waypoints and procedures used in flight planning as well as to tune navaids for position determination. The data base, supplied by Honeywell, is updated every 28 days (refer to Nav Data Base Updating on page 6-155).

The data base is designated with a name that describes its area of coverage as well as a number that indicates the type and cycle. **<u>This version of the FMS uses only data bases labeled on the disks as WORLD2-2xx</u>**. WORLD2 indicates worldwide coverage, 2 indicates a version 2 data base, and xx indicates the cycle. There are 13 cycles (28 day periods) during the year so the range of xx is 01 to 13. If a cycle has to be modified off cycle, a letter is appended starting with A. For example, WORLD2.210A indicates a modified 10th cycle of the data base.

The navigation data base contains:

- Navaids
- Airports
- Runways
- Airways (high & low)
- SIDs and STARs
- Approaches
- Named Intersections
- Outer markers.

Navaids include very high frequency (VHF) navaids, instrument landing system/microwave landing system (ILS/MLS), and navigation data bases (NDBs). VHF navaids stored in the data base consist of the following types:

- VORTAC
- VOR/DME
- TACAN (tactical air navigation)
- VOR
- DME
- VOR/DME (non co-located)
- TACAN (non co-located).

Airport waypoints are the geographic reference point for the airport.

Airways contained in the data base include all waypoints (some are unnamed) and only waypoints that define the airway. Some of these defining waypoints do not appear on paper charts. Some waypoints on the charts appear to be on an airway but are not defining waypoints for the airway.

Custom Data Base

The custom data base consists of pilot defined waypoints and stored flight plans. Up to 200 pilot defined waypoints can be stored.

The pilot can store commonly flown routes using the pilot defined flight plan procedure. The pilot can activate a flight plan straight from the FMS memory rather than repeat the flight plan definition procedure. The FMS memory can hold up to 255 flight plans with a total of 2434 waypoints (whichever comes first). Each flight plan can contain a maximum of 100 waypoints.

TEMPORARY WAYPOINTS

In addition to pilot defined waypoints that are given a name and permanently stored in the custom data base, the pilot can define temporary waypoints. Temporary waypoints are not given a name and are not stored. Refer to Temporary Waypoints on page 7-3 for additional details.

AIRBORNE FLIGHT INFORMATION SYSTEM (AFIS) (OPTIONAL)

The Honeywell FMS can be configured for an interface to the Allied Signal AFIS. In this configuration, the Honeywell FMS displays the AFIS function while the DL-800/900 Data Loader is the disk interface for the AFIS functions.

The AFIS function is accessed through the NAV INDEX. The AFIS function replaces the DATA BASE function (2R) on page 1 of the NAV INDEX when configured.

This section contains information on the operation of AFIS through the FMS. For detailed descriptions of the various functions, refer to the appropriate Global-Wulfsberg publications.

AFIS Index

Figures 6-28 and 6-29 display the AFIS index with page references for each function. This index is used to select all AFIS functions.

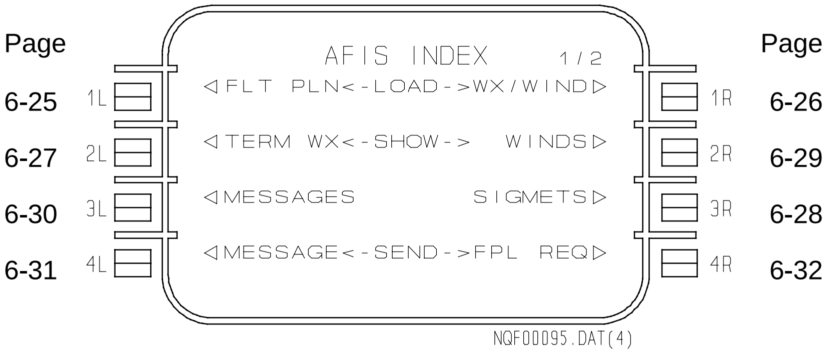


Figure 6-28

Page

6-33

6-34

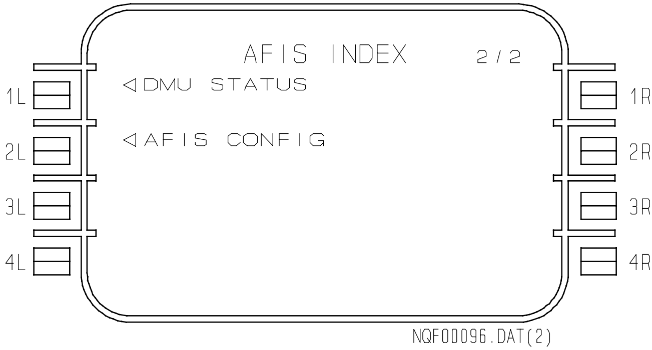


Figure 6-29

Load AFIS Flight Plans

AFIS FLT PLANS 1/X - The display, shown in figure 6-30, is accessed from the AFIS INDEX 1/2 page (1L). The page displays a menu of AFIS flight plans available from a disk that is installed in the DL-800/900 Data Loader.

Figure 6-30

When one of these flight plans (2L in this example) is selected, the CDU displays a sequential listing of the waypoints in the selected AFIS flight plan, as shown in figure 6-31.

If modifications to the AFIS flight plan are necessary, the plan must first be activated. If there is a weather briefing for the displayed flight plan, INCLUDES WEATHER BRIEF appears at the end of the flight plan. If the flight plan is loaded, the CDU can be used to load the terminal weather with the flight plan.

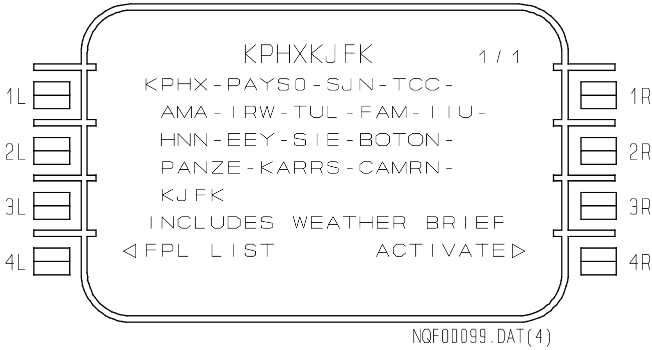


Figure 6-31

When a flight plan is selected, verify that all the required flight plan page entries have been completed. It is important to note that the destination must be displayed in the DEST window <u>and</u> it must be the <u>last</u> waypoint in the flight plan.

Refer to the appropriate AFIS operating manual for instructions on formatting flight plans on a disk.

Load Weather

- **LOAD WX/WINDS 1/1** - The page, shown in figure 6-32, is used to load weather and wind information from an AFIS disk. The page lists the types of information available from the disk.

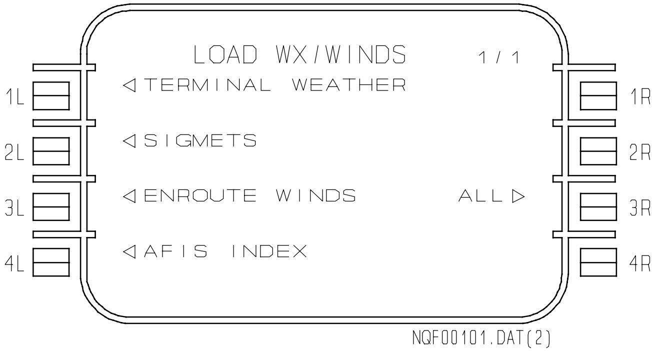


Figure 6-32

The options available are described below.

Show Terminal Weather

- **AVAIL WX REPORTS 1/1** - The page, shown in figure 6-33, is available from the AFIS INDEX or from the LOAD WX/WINDS page. It is available only when the disk contains weather data or when a report has been received.

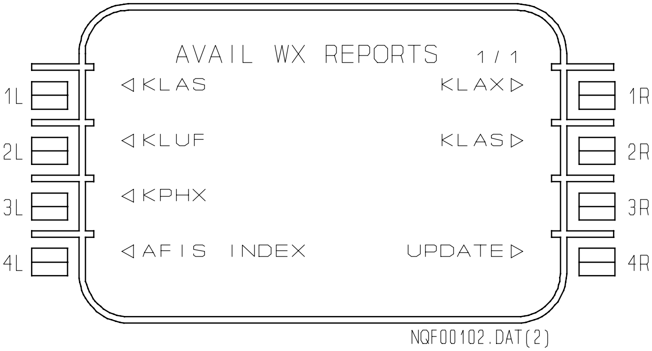


Figure 6-33

Terminal weather reports can be loaded from the airports listed on the display (maximum of 5). If terminal weather for another airport has been previously loaded, the new weather will overwrite the current weather data in the FMS. Weather for any location can be deleted using the DEL key.

If weather for another location is required, enter the identifier in place of one of the five listed on this page. If the new identifier is displayed in inverse video, it indicates that the requested weather is <u>not</u> on the disk or has not been received from a report. Use the UPDATE prompt to request new weather for all airports on the AVAIL WX REPORTS page. When selecting this option, the FMS removes the prompt from the CDU and transmits a request for the listed airports. The message NEW WX REPORTS AVAIL is displayed when the update is received.

If terminal weather information is being displayed when a new report is received, a NEW REPORT prompt (4L) tells the pilot the new report can be selected. If terminal weather is not being displayed when a new report arrives, the information is automatically updated. Figure 6-34 illustrates a typical TERMINAL WEATHER page.

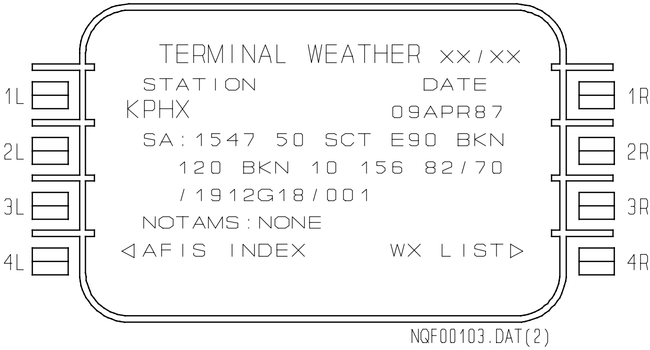


Figure 6-34

Sigmets

- **SIGMETS X/X** - The page, shown in figure 6-35, is selected through the LOAD WX/WINDS page or through AFIS INDEX (3R). This is a **view only** page with the exception of the UPDATE option key. This key functions like the UPDATE function on the AVAIL WX REPORTS page.

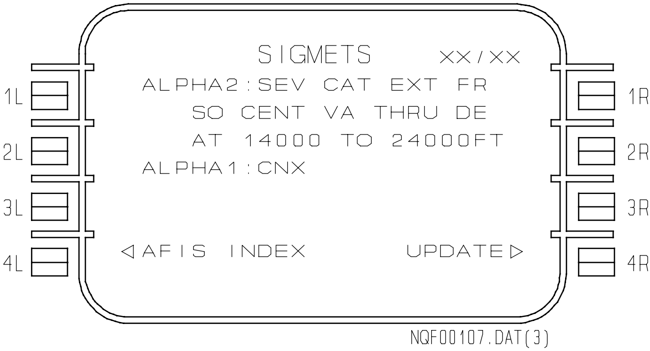


Figure 6-35

- **SIGMETS UPDATE 1/1** - The page, shown in figure 6-36, prompts the pilot for the end points of the route for which a SIGMET update is required. On this page, the origin and destination of the route can be entered. The defaults are the current origin and destination from the flight plan. Selecting the TRANSMIT prompt activates a request for a SIGMET update.

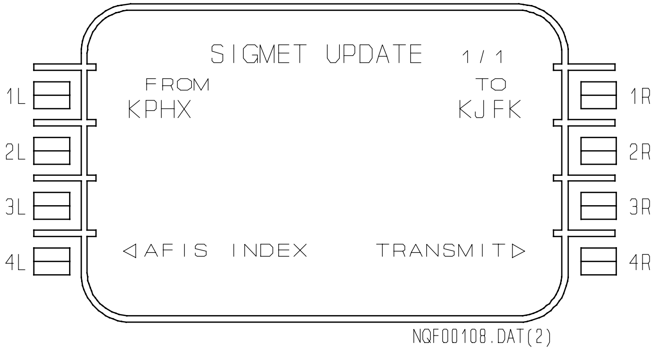


Figure 6-36

Show Winds

- **AVAIL WIND REPTS 1/1** - The page, shown in figure 6-37, is accessed through the AFIS INDEX or through the LOAD WX/WINDS page. It lists the stations that the WINDS ALOFT reports have been loaded from disk or updated from a report. Stations can be changed, deleted, or added by the pilot. Up to five stations can be listed on this page. If the pilot enters a station that the wind data is not available from the disk or the memory, it is displayed in inverse video until an UPDATE is performed.

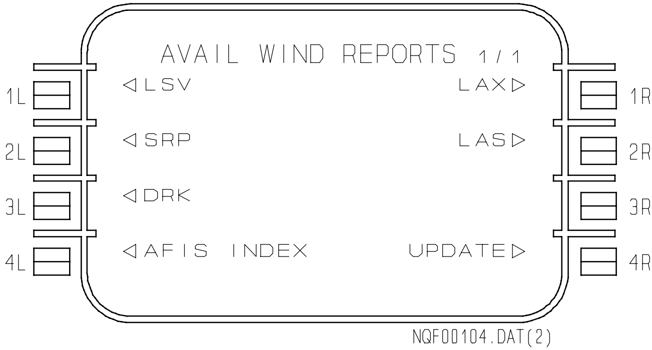


Figure 6-37

If one of the line select keys is pushed when the scratchpad is empty, the display switches to the WINDS ALOFT page, shown in figure 6-38.

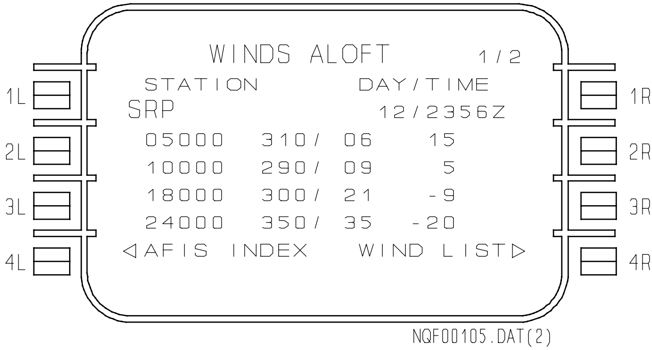


Figure 6-38

The station identification can be changed using the scratchpad and the upper left line select key (1L) to enter a new identification. If the station is not in the list of available reports, NO REPORT is displayed in place of the wind/temperature information.

Received Messages

- **RECEIVED MESSAGES X/X** - The page, shown in figure 6-39, is accessed through the AFIS INDEX page. Only one message is displayed per page. However a message can be more than one page in length. A maximum of 99 messages or 2200 total message characters can be held for display. **The numbers in the upper right corner, that are normally page numbers, are in the case of AFIS MESSAGES, message numbers**. These numbers indicate the message number currently being viewed and the total number of messages available. If a new message is received when either of the limits apply, the first (oldest) message is deleted to make room for the new message. The CLEAR MSG prompt is used to delete individual messages. When a message is deleted, the display switches to the first page of the next message (if any).

Figure 6-39

When power is removed from the FMS and AFIS, messages are not retained. However, if the data management unit (DMU) remains powered, recalled or updated flight plans can be recalled using a prompt on AFIS FLT PLANS page.

Send Message

- **SEND MESSAGE 1/XX** - The page, shown in figure 6-40, is accessed through the AFIS INDEX. Each message must contain data in the FROM, TO, and ADDRESS lines. The FROM and TO lines are limited to 16 characters. Exceeding these limits results in an INVALID ENTRY message. The address line is limited to 17 characters. The format and editing guidelines that apply are listed below.

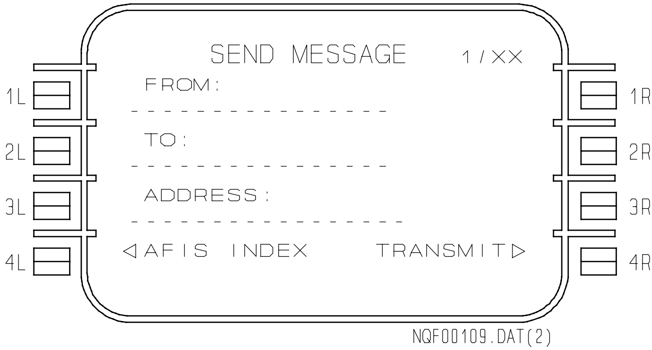


Figure 6-40

- Each message line can contain up to 20 characters.

- A TRANSMITTED message is generally limited to three pages. A RECEIVED message is generally limited to five pages. As the received message limits are reached, old messages are dropped and replaced by the new ones.
- When a message is entered, the slash (/) key inserts a space.
- Each message line can be edited while displayed in the scratchpad.
- Messages can be edited by use of the (DEL) key to delete entire lines.
- Lines can be inserted into a message using the left line select keys. The right line select keys replace the line.
- Pushing a left line select key with an empty scratchpad moves the message line to the scratchpad.
- Selecting the TRANSMIT option transmits the message.

Send Flight Plan Request

Flight plans are stored in the ground-based communications system. The flight plans can be retrieved using one of two methods. The first method retrieves by flight plan number. The second method retrieves by DATE, estimated time of departure (ETD), ORIGIN, and destination (DEST). When the proper identifying information is entered on the REQUEST AFIS FPL pages, the stored flight plan is retrieved from the ground network. It is also possible to request an update of the active flight plan from the next waypoint to the destination, as shown in figure 6-41.

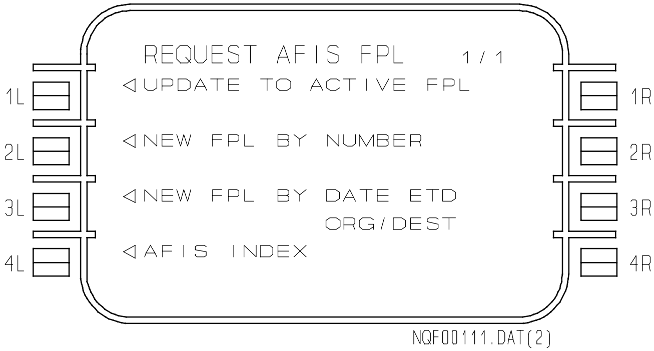


Figure 6-41

Data Management Unit Status

- **DMU STATUS 1/1** - This page is selected from page 2 of the AFIS index. The single page displays the condition of the various AFIS subsystems, as shown in figure 6-42. No data entries are permitted on this page.

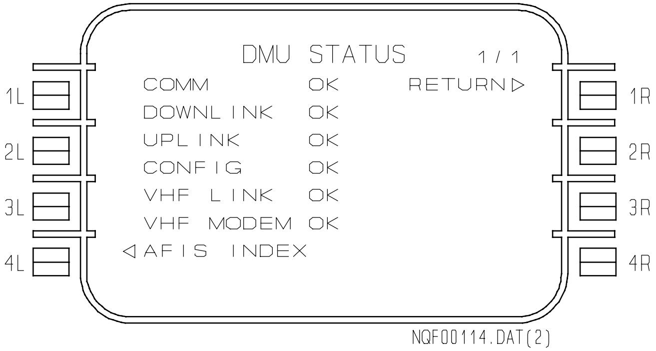


Figure 6-42

This page is also displayed each time the pilot initiates a send message or update request so the AFIS system status can be viewed.

If a subfunction of the DMU indicates a FAIL status, the pilot can take the following actions:

- COMM, DOWNLINK, UPLINK - Retransmit the last request
- CONFIG - Configuration module requires maintenance
- VHF LINK, VHF MODEM - DMU requires maintenance.

When a request is acknowledged by the global data center, the message RQST RCVD is displayed. To ensure that each transmission has been received and acknowledged by the data center, delay further transmissions until the message RQST RCVD is shown.

Caution should be used with the RQST RCVD annunciation. It is only an indication that the global data center received a request. For example, it does not ensure that a message has been delivered to the addressee. Also, the fact that no RQST RCVD is displayed does not mean the request was not received. There can be problems in getting the RQST RCVD message back to the aircraft.

AFIS Configuration

- **AFIS CONFIG 1/2** - The page, shown in figure 6-43, is selected from the second page of the AFIS INDEX. AUTO REPORT ON or OFF, AUTO WEATHER ON or OFF, and satellite links can be selected on this page.

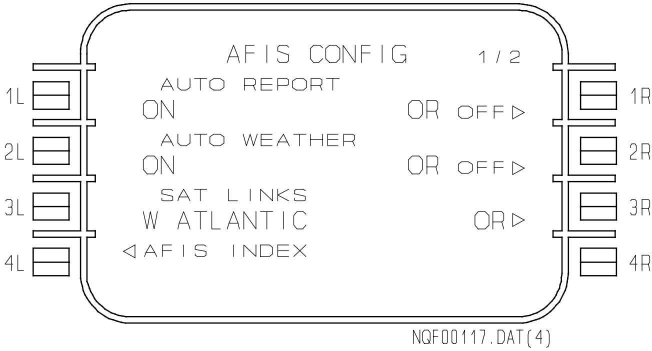


Figure 6-43

- **SATELLITE LINKS 1/1** - The pilot uses this page, shown in figure 6-44, to select a satellite link. The active link is designated with active mode (ACT). In addition, ALL or NONE of the satellite links can be selected active. RETURN displays the AFIS CONFIG 1/2 page.

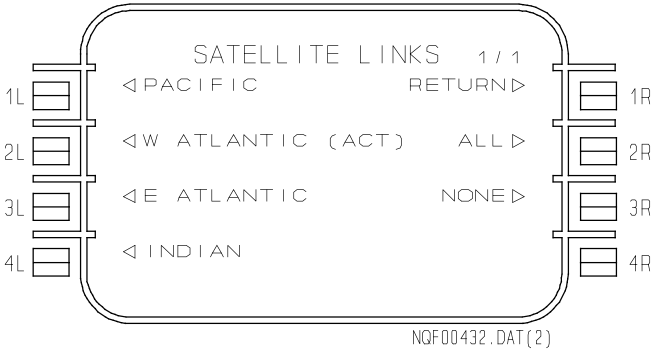


Figure 6-44

- **AFIS CONFIG 2/2 -** The page, shown in figure 6-45, displays the current configuration for the ARINC, SITA/AVICON, and AIR CANADA networks. AUTO enables automatic transmission to and from the specified network. OFF disables transmissions over the specified network.

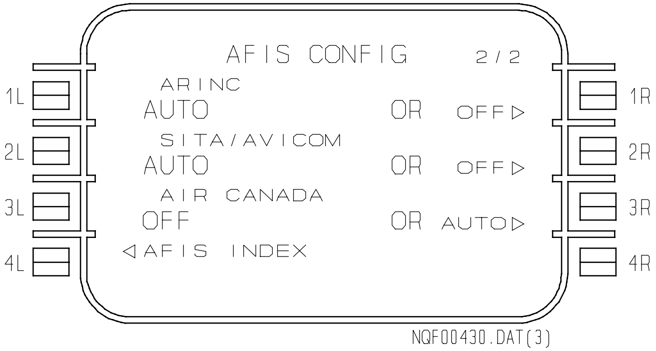


Figure 6-45

ARINC COMMUNICATIONS ADDRESSING AND REPORTING SYSTEM (ACARS) (OPTIONAL)

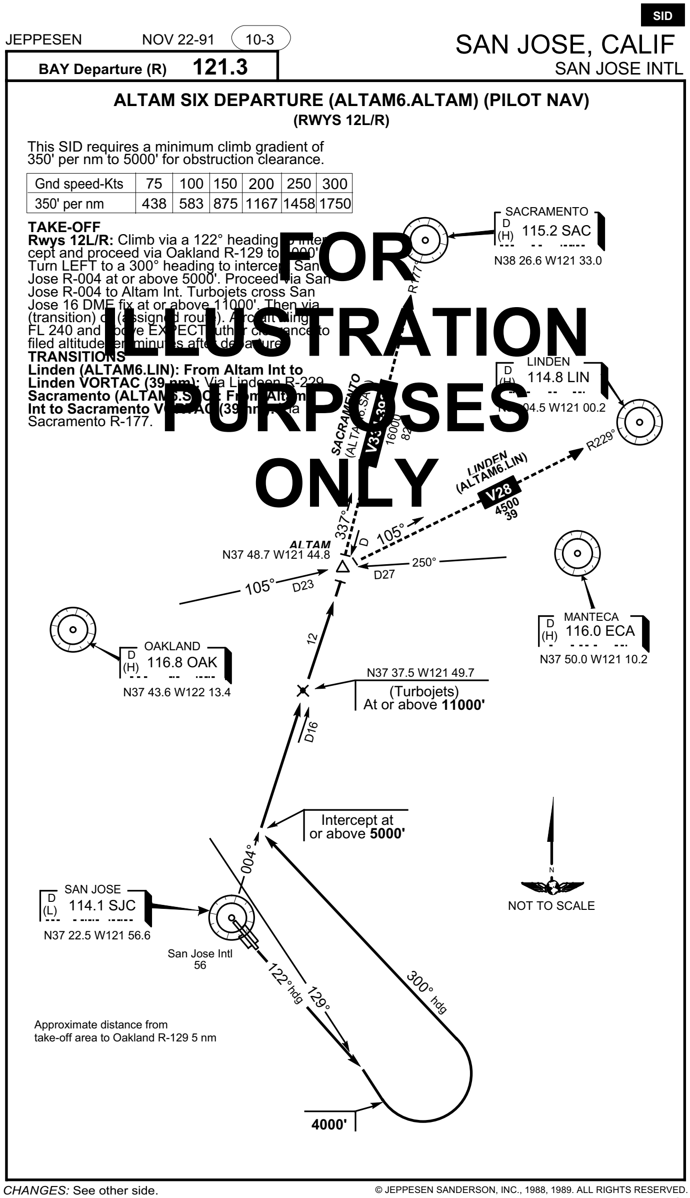
The ACARS function is accessed through the NAV INDEX. When configured, the ACARS function replaces the DATA BASE function (2R) on page 1 of the NAV INDEX. While in this function, the CDU display and function are controlled by the ACARS unit. Consult the ACARS manual for further information.

DEPARTURES

The DEPARTURE function is used to examine and select departure runways and standard instrument departures (SIDs) stored in the navigation data base.

All SIDs are not in the data base. This is because of how some procedures are defined by the controlling agency and the limitations of the FMS.

To illustrate the steps in the DEPARTURE function, San Jose, California (KSJC), is used as the origin of the active flight plan. Figure 6-46 displays the ALTAM6 departure for KSJC. Refer to procedure 6-5 for DEPARTURE RUNWAY selection. At any point in the departure selection process, entering a new or the same airport at 1L returns the display to the beginning of the selection process.



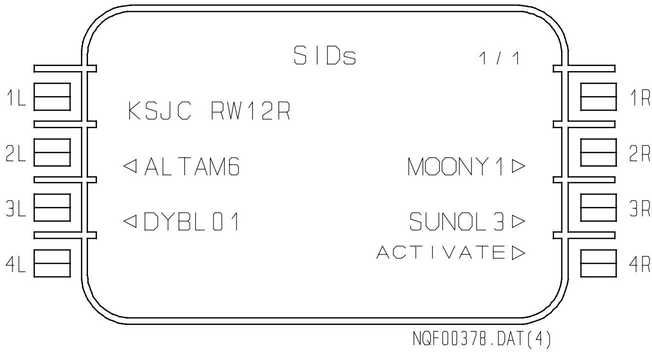
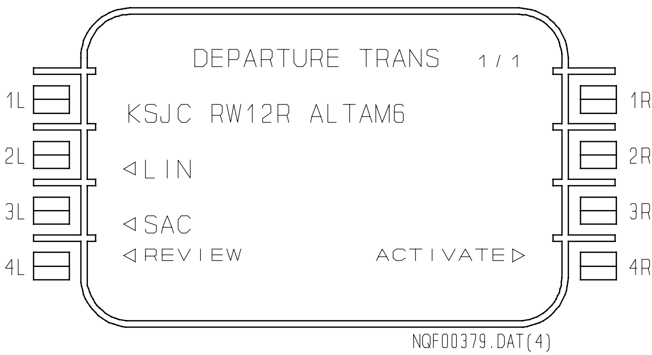
San Jose ALTAM6 Departure
Figure 6-46

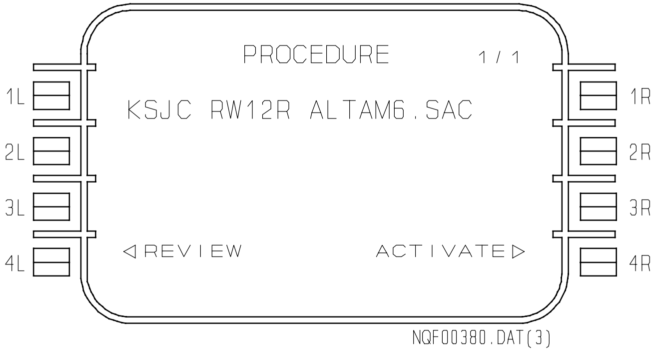
- **DEPARTURE RUNWAYS 1/X -** The page, shown in figure 6-47, is displayed when selecting the DEPARTURE function. From this page, the pilot can select a departure runway, standard instrument departure (SID), and departure transition. Access to the SID page from the ACTIVE FLT PLAN page is available only when the origin waypoint is an airport and the aircraft is within 50 NM of the origin. Access to the SID page is always available from the NAV INDEX.

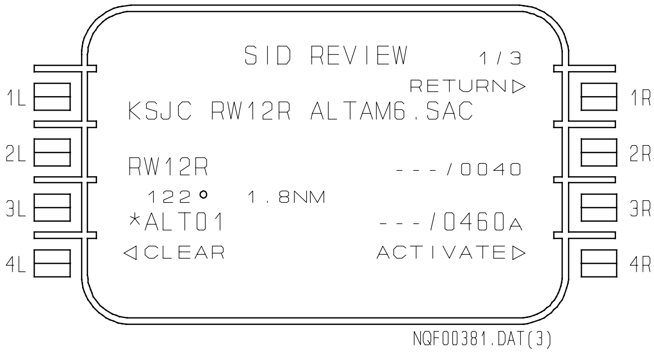
  The default airport at 1L is the origin of the active flight plan. If the origin is not defined or if it is not an airport, prompts are displayed for entry of an airport. If the origin waypoint is not an airport, access to SIDs is for review only. If the active flight plan contains a SID, the selected departure runway, SID, and transition are displayed.

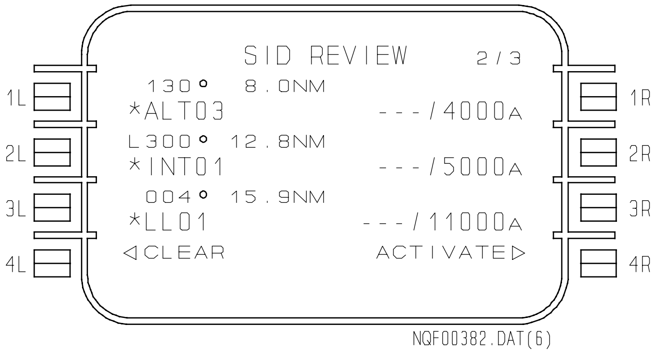
Step	Procedure 6-5 Departure Selection
1	Select DEPARTURE from the ACTIVE FLIGHT PLAN or NAV INDEX.
2	Select the desired runway from the DEPARTURE RUNWAY page, as shown in figure 6-47. RW12R is selected in this example.

Figure 6-47

Step	Procedure 6-5 Departure Selection
3	Select the SID from the SIDs page, as shown in figure 6-48. ALTAM6 is selected in this example.  **Figure 6-48**
4	Select the departure transition from the DEPARTURE TRANS page, as shown in figure 6-49. SAC is selected in this example.  **Figure 6-49**

Step	Procedure 6-5 Departure Selection
5	Select REVIEW (4L) or ACTIVATE (4R) from the PROCEDURE 1/1 page, as shown in figure 6-50. REVIEW is selected in this example.  **Figure 6-50** **DETAILS** - Select REVIEW to review the selected procedure or select ACTIVATE to insert the selected procedure into the active flight plan. The ACTIVATE prompt is only displayed on these pages if the airport is the origin airport of the flight plan. Selecting REVIEW or ACTIVATE part way through the selection procedure ends the departure selection process. The selected portion of the procedure can be reviewed and/or inserted into the flight plan.

Step	Procedure 6-5 Departure Selection
6	Review the selection shown in figure 6-51, and select NEXT to move to the next review page.  **Figure 6-51** **SID REVIEW 1/X** - The page, shown in figure 6-51, displays the selected runway, SID, and transition as it looks if ACTIVATED into the flight plan. The runway threshold elevation of 40 feet is displayed in blue on the right side of the page. The first leg of the departure is a heading of 122° to an altitude of 460 feet (*ALT01). The altitude constraint (blue lettering on the right side of the page) is followed by the letter **A** to indicate that the constraint is at or above constraint.

Step	Procedure 6-5 Departure Selection
7	Review the selection shown in figure 6-52 and select NEXT to move to the next review page.  Figure 6-52 **SID REVIEW 2/X** - The page, shown in figure 6-52, consists of a heading of 130° to an altitude at or above 4000 feet (*ALT03). Since the *ALT03 waypoint has no fixed lateral position, it is sequenced when the aircraft reaches the altitude constraint, 4000 feet in this example. This is followed by a mandatory left turn (indicated by the inverse video L) immediately above *INT01. From here, the procedure requires flying a heading of 300° to intercept the course of 004° inbound to latitude/longitude waypoint number 1 (*LL01). The intercept leg contains an altitude restriction at or above 5000 feet. For *LL01, an 11,000-foot at or above restriction exists.

Step	Procedure 6-5 Departure Selection
8	Review the selection shown in figure 6-53. In this example, this is the last page of review. Select CLEAR (4L) or ACTIVATE (4R).

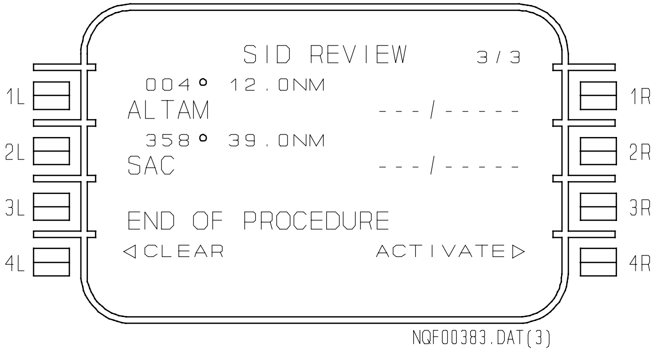


Figure 6-53

SID REVIEW 3/X - The page, shown in figure 6-53, shows a course of 004° inbound to the ALTAM intersection that is followed by the Sacramento transition leg.

Push the line select key adjacent to the CLEAR prompt (4L) to clear the selected procedure and display the DEPARTURE RUNWAYS page.

Selecting the ACTIVATE prompt (4R) inserts the selected runway, SID, and transition into the active flight plan and ends the departure selection process. However, if the airport is not part of the active flight plan, the SID cannot be activated.

ARRIVAL

The ARRIVAL pages are used to examine and select runways, approaches, and standard terminal arrival routes (STARs) stored in the navigation data base.

Some approaches and STARs are not in the data base. This is because of the way some procedures are defined by the controlling agency and the limitations of the FMS.

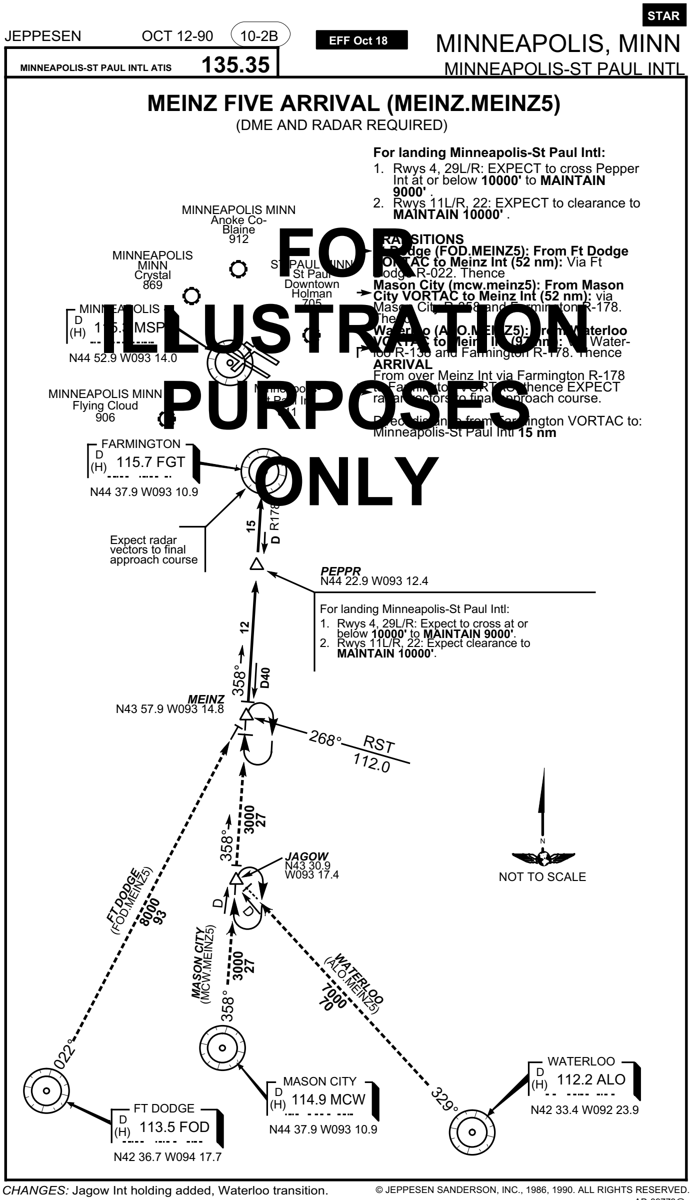
To illustrate the steps in the ARRIVAL function, Minneapolis, Minnesota (KMSP) is used as the destination of the active flight plan. This example starts with the selection of a runway. However, there is no required selection order. Also, it is not necessary to make a selection from each page. If a STAR has already been activated, it is possible to select a runway without affecting the previously selected procedure. At any point in the selection process, it is possible to return to the ARRIVAL page and review and/or activate the selected items.

On the ARRIVAL page, if a new runway is selected that is not supported by a previously selected STAR (or approach), the previous procedures are not displayed for selection into the active flight plan. In fact, only approaches to the selected runway are displayed on the APPROACH page. If these changes are activated while flying the previous procedure, the FMS prompts for CHANGE ACTIVE LEG confirmation.

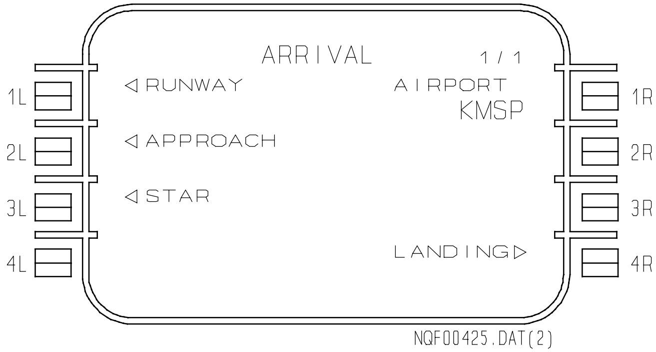
To select a new runway, return to the ARRIVAL page and select the RUNWAY prompt. Then, choose the desired runway, select the ARRIVAL prompt, and select the ACTIVATE prompt.

Circle-to-land approaches are not supported in the navigation data base.

Figure 6-54 displays the STAR plate. Refer to procedure 6-6 for arrival selection.



Meinz Five Arrival
Figure 6-54

Step	Procedure 6-6 Arrival Selection
1	Select ARRIVAL from the active flight plan or NAV INDEX.
2	Select RUNWAY, APPROACH, or STAR from the ARRIVAL page, shown in figure 6-55. If an approach is going to be selected, a step can be saved by selecting APPROACH from this page. The runway is automatically selected when an approach is selected. In this example, all steps are shown for instructional purposes by selecting RUNWAY (1L).  **Figure 6-55** **ARRIVAL 1/1** - The page, shown in figure 6-55, is displayed when the ARRIVAL function is selected. From this page, the pilot can select which element, arrival runway, approach, or STAR to be selected. This page can also be accessed from the ACTIVE FLT PLAN page when the aircraft is within 200 flight plan miles of the destination. The default airport at 1R is the destination of the active flight plan. If the destination is not defined or if it is not an airport, prompts are displayed to enter the airport. If previous selections have been made, they are displayed on this page. Selections can only be deleted on this page. The runway, approach, or STAR can be selected (or reselected) in any order. In each case, the ARRIVAL prompt is displayed in inverse video. It is used to return to the ARRIVAL page for review of the arrival selections and to activate.

<table>
<tr><th>Step</th><th>Procedure 6-6 Arrival Selection</th></tr>
<tr><td>3</td><td>

Select the desired runway from the RUNWAY page, shown in figure 6-56. In this example, runway 29L (3L) is selected.

Figure 6-56

Any previously selected runway is labeled as (ACT) or (SEL). There can be more than one page of runways.

</td></tr>
<tr><td>4</td><td>

Select the approach from the APPROACH page, shown in figure 6-57. In this example, ILS 29R (3R) is selected.

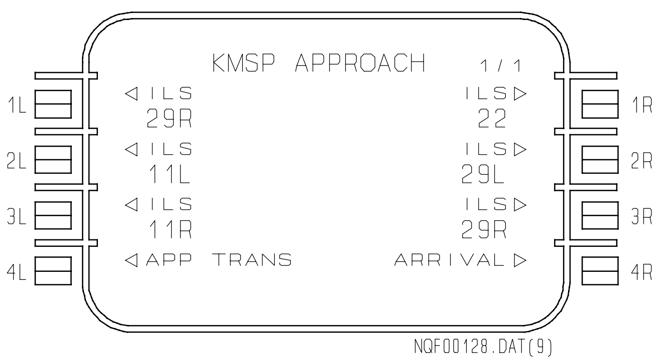


Figure 6-57

If only the straight-in portion of an approach is desired, select the approach without selecting an approach transition.

</td></tr>
</table>

<table>
<tr><th>Step</th><th>Procedure 6-6 Arrival Selection</th></tr>
<tr><td>5</td><td>

Select the approach transition (includes feeder routes) from the APPROACH TRANS page, shown in figure 6-58. In this example, FGT (1L) is selected.

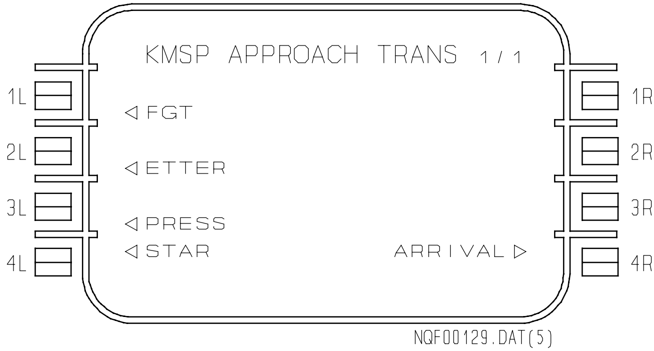


Figure 6-58

</td></tr>
<tr><td>6</td><td>

Select the STAR from the STAR page, shown in figure 6-59. In this example, MEINZ5 (1R) is selected.

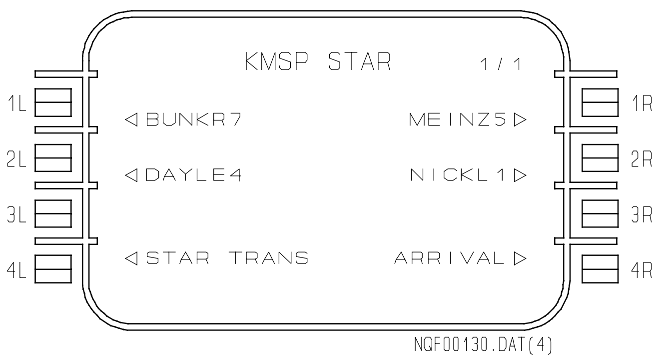
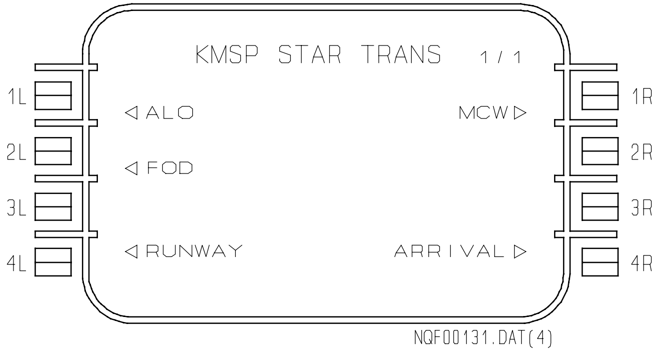
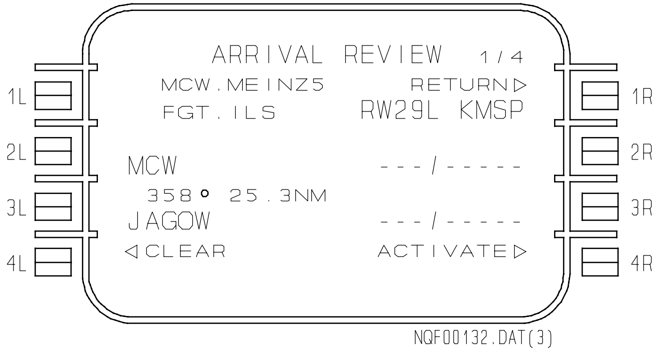
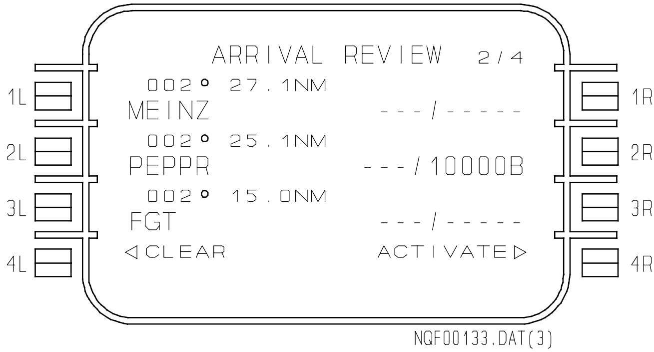


Figure 6-59

</td></tr>
</table>

Step	Procedure 6-6 Arrival Selection
7	Select the STAR transition from the STAR TRANS page, shown in figure 6-60. In this example, MCW (1R) is selected.  **Figure 6-60**
8	Once all selections have been made, the ARRIVAL page, shown in figure 6-61, is automatically displayed. The choices from this page are to repeat the selection process if necessary, ACTIVATE (4R) which inserts the selection in the flight plan, or REVIEW (4L). In this example, REVIEW (4L) is selected.  **Figure 6-61**

Step	Procedure 6-6 Arrival Selection
9	Review to verify the selection prior to activation into the active flight plan. From page 1/4, shown in figure 6-62, select NEXT (paging keys) for display of page 2/4.  **Figure 6-62**
10	At any time in the review process, the ACTIVATE prompt (4R) can be used to activate the approach into the active flight plan. The CLEAR prompt (4L) can be used to return to the selection process. The review process can be continued by using the paging keys through the end of the procedure including the missed approach procedure.  **Figure 6-63**

Approach

Once an approach has been selected, there are many things the pilot should check and/or monitor during the approach. The following is a list of those items:

- **Before starting a non-precision approach transition or approach, the crew must review the published approach procedure and verify the FMS waypoints and altitude restrictions**.

- Before starting a non-precision approach transition that is flown by the FMS, it is important to verify that the transition is cleared by ATC. Selecting the transition fix is usually the path to selecting the actual transition.

- The APRCH annunciator must turn on 2 NM before the final approach fix or 5 NM from the runway, whichever is reached first. It will remain lit for the remainder of the approach. This is a positive cue to the flight crew that the sensor configuration is correct and sensor integrity is within limits for the approach. The approach annunciator is not lit during localizer based approaches since the FMS is not authorized to be coupled during localizer approaches. The DGRAD annunciator must be off throughout the approach. If the DGRAD annunciator comes on, the FMS should not be used for the remainder of the approach. The flight crew can continue the approach using raw data or perform the missed approach procedure.

- **If VNAV (VPATH) is used for vertical guidance on the approach, verify that the approach plate waypoint altitudes are shown on the FMS CDU. Verify that the altitude selector is set to the minimum descent altitude (MDA)**.

- Industry wide standards for data base information are currently inconsistent on many approaches. Some VPATHs lead to a descent to MDA earlier than necessary. Others do not arrive at MDA until at the MAP. Some approaches provide vertical guidance below the published MDA and some VPATHs differ from the VASI/PAPI angles.

- **Since charts are continually updated, the FMS waypoint names may not exactly match the chart names. Additionally, there may be differences between courses displayed on the chart and those displayed on the CDU and EFIS. These differences are the result of changes in magnetic variation and are normally less than 2 degrees. Verify possible changes before starting an approach**.

- The NAV data base does not have step down waypoints between the final approach fix (FAF) and MAP if the VNAV path satisfies the step down restrictions. VNAV path guidance and a cross check with other navigation aids are the only assurance that all descent path restrictions are met. Using modes other than VNAV can be better for some approaches.

- Refer to the GPS under POSITION SENSORS, page 6-69, for information on GPS receiver autonomous integrity monitor (RAIM) for GPS only approaches.

- Approaches in the navigation data base consist of precision approaches (localizer based) and non-precision approaches. There are no circle-to-land procedures in the data base. The FMS is certified to fly all non-precision approaches. Approaches from the data base can contain DME arcs. The FMS flies the arc as specified in the approach. In some cases, clearance to intercept the arc other than specified in the approach is given. Refer to page 9-10 for information on intercepting an arc.

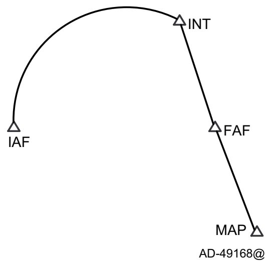
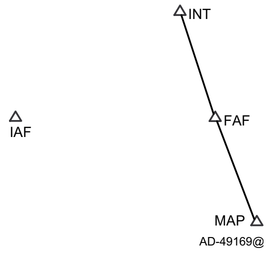
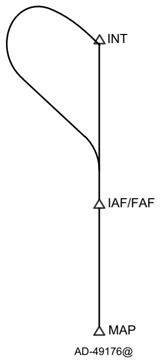
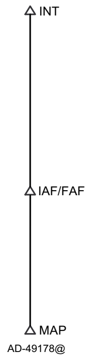
- The FMS cannot be used to fly precision (localizer) approaches. These approaches are flown by displaying the localizer data and hand flying the aircraft or by using the flight director/autopilot. However, these procedures can be selected and activated on the FMS to enhance situational awareness. The FMS displays the approach on the EFIS map displays. The FMS can be used to fly the approach transition and the missed approach phases of precision approaches.

- An approach can be selected with or without an approach transition. For example, if receiving vectors to the final approach course, an approach transition need not be selected with the approach. The pilot flies the specified vectors and arms LNAV, or LNAV and VNAV. The FMS automatically captures the final approach course.

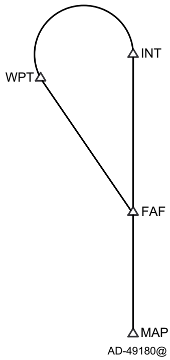
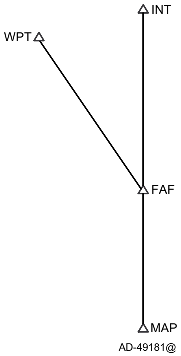
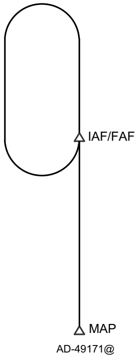
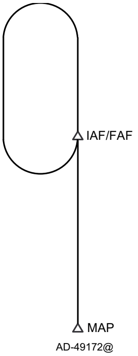
- The altitude selector is observed while in VNAV during all phases of flight, including the approach phase. The altitude selector should not be set below the published MDA until the runway is visible and the approach can be made.

- Before flying the approach, the waypoints, as well as constraints, in the procedure should be verified with the approach charts. If the data base contains more waypoints for the procedure than the chart actually shows, the flight plan should reflect the selected procedure. The data base does not contain step down fixes on the final approach if the constraint at the step down fix is satisfied by the vertical descent path into the MAP.

The examples described and shown in tables 6-1 and 6-2, show approach transitions and the typical appearance of the EFIS displays. The actual appearance on EFIS depends on the capabilities of the EFIS equipment.

Approach Transition	Actual Pattern	EFIS Display
DME Arc		
Procedure Turn		

Typical EFIS Pattern Displays
Table 6-1

Approach Transition	Actual Pattern	EFIS Display
Teardrop		
Holding Pattern Course Reversal		

Typical EFIS Pattern Displays
Table 6-2

Missed Approach

The FMS displays a MISSED APRCH prompt at 4L, 2 NM before the FAF on the active flight plan pages. If the prompt is selected, the missed approach procedure is activated and inserted in the flight plan following the MAP.

The aircraft go-around buttons can also be used to activate the missed approach procedure but only while the MISSED APRCH prompt is displayed.

When MISSED APRCH is selected, the APRCH annunciator extinguishes and the FMS transfers from the approach mode to the terminal mode.

POSITION SENSORS

One of the primary FMS tasks is to navigate the aircraft along a predefined flight plan. To do this, the FMS receives navigation data from various sensors on board the aircraft. From the available sensors, the FMS determines the best navigational mode and combination of sensors to provide the most accurate aircraft position.

Navigation Modes

The priority of the navigation modes is as follows:

- GPS.
- DME/DME.
- VOR/DME.
- LRN BLENDING.

The priority is based on sensor accuracy with GPS being the most accurate sensor. When GPS is available, it is weighted at 100% meaning the FMS position is equal to the GPS position. When more than one GPS position is available, the FMS position is equal to the blended GPS position. When GPS is used, other sensors are still monitored for position differences from the FMS position. Other sensors do not contribute to the FMS position unless GPS becomes unavailable or inaccurate.

DME/DME is the next most accurate. The FMS automatically tunes the scanning DMEs to provide the best position from DME/DME.

VOR/DME updating is less accurate than DME/DME because of the VOR bearing error. The bearing error increases with distance from the navaid thus reducing the accuracy of the VOR/DME position as the aircraft moves away from a navaid.

Long range navigation blending (LRN BLENDING) is the navigation mode where the FMS blends the available long range sensors (IRS and VLF). This mode is used primarily when the aircraft is operating over water or in a sparse navaid environment. In determining which sensors to blend, the FMS evaluates the accuracy of each sensor and uses those yielding the best FMS position. All individual long range sensor positions are continuously compared to the FMS computed position. If any sensor differs by more than 10 NM from the FMS position, a scratchpad message is displayed (example: CHECK IRS 1 POSITION).

While the FMS is using GPS, DME/DME or VOR/DME for updating, a position error for each IRS is continuously calculated and stored within the FMS. This calculated error is called an IRS bias. If the FMS starts using the IRSs for position updating, the actual position used by the FMS is each IRS position plus the last calculated bias for each IRS. This means the only IRS errors that affect FMS position are those errors that occur during times when navigating without GPS, DME/DME, or VOR/DME updating. Once GPS, DME/DME or VOR/DME updating is resumed, a new bias is calculated and again, IRS error has no impact on FMS position. For this reason, it is **not recommended** that the IRSs be updated at the end of the runway under normal circumstances.

The change from one navigation mode to another is not instantaneous. For example, each time the radios are tuned, radio position is lost for some time. However, the FMS annunciates that the mode is using radios. Some mode changes require several minutes to complete.

Refer to table 6-3 for typical sensor blending use of various sensors.

FMS Navigation Mode	FMS Position
GPS	100% GPS
DME/DME	100% DME/DME
VOR/DME	100% VOR/DME
IRS	Average IRS Position
LRN BLEND (VLF/IRS)	All VLFs are blended to compute composite VLF position. Average position of all IRS and composite VLF position are blended to computed FMS position.
LRN BLEND (VLF/AHRS)	Average VLF position

Typical Sensor Blending
Table 6-3

The following is an example of a typical transoceanic flight with an aircraft equipped with VOR/DME, IRS, and VLF/Omega. The flight begins with the FMS operating in DME/DME mode. As the aircraft leaves DME coverage, the FMS transitions to IRS navigation. During this time, the assumed error of the IRS position increases. When the assumed error of the IRS is equal to or greater than the assumed error of the VLF/Omega, the FMS transitions to the LRN BLEND navigation mode and the VLF/Omega position is blended with the IRS position. As the aircraft approaches radio coverage, the system returns to radio updating.

For GPS equipped aircraft, the GPS is used for all phases of flight (departure, enroute, oceanic, terminal, and approach). While the GPS is available and valid for navigation, the radios, IRS, and VLF/Omega positions are not used in computing the FMS position. If the GPS becomes unusable for navigation, the FMS uses the next highest priority available sensor for navigation. If over land, this is DME/DME. If oceanic, it is IRS updating initially followed by IRS and VLF/Omega position update.

Because of limits on the use of navaids, it is possible for the aircraft to approach controlled airspace before returning to radio updating. The pilot should assess the FMS position before entering controlled airspace. This assessment can be done by checking the navigation mode on PROGRESS page 1 and cross checking FMS position with raw VOR/DME information. The CROSSING POINTS page can assist in cross checking by giving the FMS bearing and distance to the selected station and comparing that to raw VOR/DME data.

The POS SENSORS pages, shown in figures 6-64 and 6-65, can be selected from the NAV INDEX page, or the POSITION INIT page. Sensors are grouped by type and listed in numerical order. The group priority is:

- IRS.
- GPS.
- VLF.

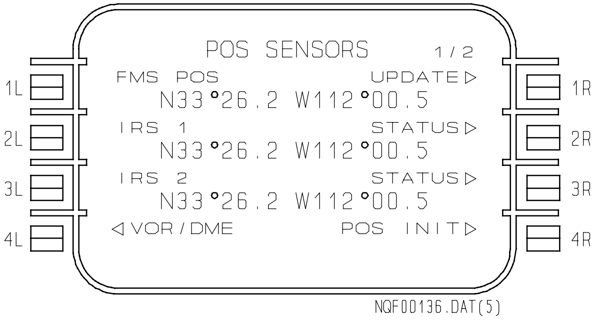


Figure 6-64

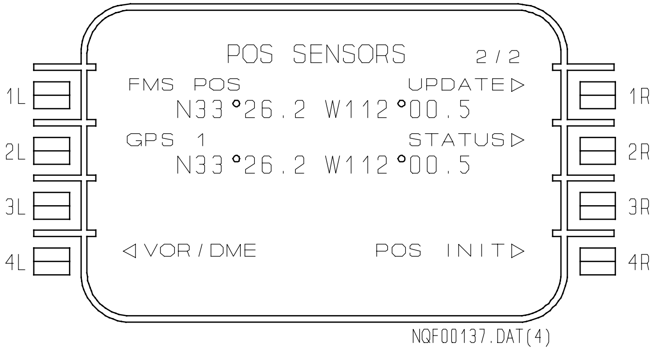


Figure 6-65

Using this page, it is possible to update the FMS position (UPDATE) and examine sensor positions and status (STATUS). This page can also be used to determine which sensors are being used by the FMS for computing the aircraft's position. From this page, the pilot can remove sensors from being used for position updating (refer to procedure 6-11, page 6-79).

FMS Position Update

The pilot can update the FMS to a sensor position or known position, using POSITION UPDATE. When POSITION UPDATE is activated, the FMS position is corrected to the selected position.

Pushing the line select key adjacent to the UPDATE prompt (1R) on the POS SENSORS pages, shown in figures 6-64 and 6-65, displays the FMS UPDATE page, shown in figure 6-66. This page displays the current FMS position (1L), MANUAL prompt (2L), and a SENSOR prompt (2R).

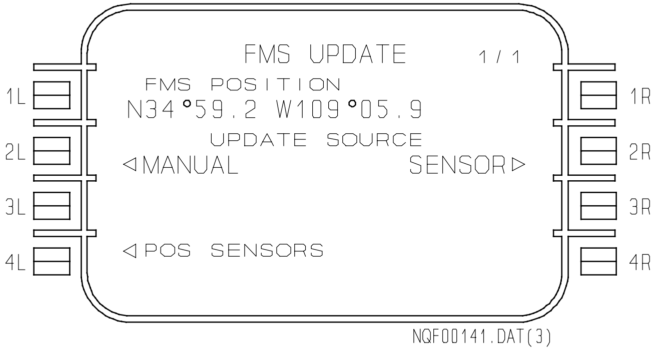
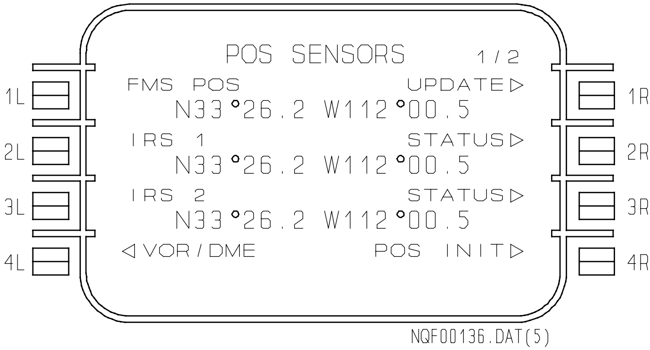
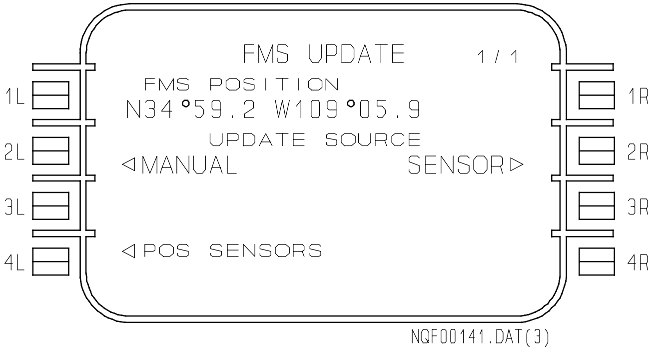
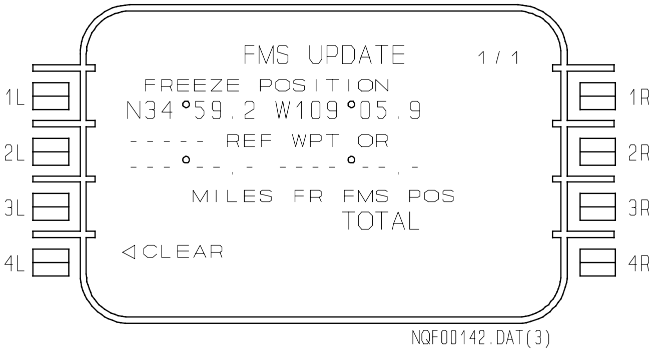
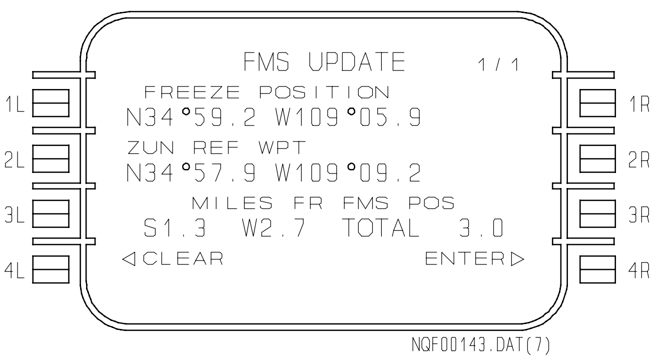


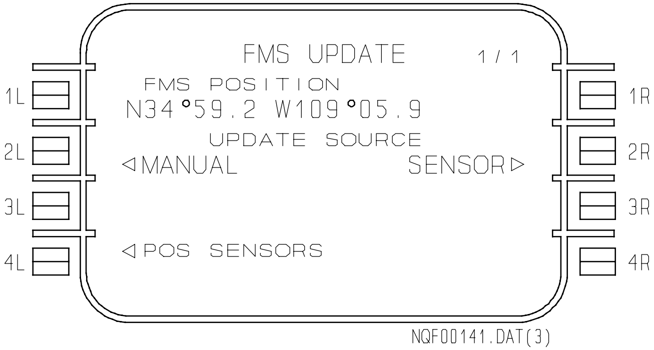
Figure 6-66

Procedure 6-7 uses the manual position UPDATE feature by flying over a known position. The FMS position is checked when the aircraft passes over the ZUN VORTAC in this example.

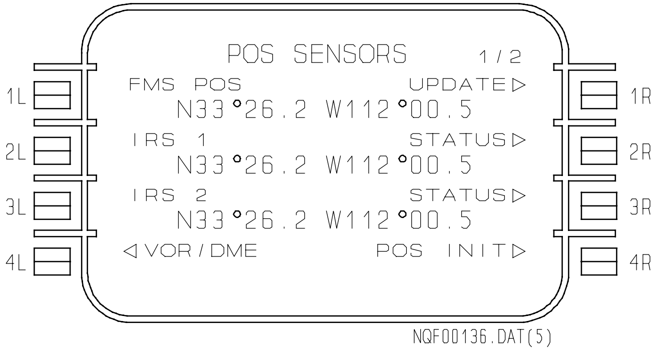
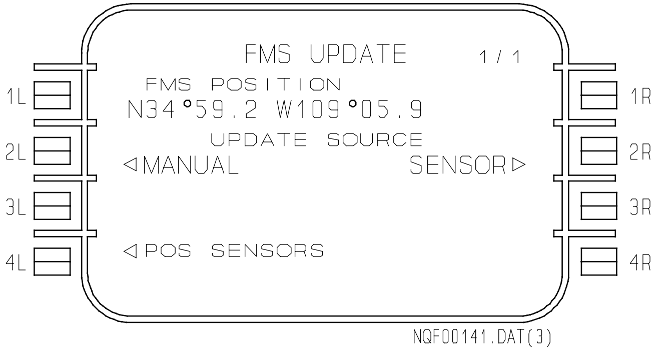
Step	Procedure 6-7 FMS Manual Position Update by Flyover
1	Select POS SENSORS from the NAV INDEX.
2	Before reaching ZUN, select the UPDATE prompt (1R), shown in figure 6-67.  **Figure 6-67**

Step	Procedure 6-7 FMS Manual Position Update by Flyover
3	When the aircraft crosses over the navaid, select the MANUAL prompt (2L), shown in figure 6-68.  **Figure 6-68** **DETAILS** - The FMS position is recorded when the MANUAL prompt is pushed as the aircraft crosses over ZUN. This recorded position, labeled FREEZE POSITION, is displayed on the CDU, shown in figure 6-69. This is NOT the current FMS position. It is the FMS position when the manual prompt was pushed. The FMS continues to update current aircraft position.

Step	Procedure 6-7 FMS Manual Position Update by Flyover
4	Enter either an identifier or coordinates for the REF WPT, shown in figure 6-69. For this example, enter ZUN as the REF WPT.  **Figure 6-69**
5	Review difference between the FREEZE POSITION and the reference position. Select either CLEAR (4L) or ENTER (4R), shown in figure 6-70.  **Figure 6-70**

Step	Procedure 6-7 FMS Manual Position Update by Flyover
5 (cont)	**DETAILS** - The FMS calculates the difference between ZUN and the FREEZE POSITION (FMS position when the aircraft overflew ZUN). Figure 6-70 shows the FMS position was 3.0 NM (1.3 NM south and 2.7 NM west) from ZUN when the aircraft flew over the navaid. At this point, one of two selections can be made. If the ENTER prompt is pushed, a 3 NM correction is added to the present FMS position (1.3 NM north and 2.7 NM east). This jumps the current FMS position (that is constantly changing) 1.3 NM north and 2.7 NM east. If the CLEAR prompt is selected, no correction is applied to the FMS position.
6	For either selection, the FMS displays the current FMS position on the FMS UPDATE page, shown in figure 6-71.  **Figure 6-71** **DETAILS** - Any position sensor set to receive an update is also updated to the new position.

It is also possible to update the FMS position to one of the long range sensors as described in procedure 6-8. If the FMS position is invalid, this feature cannot be used to update the FMS position.

Step	Procedure 6-8 FMS Position Update to Long Range Sensor
1	Select POS SENSORS from the NAV INDEX.
2	Select the UPDATE prompt (1R), shown in figure 6-72.  **Figure 6-72**
3	Select the SENSOR prompt (2R), shown in figure 6-73.  **Figure 6-73**

<table>
<tr><th>Step</th><th>Procedure 6-8 FMS Position Update to Long Range Sensor</th></tr>
<tr><td>4</td><td>Select the UPDATE prompt (right line selects), shown in figure 6-74 for the sensor to be used for updating the FMS. In this example, IRS 2 (3R) is selected.

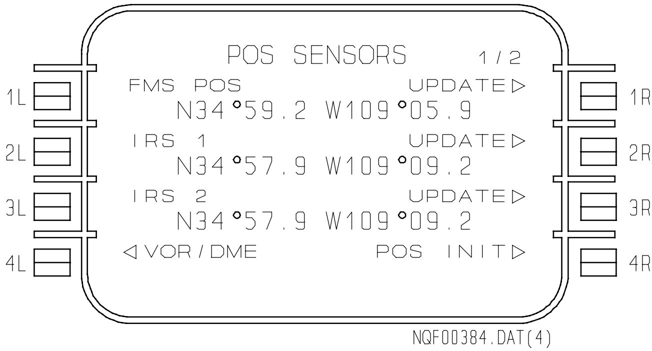


Figure 6-74</td></tr>
<tr><td>5</td><td>Select ENTER at 4R to update the FMS position or CLEAR (4L) to reset the update function, as shown in figure 6-75. Following either selection, the FMS UPDATE page, shown in figure 6-71 is displayed with the current FMS position.

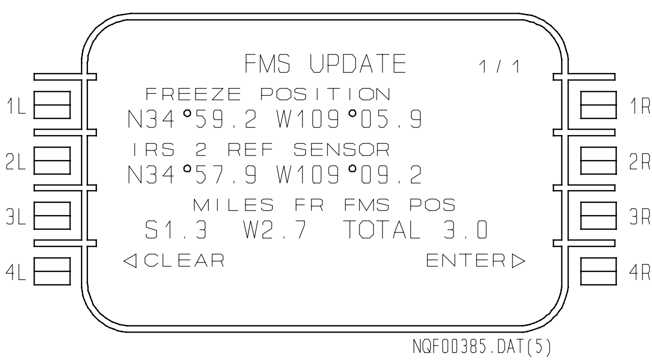


Figure 6-75

DETAILS - Any position sensors set to received an update are also updated to the new position.</td></tr>
</table>

Some long range sensors can be updated in flight. Procedure 6-9 explains how to update sensors in flight without changing the FMS position.

Step	Procedure 6-9 In Flight Sensor Update
1	Select POS SENSORS from the NAV INDEX.
2	Select the MANUAL prompt (2L), shown in figure 6-76.

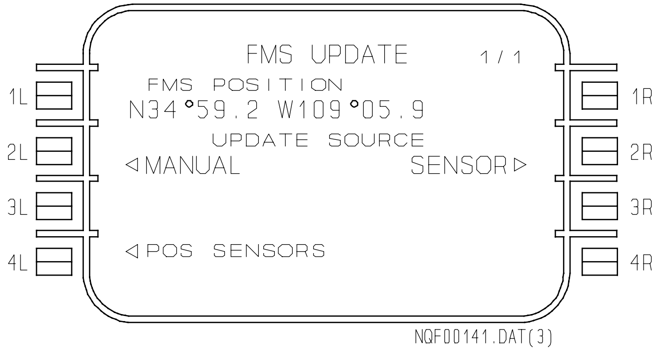
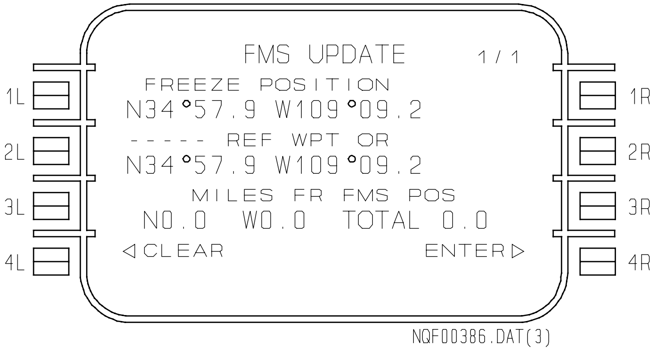


Figure 6-76

Step	Procedure 6-9 In Flight Sensor Update
3	Select the FREEZE POSITION (1L) to the scratchpad.
4	Select the scratchpad position to the REF WPT (2L).

Step	Procedure 6-9 In Flight Sensor Update
5	Select ENTER at 4R to update the sensor position or CLEAR (4L) to reset the update function, as shown in figure 6-77. Following either selection, the FMS UPDATE page, shown in figure 6-71, is displayed with the current FMS position.  **Figure 6-77** **DETAILS** - When the FREEZE POSITION is moved to the scratchpad and back to the REF WPT, the resulting difference is zero. When ENTER is selected, no corrections are added to the FMS and the FMS position is transmitted to the navigation sensors. Only the sensors capable of being updated in flight are updated (e.g., VLF/Omega).

Sensor Status Pages

To check the status of a sensor, push the line select key adjacent to the STATUS prompt, shown in figure 6-78, for that sensor on the POS SENSORS page.

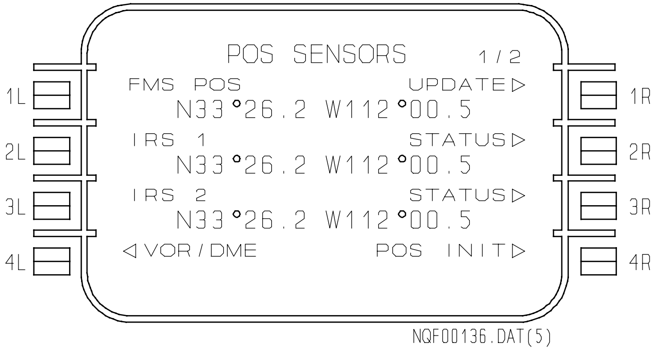


Figure 6-78

The paragraphs that follow describe the status pages used for each type of sensor (IRS, GPS, VLF). For all sensor types, selecting the POS SENSORS prompt at the bottom of any STATUS page returns the display back to the POS SENSORS page from which the sensor status was accessed, as shown in figure 6-78.

IRS STATUS

- **IRS(X) STATUS 1/1** - The page, shown in figure 6-79 shows the IRS status page when the IRS is operating in the NAV mode. Values displayed are:

  - IRS Position
  - Groundspeed
  - IRS Wind
  - Drift Rate
  - Miles from FMS Position.

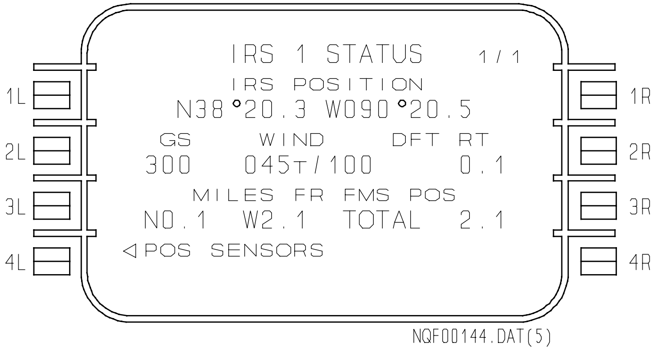


Figure 6-79

The drift rate, calculated by the FMS, is the difference between the IRS and FMS position divided by the length of time the IRS has been in the NAV mode.

When the IRS is in ALIGN mode, the time to NAV is displayed, as shown in figure 6-80.

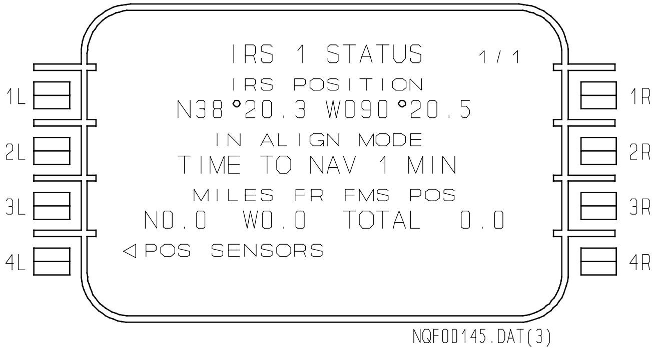


Figure 6-80

Figure 6-81 shows the information that is displayed when the IRS is in ATTITUDE mode.

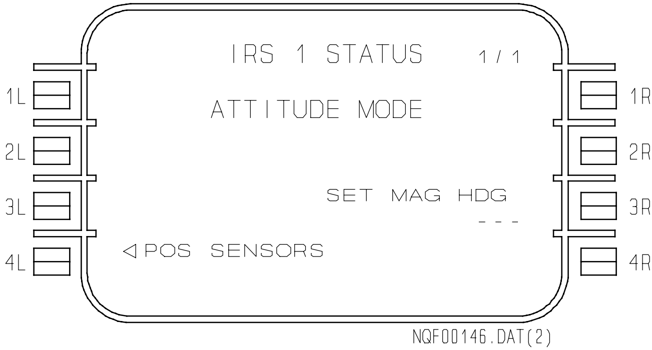


Figure 6-81

<u>If the IRS is switched to the attitude mode on the ground or in flight, the IRS magnetic heading is set to 000°. The correct magnetic heading must be entered on the STATUS page for proper navigation and autopilot/flight director operation. Use the magnetic heading from another, normally operating heading source, or the standby magnetic compass for input</u>.

GPS STATUS

- **GPS(X) STATUS 1/2** - The page, shown in figure 6-82, displays the following information:

  - GPS Position
  - Groundspeed
  - Altitude (altitude above the earth)
  - Miles from FMS Position.

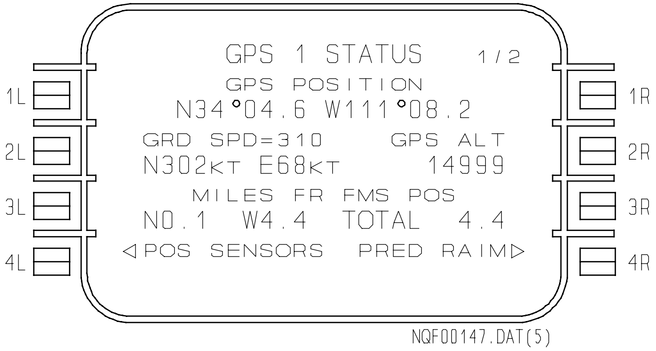


Figure 6-82

GPS altitude is the absolute altitude above the earth. BARO altitude is pressure altitude above the earth. GPS altitude and BARO altitude can differ significantly depending upon current atmospheric and constellation conditions.

- **GPS(X) STATUS 2/2** - The page, shown in figure 6-83, displays the following information:

  - Receiver Autonomous Integrity Monitor (RAIM)
  - Figure of Merit (FOM)
  - Horizontal Dilution of Precision (HDOP)
  - Vertical Dilution of Precision (VDOP)
  - Time (UTC) and Date
  - Operating Mode
  - Satellites Tracked.

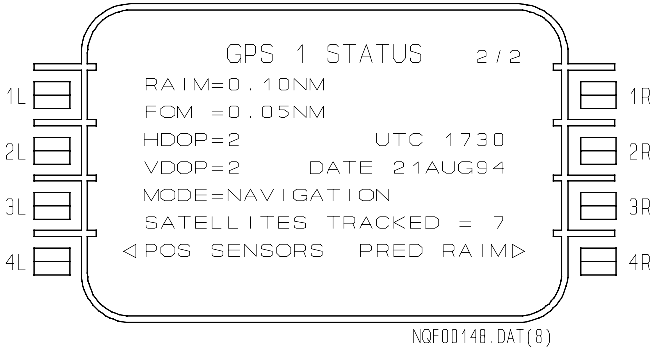


Figure 6-83

RAIM and FOM indicate current uncertainty of position expressed in nautical miles. HDOP and VDOP are numbers that rate current satellite geometry in the horizontal (HDOP) and vertical (VDOP) axis with 1 being the best geometry. Normally, HDOP and VDOP numbers are below 10.

The fifth line displays the operational mode of the GPS. Possible operational modes displayed are as follows:

- SELF-TEST
- INITIALIZATION
- ACQUISITION
- NAVIGATION
- DIFFERENTIAL
- ALTITUDE AIDING
- FAILED.

The acquisition mode is used to acquire satellites after power is applied. The GPS tracks four satellites to acquire its position.

After being in the navigation mode, altitude aiding is the mode entered when fewer than four satellites are being tracked. In this mode, the GPS uses altitude from the digital air data computer (DADC) to aid in determining position.

If the GPS is operated inside a hangar or other areas where signals cannot be received, the GPS can detect this as a failure. Cycling the power is necessary to restart the GPS in this case.

The last line of the GPS STATUS page indicates the number of satellites that are being tracked and used by the GPS.

PREDICTIVE RECEIVER AUTONOMOUS INTEGRITY MONITOR

In addition to RAIM for current conditions, the GPS receiver predictive RAIM calculation gives the pilot an indication as to whether the GPS satellite geometry will be satisfactory for approach at the selected or expected arrival time. YES indicates RAIM is predicted to be within approach criteria. NO indicates RAIM is predicted to be unacceptable or unavailable.

The predictive RAIM page is accessed by selecting the PRED RAIM prompt from any GPS STATUS page. When selected, the PREDICTIVE RAIM page, shown in figure 6-84, is displayed.

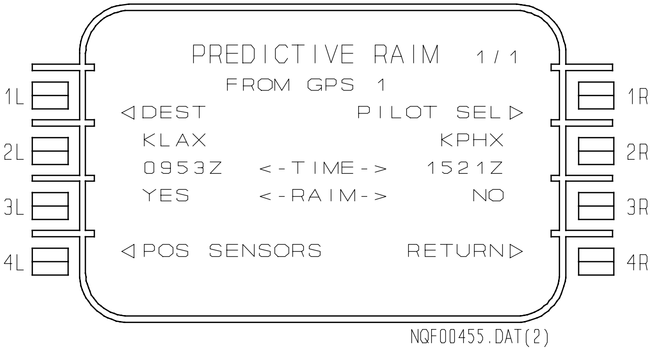


Figure 6-84

The PREDICTIVE RAIM page includes the following information:

- Predictive RAIM Source (1L)
- Destination RAIM Selection (DEST) prompt (1L)
- Destination Identifier (2L)
- ETA at Destination (2L)
- Predicted RAIM Solution for Destination (3L)
- Pilot Selection (PILOT SEL) prompt (1R)
- Pilot Selected Identifier (2R)
- Pilot Entered Time (3R)
- Predicted RAIM Solution for pilot defined place (3R)
- Access to the Position Sensors (POS SENSORS) prompt (4L)
- Return access to the GPS Status page (RETURN) (4R).

The FMS uses the high priority GPS for predictive RAIM. The priority order for the left FMS is GPS 1, GPS 3, GPS 2. The priority order for the right FMS is GPS 2, GPS 3, GPS 1. If only a single GPS is available, both FMSs use it for predictive RAIM.

The ETA on the PREDICTIVE RAIM page is updated when the ETA from the active flight plan changes by more than 10 minutes.

Should the GPS fail or the interface between the FMS and GPS not work properly, the FMS displays the message PREDICTIVE RAIM UNAVAILABLE on the PREDICTIVE RAIM page.

Predictive RAIM is calculated using GPS almanac information. The almanac within the GPS is automatically updated whenever the GPS is on and tracking satellites. The almanac within the GPS is set invalid if it is older than 3.5 days. Should this occur, the message ALMANAC EXPIRED is displayed on the PREDICTIVE RAIM page. The almanac takes approximately 12-25 minutes to update once the GPS is tracking satellites. RAIM predictions are not possible with an expired almanac.

Selecting the DEST prompt from the PREDICTIVE RAIM page, displays the DESTINATION RAIM page, shown in figure 6-85.

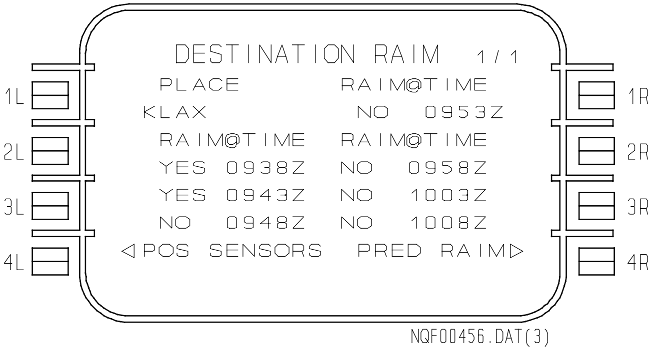


Figure 6-85

The DESTINATION RAIM page includes the following information:

- Destination Identifier (1L)
- Destination ETA from the Active Flight Plan (1R)
- Destination RAIM Predicted for the ETA (1R)
- Destination RAIM Predicted for ETA-15 minutes (2L)

- Destination RAIM Predicted for ETA-10 minutes (3L)
- Destination RAIM Predicted for ETA-5 minutes (3L)
- Destination RAIM Predicted for ETA+5 minutes (2R)
- Destination RAIM Predicted for ETA+10 minutes (3R)
- Destination RAIM Predicted for ETA+15 minutes (3R)
- Access to the Position Sensors (POS SENSORS) prompt (4L)
- Return access to the PREDICTIVE RAIM page (4R).

Selecting the PILOT SEL prompt from the PREDICTIVE RAIM page, displays the PILOT SELECT RAIM page, shown in figure 6-86.

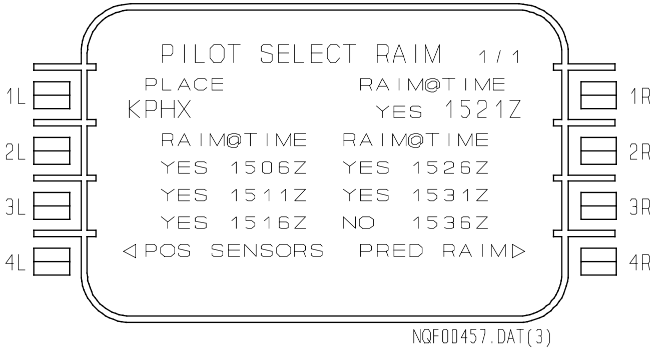


Figure 6-86

The PILOT SELECT RAIM page includes the following information:

- Identifier (1L)
- Time (1R)
- RAIM Predicted for the ETA (1R)
- RAIM Predicted for ETA-15 minutes (2L)
- RAIM Predicted for ETA-10 minutes (3L)
- RAIM Predicted for ETA-5 minutes (3L)
- RAIM Predicted for ETA+5 minutes (2R)
- RAIM Predicted for ETA+10 minutes (3R)
- RAIM Predicted for ETA+15 minutes (3R)
- Access to the Position Sensors (POS SENSORS) prompt (4L)
- Return access to the PREDICTIVE RAIM page (4R).

While the GPS is computing the predicted RAIM at the destination or pilot selected waypoint, the FMS displays the message COMPUTING RAIM on the DESTINATION RAIM and PILOT SELECT RAIM pages.

VLF/OMEGA STATUS

- **VLF/OMEGA(X) STATUS 1/5 -** The page, shown in figure 6-87, displays the following information:

  - VLF/Omega Position
  - Groundspeed
  - Navigation Mode (RELATIVE or ABSOLUTE)
  - Distance from FMS to Sensor.

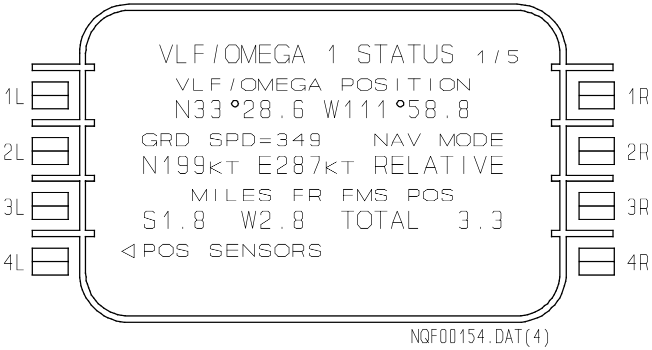


Figure 6-87

- **VLF/OMEGA(X) 2/5 -** The page, shown in figure 6-88, displays the following information:

  - Quality Factor
  - Number of available and used VLFs and Omegas
  - Date
  - GMT
  - Number of times in DR
  - Time in DR (not shown)
  - Mode (not shown):
    Not synchronized
    Major/Minor Failure.

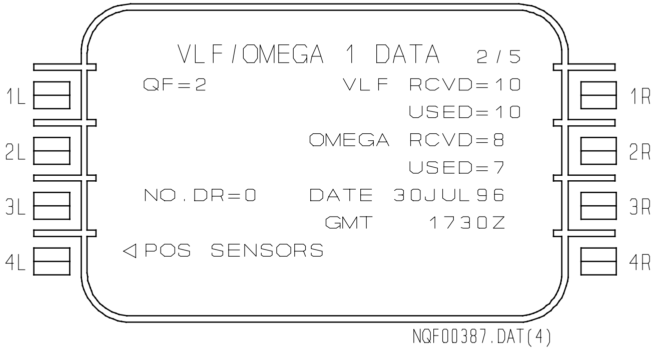


Figure 6-88

The quality factor (QF) represents the nautical miles of position uncertainty. If the quality factor is greater than four, the FMS does not use the sensor for position updating.

There are a total of 10 VLF and 8 Omega stations. The number of stations used is determined by the VLF/Omega sensor.

- **VLF/OMEGA(X) 3/5, 4/5, and 5/5** - Displays each VLF/Omega station and status, shown in figures 6-89 through 6-91. A **U** displayed adjacent to the station identifier indicates the station is being used for navigation.

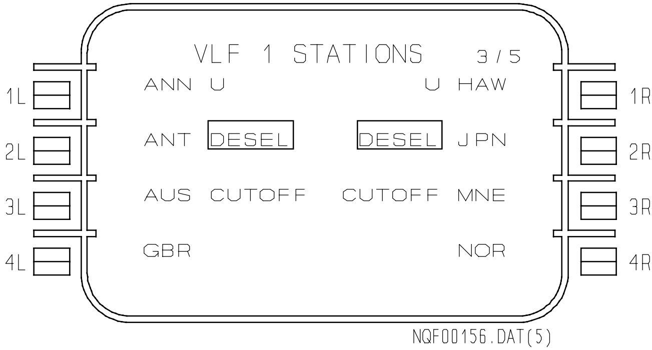


Figure 6-89

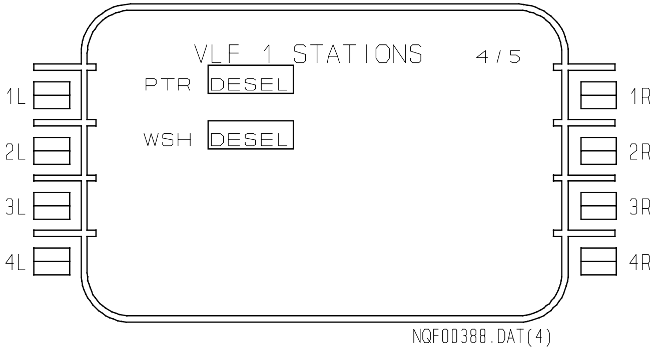


Figure 6-90

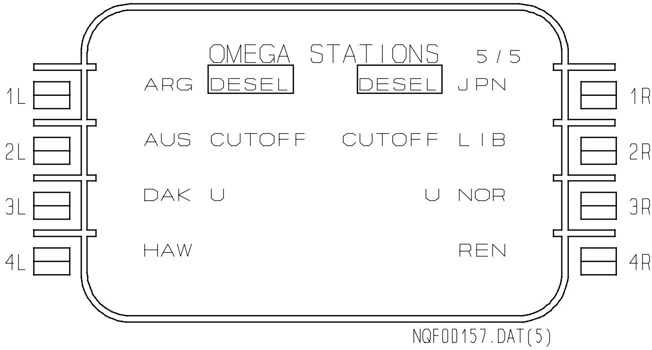


Figure 6-91

Once on these pages, a particular VLF/Omega station can be deselected by following procedure 6-10.

Step	Procedure 6-10 VLF/Omega Station Deselection
1	Push the delete key (DEL). *DELETE* is displayed in the scratchpad.
2	Push the line select key on the VLF/Omega STATUS page adjacent to the station to be deselected. DESEL is displayed adjacent to the station identifier.
3	To reselect the deselected station, push the delete key (DEL). *DELETE* is displayed in the scratch pad.
4	Push the line select key adjacent to the station that is to be used. The DESEL adjacent to the station identifier is removed and the station can be used by the VLF/Omega.

VOR/DME PAGE

- **VOR/DME(X) X/2 -** The page, shown in figure 6-92, is selected using the VOR/DME prompt on the POS SENSORS page. The raw VOR and DME data received from the radio is displayed. Each NAV radio received by the FMS has its own page. When DME hold is selected, the VOR bearing value is replaced with the word HOLD.

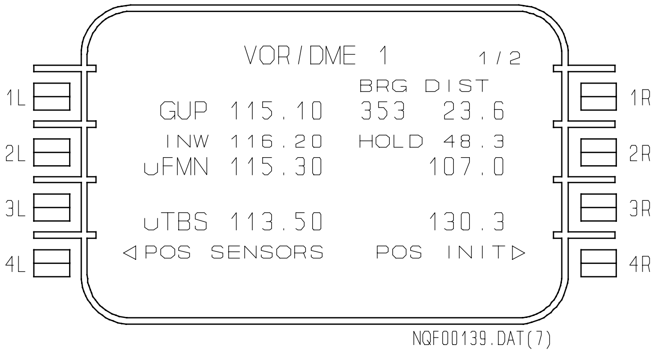


Figure 6-92

SENSORS BEING USED BY THE FMS

Position sensors in use are indicated by the letter **U** that appears before the latitude-longitude position on the POS SENSORS page.

When the FMS is using VOR and DME data for navigation, a **U** is displayed in front of the navaid identifier on the VOR/DME page. In figure 6-92 for example, the FMS is using FMN and TBS. If the letter **T** is displayed, the FMS is tuning the station and verifying the data from the navaid before it starts using the station to compute the aircraft position.

The class of a navaid and the aircraft altitude determines if the FMS can tune and use a navaid for navigation. The class of a navaid can be determined by entering the navaid identification on the DATA BASE WPT or PILOT WAYPOINT page. The class of the navaid can be different in the FMS than the published class. This is because the FMS data base class is adjusted to a lower class where stations on the same frequency interfere with each other at the higher class range limits. Table 6-4 summarizes the range and altitude limits used in selecting navaids for use.

VOR/DME Navaid Class	Aircraft Altitude	Lateral Distance
Terminal	≤ 12,000 ft MSL	≤ 40 NM
Low	≤ 18,000 ft MSL	≤ 70 NM
High	Don't Care	≤ Lesser of 130 NM or Line of Sight
Unrestricted	≤ 12,000 ft MSL	≤ Lesser of 130 NM or Line of Sight
	> 12,000 ft MSL	≤ Lesser of 200 NM or Line of Sight

Range and Altitude Limits for VOR/DME
Table 6-4

POSITION SENSOR DESELECTION

To prevent the FMS from using a sensor for position computations, use procedure 6-11.

Step	Procedure 6-11 Position Sensor Deselection
1	Select POS SENSORS from the NAV INDEX.
2	Push the delete key (DEL). *DELETE* is displayed in the scratchpad.
3	Push the left line select key on the SENSOR page next to the sensor that should no longer be used. DESEL appears adjacent to the sensor identifier.
4	To reselect the deleted sensor, push the delete key and *DELETE* is displayed in the scratch pad.
5	Push the left line select key next to the sensor that is to be used. The DESEL adjacent to the sensor identifier is deleted and the FMS can use the sensor.

To prevent the FMS from using a VOR/DME radio, use procedure 6-12.

Step	Procedure 6-12 VOR/DME Deselection
1	Select POS SENSORS from the NAV INDEX.
2	Select VOR/DME (4L).
3	Select the desired VOR/DME by using the NEXT/PREV keys.
4	Push the delete key (DEL). *DELETE* is displayed in the scratchpad.
5	Push one of the left line select keys next to one of station identifiers. DESEL is displayed adjacent to all three station identifiers. This action is removing the entire radio (VOR and all DME channels) from being used by the FMS.

Step	Procedure 6-12 VOR/DME Deselection
6	To reselect the deleted radio, push the delete key and *DELETE* is displayed in the scratch pad.
7	Push one of the left line select keys next to a station identifier. DESEL is removed from all three station identifiers and the FMS can use the radio.

RADIO TUNING

The TUNE prompt accesses the RADIO TUNING page, shown in figure 6-93 of procedure 6-13. The pilot can use the FMS to tune aircraft radios through the CDU. Depending on aircraft configuration and radio types, tunable radios include the following:

- Two VOR/DME Receiver Pairs
- Three VHF Communication Radios (COMs)
- Two ADF Receivers
- Two HF Communication Radios
- Two ATC Transponders
- Two DGPS Data Link Receivers.

Refer to Radio Configuration on page 6-134, for details on configuring the tuning page to match the aircraft configuration.

Tuning Nav Radios

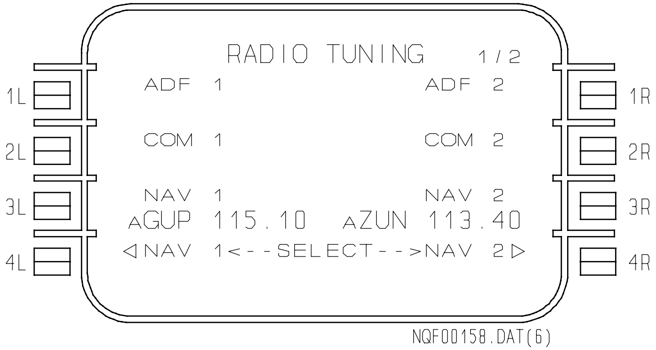
The last three lines of the RADIO TUNING page 1, shown in figure 6-93 of procedure 6-13, are dedicated to the VOR and DME (NAV) radios. The currently tuned frequencies and VOR identifiers for those radios are displayed under the headings NAV 1 and NAV 2. The same display and functions are also displayed on page 1 of PROGRESS.

It is possible to tune the NAV radios through the FMS using the following three different methods:

- NAV page
- Identifier
- Frequency.

The FMS assists tuning by displaying the six closest navaids to the aircraft position.

To tune a NAV radio to one of the listed navaids follow procedure 6-13. While the example is for NAV 1, the procedure applies to both NAV 1 and NAV 2.

Step	Procedure 6-13 NAV Tuning from Six Closest Stations
1	Select TUNE from the NAV INDEX. This procedure can also be accomplished by selecting PROGRESS page 1.
2	Select the NAV 1 (4L) or NAV 2 (4R) prompt at the bottom of the RADIO TUNING page, shown in figure 6-93, or PROGRESS page (not shown). In this example, NAV 1 is selected.  Figure 6-93

<table>
<tr><th>Step</th><th>Procedure 6-13 NAV Tuning from Six Closest Stations</th></tr>
<tr><td>3</td><td>Select the desired station of the six closest stations, shown in figure 6-94. TFD is selected in this example

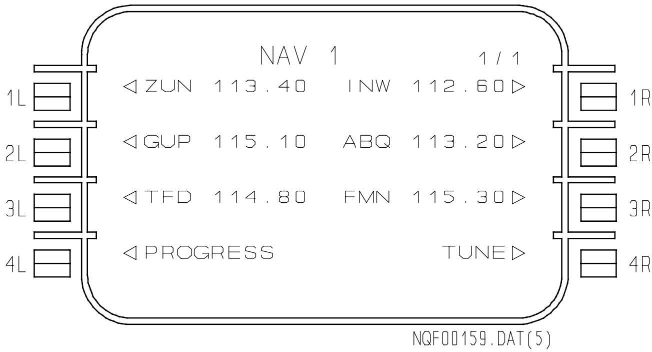


Figure 6-94</td></tr>
<tr><td>4</td><td>The RADIO TUNING page, shown in figure 6-95, or PROGRESS (not shown) is displayed with TFD tuned.

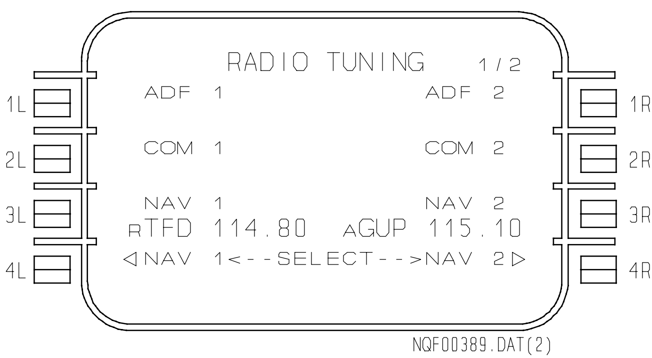


Figure 6-95</td></tr>
</table>

To tune the NAV radios using the station identifier, use procedure 6-14.

Step	Procedure 6-14 NAV Tuning by Identifier
1	Select TUNE from the NAV INDEX. This procedure can also be done using PROGRESS page 1.
2	Enter the station identifier in the scratch pad.
3	Push the line select key adjacent to NAV 1 (3L) or NAV 2 (3R).
4	The FMS tunes the NAV radio and displays the identifier and frequency on the RADIO TUNING and PROGRESS pages.

To tune a NAV radio by frequency, use procedure 6-15.

Step	Procedure 6-15 NAV Tuning by Frequency
1	Select TUNE from the NAV INDEX. This procedure can also be done using PROGRESS page 1.
2	Enter frequency in the scratchpad.
3	Push the line select key adjacent to NAV 1 (3L) or NAV 2 (3R).
4	The FMS tunes the radio to the entered frequency and searches the navigation data base for the closest navaid with the same frequency. The frequency and identifier are displayed on the RADIO TUNING and PROGRESS pages.

The FMS does not use ILS LOC/GS data for position computations. If a DME is associated with an ILS, the FMS can use it in position computation.

ILS frequency and identifier tuning is permitted on the RADIO TUNING page. ILS IDENTS do not appear on the RADIO TUNING and PROGRESS pages when the ILS is tuned by frequency. If the ILS is tuned by ident, the ident is displayed.

The small letter in front of the navaid identifier in the lower part of the RADIO TUNING and PROGRESS pages indicates the tuning mode for the NAV radios (VOR and DME). The following are the tuning modes:

- A (auto tune)
- V (VOR displayed as nav source, auto tune suspended)
- R (remote tune)
- M (manual tune).

Regardless of the tuning mode the FMS constantly tunes the scanning channels of the DME (if available) for position update.

AUTOTUNE

The tuning mode is autotune when the FMS is tuning the VOR. To select autotune, use procedure 6-16.

In autotuning, the FMS automatically selects a navaid, tunes it, and checks the data from the navaid. No pilot interaction is required.

During autotuning, the FMS tunes the VOR that the pilot would most likely tune whenever possible. If the VOR is required for navigation, the FMS tunes the VOR so the most optimum VOR/DME position can be established.

Step	Procedure 6-16 NAV Tuning by Selecting Autotune
1	Confirm that the NAV radio is not selected as the navigation source on either side EFIS. This includes the VOR mode, VOR/LOC mode or preview mode.
2	Confirm that the NAV radio is not in the manual tune mode.
3	Select TUNE from the NAV INDEX. This procedure can also be done using PROGRESS page 1.
4	Use the DEL key to enter *DELETE* in the scratchpad.
5	Line select to NAV 1 (3L) or NAV 2 (3R) on the RADIO TUNING or PROGRESS page. The FMS switches to autotuning and the letter **A** is displayed.

VOR TUNING

If autotuning is active when VOR/LOC is selected for display on EFIS, the letter **V** is displayed adjacent to the navaid identifier. The **V** indicates that autotuning is selected but is suspended while VOR/LOC is displayed. If EFIS is switched back to FMS, autotuning resumes. Remote tuning by the pilot is possible while **V** is displayed. If this is done, the tuning mode changes to remote (**R**).

If VOR/LOC has been selected with the EFIS preview display feature, autotuning is disabled.

REMOTE TUNE

The tuning mode is remote if the pilot has tuned the NAV radios through the FMS or on some aircraft, from the radio control head. The FMS does not change the frequency the pilot has selected.

MANUAL TUNING

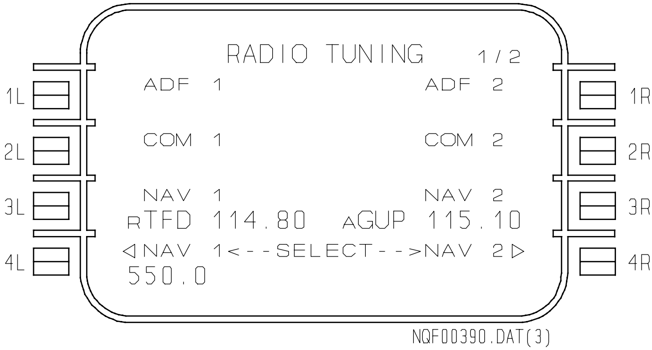
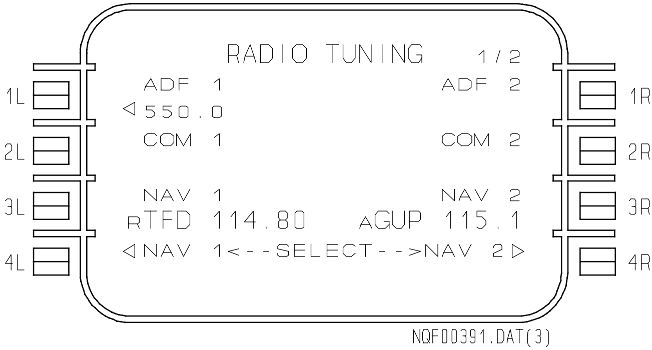
If the manual tuning mode is active, the FMS cannot tune the VOR or associated DME channel. Tuning can only be done by the pilot through the radio control head. Manual tuning is activated by a switch in the cockpit. The FMS still tunes the blind channels of the scanning DME during this mode.

If PRIMUS® II radios are installed, there is a 5 second wait after a navigation frequency is entered on the radio management unit (RMU) before the FMS A, R, V, or M tuning modes can be changed.

Tuning VHF, ADF, and ATC Radios

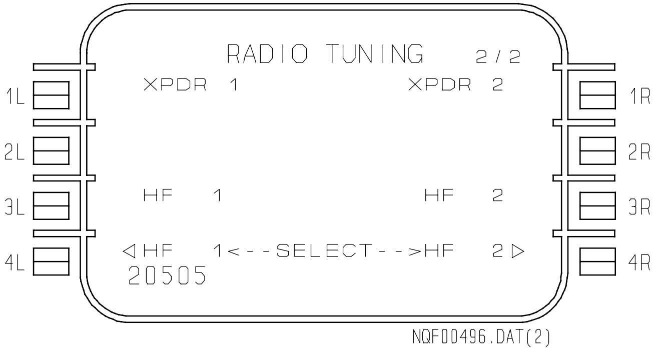
The VHF, ADF, and ATC radios on the RADIO TUNING page can be tuned by the pilot through the FMS. Procedure 6-17 is used to tune these radios.

Step	Procedure 6-17 Tuning ADF, VHF, and ATC Radios
1	Select TUNE from the NAV INDEX.
2	Enter the frequency in the scratchpad. This example tunes ADF 1 to 555.0.

Step	Procedure 6-17 Tuning ADF, VHF, and ATC Radios
3	Push the line select key adjacent to the desired radio (ADF 1 (1L)), shown in figure 6-96.  **Figure 6-96**
4	Confirm tuning, as shown in figure 6-97. Follow this same procedure for tuning any of the other radios.  **Figure 6-97**

Tuning HF Radios

The HF radios on the RADIO TUNING page can be tuned by the pilot through the FMS. Procedure 6-18 is used to tune HF radios.

Step	Procedure 6-18 Tuning HF Radios
1	Select TUNE from the NAV INDEX. HF tuning is only available on page 2 of RADIO TUNING
2	Enter the frequency in the scratchpad. This example tunes HF 1 to 20505.
3	Push the line select key adjacent to the desired radio (HF 1 (3L)), shown in figure 6-98.  **Figure 6-98**

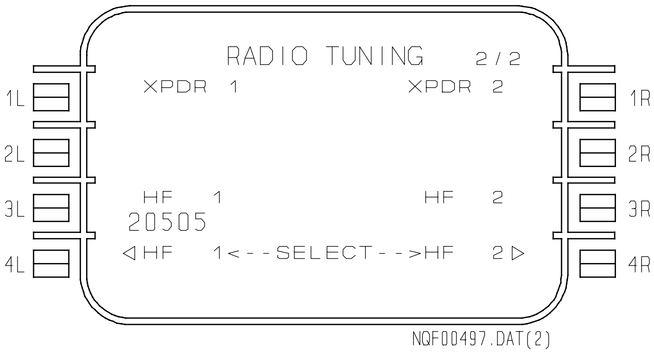
<table>
<tr><th>Step</th><th>Procedure 6-18 Tuning HF Radios</th></tr>
<tr><td>4</td><td>Confirm tuning, as shown in figure 6-99. Follow this same procedure for tuning the other HF radio.


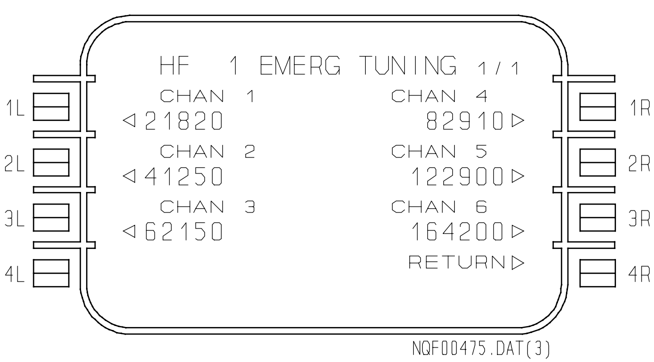
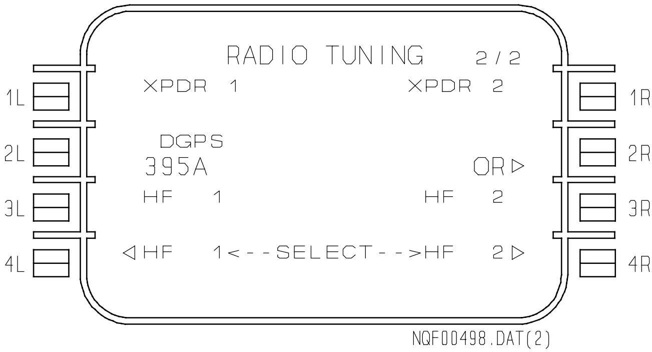
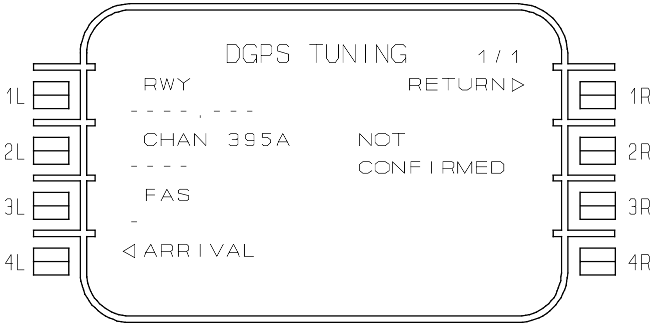
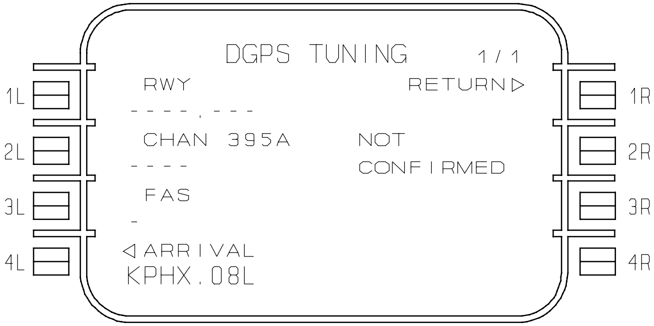
Figure 6-99</td></tr>
<tr><td>5</td><td>For tuning to emergency HF frequency, select HF 1 (4L) or HF 2 (4R).</td></tr>
<tr><td>6</td><td>The emergency frequency page display is shown in figure 6-100. Select the required frequency with the adjacent line select key.


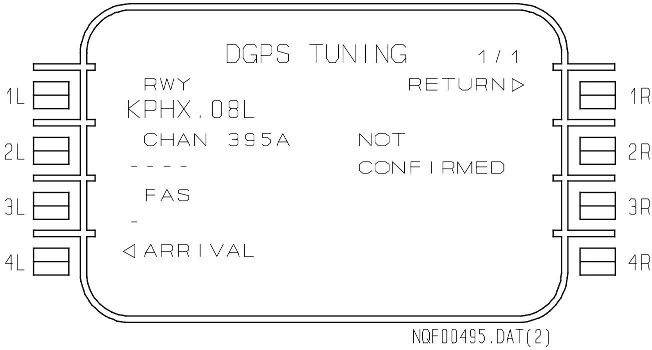
Figure 6-100</td></tr>
</table>

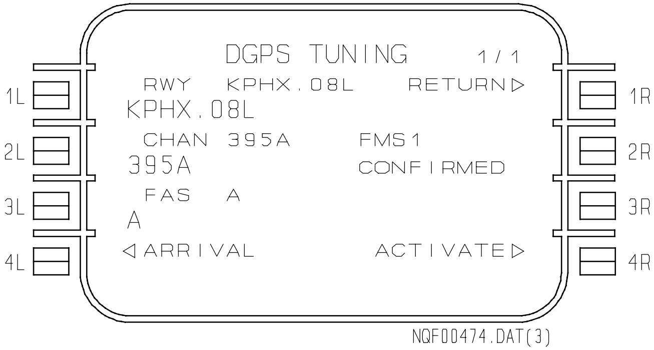
Tuning DGPS Data Link Radios

The DGPS data link radios on the RADIO TUNING page can be tuned by the pilot through the FMS. Procedure 6-19 is used to tune the DGPS data link.

Step	Procedure 6-19 Tuning DGPS Data Link Radio
1	Select TUNE from the NAV INDEX.
2	Select the OR prompt for DGPS tuning. In the example shown in figure 6-101, DGPS tuning is on page 2 at 2L and 2R.  **Figure 6-101**

Step	Procedure 6-19 Tuning DGPS Data Link Radio
3	Enter the destination airport identifier and runway being used for the approach in the scratchpad, as shown in figure 6-102. The information entered on this page is on the DGPS approach plate.  **Figure 6-102**
4	Enter the airport and runway using line select 1L, as shown in figure 6-103.  **Figure 6-103**

Step	Procedure 6-19 Tuning DGPS Data Link Radio
5	Repeat the process for channel and final approach segment (FAS), as shown in figure 6-104. FAS is not used on all approaches and is not a required entry.  **Figure 6-104**
6	Activate the tuning using line select 4R. The ACTIVATE prompt is not displayed until a channel is entered. The RADIO TUNING page is displayed automatically after activation.

Step	Procedure 6-19 Tuning DGPS Data Link Radio
7	After activating, the DGPS TUNING page displays feedback for the DGPS data link, as shown in figure 6-105. Shown at 2R is the status of the tune request. Status messages are "FMSX CONFIRMED", "FMSX TUNING", "NOT CONFIRMED", AND "DATA NOT RECEIVED". "FMS1 CONFIRMED" is shown in this example. See below for definition of each status message.  **Figure 6-105**

Step	Procedure 6-19 Tuning DGPS Data Link Radio
8	Status Message Definition **FMSX CONFIRMED**: The system is operating in the differential mode and the selected approach is being used. The system is ready for the approach. No pilot action required. **FMSX TUNING**: The system is operating in the differential mode but is still in the process of confirming the selected approach. The system is not ready for the approach. No pilot action required. **NOT CONFIRMED**: The system is operating in the differential mode but there is no selected approach or the selected approach cannot be confirmed. The system is not ready for the approach. Pilot action is required to either select an approach or changed the selected approach to one supported by the ground station. **DATA NOT RECEIVED**: The system is not operating in the differential mode because no data is being received from the ground station. This may be because of range or equipment problems.

Configuring Radio Tuning Page

The pilot can choose from several options when displaying and operating the RADIO TUNING page. These options are selected on the radio configuration page. Refer to Radio Configuration on page 6-134 for more details.

NOTICES TO AIRMEN

The pilot can prevent the FMS from using particular VOR and/or DME stations for position computations by using the NOTAM page. Stations can be entered as temporary or permanent. Entries in the temporary column (up to 3) are deleted after the FMS is powered down (upon completion of the flight). Entries in the permanent column (up to 3) are stored in FMS memory until removed by pilot action.

Procedure 6-20 explains how to enter and delete entries from the NOTAM page. The pilot can enter up to 3 navaids as temporary and up to 3 as permanent, as shown in figure 6-106. To enter a NOTAM after accessing the NOTAM page, follow procedure 6-20.

<table>
<tr><th>Step</th><th>Procedure 6-20 NOTAM Entries</th></tr>
<tr><td>1</td><td>Select NOTAM from the NAV INDEX (page 2).</td></tr>
<tr><td>2</td><td>Enter the navaid identifier into the scratchpad, shown in figure 6-106.

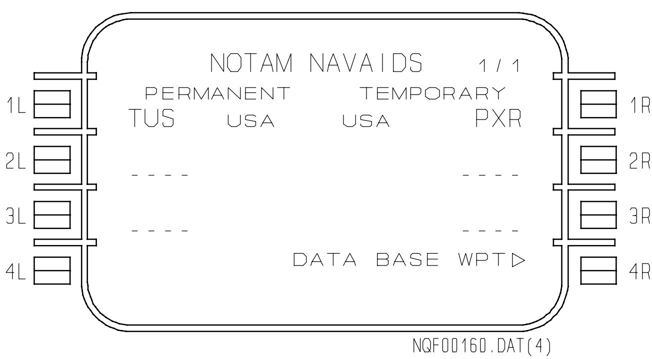


Figure 6-106</td></tr>
</table>

Step	Procedure 6-20 NOTAM Entries
3	Push a line select key under either the permanent or temporary column.
4	Delete an entry by pushing the delete key. *DELETE* is displayed in the scratchpad. Then push the line select key adjacent to the navaid identifier. An entry can be replaced with another navaid without first being deleted.

PATTERNS

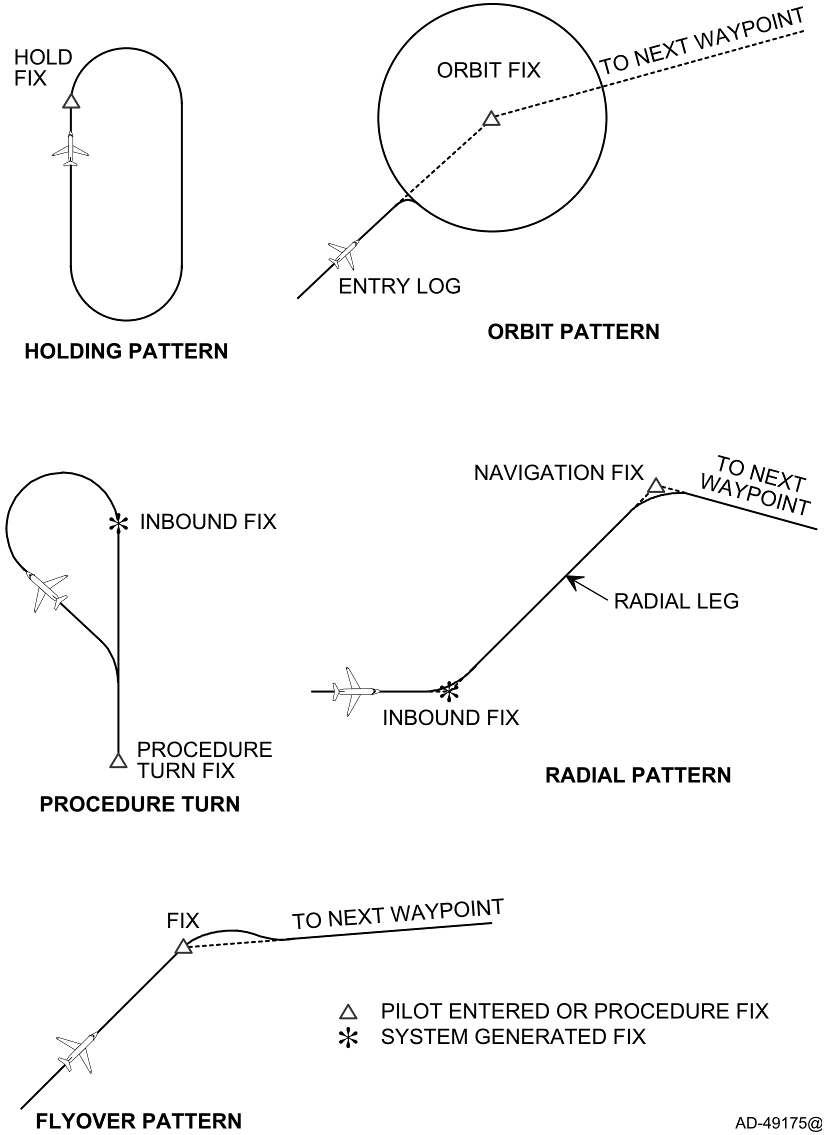
Patterns can be selected for both the active and stored flight plans. For active flight plans only, the PATTERN prompt at 4L is displayed when selecting the DIR key. For stored flight plans, the prompt at 4L is always PATTERN. The procedures for selecting and defining all patterns are similar. In addition to the pilot defined patterns, some procedures, such as approach procedures, contain patterns. These data base patterns are added to the flight plan when activating the approach procedure.

Pattern Definition

Figure 6-107 illustrates each type pattern. Procedures for using each type pattern are contained in this manual. The following patterns, along with page numbers for more detailed information, are available in the FMS:

- HOLD (page 6-97)
- PROCEDURE TURN (page 6-109)
- FLYOVER (page 6-113)
- ORBIT (page 6-115)
- RADIAL (page 6-117)

SPECIAL MISSION must be on to select the ORBIT and RADIAL patterns. See setting special mission under Flight Configuration on page 6-139 for details.



Pattern Formats
Figure 6-107

Pattern Review

Patterns activated into the flight plan can be reviewed at anytime. This is performed by selecting the PATTERNS prompt at 1R, shown in figure 6-108, or by selecting the DIR key and pushing 4L (PATTERN) and then selecting REVIEW (4L). The pilot can review all patterns of all types in the applicable flight plan.

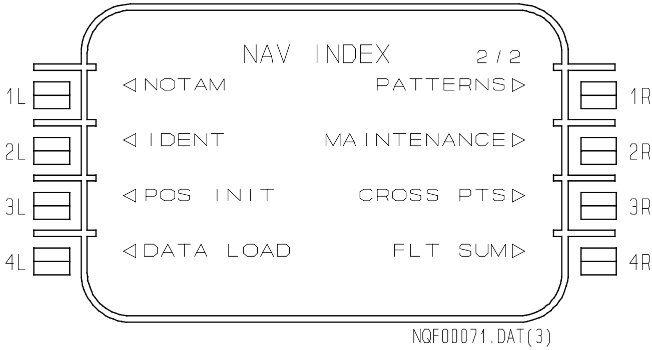
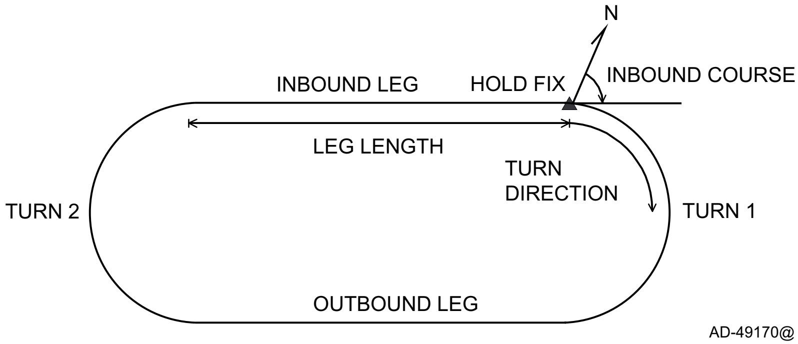


Figure 6-108

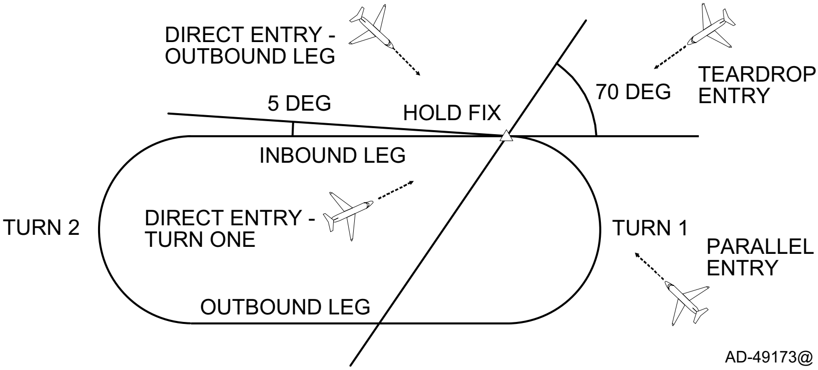
Holding Pattern

The HOLDING PATTERN page is used to define and review holding patterns. Holding quadrant, inbound course, turn direction, and leg length or time of the inbound leg of a holding pattern can be defined on the HOLDING PATTERN page. Figure 6-109 shows a typical holding pattern.



Typical Holding Pattern
Figure 6-109

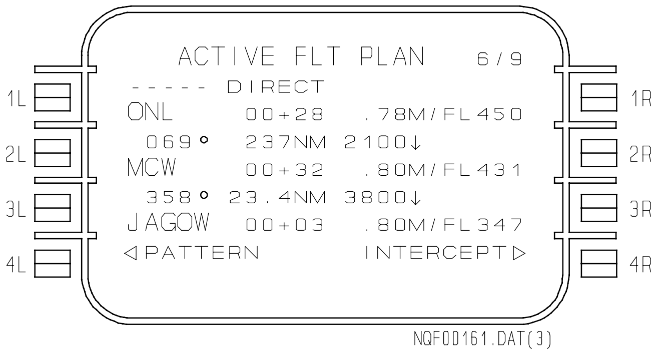
The holding pattern entry type is based on the geometry shown in figure 6-110.



Entry Geometry
Figure 6-110

DEFINING A HOLDING PATTERN

A holding pattern can be defined and reviewed by following procedure 6-21.

Step	Procedure 6-21 Holding Pattern Definition and Review
1	Select the DIR function key.
2	Select the PATTERN prompt (4L), shown in figure 6-111.  **Figure 6-111** **DETAILS** - As an alternative, the PATTERNS prompt can also be selected from the NAV INDEX (page 2).

<table>
<tr><th>Step</th><th>Procedure 6-21 Holding Pattern Definition and Review</th></tr>
<tr><td>3</td><td>Select the HOLD prompt at 1L, shown in figure 6-112. *HOLD* is placed in the scratchpad.

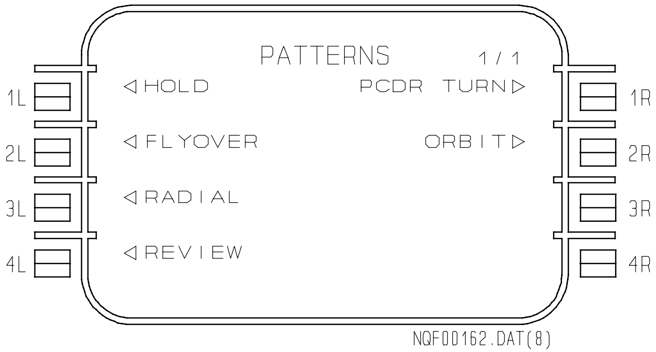


Figure 6-112</td></tr>
<tr><td>4</td><td>Push the select key that is adjacent to the desired holding fix waypoint, shown in figure 6-113. In this example, MCW (2L) is selected.

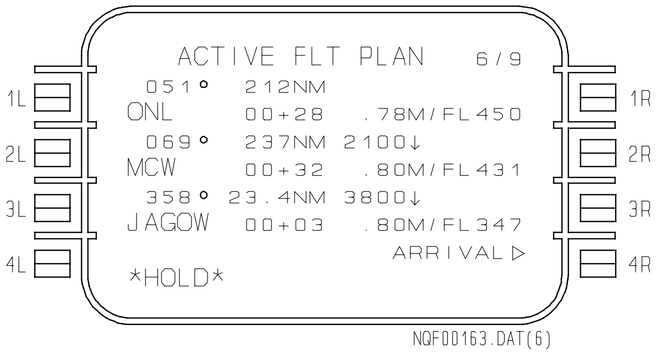


Figure 6-113</td></tr>
</table>

<table>
<tr><th>Step</th><th>Procedure 6-21 Holding Pattern Definition and Review</th></tr>
<tr><td>5</td><td>
Review the default holding pattern definition, shown in figure 6-114. If no changes are required, go to step 12. Make changes as necessary using the required steps.

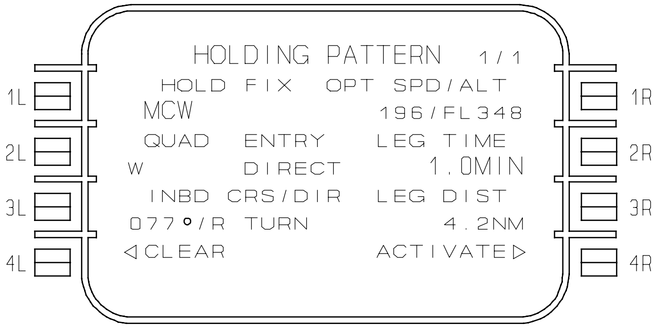
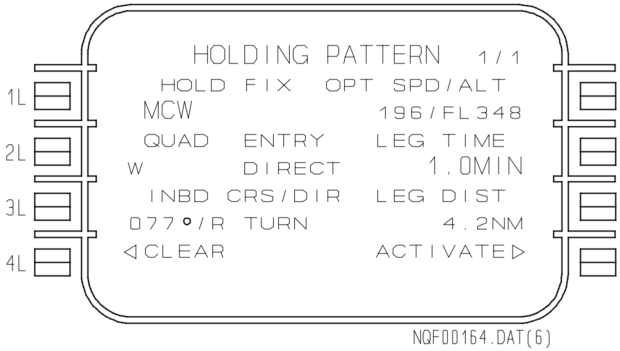
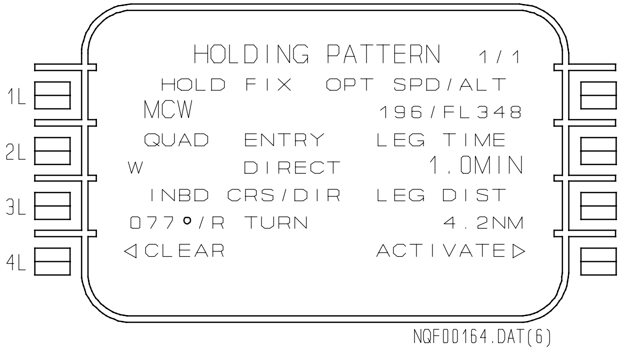


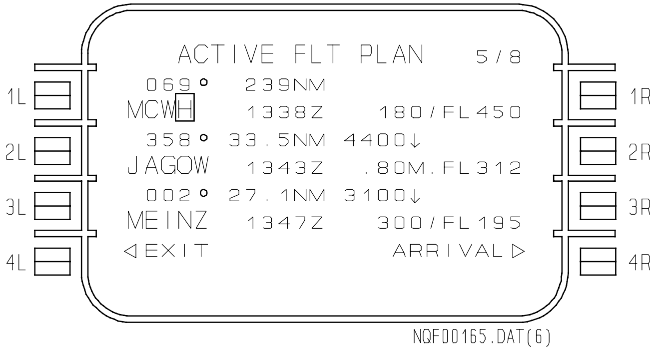
Figure 6-114

DETAILS - The default holding is a standard holding pattern at the designated holding fix with the inbound course set to the flight plan course into the holding fix. Leg times are defaulted to 1 min below 14,000 ft and 1.5 minutes at or above 14,000 ft.
</td></tr>
<tr><td>6</td><td>
Enter the desired holding quadrant and push line select 2L. The FMS displays the cardinal heading for the quadrant as the inbound course. Possible entries for the quadrant are as follows (the inbound course displayed by FMS is shown in parentheses):

- N (180°)
- NE (225°)
- E (270°)
- SE (315°)
- S (000°)
- SW (045°)
- W (090°)
- NW (135°).
</td></tr>
</table>

Step	Procedure 6-21 Holding Pattern Definition and Review
7	Enter any inbound course and/or turn direction and push line select 3L. The entry is made by entering the course followed by a slash (/) and then an **L** or **R** in the scratchpad. To change just the inbound course, only enter the course in the scratchpad. To change just the turn direction, enter a slash (/) followed by an **L** or **R**.
8	The optimum speed and altitude for holding are displayed at the top right (1R) of the HOLDING PATTERN page, shown in figure 6-115.  **Figure 6-115**
9	Enter an altitude. The FMS calculates the holding speed for the entered altitude. Entering *DELETE* returns the optimum altitude.
10	The FMS automatically controls the FGS speed target. The speed is changed to the cruise control manual recommended holding speed at an appropriate distance to decelerate by the time the holding fix is reached. The holding speed is maintained until the holding fix is crossed when exiting hold. The FMS calculates and displays the holding speed only if the FULL PERF method of calculating performance is selected.

Step	Procedure 6-21 Holding Pattern Definition and Review
11	Enter leg time (2R) or distance (3R). When a leg time is entered the FMS computes the leg distance. If a distance is entered, time is computed. Leg time defaults to 1.5 minutes at or above 14,000 feet and 1 minute below 14,000 feet. The FMS uses predicted groundspeeds to compute leg time and distance for the holding fix.
12	Select the ACTIVATE (4R) or the CLEAR (4L) prompt, shown in figure 6-116. ACTIVATE is selected in this example.  **Figure 6-116** **DETAILS -** When CLEAR is selected, the FMS does not insert the holding pattern in the active flight plan. The HOLDING PATTERN page shows the holding fix as undefined. When ACTIVATE is selected, the holding pattern is entered in the active flight plan.

Step	Procedure 6-21 Holding Pattern Definition and Review
13	Confirm placement of holding pattern in the flight plan. This is annunciated by the inverse video letter **H** next to the holding fix on the ACTIVE FLT PLAN page, shown in figure 6-117.  **Figure 6-117**

HOLDING AT PRESENT POSITION

Procedure 6-22 describes holding at present position. Refer to Procedure 6-21 (page 6-99), for basic holding pattern definition.

Step	Procedure 6-22 Holding at Present Position
1	Push the DIR button.
2	Select the PATTERN prompt at 4L. As an alternative, PATTERNS could be selected from the NAV INDEX (page 2).
3	Select the HOLD prompt (1L).
4	Push the line select key (1L) of the FROM waypoint (first waypoint on the first page of the ACTIVE FLT PLAN).

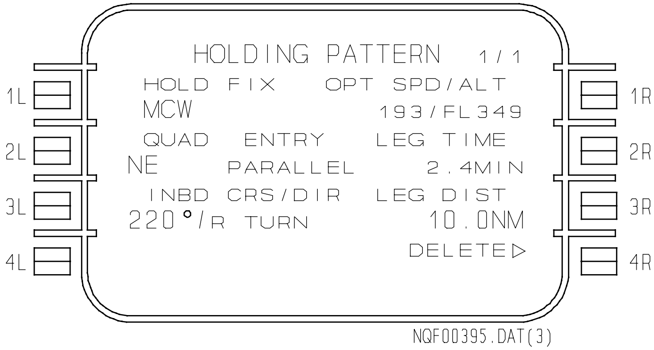
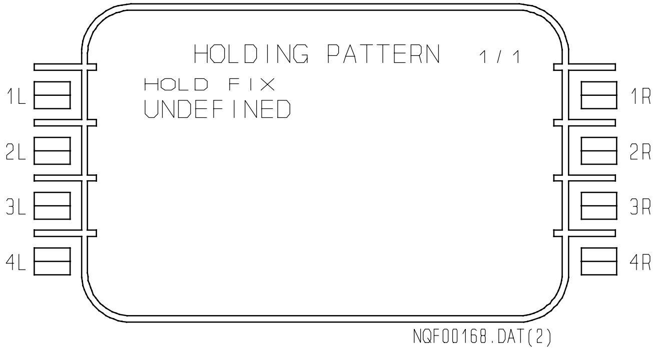
Step	Procedure 6-22 Holding at Present Position
5	The HOLDING PATTERN page with *PPOS (present position) as the holding fix is displayed. Make any necessary changes. Holding at the present position can only be done when LNAV is captured and the crosstrack error is less than 0.25 NM.
6	Select ACTIVATE (4R) or CLEAR (4L).

DELETING A HOLDING PATTERN

Once a holding pattern has been defined and activated, it is possible to delete the holding pattern before crossing the holding fix. This is performed by deleting the pattern from the ACTIVE FLIGHT PLAN page or from the HOLDING PATTERN page.

To delete the holding pattern from the ACTIVE FLT PLAN page, follow procedure 6-23. Refer to procedure 6-24 for deleting holding pattern from the HOLDING PATTERN page.

Step	Procedure 6-23 Deleting a Holding Pattern from the Active Flight Plan Pages
1	Display the active flight plan page showing the holding fix waypoint.
2	Push the delete key. *DELETE* is displayed in the scratchpad.
3	Push the line select key to the left of the waypoint with inverse video of **H**. This deletes the HOLD but not the waypoint. A second *DELETE* deletes the waypoint.

Step	Procedure 6-24 Deleting a Holding Pattern from the Holding Pattern Page
1	Display the HOLDING PATTERN page. Refer to procedure 6-21 (page 6-99).
2	Select the DELETE prompt at 4R, shown in figure 6-118.  Figure 6-118
3	The HOLDING PATTERN page is displayed as UNDEFINED, as shown in figure 6-119.  Figure 6-119

EXITING A HOLDING PATTERN

The EXIT HOLD prompt is used to exit the holding pattern. This prompt is displayed on the ACTIVE FLT PLAN page and the HOLDING PATTERN page.

One minute before the holding fix, the ACTIVE FLT PLAN page displays the EXIT HOLD prompt, shown in figure 6-120. If selected before the holding fix is crossed, the holding pattern is deleted from the flight plan.

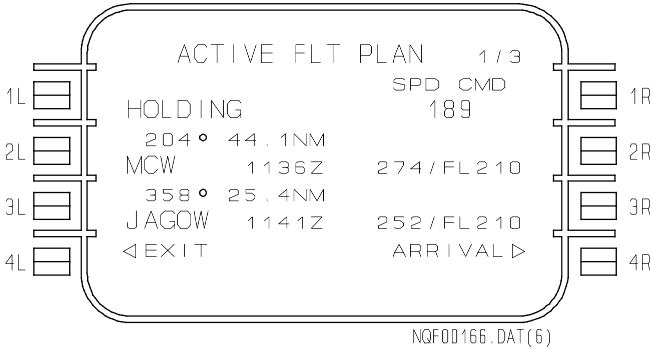


Figure 6-120

After crossing the holding fix, if EXIT HOLD is selected, the aircraft turns back to the holding fix, crosses the fix, and continues with the flight plan. The HOLDING PATTERN page also displays the EXIT HOLD prompt and has the same effect as the EXIT HOLD prompt on the ACTIVE FLT PLAN page.

Once the FMS starts holding at the fix and EXIT HOLD has been selected, the prompt is changed to RESUME on the ACTIVE FLT PLAN (and the HOLDING PATTERN), shown in figure 6-121. When RESUME is selected, the FMS continues to the holding fix and then resumes the holding pattern.

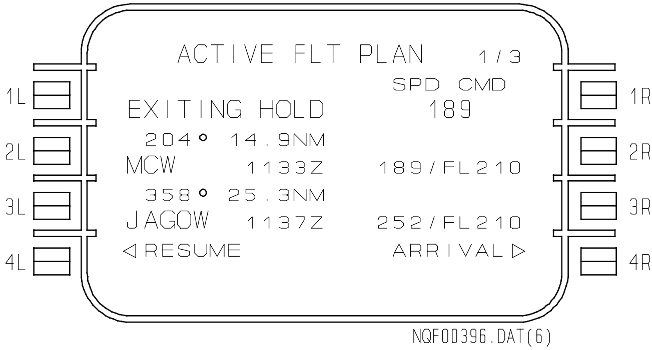


Figure 6-121

HOLDING PATTERN SIZE

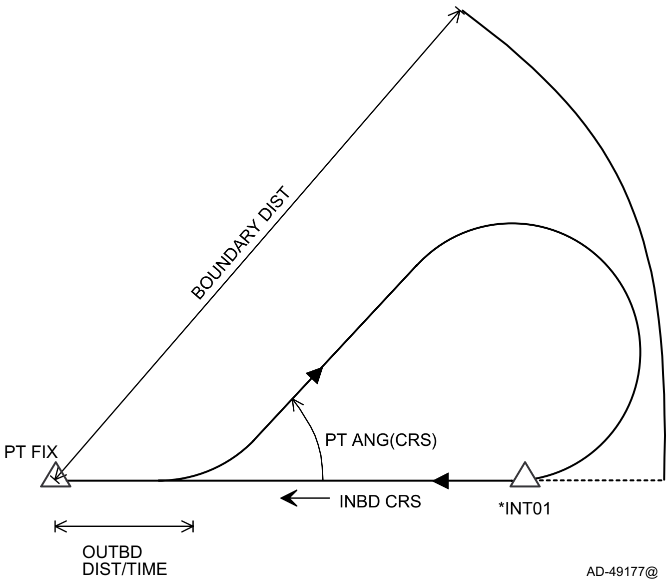
The FMS has been designed to keep the aircraft within protected airspace during holding patterns. If the aircraft approaches a holding pattern at a groundspeed that results in the aircraft exceeding protected airspace, the scratchpad message HIGH HOLDING GRD SPD is displayed 1 minute before the aircraft crosses the holding fix. If this message is displayed, the groundspeed must be reduced and the aircraft position relative to the holding pattern must be monitored. If the high groundspeed is maintained, the aircraft can overshoot the outbound leg and possibly exceed protected airspace.

HOLDING PATTERN COURSE REVERSALS

Holding patterns that are part of the approach transition are used to reverse the airplanes course and align the airplane near the final approach course. These procedures are only available from approaches in the NAV data base. This is similar to the procedure turn, described on page 6-109. The procedure is to exit after entering the holding pattern. For both teardrop and parallel entries, the FMS automatically changes to exit hold at the beginning of the entry. For direct entries, the FMS automatically changes to exit hold at the turn inbound to the hold fix. In both cases, the pilot can resume holding at anytime before exiting the holding pattern. In this instance, exiting the holding pattern requires pilot action.

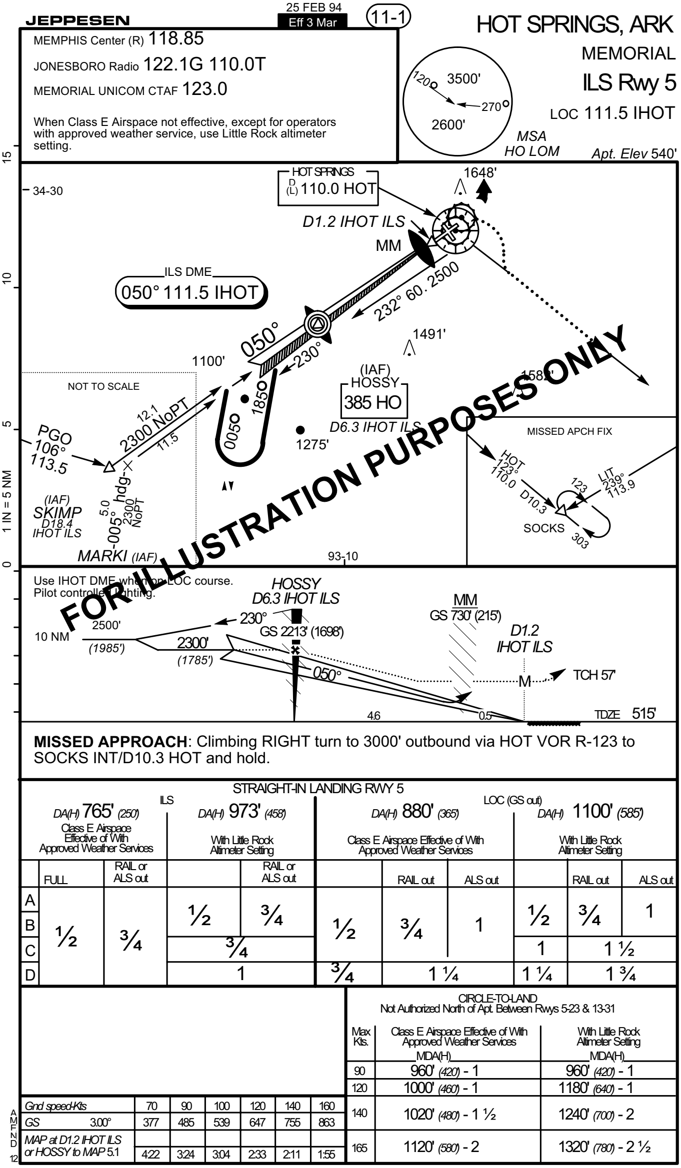
Procedure Turn

The procedure turn is used to reverse course during an approach. **<u>A procedure turn is only available from approaches in the NAV data base.</u>** Using this data, the FMS constructs the procedure turn with an outbound leg, a turn out leg, an arc leg, and an inbound leg, as shown in figure 6-122. Only the outbound leg and the procedure turn (PT) angle are adjustable.



Typical Procedure Turn
Figure 6-122

In the example shown in figure 6-123, the ILS Runway 5 at KHOT approach transition contains a procedure turn that begins at HOT VOR. The procedure turn begins with an outbound leg starting at the initial approach fix (IAF) HOSSY.



AD-43136@

Hot Springs, AR Jeppesen Chart
Figure 6-123

The FMS displays the ACTIVE FLT PLAN page with a **P** in inverse video next to HOSSY, as shown in figure 6-124. In addition, the procedure turn consists of HOSSY and the next two waypoints in the active flight plan.

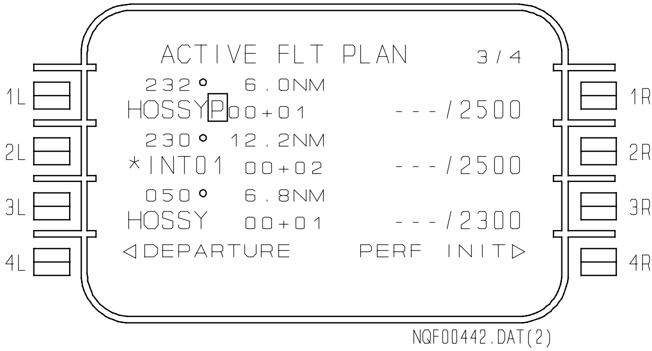


Figure 6-124

The FMS has been designed to keep the aircraft within protected airspace during procedure turns. If the aircraft approaches the procedure turn at a groundspeed that results in the aircraft exceeding protected airspace, the scratchpad message HIGH PCDR TURN GRD SPD is displayed 1 minute before the aircraft crosses the fix. If this message is displayed, the groundspeed must be reduced and the aircraft position relative to the procedure turn must be monitored. If the high groundspeed is maintained, the aircraft can overshoot the turn inbound and possibly exceed protected airspace.

While flying the procedure turn, PROCEDURE TURN is displayed at 1L on the ACTIVE FLIGHT PLAN page. A TURN prompt is displayed at 4L while the aircraft is on the outbound leg, as shown in figure 6-125. The TURN prompt can be selected to immediately begin the turn out.

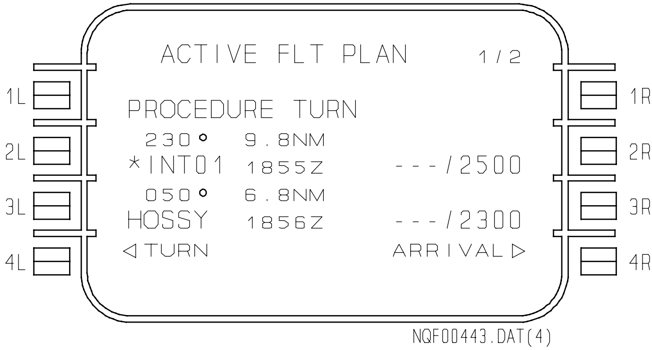


Figure 6-125

Once the procedure turn has started, the active waypoint is *INT01. This remains the active waypoint until *INT01 is overflown on the way back to the final approach fix. The *INTXX waypoint (XX represents a number to distinguish from other *INTXX waypoints) in this example is assigned the number 01 by the FMS.

DEFINING A PROCEDURE TURN

Selecting the PCDR TURN prompt on the PATTERNS page displays the PROCEDURE TURN page, shown in figure 6-126. The procedure turn fix is displayed at 1L, the boundary distance at 1R, and the inbound course at 3L. No changes to this data are permitted. The outbound leg length defined by distance (3R) or time (2R) and procedure turn angle (2L) can be changed. The outbound leg from HOSSY has a 3.5 NM default leg length while the default procedure turn angle is L45°.

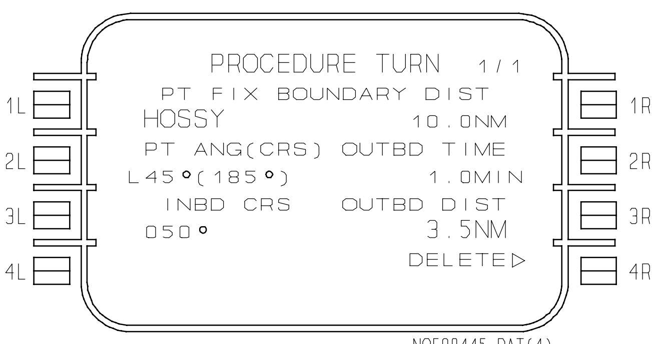


Figure 6-126

The default turn angle can be changed from the PROCEDURE TURN page. Enter an angle between 20° and 90°, prefixed with either an **L** (left) or **R** (right) that specifies the turn out direction. The outbound leg can also be changed by either specifying the outbound time (OUTBD TIME) in minutes or outbound distance (OUTBD DIST) in nautical miles. The controlling entry is in large capital letters. If time is specified, the distance is calculated based on a groundspeed at the procedure turn fix. The groundspeed used when further away than a minute to the procedure turn fix is 210 kts. When within one minute of the fix, the current groundspeed is used.

After changing any of the parameters, the ACTIVATE prompt at 4R is displayed. Select this prompt to redefine the procedure turn.

If the procedure turn is predicted to exceed the boundary distance, the outbound leg and the turn angle are displayed in inverse video. The procedure turn can still be defined with these values.

DELETING A PROCEDURE TURN

Select *DELETE* from the scratchpad to waypoint that has the inverse video **P**. The procedure turn is deleted including the following two waypoints, but not the waypoint selected. *DELETE* cannot be selected to either of the following two waypoints of a procedure turn. An INVALID DELETE message is displayed if an attempt is made to delete these waypoints.

EXITING A PROCEDURE TURN

The procedure turn is flown automatically by the FMS and requires no manual exit. It can be manually terminated while flying the procedure turn by selecting *DELETE* to either the PROCEDURE TURN header at 1L or the ∗INTXY waypoint at 2L. The inbound leg is made active and captured. The airplane turns inbound according to the procedure's turn direction. This process does not ensure compliance with procedure turn rules, but it does give a manual procedure for turning inbound when requested by ATC.

Flyover Pattern

Normally, the FMS begins a turn before reaching the waypoint. In other words, the aircraft is turned inside the waypoint. In some cases, the requirement is to proceed to the waypoint before commencing the turn. This can be done by using the flyover pattern feature of the FMS. In many cases, flyovers are entered in the flight plan automatically when required from data base procedures.

DEFINING A FLYOVER

Unlike holding patterns, there are no pilot entered options required for flyovers. Therefore, there is no dedicated FLYOVER PATTERN page. Follow procedure 6-25 to define a flyover.

Step	Procedure 6-25 Flyover Pattern Definition
1	Push DIR key.
2	Select PATTERN prompt at 4L. As an alternative, PATTERNS can be selected from the NAV INDEX (page 2).
3	Select the FLYOVER prompt at 2L. This action places *FLYOVER* in the scratchpad.
4	Push the Left line select key adjacent to the desired flyover pattern fix waypoint. The flyover is displayed as an inverse video **F** adjacent to the course flown to the waypoint. With this option, the aircraft flies to the waypoint before the turn is started.

DELETING A FLYOVER

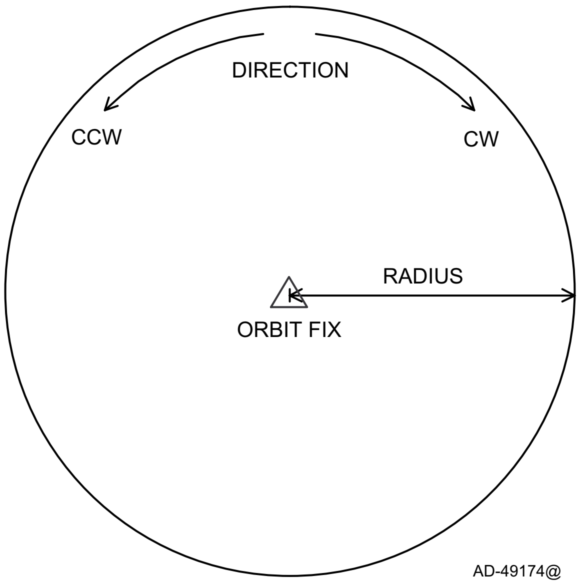
Select *DELETE* from the scratchpad to delete the flyover. Only the flyover is deleted, not the waypoint. A second delete can be used to delete the waypoint.

EXITING A FLYOVER

There are no exit procedures. Either delete the flyover, or change the flight plan to eliminate the flyover waypoint.

Orbit Pattern

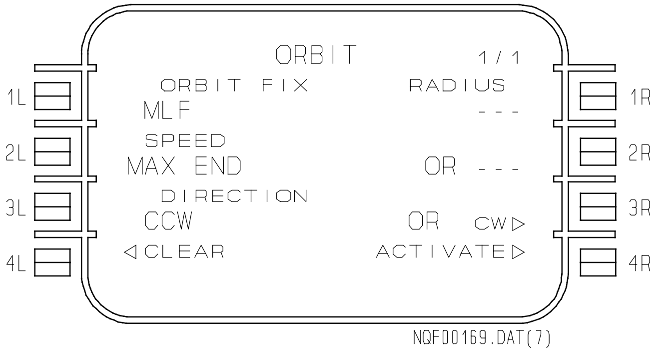
The orbit pattern is used to fly an orbit (circle) around a given waypoint at a distance from 1 NM to 99.9 NM. See figure 6-127 for the orbit definition. Orbit patterns are only available when SPECIAL MISSION is selected (refer to page 6-140).



Orbit Definition
Figure 6-127

DEFINING AN ORBIT PATTERN

Follow procedure 6-26 to define an orbit pattern.

Step	Procedure 6-26 Orbit Pattern Definition
1	Push the DIR key.
2	Select the PATTERN prompt at 4L. As an alternative, PATTERNS can be selected from the NAV INDEX (page 2).
3	Select ORBIT prompt at 2R. This action places *ORBIT* in the scratchpad.
4	Push the left line select key adjacent to the desired orbit pattern fix waypoint.
5	The ORBIT page, shown in figure 6-128, is displayed.  **Figure 6-128**
6	Enter the required radius at 1R.
7	Enter the required speed at 2R (if different from the default).
8	Enter the orbit direction at 3R (if different from the default). The direction is specified as counterclockwise (ccw) or clockwise (cw).
9	Select ACTIVATE (4R) or CLEAR (4L).

Orbit patterns are designated with an inverse video **O** on the pattern waypoint. As the aircraft approaches the orbit, it transitions on to the orbit and flies at the specified radius around the waypoint. A prompt on the active flight plan page can be used to reverse the direction of flight once in the orbit. The reversal turn is always executed to the outside of the orbit.

DELETING AN ORBIT PATTERN

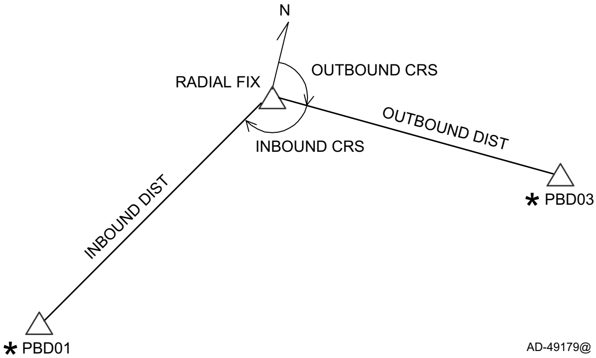
An orbit pattern can be deleted from the flight plan by selecting *DELETE* from the scratchpad to the appropriate waypoint. On the active flight plan pages, DELETE cannot be used within a minute of the pattern. In this case, pushing the EXIT prompt (4L) removes the pattern.

EXITING AN ORBIT PATTERN

One minute before an orbit is entered and while in the orbit, the EXIT prompt is displayed at 4L on the active flight plan page. If EXIT is selected, the aircraft immediately leaves the orbit and proceeds to the next waypoint in the flight plan.

Radial Pattern

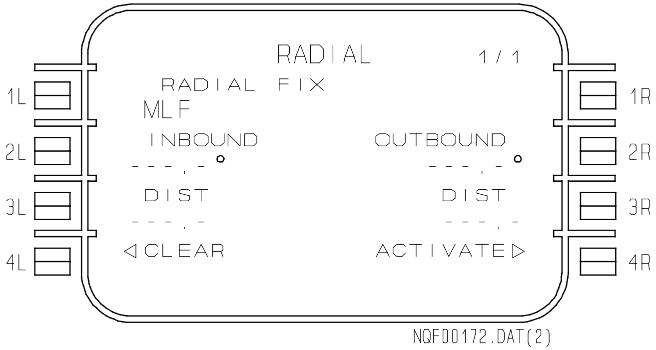
A radial pattern is used to fly a radial inbound and/or outbound from a given waypoint. See figure 6-129 for the radial definition. Radial patterns are only available when SPECIAL MISSION is selected (refer to page 6-140).



Radial Definition
Figure 6-129

DEFINING A RADIAL PATTERN

Follow procedure 6-27 to define a radial pattern.

Step	Procedure 6-27 Radial Pattern Definition
1	Push DIR key.
2	Select the PATTERN prompt at 4L. As an alternative, PATTERNS can be selected from the NAV INDEX (page 2).
3	Select the RADIAL prompt at 3L. This action places *RADIAL* in the scratchpad.
4	Push the left line select key that corresponds to the radial pattern fix waypoint.
5	The RADIAL page, shown in figure 6-130, is displayed.  **Figure 6-130**
6	At a minimum, define an inbound or outbound radial and associated distance to activate the pattern. Both can be defined.
7	Select ACTIVATE (4R) or CLEAR (4L).

A radial pattern is displayed as an inverse video **R** in the flight plan. Temporary waypoints are inserted in the flight plan to properly fly the radials as defined. The inserted waypoints are displayed in inverse video. Other waypoints cannot be inserted between radial waypoints. Radial patterns can be stored in a stored flight plan.

- **Deleting a Radial Pattern -** If both the inbound and outbound radials are defined, two temporary waypoints are inserted in the flight plan. In this case, either waypoint can be deleted individually and the remaining leg remains in the flight plan. If only one waypoint was inserted or remains in the flight plan, deleting it removes the waypoint and the pattern.

- **Exiting a Radial Pattern -** Since a radial pattern is flown as normal legs between waypoints, there is no exit procedure. The normal DIRECT-TO and waypoint delete procedures exit the radial pattern.

Multiple Patterns

It is possible to have multiple patterns in any given flight plan. It is also possible to have multiple patterns on a given waypoint. Refer to table 6-5 for the possible combinations.

Pattern Name	Additional Pattern Permitted
ORBIT	NONE
RADIAL	HOLDING, FLYOVER
HOLDING	RADIAL
FLYOVER	RADIAL
PROCEDURE TURN	HOLDING, FLYOVER

Multiple Patterns
Table 6-5

If multiple patterns exist at a waypoint, the order of delete is FLYOVER, HOLD, RADIAL. If a HOLD or ORBIT is defined on a waypoint with a FLYOVER, the FLYOVER is automatically deleted.

NAVIGATION IDENTIFICATION

The NAV IDENT page, shown in figure 6-131, displays information regarding the software of the FMS and the navigation data base. This page is accessed by pushing the IDENT prompt on the NAV INDEX page 2.

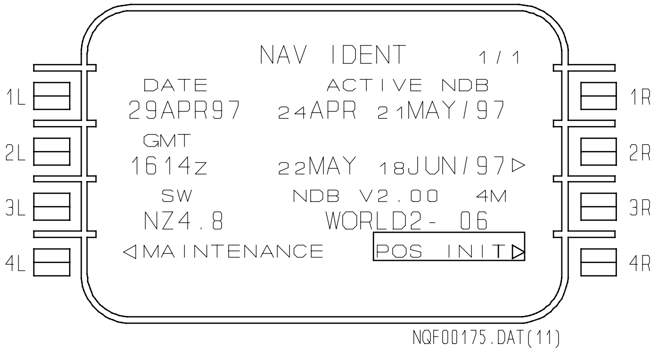


Figure 6-131

The NAV IDENT page displays the date, time, software version, and active navigation data base cycle. It also displays the version, size, and region of the navigation data base.

The date and time can be updated on this page. To change date or time, enter the new date or time in the scratchpad, shown in figure 6-132. Push the line key adjacent to the item being changed.

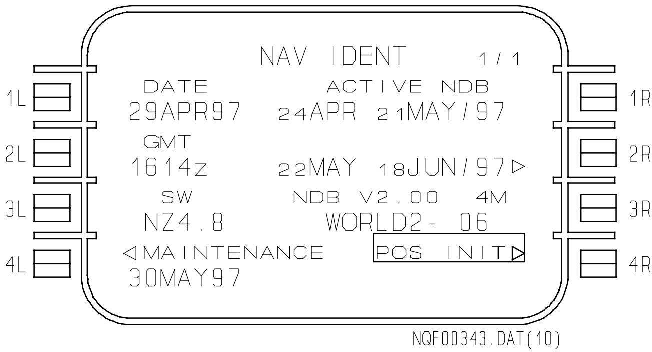


Figure 6-132

The navigation data base contains two 28-day effective cycles. To change the active navigation data base between the two cycles, push the 2R line select key.

If the FMS date corresponds to a day during one of the navigation data base cycles, that cycle is displayed in green. The remaining cycle is displayed in amber. If both cycles are displayed in amber, either the date is wrong, or the navigation data base has expired and must be updated. The data base cycle can only be changed while on the ground. If an active flight plan exists, it is cleared when changing data base cycles.

The navigation data base automatically sequences to the data base cycle at 0900Z. Depending on the location, the data base cycle date may not agree with the current local date.

MAINTENANCE

The MAINTENANCE pages are used to control the selected and active dual system modes, list failed sensors, and select true or magnetic mode for the FMS. The MAINTENANCE pages also control the operating pair and flight plan mode for triple FMS installations.

Selected and Active Operating Modes

There are four configuration modes for the FMS.

- **Dual** - The active flight plan, performance entries, pilot defined waypoints, stored flight plans, and offside radio tuning commands are transferred to the offside FMS automatically (no pilot action required).

- **Initiated Transfer** - The active flight plan and performance entries are transferred on command through a line select key prompt on the last ACTIVE FLT PLAN page. Pilot defined waypoints, stored flight plans, and offside radio tuning commands are transferred to the offside FMS automatically.

- **Independent** - Only offside radio tuning commands are transferred to the offside FMS automatically.

- **Single** - No data is transferred between FMSs.

In all operating modes, position calculation is always independent in each FMS. Table 6-6 lists the requirements necessary for each operating mode. The FMS defaults to the SINGLE mode if the requirements for the DUAL, INITIATED TRANSFER or INDEPENDENT modes cannot be met.

Requirement	Dual	Initiated Transfer	Independent	Single
NZ Software Version Identical	X	X	X	
Navigation Data Base and Cycle Identical	X	X		
Custom Data Base Identical	X	X		
FMS Positions within 10NM	X	X		
Configuration Pins Identical	X	X	X	

Operating Mode Requirements
Table 6-6

- **MAINTENANCE 1/3 -** The page, shown in figure 6-133, is dedicated to selecting and confirming the operating mode of dual FMSs. In figure 6-133, the selected mode is INITIATED TRANSFER but the active mode is INDEPENDENT.

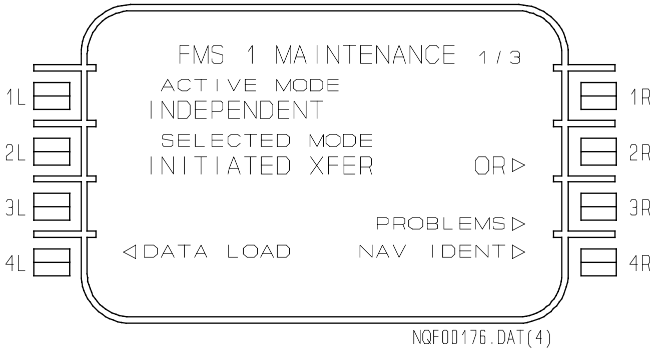


Figure 6-133

The selected operating mode can be changed by selecting the OR prompt (2R), shown in figure 6-133. The OPERATING MODE page, figure 6-134, is displayed. The selected mode is indicated on the page and selection can be made of any mode by using the appropriate line select key. After selecting a mode or the RETURN prompt (1R), the MAINTENANCE 1/3 page is automatically displayed.

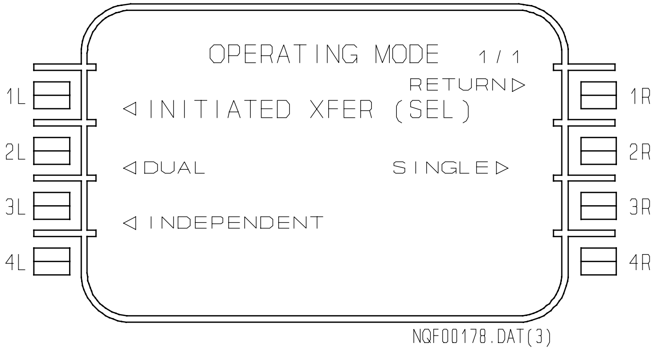


Figure 6-134

If the active mode is not the same as the selected mode, it is because of some problem. In this case, the PROBLEMS prompt (3R), figure 6-133, is displayed and can be selected. Selecting the PROBLEMS prompt displays the OP MODE PROBLEMS page, figure 6-135, which lists the problem(s) preventing the FMSs from operating in the selected mode. After the problems are resolved, the FMS can operate in the selected mode. If an automatic reversion to independent is made from initiated transfer or dual, the PROBLEMS prompt at 3R, shown in figure 6-133, is replaced with the RET TO SEL MODE when the problem is corrected. The pilot must push this prompt to return to the selected mode.

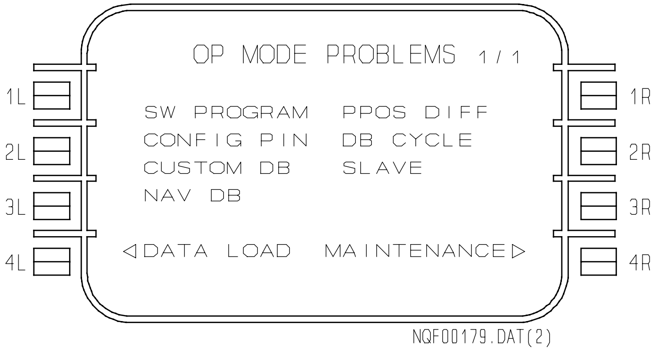


Figure 6-135

Triple FMS Installations

Some installations have three FMSs installed. The triple operation is different for NZ-2000 computer installations versus IC-800 installations. Each is described below.

TRIPLE NZ-2000 INSTALLATIONS

In triple NZ-2000 installations, the third FMS is referred to as a warm spare. The warm spare consists of a CDU and an NZ. The NZ is labeled as NZ 3.

The aircraft is wired such that the warm spare can be switched in place of FMS 1 or FMS 2. When this occurs, NZ 3 takes the place of NZ 1 or NZ 2. This means the operator can replace NZ 1 or NZ 2 when a failure occurs.

The following is an example of how the warm spare is switched into a system. Assume NZ 2 has failed during a flight. The warm spare (NZ 3) is then switched in place of NZ 2. At this point, NZ 3 is wired to CDU 2 (copilots CDU), and NZ 2 is wired to CDU 3 (warm spare CDU). In order to have dual or initiated transfer capability in this configuration, it may be necessary to transfer the custom data base to NZ 3.

The warm spare operates in single. It does **NOT** receive active flight plans, pilot defined waypoints, stored flight plans from FMS 1 or FMS 2. The warm spare does **NOT** tune NAV 1 or NAV 2. The warm spare can tune other radios and interface to AFIS if this capability has been implemented by the installer.

On the G-IV, performance predictions are not possible on the warm spare because it does not interface to either performance computer. Pushing the PERF key on the CDU blanks the CDU and returns to the NAV IDENT page. Any numbers requiring performance predictions (such as fuel remaining) use the current value.

TRIPLE IC-800 INSTALLATIONS

For installations with three FMSs in IC-800 computers, FMS 3 provides the same interface capability as FMS 1 and 2. It includes Long Range Navigation Sensors, EFIS display, autopilot coupling, lateral guidance, and vertical guidance. Any two of the three FMSs can be selected to operate as a pair via the CDU pages with no external switching.

Once two FMSs have been selected to operate as a pair, either dual, initiated transfer, independent, or single can be selected as the operating mode for these two FMSs. The active operating mode and resultant data transfers, including radio tuning, for these two FMSs are determined using the normal operating modes described on page 6-121.

When a different FMS is selected to be part of the pair, that FMS begins operating in the selected mode without a cold start. The two FMSs which are operating as a pair determine the master based on the EFIS selection. The slave then synchronizes its flight plan with the master.

When an FMS is deselected from the pair, it begins single operation without a cold start. Thus it keeps its flight plan and present position. The FMS which is operating in the single system mode, can update its flight plan automatically or via initiated transfer from either of the other FMSs. The FMS in the single system mode monitors the VOR/DME radio inputs and computes a radio position if possible. The single FMS does not tune the VOR and DMEs. However, it can tune all of the other radios (VHF COM, ATC Transponder, etc.) directly using its own tuning command outputs.

• **MAINTENANCE 1/3 -** The page, shown in figure 6-136, is dedicated to selecting the operating pair and selecting and confirming the operating mode of triple FMSs. In figure 6-136, the operating pair is FMS 1-2 and the selected mode is INITIATED TRANSFER but the active mode is INDEPENDENT. The operation of the selected and active mode is the same as for a dual system. Refer to page 6-123 for information.

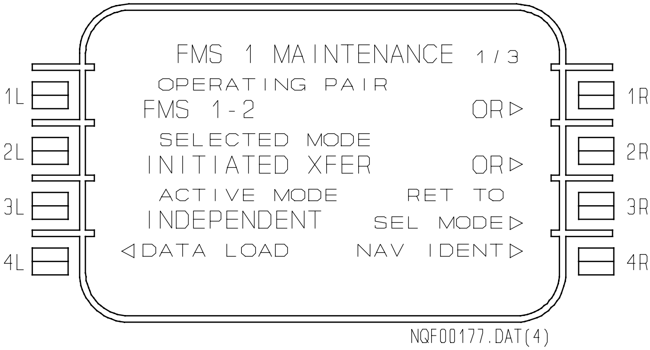


Figure 6-136

Operating pair identifies the two FMSs that can operate in dual or initiated transfer. The normal selection is FMS 1 and 2. The operating pair can be changed by selecting the OR prompt (1R), figure 6-136. The OPERATING PAIR page, figure 6-137, is displayed with the selected pair indicated. The desired pair can be selected using the appropriate line select key. After selecting a pair or the RETURN prompt (1R), the MAINTENANCE 1/3 page is automatically displayed.

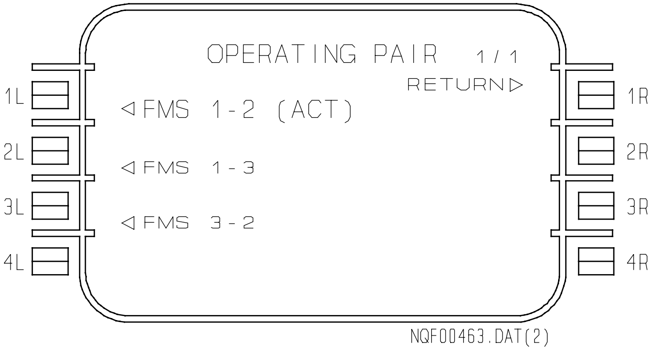


Figure 6-137

The FMS not selected as one of the pair, operates in the SINGLE mode. Even though the non-paired FMS is operating in SINGLE, the flight plan can be updated from the other FMSs. The selection of options for flight plan updating is made from MAINTENANCE 1/3 of the non-paired FMS, as shown in figure 6-138.

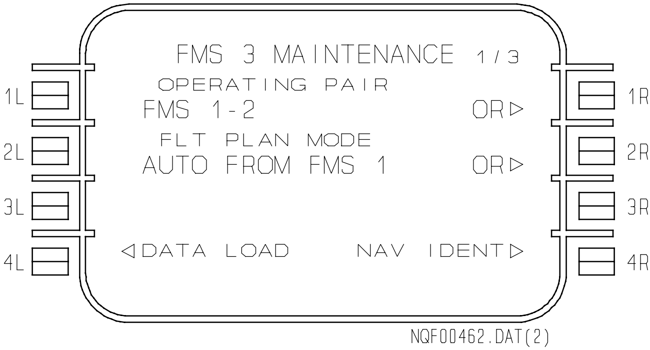


Figure 6-138

Selecting the OR prompt (2R), figure 6-138, displays the FLT PLAN MODE page, figure 6-139. The active mode is indicated and selection of modes can be made using the appropriate line select key. After selecting a mode or the RETURN prompt (1R), the MAINTENANCE 1/3 page is automatically displayed.

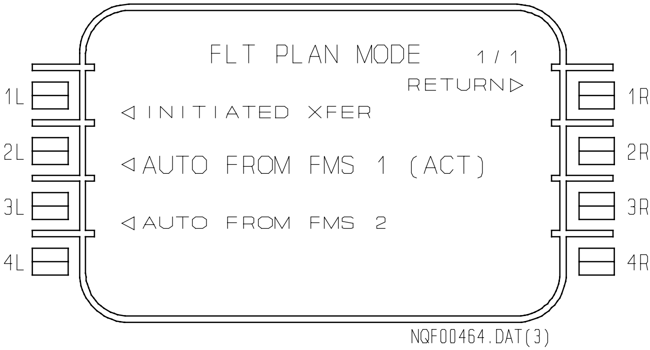


Figure 6-139

Failed Sensors

- **MAINTENANCE 2/3** - Figure 6-140 lists the currently failed sensors as determined by the FMS.

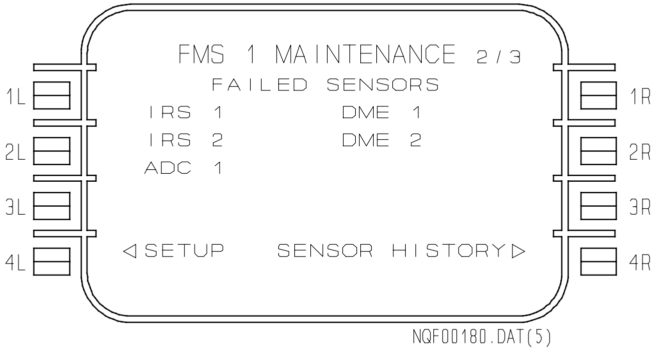


Figure 6-140

The SETUP prompt (4L) is used to access the setup pages. Refer to FMS Setup Pages, page 6-132, for further details on this function.

The SENSOR HISTORY prompt (4R) is used to display a list of sensors that have failed sometime after takeoff during the current flight, but are not failed at the present time. Figure 6-141 shows the SENSOR HISTORY page.

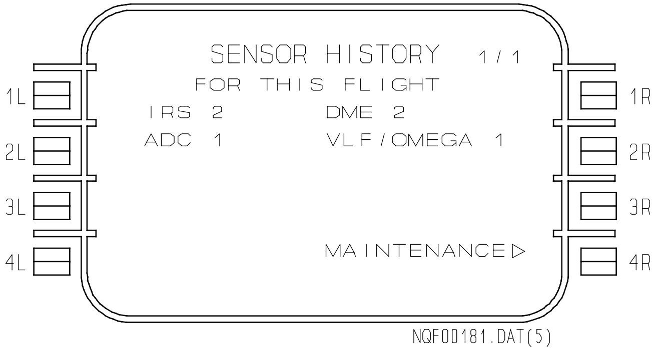


Figure 6-141

True/Magnetic Selection

- **MAINTENANCE 3/3 -** The page, shown in figure 6-142, is dedicated to selecting true or magnetic headings for the FMS and the EFIS heading display. If TRUE is the active mode, all courses and headings displayed by the FMS are followed by the letter **T**. If MAG is the active mode, all courses and headings displayed by the FMS are followed by a degree symbol (**°**) on the FMS pages.

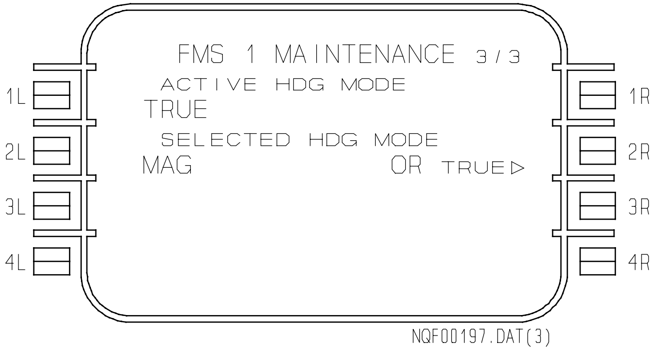


Figure 6-142

The active mode also reflects how courses are displayed on the HSI. If the FMS is selected as the navigation source for the HSI, the course displayed by the FMS is relative to the mode that is displayed for the ACTIVE HDG MODE on this page.

The pilot can toggle between magnetic and true by pushing the line select key 2R.

High Latitude Flying

There are two areas defined by the FMS for operations at high latitudes. The first area, called the high latitude area, is defined as being above 72° 30’ N or below 59° 30’ S when entering, and below 72° N or above 59° S when leaving the area. The second area, called the polar region is defined to be above 85° N or below 85° S when entering, and below 84° N or above 84° S when leaving.

- **High Latitude Area -** The FMS automatically switches to true heading when entering the high latitude area (above 72° 30’ N or below 59° 30’ S). The EFIS heading is also switched to TRUE. At the time this switch occurs, the message ACTIVE MODE IS TRUE HDG is displayed. This switch is necessary because the FMS calculates magnetic heading by using true heading and adding or subtracting the magnetic variation. Magnetic variation up to 73° N or 60° S is stored in the FMS. Above the north latitude and below the south latitude, magnetic heading cannot be calculated by the FMS.

  After leaving the high latitude area (below 72° N or above 59° S), the FMS automatically switches back to magnetic heading, if MAG is the selected mode. The message ACTIVE MODE IS MAG HDG is displayed when the switch occurs.

- **Polar Region -** Entering the polar region (above 85° N or below 85° S) results in the message ENTERING POLAR REGION being displayed. When entering the polar region, the FMS drops all except its highest priority sensor for navigation. Sensor blending is suspended and the FMS position is slowly ramped to the position of its highest priority sensor. Under normal circumstances, this means that FMS 1 uses IRS 1 and FMS 2 uses IRS 2. If the highest priority sensor has failed, the next priority sensor is used. The POS SENSORS page indicates which sensor is being used.

  Since the heading displayed on EFIS is directly from the IRS, it is important that both the FMS and IRS cross the pole at the same time. This is part of the reason for using only one sensor while in the polar region.

  The FMS uses its highest priority sensor during all operations in the polar region. When leaving the region (below 84° N or above 84° S), the message EXITING POLAR REGION is displayed. The FMS resumes available sensors blending and slowly ramps from the high priority sensor position to the blended sensor position.

  The plan mode for the EFIS map display is not useful while at/or near the pole. The information presented is correct, but the presentation is not useful because the plan mode is presented north up. When at the North pole for example, everything is south. Therefore, the plan mode must not be used during operations at or near either pole. Instead, use the regular map mode.

Correctly flown holding patterns are possible while in the polar region. However, the EFIS airplane symbol does not always show on the holding pattern. This is most pronounced the further away from the holding fix and/or the closer to the pole. If a holding pattern is hand flown in the polar region, the HSI presentation should be used for required track and deviation.

Since the FMS position is tied to the highest priority IRS (GPS if no IRS is available) and the IRS position cannot be updated, manual FMS position update is not permitted in the polar region.

During operations in the polar region, FMS lateral offset is inhibited. Any entered lateral offset is removed when entering the polar region. Therefore, the pilot cannot enter a lateral offset in the polar region.

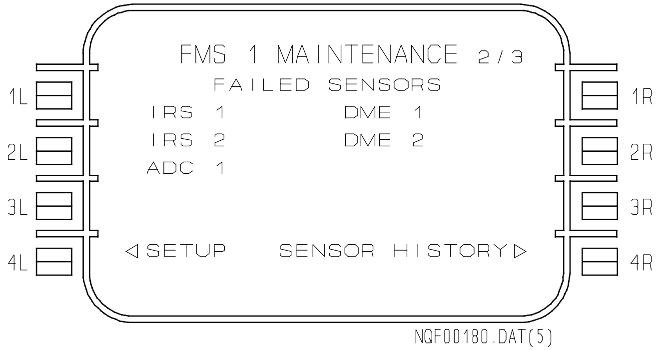
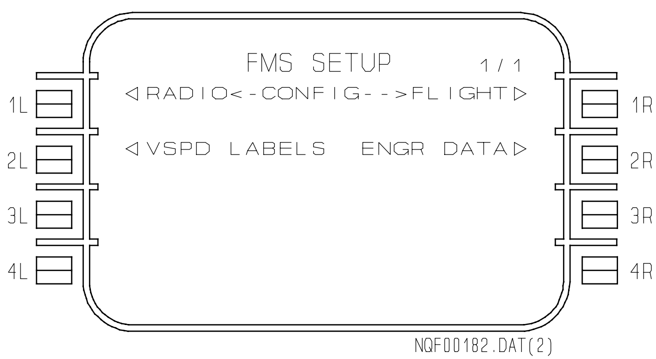
- **AHRS Equipped Aircraft -** AHRS equipped aircraft operate much the same as IRS equipped aircraft at the higher latitudes. Check the aircraft flight manual for any limitations concerning operation at high latitudes with AHRS. The following are exceptions:

  - The FMS switches to TRUE when entering the high latitude area (above 72° 30’ north or below 59° 30’ south). However, EFIS does not have a source of true heading with AHRS. Therefore, EFIS displays MAG heading, and if the FMS is the selected NAV source, TRUE FMS information. FMS position is the blended position of available sensors.

  - Entering the polar region (above 85° N or below 85° S) in an AHRS equipped aircraft, VLF/Omega is no longer used. Since the aircraft is equipped with GPS, the FMS uses the highest priority GPS while in the polar region.

FMS Setup Pages

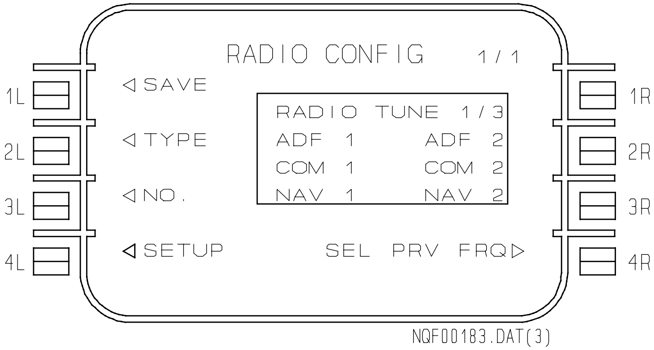
The FMS contains setup pages for configuring operational options. The setup pages are accessible from MAINTENANCE 2/3 using line select 4L, as describe in procedure 6-28. This displays the FMS SETUP page, shown in figure 6-144. From this index page, the various setup pages can be selected. The pages are described below.

Step	Procedure 6-28 FMS Setup Page Access
1	Select MAINTENANCE from the NAV INDEX (page 2).
2	Push the NEXT key to select page 2.
3	Select SETUP prompt at 4L, shown in figure 6-143.  **Figure 6-143**
4	The FMS SETUP page, shown in figure 6-144 is displayed. Select RADIO CONFIG at 1L (refer to page 6-134), FLIGHT CONFIG at 1R (refer to page 6-139), VSPD LABELS at 2L (refer to page 6-142) and ENGR DATA at 2R (refer to page 6-144).  **Figure 6-144**

RADIO CONFIGURATION

The RADIO CONFIG page is accessed from FMS SETUP line select 1L. As a default, the RADIO TUNING pages are configured for two ADFs, two VHF COM radios, two NAV receivers, two Hfs, and two transponders. If it becomes necessary to change these pages, select the RADIO CONFIG pages to make the changes. The NAV radios are the only ones that cannot be changed.

The RADIO CONFIG page shows a small box with the title RADIO TUNE 1/X. This box represents the RADIO TUNE page as currently configured. Procedure 6-29 describes how to change the configuration of the page.

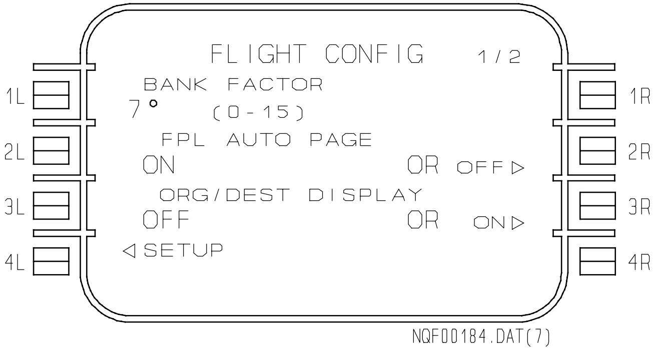
Step	Procedure 6-29 Radio Configuration Setup
1	Select RADIO CONFIG (1L) from FMS SETUP page. Refer to procedure 6-28, page 6-133.
2	RADIO CONFIG 1/1, shown in figure 6-145, is displayed. This page is used to configure the RADIO TUNING page to reflect the radios installed in the aircraft.  **Figure 6-145** Move the cursor (inverse video) to the correct location on the page using the NEXT and PREV keys. When the cursor is at the last location on the page, pushing NEXT advances to the next page. There are a total of three pages.

Step	Procedure 6-29 Radio Configuration Setup
3	Select the radio type using line select 2L. Each push of 2L selects a different radio type. The choices are COM, HF, HF9, XPDR, ADF, DGPS, and blank. Blank means no radio tuning is available at the respective location on the RADIO TUNING page. HF tuning can only be placed on line 3 of page 2. HF9 is for tuning the Collins HF 9000 system. DGPS can only be place on the left side and the adjacent right side must be blank.
4	Select the required number, using line select 3L to choose the correct number for the radio. The choices are 1, 2, 3, blank (no number). DGPS has no number.
5	Repeat steps 1 through 3 for each location to be changed on all 3 pages.
6	Select the frequency display option using 4R. The frequency display options are DE-SEL PRV FRQ or SEL PRV FRQ. In describing these options, note that the active option is not shown on the display. Only the inactive option is displayed so it can be selected. Therefore, in describing the options, the readout that is displayed on the page is enclosed in parenthesis. • **DE-SEL PRV FRQ (SEL PRV FRQ▸ Displayed)** - In this option, the tuned frequency is displayed for five seconds and then is blanked. Selecting the respective line select keys displays the last tuned frequency in the scratchpad. • **SEL PRV FRQ (DE-SEL PRV FRQ▸ Displayed)** - In this option, the tuned frequency is displayed for five seconds and then is replaced with the previously tuned frequency. Selecting the respective line select tunes the previous frequency. In both of these options, the FMS does not have a previously tuned frequency following powerup. This means that operation does not work until the radio has been tuned once.

Step	Procedure 6-29 Radio Configuration Setup
7	Select SAVE (1L) when all changes have been made. SAVE stores the configuration in memory for use on all subsequent flights. If SAVE is not selected, the changes are only effective until power is removed from the FMS.

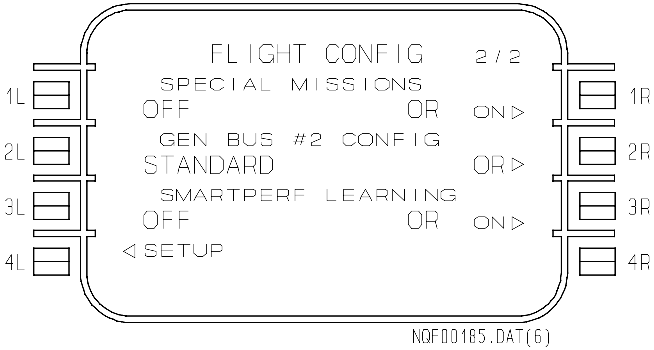
FLIGHT CONFIGURATION

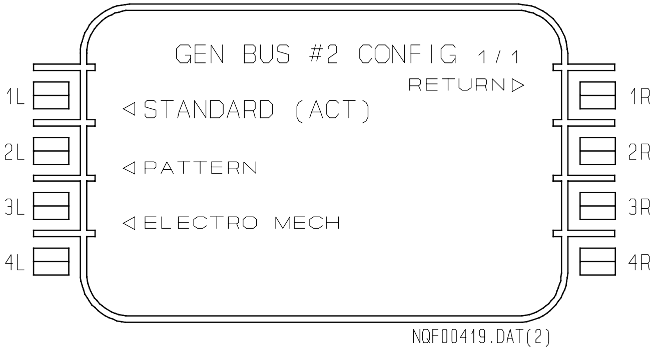
Flight configuration is used to set many operating conditions of the FMS. FLIGHT CONFIG is accessed from the FMS SETUP line select 1R.

Step	Procedure 6-30 Flight Configuration Setup
1	Select FLIGHT CONFIG (1R) from FMS SETUP page. Refer to procedure 6-28, page 6-133.
2	Review the current configuration, shown in figure 6-146, and make changes as necessary using the required steps. There are two pages of flight configuration.  **Figure 6-146**
3	Set the BANK FACTOR. Enter desired bank factor in the scratchpad and line select 1L. The BANK FACTOR entry is used to set bank limits. The default is 7. Any number from 0 to 15 can be entered.

Step	Procedure 6-30 Flight Configuration Setup
3 (cont)	**DETAILS -** The BANK FACTOR is the highest bank angle to be used by the FMS unless higher is needed to maintain protected airspace. The FMS incorporates a model of the protected airspace that includes the tighter restrictions at low altitudes and approach. The FMS checks each turn against the model and increases the bank angle above the entered BANK FACTOR, if required. The BANK FACTOR can be entered at anytime but only on the master CDU when operating in dual or initiated transfer. If the FMS configuration changes from single or independent to dual or initiated transfer, the master bank factor will overwrite the slave bank factor value.
4	Set FPL AUTO PAGE to ON or OFF at line select 2R. The FPL AUTO PAGE feature applies when building both active and stored flight plans. **DETAILS** • **FPL AUTO PAGE ON -** The FMS automatically advances the flight plan page, after a slight delay, when the third waypoint is entered on any given page. FPL AUTO PAGE continues until the destination is entered as a waypoint on the left side of the page. When an airway is entered, the FPL AUTO PAGE does not advance the pages. • **FPL AUTO PAGE OFF -** All flight plan page changes are done using the NEXT and PREV keys.

Step	Procedure 6-30 Flight Configuration Setup
5	Set ORG/DEST DISPLAY to ON or OFF at 3R. The default for this setting is off. This option applies to how flight origins and destinations are displayed on EFIS. **NOTE**: Do NOT set ORG/DEST DISPLAY to ON unless the installed EFIS has been modified to support this feature. If attempted, the origin and destination waypoint symbols/identifiers are not displayed on EFIS. **DETAILS** • **ORG/DEST DISPLAY ON** - The FMS lists the closest airports for display on EFIS. When this option is selected ON, the origin and destination airports are included in the list even when they are not among the closest airports. This option also displays the origin and destination airports as runway symbols on modified EFIS. • **ORG/DEST DISPLAY OFF -** If the selection is OFF, the origin and destination airports are only included when among the closest airports. The origin and destination airports are displayed as normal waypoint symbols.
6	Push NEXT to select page 2.

Step	Procedure 6-30 Flight Configuration Setup
7	Review the current configuration, shown in figure 6-147, and make changes as necessary using the required steps.  Figure 6-147

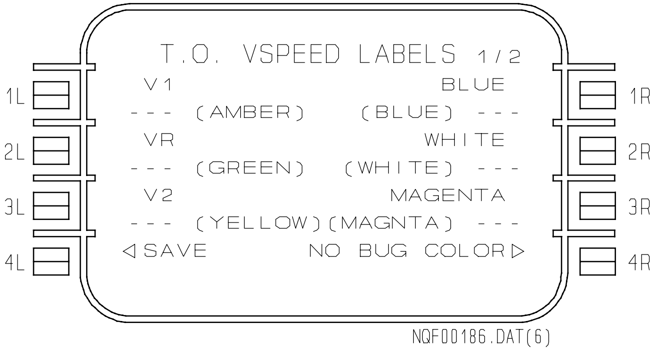
Step	Procedure 6-30 Flight Configuration Setup
8	Set SPECIAL MISSIONS to ON or OFF at 1R. The FMS contains special mission patterns. This selection makes those additional patterns available. The default for this setting is OFF. **DETAILS** • **SPECIAL MISSIONS ON** - All patterns in the FMS (HOLD, PROCEDURE TURN, FLYOVER, ORBIT, RADIAL) can be used. • **SPECIAL MISSIONS OFF** - Only standard patterns (HOLDING, PROCEDURE TURN, FLYOVER) can be used.
9	Set GEN BUS #2 CONFIG to STANDARD, PATTERN, or ELECTRO MECH. FMS General Bus #2 can be configured for various applications. Selection of the OR prompt on the FLIGHT CONFIG page for GEN BUS #2 CONFIG displays the user options, as shown in figure 6-148.  **Figure 6-148**

Step	Procedure 6-30 Flight Configuration Setup
9 (cont)	**DETAILS** • **STANDARD -** This is the default configuration for GEN BUS #2. In this configuration, the FMS outputs the standard General Bus data. • **PATTERN -** This configuration supports special missions operations. Special missions data is transmitted in place of standard GEN BUS data when this selection is active. **Selecting PATTERN eliminates cabin display data from General Bus #2. Cabin displays may become inoperative with this selection active.** • **ELECTRO MECH -** This selection is used when the FMS interfaces to electro mechanical displays instead of EFIS displays. **Selecting ELECTRO MECH eliminates cabin display data from General Bus #2. Cabin displays may become inoperative with this selection active.**
10	Set SMARTPERF LEARNING to ON or OFF at 3R. This selection is only available when an aircraft data base has been loaded (refer to page 6-156). The installed aircraft performance data base (AIRCRAFT DB) determines if the default condition of SMARTPERF LEARNING is ON or OFF. This option is only for learning, the performance function continues to operate regardless of selection.

Step	Procedure 6-30 Flight Configuration Setup
10 (cont)	**DETAILS** • **SMARTPERF LEARNING ON -** The learning which supports FULL PERF performance method continues to update to reflect the aircraft performance. The rate of learning slows as more flights accumulate. • **SMARTPERF LEARNING OFF -** The aircraft performance learning that supports the FULL PERF method of performance calculation is not updated. The performance calculations are based on the previously learned data. Under normal circumstances, learning should be left on all the time. If problems occur in learning, it can be turned off until the problem can be resolved.

VSPEED LABELS

The VSPEED pages are used to configure the takeoff and landing speed pages and provide TAKEOFF and LANDING prompts during the normal sequence of FMS operation. In some installations, these pages are automatically configured. If the EFIS supports display of the entered speeds, it is useful to configure these pages. Once the pages are configured, prompts are given during the normal sequence to complete the takeoff and landing pages. If the EFIS **does not** support the display of the entered speeds, the operator may choose not to configure these pages and avoid having the takeoff and landing prompts during the normal sequence of operations. If these pages are not configured, the TAKEOFF and LANDING pages (minus the VSPEED pages) are still available to select from the PERF INDEX. Six takeoff and six landing speeds can be configured. Some EFIS installations may only support four speeds. Follow procedure 6-31 to configure the pages.

Step	Procedure 6-31 Takeoff and Landing Speed Setup
1	Select VSPD LABELS (2L) from FMS SETUP page. Refer to procedure 6-28, page 6-133.
2	Review current T.O. VSPEED LABELS settings, shown in figure 6-149. Make any changes using the following steps. In some installations, some or all of the labels are fixed and cannot be changed.  **Figure 6-149**
3	Enter the title at 1L through 3R. The title can be any title using up to 8 characters. Examples would be V_1, V_{REF}, and other titles that describe aircraft requirements.
4	Use *DELETE* to remove the title and inhibit entry of a speed on the TAKEOFF page.
5	Push 4R to display or not display the names of the colors. If a monochrome CDU is being used, it is useful to display the color names. If a color CDU is being used, the speeds are displayed in the appropriate colors.
6	Once the titles are entered, push 4L to save the configuration. This actions saves the configuration that is used on all subsequent flights or until it is changed.
7	Select NEXT to display the LDG VSPEED LABELS page and repeat the steps.

ENGINEERING DATA

The ENGINEERING DATA page is accessed using 2R on the FMS SETUP page. Figure 6-150 shows the index of available options. These functions are primarily used under the direction of Honeywell engineering in finding and solving problems with the FMS.

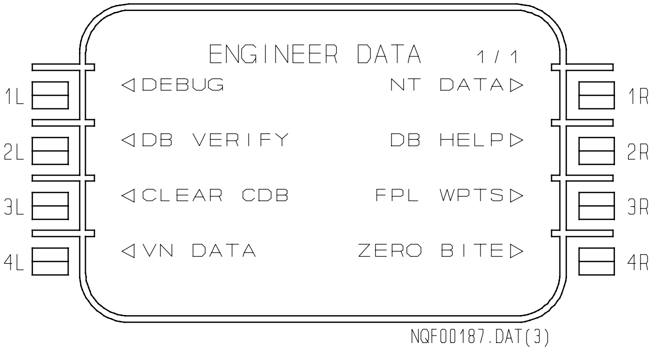


Figure 6-150

- **ENGINEERING DATA 1/1** - The ENGINEERING DATA 1/1 is used to select various functions. For each function, additional pages can be displayed.

  - DEBUG - Debug is used to upload and download diagnostic information using the data loader. It can also be used to format a disk.

  - NT (NAVAID TUNING) DATA - NT displays pages of information about each navaid that can be tuned. These are only display pages; no input can be made.

  - DB (DATA BASE) VERIFY - DB VERIFY tests the data base. If the NAV data base becomes invalid, DB VERIFY should be run. Select this prompt, load the same data base that is in the computer from disk and record the EPROM failures (if any) at the end of the test.

  - DB HELP - Use DB HELP to look at a specific location within the data base memory. It is only useful under the direction of Honeywell engineering since memory locations change with each data base update.

- CLEAR CDB (CUSTOM DATA BASE) - Use CLEAR CDB to clear the custom data base. The options are to clear pilot defined waypoints, stored flight plans, and NOTAMs. The FMS must be operating in independent or single to have access to the page. It is not possible to clear the custom data base while operating in dual or initiated transfer.

- FPL WPTS (FLIGHT PLAN WAYPOINT) - Use FPL WPTS to display FMS internal data about waypoints in the flight plan. These are only display pages, no input can be made.

- VN DATA (VERTICAL NAVIGATION DATA) - Use VN DATA to display FMS internal VNAV data about waypoints. These are only display pages, no input can be made.

- ZERO BITE - ZERO BITE clears the previous recordings of Built In Test (BITE) results.

POSITION INITIALIZATION

- **POSITION INIT 1/1** - The page, shown in figure 6-151, is used to initialize the FMS position. This page is accessed from the NAV IDENT page or from the NAV INDEX page.

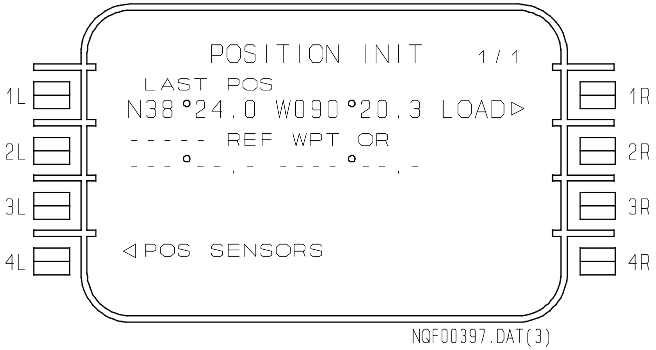


Figure 6-151

Figure 6-151 shows the POSITION INIT page presentation when the aircraft is on the ground. The last FMS position is displayed on the first line. If the line select key adjacent to the LOAD prompt (1R) is pushed, the FMS is initialized to that position. After loading a position, the prompt at 4R displays FLT PLAN for access to the flight planning function.

The reference waypoint (REF WPT) line is below the last FMS position. This line can be automatically filled by the FMS or, the pilot can make an entry at any time. In order of priority, the FMS fills in this line as follows:

- RUNWAY THRESHOLD - If a departure runway has been selected in the active flight plan, the coordinates of the runway threshold are displayed. Using this feature, runway position can be updated when the aircraft is at the end of the runway ready for takeoff.

- RAMPX WAYPOINT - If there is a last position available, the FMS compares the last position to the list of RAMP**X** waypoints. RAMP**X** waypoints are pilot defined waypoints with the name of RAMP plus any alphanumeric (0 through 9, A through Z) character.

  If one (or more) is found within 3 NM of the last position, the closest one is displayed. If more than one RAMP**X** waypoint is defined for the same airport, the FMS selects the closest one to the last position. If multiple RAMP**X** waypoints are defined with the same latitude/longitude, the FMS selects the one with highest alphanumeric priority.

- AIRPORT REFERENCE POINT (ARP) - If there is a last position available and no RAMP**X** waypoints are found within 3 NM, the FMS displays the closest ARP within 3 NM.

- PROMPTS - If none of the above waypoints are displayed, the FMS displays prompts shown in figure 6-151.

To initialize the FMS, check the displayed coordinates for either the LAST POS (1L) or REF WPT (2L) for correctness. If neither is correct, enter the correct waypoint identifier or coordinates at 2L, shown in figure 6-152.

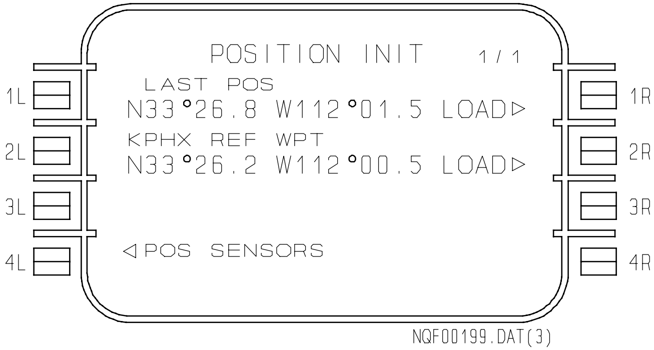


Figure 6-152

Once the correct coordinates are displayed, push the appropriate line select key (1R or 2R) to LOAD the position, shown in figure 6-153. The position is loaded to the FMS and transmitted to any long range sensors connected to the FMS.

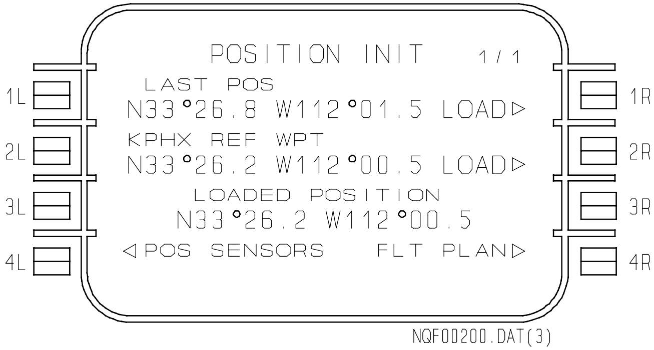


Figure 6-153

If the aircraft is in flight and the FMS position is valid, figure 6-154 is displayed. The UPDATE feature of the FMS can only be used in flight.

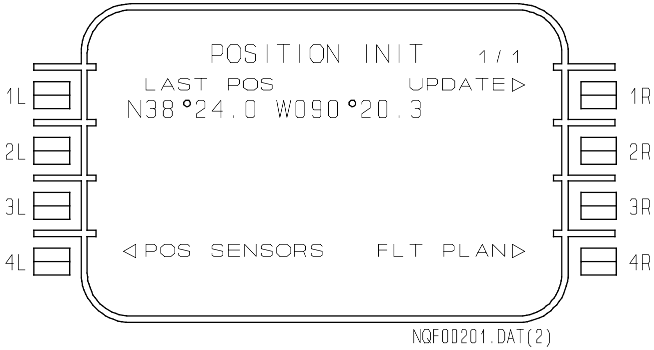


Figure 6-154

CROSSING POINTS

The CROSSING POINTS pages are used to determine the relationship of a waypoint relative to the current aircraft position. In addition, when using the full performance option equal time point and point of no return functions are available.

The FMS computes the following types of crossing points:

- Direct-to a waypoint from the current aircraft position
- Point abeam a waypoint for the current flight plan
- Crossing radial from a waypoint for the current flight plan
- Crossing latitude/longitude given latitude/longitude for the current flight plan
- Equal time point between any two given waypoints
- Point of no return from any given waypoint.

- **CROSSING POINTS 1/1** - The page, shown in figure 6-155, is displayed after selecting the CROSS PTS prompt from the NAV INDEX page 2. This page is an index of the available crossing point options.

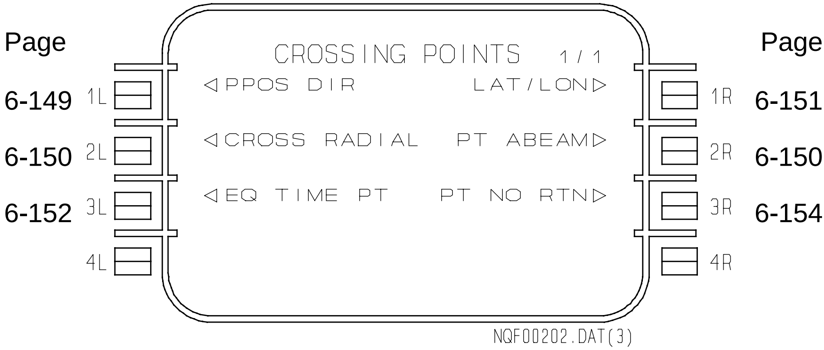


Figure 6-155

Direct-To

Select 1L from the display, shown in figure 6-155, for direct-to information from present position to any given waypoint.

For example, to determine where DEN is relative to the current aircraft position, enter DEN into the scratchpad and push line select 1L, shown in figure 6-156. At 1R, the radial and distance from DEN to the current aircraft position is displayed. The bottom half of the page displays the course, distance, ETE and the remaining fuel if the aircraft were to fly direct from the current position to DEN.

The CROSS PTS prompt at (4L) returns to the crossing point index.

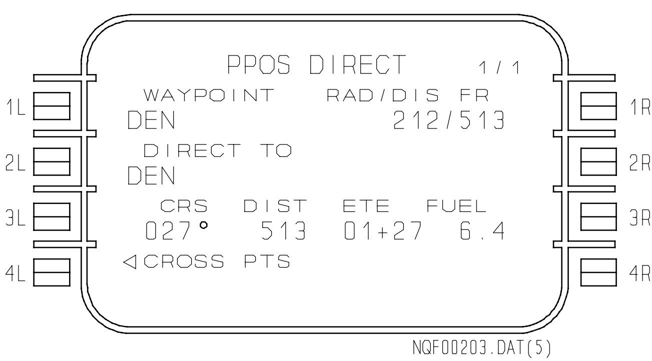


Figure 6-156

Point Abeam

If the PT ABEAM line select key (2R), shown in figure 6-155, is pushed, the FMS computes the point, along the flight plan, where the aircraft passes abeam the entered waypoint. This is usually the flight plan's closest point to the selected waypoint. Figure 6-157 shows an example. If required, the PT ABEAM definition at 2L (DEN/132/109, in the example) can be selected to the scratchpad and inserted into the flight plan as a temporary waypoint.

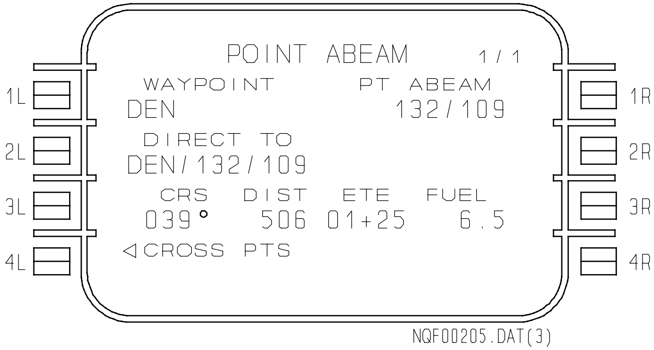


Figure 6-157

If no point abeam exists for the current flight plan, the message NO CROSSING POINT FOUND is displayed in the scratchpad.

Crossing Radial

If the CROSS RADIAL (crossing a radial) prompt is pushed (2L), shown in figure 6-155, the FMS computes the point along the flight plan where the aircraft crosses the designated radial. Enter the waypoint at 1L and the radial at 1R, shown in figure 6-158. For example, entering the 180° radial, the FMS projects that the aircraft will cross the 180° radial 117 NM from DEN. The crossing radial definition at 2L can be inserted as a temporary waypoint.

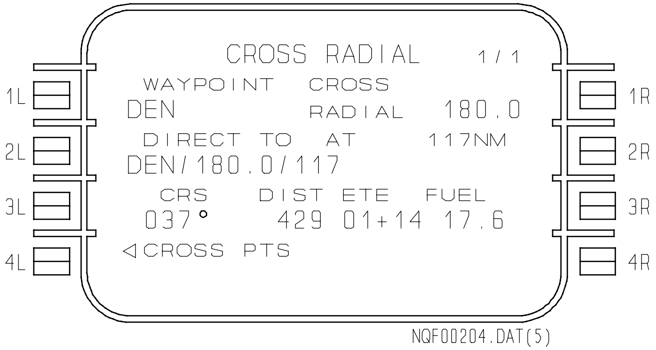


Figure 6-158

If the entered radial does not cross the flight plan, the message NO CROSSING POINT FOUND is displayed in the scratchpad.

Latitude/Longitude Crossing

Select 1R from the display, shown in figure 6-155, to calculate the crossing latitude or longitude when either the longitude or latitude is entered. The course, distance, ETE, and fuel remaining are displayed if the aircraft proceeds directly to the waypoint.

For example, to know where the aircraft crosses the 100° west longitude line for the current flight plan enter W100 at 1R, shown in figure 6-159, the FMS computes the latitude. The FMS also displays the course, distance, ETE, and fuel remaining to fly directly from the current aircraft position to N33°24.9 W100°00.0. The computed point (2L) can be line selected to the scratchpad and inserted in the flight plan as a temporary waypoint. If required, latitude can be entered and the FMS calculates the longitude. If more than one intersection with the flight plan exists, the closest one is displayed.

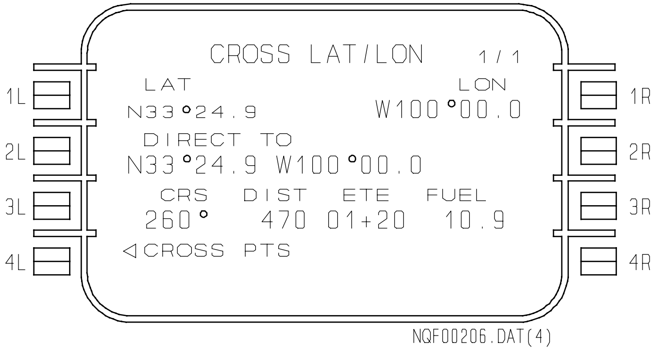


Figure 6-159

If the flight plan does not cross the entered latitude/longitude, the message NO CROSSING POINT FOUND is displayed in the scratchpad.

Equal Time Point

Select 3L from the display, shown in figure 6-155, to calculate the equal time point between any given waypoints. The default waypoints are the origin and destination of the active flight plan. Any waypoints can be entered at 1L and 1R, shown in figure 6-160.

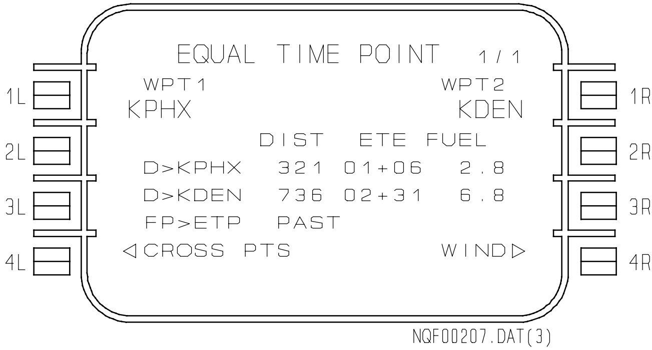


Figure 6-160

If the WPT 1 and WPT 2 are the origin/destination, the ETP is the physical point along the flight plan where time-to-go back to the origin is the same as the time-to-continue to the destination.

If WPT 1 and/or WPT 2 are not the origin/destination, the ETP is the physical point along the flight plan between WPT 1 and WPT 2, where the time-to-go back to WPT 1 is the same as the time-to-go to WPT 2.

The D> symbol indicates 'direct to' the identified waypoint. FP>ETP indicates 'along the active flight plan' to the ETP.

The FUEL digital readout is the amount of fuel remaining upon arrival at the waypoint or ETP. The fuel remaining does not necessarily represent the fuel required to satisfy reserve requirements. The FUEL values shown are always fuel remaining at a given waypoint.

If the decision is made to go to WPT 1 or WPT 2, the FMS operates under the assumption that current operating conditions continue to prevail (i.e., the same altitude, engine fuel flow, etc.).

The data on the EQUAL TIME POINT page is updated each time the page is selected, or each time a new wind entry is made. **If the page is left in view for an extended period of time, the data is <u>not updated</u> unless the page is deselected and then, reselected**.

Since the waypoints might not be on the flight plan, winds can be entered by selecting 4R. The FMS calculates default winds from the wind model (see wind model, page 5-35). Cruise winds, shown in figure 6-161, can be entered for each of the two waypoints. Entries made on this page do not change the wind model. Select 4R to return to the EQUAL TIME POINT page.

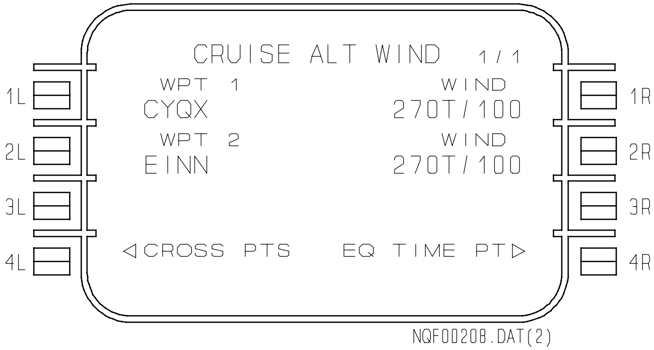


Figure 6-161

Point of No Return

Select 3R from the display, shown in figure 6-155, to calculate the point of no return from any given waypoint. The default waypoint is the origin of the active flight plan. Any waypoint can be entered at 1L, shown in figure 6-162. The default wind (1R) for the waypoint is supplied from the wind model. A cruise wind can be entered for the waypoint. Entries made on this page do not change the wind model.

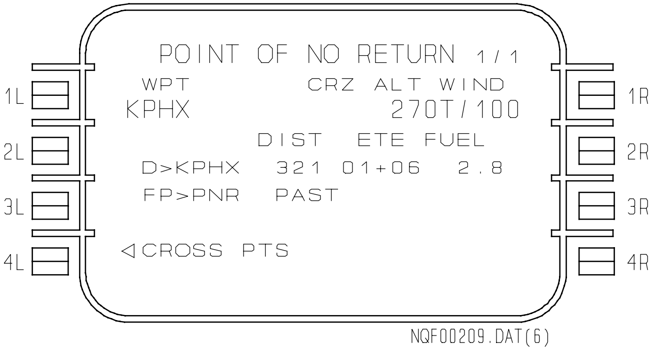


Figure 6-162

The PNR is the point along the flight plan where the fuel to reach the destination is less than the fuel to return to the WPT. The WPT can be the origin (default) or any other waypoint.

D> indicates 'direct to' the waypoint shown. FP> indicates the distance and fuel remaining along the flight plan to the PNR.

The fuel remaining does not necessarily represent the fuel required to satisfy reserve requirements.

The data on the POINT OF NO RETURN page is updated each time the page is selected, or each time a new wind entry is made. **If the page is left in view for an extended period of time, the data is <u>not updated</u> unless the page is deselected and then, reselected.**

DATA LOAD

The DATA LOAD page, shown in figure 6-163, is used to access the various data loading functions of the FMS. The load functions include uploading and downloading data from/to disk using the data loader. Refer to page 3-16 for more information on the data loader. Some data can also be crossloaded from one FMS to another.

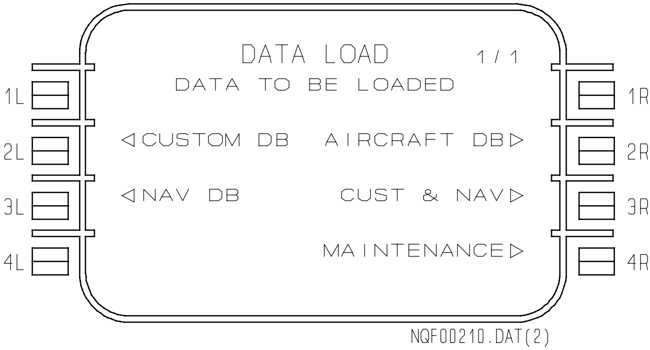


Figure 6-163

Navigation Data Base Updating

Every 28 days the navigation data base in the FMS must be updated. The update is supplied by Honeywell on 3.5 inch diskettes. The navigation data base is normally updated while the aircraft is on the ground. In flight, updating is permitted only when the nav data base is invalid (an out of date data base is not an invalid nav data base). Updating the navigation data base is done with the DL-800/900 Data Loader and following procedure 6-32.

Crossloading Custom and/or Navigation Data Base

The custom and/or NAV data bases can be transferred from one FMS to the other. Only the custom data base can be transferred in flight.

In order to transfer data, both FMSs must be turned on and have compatible software versions. All steps can be completed from just one of the FMSs. Refer to procedure 6-32 for generalized data loading procedures.

Up/Down Loading Custom Data Base to Loader

The custom data base can be transferred to or from the data loader. When loading the custom data base from the loader, the custom data base is completely replaced by the contents of the disk including stored flight plans and pilot defined waypoints. When transferring the custom data base to a disk, both the pilot defined waypoints and flight plans are transferred. Using this option, the pilot can keep a permanent record of the custom data base for loading in case the computer is replaced or the custom data base is lost. In order to transfer the custom data base to the data loader, insert a formatted disk. If the disk is not formatted, it can be formatted using the MAINTENANCE page option (refer to DEBUG on page 6-144). Refer to procedure 6-32 for generalized data loading procedures.

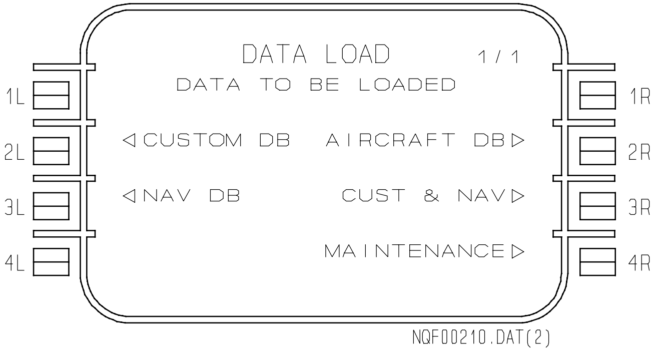
Up/Down Loading Aircraft Data Base

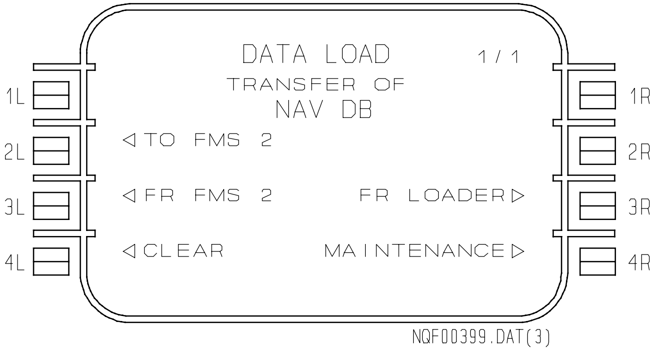
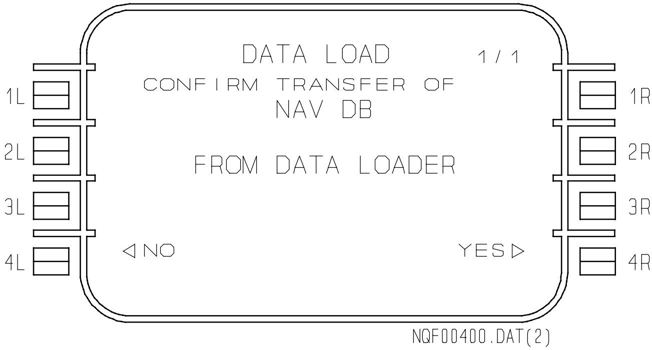
Aircraft data bases for each type aircraft are contained on the last disk of the navigation data base supplied by Honeywell. The aircraft data base can be transferred to or from the data loader. When loading an aircraft data base from the loader, the available aircraft types and tail numbers are displayed for proper selection. When down loading an aircraft data base to a disk, the aircraft data base is identified by the tail number that was entered on PERF INIT 1/5, 1R.

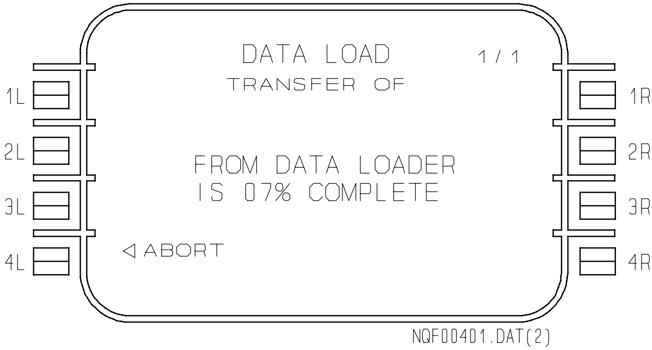
The aircraft data base should be downloaded from the aircraft if the navigation computer is going to be removed. Later, the downloaded data can be uploaded and the FMS FULL PERF performance calculating process can begin with the uploaded data.

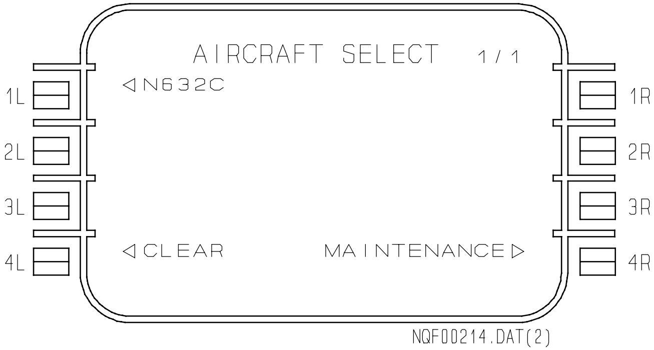
Either the DL-800 or DL-900 Data Loader can be used. However, if the DL-800 Data Loader is used, it needs MOD C and MOD D.

Refer to procedure 6-32 for generalized data loading procedures.

Step	Procedure 6-32 Generalized Data Base Updating
1	Setup the data loader. Skip this step if the data loader is not going to be used. If the DL-800/900 Data Loader is not installed in the aircraft, connect the data loader umbilical cable to the aircraft connector. Apply power to the data loader using the appropriate aircraft circuit breaker and push the data loader power switch. The power LED lights, and after the powerup BITE sequence has been completed, the data LED lights. Select LEFT, RIGHT, or AUX (third FMS) to load the respective FMS. Insert data base disk 1 into the loader.
2	Select DATA LOAD from the NAV INDEX (page 2).
3	Select the appropriate prompt, shown in figure 6-164, for data to uploaded or downloaded. In this example, NAV DB prompt at 3L is selected.  **Figure 6-164** **DETAILS** - In single FMS operation, prompts are not shown unless the data loader is selected ON.

Step	Procedure 6-32 Generalized Data Base Updating
4	Select the prompt for the source or destination of the selected data from the menu, shown in figure 6-165. In this example, the FR LOADER prompt at 3R is selected.  **Figure 6-165** **DETAILS -** The selections are based on the type of data selected in the previous step. The data loader must be turned on and the appropriate FMS selected on its selector switch to display the TO LOADER and FR LOADER prompts.
5	Confirm selection and select YES (4R) or NO (4L) on the display, shown in figure 6-166.  **Figure 6-166**

Step	Procedure 6-32 Generalized Data Base Updating
6	Monitor progress is shown in figure 6-167.  **Figure 6-167** The FMS indicates the percentage complete. If the NAV data base uses more than one disk, the FMS prompts for insertion of the each disk. Remove the completed disk and insert the next disk. The FMS automatically begins reading the next disk. When complete, the message DB TRANSFER COMPLETE is displayed and the FMS performs a restart. If power is interrupted, ABORT is selected, or other problems that stop the loading process occur, the data load process must be repeated from the beginning. Refer to page 12-1 for a listing of data loader fault codes.
7	Repeat steps 1 thru 7 for each FMS. Cross loading of the NAV and custom data base can also be done. The DL-800/DL-900 data loader is recommended for updating the NAV data base because it has a higher loading speed than the cross loading process.

Step	Procedure 6-32 Generalized Data Base Updating
8	This step only applies to aircraft DB. Select the required aircraft data base, shown in figure 6-168.  **Figure 6-168** **DETAILS** - Aircraft data bases furnished with the navigation data base are identified by aircraft type. Data bases that have been downloaded from an aircraft are identified by tail number.
9	Turn off and store the data loader if it is not permanently mounted in the aircraft.

FLIGHT SUMMARY

Figure 6-169 is a summary of the flight. The fuel used display can be reset to 0 by line selecting *DELETE* to the fuel used line (2L). Fuel used is automatically reset when power is removed.

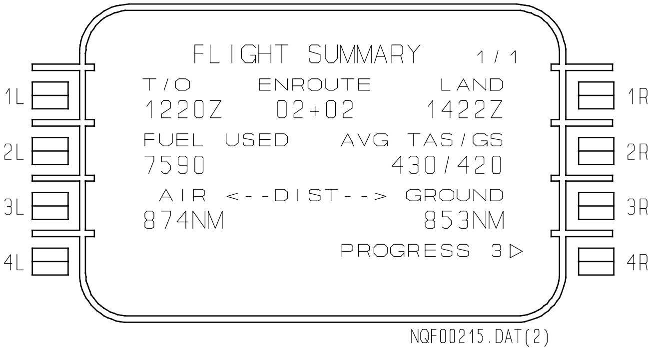


Figure 6-169

The FLIGHT SUMMARY page can be accessed through the NAV INDEX page or the PROGRESS page 2 or 3.

The FLIGHT SUMMARY data remains on this page until the aircraft is powered down or at the next takeoff if the system was not powered down (quickturn).

If the clock is changed after takeoff, the takeoff time does **<u>not</u>** change to reflect the clock change.

EFIS OPTIONS

Figure 6-170 is the EFIS OPTIONS page that is available when the Honeywell FMS is installed in an aircraft with a Collins system.

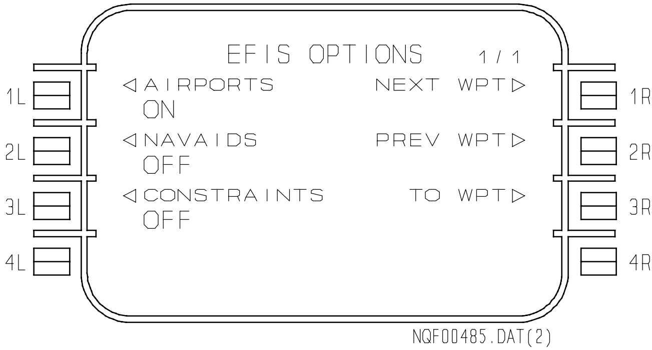


Figure 6-170

- **1L** - Selecting ON displays up to the 8 closest airports plus the origin and destination airports on the MFD. Pushing the line select key changes the selection. The default is OFF.

- **2L** - Selecting ON displays up to the 50 closest navaids on the MFD. Pushing the line select key changes the selection. The default is OFF.

- **3L** - Selecting ON displays constraints (e.g. speed, altitude, descent angle) with the respective lateral waypoint on the MFD. Pushing the line select key changes the selection. The default is OFF.

- **1R** - When in the plan mode, this key allows for stepping through the flight plan by selecting the next waypoint as the center waypoint of the map.

- **2R** - Same as 1R except is the previous waypoint.

- **3R** - This sets the center waypoint to the TO waypoint.

7. Flight Plan

This section covers the elements and operation of the flight plan pages. It also includes a description of LNAV and VNAV. This section describes both active flight plans and stored flight plans. The active flight plan is accessed by pushing the FPL key on the CDU. Refer to page 6-4 for information on accessing stored flight plans.

DEFINITION OF TERMS

This section defines the lateral and vertical elements that make up a flight plan.

- **Flight Plan** - A flight plan is a series of waypoints that define an intended route of flight. Each waypoint in the flight plan must be defined laterally and vertically. The course between two waypoints in the flight plan is called a flight plan leg. The FMS calculates the great circle course for each leg in the flight plan. The active flight plan in the Honeywell FMS can include the route to the primary destination followed by the route to the alternate destination.

- **Flight Plan Names** - Flight plan names are used to keep track of stored flight plans. Flight plan names are used to recall a stored flight plan into the active flight plan. Flight plan names must have a minimum of six characters and a maximum of 10 (A convenient naming convention for flight plans is to use the origin and destination, the International Civil Aviation Organization (ICAO) identifiers separated by a dash (-)). For more than one flight plan between the same set of identifiers, add a number at the end of the name. For example, for a flight between Phoenix and Minneapolis, use KPHX-KMSP1 for the flight plan name.

- **Flight Plan Capacity** - Stored or active flight plans, can have up to 100 waypoints including the origin and destination. For active flight plans, the combined waypoints of the primary flight plan and the alternate flight plan cannot exceed the 100 waypoint capacity. If a flight plan is revised and exceeds the 100 waypoint capacity, the revision is not performed and the message FLIGHT PLAN FULL is displayed in the scratchpad. If a SID, STAR, airway, or stored flight plan is added and exceeds the limit, none of the inserted waypoints are added to the flight plan.

- **Primary/Alternate Independence** - The primary and alternate flight plans are kept independent from one another. Revisions to either the primary or alternate flight plan do not effect the other, except as follows:

  - ALTERNATE - The alternate is the revision function that incorporates the alternate into the active flight plan. The ALTERNATE prompt is displayed on the ACTIVE FLT PLAN page (4L) when the aircraft is within 25 flight plan miles of the primary destination. After ALTERNATE is selected, there are two destinations in the flight plan: the original destination and the alternate. Both are treated as destinations, meaning the FMS sets approach and flyover criteria within 10 NM of either destination. In this case, flyover means that the FMS does not begin a turn before it flies over the destination.

    The ALTERNATE prompt is not displayed if an approach is in the flight plan. However, if the missed approach is activated, the ALTERNATE prompt is displayed. A direct-to an alternate flight plan can be performed at anytime.

  - ALTERNATE ORIGIN - The alternate flight plan origin is also the primary flight plan destination.

- **Waypoint Names** - Waypoints exist in the navigation data base, the custom data base (pilot defined waypoints), or as temporary waypoints. Waypoint names are used for convenience in keeping track of waypoints and recalling waypoints. Waypoint names (called waypoint ident or identifier) must contain at least one and as many as five alphanumeric characters. In the case of temporary waypoints, the FMS adds an asterisk (*), ampersand (&), or pound sign (#) as the first character for a total of up to six characters. Therefore the pilot has complete freedom in naming waypoints into the FMS with no conflict. Waypoint and flight plan names can be distinguished by the number of characters.

  Unnamed airway intersections are also included when airways are added to the flight plan. This means airways can be changed at a point common to both airways.

  The ampersand (&) symbol denotes waypoints with a radial pattern. Nondirectional beacons are stored by their IDENT plus the NB suffix. For example, the ABC NDB is stored in the data base as ABCNB. This reduces the list of duplicate waypoint names.

- **Temporary Waypoints** - Temporary waypoints exist only in the active flight plan. They are erased when the flight plan is completed or deleted. Temporary waypoints are listed on the last WAYPOINT LIST pages at the time they are defined. Using this page the pilot can review the definition of the waypoint.

  Temporary waypoints are used so the pilot can quickly enter the waypoint definition directly into the active flight plan. Temporary waypoints are useful when cleared to a fix. In this case they have no meaning beyond the current flight. There is no need to create a named waypoint for the clearance fix.

  Temporary waypoints are defined by entering the definition of the waypoint directly into the active flight plan. Acceptable definitions are latitude/longitude, place/bearing/distance, place/bearing/place/bearing, and along the flight plan as place/distance. When the definition is entered in the flight plan, the waypoint is assigned a name that describes how it was defined and a number (XX). Temporary waypoints entered on the left FMS are assigned odd numbers while those entered on the right FMS are assigned even numbers. The name is also preceded by an asterisk (*) to indicate a temporary waypoint. The assigned names are as follows:

Entered Definition	Waypoint Name
Lat/Long	*LLXX
Place/Bearing/Distance	*PBDXX
Place/Bearing/Place/Bearing	*RRXX
Place/Distance	*PDXX

  The definition can be entered into the scratchpad from the keyboard or retrieved for other sources. The electronic flight instrument system (EFIS) joystick can be used to insert coordinates into the scratchpad. The CROSSING POINTS pages are also sources for definition. As the name indicates, temporary waypoints are not retained in the FMS past the current flight.

  Temporary waypoints are also created when a flight plan is loaded from a disk, and either the FMS data base does not contain the same waypoint, or the waypoint definition is different. In this case, the regular name of the waypoint is used preceded by "#". For example, a flight plan is loaded containing the waypoint named CEDA. CEDA is neither in the FMS nav data base nor is it defined in the custom data base. In this case, #CEDA is displayed and the definition specified in the loaded flight plan is used.

- **Runway Extension Waypoints -** The FMS can create temporary waypoints on the runway extension line. Once a runway has been activated into the active flight plan, it can be line selected to the scratchpad. When displayed in the scratchpad, the runway is in the format of AIRPORT.RUNWAY/BEARING/. A distance can be inserted to complete the definition of a waypoint on the extension line of the runway. Insert this definition into the flight plan to create a temporary waypoint. Repeat the process with varying distances to create a number of waypoints on the extension line.

  If the runway is at the origin, the bearing brought to the scratchpad is the runway heading that permits waypoints on the departure path.

  If the runway is at the destination, the bearing brought to the scratchpad is the reciprocal of the runway heading that permits waypoints on the arrival path.

- **VNAV Offset Waypoints -** ATC sometimes clears an aircraft to cross XX miles before or after a waypoint at a specified altitude. These are called VNAV offset waypoints. Refer to VNAV OFFSET, page 7-26 for more information.

- **Origins and Destinations -** All origins and destinations can be any waypoint that is contained in the data base. This includes any pilot defined waypoints. Origins and destinations of the active flight plan can be temporary waypoints. Origins and destinations are normally airports. The origin or destination must be an airport that is defined in the nav data base to activate the respective runway, SID, or STAR.

- **FROM Waypoint -** The FROM waypoint is the first waypoint on the first page of the flight plan. It is displayed in amber. Before takeoff, the FROM waypoint is normally the selected origin airport or runway. Under normal flight conditions, the FROM waypoint is the last waypoint that was sequenced and actual time passing is displayed. In flight, the FROM waypoint can be changed. Since changing the FROM waypoint impacts the current active leg and can cause an aircraft maneuver, a confirmation step is included.

- **TO Waypoint -** The TO waypoint is the second waypoint on the first page of the flight plan and is displayed in magenta. The TO waypoint is the waypoint to which the aircraft is being steered along a course defined between the FROM and TO waypoints. When the leg sequences, the TO waypoint becomes the FROM waypoint. The TO waypoint can be changed. Since changing the TO waypoint impacts the current active leg and can cause an aircraft maneuver, a confirmation step is included.

- **Leg Sequencing -** During flight, the active flight plan automatically sequences, so that the first leg of the active flight plan is the active leg that is referenced to the guidance parameters. Normally, the FMS sequences before the waypoint for an inside turn when the aircraft is on or close to on course. If the aircraft is not on course, the normal sequence occurs not later than a point abeam of the waypoint. Some waypoints have unique sequence criteria. For example, a holding fix is a flyover waypoint. The holding fix should be overflown before entering or exiting holding. Some waypoints in SID and STAR procedures also have unique sequence criteria. The FMS is programmed to automatically comply with these requirements.

  There are situations where the sequence criteria has not been satisfied, yet the flight plan needs to be sequenced. This requires pilot action and can be handled two different ways:

  - The FROM waypoint can be deleted to force a sequence. The advantage of this method is that it preserves the leg definitions contained in the flight plan.

  - A direct-to can be performed, because doing a direct-to creates a new leg in the flight plan. This procedure must comply with the ATC.

  Some leg sequences indicate the direction of turn to the new leg by displaying an **L** or an **R** in reverse video. This notation is used when either the direction of turn is indicated by a SID or STAR, or the new leg requires a large turn (near 180°) to track the new course.

  When the destination waypoint is sequenced, it is retained by the FMS as the ’TO’ waypoint. Bearing, distance, and required track are continuously displayed.

- **Discontinuities** - A discontinuity can exist in the flight plan. A discontinuity is a segment in the flight plan where there is no lateral flight plan definition. However, there must be a lateral definition before and after a discontinuity.

  When making a change, discontinuities in the flight plan are kept to the minimum. Since there are times when it is necessary to have a discontinuity, the following rules apply:

  - When adding or deleting a single waypoint, no discontinuity can be inserted in the flight plan. The flight plan is directly linked between the waypoints. Deleting several waypoints at a time does not cause a discontinuity.

  - When linking flight plans or inserting a procedure, no discontinuity can exist when a common waypoint is used. If there is not a common waypoint, the inserted flight plan or procedure is linked at the point of insertion, but has a discontinuity at the end. For example, if the last waypoint of a SID is also a waypoint in the flight plan, the flight plan and procedure are linked at that waypoint with no discontinuity. If the last waypoint of a SID is not in the flight plan, there is a discontinuity between the SID and the flight plan. Some procedures have embedded discontinuities that are inserted along with the procedure.

  - A SID can only be replaced with another procedure and cannot be deleted. The linked portions of an arrival can be deleted via the ARRIVAL page. In both cases, the discontinuity depends upon the changed procedure. Linked flight plans or procedures can be deleted under the same operation for deleting waypoints. This operation does not cause discontinuity.

  - DIRECT-TO does not cause a discontinuity even though several waypoints are deleted or a single waypoint is added.

  - If an airway is inserted in the flight plan, there is no discontinuity since the pilot has to specify the beginning and end points.

  - The INTERCEPT function does not create a discontinuity before or after the intercept point. When choosing the heading to intercept option, a fly heading select leg is inserted that disengages the FMS when the leg is sequenced.

- **Alternate Origin** - The alternate origin is the destination of the primary flight plan. No alternate flight plan can be specified until the primary destination has been specified. Changing the primary destination clears the alternate flight plan because the alternate origin changes.

- **Alternate Waypoints** - Alternate waypoints apply to the alternate portion of the flight plan only. The FMS guidance is not engaged until the pilot selects the alternate destination. If the alternate portion of the flight plan is enabled, the corresponding waypoints are incorporated into the primary portion of the flight plan. At that point, all active flight plan rules apply.

- **Alternate Destination -** The alternate destination is entered when defining a flight plan to an alternate. Like the primary flight plan, the alternate destination is entered as the final waypoint to close out the alternate flight plan.

- **Climb Constraints** - Climb constraints are altitude and speed constraints that are associated with waypoints in the climb or cruise portion of the flight plan. Altitude constraints can be AT, AT or ABOVE, or AT or BELOW. For example, an entry of 10000A (**A** following the altitude) indicates AT or ABOVE. An entry of 10000B (**B** following the altitude) indicates AT or BELOW. An entry of 10000 (no letter following the altitude) indicates AT. Climb speed constraints are observed by the FMS until the waypoint containing the constraint is passed.

- **Speed Limit** - An example of speed limits is the 250 below 10,000 limit entered during performance initialization. Other limits can be imposed by the airframe such as V_{mo} or M_{mo}.

- **Speed Schedule** - The speed schedule is found in performance initialization. During performance initialization, a speed schedule is defined for the climb, cruise, and descent phase of flight.

- **Automatic Speed Target** - The automatic speed target is the current speed being output by the FMS for control of the aircraft described as follows:

  - The current speed command is displayed on page 1 of the ACTIVE FLT PLAN.

  - A CAS and MACH are both displayed when climbing or descending, otherwise, the cruise speed target (either CAS or a MACH) is displayed.

- The active speed target, whichever is the smallest between CAS and MACH, is shown in large characters.
- The active speed target can also be displayed on EFIS and/or other controllers.

<u>Refer to Speed Protection on page 7-32 for further information.</u>

The current speed target observes placard speeds and minimum speed, and is the lesser of the following:

- V_{mo}/M_{mo}
- Speed limit below an altitude
- Active waypoint constraint speed
- Speed schedule for phase of flight (climb, cruise, descent)
- Latched speeds.

The FMS automatically changes the speed target throughout the flight to accommodate aircraft configuration and phase of flight. This automatically controlled speed target can be used by the autopilot or autothrottle. The automatic FMS speed target for a typical flight can be changed as follows:

- Before takeoff and during initial climb, the speed target is set to the speed/altitude limit (i.e., 250/10000) or to the climb speed if no limit is entered. If a speed/altitude is entered, the speed target is set to climb speed after passing the limiting altitude.
- During climb, the speed target is the climb speed schedule selected during initialization. The change to MACH is done automatically.
- The speed target is changed to the cruise speed as the autopilot changes to altitude select (ASEL) or VNAV altitude select (VASEL) at or above the entered initial cruise altitude.

  <u>If the actual initial cruise altitude is lower than the entered initial cruise altitude, the actual cruise altitude should be entered in the FMS on either PERF DATA page 1 or PERF INIT page 4. Once the actual cruise altitude matches the entered cruise altitude, the FMS cruise altitude is automatically updated with the altitude selector and actual altitude.</u>

- The speed target is changed to the descent speed, if the altitude selector is dialed down just before the top of descent (TOD). The speed target is also changed if a deceleration is required, or at the TOD if no deceleration or acceleration is required. For any descent greater that 6,500 feet, any descent within 100 miles of the TOD, or any descent past the TOD, the speed target is changed to the descent speed at the beginning of the descent. Descents started more than 100 miles before the TOD and less than 6500 feet altitude change are considered cruise descents and the speed target remains at the cruise speed.

- During descent, the speed target is the descent speed schedule selected during initialization and the change to CAS is done automatically. This speed schedule is observed during any intermediate level off.

• **Top of Climb (TOC)** - A TOC waypoint is calculated and displayed on the vertical profile and shown on the PROGRESS page 2, but is not in the active flight plan. There can only be one TOC waypoint at a time. The TOC is calculated based on current aircraft altitude, climb speed, and the cruise altitude.

• **Initial Cruise Altitude** - An initial cruise altitude is entered during performance initialization. The initial cruise altitude is only used for flight planning, it is not a constraint. The only pilot adjustment to the initial cruise altitude that is required, is when the aircraft is leveled in cruise at a lower altitude. Using the altitude selector setting, the FMS automatically makes the adjustment if the aircraft is flown higher than the entered altitude or descends after being level at or above the entered altitude. These automatic adjustments do not change the entered value of initial cruise altitude.

• **Cruise Altitude** - Cruise altitude is the current altitude that is used by the FMS to plan the cruise portion on the flight. Initially, the cruise altitude is set equal to the entered initial cruise altitude. The cruise altitude is automatically adjusted by the FMS, using the altitude selector settings. When the aircraft levels at the cruise altitude, the FMS changes to the cruise phase of flight with the corresponding change to cruise speed targets.

- **Top of Descent (TOD)** - A TOD waypoint is calculated and displayed on the vertical profile and shown on PROGRESS page 2. If there are no constraints during the descent, the TOD is calculated using the destination elevation (if available) and the descent speed schedule. If there are constraints during the descent, the TOD is calculated using the path mode. One minute before the TOD point is reached, a vertical track alert is given. An automatic descent is initiated at the TOD, if:

  - The altitude selector is set to a lower altitude
  - The FMS is selected as the NAV source
  - Lateral navigation (LNAV) and vertical navigation (VNAV) are engaged.

- **Descent Constraints** - Descent constraints are altitude, speed, and angle constraints that are associated with waypoints in the descent portion of the flight plan. Altitude constraints can be AT, AT or ABOVE, or AT or BELOW. For example, entering 10000A (**A** following the altitude) indicates AT or ABOVE, entering 10000B (**B** following the altitude) indicates AT or BELOW, and entering 10000 (no letter) indicates AT. The FMS flies all descent constraint as AT constraints. The FMS obeys descent speed constraints at and after the waypoint that contains the constraint. The FMS obeys angle constraints from the TOD to the waypoint containing the constraint. Normally, the FMS calculates the angle constraint based on performance initialization, however, a specific angle constraint can be entered at a waypoint in the flight plan.

CREATING/CHANGING FLIGHT PLANS

An example of the ACTIVE FLT PLAN page before the flight plan is shown in figure 7-1.

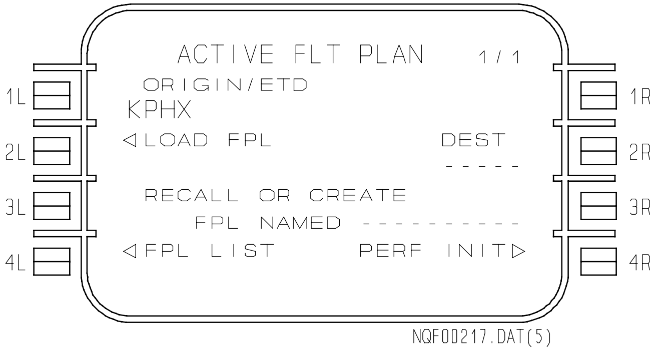


Figure 7-1

The following choices can be made to recall or create an active flight plan:

- Load a flight plan from a disk (2L)
- Recall a previously stored flight plan (3R)
- Create a stored flight plan (3R)
- Build a flight plan by entering waypoints (2R).

Each of these options are described below.

Load a Flight Plan from a Disk

Disks loaded with a flight plan can be created from a flight planning service such as Jeppesen Dataplan or it can be created on a computer with Honeywell flight planning software. Separate rules apply for loading AFIS flight plans (refer to page 6-25).

To load a flight plan from a disk, the following conditions must be met:

- No flight plan can exist in the ACTIVE FLT PLAN pages. If one has been defined, delete the origin to clear the flight plan.
- The DL-800/900 Data Loader must be connected and powered up.

- The DL-800/900 Data Loader left/right switch must be in the proper position for the FMS to be loaded.

When these conditions are satisfied, the LOAD FPL prompt at key 2L, shown in figure 7-1, is displayed on the ACTIVE FLT PLAN page. Pushing line select key 2L begins the transfer from the disk. Typical transfer time is 2 to 4 seconds.

The flight plan can only be loaded into the active flight plan pages. There is a limit of only one flight plan per disk, and, no wind or temperature data can be loaded. The name of the flight plan must be SPERRY.DAT.

Recall a Previously Stored Flight Plan

If the name of a previously stored flight plan is known, it can be entered at 3R, shown in figure 7-1. After entering, the FMS automatically recalls the flight plan and makes it the active flight plan, shown in figure 7-2. It takes the FMS 2 or 3 seconds to complete the recall of the flight plan.

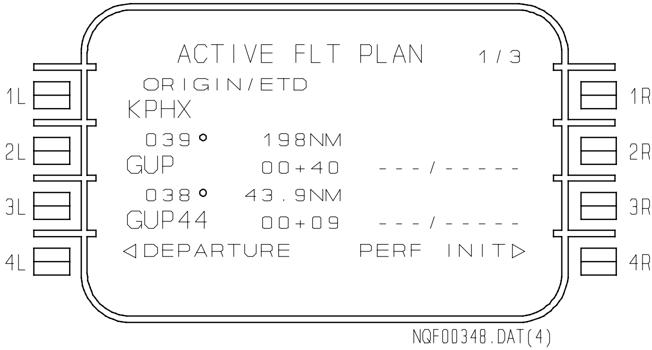


Figure 7-2

If the name of a previously stored flight plan cannot be remembered, enter the origin and destination. The FMS searches the stored flight plans for those plans with the same origin and destination. If any are found, the FLIGHT PLN LIST page, shown in figure 7-3, is displayed with the stored flight plan names marked with an asterisk (*). Select the required flight plan, shown in figure 7-4, and push RETURN (1R). This activates the flight plan and returns the display to the ACTIVE FLT PLAN pages, shown in figure 7-2. Even if the flight plan name can be remembered, this procedure saves steps over entering the flight plan name at 3R.

Figure 7-3

Figure 7-4

Store a Flight Plan and Activate

When building a flight plan, the flight plan can be retained in memory for use in the future. This is done by entering the flight plan identifier at 3R, shown in figure 7-1. **The flight plan must be built as a stored flight plan first and then activated. It is not possible to build an active flight plan and then store it**. After entering the flight plan name at 3R, the FMS switches to the stored flight plan page, shown in figure 7-5, to define the flight plan. After it is defined, the flight plan can be activated. If a flight plan name that is already defined is entered at 3R, the flight plan becomes active.

Figure 7-5

Build a Flight Plan by Entering Waypoints

When a destination is entered at 2R, shown in figure 7-1, the FMS searches for stored flight plans with the same origin and destination. If any flight plans are found, the FLIGHT PLAN LIST page is displayed. Select RETURN at 1R to return to the active flight plan and input waypoints. If no flight plan is found during the search, the active flight plan is displayed and the FMS is ready for waypoint input, as shown in figure 7-6. When building a flight plan, waypoints are entered on the line showing the VIA.TO prompt (1L through 3L). The FMS accepts a variety of inputs at the VIA.TO prompt as described below.

Figure 7-6

- **Waypoint** - Any waypoint contained in the NAV data base or the custom data base can be entered. If a waypoint name is entered that is not yet defined, the FMS automatically displays a page for waypoint definition. The waypoint can be defined and the RETURN prompt can be used to get back to the flight plan. If the waypoint name was entered in error, the RETURN prompt is used without a definition being entered.

- **Temporary Waypoint** - Any temporary waypoint can be entered.

- **Airway** - Any airway in the data base can be entered. When entering an airway, the waypoint in the flight plan preceding the point of entry must be a waypoint on the airway. The airway entry is made in the format of the VIA.TO prompt where VIA is the airway identifier and TO is the last waypoint to be used on the airway. For example, a portion of the flight plan is GUP, J102 to ALS. The first step is to insert GUP into the flight plan. This is followed by the entering J102.ALS in the scratchpad, shown in figure 7-7. The entry is completed by selecting 3L and the FMS automatically fills in all the waypoints along the airway from GUP up to and including ALS.

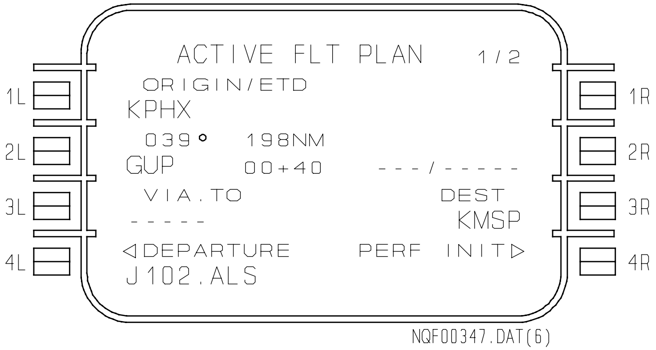


Figure 7-7

- **Flight Plan Names** - Any defined flight plan name can be entered. If a defined flight plan is entered, flight plans can be linked together. When inserting a flight plan, the FMS searches for common points between the two flight plans being linked. If the common waypoint is found in the stored flight plan, the two flight plans are linked at that point. Any waypoints in the stored flight plan preceding the common waypoint are eliminated. If no common waypoint is found, the stored flight plan is inserted beginning at the origin.

Flight plan names can also be entered using the VIA.TO format. In this case, the stored flight plan is inserted up to and including the waypoint specified in the VIA.TO entry. Any waypoints in the stored flight plan after the specified waypoint are eliminated.

After the flight plan is entered, the destination waypoint should be entered as the last waypoint. This is done with the line that selects the destination to the scratchpad from the right side of the display. The destination is then line selected from the scratchpad to the VIA.TO prompt that closes the flight plan. The destination waypoint can also be entered from the keyboard into the scratchpad and line selected to the VIA.TO prompt.

An alternate flight plan is entered using the same rules as a regular flight plan.

- **Vertical Entries** - Vertical definitions for waypoints are entered using the right hand line select keys (1R through 3R). There are four display fields available on the right side of the flight plan page, as shown in figure 7-8.

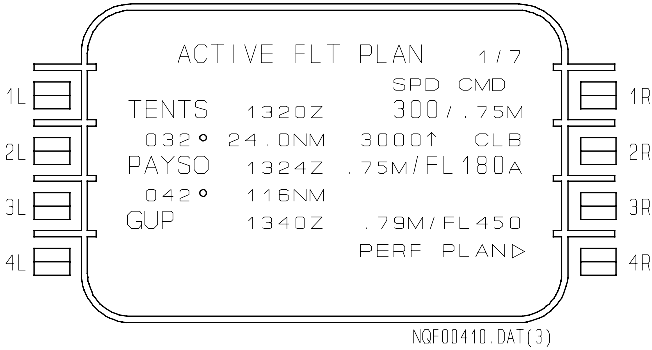


Figure 7-8

No vertical entries are required to operate VNAV. The FMS supplies predicted information for each waypoint and displays it in small characters. The predicted information is sufficient to define the vertical profile. Pilot entries are used to modify and further define the vertical profile. The following information is displayed and/or entered for each waypoint in the flight plan.

- ALTITUDE - Predicted altitudes are displayed in small characters for each waypoint. Pilot entries, displayed in large characters, become altitude constraints for VNAV. Altitude constraints from procedures are also displayed in large characters.

- CONSTRAINT TYPE - Constraint type is displayed directly above altitude constraints. In this case, the constraint type is displayed at 1R, shown in figure 7-9. The constraint type shows as CLB for climb constraints and DES for descent constraints. The FMS automatically assigns constraints in the first half of the flight plan as climb (CLB) and those in the last half as descent (DES). This automatic assignment is correct for most flights. The pilot can make an overriding entry. C, CLB, D, or DES are accepted as entries. Pilot entries are required for flights that climb, descend, and climb again.

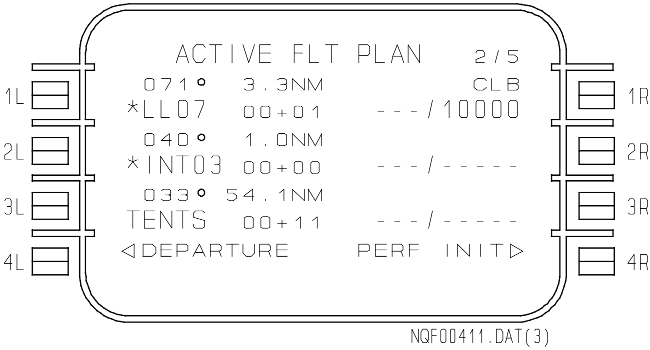


Figure 7-9

- SPEED - Speed is displayed, as shown in figure 7-10, except when an angle is entered. The FMS calculates and displays a predicted speed for each waypoint. Speed can be entered in either CAS or MACH. If the waypoint is in a path descent, the angle is displayed because it is a higher priority.

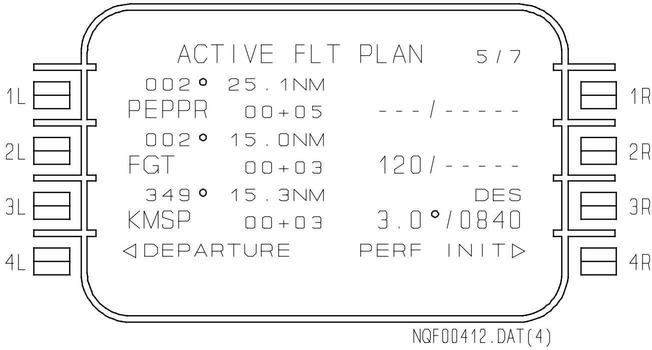


Figure 7-10

- ANGLE - When a path descent is defined by entering a descent altitude constraint, an angle is displayed. The angle is calculated based on current conditions and performance initialization. It is displayed in small characters. The pilot can enter an angle on this page. The angle is displayed in large characters. Pilot entries are only applicable for the descent to the specific altitude constraint.

- VERTICAL SPEED - The predicted vertical speed is displayed unless a higher priority item is displayed. The FMS displays this information and the pilot's vertical speed entry is not accepted.

  When vertical angle and airspeed constraints are entered, airspeed is shown above the angle and is also a constraint.

• **Additions and Deletions to the Flight Plan** - There are several actions that result in adding and/or deleting waypoints in the flight plan. Any entry that is permitted at the VIA.TO prompt can also be made in place of previously entered waypoints. The description of the rules that apply, are described as follows:

- Single waypoints, including temporary waypoints, can be added to, or deleted from, the flight plan. To add a waypoint to the flight plan, the waypoint is line selected from the scratchpad to the appropriate line. The added waypoint is displayed on the line that it is selected. When adding a waypoint, the flight plan is searched forward of the point of insertion. If the waypoint appears in the flight plan, all the waypoints between the point of insertion and the first appearance of the added waypoint are deleted. If the waypoint does not appear forward of the inserted point, the flight plan is opened and the new waypoint inserted. Searching forward in the flight plan is restricted to the portion of the flight plan that is being modified (i.e., either the primary flight plan or the alternate flight plan).

- Waypoints are deleted using the DEL key. After entering *DELETE* in the scratchpad, line selecting a waypoint deletes it. When the waypoint is deleted, the flight plan is closed and linked together. Waypoints can be deleted by entering a waypoint that is also in the flight plan forward of the point of entry.

  The pilot can delete both TO and FROM waypoints in some combinations of flight plan changes. In such cases, the FMS displays a CHANGE ACT LEG prompt.

- Stored flight plans, procedures, and airways can be called from the data base and inserted in the active flight plan. In all cases, flight plans, procedures, and airways are considered a string of waypoints and each waypoint in the string is inserted into the flight plan. In order to insert an airway, the starting point, the airway number, and the end point must be specified. The start point is the waypoint in the flight plan that precedes the insertion point of the airway and end point. Both the start point and the end point must be on the airway. When inserting a stored flight plan, the pilot only has to specify the flight plan name to insert the complete flight plan. To insert a portion of a stored flight plan, the entry is made in the form of FLIGHT PLAN NAME.WAYPOINT. When a stored flight plan is inserted, flight planning takes the active flight plan waypoint before point of insertion and searches forward in the stored flight plan. If the waypoint is found in the stored flight plan, the waypoints earlier in the stored flight plan are not inserted. Flight planning also takes the specified end point or last waypoint of the stored flight plan, and searches forward of the point of insertion in the active flight plan. If found, the waypoints earlier in the active flight plan are deleted.

- The DIRECT-TO function also adds or deletes waypoints. After selecting DIRECT-TO, line selecting a waypoint deletes all the waypoints before the selected waypoint and the selected waypoint becomes the TO waypoint. A waypoint in the alternate flight plan can be selected from the primary flight plan. If this is done, all the waypoints including the original destination are deleted and the waypoint in the alternate flight plan becomes the TO waypoint. A waypoint can be entered in the scratchpad and line selected to the prompt. This makes the added waypoint the TO waypoint. The DIRECT-TO RECOVERY function can also be used. Refer to DIRECT-TO on page 9-2.

- Using the INTERCEPT function adds an intercept waypoint. No waypoints are deleted with the INTERCEPT function. If the pilot inserts an intercept waypoint in the flight plan and changes to another page before the definition is completed, the entire operation is canceled. Refer to INTERCEPT on page 9-4.

- **Clearing of Flight Plans** - The active flight plan is automatically cleared 5 seconds after power is removed. This applies both on the ground and in flight.

  A stored flight plan can be activated while on the ground or in flight, but the pilot must confirm that the present active flight plan is being replaced. Flight plans can also be cleared one waypoint at a time, using the DEL key on the control display unit (CDU).

  While on the ground, a new origin can be entered after some or all of the flight plan has been defined. If the new origin is already a waypoint in the flight plan, the waypoints earlier than the new origin are deleted. If the new origin is not already a waypoint in the flight plan, the whole flight plan is deleted. Deleting the origin clears the entire flight plan. This applies to both active and stored flight plans.

  After landing plus a 30 second time delay, the CLEAR FPL prompt is displayed on the active flight plan page. Selecting this prompt clears the entire active flight plan. The FMS defines landing as when groundspeed is below 50 knots, CAS is below 80 knots, and weight on wheels (WOW).

  Changing the data base cycle (NAV IDENT page, line select 2R) clears the active flight plan. This rules out any discrepancies between flight plan information and the new data base cycle. The data base cycle can only changed on the ground.

LATERAL NAVIGATION

LNAV is the function in the FMS that sends a command to the flight guidance computer to laterally steer the aircraft. LNAV is engaged on the flight guidance panel. Requirements for engaging LNAV are that FMS must be the selected NAV source on the display controller, and, as a minimum, the active leg must be defined. The two submodes of LNAV are LNAV ARM and LNAV CAPTURE.

- **General LNAV Rules** - The following are general rules and concepts of LNAV:
  - A minimum of one leg must be defined for LNAV calculations.
  - LNAV is available for all phases of flight.
  - LNAV bank angles do not exceed 25° except in holding, procedure turns, and orbit patterns, and on arc legs. For these cases the limit is 30°.
  - LNAV roll rate is 3° per second during the enroute phase of flight and 5.5° per second on the approach.
  - The distance shown for each leg of the flight plan accounts for the distance traveled due to the change in course from one leg to the next.
  - LNAV uses up to the limits of bank angle to stay within protected airspace.
  - A lateral track alert is given for each waypoint sequence. The alert is given 30 seconds before starting a turn.
- **LNAV ARM** - When initially selected, LNAV ARM becomes the active mode. While armed, the FMS monitors aircraft position and heading against the active leg. When within the capture zone, the FMS automatically changes from LNAV ARM to LNAV CAPTURE and guides the aircraft to capture the active leg. While in the armed mode, the FMS does not laterally control the aircraft. Usually, the HEADING lateral mode is used to control the aircraft until the FMS changes to LNAV CAPTURE.
- **LNAV CAPTURE** - The FMS begins lateral steering control when the mode changes from ARM to CAPTURE. The FMS uses a 3° per second roll rate during enroute operations and up to 5.5° per second on the approach. Banks are planned between 0° and 23° with 25° as a maximum. In holding, procedure turns and orbit patterns, and arc legs, the maximum is increased up to 30°.

One of the requirements of LNAV is to keep the aircraft within protected airspace. This is done by incorporating a model of protected airspace into the FMS. From the model, the FMS determines the bank angle required to stay within the protected airspace boundaries during leg changes. The actual bank angle used is the greater of the pilot entered bank factor or the bank angle from the protected airspace model.

VERTICAL NAVIGATION

VNAV is the function in the FMS that sends targets to the flight guidance computer for vertical control of the aircraft. Using the FMS VNAV, the operator can define vertical profile information that is flown by the aircraft automatically when the VNAV flight director mode has been selected. FMS VNAV can be used throughout the flight. VNAV can be used to climb, cruise, and descend on the pilot selected speed schedules. Additionally, descents can be set up for a path mode (similar to glideslope) to cross waypoints at a specified altitude. The two main areas for display of VNAV information are the ACTIVE FLT PLAN page and PROGRESS page 2.

Annunciation of VNAV modes varies from aircraft to aircraft. The table below lists the various annunciations. **This manual uses the annunciations in the right hand column.**

Flight Director Mode	Annunciations	
Flight Level Change	FLC	FLCH
Vertical Flight Level Change	VFLC	VFLCH
Vertical Altitude Hold	VALT	VALT
Vertical Altitude Select	VASL	VASEL
Vertical Path	VPTH or VVS	VPATH

Mode Annunciations
Table 7-1

Some aircraft are only equipped with advisory VNAV, meaning the VNAV guidance cannot be coupled to the flight director or autopilot. In these aircraft, VNAV still operates as described in this manual. During operations in VPATH, vertical deviation is displayed and can be followed by hand flying or using the vertical speed mode and adjusting the vertical speed to stay on the path.

VNAV is engaged on the flight guidance panel. To engage VNAV, the FMS must be the selected NAV source and performance must be initialized. LNAV must be engaged to be engaged in the VPATH submode. There are five submodes of VNAV described below. One purpose of the VNAV submodes is to generate information concerning speed control. The two possibilities for speed control are throttle and pitch (elevator).

- **General VNAV Rules** - The general rules and concepts of VNAV are described below.
  - Vertical flight level change is denoted as VFLCH.
  - PERF INIT must be completed for VNAV computations.
  - VNAV is available for all phases of flight.
  - Climbs are flown using VFLCH only.
  - Descents are flown using VFLCH or VNAV path (VPATH).
  - VNAV never passes through the altitude selector.
  - The pilot should set the altitude selector only to ATC cleared altitudes.
  - VNAV keeps the aircraft as high as possible as long as possible.
  - VPATH angles are from 1° to 6°.
  - In VPATH, the path guidance is always followed except:

    When the aircraft approaches V_{mo}/M_{mo}.
    When the aircraft encounters the speed limit altitude constraint (e.g., 250 knots at 10,000 feet).
  - Speed protection and LATCHED SPEED are active in VFLCH.
  - If the altitude selector is set above (climbs) or below (descents) current altitude, the FMS commands the autopilot to begin a climb (VFLCH) or descent (VFLCH or VPATH).
  - VNAV is engaged by selecting the FMS as the navigation source and selecting the VNAV button on the guidance panel. EFIS annunciates the submode of VNAV.

- Climb, cruise, or descent speed targets are controlled by the FMS using data entered during initialization.
- The FMS must be the selected navigation source and LNAV must be engaged for VPATH to be operational.
- VPATH default descent angle is part of performance initialization. However, after the angle is displayed for each waypoint, the crew can change it.
- When the altimeter is adjusted to display height above the ground (Qfe) rather than sea level, VNAV should not be used.
- VNAV does not function until all PERFORMANCE INIT information has been programmed into the CDU. If any of the PERFORMANCE INIT data are incomplete and VNAV is armed a PERF-VNAV UNAVAILABLE message is displayed in the scratchpad.

- If the altitude selector is properly set, VNAV observes flight plan constraint altitudes.

  A vertical track alert is issued anytime the FMS commands a vertical track change. It is issued 60 seconds before a change from level flight to either a climb or descent. If the aircraft is completing a climb or descent, the vertical alert is issued 1000 feet before the level off altitude. A vertical alert is not issued when the level off altitude is set on the altitude selector.

- **VNAV Constraints** - VNAV constraints are as follows:

  - Speed (CAS or Mach)
  - Altitude
  - Descent Angle.

  VNAV constraints are specified either in the flight plan as a waypoint constraint, in the data base with procedures, or on the PERF INIT pages. For the air data modes, the climb and descent speeds from PERF INIT are used as the default limits. For VPATH descents, the DES ANGLE is used from PERF INIT unless a descent angle and an altitude are specified on a flight plan waypoint, and, if the aircraft passes below the PERF INIT SPD LIMIT ALTITUDE, the VNAV limits the IAS to the specified limit.

The constraint is entered on the right line select keys with the speed or descent angle first separated by a "**/**" and followed by the altitude constraint. For example to enter a speed of 300 knots and an altitude of FL250 at a waypoint, the scratchpad entry is 300/FL250. Constraints are displayed in large characters. If there are no constraints, the FMS provides predictions, displayed in small characters.

- **VNAV ARM (VNAV)** - When initially selected, VNAV ARM becomes the active mode. While armed, the FMS monitors aircraft position and altitude against the altitude selector and, if any, the next waypoint altitude constraint. From this, the FMS determines when to capture and which submode is appropriate.

  There are a few conditions where VNAV ARM remains the active mode for some time. For example, the altitude selector is set above aircraft altitude and the next constraint altitude is below the aircraft altitude. In this example, VNAV cannot determine whether to climb to the selector altitude or to descend to the constraint. The net result is that VNAV stays in the ARM mode until the conflict is resolved.

  While in the armed mode, the FMS does not vertically control the aircraft. Another vertical flight director mode is used to vertically control the aircraft until the FMS transitions out of VNAV ARM.

- **VNAV Flight Level Change (VFLCH)** - This mode is vertical flight level change. It is used during all climbs and, unless a path is defined, during descents. When engaging VNAV, VFLCH is set as the active mode if the altitude selector is above or below the current aircraft altitude and the current flight director mode is not altitude hold. When in other modes of VNAV, a transition to VFLCH is made by setting the altitude selector to other than current altitude and pushing the FLCH button (in aircraft with a Collins system, the VNAV button must be pushed also). In this mode, VNAV supplies the altitude leveling target. The speed displayed on the active flight plan is the speed target for this mode. Aircraft speed is controlled by the flight guidance computer through the elevator or pitch of the aircraft. The autothrottle is set to the climb power rating for climbs and idle for descents. The exception to this is if climbing or descending only a short distance, the throttle can be set to less than climb power or more than idle to avoid abrupt changes. Moving the throttle during this mode makes a change in the aircraft pitch that, in turn, changes vertical speed.

- **VNAV Altitude Capture (VASEL)** - This mode is the same as altitude capture. It is used to level the aircraft at the VNAV supplied altitude target. The altitude target is either an altitude constraint or the selector setting. The flight guidance computer controls the pitch of the aircraft in order to capture the altitude. The autothrottle controls the speed target displayed on the guidance panel. Moving the throttle changes speed.

- **VNAV Altitude Hold (VALT)** - This mode is the same as altitude hold. The flight guidance computer controls altitude by controlling pitch. The autothrottle controls the speed target. Moving the throttle changes speed, as required by the speed value on the guidance panel.

  If VNAV is disengaged while in VALT, the flight director mode becomes PITCH HOLD, not altitude hold.

- **VNAV Path (VPATH)** - The VNAV path mode is used only during descents when a waypoint altitude constraint has been entered. It is similar to flying on a glideslope. Using targets from the FMS, the flight guidance computer maintains the path by controlling vertical speed. Moving the throttle changes speed.

- **VNAV OFFSET** - ATC sometimes clears an aircraft to cross XX miles before or after a waypoint at a specified altitude. The FMS automatically places the waypoint on the flight plan at the specified distance. The waypoint name is in the form of *PDXX. This type of clearance can be entered into the FMS using procedure 7-1.

Step	Procedure 7-1 VNAV Offset Definition
1	Define a PLACE. Use the keyboard, or line select the place from the flight plan to the scratchpad.
2	Enter a "**/**" to indicate that the next entry is a bearing. If known, enter the bearing. If the bearing is not known, enter another "**/**" to indicate that the next entry is a distance.
3	Enter the distance to cross from the place. If DRK is the place, the entry is DRK//20.
4	Enter this information into the flight plan either before or after the place (DRK). The FMS automatically places the waypoint on the flight plan at the specified distance.
5	Enter the altitude constraint.

- **Climb** - All VNAV climbs are flown using flight level change (VFLCH). Intermediate level offs are entered as waypoint constraints through the CDU or they are set with the altitude selector. VNAV never flies through the selector altitude in any VNAV mode.

  If an intermediate level off is required due to an FMS waypoint altitude constraint, VNAV automatically resumes the climb after passing the waypoint, if the selector is set above the current aircraft altitude. If the selector is not set above the current altitude, VNAV maintains the intermediate altitude when passing the waypoint. In this case, the climb is resumed by setting the altitude selector higher and pushing VFLCH on the guidance panel (in aircraft with a Collins system, the VNAV button must be pushed also).

- **Cruise** - The initial cruise altitude is entered during performance initialization. If the altitude selector is set higher than the entered initial cruise altitude, the cruise altitude is adjusted to match the selector. When the aircraft levels off at the cruise altitude (initial cruise altitude or higher if set on the selector), the FMS enters the cruise phase of flight. The speed target is adjusted to the cruise values.

  Cruise is flown by the autopilot in the altitude hold mode (VALT). From cruise, a climb or descent can be executed at any time by entering the selector altitude and pushing the VFLCH button. There is a 2 to 3 second delay before VNAV resets the altitude target to the selector or next waypoint altitude constraint (whichever is closer), and the flight director changes to VFLCH.

  When in VALT, the flight guidance system (FGS) touch control steering (TCS) function can be used to maneuver the aircraft. However, when TCS is released, the aircraft returns to the original VALT altitude.

  Automatic changes from cruise can be performed for bottom of step climb (BOSC) and top of descent (TOD) points. In both cases, the selector must be properly set (i.e, above the current altitude for BOSC and below current altitude for TOD). If the selector remains at the current altitude, the aircraft remains in cruise as the points are passed.

- **Top-of-Descent -** A TOD waypoint is calculated and can be displayed on the map and on the PROGRESS pages. There can only be one TOD waypoint at a time. If there are no constraints during the descent, the TOD is calculated using the destination elevation (if available) and the speed mode. If there are constraints during the descent, a TOD is calculated using the path mode. For each TOD point, a vertical waypoint alert is given and an automatic descent is initiated if the altitude selector has been selected to a lower altitude.

- **Descent -** Descents are flown as speed descents or path descents. The type of descent is determined by whether or not there is a waypoint altitude constraint in the descent. A speed descent (VFLCH) is flown when no constraints exist in the flight plan during the descent. A VPATH descent is flown when there is an altitude constraint. After passing the last waypoint altitude constraint, VNAV changes from a path descent (VPATH) to a speed descent (VFLCH) unless the FMS is in the approach mode. In the approach mode (APRCH light on), the FMS transitions from path (VPATH) to VNAV disengaged. As a result of this transition, the flight director mode is pitch hold and the autothrottle, if installed, provides speed control.

  All constraints in descent are considered to be AT constraints. AT or ABOVE or AT or BELOW constraints contained in procedures from the data base are considered AT constraints. If the destination waypoint is an airport reference point, or a runway, the elevation from the data base is used to calculate a TOD point. This elevation is not considered a constraint. Constraints are only created by pilot or procedure entry. A pilot entry at the destination is considered a constraint.

- **Speed Descent (VFLCH) -** This mode works like the climb phase. The TOD point is calculated by looking at the destination elevation and present altitude. The TOD is calculated to put the aircraft at 1500 feet above the destination 10 miles before the destination. Also, the TOD is based on any speed constraints in the descent such as slowing to 250 knots below 10,000 feet.

  The transition to descent is automatic, assuming the altitude selector is set lower than present altitude. One minute before TOD, the vertical track alert is given. The pilot can also initiate a speed descent anytime by setting the selector to a lower altitude and pushing FLCH (in aircraft with a Collins system, the VNAV button must be pushed also).

Following an intermediate level off at the selector, the descent is resumed by dialing down the selector and pushing FLCH.

- **Path Descent (VPATH)** - This mode of descent is used when altitude constraints have been entered in the flight plan. The path is a straight line path at a specified angle. The default angle supplied by the FMS is from the performance initialization entry. An angle can also be specified as a constraint on a flight plan waypoint. During a path descent, the flight guidance computer controls vertical speed to maintain the path.

- **Vertical DIRECT-TO** - This function operates much like the lateral DIRECT-TO. Refer to page 9-2 for more information on vertical direct-to.

- **VNAV and Holding or Orbit Patterns** - There are some special considerations for holding and orbit during VNAV operation.

  - Path descents cannot be used during holding or orbit pattern operations. If the holding or orbit is entered while in VPATH, VNAV changes to VFLCH and continues the descent.

  - If the holding or orbit pattern is entered while in VFLCH, the aircraft remains in VFLCH and continues the climb or descent.

  - If the holding or orbit pattern is entered while in VALT, the aircraft remains in VALT.

  - If a present position (PPOS) holding pattern is entered while in a path descent, the aircraft changes to VFLCH while in holding.

  - If the holding or orbit pattern is entered at a waypoint that is part of a path descent, VNAV changes into VALT at the constraint altitude or the predicted altitude for the pattern waypoint.

- **VNAV (VPATH and VFLCH) and Stored Instrument Approaches**

  - All stored approach procedures have altitude constraints and VNAV descent angles associated with them. Using the path guidance insures that the minimum cruising altitudes for approaches are met.

  - <u>**It is possible to change the altitude constraint and/or the path descent angle once an approach procedure has been activated. However, the crew must verify that all the approach procedure altitude requirements are met**</u>.

- **The stored MAP altitude is generally based on the runway end point altitude plus 50 feet. Normally, it is not the non-precision approach procedure's minimum descent altitude (MDA). The crew must verify that the aircraft does not descend below the MDA until the airport environment is in sight and a descent for a normal landing can be made**.

- The stored missed approach also contains altitude constraints. Some altitude constraints do not refer to any waypoint. VFLCH can be used to fly the missed approach to comply with this type of altitude constraint. When using VFLCH, the crew should understand that the FMS uses the climb speed target during the missed approach.

- **Speed Protection** - During all VNAV operation, the FMS protects some speed limits. During path descents, speed control is secondary to path control. If the path descent is too steep, the aircraft increases speed even at idle power. If this is the case, the FMS displays the message INCREASED DRAG REQUIRED. If the speed approaches V_{mo} or M_{mo}, the FMS deviates from the path to maintain speed within limits.

  Another form of speed protection is LATCHED SPEED. If the FMS is in the LATCHED SPEED mode, it is displayed on the ACTIVE FLT PLAN page 1 at 1R. The FMS enters the LATCHED SPEED mode during automatic transitions from one submode of VNAV to another, and if there is a significant difference between actual aircraft speed and the speed target.

  The six conditions that can cause latched speed protection:

  1. If, during VALT capture, a change is made to a VFLCH/FLCH descent and the command speed is not within 5 knots of the current airspeed, the command speed is deleted and current airspeed is LATCHED and displayed as the command speed.

  2. If during descent or climb, the pilot entered intervention speed exceeds V_{mo} or M_{mo}, the pilot entered speed is deleted and V_{mo}/M_{mo} is displayed. Pilot entered speeds in excess of current V_{mo}/M_{mo} are converted to V_{mo}/M_{mo}.

  3. A latched speed can occur at the last BOD when the current speed target is more than 5 knots above the current airspeed. This is also true if the BOD altitude constraint is deleted.

4. A latched speed can occur if the altitude selector is dialed while in VALT Capture (VALT*) to a BOD and the current target is greater than 5 knots more than the current speed.

5. If VNAV has transitioned out of VPATH and the current airspeed is not within 5 knots of the speed target.

6. If VNAV is in VPATH and the CAS becomes greater than V_{mo} - 5 knots, VNAV changes to VFLCH and latches to V_{mo} - 10 knots.

The LATCHED SPEED mode can be removed by entering *DELETE* from the scratchpad to line select 1R on page 1 of the ACTIVE FLT PLAN.

- **PROGRESS Page Data** - PROGRESS page 2 displays information about the VNAV function. The speed/altitude command (SPD/ALT CMD) reflects the current command (target) of speed and altitude being sent to the flight guidance computer. If there is no command, the line is titled, but blank.

  The upper right line of this page displays the estimated vertical speed at TOD when a path descent is programmed. If a path descent is not defined, this line is blank.

  The PROGRESS page, shown in figure 7-11, shows the distance and time to the TOC, and TOD points.

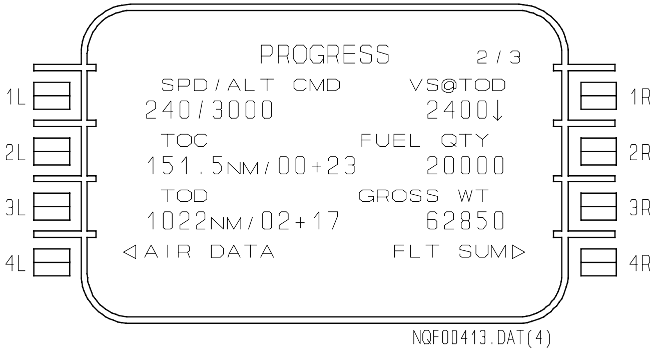


Figure 7-11

Bottom of step climb (BOSC) is displayed in place of TOC after passing TOC.

VNAV Speed Intervention

VNAV uses the speed schedule entered during performance initialization. The speed intervention mode means the speed schedule, for the current leg of the flight, can be altered while still operating in VNAV.

When VNAV is operating, the current VNAV command speed is displayed on the top, right line of the first page of the active flight plan, shown in figure 7-12. The speed consists of both CAS and MACH speed. The controlling part of the command speed is the lesser of the CAS and Mach, and is displayed in large characters. This is the same speed that is displayed at top left line on PROGRESS page 2. The prompt at top right line is normally SPD CMD, but changes to SPD INTV when speed intervention is in effect.

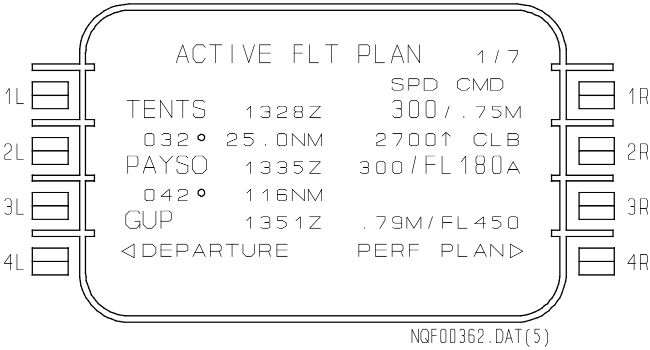


Figure 7-12

In some instances, the FMS cannot comply with the pilot entered speed target (i.e., V_{mo}, M_{mo}). The FMS displays the speed intervention target in inverse video as a reminder. These symbols and logic are also used for standard VFLCH waypoint speed targets when the FMS cannot comply with them. In any case, PROGRESS PAGE 2 always displays the speed target actually sent to the autopilot.

The actual speed displayed depends on phase of flight (climb/cruise/descent), whether speed intervention is active and V_{mo}/M_{mo}. If a manual speed is entered, the lesser of V_{mo}/M_{mo} or the entered speed is displayed. Otherwise, the displayed speed is the lesser of:

- V_{mo}/M_{mo}.
- Speed restriction speed (below speed limit (SPD LMT) altitude).
- In a climb, any climb waypoint constraint speed.
- The active waypoint constraint speed in cruise or descent when within deceleration distance to the waypoint.
- Climb speed in a climb.
- Descent speed in a descent.
- Cruise speed in cruise, cruise climb, cruise descent, or VALT capture of cruise altitude from climb.
- Latched current speed at transition from VALT capture to VFLCH/FLCH descent.

To eliminate sudden and unexpected speed changes during switches from altitude capture to a VFLCH/FLCH descent, the command speed is deleted and current airspeed is displayed (not applicable to aircraft equipped with a Collins system).

Control display unit (CDU) speed intervention (SPD INTV) becomes active when either a CAS or Mach is entered at the top right line on page 1 of the ACTIVE FLT PLN. When speed intervention is active, the prompt changes from SPD CMD to SPD INTV. CDU speed intervention remains active until any one of the following occur:

- *DELETE* is selected to the SPD INTV line.
- The aircraft has landed.
- A transition is made to VFLCH/FLCH during altitude capture.

When any of these events occur, the display returns to SPD CMD and the stored speed values are again used.

Normally, entering a CDU speed consists of both CAS and MACH separated by a '**/**' (e.g., 300/.78). If only CAS (or MACH) is entered, a default MACH (or CAS) is appended. Pilot entered speeds in excess of current V_{mo}/M_{mo} are converted to current V_{mo}/M_{mo} when they are entered.

If during descent or climb, the pilot entered speed exceeds V_{mo} or M_{mo}, the pilot entered speed is deleted and V_{mo}/M_{mo} is displayed as appropriate. Speed intervention remains active and the intervention speed resets to V_{mo}/M_{mo} in large characters. The pilot must select *DELETE* to the command line to cancel speed intervention.

To activate CDU speed follow procedure 7-2.

Step	Procedure 7-2 Speed Intervention
1	Completely initialize the PERFORMANCE INIT pages.
2	Enter required speed into scratchpad.
3	Push the 1R line select key on the ACTIVE FLT PLAN page 1.

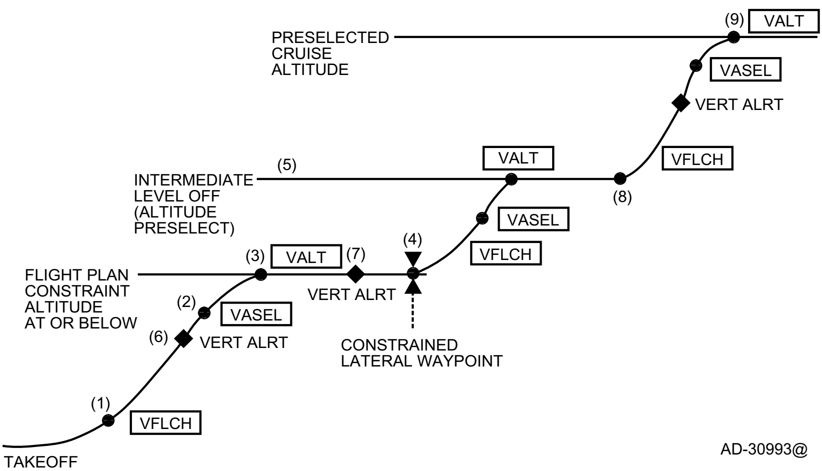
To deactivate CDU speed or remove a latched speed from the command speed display, follow procedure 7-3.

Step	Procedure 7-3 Remove Speed Intervention
1	Push the DEL key.
2	Push the 1R line select key on the ACTIVE FLT PLAN page 1.

VNAV Operational Scenarios

The operational scenarios are presented as a series of figures showing typical vertical profile segments. Certain points on the figures are labelled with numbers. These numbers are used to describe events and are enclosed in parentheses in the text. The events are not numbered in sequence order. Refer to the General VNAV Rules section, page 7-23, when reviewing these scenarios.

- **VNAV Climb (VFLCH)** - The elements of a VNAV climb profile that is shown in figure 7-13, are as follows:

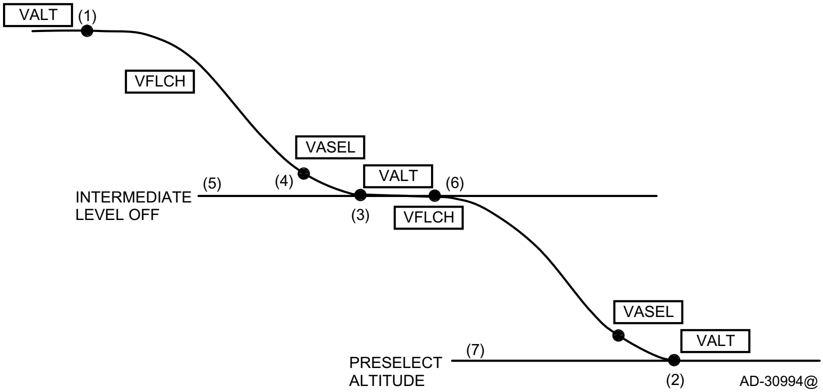


VNAV Climb Profile
Figure 7-13

- VNAV is engaged in a VFLCH airspeed climb (1) after takeoff.
- The flight guidance computer changes to VASEL to capture the altitude constraint (2).
- The flight guidance computer switches to VALT at the constraint altitude (3).
- The flight guidance computers switches to VFLCH as the waypoint is passed (4).
- An altitude constraint target is defined for the next lateral waypoint (4).
- The altitude selector is set higher than the constraint altitude (5).

- The flight guidance computer performs a normal level off at the intermediate selector altitude (5) switching from VFLCH to VASEL to VALT with the normal 1000 foot selector alert.
- 1000 feet before reaching the constraint altitude, a VTA is given (6).
- 1 minute before the constrained lateral waypoint (4) is reached, a VTA is given (7) indicating that an automatic climb begins at the waypoint.
- ATC clearance is received to the cruise altitude and the selector is dialed to the cleared altitude (8).
- The FLCH button is pushed to resume the climb (8).
- The flight guidance computer performs a normal level off at the cruise altitude (9) switching from VFLCH to VASEL to VALT with the normal 1000 foot selector alert and the speed target changes to the cruise value.

• **VNAV Flight Level Change Descent (VFLCH)** - The elements of a VNAV FLCH (IAS or MACH hold) descent profile are shown in figure 7-14. A VFLCH descent can be engaged at any time using the following:

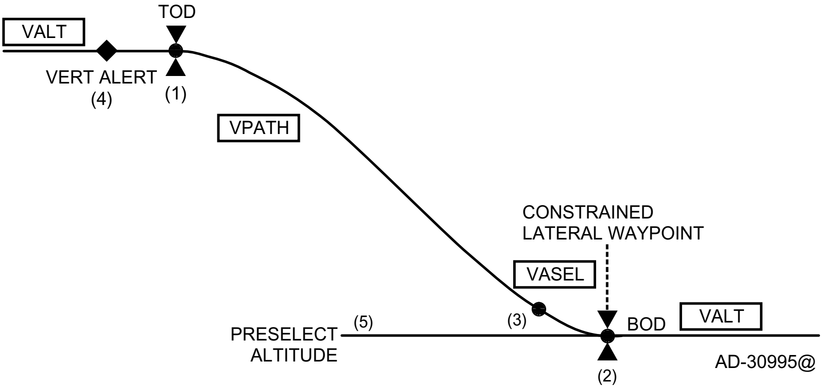


VNAV Flight Level Change Descent
Figure 7-14

- From cruise altitude (1), dial down the altitude selector to the ATC cleared altitude (5).

- Push FLCH if already engaged in a VNAV mode or VNAV if not already in VNAV. The flight guidance computer switches to VFLCH and begins a descent (1).
- 1000 feet before the selector altitude (5) is reached, the normal altitude alert is given and the flight guidance computer does a normal level off switching from VFLCH to VASEL (4) to VALT (3).
- An ATC clearance (6) is received to a lower altitude and the altitude selector is lowered (7). FLCH is pushed (6) and the aircraft begins a descent (the VNAV button also must be pushed on Collins equipped aircraft).
- 1000 feet before the selector altitude (7), the normal altitude alert is given and the flight guidance computer does a normal level off, switching from VFLCH to VASEL to VALT (2).

• **VNAV Path Descent (VPATH)** - The elements of a VNAV path descent profile are shown in figure 7-15. A VNAV path descent can be engaged from VALT at any time, if the altitude selector has been dialed down before the TOD point is reached. The VNAV path descent mode is used to descend to a new flight level at a calculated or prescribed angle (between 1° and 6°). The following steps apply:



VNAV Path Descent Profile
Figure 7-15

- An altitude constraint is entered at a waypoint (2). The FMS calculates an angle and TOD (1) for the path descent.
- The altitude selector is set to the ATC cleared altitude (5).
- 1 minute before reaching the TOD, a VTA is given (4) and the vertical deviation scale is displayed on the EFIS. If the selector is not at a lower altitude, the message RESET ALT SEL? is displayed.

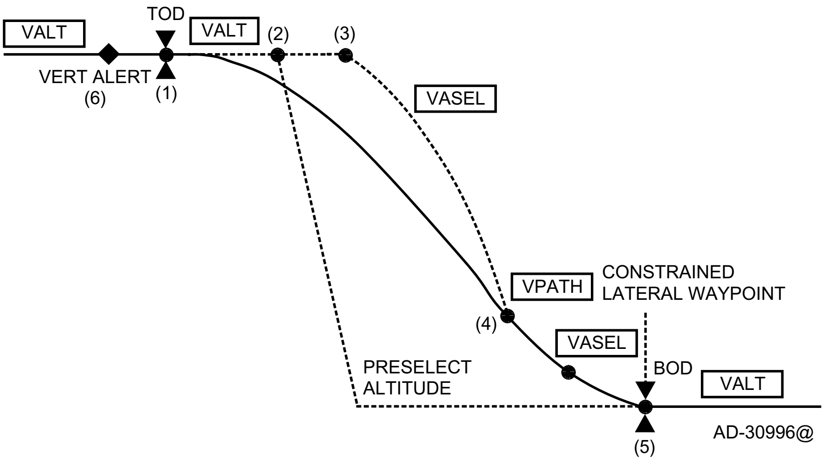
- At the TOD, the flight guidance computer switches from VALT to VPATH and begins a descent (1).
- The flight guidance computer does a normal level off switching from VPATH to VASEL (3) to VALT (2).

The VNAV angle is always displayed on CDU for path descents. The path is always followed <u>except</u> for the following two cases:

- The aircraft approaches V_{mo}/M_{mo}.
- The aircraft encounters a speed limit altitude constraint (e.g., 250 knots at 10,000 feet).

VNAV tries to satisfy both the altitude selector and the waypoint constraint altitude. However, VNAV never flies through the altitude selector.

- **VNAV Late Path Descent (VPATH)** - A VNAV late path descent is shown in figure 7-16. This scenario can occur if ATC has not given descent clearance by the time the TOD is reached. The steps are as follows:

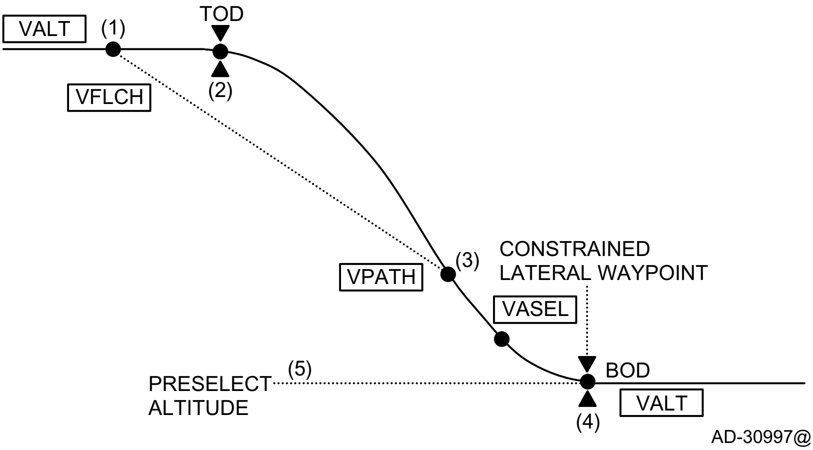


VNAV Late Path Descent
Figure 7-16

- An altitude constraint is entered at a waypoint (5). The FMS calculates an angle and TOD (1) for the path descent.
- 1 minute before reaching the TOD, a VTA is given (6) and the vertical deviation scale is displayed on the EFIS. The message RESET ALT SEL? is displayed. The altitude selector is at current altitude.

- When past the TOD and more than 500 feet above the path, the flight guidance computer remains in VALT.
- The altitude selector is set (2) to the ATC cleared altitude.
- Push the FLCH button (3) (VNAV button also on Collins equipped aircraft) to begin descent. The flight guidance computer transitions to VFLCH to begin the descent. If the aircraft is past the TOD but less than 500 feet from the path when the selector is set lower, the FMS switches directly to VPATH.
- When the path is intercepted, the flight guidance computer switches to VPATH (4).
- The flight guidance computer does a normal level off switching from VPATH to VASEL to VALT (5).

• **VNAV Early Descent to Capture Path (VPATH)** - An early descent to capture a path is shown in figure 7-17. This scenario is typical, should ATC instruct a descent before the established TOD point is reached. The steps are as follows:



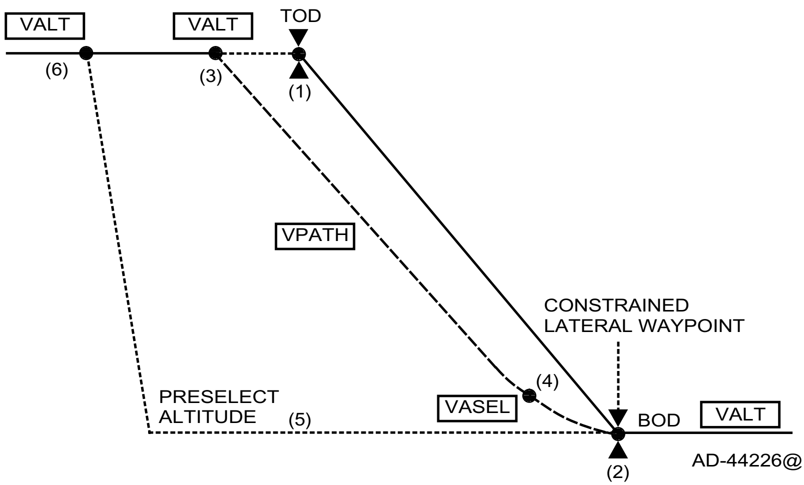
VNAV Early Descent to Capture Path
Figure 7-17

- An altitude constraint is entered at a waypoint (4). The FMS calculates an angle and TOD (2) for the path descent.
- The altitude selector is set to the ATC cleared altitude (5).
- Push the FLCH button (1) (VNAV button also on Collins equipped aircraft) to begin the descent. The flight guidance computer switches to VFLCH to begin the descent.

- As the path is approached, the vertical deviation is displayed on the EFIS. When the path is intercepted, the flight guidance computer switches to VPATH (3).

- The flight guidance computer does a normal level off, switching from VPATH to VASEL to VALT (4).

- **VNAV Early Descent Using DIRECT-TO (VPATH)** - The VNAV early path descent using vertical DIRECT-TO is shown in figure 7-18. The following steps apply:



VNAV Early Path Descent Using Vertical DIRECT-TO
Figure 7-18

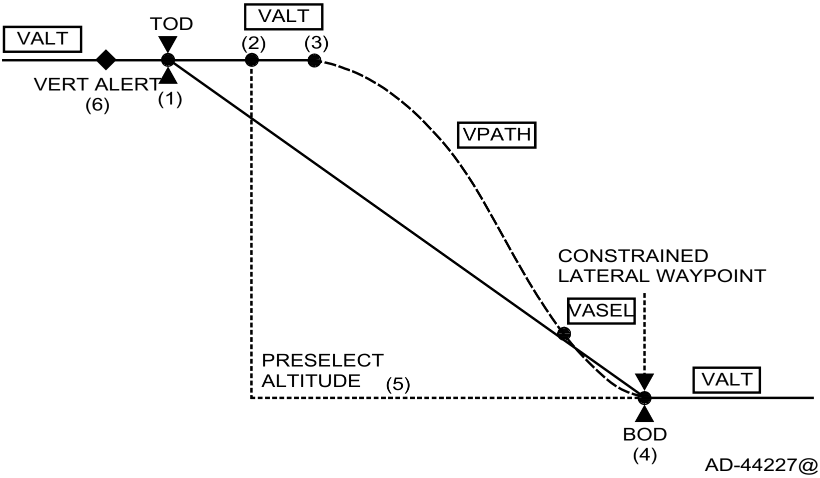
- An altitude constraint is entered at a waypoint (2). The FMS calculates an angle and TOD (1) for the path descent.

- The altitude selector is set (6) to the ATC cleared altitude (5).

- A vertical direct-to is performed (3) to the constrained waypoint (2). The FMS calculates the new angle and the flight guidance computer transitions to VPATH.

- The flight guidance computer does a normal level off, switching from VPATH to VASEL (4) to VALT (2).

- **VNAV Late Descent Using DIRECT-TO (VPATH)** - A VNAV late path descent using vertical DIRECT-TO is shown in figure 7-19. In this scenario, descent clearance is not received before the TOD is reached. The following applies:



VNAV Late Path Descent Using Vertical DIRECT-TO
Figure 7-19

- An altitude constraint is entered at a waypoint (4). The FMS calculates an angle and TOD (1) for the path descent.
- 1 minute before reaching the TOD, a VTA is given (6) and the vertical deviation scale is displayed on the EFIS. The message RESET ALT SEL? is displayed. The altitude selector is at current altitude.
- At the TOD (1), the flight guidance computer remains in VALT and remains level through the TOD.
- The altitude selector is set (2) to the ATC cleared altitude (5).
- A vertical direct-to is performed (3) to the constrained waypoint (4). The FMS calculates the angle and the flight guidance computer transitions to VPATH.
- The flight guidance computer does a normal level off, switching from VPATH to VASEL to VALT (4).

8. Progress

INTRODUCTION

The three PROGRESS pages are accessed by pushing the PROG function key. They report progress along the flight plan. These pages summarize important flight parameters and the aircraft's relationship to the flight plan.

- **PROGRESS 1/3** - Figure 8-1 shows distance to go (DTG), estimated time enroute (ETE), and estimated fuel remaining for the TO waypoint and the destination. This data can be seen for other waypoints in the flight plan by line selecting another waypoint(s) in place of either the TO (1L) or the destination (2L) waypoints.

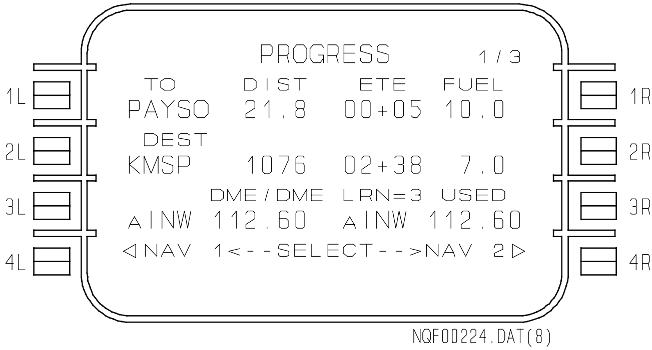


Figure 8-1

The bottom part of the page summarizes the navigation modes of the FMS. In this example, the FMS is navigating using DME/DME. There are three long range NAV sensors (LRN=3) being used, and the NAV radios are in autotuning (**A** preceding the VOR identifier) with INW selected for both radios. Refer to Tuning Nav Radios on page 6-80 for information on tuning the nav radios.

- **PROGRESS 2/3** - Figure 8-2 shows the PROGRESS 2/3 page that displays the current speed and altitude command, the predicted vertical speed at top of descent (TOD) (when a path is defined), the distance and time to top of climb (TOC), and TOD (if not past), the current fuel quantity, and the current gross weight. If the TOD point has been passed, the prediction is replaced with PAST. No entries can be made on this page.

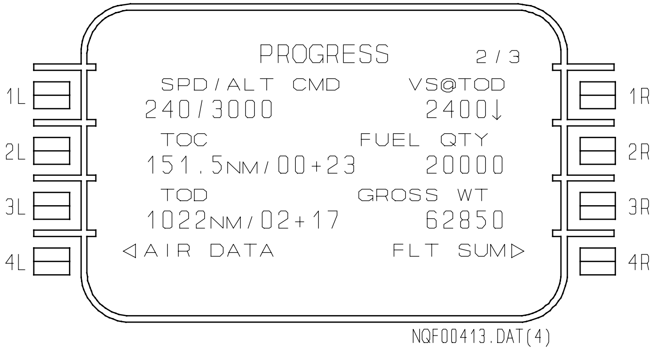


Figure 8-2

PROGRESS page 2 reflects changes based on inputs to the VNAV FMS function. The speed/altitude command (SPD/ALT CMD) reflects the current command of speed/altitude that the FMS is sending to the flight guidance computer. If there is no command, the line is titled but blank. The 1R line select of this page displays the expected vertical speed when a path has been defined in VNAV. Otherwise, this position is blank.

- **PROGRESS 3/3** - Figure 8-3 shows the PROGRESS 3/3 page that displays cross track error (XTK ERROR), lateral offset, current track and heading in magnetic or true, current wind in vector form and component form, drift angle, and groundspeed.

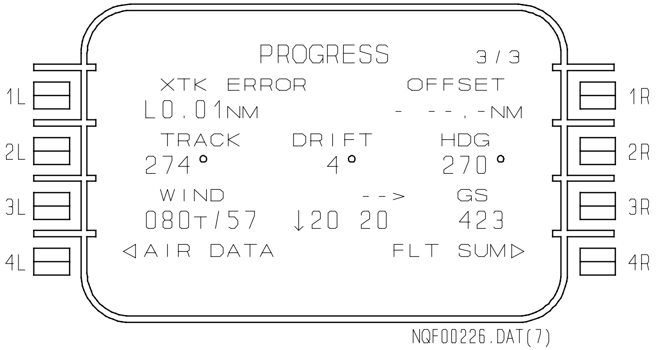
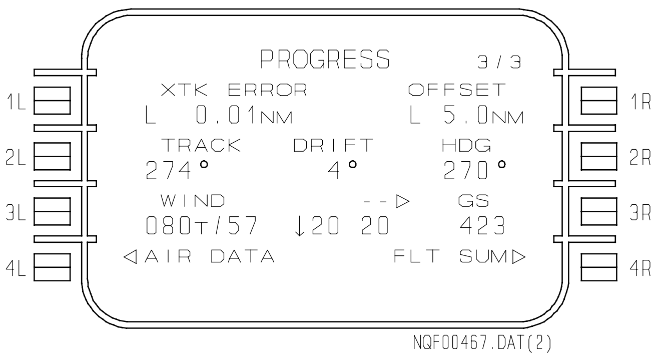


Figure 8-3

LATERAL OFFSET

Lateral offsets are entered on PROGRESS page 3. The entry is made as described in procedure 8-1

Step	Procedure 8-1 Lateral Offset Entry
1	Select PROGRESS page 3.
2	Enter lateral offset in scratchpad. Enter direction (L or R) and distance in nautical miles.
3	Enter the offset by pushing line select 1R.
4	The PROGRESS page is shown in figure 8-4.  **Figure 8-4** **DETAILS** - Lateral offsets cannot be accepted while flying a SID, STAR, any pattern, or in the polar region. Offsets are automatically canceled for course changes greater than 90°, starting SIDs, STARs, holding/orbit patterns, and intercepts. An OFFSET CANCEL NEXT WPT message is displayed before offset is automatically canceled.
5	To manually cancel the lateral offset waypoint, push the DELETE key and line select to 1R.

The FLIGHT SUMMARY and AIR DATA pages are accessed on PROGRESS pages 2 and 3. The AIR DATA page is shown in figure 8-5. This page displays the values for the on-side (ADC). If the on-side ADC fails, the information comes from the off-side ADC. The ADC data source is displayed as part of the title. Refer to page 6-161 for more information on FLIGHT SUMMARY page.

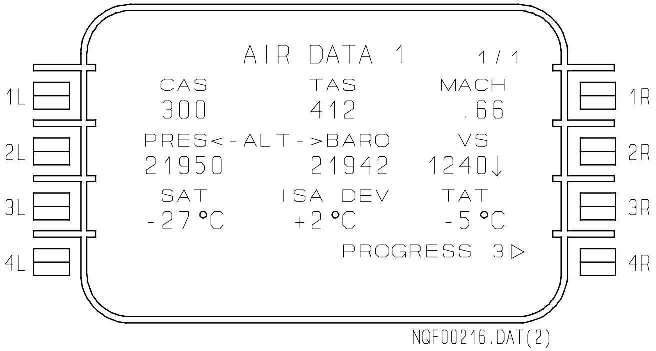


Figure 8-5

9. Direct/Pattern/Intercept

INTRODUCTION

The DIRECT, PATTERN, or INTERCEPT functions are accessed by pushing the DIR key while displaying any other page of the FMS. If the active flight plan is not being displayed when the DIR key is push, page 1 of the active flight plan is displayed. If the active flight plan is already displayed when pushing the DIR key, the display remains on the current page of the active flight plan. Pushing the DIR key inserts three prompts on the ACTIVE FLT PLAN pages. The three prompts, shown in figure 9-1, are as follows:

- DIRECT (1L) (page 9-2).
- PATTERN (4L) (pages 6-95 and 9-4).
- INTERCEPT (4R) (page 9-4).

The three prompts are used to call-up the respective function of the FMS. They remain displayed while paging through the flight plan.

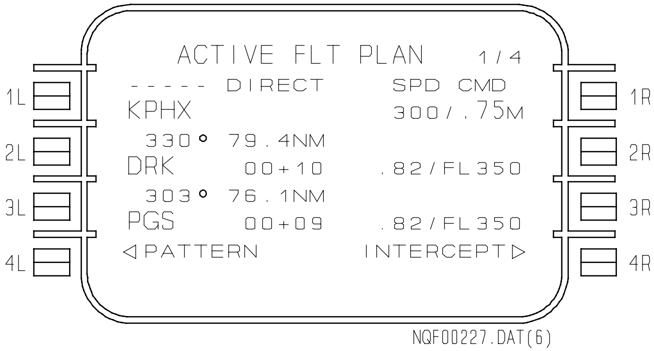


Figure 9-1

DIRECT-TO

The FMS direct-to function can either be lateral or vertical. The left line select keys are used for lateral direct-to and the right line select keys are used for vertical direct-to. The FMS also has a direct-to recovery function.

- **Lateral Direct-To** - In doing a lateral direct-to, the FMS computes the turn and the course from the end of turn. There are two ways to operate the lateral direct-to after the DIR key is selected:

    1. If the direct-to waypoint is in the flight plan, pushing the line select key next to the direct-to waypoint engages the direct-to. A direct-to course is calculated and the aircraft begins turning for the waypoint.

    2. Enter the direct-to waypoint in the scratchpad and line select the waypoint to the dashed lines (1L on page 1). This completes the direct-to. This method is required when the direct-to waypoint is not already in the flight plan and when it is optional for waypoints in the flight plan.

- **Vertical Direct-To** - A vertical direct-to is operated in a similar manner as the lateral direct-to. A vertical direct-to is connected to an altitude constraint at a waypoint in the flight plan. The altitude constraint must be in the flight plan before the vertical direct-to is done. Procedure 9-1 describes how to execute a vertical DIRECT-TO.

    Vertical DIRECT-TO can be used for climbs and descents. The aircraft does not respond to the vertical DIRECT-TO unless the altitude selector is properly set above for climbs and below for descents.

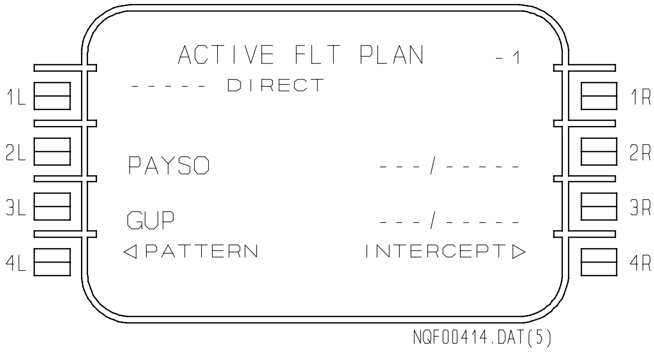
Step	Procedure 9-1 Vertical Direct-To
1	Set the altitude selector to the cleared altitude.
2	Confirm that the altitude constraint is entered in the flight plan.
3	Push the DIR key.
4	Using the right-hand line selects (1R through 3R), push the line select adjacent to the altitude constraint.

Step	Procedure 9-1 Vertical Direct-To
5	VNAV changes to VFLCH for climbs or VPATH for descents. All altitude constraints between the aircraft and the selected constraint are removed from the flight plan. No lateral changes are made to the flight plan.
6	If the altitude selector is still at the current altitude, the DIRECT-TO is performed but VNAV does not change to VFLCH or VPATH.

When performing a vertical DIRECT-TO for descent, VNAV calculates the angle from present position to the altitude constraint. The TOD is placed slightly ahead of the aircraft to allow a smooth transition to descent. The calculated angle becomes the path angle for the descent. The calculated angle is limited between 1° and 6°. If the actual angle is less than 1° or greater than 6°, the FMS begins a descent to intercept the limiting angle of 1° or 6°.

- **Direct-To Recovery** - Waypoints that were deleted by sequencing, or waypoints that were deleted when a DIRECT-TO was entered, can be recalled. This is done as described in procedure 9-2.

Step	Procedure 9-2 Direct-To Recovery
1	Push the DIR key.
2	Use the PREV key to select the page (or pages) displaying the waypoints that have been deleted or sequenced.

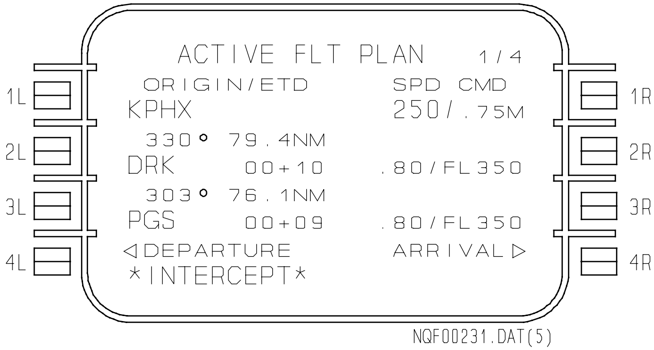
Step	Procedure 9-2 Direct-To Recovery
3	Use the line select keys to select the direct-to waypoint, shown in figure 9-2. The FMS recalls the flight plan from the selected waypoint and proceeds directly to the selected waypoint.  **Figure 9-2**

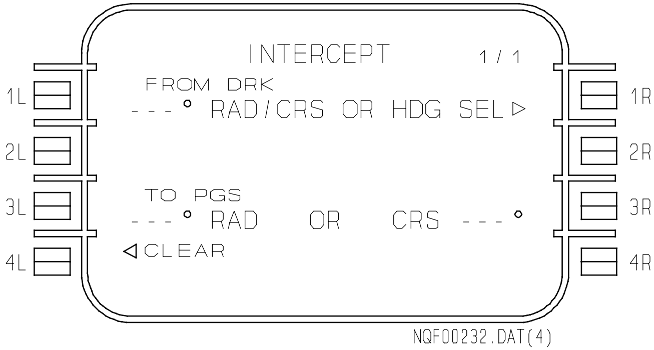
PATTERN

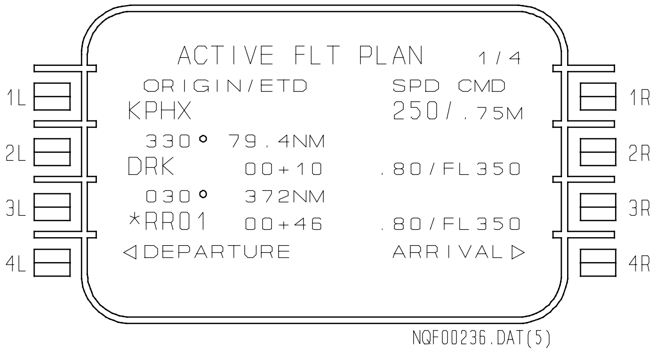
The PATTERN prompt is displayed at 4L when the DIR key is selected. The PATTERN prompt is used to start the pattern definition or review procedures. PATTERNS can also be selected from the NAV INDEX. Refer to the PATTERNS section on page 6-95 for details.

INTERCEPT

The intercept function is used to define an intercept waypoint inserted in the flight plan between two other waypoints. The intercept waypoint is defined by a course out of the first waypoint and a course into the second waypoint. The crossing of these two courses is the intercept waypoint. The course out of the first waypoint can also be used as a heading leg. To fly an intercept, follow procedure 9-3.

Step	Procedure 9-3 Intercept
1	Push the DIR key.
2	Push the line select key adjacent to the INTERCEPT prompt (4R).
3	*INTERCEPT* is displayed in the scratchpad shown in figure 9-3.  **Figure 9-3**
4	*INTERCEPT* in the scratchpad can be thought of as a waypoint yet to be defined. Insert *INTERCEPT* into the flight plan at the desired point. In this example, insert *INTERCEPT* at 3L to define an intercept waypoint between DRK and PGS.

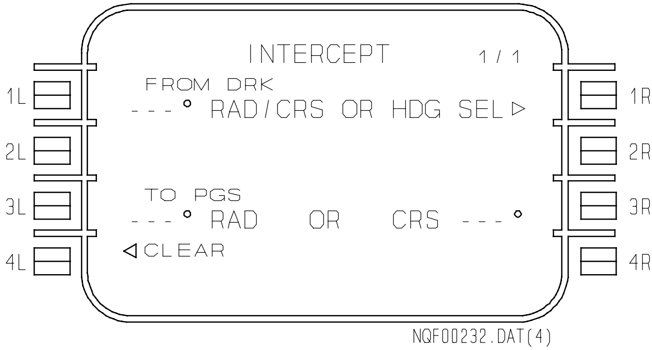
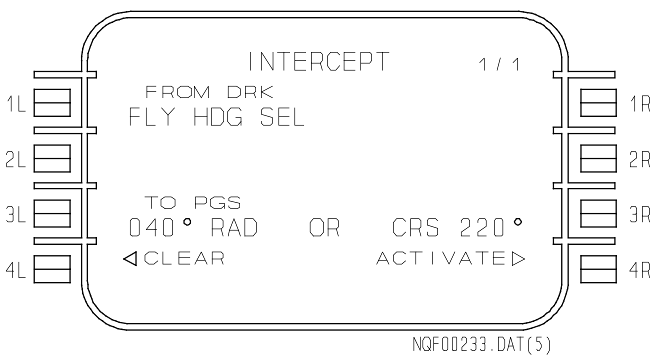
Step	Procedure 9-3 Intercept
5	This brings up the page, shown in figure 9-4, that is used to define the *INTERCEPT* waypoint.  **Figure 9-4**
6	Define the *INTERCEPT* waypoint by specifying the radial/course out of the from waypoint (1L).
7	Define the radial out of (3L) or course into (3R) the to waypoint.
8	Select ACTIVATE (4R) or CLEAR (4L). ACTIVATE is displayed at 4R after the intercept is defined.

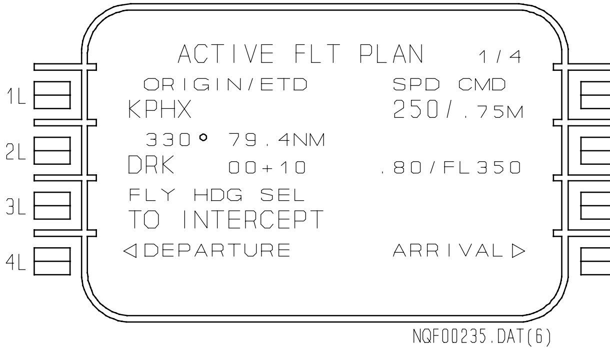
Step	Procedure 9-3 Intercept
9	The defined temporary *INTERCEPT* waypoint (now labeled *Rrnn) shown in figure 9-5, is inserted into the flight plan.  **Figure 9-5**

Intercept Using Heading Select

The intercept function can be used to fly a heading out of one waypoint to intercept a course into a second waypoint. In this case, the intercept waypoint is loosely defined as any point along the inbound course to the second waypoint depending on the heading out of the first waypoint. Follow procedure 9-4 to define this type of waypoint.

Step	Procedure 9-4 Intercept Using Heading Select
1	Push the DIR key.
2	Push the line select key adjacent to the INTERCEPT prompt (4R).
3	Insert *INTERCEPT* from the scratchpad into the proper place in the flight plan.

Step	Procedure 9-4 Intercept Using Heading Select
4	Select HDG SEL at 1R, shown in figure 9-6  **Figure 9-6**
5	Define the radial out from the waypoint (3L), or the course into (3R) the waypoint, shown in figure 9-7.  **Figure 9-7**
6	Select ACTIVATE (4R) or CLEAR (4L).

Step	Procedure 9-4 Intercept Using Heading Select
7	The defined temporary TO INTERCEPT waypoint, shown in figure 9-8, is inserted into the flight plan.  **Figure 9-8**

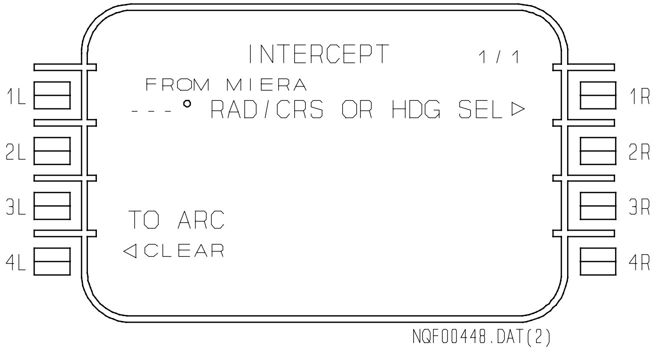
When this type of intercept is flown, the FMS disengages at the beginning of the heading select leg. The aircraft heading should be adjusted to intercept the inbound course. This can be done manually or by using the flight director heading function. LNAV should be armed in preparation for the intercept. **This feature is useful when the aircraft is being vectored for final or when flying heading select after takeoff to intercept a course onto the flight plan.**

For example, to use this feature for intercepting final, select *INTERCEPT* from the scratchpad to the arrival runway. Select HDG SEL (1R) shown in figure 9-6, for the FROM leg and enter the final course at 3R. Activate the selection. When receiving radar vectors for final, fly them using heading select and arm LNAV/VNAV to capture final.

It is important to verify that, when the intercept is activated, the active flight plan (FLT PLN) reflects the course entered on the intercept definition page. There can be slight differences in the courses due to the use of magnetic variation and magnetic declination.

Intercepting an Arc

If an arc leg is inserted into the flight plan, the intercept function can be used to modify the entry point onto the arc. To intercept an arc, follow procedure 9-5.

Step	Procedure 9-5 Intercept an Arc
1	Push the DIR key.
2	Push the line select key adjacent to the INTERCEPT prompt (4R).
3	Line select *INTERCEPT* to the second waypoint that has the inverse video **A** (that signifies the end of the arc leg).
4	The FROM waypoint at 1L is the waypoint that precedes the arc, shown in figure 9-9. Enter an intercept course (1L) from this waypoint to the arc or select HDG SEL at 1R. If no intercept waypoint is found on the arc, the message NO CRS TO ARC INTERCEPT is displayed in the scratchpad. Refer to page 6-51 for information on arcs  **Figure 9-9**
5	No entry is required for the TO waypoint since the intercept is to the arc, as shown in figure 9-9.
6	Select ACTIVATE (4R) or CLEAR (4L). ACTIVATE is displayed after the intercept is defined.

10. Control Display Unit (CDU) Entry Format

INTRODUCTION

Each entry made to the CDU must be checked for correct syntax or format at the time the entry is line selected from the scratchpad. The following list defines the requirements for each type of entry.

NOTES: 1. Leading zeros and zeros after a decimal are not required.

2. Data entry limits shown for some parameters can be exceeded.

LIST OF ENTRIES AND DEFINITION

CDU Entry Format

Entry	Format
AGL (Above Ground Level)	• Entry in feet up to 4 digits • Leading zeros not required • Range from 0 to 9999
Airport Identifiers	The FMZ Flight Management System (FMS) uses four-character International Civil Aviation Organization (ICAO) or ICAO-format airport identifiers. If a U.S. airport has a 3-letter identifier in the Jeppesen charts, it is usually prefixed with a **K** in the data base. Alaskan and Hawaiian airports with a 3-letter identifier are usually prefixed with a **P**. Canadian airports with 3-letter identifiers are usually prefixed with a **C.** Airports with numbers in the identifier (such as P07) are also included in the navigation data base. Any other entry on an airport line is assumed to be a navaid, an intersection or a pilot defined waypoint. Runway data, including SIDs, STARs and approaches are available only with an airport from the Jeppesen data base.

CDU Entry Format

Entry	Format
Alternate Destination	• The name can be from one to five alphanumeric characters • The first character cannot be a dash (-)
Altitude (Any Altitude Entry)	• Entry in feet up to five digits • Entry in flight levels (FL) • Negative altitude permitted • Automatic conversion to flight levels above transition altitude • Range from FL000 to FL600; -1300 to 60000 feet
Angle	• Entry in degrees and tenths of degrees; decimal required only when entering tenths • Range from 1.0 to 6.0
Bank Factor	• Entry is whole degrees • Range from 0 to 15
Barometer (BARO) Set	• Entry in millibars or inches of mercury (decimal required) • Leading zero not required • Range from 16.00 to 32.00 (in. Hg), 542 to 1083 (millibars)
Basic Operating Weight (BOW)	• Entry is four to six digits • Range is from 1000 to 999999
Cargo Weight	• Entry is one to six digits • Range is from 0 to 999999
Date	• Entry in day month year (no spaces) • Day is one or two digits • Month is three-letter abbreviation • Year is two digits
Destination	• The name can be from one to five alphanumeric characters • The first character cannot be a dash (-)
Direct-To Waypoint	• The name can be from one to five alphanumeric characters • The first character cannot be a dash (-)

CDU Entry Format

Entry	Format
Flight Plan Name (Any Entry)	• Use six to 10 alphanumeric characters • First character cannot be a dash (-) • If QABC-QCDF(x) format is used, QABC and QCDF are automatically used as the origin and destination of the stored flight plan
Frequency (ADF)	• The minimum entry is three digits • A decimal is not required if tenths position is zero • Range is 100.0 to 1799.5, 2179.0 to 2185.0 in 0.5 increments
Frequency (DGPS)	Runway • The minimum entry is 1 letter airport identifier and runway number Channel • The minimum entry is 1 number and a letter • Numeric range is 0 through 399 • Letter range is A through H Final approach segment • Entry is optional • Range is letters A through Z
Frequency (HF)	• The minimum entry is five digits • Range is 20000 to 299999 in increments of 1
Frequency (NAV)	• The minimum entry is two digits • A decimal is not required if tenths and hundredths are zero • Leading digit (1) is not required • Range is 108.00 to 117.95; 133.30 to 134.25; 134.40 to 135.95 in 0.05 increments **NOTE**: Not all radios are capable of this range.
Frequency (TRANSPONDER)	• A four-digit entry is required • The range for each digit is 0 to 7

CDU Entry Format

Entry	Format
Frequency (VHF COM)	• The minimum entry is two digits • A decimal is not required for all zeros to right of decimal • Leading digit (1) is not required • Range is 118.000 to 151.975 in 0.025 increments
Fuel Flow	• Range is from 0 to 99999
Fuel Weight	• Entry is one to six digits • Range is from 0 to 999999
Greenwich Mean Time (GMT)	• Entry is one to four digits • Range is from 0 to 2359 • Leading zeros are not required **NOTE**: GMT is used for universal coordinated time (UTC) for all FMS operations
Hold Inbound Course/Direction	• Entry of one to three digits is required for course • Entry of L or R is for turn direction • Slash (/) is required when making both entries or turn direction only • The range of course is 0 to 360 in increments of 1
Hold Leg Distance	• The minimum entry is one digit • Range is 1.0 to 20.0 in 0.1 increments
Hold Leg Time	• The minimum entry is one digit • Range is 0.5 to 3.0 in 0.1 increments
Instrument Landing System (ILS) Identifier	• The minimum entry is one character • The maximum entry is four characters
Intercept Radial/Course	• The minimum entry is one digit • Range is from 0 to 360 in 1 increments
International Standard Atmosphere (ISA) Deviation	• Entry is degrees, up to two digits and negative sign if required • Range is from -59 to +20 celsius

CDU Entry Format

<table>
<tr><th>Entry</th><th>Format</th></tr>
<tr><td>Latitude</td><td>

The first character must be N or S
Degrees range from 0 to 90
Minutes range is from 0.0 to 59.99 in 0.01 increments
Example of entries:

<table>
<tr><th><u>Entry</u></th><th><u>Display</u></th></tr>
<tr><td>N0</td><td>N0000.00</td></tr>
<tr><td>N1</td><td>N0100.00</td></tr>
<tr><td>N12</td><td>N1200.00</td></tr>
<tr><td>N123</td><td>N1230.00</td></tr>
<tr><td>N1234</td><td>N1234.00</td></tr>
<tr><td>N1234.5</td><td>N1234.50</td></tr>
<tr><td>N1234.56</td><td>N1234.56</td></tr>
</table>
</td></tr>
<tr><td>Latitude/Longitude</td><td>Entry of both latitude and longitude is made by combining the latitude and longitude entry with no space between (Example: N50W50).</td></tr>
<tr><td>Longitude</td><td>

The first character must be E or W
Range of degrees is from 0 to 180
Range of minutes is from 0 to 59.99 in 0.01 increments
Example of entries:

<table>
<tr><th><u>Entry</u></th><th><u>Display</u></th></tr>
<tr><td>W0</td><td>W00000.00</td></tr>
<tr><td>W1</td><td>W00100.00</td></tr>
<tr><td>W12</td><td>W01200.00</td></tr>
<tr><td>W123</td><td>W12300.00</td></tr>
<tr><td>W1234</td><td>W12340.00</td></tr>
<tr><td>W12345</td><td>W12345.00</td></tr>
<tr><td>W12345.6</td><td>W12345.60</td></tr>
<tr><td>W12345.67</td><td>W12345.67</td></tr>
</table>
</td></tr>
</table>

CDU Entry Format

Entry	Format
Nondirectional Beacons	All nondirectional beacons in the NAV data base are accessed by appending the NB suffix to the beacon identifier • The minimum entry is three characters • The maximum entry is five characters **NOTE**: If the NDB also has a waypoint identifier, it is in the NAV data base only under the waypoint name.
Oceanic Waypoints	• These waypoints are named according to ARINC 424 navigation data base specification • Southern hemisphere uses the letters **S** or **W** • Northern hemisphere uses the letters **N** or **E** • Latitude always proceeds longitude • Only the last two digits of longitude are used • Placement of the letter designator (N, S, E, W) in the string of five characters indicates the value of the longitude one-hundredths digit - The letter in the last position indicates longitude is less than 100 - The letter in the third position indicates longitude is 100 or greater • Letters are used for position designation as follows: **Letter** — **Latitude** — **Longitude** N — North and — West E — North and — East S — South and — East W — South and — West

CDU Entry Format

Entry	Format
Oceanic Waypoints (cont)	• Examples: N 52 00/W 075 00 = 5275N N 75 00/W 170 00 = 75N70 S 50 00/E 020 00 = 5020S N 50 00/E 020 00 = 5020E S 52 00/W 075 00 = 5275W **NOTE**: All oceanic waypoints may not be active in the navigation data base.
Offset (lateral)	• The minimum entry is L or R plus one digit • Range is 0.1 to 30.0 in 0.1 increments
Orbit Radius	• Entry is in tenths of miles • Range is from 1.0 to 99.9 in 0.1 increments
Orbit Speed	• Minimum entry for CAS is two digits • Range of CAS is from 75 to 340
Origin	• The name can be from one to five alphanumeric characters • The first character cannot be a dash (-)
Outside Air Temperature	• Entry is in degrees up to two digits and negative sign if required • Range is from -80 to 54 Celsius • Range is from -112 to 129 Fahrenheit
Passengers	• The minimum entry is one digit • Range is 0 to 999
Passenger Weight	• The minimum entry of slash (/) plus one digit • Range is 0 to 300

CDU Entry Format

Entry	Format
Place/Bearing/Distance (P/B/D)	• Place is any defined waypoint name • Bearing entry minimum is one digit • Distance minimum entry is one digit • Bearing range is from 0 to 360 in 0.1 increments (decimal required for tenths) • Distance range is from 0 to 9999.9 in 0.1 increments (decimal required for tenths)
Place/Bearing/Place/ Bearing (P/B/P/B)	• Place is any defined waypoint name • Bearing entry minimum is one digit • Bearing range is from 0 to 360 in 0.1 increments (decimal required for tenths)
Place//Distance (P//D)	• Place is any defined waypoint name • Distance entry minimum is one digit • Distance range is from 0 to 9999.9 in 0.1 increments (decimal required for tenths)
Procedure Turn Outbound Dist	• The minimum entry is one digit • Range is 0.1 to Boundary Dist - 4 NM in 0.1 increments
Procedure Turn Outbound Time	• The minimum entry is one digit • Range is 0.1 to (Boundary Dist - 4 NM)/groundspeed in 0.1 increments
Procedure Turn Out Angle	• The turn out angle is prefixed with the turn out direction L or R • The turn out angle range is 20 to 90 in 1 increments
Quadrant	• The minimum entry is one alpha character • Possible entries are N, NE, E, SE, S, SW, W, NW
Radial	• The minimum entry is one digit • Range is from 0.0 to 360 in 0.1 increments
Radial Distance	• Minimum entry of one digit • Range from 1.0 to 999.9 in 0.1 increments

CDU Entry Format

Entry	Format
Radial Inbound and Outbound Radials	• Minimum entry of one digit • Range from 0.0 to 360.0 in 0.1 increments
Reference Waypoint	• The name can be from one to five alphanumeric characters • The first character cannot be a dash (-)
Reserve Fuel (Minutes)	• Entry is in minutes up to three digits • Range is from 0 to 999 minutes
Reserve Fuel (Pounds)	• Entry is one to six digits • Range is from 0 to 999999
Runway Elevation	• Entry is in feet up to five digits and negative sign if required • Range is from -2000 to 19999 feet
Runway Heading	• Entry is in degrees or runway numbers • Range is from 0 to 360, or 00 to 36 runway number
Runway Length	• Entry is in feet from 2000 to 16000
Speed (Any CAS/MACH Entry)	• Minimum entry for CAS is two digits • Minimum entry for MACH is decimal plus one digit • Range of CAS is from 75 to 450 • Range of MACH is from .30 to .95 in 0.01 increments
Speed (Any Ground Speed Entry)	• Minimum entry is two digits • Range from 75 to 750
Speed Set Title	• Entry is 1 to 11 characters
Step Increment	• Entry in feet up to five digits • Range is from 0 to 30000 in increments of 1000 • Entries less than 1000 are interpreted as thousands

CDU Entry Format

Entry	Format
Temperature	• Entry is in degrees and negative sign if required • Range from -80° to 54° Celsius
Temporary Waypoint	Active flight plan entries that create temporary waypoints: • Coordinates • Place/Bearing/Distance • Place/Bearing/Place/Bearing • Place/Distance • Intercept Function Refer to page 7-3 for more details about temporary waypoints.
VIA.TO	The VIA.TO prompt is used in flight planning. A variety of entries are possible with the prompt. The same entries can be made to the flight plan without the prompt (such as when adding waypoints). The following is a list of possible entries: • Airway.Waypoint • Flight Plan Name.Waypoint • Flight Plan Name • Waypoint • Temporary Waypoint
VOR Identifier	• The minimum entry is one character • The maximum entry is three characters
Waypoint Name	• The name can be from one to five alphanumeric characters • The first character cannot be a dash (-)
Weight (any weight entry)	• Entry is one to six digits • Range is from 0 to 999999
Wind (Any Wind Entry)	• Entry is made in the form of direction/speed • The minimum entry for direction is one digit • The minimum entry for speed is one digit • The range of direction is 0 to 360 • The range of speed is 0 to 250

11. Messages

INTRODUCTION

The FMS generates messages that alert the pilot to certain conditions. The messages are displayed in the scratchpad and light the MSG light on the CDU. Any entry already in the scratchpad is placed in a stack. The CLEAR key clears a message and displays the next message or entry from the stack. Correcting whatever caused the message, clears some of the messages.

Two types of messages are contained in the FMS, alerting and advisory. Alerting messages are more important. The external annunciator, located on the pilot's and copilot's instrument panel, and the message annunciator are lit for alerting messages. Advisory messages only turn on the message annunciator on the CDU.

The following alphabetical list of each message includes the type of message and a brief explanation of what the message means.

MESSAGE LIST AND DEFINITION

FMS Messages

Message	Type	Definition
ACTIVE MODE IS MAG HDG	ALERTING	The magnetic heading has been automatically selected.
ACTIVE MODE IS TRUE HDG	ALERTING	The true heading has been automatically selected.
ADC 1 FAILED ADC 2 FAILED	ALERTING	The FMS senses an ADC failure.
AFIS DMU FAILED	ALERTING	The FMS senses an AFIS DMU failure.
AIRCRAFT DB REQD	ADVISORY	The pilot must load an aircraft data base before selecting the FULL PERF mode

FMS Messages

Message	Type	Definition
ATT/HDG 1 FAILED ATT/HDG 2 FAILED	ALERTING	The FMS is no longer receiving heading and attitude data for the identified unit.
BRG/CRS MUST BE IN TRUE	ALERTING	The bearing entry must be in true (entered xxxT) because the reference waypoint is outside the coverage of the magnetic variation table.
CAPTURE DISK IS FULL	ADVISORY	The disk in the data loader is full.
CHECK ALT CONSTRAINT	ALERTING	The pilot must check altitude constraints for a conflict between type of the constraints (CLB or DES) and current flight mode (climbing or descending).
CHECK ATT/HDG CONFIG	ALERTING	More than one input port has been configured with the same ASCB ATT/HDG sensor number.
CHECK BARO SET	ALERTING	The aircraft has passed the transition altitude by more than 3,000 feet or is leveling and the baro set has not been adjusted to the proper value. This message appears during climbs and descents.
CHECK DATA LOAD (xx)	ADVISORY	The attempted data loader operation has failed. The failure reason is indicated by the value xx. Refer to Section 12, Maintenance, for decoding xx value.

FMS Messages

Message	Type	Definition
CHECK DEST FUEL	ALERTING	The destination fuel equals zero.
CHECK DMU	ALERTING	The FMS has been waiting for a flight plan from the AFIS DMU for over 30 seconds
CHECK GPS CONFIG	ALERTING	More than one input port has been configured with the same GPS sensor number OR multiple GPS are configured and one of the sensors has an SDI of 0.
CHECK GPS POSITION CHECK GPS 1 POSITION CHECK GPS 2 POSITION CHECK GPS 3 POSITION	ALERTING	The position from the identified GPS sensor is more than 10 NM from the FMS position.
CHECK IRS CONFIG	ALERTING	More than one input port has been configured with the same IRS sensor number OR multiple IRS are configured and one of the sensors has an SDI of 0.

FMS Messages

Message	Type	Definition
CHECK IRS POSITION CHECK IRS 1 POSITION CHECK IRS 2 POSITION CHECK IRS 3 POSITION CHECK IRS 4 POSITION	ALERTING	The position from the identified IRS sensor is more than 10 NM from the FMS position.
CHECK RESERVE FUEL	ALERTING	The planned reserve fuel is equal or less than the reserve fuel required.
CHECK SPD/ ALTITUDE LIMIT	ALERTING	The upcoming speed and/or altitude constraint must be checked and proper action taken in order to meet the constraints.
CHECK SPEED CONSTRAINT	ALERTING	In cruise or descent in VNAV, the aircraft is approaching a waypoint that has a speed constraint if the FMS predicts that (based on current speed and deceleration) the constraint speed will be exceeded.
CHECK VLF/OMEGA CONFIG	ALERTING	More than one input port has been configured with the same VLF/Omega sensor number OR multiple VLF/Omega are configured and one of the sensors has an SDI of 0.

FMS Messages

Message	Type	Definition
CHECK VLF POSITION CHECK VLF 1 POSITION CHECK VLF 2 POSITION CHECK VLF 3 POSITION	ALERTING	The position from the identified VLF/Omega sensor is more than 10 NM from the FMS position.
CHECK VOR/DME CONFIG	ALERTING	The onside radio has been configured to an illegal configuration.
CHECK VOR/DME 1 DATA CHECK VOR/DME 2 DATA	ALERTING	The position from the identified VOR/DME is more than 10 NM from the FMS position.
CHECK *PD PLACEMENT	ADVISORY	The waypoint was inserted someplace other than the exact spot indicated by the entry.
COMPARE FMS POSITIONS	ALERTING	The positions of the FMSs have a difference greater than 5 NM. The systems continue to operate normally.
CONFIG DATA INVALID	ALERTING	Configuration module failed at power up.
DATA BASE OUT-OF-DATE	ADVISORY	On powerup, or on completion of NAV data base loading, the NAV data base is not current to the date entered in the FMS.

FMS Messages

Message	Type	Definition
DATALOADER IN USE	ADVISORY	Indicates that the data loader is being used.
DATALOADER UPDATE NEEDED	ADVISORY	Indicates that the data loader needs an update for the requested function.
DB TRANSFER ABORTED	ADVISORY	Indicates that transfer of the data base has been aborted.
DB TRANSFER COMPLETE	ADVISORY	Indicates that transfer of the data base has been completed.
DB TRANSFER IN PROGRESS	ADVISORY	Indicates that transfer of the data base is in progress.
DISK IS NOT FORMATTED	ADVISORY	Indicates that the disk in the data loader needs to be formatted.
DISK IS WRITE PROTECTED	ADVISORY	Indicates that the disk in the data loader is write protected.
DME 1 FAILED DME 2 FAILED	ALERTING	Indicates that the FMS senses a DME failure for the identified unit.
END OF FLIGHT PLAN	ALERTING	Indicates the last defined waypoint. It does not apply to the destination waypoint.
ENDING WPT NOT FOUND	ADVISORY	The ending waypoint of an airway or flight plan cannot be found.
ENTERING POLAR REGION	ALERTING	The polar region at 85° north or south has been entered.

FMS Messages

Message	Type	Definition
EXCEEDS CEILING ALTITUDE	ALERTING	This message is displayed when the cruise altitude exceeds the recommended performance altitude.
EXCEEDS CERT CEILING	ADVISORY	This message is displayed when the entered altitude is above the certified ceiling for the aircraft.
EXCEEDS MAX GROSS WEIGHT	ADVISORY	The gross weight exceeds the maximum ramp weight in the aircraft data base.
EXITING POLAR REGION	ALERTING	The aircraft is leaving the polar region at 84° north or south.
FILE NOT FOUND	ADVISORY	The requested file is not on the disk.
FLT PATH ANGLE TOO STEEP	ALERTING	The VNAV flight path angle exceeds the limit (6°).
FLT PLAN CHANGED	ADVISORY	The fix location at which a pattern is defined is different from when it was defined in the stored flight plan.
FLT PLAN RECEIVED	ALERTING	An AFIS flight plan has been received.
FLIGHT PLAN FULL	ADVISORY	The flight plan is full and is displayed when the pilot attempts to enter more than 100 waypoints in a flight plan.
FMS BATTERY MAINT REQD	ALERTING	The FMS battery is low and requires maintenance.
FMS POSITIONS DIFFERENT	ALERTING	The FMS positions differ by 10 nautical miles or more.

FMS Messages

Message	Type	Definition
FPL CONTAINS INVALID WPT	ADVISORY	The stored flight plan has undefined or invalid waypoints.
FPL STORAGE FULL	ADVISORY	The storage area for flight plans is full.
FULL PERF UNAVAIL	ALERTING	A numerical fault has occurred in the active predictions, and the FULL PERF mode is not available
GPS FAILED GPS 1 FAILED GPS 2 FAILED GPS 3 FAILED	ALERTING	Indicates that inputs from the identified GPS have failed.
GPS RAIM ABOVE LIMIT	ALERTING	The RAIM value is above the limit for the current phase of flight.
GPS RAIM UNAVILABLE	ALERTING	RAIM is not being generated by the GPS receiver.
HIGH PCDR TURN GRD SPD	ALERTING	The groundspeed exceeds the limit for the defined procedure turn.
HIGH HOLDING GRD SPD	ALERTING	The groundspeed exceeds the limits for the FAA allowable size of holding pattern.
INDEPENDENT OPERATION	ALERTING	The system reverted to independent operation.
INTERSECTION NOT FOUND	ADVISORY	PD waypoint does not intersect the active flight plan.

FMS Messages

Message	Type	Definition
INVALID AIRCRAFT DB	ALERTING	The aircraft data base has been corrupted and has been cleared and initialized.
INVALID CUSTOM DB	ALERTING	The custom DB has been corrupted and has been cleared and initialized.
INVALID DELETE	ADVISORY	Indicates invalid entry of the named parameter.
INVALID DIRECT TO	ADVISORY	Indicates invalid entry of the named parameter.
INVALID ENTRY	ADVISORY	Entry is not in the correct format.
INVALID NAV DB	ALERTING	The navigation data base is invalid and is not useable. Reload the data base.
INVALID NOTAM LIST	ADVISORY	Indicates that the NOTAM is invalid and has been cleared.
IRS FAILED IRS 1 FAILED IRS 2 FAILED IRS 3 FAILED IRS 4 FAILED	ALERTING	The FMS senses the identified IRS has failed.
ISA DEV EXCEEDED	ADVISORY	The entered temperature has caused the ISA deviation to be exceeded at the altitude.

FMS Messages

Message	Type	Definition
LABEL CANNOT BE CHANGED	ADVISORY	Indicates that the label specified in the aircraft data base is a required label for the aircraft and may not be changed.
LAST LEG	ALERTING	The active leg is the last leg of the flight plan and the TO waypoint is not the destination.
NEW MESSAGE AVAIL	ALERTING	A new AFIS message is available.
NEW SIGMETS AVAIL	ALERTING	New SIGMETS are available (AFIS).
NEW WINDS AVAIL	ALERTING	New winds are available (AFIS).
NEW WX REPORTS AVAIL	ALERTING	New weather reports are available (AFIS).
NO ACTIVE FPL	ADVISORY	There is no active flight plan when requesting a flight plan update from AFIS.
NO CRS TO ARC INTERCEPT	ADVISORY	No intercept to the arc can be found for the input definition.
NO CROSSING POINT FOUND	ADVISORY	No crossing points can be found for the CROSSING POINTS page.
NO DISK INSTALLED	ADVISORY	No disk is installed in the data loader.
NO FLIGHT PLAN	ADVISORY	Origin or origin/destination is entered on the FLIGHT PLAN LIST page and there is no flight plan with the same origin or origin/destination.

FMS Messages

Message	Type	Definition
NO INPUT ALLOWED	ADVISORY	No input is allowed.
NO POSITION SENSORS	ALERTING	The DR light is turned on.
NO PRESENT POSITION	ADVISORY	An action is requested that requires present position.
NO REQUIRED SENSORS	ALERTING	The DEGRAD light is turned on.
NO UPLINK FPL AVAIL	ADVISORY	An AFIS flight plan has not been received when requesting to load an AFIS flight plan.
NOT ALLOWED IN AUTO LOAD	ADVISORY	An entry to the active flight plan has been made to the FMS operating in SINGLE and Auto load in a triple FMS installation.
NOT A NAVAID	ADVISORY	An entry was made that requires a navaid and the entry is other than a navaid.
NOT AN AIRPORT	ADVISORY	An entry was made that required an airport name and other than an airport name was entered.
NOT IN DATA BASE	ADVISORY	The pilot requested some data that was not in the data base and cannot be pilot defined.
OFFSET CANCEL	ALERTING	The offset has been canceled.

FMS Messages

Message	Type	Definition
OFFSET CANCEL NEXT WPT	ALERTING	The offset is canceled at the next waypoint in the flight plan. This message can be cleared by pilot action or is automatically cleared when the offset is canceled.
ORBIT RADIUS/GS CONFLICT	ADVISORY	The ground speed is too high to fly the orbit at the defined radius.
PERF-VNAV UNAVAILABLE	ALERTING	The pilot requested a performance/VNAV function before sufficient data had been entered.
RADIALS DO NOT INTERSECT	ADVISORY	The radials defined for the intercept function do not cross.
RAIM WILL EXCEED LIMIT	ALERTING	RAIM at the time requested, will exceed the limit for the phase of flight.
RESET ALT SEL?	ALERTING	The FMS is commanding a change of altitude but the altitude selector has not been reset. The aircraft cannot change altitude until the selector has been reset.
RUNWAY NOT FOUND	ADVISORY	The data base does not contain the entered runway at the designated airport.
S.E. PERF UNAVAIL	ALERTING	Indicates that single engine performance is not available.
SINGLE/ INDEPENDENT REQD	ADVISORY	The operating modes needs to be single or independent before accessing the "CLEAR CDB" page.

FMS Messages

Message	Type	Definition
SINGLE OPERATION	ALERTING	There is a problem between the two FMSs that precludes full communication between the two systems.
SLAVE FP CHNG OVERRIDDEN	ADVISORY	A change made on the slave side could not be accepted because of a conflict. The change was overridden by the master FMS.
STORED FPL PERF UNAVAIL	ALERTING	A numerical fault in the stored flight plan predictions.
UNABLE HOLD CHANGE	ADVISORY	The pilot attempted to change the holding pattern definition while in holding and not on the inbound leg.
UNABLE MASTER TIME RQST	ADVISORY	This message indicates that the FMS time and date is being slaved to outside time and date (e.g. GPS or aircraft) and cannot be changed.
UNABLE NEXT ALT	ALERTING	The aircraft is unable to meet the altitude constraint.
UNABLE OFFSET	ADVISORY	An attempt was made to insert an offset during holding, a STAR, or a SID.
UNABLE PCDR TURN CHANGE	ADVISORY	Changing the procedure turn definition is inhibited after sequencing onto the procedure turn.
UNABLE *PD PLACEMENT	ADVISORY	The PD waypoint has been restricted from placement in the flight plan.

FMS Messages

Message	Type	Definition
UNABLE TUNE REQUEST	ADVISORY	The pilot entered a frequency while the radios were in the manual mode.
USED BY ACTIVE FPL	ADVISORY	The pilot tried to delete a waypoint from storage that is used in the active flight plan.
USED BY OFFSIDE ACT FPL	ADVISORY	The pilot attempted to delete a waypoint from storage that is used in the offside active flight plan.
USING CURRENT GS/FF	ALERTING	Indicates the current Perf mode.
VERT DIR OVER MAX ANG	ADVISORY	The angle computed during a VERTICAL DIRECT TO exceeds the limit. In this case, the angle is set to the maximum limit (6°).
VERT DIR UNDER MIN ANG	ADVISORY	The angle computed during a VERTICAL DIRECT TO is under the limit. In this case, the angle is set to the minimum limit (1°) and descent is started at that time.
VLF/OMEGA FAILED VLF/OMEGA 1 FAILED VLF/OMEGA 2 FAILED VLF/OMEGA 3 FAILED	ALERTING	The FMS senses the identified VLF/Omega has failed.

FMS Messages

Message	Type	Definition
VLF OMEGA IN DR	ALERTING	A VLF/Omega has been in DR for more than 10 minutes.
VOR 1 FAILED VOR 2 FAILED	ALERTING	The FMS senses the identified VOR has failed.
WAYPOINT NOT FOUND	ADVISORY	The entered waypoint cannot be found. If this results when attempting to enter an airway into a flight plan, the waypoint is not part of the referenced airway.
WEIGHT DEFAULT - LB	ALERTING	Indicates that the weight option has defaulted to pounds. Usually the result of the configuration module being invalid or not read.
WHAT-IF PERF UNAVAIL	ALERTING	A numerical fault has occurred in the WHAT-IF predictions.
WIND EXCEEDED AT CRZ ALT	ADVISORY	The wind entered at altitude has caused the wind at the cruise altitude to be exceeded.
WPT STORAGE FULL	ADVISORY	The storage area for pilot defined waypoints is full.

12. Maintenance

DATA LOADER FAULT CODES

When the CDU displays a message of "CHECK DATA LOAD (XX)" after an attempted disk operation, the numeric value in the "XX" position is interpreted using list.

Code	Description
01	No response to OPEN command
02	No response to STATUS command
03	Illegal database file header *
04	No response to READ command
05	Error getting 1st flight plan record
06	Flight plan record too long
07	No disk installed
08	Status command failed
09	CRC is illegal *
0A	EE size in header is bad *
0B	File size in header is bad *
0C	Database size or serial number is 0 *
0D	Database size in header is odd *
0E	Serial number is locked out *
0F	CRC lockout *
10	Bad BOW †
11	Bad fuel weight †
12	Bad cargo weight †
13	Bad number of passengers †
14	Bad initial cruise altitude †
15	Bad cruise speed †
16	Bad cruise winds †
17	Bad cruise fuel flow †
18	Bad waypoints count †
19	Too many waypoints in flight plan †
1A	Bad alternate waypoint count †
1B	Too many waypoints in alternate †
1C	Odd numbers of bytes in block *
1D	File header locked out *
1E	Error getting identifier †
1F	Error getting latitude †

Code	Description
20	Error getting longitude †
21	Error getting speed constraint †
22	Error getting flight level constraint †
23	Error getting spot wind †
24	Error getting spot temperature †
25	Error getting weather data †
26	Error getting first debug monitor record
27	Record greater than 80 characters
28	Read file not open
29	Read attempted at EOF
2A	Command in work
2B	Unknown Op code
2C	Disk error during read
2D	Disk error during write
2E	Disk is write protected
2F	Disk is full
30	No response to WRITE command
31	No response to CLOSE command
32	STATUS command illegal
33	No response from debug monitor
34	Disk is not formatted
35	No response to FORMAT command
36	Data loader requires update for attempted function
37	Illegal characters in read buffer
38	Read buffer overflow
39	Too many AFIS flight plans
3A	Illegal open RO file
3B	Illegal directory size
3C	Incorrect custom file size
3D	Wrong custom version on disk
3E	Wrong Nav version on disk
3F	Wrong Perf versions on disk
80	No response to asynchronous mode open command *
81	Dataloader not responding in asynchronous mode *
82	Receiver queue overflow in asynchronous mode *

Code	Description
83	Dataloader sending data packets out of sequence *
84	Unknown asynchronous packet *
85	No data received in asynchronous mode *
86	No response to asynchronous command *
87	Bad response to asynchronous command *
90-9F	Packet check errors in asynchronous mode *
F1	Flash setup error
F2	Flash change erase error
F3	Flash write error

* These codes are associated with the navigation database disks. Contact local Honeywell support for assistance.

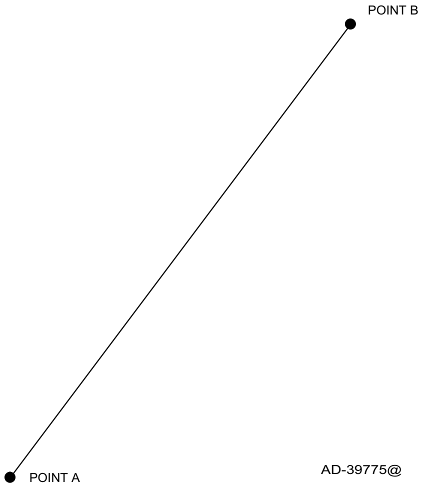
† These codes are associated with errors in flight plan format requirements. Contact flight plan provider for assistance.

13. Basics of Navigation

The navigation function of the FMS is based on fundamental navigation principals. This section is a brief review of those principles.

In order to fly from point A to B, as shown in figure 13-1, the pilot needs certain data:

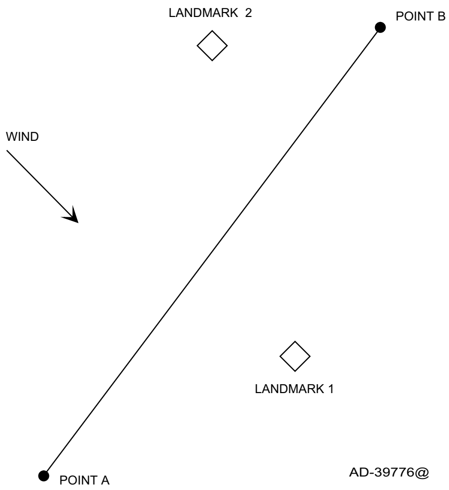
- The location of the two points with respect to some coordinate system
- The speed of the aircraft across the ground
- A method to determine and measure aircraft heading.



Basic Route of Flight
Figure 13-1

In spite of all the additional navigation tools considered minimum acceptable for a safe and predictable flight, these few pieces of data can bring the pilot close to his destination. When the FMS is navigating in dead reckoning, it is performing this basic navigation function.

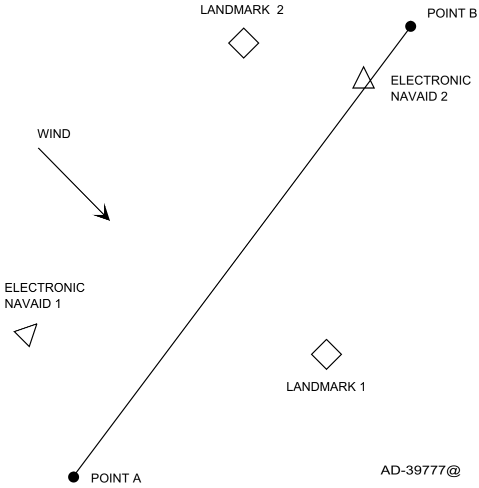
In order to add precision to the navigation problem, as shown in figure 13-2, it is best to have a navigation map with enroute landmarks, and a weather report with wind data.



Route With Visual Landmarks
Figure 13-2

With the virtually unlimited operational navaids in place today, as shown in figure 13-3, the pilot can receive additional pieces of information in the cockpit.

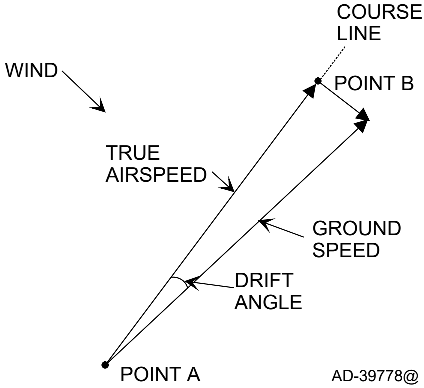
- An electronic measure of position (radio navigation, inertial)
- Navigation maps with information compatible with electronic navigation.



Route With Visual and Electronic Landmarks
Figure 13-3

Using the electronic navigation aids or landmarks, the pilot can determine the current enroute position and measure progress made toward the destination. This is what the FMS does in its normal navigation modes, when sensors are operating properly.

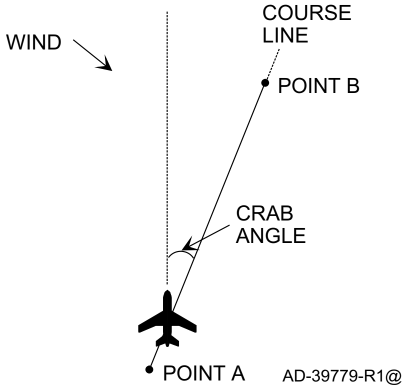
Visually or electronically, aircraft heading is the pilots main concern. The wind triangle, shown in figure 13-4, is a graphical means to determine and calculate proper heading, groundspeed and drift angle.



Basic Wind Triangle
Figure 13-4

The aircraft airspeed indicator, altimeter, and outside temperature indicators provide true airspeed. However, the effect of wind on the aircraft disturbs an otherwise simple task to determine track over the ground and groundspeed. Groundspeed is the net effect of wind on forward progress. The FMS receives true airspeed from the air data computer. It measures wind drift by noting the heading changes necessary to maintain the track. It measures groundspeed by measuring the time required to make progress toward a waypoint (or, if installed, from IRS or GPS data).

The drift angle is the net effect of the wind that moves the aircraft left or right of course. To correct for drift angle, the pilot uses a heading that maintains the desired course. The angle between the course and the heading is called the aircraft crab angle, shown in figure 13-5.

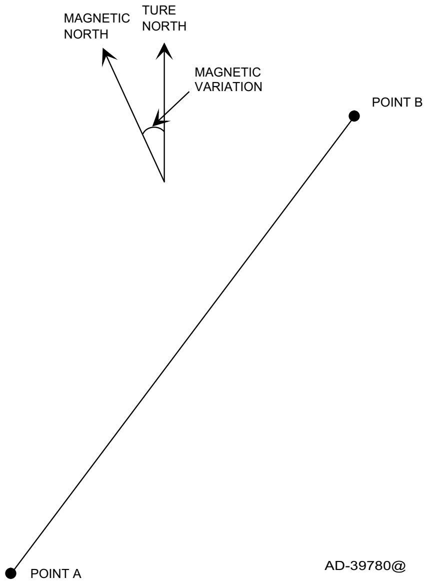


Route With Aircraft Heading Corrected for Wind
Figure 13-5

Two problems remain:

- How was the course line measured?
- What coordinate reference system was used?

The FMS map knows the geographical location of waypoints with respect to the global measuring system of latitude and longitude. It calculates the true course between the points. The course is displayed to the pilot in magnetic or true bearing according to the pilots heading reference selection. The difference between magnetic and true, called variation, is shown in figure 13-6. Since a magnetic reference system is the most commonly used in aviation, the pilot usually navigates using the magnetic referenced course data.



True Verses Magnetic North
Figure 13-6

The pilot and the FMS continually solve the following three problems:

- Determine present position relative to a map
- Determine speed of the aircraft across the ground
- Determine the correct aircraft heading to track the course line.

Even with the powerful capability of the FMS, pilots must prepare and maintain some type of flight log and map to monitor progress and verify position as the flight proceeds from point A to point B.

14. Honeywell Product Support

Honeywell provides both exchange/repair service and technical support. This section describes these support services including addresses and phone numbers.

Honeywell SPEX program for corporate operators provides an extensive Exchange and Rental service that complements a worldwide network of support centers. An inventory of more than 9000 spare components assures that your Honeywell equipped aircraft will be returned to service promptly and economically. This service is available both during and after warranty.

The aircraft owner/operator is required to ensure that units provided through this program have been approved in accordance with their specific maintenance requirements.

All articles are returned to Reconditioned Specifications limits when they are processed through a Honeywell repair facility. All articles are inspected by quality control personnel to verify proper workmanship and conformity to Type Design and to certify that the article meets all controlling documentation. Reconditioned Specification criteria are on file at Honeywell facilities and are available for review. All Exchange units are updated with the latest performance reliability MODs on an attrition basis while in the repair cycle.

When contacting a Honeywell Dealer or Customer Support Center for service under the SPEX program, the following information regarding the unit and the aircraft are required:

- Complete part number with dash number of faulty unit
- Complete serial number of faulty unit
- Aircraft type, serial number and registration number
- Aircraft Owner
- Reported complaint with faulty unit
- Service requested (<u>Exchange</u> or <u>Rental</u>)
- Is faulty unit IN WARRANTY
  - Type of warranty (NEW PRODUCT, MAINTENANCE CONTRACT, or SPEX)
  - Date warranty started
  - Warranty ID number (if applicable)
- If faulty unit is NOT IN WARRANTY, provide billing address
- Purchase order number.

The Honeywell Support Centers listed below will assist with processing exchange/rental orders.

24-HOUR EXCHANGE/RENTAL SUPPORT CENTERS

U.S.A. - DALLAS **800-USA-SPEX** **(800-872-7739)**	**CANADA - OTTAWA** **800-267-9947**
ENGLAND - BASINGSTOKE **44-256-51111**	**AUSTRALIA - TULLAMARINE** **61-3-330-1411**
FRANCE - TOULOUSE **33-6171-9662**	**FRANCE - DFS** **33-1-4934-5050**
SINGAPORE **65-542-1313**	**GERMANY - AOA GAUTING** **49-89-89317-0** **49-89-850-3695(After Hours AOG)**

CUSTOMER SUPPORT CENTERS - NORTH AMERICA

Dallas Support Center
Honeywell Inc.
Commercial Aviation Systems
7825 Ridge Point
IRVING, TX 75063
Telephone: 214-402-4300
Telex: 795539
Fax: 214-402-4999

Canada Support Center
Honeywell Inc.
Commercial Aviation Systems
3 Hamilton Avenue North
OTTAWA, ONTARIO, K1Y 4J4
Telephone: 613-728-4681
Telex: 0533637
Fax: 613-728-7084

Central Support Center
Honeywell Inc.
Commercial Aviation Systems
1830 Industrial Avenue
WICHITA, KS 67216
Telephone: 316-522-8172
Telex: 417444
Fax: 316-522-2693

Ohio Support Center
Honeywell Inc.
Commercial Aviation Systems
8370 Dow Circle
STRONGVILLE, OH 44136
Telephone: 216-243-8877
Telex: 985441
Fax: 216-243-1954

United Kingdom Support Center
Honeywell Avionics Systems Ltd
Edison Road, Ringway North
BASINGSTOKE, HANTS,
RG 21 2QD
ENGLAND
Telephone: 44-256-51111
Telex: 85-8067
Fax: 44-256-474932

France Support Center
Honeywell Aerospace Ltd
1, Rue Marcel-Doret
31700 TOULOUSE-BLAQNAC
FRANCE
Telephone: 33-62-121500
After Hours - AOG: 33-61-71-9662
Telex: 52-1635
Fax: 33-61-300258

Singapore Support Center
Honeywell Pty Ltd
2 Loyang Crescent
SINGAPORE 1750
Telephone: 65-542-1313
Telex: RS 56969
Fax: 65-542-1212

Germany Support Center
Apparatebau Gauting Gmbh
Ammerseestrasse 45-49
D 8035 Gauting
GERMANY
Telephone: 49-89-89317-0
Telex: 0521702
Fax: 49-89-89317-183

Australia Support Center
Honeywell Ltd
Trade Park Drive
TULLAMARINE, VICTORIA 3043
AUSTRALIA
Telephone: 61-3-330-1411
Telex: 35789 HWLTUL
Fax: 61-3-330-3042

FMS SUPPORT

Support for FMS products, including data base support, can be obtained by contacting the local Honeywell customer support or the FMS Support Line.

FMS Support Line
Glendale, Arizona

1-888-TALK FMS (1-888-825-5367)*

OR

1-602-436-7700 (outside toll free coverage)

*** 1-888 is a new toll free prefix in addition to 1-800.**

PUBLICATION ORDERING INFORMATION

Additional copies of this manual can be obtained by contacting:

Honeywell Inc.
Business and Commuter Aviation Systems
P.O. Box 29000
Phoenix, Arizona 85038-9000

Attention: Publication Distribution, Dept. M/S V19A1

Telephone No.: (602) 436-5553
FAX: (602) 436-1588

15. Abbreviations

Abbreviations used in this manual are defined as follows:

ABBREVIATION	EQUIVALENT
A	AT or ABOVE
A/C, ACFT	Aircraft
AC	Advisory Circular
ACARS	ARINC Communications Addressing and Reporting System
ACT	Active Mode
ADC	Air Data Computer
ADF	Automatic Direction Finder
AFCS	Automatic Flight Control System
AFDS	Autopilot Flight Director System
AFIS	Airborne Flight Information System
AFM	Aircraft Flight Manual
AHRS	Attitude Heading Reference System
AGL	Above Ground Level
ALT	Altitude
ALTN	Alternate
APPR, APRCH	Approach
ARINC	Aeronautical Radio, Inc.
ARP	Airport Reference Point
ASC	Aircraft Specification Change
ASCB	Avionics Standard Communications Bus
ASEL	Altitude Select
ATC	Air Traffic Control
AUX	Auxiliary
B	AT or BELOW
BARO	Barometric
BOD	Bottom of Descent
BOSC	Bottom of Step Climb
BOW	Basic Operating Weight
CAS	Calibrated Airspeed
CCW	Counterclockwise
CDB	Custom Data Base
CDI	Course Deviation Indicator
CDU	Control Display Unit
CF	Course to a Fixed Waypoint (Navigation leg type)

ABBREVIATION	EQUIVALENT
CLB	Climb
CLR	Clear
CMD	Command
CPU	Central Processing Unit
CROSSFILL	Data Transfer Between NAV Computers
CRS	Course
CRT	Cathode Ray Tube
CRZ	Cruise
CW	Clockwise
DADC	Digital Air Data Computer
DB	Data Base
DBDI	Distance Bearing Direction Indicator
DEG	Degree
DEL	Delete
DES	Descent
DEST	Destination
DGPS	Differential Global Positioning System
DGRAD	Degraded
DIR	Direct
DIST	Distance
DL	Data Loader
DME	Distance Measuring Equipment
DMU	Data Management Unit
DR	Dead Reckoning
DSPLY	Display
DTG	Distance To Go
EDS	Electronic Display System
EEPROM	Electronically Erasable Programmable Read Only Memory
EFIS	Electronic Flight Instrument System
EHSI	Electronic Horizontal Situation Indicator
ELEV	Elevation
EPR	Engine Pressure Ratio
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
ETE	Estimated Time Enroute
ETP	Equal Time Point
FA	Fix to an Altitude (Navigation Leg Type)
FAF	Final Approach Fix
FAS	Final Approach Segment

ABBREVIATION	EQUIVALENT
FF	Fuel Flow
FGS	Flight Guidance System
FL	Flight Level
FLC, FLCH	Flight Level Change
FLT	Flight
FMS	Flight Management System
FMZ	Flight Management System Designation
FOM	Figure of Merit
FPA	Flight Path Angle
FPL	Flight Plan
FPLN	Flight Plan
fpm	Feet per Minute
FREQ	Frequency
ft	Foot/Feet
GMT	Greenwich Mean Time
GPS	Global Positioning System (Navstar)
GRD	Ground
GS	Glideslope, Groundspeed
GSPD	Groundspeed
GW	Gross Weight
HA	High Altitude
HDOP	Horizontal Dilution of Precision
HF	High Frequency
HM	Holding Pattern With Manual Termination (Navigation Leg Type)
HP	High Pressure Engine Turbine Speed
HSI	Horizontal Situation Indicator
HUD	Head-Up Display
IAF	Initial Approach Fix
IAC	Integrated Avionics Computer
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organization
IDENT	Identifier
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
INBD	Inbound
INC	Increment
INIT	Initialization
INTV	Intervention

ABBREVIATION	EQUIVALENT
IRS	Inertial Reference System
IRU	Inertial Reference Unit
ISA	International Standard Atmosphere
JEPPESEN	Name of Navigation Data Base Supplier
Khz	Kilohertz
kt	Knot/Knots
L	Left
LA	Low Altitude
LAT	Latitude
lb	Pound(s)
LDA	Landing Directional Aid
LDG	Landing
LFL	Landing Field Length
LIM, LMT	Limit
LNAV	Lateral Navigation
LOC	ILS Localizer
LORAN	Low Frequency Radio Range
LRC	Long Range Cruise
LRN	Long Range Navigation
MAG	Magnetic
MAP	Missed Approach Point
MAX	Maximum
MDA	Minimum Descent Altitude
MHZ	Mega-Hertz
MIN	Minimum
MKR	Marker
MLS	Microwave Landing System
M_{MO}	Maximum Operating Mach
μS	Microsecond
ms(msec)	Millisecond
MSG	Message
MSL	Mean Sea Level
NAV	Navigation
NAVAID	Navigation Aid (Typically a Radio Station Providing VOR and/or DME Position Data)
NBAA	National Business Aircraft Association
NCD	No Computed Data
ND	Navigation Display

ABBREVIATION	EQUIVALENT
NDB	Navigation Data Base or Nondirectional Beacon
NM	Nautical Miles
NOTAM	Notice to Airman (Navaid Information)
NT	Navaid Tuning
NZ	Navigation Computer (Product Designator)
OAT	Outside Air Temperature
Offside	Unit on the "Other Side" of the Airplane (Left Sensor Is Offside to Right FMS)
OFST	Offset
Onside	Unit on the "Same Side" of the Airplane (Left Sensor Is Onside to Left FMS) Computer (refer to Offside)
ORG, ORIG	Origin
OSS	Omega Sensor System
OUTBD	Outbound
PB	Place/Bearing
PBD	Place/Bearing/Distance
PC	Personnel Computer
PCDR	Procedure
PD	Place//Distance
PERF	Performance
PFD	Primary Flight display
PLN	Plan
PNR	Point of No Return
POS	Position
PPOS	Present Position
PRED	Predictive
PREV	Previous
PROG	Progress
Proline	A Mnemonic Used to Describe a Bus Patented by the Collins Corp
PROM	Programmable Read Only Memory
PT	Procedure Turn
PTS	Points
PZ	Performance Computer Series (e.g., PZ-800)
QF	Quality Factor
R	Right
RAD	Radial or Roll Anticipation Distance

ABBREVIATION	EQUIVALENT
RAIM	Receiver Autonomous Integrity Monitor
REF	Reference
REM	Remaining
REQ	Required
RNAV	Area Navigation
RNG	Range
RNWY	Runway
RTCA	Radio Technical Commission for Aeronautics
RTE	Route
RW, RWY	Runway SAT
SAT	Static Air Temperature
SDF	Simplified Directional Facility
SDI	Source Destination Indicator
SEL	Select
SID	Standard Instrument Departure
SPD	Speed
STA	Station
STAR	Standard Terminal Arrival Route
T	Terminal
T-P	Turn Point
TACAN	Tactical Air Navigation
TAS	True Airspeed
TCH	Threshold Crossing Height
TCS	Touch Control Steering
TF	Track to a Fixed Waypoint
TOC	Top of Climb
TOD	Top of Descent
TRM	Thermal
UR	Unrestricted
UTC	Universal Coordinated Time
VAR	Variation
VASL, VASEL	VNAV Altitude Select
VALT	VNAV Altitude Hold
VDL	VHF Data Link
VDOP	Vertical Dilution of Precision
VEL	Velocity
VERT	Vertical
VFLC, VFLCH	Vertical Flight Level Change
VG	Velocity Over the Ground

ABBREVIATION	EQUIVALENT
VHF	Very High Frequency
VLF	Very Low Frequency
Vmin	Minimum Velocity
V_{MO}	Maximum Operating Velocity
Vref	Final Landing Configuration Speed
V1	Takeoff Decision Speed
VN, VNAV	Vertical Navigation
VOR	Very High Frequency Omni Bearing Range
VORTAC	Very High Frequency Omni Bearing Range and TACAN (a Station Broadcasting Both VOR and DME Data)
VPTH, VPATH	Vertical Path, VNAV Path
VS, VSPD	Vertical Speed
VTA	Vertical Track Alert
WOW	Weight on Wheels
WPT	Waypoint
W/T	Wind Temperature
WT	Weight
XFR	Transfer
XTK, XTRK	Crosstrack

Index

A

Index (cont)

B

C

Index (cont)

D

Index (cont)

E

F

G

Index (cont)

H

I

L

Index (cont)

M

Index (cont)

N

O

P

Index (cont)

R

S

Index (cont)

T

U

V